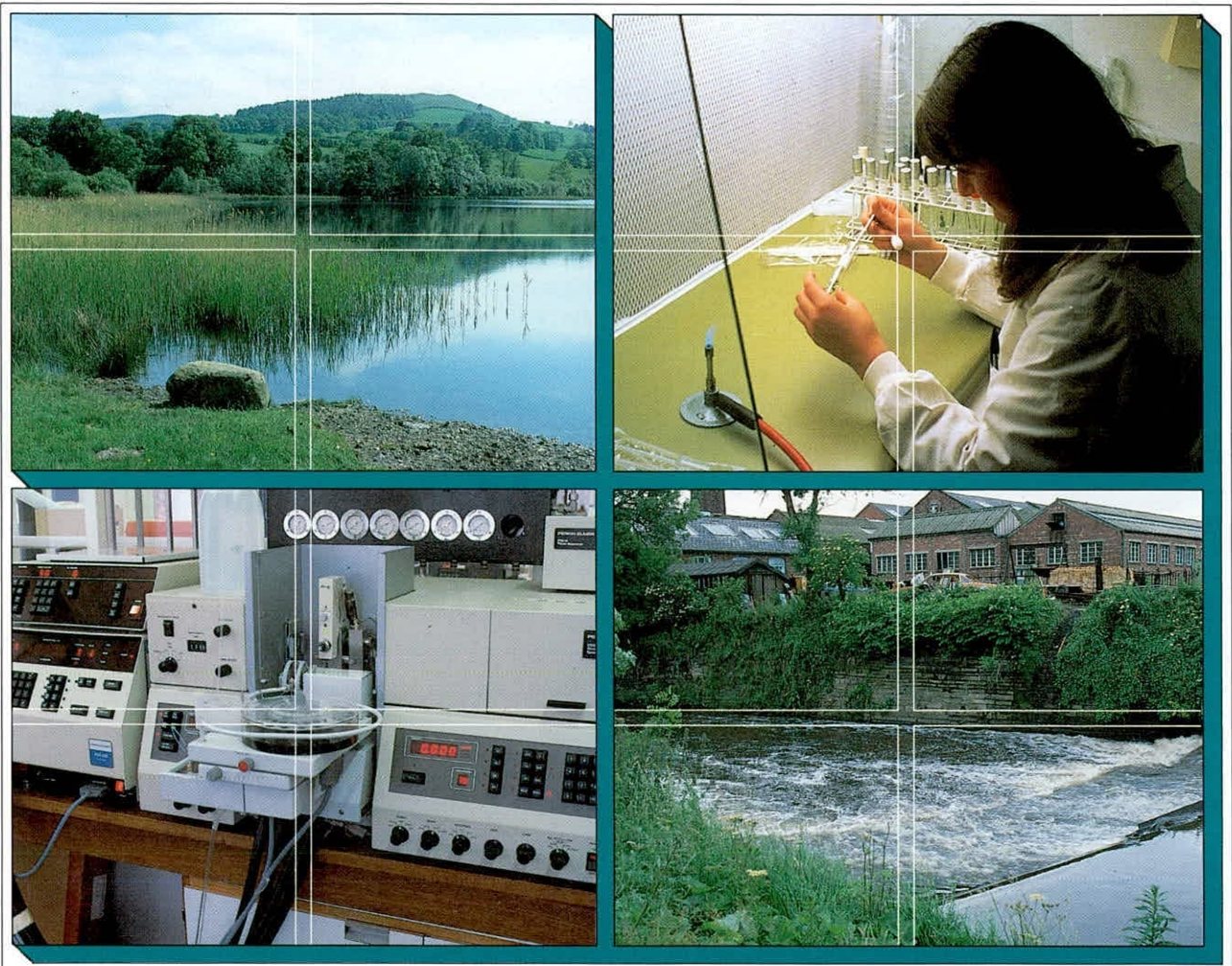




A1(M) Widening Junctions 6 to 8 - River Mimram Aquatic Survey

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1. INTRODUCTION

The River Mimram at Welwyn

1.01 The River Mimram. It is proposed to widen the A1(M) between junctions 6-8; this could cause an impact upon the River Mimram by loss of river bed, by diversion and during construction work. As part of the Environmental Statement for this proposal, a study was necessary to assess the environmental value and effects of construction on this section of river. The assessment required:

- i. collation of background data on water quality and other relevant material from normal sources;
- ii. a baseline field survey of the site and the sections of river which could be lost, diverted, & otherwise impacted, together with adjacent sections of stream to provide data on the riparian, aquatic & marginal zones and their physical features and biotic community structure,
- iii. an appraisal of bank habitats for biota in general with specific searches for protected, endangered or otherwise important species of flora or fauna, and its assessment up to national status,
- iv. an appraisal of adjacent land zones,
- v. an assessment of susceptibility of macro-biota to disturbance and the identification of the most critical areas together with the impact of road widening to river & its biota especially downstream; and,
- vi. recommendations for mitigation of impacts especially downstream.

2. SURVEY AND ASSESSMENT METHODOLOGY

Study Site

2.01 The study site on the River Mimram was from alongside the 'allotments' West of the By-pass at Welwyn downstream and under the A1(M) through the grounds of Sherrardswood School under the Hertford Road and ending at the crossing at Bessemer Road after passing alongside a site designated locally as of 'Ecological Importance' (1.5-2 km in total, Figure 1).

Survey methodology

2.02 Outline of survey methodology The study area was surveyed and the site assessed from the data collected which included; location plans of habitats and communities; protected, endangered or otherwise important species of flora or fauna for land and aquatic sections; faunal habitats with feeding & breeding areas; assessment of river quality and conservation value (as known); assessment of susceptibility of macro-biota to disturbance and identification of most critical areas; overall assessment of impact of the proposed road widening on the river & its biota especially downstream; and, recommendations for mitigation of impact of the proposed widening including construction on waters downstream by suspended and settling materials, reduced oxygen levels, or clogging of stream bed gravels for eg salmonid spawning.

2.03 Survey methodology and data collection:

- a. Collate background data on water quality and relevant documentation from normal sources including NRA & IFE/FBA data.
- b. Field survey of the 9 sections of stream including those which could be lost, diverted, or impacted, to IFE Standard Reconnaissance Methodology for Environmental Quality of Flowing Waters (Appendix 3) but specifically or additionally to provide baseline data on:
 - i) riparian zone to include: physical features of bank plant communities ie community structure; appraisal of bank habitats for biota including birds, mammals, amphibians, macro-invertebrates; specific searches for protected, endangered or otherwise important species of flora or fauna ie including Red Book species
 - ii) aquatic & marginal zones to include: plant communities (with identification to species or 'taxa' of vascular plants); channel features, cross-sections & substrate type; aquatic habitats for macro-invertebrates by net sampling to Nationally adopted RIVPACS standard (note that a full RIVPAC determination requires seasonal samples to be taken in spring, summer & autumn), vertebrates, including fish, by observation or net, & amphibians (by standardised search patterns); specific searches for protected, endangered or otherwise important species of flora or fauna ie including Red Book species
- c. Field survey of adjacent land zone for a 'Phase 1' habitat-type classification of plant communities & land-use; and, adjacent land features (within 250 m of water course).

3. RESULTS

Background data

3.01 The upper reaches of the river have all been recently reclassified as 1A in 1990, the topmost grade, having been 1B in the 1985. Comparison of these RQOs based criteria with data on the presence of macro-invertebrates and its analysis from previous IFE surveys in 1979 & 1989 confirm the high and diverse quality of the fauna at sites upstream and downstream of the proposed construction work (Appendix 2. Table 2 & 3).

3.02 The river water is of high quality; this was confirmed by analysis of water samples taken at survey. However the levels of nitrate and sulphate are higher than previously recorded but these could relate either to the specific flow conditions at survey which were reported as high by several local observers and this was considered likely from observation of the observed distribution of flora on the stream bed; or, to a general increase.

Survey and assessment data

3.03 The flora, fauna, stream morphology and chemistry was recorded in a standard form and supplemented by species lists for the 9 natural divisions of the study section of the river. (1.5-2 km in total, Figure 1. & Appendices 1 & 2 tables 1 & 2).

3.04 General overview. The River Mimram downstream of Welwyn, is a small river with open and shaded sections running through an urban area west of the A1(M) before passing through the grounds of a county house school with sections of open grazed meadow, sports fields, an artificial lake before returning to near natural section of river; the river then flows under the A1000, and continuing through un-maintained ancient water meadows.

3.05 The data surveys indicate a typical chalkstream biota and water chemistry but the field surveys indicate that the river has been periodically subjected to reduced flows notably 1992; this probably resulted from lower than average rainfall combined with the continued pumping from the bores. This low flow effect may have resulted in slightly elevated nutrient levels which could have suppress development of some aquatic flora through the overgrowth by epiphytic algae as indicated by the sporadic occurrence of algae, in particular, filamentous species.

3.06 Aquatic and riparian flora. The plant species found were typical of a floristically rich 'chalkstream'. The biomass of these plants between sites along the c 1.5 km surveyed varied primarily with access for grazing animals and with shade.

3.07 Aquatic animals. The macro-invertebrate animals found are typical of chalkstreams with no rare or 'Red book' species being found. In general, surveys showed typical chalkstream fauna but with some indications of pond fauna particularly in the presence of waterbugs and snails at some sites. By comparison to earlier surveys, few caddis larvae were present; this and the generally less diverse fauna than found elsewhere in other chalkstreams, probably relates to the recent drying of the stream.

3.08 Spatial variation downstream. Management and shade are prime constraints on development of high quality status for the aquatic community. Excessive tree planting and bank management in combination with periodically low flows, suppress the full development of flora particularly in the upstream urbanised sections 1 & 2.

3.09 Enlargement of the channel near the two road bridges allowed excessive growths and dominance of sections by particular plant species; these also tend to suppress the development of a fully diverse aquatic fauna.

3.10 Access by cattle in section 3 has destroyed the integrity of the channel banks in that section and remedial action is recommended.

3.11 The sections 4 & 5 in the immediate grounds of the country house (Sherrardswood School) have been gardened and altered to create a 'lake feature'; this has not been sufficiently maintained and is reverting to a semi-natural condition.

3.12 Further downstream, below the weir used to elevate the water level in the lake, site 6, there is some semi-natural woodland with rough grazing & playing fields which provide moderate cover and some degree of wildlife corridor and refuge for mammals.

3.13 In the southerly sections, particularly section 7 and beyond the road in sections 8 & 9, the stream has been affected by continued road development but was previously probably 'ancient' watermeadows; the stream here is artificial but has allowed the development of rich flora & fauna considered typical of many chalkstreams.

3.14 Periodic reductions in water discharge of the stream, particularly in 1992 when sections are reported to have dried down, have almost totally eliminated the game fish stock which are now beginning to recover although there are many smaller fish particularly sticklebacks and also shoals of fry (not identified).

3.15 The riparian corridor potentially provided habitat for many small mammals, birds and amphibians but few were actually detected; much development could be undertaken to encourage them.

3.16 No critical aquatic or riparian areas were detected within the normal 250 m zone of study area.

4. CONCLUSIONS & RECOMMENDATIONS

Existing situation

4.01 This section of the River Mimram is of good quality but has suffered recently from low water flows; at the local level the sections surveyed continue to suffer from access by cattle, from the construction but low maintenance of a dammed ornamental 'lake' section and from maintenance of grounds too close to the river margins.

4.02 The aquatic fauna has recently been severely affected by the near drying of the stream.

Nature conservation interests

4.03 Analysis of biota and its distribution shows no areas of particular national, regional or locally special significance other than the general and varied nature of this semi-natural riverine corridor as a whole being under low intensity use and under the control of one owner.

4.04 Identification of flora and fauna observable during the brief survey specified for July, showed only Kingfisher to be listed on the rare or vulnerable species list (Annex 1 EC Directive on Conservation of Wild Birds 79/409/EEC although the habitat was suitable for Grass snake and other amphibians Specially Protected under Schedule 5, Wildlife & Countryside Act 1981.

4.05 The area adjacent to the proposed construction is not a designated site but the area to the south of the Hertford Road (A1000) is considered of 'Ecological Importance' in Hertfordshire.

4.06 The riparian corridor is acceptable and should not be degraded further.

Water quality interests

4.07 Although the aquatic fauna has recently been severely affected by the near drying of the stream, is unlikely to suffer more as a result of construction work in the near future, although the development of species diversity may again be temporarily halted; it is however preferable to avoid any major diversions or changes of flow.

4.08 No obvious effects of the existing road on water quality were detected despite a culverted input channel from the A1(M). An oil trap is required for this and any proposed or altered surface water input 'channels' However, to be confident of this would require a special study which would need to include sampling during periods of rain, etc. There was a much higher proportion of debris likely to originate from the A1(M) immediately downstream of the A1(1) and bypass, than elsewhere. Garden debris was also common in these sections (1-3).

Assessment of impact

4.09 Further construction is unlikely to substantially degrade this section further than the current situation, provided due and reasonable care is taken.

4.10 This section of the River Mimram is of good quality but has suffered recently from low water flows, a section with excessive access by cattle, the construction of a dam and from maintenance too close to the river margins, none of these factors detract from the care required in construction work during any potential widening of the A1(M).

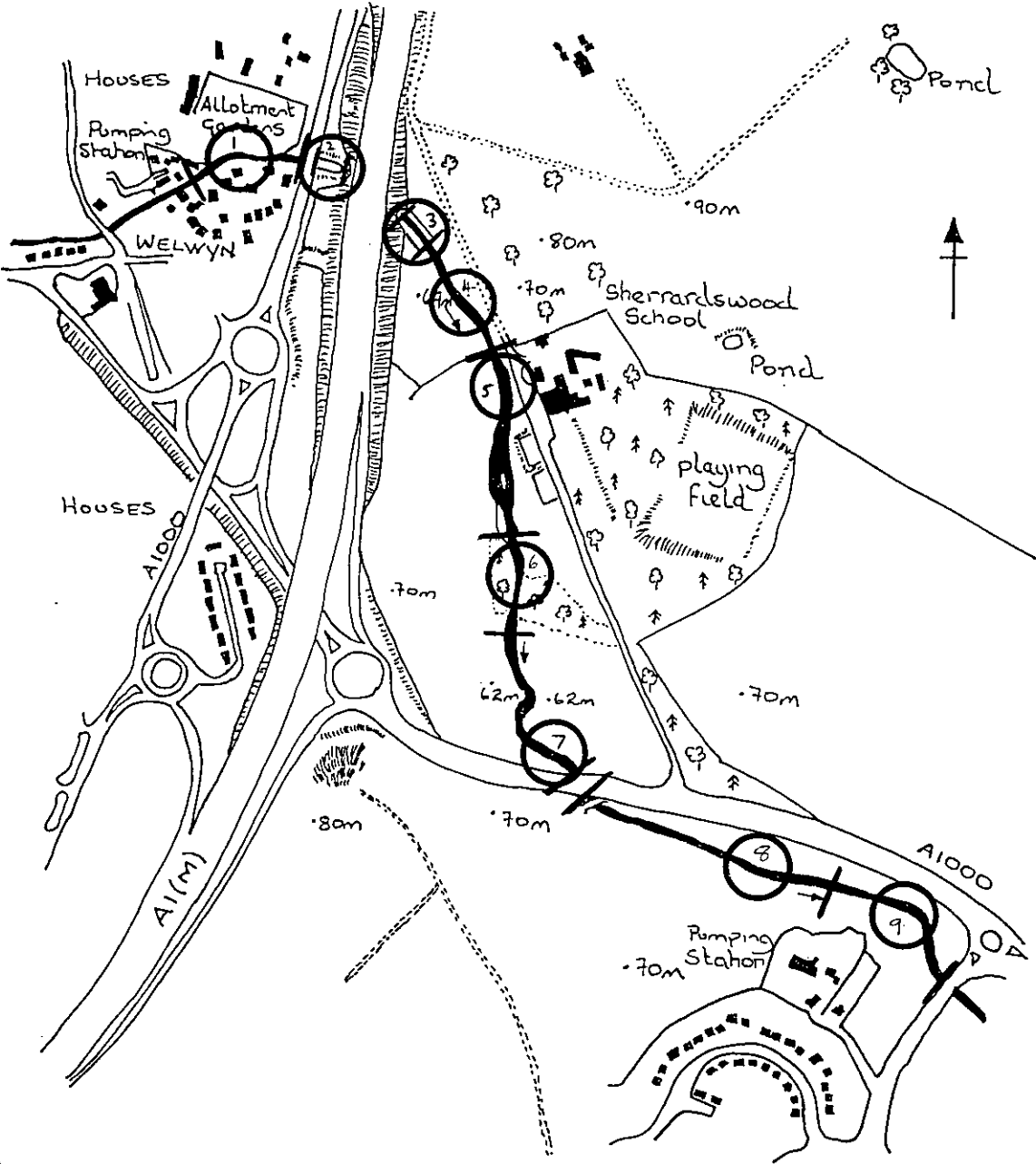
4.11 The previous construction work produced an overwide section but natural processes, outside the culvert itself, resolved these design choices, and an acceptable cross-section of stream has been produced. This process could be repeated and would be acceptable.

4.12 The previous construction work (4.08) produced an acceptable cross-section of stream and the process could be repeated and would be acceptable, a more imaginative channel design allowing potentially more environmental interest and thus ecological potential, eg a sharper reverse bend (or mirror image of that planned), is proposed in preference to the gentle curve normally considered (Figure 3).

4.13 Precautions should be taken to limit the obvious dangers from any construction activity particularly the accidental input of oil product but also the effects on waters downstream of excess suspended and settling materials, reduced oxygen levels, or clogging of stream bed gravels used for fish spawning especially for salmonids.

4.14 Any further tree planting should be restricted to intermittent stand of approximately 50 m in every 70 m and to the use of native trees and bushes

Figure 1. Sketch map of R. Mimram at crossing with A1(M) at Junction 6, Welwyn showing survey sites and adjacent features.



Key

- ○ centre of macro invertebrate sample site
- |¹| section limits eg section 1

Figure 2. Sketch map of R. Mimram at crossing with A1(M) at Junction 6, Welwyn indicating community habitat types.

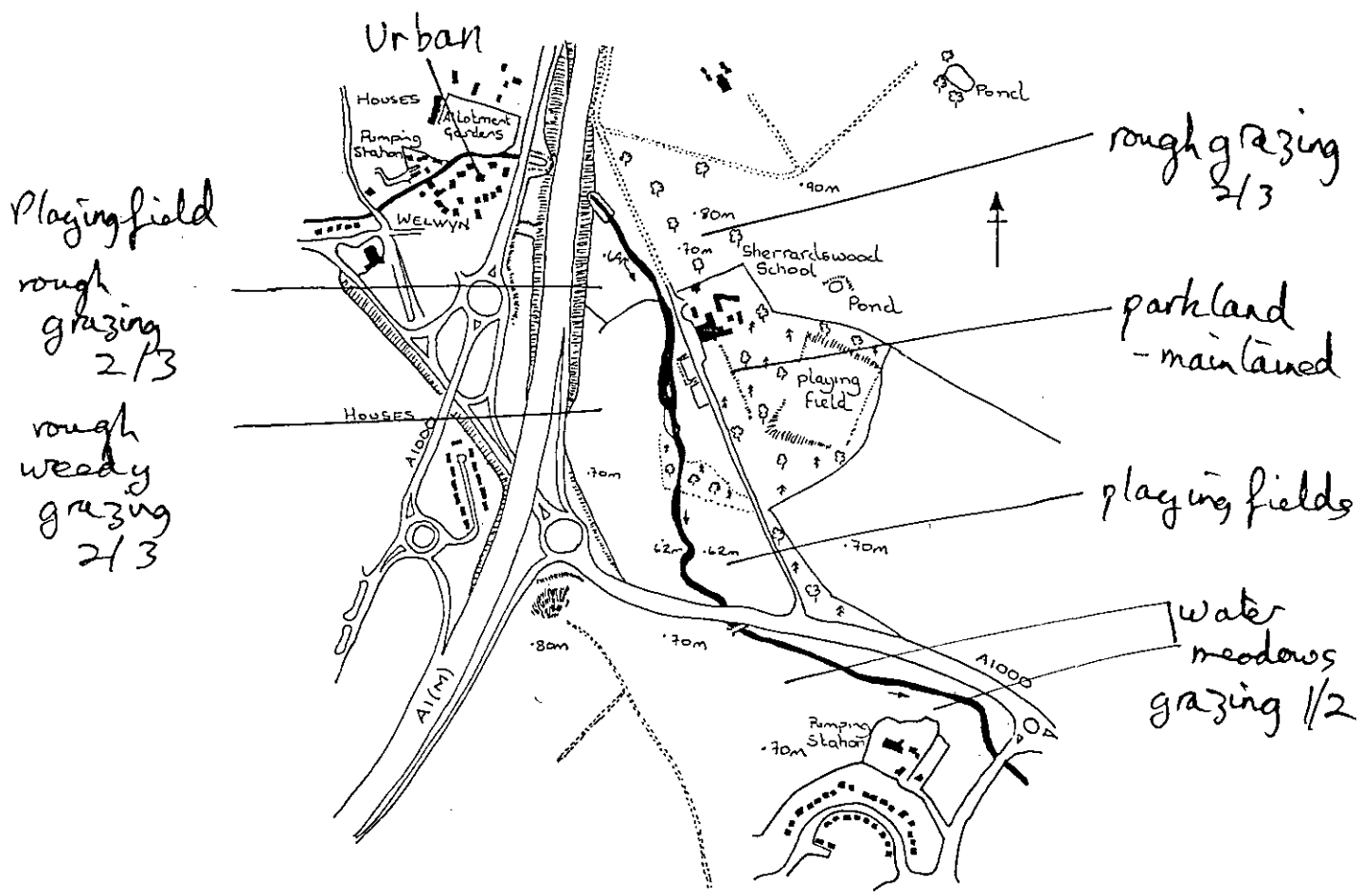
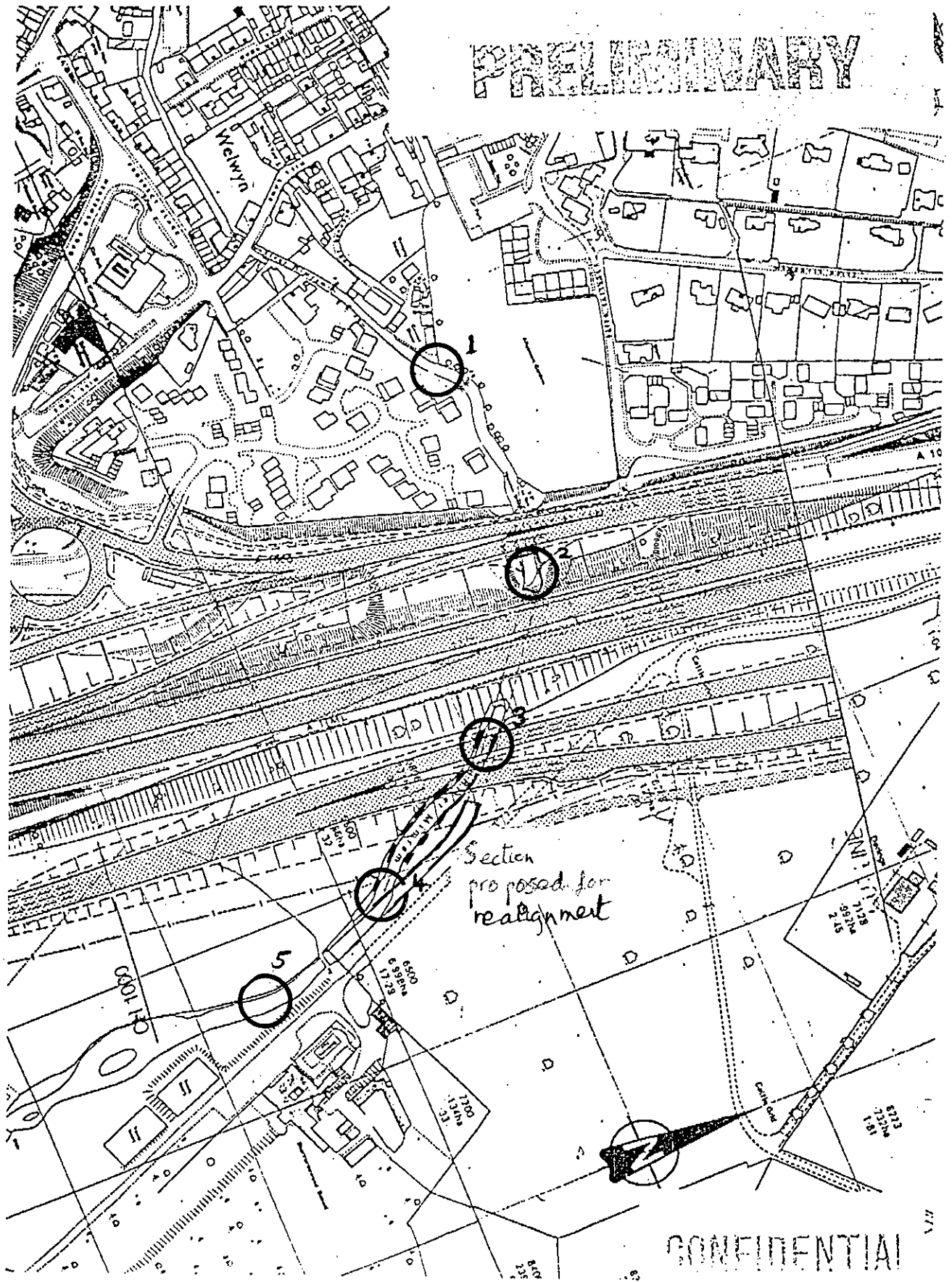


Figure 3. Map of R. Mimram at crossing with A1(M) at Junction 6, Welwyn showing proposed alteration to river channel (supplied by TM).

26-JUL-1993

TRUERS MORGAN



PRELIMINARY

Section proposed for realignment

CONFIDENTIAL

APPENDICES

Appendix 1 Field data survey sheets

1. R. Mimram @ Welwyn, W of A1(M)
 Date: 27.07.'93 c NGR: 15/23331612
 km from source 10, Altitude 62 m
 Lat 51° 49'N, Log 0° 12'W

PHYSICAL CHARACTERISTICS

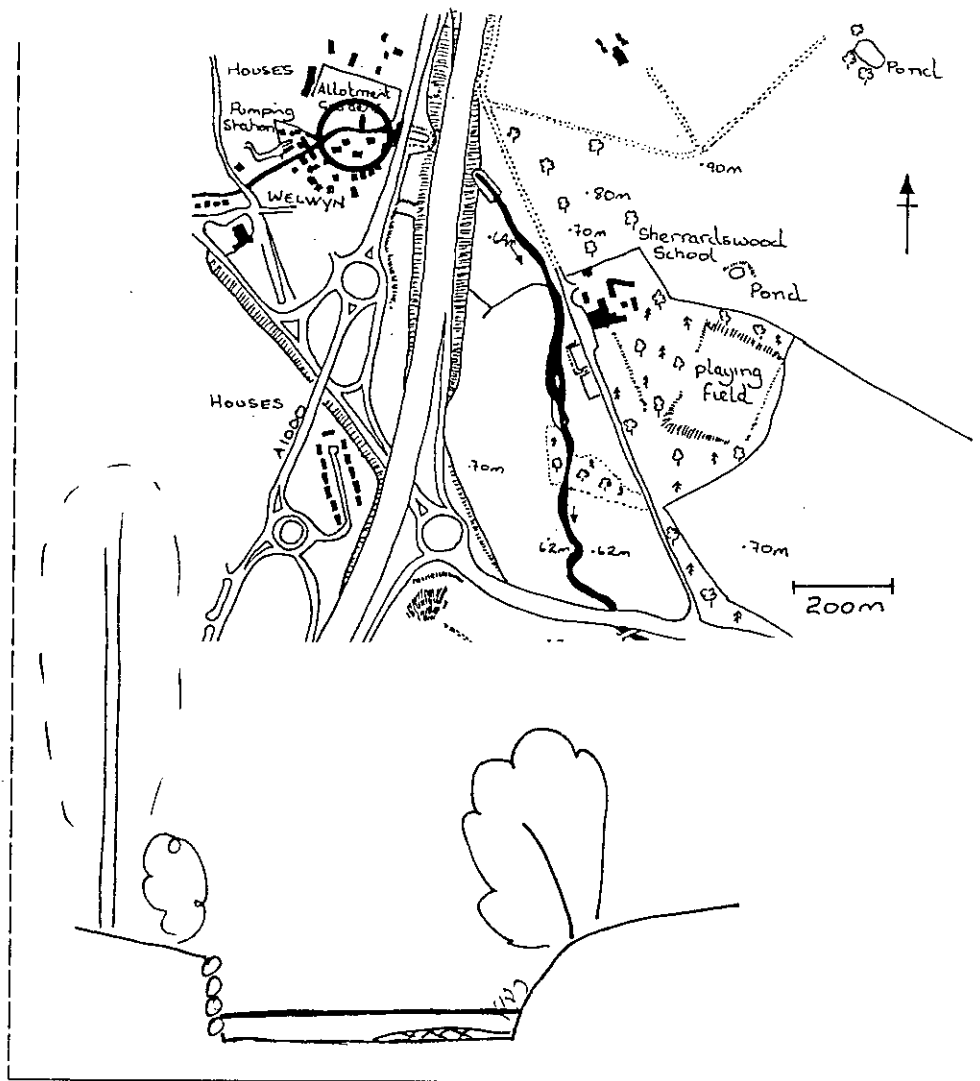
Size at survey: Width 4.5 m; depth .33 m
 Height Bd .39 m @ br.; Water depth.32 m
 est. bank full: Width 8 m; depth 1.3 m
 (stepping stones c 0.2-0.3 m underwater)
 Flow at survey - discharge .4 m s⁻¹
 - velocity 0.2 m s⁻¹
 Bed slope c .001, type: long riffle-pool
 Rel. Stream Power: 2-3
 Channel- plan form: straightened
 - sinuosity now: slight, 2-3 m
 previous: - , - m
 - section: nr vertical, artificial
 Erosion (depositing) %,type:

Substratum (cover) bed banks adjac.
 bed rock (pipes & concrete on bank)
 boulder/cobble (stepping stones on bed)
 pebbles/gravel ***/* */** *
 sand * ** ***
 silt/clay/(peat) *// (soft in margins)
 (leaf debris, roots in river)

WATER CHARACTERISTICS Colour:
 pH 8.0, Conduct. 607µS cm⁻¹, Temp 13.8°C
 Alkalinity 5.26 mmol

Anions, mg l⁻¹	Cations, mg l⁻¹
Alkalinity 263	Calcium 126
Chloride 18.1	Magnesium 2.0
Sulphate 36.4	Sodium 10.1
Nitrate N 6.2	Potassium 1.07
Phosphate P 0.076	(Iron)
Silicate Si 5.6	
Ion balance 6.64 : 5.26 mmol	

Assessment: Nutrient-rich clear
 chalk water



ADJACENT FEATURES etc.

Land use: urban to S, allotment to N
 Upstream: urban, pumping stn.
 Downstream: bridges, pipes crossing
 Maintenance: bank maint. probably regular, garden waste regularly put into river
 Fishery interest: low but could be improved esp if no drying

PHYSICAL

An urbanised section with various types of bank stabilisation and backing onto house gardens to S and allotment to N. Stepping stones c 0.2-0.3 m underwater indicating water was particularly deep(?) at time of visit.

Maintenance Factor -1.5

PLANT (shade 50%:cover; algae 1%, moss 0%, macrophytes 15%) 4 + 4 =

Score 8

An urbanised stream shaded by a variety of mature trees esp. chestnut & alder; S bank with variety of cultivated plants eg Skunk-cabbage but also natives; N bank but shaded by bushes incl. elder, semi-natural but with a variety of weedy species incl. nettles and invasives eg Himalayan Balsam. Aquatics well varied but sparse in biomass; several underwater forms of emergents indicating previous low flows without extremes, but recent periods (months) of higher flows.

ANIMAL

Score 4 1/2

A heavily shaded site (in parts). Gardens down to waters edge along one bank with number of feral and exotic plants. Allotments along other bank, good habitat for wrens and rats. Aquatic fauna rather poor probably due to lack of habitat variety.
 Duck, pigeon, 3-spined stickleback

SUMMARY (incl. potential problems, conservation, long-term morphological changes)

Modest urbanised stream. Good source of vegetation for rapid recolonisation downstream following construction.

OVERALL SCORE 4 3/4

2. R. Mimram @ Welwyn, W of A1(M)
 Date: 27.07.'93 c NGR: 15/23501615
 km from source 10, Altitude 62 m
 Lat 51° 49'N, Log 0° 12'W

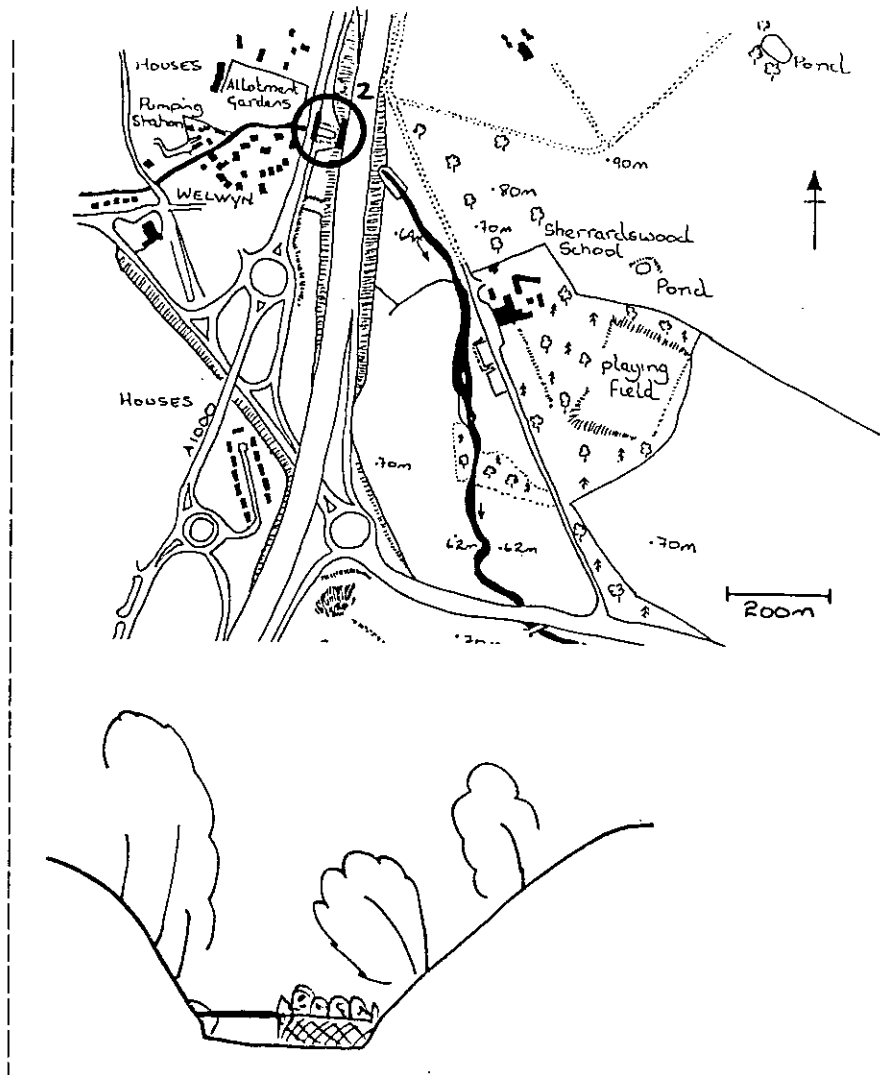
PHYSICAL CHARACTERISTICS
 Size at survey: Width 7 m; depth .38 m
 Height Board: .40 m; Water depth .2 m
 est. bank full: Width 8 m; depth 7 m

Flow at survey - discharge $.4 \text{ m s}^{-1}$
 - velocity $(0.6) \text{ m s}^{-1}$

Bed slope $c .001$, type: long riffle-pool
 Rel. Stream Power: 4 in channel vegetat.
 Channel- plan form: straightened
 - sinuosity now: slight, 2-3 m
 previous: - , - m
 - section: nr vertical, artificial

Erosion (depositing) 40 %, type: /bridges
 straightened and over enlarged between
Substratum (cover) bed banks adjacent
 bed rock

boulder/cobble
 pebbles/gravel /** /**
 sand ** **
 silt/clay/(peat) * *
 (leaf debris)



ADJACENT FEATURES etc.

Land use: potential wildlife refuge
 Upstream: bridge & urban
 Downstream: bridge & M-way, parkland
 Maintenance: nil?
 Fishery interest: low but could be improved esp if no drying

potential periodic salt inputs

PHYSICAL

A straightened & over-enlarged section between two road bridges/culverts dominated by deposited materials and overgrown by emergent vegetation. Very wide and shallow sections under both road bridges with much deposited silt; over-wide approaches to culvert. Road drain inputs, drain cover by M-way.

Maintenance Factor -2

PLANT (shade 80%:cover; algae 0%, moss 0 %, macrophytes 80%) 2 + 2 =

Score 4

A shaded section with bushes & trees and good moss understorey, with the central channel dominated by vegetation typical of slow flows which are uncharacteristic here and resulted from the over-enlarged cross-section encouraging silt deposition; fast-water ($c 1 \text{ m s}^{-1}$) sections developed between stands of vegetation. Area to E by M-way, dominated by weedy species. Poorer for aquatic plants than site 1 but not urban. The uncommon red alga *Batrachospermum* was found in the faster flowing parts; (high score but the only submerged aquatic).

ANIMAL

Score $5\frac{1}{4}$

Heavily shaded with steep, bush & tree-covered slopes. Good habitat for foxes, tits etc. Aquatic fauna slightly richer than site 1 because more instream cover. Some small mammal tracks & .05 m holes seen in banks. Fish fry, snails, ant hills.

SUMMARY (incl. potential problems, conservation, long-term morphological changes)

An interesting refuge with wild life potential if access available (not investigated).

OVERALL SCORE $2\frac{3}{4}$

3. R. Mimram @ Welwyn, E of A1(M)
 Date: 27.07.'93 c NGR: 15/23601611
 km from source 11, Altitude 62 m
 Lat 51° 49'N, Log 0° 12'W

PHYSICAL CHARACTERISTICS

Size at survey: Width 8 m; depth .6 m
 Height Board: - m; Water depth (.55) m
 est. bank full: Width 10 m; depth 2 m
 (reed vegetation across 2/3 of channel)
 Flow at survey - discharge 4 m s⁻¹
 - velocity 0.4 m s⁻¹

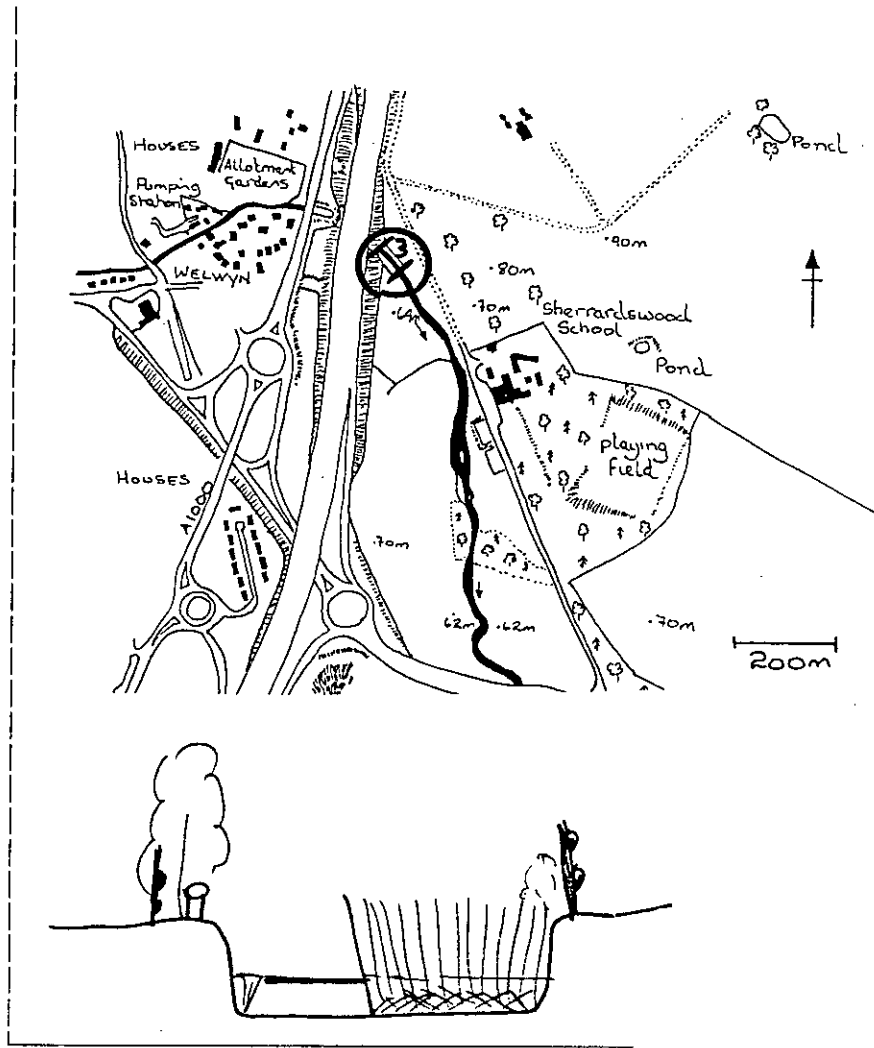
Bed slope c .001, type: long run
 Rel. Stream Power: 2-4
 Channel- plan form: straightened, fenced
 - sinuosity now: slight, 2-3 m
 previous: - , - m
 - section: nr vertical, artificial
 Erosion: (depositing) 60%, type:

Substratum (cover) bed banks adjacent
 bed rock
 boulder/cobble
 pebbles/gravel /*** ** *
 sand * ** **
 silt/clay/(peat) ***/ */ /**/
 (garden, reed & leaf debris)

WATER CHARACTERISTICS Colour:
 pH 8.0, Conduct.607 μS cm⁻¹, Temp 14 °C
 Alkalinity 5.25 mmol

Anions, mg l⁻¹	Cations, mg l⁻¹
Alkalinity 263	Calcium 122
Chloride 16.7	Magnesium 2.0
Sulphate 46.6	Sodium 10.3
Nitrate N 6.2	Potassium 1.46
Phosphate P 0.076 (Iron)	
Silicate Si 5.5	
Ion balance 6.69 : 6.76 mmol	

Assessment: nutrient rich clear
 chalk water



ADJACENT FEATURES etc.

Land use: fenced stream in rough grazing, ROMAN bath house
 Upstream: M-way
 Downstream: rough grazing & parkland
 Maintenance: nil
 Fishery interest: low but could be improved esp if no drying

PHYSICAL

A fenced partly shaded section overwidened and deepened following M-way construction; surface water input via ditch from M-way; cow-grazed outside fence with coarse grasses and some weedy and cultivated species

Maintenance Factor -1.5

PLANT (shade 30%:cover; algae 0%, moss 0 %, macrophytes 70%) 3 + 1 =

Score 4

Slightly shaded & overwidened section dominated by large stand of greater pond-sedge backed by emergent plants Hairy willowherb & water cress to SW; clear water section in shade of planted hedge/tree line (incl old, but regrowing, elm stumps) to NE with the submerged aquatic Starwort. A variety of emergents but none in abundance; few weedy species.

ANIMAL

Score 4 1/2

Fenced section with dense sedges and scrubby trees along margin. Good habitat for eels, trout, warblers, reed bunting, water vole. Aquatic fauna still rather poor. Sticklebacks, chaffinch, mallard; water fowl nests.

SUMMARY (incl. potential problems, conservation, long-term morphological changes)

No evidence of surface water effects from road wash-in but surprising collection of other debris from road and from gardens upstream. This section has already been realigned and recovered quite well mainly due to being fenced but will again be realigned. Sediment loads should be minimised to avoid deoxygenation downstream and excessive settlement as the site recovers from low flows.

OVERALL SCORE 2 3/4

4. R. Mimram @ Welwyn, E of A1(M)
 Date: 27.07.'93 c NGR: 15/23621605
 km from source 11, Altitude 61 m
 Lat 51° 49'N, Log 0° 12'W

PHYSICAL CHARACTERISTICS

Size at survey: Width 10 m; depth .5 m
 Height Board: - m; Water depth .42 m
 est. bank full: Width 14? m; depth 1.5 m

Flow at survey - discharge .4 m s⁻¹
 - velocity 0.5 - 0.3 m s⁻¹

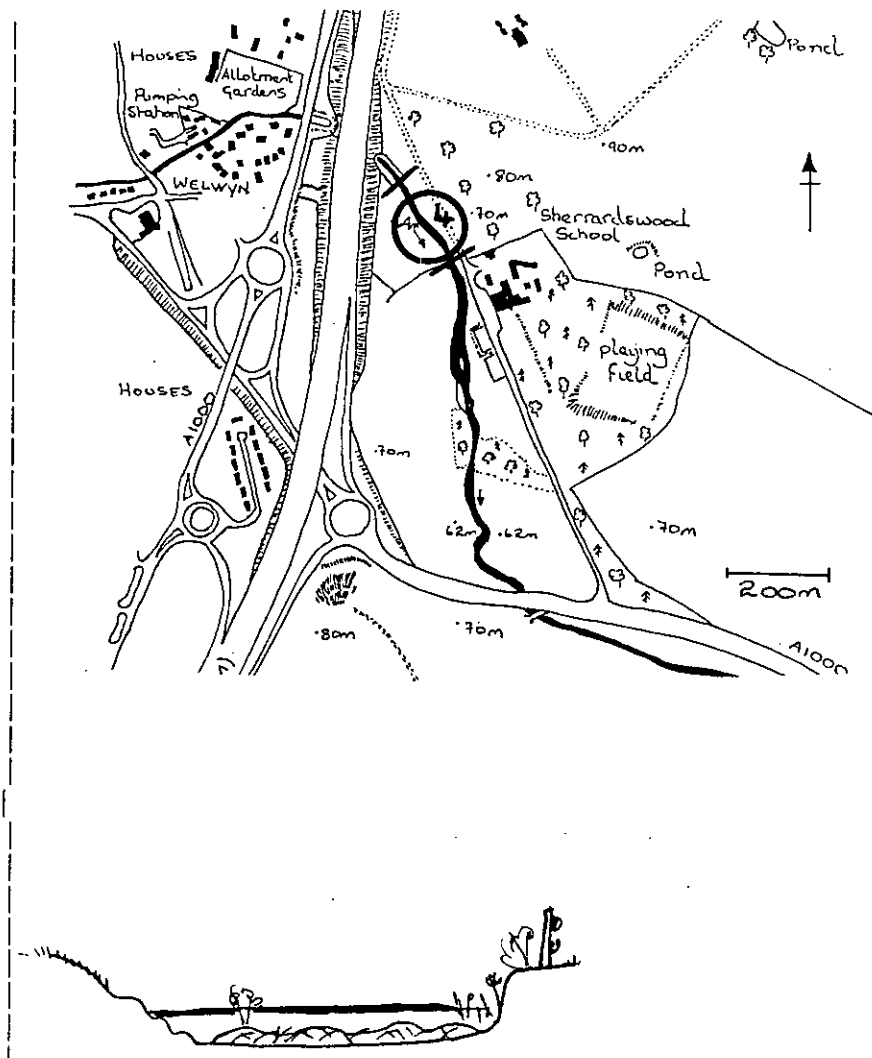
Bed slope c .001, type: long riffle (just)
 Rel.Stream Power: 2-3 with vegetat effects
 Channel- plan form: straightened
 - sinuosity now: little, 2-4 m
 previous: - , - m
 - section: nr vertical & poached

Erosion: (depositing) 90%,type:
 60% poached banks

Substratum (cover) bed banks adjacent
 bed rock

boulder/cobble
 pebbles/gravel *
 sand * * *
 silt/clay/(peat) ***/* ***/ ***/
 (general debris)

WATER CHARACTER. Colour:sl.turbid



ADJACENT FEATURES etc.

Land use: rough grazing in parkland/playing field to SW
 Upstream: fenced stream & M-way
 Downstream: dammed & woody
 Maintenance: nil?
 Fishery interest: low but could be improved esp if no drying

PHYSICAL

Over-wide with generally and badly poached banks to E, intermittent fence to W in poor state of repair but significantly reducing poaching to bank; (recommend watering places - cattle drinks). Meandering channels within soft sediments or emergent cress stands. Garden & other debris from upstream & M-way.

Maintenance Factor -1

PLANT (shade 2%:cover; algae 5%, moss 0%, macrophytes 80%) 1.5 + 1 =

Score 2.5

Open section dominated by emergent stands of Watercress with Fools cress (+ underwater forms) & Canary Reedgrass.

ANIMAL

Score 4³/₄

Open poached meadow along one bank, nettles and rank herbage on other (fenced) good habitat for frogs, grass snakes, voles. Aquatic fauna - Many more aquatic bugs than at previous sites could be an indication of drying?
 Deer tracks (Muntjac)

SUMMARY (incl. potential problems, conservation, long-term morphological changes)

Open unmanaged & overwidened section, could be improved by fencing, with cattle drinks, to E, together with allowing marginal vegetation to encroach and narrow the channel naturally (but not a far as sites 2 or 3); this would also allow sediments to be moved on downstream naturally.

OVERALL SCORE 2³/₄

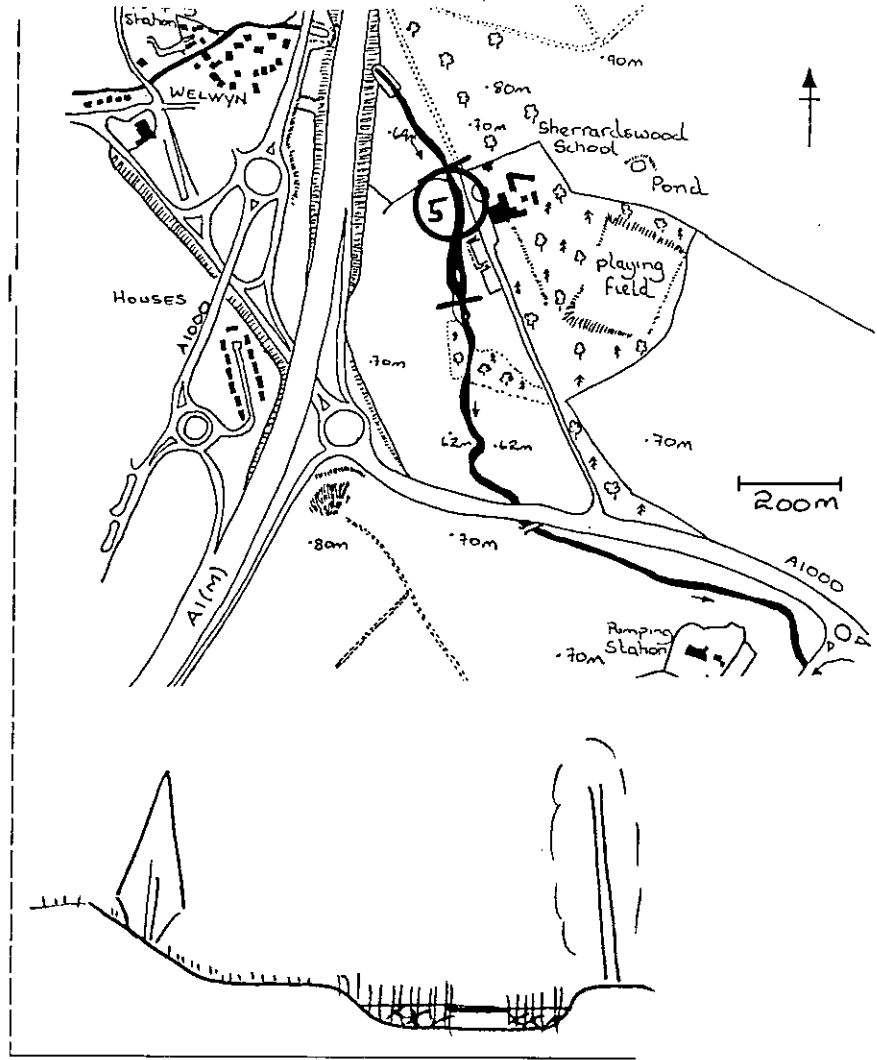
5. R. Mimram @ Welwyn, E of A1(M)
 Date: 27.07.'93 c NGR: 15/23651590
 km from source 11, Altitude 61 m
 Lat 51° 49'N, Log 0° 12'W

PHYSICAL CHARACTERISTICS
 Size at survey: Width 7 m; depth .67 m
 Height Board: - m; Water depth .6 m
 est. bank full: Width 10? m; depth 1.5 m

Flow at survey - discharge $4 \text{ m}^3 \text{ s}^{-1}$
 - velocity $0.3 \text{ m} \text{ s}^{-1}$

Bed slope c .001, type: long run
 Rel. Stream Power: 2-3 by vegetation
 Channel- plan form: probably realigned
 - sinuosity now: little, 2-3 m
 previous: - , - m
 - section: nr vertical, artificial

Erosion: (sl. depositing) %, type:
 dense vegetation
 Substratum (cover) bed banks adjacent
 bed rock
 boulder/cobble
 pebbles/gravel (*) *
 sand * *
 silt/clay/(peat) ***/*? **/**



ADJACENT FEATURES etc.

Land use: school lawns/mature trees backed by meadow
 Upstream: rough grazing/playing field
 Downstream: ornamental island with elms, lawns, tennis courts
 Maintenance: lake filled with vegetation, banks regular
 Fishery interest: low but could be improved esp if no drying

PHYSICAL

Stream narrowed from 7 m to 2.5 m by vegetation giving soft sediment accumulation but with occasional pebbles. Silt bed overlain with moderately firm crust could indicate period of extended drying. Maintenance Factor -0.5

PLANT (shade 80%:cover; algae -%, moss -%, macrophytes 70 %) $2.5 + 0.5 =$ Score 3
 Shaded section of stream narrowed by encroachment of locally dominating stands of Sweet-grass or Pond sedge, with Watercress from E; Meadowsweet & Duckweeds within stands. Large stand of Watercress downstream. Poor meadow with weedy species to W grazed to fence at back of trees. Occasional cultivated standard trees to E (Cherry, Cupressus, Red beech). Lawns mown to stream banks to E reducing wildlife habitat.

ANIMAL

Dense sedges along both banks. Nettles. Large alders shading one bank. School lawns on other side. Good habitat for tits and deer. Score 5 1/4
 Aquatic fauna similar to site 4.

Few birds, moles

SUMMARY (incl. potential problems, conservation, long-term morphological changes)

Moderate wildlife site reduced by mowing excessively close to stream banks. Not part of easily-definable wildlife corridor. Water bird nesting sites.

OVERALL SCORE 3 3/4

7. R. Mimram @ Welwyn, E of A1(M)
 Date: 27.07.'93 c NGR: 15/23691560
 km from source 12, Altitude 61 m
 Lat 51° 49'N, Log 0° 12'W

PHYSICAL CHARACTERISTICS

Size at surv: Width 4-9 m; depth .3-.7 m
 Height Board: - m; Water depth c 0.5 m
 est. bank full: Width 12m; depth 1.5 m

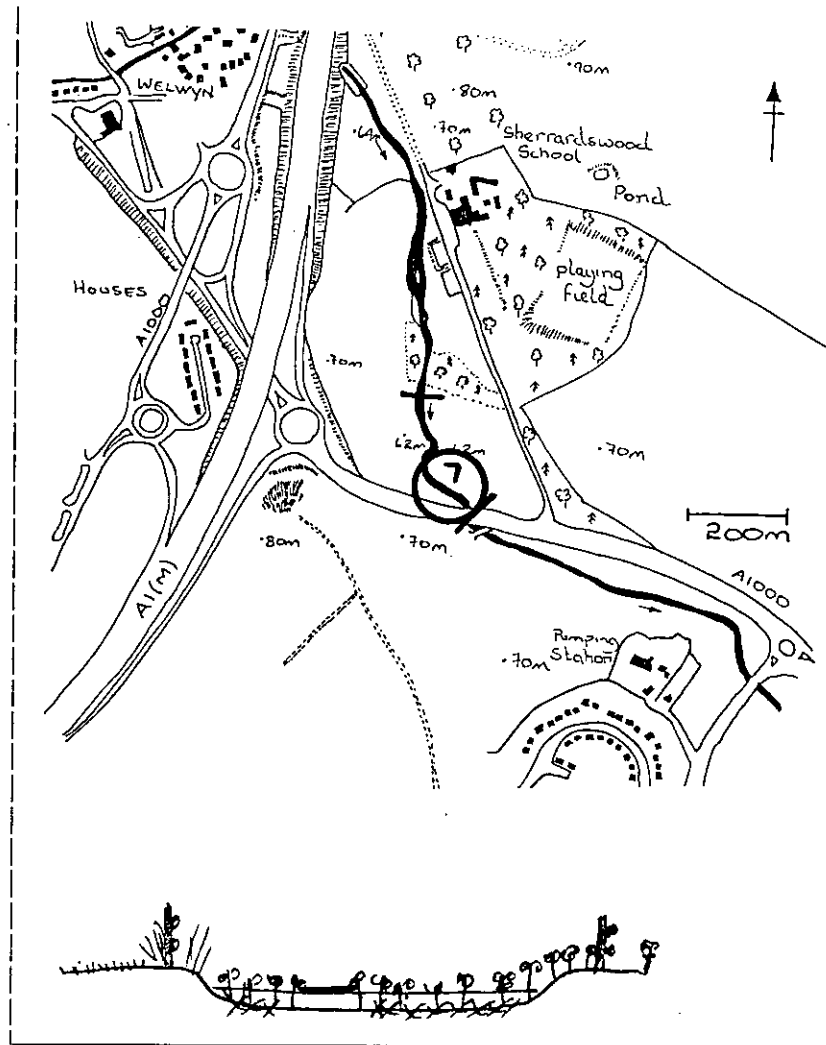
Flow at survey - discharge .4 m s⁻¹
 - velocity 0.2 m s⁻¹

Bed slope c .001, type: long riffle-pool
 Ref. Stream Power: 1-2 but much vegetat.

Channel- plan form: straightened
 - sinuosity now: little, 2-3 m
 previous: - , - m
 - section: nr vertical, artificial

Erosion (depositing) %,type:
 (0.2 m unstable sediment)

Substratum (cover) bed banks adjacent
 bed rock
 boulder/cobble
 pebbles/gravel (*) unstable
 sand *
 silt/clay/(peat)****/*



ADJACENT FEATURES etc.

- Land use: rough grazing/playing field
- Upstream: wooded section
- Downstream: road bridge and wetter meadow
- Maintenance: outside fence line only
- Fishery interest: low but could be improved esp if no drying

PHYSICAL

Maintenance Factor -1/2

A fenced section of stream varying in width from upstream norm to very wide before having been narrowed to pass under a probably undersized bridge. Sediments very soft and overgrown by emergent aquatic vegetation leaving water flow restricted to a narrow central channel. Some flooding across playing field upstream.

PLANT (shade 5%:cover; algae -%, moss -%, macrophytes 95%) + =

Score 5

A broader open section dominated by emergent plants mainly Watercress in ponded section above road bridge; Duckweeds present amongst emergents. Weedy grazing to W in corner of field between roads outside fence line with narrow line of weedy species edging cricket pitch to E but including good stand of Meadowsweet. Submerged aquatic plants include a broad-leaved submerged Pondweed and Horned Pondweed near bridge in stable deeper section; a variety of good emergent species were seen on banks with a few weedy species also.

ANIMAL

Score 4 3/4

Just above bridge. Solid with watercress. Good habitat for grass snake and vole. Jackdaws and crows overflying. Wide range of aquatic snails at this site. Muntjac known to occur here and next site and a badger set present. Relatively rich aquatic fauna. Trout 0.2 m, 10 spined stickleback, moorhen?, Meadow Browns, kestrel pr.

SUMMARY (incl. potential problems, conservation, long-term morphological changes)

OVERALL SCORE 4 1/2

8. R. Mimram @ Welwyn, S of A1000
 Date: 27.07.'93 c NGR: 15/23851545
 km from source 12, Altitude 60 m
 Lat 51° 49'N, Log 0° 12'W

PHYSICAL CHARACTERISTICS

Size at survey: Width c8m; depth .5 m
 Height Board: - m; Water depth .45 m
 est. bank full: Width 10 m; depth 0.8 m

Flow at survey - discharge .4 m³ s⁻¹
 - velocity 0.1-0.4 m s⁻¹

Bed slope c .001, type: long riffle-pool
 Rel. Stream Power: 2-3

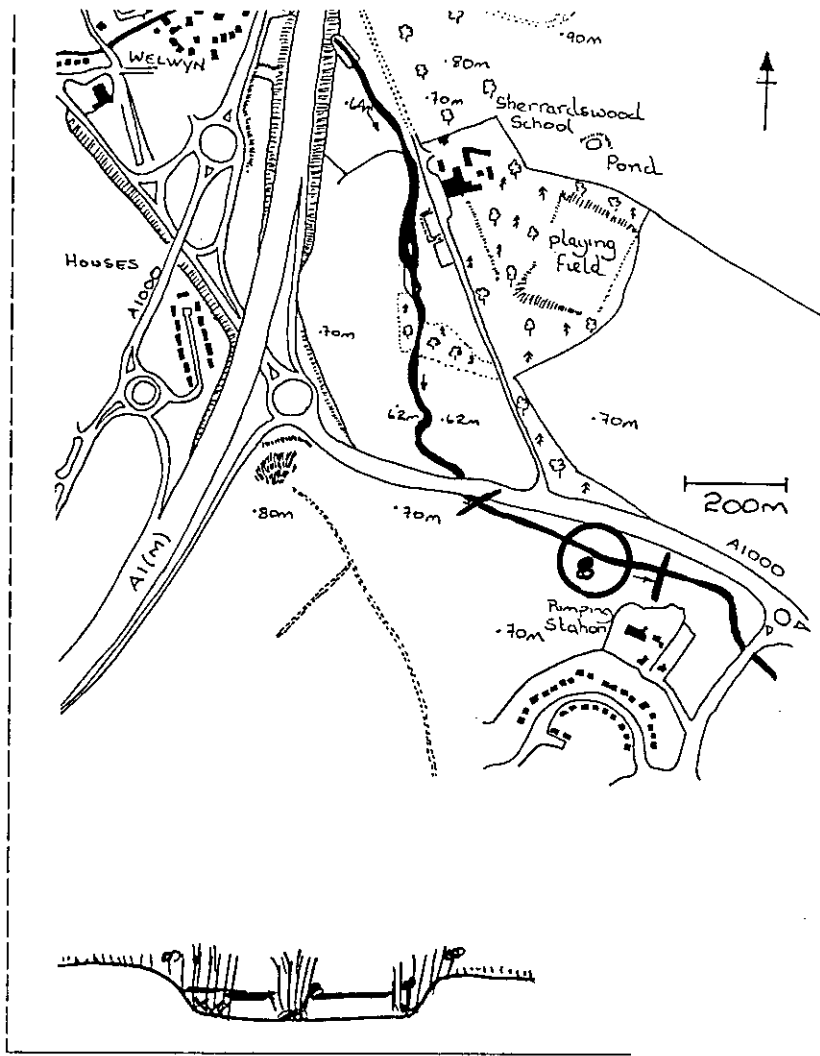
Channel- plan form: straightened
 - sinuosity now: little, 2-3 m
 previous: - , - m
 - section: nr vertical, prob. artificial

Erosion: neutral, type:
 dense emergent veg. increasing settlement
Substratum (cover) bed banks adjacent
 bed rock bricks & blocks on bed
 boulder/cobble
 pebbles/gravel *
 sand ** (sandy patches on bed)
 silt/clay/(peat) ***

WATER CHARACTERISTICS Colour:
 pH 8.1, Conduct. 606 µS cm⁻¹, Temp 13°C
 Alkalinity 5.22 mmol

Anions, mg l ⁻¹	Cations, mg l ⁻¹
Alkalinity 261	Calcium 122
Chloride 18.1	Magnesium 2.0
Sulphate 44.2	Sodium 14.7
Nitrate N 6.0	Potassium 1.08
Phosphate P 0.078	(Iron)
Silicate Si 5.44	
Ion balance 6.65 : 6.93 mmol	

Assessment: clear nutrient rich
 chalk water



ADJACENT FEATURES etc.

Land use: grazed watermeadow?, cut hay field, adjacent pumping station
 Upstream: inflow from side drain, A1000 road, school grounds
 Downstream: watermeadow, fenced meadows, minor road, pumping station
 Maintenance: regular but appears to be low frequency
 Fishery interest: low but could be improved esp if no drying, may be stocked

PHYSICAL

Typical managed lowland chalkstream within probably ancient watermeadow system with firm sandy bed; grazed to margins by cattle or horses. A second in-channel channel developed after recent floods; grazed banks but poached to S. Maintenance Factor 0

PLANT (shade 5%:cover; algae 15%, moss -%, macrophytes 80%) 2.5 + 1.5 = Score 4
 Stream codominated by extensive stands of emergents particularly Watercress and Bur-reed but with Iris, Veronica, Forget-me-not and Duckweed particularly in margins and filamentous algae over some sandy/silty substrates. Some weedy bank species to N

ANIMAL

Downstream of motorway bridge. In field. Dense marginals. Good stream habitat. Aquatic fauna rather poor. Score 5
 Wren nest, large White, Coenagrion Dragonfly

SUMMARY (incl. potential problems, conservation, long-term morphological changes)

Good stream habitat but not a good mammal wildlife corridor as little cover except for small mammals; probably good nesting ground.

OVERALL SCORE 4 1/2

9. R. Mimram @ Welwyn, S of A1000
 Date: 27.07.'93 c NGR: 15/24001540
 km from source 12, Altitude 60 m

Lat 51° 49'N, Log 0° 12'W

PHYSICAL CHARACTERISTICS

Size at survey: Width 7 m; depth .33 m
 Height Board: - m; Water depth .32 m
 est. bank full: Width 10? m; depth 2? m
 modified to fit road-curve & roundabout
 Flow at survey - discharge .4 m s⁻¹
 - velocity 0.2 m s⁻¹

Bed slope c .001, type: long riffle-pool

Rel. Stream Power: 2-3

Channel- plan form: 'straightened'

- sinuosity now: sl, 2-3 m

previous: - , - m

- section: nr vertical, prob. artificial

Erosion - neutral %, type:

dense emergent veg. increasing settlement

Substratum (cover) bed banks adjacent

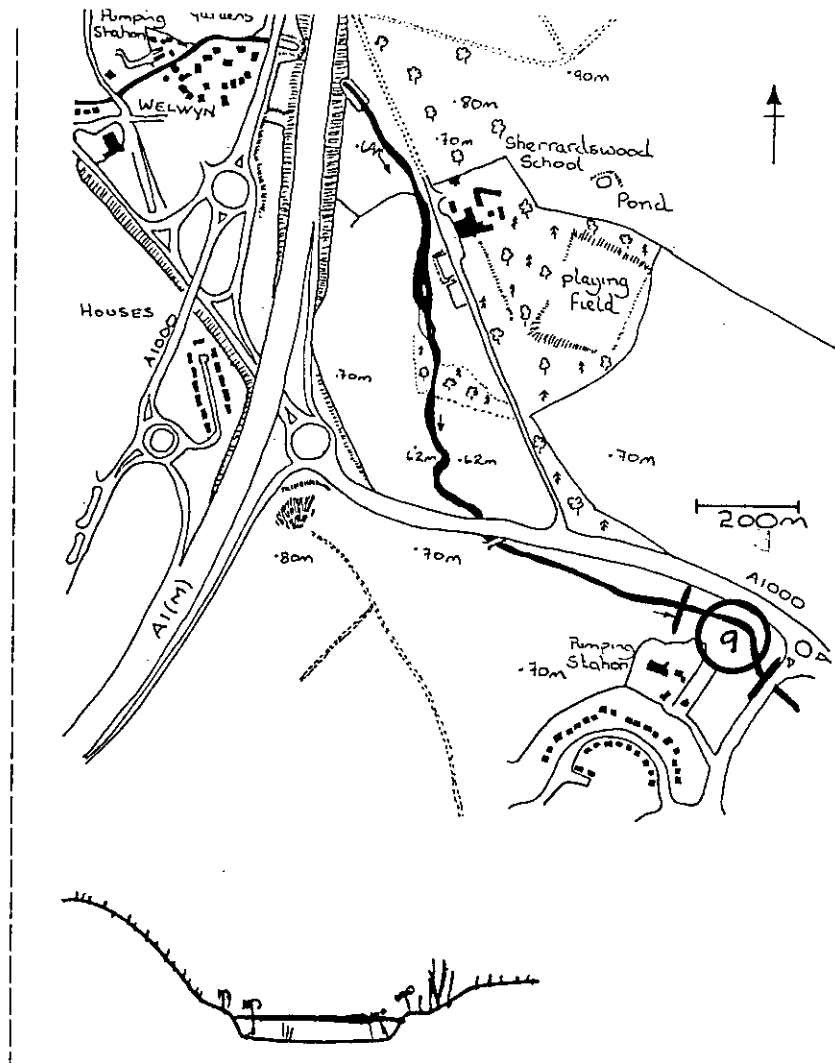
bed rock

boulder/cobble bricks on bed

pebbles/gravel *

sand ****

silt/clay/(peat) *



ADJACENT FEATURES etc.

Land use: horseculture, ancient watermeadow modified by new road

Upstream: girder foot bridge, grazing, hay

Downstream: grazing, pumping station, minor road

Maintenance: probably regular

Fishery interest: low but could be improved esp if no drying, fish stocking

PHYSICAL

Maintenance Factor 1

Firm gravel bed covered with mainly fine mobile sands in densely vegetated section.

PLANT (shade 10%:cover; algae 2%, moss - %, macrophytes 80 %) 3 + 2 =

Score 5

Stream codominated by extensive stands of emergents particularly Watercress but with Iris, Veronica, Forget-me-not and Duckweed particularly in margins and filamentous algae over some sandy/silty substrates. Some weedy bank species to N. Underwater forms of emergents but Water Crowfoot (no flower or surface leaves) the only submerged aquatic; this indicates that the extensive drying to mud, indicated as occurring may be limited at its downstream limit to around this site; mud-dwelling forms of Crowfoot exist but require at least some moisture. Slight shade from Willow trees.

ANIMAL

Score 5 1/2

Steep slope on one bank, field with horses on other. Lots of watercress. Good habitat for frogs, grass snakes and water voles.

Aquatic fauna rather poor suggestive of recent drying.

Green Woodpecker; Heron, small, white & meadow browns, numerous sticklebacks; amphibian area

SUMMARY (incl. potential problems, conservation, long-term morphological changes)

Good stream habitat but not a good mammal wildlife corridor as little cover except for small mammals; probably good nesting ground.

OVERALL SCORE 5 1/4

Appendix 2 Table 1. Genera of flora noted during surveys on 27.7.1993 of section of River Mimram mainly to the East side of the A1(M). (key: + = present)

River Site	1	2	3	4	5	6	7	8	9
TREES/BUSHES									
Acer p/c	c	p							
Aesculus	+								
Alnus	+	+			+	+			
Betula									
Corylus									
Crataegus	+	+	+						
Fraxinus								+	
Hex									
Ligustrum									
Prunus									
Pinus									
Quercus									
Rosa									
Salix	+	cc			+				+
Sambucus	+		+		+	+		+	
Taxus	+								
Tilea									
Ulmus			+					+	
Viburnum									
River Site	1	2	3	4	5	6	7	8	9
AQUATICS									
Batrachospermum	*								
Callitriche			+						
Elodea c/n									
Fontinalis									
Lemna				mi	+	+	+	10%	
Myriophyllum			?						
Oenanthe fl									
Potamogeton							+		
Ranunculus									+
Sparganium								30%	+
Zanichellia	+								
River Site	1	2	3	4	5	6	7	8	9
MARGINALS / BANK (* = recent alien species)									
Alisma									
Apium	+u/w			20%				+	10%
Arum							+		
Byrophytes		7							
Caltha									
Cardamine									
Carex p/r	p	r	r+++		r+++				
Catabrosa									
Cerastium									
Dipsacus									
Epilobium	+	+	+	+	+	+	+	+	+
Euphorbia									
Galeopsis									

River Site	1	2	3	4	5	6	7	8	9
Galium		+		+	+				
Geum									
Glyceria			+		+++	+		+	+
Graminae	2%	+		+0			+		
Hedera	+		+			+			
Heracleum	+								
Humulus									
Iris	2					+		5%	+
Impatiens*	+								
Juncus									+
F. Labiatae									3
Lycopus	+				+				
Lamium a/p									
Luzula									
Lysichiton	+								
Lythrum			+		+				
Mentha	+	+		+		+			+
Mercurialis						+			
Mimulus*									
Myosotis	+		+			+		+	+
Oenanthe cr									
Nasturtium	wild	80%	+++	60%	+	+	+	30%	70%
Petasites	+								
Phalaris	+	+		10%					10%
Phragmites									
Prunella									
Rosa			+						
Sagittaria									
Silene									
Scrophularia	+		+			+	+		
Solanum	+	+							
Symphoricarpos									
Symphytum									
Teucrium	+								
Ulmeria					+		+		
F. Umbelliferae		+			+				
Veronica a/b	a		+	b	+			a	a

River Site	1	2	3	4	5	6	7	8	9
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RUDERALS

Achillea									
Bellis									
Cocosmia	+								
Cirsium		+	+	+	+		+	+	+
Convolvulus				+	+				+
Geranium		+							
Lactuca	+						+		
Lolium		+		+			+	+	+
F. Graminae			+						
Malva									+
Phleum									+
Plantago									
Polygonum									
Rubus fr/id	r	id				+	+		
Rumex a/?	a	+					+		
Ranunculus			a				a		

River Site	1	2	3	4	5	6	7	8	9
Reynoutria									
Senecio	+	+	+	+	+		+	+	+
Urtica	+	+	+	+	+	+	+	+	
Taraxacum									
Trifolium			+						
unid. seedlings									

(key: + = present; n% = estimated cover of stream bed; 'n' number of species found in genus; 'aa' abbreviation of the single or more species found in genus when unusual or significant)

Appendix 2 Table 2 Macro invertebrate and vertebrate fauna of the River Mimram July 27 1993.

Abundance category 5>1 Based on field identifications

Site/Taxon	1	2	3	4	5	6	7	8	9	1979 Taxa 0=absent *=present
FLATWORM										
<i>Polycelis nigra</i>		2								*
AQUATIC WORMS										
<i>Oligochaeta</i>	1									*
<i>Naididae</i>						1				*
<i>Rhyacodrilus coccineus</i>		1						1		*
<i>Tubifex ignotus</i>		1					1			*
<i>Tubifex tubifex</i>		5		1		1				*
<i>Limnodrilus hoffmeisteri</i>		5		1						*
<i>Aulodrilus plurisetia</i>				1						*
<i>Eiseniella tetrahedra</i>		3				2				0
LEECHES										
<i>Glossiphonia complanata</i>	3							2	1	*
<i>Erpobdella octoculata</i>										*
FRESHWATER SHRIMPS										
<i>Gammarus pulex</i>	5	5	5	2	5	2	2	5	5	*
<i>Asellus aquaticus</i>	3	2	1	1				2	2	*
MAYFLIES										
pale watery										
<i>Centroptilum luteolum</i>	5	5	5		4			2		*
olives										
<i>Baetis</i> spp.	2	3	3					2		*
blue winged										
<i>Ephemerella ignita</i>		4							1	*
SPRINGTAILS										
<i>Collembola</i>						1	1			0
CADDIS										
<i>Trichoptera</i>		1								*
<i>Polycentropus</i> sp.					2					0
ALDER FLY										
<i>Sialis lutaria</i>								3		*
DRAGON FLY										
<i>Sympetrum sanguineum</i>								1		
WATER BOATMAN										
<i>Corixa</i> spp.				5	1					0
<i>Notonecta glauca</i>				3						0
<i>Velia caprai</i>				1						0
<i>Micronecta</i> sp.					1					0
NON-BITING MIDGE LARVAE										
<i>Chironominae</i>	1		1				2			*
<i>Orthoclaadiinae</i>		1			3		2	3	4	*
WATER MITE										
<i>Hydrachnellae</i>			1	1	4	2				*
MOLLUSCS										
Pea shell										
<i>Sphaerium comeum</i>	2									*
Spire shell										
<i>Potamopyrgus jenkinsi</i>		1	4	2	3	2	2			*
Wandering snail										
<i>Lymnaea peregra</i>			1	3	3		5	4		*
Rams horn snail										
<i>Vortex leucostoma</i>			2	2		5	5			*
Marsh snail										
<i>Lymnaea palustris</i>							4			*
Great pond snail										
<i>Lymnaea stagnalis</i>								1		0
<i>Valvata piscinalis</i>							1			*

Site/Taxon	1	2	3	4	5	6	7	8	9	0=absent	1989
HYMENOPTERA											
Common wasp											
Vespula vulgaris	1						3				
BUGS											
Hemiptera homoptera											
	1										
Ground beetle											
Carabus violaceus		1									
BUTTERFLIES											
Peacock											
Inachis io											
Small tortoiseshell											
Aglia urticae									1		
Orange tip											
Anthocharis cardamines											
meadow brown											
Maniola jurtina											
DAMSELFLY											
Ischnura elegans											
Approx ASPT	3.6	4.3	3.4	3.8	4.3	3.3	2.8	4.0	4.6		<u>1989</u>
								mean	3.4		4.28
FISH											
Gasterosteus aculeatus	5	3	2	5	4	5	5	1	1		*
Pygosteus pungitius			1	2	2	2	2	5	5		*
Salmo trutta											0
Anguilla anguilla											
Rana rana											
Natrix natrix											
Passer domesticus	1										
Turdus philomelos	1							1			
Turdus merula	1										
Picus viridis	1										
Troglodytes troglodytes	Habitat+1										
Parus major							1				
Parus caeruleus											
Aegithalos caudatus											
Columba palumbus											
Streptopelia decaocto											
Prunella modularis											
Fringilla coelebs											
Chloris chloris											
Carduelis carduelis											
Hirundo rustica											
Delichon urbica											
Pica pica											
Gallinula chloropus											
Larus ridibundus											
Emberiza schoeniclus											
Wartblers											
Alcedo atthis											
Vulpes vulpes											
Arvicola amphibius											
Rattus norvegicus											
Muntiacus muntjac											
Meles meles											
Oryctolagus cuniculus											
Talpa europea											

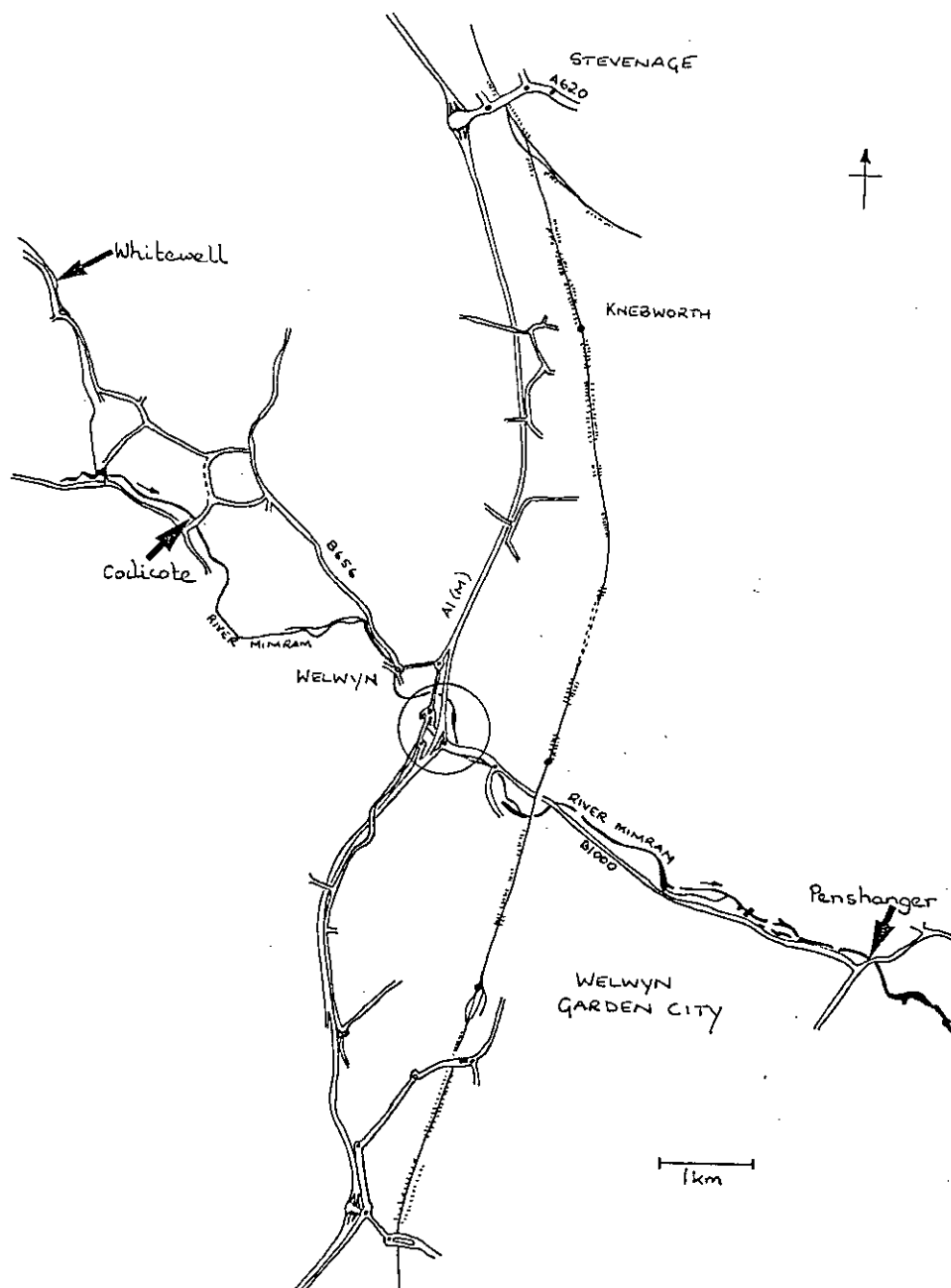
Key: Habitat = habitat suitable for species

Appendix 2 Table 2 Macro invertebrate and vertebrate fauna of the River Mimram, 1979 survey carried out for IFE River Communities included the following additional species for which the habitat is still considered suitable.

Riffle beetles	<i>Oulimnius tuberculatus</i>		
	<i>Eimis aenea</i>		
	<i>Limnius volkmari</i>		
Mayfly	<i>Baetis rhodani</i>		
	<i>B. scambus</i>		
	<i>B. vernus</i>		
Fishermans curse	<i>Caenis moesta</i>		
Stonefly	<i>Nemurella picteti</i>		
Caddis fly	<i>Rhyacophila dorsalis</i>		
	<i>Sericostoma personatum</i>		
	<i>Athripsodes aterrimus</i>		
	<i>Drusus annulatus</i>		
	<i>Silo sp.</i>		
	<i>Goera pilosa</i>		
Beetles	<i>Deronectes elegans</i>		
-	<i>Valvata cristata</i>		
Ramshorns	<i>Planorbis crista</i>		
	<i>P. contortus</i>		
	<i>P. albus</i>		
Pea shells	<i>Pisidium subtruncatum</i>		
	<i>P. nitidum</i>		
	<i>P. milium</i>		
	<i>P. casertanum</i>		
Slater	<i>Asellus meridianus</i>		
Lumbricolid Oligochaetes	<i>Stylodrilus heringianus</i>	probably	<i>Stylodrilus brachystylus</i>
Leeches	<i>Theromyzon tessulatum</i>		
	<i>Batracobdella paludosa</i>		
	<i>Helobdella stagnalis</i>		
Caddis fly	<i>Hydropsyche siltalai</i>		
	<i>Limnephilus lunatus</i>		
	<i>Limnephilus extricatus</i>		
Black fly	<i>Simulium ornatum</i>		
FISH			
Bullhead	<i>Cottus gobio</i>		

Appendix 2 Table 3 Assessment of macro-invertebrate fauna of the River Mimram, 1979 survey carried out by IFE River Communities. Figure locating 1979 sites (arrows) and site of this study (open circle).

Site	NGR	Date	BMWP	No. of Taxa	ASPT
Whitewell	15/193207	spring '89	68	16	4.25
		summer '89	55	14	3.93
		autumn '89	86	20	4.30
		combined '89	105	24	4.38
Codicote	15/208179	spring '89	108	21	5.14
		summer '89	105	23	4.57
		autumn '89	117	24	4.88
		combined '89	152	29	5.24
Penshanger	15/282133	spring '89	88	20	4.40
		summer '89	87	20	4.35
		autumn '89	69	17	4.06
		combined '89	123	26	4.73



Appendix 3 Reconnaissance survey methodology for environmental quality assessment of watercourses.

A3.1. Methods

A3.1.1 Site reconnaissance, of the agreed/approved/requested list of watercourse sites, will be undertaken to determine the relevant ecological or conservation characteristics of the watercourse by an on-site assessment of the following:

- Flora and fauna
- Bank, sediment and bed characteristics
- Watercourse size
- Adjacent land use
- On-site evidence of recreational use
- Proximity to designated sites of conservation importance
- Other potential problems including reinstatement and long-term morphological changes

At each site a water sample will be filtered for on-site characterisation or further specific laboratory analysis. Assessments will be made of the need or value of undertaking full biomorphic surveys. In addition, sites observed which may be of particular value will be noted but only a location map and outline data recorded together with a subjective assessment of value, will be reported.

The **aquatic and riparian flora**, including major mosses, liverworts or macroscopic algae, will be recorded within the section of watercourse (typically 200 m) to a width of typically 100 m either side, and limited to flora readily visible and preferably in flower; notes will be made to assist in the assignment of a value for the relative quality of the defined site. Separate assessments on a scale of 0 - 5 for bad to excellent, will be made for submerged aquatic plants and also for bank or emergent species; expected rare species will be specifically sought. These two scores will be added together to produce a score from 0 - 10 for flora for each site after correcting for bankside shade. Scores are based upon the occurrence of species to be expected in natural unmanaged watercourses of the area after considering the water flow and geology of the catchment.

Aquatic fauna, as macro-invertebrates, will be sampled within each section or centred upon the potential impact or crossing point of the watercourse. All habitats will be sampled where possible. Standard kick samples of three minute duration will be taken when the water depth is less than 0.6 m at some point; small streams will be sampled for shorter periods. Where the water is too deep to wade, a dredge will be used to collect the sample. In some situations where the substratum is unsuitable for the dredge, a pond net sample will need to be taken from the bank. The samples will be sorted on the bank by spreading them out in a tray and picking out individuals of each family present and different species of each family where possible. A score (0-10), broadly based upon the BMWP score system, will be assigned to each site in the field. In the laboratory, identifications will be checked and scores amended where necessary. This data will allow BMWP scores to be produced and used in the RIVPAC predictive system from which comparisons can be made between the actual or observed macro-invertebrate communities and the predicted one.

Observations, or traces, of other fauna, will be noted together with an assessment of the need for special surveys, eg birds or otters.

Bank, sediment and bed characteristics will be assessed in two ways, by their
a) percentage cover of the stream bed in the macro-invertebrate sample area, and by the
b) relative proportions of various materials in the banks and adjacent areas in the general sample area; specific searches will be made for materials of relevance to construction such as peat or rock as bed rock or outcrops.

Reconnaissance survey data sheets will contain information, as appropriate, on the following:

1. watercourse name with nearest village etc., as necessary;
2. reconnaissance survey number - numeric order, survey date, etc;
3. numeric National Grid Reference number (NGR);
4. distance from source of watercourse (also for RIVPACS);
5. altitude of survey section to *c* 5 m (also for RIVPACS);
6. latitude and longitude (also for RIVPACS).

Physical characteristics (estimated) :

7. size as mean width and mean depth of water at time of survey (also for RIVPACS) and at the bankfull condition of the watercourse, the mean depth of pools will be recorded if appropriate, additional comments relating to obvious recent events as seen from debris stranded on the banks or adjacent vegetation and recorded as the additional height above that at survey; mean width is the unobstructed width without allowance for dense fringing vegetation eg. reedstands and which would be accounted for in bank-full widths;
8. flow of water in watercourse at survey in cubic metres per second (RIVPACS requires discharge category from the watercourses map)
9. velocity of water (estimated mean);
10. slope of channel bed over survey length (estimated to the nearest 1°, RIVPACS uses general slope from contours over a distance of *c* 1 km);
11. type of bed or water flow - waterfall, stepped, long riffle, riffle-pool with sequence distance, glide or run, smooth, static or ponded;
12. relative stream power - estimated on scale of 0 to 10 based to cover the range of British rivers, broadly,
0-3 indicate bed and bank stable rivers and streams,
4-5 rivers or large streams with some bed scour or bank erosion or lateral migration,
6-8 active rivers with rock or worked gravels and erosion or migration or both; and a comment;
13. channel form in plan - straight, meandering, braided;
14. channel sinuosity, current and previous, where the situation may have naturally changed - slight, moderate, extreme, or the channel straightened; the actual and previous amplitude is recorded in meters - this relates to the potential lateral migration over future decades which may expose reinstatement work or construction eg buried pipework, or promote consequential downstream adjustment or erosion;
15. channel section - slope, steep, vertical, or trapezoid if managed, dredged or resectioned;
16. erosion of stream banks as percentage of stream bank of section - incising, flake or slab, slump or slide, undercut or block fall, or depositions with type of material and position;

17. substratum as percentage to within 10% for major components, or subjectively as proportions indicated by asterisks (* = c 20%), of watercourse bed (RIVPACs requires mean grain size or phi value) for:
- | | |
|--|------------------------|
| bedrock or outcrops, boulders (>256 mm), | cobbles (65 - 255 mm), |
| pebbles and gravel (2.1-64 mm), | sand (.06-2 mm), |
| silt & clays (.06-.004 mm), and | organic or peat; |
- occasionally in addition the adjacent soils of stream banks and appropriate adjacent areas will be considered if relevant or particularly different.
18. the colour and nature of the water eg presence of particles etc.

Adjacent features:

19. land use on watercourse banks together with visual features within 0.5 km;
 20. upstream features eg large farms, inflows, lakes;
 21. downstream features, eg as 20;
 22. maintenance, its frequency or extent;
 23. fishery interest

and other data may be used or referred to, if it is readily available.

Environmental data on physical parameters, flora and fauna will be summarised together with a score for environmental quality based on scales of 0-10 for flora and 0-10 for invertebrates together with a correction for maintenance. Maintenance effects will be scored on a -2 to +2 scale broadly based on:

- 2 for channel resectioning and realignment
 - 1 for either channel realignment / channel resectioning of both banks
 - 0.5 one bank
 - 0 a neutral score, for possible or historical management
 - +1 for unmanaged but agricultural banks especially rough grazing etc.
 - +2 near natural conditions for the area ie considering flow and geology
- (Combinations of these scores may also used.)

The overall environmental biomorphic score will be calculated by adding the floral (from 0-10) to the invertebrate (from 0-10) scores and dividing by two. This value will then be corrected by adding the maintenance score (from -2 to +2). Where scores were not available through difficulty in sampling or inappropriateness, eg dry ditches, an estimate (in brackets) will be made for the overall score. Artificial water courses especially canals present difficulties and two scores will normally be calculated, one incorporating the actual management value (-2) and the other a null score (0) and would be recorded for example as '1.5/3.5' for a poor quality biota. This method of assessment is still being developed but can in theory be seen to give values less than zero, for low biotic score (polluted) and highly managed sites, or higher than 10; this has not yet been revised as it allows better discrimination among the middle range of sites. The ultimate score for pristine sites or indeed values over 10 have not yet been achieved in over 350 sites within Britain.

A summary at the bottom of each site data sheet will comment on environmental matters and may suggest aspects on which further advice should be sought on aspects, methods of construction, key points and further survey recommendations together with the overall biomorphic quality score from this reconnaissance survey. Uncertainty about a value eg water depth where the river was too deep to measure without a boat or a statement will be indicated by the use of question mark.

A3.1.2 Chemical analysis will be carried out to determine the character of the water in order to indicate biotic potential. Water characterisation at survey sites will include:

- pH (Hydrogen ion)
- Total salts as conductivity

and later on return to the laboratory, may also include:

- Anion to Cation balance for common ions (in milli equivalents per litre)
- The nutrients nitrate and phosphorus

on the filtered water sample.

Anions include Alkalinity as bicarbonate (in milli-equivalents per litre, also for RIVPACS), chloride (also for RIVPACS), sulphate, nitrate-nitrogen, phosphate-phosphorus (soluble or orthophosphate), silicate-silicon; cations include calcium, magnesium, sodium, and potassium, and would be reported as milligrams per litre.