A303 Sparkford to Ilchester Dualling Scheme
TR010036
6.3 Environmental Statement
Appendix 8.13 Macroinvertebrate Technical Report

APFP Regulation 5(2)(a)
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The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

A303 Sparkford to Ilchester Dualling Scheme

Development Consent Order 201[X]

6.3 Environmental Statement
Appendix 8.13 Macroinvertebrate Technical Report

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Executive summary

The proposed A303 Sparkford to Ilchester Dualling scheme (hereafter referred to as 'the scheme') is to provide a continuous dual-carriageway on the A303 linking the Podimore Bypass and the Sparkford Bypass.

Macroinvertebrate surveys were undertaken to establish the baseline state of the watercourses adjacent to the scheme, to understand the potential impacts upon the watercourses from the scheme, and to determine if mitigation measures would be necessary.

Surveys were undertaken using standard Environment Agency methodology and the samples were identified to species level (where possible). The results were used to calculate standard biological metrics. Surveys were carried out in both spring and autumn at 5 sites (2 on Dyke Brook and 3 on tributaries to Dyke Brook).

No protected, notable or rare macroinvertebrate species were identified. The macroinvertebrates present are common and the community present is of low conservation value.

Overall the species present are tolerant of high sediment loads, low oxygen levels and low flows. The water quality is generally poor.

There is potential for impacts on the watercourses during construction and operation. During construction, topsoil would be stored close to a watercourse which could wash into the watercourse. There is also potential for other pollution from the construction site.

Operational impacts are possible owing to increased surface water run-off because of a greater surface area of road. However, the scheme has embedded mitigation as the drainage design constitutes an improvement compared to the current situation and includes new attenuation ponds.

The following best practice / mitigation and enhancement measures are recommended:

- During construction, best practice for pollution prevention and water management would be implemented as part of a Construction Environmental Management Plan (CEMP), which would be produced for the scheme. Guidance on best practice in relation to pollution prevention and water management should follow CIRIA's *Environmental good practice on site* and the Environment Agency's *Groundwater Protection: Principles and Practice (GP3)*. The Environment Agency Pollution Prevention Guidelines: *Works and maintenance in or near water: PPG5 (2007)* should be followed as best practice although the document is now withdrawn.

- When soil storage is undertaken, the contractor would follow best practice for pollution and silt control. This would be regularly monitored and carefully managed throughout the construction process.
- Pollarding and regular maintenance of the overgrown shrubs and trees which currently over shade the channels, would allow natural light to reach the bottom of the river bed.
- Increasing the width of the watercourses and allowing for erosion to take place would lessen the depth of the channel which in turn would allow natural erosion and increased sinuosity. This would increase the variance of flow types and similarly the number of hydrological features such as riffles, pools and deposition bars.
- Installing cobbles and pebbles onto the river beds would vary the sediment type and increase the process of transportation and deposition. Macroinvertebrates which are indicators of better water quality tend to prefer a gravel substrate.

1 Introduction

1.1 Overview of the scheme

Existing corridor

1.1.1 The A303 forms part of Highways England's Strategic Road Network (SRN) and a strategic link between the south west and the rest of the south, south-east and London. The route comprises multiple road standards, including dual carriageway, single carriageway and single carriageway sections with overtaking lanes. Speed limits also vary between 40 miles per hour and 70 miles per hour, depending on the character of the road and its surroundings.

Existing road

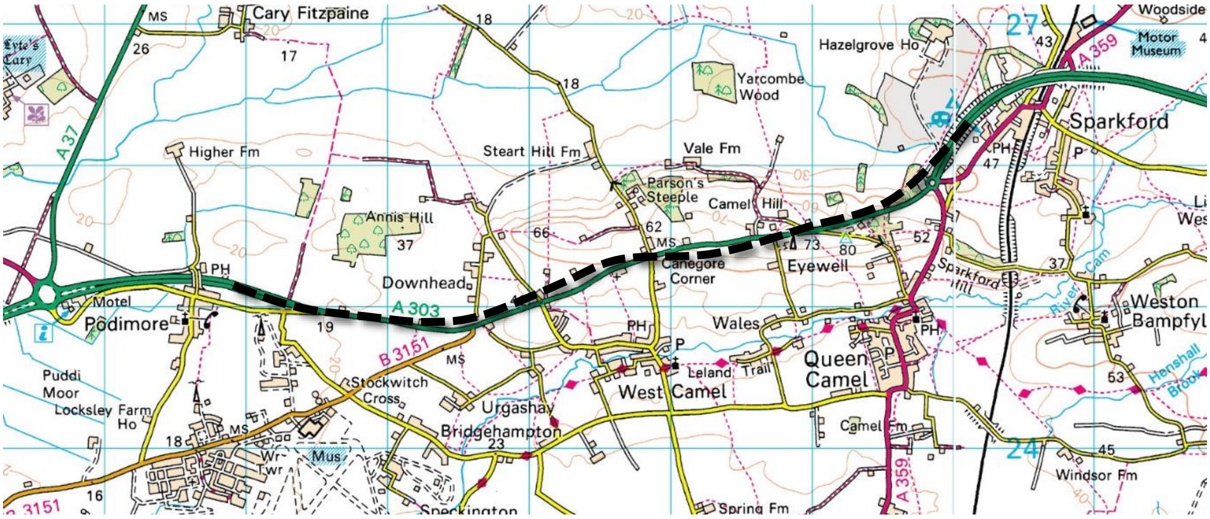
1.1.2 The section of the A303 that is being upgraded as part of this scheme commences at the eastern limits of the existing dual carriageway, the Podimore Bypass. Travelling east, the corridor reaches the junction with the B3151 before bearing north east and rising upwards through Canegore Corner to reach the crest of Camel Hill at Eyewell. This section of the corridor is characterised by a single lane road, with double white lines negating overtaking and subject to a 50 miles per hour speed limit. There are several priority junctions along the route giving access to the settlements of Queen Camel and West Camel to the south and Downhead to the north, as well as several farm accesses and parking laybys.

1.1.3 From the crest of Camel Hill, the corridor descends to meet the roundabout at the western limit of the dual carriageway Sparkford Bypass (Hazlegrove Roundabout). This section comprises 2 lanes in the westbound direction, 1 lane in the eastbound direction and is also subject to a 50 miles per hour speed limit. Hazlegrove Roundabout forms a junction between the A303 and the A359 which runs south through Queen Camel and north-east through Sparkford. The roundabout also provides access to a service station, and to a school at Hazlegrove House.

1.1.4 The section of the A303 that is to be upgraded is almost 3.5 miles, or approximately 5.6 kilometres long.

1.1.5 The extents of the scheme are illustrated in Figure 1.1 below. Figure 2.1 of Volume 6.2 shows the proposed red line boundary for the scheme.

Figure 1.1: Scheme extents



Source: Mott MacDonald Sweco Joint Venture

Scheme proposals

1.1.6 The proposed scheme is to provide a continuous dual-carriageway linking the Podimore Bypass and the Sparkford Bypass. The scheme would involve the removal of at-grade junctions and direct accesses. The Hazlegrove Junction would be constructed to grade-separated standards and Downhead Junction and Camel Cross Junction would be constructed to compact grade-separated standards, as illustrated on Figure 2.3 General Arrangement Plans, contained in Volume 6.2.

1.1.7 A detailed description of the scheme is provided within Chapter 2 The Scheme of Volume 6.1.

1.2 Aquatic study area

1.2.1 The Zone of Influence (ZoI) for the macroinvertebrate surveys included watercourses within 50m of the scheme RLB where it was considered through professional judgement, that there was potential for them to be impacted by the scheme. The distance was extended downstream where there was a potential for the watercourse to act as a pollution vector.

1.2.2 Six locations to undertake macroinvertebrate surveys were originally selected (although only 5 locations were sampled as 1 was dry). The sample locations were all to the north of the scheme and were on Dyke Brook and tributaries to Dyke Brook. None of the watercourses are within a Water Framework Directive (WFD) waterbody but they are upstream of the WFD waterbody Cary, source to confluence with King's Sedgemoor Drain (KSD), (Waterbody Number: GB108052015140). Sample point locations are shown in appendix A.

1.2.3 This WFD waterbody has an objective to achieve Good status by 2027. In the last WFD cycle (in 2016), the waterbody achieved Good for macroinvertebrates (but only Moderate for macrophytes and phytobenthos). The waterbody also only achieved Moderate for dissolved oxygen and Poor for phosphate.

1.2.4 The scheme is also partially within the catchment for the WFD waterbody Cam – lower, (Waterbody Number: GB108052015650).

1.2.5 This WFD waterbody has an objective to achieve Good status by 2027. In the last WFD cycle (in 2016), the waterbody achieved Moderate for macroinvertebrates, macrophytes and phytobenthos and Poor for phosphate.

1.3 Scope of this report

1.3.1 The objectives of this report are:

- to inform the Environmental Impact Assessment (EIA)
- to present the results of the macroinvertebrate surveys / provide baseline data
- to identify protected, notable and rare macroinvertebrate species
- to assess the composition of the macroinvertebrate communities and their conservation value
- to assess the potential impacts of the scheme on the biological quality of the tributaries to Dyke Brook and Dyke Brook
- to provide recommendations for mitigation and enhancement (to increase habitat resilience)

1.4 Legislation

1.4.1 The *Wildlife and Countryside Act 1981* (as amended) and the *Conservation of Habitats and Species Regulations 2017* form the cornerstone for species and habitat protection in England and Wales.

1.4.2 Section 40 of the *Natural Environment and Rural Communities (NERC) Act 2006* requires public bodies, including local authorities, 'to have regard to the conservation of biodiversity in England' when carrying out their normal functions. Section 41 of the Act lists the habitats and species of 'principal importance for the conservation of biodiversity in England', and guides public bodies in implementing their duty. These habitats and species are former UK *Biodiversity Action Plan* (BAP) priority habitats and species.

1.4.3 The WFD 2000 was introduced to monitor and regulate all European waterbodies, implementing a standardised status for each waterbody. This work includes identifying where pollution is, monitoring the water quality on 5-year plans, and even combating climate change. Macroinvertebrates are good bioindicators of water quality and therefore macroinvertebrate surveys are a small part of the monitoring process for WFD.

2 Methodology

2.1 Field surveys

2.1.1 Benthic (sediment-dwelling) macroinvertebrates larger than 1 millimetre were sampled at 5 locations. Two locations were within Dyke Brook and 3 locations were in a tributary of Dyke Brook (appendix A). Locations were selected to provide spatial data from the waterbodies with potential to be impacted by the scheme. Samples were taken in spring and autumn.

2.1.2 Sample points were named by watercourse (DB = Dyke Brook, TDB = Tributary of Dyke Brook), a sample point number (01-05) and whether they were the upstream (US) or downstream (DS) point within that watercourse. The sample points are herein after referred to in the text as 01, 02, 03, 04 and 05.

2.1.3 At each survey location a standard 3 minute sample was taken using a 1 millimetre mesh net and using a technique appropriate to the nature of the substrate and vegetation present. At all 5 sites, this involved a combination of a kick sample and sweep. During the sampling, the bottom edge of the net was skimmed through the top layer of sediment, or where there was dense vegetation, the net was pushed in with various forward, upward and lateral movements. The aim was to sample all habitats representatively, in accordance with the standard Environment Agency methodology for sampling aquatic invertebrates and the British Standards (BS) guidelines BS EN ISO 10870:2012[1]. This meant that most time was spent in the habitat which was most abundant. A 30 second visual search was also carried out prior to the sample. Where possible, an additional 30 second manual search of stones was carried out after the main 3 minute sample.

2.2 Laboratory processing

2.2.1 The samples were preserved immediately after sampling in Industrial Methylated Spirit (IMS). The samples were later sieved through a 1 millimetre mesh sieve, sorted and identified to species level, where possible. For some taxa, identification was not to species level, for example owing to missing features. Identification was carried out to the appropriate level of confidence and the term taxa used as an overall term rather than species or family. The abundance of each taxa was recorded.

2.3 Data processing

2.3.1 Macroinvertebrate communities are good indicators of what pressures (for example, pollution, low flows) there are on a watercourse. The pressures are

[1] British Standards (BS) (2012) *Water quality. Guidelines for the selection of sampling methods and devices for benthic macroinvertebrates in fresh waters* (BS EN ISO 10870:2012).

analysed by calculating various metrics. The metrics calculated for the data collected for this scheme are as follows:

- Total Number of Taxa (NTAXA)
- Biological Monitoring Working Party (BMWP)[2]
- Average Score per Taxon (ASPT)
- Lotic Invertebrate Flow Evaluation (LIFE)[3]
- Proportion of Sediment-Sensitive Invertebrates (PSI)[4]
- Community Conservation Index (CCI)[5]
- Walley Hawkes Paisley Trigg (WHPT)[6]

2.3.2 NTAXA is a basic diversity index and does not give an indication of environmental pressures.

2.3.3 The BMWP index gives an indication of whether a watercourse is impacted by organic pollution. BMWP is calculated at a family level as each family has a score between 1 and 10, depending on its sensitivity to organic pollution. A score of 10 indicates high organic pollution sensitivity, whilst a score of 1 indicates pollution tolerance. The total BMWP score for each site is then calculated, with a higher score indicating better water quality (Table 2.1).

Table 2.1: BMWP score category interpretation

BMWP score	Ecological interpretation
0 – 10	Very poor
11 – 40	Poor
41 – 70	Moderate
71 – 100	Good
> 100	Very good

[2] BMWP (1978). Final report: *assessment and presentation of the quality of rivers in Great Britain*. Unpublished report, Department of the Environment, Water Data Unit
[3] Extence, C.A., Balbi, D.M. and Chadd, R.P. (1999). *River flow indexing using British benthic macroinvertebrates*: A framework for setting hydroecological objectives. Regulated Rivers: Research and Management 15, 543-574
[4] Extence, C.A., Chadd, R.P., England, J., Dunbar, M.J., Wood, P.J., Taylor, E.D. (2013) *The assessment of fine sediment accumulation in rivers using macro-invertebrate community response*. River Research and Applications 29 (1). 17-55
[5] Chadd, R. AND Extence, C. (2004) *The conservation of freshwater macroinvertebrate populations: a community-based classification scheme*. Aquatic Conservation: Marine and Freshwater Ecosystems 14: 597-624
[6] Water Framework Directive – United Kingdom Technical Advisory Group (WFD-UKTAG) (2014) UKTAG River Assessment Method, Benthic Invertebrate Fauna. Invertebrates (General Degradation): Whalley, Hawkes, Paisley & Trigg (WHPT) metric in River Invertebrate Classification Tool (RICT) [online] available at: https://www.wfduk.org/sites/default/files/Media/Characterisation%20of%20the%20water%20environment/Biological%20Method%20Statements/River%20Invertebrates%20WHPT%20UKTAG%20Method%20Statement.pdf (last accessed April 2018).

2.3.4 BMWP-NTAXA is the number of taxa present of those which are used to calculate BMWP.

2.3.5 BMWP-ASPT is the normalised BMWP data and is calculated by dividing the BMWP by the BMWP-NTAXA. The ASPT gives an indication of the evenness of community diversity (for example, whether the invertebrate community consists of a few high scoring taxa or many low scoring taxa).

2.3.6 The LIFE metric indicates what pressures there are in relation to flow. LIFE scores are calculated using taxa flow groups and abundances. Each taxa has been assigned a flow group, based on preference or tolerance to certain flows, ranging from those associated with rapid flow to those resistant to drought. For each taxa the flow group and abundance is used to derive a score. Higher LIFE scores indicate faster flows, whilst low scores indicate low flows.

2.3.7 The PSI is used to determine the degree to which a site is impacted by sediment. Each species has been assigned a sensitivity rating for sediment which is used to calculate the PSI. The interpretation of the PSI is given in Table 2.2.

Table 2.2: PSI score category interpretation

PSI	River bed condition
0 – 20	Heavily sedimented
21 – 40	Sedimented
41 - 60	Moderately sedimented
61 – 80	Slightly sedimented
81 – 100	Minimally sedimented

2.3.8 The CCI is used to evaluate the conservation value of macroinvertebrate communities. The CCI is calculated based on rarity values assigned to invertebrate species, from 1 (very common) to 10 (endangered). Low CCI scores indicate low conservation value and high scores indicate high conservation value. The interpretation of CCI is given in Table 2.3.

Table 2.3: CCI score category interpretation

CCI score	Conservation Value
0 – 5	Low conservation value
>5 – 10	Moderate conservation value
>10 - 15	Fairly high conservation value
>15 - 20	High conservation value
>20	Very high conservation value

2.3.9 The WHPT metric was introduced as the basis for the UK's river invertebrate status classification under the WFD in the *second River Basin Management Plans*, published in 2016. It replaces the BMWP index that has been used since the 1980 National River Quality Survey. WHPT is more accurate than BMWP because it was derived from an analysis of a very large set of field results (more than 100,000 standard samples) from across the UK rather than on expert judgement based on the limited knowledge that was available in the late 1970s. This metric responds to organic discharges and the pressures associated with them, such as increases in organic loading, the concentrations of nutrients, ammonia and suspended solids, reduction in oxygen concentration and saturation, and habitat degradation, including reduced habitat diversity and increased siltation. It will therefore respond to other activities that cause these pressures, including industrial discharges, reductions in flow, habitat degradation and eutrophication[7].

2.3.10 WHPT-NTAXA is the number of taxa present of those which are used to calculate WHPT.

2.3.11 As with the BMWP-ASPT, the WHPT-ASPT is the normalised data obtained by dividing WHPT by WHPT-NTAXA.

2.3.12 In addition to calculating the metrics described, the Environmental Quality Ratios (EQR) were also calculated. This was done using The River Invertebrate Classification Tool (RICT). RICT analyses environmental variables at each monitoring site and calculates expected scores using data from reference sites (which are considered as close as possible to pristine conditions). The observed values are then divided by the expected values (O/E) to give an EQR value. The interpretation of the EQRs for each metric are provided in Table 2.4, Table 2.5 and Table 2.6.

Table 2.4: BMWP EQR interpretation

BMWP N-TAXA O/E	BMWP ASPT O/E	EQR – Ecological Status
> 0.85	> 0.97	High
0.71 – 0.849	0.86 – 0.969	Good
0.57 – 0.709	0.75 – 0.859	Moderate
0.47 – 0.569	0.63 – 0.749	Poor
0 – 0.469	0 – 0.629	Bad

Table 2.5: WHPT EQR interpretation

WHPT N-TAXA O/E	WHPT ASPT O/E	EQR – Ecological Status
> 0.80	> 0.97	High
0.68 – 0.799	0.86 – 0.969	Good
0.56 – 0.679	0.72 – 0.859	Moderate
0.47 – 0.559	0.59 – 0.719	Poor
<0.47	<0.59	Bad

[7] Environment Agency (2016) Walley Hawkes Paisley Trigg (WHPT) *index of river invertebrate quality and its use in assessing ecological status. Brief Guide Version 8*.

Table 2.6: LIFE EQR interpretation

LIFE O/E	EQR – Ecological Status
>1	Matches benchmark conditions
0.94 – 1	Slightly changed from benchmark conditions
< 0.94	Moderately to severely changed from benchmark conditions

2.4 Survey constraints and limitations

2.4.1 The macroinvertebrate surveys were undertaken under optimal conditions at suitable times of year. However, there is always the risk of species being overlooked, either owing to the timing of the survey or the scarcity of the species at the site.

2.4.2 The 5 selected locations for sampling were decided based upon the safest access into the watercourse. Therefore, the sampling locations were not chosen at random or at any specific intervals. This could potentially hinder the identification of macroinvertebrates proportionate to the entire length of the watercourse. It is however not considered to have a significant impact upon the results collected for this scheme, as a result of the 5 locations being well distributed.

3 Results

3.1 Sample points and environmental variables

3.1.1 All the sample points were in small silty watercourses with a discharge category of 1 (mean annual discharge <0.31 cubic meters per second). All the sample points had macrophytes present. The sample point descriptions and photographs are provided in appendix B and the environmental variables are provided in appendix C.

3.2 Species results and biological metrics

3.2.1 The full species list and abundances are shown in appendix D. Most species recorded have a conservation score of 1 (very common) using the Community Conservation Index methodology[5]. One species, *Erpobdella testacea* (a leech), has a conservation score of 5. This means it is not uncommon enough to be regionally notable but is nonetheless of some interest.

3.2.2 The CCI showed the spring samples at points 01, 02, 03 and the autumn samples at points 01 and 05 to be of moderate conservation value. However, this is just a reflection of *Erpobdella testacea* being recorded in those samples.

3.2.3 The spring and autumn observed metric results are shown in Table 3.1. Table 3.2 shows the expected results (generated using RICT), Table 3.3 shows the EQR values and Table 3.4 the EQR category.

3.2.4 The total number of taxa varied between 15 and 24 in the spring and 10 and 21 in the autumn. At all sample locations (with the exception of sample point 01) the number of taxa recorded in the spring was higher than in the autumn.

3.2.5 At all sample points the LIFE metric showed the watercourses to be moderately to severely changed from benchmark conditions (with the exception of sample point 02 in the autumn).

3.2.6 The sample points were all very silty and the species recorded reflect this, with the PSI metric showing all locations as sedimented to heavily sedimented with the exception of the spring sample at sample point 03 which was moderately sedimented.

3.2.7 The BMWP scores, which are an indicator of stress caused by organic pollution, were moderate, poor or bad in the spring and poor or bad in the autumn. This indicates the watercourses are likely to have low dissolved oxygen concentrations and suffer from organic pollution. However, at site 05 in the spring (which had a moderate BMWP score), a bullhead[8] (*Cottus gobio*) was

[8] Bullhead is listed on Annex II1 of the Habitats Directive.

recorded. This is a fish which normally has a preference for fairly fast flowing water and gravelly substrate (40% gravel was recorded at this location in the spring).

3.2.8 WHPT is the index now used for WFD and is indicative of general degradation as well as organic pollution. The WHPT-ASPT EQR’s were poor / bad at all locations in both seasons with the exception of 02 and 03 in the autumn which were moderate.

3.2.9 The overall value of the macroinvertebrate community is considered to be low to negligible.

Table 3.1: Macroinvertebrate observed metric results for spring and autumn samples at each location

OBSERVED	Spring					Autumn				
Metric	**TDB-01-DS**	**TDB-02-US**	**TDB-03-DSC**	**DB-04-US**	**DB-05-DS**	**TDB-01-DS**	**TDB-02-US**	**TDB-03-DSC**	**DB-04-US**	**DB-05-DS**
	23/05/2017	**23/05/2017**	**23/05/2017**	**23/05/2017**	**23/05/2017**	**27/09/2017**	**28/09/2017**	**26/09/2017**	**28/09/2017**	**28/09/2017**
Total NTAXA	15	18	14	24	23	19	10	14	14	21
BMWP (TL1)	29	41	45	66	57	46	29	43	32	57
BMWP-NTAXA (TL1)	9	11	10	16	14	12	7	10	10	15
BMWP-ASPT (TL1)	3.22	3.73	4.50	4.13	4.07	3.83	4.14	4.30	3.20	3.80
LIFE (TL5)	6.00	6.00	7.50	6.15	6.83	6.44	7.67	7.17	5.86	6.38
PSI (TL5)	13.04	12.00	42.11	10.81	29.41	25.81	38.46	29.41	0.00	15.63
CCI (TL5)	7.86	7.86	10.00	3.69	3.82	7.78	1.33	4.50	1.00	6.92
WHPT (TL2)	37.5	56.2	51.9	65.2	72	58.3	36.4	54.6	36.7	58.3
WHPT-NTAXA (TL2)	10	14	12	18	17	14	8	12	11	15
WHPT-ASPT (TL2)	3.75	4.01	4.33	3.62	4.24	4.16	4.55	4.55	3.34	3.89

Notes: TL1 – Taxonomic Level 1 – The 78 “BMWP family” level taxa in RIVPACSIV
TL2 – Taxonomic Level 2 – The 112 “WHPT family” in level taxa in RIVPACSIV
TL3 – Taxonomic Level 3 – The 417 “WFD Species” level taxa in RIVPACSIV (including component members of species group)

Table 3.2: Macroinvertebrate expected metric results for spring and autumn samples at each location generated from RICT

EXPECTED	Spring					Autumn				
Metric	TDB-01-DS	TDB-02-US	TDB-03-DSC	DB-04-US	DB-05-DS	TDB-01-DS	TDB-02-US	TDB-03-DSC	DB-04-US	DB-05-DS
	23/05/2017	23/05/2017	23/05/2017	23/05/2017	23/05/2017	27/09/2017	28/09/2017	26/09/2017	28/09/2017	28/09/2017
BMWP (TL1)	132.195	132.195	132.195	132.195	132.195	127.85	127.85	127.85	127.85	127.85
BMWP-NTAXA (TL1)	21.923	21.923	21.923	21.923	21.923	22.034	22.034	22.034	22.034	22.034
BMWP-ASPT (TL1)	6.043	6.043	6.043	6.043	6.043	5.828	5.828	5.828	5.828	5.828
LIFE (TL5)	8.168	8.168	8.168	8.168	8.168	8.056	8.056	8.056	8.056	8.056
PSI (TL5)	71.264	71.264	71.264	71.264	71.264	67.862	67.862	67.862	67.862	67.862
CCI (TL5)	10.418	10.418	10.418	10.418	10.418	10.877	10.877	10.877	10.877	10.877
WHPT (TL2)	154.896	154.896	154.896	154.896	154.896	147.951	147.951	147.951	147.951	147.951
WHPT-NTAXA (TL2)	24.244	24.244	24.244	24.244	24.244	24.078	24.078	24.078	24.078	24.078
WHPT-ASPT (TL2)	6.451	6.451	6.451	6.451	6.451	6.226	6.226	6.226	6.226	6.226

Table 3.3: Macroinvertebrate EQR values (observed/expected) for spring and autumn samples at each location

EQR VALUE (OBSERVED/EXPECTED)	Spring					Autumn				
Metric	TDB-01-DS	TDB-02-US	TDB-03-DSC	DB-04-US	DB-05-DS	TDB-01-DS	TDB-02-US	TDB-03-DSC	DB-04-US	DB-05-DS
	23/05/2017	23/05/2017	23/05/2017	23/05/2017	23/05/2017	27/09/2017	28/09/2017	26/09/2017	28/09/2017	28/09/2017
BMWP (TL1)	0.219	0.310	0.340	0.499	0.431	0.360	0.227	0.336	0.250	0.446
BMWP-NTAXA (TL1)	0.411	0.502	0.456	0.730	0.639	0.545	0.318	0.454	0.454	0.681
BMWP-ASPT (TL1)	0.533	0.617	0.745	0.683	0.674	0.658	0.711	0.738	0.549	0.652
LIFE (TL5)	0.735	0.735	0.918	0.753	0.837	0.800	0.952	0.890	0.727	0.793
PSI (TL5)	0.183	0.168	0.591	0.152	0.413	0.380	0.567	0.433	0.000	0.230
CCI (TL5)	0.754	0.754	0.960	0.354	0.366	0.715	0.123	0.414	0.092	0.636
WHPT (TL2)	0.242	0.363	0.335	0.421	0.465	0.394	0.246	0.369	0.248	0.394
WHPT-NTAXA (TL2)	0.412	0.577	0.495	0.742	0.701	0.581	0.332	0.498	0.457	0.623
WHPT-ASPT (TL2)	0.581	0.622	0.670	0.561	0.657	0.669	0.731	0.731	0.536	0.624

Table 3.4: Macroinvertebrate metric categories for EQR for both spring and autumn

EQR CATEGORY (OBSERVED/EXPECTED)	Spring					Autumn				
Metric	**TDB-01-DS-**	**TDB-02-US**	**TDB-03-DSC**	**DB-04-US-**	**DB-05-DS**	**TDB-01-DS**	**TDB-02-US**	**TDB-03-DSC**	**DB-04-US**	**DB-05-DS**
	23/05/2017	**23/05/2017**	**23/05/2017**	**23/05/2017**	**23/05/2017**	**27/09/2017**	**28/09/2017**	**26/09/2017**	**28/09/2017**	**28/09/2017**
BMWP - ASPT	Bad	Bad	Poor	Moderate	Moderate	Moderate	Poor	Poor	Bad	Poor
WHPT -NTAXA	Bad	Moderate	Poor	Good	Good	Moderate	Bad	Poor	Bad	Moderate
WHPT - ASPT	Bad	Poor	Poor	Bad	Poor	Poor	Moderate	Moderate	Bad	Poor
LIFE	Moderately to severely changed from benchmark conditions	Moderately to severely changed from benchmark conditions	Moderately to severely changed from benchmark conditions	Moderately to severely changed from benchmark conditions	Moderately to severely changed from benchmark conditions	Moderately to severely changed from benchmark conditions	Slightly changed from benchmark conditions	Moderately to severely changed from benchmark conditions	Moderately to severely changed from benchmark conditions	Moderately to severely changed from benchmark conditions

4 Potential impacts

4.1 Construction

4.1.1 The scheme would not involve direct impacts to any watercourse such as new culverts, bridges or channel modifications. However, construction activities have potential to cause pollution of watercourses. The watercourse which is the closest to the construction boundary (where sample 03 was taken) would have topsoil storage from the works adjacent to it. This area would also be the location of an attenuation pond. This watercourse, which is a tributary to Dyke Brook, had the highest proportion of sediment-sensitive invertebrates in the spring sample and the second highest in the autumn sample and so, if topsoil washes into the watercourse, it is likely to damage or kill the highest proportion of sediment-sensitive macroinvertebrates.

4.1.2 Any pollution incident from the construction site could also have consequences further downstream including in the WFD waterbody. However, with the exception of a major long-term on-going pollution incident, it is unlikely that an impact would be great enough to prevent the WFD water body from achieving its Good objective.

4.2 Operation

4.2.1 Once operational, there is potential for indirect effects owing to pollution events and sediment changes, which may filter through the watercourses.

4.2.2 There is potential for the traffic movements on the A303 to change as a result of the scheme. If the traffic movements increase, there is a higher chance of pollution run-off into the watercourses.

4.2.3 Once operational, the scheme would include an attenuation pond adjacent to the tributary of Dyke Brook where sample 03 was taken, and an outfall into that watercourse. The attenuation pond would prevent large fluctuations in flow in the watercourse and should also help prevent sediment and heavy metals from the road, entering the watercourse to some extent.

4.2.4 The scheme drainage at the western end makes use of an existing outfall (into Park Brook) but includes a new linear attenuation pond which would be an improvement compared with the current drainage arrangements.

4.2.5 There would also be a new attenuation pond in the middle section and the existing outfall at that location would be replaced by a new one which would discharge into the same watercourse (a ditch leading to the Lower Cam). This would also constitute an improvement compared with the current drainage arrangements.

5 Mitigation and enhancement recommendation

5.1 Mitigation measures

5.1.1 It is recommended that appropriate mitigation is applied where pollution run off cannot be avoided. During construction, best practice for pollution prevention and water management would be implemented as part of a Construction Environmental Management Plan (CEMP), which would be produced for the scheme. Guidance on best practice in relation to pollution prevention and water management is set out in CIRIA's *Environmental good practice on site*[9] and the EA's *Groundwater Protection: Principles and Practice (GP3)*[10]. The Environment Agency Pollution Prevention Guidelines: *Works and maintenance in or near water: PPG5*[11] should be followed as best practice as although the document is now withdrawn, it has not been replaced and the advice is still relevant.

5.1.2 When soil storage is undertaken, the contractor would need to follow best practice for pollution prevention, and measures would be required to ensure that soil or other materials are not washed into the watercourses. This should be regularly monitored throughout the construction process to ensure the methodology remains effective. As the topsoil storage would be located adjacent to 1 of the watercourses, it is advised that this is kept a minimum of 12 metres away to avoid unnecessary pollution run-off into the watercourses.

5.2 Enhancements

5.2.1 Currently, the watercourses surveyed are moderately to heavily sedimented, of low conservation value for macroinvertebrates with bad or poor ecological status. Improved management of the watercourses post-construction, would increase habitat resilience and attract a greater population of macroinvertebrates and variety of species.

5.2.2 The watercourses could be improved by the following enhancement measures:

- Pollarding and regular maintenance of the overgrown shrubs and trees which currently over shade the channels would allow natural light to reach the bottom of the river bed. This would improve the growth rate of native macrophytes and subsequently food and shelter for macroinvertebrates.

[9] CIRIA (2016). *Environmental good practice on site pocket book (fourth edition)*. London.
[10] Environment Agency (2013) *Groundwater protection: Principles and practice (GP3)* [online] available at: https://www.gov.uk/government/publications/groundwater-protection-principles-and-practice-gp3 (last accessed April 2018) (now withdrawn).
[11] Environment Agency (2007). *Pollution Prevention Guidelines: Works and maintenance in or near water: PPG5* [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/485199/pmho1107bnkg-e-e.pdf (last accessed April 2018) (now withdrawn).

- Increasing the width of the watercourses by physical alterations on the banks or actively digging out the banks and allowing for erosion to take place would lessen the depth of the channel which in turn would allow natural erosion to take place and allow for increased sinuosity. This would increase the variance of flow types and similarly the number of hydrological features such as, riffles, pools and deposition bars. Hydrological features such as these provide a variety of places for macroinvertebrates to successfully survive each life stage.
- Installing cobbles and pebbles onto the river beds would vary the sediment type and increase the process of transportation and deposition, subsequently reducing sedimentation rates. Those macroinvertebrates which are indicators of better water quality tend to prefer a gravel substrate where they can breed and feed.

5.3 Residual effects (with mitigation)

5.3.1 Residual effects are defined as those impacts that remain following the implementation of the mitigation measures proposed.

5.3.2 No direct impacts to the watercourses are anticipated during construction, provided appropriate pollution prevention is in place. As such the effect of the scheme on the macroinvertebrate community is considered to be Neutral.

5.3.3 During operation, there would overall be a greater road surface and therefore increased surface water run-off. However, the drainage design and installation of attenuation ponds mitigate this impact and constitute an improvement compared with the current situation. The effect on the macroinvertebrate community is therefore considered to be Neutral to Slight Beneficial.

6 Conclusion

6.1.1 The baseline macroinvertebrate data has been presented to inform Chapter 8 Biodiversity, Volume 6.1. No protected, notable or rare macroinvertebrate species were identified.

6.1.2 The macroinvertebrates present are common and the community present is of low conservation value.

6.1.3 Overall, the species present are tolerant of high sediment loads, low oxygen levels and low flows. The water quality is generally poor although slightly better close to the location where topsoil will be stored and a new attenuation pond constructed.

6.1.4 Potential impacts on water quality (and macroinvertebrate populations) are possible during construction but are preventable with the implementation of best practice.

6.1.5 Potential impacts during operation relate to increased surface water run-off owing to the increased surface area of the road. However, the embedded mitigation includes improvements to road drainage including the addition of attenuation ponds and so the overall operational impact should be neutral or positive. Further mitigation is not required.

6.1.6 Measures have been recommended for enhancements to the existing watercourses and management options to increase habitat resilience in the future.

Appendix A: Sampling point locations

Scale

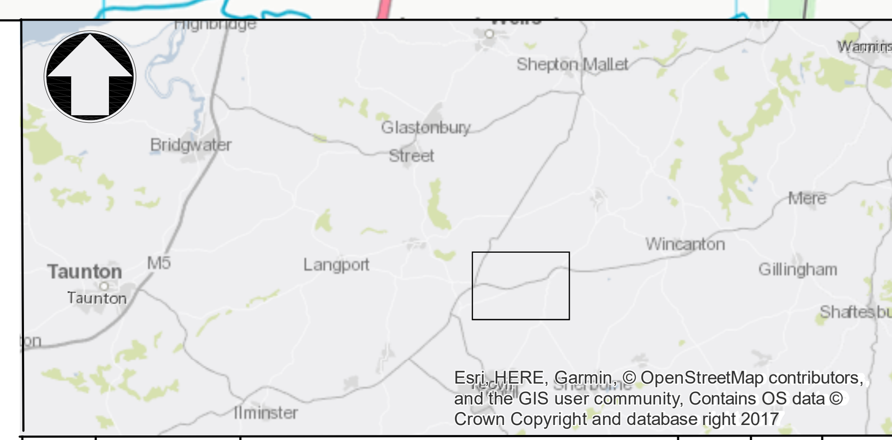
0 500 1,000m

1:10,000

KEY

PROPOSED RED LINE BOUNDARY

MACROINVERTEBRATE SURVEY SAMPLING AREAS



Project Title

A303 SPARKFORD TO ILCHESTER DUALLING

Drawing Title

MACROINVERTEBRATE SURVEY SAMPLING AREAS

C01	JULY 2018	DCO SUBMISSION	ER	VC	ER
REV.	DATE	AMENDMENT DETAILS	ORIG	CHK'D	APP'D

Drawing Status: Published - DEFINITION				Suitability: A3
Scale: AS SHOWN	Designed: NB	Drawn: ER	Checked: VC	Approved: ER
Original Size: A1	Date: JULY 2018	Date: JULY 2018	Date: JULY 2018	Date: JULY 2018

Drawing Number

HE PIN | Originator | Volume

HE551507 - MMSJV - EBD

000 - DR - LB - 0088

Location | Type | Role | Number

Project Ref. No. 389107

Revision C01

Appendix B: Sample point descriptions and photos

Table B.1: Sample point descriptions and photos

Sample Point Number	Description	Photo (Spring)
TDB-01-DS	Narrow ditch surrounded by arable crop fields with a grassland buffer. Channel has a low flow and is heavily shaded by overgrown shrubs. Macrophytes present.	
TDB-02-US	Narrow ditch surrounded by farm buildings, arable fields and tall rank vegetation. Channel has a low flow and is heavily shaded by overgrown shrubs. Macrophytes present.	
TDB-03-DSC	Narrow ditch surrounded by broadleaved woodland and arable fields. Tall rank vegetation present on banks. Channel has a low flow and is moderately shaded by overgrown shrubs. Macrophytes present.	

Sample Point Number	Description	Photo (Spring)
DB-04-US	Narrow ditch surrounded by broadleaved woodland and roads. Tall rank vegetation present on banks. Channel has a normal flow and is moderately shaded by overgrown shrubs. Macrophytes present.	

Sample Point Number	Description	Photo (Spring)
DB-05-DS	Narrow ditch surrounded by scrub and arable fields. Tall rank vegetation present on banks. Channel has a low flow and is lightly shaded by overgrown shrubs. Macrophytes present.	

Appendix C: Environmental variables

Table C.1: Spring environmental variables

SITE	TDB-01-DS	TDB-02-US	TDB-03-DSC	DB-04-US	DB-05-DS
NGR	ST	ST	ST	ST	ST
Easting	358684.24	358831.75	359334.46	357322.09	357134.23
Northing	126233.76	126116.02	126178.20	126532.34	126537.10
ALTITUDE	30	30	30	20	20
SLOPE	2.54	6.28	27.70	17.37	2.42
DISCHARGE	1	1	1	1	1
DIST_FROM_SOURCE	38.03	38.22	39.1	36.2	35.96
MEAN_WIDTH	0.7	0.6	0.8	1	0.8
MEAN_DEPTH	3	2	10	65	15
ALKALINITY	396	404	451	295	304
BOULDER_COBBLES	0	1	0	0	20
PEBBLES_GRAVEL	0	0	0	0	40
SAND	0	0	0	0	0
SILT_CLAY	100	99	100	100	40
CONDUCTIVITY	727	145	961	785	826

Table C.2: Autumn environmental variables

SITE	TDB-01-DS	TDB-02-US	TDB-03-DSC	DB-04-US	DB-05-DS
NGR	ST	ST	ST	ST	ST
Easting	358684.24	358831.75	359334.46	357322.09	357134.23
Northing	126233.76	126116.02	126178.20	126532.34	126537.10
ALTITUDE	30	30	30	20	20
SLOPE	2.54	6.28	27.70	17.37	2.42
DISCHARGE	1	1	1	1	1
DIST_FROM_SOURCE	38.03	38.22	39.1	36.2	35.96
MEAN_WIDTH	1.5	1.5	1.5	2.5	2
MEAN_DEPTH	7	5	7	40	25
ALKALINITY	299	306	337	279	302
BOULDER_COBBLES	0	0	0	0	0
PEBBLES_GRAVEL	0	0	5	0	20
SAND	5	5	15	0	5
SILT_CLAY	95	95	80	100	75

Appendix D: Full species list and abundance

Table D.1: Full species list and abundances

	Spring					Autumn				
	TDB-01-DS	**TDB-02-US-**	**TDB-03-DSC**	**DB-04-US**	**DB-05-DS**	**TDB-01-DS**	**TDB-02-US-**	**TDB-03-DSC**	**DB-04-US**	**DB-05-DS**
	23/05/2017	23/05/2017	23/05/2017	23/05/2017	23/05/2017	27/09/2017	28/09/2017	26/09/2017	28/09/2017	28/09/2017
Taxa Name	**Abundance**									
Agabus didymus					1					
Asellus aquaticus	1	32	21	182	56	48	20	15	35	106
Baetis rhodani					9					
Baetis sp.				1						
Ceratopogonidae			25		1					
Crangonyx pseudogracilis				1						
Dicranota		2	2		9		10	1		
Dixa sp.	1					5				
Elodes sp.		9				18	8	1		
Ephydridae		2								
Erpobdella testacea	6	6	2			8				1
Gammarus fossarum/pulex agg.	6	50	1000	20	30	20	60	300		38
Gammarus pulex	50	5	157	2	9	20	40	65		2
Glossiphonia complanata		4	6	2		18		1	6	4
Gyrinus substriatus										4
Haliplus lineatocollis				1	3				2	8
Haliplus sp.				3	2					
Helophorus brevipalpis										1
Hydracarina	1			1					2	
Ilybius sp.					16				2	
Ischnura elegans				1						
Libellulidae				1						
Limnephilus lunatus		4		32	2					

	Spring					Autumn				
	TDB-01-DS	**TDB-02-US-**	**TDB-03-DSC**	**DB-04-US**	**DB-05-DS**	**TDB-01-DS**	**TDB-02-US-**	**TDB-03-DSC**	**DB-04-US**	**DB-05-DS**
	23/05/2017	23/05/2017	23/05/2017	23/05/2017	23/05/2017	27/09/2017	28/09/2017	26/09/2017	28/09/2017	28/09/2017
Taxa Name	**Abundance**									
Limnephilus sp.						2				1
Limnius volckmari										1
Limoniidae					2					
Radix balthica	72					75			5	1
Lype reducta			3					1		
Micropterna sequax			13			12				11
Oligochaeta	24	20	104	2	28	18	1	2	8	39
Orthocladinae				83	89				40	42
Oulimnius sp.										2
Pericoma sp.		5		2				1		
Physa fontinalis				1						
Pisidium milium				1						
Pisidium sp.	30	100		20		5			8	52
Pisidium subtruncatum	103	275		45	116	20		2	20	183
Plectrocnemia conspersa			6			1	1	4		
Polycelis nigra/tenuis	1				1					
Potamopyrgus antipodarum	42	9		470	153	306				360
Prodiamesinae	92	276				50				
Ptychoptera lacustris		8	5				18	6		
Sciomyzidae									1	
Sialis lutaria				1					3	
Simuliidae					7					
Simulium angustipes/velutinum					11					

	Spring					Autumn				
	TDB-01-DS	**TDB-02-US-**	**TDB-03-DSC**	**DB-04-US**	**DB-05-DS**	**TDB-01-DS**	**TDB-02-US-**	**TDB-03-DSC**	**DB-04-US**	**DB-05-DS**
	23/05/2017	23/05/2017	23/05/2017	23/05/2017	23/05/2017	27/09/2017	28/09/2017	26/09/2017	28/09/2017	28/09/2017
Taxa Name	**Abundance**									
Succinea putris	2					20				
Tanypodinae	7	305	1126	86		60	700	75		29
Tanytarsini		306	1123	176	100		1500	100	45	35
Tipula sp.					5					
Ulomyia sp.						1				
Valvata piscinalis				70	5				2	9
Weidmannia					1					
Total NTAXA	**15**	**18**	**14**	**24**	**23**	**19**	**10**	**14**	**14**	**21**