A358 Taunton to Southfields Dualling Macroinvertebrates Technical Report

PCF Stage 2

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Highways England Programme Leader:	Andrew Alcorn
Highways England Project Manager:	David Stock
Mott MacDonald Sweco Joint Venture Project Manager:	Amar Parkinson
PCF STAGE 2 Supplier:	Mott MacDonald Sweco Joint Venture

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Prepared for:

Highways England
Temple Quay House
2 The Square
Temple Quay
Bristol
BS1 6HA

Prepared by:

Mott MacDonald Sweco Joint Venture
Stoneham Place
Stoneham Lane
Southampton
Hampshire
SO50 9NW

Table of contents

Executive summary
1. Introduction 1
1.1. Background 1
1.2. Scheme proposal 3
1.3. Scope of report 4
1.4. Study area 5
1.5. Legislation 5
1.6. Planning policy 7
2. Methodology 9
2.1. Desk study 9
2.2. Macroinvertebrate sampling 9
2.3. Constraints 13
3. Results 15
3.1. Desk study 15
3.2. Macroinvertebrate Sampling 17
4. Conclusion 23
Appendices 24

Appendices

Appendix A: Environment Agency Survey Sites 24
Appendix B1: Macroinvertebrate Conservation Value from Spring Sampling 25
Appendix B2: Macroinvertebrate Conservation Value from Autumn Sampling 26
Appendix C1: Taxa List from Spring Sampling 27
Appendix C2: Taxa List from Autumn Sampling 32
Appendix D1: Spring Environmental Variables Master Data 39
Appendix D2: Autumn Environmental Variables Master Data 41

Figures

Figure 1: A358 Taunton to Southfields existing road layout. 1
Figure 2: Route options presented at the 2018 public consultation 3
Figure 3: The preferred scheme option. 4

Tables

Table 1: Conservation scores for freshwater invertebrate species in the UK 12
Table 2: EA macroinvertebrate survey results 1998 - 2017 16
Table 3: Interpretation of Table 1 results 17
Table 4: Macroinvertebrate biotic indices from spring 2017 sampling 18
Table 5: Macroinvertebrate biotic indices from autumn 2017 sampling 19

Executive Summary

The proposed A358 Taunton to Southfields Dualling scheme (hereafter referred to as 'the scheme') would provide a dual carriageway along the length of the A358 between Taunton and Ilminster in Somerset, connecting the A303 at Ilminster to the M5 motorway to the north. The scheme would include grade separated junctions and, with the purpose of providing a high-quality free flow journey for those using the route, the removal of at-grade junctions and direct accesses.

A desk study was undertaken in April 2016 to obtain existing records of protected and / or notable aquatic invertebrate species. No records within 2 kilometres of the scheme were returned by Somerset Environmental Records Centre (SERC). An additional supplementary desk study in November 2020 identified eight Environment Agency macroinvertebrate sites within 2 kilometres of the scheme. No legally protected species or UK species of principal importance were identified at any of these sites.

A total of 8 watercourses are crossed by the scheme. Macroinvertebrate sampling surveys were undertaken at sites located 100 metres upstream and 100 metres downstream of where each watercourse is crossed by the scheme. Sampling surveys were undertaken by Five Rivers Environmental Contracting in May and September 2017, repeated at the same sites to account for seasonal differences in macroinvertebrate communities. Samples were analysed to species level, where possible, and processed by Five Rivers Environmental Contracting in December 2017; the data was used to generate biotic indices which help to infer general ecological health and conservation value of the sampled watercourses. The data is compliant with *EA Water Framework Directive* (WFD) assessments if they are needed, although this was not necessary at this stage of the scheme.

A total of six species of local conservation value were identified from the December 2017 sample analyses. None of these species identified from May 2017 samples were subsequently found at the same sites in September as well. Three of these species were identified from site F2 during the September sampling, contributing to the higher conservation value. However, none of the other sites exhibited more than one species of local conservation value from the same sample.

At the time of writing, the project is still within the early design phase. Therefore, the full extent of potential impacts of the scheme on the invertebrate populations is yet to be confirmed. An impact assessment, and mitigation and compensation measures to alleviate any potential impacts will be detailed within the Biodiversity chapter of the project Environmental Statement, when published.

1. Introduction

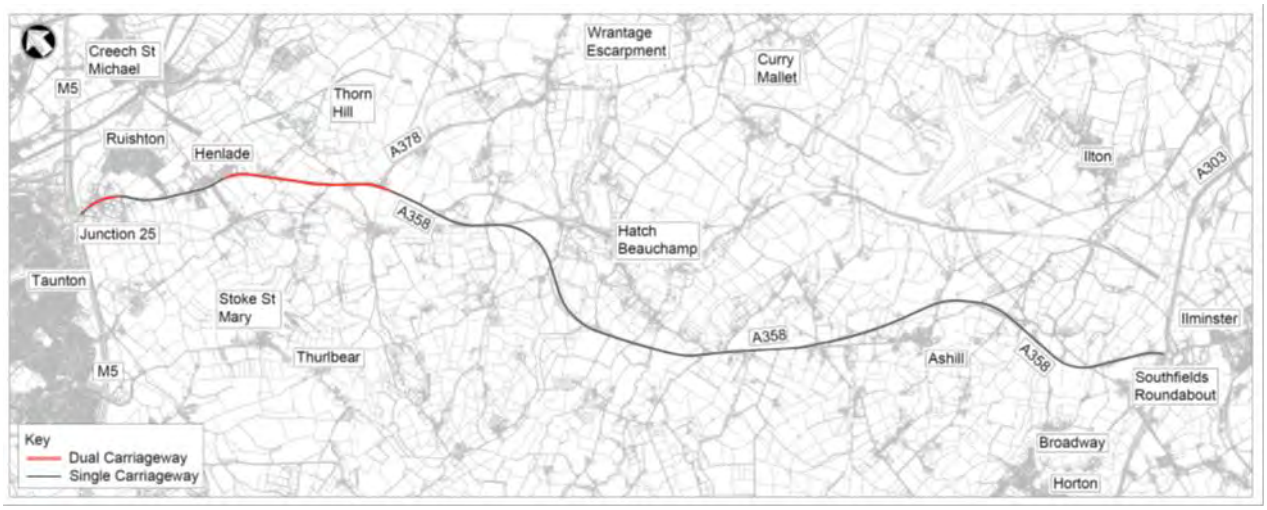
1.1. Background

1.1.1. The A303 / A358 corridor is a vital connection between the south-west of England, London and the south-east of England. Due to the population density, employment opportunities, urban concentrations and tourist attraction of the south-west, the A303 / A30 / A358 corridor experiences a wide range of traffic flows which lead directly to severe and regular instances of congestion and delay.

1.1.2. The A303 / A30 is part of the Strategic Road Network (SRN) and together with the A358 forms a key strategic link between the South West Peninsular (SWP) and the rest of the south, south-east and London. Although it is dualled over much of its length there are several unimproved single carriageway sections between the M3 motorway at Basingstoke and the M5 at Taunton and Exeter which cause congestion, especially during summer weekends.

1.1.3. The A358 between Taunton and Southfields Roundabout is predominantly single carriageway with a short (1.1 miles) dual carriageway section in the vicinity of Thornfalcon and a 3 lane (2+1) section (0.3 miles) immediately to the south of the traffic lights at the A378 junction. There are many side roads and private accesses which directly adjoin the A358. The national speed limit applies between Southfields and Henlade where it reduces to 30mph; the speed limit increases to 40mph north of Henlade on the approach to the M5 Junction 25. A plan showing the existing route between Taunton and Southfields is provided in Figure 1.

Figure 1: A358 Taunton to Southfields existing road layout.

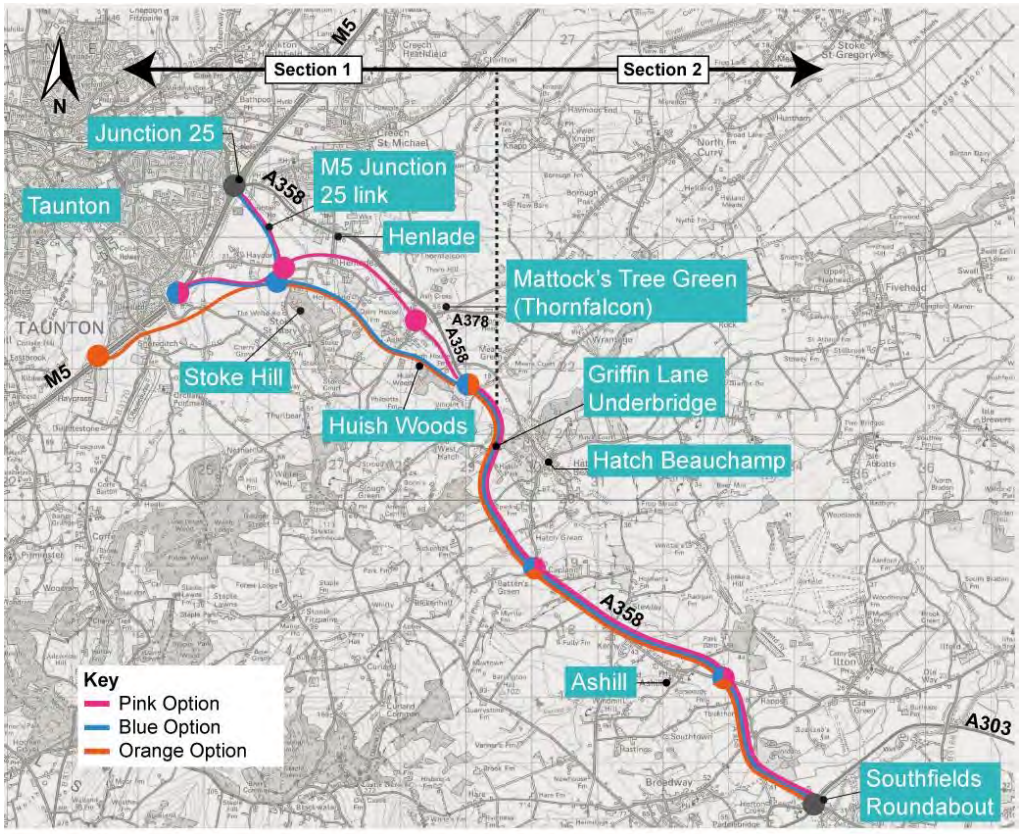


Following the most recent public consultation in 2018, the following three route options were presented; Pink, Blue and Orange route options are described below and depicted in

1.1.4. Figure 2:

- The **Pink option** commences at a new junction on the M5 approximately 1.2 miles (2 kilometres) south of junction 25. South-facing slip roads from the M5 would combine to become the new dual carriageway, which runs eastwards and north of Stoke Hill. Here a limited-movement junction is proposed with east-facing slip road connections to the new road which would allow traffic to travel between the new A358 and junction 25 via a new 0.9 mile (1.5 kilometre) dual carriageway link past the planned Nexus 25 site. The proposed route would then follow the existing A358 to Southfields Roundabout enabling the existing road to be upgraded from a single to a dual carriageway. The total length of the Pink option is 9 miles (14.6 kilometres), plus the 0.9 miles (1.5 kilometres) spur leading to M5 junction 25.
- The **Blue option** commences at the M5 approximately 1.2 miles (2 kilometres) south of junction 25 and runs eastwards on a more southerly alignment. At Stoke Hill a junction is proposed similar to that with the Pink option which would allow traffic to travel between the road and junction 25 via a new 1.2 miles (2 kilometres) dual carriageway link past the planned Nexus 25 site. The road would then continue in a south-easterly direction to West Hatch Lane, where an all-movement, grade-separated junction is proposed to allow access to Hatch Beauchamp, Henlade and surrounding communities, and the A378. This option is identical to the Pink option from this point onwards to Southfields Roundabout. The total length of the Blue option is 8.7 miles (14.1 kilometres), plus the 1.2 miles (2 kilometres) spur leading to M5 junction 25.
- The **Orange option** commences at the M5 approximately 2.1 miles (3.5 kilometres) south of junction 25 at a proposed new 2-bridge roundabout which would form a new all-movements junction between the new A358 and the motorway. The proposed road initially takes a north-easterly course towards Henlade before arcing around the north of Stoke Hill. In contrast to the Blue option, there is no link to junction 25 from this location, and therefore no junction at Stoke Hill. This option is identical to the Blue option from this point onwards. The total length of the Orange option is 9.5 miles (15.3 kilometres).

Figure 2: Route options presented at the 2018 public consultation



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1.2. Scheme proposal

1.2.1. The proposed scheme would provide a dual carriageway along the length of the A358 between Taunton and Ilminster in Somerset, connecting the A303 at Ilminster to the M5 motorway to the north. The scheme would include grade separated junctions with the purpose of providing a high-quality free flow journey for those using the route, with the removal of at-grade junctions and direct accesses.

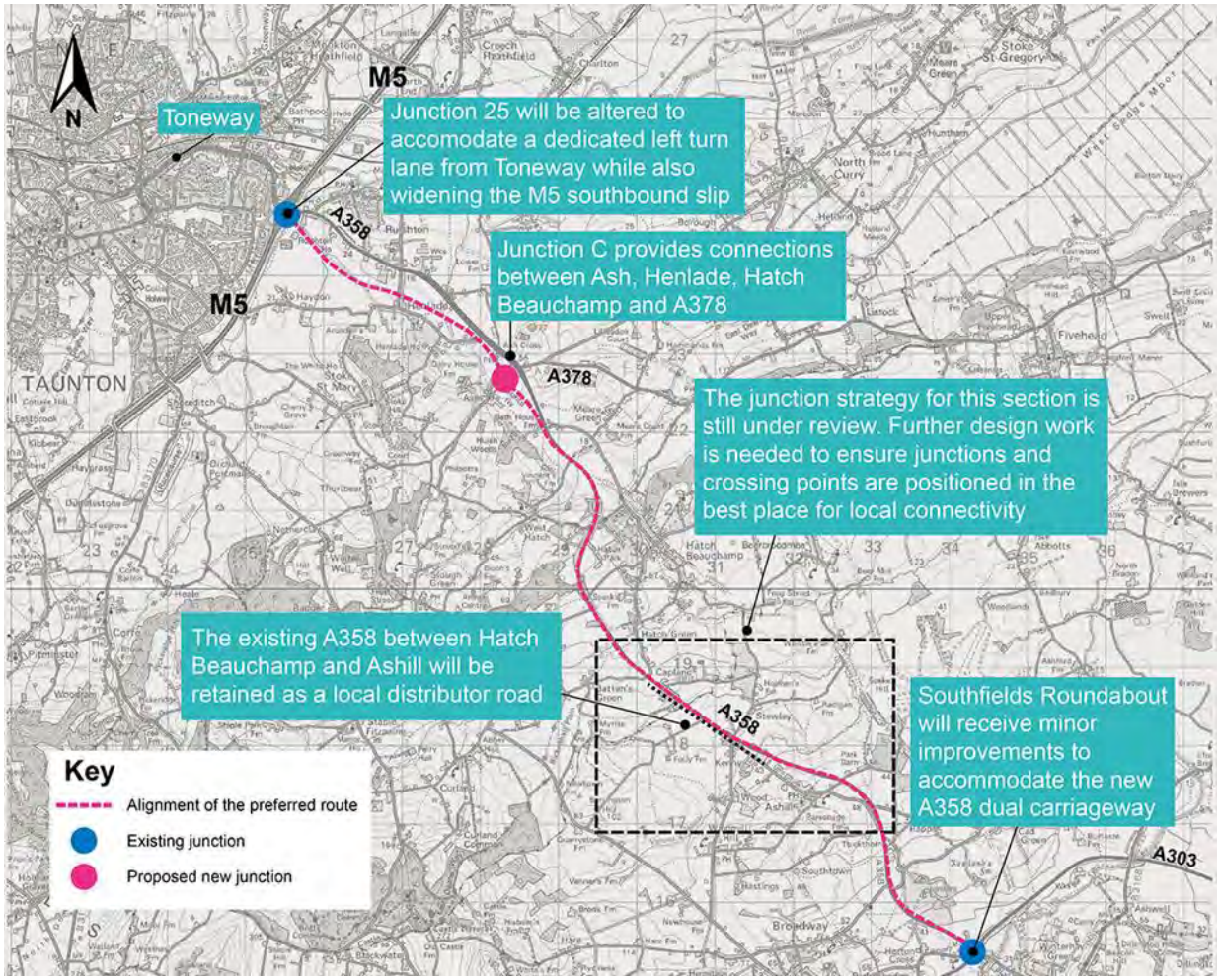
1.2.2. The Preferred Route Announcement (PRA) on the 13 June 2019 identified the Pink Modified option as the preferred route option. (refer to the Scheme Appraisal Report (SAR) for details of the development of the Pink option to the Pink Modified option). This is hereby referred to as 'the scheme'.

1.2.3. The scheme would comprise online widening between West Hatch Lane and Southfields Roundabout. This option would involve the re-use of a large amount of the existing A358 corridor, and between West Hatch Lane and Henlade the route would pass close to the A378 junction at Mattocks Tree Green. This would enable direct movement between the proposed road and the A378. The scheme retains the bypass at Henlade,

connects with the A378, and connects directly to junction 25 on the M5. A plan showing the Pink Modified option is shown in Figure 3 below.

1.2.4. The scheme would provide a dual carriageway along the length of the A358 between Taunton and Ilminster in Somerset, connecting the A303 at Ilminster to the M5 motorway to the north. The scheme would include grade separated junctions and, with the purpose of providing a high-quality free flow journey for those using the route, the removal of at-grade junctions and direct accesses.

Figure 3: The preferred scheme option.



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1.3. Scope of report

1.3.1. This macroinvertebrate Technical Report has been prepared during Stage 2 of the Highway England's (HE) Project Control Framework (PCF).

1.3.2. The objectives of this report are:

- to collate and review existing records for protected and notable aquatic invertebrate species
- to present the methods, constraints and results of macroinvertebrate sampling surveys and water quality assessments undertaken in May and September 2017
- to inform the Biodiversity chapter of the Environmental Statement

1.3.3. Only results relevant to the scheme are detailed. Sampling surveys which are not relevant to the PRA (June 2019) have not been included.

1.4. Study area

1.4.1. Guidance on ecological assessments recommends that all ecological features that occur within a zone of influence (ZoI) for a proposed scheme are investigated[1]. The potential ZoI includes:

- areas to be directly impacted by land take for the proposed scheme and access that could cause loss or degradation of suitable aquatic habitat
- aquatic habitat which could be indirectly affected by the scheme such as through changes in water levels, including any habitat hydrologically connected to the construction area.

1.4.2. The ZoI for macroinvertebrates encompasses all aquatic habitat within 100 metres of the scheme, both upstream and downstream, in accordance with the Mott MacDonald survey protocol produced for this scheme. The *Design Manual for Roads and Bridges* (DMRB) does not provide guidance on a recommended ZoI for invertebrates.

1.5. Legislation

1.5.1. Some aquatic invertebrate species are protected under European and National legislation. They are listed under Annexes II and V of the *European Council Directive 92/43/EEC* the *Habitats Directive 1992*, transposed into UK Legislation through the *Conservation of Habitats and Species Regulations 2017*. This legislation means that:

- Special Areas of Conservation (SAC) are established specifically to conserve these species where important sites are identified
- taking from the wild and exploitation (such as captive breeding programmes) must be subject to management measures
- it is illegal to damage or destroy a breeding or resting place (even accidentally)
- it is illegal to obstruct access to a resting or sheltering place (deliberately or recklessly)
- it is illegal to possess, sell, control or transport live or dead individuals, or parts, of these species

[1] Chartered Institute of Ecology and Environmental Management (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal.

1.5.2. Some aquatic invertebrates are protected under Schedule 5 of the *Wildlife and Countryside Act 1981* (as amended). Species listed under Schedule 5 may be protected under one, some or all of the following within Section 9, which makes the following an offence:

- Section 9, Part 1 – intentional killing, injuring, taking
- Section 9, Part 2 – possession or control (live or dead animal, part or derivative)
- Section 9, Part 4 (a) – damage to, destruction of, obstruction of access to any structure or place used by a scheduled animal for shelter or protection
- Section 9, Part 4 (b) – disturbance of animal occupying such a structure or place
- Section 9, Part 5 (a) – selling, offering for sale, possessing or transporting for the purpose of sale (live or dead animal, part or derivative)
- Section 9, Part 5 (b) – advertising for buying or selling live or dead animal, part or derivative

1.5.3. Close to 400 invertebrate species are listed as species of principal importance under Section 41 of the *Natural Environment and Rural Communities Act 2006* (NERC). Section 40(1) of the NERC Act states that 'every public authority must, in exercising its functions, have regard, so far as is consistent with the proper exercise of those functions, to the purpose of conserving biodiversity'. Section 40(3) explains that conserving biodiversity includes, in relation to a living organism or type of habitat, restoring or enhancing a population or habitat.

1.5.4. A full list of all invertebrate species afforded international and national protection, and those listed as Section 41 species of principal importance, is available on the Buglife website[2].

1.5.5. The *Water Framework Directive* (WFD) (2000/60/EC) is a European directive which aims to protect and improve the water environment. It is transposed into law in England and Wales by *The Water Environment (Water Framework Directive) Regulations 2017* (as amended). There are a number of objectives of the WFD in respect of which the quality of water is protected. The general protection of aquatic ecology is key and ecological protection should apply to all waters. The overall aims of the WFD relevant to aquatic invertebrates are:

- enhance the status and prevent further deterioration of surface water bodies, groundwater bodies and their ecosystems
- ensure progressive reduction of groundwater pollution
- reduce pollution of water, especially by priority substances and certain other pollutants

[2] Buglife (2014). Policy and Legislation Summary [online] available at: https://cdn.buglife.org.uk/2019/07/Policy-and-legislation-summary-final-2014_0.pdf. Last accessed November 2020.

- achieve at least good surface water status for all surface water bodies and good chemical status in groundwater bodies by 2021 (or good ecological potential in the case of artificial or heavily modified water bodies)

1.6. Planning policy

Highways England Biodiversity Action Plan (BAP)

1.6.1. *Highways England's BAP* identifies their approach to meeting the key performance indicator identified within the *Roads Investment Strategy* of "no net loss of biodiversity by 2020". Biodiversity is required to be fully considered during the building of any new roads and opportunities sought to work with stakeholders and enhance the network for wildlife[3].

South Somerset District Council Local Plan 2006 - 2028

1.6.2. Policy EQ4 (Biodiversity) within *South Somerset District Council's Local Plan 2006 – 2028* contains the following which are relevant to the conservation of aquatic invertebrates[4]:

1.6.3. "All proposals for development, including those which would affect sites of regional and local biodiversity, nationally and internationally protected sites and sites of geological interest, will:

- *protect the biodiversity value of land and buildings and minimise fragmentation of habitats and promote coherent ecological networks*
- *maximise opportunities for restoration, enhancement, and connection of natural habitats*
- *incorporate beneficial biodiversity conservation features where appropriate*
- *protect and assist recovery of identified priority species*
- *ensure that Habitat Features, Priority Habitats, and Geological Features that are used by bats and other wildlife are protected and that the design including proposals for lighting does not cause severance or is a barrier to movement.*

1.6.4. Where there is a reasonable likelihood of the presence of protected and priority species development design should be informed by, and applications should be accompanied by, a survey and impact assessment assessing their presence. If present, a sequential approach to the design of the proposal should be taken that aims first to avoid harm, then to lessen the impact, and lastly makes compensatory provision for their needs.

[3] Highways England (2015). 'Our plan to protect and increase biodiversity' [online] available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/441300/N150146_-_Highways_England_Biodiversity_Plan3lo.pdf (last accessed November 2020).
[4] South Somerset District Council (2015). South Somerset Local Plan [online] available at: https://www.southsomerset.gov.uk/media/1250/j-plan_pol-web-site-2018-1-local-plan-local-plan-2006-2028-south_somerset_local_plan_2006-2028_adoption_version_march_2015.pdf (last accessed November 2020).

1.6.5. Development will not be allowed to proceed unless it can be demonstrated that it will not result in any adverse impact on the integrity of national and international wildlife and landscape designations, including features outside the site boundaries that ecologically support the conservation of the designated site."

Taunton Deane Borough Council Core Strategy 2011 – 2028

1.6.6. The former Taunton Deane Borough Council has now merged with West Somerset to form the new Somerset West and Taunton Council. The previous Core Strategy has been adopted by the new joint council until a new Local Plan is published. As a result, the following information is still applicable to the conservation of aquatic invertebrate species.

1.6.7. Policy CP8 (Environment) within *Taunton Deane Borough Council's Core Strategy 2011 – 2028* contains the following which is relevant to the conservation of aquatic invertebrate species:

1.6.8. "The Borough Council will conserve and enhance the natural and historic environment and will not permit development proposals that would harm these interests or the settings of the towns and rural centres unless other material factors are sufficient to override their importance.

1.6.9. Development will be supported at sustainable locations to improve green infrastructure, public access, visual amenity and the overall quality of the natural environment. Development will need to mitigate and where necessary, compensate for adverse impacts on landscape, protected or important species, important habitats and natural networks, river and ground water quality and quantity so that there are no residual effects."

2. Methodology

2.1. Desk study

2.1.1. A biological records data search was requested from SERC on 7 April 2016, obtaining all records of protected and / or notable aquatic invertebrate species within 2 kilometres of the scheme.

2.1.2. A supplementary desk study was undertaken on 13 November 2020 to identify any additional data available. The Environment Agency (EA) Ecology & Fish Data Explorer[5] was used to identify locations where aquatic invertebrate sampling surveys were undertake within 2 kilometres of the scheme. Data from this resource is often not included within county species records.

2.2. Macroinvertebrate sampling

Field surveys

2.2.1. An initial desk-based assessment was undertaken in March 2017 to identify all watercourses crossed by the scheme. These were identified using 1:10,000 Ordnance Survey mapping data. A total of 8 watercourses were identified and macroinvertebrate sampling was undertaken at each.

2.2.2. Survey sites were identified at locations approximately 100 metres upstream and 100 metres downstream of the point at which the scheme crosses each watercourse, where land access was granted, resulting in a total of 16 sampling locations. Some sampling locations were located further from the intersection point but still on the same watercourse. Exact locations for sites were selected by the ecologists and chosen to be representative of the waterbody or reach.

2.2.3. Sampling surveys were undertaken in May and September 2017 at the same locations. The repetition of sampling surveys provides a representative picture of the invertebrate species present across the optimal survey period and also is compliant with WFD guidance[6].

2.2.4. Sampling surveys to identify benthic macroinvertebrates larger than 1 millimetre were undertaken using the standard three-minute kick sampling technique within the watercourse channels following the *EA Agency Operational Instruction 018_08*. The smaller stones and / or sediment of each site were agitated by foot to disturb any invertebrates within the substrate, which were then caught in a 1 millimetre (mesh size)

[5] Environment Agency. (2020). Ecology & Fish Data Explorer. [online] available at: https://environment.data.gov.uk/ecology-fish/. Last accessed November 2020.
[6] UKTAG. (December 2014). Benthic Invertebrate Fauna Invertebrates (General Degradation): Whalley, Hawkes, Paisley & Trigg (WHPT) metric in River Invertebrate Classification Tool (RICT)

hand net held immediately downstream of the disturbed location to catch them. A 30 second visual search was conducted prior to the kick sampling and a 30 second manual search of stones carried out immediately after the three minutes where possible.

2.2.5. During the sampling, the bottom edge of the net was skimmed through the top layer of the sediment or gravel bed, or if there was dense vegetation, the net was pushed in with various forward, upward and lateral movements. All habitats present were sampled representatively, in accordance with the industry standard *BS EN ISO 10870:2012*.

Laboratory analysis

2.2.6. The samples were stored in a cool box (which was kept between 1 to 3˚C) until they were preserved, on the same day, in Industrial Methylated Spirit (IMS). The samples from the spring 2017 sampling surveys were stored for six months, so that spring and autumn sample could be analysed together. The analysis for all samples was undertaken on 12 December 2017. Storage and analyses were undertaken by Five Rivers Environmental Contracting.

2.2.7. Samples were processed and analysed to mixed taxon and species level (TL5) by a qualified and experienced taxonomist following the *EA Agency Operational Instruction document no. 024_08*.

Data processing

2.2.8. Several biological indices were calculated upon completion of the taxonomic analysis. Brief descriptions of each method are provided below. All indices assess the general degradation of watercourses, using macroinvertebrate communities to determine ecological health, watercourse flow and sedimentation.

Biological Monitoring Working Party (BMWP) score

2.2.9. This method relies on the principle that different aquatic invertebrates have different tolerances to pollutants and dissolved oxygen concentrations. The BMWP index was calculated at a family level, based on the 78 “BMWP family” level taxa (TL1), which were scored between 0 – 10 depending on their sensitivity to pollution; 10 being the most sensitive to pollution and 0 being the most tolerant of polluted waterbodies[7].

Whalley, Hawkes, Paisley & Trigg (WHPT) index

2.2.10. The WHPT index superseded the BMWP scoring system for cycle 2 of the *Water Framework Directive* (WFD) reporting cycle. The WHPT system is abundance weighted rather than presence / absence, revised to be more representative of each macroinvertebrate family and reflect general pollution. The index was calculated at a

[7] Riverfly (2020). So, what’s the score? [online} available at: Biological Monitoring Working Party (BMWP) scoring system (riverfly.co.uk). Last accessed November 2020.

family level, based on the 112 “WHPT family” level taxa (TL2), which were assigned a score between -1.6 to 13 on a continuous scale; -1.6 is for abundant pollution-tolerant taxa and 13 is for highly abundant pollution-intolerant taxa[8].

Average Score Per Taxon (ASPT) and NTAXA

2.2.11. The average score per taxon (ASPT) was calculated by dividing the total BMWP and WHPT scores by the total number of scoring taxa (NTAXA) to provide a simple diversity measure which is representative of the invertebrate community, independent of sample size. Higher ASPT scores indicate better water quality. The use of BMWP and WHPT indices and ASPT scores are suitable for use in WFD assessments, even though only analysed to family level.

Lotic-Invertebrate Index for Flow Evaluation (LIFE)

2.2.12. The Lotic-Invertebrate index for Flow Evaluation (LIFE) score is calculated using taxa flow groups and abundances. Each species was assigned to one of six Flow groups, based on its preference / tolerance to certain flows, ranging from those associated with rapid flow to those resistant to drought. Each species was also placed in a second category relating to its abundance; there are five abundance categories. For each species the flow group and abundance are used to derive a score from a table. Higher LIFE scores indicate faster flows, whilst low scores indicate low flows[9]. LIFE scores were calculated at species level, based on the 417 “WFD species” level taxa (TL5).

Proportion of Sediment-sensitive Invertebrates (PSI)

2.2.13. The Proportion of Sediment-sensitive Invertebrates (PSI) was used to determine the degree to which a site is impacted by sediment. This is based on a similar principle to the LIFE and BMWP scores, with each species assigned a sensitivity rating for sediment. Species were assigned to one of four fine sediment sensitivity ratings – highly sensitive, moderately sensitive, moderately insensitive or highly insensitive. Ratings were abundance weighted and the final PSI score describes the proportion of fine sediment-sensitive invertebrates in the whole sample. Score range from 0 (heavily silted) to 100 (silt-free substrate)[10]. PSI scores were calculated at species level (TL5).

[8] Water Framework Directive – United Kingdom Advisory Group (WFD-UKTAG) (2014). Invertebrates (General Degradation): Whalley, Hawkes, Paisley & Trigg (WHPT) metric in River Invertebrate Classification Tool (RICT) [online] available at: Invertebrates (General Degradation)- Whalley, Hawkes,Paisley & Trigg (WHPT) metric Method Statement (wfduk.org). Last accessed November 2020.
[9] Pisces Conservation (2020). LIFE scores [online] available at: http://pisces-conservation.com/sdrhelp/index.html?life.htm. Last accessed November 2020.
[10] Extence, C.A. et al. (2017). Application of the Proportion of Sediment-sensitive Invertebrates (PSI) Biomonitoring Index. River research and Applications 33:10, pp. 1596-1605.

Community Conservation Index (CCI)

2.2.14. The diversity and conservation importance of the macroinvertebrate community at each site was represented by analysing species level (TL5) data through the Community Conservation Index (CCI). The CCI incorporates elements of species rarity and richness to summarise the conservation value, with scores assigned to all species within a sample to derive a total conservation score and infer a value[11].

2.2.15. Individual species' CCI scores were not provided by Five Rivers Environmental Contracting, but were determined in November 2020. This provided details on the conservation scores of all taxa identified to species level, based on Table 1 below, adapted from Chadd and Extence (2004).

Table 1: Conservation scores for freshwater invertebrate species in the UK

Conservation Score	Definition
10	RDB (Red Data Book) 1 (Endangered)
9	RDB2 (Vulnerable)
8	RDB3 (Rare)
7	Notable (but not RDB status)
6	Regionally Notable
5	Local
4	Occasional (species not in categories 10-5, which occur in up to 10% of all sample from similar habitats)
3	Frequent (species not in categories 10-5, which occur in >10-25% of all sample from similar habitats)
2	Common (species not in categories 10-5, which occur in >25-50% of all sample from similar habitats)
1	Very Common (species not in categories 10-5, which occur in >50-100% of all sample from similar habitats)

Source: Chadd and Extence (2004)

Water sampling

2.2.16. Environmental variables at each survey site were recorded to assess water quality and watercourse habitat. Water quality parameters were measured using a handheld calibrated YSI Pro-plus meter for the following:

- Velocity (metres per second (m/s))
- Alkalinity (parts per million (ppm))
- Temperature (°C)

[11] Chadd, R. and Extence, C.A. (2004). The Conservation of Freshwater Macroinvertebrate Populations: a Community-based Classification Scheme. Aquatic Conservation, 14(6).

- Dissolved oxygen (DO) %
- DO (milligrams per litre (mg/l))
- pH
- Conductivity (micro Siemens per centimetre (uS/cm))

2.2.17. The following physical properties of the watercourse were recorded:

- Mean width of watercourse (metres)
- Mean depth (centimetres)
- Substrate boulder and cobble %
- Substrate pebble and gravel %
- Sand %
- Silt and clay %

2.2.18. These environmental variables were not used in the analyses supplied but could be incorporated into a River Invertebrate Classification Tool (RICT). The RICT replaces the River Invertebrate Prediction and Classification System (RIVPACS), which is a WFD-compliant way of fully assessing the ecological quality of a watercourse[12].

2.2.19. Both models estimate the ecological health of running water sites based on the aquatic invertebrate families or species present. Drawing on datasets of which taxa exist in 'pristine' conditions, the model can predict which taxa should be present at a site, based on environmental variables and water quality parameters.

2.2.20. The difference between the expected and observed fauna indicates the ecological status of the watercourse and informs future management. This information supports successful implementation of the WFD framework.

2.3. Constraints

2.3.1. The sampling surveys provide a snapshot of activity at the sites and therefore there is always the risk of protected species being overlooked, either owing to the timing of the survey or the scarcity of the species at the site.

2.3.2. Conditions on site meant that some areas were difficult to access owing to the density of vegetation. However, sampling surveys were undertaken upstream and downstream of these areas where habitat was suitable and therefore this is not considered a significant constraint. However, there is a risk that any protected and / or notable invertebrates present and confined to these inaccessible areas would have been overlooked.

[12] Centre for Ecology and Hydrology (2020). RIVPACS reference database [online] available at: https://www.ceh.ac.uk/services/rivpacs-reference-database. Last accessed November 2020.

2.3.3. Sample sites E1 and E2 are over 500 metres upstream and 250 metres downstream from the scheme, due to issues with land access.

2.3.4. The CCI scoring system at the time of the analysis in December 2017 has since by superseded by an updated version in May 2018. As a result, CCI scores for 2017 sampling surveys may not be accurate in 2020.

2.3.5. It was not possible to identify all taxa to a species level (TL5). As a result, it was not possible to assign a conservation score. CCI values are therefore based only on confirmed species at each site.

3. Results

3.1. Desk study

3.1.1. No records for protected and / or notable aquatic invertebrate species were returned from the SERC biological record search in April 2016. The presence of protected and / or notable species within 2 kilometres of the scheme is unknown in 2020.

3.1.2. A total of 8 EA invertebrate survey sites were identified within 2 kilometres of the scheme. Survey sites which did not receive more than one survey in the same year, for example in spring and autumn, have been omitted from the results. The locations of these sites are shown in Appendix A and the results of the laboratory analyses in Table 2 below. The interpretation of BMWP, PSI and CCI scores is available in Table 3 below. Only the most recent results at each site have been included.

3.1.3. Laboratory analysis for sampling surveys post 2014 (sites 10534, 10542 and 160521), identified taxa to species level (TL5) and provided a CCI for the site. The older data at the other sites precluded the use of this metric, but other indices based on family-level taxa identification (TL1 and TL2) have been provided to allow direct comparability.

3.1.4. No legally protected species or UK species of principal importance were identified at any of these sites.

Table 2: EA macroinvertebrate survey results 1998 - 2017

Watercourse Name	Fivehead River		Fivehead River		River Isle		River Tone	
Site ID	10221		10236		10311		10534	
Biotic Index	02/05/2000	28/11/2000	13/03/2007	20/09/2007	17/05/2000	19/09/2000	10/05/2017	07/09/2017
BMWP (TL1)	171	161	187	134	130	144	158	179
NTAXA (TL1)	28	27	29	22	26	26	27	31
ASPT (TL1)	6.11	5.96	6.45	6.09	5	5.54	5.85	5.77
LIFE (TL1)	7.69	7.32	7.66	7.45	7.13	7.17	7.38	7.09
PSI (TL1)	70.18	65.31	67.69	66.67	46.94	54.76	56.14	46.67
CCI (TL5)							12.16	12.6
WHPT (TL2)	198.7	174	222.1	137.8	130.4	145.9	173.1	192.3
NTAXA (TL2)	30	28	33	23	26	26	30	34
ASPT (TL2)	6.62	6.21	6.73	5.99	5.02	5.61	5.77	5.66
Watercourse Name	Broughton Brook		Venners Water		Venners Water		Allen's Brook	
Site ID	10542		71682		77544		160521	
Biotic Index	24/03/2014	03/09/2014	14/05/1998	14/09/1998	15/05/2002	18/11/2002	25/03/2014	01/10/2014
BMWP (TL1)	150	102	101	55	169	178	114	124
NTAXA (TL1)	23	18	19	12	30	30	21	23
ASPT (TL1)	6.52	5.67	5.32	4.58	5.63	5.93	5.43	5.39
LIFE (TL1)	7.5	6.5	7.24	6.18	7.07	7.07	6.85	6.65
PSI (TL1)	64.58	26.67	57.14	40	55.56	55.74	41.3	25.58
CCI (TL5)	8.33	6.92					8	5.45
WHPT (TL2)	162.4	95.5	120.1	64.3	174.9	182.7	130.1	127
NTAXA (TL2)	25	18	21	13	30	30	25	25
ASPT (TL2)	6.5	5.31	5.72	4.95	5.83	6.09	5.2	5.08

Table 3: Interpretation of Table 1 results

BMWP Score Interpretation		PSI Score Interpretation		CCI Score Interpretation	
0 – 10	Very poor	0 - 20	Heavily sedimented	0 - 5	Low conservation value
11 – 40	Poor	21 - 40	Sedimented	>5 - 10	Moderate
41 – 70	Moderate	41 - 60	Moderately	>10 - 15	Fairly high
71 – 100	Good	61 - 80	Slightly	>15 - 20	High
> 100	Very good	81 - 100	Minimally	>20	Very high

3.2. Macroinvertebrate Sampling

Spring

3.2.1. Spring sampling surveys for benthic macroinvertebrates were undertaken between the 24th and 26th of May 2017. The biotic indices from the data analysis and processing are presented within Table 4 below. Sampling site J2 was inaccessible for spring sampling due to dense vegetation and a steep bank on the A358 verge, which was deemed unsafe. Interpretation of the results and score categories are available within Table 3 above.

3.2.2. The CCI value for each sampling site and its location within the scheme is presented within Appendix B1. A full list of all taxa identified from the spring sampling sites is available in Appendix C1. CCI has been selected as the displayed index for this report as it represents the community identified to species level and indicates the conservation value of the community.

Autumn

3.2.3. Autumn sampling surveys for benthic macroinvertebrates were undertaken between the 18 and the 22 September 2017. The biotic indices from the data analysis and processing are presented within Table 5 below.

3.2.4. The CCI value for each sampling site and its location within the scheme is presented within Appendix B2. A full list of all taxa identified from the spring sampling sites is available in Appendix C2.

3.2.5. A total of 155 taxa were identified from at least one of the samples. No protected or Section 41 aquatic invertebrate species were identified from any of the sample sites, in neither spring nor autumn.

Table 4: Macroinvertebrate biotic indices from spring 2017 sampling

	Spring							
Site	*C2*	*C3*	*D1*	*D2*	*E1*	*E2*	*F1*	*F2*
Biotic Index	*24/05/2017*	*24/05/2017*	*24/05/2017*	*24/05/2017*	*24/05/2017*	*24/05/2017*	*25/05/2017*	*25/05/2017*
BMWP (TL1)	19	129	59	53	88	60	160	136
NTAXA (TL1)	5	23	12	12	18	14	26	21
ASPT (TL1)	3.80	5.61	4.92	4.42	4.89	4.29	6.15	6.48
LIFE (TL5)	6.67	7.29	6.43	6.80	7.20	6.69	7.76	8.00
PSI (TL5)	14.29	50.00	31.82	19.35	41.38	25.00	55.93	75.61
CCI (TL5)	1.00	9.05	3.43	4.20	8.33	3.69	12.55	8.81
WHPT (TL2)	17.7	127.9	56.8	66.4	85.5	64.2	178.9	148.9
NTAXA (TL2)	5	24	12	16	18	16	28	22
ASPT (TL2)	3.54	5.33	4.73	4.15	4.75	4.01	6.39	6.77
Site	*G1*	*G2*	*H1*	*H2*	*I1*	*I2*	*J1*	*J2*
Biotic Index	*25/05/2017*	*25/05/2017*	*25/05/2017*	*25/05/2017*	*26/05/2017*	*26/05/2017*	*26/05/2017*	
BMWP (TL1)	107	96	94	71	118	84	148	
NTAXA (TL1)	19	18	19	16	21	16	26	
ASPT (TL1)	5.63	5.33	4.95	4.44	5.62	5.25	5.69	
LIFE (TL5)	7.72	7.17	7.05	5.93	7.26	8.07	6.50	
PSI (TL5)	52.08	41.03	45.28	8.57	46.67	69.23	26.19	
CCI (TL5)	8.33	8.61	8.89	3.80	7.50	8.57	7.31	
WHPT (TL2)	117.3	100.7	101.1	84.0	118.0	89.3	141.3	
NTAXA (TL2)	21	20	21	19	22	17	27	
ASPT (TL2)	5.59	5.04	4.81	4.42	5.36	5.25	5.23	

Table 5: Macroinvertebrate biotic indices from autumn 2017 sampling

	Autumn							
Site	*C2*	*C3*	*D1*	*D2*	*E1*	*E2*	*F1*	*F2*
Biotic Index	*18/09/2017*	*20/09/2017*	*20/09/2017*	*20/09/2017*	*20/09/2017*	*21/09/2017*	*21/09/2017*	*21/09/2017*
BMWP (TL1)	14	56	70	40	36	39	120	146
NTAXA (TL1)	4	13	15	9	9	11	20	25
ASPT (TL1)	3.50	4.31	4.67	4.44	4.00	3.55	6.00	5.84
LIFE (TL5)	8.00	6.50	7.33	7.29	6.6	5.73	8.11	6.72
PSI (TL5)	16.67	13.64	46.88	41.18	19.05	3.57	72.73	25.58
CCI (TL5)	1.00	3.00	7.92	10.71	3.9	4.09	8.89	9.80
WHPT (TL2)	10.1	51.4	77.1	42.6	38.2	38.1	130.1	141.9
NTAXA (TL2)	4	13	16	10	10	12	20	26
ASPT (TL2)	2.53	3.95	4.82	4.26	3.82	3.18	6.51	5.46
Site	*G1*	*G2*	*H1*	*H2*	*I1*	*I2*	*J1*	*J2*
Biotic Index	*21/09/2017*	*21/09/2017*	*21/09/2017*	*22/09/2017*	*22/09/2017*	*22/09/2017*	*22/09/2017*	*22/09/2017*
BMWP (TL1)	46	31	89	41	85	89	49	97
NTAXA (TL1)	10	9	20	10	17	17	12	20
ASPT (TL1)	4.60	3.44	4.45	4.10	5.00	5.24	4.08	4.85
LIFE (TL5)	7.00	6.00	6.58	5.71	6.60	6.81	6.00	7.39
PSI (TL5)	26.32	0.00	31.25	5.26	17.65	27.03	4.76	51.16
CCI (TL5)	1.14	1.00	8.68	4.71	7.33	3.75	7.50	8.06
WHPT (TL2)	42.1	33.6	94.9	38.2	91.5	84.2	48.0	94.3
NTAXA (TL2)	10	9	23	10	19	19	12	20
ASPT (TL2)	4.21	3.73	4.13	3.82	4.82	4.43	4.00	4.72

3.2.6. A total of 6 species of local conservation value (conservation score 5) were found across all sites:

- The caddisfly species *Athripsodes bilineatus;* 49 individuals were identified at site C3 and five individuals at site I2 in May 2017. A widespread species throughout England, adults on the wing are only seen between May and August. The larvae can be found in streams, rivers and lakes on a substratum of fine gravel to cobble. This species has no preference in terms of pH[13].

- The caddisfly species *Beraeodes minutus*: one individual was identified at site F2 in September 2017. The larvae of this species can be found amongst the roosts of vegetation in river and stream channels and show little preference for any particular flow regime. Adults of this species can be found on the wing in May[14].

- The beautiful demoiselle *Calopteryx virgo*, a European damselfly species; two individuals were identified at site F2 and one at site J1 in September 2017. This species breeds primarily in moderate to fast-flowing rivers and streams, where eggs are laid on emergent or floating plants. This species will not be seen in eutrophic (nutrient-rich) waters. Adults can be seen between late May and September[15].

- The large spurwing *Procloeon pennulatum*, a species of minnow mayfly; two individuals identified from site F2 in September 2017. Nymphs of this species live in pools and margins of rivers and streams. Adults of this species can be seen between May and October[16].

- The caddisfly species *Silo nigricornis;* one individual was identified at site C3 during May 2017. The larvae of this species can be found in rivers and streams, with a substratum preference ranging from coarse gravel to boulders and bedrock. This species shows a preference for moderately cold water (<18°C) and adults can be seen on the wing between May and September[17].

[13] Trichoptera Ireland (2018). Species profile: *Athripsodes bilineatus* [online] available at: https://trichopteraireland.wordpress.com/2016/09/07/species-profile-athripsodes-bilineatus/#:~:text=Athripsodes%20bilineatus%20is%20one%20of%2024%20members%20of,has%20a%20curved%20case%20made%20of%20sand%20grains. Last accessed December 2020.
[14] Trichoptera Ireland (2018). Species profile: *Beraeodes minutus* [online] available at: https://trichopteraireland.wordpress.com/2017/12/12/species-profile-beraeodes-minutus/. Last accessed December 2020.
[15] An Ecosustainable World (2019). Calopteryx virgo [online] available at: http://antropocene.it/en/2019/10/26/calopteryx-virgo/. Last accessed December 2020.
[16] The Riverfly Partnership (2020). Procloeon pennulatum (Large spurwing) [online] available at: https://www.riverflies.org/procloeon-pennulatum-large-spurwing. Last accessed December 2020.
[17] Trichoptera Ireland (2018). Species profile: *Silo nigricornis* [online] available at: https://trichopteraireland.wordpress.com/2015/06/19/386/. Last accessed December 2020.

- The birch-fly species *Simulium reptans*, from the blackfly family; two individuals were identified at site J2 in September 2017. No further information was found on the ecology or behaviour of this species.

3.2.7. More common species (conservation value 4 – 1) have not been referred to specifically. The conservation values of all species identified is available in Appendix D. Please note that not all taxa were identified to species level, therefore some do not have a conservation score.

3.2.8. Overall, conservation values of macroinvertebrate communities are typically of low and moderate value throughout the scheme. Notable occurrences of 'fairly high' conservation value communities were seen at site F1 in spring 2017 and D2 in autumn 2017. Species of local conservation value were not identified at either site, indicating that the higher CCI score at F1 is a result of the higher number of taxa.

3.2.9. Site D2 in autumn has a low number of taxa (NTAXA = 9) and a low BMWP score (40), yet the CCI score is comparatively high. The reason for this is not clear, as the majority of the species identified from the most recent CCI scores (May 2018) have a conservation value of 1. It is possible that the different scoring system used in the December 2017 analysis has resulted in differences in species' values.

3.2.10. CCI scores at sites F1 and F2 stayed relatively stable between spring and autumn, and these were comparatively high within the context of the schemes. These sites also had amongst the highest average BMWP and WHPT scores when identified to family level (TL1 an TL2). The presence of three species of local conservation value (*Beraeodes minutus, Calopteryx virgo* and *Procloeon pennulatum*) at site F2 in September 2017 contributes the slight increase in CCI between May and September, but overall, both sites maintain comparatively high diversity (NTAXA > 20).

3.2.11. Site C2 supported the lowest number of taxa and subsequently the lowest CCI, BMWP and WHPT scores in both spring and autumn sampling. The low PSI score indicates that the site is heavily sedimented; all indices infer a poor ecological condition at this location. All taxa identified at this site in both spring and autumn had a conservation value of 1.

3.2.12. Sites C3, G1, I1 and J1 all returned 'very good' BMWP scores in the spring, but much lower in the autumn, owing to far fewer taxa in the samples. However, the CCI scores for sites I1 and J1 remain very similar; despite increased sedimentation, only species of the lowest conservation value were absent in the autumn samples.

3.2.13. At sites C3 and G1, CCI scores decreased significantly. NTAXA dropped by 10 and 9 species respectively, with fewer species of conservation value 1. At site C3, *Athripsodes bilineatus* was also absent in September, which contributed disproportionately to the higher CCI in May.

3.2.14. Between spring and autumn, sedimentation levels increased at 11 of the 15 sites; site J2 was not surveyed so no comparison can be made. LIFE scores remained similar for all sites and indicate a fairly slow average flow for all watercourses crossed by the scheme.

3.2.15. Environmental variables were collected at each site but were not included as RICT assessments were not required at this stage of the scheme. Physical properties of each site and water quality parameters recorded using YSI pro-plus meters are included within Appendix D as supplementary information.

4. Conclusion

4.1.1. No records of protected and / or notable aquatic invertebrate species were returned from the SERC biological records search within 2 kilometres of the scheme. An additional desktop study in November 2020 identified 8 sites within 2 kilometres of the scheme which had been surveyed by the EA for cycle two of the WFD, although no protected and / or notable species were recorded.

4.1.2. A total of 8 watercourses were identified to be crossed by the scheme in 2017. Macroinvertebrate sampling at sites upstream and downstream of the crossing points was undertaken in May and September 2017 by Five Rivers Environmental Contracting at a total of 16 sites. One site, J2 was inaccessible for survey in May 2017 due to access and safety reasons.

4.1.3. Samples from each site were processed and analysed to species level (TL5) in December 2017 by Five Rivers Environmental Contracting, but no protected and / or notable aquatic invertebrate species were identified. Biotic indices were provided which indicate the ecological condition of the watercourses and the conservation value of the macroinvertebrate communities present.

4.1.4. The indices are compliant with WFD assessments and could be used in the future to assess the ecological condition of all watercourses crossed by the scheme using the RICT modelling tool. This was not necessary at the current stage of the scheme.

4.1.5. Full details of the potential impacts to macroinvertebrates and ecological mitigation measures will be included within the ecology and nature conservation chapter of the Environmental Statement for the project. Mitigation measures relevant to macroinvertebrates should include any effects identified from pollution to watercourses and any construction and operational activities which may impact upon aquatic processes.

Appendices

Appendix A: Environment Agency Survey Sites

10534

160521

10542

10221

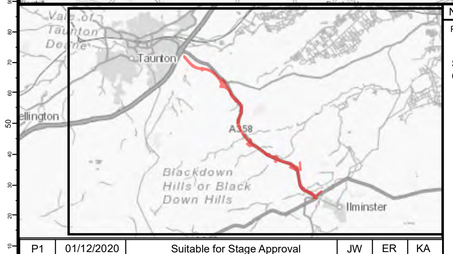
10236

77544

71682

10311

NTS 0 2,100 4,200 m



REV.	DATE	AMENDMENT DETAILS	ORIG	CHK'D	APP'D
P1	01/12/2020	Suitable for Stage Approval	JW	ER	KA

Notes

Pink modified option, Mott MacDonald (2019)

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Key to symbols

- Pink modified scheme option
- EA macroinvertebrate sites
- 500m buffer
- 1km buffer
- 2km buffer

References drawings

Drawing Status: Suitable for Stage Approval

Suitability: S4

Mott MacDonald Sweco

Stoneham Place
Stoneham Lane
Southampton
SO50 9NW

Tel : +44 (0)23 8062 8800
Fax : +44 (0)23 8062 8801
www.mottmac.com

Client: highways england

Project Title: A358 Taunton to Southfields

Drawing Title: Appendix A: EA macroinvertebrate sites 1998 - 2017

Scale	Designed	Drawn	Checked	Approved
NTS	JW	JW	ER	KA

Original Size	Date	Date	Date	Date
A1	01/12/2020	01/12/2020	01/12/2020	01/12/2020

Drawing Number: HE PIN | Originator | Volume | Location | Type | Role | Number

HE551508 - MMSJV - EBD - 000 - DR - LB - 0103

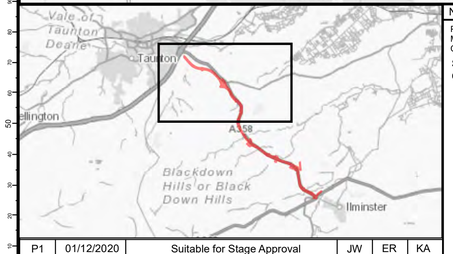
Project Ref. No.: 370774

Revision: P1

Appendix B1: Macroinvertebrate Conservation Value from Spring Sampling

C3
C2
D2
D1
E2
E1

NTS 0 750 1,500m



REV.	DATE	AMENDMENT DETAILS	ORIG	CHK'D	APP'D
P1	01/12/2020	Suitable for Stage Approval	JW	ER	KA

Notes

Pink modified option, Mott MacDonald (2019)
Macroinvertebrate sampling locations, Five Rivers Environmental Contracting (2017)

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Key to symbols

Pink modified scheme option
250m buffer
500m buffer

Community conservation index

Moderate conservation value
Low conservation value

References drawings

Drawing Status: Suitable for Stage Approval
Suitability: S4

Mott MacDonald Sweco
Stoneham Place
Stoneham Lane
Southampton
SO50 9NW
Tel : +44 (0)23 8062 8800
Fax : +44 (0)23 8062 8801
www.mottmac.com

Client: highways england

Project Title: A358 Taunton to Southfields

Drawing Title: Appendix B1: Spring 2017 macroinvertebrate results
Page 1 of 3

Scale	Designed	Drawn	Checked	Approved
NTS	JW	JW	ER	KA

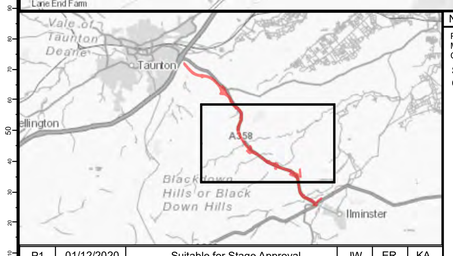
Original Size	Date	Date	Date	Date
A1	01/12/2020	01/12/2020	01/12/2020	01/12/2020

Drawing Number: HE551508 - MMSJV - EBD - 000 - DR - LB - 0104
(HE PIN | Originator | Volume | Location | Type | Role | Number)

Project Ref. No.: 370774
Revision: P1

E1
F2
F1
G2
G1
H2
H1

0 750 1,500m
NTS



REV.	DATE	AMENDMENT DETAILS	ORIG	CHK'D	APP'D
P1	01/12/2020	Suitable for Stage Approval	JW	ER	KA

Notes

Pink modified option, Mott MacDonald (2019)
Macroinvertebrate sampling locations, Five Rivers Environmental Contracting (2017)

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Key to symbols

Pink modified scheme option
250m buffer
500m buffer

Community conservation index

Fairly high conservation value
Moderate conservation value
Low conservation value

References drawings

Drawing Status: Suitable for Stage Approval
Suitability: S4

Mott MacDonald Sweco
Stoneham Place
Stoneham Lane
Southampton
SO50 9NW
Tel : +44 (0)23 8062 8800
Fax : +44 (0)23 8062 8801
www.mottmac.com

Client: highways england

Project Title: A358 Taunton to Southfields

Drawing Title: Appendix B1: Spring 2017 macroinvertebrate results
Page 2 of 3

Scale	Designed	Drawn	Checked	Approved
NTS	JW	JW	ER	KA

Original Size	Date	Date	Date	Date
A1	01/12/2020	01/12/2020	01/12/2020	01/12/2020

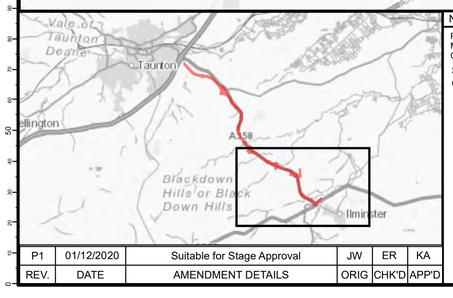
Drawing Number: HE551508 - MMSJV - EBD - 000 - DR - LB - 0106
(HE PIN | Originator | Volume | Location | Type | Role | Number)

Project Ref. No.: 370774

Revision: P1

G1
G2
H1
H2
I1
I2
J1
J2

NTS
0 750 1,500m



REV.	DATE	AMENDMENT DETAILS	ORIG	CHK'D	APP'D
P1	01/12/2020	Suitable for Stage Approval	JW	ER	KA

Notes

Pink modified option, Mott MacDonald (2019)
Macroinvertebrate sampling locations, Five Rivers Environmental Contracting (2017)

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Key to symbols

Pink modified scheme option
250m buffer
500m buffer

Community conservation index

Moderate conservation value
Low conservation value
Not sampled

References drawings

Drawing Status: Suitable for Stage Approval
Suitability: S4

Mott MacDonald Sweco
Stoneham Place
Stoneham Lane
Southampton
SO50 9NW
Tel : +44 (0)23 8062 8800
Fax : +44 (0)23 8062 8801
www.mottmac.com

Client: highways england

Project Title: A358 Taunton to Southfields

Drawing Title: Appendix B1: Spring 2017 macroinvertebrate results
Page 3 of 3

Scale	Designed	Drawn	Checked	Approved
NTS	JW	JW	ER	KA
Original Size	**Date**	**Date**	**Date**	**Date**
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Drawing Number: HE551508 - MMSJV - EBD - 000 - DR - LB - 0107
(HE PIN | Originator | Volume | Location | Type | Role | Number)

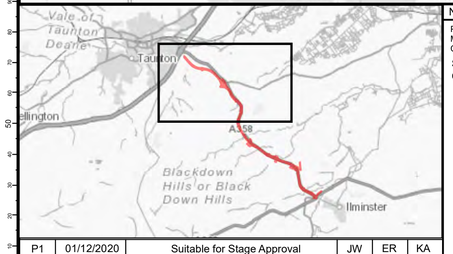
Project Ref. No.: 370774
Revision: P1

Appendix B2: Macroinvertebrate Conservation Value from Autumn Sampling

C3
C2
D2
D1
E2
E1

River Tone
Broughton Brook
Blackdown Hills or Black Down Hills

NTS
0 750 1,500m



REV.	DATE	AMENDMENT DETAILS	ORIG	CHK'D	APP'D
P1	01/12/2020	Suitable for Stage Approval	JW	ER	KA

Notes

Pink modified option, Mott MacDonald (2019)
Macroinvertebrate sampling locations, Five Rivers Environmental Contracting (2017)

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Key to symbols

Pink modified scheme option
250m buffer
500m buffer

Community conservation index

Fairly high conservation value
Moderate conservation value
Low conservation value

References drawings

Drawing Status	Suitability
Suitable for Stage Approval	S4

Mott MacDonald Sweco
Stoneham Place
Stoneham Lane
Southampton
SO50 9NW
Tel : +44 (0)23 8062 8800
Fax : +44 (0)23 8062 8801
www.mottmac.com

Client: highways england

Project Title: A358 Taunton to Southfields

Drawing Title: Appendix B2: Autumn 2017 macroinvertebrate results
Page 1 of 3

Scale	Designed	Drawn	Checked	Approved
NTS	JW	JW	ER	KA

Original Size	Date	Date	Date	Date
A1	01/12/2020	01/12/2020	01/12/2020	01/12/2020

Drawing Number: HE551508 - MMSJV - EBD - 000 - DR - LB - 0108
(HE PIN | Originator | Volume | Location | Type | Role | Number)

Project Ref. No.: 370774

Revision: P1

E1

F2

F1

G2

Page 2 of 3

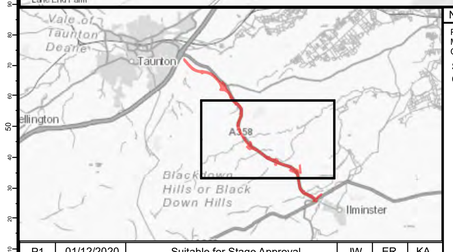
G1

H2

H1

0 750 1,500m

NTS



REV.	DATE	AMENDMENT DETAILS	ORIG	CHK'D	APP'D
P1	01/12/2020	Suitable for Stage Approval	JW	ER	KA

Notes

Pink modified option, Mott MacDonald (2019)
Macroinvertebrate sampling locations, Five Rivers Environmental Contracting (2017)

Service Layer Credits: Contains OS data © Crown Copyright and database right 2020

Key to symbols

Pink modified scheme option

250m buffer

500m buffer

Community conservation index

Moderate conservation value

Low conservation value

References drawings

Drawing Status: Suitable for Stage Approval

Suitability: S4

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SO50 9NW

Tel : +44 (0)23 8062 8800
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Page 2 of 3

Scale	Designed	Drawn	Checked	Approved
NTS	JW	JW	ER	KA

Original Size	Date	Date	Date	Date
A1	01/12/2020	01/12/2020	01/12/2020	01/12/2020

Drawing Number: HE551508 - MMSJV - EBD - 000 - DR - LB - 0109
(HE PIN | Originator | Volume | Location | Type | Role | Number)

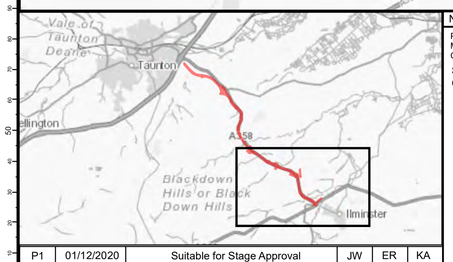
Project Ref. No.: 370774

Revision: P1

G1
G2
H1
H2
I1
I2
J1
J2

Page 3 of 3

NTS
0 750 1,500m



REV.	DATE	AMENDMENT DETAILS	ORIG	CHK'D	APP'D
P1	01/12/2020	Suitable for Stage Approval	JW	ER	KA

Notes

Pink modified option, Mott MacDonald (2019)
Macroinvertebrate sampling locations, Five Rivers Environmental Contracting (2017)

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Key to symbols

Pink modified scheme option
250m buffer
500m buffer

Community conservation index

Moderate conservation value
Low conservation value

References drawings

Drawing Status: Suitable for Stage Approval
Suitability: S4

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Tel : +44 (0)23 8062 8800
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Project Title: A358 Taunton to Southfields

Drawing Title: Appendix B2: Autumn 2017 macroinvertebrate results
Page 3 of 3

Scale	Designed	Drawn	Checked	Approved
NTS	JW	JW	ER	KA
Original Size	**Date**	**Date**	**Date**	**Date**
A1	01/12/2020	01/12/2020	01/12/2020	01/12/2020

Drawing Number: HE551508 - MMSJV - EBD - 000 - DR - LB - 0110
(HE PIN | Originator | Volume | Location | Type | Role | Number)

Project Ref. No.: 370774
Revision: P1

Appendix C1: Taxa List from Spring Sampling

Five Rivers ENVIRONMENTAL CONTRACTING	*Score*	*C2*	*C3*	*D1*	*D2*	*E1*	*E2*	*F1*	*F2*	*G1*	*G2*	*H1*	*H2*	*I1*	*I2*	*J1*
Taxa Name (species in green are of local conservation value)		**Abundance**														
Acroloxus lacustris	**2**											12				1
Agabus bipustulatus	**1**			1												
Agapetus fuscipes	**1**		53													
Agapetus sp.			100													
Amphinemura sulcicollis	**2**									1	1					
Ancylus fluviatilis	**1**									6	1				2	
Asellus aquaticus	**1**	1	204	88	576	36	120	9	3	300	350	708	196	66	48	45
Athripsodes bilineatus	**5**		49												5	
Athripsodes cinereus	**1**					8		1						1		
Athripsodes sp.			130					1								
Baetis muticus									1							
Baetis rhodani	**1**		9			1	2	50	81	660	1	78		36	32	
Baetis sp.				2					4			196		21	14	
Brachyptera risi	**3**									1						
Caenis luctuosa	**1**		1										1	1		2
Centroptilum luteolum	**4**							1			2					
Ceratopogonidae			1					1	1	1			2			
Chaetopteryx villosa	**3**									2	1	4		3		

Five Rivers ENVIRONMENTAL CONTRACTING	*Score*	*C2*	*C3*	*D1*	*D2*	*E1*	*E2*	*F1*	*F2*	*G1*	*G2*	*H1*	*H2*	*I1*	*I2*	*J1*
Chironomini		18								25			43			27
Clinocera sp.												1				
Collembola											1					
Crangonyx pseudogracilis	**Non-native**				1		1				1					1
Cyrnus trimaculatus	**3**								1							2
Dendrocoelum lacteum	**2**		2													
Dicranota sp.			40		1	1			6	80	25	2	4	1	108	
Drusus annulatus	**1**		12					1		19	2				8	1
Dugesia tigrina					3											
Dytiscus sp.				1												
Elmis aenea	**1**		54		20	24	3	8	1	1				5	23	
Elodes sp.			3	3	5									1		
Ephemera danica	**1**							36	1					145		1
Ephemera sp.																1
Erpobdella testacea	**4**		2			1		3		4	1	12				1
Gammarus fossarum / pulex agg.	**1**	1		1	4	9	42	7	15	6	5	92	20	41	35	1
Gammarus pulex	**1**	1	87		100			23		67	62	11	4		100	
Glossiphonia complanata	**1**			1	2		3			1		2	3	9		1
Gyraulus albus	**1**															4
Habrophlebia fusca	**2**					1		173	20	1003	6	22	28	3	20	6

Five Rivers ENVIRONMENTAL CONTRACTING	Score	C2	C3	D1	D2	E1	E2	F1	F2	G1	G2	H1	H2	I1	I2	J1
Halesus digitatus	**2**											1				
Halesus radiatus	**1**							1								
Helobdella stagnalis	**1**											15		12		
Helophorus aequalis	**1**			1									1	2		
Helophorus brevipalpis	**1**		1	1		1		1					4			8
Hemerodromia unilineata								1								
Heptagenia sulphurea	**3**							4	4							
Hippeutis complanatus	**3**						1						3			
Hydracarina			1		1										1	
Hydraena gracilis	**1**								1							
Hydridae			1													
Hydroporus palustris	**1**												1			
Hydroporus planus	**2**															1
Hydropsyche angustipennis	**1**														38	
Hydropsyche siltalai	**1**					3		1	1					3	175	
Ilybius fuliginosus	**1**												1			
Isoperla grammatica	**2**			1				2	2	111	25	1				
Laccobius bipunctatus	**2**												1			

Five Rivers ENVIRONMENTAL CONTRACTING	Score	C2	C3	D1	D2	E1	E2	F1	F2	G1	G2	H1	H2	I1	I2	J1
Lepidostoma hirtum	**1**							2	1							2
Leptophlebiidae											34		70		8	
Leuctra geniculata	**4**							20	3							
Limnephilus lunatus	**1**	2	41		2		4				2	8	7		2	1
Limnius volckmari	**1**		35				6	63	18	2						
Limoniidae												1	1			
Lype reducta	**2**				1											
Micropterna sequax	**1**														7	
Mystacides longicornis	**1**							3								12
Nebrioporus elegans	**1**								1							
Nepa cinerea	**3**													1		
Notonecta sp.															1	
Oligochaeta		32	104	42	180	48	91	72	11	144	91	143	161	65	96	28
Orectochilus villosus	**2**							1	1							
Orthocladinae		12	44	33		172	111			240	40	400	53	12	108	
Oulimnius sp.			25					1				7	6	2		2
Paraleptophlebia sp.			8							81						
Pericoma sp.							3			1	2	5				
Physa fontinalis	**1**		1													
Physella acuta											1					
Piscicola geometra	**2**							1								

Five Rivers ENVIRONMENTAL CONTRACTING	Score	C2	C3	D1	D2	E1	E2	F1	F2	G1	G2	H1	H2	I1	I2	J1
Pisidium milium	**2**		1													
Pisidium sp.					10		6									1
Pisidium subtruncatum	**1**		7		1	4	2	2		1	2	9	8	2		1
Planorbis carinatus	**1**					2	1									
Platambus maculatus	**1**										1					
Plectrocnemia conspersa	**2**							1						2		
Podonominae														1		
Polycelis felina	**3**					2									3	
Polycelis nigra / tenuis			1		3						1	2				
Polycentropus flavomaculatus	**2**							33	4							
Potamophylax latipennis	**2**															1
Potamopyrgus antipodarum	**Non-native**		16			72	315	15	9	117	56	510	26			98
Prodismesinae				82	271											
Psychoda sp.															1	
Psychodidae					1									2		
Ptychoptera lacustris	**3**				1											
Radix balthica	**1**							2		2		8	3			3
Scirtes sp.															18	
Sericostoma personatum	**1**		54					20	1					45		1

Five Rivers ENVIRONMENTAL CONTRACTING	Score	C2	C3	D1	D2	E1	E2	F1	F2	G1	G2	H1	H2	I1	I2	J1
Serratella ignita	**1**		8			48	5	333	258	333	3	10				1
Sialis lutaria	**1**							1								
Silo nigricornis	**5**		1													
Simulium angustipes	**4**					2						48		2	1	
Simulium sp.												348		1	2	
Tanypodinae			103			151	101	58	32		20	390	42			
Tanytarsini		42			352		106	43	31	260	30	620		121		11
Tinodes waeneri	**1**															1
Tipula sp.				1								1		1		1
Tricladia												1				
Valvata piscinalis	**1**															1
Velia sp.													1			
Weidemannia sp.													2			

Appendix C2: Taxa List from Autumn Sampling

Five Rivers ENVIRONMENTAL CONTRACTING	Score	C2	C3	D1	D2	E1	E2	F1	F2	G1	G2	H1	H2	I1	I2	J1	J2
Taxa Name (species in green are of local conservation value)		Abundance															
Acroloxus lacustris	**2**										42			1		2	
Agabus guttatus	**4**			1													

Five Rivers ENVIRONMENTAL CONTRACTING	Score	C2	C3	D1	D2	E1	E2	F1	F2	G1	G2	H1	H2	I1	I2	J1	J2
Agapetus fuscipes	**1**			15													
Ancylus fluviatilis	**1**							3	1	1				9	25		
Armiger crista	**2**								1								
Asellus aquaticus	**1**		15	224	56	40	252	1	24	65	78	531	6	35	260	10	95
Athripsodes sp.			1					2	1			2					1
Baetis muticus								10									
Baetis rhodani	**1**							15				22			2		17
Baetis sp.												10					5
Beraeodes minutus	**5**								1								
Caenis luctuosa	**1**								32								
Calopteryx sp.									2						1		
Calopteryx virgo	**5**								2							1	
Centroptilum luteolum	**4**							3	3								
Ceratopogonidae			1									1		3			
Chaetopteryx villosa	**3**				10							6					1

Five Rivers ENVIRONMENTAL CONTRACTING	Score	C2	C3	D1	D2	E1	E2	F1	F2	G1	G2	H1	H2	I1	I2	J1	J2
Chironomini						43			1		18	102	238	20	48	16	
Collembola				1													
Crangonyx pseudogracilis	**Non-native**						19		2		4						
Cyrnus trimaculatus	**3**								28				1				
Dendrocoelum lacteum	**2**											6					
Dicranota sp.								2									2
Dixa sp.				3	1												
Dugesia tigrina														1			
Ecdyonurus sp.								19									
Elmis aenea	**1**		1	1	24	4		12	7			1		5	21		18
Elodes sp.				154								2					
Ephemera danica	**1**													2			
Ephemera sp.								2						3			
Erpobdella octoculata	**1**															1	9
Erpobdella sp.																	19
Erpobdella testacea	**4**				1							1		1			

Five Rivers ENVIRONMENTAL CONTRACTING	Score	C2	C3	D1	D2	E1	E2	F1	F2	G1	G2	H1	H2	I1	I2	J1	J2
Gammarus fossarum / pulex agg.	**1**		3	63				24	1	6		101					
Gammarus pulex	**1**	2		102	75	9	1			33		152		4	5		79
Glossiphonia complanata	**1**		1				81		1			54	1	4	10		1
Gyraulus albus	**1**					2	2		1							1	
Gyrinus substriatus	**1**										1						
Habrophlebia fusca	**2**							28		1				11	12		
Haliplus lineatocollis	**1**								1					1			
Helobdella stagnalis	**1**						1					40		4	5		
Helophorus brevipalpis	**1**											1					
Hippeutis complanatus	**3**					1	2						1				
Hydraena gracilis	**1**							2						1			
Hydridae									1			1					
Hydropsyche angustipennis	**1**														5		
Hydropsyche siltalai	**1**							1									1
Hydropsyche sp.																	1

Five Rivers ENVIRONMENTAL CONTRACTING	Score	C2	C3	D1	D2	E1	E2	F1	F2	G1	G2	H1	H2	I1	I2	J1	J2
Ilybius sp.		1					8			4	1		1	6	2	2	
Leptophlebiidae								100						22			
Leuctra hippopus	**3**							39									
Limnius volckmari	**1**					54		45	3								19
Limnophora riparia											6						
Lype reducta	**2**				1				1								
Micropterna sequax	**1**									1		1					
Mystacides longicornis	**1**					3			3				1		2	12	2
Nemoura cinerea	**1**								13								
Nemoura sp.									3								
Nepa cinerea	**3**						1							1			
Odontocerum albicorne	**3**								1								
Oligochaeta		32	40	15	21	39	1	24	33	24	40	135	110	205	75	18	72
Orectochilus villosus	**2**							1									
Orthocladinae		30			36		93	22									
Oulimnius sp.			4		1	1			7			1		3	18	2	3

Five Rivers ENVIRONMENTAL CONTRACTING	Score	C2	C3	D1	D2	E1	E2	F1	F2	G1	G2	H1	H2	I1	I2	J1	J2
Paraleptophlebia sp.									1								
Physa fontinalis	**1**		1														
Physella acuta										2							
Pisidium sp.							1				21		13			1	
Pisidium subtruncatum	**1**		12	11		3		1	2		1	45	32	31		16	
Planorbis carinatus	**1**					5	4					3			1		
Platambus maculatus	**1**											1					
Plectrocnemia conspersa	**2**			1													
Polycelis felina	**3**			23													
Polycelis nigra / tenuis				8	1		1					21			2		2
Polycelis sp.				2													
Polycentropus flavomaculatus	**1**							7									
Potamopyrgus antipodarum	**Non-native**		1	1		2	36	56	54	15	36					16	32
Procloeon pennulatum	**5**								2								
Prodismesinae				112	41												
Psychodidae												1					

Five Rivers ENVIRONMENTAL CONTRACTING	Score	C2	C3	D1	D2	E1	E2	F1	F2	G1	G2	H1	H2	I1	I2	J1	J2
Radix balthica	**1**		12	1					72	12		2		24	3		
Rhyacophila dorsalis	**1**																4
Sericostoma personatum	**1**		1	1				2	5					3	5		1
Sialis lutaria	**1**		8						4				2				2
Simulium angustipes	**4**							40				1					1
Simulium noelleri	**3**											1					
Simulium reptans	**5**																2
Simulium sp.								32									
Stictotarsus duodecimpustulatus	**2**								1								
Succinea putris	**1**						2										
Tanypodinae		27	23	1111		40	102		2	41		111		13		12	402
Tanytarsini			25		31	47				58					54	20	57
Tipula sp.				4													
Valvata piscinalis																1	
Velia sp.						1											

Appendix D1: Spring Environmental Variables Master Data

Project Name: A358 - Spring Invert Sampling								
Site Name	**Site C2**	**Site C3**	**Site D1**	**Site D2**	**Site E1**	**Site E2**	**Site F1**	**Site F2**
Survey date	24/05/2017	24/05/2017	24/05/2017	24/05/2017	24/05/2017	24/05/2017	25/05/2017	25/05/2017
Time	09:48	11:54	13:10	14:24	15:18	16:50	10:05	08:30
Sample Ref No.	201707	201708	201709	201710	201711	201712	201713	201714
Sampler	SC	SC	SC	SC	SC	SC	SC	SC
Season	Spring	Spring	Spring	Spring	Spring	Spring	Spring	Spring
NGR	ST 26589 23716	ST 25641 24744	ST 27626 23391	ST 27549 23676	ST 28823 20995	ST 28799 21026	ST 29553 19186	ST 29931 19394
Velocity (m/s)	0.05	0.17	0.09	0.20	0.17	0.18	0.26	0.13
Mean Width (m)	1	1	1	1	1	1	1.5	2
Mean Depth (cm)	50	10	17	5	10	10	10	20
Boulder & Cobbles (%)	0	0	0	0	65	25	35	25
Pebbles & Gravel (%)	0	75	5	75	15	50	55	70
Sand (%)	0	0	20	10	0	0	5	0
Silt & Clay (%)	100	25	80	15	20	25	5	5
Alkalinity (ppm)	352	356	441	372	302	306	179	191
Temp (°C)	13.6	14.5	15	14	14.8	15	13.7	13.6
DO%	56.6	80.2	42.7	61.2	88.2	68.2	84.5	84.1
DO mg/L	5.99	8.14	4.3	6.32	8.93	6.84	8.76	8.65
SPC µs/cm	999	1215	990	882	643	648	463.9	482.8
pH	8.02	7.95	8.07	7.95	7.96	8	8.09	8.14

Project Name: A358 - Spring Invert Sampling								
Site Name	**Site G1**	**Site G2**	**Site H1**	**Site H2**	**Site I1**	**Site I2**	**Site J1**	**Site J2**
Survey date	25/05/2017	25/05/2017	25/05/2017	25/05/2017	26/05/2017	26/05/2017	26/05/2017	26/05/2017
Time	11:25	13:08	14:15	15:25	11:30	13:00	14:19	
Sample Ref No.	201715	201716	201717	201718	201719	201720	201721	
Sampler	SC	SC	SC	SC	SC	SC	SC	SC
Season	Spring	Spring	Spring	Spring	Spring	Spring	Spring	Spring
NGR	ST 30507 18465	ST 30760 18587	ST 31539 17835	ST 31673 18094	ST 33088 16368	ST 33473 16729	ST 33601 15764	ST 33618 15779
Velocity (m/s)	0.20	0.21	0.20	0.16	0.09	0.10	0.05	
Mean Width (m)	1.5	2	2	1	3	1.5	3	
Mean Depth (cm)	5	5	10	7	5	15	25	
Boulder & Cobbles (%)	0	10	0	0	0	0	0	
Pebbles & Gravel (%)	90	20	85	50	75	80	90	
Sand (%)	0	70	0	10	5	10	0	
Silt & Clay (%)	10	0	15	30	10	10	10	
Alkalinity (ppm)	160	159	181	191	189	190	167	
Temp (°C)	14.4	14.1	14.9	17.4	14.6	16.5	16.8	
DO%	82	65.5	66.8	121	86.6	95.8	86.1	
DO mg/L	8.3	6.61	6.62	11.28	8.68	9.31	8.35	
SPC µs/cm	444.8	465.3	553.14	568.3	601.6	528.1	458.1	
pH	8.14	7.91	7.95	8.01	8.13	8.1	8.04	

Appendix D2: Autumn Environmental Variables Master Data

Project Name: A358 - Autumn Invert Sampling								
Site Name	**Site C2**	**Site C3**	**Site D1**	**Site D2**	**Site E1**	**Site E2**	**Site F1**	**Site F2**
Survey date	18/09/2017	20/09/2017	21/09/2017	20/09/2017	20/09/2017	20/09/2017	21/09/2017	21/09/2017
Time	14:41	10:47	08:45	11:43	13:15	14:15	09:48	10:40
Sample Ref No.	201741	201742	201743	201744	201745	201746	201747	201748
Sampler	MK	SH / MK	SH /MK	SH / MK	SH / MK	SH / MK	SH / MK	SH / MK
Season	Autumn	Autumn	Autumn	Autumn	Autumn	Autumn	Autumn	Autumn
NGR	ST2658923720	ST2563224744	ST2770023100	ST2756423678	ST287210328792	ST2946121836	ST2955319186	ST2993119394
Velocity (m/s)	0	0.07	0	0	0	0	0.16	0
Mean Width (m)	1	1	0.7	1	3	2	2	3
Mean Depth (cm)	16	12.5	3	7.8	20	15	4.5	30
Boulder & Cobbles (%)	0	15	7	45	57	7	65	70
Pebbles & Gravel (%)	0	65	13	40	8	3	35	20
Sand (%)	0	0	0	0	0	0	0	0
Silt & Clay (%)	100	20	80	15	35	90	10	10
Alkalinity (ppm)	291	314	225	357	223	247	172	166
Temp (°C)	11.4	12.2	13.7	12.7	13.3	13.4	14	13.2
DO%	30.5	74.3	72.5	48.2	72.8	52.5	62.1	63.5
DO mg/L	3.25	7.76	7.43	4.95	7.48	4.94	6.45	6.43
SPC µs/cm	593.8	1627	735	1077	579.8	593.6	465.1	471.1
pH	8.00	8.19	8.66	8.07	8.28	8.17	8.53	8.43

Project Name: A358 - Autumn Invert Sampling								
Site Name	**Site G1**	**Site G2**	**Site H1**	**Site H2**	**Site I1**	**Site I2**	**Site J1**	**Site J2**
Survey date	21/09/2017	21/09/2017	21/09/2017	22/09/2017	22/09/2017	22/09/2017	22/09/2017	22/09/2017
Time	12:10	13:04	13:51	08:42	09:27	11:56	11:05	10:21
Sample Ref No.	201749	201750	201751	201752	201753	201754	201755	201756
Sampler	SH / MK	SH / MK	SH / MK	SH / MK	SH / MK	SH / MK	SH / MK	SH / MK
Season	Autumn	Autumn	Autumn	Autumn	Autumn	Autumn	Autumn	Autumn
NGR	ST3050718465	ST3076018587	ST3153917835	ST3167318094	ST3308816368	ST3347316726	ST3360115764	ST336315841
Velocity (m/s)	0	0	0	0	0	0	0.09	0.25
Mean Width (m)	1.5	2	0.5	1.7	1.1	1.2	1	3
Mean Depth (cm)	26	37.5	6	35	23	12.5	55	23
Boulder & Cobbles (%)	40	20	35	10	30	25	30	10
Pebbles & Gravel (%)	40	20	55	0	65	70	70	30
Sand (%)	0	0	0	0	0	0	0	20
Silt & Clay (%)	20	60	10	90	5	5	0	40
Alkalinity (ppm)	153	164	112	171	230	246	143	130
Temp (°C)	13.7	13.1	13.5	10.4	9.8	12	11.7	11.5
DO%	64.4	57.4	57.5	70.2	80.5	59.5	58.6	64.3
DO mg/L	6.5	5.73	5.8	7.75	8.91	6.35	6.34	6.96
SPC µs/cm	475.1	455.9	471.5	581.1	585.2	520.2	409.5	405.2
pH	8.39	8.32	8.24	8.56	8.57	8.35	8.5	8.54