The Great Grid Upgrade

Sea Link

Sea Link

Volume 6: Environmental Statement

Document: 6.3.3.2.N
Part 3 Kent
Chapter 2 Appendix 3.2.N
Aquatic Ecology Survey Report

Planning Inspectorate Reference: EN020026

Version: A
March 2025

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

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1.1 Introduction

1.1.1 The Sea Link Project (hereafter referred to as the 'Proposed Project') is a proposal by National Grid Electricity Transmission plc (hereafter referred to as National Grid) to reinforce the transmission network in the South East and East Anglia. The Proposed Project is required to accommodate additional power flows generated from renewable and low carbon generation, as well as accommodating additional new interconnection with mainland Europe.

1.1.2 This would be achieved by reinforcing the network with a High Voltage Direct Current (HVDC) Link between the proposed Friston substation in the Sizewell area of Suffolk and the existing Richborough to Canterbury 400 kV overhead line close to Richborough in Kent.

1.1.3 The purpose of this document is to:

- summarise relevant legislation and policy;
- describe the methodologies used for desk and field-based assessments;
- describe any limitations to the surveys undertaken; and,
- detail the results of ecological surveys for aquatic receptors (macrophytes, macroinvertebrates and fish) conducted in relation to the Kent Onshore Scheme.

1.1.4 The baseline findings of this report provide information on any potential ecological constraints associated with aquatic ecology receptors, for incorporation into the **Application Document 6.2.3.2 Part 3 Kent Chapter 2 Ecology and Biodiversity** for the Kent Onshore Scheme and **Application Document 6.9 Water Framework Directive Assessment**.

1.1.5 Details of avoidance, mitigation, compensation and enhancement measures relating to aquatic receptors are not included in this report and are instead reported within **Application Document 6.2.3.2 Part 3 Kent Chapter 2 Ecology and Biodiversity**.

1.1.6 This appendix should be read in conjunction with the following figures:

- **Application Document 6.4.3.2.N Aquatic Ecology Report**.

Scope

1.1.7 This report details the results of surveys undertaken to understand the aquatic macrophyte, macroinvertebrate and fish present within the Kent Onshore Scheme Order Limits through appropriate surveys.

1.1.8 The findings of aquatic ecological surveys within the Kent Onshore Scheme Order Limits have informed the ecological impact assessment and identification of mitigation measures (where required) which are reported in **Application Document 6.2.3.2 Part 3 Kent Chapter 2 Ecology and Biodiversity**.

Survey Area

1.1.9 A total of 21 watercourses (including rivers, streams and ditches) were identified as requiring survey. These areas were identified from mapping data, aerial imagery and the proposed crossings and outfalls found in **Application Document 6.3.1.4.A Appendix 1.4.A Crossing Schedules**. The locations of these water courses are shown in **Application Document 6.4.3.2.N.2 Aquatic Ecology Kent Study Areas.**

Legislation, Policy and Guidance

1.1.10 This assessment has been undertaken within the context of the following relevant legislation, planning policies and guidance documents:

- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (the 'Habitats Directive') (European Commission, 1992);
- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (the 'Water Framework Directive' or WFD) (HM Government, 2017);
- The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 (HM Government, 2015);
- Nitrate Vulnerable Zones/Nitrates Directive (The Nitrates Directive 1991) (European Commission, 1991);
- The Bern Convention (1979) also known as the Convention on the Conservation of European Wildlife and Natural habitats (European Union, 1979);
- Convention on Wetlands of International Importance ('Ramsar convention') (United Nations Educational, Scientific and Cultural Organisation, 1971);
- Wildlife and Countryside Act 1981 (as amended) (the 'WCA') (HM Government, 1981);
- Natural Environment and Rural Communities (NERC) Act (2006) (HM Government, 2006)[1];
- Salmon and Freshwater Fisheries Act (SAFFA) 1975 (HM Government, 1975);
- Environmental Protection Act 1990 (HM Government, 1990);
- The Conservation of Habitats and Species Regulations 2010 (as amended) (HM Government, 2010);
- Eels (England and Wales) Regulations 2009 (HM Government, 2009);
- Invasive Alien Species (Enforcement and Permitting) Order 2019 (HM Government, 2019);
- UK Post-2010 Biodiversity Framework (JNCC, 2012);
- Bonn Convention 1979 (JNCC, 1979);
- European Union and Trade in Wild Fauna and Flora (European Union, 2015);

[1] Section 41 of the NERC Act (2006) provides a list of habitats and plant species of principal importance for nature conservation in England

- Endangered Species of Wild Fauna and Flora (CITES) (United Nations, 1973);
- Oslo and Paris Conventions (OSPAR) 1992 (OSPAR Commission, 1992); and
- Kent Biodiversity Strategy (Kent Nature Partnership, 2020).

1.2 Methodology

Desk Study

1.2.1 A desk study was conducted to identify water bodies, designated sites and habitats within the Kent Onshore Scheme Order Limits and up to 2 km outside of the Order Limits. Where there was no or limited data a wider search was completed up to 10 km outside of the Order Limits.

1.2.2 The Environment Agency's (EA) Catchment Data Explorer website (Environment Agency, 2024) was used to identify WFD rivers within or nearby the Kent Onshore Scheme Order Limits that could be influenced by construction or operation of the Proposed Project. Available information has been reviewed for Monkton and Minster Marshes (WFD water body ID: GB107040019621), River Stour Kent (WFD water body ID: GB520704004700) and associated tributaries.

1.2.3 The EA Ecology and Fish Data Explorer (Environment Agency, 2024) was used to review ecological monitoring data within an approximate 5 km radius of the Kent Onshore Scheme Order Limits from the last five years. Data from a wider area or historical data were included at these locations where considered relevant (e.g. notable species or no data present).

1.2.4 Finally, historic crayfish records were reviewed using NBN Atlas (NBN Atlas Partnership, 2024).

1.2.5 Data provided by the local environmental records center (Kent & Medway Biological Records Centre (KMBRC), 2024) was used to identify the presence of any notable or non-native species within 2 km of the Kent Onshore Scheme Order Limits.

Zone of Influence

1.2.6 The potential impact(s) of a development are not always limited to the boundaries of the site concerned. A development may also have the potential to result in impacts upon ecologically important sites, habitats or species that are located beyond the site boundaries.

1.2.7 The area over which a development may impact ecologically important features is known as the Zone of Influence (ZOI). The ZOI is determined by the source/type of impact, the potential pathway(s) for that impact and the location and sensitivity of the ecologically important feature(s) beyond the Order Limits. The potential ZOI of a project in relation to aquatic ecology receptors (macrophytes, macroinvertebrates and fish) is used to determine the extent of the aquatic ecology survey and study areas.

1.2.8 The ZOI was determined as all suitable habitats within the Order Limits and relevant adjacent habitats (watercourses and ponds). This was used to establish the required extent of the aquatic ecology surveys.

Aquatic Macrophyte Surveys

1.2.9 Aquatic macrophyte (plant) surveys were undertaken in July 2024 at two survey locations as shown in **Application Document 6.4.3.2.N.2 Aquatic Ecology Kent Study Areas** (Table 1.1) led by a suitably qualified ecologist. These locations were chosen as the waterbodies have the greatest potential to be impacted by the Proposed Project. The recommended optimal period for undertaking aquatic macrophyte surveys is between 1 June and 30 September and not during or immediately following periods of high flow.

Table 1.1 Aquatic macrophyte survey locations and dates

Survey reach	National Grid Reference start (downstream)	National Grid Reference centre	National Grid Reference end (upstream)	Survey date
Minster Stream	TR 31000 63147	TR 31003 63102	TR 31005 63054	24 July 2024
River Stour	TR 31945 62651	TR 31923 62680	TR 31905 62692	24 July 2024

1.2.10 The aquatic macrophyte surveys followed guidance set out in the UKTAG River Assessment Method (Macrophytes and Phytobenthos) for use with LEAFPACS2 (WFD-UKTAG, 2014), which conforms to BS EN 14184:2014 Water quality - Guidance for the surveying of aquatic macrophytes in running waters (The British Standards Institution, 2014). The survey was carried out by walking within the channel of each watercourse along a 100 m transect, where safely accessible. Any inaccessible areas were bypassed as necessary before re-entering the channel at the next available access point. A list of all macrophytes encountered was collated and their relative abundance was recorded using Taxon Cover Values, detailed below (Table 1.2).

Table 1.2 Taxon Cover Values (TCV) and associated percentage cover

TCV	Percentage cover by macrophyte taxon
C1	<0.1%
C2	0.1 to 1%
C3	1 to 2.5%
C4	2.5 to 5%
C5	5 to 10%
C6	10 to 25%
C7	25 to 50%

TCV	Percentage cover by macrophyte taxon
C8	50 to 75%
C9	>75%

1.2.11 Aquatic macrophyte data was processed through the River LEAFPACS2 calculator, available from the WFD UKTAG website (WFD-UKTAG, 2014). Four metrics were calculated using macrophyte species and groups data:

1.2.12 River macrophyte nutrient index (RMNI) – Macrophyte taxa are allocated a score based on their relative tolerance of nutrients. The overall observed RMNI score for a survey is the cover weighted average of the individual scores of the different taxa found.

1.2.13 Number of macrophyte taxa (NTAXA) – The number of scoring taxa recorded in the field survey. Only true hydrophytes are included.

1.2.14 Number of functional groups (NFG) – Hydrophytes are allocated to one of 24 “functional groups”. These are groups of organisms which exploit a resource in a similar way.

1.2.15 Cover of filamentous green algae (ALG) – The percentage cover of filamentous green algae over the whole of the surveyed section.

1.2.16 LEAFPACS2 predicts the RMNI, NTAXA and NFG scores for the surveyed reach based on altitude, alkalinity, and slope. The predicted scores are then compared to reference scores and the output is an Ecological Quality Ratio (EQR). The EQR can be translated into a WFD classification (High, Good, Moderate, Poor, or Bad) as shown in **0 2.N.1**. Alkalinity data should be obtained from monthly analysis of samples from each over a period of at least one year, whereas here, alkalinity was based on the average of two samples collected during the survey visits.

1.2.17 River LEAFPACS2 analysis was designed to reflect the impact of nutrient enrichment on macrophyte communities, with High status indicating there is no impact and Bad status indicating there is a severe impact. The method may also be sensitive to alterations in river flow and/or modifications to morphological conditions which may impact macrophyte communities (WFD-UKTAG, 2014).

1.2.18 Aquatic macrophyte species were cross referenced against the JNCC Taxon Designations list (JNCC, 2023) and the Kent Biodiversity Strategy (Kent Nature Partnership, 2020) to identify if any protected and/or notable species were recorded during the surveys.

Aquatic Macroinvertebrate Surveys

1.2.19 Aquatic macroinvertebrate surveys were undertaken at 19 sites in Autumn 2023 and nine sites in Spring 2024. The specific locations and dates of the surveys are shown in Table 1.3 and **Application Document 6.4.3.2.N.2 Aquatic Ecology Kent Study Areas**. Other watercourses within the Kent Order Limits were scoped out of survey as the Proposed Project is unlikely to cause a significant impact to any aquatic features within those watercourses. No surveys were undertaken during or immediately following periods of high flow in accordance with best practice guidance.

1.2.20 Survey locations were chosen due to the direct impact from temporary and permanent outfalls and crossing points proposed during both construction and operation of the Proposed Project.

Table 1.3 Macroinvertebrate survey locations and dates

Survey site	Watercourse	National Grid Reference	Autumn survey date	Spring survey date
DS1	Ordinary Watercourse	TR 30798 62802	28/11/2023	-
New DS2	Minster Stream	TR 32912 63329	28/11/2023	-
DS3	Ordinary Watercourse	TR 31187 62591	-	29/05/2024
DS5	Ordinary Watercourse	TR 31498 62508	27/11/2023	29/05/2024
DS6	Ordinary Watercourse	TR 31771 62438	27/11/2023	29/05/2024
DS7	Ordinary Watercourse	TR 31982 62138	27/11/2023	29/05/2024
DS8	Ordinary Watercourse	TR 32172 62147	27/11/2023	-
DS9	Ordinary Watercourse	TR 32355 62025	27/11/2023	29/05/2024
DS10	Ordinary Watercourse	TR 31936 62803	28/11/2023	-
DS11	Ordinary Watercourse	TR 31675 63184	28/11/2023	-
DS12	Clapper Hill Lead Dyke	TR 31812 63498	28/11/2023	30/05/2024
DS13	Ordinary Watercourse	TR 31924 63386	28/11/2023	30/05/2024
DS14	Ordinary Watercourse	TR 32286 63348	29/11/2023	-
DS15	Brook Lane Lead Dyke	TR 32589 63246	29/11/2023	-
DS16	Minster Stream	TR 32703 63260	28/11/2023	-
New DS17	Ordinary Watercourse	TR 34123 63636	27/11/2023	-
WBS1	River Stour	TR 30668 62750	28/11/2023	30/05/2024
WBS2	Richborough Stream	TR 31981 61337	27/11/2023	29/05/2024
WBS3	Minster Stream	TR 31615 63019	28/11/2023	-
WBS4	Stoneless Main Stream	TR 33907 63681	27/11/2023	-

1.2.21 The aquatic macroinvertebrate surveys were undertaken by suitably qualified and experienced aquatic ecologists. Sampling procedures followed those standardised by the EA (EA, 2017), which conform to BS EN ISO 10870:2012 Water Quality – Guidelines for the selection of sampling methods and devices for benthic macroinvertebrates in fresh waters (The British Standards Institution, 2012). These methods allow characterisation of aquatic macroinvertebrate communities and can be used to determine whether rare or notable species or communities are present. The samples were taken using a standard Freshwater Biological Association (FBA) pattern kick net (mesh size: 1 mm). The habitats present were proportionally sampled through a combination of kick sampling and sweep sampling for three minutes followed by a one-minute active search of larger substrates in accordance with the standard methods. The samples collected were subsequently preserved in Industrial Methylated Spirit (IMS) for laboratory processing.

1.2.22 Each of the samples collected was sorted and analysed in a laboratory setting by suitably trained and experienced aquatic ecologists. Lists of the aquatic macroinvertebrate taxa present were produced in line with EA guidance (EA, 2014). The aquatic macroinvertebrate samples were identified to 'mixed-taxon level' using a stereo-microscope. Most groups were identified to species level (where practicable), except for the following:

- Worms (*Oligochaeta*), which were identified to sub-class;
- Marsh beetles (*Scirtidae*), which were identified to family;
- True-fly larvae, which were identified to the maximum resolution possible; and
- Immature or damaged specimens, which were identified to the maximum resolution possible on a case-by-case basis.

1.2.23 Aquatic macroinvertebrate species were cross referenced against the JNCC Taxon Designations list (JNCC, 2023) and the Kent Biodiversity Strategy (Kent Nature Partnership, 2020) to identify if any protected and/or notable species were identified. The survey data was then used to calculate metrics that can be used to inform an assessment of relative nature conservation value, habitat condition and general degradation as detailed below.

Community Conservation Index (CCI)

1.2.24 A Community Conservation Index (CCI) (Chadd & Extence, 2004) was calculated for each site as detailed in **Annex 2.N.2**. The CCI classifies many groups of aquatic macroinvertebrates according to their scarcity and nature conservation value in England as understood at the time that the classification was developed. Species scores range from 1 to 10, with 1 being Very Common and 10 being Endangered. Since its initial publication, in some cases the references used in the CCI classification to define scarcity and value have been superseded by more recent assessments. As a result updated species scores were obtained from the EA to take account of this new information (EA, pers. comm., 2023). These updated scores have been used within this assessment.

Lotic-invertebrate Index for Flow Evaluation (LIFE)

1.2.25 Lotic-invertebrate Index for Flow Evaluation (LIFE) scores were calculated (Extence, Balbi, & Chadd, 1999). This is an index that links benthic macroinvertebrate data to flow regimes prevailing in UK waters. Flow scores have been allocated to various

macroinvertebrates based on species/family abundance and ecological association with different flows, as detailed in **Annex 2.N.3**. The overall LIFE score for a site is calculated as the sum of the individual scores divided by the number of scoring species/families. LIFE scores increase with current velocity, scores <6.00 generally indicating sluggish or still water conditions and score >7.5 indicate fast flows. LIFE allows the mean flow preference of invertebrates colonising a reach to be determined so that effect of habitat changes such as sediment accumulation can be monitored.

Proportion of Sediment-sensitive Invertebrates (PSI)

1.2.26 Calculations were undertaken to determine the proportion of sediment sensitive macroinvertebrates present using the Proportion of Sediment-sensitive Invertebrates (PSI) index (Extence, et al., 2013). Using this approach, individual taxa of aquatic macroinvertebrate are assigned a Fine Sediment Sensitivity Rating (FSSR) ranging from A to D, as detailed in **Annex 2.N.4**. The PSI score for each aquatic macroinvertebrate sample was derived from individual species scores and abundances. The derived PSI score corresponds to the percentage of fine sediment-sensitive taxa present in a sample and ranges from 0 to 100, where low scores correspond to watercourses with high fine sediment cover. The PSI score therefore provides an indication of the extent to which watercourses are influenced by fine sediments, and therefore by inference the potential sensitivity of the associated aquatic macroinvertebrate community to changes in silt load and deposition.

Whalley, Hawkes, Paisley & Trigg (WHPT)

1.2.27 The aquatic macroinvertebrate data were analysed to generate the Whalley, Hawkes, Paisley & Trigg (WHPT) score Average Score Per Taxon (ASPT), and Number of scoring taxa (NTAXA) values, which provides an indication of the ecological quality in the watercourse (WFD-UKTAG, 2023). This assigns numerical value to taxa according to their sensitivity to organic pollution. The average of the values for each taxon in a sample, known as ASPT is a stable and reliable index of organic pollution. Therefore, these assessments can indicate to what extent an aquatic macroinvertebrate community is exposed to organic pollution (further information is provided in **Annex 2.N.5**). It is important to note that these indices can vary between geological regions and habitat types. Ditches for example are unable to support many of the high-scoring taxa associated with fast flowing habitats. Therefore, the resultant metrics should be reviewed with an awareness of their potential limitations, and the site-specific context, as described in this report.

1.2.28 The WHPT method has been primarily designed to respond to organic pollution, however it is suitable for monitoring other types of impact and is used for assessing the WFD classification parameter "*General degradation*" (WFD-UKTAG, 2023).

River Invertebrate Classification Tool (RICT)

1.2.29 The resultant WHPT-ASPT and NTAXA values and environmental data collected were processed through the River Invertebrate Classification Tool version 3 (RICT) web application, available on the Freshwater Biological Association website (Freshwater Biological Association, n.d.).

1.2.30 RICT predicts the WHPT-ASPT and NTAXA scores for the surveyed locations based on the site location, altitude, alkalinity, slope, discharge category, distance from source, channel dimensions and substrate composition. The predicted scores are then compared to actual scores and the output is an Ecological Quality Ratio (EQR). The

EQR can be translated into a WFD classification (High, Good, Moderate, Poor, or Bad). Alkalinity data should be obtained from monthly analysis of samples from each over a period of at least one year, whereas here, alkalinity was based on the average of two samples collected during the survey visits, which is typical for an assessment of this type.

Fish Surveys

1.2.31 Fish surveys were undertaken in July 2024 at two locations; the Minster Stream and River Stour. These sites were chosen for the direct impacts of permanent outfalls on the Minster Stream and the proposed temporary bridge crossing over the River Stour. Specific dates and locations are shown in Table 1.4 and **Application Document 6.4.3.2.N.2 Aquatic Ecology Kent Study Areas**.

Table 1.4. Fish survey locations

Survey reach	National Grid Reference start (downstream)	National Grid Reference (center)	National Grid Reference end (upstream)	Survey date	Method
Minster Stream	TR 30999 63146	TR 31001 63123	TR 31005 63091	24/07/24	Semi- quantitative electric fishing
River Stour	N/A	TR 31930 62678	N/A	24/07/24	Seine netting

Minster Stream

1.2.32 A semi-quantitative electric fishing survey was completed at Minster Stream by a team of four experienced aquatic ecologists where safely accessible. The survey was completed to supplement existing fish monitoring data in the catchment, and as per best practice guidance, "*counts of fish species present should be obtained from a single removal, using data either from the first pass of depletion sampling, or the catch from "semi-quantitative" catch-per-area sampling"* (WFD-UKTAG, 2008). Sampling procedure followed standard EA guidelines (Beaumont, Taylor, Lee, & Welston, 2002) (WFD-UKTAG, 2008). The survey was completed at low tide (Specific Conductivity = 883), wading over a single run in an upstream direction using a bankside electrofishing kit consisting of an Electracatch WFC4 control box with Pramac 4000 generator and double anode. This equipment was chosen after careful consideration of water depth, stream width and access (i.e., depth < 0.8 m and stream width being an average of 6 m). The river reach surveyed was approximately 50 m in length between a natural barrier (debris build up) and the EA monitoring station on Marsh Farm Road. Fish that were caught were placed in well aerated holding containers on the river margins and identified to species level. Their fork length was measured to the nearest mm before being released safely and unharmed back into the watercourse.

River Stour

An isolated area seine netting survey was completed on the River Stour close to the proposed temporary bridge location by four experienced aquatic ecologists. Sample procedure followed standard EA guidelines (EA, 2008). This survey method was chosen due to the wide nature of the river and tidal influence. The survey was completed around low slack tide using a 30 m x 2.5 m standard seine net. Four seines were completed consecutively within a 100 m area. Fish that were caught were placed in well aerated holding containers on the river margins and identified to species level and measured to fork length (mm). Fish were held until all seines were completed before being released safely and unharmed back into the watercourse.

Limitations

1.2.33 It should be noted that ecosystems are dynamic and constantly changing, and therefore species may move, or new species may be recorded in subsequent years. For this reason and in accordance with current guidance, the field survey data detailed in this report are valid for two years from the date of the survey (CIEEM, 2018). After this date, updated surveys may be required, and advice should be sought from an appropriately qualified ecologist to determine the survey scope and methods.

1.2.34 Some watercourses within the Order Limits had limited visibility and access due to steep banks and dense vegetation. While this limited the ability to survey, it is believed that the watercourses were adequately accessed for the results of these surveys to be valid and sufficient to inform the EcIA.

1.3 Results

Desk Study Results

Statutory and Non-statutory Designated Sites

1.3.1 Statutory and non-statutory designated sites within 2 km of the Kent Onshore Scheme Order Limits were provided by the local records centers (Kent & Medway Biological Records Centre (KMBRC), 2024), and from desk-based data searches.

1.3.2 A total of one international statutory and one non-statutory designated sites, which contain aquatic ecology features as part of the reason for their designation, were identified (Table 1.5).

Table 1.5 International statutory and non-statutory designated aquatic sites within 2 km of the Kent Onshore Scheme Order Limits

Designation	Name	Reasons for Designation	Central National Grid Reference	Distance from Kent Onshore Scheme Order Limits
Statutory	Sandwich Bay to Hackling	Saltmarsh, brackish ditches, patches of standing water and the creeks, emperor	TR 348 616	Within Scheme Order Limits

Designation	Name	Reasons for Designation	Central National Grid Reference	Distance from Kent Onshore Scheme Order Limits
	Marches SSSI[5]	dragonflies, River Stour		
Non-Statutory	Sandwich and Pegwell Bay NNR	Flagstaff reach leads into River Stour	TR 341 632	Within Scheme Order Limits

[1]National Nature Reserve [2] Special Protection Areas [3]Important Wetland Site under Ramsar Convention [4]Special Areas of Conservation [5]Site of Special Scientific Interest

Water Framework Directive (WFD) Status

1.3.3 There are two waterbodies with the Kent Onshore Scheme Order Limits that are part of the WFD assessment (see **Application Document 6.9 Water Framework Directive Assessment**); Monkton and Minster Marshes located within the Stour Marshes catchment and the Kent Stour located within the Kent East Coast catchment.

1.4 Monkton and Minster Marshes

1.4.1 The Monkton and Minster Marshes (WFD water body ID: GB107040019621) has a catchment area of 18.092 km^2 and is designated as ‘Heavily Modified’ with a ‘Moderate’ ecological status. Fish are not part of the ecological status assessment, but invertebrates and macrophytes both have a most recent status as ‘Moderate’. Quality elements that are preventing the catchment from achieving ‘Good’ ecological status are the physio-chemical quality elements; with dissolved oxygen classed as ‘Bad’, phosphate as ‘Moderate’ and temperature and pH as ‘High’. The waterbody also failed for levels of Mercury and its compounds and Polybrominated diphenyl ethers (PBDE).

1.4.2 The Reasons for Not Achieving Good status (RNAG) include diffuse and point source pollution from sewage discharge and land runoff from poor nutrient management which is affecting the dissolved oxygen and phosphate content. There are also physical modifications to the waterbody in relation to land drainage which is also affecting the concentration of dissolved oxygen.

1.4.3 The EA have an objective of reaching overall ‘Good ecological status by 2027. But this is given low confidence due to being disproportionately expensive. This is also only to be assessed by invertebrates as Macrophytes and Phytobenthos are no longer assessed.

1.5 Kent Stour

1.5.1 The Kent Stour (WFD water body ID: GB520704004700) has a surface area of 5.113 km^2 and is designated as ‘Heavily Modified’ with a ‘Moderate’ ecological status. Macroalgae and phytoplankton make up the only biological quality elements that contribute to the ecological status of the waterbody as it is a transitional water. Quality elements that are preventing the catchment from achieving ‘Good’ ecological status are the high levels of macroalgae, as well as high levels of pollutants namely; Arsenic, Copper, Dimethoate, Iron and Zinc. The waterbody also failed for levels of Mercury and its compounds and Polybrominated diphenyl ethers (PBDE).

1.5.2 The Reasons for Not Achieving Good status (RNAG) include diffuse and point source pollution from sewage discharge and land runoff from poor nutrient management.

1.5.3 The EA do not have an objective of increasing the ecological status due to it being disproportionately expensive in relation to burdens and an unfavorable balance of costs and benefits. For the biological quality element Phytoplankton there is an objective of reaching ‘Good’ status by 2027 but this is of low confidence due to being disproportionately expensive.

Notable Species

1.5.4 Eight EA monitoring locations that have been surveyed within the last five years were identified within 5 km of the Kent Onshore Scheme Order Limits (Table 1.6). Six of these are monitored for macroinvertebrate and macrophyte receptors and two are monitored for fish receptors. One of the fish sites, Plucks Gutter, was surveyed six years ago. This has been included as it is the nearest EA monitoring location for fish to the Kent Onshore Scheme Order Limits.

Table 1.6 EA monitoring locations within 5 km of the Kent Onshore Scheme Order Limits surveyed within the last 5 years

Catchment	Site Name	Site ID	National Grid Reference	Approximate proximity to Order Limits (km)	Last year surveyed	Group monitored
Monkton and Minster Marshes	Minster Stream	157545	TR 30924 63606	0.08	2024 (macrophytes) 2022 (invertebrates)	Macrophytes Macroinvertebrates
Stour Marshes	Goshall Dyke	78617	TR 31049 59728	1.2	2024 (macrophytes) 2022 (invertebrates)	Macrophytes Macroinvertebrates
	Eastern Monkton Stream	159812	TR 28269 64570	2.7	2024 (macrophytes) 2023 (invertebrates)	Macrophytes Macroinvertebrates
	Western Monkton Stream	207871	TR 27603 63702	3.2	2022	Macrophyte Macroinvertebrates
	Ash Level Dyke	78578	TR 27190 63190	3.4	2024 (macrophytes) 2022 (invertebrates)	Macrophyte Macroinvertebrates
Great Stour	Richborough Stream	163324	TR 29723 61447	1.5	2024 (macrophytes) 2022 (invertebrates)	Macrophytes Macroinvertebrates
	Plucks Gutter	23964	TR 26937 63395	3.7	2018*	Fish
	Sandwich	2579	TR 34825 57655	2.9	2024	Fish

*This site is included in scope as it is the closest EA monitoring point to the Scheme Order Limits on the River Stour

1.6 Fish

1.6.1 Two records of the protected European eel (*Anguilla anguilla*) were identified in the desk study at EA site Plucks Gutter in 2015. Five records of European eel were also identified at the EA site Sandwich in 2024. All the eels located at both sites were identified to be elvers (pigmented juvenile eels) (Environment Agency, 2024) (Table 1.7).

Table 1.7 Notable fish species locations within 5 km of the Kent Onshore Scheme Order Limits

Species	Date Found	Location	Approximate proximity to the Order Limits (km)	Legislation & Designations
European Eel (*Anguilla Anguilla)*	11/06/2015	TR 26937 63395	3.7	Bonn Convention Appendix II NERC Section 41 Kent Biodiversity Strategy 2020-2045 Priority Species Eels (England and Wales) Regulations 2009 SAFFA 1975 IUCN Red List 2001 – Critically Endangered
	26/06/2024	TR 34825 57655	2.9	

1.6.2 No fish invasive non-native species (INNS) were found in the desk study.

1.7 Macrophytes

1.7.1 Three records of the notable macrophyte European frog-bit (*Hydrocharis morsus-ranae*) designated as Vulnerable under The International Union for Conservation of Nature (IUCN) Red List of Threatened Species was identified in the desk study within the 2 km of the Kent Onshore Scheme Order Limits in the last five years (Environment Agency, 2024) (Table 1.8).

Table 1.8 Notable macrophyte species locations within the Kent Onshore Scheme Order Limits

Species	Date Found	Location	Approximate proximity to the Order Limits (km)	Legislation & Designations
European frog-bit (*Hydrocharis morsus-ranae*)	08/06/2021	TR 31049 59728	1.2	IUCN Red List 2001 - Vulnerable
	20/06/2024	TR 31049 59728	1.2	
	20/06/2024	TR 29723 61447	1.5	

1.7.2 Six species of macrophyte INNS or non-native species were identified in the desk study within a 2 km radius of the Kent Onshore Scheme Order Limits; water fern (*Azolla filiculoides*), floating pennywort (*Hydrocotyle ranunculoides*), nuttall's waterweed (*Elodea nuttallii*), parrot feather (*Myriophyllum aquaticum*), least duckweed (*Lemna minuta*) and turion duckweed (*Lemna turionifolia*) (Table 1.9).

Table 1.9 Invasive and non-native macrophyte species found within 2 km of the Kent Onshore Scheme Order Limits

Species	Date Found	Location	Approximate proximity to the Order Limits (km)	Legislation & Designations
Water Fern (*Azolla filiculoides*)	28/07/2015	TR 30924 63606	0.08	Non-native WCA Sch9
Nuttall's Waterweed (*Elodea nuttallii*)	28/07/2015 19/07/2016 08/06/2021 09/06/2021 13/06/2023 20/06/2024	TR 30924 63606 TR 29723 61447 TR 31049 59728	0.08 1.5 1.0	INNS IAS 2019
Parrot Feather (*Myriophyllum aquaticum)*	28/07/2015	TR 30924 63606	0.08	INNS IAS 2019 WCA Sch9
Least Duckweed (*Lemna minuta*)	08/06/2021 13/06/2023 20/06/2024 26/06/2024 28/06/2024	TR 31049 59728 TR 29723 61447 TR 30924	1.0 1.5 0.08 2.8	Non-native

Species	Date Found	Location	Approximate proximity to the Order Limits (km)	Legislation & Designations
		63606 TR 28269 64570		
Turion Duckweed (*Lemna turionifolia*)	13/06/2023	TR 29723 61447 TR 30924 63606 TR 31049 59728	1.5 0.08 1.0	Non-native
Floating pennywort (*Hydrocotyle ranunculoides*)	08/06/2021	TR 29723 61447	1.5	INNS IAS 2019 WCA Sch9

1.8 Macroinvertebrates

1.8.1 Ten records of the notable macroinvertebrate shining rams-horn (*Segmentina nitida*) designated under the Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006 and the Kent Biodiversity Strategy 2020-2045 Priority Species List were found within the Kent Onshore Scheme Order Limits south of the River Stour between 2005 and 2022 by the EA (NBN Atlas Partnership, 2024) (Environment Agency, 2024) (Table 1.10).

Table 1.10 Notable macroinvertebrate species locations within 5 km of the Kent Onshore Scheme Order Limits

Species	Date Found	Location	Approximate proximity to the Order Limits (km)	Legislation & Designation
The Shining Ram's-horn (*Segmentina nitida*)	05/08/2022 24/04/2021	TR 29723 61447	1.5	Kent Biodiversity Strategy 2020-2045 Priority Species
	29/06/2021	TR 27190 63190	3.4	
	13/09/2005*	TR 29143 62779	1.6	BAP-2007
	13/09/2005*	TR 30497 62633	0.1	
	13/09/2005*	TR 29412 62785	1.4	NERC 2006 Section 41
	14/09/2005*	TR 31304 62264	0.2	
	13/09/2005*	TR 30969 62576	0.08	

Species	Date Found	Location	Approximate proximity to the Order Limits (km)	Legislation & Designation
	13/09/2005*	TR 29590 62856	1.0	
	14/09/2005*	TR 3142 6227	0.1	
The caddisfly *Oecetis furva*	30/05/2022	TR 31049 59728	1.0	Nationally Scarce
Lesser water boatman *Sigara striata*	16/11/2021	TR 31049 59728	1.0	Nationally Scarce
Minute moss beetle *Ochthebius nanus*	06/04/2023	TR 28269 64570	2.8	Nationally Scarce
Water scavenger beetle *Limnoxenus niger*	05/08/2022	TR 29723 61447	1.5	Near Threatened IUCN
Diving beetle *Ilybius subaeneus*	30/05/2022	TR 29723 61447	1.5	Nationally Scarce

*These records have been included due to their close proximity to the Kent Onshore Scheme Order Limits.

1.8.4 Four non-native species were also found; Capsian mud shrimp (*Chelicorophium curvispinum*), amphipod (*Crangonyx pseudogracilis/floridanus*), North American flatworm (*Girardia tigrine*) and New Zealand mud snail (*Potamopyrgus antipodarum*) (Table 1.11).

1.8.5 No records of American signal crayfish (*Pacifastacus leniusculus*) or white-clawed crayfish (*Austropotamobius pallipes*) were found within 10 km of the Order Limits within the last 10 years.

Table 1.11 Non-native macroinvertebrate species found within 10 km of the Kent Onshore Order Limits

Species	Date Found	Location	Approximate proximity to the Order Limits (km)	Legislation & Designation
Caspian mud shrimp (*Chelicorophium curvispinum*)	18/03/2015 10/05/2023	TR 23400 63150	7.2	Non-native

Species	Date Found	Location	Approximate proximity to the Order Limits (km)	Legislation & Designation
Amphipod (*Crangonyx pseudogracilis/floridanus*)	18/03/2015 15/03/2016 13/10/2016 21/04/2021 28/04/2021 29/06/2021 12/08/2021 09/11/2021 16/11/2021 30/05/2022 05/08/2022 02/11/2022 06/04/2023 10/05/2023	TR 30924 63606	0.08	Non native
		TR 31049 59728	1.1	
		TR 28269 64570	2.7	
		TR 27603 63702	3.2	
		TR 27190 63190	3.4	
		TR 29723 61447	1.5	
		TR 23400 63150	7.2	
North American flatworm (*Girardia tigrina*)	18/03/2015	TR 23400 63150	7.2	Non-native
New Zealand mud snail (*Potamopyrgus antipodarum*)	18/03/2015 10/05/2023	TR 23400 63150	7.2	Non-native
Freshwater limpet *Ferrissia californica*	16/11/2021 02/11/2022	TR 31049 59728	1.1	Non-native

Aquatic Macrophyte Survey Results

1.8.6 The full aquatic macrophyte taxa list can be found in **Annex 2.N.10**. Cross-reference with the JNCC Taxon Designations list and the Kent Biodiversity Strategy 2020 to 2045 (Kent Nature Partnership, 2020) revealed that none of the macrophyte taxa identified during the surveys were protected and/or notable. A single INNS; Canadian waterweed *Elodea canadensis,* was recorded.

River Stour

1.8.7 The channel was over 20 m wide throughout the survey reach. The entirety of both banks was unshaded. The channel substrate primarily comprised 70% silt/clay, with the addition of 30% pebbles/gravel.

1.8.8 The macrophyte community consisted of 30% channel cover from nine in-channel aquatic plants: fennel pondweed (*Stuckenia pectinate*), unbranched bur-reed (*Sparganium emersum*), reed sweet grass (*Glyceria maxima*), reed canary grass (*Phalaris arundinacea*), spiked woodrush (*Juncus spicata*), Canadian waterweed (*E. canadensis*), rush (*Juncus* sp.), hairlike pondweed (*Potamogeton trichoides*) and water fern (*Azolla filiculoides*). Blanketweed (*Cladophora* agg.) accounted for an additional 5% cover of the river channel.

Minster Stream

1.8.9 The channel was between 1 – 5 m wide throughout the survey reach, with a depth varying from 0.5 m to greater than 1 m across the wetted width. Both banks were unshaded, and the substrate primarily comprised 80% silt/clay with the addition of 20% pebbles/gravel.

1.8.10 The macrophyte community consisted of 40% channel cover from twelve in-channel aquatic plants: fennel pondweed, great water cress, hornwort (*Ceratophyllum demersum*), great duckweed (*Spirodela polyrhiza*), common duckweed (*Lemna minor*), ivy-leaved duckweed (*Lemna trisulca*), reed canary grass, sea lettuce (*Ulva intestinalis*), spiked water milfoil (*Myriophyllum spicatum*), Canadian waterweed, brookweed (*Samolus valerandi*) and branched bur-reed (*Sparganium erectum*). Gutweed (*Ulva flexuosa*) accounted for an additional 5% cover of the river channel.

Macrophyte Indices and WFD Classification

1.8.11 Based on the criteria outlined in the Methods, RMNI, NTAXA, NFG and ALG, observed and predicted scored for each survey reach on the River Stour and Minster Stream are detailed in Table 1.12. The table also includes the overall EQR and WFD macrophyte status for each survey reach.

Table 1.12 Macrophyte WFD metrics for River Stour and Minster Stream

Metric		River Stour	Minster Stream
River macrophyte nutrient index (RMNI)	Observed	8.82	8.35
	Predicted	7.69	8.44
Number of macrophyte taxa (NTAXA)	Observed	6.00	8.00
	Predicted	9.92	9.83
Number of functional groups (NFG)	Observed	6.00	5.00
	Predicted	6.24	6.20
Cover of filamentous green algae (ALG)	-	3.80	3.80
Overall Ecological Quality Ratio (EQR)	-	0.39	0.86
WFD macrophyte classification	**-**	**Poor**	**High**

1.8.12 The EQR of 0.86 for Minster Stream equates to High WFD status, indicating the site is minimally or un-impacted by eutrophication and/or modification to morphological conditions. In comparison, the River Stour attained an EQR of 0.39, equating to poor WFD status and indicating the site is subject to substantial impact by eutrophication and/or modification to morphological conditions.

1.8.13 As the alkalinity of both survey sites was >200 mgL-1 (varying between 243 and 318 mgL-1), LEAFPACS analysis alone can be used, as the macrophyte-based status is consistently lower than the diatom-based status in waters of these alkalinities (WFD-UKTAG, 2014).

Aquatic Macroinvertebrate Survey Results

Autumn 2023

1.8.14 The full aquatic macroinvertebrate taxa list for autumn 2023 can be found in **Annex 2.N.6**. A description of the macroinvertebrate community at each site is provided below. Location of the sites can be seen in **Application Document 6.4.3.2.N.2 Aquatic Ecology Kent Study Areas**.

1.9 DS1 (Unnamed ditch –Stour Marshes)

1.9.1 Freshwater hoglouse *Asellus aquaticus* comprised the majority of the individuals recorded at DS1, accounting for 45% of the community. True fly larvae, including phantom midges (*Chaoborus* sp.), accounted for a further 19%. Several beetle species were also recorded, including *Hydroporus palustris*, *Agabus bipustulatus*, *Helophorus brevipalpis*, *Anacaena limbata* and *Ochthebius minimus*. Also recorded was the hairy dragonfly (*Brachytron pratense*).

1.10 New DS2 (Unnamed ditch - Monkton & Minster Marshes)

1.10.1 The autumn community at New DS2 was dominated by non-native but non-invasive freshwater shrimp *C.pseudogracilis/floridanus*, which comprised 68% of the community. The second most abundant species was the freshwater hoglouse (*A. aquaticus*), which totaled 12% of the assemblage. Several beetle species of the family *Dytiscidae* were also recorded in small numbers, including *Liopterus haemorrhoidalis*, and the Nationally Scarce beetle *Hydaticus seminiger* (Foster, 2010).

1.11 DS5 (Unnamed ditch – Stour Marshes)

1.11.1 The most abundant species found at DS5 was the non-native but non-invasive freshwater shrimp *C. pseudogracilis/floridanus*, which comprised 22% of the assemblage. The freshwater hoglouse (*A. aquticus*) accounted for a further 17%. Also of relative abundance was the flatworm *Polycelis nigra/tenuis* (16%) and mosquito *Coquillettidia richiardii* (11%). A relatively diverse snail assemblage was also recorded, including the wandering snail (*Ampullaceana balthica*), the trapdoor snail species (*Bithynia tentaculate*) and (*B. leachii*), the non-native but non-invasive bladder snail *Physella*, and the ramshorn snail species *Planorbarius corneus*, *P. planorbis*, *Anisus vortex* and *Bathyomphalus contortus*.

1.12 DS6 (Unnamed ditch – Stour Marshes)

1.12.1 The autumn community at DS6 was primarily composed of the mosquito (*C. richiardii*), which comprised 34% of the assemblage. The amphipod *C. floridanus/pseudogracilis* (25%) and freshwater hoglouse (*Proasellus* sp.) (22%) represented the next most

abundant species. A relatively diverse assemblage of five beetle species was also present, including *Anacaena bipustulata*, *Ochthebius minimus* and *Hydraena testacea*.

1.13 DS7 (Unnamed ditch – Stour Marshes)

1.13.1 The autumn community at DS7 was dominated by snails and crustaceans, with the only exceptions being a single flatworm *Dendrocoelum lacteum* and two specimens of the caddisfly family Limnephilidae. Most abundant was the freshwater hoglouse (*A. aquaticus*), accounting for 36% of the community. The non-native but non-invasive *C. pseudogracilis*/*floridanus* accounted for a further 18%.

1.14 DS8 (Unnamed ditch – Stour Marshes)

1.14.1 The freshwater hoglouse (*A. aquaticus*) comprised most of the individuals recorded at DS8, accounting for 36% of the community. The flatworm *Schmidtea lugubris*/*polychroa* represented a further 17%. Several snail species were again recorded, including the non-native but non-invasive bladder snail *Physella* sp., the trapdoor snail*, P. planorbis* and *B. contortus*.

1.15 DS9 (Unnamed ditch – Stour Marshes)

1.15.1 The autumn community at DS9 was dominated by the freshwater hoglouse (*A. aquaticus*), which comprised 67% of the community. The non-native but non-invasive amphipod *C. pseudogracilis*/*floridanus* accounted for a further 16%.

1.16 DS10 (Unnamed ditch - Monkton & Minster Marshes)

1.16.1 A relatively diverse community was recorded at DS10, represented by 23 different taxa. Prevalent among these were true flies, particularly the subfamily of non-biting midges Orthocladiinae which represented 21% of the community. Species indicative of ditch habitats were again present, including the freshwater hoglouse (*A. aquaticus*), the non-native but non-invasive amphipod *C. pseudogracilis*/*floridanus*, the flatworm *Polycelis nigra*/*tenuis*, as well as several snail species.

1.17 DS12 (Unnamed ditch - Monkton & Minster Marshes)

1.17.1 The most abundant species found at DS12 was the freshwater hoglouse (*A. aquaticus*), which comprised 39% of the community. Also abundant was the flatworm *P. nigra*/*tenuis* which accounted for an additional 13%. In addition, twelve specimens of the non-native but non-invasive amphipod *C. pseudogracilis*/*floridanus* were recorded. All three species are indicative of ditch-like habitats. A single individual of the Nationally Scarce lesser water boatman (*Corixa affinis*) (Cook, 2015) was also recorded. Finally, a relatively diverse assemblage of nine snail species was recorded, including the non-native but non-invasive bladder snail (*Physella* sp.) and the great ramshorn (*Planorbarius corneus*).

1.18 DS13 (Unnamed ditch - Monkton & Minster Marshes)

1.18.1 The water hoglouse (*A. aqucticus*) accounted for 30% of the autumn community at DS13. Eight of the 26 taxa recorded comprised of true flies, with non-biting midge Chironomidae larvae accounting for a further 20%. The assemblage of true bugs was also relatively diverse, including *Plea minutissima*, *C. affinis*, *Hesperocorixa sahlbergi* and *Notonecta glauca*. the non-native but non-invasive bladder snail *Physella* sp. was also present at the site.

1.19 DS14 (Unnamed ditch - Monkton & Minster Marshes)

1.19.1 The autumn community at DS14 was primarily comprised of ramshorn snails (*P. planorbis*), which accounted for 44% of the community. The non-native but non-invasive amphipod *C. pseudogracilis*/*floridanus* comprised a further 18%.

1.20 DS15 (Unnamed ditch - Monkton & Minster Marshes)

1.20.1 The community at DS15 primarily comprised of non-native but non-invasive amphipod *C. pseudogracilis*/*floridanus* (19%) and the non-biting midge sub-family Chironomini (17%). In addition, a relatively diverse snail assemblage was recorded with six species identified, including the native bladder snail species (*Physa fontinalis*).

1.21 DS16 (Unnamed ditch - Monkton & Minster Marshes)

1.21.1 A relatively diverse community was recorded at DS16 which primarily comprised marsh beetle Scirtidae (35%) and the non-native but non-invasive *C. pseudogracilis*/*floridanus* (14%). The formerly Nationally Notable List B Hydrophilidae beetle (*Enochrus melanocephalus*) was also recorded.

1.22 WBS1 (River Stour)

1.22.1 A relatively small community was recorded at WSB1, primarily comprised of the freshwater shrimp aggregate *Gammarus pulex*/*fossarum* which accounted for almost half (49%) of the community.

1.23 WBS2 (Richborough Stream)

1.23.1 Almost half (45%) of the autumn community at WBS2 comprised the non-native but non-invasive freshwater shrimp *C. pseudogracilis*/*floridanus*. The freshwater hoglouse (*A. aquaticus*) accounted for an additional 19% of the community. A diverse snail assemblage of ten species was found, including the flat ramshorn snail (*Hippeutis complanatus*).

1.24 WBS4 (Unnamed watercourse – Monkton & Minster Marshes)

1.24.1 The autumn community at WBS4 was dominated by the non-native but non-invasive New Zealand mud snail (*Potamopyrgus antipodarum*), which comprised 88% of the community. A diverse community of snails comprising the wandering snail (*A. balthica*), the valve snail (*V. piscinalis*), the trapdoor snail, the native bladder snail (*P. fontinalis*),

and the ramshorn snails *P. planorbis* and *Gyraulus crista* was also present. In addition, a single specimen of the water boatman *Sigara stagnalis* was recorded.

Spring 2024 Survey Results

1.24.2 The full aquatic macroinvertebrate taxa list for spring 2024 can be found in **Annex 2.N.6**. A description of the macroinvertebrate community at each site is provided below.

1.25 DS3 (Unnamed ditch – Stour Marshes)

1.25.1 The spring community at DS3 was dominated by non-biting midge larvae Chironomini, which accounted for over half (54%) of the community. The next most abundant species was the water hoglouse (*A. aquaticus*) which represented 9% of the community. In addition, a relatively diverse snail assemblage comprising eleven species was present.

1.26 DS5 (Unnamed ditch – Stour Marshes)

1.26.1 The trapdoor snail comprised 16% of the spring community, with the freshwater hoglouse (*A. aquaticus*) (14%) and the non-native but non-invasive amphipod *C. pseudogracilis*/*floridanus* (13%) also relatively abundant. In addition to five species of ramshorn snails, a relatively diverse flatworm community was also recorded, including *Dendrocoelum lacteum*, *Polycelis* sp., and *Schmidtea lugubris*/*polychroa*).

1.27 DS6 (Unnamed ditch – Stour Marshes)

1.27.1 A third (34%) of the spring community at DS6 comprised the non-native but non-invasive amphipod *C. pseudogracilis*/*floridanus*. Freshwater hoglouse Asellidae was also abundant (20%) with an additional 19% identified as (*A. aquaticus*). Although not abundant, six beetle species were present, including *Noterus clavicornis*.

1.28 DS7 (Unnamed ditch – Stour Marshes)

1.28.1 DS7 was dominated by freshwater hoglouse (*A. aquaticus*), which accounted for 58% of the community. The non-native but non-invasive amphipod *C. pseudogracilis*/*floridanus* comprised an additional 17%.

1.29 DS9 (Unnamed ditch – Stour Marshes)

1.29.1 Over half (52%) of the community at DS9 comprised freshwater hoglouse Asellidae, with an additional 26% identified as *A. aquaticus*. The non-native but non-invasive amphipod *C. pseudogracilis*/*floridanus* accounted for an additional 9%.

1.30 DS12 (Unnamed watercourse – Monkton & Minster Marshes)

1.30.1 The community at DS12 was dominated by non-biting midge larvae, with Chironomidae tribes comprising 65%. Diverse beetle and snail assemblages were found, each with six species identified.

1.31 DS13 (Unnamed watercourse – Monkton & Minster Marshes)

1.31.1 A diverse snail assemblage of six species was found, with *A. balthica* comprising 19% of the community at DS13. Several beetle species were also identified, including the cherrystone beetle (*Hyphydrus ovatus*).

1.32 WBS1 (River Stour)

1.32.1 A relatively small community was found at WBS1 which primarily comprised freshwater shrimp *Gammarus* sp. (55%). The non-native but non-invasive New Zealand mud snail was also identified.

1.33 WBS2 (Richborough Stream)

1.33.1 The community at WBS2 was primarily comprised of freshwater hoglouse (*A. asellus*), which accounted for 39% of the sample. The non-native but non-invasive amphipod *C. pseudogracilis*/*floridanus* accounted for a further 26%. Relatively diverse flatworm and snail assemblages were found, including the flatworm *Polycelis nigra*/*tenuis*.

Aquatic macroinvertebrate indices and indicative WFD classification

1.33.2 Based on the criteria outlines in the Methodology, the CCI, WHPT, ASPT and NTAXA, LIFE and PSI values for each survey site are summarised in Table 1.13 (autumn 2023) and Table 1.14 (spring 2024).

Table 1.13 Macroinvertebrate index scores for autumn 2023 surveys

Index	DS1	New DS2	DS5	DS6	DS7	DS8	DS9	DS10	DS12	DS13	DS14	DS15	DS16	WBS1	WBS2	WBS4
WHPT-NTAXA	15	11	16	11	9	11	6	16	20	15	9	17	30	7	16	20
WHPT-ASPT	3.94	3.79	3.56	4.74	3.70	3.80	3.27	4.04	3.58	3.38	3.98	3.47	3.85	3.30	3.45	3.68
CCI score	7.2	17.0	9.3	12.9	1.5	10.0	13.3	4.2	9.3	12.0	6.0	8.8	18.6	18.3	9.7	9.2
CCI score - interpretation	Moderate conservation value	High conservation value	Moderate conservation value	Fairly High conservation value	Low conservation value	Fairly High conservation value	Fairly High Conservation value	Low Conservation value	Moderate Conservation value	Fairly High Conservation value	Moderate Conservation value	Moderate Conservation value	High Conservation value	High Conservation value	Moderate Conservation value	Moderate Conservation value
LIFE score (species)	5.77*	5.50*	5.60	5.33*	5.78*	5.56*	5.00*	5.83*	5.62	5.73	5.50*	5.57	5.58	7.20*	5.82	6.10
LIFE score - interpretation	Low sensitivity to reduced flows	Low sensitivity to reduced flows	Low sensitivity to reduced flows	Low sensitivity to reduced flows	Low sensitivity to reduced flows	Low sensitivity to reduced flows	Low sensitivity to reduced flows	Low sensitivity to reduced flows	Low sensitivity to reduced flows	Low sensitivity to reduced flows	Low sensitivity to reduced flows	Low sensitivity to reduced flows	Low sensitivity to reduced flows	Moderate sensitivity to reduced flows	Low sensitivity to reduced flows	Low sensitivity to reduced flows

Index	DS1	New DS2	DS5	DS6	DS7	DS8	DS9	DS10	DS12	DS13	DS14	DS15	DS16	WBS1	WBS2	WBS4
PSI score (species)	15.00*	17.65*	0.00	25.00*	5.88*	8.70*	0.00*	3.85	0.00	0.00	12.50*	2.86	0.00	62.50*	0.00	0.00
PSI score (MTL)	Heavily Sedimented	Heavily Sedimented	Heavily Sedimented	Sedimented	Heavily Sedimented	Heavily Sedimented	Heavily Sedimented	Heavily Sedimented	Heavily Sedimented	Heavily Sedimented	Heavily Sedimented	Heavily Sedimented	Heavily Sedimented	Slightly Sedimented	Heavily Sedimented	Heavily Sedimented

*Lack of scoring species may result in inaccurate scores, consequently family level scores have been presented

Table 1.14 Macroinvertebrate index scores for spring 2024 surveys

Index	DS3	DS5	DS6	DS7	DS9	DS12	DS13	WBS1	WBS2
WHPT-NTAXA	15	17	14	16	15	20	14	6	21
WHPT-ASPT	3.33	3.62	3.51	3.82	3.48	3.59	4.02	3.68	3.43
CCI score	9.2	10.4	1.3	10.8	5.1	8.6	1.2	1.0	10.7
CCI score - interpretation	Moderate Conservation value	Fairly High Conservation value	Low Conservation value	Fairly High Conservation value	Moderate Conservation value	Moderate Conservation value	Low Conservation value	Low Conservation value	Fairly High Conservation value
LIFE score (species)	5.36	5.58	5.36*	5.54	5.77*	5.73	5.30	6.60*	5.73
LIFE score - interpretation	Low sensitivity to reduced flows	Low sensitivity to reduced flows	Low sensitivity to reduced flows	Low sensitivity to reduced flows	Low sensitivity to reduced flows	Low sensitivity to reduced flows	Low sensitivity to reduced flows	Moderate sensitivity to reduced flows	Low sensitivity to reduced flows
PSI score (species)	2.27	0.00	0.00	0.00	3.85*	0.00	3.13	40.00*	0.00
PSI score (MTL)	Heavily Sedimented	Heavily Sedimented	Heavily Sedimented	Heavily Sedimented	Heavily Sedimented	Heavily Sedimented	Heavily Sedimented	Slightly Sedimented	Heavily Sedimented

*Lack of scoring species may result in inaccurate scores, consequently family level scores have been presented

1.33.3 For autumn, the CCI scores ranged between 1.5 and 18.6 demonstrating the resident macroinvertebrate communities ranged from Low conservation value (DS7 and DS10) to High conservation value (New DS2, DS16 and WBS1). The CCI scores for the spring sites ranged between 1.0 and 10.8 demonstrating the resident macroinvertebrate communities ranged from Low conservation value (DS6, DS13 and WBS1) to Fairly high conservation value (DS5, DS7 and WBS2).

1.33.4 Notable species recorded comprise the water boatman *Corixa affinis,* and the beetles *Hydaticus seminiger*, *Limnoxenus niger* and *Enochrus melanocephalus.* All notable species were recorded during the autumn 2023 surveys, with *C. affinis* recorded at DS12 and DS13, *H. seminiger* at New DS2, and *L. niger* and *E. melanocephalus* both recorded at DS16.

1.33.5 *L. niger* is designated as IUCN Near Threatened (Foster, 2010), whilst *H. seminiger* is designated as Nationally Scarce (Foster, 2010) but is not sufficiently rare to qualify for an IUCN Red List status. The beetle *E. melanocephalus* was formerly recognised as Nationally Notable List B but is currently considered too widespread to qualify as Nationally Scarce and not sufficiently rare to qualify for an IUCN Red List status (Foster, 2010). The water boatman *C. affinis* is also considered as Nationally Scarce and also insufficiently rare to qualify for an IUCN Red List status (Cook, 2015).

1.33.6 In addition to the notable species recorded, several non-native taxa were also present during the surveys. The non-native and non-invasive New Zealand mud snail was recorded at WBS4 in autumn 2023 and WBS1 in spring 2024. The non-native and non-invasive bladder snail *Physella* sp. was recorded at DS5, DS8, DS12 and DS13 in autumn 2023, whilst the non-native and non-invasive freshwater amphipod *Crangonyx pseudogracilis/floridanus* was recorded at all sites surveyed in autumn 2023 except WBS1.

1.33.7 The LIFE score for all sites across both seasons represented low sensitivity to reduced flows except WBS1 which represented moderate sensitivity to reduced flows in autumn and spring. The PSI scores for the autumn surveys ranged from 0.00 to 25.00 indicating all sites were heavily sedimented, except DS6 which was sedimented (PSI score 25.00) and WBS1 had a PSI score of 62.50 reflecting slightly sedimented. All sites in the spring surveys PSI scores reflecting heavily sedimented conditions, except WBS1 which attained a PSI score of 40.00 reflective of slightly sedimented conditions.

1.33.8 In autumn, the WHPT-NTAXA number was low (10 or less) at sites DS7, DS9, DS14 and WBS1, with the highest WHPT-NTAXA score of 30 achieved by DS16. WHPT-ASPT scores ranged from 3.27 for DS9 to 4.74 for DS6 reflecting the modified nature of the habitats surveyed. In spring, the WHPT-NTAXA number was below 10 at site WBS1, with the highest WHPT-NTAXA score of 21 achieved by WBS2. WHPT-ASPT scores ranged from 3.33 for DS3 to 4.02 for DS13, indicative of the modified nature of the surveyed water bodies.

1.33.9 Table 1.15 displays the EQR and WFD macroinvertebrate status for the WHPT ASPT and NTAXA indices for each riverine survey site, as well as the most probable WDF status based on the combination of the modelled distributions for each ASPT and NTAXA across all classes, termed MINTA (Minimum of NTAXA and ASPT EQRs).

1.33.10 Analysis using RICT is only suitable for freshwater (not estuarine or marine) sites on rivers or streams that are naturally permanently flowing. As such, RICT analysis was not undertaken for those sites identified as ditches due to their nature (i.e., not naturally permanently flowing condition) as the application is only applicable to sites located on naturally and permanently flowing watercourses. Note that WBS4 was considered as a

drainage channel rather than a true watercourse. As such, it was treated as a ditch and was not included in the RICT analysis.

Table 1.15 Macroinvertebrate indicative WFD classification for riverine survey sites

Index	Season	WBS1	WBS2
WHPT-NTAXA Ecological Quality Ratio	Autumn	0.33 (Bad)	0.67 (Moderate)
	Spring	0.28 (Bad)	0.83 (High)
WHPT-ASPT Ecological Quality Ratio (EQR)	Autumn	0.90 (Moderate)	0.91 (Good)
	Spring	0.96 (High)	0.85 (Moderate)
MINTA most probable WFD invertebrate classification	Spring and autumn combined	Bad	Moderate

1.33.11 WBS1 attained a Bad WFD classification for invertebrates, with the WHPT-ASPT EQR reflecting Moderate condition in autumn and High condition in spring, whilst WHPT-NTAXA EQRs reflected Bad condition in both autumn and spring. These results suggest poor habitat quality is dictating the quality of the resident macroinvertebrate community at WBS1.

1.33.12 WBS2 attained a Moderate WFD classification for invertebrates. The WHPT-ASPT EQR reflected Good condition in autumn and Moderate condition in spring, whilst WHPT-NTAXA EQR reflected Moderate condition in autumn and High condition in spring.

Fish Survey Results

1.33.13 Raw species presence, abundance and fork length (nearest mm) data for fish species caught are provided in **Annex 2.N.7** and photos in **Annex 2.N.8**.

Minster Stream

1.33.14 At the Minster Stream survey reach, the average river width was 5 m and the average water depth was 60 cm. There was minimal shading, low tidal flow with slight turbidity. The substrate was dominated by clay (80%), sand (10%), silt (5%) and gravel (5%). The habitat within the reach was dominated by a uniform slack as the survey was undertaken at low tide (Specific Conductivity = 883 µS/cm) and an oil film was observed on the water by the survey team. The bank structure was considered complex (> 3 vegetation types present) on both banks and the surrounding land use was tilled arable. During the survey the weather was sunny, with a light breeze (Plate 1.1).

Plate 1.1 Minster Stream survey location

1.33.15 Five fish species were recorded on the Minster Stream (Table 1.16). Roach (*Rutilus rutilus*) were the most abundant species recorded during the survey (n = 29), alongside three-spined stickleback (*Gasterosteus aculeatus*) (n = 9), dace (*Leuciscus leuciscus*) (n = 7), nine-spined stickleback (*Pungitius pungitius*) (n = 2) and European eel (n = 1).

Table 1.16 Summary of fish recorded on Minster stream

Species	Number caught	Length range (mm)	Mean length (mm)
Dace (*Leuciscus leuciscus*)	7	20 - 32	26
European eel (*Anguilla Anguilla*)	1	330	330
Roach (*Rutilus rutilus*)	29	20 - 36	27
Nine-spined stickleback (*Pungitius pungitius*)	2	34 -38	36
Three-spined stickleback (*Gasterosteus aculeatus*)	9	23 - 39	34

1.33.16 Length frequency histograms were created for roach (Plate 1.2), three-spined stickleback (Plate 1.3) and dace (Plate 1.4) to provide a summary of age classes present. Due to the low numbers caught, this was not possible for European eel or nine-spined stickleback.

1.33.17 All three species (roach, dace and three-spined stickleback) show a single age class, either 0+ or 1+, however, low numbers of dace and three-spined stickleback limit statistical robustness. The presence of 0+ or 1+ age classes suggests that the Minster Stream has suitable juvenile fish habitat.

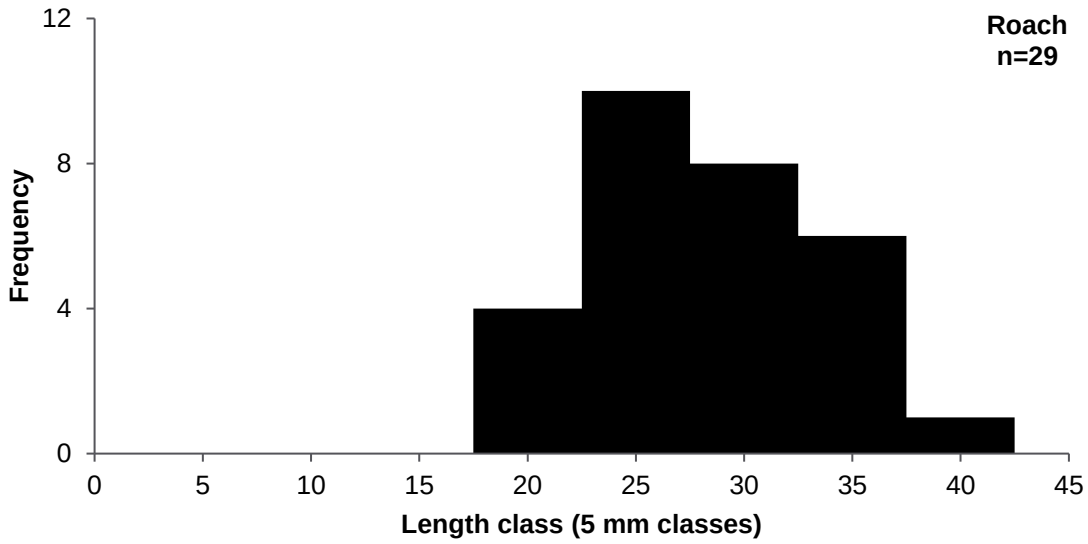

Plate 1.2 Length frequencies of roach in Minster Stream

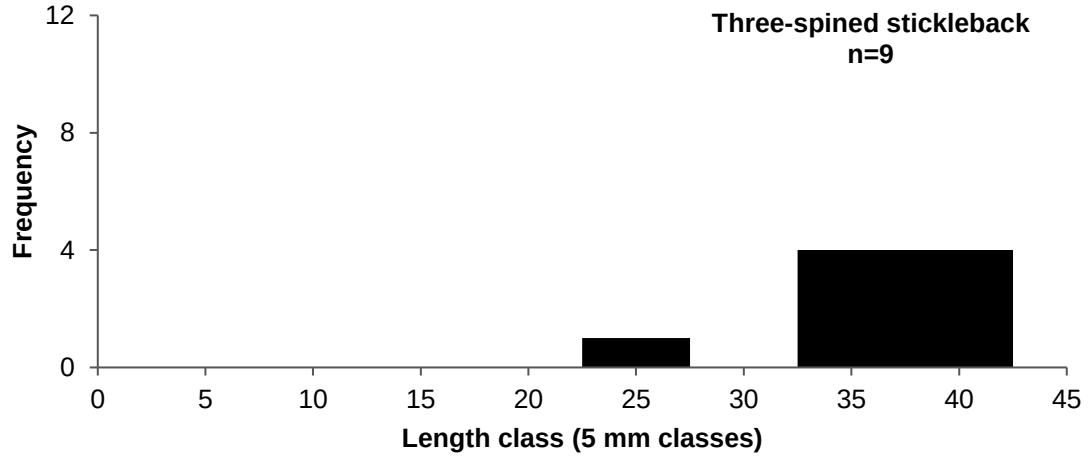

Plate 1.3 Length frequencies of three-spined stickleback in Minster Stream

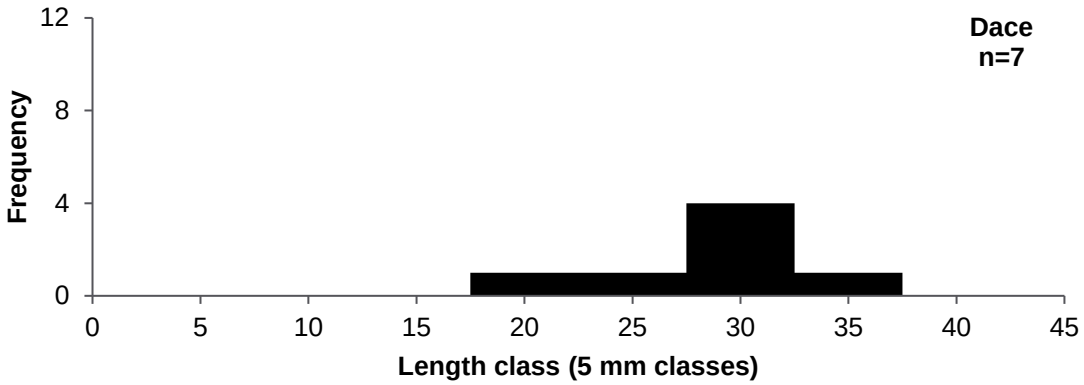

Plate 1.4 Length frequencies of dace in Minster Stream

River Stour

1.33.18 At the River Stour survey reach (Plate 1.5), it was slack tide with minimal shading and moderate turbidity. The weather was overcast and breezy. The flow habitat within the survey area was dominated by slack or run (Specific Conductivity = 786 µS/cm) and the bank structure was simple (1-3 vegetation types present) on the right bank and complex (> 3 vegetation types present) on the left bank. The land usage was arable.

Plate 1.5 River Stour Survey Location

1.33.19 Seven fish species were recorded on the River Stour (Table 1.17). Bream (*Abramis brama*) was the most abundant species identified (n = 17). The second most abundant

species was roach (n = 14), followed by chub (*Squalius cephalus*) (n = 6), dace (n = 4), perch (*Perca fluviatilis*) (n = 1) and bleak (*Alburnus alburnus*) (n=1).

Table 1.17 Summary of fish recorded on the River Stour

Species	Number caught	Length range (mm)	Mean length (mm)
Bleak (*Alburnus alburnus*)	1	73	73
Bream (*Abramis brama*)	17	61 - 212	94
Chub (*Squalius cephalus*)	6	68 – 88	77
Dace (*Leuciscus leuciscus*)	4	48 – 66	58
Perch (*Perca fluviatilis*)	1	121	121
Roach (*Rutilus rutilus*)	14	30 – 128	70

1.33.20 Length frequency histograms were created for bream (Plate 1.6), roach (Plate 1.7) and chub (Plate 1.8) to provide a summary of age classes present. Length frequency distribution analysis could not be carried out for bleak, dace and perch as less than 5 individuals were caught.

1.33.21 All three species (bream, roach and chub) show a single age class, either 0+ or 1+, however low numbers of chub limit statistical robustness. The presence of 0+ or 1+ age classes suggests that the River Stour has suitable juvenile fish habitat.

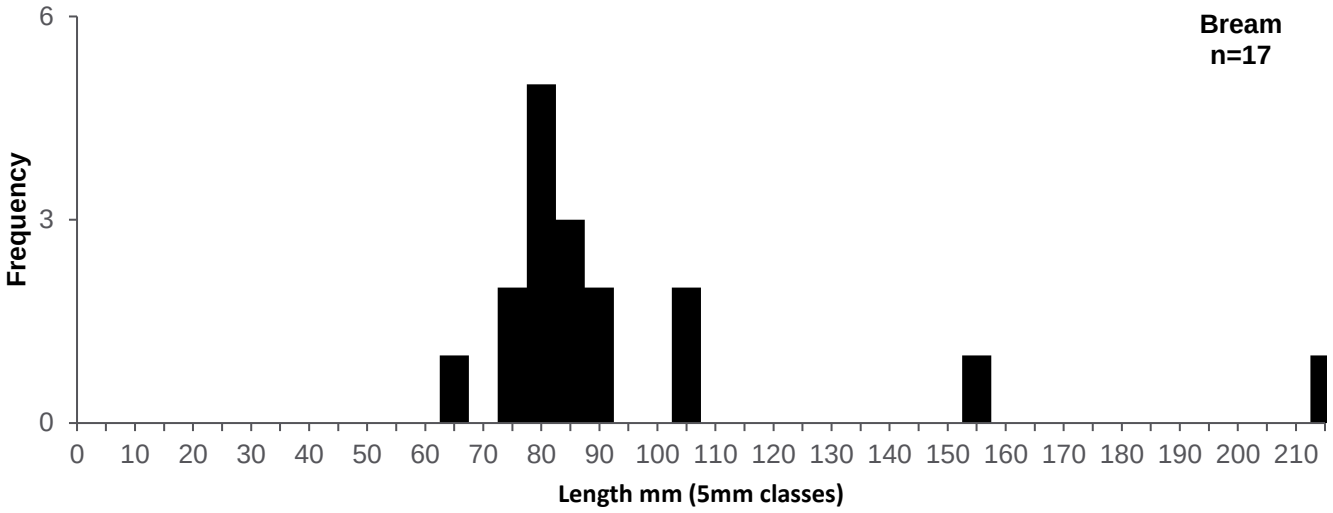

Plate 1.6 Length frequencies of bream in the River Stour

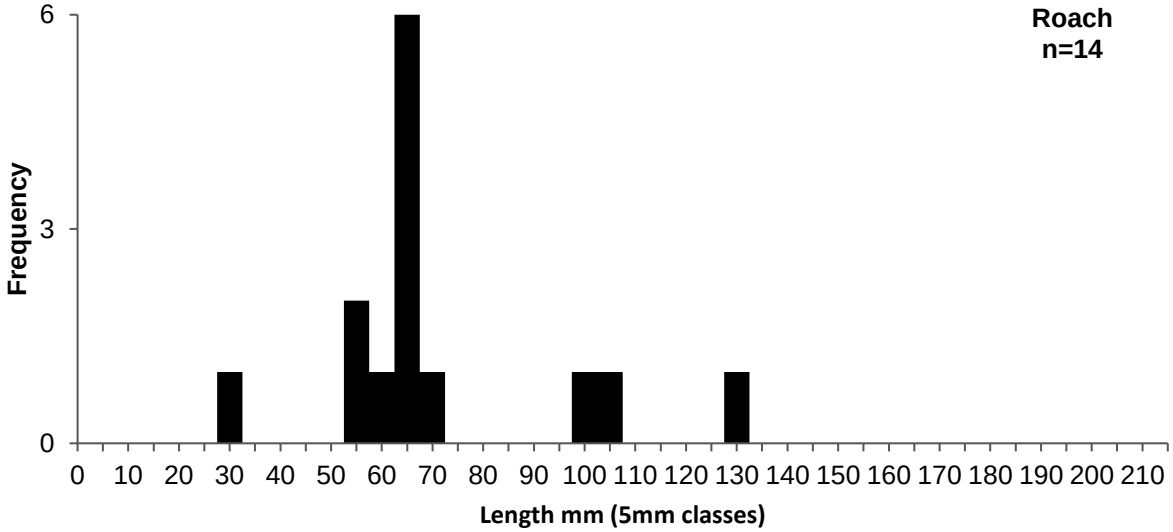

Plate 1.7 Length frequencies of roach in the River Stour

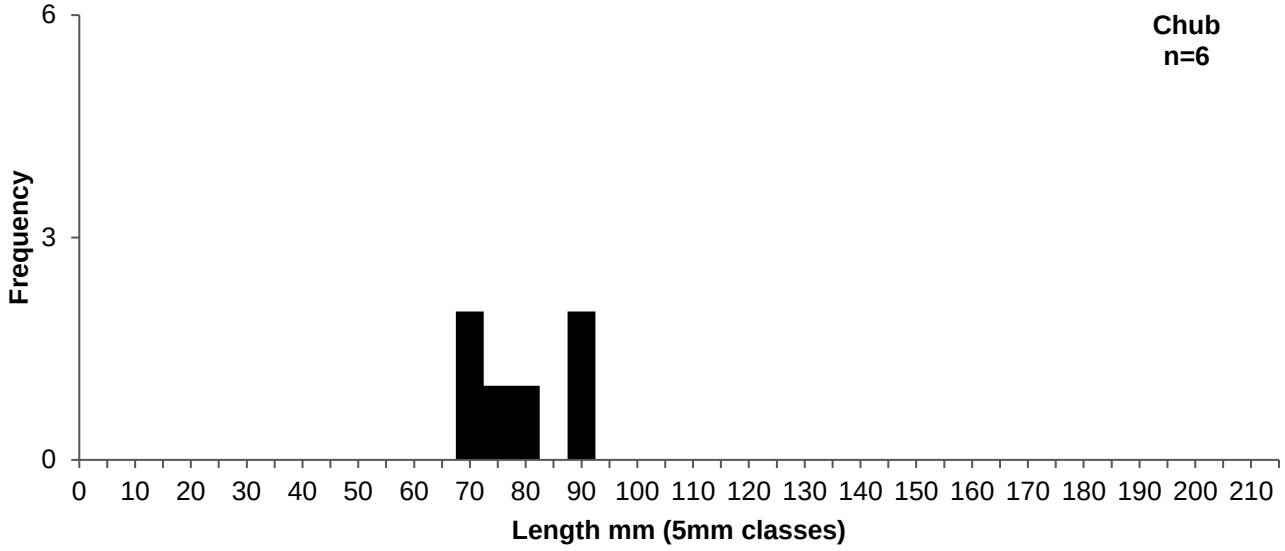

Plate 1.8 Length frequencies of chub in the River Stour

1.34 Discussion

Summary

1.34.1 Three statutory and one non-statutory designations were identified within the Kent Onshore Scheme Order Limits with associated aquatic ecology features that form part of their designation, which could be impacted by the proposed crossing points and/or outfalls.

1.34.2 The overall status of the WFD waterbody Monkton and Minster Marshes, located within the Kent Onshore Scheme /Order Limits; is of Moderate ecological status according to the WFD Directive, with the Reasons for Not Achieving Good status suggesting that there are already water quality pressures in the area from both diffuse and point sources. Therefore, proposed outfalls on this waterbody could decrease its ecological status.

Aquatic Macrophytes

1.34.3 One notable macrophyte species, frogbit (*Hydrocharis morsus-ranae*) was identified in the desk study. Frogbit has an IUCN Red List status of Vulnerable. Four non-native species were identified: water fern (*Azolla filiculoides*), Nuttall's waterweed (*Elodea* nuttalli)i, least duckweed (*Lemna minuta*), and a single record of parrot's feather (*Myriophyllum aquaticum*). Least duckweed is not listed in any current UK legislation, whereas water fern and parrot's feather are both listed in Schedule 9 of the Wildlife and Countryside Act 1981 (as amended). Nuttall's waterweed and parrot's feather are also listed in the Invasive Alien Species (Enforcement and Permitting) Order 2019. Whilst there are no statutory obligations due to least duckweed, the legislation referenced in relation to water fern, Nuttall's waterweed, and parrot's feather makes it an offence to plant, or otherwise cause to grow (including allowing to spread), listed plant species in

the wild. If transported off site, there is a duty of care with regards to the disposal of any part of the plant that may facilitate establishment in the wild and cause environmental harm (as per the Environmental Protection Act, 1990). The legislation also makes it an offense to release, or allow to escape, listed species (or species not ordinarily resident in and not a regular visitor to Great Britain in a wild state) into the wild.

1.34.4 The results of the macrophyte surveys completed in 2024 indicated that Minster Stream is minimally or un- impacted by eutrophication and/or modification to morphological conditions at the surveyed reach, demonstrated by the High WFD macrophyte status attained.

1.34.5 In contrast, the Poor WFD macrophyte status attained for the reach of the River Stour surveyed in 2024, based on five scoring macrophyte taxa, indicates the site is subject to substantial impact by eutrophication and/or modification to morphological conditions.

1.34.6 No protected or notable species were recorded at either survey reach, nor were any of the species recorded present in the Kent Biodiversity Strategy. All species were common and widespread, and highly likely to be present in the wider landscape.

1.34.7 The INNS water fern was recorded at the River Stour, and Canadian waterweed (*Elodea canadensis*) was recorded at both the River Stour and Minster Stream. These species are both listed in Schedule 9 of the Wildlife and Countryside Act 1981 (as amended).

Aquatic Macroinvertebrates

1.34.8 Seven records of the notable macroinvertebrate shining rams-horn snail (*Segmentina nitida*) were identified in the desk study. The shining rams-horn snail is a Section 41 Species of Principle Importance (SPI) for the purpose of conserving of biodiversity under the Natural Environment and Rural Communities Act 2006, a Priority Species in the Kent Biodiversity Strategy 2020-2045, and is designated as Nationally Scarce but with an IUCN status of Least Concern (Seddon, Killeen, & Fowles, 2014).

1.34.9 The surveys undertaken in autumn 2023 and spring 2024 found that all ditch survey sites were resident to a typical macroinvertebrate community indicative of sedimented/heavily sedimented conditions and with low sensitivity to flow reductions. All ditch locations attained WHPT-ASPT scores reflecting generally good water quality, however DS7, DS9 and DS14 all attained low WHPT-NTAXA scores (below 10) suggesting habitat pressures at these sites.

1.34.10 The surveys completed on the riverine sites demonstrated that all survey locations possessed a macroinvertebrate community generally adapted towards heavily sedimented habitats and with a low sensitivity to flow reductions. At WBS1 a macroinvertebrate community adapted towards slightly sedimented habitats and with moderate sensitivity to reduced flows was recorded. Analysis by RICT indicated that WBS1 had generally good water quality but a lack of habitat diversity/quality is the driving factor restricting the quality of the macroinvertebrate community to an overall WFD classification for invertebrates of Bad. In contrast, RICT analysis demonstrated that seasonal variations in both water quality and habitat diversity/quality influence the macroinvertebrate community at WBS2 to result in an overall WFD classification for invertebrates of Moderate.

1.34.11 All sites attained CCI scores indicative of a resident macroinvertebrate community with Moderate conservation value or greater except for DS7 and DS10 in autumn 2023 and DS6, DS13 and WBS1 in spring 2024, which all attained CCI scores indicative of Low

conservation value. Notable macroinvertebrate species recorded comprise the water boatman *Corixa affinis* (recorded at DS12 and DS13), the beetle species *Hydaticus seminiger* (recorded at New DS2) and *Limnoxenus niger* (recorded at DS16).

1.34.12 The water boatman *C. affinis* is considered as Nationally Scarce but is insufficiently rare to qualify for an IUCN Red List status (Cook, 2015). *H. seminiger* is designated as Nationally Scarce (Foster, 2010) but is not sufficiently rare to qualify for an IUCN Red List status. *L. niger* is designated as IUCN Red List Near-Threatened (Foster, 2010). The beetle *Enochrus melanocephalus* (recorded at DS16) was formerly recognised as Nationally Notable List B but is currently considered too widespread to qualify as Nationally Scarce (Foster, 2010).

1.34.13 No macroinvertebrate INNS were recorded, however several non-native and non-invasive species were found. The autumn 2023 surveys found the New Zealand mud snail (*Potamopyrgus antipodarum*) at WBS4, the bladder snail *Physella* sp. at DS5, DS8, DS12 and DS13, and the freshwater amphipod *C. pseudogracilis*/*floridanus* at all sites except WBS1. The spring 2024 surveys found the New Zealand mud snail at WBS1. Whilst there are no statutory constraints arising due to the presence of these non-native and non-invasive macroinvertebrate species, best practice biosecurity measures should be implemented for any in-channel works undertaken to prevent any further spread of these species.

Fish

1.34.14 Two records of the protected species European eel were identified in the desk study as well as being found on Minster Stream. The European eel is listed as Critically Endangered on the International Union for Conservation of Nature Red List of Threatened Species. It is also a Section 41 Species of Principle Importance for the purpose of conserving of biodiversity under the Natural Environment and Rural Communities Act 2006 and on the Bonn Convention Appendix. The species is protected under the Eels (England and Wales) Regulations 2009, as well as the Salmon and Freshwater Fisheries Act 1975 (as amended under the Environment Act 1995) and is a Priority Species in the Kent Biodiversity Strategy 2020-2045.

1.34.15 Furthermore, none of the other species caught at both Minster Stream or River Stour are protected by legislation. The fish assemblage recorded on the River Stour were similar to that previously caught at EA site Plucks Gutter (Site ID: 23964) 4 km upstream of the survey location in 2018. The EA catch was dominated by roach, with the addition of chub, dace and pike suggesting that fish assemblage has not changed much within the last six years.

1.35 Conclusions

Aquatic Macrophytes

1.35.1 The surveys demonstrated the aquatic macrophyte community of Minster Stream was of high biological quality and that of the River Stour was of moderate quality.

1.35.2 No protected or notable species were recorded from either the River Stour or Minster Stream, nor were any of the species recorded present in the Kent Biodiversity Strategy 2020 to 2045. All species were common and widespread, and highly likely to be present in the wider landscape. However, the IUCN Red List Vulnerable macrophyte species

European frog-bit was identified in the desk study as present within 2 km of the Kent Onshore Scheme Order Limits.

1.35.3 The macrophyte INNS water fern *Azolla filiculoides* was recorded within the River Stour, and Canadian waterweed was recorded within the River Stour and Minster Stream survey reaches. The desk study also returned records of the INNS Nuttall's waterweed and the non-native and non-invasive least duckweed, and a single record of the INNS parrot's feather within 2 km of the Kent Onshore Scheme Order Limits.

Aquatic Macroinvertebrates

1.35.4 The surveys found that all survey sites contained a macroinvertebrate community adapted to tolerate sedimented/heavily sedimented habitats and low flow-velocity conditions. The survey results indicated generally good water quality at all locations, but that habitat quality was likely restricting the quality of the residing macroinvertebrate community.

1.35.5 Three notable macroinvertebrate species were recorded: the nationally Scarce water boatman *Corixa affinis* the Nationally Scarce beetle *Hydaticus seminiger* and the IUCN Near Threatened beetle *Limnoxenus niger*. None of these taxa are considered sufficiently rare to qualify for an IUCN Red List status, and all are likely to occur in the local landscape where suitable habitat is present. Additionally, the Nationally Scarce but IUCN Least Concern shining rams-horn snail *Segmentina nitida* was identified in the desk study as present within 2 km of the Order Limits.

1.35.6 No macroinvertebrate INNS were recorded. However, several non-native and non-invasive species were found; namely the New Zealand mud snail, the bladder snail *Physella* sp., and the freshwater amphipod *C*. *pseudogracilis*/*floridanus*.

Fish

1.35.7 The fish assemblage recorded on the River Stour was similar to what has previously been reported at an EA monitoring location on the river. No notable fish species were caught on either Minster Stream or River Stour.

1.35.8 The proposed outfalls containing construction water on Minster Marshes may not be regularly flushed out of the ditches increasing the water quality pressures in the area which may affect the WFD status of the Monkton and Minster Marshes waterbody and subsequently the fish and invertebrate communities found there.

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Annex 2.N.1 Macrophyte taxa list

Table A.1 WFD boundary values for macrophytes in rivers

Ecological Quality Ratio (EQR)	WFD Ecological Status for Macrophytes
≥ 0.80	High
≥ 0.60	Good
≥ 0.40	Moderate
≥ 0.20	Poor
< 0.20	Bad

Table A.2 Macrophyte taxa list and associated cover values for River Stour and Minster Stream

Scientific name	Common name	River Stour	Minster Stream
Azolla filiculoides	Water fern	C1	
Ceratophyllum demersum	Hornwort		C4
Cladophora sp.	Blanketweed		
Elodea canadensis	Canadian waterweed	C2	C4
Glyceria maxima	Reed sweet grass	C6	C2
Juncus sp.	Rush	C2	
Juncus spicata	Spiked woodrush	C3	
Lemna minor	Common duckweed		C4
Lemna trisulca	Ivy-leaved duckweed		C3
Myriophyllum spciatum	Spiked water milfoil		C5
Phalaris arundinacea	Reed canary grass	C5	C7
Potamogeton trichoides	Hairlike pondweed	C3	
Samolus valerandi	Brookweed		C2
Sparganium emersum	unbranched bur-reed	C4	

Scientific name	Common name	River Stour	Minster Stream
Sparganium erectum	Branched bur-reed		C1
Stuckenia pectinata	Fennel pondweed	C5	C4
Spirodela polyrhiza	Great duckweed		C3
Ulva flexuosa	Gutweed		C4

Annex 2.N.2 Community Conservation Index (CCI)

1.35.9 The Community Conservation Index (Chadd & Extence, 2004) allows a classification of the nature conservation value associated with a macroinvertebrate community. The CCI score for one sample is derived from individual Conservation Scores (CS), assigned to some species of aquatic macroinvertebrates and relating closely to the available published Red Data Books and subsequently updated Red Lists. Conservation Scores assigned to individual species vary from 1 to 10, as detailed on the Table B.1 below. The derived CCI scores generally vary from 0 to > 20, as detailed in the Table B.2 below. The Table B.2 below provides a guide to interpreting CCI scores.

Table A.3 Conservation Scores from the Community Conservation Index (from Chadd & Extence, 2004)

Conservation Score	Relation to Red Data Books
10	RDB1 (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 samples from similar habitats)
3	Frequent (species not in categories 10-5, which occur in up to >10-25% of all samples from similar habitats)
2	Common (species not in categories 10-5, which occur in up to >25-50% of all samples from similar habitats)
1	Very common (species not in categories 10-5, which occur in up to >50-100 % of all samples from similar habitats)

Table A.4 General guide to CCI scores (from Chadd & Extence, 2004)

CCI Score	Description	Interpretation
0 to 5.0	Reaches supporting only common species and/or community of low taxon richness	Low conservation value

CCI Score	Description	Interpretation
> 5.0 to 10.0	Reaches supporting at least one species of restricted distribution and/or a community of moderate taxon richness	Moderate conservation value
> 10.0 to 15.0	Reaches supporting at least one uncommon species, or several species of restricted distribution and/or a community of high taxon richness	Fairly high conservation value
> 15.0 to 20.0	Reaches supporting several uncommon species, at least one of which may be nationally rare and/or a community of high taxon richness	High conservation value
> 20.0	Reaches supporting several rarities, including species of national importance and/or a community of very high taxon richness	Very high conservation value

Annex 2.N.3 Lotic-Invertebrate Index of Flow Evaluation (LIFE)

The Lotic-Invertebrate Index for Flow Evaluation (LIFE) provides an assessment of the impact of variable flows on benthic macroinvertebrate communities (Extence, Balbi, & Chadd, 1999). Under the assessment, individual species of aquatic macroinvertebrates are assigned to a flow group varying from I to VI, as detailed on the Table C.1 below. The LIFE score for a macroinvertebrate sample is then derived (mean of individual scores) from individual taxon scores and abundances, as detailed in the Table C.2. LIFE scores for a macroinvertebrate sample ranges from 1 to 12, where highest scores describe communities adapted to rapid flows.

Table A.5 Flow groups used to derive LIFE scores (from Extence, Balbi & Chadd, 1999)

LIFE score Group	Description	Mean current velocity
I	Taxa primarily associated with rapid flows	Typically > 100 $cm.s^{-1}$
II	Taxa primarily associated with moderate to fast flows	Typically 20 to 100 $cm.s^{-1}$
III	Taxa primarily associated with slow or sluggish flows	Typically < 20 $cm.s^{-1}$
IV	Taxa primarily associated with (usually slow) and standing waters	
V	Taxa primarily associated with standing waters	
VI	Taxa frequently associated with drying or drought impacted sites	

Table C.2 LIFE scoring matrix combining flow groups and abundance categories (from Extence, Balbi & Chadd, 1999)

Flow groups	Abundance categories			
	A (1 to 9)	B (10 to 99)	C (100 to 999)	D/E (> 1000)
I	9	10	11	12
II	8	9	10	11
III	7	7	7	7
IV	6	5	4	3
V	5	4	3	2
VI	4	3	2	1

Annex 2.N.4 Proportion of Sediment-sensitive Invertebrates (PSI)

The Proportion of Sediment-sensitive Invertebrates (PSI) index allows an assessment of the extent to which a water body is composed of, or covered by, fine sediments (Extence, et al., 2013). Under this system, individual species of aquatic macroinvertebrates are assigned a Fine Sediment Sensitivity Rating (FSSR) as detailed in Table D.1, and abundance rating based on LIFE scores as detailed in Table D.2. The PSI score for the aquatic macroinvertebrate sample is then derived from the individual species scores and abundances, as detailed in Table D.3. The PSI score corresponds to the percentage of fine sediment-sensitive taxa present in a sample and ranges from 0 to 100, with low scores corresponding to waterbodies with high fine sediment cover.

Table D.1 Fine Sediment Sensitivity Rating (FSSR) groups used to derive PSI scores

FSSR group	Description
A	Highly sensitive
B	Moderately insensitive
C	Moderately insensitive
D	Highly insensitive

Table D.2 Abundance categories and scoring matrix used to derive PSI scores

FSSR group	Abundance categories			
	A (1 to 9)	B (10 to 99)	C (100 to 999)	D/E (> 1000)
A	2	3	4	5
B	2	3	4	5
C	1	2	3	4
D	1	2	3	4

Table D.3 Interpretation of PSI scores

PSI	Description
81-100	Minimally sedimented
61-80	Slightly sedimented
41-60	Moderately sedimented
21-40	Sedimented
0-20	Heavily sedimented

Annex 2.N.5 Whalley, Hawkes, Paisley & Trigg (WHPT) Metric

1.35.10 There are approximately 4,000 species of aquatic macroinvertebrates in the British Isles. To simplify the analysis of the samples and the data we do not identify individual species but only the major types (taxa), mostly at the family taxonomic level. A key piece of information is the number of different taxa at a site. A fall in the number of taxa indicates ecological damage, including pollution (organic, toxic and physical pollution such as siltation, and damage to habitats or the river channel).

1.35.11 The WHPT scoring system (WFD-UKTAG, 2023) is based upon the sensitivity of macroinvertebrate families to organic pollution. It replaces the Biological Monitoring Working Party (BMWP) system (Hawkes, 1997) previously used in the UK.

1.35.12 The WHPT system assigns a numerical value to about 100 different taxa (known as the WHPT-scoring taxa) according to their sensitivity to organic pollution. In addition to the presence of macroinvertebrate taxa at a sampling Reach, as in the BMWP scoring system, the WHPT system also uses another type of information, this being the abundances of different scoring taxa.

1.35.13 Taxa abundances are classified in four categories (Class 1: 1 to 10 individuals, Class 2: 11 to 100 individuals, Class 3: 101 to 1,000 individuals, and Class 4: > 1,000 individuals). A score (Pressure Sensitivity Scores (PSs) is then assigned to each taxa, depending of the taxa sensitivity and abundances recorded.

1.35.14 The total WHPT score for a sample corresponds to the sum of PSs of scoring taxa recorded. The Average Score Per Taxon (ASPT) values are calculated as the Sum PSs divided by the number of scoring taxa (NTAXA). As such, three metrics are calculated:

- WHPT score;
- NTAXA; and
- ASPT.

1.35.15 Some animals are more susceptible to organic pollution than others, and the presence of sensitive species indicates good water quality. This fact is taken into account by the WHPT metrics.

1.35.16 The most useful way of summarising the biological data was found to be one that combined the number of taxa and the ASPT. The best quality is indicated by a diverse variety of taxa, especially those that are sensitive to pollution. Poorer quality is indicated by a smaller than expected number of taxa, particularly those that are sensitive to pollution. Organic pollution sometimes encourages an increased abundance of the few taxa that can tolerate it. However, maximum achievable values will vary between geological regions. For example, pristine lowland streams in East Anglia will always score lower than pristine Welsh mountain streams because they are unable to support many of the high-scoring taxa associated with fast flowing habitat. WHPT scores and ASPT for different types watercourse are dependent on the quality and diversity of habitat, natural water chemistry (associated with geology, distance from source etc.), altitude, gradient, time of year the sample was taken and other factors.

Annex 2.N.6 Macroinvertebrate Taxa Lists

A.1 Macroinvertebrate taxa list for autumn 2023 surveys

Family	Taxon	DS10	DS12	DS13	DS14	New DS2	DS5	DS6	DS7	DS8	WBS1	WBS2	WBS4	DS1	DS9	DS15	DS16
Flatworms																5	
Dendrocoelidae	*Dendrocoelum lacteum*					2	1		1	3							
Planariidae	*Polycelis* sp.															5	
Planariidae	*Polycelis nigra / tenuis*	11	61				55					9	1				4
Dugesiidae	*Schmidtea lugubris/polychroa*		1				24			19		1					1
Snails																	
Lymnaeidae	Lymnaeidae (juvenile / damaged)												4			1	
Lymnaeidae	*Stagnicola* sp.											1				2	2
Lymnaeidae	*Lymnaea stagnalis*				1	1			1							1	
Lymnaeidae	*Ampullaceana balthica*	5	6				12			1		3	82			1	2
Valvatidae	*Valvata cristata*		3	4					7			9				4	3
Valvatidae	*Valvata piscinalis*												7				
Hydrobiidae	*Potamopyrgus antipodarum*												1388				

Family	Taxon	DS10	DS12	DS13	DS14	New DS2	DS5	DS6	DS7	DS8	WBS1	WBS2	WBS4	DS1	DS9	DS15	DS16
Bithyniidae	*Bithynia tentaculata*		3				2		9			1				10	1
Bithyniidae	*Bithynia leachii*						4			1		3	1		1	3	3
Physidae	*Physa fontinalis*											7	4			10	
Physidae	*Physella* sp.		3	1			2			3							
Planorbidae	*Planorbarius corneus*		1		1		1					1					2
Planorbidae	*Planorbis* sp.															13	
Planorbidae	*Planorbis planorbis*	3	10	3	36	5	13			4		14	5	2		11	5
Planorbidae	*Anisus vortex*		3				1					2					
Planorbidae	*Gyraulus crista*												1				
Planorbidae	*Bathyomphalus contortus*	12	23				10		9	15		3			4		7
Planorbidae	*Hippeutis complanatus*											1					13
Limpets and mussels																	
Sphaeriidae	*Sphaerium* sp.								1								
Sphaeriidae	*Sphaerium corneum*	2					1					4					
Sphaeriidae	*Pisidium/Euglesa/Odhneripisidium*								1				18				
Worms																	
Oligochaeta	Oligochaeta	19	32	9			8	1		1	18	5	3	2		7	3

Family	Taxon	DS10	DS12	DS13	DS14	New DS2	DS5	DS6	DS7	DS8	WBS1	WBS2	WBS4	DS1	DS9	DS15	DS16
Leeches																	
Glossiphoniidae	*Theromyzon tessulatum*	1															
Erpobdellidae	*Erpobdella testacea*						2									6	
Erpobdellidae	*Erpobdella octoculata*		3				2										
Piscicolidae	*Piscicola siddalli*										1						
Crustaceans																	
Ostracoda		7															
Cladocera														1			15
Gammaridae	*Gammarus* sp.															1	
Gammaridae	*Gammarus zaddachi*	5															
Gammaridae	*Gammarus pulex/fossarum agg.*										26		2				
Crangonyctidae	*Crangonyx floridanus/pseudogracilis*	13	12	34	15	104	76	58	12	18		114	4	16	107	35	117
Corophidae	*Corophium multisetosum*	1															
Asellidae	Asellidae				3								8		100		48
Asellidae	*Proasellus* sp.							50					10				
Asellidae	*Asellus aquaticus*	35	184	116	12	19	59		24	41		47	9	46	462	10	55
Mayflies																	

Family	Taxon	DS10	DS12	DS13	DS14	New DS2	DS5	DS6	DS7	DS8	WBS1	WBS2	WBS4	DS1	DS9	DS15	DS16
Baetidae	Baetidae		4								3		3	1			
Baetidae	*Cloeon* sp.			13													
Baetidae	*Cloeon dipterum*			1												1	19
Damselflies																	
Coenagrionidae	Coenagrionidae													1			19
Coenagrionidae	*Coenagrion* sp.																4
Dragonflies																	
Aeshnidae	*Brachytron pratense*													1			2
True bugs																	
Nepidae	*Nepa cinerea*							1									2
Naucoridae	*Ilyocoris cimicoides*																2
Pleidae	*Plea minutissima*			1							2	9					1
Corixidae	*Corixa punctata*			1													
Corixidae	*Corixa affinis*		1	1													
Corixidae	*Hesperocorixa linnaei*																1
Corixidae	*Hesperocorixa sahlbergi*			1													
Corixidae	*Sigara* sp.												2				

Family	Taxon	DS10	DS12	DS13	DS14	New DS2	DS5	DS6	DS7	DS8	WBS1	WBS2	WBS4	DS1	DS9	DS15	DS16
Corixidae	*Sigara lateralis*															1	
Corixidae	*Sigara stagnalis*												1				
Notonectidae	*Notonecta glauca*		8	5	1		1	1						1		6	5
Notonectidae	*Notonecta maculata*			1													
Beetles																	
Haliplidae	Haliplidae												4				
Haliplidae	*Haliplus lineaticollis*											1					1
Haliplidae	*Haliplus ruficollis group*											3					
Dytiscidae	Dytiscidae	1	5	12		2	1							1	11		1
Dytiscidae	*Liopterus haemorrhoidalis*				1	1											
Dytiscidae	*Hygrotus inaequalis*																1
Dytiscidae	*Hydroporus palustris*					3								1			
Dytiscidae	*Stictotarsus duodecimpustulatus*												1				
Dytiscidae	*Agabus bipustulatus*													1			
Dytiscidae	*Hydaticus seminiger*					2											
Noteridae	*Noterus clavicornis*		1														
Hydrophilidae	Hydrophilidae (larvae / damaged)																2

Family	Taxon	DS10	DS12	DS13	DS14	New DS2	DS5	DS6	DS7	DS8	WBS1	WBS2	WBS4	DS1	DS9	DS15	DS16
Hydrophilidae	*Helophorus brevipalpis*													1			
Hydrophilidae	*Hydrobius fuscipes*																1
Hydrophilidae	*Limnoxenus niger*																1
Hydrophilidae	*Anacaena bipustulata*							1									
Hydrophilidae	*Anacaena globulus*							1									
Hydrophilidae	*Anacaena limbata*							1						4			
Hydrophilidae	*Enochrus melanocephalus*																5
Hydraenidae	*Ochthebius minimus*							1						1			
Hydraenidae	*Hydraena* sp.	1															
Hydraenidae	*Hydraena testacea*							1									
Scirtidae	Scirtidae (larvae / damaged)							11									303
Caddisflies																	
Limnephilidae	Limnephilidae		40		6	3	1		2	6		6	7	1		8	54
Limnephilidae	*Limnephilus* sp.	22						7									
Limnephilidae	*Limnephilus marmoratus*	3														1	
Trueflies																	
Chironomidae	Chironomidae	42		77													
Chironomidae	Tanypodinae		15	9								3					7

Family	Taxon	DS10	DS12	DS13	DS14	New DS2	DS5	DS6	DS7	DS8	WBS1	WBS2	WBS4	DS1	DS9	DS15	DS16
Chironomidae	Orthocladiinae	55		13												2	23
Chironomidae	Chironomini	8	36	8		1					2	1		1		32	3
Chironomidae	Tanytarsini	2	4	6									3			3	
Limoniidae	Limoniidae		1	1		2							1				
Dixidae	*Dixella* sp.				4	2		3		1							11
Psychodidae		13	4	1									1				
Ceratopogonidae																	8
Syrphidae																	1
Stratiomyidae	Stratiomyidae				1							1			1		26
Culicidae	Culicidae					5								1			8
Culicidae	*Coquillettidia richiardii*						36	77									
Culicidae	*Culex*						2	13									
Chaoboridae	*Chaoborus* sp.			1	1						1			20		3	2
Chaoboridae	*Chaoborus crystallinus*															3	
Ephydridae		1															
Sciomyzidae																	1
Other Taxa																	
Lepidoptera																2	55

Family	Taxon	DS10	DS12	DS13	DS14	New DS2	DS5	DS6	DS7	DS8	WBS1	WBS2	WBS4	DS1	DS9	DS15	DS16
Lepidoptera	Crambidae	1	7	1			24					2					
Collembola			1	14				1				1					15
Daphniidae				57						1							

A.2 Macroinvertebrate taxa list for spring 2024 surveys

Family	Taxon		DS3	DS5	DS6	DS7	DS9	DS13	WBS2	WBS1	DS12
Flatworms											
Tricladida	Tricladida		2			10					
Dendrocoelidae	*Dendrocoelum lacteum*		1	4		3	8		3		
Planariidae	*Polycelis* sp.	1					2				
Planariidae	*Polycelis nigra / tenuis*								3		
Dugesiidae	Dugesiidae			3					10		
Dugesiidae	*Schmidtea lugubris/polychroa*			2	12	20	1		20		
Snails											
Lymnaeidae	Lymnaeidae		22	23	3		1	40	78		
Lymnaeidae	*Lymnaea stagnalis*		1					1			
Lymnaeiidae	*Ampullaceana balthica*						3				
Lymnaeiidae	*Stagnicola* sp.						2				
Tateidae	*Potamopyrgus antipodarum*						3				
Bithyniidae	*Bithynia* sp.								1		4
Bithyniidae	*Bithynia leachii*		65	53		4			10		
Physidae	Physidae			2					5		
Physidae	*Physa fontinalis*					1					3
Succineidae	*Succinea* sp.				1						1
Planorbidae	Planorbidae			4				20	4		
Planorbidae	*Planorbarius corneus*		1	2							
Planorbidae	*Anisus vortex*		15	3							

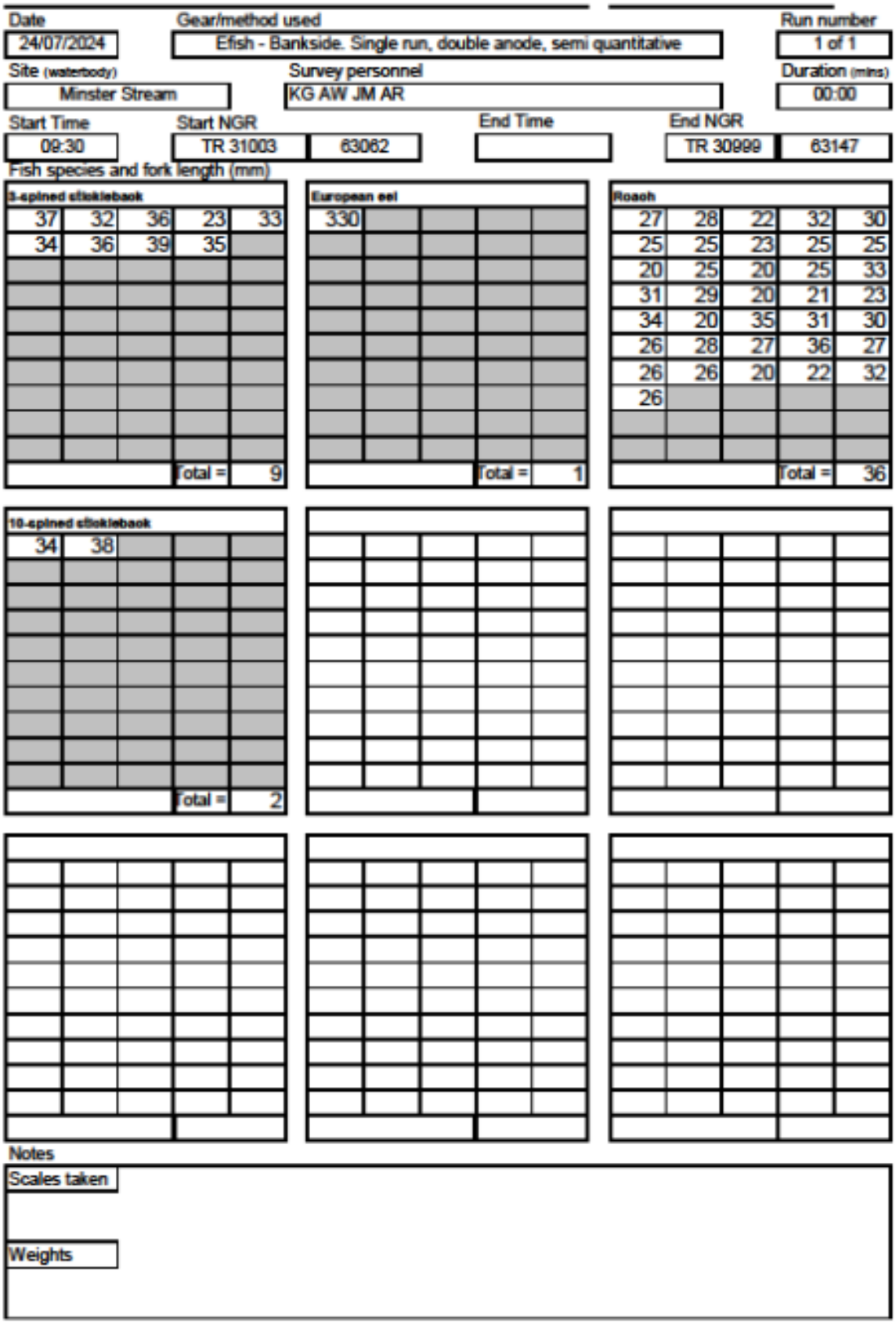
Family	Taxon	DS3	DS5	DS6	DS7	DS9	DS13	WBS2	WBS1	DS12
Planorbidae	*Bathyomphalus contortus*	16	34		20		2	2		
Planorbidae	*Hippeutis complanatus*	6	6							
Limpets and mussels										
Acroloxidae	*Acroloxus lacustris*				1					
Sphaeriidae	*Sphaerium* sp.	18	13	2						
Sphaeriidae	*Sphaerium rivicola*							17		
Sphaeriidae	*Sphaerium corneum*	5	5		2			1		
Sphaeriidae	Sphaerium lacustre 3				2					
Sphaeriidae	*Pisidium/Euglesa/Odhneripisidium*	1		2						
Leeches										
Glossiphoniidae	*Helobdella stagnalis*							1		
Erpobdellidae	Erpobdellidae		1		2					
Erpobdellidae	*Erpobdella octoculata*				2					
Mites										
Hydracarina	Hydracarina							1		
Crustaceans										
Ostracoda										2
Cladocera			8	8				1	2	
Gammaridae	*Gammarus* sp.	1							26	
Gammaridae	*Gammarus zaddachi*								4	
Asellidae	Asellidae		3	117		265		237		
Damselflies										

Family	Taxon	DS3	DS5	DS6	DS7	DS9	DS13	WBS2	WBS1	DS12
Lestidae	Lestidae									2
Dragonflies										
Libellulidae	*Sympetrum* sp.									2
True bugs										
Gerridae	Gerridae								1	
Nepidae	*Nepa cinerea*							1		
Pleidae	*Plea minutissima*					1				
Corixidae	Corixidae	3							1	9
Corixidae	*Hesperocorixa linnaei*									1
Notonectidae	Notonectidae		16	11	18	2		4	1	
Notonectidae	*Notonecta glauca*	1								
Beetles										
Haliplidae	*Haliplus lineaticollis*									1
Dytiscidae	Dytiscidae		1				3	1		2
Dytiscidae	*Hyphydrus ovatus*						2			2
Dytiscidae	*Hydroporus* sp.			1		1		2		
Dytiscidae	*Hydroporus palustris*									1
Dytiscidae	*Hydroporus planus*				1					
Dytiscidae	*Agabus bipustulatus*			1		1				1
Dytiscidae	*Agabus nebulosus*			1						
Dytiscidae	*Ilybius quadriguttatus*							1		1
Noteridae	*Noterus clavicornis*			1				1		1

Family	Taxon	DS3	DS5	DS6	DS7	DS9	DS13	WBS2	WBS1	DS12
Hydrophilidae	*Anacaena globulus*	8								
Hydrophilidae	*Anacaena limbata*	1								
Hydrophilidae	*Helophorus* sp.						2			
Hydrophilidae	*Helophorus aequalis*						2			
Hydrophilidae	*Helophorus brevipalpis*						6			
Hydraenidae	*Hydraena testacea*				1					
Scirtidae	Scirtidae	10	2					1		
Curculionidae	Curculionidae	1				1		3		
Caddisflies										
Limnephilidae	Limnephilidae			4	1	1				
Limnephilidae	*Limnephilus lunatus*									1
True-flies										
Chironomidae	Chironomidae							1		
Limoniidae	Limoniidae						1			
Dixidae	*Dixa* sp.						2			
Psychodidae										1
Stratiomyidae	Stratiomyidae	1					1	2		1
Chaoboridae							6			
Other Taxa										
Lepidoptera										1
Nematoda										1
Collembola			5						1	

Family	Taxon	DS3	DS5	DS6	DS7	DS9	DS13	WBS2	WBS1	DS12
Diptera	*Diptera (sp)*	1							3	1

Annex 2.N.7 Fish Survey Data



Date	Gear/method used	Run number
24/07/2024	Efish - Bankside. Single run, double anode, semi quantitative	1 of 1

Site (waterbody)	Survey personnel	Duration (mins)
Minster Stream	KG AW JM AR	00:00

Start Time	Start NGR		End Time	End NGR	
09:30	TR 31003	63062		TR 30999	63147

Fish species and fork length (mm)

3-spined stickleback					
37	32	36	23	33	
34	36	39	35		
			Total =	9	

European eel					
330					
			Total =	1	

Roach					
27	28	22	32	30	
25	25	23	25	25	
20	25	20	25	33	
31	29	20	21	23	
34	20	35	31	30	
26	28	27	36	27	
26	26	20	22	32	
26					
			Total =	36	

10-spined stickleback					
34	38				
			Total =	2	

Notes

Scales taken
Weights

Date	Gear/method used	Run number
24/07/2024	30m Standard Seine Net	1 of 4

Site (waterbody)	Survey personnel	Duration (mins)
River Stour	KG AW JM AR	00:00

Start Time	Start NGR		End Time	End NGR	
13:30	TR 31800	62678		TR 31883	62732

Fish species and fork length (mm)

Dace				
65	66	54	48	
			Total =	4

Bleak				
73				
			Total =	1

Chub				
86	76	88	68	74
68				
			Total =	6

Roach				
62	63	54	64	61
			Total =	5

Notes

Scales taken
Weights

Date	Gear/method used	Run number
24/07/2024	30m Standard Seine Net	2 of 4

Site (waterbody)	Survey personnel	Duration (mins)
River Stour	KG AW JM AR	00:00

Start Time	Start NGR		End Time	End NGR	
13:30	TR 31930	62678		TR 31883	62732

Fish species and fork length (mm)

Roach				
128	64	102	55	
			Total =	4

Bream				
87				
			Total =	1

Notes

Scales taken

Weights

Date	Gear/method used	Run number
24/07/2024	30m Standard Seine Net	3 of 4

Site (waterbody)	Survey personnel	Duration (mins)
River Stour	KG AW JM AR	00:00

Start Time	Start NGR		End Time	End NGR	
13:30	TR 31930	62678		TR 31883	62732

Fish species and fork length (mm)

Perch				
121				
			Total =	1

Bream				
76	75			
			Total =	2

Roach				
30				
			Total =	1

Notes

Scales taken

Weights

Date	Gear/method used		Run number
24/07/2024	30m Standard Seine Net		4 of 4

Site (waterbody)	Survey personnel	Duration (mins)
River Stour	KG AW JM AR	00:00

Start Time	Start NGR		End Time	End NGR	
13:30	TR 31930	62678		TR 31883	62732

Fish species and fork length (mm)

Roach				
65	60	100	75	
		Total =	4	

Bream				
212	83	74	151	104
76	105	84	79	80
88	80	61	84	
		Total =	14	

Notes

Scales taken
Weights

Annex 2.N.8 Fish Photos

Plate 2.N.9.1 Roach

Plate 2.N.9.2 Bream

Plate 2.N.9.3 Bream

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