Cambridge Waste Water Treatment Plant Relocation Project
Anglian Water Services Limited

Appendix 8.1: Aquatic Technical Appendices [redacted]

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1 Introduction

1.1 Overview

1.1.1 The aquatic species and habitats surveys were carried out to inform the biodiversity assessment completed for the Proposed Development as reported in Chapter 8: Biodiversity (Application Document Reference 5.2.8). These habitats and species could be potential constraints to the Proposed Development or influence the design and implementation of the Proposed Development. An extended Phase 1 Habitat Survey identified and mapped the main habitats within 5km of the boundary of the Proposed Development as it was in 2020/21.

1.1.2 Figures 8.12 to 8.15 referenced within this document can be found in the Book of Figures – Biodiversity (Application Document Reference 5.3.8).

1.2 Aims and Objectives

1.2.1 A Preliminary Ecological Appraisal (PEA) was undertaken between July and September 2020 to establish the broad ecological baseline for the Proposed Development, which includes the proposed WWTP and Waterbeach Pipeline, and surrounding areas, which may be affected by the works (defined as the proposed survey area). Based on the findings of the PEA, habitat and protected species surveys[1] have been undertaken throughout 2021 to determine the ecological baseline.

1.2.2 This technical appendix presents a summary of the baseline data collected on freshwater aquatic species and habitats to inform the Proposed Development. This data has been gathered by a desk study covering an area within 5km of the Scheme Order Limits, and surveys within 100m of the Scheme Order Limits, which meets the requirements set out in the Scoping Report. This report details data collection, processing methodology and results of these activities.

1.2.3 This report should be read in conjunction with the Chapter 8: Biodiversity (App Doc Ref 5.2.8) of the Environmental Statement produced to which this report is appended.

1.3 Project Description

1.3.1 A detailed project description is included in Chapter 2: Project Description (App Doc Ref 5.2.2) of the Environmental Statement.

1.3.2 The Proposed Development is located north-west of Cambridge and is mostly comprised of arable land. The A14 and Low Fen Drove Way Country Wildlife Site (CWS) are dominant features of the landscape lying to the south and east respectively of the Proposed Development. The B1047 Horningsea Road boarders the proposed WWTP site to the west. The River Cam is west of the WWTP site and is where discharges are treated effluent will occur.

[1] Invasive species surveys were conducted in conjunction with ecological surveys and target notes on maps were made when invasive species were encountered.

1.3.3 The Scheme Order Limits covers an area of approximately 217.84 ha. Surveys were undertaken within the Scheme Order Limits plus a 100m buffer.

1.3.4 Figure 1.1 below details the location of the Proposed Development and shows the Scheme Order Limits.

Figure 1.1: Scheme Order Limits

1.4 Legislation and Policy

1.4.1 This assessment has been undertaken within the context of the following relevant legislative instruments and planning policies:

- Wildlife and Countryside Act 1981 (as amended);
- The Conservation of Habitats and Species Regulations 2017 (as amended);
- The Natural Environment and Rural Communities (NERC) Act (2006). This act places the duty on every local authority to conserve biodiversity. Section 40 refers to the restoration and enhancement of populations and habitats, whilst Section 41 (S41) lists species and habitats of Principal Importance for the conservation of biodiversity in England.
- Water Environment (Water Framework Directive) (England and Wales) Regulations 2017;
- The Invasive Alien Species (Enforcement and Permitting) Order 2019;
- UK Post-2010 Biodiversity Framework; and
- Cambridge and Peterborough Local Habitat Action Plans. These remain in place but are supplemented by a local list of priority habitats and species (S41). These lists ensure that practical conservation projects can be targeted towards these species including in development proposals and site management plans.

2 Methodology

2.1 Desk Study

2.1.1 The aim of the desk study was to collate and review existing information within the Scheme Order Limits and its surroundings to inform the design and implementation of subsequent freshwater ecology surveys, and inform the impact assessment for the project.

2.1.2 A data search was undertaken to determine the presence of records of aquatic species which are invasive or notable.

2.1.3 Results from a biological records search within a 5km radius of a central point (National Grid Reference (NGR) TL 49740 61214) within the proposed WWTP are discussed within this report. Records were provided by the Cambridgeshire and Peterborough Environmental Records Centre (CPERC) in December 2021. Biological records up to 10 years old were considered as part of the desk study.

2.1.4 A Preliminary Ecological Appraisal (PEA) was undertaken between July and September 2020 to establish the broad ecological baseline for the Proposed Development and surrounding areas, which may be affected by the works (defined as the proposed survey area). Based on the findings of the PEA, habitat and protected species surveys have been undertaken throughout 2021 to determine the ecological baseline. A desk study was undertaken to ascertain the presence of the following:

- protected and priority habitats and species; and
- Invasive Non-Native Species (INNS).

2.1.5 Information on the above features has been accessed from:

- Environment Agency Ecology and Fish Data Explorer (Environment Agency, 2022) and
- Cambridgeshire and Peterborough Environmental Records Centre (CPERC).

2.2 Field Survey Scoping and Design

Overview

2.2.1 The study area for aquatic ecology surveys included the Proposed Development plus a 100m buffer. This included the River Cam, all ditches and all ponds within 100m of the Proposed Development. The reach of the River Cam where the Waterbeach Pipeline will cross will be directionally drilled, resulting in no impact to the river. Maps of the survey locations are shown in Figures 8.12 and 8.13 (Book of Figures – Biodiversity (App Doc Ref 5.3.8).

River Fish, Macroinvertebrates and Macrophytes

2.2.2 Survey sites were selected to allow for an assessment of baseline ecological conditions both upstream and downstream of the existing and proposed outfalls on the River Cam. In terms of river biology, fish, macroinvertebrate and macrophyte

surveys were scoped in for assessment. These survey sites are shown in Figure 8.12, Book of Figures – Biodiversity (App Doc Ref 5.3.8).

River Physical Habitat

2.2.3 Surveys of river physical habitat were undertaken to document the baseline condition of the reach of the River Cam which may be affected by the scheme. These surveys captured river habitat quality and modification, and informed river condition for the purpose of Biodiversity Net Gain (BNG) calculations.

2.2.4 River physical habitat surveys undertaken were River Habitat Survey (RHS) and Modular River Physical Survey (MoRPh), the latter of which informed a River Condition Assessment (RCA). Both surveys were centred on the proposed outfall location, whilst the 500m RHS reach also included the existing outfall. These survey sites are shown in Figure 8.13, Book of Figures – Biodiversity (App Doc Ref 5.3.8).

Ditch Macroinvertebrates and Macrophytes

2.2.5 All ditches within the Scheme Order Limits plus 100m buffer were visited during the scoping stage to identify the need for further ditch macroinvertebrate and macrophyte surveys. Those which contained water during this initial visit were scoped in for ditch macroinvertebrate and macrophyte surveys. Those which were dry and contained no wetland plant species were scoped out for further survey. Ditches which were dry but supported wetland plants would have been scoped in for macrophyte surveys only; however, in practice this did not apply to any ditches within the Scheme Order Limits or 100m buffer.

2.2.6 In terms of the prescribed ditch survey methodology (Palmer *et al*., 2013), WB300/WB301 were effectively a continuation of the same feature. The ditch was dry and dominated by nettles and grasses. The ditch contained no standing water and was scoped out for a macroinvertebrate survey. During the scoping visit the ditch was observed to contain only one wetland plant species – reed sweet-grass (*Glyceria maxima*); therefore it was considered unnecessary to undertake a full ditch macrophyte survey.

2.2.7 Twenty-three ditches were scoped in for macroinvertebrate and macrophyte surveys, the locations of which are shown in Figures 8.14 and 8.15, Book of Figures – Biodiversity (App Doc Ref 5.3.8).

PSYM Ponds

2.2.8 All ponds within the Scheme Order Limits plus 100m buffer were visited during the scoping stage to identify the need for further surveys. These ponds were subject to Predictive SYstem for Multimetrics (PSYM) surveys which involve an assessment of macroinvertebrate and macrophyte species present.

2.2.9 PSYM surveys were conducted on the two ponds found within the 100m buffer of the Scheme Order Limits, the location of which are shown in Figure 8.14, Book of Figures – Biodiversity (App Doc Ref 5.3.8).

2.3 Guidance Documents

2.3.1 The following guidance has been considered in survey design and execution. Any deviation from standard industry practice is noted in section 2.9.

River Fish – Physical Survey

- Water Framework Directive – UK Technical Advisory Group (WFD-UKTAG, 2008). River Assessment Method – Fish Fauna (Fisheries Classification Scheme 2 (FCS2)) (WFD-UKTAG, 2008).

River Macroinvertebrates

- Best practice guidance for the undertaking of aquatic macroinvertebrate surveys and assessment is provided in British Standards (BS) EN ISO 10870:2012 (European Committee of Standardization, 2014).
- Macroinvertebrate sampling and taxonomic analysis was undertaken in accordance Environment Agency's standard macroinvertebrate sampling and analysis manual – BT001 (Murray-Bligh, 1999) and standard River Invertebrate Prediction and Classification System (RIVPACS) procedures (EU-STAR, 2004); and
- Macroinvertebrate data analysis using the River Invertebrate Classification Tool (RICT) was informed by the Water Framework Directive – United Kingdom Technical Advisory Group (WFD-UKTAG) document (WFD-UKTAG, 2014a).

River Macrophytes

- European Committee for Standardization (2014). Water quality. Guidance for the Surveying of Aquatic Macrophytes in Running Waters. BS EN 14184: 2014; and
- (WFD-UKTAG, 2014b). River Assessment Method. Macrophytes and Phytobenthos. Macrophytes (River LEAFPACS2).

River Habitat Survey

- The RHS was undertaken according to the River Habitat Survey in Britain and Ireland Field Survey Guidance Manual (Environment Agency, 2003).

River Condition Assessment

- The MoRPh surveys were undertaken in accordance with 2020 MoRPh survey technical reference manual (Gurnell *et al*., 2020a).

Ditch Macroinvertebrates and Macrophytes

- The Buglife manual (Palmer *et al*., 2013) describes the standard method for surveying macroinvertebrates and macrophytes within ditches. This methodology provided a checklist of target species.

PSYM Ponds

- Pond Action [now Pond Conservation] (2002). PSYM sampling protocols used for ponds. Pond Action, Oxford. 14pp; and
- Freshwater Habitats Trust (2002). A guide to monitoring the ecological quality of ponds and canals using PSYM. Joint Nature Conservation Committee (2005).

2.4 Field Survey Methodology

River Fish – Physical Survey

2.4.1 River fish were surveyed at the following two sites (Figure 8.12, Book of Figures – Biodiversity (App Doc Ref 5.3.8) and dates:

- Site 1: River Cam upstream of existing and proposed outfalls – TL 48357 61537, 10/09/2021
- Site 2: River Cam downstream of proposed and existing outfalls – TL 48398 61691, 09/09/2021

2.4.2 Section 27A (Salmon and Freshwater Fisheries Act 1975) authorisation/ exception for the use of fishing instruments (other than rod and line) was obtained from Environment Agency prior to surveys being conducted.

2.4.3 Sites were 100m in length and stop-netted twice with micro seine netting (20m x 4m) at upstream and downstream limits to prevent the movement of fish into and out of the survey area. This methodology was considered to be most appropriate due to the size and nature of the waterbody. Prior to the start of fish surveys, dissolved oxygen (DO) concentration (mg/l), conductivity (µS) and temperature (°C) were recorded using a hand-held meter.

2.4.4 Processing of the catch was conducted as soon as possible after capture to minimise stress. The processing of samples involved the taxonomic identification of each fish and measurement of its fork-length (measurement taken from the tip of the mouth to the centre of the caudal fin fork). Fish were returned unharmed to the river after processing.

River Fish – Environmental DNA

2.4.5 In addition to seine netting, environmental DNA (eDNA) samples were collected at these sites to increase the chances of detecting species:

- Site 1: River Cam upstream of existing and proposed outfalls – TL 48352 61521
- Site 2: River Cam downstream of existing and proposed outfalls – TL 48398 61691

2.4.6 NatureMetrics provided sampling kits and a protocol for the procedure. Two water samples were collected at each site, one on 29 July 2021 and one on 25 October 2021 to account for seasonal variation in the fish community and differing spawning times between species associated with fish movement and spawning migration. For each sample, up to 1000ml of sampled water was filtered through an encapsulated

syringe filter immediately after collection. A preservative solution was then added to the filter units and they were subsequently sent to NatureMetrics for analysis.

River Macroinvertebrates

2.4.7 In accordance with the seasons recognised by RIVPACS (EU-STAR, 2004) macroinvertebrates were surveyed in Spring on 28 April 2021 (both upstream and downstream of the existing and proposed outfall) and Autumn on 9 September 2021 (upstream site) and 10 September 2021 (downstream site). The surveys sites are shown in Figures 8.12 and 8.13, Book of Figures – Biodiversity (App Doc Ref 5.3.8) and were at the following locations:

- Site 1: River Cam upstream of existing outfalls – TL 48360 61424
- Site 2: River Cam downstream of existing outfalls – TL 48402 61726

2.4.8 In accordance with best practice, all samples comprised three minutes of pond net sampling and a one-minute manual search to capture surface-dwelling invertebrates and those organisms attached to submerged objects such as cobbles and woody debris. As the River Cam is too deep for kick sampling, sweep samples were taken from the bank, whereby the net was used from the bank to sample all habitat components possible including marginal vegetation and the riverbed (EU-STAR, 2004).

2.4.9 Environmental data for the sampling area, banks and surrounding area were collected alongside each sample. Data included the variant predictor variables (watercourse width, depth, substrate composition) required for subsequent analysis (EU-STAR, 2004).

2.4.10 Samples were stored in a cool box (kept between 1-3˚C) until preservation later that day in Industrial Methylated Spirit (IMS). Samples were then sent to a laboratory for taxonomic analysis.

River Macrophytes

2.4.11 River macrophytes were surveyed on 9 September 2021 at the following two sites, each comprising a 100m river reach, the centre-point of which are shown in Figure 8.12, Book of Figures – Biodiversity (App Doc Ref 5.3.8).

- Site 1: River Cam upstream of existing and proposed outfalls – TL 48337 61417 to TL 48352 61521 (centre TL 48372 61702)
- Site 2: River Cam downstream of existing and proposed outfalls – TL 48373 61651 to TL 48373 61752 (centre TL 48346 61470)

2.4.12 Due to the depth of the River Cam, surveys were conducted by boat, aided by a bathyscope and grapnel for assessing submerged vegetation.

2.4.13 Macrophytes present throughout the reach were recorded and assigned a taxon cover value (TCV) based on a visual estimate of its coverage of the survey reach (see Table 2-1:). Where taxa were difficult to identify in the field, samples were taken for subsequent identification and/or verification.

2.4.14 As a minimum, all taxa listed in the WFD-UKTAG (2014b) guidance were recorded. Additional taxa not listed in the WFD-UKTAG guidance but commonly associated

with river margins were also recorded, as well as INNS, as standard best practice. At each survey site the reach was photographed and physical characteristics were recorded.

Table 2-1: Taxon cover values

Taxon Cover Value	Percentage Cover Range
1	<0.1%
2	0.1-1%
3	1-2.5%
4	2.5-5%
5	5-10%
6	10-25%
7	25-50%
8	50-75%
9	>75%

River Habitat Survey

2.4.15 A RHS is a field method used to characterise and assess the physical structure and quality of a 500m stretch of river through observations of channel modification, geomorphological and habitat features.

2.4.16 A RHS survey was conducted on 30 June 2021, centered on the proposed outfall location as shown in Figure 8.13, Book of Figures – Biodiversity (App Doc Ref 5.3.8). Location details are as follows:

- Upstream NGR (spot-check 1): TL 48341 61429;
- Mid-point (spot-check 6) NGR: TL 48379 61637; and
- Downstream NGR: TL 48473 61921

2.4.17 The survey technique comprises two main methods; spot-checks and a sweep-up. Spot-checks are a series of ten 1m (physical attributes) and 10m (vegetation and land-use) wide transects across the channel at 50m intervals where the physical structure, artificial modification, and vegetation structure of both the banks and channel are recorded. During the sweep-up the total number of physical features, land-use, bank profile and structure, extent of trees, extent of channel features, channel dimensions, flow features and features of special interest are recorded.

2.4.18 More specifically, the RHS technique requires the following river characteristics to be recorded:

- the number of natural features within the 500m reach, such as riffles, pools, unvegetated and vegetated point bars;
- the number of artificial features within the 500m reach, including weirs/ sluices, culverts, bridges, outfalls/intakes, fords and deflectors/ groynes/ croys;

- at the ten spot-check points, bank and channel material, bank and channel modifications and features, channel substrate, flow type, channel vegetation types, riparian vegetation structure and surrounding land use;
- an indication of the length of natural/unmodified bank and artificial/ modified bank along the 500m reach;
- the extent of trees and associated features;
- the extent of channel and bank features, including cliffs within banks, flow types, side bars, point bars, mid-channel bars, mature islands, side bars, and other discrete deposits;
- an estimate of channel dimensions;
- any features of special interest, including boulders, leafy debris, backwaters, marshes and wet woodland;
- any invasive plant species;
- any other relevant observations, such as major impacts on the river habitat, evidence of recent management, or animal sightings;
- predominant valley form and structure; and
- land use types within 50m of the channel.

River Condition Assessment

2.4.19 A RCA requires both a field assessment and desk study. The field assessment is based on the use of the MoRPh survey technique, with five contiguous MoRPh surveys (or 'modules') required to form a 'MoRPh5 sub-reach', the survey units needed to inform an RCA (see Figure 2.1 below). The length of each MoRPh module and thus each MoRPh5 sub-reach is determined by river width and type. A River Type Desk Study is used to predict the expected quality of river habitat and provides the benchmark against which the results of MoRPh surveys can be compared.

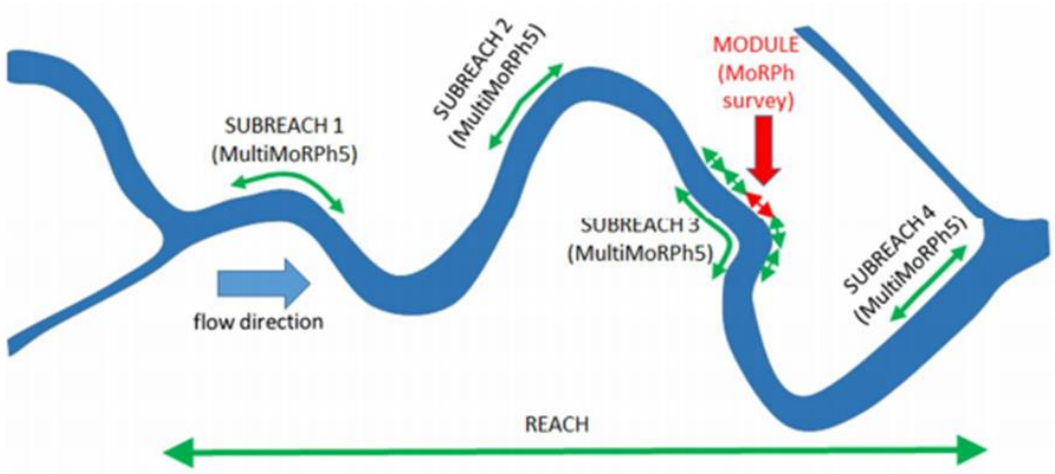


Figure 2.1: MoRPh survey arrangement for RCA
Source: Gurnell et al., (2020a)

2.4.20 MoRPh surveys were undertaken on 29 June 2021, with the MoRPh5 sub-reach centred on the proposed outfall location. Individual MoRPh survey locations are

listed in Table 2-2 below and shown in Figure 8.13, Book of Figures – Biodiversity (App Doc Ref 5.3.8). The estimated width of the River Cam in this location was 20-30m, therefore individual MoRPh modules of 40m in length were used.

Table 2-2: MoRPh module locations on the River Cam, under the A14 bridge

MoRPh module no.	Mid-point NGR	Survey date	Undertaken from	Module length
1	TL 48358 61555	29/06/2021	Left bank	40m
2	TL 48362 61599	29/06/2021	Left bank	40m
3	TL 48379 61637	29/06/2021	Left bank	40m
4	TL 48368 61677	29/06/2021	Left bank	40m
5	TL 48369 61723	29/06/2021	Left bank	40m

2.4.21 In accordance with the prescribed methodology, the following characteristics of the river channel and corridor were assessed:

2.4.22 Overview

- Bed visibility and any adverse conditions affecting the survey.
- Channel depth and width.
- Water depth and width.

2.4.23 Banktops (within 10m)

- Artificial/managed ground cover.
- Terrestrial vegetation structure.
- Non-native invasive plant species[2] (NNIPS).
- Water-related features (ponds, side channels, wetlands).

2.4.24 Bank faces

- Natural and artificial bank profiles.
- Natural and artificial bank face materials.
- Bank reinforcement extent and type.
- Natural physical features (i.e. bars, berms, 'benches', eroding and stable cliffs, toes, animal nests and burrows, marginal backwaters, and tributary junctions).
- Artificial physical features (i.e. pipes, outfalls, jetties, and deflectors).
- Terrestrial vegetation structure.
- Aquatic vegetation at the bank-water margin.

[2] The term non-native invasive plant species is specifically used within the 2021 MoRPh survey technical reference manual. This term refers to non-native invasive plant species only when the river condition assessment is discussed. Elsewhere within the report the term invasive non-native species is used to describe all invasive species (fauna and flora).

- NNIPS.

2.4.25 Channel

- Channel bed natural materials.
- Channel bed reinforcement type.
- Water surface flow patterns.
- Channel bed natural features (i.e. exposed bedrock, boulders, bars, islands, cascades, pools, riffles, steps, and waterfalls).
- Channel bed artificial features (i.e. large trash, weirs, bridge piers within the channel, bridge shadows, and culverts).
- Channel bed vegetation types.
- Vegetation interactions within wetted channel (e.g. shading, tree roots, large wood, and discrete accumulations of organic material).
- NNIPS.

Ditch Macroinvertebrates

2.4.26 In accordance with the methodology prescribed by Palmer *et al*. (2013), macroinvertebrate sampling was attempted at each ditch which had been scoped in for assessment. Surveyed ditches within the proposed Waterbeach Pipeline and WWTP respectively are detailed in Table 2-3 and Table 2-4 below, and shown in Figures 8.14 and 8.15, Book of Figures – Biodiversity (App Doc Ref 5.3.8).

Table 2-3: Ditch macroinvertebrate surveys in the vicinity of the proposed Waterbeach Pipeline (See Figure 8.14, Book of Figures – Biodiversity (App Doc Ref 5.3.8)

Ditch	NGR	Sampling date	Ditch Location
WB160	TL 50583 65242	21/10/2021	Within 100m buffer
WB041	TL 50302 65274	12/10/2021	Within 100m buffer
WB047	TL 49831 62804	13/10/2021	Wholly/partially within Scheme Order Limits
WB055	TL 50441 64849	22/09/2021	Wholly/partially within Scheme Order Limits
WB123a	TL 50529 64927	22/09/2021	Wholly/partially within Scheme Order Limits
WB120	TL 50409 66355	13/10/2021	Wholly/partially within Scheme Order Limits
WB078	TL 50577 65781	13/10/2021	Wholly/partially within Scheme Order Limits

Ditch	NGR	Sampling date	Ditch Location
WB085	TL 50494 65685	13/10/2021	Wholly/partially within Scheme Order Limits
WB107	TL 50431 65359	13/10/2021	Within 100m buffer
WB121	TL 50797 66137	02/11/2021	Wholly/partially within Scheme Order Limits
WB141	TL 50590 65507	03/11/2021	Within 100m buffer
WB159	TL 50398 65810	02/11/2021	Wholly/partially within Scheme Order Limits
WB234	TL 50328 65253	02/11/2021	Within 100m buffer
WB245	TL 50811 66133	02/11/2021	Within 100m buffer
WB297	TL 50301 64449	03/11/2021	Within 100m buffer

Table 2-4: Ditch macroinvertebrate surveys in the vicinity of the proposed WWTP (see Figure 8.15, Book of Figures – Biodiversity (App Doc Ref 5.3.8)

Ditch	NGR	Sampling date	Within Scheme Order Limits
WB260	TL 47930 61470	29/04/2021	Wholly/partially within Scheme Order Limits
WB095	TL 48110 61750	29/04/2021	Within 100m buffer
WB001	TL 48410 61710	30/04/2021	Wholly/partially within Scheme Order Limits
WB171 West	TL 48270 61840	29/04/2021	Within 100m buffer
WB230	TL 48310 61830	29/04/2021	Within 100m buffer
WB171 East	TL 48320 61770	29/04/2021	Within 100m buffer
WB319	TL 48460 61730	30/04/2021	Within 100m buffer

2.4.27 Samples were taken by pond net from a section of ditch at least 50m long, where the vegetation is moderately similar. Four samples were taken at each site and processed in the field, with the aim to sample the range of microhabitats present.

2.4.28 Each sample was examined in the field for 7.5 minutes to assess the aquatic invertebrate species present. Abundance was estimated on a semi-logarithmic scale

(1-9, 10-99, >100) and noted as 1, 2 or 3. Animals that could not be identified in the field were taken back to the laboratory for identification.

Ditch Macrophytes

2.4.29 In accordance with the methodology prescribed by Palmer *et al*. (2013), macrophyte surveys were undertaken at each ditch which had been scoped in for assessment as shown in Table 2-5 and Table 2-6, and shown in Figures 8.14 and 8.15, Book of Figures – Biodiversity (App Doc Ref 5.3.8). Due to time constraints for the project, most macrophyte surveys within the proposed Waterbeach Pipeline area were outside of the peak growth season of June to September inclusive.

Table 2-5: Waterbeach pipeline ditch macrophyte survey locations and dates (see Figure 8.14, Book of Figures – Biodiversity (App Doc Ref 5.3.8)

Ditch	NGR	Survey date	Ditch location
WB160	TL 50583 65242	21/10/2021	Within 100m buffer
WB041	TL 50302 65274	12/10/2021	Within 100m buffer
WB047	TL 49831 62804	13/10/2021	Wholly/partially within Scheme Order Limits
WB055	TL 50441 64849	22/09/2021	Wholly/partially within Scheme Order Limits
WB123a	TL 50529 64927	22/09/2021	Wholly/partially within Scheme Order Limits
WB120	TL 50409 66355	13/10/2021	Wholly/partially within Scheme Order Limits
WB078	TL 50577 65781	13/10/2021	Wholly/partially within Scheme Order Limits
WB085	TL 50494 65685	13/10/2021	Wholly/partially within Scheme Order Limits
WB107	TL 50431 65359	13/10/2021	Within 100m buffer
WB121	TL 50797 66137	02/11/2021	Wholly/partially within Scheme Order Limits
WB141	TL 50590 65507	03/11/2021	Within 100m buffer
WB159	TL 50398 65810	02/11/2021	Wholly/partially within Scheme Order Limits
WB234	TL 50328 65253	02/11/2021	Within 100m buffer
WB245	TL 50811 66133	02/11/2021	Within 100m buffer

Ditch	NGR	Survey date	Ditch location
WB297	TL 50301 64449	03/11/2021	Within 100m buffer

Table 2-6: Outfall ditch macrophyte survey locations and dates (see Figure 8.15, Book of Figures – Biodiversity (App Doc Ref 5.3.8)

Ditch	NGR	Date	Within Scheme Order Limits
WB001 West	TL 48520 61890	16/07/2021	Wholly/partially within Scheme Order Limits
WB260	TL 48020 61610	21/06/2021	Within 100m buffer
WB319	TL 48450 61750	24/06/2021	Within 100m buffer
WB171 West	TL 48280 61820	21/06/2021	Within 100m buffer
WB171 East	TL 48320 61770	21/06/2021	Within 100m buffer
WB230	TL 48330 61850	21/06/2021	Within 100m buffer

2.4.30 For each survey, one 20m reach was selected as the core sampling area. An 8-figure NGR was recorded for all core reaches. Within each 20m reach plants growing both in the ditch and on the banks were recorded. Species present within the 20m sample reach were recorded and their abundances assessed using the 'DAFOR' scale shown in Table 2-7.

2.4.31 Table 2-7: A 'sweep-up' to record additional species present in the rest of each ditch was carried out after the 20m section had been surveyed. Macrophytes and riparian plants were recorded in three zones in relation to the ditch: within the ditch itself (W), on the banks (B), or outside the immediate survey location but observed elsewhere in the ditch (R).

Table 2-7: DAFOR score scale

Score	Cover
D (Dominant)	70-100%
A (Abundant)	30-70%
F (Frequent)	10-30%
O (Observed)	3-10%
R (Rare)	<3%

Source: Palmer et al. (2013)

PSYM Ponds

2.4.32 To assess the biological quality of ponds, the PSYM method (Pond Conservation, 2002) was used, with surveys completed during 21 September 2021 for ponds listed

in Table 2-8. This methodology involves the recording of macroinvertebrates and wetland plants.

Table 2-8: Pond survey location and date (see Figure 8.12, Book of Figures – Biodiversity (App Doc Ref 5.3.8)

Pond	NGR	Date
PD008	TL 49888 62800	21/09/2021
PD047	TL 50355 64994	21/09/2021

2.4.33 Macroinvertebrate samples were taken using a kick/sweep sampling approach for three minutes, followed by a one-minute manual search of larger substrates and for surface-dwellers using a standard pond net.

2.4.34 Samples were stored in a cool box (kept between 1-3˚C) until preservation later that day in IMS. Samples were then sent to a laboratory for taxonomic analysis. The samples were analysed, and individuals were identified to species level where possible.

2.4.35 Pond macrophytes were surveyed by walking or wading the entire perimeter of the dry and shallow water areas of the waterbody. Deeper water areas were sampled by grapnel thrown from shallow water or the bank. The aim of plant recording was to make a complete list of wetland plants present within and on the banks of each pond.

2.5 Biosecurity Considerations

2.5.1 Biosecurity measures were implemented to prevent the spread of diseases and INNS between the sites visited for surveys. Substrate (for example silt or sand) and plant fragments were removed from survey equipment and personal protective equipment (including waders) between visits to different survey locations. Additionally, all equipment was washed using Virkon Aquatic disinfectant between surveys, in accordance with the manufacturer's guidance.

2.6 Sample Processing

River Fish – Environmental DNA

2.6.1 NatureMetrics used metabarcoding to analyse the filtrate samples. Following extraction from the filter paper, DNA was amplified using a primer optimised for fish, which was then sequenced using a high-throughput sequencing (HTS) platform (Illumina MiSeq). The output was a species-by-sample table showing how many sequences from each sample were identified as each species.

River Macroinvertebrates

2.6.2 In the laboratory, macroinvertebrate samples were analysed to the taxonomic level required for the calculation of biological indices, this being RIVPACS Taxonomic Level 5 (TL5) (Davy-Bowker, et al., 2010). This is predominantly species-level, with exceptions where this is either not possible (e.g. many true fly larvae) or would involve disproportionate effort (e.g. aquatic worms). Within this framework, specimens were identified to the highest taxonomic level possible given their life

stage and condition. This level of taxonomic resolution enabled calculation of the biological indices described below, and the detection of non-native species, and species of conservation importance.

2.7 Data Processing

River Fish – Physical Survey

2.7.1 For each survey site, population abundance (n) of all species caught was estimated in accordance with Carle & Strub (1978) method for estimating population size for fish biometrics. Where catch data was insufficient for the Carle & Strub (1978) method to be applied (for instance, where catch depletion across three runs did not follow the 60:30:10 ratio), the number of fish caught was taken as the minimum abundance.

2.7.2 Species density at each site was calculated by dividing the estimated population abundance (or minimum abundance) by the area (m^2) of the survey reach to obtain a measure of fish per unit area (n/m^2), which was then multiplied by 100 to provide a density (n) per 100 m^2 ($n/100m^2$).

2.7.3 Species biomass ($g/100m^2$) was estimated for each survey site using species-specific length-weight relationships from the Environment Agency's National Fish Population Database (NFPD). The total weight of each species was divided by the survey area (m^2) and multiplied by 100 to provide a biomass (g) per $100m^2$ ($g/100m^2$). For those sites where a sub-sample of species was measured, the average length of fish in the sub-sample was applied to the total number of fish caught in the calculation of species biomass.

2.7.4 Where a sufficient number of individuals were caught (≥ 30 individuals), the length measurements of the individual fish were collated to produce length-frequency histograms for the site.

River Macroinvertebrates

2.7.5 River Macroinvertebrate results were summarised using the following biotic indices:

- Whalley, Hawkes, Paisley and Trigg Average Score Per Taxon (WHPT ASPT) (WFD-UKTAG, 2014a) – an index used to assess the general degradation of rivers. Required for WFD assessment;
- WHPT No. of Taxa (WHPT NTAXA) (WFD-UKTAG, 2014a) – the number of taxa which score within the WHPT system. Required for WFD assessment;
- The Lotic Invertebrate Index Flow Evaluation (LIFE) index (Extence, Balbi, & Chadd, 1999) – can indicate whether riverine macroinvertebrate communities are affected by flow pressure;
- Proportion of Sediment-sensitive Intolerant invertebrates (PSI) index (Extence, et al., 2011)– can indicate whether riverine macroinvertebrate communities are affected by deposition of fine sediment; and
- Community Conservation Index (CCI) (Chadd & Extence, 2004) – used to evaluate the conservation value of freshwater habitats with respect to macroinvertebrates.

2.7.6 In order to provide contextual analysis of these indices, the River Invertebrate Classification Tool (RICT) (Freshwater Biological Association, 2022) was used. This tool is an online interface which uses the RIVPACS IV model to predict the expected invertebrate community for river sites on a seasonal basis. This tool requires 'variant' and 'invariant' environmental variables to be determined in order to predict the macroinvertebrate assemblage. Variant variables include channel width, channel depth, and substrate composition within the sampling area, and were collected during field sampling. Invariant variables include site altitude, slope, 'discharge category', distance from source, and alkalinity.

2.7.7 Where no data was available for the watercourse, the nearest watercourse with similar characteristics was used. Site altitude, alkalinity, slope, and distance from source were obtained from EA biology site 56063 (TL 50789 65663) downstream of the survey sites on the River Cam.

2.7.8 Following WFD-UKTAG (2014a) guidance and using RICT, WHPT ASPT and WHPT ASPT NTAXA values were processed to provide an indicative WFD status for each site. To achieve this, the observed WHPT indices were entered into RICT alongside the predictor variables.

2.7.9 RICT compares observed and expected WHPT ASPT and WHPT NTAXA scores (observed:expected (O:E) ratios) to produce an Ecological Quality Ratio (EQR) value for each index. Spring and autumn EQR values are averaged for each index when a single classification is required for the year. The EQR values for each index are then equated to a WFD class based on the boundaries shown in Table 2-9 and status descriptions in Table 2-10. The lowest of these classes is subsequently reported as the WFD status for the site.

Table 2-9: WFD class boundaries for macroinvertebrates

Class boundary	WHPT NTAXA EQR	WHPT ASPT EQR
High/Good	0.80	0.97
Good/Moderate	0.68	0.86
Moderate/Poor	0.56	0.72
Poor/Bad	0.47	0.53

Table 2-10: WFD class boundaries for macroinvertebrates and status descriptions

WFD status	Description
High	Near natural conditions
Good	Slight change from natural conditions as a result of human activity
Moderate	Moderate change from natural conditions as a result of human activity
Poor	Major change from natural conditions as a result of human activity
Bad	Severe change from natural conditions as a result of human activity

2.7.10 Macroinvertebrate species were also screened to identify the presence of any protected, notable, or non-native species at both sites.

River Macrophytes

2.7.11 The macrophyte data from each survey was processed using the River LEAFPACS2 survey metric calculator (WFD-UKTAG, 2014b) to provide an indicative WFD classification. For each survey, this generated the following indices:

- River Macrophyte Nutrient Index (RMNI) – derived from the individual RMNI scores of the taxa recorded in the survey;
- Number of Taxa (NTAXA) – the recorded number of scoring hydrophytes (aquatic taxa) as listed in WFD-UKTAG (2014b);
- Number of Functional Groups (NFG) – each hydrophyte taxon is assigned to one of 24 functional groups described in WFD-UKTAG (2014b) . This index is equivalent to the number of different functional groups represented by the scoring hydrophytes recorded in the survey; and
- Cover of Filamentous Algae (ALG) – the percentage cover of green filamentous algae over the whole survey reach.

2.7.12 The River LEAFPACS2 class calculator (WFD-UKTAG, 2014c) was used to calculate an overall EQR for each site, derived from the calculated indices. The EQR is based on the comparison of observed data and predicted reference values. Once calculated, this was equated to an overall status class as defined by the WFD.

2.7.13 The indicative WFD status for each site was used to determine the condition of the macrophyte community. These classes are designed to reflect the degree to which biological communities have been degraded as a result of human activity, with the primary intention of indicating nutrient pressure. The interpretation of these classes is shown in Table 2-11.

Table 2-11: WFD class boundaries for macrophytes and status descriptions

Status	EQR	WFD Status Description
High	≥0.80	Near natural conditions
Good	≥0.60	Slight change from natural conditions as a result of human activity
Moderate	≥0.40	Moderate change from natural conditions as a result of human activity
Poor	≥0.20	Major change from natural conditions as a result of human activity
Bad	<0.20	Severe change from natural conditions as a result of human activity

2.7.14 Recorded species were cross-referenced with the following lists to identify taxa with a conservation designation:

- The Conservation of Habitats and Species Regulations 2017 (as amended);
- The Wildlife and Countryside Act 1981 (as amended) – Schedules 1, 5 and 8;

- The NERC Act (2006) – Species of Principal Importance in England (S41); and
- The International Union for the Conservation of Nature (IUCN) Red List of Threatened Species 2010.

2.7.15 Taxa identified were also screened for non-native species.

River Habitat Survey

Habitat Quality and Habitat Modification Assessment

2.7.16 The RHS data were used to calculate the Habitat Quality Assessment (HQA) score and Habitat Modification Score (HMS) for the site, using River Habitat Survey Toolbox software (Naura, 2017).

2.7.17 The HQA scores provide a broad indication of habitat diversity along the surveyed reach and were calculated based on the presence of natural features along the river corridor, such as point, side and mid-channel bars, eroding cliffs, large woody debris, backwaters and floodplain wetlands. Additional points were given for channel substrate diversity, flow types, in-channel vegetation and the distribution of bank-side trees (Naura, 2017).

2.7.18 The HQA scores were assigned to an HQA class from one to five (Very High to Very Poor) which gave an indication of overall habitat diversity within the context of baseline rivers of a similar type within the UK River type was determined by map data sourced post-survey and placing these data into context with the baseline reference sites. The map data required were altitude of reach, slope, distance to source and source altitude. The HQA score categories are detailed in Table 2-12.

Table 2-12: Contextualised HQA Class habitat diversity descriptions

HQA Score Category	HQA Class	Habitat Diversity Description
0 – 20%	5	Very Poor
20 – 40%	4	Poor
40 – 60%	3	Moderate
60 – 80%	2	High
80 – 100%	1	Very High

2.7.19 HMC scores provided an indication of artificial modification to the river channel. Points were allocated with the presence and extent of artificial features such as culverts, weirs, bridges and the extent of reprofiling and reinforcement of the banks.

2.7.20 HMS scores were translated to a Habitat Modification Class (HMC) from one to five (Pristine/semi-natural to Severely modified) based on the total HMS score, which gave an overall indication of the extent of modification to the river channel. River channel modification typically has an adverse impact on habitat diversity and subsequently the biological receptors that occupy these habitats.

2.7.21 The Habitat Modification Score (HMS) quantifies the extent, potential impact and persistence of engineering structures on the river channel, banks and riparian zone (Walker, 2005). HMS describes the presence and extent of different engineering

structures such as culverts, bridges, outfalls, deflectors, bank and bed reinforcement, bank and bed resectioning, artificial berms, embankments, weirs, dams, sluices, fords, and poaching. The HMS score can be equated to five Habitat Modification Classes (HMC), which describe the condition of the river channel at increasing levels of engineering impact, from semi-natural to severely modified. HMC and HMS descriptions and the underpinning scores are presented are given in Table 2-13.

Table 2-13: Habitat modification Class description and underpinning scores

Habitat Modification Score	Habitat Modification Class	HMC Description
0 – 16	1	Pristine/semi natural
17 – 199	2	Predominantly unmodified
200 – 499	3	Obviously modified
500 – 1399	4	Significantly modified
1400+	5	Severely modified

Hydromorphological Indices

2.7.22 The complexity sub-score is based on vegetation structure complexity of both the bank top and bank face. A score of 0 to 3 depending on complexity is allocated for each spot-check based on the combination of vegetation structure shown in Table 2-14. Scores allocated at each spot-check are added together up to a maximum of 60 (a maximum of 3 per spot-check, 10 spot-checks per bank).

Table 2-14: Complexity sub-score method

Bank top vegetation structure	Bank face vegetation structure	Score
Complex or simple	Complex	3
Complex	Complex or simple	3
Simple	Simple	2
Complex or simple	Uniform or bare	1
Uniform or bare	Complex or simple	1
Uniform or bare	Uniform or bare	0

2.7.23 The Riparian Quality Index (RQI) characterises the complexity, naturalness, and continuity of the riparian zone that comprises the bank face, bank top and the 5m buffer from bank top. The RQI score is based on three sub-scores derived from riparian complexity, naturalness, and continuity. Each sub-score is calculated on a spot-check basis on each bank and added to produce a score between 0 to 120. The final RQI is classed into five categories of increasing riparian quality, see Table 2-15 below.

Table 2-15: Riparian Quality Index (RQI) score descriptions

Riparian Quality Index class	Description
5	Very high
4	High
3	Moderate
2	Low
1	Very low

2.7.24 Channel Substrate Index (CSI), Flow Regime Index (FRI), Channel Vegetation Index (CVI) and Geomorphic Activity Index (GAI) are derived using RHS spot-check data on channel substrate, flow types, channel vegetation structure, erosion and deposition features, riffles and pools (Naura, 2017). The indices represent natural hydromorphological dimensions in British rivers.

- Channel Substrate Index (CSI) operates on a gradient between -2.33 to 0.84 representing average channel substrate size. The gradient is correlated with measures that relate to stream power, shear stress, climate and sediment supply. At the lower end of the scale sites are dominated by fine substrate with an increase in average sediment size towards the upper end of the gradient.
- Flow Regime Index (FRI) represents a gradient between slow tranquil and fast turbulent flow types and is strongly correlated to measures of discharge and slope as well as altitude and geology. The index ranges from -1.1- to 1.74 to account for sites dominated by slow flowing less turbulent features, such as glides and pools at the lower end of the gradient, to sites dominated by fast flowing features such as waterfalls, cascades and rapids at the higher end of the gradient.
- Channel Vegetation Index (CVI) follows a gradient of -1.69 to 1.10 representing flow velocity, energy and channel condition. The lower end of the scale is dominated by floating vegetation typical of slow flowing environments with stable hydrographs. As we progress along the scale, submerged and emergent vegetation types become dominant followed by filamentous algae, mosses, liverworts and lichens. The CVI gradient is strongly correlated with stream energy, geology and altitude.
- Geomorphic Activity Index (GAI) represents a gradient of increased activity from -0.83 to 1.20. It is based on the relative occurrence of erosion and deposition features such as bars, cliffs, riffles and pools. Sites at the lower end of the scale display few or no signs of activity whilst sites at the upper end of the scale are dominated by active erosion and deposition features. The index is not simply a representation of the number of eroding/depositing features, it also differentiates between types of activity. The lower end of the scale displays a higher proportion of stable erosion and deposition features (i.e. stable cliffs and vegetated bars) compared to the upper end of the scale which is dominated by more active features (i.e. eroding cliffs and unvegetated bars). The GAI is correlated to measures of stream power, shear

stress as well as attributes relating to climatic, land-use and geological controls.

River Condition Assessment

2.7.25 In order to contextualise the MoRPh survey results, a River Type Desk Study was undertaken to classify the watercourse as one of 13 near-natural River Types (types A to M), based on sediment type, sinuosity, channel confinement, and the extent of any braiding or anabranching. The methodologies used for determining each of the River Type parameters are shown in Table 2-16.

2.7.26 The River Type reach used was a 5.6km reach from TL 44986 59307 to TL 49033 62572.

Table 2-16: River Type parameter calculation methodologies

Parameter	Method of calculation/determination
River Category	The options for this category are 'Navigable river/canal', 'Large river', and 'Other river', which is determined principally on the basis of field observations
A1: Braiding Index	Using Google Earth Pro, plot the centre line of the river, plot ten equally spaced points along this line, and average the number of channels separated by vegetated bars or islands at each point
A2: Sinuosity Index	Use Google Earth Pro to measure the River Reach Length and River Valley Length; then divide the River Reach Length by the River Valley Length to give the Sinuosity Index
A3: Anabranching Index	Using Google Earth Pro, plot the centre line of the river, plot ten equally spaced points along this line, and average the number of channels at each point
A4: Level of Confinement	Use Google Earth Pro to determine extent to which the river is laterally confined by topography, with options being 'Confined', 'Partly Confined', or 'Unconfined'
A5: River Reach Gradient	Use Google Earth Pro to estimate the elevation at the upstream and downstream extents of the River Reach, measure the River Reach Length between these two points; then divide the difference in elevation by the River Reach Length
A6: Bedrock Reach	Value taken from output of MoRPh5 survey
A7: Coarsest Bed Material	Value taken from output of MoRPh5 survey
A8: Average Bed Material	Value taken from output of MoRPh5 survey

2.7.27 River condition is assessed using 32 condition indicators that are generated by MoRPh5 field surveys. Some of these indicators are positive, representing physical habitats offered by vegetation, sediment, related physical features, and hydraulic habitats that can be observed at low flow. These positive indicators are assigned a

score from 0 to 4, depending on their diversity (richness) and abundance (extent). The remaining are negative indicators which present the extent and severity of local human interventions or pressures, reflected in scores between 0 and -4.

2.7.28 A Preliminary Condition Score is calculated for each MoRPh5 sub-reach, by summing the average of the positive condition indicator scores and the average of the negative condition indicator scores for the sub-reach.

2.7.29 This Preliminary Condition Score is translated into a Final Condition Score (5 – Good, 4 – Fairly Good, 3 – Moderate, 2 – Fairly Poor, 1 – Poor) based upon the previously determined River Type (see supporting information for (Gurnell, et al., 2020b). This is undertaken automatically within the online recording system, based on the thresholds detailed in Table 2-17. The thresholds shown in this table are used to determine the Final Condition Score depending on the river type of the reach surveyed. The River Condition Score determined is shown in section 3.7.3.

Table 2-17: Final Condition Score thresholds

River Type	Likely best average condition score	Lower threshold for 5 – Good	Lower threshold for 4 – Fairly Good	Lower threshold for 3 – Moderate	Lower threshold for 2 – Fairly Poor	Likely worst average condition score, 1 – Poor
Canal/ navigable	1.8	1.4	0.7	-0.1	-1.2	-2.5
Large river	2.5	2.0	1.3	0.3	-1.0	-2.5
A	2.4	1.9	1.2	0.2	-1.0	-2.5
B	2.7	2.2	1.4	0.2	-0.9	-2.5
C	2.7	2.2	1.4	0.2	-0.9	-2.5
D	2.7	2.2	1.4	0.2	-0.9	-2.5
E	2.7	2.2	1.4	0.2	-0.9	-2.5
F	2.8	2.3	1.5	0.4	-0.9	-2.5
G	3.0	2.5	1.6	0.5	-0.9	-2.5
H	2.9	2.4	1.6	0.5	-0.9	-2.5
I	3.1	2.5	1.7	0.6	-0.8	-2.5
J	2.8	2.3	1.5	0.4	-0.9	-2.5
K	2.4	1.9	1.2	0.2	-1.0	-2.5
L	2.4	1.9	1.2	0.2	-1.0	-2.5
M	2.4	1.9	1.2	0.2	-1.0	-2.5

Source: (Gurnell, England, Shurker, & Wharton, 2020a)

Ditch Macroinvertebrates

2.7.30 In accordance with Buglife ditch survey guidance (Palmer, Drake, & Stewart , 2013),macroinvertebrate results were used to generate the following four community metrics:

- Native Invertebrate Species Richness – The number of native aquatic taxa recorded;
- Invertebrate Species Conservation Status Score – (Species Quality Index – average score per native taxon). Scores according to the relative rarity of species present. The Invertebrate Species Conservation Status Score (SQI) cannot be calculated if a sample contains fewer than ten invertebrate taxa;
- Invertebrate Habitat Quality Score – For invertebrates, the proportion of species faithful to the grazing marsh habitat (i.e. seldom found in other habitats). Calculated for information however of limited relevance in a ditch network; and
- Invertebrate Community Naturalness – The sum of threat scores for introduced species, expressed as a negative score. The threat scores are given in the methodology and relate to the potential impact of introduced species.

Ditch Macrophytes

2.7.31 In accordance with Buglife ditch survey guidance (Palmer, Drake, & Stewart , 2013), Ditch macrophyte results were used to generate the following four community metrics:

- Native Plant Species Richness – Number of native aquatic species recorded, based on check list provided by the Buglife (Palmer, Drake, & Stewart , 2013) methodology;
- Plant Species Conservation Status Score – Scores according to the relative rarity of the species;
- Plant Habitat Quality Score – Uses water quality as a surrogate as it is one of the important variables influencing ditch vegetation. The presence of species typical of waters with relatively low fertility is a good indication that water quality is good. Vascular plant species sensitive to enrichment are identified by referring to the British Ellenberg nitrogen indicator values for plants (Hill, Preston, & Roy, 2004) and
- Plant Community Naturalness – The sum of threat scores for introduced species, expressed as a negative score. The threat scores are given in the methodology and relate to the potential impact of introduced species.

PSYM Ponds

2.7.32 PSYM pond survey results were used to generate the following indices method (Pond Conservation, 2002):

- Average Score Per Taxon (ASPT) and number of scoring taxa (NTAXA) – indicating biological water quality and organic nutrient enrichment.
- Biomonitoring Working Party (BMWP) index is calculated by adding up the individual tolerance scores of aquatic macroinvertebrates at family taxonomic level present at a sample site

- Trophic Ranking Score (TRS) is a measure of the average trophic rank for the pond. This is calculated by assigning each plant species with a trophic score based on its affinity to waters of a particular nutrient status.
- The Index of Biotic Integrity (IBI) is calculated by combining the scores for each metric to produce an Index of which provides an overall indication of the ecological quality of the pond. Ponds are then categorised as Very Poor, Poor, Medium or Good.

2.7.33 The pond macroinvertebrate and macrophyte data was submitted to the Freshwater Habitats Trust (FHT) to be compared against the national pond database. This analysis provides a pond quality rating from Very Poor to Good and determines whether a pond is a 'Priority Pond' for conservation purposes.

2.8 Quality Assurance

2.8.1 All surveys and assessments were undertaken in accordance with the prescribed methodologies.

2.8.2 Surveys were led by appropriately trained and, where applicable, certified, or accredited surveyors.

2.8.3 Laboratory analysis of macroinvertebrate samples was subject to a quality assurance process involving re-processing of a proportion of samples by an experienced analyst.

2.9 Limitations and Assumptions

2.9.1 Biological records obtained from third parties and presented in the desk study do not represent a full and complete species list for the area. They are mostly given by individuals on an ad hoc basis, often meaning there are areas of deficiency in the data.

2.9.2 It should be noted that the absence of certain protected or rare species does not preclude their presence on a site. There is always the risk of protected or rare species being over-looked, either owing to the timing of the survey or the scarcity of the species at the site.

2.9.3 For the river fish (physical) survey, at the site upstream of the outfall, the thick reed bed made it difficult to retrieve the seine net and keep the lead line down. Seine netting is not as effective at capturing eels as electrofishing surveys. Sub-samples were taken where species numbers were high and time was limited, a sub sample of a minimum of 50 fish were measured from each run. From the sub-sample an average length has been calculated to estimate weight (g) using EA length weight data.

2.9.4 During the RHS along the right bank occasional clumps of terrestrial and riparian vegetation concealed the bank making it less evident at spot check 1.

2.9.5 Weed cutting limited the accuracy of the recording of in channel vegetation during the RCA.

2.9.6 Ditch vegetation surveys are optimally completed within the period mid-June to the end of September. However, due to the timescale and requirement for these

assessments, surveys were undertaken outside this season. The ditches which were surveyed outside of the optimum season are shown in Table 2-5 and Table 2-6.

2.9.7 Ditch WB129 was a deep channel with near-vertical banks of 2.5 m height. It consisted of dry, bare silt and was dominated by terrestrial vegetation. While it was considered likely to hold water intermittently, it was not surveyed for macroinvertebrates or macrophytes due to health and safety considerations;

2.9.8 Ditch WB095 was surveyed for macroinvertebrates during April 2021. However, it was not possible to survey macrophytes during when visited during summer as access was prevented by dense vegetation.

2.9.9 Pond surveys were carried out as early as possible within the constraints of this assessment, which was outside the optimal PSYM survey season (June to August inclusive). However, the pond assessment still provides a useful indication of pond quality, especially as the surveyed ponds are reasonably southerly located within the UK.

3 Results

3.1 Desk Study Results

3.1.1 Protected Species

3.1.2 Table 3-1 summarises the protected aquatic species records found during the desk study. The search returned four fish species, one macroinvertebrate species, and one aquatic plant species.

Table 3-1: Protected aquatic species returned from the desk study

Species	Group	EA biology site ID	NGR	Most recent record	Distance from Scheme Order Limits	Conservation status/ designation
Spined loach *(Cobitis taenia)*	Fish	EA site ID 41826	TL 51072 65753	23/02/2012	3.88km	Bern Convention Appendix 3; Habitats Directive Annex 2; NERC S. 41
European eels > elvers *(Anguilla anguilla)*	Fish	EA site ID 66604	TL 44777 57530	13/09/2019	5km	Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR); IUCN Red List Global post-2001 Critically Endangered; NERC S.41
Brown/ sea trout *(Salmo trutta)*	Fish	EA site ID 66605	TL 44642 57694	13/09/2019	5km	NERC S.41
European bullhead *(Cottus gobio)*	Fish	EA site ID 163772	TL 47337 59908	06/09/2018	1.5km	Habitats Directive Annex 2; NERC S.41
Opposite-leaved pondweed *(Groenlandia densa)*	Plant	EA site ID 56061	TL 50992 59430	17/04/2018	1km	IUCN Red List England post-2001 Vulnerable

Source: EA Ecology and Fish Data Explorer (Environment Agency, 2022) and Biological Records Centre (CPERC)

Non-native species

3.1.3 The summary of the INNS records derived by the desk study are shown in Table 3-2. Discounting those for which there may be some taxonomic uncertainty, eight distinct macroinvertebrate and five aquatic and riparian non-native plant species were returned in the search.

Table 3-2: Invasive non-native species derived from desk study

Taxon	Group	Data source	NGR	Most recent record	Distance from Scheme Order Limits
Florida crangonyctid *(Crangonyx floridanus)*	Invertebrate	EA biology site ID 6063	TL 50789 65663	28/11/2018	0.285km
Northern River/Florida crangonyctid *(Crangonyx pseudogracilis/ floridanus)*	Invertebrate	EA biology site ID 56074	TL 48567 62009	29/08/2012	0.288km
Demon shrimp *(Dikerogammarus haemobaphes)*	Invertebrate	EA biology site ID 56041	TL 53763 69885	22/10/2015	4.76km
Zebra mussel *(Dreissena polymorpha)*	Invertebrate	EA site ID 56041	TL 53763 69885	15/04/2013	4.76km
Freshwater limpet *(Ferrissia wautieri)*	Invertebrate	EA site ID 56063	TL 50789 65663	28/11/2018	0.285km
Amphipod crustacean *(Gammarus tigrinus)*	Invertebrate	EA site ID 56041	TL 53763 69885	09/09/2013	4.82km
Bladder snail *(Physella sp.)*	Invertebrate	EA site ID 56063	TL 50789 65663	28/11/2018	0.285km
European physa *(Physella acuta)*	Invertebrate	EA site ID 161025	TL 45263 56967	04/11/2019	5km
Tadpole physa *(Physella gyrina)*	Invertebrate	EA site ID 161025	TL 45263 56967	14/04/2016	5km

Taxon	Group	Data source	NGR	Most recent record	Distance from Scheme Order Limits
New Zealand mud snail *(Potamopyrgus antipodarum)*	Invertebrate	EA site ID 56063	TL 50789 65663	28/11/2018	0.285km
New Zealand pigmyweed *(Crassula helmsii)*	Plant	Biological Records Centre	TL 47140 59140	01/05/2014	2.25km
Waterweed species *(Elodea* sp.)	Plant	EA site ID 163772	TL 47337 59908	06/09/2018	1.45km
Canadian waterweed *(Elodea canadensis)*	Plant	EA site ID 56061	TL 50992 59430	09/09/2013	1km
Japanese knotweed *(Fallopia japonica)*	Plant	Biological Records Centre	TL 4446 5874	01/05/2014	3.64km
Giant hogweed *(Heracleum mantegazzianum)*	Plant	Biological Records Centre	TL 4744 6134	01/05/2014	0km
Floating pennywort *(Hydrocotyle ranunculoides)*	Plant	EA site ID 56074	TL 48567 62009	29/08/2012	0.283km
Indian balsam *(Impatiens glandulifera)*	Plant	Biological Records Centre	TL 4732 5991	01/05/2014	1.63km

Source: EA Ecology and Fish Data Explorer (Environment Agency, 2022) and Biological Records Centre (CPERC)

3.2 River Fish – Physical Survey

3.2.1 Survey detail and environmental information captured alongside fish surveys are shown in Table 3.3 below.

Table 3-3: Fish survey and environmental information

Site	Nets	Water Level (L/M/H)	Temp (°C)	Conductivity (µS)	DO (mg/l)	Substrate (%)	Habitat type
1 - Upstream of existing and proposed outfalls	2	Medium	19.50	823.00	9.74	Boulders – 1 Silt – 98 Compacted clay -1	Glide

Site	Nets	Water Level (L/M/H)	Temp (°C)	Conductivity (µS)	DO (mg/l)	Substrate (%)	Habitat type
2 - Downstream of existing and proposed outfalls	2	Medium	19.80	930.00	7.63	Cobbles - 20 Gravel - 30 Fine sand - 20 Silt - 30	Glide

3.2.2 River Cam upstream of existing and proposed outfalls

3.2.3 Table 3-4 summarises the survey catch, estimated population abundance (n), estimated density (n/100m2) and estimated biomass (g/100m2) of species identified at the River Cam upstream survey site.

3.2.4 The fish survey results included three-spined stickleback (*Gasterostreus aculeatus)*, nine-spined stickleback (*Pungitius pungitius)*, bullhead (*Cottus gobio*), spined loach (*Cobitis taenia*), roach (*Rutilus rutilus*) (sub-sampled), bitterling (sub-sampled) (*Rhodeus sericeus*), chub (*Squalius cephalus)* and gudgeon (*Gobio gobio*). These are shown in

3.2.5 Table 3-4. Eight taxa were recorded at the upstream survey location.

Table 3-4: River Cam upstream fish survey results

Net	Common name	Scientific name	Abundance	Estimated Density ($n/100m^2$)	Estimated Biomass ($g/100m^2$)
1	Three-spined stickleback	*Gasterostreus aculeatus*	10	16	16
	Nine-spined stickleback	*Pungitius pungitius*	16	25	23
	Bullhead	*Cottus gobio*	2	3	6
	Spined Loach	*Barbatula barbatula*	1	2	9
	Roach (sub-sampled)	*Rutilus rutilus*	255	401	92
	Bitterling (sub-sampled)	*Rhodeus sericeus*	1377	2163	589
	Chub	*Squalius cephalus*	3	5	2
2	Three-spined stickleback	Gasterostreus aculeatus	1	2	2
	Nine-spined stickleback	Pungitius pungitius	4	6	6
	Bullhead	Cottus gobio	1	2	2

Gudgeon	Gobio gobio	1	2	1
Roach	Rutilus rutilus	13	20	4
Bitterling	Rhodeus sericeus	4	6	1

3.2.6 Figure 3.1 and Figure 3.2 below, show the length-frequency distribution histograms for the two species – roach and bitterling – where the count was greater than or equal to 30 fish.

Figure 3.1: Species length-frequency distributions of roach on the River Cam upstream

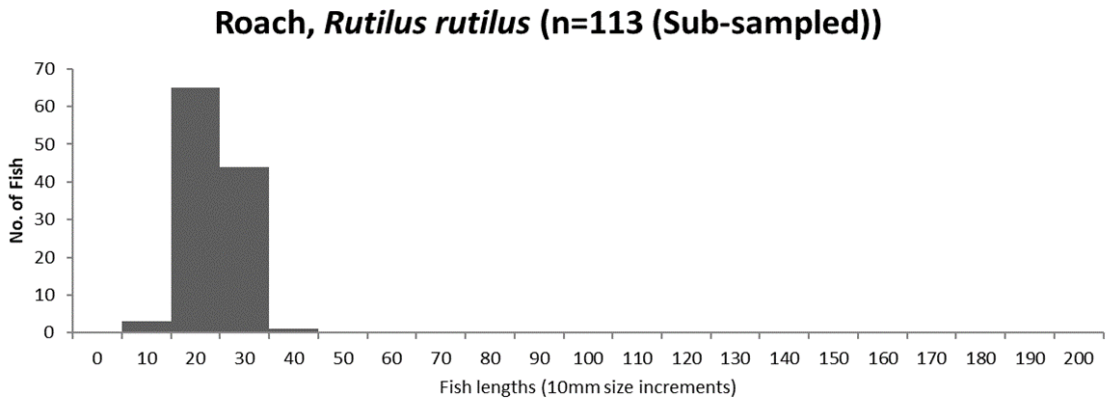
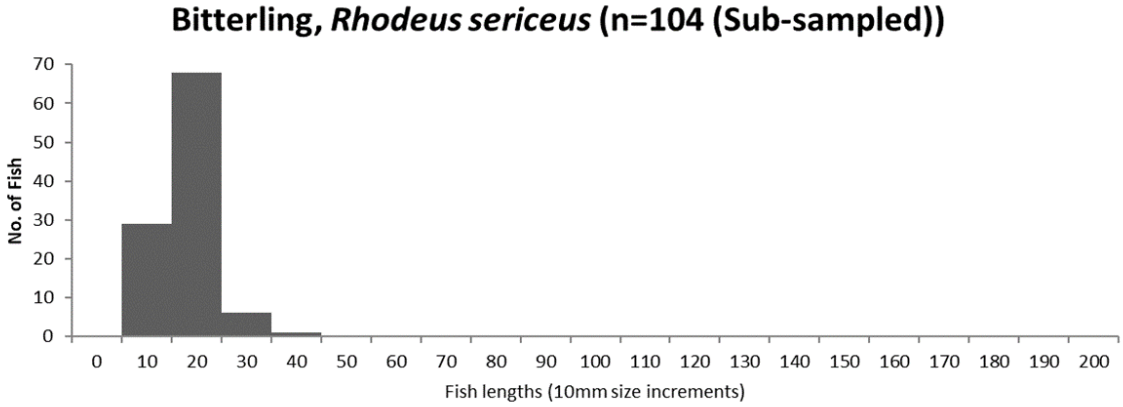


Figure 3.2: Species length-frequency distributions of bitterling on the River Cam upstream



3.2.7 The predominant flow type was glide. The bed substrate mainly comprised of silt. Boulders and compacted clay were minor substrate constituents.

River Cam downstream of existing and proposed outfalls

3.2.8 Table 3-5 summarises the survey catch, estimated population abundance (*n*), estimated density (*n*/100m^2) and estimated biomass (g/100m^2) of species identified at the River Cam downstream of outfall survey site.

3.2.9 The results included nine-spined stickleback, bullhead, gudgeon, roach, bitterling, and chub. These are shown in Table 3-5. Species length-frequency distributions at this survey site are shown in Figure 3.3 and 3.4 below. Six taxa were recorded at the downstream survey point. The predominant flow type was glide. The bed substrate mainly comprised of cobbles, gravel, fine sand, and silt. The survey reach was heavily modified with reshaped channel walls reinforced with concrete.

Table 3-5: River Cam downstream survey results

Net	Common name	Scientific name	Abundance	Estimated Density (n/100m^2)	Estimated Biomass (g/100m^2)
1	Nine-spined stickleback	*Pungitius pungitius*	5	8	5
	Bullhead	*Cottus gobio*	1	2	1
	Gudgeon	*Gobio gobio*	15	24	14
	Roach	*Rutilus rutilus*	42	66	19
	Bitterling	*Rhodeus sericeus*	63	99	62
	Chub	*Squalius cephalus*	1	2	0.3
2	Nine-spined stickleback	*Pungitius pungitius*	2	3	3
	Spined Loach	*Cobitis taenia*	1	2	12
	Gudgeon	*Gobio gobio*	2	3	1
	Roach	*Rutilus rutilus*	5	91	36
	Bitterling (sub-sampled)	*Rhodeus sericeus*	199	313	342

3.2.10 Figure 3.3 and Figure 3.4 below, show the length-frequency distribution histograms for the two species – roach and bitterling – where the count was greater than or equal to 30 fish.

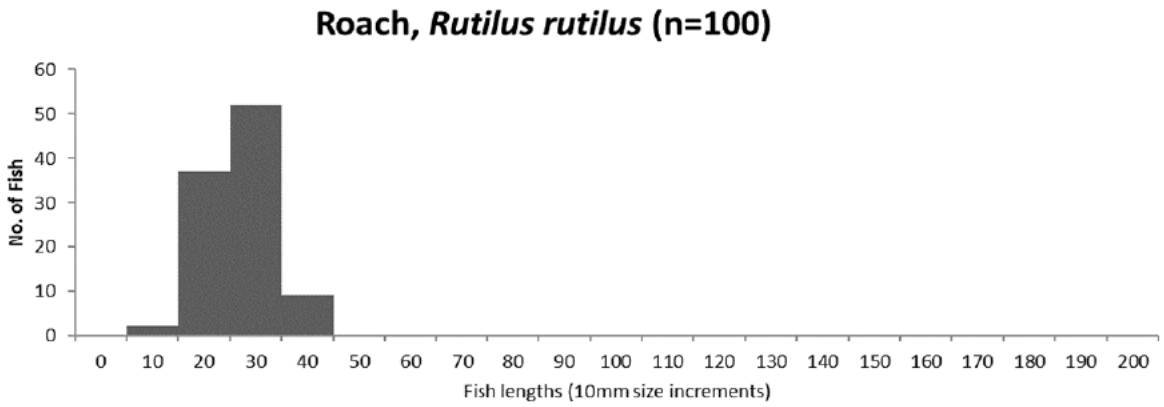


Figure 3.3: Species length-frequency distributions of roach on the River Cam downstream of the outfall.

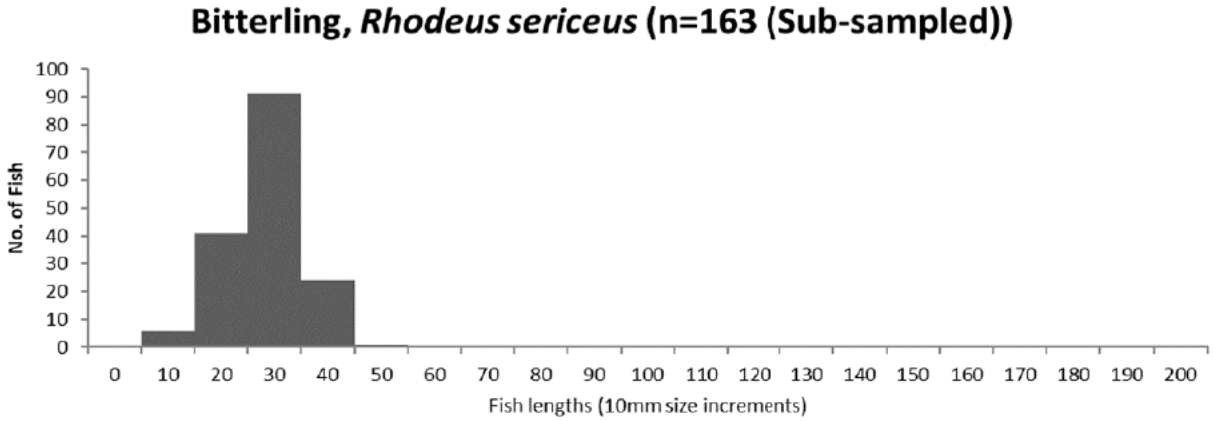


Figure 3.4: Species length-frequency distribution of bitterling on the River Cam downstream of the outfall

3.3 River Fish – Environmental DNA

River Cam upstream of existing and proposed outfalls

3.3.1 In Summer 2021 (samples taken 29 July 2021) a total of 15 taxa were detected (see, Table 3-6). Roach were found to have the greatest proportion of eDNA sequencing output allocated. Species of note include: European eel (*Anguilla anguilla* – Critically Endangered, S41), spined loach (S41, SAC Habitat directive Annex II – Non-priority), and European bullhead (SAC Habitat directive Annex II – Non-priority).

Table 3-6: Fish species detected in eDNA sample upstream of outfalls in summer 2021

Species	Common Name
Anguilla anguilla	European eel
Cobitis taenia	Spined loach
Abramis brama	Common bream
Alburnus alburnus	Bleak
Blicca bjoerkna	Silver bream

Species	Common Name
Gobio gobio	Gudgeon
Rhodeus sericeus/amarus	Bitterling species
Rutilus rutilus	Roach
Tinca tinca	Tench
Esox lucius	Northern pike
Gasterosteus aculeatus	Three-spined stickleback
Pungitius pungitius	Nine-spined stickleback
Gymnocephalus cernua	Ruffe
Perca fluviatilis	Perch
Cottus gobio	European bullhead

3.3.2 In Autumn 2021 (samples taken 25/10/2021) a total of three taxa were detected upstream of the outfall (see Table 3-7) – roach, bitterling and nine-spined stickleback, of which bitterling are a non-native species. Each of these species had been previously detected by physical survey and eDNA sampling. The low number of species suggests a seasonal effect on the efficacy of the technique.

Table 3-7: Fish species detected in eDNA sample upstream of outfalls in autumn 2021

Species	Common Name
Rhodeus sericeus/amarus	Bitterling species
Rutilus rutilus	Roach
Pungitius pungitius	Nine-spined stickleback

River Cam downstream of existing and proposed outfalls

3.3.3 In Summer 2021 (samples taken 29/07/2021) a total of 16 taxa were detected (see Table 3-8). The most abundant sequence of eDNA as with the upstream site belonged to roach. Species found which are of note include European eel (IUCN Critically Endangered & S41), spined loach (SAC Habitat directive Annex II- Non-priority & S41), and European bullhead (SAC Habitat directive Annex II- Non-priority).

Table 3-8: Fish species detected in eDNA sample downstream of outfalls in summer 2021

Scientific name	Common Name
Anguilla anguilla	European eel
Cobitis taenia	Spined loach
Abramis brama	Common bream
Alburnus alburnus	Bleak
Blicca bjoerkna	Silver bream
Gobio gobio	Gudgeon
Rhodeus sericeus/amarus	Bitterling species

Scientific name	Common Name
Rutilus rutilus	Roach
Tinca tinca	Tench
Barbatula barbatula	Stone loach
Esox lucius	Pike
Gasterosteus aculeatus	Three-spined stickleback
Pungitius pungitius	Nine-spined stickleback
Gymnocephalus cernua	Ruffe
Perca fluviatilis	Perch
Cottus gobio	European bullhead

3.3.4 In Autumn 2021 (25/10/2021) only one taxon was detected at the downstream site (see Table 3-9) – the invasive non-native species bitterling, which had previously been recorded by other techniques. Similarly to the upstream site, a seasonal effect on the effectiveness of the technique is indicated.

Table 3-9: Fish species detected in eDNA sample downstream of outfalls in autumn 2021

Species	Common Name
Rhodeus sericeus/amarus	Bitterling species

3.4 River Macroinvertebrates

3.4.1 On the River Cam at the two sampling points, upstream and downstream of the proposed and existing outfalls, macroinvertebrate samples were taken in Spring and Autumn 2021. Table 3-10 shows the observed (raw) macroinvertebrate index scores for both samples on the River Cam, whilst O:E ratios generated by RICT analysis are shown in Table 3-11 for relevant indices (ie WHPT, LIFE, PSI).

Table 3-10: Observed river macroinvertebrate biotic indices

Biotic Index	Upstream outfalls Spring	Downstream outfalls Spring	Upstream outfalls Autumn	Downstream outfalls Autumn
WHPT ASPT	4.35	3.93	4.13	3.51
WHPT NTAXA	24	23	23	22
LIFE	6.10	5.82	6.04	5.71
PSI	0.00 (Heavily sedimented)	0.00 (Heavily sedimented)	2.00 (Heavily sedimented)	3.33 (Heavily sedimented)
CCI	7.00 (Moderate conservation value)	3.75 (Low conservation value)	8.04 (Moderate conservation value)	5.00 (Low conservation value)

Table 3-11: Observed:expected ratios for river macroinvertebrate biotic indices

Biotic Index	Upstream Spring	Downstream Spring	Upstream Autumn	Downstream Autumn
WHPT ASPT O:E	1.053	0.950	1.034	0.878
WHPT NTAXA O:E	0.898	0.861	0.881	0.843
LIFE TL5 (Species) O:E	1.044	0.995	1.053	0.995
PSI TL5 (Species) O:E	0.000	0.000	0.360	0.586
WHPT ASPT O:E	1.053	0.950	1.034	0.878
WHPT NTAXA O:E	0.898	0.861	0.881	0.843

3.4.2 In both spring and autumn 2021, WHPT ASPT was notably higher for the upstream site in comparison to downstream. WHPT NTAXA was also lower downstream in both cases, though only by one taxon. These result may indicate an impact from the existing outfall.

3.4.3 LIFE O:E scores were above 1 for the upstream site in both spring and autumn 2021. LIFE O:E scores were slightly below 1 for the downstream site, though still above the threshold of 0.945 which may indicate a flow impact. Supressed scores for the downstream site may be due to co-dependence of the WHPT and LIFE indices (ie some species are sensitive to flow and water quality). As this reach of the River Cam is characteristically sluggish, it is not expected to support a particularly flow-sensitive assemblage, overall it is not evident that the community is flow stressed at this location.

3.4.4 PSI scores were notably low at both sites and in both seasons, indicating that the site is 'Heavily sedimented' (Extence, et al., 2011). This interpretation is consistent with the characteristic sluggish and largely depositional nature of this reach of the River Cam.

3.4.5 CCI scores for the upstream site were equivalent to 'Moderate conservation value' (Chadd & Extence, 2004), and 'Low conservation value' at the downstream site. It is interpreted that the assemblage within this reach of the River Cam is of at least Moderate conservation value, but that the conservation value may be reduced by water quality impacts.

3.4.6 WHPT EQR scores were further processed to produce an indicative WFD status for the two sites, as shown in Table 3-12 below. Reflecting the differences seen in raw scores, EQR scores were higher for the upstream site than the downstream site, indicating High and Good WFD status for these sites respectively.

Table 3-12: Table of EQR results and indicative WFD status

Site	Season	WHPT ASPT EQR	WHPT NTAXA EQR	Overall WHPT ASPT EQR	Overall WHPT NTAXA EQR	Indicative WFD Status
Upstream outfalls	Spring	1.039	0.950	1.046	0.943	High
	Autumn	1.053	0.937			
Downstream outfalls	Spring	0.957	0.914	0.925	0.906	Good
	Autumn	0.894	0.899			

3.4.7 Non-native macroinvertebrate taxa recorded are detailed in Table 3-13. As shown, two distinct taxa were found, both of which are amphipod crustaceans. These were the High impact (WFD-UKTAG, 2021) demon shrimp (*Dikerogammarus haemobaphes*) and the Low impact Northern River/Florida crangonyctid (*Crangonyx pseudogracilis/floridanus* agg.).

Table 3-13: Non-native aquatic invertebrate taxa recorded in river macroinvertebrate samples

Season	Site	Taxa	Common name	Risk UK TAG WFD (WFD-UKTAG, 2021)
Spring	R. Cam U/S outfalls	*Crangonyx pseudogracilis/ floridanus* agg.	Northern River/ Florida crangonyctid	Low impact
	R. Cam D/S outfalls	*Crangonyx pseudogracilis/ floridanus* agg.	Northern River/ Florida crangonyctid	Low impact
		Dikerogammarus haemobaphes	Demon shrimp	High impact
Autumn	R. Cam U/S outfalls	*Crangonyx pseudogracilis/ floridanus* agg.	Northern River/ Florida crangonyctid	Low impact
		Dikerogammarus haemobaphes	Demon shrimp	High impact
	R. Cam D/S outfalls	*Crangonyx pseudogracilis/ floridanus* agg.	Northern River/ Florida crangonyctid	Low impact
		Dikerogammarus haemobaphes	Demon shrimp	High Impact

3.5 River Macrophytes

3.5.1 Macrophyte surveys were conducted on the River Cam on 9 September 2021 on the River Cam at two locations: one upstream and one downstream of both the existing and proposed outfall locations. Macrophyte taxa and associated cover values are shown in Table 3-14 below.

Table 3-14: Taxon cover values (TCV) for taxa identified at River Cam downstream and upstream survey sites

Taxa	Common Name	Taxonomic group	Upstream TCV	Downstream TCV	LEAF-PACS 2 Scoring taxon
Lemna minuta	Least duckweed	Higher plant	0	2	Yes
Elodea nuttallii	Nuttall's pondweed	Higher plant	6	2	Yes
Sparganium emersum	Unbranched bur-reed	Higher plant	6	8	Yes
Ceratophyllum demersum	Rigid hornwort	Higher plant	3	5	Yes
Cladophora glomerata/ Rhizoclonium hieroglyphicum	Blanket weed	Algae	5	5	Yes
Ulva flexuosa	Gut weed	Algae	2	2	Yes
Lemna gibba	Swollen duckweed	Higher plant	2	2	Yes
Nuphar lutea	Yellow water lily	Higher plant	7	6	Yes
Carex riparia	Greater pond sedge	Higher plant	0	2	Yes
Spirogyra sp.	Slimy unbranched algae	Algae	1	6	Yes
Phalaris arundinacea	Reed canary grass	Higher plant	0	1	Yes
Sagittaria sagittifolia	Arrowhead	Higher plant	3	2	Yes
Stuckenia pectinata	Fennel pondweed	Higher plant	1	1	Yes
Callitriche sp.	Water starwort	Higher plant	0	2	Yes
Glyceria maxima	Reed sweet grass	Higher plant	0	2	Yes
Iris pseudacorus	Yellow flag iris	Higher plant	0	2	Yes
Stachys palustris	Marsh woundwort	Higher plant	1	0	No

Taxa	Common Name	Taxonomic group	Upstream TCV	Downstream TCV	LEAF-PACS 2 Scoring taxon
Butomus umbellatus	Flowering rush	Higher plant	1	0	Yes
Sparganium erectum	Branched bur reed	Higher plant	5	0	Yes
Potamogeton perfoliatus	Perfoliate pondweed	Higher plant	2	0	Yes
Scrophularia auriculata	Water figwort	Higher plant	1	0	No
Nitella mucronata var. *gracillima*	Stonewort	Algae	3	0	Yes (at genus level)
Potamageton lucens	Shining pondweed	Higher plant	4	2	Yes
Carex acutiformis	Lesser pond sedge	Higher plant	1	0	Yes
Solanum dulcamara	Woody nightshade	Higher plant	2	0	No
Epilobium hirsutum	Hairy willow herb	Higher plant	1	0	No
Lycopus europaeus	Gypsywort	Higher plant	1	0	No

3.5.2 Biotic indices, and indicative WFD status for both sites are shown in Table 3-15.

Table 3-15: Macrophyte LEAFPACS2 indices for survey sites on the River Cam

Site	River Cam upstream	River Cam downstream
Taxa Count	22	17
Observed RMNI	8.54	8.49
Expected RMNI	7.547	7.543
Observed aquatic NTAXA	14	13
Expected NTAXA	9.85	9.85
Observed NFG	8	8
Expected NFG	6.21	6.21
Expected ALG	0.5	0.5
ALG	8.05	25.50
EQR	0.484	0.413
Indicative WFD Status	Moderate	Moderate

3.5.3 RMNI scores were similar for the upstream and downstream sites, though higher than the expected values and potentially indicating nutrient pressure.

3.5.4 Observed aquatic NTAXA was also similar between the upstream and downstream sites (14 and 13 respectively) and also notably higher than expected values. Similarly, the number of functional groups (NFG)was the same at both sites (8), and higher than the expected values. These two diversity indices suggest that macrophyte diversity at the community level is not adversely affected by environmental pressures.

3.5.5 For both sites, filamentous algae cover (ALG) was relatively high, and observably higher at the downstream site. In combination with RMNI scores, these results indicate that this reach of the River Cam is somewhat impacted by nutrient pressure, but also that the existing outfall may be having an effect.

3.5.6 The overall indicative WFD classification for the upstream and downstream sites was Moderate status, which appears to be most influenced by nutrient status.

3.5.7 No protected or notable taxa were observed during the surveys.

3.5.8 Both sites contained the invasive non-native Nuttall's waterweed, with greater coverage upstream of the existing and proposed outfalls, whilst the non-native species least duckweed (*Lemna minuta*) was recorded downstream.

3.6 River Habitat Survey

3.6.1 The River Cam in the vicinity of the new outfall proposed downstream of the A14 bridge is a navigable waterway, with a 20m water width and an approximate bank full width of 20.5m. It is likely to have been modified through realignment, over-deepening and over-widening of the channel. It was evident that both banks had been re-sectioned and re-enforced, although the left bank was modified extensively across the whole reach whereas the right bank in the vicinity of spot checks 4, 7 and 9 was not obviously modified. The reach was observed to be sluggish with little flow heterogeneity and habitat diversity. Table 3-16 below provides a summary of the Survey results.

Table 3-16: River Habitat Survey summary

Site	River Cam at A14
Date	30/06/2021
Grid reference start	TL 48473 61921
Grid reference end	TL 48341 61429
Site surveyed from	Left bank
Habitat Modification Score (HMS)	3405
Habitat Modification Class (HMC) and descriptor	5 – Severely modified
Habitat Quality Assessment (HQA) score	35
Habitat Quality Assessment (HQA) class and descriptor	2 - Good
River Habitat Quality Class and descriptor	4 - Poor
Riparian Quality Index score (class)	44 (4)

Habitat Modification Score

3.6.2 The HMS suggests a Severely Modified channel (see Table 3-16). A score of 3405 was driven predominantly by modifications to the banks (see Figure 3.6 - Section 3.7); it was also recorded that the reach has an area of reinforced bed, whilst a major bridge and minor outfall contributed to the score.

Habitat Quality Assessment Score

3.6.3 The HQA score of 35 was predominately driven by the presence of channel vegetation, bank vegetation and channel substrate, although some flow diversity, land use and trees also contributed to the HQA score. No features were recorded on the left bank.

3.6.4 Submerged broad-leaved, linear leaved and fine leaved vegetation were present along the reach. Emergent reeds and sedges were present at spot check 5, 6, 9 and 10. No channel shading, overhanging boughs, exposed and submerged tree roots, fallen trees or large woody debris to provide flow refugia was observed in the channel.

3.6.5 An area of marginal deadwater was recorded as the only hydro-geomorphological feature, with no riffle, pools, or bars present.

Habitat Quality Class

3.6.6 In order to perform the context analysis and derive the HQA class and HQA class position, a silt substrate for one spot-check was assumed based on the flow types (smooth). This did not alter the HQA score which remained at 35.

3.6.7 A baseline HQA class of 2 is indicative of Good habitat diversity (Table 3-16) and the HQA class position is 66.7%, indicating that the surveyed river reach is above the average HQA for sites of similar type. Above average scores were returned for HQA in-stream channel vegetation and HQA Channel substrate score and HQA bank vegetation.

River Habitat Quality

3.6.8 A RHQ of 4 indicates that the surveyed reach has a poor quality overall when compared against benchmark sites, taking into account habitat quality and modification (Table 3-17).

Riparian Quality Index

3.6.9 A RQI score of 44 is indicative of a high quality riparian zone (Table 3-17). This score is comprised of:

- A complexity score of 21 (35% of the maximum). This is a low score that indicates poor vegetation structure complexity on both the bank top and bank face;
- A naturalness score of 16 (40% of the maximum). This is a low score suggesting banks within the surveyed reach are comprised of unnatural material with modifications, and/or land-use is also semi-natural; and

- A continuity score of 7 (35% of the maximum). This is a low score and indicates a simple riparian vegetation structure is present on the bank face or bank top within the surveyed reach. The right bank did have occasional clumps of trees, but none were recorded on the left bank.

Hydromorphological Indices

3.6.10 The Channel Substrate Index (CSI) score of -1.6390 (Table 3-17) indicates the dominance of silt substrate within the reach.

3.6.11 Flow Regime Index (FRI) score of -1.1980 (Table 3-17) weighted on all 10 spot-checks, suggests that flow types within the site are dominated by smooth and sluggish flow types remain a substantial proportion of the total flow regime.

3.6.12 Channel Vegetation Index (CVI) score of -0.7560 (Table 3-17), weighted on observations made at three spot-checks only, suggests channel vegetation at the site is dominated by both emergent reeds and sedges but also submerged

3.6.13 broad-leaved, linear leaved and fine leaved vegetation.

3.6.14 Geomorphic Activity Index (GAI) score of -0.8250 (Table 3-17), weighted on observations in all 10 spot-checks, suggests the site has little geomorphic activity with little or no sign of erosion and deposition features.

Table 3-17: Summary of River Habitat Surveys indices calculated for River Cam

Habitat Modification Score		Habitat Quality Assessment	
Habitat Modification Class:	5	HQA Score:	35
Habitat Modification Score:	3405	HQA 1994 adjusted:	31
		Baseline HQA Class:	2
		HQA class position:	66.7%
		River Habitat Quality Class:	4
Hydromorphological Indices		**Riparian Quality Index**	
Channel Substrate Index	-1.6390	Riparian Quality Index class:	4
Flow Regime Index:	-1.1980	Riparian Quality Index score:	44
Geomorphic Activity Index:	-0.8250	Complexity subscore:	21
Channel Vegetation Index:	-0.7560	Naturalness subscore:	16
		Continuity subscore:	7

3.7 River Condition Assessment

3.7.1 Following the methodologies described in Table 2-16, the River Type parameters derived are shown in Table 3-18.

Table 3-18: Results from River Type Desk Study for River Cam

Parameter	River Cam
River Category	Navigable
A1: Braiding Index	1
A2: Sinuosity Index	1.13360322
A3: Anabranching Index	1
A4: Level of Confinement	Unconfined

Parameter	River Cam
A5: River Reach Gradient	0.00101214577
A6: Bedrock Reach	False
A7: Coarsest Bed Material	Gravel-pebble
A8: Average Bed Material	Sand

3.7.2 The positive and negative index values, and the Preliminary Condition Scores generated when these values are summed, are shown in Table 3-19 as well as the Final Condition Class.

Table 3-19: River Condition Indicator scores and Final Condition Class for River Cam

River Condition Indicator	River Cam
Positive Index Average	1.26
Negative Index Average	-1.69
Preliminary Condition Score	-0.43
Final Condition Class	**Fairly Poor**

3.7.3 The Final Condition Class for the River Cam section covered by the MoRPh5 sub-reach was 'Fairly Poor'. This follows the threshold guidance for a navigable river shown in Table 2-17 (section 2.7). A more detailed breakdown on how this score was calculated and what aspects of the river resulted in this class is seen in Table 3-20, Table 3-21, Table 3-22 and Table 3-23 which list the individual indicator scores.

Bank tops

Table 3-20: Bank top indicator scores

River Condition Indicator	Indicator Score
B1 – Banktop vegetation structure	2
B2 – Banktop tree feature richness	1
B3 – Banktop water-related features	0
B4 – Banktop NNIPS cover	0
B5 – Banktop managed ground cover	-3

3.7.4 A Bank top managed ground cover score of -3 was attributed to all MoRPh5 sub-reaches. This is due to the urbanised surroundings, in which land uses included transport infrastructure and pedestrianised footpath (Figure 3.5, below).

3.7.5 Bank top vegetation structure achieved a moderate score of 2. This reflected moderate diversity and abundance of riparian vegetation on the right bank, particularly within the permanently vegetated recreation, in contrast to the less natural left bank which had direct access to the channel for mooring.

3.7.6 Trees were sparse but present along the left and right banks, hence a score of 1 for Banktop tree feature richness. A score of trace was also recorded for trees trailing into channel.

3.7.7 No NNIPS were observed on the bank tops and therefore the Bank top NNIPS cover indicator score was 0.

Figure 3.5: Bank top managed ground cover example and outfall (Module 1, downstream)

3.7.8 Bank top water-related features (wetlands, ponds, functional side channels) within 10m of the bank tops were absent in all modules and therefore scored 0.

Bank face

Table 3-21: Bank face indicator scores

River Condition Indicator	Indicator Score
C1 – Bank face riparian vegetation structure	1
C2 – Bank face tree feature richness	1
C3 – Bank face natural profile extent	2
C4 – Bank face natural profile richness	3
C5 – Bank face natural channel material richness	1
C6 – Bank face bare sediment extent	1
C7 – Bank face artificial profile extent	-4
C8 – Bank face reinforcement extent	-4
C9 – Bank face reinforcement material severity	-4
C10 – Bank face NNIPS cover	0

3.7.9 The bank faces were determined to be obviously re-shaped (see Figure 3.6), therefore all sub-reaches were assigned very low Bank face artificial profile extent score. Due to extensive concrete and steel bank reinforcements, Bank face reinforcement extent and Bank face reinforcement material severity scored -4.

3.7.10 However, the Bank face natural profile extent score was higher as the right bank did have semi-natural profiles.

3.7.11 The Bank face natural channel material richness score was a 1 due to the presence of earth in the top zone of the banks.

3.7.12 The Bank face riparian vegetation structure score was 1. It was not possible for vegetation to establish on the bank face of the left bank as the reinforcements prevented this. Although, where there were natural materials on the right bank face vegetation was supported (see Figure 3.7, below).

Figure 3.6: Bank face artificial profile extent example (Module 3, upstream)

Figure 3.7: Bank face riparian vegetation structure (Module 4, cross section)

Figure 3.8: Bank face riparian vegetation structure (Module 4, cross section)

3.7.13 Throughout much of the site, bankside trees were relatively sparse, with the Bank face tree feature richness indicator scoring 1. Bank face natural profile richness was

a high score of 3 indicating that there are sections of the reach where the natural bank profile types were recorded along the reach most likely due to the lack of reinforcement present.

3.7.14 No NNIPS were observed on the bank faces and therefore the Bank face NNIPS cover indicator score was 0.

Channel margin

Table 3-22: Channel margin indicator scores

River Condition Indicator	Indicator Score
D1 – Channel margin aquatic vegetation extent	2
D2 – Channel margin aquatic vegetation morphotype richness	2
D3 – Channel margin physical feature extent	0
D4 – Channel margin physical feature richness	0
D5 – Channel margin artificial features	-1

3.7.15 Channel margin physical feature extent had a low score of 0. This indicator records the extent of marginal physical features and there were non-present due to reinforcement and channel reshaping. Channel margin physical feature richness indicates the number of physical features recorded, which was also 0.

3.7.16 Channel margin aquatic vegetation morphotype richness gained a moderate score of 2 reflecting the presence of amphibious vegetation, and emergent reeds.

3.7.17 Channel margin artificial features had a score of -1 and this is influenced by the presence of an outfall in module one on the left bank (see Figure 3.5 above).

Figure 3.9: Channel margin physical feature richness example (Module 4, upstream)

Channel

Table 3-23: Channel indicator scores

River Condition Indicator	Indicator Score
E1 – Channel aquatic morphotype richness	3
E2 – Channel bed tree features richness	1
E3 – Channel bed hydraulic features richness	1
E4 – Channel bed natural features extent	0
E5 – Channel bed natural features richness	0
E6 – Channel bed material richness	3
E7 – Channel bed siltation	0
E8 – Channel bed reinforcement extent	0
E9 – Channel bed reinforcement severity	0
E10 – Channel bed artificial features severity	-2
E11 – Channel bed NNIPS extent	-3
E12 – Channel bed filamentous algae extent	-1

3.7.18 Channel bed material richness had a high score of 3 with the presence of gravel-pebble, silt clay and organic (leaves, twigs, etc. not fully decomposed) recorded. The Channel bed siltation score was 0 as there was no additional silt layer recorded.

3.7.19 Channel bed natural features were very restricted and a score of 0 was recorded due to this. Channel bed natural feature richness also scored of 0. This can be largely attributed to the highly modified nature of the watercourse but also the lack of visibility of the channel bed due to the depth of the channel, it is possible that occasional features were missed.

3.7.20 Channel Bed hydraulic features richness only the flow types 'smooth', and 'no perceptible flow' were recorded leading to a low score of 1 (see Figure 3.9 above). The NNIPS had a score of -3.

Figure 3.10: Example of flow type recorded (Module 5, cross section)

3.7.21 Artificial features or reinforcements were not encountered within the channel, therefore a score of 0 was assigned for Channel bed reinforcement extent, and Channel bed reinforcement severity. Channel bed artificial features severity scored -2, which is due to the presence of a wide, extensive bridge in module 2 (see Figure 3.10 above).

3.7.22 Channel aquatic morphotype richness gained a high score of 3. Aquatic vegetation morphotypes encountered included floating leaved (rooted), free-floating, submerged broad-leaved, submerged linear-leaved, and submerged fine-leaved (see Figure 3.11 below).

Figure 3.11: Example of bridge (module 2, upstream)

Figure 3.12: Channel aquatic morphotype richness with example of weed cutting (Module 1, cross section)

3.7.23 Channel bed tree features richness scored 1. Trace (<5%) coverage of Vegetation shading channel and discrete accumulations of organic material (e.g. twigs and leaves) were recorded in modules.

3.7.24 Filamentous algae were observed and a score of -1 was given for Channel bed filamentous algae extent. The NNIPS Nuttall's waterweed was observed in the channel in all modules and therefore the Channel bed NNIPS cover indicator score was -3.

3.8 Ditch Macroinvertebrates

Waterbeach Pipeline Area

3.8.1 Fifteen ditches were surveyed for macroinvertebrates in the vicinity of the proposed Waterbeach Pipeline, the results of which are shown in Table 3-24. Site locations are also shown in Figure 8.14, Book of Figures – Biodiversity (App Doc Ref 5.3.8).

Table 3-24: Ditch macroinvertebrate biotic indices for sites within the vicinity of the Waterbeach Pipeline

Ditch	Native Invertebrate Species Richness	Invertebrate Conservation Status Score (SQI)	Invertebrate Habitat Quality Score	Invertebrate Community Naturalness
WB160	6	Not calculable	1	0
WB041	3	Not calculable	1	-2
WB047	18	1.1	1	-2
WB055	7	Not calculable	1.25	-3
WB123a	6	Not calculable	1	-3
WB120	11	1	1	-4
WB078	0	Not calculable	0	0
WB085	2	Not calculable	1	0
WB107	9	Not calculable	1.11	0
WB121	7	Not calculable	1.14	0
WB141	12	1	1	0
WB159	4	Not calculable	1	-2
WB234	7	Not calculable	1	0
WB245	10	1	1	0
WB297	5	Not calculable	1	0

3.8.2 Native Invertebrate Species Richness varied between the ditches from 0 (WB078) to 18 (WB047). No protected or notable macroinvertebrate species were found within these ditches. The Invertebrate Conservation Status Score (SQI) was only calculable for four ditches, with less than ten taxa recorded in each of the other eleven. Due to the low conservation value of the species recorded, the SQI was low (1 to 1.1) for these four ditches, indicating that these ditches are of low conservation value.

3.8.3 Few species associated with grazing marshes were found within these ditches. Consequently, Invertebrate Habitat Quality Scores were low, with only three ditches (WB055, WB107 and WB121) achieving scores greater than 1 (1.25, 1.11 and 1.14 respectively).

3.8.4 Eight ditches in the Waterbeach Pipeline survey area scored negatively for Naturalness for macroinvertebrates due to the presence of the non-native Northern River crangonyctid, New Zealand mud snail, and the bladder snail *Physella* sp..

Proposed WWTP Area

3.8.5 Seven ditches were surveyed for macroinvertebrates in the vicinity of the proposed WWTP area. Survey locations are shown in Figure 8.15, Book of Figures – Biodiversity (App Doc Ref 5.3.8), whilst resulting index scores are shown in Table 3-25.

Table 3-25: Ditch macroinvertebrate biotic indices for sites within the vicinity of the proposed WWTP

Ditch number	Native Invertebrate Species Richness	Invertebrate Conservation Status Score (SQI)	Invertebrate Habitat Quality Score	Invertebrate Community Naturalness
WB260	17	1.18	1	0
WB095	18	1.11	1	0
WB001	7	Not calculable	1	0
WB171 West	13	1.13	1	0
WB230	20	1.15	1	0
WB171 East	8	Not calculable	1	0
WB319	18	1.01	1	-3

3.8.6 Native Invertebrate Species Richness varied between the ditches from 7 (WB001) to 20 (WB230). The Invertebrate Conservation Status Score (SQI) was calculable for five ditches, with less than ten taxa recorded in each of the other two. No protected or notable macroinvertebrate species were found within the surveyed ditches. Due to the low conservation value of the species recorded, the SQI was low (1 to 1.18) for these five ditches, indicating that these ditches are of low conservation value.

3.8.7 Ditch WB319 had a negative Invertebrate Community Naturalness score of -3 due to the presence of the non-native Northern River/Florida crangonyctid at site WB319.

3.9 Ditch Macrophytes

Proposed Waterbeach Pipeline Area

3.9.1 Fifteen ditches were surveyed for macrophytes in the vicinity of the proposed Waterbeach Pipeline, the results of which are shown in Table 3-26. Site locations are shown in Figure 8.14, Book of Figures – Biodiversity (App Doc Ref 5.3.8).

Table 3-26: Ditch macrophyte biotic indices for sites within the vicinity of the Waterbeach Pipeline

Ditch number	Native Species Richness	Plant Species Conservation Status Score	Plant Habitat Quality Score	Plant Community Naturalness
WB160	5	1	1.42	-3
WB041	3	1	1	0

Ditch number	Native Species Richness	Plant Species Conservation Status Score	Plant Habitat Quality Score	Plant Community Naturalness
WB047	5	1	1.6	0
WB055	4	1	1.375	0
WB123a	4	1	1.375	0
WB120	2	1	1.5	0
WB078	2	1	1.33	-6
WB085	1	1	1.5	-3
WB107	4	1	1.2	-3
WB121	1	1	1.5	-3
WB141	11	1.091	1.375	-3
WB159	0	0	0	0
WB234	4	1	1.25	0
WB245	3	1	1.33	0
WB297	0	0	0	0

3.9.2 All ditches surveyed within the Waterbeach Pipeline survey area were generally of low quality, with protected or notable species recorded. The highest scoring species was hemlock water dropwort (*Oenanthe crocata*), which was recorded in WB141 and has a conservation score of 2 (locally notable). WB141 had the highest recorded native species richness at 11, with the highest conservation score of 1.091 due to the presence of hemlock water dropwort.

3.9.3 WB047 had the highest habitat quality score at 1.6 due to the presence of common duckweed (*Lemna minor*), water forget-me-not (*Myosotis scorpioides*) and brooklime (*Veronica beccabunga*), and the absence of non-native species.

3.9.4 The non-native invasive species water fern (*Azolla filiculoides*) was present in five ditches with the proposed Waterbeach Pipeline area: WB078, WB085, WB107, WB121, and WB141. The non-native species least duckweed was present in two ditches: WB078 and WB160. In total, seven ditches scored a negative naturalness score for macrophytes due to the presence of non-native species.

Proposed WWTP Area

3.9.5 Six ditches were surveyed for macrophytes in the vicinity of the proposed WWTP area. Survey locations are shown in Figure 8.15, Book of Figures – Biodiversity (App Doc Ref 5.3.8), whilst resulting index scores are shown in Table 3-27.

Table 3-27: Ditch macrophyte biotic indices for sites within the vicinity of the proposed WWTP

Ditch number	Native Species Richness	Plant Species Conservation Status Score	Plant Habitat Quality Score	Plant Community Naturalness
WB001 West	7	1	1	-3
WB260	6	1	1	-3
WB319	8	1	1	-3
WB171 West	8	1	1	-3
WB171 East	6	1	1.17	0
WB230	12	1	1	-3

3.9.6 Within the vicinity of the proposed WWTP, Native Species Richness scores ranged from 6 (WB260) to 12 (WB230). No species of conservation importance were recorded, resulting in Plant Species Conservation Status Scores of 1 for all ditches. The Plant Habitat Quality Score was also 1.

3.9.7 Five of the six ditches within the proposed WWTP area contained non-native plant species, including least duckweed (in WB260 and WB319) and Nuttall's waterweed (in WB260, WB319, WB001 West, WB230, and WB171 West. Consequently, these ditches each scored -3 in the Plant Community Naturalness index.

3.10 PSYM Ponds

3.10.1 Two ponds were surveyed using PSYM methodology. Both ponds were in the vicinity of the proposed Waterbeach Pipeline. Locations are shown in Figure 8.15, Book of Figures – Biodiversity (App Doc Ref 5.3.8) and results are summarised in Table 3-28 below.

Table 3-28: PSYM pond survey summary results

Index	PD008	PD047
No. uncommon Plant Species	1	0
Trophic Ranking Score (TRS)	6.30	8.70
ASPT	4.40	2.75
Odonata & Megaloptera (OM) Families	0	0
Coleoptera Families	3	0
Index of Biotic Integrity (%)	44%	28%
PSYM quality category	Poor	Poor
Priority Pond	No	No
BMWP	44	11

3.10.2 Pond PD008 was mostly unshaded (<1% overhung) with the pond base comprised of 95% clay/silt and 5% sand/gravel/cobbles. The pond was at an altitude of 5m, was approximately 5,500m^2 in surface area and had <0.1% emergent plant cover. Inflows were absent and the pH was 7.2 at the time of survey.

3.10.3 A total of ten scoring macroinvertebrate taxa were recorded, the Biological Monitoring Working Party (BMWP) score was 44 and the ASPT score was 4.4. Three water beetle families were identified: Haliplidae, Dytiscidae and Hydrophilidae. The non-native amphipod family Crangonyctidae was also found.

3.10.4 There were four emergent plants present, three were of common status; bulbous rush (*Juncus bulbosus*), hard rush (*Juncus inflexus*, and common reed (*Phragmites australis*); and one of local status, round-fruited rush (*Juncus compressus*).

3.10.5 The Trophic Ranking Score was 6.30; this pond was assessed as a Poor-Quality Pond and is therefore not considered a Priority Pond.

3.10.6 Pond PD047 was at an altitude of 5m, was approximately 120m^2 and had 50% emergent plant cover. Pond inflows were absent, and pH was 8.2 at the time of survey. The pond was heavily shaded (95%) with the pond base comprising 67% to 100% clay/silt. It was estimated that 0% of the pond margin was grazed.

3.10.7 Four scoring macroinvertebrate taxa were present and the BMWP score was 11, whilst the ASPT score was 2.8. These taxa included the diving beetle family Noteridae, freshwater hoglouse (family Asellidae), non-biting midge larvae (family Chironomidae) and aquatic worms (sub-class Oligochaeta).

3.10.8 Five emergent plant species and one free floating species were identified. The emergent plants were common species and comprised redshank (*Persicaria maculosa*), common reed, common bulrush (*Typha latifolia)*, gypsywort (*Lycopus europaeus)* and woody nightshade (*Solanum dulcamara*).

3.10.9 The Trophic Ranking Score was 8.70; this pond was assessed as a Poor-Quality Pond and is therefore not considered a Priority Pond.

4 References

Carle, F., & Strub, M. (1978). A New Method for Estimating Population Size from Removal Data. *Biometrics, 34*, 621-830.

Chadd, R., & Extence, C. (2004). The conservation of freshwater macroinvertebrate populations: a community based classification scheme. *Aquatic conservation: Marine and Freshwater Ecosystems, 14*(6), 597-624. doi:https://doi.org/10.1002/aqc.630

Davy-Bowker, J., Arnott, S., Close, R., Dobson, M., Dunbar, M., Jofre, G., . . . Gordon, V. (2010). Further Development of River Classification Tool. *SNIFFER project WFD100*.

Environment Agency. (2003). *The River Habitat Survey in Britain and Ireland Field Survey Guidance Manual: 2003 Version 1.* Peterborough: Environment Agency.

Environment Agency. (2022). Retrieved February 23, 2022, from EA Ecology & Fish Data Explorer: https://environment.data.gov.uk/ecology/explorer/

European Committee of Standardization. (2014). *Water Quality*. Retrieved from Guidelines for the Selection of Sampling Methods and Devices for Benthic Macroinvertebrates in Fresh Waters.

EU-STAR. (2004). RIVPACS Macro-invertebrate Sampling Protocol. Retrieved October 11, 2022, from http://www.eu-star.at/pdf/RivpacsMacroinvertebrateSamplingProtocol.pdf

Extence, C., Balbi, D., & Chadd, R. (1999). River Flow Indexing Using British Benthic Macroinvertebrates: A Framework for Setting Hydroecological Objectives. *Regulated Rivers: Research & Management, 15*(6), 545-574. doi:https://doi.org/10.1002/(SICI)1099-1646(199911/12)15:6<545::AID-RRR561>3.0.CO;2-W

Extence, C., Chadd, R., England, J., Dunbar, M., Wood, P., & Taylor, E. (2011). The Assessment of Fine Sediment Accumulation in Rivers Using Macro-invertebrate Community Response. *River Research and Applications, 29*(1), 17-55. doi: https://doi.org/10.1002/rra.1569

Freshwater Biological Association. (2022). *River Invertebrate Classification Tool (RICT)*. Retrieved Feburary 23, 2022, from https://www.fba.org.uk/rivpacs-and-rict/river-invertebrate-classification-tool#:~:text=The%20River%20Invertebrate%20Classification%20Tool,Wales%2C%20Scotland%20and%20Northern%20Ireland

Freshwater Habitats Trust. (2002). *A guide to monitoring the ecological quality of ponds*.

Gurnell, A., England, J., Shurker, L., & Wharton, G. (2020a). The MoRPh Survey. *Technical Reference Manual. 2020 Version*. Retrieved from Technical Reference Manual.

Gurnell, A., Scott , S., England J, Gurnell, D., Jeffries, R., Shuker, L., & Wharton , G. (2020b). Assessing River Condition: A multiscale Approach Designed for Operational Application in the Context of Biodiversity Net Gain. *River Research and Applications, 36*, 1559-1578. Retrieved June 28, 2021, from https://onlinelibrary.wiley.com/doi/10.1002/rra.3673 (accessed 24 March 2021). Supporting information [Online] Available at: https://onlinelibrary.wiley.com/action/downloadSupplement?doi=10.1002%2Frra.3673&file=rra3673-sup-0001-Supinfo.pdf

Hill, M., Preston, C., & Roy, D. (2004). Attributes of British and Irish Plants: Status, Size, Life History, Geography and Habitats. *Biological Records Centre NERC Centre for Ecology and Hydrology*.

Joint Nature Conservation Committee. (2005). *Common Standards Monitoring Guidence for Ditch Systems*. Retrieved from www.JNCC.gov.uk

Murray-Bligh, J. (1999). Procedure for collecting and analysing macro-invertebrate samples. *Quality Management Systems for Environmental Monitoring: Biological Techniques, BT003. Version 1.0*.

Naura, M. (2017). Habitat Modification Score Rules Version 1. *Riverdene Consultancy*. Retrieved February 23, 2022, from : http://www.riverhabitatsurvey.org/wp-content/uploads/2018/04/Habitat-Modification-Score-Rules-2003-Version-1.pdf

Palmer, M., Drake, M., & Stewart , N. (2013). A Manual for the Survey and Evaluation of the Aquatic Plant and Invertebrate Assemblages of Grazing Marsh Ditch Systems: Version 6. *Esmée Fairbairn Foundation & Environment Agency*.

Pond Action [now Pond Conservation]. (2002). Predictive System for Multimetrics (PSYM) Sampling Protocols Used for Ponds. Oxford: Pond Action.

Walker, J. (2005). *River Habitat Objectives.* England and Wales: Environment Agency.

WFD-UKTAG. (2008). UKTAG Rivers Assessment Methods Fish Fauna (Fisheries Classification Scheme 2 (FCS2)). Edinburgh. Retrieved from www.wfduk.org: https://www.wfduk.org/sites/default/files/Media/Characterisation%20of%20the%20water%20environment/Biological%20Method%20Statements/river%20fish.pdf

WFD-UKTAG. (2014a). River Assessment Method, Benthic Invertebrate Fauna. *Invertebrates (General Degradation): Whalley, Hawkes, Paisley & Trigg (WHPT). Metric in River Invertebrate Classification Tool (RICT)*. Retrieved February 23, 2022, from https://www.wfduk.org/sites/default/files/Media/Characterisation%20of%20the%20water%20environment/Biological%20Method%20Statements/River%20Invertebrates%20WHPT%20UKTAG%20Method%20Statement.pdf

WFD-UKTAG. (2014b). River Assessment Method Macrophytes and Phytobenthos, Macrophytes (River LEAFPACS2). Retrieved February 2022, 2022, from https://www.wfduk.org/sites/default/files/Media/Characterisation%20of%20the%20water%20environment/Biological%20Method%20Statements/River%20Macrophytes%20UKTAG%20Method%20Statement.pdf

WFD-UKTAG. (2014c). *River LEAFPACS2 Survey Metric Calculator*.

WFD-UKTAG. (2021). Classification of Aquatic Alien Species According to their Level of Impact. *Version 8*. Retrieved November 25, 2021, from http://www.wfduk.org/sites/default/files/UKTAG%20classification%20of%20alien%20species%20working%20paper%20v8.pdf

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