Norwich Western Link

Environmental Statement Chapter 10: Biodiversity – Appendix 10.8: Interim River Wensum Macrophyte Report 2020

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Contents

1 Introduction

1.1.1 WSP UK Ltd was commissioned by Norfolk County Council to complete a desk study and macrophyte surveys to fulfil the following objectives:

- To determine the presence/likely absence of protected and/or notable macrophyte species within the Survey Area; and
- Present the findings of the survey in a baseline report.

1.1.2 The findings of the desk study and surveys will be used to inform the impact assessment, proposed mitigation and enhancement opportunities for macrophytes across the Scheme. Details of the impact assessment and mitigation will be included within the Biodiversity Chapter of the Environmental Statement for the Scheme.

1.1.3 We have included a summary of key information shown in this document in an accessible format. However, some users may not be able to access all technical details. If you require this document in a more accessible format please contact norwichwesternlink@norfolk.gov.uk

Norfolk County Council

NORWICH WESTERN LINK ROAD

River Wensum and Floodplain Macrophyte Report

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1 INTRODUCTION

1.1 PROJECT BACKGROUND

1.1.1. The Norwich Western Link Road (NWL) is a highway scheme linking the A1270 Broadland Northway from its junction with the A1067 Fakenham Road to the A47 trunk road near Honingham.

1.1.2. The NWL, hereafter referred to as the Scheme, will comprise:

- Dualling the A1067 Fakenham Road westwards from its existing junction with the A1270 to a new roundabout located approximately 400m to the north west.
- Construction of a new roundabout.
- Constructing a dual carriageway link from the new roundabout to a new junction with the A47 near Honingham.

1.1.3. As part of a separate planned scheme, Highways England proposes to realign and dual the A47 from the existing roundabout at Easton to join the existing dual carriageway section at North Tuddenham. If that scheme proceeds, it is expected that Highways England will construct the Honingham junction and the Norwich Western Link will connect to the north-eastern side of that junction.

1.1.4. The Scheme will cross the River Wensum and its flood plain by means of a viaduct. The Scheme will also cross four minor roads by means of overpass or underpass bridges. The Scheme will include ancillary works such as provision for non-motorised users, necessary realignment of the local road network and the provision of environmental mitigation measures.

1.2 ECOLOGICAL BACKGROUND

1.2.1. The requirement for aquatic macrophyte survey followed the identification of suitable habitats with the potential to support this species group, that may be impacted by the Scheme. These habitats were identified following the Phase 1 Habitat Survey and associated desk study (WSP UK Ltd., 2018B) and the refined survey in 2020. The floodplain contains several ordinary watercourses (hereafter referred to as “ditches”) which are connected to the River Wensum. It was therefore recommended that macrophyte surveys be undertaken to establish a baseline to inform further assessment, suitable mitigation and enhancement opportunities.

1.2.2. As part of the Scheme, a viaduct structure is required to carry the NWL across the River Wensum at NGR TG 13979 15483 and its floodplain.

1.2.3. The ‘Survey Area’, as it is referred to hereafter, includes the locations at which macrophyte surveys were conducted (Figure 3.1). The Survey Area includes the location of the proposed viaduct where it crosses the River Wensum the hydrologically connected ditch that lies to the south west.

1.3 BRIEF AND OBJECTIVES

1.3.1. WSP UK Ltd was commissioned by Norfolk County Council to complete a desk study and macrophyte surveys to fulfil the following objectives:

- To determine the presence/likely absence of protected and/or notable macrophyte species within the Survey Area; and

- Present the findings of the survey in a baseline report.

1.3.2. The findings of the desk study and surveys will be used to inform the impact assessment, proposed mitigation and enhancement opportunities for macrophytes across the Scheme. Details of the impact assessment and mitigation will be included within the Biodiversity Chapter of the Environmental Statement for the Scheme.

2 RELEVANT LEGISLATION

2.1 LEGAL COMPLIANCE

2.1.1. Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation are an Annex I habitat and a primary reason for the designation of the River Wensum as a Special Area of Conservation (SAC) (JNCC, 2019) under The Conservation of Habitats and Species Regulations 2017 (HMSO, 2017a).

2.1.2. Such habitats designated as Sites of Community Importance (SCIs) and included in the Natura 2000 network (now referred to as National Network Sites following the UKs exit from the European Union[1]. These sites must be managed in accordance with the ecological needs of the features that characterise them.

2.1.3. The River Wensum is also designated as Site of Special Scientific Interest (SSSI), as specified under the Wildlife and Countryside Act (HMSO, 1981). The purpose of this SSSI designation is to safeguard the diversity and geographic range of habitats, species and geological and physiographic features. Public bodies have a statutory duty to take reasonable steps, consistent with the proper exercise of its functions, to further the conservation and enhancement of the sites special scientific interest.

2.1.4. The Natural Environment and Rural Communities (NERC) Act 2006 reinforces the duty upon all public authorities, including planning authorities, to have regard for the conservation of biodiversity when discharging their duties. The Act refines the definition of biodiversity conservation, stating that it includes restoring or enhancing a population or habitat. Section 41 of the NERC Act requires the Secretary of State to list habitats and species of principal importance (HPIs and SPIs) for the conservation of biodiversity in England. The habitats and species listed in accordance with Section 41 largely replicate those listed on the UK Biodiversity Action Plan (BAP) which occur in England.

2.1.5. The Water Environment (Water Framework Directive) (England and Wales) Regulations (HMSO, 2017b) establish a framework for the protection of inland surface waters (rivers and lakes), transitional waters (estuaries), coastal waters and groundwater, and for water all waterbodies (unless artificial or heavily modified) to achieve “Good” ecological status. This is a retained EU law following United Kingdom’s exit from the EU, as managed by The Floods and Water (Amendment etc.) (EU Exit) Regulations 2019 (HMSO, 2019b).

2.1.6. Ecological Status is expressed in terms of five classes (High, Good, Moderate, Poor or Bad). These classes are based on specific criteria and boundaries defined against biological, physico-chemical and hydromorphological quality elements. Biological assessment uses numeric measures of communities of aquatic plants and animals, including fish. The overall Ecological Status of a water body is determined by its poorest quality element. For example, a water body’s chemical and physico-chemical quality elements might be classed as ‘Good’ but the biological element classed as

[1] https://www.gov.uk/government/publications/changes-to-the-habitats-regulations-2017/changes-to-the-habitats-regulations-2017

‘Moderate Status’. In this case it would be classed overall as ‘Moderate Ecological Status’. To achieve the overall aim of Good surface water status, the Directive requires that surface waters be of at least Good Ecological Status and Good Chemical Status. To achieve High Status, the Directive requires that the hydromorphological Quality Elements are also in place. When considering the impact of a development or activity on a waterbody it is a regulatory requirement under the WFD to assess if it will cause or contribute to a deterioration in status or jeopardise the waterbody achieving Good status in the future.

3 METHODS

3.1 DESK STUDY

3.1.1. A desk study was undertaken in December 2020 to review relevant existing ecological baseline information available in the public domain and to obtain information held by relevant third parties. For the purpose of the desk study exercise, records were collated within various radii around the Survey Area. This approach is consistent with current good practice guidance published by the Chartered Institute of Ecology and Environmental Management (CIEEM) (2017).

3.1.2. Freely downloadable datasets (available from Natural England) were consulted for information regarding the presence of statutory designated sites within 2km of the Survey Area. This search was extended to 10km for Natura 2000 sites (SAC's and Special Protection Areas (SPA)) of European importance and internationally designated Ramsar sites.

3.1.3. The current Water Framework Directive (WFD) status for the relevant catchment was obtained from the Environment Agency's Catchment Data Explorer Website (Environment Agency, 2020a).

3.1.4. Macrophyte survey data for the River Wensum was obtained from the Environment Agency's Ecology and Fish Data Explorer (Environment Agency, 2020b).

3.2 MACROPHYTE SURVEYS

3.2.1. Macrophyte surveys were conducted along 100m stretches of the River Wensum and two of the adjoining floodplain ditches on 10 August 2020. The survey locations were selected as representative of the river and ditches in relation to the water course crossing points of Proposed Scheme (Figure 3-1). The northerly ditch, on the boundary of the Hall land parcel, is hereafter known as 'Hall Ditch' and the southerly ditch, within the Ringland Estate land parcel, is hereafter known as 'Ringland Ditch'.

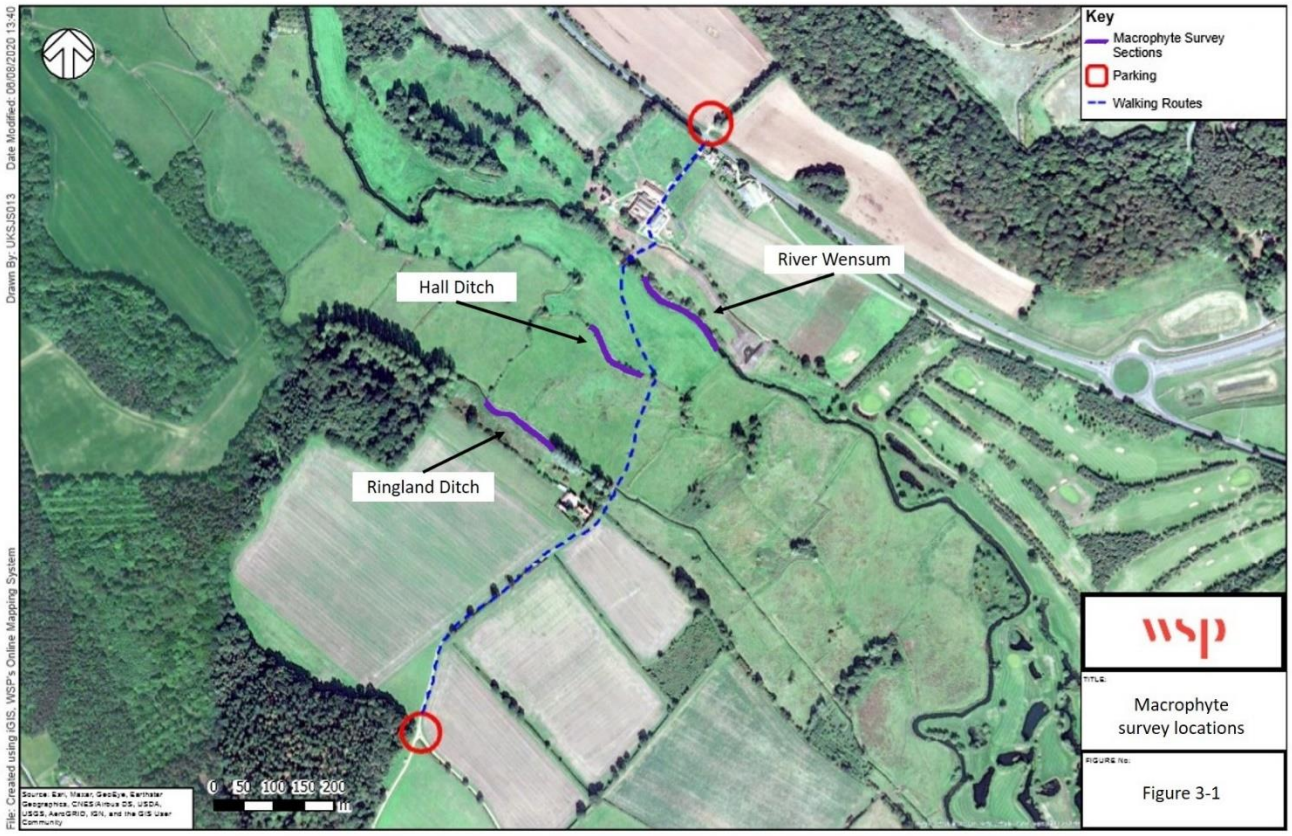

Figure 3-1 - Map displaying macrophyte surveys areas within the River Wensum and connected ditch network.

3.2.2. The survey was carried out using the Water Framework Directive UK Technical Advisory Group's methodology for assessing macrophytes in rivers (WFD-UKTAG, 2014). This method conforms with CEN 14184: 2003 Water Quality – Guidance standard for the surveying of aquatic macrophytes in running waters.

3.2.3. The methodology specifies that a 100m stretch of the watercourse should be sampled between 1 June and 30 September. Sampling should not be completed during or immediately after high flows. If cold weather or spring floods have delayed the growth of macrophyte taxa, sampling should commence after 30 June.

3.2.4. Surveyors recorded the presence of all macrophytes present within the Survey Area to species level where possible. Where it was not possible to identify a particular macrophyte to species level, it was recorded under its genus or other aggregate taxon level.

3.2.5. The presence and percentage of the river channel (up to the height of bank that would typically be submerged for >50% of the year) covered by each species was estimated by assigning it the appropriate taxon cover value, as detailed in Table 3-1.

Table 3-1 – Cover values for lotic macrophyte taxa.

Percentage cover range (% of channel area)	Taxon cover level	Mid-point percentage
< 0.1	1	0.05
0.1 < 1	2	0.5
1 < 2.5	3	1.7
2.5 < 5	4	3.8
5 < 10	5	7.5
10 < 25	6	17.5
25 < 50	7	37.5
50 < 75	8	62.5
≥ 75	9	87.5

BIOLOGICAL INDICES

3.2.6. The condition of the River Wensum's macrophyte community within the Survey Area was assessed by calculating various indices using data recorded during the field survey. The River Wensum was analysed using LEAFPACS2 in order to establish the condition and quality of the macrophyte communities present. The ditches were analysed in terms of their National Vegetation Classification (NVC) community, as it is generally regarded that LEAFPACS assessment is not appropriate for smaller watercourses, including ditches. These indices are detailed in the following paragraphs within this section.

River Macrophyte Nutrient Index

3.2.7. The River Macrophyte Nutrient Index (RMNI) is a measure of the plants that grow in the river and their association with high nutrient levels; it is measured on a scale from 1-10.

3.2.8. Each scoring macrophyte taxon was assigned its corresponding RMNI species score. RMNI was then calculated using the equation:

3.2.9. $$RMNI = \frac{\sum_{j=1}^{n}(C_j x\, R_j)}{\sum_{j=1}^{n} C_j}$$

where:

"R_j" is the river macrophyte nutrient index score for taxon "j";

"j" represents a scoring taxon and has a value of 1 to "n" indicating which taxon it represents;

and

"Cj" is the taxon cover value for taxon "j".

Number of Macrophyte Taxa

3.2.10. The Number of Macrophyte Taxa (NTAXA) is the number of truly aquatic (non-helophyte) scoring taxa recorded in the field survey, which is used as a measure of diversity.

Number of Functional Groups

3.2.11. The Number of Functional Groups (NFG) is a diversity metric calculated by assigning all truly aquatic (non-helophyte) scoring taxa to one of 24 'functional groups'. The NFG value is given by the sum of the number of different functional groups of taxa that were identified as being present in the river.

Cover of Green Filamentous Algae

3.2.12. The Cover of Green Filamentous Algae (ALG) is the percentage cover of green filamentous algae over the whole survey section. This was calculated by adding up the mid-point percentage cover values for all algae species identified as being present.

3.2.13. The value for the parameter ALG represents the total coverage of the riverbed by green filamentous algae and will range from 0-100. This metric is used as a measure of nutrient enrichment.

RIVER PREDICTIONS AND CLASSIFICATION SYSTEMS FOR MACROPHYTES (LEAFPACS2)

3.2.14. The River LEAFPACS2 classification tool was used to contextualise RMNI, NTAXA, NFG, and ALG metric scores. Ecological quality ratios (EQRs) are derived from these metrics based on observed data and site-specific predicted reference values derived from the physical and chemical parameters listed in Table 3-2.

Table 3-2 – Predictive variables for LEAFPACS2.

Invariant data	Variant data
National Grid Reference (NGR)	Alkalinity
Slope	-
Distance from source	-
Altitude	-

3.2.15. EQRs are normalised so they fit the same scale and combined to provide an overall EQR representing an ecological status class as defined by the WFD (High, Good, Moderate, Poor and Bad). The class boundaries are outlined in **Table 3-3** below.

Table 3-3 – River LEAFPACS class boundaries.

Status class boundary	EQR
High/Good	0.8
Good/Moderate	0.6
Moderate/Poor	0.4
Poor/Bad	0.2

ELLENBERG LIGHT INDICATOR VALUES

3.2.16. Ellenberg light indicator values score flora along gradients reflecting various habitat preferences (Ellenberg *et al*. 1991). The purpose of these indicator values is to assess the ecological niche of regional flora.

3.2.17. Ellenberg light indicator values were attributed to the species identified within the River Wensum. The values and associated tolerances are described in Table 3-4 below.

Table 3-4 – Ellenberg light indicator values and descriptions (Ellenberg *et al.* 1991).

Value	Description
1	Plant in deep shade
2	Between 1 and 3
3	Shade plant, mostly less than 5% relative illumination, seldom more than 30% illumination when trees are in full leaf
4	Between 3 and 5
5	Semi-shade plant, rarely in full light, but generally with more than 10% relative illumination when trees are in leaf
6	Between 5 and 7
7	Plant generally in well-lit places, but also occurring in partial shade
8	Light-loving plant rarely found where relative illumination in summer is less than 40%
9	Plant in full light, found mostly in full sun

3.3 LIMITATIONS

3.3.1. Ecological survey data is typically valid for up to 18 months unless otherwise specified. The likelihood of surveys needing to be updated increases with time and is greater in circumstances where the habitat or its management has changed significantly since the surveys were undertaken.

(CIEEM, 2019). No such changes to habitat or management have been identified with respect to aspects discussed in this report.

4 RESULTS

4.1 DESK STUDY

DESIGNATED NATURE CONSERVATION SITES

4.1.1. Two statutory designated nature conversation sites of interest were identified within 2km of the Survey Area:

- River Wensum SAC; and,
- River Wensum SSSI.

4.1.2. There are no additional designated sites with aquatic species as a primary reason for selection or as a qualifying feature within 2km of the Survey Area.

RIVER WENSUM SPECIAL AREA OF CONSERVATION

4.1.3. One of the primary reasons for the selection of this site as a SAC is Annex I habitat consisting of '*watercourses of plain to montane levels with Ranunculion fluitantis and Callitricho-Batrachion vegetation*' (JNCC, 2019a).

4.1.4. This habitat type is characterised by the abundance of water-crowfoots *Ranunculus* spp., subgenus *Batrachium*. Floating mats of these white-flowered species are characteristic of river channels in early to mid-summer. They may modify water flow, promote fine sediment deposition, and provide shelter and food for fish and invertebrate animals (JNCC, 2019b).

4.1.5. In this habitat type, *Ranunculus* species are associated with a different assemblage of other aquatic plants, such as water-cress *Rorippa nasturtium-aquaticum*, water-starworts *Callitriche* spp., greater water-parsnip *Sium latifolium* and lesser water-parsnip *Berula erecta*, water-milfoils *Myriophyllum* spp. and water forget-me-not *Myosotis scorpioides*. In some rivers, the cover of these species may exceed that of *Ranunculus* species (JNCC, 2019b).

4.1.6. Although the River Wensum is extensively regulated by weirs, *Ranunculus* vegetation occurs sporadically throughout much of the river's length. Stream water-crowfoot *Ranunculus penicillatus* ssp. *pseudofluitans* is the dominant *Ranunculus* species, but thread-leaved water-crowfoot *Ranunculus trichophyllus* and fan-leaved water-crowfoot *Ranunculus circinatus* also occur (JNCC, 2019a).

RIVER WENSUM SITE OF SPECIAL SCIENTIFIC INTEREST

4.1.7. The River Wensum has been selected as a SSSI as an example of an enriched, calcareous lowland river. Whilst the river is of rich ecological and cultural value in its present state, the condition of the River Wensum SSSI aquatic units is currently regarded as being "Unfavourable – Recovering".

WATER FRAMEWORK DIRECTIVE

4.1.8. The River Wensum within the Survey Area falls within the WFD 'Wensum Upstream (US) Norwich' waterbody (GB105034055881) (Environment Agency, 2020a). The River Wensum is designated as a WFD watercourse, whilst the connected drainage ditch network, located to the south-west of the river within the Survey Area, is classed as an ordinary watercourse.

4.1.9. The 2019 WFD ecological status of the 'Wensum Upstream (US) Norwich' waterbody was Moderate, with the macrophyte and phytobenthos combined quality element also classified as

Moderate (Environment Agency, 2020a). The reasons provided for this element not achieving Good status are listed as agriculture and rural land management issues (nutrient and livestock) management and sewage discharges from the water industry.

4.1.10. The hydromorphological designation of the 'Wensum Upstream (US) Norwich' waterbody is 'heavily modified', meaning it is considered to be heavily influenced by anthropogenic activity (Environment Agency, 2020a).

ENVIRONMENT AGENCY MACROPHYTE SURVEY RECORDS

4.1.11. The nearest Environment Agency macrophyte monitoring location on the River Wensum is located at TG 15970 13710, approximately 7km downstream of the proposed viaduct over the River Wensum. Results from the most recent survey at this location, undertaken on 13 July 2017, are displayed in Table 4-1 and Table 4-2.

Table 4-1 – Environment Agency macrophyte biometric data for the River Wensum (TG 15970 13710) on 13/07/2017.

Site	Date	RMHI	RMNI	NTAXA	NFG	RFA_PC
River Wensum	13/07/2017	8.12	8.14	18	12	1

Table 4-2 - Environment Agency macrophyte taxon lists from 13/07/2017, including respective percentage cover bands.

Taxa	Common Name	13/07/2017
Apium nodiflorum	Fool's water-cress	2
Berula erecta	Lesser water parsnip	3
Butomus umbellatus	Flowering rush	1
Callitriche	Water-starwort	3
Cladophora sp.	Filamentous algae (reticulated)	2
Elodea nuttallii	Western waterweed	2
Epilobium hirsutum	Hairy willowherb	2
Fontinalis antipyretica	Greater water-moss	3
Glyceria maxima	Reed sweet grass	4
Impatiens glandulifera	Himalayan balsam	1
Iris pseudacorus	Yellow iris	2
Lemna gibba	Gibbous duckweed	2

Taxa	Common Name	13/07/2017
Myosotis scorpioides	Water forget-me-not	2
Myriophyllum spicatum	Spiked water milfoil	2
Nuphar lutea	Yellow water-lily	3
Oenanthe fluviatilis	River water dropwort	2
Phalaris arundinacea	Reed canary grass	3
Potamogeton pectinatus	Fennel pondweed	2
Potamogeton perfoliatus	Claspingleaf pondweed	3
Ranunculus (Batrachian) spp.	Water crowfoot	4
Rorippa nasturtium-aquaticum agg.	Watercress	2
Sagittaria sagittifolia	Arrowhead	2
Sparganium emersum	European bur-reed	3
Sparganium erectum	Branched bur-reed	3
Stachys palustris	Marsh woundwort	2
Schoenoplectus lacustris	Common clubrush	6
Veronica anagallis-aquatica/Veronica catenata	Water speedwell	2
Zygnematalean	Filamentous algae (unbranched)	2
	Recorded number of taxa	28

4.1.12. Water crowfoot *Ranunculus (Batrachian)* spp. was recorded by the Environment Agency, a species characteristic of the River Wensum SAC. In addition, watercress *Rorippa nasturtium-aquaticum* agg., water-starwort *Callitriche*, lesser water parsnip *Berula erecta*, spiked water milfoil *Myriophyllum spicatum* and water forget-me-not *Myosotis scorpioides* were recorded, each being associated with *Ranunculus* spp. in 'watercourses of plain to montane levels'.

4.1.13. Two non-native species were recorded during the Environment Agency survey, in the form of western waterweed *Elodea nuttallii* and Himalayan balsam *Impatiens glandulifera*.

4.1.14. A search for Environment Agency macrophyte survey information within the ditch network returned no results.

4.2 MACROPHYTE SURVEYS

RIVER WENSUM

4.2.1. The mean width of the River Wensum within the Survey Area was approximately 8m. The river was found to be greater than 1m deep for the majority of the surveyed section.

4.2.2. Water turbidity was observed to be elevated throughout the survey section, while the river bed was observed to be sedimented in several areas. Flow rate of the river was low with occasional shading of the watercourse margins due to the presence of several willow trees on the left-hand bank.

4.2.3. Images of the surveyed stretch of the River Wensum are displayed in Appendix A. The raw survey data for the River Wensum is presented in Appendix B.

4.2.4. A total of 19 macrophyte taxa were recorded, 15 of which are LEAFPACS2 scoring taxa. The majority of the River Wensum Survey Area was dominated by macrophytes with Ellenberg light indicator values of 6 or 7.

4.2.5. European bur-reed *Sparganium emersum* was the most dominant species, accounting for 30% of macrophyte cover closely followed by clasping-leaf pondweed *Potamogeton perfoliatus*, which accounted for 25% of cover. Reed sweet grass *Glyceria maxima*, fennel pondweed *Potamogeton pectinatus* and greater water moss *Fontinalis antipyretica* were observed at 2.5<5% cover each (Table 4-3).

Table 4-3 - Macrophyte species with taxon cover of 4 or above that were sampled during the macrophyte survey of the River Wensum carried out on 10 August 2020.

Common name	Scientific name	Taxon cover value	% cover	Ellenberg light indicator value
European bur-reed	*Sparganium emersum*	7	25 < 50	7
Clasping-leaf pondweed	*Potamogeton perfoliatus*	7	25 < 50	6
Reed sweet-grass	*Glyceria maxima*	4	2.5 < 5	7
Fennel pondweed	*Potamogeton pectinatus*	4	2.5 < 5	6
Greater water moss	*Fontinalis antipyretica*	4	2.5 < 5	-

4.2.6. Stream water-crowfoot, a species characteristic of the River Wensum SAC, was the only species of water-crowfoot sampled. This species was found to cover 1<2.5% of the Survey Area and has an Ellenberg light indicator value of 7 (Table 4-4).

4.2.7. Furthermore, four species associated with *Ranunculus* spp. in 'watercourses of plain to montane levels' were sampled; watercress, water forget-me-not, blunt-fruited water starwort *Callitriche obtusangula* and common water starwort *Callitriche stagnalis* were each found to cover 1<2.5% of the Survey Area (Table 4-4).

4.2.8. The taxa with the highest recorded Ellenberg light indicator value of 8, were the blunt-fruited water-starwort and the yellow water-lily *Nuphar lutea* (Table 4-4). The percentage cover for this species was recorded as 2% and 1% of the Survey Area, respectively.

Table 4-4 - Notable species sampled during the macrophyte survey of the River Wensum that was carried out on 10 August 2020.

Common name	Latin name	Taxon cover value	% cover	Ellenberg Light Indicator Value
Water-crowfoot*	*Ranunculus penicillatus* subsp. *pseudofluitans*	3	1 < 2.5	7
Water-cress**	*Rorippa nasturtium-aquaticum*	3	1 < 2.5	7
Water forget-me-not**	*Myosotis scorpioides*	3	1 < 2.5	7
Blunt-fruited water-starwort** ***	*Callitriche obtusangula*	3	1 < 2.5	8
Common water starwort**	*Callitriche stagnalis*	3	1 < 2.5	6
Yellow water-lily***	*Nuphar lutea*	3	1 < 2.5	8

* species which characterise the River Wensum SAC
** species which are associated with species that are characteristic of the River Wensum SAC
*** species that score Ellenberg Light Indicator value of 8 or above.

4.2.9. The observed RMNI, NTAXA and NFG in the River Wensum were all higher than the values predicted by LEAFPACS2, see Table 4-5.

Table 4-5 - River Wensum LEAFPACS2 class calculator results.

Parameter	Observed value	Expected value	Raw EQR	Adjusted EQR	Final EQR	Class
RMNI	8.11	7.88	0.89	0.86	0.86	High
NTAXA	15	10.03	1.50	1.50		
NFG	11	6.80	1.74			
ALG	0.50	-	1.00	0.96		

4.2.10. The overall EQR for the surveyed stretch of the River Wensum was 0.86, which classifies the macrophyte quality component the watercourse as being of 'High' ecological status.

DITCH NETWORK

Hall Ditch

4.2.11. Hall Ditch was less than 2m wide for the entire surveyed section and heavily shaded by small willow trees and other woody species along much of its length. Open water was also absent within most the channel, with the exception of isolated puddles approximately 1-2cm deep at the time of survey.

4.2.12. Images of the surveyed stretch of Hall Ditch are displayed in Appendix A.

4.2.13. Where scrub cover was reduced, small sections of reed sweet grass swamp and greater pond sedge *Carex riparia* swamp were recorded, but were generally species-poor, with associates of

bittersweet *Solanum dulcamara*, willowherb *Epilobium hirsutum* and common duckweed *Lemna minor*.

4.2.14. The bankside vegetation was slightly more diverse, with an area of set aside/buffer strip dominated by reed canary grass *Phalaris arundinacea*, false oat-grass *Arrhenatherum elatius* and common nettle *Urtica dioica.*

4.2.15. The plant community was found to consist mainly of emergent macrophytes and plant species that predominantly occupy terrestrial habitats.

Ringland Ditch

4.2.16. The channel of the Ringland Ditch was 2m to 2.5m wide throughout the surveyed section with approximately 60cm depth of turbid water and no visible flow at the time of survey.

4.2.17. Images of the surveyed stretch of Ringland Ditch are displayed in Appendix A.

4.2.18. The ditch contained a modest diversity of submerged, floating and emergent plant species, including fragments of starwort *Callitriche* spp, fan-leaved water-crowfoot *Ranunculus circinatus* and water-crowfoot *Ranunculus. pencilliatus* ssp*. pseudofluitans*. However, a layer of brown scum had accumulated across much of the water surface and, where macrophytes were sampled, they were smothered in silt and displayed early signs of decomposition.

4.2.19. Emergent vegetation was found to consist mostly of reed sweet grass. Occasional cattle poaching of the northern bank was found to have locally reduced abundance of emergent species.

5 REFERENCES

Chartered Institute of Ecology and Environmental Management (CIEEM) (2017). Guidelines for Preliminary Ecological Appraisal. CIEEM, Winchester. Available online: https://cieem.net/wp-content/uploads/2019/02/Guidelines-for-Preliminary-Ecological-Appraisal-Jan2018-1.pdf [Accessed January 2021]

Chartered Institute of Ecology and Environmental Management (CIEEM) (2019). *Advice note on the lifespan of ecological reports & surveys.* Available online: https://cieem.net/wp-content/uploads/2019/04/Advice-Note.pdf. [Accessed January 2021]

Ellenberg, H., Weber, H.E., Düll, R., Wirth, V., Werner, W. and Paulissen, D. (1991.) Zeigerwerte von Pflanzen in Mitteleuropa. Scripta Geobotanica, 18, 1–248.

Environment Agency (2020a). *Catchment Data Explorer*. Available online: https://environment.data.gov.uk/catchment-planning [Accessed January 2021].

Environment Agency (2020b). *Ecology and Fish Data Explorer*. Available online: https://defra-ecology-prod.publishmydata.com/ecology-fish/ [Accessed January 2021].

Her Majesty's Stationary Office (HMSO) (1981). *Wildlife and Countryside Act* (as amended by the Countryside and Rights of Way Act 2000). HMSO, Norwich.

Her Majesty's Stationary Office (HMSO) (2006). *Natural Environment and Rural Communities Act*. HMSO, Norwich.

Her Majesty's Stationary Office (HMSO) (2017a). *The Conservation of Habitats and Species Regulations.* HMSO, Norwich. Available online: https://www.legislation.gov.uk/uksi/2017/1012/contents/made [Accessed: December 2020].

Her Majesty's Stationary Office (HMSO) (2017b). *The Water Environment (Water Framework Directive) (England and Wales) Regulations.* HMSO, Norwich.

Her Majesty's Stationary Office (HSMO) (2019a). *The Conservation of Habitats and Species Regulations (Amendment) (EU Exit) Regulations 2019*. HMSO, Norwich. Available online: https://www.legislation.gov.uk/ukdsi/2019/9780111176573 [Accessed: December 2020].

Her Majesty's Stationary Office (HMSO) (2019b). *The Floods and Water (Amendment etc.) (EU Exit) Regulations 2019*. HMSO, Norwich. Available online: https://www.legislation.gov.uk/uksi/2019/558/contents [Accessed: December 2020].

JNCC. (2019a). *River Wensum – Designated Special Area of Conservation (SAC)*. Available at: https://sac.jncc.gov.uk/site/UK0012647. [Accessed: January 2021].

JNCC. (2019b). River Wensum – Designated Special Area of Conservation (SAC). Available at: https://sac.jncc.gov.uk/habitat/H3260. [Accessed: January 2021].

Water Framework Directive – United Kingdom Technical Advisory Group (WFD-UKTAG). (2014). UKTAG River Assessment Method. Macrophytes and Phytobenthos: Macrophytes (River LEAFPACS2). WFD-UKTAG, Stirling.

WSP UK Ltd. (2018). *Ecological Desk Study*. WSP UK Limited. London, UK.

Appendix A

SITE PHOTOGRAPHS

Figure A-1 – Upstream extent of the River Wensum Survey Area.

Figure A-2 – Central point of the River Wensum Survey Area.

Figure A-3 – Downstream extent of the River Wensum Survey Area.

Figure A-4 – Upstream extent of the Hall Ditch Survey Area.

Figure A-5 – Central point of the Hall Ditch Survey Area.

Figure A-6 – Downstream extent of the Hall Ditch Survey Area.

Figure A-7 – Upstream extent of the Ringland Ditch Survey Area.

Figure A-8 – Central point of the Ringland Ditch Survey Area.

Figure A-9 - Downstream extent of the Ringland Ditch Survey Area.

Appendix B

FULL MACROPHYTE SURVEY DATA

Table B-1 - Full macrophyte data from the surveys of the River Wensum and adjoining ditches.

Section	River Wensum		Hall Ditch		Ringland Ditch	
Channel/Bank	*Channel*	*Bank*	*Channel*	*Bank*	*Channel*	*Bank*
Section start: Easting	613962		613836		613670	
Section start: Northing	315491		315428		315315	
Section end: Easting	614032		613919		613759	
Section end: Northing	315419		315382		315263	
Channel width (m)	8		2		2	
Water depth (m)	1.3		0.01		0.6	
Flow (1 none to 5 fast)	2		1		1	
Clarity (1 clear to 5 v.poor)	3		N/A		4	
Bank slope (degrees)	30		50		40	
Adjacent land use	Pasture		Pasture/set aside		Rough pasture/marsh	
Total submerged plant cover (%)	90		0		20	
Total floating plant cover (%)	20		5		10	
Total green algae cover (%)	1		0		0	
Total emergent cover (%)	10		60		40	
Total shade cover (%)	2		80		0	
Muddy edges present?	No		Yes		Yes	
Channel dominant substrate	Gravel/sand		Silt		Silt	

Section	River Wensum		Hall Ditch		Ringland Ditch	
Species: (% cover)	*Channel*	*Bank*	*Channel*	*Bank*	*Channel*	*Bank*
Agrostis stolonifera				2		
Angelica sylvestris						1
Apium nodiflorum				1	1	
Arrhenatherum elatius		3		10		
Berula erecta						
Butomus umbellatus	2					
Callitriche obtusangula	2				2	
Callitriche stagnalis	1					
Cardamine pratensis				1		2
Carex hirta				2		
Carex riparia			30			
Cirsium arvense				5		
Cladophora	1					
Crataegus monogyna				1		
Dactylis glomerata				2		
Deschampsia cespitosa				4		
Elodea canadensis	1					
Enteromorpha	1					
Epilobium hirsutum				2		1
Epilobium parviflorum						1
Equisetum fluviatile				1		

Equisetum palustre				1		
Festuca rubra				2		
Filipendula ulmaria						3
Fontinalis antipyretica	3					
Galium aparine						
Galium palustre						3
Glechoma hederacea				2		
Glyceria fluitans						2
Glyceria maxima	5	40	30	10	30	80
Holcus lanatus				3		
Iris pseudacorus			1			
Jacobaea aquatica						1
Juncus inflexus				2		
Lemna minor	2		3		10	
Lemna trisulca						
Lolium perenne		1				
Lycopus europaeus		1				
Mentha aquatica		1		2		3
Myosotis scorpioides	1	1				2
Nuphar lutea	1					
Phalaris arundinacea		10		50		
Phleum pratense				2		
Phragmites australis		1				

Persicaria amphibia		1				1
Potamogeton crispus	1					
Potamogeton pectinatus	5					
Potamogeton perfoliatus	25					
Potentilla anserina						2
Pulicaria dysentica						1
Ranunculus circinatus					5	
Ranunculus psuedofluitans	2				5	
Ranunculus sceleratus				1		1
Rorippa nasturtium-aquaticum	2					
Rubus fruticosus				4		
Sagittaria sagittifolia	2					
Salix cinerea			80	0		
Salix sp	2	3				
Scrophularia auriculata						1
Sinapis arvensis						1
Solanum dulcamara			2			
Sonchus oleraceus				1		
Sparganium emersum	30					
Sparganium erectum		5	5			1
Stachys officinalis				2		1
Urtica dioica		5		10		
Veronica anagallis-aquatica		1			3	

Veronica beccabunga						3
Veronica catenata		1				

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