



Norfolk County Council

NORWICH WESTERN LINK ROAD

Interim River Wensum 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; and,
 - 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 include ancillary works such as provision for non-motorised users, necessary realignment of the local road network and the provision of environmental mitigation measures.
- 1.1.5. Following feasibility studies, six route options were presented at public consultations in 2018 and 2019. The preferred route option was announced in June 2019.

1.2 ECOLOGICAL BACKGROUND

- 1.2.1. A desk study (WSP UK Ltd., 2018) was commissioned in 2018, to inform route options for the Scheme. An updated macrophyte desk study for the preferred route option is included in this report.
- 1.2.2. The requirement for macrophyte surveys followed the identification of habitats within the River Wensum that may be impacted by the Scheme. As part of the Scheme a viaduct structure is required to carry the NWL across the River Wensum at NGR TG 13979 15483. It was therefore recommended that macrophyte surveys be undertaken to establish a sufficient baseline to inform impact assessment.
- 1.2.3. The 'Survey Area', as it is referred to hereafter, includes the location of the proposed viaduct where it crosses the River Wensum (Figure 1-1).

Figure 1-1 - Macrophyte Survey Area



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 species; and
 - To provide recommendations to enable compliance with relevant legislation and planning policy.
- 1.3.2. The findings of the desk study and surveys will be used to inform the impact assessment and proposed mitigation for macrophytes, which are to be presented within the Nature Conservation 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 Callitriche-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) under The Conservation of Habitats and Species Regulations 2017 (HMSO, 2017). Annex I habitat are habitats of community interest whose conservation requires the designation of Special Areas of Conservation.
- 2.1.2. Such habitats designated as Sites of Community Importance (SCIs) and included in the Natura 2000 network. These sites must be managed in accordance with the ecological needs of the features that characterise them.
- 2.1.3. The River Wensum is 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.

3 METHODS

3.1 DESK STUDY

DESIGNATED SITES

- 3.1.1. An online desk study of aquatic ecological information relating to statutory sites within 2km of the Survey Area was undertaken. Information was obtained from Multi Agency Geographical Information for the Countryside (MAGIC) website (Natural England, 2019).

ENVIRONMENT AGENCY MACROPHYTE SURVEY RECORDS

- 3.1.2. Macrophyte survey records, relating to the River Wensum between NGRs TG 13749 15640 and TG 14185 15336, were requested from the Environment Agency on 28th October 2019.

WATER FRAMEWORK DIRECTIVE (WFD)

- 3.1.3. The current Water Framework Directive (WFD) status for the affected catchment was obtained from the Environment Agency's Catchment Data Explorer website (Environment Agency, 2019).

3.2 MACROPHYTE SURVEY

- 3.2.1. A macrophyte survey was conducted along a 100m stretch of the River Wensum, between TG 13946 15501 and TG 14020 15442, on 25th September 2019. The survey area included the 35m length of river that will be crossed by the viaduct and approximately 32.5m up and downstream.
- 3.2.2. The macrophyte survey was carried out using the Water Framework Directive UK Technical Advisory Group's methodology for assessing macrophytes in rivers (WFDUKTAG) (WFDUKTAG, 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 1st June and 30th September and that sampling should not be completed during or immediately after high flows.
- 3.2.4. Surveying recorded the presence of all macrophytes present with the Survey Area to species level where possible. Where this was not possible species were recorded under its genus or other aggregate taxon level.
- 3.2.5. The 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 an 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

3.3 BIOLOGICAL INDICES

3.3.1. 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. These indices are detailed in the following paragraphs within this section.

RIVER MACROPHYTE NUTRIENT INDEX (RMNI)

3.3.2. The 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.

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

$$RMNI = \frac{\sum_{j=1}^n (C_j \times R_j)}{\sum_{j=1}^n C_j}$$

where:

- ‘Rj’ 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 (NTAXA)

3.3.4. 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 (NFG)

- 3.3.5. 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 (ALG)

- 3.3.6. 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.
- 3.3.7. 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.

3.4 RIVER PREDICTIONS AND CLASSIFICATION SYSTEMS FOR MACROPHYTES (LEAFPACS2)

- 3.4.1. 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 reference parameters for LEAFPACS2

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

- 3.4.2. 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 LEAFPACS2 class boundaries

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

3.5 ELLENBERG LIGHT INDICATOR VALUES

- 3.5.1. 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.
- 3.5.2. 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

3.6 LIMITATIONS

- 3.6.1. 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).

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 Study 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 Study Area.

RIVER WENSUM SAC

- 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 *Callitriche-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* subsp. *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 SSSI

- 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".

4.2 ENVIRONMENT AGENCY MACROPHYTE SURVEY RECORDS

- 4.2.1. A request to the Environment Agency for macrophyte survey data, collected between NGRs TG 13749 15640 and TG 14185 15336, since January 2009, returned no records.

WATER FRAMEWORK DIRECTIVE (WFD)

- 4.2.2. The Survey Area falls within the WFD 'Wensum Upstream (US) Norwich' waterbody (Environment Agency, 2019). The River Wensum is designated as a WFD watercourse whilst the connected drainage ditch network, located to the south-west, is classed as an ordinary watercourse.
- 4.2.3. The 2016 WFD ecological status of the River Wensum, within the Survey Area, was classified as Moderate overall in 2016 (Environment Agency, 2019). The macrophytes/phytobenthos (combined) classification item was assessed to be 'Moderate'.
- 4.2.4. 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, 2019).

4.3 MACROPHYTE SURVEY

- 4.3.1. 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 80% of the surveyed section.
- 4.3.2. Increased turbidity and heavy sedimentation were observed in several areas. Several willow trees were noted on the left-hand bank which resulted in shading of the watercourse margins.
- 4.3.3. A summary of the species recorded within the River Wensum, alongside the respective taxon cover values, RMNI scores, aquatic taxa, functional groups and Ellenberg light indicator values are detailed in Appendix A.
- 4.3.4. A total of 37 macrophyte taxa were recorded, 31 of which are LEAFPACS2 scoring taxa. The majority of the Survey Area was dominated by macrophytes with an Ellenberg light indicator value of 7.
- 4.3.5. Arrowhead was the most dominant species, accounting for 10<25% of macrophyte cover. Reed sweet-grass accounted for 5<10% of the Survey Area, followed by reed canary grass *Phalaris arundinacea*, sago pondweed, water-cress and branched bur-reed, all of which were observed at 2.5<5% cover each (Table 4-1).

Table 4-1 - Macrophyte species with taxon cover of 4 or above that were sampled during the macrophyte survey of the River Wensum carried out on 25th September 2019.

Common name	Latin name	Taxon cover value	% cover	Ellenberg light indicator value
Arrowhead	<i>Sagittaria sagittifolia</i>	6	10 < 25	7
Reed sweet-grass	<i>Glyceria maxima</i>	5	5 < 10	7
Reed canary grass	<i>Phalaris arundinacea</i>	4	2.5 < 5	7
Sago pondweed	<i>Potamogeton pectinatus</i>	4	2.5 < 5	6
Watercress	<i>Rorippa nasturtium-aquaticum</i> agg.	4	2.5 < 5	7
Branched bur-reed	<i>Sparganium erectum</i>	4	2.5 < 5	7

- 4.3.6. Stream water-crowfoot was the only species of water-crowfoot sampled. This species was found to cover 0.1<1% of the Survey Area and has an Ellenberg light indicator value of 7 (Table 4-2).
- 4.3.7. Three species associated with *Ranunculus* spp. in 'watercourses of plain to montane levels' were sampled; watercress was found to cover 2<5% of the Survey Area, with the water-milfoil *Myriophyllum spicatum* and water forget-me-not covering 1<2.5% and 0.1<1% respectively Table 4-2. All these species have Ellenberg light indicator values of 7.
- 4.3.8. The taxon with the highest recorded Ellenberg light indicator value was great yellowcress *Rorippa amphibia*, which scored a value of 8 (Table 4-2). The percentage cover for this species was recorded as <0.1% of the Survey Area.

Table 4-2 - Notable species sampled during the macrophyte survey of the River Wensum that was carried out on 25/09/2019.

Common name	Latin name	Taxon cover value	% cover	Ellenberg Light Indicator Value
Water-crowfoot*	<i>Ranunculus penicillatus</i> subsp. <i>pseudofluitans</i>	2	0.1 < 1	7
Water-cress**	<i>Rorippa nasturtium-aquaticum</i>	4	2.5 < 5	7
Water-milfoil**	<i>Myriophyllum spicatum</i>	3	1 < 2.5	7
Water forget-me-not**	<i>Myosotis scorpioides</i>	2	0.1 < 1	7
Great yellowcress***	<i>Rorippa amphibia</i>	1	< 0.1	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.

4.4 BIOLOGICAL INDICES AND LEAFPACS2

- 4.4.1. The observed RMNI, NTAXA and NFG were all higher than the values predicted by LEAFPACS 2 (Table 4-3).

Table 4-3 - River Wensum LEAFPACS2 class calculator results

Parameter	Observed value	Expected value	Raw EQR	Adjusted EQR	Final EQR	Confidence of class	Class
RMNI	7.90	7.88	0.991	0.988	0.988	100%	High / Good
NTAXA	20	9.77	2.047	1.924			
NFG	11	6.16	1.785				
ALG	0.05	-	1.000	1.000			

- 4.4.2. The overall EQR for the surveyed stretch of the River Wensum was 0.988, which classifies the macrophyte quality component the watercourse as being of 'High/Good' ecological status, with a 'confidence of class' of 100% (Table 4-3).

5 RECOMMENDATIONS FOR FURTHER SURVEY

- 5.1.1. Should the survey data within this report become older than 18 months before the planning application for the Proposed Scheme is submitted, it is advised that the macrophyte survey of the River Wensum be repeated. Eighteen months is the time for which ecological survey data is likely to remain valid (CIEEM, 2019).
- 5.1.2. Vehicle crossings of a network of ordinary watercourses, that are connected to the River Wensum, are proposed as part of the Proposed Scheme. Given the sensitivity of these interconnected habitats, macrophyte surveys of these ordinary watercourses are recommended and are scheduled to take place from April 2020.

6 REFERENCES

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Appendix A

MACROPHYTE TAXON LIST AND METRIC SCORES



Table A-1 - LEAFPACS2 taxon list and metric scores

Species	Taxon cover value	RMNI score	Aquatic taxa	Functional group	Filamentous alga	Ellenberg light indicator values
<i>Apium nodiflorum</i>	3	8.64	1	8	-	7
<i>Callitriche brutia</i> var <i>hamulata</i>	2	4.51	1	6	-	7
<i>Callitriche obtusangula</i>	2	8.04	1	6	-	7
<i>Callitriche</i> spp.	1	6.67	1	6	-	-
<i>Elodea nuttallii</i>	1	9.44	1	5	-	6
<i>Fontinalis antipyretica</i>	2	5.40	1	21	-	-
<i>Glyceria maxima</i>	5	9.64	-	-	-	7
<i>Lemanea</i> spp.	3	4.53	1	19	-	-
<i>Lemna minor</i>	2	8.80	1	1	-	7
<i>Lemna trisulca</i>	1	8.21	1	1	-	7
<i>Leptodictyon riparium</i>	1	7.57	1	21	-	-
<i>Mentha aquatica</i>	1	6.27	-	-	-	7
<i>Myosotis scorpioides</i>	2	6.83	-	-	-	7
<i>Myriophyllum spicatum</i>	3	8.26	1	7	-	7
<i>Nuphar lutea</i>	3	8.42	1	12	-	7
<i>Nymphaea alba</i>	1	5.69	1	12	-	7
<i>Pellia endiviifolia</i>	1	6.50	-	-	-	-
<i>Phalaris arundinacea</i>	4	7.52	-	-	-	7
<i>Phragmites australis</i>	2	7.70	-	-	-	7
<i>Platyhypnidium riparioides</i>	3	5.16	1	21	-	-

Species	Taxon cover value	RMNI score	Aquatic taxa	Functional group	Filamentous alga	Ellenberg light indicator values
<i>Potamogeton crispus</i>	2	8.02	1	17	-	7
<i>Potamogeton pectinatus</i>	4	9.59	1	15	-	6
<i>Potamogeton perfoliatus</i>	3	8.16	1	17	-	7
<i>Ranunculus penicillatus</i> subsp. <i>pseudofluitans</i> var <i>pseudofluitans</i>	2	7.92	1	18	-	7
<i>Rorippa amphibia</i>	1	9.20	-	-	-	8
<i>Rorippa nasturtium-aquaticum</i> agg.	4	8.42	-	-	-	7
<i>Sagittaria sagittifolia</i>	6	9.24	1	12	-	7
<i>Sparganium erectum</i>	4	8.34	-	-	-	7
<i>Ulva flexuosa</i>	1	9.52	1	19	1	-
<i>Veronica anagallis-aquatica</i>	2	8.45	-	-	-	7
<i>Veronica beccabunga</i>	1	7.31	-	-	-	7
Additional Taxa						
<i>Enteromorpha</i> spp.	1	-	-	-	-	-
<i>Epilobium hirsutum</i>	-	-	-	-	-	7
Filamentous algae	2	-	-	-	-	-
<i>Filipendula ulmaria</i>	-	-	-	-	-	7
<i>Impatiens glandulifera</i>	-	-	-	-	-	6
<i>Solanum dulcamara</i>	-	-	-	-	-	7

Appendix B

SITE PHOTOGRAPHS



Figure B-1 - River Wensum within the Survey Area



Figure B-2 - River Wensum within the Survey Area



Figure B-3 - River Wensum within the Survey Area



Figure B-4 - River Wensum within the Survey Area



Figure B-5 - River Wensum within the Survey Area



Figure B-6 - River Wensum within the Survey Area



Figure B-7 - River Wensum within the Survey Area



Figure B-8 - River Wensum within the Survey Area



Figure B-9 - River Wensum within Survey Area



Figure B-10 - River Wensum within the Survey Area



Figure B-11 - River Wensum within the Survey Area



Figure B-12 - River Wensum upstream of the Survey Area



Figure B-13 - River Wensum upstream of the Survey Area



Figure B-14 - River Wensum upstream of the Survey Area



Figure B-15 - River Wensum upstream of the Survey Area



Figure B-16 - River Wensum upstream of the Survey Area





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