

A27 Arundel Bypass Watercourse Vegetation Baseline Survey Report

Appendix 8-16: Watercourse Vegetation Baseline Survey Report

16 August 2019

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Executive Summary

WSP was commissioned by Highways England to identify and describe the aquatic plant communities present in watercourses near the A27 Arundel Bypass scheme (the Scheme), Arundel, West Sussex. This study will inform the Environmental Assessment of the A27 Arundel Bypass.

This report presents the findings of the baseline desktop studies and field surveys carried out in 2017 and 2018, and makes recommendations for further surveys. 98 watercourses or watercourse sections were identified in the Field Survey Area. Sixty watercourses were subject to detailed botanical survey in 2017 and 2018. Eleven watercourse were 'scoped out' from detailed survey, as they were either dry or did not contain aquatic vegetation due to shading from woodland. Seventeen watercourses were not surveyed as they only marginally overlapped the Field Survey Area but were mainly outside of it. Ten watercourses were no accessible for survey.

The Field Survey Area contained a moderate diversity of aquatic and wetland species, including three species listed as Vulnerable on the Great Britain Red Data Book and five that are scarce in Sussex. Notable plant species recorded during surveys included common stonewort (*Chara vulgaris*), opposite-leaved pondweed (*Groenlandia densa*), frogbit (*Hydrocharis morsus-ranae*), smooth stonewort (*Nitella flexilis* agg.), tubular water-dropwort (*Oenanthe fistulosa*), small pondweed (*Potamogeton berchtoldii*), brooklime (*Samolus verandi*) and wild celery (*Apium graveolens*).

The River Arun valley north of Arundel is well known as a very rich area for aquatic and wetland plants in several grazing marsh ditch systems, including larger populations of all of the notable species found in the Field Survey Area. This Field Survey Area is therefore likely to be an impoverished, but still noteworthy, outlier from the main River Arun valley grazing marsh systems.

Species-rich ditches are restricted to three areas; the floodplain on the east side of the River Arun, between the river and the railway; the flood plain on the west side of the River Arun, between the river and Ford Lane and; ditches AQ060 and AQ064 to the north-east of Tortington Rife. Even in these areas the botanical interest is localised.

The Schedule 9 species Canadian pondweed (*Elodea canadensis*) was recorded in one watercourse

1 Introduction

1.1 Project Background

1.1.1.1 The scope of the A27 Arundel Bypass scheme (the Scheme) as described in the Highways England Road Investment Strategy¹ is:

“The replacement of the existing single carriageway road with a dual carriageway bypass, linking together the two existing dual carriageway sections of the road”.

1.1.1.2 This corresponds to the 6km section of the A27 from the A284 Crossbush junction (east of Arundel) to the west of Yapton Lane (west of Arundel). The A27 currently goes through the South Downs National Park and the town of Arundel passing over the River Arun and crossing the railway line.

1.1.1.3 The Scheme options taken forward to the Public Consultation were Options 1, Option 3 and Option 5A. These are briefly described individually below.

- **Option 1** consists of new dual carriageway from Crossbush junction south of the current A27 to the south-west of Arundel railway station, which connects with an upgraded A27 Ford Road junction. With a new bridge over the River Arun alongside the existing bridge. From Ford Road roundabout, which will be signalised, the existing A27 would be widened to dual carriageway.
- **Option 3** is an off-line route from the existing A27 alignment. Option 3 would consist of a new dual carriageway corridor along its entire length. The proposed alignment will then be joined to the existing A27 via an extension of the existing infrastructure at Crossbush Junction. The alignment then runs westwards across the floodplain south of Tortington Priory and requires two new overbridges, firstly over the Arun Valley Railway Line and secondly over the River Arun. Its alignment diverges north through the Binsted Woods Complex Local Wildlife Site (LWS), Tortington Common and South Downs National Park, re-joining the existing A27 at Havenwood Park. It requires four new underbridges at Old Scotland Lane, Binsted Lane, Tortington Lane and at Ford Road.
- **Option 5A** is a new dual carriageway from Crossbush junction south of the current A27. The alignment crosses the Arun Valley Railway, continuing west across the floodplain, over Ford Road, running south of Tortington Priory Scheduled Monument before going north through the Binsted Woods Complex LWS and the South Downs National Park, re-joining the existing A27 at a new junction near Yapton Lane.

¹ Road Investment Strategy: for the 2015/2016 – 2019/2020 Road Period, Department for Transport, March 2015

- 1.1.1.4 In October 2018, Highways England announced that a further, non-statutory public consultation would be undertaken on the Scheme (the Further Consultation) and that the Scheme would return to PCF Stage 2 (Option Selection). Through the additional studies and surveys, Highways England came across new and important information. Highways England wishes to ensure that forthcoming decision on the preferred route is made taking this new information into account and that consultees are given a fair opportunity to comment on the options on the basis of the information available. The further PCF Stage 2 work (Option Selection) (2018/2019) work included the identification of a suite of potential new Scheme options.
- 1.1.1.5 The process for identifying and short-listing the new set of Scheme options for consideration in PCF Stage 2, is set out in Chapter 3 of the Environmental Assessment Report. Ecological field survey data is not available for the western sections of Options 4/5AV1 and 5BV1. This is because these sections were previously too far west of the study area to necessitate a survey. Additional survey work targeting these areas is ongoing in 2019 and will be reported on in winter 2019. The information collected for Options 1, 3 and 5A in 2017 and 2018 will be used to inform an assessment of the six Scheme options and Scheme option selection.
- 1.1.1.6 When referring to the combined footprint of the Scheme (all options), the term ‘Scheme options’ is used in this report. When discussing the footprint of any single option, it is referred to be its number i.e. Option 1, Option 3 or Option 5A.

1.2 Ecological Background

- 1.2.1.1 The Mid-Arun Valley is a diverse landscape comprising a range of different habitats. These include ancient semi-natural woodland and ancient trees, grasslands, arable fields with grass margins, streams surrounded by swamp, fen and marsh habitats and ponds. These habitats are drained by a dense network of streams and ditches, which have potential to support protected and notable aquatic plant species.
- 1.2.1.2 The principal watercourses in the Field Survey Area are the River Arun to the east, which has extensive grazing marshes and ditches on its east floodplain, with a smaller area of ditches/grazing marsh on its west floodplain. Tortington Rife² is located centrally in the Field Survey Area, while Binsted Rife is a stream situated in the west of the Field Survey Area but is mostly outside of the Field Survey Area. Key survey areas are shown in **Appendix A**.

² Rife is the local name given to a stream in the Sussex coastal plain between Ferring and Pagham Harbour.

1.3 Aims and Objectives

1.3.1.1 WSP was commissioned by Highways England to:

- Identify and describe the aquatic plant communities present in the watercourses and ditches surrounding the Scheme options;
- Identify any notable or protected aquatic plant species that may be present; and
- Review the nature conservation importance of aquatic plant communities/habitats.

1.3.1.2 The scope of this study was developed to meet these aims:

- Conduct a detailed desk study to review evidence provided by third party organisations relating to aquatic habitats and plants in the landscape adjacent to the Scheme options; and
- Conduct field surveys to record aquatic plant species present in watercourse and ditches close to the Scheme options to ascertain if populations or habitats of rare or notable species were present.

1.3.1.3 The focus of this report is watercourses. Surveys of ponds and other waterbodies to ascertain if they support aquatic plant communities of nature conservation importance is reported in the aquatic ecology baseline report for the Scheme³. Surveys of grassland, marshy grassland and fen habitats are reported in the grassland interim baseline survey report⁴. Survey findings relating to water vole and otter are reported in the otter and water vole report⁵. Results have been discussed in this report where they are relevant to watercourse condition and character.

³ WSP (2019). Aquatic Ecology – Baseline Survey Report. Prepared for Highways England.

⁴ WSP (2019). Grassland – Baseline Survey Report. Document reference HE551523-WSP-GEN-SWI-RP-LE-00016. Prepared for Highways England.

⁵ WSP (2019). Otter and water vole – Baseline Survey Report. Document reference HE551523-WSP-GEN-SWI-RP-LE-00027. Prepared for Highways England.

2 Methods

2.1 Study Area

2.1.1.1 The following study areas were selected for desk study and field survey work:

- **Desk Study Area** – a zone of two kilometres from the outer boundary of the Scheme options was selected to gather information on habitats and plants species. This Desk Study Area included the entire Scheme options and a further two kilometres to inform an assessment of potential indirect hydrological interactions at the landscape scale.
- **Field Survey Area** – a zone extending 0.1 kilometres from the outer boundary of the Scheme options was selected for field survey. This Field Survey Area encompassed the entire Scheme options and a further 0.1 kilometres, which was considered appropriate to provide representative information on the diversity and composition of aquatic plant populations which may be affected by the Scheme. In practice, the 0.1 kilometres Field Survey Area was often extended to the natural end of a watercourse (e.g. its junction with another watercourse) to ensure the full diversity of plant communities present along an individual watercourse were recorded. This led to numerous surveys extending beyond 0.1 kilometres from the Scheme options. Binsted Rife is located mostly outside of the Field Survey Area, but is considered in this report because it is hydrologically linked to, and downstream of, the Field Survey Area.

2.2 Desk Study

2.2.1 Data Search

2.2.1.1 A desk study was undertaken in May 2017 and updated in October 2018 to review existing ecological baseline information available in the public domain and to obtain information held by relevant third parties in the Desk Study Area from the following sources:

- Open source 1:25,000 Ordnance Survey mapping and aerial photography;
- Freely downloadable datasets (available from Natural England) were consulted for information regarding the presence of statutory designated sites;
- Freely downloadable datasets (available from Natural England) were consulted for information regarding Habitats of Principal Importance;
- A data search obtained for the Desk Study Area from Sussex Biodiversity Records Centre;

- Local Biodiversity Action Plan Habitats were identified from Sussex Biodiversity Partnership; ⁶
- Botanical information collected by the Mid-Arun Valley Environmental Survey on aquatic habitats and plants:
 - Thompson, J. (March 2017). An ecological survey of the Mid-Arun Valley. Wildlife Splash on behalf of the Mid-Arun Environmental Survey.
 - Thompson, J. (October 2017). The Mid-Arun Valley 2015 – 2017 A27 Arundel bypass Road Options 1, 3 and 5A Ecological Impact Report (using current data) Wildlife Splash on behalf of the Mid-Arun Environmental Survey.

2.2.1.2 Phase 1 Habitat Survey data collected by Highways England is reported in the Phase 1 Habitat Survey report ⁷. This was reviewed as part of the desk study for information relating to watercourses.

2.2.1.3 Protected and notable plant species are defined in this report as follows:

- Plants and habitats listed on Annex 1 or Annex 2 of the Habitats Directive (Council Directive 92/43/EEC);
- Plants on Schedule 8 of the Wildlife and Countryside Act, 1981;
- Plant Species of Principal Importance in England included on Section 41 of the Natural Environment and Rural Communities Act 2006;
- Joint Nature Conservation Committee Conservation Designations for UK Taxa spreadsheet containing details of plant species listed on the UK or England Red Data Book and National Notable, Nationally Rare or Nationally Scarce plant species;
- Plant species or habitats on the Sussex Biodiversity Action Plan; and
- Plant species included on the Sussex Rare Species Inventory (provided by Sussex Biodiversity Records Centre).

2.2.2 Identification of Watercourses for Survey

2.2.2.1 Watercourses were identified within the Field Survey Area using the desk study sources listed in **Section 3.1** and Phase 1 Habitat Survey data collected by Highways England and reported in the Phase 1 Habitat Survey interim baseline report⁸. All watercourses were considered for survey unless they were less than 10 metres in length or for longer watercourses where only 10 metres or less overlapped the Field Survey Area.

⁶ Sussex Biodiversity Partnership (2016) <https://www.biodiversitysussex.org.uk/> (accessed November 2017).

⁷ WSP (2018). Phase 1 Habitat Survey – Baseline Survey Report. Document reference A27_ECO_11. Prepared for Highways England.

⁸ WSP (2018). Phase 1 Habitat Survey – Baseline Survey Report. Document reference A27_ECO_11. Prepared for Highways England.

2.2.2.2 The watercourses in the Field Survey Area were numbered using the watercourse ID code mapped in **Appendix B** and listed in **Appendix E**. However, in a few cases, it was necessary to further subdivide ditches to take multiple samples to record differing vegetation/wetland habitat types. Subdivision was coded by adding 'A' or 'B' to the watercourse code.

2.3 Field Survey

2.3.1.1 Each watercourse was surveyed based on the botanical part of the survey method detailed in Palmer, Drake & Stewart (2013)⁹. This is set out in full in **Appendix C** with a copy of the survey form used.

2.3.1.2 Watercourses were surveyed by throwing a grapnel¹⁰ into the watercourse at regular intervals where there were gaps in any swamp vegetation and by recording marginal, wetland plants from the shore.

2.3.1.3 For each watercourse a list of aquatic and wetland species was recorded and the abundances of each species assessed over the whole ditch length using the DAFOR scale¹¹.

2.3.1.4 In slight deviation to the Palmer, Drake & Stewart (2013)¹² method, land in the Field Survey Area for each watercourse was surveyed, rather than 20 metre sections, for reasons outlined in **Section 2.1**.

2.3.1.5 For each watercourse the following data was also collected:

- Adjacent land use;
- Ditch dimensions (water width, bank top width, freeboard¹³, water depth, silt depth, bank slope, slope of ditch bottom);
- pH, conductivity, water colour and cloudiness using a Hanna HI98129 meter;
- Bank vegetation structure;
- Levels of grazing and poaching of the banks;
- Cover of different vegetation structural types (e.g. floating, submerged, swamp etc.);
- Photographs; and
- A short description of the main features of the ditch.

⁹ Palmer, M.A., Drake, M & Stewart, N.F. (2013) A manual for the survey and evaluation of the aquatic plant and invertebrate assemblages of ditches. Buglife, Peterborough.
(https://www.buglife.org.uk/sites/default/files/2013Manual_0.pdf)

¹⁰ A device consisting of metal hooks on a rope used for collecting aquatic plants growing underwater or on the water surface.

¹¹ The DAFOR scale has been used to estimate the frequency and cover of the different plant species as follows: Dominant (D) - >75% cover, Abundant (A) – 51-75% cover, Frequent (F) – 26-50% cover, Occasional (O) – 11-25% cover, Rare (R) – 1-10% cover., The term 'Locally' (L) is also used where the frequency and distribution of a species are patchy and 'Edge' (E) is also used where a species only occurs on the edge of a habitat type.

¹² Palmer, M.A., Drake, M & Stewart, N.F. (2013) A manual for the survey and evaluation of the aquatic plant and invertebrate assemblages of ditches. Buglife, Peterborough.
(https://www.buglife.org.uk/sites/default/files/2013Manual_0.pdf)

¹³ The distance between bank top height and water surface.

2.3.1.6 In a small number of cases, vegetation was referenced to the National Vegetation Classification (NVC) as described in *British Plant Communities* (Rodwell, 2000)¹⁴, but formal quadrat sampling was not undertaken and the NVC community typing was based on surveyor experience alone. Comprehensive NVC community analysis was not an objective of this study and is not required to provide a nature conservation evaluation of aquatic plant communities.

2.3.2 Dates of Survey and Personnel

2.3.2.1 The majority of surveys, including all those undertaken in 2017 were undertaken by Nick Stewart, who has over 30 years' experience in botany and nature conservation. He specialises in aquatic ecology and is the Botanical Society of Britain and Ireland referee for stoneworts and is Chair of the charophyte subcommittee of the International Union for Conservation of Nature Species Survival Commission Freshwater Plant Specialist Group.

2.3.2.2 A small number of additional surveys were undertaken in 2018 by Richard Gowing who has over 12 years' experience as an ecological consultant and is a qualified to Field Identification Skills Certificate Level 4 standard in botany and has undertaken a large number of botanical surveys.

2.3.2.3 Surveys were conducted in dry weather conditions with no preceding rain or high river flows. Conditions were suitable for accurately recording aquatic plant species composition and structure. Surveys were undertaken on:

- 13 September 2017
- 14 September 2017
- 11 October 2017
- 12 October 2017
- 6 June 2018

2.3.3 Evaluation of Survey Findings

2.3.3.1 Watercourse vegetation survey findings were compared to the following sources information to ascertain if they qualify as nature conservation priorities:

- Habitat of Principal Importance, definitions listed by Maddock (2011)¹⁵;
- A Vascular Plant Red List for England¹⁶;
- The Vascular Plant Red Data List for Great Britain¹⁷;
- Sussex Local Biodiversity Action Plans¹⁸;
- Sussex Local Wildlife Site Selection Criteria¹⁹; and

¹⁴ Rodwell, J. S. (Ed). (2000) *British Plant Communities*, Vol. 5: maritime communities and vegetation of open habitats. Cambridge University Press, Cambridge.

¹⁵ Maddock, A. (Ed). (2011). UK Biodiversity Action Plan - Priority Habitat Descriptions. BRIG.

¹⁶ Stroh, P.A., *et al.* (2014). A Vascular Plant Red List for England. Botanical Society for Britain and Ireland.

¹⁷ Cheffings, C.M., Farrell, L. (eds), Dines, T.D., Jones, R.A., Leach, S.J., Mckean, D.R., Pearman, D.A., Preston, C.D., Rumsey, F.J. & Taylor, I. (2005). *The Vascular Plant Red Data List for Great Britain*. Species Status 7: 1-116. Joint Nature Conservation Committee, Peterborough.

¹⁸ Sussex Biodiversity Partnership (2016) <https://www.biodiversitysussex.org.uk/> (accessed November 2017).

¹⁹ Sussex Wildlife Trust (2017) Sussex Local Wildlife Site Selection Criteria

- Sussex Rare Plant Register²⁰.

2.4 Assumptions and Limitations

- 2.4.1.1 Ten watercourses were not surveyed because of access restrictions. These represent a small part of the Field Survey Area (see **Appendix B**) and are not considered a constraint to the robustness of the baseline data set.
- 2.4.1.2 Most watercourses were surveyed from at least one bank where access was permitted. However, lack of access permission prevented a full survey of some ditches, notably most of ditch AQ065, ditch AQ056, the northern part of ditch AQ057 and ditches AQ068 and AQ069. All of these are shaded streamlets and, as discussed in the results section, are unlikely to have aquatic vegetation of interest as a result of low light penetration.
- 2.4.1.3 There is some taxonomic uncertainty regarding intermediate water-starwort (*Callitriche brutia*), which is listed as Scarce in Sussex, but this refers to what is now known as (*Callitriche brutia var. brutia*) which is not the variety recorded during this survey. Various-leaved water-starwort (*Callitriche platycarpa*) is also listed as scarce in Sussex but this is now known to be due to under-recording because of difficulty of identification²¹.
- 2.4.1.4 Two surveys were undertaken in October, which may have missed earlier flowering plants. This is considered a minor limitation as the majority of plants, even those in a vegetative state were able to be identified to species level.
- 2.4.1.5 Possible dittander (*Lepidium latifolium*) was noted on the east side of the River Arun at the corner of the embankment at the northern edge of the reed bed at approximately TQ01140567. The specimen concerned was withered and lacked seed at the time of survey so could not be certainly identified.

²⁰ Sussex Wildlife Trust (2001) The Sussex rare plant register of Scarce and Threatened Vascular Plants, Charophytes, Bryophytes and Lichens

²¹ Stewart, Nick. (Personal communication, February 2018).

3 Results

3.1 Desk Study

3.1.1 Statutory and Non-Statutory Site Designations

3.1.1.1 Statutory and non-statutory sites designated for aquatic habitats or species within the Desk Study Area are described in **Table 3.1**.

3.1.1.2 No statutory or non-statutory sites are within the Field Survey Area. The Arun Valley, Watersfield to Arundel Local Wildlife Site is upstream and hydrologically connected to the northern part of the Field Survey Area by ditches and the River Arun.

3.1.1.3 There are three Sites of Special Scientific Interest (SSSI) upstream of the Field Survey Area that include notified features of aquatic interest, although these are not within the Desk Study Area. These are Waltham Brooks, Amberley Wild Brooks and Pulborough Brooks, which are notified because of the presence of features including the lowland ditch system including notable species such as cut-grass (*Leersia oryzoides*).

Table 3-1 - Statutory and Non-Statutory Sites within 2km with aquatic plants included in the designation

Site Designation	Statutory/Non-statutory	Site Name	Approx Distance from closest Scheme option	Key Habitat and Species
Site of Special Scientific Interest	Statutory	Arundel Park	0.4km north	Swanbourne Lake vegetation includes great fen-sedge (<i>Cladium mariscus</i>) and sweet flag (<i>Acorus calamus</i>).
Site of Nature Conservation Interest	Non-statutory	Arun Valley, Watersfield to Arundel	0.4km	River and network of ditches, some being of botanical importance.

3.1.2 Important Stonewort Area

3.1.2.1 An area of the Lower Arun Valley has been designated as the Lower Arun Grazing Marsh important stonewort area²². However, watercourses within the survey area in the Arun valley were found to be in a sub-optimal brackish condition, with a low diversity of stoneworts.

3.1.3 Sussex Biodiversity Record Centre - Protected & Designated Species

3.1.3.1 A summary of species records from Sussex Biodiversity Records Centre for the last ten years in the Field Survey Area is provided in **Table 3.2**. Water-soldier (*Stratioties aloides*) is only native in the Norfolk Broads and is therefore likely an introduction²³. The Department of Transport Ecological Impact Assessment (1991)²⁴ refers to water-soldier within a pond by Binsted Lane 'Pond at SU 982 069', as '*...one nationally scarce plant which has been introduced here, water soldier.*'

Table 3-2 - Protected and Notable Aquatic and Wetland Species provided by Sussex Biodiversity Record Centre

Common name	Scientific name	Status*	Location	Distance from Scheme options
Opposite-leaved Pondweed	<i>Groenlandia densa</i>	England Red list – Vulnerable / Great Britain Red List – Vulnerable / Rare in Sussex (Briggs et al. 2001) / Locally frequent West Sussex (Sussex Botanical Recording Group, 2018)	Arundel, Park Bottom. West of A284	180 m to north
Frogbit	<i>Hydrocharis morsus-ranae</i>	Great Britain Red List – Vulnerable / Locally common in Sussex	Six records, four in Binsted Rife, one in Tortington Rife and one the Arun floodplain east of Arundel	
Tubular water-dropwort	<i>Oenanthe fistulosa</i>	Great Britain Red List – Vulnerable / Species of Principal Importance / Locally common in Sussex	One record at Walberton Green	

²² Stewart, N. F. (2004). Important Stonewort Areas. An assessment of the best areas for stoneworts in the United Kingdom (summary). Plantlife International, Salisbury, UK.

²³ Streeter, D. et al. (2016) Collins Wild flower Guide, 2nd edition.

²⁴ Department of Transport (South-East Region) (1991). A27 Arundel By-pass, West Sussex, Ecological Impact Assessment, Final Report.

Common name	Scientific name	Status*	Location	Distance from Scheme options
Water-soldier	<i>Stratiotes aloides</i>	England Red Data Book – Least Concern / Great Britain Red List – Near threatened / Scarce or Rare in Sussex but regarded as planted/arising from dumped garden waste (Sussex Botanical Recording Group, 2018)	Six records in waterbodies off Binsted Lane in west of Field Survey Area.	115m to north

*These designations are based on Briggs (2001)²⁵, Cheffings and Farrell (2005)²⁶, Stroh et al. (2014)²⁷; Species of Principal Importance identified on Section 41 of the NERC Act; and Sussex Botanical Recording Group (2018). The Flora of Sussex. Pisces Publications. Where the lists for Sussex (Briggs *et al* and Sussex Botanical Recording Group) disagree both designations are given.

3.1.4 Habitats of Principal Importance

3.1.4.1 The following wetland/aquatic Habitats of Principal Importance were identified within the Desk Study Area by Natural England and/or the Mid-Arun Valley Environmental Survey²⁸:

- **Lowland Fen** - The Mid-Arun Valley Environmental Survey considers swamp and tall wetland herb communities in the valley of Binsted Rife, and potentially reed and sedge swamp communities in a field west of Tortington Rife (at approximate National Grid reference SU 99413 05631) to qualify as Lowland Fen Habitat of Principal Importance. Possible Lowland Fen Habitat of Principal Importance - in Binsted Rife valley is 0.8 kilometres downstream of the Scheme options. Possible Lowland Fen Habitat of Principal Importance in a field west of Tortington Rife is approximately 1.5 kilometres downstream of where the Scheme options cross a woodland stream which is connected to Tortington Rife.
- **Reedbed** – The Mid-Arun Valley Environmental Survey identified the main community along Binsted Rife as NVC community S4 *Phragmites australis* swamp and reedbed. Mostly of the reedbed in the Field Survey Area occurs as thin, narrow strips of common reed alongside ditches.

²⁵ Briggs, M. (ed.) (2001) The Sussex Rare Plant Register of Scarce & Threatened Vascular Plants, Charophytes, Bryophytes and Lichens. Sussex Wildlife Trust.

²⁶ Cheffings, C.M., Farrell, L. (eds), Dines, T.D., Jones, R.A., Leach, S.J., McKean, D.R., Pearman, D.A., Preston, C.D. Rumsey, F.J. & Taylor, I. (2005). The Vascular Plant Red Data List for Great Britain. Species Status 7: 1-116. Joint Nature Conservation Committee, Peterborough.

²⁷ Stroh, P.A., *et al.* (2014). A Vascular Plant Red List for England. Botanical Society for Britain and Ireland.

²⁸ Thomson, J. (March, 2017) An ecological survey of the Mid-Arun Valley. Wildlife Splash on behalf of the Mid-Arun Environmental Survey and Thomson, J. (October, 2017). The Mid-Arun Valley 2018-2017 A27 Arundel bypass Road Options 1,3 and 5A Ecological Impact Report (using current data) Wildlife Splash on behalf of the Mid-Arun Environmental Survey.

- However, on the east bank of the River Arun (at approximate National Grid reference TQ 011 055) a larger reedbed is present.
- **Coastal and Floodplain Grazing Marsh** - Natural England has mapped this habitat type on both west and east floodplains of the River Arun to the south of Arundel. Information within the Natural England Geographic Information System files notes that there is 'insufficient information to establish [the] hydrological regime and ornithological interest' of the coastal and floodplain grazing marsh. Binsted Rife which is south-west of the Field Survey Area, has this habitat to the east and west.
- **Ponds** – Standing water is present across the Field Survey Areas, in various forms including a number of ponds and several small lakes.
- **River and chalk stream** - The River Arun is a large watercourse which is likely to qualify as River Habitat of Principal Importance. However, where it flows through the Field Survey Area it is embanked by flood walls and is not in a near natural state. The Mid-Arun Valley Environmental Survey has identified Binsted Rife and a second stream originating from above Sandy Hole Pond (National Grid reference SU 98191 06947) as 'chalk streams' on the basis that they are likely to originate from the chalk aquifer under the South Downs; and that both watercourses support plant species associated with water that is rich in calcium carbonate.

3.1.4.2 Habitats of Principal Importance mapped by Natural England are shown in **Appendix D** those identified by The Mid-Arun Valley Environmental Survey are described in this section but are not mapped.

3.1.5 Identification of Watercourses for Survey

3.1.5.1 Ninety-eight watercourses or watercourse sections are discussed within this report. These are detailed in **Appendix E** and shown in **Appendix B**.

3.2 Field Survey

3.2.1 Overview

3.2.1.1 Of the 98 watercourses present in the Field Survey Area, the following actions were taken, as detailed in **Appendix E** and shown in **Appendix B**

- Sixty received a detailed botanical survey, the data from which is presented in this report.
- Eleven watercourses were 'scoped out' from detailed survey, as they were either dry or did not contain aquatic vegetation due to shading from woodland. This was based on a walkover undertaken during the course of aquatic plant surveys, using Phase 1 habitat survey data or otter and water vole data.
- Seventeen watercourses were not surveyed as they only marginally overlapped the Field Survey Area but were mainly outside of it.

- Ten watercourses were not surveyed owing to land access restrictions.

3.2.1.2 A list of species recorded during the survey is given in **Appendix F**, photographs are provided in **Appendix G** and short descriptions of each watercourse are given in **Appendix H**.

3.2.1.3 Raw data collected for each watercourse, incorporating plant species lists, physical, chemical and structural data are provided in **Appendix I**.

3.2.1.4 The survey data may be summarised as follows by combining watercourse of similar character and location in the following groups:

- Ditches east of the River Arun;
- The River Arun;
- Ditches west of Ford Road;
- Ditches from Ford Road to Tortington Lane;
- Ditches from Tortington Lane to Binsted Lane;
- Ditches West of Binsted Lane; and
- Ditches streamlets in Binsted and Tortington Wood.

3.2.2 East of The River Arun

3.2.2.1 The floodplain ditches on the east side of the River Arun are quite varied, containing a mix of dry ditches, shallow ditches with creeping bent (*Agrostis stolonifera*) and sweet grass species (*Glyceria spp.*), shaded ditches with little vegetation, common reed (*Phragmites australis*) swamp dominated ditches (sometimes with duckweed (*Lemna spp.*) or filamentous algae abundant beneath), duckweed dominated ditches but only a few with a submerged aquatic flora. The main arterial ditch is ditch AQ018/017 which is sluiced at its junction with ditch AQ017.

3.2.2.2 To the south-west of this many of the ditches had low water at the time of survey, up to 60 cm less than in ditches AQ018 and AQ007 but often 20-30 cm below other tributary ditches.

3.2.2.3 The more notable ditches for aquatic vegetation are ditch AQ015A which contains the England Red List - Vulnerable opposite-leaved pondweed (*Groenlandia densa*), and there are small areas on ditches AQ002, AQ023 and AQ030B where there is significant underwater vegetation including common stonewort (*Chara vulgaris*), horned pondweed (*Zannichellia palustris*), ivy-leaved duckweed (*Lemna trisulca*) and thread-leaved water-crowfoot (*Ranunculus trichophyllus*). Elsewhere the aquatic vegetation, where present, is restricted to duckweeds and water starworts (*Callitriche spp.*).

3.2.3 River Arun (AQ199)

3.2.3.1 Much of the River Arun within the survey area was faced with sloping concrete flood embankments. The river is tidal here and evidently brackish. There is often seaweed brown alga species (*Fucus spp.*) attached to the lower part of the facing with patchy *Ulva flexuosa* and *Vaucheria* above this. The upper two metres of the facing has tufts of common couch (*Elytrigia repens*) and occasional saltmarsh species, however, this gives way to common couch grassland immediately above the concrete.

3.2.3.2 At the southern end of the section on the east side the facing gives way to a more natural common reed fringe forming a band about 50 metres wide at approximate National Grid reference TQ 011 055. In an indentation at the northern end of this (c. TQ 1116 0566) there is a small patch of saltmarsh vegetation extending for about 30 metres by 10 metres. This grades from the lower saltmarsh referable to:

- NVC community SM13a *Puccinellia maritima* saltmarsh, *Puccinellia maritima* dominant sub-community with common saltmarsh grass (*Puccinellia maritima*) with some sea aster (*Aster tripolium*) beside the river; and
- NVC Community SM16a *Festuca rubra* saltmarsh *Puccinellia maritima* sub-community common saltmarsh grass and red fescue (*Festuca rubra*) with abundant sea aster (*Aster tripolium*) and some sea arrowgrass (*Triglochin maritima*), sea-milkwort (*Glaux maritima*) and sea arrowgrass to the upper marsh community SM16c (*Festuca rubra* saltmarsh *Festuca rubra*-*Glaux maritima* sub-community) (as previously, however creeping bent replace common saltmarsh grass.)

3.2.3.3 Notably, marsh mallow (*Althaea officinalis*) which is considered to be Nationally Threatened in the England Red List²⁹ was identified in this area of dry grassland on top of the flood embankment. This species occurs on the east bank of the river on the landward side of the embankment (one plant at National Grid Reference TQ 0108 0600, two plants at National Grid Reference TQ 01080 05635 and six plants at National Grid Reference TQ 01079 05624).

3.2.4 West of The River Arun To Ford Road

3.2.4.1 This was an area of flat floodplain. Some ditches were dry and shaded with little aquatic vegetation but those that are wet are dominated by common reed (when they are not overshadowed by trees and shrubs) which also severely limits the aquatic vegetation beneath.

²⁹ Stroh, P.A., et al. (2014). A Vascular Plant Red List for England. Botanical Society for Britain and Ireland.

3.2.4.2 However, there were usually some abundant duckweeds including common duckweed (*Lemna minor*) and least duckweed (*Lemna minuta*) and occasional plants of water starwort (*Callitriche spp.*).

3.2.5 Ford Road to Tortington Lane

3.2.5.1 The ground rises in this part and there were only a few dry or slightly trickling ditches at the edges of arable fields. Much of these are shaded by trees but where open the grassy bank vegetation often shades over the ditches. As a result, there was very little wetland vegetation and no aquatic vegetation.

3.2.6 Tortington Lane to Binsted Lane

3.2.6.1 Many of the ditches in this section are more or less dry and shaded by hedges or trees. Usually there is little aquatic or wetland vegetation but where there is shallow standing and no shade there are patches of common reed. The exceptions are two ditches (AQ060 and AQ064) towards the south-west of this area which are standing water ditches with water c.50m deep. These have significant aquatic vegetation including small pondweed (*Potamogeton berchtoldii*), curled pondweed (*Potamogeton crispus*), broad-leaved pondweed (*Potamogeton natans*), Canadian waterweed (*Elodea canadensis*), horned pondweed, smooth stonewort (*Nitella flexilis agg.*) and frogbit (*Hydrocharis morsus-ranae*) as well as a mix of duckweeds and water starworts (*Callitriche spp.*) AQ060 is Tortington Rife and the richest ditch in the survey area with ten aquatic species and ditch AQ064, a tributary of Tortington Rife is also rich with five aquatic species. Both are off the proposed line of the road but could be affected by run-off both during the construction phase and when the road is in use.

3.2.7 West of Binsted Lane

3.2.7.1 This section contains two shallow streamlets both within woodland and shaded and with no aquatic vegetation. A pond has been created by damming on the western stream. This is only partly shaded but contained cloudy water with no aquatic vegetation.

3.2.8 Binsted Woods Complex LWS and Tortington Common

3.2.8.1 This is an area of woodland with a number of shaded streamlets running through it. This area was not investigated fully as the habitat was too shaded to allow growth of significant aquatic vegetation in the parts surveyed. Ditches AQ068 and AQ070 were subject to a walkover survey, with AQ068, AQ069, AQ072, AQ073 and AQ076 excluded from survey due to findings in the Otter and Water Vole Report³⁰.

³⁰ WSP (2018). Otter and water vole – Interim Baseline Survey Report. Document reference A27_ECO_10.
Prepared for Highways England.

3.2.9 Notable Species

3.2.9.1 A full list of species recorded is provided in **Appendix F**. A total of 20 aquatic species (excluding filamentous algae) and 67 wetland species were recorded. Of these, the most notable are listed in **Table 3.3**.

Table 3-3 - Notable plant species

Common name	Species	Status*	Location
Common stonewort	<i>Chara vulgaris</i>	Scarce in Sussex	Ditch AQ030B
Opposite-leaved pondweed	<i>Groenlandia densa</i>	England Red List – Vulnerable / Great Britain Red List – Vulnerable / Rare in Sussex (Briggs <i>et al</i> 2001) / Occasional to Locally Frequent in West Sussex (particularly in the Arun Valley; Sussex Botanical Recording Group, 2018)	Ditch AQ015A
Frogbit	<i>Hydrocharis morsus-ranae</i>	England Red List – Vulnerable / Great Britain Red List – Vulnerable / Locally common in Sussex	Ditch AQ060
Smooth stonewort	<i>Nitella flexilis</i> agg.	Scarce in Sussex	Ditch AQ060
Tubular water-dropwort	<i>Oenanthe fistulosa</i>	England Red List – Vulnerable / Great Britain Red List – Vulnerable / Section 41 Species of Principal Importance / Locally common in Sussex	Close to ditch AQ012
Small pondweed	<i>Potamogeton berchtoldii</i>	Great Britain Red List – Least concern / Scarce in Sussex	Ditch AQ060
Wild celery	<i>Apium graveolens</i>	Scarce in West Sussex, known from the Arun Valley	Ditch AQ038
Brooklime	<i>Samolus verandi</i>	Scarce in West Sussex, known from the Arun Valley	Ditches AQ038 and AQ006

*These designations are based on Briggs (2001)³¹, Cheffings and Farrell (2005)³², Stroh *et al.* (2014)³³, Species of Principal Importance identified on Section 41 of the NERC Act; and Sussex Botanical Recording Group (2018)³⁴. Where the lists for Sussex (Briggs *et al* and Sussex Botanical Recording Group) disagree both designations are given.

³¹ Briggs, M. (ed.) (2001) The Sussex Rare Plant Register of Scarce & Threatened Vascular Plants, Charophytes, Bryophytes and Lichens. Sussex Wildlife Trust.

³² Cheffings, C.M., Farrell, L. (eds), Dines, T.D., Jones, R.A., Leach, S.J., McKean, D.R., Pearman, D.A., Preston, C.D. Rumsey, F.J. & Taylor, I. (2005). The Vascular Plant Red Data List for Great Britain. *Species Status 7*: 1-116. Joint Nature Conservation Committee, Peterborough.

³³ Stroh, P.A., *et al.* (2014). A Vascular Plant Red List for England. Botanical Society for Britain and Ireland.

³⁴ Sussex Botanical Recording Group (2018). The Flora of Sussex. Pisces Publications.

3.2.9.2 In addition, marsh mallow (*Althaea officinalis*) which is considered to be Nationally Threatened in the England Red List³⁵ was noted on the east bank of River Arun but is not an aquatic plant species.

3.2.10 Notable Ditches for Species Diversity

3.2.10.1 **Table 3.4** gives the number of species recorded from each ditch, ordered by the number of aquatic species. This shows that the most notable ditches occur in two areas, the floodplain east of the River Arun and two ditches AQ060 and AQ064 near Tortington Rife. Ditch AQ060 and AQ064 are outside but within 200m of the Scheme options.

Table 3-4 - Number of species recorded from each ditch, ordered by decreasing number of aquatic species

Watercourse Reference	No. of species	No. of aquatic species	No. of wetland species	Notable species
AQ060	54	10	34	3
AQ030B	26	7	10	1
AQ023	32	6	14	-
AQ064	50	5	37	-
AQ015A	36	5	26	1
AQ002	36	5	17	-
AQ034	36	4	15	-
AQ018A	28	3	15	-
AQ018C	34	3	14	-
AQ021	26	3	11	-
AQ044	18	3	8	-
AQ046A	12	3	8	-
AQ065	26	2	17	-
AQ006	25	2	15	-
AQ012	18	2	13	1
AQ01B	33	2	13	-
AQ004	25	2	13	-
AQ014	25	2	12	-
AQ046B	18	2	9	-
AQ050	15	2	9	-
AQ024	18	2	9	-
AQ042	29	2	9	-
AQ01A	21	2	8	-
AQ035	9	2	6	-

³⁵ Stroh, P.A., *et al.* (2014). A Vascular Plant Red List for England. Botanical Society for Britain and Ireland.

Watercourse Reference	No. of species	No. of aquatic species	No. of wetland species	Notable species
AQ032	32	1	18	-
AQ045A	20	1	13	-
AQ031B	23	1	12	-
AQ005	21	1	11	-
AQ041	27	1	10	-
AQ013	16	1	9	-
AQ048B	14	1	8	-
AQ049	15	1	8	-
AQ007	25	0	16	-
AQ029	23	0	14	-
AQ054	19	0	13	-
AQ051	23	0	13	-
AQ091	19	0	13	-
AQ078A	12	0	12	-
AQ057A	18	0	12	-
AQ038	20	0	12	-
AQ057B	17	0	11	-
AQ031A	19	0	10	-
AQ053	21	0	9	-
AQ030A	18	0	9	-
AQ028	18	0	9	-
AQ078C	8	0	8	-
AQ010	14	0	8	-
AQ058	18	0	8	-
AQ011	19	0	8	-
AQ015B	14	0	7	-
AQ003	22	0	7	-
AQ067	16	0	7	-
AQ066	16	0	6	-
AQ045B	10	0	6	-
AQ009	8	0	4	-
AQ048A	12	0	4	-
AQ047	8	0	4	-
AQ052	10	0	4	-
AQ093	7	0	4	-

4 Discussion and Recommendations

4.1 Discussion

4.1.1 Summary of Watercourse Aquatic and Wetland Species.

4.1.1.1 The Field Survey Area contained a moderate diversity of aquatic and wetland species, including three species listed as Vulnerable on the Great Britain Red Data Book and three that are scarce in Sussex. The River Arun valley north of Arundel is well known as a very rich area for aquatic and wetland plants in several grazing marsh ditch systems, including larger populations of all of the notable species found in the Field Survey Area. This Field Survey Area is therefore likely to be an impoverished, but still noteworthy, outlier from the main River Arun valley grazing marsh systems.

4.1.1.2 As shown in **Table 3.4**, much of the diversity is restricted to a small number of ditches. Many of the watercourses on the higher ground west of the Ford Lane are shallow to dry streamlets with little to no aquatic plants and only a few common wetland species. Many watercourses are also partially or wholly shaded. Ditches with significant depths of water are restricted to three areas; the floodplain on the east side of the River Arun, between the river and the railway; the flood plain on the west side of the River Arun, between the river and Ford Lane and; ditches AQ060 and AQ064 to the north-east of Tortington Rife. Even in these areas the botanical interest is localised.

4.1.1.3 The main ditches of botanical interest are:

(A) Flood Plain East of The River Arun

- Watercourse AQ015A – Relatively high species diversity, including opposite-leaved pondweed;
- Watercourse AQ002 – Relatively high species diversity but mostly in one area c. TQ01400588;
- Watercourse AQ012 – Population of tubular water-dropwort (*Oenanthe fistulosa*) at TQ 0178 0590;
- Watercourse AQ034 – Moderate species diversity, mostly at east end c. TQ 0215 0638 to TQ 0216 0633;
- Watercourse AQ030B – Relatively high species diversity, including common stonewort, but mostly in one area c. TQ 0177 0647; and
- Watercourse AQ023 – Good species diversity.
- Watercourse AQ006 – small population of brooklime.
- Watercourse AQ038 – small populations of wild celery and brooklime.

(B) Tortington Rife and Tributary

- Watercourse AQ060 – Relatively high species diversity, including small pondweed, smooth stonewort and frogbit; and

- Watercourse AQ064 – Relatively high species diversity.

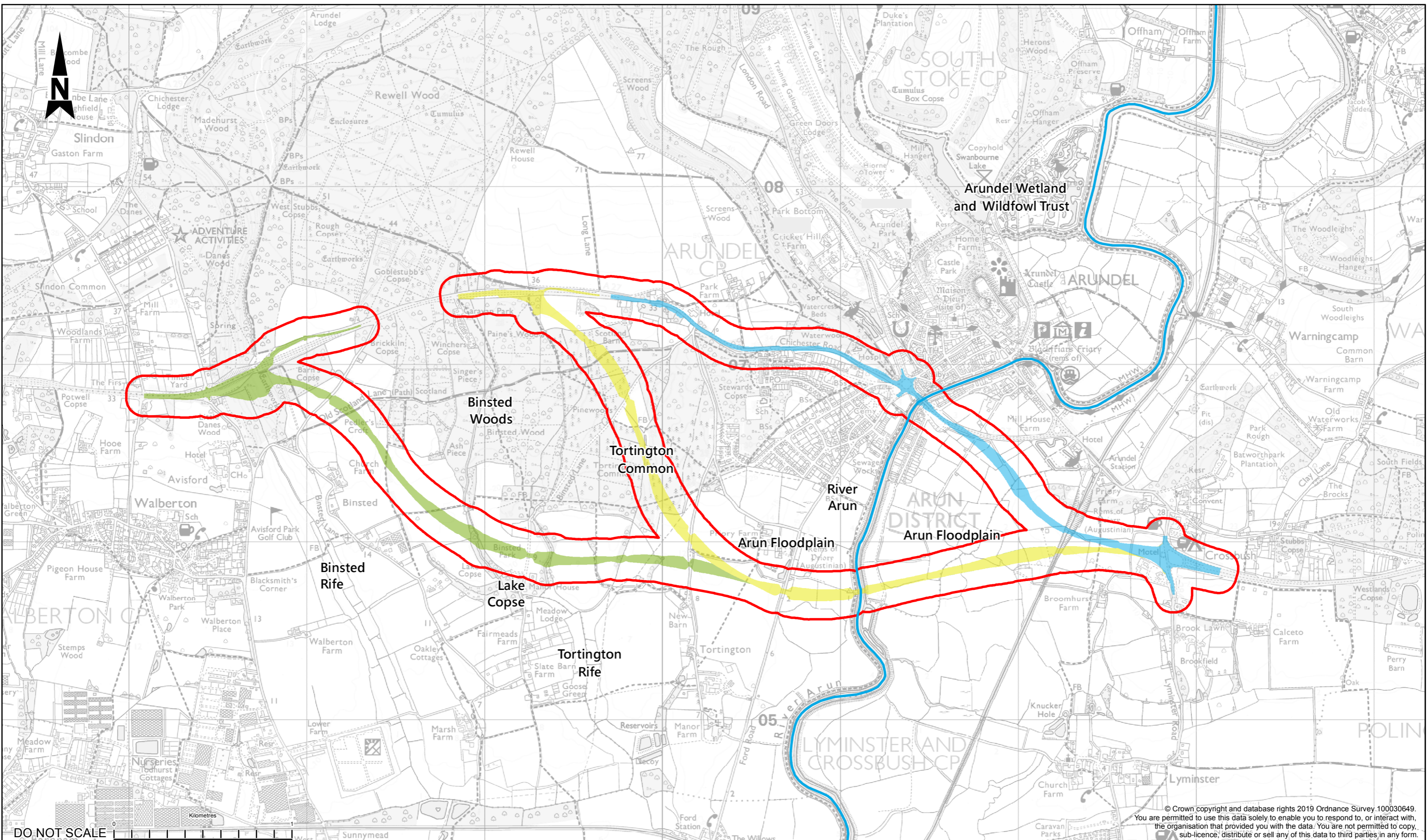
4.1.2 Current Management

- 4.1.2.1 Many of the ditches were suffering from neglect. Apart from the main arterial ditches, ditch clearance has probably been occasional and many have been left to silt up or become overgrown by reeds and/or scrub.
- 4.1.2.2 There is considerable scope for improvements to the management to favour the aquatic vegetation as well as improving their function as wet fences. It may be that with better, more regular management there would be an increase in the species richness of the ditches and populations of the more notable species may become more abundant.
- 4.1.2.3 However, improved ditch clearance needs to be done with care because of problems of nutrient enrichment. This is particularly evident in the floodplain east of the River Arun where the main arterial ditch (watercourse AQ018/017) appears to have lower quality, enriched water, indicated by the higher turbidity and increased growth of filamentous algae. The western end of watercourse AQ034 has been cleaned out allowing the more enriched water from watercourse AQ018 to feed into this part of the ditch resulting in a flush of the alga (*Ulva flexuosa*).

4.2 Further Survey Recommendations

- 4.2.1.1 Broad spatial coverage of watercourses was achieved by 2017 and 2018 surveys incorporating the majority of watercourses which are fully in the Field Survey Area. It is possible that localised populations of notable plant species and/or species-rich ditches may be present in watercourses that were inaccessible for survey (ten watercourses). However, based on the large sample size and even distributed spatial coverage that was achieved, it is likely that the data are representative and robust to inform an Ecological Impact Assessment.
- 4.2.1.2 When access becomes possible the ten inaccessible watercourses should be surveyed.
- 4.2.1.3 Depending on which Scheme option is selected as the Preferred Route, it may be beneficial to survey downstream sections of Tortington Rife and Binsted Rife on account of possible hydrological links to the Scheme and the potential for impacts arising from changes to water quality or hydro-geomorphology.
- 4.2.1.4 The aim of further surveys should be as documented in the introduction to this report.

Appendix A: Survey Area



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- KEY:**
- █ OPTION 1
 - █ OPTION 3
 - █ OPTION 5A
 - 100M FIELD SURVEY AREA

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION	
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).	
Construction	
Maintenance / Cleaning	
Use	
Decommissioning / Demolition	
Rev.	Date Description By Chkd App'd
P01.1	--- First Issue ---

Drawing Status: **FINAL**

Suitability: **S0**



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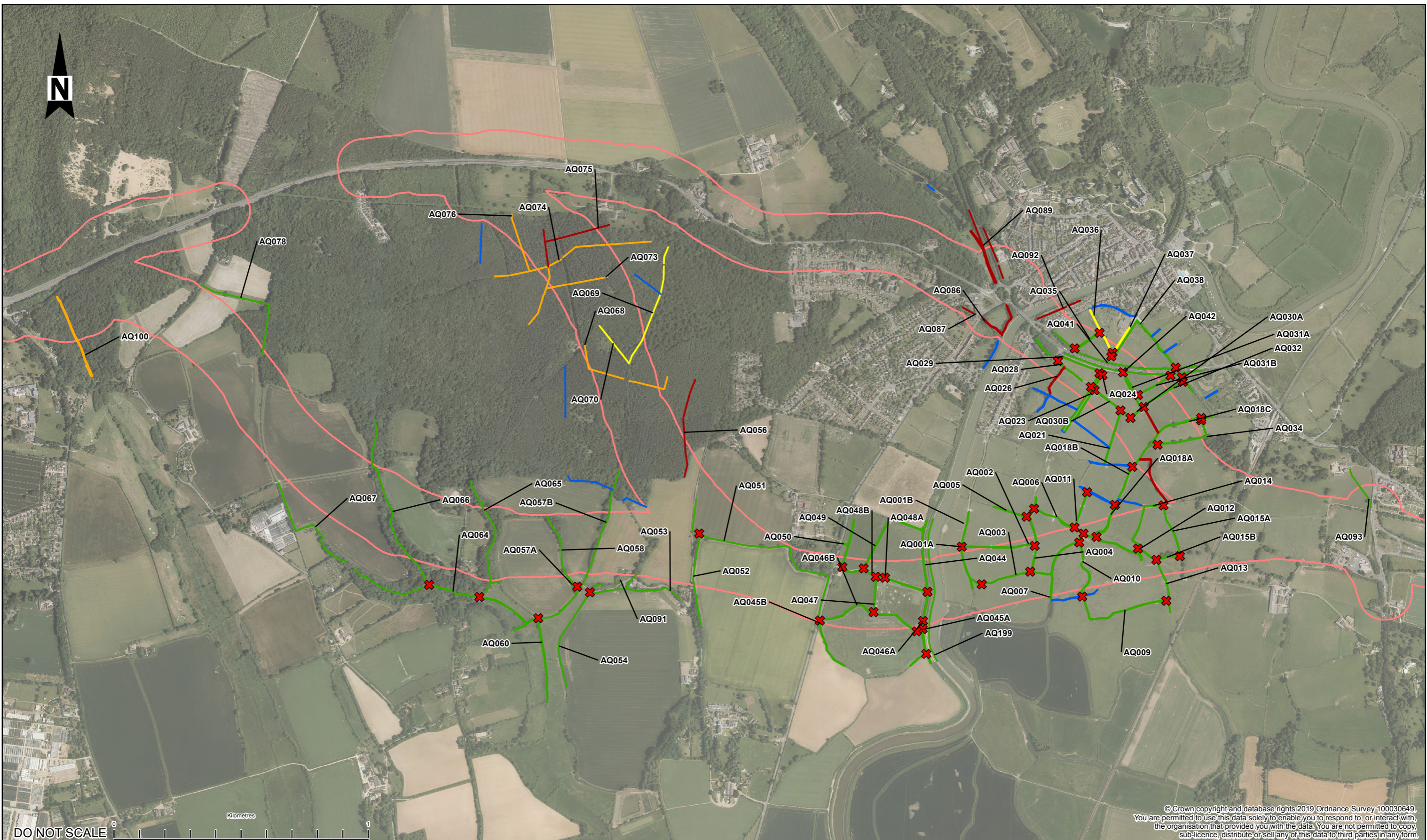
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Client: **Working on behalf of**



Project Title		REGIONAL INVESTMENT PROGRAMME A27 ARUNDEL BYPASS			
Drawing Title		APPENDIX A: NVC WATERCOURSE KEY LOCATIONS			
Scale	1:20,000	Drawn	CR	Checked	RG
Original Size	A3	Date	15/08/19	Date	15/08/19
Approved	AB	Date	15/08/19	Authorised	PA
Drawing Number	Project	Originator	Volume	Project Ref. No.	70052558
HE551523-WSP-GEN-SWI-GI-DR-0540				Revision	P01
Location	Type	Role	Number		

Appendix B: Map of Watercourses



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- KEY:**
- 100M FIELD SURVEY AREA
 - ✕ BREAK POINTS BETWEEN DITCHES
 - SURVEYED
 - BRIEF WALKOVER
 - SCOPED OUT
 - OUTSIDE OF 100M FIELD SURVEY AREA
 - NOT SURVEYED

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).

Construction	
Maintenance / Cleaning	
Use	
Decommissioning / Demolition	

Rev.	Date	Description	By	Chkd	App'd
P01.1		First Issue			

Drawing Status: **FINAL**

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Client: **Working on behalf of highways england**

Project Title: REGIONAL INVESTMENT PROGRAMME A27 ARUNDEL BYPASS				
Drawing Title: APPENDIX B: NVC WATERCOURSE FIELD SURVEY				
Scale: 1:14,000	Drawn: CR	Checked: AS	Approved: RG	Authorised: RG
Original Size: A3	Date: 15/08/19	Date: 15/08/19	Date: 15/08/19	Date: 15/08/19
Drawing Number: HE551523-WSP-GEN-SWI-GI-DR-0542	Originator: []	Volume: []	Project Ref. No: 70052558	Revision: P01
Location: []	Type: []	Role: []	Number: []	

Appendix C: Methods and Recording Form

Site		Ditch no.		Recorder	
Grid ref.		Date		Photo	

ADJACENT LAND USE	A E/N	B W/S
Improved grassland		
Semi-improved grassland		
Unimproved grassland		
Arable		
Swamp or Fen		
Woodland or Carr		
Other		
Cattle/Horse grazed		
Sheep grazed		
Hay/Silage		
Stockproof boundary		
Temporary fencing		
Spoil on bank		

DITCH FEATURES					
Water width	0	1	2	3	4
Banktop width	0	2½	5	7½	10
Freeboard	0	20	50	100	200
Water depth (cm)					
Silt depth (cm)					
Conductivity (µS/cm)					
pH					
Turbidity	Clear				Opaque
Water colour					
Slope bank A	0	15	30	55	70
Slope bank B	0	15	30	55	70
Underwater bank A	0	15	30	55	70
Underwater bank B	0	15	30	55	70
Soil type	clay	alluv.	peat	sand	

BANK VEGETATION DAFOR	A E/N	B W/S
Tall grass/reed		
Short grass		
Bare ground		
Tall herbs		
Scrub		
Fen		
Woodland ground flora		
Shaded (%)		

VEGETATION COVER	0	1	2	3	4	5
Open water surface						
Floating Lemna/Azolla						
Other floating aquatics						
Floating algae						
Lemna trisulca						
Other submerged plants						
Submerged algae						
Open substrate						
Emergent						
Floating mat						
Exposed vegetated						
Exposed mud						
Litter / detritus						
Shaded						
Emergents/floating mat in channel %						

	%	width
Swamp margin A		
Swamp margin B		

GRAZING	Bank A (E/N)				Bank B (W/S)			
	none	low	med.	high	none	low	med.	high
Grazing								
Poaching								
Block formation								
Shelf formation								
Tangled								
Grassy margin								

D 5	70-100%
A 4	30-70%
F 3	10-30%
0 2	3-10%
R 1	0-3%

Notes

MANAGEMENT				
Years since last cleared	1	2-3	4-10	>10
Water relative to normal		cm (+ above normal, - below normal)		
Cleared to side	A	B		
Benched profile	A	B		
Cleared by	Land manager		IDB	EA

BUGLIFE GRAZING MARSH SURVEY: EXPLANATION OF RECORDING FORMS

Adjacent land use

This is the main land use beyond the bank top. If there is a margin more than 5 metres of another land use then this should be recorded with an "M".

It is difficult to define the terms improved, semi-improved and unimproved grassland in any sort of consistent way. Essentially improved grasslands will tend to have Rye Grass at over 50% cover while unimproved grasslands will have low levels of Rye Grass and usually some diversity of herb species.

Bank vegetation

This section deals mainly with the ground and field layers below 1.5 metres height (including reeds etc taller than this). The amount of shade from canopy over 1.5 metres above the ground should be recorded as a percentage under "shaded".

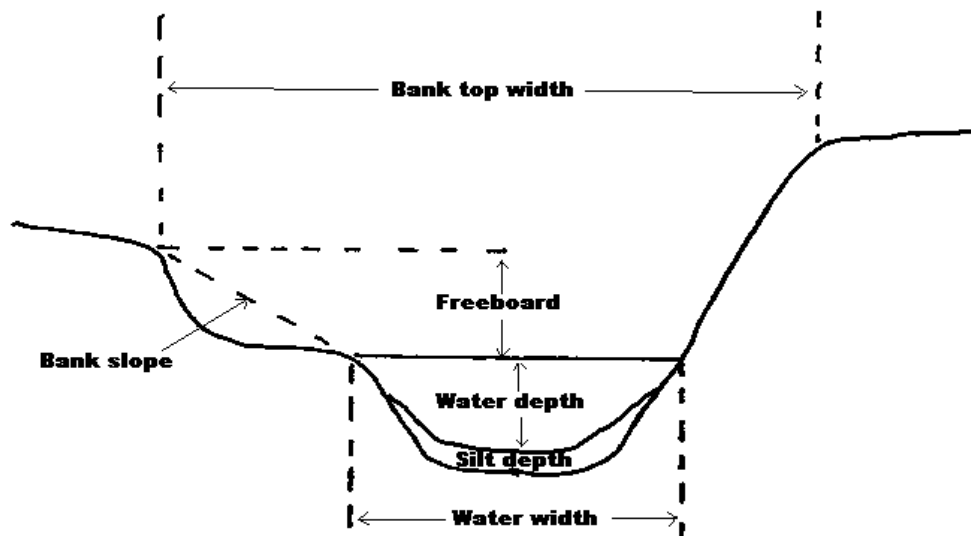
Tall grasses/ reeds includes vegetation over 50 cm tall as opposed to short grass which is less than this. Grass and/or sedge dominated communities should be recorded here.

Tall herbs includes tall communities not dominated by grasses or sedges, such as stands of *Urtica dioica*, *Epilobium hirsutum* and *Persicaria hydropiper*. Lower growing herbs should be recorded in short grass.

Scrub includes brambles where these form significant patches rather than just scattered stems in other vegetation.

Fen is a rather rare category where the ditch merges directly into fen vegetation.

Ditch features



The recording form gives bandings for recording bank top and water widths, freeboard and bank slopes. These features should be recorded by ticking between the appropriate figures. *** should water width and depth be based on actual or estimated normal (when obviously lowered or drying out)????

Water and silt depth should be recorded to the nearest 10 cm.

Conductivity should be recorded to the nearest 5 if less than 1000, to the nearest 50 if less than 10,000.

pH should be recorded to the nearest 0.1

Turbidity should be recorded on a five point scale based on 1 = gin clear, 3 = base of ditch just visible at 50cm, 5 = visibility < 10cm.

Water colour should be recorded by looking into the ditch rather than taking water out and looking through a bottle. Peatiness can be recorded on a five point scale based on 1 = gin, 2 = lemon juice, 3 = white wine (e.g. chardonnay), 4 = medium black tea, 5 = black coffee, but this is only possible if turbidity is low.

Bank slope is based on the angle from the bank top to the water's edge, irrespective of variations between the lower and upper sections.

Vegetation cover

This should be recorded on a DAFOR scale based on the area of the ditch which is flooded for the majority of the year. This includes partially vegetated mud, *Agrostis* patches, beached *Lemna* etc exposed in partially dried out ditches or where the water level has been obviously lowered. If it is not clear what the normal water level the current level should be used.

Some emergents (particularly *Phragmites*) can be dense but have thin stems which occupy only a small area of the water surface. For the purposes of emergent cover, open water surface and open substrate, the abundances should be estimated as though each emergent stem occupied a radius of 5 cm. Floating and submerged aquatics should however be recorded based on their actual areas.

Floating Lemna/Azolla includes *Spirodela polyrhiza* and *Wolfia arrhiza* but not *Lemna trisulca*.

Other floating aquatics includes *Hydrocharis morsus-ranae*, water lilies, *Potamogeton natans*. It also includes the floating leaved stages of emergent species such as *Alisma*, *Sagittaria*, *Persicaria amphibia* etc and the early stages of *Hydrocotyle ranunculoides* before it starts forming floating rafts. ***Should *Ricciocarpus natans* be here or with the other small floaters???

Submerged plants includes the underwater leaves of emergent and floating species.

Open substrate is the amount of substrate that can be seen looking down into the ditch i.e. not shaded or covered by emergents, floating or submerged plants or algae.

Floating mat covers low growing wetland species that extend out over the water surface, such as *Myosotis scorpioides*, *Apium nodiflorum*, *Rorippa nasturium-aquaticum*, *Hydrocotyle ranunculoides*, etc.

Exposed vegetated and exposed mud includes areas exposed by low water levels in partially or fully empty ditches.

Shaded is the amount shaded by trees and scrub over 1.5 metres tall but not including overhanging *Phragmites* and other non-woody vegetation. **** Should this include brambles where they form significant patches???

Emergents/floating mat in channel. This should be recorded as a percentage to the nearest 10% except at very low or very covers in the 0-10% and 90-100% ranges. The channel excludes the emergent fringe of the ditch (normally around 50cm out from the edge) even when there is not much emergent fringe present. It is therefore equivalent to the aquatic zone of the species recording (see below). The aim of this measure is to indicate the period of time since the last clearance but if there are reasons to suggest that this measure does not reflect this, this should be noted in the notes section.

Grazing

These feature should be recorded on a 0-3 scale - absent, low, medium and high and should be assessed on the visible impact rather than the actual situation at the time of survey. In other words, grazing levels can be recorded as high if it has evidently been so, even if there are no animals actually present. The assessment should also be based on the ditch banks, for example where grazing animals are excluded by temporary or permanent fencing.

Poaching covers where the ground level has been broken by the weight of the livestock animals. Block formation covers where poaching is extensive enough to leave isolated raised blocks. Shelf formation covers where the poaching has resulted in a low gradient zone backed by a steeper turf bank or cliff.

Tangledness is a reflection of the heterogeneity of the ditch vegetation, roughly as follows (Drake pers. comm.)

- none empty of vegetation (e.g. recently cleaned).
- low ditches with very little vegetation; homogenous stands of submerged plants next to vertical margins; very dense stands of emergents (e.g. ditches dominated by *Glyceria maxima*); or with dominant floating plants (duckweeds, *Azolla*, floating algae).
- medium intermediate between 1 and 3 (this is subjective!); usually ditches with moderately high covers of vegetation but tending to large patches of each abundant species, often with little disturbance by cattle.
- high complex vegetation stands, usually botanically diverse, but more importantly structurally diverse (e.g. rafts of *Berula* mixed with a trampled fringe of emergents with moderate cover of submerged vegetation such as *Ceratophyllum*).

Grassy margin - **** not sure what this is exactly.

Management

In many cases it will not be possible to fill some of these boxes but they should be filled in where the information is available (or can be estimated). Any elaboration can be included in the notes.

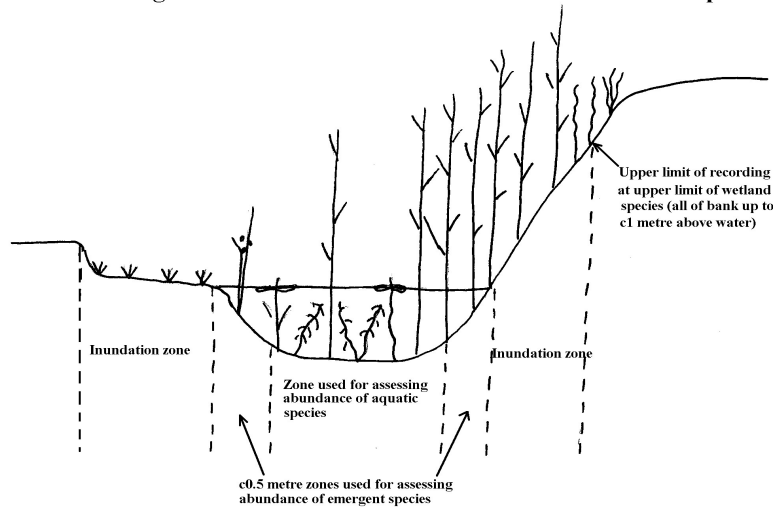
Species recording

For each species the zones (ie aquatic, emergent and inundation - see below for definitions) in which they were present should be recorded with '/' and the zone in which it was most abundant was recorded with a 'X'. When a species just enters another zone in trace amounts this zone should not be recorded (or can be marked with a '.'). Each species should be scored with a DAFOR abundance based on the main zone in which it occurred, qualified by a local DAFOR value if this differed from the overall abundance in the section as a whole (e.g. Occasional locally abundant).

Dominant	70-100%
Abundant	30-70%
Frequent	10-30%
Occasional	3-10%
Rare	<3%

DAFOR abundance scale used

FIGURE 1 - Diagram of the zones used to assess the abundance of species



The three zones are defined as follows. The aquatic zone covers all submerged and floating vegetation (excluding the underwater parts of emergent species). Only a few species in this zone overlap with other zones but these should be recorded for whichever zones are appropriate. Thus unbranched bur-reed *Sparganium emersum* is often scored mainly for the aquatic zone but also as present in the emergent zone. Young plants of water plantain *Alisma plantago-aquatica* should be scored as aquatic when they are not part of emergent plants and terrestrial plants of water starwort *Callitriche* spp should be scored in the inundation zone. However, floating pennywort *Hydrocotyle ranunculoides* should be recorded for the aquatic or inundation zones even though it is often becomes slightly emergent where it is growing densely.

The emergent and inundation zones have a high degree of overlap in their species content and there is rarely any significant discontinuity between the two. The boundary should therefore be taken as the edge of the water at the time of survey.

The abundance scores should be based on the cover within the zone in question. For the aquatic zone this should be taken as the proportion of the surface area of water not occupied by the emergent bands along the edges. Where emergents extend across the middle of the ditch, the area they occupy outside the emergent zone should be included in the surface area for calculating aquatic abundances so that these are lower in emergent-dominated ditches.

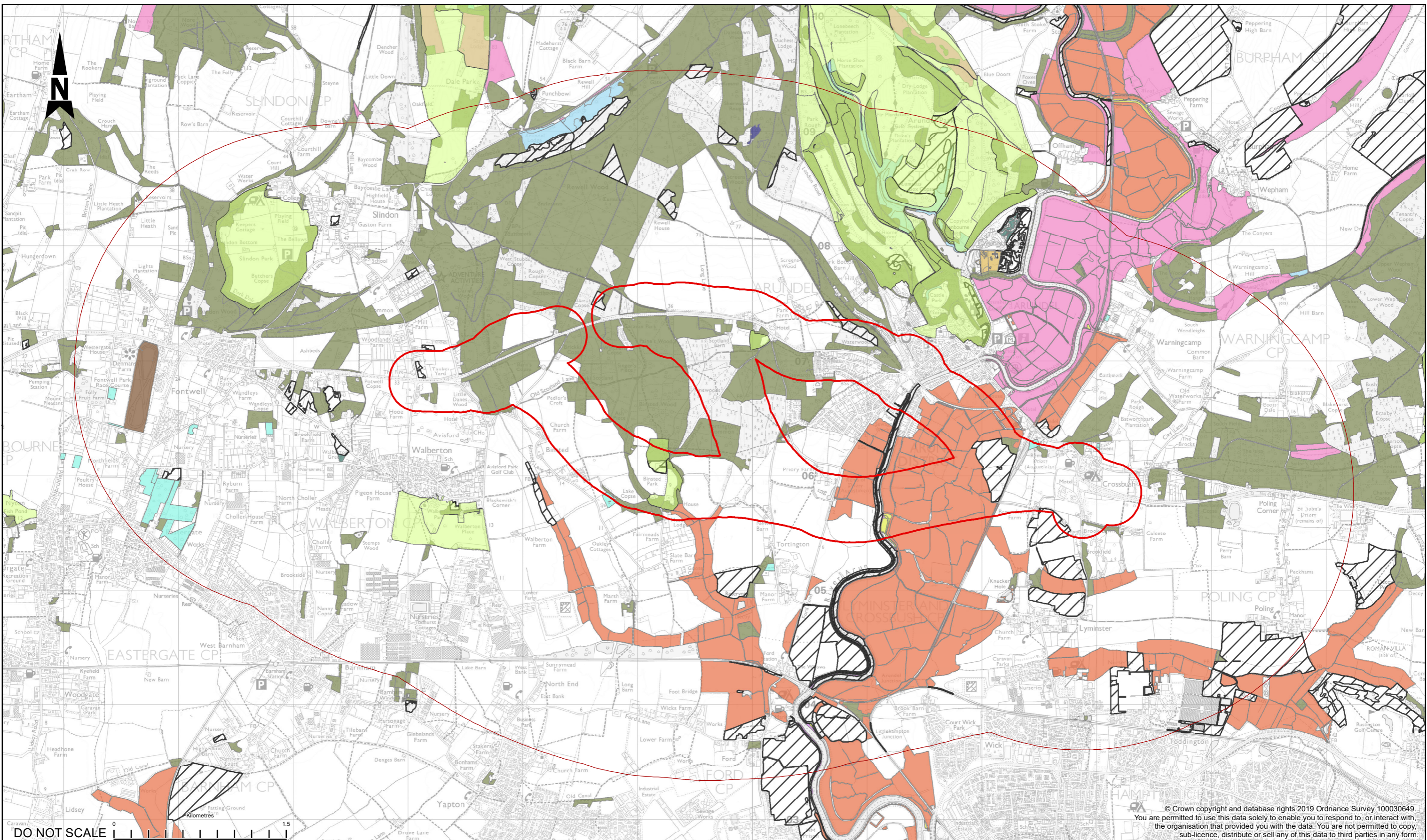
For the emergent zone, abundance scores should be based on the proportion of the surface area within the emergent bands along the edges of the ditch section. Where emergents are sparse or absent, the scores should be based on a zone c0.5 metres wide along the edges whether occupied by emergents or not. Emergents in the middle of the ditch are largely discounted from the assessment so that dense fringes of a particular species would be scored as dominant irrespective of whether it is absent, sparse or dense in the middle of the ditch. This would, however, be accounted for in the vegetation structure assessments (see above). Where emergent species are more frequent in the middle of the ditch than in the edge zones, abundance scores should be up-weighted to reflect this. For example, common reed *Phragmites* can be sometimes be restricted to the middle of the ditch.

The definition of the inundation zone should be "close to the water's edge on the lower bank, ie on that portion of the bank that, in the judgement of the field surveyor, appeared to be regularly flooded" (e.g. Leach et al. 1991). The upper limit of this definition is often difficult to interpret as there is rarely any marked vegetation boundary and indeed many ditches overtop their banks periodically in the winter. It may be easier to define this as the zone dominated by wetland species, or, where *Agrostis stolonifera* is the dominant species, where the associated species are mainly wetland species. Often this includes much or all of the banks except where they exceeded about one metre freeboard.

Tree and shrub species should be recorded when they occur in the inundation zone (or the water) and the abundance scores based on the plant bases rather than on the shade that they cast above.

Nick Stewart
March 2007

Appendix D: Habitats of Principal Importance



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Key	
	ROADSIDE VERGE (BOTANY)
	ROADSIDE VERGE (INVERTEBRATE)
	DESK STUDY AREA
	FIELD SURVEY AREA
	WOODPASTURE AND PARKLAND
	COASTAL AND FLOODPLAIN GRAZING MARSH
	COASTAL SALT MARSH
	DECIDUOUS WOODLAND
	GOOD QUALITY SEMI-IMPROVED GRASSLAND
	LOWLAND CALCAREOUS GRASSLAND
	LOWLAND FENS
	LOWLAND HEATHLAND
	LOWLAND MEADOWS
	MUDFLATS
	REEDBEDS
	TRADITIONAL ORCHARD
	NO MAIN HABITAT BUT ADDITIONAL HABITATS

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION				
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).				
Construction				
Maintenance / Cleaning				
Use				
Decommissioning / Demolition				
Rev.	Date Description By Chkd App'd			
P01.1	First Issue			

Drawing Status: **FINAL**

Subsidiary: **S0**

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Client: **Working on behalf of**

Project Title		REGIONAL INVESTMENT PROGRAMME A27 ARUNDEL BYPASS			
Drawing Title		APPENDIX D: NVC WATERCOURSE HABITATS OF PRINCIPAL IMPORTANCE			
Scale	1:31,000	Drawn	CR	Checked	RG
Original Size	A3	Date	15/08/19	Date	15/08/19
Approved	AB	Date	15/08/19	Authorised	PA
Drawing Number	HE551523-WSP-GEN-SWI-GI-DR-0541	Project Ref. No.	70052558	Revision	P01
Location	Type	Role	Number		

Appendix E: Identification of Watercourses and Surveys Undertaken

E1 - Watercourses identified within Field Survey Area

Watercourse ID	Survey information	Notes
AQ001A	11/10/2017	-
AQ001B	11/10/2017	-
AQ002	11/10/2017	-
AQ003	11/10/2017	-
AQ004	11/10/2017	-
AQ005	11/10/2017	-
AQ006	11/10/2017	-
AQ007	11/10/2017	-
AQ008	Survey not required	Beyond 100m
AQ009	11/10/2017	-
AQ010	11/10/2017	-
AQ011	12/10/2017	-
AQ012	11/10/2017	-
AQ013	11/10/2017	-
AQ014	11/10/2017	-
AQ015A	11/10/2017	-
AQ015B	11/10/2017	-
AQ017	Survey not required	Beyond 100m
AQ018A	12/10/2017	-
AQ018B	12/10/2017	-
AQ020	Survey not required	Mainly outside of Field Survey Area
AQ021	12/10/2017	-
AQ022	Survey not required	Beyond 100m
AQ023	12/10/2017	-
AQ024	12/10/2017	-
AQ025	Survey not required	Beyond 100m
AQ026	Not surveyed	No access
AQ027	Survey not required	Beyond 100m
AQ028	12/10/2017	-
AQ029	12/10/2017	-
AQ030A	12/10/2017	-
AQ030B	12/10/2017	-
AQ031A	12/10/2017	-
AQ031B	12/10/2017	-
AQ032	12/10/2017	-
AQ034	12/10/2017	-

Appendix 8-16: Watercourse Vegetation Baseline Survey
 Report
 A27 Arundel Bypass – PCF Stage 2 Further Consultation



Watercourse ID	Survey information	Notes
AQ035	12/10/2017	-
AQ036	Walkover survey 12/10/17	-
AQ037	Walkover Survey 12/10/17	-
AQ038	12/10/2017	-
AQ039	Survey not required	Beyond 100m
AQ040	Survey not required	Beyond 100m
AQ041	12/10/2017	-
AQ042	12/10/2017	-
AQ043	Survey not required	Beyond 100m
AQ044	13/09/2017	-
AQ045A	13/09/2017	-
AQ045B	13/09/2017	-
AQ046A	13/09/2017	-
AQ046B	13/09/2017	-
AQ047	13/09/2017	-
AQ048A	13/09/2017	-
AQ048B	13/09/2017	-
AQ049	13/09/2017	-
AQ050	13/09/2017	-
AQ051	14/09/2017	-
AQ052	14/09/2017	-
AQ053	14/09/2017	-
AQ054	14/09/2017	-
AQ055	Survey not required	Beyond 100m
AQ056	Not surveyed	No access
AQ057A	14/09/2017	-
AQ057B	14/09/2017	-
AQ058	14/09/2017	-
AQ059	Survey not required	Beyond 100m
AQ060	14/09/2017	-
AQ064	14/09/2017	-
AQ065	14/09/2017	-
AQ066	14/09/2017	-
AQ067	14/09/2017	-
AQ068	Survey not required	Dry ditch in woodland, confirmed by otter and water vole survey findings
AQ069	Walkover Survey 14/09/17	Dry ditch in woodland
AQ070	Walkover Survey 14/09/17	Dry ditch in woodland

Watercourse ID	Survey information	Notes
AQ071	Survey not required	Beyond 100m
AQ072	Survey not required	Dry ditch in woodland, confirmed by otter and water vole survey findings
AQ073	Survey not required	Dry ditch in woodland, confirmed by otter and water vole survey findings
AQ074	Survey not required	Dry ditch in woodland, confirmed by otter and water vole survey findings
AQ075	Not surveyed	No access
AQ076	Survey not required	Dry ditch in woodland, confirmed by otter and water vole survey findings
AQ077	Survey not required	Beyond 100m
AQ078A	06/06/18	-
AQ078B	Walkover Survey 06/06/18	Walkover survey, within woodland and heavily shaded supporting little aquatic vegetation
AQ078C	06/06/2018	-
AQ085	Survey not required	Beyond 100m
AQ086	Not surveyed	No access
AQ087	Not surveyed	No access
AQ088	Not surveyed	No access
AQ089	Not surveyed	No access
AQ091	14/09/2017	-
AQ092	Not surveyed	No access
AQ093	12/10/2017	-
AQ095	Survey not required	Beyond 100m
AQ096	Survey not required	Beyond 100m
AQ097	Survey not required	Beyond 100m
AQ098	Not surveyed	No access
AQ099	Not surveyed	No access
AQ100	Walkover survey 06/06/18	Walkover survey, within woodland and heavily shaded supporting little aquatic vegetation. Feature considered during NVC woodland survey and reported in woodland baseline survey report ³⁶ .
AQ199	13/09/2017	River Arun

³⁶ WSP (2019). Woodland – Baseline Survey Report. Prepared for Highways England.

Appendix F: Species List

Table F1 - List of species recorded during the watercourse surveys

Common name	Scientific name
Sycamore	<i>Acer pseudoplatanus</i>
Yarrow	<i>Achillea millefolium</i>
Creeping bent	<i>Agrostis stolonifera</i>
Water-plantain	<i>Alisma plantago-aquatica</i>
Common alder	<i>Alnus glutinosa</i>
Marsh foxtail	<i>Alopecurus geniculatus</i>
Meadow foxtail	<i>Alopecurus pratensis</i>
Scarlet pimpernel	<i>Anagallis arvensis</i>
Wild angelica	<i>Angelica sylvestris</i>
Barren brome	<i>Anisantha sterilis</i>
Wild celery	<i>Apium graveolens</i>
Fool's-water-cress	<i>Apium nodiflorum</i>
False oat-grass	<i>Arrhenatherum elatius</i>
Hart's-tongue	<i>Asplenium scolopendrium</i>
Sea aster	<i>Aster tripolium</i>
Lady fern	<i>Athyrium filix-femina</i>
Common orache	<i>Atriplex patula</i>
Spear-leaved orache	<i>Atriplex prostrata</i>
Water fern	<i>Azolla filiculoides</i>
Sea club-rush	<i>Bolboschoenus maritimus</i>
False brome	<i>Brachypodium sylvaticum</i>
Buddleia	<i>Buddleja davidii</i>
Pedunculate water-starwort	<i>Callitriche brutia</i>
Blunt-fruited water-starwort	<i>Callitriche obtusangula</i>
Various-leaved water-starwort	<i>Callitriche platycarpa</i>
Common water-starwort	<i>Callitriche stagnalis</i>
Bindweed	<i>Calystegia sepium</i>
Wavy bittercress	<i>Cardamine flexuosa</i>
Cuckoo flower	<i>Cardamine pratensis</i>
Lesser pond-sedge	<i>Carex acutiformis</i>
Hairy sedge	<i>Carex hirta</i>
False fox sedge	<i>Carex otrubae</i>
Greater tussock-sedge	<i>Carex paniculata</i>
Pendulous sedge	<i>Carex pendula</i>
Cyperus sedge	<i>Carex pseudocyperus</i>
Remote sedge	<i>Carex remota</i>
Greater pond-sedge	<i>Carex riparia</i>

Common name	Scientific name
Wood sedge	<i>Carex sylvatica</i>
Common mouse-ear	<i>Cerastium fontanum</i>
Sticky mouse-ear	<i>Cerastium glomeratum</i>
Common stonewort	<i>Chara vulgaris</i>
Fat hen	<i>Chenopodium album</i>
Red goosefoot	<i>Chenopodium rubrum</i>
Opposite-leaved golden saxifrage	<i>Chrysosplenium oppositifolium</i>
Creeping thistle	<i>Cirsium arvense</i>
Marsh thistle	<i>Cirsium palustre</i>
Spear thistle	<i>Cirsium vulgare</i>
Hemlock	<i>Conium maculatum</i>
Canadian fleabane	<i>Conyza canadensis</i> agg.
Swine-cress	<i>Lepidium coronopus</i> (<i>Coronopus squamatus</i>)
Common hazel	<i>Corylus avellana</i>
Common hawthorn	<i>Crataegus monogyna</i>
Smooth Hawk's-beard	<i>Crepis capillaris</i>
Crested dog's-tail	<i>Cynosurus cristatus</i>
Cock's foot	<i>Dactylis glomerata</i>
Tufted hair-grass	<i>Deschampsia cespitosa</i>
Common teasel	<i>Dipsacus fullonum</i>
Drepanocladus moss species	<i>Drepanocladus</i> sp.
Male fern	<i>Dryopteris filix-mas</i>
Broad buckler-fern	<i>Dryopteris dilatata</i>
Common spike-rush	<i>Eleocharis palustris</i>
Canadian pondweed	<i>Elodea canadensis</i>
Couch grass	<i>Elytrigia repens</i>
American willowherb	<i>Epilobium ciliatum</i>
Great willowherb	<i>Epilobium hirsutum</i>
Short-fruited willowherb	<i>Epilobium obscurum</i>
Hoary willowherb	<i>Epilobium parviflorum</i>
Square-stalked willowherb	<i>Epilobium tetragonum</i>
Field horsetail	<i>Equisetum arvense</i>
Water horsetail	<i>Equisetum fluviatile</i>
Hemp-agrimony	<i>Eupatorium cannabinum</i>
Tall fescue	<i>Festuca arundinacea</i>
-	filamentous algae
Meadowsweet	<i>Filipendula ulmaria</i>
Ash	<i>Fraxinus excelsior</i>

Common name	Scientific name
Cleavers	<i>Galium aparine</i>
Hedge bedstraw	<i>Galium mollugo</i>
Cut-leaved crane's-bill	<i>Geranium dissectum</i>
Herb-robert	<i>Geranium robertianum</i>
Ground-ivy	<i>Glechoma hederacea</i>
Floating sweet grass	<i>Glyceria fluitans</i>
Reed sweet grass	<i>Glyceria maxima</i>
Plicate sweet grass	<i>Glyceria notata</i>
Opposite-leaved pondweed	<i>Groenlandia densa</i>
Common ivy	<i>Hedera helix</i>
Bristly oxtongue	<i>Helminthotheca echioides</i>
Yorkshire fog	<i>Holcus lanatus</i>
Meadow barley	<i>Hordeum secalinum</i>
Frogbit	<i>Hydrocharis morsus-ranae</i>
Stinking iris	<i>Iris foetidissima</i>
Yellow iris	<i>Iris pseudacorus</i>
Jointed rush	<i>Juncus articulatus</i>
Soft rush	<i>Juncus effusus</i>
Hard rush	<i>Juncus inflexus</i>
White dead-nettle	<i>Lamium album</i>
Fat duckweed	<i>Lemna gibba</i>
Common duckweed	<i>Lemna minor</i>
Least duckweed	<i>Lemna minuta</i>
Star duckweed	<i>Lemna trisulca</i>
Garden privet	<i>Ligustrum ovalifolium</i>
Wild privet	<i>Ligustrum vulgare</i>
Perennial rye grass	<i>Lolium perenne</i>
Japanese honeysuckle	<i>Lonicera japonica</i>
Common honeysuckle	<i>Lonicera periclymenum</i>
Crescent-cup liverwort	<i>Lunularia cruciata</i>
Gypsywort	<i>Lycopus europeus</i>
Creeping jenny	<i>Lysimachia nummularia</i>
Yellow loosestrife	<i>Lysimachia vulgaris</i>
Purple loosestrife	<i>Lythrum salicaria</i>
Cultivated apple	<i>Malus domestica</i>
Liverwort species	<i>Marchantia polymorpha</i>
Water mint	<i>Mentha aquatica</i>
Tufted forget-me-not	<i>Myosotis laxa</i>

Common name	Scientific name
Water forget-me-not	<i>Myosotis scorpioides</i>
Smooth stonewort	<i>Nitella flexilis</i> agg.
Water hemlock	<i>Oenanthe crocata</i>
Tubular water-dropwort	<i>Oenanthe fistulosa</i>
Amphibious bistort	<i>Persicaria amphibia</i> (terr.)
Water pepper	<i>Persicaria hydropiper</i>
Redshank	<i>Persicaria maculosa</i>
Reed canary grass	<i>Phalaris arundinacea</i>
Common reed	<i>Phragmites australis</i>
Greater plantain	<i>Plantago major</i>
Annual meadow grass	<i>Poa annua</i>
Rough meadow grass	<i>Poa trivialis</i>
Knotgrass	<i>Polygonum aviculare</i>
Soft shield-fern	<i>Polystichum setiferum</i>
Black poplar	<i>Populus nigra</i> agg.
Small pondweed	<i>Potamogeton berchtoldii</i>
Curled pondweed	<i>Potamogeton crispus</i>
Broad-leaved pondweed	<i>Potamogeton natans</i>
Silver cinquefoil	<i>Potentilla anserina</i>
Creeping cinquefoil	<i>Potentilla reptans</i>
Plum family species	<i>Prunus</i> sp.
Blackthorn	<i>Prunus spinosa</i>
Common fleabane	<i>Pulicaria dysenterica</i>
Pendunculate oak	<i>Quercus robur</i>
Meadow buttercup	<i>Ranunculus acris</i>
Creeping buttercup	<i>Ranunculus repens</i>
Celery-leaved buttercup	<i>Ranunculus sceleratus</i>
Thread-leaved water-crowfoot	<i>Ranunculus trichophyllus</i>
Watercress	<i>Rorippa nasturtium-aquaticum</i> agg.
Dog-rose	<i>Rosa canina</i>
Blackberry	<i>Rubus fruticosus</i> agg.
Clustered dock	<i>Rumex conglomeratus</i>
Curly dock	<i>Rumex crispus</i>
Broad-leaved dock	<i>Rumex obtusifolius</i>
Wood dock	<i>Rumex sanguineus</i>
Arrowhead	<i>Sagittaria sagittifolia</i>
Grey willow	<i>Salix cinerea</i>
Crack willow	<i>Salix fragilis</i>

Common name	Scientific name
Common elder	<i>Sambucus nigra</i>
Brookweed	<i>Samolus valerandii</i>
Grey club-rush	<i>Schoenoplectus tabernaemontani</i>
Water figwort	<i>Scrophularia auriculata</i>
Marsh ragwort	<i>Senecio aquaticus</i>
Hoary ragwort	<i>Senecio erucifolius</i>
Common ragwort	<i>Senecio jacobea</i>
Stone parsley	<i>Sison amomum</i>
Bittersweet	<i>Solanum dulcamara</i>
Field sow-thistle	<i>Sonchus arvensis</i>
Prickly sow-thistle	<i>Sonchus asper</i>
Branched bur-weed	<i>Sparganium erectum</i>
Bog stitchwort	<i>Stellaria alsine</i>
White clover	<i>Trifolium repens</i>
Bullrush	<i>Typha latifolia</i>
Wych elm	<i>Ulmus glabra</i>
Sea lettuce species	<i>Ulva (Enteromorpha)</i>
Common nettle	<i>Urtica dioica</i>
Brooklime	<i>Veronica beccabunga</i>
Pink water-speedwell	<i>Veronica catenata</i>
Tufted vetch	<i>Vicia cracca</i>
Horned pondweed	<i>Zannichelia palustris</i>

Appendix G: Photographs

Watercourse Ref Code	Image	Description / Comment
AQ004		11765_PH2_NS_AQ004_P_111017
AQ006		11765_PH2_NS_AQ006_P_111017



11765_PH2_NS_AQ018B_P1_12101
7



11765_PH2_NS_AQ018B_P2_12101
7

AQ001A		11765_PH2_NS_AQ001A_P1_11101 7
AQ001B	 	11765_PH2_NS_AQ001B_P1_11101 7 11765_PH2_NS_AQ001B_P4_11101 7

AQ002		11765_PH2_NS_AQ002_P_111017
AQ003		11765_PH2_NS_AQ003_P_111017

<p>AQ005</p>		<p>11765_PH2_NS_AQ005_P_111017</p>
<p>AQ007</p>		<p>12260_PH2_NS_AQ007_P1_111017</p>

AQ010



12260_PH2_NS_AQ010_P1_111017
12260_PH2_NS_AQ010_P2_111017

<p>AQ011</p>		<p>11765_PH2_NS_AQ011_P1_121017</p> <p>11765_PH2_NS_AQ011_P3_121017</p>
<p>AQ012</p>		<p>11765_PH2_NS_AQ012_P1_111017</p>

AQ013A



12260_PH2_NS_AQ013A_P1_11101
7



AQ013B



12260_PH2_NS_AQ013B_P3_11101
7

<p>AQ014</p>		<p>11765_PH2_NS_AQ014_P1_111017</p>
<p>AQ015A</p>		<p>11765_PH2_NS_AQ015A_P_111017</p>

<p>AQ015B</p>		<p>11765_PH2_NS_AQ015B_P_111017</p>
<p>AQ018A</p>		<p>11765_PH2_NS_AQ018A_P3_121017</p> <p>11765_PH2_NS_AQ018A_P8_121017</p>

<p>AQ023</p>		<p>11765_PH2_NS_AQ023_P2_121017</p> <p>11765_PH2_NS_AQ023_P3_121017</p>
<p>AQ024A</p>		<p>11765_PH2_NS_AQ024A_P1_121017</p> <p>11765_PH2_NS_AQ024A_P3_121017</p>

<p>AQ028A</p>		<p>11765_PH2_NS_AQ028A_P1_121017 7</p> <p>11765_PH2_NS_AQ028A_P4_121017 7</p>
<p>AQ029</p>		<p>11765_PH2_NS_AQ029_P1_121017</p> <p>11765_PH2_NS_AQ029_P2_121017</p>

<p>AQ031B</p>		<p>11765_PH2_NS_AQ031B_P1_121017</p> <p>11765_PH2_NS_AQ031B_P4_121017</p>
<p>AQ032</p>		<p>11765_PH2_NS_AQ032_P1_121017</p> <p>11765_PH2_NS_AQ032_P6_121017</p>
<p>AQ034</p>		<p>11765_PH2_NS_AQ034_P1_121017</p> <p>11765_PH2_NS_AQ034_P2_121017</p>




		
<p>AQ035</p>	 	<p>12275_PH2_NS_AQ035_P1_121017</p> <p>12275_PH2_NS_AQ035_P3_121017</p>
<p>AQ037</p>		<p>12275_PH2_NS_AQ037_P1_121017</p> <p>12275_PH2_NS_AQ037_P3_121017</p>



		
<p>AQ038</p>	 	<p>12275_PH2_NS_AQ038_P1_121017</p> <p>12275_PH2_NS_AQ038_P2_121017</p>
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<p>AQ042</p>		<p>12730_PH2_NS_AQ042_P1_121017</p> <p>12730_PH2_NS_AQ042_P2_121017</p>
<p>AQ044</p>		<p>11235_PH2_NS_AQ044_P1_130920 17</p> <p>11235_PH2_NS_AQ044_P2_130920 17</p>


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<p>AQ045B</p>		<p>11235_PH2_NS_AQ045B_P1_13091 7</p> <p>11235_PH2_NS_AQ045B_P3_13091 7</p>
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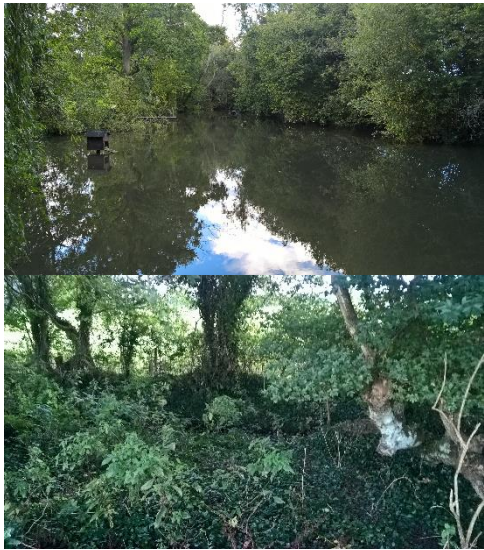


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AQ100		

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Appendix H: Watercourse Description

Table H1 - Ditch Descriptions

Water-course	Description
AQ001A Ditch	Dominated by common reed in the channel and on the east bank. West bank false oat-grass and common nettle. Locally greater pond-sedge replaces the common reed at the northern end. Beneath the swamp is abundant in least duckweed with frequent common duckweed.
AQ001B Ditch	East bank with dense hedge (mainly hawthorn) all the way along. West bank neutral grassland (false oat-grass, cock's-foot and common nettle). Channel with abundant common reed at the southern end but the rest is more or less open with an incomplete crust of filamentous algae on the bottom; the ditch may have been dry and been reflooded. There is also a scattering of least duckweed.
AQ002 Ditch	North side dominated by hedge overhanging the ditch with creeping bent, Yorkshire fog, false oat-grass and common nettle beneath. South bank unshaded, with false oat-grass, common couch, creeping bent and common nettle. Bottom of ditch mostly sparse to dense creeping bent and sweet grass species with a solid mass of common duckweed growing among this. Least duckweed becomes the main duckweed at the western end and there are areas with abundant <i>Ulva flexuosa</i> and <i>Cladophora</i> here. There is a small area just west of the corner at TQ01400588 where the ditch is clearer and there are small amounts of thread-leaved water-crowfoot, intermediate water-starwort and common water-starwort.
AQ003 Ditch	A dry ditch with substantial relics of a double hedge on either side, resulting in 60% of the ditch shaded with more or less no vegetation beneath. The rest is dominated by creeping bent with some bare areas with weed species due to cattle poaching.
AQ004 Ditch	Much of this ditch has an intermittent hedge on the west side and grassy MG1 on the east side, but the in the southern section this arrangement is reversed. The channel has intermittent common reed patches and some greater pond-sedge. But mostly the channel is open with rather anoxic mud on the bottom and not much vegetation. There is a sparse presence of least duckweed, <i>Ulva flexuosa</i> and <i>Cladophora</i> with a few bits of blunt-fruited water-startwort (<i>Callitriche cf. obtusangula</i>). One plant of the saltmarsh species, sea aster, at the southern end is surprising so far from the river.
AQ005 Ditch	South side of ditch is shaded by a hedge with a mixture of ivy, creeping bent and common nettle beneath. The north side is unshaded with creeping bent with false oat-grass, Cock's-foot and common nettle. The ditch bottom is mostly creeping bent and sweet grass species in shallow water but with a little common duckweed.
AQ006 Ditch	Both sides of this ditch are fringed with swamp; in the western half this is a mixture of greater pond-sedge with some common reed and sea club-rush but in the eastern half common reed is the dominant species. The swamp continues up the banks bit where greater pond-sedge is the main species, this often gives way neutral grassland (MG1) on the upper bank. The channel is fairly open with little vegetation or locally with frequent <i>Ulva flexuosa</i> and some least duckweed. Towards the east <i>Cladophora</i> becomes more frequent and forms a thin cover over the bottom mud. Near the east end the ditch narrows to 2 m wide and the fringing common reed closes in on the channel. Despite the increase leaf litter there is still scattered least duckweed in the channel despite the overhanging common reed. Of note was a small amount of brooklime (<i>Samolus velarandi</i>).
AQ007 Ditch	This appears to be a more arterial ditch. The water level was very low exposing extensive mud with an abundant covering of <i>Cladophora</i> and some patches of pink water-speedwell and scattered common reed. The south-eastern bank is ungrazed and dominated by common reed. The north-west bank is grazed and gently sloping with poaching and raised blocks. Mainly creeping bent, with scattered sea club-rush, hard rush, celery-leaved buttercup, common reed and locally some common spike-rush. A branch towards Ditch AQ004 has been included with this ditch because it is more similar to Ditch AQ007.
AQ009 Ditch	A shallow ditch, dominated by common reed at the margins and on the banks. A bit more open in the channel but still abundant common reed and litter but no aquatic vegetation.

Water-course	Description
AQ010 Ditch	The margins and banks are dominated by common reed but there are few areas where the reeds give way to short creeping bent, Yorkshire fog, false oat-grass grassland. The channel is more open but still with frequent common reed. Beneath this is a mat of <i>Cladophora</i> often caught above the water around the reeds due to the very low water level. The north end of the ditch (north of a gateway) is narrower and more or less completely overhung by common reed. However, beneath this the channel is fairly open with just reed litter and no algae.
AQ011 Ditch	Dry ditch with gently sloping banks. Bottom winter-wet, mainly creeping bent with some marsh foxtail, sweet grass species, celery-leaved buttercup, <i>Atriplex</i> species. Bottom poached resulting in some bare ground, sometimes with a filamentous algal film. Banks with perennial rye grass, Yorkshire fog and scattered creeping thistle.
AQ012 Ditch	Ditch dominated by common reed on both banks and edge. Channel with abundant <i>Cladophora</i> beneath and rare common duckweed. The channel is a bit more open at the eastern end where there is occasional common duckweed and some <i>Ulva flexuosa</i> and various-leaved water-starwort (<i>Callitriche cf. platycarpa</i>) but still with frequent <i>Cladophora</i> .
AQ013 Ditch	This ditch has a fairly open channel dominated by a solid mass of <i>Cladophora</i> with frequent <i>Ulva flexuosa</i> . Fringed on either side by common reed with locally abundant greater pond-sedge and frequent sea club-rush.
AQ014 Ditch	Channel dominated by a floating mass of <i>Ulva flexuosa</i> with scattered common duckweed and the occasional bit of water-starwort. East bank dominated common reed with a few relics of scrub. West bank mostly open to grazing with short grass, creeping bent with scattered creeping thistle, common nettle. The southern section of the west bank has grazing excluded and is dominated by common reed on both sides. This results in more common reed overhanging the channel and the cover of <i>Ulva flexuosa</i> is less (but still abundant).
AQ015A Ditch	Bottom of ditch dominated by low swamp of floating sweet grass with some fool's water-cress, water-plantain and water horsetail. Towards the south there are more openings in this with abundant water starwort (especially intermediate water-starwort). Also in this area is occasional opposite-leaved pondweed and little filamentous algae. The banks are mainly soft rush, Yorkshire fog, creeping bent with frequent gipsywort and tufted hair-grass.
AQ015B Ditch	A dry ditch, dominated by common reed. There are a few relics of a hedge on the north side and sometimes some shading from an open shelter belt on the north side.
AQ018A Ditch	This seems to be part of more arterial ditch. The water was very low exposing mud and much of the emergent fringe. The channel is fairly open with greyish water, and has locally abundant water fern, frequent filamentous algae and <i>Ulva flexuosa</i> . Fringed by common reed with some sea club-rush and occasional grey club-rush. Both banks have common reed on the lower part, becoming perennial rye grass/creeping bent grassland above.
AQ018B Ditch	This seems to be part of a more arterial ditch and the water is held back by a sluice at the southern end. This stretch is outside the 100m survey corridor and was only looked at briefly. It seems to be similar to the stretch above (ditch 18C) in having greyish water with little vegetation. It is fenced on both side and is partially shaded by a hedge on the east side.
AQ018C Ditch	This appears to be part of a more arterial ditch and the water level is maintained by a sluice at the southern end of Ditch AQ018B. The channel is fairly open with greenish grey water but little vegetation. Rare duckweed species, common water-starwort (<i>Callitriche cf. stagnalis</i>) and some filamentous algae attached to the bases of emergent vegetation. Fringed with common reed although this is intermittent on the NW bank. Otherwise banks mainly grassy. Upper banks with creeping bent, Yorkshire fog, perennial rye grass with some common nettle and creeping thistle. Open to grazing on both banks in the part although the grazing impact is low. SW part fenced on both sides and hedges and trees on the SE side. The common nettle fringe is more extensive in this area and extends up the banks. The NW branch is smaller and has a hedge shading the east side. It should perhaps be treated separately as it is a more minor ditch and probably managed differently but it had similar greyish water with little vegetation.

Water-course	Description
AQ015A Ditch	Bottom of ditch dominated by low swamp of floating sweet grass with some fool's water-cress, water-plantain and water horsetail. Towards the south there are more openings in this with abundant water-starwort (especially intermediate water-starwort). Also in this area is occasional opposite-leaved pondweed and little filamentous algae. The banks are mainly soft rush, Yorkshire fog, creeping bent with frequent gipsywort and tufted hair-grass.
AQ021 Ditch	Ditch with an intermittent single hedge on the N side. N bank is neutral grassland (MG1). South bank is mainly short grass (creeping bent, Yorkshire fog) with patches of tall herbs. Ditch dominated by duckweeds with intermittent patches of common reed and <i>Ulva flexuosa</i> .
AQ023 Ditch	A steep-sided ditch dominated in the north-eastern part by common reed and greater pond-sedge with some sea club-rush and with a carpet of duckweed beneath (common duckweed, least duckweed and fat duckweed). The south-western part is more open with ivy-leaved duckweed also abundant. South-eastern bank with common reed and greater pond-sedge continuing onto the lower bank and neutral grassland (MG1 <i>Arrhenatherum elatius</i> grassland) above. North-western bank grazed with mainly short grass (creeping bent and perennial rye grass) with some creeping thistle.
AQ024 Ditch	Steep-sided ditch with open common reed across and frequent <i>Ulva flexuosa</i> and least duckweed beneath. NW bank with common reed predominant below and false oat-grass (MG1 <i>Arrhenatherum elatius</i> grassland) above. SE bank grazed with creeping bent and false oat-grass and scattered common reed.
AQ028 Ditch	Ditch with double hedgerow. Dry for around 80% of length. Sweet grass species and creeping bent patchy and locally abundant but little tall swamp. Where this ditch meets ditch AQ029 and the A27 there is a short length with deep standing water but under shade and with little vegetation.
AQ029 Ditch	A shallow ditch, mostly dominated by sea club-rush. The banks are mainly neutral grassland (MG1 <i>Arrhenatherum elatius</i> grassland creeping bent/false oat-grass), with a fringe of hard rush and frequent clustered dock. They also have some creeping thistle, common nettle, Bristly oxtongue and common fleabane. The east bank has been mown, resulting in quite of grass litter being distributed into the ditch.
AQ030A Ditch	Most of this ditch is completely shaded by a double hedge with only sparse vegetation beneath – mainly creeping bent and common nettle. The channel wet but very shallow all the way and not vegetated. Where the ditch bends westwards at the southern end it is similar but the hedges are less continuous. This allows more light into the ditch resulting in locally frequent common reed and creeping bent.
AQ030B Ditch	This has open common reed across most of the ditch with a solid mass of duckweeds underneath. Filamentous algae is also abundant under the duckweed carpet and there is some <i>Ulva flexuosa</i> . At the edges there is some greater pond-sedge and sea club-rush among the common reed. The banks are relatively gently sloping with creeping bent, Yorkshire fog and perennial rye grass predominant with scattered common reed. There is one small area in the middle of this stretch where there is a little common stonewort, horned pondweed and Knieff's Hook-moss but mostly the duckweed is too dense to allow submerged vegetation. The south-eastern end of the ditch (E of the junction with ditch AQ021) has a hedge on the north-eastern side.
Ditch31A Ditch	More or less dry ditch dominated by double hawthorn hedge shading most of the ditch. The ditch is a bit more open on the west side in the northern half. Here there is locally abundant greater pond-sedge with some common reed with creeping bent and false oat-grass on the upper bank.
AQ031B Ditch	Ditch under a single gappy hedgerow and only intermittently wet. It is 80% heavily shaded but where there is more light there is patchy swamp vegetation dominated by sweet-grass species and greater pond-sedge. Both banks are improved perennial rye grass pasture.
AQ032 Ditch	A hedge runs along the north side but the south side is gently sloping creeping bent with meadow barley, Yorkshire fog and perennial rye grass. Soft rush, creeping thistle and clustered dock are also frequent. The ditch bottom is dry at the western end but becomes wetter eastwards. It is dominated by creeping bent and plicate sweet-grass but, as the ditch gets wetter, celery-leaved buttercup and blunt-fruited water-starwort also become locally abundant. There is also some scattered common reed in the wetter east part.

Water-course	Description
AQ034 Ditch	Most of this ditch is dry and dominated by creeping bent with frequent sweet-grass. The south bank has a hedge all the way along and also some larger oaks shading over but the north bank is gently sloping creeping bent, Yorkshire fog, perennial rye grass. The eastern part running north- south is wetter and has frequent water-starwort species but is otherwise similar. The western end is also wetter and is connected to ditch 18C. Like the latter, the water is greyish and it has frequent <i>Ulva flexuosa</i> and scattered least duckweed. This part is fenced off from grazing and has an intermittent common reed fringe.
AQ035 Ditch	This is just a grassy depression in a field and is poorly defined for 75% of the length. The remaining 25% is a broad, wet depression with creeping bent and plicate sweet-grass but it is wet enough for a few plants of thread-leaved water-crowfoot. Note: There is another damp linear depression similar to so-called ditch 35 in the field to the east. This is not marked on the map and was not surveyed and there may be other similar damp depressions in this section.
AQ036 Ditch	This ditch is largely outside the 100m survey corridor and was surveyed only briefly. It is a steep-sided ditch dominated by common reed with least duckweed abundant beneath.
AQ037 Ditch	This ditch is largely outside the 100m survey corridor and was surveyed only briefly. It is a steep-sided ditch dominated by common reed with least duckweed abundant beneath. The banks are fenced on both sides and have common reed with some hawthorn scrub on the west side, and rank neutral grassland (MG1 <i>Arrhenatherum elatius</i> grassland) on east side.
AQ038 Ditch	A steep-sided ditch sandwiched between a track and a pasture field from which it is fenced off. It is dominated by creeping bent and sweet-grass species with sparse sea club-rush and common reed. The banks are mixture of MG1 <i>Arrhenatherum elatius</i> grassland and shorter creeping bent, perennial rye grass, with frequent meadow barley, tall fescue and fleabane. Of note was a small amount of wild celery and brooklime (<i>Samolus valerandi</i>) at approximately TQ 01833 06683.
AQ041 Ditch	This is a long ditch running along the north side of the A27. It is mostly dominated by common reed with some least duckweed beneath. The common reed extends up the banks with locally abundant common nettle and spear thistle. There is some shade from trees along the roadside and towards the east the ditch becomes more shaded. Here the common reed becomes sparser and the banks have a woodland ground flora with abundant patches of common nettle etc. The water here still has scattered least duckweed but there are some areas with locally abundant filamentous algae.
AQ042 Ditch	A long ditch along the southern side of the A27. It is largely dry and overwhelmed by brambles and scrub with only occasional common reed indicating the ditch line. However, the eastern part (east of ditch AQ031A) is significantly wetter with water to 20cm deep. This part has abundant common reed with abundant least duckweed and occasional blunt-fruited water-starwort beneath. The environmental measurements in the data file are from the dryer western part apart from pH and conductivity.
AQ044 Ditch	A deep ditch with high banks, dominated by common reed on the east side and common reed and scrub on the west side. The channel is quite open but overhung by common reed. However, there is intermittent water-starwort where there is less overhanging common reed.
AQ045A Ditch	A deep ditch with high banks. It is dominated by common reed on both sides with only a little scrub. The west bank is mown at the southern end. The channel is quite open but overhung by common reed and there is abundant least duckweed on the water surface.
AQ045B Ditch	A shallow ditch with c. 2m banks. It is dominated by common reed on the banks and in the water with a few bushes (hawthorn etc). The ditch shallows towards the western end and the common reed becomes denser. There are also more frequent brambles and scrub towards the west. The upper bank is mown on the south side.

Water-course	Description
AQ046A Ditch	A short stretch of ditch, separated off because the water was visibly flowing (at least at low tide), disappearing through a culvert to the River Arun. The banks are high and steep, the west side with a mixture of blackthorn and common reed and the east side dominated by common reed. The channel is quite open but overhung by common reed and there is only scattered water-starwort and duckweed.
AQ046B Ditch	A shallow ditch with steep banks c.2 m high. It is dominated by common reed on the banks and in the water. Although the common reed is not dense in the water in the eastern half there is only scattered duckweed beneath and the common reed becomes denser across the channel westwards. There are also frequent hawthorns and brambles on the north bank.
AQ047 Ditch	A dry ditch, more or less completely shaded by a double hedge of hawthorn, bramble and blackthorn. There is very little growing beneath this but there is the occasional tuft of common reed and scattered nettles.
AQ048A Ditch	This ditch is very largely overshadowed by hawthorn hedges on both sides. There was little water but what remained formed a fairly continuous puddle along the middle of the channel. The bottom is mainly bare mud with leaf litter and the banks have patchy common nettle and woodland herbs such as ground ivy.
AQ048B Ditch	This part was differentiated from ditch 48A because the water is deeper (generally 20-30 cm) and the scrub is less continuous and broken up by stretches of common reed. There is very little vegetation under the scrub but least duckweed is locally abundant under the common reed.
AQ049 Ditch	The channel is dominated by common reed with a carpet of least duckweed beneath. The water was shallow and became almost dry by the western end. The banks are a mix of common reed dominated areas and brambles with occasional larger scrub (hawthorn, willow etc.).
AQ050 Ditch	Unlike most of the ditches in this area, the water level was normal rather lowered. There is abundant least duckweed under common reed and locally greater pond-sedge although the swamp is quite open across the channel. Both banks are dominated by common reed with patchy brambles and scrub.
AQ051 Ditch	A more or less dry ditch with a distinct gradient, dominated by nettles and rank grasses (MG1 <i>Arrhenatherum elatius</i> grassland). The western part runs between two arable fields and has mown neutral grass with frequent tall herbs on both banks. To the east, the north bank is adjacent to woodland and is dominated by brambles and scrub. The wettest part is at the eastern end where the ditch runs along a minor road. Here there were still some puddles and fool's water-cress is locally abundant on the ditch bottom.
AQ052 Ditch	A dry ditch overhung by a woodland strip/hedge along the road on the W side. However, light gets in from largely nettles and grassy field-side bank on the east side which has been mown. The bottom of the ditch is often just leaf-litter covered with some nettle patches but nettles become dominant where the ditch is less shaded, such is in a few breaks in the hedge towards the south end of the ditch.
AQ053 Ditch	A dry channel with high banks running past a farmyard. The whole system including 2 smaller side ditches is mostly dominated by common nettle with patches of bramble and other scrub. The ditch is completely shaded by scrub at the east and west ends, often still with common nettle abundant but sometimes with a more open woodland ground flora with ivy etc.
AQ054 Ditch	East bank steep with neutral grassland (MG1 <i>Arrhenatherum elatius</i> grassland) and nettles, but mown. West bank is a bramble/blackthorn hedge. Common reed over shallow water in the channel. The common reed sometimes ascends the east bank towards the southern end of the ditch.
AQ057A Ditch	Scrub and bramble dominated, particularly on the south side. Still mainly common reed dominated along the channel, except at the east and west ends where the scrub/brambles are thicker and the ditch is more densely shaded. Here the ground is common nettle dominated or bare. There are some breaks in the scrub on the north bank which are grassy (MG1 <i>Arrhenatherum elatius</i> grassland) with nettles.
AQ057B Ditch	A very shallow ditch with a distinct gradient. Shaded on east side by a woodland strip but open on the western side. No aquatic vegetation but channel overhung by grass and nettles from the banks.

Water-course	Description
AQ058 Ditch	A dry ditch with a distinct gradient. Mostly shaded to some degree but some stretches without shade. Channel overhung by bank vegetation of nettles and bramble with some rank grasses.
AQ060 Ditch	One of the few ditches with a reasonable depth of water in this area and with good aquatic vegetation. West side is common reed fen with some scrub. East side is cattle grazed pasture with some poaching of the margin. This side grassy with common nettle and water-pepper abundant but also a good mix of wetland species. Local more intense poaching has created some bare areas. Water at south end dominated by Canadian waterweed with filamentous algae abundant as a covering on the vegetation and sometimes floating and also frequent scattered duckweed. There are also small amounts of broad-leaved pondweed, frogbit, arrowhead, small pondweed and horned pondweed. In the northern half of the ditch, Canadian waterweed becomes much sparser and filamentous algae predominates. The water is more turbid here and there is more frequent duckweed.
AQ064 Ditch	One of the few ditches with a reasonable depth of water in this area and with reasonable aquatic vegetation. Common reed and branched bur-reed occur along the margins and sometimes as patches in the middle. In the ditch there are frequent patches of intermediate water-starwort and blunt-fruited water-starwort (<i>C. cf. obtusangula</i>) and filamentous algae with local scatterings of duckweed. There is also a small amount of curled pondweed. The north bank is grazed and has a shelf with poaching. This supports a diverse community with some parts containing abundant water-pepper, common nettle or mixed wetland species and some parts short creeping bent grassland. The south side is a steep bank adjacent to an area of dry common reed, common nettle and scrub with frequent hedge bindweed, great willowherb, meadowsweet and bramble.
AQ065 Ditch	This ditch was assessed only at the southern end due to limited access permission. This part is a shallow ditch at the edge of a wood and more or less shaded but with some light penetration. The banks are steep with woodland vegetation (false brome, common nettle, ivy) and with bramble also abundant on the southern (less shaded) bank. There is no aquatic vegetation in the channel except in the final western end shortly before it connects to ditch AQ064. This area is much less shaded (30%) and the banks are overgrown with bramble and common nettle except in a section where there is grazing access where there is some common reed, soft rush, remote sedge and water pepper. The water is 30cm deep here and there is some various-leaved water-starwort (<i>Callitriche cf. platycarpa</i>). To the north of the section surveyed, the ditch is within woodland and shaded. There is still shallow water in the bottom of the ditch but no aquatic vegetation. The banks are dominated by common nettle and false brome.
AQ066 Ditch	A completely shaded streamlet at the bottom of a shallow wooded valley. The channel is gravelly and mostly bare, with some parts dry and some parts with puddles up to 5centim deep. The banks have abundant ivy with patches of common nettle especially where there is more light penetration.
AQ067 Ditch	A shallow streamlet with a gravelly bottom running through woodland and completed shaded. It is interrupted in the middle part by a large pond and then a series of small ponds formed by damming the streamlet (not included in this survey). The channel is mostly bare and the banks have abundant ivy with patches of common nettle where more light penetrates and these sometimes overhang the channel. At the north-western end the woodland breaks up into a hedge/scrub. At this point the ditch was dry and dominated by common nettle and bramble.
AQ069 Streamlet	Open woodland with abundant bracken resulting in it being effectively shaded. It is a shallow streamlet with no aquatic vegetation.
AQ070 Streamlet	Open woodland with abundant bracken resulting in it being effectively shaded. It is a shallow streamlet with no aquatic vegetation.
AQ078A	A shallow ditch with a silted bed running through arable land, vegetation is dominated by hemlock water-dropwort.
AQ078B	The ditch enters ash and oak woodland and becomes dry. Pendulous sedge is found within channel with bramble on banksides

Water-course	Description
AQ078C	A shallow ditch with a silted bed running through arable land, vegetation is dominated by hemlock water-dropwort. A hedge borders the west of the bank of the ditch with rough MG1 <i>Arrhenatherum elatius</i> grassland to the east.
AQ091 Ditch	A dry ditch mostly under willow etc. scrub and difficult to follow for most of its route. Under the shade there is a mixture of bare ground, nettle dominated areas and woodland ground flora communities (e.g. ivy). There is a short stretch with broken shade at the western end which has abundant common reed.
AQ093 Ditch	A dry ditch with gently banks running through improved pasture. The bottom is dominated by creeping bent and Yorkshire fog with some sweet-grass. The banks have creeping bent, Yorkshire fog and perennial rye grass with some common nettle and spear thistle.
AQ100	Small stream in area of ancient woodland (Hundredhouse Copse). Heavily shaded and supporting little aquatic vegetation other than occasional areas of water mint (<i>Mentha aquatica</i>), lesser water parsnip (<i>Berula erecta</i>) and sparse aquatic mosses. The stream is surrounded in places by alder and ash wet woodland which has been surveyed in the NVC woodland baseline survey report. Scoped out from further aquatic plan survey as woodland vegetation present and few aquatic plants present.
AQ199 River	<p>River Arun, east bank TQ011060 to TQ011054 Most of this part of the Arun has sloping (45°) concrete facing for the full tidal range (c.3-4 m). There is no vegetation in the channel which is mud dominated and there is frequent <i>Fucus</i> on the lower parts of the concrete and scattered <i>Ulva flexuosa</i> and <i>Vaucheria</i>. A strip along the upper part 2m of the concrete has tufts of common couch with occasional sea beet, spear-leaved orache and sea-purslane. Going southwards there are increasing numbers of other saltmarsh species with sea aster and lesser sea-spurrey additionally becoming frequent south of TQ 011 058. Also present in small amounts are common saltmarsh grass, common glasswort, annual sea-blite and fern grass. Above the concrete is mesotrophic common couch grassland (MG1 <i>Arrhenatherum elatius</i> grassland) although sea beet is sometimes present in the bottom of this suggesting a narrow transitional strip through common couch saltmarsh (SM28 <i>Elymus repens</i> salt-marsh community).</p> <p>At TQ 0113 0567 the river embankment turns away from the river edge leaving a broad (50m wide) band of common reed extending southwards along the edge of the river. Much of this seems to be dry swamp for most of the time but doubtless gets flooded by higher tides. Just at the northern end of this where the embankment turns inland there is an indentation with a small area of natural saltmarsh vegetation about 10m wide and extending 30m inland (c.TQ 1116 0566). This grades from SM13a (common saltmarsh grass) with some sea aster) beside the river through SM16a <i>Festuca rubra</i> salt-marsh community, <i>Puccinellia maritima</i> sub-community (common saltmarsh grass and red fescue with abundant sea aster and some sea arrowgrass, sea-milkwort and common saltmarsh grass) to SM16c <i>Festuca rubra</i> salt-marsh community, <i>Festuca rubra-Glaux maritima</i> sub-community (as previously but with creeping bent replacing common saltmarsh grass). A patch of possible dittander was noted at the corner of the river embankment at TQ 0114 0567 but the plants were too dried out for certain identification.</p> <p>River Arun, west bank TQ010060 to TQ010054 The river is tidal at this point and the bank is covered by sloping (45°) concrete for the full tidal range (c.3-4 m). There is no vegetation in the channel which is mud dominated. There is frequent <i>Fucus</i> on the lower parts of the concrete and scattered <i>Ulva flexuosa</i> and <i>Vaucheria</i>. The uppermost part of the concrete has frequent patches of sea-purslane and sea aster (mostly rayed but sometimes the unrayed form). Then above the concrete facing there is a narrow band of common couch saltmarsh (SM28) with some sea beet and spear-leaved orache giving way to common couch mesotrophic grassland (MG1 <i>Arrhenatherum elatius</i> grassland) above. Other saltmarsh species are rare but a few plants of common saltmarsh grass, lesser sea-spurrey and sea plantain start to appear towards the southern end of the 200m buffer zone. At the southern end of this zone the concrete facing is similar but older and more weathered. The zonation is the same as before but there are more patches of vegetation on the upper part of the concrete, particularly sea-purslane.</p> <p>Also of note near the top of the river embankment were a few plants of marsh mallow (<i>Althaea officinalis</i>); 1 plant at TQ 0108 0600, 2 plants at TQ 01080 05635 and six plants at TQ 01079 05624</p>

Appendix I: Raw Data

A27 Arundel - Watercourse Survey Plant Species Data

AQ No.			No. species	No. aquatic species	No. wetland species	<i>Ulmus glabra</i>	<i>Ulv</i> <i>(Enteromorpha)</i>	<i>Urtica dioica</i>	<i>Veronica beccabunga</i>	<i>Veronica catenata</i>	<i>Vicia cracca</i>	<i>Zannichellia palustris</i>
	Aqua/wet/dry/fil.alg					D	F	W	W	W	B	A
	No. occurrences					1	14	53	3	4	1	2
60			54	10	34			A	O			R
30B			26	7	10		F	O				R
23			32	6	14			F				
64			50	5	37			A	F	O		
15A			36	5	26			F	O			
2			36	5	17		OLA	A				
34			36	4	15		R	O				
18A			28	3	15		O	R		R		
18C			34	3	14			F				
21			26	3	11		OLF	F				
44			18	3	8			A				
46A			12	3	8			O				
65			26	2	17			ALD				
6			25	2	15		F	F				
12			18	2	13		R	F				
1B			33	2	13		OLA	FLA				
4			25	2	13		F					
14			25	2	12		D	FLA			R	
46B			18	2	9							
50			15	2	9			A				
24			18	2	9		A	O				
1A			21	2	8		OLF	A				
35			9	2	6							
32			32	1	18			O		O		
45A			20	1	13			A				
31B			23	1	12			F				
5			21	1	11			A				

A27 Arundel - Watercourse Survey Plant Species Data

AQ No.			No. species	No. aquatic species	No. wetland species							
	Aqua/wet/dry/fil.alg					<i>Ulmus glabra</i>	<i>Ulv</i> (<i>Enteromorpha</i>)	<i>Urtica dioica</i>	<i>Veronica beccabunga</i>	<i>Veronica catenata</i>	<i>Vicia cracca</i>	<i>Zannichellia palustris</i>
	No. occurrences					D	F	W	W	W	B	A
41			27	1	10	1	14	53	3	4	1	2
13			16	1	9		FLA					
48B			14	1	8		FLA	F				
49			15	1	8			A				
7			25	0	16		O			A		
29			23	0	14			F				
54			19	0	13			A				
51			23	0	13			ALD				
91			19	0	13			A				
57A			18	0	12			A				
38			20	0	12							
57B			17	0	11			A				
31A			19	0	10			O				
53			21	0	9			D				
42			27	0	9			A				
30A			18	0	9			F				
28			18	0	9			R				
10			14	0	8			A				
58			18	0	8			ALD				
11			19	0	8							
15B			14	0	7			F				
3			22	0	7			F				
67			16	0	7	F		ALD				
66			16	0	6			ALD				
45B			10	0	6			U				
9			8	0	4			A				
48A			12	0	4			A				

A27 Arundel - Watercourse Survey Plant Species Data

AQ No.			No. species	No. aquatic species	No. wetland species	<i>Ulmus glabra</i>	<i>Ulvia (Enteromorpha)</i>	<i>Urtica dioica</i>	<i>Veronica beccabunga</i>	<i>Veronica catenata</i>	<i>Vicia cracca</i>	<i>Zannichellia palustris</i>
	Aqua/wet/dry/fil.alg					D	F	W	W	W	B	A
	No. occurrences					1	14	53	3	4	1	2
47			8	0	4			A				
52			10	0	4			ALD				
93			7	0	4			F				
78A			12	0	0			R				
78B			4	0	0							
78C			9	0	0			F				

A27 Watercourse Survey - Ditch Environmental Data

Ditch no.	Date	Recorder	Orientation	Adjacent land use A					Adjacent land use B					Bank vegetation A					Bank vegetation B					Grazing A					Grazing B					Ditch features																						
				Habitat	Cattle	Sheep	Hay/silage	Boundary	Spoil	Habitat	Cattle	Sheep	Hay/silage	Boundary	Spoil	Tall grass/reed	Short grass	Bare	Tall herbs	Scrub	Fen	Wood GF	Shaded %	Tall grass/reed	Short grass	Bare	Tall herbs	Scrub	Fen	Wood GF	Shaded %	Grazing	Poaching	Block	Shelf	Tangled	Grass margin	Grazing	Poaching	Block	Shelf	Tangled	Grass margin	Water width	Banktop width	Freeboard	Water depth	Estim winter water depth	Silt depth	Conductivity	pH	Turbidity	Water colour	Slope bank A	Slope bank B	Underwater slope A
AQ002	11/10/2017	NFS/KJ	N	S	I	Y	Y	P	I	Y	Y	P	#	#	#	5				95	#	#	#						5	0	0	0	0	2	3	0	0	0	2	3	2	2	4	20	30	30	NR	NR	NR	2	Colourless	2	3	2		
AQ003	11/10/2017	NFS/KJ	N	S	I	Y	Y	P	I	Y	Y	P	#	#	#	4				60	#	#	#						60	2	2	0	1	2	3	2	2	0	2	3	2	3	3	0	30	20	NR	NR	NR	2	Colourless	2	2	2		
AQ004	11/10/2017	NFS/KJ	E	W	I	Y	Y	P	I	Y	Y	P	#	#	#	F				20	#	#	#	A					40	0	0	0	0	2	2	0	0	0	2	1	2	2	4	30	60	60	NR	NR	NR	2	Greyish	3	4	4		
AQ005	11/10/2017	NFS/KJ	N	S	I	Y	Y	P	I	Y	Y	P	#	#	#					0	#	#	#	#					100	0	0	0	0	2	3	0	0	0	2	2	1	2	3	10	20	20	NR	NR	NR	1	Colourless	3	4	3		
AQ006	11/10/2017	NFS/KJ	N	S	S	Y	Y	P	S	Y	Y	P	#	#	#					0	#	#	#						0	0	0	0	0	1	0	0	0	0	1	0	5	3	3	20	70	70	NR	NR	NR	2	Greyish	3	3	2		
AQ007	11/10/2017	NFS/KJ	N	S	I	Y	Y	P	I	I	I	T	#	#	#					0	5								0	2	1	2	1	2	3	0	0	0	1	0	5	3	3	20	80	90	NR	NR	NR	2	Colourless	1	3	2		
AQ009	11/10/2017	NFS/KJ	N	S	I	Y	Y	P	I	Y	Y	P	#	#	#					0	5								0	0	0	0	0	1	0	0	0	0	1	0	2	2	4	5	30	15	NR	NR	NR	2	Colourless	3	3	3		
AQ010	11/10/2017	NFS/KJ	E	W	I	Y	Y	P	I	Y	Y	P	#	#	#					0	#	#	#						0	0	0	0	0	1	0	0	0	0	1	0	2	2	3	35	85	50	NR	NR	NR	1	Colourless	3	3	3		
AQ011	12/10/2017	NFS/RG	E	W	I	Y	Y	P	I	Y	Y	P	D	5		1				0	5	5		1					0	2	2	0	0	1	3	2	2	0	1	3	1	3	3	0	10	20	NR	NR	NR	NR	NR	2	2	2		
AQ012	11/10/2017	NFS/KJ	N	S	I	Y	Y	P	I	Y	Y	P	D	5						0	5								0	0	0	0	0	1	0	0	0	0	1	0	2	2	3	20	50	55	NR	NR	NR	2	Colourless	3	3	4		
AQ013	11/10/2017	NFS/KJ	E	W	I	Y	Y	P	I	Y	Y	P	#	5						0	5								0	0	0	0	0	1	0	0	0	0	1	0	3	2	3	55	80	75	NR	NR	NR	2	Colourless	4	4	4		
AQ014	11/10/2017	NFS/KJ	E	W	I	Y	Y	P	I	Y	Y	P	#			#	R			3	#	#	#						0	0	0	0	0	1	0	1	1	0	0	2	3	3	3	3	20	40	30	NR	NR	NR	2	Colourless	3	2	4	
AQ021	12/10/2017	NFS/RG	N	S	I	Y	Y	P	I	Y	Y	P	3	4		3	4			60	4	4		2					0	0	0	0	0	2	1	0	0	0	2	2	2	2	3	30	40	25	3258	7.28	3	Greyish	3	3	3			
AQ023	12/10/2017	NFS/RG	E	W	D	Y			I	Y		5								0	5		2						0	0	0	0	0	2	0	1	0	0	2	2	2	2	4	40	50	50	1536	7.56	2	Greyish	5	3	5			
AQ024	12/10/2017	NFS/RG	E	W	I	Y		P	D	S		3	5		1	1				2	5		2						0	0	0	0	0	2	1	0	0	0	2	0	2	3	4	25	60	50	2700	8.21	2	Lemon juice	3	4	4			
AQ028	12/10/2017	RG	N	S	I	Y		P	I	Y		2								50		2		4					50	1	0	0	0	1	1	1	0	0	1	2	1	2	3	5	5	NR	NR	NR	3	Greyish	2	1	2			
AQ029	12/10/2017	NFS	E	W	D	Y			I	Y		3	5							0	4	4		0	1				0	0	0	0	0	2	2	0	0	0	2	1	2	2	3	5	20	10	2417	7.77	1	Colourless	3	3	2			
AQ032	12/10/2017	NFS	N	S	I	Y			I	Y		2	4							95	3	5	1	1					0	1	1	0	0	2	1	2	2	2	2	3	2	2	3	25	35	20	965	7.84	2	Lemon juice	3	2	2			
AQ034	12/10/2017	NFS/RG	N	S	I	Y			I	Y		2	5		1					10	2	4		1	2				90	2	1	0	0	1	3	0	0	0	0	1	2	2	2	3	0	10	15	NR	NR	NR	NR	NR	3	4	2	
AQ035	12/10/2017	NFS/RG	E	W	I	Y			I	Y		5								0	5								0	1	1	0	0	1	3	1	1	0	0	1	3	5	4	3	20	20	30	1663	8.26	2	Brownish	2	2	2		
AQ038	12/10/2017	NFS/RG	E	W	I	Y		P	D			4	3		2					0	4	3		2					0	0	0	0	0	2	2	0	0	0	2	2	2	3	10	20	10	NR	NR	NR	1	Colourless	4	4	3			
AQ041	12/10/2017	NFS/RG	N	S	I	Y		P	D			3	3		4					4	50			4	3				4	50	0	0	0	0	1	0	0	0	0	1	0	2	3	4	15	45	15	3246	7.73	1	Colourless	3	3	3		
AQ042	12/10/2017	NFS/RG	N	S	D				D			3			3	5				95				3	5				95	0	0	0	0	1	0	0	0	0	0	1	0	2	4	4	0	20	10	NR	NR	NR	NR	NR	3	3	3	
AQ044	13/09/2017	NFS/SI	E	W	U				I	S		5								0	4			4					70	0	0	0	0	2	0	0	0	0	0	2	0	4	4	4	40	60	35	838	7.53	2	Colourless	3	3	3		
AQ047	13/09/2017	NFS/SI	E	W	UO				S	?										5	100			5					99	0	0	0	0	0	0	0	0	0	0	0	2	2	2	3	0	20	95	NR	NR	NR	NR	NR	3	3	3	
AQ049	13/09/2017	NFS/SI	E	W	I	?		P	I	?		4			4					80	4			4					60	0	0	0	0	1	0	0	0	0	0	1	0	2	2	3	20	40	25	952	7	1	Colourless	3	3	3		
AQ050	13/09/2017	NFS/SI	E	W	S			P	U	F		5								30	5			3					50	0	0	0	0	1	0	0	0	0	0	1	0	3	3	4	40	40	55	756	6.78	2	Colourless	3	4	3		
AQ051	13/09/2017	NFS	N	S	AW				A			4			4	4				40	4			3	2				5	0	0	0	0	1	0	0	0	0	0	1	0	1	2	4	0	10	0	NR	NR	NR	NR	NR	3	3	2	
AQ052	13/09/2017	NFS	E	W	A				W	D		4			4	3				80		3		4	5				4	100	0	0	0	0	1	3	0	0	0	0	1	0	2	2	3	0	0	35	NR	NR	NR	NR	NR	3	3	3
AQ053	14/09/2017	NFS/SI	N	S	WDO				S	Y					5	3				30			3	30					3	30	0	0	0	0	1	0	0	0	0	0	1	0	1	4	5	0	10	20	NR	NR	NR	NR	NR	4	4	4
AQ054	14/09/2017	NFS/SI	E	W	A				I	Y		5			3					0				5					99	0	0	0	0	1	0	0	0	0	0	1	0	1	2													

