Improvement Programme for England's Natura 2000 Sites (IPENS) – Planning for the Future IPENS004

Lower Avon Valley Macrophyte Survey 2013

River Avon Special Area of Conservation (SAC)
Avon Valley Special Protection Area (SPA)

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Foreword

The **Improvement Programme for England's Natura 2000 sites (IPENS)**, supported by European Union LIFE+ funding, is a new strategic approach to managing England's Natura 2000 sites. It is enabling Natural England, the Environment Agency, and other key partners to plan what, how, where and when they will target their efforts on Natura 2000 sites and areas surrounding them.

As part of the IPENS programme, we are identifying gaps in our knowledge, and where possible, we are addressing these through a range of evidence projects. Results from these projects will feed into Theme Plans and Site Improvement Plans. This project forms one of these studies.

A survey of the River Avon Special Areas of Conservation (SAC) was commissioned to assess the response of the river macrophyte communities to the cessation of annual weed cutting by the Environment Agency in 2010. The survey focused on the Lower Avon River, which is underpinned by the River Avon System, and Avon Valley (Bickton to Christchurch) Sites of Special Scientific Interest (SSSIs), and used a repeatable and robust methodology designed to produce baseline data to provide evidence for assessing changes within the site and to enable monitoring of any future changes. Details of any obvious problems with water availability, or other issues such as: non-natives; excessive siltation; or the impact of the plant community on the river's channel and flow, were noted during the survey.

The report indicates that the macrophyte flora of the Lower Avon Valley has remained broadly consistent between 2011 and 2013 when compared with a basic river vegetation survey undertaken in 2011. However, it notes an increase in the number of survey locations supporting the invasive species Nuttall's pondweed Elodea nuttallii, and the relatively high cover of this species, particularly at the southern survey locations. Issues identified within the report have been incorporated into the Avon River and Valley Site Improvement Plan.

The key audience for this work is the staff within Natural England and should be used to assess the response of the river macrophyte communities to the cessation of annual weed cutting and to inform future monitoring and management requirements within the site.

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Summary

Five days of survey work were carried out in the Lower Avon Valley in August 2013. A repeatable and robust methodology was followed, designed to produce baseline data which will allow any future change to be quantified and characterised. Ten sites were surveyed from the bankside survey points established in 2011, stretching for 250m upstream and downstream, and species abundance and cover were recorded.

A total of 26 species were recorded from the river, and 79 from the marginal bankside vegetation (100 in total). Instream cover was variable within and between sites, and average cover per site ranged from 50% to 80%.

Comparison with previous surveys is limited due to differences in data collection and recording, but no major changes have been identified.

Contents

1. Acknowledgements

We would like to thank the farmers, landowners and agents within the Avon Valley for permission to survey on their land: Angie Hill, C Thomasin-Foster, Derek Goulding, Hallam Mills, Malcolm Bull, Mrs Ward, Ollie Alderley, Rae Borras, Richard Pierson, and Terry Simpson of Ringwood Town Council. Thanks also to Simon Curson at Natural England, who commissioned the survey.

2. Introduction

2.1 The aim of this repeat survey of the Lower Avon River is to provide a baseline to assess the response of the river macrophyte communities to the cessation of annual weed cutting by the Environment Agency. These data are in addition to those provided by the Condition Assessment which is undertaken on a six year cycle. A basic river vegetation survey of 10 sites of the river south of Fordingbridge was undertaken in 2011 (Steven & Curson 2011) which provides a baseline for comparison with the work undertaken in 2013.

2.2 This project is part of the Improvement Programme for England's Natura 2000 Sites[1] (IPENS) programme (LIFE11NAT/UK/000384IPENS) which is financially supported by LIFE, a financial instrument of the European Community. IPENS is a new strategic approach to managing England's Natura 2000 sites. It will enable Natural England, the Environment Agency, and other key partners to plan what, how, where and when they will target their efforts on Natura 2000 sites and areas surrounding them.

The River Avon

2.3 The River Avon shows a greater range of habitats and a more diverse flora and fauna than any other chalk river valley in Britain. The flood plain and associated river terraces within the SSSI contain a variety of habitats ranging from herb-rich hay meadows and pastures, through a range of fens and mires to riparian woods, dune grassland and heathland.

2.4 The Avon is more varied than most chalk streams and also supports one of the most diverse fish faunas in Britain and a wide range of aquatic invertebrates. The river is designated as an SAC for "floating vegetation of *Ranunculus* of plain and submountainous rivers", as well as various fish species and Desmoulin's Whorl Snail *Vertigo moulinsiana*. The River Avon System Site of Special Scientific Interest (SSSI[2]) covers the entire river system and the SSSI citation refers to around 180 species of aquatic plants that have been recorded from the river.

2.5 Also relevant is the Avon Valley (Bickton to Christchurch) SSSI[3], designated for many features of interest including its wet grassland habitats, breeding waders and overwintering wildfowl. The site encompasses part of the River Avon floodplain south of Fordingbridge to the sea at Christchurch. The valley is also designated under European law as a Special Protection Area (SPA)[4] for its wintering wildfowl.

Management of the aquatic plants in the Lower Avon

2.6 Historically the river channel has been managed by weed cutting in the growing season, to control water levels, assist fishing interests and to permit farming operations on the floodplain by reducing the incidence of periods of summer flooding. This type of operation has persisted in the lower Avon, certainly since mediaeval times, using various methods including, at times, prison labour working from the bank sides. In recent decades the weed cutting has been carried

[1] www.naturalengland.org.uk/ipens2000
[2] http://www.sssi.naturalengland.org.uk/citation/citation_photo/2000183.pdf
[3] http://www.sssi.naturalengland.org.uk/Special/sssi/sssi_details.cfm?sssi_id=1006622
[4] http://www.jncc.gov.uk/default.aspx?page=2038

out by the Environment Agency (EA) operating from boats within the river channel. A significant stretch of the river north of Ringwood has not been cut in this way by EA – the Somerley Estate section – though here the estate undertakes specific weed management for fishery purposes.

2.7 Over time, in common with most wet grassland river flood plains, maintenance activities in the valley have declined. Some hatch and sluice structures have fallen into disrepair and not all ditches have been maintained. Historic photos of the valley show an open, intensively managed grass floodplain, with few trees, whereas now, the aerial photographs show areas of scrub and woodland, particularly lines of willows on the ditch systems, suggesting a degree of abandonment. Some areas of pasture have also been abandoned in recent years and have been taken over by fen and swamp vegetation.

2.8 In recent years cutting has been carried out by the Environment Agency. However, following a review, the Environment Agency decided this was not sustainable (consultation with Natural England concluded that mechanical weed cutting was neither detrimental nor essential to maintaining the SAC and SSSI features) and in 2005 announced that it would cease cutting in 2010.

2.9 Against this background there is also the gradual impact of climate change, with increased likelihood of extreme weather events. The recent Catchment Management Plan produced by the Environment Agency considers that climate change will have the greatest impact on flood risk and that this, combined with sea level rise, will result in increased peak river flows, a greater incidence of large-scale flood events and a greater probability of tidal flooding on the lower reaches of the river.

The need for detailed monitoring

2.10 Detailed consideration of the effects of changes in weed cutting to different units within the Lower Avon SSSI are considered by Hoodless (2010) and land management implications are considered by Lake et al. (2011). Hoodless (2010) concluded that the full effect of a cessation in weed cutting on the River Avon is unclear although the water levels will certainly be higher in the future. The role of weed in impeding river flow is ambiguous because, if left uncut the biomass of *Ranunculus* communities is likely to decrease through self-shading and natural wash-out after flowering. However, it is not clear how soon an equilibrium might be achieved. Natural England needs to have a good understanding of how changes may be affecting the overall ecology of the river valley and how this relates to the features of special nature conservation importance in the SSSI, which will influence their advice on management of the river (Stevens and Curson, 2011).

2.11 Robust monitoring is therefore necessary to determine the extent of any change overtime. This report documents the results of monitoring undertaken in August 2013 to assess the river macrophyte community following the cessation of the EA weed cut in 2010. The results are compared with those of the 2011 survey where possible.

2.12 The survey also recorded other observations of specified invertebrate and bird species of interest requested by Natural England, including:

- Scarce Chaser *Libellula fulva*
- Waders (Redshank, Lapwing, Oystercatcher or Snipe, with indication of chicks)
- the Pea Mussel Pisidium tenuilineatum
- the snails *Valvata macrostoma* and Desmoulin's Whorl Snail.

3. Methods

3.1 The methods used were confirmed in discussion with Natural England, and broadly follow standard macrophyte survey protocols as set out by JNCC (see Holmes, Boon, & Rowell 1999, where survey details are set out in Appendix G) and CEH[5].

3.2 Survey locations were those established in 2011 and are shown in Map 1 and listed in Table 1. These locations were initially selected on the basis of relative ease of access and to provide a geographic spread up and down the river (Stevens and Curson, 2011).

Table 1. Survey locations.

Location name	2013 survey point	Upstream limit	Downstream limit	Previous grid ref if survey point altered	Change and reason	Bank
Hucklesbrook	SU1499.106	SU1482.1074	SU1496.1037			East
Ibsley Bridge	SU1461.0934 downstream SU 1497.0970 upstream	SU1497.0970	SU1441.0919	SU1498.0968	Downstream section 100m downstream to avoid channels in wood	West
Ringwood Weir	SU1458.0559	SU1469.0586	SU1457.0555		Reach from 400m upstream - 100m downstream, due to access constraints	West
Bickerley Millstream	SU1478.0479	SU1478.0479	SU1478.0479		Downstream of access point only due to access constraints	East
Main river at Castlemain Trailway	SU1412.0485	SU1426.0509	SU1429.0481			East
Wattons Ford	SU1401.0158	SU1401.0158	SU1371.0119		Surveyed downstream due to sallow wood upstream	East
Sabines Farm	SZ1418.9945	SZ14018.99661	SZ14249.99365			East
Avon Causeway	SZ1494.9778	SZ1503.9768	SZ1478.9809			West
Confluence s. of Sopley Mill	SZ1566.9646	SZ15580.96434	SZ15669646		Surveyed upstream of survey point due to millstream	North
Winkton Common	SZ1586.9470	SZ1566.9476	SZ1575.9456			East

3.3 Survey points were relocated in 2013 using the OS 1:25000 map and a handheld GPS. In some cases, locations were altered slightly to enable the full 500m to be surveyed wherever possible (the previous survey was largely from the bank at the survey point). Access permission was

[5] http://www.eu-star.at/pdf/MacrophyteGuidance.pdf

requested by letter followed up with a telephone call as needed before the survey, and land owners/tenants contacted again with specific dates and times if requested.

3.4 Digital photographs were taken both upstream and downstream of survey points and to match images those in the 2011 survey. Additional photographs of points of interest were also taken.

3.5 From each survey location, the river bank and submerged vegetation was surveyed for 250m in each direction along the specified bank (usually the west bank), and notes taken on physical characteristics of the river. Both river and bank vegetation was surveyed visually, wading where necessary or using a grapnel. Species were recorded using a DAFOR scale and percentage cover classes broadly based on the Common Standards Monitoring for Rivers[6], and split into river and bank records. Percentage cover was described as <0.1, 0.1-5, thereafter rounded to the nearest 10% (monitoring protocol suggests using only one third class of >5, but it was thought preferable to retain more information to maximise opportunities for future analysis.

Table 2. Abundance classes used in the 2013 Lower Avon macrophyte survey.

DAFOR code for relative abundance	Abundance
D	Dominant
A	Abundant
F	Frequent
O	Occasional
R	Rare
(L)	(Locally)

Macrophytes

3.6 Estimating cover can be difficult, so as a general guide surveyors envisaged a dense stand of vegetation, stretching from bank to bank, and extending for 5 m downstream as covering 1% of the 500 m stretch. Similarly, a continuous fringe of a single species stretching 5 m represented 1%. A species with cover value 3 means that it completely covered the stream bed for 25 m, or it covered half the bed for 50 m, a quarter of the bed for 100 m, or it occurred more sparsely throughout the whole 500 m. For a score of 3 to be given, bank taxa formed a co-dominant fringe of 100 m or occurred as 50 plants or colonies each covering one metre. In practice, surveyors found it more useful to use abundance descriptions, appending “local” to abundance classes as relevant.

3.7 River records include macrophytes which occurred in the region of the river which was considered to be rarely uncovered, and shallow sections with an upper limit that may be exposed for a maximum of 50 days in any year. ‘Bank’ records were those plants that occurred on the sides of the river above the limit of the ‘river’ plants, but were considered likely to be submerged, or partially so, during mean flow periods. The upper limit of the ‘bank’ excluded areas considered likely to be submerged when river flows are at their highest.

[6] http://jncc.defra.gov.uk/pdf/csm_rivers_mar05.pdf

3.8 A grapnel or specially designed long-handled three-pronged rake was used to collect specimens for examination where necessary. The grapnel was not however used to 'search' for macrophytes as a substitute for visual observation as such an approach would potentially have meant that fine-leaved and deep rooted species were missed and frequent species over-recorded.

3.9 Where necessary, any unidentified specimens were keyed out at the end of the survey, or the following day. All species were recorded to species or subspecies level with the exception of water-starwort *Callitriche*. For this genus, ripe brown fruits are needed to confirm identity (R. Lansdowne, pers. comm.). These were not observed during the survey, so although it is considered likely that the species present was blunt-fruited water-starwor *C. obtusangula*, this has been recorded as water-starwort *Callitriche* sp. A second opinion was sought from Christopher Preston on the identification of the pondweed hybrid *Potamogeton x salicifolia.*

Physical characteristics

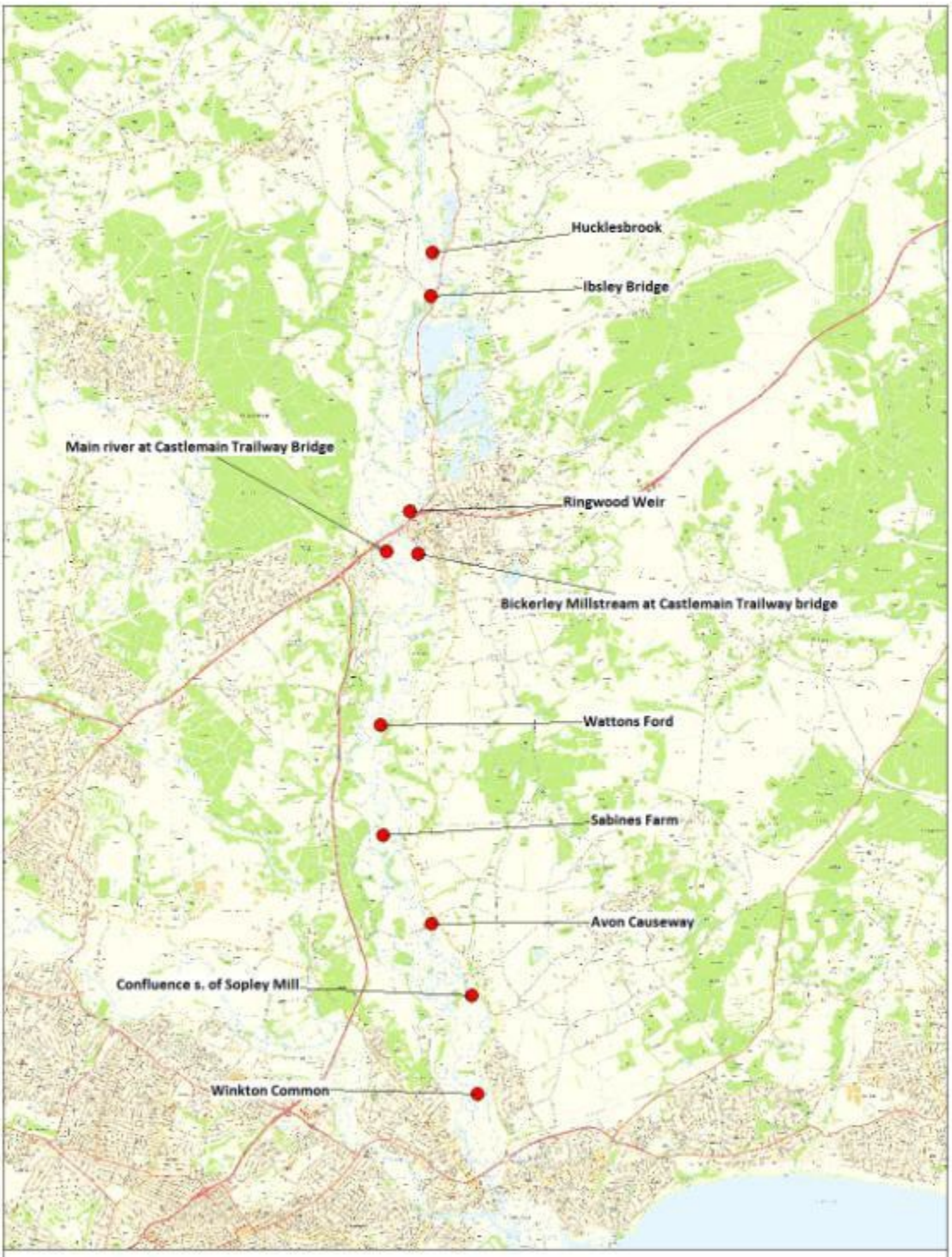
3.10 After the first field visit, it was agreed with Natural England that notes would be taken of physical characteristics of the river at each survey point, specifically water availability and quality. Notes were made highlighting any obvious problems with water availability at the time of survey e.g. a very shallow water depth, an apparent reduction in the wetted area, or reduced water movement relative to what might be expected. Any observable impact of the plant community on the river's channel and flow were also made. Surveyors also checked for and noted any indicators of problems e.g. excessive turbidity (due to elevated levels of suspended solids or phytoplankton blooms), excessive siltation, or large amounts of filamentous algae.

Recording

3.11 The recording form (see Appendix 1) included a space for a sketch map with locations of all nationally rare, nationally scarce or other priority plant species, plus negative indicator species (non-native) and any other points of interest.

3.12 Survey section boundaries, rare plants, other key species and photograph locations were recorded using a GPS.

3.13 An additional survey form was available for ad hoc sightings of invertebrates and birds of interest, particularly Scarce Chaser dragonfly, waders (Redshank, Lapwing, Oystercatcher or Snipe, with any indication of breeding behaviour), the Pea Mussel *Pisidium tenuilineatum*, the snails *Valvata macrostoma* and Desmoulin's Whorl Snail *Vertigo moulinsiana*. Surveyors were provided with ID guidance notes for the Scarce Chaser and target molluscs.



Map 1: Approximate locations of survey points, as set out in specification

4. Results

4.1 Species data are presented in Appendix 2. A total of 100 species was recorded, 79 (mean 27 +/-3.8) from the river bank, and 26 (mean 12 +/-1.1) from within the river (4 species were recorded from both locations). Many of these were recorded as occurring occasionally (44% of records in the river, 53% on the bank) or rarely (31% for both river and bank). Virtually no species were dominant at any of the survey locations, although reed sweetgrass *Glyceria maxima* was recorded as dominant at one site, and spiked water milfoil *Myriophyllum spicatum* and broad-leaved pondweed *Potamogeton pectinatus* were locally dominant within the river at two sites. Abundant records and locally abundant records were also more common in the river (3% and 7% respectively).

4.2 The species most widely distributed in the river (i.e. occurring in at least nine of the ten sites sampled) were broad-leaved pondweed *Potamogeton pectinatus,* arroweed *Sagittaria sagittifolia* and common duckweed *Lemna minor. P. pectiniatus* cover was variable but highest overall, reaching 50% at Avon Causeway. Cover of *S. sagittifolia* was generally much lower, only reaching 20% at Avon Causeway. *L. minor* cover was always below 5%. Other widespread species (i.e. recorded at eight or more sites) included flowering rush *Butomus umbellatus,* shining pondweed *Potamogeton lucens,* stream water crowfoot *Ranunculus pencillatus* and the introduced invasive species Nuttall's pondweed *Elodea nuttallii*. Cover of these species was correspondingly lower, although it varied between sites. Cover of *E. nuttallii* was higher in the southern section of the river, and reached 30% at Winkton. Similarly *P. lucens* increased to the south (30% at Sopley Mill). Spiked water milfoil *Myriophyllum spicatum* was less widely distributed, but generally had a relatively high cover where present.

4.3 Of the bank vegetation, reed sweetgrass *Glyceria maxima* and watercress *Rorippa nasturtium-aquaticum* were recorded from all sites, with a cover averaging 15% and 12% respectively. reed canarygrass *Phalaris arundinacea* occurred at nine sites, with a similar average cover. Other widespread species (7-8 sites) included Fool's watercress *Apium nodiflorum,* lesser pond-sedge *Carex acutiformis,* hard rush *Juncus inflexus,* gypsywort *Lycopus europaeus,* water mint *Mentha aquatica,* water forget-me-not *Myosotis scorpoides,* hemlock water-dropwort *Oenanthe crocata,* reed *Phragmites australis,* marsh woundwort *Stachys palustris,* hybrid water speedwell *Veronica x lackschewitzii.* For these species cover was generally below 5%, with the exception of *P. australis* which reached almost 20% cover where present. A significant proportion of the remaining species (41%) were only recorded from one site and generally had cover values under five.

4.4 The following sections describe the river and vegetation in each of the ten survey sections separately. For full species lists, please refer to Appendices 2 and 3. Comparison is made with the 2011 survey where possible.

4.5 No records of Scarce Chaser dragonfly, the Pea Mussel *Pisidium tenuilineatum*, or the snails *Valvata macrostoma* and Desmoulin's Whorl Snail *Vertigo moulinsiana* were made. Twenty-seven lapwings were recorded over the pasture on the east bank at Hucklebrook and also around 20 observed near the Avon Causeway. Scarce Chaser normally flies in June and July

and so observations were not expected in August. Similarly, lapwing would have finished breeding by this time, so only small, localised flocks were expected.

Hucklebrook

4.6 At Hucklebrook, cover of vegetation in the river was approximately 50% overall. The river was fast-flowing over a shingly bed, the flow slightly impeded where submerged vegetation, mainly unbranched bur-reed *Sparganium emersum*, spiked water milfoil *Myriophyllum spicatum,* and stream water crowfoot *Ranunculus pencillatus* together with arroweed *Sagittaria sagittifolia* formed large patches in the centre of the river, particularly in the section south of the survey point. In the northern section, yellow water-lily *Nuphar lutea* formed patches closer to the east bank in the bend of the river. Bankside vegetation was cattle grazed, and comprised of reed sweetgrass *Glyceria maxima*, reed canarygrass *Phalaris arundinacea* and lesser pond-sedge *Carex acutiformis*, with stands of reed *Phragmites australis* north of the survey point. An area near the outflow of Huckle Brook was poached, and although apparently inundated at times, supported species such as marsh cudweed *Gnaphalium uliginosum,* redshank *Persicaria maculosa,* annual meadow-grass *Poa annuna,* annual pearlwort *Sagina apelata,* self-heal *Prunella vulgaris*, lesser swinecress *Coronopus didymus* and toad rush *Juncus bufonius.*

Water flow	Fast flowing, slowing slightly where submerged vegetation is impeding flow.
Water quality	Clear, over shingly bed, more sandy silt under vegetation
Water depth	1m
Approx. cover of river vegetation	50%
Notes	Deepest near bank where water flow is faster. Some livestock poaching nr. Huckle Brook.
Invasive species	*Elodea nuttallii* recorded as rare with cover <0.1%
Other species	27 lapwings

4.7 Stream water crowfoot *Ranunculus penicillatus* was not recorded in the 2011 survey, with very little recorded in 2000 in what was described as “mixed channel vegetation”.

Figure 1. Hucklebrook downstream of the survey point.

Figure 2. Hucklebrook upstream of the survey point.

Figure 3. Hucklebrook, north of the survey point replicating 2011 photograph (Stevens & Curson 2011, p7).

Ibsley Bridge

4.8 The channel contained thick submerged mats of broad-leaved pondweed *Potamogeton pectinatus*, which with frequent arroweed *Sagittaria sagittifolia* covered an average of just over 50% of the river (up to 80% in places, see Figure 4). The river remained fast-flowing. Other species such as unbranched bur-reed *Sparganium emersum*, shining pondweed *Potamogeton lucens*, *Ranunculus pencilliatus,* spiked water milfoil *Myriophyllum spicatum,* Nuttall's pondweed *Elodea nuttallii* and the willow moss *Fontinalis antipyretica* were rare here. On the bankside, reed sweetgrass *Glyceria maxima* and reed canarygrass *Phalaris arundinacea* were locally dominant in frequent stands, although absent from some stretches notably where the bank was eroding. Many stands were grazed south of the bridge (although the east bank was ungrazed). A number of other relatively robust species were occasional, including Fool's watercress *Apium nodiflorum,* Spear-leaved orache *Atriplex prostrata,* Nodding bur-marigold *Bidens cernua,* greater pond-sedge *Carex riparia* great willowherb *Epilobium hirsutum,* gypsywort *Lycopus europaeus,* watercress *Rorippa nasturtium-aquaticum,* marsh yellow-cress *R. palustris,* unbranched bur-reed *Sparganium emersum,* marsh woundwort *Stachys palustris.* The remaining species which occurred rarely included many weedy, ruderal or tall herb species, which contributed to the species total of 50 bankside species, twice the average of the sample sites.

Water flow	Quite fast
Water quality	Clear, over mainly gravelly substrate
Water depth	1.5m, appeared uniform across width
Approx. cover of river vegetation	50%
Notes	Actively eroding on west bank.
Invasive species	*Elodea nuttallii* recorded as rare with cover <0.1%

4.9 The 2013 survey results seem broadly similar to those of 2011. A greater cover of submerged vegetation was recorded in 2011 but given the difficulty in estimating cover of submerged vegetation, and the fact that the 2013 survey started 100m further downstream, (omitting area around the bridge and sluice), this may not be significant.

Figure 4. Submerged aquatic vegetation downstream of Ibsley Bridge.

Figure 5. Looking downstream from the (new) Ibsley Bridge survey point.

Figure 6. Looking upstream from the (new) Ibsley Bridge survey point.

Figure 7. Looking downstream from Ibsley Bridge (replicating the 2011 photo in Stevens & Curson 2011, p8).

Ringwood Weir

Water flow	Moderate to fast flow.
Water quality	Pellucid (clear)
Water depth	Deep >1m
Approx. cover of river vegetation	50%
Notes	Uniform reach in a wide channel except at upper limit. Shallows to E with shallow rapids.

4.10 Submerged vegetation (approximately 50% cover) was characterised by *Potamegoton pectinalis* and stream water crowfoot *Ranunculus pencillatus*, both of which are locally abundant. Other species included occasional unbranched bur-reed *Sparganium emersum* plus small amounts of willow moss *Fontinalis antipyretica,* branched bur-reed *Sparganium erectum* and *Sagitaria sagittifolia*. The cover was comparable to that recorded in 2011, although appears to include more pondweeds *Potamogeton*. The emergent bankside vegetation comprised dense, thick stands of locally dominant *Phalaris arundinace,* reed *Phragmites australis* and nettle *Urtica dioica* with reed sweetgrass *Glyceria maxima*, great willowherb *Epilobium hirsutum*, hedge bindweed *Calystegia sepium* and *Rorippa aquatic- nasturtium* and backed by grey willow *Salix cinerea.* greater pond-sedge *Carex riparia* was also locally dominant, although with a low overall cover, and a number of typical herbs (e.g. marsh woundwort *Stachys palustris, Pulicaria dysenterica , Scrophularia auriculata,* bittersweet *Solanum dulcamara* etc.) were also occasionally present with low cover. This vegetation was protected by stock fencing from livestock grazing the west bank, and included breaks where the vegetation has been cut back, presumably for access for anglers.

Figure 8. Upstream of Ringwood Weir.

Figure 9. Downstream of Ringwood Weir.

Bickerley Stream

Water flow	Faster running over shallow gravel under bridge , deeper and slower after about 100m
Water quality	Clear
Water depth	Variable, 0.3 over gravel shoals, deepening downstream (>1m)
Approx. cover of river vegetation	Variable, 50% overall
Notes	Shallows under bridge heavily used by horses and children
Invasive species	*Impatiens glandulifera* recorded at SU14973.04541 (E & W banks) and SU14851.04728 (W bank)

4.11 Cover of submerged vegetation was variable at Bickerley Millstream, a branch of the Avon, but was about 50% overall. The channel was surveyed immediately downstream of the old railway bridge, where a number of gravelling shoals appeared to be heavily used by horses and did not support any river vegetation. After about 100m, the river became deeper and slower, and spiked water milfoil *Myriophyllum spicatum* became locally abundant with some arroweed *Sagittaria sagittifolia* and occasional broad-leaved pondweed *Potamogeton pectinatus* and stream water crowfoot *Ranunculus pencillatus*. Flowering rush *Butomus umbellatus,* curled pondweed *Potamogeton crispus* and branched bur-reed *Sparganium erectum* were also recorded.

4.12 A notable feature of the bank vegetation was a large population of hybrid water speedwell *Veronica x lackschewitzii* in the disturbed area near the bridge, together with a number of other species characteristic of disturbed wet ground. Further downstream, the river became lined with stands dominated by reed sweetgrass *Glyceria maxima* and over hung by grey willow *Salix cinerea* and crack willow *Salix fragilis*. Where the river was fenced off

from the horse-grazed pasture, stands of tall herb vegetation with nettle *Urtica dioica* and willowherb *Epilobium hirustum* were present. Three stands of Himalayan balsam *Impatiens glandulifera* were noted, two on the east bank and one on the west.

4.13 The stretch upstream of the bridge was not surveyed, as it was not possible to gain access to the river bank, but was photographed from the bridge. The downstream stretch did not appear to have changed significantly since 2011, although the cover of stream water crowfoot *R. pencillatus* appeared to be much lower in 2013. The adjacent meadow, which was horse grazed at the time of the survey, contained interesting hollows which had clearly been inundated for significant periods of time, and supported flowering rush *Butomus umbellatus.*

Figure 10. Bickerley Stream, downstream from survey point, showing shallow gravel shoal and grazed banksides.

Figure 11. Bickerley Stream, upstream from survey point.

Castlemain Tramway

Water flow	Fast
Water quality	Pellucid (clear)
Water depth	Variable, 0.5-1.5m
Approx. cover of river vegetation	Variable, 60% overall
Notes	A fairly uniform reach, although a little deeper above the bridge.
Invasive species	*Elodea nuttallii*, rare, <0.1% cover Scattered *Impatiens glandulifera* upstream of the bridge (east bank)

4.14 Broad-leaved pondweed *Potamogeton pectinatus* and stream water crowfoot *Ranunculus pencillatus* made up the bulk of the submerged vegetation in the main river channel at Castlemain Tramway, with a combined cover of about 60%. Other species present in small amounts included flowering rush *Butomus umbellatus*, branched bur-reed *Sparganium erectum,* arroweed *Sagittaria sagittifolia,* perfoliate pondweed *Potamogeton perfoliatus,* shining pondweed *Potamogeton lucens, Lemna* species and the invasive species Nuttall's pondweed *Elodea nuttallii*.

4.15 Marginal vegetation comprised continuous tall stands dominated by reed canarygrass *Phalaris arundinacea* and reed *Phragmites australis* backed by reed sweetgrass *Glyceria maxima with* locally abundant nettle *Urtica dioica,* frequent hedge bindweed *Calystegia sepium,* and occasional great willowherb *Epilobium hirsutum.* Smaller herbs present included frequent watercress *Rorippa nasturtium-aquaticum,* bittersweet *Solanum dulcamara,* and occasional hybrid water speedwell *Veronica x lackschewitzii,* marsh woundwort *Stachys palustris,* purple loosestrife *Lythrum salicaria* and a scattering of other typical species. Bankside vegetation was shorter south of the bridge. Himalayan balsam

Impatiens glandulifera was recorded upstream of the bridge.

4.16 Water whorl-grass *Catabrosa aquatica* and reedmace *Typha latifolia,* reported in 2011, were not recorded, but otherwise the submerged and bank vegetation seem little changed. The cover of submerged macrophytes may have been less in 2000, when water crowfoot *Ranunculus* cover was reported to be 20% amongst mixed vegetation.

Figure 12. Looking upstream from Castlemain Tramway bridge

Figure 13. Looking downstream from Castlemain Tramway bridge.

Watton's Ford

Water flow	Fast in shallows
Water quality	Slightly turbid
Water depth	Variable, shallower upstream, deeper below sallow copse downstream where river narrows
Approx. cover of river vegetation	Variable, 10-80%
Notes	Wide, shaded in places by *Salix* spp.
Invasive species	*Elodea nuttallii* (rare, cover<0.1%)

4.17 A good variety of aquatic species formed a variable cover of 10-80% at Watton's Ford. Submerged stream water crowfoot *Ranunculus pencillatus* and broad-leaved pondweed *Potamogeton pectinatus* with perfoliate pondweed *P. perfoliatus* and spiked water milfoil *Myriophyllum spicatum* covered up to 80% of the channel in places. Other species included shining pondweed *P.lucens,* curled pondweed *P. crispus,* willow moss *Fontinalis antipyretica,* amphibious bistort *Persicaria amphibium,* horned pondweed *Zannichellia palustris* and the invasive Nuttall's pondweed *Elodea nuttallii.*

4.18 The adjoining pasture had been grazed, but not recently, and relatively short marginal vegetation included frequent reed sweetgrass *Glyceria maxima,* reed canarygrass *Phalaris arundinacea* plus lesser pond-sedge *Carex acutiformis* together with a good number of herbs including gypsywort *Lycopus europaeus*¸ marsh woundwort *Stachys palustris* , *Scrophularia auriculata,* and less robust species such as Trifid bur-marigold *Bidens tripartita,* purple loosestrife *Lythrum salicaria,* water mint *Mentha aquatica,* water forget-me-not *Myosotis scorpoides,* fleabane *Pulicaria dysenterica and Veronica beccabunga.* A gravelly beach supported additional species such as pineappleweed *Matricaria discoidea,*

curled dock *Rumex crispus,* hairy sedge *Carex hirta,* annual meadow-grass *Poa annua,* Nodding bur- marigold *Bidens cernua,* water speedwell *Veronica anagallis-aquatica* and creeping yellow- cress *Rorippa sylvestris.* A sallow copse occupied the bank towards the downstream end of the reach.

4.19 There was little apparent change in the vegetation since 2011, with similar cover and species of submerged vegetation. Water crowfoot *Ranunculus* spp. cover was reported as 20% in 2000 and 25% in 2013. The photographs taken looking upstream from the survey point suggest a shift in species composition on the bank, with more rush *Juncus* spp. and less nettle *Urtica dioica*, presumed to be related to grazing levels.

Figure 14. Looking upstream from the Watton's Ford survey point.

Figure 15. Looking downstream from the Watton's Ford survey point.

Sabine's Farm

Water flow	Moderate, no obstructions
Water quality	Clear over gravel or silt
Water depth	Variable, 0.5-2m
Approx. cover of river vegetation	80%
Notes	Wide river, shallow gravelly beaches inside meanders, bank poached in places
Other species	Two large populations of *Pulicaria vulgaris* in peaty depressions on cattle grazed meadow fringed with *Carex acuta* SZ14901.99578, SZ14201.99500
Invasive species	*Elodea nuttallii* and *E. Canadensis*, occasional, cover 0.1-5%

4.20 The river at Sabine's Farm supports dense mats of mixed submerged vegetation covering 80% of the channel. These are characterised by abundant broad-leaved pondweed *Potamogeton pectinatus* together with spiked water milfoil *Myriophyllum spicatum,* perfoliate pondweed *P. perfoliatus,* willow pondweed *P. x salicifolius,* and shining pondweed *P.lucens* and a little stream water crowfoot *Ranunculus penicillatus*. Other species present include yellow water-lily *Nuphar lutea,* branched bur-reed *Sparganium emergum*, flowering rush *Butomus umbellatus,* common duckweed *Lemna minor* and the invasive species Nuttall's pondweed *Elodea nuttallii* and Canadian waterweed *Elodea canadensis.*

The banks were cattle-grazed and heavily trampled and poached at the ferry point (see Figure 16). Canada geese were also observed grazing on both sides of the river. The vegetation was intact in other parts, and included a thin, grazed, marginal fringe of reed canarygrass *Phalaris arundinacea,* slender tufted-sedge *Carex acuta, Juncus inflexa,* hairy sedge *Carex hirta, Agrostis stolonifera,* lesser pond-sedge *Carex acutiformis* and sharp-

flowered rush *Juncus acutiflorus*. Frequent herbs included hybrid water speedwell *Veronica x lackschewitzii,* watercress *Rorippa nasturtium aquaticum,* water mint *Mentha aquatic,* water forget-me-not *Myosotis scorpoides*, with a handful of more occasional species plus marsh foxtail *Alopecurus geniculatus*. A highlight of the site was the presence of two large populations of small fleabane *Pulicaria vulgaris* in peaty hollows in the meadow which appear to be maintained through seasonal flooding (other populations may be present – these were observed en route to the survey point).

4.21 The vegetation seems similar to that reported in 2011 and 2000.

Figure 16. Looking downstream from survey point at Sabine's Farm (at the ferry point, slightly downstream of photo in Stevens & Curson, p19.

Figure 17. Looking across the River Avon at the Sabine's farm confluence (replicating the photo in Stevens & Curson, p18).

Figure 18. Looking upstream from the Sabine's Farm survey point (no equivalent photo in Stevens & Curson, 2011).

Avon Causeway

Water flow	Moderate flow where water >1m, more rapid over gravels where shallow
Water quality	Slightly turbid
Water depth	Variable, 0.5-1.5m
Approx. cover of river vegetation	70%
Notes	Marginal vegetation cattle grazed, aquatics apparently grazed by Canada geese south of bridge
Other species	Approx 20 lapwing recorded at northern limit of reach .
Invasive species	*Elodea nuttallii* occasional, cover 0.1-5%, *E. canadensis*

4.22 Mixed submerged vegetation (70% cover) was made up of abundant broad-leaved pondweed *Potamogeton pectinatus,* frequent arroweed *Sagittaria sagittifolia* and unbranched bur-reed *Sparganium emersum* and occasional *P. perfoliatus,* shining pondweed, *P. lucens ,* stream water crowfoot *Ranunculus pencillatus,* and spiked water milfoil *Myriophyllum spicatum.* Common clubrush *Schoenoplectrus lacustris,* curled pondweed *P. cripsus,* water starwort *Callitriche sp., P. x cooperi,* Nuttall's pondweed *Elodea nuttallii* and *E. canadensis* were also recorded. Floating vegetation included yellow water-lily *Nuphar lutea,* common duckweed *Lemna minor* and *L. gibba*. South of the bridge aquatic species were more scarce, possibly due to Canada geese (observed on the adjacent pasture).

4.23 Marginal vegetation was not species-rich, and mainly comprised heavily grazed reed canarygrass *Phalaris arundinacea* with lesser pond-sedge *Carex acutiformis.* Other species present included reed sweetgrass *Glyceria maxima, Sparganum erectum,* hard rush *Juncus inflexus, Agrostis stolonifera* with hybrid water speedwell *Veronica x lackschewitzii,* watercress *Rorippa nasturtium-aquaticum,* Fool's watercress *Apium nodiflorum,* marsh woundwort *Stachys palustris* and *Rumex conglomeratum.* In places the ground was heavily cattle-poached.

4.24 Cover appeared to be greater in 2013 than in 2011, when roughly equal proportions of stream water crowfoot *Ranunculus pencillatus* and broad-leaved pondweed *Potamogeton pectinatus* contributed to 50% overall cover. However the area below the bridge appeared degraded in 2013, possibly due to Canada geese. Cover had increased from 2000, when sparse stream water crowfoot *R. pencillatus* was reported with 10% broad-leaved pondweed *P. pectinatus* cover.

Figure 19. Looking downstream from the Avon Causeway survey point.

Figure 20. Looking upstream from the Avon Causeway survey point.

Sopley Mill

Water flow	Slow
Water quality	Clear
Water depth	1.5-2m
Approx. cover of river vegetation	70%
Notes	Deep rectangular channel, muddy substrate
Invasive species	*Elodea nuttallii* frequent (cover 30%) One small plant of *Impatiens glandulifera* reported

4.25 The reach surveyed at Sopley Mill only extended 100m, as access was constrained by the mill stream downstream, and by a significant ditch and impenetrable wood upstream. Within this stretch cover of submerged vegetation was about 70%, made up of shining pondweed *Potamogeton lucens* and Nuttall's pondweed *Elodea nuttallii* (both 30% cover) and other species included perfoliate pondweed *P. pectinalis, P. x salicifolius,* arroweed *Sagittaria sagittifolia,* flowering rush *Butomus umbellatus* and a little greater duckweed *Spirodela polyrhiza* and water starwort *Callitriche s*p.. Yellow water-lily *Nuphar lutea* was present in a slow flowing, muddy bay, surrounded by common duckweed *Lemna minor*.

4.26 Thick marginal vegetation was dominated by reed sweetgrass *Glyceria maxima* (with one stand of reed *Phragmites australis)*, backed by a trampled, poached and grazed sward. Other species were limited, but included gypsywort *Lycopus europaeus,* water mint *Mentha aquatic,* water forget-me-not *Myosotis scorpoides,* reed canarygrass *Phalaris arundinacea,* reed *Phragmites australis,* and broad-leaved dock *Rumex obtusifolius,* with grey willow *Salix cinerea* where the millstream joined the main channel. Watercress *Rorippa nasturtium- aquaticum* was frequent, forming 40% cover.

4.27 The cover of in-channel vegetation appeared lower than in 2011, when it was recorded as nearly 100%. Nuttall's pondweed *Elodea nuttallii* was not reported by Stevens & Curson (2011).

Figure 21. A small muddy bay just upstream from the Sopley Mill survey point (replicating Stevens & Curson, p23).

Figure 22. Looking up the main channel from the Sopley Mill survey point.

Winkton Common

Water flow	Slow in upper section, sluggish in meander, moderate in lower
Water quality	Clear
Water depth	Variable, up to 2m
Approx. cover of river vegetation	80%
Notes	Some wide sand/gravel submerged beaches in upstream section. Channel deeper on west side and centre, with shallow beaches on east.
Invasive species	*Elodea nuttallii* abundant (cover 40%)

4.28 Total vegetation cover in the river was about 80%. The bulk of this was made up of spiked water milfoil *Myriophyllum spicatum* and Nuttall's pondweed *Elodea nuttallii,* with smaller amounts of broad-leaved pondweed *Potamogeton pectinatus* and perfoliate pondweed *P. perfoliatus.* Emergent arroweed *Sagittaria sagittifolia,* common clubrush *Schoenoplectrus lacustris* and the sweet-grass hybrid *Glyceria x pediculata* were occasionally present in the channel (Figure 23) and the sluggishly flowing meander supported beds of yellow water-lily *Nuphar lutea.* Other species included water-starwort *Callitriche sp.,* flowering rush *Butomus umbellatus,* stream water crowfoot *Ranunculus pencillatus,* small pondweed *P. berchtoldii,* shining pondweed *P. lucens,* and greater duckweed *Spirodela polyrhiza.*

4.29 A thin band of discontinuous marginal vegetation comprised roughly equal proportions of reed sweetgrass *Glyceria maxima* and branched bur-reed *Sparganium erectum. Rorippa nasturtium-aquatica* was also frequent. Tall herb species included *Epilobium hirstum,* nettle *Urtica dioica,* yellow loosestrife *Lysmachia vulgaris,* iris *Iris pseudacorus and* hemlock water- dropwort *Oenanthe crocata.* Smaller herbs included water mint *Mentha aquatic,* water forget-me-not *Myosotis scorpoides,* Fool's watercress *Apium nodiflorum,* amphibious bistort *Persicaria amphibia, P. hydropiper, Potentilla anserine,* lesser spearwort *Ranunculus flammula* and *R. repens.* The low bank was trampled in places.

4.30 The cover of submerged vegetation appears to have increased from about 10% to 50-60% in 2011, and again to 80% in 2013. In 2000 only sparse broad-leaved pondweed *Potamogeton pectinatus* was recorded, but the species present in 2011 and 2013 were similar, with the exception of Nuttall's pondweed *Elodea nuttallii* which was not reported in 2011 but formed 30% of cover in 2013.

Figure 23. Looking downstream from the Winkton Common survey point.

Figure 24. Looking upstream from the Winkton Common survey point.

5. Conclusions

5.1 The 2013 survey suggests that the macrophyte flora of the Lower Avon Valley has remained broadly consistent between 2011 and 2013, and is generally in reasonable condition. In general the species composition of river and bank vegetation was similar. A larger number of species was recorded in 2013, as would be expected of a more detailed survey. However, a key change was the increase in the number of sites supporting the invasive species Nuttall's pondweed *Elodea nuttallii*, and the relatively high cover of this species in 2013, particularly at the southern sites.

5.2 The overall cover of river species in 2013 was also similar to that reported in 2011. Differences in the way cover is described mean that any comparison must be tentative, but macrophyte cover may have increased at Castlemain, Avon Causeway and Winkton, and decreased at Sopley Mill, Bickerley and Ibsley Bridge, while remaining roughly constant at Hucklebrook, Ringwood Weir and Watton's Ford. No change greater than 20% cover seems likely.

5.3 Similarly, it is not possible to make a robust comparison in the cover of *Ranunculus* between 2000, 2011 and 2013, particularly as it is not always specifically referred to in Stevens & Curson (2011). It appears to have remained fairly constant at Hucklebrook, Ibsley Bridge, Avon Causeway, Sopley Mill and Winkton. At Castlemain, Bickerley and Ringwood Weir, the cover of *Ranunculus* appeared to increase significantly (by between 40 and 60%) between 2000 and 2011, then decrease to a similar or slightly lower level to 2000 in 2013. It may have declined by about 30% since 2000 at Sabine's Farm. However, discrepancies in survey methodology may account for some of these changes, which should be interpreted with caution. Only stream water crowfoot *Ranunculus pencillatus* var. *pseudofluitans* was positively identified during the 2013 survey.

5.4 Changes in *Ranunculus* cover cannot necessarily be attributed to changes in the weed cutting regime, as there is likely to be natural variation in the cover of *Ranunculus* between years. The volume of *Ranunculus* increases enormously from spring onwards until it is washed out in winter floods. However, differences in seasonal temperatures (e.g. a cold spring, delaying growth) may result in different survey results, even if the surveys are carried out on the same dates each year.

5.5 No significant flooding was apparent at the time of the survey, although the vegetation in the adjacent pasture at Bickerley Mill Stream was indicative of prolonged flooding in the past.

5.6 Grazing is clearly a factor influencing marginal bankside vegetation. Where grazing is excluding (e.g. by fencing) a tall fen vegetation dominated by coarse grasses and other tall monocotyledons was found, reducing overall diversity. However, on heavily grazed sites this marginal vegetation was greatly reduced or absent. Poached areas where livestock have access to the river were also recorded and, where not severe, supported a suite of characteristic ruderal species. More intensive use (such as at Bickerley Millstream) resulted in patches of un-vegetated substrate.

5.7 The methodology of the 2013 survey was designed to be easily and reliably replicated in future years. This will allow a robust comparison in the changes to the macrophyte flora of the Lower Avon River from 2013 onwards.

References

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Appendix 1

Site: Surveyor:

Date: Weather:

Image no.s:

Species	River		Bank		Map point
	Abundance	Cover	Abundance	Cover	

Sketch map
Water flow:
Water quality:
Notes:

Appendix 2

Table 3. Abundance (A) and cover (C) of bankside macrophytes recorded within the Lower Avon survey (D – dominant, A – abundant, F – frequent, O – occasional, R – rare, L – locally).

English name	Species	Hucklebrook		Ibbsley Bridge		Ringwood Weir		Castlemain		Bickerley Stream		Watton's Ford		Sabine's Farm		Avon Causeway		Sopley Mill		Winkton	
		A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C
Common water-plantain	*Alisma plantago- aquatica*	O	0.1-5	R	<0.1									R	0.1-5					R	0.1-5
Alder	*Alnus glutinosus*	O	0.1-5																		
Marsh foxtail	*Alopecurus geniculatus*			R	<0.1							R	<0.1	R	0.1-5						
Fool's watercress	*Apium nodiflorum*	O	0.1-5	O	0.1-5			R	0.1-5	O	0.1-5	O	0.1-5			O	0.1-5	R	<0.1	O	0.1-5
Spear-leaved orache	*Atriplex prostrata*	O	0.1-5	O	0.1-5			R	<0.1	O	0.1-5										
wintercress	*Barbarea vulgaris*			O	0.1-5																
Nodding bur-marigold	*Bidens cernua*			O	<0.1					O	0.1-5							R	<0.1	O	0.1-5
Trifid bur-marigold	*Bidens tripartita*	O	0.1-5							O	0.1-5	R	<0.1	R	0.1-5						
Flowering rush	*Butomus umbellatus*									R	<0.1	O	0.1-5								
Hedge bindweed	*Calystegia sepium*			O	0.1-5	LF	0.1-5	F	0.1-5			O	<0.1								
Cuckoo flower	*Cardamine pratensis*											R	<0.1								
Slender tufted-sedge	*Carex acuta*													O	5						
Lesser pond-sedge	*Carex acutiformis*	O	0.1-5							R	<0.1	F	15	LA	10	F	20	O	0.1-5	O	6
Hairy sedge	*Carex hirta*			R	<0.1	R	<0.1			O	0.1-5			O	0.1-5					O	<0.1
False fox-sedge	*Carex otrubae*	R	<0.1																		
Greater pond-sedge	*Carex riparia*	O	0.1-5	O	0.1-5	LD	>5														

English name	Species	Hucklebrook		Ibbsley Bridge		Ringwood Weir		Castlemain		Bickerley Stream		Watton's Ford		Sabine's Farm		Avon Causeway		Sopley Mill		Winkton	
		A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C
Creeping thistle	*Cirsium arvense*			R	<0.1																
Cock's foot	*Dactylis glomerata*			R	<0.1																
Common spike-rush	*Eleocharis palustris*											R	<0.1								
Great willowherb	*Epilobium hirsutum*	O	0.1-5	O	0.1-5	F	0.1-5	O	0.1-5	O	0.1-5									O	0.1-5
Field horsetail	*Equisetum arvensis*									O	0.1-5										
Marsh horsetail	*Equisetum palustre*	R	<0.1																	R	
Hemp agrimony	*Eupatorium cannabinum*	O	0.1-5	R	<0.1																
Tall fescue	*Festuca arundinacea*													O	0.1-5						
Floating sweetgrass	*Glyceria fluitans*											O	0.1-5								
Reed sweetgrass	*Glyceria maxima*	F	50	F	20	LF	>5	LD	>5	F	10	F	10	O	0.1-5	O	0.1-5	D	20	F	20
Sweetgrass hybrid	*Glyceria x pedicellata*																			O	<0.1
Marsh cudweed	*Gnaphalium uliginosus*									O	0.1-5										
Square-stalked St. John's wort	*Hypericum tetrapterum*			R	<0.1																
Himalayan balsam	*Impatiens glandulifera*					R	<0.1	O	0.1-5									R	<0.1		
Iris	*Iris pseudacorus*	O	0.1-5																	R	0.1-5
Sharp-flowered rush	*Juncus acutifloris*													O	0.1-5						
Toad rush	*Juncus bufonius*											O	0.1-5	R	0.1-5						
Soft rush	*Juncus effusus*	R	0.1-5																	O	<0.1
Hard rush	*Juncus inflexus*	O	<0.1	R	<0.1					O	0.1-5	O	0.1-5	O	0.1-5	O	0.1-5			R	0.1-5

English name	Species	Hucklebrook		Ibbsley Bridge		Ringwood Weir		Castlemain		Bickerley Stream		Watton's Ford		Sabine's Farm		Avon Causeway		Sopley Mill		Winkton	
		A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C
Gypsywort	*Lycopus europaeus*	O	0.1-5	O	0.1-5	R	<0.1					O	<0.1	O	5			O	0.1-5	O	0.1-5
Yellow loosestrife	*Lysmachia vulgaris*																			R	0.1-5
Purple loosestrife	*Lythrum salicaria*	O	0.1-5	R	<0.1	LF	0.1-5	O	0.1-5			O	0.1-5								
Pineappleweed	*Matricaria discoidea*	R	<0.1	R	<0.1																
Ribbed melilot	*Melilotus officinalis*			R	<0.1																
water mint	*Mentha aquatica*	O	0.1-5	R	<0.1					O	0.1-5	O	<0.1	F	10			O	0.1-5	O	0.1-5
Water forget-me-not	*Myosotis scorpoides*	O	0.1-5	R	<0.1					O	0.1-5	O	0.1-5	F	15	O	0.1-5	R	<0.1	O	0.1-5
Water chickweed	*Myosoton aquaticum*	O	0.1-5	R	<0.1					O	0.1-5										
Hemlock water-dropwort	*Oenanthe crocata*	O	<0.1	R	<0.1	O	<0.1			O	0.1-5	O	0.1-5	O	0.1-5					O	0.1-5
Amphibious bistort	*Persicaria amphibia*	O	0.1-5	F	0.1-5			O	0.1-5	O	0.1-5			O	8					O	0.1-5
Water pepper	*Persicaria hydropiper*	O	0.1-5	O	0.1-5			O	0.1-5	O	0.1-5			R	0.1-5					O	0.1-5
Redshank	*Persicaria maculosa*					O	<0.1			O	0.1-5										
Reed canarygrass	*Phalaris arundinacea*	O	0.1-5	LD	40	LD	>5	LD	>5	O	0.1-5	F	25	LD	40			O	0.1-5	O	0.1-5
Reed	*Phragmites australis*	LA	20			LD	>5	LD	>5			O	0.1-5			A	90	R	0.1-5	O	0.1-5
Greater plantain	*Plantago major*			R	<0.1																
Common knotgrass	*Polygonum aviculare*									O	0.1-5										
Silverweed	*Potentilla anserina*									O	0.1-5			O	0.1-5					O	0.1-5
Fleabane	*Pulicaria dysenterica*	O	0.1-5	O	<0.1	R	<0.1					O	0.1-5	O	5						
Lesser spearwort	*Ranunculus flammula*																			R	0.1-5
Creeping buttercup	*Ranunculus repens*			R	<0.1							R	<0.1							R	0.1-5
Celery-leaved buttercup	*Ranunculus sceleratus*	R	0.1-5	R	<0.1					O	0.1-5										

English name	Species	Hucklebrook		Ibbsley Bridge		Ringwood Weir		Castlemain		Bickerley Stream		Watton's Ford		Sabine's Farm		Avon Causeway		Sopley Mill		Winkton	
		A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C
Water cress	*Rorippa nasturtium aquaticum*	O	0.1-5	O	0.1-5	LA	0.1-5	F	>5	O	5	O	<0.1	F	20	O	0.1-5	F	40	A	30
Marsh yellow-cress	*Rorippa palustris*	O	0.1-5	O	<0.1							O	<0.1								
Creeping yellow-cress	*Rorippa sylvestris*	O	0.1-5	R	<0.1															O	0.1-5
Clustered dock	*Rumex conglomeratus*	O	0.1-5	R	<0.1											O	<0.1			R	0.1-5
Curled dock	*Rumex crispus*			R	<0.1					R	<0.1									R	0.1-5
Broad-leaved dock	*Rumex obtusifolius*	O	0.1-5	R	<0.1									O	5			R	0.1-5	R	0.1-5
Grey willow	*Salix cinerea*	O	0.1-5	R	0.1-5	R	0.1-5	R	<0.1			LA	20					O	10		
Crack willow	*Salix fragilis*							R	<0.1												
Water figwort	*Scophularia auriculata*			R	<0.1	R	<0.1			R	<0.1	O	<0.1	R	0.1-5					R	0.1-5
Marsh ragwort	*Senecio aquaticus*	O	0.1-5																		
Groundsel	*Senecio vulgaris*			R	<0.1																
Bittersweet	*Solanum dulcamara*	O	0.1-5	R	<0.1	F	0.1-5	F	>5	O	0.1-5										
Prickly sow-thistle	*Sonchus asper*			R	<0.1									R	0.1-5						
Unbranched bur-reed	*Sparganium emersum*	LA	10	O	0.1-5																
Branched bur-reed	*Sparganium erectum*			R	<0.1	O	0.1-5									R	0.1			F	20
Marsh woundwort	*Stachys palustris*	O	0.1-5	O	0.1-5	F	0.1-5	O	0.1-5			O	0.1-5	R	0.1-5	O	<0.1				
Bog stitchwort	*Stellaria alsine*									R	<0.1										
Comfrey	*Symphytum officinale*			R	<0.1	O	<0.1			O	0.1-5	O	0.1-5								

English name	Species	Hucklebrook		Ibbsley Bridge		Ringwood Weir		Castlemain		Bickerley Stream		Watton's Ford		Sabine's Farm		Avon Causeway		Sopley Mill		Winkton	
		A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C
Common Meadow-rue	*Thalictricum flavum*			R	<0.1																
Reedmace	*Typha latifolia*																			R	<0.1
Nettle	*Urtica dioica*			R	<0.1	LD	0.5	LA	>5	O	0.1-5							R	<0.1		
Broooklime	*Veronica becca- bunga*	O	0.1-5	R	<0.1					O	0.1-5	R	<0.1	O	0.1-5					O	0.1-5
Hybrid water speedwell	*Veronica x lackschewitzii*	O	0.1-5	O	<0.1			O	0.1-5	LA	25	O	<0.1	F	20	O	0.1-5				

Appendix 3

Table 4. Abundance (A) and cover (C) of river macrophytes recorded within the Lower Avon survey (D – dominant, A – abundance, F – frequent, O – occasional, R – rare, L – locally).

English name	Species	Hucklebrook		Ibbsley		Ringwood Weir		Bickerley Stream		Castlemain		Watton's Ford		Sabine's Farm		Avon Causeway		Sopley Mill		Winkton	
		A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C
Flowering rush	*Butomus umbellatus*	R	<0.1	R	<0.1			R	<0.1	O	<0.1	O	<0.1	O	10			O	3	O	0.1-5
Water starwort	*Callitriche sp.*	O	<0.1	R	<0.1									O	0.1-5	R	<0.1	R	<0.1	R	0.1-5
Canadian waterweed	*Elodea canadensis*	R	<0.1											O	0.1-5	R	<0.1				
Nuttall's pondweed	*Elodea nuttallii*	R	<0.1	R	<0.1					R	<0.1	O	0.1-5	O	0.1-5	O	0.1-5	F	30	A	40
Willow moss	*Fontinalis antipyretica*			R	<0.1	O	<0.1					O	<0.1								
Sweet- grass hybrid	*Glyceria x pedicellata*																			O	10
Common duckweed	*Lemna minor*	O	<0.1	O	<0.1	R	<0.1			R	<0.1	R	<0.1	O	0.1-5	O	0.1-5	O	5	O	0.1-5
Fat duckweed	*Lemna gibba*									R	<0.1	R	<0.1			R	<0.1			O	0.1-5
Ivy-leafed duckweed	*Lemna trisulca*																			R	0.1-5
Spiked water milfoil	*Myriophyllum spicatum*	LD	30	R	<0.1			LA	10			LA	10	F	15	O	0.1-5			A	40
Yellow water-lily	*Nuphar lutea*	LA	0.1 - 5													O	0.1-5	O	8	F	10
Amphibious bistort	*Persicaria amphibium*											O	<0.1								
Small pondweed	*Potamogeton berchtoldii*																			O	6
Pondweed hybrid	*Potamogeton x cooperi*															R	<0.1				
Curled pondweed	*Potamogeton crispus*	R	<0.1					R	<0.1			O	5			R	<0.1				
Shining pondweed	*Potamogeton lucens*	R	<0.1	R	<0.1					R	<0.1	O	0.1-5	O	4	O	10	F	30	R	0.1-5
Perfoliate pondweed	*Potamogeton perfoliatus*	O	0.1 - 5							R	<0.1	O	10	O	0.1-5	O	10			O	8

English name	Species	Hucklebrook		Ibbsley		Ringwood Weir		Bickerley Stream		Castlemain		Watton's Ford		Sabine's Farm		Avon Causeway		Sopley Mill		Winkton	
		A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C
Broad-leaved pondweed	*Potamogeton pectinatus*			LD	40	LA	30	O	0.1 -5	LA	30	LA	25	A	30	A	50	O	5	F	10
Willow-leaved pondweed	*Potamogeton x salicifolius*													O	0.1-5			O	5		
Stream water crowfoot	*Ranunculus pencillatus*	O	5	R	0.1-5	LA	0.1-5	O	5	LA	20	LA	25	O	0.1-5	O	10			O	0.1-5
Arroweed	*Sagittaria sagittifolia*	F	15	F	10	R	<0.1	O-A	10	F	>5			R	<0.1	F	20	O	5	F	10
Common club-rush	*Schoenoplectrus lacustris*															O	0.1-5				
Branched bur-reed	*Sparganium erectum*	LA	10			R	<0.1	R	<0.1	F	>5										
Unbranched bur-reed	*Sparganium emersum*			O	0.1-5	O	5					O	0.1-5	F	10	F	5			O	0.1-5
Greater duckweed	*Spirodela polyrhiza*																	R	0.1-5	O	0.1-5
Horned pondweed	*Zannichellia palustris*											O	0.1-5			R	<0.1				