Eastleigh Local Plan:
Note on Habitats Regulations Assessment of Air Quality Effects on Southern damselfly within the River Itchen SAC

Background

In 2016, Eastleigh Borough Council commissioned AECOM[1] to undertake air quality impact assessment of two development scenarios and their potential impact on internationally important wildlife sites (specifically Solent & Southampton Water SPA/Ramsar site, Solent Maritime SAC and River Itchen SAC) and, as a separate exercise, Moorgreen Meadows SSSI. The AECOM Report considered a series of nine road links within 200m of either the Solent European sites, River Itchen SAC or Moorgreen Meadows SSSI. Five of these were associated with the River Itchen SAC.

For each of these roads, transport modellers working to Eastleigh Borough Council calculated three scenarios[2]:

- DM1 = Forecast Baseline (i.e. traffic flows expected by 2036, without the new sites being proposed for allocation in the revised Local Plan)
- DM2 = Forecast Baseline + New Sites (i.e. same as scenario DM2 but with the new sites proposed for allocation in the revised Local Plan)
- DS2a = Forecast Baseline + New Sites + All Mitigation (i.e. same as DM2 but with various identified transport schemes included)

Using these Scenarios, and information on average vehicle speeds and percentage heavy duty vehicles, AECOM calculated expected NOx concentrations, nitrogen deposition rates and acid deposition rates for all nine road links.

This note is based solely on the results the transport modelling undertaken for the Eastleigh Strategic Transport Study (2016) and consequent pollution modelling undertaken by AECOM and does not take into account any more recent traffic modelling. Although the distribution of development and transport infrastructure additions was not the same as currently proposed, the 2016 modelling did include a mix of major development options in the northern half of the Borough as a whole. This note therefore gives an indication of the implications of major growth in the Borough in general, but further work is required to relate this to the specific effects of the current recommended Local Plan.

The method used in the AECOM Report states;

> Environment Agency guidance[3], to which Natural England also subscribe, advises that where the concentration within the emission footprint [i.e. the Process Contribution, the contribution of the scheme in question] in any part of the European site(s) is less than 1% of the relevant long-term benchmark (critical level or critical load), the emission is not likely to have a significant effect alone or in combination irrespective of the background levels. When the PC does exceed 1% of the critical level/load but the Predicted Environmental Concentration (the sum of the PC and the background concentrations) falls at or below 70% of the critical level/load then it is still possible to conclude without further analysis that no likely significant effect will result. Where the PC exceeds 1% of the critical level/load and the PEC exceeds 70% of the critical level/load this does not necessarily mean that an adverse effect will occur, but does mean further consideration of any potential effect is required.

This paragraph usefully introduces the concepts of Process Contribution (PC), Predicted Environmental Concentration (PEC) and the 1% and 70% critical level/load exceedance thresholds. The method goes on to

[1] AECOM (2016) Eastleigh Borough Local Plan, Air Quality Analysis to Support Habitat Regulations Assessment Process, May 2016, Report to Eastleigh Borough Council

[2] Eastleigh Strategic Transport Study (2016).

[3] Environment Agency. 2007. Appendix ASC 1 Environment Agency Stage 1 and 2 Assessment of New PIR Permissions under the Habitats Regulations

describe the two measures of relevance regarding air quality impacts from vehicle exhausts; the concentration of oxides of nitrogen (NOx). It can be assumed that these thresholds have been set by Environment Agency and Natural England taking the precautionary approach required to conclude no likely significant effect.

There are two measures of relevance regarding air quality impacts from vehicle exhausts. The first is the atmospheric concentration of oxides of nitrogen (known as NOx) in the atmosphere, the second, the rate of resulting nitrogen deposition expressed in terms of the weight of nitrogen deposited per hectare per year.

The guideline atmospheric concentration advocated by Government for the protection of vegetation is 30 micrograms per cubic metre (μgm^{-3}), known as the Critical Level. This is driven primarily by the role of NOx in nitrogen deposition. The rate of nitrogen deposition below which there is confidence that effects will not arise are different for each habitat. The rate for each broad habitat type as well as a selected number of species (known as the Critical Load) is provided on the APIS website.

Therefore if NOx concentrations are less than 0.3 μgm^{-3} (i.e. 1% of the generic critical level for vegetation of 30 μgm^{-3}) then impacts can be screened out as there would be no likely significant effect on the vegetation. Similarly, if nitrogen deposition rates are below 0.10 $kgNha^{-1}yr^{-1}$ (1% of the lowest point in the critical load range) for Fen, Marsh and Swamp (see Box 2) there would also be no likely significant effect on this broad habitat type.

The AECOM report's assessment of the impact of air quality on the River Itchen SAC is reproduced below in Box 1. It concludes that there would be an exceedance of the 1% critical load for NOx up to 50m from the roadside at Highbridge Farm. When considered in combination with background concentrations and expected traffic growth, this exceedance would also result in an increase in nitrogen deposition equivalent to more than 1% of the Critical Load. However, when taking habitat information into account, the report concludes that there are no habitats or features of importance to the Southern damselfly within 50m of the road and hence "Given the absence of sensitive SAC habitats the increase in nitrogen deposition rate would not result in a likely significant effect on the SAC."

Box 1: Extract from AECOM Report (May 2016)

Under Scenario DM2, there is a single road link (the B3335 at grid reference 446127, 121087[4]) at which the PC will exceed 1% of the critical level for NOx. This occurs adjacent to the road and is not accompanied by a similar increase in nitrogen deposition rate. Moreover, the total expected NOx concentration (i.e. the PC combined with expected traffic growth from other sources, adjusted for expected improvements over time to background air quality) is expected to be below the Critical Level of 30 μgm^{-3}.

At this same link, the PC for DS2a is predicted to exceed 1% of the critical load for NOx over a greater distance (up to 50m from the roadside). Adjacent to the road the increase is sufficiently great to cause a breach of the Critical Level when considered in combination with background concentrations and other expected traffic growth. Therefore the exceedance at this point also results in an increase in nitrogen deposition equivalent to more than 1% of the Critical Load. Potential effects cannot therefore be dismissed purely on numerical criteria for Scenario DS2a.

However, scrutiny of aerial photography and mapping for the relevant area of SAC does not identify any habitats for which the SAC was designated, or habitat that appears to be likely to support Southern damselfly. The habitat within this zone is either open water with relatively little emergent vegetation or dry grassland (it is part of management unit 87 of the underlying SSSI and is described in the Natural England condition assessment as lowland neutral grassland). From a review of the condition assessment, inappropriate management appears to have a much greater effect on habitat structure and quality than input of nitrogen from atmosphere. Given the absence of sensitive SAC habitats the increase in nitrogen deposition rate would not result in a likely significant effect on the SAC.

Without an accompanying exceedance of nitrogen deposition rate a NOx exceedance is unlikely to result in a significant adverse effect on vascular plants based on current evidence unless NOx reaches very high concentrations[5]. Even when the PC of the project is considered cumulatively in combination with expected background traffic growth from other sources (i.e. combined with DM1) the total NOx concentration under Scenario DS2a would remain well below 100 μgm^{-3}. There is also no reason to believe NOx in atmosphere would have a directly toxic effect on Southern damselfly since the known effect of nitrogen dioxide poisoning is through effects on the lungs and associated mucus membranes, which are absent in insects. Given this and the absence of sensitive SAC habitats (or Southern damselfly habitat) from this area, it is considered that the elevated NOx would not result in a likely significant effect on the SAC, even when considered in combination.

There are three other links where DS2 will result in a PC exceeding 1% of the critical level for NOx immediately adjacent to the road: the B3335 at Highbridge Farm (national grid reference 446751, 121408) and the A27 as it crosses the River Itchen and also lies within 200m of the M27 (grid references 445216, 115577 and 445168, 115588). However, the exceedance of NOx is also not accompanied by a similar increase in nitrogen deposition. In addition, scrutiny of aerial photography and the Natural England condition assessment for the underlying SSSI management unit at Highbridge Farm (Unit 87) indicates that the affected parcel of land is lowland neutral grassland and largely dry[6]. As such, it does not appear to present suitable habitat for southern damselfly. Equally, the habitat immediately adjacent to the A27 (within management unit 108 of the underlying SSSI) does not appear to be suitable for southern damselfly. The same arguments in paragraph 4.2.4 therefore apply to these links. Both exceedances are removed under Scenario DS2a, indicating that the transport measures included in this Scenario result in a decrease in NOx emissions on these links (in contrast to the B3335 at 446127, 121087).

Additionally, while empirical studies have identified that nitrogen deposition rates above the critical load for fenland can result in adverse effects on this habitat through excessive growth of coarse competitive species,

[4] This point where the B3335 crosses the Itchen Navigation to the west of Highbridge Farm.

[5] A NOx exceedance, without an accompanying exceedance of nitrogen deposition rate, is unlikely to result in a significant adverse effect on vascular plants based on current evidence unless NOx reaches very high concentrations. WHO Regional Office for Europe, Copenhagen, Denmark, 2000. Air Quality Guidelines – Second Edition. Chapter 11, Figure 2, indicates that exposure to annual average concentrations below 100 μgm^{-3} are unlikely to cause direct biochemical or physiological effects based on the available studies.

[6] Habitat mapping on MAGIC identifies the parcel as reedbed, but this is not supported by either aerial photography or the Natural England condition assessment

this does not mean that deposition above the critical load will result in adverse effects in every given situation. Other factors must be taken into account, such as management regime and the relevant limiting nutrient.

'Poor fens' (i.e. acidic fens) are strongly nitrogen limited. In other words, nitrogen availability is the factor which ultimately controls vegetation response to other nutrients and a small change in nitrogen inputs can result in a major change in the vegetation composition. In contrast, other types of fen with a relatively alkaline pH (called 'rich' fens) such as those along the River Itchen are phosphorus-limited meaning that phosphorus availability is the factor which ultimately controls vegetation response to other nutrients. In a phosphorus limited system, high nitrogen availability may not result in a deleterious effect on vegetation provided that phosphorus availability is controlled[7]. That is not to say that nitrogen inputs would therefore be irrelevant, but it does mean that a proportionate response must be made to the risk posed by small additional nitrogen inputs. The River Itchen system is already nitrogen-rich primarily due to effluent discharge from Chickenhall WwTW and other WwTWs upstream. Nitrogen always will be present in excess in the River Itchen system, primarily due to fluvial sources.

The system is believed to be sufficiently phosphorus-limited that the Environment Agency Review of Consents for the River Itchen SAC, scopes out nitrogen loading early in the process. The likely ecological consequences of further exceedence of the fenland critical load for nitrogen deposition from atmospheric sources due to development in Eastleigh must therefore be set against the background of:

- phosphorus remaining the key limiting nutrient in the system; and
- nitrogen being already in excess and dominated by fluvial/WwTW/agricultural rather than atmospheric inputs.

Within this context, it is considered that the focus on nutrients in the River Itchen should be on phosphorus inputs (on the basis that keeping phosphorous levels low will prevent the habitat from responding as much to the nitrogen in the system) and that if nitrogen reduction in the River Itchen is considered necessary the greatest reductions are likely to be derived from reducing inputs from sewage treatment works and agriculture.

Critical Load/Level:

Habitat/ Ecosystem Type	Eunis Code	Critical Load/ Level	Status	Reliability	Indication of exceedance	Reference
Valley mires, poor fens and transition mires	D2	10-15 kg N ha^{-1} $year^{-1}$	UNECE 2010 - Noordwijkerhout workshop	quite reliable	Increase sedges and vascular plants, negative effects on bryophytes.	472
Rich fens	D4.1	15-30 kg N ha^{-1} $year^{-1}$	UNECE 2010 - Noordwijkerhout workshop	expert judgement	Increase in tall graminoids, decrease in bryophytes.	472

Box 2: Critical loads for N deposition in Fen, Marsh and Swamp

[7] *'In a nutrient limited system, excess of the non-limiting nutrient may not result in any signs of enrichment in the vegetation as the plants are unable to make use of one nutrient without sufficient amounts of the other'*. Source: Understanding Fen Nutrients http://www.snh.gov.uk/docs/A416930.pdf

Review of the AECOM Report assessment

The AECOM Report presents a well argued and reasoned case for concluding that predicted levels of atmospheric nitrogen (NOx) and resultant nitrogen deposition will have no likely significant effect on Southern damselfly within the River Itchen SAC. However, further information is now available that requires this assessment to be reviewed.

Southern damselfly survey data

The comprehensive surveys that have been undertaken by Ben Rushbrook for Arcadia Ecology have demonstrated the presence of water courses with Southern damselfly within the 50m buffer from the road identified by the AECOM report. A map over-laying the location of the Southern damselfly survey transects within the 50m buffer around the road at Highbridge is shown in Figure 1. This shows that water courses from which Southern damselfly have been recorded occur within the 50m buffer in which NOx concentrations are predicted to exceed the 1% threshold. These affects are predicted for the western end of survey transect 2c and the northern end of transects 1 and 4. All three of these are within the River Itchen SAC.

Nitrogen deposition is however not predicted to exceed the identified threshold level of 0.1 kgN/ha/yr beyond 1m from the road edge. In the zone 1-50m the increase is only predicted to be 0.05 kgN/ha/yr. This is half the threshold level using 1% of the lowest bound of 10-15 kg N/ha/yr Critical Load and less than half of the Critical Load for Rich Fen habitat of 15-30 kg N/ha/yr.

Improved habitat data

The description of the habitats present within SSSI unit 87 provided in the AECOM Report is not accurate and fails to take account of water courses along transect 2 (a-c) and areas of fen vegetation flanking the main river channel and carrier in transects 1 and 4.

The vegetation of the Itchen Valley flood plain was surveyed in detail during 2002 by Richard Collingridge as part of the Itchen Sustainability Study[8]. This remains the most comprehensive survey of vegetation within the Itchen flood plain and although quite old is still considered to be reliable. The field adjoining the road at Highbridge Farm supports agriculturally improved grassland that is outside of the SAC boundary. However, at the western end of transect 2c there is a more diverse grassland within the SAC boundary described by the National Vegetation Classification[9] (NVC) as MG6 *Lolium perenne-Cynosorus cristatus*/MG11 *Agrostis stolonifera* grassland. These are typically grasslands that have been treated with artificial fertiliser or herbicide and are often termed 'semi-improved' grasslands. The northern end of transects 1 and 4 supports a more diverse fen vegetation with NVC communities M27 *Filipendula ulmaria-Angelica sylvestris* mire/S26 *Phragmites australis-Urtica dioica* fen. These are both Rich Fen vegetation types in the context of the APIS habitat classification (Box 2).

The distribution of vegetation types in the vicinity of Highbridge Farm is shown in Figure 2.

Of greater importance is the aquatic and marginal swamp vegetation along the water courses in which Southern damselflies have been recorded. Good habitat is described by Ben Rushbrook in the Southern damselfly survey report as comprising the following;

- Shallow, well oxygenated, base-rich water;
- A constant (perennial) slow to moderate flow of water;
- Channel substrate consisting primarily of silt and detritus;
- Presence of a broad fringe of herbaceous emergent dicotyledon plants along margins;
- Presence of some areas of open water; and
- Largely (but not necessarily completely) unshaded by bankside shrubs and trees.

[8] Collingridge, R. (2002). *River Itchen wet grassland NVC survey. November 2002*. Report to the River Itchen Steering Group

[9] Rodwell, J.S. ed. (1995). *British Plan Communities, Volume 4. Aquatic communities, swamps and tall-herb fens.* CUP.

The fringe of herbaceous emergent dicotyledon plants is particularly important for egg laying and is likely to be the most vulnerable element of this habitat to nutrient enrichment and nitrogen deposition. This vegetation is classified by the NVC as S23 Other Water Margin Vegetation. The NVC describes this vegetation as being characteristically heterogenous, but the most frequent species are Fool's water-cress *Apium nodiflorum*, Water-cress *Rorippa nasturtium-aquaticum* and Brooklime *Veronica beccabunga*. The NVC states; "The vegetation is most typical of unshaded margins of mesotrophic to eutrophic waters where there is some accumulation of medium to fine textured mineral sediments." In other words, this is a vegetation type that is associated with habitats with some degree of nutrient enrichment. This community of emergent swamp vegetation is therefore considered a component of the Rich Fen broad habitat type (Box 2).

Conclusion

Although new information on the distribution of Southern damselfly and its habitat has been identified at Highbridge, this does not significantly alter the conclusions of the AECOM Report for the effect of model DS2a[10] on Southern damselfly. Based on the results of the 2016 traffic and pollution modelling undertaken by AECOM, it can be concluded that;

1. Atmospheric nitrogen concentrations may exceed the 1% threshold of 0.3 μgm^{-3} for up to 50m from the edge of the road at Highbridge with a predicted change of 1.1 μgm^{-3} at 50m.
2. Increased atmospheric NOx concentrations do not translate directly to levels of nitrogen deposition over the 50m zone. Predicted change in nitrogen deposition only exceeds the 0.1 kg/ha/yr threshold within 1m of the road edge (0.38 kg/ha/yr). In the 1-50m zone the change in nitrogen deposition drops to 0.05 kg/ha/yr.
3. The fen vegetation within the flood plain of the River Itchen including the marginal swamp vegetation that is of critical importance for egg laying Southern damselfly can all be classed as Rich Fen. This vegetation type is less vulnerable to nitrogen enrichment than other fen vegetation types (Box 2).
4. It is widely considered that nitrogen is in excess in the River Itchen and its associated flood plain water courses with plant growth being limited by phosphate concentrations. As the AECOM Report states;

   "The system is believed to be sufficiently phosphorus-limited that the Environment Agency Review of Consents for the River Itchen SAC, scopes out nitrogen loading early in the process. The likely ecological consequences of further exceedence of the fenland critical load for nitrogen deposition from atmospheric sources due to development in Eastleigh must therefore be set against the background of:

   - phosphorus remaining the key limiting nutrient in the system; and
   - nitrogen being already in excess and dominated by fluvial/WwTW/agricultural rather than atmospheric inputs."
5. In the absence of further evidence of nitrogen deposition linked to increased atmospheric NOx concentrations associated with the road it is difficult to reach a conclusion that differs from that provided in the AECOM Report, that is there is no likely significant effect of the DS2a model. However, changes to the road alignment through Highbridge that brings the road closer to the SAC and water courses supporting Southern damselflies and changes in traffic and pollution modelling may alter this conclusion.

[10] DS2a = Forecast Baseline + New Sites + All Mitigation (i.e. same as DM2 but with various identified transport schemes included)

Mitigation measures

Should changes to the model and consequent levels of nitrogen deposition change, it may be that a precautionary approach to the Habitats Regulations Assessment will conclude that mitigation is required to avoid predicted impacts of increased nutrient load on the habitat of the Southern damselfly.

Mitigation measures will be required that prevent or avoid damage to the SAC and address the identified nutrient enrichment impact pathway on marginal swamp (rich fen) vegetation. This might be achieved through implementation of habitat enhancement proposals for water courses at Highbridge Farm that are within the potential zone of pollution as described in the Strategic Conservation Plan (2017)[11].

Transect 1: Proposals for the water course along this transect involve the removal of scrub and other encroaching vegetation from the channel banks and the implementation of a programme of rotational ditch clearance (removal of encroaching monocotyledon vegetation – mostly grasses and sedges). The removal of plant biomass from the banks and margins of the channel as scrub and other encroaching vegetation will result in the removal of plant nutrients including nitrogen. Hence, scrub and rotational ditch clearance not only increases the suitability of the habitat by increasing light levels and improving the quality of the marginal vegetation, it also has a direct effect in removing nutrients from the habitat that might have accumulated from atmospheric nitrogen deposition.

Transect 2: The Strategic Conservation Plan proposes further scrub removal from the banks of the watercourse along transect 2. This would have a similar effect in removing plant nutrients in particular nitrogen from the channel and improving the habitat quality for Southern damselfly.

Other measures: Farm yards and their associated tracks used for the movement and livestock and farm machinery can be a significant source of plant nutrients, in particular nitrogen and phosphate. The impact of nitrogen on the environment in the vicinity of Highbridge Farm might be reduced through a thorough review of surface water drainage from the farm buildings, hard-standings, tracks and soak-aways. Measures may then be identified to ensure nutrient enriched water is prevented from entering the local environment, in particular the drainage channels along transect 1 and 2 that encircle the farm. Treatment might include the creation of one or more root zone plots (artificial reed beds).

Airborne pollution may also be intercepted between the road and the SAC boundary with the provision of suitable tree and shrub planting. A belt of tree planting along the road edge within the improved grass field on Highbridge Farm could act as a significant interceptor of airborne pollution.

Jonathan Cox
27th November 2017

[11] Rushbrook, B. (2017) *Strategic Conservation Plan for Southern Damselfly* Coenagrion mercuriale*; Habitat Enhancement and Creation Opportunities in and adjacent to Eastleigh Borough.* Report by Arcadia Ecology to Eastleigh Borough Council.

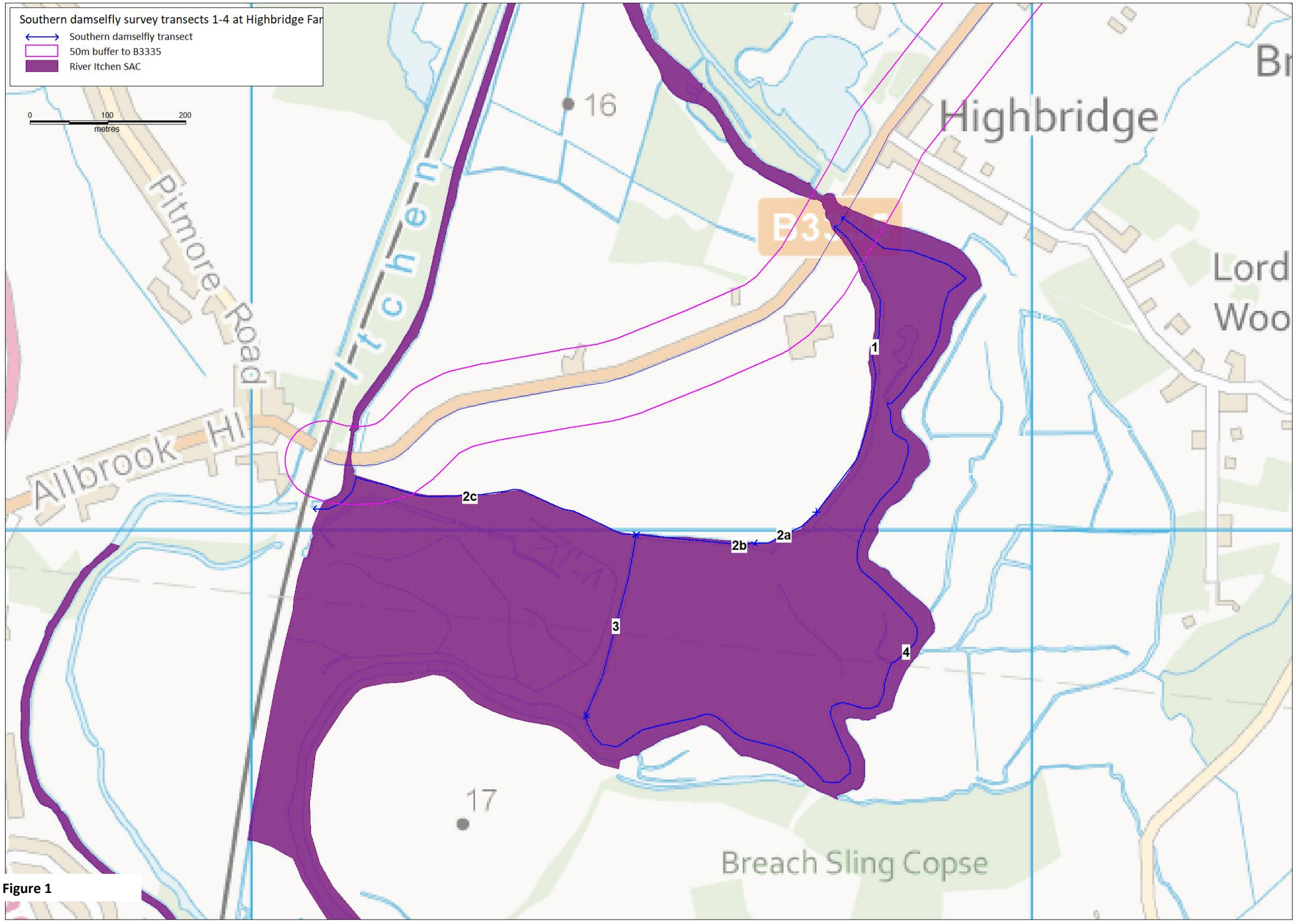
Southern damselfly survey transects 1-4 at Highbridge Far
Southern damselfly transect
50m buffer to B3335
River Itchen SAC
0
100
200
metres
16
Highbridge
Br
Pitmore Road
Itchen
B3
Lord
Woo
Allbrook Hi
1
2c
2a
2b
3
4
17
Breach Sling Copse

Figure 1

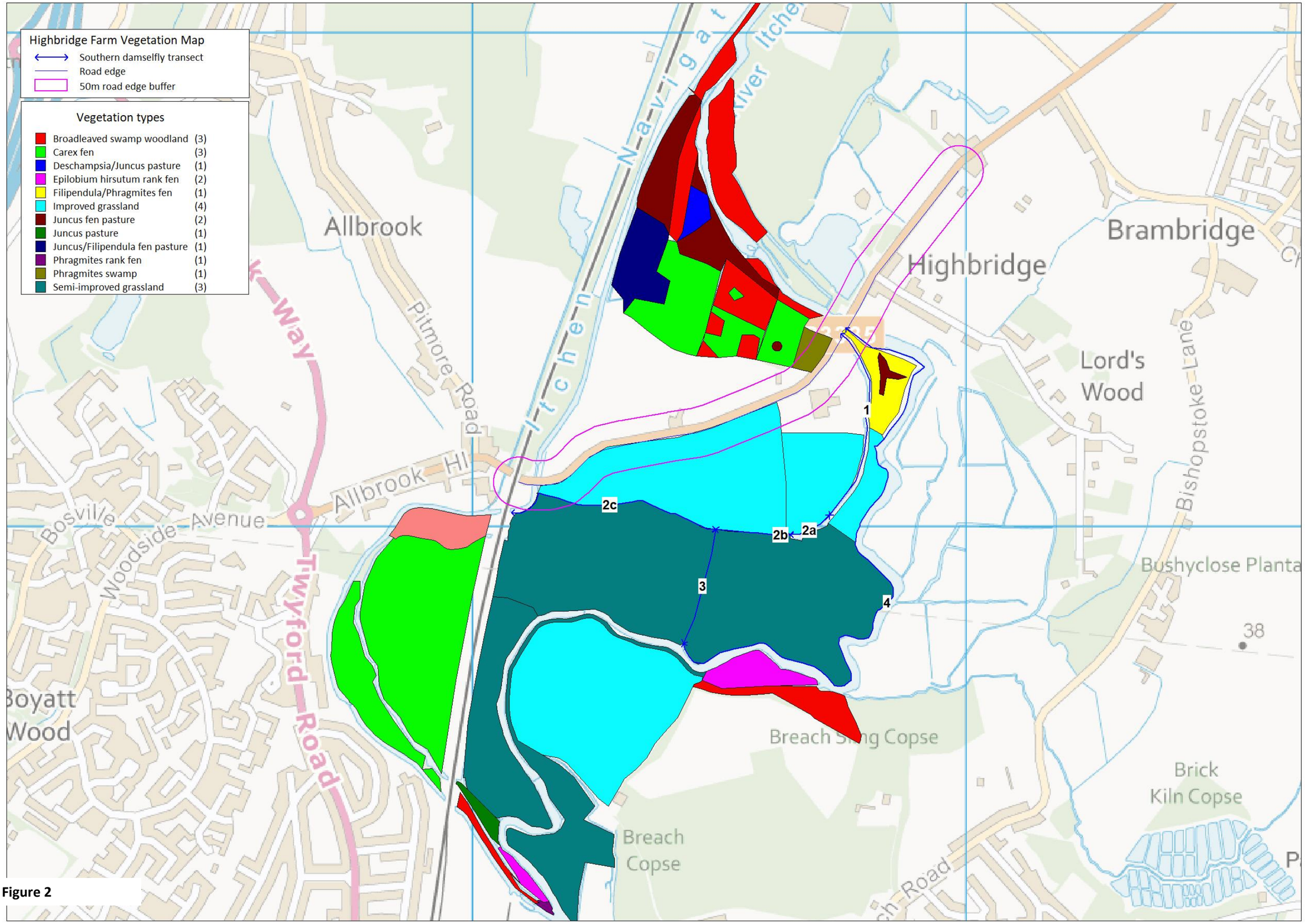
Highbridge Farm Vegetation Map
Southern damselfly transect
Road edge
50m road edge buffer
Vegetation types
Broadleaved swamp woodland (3)
Carex fen (3)
Deschampsia/Juncus pasture (1)
Epilobium hirsutum rank fen (2)
Filipendula/Phragmites fen (1)
Improved grassland (4)
Juncus fen pasture (2)
Juncus pasture (1)
Juncus/Filipendula fen pasture (1)
Phragmites rank fen (1)
Phragmites swamp (1)
Semi-improved grassland (3)
Allbrook
Highbridge
Brambridge
Lord's Wood
Bishopstoke Lane
Pitmore Road
Allbrook Hill
Bosville Avenue
Woodside Avenue
Tiwyford Road
Boyatt Wood
Breach Copse
Breach Copse
Brick Kiln Copse
Bushyclose Planta
1
2a
2b
2c
3
4

Figure 2