

Lower Thames Crossing

6.3 Environment Statement

Appendix 8.3 - Terrestrial Invertebrates

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Lower Thames Crossing

Appendix 8.3 Terrestrial Invertebrates

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1 Introduction

- 1.1.1 This document presents the results of the invertebrate desk study and field surveys carried out between 2017 and 2022 to inform the Environmental Impact Assessment of the A122 Lower Thames Crossing Project (the Project).
- 1.1.2 The main aim of the survey and associated desk study was to establish the conservation value of terrestrial invertebrates living in selected sites within and adjacent to the footprint of the Project. The methodology and results are presented below.

2 Legislation and conservation status

- 2.1.1 The following legislation, conservation status and conservation plans are relevant to terrestrial invertebrates living within the Project area:
- a. European Communities Council Directive of the Conservation of Natural Habitats and Wild Fauna and Flora (Habitats Directive) – Annex II species have core areas of their habitat designated as sites of Community importance and included in the Natura 2000 network (Council of Europe, 1992).
 - b. Bern Convention on the Conservation of European Wildlife and Natural Heritage (Council of Europe, 1979) – Appendix III species list.
 - c. Species listed in the Convention on the Conservation of European Wildlife and Natural Heritage (Council of Europe, 1992) - Annex III.
 - d. Species of Principal Importance, listed in Section 41 of the Natural Environment and Rural Communities Act (NERC, 2006).
 - e. Local Biodiversity Action Plans (BAP), for Essex (Essex BAP, 2011) and Kent (Kent BAP, 2011).
 - f. International Union for Conservation for Nature (IUCN) Red List of Threatened Species (IUCN, 2012):
 - i. Pre-1994 classifications: Red Data Book 2 (RDB2) (Vulnerable): species that are declining in range or live in vulnerable habitats and are likely to move into the Endangered category; RDB3 (Rare): species that are not currently either Endangered or Vulnerable, are at risk and exist in 15, or fewer, 10km squares; RDBK (Insufficiently Known): species suspected to merit either Endangered, Vulnerable Rare or Indeterminate status, but lacking enough information.
 - ii. Post-1994 classifications: IUCN Endangered: species, which the best available evidence indicates, that are facing a very high risk of extinction in the wild; IUCN Near Threatened: species that do not qualify for Endangered or Vulnerable now but are likely to in the near future; Nationally Scarce: species that have been recorded from more than 16, and no more than 100, 10km squares in the UK.
 - g. Species listed in the Essex RDB as a priority for conservation in Essex (Essex RDB, 2014)
 - h. Species listed in the Kent RDB as a priority for conservation in Kent (Kent RDB, 1999)

3 Background ecology

- 3.1.1 The following paragraphs present a brief background summary of the main habitat types and features associated with invertebrate collections likely to be of high conservation value within the Order Limits.
- 3.1.2 The climatic conditions and topography of the Greater Thames Estuary National Character Area (NCA) provide conditions conducive to a diverse collection of terrestrial invertebrates (Harvey, 2000), with lower than average rainfall, higher than average temperatures in summer and mild winters (Met Office, 2016). The updated Order Limits runs through or passes near a range of habitats that are of particularly high value to invertebrates. These include ancient woodland, grazing marsh, Thames Terrace grassland, open mosaic habitat (OMH) (sometimes referred to as brownfield land) on previously disturbed ground, lowland heath and neutral grassland (see Table 3.1).
- 3.1.3 In between the areas of habitat of high value to invertebrate species value, the Order Limits crosses arable farmland, minor roads, a railway and amenity land. These are typically of lower value for invertebrates than the habitats highlighted above and are likely to contain features such as hedgerows, verges, railway sidings and small waterbodies (such as ponds or lakes) that are used by common and widespread invertebrate species.

Table 3.1 Overview of habitat type and typical invertebrate assemblage

Habitat	Invertebrate assemblage overview
Ancient woodland and other semi-natural broadleaved woodland	<p>Contains a range of features (veteran and mature trees, standing and fallen dead wood, wet woodland, scrub, waterbodies, tracks and rides) that can support important and invertebrate fauna. Ancient woodlands with a long, continuous history of traditional management often provide the best invertebrate habitat. These sites may support trees ranging in age classes from sapling to veteran. The diversity of tree species and structural diversity achieved through management increases the biodiversity value for woodland invertebrates including arboreal (tree-living), wood decay, epiphyte (that live on the plants and get their water from the air and rain, for example) and ground-dwelling species. These habitats can support an invertebrate fauna of high conservation value. The presence of woodland edge habitat with open rides and adjacent grassland are often critical for woodland invertebrates. As a result, the proximity of woodland to herb-rich grassland and OMH can increase the collective conservation value of these habitats.</p>
Grazing marsh	<p>Coastal and floodplain grazing marsh is not a specific habitat. It is a landscape type that supports a variety of habitats. The defining features are hydrological and topographical rather than botanical. Grazing marsh is defined as periodically inundated pasture or meadow, typically with ditches or rills (small brooks or streams) containing standing brackish (water that is slightly saltier than fresh water but not as salty as sea water) or fresh water that support a wide range of aquatic and other wetland and brackish water associated invertebrates. These include habitat specialists that are rare and/or of limited range in the UK.</p> <p>Representative coastal and floodplain grazing marsh habitat is listed as a priority habitat within Section 41 of the NERC Act 2006.</p>
Thames Terrace grassland	<p>Thames Terrace grasslands in their original form are now an extremely scarce habitat but would formerly have spread along the ridge of sand and gravel from Grays, eastwards through Chadwell St Mary and then upwards towards the Langdon Hills. These grasslands would have supported a drought-resistant, flower-rich sward (grassy areas), the likes of which can be gauged by looking at such sites as Broom Hill, West Tilbury Hall and Mucking Heath. As well as supporting rare Essex plants, these grasslands developed a unique invertebrate fauna, taking advantage of the favourable climate and geology (Green Grid Wildlife Strategy, 2007).</p> <p>The decline of Thames Terrace grassland has led to the associated invertebrate fauna depending on similar grasslands in the NCA that occur on drought-stressed surfaces within brownfield land such as old sand and chalk quarries and pulverised fuel ash lagoons, classified as OMH. Within the Green Grid Wildlife Strategy (2007), it is stated that 'The ecology of brownfield land areas must be viewed alongside the Thames Terrace grasslands local BAP habitat.'</p>

Habitat	Invertebrate assemblage overview
OMH on previously developed land	<p>In recognition of its often significant conservation value, especially for invertebrates, OMH on previously developed land is included as a priority habitat in Section 41 of the NERC Act 2006. OMH comprises a range of habitat types living on land that has a history of human disturbance. For a site to qualify as OMH Section 41 habitat, it must: occupy an area of at least 0.25ha; have a known history of disturbance from major historical industrial use or development; contain early successional vegetation communities; contain habitat with loose unvegetated bare substrate in which pools may be present and support a mosaic of one or more early successional communities plus bare substrate (Riding et al., 2010). The post-industrial sites adjacent to the Thames in south Essex are recognised as supporting some of the most important examples of OMH in the UK. These habitats typically occur on drought-stressed substrates within brownfield land such as old sand and chalk quarries and pulverised fuel ash lagoons. Remnants of historic habitats, such as Thames Terrace grassland, may occur within the overall OMH.</p> <p>The invertebrate collections associated with this habitat type can be rich in species and include many uncommon species (Eyre et al., 2002, 2004), and between 12% and 15% of all Nationally Rare and Nationally Scarce insects are recorded from brownfield sites (Gibson, 1998).</p>
Lowland heathland	<p>Contains a mosaic of vegetation types and sward heights that supports many rare British species that are at the edge of their European range either due to climate or habitat preference (Buglife, 2018a). Although some sites were described as lowland heathland in the Local Wildlife Site (LWS) descriptions, none of the Survey Areas supported true heathland habitat in terms of the definition in JNCC (2009) (i.e. at least 25% cover of dwarf shrubs including ericoids and dwarf gorses). Dwarf shrubs, such as heathers, that are a fundamental component of lowland communities were entirely absent from the Survey Areas. However, the acid grassland in mosaic with common gorse <i>Ulex europaeus</i> and broom <i>Cytisus scoparius</i> at Mucking Heath provided habitat suitable to support certain species also associated with more representative lowland heathland habitat.</p>
Neutral grassland	<p>Neutral grasslands include habitats that typically occur on fertile soils of more neutral pH. They tend to comprise the majority of grassland subject to a history of agriculture in lowland England. There are many areas of neutral grassland the Project Survey Area, and there was more herb-rich semi-improved neutral grassland often as a component of OMH habitat as well as within habitat historically managed as pasture or meadowland. This habitat often supports a diverse range of typical meadowland insects. Due in part to the important role of climate in relation to invertebrate diversity in Essex, semi-improved neutral grassland can support a wider range of invertebrates compared with most other parts of lowland England. A number of rarities such as the Section 41 phoenix fly (<i>Dorycera graminum</i>) may also live in suitable areas of neutral grassland. Similarly, where there is a rich flower resource, the habitat may provide important foraging for bee species associated primarily with OMH and Thames Terrace grasslands, such as the shrill carder bee (<i>Bombus sylvarum</i>).</p>

4 Methodology

4.1 Desk study

- 4.1.1 A desk study was carried out in 2020 and subsequently updated in 2022, taking into account of the revised Order Limits, which considered all information on nationally and locally important designated sites with an invertebrate interest, and ancient woodlands and records of invertebrate species within 1km of the Order Limits. Records were requested from Kent & Medway Biological Records Centre (2022), Essex Wildlife Trust Biological Records Centre (2020), Essex Field Club (2022) and Greenspace Information for Greater London (GiGL) (2022).
- 4.1.2 The locations of designated sites of international, national and local importance for biodiversity were also obtained within 20km, 2km and 1km of the Order Limits respectively. Citations for these sites, which provide information on the reasons for their designation, were reviewed to ascertain whether invertebrates are included as interest features. All designated sites are shown in Figure 8.1 – Designated sites (Application Document 6.2), with additional detailed information provided in Appendix 8.1 – Designated Sites (Application Document 6.3).
- 4.1.3 Information on habitats of importance to invertebrate species located within the Thames Estuary was obtained from Natural England’s priority habitats inventory (Natural England, 2021), the Woodland Trust’s ancient tree hunt, and Chafford Hundred 2014 invertebrate survey report (Harvey, 2014).

4.2 Invertebrate Survey Areas

- 4.2.1 Desk study data, aerial maps and habitat data from the Extended Phase 1 habitat survey – refer to Appendix 8.2 – Plants and Habitats (Application Document 6.3) were reviewed to define areas that required further assessment with regards to terrestrial invertebrates. A total of 14 areas (Survey Areas) of potentially valuable invertebrate habitat were identified within the Order Limits, plus a 200m buffer as requiring further assessment for invertebrates. Survey Areas are described in Table 4.1 and are shown on Figure 8.7 (Application Document 6.2).

Table 4.1 Invertebrate Survey Areas

Survey Area	Proximity to River Thames	Size (ha)	Grid reference	Broad description
Survey Area 1: Shorne Woods Country Park, Ashenbank Woods and Brewers Wood	South	35	TQ677697	Broadleaved ancient woodland with veteran and mature trees, standing and fallen dead wood, wet woodland, scrub, waterbodies, tracks and rides.
Survey Area 2: Claylane Wood	South	15	TQ664704	Semi-improved neutral grassland, scrub and ruderal (a species of plant that often lives on wasteland) vegetation surrounding ancient broadleaved woodland which contains tracks and rides.
Survey Area 12: Filborough Marshes	South	38	TQ680739	Coastal and floodplain grazing marsh with a network of ditches running through cattle-grazed semi-improved grassland.
Survey Area 3: Goshems Farm	North	100	TQ671759	OMH on previously developed land with a mix of artificial spoil (the layer of soil directly beneath the topsoil), pulverised fuel ash, tall ruderal and scrub, moderately species-rich neutral grassland, ephemeral (short life cycles) short perennial vegetation, tracks and rides, and numerous ditches, with both running and standing water.
Survey Area 4: Horse field	North	80	TQ680763	Historic clay-capped landfill site dominated by rough semi-improved neutral grassland with patches of scrub. Bordered by vegetated drainage ditches. Low level of grazing by horses.
Survey Area 5: Lyttag Brownfield	North	25	TQ657763	Extensive developing acid grassland and OMH on previously developed land. Abundant potential valuable invertebrate habitat.
Survey Area 6: Tilbury Fort	North	40	TQ651758	Former coastal grazing marsh, now largely arable land, brackish ditches and Tilbury Fort grasslands.
Survey Area 7: Low Street Pit	North	10	TQ671776	Remnant of Thames Terrace grassland. Mix of scrub, unimproved acid grassland, tall ruderal and woodland with a waterbody. Area of OMH in the north of the area.

Survey Area	Proximity to River Thames	Size (ha)	Grid reference	Broad description
Survey Area 8: Mucking Heath	North	7	TQ654802	The rough areas of golf course, constructed on relict (a remnant of habitat that was once widespread) acidic grassland/heath, that are of interest to both flora and invertebrates.
Survey Area 9: Blackshots Nature Area	North	25	TQ631807	A large area of rough grassland interspersed with scattered scrub. To the east, was an area of Brownfield land containing piles of soil and rubble, now developing with pioneer vegetation and scrub.
Survey Area 10a: North Ockendon (woodland)	North	5	TQ559967	The woodland site supported semi-natural broadleaved woodland with two large ponds.
Survey Area 10b: North Ockendon (grassland)	North	9	TQ591843	The open habitat comprised a mosaic of rough, semi-improved grassland and tall herb, and scrub habitat on the site of a historic landfill site.
Survey Area 11: M25 woodlands	North	25	TQ584884	Woodlands and scrub surrounding M25 J29. Ancient broadleaved woodland to the north-east, north-west and south-east of the junction. The area to the south-west of the junction comprised an area of woodland and scrub interspersed with open rides containing floristically rich borders.
Survey Area 13: Linford	North	42	TQ631807	Habitats set around a working block making site including brownfield habitat, ancient woodland, rough grassland with scattered scrub and a lake bordered by common reed, ruderal and mature willow sp.

4.3 Tilbury2 invertebrate survey

4.3.1 Survey Areas 5 and 6 were previously subjected to extensive invertebrate surveys as part of a neighbouring development, Tilbury2, the results of which have been published in the following reports:

- a. Land Adjacent to Tilbury Power Station, Essex, Invertebrate Survey Report (Colin Plant Associates, 2016)
- b. Invertebrate Survey of Tilbury 2 (Telfer, 2017)

4.3.2 Since the results of these surveys were readily available, Survey Areas 5 and 6 were not subjected to field surveys as part of the Project. Instead, the findings of these reports are considered in the results and discussion sections of this appendix.

4.4 Field surveys

- 4.4.1 Of the 14 Survey Areas identified during the desk study, 10 were subjected to field surveys for terrestrial invertebrates. Surveys were not carried out in Survey Areas 5 and 6, as described above. Survey Area 9 was not subject to field surveys due to land access restrictions. Survey Area 12 was scoped out as requiring further surveys on the basis that it would not be impacted by the Project.
- 4.4.2 The remaining Survey Areas, 1, 2, 3, 4, 7, 8, 10, 11 and 13, were subjected to field surveys described below.

Survey timing

- 4.4.3 Surveys in 2018 were carried out over two periods. Sites were surveyed first, over two weeks between 25 June 2018 and 13 July 2018. The second survey phase was carried out between 13 August 2018 and 23 August 2018. During the initial survey, where permissions allowed, sites with woodland habitat were surveyed first, followed by sites with predominantly grassland/OMH on previously developed land.
- 4.4.4 Surveys in 2019 focused on Survey Area 13. Surveys on Survey Areas 11 and 13 took place in 11-13 June 2019, 4 July 2019 and 6-7 August.
- 4.4.5 A May to late September survey period reflects the crucially important period for many invertebrate collections.

Habitat scoping

- 4.4.6 During the initial visit, each site was walked, and habitats and habitat features with potential to support notable invertebrate collections/key species were noted, mapped and geo-referenced. To enable a tangible comparison to be made between invertebrate species/assemblage recorded and the assemblage descriptions from the analysis, habitat was described in terms of topography, substrate and general vegetation composition and structure. In relation to OMH sites, the methodology aimed to comply with the Invertebrate Standard for Essex produced by Natural England (Natural England, 2014).

Invertebrate sampling

- 4.4.7 From each main Survey Area, enough samples were taken, using a combination of standard capture methods (Drake *et al.*, 2007), to enable subsequent analysis using both the Species Quality Index (SQI) required within the Essex Standard, and Pantheon analysis. These analysis methodologies are described below. Field sample survey methods, dates and habitat types are outlined in Annex A.
- 4.4.8 Where possible, sampling was carried out during periods of dry, sunny and calm weather.
- 4.4.9 The number of samples collected per site varied, depending, to some extent, on the degree of habitat diversity. Typically, four samples per layer were taken when the habitat layer sampled from was more or less uniform. Additional samples were collected in more diverse sites to allow robust analysis of each distinct habitat type as a standalone unit. For example, when both open grassland and woodland habitats were present.

- 4.4.10 The surveys covered groups from all the larger¹ and most of the smaller², insect groups as well as other arthropods, such as spiders (Araneae), harvestmen (Opiliones), woodlice (Isopoda), centipedes (Chilopoda) and pseudoscorpions *Pseudoscorpiones*. For certain large groups, only target groups recognised within were identified. For example, parasitic Hymenoptera (such as Ichneumonoidea) were not identified. And these groups are generally excluded from standard invertebrate surveys, as are non-arthropods (such as molluscs and annelids).
- 4.4.11 The precise approach to sampling varied according to habitat type, and a combination of two or more of the sampling methods, shown in Table 4.2, were used. The methods used, and number of samples that were taken in each site, are outlined in Annex A.

Table 4.2 Invertebrate sampling techniques

Sample technique	Sample protocol	Timing protocol	Target group
Beating	Invertebrates living on the foliage and branches of trees, bushes and tall herbage (such as grasses and plants) were collected by jarring the branches with a stick, so the animals fell onto a sheet held beneath. Invertebrates were then collected with a pooter (a bottle to collect them in).	15 minutes	Coleoptera, Hemiptera, Lepidoptera larvae, Psocoptera, Neuroptera, Arachnida
Sweep netting	A stout net was swept back and forth through vegetation, keeping the net as low as practical. Invertebrates were collected from the net, and timed with the pooter.	10 minutes	Diptera, Coleoptera, Hemiptera, Arachnida
Vacuum sampling	A leaf blower with a mesh bag installed in its suction tube was used to catch invertebrates from ground level and low vegetation. The sample was transferred from the mesh bag to a white tray and invertebrates were collected with a pooter.	Two minutes	Coleoptera, Hemiptera, Diptera, Arachnida, Crustacea

¹ Larger orders include: True bugs *Hemiptera*, butterflies and day-flying moths *Lepidoptera*, two-winged flies *Diptera*, bees, ants and wasps *Aculeate Hymenoptera*, and beetles *Coleoptera*.

² Examples of smaller orders include: grasshoppers and crickets *Orthoptera*, dragonflies and damselflies *Odonata*.

Sample technique	Sample protocol	Timing protocol	Target group
Direct searching	<p>Direct methods of catching invertebrates included:</p> <p>Spot sampling: A net was used to catch large, conspicuous or fast-moving insects.</p> <p>Ground searching: Grubbing around the base of vegetation and in/under dead wood.</p> <p>Invertebrates that could not be identified in the field were transferred to a killing jar.</p>	N/A	<p>Spot sampling Hymenoptera, Lepidoptera, Diptera</p> <p>Ground searching Coleoptera, Myriapoda, Crustacea</p>
Direct observation	Easily identifiable, usually charismatic macro-invertebrates observed on site were identified and recorded in the field.	N/A	Lepidoptera, Hymenoptera, Diptera, Coleoptera, Hemiptera, Arachnida

Identification

- 4.4.12 Where practical, species were identified onsite. No butterflies, or more readily identified species (such as the shrill carder bee, grasshoppers and crickets) were purposefully collected during the survey. However, the bulk of invertebrates cannot be adequately identified in the field, especially considering fieldwork timescales. As is standard for detailed invertebrate survey, it was necessary for samples to be taken offsite for identification.
- 4.4.13 Offsite identification involved using a binocular microscope and appropriate taxonomic keys (used to identify them) as required. Where considered necessary, specialist verification of rare or uncommon species was sought from the appropriate county recorder or expert in the relevant species group. Some Diptera (flies) were subcontracted to a third party for identification.

Data analysis

Conservation status

- 4.4.14 Despite a number of species from different groups having been assigned threat status under post-2001 IUCN criteria, for many, including those not recently reviewed and where there is not enough recording for levels of decline to be adequately assessed, threat status information is not available. Therefore, for consistency, pre-1994 status criteria have been used in this report, alongside where applicable, Section 41 status and Essex RDB status.

SQL

- 4.4.15 Data was analysed on a site-by-site level using a version of SQL used in Harvey (2014), which is based on the method described in Ball (1986).
- 4.4.16 All species recorded from a site were scored according to conservation status. The scores were then added together and divided by the total number of species in the list (including both scoring and non-scoring species). The resulting SQL score provides a means for appraising the overall conservation

value of a site. But, unlike Pantheon (see below), it does not take into account the variation in rarity values of collections found in different habitats.

- 4.4.17 SQI analysis was undertaken by scoring all species listed for each site according to status, shown in Table 4.3.

Table 4.3 Species Quality Index scores

Conservation status	Score
RDB species	100 points
Notable – Na species ³	50 points
Notable – Nb species	40 points
Notable – N species	40 points
Local species	20 points
Common species	No score
Status not formally known	No score

- 4.4.18 According to Harvey (2014) ‘in the bulk of the Essex countryside a “good” invertebrate site might have an SQI value of at least 5.00 after moderate recording coverage. An “excellent” site might have a value of 7.50 and any site with an SQI value approaching 10.00 is almost certainly of national significance.’

Pantheon analysis

- 4.4.19 Species data was added to Natural England’s Pantheon invertebrate analytical package (version 3.7.6) (Webb *et al.*, 2017), which then produces analysis tables and descriptions. The key elements used are included in three hierarchical levels (and three output tables) recognised within the Pantheon output, defined as follows (from Webb *et al.*, 2017):
- a. **Broad Biotope Level** – Broad Biotopes are a useful way to split sample data into something manageable, but which still retains a strong ecological grounding. They include tree associated, open, wetland and coastal habitats. Species can be found in more than one broad biotope. This occurs when the same habitat has been typed into two divisions. A good example is wet woodland, which is found in both tree associated and wetlands biotopes.
 - b. **Habitat Level** – habitats are a mid-level category within the hierarchy and ⁴often readily identifiable and recognisable by conservation workers (e.g. saltmarsh). Some are identified as broad habitats in the UK but most are

³ The old system of notable a and notable b is no longer used as a status classification; all former ‘notable’ species are now classed uniformly as ‘Nationally Scarce’. However, for the purpose of analysis, former notable a and b species, which still retain Nationally Scarce status, were scored using this system, to be consistent with the approach used in Harvey (2014) which conforms to the requirements of the Essex Standard.

⁴

new terms used to refer to a series of resources or a series of broad habitat types.

- c. **Specific Assemblage Types (SATs)** – these are characterised by ecologically restricted species and were generally only expressed in lists from sites with conservation value. This classification is particularly useful for identifying assemblages of higher conservation value.

- 4.4.20 At each scale, invertebrates were grouped according to a known affinity to a particular habitat or habitat resource. On the biotope scale, the resolution is very broad (e.g. wetland, open habitats, tree associated or coastal). The habitat scale groups invertebrates into more defined subdivisions. For example, marshland and peatland, which are subdivisions of the wetland biotope scale. Examples of assemblages within the most precise scale, the SAT include reed-fen and pools grouped within the wetland. Peatland hierarchy and undisturbed fluctuating marsh is nested as a third tier within the wetland – marshland hierarchy.
- 4.4.21 Pantheon lists all species of higher conservation status that are grouped within a particular assemblage. These include species of importance listed on Section 41 of the NERC Act 2006, RDB (Shirt, 2017) and Nationally Scarce species. The tables also classify each assemblage in terms of favourable condition status and, at the broader biotope and habitat scales, SQI scores are given for each defined assemblage. The SQI scores provide assessment of the rarity value of a group of invertebrates based on mean rarity value. The predecessor to Pantheon – the Invertebrate Species-habitat Information System (ISIS), had predetermined favourable condition thresholds for habitat-level assemblage, previously called Broad Assemblage Types (BATs). These are used in the analysis as an indication of the importance of Pantheon habitat-level assemblages.
- 4.4.22 Some SATs are based on a resource rather than a tangible habitat. An example of a resource-based SAT is F002 - rich flower resource. Rich flower resource is expressed across a wide range of habitats. It is therefore less useful in determining the conservation value of a particular habitat within a site. However, while this SAT has a default-favourable condition target, the quality (in conservation terms) of the species attributed to this group should have as much bearing as the species number. Below-threshold species counts of very rare species and their brood parasites will give added value to the assemblage.

5 Results

5.1 Desk study

Designated sites

- 5.1.1 A description of all designated sites that may be impacted by the Project is presented in Appendix 8.1 – Designated Sites (Application Document 6.3). For the location of all designated sites, please refer to Figure 8.1 – Designated sites (Application Document 6.2).
- 5.1.2 Table 5.1 identifies the internationally important statutory designated sites (Ramsar sites) that are relevant to the Project and which are noted for their invertebrate interest, which forms part of their selection.

Table 5.1 Internationally important designated sites with invertebrate interests

Designated site	North or south of the River Thames	Distance from Order Limits and associated Survey Area (where applicable)	Invertebrate interest
Thames Estuary and Marshes Ramsar site (JNCC, 2000)	South	Within Order Limits – within Survey Area 12 and east of Survey Area 4	A complex of brackish, floodplain grazing marsh ditches, saline lagoons and intertidal saltmarsh and mudflat (the area that is above water level at low tide and underwater at high tide). The saltmarsh and grazing marsh are of international importance for their diverse wetland plants and invertebrates. The Endangered species ⁵ <i>Bagous longitarsis</i> occurs on the site. The following Vulnerable species ⁶ are found on the site: ground bug <i>Henestaris halophilus</i> ; weevil <i>Bagous cylindrus</i> ; ground beetle <i>Polistichus connexus</i> ; crane fly <i>Erioptera bivittata</i> ; crane fly <i>Limnophila pictipennis</i> ; horsefly <i>Hybomitra expollicata</i> ; hoverfly <i>Lejops vittata</i> ; dancefly <i>Poecilobothrus ducalis</i> ; snail-killing fly <i>Pteromicra leucopeza</i> ; solitary wasp <i>Philanthus triangulum</i> ; and the scarce emerald damselfly <i>Lestes dryas</i> . The following Rare species ⁷ are also on the site: ground beetle <i>Anisodactylus poeciloides</i> ; water beetles <i>Aulacochthebius exaratus</i> , <i>Berosus fulvus</i> , <i>Cercyon bifenestratus</i> , <i>Hydrochus elongatus</i> , <i>Hydrochus ignicollis</i> , <i>Ochthebius exaratus</i> ; great silver water beetle <i>Hydrophilus piceus</i> ; green beetle <i>Malachius vulneratus</i> ; rove beetle <i>Philonthus punctus</i> ; fungus beetle <i>Telmatophilus brevicollis</i> ; fancy-legged fly <i>Campsicnemus magius</i> ; horsefly <i>Haematopota bigoti</i> ; soldier fly <i>Stratiomys longicornis</i> ; and spider <i>Baryphyma duffeyi</i> .

⁵ A species is considered Endangered when the best available evidence indicates that it is facing a very high risk of extinction in the wild.

⁶ A species is considered vulnerable when the best available evidence indicates that it is facing a high risk of extinction in the wild.

⁷ Species that are recorded from no more than 15 of the 10km by 10km squares in Britain.

5.1.3 Table 5.2 identifies the nationally important statutory designated sites that are relevant to the Project (Sites of Special Scientific Interest (SSSI) and Local Nature Reserves (LNR)). These are noted for their invertebrate interest, which forms part of their selection.

Table 5.2 Nationally important designated sites with invertebrate interests

Designated site	North or South of the River Thames	Distance from Order Limits and associated Survey Area (where applicable)	Invertebrate interest
Halling to Trottiscliffe Escarpment SSSI (Natural England, 1984a)	South	1.5km	Invertebrates: Only known location in Britain for moth <i>Hypercallia citrinalis</i> , and several other scarce moths, beetles and grasshoppers. Uncommon bug <i>Psylla viburni</i> . Populations of Nationally Scarce ⁸ butterfly species Adonis Blue <i>Polyommatus bellargus</i> .
Holborough to Burnham Marshes SSSI (Natural England, 1990)	South	1.4km	This site lies along the flood plain of the River Medway. A variety of habitats are present including extensive reedbeds, open water, fen, grassland, scrub and woodland. A number of scarce invertebrate species occur including of the rare marsh-mallow moth <i>Hydraecia osseota</i> , the rare rove beetle <i>Stenus calcaratus</i> , and 3 rare bee species.
Cobham Woods SSSI (Natural England, 1984b)	South	0.3km – south of Survey Area 1	Old woodland and parkland representative of woods in North Kent which occur in part on acidic Thanet Sands and in part on chalk soils with a wide assemblage of plants. In the past, this area was well known for the large number of beetles and bugs it supported. However, although conditions are still suitable, there is little recent information on these groups.

⁸ Species that are recorded from 16 to 100 of the 10km by 10km squares in Britain.

Designated site	North or South of the River Thames	Distance from Order Limits and associated Survey Area (where applicable)	Invertebrate interest
Shorne Woods Country Park and Ashenbank Woods SSSI (Natural England, 1988)	South	Within Order Limits – within Survey Area 1	Shorne Woods Country Park and Ashenbank Woods form a complex of ancient and plantation woodland. Invertebrates: Beetles and true bugs <i>Hemiptera</i> are well represented. Rare species include beetles <i>Mordella holomelaena</i> and <i>Peltodytes caesus</i> , as well as the ruddy darter dragonfly <i>Sypetrum sanguineum</i> and satin lutestring moth <i>Tetheela fluctuosa</i> .
South Thames Estuary and Marshes SSSI (Natural England, 1991a)	South	Within the Order Limits – within Survey Area 12	The site consists of an extensive mosaic of grazing marsh, saltmarsh, mudflats and shingle, characteristic of the estuarine habitats of the north Kent marshes. Freshwater pools and some areas of woodland provide additional variety and complement the estuarine habitats. This site supports a diverse range of invertebrate fauna, and includes Nationally Rare beetles, flies and true bugs. The scarce emerald damselfly <i>Lestes dryas</i> , listed in the British RDB, has been recorded in the Cliffe area of the site. In addition, 100 Nationally Scarce species of invertebrate have been recorded. These include a hoverfly <i>Lysmamta vittata</i> , a shorebug <i>Saldula opacula</i> and the dotted fan-foot moth <i>Macrochilo cribrumalis</i> . All of these are restricted to wetland, estuarine or grazing marsh habitats. The water beetle fauna is of particular interest and includes four species of aquatic weevils <i>Bagous</i> , three species of <i>Berosus</i> , and the great silver water beetle <i>Hydrophilus piceus</i> .
Rede Common LNR (Natural England, 2018)	South	1km	An area of open acid grasslands surrounded by scrub and trees providing habitat for invertebrates.

Designated site	North or South of the River Thames	Distance from Order Limits and associated Survey Area (where applicable)	Invertebrate interest
Swanscombe Peninsula SSSI (Natural England 2021)	South	670m	<p>Extensive areas of OMH on previously developed land and semi-natural habitat, including chalk pits, free-draining grassland, scrub, wetlands, grazing marsh and saltmarsh support four diverse collections of invertebrates.</p> <p>Brownfield areas within the SSSI support species associated with bare sand and chalk, and open short swards. These groups are rich in bee and wasp species, which they use for nesting, prey collection and basking, and the rich wild flower resource for nectar and pollen. Priority Species (Section 41) within the assemblage include the Critically Endangered distinguished jumping spider <i>Sitticus distinguendus</i>, rare five-banded weevil wasp <i>Cerceris quinquefasciata</i>, and Nationally Scarce brown-banded carder bee <i>Bombus humilis</i>.</p> <p>This site supports over 1,700 invertebrate species, which includes over a quarter of the UK's water beetle species and more than 200 species that are considered of conservation importance.</p>
Mucking Flats and Marshes SSSI (Natural England, 1991b)	North	Immediately adjacent to Order Limits – east of Survey Area 4	<p>An extensive stretch of Thames mudflats and saltmarsh, together with sea wall grassland. The saltmarsh has a high invertebrate interest. This includes the rare spider <i>Baryphyma duffeyi</i>, as well as many notable and local species.</p>

Designated site	North or South of the River Thames	Distance from Order Limits and associated Survey Area (where applicable)	Invertebrate interest
Grays Thurrock Chalk Pit SSSI (Natural England, 1993a)	North	1.1km	<p>Former chalk quarry now hosting a range of woodlands, scrub and calcareous grassland habitats, with an area of open water in the north-east corner of the pit.</p> <p>Invertebrates:</p> <p>RDB beetle species <i>Mordellistena humeralis</i>, <i>Mordellistena neuwaldeggiana</i> and <i>Cryptocephalus sexpunctatus</i>, plus another 20 beetle species.</p> <p>RDB moth species including <i>Dahlica triquetrala</i> and 27 other notable species.</p> <p>RDB true flies, including <i>Dicranoptycha fuscisceus</i> – so far only recorded in this country in Kent and Essex – and another 11 notable true flies.</p> <p>Spider <i>Centromeros serratos</i> and locally important spider <i>Entelecora flavipes</i> are found nowhere else in Essex.</p> <p>Best concentration and diversity of calcareous invertebrate fauna in Essex.</p>
Cranham Brickfields LNR (Natural England, 2008)	North	0.02km – south-west of Survey Area 11	<p>Former Brickfield (where topsoil was removed and the clay beneath stripped and mixed with chalk and ash to create bricks), with large areas of grassland and scrub.</p> <p>Invertebrates include stag beetle <i>Lucanus cervus</i> and green Hairstreak butterfly <i>Callophrys rubi</i>.</p>
The Manor LNR (Natural England, 2005)	North	1.14km	<p>A wide and diverse range of habitats, including acid and neutral grassland along secondary woodland, ancient coppice woodland, hedgerows, ponds and lakes. Species include bumble bees <i>Bombus sp.</i> and stag beetle.</p>

Designated site	North or South of the River Thames	Distance from Order Limits and associated Survey Area (where applicable)	Invertebrate interest
Grove House Wood LNR (Natural England, 1993b)	North	1.42km to 1.5km north-east of Survey Area 13	Grove House Wood LWS are on regionally important Thames Terrace gravels. They support remnant Thames Terrace grassland in mosaic, with disturbance habitats arising from historic gravel extraction. This is noted in the Green Grid Wildlife Strategy (2007) for supporting a diverse invertebrate fauna.

5.1.4 Identified in Table 5.3 are the locally important non-statutory designated sites that are relevant to the Project and that are noted for their invertebrate interest, which forms part of their selection. This includes LWS along with Ancient semi-natural woodland (ASNW) sites. These are considered to be one of the richest and most diverse habitats for invertebrates, as identified during the desk study.

Table 5.3 Locally important ecological sites with invertebrate interests

Site	North or south of the River Thames	Distance from Order Limits and associated Survey Area (where applicable)	Invertebrate interest
Ashenbank Woods Woodland Trust Reserve ASNW	South	Within the Order Limits – in Survey Area 1	Ancient woodland and important and diverse invertebrate fauna. Part of the Shorne Woods Country Park and Ashenbank Woods SSSI.
Shorne Woods Country Park, and Shorne and Brewers Wood ASNW	South	Within the Order Limits – in Survey Area 1	Ancient woodland and important and diverse invertebrate fauna. Part of the Shorne Woods Country Park and Ashenbank Woods SSSI.
Claylane Wood ASNW	South	Within the Order Limits – in Survey Area 2	Area of ancient woodland.
Shorne Pasture LWS (KWT, 1993)	South	0.34km south-east of Survey Area 12	Area of rough unimproved pasture supporting a herb-rich flora with ant hills. Abundant butterflies, day-flying moths, grasshoppers and Roesel's bush-cricket <i>Metrioptera roeselii</i> present.

Site	North or south of the River Thames	Distance from Order Limits and associated Survey Area (where applicable)	Invertebrate interest
Ebbsfleet Marshes LWS (KWT, 2018)	South	0.41km west of Survey Area 12	Reedbed and matrix of adjacent habitats, including the calcareous (mostly chalky) Ebbsfleet stream, a lake, damp scrub woodland, plus calcareous and more neutral grassland areas that support a good invertebrate fauna.
Canal and Grazing Marsh Higham LWS (KWT, 2009)	South	Within the Order Limits – adjacent to Survey Area 12	The site includes managed and unmanaged grazing marsh, dykes, a sea wall, salt marsh and a long stretch of the Thames and Medway Canal, with common reed <i>Phragmites australis</i> on some of the banks. Supports a rich invertebrate fauna.
Blue Bell hill banks and verges Local Wildlife Site (KMBRC, 2022)	South	105m	Species rich chalk grassland and scrub woodland. The site supports a good diversity of invertebrate species including Adonis blue, chalkhill blue <i>Polyommatus coridon</i> and brown argus <i>Aricia agestis</i> and green hairstreak butterflies <i>Callophrys rubi</i> .
Waldersalde Woods, Chatham LWS (KMBRC, 2022)	South	216m	Areas of anent woodland and some unimproved grassland. The grassland and clearings are used by many common grassland butterflies and several day flying moths
A227/A20 London Road RNR (KMBRC, 2022)	South	428m	Roadside verge with a range of chalkland habitat species. The south facing bank supports butterflies and insects such as grasshoppers and hoverflies.
B2015 Branbridge RNR (KMBRC, 2022)	South	495m	A species rich roadside verge and ditch. Silver Y <i>Autographa gamma</i> and cinnabar moth <i>Tyria jacobaeae</i> are among the insects recorded on the verge

Site	North or south of the River Thames	Distance from Order Limits and associated Survey Area (where applicable)	Invertebrate interest
Goshems Farm LWS (Thurrock Council, 2007)	North	Within the Order Limits – in Survey Area 3	This former landfill area supports an important population of Hornet robberfly <i>Asilus crabroniformis</i> , which is a Species of Principal Importance under Section 41 of the NERC Act (2006).
Tilbury Centre LWS (Thurrock Council, 2007)	North	Within the Order Limits – in Survey Area 3	<p>The habitats are a complex mosaic of grassland, flower-rich early successional/pioneer vegetation (species which are the earliest colonisers of bare ground), ditches, a small reedbed and a pond.</p> <p>The complex mosaic of habitats includes a pond that contains great silver water beetle, and pioneer vegetation that provides a foraging resource for Section 41 brown-banded carder bee. Other important invertebrates have also been recorded here. These form part of a complex of habitats considered to be of national importance for invertebrate biodiversity (Telfer, 2017).</p>
Tilbury Marshes LWS (Thurrock Council, 2007)	North	Within the Order Limits – in Survey Area 6	<p>Relic grazing marsh, saltmarsh, brackish ditches and the grassland of Tilbury Fort, as well as saltmarsh habitat and collections of invertebrate species.</p> <p>This site could support invertebrates associated with saline lagoons (shallow coastal water), an Essex BAP habitat. The north section forms part of a complex of habitats considered to be of national importance for invertebrate biodiversity (Telfer, 2017).</p>

Site	North or south of the River Thames	Distance from Order Limits and associated Survey Area (where applicable)	Invertebrate interest
Broom Hill LWS (Thurrock Council, 2007)	North	Within the Order Limits	<p>Ancient acid grassland, home to flora and a diverse invertebrate community.</p> <p>The invertebrate populations are of exceptional importance, this being one of the key Thames Terrace grassland sites within Thurrock. The invertebrate fauna includes: seven Nationally Rare (RDB) species, including the ant <i>Myrmica specioides</i>, which is normally associated with more strictly coastal grasslands; 39 Nationally Scarce species; and over 120 local species. Section 41 Species of Principal Importance include the five-banded weevil wasp, the Hornet robberfly and the brown-banded carder bee. The species in the Essex Red Data List also includes the great green bush-cricket <i>Tettigonia viridissima</i>.</p>
Lytag Brownfield LWS (Thurrock Council, 2007)	North	Within the Order Limits – in Survey Area 5	Forms part of a complex of habitats developing as acid grassland, with an important invertebrate community considered to be of national importance for invertebrate biodiversity (Telfer, 2017).
Low Street Pit LWS (Thurrock Council, 2007)	North	Within the Order Limits – in Survey Area 7	The site lies on the regionally important Thames Terrace gravels. There is a diverse invertebrate fauna associated with the site, including Section 41 species Hornet robberfly.

Site	North or south of the River Thames	Distance from Order Limits and associated Survey Area (where applicable)	Invertebrate interest
West Tilbury Hall LWS (Thurrock Council, 2007)	North	0.05km west of Survey Area 7	This river terrace slope site, adjacent to Broom Hill LWS, contains a diverse invertebrate fauna. These include the Nationally Rare (RDB3 ⁹) bee <i>Andrena florea</i> (which is strongly associated with the flowers of White bryony <i>Bryonia dioica</i>) and the Nationally Scarce bee <i>Osmia bicolor</i> (which nests in empty snail shells and is therefore generally associated with chalky areas where these molluscs are most abundant). It is a rare species in Essex and included on the Essex Red Data List.
Rainbow Shaw LWS (Thurrock Council, 2007)	North	Within the Order Limits – in Survey Area 13	A small ancient woodland fragment. The insect fauna includes glow-worm <i>Lampyrus noctiluca</i> , a very localised beetle in Essex that needs good numbers of snails as prey for its larvae.
Linford Pit LWS (Thurrock Council, 2007)	North	Within Order Limits – in Survey Area 13	This brownfield site supports an important invertebrate fauna and lies within a very significant cluster of such sites. The invertebrate fauna includes several Nationally Rare (RDB) species. These include the bees <i>Apis florea</i> and <i>Nomada fulvicornis</i> (both RDB3), and the wasps <i>Cerceris quinquefasciata</i> (RDB3 and a Section 41 species) and <i>Hedychrum niemelai</i> (also RDB3), as well as several Nationally Scarce spiders and the Nationally Rare fly <i>Myopa polystigma</i> (RDB3).
Linford Wood LWS (Thurrock Council, 2007)	North	0.1km to 0.2km east of Survey Area 13	A hedgebank, mixed woodland, willow plantation, ditches and open area, surrounded by open farmland.

⁹ RDB category 3 species (Rare): Pre-2001 classification for species that occur in small populations and, although not considered Endangered or Vulnerable, are at risk. Recorded from no more than 15 of the 10km by 10km squares in Britain. Superseded by Nationally Rare from the GB Rarity Status categories.

Site	North or south of the River Thames	Distance from Order Limits and associated Survey Area (where applicable)	Invertebrate interest
Buckingham Hill LWS (Thurrock Council, 2007)	North	0.38km to 0.4km to the east of Survey Area 13	Supports 'extensive developing acid grassland'. The national BAP bumblebee <i>Bombus humilis</i> was also recorded in the golf course area and is likely to be foraging extensively on the clovers that are locally abundant in the Tarmac pit. The site is likely to have a high invertebrate interest.
West Tilbury Church LWS (Thurrock Council, 2007)	North	Immediately adjacent to the Order Limits – 1.7km south of Survey Area 13	Supports established grassland similar to what is adjacent to West Tilbury Hall LWS.
Mucking Heath LWS (Thurrock Council, 2007)	North	Within the Order Limits – in Survey Area 8	The rough areas of this golf course, constructed on relict acidic grassland/heath, attract a range of invertebrate species. The insect fauna includes: four Nationally Rare; 50 Nationally Scarce; and over 100 local species.
Orsett Camp Quarry LWS (Thurrock Council, 2007)	North	Immediately adjacent to the Order Limits – north of Survey Area 8 and 0.6km north of Survey Area 13	This former sand/gravel pit has now developed important acid grassland flora in places, along with areas of taller grassland and scrub. Its primary importance lies in its invertebrate populations, notably <i>Hymenoptera</i> (bees, ants and wasps). Within this group there are at least six Nationally Rare RDB and 16 Nationally Scarce species. These include three UK BAP species: the bumblebees <i>Bombus humilis</i> and <i>Bombus sylvarum</i> and the digger wasp <i>Cerceris quinquefasciata</i> . The bumblebee fauna also includes the scarce and declining species <i>Bombus ruderarius</i> , which requires large expanses of flower-rich grassland in which to forage for nectar and pollen.

Site	North or south of the River Thames	Distance from Order Limits and associated Survey Area (where applicable)	Invertebrate interest
Blackshots Nature Area LWS (Thurrock Council, 2007)	North	Within the Order Limits – in Survey Area 9	This large area of rough grassland supports an important invertebrate population. The invertebrate fauna includes seven Essex Red Data List species, as well as the Section 41 fly <i>Dorycera graminum</i> .
West of Arisdale Avenue LWS (Thurrock Council, 2007)	North	Immediately adjacent to the Order Limits – south-west of Survey Area 10	Brownfield site supporting significant populations of invertebrate species with rough, weedy and flower-rich grassland and a small reed-filled hollow.
St Nicholas Church LWS (Thurrock Council, 2007)	North	0.33km south of Survey Area 10	Supports the Nationally Scarce bee <i>Andrena labiata</i> .
Hobbs Hole Wood LWS and ASNW (Brentwood Borough Council, 2012)	North	Within the Order Limits – in Survey Area 11	Area of ancient woodland.
Codham Hall Wood LWS and ASNW (Brentwood Borough Council, 2012)	North	Within the Order Limits – in Survey Area 11	Area of ancient woodland.
Stubbers Adventure Centre SINC (GiGL 2020)	North	Within the Order Limits – west of Survey Area 10b	Acid grassland, secondary woodland and veteran trees. Open water areas that support dragonflies.
Cranham Marsh SINC (GiGL 2022)	North	259m – 1.6km west from Survey Area 10b	Combination of ancient wet woodland, wet meadow and marsh. The invertebrate fauna includes the nationally scarce bee <i>Macropis europaea</i> .
Fields south of Cranham Marsh SINC (GiGL 2020)	North	Within the Order Limits – west of Survey Area 10b	A series of arable fields, hedges and drains, which include rare arable weeds – possibly supporting invertebrate populations and water vole.
Cranham Hall Shaws and Pasture SINC (GiGL 2020)	North	0.05km south-west of Survey Area 11	Mosaic of habitats with botanical interest, of value to a variety of birds and invertebrates, and possibly amphibians.

Site	North or south of the River Thames	Distance from Order Limits and associated Survey Area (where applicable)	Invertebrate interest
Puddle Dock Angling Centre SINC (GiGL 2020)	North	Within the Order Limits – south of Survey Area 11	Grassland, hedgerows and open water areas of potential interest for nesting birds, bats and invertebrates. The area may also support water voles.
Pot Kiln Wood and Sickle Wood SINC (GiGL 2020)	North	0.12km west of Survey Area 11	Pot Kiln Wood is a mosaic of scrub and grassland providing habitat for nesting birds. Sickle Wood is an area of scrub with a partial woodland canopy providing a suitable habitat for foraging and breeding birds and a variety of invertebrates.
Tomkyns East Pastures SINC (GiGL 2020)	North	0.28km north-west of Survey Area 11	Species-rich grassland that is likely to be supporting a diverse range of invertebrate, with ancient hedge and treelines.
Jermains Wood SINC (GiGL 2020)	North	Within the Order Limits – north-west of Survey Area 11	Ancient woodland providing habitat for invertebrates and breeding birds.
Ingrebourne Valley SINC (GiGL 2020)	South	0.3km north of Survey Area 11	Areas of wetland and ancient woodland that contain bare ground suitable for a range of insects <i>Hymenoptera</i> .

Species records

- 5.1.5 The desk study data from the Kent & Medway Biological Records Centre indicated that 171 species had been recorded within 2km of the Order Limits since 2008. This includes: 42 IUCN Red List/Pre-1994 RDB species, including one Extinct, three Endangered, eight Vulnerable, 19 Rare and seven Near Threatened; 34 Kent RDB species; 62 Species of Principal Importance listed under Section 41 of the NERC Act 2006; one Nationally Rare; and 67 Nationally Scarce species. Jersey tiger moth *Euplagia quadripunctaria* and stag beetle were also recorded, which are non-priority species under Annex II of the Habitats Directive.
- 5.1.6 The desk study data from the Essex Wildlife Trust Biological Records Centre indicated that 239 species had been recorded within 2km of the Order Limits since 2008. This includes: 65 IUCN Red List/Pre-1994 RDB species, including two Extinct, 10 Endangered, 23 Rare, eight Vulnerable and 13 Near Threatened; 49 Species of Principal Importance listed under Section 41 of the NERC Act 2006; and 142 Nationally Scarce species. Jersey tiger moth and stag beetle were also recorded, along with an unconfirmed record of lesser whirlpool ramshorn snail *Anisus (Disculifer) vorticulus*, which is a non-priority species under Annex II of the Habitats Directive and considered in need of strict protection under Annex IV of the Habitats Directive. If present, this species,

recorded 730m outside the Order Limits from Chafford Gorges Nature Park, is unlikely to be affected by the Project due to the built environment. This includes housing, industrial units and roads that form a barrier between Chafford Gorges Nature Park and the Project.

- 5.1.7 The desk study data from Essex Field Club (2020) indicated that 4,732 species have been recorded within 2km of the Order Limits since 2008. This includes: 65 IUCN Red List/Pre-1994 RDB species, including: two Extinct, 18 Endangered, 45 Rare, 18 Vulnerable and 22 Near Threatened; 79 Species of Principal Importance listed under Section 41 of the NERC Act 2006; and 268 Nationally Scarce species. Jersey tiger moth and stag beetle were also recorded, which are non-priority species under Annex II of the Habitats Directive.
- 5.1.8 The desk study data from GiGL (2020) indicated that 23 species have been recorded within 2km of the Order Limits since 2008. This includes: 6 IUCN Red List/Pre-1994 RDB species, including one Endangered and three Near Threatened; two Species of Principal Importance listed under Section 41 of the NERC Act 2006; and two Nationally Scarce species. Stag beetle were also recorded, which are a non-priority species under Annex II of the Habitats Directive.

5.2 Tilbury2 Invertebrate survey

- 5.2.1 Survey Areas 5 and 6, selected for their potentially valuable invertebrate interest, lie within the neighbouring Tilbury2 development. The Invertebrate Survey of Tilbury 2 Report (Telfer, 2017) collated results from field surveys carried out in 2017 by Mark Telfer and from the Land Adjacent to Tilbury Power Station, Essex, Invertebrate Survey Report (Colin Plant Associates, 2016).
- 5.2.2 In the report, the whole Tilbury2 Survey Area was split into five subsites. Survey Area 5 of the Project was covered by three of these subsites (Lytag, Tilbury Education and Environment Centre (TEEC) and The Rest), while Survey Area 6 was partially covered by subsite Infrastructure Corridor. Telfer (2017) analysed the data by first looking at the percentage of key species and rare key species (Shirt, 1987). An analysis of the condition of invertebrate habitats found onsite, using the associated invertebrate assemblages they supported, was then carried out. This used ISIS (and its replacement, Pantheon).
- 5.2.3 Over the whole Tilbury2 site, the combination of 2016 and 2017 surveys recorded 1,397 species of invertebrate – covering a wide range of taxonomic groups. This included 10 Species of Principal Importance listed under Section 41 of the NERC Act 2006 and 159 key species (11.4% of the total¹⁰), 31 of which were rare key species (2.2% of the total¹¹). The number of Species of Principal Importance and percentage of key species found is regarded by the author as a strong indication of a site of national importance for conservation.
- 5.2.4 Results from ISIS and Pantheon analysis were contradictory. ISIS analysis defined nine well-represented BATs, seven of which yielded very high or high

¹⁰ Considered a very high percentage when compared with 59 other sites proposed for development, surveyed by the author.

¹¹ Considered a very high percentage when compared with 59 other sites proposed for development, surveyed by the author.

rarity scores¹². This suggested habitats that support these assemblages were in favourable condition and therefore nationally important. Pantheon analysis identified four Broad Biotores onsite and suggested that the SQI values¹³ for three of these sites were low, except for the coastal broad biotope, which supported a very high-quality assemblage. Despite this, the Tilbury2 site was still considered by Telfer (2017) to be of 'national importance'. It was explained that the contradiction in the results between ISIS and Pantheon analysis for the whole Tilbury2 site was due to Pantheon results being harder to contextualise.

- 5.2.5 Two of the three subsites covered by Survey Area 5, Lytag and TEEC, were considered the least important of the five subsites (Telfer, 2017). This is contrary to the report by Colin Plant Associates (2016), which regarded Lytag as the most important area. Despite this, these two subsites still supported a large number of key species and Lytag is the only subsite that supported the Species of Principal Importance, *Ribautodelphax imitans*. The Rest subsite was considered more important than both Lytag and TEEC, with the highest species count (886), a high percentage of key species (11.1%), rare key species (2.4%) and nine Species of Principal Importance recorded.
- 5.2.6 The subsite partially covered by Survey Area 6, the Infrastructure Corridor, was ranked as the third most important subsite, although rare key species were more poorly represented relative to the other subsites (1.6%) it was considered to probably be of national importance of its own right (Telfer, 2017).

5.3 Invertebrate Survey Areas 9 and 12

- 5.3.1 Surveys were not carried out in Survey Areas 9 and 12 for the reasons set out above. Professional judgement, following an analysis of desk study data, analysis of the terrestrial invertebrate components of any designated sites within these areas, and Phase 1 habitat survey data, was used to provide an evaluation of the conservation value of these two areas.

Survey Area 12

- 5.3.2 Survey Area 12, south of the River Thames, comprised coastal and floodplain grazing marsh with a network of drainage ditches running through cattle-grazed semi-improved grassland.
- 5.3.3 Survey Area 12 forms the westernmost extremity of the South Thames Estuary and Marshes SSSI. This is a very large, connected coastal site supporting habitats of high conservation importance of invertebrate interest. Habitat size is an important factor in the robustness and conservation value of a site for invertebrates and in general ecological terms. Despite being a relatively small part of the overall SSSI, at 75ha, Survey Area 12 can be regarded as being a large site in relative terms. However, some of the site lies outside the SSSI boundary and is likely to be of lower conservation value. Furthermore, some of the grazing marsh habitat has been damaged by agricultural activity.

¹² The BAT Rarity Score is the average of all the individual species rarity scores in the assemblage. The rarity scores of individual species are often derived from their designated conservation status, but in some groups they have been taken from an analysis of the number of hectads (a 10km by 10km area) the species occupies, according to data held in the appropriate national recording scheme.

¹³ A measure of the number of rare species in a sample, divided by the total number of species in the sample.

- 5.3.4 In terms of habitat continuity, the value of the site for invertebrates is increased by being part of a much larger biotope, comprising representative estuarine habitats. The major components are known collectively and individually to be important for specialist invertebrates. On a landscape scale, the site is also close to important areas of OMH, coastal grazing marsh and other coastal habitats on the Essex side of the Thames Estuary, with areas known to support extremely rare species and those of high conservation value. These areas are representative of coastal grassland and brownfield sites within the Thames corridor. Survey Area 12 lies within a landscape known to include some of the richest sites for rare and threatened invertebrates in the UK.
- 5.3.5 Although not necessarily recorded from Area 12 itself, threatened species – including Section 41 shrill carder bee, brown-banded carder bee, moss carder bee and red-shanked carder bee, and possibly the sea aster bee *Colletes halophilus* – may forage in the grassland and saltmarsh elements of the site. Also, species such as scarce emerald damselfly, great silver water beetle and other rarities (including aquatic weevils of the genus *Bagous* and water-scavenger beetles of the genus *Berosus*) could potentially be present on site, alongside a range of other rare and uncommon species which specialise in estuarine biotopes within the wider Survey Area. Brackish habitats, including intertidal saltmarsh pools and the mudflats, would be expected to support specialist meiofauna (small invertebrates that live in both marine and freshwater environments). These include bugs such as *Saldula opacula* and *Hebrus pusillus*, as well as mud-living benthos (organisms that live at the bottom of a lake, river or stream, for example) in the intertidal zone.
- 5.3.6 The site supports coastal grazing marsh, saltmarsh and intertidal mudflat habitat. This is unlike the bulk of habitat surveyed in relation to the other Project sites subject to invertebrate surveys during 2018 and 2019. Provisionally, owing to the larger part of Survey Area 12 being subject to SSSI designation and the overall site supporting significant invertebrate assemblages (characteristic of habitat present within the SSSI as a whole) the invertebrate fauna should be considered to be of, at least, national significance. It should be noted that this assessment is not made on detailed invertebrate or habitat information.

Survey Area 9

- 5.3.7 Survey Area 9, north of the River Thames, comprises a matrix of grassland and scrub habitats with some microtopographic features (surface of an area on a microscopic scale) and a probable bare ground resource. Survey Area 9 includes Blackshots Nature Area LWS, designated in part for its importance for invertebrates. The additional part of Survey Area 9, brownfield land to the east, appears to support grassland, scrub and partly vegetated bare ground habitat with elements of disturbance, characteristic of habitat within the definition for Section 41 OMH on previously developed land.
- 5.3.8 Both components of Survey Area 9 are within 2km of other LWSs supporting OMH and remnant acid and/or Thames Terrace grassland, such as Mucking Heath LWS and Orsett Golf Course LWS. Collectively, these sites are large in area and, in turn, connect similar habitat within the wider south Essex Thames corridor. Despite being fragmented, this biotope is recognised for its importance for brownfield and grassland invertebrate assemblages, which include some of the richest sites for rare and threatened invertebrates in the UK.

- 5.3.9 The Blackshots Nature Area LWS component of Survey Area 9 is considered to be important for invertebrates characteristic of grassland and OMH habitats within the wider Essex landscape. It is also known to support Section 41 priority species such as the Phoenix Fly and Small Heath butterfly. The LWS citation refers to seven Essex RDB species onsite. However, it is uncertain whether the site has been subject to a detailed invertebrate survey, either historically or recently.
- 5.3.10 There are recent records of Section 41 and OMH flagship species from within 2km of Survey Area 9. This includes threatened, albeit mobile, species such as the shrill carder bee, brown-banded carder bee, red-shanked carder bee, five-banded weevil wasp and Hornet robberfly, as well as Nationally Rare and Essex Endangered species including the Large scabious mining bee and a gnaphosid spider *Zelotes petrensis*. At least some of these species are potentially present in Area 9.
- 5.3.11 Owing to their locality, size and apparent floristic and structural composition, it is likely that the Blackshots Nature Area LWS, or the brownfield land to the east of these sites, collectively and individually support invertebrate assemblages of at least regional significance. It should be noted that this assessment is not made on detailed invertebrate and habitat information.

5.4 Field surveys

- 5.4.1 Of the two sites to the south of the River Thames, Survey Area 1 comprised broadleaved semi-natural woodland, including ancient woodland. Survey Area 2 broadly supported combinations of habitat classifiable as OMH on previously developed land, broadleaved woodland and flower-rich grassland habitats.
- 5.4.2 To the north of the River Thames, Survey Areas 3, 4, 7, 8, 10b and 13 broadly supported combinations of OMH and flower-rich grassland habitats. Survey Areas 10a and 11 supported predominately broadleaved semi-natural woodland. Most sites were generally dry with, at most, some sign of elements that block drainage or evidence of seasonal flooding. However, there was significant wetland habitats within the woodland of Survey Areas 10a, 3 and 7. The habitat in the latter two sites included brackish habitat.
- 5.4.3 In total, 1,075 species were recorded from the Survey Areas. A list of notable species recorded during the 2018 surveys is included in Annex B, together with a breakdown of the number of species recorded per taxon.
- 5.4.4 From the Survey Areas, a total of 136 species of higher conservation status in the UK were recorded. These included one species of cuckoo wasp *Hedychrum rutilans*, which has been classed as Extinct in the UK since last being recorded in 1902.
- 5.4.5 Eight species classed as Species of Principal Importance under Section 41 of the NERC Act 2006 were recorded. Also recorded were:
- Plate A.1 Three species classed as (RDB2) nationally Vulnerable
 - Plate A.2 Fourteen Nationally Rare (RDB3) species
 - Plate A.3 Three species classed as unknown (RDBK)

d. Plate A.4 Ninety-one species currently classed as Nationally Scarce

5.4.6 In addition, at least 79 of the recorded species are listed as Essex RDB species. All species of higher conservation status recorded are set out in Annex B. The species are also discussed at a site-specific level in the discussion and evaluation sections of this report.

5.4.7 Due to the spread of survey sites over a large area, including sites to the north and south of the River Thames, data search results are considered at a site-by-site level. For each Survey Area, the landscape scale interrelationships between Survey Areas, designated sites and other habitats of note, are considered within the discussion and evaluation sections of this report. Conclusions on the survey data for each Survey Area are presented below, with a summary provided in Annex C.

Survey Area 1: Shorne Woods Country Park, Ashenbank Woods and Brewers Wood

5.4.8 The Survey Area supported almost continuous ancient semi-natural broadleaved woodland on a mix of gravels, clays and sand. The main variation was due to differences in habitat structure and composition. The sample sites covered both mature wooded areas and woodland clearings.

5.4.9 Habitat within Survey Area 1 was fairly representative of the Shorne Woods Country Park and Ashenbank Wood SSSI, designated in part for its important and diverse invertebrate fauna, especially its beetles *Coleoptera*, true bugs *Hemiptera* and dragonflies *Odonata*. The conservation value of this ancient woodland is increased by its large size, the representativeness of habitat and close proximity to other designated woodland habitat in the local area.

5.4.10 A diverse range of tree, scrub and ground flora species were recorded, although ancient woodland ground flora indicators were rather locally distributed. There was also a standing and fallen wood decay habitat. However, the wood decay habitat was often inaccessible during the survey.

5.4.11 During the survey, 13 species of higher conservation importance were recorded from Survey Area 1. At a habitat level, none of the recorded assemblages achieved SQI scores approaching their corresponding favourable condition (FC) targets. However, on a SAT level, one assemblage F002 rich flower resource exceeded its specified FC threshold.

Survey Area 2: Claylane Wood

5.4.12 The site comprised significant areas of ancient semi-natural broadleaved woodland (approximately 9.5ha) and herb-rich, semi-improved neutral grassland, tall ruderal and disturbed ground (approximately 4.5ha).

5.4.13 Although Survey Area 2 was not subject to a statutory designation, the site supported habitat of high potential value for invertebrates. The value of the site was increased both by its variety in structure, the age of woodland and the diversity of flowering species within the grassland and woodland edge. The contrast of ancient woodland with sparsely vegetated, disturbed ground habitat in sunny open conditions provided habitat of high potential value for ground-nesting aculeate (such as flies, bees, ants and wasps) *Hymenoptera* and other thermophilic taxa (organisms that live in quite high temperatures). This was

borne out both by the number of rare and uncommon species recorded and by the results of Pantheon analysis. The continued history of woodland on the site increased the biodiversity value of the site, and the edge habitat added significantly to the overall conservation value of Survey Area 2.

- 5.4.14 The value of the site contributes to the woodland and grassland habitat resources on a landscape scale, being close to the Shorne Wood Country Park and Ashenbank Wood SSSI complex, and with some habitat connecting with grassland, hedgerow and wooded habitats stretching towards the floodplain grazing marsh habitat, approaching the River Thames to the north.
- 5.4.15 Despite the relatively small size of the site, 29 species of higher conservation importance were recorded during the survey.
- 5.4.16 Three SATs – the F002 rich flower resource, F001 scrub edge and F112 open short sward – produced scores that exceeded their corresponding favourable condition thresholds set in Pantheon. Assemblages exceeding their favourable condition thresholds can be considered to be of national importance; i.e. are of a quality expected to be achieved by an invertebrate population as a designated, monitorable feature in an SSSI.

Survey Area 3: Goshems Farm

- 5.4.17 At the time of the 2018 survey, a large proportion of the Goshems Farm LWS, which had comprised a mixture of OMH on previously developed land and grassland, had been destroyed through aggregate works. There was also significant ongoing activity to remove pulverised fuel ash from the site. Despite significant habitat destruction through aggregate working on the site and loss of extensive areas of land previously comprising Goshems Farm LWS, Survey Area 3 still supported extensive areas of OMH and grassland habitat. Areas of habitat surveyed were typically flower rich and botanically diverse. In terms of representativeness, the habitat was typical of the OMH on previously developed land habitat type, characteristic of brownfield sites adjoining the River Thames in Essex. These habitats benefit from a consistent climate and the habitat structure and diversity of nectar-bearing plants, which provide a microhabitat of high conservation value for specialist invertebrate species.
- 5.4.18 The site was adjacent to significant areas of post-industrial OMH habitat, Thames Terrace grasslands, saltmarsh, ditches and grazing marsh. These form an extensive network of habitats recognised as supporting invertebrate assemblages of national importance.
- 5.4.19 During the survey, 55 species of higher conservation importance were recorded from Survey Area 3. The record of greatest interest for the survey as a whole was the discovery of a cuckoo wasp *Hedychrum rutilans* on site. *Hedychrum rutilans* was considered Extinct in the UK before 2018.
- 5.4.20 Three SATs – the F002 rich flower resource, F111 bare sand and chalk and F003 scrub-heath and moorland – produced scores that exceeded their corresponding favourable condition thresholds set in Pantheon. Assemblages exceeding their favourable condition thresholds can be considered to be of national importance.
- 5.4.21 The rich flower resource assemblage included several species of high conservation value, including the Species of Principal Importance shrill carder

bee, brown-banded carder bee, red-shanked carder bee and several ground-nesting RDB and Nationally Scarce species. The bare sand and chalk assemblage included species that are associated with hot, dry soil conditions normally found in bare ground in early successional habitats and the closely allied scrub-heath and moorland assemblage. While being more often found in acid heathlands, they are also indicative of the more xerophile (organisms that live in dry areas) scrubby conditions found in OMH.

- 5.4.22 Since the initial survey work was undertaken in 2018, there has been a particular focus on ditch “JN1” (TQ672758 to TQ674766) with regards to its possible inclusion within a SSSI boundary. Therefore, further survey was undertaken in June 2022 to focus on this area (see Annex D of this report).
- 5.4.23 Fifteen protected / notable terrestrial invertebrate species were present within the “JN1” survey area update. The findings of this survey update are in accord with the 2018 survey results for Survey Area 3 which indicated a site of national significance. A high number of species, including protected / notable species, were generated from one visit (see document 6.3-ES_App8.03a – Terrestrial Invertebrate Survey Update JN1).

Survey Area 4: Horse Field

- 5.4.24 Survey Area 4 was a large site supporting flower-rich grassland and scrub habitat of consistent quality. The site was located within, and was integral to, a complex of sites supporting post-industrial, remnant Thames Terrace grassland and coastal brackish habitats. These sites are collectively known to support invertebrate populations of national or international significance. During the survey, 32 species of higher conservation importance were recorded from Survey Area 4.
- 5.4.25 Survey Area 4 data analysis using Pantheon produced habitat-level divisions with tall sward and scrub, short sward and bare ground and arboreal assemblages all significantly represented. The SQI score attained for the short sward and bare ground indicated that this was the habitat-level assemblage of highest conservation value, supporting a collection marginally short of national importance.
- 5.4.26 For Survey Area 4, two SATs – the F002 rich flower resource and F112 open short sward – produced scores that exceeded their corresponding favourable condition thresholds. This also included several species of high conservation value, including shrill carder bee, brown-banded carder bee and several ground-nesting RDB and Nationally Scarce species.

Survey Area 7: Low Street Pit

- 5.4.27 The Low Street Pit section supported Thames Terrace grassland remnants and a mosaic of scrub/woodland/tall ruderal (approximately 3ha), unimproved acid grassland (approximately 1ha) and wetland habitat (0.2ha). The European Metal Recycling (EMR) section included primarily OMH with extensive areas of dense, continuous scrub and tall herb habitat at the margins. The surveyed OMH occupied an area of approximately 4ha.
- 5.4.28 The two areas surveyed collectively as Survey Area 7 supported a combination of habitats representative of sites of higher conservation value, characteristic of the south Essex landscape. The EMR site supported typical flower-rich OMH

habitat with varied topography and a combination of native and naturalised herbs and elements of anthropogenic disturbance (from human activity). These elements provided a mosaic of both sparsely and densely vegetated habitat suitable for supporting more xerophilous (those adapted to a dry habitat) and thermophilic (those that thrive in relatively high temperatures) invertebrate assemblages. In contrast, the Low Street Pit LWS site supported an established mosaic of grassland and scrub, with areas of rabbit-grazed acid grassland and wetland habitat supporting brackish and freshwater species. The site was within and is integral to, a complex of sites supporting post-industrial OMH, remnant Thames Terrace grassland and coastal brackish habitats. These sites are collectively known to support invertebrate populations of national or international significance.

- 5.4.29 During the survey, 36 species of higher conservation importance were recorded from Survey Area 7.
- 5.4.30 Pantheon analysis produced habitat-level divisions that reflected the actual habitat surveyed with tall sward and scrub, short sward and bare ground, arboreal, peatland and marshland assemblages all significantly represented within the output. The SQI score attained for the short sward and bare ground assemblage, indicated that this was the habitat-level assemblage of highest conservation value, supporting a collection approaching nationally important.
- 5.4.31 Three SATs – the F002 rich flower resource, F112 open short sward and F003 scrub-heath and moorland – produced scores that exceeded their corresponding favourable condition thresholds. The rich flower resource assemblage also included several species of high conservation value. This included the brown-banded carder bee and sea aster bee, as well as two RDB species, squat furrow bee *Lasioglossum pauperatum* and little blue carpenter bee *Ceratina cyanea*, and several Nationally Scarce species.

Survey Area 8: Mucking Heath

- 5.4.32 The site comprised relict acid grassland (approximately 4ha), with deciduous scrub/woodland at the margins (approximately 3ha).
- 5.4.33 Compared with most sites surveyed during 2018, Survey Area 8 was relatively small, consisting of approximately 7ha of acid grassland and scrub habitat. However, the Survey Area was part of the much larger (approximately 50ha) Mucking Heath LWS, which largely consisted of the Orsett Golf Course.
- 5.4.34 Although much of the golf course grassland constituted manicured fairway and green, the site supported considerable rough habitat representative of remnant Thames Terrace grassland, overlaying characteristic sand and gravel geology. The habitat within the Survey Area was representative acid/Thames Terrace grassland. And the Mucking Heath LWS was connected in the wider landscape to other LWS supporting similar grassland habitat, as well as habitat classifiable as OMH on previously developed land.
- 5.4.35 During the survey, 10 species of higher conservation importance were recorded from Survey Area 7.
- 5.4.36 Onsite, the habitat was reasonably structurally diverse, with areas of shorter and taller sward acid grassland. While this habitat was not as flower rich as some of the other grasslands or OMH sites surveyed, it was representative of

acid grassland/Thames Terrace grasslands in terms of composition. The scrub component provided habitat for epiphyte invertebrate species. Rabbit grazing was a feature of parts of the site. Shorter grazed, scrub-edged areas of dry, free-draining grassland, with patches of exposed, sandy soil and anthills created by yellow meadow ant *Lasius flavus*, added to the structural dynamic and provided habitat for more xerophile invertebrates associated with warm, dry microhabitats.

- 5.4.37 Most species recorded from Survey Area 8 were attributed to the tall sward and scrub habitat-level assemblage, with both short sward and bare ground and arboreal assemblages being reasonably well represented. Short sward and bare ground was of highest conservation value.
- 5.4.38 A single assemblage – F003 scrub-heath and moorland – achieved a species score exceeding its corresponding favourable condition threshold, indicating an assemblage approaching national significance.

Survey Area 10a: North Ockendon (woodland)

- 5.4.39 This Survey Area consisted of woodland that supported semi-natural broadleaved woodland (approximately 4ha) with two large ponds (approximately 0.1ha in total).
- 5.4.40 Survey Area 10a site was mature and provided a diverse range of features representative of semi-natural broadleaved woodland. While the ponds within the woodland were evidently man-made, these features, associated watercourses and silted margins, provided habitat for invertebrate species associated with wetlands and wet woodland seepage habitats. Although much of the ground layer was shaded, there was a valuable resource of wood decay habitat of value to bark and sapwood decay invertebrates. There was also tree with fungal resource and some rot holes and other features with potential to support heartwood decay invertebrates.
- 5.4.41 In terms of habitat, the site was somewhat isolated, with little connected arboreal habitat. However, deciduous woodlands are generally under-represented within the Thurrock district of south Essex. And, on a broader landscape scale, there were several wooded areas within a 2km radius of the site and to the north. Stepping-stone woodland habitat provided some link with more substantial woodland areas such as Survey Area 11.
- 5.4.42 During the survey, 16 species of recognised conservation status were recorded.
- 5.4.43 From Pantheon analysis, the largest number of species were attributed to the tall herb and scrub assemblage at a habitat level. However, the tree associated arboreal and shaded woodland floor assemblages were of slightly higher conservation value.

Survey Area 10b

- 5.4.44 This Survey Area consisted of open habitats. This comprised a mosaic of rough, semi-improved grassland and tall herb (approximately 13ha), and scrub (approximately 1ha in total) habitat on the site of a historic landfill site.
- 5.4.45 In relation to other 2018 Survey Areas, Survey Area 10b was of moderate size and was not subject to any statutory or non-statutory designations. On a landscape scale, Survey Area 10b was somewhat removed from sites

statutorily designated for their nature conservation value. However, the site was sufficiently close to the band of coastal and inland brownfield and Thames Terrace grassland to provide a stepping-stone habitat with characteristics of value to OMH invertebrate species occurring in metapopulations (separate populations of species that interact on some level) and known to move between sites on a landscape scale.

- 5.4.46 During the survey, 13 species of higher conservation importance were recorded from Survey Area 10b.
- 5.4.47 The Pantheon output showed that the majority of species by far recorded during 2018 were open habitat species, with tree associated and wetland species, in descending order, being attributed by far fewer species.
- 5.4.48 At habitat level, again the deployment of species was as expected in terms of Pantheon output, with the tall sward and scrub comprising over half of all recorded species from the site. Although the SQI registered for this assemblage was not particularly high, the assemblage did contain both shrill carder bee and brown-banded carder bee. Importantly, the importance of Species of Principal Importance as listed under Section 41 of the NERC Act 2006 is not recognised in Pantheon, the analysis being based on species' rarity status.
- 5.4.49 At SAT level, 1 assemblage, epiphyte fauna, achieved favourable condition status in the Pantheon output. While generally an assemblage achieving FC in Pantheon is considered to be of or around national significance, the very low species threshold set in Pantheon for this assemblage and the fact that several of the species ascribed to it are fairly common. This means that this status is achieved fairly frequently for sites of otherwise modest conservation value.

Survey Area 11: M25 Woodlands

- 5.4.50 The Survey Area comprised two blocks of semi-natural broadleaved woodland situated around the roundabout at the junction between the M25 and A127. The north-east woodland block (Codham Hall Wood) comprised approximately 14ha of ancient woodland, and a small area of woodland edge habitat at the north-east corner was also surveyed (0.1ha). The south-west compartment comprised semi-natural broadleaved woodland (13ha) and open grassland and scrub woodland edge and clearing habitat (approximately 3ha). The north-east and south-west compartments were surveyed as a single unit.
- 5.4.51 The datasets from Survey Area 11, including the north-east, ancient woodland site Codham Hall Wood and the non-ancient woodland south-west section, were combined for the purpose of analysis.
- 5.4.52 The structural diversity of the Codham Hall Wood habitat was limited, and the ground layer, while supporting some ancient woodland indicator flora, was for the most-part heavily shaded. In contrast, the south-west section exhibited considerable structural diversity and also included an extensive woodland edge clearing, with herb-rich grassland, tall herb vegetation and scrub mosaic. This open habitat was characterised by free-draining patches of short sward grassland interspersed with sparsely vegetated bare ground and localised areas of damper habitat, subject to drainage impedance. Collectively, these two subsites provided a good representation of broadleaved woodland heterogeneity.

- 5.4.53 During the survey, 19 species of higher conservation importance were recorded from Survey Area 11.
- 5.4.54 Within the biotope-level Pantheon output, more than half of all species recorded from Survey Area 11 were attributed to the open habitats assemblage, with only approximately 25% of the species being attributed to the tree associated assemblages. At habitat level, approximately 50% of surveyed species were attributed to the tall sward and scrub assemblages at habitat level. This habitat, to some extent, represents species associated with woodland edge and scrub habitats as well as open habitats.
- 5.4.55 While tall sward and scrub supported most species, results indicated that the habitat-level assemblage of greatest conservation value recorded from analysis of the entire Survey Area 11 dataset was short sward and bare ground.

Survey Area 13

- 5.4.56 Survey Area 13 comprised: semi-natural broadleaved woodland and scrub (24ha); semi-improved neutral grassland (11ha); OMH (9ha); unvegetated bare ground/active quarry (4ha) and standing water (1ha).
- 5.4.57 Two LWS sites occupy the footprint of Survey Area 13. The north corner of the site comprises Linford Pit LWS, a brownfield site, which supports an important invertebrate fauna and lies within a very significant cluster of similar sites. The eastern part of the site includes Rainbow Shaw LWS, which, according to the Green Grid Wildlife Strategy (2007), is thought to be a small ancient woodland fragment. The part of Survey Area 13 lying outside the LWS boundary to the south comprised a mixture of tussocky grassland, with scattered scrub, OMH (bare ground and rubble piles) and a lake bordered with common reed *Phragmites australis* and mature willow *Salix spp.*, alder *Alnus glutinosa* and oak *Quercus sp.* There was also a dead wood resource in and around the lake.
- 5.4.58 During the survey, 48 species of recognised conservation status in the UK and/or within the Essex RDB were recorded.
- 5.4.59 Most of the 48 species of recognised conservation status were shared between the two open ground assemblages tall sward and scrub and short sward and bare ground, with the remainder being deployed between the remaining wetland and tree associated assemblages at habitat level.
- 5.4.60 Results of the Pantheon analysis indicated that assemblages relating to the OMH and herb-rich grassland components of the site supported assemblages of the highest conservation value. Favourable condition status thresholds were exceeded for the resource-based F002 rich flower resource and F001 scrub edge SATs, and the rich flower resource SAT supported species characteristic of OMH and herb-rich grassland of high conservation value. The stand-out habitat-based SATs included F112 open short sward and F111 bare sand and chalk and their parent habitat level assemblage short sward and bare ground, which fell slightly short of achieving their favourable condition targets.

6 Assumptions and limitations

- 6.1.1 The initial survey timing was sub-optimal to enable the sampling of key tree associated invertebrate species. Therefore, a precautionary approach has been taken in evaluating arboreal sites to account for such limitations whereby it is assumed that tree associated species were of a higher conservation value than the results show.
- 6.1.2 No targeted night-flying moth survey was carried out. In relation to arboreal canopy species, Drake et al. (2007) describe moths as being ‘the dominant group and the tree canopy is the habitat that supports the greatest number of species’. The only satisfactory method for sampling night-flying moths is by overnight mercury vapour trapping. This can be impractical in public areas due to the likelihood of public interference with the equipment and, as such, was not carried out for this Project. A precautionary approach has been taken in evaluating arboreal sites to account for such limitations.
- 6.1.3 Owing to the late start of the 2018 survey, data was collected over two sampling events. The timings of these coincided with peak emergence times of OMH and grassland habitats and complied with the recommendations within the Essex Standard. However, under optimal conditions at least three survey visits are recommended, beginning earlier in the season. A precautionary approach has been taken in evaluating Survey Areas to account for such limitations.
- 6.1.4 During the 2018 survey, a number of species ascribed to both wetland and coastal assemblages in Pantheon were recorded. However, although wetland margins were sampled, aquatic habitats were not sampled for the purpose of this report and are reported separately in the Environmental Statement Terrestrial Biodiversity Appendix 8.4 Freshwater Ecology (Application Document 6.3).
- 6.1.5 Sampling in 2018 was restricted to sites and parts of sites for which survey permission was granted. Certain areas (including Survey Area 9) selected for survey during the scoping study were omitted due to lack of site access.
- 6.1.6 For practical reasons, only direct capture methods were used during the 2018 surveys. These included standard methods recommended for analysis using Pantheon and therefore can be seen as being sufficiently robust in terms of providing a sufficient resolution of data for robust analysis. However, a greater data resolution may have been achieved had indirect methods, such as pitfall trapping, flight interception traps and water traps, been used alongside the direct capture methods. Indirect methods were not used because of the length of time in between survey visits made sample collection difficult, and the level of public access to most Survey Areas meant a high likelihood of tampering.
- 6.1.7 Relatively few records of incidental invertebrates were made during the 2019 survey. It is uncertain whether certain species frequently recorded in comparable habitat in south Essex, but not recorded either by direct observation during the survey or included within samples, had been overlooked or were genuinely absent.

References

- Ball, S. G (1986). Terrestrial and freshwater invertebrates with Red Data Book, Notable or habitat indicator status. Invertebrate Site Register internal report number 66. NCC.
- Brentwood Borough Council (2012). Brentwood Borough Local Wildlife Site Review 2012. Accessed December 2019. <https://document.brentwood.gov.uk/pdf/17072013120644u.pdf>
- Buglife (2018). Advice on managing BAP habitats: Lowland heathland. Buglife, Peterborough. [REDACTED]
- Chartered Institute of Ecology and Environmental Management (CIEEM) (2018). Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, 2nd edition. CIEEM, Winchester.
- Colin Plant Associates (2016). Land Adjacent to Tilbury Power Station, Essex, Invertebrate Survey Report. Bioscan (UK) Ltd, Oxford.
- Council of Europe (1979). Convention on the Conservation of European Wildlife and Natural Heritage. Bern, Switzerland. [REDACTED]
- Council of Europe (1992). Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Habitats Directive). Official Journal of the European Communities.
- Drake, C.M., Lott, D.A., Alexander, K.N.A. and Webb, J. (2007). Research report NERR005 – surveying terrestrial and freshwater invertebrates for conservation evaluation. Peterborough: Natural England.
- Essex Biodiversity Project (2011). Essex Biodiversity Action Plan 2010 – 2020. A vision to protect and enhance the biodiversity of Essex. Essex Biodiversity Project, Essex Wildlife Trust.
- Essex Field Club (2022). Biological records data request; issued April 2020. [REDACTED]
- Essex RDB (2014). Essex Red Data list. [REDACTED]
- Essex Wildlife Trust Biological Records Centre (2020). Biological records data request; issued 30 March 2020. [REDACTED]
- Eyre, M.D., Luff, M.L. & Woodward, J.C. (2002). Rare and notable Coleoptera from post-industrial and urban sites in England.
- Eyre, M.D., Luff, M.L. & Woodward, J.C. (2004). Beetles (Coleoptera) on brownfield sites in England: an important conservation resource? *Journal of Insect Conservation*, 7, 223–231.
- Falk, S.J. and Crossley, R. (2005). A review of the scarce and threatened flies of Great Britain Part (3):Empidoidea. Species status 3: 1-134. Joint Nature Conservation Committee, Peterborough.
- Falk, S.J., Ismay, J.W., and Chandler, P.J. (2016). A provisional assessment of the status of acalyptatae flies in the UK. Natural England commissioned reports, number 217.

Gibson, C.W.D. (1998). Brownfield: red data. The values of artificial habitats have for uncommon invertebrates. (pp. 1-43). Peterborough: English Nature.

Green Grid Wildlife Strategy (2007). Thurrock Biodiversity Study 2006-2011. Version 1.2. EECOS.

Greenspace Information for Greater London CIC (GiGL) (2022). Biological records data request; issued June 2020. [REDACTED]

Harvey, P., (2000). The East Thames Corridor: a nationally important invertebrate fauna under threat. *British Wildlife*, 12(2), 91-98.

Harvey, P.R. (2014). Chafford Hundred 2014 invertebrate survey report. Accessed August 2018. [REDACTED]

IUCN (2012). Guidelines for the application of IUCN Red List criteria at regional and national levels: Version 4.0 Switzerland.

JNCC (2000). Information Sheet on Ramsar Wetlands (RIS) Thames Estuary and Marshes Ramsar. Accessed October 2018. [REDACTED]

JNCC (2009). Common standards monitoring for lowland heathland. Peterborough: Joint Nature Conservation Committee.

Kent RDB (1999). Kent Red Data list.

<https://shareweb.kent.gov.uk/Documents/environment-and-planning/kent-red-data-book.pdf>

Kent BAP (2011). The State of Kent's Wildlife in 2011, which lists Kent's BAP priority species. [REDACTED]

Kent & Medway Biological Records Centre (2022). Biological records data request; issued 27 March 2020. [REDACTED]

KWT (1993). Designated sites data request; Kent Local Wildlife Site. Shorne Pasture citation GR18. Issued September 2017. [REDACTED]

KWT (2018). Designated sites data request; Kent Local Wildlife Site. Ebbsfleet Marshes: citation GR05. Issued April 2020.

KWT (2009). Designated sites data request; Kent Local Wildlife Sites. Canal and Grazing Marsh: citation GR17. Issued September 2017. [REDACTED]

Lott, D.A. (2008). Synopsis of ISIS, 2009 and its use in common standards monitoring. Stenus Research.

Met Office (2016). Southern England: climate. Met Office, Exeter. [Online]
<https://www.metoffice.gov.uk/climate/uk/regional-climates/so>

Natura 2000 (2008). Protecting Europe's biodiversity, published on 2008/11/11, in English digital book or in paper book (ISBN 978-92-79-08308-2).

Natural England (1984a). Halling to Trottscliffe Escarpment SSSI citation. Accessed December 2019.

h [REDACTED]

Natural England (1984b). Church Woods, Blean SSSI Citation. Accessed March 2020.
[REDACTED]

Natural England (1988). Shorne and Ashenbank Woods SSSI Citation. Accessed October 2018.
[REDACTED] f

Natural England (1990). Holborough to Burnham Marshes SSSI Citation. Accessed March 2020.
[REDACTED]

Natural England (1991a). South Thames Estuary and Marshes SSSI Citation. Accessed October 2018.
[REDACTED]

[REDACTED].pdf

Natural England (1991b). Mucking Flats and Marshes SSSI Citation. Accessed October [REDACTED] df

Natural England (1993a). Grays Thurrock Chalk Pit SSSI Citation. Accessed December [REDACTED]

Natural England (1993b). Grove House Wood LNR. Accessed December 2019.
[REDACTED] =

Natural England (2005). The Manor LNR. Accessed December 2019.

Natural England (2008). Cranham Brickfields LNR. Accessed October 2018.
[REDACTED]

Natural England (2013). Thames Terrace Invertebrates: A Masterplan for Landscape-scale Conservation in the Greater Thames Marshes.

Natural England (2014). Invertebrate Standard Advice for Essex. Natural England, Peterborough.

Natural England (2018). Rede Common LNR. Accessed June 2020.
[REDACTED]

Natural England (2021). Swanscombe Peninsula SSSI Kent, Notification under Section 28C of the wildlife and Countryside Act 1981. Accessed July 2021.

https://consult.defra.gov.uk/natural-england/swanscombe-peninsula/supporting_documents/1%20%20Swanscombe%20Peninsula%20Notification%20Document%2011%20March%202021.pdf

Natural England (2021). Priority Habitats Inventory. Accessed December 2021

<https://data.gov.uk/dataset/4b6ddab7-6c0f-4407-946e-d6499f19fcde/priority-habitat-inventory-england>

NERC (2006). Natural Environment and Rural Communities Act. 2006. [Online].
<http://www.legislation.gov.uk/ukpga/2006/16/contents>

Riding, A., Critchley, N., Wilson, L. and Parker, J. (2010). Definition and mapping of open mosaic habitats on previously developed land: Phase 1. Wolverhampton: ADAS Ltd.

Shirt, D.B. ed. (1987). Red Data Book of British Insects. Joint Nature Conservation Committee.

Telfer, M.G. (2017). Invertebrate Survey of Tilbury2, Port of Tilbury, London.

Thurrock Council (2007) Thurrock Biodiversity Study 2006-2011. Accessed October 2018.
<https://www.thurrock.gov.uk/sites/default/files/assets/documents/eb.010.pdf>

Webb, J., Heaver, D., Lott, D., Dean, H.J., van Breda, J., Curson, J., Harvey, M., Gurney, M., Roy, D.B., van Breda, A., Drake, M., Alexander, K.N.A. and Foster, G. (2017).
Pantheon – database version 3.7.4. [Online]. Accessed October 2017.
<http://www.brc.ac.uk/pantheon/>

Annexes

Annex A Field Survey Sample Method

Table A.1 Field survey sample method per Survey Area and sample number

Invertebrate Survey Area	Number of samples	Sample type	Survey dates	Broad habitat surveyed	Habitat layer surveyed
Survey Area 1	24	<ul style="list-style-type: none"> • Timed sweep • Timed vacuum • Timed beat • Direct search 	27 June 2018 15 August 2018	Semi-natural broadleaved woodland	<ul style="list-style-type: none"> • Shrub/tree layer • Field layer • Ground layer
Survey Area 2	23	<ul style="list-style-type: none"> • Timed sweep • Timed vacuum • Timed beat • Direct search 	26 June 2018 15 August 2018 16 August 2018	Semi-improved grassland and scrub/OMH Semi-natural broadleaved woodland	<ul style="list-style-type: none"> • Shrub/tree layer • Field layer • Ground layer
Survey Area 3	21	<ul style="list-style-type: none"> • Timed sweep • Timed vacuum • Timed beat • Direct search 	10 July 2018 11 July 2018 22 August 2018	OMH/brackish pond margin Woodland edge and scrub	<ul style="list-style-type: none"> • Shrub/tree layer • Field layer • Ground layer
Survey Area 4	15	<ul style="list-style-type: none"> • Timed sweep • Timed vacuum • Timed beat • Direct search 	11 July 2018 21 August 2018	Semi-improved grassland and scrub/OMH	<ul style="list-style-type: none"> • Shrub/tree layer • Field layer • Ground layer
Survey Area 7	26	<ul style="list-style-type: none"> • Timed sweep • Timed vacuum • Timed beat • Direct search 	17 June 2018 28 June 2018 20 August 2018	OMH Semi-improved acid grassland and scrub	<ul style="list-style-type: none"> • Shrub/tree layer • Field layer • Ground layer

Invertebrate Survey Area	Number of samples	Sample type	Survey dates	Broad habitat surveyed	Habitat layer surveyed
Survey Area 8	12	<ul style="list-style-type: none"> • Timed sweep • Timed vacuum • Timed beat • Direct search 	27 June 2018 9 July 2018 17 August 2018	Semi-improved acid grassland and scrub	<ul style="list-style-type: none"> • Shrub/tree layer • Field layer • Ground layer
Survey Area 9 (not surveyed due to access constraints)					
Survey Area 10a	13	<ul style="list-style-type: none"> • Timed sweep • Timed vacuum • Timed beat • Direct search 	12 July 2018 14 August 2018	Semi-natural broadleaved woodland	<ul style="list-style-type: none"> • Shrub/tree layer • Field layer • Ground layer
Survey Area 10b	6	<ul style="list-style-type: none"> • Timed sweep • Timed vacuum • Timed beat • Direct search 	14 August 2018	Grassland, tall ruderal and scrub, and OMH	<ul style="list-style-type: none"> • Shrub/tree layer • Field layer • Ground layer
Survey Area 11	16	<ul style="list-style-type: none"> • Timed sweep • Timed vacuum • Timed beat • Direct search 	29 June 2018 13 August 2018	Semi-natural broadleaved woodland and herb-rich grassland/scrub mosaic	<ul style="list-style-type: none"> • Shrub/tree layer • Field layer • Ground layer
Survey Area 12 (area scoped out due to lack of predicted impacts)					

Invertebrate Survey Area	Number of samples	Sample type	Survey dates	Broad habitat surveyed	Habitat layer surveyed
Survey Area 13	5	<ul style="list-style-type: none"> • Timed sweep • Timed vacuum • Timed beat • Direct search 	11 June 2019 13 June 2019 4 July 2019 6 August 2019 7 August 2019	Wetland habitats including marshy grassland and marginal macrophyte beds OMH and tall herb habitat, herb-rich semi-improved grassland, woodland edge (arboreal species from scrub) and lower canopy (ground and field layer)	<ul style="list-style-type: none"> • Shrub/tree layer • Field layer • Ground layer • Aquatic habitat

Annex B Species Recorded During Field Surveys

Table B.1 Number of species recorded by taxon from total field survey data (2018 to 2019)

Order	Vernacular	Number of species per taxon
Survey Areas 1, 2, 3, 4, 7, 8, 10, 11 and 13		
<i>Coleoptera</i>	Beetles	361
<i>Diptera</i>	Two-winged flies	317
<i>Hemiptera</i>	True bugs	213
<i>Araneae</i>	Spiders	132
<i>Aculeate Hymenoptera</i>	Bees, ants and wasps	122
<i>Lepidoptera</i>	Butterflies and moths	41
<i>Orthoptera</i>	Grasshoppers and crickets	14
<i>Odonata</i>	Dragonflies and damselflies	14
<i>Opiliones</i>	Harvestmen	8
<i>Isopoda</i>	Woodlice and slaters	5
<i>Dermaptera</i>	Earwigs	3
<i>Lithobiomorpha; Scolopendromorpha</i>	Centipedes	3
<i>Pseudoscorpions</i>	Pseudoscorpions	2
<i>Glomerida</i>	Pill millipedes	1
	Total	1,236

Table B.2 Species recorded during the survey listed as having a conservation designation in the UK/England (includes Nationally Scarce and Section 41 species) from Survey Areas 1, 2, 3, 4, 7, 8, 10, 11 and 13

Common name	Scientific name	Family	UK status	Survey Area(s)	Recorded habitat	Pantheon/ISIS affinities
Ground beetle	<i>Acupalpus exiguus</i>	Carabidae	Nationally Scarce; Essex RDB Listed	13	Marshy grassland and macrophytes (plants growing in or near water)	Wetland – marshland – undisturbed fluctuating marsh
Mirid bug	<i>Agnocoris reclairei</i>	Miridae	Nationally Scarce (Nb); Essex RDB listed	10 (woodland)	Broadleaved woodland edge	Tree associated – arboreal
Alydid bug	<i>Alydus calcaratus</i>	Alydidae	Nationally Scarce	3 and 10b	OMH and grassland	Open habitats – short sward and bare ground
Scraptiid beetle	<i>Anaspis costai</i>	Scraptiidae	Nationally Scarce	2	Deciduous scrub, with semi-natural broadleaved woodland on the margins	Tree associated – decaying wood
Large Gorse mining bee	<i>Andrena bimaculata</i>	Andrenidae	Nationally Scarce (Nb); Essex RDB; Essex threatened	3	OMH	Open habitats – short sward and bare ground
Bryony mining bee	<i>Andrena florea</i>	Andrenidae	RDB3 (pre-1994); Essex RDB; Essex threatened	2	Scrub edge, species feeding on the nectar of White bryony <i>Bryonia alba</i>	Open habitats – short sward and bare ground
Hawk's-beard mining bee	<i>Andrena fulvago</i>	Andrenidae	Nationally Scarce (Na); Near Threatened (post-2001 IUCN); Essex RDB Regionally important	13	Grassland	Open habitats – short sward and bare ground

Common name	Scientific name	Family	UK status	Survey Area(s)	Recorded habitat	Pantheon/ISIS affinities
Large scabious mining bee	<i>Andrena hattorfiana</i>	Andrenidae	RDB3 (pre-1994); Essex RDB; Essex Endangered	8	Grassland, species feeding on the nectar of Large scabious <i>Knautia arvensis</i>	Open habitats – short sward and bare ground
Scarce black mining bee	<i>Andrena nigrospina</i>	Andrenidae	Essex RDB (Essex Vulnerable); pRDB2 Vulnerable	3	OMH	Open habitats – short sward and bare ground
Black mining bee	<i>Andrena pilipes</i>	Andrenidae	Nationally Scarce (Nb); Essex RDB listed	3	OMH	Open habitats – tall sward and scrub
Ptiniid beetle	<i>Anobium inexpectatum</i>	Ptinidae	Essex RDB listed; Local (formerly Nationally Scarce)	3	Deciduous scrub, with semi-natural broadleaved woodland on the margins	Tree associated – decaying wood
Leafhopper	<i>Anoscopus albifrons</i>	Cicadellidae	Nationally Scarce (Nb)	8	Grassland scrub mosaic	Open habitats – tall sward and scrub
Flea beetle	<i>Aphthona nigriceps</i>	Chrysomelidae	Nationally Scarce	4	Herb-rich semi-improved grassland	Open habitats – tall sward and scrub
Spider-hunting wasp	<i>Aporus unicolor</i>	Pompilidae	Nationally Scarce (Na); Essex RDB listed (Essex Vulnerable)	7 (Low Street Pit)	Semi-improved grassland	Open habitats – short sward and bare ground; tall sward and scrub (associated with the purse-web spider H130)
Hornet robberfly	<i>Asilus crabroniformis</i>	Asilidae	Section 41 priority species/Nationally Scarce; Essex RDB - Essex threatened	4 and 8	Grassland scrub mosaic	Open habitats – tall sward and scrub

Common name	Scientific name	Family	UK status	Survey Area(s)	Recorded habitat	Pantheon/ISIS affinities
Planthopper	<i>Asiraca clavicornis</i>	Delphacidae	Nationally Scarce (Nb); Essex RDB listed	2, 3, 4, 7 and 13	OMH, grassland and scrub; marshy grassland; and macrophytes, woodland edge	Open habitats – short sward and bare ground – open short sward
Rove beetle	<i>Astenus immaculatus</i>	Staphylinidae	Nationally Scarce; Essex RDB listed	2, 7 (EMR) and 10 (woodland)	OMH, broadleaved woodland/woodland on the margins	Not specified
Jumping spider	<i>Ballus chalybeius</i>	Salticidae	Nationally Scarce	1, 2, 3, 4, 7, 8, 10, 11 and 13	Semi-natural broadleaved woodland and scrub	Tree associated – arboreal
Cryptic leather bug	<i>Bathysolen nubilus</i>	Coreidae	Nationally Scarce; Essex RDB listed	2	Semi-improved, flower-rich grassland, bare earth and OMH	Open habitats – short sward and bare ground
Ground beetle	<i>Bembidion normannum</i>	Carabidae	Nationally Scarce	3	Exposed mud at the margins of brackish scrape	Coastal – saltmarsh
Stilt bug	<i>Berytinus hirticornis</i>	Berytidae	Nationally Scarce (Nb); Essex RDB listed	2, 3, 4, 10b and 11 (south-west compartment)	Broadleaved woodland and scrub grassland mosaic	Open habitats – short sward and bare ground
Brown-banded carder bee	<i>Bombus humilis</i>	Apidae	Section 41 priority species; Essex RDB (Essex Vulnerable)	3, 4, 7, 10 and 10b	OMH	Open habitats – tall sward and scrub
Red-shanked carder bee	<i>Bombus ruderarius</i>	Apidae	Section 41 priority species	3	OMH	Open habitats – tall sward and scrub

Common name	Scientific name	Family	UK status	Survey Area(s)	Recorded habitat	Pantheon/ISIS affinities
Shrill carder bee	<i>Bombus sylvarum</i>	Apidae	Section 41 priority species/Nationally Scarce (Nb); Essex RDB - Essex Vulnerable	3, 4 and 10b	OMH	Open habitats – tall sward and scrub
Bean seed beetle	<i>Bruchidius imbricornis</i>	Chrysomelidae	Recent colonist to UK (2012)	3, 4, 11 and 13	Scrub and OMH habitat; marshy grassland and macrophytes; and woodland	Not specified
Seed beetle	<i>Bruchus brachialis</i>	Chrysomelidae	Recent colonist to UK (2010)	4	Scrub and OMH	Not specified
Tortoise beetle	<i>Cassida nobilis</i>	Chrysomelidae	Nationally Scarce; Essex RDB listed	3 and 7 (EMR)	OMH and brackish lagoon margin	Open habitats – tall sward and scrub
Little blue carpenter bee	<i>Ceratina cyanea</i>	Apidae	RDB3 (pre-1994); Essex RDB	3 and 7	OMH	Open habitats – tall sward and scrub
Five-banded Tailed-digger wasp	<i>Cerceris quinquefasciata</i>	Crabronidae	RDB3 rare; Essex RDB; Section 41 priority species	3	OMH	Open habitats – short sward and bare ground
Crabronid wasp	<i>Cerceris ruficornis</i>	Crabronidae	Essex RDB (Essex Vulnerable)	3	OMH	Open habitats – short sward and bare ground
Clubionid spider	<i>Cheiracanthium virescens</i>	Clubionidae	Nationally Scarce	3	OMH and grassland	Open habitats – short sward and bare ground
Latticed heath	<i>Chiasmia clathrata</i>	Geometridae	Section 41 research only/widespread	4	Herb-rich SI grassland and scrub	Open habitats – tall sward and scrub
Leaf beetle	<i>Chrysolina sturmi</i>	Chrysomelidae	Nationally Scarce (Nb)	13	Woodland edge	Open habitats – tall sward and scrub

Common name	Scientific name	Family	UK status	Survey Area(s)	Recorded habitat	Pantheon/ISIS affinities
Dolichopodid fly	<i>Chrysotus cupreus</i>	Dolichopodidae	Nationally Scarce	11 (south-west compartment)	Broadleaved woodland and scrub grassland mosaic	Wetland – marshland and running water
Big-headed fly	<i>Clistoabdominalis ruralis</i>	Pipunculidae	DD (data deficient) post-2001 IUCN criteria	13	Woodland edge (ground and field layer)	Open habitats – tall sward and scrub
Small heath	<i>Coenonympha pamphilus</i>	Nymphalidae	Post-2001 IUCN Near Threatened/Section 41 priority species	3,4,7,8,11 and 13	Grassland and OMH	Open habitats – short sward and bare ground
Sea aster bee	<i>Colletes halophilus</i>	Colletidae	Section 41 priority species/ Nationally Scarce (Na) / IUCN post-2001 Near Threatened; Essex RDB listed	Survey Area 7	Flower-rich OMH	Coastal, open habitat – brackish pools and ditches, saltmarsh
Ant-like flower beetle	<i>Cyclodinus constrictus</i>	Anthicidae	Nationally Scarce	3 and 4	Scrub and OMH	Coastal – saltmarsh
Pantaloon bee	<i>Dasypoda hirtipes</i>	Melittidae	Nationally Scarce; Essex Regionally important	3,7 and 13	OMH	Open habitats – short sward and bare ground, bare sand and chalk-rich flower resource
Mirid bug	<i>Deraeocoris olivaceus</i>	Miridae	Nationally Scarce (Nb); Essex RDB listed	11 (south-west compartment)	Broadleaved woodland and scrub grassland mosaic	Tree associated – arboreal
Chloropid fly	<i>Dicraeus tibialis</i>	Chloropidae	Nationally Scarce	13	OMH and ruderal and grassland	Open habitats – tall sward and scrub
Tephritid fly	<i>Dioxya bidentis</i>	Tephritidae	Nationally Scarce	4	OMH and grassland	Wetland – marshland, peatland

Common name	Scientific name	Family	UK status	Survey Area(s)	Recorded habitat	Pantheon/ISIS affinities
Apionid weevil	<i>Diplapion stolidum</i>	Apionidae	Nationally Scarce (Nb)	11 (south-west compartment)	Broadleaved woodland and scrub grassland mosaic	Open habitats – short sward and bare ground
Phoenix fly	<i>Dorycera graminum</i>	Uliidiidae	RDB3 rare (pre-1994); Near Threatened (post-2001 IUCN guidelines); Section 41 Priority Species	2	OMH and grassland	Open habitats – tall sward and scrub
Ground bug	<i>Drymus latus</i>	Lygaeidae	Nationally Scarce (Nb); Essex RDB listed	4 and 7 (EMR)	SI grassland and scrub; OMH	Open habitats – tall sward and scrub
Crabronid wasp	<i>Ectemnius dives</i>	Crabronidae	Essex RDB; Regionally important	2	Semi-natural broadleaved woodland	Open habitats – tree associated, decaying wood
Calliphorid fly	<i>Eggisops pecchiolii</i>	Calliphoridae	Nationally Scarce	13	Woodland edge (ground and field layer)	Open habitats – tall sward and scrub
Water-scavenger beetle	<i>Enochrus halophilus</i>	Hydrophilidae	Nationally Scarce; Essex RDB listed	7 (Low Street Pit)	Wet grassland/pond edge/swamp	Coastal – brackish pools and ditches, saltmarsh
Pirate spider	<i>Ero aphana</i>	Mimetidae	Nationally Scarce	2 and 3	Woodland edge	Open habitats – tall sward and scrub
Big-headed fly	<i>Eudorylas zermattensis</i>	Pipunculidae	Nationally Scarce	13	Woodland edge	Open habitats – short sward and bare ground, bare sand and chalk
Scarce tortoise bug	<i>Eurygaster maura</i>	Scutelleridae	Nationally Scarce (Nb); Essex RDB listed	1 (Brewers Wood) and 13	Woodland ride and clearing; grassland and OMH	Open habitats – short sward and bare ground, open short sward

Common name	Scientific name	Family	UK status	Survey Area(s)	Recorded habitat	Pantheon/ISIS affinities
Lesne's earwig	<i>Forficula lesnei</i>	Forficulidae	Nationally Scarce (Nb); Essex RDB listed	3,4,10,10b and 13	Deciduous scrub, semi-natural broadleaved woodland, grassland and OMH	Tree associated – decaying wood
Opomyzid fly	<i>Geomyza apicalis</i>	Opomyzidae	Nationally Scarce	4	OMH and grassland	Open habitats – tall sward and scrub
Opomyzid fly	<i>Geomyza breviseta</i>	Opomyzidae	Data deficient (Nationally Scarce)	3	OMH and grassland	Open habitats – tall sward and scrub
Opomyzid fly	<i>Geomyza subnigra</i>	Opomyzidae	Nationally Scarce	13	Grassland	Open habitats – tall sward and scrub
Ceutorhynchine weevil	<i>Glocianus punctiger</i>	Curculionidae	Nationally Scarce (Nb); Section 41 priority species; Essex RDB listed	2,3 and 4	Semi-improved, flower-rich grassland, bare earth and OMH	Open habitats – tall sward and scrub
True weevil	<i>Gymnetron melanarium</i>	Curculionidae	Nationally Scarce (Nb); Essex RDB listed	8	Grassland scrub mosaic	Open habitats – tall sward and scrub
Tachinid fly	<i>Gymnosoma rotundatum</i>	Tachinidae	RDB3 rare pre-1994 criteria	1 (Brewers Wood)	Woodland ride and clearing	Open habitats
Rove beetle	<i>Gyrohypnus atratus</i>	Staphylinidae	Nationally Scarce (Nb); Essex RDB listed	3	Deciduous scrub semi-natural broadleaved woodland on the margins	Tree associated – shaded woodland floor
Long-horned cleg	<i>Haematopota grandis</i>	Tabanidae	Nationally Scarce; Essex Regionally important; (IUCN post-2001 LC)	13	Unrecorded	Coastal – brackish marsh and ditches Saltmarsh – saltmarsh and transitional brackish marsh

Common name	Scientific name	Family	UK status	Survey Area(s)	Recorded habitat	Pantheon/ISIS affinities
Ground beetle	<i>Harpalus attenuatus</i>	Carabidae	Nationally Scarce	3	OMH	Open habitats – short sward and bare ground
Cuckoo wasp	<i>Hedychrum niemelai</i>	Chrysididae	RDB3 (pre-1994); Essex RDB; Essex threatened	2	Semi-improved, flower-rich grassland, bare earth and OMH	Open habitats – short sward and bare ground
Cuckoo wasp	<i>Hedychrum rutilans</i>	Chrysididae	Extinct	3	OMH	Not specified
Darkling beetle	<i>Helops caeruleus</i>	Tenebrionidae	Nationally Scarce (Notable B); Essex RDB listed	3	Ivy	Tree associated – decaying wood
Ghost moth	<i>Hepialus humuli</i>	Hepialidae	Section 41 research only	2	Grassland	Open habitats – tall sward and scrub
Large-headed resin bee	<i>Heriades truncorum</i>	Megachilidae	RDBK insufficiently known; Essex RDB Regionally important	1 (Brewers Wood), 10b and 13	Woodland ride and clearing	Open habitats – tree associated, decaying wood, bark and sapwood decay, rich flower resource
Adonis ladybird	<i>Hippodamia variegata</i>	Coccinellidae	Nationally Scarce (Nb); Essex RDB listed	3, 4, 7 (EMR and Low Street Pit) and 13	OMH and grassland	Open habitats – tall sward and scrub
Wetted lesser mason bee	<i>Hoplitis claviventris</i>	Megachilidae	Nationally Scarce; Essex RDB (Essex Vulnerable)	1 (Brewers Wood)	Woodland ride and clearing	Open habitats – tall sward and scrub
Levels yellow-horned Horsefly	<i>Hybomitra ciureai</i>	Tabanidae	Nationally Scarce); Essex RDB	1	Woodland ride and clearing	Wetland – peatland

Common name	Scientific name	Family	UK status	Survey Area(s)	Recorded habitat	Pantheon/ISIS affinities
Large yellow-faced bee	<i>Hylaeus signatus</i>	Colletidae	Nationally Scarce (Nb); Essex RDB listed	7	Swept from flower-rich OMH	Open habitats – short sward and bare ground
Leafhopper	<i>Iassus scutellaris</i>	Cicadellidae	Nationally Scarce (Na); Essex RDB listed	8	Grassland scrub mosaic, beaten from <i>Ulmus procera</i>	Tree associated – arboreal
Leafhopper	<i>Idiocerus herrichi</i>	Cicadellidae	Nationally Scarce (Nb)	10 (woodland)	Broadleaved woodland edge	Tree associated – arboreal
Jumping weevil	<i>Isochnus sequensi</i>	Curculionidae	RDBK pre-1994 (insufficiently known)	10	Broadleaved woodland edge	Tree associated – arboreal
Theridiid spider	<i>Kochiura aulica</i>	Theridiidae	Nationally Scarce	3	OMH and grassland	Open habitats
Orb-web spider	<i>Larinioides patagiatus</i>	Araneidae	Nationally Scarce	3	Scrub-dominated within OMH	Tree associated – arboreal
True weevil	<i>Larinus planus</i>	Curculionidae	Nationally Scarce (Nb)	10b	Grassland and OMH	Open habitats – short sward and bare ground
Chloropid fly	<i>Lasiochaeta pubescens</i>	Chloropidae	Nationally Scarce (but has been downgraded in Falk <i>et al.</i>) (2016)	7 (Low Street Pit) and 13	Grassland scrub mosaic and wet grassland; marshy grassland and macrophytes; woodland edge (ground and field layer)	Wetland – peatland
Sharp-collared furrow bee	<i>Lasioglossum malachurum</i>	Halictidae	Nationally Scarce (Nb)	2, 7 (EMR) and 13	Semi-improved grassland, OMH, marshy grassland and macrophytes	Open habitats – short sward and bare ground, rich flower resource

Common name	Scientific name	Family	UK status	Survey Area(s)	Recorded habitat	Pantheon/ISIS affinities
Squat furrow bee	<i>Lasioglossum pauperatum</i>	Halictidae	RDB3 Rare; Essex RDB Regionally important	2, 3, 4, 7 (EMR) 11 and 13	Grassland, OMH, ruderal, woodland edge (field layer)	Open habitats – short sward and bare ground, rich flower resource
Lobe-spurred furrow bee	<i>Lasioglossum pauxillum</i>	Halictidae	Nationally Scarce (Na)	4, 7, 10 (woodland), 11 and 13	OMH, grassland, marshy grassland and macrophytes, and woodland edge (field layer)	Open habitats – short sward and bare ground, rich flower resource
Ridge-cheeked furrow bee	<i>Lasioglossum puncticolle</i>	Halictidae	Nationally Scarce (Nb); Essex RDB Regionally important	1, 4, 11 and 13	Woodland edge grassland and scrub; grassland and OMH	Open habitats – short sward and bare ground, rich flower resource
Brown ant	<i>Lasius brunneus</i>	Formicidae	Nationally Scarce (Nb); Essex RDB Regionally important	1 (Ashenbank Woods and Shorne Woods Country Park), 10 (woodland), 11 and 13	Broadleaved woodland margin	Tree associated – decaying wood, heartwood decay (caused by a fungus)
Flea beetle	<i>Longitarsus curtus</i>	Chrysomelidae	Nationally Scarce	2	Semi-improved, flower-rich grassland, bare earth and OMH	Open habitats – short sward and bare ground
Flax flea beetle	<i>Longitarsus parvulus</i>	Chrysomelidae	Local; Essex RDB Listed	11 (south-west compartment) and 13	Broadleaved woodland and scrub grassland mosaic	Open habitats – tall sward and scrub

Common name	Scientific name	Family	UK status	Survey Area(s)	Recorded habitat	Pantheon/ISIS affinities
Mirid bug	<i>Lygus pratensis</i>	Miridae	RDB3 (pre-1994)	2, 3, 4, 10b, 11 (south-west compartment) and 13	Broadleaved woodland and scrub grassland mosaic	Open habitats – scrub-heath and moorland
Silvery leafcutter bee	<i>Megachile leachella</i>	Megachilidae	Nationally Scarce (Nb)	3	OMH	Open habitats – short sward and bare ground
Ground bug	<i>Megalonotus antennatus</i>	Lygaeidae	Nationally Scarce (Nb); Essex RDB listed	2 and 10b	Semi-improved, flower-rich grassland, bare earth and OMH	Open habitats – tall sward and scrub
Ground bug	<i>Megalonotus praetextatus</i>	Lygaeidae	Nationally Scarce (Nb); Essex RDB listed	7 (EMR) and 13	OMH	Open habitats – short sward and bare ground, bare sand and chalk
Pollen beetle	<i>Meligethes fulvipes</i>	Nitidulidae	Nationally Scarce	11 (north-east compartment)	Arable margin of broadleaved woodland	Not specified
Clover Melitta	<i>Melitta leporina</i>	Melittidae	Essex RDB; Local	11	Grassland, scrub mosaic and woodland margin	Open habitats – short sward and bare ground
Chloropid fly	<i>Meromyza nigriseta</i>	Chloropidae	Nationally Scarce	4	Grassland scrub mosaic	Wetland – peatland
Sepsid fly	<i>Meroplius minutus</i>	Sepsidae	Vulnerable (declining – only four post-2000 records)	13	Woodland edge (ground and field layer)	Not assigned
Tephritid fly	<i>Merzomyia westermanni</i>	Tephritidae	Nationally Scarce	11 (south-west compartment)	Broadleaved woodland and scrub grassland mosaic	Open habitats – short sward and bare ground, tall sward and scrub

Common name	Scientific name	Family	UK status	Survey Area(s)	Recorded habitat	Pantheon/ISIS affinities
Sarcophagid fly	<i>Miltogramma germari</i>	Sarcophagidae	RDB3 rare pre-1994 criteria	3	OMH, grassland and scrub	Open habitats – short sward and bare ground
Tumbling flower beetle	<i>Mordellistena brevicauda</i>	Mordellidae	RDB3 rare; Essex RDB listed	1 (Ashenbank) and 7 (EMR)	OMH, woodland edge and grassland	Not specified
Tumbling flower beetle	<i>Mordellistena neuwaldeggiana</i>	Mordellidae	Nationally Scarce; Essex RDB	3	Deciduous scrub, semi-natural broadleaved woodland margin	Tree associated – decaying wood
Myrmicine ant	<i>Myrmica schencki</i>	Formicidae	Nationally Scarce (Nb); Essex RDB listed	7 (Low Street Pit)	Semi-improved grassland	Open habitats – short sward and bare ground
Painted nomad bee	<i>Nomada fucata</i>	Apidae	Nationally Scarce (Na); Essex RDB	2	Semi-improved grassland	Open habitats – short sward and bare ground
Orange-horned nomad bee	<i>Nomada fulvicornis</i>	Apidae	RDB3 rare; Essex RDB listed	3	OMH	Open habitats – short sward and bare ground
Ground bug	<i>Nysius graminicola</i>	Lygaeidae	RDB3 (pre-1994)	7	OMH	Open habitats – short sward and bare ground
Silver colonel	<i>Odontomyia argentata</i>	Stratiomyidae	Nationally Scarce; Essex Endangered; (IUCN post-2001 LC)	13	Unrecorded	Wetland – peatland, reed-fen and pools
Phalacrid beetle	<i>Olibrus flavicornis</i>	Phalacridae	RDBK pre-1994 (insufficiently known); Essex RDB	10b	SI grassland and scrub	Not specified

Common name	Scientific name	Family	UK status	Survey Area(s)	Recorded habitat	Pantheon/ISIS affinities
Ground beetle	<i>Ophonus ardosiacus</i>	Carabidae	Local; Essex RDB listed	3 and 4	OMH, herb-rich SI grassland and scrub	Open habitats – short sward and bare ground
True weevil	<i>Orthochaetes setiger</i>	Curculionidae	Nationally Scarce (Nb); Essex RDB listed	2, 3, 4 and 13	Semi-improved, flower-rich grassland, bare earth, OMH, woodland edge (ground and field layer)	Open habitats – tall sward and scrub
Chloropid fly	<i>Oscinimorpha arcuata</i>	Chloropidae	Nationally Scarce	13	Grassland; OMH and ruderal; woodland edge field layer	Open habitats – tall sward and scrub
Broad-nosed weevil	<i>Otiorhynchus raucus</i>	Curculionidae	Nationally Scarce (Nb); Essex RDB listed	3 and 13	OMH, grassland and woodland edge (ground and field layer)	Open habitats – short sward and bare ground, bare sand and chalk
Delicate soldierfly	<i>Oxycera nigricornis</i>	Stratiomyidae	Essex RDB; Local	10 (woodland)	Broadleaved woodland margin	Wetland – running water
Ephydrid fly	<i>Parydroptera discomyzina</i>	Ephydridae	RDB2 Vulnerable pre-1994 criteria; Nationally Scarce in Falk <i>et al.</i> (2016)	3	OMH, grassland and scrub	Coastal – brackish pools and ditches, saltmarsh
Little black wasp	<i>Pemphredo n lethifer</i>	Crabronidae	Listed as RDB3 on NBN, but dubious	13	Woodland	Open habitats – F001 scrub edge Tree associated – decaying wood, A212 bark and sapwood decay Open habitats – tall sward and scrub

Common name	Scientific name	Family	UK status	Survey Area(s)	Recorded habitat	Pantheon/ISIS affinities
Lacehopper	<i>Pentastiridius leporinus</i>	Cixiidae	Nationally Scarce (Nb); Essex RDB listed	3	OMH and Brackish wetland	Coastal – saltmarsh
Beewolf	<i>Philanthus triangulum</i>	Crabronidae	RDB2 (pre-1994)	3, 4 and 7	OMH	Open habitats – short sward and bare ground
Philodromid spider	<i>Philodromus longipalpis</i>	Philodromidae	Nationally Scarce; Essex RDB listed	1 (Ashenbank Woods)	Broadleaved woodland clearing	Tree associated – arboreal
Big-headed fly	<i>Pipunculus fonscai</i>	Pipunculidae	Nationally Scarce	7 (Low Street Pit)	Grassland scrub mosaic and wet grassland	Open habitats
Lycosid spider	<i>Pirata uliginosus</i>	Lycosidae	Local; Essex RDB Essex Threatened	13	Marshy grassland and macrophytes	Open habitats – tall sward and scrub
Ladybird beetle	<i>Platynaspis luteorubra</i>	Coccinellidae	Nationally Scarce (Na); Essex RDB listed	2, 3, 4, 7 and 10	Semi-improved, flower-rich grassland, bare earth and OMH	Open habitats – tall sward and scrub
Hybotid fly	<i>Platypalpus albiseta</i>	Hybotidae	Nationally Scarce (but has been downgraded in Falk and Crossley, 2005)	3	OMH, grassland and scrub	Not specified
Leaf beetle	<i>Podagrica fuscipes</i>	Chrysomelidae	Nationally Scarce; Essex RDB listed	7 (EMR) and 13	OMH, ruderal; and woodland edge (field layer)	Open habitats – tall sward and scrub
Leaf weevil	<i>Polydrusus formosus</i>	Curculionidae	Nationally Scarce (Na)	2	Deciduous scrub semi-natural broadleaved woodland margin	Tree associated – arboreal
Indolent ant	<i>Ponera coarctata</i>	Formicidae	Nationally Scarce (Nb); Essex RDB Threatened	13	Grassland	Open habitats – short sward and bare ground

Common name	Scientific name	Family	UK status	Survey Area(s)	Recorded habitat	Pantheon/ISIS affinities
Spider-hunting wasp	<i>Priocnemis confusor</i>	Pompilidae	Nationally Scarce; Essex RDB Listed	13	Marshy grassland and macrophytes	Open habitats – short sward and bare ground
Apionid weevil	<i>Protapion difforme</i>	Apionidae	Nationally Scarce (Nb); Essex RDB listed	4, 7 and 11 (SW compartment)	Broadleaved woodland and scrub grassland mosaic	Open habitats – tall sward and scrub
Apionid weevil	<i>Protapion filirostre</i>	Apionidae	Nationally Scarce (Nb); Essex RDB listed	7 (EMR)	OMH	Open habitats – short sward and bare ground
Leaf beetle	<i>Psylliodes cuprea</i>	Chrysomelidae	Nationally Scarce	13	Woodland edge (arboreal)	Open habitats – tall sward and scrub
Ground bug	<i>Raglius alboacuminatus</i>	Lygaeidae	Nationally Scarce (Nb); Essex RDB listed	4	Herb-rich SI grassland	Open habitats - Short sward and bare ground
Soldier beetle	<i>Rhagonycha lutea</i>	Cantharidae	Nationally Scarce; Essex RDB listed	1 (Shorne Woods Country Park) and 2	Broadleaved woodland clearing	Tree associated – arboreal
Saldid bug	<i>Saldula opacula</i>	Saldidae	Nationally Scarce (Nb); Essex RDB listed	7 (Low Street Pit)	Wet grassland, pond edge and swamp	Coastal – brackish pools and ditches, saltmarsh
Saldid bug	<i>Saldula orthochila</i>	Saldidae	Nationally Scarce (Nb); Essex RDB listed	7 (EMR)	OMH	Open habitats – short sward and bare ground
White-letter Hairstreak	<i>Satyrrium w-album</i>	Lycaenidae	Section 41 priority species/Post-2001 IUCN Endangered	10	Woodland edge with Wych Elm <i>Ulmus glabra</i> , English Elm <i>U. procera</i> and Bramble <i>Rubus fruticosus</i> agg	Tree associated – arboreal

Common name	Scientific name	Family	UK status	Survey Area(s)	Recorded habitat	Pantheon/ISIS affinities
Sand-runner Shieldbug	<i>Sciocoris cursitans</i>	Pentatomidae	Nationally Scarce; Essex RDB listed	7 (EMR) and 13	OMH	Open habitats – short sward and bare ground, open short sward
Jumping spider	<i>Sibianor aurocinctus</i>	Salticidae	Nationally Scarce; Essex RDB	3, 11 and 13	Grassland scrub mosaic in broadleaved woodland	Open habitats – short sward and bare ground, bare sand and chalk
Pea weevil	<i>Sitona waterhousei</i>	Curculionidae	Nationally Scarce (Nb)	3 and 4	OMH and grassland	Open habitats – short sward and bare ground
Drab wood-solidierfly	<i>Solva marginata</i>	Xylomyidae	Nationally Scarce; Essex RDB listed; Regionally important	2	Woodland edge OMH and grassland	Tree associated – decaying wood
Swollen-thighed blood bee	<i>Sphecodes crassus</i>	Halictidae	Nationally Scarce (Nb); Essex RDB listed	2 and 13	Semi-improved grassland and OMH	Open habitats – short sward and bare ground, rich flower resource
Little sickle-jawed blood bee	<i>Sphecodes longulus</i>	Halictidae	Nationally Scarce (Na); Essex RDB listed	3	OMH	Open habitats – short sward and bare ground
Apionid weevil	<i>Squamapion cineraceum</i>	Apionidae	Nationally Scarce (Na)	11 (south-west compartment)	Broadleaved woodland and scrub grassland mosaic	Open habitats – short sward and bare ground
Spotted dark bee	<i>Stelis ornatula</i>	Megachilidae	RDB3 Rare; Essex RDB Endangered	13	OMH and ruderal	Open habitats – tall sward and scrub, rich flower resource

Common name	Scientific name	Family	UK status	Survey Area(s)	Recorded habitat	Pantheon/ISIS affinities
Banded general	<i>Stratiomys potamida</i>	Stratiomyidae	Essex RDB; Local	10	Wet woodland edge	Wetland – marshland, peatland, running water
Flecked general	<i>Stratiomys singularior</i>	Stratiomyidae	Essex RDB; Local	4	SI grassland and scrub	Coastal, wetland – brackish pools and ditches, peatland, saltmarsh
Broad-nosed weevil	<i>Strophosoma faber</i>	Curculionidae	Nationally Scarce (Nb); Essex RDB listed	7 (EMR)	Herb-rich grassland and OMH	Open habitats – short sward and bare ground
Ground beetle	<i>Syntomus truncatellus</i>	Carabidae	Nationally Scarce	3 and 7	OMH	Open habitats – tall sward and scrub
Ground beetle	<i>Tachys bistriatus</i>	Carabidae	Nationally Scarce (Nb)	3	OMH and Brackish lagoon margin	Wetland – marshland
Broad-nosed weevil	<i>Tanymecus palliatus</i>	Curculionidae	Nationally Scarce (Nb); Essex RDB Listed	13	Marshy grassland and macrophytes	Open habitats – tall sward and scrub
Tephritid fly	<i>Tephritis divisa</i>	Tephritidae	RDBK insufficiently known	13	OMH and ruderal and grassland	Not analysed
Philodromid spider	<i>Thanatus striatus</i>	Philodromidae	Nationally Scarce	3, and 10b	Rough grassland and OMH	Open habitats – tall sward and scrub
Twin-spot stiletto	<i>Thereva bipunctata</i>	Therevidae	Essex RDB Vulnerable; Local	13	Woodland edge (ground and field layer)	Open habitats – short sward and bare ground, bare sand and chalk
Theridiid spider	<i>Theridion blackwalli</i> (<i>Sardinidion blackwalli</i>)	Theridiidae	Nationally Scarce	10	Not specified	Not specified

Common name	Scientific name	Family	UK status	Survey Area(s)	Recorded habitat	Pantheon/ISIS affinities
Theridiid spider	<i>Theridion pictum</i>	Theridiidae	Local; Essex RDB Threatened	3, 10b and 13	Grassland scrub mosaic	Open habitats – tall sward and scrub
Blood-vein	<i>Timandra comae</i>	Geometridae	Section 41 research only/widespread	8	Grassland scrub mosaic	Open habitats – tall sward and scrub
Cranefly	<i>Tipula helvola</i>	Tipulidae	Nationally Scarce; Essex RDB	2	Woodland edge, OMH and grassland	Tree associated – shaded woodland floor
Ground-ivy jewel beetle	<i>Trachys scrobiculatus</i>	Buprestidae	Nationally Scarce	13	Woodland edge (ground and field layer)	Open habitats – tall sward and scrub
Chloropid fly	<i>Trachysiphonella scutellata</i>	Chloropidae	Nationally Scarce (but has been downgraded in Falk <i>et al.</i>) (2016)	3	OMH, grassland and scrub	Open habitats – short sward and bare ground
Gnaphosid spider	<i>Trachyzelotes pedestris</i>	Gnaphosidae	Local; Essex RDB Regionally important	13	Grassland	Open habitats – tall sward and scrub
True weevil	<i>Tychius brevisculus</i>	Curculionidae	Potential RDBK; Recent UK colonist	3	OMH and grassland	Open habitats – short sward and bare ground
Linyphiid spider	<i>Typhochrestus digitatus</i>	Linyphiidae	Nationally Scarce; Essex RDB (Essex threatened)	4	Grassland and OMH	Open habitats – short sward and bare ground
Cinnabar	<i>Tyria jacobaeae</i>	Erebidae	Section 41 research only	1, 2, 3, 4, 7, 8, 10, 10b, 11 and 13	OMH, grassland, marshy grassland and macrophytes	Open habitats – tall sward and scrub
Hoverfly	<i>Volucella inanis</i>	Syrphidae	Essex RDB Regionally important; Local	1 (Shorne Woods Country Park)	Woodland ride and clearing	Open habitats – short sward and bare ground, tall sward and scrub

Common name	Scientific name	Family	UK status	Survey Area(s)	Recorded habitat	Pantheon/ISIS affinities
Hornet hoverfly	<i>Volucella zonaria</i>	Syrphidae	Essex RDB; Regionally important; Local	2 and 10	Woodland ride and clearing	Open habitats – short sward and bare ground, tall sward and scrub
Linyphiid spider	<i>Walckenaeria dysderoides</i>	Linyphiidae	Nationally Scarce	10	Broadleaved woodland and woodland edge	Open habitats – tall sward and scrub
Bloody cranesbill weevil	<i>Zacladus exiguus</i>	Curculionidae	Nationally Scarce (Nb); Essex RDB listed	2 and 7	Semi-improved, flower-rich grassland, bare earth and OMH	Open habitats – tall sward and scrub
Gnaphosid spider	<i>Zelotes petrensis</i>	Gnaphosidae	RDB3 Nationally Rare; Essex RDB	8	Grassland scrub mosaic	Open habitats – short sward and bare ground
Zodariid spider	<i>Zodarion italicum</i>	Zodariidae	Nationally Scarce; Essex RDB Regionally important	13	OMH and ruderal	Open habitats – short sward and bare ground

Annex C Summary of Survey Analysis

Table C.1 Summary of survey analysis

Survey Area	Broad description	Associated designated site with invertebrate interest	Field survey results			Conclusions
			Recorded species with recognised conservation status*	SQL score	Supported Pantheon invertebrate assemblages	
Survey Area 1: Shorne Woods Country Wood, Ashenbank Woods and Brewers Wood	Broadleaved ancient woodland with veteran and mature stands, standing and fallen dead wood, wet woodland, scrub, waterbodies, tracks and rides.	Shorne and Ashenbank Woods SSSI; Ashenbank Woodland Trust Reserve LWS; Shorne Wood Country Park and Shorne and Brewers ASNW	Thirteen species (out of 303 (4.3%)), including: two RBD3; eight Nationally Scarce; one RDBK; one Essex RDB 'Regionally important'; and one Section 41 species	5.2	This Survey Area supported a specific rich flower resource invertebrate assemblage of high conservation value. Also supported were habitat level arboreal, shaded woodland floor, decaying wood, short sward & bare ground and tall sward & scrub invertebrate assemblages of relatively low conservation value.	An overall SQL score of 5.2 for the whole site indicates a 'good' invertebrate assemblage. The overall conclusion for Survey Area 1 may be that the rarity value was rather thinly scattered between a number of habitat resources, and that more specialised, tree associated assemblages may have been under-represented in the sample data. This deficit is likely to be due to a combination of the absence of sampling during the peak activity of arboreal and decaying wood assemblages in April/May, coupled with a lack of dedicated sampling of night-flying moths, which constitute a major component of the overall arboreal assemblage. It is also worth noting that two of the three rarest species

Survey Area	Broad description	Associated designated site with invertebrate interest	Field survey results			Conclusions
			Recorded species with recognised conservation status*	SQL score	Supported Pantheon invertebrate assemblages	
						recorded during the survey, <i>Gymnosoma rotundatum</i> and <i>Mordellistena brevicauda</i> , were not ascribed to any assemblage in Pantheon. This omission should be, to some extent, rectified by the site-level SQL score, to which these species contributed. This also takes into account local species, these otherwise being weighted the same as widespread species in the Pantheon version of SQL. Survey Area 1 is considered to be of national importance.
Survey Area 2: Claylane Wood	Semi-improved neutral grassland, scrub and ruderal vegetation surrounding ancient broadleaved woodland (which contains tracks and rides).	None	Twenty-nine species (out of 414 (7%)), including: one RDB3, IUCN Near Threatened, Section 41 species; four RDB3; 20 Nationally Scarce species; and two Essex RDB 'Regionally important' species	6.4	Habitat-level tall sward & scrub, short sward & bare ground, arboreal, shaded woodland floor and decaying wood invertebrate assemblages were significantly represented within this area. Specific scrub edge, open short sward and rich flower resource	An overall SQL score of 6.4 for the whole site indicates that the site is of reasonably high conservation value. This overall value is reflected in the habitat-specific SQL scores resulting from Pantheon analysis. However, the presence of nationally important specific invertebrate assemblages increases the value of the site. Survey Area 2 supports representative habitats and

Survey Area	Broad description	Associated designated site with invertebrate interest	Field survey results			Conclusions
			Recorded species with recognised conservation status*	SQL score	Supported Pantheon invertebrate assemblages	
					invertebrate assemblages of national importance were supported within this area.	species, and contributes as a stepping-stone habitat of higher quality, supporting metapopulation species associated with flower-rich grassland and irreplaceable ancient woodland habitats in the wider landscape. The importance of the rich flower resource assemblage was based on the diversity of bee species occurring onsite. Survey Area 2 is considered to be of regional importance.
Survey Area 3: Goshems Farm	OMH on previously developed land with a mix of artificial spoil, pulverised fuel ash, tall ruderal and scrub, moderately species-rich neutral grassland, ephemeral short perennial vegetation, tracks and rides, and numerous ditches. At the time of the 2018 survey, 75% of the Goshems Farm LWS had been destroyed through	Goshems Farm LWS	Fifty-five species (out of 372 (14.8%)), including one species previously thought Extinct in the UK (<i>Hedychrum rutilans</i>), two RDB2, six RDB3, one RDBK, one IUCN Near Threatened, seven Section 41 and 37 Nationally Scarce species. Twenty-seven species are Essex RDB listed.	11.2	Habitat level sward & scrub, short sward & bare ground, arboreal, marshland and peatland invertebrate assemblages were well represented in this area. Specific bare sand & chalk, scrub-heath & moorland and rich flower resource invertebrate assemblages of national importance	An overall SQL score of 11.2 for Survey Area 3 indicates that the site is of national significance. This value is strongly reflected in the habitat-specific representation of assemblages from a mosaic of habitats and the stronger conservation features. This includes the rich flower resource and bare sand & chalk and scrub-heath & moorland assemblages, which are of national significance. The presence of a previously Extinct cuckoo wasp

Survey Area	Broad description	Associated designated site with invertebrate interest	Field survey results			Conclusions
			Recorded species with recognised conservation status*	SQL score	Supported Pantheon invertebrate assemblages	
	aggregate removal and earthworks.				were supported within this area.	<i>Hedychrum rutilans</i> onsite, the ecological position of the site in relation to other important invertebrate sites, the habitat representativeness and the overall size of the site also increase the intrinsic value of Survey Area 3 and reinforce the site as being of national importance for invertebrates.
Survey Area 4: Horse Field	Semi-improved grassland and scrub mosaic on the site of a capped former landfill.	None	Thirty-two species (out of 299 (11%)), including one RDB2, one RDB3, one IUCN Near Threatened, five Section 41 and 21 Nationally Scarce species. 13 species are Essex RDB listed.	7.9	Habitat level tall sward & scrub, short sward & bare ground, arboreal invertebrate assemblages were significantly represented within this area. Within these assemblages, Survey Area 4 supported specific open short sward and rich flower resource invertebrate assemblages of national importance.	The SQL score indicates that the area, overall, is of high conservation value but not of national importance. However, the presence of open short sward and rich flower resource invertebrate assemblages, the ecological position of the area in relation to other important invertebrate areas. along with the presence of Section 41 OMH indicator species (shrill carder bee, brown-banded carder bee and Hornet robberfly), which are known to occur in metapopulations over the wider landscape, increases the intrinsic value of Survey Area 4. On this basis, Survey Area 4 is considered to be of

Survey Area	Broad description	Associated designated site with invertebrate interest	Field survey results			Conclusions
			Recorded species with recognised conservation status*	SQL score	Supported Pantheon invertebrate assemblages	
						national importance for invertebrates.
Survey Area 5: Lytag Brownfield	Extensive developing acid grassland and OMH on previously developed land. Abundant potential valuable invertebrate habitat.	Within Lytag Brownfield LWS	Survey Area 5 was surveyed in 2016 and 2017 to inform the Environment Statement of the neighbouring Tilbury2 development. The results of this found that Survey Area 5 supported a large number of key species and is considered to be of national importance for invertebrates (Telfer, 2017).			
Survey Area 6: Tilbury Fort	Former coastal grazing marsh, now largely arable land, brackish ditches and grasslands of Tilbury Fort.	Within Tilbury Marshes LWS	The north half of Survey Area 6 was surveyed in 2016 and 2017 to inform the Environment Statement of the neighbouring Tilbury2 development. Survey Area 6 supported a number of rare key species and is considered ' <i>probably of national importance of its own right</i> ' (Telfer, 2017).			
Survey Area 7: Low Street Pit	The Low Street Pit section supported Thames Terrace grassland remnants and a mosaic of scrub/woodland/tall ruderal, unimproved acid grassland, and wetland habitat. The EMR section includes primarily OMH with extensive areas of dense, continuous	Low Street Pit LWS	Thirty-six species (out of 410 (8.8%)), including one RDB2, five RDB3, two IUCN Near Threatened, four Section 41 and 26 Nationally Scarce species. Twenty-two species are Essex RDB listed.	7.9	Habitat-level tall sward & scrub, short sward & bare ground, arboreal, peatland and marshland invertebrate assemblages were significantly represented within this area. Within these assemblages, Survey Area 7 supported specific open short sward, scrub-heath &	An overall SQL score of 7.9 for Survey Area 7 indicates that the site is of high conservation value, but below national significance. This overall value is reasonably reflected in the habitat-specific SQL scores resulting from Pantheon analysis, for short sward & bare ground and tall sward & scrub assemblages. However, the stronger conservation features, including the rich flower resource, open short

Survey Area	Broad description	Associated designated site with invertebrate interest	Field survey results			Conclusions
			Recorded species with recognised conservation status*	SQL score	Supported Pantheon invertebrate assemblages	
	scrub and tall herb habitat at the margins.				moorland and rich flower resource invertebrate assemblages of national importance.	<p>sward and scrub-heath & moorland assemblages, are indicative of national significance.</p> <p>Furthermore, neither the SQL or Pantheon scoring system take into account the presence of Section 41 species recorded onsite. Brown-banded carder bee (alongside the wealth of other non-Section 41 species of conservation importance) is considered an important indicator of high-quality grassland and OMH habitat in Essex. And this species is known to occur in metapopulations over the wider landscape. While Hornet robberfly was not recorded during the survey, the scrub/grassland mosaic habitat present was highly suitable for this metapopulation species, which has formerly been recorded from Low Street Pit. The ecological position of the site in relation to other important invertebrate sites, the habitat representativeness</p>

Survey Area	Broad description	Associated designated site with invertebrate interest	Field survey results			Conclusions
			Recorded species with recognised conservation status*	SQL score	Supported Pantheon invertebrate assemblages	
						and the overall size of the site, increase the intrinsic value of Survey Area 7. On this basis, Survey Area 7 is considered to be of national importance for invertebrates.
Survey Area 8: Mucking Heath	The site comprised relict acid grassland and deciduous scrub/woodland at margins.	Mucking Heath LWS	Ten species (out of 212 (4.7%)), including one Nationally Rare, one RDB3, four Section 41 and one Nationally Scarce species. Five species are Essex RDB listed.	6.4	Habitat-level tall sward & scrub, short sward & bare ground and arboreal invertebrate assemblages were represented within this area. In addition, Survey Area 8 supported a specific scrub-heath & moorland invertebrate assemblage of regional importance.	The SQL score indicates that the site overall is of reasonably high conservation value, but below national importance. However, the representation of specific invertebrate assemblages of national importance, the presence of one RDB3 species, <i>Andrena hattorfiana</i> , and the Nationally Rare spider <i>Zelotes petrensis</i> , which are classified as Endangered in Essex, coupled with the presence onsite of the Section 41 species Hornet robberfly, elevates the overall value of the site. Survey Area 8 is a representative component of the network of Thames Terrace grassland and OMH invertebrate sites within the south Essex landscape and is of regional importance.

Survey Area	Broad description	Associated designated site with invertebrate interest	Field survey results			Conclusions
			Recorded species with recognised conservation status*	SQL score	Supported Pantheon invertebrate assemblages	
Survey Area 9: Blackshots Nature Area	A large area of rough grassland interspersed with scattered scrub. To the east was an area of brownfield land containing piles of soil and rubble, now developing with pioneer vegetation and scrub.	Blackshots Nature Area LWS	No field surveys were carried out in this area due to lack of access.			Blackshots Nature Area LWS is described within the Thurrock Biodiversity Study 2006-2011 as supporting an important invertebrate population which includes seven Essex Red Data List species, as well as the national BAP fly <i>Dorycera graminum</i> . From an assessment based on desk study information, Survey Area 9 is considered to be of regional importance for invertebrates.
Survey Area 10a: North Ockendon (woodland)	The woodland site supported semi-natural broadleaved woodland with two large ponds.	None	Sixteen species (out of 274 (5.8%)), including one IUCN Endangered, Section 41 species (White-letter Hairstreak <i>Satyrrium w-album</i>) along with one RDBK, two Section 41 and nine Nationally Scarce species. Eight species are Essex RDB listed.	5.7	No invertebrate assemblages of national importance were recorded in this area. Habitat-level arboreal and shaded woodland floor invertebrate assemblages of some conservation value were present alongside tall sward & scrub and peatland invertebrate assemblages, all of which contained	The overall SQL score of 5.7 calculated for Survey Area 10A indicates that the site is of good invertebrate value, but from available data, the score is far from achieving national significance. This overall score is reasonably reflected within the assemblages recorded from Pantheon analysis. The site is generally fairly small but supports a wide range of habitat nuances and there was a strong resource of English Elm on the site, as well as conditions suitable for the

Survey Area	Broad description	Associated designated site with invertebrate interest	Field survey results			Conclusions
			Recorded species with recognised conservation status*	SQL score	Supported Pantheon invertebrate assemblages	
					species with recognised conservation status.	Endangered Section 41 species, White-letter Hairstreak, recorded during the survey. Survey Area 10a is considered to be of county importance.
Survey Area 10b: North Ockendon (grassland)	The open habitat comprised a mosaic of rough, semi-improved grassland and tall herb, and scrub habitat on the site of a historic landfill site.	None	Thirteen species (out of 175 (7.4%)), including one RDB3, two RDBK, three Section 41 and eight Nationally Scarce species. Six species are Essex RDB listed.	7.2	No invertebrate assemblages of national importance were recorded in this area. Habitat-level short sward & bare ground and tall sward & scrub invertebrate assemblages of some conservation were present.	<p>Overall, the survey site was surveyed less than the other 2018 sites and while the sampling picked up a general pattern of species deployment on a biotope and to some extent, habitat level, the diffuse nature of species deployment at SAT level indicated that more targeted survey effort may be needed at different times of year.</p> <p>The site was generally lacking management and disturbance factors (other than localised rabbit grazing) which would increase the potential of the site to more specialist invertebrates associated with OMH and Thames Terrace grasslands. However, the overall SQL value of 7.2 calculated from 2018 sample data indicated a high overall</p>

Survey Area	Broad description	Associated designated site with invertebrate interest	Field survey results			Conclusions
			Recorded species with recognised conservation status*	SQL score	Supported Pantheon invertebrate assemblages	
						invertebrate conservation value. The chaotic topography and haphazard composition of underlying substrates of the site provided considerable hydrological diversity, with locally wetted areas closely juxtaposed with raised, free-draining and very dry patches. These elements increase the overall potential of the site for a range of invertebrate assemblages including species with specialised habitat requirements. Survey Area 10b is considered to be of county importance.
Survey Area 11: M25 Woodlands	The four woodland sections comprising Area 11 collectively comprise a significant area of primarily semi-natural broadleaved and ancient woodland around the roundabout at the junction between the M25 and A127.	None	Nineteen species (out of 276 (6.9%)), including two RDB3, one IUCN Near Threatened, 2 Section 41 and 14 Nationally Scarce species. Twelve species are Essex RDB listed.	6.5	This area supported a habitat-level short sward & bare ground invertebrate assemblage of high conservation value and an arboreal assemblage of moderate conservation value. Also supported were shaded woodland floor and tall sward &	The assemblages recorded from the south-west section of Survey Area 11 were generally of higher conservation value than those recorded from Codham Hall Wood. However, the greatest conservation value was represented in the short sward & bare ground assemblages, more characteristic of open grassland and scrub mosaic, than the tree associated

Survey Area	Broad description	Associated designated site with invertebrate interest	Field survey results			Conclusions
			Recorded species with recognised conservation status*	SQL score	Supported Pantheon invertebrate assemblages	
					scrub habitat level invertebrate assemblages.	woodland assemblages. Survey Area 11 is considered to be of county importance.
Survey Area 12**	Filborough Marshes – coastal and floodplain grazing marsh with a network of ditches running through cattle-grazed semi-improved grassland.	Thames Estuary and Marshes Ramsar site; South Thames Estuary and Marshes SSSI; GR17 canal and grazing marsh (LWS)	No field surveys were carried out in this area due to lack of access.			The diverse habitats within the South Thames Estuary and Marshes SSSI (over half of Survey Area 12 is within this SSSI) support a number of Nationally Rare and Nationally Scarce invertebrate species. From an assessment based on desk study information, Survey Area 12 is considered to be of national importance for invertebrates.
Survey Area 13: Linford	An area of semi-natural broadleaved woodland and scrub; semi-improved neutral grassland; OMH; unvegetated bare ground/active quarry; and standing water.	Linford Pit LWS; Rainbow Shaw LWS	Forty-eight species (out of 513 (9.4%)), including one proposed Nationally Vulnerable; four Nationally Rare (RDB3); four Near Threatened; three RDBK 'unknown' or Data Deficient (DD); 33 Nationally Scarce; two Section 41; and 28 listed as one of	8.7	Assemblages relating to the OMH and herb-rich grassland components of the site supported assemblages of highest conservation value. The wetland habitats surveyed, and the open water habitat subject to aquatic sampling, returned low scores in	An overall SQL score of 8.7 indicates that the site is of very high conservation value, at least approaching national significance. This overall value is reasonably reflected in the habitat-specific SQL scores resulting from Pantheon analysis, for short sward and bare ground and at SAT level, and the open short sward. This assemblage fell narrowly short of its favourable condition target, and bare sand

Survey Area	Broad description	Associated designated site with invertebrate interest	Field survey results			Conclusions
			Recorded species with recognised conservation status*	SQL score	Supported Pantheon invertebrate assemblages	
			Essex Red Data Book categories.		terms of conservation value.	<p>and chalk which was attributed with several Nationally Scarce species, was also significantly attributed. The rich flower resource SAT, which achieved a score exceeding its favourable condition targets, also supported several RDB and Nationally Scarce bee species characteristic of OMH and herb-rich grassland habitat and should be considered significant despite being resource-based and being derived from a non-standard number of samples.</p> <p>Survey Area 13 as a whole occupied a large area and comprised several interrelated habitats representative of those within the broader south Essex/Thames corridor landscape. The site was also located in close proximity to similar sites known to be of importance for OMH and Thames Terrace grassland invertebrates. These factors in combination indicate that the site may be considered of</p>

Survey Area	Broad description	Associated designated site with invertebrate interest	Field survey results			Conclusions
			Recorded species with recognised conservation status*	SQL score	Supported Pantheon invertebrate assemblages	
						national importance to OMH and short sward grassland invertebrates. However, the importance of other habitat features including woodland and wetland biotopes undoubtedly contribute to the overall biodiversity value of the site.

* **RDB2 (Vulnerable):** Pre-1994 classification – Species that are declining throughout their range or occupy vulnerable habitats and are likely to move into the Endangered category.

RDB3 (Rare): Pre-1994 classification – Species which are not currently either Endangered or Vulnerable, are at risk and exist in 15 or fewer 10km squares.

RDBK (Insufficiently Known): Pre-1994 classification – Species suspected to merit either Endangered, Vulnerable, Rare or Indeterminate status but lacking enough information.

IUCN Endangered: Post 1994 IUCN threat guidelines – Species, which the best available evidence indicates, is facing a very high risk of extinction in the wild.

IUCN Near Threatened: Post 1994 IUCN threat guidelines – Species which do not qualify for Endangered or Vulnerable now but is likely to qualify in the near future.

Nationally Scarce: Post 1994 GB rarity status – Species which have been recorded from more than 16 and no more than 100 10km squares in the UK.

Section 41: Species of Principal Importance, listed on Section 41 of the NERC Act (NERC, 2006).

Essex RDB: Species listed in the Essex Red Data Book as a priority for conservation in Essex.

** Area not surveyed, and assessment based on desk study information.

Annex D Terrestrial Invertebrate Survey Update

D.1 Proposed Scheme

Background

- D.1.1 A terrestrial invertebrate survey was commissioned and undertaken in June 2022. The survey focused on ditch “JN1” (TQ672758 to TQ674766) and its adjacent habitats. Previous survey work had been carried out in this area, aimed at establishing the conservation value of its terrestrial invertebrate assemblages (Mellings, 2018) see 6.3-ES_App8.03 - HE540039-CJV-GEN-GEN-REP-ENV-00030_ES_Terrestrial Biodiversity Appendix - Terrestrial Invertebrates_v2.
- D.1.2 Since the initial survey work was undertaken in 2018, there has been a particular focus on ditch “JN1” with regards to its possible inclusion with a SSSI boundary. Therefore, further survey was commissioned to focus on this particular area

D.2 Purpose of this Report and Survey Objectives

- D.2.1 The purpose of this report is to present the results of the terrestrial invertebrate survey undertaken in June 2022.
- D.2.2 The objective of the terrestrial invertebrate survey was to identify protected, notable or priority terrestrial invertebrate species within and adjacent to ditch “JN1”. This report should be read in conjunction with the findings of previous survey work for Area 3 – Goshems Farm (Mellings, 2018) see 6.3-ES_App8.03 - HE540039-CJV-GEN-GEN-REP-ENV-00030_ES_Terrestrial Biodiversity Appendix - Terrestrial Invertebrates_v2.

D.3 Methodology

Survey Timing

- D.3.1 The terrestrial invertebrate survey was carried out between 11:00 and 13:00 on 7 June and between 13:00 and 18:00 on 8 June 2022.
- D.3.2 The survey was led by Principal Ecologist and invertebrate specialist Catherine Burton. Where identification in the field was not possible invertebrate samples were collected and sent for identification to experienced entomologists, Marcel Ashby and Tristan Bantock.

Survey Area

- D.3.3 The terrestrial invertebrate survey area comprised the ditch “JN1” (TQ672758 to TQ674766) and adjacent habitat as also referenced in the Freshwater Ecology

appendix 6.3-ES_App8.04 - HE540039-CJV-GEN-GEN-REP-ENV-00030 - Environmental Statement - Terrestrial Biodiversity Appendix - Freshwater Ecology.

Terrestrial Invertebrate Survey

- D.3.4 The sampling methods for each habitat compartment followed those proposed by Drake et al. (2007) and included spot searching, sweep netting, beating, hand searching, and suction sampling. Each survey area was initially subject to a visual appraisal with one or more sampling areas selected for direct survey. The number of sampling areas was decided according to the size of the compartment, variety of habitats, and the likely species present.
- D.3.5 All samples were timed to ensure that analysis by Natural England’s Pantheon system could be undertaken if required, as outlined in Drake et al. (2007). The Pantheon system, a tool developed by Natural England and the Centre for Ecology and Hydrology to analyse invertebrate sample data, is used to allocate species to assemblage types and to allow a standardised comparison of the habitats of importance at sites.
- D.3.6 Spot searching, beating, and hand searching were each undertaken for 30 minutes within each sampling area. Sweep-netting was undertaken for 20 minutes within each sampling area. Suction sampling was undertaken for two minutes within each sampling area.
- D.3.7 The survey was completed in sunny conditions with weather considered to be optimal for terrestrial invertebrate survey. Survey temperatures ranged from 17 to 21°C with approximately 30 to 60% cloud cover and little wind. Survey was stopped at 13:00 on 7 June due to rain however it was resumed the following day when survey conditions were again optimal, and vegetation had dried sufficiently for sweep sampling to be carried out.

Limitations

- D.3.8 Due to the steep nature of the ditch banks and density of scrub in some areas it was not possible to access some parts of the ditch for sampling. However, most areas of the ditch were accessible, and all representative habitats could be sampled.
- D.3.9 The single visit undertaken here is in addition to previous survey work in this area (Area 3 – Goshems Farm) (Mellings, 2018) and has been undertaken to ensure adequate survey coverage of Ditch “JN1”. As such this report should be considered as an addendum to previous reports rather than as a standalone document. The dataset generated from this survey of 211 species, including 15 of protected / notable status, reflects a robust sampling effort.

D.4 Results

Terrestrial Invertebrate Survey

Ditch and Adjacent Habitats (see Appendix A)

- D.4.1 In-channel vegetation mainly comprised dense beds of Sea Club-rush *Bolboschoenus maritimus* and intermittent stands of Common Reed *Phragmites australis* and beds of Bittersweet *Solanum dulcamara*.
- D.4.2 Bankside slope vegetation was primarily comprised of dense Common Nettle *Urtica dioica* and Brambles *Rubus* spp. with occasional Hawthorn *Crataegus monogyna*, Dog Rose *Rosa canina* agg., Elder *Sambucus nigra*, and Blackthorn *Prunus spinosa*.
- D.4.3 Along the top of the banks tall ruderal vegetation was present composed primarily of abundant Hedge Mustard *Sisymbrium officinale*, Common Butterbur *Petasites hybridus*, and Creeping thistle *Cirsium arvense*. Also present was frequent Wild Carrot *Daucus carota* and Common Hogweed *Heracleum sphondylium* with occasional Fennel *Foeniculum vulgare*.
- D.4.4 Other species present along the banks and within adjacent habitat (along track margins and surrounding spoil heaps) were Meadow Crane's-bill *Geranium pratense*, Common poppy *Papaver rhoeas*, Hedge Bindweed *Calystegia sepium*, Field Bindweed *Convolvulus arvensis*, Bristly Ox-tongue *Helminthotheca echioides*, Cleavers *Galium aparine*, Spear-leaved Orache *Atriplex prostrata*, Teasel *Dipsacus fullonum*, Hoary cress *Lepidium draba*, Tufted Vetch *Vicia cracca*, Goat's-rue *Galega officinalis*, Mallow *Malva sylvestris* and Sow Thistle *Sonchus arvensis*. Grasses present consisted of Creeping Bent *Agrostis stolonifera*, False-oat grass *Arrhenatherum elatius*, Soft Brome *Bromus hordaceus*, Cock's-foot *Dactylis glomerata*, Red Fescue *Festuca rubra*, Yorkshire Fog *Holcus lanatus* and Rough Meadow Grass *Poa trivialis*.
- D.4.5 Rubble piles were also present along the length of the ditch.
- D.4.6 Overall the banks and adjacent habitat were herb-rich open mosaic habitats with extensive areas of bare ground. The vegetative structure and topography of the site were varied and the herb-rich banks provided abundant pollinator interest.

Pantheon Results

- D.4.7 Pantheon covered 197 of the 211 species identified from this survey area, with 14 species not included within the Pantheon conservation status database. Within that subset, three broad biotopes were represented. These broad biotopes could be subdivided into habitat types (Table D.1). Only habitat types which contained a sufficient number of species for accurate assessment are

included hence the disparity in total species numbers between habitats and biotopes.

Table D.1 Broad biotopes and habitats within the Survey Area

Broad biotope (no. of species)	Broad biotope SQI	Species with Conservation Status**	Conservation Status**	Habitats with a species quality score (no. of species)	Habitat at SQI
Open habitats (133)	121	8	8 Nationally Scarce (1 also RDB2 & NERC S41)	Tall sward & scrub (102)	110
				Short sward & bare ground (29)	154
Tree-associated (28)	111	1	1 Nationally Scarce	Arboreal (15)	100
				Decaying wood (7)	143*
				Shaded woodland floor (6)	100*
				Wet Woodland (1)	100*
Wetland (25)	124	2	2 Nationally Scarce	Acid & Sedge Peats (11)	127*
				Marshland (9)	100*
				Running Water (3)	200*
				Wet Woodland (1)	100*

SQI = Species Quality Index

* Calculated from less than 15 species so may not be reliable.

** Excluding local scarcity designations such as Essex Red List.

- D.4.8 The assemblage of “Open habitat” species was best represented with 133 associated species which could be further subdivided in to “Tall sward & scrub” (102 species) and “Short sward & bare ground” (29 species).
- D.4.9 This was followed by “Tree-associated” assemblages (28 species), which could be further divided in to “Arboreal” (15 species), “Decaying wood” (7 species)*, “Shaded woodland floor” (6 species)*, and “Wet Woodland” (1 species)*.
- D.4.10 This was followed by “Wetland” assemblages (25 species), which could be further divided in to “Acid & Sedge Peats” (11 species)*, “Marshland” (9 species)*, “Running Water” (3 species)*, and “Wet Woodland” (1 species)*.
- D.4.11 Eleven species were associated with “short sward & bare ground”. These were the spider *Synageles venator* (Nationally Scarce (LC); Essex RDB), beetles *Agrypnus murinus*, Bombardier Beetle *Brachinus crepitans* (Nationally Scarce (LC); Essex RDB), *Calathus mollis*, *Cordylepherus viridis*, *Isomira murina*, *Ophonus ardosiacus* (Essex RDB), *Panageus bipustulatus* (Nationally Scarce (LC); Essex RDB), and true bugs *Asiraca clavicornis* (Nationally Scarce; Essex

RDB), *Euscelidius variegatus* (Nationally Scarce; Essex RDB), and *Legnotus limbosus*.

- D.4.12 Seven species were associated with “decaying wood”. These were beetles *Anobium fulvicorne*, *Dasytes plumbeus* (Nationally Scarce (LC); Essex RDB), Common Malachite Beetle *Malachius bipustulatus*, *Anaspis fasciata* and *Anaspis maculata*, the Horned Black Wasp *Passaloecus corniger*, and the Patchwork Leafcutter Bee *Megachile centuncularis*.
- D.4.13 Two species were associated with “acid & sedge peats”. These were the beetle *Paederus riparius* and Reed Yellow-face Bee *Hylaeus pectoralis* (Possibly Nationally Scarce; Essex RDB).
- D.4.14 The number of species representative of each assemblage or habitat is not necessarily an indicator of higher conservation importance. This is instead indicated by the Species Quality Index (SQI).
- D.4.15 The “Open habitats” broad biotope for this survey area had the highest reliable SQI, followed by the “Tree-associated”, and “Wetland” broad biotopes.
- D.4.16 The “Tall sward & scrub” habitat for this survey area had the highest reliable SQI, followed by the “Short sward & bare ground” habitat, and finally the “Arboreal” habitat.

Protected and Notable Species

- D.4.17 Two hundred and eleven species were found within the survey area (see Appendix B), 15 of which are protected / notable terrestrial invertebrate species as detailed below.

***Synageles venator* (Nationally Scarce (Least Concern); Essex RDB (Endangered) species – see Appendix D)**

- D.4.18 Pantheon habitat association: Short sward & bare ground
- D.4.19 An ant mimic spider largely confined to coastal sand dune habitats with some records from inland fenland sites. Found amongst marram grass, tussocky vegetation and reed beds. It has also been found at several other brownfield sites in South Essex (British Arachnological Society). Locally distributed but can be common where it occurs (Bee, Oxford, & Smith, 2017).

Bombardier Beetle *Brachinus crepitans* (Nationally Scarce (Least Concern; Amber Listed); Essex RDB Species – see Appendix D)

- D.4.20 Pantheon habitat association: Short sward & bare ground
- D.4.21 The Bombardier beetle can be found on warm, bare, gravel or chalk substrates in grasslands, quarries and waste ground. It is predatory on the larvae of ground beetles, rove beetles and water scavenger beetles. Bombardier beetles can emit an explosive spray of irritant chemicals from the tip of the abdomen

when threatened. Very locally distributed and often coastal in southern England and south Wales (Luff, 2007). It is Amber Listed because of the potential for populations to become severely fragmented.

***Ophonus ardosiacus* (Essex RDB species – see Appendix D)**

D.4.22 Pantheon habitat association: Short sward & bare ground

D.4.23 A metallic looking ground beetle found on open habitats such as chalk, limestone soils, agricultural margins, and coastal clay cliffs (Luff, 2007). The beetle has seed-feeding larvae, especially favouring wild carrot (*Daucus carota* L.) (<https://www.ukbeetles.co.uk/>). The species is Locally distributed in England and south Wales. It has become more common within recent decades and occurs more widely inland than its historically (Harvey, 2004).

***Panagaeus bipustulatus* (Nationally Scarce (Least Concern; Amber Listed); Essex RDB species – see Appendix D)**

D.4.24 Pantheon habitat association: Short sward & bare ground

D.4.25 A red and black ground beetle found on well-drained grasslands, dunes, chalk and gravel pits; the species can also be found among debris in marginal wetland sites. Their biology is poorly understood but adults occur all year round (Luff, 2007) (<https://www.ukbeetles.co.uk/>). Locally distributed across southern England, south Wales and East Anglia. It is Amber Listed because of the potential for populations to become severely fragmented.

Mallow Flea Beetle *Podagrica fuscipes* (Nationally Scarce (Least Concern; Amber Listed); Essex RDB species – see Appendix X)

D.4.26 Pantheon habitat association: Tall sward & scrub

D.4.27 The mallow flea beetle is mainly found in eastern England however, the species is thought to be declining nationally. The species is found in grassland, scrub, wood margins, disturbed ground and coastal sites and feeds on mallows and probably Marsh-mallow *Althaea officinalis*. The larvae probably feed on the roots of the foodplant (Hyman & updated by Parsons, 1992).

***Gymnetron villosulum* (Nationally Scarce; Essex RDB species – see Appendix D)**

D.4.28 Pantheon habitat association: Running water

D.4.29 A small weevil (beetle) which is found on waterside speedwells *Veronica* spp. The larvae feed in the fruits of the plant causing swelling (galls). The beetle is found in the margins of aquatic habitats. Local in central and southern England. Very local in south-east Wales and Ireland (Duff A. G., 2020).

***Dasytes plumbeus* (Nationally Scarce (Least Concern); Essex RDB species – see Appendix D)**

- D.4.30 Pantheon habitat association: Decaying wood
- D.4.31 A saproxylic, soft-winged flower beetle with adults occurring over a short season from May to July. Usually found in open grassland, wood pastures, or densely vegetated scrubland. The larvae are predatory and develop in decaying wood. The beetle is locally common across lowland Wales and England (north up to Yorkshire) but is variously classified as scarce due to historic confusion with nomenclature and with similar species (James, 2018), (<https://www.ukbeetles.co.uk/>).

***Cercyon sternalis* (Essex RDB species – see Appendix D)**

- D.4.32 Pantheon habitat association: Acid & Sedge Peats
- D.4.33 A local water beetle with records concentrated in East Anglia and the Thames and Essex Marshes (Essex Field Club). Found in damp vegetation on marshy ground or by water. Once nationally rare its distribution has increased (James, 2018).

***Cercyon tristis* (Essex RDB species – see Appendix D)**

- D.4.34 Pantheon habitat association: Marshland
- D.4.35 A semi-aquatic beetle found in and besides shallow water in ditches and ponds (James, 2018).

***Meligethes rotundicollis* (Nationally Scarce; Essex RDB species – see Appendix D)**

- D.4.36 Pantheon habitat association: Not Listed
- D.4.37 A very local pollen beetle. The pollen beetle's larvae develop in unopened flower buds of various brassicas. Found on or near flowering Charlock *Sinapis arvensis* and Hedge Mustard *Sisymbrium officinale* (Duff A. G., 2020).

***Euscelidius variegatus* (Nationally Scarce - see Appendix D)**

- D.4.38 Pantheon habitat association: Short sward & bare ground
- D.4.39 A leafhopper (plant bug) often found in short, sparse, dry grassland. Very local in the south-east of England. Its distribution has increased in recent years (Essex Field Club).

Rambur's Pied Shieldbug *Tritomegas sexmaculatus* (New to Britain)

- D.4.40 Pantheon habitat association: Not Listed
- D.4.41 This shieldbug was found in Britain in 2011 from two sites in Kent. Since then it has spread rapidly across Kent, south Essex and London. All British records have been associated with Black Horehound *Ballota nigra* (Bantock, 2011).

***Asiraca clavicornis* (Nationally Scarce; Essex RDB species - see Appendix D)**

D.4.42 Pantheon habitat association: Short sward & bare ground

D.4.43 A distinctive plant bug, with expanded front legs and antennae, which has declined in distribution to become restricted to the London area and Thames estuary. It is local in rough grassland and wasteland (British Bugs).

Shrill Carder Bee *Bombus sylvarum* (Nationally Scarce; NERC Section 41; RDB2 (Vulnerable); Essex RDB species - see Appendix C & D)

D.4.44 Pantheon habitat association: Tall sward & scrub

D.4.45 A small bumblebee whose workers have a slow hovering flight with a distinct, shrill buzz. The species inhabits species-rich grassland, coastal grazing marsh, coastal dunes, vegetated shingle and brownfield sites. Queens forage on White Dead-nettle, clovers and vetches. Workers visit a wide variety of flowers including composites, legumes, labiates, Red Bartsia, brambles, Teasel and scabious. On coastal flood defences they forage heavily on Red Clover, Red Bartsia, Creeping Thistle and Bristly Oxtongue. Males like thistles, ragworts, Bristly Oxtongue and Black Horehound. Queens nest on dense vegetation and colonies are usually small with less than 50 workers. The bumblebee was historically widespread but has suffered severe declines in the twentieth century, leaving modern populations largely restricted to the Thames Gateway, Somerset Levels, Salisbury Plain, the coast of South Wales and parts of western Ireland (Falk, 2015).

Reed Yellow-face Bee *Hylaeus pectoralis* (Possibly Nationally Scarce; Essex RDB species – see Appendix D)

D.4.46 Pantheon habitat association: Acid & Sedge Peats

D.4.47 This bee is a reedbed specialist, nesting in ‘cigar galls’ formed by a chloropid fly, and hollow reed stems. It is found in reed beds of brackish and fresh water where it prefers the drier margins. The species is frequently observed on umbellifers, brambles, and thistles, also hawkbits and sow thistles. It is a localised species of southern England and maybe under-recorded as it readily colonises new reedbeds (Falk, 2015). The species is possibly nationally scarce (Bees, Wasps & Ants Recording Society (BWARS)).

D.4.48 In addition to the findings of the terrestrial invertebrate survey it also of note that the Nationally Scarce water beetle, *Rhantus frontalis*, was found within ditch “JN1” during the Freshwater Ecology survey (see: 6.3-ES_App8.04 - HE540039-CJV-GEN-GEN-REP-ENV-00030 - Environmental Statement - Terrestrial Biodiversity Appendix - Freshwater Ecology)




D.5 Discussion


Terrestrial Invertebrate Survey

- D.5.1 Fifteen protected / notable terrestrial invertebrate species were present within the survey area. An overall Pantheon assessment of the total species list found the open habitats (comprising bare sand and chalk, rich flower resource, open short sward, and scrub edge) to have the highest SQI of the broad biotopes present which is reflected in the open mosaic nature of the site, with herb-rich banks, high pollinator interest, and 12 species of bee and wasp utilising the survey area for this resource both for foraging and nesting.
- D.5.2 Previous survey for the wider area (Area 3 – Goshems Farm) found 54 protected / notable species (Mellings, 2018). Three of which were recorded again in this updated ditch survey (the ground beetle *Ophonus ardosiacus*, plant bug *Asiraca clavicornis*, and Shril Carder Bee) in addition to another 12 species of conservation importance. The previous overall SQI score for Area 3 – Goshems Farm was 11.2 which indicates a site of National significance. The findings of this survey update for Ditch “JN1” are in accord with this, with a high number of species, including protected / notable species, generated from one visit.

Annex E Terrestrial Invertebrate Photographs

Table E.1 Photographs collected during Terrestrial Invertebrate Survey

Location	Photograph	Description
In-channel vegetation		In-channel vegetation mainly comprised dense beds of Sea Club-rush and intermittent stands of Common Reed and beds of Bittersweet. Dense Common Nettle and Bramble were present on the ditch slopes.
Bank-side vegetation		Dense vegetation including Common Nettle, Hedge Mustard and Common Butterbur were dominant as bankside vegetation.
Top bank margin vegetation		Umbellifers such as Common Hogweed and Wild Carrot were present along the ditch margin as well as abundant Hedge Mustard

Location	Photograph	Description
Rubble Piles and Bare Ground		Rubble piles and large areas of bare ground were present along the length of the ditch.

Annex F Species List

Table F.1 Species List

Taxon group	Species Name	Vernacular Name	Status (see Appendix D & E)	In-channel	Ditch Slope & Reed Bed Margin	Top of Ditch / Ruderal Margin	Shrubs (Hawthorn, Elder, Dog Rose & Blackthorn)
Araneae	<i>Araneus diadematus</i>	Garden spider			X		
Araneae	<i>Araniella cucurbitina sensu lato</i>	Cucumber spider				X	
Araneae	<i>Larinioides cornutus</i>	The Furrow spider				X	
Araneae	<i>Mangora acalypha</i>	Cricket Bat Orb-weaver			X	X	
Araneae	<i>Clubiona brevipes</i>						X
Araneae	<i>Clubiona pallidula</i>						X
Araneae	<i>Clubiona phragmitis</i>				X		
Araneae	<i>Clubiona subtilis</i>			X			
Araneae	<i>Dictyna latens</i>				X	X	X
Araneae	<i>Dictyna uncinata</i>						X
Araneae	<i>Bathypantes gracilis</i>				X		
Araneae	<i>Oedothorax apicatus</i>					X	
Araneae	<i>Pocadicnemis juncea</i>					X	
Araneae	<i>Tenuiphantes flavipes</i>			X			

Taxon group	Species Name	Vernacular Name	Status (see Appendix D & E)	In-channel	Ditch Slope & Reed Bed Margin	Top of Ditch / Ruderal Margin	Shrubs (Hawthorn, Elder, Dog Rose & Blackthorn)
Araneae	<i>Pardosa prativaga</i>				X	X	
Araneae	<i>Philodromus cespitum</i>	Turf-running spider			X	X	X
Araneae	<i>Tibellus oblongus</i>				X	X	
Araneae	<i>Euophrys frontalis</i>	White-palped Jumper			X		
Araneae	<i>Heliophanus cupreus</i>	Copper sun jumper			X		X
Araneae	<i>Heliophanus flavipes</i>						X
Araneae	<i>Synageles venator</i>		Nationally Scarce (Least Concern) Essex RDB (Endangered)		X		
Araneae	<i>Tetragnatha extensa</i>					X	
Araneae	<i>Tetragnatha montana</i>						X
Araneae	<i>Anelosimus vittatus</i>						X
Araneae	<i>Enoplognatha ovata sensu lato</i>	Common Candy-striped spider			X	X	X
Araneae	<i>Episinus angulatus</i>					X	
Araneae	<i>Neottiura bimaculata</i>			X			
Araneae	<i>Simitidion simile</i>						X
Araneae	<i>Theridion varians</i>						X

Taxon group	Species Name	Vernacular Name	Status (see Appendix D & E)	In-channel	Ditch Slope & Reed Bed Margin	Top of Ditch / Ruderal Margin	Shrubs (Hawthorn, Elder, Dog Rose & Blackthorn)
Araneae	<i>Xysticus cristatus</i>	Common Crab spider			X	X	
Araneae	<i>Zora spinimana</i>						X
Coleoptera	<i>Aspidapion radiolus</i>					X	
Coleoptera	<i>Hemicoelus fulvicornis</i>						X
Coleoptera	<i>Malvapion malvae</i>					X	
Coleoptera	<i>Perapion hydrolapathi</i>					X	
Coleoptera	<i>Perapion violaceum</i>					X	
Coleoptera	<i>Cantharis lateralis</i>				X	X	X
Coleoptera	<i>Acupalpus meridianus</i>			X	X		
Coleoptera	<i>Anchomenus dorsalis</i>				X		
Coleoptera	<i>Badister bullatus</i>				X		
Coleoptera	<i>Bembidion lunulatum</i>				X		
Coleoptera	<i>Brachinus crepitans</i>	Bombardier Beetle	Nationally Scarce (Least Concern; Amber Listed) Essex RDB			X	
Coleoptera	<i>Bradycellus verbasci</i>					X	
Coleoptera	<i>Calathus mollis</i>					X	
Coleoptera	<i>Demetrias atricapillus</i>				X	X	
Coleoptera	<i>Notiophilus palustris</i>				X	X	

Taxon group	Species Name	Vernacular Name	Status (see Appendix D & E)	In-channel	Ditch Slope & Reed Bed Margin	Top of Ditch / Ruderal Margin	Shrubs (Hawthorn, Elder, Dog Rose & Blackthorn)
Coleoptera	<i>Ophonus ardosiacus</i>		Essex RDB		X	X	
Coleoptera	<i>Ophonus rufibarbis</i>					X	
Coleoptera	<i>Panagaeus bipustulatus</i>		Nationally Scarce (Least Concern; Amber Listed) Essex RDB			X	
Coleoptera	<i>Paradromius linearis</i>				X	X	
Coleoptera	<i>Syntomus obscuropustulatus</i>				X	X	
Coleoptera	<i>Trechus obtusus</i>			X			
Coleoptera	<i>Agapanthia villosa</i> <i>viridescens</i>	Golden-bloomed Grey Longhorn				X	
Coleoptera	<i>Bruchidius imbricornis</i>					X	X
Coleoptera	<i>Bruchus rufimanus</i>	Broad Bean Weevil				X	
Coleoptera	<i>Cryptocephalus rufipes</i>						X
Coleoptera	<i>Phyllotreta atra</i>	Cabbage Flea beetle			X		
Coleoptera	<i>Podagrica fuscipes</i>	Mallow Flea beetle	Nationally Scarce (Least Concern; Amber Listed) Essex RDB		X		

Taxon group	Species Name	Vernacular Name	Status (see Appendix D & E)	In-channel	Ditch Slope & Reed Bed Margin	Top of Ditch / Ruderal Margin	Shrubs (Hawthorn, Elder, Dog Rose & Blackthorn)
Coleoptera	<i>Sphaeroderma testaceum</i>	Artichoke beetle				X	
Coleoptera	<i>Coccinella septempunctata</i>	Seven-spot Ladybird			X	X	
Coleoptera	<i>Exochomus quadripustulatus</i>						X
Coleoptera	<i>Harmonia axyridis</i>	Harlequin Ladybird				X	X
Coleoptera	<i>Propylea quattuordecimpunctata</i>	Pine Ladybird				X	
Coleoptera	<i>Psyllobora vigintiduopunctata</i>	Twenty-two spot Ladybird				X	
Coleoptera	<i>Rhyzobius chrysomeloides</i>						X
Coleoptera	<i>Rhyzobius litura</i>			X	X	X	X
Coleoptera	<i>Subcoccinella vigintiquattuor punctata</i>	Twenty-four spot Ladybird			X	X	
Coleoptera	<i>Corylophus cassidoides</i>			X			
Coleoptera	<i>Corylophus sublaevipennis</i>			X			
Coleoptera	<i>Antherophagus pallens</i>					X	
Coleoptera	<i>Cryptophagus setulosus</i>					X	

Taxon group	Species Name	Vernacular Name	Status (see Appendix D & E)	In-channel	Ditch Slope & Reed Bed Margin	Top of Ditch / Ruderal Margin	Shrubs (Hawthorn, Elder, Dog Rose & Blackthorn)
Coleoptera	<i>Ceutorhynchus contractus</i>					X	
Coleoptera	<i>Ceutorhynchus obstrictus</i>			X	X	X	X
Coleoptera	<i>Ceutorhynchus pallidactylus</i>	Cabbage Stem Weevil			X	X	
Coleoptera	<i>Ceutorhynchus picitarsis</i>	Rape Winter Stem Weevil				X	
Coleoptera	<i>Gymnetron villosulum</i>		Nationally Scarce Essex RDB			X	
Coleoptera	<i>Nedyus quadrimaculatus</i>				X		
Coleoptera	<i>Parethelcus pollinarius</i>				X		
Coleoptera	<i>Phyllobius roboretanus</i>	Small Green Nettle Weevil			X		
Coleoptera	<i>Dasytes plumbeus</i>		Nationally Scarce (Least Concern; Amber Listed) Essex RDB				X
Coleoptera	<i>Agrypnus murinus</i>				X	X	
Coleoptera	<i>Athous haemorrhoidalis</i>				X	X	X
Coleoptera	<i>Cercyon sternalis</i>		Essex RDB	X			
Coleoptera	<i>Cercyon tristis</i>		Essex RDB	X			

Taxon group	Species Name	Vernacular Name	Status (see Appendix D & E)	In-channel	Ditch Slope & Reed Bed Margin	Top of Ditch / Ruderal Margin	Shrubs (Hawthorn, Elder, Dog Rose & Blackthorn)
Coleoptera	<i>Megasternum concinnum</i>				X		
Coleoptera	<i>Brachypterus glaber</i>				X		
Coleoptera	<i>Corticaria gibbosa</i>						X
Coleoptera	<i>Cordylepherus viridis</i>				X		
Coleoptera	<i>Malachius bipustulatus</i>	Common Malachite Beetle			X	X	
Coleoptera	<i>Meligethes aeneus</i>	Common Pollen Beetle			X	X	X
Coleoptera	<i>Meligethes rotundicollis</i>		Nationally Scarce Essex RDB			X	
Coleoptera	<i>Oedemera nobilis</i>	Swollen-thighed Flower Beetle				X	
Coleoptera	<i>Olibrus affinis</i>				X		
Coleoptera	<i>Acrotrichis atomaria</i>				X		
Coleoptera	<i>Neocoenorrhinus aequatus</i>	Apple Fruit Weevil					X
Coleoptera	<i>Cyphon coarctatus</i>				X	X	X
Coleoptera	<i>Anaspis fasciata</i>					X	
Coleoptera	<i>Anaspis maculata</i>	Tumbling Flower Beetle			X		X

Taxon group	Species Name	Vernacular Name	Status (see Appendix D & E)	In-channel	Ditch Slope & Reed Bed Margin	Top of Ditch / Ruderal Margin	Shrubs (Hawthorn, Elder, Dog Rose & Blackthorn)
Coleoptera	<i>Achenium depressum</i>					X	
Coleoptera	<i>Cypha longicornis</i>				X		
Coleoptera	<i>Drusilla canaliculata</i>				X		
Coleoptera	<i>Paederus littoralis</i>				X		
Coleoptera	<i>Paederus riparius</i>			X			
Coleoptera	<i>Quedius levicollis</i>					X	
Coleoptera	<i>Sepedophilus marshami</i>			X			
Coleoptera	<i>Stenus impressus</i>			X			
Coleoptera	<i>Stenus junco</i>			X	X		
Coleoptera	<i>Tachyporus hypnorum</i>				X	X	
Coleoptera	<i>Isomira murina</i>				X		
Dermaptera	<i>Forficula auricularia</i>	Common Earwig				X	X
Diptera	<i>Dolichocephala guttata</i>			X			
Diptera	<i>Geomyza tripunctata</i>					X	
Diptera	<i>Palloptera modesta</i>	Dumbell-spotted Flutter Fly			X	X	
Diptera	<i>Pipunculus campestris</i>				X		
Diptera	<i>Sarcophaga haemorrhoea</i>	Lesser Red-tailed Flesh Fly			X		
Diptera	<i>Coremacera marginata</i>					X	

Taxon group	Species Name	Vernacular Name	Status (see Appendix D & E)	In-channel	Ditch Slope & Reed Bed Margin	Top of Ditch / Ruderal Margin	Shrubs (Hawthorn, Elder, Dog Rose & Blackthorn)
Diptera	<i>Eupeodes latifasciatus</i>	Meadow Field Syrph				X	
Diptera	<i>Eupeodes luniger</i>	Common Spotted Field Syrph			X	X	
Diptera	<i>Helophilus pendulus</i>	Tiger Hoverfly				X	
Diptera	<i>Neoascia tenur</i>	Bridged Clubtail				X	
Diptera	<i>Pipizella viduata</i>					X	
Diptera	<i>Sphaerophoria scripta</i>	Common Twist-tail			X		
Diptera	<i>Syrphus ribesii</i>	Humming Syrphus				X	
Diptera	<i>Tropidia scita</i>	Tooth-thighed Hoverfly			X	X	
Diptera	<i>Volucella bombylans</i>	Bumblebee Plumehorn				X	
Diptera	<i>Campiglossa misella</i>					X	
Diptera	<i>Oxyna parietina</i>					X	
Diptera	<i>Tephritis divisa</i>					X	
Diptera	<i>Tephritis formosa</i>					X	
Diptera	<i>Tephritis ruralis</i>					X	

Taxon group	Species Name	Vernacular Name	Status (see Appendix D & E)	In-channel	Ditch Slope & Reed Bed Margin	Top of Ditch / Ruderal Margin	Shrubs (Hawthorn, Elder, Dog Rose & Blackthorn)
Diptera	<i>Nephrotoma appendiculata</i>	Spotted Cranefly			X	X	
Diptera	<i>Tipula paludosa</i>				X	X	
Hemiptera	<i>Anthocoris confusus</i>					X	X
Hemiptera	<i>Anthocoris nemoralis</i>						X
Hemiptera	<i>Neophilaenus campestris</i>				X	X	X
Hemiptera	<i>Anaceratagallia ribauti</i>					X	
Hemiptera	<i>Aphrodes makarovi</i>				X		X
Hemiptera	<i>Arthaldeus pascuellus</i>			X			
Hemiptera	<i>Eupteryx urticae</i>				X	X	X
Hemiptera	<i>Euscelidius variegatus</i>		Nationally Scarce			X	
Hemiptera	<i>Euscelis incisus</i>					X	
Hemiptera	<i>Macustus grisescens</i>					X	
Hemiptera	<i>Tachycixius pilosus</i>						X
Hemiptera	<i>Legnotus limbosus</i>	Bordered Shieldbug			X	X	
Hemiptera	<i>Tritomegas sexmaculatus</i>	Rambur's Pied Shieldbug	New to Britain		X	X	

Taxon group	Species Name	Vernacular Name	Status (see Appendix D & E)	In-channel	Ditch Slope & Reed Bed Margin	Top of Ditch / Ruderal Margin	Shrubs (Hawthorn, Elder, Dog Rose & Blackthorn)
Hemiptera	<i>Asiraca clavicornis</i>		Nationally Scarce Essex RDB			X	
Hemiptera	<i>Javesella obscurella</i>			X			
Hemiptera	<i>Javesella pellucida</i>			X			
Hemiptera	<i>Stenocranus minutus</i>					X	
Hemiptera	<i>Scolopostethus affinis</i>				X	X	X
Hemiptera	<i>Scolopostethus thomsoni</i>				X	X	
Hemiptera	<i>Atractotomus mali</i>						X
Hemiptera	<i>Capsus ater</i>				X	X	
Hemiptera	<i>Closterotomus norwegicus</i>	Potato Capsid			X	X	
Hemiptera	<i>Deraeocoris (Knightocapsus) lutescens</i>				X		
Hemiptera	<i>Leptopterna dolabrata</i>	Meadow Plant Bug			X		
Hemiptera	<i>Liocoris tripustulatus</i>				X	X	
Hemiptera	<i>Megaloceroea recticornis</i>				X		
Hemiptera	<i>Notostira elongata</i>				X	X	

Taxon group	Species Name	Vernacular Name	Status (see Appendix D & E)	In-channel	Ditch Slope & Reed Bed Margin	Top of Ditch / Ruderal Margin	Shrubs (Hawthorn, Elder, Dog Rose & Blackthorn)
Hemiptera	<i>Pithanus maerkelii</i>				X		
Hemiptera	<i>Plagiognathus (Plagiognathus) arbustorum</i>				X		
Hemiptera	<i>Polymerus (Polymerus) nigrita</i>				X		
Hemiptera	<i>Stenodema (Brachystira) calcarata</i>					X	
Hemiptera	<i>Stenodema (Stenodema) laevigata</i>					X	
Hemiptera	<i>Teratocoris antennatus</i>				X		
Hemiptera	<i>Nabis (Dolichonabis) limbatus</i>					X	
Hemiptera	<i>Nabis (Limnonabis) lineatus</i>	Reed Damsel Bug			X		
Hemiptera	<i>Eurydema (Eurydema) oleracea</i>	Crucifer Shieldbug				X	
Hymenoptera	<i>Andrena chrysoseles</i>	Hawthorn Mining Bee				X	
Hymenoptera	<i>Andrena flavipes</i>	Yellow-legged Mining Bee				X	
Hymenoptera	<i>Apis mellifera</i>	Honey Bee				X	X

Taxon group	Species Name	Vernacular Name	Status (see Appendix D & E)	In-channel	Ditch Slope & Reed Bed Margin	Top of Ditch / Ruderal Margin	Shrubs (Hawthorn, Elder, Dog Rose & Blackthorn)
Hymenoptera	<i>Bombus lapidarius</i>	Red-tailed Bumblebee				X	
Hymenoptera	<i>Bombus lucorum</i>	White-tailed Bumblebee				X	
Hymenoptera	<i>Bombus pascuorum</i>	Common Carder Bee				X	
Hymenoptera	<i>Bombus sylvarum</i>	Shrill Carder Bee	Nationally Scarce NERC S41 Essex RDB			X	
Hymenoptera	<i>Bombus sylvestris</i>	Forest Cuckoo Bee				X	
Hymenoptera	<i>Nomada flava</i>	Flavous Nomad Bee				X	
Hymenoptera	<i>Cephus pygmeus</i>	Wheat Stem Borer				X	
Hymenoptera	<i>Hylaeus pectoralis</i>	Reed Yellow-face Bee	Possibly Nationally Scarce Essex RDB			X	
Hymenoptera	<i>Passaloecus corniger</i>	Horned Black Wasp				X	
Hymenoptera	<i>Formica fusca</i>	Dusky Ant			X	X	
Hymenoptera	<i>Lasius niger</i>	Small Black Ant			X	X	
Hymenoptera	<i>Myrmica ruginodis</i>				X	X	

Taxon group	Species Name	Vernacular Name	Status (see Appendix D & E)	In-channel	Ditch Slope & Reed Bed Margin	Top of Ditch / Ruderal Margin	Shrubs (Hawthorn, Elder, Dog Rose & Blackthorn)
Hymenoptera	<i>Lasioglossum pauxillum</i>	Lobe-spurred Furrow Bee				X	
Hymenoptera	<i>Megachile centuncularis</i>	Patchwork Leafcutter Bee				X	
Isopoda	<i>Armadillidium vulgare</i>	Pill Woodlouse		X	X	X	
Isopoda	<i>Philoscia muscorum</i>	Common Striped Woodlouse		X	X	X	
Lepidoptera	<i>Hypena proboscidalis</i>	The Snout			X		
Lepidoptera	<i>Tyria jacobaeae</i>	Cinnabar Moth				X	
Lepidoptera	<i>Ochlodes sylvanus</i>	Large Skipper				X	
Lepidoptera	<i>Thymelicus sylvestris</i>	Small Skipper				X	
Lepidoptera	<i>Polyommatus icarus</i>	Common Blue				X	
Lepidoptera	<i>Autographa gamma</i>	Silver-Y				X	
Lepidoptera	<i>Aglais io</i>	Peacock Butterfly				X	
Lepidoptera	<i>Aglais urticae</i>	Small Tortoiseshell				X	
Lepidoptera	<i>Pieris rapae</i>	Small White				X	
Lepidoptera	<i>Emmelina monodactyla</i>	Common Plume				X	
Lepidoptera	<i>Saturnia pavonia</i>	Emperor Moth			X		
Mecoptera	<i>Panorpa communis</i>	Scorpionfly			X		

Taxon group	Species Name	Vernacular Name	Status (see Appendix D & E)	In-channel	Ditch Slope & Reed Bed Margin	Top of Ditch / Ruderal Margin	Shrubs (Hawthorn, Elder, Dog Rose & Blackthorn)
Mecoptera	<i>Panorpa germanica</i>	German Scorpionfly			X		
Neuroptera	<i>Chrysopa perla</i>	Green Lacewing			X	X	
Neuroptera	<i>Micromus variegatus</i>	Brown Lacewing			X		
Odonata	<i>Aeshna grandis</i>	Brown Hawker		X	X	X	
Odonata	<i>Anax imperator</i>	Emperor Dragonfly		X	X	X	
Odonata	<i>Coenagrion puella</i>	Azure Damselfly		X	X	X	
Odonata	<i>Ischnura elegans</i>	Blue-tailed Damselfly		X	X	X	
Opiliones	<i>Leiobunum rotundum</i>	A Harvestman			X		
Orthoptera	<i>Roeseliana roeselii</i>	Roesel's Bush-cricket			X	X	
Pulmonata	<i>Cepaea (Cepaea) nemoralis</i>	Brown-lipped Snail		X	X	X	
Pulmonata	<i>Cornu aspersum</i>	Garden Snail		X	X	X	

Annex G Legislative and Planning Context

G.1 The Habitats Regulations, and Wildlife and Countryside Act 1981 (as amended) (WCA)

- G.1.1 The Habitat Regulations transpose Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (EC Habitats Directive) into UK law. The Regulations provide for the designation and protection of 'European Sites', the protection of 'European Protected Species' (EPS), and the adaptation of planning and other controls for the protection of European Sites. EPS are listed on Schedule 2 of the Conservation Regulations.
- G.1.2 Under the combined measures included in the Habitats Regulations and WCA it is an offence to:
- a. deliberately capture, injure or kill any wild animal listed as an EPS;
 - b. deliberately disturb wild animals of any such species in such a way as to be likely to impair their ability:
 - i. to survive, to breed or reproduce, or to rear or nurture their young; or
 - ii. in the case of animals of a hibernating or migratory species, to hibernate or migrate;
 - c. to affect significantly the local distribution or abundance of the species to which they belong;
 - d. deliberately take or destroy the eggs of such an animal; or
 - e. damage or destroy a breeding site or resting place of such an animal.
- G.1.3 Natural Environment and Rural Communities Act 2006 (NERC 2006) Section 40 of the Act concerns biodiversity and states: *“Every public authority must, in exercising its functions, have regard, so far as is consistent with the proper exercise of those functions, to the purpose of conserving biodiversity.”*
- G.1.4 Section 41 of the NERC Act states that: *“The Secretary of State must, as respects England, publish a list of the living organisms and types of habitat which in the Secretary of State’s opinion are of principal importance for the purpose of conserving biodiversity”*. Many terrestrial invertebrate species are categorised as ‘Species of Principal Importance’ under the NERC Act. The list of species can be downloaded from the natural England website at: <http://www.naturalengland.org.uk/ourwork/conservation/biodiversity/protectandmanage/habsandspeciesimportance.aspx>

- G.1.5 The Act stresses that “it is important that public authorities seek not only to protect important habitats and species, but actively seek opportunities to enhance biodiversity through development proposals, where appropriate. Incorporating enhancement opportunities into projects may help applicants to achieve planning permission.”
- G.1.6 A full list of UK Invertebrate Species protected by the Habitats Regulations, WCA and NERC Act (2006) can be found at: <http://jncc.defra.gov.uk/page-3408>.

IUCN Red List and GB Rarity Status Categories

IUCN Red List

Extinct (EX)

- G.1.7 A taxon is Extinct when there is no reasonable doubt that the last individual has died. Extensive surveys in the taxon’s known and / or expected habitat have failed to record an individual.

Extinct in the Wild (EW)

- G.1.8 A taxon is Extinct in the Wild when it is known to only survive in cultivation, captivity or as a naturalised population/s well outside its past range. A taxon is Extinct in the Wild when extensive surveys in the taxon’s known and / or expected habitat have failed to record an individual.

Critically Endangered (CR)

- G.1.9 A taxon is Critically Endangered when it is considered to be facing an extremely high risk of extinction in the wild. The taxon must meet any of the following criteria:
- a. Reduction in population size based on any of the following:
 - i. population size reduction of $\geq 90\%$ over the last 10 years of three generations, whichever is the longer, where the causes are clearly reversible, understood and ceased.
 - ii. population size reduction $\geq 80\%$ over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may NOT be reversible, understood or ceased.
 - iii. projected population size reduction $\geq 80\%$ to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years).
 - iv. observed or projected population size reduction $\geq 80\%$ over any 10 year or three generation period, whichever is the longer (up to a maximum of 100 years in the future). The time period must include the past and

future and the reduction or its causes may not be reversible, understood or ceased.

- b. Extent of occurrence is estimated to be less than 100 km² or area of occupancy is estimated to be less than 10 km² and indicates at least two of: severe fragmentation, continuing decline (observed or projected) and/or extreme fluctuations.
- c. Population size is estimated to be fewer than 250 mature individuals and either:
 - i. an estimated decline of at least 25% within three years or one generation whichever is the longer (up to a maximum of 100 years in the future).
 - ii. a continuing decline, observed or projected with no subpopulation estimated to contain more than 50 mature individuals or at least 90% of mature individuals are in one subpopulation.
- d. Population size estimated to be fewer than 50 mature individuals.
- e. Probability of extinction in the wild is at least 50% within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years).

G.1.10 More details of these criteria can be found in the IUCN Red List Categories and Criteria report (IUCN)

Endangered (EN)

G.1.11 A taxon is Endangered when it is considered to be facing an extremely high risk of extinction in the wild. The taxon must meet any of the following criteria:

- a. Reduction in population size based on any of the following:
 - i. population size reduction of $\geq 70\%$ over the last 10 years of three generations, whichever is the longer, where the causes are clearly reversible, understood and ceased.
 - ii. population size reduction $\geq 50\%$ over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may NOT be reversible, understood or ceased.
 - iii. projected population size reduction $\geq 50\%$ to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years).
 - iv. observed or projected population size reduction $\geq 50\%$ over any 10 year or three generation period, whichever is the longer (up to a maximum of

100 years in the future). The time period must include the past and future and the reduction or its causes may not be reversible, understood or ceased.

- b. Extent of occurrence is estimated to be less than 5000 km² or area of occupancy is estimated to be less than 500 km² and indicates at least two of: severe fragmentation, continuing decline (observed or projected) and/or extreme fluctuations.
- c. Population size is estimated to be fewer than 2500 mature individuals and either:
 - i. an estimated decline of at least 20% within five years or two generations whichever is the longer (up to a maximum of 100 years in the future).
 - ii. A continuing decline, observed or projected with no subpopulation estimated to contain more than 250 mature individuals or at least 95% of mature individuals are in one subpopulation.
- d. Population size estimated to be fewer than 250 mature individuals.
- e. Probability of extinction in the wild is at least 20% within the next 20 years or five generations, whichever is the longer (up to a maximum of 100 years).

G.1.12 More details of these criteria can be found in the IUCN Red List Categories and Criteria report (IUCN)

Vulnerable (VU)

G.1.13 A taxon is Vulnerable when it is considered to be facing an extremely high risk of extinction in the wild. The taxon must meet any of the following criteria:

- a. Reduction in population size based on any of the following:
 - i. population size reduction of $\geq 50\%$ over the last 10 years of three generations, whichever is the longer, where the causes are clearly reversible, understood and ceased.
 - ii. population size reduction $\geq 30\%$ over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may NOT be reversible, understood or ceased.
 - iii. projected population size reduction $\geq 30\%$ to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years).

- iv. observed or projected population size reduction $\geq 30\%$ over any 10 year or three generation period, whichever is the longer (up to a maximum of 100 years in the future). The time period must include the past and future and the reduction or its causes may not be reversible, understood or ceased.
- b. Extent of occurrence is estimated to be less than 20 000 km² or area of occupancy is estimated to be less than 2000 km² and indicates at least two of: severe fragmentation, continuing decline (observed or projected) and/or extreme fluctuations.
- c. Population size is estimated to be fewer than 10 000 mature individuals and either:
 - i. an estimated decline of at least 10% within 10 years or three generations whichever is the longer (up to a maximum of 100 years in the future).
 - ii. A continuing decline, observed or projected with no subpopulation estimated to contain more than 1000 mature individuals or 100% of mature individuals are in one subpopulation.
- d. Population size estimated to be fewer than 1000 mature individuals and with a very restricted area of occupancy or number of locations.
- e. Probability of extinction in the wild is at least 10% within the next 100 years.

G.1.14 More details of these criteria can be found in the IUCN Red List Categories and Criteria report (IUCN)

Near Threatened (NT)

G.1.15 A taxon is Near Threatened when it has been evaluated against the Red List criteria but does not qualify for any of the above threatened categories but is close to qualifying for or is likely to qualify for a threatened category in the near future.

Least Concern (LC)

G.1.16 A taxon is Least Concern when it does not qualify for the above criteria. Widespread and abundant taxa are included in this category.

Data Deficient (DD)

G.1.17 A taxon is Data Deficient when there is inadequate information to make an assessment of its risk of extinction based on its distribution and/or population status.

Not Evaluated (NE)

- G.1.18 A taxon is Not Evaluated having not yet been evaluated against the Red List criteria.

GB Rarity Status Categories

- G.1.19 At the national level countries are permitted to refine the definitions for non-threatened categories and define categories of their own. Nationally Rare and Nationally Scarce categories are unique to Great Britain.

Nationally Rare

- G.1.20 Taxa which occur in 15 or fewer hectads (10 km squares) in Great Britain

Nationally Scarce

- G.1.21 Taxa which are recorded in 16 – 100 hectads (10 km squares) in Great Britain but are not included in one of the Red List Categories

Red Data Book

- G.1.22 Taxa occurring in fewer than 16 10km squares of the National Grid, divided as:
- a. endangered (Red Data Book 1), for species known from a single population or in continuous recent decline and now known from five or fewer 10km squares
 - b. vulnerable (Red Data Book 2), likely to become endangered (Red Data Book 1) if causal factors continue
 - c. rare (Red Data Book 3), species at risk but not qualifying as vulnerable
 - d. Red Data Book K, species insufficiently known but likely to qualify at least as rare

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