Taxon	Summary	Survey standard / guidelines followed	Additional detail
Invertebrates	Visual appraisal for key habitats and microhabitats.	English Nature (2005)[17], Drake et al., (2007)[18]	-

GUIDANCE

2.3 This report has been prepared with reference to best practice guidance published by the Chartered Institute for Ecology and Environmental Management (CIEEM) and as detailed in British Standard 42020:2013 Biodiversity - Code of Practice for Biodiversity and Development. Current guidance with respect to different features and taxa has also been followed as described for each feature/species group.

CONSTRAINTS

2.4 There were no constraints to the surveys as described.

[17] English Nature (2005) *Organising Surveys to Determine Site Quality for Invertebrates A Framework Guide for Ecologists*. Available from: http://publications.naturalengland.org.uk/file/116024

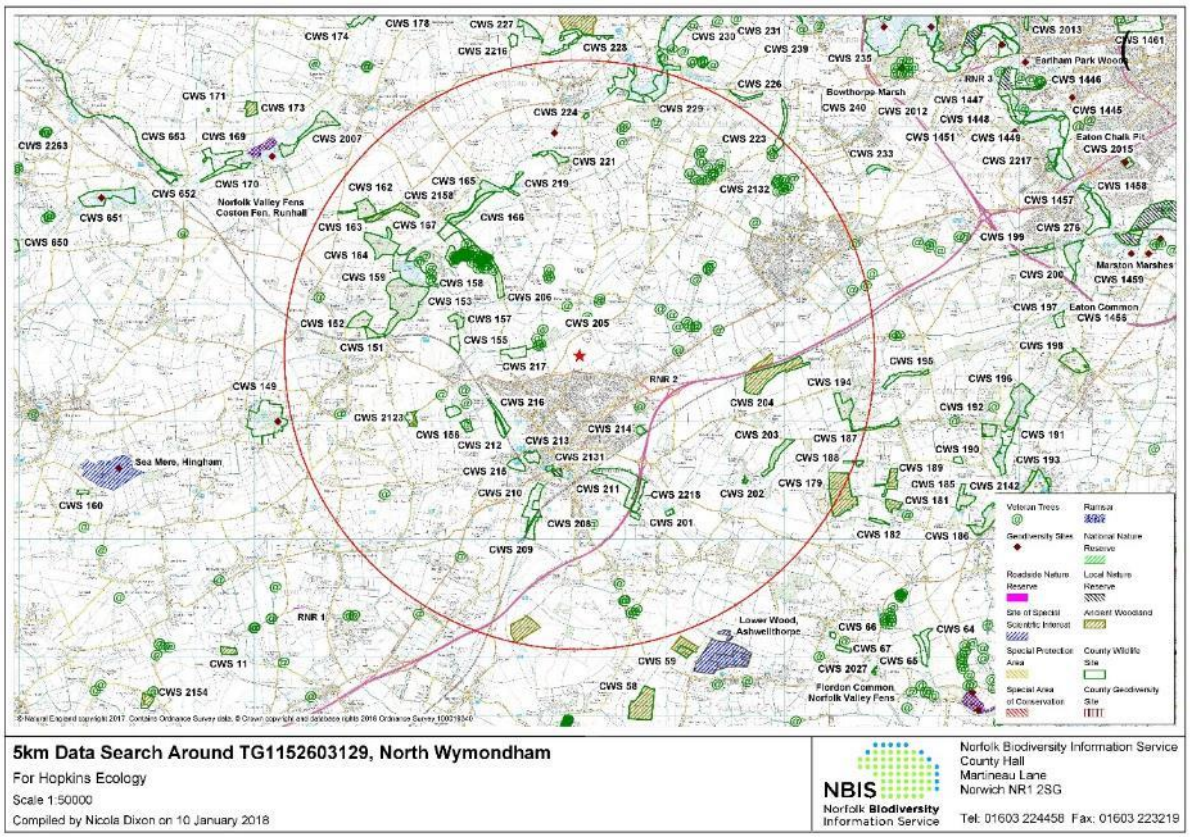
[18] Drake C.M., Lott, D.A., Alexander, K.N.A. & Webb, J. (2007) Surveying *Terrestrial and Freshwater Invertebrates for Conservation Evaluation.* Natural England, Sheffield.

3. DESIGNATED SITES

OVERVIEW

3.1 An overview of the Site in relation to nearby designated sites is shown in Figure 1, showing a concentration of sites along the River Tiffey Valley to the west (>500m distant) and as an 'arc' running along the western fringe of Wymondham. As reviewed under 'Section 4: Green Infrastructure Policies' these sites and the wider River Tiffey Valley are seen as important in terms of the Kett's Country landscape and local green infrastructure strategies.

Figure 1. Data search results for designated sites within a 5km radius.



STATUTORY (INTERNATIONAL AND NATIONAL) SITES

3.2 There are no statutory sites within 5km.

3.3 The nearest international site is located ~5.8km to the north-east (Euclidean), designated as the Norfolk Valley Fens Special Area of Conservation and the component site being Coston Fen, Runhall Site of Special Scientific Interest. This is designated for wetland and fenland species and vegetation, and is located on the River Yare upstream of the confluence to the River Tiffey.

NON-STATUTORY SITES

3.4 Within a 5km radius there is a high number of non-statutory County Wildlife Sites (CWS), with 44 in total (see Figure 1 and Appendix 2). Two are located close to the site (within 1km) (Table 2), of which Deep Road Meadow CWS straddles the unnamed tributary of the River Tiffey[19] that runs along and through the eastern part of the Site and is ~1.43km downstream (by

[19] http://environment.data.gov.uk/catchment-planning/OperationalCatchment/3553

channel length; 560m by Euclidean distance). The other is Melton Road Meadow CWS, 95m north. Neither of these CWSs has public access.

Table 3. CWSs within 1km.

CWS reference | name	Location	Description
217 | Deep Road Meadow	560m north-west	Tall fen vegetation with associated dykes and a species-poor dry grassland. The unnamed tributary of the River Tiffey that exists the site flows through this CWS, with a channel distance of ~1.43km from the Site boundary
205 | Melton Road Meadow	95m north-east	A grassland site with invading scrub

3.5 The remaining CWS are summarised in Table 3, broadly divided into 'zones' for brevity: those associated with the River Tiffey and River Yare Valleys, and those of open countryside. The River Tiffey Valley and its high density of CWSs is of particular significance in that it is specifically named within local planning policies (see Section 4: Green Infrastructure Policies). At the closest point the River Tiffey and its associated CWSs are ~1.3km west of the Site (separated by urban areas or 1.47km across arable fields). A full listing of the CWSs is given in Appendix 2.

Table 4. Other CWSs within 5km, according to broad location and habitat association.

Zone	Number of CWSs	Summary
River Tiffey valley, downstream of confluence	10	Associated with the River Tiffey including sections of the channel. Extending roughly north-eastwards from the confluence with the unnamed tributary to the confluence of the Rivers Tiffey and Yare ~4.9km north (Euclidean)
River Tiffey Valley, upstream of confluence	10	Associated with the River Tiffey including sections of the channel. Extending roughly south-eastwards around the edge of Wymondham and then eastwards under the A11 into open farmland
River Yare valley	1	A single CWS 5.2km north-east associated with the River Yare below its confluence with the River Tiffey
Wider countryside north or west of Wymondham	12	Located as parcels within open farmland north and north-west of Wymondham, and without close association with the River Tiffey or comprising wetland or fen habitat likely to be of functional association with the River Tiffey. Mainly woodland and parkland habitat with some grasslands
Wider countryside south or east of Wymondham	9	Located mainly within open farmland along the western and southern edges of Wymondham and also extending east of the A11 into open countryside. Mainly woodland habitats but also ponds and lakes

4. GREEN INFRASTRUCTURE AND LANDSCAPE CONTEXT

OVERVIEW

4.1 Green infrastructure is considered to be a key requirement for development in the Wymondham area, with the policy requirements originating in the Joint Core Strategy[20]. Wymondham is considered a priority area for green infrastructure with two converging corridors: the *'Wymondham to Norwich'* corridor and the *'Five Rivers'* corridor along the River Tiffey Valley (along the wester fringe of Wymondham) and into open countryside both upstream and downstream. The spatial vision for these corridors is informed by a Green Infrastructure Strategy (CBA, 2007[21]) and associated studies (e.g. Green Networks, Norfolk Wildlife Trust, 2007[22]). Such policies are broadly in-line with other countryside restoration schemes, such as the Norfolk Wildlife Trust's *'Claylands Living Landscape'* project[23] within the South Norfolk area:

> *"The Claylands Living Landscape project aims to enhance the management of the area's wildlife habitats and expand its area of grassland and woodland – thereby creating a more joined-up ecological network – as well as to encourage the more sensitive management of farmland. To achieve this aim, (Norfolk Wildlife Trust) will be working closely with community groups and landowners in South Norfolk to raise wildlife awareness, as well as encouraging their active participation in conserving and enjoying the area's historic natural environment."*

4.2 The green infrastructure policies relevant to the Site and north Wymondham area are synthesised within the Wymondham Area Action Plan[24] (AAP), referring to the local countryside as a "Kett's Country". The broad environmental objective is described as:

> The *"Kett's Country pastoral landscape of grassland, woodland, farmland, hedgerow and wetland habitats will be protected and enhanced with the aim of strengthening the role of the Tiffey valley, maintaining the open land between Wymondham and Hethersett, conserving the historic landscape setting of the town and abbey and creating connections between green infrastructure".*

POLICIES

4.3 The individual documents and policies of relevance are summarised in Table 4, with the identified routes of green infrastructure corridors shown in Figure 2. The green infrastructure corridors proposed within the AAP and relevant to the site are:

- A local neighbourhood green infrastructure corridor running along Melton Road, north-eastwards from Wymondham. This is currently field boundaries largely without woody vegetation and open and featureless in character.

---

[20] Greater Norwich Development Partnership (2014) *Joint Core Strategy for Broadland, Norwich and South Norfolk.* Available from: http://www.greaternorwichgrowth.org.uk/planning/joint-core-strategy/

[21] CBA (2007) *Greater Norwich Development Partnership. Green Infrastructure Strategy. A Proposed Vision for Connecting People, Places and Nature*. Available from: http://www.greaternorwichgrowth.org.uk/dmsdocument/201

[22] Norfolk Wildlife Trust (2006) *Report of the Ecological Network Mapping Project for Norfolk.* Available from: http://www.norfolkbiodiversity.org/pdf/news/Final_report_of_indicative_map_July%202006.pdf

[23] https://www.norfolkwildlifetrust.org.uk/a-living-landscape/claylands

[24] South Norfolk DC (2015) *South Norfolk Local Plan. Wymondham Area Action Plan Adopted Version 2015.* Available from: https://www.south-norfolk.gov.uk/sites/default/files/Wymondham_Area_Action_Plan_1.pdf

- A local neighbourhood green infrastructure corridor running perpendicular to Tuttles Lane East following the route of a footpath across the open arable field on the south-western part of the Site.
- A neighbourhood green infrastructure corridor running along Tuttles Lane East. Substantial lengths of this route lack woody vegetation with only occasional clumps of low scrub as well as a short length of trimmed hedgerow. There is a small block of woodland at its eastern limit.

4.4 Additional points of note within the Wymondham AAP policies is the aspiration to achieve net biodiversity gain from development.

Figure 2. Plan of the local green infrastructure proposals (from AAP) with local areas of semi-natural habitats (from MAGIC).

Table 5. Summary of polices and background documents relevant to green infrastructure and ecology.

Source	Text
Joint Core Strategy	
Area-wide policies addressing climate change and protecting environmental assets and Policy 10: Locations for major new or expanded communities in the Norwich Policy Area, with associated requirements and policies	Provision of extensive levels of green infrastructure around Wymondham to create a Kett's Country pastoral landscape
GNDP (2007) Green infrastructure strategy	
Overview of potential green infrastructure requirements within the greater Norwich area	Wymondham as a point where two strategic and one local infrastructure corridors meet
Wymondham AAP	
POLICY WYM 8 General green infrastructure requirements for New Developments within Wymondham AP area	New development in Wymondham will be required to maintain, protect and enhance green infrastructure, and developers will be expected to contribute towards green

Source	Text
	infrastructure requirements through s106 contributions and/or CIL as appropriate Where appropriate new developments will be required to provide ecological links to the nearest green infrastructure and provide effective ecological buffers, the design of which to be negotiated with South Norfolk Council and other relevant bodies to ensure adequate protection of important ecological sites and maintenance of habitat connectivity. In particular it will be important for new development to consider the following (where relevant): 1) Improved habitat connectivity 2) Improved public access to the countryside 3) Improved recreational provision to alleviate visitor pressure on sensitive areas 4) Improve the quality of local County Wildlife Sites All new developments should aspire to net biodiversity gain and planning proposals should be accompanied by detailed ecological assessment where appropriate. The cumulative impact of developments on biodiversity assets should be considered.
POLICY WYM 9 General green infrastructure requirements for new developments in the north of Wymondham	In particular, where relevant, new development must consider the following: 1) Improved public access to the countryside 2) Improved recreational provision And where appropriate and/or through community projects: 3) Creation of footpaths and cycleways between Health Walk 5 and the west to Kimberley park [N1] the north of Wymondham and to the east to the site allocations, rugby club and Kett's Oak 4) Enhancement of the setting of Kett's Oak 5) Planting of hedgerow/parkland trees along Tuttles Lane East, from east to west creating an ecological corridor

OTHER INITIATIVES

4.5 The Site lies within the Claylands Living Landscape[25], as does most of South Norfolk DC area This is promoted by the Norfolk Wildlife Trust with the following aim:

- *"The Claylands Living Landscape project aims to enhance the management of the area's wildlife habitats and expand its area of grassland and woodland – thereby creating a more joined-up ecological network – as well as to encourage the more sensitive management of farmland. To achieve this aim, (Norfolk Wildlife Trust) will be working closely with community groups and landowners in South Norfolk to raise wildlife awareness, as well as encouraging their active participation in conserving and enjoying the area's historic natural environment."*

4.6 It does not lie within a B-Line (bee-line) for pollinating insects as promoted by Buglife – The Invertebrate Conservation Trust[26].

[25] https://www.norfolkwildlifetrust.org.uk/a-living-landscape/claylands

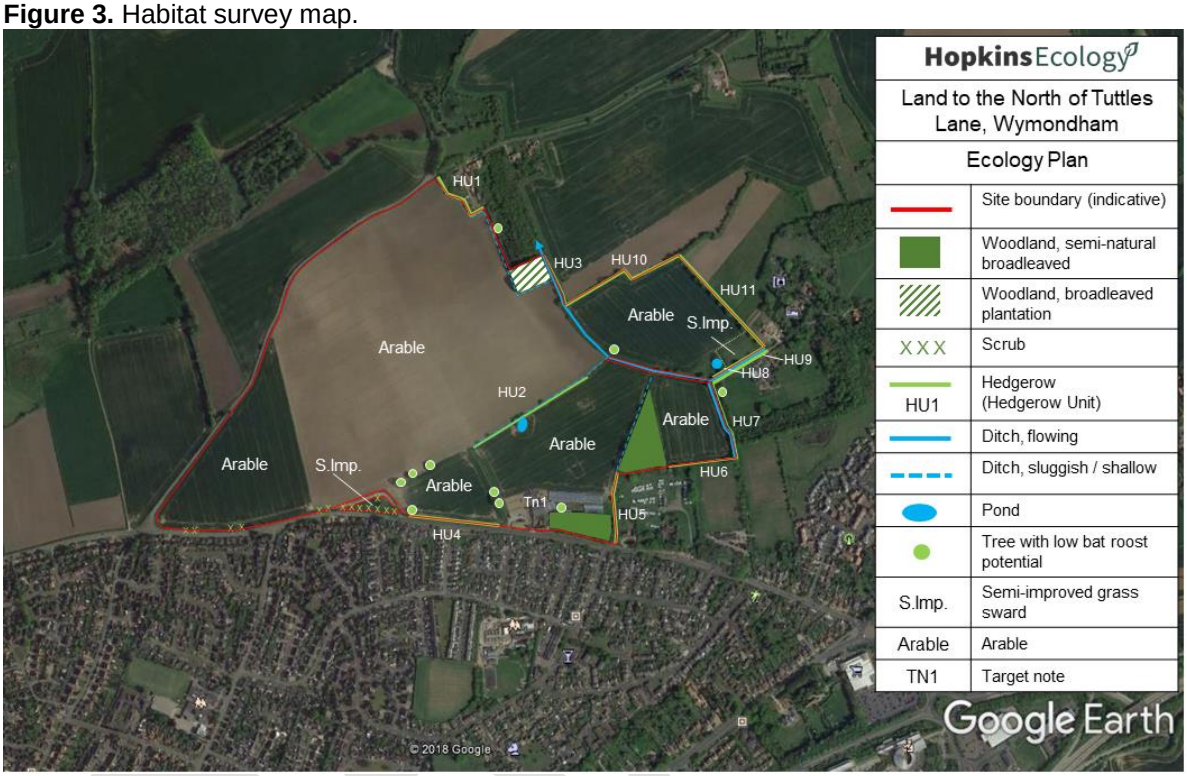
[26] https://www.buglife.org.uk/*B-Line*s-hub/east-of-england

5. HABITATS AND BOTANY

OVERVIEW

5.1 The Site is largely arable cropland, with a single field extending to over 35ha in area and a total area of circa 55ha. At the time of survey, the arable fields were not under a crop, presumably in anticipation of spring ploughing. As well as arable fields there are lengths of hedgerow, some grass swards, woodland, ditches and two ponds (Figure 3). The soil is classed as a 'lightly acid loamy and clayey soil with impeded drainage'.

Figure 3. Habitat survey map.



ARABLE FIELDS

5.2 The arable fields comprise the majority of the Site and were under winter wheat in the spring and summer of 2019. The associated arable margin flora is described separately below.

GRASS SWARDS

5.3 The grass swards are all considered to be semi-improved, with three areas:

- A block of grass sward near the east boundary (~0.3ha) appears to be unmanaged other than perhaps occasional cutting, and comprises a rank sward of false oat grass *Arrhenatherum elatius* with cock's foot *Dactylus glomerata* with occasional tall herbs such as creeping thistle *Cirsium arvense*, nettle *Urtica dioica* and shorter herbs such as creeping buttercup *Ranunculus repens*.
- A small patch (~0.2ha) is located alongside Tuttles Lane East, cut off from the adjacent field by a secondary farm road. The sward is short with some evidence of rabbit grazing and mainly a meadow grass *Poa* species sward with rye grass *Lolium* species and Yorkshire fog *Holcus lanatus*, with occasional plants of nettle, creeping buttercup, dove's foot cranesbill *Geranium molle*, ground ivy G*lechoma hederacea* and ragwort *Jacobaea vulgaris*. This is the proposed route of a green infrastructure corridor.

- Alongside Melton Road is a long stretch of verge (~0.9km in length) on a low bank and with only a few patches of woody vegetation but with the vast majority of the length without woody vegetation. This is the proposed route of a green infrastructure corridor. The sward appears to be mainly false oat grass with rye grass, couch, red fescue *Festuca rubra*, and cock's foot as occasional components. An occasional straggly stem of bramble *Rubus fruticosus* agg and ivy *Hedera helix* are also present as prostrate cover. The herb component comprises widespread grassland and tall ruderal species, those noted being: white dead nettle *Lamium album*, spear thistle *Cirisum arvense*, yarrow *Achillea millefolium*, hogweed *Heracleum sphondylium*, dandelion *Taraxacum officinale*, broad-leaved dock *Rumex obtusifolius*, ground ivy, cow parsley *Anthriscus sylvestris*, lanceolate plantain *Plantago lanceolata*, creeping buttercup, mugwort *Artemisia vulgaris*, dove's foot cranesbill, hedge bedstraw *Galium mollugo* and cleavers *Galium aparine.*
- The grass verge running alongside Tuttles Lane East is generally narrow (~1.5m) with sections lacking associated woody vegetation (western end) and also sections with associated linear scrub and hedgerow. The sward is similar to that along Melton Road, with Alexanders *Smyrnium olusatrum* as an additional species.

HEDGEROWS

5.4 The hedgerows on the Site comprise lengths running for parts or entire lengths of various field boundaries, albeit with extensive lengths of hedgerow missing from existing fields. Pre-1980s hedgerow removal created larger fields.

5.5 Typically, the hedgerows are tall and leggy with hawthorn *Crataegus monogyna* and oak *Quercus robur* as the most frequent species but with additionally other widespread species occurring in many lengths: sycamore *Acer pseudoplatanus*, ivy, dog rose *Rosa canina*, field rose *Rosa arvensis*, hazel *Corylus avellana*, ash *Fraxinus excelsior*, blackthorn *Prunus spinosa*, elder *Sambucus nigra*, elm *Ulmus* species and field maple *Acer campestre*; hornbeam *Carpinus betulus* is also present as occasional specimens.

5.6 The verges are narrow and grassy swards, with only wood avens *Geum urbanum*, lords and ladies *Arum maculatum*, herb Robert *Geranium robertianum* and dog's mercury *Mercurialis perennis* as woodland species (as defined by Schedule 2 of the Hedgerow Regulations), along with more widespread herbs: buttercup, nettle, ground ivy, red dead nettle *Lamium purpureum*, white dead nettle, common sowthistle *Sonchus oleraceus*, lanceolate plantain, ground ivy, cow parsley, hedge bedstraw, celandine *Ranunculus ficaria* and cow parsley. Table 5 summarises each length.

Table 6. Hedgerow descriptions (reference numbers cross-reference to Figure 2).

Reference	Description	Woody species	Woodland herbs (from Schedule 2 of Hedgerow Regulations)	Priority and Important status	
				Priority	Important
H1	Tall (>5m), defunct hedgerow to garden curtilage.	Hawthorn, oak, ash, bramble, elm also ornamentals (juniper *Juniperus* species, privet *Ligustrum japonica* and others).	-	✓	-

Reference	Description	Woody species	Woodland herbs (from Schedule 2 of Hedgerow Regulations)	Priority and Important status	
				Priority	Important
H2	Trimmed to ~1.5m, associated with a ditch.	Hawthorn, bramble, ivy, hazel, and field maple	-	✓	-
H3	Hedgerow on opposite side of ditch on low bank, tall (>5m) and straggly.	Hawthorn, oak, hazel, field maple, ivy and bramble.	Wood avens.	✓	-
H4	Trimmed to ~1.5m, leggy and on a low bank.	Hawthorn with bramble and ivy	Lords and ladies.	✓	
H5	Tall (>5m) alongside garden curtilage.	Hawthorn, sycamore, hazel, elm, ivy, bramble, dog rose and blackthorn.	-	✓	
H6	A wire fence with hedgerow on opposite side on low bank. Leggy and tall (>5m).	Hawthorn, field maple, elder, bramble, hazel and sycamore.	Dog's mercury and lords and ladies.	✓	
H7	Hedgerow op opposite side of a ditch. Tall (>5m).	Hawthorn, ivy, ash, sycamore, oak, hazel, bramble and an ornamental cherry *Prunus* species.	-	✓	-
H8	Mostly trimmed to ~1.5m but with young oak and sycamore standards. Part of a double hedgerow alongside a track.	Oak, sycamore, hawthorn, bramble, field rose and ivy.	-	✓	-
H9	Located on the opposite side of a ditch, part of the double hedgerow alongside a track.	Oak, sycamore, hawthorn, bramble, field rose and ivy.	-	✓	-
H10	Tall (>5m), leggy on a low half-bank. Some former coppice stool specimens of oak and sycamore.	Oak, field maple, blackthorn, sycamore, elder, hazel, field rose, hawthorn, ivy, elder, ash and bramble.	Dog's mercury and lords and ladies	✓	✓
H11	Tall (>5m), leggy on a low bank. Some former coppice stool specimens of oak and sycamore.	Oak, field maple sycamore, field rose, hawthorn, ivy, hazel, elder, ash, spindle *Euonymus europaeus* and bramble; a single horse chestnut *Aesculus hippocastanum* of low stature.	Dog's mercury and lords and ladies	✓	✓

SCRUB

5.7 The central section of the boundary to Tuttles Lane East lacks a hedgerow but has developed a sparse scrub vegetation, mainly bramble with some hawthorn and an occasional butterfly bush *Buddleja davidii*. Growing through are occasional tall ruderals: nettle, mugwort *Artemisia vulgaris*, and creeping thistle.

SEMI-NATURAL BROADLEAVED WOODLAND

5.8 There are two blocks of semi-natural broadleaved woodland, both of which are shown on the OS map of the 1880s:

- A block located close to the south-east boundary (~0.7ha) appears to be former coppice, now with a high canopy and sparse shrub layer and ground flora. The most frequent canopy species is oak with ash, but hornbeam also present as coppice stools; sycamore also forms a canopy component but without apparent coppiced specimens. The shrub layer comprises occasional bushes of elder, hawthorn, bramble and hazel. The ground flora was sparse at the time of survey but plants noted included extensive patches of dog's mercury with lords and ladies, ground ivy, celanide, nettle, ivy and wood rush *Luzula* species.
- Alongside Tuttles Lane East is a block of mature woodland, albeit without overmature or veteran trees and without evidence of former coppicing (~0.5ha). The main canopy species is oak, with sycamore and a small number of Scot's pines *Pinus sylvatica*. The shrub layer is moderately dense with holly *Ilex aquifolium*, brambles, elm suckers and hawthorn. The ground flora was sparse at the time of surveys with nettle, lords and ladies and prostrate ivy evident.

DECIDUOUS PLANTATION WOODLAND

5.9 Towards the north boundary, continuous with a block of young broadleaved plantation woodland located off-Site is a small (~0.3ha) block of poplar plantation, probably hybrid Canadian poplar *Populus x canadensis*. The shrub layer is sparse with occasional brambles and elder.

DITCHES

5.10 The field survey was undertaken in late winter, with moderate amounts of rain in the preceding weeks. Two types of ditches are described:

- Flowing ditches, possibly with open water all year but nevertheless shallow and with a gravel substrate in places. These are managed with steep sides and lack aquatic flora.
- Wet ditches with at most sluggish flow, and likely to be dry for much of the year. Again, managed with steep sides, lacking aquatic or wetland flora and with silty substrates.

PONDS

5.11 There are two ponds on-Site:

- A hedgerow pond is located roughly centrally, with a diameter of ~5m. It is heavily shaded by surrounding scrub of hawthorn and oak, lacking aquatic flora and likely to have open water in most summers.
- A field pond is located towards the eastern boundary, with a diameter of ~5m. It is heavily shaded by surrounding scrub of willow *Salix* species, hawthorn and oak, lacking aquatic flora and likely to have open water in most summers.

BUILDINGS (TN1)

5.12 Alongside Tuttles Lane East are a series of buildings including a traditional cottage with modern extension, a converted barn used as a garden centre and modern farm buildings with pre-fabricated structure.

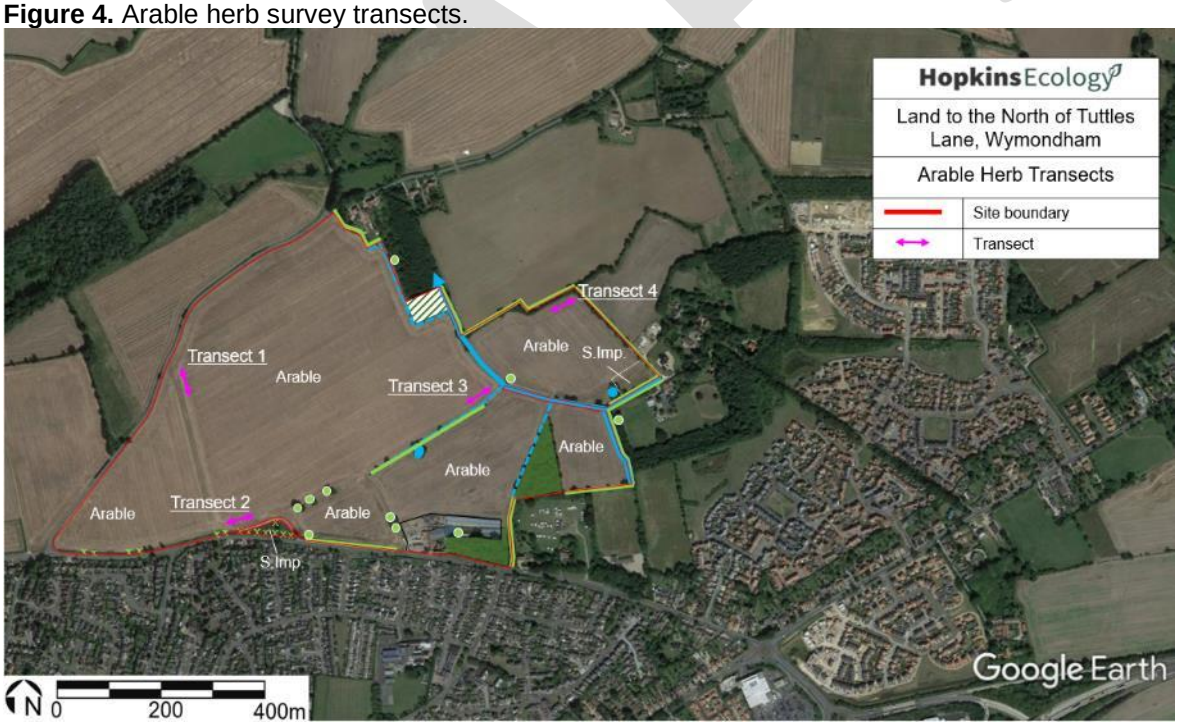
ARABLE WEED SURVEY

5.13 The data search returned records for few plants of conservation concern, the only non-wetland species is small flowered catchfly *Silene gallica*, an arable margin species. The broader landscape has a moderate diversity of arable margin species (Walker et al. 2012[27]).

5.14 The arable herbs were surveyed along four transects (Figure 4), with 23-25 species recorded on each. The species recorded on each being soft brome *Bromus hordaceus*, sterile brome *Anisantha sterilis*, smooth sow thistle *Sonchus oleraceus* and scentless mayweed *Tripleurospermum inodorum*.

5.15 All of the species recorded are considered to be common and widespread, in as much as none achieve an Important Arable Plant Area score of 1 or more, on a scale of 1-9, with '1' being equivalent to species of local concern.

Figure 4. Arable herb survey transects.



[27] Walker, H., Cunningham, S., Ellis, B., Neal, S. and Swan, E. (2012) *Important Arable Plant Areas in Norfolk.* Available from: http://www.nbis.org.uk/sites/default/files/documents/Important%20Arable%20Plant%20Areas%20in%20Norfolk_SCREEN.pdf

6. GREAT CRESTED NEWTS

DATA SEARCH AND PONDSCAPE

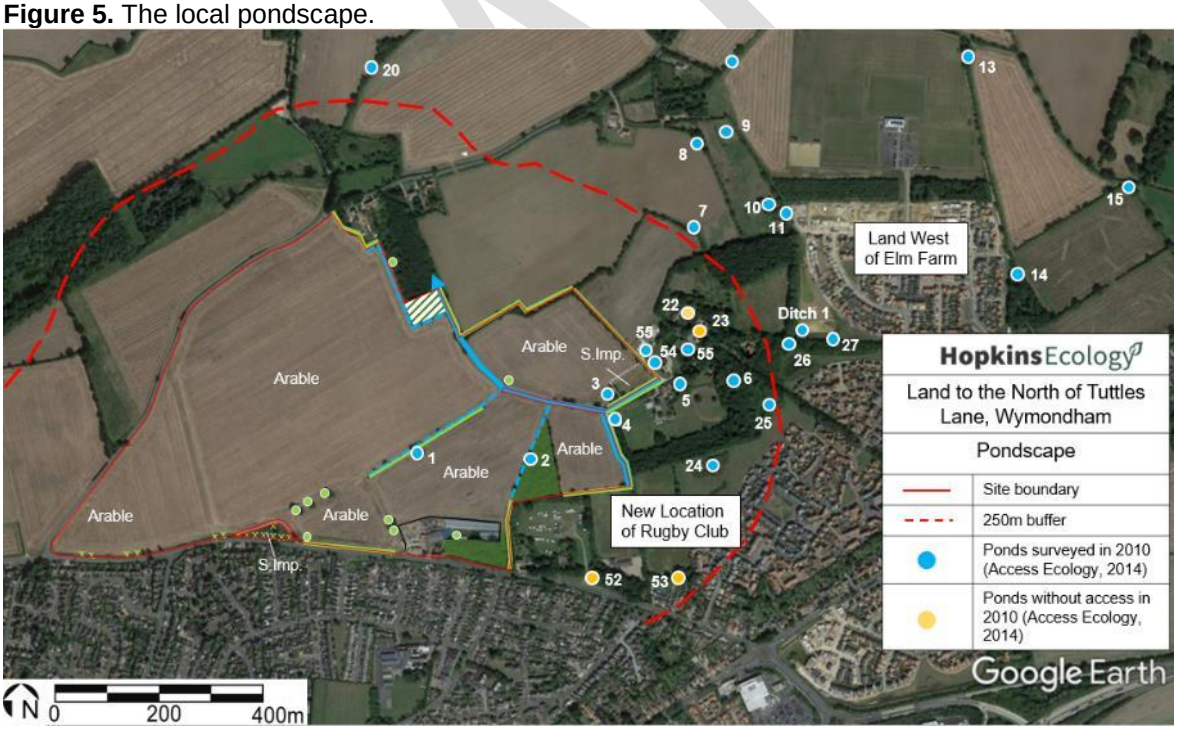
6.1 The South Norfolk Claylands area is considered to be a 'stronghold' for the great crested newt[28]. The data search returned numerous records from the south of Wymondham, such as from The Lizard CWS and other sites near to Silfield Road. From the northern part of the search radius, more relevant to the Site, the only records are from the north-east near to Hethersett and further afield (at least 2.4km distant).

6.2 In terms of assessing the potential for great crested newts to be present, consideration is typically given to on-Site ponds and nearby ponds, with a 250m radius considered appropriate given the open character of surrounding habitat (following English Nature, 2001[29]).

6.3 An extensive suite of great crested newt surveys were undertaken in 2010 for the scheme at Land West of Elm Farm and the re-location the rugby club (Access Ecology, 2014)[30]. They surveyed a total of 50 ponds locally (Figure 5), with access refused to four ponds. Of the four with access denied it is believed that two have been surveyed for other schemes, leaving only ponds 22 and 23 without any historic information.

6.4 None of these previous surveys have recorded great crested newts locally.

Figure 5. The local pondscape.



[28] Natural England (2007) loc. cit.

[29] English Nature (2001) *Great Crested Newt Mitigation Guidelines*. English Nature, Peterborough.

[30] Access Ecology (2010) *Wymondham Rugby Club and Land West of Elm Farm. Ecological Baseline Assessment.* Unpublished report informing planning reference 2015|1482.

Table 7. Summary of previous survey work locally (cross-referencing to Figure 4).

Pond reference (as shown on Figure 5)	Source	Survey result for great crested newts
All numbered ponds (with access denied to other 22, 23, 52 and 53).	Aspect Ecology (2014)[31]	Negative
52, 53, 2, 4, 3, 29, 30, and 31	PAA (2008)[32]	Negative
27 and 14	Surveyed by Bioscan in 2004 and 2008	Negative
"27 ponds in the wider north Wymondham area)" believed to have been surveyed in 2008	Unpublished data cited by PAA (loc. cit.)	Negative
52.	Norfolk Wildlife Services (2007)[33]	Negative

2019 SURVEYS

6.5 Direct manual surveys were undertaken of the two on-Site ponds in 2019 (ponds labelled 1 and 3 in Figure 5 above). Pond 2, is a shallow depression that does not support open water in 2018 and 2019. Access was not allowed to the ponds within 250m (ponds 4, 5, 6, 21, 22, 23, 24, and 25). Ponds 52 is no longer present and pond 53 is now isolated from the Site by the re-located rugby club.

6.6 The ponds were rated as being of 'below average' and 'average' suitability for great crested newts, using a Habitats Suitability Index. No great crested newts were recorded in 2019.

[31] South Norfolk DC planning reference 2015|1482.

[32] South Norfolk DC planning reference 2008|2092.

[33] South Norfolk DC planning reference 2007|2476.

7. BATS

DATA SEARCH

7.1 Records for eight species of bat were returned by the data search: barbastelle, serotine, Natterer's, noctule, Nathusius' pipistrelle, common pipistrelle, soprano pipistrelle, and brown long-eared. The majority of these records were obtained during field surveys for the Norfolk Bat Survey[34]; the only roost records are for two separate brown long-eared roosts, both >1.5km distant.

TREES

7.2 Eight trees within the Site or on its boundaries are rated as having low but not negligible bat roost potential, with at least two other trees off-Site but very close to the boundary likewise having low bat roost potential (see Figure 3 and Appendix 5). The two blocks of woodland are likewise of low potential suitability. The trees are mostly living trees with minor dead limbs and moderate ivy cover, although one towards the eastern boundary is a tall 'snag' (a dead, standing tree). Many of the trees are isolated within open fields without nearby cover or associated linear features, such that the likelihood of bats using them is reduced.

7.3 Direct emergence surveys were undertaken of the trees that are likely to be located within areas of development rather than withing wider tracts of retained or created open space. Thus, six trees were identified as justifying direct surveys on this basis, all located close to the south boundary west of the Wymondham Garden Centre. No bats were seen to emerge or were suspected as roosting and it is concluded that roosts are absent from these trees.

SITE-WIDE FORAGING

7.4 Much of the Site is open arable farmland with very little foraging habitat for bats and without the linear features (i.e. hedgerows) that many bats need for commuting or foraging along. The patches of grassland are low in quality and extent, and while the woodlands offer habitat of moderate suitability for several species they are small in area. High quality foraging habitat, such as extensive wetlands, wet humus-rich soil, herb-rich grassland or extensive woodland are absent. The overall quality of the Site for foraging bats is therefore low but with higher value towards the eastern side.

7.5 Static recorder surveys were undertaken monthly May to September using six detectors, of which one was in an area likely to be of low value but typical of much of the Site, while the remainder were along the eastern boundary adjacent to hedgerows or woodland. Transects ran the Site perimeter and the internal hedgerow and ditch.

7.6 Five species were recorded: *Myotis* species, common pipistrelle, soprano pipistrelle, noctule and brown long-eared. Al species were recorded by the static detectors but brown long-eared bats were not recorded along the transects. The survey information is summarised in Table 8 and Figure 6.

7.7 There was no evidence of commuting across the Site, rather the activity appears to comprise foraging and with more sustained foraging activity along hedgerows and woodland. Common and soprano pipistrelles were by far the most frequently recorded species, present across the Site but with greater activity along the eastern part, where there are larger hedgerows and woodland edge habitat. The *Myotis* species and brown long-eared are also recorded along

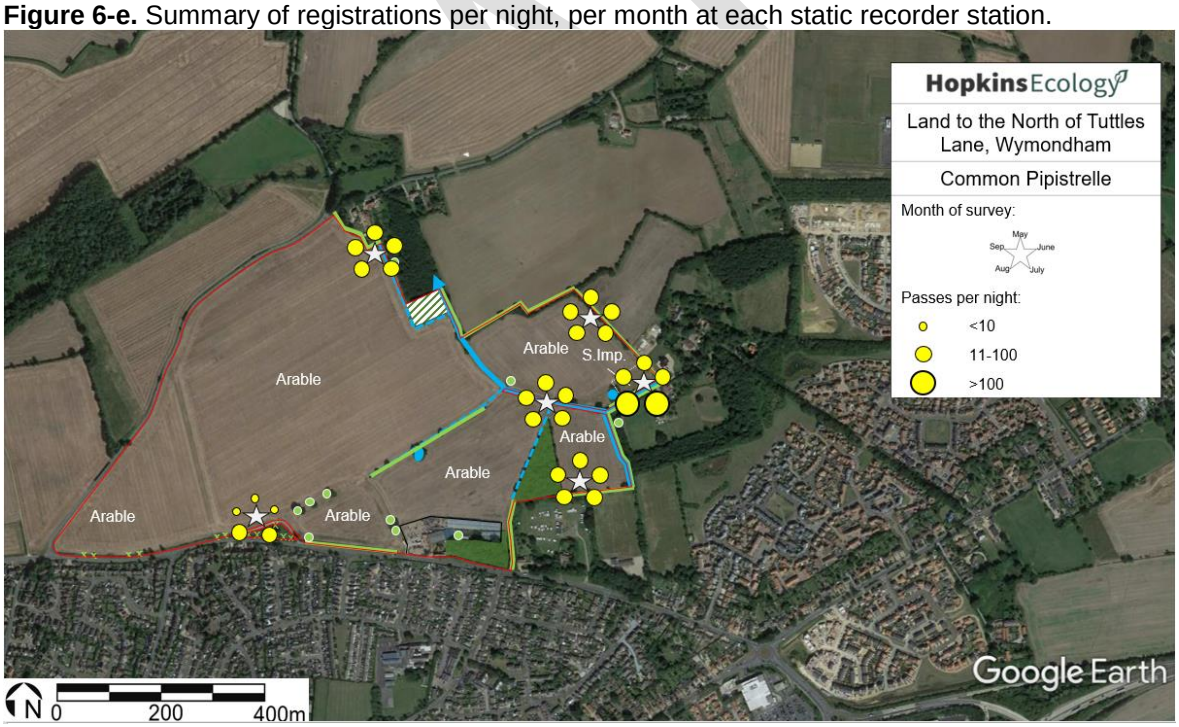
[34] http://www.batsurvey.org/

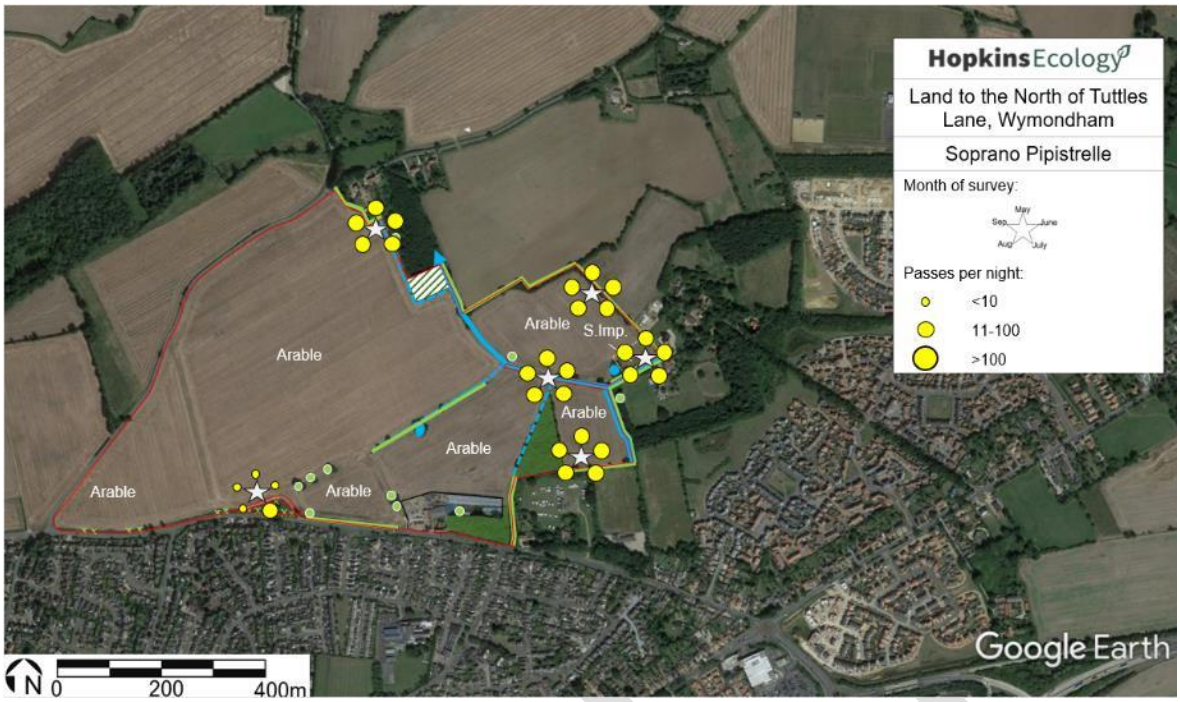
the eastern boundary, but with substantially fewer registrations. Noctules were recorded across much of the Site and this is thought to reflect over-flying and some foraging.

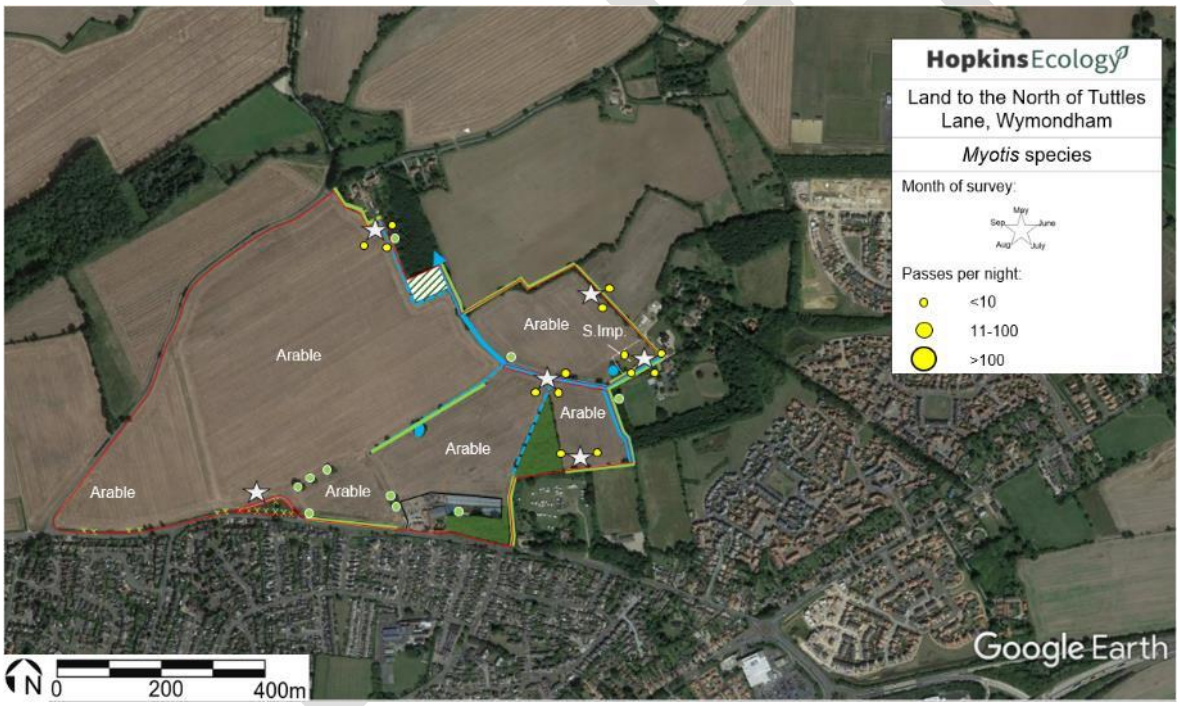
Table 8. Occurrences of bats in static detector and transect surveys in 2019.

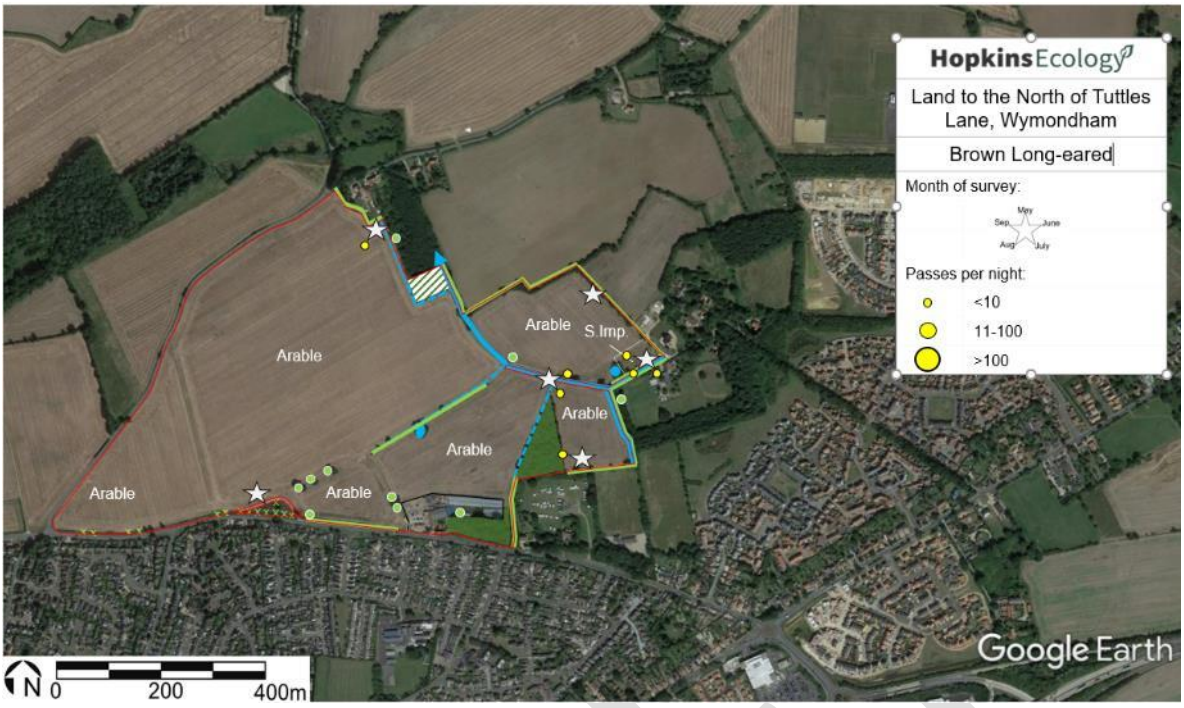
Species	Static detector survey	
	Total passes (5 detectors for 25 nights each over May to September 2019)	Comment
Common pipistrelle	8193	The most frequent species, with regular activity along the hedgerows and woodland edge habitat along the east of the Site.
Soprano pipistrelle	6443	The second most frequent species, with regular activity along the hedgerows and woodland edge habitat along the east of the Site.
Myotis species	335	A low level of activity along the eastern hedgerows and woodland edge only, with infrequent passes of presumably foraging bats.
Brown-long eared	58	A low level of activity along the eastern hedgerows and woodland edge only, with infrequent passes of presumably foraging bats.
Noctule	674	A low level of activity with infrequent passes of presumably overflying bats. Widely recorded but with greater activity along the eastern part of the Site.

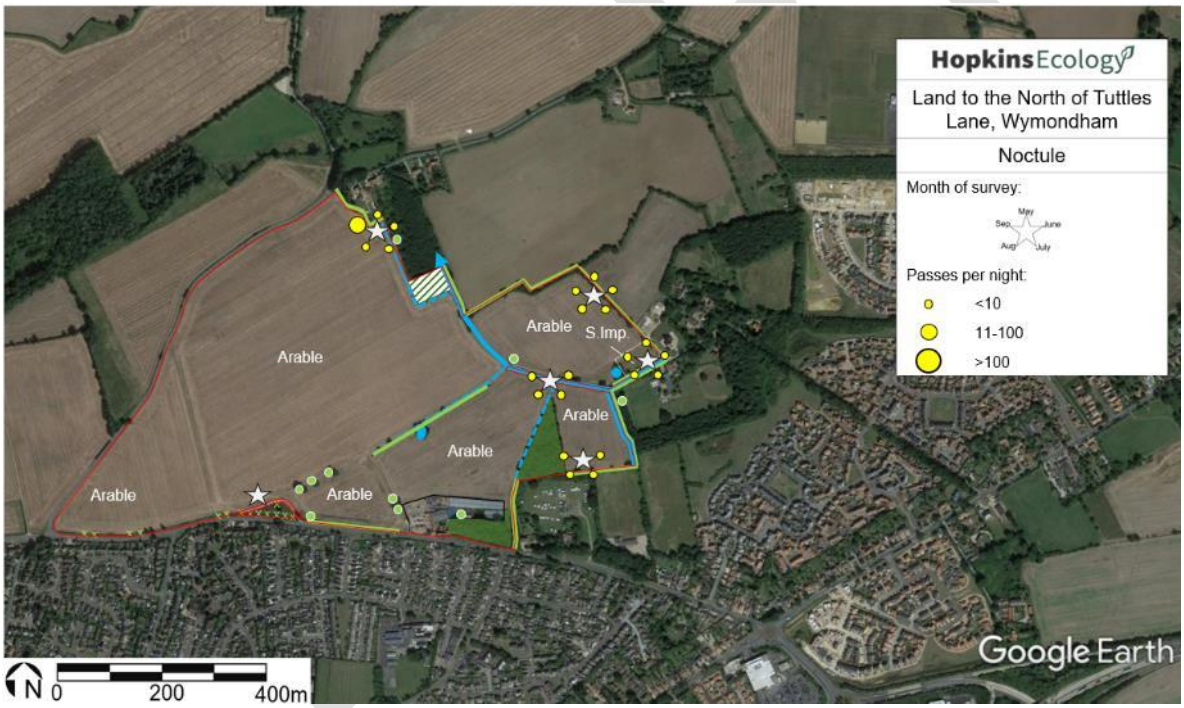
Figure 6-e. Summary of registrations per night, per month at each static recorder station.




HopkinsEcology
Land to the North of Tuttles Lane, Wymondham
Soprano Pipistrelle
Month of survey:
May
June
July
Aug
Sep
Passes per night:
<10
11-100
>100
Arable
S.Imp.
Arable
Arable
Arable
Arable
Arable
Arable
Google Earth
N
0
200
400m


HopkinsEcology
Land to the North of Tuttles Lane, Wymondham
Myotis species
Month of survey:
May
June
July
Aug
Sep
Passes per night:
<10
11-100
>100
Arable
S.Imp.
Arable
Arable
Arable
Arable
Arable
Arable
Google Earth
N
0
200
400m


HopkinsEcology
Land to the North of Tuttles Lane, Wymondham
Brown Long-eared
Month of survey:
May
June
July
Aug
Sep
Passes per night:
<10
11-100
>100
Arable
S.Imp
Arable
Arable
Arable
Arable
Arable
Google Earth
N
0
200
400m


HopkinsEcology
Land to the North of Tuttles Lane, Wymondham
Noctule
Month of survey:
May
June
July
Aug
Sep
Passes per night:
<10
11-100
>100
Arable
S.Imp
Arable
Arable
Arable
Arable
Arable
Google Earth
N
0
200
400m

8. BREEDING BIRDS

DATA SEARCH

8.1 The data search returned a diverse range of species records, including a number unlikely to be relevant, such as great white egret and species with strong association with wetland areas. Included on the search are species potentially likely to overwinter on arable farmland and utilise open fields and hedgerows / verges for nesting:

- Overwintering species: lapwing, golden plover, herring gull, lesser black-backed gull and passerines, namely skylark, and yellowhammer;
- Nesting in open fields: skylarks; and
- Nesting in hedgerows and field margins: grey partridge, turtle dove, willow warbler, dunnock, mistle thrush, song thrush, bullfinch, yellowhammer and reed bunting.

BREEDING BIRDS

8.2 Five species of conservation concern were recorded as breeding species on-Site, with house sparrows and starlings present on-Site but with the nests located off-Site (Table 9, Figure 7). The skylarks are associated with the open fields while the remainder are scrub or hedgerow nesting species, of which all but dunnock are likely to be foraging within field margins and verges.

Table 9. Summary of birds of conservation concern.

Species	Breeding status	Estimated no. breeding pairs[1]	Priority status and Red or Amber list status
On-Site			
Skylark	Probable	4-7	Priority and Red list
Dunnock	Probable	3-4	Priority and Amber list
Mistle thrush	Probable	1	Red list
Song thrush	Possible	1	Priority and Red list
Yellowhammer	Possible	2	Priority and Red list
Off-Site			
Starling	Possible	-	Priority and Red list
House sparrow	Confirmed	-	Priority and Red list

[1]Note, where a range is given for estimated number of breeding pairs, 'Breeding status' represents the highest level of likelihood of breeding category ascertained and takes into account other pairs that might be breeding at the lower category level(s); e.g. 1 pair confirmed, 1 probable and 2 possible = 1-4; '+' denotes more pairs likely to be present (see also notes for each species for clarification).

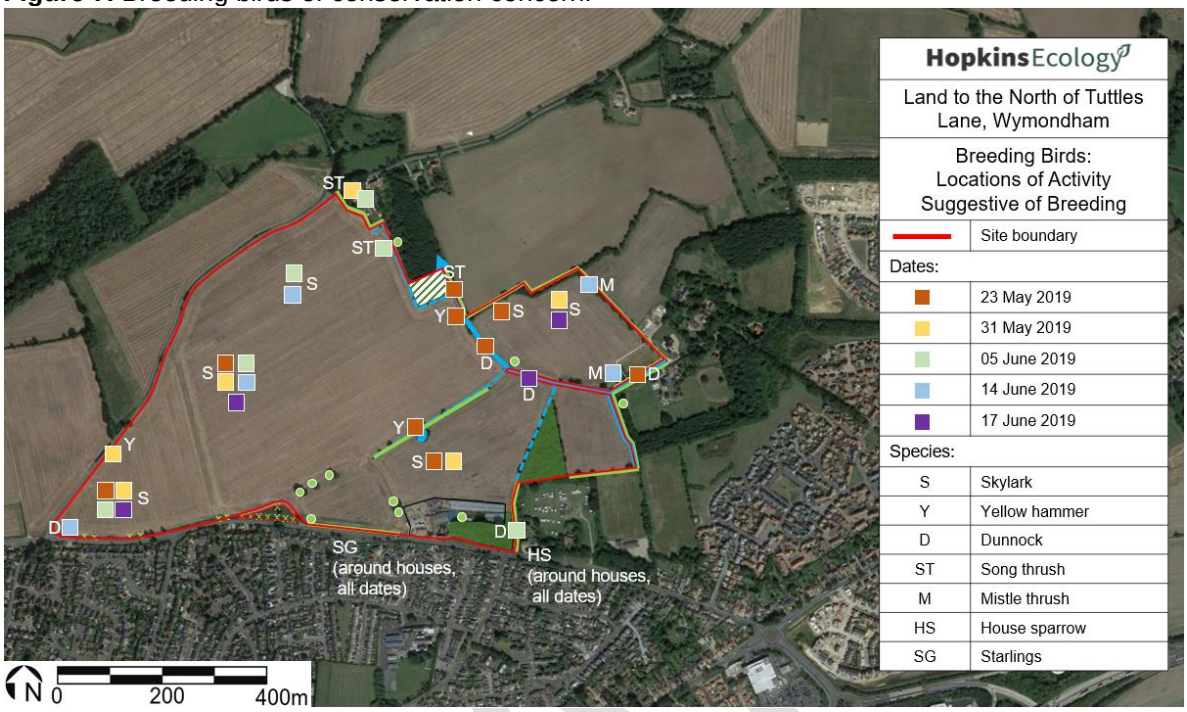
8.3 Fourteen species that are common and widespread – i.e. Green-list and not of conservation concern – were recorded as possible or probable breeders (Table 10).

Table 10. Species not of conservation concern (Green-list) and probable or possible breeders.

Species	Breeding status	Estimated no. breeding pairs
Green woodpecker	Possible	1
Woodpigeon	Confirmed	6-8
Wren	Probable	7-9
Robin	Possible	3
Blackbird	Probable	3-4
Carrion crow	Probable	1-2
Jackdaw	Possible	1
Jay	Possible	1
Common whitethroat	Possible	1
Blackcap	Probable	4
Chiffchaff	Possible	1-2
Great tit	Possible	1

Species	Breeding status	Estimated no. breeding pairs
Blue tit	Possible	1
Chaffinch	Probable	2-4

Figure 7. Breeding birds of conservation concern.



8.4 Bird species observed on (or immediately adjacent to) site but not showing behaviour indicative of breeding, or overflying, and nesting habitat suitability appraisal:

Mallard	Lesser black-backed gull	Bullfinch
Common buzzard	Feral pigeon	Goldfinch
Barn owl	Stock dove	Greenfinch
Red-legged partridge	Collared dove	Linnet
Common pheasant	Swift	
Black-headed gull	Magpie	

WINTERING BIRDS

8.5 As wintering habitat for birds, the Site is appraised visually as being of relatively low value, based on the absence of extensive ponding on the fields and the absence of seed-rich stubbles or arable margins.

8.6 During the wintering bird survey 20 birds of conservation concern were recorded. These species are all Red/Amber listed, and 11 are also listed as priority Species of Principal Importance. The numbers of individuals are relatively low, without particularly large flocks of birds on the fields.

Table 11. Observations of wintering bird species of conservation concern recorded between November 2019 and January 2020.

Species	Observations	Peak Count	Priority status and Red or Amber list status
Mallard	Pair in water-filled field ditch (Nov)	2	Amber list
Grey partridge	Singletons.	1	Priority and Red list
Lapwing	Singleton (Jan)	3	Priority and Red list
Black-headed gull	Small flocks on fields.	48	Amber list
Common gull	Small flocks on fields.	14	Amber list
Herring gull	Overflying.	4	Priority and Red list
Lesser black - backed gull	Overflying	12	Amber list
Stock dove	Foraging.	2	Amber list
Kestrel	Singletons.	1	Amber list
Skylark	Small flocks on all dates.	15	Priority and Red list
Dunnock	Singletons across the site	12	Priority and Amber list
Mistle thrush	As singletons with peak in Jan	3	Red list
Fieldfare	Singletons and flocks.	25	Red list
Redwing	Singletons and small flocks.	6	Red list
Song thrush	Singletons	3	Priority and Red list
Starling	Small foraging flocks on all dates.	60	Priority and Red list
House sparrow	Around dwellings only, on all dates.	12	Priority and Red list
Linnet	Foraging in November.	3	Priority and Red list
Bullfinch	Singletons.	2	Priority and Amber list
Yellowhammer	Singletons only.	3	Priority and Red list

9. OTHER SPECIES OF CONSERVATION CONCERN

REPTILES

9.1 The data search returned records for slow worm, grass snake and common lizard, all from the south edge fringe of Wymondham (>1.4km distant). Arable landscapes typically support few if any reptiles and much of the Site is rated as being of negligible suitable and lacking reptiles, with only narrow grass verges and little other shelter or cover. Elsewhere, there some areas of grassland in association with scrub and hedgerows, but the overall extent is small and it is of lower quality.

9.2 The direct reptile surveys in 2019 did not record any reptiles and they are concluded to be absent.

WATER VOLES AND OTTERS

9.3 In May 2019 the network of ditches on-Site supported little water, with depths of <20cm in most areas and by summer and into early-autumn open water was absent. On this basis the ditches are concluded to be unsuitable for water voles, and this was reinforced by the absence of any evidence during the surveys. Likewise, the ditches are unlikely to be used by otters other than on a transitory basis.

BADGERS

9.4 Records of badgers were not returned from within 2km and no evidence was found on any visits. They are concluded to be absent.

BROWN HARE

9.5 Numerous records were returned from within 2km. None were seen during the various Site surveys and they are concluded do be absent.

HEDGEHOGS

9.6 Hedgehogs are known widely locally, including nearby residential areas. The hedgerows and woodland blocks offer shelter and foraging habitat and they are probably present in low numbers.

INVERTEBRATES

9.7 Records for 76 species of invertebrate of conservation concern were returned from within 5km, comprising records of species collected from incidental recording and also regular moth trapping stations in domestic gardens in Wymondham and Hethersett.

9.8 These data are analysed using Natural England's *Invertebrate Species-habitat Information System* (Drake et al., loc. cit.) (ISIS) that classifies such inventory data into standardised habitat assemblages (Table 12). A small number of species are associated with wetland habitats and microhabitat (Broad and Specific Assemblage Types), but the majority are generalists of grassy and woodland vegetation with the only potentially relevant specialist species being those found in 'open short sward' grassland and 'bark and sapwood decay'.

Table 12. Habitat (assemblage type) associations of the invertebrates from the data search.

Assemblage code	Assemblage name	Number of species
Broad Assemblage Type		
A1	Arboreal canopy	14
F2	Grassland & scrub matrix	11
W3	Permanent wet mire	5
F1	Unshaded early successional mosaic	4
A2	Wood decay	3

Assemblage code	Assemblage name	Number of species
Specific Assemblage Type		
W313	Moss and tussock fen	2
F112	Open short sward	2
W314	Reedfen and pools	1
A212	Bark & sapwood decay	3

6.7 The extent of habitat for noteworthy invertebrates on the Site is low, restricted to hedgerows, woodland and grass verges. The field boundary habitats are typically narrow and isolated from habitats that would enhance their value, such as areas with an abundance of blossom. The woodland blocks are also small and isolated, and lack specialist microhabitats such as dead wood (other than narrow fallen timbers, and without more high value dead wood such as heart rot). Specifically, the Site lacks 'open short sward' grassland associated with some of the specialist species known locally and the 'bark and sapwood decay' resource is low in quality without associated flower-rich foraging habitat.

6.8 The Site is likely to be of low value for invertebrates, and at most it may support a small assemblage of generalist moths that include a number of Species of Principal Importance that have undergone national declines but remain widespread (Butterfly Conservation, 2007[35]).

[35] Butterfly Conservation (2007) *Biodiversity Action Plan – Moths*. Available from: http://butterfly-conservation.org/files/uk-bap-species-moths-research-only.pdf

10. EVALUATION

STRATEGIC GREEN INFRASTRUCTURE

10.1 A key policy requirement locally is the provision of green infrastructure to maintain and enhance habitat connectivity across the landscape. The Site is relevant to three green infrastructure corridors:

- A local neighbourhood green infrastructure corridor running along Melton Road, north-eastwards from Wymondham;
- A local neighbourhood green infrastructure corridor running northwards, perpendicular to Tuttles Lane East; and
- A neighbourhood green infrastructure corridor running along Tuttles Lane East.

10.2 At present all three corridors are of low quality and are likely to have limited value as green infrastructure in ecological terms, lacking structural features likely to offer shelter, habitat and a structural feature across the landscape. As discussed below ('Mitigation'), the scheme could offer soft landscaping to create green infrastructure and significantly enhance the ecological value of these corridor.

10.3 There are footpaths away from the Site onto open countryside at the western end, but the two nearby CWSs are without public access.

HABITATS

10.4 The hedgerows and woodland are considered to qualify as the Habitat of Principal Importance (Maddock, 2011[36]):

- Two lengths of hedgerow are considered to qualify as Important Hedgerows under the Hedgerow Regulations:
  - Hedgerow H10, along the east boundary.
  - Hedgerow H11, along the east boundary.
- The woodland within the Site qualifies as Lowland Mixed Deciduous Woodland. Neither is marked as ancient woodland on MAGIC, but both are marked on the 1880s OS map

10.5 Other habitats are considered to be of low conservation value and not qualifying as Habitats of Principal Importance, including the arable margins, grassland, scrub and plantation areas.

SPECIES

Species Scoped Out / Absent

10.6 Great crested newts are concluded to be absent on the basis of the negative surveys of on-Site ponds in 2019. Although off-Site ponds could not be accessed for survey, of which there are ten within 250m, all but two of these ponds were surveyed for nearby schemes in 2010, with those surveys being negative. Further, from the suite of surveys in 2010, and earlier survey work, the vast majority of ponds in the wider locality (>60 ponds) have been surveyed and great crested newts have not been reported, such that it is reasonable to conclude that

[36] Maddock, A. (2011) *UK Biodiversity Action Plan Priority Habitat Descriptions*. Available from: http://jncc.defra.gov.uk/PDF/UKBAP_PriorityHabitatDesc-Rev2011.pdf

they are not present locally, and they are not breeding on-Site or otherwise using the Site as terrestrial habitats.

10.7 No evidence of badgers has been found during surveys, and water vole, otter and reptile surveys in 2019 were negative, thus of these groups are concluded to be absent.

Bats

10.8 As appraised visually much of the Site is of low or negligible value for foraging bats, comprising extensive arable cropland with only a sparse hedgerow network. The eastern part of the site is likely to be of greatest value for foraging, with a more extensive hedgerow network, small woodland blocks, and the ditch.

10.9 Although no evidence of roosting was found in the trees surveyed, it is very difficult to rule-out roosts from trees. However, it is likely that if there are trees roosts on-Site that they are small.

10.10 The scheme presented by Wray et al. (2010)[37] is used to evaluate the Site for bats, based on the rarity of species, numbers of individuals, roosting potential of a locality, and the landscape character. The completed evaluation is shown in Table 13 and it is considered that the Site is of local value for bats.

Table 13. Evaluation of the Site for individual bat species.

Species	Criterion scores				Summed score	Value
	Rarity	No. of individuals	Roosting potential	Landscape value		
Myotis species	5 (rarer)	5 (individuals)	3 (low potential)	2 (moderate sized fields / gappy hedgerows)	15	Local
Common pipistrelle	2 (common)	10 (small numbers)	3 (low potential)	2 (moderate sized fields / gappy hedgerows)	17	Local
Soprano pipistrelle	2 (common)	10 (individuals)	3 (low potential)	2 (moderate sized fields / gappy hedgerows)	17	Local
Brown long-eared	2 (common)	5 (individuals)	3 (low potential)	2 (moderate sized fields / gappy hedgerows)	12	Local
Noctule	5 (rarer)	5 (individuals)	3 (low potential)	2 (moderate sized fields / gappy hedgerows)	15	Local

Breeding Birds

10.11 The assemblage of breeding birds within the Site and survey area is considered to be relatively typical of Norfolk farmland and rural-countryside interface and mostly comprises widespread species that are of conservation concern due to recent declines and which are associated with broad habitat types rather than having high levels of habitat specificity and fidelity (Table 14).

10.12 Skylarks are the most numerous species of conservation concern, with 4+ pairs. Published density estimates in winter cereals and other crops are (Browne et al., 2000[38]):

- Winter cereals,10 per km^2 (=10 per 100ha) or 1 per 10ha.

[37] Wray, S., Wells, D., Long, E. and Mitchell-Jones, T. (2010) Valuing bats in ecological impact assessment. *In Practice* 70, 23-25.

[38] Browne, S., Vickery, J. and Chamberlain, D. (2000) Densities and population estimates of breeding skylarks *Alauda arvensis* in Britain in 1997. *Bird Study*, 47, 52-65.

- Spring cereals,12.2 per km^2.
- Agricultural set-aside, 30.6 per km^2.

10.13 With 4 pairs on the Site, the density (using a Site area of 55ha) is 1 per 13.75ha or with 5 pairs the density is 1 per 11ha. The density of skylarks, taking into account that not all of the Site is arable is very close to the typical density reported in the literature for winter cereals.

Table 14. Status of species of conservation concern on-Site and in wider survey area.

Species	Conservation status		National status[39]	Norfolk status[40]	Pairs on-Site
	Priority species	Red- / Amber-listing			
On-Site					
Skylark	✓	Red	1.4 million territories (summer)	Common resident	4+
Song thrush	✓	Red	1.1 million territories (summer)	Common resident	1
Mistle thrush	-	Red	165 thousand territories (summer)	Common resident	1
Yellowhammer	✓	Red	700 thousand territories (summer)	Common resident	1-2
Dunnock	✓	Amber	2.3 million territories (summer)	Abundant resident	2-4
Off-Site only					
Starling	✓	Red	1.8 million pairs (summer),	Very common resident	-
House sparrow	✓	Red	5.1 million pairs (summer)	Common resident	-

Other Species

10.14 The two other species groups scoped in are

- Hedgehogs.
- Widespread but declining moth with priority species status.

10.15 Both are likely to be present in low numbers only, as a small assemblage and as components of larger local populations across the landscape.

SUMMARY

10.16 A summary of the results and evaluations is provided below (Table 15).

Table 15. Summary of the ecology assessment.

Feature	Description	Assessment
Habitats	Mainly low quality habitats, those of greater value being hedgerows and woodland	Two priority habitats present: Hedgerows and Lowland Mixed Deciduous Woodland. Two lengths of Important Hedgerows present, along the east boundary.

[39] Robinson, R.A. (2005) *BirdFacts: Profiles of Birds Occurring in Britain and Ireland (BTO Research Report 407)*. BTO, Thetford. Available from: http://www.bto.org/birdfacts, accessed on November 2018).

[40] NNNS (2019) *Norfolk Bird and Mammal Report. 2018.* Norfolk and Norwich Naturalists' Society, Norwich.

Feature	Description	Assessment
Great crested newts	None reported by surveys in 2010, or otherwise known from the vicinity. Surveys of on-Site ponds negative in 2019.	Absent, from ponds and terrestrial habitat.
Bats	No evidence of roosting, but small roosts cannot be ruled out. Foraging by five species: Myotis species, common pipistrelle, soprano pipistrelle, noctule and brown long-eared. Most activity towards the east of the Site.	Local importance.
Birds	Nesting species of conservation concern on-Site: skylarks, yellowhammer, dunnock, istle thrush and song thrush. Off-Site, but foraging on-Site: house sparrows and starlings. Small assemblage and numbers of wintering species.	Typical of Norfolk farmland, with skylarks at 'typical' densities for winter cereals. Local value.
Reptiles	No local records from the north fringe of Wymondham. None recorded by direct surveys.	Absent.
Badgers	No records from within 1km and no evidence on-Site	Absent.
Otters and water voles	Know from the River Tiffey~1.3km distant. On-Site ditches of very low quality, lacking vegetation and possibly dry in summer	Absent.
Brown hare	Hares reported from within 2km but none noted during surveys. On-Site habitat suitable within open fields but at most they are likely to eb present as transitory individuals and they are scoped out.	Absent.
Hedgehogs	Known to be present locally and hedgerows and woodland offer shelter and foraging habitat	Assumed to be present.
Invertebrates	Specialist microhabitats generally absent, although the trees support dead wood that may be relevant to dead wood species but a rich dead wood fauna is not known locally	A small assemblage of widespread but declining moths is likely.

11. IMPACTS, MITIGATION AND ENHANCEMENTS

IMPACTS

Sites

11.1 Adverse impacts from the development of the Site are likely to be driven by habitat loss, with the significance of this dependant on the extent and location of development while also noting the likely value of the ecological features and species as being relatively low, as widespread species that are component(s) of larger local populations(s). Mitigation of impacts will be achievable in most instances. Site landscaping, provision of open green space and also the creation of the green infrastructure corridors will provide the potential for net biodiversity gain.

11.2 Other potential pathways of impacts include:

- Surface water management, with the River Tiffey Valley and the Deep Road Meadow CWS connected via the unnamed tributary of the River Tiffey. Mitigation of flows and water quality will require an appropriate surface water management mitigation train, and is likely to be achievable.
- Recreational impacts on the two CWSs are of low likelihood given that neither has public access. In terms of broader recreational impacts in the vicinity of Wymondham, the Site has public footpaths leading from the Site to nearby open countryside and the creation of the green infrastructure corridors with on-Site greenspace will further mitigate recreational impacts.

11.3 It is not expected that there will be impacts on statutory sites, by virtue of distance and location. In particular the nearest component site of the Norfolk Valley Fens SAC is associated with the River Yare upstream of the confluence with the River Tiffey, at an Euclidean distance of 5.8km; impacts on its integrity are very unlikely.

Habitats and Species

11.4 The scheme masterplan largely aims to avoid development within the non-arable areas and includes areas of public open space alongside many lengths of hedgerow and woodland. The overall planting scheme and creation of green infrastructure corridors are likely to be of benefit to most species present on-Site or nearby.

11.5 Skylarks, however, are species of open shields and cannot be accommodated within the scheme. However, they remain a widespread species in Norfolk and the scheme proposals will provide substantial enhancement for species with equivalent conservation status, both birds and other species groups.

MITIGATION OF CONSTRUCTION

11.6 For the majority of species groups considered no mitigation is required, by virtue of their absence. During Site works the following is recommended:

- Nesting birds. General site clearance works should avoid the nesting bird season of March to August inclusive, with nesting likely within hedgerows, scrub and also open fields. Where works cannot be timed to outside of the nesting seasons then a watching brief should be employed to survey areas prior to works.
- Bat roosts in trees. While no evidence of roosting was found, with direct surveys undertaken six trees that are to be located close to development areas rather than being within open space. However, roosts are difficult to rule out. However, all the on-Site trees were rated as having low roost potential, and in accordance with Bat

Conservation Trust guidance (Collins loc. cit.) where works are required on these trees then appropriate mitigation is for pre-works inspections by the arboriculturists to confirm the absence of roosts, without the need for roost surveys. Where roosts are suspected in these circumstances then advice should be sought.

- Works near water. Measures to prevent soil and other run-off into the ditch network should be avoided, by following appropriate guidance[41].

ENHANCEMENTS

Green Infrastructure Corridors

11.7 As described, three green infrastructure corridors are identified as being relevant to the scheme, based on the Wymondham AAP. These are required to enhance connectivity across the landscape by offering movement corridors for species and also habitat in their own right. Figure 5 shows these corridors within the masterplan strategy. Key principles for such corridors are:

- As far as possible, the corridors should offer near-continuous belts of structural planting along which species that tend not to stray from cover will fly along. This includes many bats and also birds.
- Conversely, structural planting should not form overly dense belts of trees through which many species will struggle to fly. The options are to create paths through the planting, akin to double hedgerows or by spacing trees such that gaps will be retained between individual tree canopies. Planting should also aim to provide a diversity of local conditions, from open grassland to longer grassland forming a matrix with scrub, ultimately grading into denser scrub and tree cover.
- The corridors should be as dark as possible, through a combination of reduced lighting and also structural planting to screen from light spill (Gunnell and Grant, 2012[42]).
- The corridors should offer resources for a range of species, increasing the value of the corridors as stepping stones across the landscape. Examples include the provision of blossom over an extended period, required by many pollinating insects, and fruit and berries in autumn for many birds, and insect food plants.

Figure 8. Scheme masterplan strategy.

[41] *Guidance for Pollution Prevention Works and maintenance in or near water: GPP 5 January 2017.* Available from: http://www.netregs.org.uk/media/1418/gpp-5-works-and-maintenance-in-or-near-water.pdf

[42] Gunnell, K. and Grant, G. (2012) *Landscape and Urban Design for Biodiversity and Bats*. Bat Conservation Trust, London.

Generic Soft Landscaping

11.8 Soft landscaping is the most appropriate Site-wide enhancement, using appropriate native species and species of known wildlife value. Key points for many species groups is the need for insect prey, for bats and also for the chicks and fledgling birds of many species. Thus, range of native plant types should be planted to provide a range of resources across the seasons from spring to autumn (insects and their predators), and also fruit and berry producing species in autumn and winter (birds).

11.9 For woody species appropriate for structural planting, those typical of local hedgerows (Norfolk County Council, undated[43]) are:

- Hawthorn, blackthorn, ash, maple, dogwood *Cornus sanguinea*, elm and hazel, with lesser amounts of crab apple *Malus sylvestris*, hornbeam and holly, and scattered examples of privet *Ligustrum vulgare*, oak, spindle *Euonymus europaeus*, wild cherry *Prunus avium* and guelder rose *Viburnum opulus*.

11.10 Shrubs suitable for planting within the scheme include most of the species listed for hedgerows, other than blackthorn and hawthorn (due to spines) and those with requirements for large distances to the nearest buildings (mainly ash and oak). Small trees with smaller minimum distances to buildings include silver birch *Betula pendula*, rowan *Sorbus aucuparia*, whitebeams *Sorbus* species, and fastigiate forms of hornbeam. Within open green space trees allowed to develop open growth forms typical of parkland trees would be of particular value in

[43] Norfolk County Council (undated) *Planting Hedges in Norfolk – Maintaining Regional Character*. Available from: http://www.norfolkbiodiversity.org/pdf/reportsandpublications/HedgeBookletPROOF4.pdf

the medium- and long-term, with oak and beech *Fagus sylvatica* of very high value in such contexts.

11.11 Within areas of grassland and SUDS features a number of wildflower seed mixes are available from commercial suppliers, including wetland and pond planting (e.g. Emorsgate EM8 meadow mixture for wetlands), wildflower swards on heavy soils (e.g. EM4 meadow mixture for clay soils and EM10 tussock mixture) and flowering lawns for areas with more intensive use and management (e.g. EL1 flowering lawn mixture).

11.12 Along the ditch-side areas soft landscaping would serve to substantially enhance the value of these areas for wildlife, as areas of habitat and also as corridors across the landscape.

11.13 Additional measures could include:

- Bat boxes to be erected on buildings, either as integral 'bat tubes' embedded within walls or as external boxes. A wide range of types are suitable[44].
- Bird boxes should be erected for locally relevant species, including swifts and house sparrows.
- The scheme should allow for the continued movements of hedgehogs, with garden gates raised to allow them to pass under and holes within gravel boards to allow them to pass through[45].

[44] http://www.wildlifeservices.co.uk/batboxes.html

[45] https://www.jacksons-fencing.co.uk/News/outdoor-living/new-hedgehog-friendly-gravel-boards-winter-news-topical-treats-and-more-6511.aspx

12. CONCLUSION

12.1 The scheme will not directly or indirectly impact designated sites.

12.2 The Site is considered to be typical of an intensive arable landscape, dominated by relatively large fields with partial hedgerows and small areas of other habitats.

12.3 There are two priority Habitats of Principal Importance: Hedgerows and Lowland Mixed Deciduous Woodland. Two lengths of hedgerow on the east boundary qualify as Important Hedgerows under the Hedgerow Regulations.

12.4 Great crested newts are concluded to be absent on the basis of the negative surveys of on-Site ponds in 2019. Although off-Site ponds could not be accessed for survey, of which there are ten within 250m, all but two of these ponds were surveyed for nearby schemes in 2010, with those surveys being negative. Further, from the suite of surveys in 2010, and earlier survey work, the vast majority of ponds in the wider locality (>60 ponds) have been surveyed and great crested newts have not been reported, such that it is reasonable to conclude that they are not present locally, and they are not breeding on-Site or otherwise using the Site as terrestrial habitats.

12.5 Direct surveys in 2019 did not find any evidence of a number of other groups and they are also considered to be absent: water voles, otters, badgers, reptiles and brown hares.

12.6 No evidence of roosting bats was found within the six trees surveyed, but small roosts cannot be ruled out. Foraging was recorded by five species: *Myotis* species, common pipistrelle, soprano pipistrelle, noctule and brown long-eared. Most activity was towards the east of the Site. The assemblage and individual species are considered to be of no more than local importance.

12.7 Nesting species of conservation concern present on on-Site were: skylarks, yellowhammer, dunnock, istle thrush and song thrush. Nesting off-Site, but foraging on-Site, were: house sparrows and starlings. The assemblage of wintering species was small, in terms of species and individuals. The Site is considered to be typical of Norfolk farmland, with skylarks at 'typical' densities for winter cereals. The assemblage and individual species are considered to be of no more than local importance.

12.8 The other species scoped in are hedgehogs and widespread but declining moths. These would be of local importance and minor components of larger populations across the landscape.

12.9 For the majority of species groups considered no mitigation of construction is required, by virtue of their absence. During Site works the following are recommended:

- Nesting birds. General site clearance works should avoid the nesting bird season of March to August inclusive, with nesting likely within hedgerows, scrub and also open fields. Where works cannot be timed to outside of the nesting seasons then a watching brief should be employed to survey areas prior to works.
- Bat roosts in trees. While no evidence of roosting was found, roosts are difficult to rule out. The trees with roosts features are rated as having low potential and appropriate mitigation is for pre-works inspections by the arboriculturists to confirm the absence of roosts, without the need for roost surveys. Where roosts are suspected in these circumstances then advice should be sought.
- Works near water. Measures to prevent soil and other run-off into the ditch network should be avoided, by following appropriate guidance.

12.10 Habitat loss is considered to be the principal pathway of adverse impact, with mitigation available for most species via appropriate soft landscaping and scheme masterplanning. Skylarks, however, are species of open shields and cannot be accommodated within the scheme. However, they remain a widespread species in Norfolk and the density on-Site is typical for winter cereals. Overall however the scheme proposals will provide substantial enhancement for species with equivalent conservation status, both birds and other species groups.

12.11 In conclusion, it is considered likely that the impacts on the majority of species can be mitigated. Appropriate landscaping and scheme design have the potential to deliver net ecological enhancement. A key enhancement could be the delivery of the green infrastructure corridors identified within the Wymondham AAP, as part of scheme design and landscaping.

13. APPENDIX 1: PHOTOGRAPHS

Figure 9.
Arable field, with adventitious weeds and brassica seedlings.

Figure 10.
Semi-improved grass sward adjacent to Tuttles Lane East.

Figure 11.
Semi-improved grass sward adjacent to east boundary.

Figure 12.
Melton Road boundary, looking north-east. Grass sward along route of former hedgerow but now lacking woody vegetation.

Figure 13.
Hedgerow (HU2)

Figure 14.
Hedgerow (HU12)

Figure 15.
Semi-natural broadleaved woodland, near east boundary.

Figure 16.
Flowing ditch.

Figure 17. Transect 1 (TG 11302 03184 to TG 11316 03137) to right of footpath, looking north towards Melton Road (note dense cover of great brome with hedge mustard in foreground); 1 June 2019.

Figure 18. Transect 2 (TG 11417 02862 to TG 11467 02870) along crop edge (i.e. *not* the grassy margin) looking north-east (Tuttle Lane East to right, south side of hedge); 1 June 2019.

Figure 19. Transect 3 (TG 11998 03188 to TG 11962 03153) looking southwest (note dense tall cover of great and soft brome, and herbs including sun spurge, visible foreground right); 1 June 2019.

Figure 20. Transect 4 (TG 12131 03390 to TG 12088 03363) looking SW (note dense tall mass of great brome, with herbs including upright hedge-parsley, visible in foreground); 1 June 2019.

14. APPENDIX 2: COUNTY WILDLIFE SITES

Table 16. Details of County Wildlife Sites within 5km.

Zone	Location	CWS Reference	Name	Description
River Tiffey valley, downstream of confluence	1.4km west	156	Big Wood Meadow	Three distinct fields of undulating marshy grassland of moderate species diversity with species rich ditches.
	1.44km north-west	153	Falstoff's Wood	A large wet woodland criss-crossed by drains and a stream.
	1.44km west	155	Little Profit	An area of moderately species-rich marshy grassland.
	1.55north-west	157	Crownthorpe Carr	Semi-natural woodland to the west of the River Tiffey.
	2.8km north-west	159	Kimberley Lake	A large lake with small inlets and islands which is surrounded by a diversity of habitats.
	2.8km north-west	166	Carlton Plantation	A thin strip of wet woodland adjacent to the River Tiffey.
	2.8km north-west	165	Tiffey River Corridor	An area of woodland situated adjacent to the River Tiffey.
	3.1km north-west	164	Reed Meadow	A large and varied site with woodland to the west but fen and grassland towards the east.
	3.5km north	219	Spring Plantation	An L-shaped area of old plantation on sloping land alongside the River Tiffey.
	3.6km north	221	Tiffey Woods	An area of woodland lies either side of the River Tiffey.
River Yare valley	5.2km north-east	229	Yare Valley (Marlingford Hall)	Woodland, marshy grassland and fen either side of the River Yare.
River Tiffey Valley, upstream of confluence	2.3km south-east	2218	Silfield Newt Reserve	Five connected fields with ponds, grassland, scattered scrub and hedges.
	2.6km south	201	Breakers Yard Meadow	A largely of improved grassland with small pockets of semi-improved, wet grassland.
	1.16km west	216	Tiffey Meadow North	Remnant of marshy grassland situated adjacent to a disused railway.
	1.18km west	212	Tiffey Meadow South	Marshy grassland situated adjacent to a disused railway line.
	1.44km west	215	Wymondham Marshes	Marshy grassland crossed by dykes which support a pure swamp vegetation.
	1.7km south	211	The Lizard	A mixed grassland site with species-rich acidic grassland to the south and less rich, largely improved grassland to the north.

Zone	Location	CWS Reference	Name	Description
	1.8km west	2131	Toll's Meadow & Friarscroft	Toll's Meadow, a designated Local Nature Reserve (LNR), is situated on both sides of the River Tiffey, which bisects the site from east to west.
	2.0km south-west	210	Bays River Meadow North	A narrow, river valley wetland mosaic.
	2.6km south-west	209	Bays River Meadows South	A mosaic of wet basic and neutral grasslands and swamp.
	3.9km north	224	Turnpike Farm Pond	A sizeable fenced-off pond surrounded by species-poor grassland
Unnamed tributary of the River Tiffey	560m north-west	217	Deep Road Meadow	Tall fen vegetation with associated dykes and a species-poor dry grassland
Wider countryside north or north-west of Wymondham	1.17km south-west	213	Wymondham Abbey Meadows	Dry neutral grassland around the remains of Wymondham Abbey.
	1.3km north	206	Wymondham Plantations	A belt of mature plantation with a semi-natural character.
	95m north-east	205	Melton Road Meadow	A grassland site with invading scrub.
	2.2km north-west	158	Wymondham Plantation	Planted woodland and parkland either side of the driveway to Kimberley House.
	2.4km north-west	151	Alma Plantation	An area of neglected coppice woodland with standards.
	2.4km west	2123	Groundsel Wood	A small block of ancient woodland, consisting of coppice with standards.
	2.7km north-west	167	Kimberley Park	Parkland site consisting of oak over a species-poor improved grassland.
	3.1km north-west	152	New Wood	An area of broad-leaved woodland over an acid soil.
	3.1km north-west	163	Forehoe Wood	An ancient woodland site that is now a broad-leaved plantation.
	3.1km north-west	2158	Farthingale Wood	A boomerang-shaped semi natural ancient woodland.
	3.2km north-west	162	Forehoe Big Wood & Bullsmoor Strips	A large block of plantation woodland and an additional narrow strip, both of considerable age.
	5.1km north-east	2132	Beckhithe Meadow	A small meadow sloping down to the west.
	5.2km north-east	223	Low Common	A mosaic of grassland, fen and woodland around a stream
Wider countryside south or east of Wymondham	1.04km south	214	Moot Hill	Semi-natural woodland surrounded by a moat.
	2.4km east	204	Smeeth Wood	A mixed plantation wood on what is a site of ancient woodland.
	2.6km south-west	208	Railway Pond	A moderate sized mesotrophic pond with a varied aquatic and marginal vegetation.
	2.8km south-east	202	Stanfield Hall Moat	A mesotrophic water surrounding Stanfield Hall.

Zone	Location	CWS		Description
		Reference	Name	
	3.3km south-east	203	North Drive	Semi-natural woodland.
	3.6km east	194	Bean & Outer Park Woods	Mixed plantation which is surrounded by a dense high hedge and crossed by several rides.
	3.9km south-east	179	Hethel Wood	Semi-natural woodland.
	4.1km east	187	St. Thomas' Belt	Broad-leaved plantation crossed by several dykes and containing local marshy areas.
	4.1km south-east	188	Hethel Hall Moat	A small, shaded and partially dry U-shaped moat surrounded by grassland and woodland.

15. APPENDIX 3: ARABLE PLANTS

SURVEY TIMING

During bird surveys (23 May to 17 June 2019) *ad hoc* observations were made of vascular plants growing along field margins. Formal plant surveys were conducted along transects (see Methods) on 1 and 17 June. During this early summer period in the East Anglian region, many arable-associated species are flowering or close to flowering. It is acknowledged that a very few may have been missed, i.e. small early flowering annuals (but evidence of presence still likely, e.g. seed heads on dying/dead plants) and late flowering species (e.g. night-flowering catchfly *Silene noctiflora*, but young plants should be evident). Despite this constraint, it is considered that the survey effort gives a good indication as to the arable flora present and that any nationally rare (or locally uncommon) species (arable-associated or otherwise) are very likely to have been recorded.

OBJECTIVES

The main objectives were to identify if any 'Nationally threatened' (i.e. critically endangered, endangered or vulnerable) arable plants (Byfield & Wilson 2005[46]; Cheffings et al. 2005[47]) were present and to assess whether species assemblages constituted an 'Important Arable Plant Area' (IAPA) following Plantlife criteria (Byfield & Wilson loc. cit.; Plantlife loc. cit.). Secondarily to record any locally or nationally rare plants (regardless if arable-associated or not).

METHODS

On 1 and 17 June 2019, four transects each of 50-m long by about 1 m-wide (a little wider if low crop density allowed observation into the field) along arable field margins with a wheat crop (note: all six fields on-Site where under wheat at time of survey) were surveyed (Figs. 1-4; see Map, Appendix 1, for locations; OS grid reference given in Fig. captions). These four margins were selected for formal survey on the basis that they appeared, via brief prior observation, to be the most floristically-rich within the survey area and most likely to hold less common species, bearing in mind the main focus to ascertain if any nationally threatened arable-associated plants were present. Within transects, as well as arable plants, all other non-woody species (often typical of grassy margins/verges and hedgerow edges), were also recorded.

IMPORTANT ARABLE PLANT AREAS

In 2005, Plantlife International developed a simple method to identify areas of importance for arable plants, coined 'Important Arable Plant Areas' (IAPAs). A rarity score based system (taking into account soil type) is applied. Nationally Threatened species, i.e. Critically Endangered, Endangered or Vulnerable, score 9, 8 and 7 respectively. Less rare species score 6 (Near Threatened) down to 1 for the most common (Table 17). As well as presence of threatened species (qualifying a site as an IAPA under Criterion A), scores are tallied to assess if the plant communities represent 'outstanding assemblages' (IAPA qualification under Criterion B) based on national and county level threshold scores. For the soil types present, threshold scores are: clay/silt soils National 30-69, County 20-29; and sandy loams/freely draining acidic soils National 35-69, County 20-34.

Table 17. Scores and definitions within the IPA scheme.

Score	Status
9	Critically Endangered (CR) or Extinct (EX).
8	Endangered (EN).
7	Vulnerable (VU).
6	Near threatened (NT) OR additional Nationally Rare (i.e. 1-15 10-km squares).
5	Additional Nationally scarce: 16 to 50 10-km squares OR 51 to 100 10-km squares and change index of –1.0 or less.
4	Additional Nationally scarce: other Nationally scarce species not covered by the above category.

[46] Byfield A.J. & Wilson P. J. (2005) *Important Arable Plant Areas: Identifying Priority Sites for Arable Plant Conservation in the United Kingdom*. Plantlife International, Salisbury, UK.

[47] Cheffings C.M. & Farrell L. (Eds.) (2005) *The Vascular Plant Red Data list for Great Britain. Species Status 7: 1-116*. Joint Nature Conservation Committee, Peterborough, UK.

3	Species of local concern: 101 to 500 10-km squares.
2	Species of local concern: 501 to 1000 10-km squares.
1	Species of local concern: 1001 to 1500 10-km squares and change index less than 0.0 (i.e. negative).

RESULTS

Plant species recorded along each transect, their DAFOR abundance (highest over the two surveys) and rarity score, are summarised in Table 1.

No nationally threatened (i.e. critically endangered, endangered or vulnerable) or near threatened arable plants (allocated scores of 6 – 9), nationally scarce (scores of 4 – 5) or species of local concern (scores of 1 – 3) were recorded. The site does not constitute an IAPA based on Plantlife criteria, either at the national or county scale, as it achieved a score of 0 (zero).

Additional arable plants recorded outside transects (all of low abundance) included smooth hawk's-beard *Crepis capillaris*, black bindweed *Fallopia convolvulus*, redshank *Persicaria maculosa* and small nettle *Urtica urens.*

Table 18. Plants recorded in transects, abundance (DAFOR scale) and rarity score, Wymondham north of Tuttles Lane East, June 2019. Key: DAFOR scale: D = Dominant; A = Abundant; F = Frequent; O = Occasional; R = Rare.

Species	T1 (wheat)	T2 (wheat)	T3 (wheat)	T4 (wheat)	Score
Agrostis stolonifera Creeping bent	-	-	-	R	0
Alopecurus myosuroides Black grass	-	-	O	-	0
Arrenatherum elatius False oat-grass	F	-	R	R	0
Bromus diandrus Great brome	D	-	F	A	0
Bromus hordaceus Soft brome	O	F	F	F	0
Bromus sterilis Barren brome	O	O	O	F	0
Dactylis glomerate Cock's-foot	-	R	R	O	0
Lolium multiflorum Italian rye-grass	-	-	-	R	0
Lolium perenne Perennial rye-grass	O	-	R	O	0
Poa annua Annual meadow-grass	F	O	O	-	0
Poa trivialis Rough meadow-grass	-	R	-	O	0
Alliaria petiolata Garlic mustard	-	-	R	O	0
Arctium lappa Greater burdock	-	-	-	O	0
Atriplex prostrata Spear-leaved orache	-	-	R	-	0
Capsella bursa-pastoris Shepherd's purse	-	R	R	R	0
Chenopodium album Fat-hen	-	-	R	-	0
Cirsium arvense Creeping thistle	O	R	R	-	0
Cirsium vulgare Spear thistle	O	R	R	-	0
Convolvulus arvensis Field bindweed	-	-	O	-	0
Crepis vesicaria Beaked hawk's-beard	-	-	-	R	0
Dipsacus fullonum Teasel	-	O	-	-	0
Euphorbia helioscopia Sun spurge	-	-	O	-	0

Species	T1 (wheat)	T2 (wheat)	T3 (wheat)	T4 (wheat)	Score
Galium aparine Cleavers	R	O		O	0
Geranium dissectum Cut-leaved crane's-bill	-	R	O	F	0
Geranium molle Dove's-foot crane's-bill	R	R	O	-	0
Geranium pyrenaicum Hedgerow crane's-bill	-	R	-	-	0
Heracleum sphondylium Hogweed	-	-	R	R	0
Lamium album White dead-nettle	-	-	R	-	0
Lapsana communis Nipplewort	-	-	O	-	0
Malva Sylvestris Common mallow	-	-	R	-	0
Matricaria discoidea Pineapple mayweed	F	-	-	-	0
Myosotis arvensis Field forget-me-knot	O	-	-	-	0
Papaver rhoeas Common poppy	R	R	O	O	0
Picris echioides Bristly ox-tongue	-	-	-	R	0
Plantago lanceolata Ribwort plantain	-	-	R	-	0
Polyganum aviculare Common knotgrass	O	-	-	-	0
Rannunculus acris Meadow buttercup	-	-	R	-	0
Raphanus r. raphanastrum Wild radish	O	-	-	-	0
Rumex crispus Curled dock	R	-	O	-	0
Senecio Jacobaea Common ragwort	R	-	-	-	0
Senecio vulgaris Groundsel	R	-	R	R	0
Sisymbrium officinale Hedge mustard	F	-	O	O	0
Sonchus oleraceus Smooth sow-thistle	R	R	R	R	0
Stachys sylvatica Hedge woundwort	-	-	R	-	0
Stellaria media Common chickweed	-	O	-	-	0
Taraxacum agg. dandelion	R	-	-	R	0
Torilis japonica Upright hedge-parsley	-	-	-	F	0
Tripleurospermum inodorum Scentless mayweed	R	O	R	R	0
Urtica dioica Common nettle	-	-	O	O	0
Veronica arvensis Wall speedwell	-	R	-	-	0
Veronica chamaedrys Germander speedwell	-	R	-	-	0
Veronica hederacea Ivy-leaved speedwell	-	R	-	-	0

Species	T1 (wheat)	T2 (wheat)	T3 (wheat)	T4 (wheat)	Score
Veronica persica Common field speedwell	R	R	R	-	0
Viola arvense Field pansy	O	O	R	-	0
Equisetum arvense Field horsetail		R	O	-	0
Total number of species in transect:	**24**	**23**	**35**	**25**	**Score: 0**

No other (non-arable) uncommon plant species were recorded (note: woody species in hedgerows/woodland and woodland ground flora, not examined as beyond the remit of this survey). Squirrel-tail fescue *Vulpia bromoides* (a grass associated with dry sandy soils) recorded in one area (low abundance), is perhaps of local interest (but widespread in the county).

GENERAL APPRAISAL AND DISCUSSION

No 'Nationally threatened' (critically endangered, endangered or vulnerable) arable plants were recorded, or any other more common species allocated a rarity score by Plantlife (loc. cit.) in the survey area. It is considered that the survey effort gives a very good indication as to the quality of the arable flora present and that any uncommon species present were highly likely to have been observed. The arable margins were floristically species-poor (range 23 – 35 per transect; species common and widespread at the county level), and sparse in terms of non-crop species cover other than some tall dense strips of great brome *Bromus diandrus* and soft brome *B. hordaceus* along some stretches. The crop was mostly sown very close to the field margins, with only a few patches of more open ground harbouring a greater diversity of arable plants.

The site cannot be considered an 'Important Arable Plant Area', either at the national or county scale, as it achieved a score of 0 (zero).

16. APPENDIX 4: GREAT CRESTED NEWTS

HABITAT SUITABILITY INDEX

The ponds were evaluated using the Habitat Suitability Index (HSI) methodology (ARG, loc. cit.). The HSI of a pond is determined by calculating a geometric mean of 10 component factors of 'Suitability Indices' (SI) that are known to have an influence on its suitability as a breeding location for great crested newts (see Table 5), thus:

- $HSI = (SI1 \times SI2 \times SI3 \times SI4 \times SI5 \times SI6 \times SI7 \times SI8 \times SI9 \times SI10)^{1/10}$

Once calculated, the HSI score for a waterbody can be categorised as follows:

- Excellent (>0.8)
- Good (0.7 – 0.79)
- Average (0.6 – 0.69)
- Below Average (0.5 – 0.59)
- Poor (<0.5)

Table 19. Habitat Suitability Index: component factors or SIs.

Index	Name	Description
SI1	Geographic Location	Lowland England or upland England, Scotland and Wales
SI2	Pond area	To the nearest 50m²
SI3	Permanence	Number of years pond dry out of ten
SI4	Water quality	Measured by invertebrate diversity
SI5	Shade	Percentage shading of pond edge at least 1m from shore
SI6	Fowl	Level of waterfowl use
SI7	Fish	Level of fish population
SI8	Pond count	Number of ponds within 1km²
SI9	Terrestrial habitat	Quality of surrounding terrestrial habitat
SI10	Macrophytes	Percentage extent of macrophyte cover on pond surface

The HSI scores for ponds 1 and 3 are shown in Table 20, survey information in Tables 21 and 22, and the results in Table 23.

Table 20. Habitat Suitability Index assessments (as presented in the preliminary ecological appraisal).

Factor	Pond 1		Pond 3	
	Field Score	Factor Score (SI)	Field Score	Factor Score (SI)
Location	Optimal	1	Optimal	0.77
Pond area (m^2)	20	0.1	80	0.2
Pond permanence	Sometimes dries	0.5	Sometimes dries	0.5
Water quality	Moderate	0.67	Moderate	0.67
Shade %	90	0.3	60	1
Fowl	Absent	1	Absent	1
Fish	Absent	1	Absent	1
Pond density km^{-2}	>5	1	>5	1
Terrestrial habitat	Poor	0..33	Moderate	0.67
Macrophyte cover % (likely, estimated)	5	0.35	20	0.5
HSI score	-	0.51	-	0.67
Rating	**Below average**		**Average**	

DIRECT SURVEYS

The direct surveys used an appropriate combination of methods, with torching and egg search on each visit and with bottle trapping on the final three. Netting was the third method on the first visit.

Table 21. Weather conditions

Date	Weather
10 May 2019	12°C, partial cloud cover (60%), light wind (Beaufort 1)
12 May 2019	11°C, partial cloud cover (40%), light wind (Beaufort 1)
13 May 2019	10°C, partial cloud cover (30%), light wind (Beaufort 1)
16 May 2019	12°C, partial cloud cover (20%), light wind (Beaufort 1)

Table 22. Summary of survey conditions.

Date	Turbidity (0=completely clear, 5=very turbid)	Vegetation cover (0=no vegetation obscuring, 5=water completely obscured)
Pond 1		
All dates	2	0
Pond 3		
All dates	2	2

Table 23. Survey results. Where traps were deployed, 5 were used in pond 1 and 10 in pond 3.

Pond	Date	Great crested newts		Common frog		Common toad		Smooth newt	
		Torch	Traps	Torch	Traps	Torch	Traps	Torch	Traps
1	10 May 2019	0	-	1	-	0	-	1	-
	12 May 2019	0	0	2	0	0	0	1	2
	13 May 2019	0	0	0	0	0	0	2	1
	16 May 2019	0	0	0	0	0	0	3	3
3	10 May 2019	0	-	1	-	0	-	4	-
	12 May 2019	0	0	2	0	0	0	2	2
	13 May 2019	0	0	2	0	0	0	4	1
	16 May 2019	0	0	0	0	0	0	7	1

17. APPENDIX 5: BATS

METHODS

The survey methods are in accordance with Bat Conservation Trust recommendations (Collings, loc. cit.).

For the six trees with potential roost features not to be located within open space, single emergence surveys were undertaken (Table 24, Figure 21). Foraging surveys comprised monthly transect and static recording surveys (using 5 nights of survey per month with six Anabat Express units) (Table 25, Figure 22). Summary data from the static recorders are given in Table 17.

Table 24. Details for tree emergence surveys.

Date	Trees	Weather
11 July 2019	T6 and T7	19°C, warm, calm and dry
12 July 2019	T8 and T9	17°C, warm, calm and dry
17 July 2019	T4 and T5	15°C, warm, calm and dry

Table 25. Details for bat foraging surveys.

Date	Survey type	Weather
16 May 2019	Transect and start of static recordings	18°C, warm, calm and dry
19 June 2019	Transect and start of static recordings	20°C, warm, calm and dry
20 July 2019	Transect and start of static recordings	22°C, warm, calm and dry
28 August 2019	Transect and start of static recordings	18°C, warm, calm and dry
25 September 2019	Transect and start of static recordings	16°C, mild, calm and dry

The evaluation scheme for bats is as described by Wray et al. (2010)[48]. This considers the rarity of the species encountered, numbers of individuals roosting potential at a locality and the landscape character.

Briefly, rarity is scored as 2, 5 or 20 (for common, rare and rarest species); the number of bats as 5, 10 or 20 (individuals, small numbers or large numbers); roosting potential as 1, 3, 4, 5 or 20 (none, low potential, moderate, large number of roosts or close to a Special Conservation Area for the species); and landscape value of 1, 2, 3, 4 or 5 (limited habitat, large fields with poor hedges; moderate field sizes and gappy hedgerows of isolated tall hedgerows, small fields with many hedgerows and a high value landscape with small fields, streams and many hedgerows). For each criterion a score is assigned and the sum of scores is used as the value score thus: 1-10, zone of influence only; 11-20, Local; 21-30, County; 31-40, Regional; 41+, National or International.

RESULTS

Table 26. Summary of bat activity from static recorders.

Station	Total registrations over 5 nights							Mean registrations per night				
	M	J	J	A	S	∑		M	J	J	A	S
***Myotis* species**												
1	0	11	23	48	0	82		0	2.2	4.6	9.6	0
2	0	31	19	0	0	50		0	6.2	3.8	0	0
3	0	36	11	28	19	94		0	7.2	2.2	5.6	3.8
4	0	21	0	0	8	29		0	4.2	0	0	1.6
5	0	19	32	29	0	80		0	3.8	6.4	5.8	0

[48] Wray, S., Wells, D., Long, E. and Mitchell-Jones, T. (2010) Valuing bats in ecological impact assessment. *In Practice* 70, 23-25.

Station	Total registrations over 5 nights							Mean registrations per night				
	M	J	J	A	S	∑		M	J	J	A	S
6	0	0	0	0	0	0		0	0	0	0	0
						335						
	M	J	J	A	S	∑		M	J	J	A	S
Common Pipistrelle												
1	302	226	189	323	180	1220		60.4	45.2	37.8	64.6	36
2	185	247	325	296	302	1355		37	49.4	65	59.2	60.4
3	225	368	274	302	400	1569		45	73.6	54.8	60.4	80
4	208	358	865	1087	325	2843		41.6	71.6	173	217.4	65
5	198	214	189	165	223	989		39.6	42.8	37.8	33	44.6
6	36	11	68	85	17	217		7.2	2.2	13.6	17	3.4
						8193						
	M	J	J	A	S	∑		M	J	J	A	S
Soprano pipistrelle												
1	208	321	289	452	108	1378		41.6	64.2	57.8	90.4	21.6
2	85	198	214	168	210	875		17	39.6	42.8	33.6	42
3	254	302	189	268	332	1345		50.8	60.4	37.8	53.6	66.4
4	289	354	268	301	185	1397		57.8	70.8	53.6	60.2	37
5	185	278	368	287	201	1319		37	55.6	73.6	57.4	40.2
6	8	28	58	24	11	129		1.6	5.6	11.6	4.8	2.2
						6443						
	M	J	J	A	S	∑		M	J	J	A	S
Noctule												
1	11	12	16	32	68	139		2.2	2.4	3.2	6.4	13.6
2	42	32	46	23	42	185		8.4	6.4	9.2	4.6	8.4
3	23	18	19	38	8	106		4.6	3.6	3.8	7.6	1.6
4	0	46	35	18	21	120		0	9.2	7	3.6	4.2
5	0	32	18	25	49	124		0	6.4	3.6	5	9.8
6	0	0	0	0	0	0		0	0	0	0	0
						674						
	M	J	J	A	S	∑		M	J	J	A	S
Brown long-eared												
1	0	0	0	6	0	6		0	0	0	1.2	0
2	0	0	0	0	0	0		0	0	0	0	0
3	0	0	9	16	8	33		0	0	1.8	3.2	1.6
4	0	0	0	0	6	6		0	0	0	0	1.2
5	0	2	11	0	0	13		0	0.4	2.2	0	0
6	0	0	0	0	0	0		0	0	0	0	0
						58						

Figure 21. Trees with roost potential.

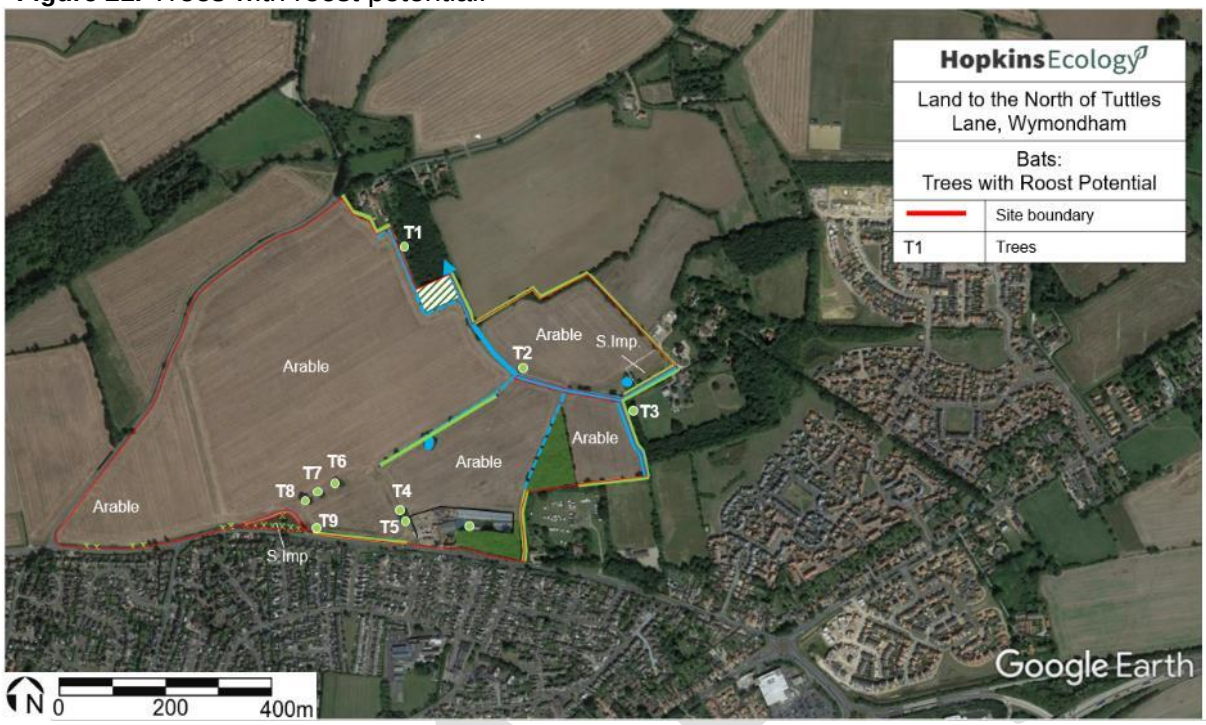
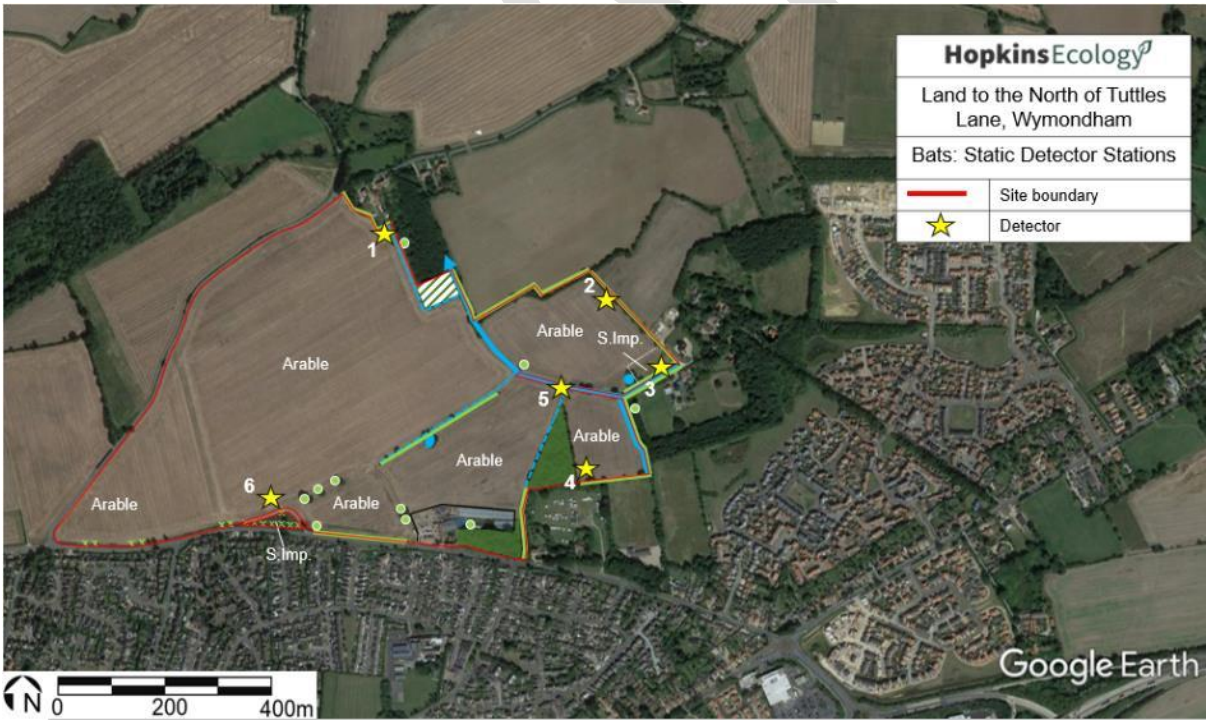


Figure 22. Static recorder stations.



18. APPENDIX 6: BIRDS

HABITATS

Habitats within the survey site (are only very briefly summarised here.

- **Arable fields:** six fields, all under wheat at time of survey.
- **Hedgerows:** species-poor to moderately species-rich hedgerows are present around most of the eastern and southern site margins, with a 280m length of hedgerow running SW-NE across the central-southern part of the site. There are numerous hedgerow-associated trees, including some mature pedunculate oak *Quercus robur*. Along the NW edge (Melton Road; no hedge) are a few small patches of scrub/small trees and bramble *Rubus fruticosus* agg.
- **Woodland:** there are three small deciduous blocks of woodland. From N-S, (a) along E edge, a rectangular plantation (50 x 70 m) of poplars *Populus* sp. with ash etc., understory dominated by elder *Sambucus nigra* and stinging nettle *Urtica dioica*, (b) towards the south-east corner, a triangular block (100 x 150 x 170 m) dominated by ash *Fraxinus excelsior* with pedunculate oak, sycamore *Acer pseudoplatanus* etc., and (c) in the SE corner, a rectangular block (50 x 100 m) with a similar mix of tree species.
- **Ponds**: a fairly centrally located, single pond lies along the southern edge of a hedgerow; it has scrubby margins and is surrounded by small to semi-mature deciduous trees.
- **Buildings:** at the south-east corner is Wymondham Garden Centre with parking area, polytunnels, and 2-3 domestic dwellings.
- **Bordering areas** The B1135 (Tuttles Lane East) runs along the south edge of the site, south of which is a large area of housing and associated gardens (Wymondham). A minor road (Melton Road) runs along its north-west edge. Abutting the north-east corner are residential/farm buildings (Mayes Farm), likewise at the east-most point of the survey area, also a playing field (disused rugby pitch). Otherwise to the north and east the site is surrounded mostly by arable farmland with a block of deciduous woodland north of Melton Road.

SURVEY TIMING

The site was surveyed from 23 May to 17 June 2019. This falls within the breeding season of all bird species likely to be encountered (given location and habitats present).

OBJECTIVES

The main objective was to record birds exhibiting behaviour indicative of breeding (i.e. displaying territorial behaviour, primarily song, as well as direct evidence of nesting) on-Site and to assess their breeding status (i.e. possible, probable or confirmed as nesting) and the number of potential nesting pairs. Special regard was given to ascertain the status any declining '*Species of Conservation Concern*' (i.e. Amber- and Red-listed species; Eaton et al. 2015) observed in the survey area.

METHODOLOGY

Five morning bird surveys were undertaken: 23 and 31 May, and 5, 14 and 17 June 2019. Mornings were selected when weather conditions were good for survey, i.e. no precipitation and wind speed ranging from Beaufort Scale 0 to 2: calm (< 2 km/h) to light breeze (6 to 12 km/h). Surveys commenced 04:50 **–** 05:30 h (i.e. soon after dawn) and ended at the latest at 07:40 h. Features within the survey area likely to support nesting birds, i.e. hedgerows,

woodland edge and field margins, were walked at moderate pace. Each survey took about 2 h 15 min to complete. All contacts (i.e. 'registrations') with birds, sight (assisted using Leica 8 x 32 BA binoculars) and sound, indicative of territoriality/breeding were plotted on field maps. Bird species codes (following those of the British Trust for Ornithology; BTO) were used to denote each species, and simple abbreviations/symbols used to record activity (e.g. song, alarm calling, carrying food) and observations of fledged young (see Appendix A). Additional species within the survey area but not showing behaviour indicative of breeding and those overflying were also noted, and an assessment as to whether suitable nesting habitat was present on-Site for these was made.

Observations were collated post-survey and the numbers of birds of each species exhibiting signs of territoriality/breeding were assessed. An assessment was made as to whether a species was 'possible', 'probable' or 'confirmed' (active nest) as breeding onsite, and the number of breeding pairs estimated. This follows BTO criteria except that 'Probable' was allocated to where a bird was singing twice or more through the survey period, rather than 'Permanent Territory presumed through registration of territorial behaviour (song etc.) on at least two different days a week'. Birds singing on one survey only (following guidelines) are included as 'Possible' nesting species if suitable nesting habitat was deemed present. It should be noted that young birds (i.e. fledglings/juveniles) observed might not denote nesting on-Site as they may be offspring derived from nests located nearby, but off site.

RESULTS

Possible, probable or confirmed breeding bird species

A total of 21 bird species considered possible, probable or confirmed breeding on-Site were recorded. Observations are summarised in Table 27, with an assessment of breeding status and number of pairs, and species of conservation concern (i.e. Red or Amber listed) indicated. All species encountered were those that would be typically expected to nest in the types habitats present on-Site within the East Anglian region. Of these, six were Red list species (skylark, mistle thrush, song thrush, starling, house sparrow and yellowhammer) and two were Amber list species (green woodpecker and dunnock). Locations of observations are indicated on redrawn survey field maps (Appendix B).

Table 27. Bird species considered possible, probable or confirmed breeding and estimate of number of breeding pairs, based on surveys conducted 23 May – 17 June 2019.

Species (BTO code)	Observations indicative of territoriality/ breeding (and additional notes)	Breeding status	Estimated no. breeding pairs[1]	Red or Amber list species
Woodpigeon (WP)	6-8 singing/survey (plus others immediately adjacent), active nest confirmed 31/5; many observations throughout.	Confirmed	6-8	
Green woodpecker (G.)	Juvenile in triangular woodland block, 5/6; also adult(s) flying in/out of this area 14 and 17/6, plus 1 calling/singing E edge.	Possible	1	Amber
Skylark (S.)	4-7 singing/survey; a pair possibly with 2 juveniles 23/5; 1 descending with food, 5/6.	Probable	4-7	Red
Wren (WR)	7-9 singing/survey.	Probable	7-9	-
Dunnock (D.)	1 singing, 1 calling (possibly alarm call to young), 1 with food, 23/5; 31/5; adult with juvenile, 1 singing 5/6; 1 calling 14/6; 1 alarm calling 17/6.	Probable	3-4	Amber
Robin (R.)	Brief song 23/5, likewise of 2, 31/5; juvenile east end of site 5, 14 and 17/6.	Possible	3	-

Species (BTO code)	Observations indicative of territoriality/ breeding (and additional notes)	Breeding status	Estimated no. breeding pairs[1]	Red or Amber list species
Mistle thrush (M.)	1 recently fledged young (barely able to fly), north-east corner of site (but cannot be said with certain from nest on-Site), 23/5; 2 overflying 31/5; pair (near where fledgling observed), 14/6.	Probable	1	Red
Song thrush (ST)	1 singing by poplar plantation, 23/5; 1 singing just off-Site north of Mayes Farm, 31/5, 5/6 (and 1 other singing just to S of farm, 5/6).	Possible	1	Red
Blackbird (B.)	2-3 singing/survey (plus just adjacent), several alarm calling and occasional juveniles; male taking food to probable nest (or fledgling?), 31/5.	Probable	3-4	-
Carrion crow (C.)	2 adults with juvenile south edge of site, 31/5, and regularly calling from this area; 2nd pair calling in response, 14/6. Occasional (calling/overflying) elsewhere.	Probable	1-2	-
Jackdaw (JD)	1 calling east edge (nesting opportunity in cavities in trees), 23/5; occasional overflying.	Possible	1	-
Jay (J.)	1 by garden centre, 31/5, 1 flying into triangular wood block, 14/6 where 1 calling, 17/6).	Possible	1	-
Common whitethroat (WH)	1 singing E end, 1 calling west end 31/5; 1 alarm calling towards east end (perhaps same individual as singing 31/5), 14/6.	Possible	1	-
Blackcap (BC)	4 singing (1 each from the 3 woodland areas, 1 hedge at east end), 23/5; 3 singing 31/5, 2 on 5/6, 3 on 14/6 and 4 (same areas as 23/5) on 17/6.	Probable	4	-
Chiffchaff (CC)	1 singing east edge, 23/5; 1 singing from triangular woodland block, 17/6.	Possible	1-2	-
Great tit (GT)	1 alarm calling south-east corner 23/5; adult with 2 juveniles east edge, 5/6; occasional observations elsewhere.	Possible	1	-
Blue tit (BT)	2 juveniles east end 14/6; occasional observations elsewhere.	Possible	1	-
Starling (SG)	Many overflying (adults and juveniles) and occasional foraging/perched on-Site. Many observations around houses just off-Site where undoubtedly nesting; some nesting opportunities on-Site.	Possible	1	Red
Chaffinch (CH)	2-4 singing/survey and several adjacent, plus numerous other observations.	Probable	2-4	-
House sparrow (HS)	Nesting south-east corner of site (under house eaves); many observations (including several juveniles) foraging on-Site and in hedges along south edge, also elsewhere. (numerous singing/calling from adjacent houses, where undoubtedly nesting).	Confirmed	1-2	Red
Yellowhammer (Y.)	2 singing (centre and north-east of site), 23/5; male west end 31/5 and 1 just off-Site in same area, 5/6.	Possible	2	Red

[1]Note, where a range is given for estimated number of breeding pairs, 'Breeding status' represents the highest level of likelihood of breeding category ascertained and takes into account other pairs that might be breeding at the lower category level(s); e.g. 1 pair confirmed, 1 probable and 2 possible = 1-4; '+' denotes more pairs likely to be present (see also notes for each species for clarification).

Bird species observed on (or immediately adjacent to) site but not showing behaviour indicative of breeding, or overflying, and nesting habitat suitability appraisal.

- Mallard (MA) – 3 overflying low (2 male, female) 5/6 and 17/6; (low quality nesting habitat on-Site; Amber list).
- Common buzzard (BZ) – 1 flying from poplar plantation (potential nesting habitat; note: large stick nest plantation, uncertain if active and may refer to carrion crow), 31/5 and nearby on 5/6. Perhaps nesting in woodland N of site (where observed overflying).
- Kestrel (K.) – 1 hunting just beyond W end of site (potential nesting habitat on-Site; Amber list).
- Barn owl (BO) – 1 hunting just beyond SE corner of site, 23/5 (probably suitable nesting habitat on-Site).
- Red-legged partridge (RL) Pair S edge of site, 23/5 (plus 1 flushed NW corner); 1 N edge, 31/5.
- Common pheasant (PH) Pair on fallow just off NE corner of site, 23/5.
- Black-headed gull (BH) – occasional singles overflying (no suitable nesting habitat; Amber list).
- Lesser black-backed gull (LB) – occasional singles overflying (no suitable nesting habitat on-Site; Amber list).
- Feral pigeon (FP) – occasional overflying (no suitable nesting habitat on-Site).
- Stock dove (SD) – Singing just N of garden centre off-Site (plus 2 overflying), 5/6 (suitable nesting habitat on-Site).
- Collared dove (CD) – Numerous observations (including singing birds) just S of site associated with houses and gardens, occasional overflying (suitable nesting habitat on-Site).
- Swift (SI) – occasional overflying/foraging; also adjacent to site where probably nesting under roof tiles of adjacent buildings (no suitable nesting habitat on-Site; Amber list).
- Great spotted woodpecker (GS) – 1 flying from poplar plantation (suitable nesting habitat on-Site).
- Magpie (MG) – 1-2 alarm calling, just off-Site north-esat corner(suspected nesting) 5, 14 and 17/6; 1 calling adjacent to site by Merton Road, 31/5 and 17/6 (suitable nesting habitat on-Site).
- Bullfinch (BF) – male E end of site 23/5, male north end of site, 14/6 (suitable nesting habitat on-Site; Amber list).
- Goldfinch (GO) – surprisingly only 1 recorded on-Site (overflying); numerous observations in gardens/around houses to S (suitable nesting habitat on-Site).
- Greenfinch (GR) – 1 singing from garden just off-Site to south-west (suitable nesting habitat on-Site).
- Linnet LI – 2 singles calling just off site, 31/5, 1 calling just off site, 5/6 (suitable nesting habitat on-Site; Red list).

DISCUSSION

All birds encountered were of species expected to be typically encountered given the habitats present (arable cereal crops, hedgerows, scrub and woodland) in a primarily arable landscape in the East Anglian region. However, given considerable recent population declines, presence of up to possibly seven pairs of skylark (Red list), is of note. A least one pair of house sparrows (Red list) was confirmed nesting on-Site, with numerous birds using the site, e.g. for foraging. Regarding of Red list species, the site also likely supports small numbers of nesting mistle thrush (1 pair), song thrush (1 pair) and yellowhammer (2 pairs). Starlings might nest (undoubtedly nesting in houses to S) but, as house sparrow, were observed foraging on-Site.

Appendix A. Codes used on field maps, using Wren (WR) as an example.

WR circled = singing wren

WR encircled by dashes = territorial dispute (2 or more individuals, as indicated on field map)

WR — — — WR = 2 wrens singing consecutively

WR ——— WR = same individual singing from different positions

WR = scolding/alarm calling

WR = calling (i.e. a call not necessarily indicative of breeding/territoriality)

WR $_{food}$ = carrying food

WR $_{forage}$ = foraging (note: not necessarily indicative of breeding/territoriality)

WR $_{fledg.}$ = fledgling (young recently left nest)

WR $_{juvenile}$ = juvenile (older young of year, able to fly well)

WR $_{nest}$ = nest confirmed

WR $_{n?}$ = probable nest but unconfirmed (e.g. adult taking food into hedge, where nest likely located)

Appendix B. Bird survey field maps.

Note: Some additional observations just beyond the survey site boundary are also included on the (redrawn) field maps. Overflying woodpigeons are not indicated.

Survey 1: 23/5/19

North of Tuttles Lane, Wymondham, Norfolk

Date: 23/5/19

Survey 2: 31/5/19

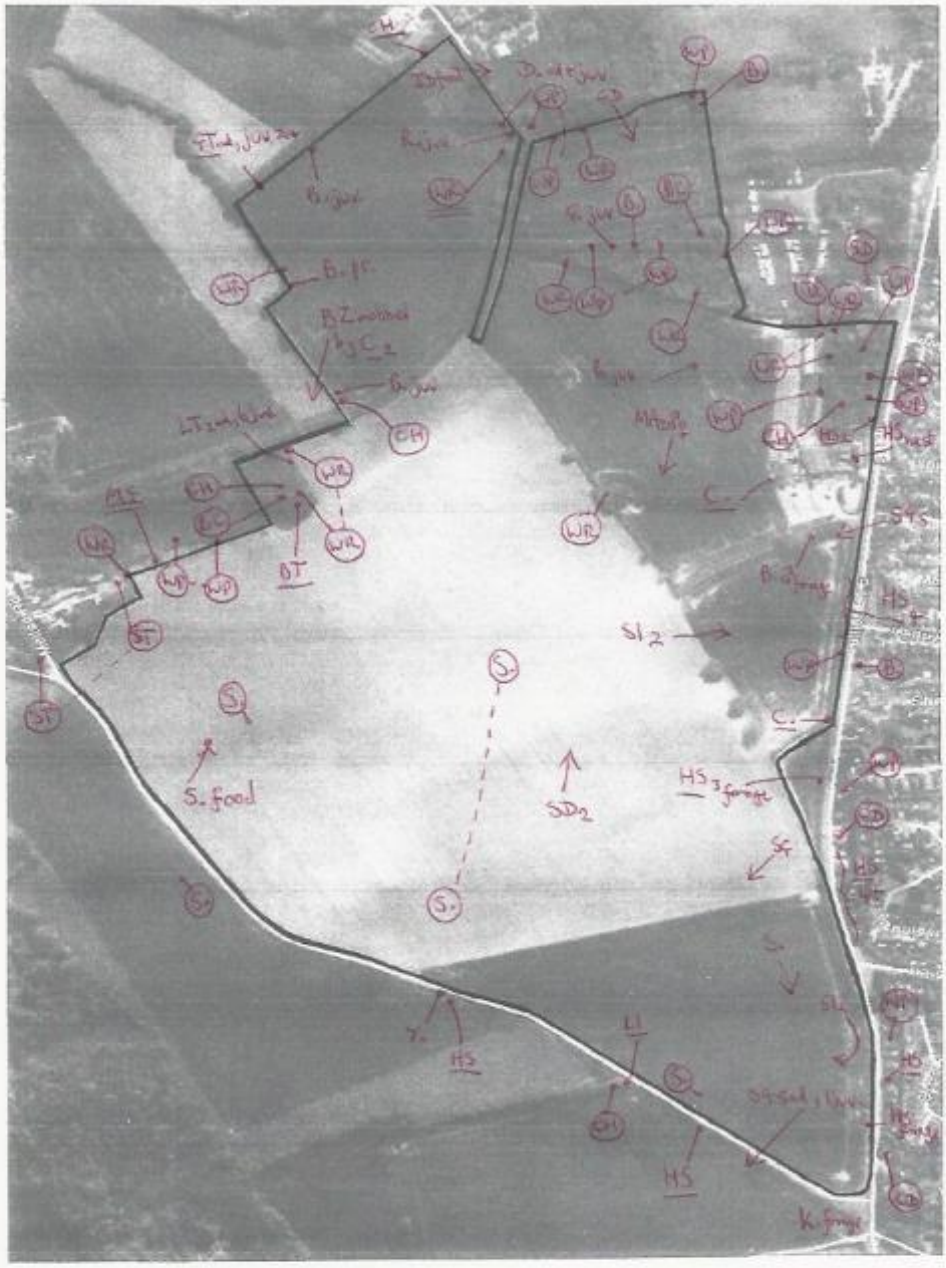
North of Tuttles Lane, Wymondham, Norfolk

Date: 31/5/19

Survey 3: 05/6/19

North of Tuttles Lane, Wymondham, Norfolk

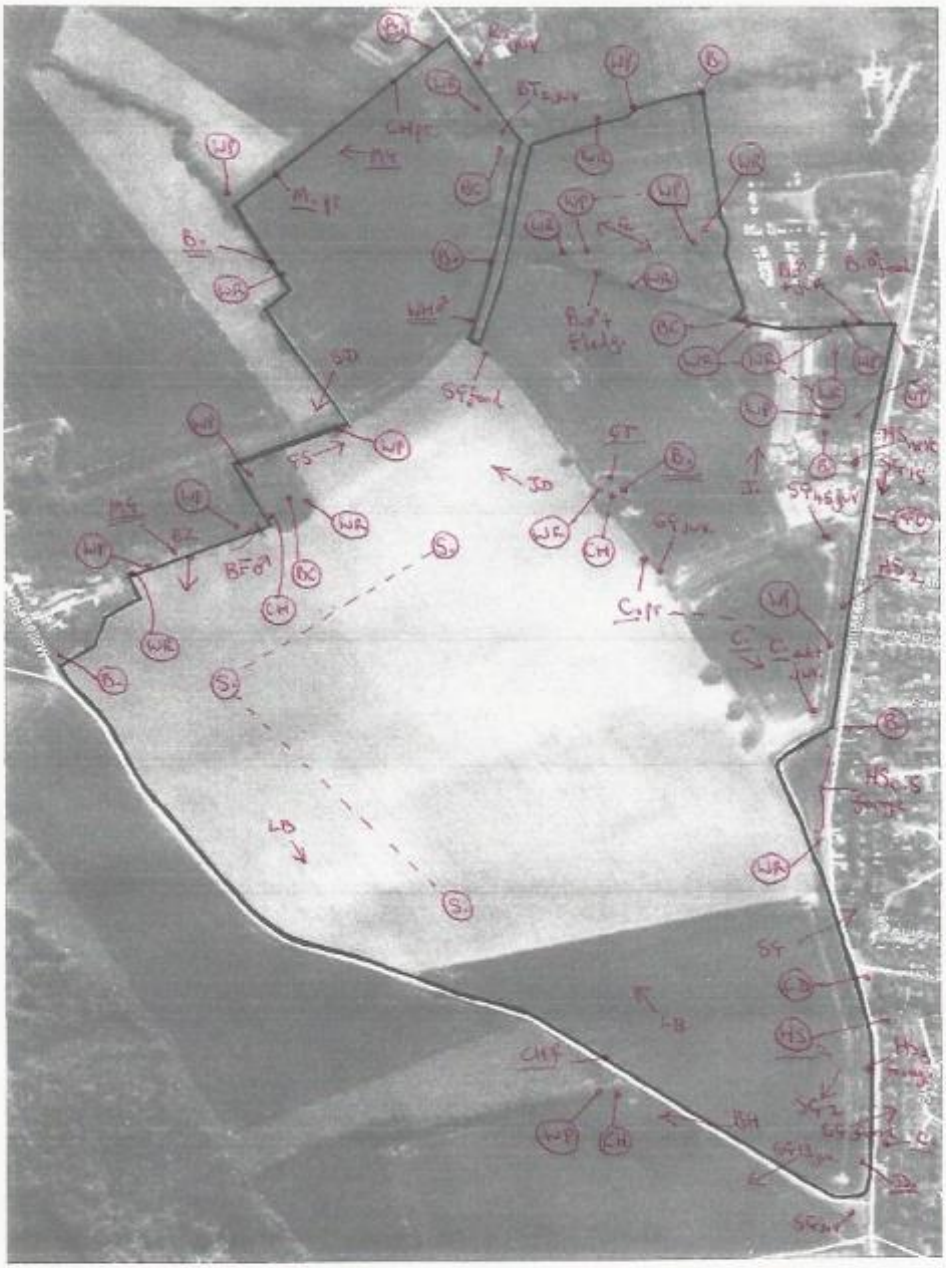
Date: 5/6/19



Survey 4: 14/6/19

North of Tuttles Lane, Wymondham, Norfolk

Date: 14/6/19



Survey 5: 17/6/19

North of Tuttles Lane, Wymondham, Norfolk

Date: 17/6/19

19. APPENDIX 7: REPTILES

METHODS

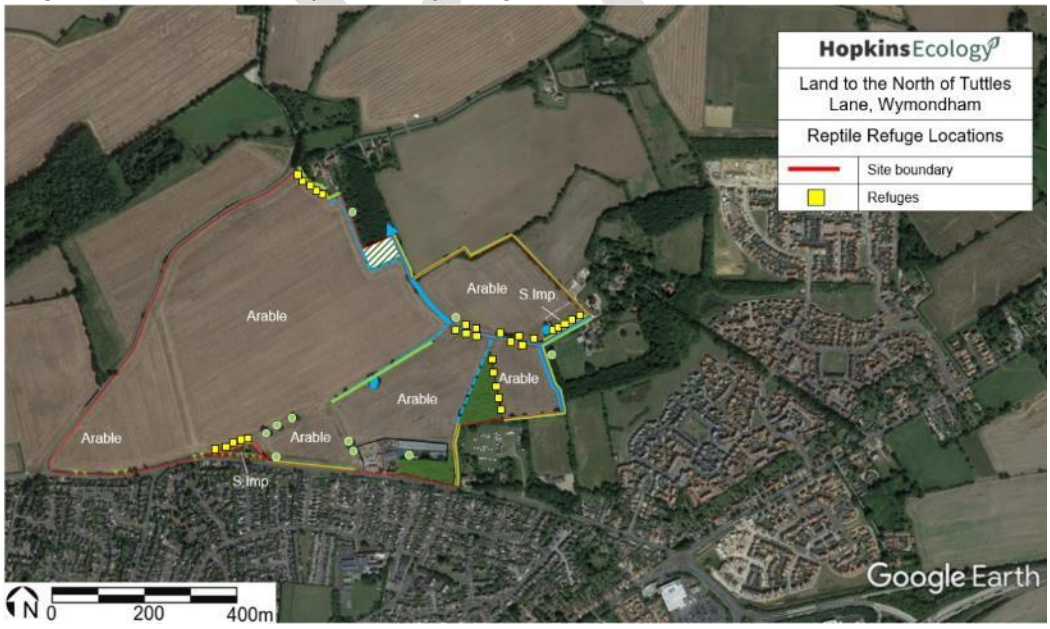
Reptile surveys were undertaken using direct survey methods on the Site, intended to identify the presence / absence of reptiles and the species present. These surveys were carried out following best practice guidance recommended by the JNCC *Herpetofauna Workers' Manual* (Gent and Gibson, 2003[49]) and Froglife (loc. cit.).

The reptile survey involved the placement and checking of artificial refugia, together with general observations during visits. The refugia were made from heavy grade bitumen felt, cut to a size of approximately 50cm x 50cmm. A total of 30 refugia were deployed (Figure 21). Surveys were undertaken during optimal weather conditions whenever possible: temperatures between 10ºC and 18ºC with intermittent or hazy sunshine and little or no wind (as described by Beebee and Griffiths, 2000[50]) (Table 28).

Table 28. Reptile survey dates and weather conditions.

Visit Number	Date	Start Time	Temp. °C	Weather
Felts out	18 August 2019	n/a	n/a	n/a
1	05 September 2019	08.00	15	Light wind, 20% cloud
2	09 September 2019	09.00	16	Light wind, 20% cloud
3	16 September 2019	09.30	16	Light wind, 30% cloud
4	20 September 2019	09.00	15	Light wind, 40% cloud
5	27 September 2019	07.30	12	Light wind, 40% cloud
6	30 September 2019	17.30	15	Light wind, 40% cloud
7	02 October 2019	11.30	16	Light wind, 30% cloud
8	11 October 2019	08.00	14	Light wind, 30% cloud

Figure 23. Location of reptile survey refuges.



[49] Gent, T. and Gibson, S. (2003) *Herpetofauna Workers Manual.* Joint Nature Conservancy Council, Peterborough UK.

[50] Beebee, T. and Griffiths, R. (2000) Am*phibians and Reptiles – A Natural History of the British Herpetofauna.* HarperCollins, London.

20. APPENDIX 8: LEGISLATION SUMMARY

Non-technical account of relevant legislation and policies.

Species	Legislation	Offence	Licensing
Bats: European protected species	Conservation of Habitats and Species Regulations 2017 (as amended) Reg 41.	Deliberately capture, injure or kill a bat; deliberate disturbance of bats; or damage or destroy a breeding site or resting place used by a bat. [The protection of bat roosts is considered to apply regardless of whether bats are present.]	A Natural England (NE) licence in respect of development is required.
Bats: National protection	Wildlife and Countryside Act 1981 (as amended) S.9.	Intentionally or recklessly obstruct access to any structure or place used for shelter or protection or disturb a bat in such a place.	Licence from NE is required for surveys (scientific purposes) that would involve disturbance of bats or entering a known or suspected roost site.
Birds	Wildlife and Countryside Act 1981 (as amended) S.1.	Intentionally kill, injure or take any wild bird; intentionally take, damage or destroy the nest of any wild bird while that nest is in use or being built. Intentionally or recklessly disturb a Schedule 1 species while it is building a nest or is in, on or near a nest containing eggs or young; intentionally or recklessly disturb dependent young of such a species [e.g. kingfisher].	No licences are available to disturb any birds in regard to development.
Great crested newt: European protected species	Conservation of Habitats and Species Regulations 2010 (as amended) Reg 41.	Deliberately capture, injure or kill a great crested newt; deliberate disturbance of a great crested newt; deliberately take or destroy its eggs; or damage or destroy a breeding site or resting place used by a great crested newt.	Licences issued for development by Natural England.
Great crested newt: National protection	Wildlife and Countryside Act 1981 (as amended) S.9.	Intentionally or recklessly obstruct access to any structure or place used for shelter or protection or disturb it in such a place.	A licence is required from Natural England for surveying and handling.
Adder, common lizard, grass snake slow worm	Wildlife and Countryside Act 1981 S.9(1) and S.9(5).	Intentionally kill or injure any common reptile species.	No licence is required. However, an assessment for the potential of a site to support reptiles should be undertaken.

Species	Legislation	Offence	Licensing
Scientific Interest (SSSI)	Wildlife and Countryside Act 1981 (as amended).	To carry out or permit to be carried out any potentially damaging operation. SSSIs are given protection through policies in the Local Development Plan.	Owners, occupiers, public bodies and statutory undertakers must give notice and obtain the appropriate consent under S.28 before undertaking operations likely to damage a SSSI. All public bodies to further the conservation and enhancement of SSSIs.
County Wildlife Sites	There is no statutory designation for local sites.	Local sites are given protection through policies in the Local Development Plan.	Development proposals that would potentially affect a local site would need to provide a detailed justification for the work, an assessment of likely impacts, together with proposals for mitigation and restoration of habitats lost or damaged.

APPENDIX 5
FLOODING & SURFACE WATER MANAGEMENT NOTE

W121 – Land North of Tuttles Lane East, Wymondham,
Norfolk Flooding and Surface Water Management Note
Welbeck Strategic Land III Limited
March 2018

Introduction

This note has been prepared to support the allocation of Land North of Tuttles Lane East, Wymondham.

This review takes account of the National Planning Policy Framework (NPPF) and its associated planning practice guidance and the definitions of sources of flooding within the Flood and Water Management Act (FWMA) 2010.

Information to inform this note has been obtained from the following sources:

- Various sources of mapping;
- Anglian Water (AW) sewer plans and liaison with AW;
- The Norfolk County Council Preliminary Flood Risk Assessment (PFRA); and
- A site visit.

The site is approximately centred on OS grid reference 611696, 303159 and extends to approximately 55.0 ha. The majority of the site is currently undeveloped agricultural land.

An unnamed tributary of the River Tiffey flows through the eastern area of the site. The watercourse flows in a predominantly north-westerly direction from the south-east corner of the site.

Ordnance Survey contours show ground levels falling from the east and west toward the aforementioned watercourse.

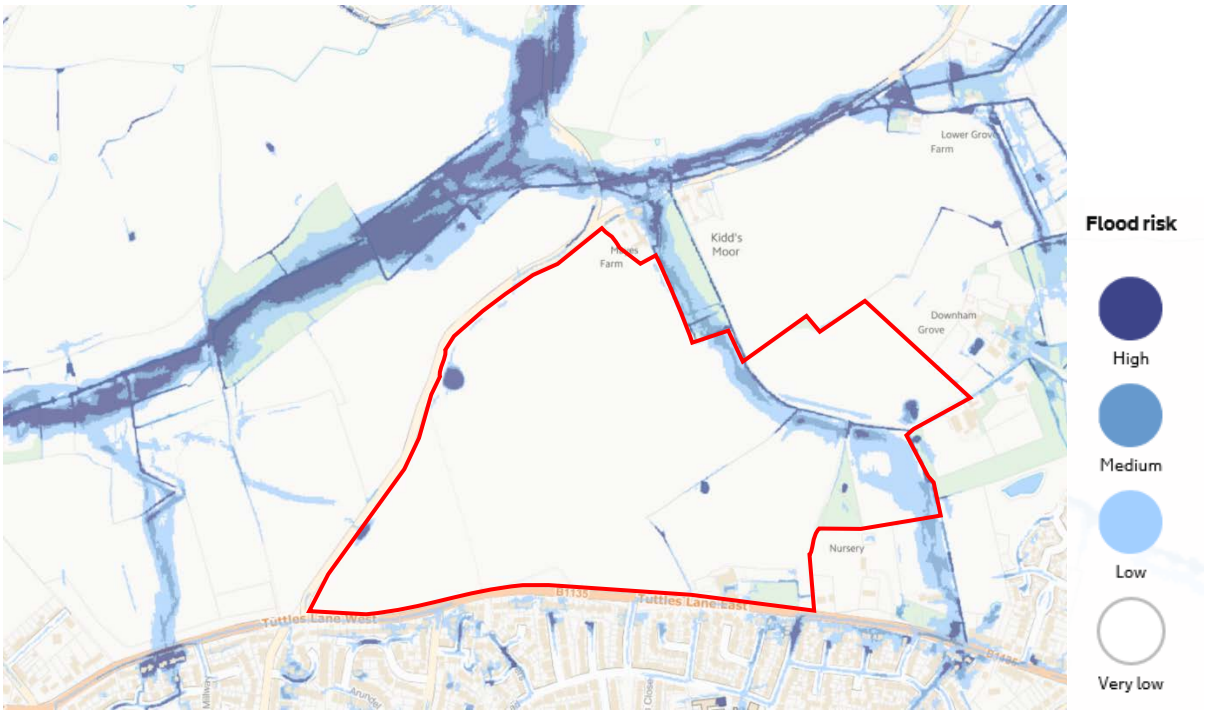
Sources of Flooding

GOV.UK flood mapping shows the entire site as Flood Zone 1 (the low probability flood area). The site is not therefore considered to be exposed to flooding as the result of overtopping of a Main River or other significantly sized watercourse.

Surface water flood mapping indicates areas where surface water runoff may pool and flow during and following various rainfall events. There are four bands of surface water flooding:

- High (indicates an area with greater than a 1 in 30 chance of flooding);
- Medium (indicates between a 1 in 30 and 1 in 100 chance of flooding);
- Low (indicates between a 1 in 100 and 1 in 1,000 chance of flooding); and
- Very Low (covers all other land i.e. less than a 1 in 1,000 chance of flooding).

The mapping (refer to extract provided below) shows that the majority of the site is located in the Very Low flood risk area. There are localised areas of surface water flooding associated with the watercourse in the east of the site and also a number of isolated areas of flooding within the site.



Extract of the surface water flooding map, source GOV.UK website (Feb 2018)

The impact of surface water flooding on the proposed residential units should be readily manageable through appropriate masterplanning that makes space in the layout for water (allowing for low impact flood routes along landscaped corridors for example).

British Geological Survey (BGS) borehole records and mapping shows that the site is underlain by Boulder Clay with Chalk at depth. Groundwater flooding (flooding resulting from the emergence of a groundwater body at the surface of the site) is therefore not considered a realistic threat.

AW sewer plans (appended) show a network of surface water sewers which serve the development to the south of the site, and outfall to the watercourse which runs through the site. The land to the south of the site slopes down towards the site. Floodwater arising from any overloading of the network could potentially be directed towards Tuttles Lane. Any such flows would tend to be directed east and west along/within Tuttles Lane rather than directly onto the site. Any flows which were able to enter onto the site (via the creation of new access roads) would tend to be managed within the on-site road network (rather than affecting the proposed housing etc). Sewer flooding is not therefore considered a significant or unmanageable threat for the proposed development.

The site does not lie in a reservoir inundation zone and there are no lakes or canals in the vicinity of the site.

In light of the findings there are not considered to be any flood risk related reasons why the site could not be developed in line with current guidance on flood risk and development.

Surface Water Management

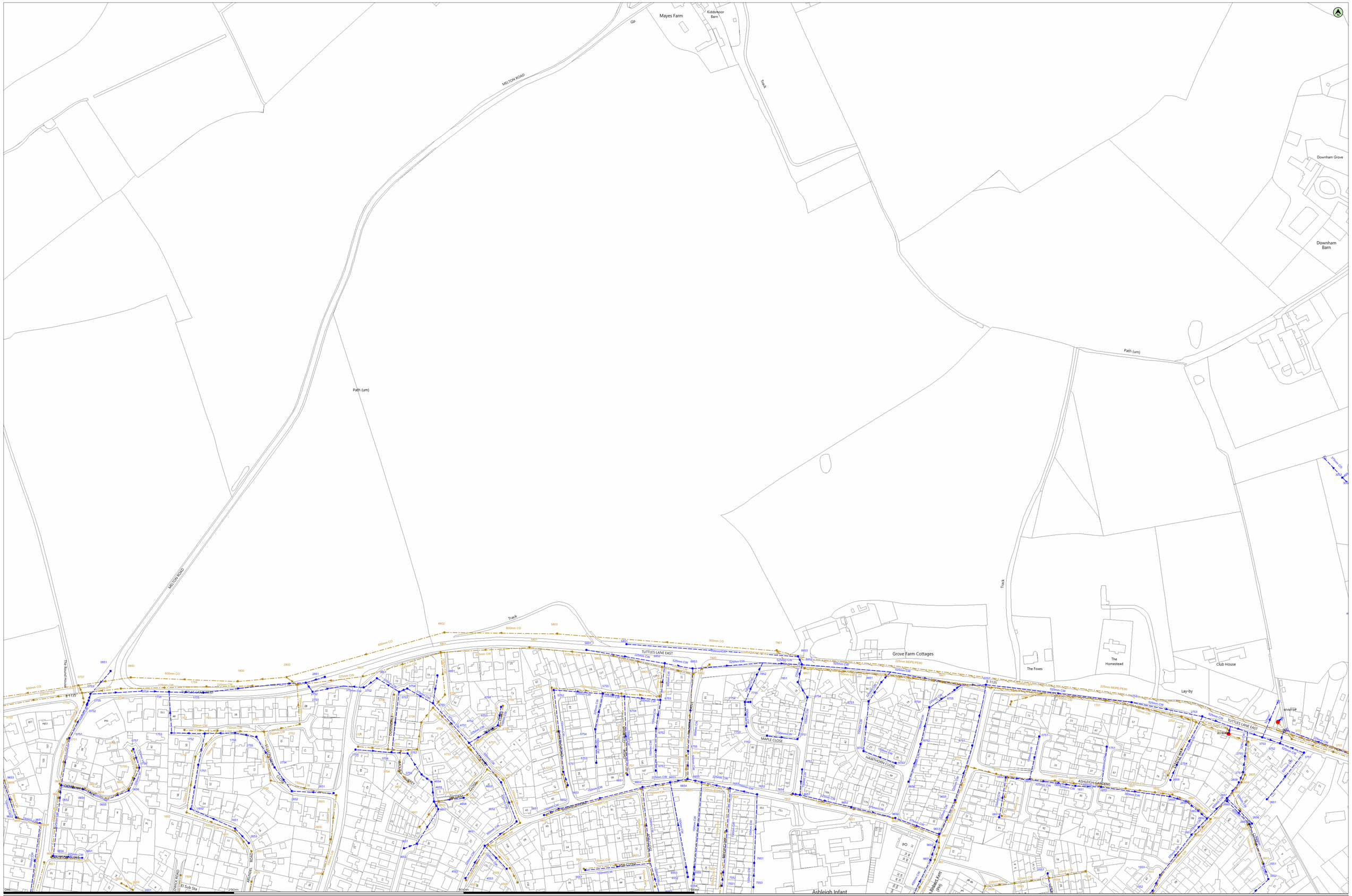
BGS mapping shows that the site is underlain by superficial deposits of the Lowestoft Formation (Diamicton) and bedrock geology of the Lewes Nodular Chalk Formation. The BGS report shows that the ground conditions across the site have a low to moderate permeability potential. Later stage intrusive ground investigations and site-specific infiltration testing may identify areas of the site where infiltration drainage techniques can be used.

However, for the purposes of securing sufficient space for surface water in the emerging layout an attenuated discharge from the site to the local watercourse has been assumed. Surface water runoff from the proposed development would be managed via on-site attenuation (sized for the 1 in 100 annual probability storm plus an appropriate climate change allowance). Currently it is proposed that flows would be discharged at the mean annual greenfield runoff rate (Q_{BAR}) of 3.2 l/s/ha.

Drawing number W121 – 300 (appended) shows an outline attenuation strategy assuming 1 m deep grassed basins with 1 in 4 side slopes. The attenuation has been sized assuming that approximately 50 % of the site area becomes impermeable (i.e. provision roads, roofs, hard landscaping etc).

Appended Information

Anglian Water Sewer plans
BGS Infiltration SuDS GeoReport
CCE drawing number W121 - 300



(c) Crown copyright and database rights 2018 Ordnance Survey 100022432

Date: 17/01/18

Scale: 1:1250

Map Centre: 611667,303054

Data updated: 01/10/17

Our Ref: 249464 - 1

Wastewater Plan A0

This plan is provided by Anglian Water pursuant to obligations under the Water Industry Act 1991 sections 198 or 199. It must be used in conjunction with any search results attached. The information on this plan is based on data currently recorded but position must be regarded as approximate. Service pipes, private sewers and drains are generally not shown. Users of this map are strongly advised to commission their own survey of the area shown on the plan before carrying out any works. The actual position of all apparatus MUST be established by trial holes. No liability whatsoever, including liability for negligence, is accepted by Anglian Water in respect of any claims arising out of the provision of this plan or the information on it. Service pipes, any lateral drain, discharge pipe, sewer or disposal main or any item of apparatus. This information is valid for the date printed. This plan is produced by Anglian Water Services Limited (c) Crown copyright and database rights 2018 Ordnance Survey 100022432.This map is to be used for the purposes of viewing the location of Anglian Water plant only. Any other uses of the map data or further copies is not permitted. This notice is not intended to exclude or restrict liability for death or personal injury resulting from negligence.

Foul Sewer	Outfall*	Sewage Treatment Works	
Surface Sewer			
Combined Sewer			
Final Effluent	Inlet*	Public Pumping Station	
Rising Main*			
Private Sewer*	Manhole*	Decommissioned Pumping Station	
Decommissioned Sewer*			

*(Colour denotes effluent type)

jenni.askew@cannonce.co.uk

Wymondham

love every drop
anglianwater

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert
0502	611065	302581	F	-	-	-
0503	611077	302574	F	-	-	-
0504	612072	302587	F	44.69	42.87	1.82
0505	612035	302581	F	45.37	43.98	1.39
0506	612003	302578	F	45.8	44.31	1.49
0601	611020	302607	F	45.81	43.85	1.96
0601	612027	302697	F	43.98	41.97	2.01
0602	610998	302689	F	46.26	42.87	3.39
0602	612079	302693	F	43.83	41.87	1.96
0603	611025	302684	F	45.58	43.14	2.44
0603	612099	302690	F	43.48	41.57	1.91
0604	611048	302673	F	45.27	43.38	1.89
0604	612021	302654	F	-	-	-
0605	611072	302684	F	45.41	43.55	1.86
0701	611006	302738	F	45.15	42.42	2.73
0701	612015	302700	F	44.41	42.45	1.96
0702	611024	302778	F	44.47	42.09	2.38
0702	612064	302787	F	44.25	42.04	2.21
0703	611022	302788	F	44.84	42.33	2.51
0703	612031	302779	F	-	-	-
0704	611064	302793	F	44.67	42.44	2.23
0705	611081	302707	F	45.59	43.79	1.8
0706	611076	302725	F	45.8	44.14	1.66
0707	611018	302796	F	-	-	-
0800	611075	302805	F	-	-	-
1502	612185	302571	F	43.93	41.66	2.27
1503	612195	302590	F	43.88	41.55	2.33
1504	612112	302594	F	44.53	43.35	1.18
1504	611129	302590	F	-	-	-
1601	611188	302638	F	46.72	45.2	1.52
1601	612156	302684	F	43.59	41.38	2.21
1602	611135	302658	F	46.49	44.85	1.64
1602	612188	302680	F	43.68	41.27	2.41
1603	612201	302699	F	43.59	41.85	1.74
1701	612134	302780	F	43.57	41.51	2.06
1701	611145	302719	F	46.58	44.45	2.13
1702	611133	302748	F	46.57	44.76	1.81
1703	611169	302747	F	46.43	44.23	2.2
1704	611157	302795	F	45.84	42.83	3.01
1800	611191	302801	F	-	-	-
2504	611283	302591	F	48.36	46.25	2.11
2505	611206	302583	F	-	-	-
2601	612232	302635	F	43.88	41.43	2.45
2601	611206	302616	F	46.94	45.74	1.2
2602	611227	302693	F	47.33	44.28	3.05
2602	612248	302651	F	43.46	41.1	2.36
2603	611298	302677	F	47.95	44.9	3.05
2603	612271	302680	F	43.33	40.97	2.36
2604	611292	302629	F	48.13	45.69	2.44
2604	612281	302691	F	42.93	-	-
2605	612285	302699	F	42.93	40.72	2.21
2606	612206	302678	F	43.6	41.19	2.41
2607	612224	302670	F	43.5	-	2.41
2608	612288	302645	F	43.37	41.74	1.63
2701	612232	302756	F	42.92	-	-
2701	611220	302746	F	46.46	43.85	2.61
2702	612216	302763	F	43.1	40.94	2.16
2702	611258	302754	F	46.5	43.53	2.97
2703	611255	302797	F	47.25	43.22	4.03
2703	612289	302735	F	-	-	-
2800	611244	302805	F	-	-	-
3601	611389	302643	F	48.1	45.64	2.46
3601	612304	302604	F	43.64	42.38	1.26
3602	611376	302691	F	47.29	45.71	1.58
3701	611322	302730	F	47.12	45.65	1.47
3701	612381	302724	F	43.13	40.64	2.49
3702	611354	302727	F	47.09	45.23	1.86
3702	612336	302738	F	42.81	40.3	2.51
3703	611368	302725	F	47.21	45.06	2.15
3704	611366	302703	F	47.36	45.36	2
3706	611361	302786	F	-	-	-
3707	611386	302727	F	47.2	44.9	2.3
3708	611390	302756	F	47.24	44.7	2.54
3801	611327	302806	F	47.07	43.46	3.61
4503	611439	302585	F	48.71	46.9	1.81
4504	611495	302582	F	48.46	47.06	1.4
4505	611487	302598	F	48.3	46.76	1.54
4601	611463	302623	F	48.19	46.17	2.02
4602	611498	302647	F	47.95	45.46	2.49
4603	611409	302670	F	47.35	45.36	1.99
4604	611440	302677	F	47.61	45.14	2.47
4605	611479	302694	F	47.57	45.11	2.46
4701	611462	302705	F	47.39	44.83	2.56
4702	611444	302726	F	47.35	44.75	2.6
4703	611442	302729	F	47.3	44.78	2.52
4704	611422	302754	F	47.41	44.6	2.81
4705	611403	302772	F	47.12	44.4	2.72
4706	611416	302786	F	47.23	44.16	3.07
4707	611461	302743	F	47.63	45.18	2.45
4708	611476	302752	F	47.67	45.32	2.35
4709	611479	302774	F	47.72	45.61	2.11
4801	611411	302832	F	47.38	43.87	3.51
4802	611416	302854	F	-	-	-
5601	611567	302597	F	48.63	47.22	1.41
5602	611526	302655	F	48.08	47.02	1.06
5603	611540	302661	F	48.14	46.58	1.56
5604	611548	302686	F	48.06	46.8	1.26
5701	611544	302700	F	48	46.64	1.36
5702	611532	302794	F	47.23	45.67	1.56
5801	611508	302838	F	47.59	44.13	3.46
5802	611599	302829	F	47.69	44.48	3.21
5803	611538	302853	F	-	-	-
6501	611644	302578	F	48.52	46.08	2.44
6601	611638	302605	F	48.67	-	-
6602	611629	302684	F	48.3	45.59	2.71
6603	611678	302693	F	48.08	45.32	2.76
6701	611613	302701	F	48.22	46.51	1.71
6702	611608	302787	F	47.53	45.27	2.26
6703	611649	302785	F	47.36	44.95	2.41
6704	611678	302720	F	47.84	45.18	2.66
6801	611652	302816	F	47.17	44.71	2.46
6802	611686	302809	F	47.09	44.83	2.26
7502	611717	302592	F	48.3	46.79	1.51
7601	611724	302683	F	47.91	45.65	2.26
7602	611793	302678	F	47.31	45.2	2.11
7800	611704	302819	F	-	45.7	-
7801	611776	302834	F	-	-	-
8601	611860	302662	F	46.53	44.42	2.11
8801	611807	302815	F	46.41	44.75	1.66
8802	611894	302808	F	45.69	43.98	1.71
9601	610981	302604	F	47.18	45.84	1.34
9601	611948	302607	F	45.92	44.34	1.58
9602	610988	302610	F	46.74	43.46	3.28
9602	611953	302620	F	45.93	44.24	1.69
9603	610996	302674	F	45.43	42.99	2.44
9603	611953	302632	F	45.89	-	-
9604	610977	302645	F	46.86	44.52	2.34
9604	611903	302652	F	46.13	44.62	1.51
9605	610952	302652	F	45.63	43.85	1.78
9605	611971	302669	F	45.42	44.06	1.36
9606	610938	302693	F	44.6	42.67	1.93
9701	611984	302708	F	43.83	42.88	0.95
9703	610969	302780	F	43.71	40.95	2.76
9801	611957	302800	F	44.86	42.75	2.11
0557	612071	302592	S	44.65	43.44	1.21
0651	611022	302609	S	45.83	44.52	1.31
0651	612018	302653	S	44.51	43.35	1.16
0652	610998	302674	S	45.38	43.7	1.68
0652	612025	302696	S	44.36	42.75	1.61
0653	610999	302688	S	46.26	43.62	2.64
0653	612051	302694	S	44.08	42.37	1.71
0654	611023	302683	S	45.58	43.76	1.82
0654	612083	302690	S	43.98	42.32	1.66
0655	611047	302672	S	45.38	44.06	1.32
0656	611073	302682	S	45.4	44.24	1.16
0751	611008	302739	S	45.1	43.25	1.85
0751	612062	302741	S	43.84	42.83	1.01
0752	611027	302775	S	44.45	42.77	1.68
0752	612004	302797	S	44.74	42.88	1.86
0753	611031	302787	S	-	-	-
0754	611087	302790	S	-	-	-
0755	611029	302780	S	-	-	-
0756	611084	302707	S	45.45	44.44	1.01
0757	611078	302727	S	45.85	44.59	1.26
0851	611053	302812	S	-	-	-
1552	612185	302573	S	43.95	41.84	2.11
1553	612193	302590	S	43.9	41.84	2.06
1651	611188	302641	S	-	-	-
1651	612101	302687	S	43.83	42.12	1.71
1652	611140	302662	S	-	-	-
1652	612129	302686	S	43.71	42	1.71
1751	611148	302710	S	-	-	-
1751	612135	302730	S	43.35	42.49	0.86
1752	611155	302744	S	-	-	-
1752	612162	302778	S	43.39	42.13	1.26
1753	611119	302745	S	-	-	-
1754	611116	302789	S	-	-	-
1755	611154	302789	S	-	-	-
1756	611188	302745	S	-	-	-
2651	611295	302679	S	-	-	-
2651	612227	302634	S	43.47	41.41	2.06
2652	611250	302681	S	-	-	-
2652	612244	302652	S	43.3	41.29	2.01
2653	612234	302660	S	43.54	41.38	2.16
2653	611203	302625	S	-	-	-
2654	612221	302670	S	43.6	41.51	2.09
2655	612204	302676	S	43.69	41.68	2.01
2656	612293	302646	S	43.42	42.05	1.37
2657	612266	302674	S	43.21	41.21	2
2658	612279	302691	S	43.01	41.15	1.86
2659	612204	302693	S	43.57	42.36	1.21
2660	612266	302670	S	43.225	41.265	1.96
2661	612290	302646	S	43.405	41.325	2.08
2751	612283	302702	S	42.95	41.09	1.86
2752	611265	302799	S	-	-	-
2753	611272	302789	S	-	-	-
2753	612239	302763	S	-	-	-
2754	611231	302707	S	-	-	-
2754	612211	302710	S	43.43	41.67	1.76
2755	611211	302740	S	-	-	-
2755	612285	302719	S	42.81	-	1.66
2851	611286	302806	S	-	-	-
3051	612391	303022	S	-	-	-
3551	612305	302603	S	43.685	41.445	2.24
3552	612311	302586	S	43.795	41.575	2.22
3651	611386	302624	S	48	47.11	0.89
3651	612309	302673	S	-	-	-
3652	611372	302619	S	48.03	47.24	0.79
3751	612349	302723	S	-	-	-
3752	611328	302794	S	47.26	45.4	1.86
3752	612323	302733	S	-	-	-
3753	611366	302790	S	46.9	45.65	1.25
3753	612304	302740	S	-	-	-
3754	611375	302793	S	47.01	45.72	1.29
3755	611319	302727	S	47.14	46.18	0.96
3756	611358	302724	S	47.1	45.78	1.32
3757	611376	302723	S	47.31	45.92	1.39
3758	611391	302699	S	47.28	46.04	1.24
3851	611342	302804	S	47.33	45.52	1.81
4552	611438	302587	S	48.64	47.36	1.28
4553	611483	302597	S	48.3	47.29	1.01
4651	611459	302622	S	48.18	46.92	1.26
4652	611494	302648	S	47.91	46.73	1.18
4653	611477	302691	S	47.5	46.49	1.01
4654	611402	302691	S	47.2	46.1	1.1
4655	611404	302670	S	47.31	46.35	0.96
4657	611409	302662	S	47.62	46.41	1.21
4658	611437	302674	S	-	-	-
4751	611442	302734	S	47.5	46.09	1.41
4752	611461	302745	S	47.6	46.39	1.21
4753	611473	302753	S	47.68	46.67	1.01
4754	611477	302773	S	47.8	46.63	1.17
4755	611403	302777	S	47.5	45.87	1.63
4851	611408	302807	S	47.24	46.07	1.17
5557	611569	302596	S	48.62	47.51	1.11
5651	611524	302655	S	48.06	47.15	0.91
5652	611540	302662	S	48.16	46.95	1.21
5653	611550	302688	S	48.06	-	-
5751	611545	302702	S	47.98	46.87	1.11
5752	611534	302791	S	47.26	46.05	1.21
5753	611581	302712	S	48.2	46.89	1.31
5754	611579	302749	S	48.05	46.34	1.71
5755	611587	302787	S	47.66	45.85	1.81
5851	611570	302835	S	-	-	-
6552	611680	302588	S	47.78	46.32	1.46
6553	611678	302599	S	47.71	46.1	1.61
6554	611686	302585	S	48.84	47.48	1.36
6555	611687	302599	S	48.75	47.19	1.56
6651	611614	302699	S	48.2	46.74	1.46
6652	611631	302686	S	48.3	46.29	2.01
6653	611661	302691	S	48.13	46.02	2.11
6654	611680	302695	S	48.03	45.82	2.21
6655	611695	302691	S	48.04	-	-
6751	611645	302704	S	48.52	46.91	1.61
6752	611645	302749	S	48.01	46.35	1.66
6753	611650	302780	S	47.36	45.7	1.66
6754	611611	302784	S	47.52	45.76	1.76
6755	611680	302725	S	47.79	45.73	2.06
6851	611613	302841	S	-	-	-
6852	611655	302820	S	-	-	-
6853	611685	302815	S	-	-	-
7551	611717	302579	S	48.37	47.26	1.11
7552	611718	302593	S	48.28	47.07	1.21
7553	611751	302577	S	48.15	47.14	1.01
7651	611752	302603	S	48.03	46.87	1.16
7652	611755	302678	S	47.8	46.24	1.56
7653	611726	302685	S	47.91	46	1.91
7654	611794	302679	S	47.3	45.39	1.91
7751	611799	302738	S	46.89	45.78	1.11
7752	611766	302742	S	47.14	46.23	0.91
7753	611743	302752	S	46.97	45.96	1.01
7754	611742	302778	S	46.71	45.9	0.81
7755	611748	302778	S	46.65	45.69	0.96
7851	611799	302800	S	-	-	-
7852	611755	302808	S	-	-	-
8651	611802	302677	S	47.21	45.35	1.86
8652	611858	302664	S	46.6	45.04	1.56
8751	611804	302705	S	47.08	45.77	1.31
8752	611871	302725	S	45.96	44.59	1.37
8753	611876	302779	S	45.81	44.2	1.61
8754	611810	302783	S	46.54	45.33	1.21
8851	611890	302800	S	-	-	-
8852	611804	302819	S	-	-	-
8853	611800	302828	S	-	-	-
9651	610976	302646	S	46.77	44.76	2.01
9651	611944	302606	S	46.04	43.97	2.07
9652	610950	302653	S	45.63	44.03	1.6
9652	611948	302620	S	45.92	43.91	2.01
9653	611953	302635	S	45.61	43.75	1.86
9654	610990	302611	S	46.61	44.38	2.23
9654	611905	302652	S	46.08	44.77	1.31
9655	611970	302672	S	45.26	43.5	1.76
9656	611920	302692	S	45.8	44.49	1.31
9751	611989	302731	S	-	-	-
9752	611933	302732	S	45.44	44.23	1.21
9753	611906	302712	S	45.75	44.92	0.83
9754	611942	302773	S	45.08	43.72	1.36
9755	611970	302791	S	44.66	43.55	1.11

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

GeoReports

James Howard
34
CB7 5NQ

Infiltration SuDS GeoReport:

This report provides information on the suitability of the subsurface for the installation of infiltration sustainable drainage systems (SuDS). It provides information on the properties of the subsurface with respect to significant constraints, drainage, ground stability and groundwater quality protection.

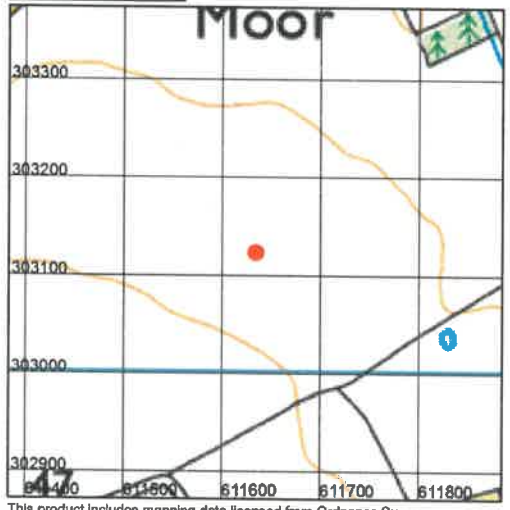
Report Id: *GR_217855/1*

Client reference:

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

GeoReports

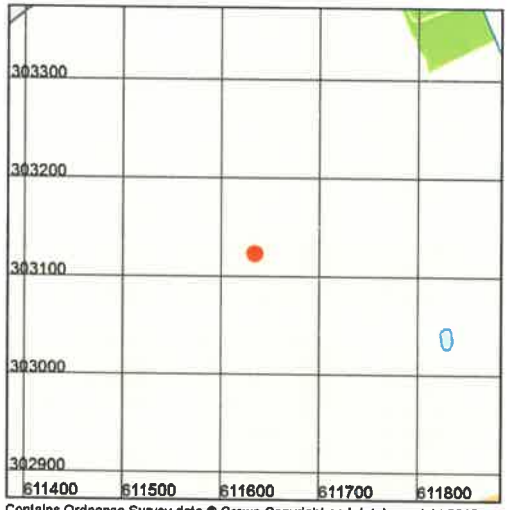
Search location



Point centred at:
611634,303123

Search location indicated in red

Scale: 1:5 000 (1cm = 50 m)



OS Street View: Scale: 1:5 000 (1cm = 50 m)

Date: 23 February 2018

Assessment for an infiltration sustainable drainage system

Introduction

Sustainable drainage systems (SuDS) are drainage solutions that manage the volume and quality of surface water close to where it falls as rain. They aim to reduce flow rates to rivers, increase local water storage capacity and reduce the transport of pollutants to the water environment. There are four main types of SuDS, which are often designed to be used in sequence. They comprise:

- **source control:** systems that control the rate of runoff
- **pre-treatment:** systems that remove sediments and pollutants
- **retention:** systems that delay the discharge of water by providing surface storage
- **infiltration:** systems that mimic natural recharge to the ground.

This report focuses on infiltration SuDS. It provides subsurface information on the properties of the ground with respect to drainage, ground stability and groundwater quality protection. It is intended principally for those involved in the preliminary assessment of the suitability of the ground for infiltration SuDS, and those involved in assessing proposals from others for sustainable drainage, but it may also be useful to help house-holders judge whether or not further professional advice should be sought. If in doubt, users should consult a suitably-qualified professional about the results in this report before making any decisions based upon it.

This GeoReport is structured in two parts:

- **Part 1. Summary data.**

  Comprises three maps that summarise the data contained within Part 2.

- **Part 2. Detailed data.**

  Comprises a further 24 maps in four thematic sections:

  - **Very significant constraints.** Maps highlight areas where infiltration may result in adverse impacts due to factors including: ground instability (soluble rocks, non-coal shallow mining and landslide hazards); persistent shallow groundwater, or the presence of made ground, which may represent a ground stability or contamination hazard.
  - **Drainage potential.** Maps indicate the drainage potential of the ground, by considering subsurface permeability, depth to groundwater and the presence of floodplain deposits.
  - **Ground stability.** Maps indicate the presence of hazards that have the potential to cause ground instability resulting in damage to some buildings and structures, if water is infiltrated to the ground.
  - **Groundwater protection.** Maps provide key indicators to help determine whether the groundwater may be susceptible to deterioration in quality as a result of infiltration.

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL
GeoReports

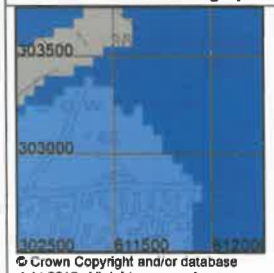
This report considers the suitability of the subsurface for the installation of infiltration SuDS, such as soakaways, infiltration basins or permeable pavements. It provides subsurface data to indicate whether, and which type of infiltration system may be appropriate. It does not state that infiltration SuDS are, or are not, appropriate as this is highly dependent on the design of the individual system. This report therefore describes the subsurface conditions at the site, allowing the reader to determine the suitability of the site for infiltration SuDS.

The map and text data in this report is similar to that provided in the '*Infiltration SuDS Map: Detailed*' national map product. For further information about the data, consult the '*User Guide for the Infiltration SuDS Map: Detailed*', available from http://nora.nerc.ac.uk/16618/.

PART 1: SUMMARY DATA

This section provides a summary of the data on the following pages.

In terms of the drainage potential, is the ground suitable for infiltration SuDS?



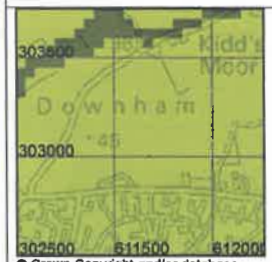
Highly compatible for infiltration SuDS.
The subsurface is likely to be suitable for free-draining infiltration SuDS.

Probably compatible for infiltration SuDS.
The subsurface is probably suitable although the design may be influenced by the ground conditions.

Opportunities for bespoke infiltration SuDS.
The subsurface is potentially suitable although the design will be influenced by the ground conditions.

Very significant constraints are indicated.
There is a very significant potential for one or more hazards associated with infiltration.

Is ground instability likely to be a problem?



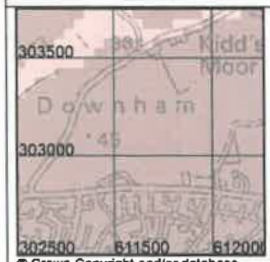
Increased infiltration is very unlikely to result in ground instability.

Ground instability problems may be present or anticipated, but increased infiltration is unlikely to result in ground instability

Ground instability problems are probably present. Increased infiltration may result in ground instability.

There is a very significant potential for one or more geohazards associated with infiltration.

Is the groundwater susceptible to deterioration in quality?



The groundwater is not expected to be especially vulnerable to contamination.

The groundwater may be vulnerable to contamination.

The groundwater is likely to be vulnerable to contaminants.

Made ground is present at the surface. Infiltration may increase the possibility of remobilising pollutants.

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL
GeoReports

PART 2: DETAILED DATA

This section provides further information about the properties of the ground and will help assess the suitability of the ground for infiltration SuDS.

Section 1. Very significant constraints

Where maps are overlain by grey polygons, geological or hydrogeological hazards may exist that could be made worse by infiltration. The following hazards are considered:

- soluble rocks
- landslides
- shallow mining
- shallow groundwater
- made ground

For more information read 'Explanation of terms' at the end of this report.

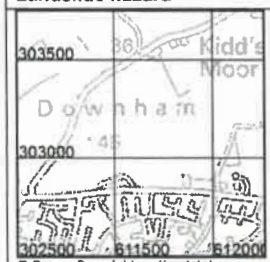
Soluble rock hazard

Very significant soluble rock hazard.

Soluble rocks are present with a very significant possibility of localised subsidence that could be initiated or made worse by infiltration. The site investigation should consider whether the potential for or the consequences of subsidence as a result of infiltration are significant.

Very significant soluble rock hazards are not present; however this hazard may still need to be considered. See Part 3.

Landslide hazard

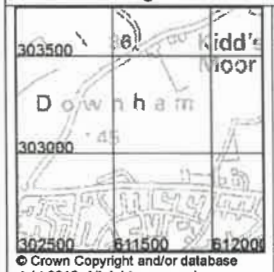


Very significant landslide hazard.

Slope instability problems are almost certainly present and may be active. An increase in moisture content as a result of infiltration may cause the slope to fail. The site investigation should consider whether the potential for or the consequences of landslide as a result of infiltration are significant.

Very significant landslide hazards are not present; however this hazard may still need to be considered. See Part 3.

Shallow mining hazard

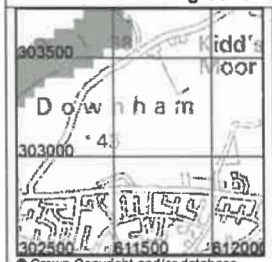


■ Very significant mining hazard.

Shallow mining is likely to be present with a very significant possibility of localised subsidence that could be initiated or made worse by increased infiltration. Also, infiltration may increase the possibility of remobilising pollutants. The site investigation should consider whether the potential for or consequences of subsidence and/or remobilisation of pollutants as a result of infiltration are significant.

☐ Very significant mining hazards are not present; however this hazard may still need to be considered. See Part 3.

Persistent shallow groundwater



■ Very high likelihood of persistent or seasonally shallow groundwater.

Persistent or seasonally shallow groundwater is likely to be present. Infiltration may increase the likelihood of soakaway inundation, or groundwater emergence at the surface. The site investigation should consider whether the potential for or the consequences of groundwater level rise as a result of infiltration are significant.

☐ See Part 2 for the likely depth to water table.

Made ground

■ Made ground present.

Made ground is present at the surface. Infiltration may affect ground stability or increase the possibility of remobilising pollutants. The site investigation should consider whether the potential for or consequences of ground instability and/or pollutant leaching as a result of infiltration are significant.

☐ None recorded

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL
GeoReports

Section 2. Drainage potential

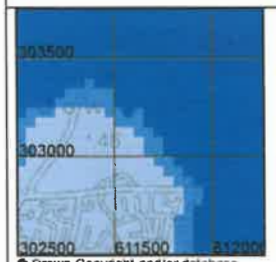
The following pages contain maps that will help you assess the drainage potential of the ground by considering the:

- depth to water table
- permeability of the superficial deposits
- thickness of the superficial deposits
- permeability of the bedrock
- presence of floodplains

Superficial deposits are not present everywhere and therefore some areas of the *superficial deposit permeability* map may not be coloured. Where this is the case, the *bedrock permeability* map shows the likely permeability of the ground. Superficial deposits in some places are very thin and hence in these places you may wish to consider both the permeability of the superficial deposits and the permeability of the bedrock. The *superficial thickness* map will tell you whether the superficial deposits are thin (< 3 m thick) or thick (>3 m). Where they are over 3 m thick, the permeability of the bedrock may not be relevant.

For more information read 'Explanation of terms' at the end of this report.

Depth to groundwater table

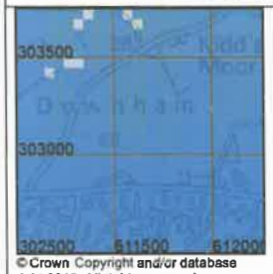


■ Groundwater is likely to be **more than 5 m** below the ground surface throughout the year.

■ Groundwater is likely to be between **3 and 5 m** below the ground surface for at least part of the year.

■ Groundwater is likely to be **less than 3 m** below the ground surface for at least part of the year.

Superficial deposit permeability



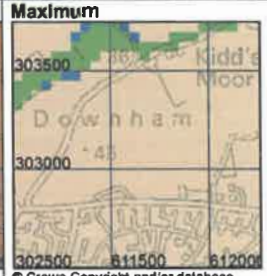
- Superficial deposits are likely to be **free-draining**.
- The superficial deposit permeability is **spatially variable**, but likely to permit moderate infiltration.
- Superficial deposits are likely to be **poorly draining**.

These maps show the permeability range that is summarised above.

- Very Low
- Low
- Moderate
- High
- Very High

Minimum

Maximum

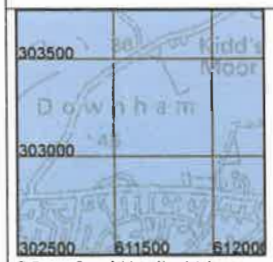


Superficial deposit thickness

- The thickness of superficial deposits is **< 3 m** and hence the permeability of the ground may be dependent on both the superficial deposits (where present) and underlying bedrock (see below).
- The thickness of superficial deposits is **> 3 m** and hence the permeability of the superficial deposits is likely to determine the permeability of the ground.

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL
GeoReports

Bedrock permeability



- Bedrock deposits are likely to be **free-draining**.
- The bedrock permeability is **spatially variable**, but likely to permit moderate infiltration.
- Bedrock deposits are likely to be **poorly draining**.

These maps show the permeability range that is summarised above.

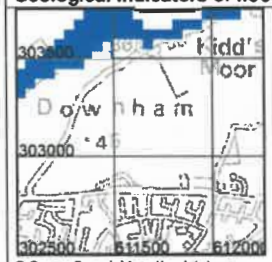
Key

- Very Low
- Low
- Moderate
- High
- Very High

Minimum

Maximum

Geological indicators of flooding



- Superficial floodplain deposits or low-lying coastal areas have been identified. Groundwater levels may rise in response to high river or tide levels, potentially causing inundation of subsurface infiltration SuDS.

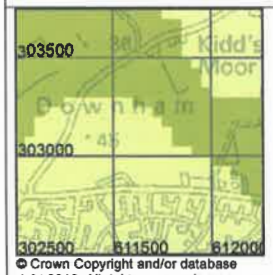
Section 3. Ground stability

The following pages contain maps that will help you assess whether infiltration may impact the stability of the ground. They consider hazards associated with:

- soluble rocks
- landslides
- shallow mining
- running sands
- swelling clays
- compressible ground, and
- collapsible ground

In the following maps, geohazards that are identified in green are unlikely to prevent infiltration SuDS from being installed, but they should be considered during design.
For more information read 'Explanation of terms' at the end of this report.

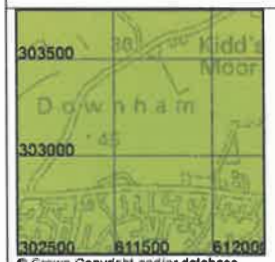
Soluble rocks



- Increased infiltration is unlikely to result in subsidence.
- Increased infiltration is unlikely to cause localised subsidence, but potential impacts should be considered.
- Increased infiltration may result in localised subsidence. The potential for or the consequences of subsidence associated with soluble rocks should be considered.
- Very significant possibility of localised subsidence that could be initiated or made worse by infiltration.

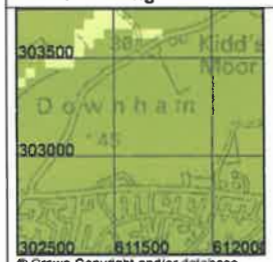
British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL
GeoReports

Landslides



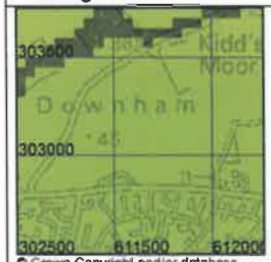
- Increased infiltration is unlikely to lead to slope instability.
- Slope instability problems may be present or anticipated, but increased infiltration is unlikely to cause instability
- Slope instability problems are probably present or have occurred in the past, and increased infiltration may result in slope instability.
- Slope instability problems are almost certainly present and may be active. An increase in moisture content as a result of infiltration may cause the slope to fail.

Shallow mining



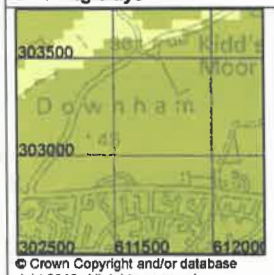
- Increased infiltration is unlikely to lead to subsidence.
- Shallow mining is possibly present. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
- Shallow mining could be present with a significant possibility that localised subsidence could be initiated or made worse by increased infiltration.
- Shallow mining is likely to be present, with a very significant possibility that localised subsidence may be initiated or made worse by increased infiltration.

Running sand



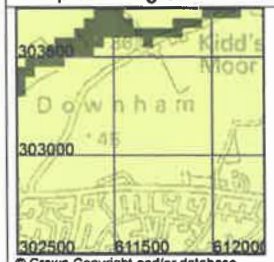
- Increased infiltration is unlikely to cause ground collapse associated with running sands.
- Running sand is possibly present. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
- Significant possibility for running sand problems. Increased infiltration may result in a geohazard.

Swelling clays



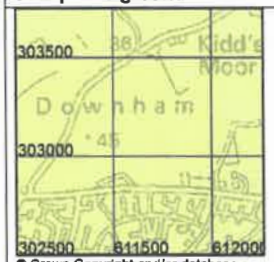
- Increased infiltration is unlikely to cause shrink-swell ground movement.
- Ground is susceptible to shrink-swell ground movement. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
- Ground is susceptible to shrink-swell ground movement. Increased infiltration may result in a geohazard.

Compressible ground



- Increased infiltration is unlikely to lead to ground compression.
- Compressibility and uneven settlement hazards are probably present. Increased infiltration may result in a geohazard.

Collapsible ground



- Increased infiltration is unlikely to result in subsidence.
- Deposits with potential to collapse when loaded and saturated are possibly present in places. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
- Deposits with potential to collapse when loaded and saturated are probably present in places. Increased infiltration may result in a geohazard.

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL
GeoReports

Section 4. Groundwater quality protection

The following pages contain maps showing some of the information required to ensure the protection of groundwater quality. Data presented includes:

- groundwater source protection zones (Environment Agency data)
- predominant flow mechanism
- made ground

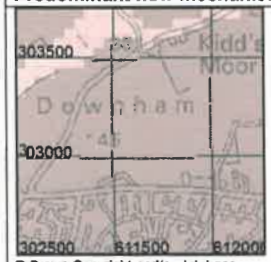
For more information read 'Explanation of terms' at the end of this report.

Groundwater source protection zones

Derived in part from Source Protection Zone data provided under licence from the Environment Agency © Environment Agency 2018.

- Groundwater is not within a source protection zone.
- Source protection zone IV
- Source protection zone III
- Source protection zone II
- Source protection zone I.

Predominant flow mechanism



- Water is likely to percolate through the unsaturated zone to the groundwater through either the pore space in granular media or through porespace and fractures; these processes have some potential for contaminant removal and breakdown.
- Water is likely to percolate through the unsaturated zone to the groundwater through fractures, a process which has little potential for contaminant removal and breakdown.

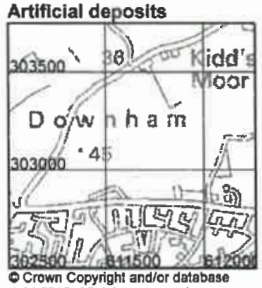
Made ground	
	Made ground is present at the surface. Infiltration may increase the possibility of remobilising pollutants.

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL
GeoReports

Section 5. Geological Maps

The following maps show the artificial, superficial and bedrock geology within the area of interest.

Artificial deposits



Superficial deposits

Bedrock

Fault

Coal, ironstone or mineral vein

Note: Faults and Coals, ironstone & mineral veins are shown for illustration and to aid interpretation of the map. Not all such features are shown and their absence on the map face does not necessarily mean that none are present

Key to Artificial deposits:
No deposits recorded by BGS in the search area

Key to Superficial deposits:

Map colour	Computer Code	Rock name	Rock type
	ALV-XCZSV	ALLUVIUM	CLAY, SILT, SAND AND GRAVEL
	LOFT-DMTN	LOWESTOFT FORMATION	DIAMICTON
	RTD1-XSV	RIVER TERRACE DEPOSITS, 1	SAND AND GRAVEL

Key to Bedrock geology:

Map colour	Computer Code	Rock name	Rock type
	LPCK-CHLK	LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMATION, NEWHAVEN CHALK FORMATION, CULVER CHALK FORMATION AND PORTSDOWN CHALK FORMATION (UNDIFFERENTIATED)	CHALK

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL
GeoReports

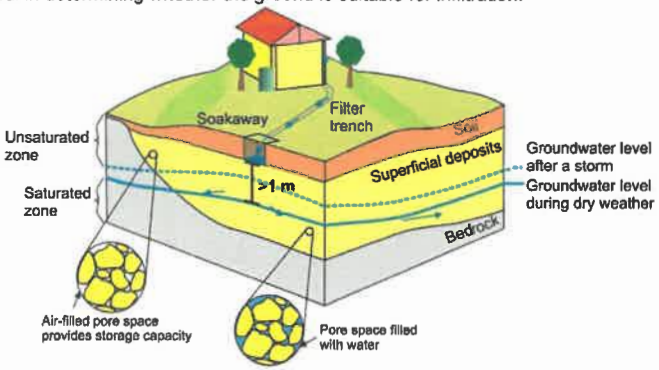
Limitations of this report:

- This report is concerned with the potential for infiltration-to-the-ground to be used as a SuDS technique at the site described. It only considers the subsurface beneath the search area and does NOT consider potential surface or subsurface impacts outside of that area.
- This report is NOT an alternative for an on-site investigation or soakaway test, which might reach a different conclusion.
- This report must NOT be used to justify disposal of foul waste or grey water.
- This report is based on and limited to an interpretation of the records held by the British Geological Survey (BGS) at the time the search is performed. The datasets used (with the exception of that showing depth to water table) are based on 1:50 000 digital geological maps and not site-specific data.
- Other more specific and detailed ground instability information for the site may be held by BGS, and an assessment of this could result in a modified assessment.
- To interpret the maps correctly, the report must be viewed and printed in colour.
- The search does NOT consider the suitability of sites with regard to:
    - previous land use,
    - potential for, or presence of contaminated land
    - presence of perched water tables
    - shallow mining hazards relating to coal mining. Searches of coal mining should be carried out via The Coal Authority Mine Reports Service: www.coalminingreports.co.uk.
    - made ground, where not recorded
    - proximity to landfill sites (searches for landfill sites or contaminated land should be carried out through consultation with local authorities/Environment Agency)
    - zones around private water supply boreholes that are susceptible to groundwater contamination.
- This report is supplied in accordance with the GeoReports Terms & Conditions available separately, and the copyright restrictions described at the end of this report

Explanation of terms

Depth to groundwater

In the shallow subsurface, the ground is commonly unsaturated with respect to water. Air fills the spaces within the soil and the underlying superficial deposits and bedrock. At some depth below the ground surface, there is a level below which these spaces are full of water. This level is known as the groundwater level, and the water below it is termed the groundwater. When water is infiltrated, the groundwater level may rise temporarily. To ensure that there is space in the unsaturated zone to accommodate this, there should be a minimum thickness of 1 m between the base of the infiltration system and the water table. An estimate of the *depth to groundwater* is therefore useful in determining whether the ground is suitable for infiltration.



Groundwater flooding

Groundwater flooding occurs when a rise in groundwater level results in very shallow groundwater or the emergence of groundwater at the surface. If infiltration systems are installed in areas that are susceptible to groundwater flooding, it is possible that the system could become inundated. The susceptibility map seeks to identify areas where the geological conditions and water tables indicate that groundwater level rise could occur under certain circumstances. A high susceptibility to groundwater flooding classification does not mean that groundwater flooding has ever occurred in the past, or will do so in the future as the susceptibility maps do not contain information on how often flooding may occur. The susceptibility maps are designed for planning; identifying areas where groundwater flooding might be an issue that needs to be taken into account.

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL
GeoReports

Geological indicators of flooding

In floodplain deposits, groundwater level can be influenced by the water level in the adjacent river. Groundwater level may increase during periods of fluvial flood and therefore this should be taken into account when designing infiltration systems on such deposits. The *geological indicators of flooding* dataset shows where there is geological evidence (floodplain deposits) that flooding has occurred in the past.

For further information on flood-risk, the likely frequency of its recurrence in relation to any proposed development of the site, and the status of any flood prevention measures in place, you are advised to contact the local office of the Environment Agency (England and Wales) at www.environment-agency.gov.uk/ or the Scottish Environment Protection Agency (Scotland) at www.sepa.org.uk.

Artificial ground

Artificial ground comprises deposits and excavations that have been created or modified by human activity. It includes ground that is worked (quarries and road cuttings), infilled (back-filled quarries), landscaped (surface re-shaping), disturbed (near surface mineral workings) or classified as made ground (embankments and spoil heaps). The composition and properties of artificial ground are often unknown. In particular, the permeability and chemical composition of the artificial ground should be determined to ensure that the ground will drain and that any contaminants present will not be remobilised.

Superficial permeability

Superficial deposits are those geological deposits that were formed during the most recent period of geological time (as old as 2.6 million years before present). They generally comprise relatively thin deposits of gravel, sand, silt and clay and are present beneath the pedological soil in patches or larger spreads over much of Britain. The ease with which water can percolate through these deposits is controlled by their permeability and varies widely depending on their composition. Those deposits comprising clays and silts are less permeable and thus infiltration is likely to be slow, such that water may pool on the surface. In comparison, deposits comprising sands and gravels are more permeable allowing water to percolate freely.

Bedrock permeability

Bedrock forms the main mass of rock forming the Earth. It is present everywhere, commonly beneath superficial deposits. Where the superficial deposits are thin or absent, the ease with which water will percolate into the ground depends on the permeability of the bedrock.

Natural ground instability
Natural ground instability refers to the propensity for upward, lateral or downward movement of the ground that can be caused by a number of natural geological hazards (e.g. ground dissolution/compressible ground). Some movements associated with particular hazards may be gradual and of millimetre or centimetre scale, whilst others may be sudden and of metre or tens of metres scale. Significant natural ground instability has the potential to cause damage to buildings and structures, especially when the drainage characteristics of a site are altered. It should be noted, however, that many buildings, particularly more modern ones, are built to such a standard that they can remain unaffected in areas of significant ground movement.

Shrink-swell
A shrinking and swelling clay changes volume significantly according to how much water it contains. All clay deposits change volume as their water content varies, typically swelling in winter and shrinking in summer, but some do so to a greater extent than others. Contributory circumstances could include drought, leaking service pipes, tree roots drying-out the ground or changes to local drainage patterns, such as the creation of soakaways. Shrinkage may remove support from the foundations of buildings and structures, whereas clay expansion may lead to uplift (heave) or lateral stress on part or all of a structure; any such movements may cause cracking and distortion.

Landslides (slope stability)
A landslide is a relatively rapid outward and downward movement of a mass of ground on a slope, due to the force of gravity. A slope is under stress from gravity but will not move if its strength is greater than this stress. If the balance is altered so that the stress exceeds the strength, then movement will occur. The stability of a slope can be reduced by removing ground at the base of the slope, by placing material on the slope, especially at the top, or by increasing the water content of the materials forming the slope. Increase in subsurface water content beneath a soakaway could increase susceptibility to landslide hazards. The assessment of landslide hazard refers to the stability of the present land surface. It does not encompass a consideration of the stability of excavations.

Soluble rocks (dissolution)
Some rocks are soluble in water and can be progressively removed by the flow of water through the ground. This process tends to create cavities, potentially leading to the collapse of overlying materials and possibly subsidence at the surface. The release of water into the subsurface from infiltration systems may increase the dissolution of rock or destabilise material above or within a cavity. Dissolution cavities may create a pathway for rapid transport of contaminated water to an aquifer or water course.

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL
GeoReports

Compressible ground
Many ground materials contain water-filled pores (the spaces between solid particles). Ground is compressible if a building (or other load) can cause the water in the pore space to be squeezed out, causing the ground to decrease in thickness. If ground is extremely compressible the building may sink. If the ground is not uniformly compressible, different parts of the building may sink by different amounts, possibly causing tilting, cracking or distortion. The compressibility of the ground may alter as a result of changes in subsurface water content caused by the release of water from soakaways.

Collapsible deposits
Collapsible ground comprises certain fine-grained materials with large pore spaces (the spaces between solid particles). It can collapse when it becomes saturated by water and/or a building (or other structure) places too great a load on it. If the material below a building collapses it may cause the building to sink. If the collapsible ground is variable in thickness or distribution, different parts of the building may sink by different amounts, possibly causing tilting, cracking or distortion. The subsurface underlying a soakaway will experience an increase in water content that may affect the stability of the ground. This hazard is most likely to be encountered only in parts of southern England.

Running sand
Running sand conditions occur when loosely-packed sand, saturated with water, flows into an excavation, borehole or other type of void. The pressure of the water filling the spaces between the sand grains reduces the contact between the grains and they are carried along by the flow. This can lead to subsidence of the surrounding ground. Running sand is potentially hazardous during the drainage system installation. During installation, excavation of the ground may create a space into which sand can flow, potentially causing subsidence of surrounding ground.

Shallow mining hazards (non coal)
Current or past underground mining for coal or for other commodities can give rise to cavities at shallow or intermediate depths, which may cause fracturing, general settlement, or the formation of crown-holes in the ground above. Spoil from mineral workings may also present a pollution hazard. The release of water into the subsurface from soakaways may destabilise material above or within a cavity. Cavities arising as a consequence of mining may also create a pathway for rapid transport of contaminated water to an aquifer or watercourse. The mining hazards map is derived from the geological map and considers the potential for subsidence associated with mining on the basis of geology type. Therefore if mining is known to occur within a certain rock, the map will highlight the potential for a hazard within the area covered by that geology.

For more information regarding underground and opencast **coal mining**, the location of mine entries (shafts and adits) and matters relating to subsidence or other ground movement induced by **coal mining** please contact the Coal Authority, Mining Reports, 200 Lichfield Lane, Mansfield, Nottinghamshire, NG18 4RG; telephone 0845 762 6848 or at www.coal.gov.uk. For more information regarding other types of mining (i.e. non-coal), please contact the British Geological Survey.

Groundwater source protection zones

In England and Wales, the Environment Agency has defined areas around wells, boreholes and springs that are used for the abstraction of public drinking water as source protection zones. In conjunction with Groundwater Protection Policy the zones are used to restrict activities that may impact groundwater quality, thereby preventing pollution of underlying aquifers, such that drinking water quality is upheld. The Environment Agency can provide advice on the location and implications of source protection zones in your area (www.environment-agency.gov.uk/)

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL
GeoReports

Contact Details

Keyworth Office
British Geological Survey
Environmental Science Centre
Nicker Hill
Keyworth
Nottingham
NG12 5GG
Tel: 0115 9363143
Fax: 0115 9363276
Email: enquiries@bgs.ac.uk

Wallingford Office
British Geological Survey
Maclean Building
Wallingford
Oxford
OX10 8BB
Tel: 01491 838800
Fax: 01491 692345
Email: hydroenq@bgs.ac.uk

Edinburgh Office
British Geological Survey
Lyell Centre
Research Avenue South
Edinburgh
EH14 4AP
Tel: 0131 6671000
Email: enquiry@bgs.ac.uk

Terms and Conditions

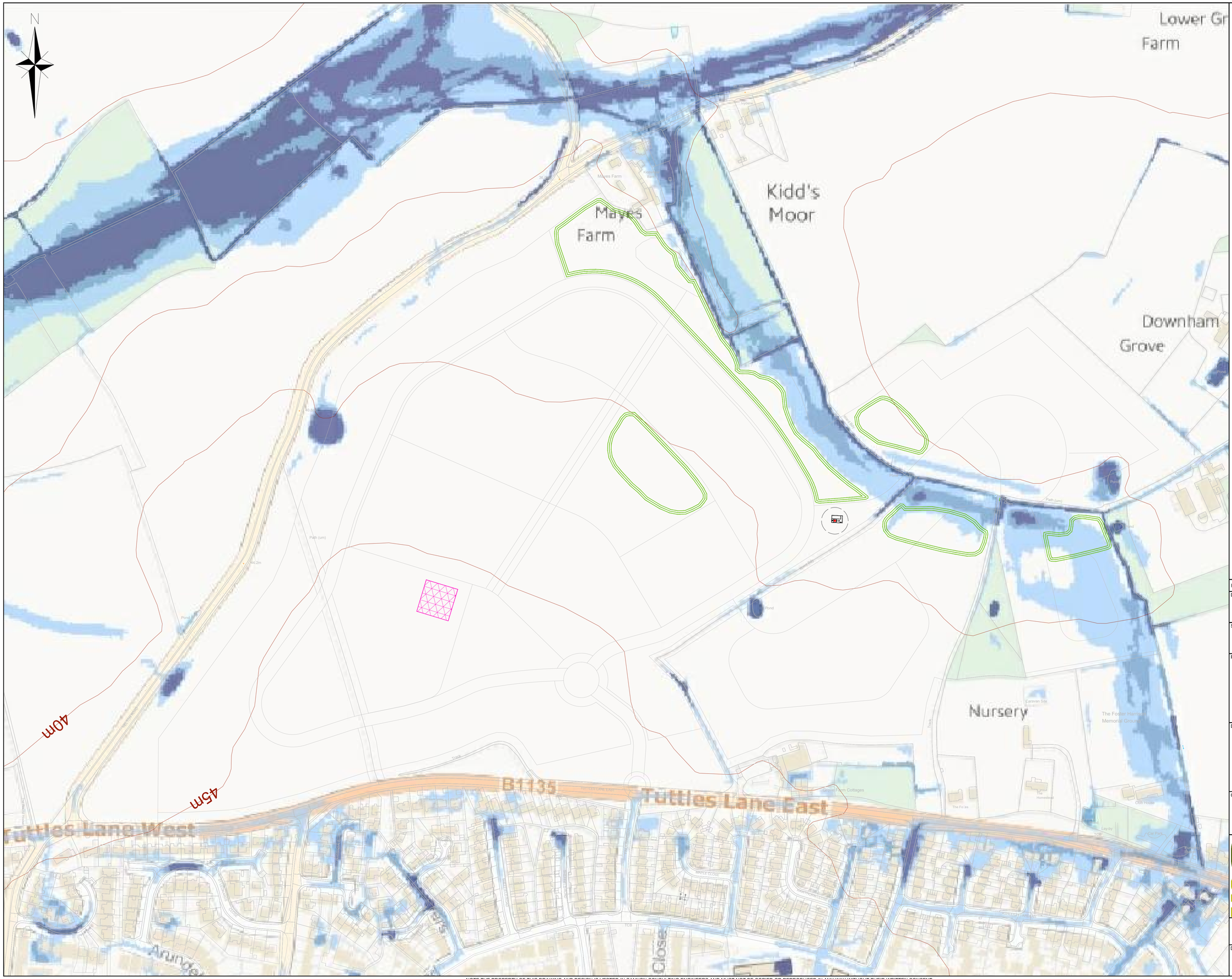
General Terms & Conditions

This Report is supplied in accordance with the GeoReports Terms & Conditions available on the BGS website at https://shop.bgs.ac.uk/georeports and also available from the BGS Central Enquiries Desk at the above address.

Important notes about this Report

- The data, information and related records supplied in this Report by BGS can only be indicative and should not be taken as a substitute for specialist interpretations, professional advice and/or detailed site investigations. You must seek professional advice before making technical interpretations on the basis of the materials provided.
- Geological observations and interpretations are made according to the prevailing understanding of the subject at the time. The quality of such observations and interpretations may be affected by the availability of new data, by subsequent advances in knowledge, improved methods of interpretation, and better access to sampling locations.
- Raw data may have been transcribed from analogue to digital format, or may have been acquired by means of automated measuring techniques. Although such processes are subjected to quality control to ensure reliability where possible, some raw data may have been processed without human intervention and may in consequence contain undetected errors.
- Detail, which is clearly defined and accurately depicted on large-scale maps, may be lost when small-scale maps are derived from them.
- Although samples and records are maintained with all reasonable care, there may be some deterioration in the long term.
- The most appropriate techniques for copying original records are used, but there may be some loss of detail and dimensional distortion when such records are copied.
- Data may be compiled from the disparate sources of information at BGS's disposal, including material donated to BGS by third parties, and may not originally have been subject to any verification or other quality control process.
- Data, information and related records, which have been donated to BGS, have been produced for a specific purpose, and that may affect the type and completeness of the data recorded and any interpretation. The nature and purpose of data collection, and the age of the resultant material may render it unsuitable for certain applications/uses. You must verify the suitability of the material for your intended usage.
- If a report or other output is produced for you on the basis of data you have provided to BGS, or your own data input into a BGS system, please do not rely on it as a source of information about other areas or geological features, as the report may omit important details.
- The topography shown on any map extracts is based on the latest OS mapping and is not necessarily the same as that used in the original compilation of the BGS geological map, and to which the geological linework available at that time was fitted.
- Note that for some sites, the latest available records may be quite historical in nature, and while every effort is made to place the analysis in a modern geological context, it is possible in some cases that the detailed geology at a site may differ from that described.

Report Issued by
BGS Enquiry Service



KEY:

- INDICATIVE WASTWATER PUMPING STATION
- INDICATIVE SW ATTENUATION BASIN
- INDICATIVE CELLULAR STORAGE CRATES
- E□TENT OF SW FLOODING
- HIGH PROBABILITY
- MEDIUM PROBABILITY
- LOW PROBABILITY

REV	DESCRIPTION	DE	DR	CH	PA	DATE

DESIGNED BY	DRAWN BY	CHECKED BY	PASSED BY
-	DP	-	-

SCALES @ A1 SIZE	DATE	ISSUE STATUS
D.N.S.	21/02/2018	PLANNING

PROJECT TITLE

LAND OFF TUTTLES LANE, WYMONDHAM

DRAWING TITLE

CONSTRAINTS AND OPPORTUNITIES PLAN

CLIENT

WELBECK STRATEGIC LAND III LTD

CANNON CONSULTING ENGINEERS
Highways, Transport & Infrastructure Planning

Cannon Consulting Engineers
Cambridge House, Kentford, Newmarket, Cambs, CB8 7PN
Tel: □44 (0)1638 555 107
info@cannonce.co.uk www.cannonce.co.uk

DRAWING NUMBER	REV.
W121 - 300	-

APPENDIX 6
CULTURAL HERITAGE DESK BASED ASSESMENT

CgMs HERITAGE

PART OF RPS

CULTURAL HERITAGE DESK BASED ASSESSMENT

Land North of Tuttles Lane East Wymondham Norfolk

March 2018

Local Planning Authority:
South Norfolk Council

Site centred at:
TG 11747 03119

Author:
Manca Petric MA ACIfA

Approved by:
Matthew Smith BSc MIfA

Report Status:
Final

Issue Date:
March 2018

CgMs Ref:
MP/MS/24099

CONTENTS

LIST OF ILLUSTRATIONS

APPENDICES

Appendix 1: Gazetteer of HER Records within 500m search buffer surrounding the study site

Appendix 2: Geophysical Survey (Northamptonshire Archaeology 2010)

Appendix 3: Historic Landscape Characterisation

EXECUTIVE SUMMARY

Land North of Tuttles Lane East, Wymondham, Norfolk has been assessed for its archaeological and heritage interest as part of its promotion through the Greater Norwich Local Plan.

Non designated heritage assets are recorded on the study site.

The study site is considered to have a high archaeological potential for Roman and Bronze Age evidence with remains known to be located within the site. A moderate archaeological potential for Early Prehistoric, Neolithic, Iron Age and Medieval evidence, a low to moderate archaeological potential for Anglo-Saxon evidence and a low archaeological potential for Post-Medieval evidence is also considered.

The development of the site is therefore considered likely to impact on locally significant non designated archaeological remains.

It is considered that the proposed development will not impact on the significance of any designated built heritage assets or the ability to appreciate them.

An assessment of historic field boundaries on the study site might be required and the boundaries themselves respected within any development proposals.

Accordingly, there are no heritage constraints identified which would preclude the promotion of the site through the Greater Norwich Local Plan. The Assessment has established that the archaeological interest identified at the study site could be secured by an implementation of a program of archaeological mitigation measures in advance of redevelopment.

1.0 INTRODUCTION AND SCOPE OF STUDY

1.1 This cultural heritage desk-based assessment has been prepared by Manca Petric, and edited by Matthew Smith of CgMs Heritage (part of RPS) on behalf of Welbeck Strategic Land III Ltd.

1.2 The subject of this Assessment comprises land north of Tuttles Lane East Wymondham, Norfolk, also referred to as the study site. The site is c.55ha in extent and is centred at TG 11747 03119 within South Norfolk Council (see Figure 1).

1.3 In terms of relevant designated heritage assets, no World Heritage Sites, Scheduled Monuments, Historic Battlefields or Historic Wrecks lie within the study site or its immediate environs.

1.4 Welbeck Strategic Land III Ltd have commissioned CgMs Heritage (part of RPS) to establish the archaeological potential of the study site, and to provide guidance on ways to accommodate any archaeological and heritage constraints identified.

1.5 In accordance with central and local government policy and guidance on archaeology and planning, and in accordance with the 'Standard and Guidance for Historic Environment Desk-Based Assessments' (Chartered Institute for Archaeologists August 2014), this assessment draws together the available archaeological, topographic and land-use information in order to clarify the archaeological potential of the site.

1.6 This desk-based assessment comprises an examination of evidence on the Norfolk Historic Environment Record (HER) and other sources. This report also includes the results of a comprehensive map regression exercise.

1.7 The assessment thus enables relevant parties to assess the archaeological potential of various parts of the site and to consider the need for design, civil engineering, and archaeological solutions to the archaeological potential identified. This assessment also considers the development impact upon the designated heritage assets within a 1.25km search buffer surrounding the study site.

2.0 DEVELOPMENT PLAN FRAMEWORK

2.1 Legislation regarding archaeology, including scheduled monuments, is contained in the Ancient Monuments and Archaeological Areas Act 1979, amended by the National Heritage Act 1983 and 2002.

2.2 In March 2012, the government published the National Planning Policy Framework (NPPF), which replaced previous national policy relating to heritage and archaeology (PPS5: Planning Policy Statement 5: Planning for the Historic Environment). The NPPF Planning Practice Guidance was published online 6th March 2014 (http://planningguidance.planningportal.gov.uk). The Planning Practice Guide issued in support of PPS5 is still valid however, and Historic England (formerly English Heritage) have provided documentation translating former PPS5 policy into its NPPF counterpart.

2.3 The Planning Practice Guide previously issued in support of PPS5, together with accompanying English Heritage documentation, was cancelled 25 March 2015, to be replaced by three Good Practice Advice (GPA) documents published by Historic England: GPA 1: The Historic Environment in Local Plans; GPA 2: Managing Significance in Decision-Taking in the Historic Environment, and GPA 3: The Setting of Heritage Assets (updated in December 2017).

2.4 Section 12 of the NPPF, entitled Conserving and Enhancing the Historic Environment provides guidance for planning authorities, property owners, developers and others on the conservation and investigation of heritage assets. Overall, the objectives of Section 12 of the NPPF can be summarised as seeking the:

- Delivery of sustainable development
- Understanding the wider social, cultural, economic and environmental benefits brought by the conservation of the historic environment
- Conservation of England's heritage assets in a manner appropriate to their significance, and
- Recognition of the contribution that heritage assets make to our understanding of the past.

2.5 Section 12 of the NPPF recognises that intelligently managed change may sometimes be necessary if heritage assets are to be maintained for the long term. Paragraph 128 states that planning decisions should be based on the significance of the heritage asset, and that level of detail supplied by an applicant should be proportionate to the

importance of the asset and should be *no more than sufficient* to review the potential impact of the proposal upon the significance of that asset.

2.6 *Heritage Assets* are defined in Annex 2 of the NPPF as: a building, monument, site, place, area or landscape positively identified as having a degree of significance meriting consideration in planning decisions. They include designated heritage assets (as defined in the NPPF) and assets identified by the local planning authority during the process of decision-making or through the plan-making process.

2.7 Annex 2 also defines *Archaeological Interest* as a heritage asset which holds, or potentially could hold, evidence of past human activity worthy of expert investigation at some point. Heritage assets with archaeological interest are the primary source of evidence about the substance and evolution of places, and of the people and cultures that made them.

2.8 A *Designated Heritage Asset* comprises a: World Heritage Site, Scheduled Monument, Listed Building, Protected Wreck Site, Registered Park and Garden, Registered Battlefield or Conservation Area.

2.9 *Significance* is defined as: The value of a heritage asset to this and future generations because of its heritage interest. This interest may be archaeological, architectural, artistic or historic. Significance derives not only from a heritage asset's physical presence, but also from its setting.

2.10 *Setting* is defined as: The surroundings in which a heritage asset is experienced. Its extent is not fixed and may change as the asset and its surroundings evolve. Elements of a setting may make a positive or negative contribution to the significance of an asset, may affect the ability to appreciate that significance or may be neutral.

2.11 In short, government policy provides a framework which:

- Protects nationally important designated Heritage Assets (which include World Heritage Sites, Scheduled Ancient Monuments, Listed Buildings, Protected Wreck Sites, Registered Parks and Gardens, Registered Battlefields or Conservation Areas)
- Protects the settings of such designations
- In appropriate circumstances seeks adequate information (from desk based assessment and field evaluation where necessary) to enable informed decisions

- Provides for the excavation and investigation of sites not significant enough to merit *in-situ* preservation.

2.12 The 2014 NPPF Planning Practice Guidance reiterates that the conservation of heritage assets in a manner appropriate to their significance is a core planning principle, requiring a flexible and thoughtful approach. Furthermore, it highlights that neglect and decay of heritage assets is best addressed through ensuring they remain in active use that is consistent with their conservation. Importantly, the guidance states that if complete or partial loss of a heritage asset is justified, the aim should then be to capture and record the evidence of the asset's significance, and make the interpretation publically available. Key elements of the guidance relate to assessing harm. An important consideration should be whether the proposed works adversely affect a key element of the heritage asset's special architectural or historic interest. Additionally, it is the degree of harm, rather than the scale of development, that is to be assessed. The level of 'substantial harm' is considered to be a high bar that may not arise in many cases. Essentially, whether a proposal causes substantial harm will be a judgment for the decision taker, having regard to the circumstances of the case and the NPPF. Importantly, harm may arise from works to the asset or from development within its setting. Setting is defined as the surroundings in which an asset is experienced, and may be more extensive than the curtilage. A thorough assessment of the impact of proposals upon setting needs to take into account and be proportionate to the significance of the heritage asset and the degree to which proposed changes enhance or detract from that significance and the ability to appreciate it.

2.13 In considering any planning application for development, the planning authority will be mindful of the framework set by government policy, in this instance the NPPF, by current Development Plan Policy and by other material considerations.

2.14 The relevant Local Development Framework (LDF) is currently provided by the Joint Core Strategy for Broadlands, Norwich and South Norfolk that was adopted in March 2011 with amendments in January 2014 and contains the following relevant policy:

POLICY 1: ADDRESSING CLIMATE CHANGE AND PROTECTING ENVIRONMENTAL ASSETS

THE BUILT ENVIRONMENT, HERITAGE ASSETS, AND THE WIDER HISTORIC ENVIRONMENT WILL BE CONSERVED AND ENHANCED THROUGH THE PROTECTION OF BUILDINGS AND STRUCTURES WHICH CONTRIBUTE TO THEIR SURROUNDINGS, THE PROTECTION OF THEIR SETTINGS, THE ENCOURAGEMENT OF HIGH-QUALITY MAINTENANCE AND REPAIR AND THE ENHANCEMENT OF PUBLIC SPACES.

POLICY 8: CULTURE, LEISURE AND ENTERTAINMENT

THE CULTURAL OFFER IS AN IMPORTANT AND VALUED PART OF THE AREA. EXISTING CULTURAL ASSETS AND LEISURE FACILITIES WILL BE MAINTAINED AND ENHANCED. THE DEVELOPMENT OF NEW OR IMPROVED FACILITIES INCLUDING THOSE SUPPORTING THE ARTS, STREET EVENTS, CONCERTS AND THE CREATIVE INDUSTRIES SECTOR WILL BE PROMOTED.

CULTURAL HERITAGE WILL BE ENRICHED THROUGH USE OF INNOVATIVE DESIGN AND ART IN THE PUBLIC REALM.

DEVELOPMENT WILL BE EXPECTED TO PROVIDE FOR LOCAL CULTURAL AND LEISURE ACTIVITIES, INCLUDING NEW OR IMPROVED BUILT FACILITIES, PROVIDE FOR A RANGE OF ACTIVITIES INCLUDING PERFORMANCE SPACE, AND/OR ACCESS TO GREEN SPACE, INCLUDING FORMAL RECREATION, COUNTRY PARKS AND THE WIDER COUNTRYSIDE.

2.15 The South Norfolk Local Plan Development Management Policies Document (October 2015) set out the following policies relating to historic environment:

POLICY DM 4.10 HERITAGE ASSETS

ALL DEVELOPMENT PROPOSALS MUST HAVE REGARD TO THE HISTORIC ENVIRONMENT AND TAKE ACCOUNT OF THE CONTRIBUTION WHICH HERITAGE ASSETS MAKE TO THE SIGNIFICANCE OF AN AREA AND ITS SENSE OF PLACE, AS DEFINED BY REFERENCE TO THE NATIONAL AND LOCAL EVIDENCE BASE RELATING TO HERITAGE. CHANGE OF USE, ALTERATIONS AND EXTENSIONS AFFECTING THE SIGNIFICANCE OF A DESIGNATED HERITAGE ASSET, INCLUDING ITS SETTING, MUST HAVE REGARD TO AND POSITIVELY RESPOND TO, THAT SIGNIFICANCE. PROPOSALS MUST SUSTAIN, AND WHERE POSSIBLE ENHANCE AND BETTER REVEAL THE SIGNIFICANCE OF THE ASSET AND MAKE A POSITIVE CONTRIBUTION TO LOCAL DISTINCTIVENESS.

PROPOSALS MUST SHOW HOW THE SIGNIFICANCE OF THE HERITAGE ASSET HAS BEEN ASSESSED AND TAKEN INTO ACCOUNT BY REFERENCE TO THE HISTORIC ENVIRONMENT RECORD, SUITABLE EXPERTISE AND OTHER EVIDENCE/RESEARCH AS MAY BE NECESSARY.

CONSIDERABLE IMPORTANCE AND WEIGHT MUST BE GIVEN TO THE DESIRABILITY OF PRESERVING LISTED BUILDINGS, THEIR SETTINGS AND THE CHARACTER AND APPEARANCE OF CONSERVATION AREAS. DEVELOPMENT SHOULD AVOID CAUSING ANY LOSS TO A HERITAGE ASSET, OR HARM TO IT. SUBSTANTIAL HARM OR TOTAL LOSS WILL ONLY BE JUSTIFIED WHERE IT CAN BE DEMONSTRATED THAT IT IS NECESSARY TO ACHIEVE SUBSTANTIAL BENEFITS OR WHERE THE RETENTION OF THE ASSET IS UNSUSTAINABLE, NO VIABLE ALTERNATIVES CAN BE IDENTIFIED AND THE HARM OR LOSS IS OUTWEIGHED BY THE BENEFITS OF BRINGING THE SITE BACK INTO USE. LESS THAN SUBSTANTIAL HARM WILL ONLY BE JUSTIFIED WHERE THERE ARE PUBLIC BENEFITS THAT OUTWEIGH THE HARM. IN CARRYING OUT THIS PLANNING BALANCE, LESS THAN SUBSTANTIAL HARM WILL BE AFFORDED CONSIDERABLE IMPORTANCE AND WEIGHT. PROPOSALS WHICH ADVERSELY AFFECT THE SIGNIFICANCE OF A HERITAGE ASSET WILL ONLY EXCEPTIONALLY BE PERMITTED WHERE CLEAR AND CONVINCING JUSTIFICATION IS PROVIDED.

POLICY DM 2.12 TOURIST ACCOMMODATION

...

(4) IN ALL CASES OF PROPOSALS FOR THE CHANGE OF USE OF LAND, PARTICULAR CONSIDERATION WILL BE GIVEN TO:

C) THE PROPOSED ONGOING MANAGEMENT OF THE SITE TO PROTECT THE AMENITY OF THE LOCALITY AND PROTECT NATURE CONSERVATION, LANDSCAPE AND ARCHAEOLOGICAL VALUE; AND

D) ENSURING THAT GOOD QUALITY AGRICULTURAL LAND IS NOT TAKEN OUT OF PRODUCTION.

2.16 In terms of relevant designated archaeological heritage assets, as defined above and as shown on Figure 2, the site does not lie within the vicinity of a World Heritage Site, Scheduled Monument, Historic Battlefield or Historic Wreck site.

2.17 A Scheduled Monument lies c.1km south of the study site. The nearest Listed Building lies c.700m north of the study site and the Wymondham Conservation Area lies c.850m south-west of the study site (Fig. 3).

2.18 This desk based assessment therefore aims to meet the national and local policy and policy guidance as set out above, in clarifying the archaeological potential of the study site and other heritage constraints, and the need or otherwise for further mitigation measures.

3.0 GEOLOGY AND TOPOGRAPHY

3.1 Geology

3.1.1 The solid geology across the study site is Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation (undifferentiated) - Chalk, as shown by the British Geological Survey website (BGS 2018). Lowesoft Formation – (Diamicton) is recorded as a superficial deposit.

3.1.2 Site specific geotechnical information is currently unavailable.

3.2 Topography

3.2.1 The study site rises gently towards the south from c.36m OD at Kidd's More in the north to c.45mOD at Tuttles Lane East in the south. The intensive modern ploughing has given the areas of the study site the appearance of being flat.

3.2.2 The study site is an irregularly shaped parcel of land that measures c.55 ha in extent.

3.2.3 A drain runs across the eastern area of the study site and the River Tiffrey runs c.1.5km west of the study site.

4.0 ARCHAEOLOGICAL AND HISTORICAL BACKGROUND, WITH ASSESSEMENT OF SIGNIFICANCE

(Including Historic Map Regression exercise)

4.1 Timescales used in this report:

Prehistoric

Palaeolithic	900,000 -	12,000 BC
Mesolithic	12,000 -	4,000 BC
Neolithic	4,000 -	1,800 BC
Bronze Age	1,800 -	600 BC
Iron Age	600 -	AD 43

Historic

Roman	AD 43 -	410
Anglo Saxon/Early Medieval	AD 410 -	1066
Medieval	AD 1066 -	1485
Post Medieval	AD 1486 -	1749
Modern	AD 1750 -	Present

4.2 Introduction

4.2.1 This chapter reviews existing archaeological evidence for the site and the archaeological/historical background of the general area and, in accordance with NPPF, considers the potential for as yet undiscovered archaeological evidence on the site.

4.2.2 What follows comprises a review of archaeological findspots within a 500m search buffer of the study site, also referred to as the study area, held on the Norfolk Historic Environment Record (HER), together with a historic map regression exercise charting the development of the study area from the 18th century onwards until the present day.

4.2.3 In terms of designated heritage assets, as defined above and as shown on Figure 2, the study site does not lie within the vicinity of a World Heritage Site, Scheduled Monument, Historic Battlefield or Historic Wreck site.

4.2.4 Chapter 5 subsequently considers the site conditions and whether any archaeological potential identified in this chapter is likely to have survived later truncations.

4.3 Early Prehistoric – Palaeolithic and Mesolithic

4.3.1 A Lower/Middle Palaeolithic flint flakes were recovered during metal detecting between 2002 and 2015 c.150m west (MNF42061) and c.500m west of the study site (MNF24019). Two possible Palaeolithic flint flakes and a Palaeolithic flint axe were also recovered during fieldwalking c.100m north of the study site (MNF23693; MNF23694).

4.3.2 No Mesolithic findspots have been recorded in the study area.

4.3.3 Overall, in considering that the superficial deposits at the study site comprises an extensive sheet of chalky till, together with outwash sands and gravels, silts and clays, it is not unreasonable to identify a moderate archaeological potential for residual and isolated Early Prehistoric findspots.

4.4 Later Prehistoric – Neolithic, Bronze Age and Iron Age

4.4.1 The majority of Neolithic finds was recovered during various stages of metal detecting and filedwalking within the study area. Neolithic findspots were recovered c.100m north (MNF23694; MNF23693) and c.500m west of the study site (MNF24019). A Neolithic polished axe was found immediately east of the study site (MNF41227).

4.4.2 In 1976 a thin scatter of Neolithic worked flints was recovered from the ploughed surface alongside of Deep Road c.250m north-west of the study site (MNF11791). Metal detecting in 2014 and 2015 recovered a Neolithic/Bronze Age retouched flake in the same area.

4.4.3 An archaeological evaluation c.450m south-east of the study site (MNF64434) recorded Prehistoric activity that was indicated by a small assemblage of unstratified Early Neolithic worked flint recovered from the southern half of the site.

4.4.4 In 1979 a number of Neolithic and Bronze Age flint scrapers and flakes were recovered from an area c.300m north-east of the study site (MNF18264).

4.4.5 Late Neolithic – Early Bronze Age activity was recorded c.400m east of the study site (MNF56676). A part of a possible Neolithic/Bronze Age oval ring ditch, perhaps marking the site of a prehistoric funerary barrow, is visible as a cropmark on aerial photographs c.500m west of the study site (MNF62174).

4.4.6 The quantity and distribution of Neolithic flintwork recovered from within the study area indicates that Neolithic activity was taking place in the near vicinity.

4.4.7 Fieldwalking and metal detecting in the 1990s recovered a number of Prehistoric worked flints in the northern area of study site, including a Bronze Age ingot (MNF22603).

4.4.8 A ring ditch, probably marking the site of a Bronze Age round barrow, is visible as a cropmark on aerial photographs and as a sub-circular anomaly on a geophysical survey undertaken in 2010 in the western area of study site (MNF57459; Appendix 2). A second ring ditch recorded on the HER and visible as a cropmark (MNF57460), also interpreted as a possible Bronze Age round barrow, lies only c.110m to the south, also within the study site boundary.

4.4.9 The presence of the ring ditches, complemented by the residual flintwork, suggest the study site is likely to have lain in a developed agricultural and ritual landscape during the Bronze Age.

4.4.10 Fieldwalking in 1998 and metal detecting in 2001 recovered Iron Age pottery sherds in the north-eastern area of the study site (MNF24588).

4.4.11 An archaeological evaluation c.500m south-east of the study site recorded three charcoal-rich pits exhibiting similarities to those associated with Iron Age settlement elsewhere in the county, but no clear dating evidence was found (MNF64434).

4.4.12 Metal detecting c.200m west of the study site was conducted between 2002 and 2015. The metal finds include an Early Iron Age/Roman copper alloy bead (MNF42061). Late Iron Age finds were also recovered during metal detecting c.500west of the study site (MNF44243).

4.4.13 Additionally, a number of Prehistoric flints (MNF24061; MNF22447; MNF23694; MNF23693; MNF22752; MNF22448; MNF22603) have been recovered in the study area and within the study site boundary.

4.4.14 The archaeological potential for the Bronze Age can be defined as high due to the presence of one or possibly two Bronze Age ring ditches within the study site boundary. Neolithic and Iron Age findspots within the study site, together with evidence of Neolithic and Iron Age occupation within the study area indicate a moderate archaeological potential for these periods within the study site.

4.5 Roman

4.5.1 The line of a Roman road between Caistor St Edmund (Venta Icenorum) and Crownthorpe (the site of a Roman temple) has been traced, principally through earthworks, soil marks and cropmarks visible on aerial photographs. A cropmark, representing a Roman Road passes east to west bisecting the central area of the study site (MNF19725). Linear anomalies, possibly associated with a silted hollow-way, or perhaps one of the side ditches of the road, were also interpreted within the study site during a geophysical survey in 2010 (Appendix 2).

4.5.2 Roman finds were recovered during fieldwalking and metal detecting within the study site boundary (MNF33080; MNF22603; MNF24588) and within the study area (MNF18264; MNF41227; MNF42061; MNF44243; MNF66611; MNF21588; MNF18586).

4.5.3 A small-scale Roman domestic settlement in the form of a cluster of rubbish pits and possible extraction pits was recorded between 2007 and 2011 c.500m south-east of the study site (MNF56676).

4.5.4 Overall the archaeological potential of the study site for this period must be defined as high. A Roman road alignment is expected to be present. Evidence for agricultural activity and land division is most likely to be represented, particularly field boundaries aligned on the Roman Road, but evidence for rural roadside occupation could potentially occur.

4.6 Anglo Saxon & Medieval

4.6.1 Wymondham (*Wimondham, Wimundham,* or *Winmuntham*) is possibly of Roman, but certainly of Saxon origin. The settlement name means *the village on the pleasant mount* [win-Munte-ham]. The large parish is a rare survivor of an intact Anglo-Saxon royal or aristocratic estate (Blomfield 1805; NCC 2009).

4.6.2 Metal detecting carried out in 2015 immediately north-east of the study site recovered Early Saxon coins and a brooch and a Late Saxon harness fitting (MNF68052).

4.6.3 Late Saxon pottery sherds were recovered from the ploughed surface alongside of Deep Road c.500m north-west of the study site (MNF11791). Anglo-Saxon objects were also identified c.350m west (MNF44243; MNF42061), c.500m north-east (MNF21588), and also immediately east of the study site (MNF41227).

4.6.4 The archaeological potential for the Anglo-Saxon settlement evidence can be defined as low to moderate. Evidence of land division and drainage could conceivably be present.

4.6.5 Wymondham is recorded in the 1086 Domesday Survey as a very large settlement c.1.3km south of the study site (Open Domesday 2018). The settlement comprised 376 households, 6 mills, 99 acres of meadow, 50 men's plough teams and woodland for 96 pigs.

4.6.6 A route between the Viking-established Norwich and Thetford passed through Wymondham and brought with it extra trade and prosperity. During the late 11th and 12th centuries the area was further transformed through the ownership of the d'Aubigny family, who founded the Priory (which became an Abbey later), created two deer parks, and built a castle (NCC 2009).

4.6.7 Medieval metal objects were recovered from the eastern area of study site during metal detecting in 1997 (MNF33081; MNF63889)). Medieval pottery sherds were also found across the study site during fieldwalking in 1986 (MNF22448: MNF22447; MNF22603).

4.6.8 Downham Grove is located c.100m east of the study site. The Grove appears to have originated as a Medieval moated farmstead or manorial complex (MNF9455). The moat is clearly visible on the sequence of historic maps (Figs. 6-9) until it was largely filled in between 1957 and 1973. When the moat was first built (probably between the 12th and 14th centuries), it may have been positioned just south of the former Roman Road alignment, which could still have been serving as a country lane in this period.

4.6.9 An earthwork survey undertaken in 2010 recorded remains of a probable Medieval settlement c.380m north-east of the study site (MNF61825). The surveyed field comprises a number of substantial ditches and banks, some of which were former

water-filled, which run roughly northeast to southwest, back at right angles from the eastern boundary of the field. As the latter was (until the enclosure of Wymondham in 1810) the edge of a common, the earthworks evidently represent a number of Medieval house sites and associated fields.

4.6.10 A probable Medieval moat lies c.350m north from the study site (MNF16212). A number of Medieval pottery sherds including Grimston green glazed ware, as well as some iron slag, also thought to be Medieval, was recovered nearby (MNF21577).

4.6.11 Further Medieval findspots were identified immediately west of the study site (MNF64401) and c.250m south-west and north-west of the study site (MNF9454; MNF66614; MNF66615).

4.6.12 The study site lay in a developed Medieval landscape, probably within agricultural land associated with the nearby settlement areas. The archaeological potential of the study site for the Medieval period can be identified as moderate in the areas adjacent to Downham Grove where deposits associated with the domestic or industrial activity of this fortified sites may be present. Away from these areas, the archaeological potential for the remainder of the study site for the period can be defined as low to moderate. The wider areas are likely to have been woodland or fields at this time and evidence of land division and drainage could be present.

4.7 **Post Medieval and Modern (including map regression exercise)**

4.7.1 Post-Medieval pottery sherds and metal objects were recovered during metal detecting and fieldwalking within the study site (MNF22603; MNF22448; MNF24588) and within the study area (MNF63759; MNF63578; MNF41227; MNF18264; MNF23693; MNF11791; MNF42061).

4.7.2 Faydens Map of 1797 (Fig. 4) shows the study site as open land, assumed to be agricultural, criss-crossed with various paths and trackways. The route ways in the east are shown lined on either side by common land as they are on the route to Great Melton Common to the north-east and Wymondham Common to the east.

4.7.3 The 1817 Ordnance Survey Drawing shows the study site within open agricultural land with a road forming its northern and southern boundary (Fig. 5).

4.7.4 The 1826 Bryant Map (Fig. 6) shows the study site in a similar form. Brick kilns, also recorded on the HER, are shown to the south of the site boundary (MNF15949).

4.7.5 The Wymondham Tithe Map of 1839 (Fig. 7) and the associated Award show the site primarily as agricultural land and records it as being divided between the many ownerships of the farms integrated with the site. Structures are shown along the south-eastern site boundary and the study site occupies the following plots:

86 – Wood	95 - Arable	103 - Arable
87 – Arable	96 – Arable	104 - Arable
88 – Arable	97 – Arable	105 - Pasture
89 – Pasture	98 – Arable	195 - Arable
90 – Pasture	99 – Arable	196 - Arable
91 – Pasture	100 – Arable	361 – Arable
93 – Arable	101 – Arable	363 – Arable
94 – Arable	102 - Pasture	

4.7.6 Many of the historic field boundaries which comprise the site boundary today, and could be of potential interest, are shown at this time (Figs. 7 and 15).

4.7.7 The 1887 First Edition Ordnance Survey (Fig. 8) shows the study site occupied by farmland with a wooded area located to the south of Downham Grove. A reduction in the number of field boundaries can be observed in the northern area of site.

4.7.8 No significant change occurs with the study site for the next 80 years (Figs. 9-12). The 1938 Ordnance Survey mapping to cover the northern part of the site was not available.

4.7.9 A substantial reduction in field boundaries can be observed on the 1986 Ordnance Survey (Fig. 13).

4.7.10 The study site has remained largely unchanged until the present (14-15).

4.7.11 The majority of the study site lay within unremarkable agricultural land in the Post-Medieval period and accordingly, the archaeological potential can reasonably be defined as low. Historic field boundaries observed on the 19th century mapping have partially been preserved until present (Figures 7 and 15).

4.8 Historic Landscape Characterisation

4.8.1 The majority of the study site (HNF48107, HNF48112; HNF48273; Appendix 3) is characterised as an area of 20th century agriculture characterised by recent boundary loss. Field boundary loss and creation have been the most recent and far reaching changes in the rural landscape. This was due to the heady combination of mechanisation and a series of agricultural reforms including the post-war and later subsidies. Despite the degree of boundary loss the surviving residual edges of these often huge fields are the relict remains of their parent historic field systems (NLA 2009).

4.8.2 The eastern area of site (HNF48113; HNF48114; Appendix 3) lies in an area of the so called 'Piecemeal enclosure by agreement'. This was the most commonplace type of field in Norfolk, of this period, until the 20th century. The fields were formed by informal piecemeal subdivision and enclosure of earlier field systems such as open fields. This type of enclosure has a long history within Norfolk and may have been replacing open fields since the 16th century to allow for the rationalisation of field boundaries and the concentration of land holdings into single blocks. These may reflect various earlier episodes of reversion to sheep grazing and pasture in the medieval period (NLA 2009).

4.9 Assessment of Significance

4.9.1 Existing national policy guidance for archaeology (the NPPF as referenced in section 2) enshrines the concept of the 'significance' of heritage assets. Significance as defined in the NPPF centres on the value of an archaeological or historic asset for its 'heritage interest' to this or future generations.

4.9.2 Non designated heritage assets, as defined in the NPPF, are recorded on the study site.

4.9.3 The study site is considered to have a high archaeological potential for Roman and Bronze Age evidence, a moderate archaeological potential for Early Prehistoric, Neolithic, Iron Age and Medieval evidence, a low to moderate archaeological potential for Anglo-Saxon evidence and a low archaeological potential for Post-Medieval evidence.

4.9.4 Certain Early Prehistoric, Bronze Age or Roman remains could be regionally significant, depending on the level of preservation. However, the remains of heavily ploughed barrows and a putative Roman Road within the study site boundary are expected to be locally significant. Any other archaeological remains that may be present at the study site are also expected to be of local significance.

5.0 SITE CONDITIONS AND THE PROPOSED DEVELOPMENT

(Review of potential impact upon Heritage Assets)

5.1 Site Conditions

5.1.1 The study site currently comprises agricultural fields. Former and present field boundaries and ponds can be observed on the LiDAR data plot (Fig. 15). The projected line of the Roman Road is shown on the plot, however no apparent surface archaeological features are visible.

5.1.2 Medieval and Post-Medieval ploughing would have had a widespread but superficially damaging impact on any sub-surface horizons.

5.1.3 Modern ploughing is likely to have had a further negative impact on any archaeological deposits on the study site.

5.2 The Proposed Development

5.2.1 It is understood that the study site is proposed for a promotion through the Greater Norwich Local Plan for a residential development with associated public open space, community uses, infrastructure and a Primary School (Figs. 17 and 18).

5.3 Potential Impact on Non-Designated Archaeological Assets

5.3.1 The proposed development has the potential to impact on locally significant archaeological remains, as regionally significant archaeological remains are unlikely to be present at the study site.

5.3.2 The proposed development could potentially have a archaeological impact within the build areas of the site. In these areas archaeology is unlikely to survive the development process.

5.3.3 Any areas proposed to remain open space at the site are likely to incur low/or no archaeological impact depending on the extent of landscaping and associated works. Consideration and sympathetic design should be applied to the landscaping to ensure that any potential remains in these areas can remain undisturbed and in situ.

5.3.4 In view of the site's archaeological potential and the potential impact of the proposed development a suite of archaeological mitigation measures will require implementation in advance of redevelopment. These are likely to include:

- Archaeological Evaluation
- Archaeological Excavation

5.4 Potential Impact on Designated Heritage Assets

5.4.1 No designated heritage assets lie within the 500m search buffer of the study site, but there are some within the 1.25km search buffer of the study site (Figs. 2 and 3).

5.4.2 Moot Hill ring work of a probable Medieval date (SM1003993) lies c.1km south of the study site. The significance of the Scheduled Monument lies in the physical preservation of earthworks, in its research potential and historical association with the Medieval development of Wymondham. The monument lies a wooded area to the south of Kett's Park and is overgrown.

5.4.3 The setting of the Scheduled Monument is considered to make a moderate contribution to the overall significance of the Scheduled Monument.

5.4.4 There is no functional link or indivisibility between the Scheduled Monument and the study site.

5.4.5 The nearest Listed Building lies c.700m north of the study site and the Wymondham Conservation Area lies c.850m south-west of the study site (Fig. 3).

5.4.6 It is therefore considered that the proposed development will not impact on the significance of any designated heritage assets or the ability to appreciate them.

6.0 SUMMARY AND CONCLUSIONS

6.1 Land off Tuttles Lane, Wymondham, Norfolk has been assessed for its archaeological and heritage interest as part of its promotion through the Greater Norwich Local Plan.

6.2 Non designated heritage assets are recorded on the study site.

6.3 The study site is considered to have a high archaeological potential for Roman and Bronze Age evidence with remains known to be located within the site. A moderate archaeological potential for Early Prehistoric, Neolithic, Iron Age and Medieval evidence, a low to moderate archaeological potential for Anglo-Saxon evidence and a low archaeological potential for Post-Medieval evidence is also considered.

6.4 The development of the site is therefore considered likely to impact on locally significant non designated archaeological remains.

6.5 It is considered that the proposed development will not impact on the significance of any designated built heritage assets or the ability to appreciate them.

6.6 An assessment of historic field boundaries on the study site might be required and the boundaries themselves respected within any development proposals.

6.7 Accordingly, there are no heritage constraints identified which would preclude the promotion of the site through the Greater Norwich Local Plan. The Assessment has established that the archaeological interest identified at the study site could be secured by an implementation of a program of archaeological mitigation measures in advance of redevelopment.

SOURCES CONSULTED

1. General

British Library

National Archives

Norfolk Historic Environment Record (HER)

Historic England National Heritage List for England

2. Internet

http://archaeologydataservice.ac.uk

http://www.britainfromabove.org.uk/

http://www.british-history.ac.uk/

https://finds.org.uk/database/

https://www.historicengland.org.uk/listing/the-list

https://opendomesday.org.uk

http://www.pastscape.org.uk

http://planningguidance.planningportal.gov.uk

3. Bibliographic

Blomefield, F. 1805. 'Hundred of Forehoe: Windham', in An Essay Towards A Topographical History of the County of Norfolk: Volume 2.

Chartered Institute for Archaeologists *Standard & Guidance for historic environment desk based assessment* August 2014 unpublished document

Department of Communities and Local Government *National Planning Policy Framework* 2012

Historic England (formerly English Heritage) *Conservation Principles, Policies and Guidance for the Sustainable Management of the Historic Environment* 2008

Historic England *Historic Environment Good Practice Advice in Planning: 1 The Historic Environment in Local Plans* July 2015 unpublished document

Historic England *Historic Environment Good Practice Advice in Planning: 2 Managing Significance in Decision-Taking in the Historic Environment* July 2015 unpublished document

Historic England *Historic Environment Good Practice Advice in Planning: 3 The Setting of Heritage Assets* July 2015 unpublished document (Updated in December 2017)

Mills, A.D. 2011. *A Dictionary of British place names*.

Norfolk County Council. 2009. *Historic Characterisation and Sensitivity Assessment*; GNGP preferred option growth areas.

Norfolk Landscape Archaeology. 2009. Norfolk's Historic Landscape Character: A report on the Norfolk Historic Landscape Characterisation (HLC) Project.

3. **Cartographic**

1797 Faden Map

1817 Ordnance Survey Drawing

1826 Bryant Map

1839 Wymondham Parish Tithe Map

1887 Ordnance Survey

1905 Ordnance Survey

1938 Ordnance Survey

1950 Ordnance Survey

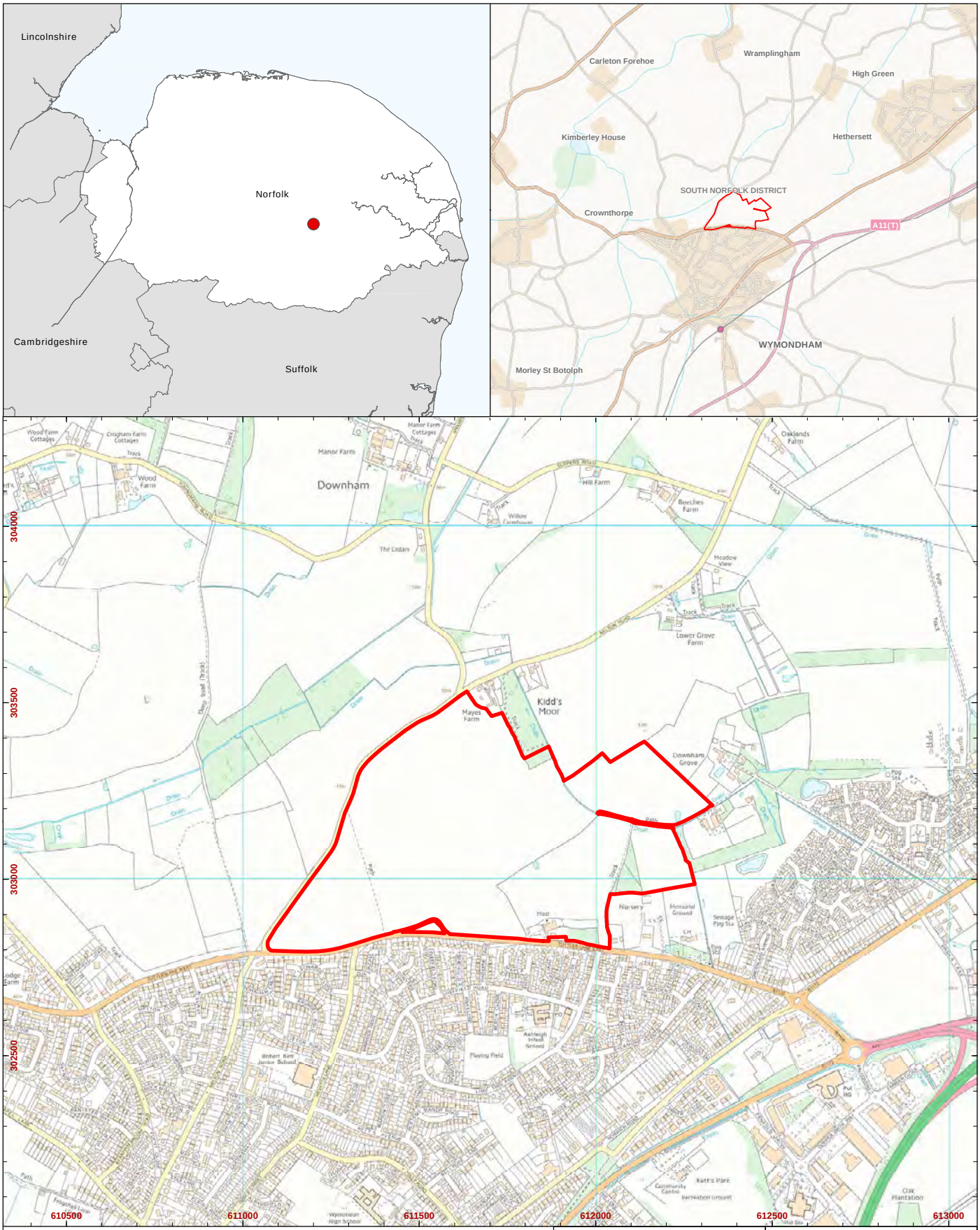
1956 Ordnance Survey

1986 Ordnance Survey

1999 Google Earth Image

2017 Google Earth Image

LiDAR Data Plot



Site Boundary

N

Scale at A4: 1:15,000

0 400m

CgMs HERITAGE PART OF RPS

Figure 1:
Site Location

MNF18264
MNF16212
MNF21577
MNF11791
MNF23693
MNF68052
MNF21588
MNF61825
MNF66611
MNF66615
MNF23694
MNF63889
MNF22603
MNF24588
MNF41227
MNF66614
MNF22447
MNF19725
MNF9455
MNF19725
MNF19725
MNF56676
MNF44243
MNF63759
MNF63758
MNF19725
MNF57459
MNF22752
MNF22448
MNF62382
MNF33081
MNF24019
MNF64401
MNF57460
MNF33080
MNF62174
MNF62383
MNF57294
MNF15949
MNF58094
MNF31300
MNF64434
MNF62760
MNF42061
MNF18586
MNF9454
MNF18027
MNF9459

Manor Farm
Downham
Barnard's Farm
Wood Farm
Hill Farm
Beeches Farm
Willow Farmhouse
Meadow View
Lower Grove Farm
Mayes Farm
Kidd's Moor
Downham Grove
Lodge Farm
Robert Kett Junior School
Playing Field
Ashleigh Infant School
Nursery
Memorial Ground
Sewage Ppg Sta
Community Centre
Kett's Park
Recreation Ground
Oak Plantation
Pol HQ

SLOPERS ROAD
YOUNGMANS ROAD
TUTTLES LANE WEST
TUTTLES LANE EAST
TUDOR ROAD
SHEFFIELD ROAD
CLIFTON ROAD
LIME TREE AVENUE
ASHLEIGH GARDENS
SYCAMORE AVENUE
OAKWOOD DR
NORWICH ROAD
PENFOLD DRIVE
COPPERSMITH WAY
FARRIER CLOSE
SALGONERS C
CHAPEL LANE
MELTON ROAD
GOOCH ROAD
KETT'S AVENUE
HUBBARD CLOSE
MURGARD CLOSE
NORTHFIELD GARDENS
Deep Road (Track)

304000
303500
303000
302500
610500
611000
611500
612000
612500
613000

CgMs HERITAGE PART OF RPS

- Site Boundary
- Search Buffer 500m

Non-Designated Heritage Assets:

HER Record (Point)
- Find Spot
- Monument

HER Record (Line)
- Monument

HER Record (Polygon)
- Find Spot
- Monument

Previous Archaeological Work:

NMP Feature
- Bank
- Ditch
- Extent of Area
- Stonework / Structure
- NMP Polygon

N

Scale at A3: 1:8,000

0 250m

Figure 2: Summary of non-designated heritage assets (Norfolk HER)

1291979 - OAKLAND FARMHOUSE
1196664 - WOOD FARMHOUSE
1291801 - MANOR FARMHOUSE
1218744 - TWO BARNS TO WEST OF WOOD FARMHOUSE
1217992 - WAREHOUSE RANGE TO REAR OF 22
1196697 - 18 AND 20, COCK STREET
1243874 - THE CHESTNUTS
1217953 - 12 AND 14, COCK STREET
1196696 - 8 AND 10, COCK STREET
1292218 - 4 AND 6, COCK STREET
1196689 - 1, 3 AND 5, POPLE STREET
1297490 - 23 AND 25, POPLE STREET
1218462 - 9, POPLE STREET
1196658 - LYNG COTTAGES
1196657 - THE YEOMAN'S HOUSE
1291817 - METHODIST CHURCH
1291875 - TOWN GREEN VILLA AND ATTACHED RAILINGS
1291869 - 2, 2A, 2B AND 4, TOWN GREEN
1297489 - 24, 26 AND 28, MIDDLETON STREET
1291991 - STABLES 15 METRES NORTH WEST OF PRIORY HOUSE
1291955 - BEECH HOUSE
Wymondham CA
1297488 - PRIORY HOUSE
1218417 - YORK HOUSE
1196685 - CAUIS HOUSE
1196687 - TOWN HALL
1196686 - 10 AND 12, MIDDLETON STREET
1218410 - 6, 8 AND 8A, MIDDLETON STREET
1218402 - 2 AND 4, MIDDLETON STREET
1297496 - TRAFFORD
1218004 - THE COCK INN
1196698 - THE LITTLE HOUSE
1217964 - OAK HOUSE WINCAR HOUSE
1218672 - 17, TOWN GREEN
1218657 - 9, TOWN GREEN
1196656 - MAYFAIR
1196655 - 3, 3A AND 5, TOWN GREEN
1196660 - CANTERBURY HOUSE
1218727 - ROOK HOUSE
1291835 - CONON HOUSE
1291797 - STABLES TO EAST OF 12
1196662 - ABBOTSFORD
1291819 - 1 AND 3, VICAR STREET
1218713 - STABLES 5 METRES NORTH EAST OF THE VICARAGE AND ATTACHED WALL
1196659 - THE VICARAGE INCLUDING ATTACHED FORECOURT WALL
1218720 - NO 7 AND ATTACHED GARAGE
1297516 - 14 AND 16, VICAR STREET
1196661 - 7A, VICAR STREET
1218737 - ABBEYWAY
1297515 - VICAR STREET HOUSE
1291967 - 132, NORWICH ROAD
1003993 (SM) Moot Hill
WYMONDHAM
Downham
Kidd's Moor
Crogham Farm
Britton's Farm
Manor Farm
Wood Farm
Barnard's Farm
Willow Farmhouse
Hill Farm
Beeches Farm
Oaklands Farm
Lower Grove Farm
Downham Grove
Carpenter's Farm
Meadow View
The Cedars
Mayes Farm
Lodge Farm
Ashleigh Infant School
Robert Kett Junior School
Recreation Ground
Nursery
Memorial Ground
Kett's Park
Community Centre
Gristlewood
Oak Plantation
Ash Plantation
Fishpond Plantation
New Plantation
Crownthorpe Carr
Chatterley
Kimberley Home Farm
Model Cottages
Wong Farm
Wong Farm Cottages
The Wong
Elm Farm Business Park
Pol HQ
Brewick Hall
Site Boundary
Search Buffer 1.25km
Designated Heritage Assets:
Scheduled Monument
Registered Park or Garden
Listed Building Grade I
Listed Building Grade II*
Listed Building Grade II
Conservation Area
N
Scale at A3: 1:12,500
0
400 m
Figure 3: Summary of designated heritage assets
304500
304000
303500
303000
302500
302000
609500
610000
610500
611000
611500
612000
612500
613000
613500

Approximate Site Location

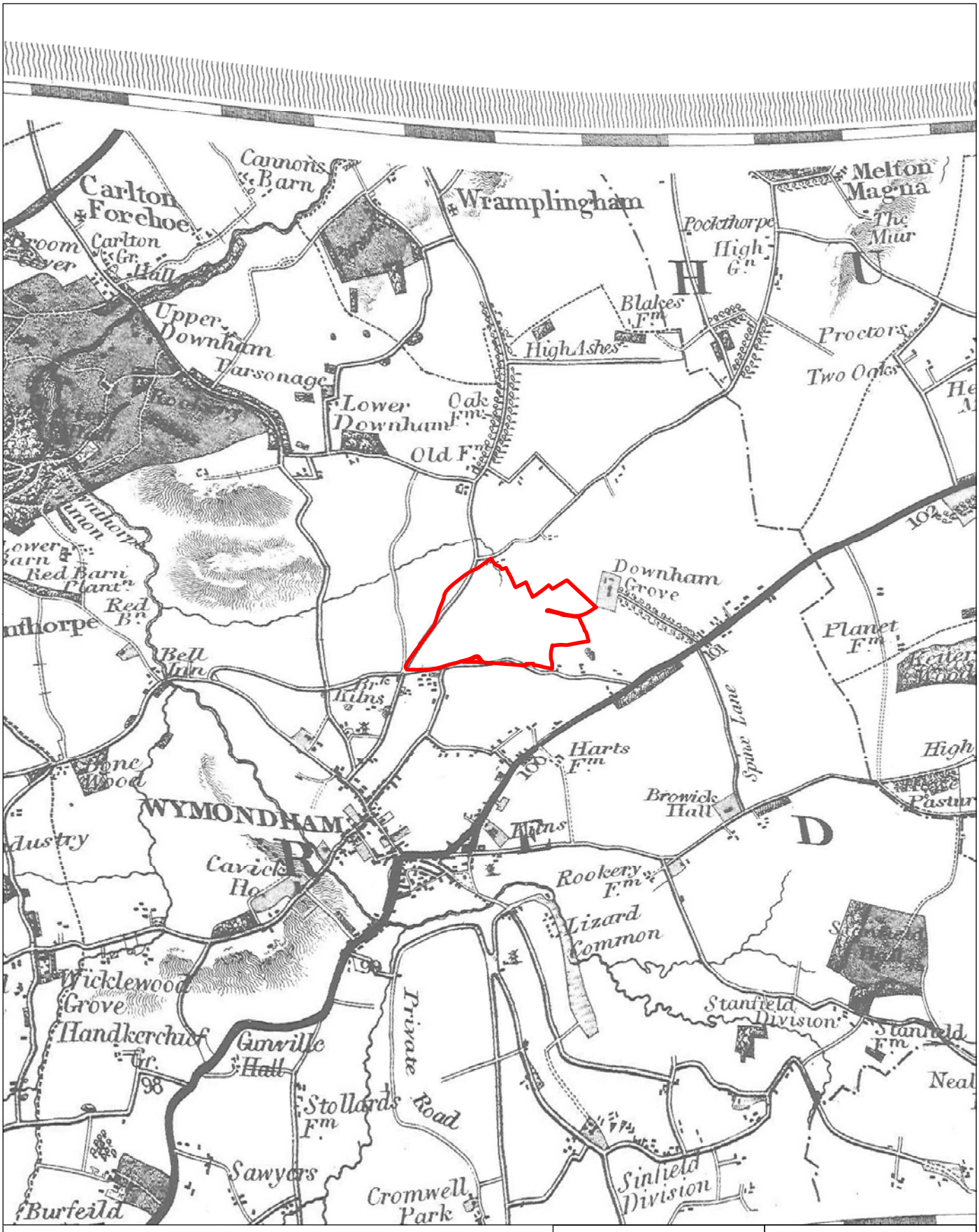
N

Scale at A4: 1:15,000

0 450 m

CgMs HERITAGE PART OF RPS

Figure 5:
1817 Ordnance Survey Drawing



Approximate Site Location

Historic Boundaries of Potential Interest

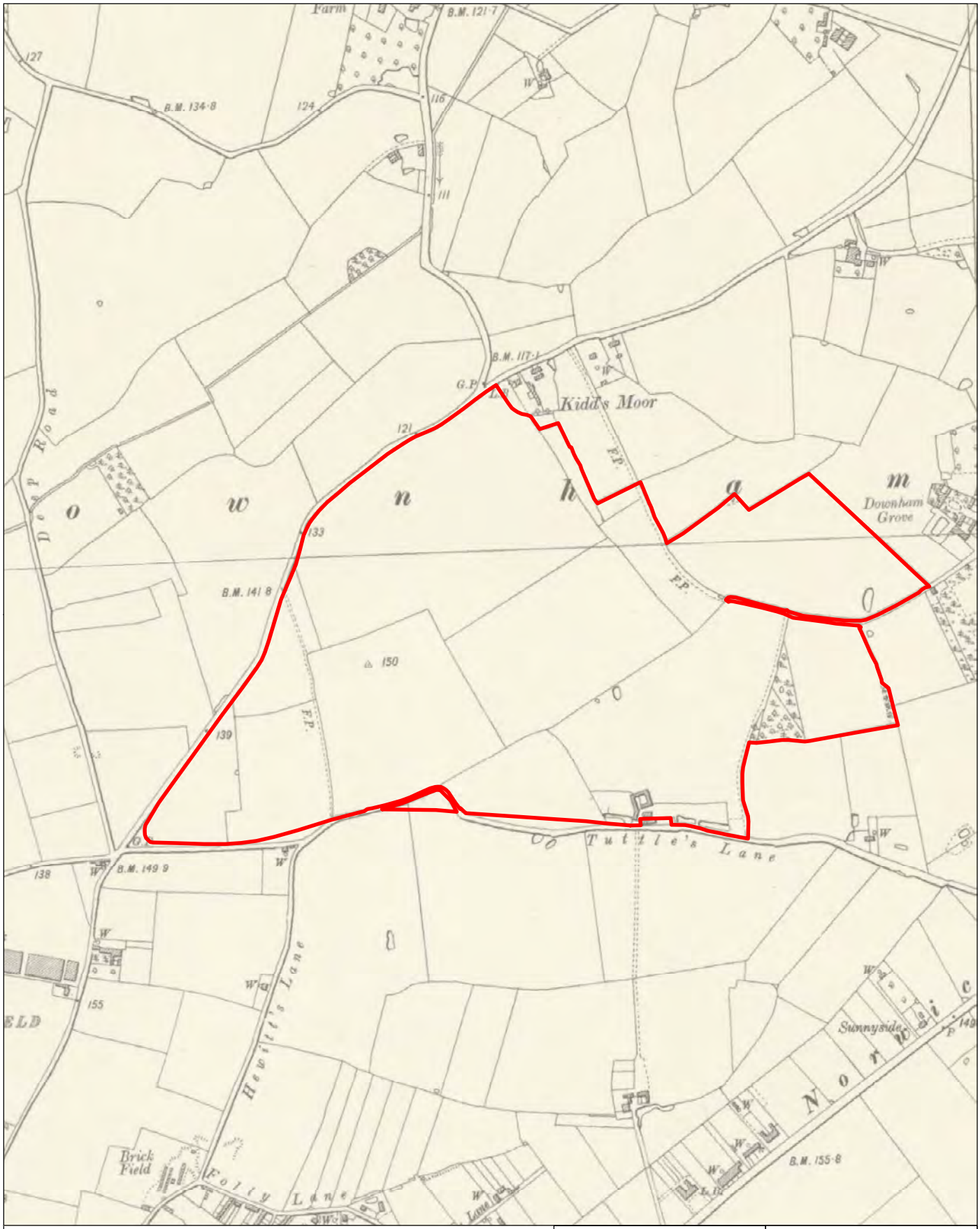
N

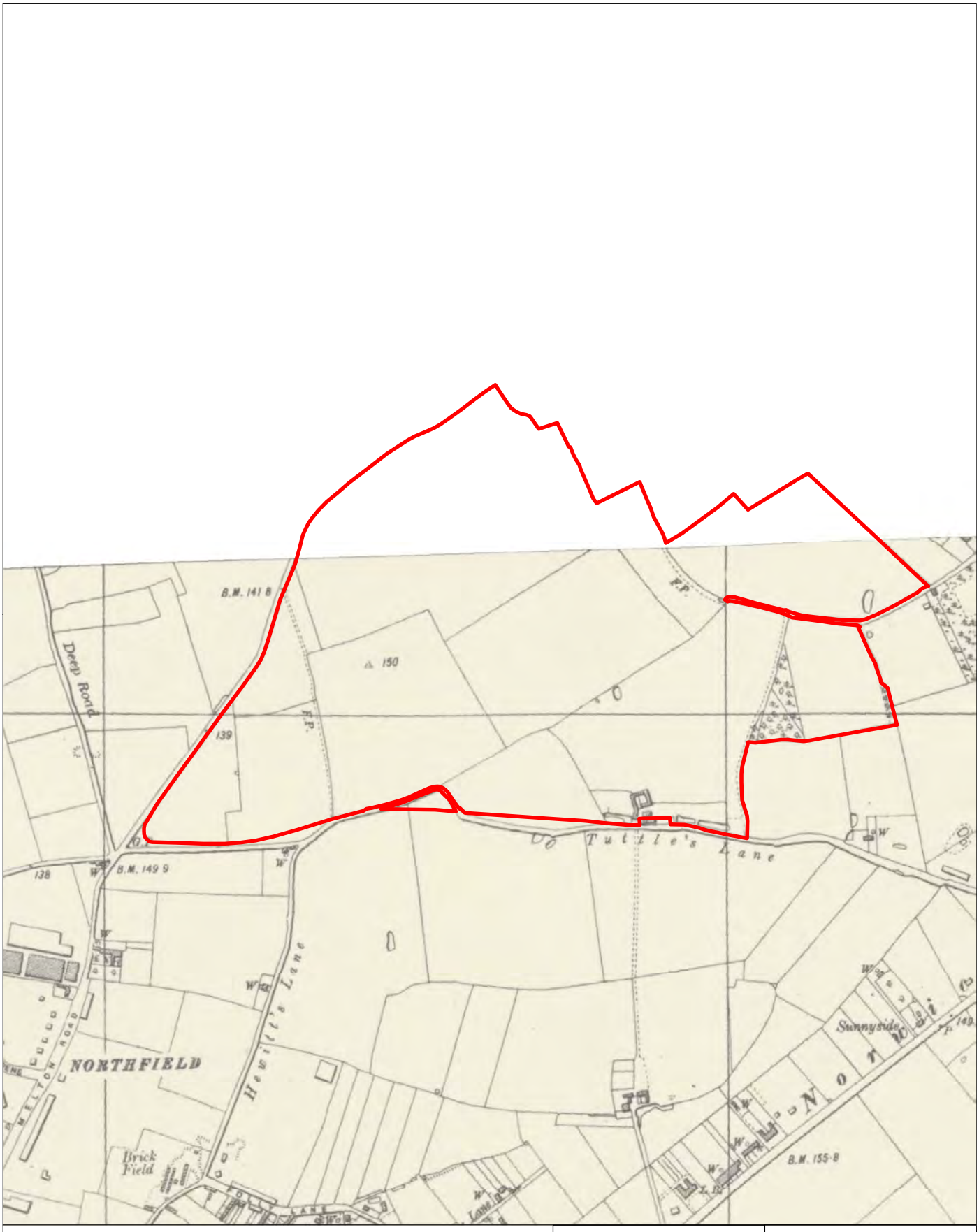
CgMs HERITAGE PART OF RPS

Scale at A4: 1:8,500

0 250 m

Figure 7:
1839 Wymondham
Parish Tithe Map





Site Boundary

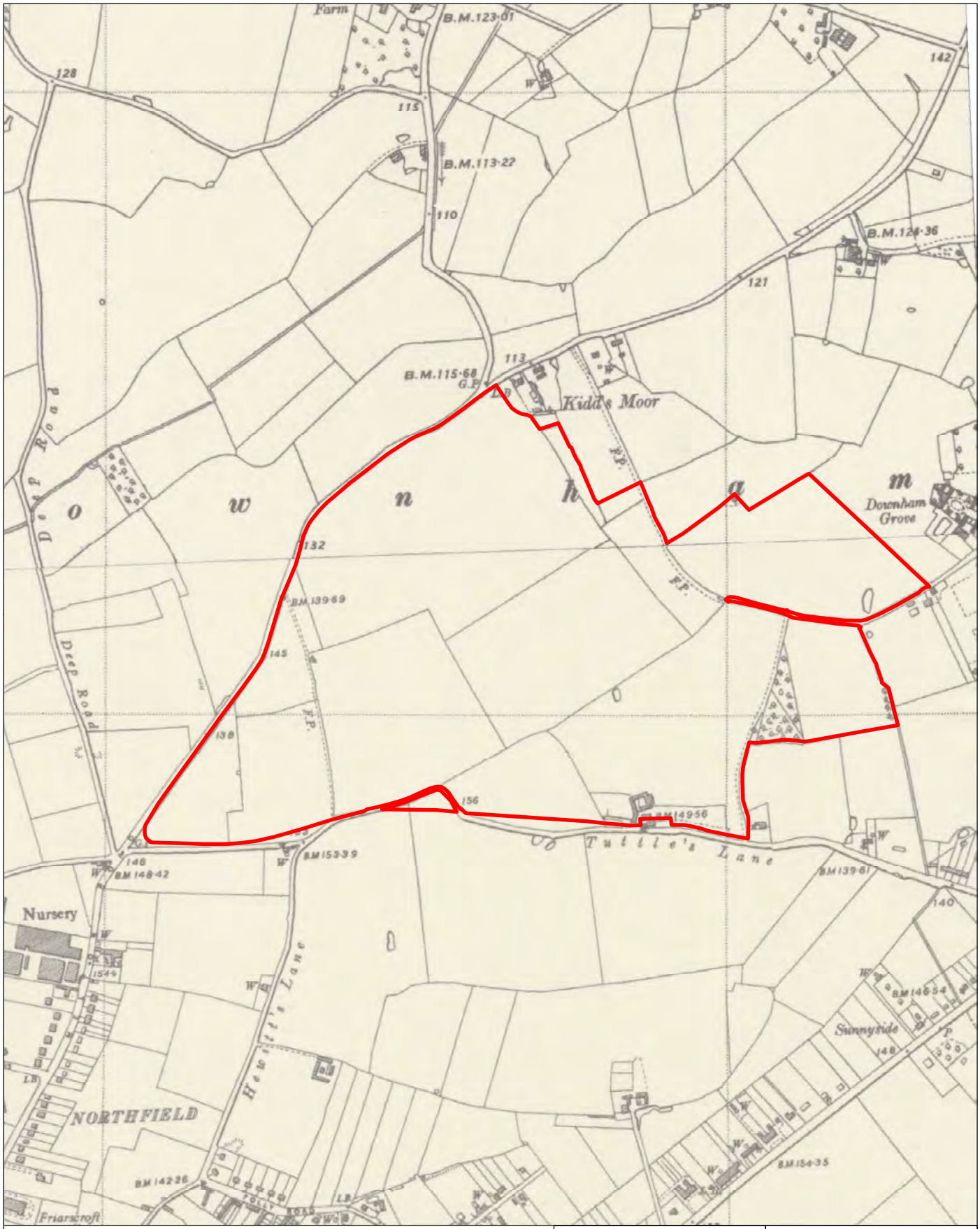
N

Scale at A4: 1:8,500

0 250 m

CgMs HERITAGE PART OF RPS

Figure 10:
1938 Ordnance Survey



Site Boundary

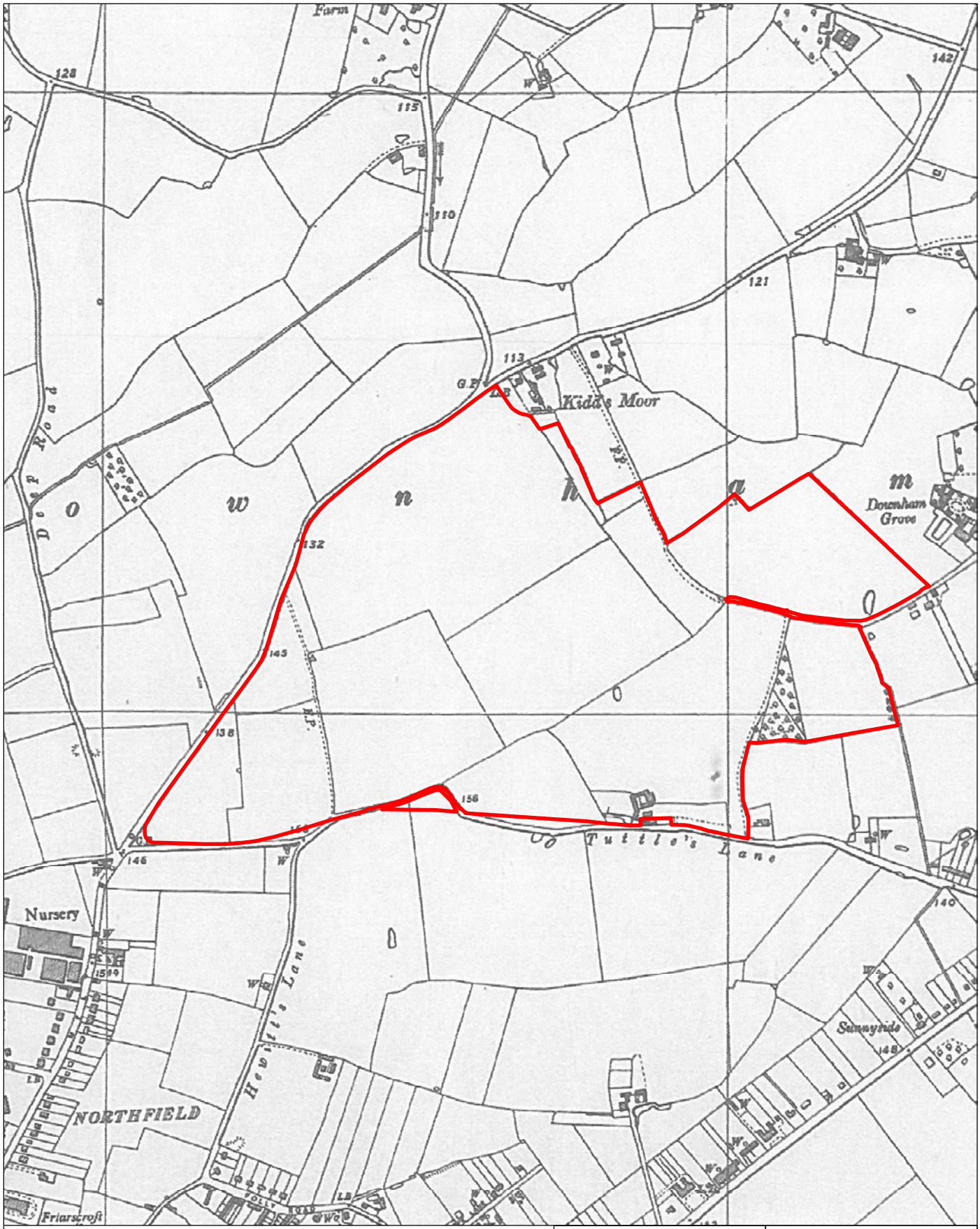
N

Scale at A4: 1:8,500

0 250 m

CgMs HERITAGE PART OF RPS

Figure 11:
1950 Ordnance Survey



Site Boundary

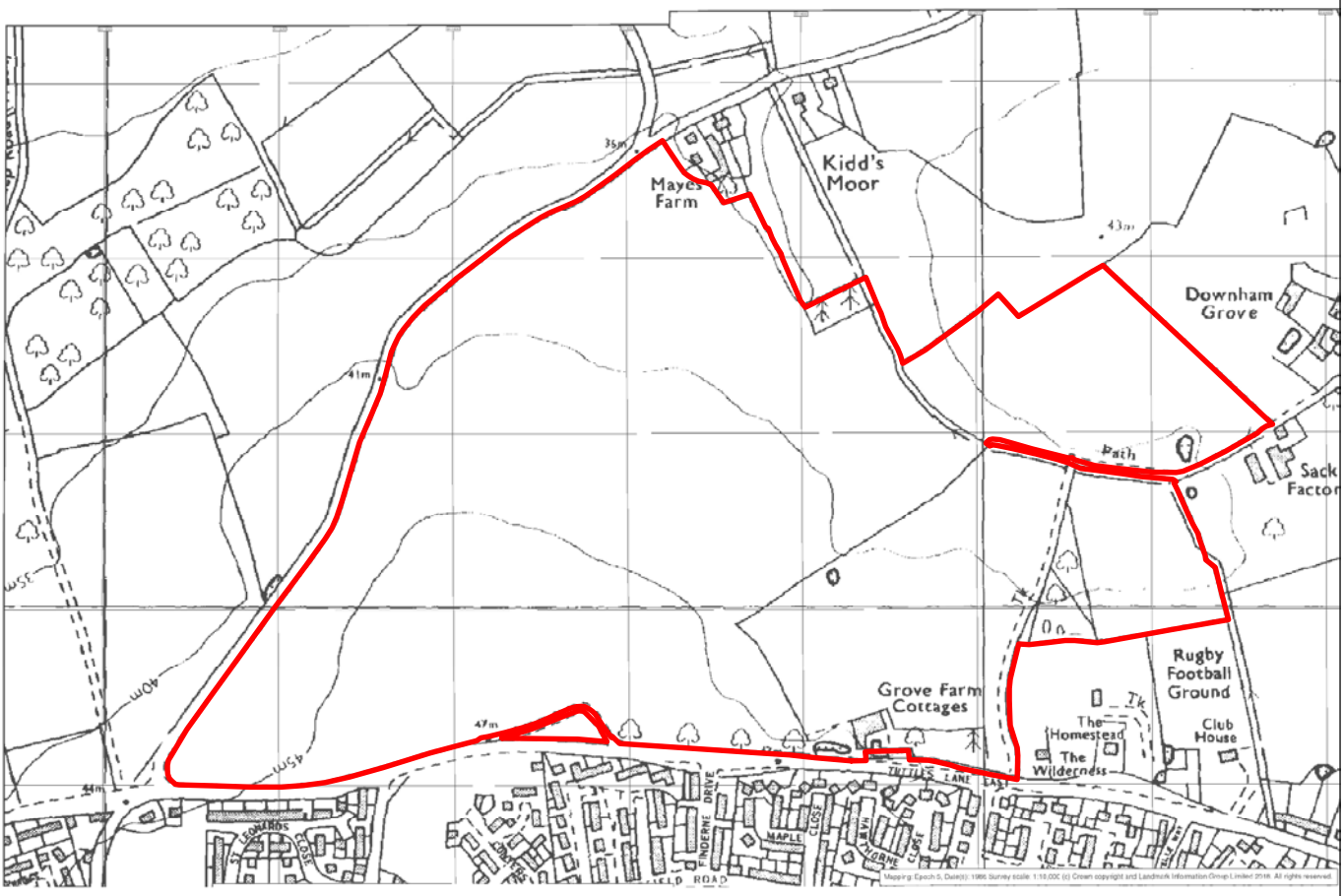
N

Scale at A4: 1:8,500

0 250 m

CgMs HERITAGE PART OF RPS

Figure 12:
1956 Ordnance Survey



Site Boundary

N

Scale at A4: 1:8,500

0 250 m

CgMs HERITAGE PART OF RPS

Figure 13:
1986 Ordnance Survey