The Sizewell C Project

9.34 Fen Meadow Plan Report - Baseline Report

Part 1 of 2

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1 INTRODUCTION

1.1 Context

1.1.1 The Sizewell C (SZC) proposals would lead to the permanent loss of approximately 0.46ha of 'fen meadow' habitat from the Sizewell Marshes SSSI [AS-209]. This permanent loss arises from the size and location of the SZC main platform to the north of the existing Sizewell B station. The platform location is constrained to the west and north by the SSSI and to the east by the coast and the appropriate coastal defence alignment such that the loss of this area of fen meadow is unavoidable.

1.1.2 Sizewell Marshes SSSI is designated in part for its fen meadow habitats and the loss of the fen meadow habitat from the SSSI leads to a need to provide compensatory habitat for this loss. SZC Co. is therefore proposing to deliver at least 4.5 ha of compensatory fen meadow habitat.

1.1.3 The application for development consent [now as amended with a recent change application] includes within the draft order limits, the three sites identified as follows:

- Fen Meadow compensation site at Benhall;
- Fen Meadow compensation site at Halesworth;
- Fen Meadow compensation site at Pakenham.

1.1.4 A Fen Meadow Strategy [AS-209] has been prepared to define SZC Co's commitment to provide appropriate compensation measures to mitigate the loss of fen meadow habitat through the creation of at least 4.5 ha of compensatory fen meadow habitats, and the provision of a contingency fund. The Fen Meadow Strategy proposes that a 'Fen Meadow Plan' be prepared.

1.1.5 The Fen Meadow Plan will include conceptual models for the three selected sites based on detailed data review and investigations and including:

- Detailed ecological survey;
- Review of available groundwater level data (including output from the Environment Agency model for high, low and average groundwater level conditions) and the seasonal variation in groundwater levels. Also effects of groundwater abstraction on groundwater levels below the site;

- Collection of topographic data;
- Collection of surface water level and groundwater level data to determine the relationship between groundwater and surface water levels on site. Also detailed study of the existing and wider ditch network to determine potential for water management without risk to upstream receptors; and
- Collection of hydrochemical data.
- Preliminary conceptual design to define:
  - Most appropriate restoration methods;
  - How water levels could be managed (if needed); and
  - To what extent earthworks will be required.

1.1.6 The Fen Meadow Strategy [AS-209] defined a series of three reports, which will lead to the establishment of the Fen Meadow Plan, which will be prepared to further define the approaches to maximise the extent of fen meadow habitats at the three sites. The reports are to be delivered in order to provide updates to the planning process, as follows:

- This Report, Fen Meadow Plan Report 1, which provides the baseline reports for the sites and water data available to May 2021;
- Subsequently Fen Meadow Plan Draft 1 will provide further interim data and define in draft the management interventions required to create fen meadow habitats. The measures will seek to maximise the extent of the establishment of fen meadow at each site and will describe any interventions that may be required to ensure the successfully delivery of the habitats at each site. This draft will be submitted at Deadline 6 and will be sufficient for the Examining Authority and the Secretary of State to understand the proposals at each site.
- In due course, Fen Meadow Plan Draft 2 will provide be updated with 12 months of water data collection at each site. It would be reviewed by the Environment Review Group and other stakeholders as relevant. Upon finalisation it will become the Fen Meadow Plan.

1.1.7 SZC Co will then take forward the establishment of the fen meadow in accordance with the approach set out in the Fen Meadow Plan.

1.2 This report

1.2.1 This report provides the following studies (or updates thereof) for the three fen meadow sites:

- Desk studies
  - Ecological; and
  - Hydrogeological
- Ecological surveys
  - Extended Phase 1 habitat survey
  - National vegetation classification (NVC) survey
  - Water vole and otter survey
  - Aquatic (ditch) invertebrate survey.
- Site investigation
  - Installation of boreholes, dipwells and gaugeboards
  - Topographic survey
  - Monitoring of water levels, flows and quality.

1.2.2 The above studies are at different stages of completion as detailed in **Table 1.1** below:

Table 1.1: Status of studies as at May 2021

Site	Study	Status
Benhall and Halesworth	Ecology desk study	Completed in 2020
	Ecology field surveys	Completed in 2020
	Hydrogeological desk study	Completed in 2021
	Installation of piezometers, dipwell, gaugeboards	Installed October 2020
	Topgraphic survey of site and installations	Completed 2020
	Water flow, level and quality monitoring	Commenced November 2020 for 1 year.

Site	Study	Status
Pakenham	Ecology desk study	Completed in 2021
	Ecology field surveys	Phase 1 habitat survey completed May 2021. Others to be undertaken in appropriate seasons in 2021.
	Hydrogeological desk study	Completed in 2021
	Installation of piezometers, dipwell, gaugeboards	Completed March 2021
	Topgraphic survey of site and installations	Undertaken March 2021
	Water flow, level and quality monitoring	Commenced April 2021 for 1 year

1.2.3 This report, the Fen Meadow Plan Report 1, presents a series of baseline reports in Appendices as follows:

- Benhall Site 10_11 Ecology Baseline Report in **Appendix A**;
- Halesworth Site 28 Ecology Baseline Report in **Appendix B**;
- Pakenham Site 54 Ecology Baseline Report in **Appendix C**;
- Benhall Site 10 & 11 - Baseline Hydrogeological Report in **Appendix D**;
- Water Monitoring Summary – Benhall Site 10 & 11, November 2020 to April 2021, Appendix E;
- Halesworth Site 28 - Baseline Hydrogeological Report in **Appendix F**;
- Water Monitoring Summary – Halesworth Site 28, November 2020 to April 2021, **Appendix G**;
- Pakenham Site 54 - Baseline Hydrogeological Report in **Appendix H**;
- Water Monitoring Summary – Pakenham Site 54, April 2021, **Appendix I**.

1.2.4 Brief summaries of each are presented in **Section 2**.

2 BASELINE REPORTS

2.1 Baseline Ecology Reports

2.1.1 The studies at each site comprise:

- A desk study;
- An extended Phase 1 habitat survey:
- A National Vegetation Classification (NVC) survey;
- A survey for signs of otter and water vole; and
- A survey of aquatic invertebrates of the ditches.

2.1.2 The status of each of these at the time of writing is detailed in **Table 1.1** and the detail is provided .

a) Benhall Site 10_11 Ecology baseline report (**Appendix A**)

i. Desk study

2.1.3 There are no statutory designated sites of nature conservation value within the Benhall site boundary, however a compartment of Manor Farm County Wildlife Site (CWS) is located within the red line, and a further compartment is located adjacent to the western Site boundary.

2.1.4 Coastal and floodplain grazing marsh, deciduous woodland and lowland meadows priority habitats are mapped in MAGIC as occurring on Site.

2.1.5 There are no records of protected or conservation notable species from within the Site, although there are records nearby.

2.1.6 There are no records for species listed in Schedule 9 of the *Wildlife and Countryside Act 1981* (as amended) on Site, although there are records nearby.

2.1.7 Thirteen waterbodies have been identified off-site but within 500m and there is a network of drains on site that feed into the River Fromus that forms the eastern site boundary. Great crested newts are not typically found in rivers, and the wettest drains on site are linked to the river and are likely to support fish, which would make them unfavourable for great crested newts. All off-site waterbodies, with the exception of W9, are separated from the site by a barrier to great crested newt migration. It is possible that W9 is the source of a great crested newt record, however

there is some uncertainty over this as the grid reference for the record is some distance away at a location with no waterbody.

ii. Phase 1 habitat survey

2.1.8 The habitats present on-site comprise:

- Semi-natural broadleaved woodland;
- Scattered trees;
- Poor semi-improved grassland
- Tall ruderal vegetation;
- Inundation vegetation;
- Flowing water and wet ditches;
- Amenity grassland; and
- Species-poor hedgerow.

2.1.9 In respect of potential for the site to support protected or conservation notable species:

- No evidence of badgers was found during the survey, although they are likely to be present in the vicinity of the site, given its rural location, and they may use the site in future
- The hedgerows and tree lines, wet ditch network, river and grassland on the site are considered suitable to support foraging and commuting bats and trees with potential to support roosting bats are also present, especially on the south-western boundary.
- There is general nesting bird potential in the woodland, all the boundary hedgerows and scattered boundary trees, and also within the scattered trees, scrub and grassland that occur across the site.
- The permanently wet ditches on site likely support fish, making them sub-optimal for great crested newts.
- The habitats present on-site (rough grassland, tall ruderal and wet ditches) provide foraging habitat for reptiles, whilst the roots of trees and hedgerow along with the debris present provides suitable hibernation areas.

- The River Fromus and ditches on site provide suitable habitat for use by both otter and water vole.
- The mix of habitats on- site including inundation vegetation and areas of short grassland through to woodland provides a variety of niches for terrestrial invertebrates.
- The ditches on-site support a variety of plant species, and would be expected to support a range of aquatic invertebrate species, potentially including some notable species.

2.1.10 In respect of controlled species:

- Giant hogweed and Himalayan balsam were present along the banks of the River Fromus. A small patch of giant hogweed was also noted within the Site.

iii. National Vegetation Classification (NVC) survey

2.1.11 The NVC survey identified six alliances within and on the margin of the floodplain and also a block of wet woodland on the valley toeslope. These vegetation types are assigned to the following NVC communities.

2.1.12 Floodplain and toeslope grasslands

- MG7b *Lolium perenne-Poa trivialis* leys
- MG7c *Lolium perenne-Alopecurus pratensis-Festuca pratensis* grassland
- MG10a *Holco-Juncetum effusi*, Typical sub-community
- MG10b *Holco-Juncetum effusi, Juncus inflexus* sub-community
- MG13 *Agrostis stolonifera-Alopecurus geniculatus* grassland

2.1.13 Dry, valleyside grassland

- MG6b *Lolio-Cynosuretum cristati, Anthoxanthum odoratum* sub-community

2.1.14 Wet woodland

- W6d *Alnus glutinosa-Urtica dioica* woodland, *Sambucus nigra* sub-community

2.1.15 Of these, the stands of *Holco-Juncetum* and *Lolium-Alopecurus-Festuca* grassland support suites of groundwater-influenced and typical floodplain species, respectively.

2.1.16 The *Holco-Juncetum* stands and the wet woodland were found to support the majority of phreatophyte species, with areas of 2.39 ha and 1.10 ha respectively, which, in total, account for 30.6 per cent of the surveyed area.

2.1.17 Based on this detailed survey, the *Holco-Juncetum* would be the key area of potential for fen meadow habitat creation, albeit as reported in Wood (2019), there additional areas which have some potential for fen meadow creation. The MG13 *Agrostis stolonifera-Alopecurus geniculatus* grassland also remains a locus for fen meadow creation assuming that ditch water levels can be controlled.

2.1.18 The associated ditch network supports emergent vegetation (and occasional aquatic species) which indicate that it is spring-fed and summer-wet. The stands of vegetation were assigned to the following NVC communities: S23 *Glycerio-Sparganion* marginal vegetation; S14 *Sparganietum erectae* swamp; S6 *Caricetum ripariae* swamp; and S28 *Phalaridetum arundinaceae* tall-herb fen.

2.1.19 The grassland and woodland habitats present qualify as coastal and floodplain grazing marsh and deciduous woodland respectively, habitats of principal importance listed under Section 41 (S41) of the *Natural Environment and Rural Communities Act 2006*.

iv. Otter and water vole survey

2.1.20 No sign of otter presence was recorded on site, although the river and some of the wet ditches provide suitable habitat, and there is an otter record nearby.

2.1.21 Four of the 18 transects surveyed provided optimal aquatic habitat for water voles, with a further two meeting most of the noted habitat requirements but holding less water, and eleven containing relatively shallow water. Water vole presence was confirmed on four transects (two ditches and two river transects).

v. Aquatic invertebrates of ditches and watercourses

2.1.22 The aquatic invertebrate fauna of the Benhall site comprises predominantly common and local species, which, as a result, score modestly using the approach defined by Palmer *et al.* (2013).

b) Halesworth Site 28 Ecology baseline report (**Appendix B**)

i. Desk study

2.1.23 There are no statutory, or non-statutory, designated sites of nature conservation value within the Site or immediately adjacent to it.

2.1.24 Coastal and floodplain grazing marsh priority habitat is mapped in MAGIC as occurring on Site.

2.1.25 The only records of protected or conservation notable species from within the Site is for a soprano pipistrelle foraging/commuting over the site, although there are records for other species nearby.

2.1.26 There are no records for species listed in Schedule 9 of the *Wildlife and Countryside Act 1981* (as amended) on Site, although there are records nearby.

2.1.27 Five water bodies are located off-site within 500m of the Site boundary. The Site also contains a network of drains. The River Blyth is present along the south-eastern boundary of the Site. All the off-site waterbodies are separated from the Site by some form of barrier to great crested newt migration. Great crested newts are not typically found in rivers, and the wettest drains on site are likely to support fish, which would make them unfavourable for great crested newts.

ii. Phase 1 habitat survey

2.1.28 The habitats present on-site comprise:

- Semi-improved neutral grassland;
- Wet ditches;
- Tall ruderal vegetation;
- Species-poor defunct hedge;
- Scrub;
- Scattered broadleaved trees; and
- Flowing water.

2.1.29 In respect of potential for the site to support protected or conservation notable species:

- No evidence of badgers was found during the survey, although they are likely to be present in the vicinity of the site, given its rural location, and they may use the site in future
- The hedgerows and tree lines, wet ditch network, river and grassland on the Site are considered suitable to support foraging and commuting bats. Trees with potential roosting features were limited to boundary trees in the hedgerow along the north-eastern boundary and scattered mature alder trees along the River Blyth
- There is general nesting bird potential in all the boundary hedgerows and scattered boundary trees, and also within the scattered trees and scrub that are spread across the Site.
- The permanently wet ditches on site likely support fish, making them sub-optimal for great crested newts.
- The habitats present on-site (rough grassland and wet ditches) provide foraging habitat for reptiles, whilst the tussocky grass and rush species on site provide suitable hibernation areas.
- The River Blyth and ditches on site provide suitable habitat for use by both otter and water vole.
- The site is likely to support a number of terrestrial invertebrates, although as a sheep and cattle grazed pasture, the assemblage is unlikely to be notable.
- The ditches on site support a variety of plant species, and would be expected to support a range of aquatic invertebrate species, potentially including some notable species.

2.1.30 In respect of controlled species:

- Himalayan balsam is present in several locations on site.

iii. Terrestrial and ditch plant communities

2.1.31 The NVC survey identified four distinct grassland-types within and on the margin of the floodplain and also a block of riparian fringe tall-herb vegetation. These vegetation types are assigned to the following NVC communities:

2.1.32 Grasslands

- OV23d *Lolium perenne-Dactylis glomerata* community, *Arrhenatherum elatius-Medicago lupulina* sub-community;
- MG7d *Lolium perenne-Alopecurus pratensis* grassland; and
- MG10b *Holco-Juncetum effusi, Juncus inflexus* sub-community.

2.1.33 Riparian fringe tall-herb vegetation

- OV26e *Epilobium hirsutum* community, *Urtica dioica-Cirsium arvense* sub-community.

2.1.34 The sward supporting the majority of phreatophyte species (Stand C2) is calculated to have an area of 1.06 ha, covering c.24 per cent of the survey area. Based on this detailed survey, this would be the key area of potential for fen meadow habitat creation, albeit as reported in Wood (2019), there is also a large area of the floodplain where ditch water could be detained above the layer of silty clay which also has some potential for fen meadow creation.

2.1.35 The associated ditch network supports stands of groundwater-dependent swamp species, notably two pond-sedges, forming S6 *Caricetum ripariae* and S7 *Caricetum acutiformis* swamps, and branched bur-reed stands of the S14 *Sparganietum erecti* swamp. Several small helophytes are also present, including fool's watercress, water mint, watercress, lesser water-parsnip and water forget-me-not. This group is also associated with groundwater influence and, where the tall swamp species are sub-ordinate, they form stands of the S23 *Glycerio-Sparganion* vegetation. The ditches also support alder sprouts near the catch dyke; this species only germinates and establishes successfully in summer-wet situations.

2.1.36 The habitats present qualify as coastal and floodplain grazing marsh, a habitat of principal importance listed under Section 41 (S41) of the *Natural Environment and Rural Communities (NERC) Act 2006*.

iv. Otter and water vole

2.1.37 No sign of otter presence was recorded on site. A number of ditches provided optimal water vole habitat and water vole presence was located on seven of the surveyed transects (3 different ditches).

v. Aquatic invertebrates of ditches and watercourses

2.1.38 The aquatic invertebrate fauna of the Halesworth site comprises predominantly common and local species, which, as a result, score modestly using the approach defined by Palmer *et al.* (2013).

c) Pakenham Site 54 Ecology baseline report (**Appendix C**)

i. Desk study

2.1.39 There are no statutory, or non-statutory, designated sites of nature conservation value within the Site. Pakenham Meadows SSSI is located adjacent to the Site, to the east of Pakenham Stream, and Pakenham Fen Meadows County Wildlife Site is also located to the east of Pakenham Stream.

2.1.40 Coastal and floodplain grazing marsh and deciduous woodland priority habitats are mapped in MAGIC as occurring on Site.

2.1.41 The only records of protected or conservation notable species from within the Site is for a house sparrow (albeit represented only by a 4 figure grid reference), although there are records for other species nearby.

2.1.42 There are no records for species listed in Schedule 9 of the *Wildlife and Countryside Act 1981* (as amended) on Site, although there are records nearby.

2.1.43 Twenty seven water bodies have been identified from ordnance survey mapping within 500m of the Site boundary, including a single waterbody on site in woodland at the southern end. The Site also contains a network of drains. Pakenham Stream forms the eastern site boundary, with a network of drains present on-site and within the wider area. Great crested newts are not typically found in rivers, and the wettest drains on site are likely to support fish, which would make them unfavourable for great crested newts. However, the on site pond, and those located to the west of the Site are not separated by a barrier to great crested newt migration.

ii. Phase 1 habitat survey

2.1.44 The habitats present on-site comprise:

- Semi-natural broadleaved woodland;
- Parkland and scattered trees – broadleaved;
- Parkland and scattered trees – mixed;
- Semi-improved neutral grassland;
- Marsh/marshy grassland;
- Improved grassland;

- Swamp;
- Standing water;
- Running water;
- Intact hedge native species poor;
- Defunct hedge native species poor;
- Bare ground.

2.1.45 In respect of potential for the site to support protected or conservation notable species:

- No evidence of badgers was found during the survey, although they are likely to be present in the vicinity of the site, given its rural location, and they may use the site in future.
- The mature trees, tree lines, hedgerows, wet ditch network, stream and grassland on the site are considered suitable to support foraging and commuting bats and trees. There were many mature oak and hornbeam trees in the hedgerows, woodland and individually in the fields, which were of sufficient age and size to support roosting bats. Overall these features make up continuous high-quality habitats for bats to use and therefore the site is high suitability for foraging and commuting bats following the Bat Conservation Trust Guidance (Collins, 2016).
- There is general nesting bird potential in the woodland, the hedgerows and parkland and scattered trees, as well as the grassland that occur across the site.
- The wettest drains on site are likely to support fish, which would make them sub-optimal for great crested newts however the on-site pond has potential to support great crested newts.
- The habitats present on-site (rough grassland, tall ruderal and wet ditches) provide foraging habitat for reptiles, whilst the roots of trees and hedgerow along with the log piles present provides suitable hibernation areas.
- The Pakenham Stream and ditches on site provide suitable habitat for use by both otter and water vole.

- The mix of habitats on- site including inundation vegetation and areas of short grassland through to woodland provides a variety of niches for terrestrial invertebrates.
- The ditches on-site support a variety of plant species, and would be expected to support a range of aquatic invertebrate species, potentially including some notable species.
- Brown hares (priority species) were seen in the fields.

2.1.46 No controlled species were recorded during the survey.

2.2 Baseline Hydrogeology Reports

2.2.1 The studies undertaken at each site comprise:

- A desk study to obtain existing data on the hydrological, hydrogeological and physical (e.g. topographic) conditions at each site;
- Survey work. An initial hand augering survey was undertaken in April 2019 to identify general substrate type and condition, sub-surface geological materials, presence of water table and areas of upwelling groundwater. Findings were reported in Wood (2019). Building on the 2019 findings, a programme of hydrogeological monitoring was designed and is being implemented, including:
  - Installation of gaugeboards to monitor surface water levels in site watercourses / drains;
  - Monitoring of deep and shallow groundwater conditions via piezometers and shallow dipwells. Each installation is visited monthly with water levels recorded manually as a spot check, but each is also fitted with a water level logger that records at 15 minute intervals and is downloaded on a quarterly basis.
  - Water quality sampling, undertaken quarterly;
  - A topographic survey to allow profiling of the land surface and channels so that water levels and ground levels can be related to a common datum to further inform potential water management options. The surveys comprised recording a series of predefined sections through each site, with a grid approach taken in the primary loci for fen meadow creation.

2.2.2 The status of each of these studies at the time of writing is detailed in **Table 1.1**.

a) Benhall Site 10 & 11 - Baseline Hydrogeological Report (**Appendix D**)

2.2.3 The Baseline Hydrogeological Report summarises the data available on the hydrological, hydrogeological and physical (e.g. topographic) conditions at the site, including drawing on the topographic survey and drilling logs for the groundwater monitoring installation points. A conceptual site model for the Benhall site has been developed based on these data, which focuses on the main elements which will influence the feasibility of creating fen meadow habitat at this site. The conceptual site model is presented below.

- The Benhall site covers an area of 12.9 ha. The Site can be considered as two land packages, site 10 in the north and site 11 in the south. A primary locus area for fen meadow is identified in both sites, along with areas for potential additional fen meadow. Annual average rainfall is for the area is *c.*606 mm.
- The surface elevation across much of Site 10 and the northern half of Site 11 is relatively flat, generally between 3.8 and 4.0 mAOD. At the margins of the site the land surface rises to 6.7 mAOD in the northwest near Aldecar Lane and to 5.2 mAOD in the southwest. The lower half of Site 11 has a more well defined slope from west to east towards the River Fromus and contains a cut-off meander channel with a bed level of approximately 3.5 mAOD.
- The River Fromus forms the eastern boundary of the Site and flows from north to south.
- The Benhall site is located in Flood Zone 3 (high probability of flooding) and falls within the high risk category with a greater than 3.3% chance of flooding from the River Fromus each year.
- Site 10 and 11 are separated by an ordinary watercourse named ‘The Canal’ which originates to the west of the A12 road. The Canal passes at right angle past two sides of the Benhall Sewage Treatment works before turning east again and discharging to the River Fromus. The Canal is the receiving watercourse for the Benhall Sewage Treatment Works discharge.
- The Benhall site is criss-crossed by a network of land drainage ditches which discharge to the River Fromus at three locations.
- Topographic surveys initially indicate that water levels coming on to the site from the west via the Canal are around 3.9 mAOD and on-site

drainage ditches generally between 3.5 and 3.8 mAOD (November 2020). Ditch water levels are slightly lower in the southern half of Site which do not appear to be well connected to other ditches or to the River Fromus.

- The bedrock geology at the site is Crag sands (c.10-20m thick) overlying London Clay of the Thames Group. The combined thickness of the Thames Group and Lambeth Group in this locality is thought be c. 25-30 metres in this locality. The Lambeth Group lies unconformably over the Chalk Group.

- Alluvial deposits of clay, silt, sand and gravel directly overlie the Crag at the Benhall site and borehole logs indicate that they increase in thickness from around 7.7m in the south to >10m in the north of the Site. Head deposits of clay, silt, sand and gravel are mapped at the western edge of the Alluvium close to the boundary of the Site.

- Development of Peat has occurred in the northern half of Site 11 and in Site 10 and is encountered between 0.4 and 2.5 m below ground surface. The borehole logs indicate a peat thicknesses of up to 4 m thick in places. Soils cores show that a silty clay layer is often present above the Peat which may hold a higher water level than that of the underlying sands and gravels. The basal part of the peat was more degraded than the upper part in some areas which may indicate that the groundwater level is fluctuating through the lower part, though it may rise through the peat during periods of heavier rainfall.

- The soils core surveys carried out in April 2019 indicated that the initial water table was generally between 0.5m and 1m below ground level, rising to 0.4 and 0.1m below ground level at two locations after rest. The rising groundwater levels indicates that water in the peat and sands and gravels beneath the silty clay layer near the surface has a positive hydrostatic pressure in some locations. The October 2020 drilling programme recorded similar rest ground water levels (0.48 to 0.84m). General groundwater flow is thought to be towards the River Fromus (west to east) but collected data from the surveys suggest a relatively flat water table at the Benhall site.

- The soil core surveys, drilling logs and topographic survey indicate that groundwater levels are in continuity with surface water levels in the on-site ditches. The River Fromus has a bed level of 2.8 mAOD and a water level of 3.51 mAOD at the northern end of the Benhall site and this gently decreases downstream to a bed level of 2.3 mAOD and a water level of 2.9 mAOD at the southern end of the Benhall site, indicating the potential for groundwater discharge to the river.

- There is a licenced surface water abstraction from the River Fromus on the edge of the Site 11 boundary (AN/035/0004/017), although this is toward the downstream end of the site away from the potential Fen Meadow areas. The groundwater abstraction at Ham Farm (7/35/04/*G/0095) is relatively close to (0.2km), and upgradient of, the Site and therefore has the potential to impact groundwater levels on the Site. The impact is likely to be minimal due to the relatively low abstraction quantities.

- The River Fromus is gauged at Benhall Bridge (Ref No. 35016), *c.*1.2km upstream of the Benhall site. The average flow is 0.059 m^3/s (5.1 Ml/d). The Benhall Sewage Treatment Works discharge to The Canal which flows through the Site and discharges to the River Fromus. The licensed discharge volume is 1.5 Ml/d.

- Monitoring will continue for a period of 12 months from November 2020 to further develop and refine this conceptual site model.

b) Water Monitoring Summary – Benhall Site 10 & 11, November 2020 to April 2021 (**Appendix E**)

2.2.4 The note summarises water monitoring data collected from November 2020 to April 2021 at the Benhall site. The note is a factual presentation of the data rather than an interpretive report.

c) Halesworth Site 28 - Baseline Hydrogeological Report (**Appendix F**)

2.2.5 The Baseline Hydrogeological Report summarises the data available on the hydrological, hydrogeological and physical (e.g. topographic) conditions at the site, including drawing on the topographic survey and drilling logs for the groundwater monitoring installation points. A conceptual site model for the Halesworth site has been developed based on these data, which focuses on the main elements which will influence the feasibility of creating fen meadow habitat at this site. The conceptual site model is presented below.

- The Halesworth site covers an area of 4.3 ha. The primary locus area for fen meadow has an area of 1.2 ha and the potential additional area for fen meadow is 1.3 ha. Annual average rainfall is for the area is *c.*602mm.

- The surface elevation slopes gently from northwest to southeast towards the Walpole River, which is a main river that flows north-easterly. Ground elevations are highest in the northwest at 7.5-8.25 mAOD, flattening out to between 6.6-7 mAOD across much of the Site. The Walpole River cuts a channel past the south-eastern

boundary of the Site and has relatively steep banks, particularly to the south.

- The Halesworth site is located in Flood Zone 3 (high probability of flooding) and falls with the medium risk category with a 1% to 3.3% chance of flooding from the Walpole River each year.

- The Halesworth site is criss-crossed by a network of land drainage ditches many of which feed into a main catch dyke which runs from southwest to northeast and drains north-eastwards past the Halesworth Sewage Treatment Works. Surface drainage from Blyth Road industrial estate is culverted beneath the catch dyke but discharges to an open ditch and is conveyed along the lower part of the site before discharge to the Walpole River via a second culvert.

- Data obtained from the topographic surveys initially indicate that water levels in the catch dyke and attached drainage ditches are between 6.4-6.5 mAOD (November 2020). The Blyth Road drainage channel (W6) recorded a water level of 5.69 mAOD during the survey visit and Walpole River levels were 5.6 mAOD.

- The bedrock geology at the site is Crag sands (c.21-26m thick) overlying London Clay. Although the Site is near the feather edge of the London Clay it is recorded to have a >10m thickness at the deeper on site borehole. The London Clay overlies the Chalk. Superficial deposits of Lowestoft Sands and Gravels overlie the Crag sands which are in turn overlaid by a combination of Alluvium (clay, silt, sand and gravel) and Head deposits.

- Development of Peat has occurred on the southern side of the catch dyke and is encountered between 0.4 and 0.7 m bgl with a thickness of 1.1m at borehole HAL_2803_d. Soils cores show that a silty clay layer is often present above the Peat and is likely to impede movement of groundwater, rainwater and also flood water.

- The soil core survey (April 2019) indicated that groundwater levels were within the Peat (often below its upper surface) between 0.45 and 0.9 m bgl. The October 2020 drilling programme, which occurred during a relatively wet few weeks, showed a slightly higher rest groundwater level between 0.07 and 0.2 m, which indicates that the upper part of the peat may experience seasonal wetting and drying as the water table changes. Groundwater flow is generally toward the Walpole river in the southeast.

- Groundwater in the deeper Crag sands is under positive hydrostatic pressure, resulting in slightly artesian conditions at piezometer HAL_2803_d. This indicates the presence of semi-confining clay layers within the Crag.

- The soil core surveys, drilling logs and topographic survey indicate that groundwater levels are in continuity with surface water levels in the on-site ditches. The catch dyke intercepts groundwater flow from the northwest. Beyond the catch dyke to the southeast the water table flattens out and is higher than the Walpole River water level, indicating the potential for groundwater discharge to the river.

- There are two significant groundwater abstractions licences for public water supply from six boreholes within 1.2km of the Halesworth site. These abstractions are sourced from the Chalk aquifer and their potential impact on near surface groundwater levels below the Site is likely to be small due to the presence of London Clay and semi-confining clay layers within the Crag. Nevertheless, the Site falls within Zone 3 of the groundwater protection zones for those sources.

- The Halesworth Sewage Treatment Works discharge to the Walpole River approximately 50m upstream of the Site. The licensed discharge volume is 3.553 Ml/d. Flow is not gauged in the Walpole River. The closest permanent flow gauging station is located on the River Blyth approx. 2km downstream (east) of the Site at Holton (Ref No. 35013) which has an average flow of 0.46 m^3/s (39.7 Ml/d).

- Monitoring will continue for a period of 12 months from November 2020 to further develop and refine this conceptual site model.

d) Water Monitoring Summary – Halesworth Site 28, November 2020 to April 2021 (**Appendix G**)

2.2.6 The note summarises water monitoring data collected from November 2020 to April 2021 at the Halesworth site. The note is a factual presentation of the data rather than an interpretive report.

e) Pakenham Site 54 - Baseline Hydrogeological Report (**Appendix H**)

2.2.7 The Baseline Hydrogeological Report summarises the data available on the hydrological, hydrogeological and physical (e.g. topographic) conditions at the site, including drawing on the topographic survey and drilling logs for the groundwater monitoring installation points. A conceptual site model for the Halesworth site has been developed based on these data, which focuses on the main elements which will influence

the feasibility of creating fen meadow habitat at this site. The conceptual site model is presented below.

- The Pakenham site covers an area of 32.7 ha. The primary locus area for fen meadow has an area of 6.1 ha and the potential additional area for fen meadow is 12.05 ha.
- Annual average rainfall is for the area is c.602mm.
- The surface elevation slopes gently from northern boundary towards the central drain and then rises slightly back up to the Pakenham Stream, which is a main river that flows north-easterly towards Grimstone End. Ground elevations between 30.5 and 31 mAOD across the Site.
- The Pakenham site is in Flood Zone 3 (high probability of flooding) and falls within the medium risk category with a 1% to 3.3% chance of flooding from the Pakenham Stream each year.
- The Pakenham site is criss-crossed by a network of land drainage ditches. The main ditch across the site runs from south to north parallel with the Pakenham Stream. This central drain is bisected by a second west-east primary drain; both ditches appear to be carriers for near-surface groundwater. The Pakenham stream is, at least in appearance, elevated above the floodplain. There are several small boundary drains which appear to drain along the upland margin and run to the main central drain.
- Site visits have identified a breach in the Pakenham Stream bank where the stream crosses over the west-east drain, which is culverted at this location. The flow, from east to west, in to the site in this drain, and subsequently in to the central drain, is being supported by flow from Pakenham Stream via this breach. This 'leak' was also confirmed by Pakenham Mill.
- A visit to the Mill site also confirmed that the central drain flows north from the site, under the road before entering a culvert within which is crosses back under the Pakenham Stream and discharges downstream of the Pakenham Mill Pond.
- Data obtained from the topographic surveys initially indicate that water level in the central drain is around 30.4 mAOD. The lowest channel elevation recorded in the topographic survey was 28.6 mAOD. Groundwater levels across the site recorded at between around 29.5 mAOD and 30.6 mAOD for the same day.

- Data obtained from the topographic surveys initially indicate that water level in the Pakenham Stream is around 31.1 mAOD. The lowest elevation of the channel bed on the short Pakenham Stream reach surveyed was 29.9 mAOD. The Pakenham Stream is at a higher elevation that the central drain, although there is still likely continuity between the Pakenham Stream and groundwater levels.

- The Pakenham Site covers the valley floor of the Pakenham Stream. The bedrock geology underlying the Site is Chalk. The chalk is overlain by superficial deposits of varying thicknesses; the most dominant is Peat, but there are also river terrace sands and gravels and Head deposits which thin towards the western margin. The boundary to the west is the upland toeslope. The margin of this upland is composed of sands and gravels. The upland also has a pronounced sandy terrace toeslope occupying much of the northern part of this site. To the east, the site is bounded by the Pakenham Stream.

- There is a buried valley that dissects the site which is infilled with Glacial Till.

- Regionally, groundwater flow in the Chalk is towards the Little Ouse but is considered to deflect towards the Pakenham Stream locally and to the north-east regionally. Chalk groundwater levels are generally considered to be at between 32 mAOD and 36 mAOD.

- Locally, the water table in the superficial deposits is modelled as flowing towards the Pakenham Stream and is considered to be at between 32 mAOD and 36 mAOD.

- Development of Peat has occurred at the site and is encountered between 0.1 and 0.6 mbgl with a thickness of up to 2.9 m at borehole PAK-HA-2. Soils cores show that where present the peat is between 30 and 110 cm thick. Most cores exhibited the deposition of peat over sand, with chalky boulder clay or 'putty' chalk proved in cores in the centre of the survey or the southwest corner, respectively.

- The soils cores also showed little in terms of the water. It is likely that the historical water table relates to the zones of sapric peat or, in Core 9, where manganiferous streaks were proved. It is also evident that where peat is at the ground surface, it is in poor condition, and recorded as earthy peat. The reduction of the water table from the ground surface is clearly long-standing.

- The only significant groundwater abstraction nearby is for public water supply from two boreholes within 1km of the Pakenham site. The

abstraction is sourced from the Chalk aquifer and their potential impact on near surface groundwater levels below the Site is likely to be minimal due presence of the buried valley, and given the groundwater protection zone follows up the Black Bourne River and does not intersect the site.

- Two surface water abstraction points, from one abstraction licence, are located on the ditches on site. One further abstraction, which abstracts during the winter, is located on the Pakenham Stream adjacent to the site and piped to the west under the site.
- Monitoring will continue for a period of 12 months from April 2021 to further develop and refine this conceptual site model.

f) Water Monitoring Summary – Pakenham Site 54, April 2021 (**Appendix I**)

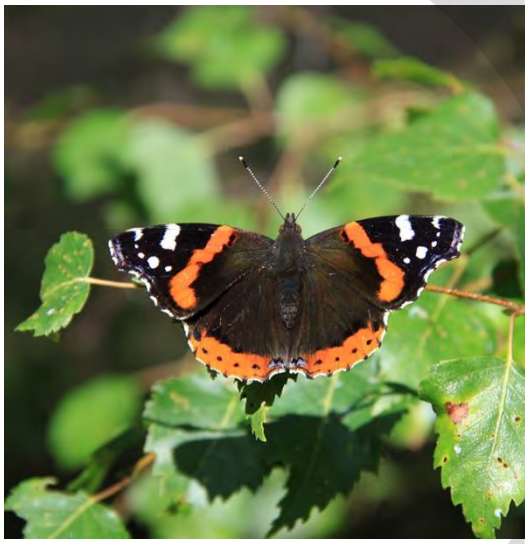
2.2.8 The note summarises water monitoring data collected from April 2021 at the Pakenham site. The note is a factual presentation of the data rather than an interpretive report.

APPENDIX A: BENHALL SITE 10_11 ECOLOGY BASELINE REPORT

EDF Energy

Sizewell C

Fen Meadow Compensation Sites: Benhall Site 10_11 Baseline Ecology Report



Wood Group UK Limited – June 2021

Report for

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Document revisions

No.	Details	Date
1	for client comment	09/11/20
2	Final	08/06/21

Contents

1. Introduction

1.1 Background

The proposed development platform for Sizewell C will extend a short distance into the eastern margins of Sizewell Marshes Site of Special Scientific Interest. The toe of the batter of the proposed platform will define the extent of permanent land-take but, additional to that, ditch re-alignment is required which will take a limited amount of further land.

Based on National Vegetation Classification (NVC) survey data the main affected habitats are M22 *Juncus subnodulosus – Cirsium palustre* fen meadow, S26 *Phragmites australis - Urtica dioica* tall-herb fen, S4 *Phragmites australis* reedbed and some W5 *Alnus glutinosa – Carex paniculata* wet woodland.

Studies focussed on the provision of compensatory fen meadow habitat, particularly M22 *Juncus subnodulosus – Cirsium palustre* fen meadow were reported in Wood (2018). Five sites were identified for further investigation, whilst 17 sites were put on hold subject to further assessment of the initial five sites. The five sites identified for further investigation (Wood (2018)) were:

- Site No. 10 – Aldecar Lane, Benhall;
- Site No. 11 – Watering Lane, Benhall;
- Site No. 28 – Halesworth;
- Site No. 33 – Stratford St Andrew; and
- Site No. 54 – Pakenham Fen.

Subsequently, one day site visits to Sites 10, 11, 28 and 54 were undertaken in April and May 2019. Site 33 was not visited as access had not been agreed at the time (Wood, 2019), however, following further consideration of the site characteristics and suitability for fen meadow creation, it was also concluded that the sites that were taken forward all provide greater potential for fen meadow creation than Site 33.

The one day site visits to Sites 10, 11, 28 and 54 comprised:

- A walkabout survey to identify areas where (1) the peat is currently influenced by groundwater or near-surface seepage; and (2) fen meadow species are present within or close to the site margins;
- A reconnaissance hand augering survey to identify general peat quality (substrate condition), sub-surface geological materials, presence of water table and areas of upwelling groundwater; and
- Consideration of broad options for water management and potential for changes to land management.

Findings were reported in Wood (2019). Sites 10, 28 and 54 were all identified as having potential for the development of fen meadow as follows:

- Site 10: primary locus 1.5ha, further area 0.7ha (Site 11 has relatively limited potential (primary locus of 0.5ha although part already supports fen meadow species, and further area of 1.2ha) but is close to Site 10, so warrants further consideration in that context);
- Site 28: primary locus 1.2ha, further area 1.3ha;
- Site 54 north: primary locus 3.2ha, further area 6.2ha; and

- Site 54 south: primary locus 1.7ha, further area: 4.3ha.

Subsequently EDF has progressed with detailed site conceptualisation and feasibility assessment work at Sites 10/11, 28 and 54.

The scope of the conceptualisation and feasibility assessment work can be summarised as follows:

- Ecological studies:
  - Desk based review of ecological data for the sites and surrounding area; and
  - Targeted ecological surveys.
- Hydrological studies:
  - Desk based review of available groundwater level data (including output from the Environment Agency model for high, low and average groundwater level conditions) and the seasonal variation in groundwater levels. Also, effects of groundwater abstraction on groundwater levels below the site;
  - Collection of topographic data;
  - Collection of surface water level and groundwater level data to determine the relationship between groundwater and surface water levels on site. Also detailed study of the existing and wider ditch network to determine potential for water management without risk to upstream receptors; and
  - Collection of hydrochemical data.

1.2 This report

The scope of the studies undertaken were defined following consideration of:

- The habitat types present on-site defined from the one day visit undertaken in the previous project phase;
- The types of ecological receptor that would be expected to occur in such habitats in Suffolk, based on professional judgement; and
- The potential activities and related impacts of creating fen meadow habitat, principally through raising water levels, on such sites.

The studies undertaken have comprised:

- A desk study;
- An extended Phase 1 habitat survey;
- A National Vegetation Classification (NVC) survey;
- A survey for signs of otter and water vole; and
- A survey of aquatic invertebrates of the ditches.

This report presents the ecological baseline for Benhall, Sites 10 and 11 combined (hereafter the 'Benhall site' or 'the Site') (Figure 1.1). In this report, where possible, common species names are used in the text, though scientific names may also be used for clarity, particularly in naming the published community-types and in instances when the given common names are not widely used. Common and scientific names of species referred to in this report are presented in Appendix A.

The structure of this report is as follows:

- Section 2 presents the methods and results of a desk study;
- Section 3 presents the methods and results of an extended Phase 1 habitat survey;
- Section 4 presents the methods and results of a National Vegetation Classification survey;
- Section 5 presents the methods and results of a survey for water voles, and otters;
- Section 6 presents the methods and results of a survey of aquatic invertebrates of the ditches on site; and
- Section 7 presents a brief summary of the findings.

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636000 637000 638000 639000 640000 641000

263000 262000 261000 260000 259000 258000

Dodd's Wood
Hill House Farm
Shingle Farm
Keepers Cottage
High House Farm
Tythe Cottage
Cottage Farm
Kiln House
Old Lodge
Church Bungalow
Barn Cottages
Walnut Tree Farm
Home Farm
Benhall Street
Blythe Lodge
Stratford Hall
Stratford St Andrew
Farnham
Main Road
Mollett's Farm
The Old Police House
Farnham Hall Farm House
Walk Barn Farm
Pond Barn Cottages
Hill Farm
Sink Farm
Beversham Mill
Gorse Farm
The Old
Mill Hole
Saxmundham
Wardspring Farm
Buxlow Cottage
Hall Farm House
Hurtshall Park
Wood Farm
Trust Farm
Meadow Farm
Kiln Farm
Boundary House
Enchanted Cottage
Mitford House
Benhall Green
Hill Farm
Red House Farm
High House Farm
Little Moor Farm
Clouting's Farm
Baldrys Cottage
Sternfield
Moor Farm
Honey Pot Lodge
Meadowcroft
Friston House
Manor Farm House
Friston Hall Cottages
Friston Hall Cottage
Friston
Watering Fm
Watering Farm
Hillcrest
Monks Valley House
Botany Farm
Racewalk Covert
Snape Watering
Farnham Road
Church Common
Priory Lodge
The Priory
Firs Farm
Firs Farm Cottages
The Gate House
Botany Farm
Gromford
Chagford
Rookery Farm
Burnt House Farm
Sailors Path Cottages
The Street
Abbey Farm
New England Farm
B1119
B1121
A12
A1094

Key

Site 10 _11 boundary

0 250 500 750 1,000 m

Scale at A3: 1:20,000

Fen Meadow Compensation Sites:
Benhall Site 10_11

Figure 1.1
Site No. 10 and 11 location plan

November 2020

wood.

2. Desk study

2.1 Method

A data-gathering exercise was undertaken in July 2020 to obtain information relating to statutory and non-statutory biodiversity sites (excluding sites designated for geological features of interest); species or habitats of principal importance for the conservation of biodiversity; legally protected and controlled species; and other conservation-notable habitats or species (see Boxes 2.1 and 2.2).

Box 2.1 – Designated Biodiversity Sites, and Priority Habitats and Species

Statutory Biodiversity Sites

- European sites: Important biodiversity sites designated under international law or treaties. European sites are any Special Area of Conservation (SAC) from the point at which the European Commission and the UK Government agree the site as a 'Site of Community Importance' (SCI); any classified Special Protection Area (SPA); any candidate SAC (cSAC); and (exceptionally) any other site or area that the Commission believes should be considered as an SAC but which has not been identified by the Government. This term is also commonly used when referring to potential SPAs (pSPAs), to which the provisions of Article 4(4) of Directive 2009/147/EC (the 'new wild birds directive') apply; and to possible SACs (pSACs) and listed Ramsar sites, to which the provisions of *The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019* (the Habitats Regulations) are applied as a matter of Government policy (NPPF para 118) when considering development proposals that may affect them;
- Sites of Special Scientific Interest (SSSIs): Nationally important sites notified under the *Wildlife and Countryside Act 1981* (as amended) that provide the best examples of the UK's flora, fauna, or geological or physiographical features (note, this assessment focuses on those sites notified for their biodiversity interest);
- National Nature Reserves (NNRs): Nationally important sites notified under the National Parks and Access to the Countryside Act 1949 and the Wildlife and Countryside Act 1981; in practice most NNRs are SSSIs also;
- Local Nature Reserves (LNRs): statutory sites that are designated under the *National Parks and Access to the Countryside Act 1949* with the objective of encouraging their use for the study, research or enjoyment of nature. If an LNR has no other statutory or non-statutory designation it is treated as being of borough/district-level importance for biodiversity (although it may be of greater socio-economic value).

Non-statutory Biodiversity Sites

Non-statutory biodiversity sites in Suffolk are known as County Wildlife Sites (CWS) or Potential CWS (pCWS) or Candidate Local Wildlife Sites (cLWS).

Other important habitats or species

Species or habitats of "*principal importance for the conservation of biodiversity*" are those listed by Natural England (NE) pursuant to Section 41 of the *Natural Environment and Rural Communities Act 2006* (as amended). These include those UK Biodiversity Action Plan (BAP) priority habitats and species that occur in England. They are commonly referred to as 'Section 41' or 'S.41' habitats or species.

Other conservation-notable habitats and species would include:

- Species listed as being of conservation concern in the relevant UK Red Data Book (RDB) or the Birds of Conservation Concern 4 Red List (Eaton *et al.* 2015);
- Ancient woodland (i.e. areas that have been under continuous woodland cover since at least 1600) on the Ancient Woodland Inventory (AWI);
- Nationally Rare and Nationally Scarce species in the UK, which are species recorded from, respectively, 1-15 and 16-100 hectads (10x10km squares of the UK national grid);
- Populations of birds comprising at least 1% of the relevant British breeding/wintering population (where data are available).
- Priority habitats and species listed in the Suffolk Biodiversity Action Plan (LBAP);
- Other species or assemblages such as large populations of animals considered uncommon or threatened in a wider context; and
- Important hedgerows as defined using the habitat criteria in *The Hedgerows Regulations 1997*.

Box 2.2 – Legally Protected and Controlled Species

Legal Protection
Many species of animal and plant receive some degree of legal protection. For the purposes of this report, legal protection refers to:

- Species included on Schedules 5 and 8 of the *Wildlife and Countryside Act 1981* (as amended), excluding species that are only protected in relation to their sale (see section 9[5] and 13[2]);
- Species included on Schedules 2 and 5 of *The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019*; and
- Badgers, which are protected under the *Protection of Badgers Act 1992*.

Further detail on the legislative protection afforded to species and sites is provided in Appendix B.

Legal Control
Schedule 9 of the *Wildlife and Countryside Act 1981* (as amended) lists species of animal that it is an offence to release or allow to escape into the wild (for example grey squirrel) and species of plant that it is an offence to plant or otherwise cause to grow in the wild (for example, Japanese knotweed).

Data were obtained for:

- Statutory designated sites within 2km of the Site boundary;
- Other statutory and non-statutory sites designated for their nature conservation interest within 1km;
- Habitats of principal importance for the conservation of biodiversity, or other conservation-notable habitats recorded within 1km; and
- Protected species, species of principal importance for the conservation of biodiversity, or other conservation-notable species recorded within 1km.

The geographical context of the Site was examined using the relevant Ordnance Survey 1:10,000 scale maps and freely-available aerial photographs, to identify key landscape features that may be important for protected or conservation-notable species, such as potential migration or dispersal routes, or any potential receptors of site-derived pollutants in the wider landscape.

The sources of desk study information were:

- MAGIC (the government environmental information partnership project) www.magic.gov.uk;
- Natural England (https://designatedsites.naturalengland.org.uk/);
- Joint Nature Conservation Committee (JNCC, http://jncc.defra.gov.uk/page-4); and
- Suffolk Biodiversity Information Service (https://www.suffolkbis.org.uk/biodiversity/speciesandhabitats).

2.2 Results

Designated Sites

There are no statutory designated sites present on-site, however, there is one within 2km: Gromford Meadow SSSI located 1.1km south of the Site.

The site falls within the Impact Risk Zone for Gromford Meadows SSSI, located 1.1km south, and also for the Alde-Ore Estuary and other nearby SSSI. Creation of fen meadow does not, however, fall within the criteria that would require consultation with Natural England in respect of risk to these SSSIs.

A compartment of Manor Farm CWS is located within the red line boundary, and a further compartment is located adjacent to the western Site boundary (Figure 2.1). There are a further three non-statutory designated sites within 1km. One, Foxburrow Wood CWS, is also designated as ancient woodland.

The interest features of the designated sites are summarised in Table 2.1 and locations are shown in Figures 2.1 and 2.2.

Table 2.1 Designated Nature Conservation Sites

Designation	Distance from Site Boundary	Description
Statutory Designated Sites within 2km		
Gromford Meadow SSSI	1.1km south.	The site consists of unimproved base-rich marsh on an alluvial soil with a high organic content. It borders the River Alde and is fed by springs. It is species-rich and contains a variety of characteristic fen meadow and marshland plants.
Non-Statutory Designated Sites within 1km		
Manor Farm Meadows CWS	The CWS consists of two meadows, one of which is located adjacent to the western site boundary and the second forms a small part of the north-western end of the Site.	The CWS site consists of small wet meadows which support good wet grassland flora typical of lowland grazing meadows (biodiversity priority habitat), with the wettest areas near the drains consisting of fen. The second meadow, part of which lies within the boundary of the Site, contains a richer flora with good colonies of southern march orchids and a greater diversity of marsh flowers. Floristic diversity has benefited from traditional grazing in the past, preventing it from becoming rank and overgrown, reducing diversity.
Benhall Green Meadows CWS	0.42km north	A series of meadows which form one of the largest remaining areas of flower-rich marsh in the Alde catchment. They are bordered by the River Fromus and contain a wide range of wet meadow plants. The site is managed by a combination of hay cutting and/or grazing.
River Fromus Marshes CWS	0.97km south	The site consists of complex habitats bordering the River Fromus at Gromford which include: drier open areas of bracken with scattered oak standards, river banks with sallow and overhanging willows, managed areas which have been planted with oak and field maple, and wet marshland with old willows and willow/alder carr. A wet meadow located to the south of Gromford Meadow SSSI contains similar species rich flora.
Foxburrow Wood CWS (which includes two Ancient woodland sites Foxburrow and Palent's Grove)	0.74km south	The site is an ancient woodland on sandy soils with a variety of tree species including oak, ash beech (some very mature), hazel, field maple, hawthorn and hornbeam. The shrub layer includes elder and holly, and the ground flora includes ferns, bluebells and dog's-mercury.

Priority Habitats

MAGIC indicates that four priority habitats are located within 1km of the Site, with three identified as being present on-site (the nearest distance provided for each priority habitat):

- Coastal and floodplain grazing marsh (forms much of the Site);
- Deciduous woodland (forms part of the Site);
- Lowland meadows (forms part of the Site); and

- Wood pasture and parkland (0.49km west).

Species Records

A summary of the key species records within 1km of the Site are presented in Table 2.2

Table 2.2 Protected and conservation notable species within 1km

Common Name	Distance of closest record from Site	Protection		Other Conservation Criteria (as identified on SBIS records)
		HR	WCA	
Herpetofauna				
Common lizard	0.1km west		✓	✓ (S41)
Grass snake	0.4km north-east		✓	✓ (S41)
Great crested newt	0.13km west	✓	✓	✓ (S41)
Slow worm	0.6km north-west		✓	✓ (S41)
Mammals				
Badger	0.4km west			✓ (PBA)
Brown Hare	0.8km north-west			✓ (S41)
Hedgehog	0.2km south-west			✓ (S41)
Otter	0.1km north-east	✓	✓	✓ (S41)
Brown long-eared	0.3km north-east (R)	✓	✓	✓ (S41)
Common pipistrelle	0.3km north-east (F/C)	✓	✓	
Daubenton's bat	0.2km south-east	✓	✓	
Leisler's bat	0.4km north-east (F/C)	✓	✓	✓ (S41)
Noctule bat	0.3km north-east (F/C)	✓	✓	✓ (S41)
Pipistrelle bat	0.4km north-east (R)	✓	✓	
Soprano pipistrelle	0.2km south-east (F/C)	✓	✓	✓ (S41)
Birds				
Barn owl	0.1km south		✓*	
Dunnock	0.1km east			✓ (S41)
House sparrow	0.2km north			✓ (RL, S41)
Pintail	0.6km south		✓*	
Starling	0.2km north			✓ (RL, S41)
Fish				

Common Name	Distance of closest record from Site	Protection		Other Conservation Criteria (as identified on SBIS records)
		HR	WCA	
Brook lamprey	0.1km south-east	✓**		✓ (RL, **HR Annex 2)
European eel	0.1km south-east			✓ (ER, S41)
Invertebrate				
Ghost moth	0.5km north-east			✓ (RL, S41)
Grayling	0.9km south-west			✓ (RL, S41)
Small heath	0.8km south-west			✓ (RL, S41)
Small square-spot	0.5km north-east			✓ (RL, S41)
Vascular plants				
Round-leaved mint	0.2km south-east			✓ (NS)
Fungus				
Sandy stilt puffball	0.6km north			✓ (S41)

* Schedule 1 (*Wildlife and Countryside Act 1981*)
The other principle protective legislations for individuals of a species in England are:
WCA – *Wildlife and Countryside Act 1981* (as amended)
PBA – *Protection of Badgers Act 1992*
ER- *The Eels (England and Wales) Regulations 2009*
HR – *The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019*, ** HR Annex 2 only
S41 – Section 41 species; see Box 2.1
RL – Red list species; see Box 2.1
NS – Nationally scarce, see Box 2.1.

A MAGIC search found a great crested newt (GCN survey) record approximately 135m west of the Site (dated 9 June 2017).

There were also two records for black poplars which were classed as Ancient Veteran Trees, one to the south of the Site at NGR TM3819060204 and the second to the east of the Site at NGR TM3818160459.

The search also identified lapwing, redshank, stone-curlew and turtle dove to be present within 1km of the Site (however, national grid references were provided).

Non-native Species / Notifiable Weeds

There were no records for species listed in Schedule 9 of the *Wildlife and Countryside Act 1981* (as amended) found on Site. However, the following Schedule 9 species were found within 1km (with the nearest record to Site):

- Canadian waterweed 0.5km north-east;
- Indian balsam 0.5km north-east;
- Yellow archangel 0.5km north-east;
- American mink 0.1km north-east; and
- Grey squirrel 0.8km south.

Waterbodies

The River Fromus forms the eastern site boundary, with a network of drains present on-site and within the wider area which feed into the river. Great crested newts are not typically found in rivers, and the wettest drains on site are linked to the river and are likely to support fish, which would make them unfavourable for great crested newts.

Thirteen further waterbodies are located off-site within 500m of the Site boundary (Table 2.3 and Figure 2.3). The majority of the off-site waterbodies are separated from the site by some form of barrier to newt migration (river, road, drains likely containing fish), although it is considered possible that, if newts were present in W9, it is possible they may reach the site. It is possible that W9 is the source of the great crested newt record referred to above, although the grid reference does not match (this being for a location with no pond to the south-west of W9 and across the railway.

Table 2.3 Water bodies within 500m of the Site

Water bodies	NGR	Distance and direction from Site	Description
W1	TM3853 6076	76m north	Large waterbody, may contain fish, and separated from site by drain linked to river.
W2	TM3859 6096	274m north	Large waterbody, may contain fish, and separated from site by drain linked to river.
W3	TM3849 6204	340m north	Pond separated from site by drain linked to river
W4	TM3865 6106	408m north	Waterbody likely to be connected to drainage network and may contain fish.
W5	TM3795 6104	390m north-west	Pond which is separated from Site by a minor road.
W6	TM3792 6094	272m north-west	Pond which is separated from Site by a minor road.
W7	TM3831 6046	10m east	Large waterbody, may contain fish, and separated from site but the River Fromus.
W8	TM3826 6040	10m east	Pond, separated from site by the River Fromus
W9	TM3807 6031	40m east	Detached waterbody. May contain fish.
W10	TM3872 6047	395m east	Pond, separated from site by the River Fromus
W11	TM3822 6012	17m east	Pond, separated from site by the River Fromus
W12	TM3833 6008	82m east	Pond, separated from site by the River Fromus
W13	TM3820 5968	195m south-west	Detached waterbody separated from Site by the A1095 road.

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636000 637000 638000 639000 640000 641000

263000 262000 261000 260000 259000 258000

N

Dodd's Wood
Shingle Farm
Keepers Cottage
High House Farm
Tythe Cottage
Kiln House
Cottage Farm
Old Lodge
Church Bungalow
Barn Cottages
Walnut Tree Farm
Home Farm
Benhall Street
Blythe Lodge
Stratford Hall
Stratford St Andrew
Farnham
Chapel Cottages
Main Road
Parkgate Farm
Farnham Hall Farm House
Walk Barn Farm
Pond Barn Cottages
Hill Farm
Sink Farm
Beversham Mill
Gorse Farm
The Old Rectory
Grove Farm
Burnt House Farm
Botany Farm
The Gate House
Racewalk Covert
Gromford
Chagford
Abbey Farm
The Street
Rookery Farm
Sailors Path Cottages
New England Farm
Firs Farm Cottages
The Priory
Priory Lodge
Church Common
Farnham Road
Snape Watering
Monks Valley House
Hillcrest
Watering Fm
Manor Farm House
Friday Street
Mollett's Farm
The Old Police House
Honey Pot Lodge
Meadowcroft
Friston Hall Cottages
Friston Hall Cottage
Friston
Mill Hole
Saxmundham
Kiln Farm
Boundary House
Enchanted Cottage
Mitford House
Benhall Green
Sternfield
Hall Farm House
Hurtshall Park
Wood Farm
Wardspring Farm
Trust Farm
Meadow Farm
Buxlow Cottage
Clouting's Farm
Hill Farm
Red House Farm
High House Farm
Little Moor Farm
Baldrys Cottage
Moor Farm
Friston House
A12
A1094
B1121
B1119

Gromford Meadow

Key

Site 10_11 boundary

Site 10_11 boundary 2km buffer

Site of Special Scientific Interest (SSSI)

0 250 500 750 1,000 m

Scale at A3: 1:20,000

Fen Meadow Compensation Sites:
Benhall Site 10_11

Figure 2.1
Statutory designated sites within 2km of the Site

November 2020

wood.

637000 638000 639000 640000

262000 261000 260000 259000

Benhall Green Meadows

Manor Farm Meadows

Foxburrow Wood

River Fromus Marshes

Key

- Site 10_11 boundary
- Site 10_11 boundary 1km buffer
- County Wildlife Sites (CWS)

0 250 500 750 m

Scale at A3: 1:12,500

Fen Meadow Compensation Sites:
Benhall Site 10_11

Figure 2.2
Non-statutory designated Sites within 1km of the site

November 2020

wood.

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638000

639000

261000

260000

N

Stewon's Covert

Mitford House

Green

Mill La

Sandy La

Sternfield

Aldecar La

Red La

Honey Pot Lodge

Meadowcroft

A12

A1094

Friday Street

Manor Farm House

Wenhurg La

Watering Fm or Watering Farm

Hillcrest

Monks Valley House

Palant's Grove

Wood

Botany Farm

Racewalk Covert

Walk Barn Farm

Snape Watering

Farnham Rd

W1 W2 W3 W4 W5 W6 W7 W8 W9 W10 W11 W12 W13

Key

Site 10_11 boundary

Site 10_11 boundary 500m buffer

W1 Waterbody

0 100 200 300 400 m

Scale at A3: 1:7,500

Fen Meadow Compensation Sites:
Benhall Site 10_11

Figure 2.3
Waterbodies located with 500m of the site

November 2020

wood.

3. Extended Phase 1 Habitat Survey

3.1 Method

Habitats

A Phase 1 habitat survey of the Site and, where possible, a 30m buffer, was completed by a Wood Ecologist on the 12 June 2020. During the survey, distinct habitats were identified, and any features of interest recorded and included on a Phase 1 habitat map as a target note (TN), in accordance with JNCC (2010).

Protected and Notable Species

As the standard Phase 1 habitat survey methodology is mainly concerned with vegetation communities, the survey was extended, in general accordance with IEA (1995), to allow for the provision of information on other ecological features, including identification of the presence, or potential presence, of legally protected or conservation notable species.

The methodologies used to establish the presence or potential presence of species and / or species groups are summarised below. Species or biological taxa included in the surveys were targeted due to the desk study and / or habitat types indicating potential for presence on the Site.

Great crested newt

Great crested newt is legally protected and is also a Species of Principal Importance.

The Site was assessed for its potential to support a population of this species. This assessment considered the presence of suitable aquatic and terrestrial habitats on site (the latter including foraging habitat, hibernacula and refugia). All waterbodies were subject to Habitat Suitability Index HSI assessment (Oldham et al., 2000), recording the context and features of them to generate a score relative to the likelihood of great crested newts using them

Reptiles

All species of British reptile are legally protected and are also Species of Principal Importance.

The Site was assessed for its potential to support populations of reptile species. This involved looking for potential foraging habitat, hibernacula, refugia and areas for basking (as described in Froglife, 1999).

Birds

All nesting birds are legally protected, some are afforded a higher level of protection when breeding, and many are also Species of Principal Importance.

The habitats on-site were assessed for their potential to support important populations of breeding and wintering birds.

Badger

Badgers and their setts are legally protected.

The Site was searched for evidence of badger activity. This involved looking for setts, badger trails, snuffle holes, latrines and badger hairs. Furthermore, information was gathered about the suitability of habitats for

foraging badger on-site and of suitable sett-digging habitat likely to be present within 30m of the Site (as described in Natural England, 2015).

Bats (all species)

All species of British bats and their roosts are legally protected, and many are also Species of Principal Importance.

A general assessment was made for the potential of on-site trees to contain potential roost features for bats (e.g. rot and woodpecker holes, splits, cracks, and dense woody ivy on trees). Additionally, a general assessment was made as to whether habitats within and adjacent to the Site are likely to provide an important foraging resource and/or commuting route for bats (as described in Collins *et al.,* 2016).

Dormouse

Dormouse is legally protected and is also a Species of Principal Importance.

The extent and quality of the habitats within and adjacent to the Site were assessed for their potential to support dormouse; in particular whether or not key food plants occurred and whether any of the habitats present are connected to large areas of suitable woodland (as described in Bright *et al.,* 2006).

Otter

Otter is legally protected and is also a Species of Principal Importance.

The Site was assessed for its potential to provide habitat that could support otter. This involved considering the size and connectivity of any watercourse present on-site (or within the vicinity) with regard to providing suitable foraging resources, as well as the presence of areas of woodland and other dense vegetation suitable for creation of holts, natal dens and/or laying-up areas (as described in Chanin, 2003).

Water vole

Water vole is legally protected and is also a Species of Principal Importance.

The Site was assessed for its potential to provide habitat that could support a population of water vole. This involved considering the size and connectivity of any watercourse present on-site (or within the vicinity), as well as the potential presence of suitable foraging resources and burrowing substrate along the banks (as described in Strachan *et al*., 2011).

Invertebrates

A number of invertebrate species are legally protected, and some are also Species of Principal Importance.

An assessment was made of the potential for habitats on-site to support an assemblage of priority invertebrate species, by considering the provision of a mosaic of varied habitat and substrate types and nectar-rich flowering species.

Other priority faunal species

Drawing upon information that was collected during the desk study, an assessment was made of the potential for the Site to support any other legally protected and/or Species of Principal Importance.

Limitations

While every effort has been made to provide a comprehensive description of the Site, this survey does not constitute a full botanical survey. Nevertheless, it is considered that the survey is sufficient quality to capture the overall character of the site and all of the major vegetation communities.

To determine presence or likely absence of protected species usually requires multiple visits at suitable times of the year. As a result, this survey focuses on assessing the potential of the site to support habitats and species of note, which are considered to be of principal importance for the conservation of biodiversity with reference to those given protection under UK or European wildlife legislation. This survey therefore cannot be considered a comprehensive assessment of the ecological interest of the site. However, it does provide an assessment of the ecological interest present on the day the site was visited and highlights areas where further survey work may be required.

The data from this survey is generally considered valid for a maximum of two years. Therefore, if more than two years elapse prior to commencement of the works, a repeat survey might be required to ensure up-to-date information is available to inform decisions.

3.2 Results

Habitats

The habitats present on-site comprise:

- Semi-natural broadleaved woodland;
- Scattered trees;
- Poor semi-improved grassland
- Tall ruderal vegetation;
- Inundation vegetation;
- Flowing water and wet ditches;
- Amenity grassland; and
- Species-poor hedgerow.

Further details are provided below. Habitat distribution is illustrated on Figure 3.1, and Target Notes are presented in Appendix C.

Broadleaved woodland

Within the north-west of the site is a small block (c. 0.5 ha) of woodland which was mostly growing on very damp soil (ditches run through and adjacent). It had a dense canopy with abundant alder with occasional pedunculate oak. The understorey included willow species, with a ground flora dominated by nettle, yellow iris, and broad-leaved dock. This habitat fits within the description of *wet woodland* priority habitat (JNCC, 2008) and this, along with the immediately adjacent grassland (following the priority grassland description) should be considered as the Habitat of Principal Importance, *wet woodland*.

Scattered trees

Scattered trees and tree lines of various ages bordered the site. Those along the south-western boundary appeared to contain the most mature trees, each at least 200 years old. These included pedunculate oak and a possible native black poplar (Target Note 1 on Figure 3.1). Along the south-eastern boundary along the

River Fromus was a line of Lombardy poplar, whilst ash and immature alder were found growing in the inundation vegetation in the south of the site. Along the western boundary was a row of mature Lombardy poplar with willow species and bittersweet at the base.

Poor semi-improved grassland

Poor semi-improved grassland covered much of the Site. Throughout the site it appeared to be barely managed, with a relatively tall sward (up to 0.75m), although the Site is presumably grazed at times as there was evidence of poached ground. The grassland was dominated by Yorkshire fog, with crested dog's-tail, meadow thistle, daisy, creeping buttercup and white clover frequent found. Hard rush was also common in the central and northern areas. Southern marsh orchid were occasionally found near to ditches throughout the site. In an area poached by cattle (Target Note 2 on Figure 3.1), with sparse vegetation, common orache was abundant.

Tall ruderal vegetation

Tall ruderal vegetation was found throughout the site, all with a medium-tall height (0.5-1.5m), but comprising different dominant species. In the south there was an enclosed area north of the A1094 which appeared to be ungrazed, and was damp towards the eastern end. It also contained rubble and other debris (Target Note 3 on Figure 3.1), which may have supported this vegetation type more than it would grassland. The species found in this area included broad-leaved dock, cow parsley, nettle, ground ivy, Yorkshire fog, false-oat grass and cock's foot. Towards the damper eastern end of this enclosure (Target Note 4 on Figure 3.1), species including water mint, tutsan and willow were abundant.

Along the central eastern edge of the site the tall ruderal vegetation was dominated by broad-leaved dock and thistle species. Further north this vegetation type was dominant along some of the ditch banks and reached its tallest height (around 1.5m). The species found included abundant hemlock, cow parsley and broad-leaved dock.

Inundation vegetation

There were several ditches in the southern third of the site which had dried out, but still had very damp soil underneath. It is likely these are flooded in wetter months. The vegetation was an extension of the poor semi-improved grassland but was dominated by damp-tolerant species including hard rush, horsetail, creeping buttercup, yellow iris, water mint and marsh thistle.

Running water

The River Fromus forms the eastern boundary of the site, except at the northern end where the red line crosses the river. There are also a series of ditches on Site. There was no apparent flow in most of the ditches, which were heavily vegetated along their banks either by poor semi-improved grassland or tall ruderal vegetation, though the water appeared open under this vegetation 'canopy'. The water in the waterbodies appeared, in general, to be between 0.5 and 1 m deep.

Amenity grassland

An area of amenity grassland lies to the north and north-west of the Site. This comprises areas of close cut (sward height less than 100 mm) amenity grassland surrounding fishing ponds. A small area of this habitat lies within the Site where the red line crosses the river at the northern end. The area was not accessible for survey but was assumed to support common grassland species.

Hedgerow (species-poor)

A hedgerow runs along the southern boundary of the site, next to the A1094. Gaps have appeared along its length making it defunct, and a fence had been installed adjacent to it to act as the boundary. The species within the hedge included pedunculate oak (there were several mature trees), hawthorn and blackthorn. The hedge was 2-5 m wide and 4- 10 m tall as some tree had reached maturity.

Protected and notable species

Badger

No evidence of badgers was found during the survey, although they are likely to be present in the vicinity of the site, given its rural location, and they may use the site in future.

Bats

The hedgerows and tree lines, wet ditch network, river and grassland on the site are considered suitable to support foraging and commuting bats.

There were several mature trees within the site, especially on the south-western boundary, where bats could roost in woodpecker holes, cracks, crevices or similar. The mixture of vegetation types and water bodies is likely to result in an abundant invertebrate fauna on which bats can feed, whether they roost on-site or not. Furthermore, the River Fromus, hedgerows, and tree lines all provide navigational aids for bats to fly through the site. These features make up continuous high-quality habitats for bats to use and therefore the site is high suitability for foraging and commuting bats following the Bat Conservation Trust Guidance (Collins, 2016).

Nesting birds

There is general nesting bird potential in the woodland, all the boundary hedgerows and scattered boundary trees, and also within the scattered trees, scrub and grassland that occur across the site.

Great crested newt

There is a record of great crested newt within 200m of the Site. Additionally, the habitats provided by the ditch network on site have the potential to support breeding great crested newts and the site represents suitable terrestrial foraging habitat for this species. Roots of trees and hedgerow along with the debris found at Target Note 3 (Figure 3.1) provide suitable hibernation areas. However, as indicated earlier, the permanently wet ditches likely support fish, making them sub-optimal for newts.

Reptiles

The habitats present on-site (rough grassland, tall ruderal and wet ditches) provide foraging habitat, whilst the roots of trees and hedgerow along with the debris found at Target Note 3 (Figure 3.1) provides suitable hibernation areas. Grass snake is often found in aquatic environments and the ditches provide a suitable foraging ground, and there are records of a range of reptile species nearby.

Hazel dormouse

There are no records of hazel dormice from within 1km of the site, although there is a record from around 1km south of Saxmundam. The habitats on-site (woodland and hedgerow in the north-western area in particular) provide suitable foraging habitat for dormouse. The species could therefore use the site.

Otter

The River Fromus provides a habitat for otter to feed with quiet areas for them to build holts and/or rest couches. There is a record close to the site, and it is likely that otters use the site.

Water vole

The River Fromus and ditches on the site provide a network of waterbodies where water voles could feed under cover and/or escape into the water as needed. Most of the banks had a steep profile such that water voles could access them without their burrows being regularly submerged. It is likely that water voles use the site.

Other species – Terrestrial Invertebrates

The mix of habitats on- site including inundation vegetation and areas of short grassland through to woodland provides a variety of niches for terrestrial invertebrates. As a result a diverse community is possible with the potential to support notable species.

Other species – Aquatic Invertebrates

The ditches on-site support a variety of plant species, and would be expected to support a range of aquatic invertebrate species, potentially including some notable species.

Notable plants

No notable plants were recorded during the Phase 1 habitat survey.

Controlled species

Giant hogweed and Himalayan balsam were present along the banks of the River Fromus. A small patch of giant hogweed was also noted within the Site at Target Note 2 (Figure 3.1).

Japanese knotweed was noted in the wet woodland in the north-western corner of the site.

No other controlled species were noted. However, the presence of other legally controlled species in addition to those described above cannot be ruled out on the basis of this survey alone.

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638000

638500

260500

260000

N

Honey Pot Lodge

Manor Farm House

Watering Fm or Watering Farm

Not present

1

2

3

4

Key

- Site 10_11 boundary
- Broadleaved woodland - semi-natural
- SI SI Poor semi-improved grassland
- Tall ruderal
- Inundation vegetation
- Running water
- A A A Amenity grassland
- Intact hedge native species poor
- Scattered trees- broad-leaved
- Target note

0 50 100 150 200 m

Scale at A3: 1:3,500

Fen Meadow Compensation Sites:
Benhall Site 10_11

Figure 3.1
Phase 1 habitat survey map

November 2020

wood.

4. National Vegetation Classification

4.1 Method

Fieldwork

The field survey was carried out on 24 – 25 June 2020, following the standard methodologies in the JNCC NVC Users' Handbook (Rodwell, 2006). These are based on sampling representative patches within homogeneous blocks of grassland and tall-herb vegetation using standard-sized sample plots. The plots were assessed both for their floristic composition and for the range of variables required to assess the vegetation structure of the habitat. For grasslands, these include sward height, and the relative coverage of the constituent plant groups, such as lichens and mosses.

All vascular plants are named following Stace (2010); the bryophyte flora follows Hill *et al.* (2008); no lichen species were observed.

The characters of the surveyed habitats were assessed by an initial walkover to establish the location and extent of distinctive vegetation types. Sample plot locations were selected to represent typical sward characters within each type of grassland. Five or more sample plots were selected from the main vegetation types; as will be evident from the results section, the wetter grassland stands were sampled multiple times to establish the relatively minor differences between the constituent swards.

Vegetation classification and assessment

Field data have been tabulated in Microsoft Excel alongside CEH's Environmental Indicator Values (Hill *et al.* 2004; Hill *et al.* 2007) and relevant plant traits. This approach provides a reproducible dataset for each vegetation type and enables an evidence-based assessment of both their floristic and physiognomic characters.

The sample plots for each vegetation type are then grouped together to show the common and typical characters; each type is then compared with the published NVC accounts (Rodwell 1992, 1995, 2000) and phytosociological literature (e.g. Oberdörfer 2001). An interpretation of the site's vegetation is then developed using the published accounts, other sites known to the author, and expert knowledge.

The interpretation of the vegetation present is focussed on their existing nature conservation value and evidence for groundwater dependency. The primary source for determining the relationship of recorded species to groundwater-dependency was Londo (1988). Londo's classification for 'phreatophytes' (groundwater-dependent plant species) is given in Table 4.1. All names of the phytosociological units with which each species has greatest affinity (Oberdorfer 2001) follow Mucina *et al.* (2016) unless otherwise specified.

Table 4.1 Phreatophyte categories (Londo 1988)

Category	Definition
H	Hydrophytes, species with vegetative parts submerged or floating on the water
W	Obligate phreatophyte. Species requiring a water table at the soil surface (in years with a normal water table) or higher during part of the year or permanently for good development and completion of their life-cycle, e.g. germination.
F	Obligate phreatophyte. Species growing only within the sphere of influence of the water table, which is generally below the soil surface.

Category	Definition
V	Non-obligate phreatophyte. Species growing mainly or almost exclusively within the sphere of influence of the water table, which is generally below the soil surface.
K	Non-obligate phreatophyte – 'Lime aphreatophytes'. Species growing mainly or almost exclusively within the influence of the water table (which is generally below the soil surface) but occurring above this sphere of influence on soils rich in lime.
P	Non-obligate phreatophyte – 'Local phreatophytes'. Species that grow above the sphere of influence of the water table in much of their area of distribution but depend on this sphere of influence in certain areas or places.
A	Aphreatophytes. Species that are not bound to the sphere of influence of the water table. However, many of these species can be found, often abundantly, within the sphere of influence of the groundwater.

Limitations to the survey

A single area of the site was not accessed. This was a small block of grassland at the north-west corner of the survey area. The area was surrounded by a live electric fence and was very short-grazed. It appeared to have been used as a holding area for horses for some time.

The survey also excluded the ditch network, as this was considered during the site visits in 2019, and reported in Wood (2019). The survey area therefore extended to 11.40ha.

The survey was carried out at a generally accepted optimal time for vascular plant surveys. It was noted that no grazing appeared to have occurred in the year of the survey and several low-growing species of the formerly short swards assessed for the site investigation in April 2019 (Wood, 2019) were not recorded. This included lady's-smock and daisy.

As noted by the surveyor at other sites during the survey season, the very wet February followed by a dry spring appears to have greatly reduced the number of seedlings present in the sward. Although it is possible that some plant species were undetected by the surveys, this is not considered to have significantly affected the conclusions of this report.

The appearance of several taxa varied amongst their populations and a decision was made in the field on how they should be recorded:

The small population of non-flowering jointed rushes frequently matched descriptions of the hybrid between jointed rush and sharp-flowered rush (Stace *et al*. 2015). All material in sample plots is treated as the hybrid jointed rush *J. x surrejanus*.

The widespread horsetail varied in critical characters but is all referred to marsh horsetail. It was noted that field horsetail was an uncommon species of drier, more ruderal soils within the survey area. Although they are known to hybridize to give *Equisetum x rothmaleri*, this has not been recorded in Suffolk (Sanford & Fisk 2010).

4.2 Results

Floristic characteristics and affinities

A total of 73 species were recorded in the sample plots. All are listed in Appendix D with Londo's (1988) phreatophyte category.

Forbs and graminoids (grasses, rushes and sedges) are the two major groups, comprising 86 per cent of the flora. Creeping bent, Yorkshire fog and rough meadow-grass are by far the most commonly occurring

graminoids and form the matrix of all the floodplain swards. They are typically accompanied by ryegrass, meadow fescue and meadow foxtail, with hairy sedge and marsh foxtail in damper areas. Meadow barley is a distinctive component of slightly elevated stands on the floodplain and reed canary-grass is locally dominant on the margins of the ditch network. These species are replaced by common bent on the valleyside grasslands, with the exception of Yorkshire fog.

Creeping buttercup is the sole forb occurring throughout the floodplain grassland, with meadow buttercup and curled dock frequent associates. Marsh horsetail is a frequent component of the damper floodplain grassland. Creeping thistle is locally abundant along sections of the river frontage, especially on the disturbed soils of the low dredging bund.

Alder is the sole dominant in the canopy of the gently sloping wet woodland in the northwest corner of the survey area, where nettle is ubiquitous in the field layer with carpets of common bryophytes, which were not recorded elsewhere.

The estimated degree of influence that groundwater has on the presence of species (Londo 1988) is given in Appendix D for all recorded species with the exception of the bryophytes. Twenty-four species (33 per cent of the sample plot flora) are regarded as typically growing solely or mainly within the sphere of the influence of the groundwater and are listed in Table 4.2 as 'obligate' or 'non-obligate' phreatophytes. Marsh horsetail is the only widespread 'obligate' phreatophyte; it is a perennial species with widely-spreading rhizomes and – in common with brown sedge and water mint – may represent a persistent marker of seepage conditions along the valley margin. The group of 'non-obligate' phreatophytes includes a number of species from the wet woodland, but also includes other species from the floodplain which are often indicators of groundwater seepage (hard rush, southern marsh-orchid) or of periodic waterlogging (marsh foxtail, toad rush).

Table 4.2 Phreatophytes recorded in sample plots

'Obligate' phreatophytes	**'Non-obligate' phreatophytes**
Brown sedge	Alder
Common spike-rush	Southern marsh-orchid
False fox-sedge	Enchanter's nightshade
Floating sweet-grass	Hard rush
Grey willow	Hybrid jointed rush
Marsh horsetail	Marsh bird's-foot trefoil
Marsh marigold	Marsh foxtail
Meadowsweet	Marsh thistle
Plicate sweet-grass	Reed canary-grass
Square-stemmed St john's-wort	Remote sedge
Water mint	Soft rush
	Toad rush
	Wood dock

The Environmental Indicator Value (EIV) for Moisture (EIV – F[1]) for the plot species given in Appendix D spans values of 4 (dry-site) to 10 (shallow water) (Hill *et al*. 2004, 2007). The dry-site species are predominantly those of the valleyside and include common ragwort and smaller cat's-tail. Slightly over one-third of species typically occur in constant moist or damp soils or wetter; the most widespread examples of this group are creeping buttercup and marsh horsetail, with hairy sedge, marsh foxtail and hard rush.

Appendix D also lists the primary syntaxon with which each species has affinity in this landscape context.

The wet woodland species span a range of woodland types but are not typical of wetland habitats *per se*. The central syntaxon is the ***Alnion incanae*** (the *Alno-Ulmion* in the NVC), which typically occurs on flushed

[1] Feuchtigkeit

slopes low on the valley-side; although groundwater is close to the surface, the topsoil is sufficiently well-oxygenated to support non-wetland species.

Three-quarters of the non-woodland species are classified within the *Molinio-Arrhenatheretea*, a broad class of managed pastures, meadows and tall-herb meadow fringes on fertile deep soils. Some species, such as Yorkshire fog and meadow fescue, occur in the majority of these grassland types, while others are typical of only one of the three main orders of which the class is composed.

- ***Arrhenatheretalia elatioris*** - Meadows and pastures on well-drained mineral soils. Perennial ryegrass, meadow foxtail and meadow buttercup are the most widespread of the common grassland species that are affiliated with this order. These are species of fresh or even damp soils but tend to be replaced by species more tolerant of periodic waterlogging in wetter situations.
- ***Molinietalia caeruleae*** - Wet mown meadows on mineral and peaty soils. This order contains wet grasslands and fen meadows where groundwater influence is often strongly influencing the species composition. As noted above, marsh horsetail is the main species from the group, which also includes hybrid jointed rush.
- ***Potentillo-Polygonetalia avicularis*** - Temporarily flooded and heavily grazed zoo-anthropogenic nutrient-rich meadows and pastures. These are described as inundation pastures in the NVC. Several species associated with this order are widespread across the floodplain communities, and include creeping bent, creeping buttercup and rough meadow-grass. Others, notably hard rush and hairy sedge, are largely found with *Calthion* species. One further species, marsh foxtail, tends to aggregate with other species tolerant of more prolonged waterlogging to form stands representing this alliance.

Synopsis of the plant communities

The surveyed area totals 11.40 ha. The assemblages of plant species separate into four grassland stands on the floodplain and its upland margin and one tall-herb stand. Stand boundaries and sample plot locations are indicated on Figure 4.1, with grid references for the plot locations provided in Appendix E.

Communities from six vegetation alliances are recognised in the survey area (see Table 4.3), though it should be noted that there are sometimes quite small differences in species composition amongst the surveyed floodplain grasslands.

The distribution of the NVC communities is shown in Figure 4.2. Stands A1 and A2 are both assigned to the *Holco-Juncetum* community but continue to be distinguished as MG10b-A1 and MG10b-A2 to emphasise the consistent and significant difference in species composition discussed below.

Table 4.3 NVC plant communities

Alliance	NVC Community	Stand	Area (ha)
Calthion	Wet grasslands with at least some groundwater influence		
MG10b	*Holco-Juncetum effusi*, *Juncus inflexus* sub-community	A1 and A2	2.29
MG10a	*Holco-Juncetum effusi*, Typical sub-community	D	0.24
Potentillion	Temporarily-flooded nutrient-rich grasslands		
MG13	*Agrostis stolonifera-Alopecurus geniculatus* grassland	B1 and B2	2.65
Lolio-Plantaginion	Ryegrass grasslands subject to occasional waterlogging		

Alliance	NVC Community	Stand	Area (ha)
MG7c	*Lolium perenne-Alopecurus pratensis-Festuca pratensis* grassland	C1 and C2	1.71
MG7b	*Lolium perenne-Poa trivialis* leys	E	0.24
Arrhenatherion	Tall mown grasslands in moist to dry locations		
MG1b	*Arrhenatheretum elatioris* grassland, *Urtica dioica* sub-community	F	0.43
Cynosurion	Typically grazed swards of circumneutral soils		
MG6b	*Lolio-Cynosuretum cristati*, *Anthoxanthum odoratum* sub-community	G	1.98
Salicion albae	Willow and poplar floodplain woodland		
W6d	*Alnus glutinosa-Urtica dioica* woodland, *Sambucus nigra* sub-community	H	1.10

The stand community tables are set out in Appendix F to show the presence of species and their cover/abundance in each plot sampling the stand.

Grassland types

The main stands in the floodplain represent grasslands showing a weak groundwater influence (Stands A1 and A2), those where waterlogging is most prevalent (Stands B1 and B2) and where the ground is slightly elevated (Stand C). Two smaller stands in the floodplain (Stands E and F) had been unmanaged for some time and, being located near the draining influence of deeply-dug channels, were both composed of tall, shading species and had been colonised by common nettle.

In the northern part of the site an abrupt boundary between the floodplain and the valleyside is marked by a wet ditch. Here, the wet woodland is mapped as a distinct unit, although an alder thicket has developed along the northern boundary and a separate grassland stand (Stand D) is defined in an open area where scrub is encroaching. To the south, the valleyside forms a more gradual boundary with the floodplain and the valleyside grassland (Stand G) has a diffuse boundary.

Floodplain grasslands

The *Calthion palustris* alliance, representing the *Molinietalia caeruleae* order, is made up of damp to wet pastures with at least some groundwater influence. Stands A1, A2 and D are distinguished from the other floodplain swards, and each support a group of phreatophytes.

- **MG10b *Holco-Juncetum effusi*, *Juncus inflexus* sub-community (Stands A1 and A2)**

  One of the three main floodplain grassland types supports a small number of species that tend to occur where there is at least weak groundwater influence. The matrix of the sward is similar to that found in the other grasslands, being grass-dominated with Yorkshire fog, creeping bent and rough meadow-grass, as well as constant creeping and meadow buttercups. The phreatophyte group consists mainly of brown sedge, marsh horsetail, hard rush and water mint, with occasional hybrid jointed rush and southern marsh orchid. As a group, these species are typical of mildly calcareous conditions.

  The community table for Stands A1 and A2 is given in Table F.1 in Appendix F.

Stand A1 is mapped from a narrow strip on the upland side of the central part of the survey area, south of the County Wildlife Site. It is distinct from Stand A2 in supporting frequent meadow fescue, hairy sedge and curled dock, all species which are often found in the hard rush sub-community of this type of rush-pasture. The stand is adjacent to a spring-fed ditch and is in contact with small stands of reed canary-grass and pond-sedge.

Stand A2 overlaps Stand A1 at its northern tip, but largely occupies a tract of ground in the central part of the floodplain, giving way to a valleyside sward on the west and ryegrass pasture or creeping thistle stands near the modern course of the river. Although supporting the phreatophyte group listed above, it lacks the distinguishing species for Stand A and has few distinctive features of its own. The presence of isolated clumps of common spikerush, with a widespread scatter of hard rush, may indicate periodic groundwater influence extending into the centre of the stand. This block of grassland lies on the margin of the *Calthion* alliance and is somewhat similar to the *Lolio-Plantaginion* swards to the north. Notwithstanding, it provides an indication of the extent which groundwater influence currently extends into the Fromus floodplain within the survey area.

- **MG10a *Holco-Juncetum effusi*, Typical sub-community (Stand D)**

  A rather different form of grassland has developed on the toeslope of the valleyside on the southern margin of the wet woodland. Here the sward is dominated by Yorkshire fog with some meadowsweet, common sorrel and marsh bird's-foot trefoil (see Table F.1 in Appendix F). The associate species are absent or rare elsewhere on the site but tend to occur together in circumneutral fenny grasslands in the county. The stand may represent a degraded form of the vegetation present in the nearby County Wildlife Site and has developed on the fringe of what appears to be a ditched seepage area near the edge of wet woodland.

Grasslands of the *Potentillion anserinae* alliance develop in temporarily flooded, nutrient-rich areas. Flooding is most common in the late winter and early spring.

- **MG13 *Agrostis stolonifera-Alopecurus geniculatus* grassland (Stands B1 and B2)**

  The second of the three main floodplain grassland types is composed of abundant creeping bent, rough meadow-grass and creeping buttercup, and is distinguished by constant marsh foxtail. These swards are typical of temporarily-flooded nutrient-rich grasslands on floodplains. The sources of flooding are potentially three-fold, from upland ditches, from groundwater seepage via the ditches and/or from the river. By eye, it would appear that localised flooding from the ditch network is more likely than over-topping of the riparian bund. However, floodwaters may derive from all three sources, particularly when the river 'backs-up' into the ditch network. Community tables are given in Table F.2 in Appendix F.

  Stand B1 is the more extensive stand and occupies a large, shallow basin spanning the floodplain east of the sewage works. The central drain bisecting the stand may have been dug as a carrier drain across the stand, taking water from the northern ditches. The associate species are largely those of rush pasture, with frequent soft rush in the western part of the stand indicating that impeded rainwater may be a significant source of waterlogging.

  Stand B2 is a smaller feature occupying the shallow hollow draining part of the valleyside toeslope. This has the appearance of a relict seepage and marsh horsetail is a constant associate, with occasional water mint and hybrid jointed rush. The sward is broken in places – by cattle poaching and vehicular traffic - and several ephemeral wetland species are present, including toad rush.

The *Arrhenatheretalia elatioris* order is largely represented in the survey area by the *Lolio perennis-Plantaginion*[2] alliance. These are ryegrass grasslands that are typical of the drier parts of floodplains and the valleyside slope, where groundwater dependent species are uncommon. Community tables are given in Table F.3 and F4 in Appendix F.

- **MG7c *Lolium perenne-Alopecurus pratensis-Festuca pratensis* grassland (Stands C1 and C2)**

  In slightly elevated positions on the floodplain, typically on the eastern side of the northern half of the site, meadow barley is a particularly distinctive component of the Stand C swards, with creeping bent, creeping buttercup, meadow fescue and some meadow foxtail. Timothy is also present in undermanaged parts of this grassland-type. This is an interesting form of damp pasture and bears some resemblance to the water meadows grassland type discussed by Page (1980). When the grassland volume of the NVC was published (Rodwell 1992), this type of vegetation was placed within the *Lolio-Plantaginion* alliance. Subsequent sampling by Gowing *et al.* (2002) led Wallace & Prosser (2017) to propose a revision to reposition this kind of grassland within an *Alopecurion* alliance, linking it with the more species-rich alluvial meadow vegetation.

  Stand C1 is largely restricted to a discrete area in the centre of the survey area but is separated from an outlier by the large block of *Potentillion* grassland. The abundance of the short-lived perennial meadow barley in this stand is likely to be favoured by limited waterlogging and persistent grazing.

  Stand C2 shares a number of floristic elements in common with Stand C2, but some of the 'bottom grasses' – with most leaves borne low down on the stems – and forbs with stolons or basal rosettes have declined and been replaced by tall grasses, including cock's-foot and false oat-grass.

- **MG7b *Lolium perenne-Poa trivialis* leys (Stand E)**

  Stand E is only present in the southern half of the survey area and has developed in fertile and partly shaded soils. In the earlier site investigation, daisy and occasional cuckooflower were evident in a much short, cattle-grazed sward, often found in extensive mats of creeping buttercup. In the current survey, no management was evident, and these low-growing species were not found amongst the tangle of buttercup and Yorkshire fog.

  The sample plots were selected from two typical areas of the stand (Appendix F), which show a shift from ryegrass pasture towards a form of rush pasture that lacks groundwater-dependent species. As elsewhere along the river frontage, creeping thistle has colonised. The grazed and ungrazed facies of the stand, separated by c.14 months, demonstrate the significance of a grazing regime in maintaining the character and floristic compositions of these fertile grasslands on the floodplain.

The *Arrhenatheretalia elatioris* order also includes unmanaged and tall, occasionally mown neutral grasslands as a separate alliance, the *Arrhenatherion elatioris*. This type of sward is only present on the floodplain where the intensity of management has declined, and tends to favour tall, competitive species. Samples of this grassland are given in Table F.4 in Appendix F.

- **MG1b *Arrhenatheretum elatioris* grassland, *Urtica dioica* sub-community (Stand F)**

  Stand F is a small, localised stand occurring on the slightly elevated riparian bund in the north-west corner of the survey area. False oat-grass is abundant, forming a tall sward with meadow

[2] This alliance is now subsumed within the *Cynosurion cristati* (Mucina et al. 2016)

foxtail, common nettle and cock's-foot over Yorkshire fog. Other species are uncommon. This is likely to be a long-established sward as species restricted to shorter swards are absent.

Persistent stands of creeping thistle have developed in patches along the slightly elevated riparian frontage. These can be placed into an unsampled stand broadly corresponding to *Cirsium arvense*-[*Arrhenatherion*] vegetation: rough grassland with abundant thistle.

Valleyside grasslands

The *Cynosurion cristati* alliance is also part of the *Arrhenatheretalia elatioris* order and is composed of grazed swards on circumneutral soils with limited parching or waterlogging. One part of the alliance is composed of pastures on fresh to dry soils that are mildly acid in reaction. In Suffolk, they are a feature of silty sands over crag sands, where parching can be significant, but the substrate is too nutrient-rich to favour species of acid grassland. The community table is given in Table F.5 in Appendix F.

- **MG6b *Lolio-Cynosuretum cristati, Anthoxanthum odoratum* sub-community (Stand G)**

  The valleyside grasslands are typically dry, though they are most prone to droughting in the more elevated areas of the southern half of the stand. The sward is an unvarying mosaic of the two dominants, common bent and Yorkshire fog. The bent grass is restricted to the damp to parched soils of the valleyside and, with smaller cat's-tail and common ragwort, is part of a group of species typical of free-draining, circumneutral substrates associated with loamy sands in East Anglia, both on the fringes of the southern Suffolk Sandlings (especially where upper red crags are exposed) and on the loessy sands of the Shotley, Tendring and Dengie peninsulas.

  The sward varies from a thick, fine mat to patches of bare, droughted ground, with sprouts of nettle and other ruderals associated with dunging.

  Although this type of pasture can readily be placed within the *Cynosurion* alliance of grazed grasslands, it lies on the fertile margin of a group of dry grasslands affiliated with the published syntaxa recognised by the NVC. It is tentatively placed within the *Anthoxanthum odoratum* sub-community of the *Lolio-Cynosuretum* (MG6b) as this is the locus for common bent on free-draining circumneutral brown soils in the classification.

Ditch flora

The ditch flora was assessed during the site investigations in 2019 (Wood, 2019) and was not resurveyed. The margins and shallow water are typically dominated by greater pond-sedge *Carex riparia* - favoured by nutrient-rich groundwater – forming stands of the S6 *Caricetum ripariae* swamp. Reed canary-grass *Phalaris arundinacea* is also abundant around the margins of the central ditch running through Stand B1 and, where well-lit, ditch margins also provide the locus for lesser water-parsnip *Berula erecta*, branched bur-reed *Sparganium erectum* and water mint. These assemblages can be referred to the *Glycerio-Sparganion* alliance (S23 Other water-margin vegetation) or, where bur-reed or canary-grass are sole dominants, to the S14 *Sparganietum erectae* swamp or S28 *Phalaridetum arundinaceae* tall-herb fen.

The only notable aquatic species recorded was various-leaved water-starwort *Callitriche platycarpa* which is recognised as a character species of the *Ranunculion fluitantis* alliance (of moderately fertile, calcium-rich slow-moving waters) in the Netherlands (Westhoff & Den Held 1975). Although an associate in a number of NVC communities, it was only sampled for the classification as a constant in the A4 *Hydrocharis morsus-ranae-Stratiotes aloides* community, which is now very local in distribution and mostly confined to Broadland.

As a group, the ditch flora is noted for its strong affiliation with waters largely deriving from the mildly calcareous discharge of the local groundwater.

Wet woodland

The phytosociological position of the wet woodland is somewhat transitional between the Valley Alder-woods (*sensu* Rackham 1980) and those of flushed fen-peat systems where there has been some degree of enrichment through drainage. In the NVC, examples of the latter tend to be grouped with various forms of willow woodland in the *Salicion albae* alliance, part of the *Salicetalia purpureae* order of willow and poplar woodland on floodplain alluvium. In this, they are united by the proliferation of common nettle and other indicators of fertility, rather than by swamp and fen species.

- **W6d *Alnus glutinosa-Urtica dioica* woodland, *Sambucus nigra* sub-community (Stand H)**

  The gently sloping wet woodland in the northwest corner of the survey area is a gallery woodland of alder over common nettle occupying a seepage area on the valley toeslope. The community table for this stand is given in Table F.6 in Appendix F. The associate species are affiliated with the *Alnion incanae* alliance, referred to as the *Alno-Ulmion* alliance in the NVC: ash and alder woodland communities of flushed and impeded lime-rich soils (Rodwell *et al.* 2000). However, the seepage has been deeply drained (prior to 1884[3]) and the wood lacks the distinctive features that may once have placed it within the *Urtica dioica* sub-community of *Alnus glutinosa-Fraxinus excelsior-Lysimachia nemorum* woodland (W7a). It is now indistinguishable from the *Sambucus nigra* sub-community of the *Alnus glutinosa-Urtica dioica* woodland (W6d), which occurs largely on drained floodplains. Notwithstanding, groundwater seepage elsewhere on the valleyside maintains a high water table in the catch drain at the foot of the wood.

4.3 Summary

NVC Communities

The NVC survey identified six alliances within and on the margin of the floodplain and also a block of wet woodland on the valley toeslope. These vegetation types are assigned to the following NVC communities:

Floodplain and toeslope grasslands

- MG7b *Lolium perenne-Poa trivialis* leys
- MG7c *Lolium perenne-Alopecurus pratensis-Festuca pratensis* grassland
- MG10a *Holco-Juncetum effusi*, Typical sub-community
- MG10b *Holco-Juncetum effusi, Juncus inflexus* sub-community
- MG13 *Agrostis stolonifera-Alopecurus geniculatus* grassland

Dry, valleyside grassland

- MG6b *Lolio-Cynosuretum cristati, Anthoxanthum odoratum* sub-community

Wet woodland

- W6d *Alnus glutinosa-Urtica dioica* woodland, *Sambucus nigra* sub-community

Of these, the stands of *Holco-Juncetum* and *Lolium-Alopecurus-Festuca* grassland support suites of groundwater-influenced and typical floodplain species, respectively.

[3] Ordnance Survey. Six-inch to the mile. 1884. https://maps.nls.uk/view/101577878

The *Holco-Juncetum* stands and the wet woodland were found to support the majority of phreatophyte species, with areas of 2.39 ha and 1.10 ha respectively, which, in total, account for 30.6 per cent of the surveyed area.

Using Londo's (1988) assessment of species as 'obligate', 'non-obligate' or 'non'-phreatophyte, the relationship of recorded species to groundwater-dependency was established. One-third of species recorded in the sample plots are classified as occurring within the 'sphere of influence' of groundwater, and these were clustered along the toeslope and floodplain margin. Marsh horsetail is the only widespread 'obligate' phreatophyte and – in common with brown sedge and water mint – may represent a persistent marker of seepage conditions along the valley margin.

Conservation Interest

The grassland habitats present qualify as coastal and floodplain grazing marsh, a habitat of principal importance listed under Section 41 (S41) of the *Natural Environment and Rural Communities (NERC) Act 2006.* S41 requires the Secretary of State to publish a list of habitats and species which are of principal importance for the conservation of biodiversity in England. The S41 list is used to guide decision-makers such as public bodies, including local and regional authorities, in implementing their duty under section 40 of the *Natural Environment and Rural Communities Act 2006,* to have regard to the conservation of biodiversity in England, when carrying out their normal functions.

The wet woodland on site is indicated on Magic as being 'Deciduous woodland' and the survey confirms it is likely to qualify as this habitat type, albeit only a small area is present.

No rare or scarce vascular plant, or bryophyte and lichen species were recorded during the survey.

Indications of current hydrologic conditions

Phytosociological indications

The floodplain swards in the southern half of the western part of the floodplain are assigned to the *Holco-Juncetum* community within the *Calthion palustris* alliance with at least some groundwater influence. The presence of the hard rush sub-community concords with mildly calcareous near-surface groundwater.

The influence of near-surface groundwater is also evident in the formation of the wet woodland and its associated grassland (Stand D) - and in the nearby alder-lined ditches and fen-meadow - along the valleyside toeslope in and beside the northern half of the survey area.

The vegetation of the ditch network is also typical of a spring-fed situation, and the lush growth of the *Glycerio-Sparganion* vegetation along the ditches is an indicator of summer-wet conditions. If it is assumed that the contribution of ditch over-spill after heavy rain is at least locally significant, the stands of inundation vegetation (*Potentillion* alliance) may also be periodically influenced by groundwater discharge.

The MG13 *Agrostis stolonifera-Alopecurus geniculatus* grassland remains a locus for fen meadow creation assuming that ditch water levels can be controlled.

Species indicators

Table 4.2 lists twenty-four phreatophyte species (*sensu* Londo, 1988) - representing one-third of species recorded in the sample plots. Marsh horsetail is the only widespread 'obligate' phreatophyte and – in common with brown sedge and water mint – may represent a persistent marker of seepage conditions along the valley margin.

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638000

638500

260500

260000

Honey Pot Lodge

Aldecar La

Manor Farm House

Watering La

Watering Fm or Watering Farm

Hillcrest

A1(M)

Key

Site 10_11 boundary

NVC sample plot

NVC Community Stands

Cirsium arvense

Not surveyed

Stand A1

Stand A2

Stand B1

Stand B2

Stand C1

Stand C2

Stand D

Stand E

Stand F

Stand G

Stand H

0 50 100 150 200 m

Scale at A3: 1:3,500

Fen Meadow Compensation Sites:
Benhall Site 10_11

Figure 4.1
NVC community stands and sample plots

November 2020

wood.

H:\Projects\40773 Sizewell C Fen Meadow Compensation and Marsh Harrier Mitigation Strategies\Deliver Stage\D Design_Technical\Drawings\GIS\MXDs\40773-WOOD-XX-XX-FG-OE-0020_S2_P01.mxd Originator:jacqui.parkin

638000

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260500

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N

Honey Pot Lodge

Aldecar La

Manor Farm House

Watering La

Watering Fm or Watering Farm

Hillcrest

A1094

Key

Site 10_11 boundary

NVC Community

- Cirsium arvense
- MG10a
- MG10b-A1
- MG10b-A2
- MG10b-C1
- MG10b-C2
- MG13
- MG1b
- MG6b
- MG7
- MG7c
- MG7d
- Not surveyed
- OV23d
- OV26e
- W6d

0 50 100 150 200 m

Scale at A3: 1:3,500

Fen Meadow Compensation Sites:
Benhall Site 10_11

Figure 4.2
NVC communities

November 2020

wood.

5. Water vole and Otter

5.1 Methods

Habitat assessment

Watercourses on the Benhall site were assessed for potential to support aquatic mammals over two visits undertaken on 17 July 2020 and on 9 October 2020.

The approximate depth and speed of water flow, the waterway width, bank side vegetation and surrounding land use was also recorded at each water course surveyed: all of these being factors that may determine the suitability of habitat for supporting water voles (Strachan *et al*., 2011).

Habitats were also assessed for the potential to support otter, albeit this species can exploit a wide range of aquatic habitats, including virtually all types of water and waterway: still waters; rivers; and streams of all sizes. They will also use very small streams and ditches, including dry watercourses, as regular commuting routes. The most significant determinant of otter usage of freshwater habitats is likely to be abundance of prey, particularly fish, but also frogs (Chanin, 2003).

For reporting purposes, the ditch system and water courses were divided into transects. Where there were notable changes in habitat type along a single length of water course (e.g. changes in vegetation, water depth and width) the ditch/river was split into multiple transect lengths, with each transect sampling a length of broadly similar habitat.

Water vole presence/absence survey

In combination with the habitat assessment, watercourses (including ditches) on Site were surveyed for evidence of water vole presence. In line with best practice guidelines (Strachan *et al*, 2011), this involved searching bankside vegetation for:

- Latrines/droppings – water vole droppings are often concentrated in discrete latrine sites near the nest, at range boundaries and places where they regularly enter and exit the water. While most droppings will be deposited in latrines, some may also be found scattered along runways in vegetation;
- Feeding stations – feeding remains in the form of neat piles of chewed lengths of vegetation, are often found in runways and at haul-out platforms;
- Burrows - these are typically found along the water's edge and on top of the bank up to 5m from the water's edge. Holes on top of the banks often have grazed 'lawns' around them; and
- Footprints – these may be identified in soft mud or silt.

The survey was undertaken at an appropriate time of year for detecting water vole presence, with water voles actively marking their breeding territories with latrines between late April and early October.

Otter presence/absence survey

All on-site ditches, and all accessible connected watercourses within the Site were surveyed for signs indicative of the presence of otter, including:

- Footprints – located in soft mud, silt, or sand banks;

- Spraints (faeces) – which are often located on prominent features within the channel or on the bank (including bridges, rocks, tree roots, etc.);
- Sign heaps – mounds of scraped mud, gravel, grass or silt;
- Feeding remains – including fish or frog carcasses;
- Slides or other well-used access points to watercourses; and
- Actual or potential resting sites – including underground holts (e.g. beneath the roots of bankside trees) or above ground couches (e.g. in reedbeds).

Although otters are active throughout the year, the current survey was undertaken at the optimal time for carrying out otter surveys, which is May and September, when water levels tend to be lower and less variable (Chanin, 2003).

Limitations

It was not possible to survey at the specific times required by the guidance on water vole survey, which indicates surveys should be undertaken in mid-April-June and in July-September, as access was only gained to the site initially in mid July. However, the surveys were undertaken during the water vole active period and therefore the results are considered robust.

It was not possible to search the entire bank of every water course during the survey due to restricted access to some ditches and associated health and safety concerns. Once distinctive water vole signs were recorded in a water course and presence of the species had been established, further survey work completed along the length habitat involved spot checks at points where safe access was possible.

Typically surveys for water voles would include areas 30m upstream and downstream of a site, and for otters 100m upstream and downstream, however this was possible here due to lack of access to off-site areas.

5.2 Results

Habitat assessment

The location of the 18 surveyed transects along ditches and two sections of river are indicated on Figure 5.1. Table 5.1 summarises the results of the habitat assessment.

July survey visit

Of the transects surveyed in July, two (W1 and W16) provided optimal aquatic habitat for water voles, comprising still water over 1m deep with wide swathes of riparian vegetation and earth banks, whilst W10 provided optimal habitat on the western bank but was subject to intense management on the eastern side. Two transects (W2 and W5) met most of these habitat requirements but held less water (being 0.5-1m deep) at the time of surveying. A further nine transects (W3, W7, W8, W9, W13, W14, W15, W17 and W18) contained water less than 0.5m deep with and habitat considered suitable to support water vole, however, due to the low shallow banks of these ditches it is considered unlikely that they would support burrowing and therefore may support only foraging or dispersing water vole. The final two transects (W4 and W6) were considered unsuitable due to the lack of vegetation providing no foraging potential or cover from predators.

It was not possible to survey W11 and W12 during the July surveys due to health and safety issues relating to the dense vegetation and steep banks.

October survey visit

The October survey visit found that transects W11 and W12 provided optimal habitat for water vole, with suitable riparian vegetation, water over 1m deep and earth banks. Transects W2, W3, W5, W7, W9, W13, W14, W15 and W17 were found to have high levels of water meaning any burrows present would be flooded and therefore were unsuitable for water vole occupation at this time.

Transects W1 and W16 remained optimal for water vole, whilst W18 contained water over 1m deep, improving its suitability since July.

The October survey visit also confirmed that W10 still provided optimal habitat on the western bank only and whilst the water in W4 and W6 was higher, the habitat remained sub-optimal and the transects unsuitable.

The river (W16) offers good opportunities for otter, with shelter provided in the form of mature bankside trees and vegetation, and abundant prey species noted to be present (freshwater mussels). However, the majority of the ditches were suboptimal for otter, due to typically supporting a low water level and the river section (W10) being intensively managed and disturbed as part of the caravan park activities to the east of the river at the northern end of the Site. That said, otters will use shallow and dry ditches as commuting routes, so the on-site habitats do offer potential for transient otters moving around the wider landscape.

Table 5.1 Benhall Site 10_11 otter and water vole habitat assessment results

Transect reference (Figure 5.1)	Transect length (m)	Bordering land uses	Bank profile	Depth (m) first visit	Depth (m) second visit	Width (m)	Dominant bankside vegetation	Other abundant vegetation
W1 (ditch)	89	Semi-improved grassland, sheep grazed during second visit	Steep	1-2	>2	1-2	Submerged weed, reeds and sedges, tall grass	Herbs
W2 (ditch)	167	Semi-improved grassland, sheep grazed during second visit	Shallow	0.5-1	1-2	1-2	Sedge, tall grass	Herbs
W3 (ditch)	57	Woodland, semi-improved grassland, sheep grazed during second visit	Shallow	<0.5	1-2	2	Sedge, bankside trees on northern bank	Tall grass
W4 (ditch)	120	Woodland, semi-improved grassland	Shallow	<0.5	0.5-1	1-2	Bankside trees	Sedge
W5 (ditch)	33	Woodland, semi-improved grassland, sheep grazed during second visit	Steep	0.5-1	>2	2	Bankside trees, herbs	Submerged weed
W6 (ditch)	84	Woodland, Semi-improved grassland	Shallow	<0.5	0.5-1	2	Bankside trees	Nettle
W7 (ditch)	30	Semi-improved grassland, sheep	Shallow	<0.5	1-2	2-5	Yellow flag iris	Submerged weed

Transect reference (Figure 5.1)	Transect length (m)	Bordering land uses	Bank profile	Depth (m) first visit	Depth (m) second visit	Width (m)	Dominant bankside vegetation	Other abundant vegetation
		grazed during second visit						
W8 (ditch)	163	Semi-improved grassland, sheep grazed during second visit	Shallow	<0.5	1-2	2	Yellow flag iris	Submerged weed
W9 (ditch)	26	Semi-improved grassland	Very shallow (almost flat)	<0.5	0.5-1	2-5	Herbs	Tall grass
W10 (river)	52	Semi-improved grassland, caravan park (no vegetation on eastern bank)	Steep	>2	>2	1-2	Herbs, yellow flag iris	Submerged weed
W11 (ditch)	97.4	Semi-improved grassland caravan park (no vegetation on northern bank)	Steep	1-2	1-2	1-2	Herbs, yellow flag iris	Submerged weed
W12 (ditch)	126.6	Semi-improved grassland caravan park (no vegetation on northern bank)	Steep	1-2	1-2	1-2	Herbs, yellow flag iris	Submerged weed
W13 (ditch)	204	Semi-improved grassland	Very shallow (almost flat)	<0.5	0.5-1	2-5	Reeds and sedges	Herbs
W14 (ditch)	56	Semi-improved grassland	Very shallow (almost flat)	Dry	0.5-1	2-5	Reeds and sedges	Herbs
W15 (ditch)	137	Semi-improved grassland	Very shallow (almost flat)	<0.5	0.5-1	2-5	Reeds and sedges	Herbs
W16 (slow-flowing river)	417	Semi-improved grassland	Steep	1-2	1-2	1-2	Sedge, bankside trees, herbs	Submerged weed
W17 (ditch)	58	Semi-improved grassland	Very shallow (almost flat)	Dry	0.5-1	2-5	Reeds and sedges	Herbs
W18 (ditch)	32	Semi-improved grassland	Shallow	<0.5	1-2	1-2	Sedge, yellow flag iris	Herbs

Water vole presence/absence survey

Table 5.2 presents the results of the water vole presence/absence survey. Evidence of water vole activity in the form of latrines, feeding remains, and/or burrows was found on the banks of two of the ditch transects (W1 and W11) and two river transects (W10 and W16). A further seven transects (W2, W3, W5, W7, W8, W12 and W18) are considered to offer suitable habitat for water voles during the summer, with connections to ditches where field signs were found, but no evidence of water vole was recorded. It is considered likely that water voles do use these habitats, however, access for the presence/absence survey was restricted by dense vegetation during July and high levels of water in October.

No evidence of water vole was identified in the remaining transects (W4, W6, W9, W13, W14 W15 and W17), and these transects recorded only suboptimal habitat for the species.

Table 5.2 Benhall Site 10_11 water vole presence/absence survey results

		Water vole signs recorded			
Transect reference (Figure 5.1)	**Presence confirmed (yes/no)**	**Latrines/ droppings**	**Feeding remains**	**Burrows**	**Other comments**
W1 (ditch)	Yes	4	8	1	Restricted survey due to access being limited by dense vegetation – no access to northern bank. However, water voles present.
W2 (ditch)	No	0	0	0	Restricted survey due to access being limited by dense vegetation in July and high water levels in October.
W3 (ditch)	No	0	0	0	Restricted survey due to access being limited by dense vegetation in July and high water levels in October.
W4 (ditch)	No	0	0	0	No aquatic or emergent vegetation present.
W5 (ditch)	No	0	0	0	Restricted survey due to access being limited by dense vegetation in July and high water levels in October.
W6 (ditch)	No	0	0	0	No aquatic or emergent vegetation present.
W7 (ditch)	No	0	0	0	Restricted survey due to access being limited by dense vegetation in July and high water levels in October.
W8 (ditch)	No	0	0	0	Restricted survey due to access being limited by dense vegetation in July and high water levels in October.
W9 (ditch)	No	0	0	0	Very shallow, almost flat banks.
W10 (river)	Yes	0	0	2	Restricted survey due to access being limited by dense vegetation; no vegetation present on eastern bank due to intensive management for a caravan park. Signs of water vole found in one section only.
W11 (ditch)	Yes	1	0	3	Not surveyed in July as dense vegetation limited access. Burrows found were <5 m apart so assume presence along the length of the ditch.

Transect reference (Figure 5.1)	Presence confirmed (yes/no)	Water vole signs recorded			Other comments
		Latrines/ droppings	Feeding remains	Burrows	
W12 (ditch)	No	0	0	0	Not surveyed in July as dense vegetation limited access. Suitable for water vole and linked to W11 so high chance of presence.
W13 (ditch)	No	0	0	0	Very shallow, almost flat banks.
W14 (ditch)	No	0	0	0	Very shallow, almost flat banks.
W15 (ditch)	No	0	0	0	Very shallow, almost flat banks.
W16 (river)	Yes	0	0	2	Restricted survey due to access being limited by dense vegetation.
W17 (ditch)	No	0	0	0	Very shallow, almost flat banks.
W18 (ditch)	No	0	0	0	Restricted survey due to access being limited by dense vegetation.

Otter presence/absence survey

Although the habitats, and particularly the river, were considered as being suitable to support otter, no evidence of this species was recorded during the current field survey.

5.3 Summary

Three of the 16 transects surveyed in July provided optimal aquatic habitat for water voles, with a further five meeting most of the noted habitat requirements but holding less water, and nine contained relatively shallow water, and were therefore assessed as being suboptimal. Water vole presence was confirmed on four of the surveyed transects (two ditches and two river transects).

The October visit found that of the 18 transects surveyed on that occasion, five provided optimal aquatic habitat for water voles, with vole presence found on four (W1, W10, W11 and W16). The survey also highlighted that the use of the ditch system may be transient depending on the time of year in response to varying water levels. During the second visit, water levels in all transects (excluding W1, W11, W12, and W18 had increased and reached the top of the banks. Any burrows which may have been present earlier in the year would likely be flooded and therefore unsuitable for water vole occupation at this time.

No signs of otter presence were recorded.

637700 637800 637900 638000 638100 638200 638300 638400 638500 638600 638700

260800 260700 260600 260500 260400 260300 260200 260100 260000 259900

N

W12 W6 W4 W7 W7 W8 W11 W3 W5 W3 W2 W10 W1 W9 W10 W16 W18 W17 W14 W16 W13 W15

Not present

Honey Pot Lodge

Aldecar La

Manor Farm House

Watering La

Watering Fm or Watering Farm

Hillcrest

A61

Key

Site 10_11 boundary

W1 Watercourse/transect number

Water vole habitat assessment

Water vole presence confirmed

Optimal habitat - no evidence of water vole identified

Suboptimal habitat - no evidence of water vole identified

0 25 50 75 100 125 150 175 200 m

Scale at A3: 1:3,500

Fen Meadow Compensation Sites:
Benhall Site 10_11

Figure 5.1
Locations of transects surveyed and water vole distribution

November 2020

wood.

40773-WOOD-XX-XX-FG-OE-0012_S2_P01

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Originator: jacqui.parkin

6. Aquatic Invertebrates

6.1 Methods

Sample collection

Aquatic invertebrate samples were collected from twelve locations on site (eleven from within the ditch system and one from the River Fromus)(see Figure 6.1), on 17 July 2020. The weather was dry and sunny.

Samples were collected with a standard pond net (supplied by EFE Field Equipment, Totnes) and represent 3-minute sweep samples taken either in the channels if they were shallow and it was safe to do so, or from the bank. The material was processed by washing and sieving in the field. Each sample was initially washed using a coarse (1cm) sieve and 500-micron sieve first to remove any twigs, leaves, seeds, large stones, etc. The coarse material retained by the 1cm sieve was retained along with the 500-micron fraction. The sample was preserved using 10% formalin.

The samples were later examined in the laboratory by placing small amounts of material into gridded petri-dishes and adding water. These petri-dishes were then examined carefully under a stereomicroscope. Each sample typically used 40-50 petri-dishes this way. Aquatic invertebrates were removed from the sample for identification and were counted as this was done. For particularly abundant taxa, sub-sampling was used to estimate the total number of specimens (i.e. individuals were counted from 20-25% of the dishes and multiplied up).

Physical and chemical parameters

Data was collected on pH, conductivity, water temperature and total dissolved solids, measured using a hand-held Hanna HI98129 pH/conductivity meter, at each sample site. Wetted width was measured with a metre rule.

Sample identification

The majority of the aquatic macroinvertebrates have been identified to species level. The exceptions include nematodes, oligochaetes, water mites (Hydrachnellae) and pea mussels (*Pisidium* spp). Identification of these requires specialist input and because of this, is rarely undertaken for routine aquatic biological monitoring. For immature specimens and females not separable to species, identification has been left at the appropriate level.

The pupal exuviae of some chironomids have been identified because these are often much easier to identify than the larvae. The terrestrial life stages of aquatic insects caught in the kick net samples have also been identified since these help in identifying the often difficult aquatic larval stages. A few wholly terrestrial invertebrate species have also been recorded from the kick samples, but these are often wetland species typical of spring or flush habitats and they help to indicate the value of the habitat.

Methods of Assessing Ditch Invertebrate Faunas

The results have been analysed to develop a Species Quality Index (SQI) (or Invertebrate Conservation Status Score), based on the Native Species Conservation Score, in accordance with Palmer *et al.* (2013). This is a methodology devised specifically to assess ditch flora and invertebrates for the European Water Framework Directive (WFD). The method was widely tested throughout grazing marshes in England and Wales (Drake *et al*. 2010). The scoring system is shown in Table 6.1. The SQI (or Invertebrate Conservation Status Score) for a sample or a wetland is obtained by adding together all the individual species scores, then dividing by the

number of native taxa recorded. Non-native taxa are not used when calculating this metric. Also, if a sample contains fewer than ten invertebrate taxa the SQI should not be calculated.

Table 6.1 Allocation of conservation scores used by Palmer *et al.* (2013)

Category	Score
Habitats Directive Annex II and/or IV; WCA Schedule 5; Red List CR, EN, VU (revised assessments); Red List E or V (unrevised lists)	5
Red List Rare (R in unrevised lists), DD or K; Near Threatened	4
Nationally Scarce (Nationally Scarce, Nationally Notable Na and Nb)	3
Local	2
None of the above (common)	1

Red List CR: Revised British Red List: Critically endangered
Red List EN: Revised British Red List: Endangered
Red List VU: Revised British Red List: Vulnerable
Red list E: British Red List: Engandered (Red Data Book 1)
Red list V: British Red List: Vulnerable (Red Data Book 2)
Red list R: British Red List: Rare (Red Data Book 3)
Red list DD: Data deficient
Red list K: Insufficiently known
Nationally Scarce: Restricted range. Occurring as notice in 16-100 10x10km squares in Britain
Nationally Notable Na: Restricted range. Occurring as notice in 16-30 10x10km squares in Britain
Nationally Notable Nb: Restricted range. Occurring as notice in 31-100 10x10km squares in Britain
Local: Confined to a particular habitat or geographic area, or too widespread to warrant Nationally scarce.

Species rarity status

The rarity of species recorded has been checked against the Red Data Book and Nationally Scarce statuses given to invertebrates by the Joint Nature Conservation Committee. The JNCC statuses are taken from the latest national reviews to different insect orders and these are also given on the computer database software RECORDER. Red Data Book species are confined to between 1 and 15 10km squares in Britain whilst Nationally Scarce species are those confined to between sixteen and one hundred 10km squares. Since 1995, International Union for Conservation of Nature and Natural Resources (IUCN) categories have been adopted by the JNCC as the new standard for Red Lists in Britain. JNCC aims to work towards assessing the status of all native species against standard criteria based on the internationally accepted guidelines developed by the IUCN (see IUCN 2001, 2003). Only a few taxonomic groups have been given IUCN codes, but these include the water beetles (Foster 2010).

6.2 Results

Twelve sites were identified for sampling, although only nine had sufficient water for survey. Sites 9, 10 and 11 were either dry, had wet mud or had very shallow pockets of water and could not be sampled with a pond net. The locations of the sites sampled are shown on Figure 6.1.

A total of 92 aquatic invertebrate taxa were recorded (see Appendix G). Twenty-two additional invertebrates were recorded that included terrestrial species with a general affinity to wetlands and the terrestrial life-stages of taxa with aquatic larvae. Two fish species were also recorded.

Assessment of ditch invertebrate fauna

The Palmer analysis was used at all sites sampled. Whilst Site 12 could have been assessed using other methods as it was on the River Fromus , only marginal habitats were sampled. Sites 1 and 7 were also on streams on the western site margin, however, no flow was obvious and so the Palmer method was adopted for the analysis in these locations also.

The SQI for the Benhall ditch system varied from 1 to 1.3 and the number of scoring taxa varied from three to twenty (see Table 6.2).

Overall scores of between 1 and 1.3 are modest, indicating a predominance of common and local status species.

Sites 5 had the highest SQI, with a score of 1.3. Site 5, which was located in the northern part of the site, also had the highest number of scoring taxa (twenty). Site 4 had the lowest number of taxa (three) although the reason is unclear since the ditch appeared unpolluted, not obviously connected with the adjacent sewage treatment works, was unshaded and was not obviously drying-out.

Table 6.2 Species quality scores based on Palmer *et al.* (2013)

Sample	1	2	3	4	5	6	7	8	12
No. taxa	10	17	20	4	26	10	12	21	15
Sum of individual species scores	8	13	17	3	20	8	10	18	12
SQI	1.2	1.3	1.1	-*	1.3	1.2	1.2	1.1	1.2

* Not calculated as less than 10 taxa present.

Species richness and species rarity

The most significant aquatic species is a Nationally Scarce crawling water beetle, *Cercyon granaries,* for which a single specimen was recorded from Site 6. Most of the records of this small water beetle come from East Anglia where it is associated with vegetation in marsh drains.

Of the remaining species recorded, ten are assigned Local status, and the rest comprise common species.

Additionally, three terrestrial species of note were recorded during the sampling.

- Roesel's bush cricket *Metrioptera roeselii* was fairly frequent in the long grass and associated vegetation between the ditch systems and was specifically recorded at Sites 6, 8 and 10. It was formerly restricted to coastal and estuarine habitats in south-eastern England but has spread north and west in recent decades and is now much more frequent. It is assigned Nationally Scarce B status.
- The anthomyzid *Anagnota bicolor* was recorded from two samples namely Samples 1 and 3. This species has recently been downgraded from Notable to Local. The larvae probably feed on emergent vegetation in wetlands.
- The dolichopodid fly *Achalcus britannicus* was recorded from Site 4. This species was described as new to science and new to Britain in 1997. Because so little is known about it and there are few records it has not been given a conservation status as yet, but it would appear to be uncommon.

Further detail on the ecology and distribution of these species is provided in Appendix H.

6.3 Summary

The aquatic invertebrate fauna of the Benhall site comprises predominantly common and local species, which, as a result, score modestly using the approach defined by Palmer *et al*. (2013).

638000

638500

260500

260000

N

Honey Pot Lodge

Ridecar Ln

Manor Farm House

Watering La

Watering Fm or Watering Farm

Hillcrest

A1094

W12
W6
W4
W7
W7
W8
W11
W10
W3
W5
W3
W2
W1
W10
W16
W18
W17
W16
W13
W15

1
2
3
4
5
6
7
8
9
10
11
12

Not present

Key

- Site 10_11 boundary
- Running water
- W1 — Ditch number
- Aquatic invertebrate survey location

0 50 100 150 200 m

Scale at A3: 1:3,500

Fen Meadow Compensation Sites:
Benhall Site 10_11

Figure 6.1
Aquatic invertebrate survey locations

November 2020

wood.

7. Summary

7.1 Overview

The proposals for the fen meadow creation at the site will, subject to further hydrological assessment and conceptualisation, likely entail raising water levels in ditches and habitat manipulation activities.

Based on this, and taking account of the results of the 2019 site visits (Wood, 2019), and the results of the 2020 desk study and extended Phase 1 habitat survey presented earlier in this report the following surveys were undertaken:

- An NVC survey of the terrestrial flora was undertaken to complement observations made on the ditch communities in Wood (2019),
- Otter and water vole surveys; and
- Aquatic invertebrates in the ditch system.

7.2 Terrestrial and ditch plant communities

The NVC survey identified six alliances within and on the margin of the floodplain and also a block of wet woodland on the valley toeslope. These vegetation types are assigned to the following NVC communities.

Floodplain and toeslope grasslands

- MG7b *Lolium perenne-Poa trivialis* leys
- MG7c *Lolium perenne-Alopecurus pratensis-Festuca pratensis* grassland
- MG10a *Holco-Juncetum effusi*, Typical sub-community
- MG10b *Holco-Juncetum effusi, Juncus inflexus* sub-community
- MG13 *Agrostis stolonifera-Alopecurus geniculatus* grassland

Dry, valleyside grassland

- MG6b *Lolio-Cynosuretum cristati, Anthoxanthum odoratum* sub-community

Wet woodland

- W6d *Alnus glutinosa-Urtica dioica* woodland, *Sambucus nigra* sub-community

Of these, the stands of *Holco-Juncetum* and *Lolium-Alopecurus-Festuca* grassland support suites of groundwater-influenced and typical floodplain species, respectively.

The *Holco-Juncetum* stands and the wet woodland were found to support the majority of phreatophyte species, with areas of 2.39 ha and 1.10 ha respectively, which, in total, account for 30.6 per cent of the surveyed area.

Based on this detailed survey, the *Holco-Juncetum* would be the key area of potential for fen meadow habitat creation, albeit as reported in Wood (2019), there additional areas which have some potential for fen meadow creation. The MG13 *Agrostis stolonifera-Alopecurus geniculatus* grassland also remains a locus for fen meadow creation assuming that ditch water levels can be controlled.

The associated ditch network supports emergent vegetation (and occasional aquatic species) which indicate that it is spring-fed and summer-wet. The stands of vegetation were assigned to the following NVC communities: S23 *Glycerio-Sparganion* marginal vegetation; S14 *Sparganietum erectae* swamp; S6 *Caricetum ripariae* swamp; and S28 *Phalaridetum arundinaceae* tall-herb fen.

The grassland and woodland habitats present qualify as coastal and floodplain grazing marsh and deciduous woodland respectively, habitats of principal importance listed under Section 41 (S41) of the *Natural Environment and Rural Communities Act 2006*.

7.3 Otter and water vole

No sign of otter presence was recorded on site, although the river and some of the wet ditches provide suitable habitat, and there is an otter record nearby.

Four of the 18 transects surveyed provided optimal aquatic habitat for water voles, with a further two meeting most of the noted habitat requirements but holding less water, and eleven containing relatively shallow water. Water vole presence was confirmed on four transects (two ditches and two river transects).

7.4 Aquatic invertebrates of ditches and watercourses

The aquatic invertebrate fauna of the Benhall site comprises predominantly common and local species, which, as a result, score modestly using the approach defined by Palmer *et al.* (2013).

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Appendix A
Species Scientific Name

Table A.1 Species Names

Species	Scientific Name
Higher plants	
Alder	*Alnus glutinosa*
Annual Meadow-grass	*Poa annua*
Ash	*Fraxinus excelsior*
Bittersweet	*Solanum dulcamara*
Black poplar	*Populus nigra*
Blackthorn	*Prunus spinosa*
Bramble	*Rubus fruticosus agg.*
Broad Buckler-fern	*Dryopteris dilatata*
Broad-leaved Dock	*Rumex conglomeratus*
Brown Sedge	*Carex disticha*
Chicory	*Cichorium intybus*
Cleavers	*Galium aparine*
Clustered Clover	*Trifolium glomeratum*
Clustered Dock	*Rumex obtusifolius*
Cock's-foot	*Dactylis glomerata*
Common Bent	*Agrostis capillaris*
Common Elder	*Sambucus nigra*
Common Feather-moss	*Kindbergia praelonga*
Common Mouse-ear	*Cerastium fontanum*
Common Nettle	*Urtica dioica*
Common orache	*Atriplex patula*
Common Ragwort	*Senecio jacobaea*
Common Sorrel	*Rumex acetosa*
Common Spike-rush	*Eleocharis palustris*
Couch	*Elytrigia repens*

Species	Scientific Name
Cow parsley	*Anthriscus sylvestris*
Creeping Bent	*Agrostis stolonifera*
Creeping Buttercup	*Ranunculus repens*
Creeping Thistle	*Cirsium arvense*
Crested dog's-tail	*Cynosurus cristatus*
Curled Dock	*Rumex crispus*
Daisy	*Bellis perennis*
Dandelion	*Taraxacum sp.*
Elder	*Sambucus nigra*
Enchanter's Nightshade	*Circaea lutetiana*
False Fox-sedge	*Carex otrubae*
False Oat-grass	*Arrhenatherum elatius*
Fescue Ryegrass	X *Schedolium loliaceum*
Field scabious	*Knautia arvensis*
Floating Sweet-grass	*Glyceria fluitans*
Giant hogweed	*Heracleum mantegazzianum*
Greater Plantain	*Plantago major*
Grey Willow	*Salix cinerea*
Ground ivy	*Glechoma hederacea*
Hairy Sedge	*Carex hirta*
Hard Rush	*Juncus inflexus*
Hawthorn	*Crataegus monogyna*
Herb Robert	*Geranium robertianum*
Himalayan balsam	*Impatiens glandulifera*
Hoary cinquefoil	*Potentilla argentea*
Horsetail	*Equisetum hyemale*
Hybrid Jointed Rush	*Juncus x surrejanus*
Japanese knotweed	*Fallopia japonica*
Knot-grass	*Polygonum aviculare*
Lombardy poplar	*Populus nigra italica*

Species	Scientific Name
Maidenhair fern	*Adiantum capillus-veneris*
Male Fern	*Dryopteris filix-mas*
Marsh Bird's-foot Trefoil	*Lotus pedunculatus*
Marsh Foxtail	*Alopecurus geniculatus*
Marsh Horsetail	*Equisetum palustre*
Marsh Marigold	*Caltha palustris*
Marsh thistle	*Cirsium palustre*
Meadow Barley	*Hordeum secalinum*
Meadow Buttercup	*Ranunculus acris*
Meadow Fescue	*Schedonorus pratensis*
Meadow Foxtail	*Alopecurus pratensis*
Meadow thistle	*Cirsium dissectum*
Meadowsweet	*Filipendula ulmaria*
Nettle	*Urtica dioica*
Pedunculate oak	*Quercus robur*
Perennial Ryegrass	*Lolium perenne*
Plicate Sweet-grass	*Glyceria notata*
Quaking-grass	*Briza media*
Red Campion	*Silene dioica*
Red Clover	*Trifolium pratense*
Red Fescue	*Festuca rubra*
Redshank	*Persicaria maculosa*
Reed Canary-grass	*Phalaris arundinacea*
Remote Sedge	*Carex remota*
Rough Meadow-grass	*Poa trivialis*
Rough-stalked Feather moss	*Brachythecium rutabulum*
Round-leaved mint	*Mentha suaveolens*
Sandy stilt puffball	*Battarrea phalloides*
Smaller Cat's-tail	*Phleum bertolonii*
Soft Rush	*Juncus effusus*

Species	Scientific Name
Southern Marsh-orchid	*Dactylorhiza praetermissa*
Spear Thistle	*Cirsium vulgare*
Spreading Meadow-grass	*Poa humilis*
Square-stemmed St John's-wort	*Hypericum tetrapterum*
Sweet Vernal-grass	*Anthoxanthum odoratum*
Sycamore	*Acer pseudoplatanus*
Sycamore	*Acer pseudoplatanus*
Timothy	*Phleum pratense*
Toad Rush	*Juncus bufonius*
Tutsan	*Hypericum androsaemum*
Water Mint	*Mentha aquatica*
Water-soldier	*Stratiotes aloides*
White Clover	*Trifolium repens*
Willow sp.	*Salix* sp.
Wood Dock	*Rumex sanguineus*
Yellow iris	*Iris pseudocorus*
Yorkshire fog	*Holcus lanatus*
Animals	
Badger	***Meles meles***
Barbastelle	*Barbastella barbastellus*
Barn owl	*Tyto alba*
Bats	*Chiroptera*
Brook lamprey	*Lampetra planeri*
Brown hare	*Lepus europaeus*
Brown long-eared	*Plecotus auritus*
Bullfinch	*Pyrrhula pyrrhula*
Common lizard	*Zootoca vivipara*
Common pipistrelle	*Pipistrellus pipistrellus*
Common toad	*Bufo bufo*
Daubenton's bat	*Myotis daubentonii*

Species	Scientific Name
Dormouse	*Muscardinus avellanarius*
Dunnock	*Prunella modularis*
European eel	*Anguilla anguilla*
Fieldfare	*Turdus pilaris*
Fritillary	
Ghost moth	*Hepialus humuli*
Grass snake	*Natrix helvetica*
Grass snake	*Natrix natrix*
Grayling	*Hipparchia semele*
Great crested newt	*Triturus cristatus*
Great crested newt	*Triturus cristatus*
Grey wagtail	*Motacilla cinerea*
Harvest mouse	*Micromys minutus*
Hedgehog	*Erinaceus europaeus*
Herring gull	*Larus argentatus*
House sparrow	*Passer domesticus*
Kingfisher	*Alcedo atthis*
Leisler's bat	*Nyctalus leisleri*
Linnet	*Linaria cannabina*
Mistle thrush	*Turdus viscivorus*
Natterer's bat	*Myotis nattereri*
Noctule	*Nyctalus noctula*
Noctule bat	*Nyctalus noctula*
Norfolk Hawker	*Anaciaeschna isoceles*
Otter	*Lutra lutra*
Pintail	*Anas acuta*
Pipistrelle bat	*Pipistrellus*
Redwing	*Turdus iliacus*
Serotine	*Eptesicus serotinus*
Skylark	*Alauda arvensis*

Species	Scientific Name
Slow worm	*Anguis fragilis*
Small heath	*Coenonympha pamphilus*
Small square-spot	*Diarsia rubi*
Song thrush	*Turdus philomelos*
Soprano pipistrelle	*Pipistrellus pygmaeus*
Spotted flycatcher	*Turdus philomelos*
Starling	*Sturnus vulgaris*
Water vole	*Arvicola amphibius*

Appendix B
Species Protection or Control Legislation

Great crested newts, Bats, Dormouse

These species / species groups are listed in Schedule 5 of the *Wildlife and Countryside Act 1981* (as amended) and Schedule 2 of *The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019*. They are afforded full protection under Section 9(4) of the Act and Regulation 43 of the Regulations. These make it an offence, *inter alia*, to:

- Deliberately capture, injure or kill any such animal;
- Deliberately disturb any such animal, including in particular any disturbance which is likely;
  - to impair its ability to survive, breed, or rear or nurture their young;
  - to impair its ability to hibernate or migrate;
  - to affect significantly the local distribution or abundance of that species;
- Damage or destroy a breeding site or resting place of any such animal;
- Intentionally or recklessly disturb any of these animals while it is occupying a structure or place that it uses for shelter or protection (for bats this is taken to mean all bat roosts whether bats are present or not); or
- Intentionally or recklessly obstruct access to any place that any of these animals uses for shelter or protection.

In addition, five British bat species are listed on Annex II of the Habitats Directive. These are:

- Greater horseshoe bat (*Rhinolophus ferrumequinum*);
- Lesser horseshoe bat (*Rhinolophus hipposideros*);
- Bechstein's bat (*Myotis bechsteinii*);
- Barbastelle (*Barbastella barbastellus*);
- Greater mouse-eared bat (*Myotis myotis*).

In certain circumstances where these species are found the Directive requires the designation of Special Areas of Conservation (SACs) by EC member states to ensure that their populations are maintained at a favourable conservation status. Outside SACs, the level of legal protection that these species receive is the same as for other bat species.

Badger

The *Protection of Badgers Act 1992* consolidates previous legislation (including the *Badgers Acts 1973* and the *Badgers (Further Protection) Act 1991*). It makes it an offence to:

- Kill, injure or take a badger;
- Attempt to kill, injure or take a badger;
- To damage or interfere with a sett.

The 1992 Act defines a badger sett as "any structure or place which displays signs indicating current use by a badger".

Nesting Birds

With certain exceptions, all wild birds, their nests and eggs are protected by Section 1 of the *Wildlife and Countryside Act 1981* (as amended). Therefore, it is an offence, inter alia, to:

- Intentionally kill, injure or take any wild bird;
- Intentionally take, damage or destroy the nest of any wild bird while it is in use or being built;
- Intentionally take or destroy the egg of any wild bird.

Bird species listed on Schedule 1 of the Act receive further protection, thus for these species it is also an offence to:

- Intentionally or recklessly disturb any bird while it is nest building, or is at a nest containing eggs or young;
- Intentionally or recklessly disturb the dependent young of any such bird.

Reptiles

The four widespread species of reptile that are native to Britain, namely common or viviparous lizard (*Zootoca vivipara*), slow worm (*Anguis fragilis*), adder (*Vipera berus*) and grass snake (*Natrix natrix*), are listed in Schedule 5 of the *Wildlife and Countryside Act 1981* (as amended) and are afforded limited protection under Section 9 of this Act. This makes it an offence, inter alia, to:

- Intentionally kill or injure any of these species.

In addition sand lizard and smooth snake are listed in Schedule 5 of the *Wildlife and Countryside Act 1981* (as amended) and Schedule 2 of *The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019*: They are afforded full protection under Section 9(4) of the Act and Regulation 43 of the Regulations.

These make it an offence, inter alia, to:

- Deliberately capture, injure or kill any such animal;
- Deliberately disturb any such animal, in particular in such a way as to be likely to:
- Impair their ability to survive, breed or reproduce, or rear or nurture their young;
- Impair their ability to hibernate or migrate which could affect significantly the local distribution or abundance of that species;
- Damage or destroy a breeding site or resting place of any such animal;
- Intentionally or recklessly disturb any of these animals while it is occupying a structure or place that it uses for shelter or protection; or
- Intentionally or recklessly obstruct access to any place that any of these animals uses for shelter or protection.

The legislation applies to all life stages of these species.

Notifiable / Controlled Species

Schedule 9 of the *Wildlife and Countryside Act 1981* (as amended) lists species of animal that it is an offence to release or allow to escape into the wild (for example grey squirrel) and species of plant that it is an offence to plant or otherwise cause to grow in the wild (for example, Japanese knotweed)

Appendix C
Phase 1 Target Notes

Table C.1 Extended Phase 1 Survey Target Notes

Target Note no.	Ordnance Survey Grid Reference	Description
1	TM 38024 60228	Very old black poplar, potentially native (i.e. not hybridised)
2	TM 38214 60519	An area about 5m^2 by a gate where the cattle have repeatedly walked over (poached) the surface churning the grass into bare mud. In this area common orache and giant hogweed have grown up.
3	TM 38154 59930	Piles of rubble which appear to be mainly concrete remains which have been left in an enclosure to the south of the site. These have colonised with tall ruderal vegetation and now potentially offer hibernacula potential to reptiles, great crested newts and other small animals.
4	TM 38208 59923	Damp area of tall ruderal vegetation, likely influenced by ditches which run by/into it. It contains a greater variety of damp tolerant species as a consequence of the underlying soil conditions.

Appendix D
Species recorded in NVC sample plots

Table D.1 Species recorded in sample plots

Scientific name	Common name	Londo	*Primary syntaxon*		EIV F
Acer pseudoplatanus	Sycamore	A	POP-02A	*Alnion incanae*	5
Agrostis capillaris	Common bent	A	MOL-01	*Arrhenatheretalia dry*	5
Agrostis stolonifera	Creeping bent	P	MOL-10	*Potentillo-Polygonetalia avicularis*	6
Alnus glutinosa	Alder	K	ALN-01	*Alnetalia glutinosae*	8
Alopecurus geniculatus	Marsh foxtail	V	MOL-10	*Potentillo-Polygonetalia avicularis*	7
Alopecurus pratensis	Meadow foxtail	P	MOL-01	*Arrhenatheretalia*	5
Anthoxanthum odoratum	Sweet vernal-grass	A	MOL	*Molinio-Arrhenatheretea*	6
Anthriscus sylvestris	Cow parsley	A	MOL-01	*Arrhenatheretalia*	5
Arrhenatherum elatius	False oat-grass	A	MOL-01	*Arrhenatheretalia*	5
Bellis perennis	Daisy	D	MOL-01	*Arrhenatheretalia*	5
Brachythecium rutabulum	Rough-stalked feather moss	-	MOL	*Molinio-Arrhenatheretea*	6
Caltha palustris	Marsh marigold	W	MOL-05	*Molinietalia*	9
Carex disticha	Brown sedge	W	PHR-04A	*Magnocaricion elatae*	8
Carex hirta	Hairy sedge	A	MOL-10	*Potentillo-Polygonetalia avicularis*	7
Carex otrubae	False fox-sedge	F	MOL-10	*Potentillo-Polygonetalia avicularis*	8
Carex remota	Remote sedge	V	POP-02A	*Alnion incanae*	8
Cerastium fontanum	Common mouse-ear	A	MOL-01	*Arrhenatheretalia*	5
Circaea lutetiana	Enchanter's nightshade	V	POP-02A	*Alnion incanae*	6
Cirsium arvense	Creeping thistle	A	ART	*Artemisietea vulgaris*	6
Cirsium palustre	Marsh thistle	V	MOL-05	*Molinietalia*	8
Cirsium vulgare	Spear thistle	A	ART	*Artemisietea vulgaris*	5
Crataegus monogyna	Hawthorn	A	RHA-01	*Prunetalia spinosae*	5
Dactylis glomerata	Cock's-foot	A	MOL-01	*Arrhenatheretalia dry*	5
Dactylorhiza praetermissa	Southern marsh-orchid	V	SCH	*Scheuchzerio-Caricetea*	8
Dryopteris dilatata	Broad buckler-fern	A	POP-02C	*Fraxino-Quercion roboris*	6
Dryopteris filix-mas	Male fern	A	FAG-02	*Fagetalia sylvaticae*	6
Eleocharis palustris	Common spike-rush	W	MOL-05	*Molinietalia*	10
Elytrigia repens	Couch	A	MOL-10	*Potentillo-Polygonetalia avicularis*	5
Equisetum palustre	Marsh horsetail	W	MOL-05	*Molinietalia*	8
Festuca rubra	Red fescue	A	MOL	*Molinio-Arrhenatheretea*	5
Filipendula ulmaria	Meadowsweet	F	MOL-05	*Molinietalia*	8
Galium aparine	Cleavers	A	ART	*Artemisietea vulgaris*	6
Geranium robertianum	Herb robert	A	POP-02A	*Alnion incanae*	6
Glechoma hederacea	Ground ivy	A	EPI-02	*Circaeo lutetianae-Stachyetalia sylvaticae*	6
Glyceria fluitans	Floating sweet-grass	W	PHR-05A	*Glycerio-Sparganion*	10
Glyceria notata	Plicate sweet-grass	W	PHR-05A	*Glycerio-Sparganion*	10
Holcus lanatus	Yorkshire fog	P	MOL	*Molinio-Arrhenatheretea*	6
Hordeum secalinum	Meadow barley	P	MOL-01	*Arrhenatheretalia*	6
Hypericum tetrapterum	Square-stemmed St John's-wort	W	MOL-05	*Molinietalia*	8
Juncus bufonius	Toad rush	V	ISO-02	*Nanocyperetalia*	7
Juncus effusus	Soft rush	V	MOL-05	*Molinietalia*	7
Juncus inflexus	Hard rush	V	MOL-10	*Potentillo-Polygonetalia avicularis*	7
Juncus x surrejanus	Hybrid jointed rush	V	MOL-05	*Molinietalia*	9
Kindbergia praelonga	Common feather-moss	-	MOL	*Molinio-Arrhenatheretea*	6
Lolium perenne	Perennial ryegrass	A	MOL-01	*Arrhenatheretalia*	5
Lotus pedunculatus	Marsh bird's-foot trefoil	V	MOL-05	*Molinietalia*	8

Scientific name	Common name	Londo	*Primary syntaxon*	EIV F
Mentha aquatica	Water mint	F	PHR-01 *Phragmitetalia*	8
Persicaria maculosa	Redshank	A	BID-01 *Bidentetalia*	6
Phalaris arundinacea	Reed canary-grass	V	PHR-04A *Magnocaricion elatae*	8
Phleum bertolonii	Smaller cat's-tail	A	MOL-01 *Arrhenatheretalia*	4
Phleum pratense	Timothy	A	MOL-01 *Arrhenatheretalia*	5
Plantago major	Greater plantain	P	MOL-10 *Potentillo-Polygonetalia avicularis*	5
Poa annua	Annual meadow-grass	A	MOL-10 *Potentillo-Polygonetalia avicularis*	5
Poa humilis	Spreading meadow-grass	A	CRU-01A *Koelerion arenariae*	5
Poa trivialis	Rough meadow-grass	A	MOL-10 *Potentillo-Polygonetalia avicularis*	6
Polygonum aviculare	Knot-grass	A	POL-01A *Polygono-Coronopodion*	5
Ranunculus acris	Meadow buttercup	D	MOL-01 *Arrhenatheretalia*	6
Ranunculus repens	Creeping buttercup	P	MOL-10 *Potentillo-Polygonetalia avicularis*	7
Rumex acetosa	Common sorrel	A	MOL *Molinio-Arrhenatheretea*	5
Rumex conglomeratus	Broad-leaved dock	P	MOL-10 *Potentillo-Polygonetalia avicularis*	8
Rumex crispus	Curled dock	A	MOL-10 *Potentillo-Polygonetalia avicularis*	6
Rumex obtusifolius	Clustered dock	A	MOL-10 *Potentillo-Polygonetalia avicularis*	5
Rumex sanguineus	Wood dock	V	POP-02A *Alnion incanae*	7
Salix cinerea	Grey willow	F	FRA-01A *Salicion cinereae*	8
Sambucus nigra	Common elder	A	FAG-02 *Fagetalia sylvaticae*	5
X *Schedolium loliaceum*	Fescue ryegrass	P	MOL-01 *Arrhenatheretalia*	6
Schedonorus pratensis	Meadow fescue	A	MOL *Molinio-Arrhenatheretea*	6
Senecio jacobaea	Common ragwort	A	MOL-01 *Arrhenatheretalia*	4
Silene dioica	Red campion	A	POP-02A *Alnion incanae*	6
Taraxacum sp.	Dandelion	A	MOL-01 *Arrhenatheretalia*	5
Trifolium pratense	Red clover	A	MOL *Molinio-Arrhenatheretea*	5
Trifolium repens	White clover	A	MOL-01 *Arrhenatheretalia*	5
Urtica dioica	Common nettle	A	ART *Artemisietea vulgaris*	6

Appendix E
Location of NVC sample plots

Table E.1 Location of NVC survey sample plots

Plot	Easting	Northing	Stand	NVC code
1	638142	259952	G	MG6b
2	638148	259982	G	MG6b
3	638089	260078	G	MG6b
4	638051	260205	G	MG6b
5	638099	260172	B2	MG13
6	638065	260163	B2	MG13
7	638102	260161	B2	MG13
8	638122	260174	B2	MG13
9	638126	260202	B2	MG13
10	638140	260275	A1	MG10b
11	638140	260335	A1	MG10b
12	638144	260404	A1	MG10b
13	638222	260405	C1	MG7c
14	638253	260467	C1	MG7c
15	638246	260545	B1	MG13
16	638281	260647	B1	MG13
17	638361	260670	C1	MG7c
18	638407	260689	C2	MG7c
19	638114	260041	G	MG6b
20	638198	259983	A2	MG10b
21	638201	259945	A2	MG10b
22	638249	259940	E	MG7b
23	638234	260000	E	MG7b
24	638171	260044	A2	MG10b
25	638167	260112	A2	MG10b
26	638140	260152	A2	MG10b
27	638153	260188	A2	MG10b
28	638149	260247	A2	MG10b
29	638129	260251	A1	MG10b
30	638150	260425	A1	MG10b
31	638195	260380	C1	MG7c
32	638175	260363	C1	MG7c
33	638181	260446	C1	MG7c
34	638205	260494	B1	MG13
35	638309	260539	B1	MG13
36	638345	260620	B1	MG13
37	638413	260650	F	MG1b
38	638436	260677	F	MG1b
39	638378	260702	C2	MG7c
40	638359	260717	C2	MG7c
41	638219	260459	C1	MG7c
42	638293	260714	H	W6d
43	638264	260734	H	W6d
44	638265	260691	H	W6d
45	638230	260729	H	W6d
46	638234	260696	H	W6d
47	638184	260683	D	MG10a
48	638207	260669	D	MG10a

Appendix F
NVC stand community tables

The stand community tables are presented below, with Domin values defined.

Domin cover/abundance scale

Cover	91-100 per cent	10
	76-90 per cent	9
	51-75 per cent	8
	34-50 per cent	7
	26-33 per cent	6
	11-25 per cent	5
	4-10 per cent	4
	<4 per cent (many)	3
	(several)	2
	(few)	1

Table 5. Community table species constancy

V	=	81-100 per cent	Constant
IV	=	61-80 per cent	Constant
III	=	41-60 per cent	Frequent
II	=	21-40 per cent	Occasional
I	=	1-20 per cent	Scarce

At the right-hand side of each stand community table the constancy values of each species in the community is given with the range of Domin values with which they have been recorded.

Table F.1 Stands A1 and A2

NVC: **MG10b *Holco-Juncetum effusi*, *Juncus inflexus* sub-community**
Alliance: ***Calthion***
Order: ***Molinietalia caeruleae***

	Stand A1							Stand A2								
Sample plot	**10**	**11**	**12**	**29**	**30**			**20**	**21**	**24**	**25**	**26**	**27**	**28**		
Holcus lanatus	5	6	6	6	7	V	(5-7)	9	9	10	8	9	8	2	V	(2-10)
Ranunculus repens	4	4	5	3	6	V	(3-6)	2	3	2		7	2	9	V	(2-9)
Poa trivialis	8	7	7	4	6	V	(4-8)	4	4	3	3	3	5	6	V	(3-6)
Agrostis stolonifera	7	7	6	5	2	V	(2-7)	8	7	6	2	3	6	6	V	(2-8)
Equisetum palustre	3	2	3	2	7	V	(2-7)	3	2	6	10	7	8	2	V	(2-10)
Carex hirta	4	5	2	4	3	V	(2-5)						2		I	(2)
Schedonorus pratensis	5	1	3	5	6	V	(1-6)									
Ranunculus acris	6	8	7		4	IV	(4-8)	2	3	2	2	1		2	V	(1-3)
Juncus inflexus	4	4	2		1	IV	(1-4)			1	4		4	1	III	(1-4)
Trifolium repens	2	1		2	2	IV	(1-2)									
Carex disticha			4	8	7	III	(4-8)				2	4	3		III	(2-4)
Rumex crispus		2		2	2	III	(2)							1	I	(1)
Festuca rubra		1	1		2	III	(1-2)	2	4						II	(2-4)
Mentha aquatica			2		3	II	(2-3)				1		2		II	(1-2)
Alopecurus pratensis			2		2	II	(2)	1						1	II	(1)
X *Schedolium loliaceum*	1			1		II	(2)									
Juncus x *surrejanus*	2	1				II	(1-2)					2		1	II	(1-2)
Lolium perenne		1	1			II	(1)	2	1				1		III	(1-2)
Phleum pratense		1	1			II	(1)	2	2						II	(2)
Rumex conglomeratus	1	1				II	(1)									
Cerastium fontanum					3	I	(3)									
Dactylorhiza praetermissa					2	I	(2)					1			I	(1)
Alopecurus geniculatus				2		I	(2)									
Trifolium pratense					2	I	(2)									
Phalaris arundinacea				1		I	(1)									
Hypericum tetrapterum					1	I	(1)									
Cirsium arvense								1	1						II	(1)
Glyceria fluitans														2	I	(2)
Eleocharis palustris										1					I	(1)
Sward height (cm)	25	22	20	18	20			25	25	22	25	17	25	20		
% Vascular plant cover	100	100	95	90	100			100	95	100	100	100	100	95		
% Bryophyte cover	0	0	0	0	0			0	0	0	0	0	0	0		
% Plant litter	1	1	5	10	1			1	5	0	0	0	1	5		
% Bare ground	0	0	0	0	0			0	0	0	0	0	0	0		
Activity[1]	-	-	-	-	-			-	-	-	-	-	-	-		
No. of species	13	16	15	13	19	Av.	14.6	11	10	8	8	9	10	11	Av.	9.6

[1] No evidence of grazing or other disturbance

Table F.2 Stands B1 and B2

NVC: **MG13 *Agrostis stolonifera-Alopecurus geniculatus* grassland**
Alliance: ***Potentillion anserinae***
Order: ***Potentillo-Polygonetalia avicularis***

	Stand B1						Stand B2					
Sample plot	**15**	**16**	**34**	**35**	**36**		**5**	**6**	**7**	**8**	**9**	
Agrostis stolonifera	10	10	6	10	10	V (6-10)	8	9	9	9	10	V (8-10)
Ranunculus repens	9	6	10	6	5	V (5-10)	3	1	4	5	6	V (1-6)
Poa trivialis	6	2	5	3	3	V (2-6)	4	5	5	3	4	V (3-5)
Rumex crispus	2	2	2	2	2	V (2)						
Alopecurus geniculatus	2	2	1	3	4	V (1-4)	5	6	2	1	1	V (1-6)
Lolium perenne	1		1	3		III (1-3)	3	3		4	1	IV (1-4)
Equisetum palustre	2		5			II (2-5)	4	1	5	2	4	V (1-5)
Carex hirta	1				2	II (1-2)	1	1	4	4	1	V (1-4)
Alopecurus pratensis				2	1	II (1-2)						
Glyceria fluitans	1		2			II (1-2)						
Juncus effusus	4	4				II (4)						
Carex otrubae	4					I (4)						
Schedonorus pratensis			2			I (2)				1		I (1)
X *Schedolium loliaceum*			2			I (2)						
Juncus inflexus					1	I (1)				1	1	II (1)
Phalaris arundinacea	1					I (1)						
Juncus bufonius							3		1	3	3	IV (1-3)
Holcus lanatus							1	1	4			III (1-4)
Ranunculus acris									1	3		II (1-3)
Poa annua							1	3				II (1-3)
Cirsium arvense							1		1			II (1)
Juncus x *surrejanus*										2		I (2)
Persicaria maculosa											2	I (2)
Glyceria notata											2	I (2)
Polygonum aviculare											2	I (2)
Cerastium fontanum										1		I (1)
Trifolium repens											1	I (1)
Bellis perennis										1		I (1)
Mentha aquatica									1			I (1)
Plantago major										1		I (1)
Sward height (cm)	35	35	25	20	25		10	15	15	20	15	
% Vascular plant cover	100	100	100	100	100		90	95	95	90	98	
% Bryophyte cover	0	0	0	0	0		0	0	0	0	0	
% Plant litter	0	0	0	0	0		0	0	0	0	0	
% Bare ground	0	0	0	0	0		10	5	5	10	2	
Activity[1]	0	0	0	0	0		0	0	0	0	0	
No. of species	12	6	10	7	8	Av. 8.6	11	9	11	15	13	Av. 11.8

[1] No evidence of grazing or other disturbance

Table F.3 Stands C1 and C2

NVC: **MG7c *Lolium perenne-Alopecurus pratensis-Festuca pratensis* grassland**
Alliance: ***Lolio-Plantaginion*** [***Alopecurion*** *per* Wallace & Prosser 2017)
Order: ***Arrhenatheretalia elatioris***

	Stand C1									Stand C2		
Sample plot	**13**	**14**	**17**	**31**	**32**	**33**	**41**			**18**	**39**	**40**
Agrostis stolonifera	8	9	8	8	9	10	9	V	(8-10)		6	
Ranunculus repens	8	8	4	8	9	8	4	V	(4-9)			
Hordeum secalinum	8	6	6	7	2	2	5	V	(2-8)	1		
Schedonorus pratensis	1	1	2	5	3	1	3	V	(1-5)	2	5	6
Lolium perenne	3	4	1	2	3	3	3	V	(1-4)		2	
Poa trivialis	4	5	5	4		3	4	V	(3-5)	4		4
Ranunculus acris	6	4	1	3		2	3	V	(1-6)			
Holcus lanatus		1	1	4	2	2	2	V	(1-4)	7	6	7
Rumex crispus	2	1	2	1			1	IV	(1-2)	2	4	2
Alopecurus pratensis		1	5	1	1			III	(1-5)	8	7	6
Taraxacum sp.	1	1					1	III	(1)			
Cirsium arvense		1	5					II	(1-5)	5	5	7
X *Schedolium loliaceum*	1	1						II	(1)			
Carex hirta				4				I	(4)	1	2	
Equisetum palustre			2					I	(2)	2	3	2
Alopecurus geniculatus	2							I	(2)			
Dactylis glomerata											4	1
Arrhenatherum elatius										4		
Phleum pratense											4	
Rumex obtusifolius											4	
Sward height (cm)	35	25	30	35	25	35	30			55	75	70
% Vascular plant cover	100	100	95	100	100	100	95			90	95	95
% Bryophyte cover	-	-	-	-	-	-	-			-	-	-
% Plant litter	0	0	1	0	1	1	0			10	5	10
% Bare ground	0	0	5	0	0	0	5			2	1	1
Activity[1]	-	-	-	-	-	-	-			-	-	-
No. of species	11	13	12	11	7	8	10	Av.	10.3	10	12	8

[1] No evidence of grazing or other disturbance

Table F.4 Stands D, E and F

Stand D
NVC: **MG10a *Holco-Juncetum effusi*, Typical sub-community**
Alliance: ***Calthion***
Order: ***Molinietalia caeruleae***

Stand E
NVC: **MG7b *Lolium perenne-Poa trivialis* leys**
Alliance: ***Lolio-Plantaginion***
Order: ***Arrhenatheretalia elatioris***

Stand F
NVC: **MG1b *Arrhenatheretum elatioris* grassland, *Urtica dioica* sub-community**
Alliance: ***Arrhenatherion***
Order: ***Arrhenatheretalia elatioris***

	Stand D		Stand E		Stand F	
Sample plot	**47**	**48**	**22**	**23**	**37**	**38**
Holcus lanatus	10	10	9	7	5	6
Rumex crispus	5	2	1	2	1	2
Rumex acetosa	3	1				
Equisetum palustre	2	1				
Filipendula ulmaria	2	1				
Juncus effusus	4		1			
Lotus pedunculatus	4					
Ranunculus repens		2	8	9		
Cerastium fontanum		2	1	1		
Rumex obtusifolius		1				
Lolium perenne			4	5		
Agrostis stolonifera			5	4		2
Cirsium arvense			3	5		
Poa trivialis			3	4	3	2
Festuca rubra			2			
Cirsium vulgare				1		
Cirsium palustre			1			
Arrhenatherum elatius					10	9
Alopecurus pratensis					5	4
Urtica dioica					3	4
Dactylis glomerata					2	5
Anthriscus sylvestris					1	
Sward height (cm)	45	40	25	30	120	115
% Vascular plant cover	100	100	100	100	100	99
% Bryophyte cover	0	0	0	0	0	0
% Plant litter	1	5	0	0	20	15
% Bare ground	0	0	0	0	0	1
Activity[1]	-	-	-	-	-	-
No. of species	7	8	11	9	8	8

[1] No evidence of grazing or other disturbance

Table F.5 Stand G

NVC: **MG6b *Lolio-Cynosuretum cristati*, *Anthoxanthum odoratum* sub-community**
Alliance: ***Cynosurion***
Order: ***Arrhenatheretalia elatioris***

Sample Plot	1	2	3	4	19		
Agrostis capillaris	10	9	8	7	9	V	(7-10)
Holcus lanatus	5	6	7	9	4	V	(4-9)
Lolium perenne	2	3	3	3	2	V	(2-3)
Phleum bertolonii	3	2	2	1	2	V	(1-3)
Cirsium arvense	1	1	2	1		IV	(1-2)
Senecio jacobaea		2		2		II	(2)
Urtica dioica	2				2	II	(2)
Elytrigia repens		1			5	II	(1-5)
Poa humilis	1				3	II	(1-3)
Dactylis glomerata	1				2	II	(1-2)
Ranunculus repens			2	1		II	(1-2)
Ranunculus acris		1	1			II	(1)
Anthoxanthum odoratum		1		1		II	(1)
Trifolium repens			2			I	(2)
Festuca rubra					1	I	(1)
Alopecurus pratensis		1				I	(1)
Agrostis stolonifera			1			I	(1)
Cerastium fontanum	1					I	(1)
Bellis perennis	1					I	(1)
Sward height (cm)							
% Vascular plant cover							
% Bryophyte cover							
% Plant litter							
% Bare ground							
Activity[1]	R	R	R	R			
No. of species	10	10	9	8	9	Av.	9.2

[1] R = Rabbit

Table F.6 Stand H

NVC: **W6d *Alnus glutinosa-Urtica dioica* woodland, *Sambucus nigra* sub-community**
Alliance: ***Salicion albae***
Order: ***Salicetalia purpureae***

Sample plot	42	43	44	45	46		
Alnus glutinosa	10	9	10	10	10	V	(9-10)
Acer pseudoplatanus		5				I	(5)
Sambucus nigra	5	4				II	(4-5)
Crataegus monogyna		1		4		II	(1-4)
Salix cinerea				1		I	(1)
Poa trivialis	10	7	8	8	10	V	(7-10)
Urtica dioica	8	5	10	9	3	V	(3-10)
Galium aparine	5	4	6	4	1	V	(1-6)
Kindbergia praelonga		2	6	2	4	IV	(2-6)
Silene dioica	4	2		3		III	(2-4)
Rumex sanguineus	2	6				II	(2-6)
Glechoma hederacea	2			2		II	(2)
Carex remota		1		2		II	(1-2)
Brachythecium rutabulum	2			1		II	(1-2)
Glyceria fluitans					6	I	(6)
Dryopteris dilatata		4				I	(4)
Geranium robertianum					3	I	(3)
Phalaris arundinacea				2		I	(2)
Circaea lutetiana		2				I	(2)
Epilobium montanum					2	I	(2)
Dryopteris filix-mas				1		I	(1)
Caltha palustris				1		I	(1)
No of species	9	13	5	14	8	Av.	9.8

Appendix G
Aquatic invertebrate site data and taxa recorded

PHYSICAL AND CHEMICAL PARAMETERS RECORDED FROM THE DITCH SYSTEM NEAR SAXMUNDHAM, SUFFOLK: JULY 2020									
SAMPLE NUMBER	1	2	3	4	5	6	7	8	12
MAIN SITE	10	10	10	10	10	10	11	11	11
SURVEY DATE	16/07/2020	16/07/2020	17/07/2020	17/07/2020	17/07/2020	17/07/2020	17/07/2020	17/07/2020	17/07/2020
GRID REFERENCE SUFFIX	TM	TM	TM	TM	TM	TM	TM	TM	TM
GRID REFERENCE EASTINGS	38177	38262	38223	38276	38317	38385	38139	38128	38248
GRID REFERENCE NORTHINGS	60464	60497	60564	60557	60708	60681	60396	60240	60033
MAXIMUM WATER DEPTH	Not visible	Not visible	>100	Not visible	>50	16	18	18	>50
MAXIMUM WETTED WIDTH	250	500	600	400	400	200	Not visible	100	400
FLOW	0	0	0	0	0	0	0	0	2
EMERGENT COVER (%)	100	100	5	100	100	100	100	100	15
PH	7.8	7.8	7.3	7.6	7.7	7.6	7.8	7.9	7.9
CONDUCTIVITY	1032	1750	1804	1610	1057	1071	864	1004	1314
WATER TEMPERATURE (°C)	8.2	19.2	19	16.2	16.8	16.1	14.3	14.3	17.6
TOTAL DISSOLVED SOLIDS (PPM)	517	875	896	813	529	558	442	502	658
SHADE (%)	35	0	0	0	30	1	40	20	30
FLOW: 0 = No flow, 1 = very little flow, 2 = slow flow									

AQUATIC INVERTEBRATES RECORDED FROM A DITCH SYSTEM NEAR SAXMUNDHAM, SUFFOLK: JULY 2020											
		Site	1	2	3	4	5	6	7	8	12
Species	STAGE	Cons.Status Score									
Dugesia sp	Adults									1	
Planaria torva	Adult							1			
Polycelis nigra	Adults								7		
Polycelis tenuis	Adults		2	1		1	1		3		
Oligochaeta	Various		21	103	1	12	5	4	66	6	
Eisenella tetraedra	Various			2	1	3					
Erpobdella octoculata	Adults	1			1				2	1	
Erpobdellidae	Juveniles		2		2				3		1
Glossiphonia complanata	Juveniles	1		1			1		4		
Helobdella stagnalis	Juveniles	1		1					341		
Anisus vortex	Various	1	6	7						152	19
Bathyomphalus contortus	Various	2	1200	7	3		30		1	6	3
Bithynia tentaculata	Various	1			63					2	20
Gyraulus albus	Juveniles	2									2
Hippeutis complanatus	Adults	2					1				
Lymnaea stagnalis	Various	1	1		2						3
Physa fontinalis	Various	1			10		2			37	11
Planorbarius corneus	Juvenile	1			1						
Planorbis carinatus	Adults	1									
Planorbis sp	Juveniles			1	1		4			2	3
Potamopyrgus antipodarum	Various				476	3					
Radix balthica	Various	1		1	30		4			74	3
Stagnicola sp	Various	1	1	2	1		2				2
Valvata cristata	Adults	2	54	13			7		5		
Valvata piscinalis	Adults	2		1	7						
Pisidium sp	Various	1	4	63	1		5		10	3	1
Sphaerium corneum	Various	1								1	
Hydrachnellae	Adults		2				1		3		
Asellus aquaticus	Adults	1	156	135	126	6	42	160		96	11
Asellus sp	Juveniles		1								
Crangonyx pseudogracilis	Various		42	2	1		6	184			
Gammarus pulex	Various	1							187	352	5
Ostracoda	Adults				1			1			
Cloeon dipterum	Nymph	1					1				
Nemouridae	Early instar								1		
Sialis fuliginosa	Nymph									1	
Coenagrion puella	Nymphs	1								2	
Pyrrhosoma nymphula	Nymphs	1								1	
Aesnidae	Early instar				1						
Sympetrum striolatum	Nymphs	1					1				
Limnephilus lunatus	Larvae	1			1			2	1	4	
Limnephilidae	Early instars						1				
Corixidae	Nymphs				1		7			1	
Gerris sp	Nymphs						1				
Hesperocorixa sahlbergi	Adults	1			1		9				
Notonecta sp	Nymphs				1		2				
Velia caprai	Adults	1	1		1						
Velia sp	Nymphs								1		
Haliplus flavicollis	Adult	2								1	
Haliplus ruficollis group	Adult female						1				
Haliplus sp	Larvae				2						
Dytiscini	Larvae						1	3			
Agabus sturmii	Adults	1					2				
Hydroporus angustatus	Adults	1								1	
Hydroporus palustris	Adults	1					3				
Hydroporus planus	Adults	1					1				
Ilybius ater	Adults	1								1	
Liopterus haemorrhoidalis	Adults	1						1			
Hydrophilidae	Larvae					3		2	1	1	
Anacaena limbata	Adults	1					3	15	4	6	
Cercyon granarius	**Adults**							**1**			
Cercyon tristis	Adults	2			1			2			
Cercyon sp	Adults							1			
Helophorus brevipalpis	Adults	1		1	2	3	2	1	1	3	
Helophorus minutus	Adults	1			3						
Tipula sp	Larva			1							
Limoniidae	Larvae			1		14					
Limoniidae	Pupa		1								
Pilaria sp	Larva						1				
Pedicia sp	Larva						1				
Ptychoptera sp	Larvae						1		2		
Ceratopogonidae	Larvae								4		
Ceratopogonidae	Pupae								1	1	
Chironomini	Larvae				2		30			1	
Metriocnemus sp	Larvae								1	6	
Orthocladiinae	Larvae				49	1	1	1	5	80	1
Psectrotanypus varius	Pupa				1						
Tanypodinae	Larvae						6		2	4	
Tanytarsini	Larvae			1	1	1			6	80	6
Anopheles claviger	Larvae	1				1					
Dixella amphibia	Larvae	1						1			
Dixella attica/autumnalis	Larvae	2		1			2			2	2
Dixella nebulosa	Larvae			1							
Dixidae	Pupae						1				
Psychodidae	Larvae			3	1	20	6	2	121	4	
Oplodontha viridula	Larvae	2					1	3			
Oxycera nigricornis	Larvae	2				10	4				
Oxycera sp	Larvae					1					
Hemerodrominae	Larva									1	
Tabanidae	Larvae	1		1							
Sciomyzidae	Larvae						1	1			
Sciomyzidae	Pupae		2	1				1			

		Site	1	2	3	4	5	6	7	8	12
Species	**STAGE**	**Cons.Status Score**									
VERTEBRATES											
Gasterosteus aculeatus	Adults									7	
Pungitius pungitius	Adults		1							3	
TERRESTRIAL INVERTEBRATES OR TERRESTRIAL LIFE-STAGES											
Cochlicopa lubrica	Adult										1
Punctum pygmaeum	Adults					6					
Succinea putris	Various		2	18	30	15	20	30		15	12
Conocephalus dorsalis	Adult										
Metrioptera roeselii	**Adults**							**1**		**1**	
Tetrix undulata	Adult									1	
Calopteryx splendens	Adults									1	1
Ischnodemus sabuleti	Various					462	5				
Papilio machaon	**Chrysalis**			**1**							
Donacaula forficella	Adult					1					
Erioptera flavata	Adults					1	1	2	1		
Helius flavus	Adults					2					
Dixella autumnalis	Adult			1							
Achalcus britannicus	**Adult males**					**2**					
Lonchoptera sp	Larvae					7	1	1	2	2	
Eristalini	Larva							1			
Anagnota bicolor	**Adults**		**1**		**1**						
Phytomyza ranunculi	Larvae					1					
Calamoncosis glyceriae	Adult					1					
Elachiptera megaspis	Adults									2	
Oscinisoma gilvipes	Adults					4					
Spaziophora hydromyzina	Adult male				1						

Appendix H
Ecology and distribution of notable invertebrate species

Coleoptera (beetles)

Cercyon granarius Hydrophilidae Nationally Scarce

There are 48 records for this small water beetle on the National Biodiversity Network Atlas, the majority of which for East Anglia. It is associated with vegetation in marsh drains.

Orthoptera (crickets and grasshoppers)

Metrioptera roeselii Tetrigidae Nationally Scarce B

Roesel's bush-cricket was formerly restricted to coastal and estuarine habitats in south-eastern England but it has spread northwards and westwards in recent decades and is now much more frequent. It has now been recorded from urban wasteland, road and railway verges and also in agricultural set-aside land. It is usually found in coarse vegetation in warm and sunny locations at low altitudes.

True flies

Anagnota bicolor Anthomyzidae Nationally Scarce

This species was given Notable status in Falk (1991) but it was downgraded in Falk *et al.* (2017). The larvae probably feed on emergent vegetation in wetlands.

Achalcus britannicus Dolichopodidae

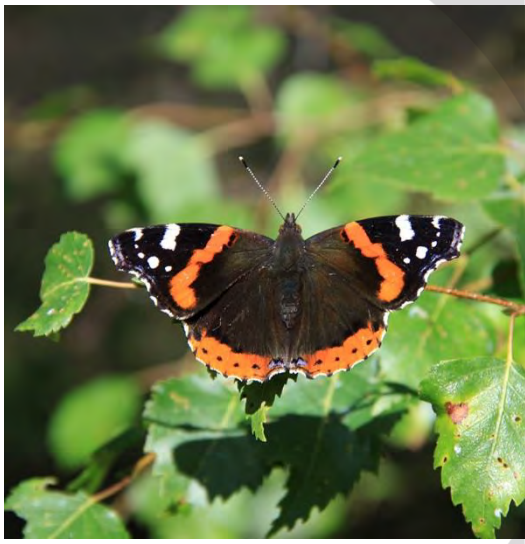
This dolichopodid was described as new to science and added to the British list by Pollet in 1997. It has not been evaluated for its conservation status because of the short period entomologists have had to record the species. However, there are few records and it would appear to be scarce. This is a wetland species and the larvae are unknown.

APPENDIX B: HALESWORTH SITE 28 ECOLOGY BASELINE REPORT

EDF Energy

Sizewell C

Fen Meadow Compensation Sites: Halesworth Site 28 Baseline Ecology Report



Wood Group UK Limited – June 2021

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Contents

1. Introduction

1.1 Background

The proposed development platform for Sizewell C will extend a short distance into the eastern margins of Sizewell Marshes Site of Special Scientific Interest. The toe of the batter of the proposed platform will define the extent of permanent land-take but, additional to that, ditch re-alignment is required which will take a limited amount of further land.

Based on National Vegetation Classification (NVC) survey data the main affected habitats are M22 *Juncus subnodulosus – Cirsium palustre* fen meadow, S26 *Phragmites australis - Urtica dioica* tall-herb fen, S4 *Phragmites australis* reedbed and some W5 *Alnus glutinosa – Carex paniculata* wet woodland.

Studies focussed on the provision of compensatory fen meadow habitat, particularly M22 *Juncus subnodulosus – Cirsium palustre* fen meadow, were reported in Wood (2018). Five sites were identified for further investigation, whilst 17 sites were put on hold subject to further assessment of the initial five sites. The five sites identified for further investigation (Wood (2018)) were:

- Site No. 10 – Aldecar Lane, Benhall;
- Site No. 11 – Watering Lane, Benhall;
- Site No. 28 – Halesworth;
- Site No. 33 – Stratford St Andrew; and
- Site No. 54 – Pakenham Fen.

Subsequently, one day site visits to Sites 10, 11, 28 and 54 were undertaken in April and May 2019. Site 33 was not visited as access had not been agreed at the time (Wood, 2019), however, following further consideration of the site characteristics and suitability for fen meadow creation, it was also concluded that the sites that were taken forward all provide greater potential for fen meadow creation than Site 33.

The one day site visits to Sites 10, 11, 28 and 54 comprised:

- A walkabout survey to identify areas where (1) the peat is currently influenced by groundwater or near-surface seepage; and (2) fen meadow species are present within or close to the site margins;
- A reconnaissance hand augering survey to identify general peat quality (substrate condition), sub-surface geological materials, presence of water table and areas of upwelling groundwater; and
- Consideration of broad options for water management and potential for changes to land management.

Findings were reported in Wood (2019). Sites 10, 28 and 54 were all identified as having potential for the development of fen meadow as follows:

- Site 10: primary locus 1.5ha, further area 0.7ha (Site 11 has relatively limited potential (primary locus of 0.5ha although part already supports fen meadow species, and further area of 1.2ha) but is close to Site 10, so warrants further consideration in that context);
- Site 28: primary locus 1.2ha, further area 1.3ha;
- Site 54 north: primary locus 3.2ha, further area 6.2ha; and

- Site 54 south: primary locus 1.7ha, further area: 4.3ha.

Subsequently EDF has progressed with detailed site conceptualisation and feasibility assessment work at Sites 10/11, 28 and 54.

The scope of the conceptualisation and feasibility assessment work can be summarised as follows:

- Ecological studies:
  - Desk based review of ecological data for the sites and surrounding area; and
  - Targeted ecological surveys.
- Hydrological studies:
  - Desk based review of available groundwater level data (including output from the Environment Agency model for high, low and average groundwater level conditions) and the seasonal variation in groundwater levels. Also, effects of groundwater abstraction on groundwater levels below the site;
  - Collection of topographic data;
  - Collection of surface water level and groundwater level data to determine the relationship between groundwater and surface water levels on site. Also detailed study of the existing and wider ditch network to determine potential for water management without risk to upstream receptors; and
  - Collection of hydrochemical data.

1.2 This report

The scope of the studies undertaken were defined following consideration of:

- The habitat types present on site defined from the one-day visit undertaken in the previous project phase;
- The types of ecological receptor that would be expected to occur in such habitats in Suffolk, based on professional judgement; and
- The potential activities and related impacts of creating fen meadow habitat, principally through raising water levels, on such sites.

The studies undertaken have comprised:

- A desk study;
- An extended Phase 1 habitat survey;
- A National Vegetation Classification (NVC) survey;
- A survey for signs of otter and water vole; and
- A survey of aquatic invertebrates of the ditches.

This report presents the ecological baseline for Site 28 Halesworth (hereafter the 'Halesworth site' or 'the Site') (Figure 1.1). In this report, where possible, common species names are used in the text, though scientific names may also be used for clarity, particularly in naming the published community-types and in instances when the given common names are not widely used. Common and scientific names of species referred to in this report are presented in Appendix A.

The structure of this report is as follows:

- Section 2 presents the methods and results of a desk study;
- Section 3 presents the methods and results of an extended Phase 1 habitat survey;
- Section 4 presents the methods and results of a National Vegetation Classification survey;
- Section 5 presents the methods and results of a survey for water voles, and otters;
- Section 6 presents the methods and results of a survey of aquatic invertebrates of the ditches on site; and
- Section 7 presents a brief summary of the findings.

637500 638000 638500 639000 639500 640000 640500

277500 277000 276500 276000 275500

Fenn Farm
Norwich Rd
Halesworth
Dairy Hill
Town Farm
Bungay Rd
B1124 Beccles Rd
School La
New Cut
Quay St
Loam Pit La
Orchard Valley
Saxons Way
Town Park
A144
Holton
The St
Mill Rd
Halesworth
B1123
Holton Rd
Chediston St
London Rd
New Reach
Barons Close
Duke's Dr
Ohlfield Rd
Bramfield Rd
B1117
Blyth Rd
Mells
Red House Farm
Walpole Rd
Kennedy Ave
Brick Kiln Farm
Nine Acres
Wash La
Black House
Red House Farm
Orsborn Cottages
White House Farm
River Blyth
Wenhaston Grange
Home Covert
Bramfield Railway Cottage
Melles Court Farm
Waterworks Cottages
Oak Hill
Railway Wood
Manwood

Key

Site 28 boundary

0 100 200 300 400 500 600 m

Scale at A3: 1:10,000

Fen Meadow Compensation Sites:
Halesworth Site 28

Figure 1.1
Site location plan

October 2020

wood.

2. Desk study

2.1 Method

A data-gathering exercise was undertaken in July 2020 to obtain information relating to statutory and non-statutory biodiversity sites (excluding sites designated for geological features of interest); species or habitats of principal importance for the conservation of biodiversity; legally protected and controlled species; and other conservation-notable habitats or species (see Boxes 2.1 and 2.2).

Box 2.1 – Designated Biodiversity Sites, and Priority Habitats and Species

Statutory Biodiversity Sites

- European sites: Important biodiversity sites designated under international law or treaties. European sites are any Special Area of Conservation (SAC) from the point at which the European Commission and the UK Government agree the site as a 'Site of Community Importance' (SCI); any classified Special Protection Area (SPA); any candidate SAC (cSAC); and (exceptionally) any other site or area that the Commission believes should be considered as an SAC but which has not been identified by the Government. This term is also commonly used when referring to potential SPAs (pSPAs), to which the provisions of Article 4(4) of Directive 2009/147/EC (the 'new wild birds directive') apply; and to possible SACs (pSACs) and listed Ramsar sites, to which the provisions of *The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019* (the Habitats Regulations) are applied as a matter of Government policy (NPPF para 118) when considering development proposals that may affect them;
- Sites of Special Scientific Interest (SSSIs): Nationally important sites notified under the *Wildlife and Countryside Act 1981* (as amended) that provide the best examples of the UK's flora, fauna, or geological or physiographical features (note, this assessment focuses on those sites notified for their biodiversity interest);
- National Nature Reserves (NNRs): Nationally important sites notified under the *National Parks and Access to the Countryside Act 1949* and the *Wildlife and Countryside Act 1981*; in practice most NNRs are SSSIs also; and
- Local Nature Reserves (LNRs): statutory sites that are designated under the *National Parks and Access to the Countryside Act 1949* with the objective of encouraging their use for the study, research or enjoyment of nature. If an LNR has no other statutory or non-statutory designation it is treated as being of borough/district-level importance for biodiversity (although it may be of greater socio-economic value).

Non-statutory Biodiversity Sites

Non-statutory biodiversity sites in Suffolk are known as County Wildlife Sites (CWS) or Potential CWS (pCWS) or Candidate Local Wildlife Sites (cLWS).

Other important habitats or species

Species or habitats of "*principal importance for the conservation of biodiversity*" are those listed by Natural England (NE) pursuant to Section 41 of the *Natural Environment and Rural Communities Act 2006* (as amended). These include those UK Biodiversity Action Plan (UK BAP) priority habitats and species that occur in England. They are commonly referred to as 'Section 41' or 'S.41' habitats or species.

Other conservation-notable habitats and species would include:

- Species listed as being of conservation concern in the relevant UK Red Data Book (RDB) or the Birds of Conservation Concern 4 Red List (Eaton *et al.* 2015);
- Ancient woodland (i.e. areas that have been under continuous woodland cover since at least 1600) on the Ancient Woodland Inventory (AWI);
- Nationally Rare and Nationally Scarce species in the UK, which are species recorded from, respectively, 1-15 and 16-100 hectads (10x10km squares of the UK national grid);
- Populations of birds comprising at least 1% of the relevant British breeding/wintering population (where data are available).
- Priority habitats and species listed in the Suffolk Biodiversity Action Plan (LBAP);
- Other species or assemblages such as large populations of animals considered uncommon or threatened in a wider context; and
- Important hedgerows as defined using the habitat criteria in *The Hedgerows Regulations 1997*.

Box 2.2 – Legally Protected and Controlled Species

Legal Protection

Many species of animal and plant receive some degree of legal protection. For the purposes of this report, legal protection refers to:

- Species included on Schedules 5 and 8 of the *Wildlife and Countryside Act 1981* (as amended), excluding species that are only protected in relation to their sale (see section 9[5] and 13[2]);
- Species included on Schedules 2 and 5 of *The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019*; and
- Badgers, which are protected under the *Protection of Badgers Act 1992*.

Further detail on the legislative protection afforded to species and sites is provided in Appendix B.

Legal Control

Schedule 9 of the *Wildlife and Countryside Act 1981* (as amended) lists species of animal that it is an offence to release or allow to escape into the wild (for example grey squirrel) and species of plant that it is an offence to plant or otherwise cause to grow in the wild (for example, Japanese knotweed).

Data were obtained for:

- Statutory designated sites within 2km of the Site boundary;
- Other statutory and non-statutory sites designated for their nature conservation interest within 1km;
- Habitats of principal importance for the conservation of biodiversity, or other conservation-notable habitats recorded within 1km; and
- Protected species, species of principal importance for the conservation of biodiversity, or other conservation-notable species recorded within 1km.

The geographical context of the Site was examined using the relevant Ordnance Survey 1:10,000 scale maps and freely-available aerial photographs, to identify key landscape features that may be important for protected or conservation-notable species, such as potential migration or dispersal routes, or any potential receptors of site-derived pollutants in the wider landscape.

The sources of desk study information were:

- MAGIC (the government environmental information partnership project) www.magic.gov.uk;
- Natural England (https://designatedsites.naturalengland.org.uk/);
- Joint Nature Conservation Committee (JNCC, http://jncc.defra.gov.uk/page-4); and
- Suffolk Biodiversity Information Service (https://www.suffolkbis.org.uk/biodiversity/speciesandhabitats).

2.2 Results

Designated Sites

There are no statutory designated sites present on, or within 2km, of the Site. The site falls within the Impact Risk Zone for Dew's Pond SSSI, located 4.5km south. Creation of fen meadow does not however fall within the criteria that would require consultation with Natural England in respect of risk to this SSSI.

There are no non-statutory designated sites on-site. However, there are three non-statutory CWSs within 1km of the Site, with the nearest being New Reach River and Marsh CWS located 0.43km north of the Site. The interest features of the CWSs are summarised in table 2.1 and locations are shown in Figure 2.1.

Table 2.1 Non-Statutory Designated Sites within 1km of Halesworth Site 28

Designation	Distance from Site Boundary	Description
New Reach River and Marsh CWS	0.43km north	Comprises a small stretch of tributary of the River Blyth, providing a direct link between Halesworth and the sea at Southwold. The site forms part of a larger area known as Millennium Green, which comprises 20ha of habitat including meadows south of New Reach. The tributary, banks and wet meadow support a diverse range of wildlife such as terrestrial and aquatic invertebrates, water vole, otter, water shrew, and a number of species of bat. The site also provides opportunities for black cap and reed warbler.
Birds Folly CWS	0.57km north	Comprises a mosaic of habitat types such as secondary mature woodland, dense scrub, acid heath and acid grassland. Dense scrub provides an important refuge for nesting birds. The site is valuable for reptiles, with records of grass snake, slow worm and common lizard. The site also forms part of Millennium Green and has excellent connectivity with the wider countryside.
Halesworth Cemetery CWS	0.92km north	There are two sections of Halesworth cemetery. The Quay Street section to the north is a good example of species rich grassland; and the Loam Pit Lane section to the south-east, which contains more scattered trees comprising dogwood, elder and hawthorn. The ground flora is less rich in this section. The site overall provides opportunities for a range of invertebrates and is important for reptiles with grass snake, slow worm and common lizard recorded.

Priority Habitats

MAGIC indicates that four priority habitats are located within 1km of the Site, with one priority habitat identified as being present on-site (the nearest distance provided for each priority habitat):

- Coastal and floodplain grazing marsh (mapped over much of the Site);
- Deciduous woodland (180m north-west);
- Traditional orchards (980m north-east); and
- Wood pasture and parkland (35m west of the Site).

Species Records

A summary of the key species records within 1km of the Site are presented in table 2.2.

Table 2.2 Protected and conservation notable species within 1km

Common Name	Distance of Closest Record from Site	Protection		Other Conservation Criteria (as identified on SBIS records)
		HR	WCA	
Herpetofauna				
Common lizard	0.5km north		✓	✓ (S41)
Common toad	0.3km south-west			✓(S41)
Grass snake	0.3km south-east		✓	✓ (S41)
Great crested newt	0.3km south-west	✓	✓	✓ (S41)

Common Name	Distance of Closest Record from Site	Protection		Other Conservation Criteria (as identified on SBIS records)
		HR	WCA	
Slow worm	0.3km north-west		✓	✓ (S41)
Mammals				
Brown hare	0.6km east			✓ (S41)
Harvest mouse	0.1km north-east			✓ (S41)
Hedgehog	0.1km south-west			✓ (S41)
Otter	0.1km south-east	✓	✓	✓ (S41)
Water vole	0.2km east		✓	✓ (S41)
Barbastelle	0.4km north-east	✓	✓	✓ (S41)
Bats	On Site south-west (*)	✓	✓	✓ (S41 (some species))
Brown long-eared	0.4km north-east	✓	✓	✓ (S41)
Common pipistrelle	0.4km north-east (F/C)	✓	✓	
Daubenton's	0.4km north-east (F/C)	✓	✓	
Natterer's	0.4km north-east (F/C)	✓	✓	
Noctule	0.4km north-east (F/C)	✓	✓	✓ (S41)
Pipistrelle bat	On Site south-west (**)	✓	✓	
Serotine	0.4km north (F/C)	✓	✓	
Soprano pipistrelle	On Site (F/C)	✓	✓	✓ (S41)
Bird				
Barn owl	0.3km east		✓*	
Bullfinch	0.3km north			✓ (S41)
Dunnock	0.3km north			✓ (S41)
Fieldfare	0.3km north		✓*	✓ (RL)
Grey wagtail	0.3km north			✓ (RL)
Herring gull	0.5km north			✓ (S41)
House sparrow	0.4km north-west			✓ (S41)
Kingfisher	0.3km east		✓*	
Linnet	0.3km north			✓ (S41)
Mistle thrush	0.3km north			✓ (RL)
Redwing	0.3km north		✓*	✓ (RL)

Common Name	Distance of Closest Record from Site	Protection		Other Conservation Criteria (as identified on SBIS records)
		HR	WCA	
Skylark	0.3km north			✓ (S41)
Song thrush	0.2km south			✓ (RL and S41)
Spotted flycatcher	0.5km north			✓ (RL and S41)
Starling	0.3km north			✓ (RL and S41)
Fish				
European eel	0.3km east			✓ (ER and S41)
Invertebrates				
Grayling	0.4km west			✓ (RL and S41)
Norfolk hawker	0.4km north			✓ (RL and S41)
Vascular Plants				
Chicory	0.1km north-west			✓ (RL)
Clustered clover	0.5km north-east			✓ (NS)
Field scabious	0.8km north			✓ (RL)
Fritillary	0.4km north			✓ (NS)
Hoary cinquefoil	0.9km north-west			✓ (RL)
Maidenhair fern	0.8km north			✓ (NS)
Quaking-grass	0.8km north			✓ (RL)
Water-soldier	0.6km north			✓ (NR)

* Schedule 1 (*Wildlife and Countryside Act 1981*)
The other principle protective legislations for individuals of a species in England are:
WCA – *Wildlife and Countryside Act 1981* (as amended)
HR – *The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019*
ER – *The Eels (England and Wales) Regulations 2009*
S41 – Section 41 species; see Box 2.1
RL – Red list species; see Box 2.1 '
NR – Nationally Rare; See Box 2.1'
NS – Nationally Scarce; See Box 2.1'
F/C – Foraging/commuting.
(*) – On-Site two fresh bat droppings in open shed possibly brown long-eared (2014).
(**) – Three old pipistrelle droppings in storage shed (2014). Same location and the droppings above.

Additional to those listed, MAGIC indicates great crested newt (GCN) records from within 1km of the Site, based on GCN survey licence returns information. There were survey records for two locations: 720m north-west (with the most recent record dated 17 June 2014) and 950m north (with the most recent dated 31 May 2017), albeit these would be separated from the Site by urban development.

MAGIC also identified lapwing, redshank, grey partridge and stone-curlew and turtle dove to be present within 1km of the Site (however, national grid references were not provided).

Non-native Species / Notifiable Weeds

There were no records for species listed in Schedule 9 of the *Wildlife and Countryside Act 1981* (as amended) found on-site. However, the following Schedule 9 species were found within 1km (with the nearest record to Site):

- Canadian waterweed (0.5km north);
- Nuttall's waterweed (0.5km north);
- Himalayan balsam (0.1km south-east);
- Yellow archangel (0.8km north);
- Rhododendron (0.8km north);
- Chinese muntjac (0.3km east); and
- Grey squirrel (0.3km east).

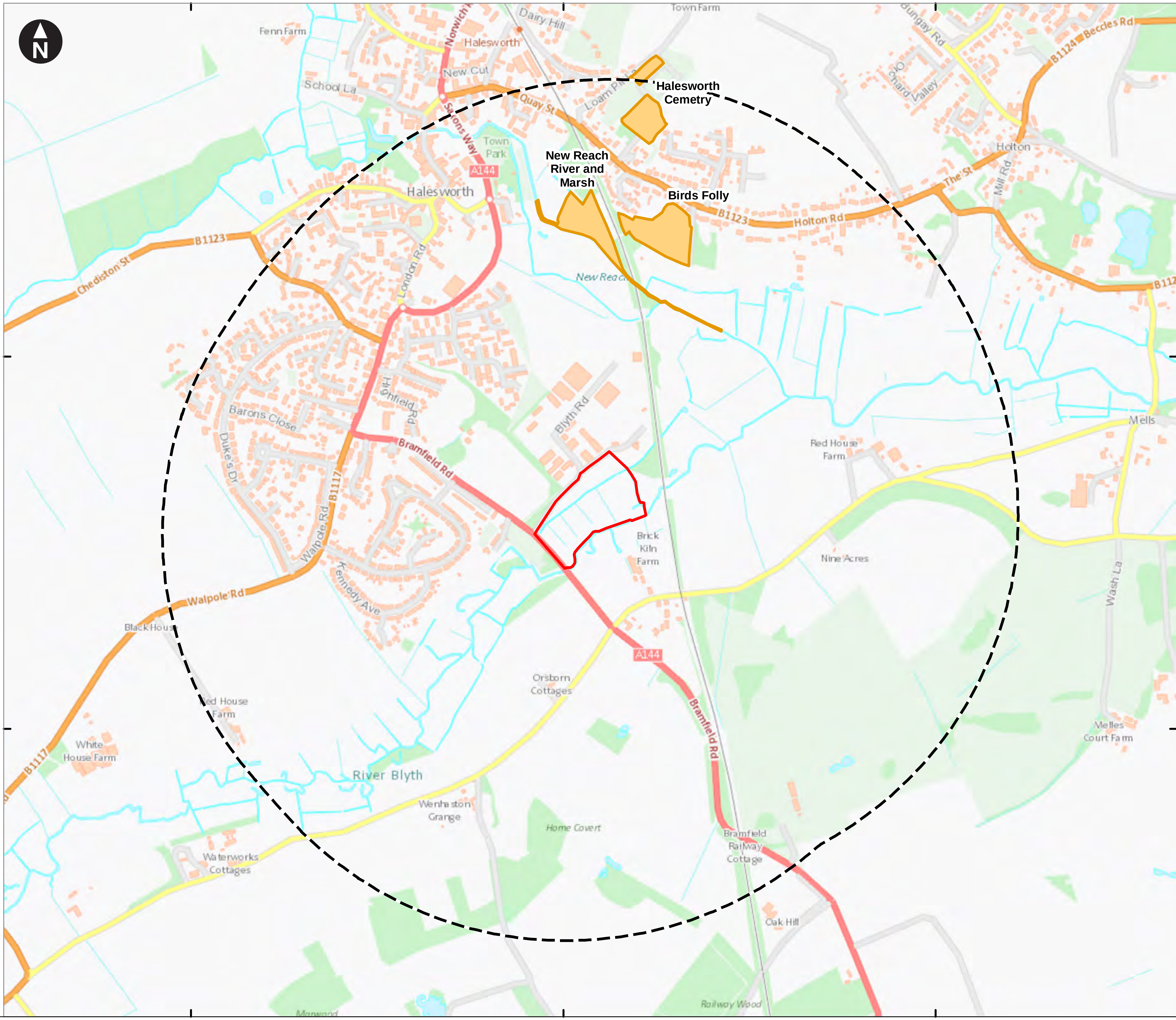
Waterbodies

The River Blyth is present along the south-eastern boundary of the Site, with a network of drains which are present on-site and within the wider area which feed into the river. Great crested newts are not typically found in rivers, and the wettest drains on-site are likely to support fish, which would make then unfavourable for great crested newts.

Five water bodies are located off-site within 500m of the Site boundary (Table 2.3 and Figure 2.2). All the off-site waterbodies are separated from the Site by some form of barrier to newt migration.

Table 2.3 Water bodies within 500m of the Site.

Water bodies	NGR	Distance and direction from Site	Description
W1	TM3929 7669	100m east	Pond – separated from Site by the railway embankment.
W2	TM3872 7683	365m north-west	Pond – separated from Site by a minor road (Blyth Road). This is a pond in the garden immediately to the north of a large residential property, which is surrounded by what appears from an aerial photograph, to be a gravel drive.
W3	TM3926 7613	385m south-east	Pond – separated from Site by A144 Bramfield Road and the River Blyth.
W4	TM3916 7600	448m south-east	Pond – separated from Site by A144 Bramfield Road and the River Blyth.
W5	TM3915 7598	458m south-east	Pond – separated from Site by A144 Bramfield Road and the River Blyth.



Key

- Site 28 boundary
- Site 28 boundary 1km buffer
- County Wildlife Sites (CWS)

0 100 200 300 400 500 600 m

Scale at A3: 1:10,000

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Fen Meadow Compensation Sites:
Halesworth Site 28

Figure 2.1
Non-statutory designated sites within 1km of the site

October 2020

wood.

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638500 639000 639500

277000 276500 276000

N

New Reach

Red House Farm

Brick Kiln Farm

Nine Acres

Orsborn Cottages

W1 W2 W3 W4 W5

A144

Key

Site 28 boundary

Site 28 boundary 500m buffer

W1 Waterbody

0 100 200 300 m

Scale at A3: 1:5,000

Fen Meadow Compensation Sites:
Halesworth Site 28

Figure 2.2
Waterbodies within 500m of the Site boundary

October 2020

wood.

3. Extended Phase 1 Habitat Survey

3.1 Method

Habitats

A Phase 1 habitat survey of the Site and, where possible, a 30m buffer, was completed by a Wood Ecologist on 16 July 2020. During the survey, distinct habitats were identified, and any features of interest recorded and included on a Phase 1 habitat map as a target note (TN), in accordance with JNCC (2010).

Protected and Notable Species

As the standard Phase 1 habitat survey methodology is mainly concerned with vegetation communities, the survey was extended, in general accordance with IEA (1995), to allow for the provision of information on other ecological features, including identification of the presence, or potential presence, of legally protected or conservation notable species.

The methodologies used to establish the presence or potential presence of species and / or species groups are summarised below. Species or biological taxa included in the surveys were targeted due to the desk study and / or habitat types indicating potential for presence on the Site.

Great crested newt

Great crested newt is legally protected and is also a Species of Principal Importance.

The Site was assessed for its potential to support a population of this species. This assessment considered the presence of suitable aquatic and terrestrial habitats on site (the latter including foraging habitat, hibernacula and refugia). All waterbodies were subject to Habitat Suitability Index HSI assessment (Oldham *et al.*, 2000), recording the context and features of them to generate a score relative to the likelihood of great crested newts using them

Reptiles

All species of British reptile are legally protected and are also Species of Principal Importance.

The Site was assessed for its potential to support populations of reptile species. This involved looking for potential foraging habitat, hibernacula, refugia and areas for basking (as described in Froglife, 1999).

Birds

All nesting birds are legally protected, some are afforded a higher level of protection when breeding, and many are also Species of Principal Importance.

The habitats on site were assessed for their potential to support important populations of breeding and wintering birds.

Badger

Badgers and their setts are legally protected.

The Site was searched for evidence of badger activity. This involved looking for setts, badger trails, snuffle holes, latrines and badger hairs. Furthermore, information was gathered about the suitability of habitats for

foraging badger on-Site and of suitable sett-digging habitat likely to be present within 30m of the Site (as described in Natural England, 2015).

Bats (all species)

All species of British bats and their roosts are legally protected and many are also Species of Principal Importance.

A general assessment was made for the potential of onsite trees to contain potential roost features for bats (e.g. rot and woodpecker holes, splits, cracks, and dense woody ivy on trees). Additionally, a general assessment was made as to whether habitats within and adjacent to the Site are likely to provide an important foraging resource and/or commuting route for bats (as described in Collins *et al*., 2016).

Dormouse

Dormouse is legally protected and is also a Species of Principal Importance.

The extent and quality of the habitats within and adjacent to the Site were assessed for their potential to support dormouse; in particular whether or not key food plants occurred and whether any of the habitats present are connected to large areas of suitable woodland (as described in Bright *et al*, 2006).

Otter

Otter is legally protected and is also a Species of Principal Importance.

The Site was assessed for its potential to provide habitat that could support otter. This involved considering the size and connectivity of any watercourse present on site (or within the vicinity) with regard to providing suitable foraging resources, as well as the presence of areas of woodland and other dense vegetation suitable for creation of holts, natal dens and/or laying-up areas (as described in Chanin, 2003).

Water vole

Water vole is legally protected and is also a Species of Principal Importance.

The Site was assessed for its potential to provide habitat that could support a population of water vole. This involved considering the size and connectivity of any watercourse present on site (or within the vicinity), as well as the potential presence of suitable foraging resources and burrowing substrate along the banks (as described in Strachan *et al*, 2011).

Invertebrates

A number of invertebrate species are legally protected and some are also Species of Principal Importance.

An assessment was made of the potential for habitats on site to support an assemblage of priority invertebrate species, by considering the provision of a mosaic of varied habitat and substrate types and nectar-rich flowering species.

Other priority faunal species

Drawing upon information that was collected during the desk study, an assessment was made of the potential for the Site to support any other legally protected and/or Species of Principal Importance.

Limitations

While every effort has been made to provide a comprehensive description of the Site, this survey does not constitute a full botanical survey. Nevertheless, it is considered that the survey is sufficient quality to capture the overall character of the Site and all of the major vegetation communities.

To determine presence or likely absence of protected species usually requires multiple visits at suitable times of the year. As a result, this survey focuses on assessing the potential of the Site to support habitats and species of note, which are considered to be of principal importance for the conservation of biodiversity with reference to those given protection under UK or European wildlife legislation. This survey therefore cannot be considered a comprehensive assessment of the ecological interest of the Site. However, it does provide an assessment of the ecological interest present on the day the Site was visited and highlights areas where further survey work may be required.

The data from this survey is generally considered valid for a maximum of two years. Therefore, if more than two years elapse prior to commencement of the works, a repeat survey might be required to ensure up-to-date information is available to inform decisions.

3.2 Results

Habitats

The habitats present on-site comprise:

- Semi-improved neutral grassland;
- Wet ditches;
- Tall ruderal vegetation;
- Species-poor defunct hedge;
- Scrub;
- Scattered broadleaved trees; and
- Flowing water.

Further details are provided below. Habitat distribution is illustrated on Figure 3.1, and target notes are presented in Appendix C.

Semi-improved neutral grassland

The majority of the Site is covered by three variations of sheep grazed grassland which all fall under the broad umbrella term of semi-improved neutral grassland. However, the grassland is not homogenous throughout, there is variability across the Site in the composition of the semi-improved neutral grassland.

In the northern corner of the Site there is semi-improved grassland that is not groundwater dependent (Target Note 13), like much of the rest of the site is. It has a relatively generic sward including common and widespread grasses such as cock's foot, Yorkshire fog, perennial ryegrass, smaller cat's-tail, soft brome, and wall barley with common herbs including common nettle, common stork's-bill, creeping buttercup, creeping thistle, dandelion, dove's-foot cranesbill, groundsel, nipplewort, shepherd's purse, smooth hawk's-beard, spear thistle, wild pansy, and yarrow. Sward height is relatively short (15-30 cm).

Moving south and eastwards, from that northern corner, there is then a strip of semi-improved neutral grassland that has abundant Yorkshire fog (Target Note 14) and a taller sward (*c.* 30-40 cm). Some new grasses (Timothy, smooth meadow-grass, red fescue, and creeping bent) and herbs (red clover, white clover,

ragged robin, common mouse ear, cow parsley, and broad-leaved dock) which were not evident in the upland (northern) section of the Site are present. What also distinguishes this area is the occasional to frequent soft rush, hard rush and tufted hair grass that has entered the sward and visually delineates the start of groundwater dependent grassland.

Beyond this, in the central part of the Site, the sward becomes slightly taller (*c.* >40 cm) and is characterised by an increased abundance of tufted hair grass, soft and hard rushes; in this area jointed rush also constitutes a frequent part of the sward (Target Note 15). Yorkshire fog is the most abundant grass and there is a relatively poor diversity of forbs present including creeping buttercup, creeping thistle and spear thistle. It is very much a graminoid dominated grassland. Whilst this habitat with the abundant rushes may appear to be better described as a marshy grassland, JNCC (2010) states:

> *"The following communities are included in marsh/marshy grassland:-*
>
> *vegetation with a greater than 25% cover of Juncus acutiflorus, J. effusus, J. inflexus, Carex species or Filipendula ulmaria, except for grazed Juncus effusus – Holcus lanatus/Deschampsia cespitosa grasslands, which should be classified under neutral grassland, B2"*

Based on the above definition, this habitat on site appears to better fit the neutral grassland category.

Beyond this, moving towards the south-eastern boundary of the site (Target Note 16), the abundance of rushes and tufted hair grass begins to reduce once again and the grassland grades back into something close to the second semi-improved grassland type described in Target Note 14, with Yorkshire fog and perennial ryegrass being abundant.

Wet ditches

The Site is dissected by wet ditches (Figure 3.1). There is a single ditch (W1) running the entire length of the Site from the south-western boundary all the way to the north-eastern boundary. Five other, shorter, ditches branch off this and run down towards the River Blyth.

Plant species vary to a degree across the different ditches, but there was also significant crossover in the species present. Most of the ditches featured floating sweet grass, greater pond sedge, and soft and hard rush, with occasional to rare occurrences of other plants including as woody nightshade, purple loosestrife, reedmace, horsetail species, redshank and branched bur-reed.

An example of some of the variation occurs between the ditch indicated as W2 and W3 which lies along the north-eastern boundary of the Site. Here the ditch is tree lined with alder growing in and adjacent to the ditch so herbaceous vegetation is less diverse than in other ditches. Ditch W6 has some aquatic species, such as water plantain, water forget-me-not, celery-leaved buttercup, brooklime and fool's watercress, which are not recorded in abundance elsewhere; this is one of the more diverse ditches floristically. W9 is drier than the rest and here there is yellow flag iris, square-stemmed St John's wort, common bird's-foot trefoil and water mint, all of which were either absent or rare in other ditches on-site.

Himalayan balsam is present in ditches W2 and W3 which run along the north-eastern boundary and link to the River Blyth (Target Notes 2-4).

Tall ruderal vegetation

Alongside ditch W6 there is a strip of relatively bare earth with occasional ruderal species including common nettle and creeping thistle which are beginning to colonise it.

Species-poor defunct hedge

There are two small stretches of species-poor defunct hedge throughout the survey area, one along the north-eastern boundary and the other along the south-western boundary running parallel to the A144. These comprise a limited number of common species.

The hedge along the north-eastern boundary of the Site is sheep browsed and has therefore become very 'leggy' with exposed trunks up to about 1 m. It also contains a wet drainage ditch (W2 and W3) along part of it. Species in this hedgerow include alder, hawthorn, dog rose, and elm, with bramble, hop and ivy throughout. Alder became more frequent in the eastern section of the hedge in the where it linked to the stream.

The hedge that runs along the border with the A144 contains a dry drainage ditch and comprised a limited number of species including blackthorn, alder, hawthorn, elm and grey willow, with bramble throughout.

Scrub

There is occasional scattered alder scrub throughout the grassland on the Site.

Scattered broad-leaved trees

There are several different species of tree scattered across the survey area. Along the north-western boundary there are scattered English oak, evergreen oak, silver birch and alder. Across the remainder of the Site there are sporadic scattered alder saplings and trees.

Flowing water

Flowing water is present along the south-eastern boundary of the Site as delineated by the River Blyth (deonted as W10 at the western extent of the Site, and W5 towards the east). Where it runs adjacent to the Site, the River Blyth is a relatively small (<10 m wide and <1 m deep) meandering river which flows eastwards, eventually reaching a tidal estuary between Southwold and Walberswick on the North Sea coast.

Adjacent to the Site the river is lined with scattered mature alder trees (Target Note 7). The banks of the river had relatively diverse marginal vegetation including greater pond sedge, hemp agrimony, water figwort, water forget-me-not, woody nightshade, common teasel, small teasel, hedge woundwort and hemlock. Emergent vegetation included common reed, greater pond sedge, yellow flag iris and branched bur-reed. Aquatic species included water plantain, fool's watercress and yellow waterlily.

Himalayan balsam was also present throughout this section of river (see below).

Protected and notable species

Badgers

No evidence of badger was noted during the survey though they are likely to be present in the vicinity of the Site, given its rural location, and they may use the Site in future.

Bats

The hedgerows and tree lines, wet ditch network, river and grassland on the Site are considered suitable to support foraging and commuting bats.

Trees with potential roosting features were limited to boundary trees in the hedgerow along the north-eastern boundary and scattered mature alder trees along the River Blyth. The following were observed:

- Two mature alder pollards (Target Note 6) which have rot cavities on limb scars;
- A standing deadwood tree (Target Note 4) in the eastern corner of the Site which had features of decay suitable for roosting bats; and
- Mature alder trees bordering the River Blyth along the south-eastern boundary of the Site. Several of these, Target Notes 7, 10, and 11, have potential roosting features including woodpecker holes, and deadwood limbs.

Nesting birds

There is general nesting bird potential in all the boundary hedgerows and scattered boundary trees, and also within the scattered trees and scrub that are spread across the Site.

Great crested newts

The ditch network on the Site has the potential to support breeding great crested newts, and the site represents suitable terrestrial foraging habitat for this species. However, as indicated earlier, the permanently wet ditches are likely to support fish, making them sub-optimal for newts.

Reptiles

There are reptile records within 500m of the site and the terrestrial habitats present (rough grassland and wet ditches) are suitable for reptile foraging and also provision of refugia. The tussocky graminoids on the site, such as tufted hair grass and also the soft and hard rushes, provide suitable refugia for reptiles. Reptiles are therefore likely to be present on-site, albeit in low numbers due to the grazed nature of the site.

Otter

The River Blyth provides a habitat for otter to feed with quiet areas for them to build holts and/or rest couches. There is a record close to the site and it is likely that otters use the site.

Water vole

The River Blyth and ditches on the site provide a network of waterbodies where water voles could feed under cover and/or escape into the water as needed. Most of the banks had a steep profile such that water voles could access them without their burrows being regularly submerged. It is likely that water voles use the site.

Hazel dormouse

There are no records of hazel dormice from within 1km of the site. Furthermore, the only potentially suitable habitat for this species on the site are the two short stretches of species-poor defunct hedgerow along the north-eastern and south-western boundaries. Additionally, these do not appear to be connected to larger area of potentially suitable habitat for dormouse. It is therefore considered that dormouse would not use this habitat, even if present in the area.

Other species - Moles

In the western part of the site, close to Blyth Road, there is a patch of approximately 30 mole hills (Target Note 1). However, moles are not a conservation notable species.

Other species – Terrestrial invertebrates

The site is likely to support a number of terrestrial invertebrates, although as a sheep and cattle grazed pasture, the assemblage is unlikely to be notable.

Other species – Aquatic invertebrates

The ditches on site support a variety of plant species, and would be expected to support a range of aquatic invertebrate species, potentially including some notable species.

Controlled species

Himalayan balsam is present in ditches W2 and W3 which run along the north-eastern boundary and link to the River Blyth (Target Notes 2-4). Himalayan balsam was also observed in several patches scattered throughout the entire length of the River Blyth which delineates the Site's south-eastern boundary (Target Notes 8, 10 and 12). Himalayan balsam was also found along the River Blyth in areas of the river beyond the confines of the Site survey area (Target Note 5) thus showing that the infestation likely extends along the river beyond the Site both upstream and downstream.

No other controlled species were noted. However, the presence of other legally controlled species in addition to those described above cannot be ruled out on the basis of this survey alone.

Notable plants

No designated or otherwise noteworthy plants were observed during the survey, although small teasel was found along the bank of the River Blyth, which is lined with mature alder trees, and this plant is considered an ancient woodland indicator in Suffolk. It is listed as 'Locally Common' in the vascular plant red list for England (Stroh *et al*. 2014).

H:\Projects\40773 Sizewell C Fen Meadow Compensation and Marsh Harrier Mitigation Strategies\Deliver Stage\D Design_Technical\Drawings\GIS\MXDs\40773-WOOD-XX-XX-FG-OE-0007_S2_P01.mxd Originator: jacqui.parkin

638900 639000 639100 639200 639300

276700 276600 276500 276400

N

Key

- Site 28 boundary
- Neutral grassland - semi-improved
- Running water
- W1 Ditch number
- Defunct hedge native species poor
- Scattered scrub
- Scattered trees- broad-leaved
- Target note

0 25 50 75 m

Scale at A3: 1:1,500

Fen Meadow Compensation Sites:
Halesworth Site 28

Figure 3.1
Phase 1 habitat survey map

November 2020

wood.

4. National Vegetation Classification

4.1 Method

Fieldwork

The field survey was carried out on 16-17 July 2020, following the standard methodologies in the JNCC NVC Users' Handbook (Rodwell, 2006). These are based on sampling representative patches within homogeneous blocks of grassland and tall-herb vegetation using standard-sized sample plots. The plots were assessed both for their floristic composition and for the range of variables required to assess the vegetation structure of the habitat. For grasslands, these include sward height and the relative coverage of the constituent plant groups, such as lichens and mosses.

All vascular plants are named following Stace (2010); the bryophyte flora follows Hill *et al*. (2008); no lichen species were observed.

The characters of the surveyed habitats were assessed by an initial walkover to establish the location and extent of distinctive vegetation types. Sample plot locations were selected to represent typical sward characters within each type of grassland. Five or more sample plots were selected from the main vegetation types; as will be evident from the results section, the wetter grassland stands were sampled multiple times to establish the relatively minor differences between the constituent swards.

Vegetation classification and assessment

Field data have been tabulated in Microsoft Excel alongside CEH's Environmental Indicator Values (Hill, *et al.* 2004; Hill, *et al.* 2007) and relevant plant traits. This approach provides a reproducible dataset for each vegetation type and enables an evidence-based assessment of both their floristic and physiognomic characters.

The sample plots for each vegetation type are then grouped together to show the common and typical characters; each type is then compared with the published NVC accounts (Rodwell, 1992, 1995, 2000) and phytosociological literature (e.g. Oberdörfer, 2001). An interpretation of the site's vegetation is then developed using the published accounts, other sites known to the author, and expert knowledge.

The interpretation of the vegetation present is focussed on their existing nature conservation value and evidence for groundwater dependency. The primary source for determining the relationship of recorded species to groundwater-dependency was Londo (1988). Londo's classification for 'phreatophytes' (groundwater-dependent plant species) is given in Table 4.1. All names of the phytosociological units with which each species has greatest affinity (Oberdorfer, 2001) follow Mucina *et al*. (2016) unless otherwise specified.

Table 4.1 Phreatophyte categories (Londo, 1988)

Category	Definition
H	Hydrophytes, species with vegetative parts submerged or floating on the water.
W	Obligate phreatophyte. Species requiring a water table at the soil surface (in years with a normal water table) or higher during part of the year or permanently for good development and completion of their life-cycle, e.g. germination.
F	Obligate phreatophyte. Species growing only within the sphere of influence of the water table, which is generally below the soil surface.

Category	Definition
V	Non-obligate phreatophyte. Species growing mainly or almost exclusively within the sphere of influence of the water table, which is generally below the soil surface.
K	Non-obligate phreatophyte – 'Lime aphreatophytes'. Species growing mainly or almost exclusively within the influence of the water table (which is generally below the soil surface) but occurring above this sphere of influence on soils rich in lime.
P	Non-obligate phreatophyte – 'Local phreatophytes'. Species that grow above the sphere of influence of the water table in much of their area of distribution but depend on this sphere of influence in certain areas or places.
A	Aphreatophytes. Species that are not bound to the sphere of influence of the water table. However, many of these species can be found, often abundantly, within the sphere of influence of the groundwater.

Limitations to the survey

All areas of grassland and tall-herb vegetation within the survey area were accessed. The surveyed area excludes the ditch network and hedgerows and totals 4.48 ha.

The survey was carried out at a generally accepted optimal time for vascular plant surveys. The swards had been sheep-grazed for some time but, as they were introduced after the spring flush, closely cropped lawns were restricted to the drier grasslands along the shallow river bund. The taller vegetation had been widely disturbed, with tussock species often trampled or lodged; some smaller species, such as daisy and lady's-smock, are likely to be under-represented. As noted by the surveyor at other sites during the survey season, the very wet February followed by a dry spring appears to have greatly reduced the number of seedlings present in the sward. Although it is possible that some plant species were undetected by the surveys, this is not considered to have significantly affected the conclusions of this report.

As noted in the initial site investigation (Wood, 2019), the population of non-flowering jointed rushes frequently matched descriptions of the hybrid between jointed rush and sharp-flowered rush (Stace *et al*. 2015). All material in sample plots was inspected and treated as the hybrid jointed rush *J. x surrejanus*.

4.2 Results

Floristic characteristics and affinities

A total of 68 species were recorded. All are listed in Appendix D with Londo's (1988) phreatophyte category.

Forbs and graminoids (grasses, rushes and sedges) are the two major groups, comprising 88 per cent of the flora. Although grass species are well represented (23 species), a greater number of forbs were recorded, though creeping buttercup and common mouse-ear are the only forbs frequent in all the floodplain swards. White clover, meadow buttercup and marsh bird's-foot trefoil were restricted to the wetter stands and creeping thistle, Timothy and common nettle occur largely in the drier parts of the floodplain.

Creeping bent, Yorkshire fog and perennial ryegrass are ubiquitous and are by far the most commonly occurring graminoids and form the matrix of all the floodplain swards. Hard rush and the hybrid jointed rush are common in the wetter stands, often with some soft rush, particularly on the drier margins of these areas. Soft brome is a typical constituent of the dry grassy fringe of the valley slope.

The estimated degree of influence that groundwater has on the presence of species (Londo, 1988) is given in Appendix D for all recorded species with the exception of the five bryophyte species recorded. Twelve species (18 per cent of the sample plot flora) are regarded as typically growing solely or mainly within the sphere of the influence of the groundwater and are listed in Table 4.2 as 'obligate' or 'non-obligate'

phreatophytes. None of the 'obligate' phreatophytes are more than occasional in the wetter parts of the floodplain grassland, though the pond-sedge is a local dominant within the ditch network. Amongst the group of 'non-obligate' phreatophytes, the taller rushes define the wetter floodplain swards; tufted hair-grass and marsh bird's-foot trefoil are typical of the drier and wetter stands, respectively.

Table 4.2 Phreatophytes recorded in sample plots

'Obligate' phreatophytes	'Non-obligate' phreatophytes
Brown sedge	Hard rush
Greater pond-sedge	Hybrid jointed rush
Marsh horsetail	Lady's-smock
	Marsh bird's-foot trefoil
	Marsh foxtail
	Marsh thistle
	Soft rush
	Toad rush
	Tufted hairgrass

The Environmental Indicator Value (EIV) for Moisture (EIV-F) for the plot species given in Appendix D span values of 4 (dry-site) to 9 (wet-site) (Hill *et al.*, 2004, 2007). The dry-site species are clustered along the upslope margin of the site on the footslope of the valley side and include soft brome and smooth hawk's-beard. One-fifth of species typically occur in constant moist or damp soils or wetter; in addition to the phreatophytes, these include creeping buttercup on the floodplain grassland and several of the tall-herb species growing on the riparian fringe in the northern part of the survey area.

Appendix D also lists the primary syntaxon with which each species has affinity in this landscape context.

Over half of the recorded species are affiliated with the *Molinio-Arrhenatheretea*, the class of managed pastures, meadows and tall-herb meadow fringes on fertile deep soils. Some species, such as Yorkshire fog and red fescue, occur in the majority of these grassland types, while others are typical of only one of the three main orders of which the class is composed.

- ***Arrhenatheretalia elatioris*** - Meadows and pastures on well-drained mineral soils. Perennial ryegrass and common mouse-ear are the most widespread and frequent of the common grassland species that are affiliated with this order. These are species of fresh or even damp soils but tend to be replaced by species more tolerant of periodic waterlogging in wetter situations;
- ***Molinietalia caeruleae*** - Wet mown meadows on mineral and peaty soils. This order contains wet grasslands and fen meadows where groundwater influence is often strongly influencing the species composition. The hybrid jointed rush and soft rush are typical *Molinietalia* species and, with tufted hair-grass and marsh bird's-foot trefoil, are restricted to the damper grasslands either side of the main south-west to north east oriented ditch, referred to in this Section as 'catch dyke'; and
- ***Potentillo-Polygonetalia avicularis*** - Temporarily flooded and heavily grazed zoo-anthropogenic nutrient-rich meadows and pastures. These are described as inundation pastures in the NVC. Three species with a strong affinity to this order are common in the floodplain grassland – creeping bent, creeping buttercup and hard rush.

A second suite of species is typically associated with the ***Epilobietea angustifolii*** class (*sensu* Mucina *et al.* 2016) of tall-herb perennials, which are often found in nutrient-rich semi-natural situations such as woodland edges and riparian fringes. These species are associated with the following orders:

- ***Arctio-Artemisietalia*** – Ruderal vegetation dominated by short-lived perennials on mesic loamy soils. Typical species of this order include common nettle and creeping thistle, which are constant and sometimes abundant constituents of ungrazed tall-herb stands in the survey area and have successfully colonised the drier grassland swards. Hemlock and cleavers are intolerant of grazing and are restricted to the stands of tall-herbs; and
- ***Convolvuletalia*** - Semi-natural fringe vegetation on banks of rivers and other water bodies. Great willowherb and hedge bindweed are typical of this order and the former, in particular, is an abundant feature of the large, tall herb stand in the eastern tip of the survey area.

Synopsis of the plant communities

The surveyed area totals 4.49 ha. The assemblages of plant species separate into four grassland stands on the floodplain and its upland margin and one tall-herb stand. Stand boundaries and sample plot locations are indicated on Figure 4.1, with grid references for the plot locations provided in Appendix E.

Communities from three vegetation alliances are recognised in the survey area (see Table 4.3), though it should be noted that there are sometimes quite small differences in species composition amongst the surveyed floodplain grasslands.

The distribution of the NVC communities is shown in Figure 4.2. Stands C1 and C2 are both assigned to the *Holco-Juncetum* community but continue to be distinguished as MG10b-C1 and MG10b-C2 to emphasise the consistent and significant difference in species composition discussed below.

Table 4.3 NVC plant communities

Alliance	NVC Community	Stand	Area (ha)
Lolio-Plantaginion	Ryegrass grasslands subject to occasional waterlogging		
OV23d	*Lolium perenne-Dactylis glomerata* community, *Arrhenatherum elatius-Medicago lupulina* sub-community	A	0.08
MG7d	*Lolium perenne-Alopecurus pratensis* grassland	B	1.70
Calthion	Wet grasslands with at least some groundwater influence		
MG10b	*Holco-Juncetum effusi, Juncus inflexus* sub-community	C1 and C2	2.27
Convolvulion	Tall-herb fringe vegetation on nutrient-rich riverbanks and in ditches		
OV26e	*Epilobium hirsutum* community, *Urtica dioica-Cirsium arvense* sub-community	D	0.44

The stand community tables are set out in Appendix F to show the presence of species and their cover/abundance in each plot sampling the stand.

Grassland types

The grassland stands are managed as an entire grazing unit, with the division into stands following the visual patterning created by the presence and frequency of occurrence of the rush species. The lowest-lying land lies along the southern side of the catch dyke. Cattle-grazed in 2019, the fields were given over to sheep during the current survey and they had created a distinctive network of trails along the raised sward beside the river and into each of the open compartments between the cross ditches.

The *Arrhenatheretalia elatioris* order is represented in the survey area by the *Lolio perennis-Plantaginion*[1] alliance. These are ryegrass grasslands that are typical of the drier parts of floodplains and the valleyside slope, where groundwater dependent species are uncommon.

- **OV23d *Lolium perenne-Dactylis* glomerata community, *Arrhenatherum elatius-Medicago lupulina* sub-community**

  Stand A (Table F1 in Appendix F) occupies the toeslope of the valley side along part of the northern edge of the site. Perennial ryegrass (neutral grassland) forms the sward matrix with common nettle and smooth hawk's-beard (ruderals) as well as the ubiquitous creeping bent and Yorkshire fog. Although other neutral grassland species are present in low numbers – such as cock's-foot and common mouse-ear – sward gaps are colonised by a range of ruderal species including soft brome and shepherd's purse. The majority of these associates are species favouring summer-dry conditions of fertile, free-draining soils including species from the Onopordetalia (sub-xeric ruderal short-lived perennials), Sisymbrietalia (annual nutrient-demanding species of disturbed soils) and Aperetalia (annuals of acidic and nutrient-poor soils). They are thus restricted to the elevated, sandy soils of the valleyside toeslope.

  The *Lolium-Dactylis* community in its grazed form is a thin, weedy sward susceptible to scuffing by stock and – as here – subject to mole and rabbit activity. It has an abrupt edge where the shallow, sandy footslope joins the heavier alluvial soils of the floodplain;

- **MG7d *Lolium perenne-Alopecurus pratensis* grassland**

  The larger southern block of Stand B (Table F2 in Appendix F) occupies the slightly elevated riparian bund forming the southern margin of the survey area. Although – as in Stand A – perennial ryegrass is constant, it is often subordinate to Yorkshire fog and creeping bent grasses. Timothy, creeping buttercup and common mouse-ear are scattered through the sward. The fresh to damp sward favours creeping thistle and, with occasional nettle and broad-leaved dock, gives a rather weedy appearance to the sward.

  The northern blocks of *Lolium-Alopecurus* grassland are rather more developed than that in the south, which may be frequently disturbed by stock movements and more frequent grazing, and meadow foxtail and red fescue are sometimes prominent. Occasional hairy sedge and soft rush suggest that these swards are transitional to the adjacent damp *Calthion* grassland stands.

  The *Calthion palustris* alliance, representing the *Molinietalia caeruleae* order, is made up of damp to wet pastures with at least some groundwater influence. The swards either side of the catch dyke are both assigned to the same NVC community fringing a wetter zone centred on the dyke; and

- **MG10b *Holco-Juncetum effusi, Juncus inflexus* sub-community**

  The *Holco-Juncetum* is a rush pasture typically representing weak groundwater influence, where groundwater-dependent species are typically present, but the main source of water is likely to be rainwater, with periodic flooding from the ditch network. The basic matrix of the sward is the same as for Stand B and is typical of the fertile Suffolk floodplains. Yorkshire fog, creeping bent and perennial ryegrass are co-abundant, with constant creeping buttercup and common mouse-ear. Apart from rush species, marsh horsetail and brown sedge are present in the sward in low numbers.

  Stand C1 (Table F3 in Appendix F) forms the fringes of these wetter grasslands where the sward supports white clover and mixed soft and hard rush tussocks, with scattered hybrid jointed rush. The full species-table for this rush pasture is given as Table F3 in Appendix F. Tufted hair-

[1] This alliance is now subsumed within the *Cynosurion cristati* (Mucina et al. 2016)

grass is the most noticeable associate, particularly at the eastern end of the stand. The margin of the stand is abrupt around the northern edge, which is a typical feature of groundwater flushing. It is far more diffuse around the southern edge, and the edge of the stand is perforce an approximation.

Stand C2 (Table F4 in Appendix F) lies either side of the catch dyke, where the balance of rush species changes in favour of the hybrid jointed rush – which is often abundant – and the calciphilous hard rush. These two species mark out the primary area flushed by mildly calcareous groundwater. Red fescue and meadow buttercup are also widespread and, with white clover and occasional marsh bird's-foot trefoil, are the most distinctive associates.

As demonstrated in the site investigation (Wood, 2019), the associated ditch network supports stands of groundwater-dependent swamp species, notably two pond-sedges, forming S6 *Caricetum ripariae* and S7 *Caricetum acutiformis* swamps, and branched bur-reed stands of the S14 *Sparganietum erecti* swamp. Several small helophytes are also present, including fool's watercress, water mint, watercress, lesser water-parsnip and water forget-me-not. This group is also associated with groundwater influence and, where the tall swamp species are sub-ordinate, they form stands of the S23 *Glycerio-Sparganion* vegetation. The ditches also support alder sprouts near the catch dyke; this species only germinates and establishes successfully in summer-wet situations.

Riparian fringe tall-herb vegetation

The damp, fertile soils at the eastern end of the survey area support an unmanaged tall-herb stand composed of species typical of the ***Epilobietea angustifolii*** class. The species assemblage in this clearly defined and separate unit conforms to the ***Convolvulion sepium***[2] alliance common along ungrazed sections of Suffolk rivers.

- **OV26e *Epilobium hirsutum* community, *Urtica dioica-Cirsium arvense* sub-community**

  In Stand D (Table F5 in Appendix F), great willowherb and common nettle are abundant and typically form a canopy over associate species, except where hemlock is present. This species is more common near the river and greater pond-sedge forms large patches on the damper ground away from it. The main associate species are rough meadow-grass, creeping thistle and false oat-grass. Locally, the scramblers cleavers and hedge bindweed form tangles amongst the tall herbs.

  Although other associates such as water chickweed are present in low numbers, the thickness of the stand – and the heavy shade – limit the opportunities for most species.

4.3 Summary

NVC Communities

The NVC survey identified four distinct grassland-types within and on the margin of the floodplain and also a block of riparian fringe tall-herb vegetation. These vegetation types are assigned to the following NVC communities:

Grasslands

- OV23d *Lolium perenne-Dactylis glomerata* community, *Arrhenatherum elatius-Medicago lupulina* sub-community;

[2] Now subsumed within the *Senecionion fluviatilis* (Mucina et al. 2016)

- MG7d *Lolium perenne-Alopecurus pratensis* grassland; and
- MG10b *Holco-Juncetum effusi, Juncus inflexus* sub-community.

Riparian fringe tall-herb vegetation

- OV26e *Epilobium hirsutum* community, *Urtica dioica-Cirsium arvense* sub-community.

The sward supporting the majority of phreatophyte species (Stand C2) is calculated to have an area of 1.06 ha, covering c.24 per cent of the survey area.

Using Londo's (1988) assessment of species as 'obligate', 'non-obligate' or 'non'-phreatophyte, the relationship of recorded species to groundwater-dependency was established. Nearly one-fifth of species recorded in the sample plots are classified as occurring within the 'sphere of influence' of groundwater, and these were clustered in two stands centred around the catch dyke. Only hybrid jointed rush was commonly recorded, however, and the primary indicator of the mildly calcareous groundwater was hard rush.

Conservation Interest

The habitats present qualify as coastal and floodplain grazing marsh, a habitat of principal importance listed under Section 41 (S41) of the Natural Environment and Rural Communities (NERC) Act 2006. S41 requires the Secretary of State to publish a list of habitats and species which are of principal importance for the conservation of biodiversity in England. The S41 list is used to guide decision-makers such as public bodies, including local and regional authorities, in implementing their duty under section 40 of the *Natural Environment and Rural Communities Act 2006*, to have regard to the conservation of biodiversity in England, when carrying out their normal functions.

No rare or scarce vascular plant, or bryophyte and lichen species were recorded during the survey.

Indications of current hydrologic conditions

Phytosociological indications

The floodplain swards either side of the catch dyke are assigned to the *Holco-Juncetum* community within the *Calthion palustris* alliance of damp to wet pastures with at least some groundwater influence. The presence of the hard rush sub-community concords with mildly calcareous near-surface groundwater. The increasing frequency of soft rush away from the catch dyke is also likely to indicate the replacement of groundwater with an increasing proportion of rainwater over the floodplain away from the seepage area.

The vegetation of the catch dyke and transverse ditches is also typical of a spring-fed ditch network, and the lush growth of the *Glycerio-Sparganion* vegetation and establishment of alder along the ditches are both indicators of summer-wet conditions.

Species indicators

Table 4.1 lists twelve phreatophyte species (*sensu* Londo, 1988). While representing nearly one-fifth of species recorded in the sample plots, only the hybrid jointed rush is common, though the group of species is clustered in the *Holco-Juncetum* stands. This is indicative of weak, localised groundwater seepage. The presence of another obligate' phreatophyte - blunt-flowered rush - on the side of one ditch near its junction with the catch dyke may be interpreted as a relic of a more distinctive fen meadow flora that persists in association with the ditch network.

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638900 639000 639100 639200 639300

276700 276600 276500 276400

N

Blyth Rd

Brick Kiln Farm

Key

- Site 28 boundary
- NVC sample plot

NVC Community Stands

- Stand A
- Stand B
- Stand C1
- Stand C2
- Stand D

0 25 50 75 m

Scale at A3: 1:1,500

Fen Meadow Compensation Sites:
Halesworth Site 28

Figure 4.1
NVC community stands and sample plots

November 2020

wood.

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638900 639000 639100 639200 639300

276700 276600 276500 276400

Blyth Rd

Brick Kiln Farm

Key

Site 28 boundary

NVC sample plot

NVC Community

MG10b-C1

MG10b-C2

MG7d

OV23d

OV26e

0 25 50 75 m

Scale at A3: 1:1,500

Fen Meadow Compensation Sites:
Halesworth Site 28

Figure 4.2
NVC communities

November 2020

wood.

5. Water vole and Otter

5.1 Methods

Habitat assessment

Watercourses on the Site were assessed for their potential to support aquatic mammals over two visits undertaken on 16 July 2020 and on 8 October 2020.

The approximate depth and speed of water flow, the waterway width, bank side vegetation and surrounding land use was also recorded at each water course surveyed: all of these being factors that may determine the suitability of habitat for supporting water voles (Strachan *et al*., 2011).

Habitats were also assessed for the potential to support otter, albeit this species can exploit a wide range of aquatic habitats, including virtually all types of water and waterway: still waters; rivers; and streams of all sizes. They will also use very small streams and ditches, including dry watercourses, as regular commuting routes. The most significant determinant of otter usage of freshwater habitats is likely to be abundance of prey, particularly fish, but also frogs (Chanin, 2003).

For reporting purposes, the ditch system and water courses were divided into transects. Where there were notable changes in habitat type along a single length of water course (e.g. changes in vegetation, water depth and width) the ditch/river was split into multiple transect lengths, with each transect sampling a length of broadly similar habitat.

Water vole presence/absence survey

In combination with the habitat assessment, watercourses (including ditches) on Site were surveyed for evidence of water vole presence. In line with best practice guidelines (Strachan *et al*, 2011), this involved searching bankside vegetation for:

- Latrines/droppings – water vole droppings are often concentrated in discrete latrine sites near the nest, at range boundaries and places where they regularly enter and exit the water. While most droppings will be deposited in latrines, some may also be found scattered along runways in vegetation;
- Feeding stations – feeding remains in the form of neat piles of chewed lengths of vegetation, are often found in runways and at haul-out platforms;
- Burrows - these are typically found along the water's edge and on top of the bank up to 5m from the water's edge. Holes on top of the banks often have grazed 'lawns' around them; and
- Footprints – these may be identified in soft mud or silt.

The survey was undertaken at an appropriate time of year for detecting water vole presence, with water voles actively marking their breeding territories with latrines between late April and early October.

Otter presence/absence survey

All on-site ditches, and all accessible connected watercourses within the site were surveyed for signs indicative of the presence of otter, including:

- Footprints – located in soft mud, silt, or sand banks;

- Spraints (faeces) – which are often located on prominent features within the channel or on the bank (including bridges, rocks, tree roots, etc.);
- Sign heaps – mounds of scraped mud, gravel, grass or silt;
- Feeding remains – including fish or frog carcasses;
- Slides or other well-used access points to watercourses; and
- Actual or potential resting sites – including underground holts (e.g. beneath the roots of bankside trees) or above ground couches (e.g. in reedbeds).

Although otters are active throughout the year, the current survey was undertaken at the optimal time for carrying out otter surveys, which is May and September, when water levels tend to be lower and less variable (Chanin, 2003).

Limitations

It was not possible to survey at the specific times required by the guidance on water vole survey, which indicates surveys should be undertaken in mid-April-June and in July-September, as access was only gained to the site initially in mid-July. However, the surveys were undertaken during the water vole active period and therefore the results are considered robust.

It was not possible to search the entire bank of every water course during the survey due to restricted access to some ditches and associated health and safety concerns. Once distinctive water vole signs were recorded in a water course and presence of the species had been established, further survey work completed along the length habitat involved spot checks at points where safe access was possible.

Typically surveys for water voles would include areas 30m upstream and downstream of a site, and for otters 100m upstream and downstream, however this was possible here due to lack of access to off-site areas.

5.2 Results

Habitat assessment

The locations of the 14 surveyed transects along ditches and two sections of river are indicated on Figure 5.1. Table 5.1 summarises the results of the habitat assessment.

Of the transects surveyed in July, seven (W1b, W1c, W1e, W2, W3, W5 and W10) provided optimal aquatic habitat for water voles, comprising still water over 1m deep with wide swathes of riparian vegetation and earth banks. Four transects (W1a, W7, W8, and W9) met most of these habitat requirements but held less water (being 0.5-1m deep) at the time of surveying, while a further two transects (W1d and W12) contained water less than 0.5m deep. During the October survey visit all transect locations contained water up to bank-top level. The high-water level suggests that any burrows which may have been present earlier in the year would have been flooded and therefore unsuitable for water vole occupation at this time.

Ditch W6 showed signs of dredging with very little bankside or emergent vegetation in July, however, signs of re-growth during the October survey suggest that although suboptimal earlier in the year, this may be temporary. The steepness of the banks also meant that although water levels had risen, they were not high enough to have prevented burrowing behaviour.

Ditches W4 and W11 were both dry during the July survey, however W4 did contain water 0.5m deep in October. The lack of aquatic vegetation in W11 during both visits and its location parallel to a road suggests it is either permanently dry or used for run-off during very wet weather.

The habitats on the site generally offered good opportunities for otter, with shelter provided in the form of mature bankside trees and vegetation, and deep water likely to support prey species. Those ditches that did not offer optimal conditions (i.e. because they were dry) may still be used by otters to move around the wider landscape.

Table 5.1 Halesworth Site 28 otter and water vole habitat assessment results

Transect reference (Figure 5.1)	Transect length (m)	Bordering land uses	Bank profile	Depth (m) July	Depth (m) October	Width (m)	Dominant bankside vegetation	Other abundant vegetation
W1a (ditch)	31	Rough pasture, sheep grazing	Shallow	0.5-1	>2	1-2	Submerged weed, sedges, soft and hard rush	Bankside trees
W1b (ditch)	44	Rough pasture, sheep grazing (heavy grazing with poaching)	Shallow	1-2	>2	1	Sedges, soft and hard rush	Submerged weed, herbs
W1c (ditch)	51	Rough pasture, sheep grazing	Shallow	>2	>2	1	Submerged weed, sedges, soft and hard rush	Tall grass
W1d (ditch)	69	Rough pasture, sheep grazing (with minor poaching)	Shallow	<0.5	1-2	1	Sedges, soft and hard rush	Tall grass
W1e (ditch)	97	Rough pasture, sheep grazing	Shallow	1-2	>2	1	Sedges, soft and hard rush	Herbs, submerged weed
W2 (ditch)	34	Rough pasture, sheep grazing, public footpath	Steep	1-2	1-2	1-2	Sedge, bankside trees/hedge	Yellow flag iris, tall grass
W3 (ditch)	58	Rough pasture, sheep grazing, public footpath	Steep	1-2	1-2	1-2	Sedge, bankside trees/hedge	Yellow flag iris, tall grass
W4 (ditch)	51	Rough pasture, sheep grazing	Shallow	Dry	0.5-1	1-2	Grass	Two trees (within ditch)
W5 (slow-flowing river)	133	Rough pasture, sheep grazing, cattle grazing	Steep	1-2	1-2	2-5	Reed/sedge, yellow flag iris	Bankside trees, submerged weed
W6 (ditch)	104	Rough pasture, sheep grazing	Steep	<0.5-dry	1-2	2	Mostly cleared/dredged with an area of floating sweet grass, greater pond sedge, and soft and hard rush	Submerged weed (at southern end of the ditch only)

Transect reference (Figure 5.1)	Transect length (m)	Bordering land uses	Bank profile	Depth (m) July	Depth (m) October	Width (m)	Dominant bankside vegetation	Other abundant vegetation
W7 (ditch)	71	Rough pasture, sheep grazing	Shallow	0.5-1	1-2	1-2	Sedges, and soft and hard rush	Trees (in the ditch), submerged weed
W8 (ditch)	75	Rough pasture, sheep grazing	Shallow	0.5-1	1-2	1	Sedges, soft and hard rush	Trees (in the ditch), submerged weed
W9 (ditch)	78	Rough pasture, sheep grazing	Shallow	0.5-1	1-2	1	Trees (in the ditch), sedges, tall grass	Herbs; channel is becoming choked with trees and tall grass
W10 (slow-flowing river)	379	Rough pasture, sheep grazing (with minor poaching, northern bank), cattle grazing (heavy grazing with poaching, southern bank)	Steep	1-2	1-2	2-5	Reed/sedge, yellow flag iris	Bankside trees, submerged weed
W11 (ditch)	114	Rough pasture, sheep grazing	Shallow	Dry	Dry	1-2	Bankside trees	Nettle
W12 (ditch)	29	Rough pasture, sheep grazing	Shallow	<0.5 - dry	1-2	1	Reeds/sedges, bushes, bankside trees/hedge	Herbs, submerged weed; channel is choked with dense vegetation

Water vole presence/absence survey

Table 5.2 presents the results of the water vole presence/absence survey in July. No evidence of water vole presence was found on site in the October visit. Further detail is provided below.

In July, evidence of water vole activity in the form of latrines, feeding remains, and/or burrows was found on the banks of seven of the survey transects (W1a, W1b, W1c, W1e, W7 and W8). A further six are considered to offer good habitat for water voles, with connections to ditches where field signs were found, but no evidence of water vole was found at the time of the survey (W2, W3, W9, W12, W5 and W10). It is considered highly likely that water vole does use these habitats, however, access for survey was restricted by dense vegetation (W2, W3, W9 and W12), and steep banks (W5 and W10).

The banks of ditch W6 showed signs of relatively recent dredging and, therefore, the disturbance and lack of vegetation is likely to have pushed water voles out of the area temporarily, albeit it is expected that they would return once the vegetation regrows.

During the October survey visit, all transects locations but W11 and W6 saw an increase in water level to the top of the bank meaning that they were no-longer suitable for water vole. Although W6 saw an increase in

water level, it did not reach the top of the banks leaving some suitable habitat for burrowing. W11 remained dry in October. .

Table 5.2 Halesworth Site 28 water vole presence/absence survey results

		Water vole signs recorded			
Transect reference (Figure 5.1)	**Presence confirmed (yes/no)**	**Latrines/ droppings**	**Feeding remains**	**Burrows**	**Other comments**
W1a (ditch)	Yes	1	1	0	
W1b (ditch)	Yes	1	0	0	
W1c (ditch)	Yes	12	6	1	
W1d (ditch)	Yes	10	4	0	
W1e (ditch)	Yes	5	3	0	
W2 (ditch)	No	0	0	0	Unable to survey due access restrictions
W3 (ditch)	No	0	0	0	Unable to survey due access restrictions
W4 (ditch)	No	0	0	0	Dry at time of survey in July
W5 (slow-flowing river)	No	0	0	0	Restricted survey due steep bank limiting accessibility
W6 (ditch)	No	0	0	0	Recently dredged and cleared of vegetation.
W7 (ditch)	Yes	5	6	0	
W8 (ditch)	Yes	2	4	1	
W9 (ditch)	No	0	0	0	Restricted survey due channel being heavily choked with trees and grass
W10 (slow-flowing river)	No	0	0	0	Restricted survey due steep bank limiting accessibility
W11 (ditch)	No	0	0	0	Dry at time of survey in July.
W12 (ditch)	No	0	0	0	Restricted survey due to channel being heavily choked with dense vegetation

Otter presence/absence survey

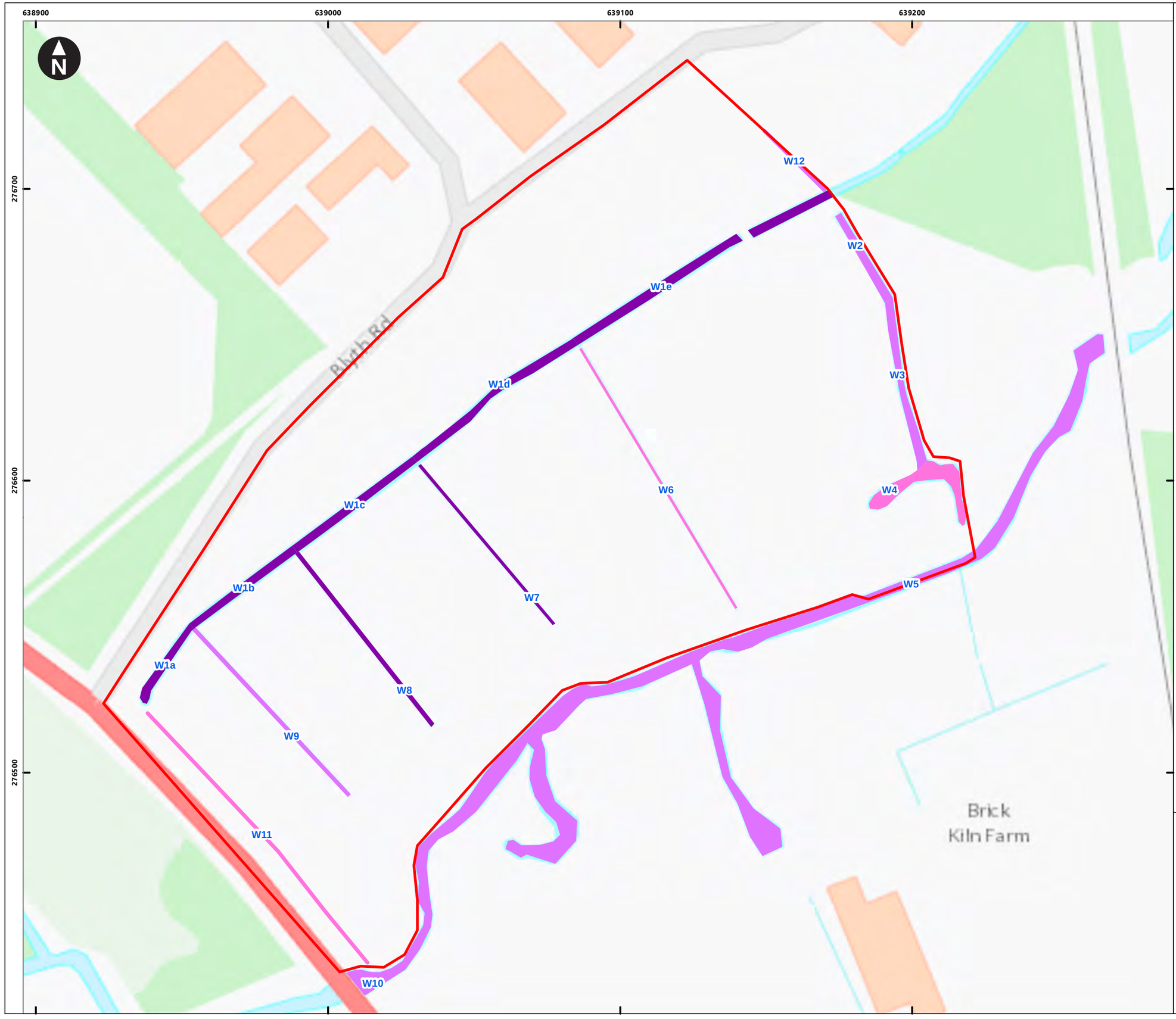
Although the habitats, and particularly the river, were considered as being suitable to support otter no evidence of this species was recorded during either survey visit.

5.3 Summary

Seven of the 16 transects surveyed provide optimal aquatic habitat for water voles in July, with a further four meeting most of the noted habitat requirements, in July, but held less water, and two contained relatively shallow water. Water vole presence was confirmed on seven of the surveyed transects (three different ditches) in July. All provided optimal habitat.

The October survey visit, however, highlighted that the use of the ditch system may be transient, as ditch water levels were very high and no evidence of water vole presence was found during this visit.

No signs of otter presence were recorded.



Key

Site 28 boundary

W1 Ditch number

Water vole habitat assessment

Water vole presence confirmed

Optimal habitat - no evidence of water vole identified

Suboptimal habitat - no evidence of water vole identified

Note
The October survey found all ditches (excluding W5, W6, and W11) contained high levels of water making any burrows present unsuitable for occupation at this time.

0 25 50 75 m

Scale at A3: 1:1,250

Fen Meadow Compensation Sites:
Halesworth Site 28

Figure 5.1
Location of transects surveyed and water vole districbution

November 2020

wood.

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6. Aquatic Invertebrates

6.1 Methods

Sample collection

Aquatic invertebrate samples were collected from nine locations on-site (seven from within the ditch system and one from the River Blyth)(see Figure 6.1), on 16 July 2020. The weather was cloudy in the morning but sunny in the afternoon with a slight breeze and there was no rain.

Samples were collected with a standard pond net (supplied by EFE Field Equipment, Totnes) and represent 3-minute sweep samples taken either in the channels if they were shallow and it was safe to do so, or from the bank. The material was processed by washing and sieving in the field. Each sample was initially washed using a coarse (1cm) sieve and 500-micron sieve first to remove any twigs, leaves, seeds, large stones, etc. The coarse material retained by the 1cm sieve was retained along with the 500-micron fraction. The sample was preserved using 10% formalin.

The samples were later examined in the laboratory by placing small amounts of material into gridded petri-dishes and adding water. These petri-dishes were then examined carefully under a stereomicroscope. Each sample typically used 40-50 petri-dishes this way. Aquatic invertebrates were removed from the sample for identification and were counted as this was done. For particularly abundant taxa, sub-sampling was used to estimate the total number of specimens (i.e. individuals were counted from 20-25% of the dishes and multiplied up).

Physical and chemical parameters

Data was collected on pH, conductivity, water temperature and total dissolved solids, measured using a hand-held Hanna HI98129 pH/conductivity meter, at each sample site. Wetted width was measured with a metre rule.

Sample identification

The majority of the aquatic macroinvertebrates have been identified to species level. The exceptions include nematodes, oligochaetes, water mites (Hydrachnellae) and pea mussels (*Pisidium* spp). Identification of these requires specialist input and because of this, is rarely undertaken for routine aquatic biological monitoring. For immature specimens and females not separable to species, identification has been left at the appropriate level.

The pupal exuviae of some chironomids have been identified because these are often much easier to identify than the larvae. The terrestrial life stages of aquatic insects caught in the kick net samples have also been identified since these help in identifying the often difficult aquatic larval stages. A few wholly terrestrial invertebrate species have also been recorded from the kick samples, but these are often wetland species typical of spring or flush habitats and they help to indicate the value of the habitat.

Methods of assessing ditch invertebrate faunas

The results have been analysed to develop a Species Quality Index (SQI) (or Invertebrate Conservation Status Score), based on the Native Species Conservation Score, in accordance with Palmer *et al.* (2013). This is a methodology devised specifically to assess ditch flora and invertebrates for the European Water Framework Directive (WFD). The method was widely tested throughout grazing marshes in England and Wales (Drake *et al.* 2010). The scoring system is shown in Table 6.1. The SQI (or Invertebrate Conservation Status Score) for a

sample or a wetland is obtained by adding together all the individual species scores, then dividing by the number of native taxa recorded. Non-native taxa are not used when calculating this metric. Also, if a sample contains fewer than ten invertebrate taxa the SQI should not be calculated.

Table 6.1 Allocation of conservation scores used by Palmer *et al.* (2013)

Category	Score
Habitats Directive Annex II and/or IV; Wildlife and Countryside Act Schedule 5; Red List CR, EN, VU (revised assessments); Red List E or V (unrevised lists)	5
Red List Rare (R in unrevised lists), Red list DD or K; Near Threatened	4
Nationally Scarce (Nationally Scarce, Nationally Notable Na and Nb)	3
Local	2
None of the above (common)	1

Red List CR: Revised British Red List: Critically endangered
Red List EN: Revised British Red List: Endangered
Red List VU: Revised British Red List: Vulnerable
Red list E: British Red List: Engandered (Red Data Book 1)
Red list V: British Red List: Vulnerable (Red Data Book 2)
Red list R: British Red List: Rare (Red Data Book 3)
Red list DD: Data deficient
Red list K: Insufficiently known
Nationally Scarce: Restricted range. Occurring as notice in 16-100 10x10km squares in Britain
Nationally Notable Na: Restricted range. Occurring as notice in 16-30 10x10km squares in Britain
Nationally Notable Nb: Restricted range. Occurring as notice in 31-100 10x10km squares in Britain
Local: Confined to a particular habitat or geographic area, or too widespread to warrant Nationally scarce.

Species rarity status

The rarity of species recorded has been checked against the Red Data Book and Nationally Scarce statuses given to invertebrates by the Joint Nature Conservation Committee. The JNCC statuses are taken from the latest national reviews to different insect orders and these are also given on the computer database software RECORDER. Red Data Book species are confined to between 1 and 15 10km squares in Britain whilst Nationally Scarce species are those confined to between sixteen and one hundred 10km squares. Since 1995, International Union for Conservation of Nature and Natural Resources (IUCN) categories have been adopted by the JNCC as the new standard for Red Lists in Britain. JNCC aims to work towards assessing the status of all native species against standard criteria based on the internationally accepted guidelines developed by the IUCN (see IUCN 2001, 2003). Only a few taxonomic groups have been given IUCN codes but these include the water beetles (Foster 2010).

6.2 Results

Eight sites were sampled, the locations of which are shown on Figure 6.1. A total of 78 aquatic invertebrate taxa were recorded (see Appendix G). Twenty additional invertebrates were recorded that included terrestrial species with a general affinity to wetlands and the terrestrial life-stages of taxa with aquatic larvae. One fish and one amphibian were also recorded.

Assessment of ditch invertebrate fauna

The Palmer analysis was used at all sites. Whilst Sites 3 & 8 could have been assessed using other methods as Site 3 is a stream and 8 is the River Blyth, neither had visible flow where sampled and so the Palmer method was adopted for the analysis in these locations also.

The SQI for the Halesworth ditch system varied from 1 to 1.3 and the number of scoring taxa varied from four to twenty-two (see Table 6.2).

Overall scores of between 1 and 1.3 are modest, indicating a predominance of common and local status species.

Sites 3 and 7 were the highest scoring in terms of SQI, both with a value of 1.3. The ditches with the highest number of scoring taxa were 5 & 6 which were open ditches with some regenerating alder along their sections.

Site 4 had only four scoring taxa and hence an SQI was not calculated. This ditch was visibly polluted with an oily scum on the surface, abundant submerged brown filamentous algae and black anoxic mud. The steep banks and bank tops had little vegetation which has led to soil erosion.

Table 6.2 Species quality scores based on Palmer *et al.* (2013)

Sample	1	2	3	4	5	6	7	8
No. taxa	11	14	9	4	18	22	11	11
Sum of individual species scores	13	16	12	4	22	26	15	11
SQI	1.1	1.1	1.3	-*	1.2	1.1	1.3	1

* Not calculated as less than 10 taxa present.

Species richness and species rarity

The most significant species is a soldierfly larva that appears to be *Stratiomys singularior*, represented by a single larva from sample 7. This species is found mainly on brackish coastal marshes where it occurs along ditches with plants such as sea club-rush. This species is assessed on the IUCN list as being of Least Concern, scoring 3 on the scale in Palmer (2013). Further detail on the ecology and distribution of this species is provided in Appendix H.

Of the remaining species recorded, eight are assigned Local status, scoring 2 of the scale in Palmer (2013), and the rest comprise common species.

6.3 Summary

The aquatic invertebrate fauna of the Halesworth site comprises predominantly common and local species, which, as a result, score modestly using the approach defined by Palmer *et al.* (2013).

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Key

Site 28 boundary

Running water

W1 Ditch number

Aquatic invertebrate survey location

0 25 50 75 m

Scale at A3: 1:1,250

Fen Meadow Compensation Sites: Halesworth Site 28

Figure 6.1
Aquatic invertebrate survey locations

November 2020

wood.

40773-WOOD-XX-XX-FG-OE-0018_S2_P01

7. Summary

7.1 Overview

The proposals for the fen meadow creation at the site will, subject to further hydrological assessment and conceptualisation, likely entail raising water levels in ditches and habitat manipulation activities.

Based on this, and taking account of the results of the 2019 site visits (Wood, 2019), and the results of the 2020 desk study and extended Phase 1 habitat survey presented earlier in this report the following surveys were undertaken:

- An NVC survey of the terrestrial flora was undertaken to complement observations made on the ditch communities in Wood (2019);
- Otter and water vole surveys; and
- Aquatic invertebrates in the ditch system.

7.2 Terrestrial and ditch plant communities

The NVC survey identified four distinct grassland-types within and on the margin of the floodplain and also a block of riparian fringe tall-herb vegetation. These vegetation types are assigned to the following NVC communities:

Grasslands

- OV23d *Lolium perenne-Dactylis glomerata* community, *Arrhenatherum elatius-Medicago lupulina* sub-community;
- MG7d *Lolium perenne-Alopecurus pratensis* grassland; and
- MG10b *Holco-Juncetum effusi, Juncus inflexus* sub-community.

Riparian fringe tall-herb vegetation

- OV26e *Epilobium hirsutum* community, *Urtica dioica-Cirsium arvense* sub-community.

The sward supporting the majority of phreatophyte species (Stand C2) is calculated to have an area of 1.06 ha, covering c.24 per cent of the survey area. Based on this detailed survey, this would be the key area of potential for fen meadow habitat creation, albeit as reported in Wood (2019), there is also a large area of the floodplain where ditch water could be detained above the layer of silty clay which also has some potential for fen meadow creation.

The associated ditch network supports stands of groundwater-dependent swamp species, notably two pond-sedges, forming S6 *Caricetum ripariae* and S7 *Caricetum acutiformis* swamps, and branched bur-reed stands of the S14 *Sparganietum erecti* swamp. Several small helophytes are also present, including fool's watercress, water mint, watercress, lesser water-parsnip and water forget-me-not. This group is also associated with groundwater influence and, where the tall swamp species are sub-ordinate, they form stands of the S23 *Glycerio-Sparganion* vegetation. The ditches also support alder sprouts near the catch dyke; this species only germinates and establishes successfully in summer-wet situations.

The habitats present qualify as coastal and floodplain grazing marsh, a habitat of principal importance listed under Section 41 (S41) of the *Natural Environment and Rural Communities (NERC) Act 2006*.

7.3 Otter and water vole

No sign of otter presence was recorded on site. A number of ditches provided optimal water vole habitat and water vole presence was located on seven of the surveyed transects (3 different ditches).

7.4 Aquatic invertebrates of ditches and watercourses

The aquatic invertebrate fauna of the Halesworth site comprises predominantly common and local species, which, as a result, score modestly using the approach defined by Palmer *et al.* (2013).

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Appendix A
Species Scientific Name

Table A1 Species Names

Species	Scientific Name
Higher plants	
Ash	*Fraxinus excelsior*
Blackthorn	*Prunus spinosa*
Bramble	*Rubus fruticosus* agg.
Branched bur-reed	*Sparganium erectum*
Broadleaved dock	*Rumex obtusifolius*
Brooklime	*Veronica beccabunga*
Brown sedge	*Carex disticha*
Celery-leaved buttercup	*Ranunculus sceleratus*
Chicory	*Cichorium intybus*
Cleavers	*Galium aparine*
Clustered clover	*Trifolium glomeratum*
Clustered dock	*Rumex obtusifolius*
Cock's-foot	*Dactylis glomerata*
Common alder	*Alnus glutinosa*
Common bird's-foot trefoil	*Lotus corniculatus*
Common hawthorn	*Crataegus monogyna*
Common hop	*Humulus lupulus*
Common mallow	*Malva sylvestris*
Common mouse-ear	*Cerastium fontanum*
Common nettle	*Urtica dioica*
Common ragwort	*Senecio jacobaea*
Common reedmace	*Typha latifolia*
Common sorrel	*Rumex acetosa*
Common Stork's-bill	*Erodium cicutarium*
Corn poppy	*Papaver rhoeas*

Species	Scientific Name
Cow parsley	*Anthriscus sylvestris*
Creeping bent	*Agrostis stolonifera*
Creeping buttercup	*Ranunculus repens*
Creeping thistle	*Cirsium arvense*
Creping bent	*Agrostis capillaris*
Curled dock	*Rumex crispus*
Cut-leaved crane's-bill	*Geranium dissectum*
Dandelion	*Taraxacum* agg.
Dog rose	*Rosa canina*
Dove's-foot cranesbill	*Geranium molle*
English elm	*Ulmus procera*
Evergreen oak	*Quercus ilex*
False Oat-grass	*Arrhenatherum elatius*
Fescue ryegrass	X *Schedolium loliaceum*
Field horsetail	*Equisetum arvense*
Field scabious	*Knautia arvensis*
Floating sweet-grass	*Glyceria fluitans*
Fool's water-cress	*Apium nodiflorum*
Germander speedwell	*Veronica chamaedrys*
Glaucus sedge	*Carex flacca*
Great hairy screw-moss	*Syntrichia ruralis*
Great willowherb	*Epilobium hirsutum*
Greater Pond-sedge	*Carex riparia*
Grey willow	*Salix cinerea*
Ground ivy	*Glechoma hederacea*
Groundsel	*Senecio vulgaris*
Hairy sedge	*Carex hirta*
Hard rush	*Juncus inflexus*
Hedge bindweed	*Calystegia sepium*
Hedge mustard	*Sisymbrium officinale*

Species	Scientific Name
Hedge woundwort	*Stachys sylvatica*
Hemlock	*Conium maculatum*
Hemp-agrimony	*Eupatorium cannabinum*
Himalayan balsam	*Impatiens glandulifera*
Hoary cinquefoil	*Potentilla argentea*
Hybrid jointed rush	*Juncus* x *surrejanus*
Jointed rush	*Juncus articulatus*
Lady's-smock	*Cardamine pratensis*
Lesser burdock	*Arctium minus* agg
Lesser stitchwort	*Stellaria graminea*
Maidenhair fern	*Adiantum capillus-veneris*
Marsh bird's-foot trefoil	*Lotus pedunculatus*
Marsh foxtail	*Alopecurus geniculatus*
Marsh horsetail	*Equisetum palustre*
Marsh thistle	*Cirsium palustre*
Meadow buttercup	*Ranunculus acris*
Meadow foxtail	*Alopecurus pratensis*
Meadow vetchling	*Lathyrus pratensis*
Meadowsweet	*Filipendula ulmaria*
Mugwort	*Artemisia vulgaris*
Nipplewort	*Lapsana communis*
Pedunculate oak	*Quercus robur*
Perennial ryegrass	*Lolium perenne*
Purple-loosestrife	*Lythrum salicaria*
Quaking-grass	*Briza media*
Ragged-robin	*Silene flos-cuculi*
Red clover	*Trifolium pratense*
Red fescue	*Festuca rubra*
Redshank	*Persicaria maculosa*
Rough meadow-grass	*Poa trivialis*

Species	Scientific Name
Rough-stalked feather moss	*Brachythecium rutabulum*
Round-leaved mint	*Mentha suaveolens*
Sandy stilt puffball	*Battarrea phalloides*
Scarlet pimpernel	*Anagallis arvensis*
Shepherd's-purse	*Capsella bursa-pastoris*
Silver birch	*Betula pendula*
Small teasel	*Dipsacus pilosus*
Smaller Cat's-tail	*Phleum bertolonii*
Smooth hawk's-beard	*Crepis capillaris*
Smooth meadow-grass	*Poa pratensis*
Soft brome	*Bromus hordeaceus hordeaceus*
Soft rush	*Juncus effusus*
Soft-brome	*Bromus hordeaceus*
Spear thistle	*Cirsium vulgare*
Springy turf-moss	*Rhytidiadelphus squarrosus*
Square-stalked St John's-wort	*Hypericum tetrapterum*
Swartz's feather-moss	*Oxyrrhynchium hians*
Sweet vernal-grass	*Anthoxanthum odoratum*
Tansy	*Tanacetum vulgare*
Teasel	*Dipsacus fullonum*
Timothy	*Phleum pratense*
Toad rush	*Juncus bufonius*
Tufted hairgrass	*Deschampsia cespitosa*
Tufted thread-moss	*Bryum caespiticium* agg.
Wall barley	*Hordeum murinum*
Water figwort	*Scrophularia umbrosa*
Water horsetail	*Equisetum fluviatile*
Water mint	*Mentha aquatica*
Water-cress	*Nasturtium officinale*
Water-plantain	*Alisma plantago-aquatica*

Species	Scientific Name
Water-soldier	*Stratiotes aloides*
White clover	*Trifolium repens*
Wild pansy	*Viola tricolor*
Woody nightshade	*Solanum dulcamara*
Yarrow	*Achillea millefolium*
Yellow flag iris	*Iris pseudacorus*
Yorkshire fog	*Holcus lanatus*
Animals	
Badger	*Meles meles*
Barbastelle	*Barbastella barbastellus*
Barn owl	*Tyto alba*
Bats	*Chiroptera*
Brook lamprey	*Lampetra planeri*
Brown hare	*Lepus europaeus*
Brown long-eared bat	*Plecotus auritus*
Bullfinch	*Pyrrhula pyrrhula*
Common lizard	*Zootoca vivipara*
Common pipistrelle	*Pipistrellus pipistrellus*
Common toad	*Bufo bufo*
Daubenton's bat	*Myotis daubentonii*
Dunnock	*Prunella modularis*
European eel	*Anguilla anguilla*
Fieldfare	*Turdus pilaris*
Fritillary	
Ghost moth	*Hepialus humuli*
Grass snake	*Natrix helvetica*
Grayling	*Hipparchia semele*
Great crested newt	*Triturus cristatus*
Grey wagtail	*Motacilla cinerea*
Harvest mouse	*Micromys minutus*

Species	Scientific Name
Hedgehog	*Erinaceus europaeus*
Herring gull	*Larus argentatus*
House sparrow	*Passer domesticus*
Kingfisher	*Alcedo atthis*
Leisler's bat	*Nyctalus leisleri*
Linnet	*Linaria cannabina*
Mistle thrush	*Turdus viscivorus*
Mole	Talpa europaea
Natterer's bat	*Myotis nattereri*
Noctule	*Nyctalus noctula*
Norfolk hawker	*Anaciaeschna isoceles*
Otter	*Lutra lutra*
Pintail	*Anas acuta*
Pipistrelle bat	*Pipistrellus*
Redwing	*Turdus iliacus*
Serotine	*Eptesicus serotinus*
Skylark	*Alauda arvensis*
Slow worm	*Anguis fragilis*
Soprano pipistrelle	*Pipistrellus pygmaeus*
Spotted flycatcher	*Turdus philomelos*
Starling	*Sturnus vulgaris*
Water vole	*Arvicola amphibius*

Appendix B
Species Protection or Control Legislation

Great crested newts, Bats, Dormouse

These species / species groups are listed in Schedule 5 of the *Wildlife and Countryside Act 1981* (as amended) and Schedule 2 of *The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019*. They are afforded full protection under Section 9(4) of the Act and Regulation 43 of the Regulations. These make it an offence, *inter alia*, to:

- Deliberately capture, injure or kill any such animal; and
- Deliberately disturb any such animal, including in particular any disturbance which is likely;
  - to impair its ability to survive, breed, or rear or nurture their young;
  - to impair its ability to hibernate or migrate; and
  - to affect significantly the local distribution or abundance of that species.
- Damage or destroy a breeding site or resting place of any such animal;
- Intentionally or recklessly disturb any of these animals while it is occupying a structure or place that it uses for shelter or protection (for bats this is taken to mean all bat roosts whether bats are present or not); or
- Intentionally or recklessly obstruct access to any place that any of these animals uses for shelter or protection.

In addition, five British bat species are listed on Annex II of the Habitats Directive. These are:

- Greater horseshoe bat (*Rhinolophus ferrumequinum*);
- Lesser horseshoe bat (*Rhinolophus hipposideros*);
- Bechstein's bat (*Myotis bechsteinii*);
- Barbastelle (*Barbastella barbastellus*); and
- Greater mouse-eared bat (*Myotis myotis*).

In certain circumstances where these species are found the Directive requires the designation of Special Areas of Conservation (SACs) by EC member states to ensure that their populations are maintained at a favourable conservation status. Outside SACs, the level of legal protection that these species receive is the same as for other bat species.

Badger

The *Protection of Badgers Act 1992* consolidates previous legislation (including the *Badgers Acts 1973* and the *Badgers (Further Protection) Act 1991*). It makes it an offence to:

- Kill, injure or take a badger;
- Attempt to kill, injure or take a badger; and
- To damage or interfere with a sett.

The 1992 Act defines a badger sett as "any structure or place which displays signs indicating current use by a badger".

Nesting Birds

With certain exceptions, all wild birds, their nests and eggs are protected by Section 1 of the *Wildlife and Countryside Act 1981* (as amended). Therefore, it is an offence, inter alia, to:

- Intentionally kill, injure or take any wild bird;
- Intentionally take, damage or destroy the nest of any wild bird while it is in use or being built; and
- Intentionally take or destroy the egg of any wild bird.

Bird species listed on Schedule 1 of the Act receive further protection, thus for these species it is also an offence to:

- Intentionally or recklessly disturb any bird while it is nest building, or is at a nest containing eggs or young; and
- Intentionally or recklessly disturb the dependent young of any such bird.

Reptiles

The four widespread species of reptile that are native to Britain, namely common or viviparous lizard (*Zootoca vivipara*), slow worm (*Anguis fragilis*), adder (*Vipera berus*) and grass snake (*Natrix natrix*), are listed in Schedule 5 of the *Wildlife and Countryside Act 1981* (as amended) and are afforded limited protection under Section 9 of this Act. This makes it an offence, inter alia, to:

- Intentionally kill or injure any of these species.

In addition sand lizard and smooth snake are listed in Schedule 5 of the *Wildlife and Countryside Act 1981* (as amended) and Schedule 2 of *The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019*: They are afforded full protection under Section 9(4) of the Act and Regulation 43 of the Regulations.

These make it an offence, inter alia, to:

- Deliberately capture, injure or kill any such animal;
- Deliberately disturb any such animal, in particular in such a way as to be likely to:
- Impair their ability to survive, breed or reproduce, or rear or nurture their young;
- Impair their ability to hibernate or migrate which could affect significantly the local distribution or abundance of that species;
- Damage or destroy a breeding site or resting place of any such animal;
- Intentionally or recklessly disturb any of these animals while it is occupying a structure or place that it uses for shelter or protection; or
- Intentionally or recklessly obstruct access to any place that any of these animals uses for shelter or protection.

The legislation applies to all life stages of these species.

Notifiable / Controlled Species

Schedule 9 of the *Wildlife and Countryside Act 1981* (as amended) lists species of animal that it is an offence to release or allow to escape into the wild (for example grey squirrel) and species of plant that it is an offence to plant or otherwise cause to grow in the wild (for example, Japanese knotweed).

Appendix C
Phase 1 Target Notes

Table C1 Extended Phase 1 Survey Target Notes

Target Note no.	Ordnance Survey Grid Reference	Description
1	TM 39016 76639	In the western part of the site, close to Blyth Road, there is a patch of approximately 30 mole hills.
2	TM 39187 76683	A *c.* 5 m stretch of Himalayan balsam in the hedgerow and ditch on the north-eastern boundary.
3	TM 39196 76626	A *c.* 15 m stretch of Himalayan balsam in the hedgerow and ditch on the north-eastern boundary.
4	TM 39217 76601	A *c.* 20 m stretch of Himalayan balsam in the hedgerow and ditch on the north-eastern boundary. And; A standing deadwood tree in the eastern corner of the site which had features of decay suitable for roosting bats.
5	TM 39252 76620	A *c.* 10 m stretch of Himalayan balsam either side of a footbridge off site, further downstream the River Blyth.
6	TM 39197 76608	Two mature common alder pollards which have rot cavities on limb scars.
7	TM 39142 76548	Mature common alder trees bordering the River Blyth along the south-eastern boundary of the site. Several of these, have potential roosting features including woodpecker holes, and deadwood limbs.
8	TM 39134 76550	A *c.* 5 m^2 patch of Himalayan balsam on the bank of the River Blyth. Also present is small teasel.
9	TM 39120 76546	Small teasel on bank of the River Blyth.
10	TM 39095 76540	Mature common alder trees bordering the River Blyth along the south-eastern boundary of the site. Several of these, have potential roosting features including woodpecker holes, and deadwood limbs. and A c. 10 m stretch of Himalayan balsam on the bank of the River Blyth. Also present is small teasel.
11	TM 39084 76547	Mature common alder trees bordering the River Blyth along the south-eastern boundary of the site. Several of these, have potential roosting features including woodpecker holes, and deadwood limbs.
12	TM 39013 76437	Himalayan balsam on the bank of the River Blyth. Also present is small teasel.
13	TM 39111 76727	In the northern corner of the site there is semi-improved grassland that is not groundwater dependent, like much of the rest of the site. It has a relatively generic sward including common and widespread grasses like cock's foot, Yorkshire fog, perennial rye, smaller cat's-tail, soft brome, and wall barley with common herbs including common nettle, common stork's-bill, creeping buttercup, creeping thistle, dandelion, dove's-foot cranesbill, groundsel,

Target Note no.	Ordnance Survey Grid Reference	Description
		nipplewort, shepherds purse, smooth hawk's-beard, spear thistle, wild pansy, and yarrow. Sward height is relatively short (15-30 cm).
14	TM 39057 76670	Moving south and eastwards from TN13 there is then a strip of semi-improved neutral grassland that has abundant Yorkshire fog and a taller sward (c. 30-40 cm). Some new grasses (Timothy, smooth meadow-grass, red fescue, and creeping bent) and herbs (red clover, white clover, ragged robin, common mouse ear, cow parsley, and broad-leaved dock) not evident in the upland section of the site were present. What also distinguishes this area is the occasional to frequent soft rush, hard rush and tufted hair grass that has entered the sward and visually delineates the start of groundwater dependent grassland.
15	TM 39073 76658	Beyond TN14, in the central part of the site, the sward becomes slightly taller (c. >40 cm) and is characterised by an increased abundance of tufted hair grass, soft and hard rushes, and here jointed rush also constitutes a frequent part of the sward. Yorkshire fog is the most abundant grass and there is a relatively poor diversity of forbs present including creeping buttercup, creeping thistle and spear thistle. It is very much a graminoid dominated grassland.
16	TM 39137 76593	Beyond TN15, as you move towards the south-eastern boundary of the site, the abundance of the rushes and tufted hair grass begins to reduce once again and the grassland grades back into something close to the second semi-improved grassland type described in at Target Note 14 with Yorkshire fog and perennial ryegrass being abundant.

Appendix D
Species recorded in NVC sample plots

Table D1 Species recorded in sample plots

Scientific name	Common name	Londo	Primary syntaxon		EIV F
Achillea millefolium	Yarrow	A	ART-01	*Onopordetalia*	5
Agrostis stolonifera	Creeping bent	P	MOL-10	*Potentillo-Polygonetalia avicularis*	6
Alopecurus geniculatus	Marsh foxtail	V	MOL-10	*Potentillo-Polygonetalia avicularis*	7
Alopecurus pratensis	Meadow foxtail	P	MOL-01	*Arrhenatheretalia*	5
Anagallis arvensis	Scarlet pimpernel	A	PAR-01	*Aperetalia*	4
Anthoxanthum odoratum	Sweet vernal-grass	A	MOL	*Molinio-Arrhenatheretea*	6
Arctium minus agg	Lesser burdock	A	EPI-03	*Arctio-Artemisietalia*	4
Arrhenatherum elatius	False oat-grass	A	MOL-01	*Arrhenatheretalia*	5
Artemisia vulgaris	Mugwort	A	ART-01	*Onopordetalia*	4
Brachythecium rutabulum	Rough-stalked feather moss	-	MOL	*Molinio-Arrhenatheretea*	6
Bromus hordeaceus hordeaceus	Soft brome	A	SIS-01	*Sisymbrietalia*	4
***Bryum caespiticium* agg.**	Tufted thread-moss	-	POL-01	*Polygono-Poetalia*	4
Calystegia sepium	Hedge bindweed	P	EPI-04	*Convolvuletalia*	8
Capsella bursa-pastoris	Shepherd's purse	A	SIS-01	*Sisymbrietalia*	5
Cardamine pratensis	Lady's-smock	V	MOL	*Molinio-Arrhenatheretea*	8
Carex disticha	Brown sedge	W	PHR-04A	*Magnocaricetalia*	8
Carex hirta	Hairy sedge	A	MOL-10	*Potentillo-Polygonetalia avicularis*	7
Carex riparia	Greater pond-sedge	W	PHR-04A	*Magnocaricetalia*	9
Cerastium fontanum	Common mouse-ear	A	MOL-01	*Arrhenatheretalia*	5
Cirsium arvense	Creeping thistle	A	EPI-03	*Arctio-Artemisietalia*	6
Cirsium palustre	Marsh thistle	V	MOL-05	*Molinietalia*	8
Cirsium vulgare	Spear thistle	A	ART-01	*Onopordetalia*	5
Conium maculatum	Hemlock	A	EPI-03	*Arctio-Artemisietalia*	5
Crepis capillaris	Smooth hawk's-beard	A	ART-01	*Onopordetalia*	4
Dactylis glomerata	Cock's-foot	A	MOL-01	*Arrhenatheretalia*	5
Deschampsia cespitosa	Tufted hairgrass	V	MOL-05	*Molinietalia*	6
Epilobium hirsutum	Great willowherb	K	EPI-04	*Convolvuletia*	8
Equisetum arvense	Field horsetail	D	ART-03	*Agropyretalia*	6
Equisetum palustre	Marsh horsetail	W	MOL-05	*Molinietalia*	8
Erodium cicutarium	Common stork's-bill	A	PAR-01	*Aperetalia*	4
Festuca rubra	Red fescue	A	MOL	*Molinio-Arrhenatheretea*	5
Galium aparine	Cleavers	A	EPI-03	*Arctio-Artemisietalia*	6
Geranium dissectum	Cut-leaved crane's-bill	A	PAR-02	*Papaveretalia*	5
Geranium molle	Dove's-foot crane's-bill	A	EPI-03	*Arctio-Artemisietalia*	5
Glechoma hederacea	Ground ivy	A	EPI-02	*Glechometalia*	6
Holcus lanatus	Yorkshire fog	P	MOL	*Molinio-Arrhenatheretea*	6
Hordeum murinum	Wall barley	A	SIS-01	*Sisymbrietalia*	4
Juncus bufonius	Toad rush	V	ISO-02	*Nanocyperetalia*	7
Juncus effusus	Soft rush	V	MOL-05	*Molinietalia*	7
Juncus inflexus	Hard rush	V	MOL-10	*Potentillo-Polygonetalia avicularis*	7

Scientific name	Common name	Londo Primary syntaxon		EIV F
Juncus x surrejanus	Hybrid jointed rush	V	MOL-05 *Molinietalia*	9
Lathyrus pratensis	Meadow vetchling	A	MOL-01 *Arrhenatheretalia*	6
Lolium perenne	Perennial ryegrass	A	MOL-01 *Arrhenatheretalia*	5
Lotus pedunculatus	Marsh bird's-foot trefoil	V	MOL-05 *Molinietalia*	8
Malva sylvestris	Common mallow	A	ART-01 *Onopordetalia*	4

Scientific name	Common name	Londo	Primary syntaxon		EIV F
Oxyrrhynchium hians	Swartz's feather-moss	-	MOL	*Molinio-Arrhenatheretea*	5
Papaver rhoeas	Corn poppy	A	PAR	*Papaveretea rhoedis*	5
Phleum pratense	Timothy	A	MOL-01	*Arrhenatheretalia*	5
***Poa pratensis* agg.**	Smooth meadow-grass	A	MOL	*Molinio-Arrhenatheretea*	5
Poa trivialis	Rough meadow-grass	A	MOL-10	*Potentillo-Polygonetalia avicularis*	6
***Quercus robur* seedling**	Pedunculate oak	A	FAG-03	*Carpinion*	5
Ranunculus acris	Meadow buttercup	D	MOL-01	*Arrhenatheretalia*	6
Ranunculus repens	Creeping buttercup	P	MOL-10	*Potentillo-Polygonetalia avicularis*	7
Rhytidiadelphus squarrosus	Springy turf-moss	-	MOL-01	*Arrhenatheretalia*	5
Rumex acetosa	Common sorrel	A	MOL	*Molinio-Arrhenatheretea*	5
Rumex crispus	Curled dock	A	MOL-10	*Potentillo-Polygonetalia avicularis*	6
Rumex obtusifolius	Clustered dock	A	MOL-10	*Potentillo-Polygonetalia avicularis*	5
X *Schedolium loliaceum*	Fescue ryegrass	P	MOL-01	*Arrhenatheretalia*	6
Senecio jacobaea	Common ragwort	A	MOL-01	*Arrhenatheretalia*	4
Senecio vulgaris	Groundsel	A	PAR-01	*Aperetalia*	5
Sisymbrium officinale	Hedge mustard	A	SIS-01	*Sisymbrietalia*	4
Stellaria graminea	Lesser stitchwort	A	MOL	*Molinio-Arrhenatheretea*	6
Syntrichia ruralis	Great hairy screw-moss	-	SED-02	*Sedo-Scleranthetalia*	3
***Taraxacum* sp.**	Dandelion	A	MOL-01	*Arrhenatheretalia*	5
Trifolium pratense	Red clover	A	MOL	*Molinio-Arrhenatheretea*	5
Trifolium repens	White clover	A	MOL-01	*Arrhenatheretalia*	5
Urtica dioica	Common nettle	A	EPI-03	*Arctio-Artemisietalia*	6
Veronica chamaedrys	Germander speedwell	A	MOL-01	*Arrhenatheretalia*	5

Appendix E
Locations of sample plots

Table E1 Location of NVC survey sample plots

Plot	Easting	Northing	Stand	NVC
1	639114	276729	A	OV23d
2	639101	276719	A	OV23d
3	639086	276710	A	OV23d
4	639072	276704	A	OV23d
5	639053	276689	A	OV23d
6	639137	276723	B	MG7d
7	639106	276708	B	MG7d
8	638969	276572	B	MG7d
19	639164	276600	B	MG7d
20	639107	276562	B	MG7d
23	639067	276547	B	MG7d
26	639030	276509	B	MG7d
29	639009	276475	B	MG7d
9	638991	276595	C1	MG10b
10	639037	276650	C1	MG10b
16	639169	276661	C1	MG10b
18	639138	276629	C1	MG10b
21	639090	276591	C1	MG10b
24	639042	276560	C1	MG10b
27	638997	276540	C1	MG10b
30	638980	276503	C1	MG10b
11	639000	276612	C2	MG10b
12	639015	276630	C2	MG10b
13	639049	276643	C2	MG10b
14	639086	276682	C2	MG10b
15	639148	276713	C2	MG10b
17	639128	276666	C2	MG10b
22	639060	276620	C2	MG10b
25	639019	276585	C2	MG10b
28	638984	276552	C2	MG10b
31	638959	276525	C2	MG10b
32	639196	276679	D	OV26e
33	639201	276668	D	OV26e
34	639210	276652	D	OV26e
35	639215	276640	D	OV26e
36	639235	276632	D	OV26e

Appendix F
NVC stand community tables

The stand community tables are presented below, with Domin values defined.

Domin cover/abundance scale

Cover	91-100 per cent	10
	76-90 per cent	9
	51-75 per cent	8
	34-50 per cent	7
	26-33 per cent	6
	11-25 per cent	5
	4-10 per cent	4
	<4 per cent (many)	3
	(several)	2
	(few)	1

Table 5. Community table species constancy

V	=	81-100 per cent	Constant
IV	=	61-80 per cent	Constant
III	=	41-60 per cent	Frequent
II	=	21-40 per cent	Occasional
I	=	1-20 per cent	Scarce

At the right-hand side of each stand community table the constancy values of each species in the community is given with the range of Domin values with which they have been recorded.

Table F1 Stand A

NVC: **OV23d *Lolium perenne-Dactylis glomerata* community, *Arrhenatherum elatius-Medicago lupulina* sub-community**
Alliance: ***Lolio-Plantaginion***
Order: ***Arrhenatheretalia***

Sample plot	1	2	3	4	5		
Lolium perenne	7	8	7	7	6	V	(6-8)
Urtica dioica	4	5	6	5	4	V	(4-6)
Holcus lanatus	4	3	3	5	7	V	(3-7)
Agrostis stolonifera	6	5	2	2	4	V	(2-6)
Bromus hordeaceus hordeaceus	5	3	2	4	2	V	(2-5)
Crepis capillaris	3	2	3	1	1	V	(1-3)
Dactylis glomerata	2	2	1	1		IV	(1-2)
Cerastium fontanum	1	1	1	1		IV	(1)
Capsella bursa-pastoris	3	1	1			III	(1-3)
Geranium molle	2	1	2			III	(1-2)
Veronica chamaedrys		2	1	2		III	(1-2)
Cirsium vulgare	1	1			1	III	(1)
Achillea millefolium			2	4		II	(2-4)
Cirsium arvense	1		1			II	(1)
Erodium cicutarium		1			1	II	(1)
Poa trivialis			4			I	(4)
Arrhenatherum elatius	2					I	(2)
Taraxacum sp.	2					I	(2)
Equisetum arvense					2	I	(2)
Senecio vulgaris			2			I	(2)
Glechoma hederacea					2	I	(2)
Brachythecium rutabulum					2	I	(2)
Malva sylvestris					2	I	(2)
Arctium minus agg					1	I	(1)
Ranunculus acris				1		I	(1)
Rumex obtusifolius				1		I	(1)
Bryum caespiticium agg.		1				I	(1)
Senecio jacobaea					1	I	(1)
Poa pratensis agg.			1			I	(1)
Artemisia vulgaris					1	I	(1)
Papaver rhoeas					1	I	(1)
Hordeum murinum				1		I	(1)
Sisymbrium officinale				1		I	(1)
Sward height (cm)	7	8	11	12	11		
% Vascular plant cover	90	95	85	90	90		
% Bryophyte cover	0	+	+	0	1		
% Plant litter	1	2	0	1	1		
% Bare ground	10	5	15	10	10		
Activity º	MR	MS	MS	M	MS		
No. of species	14	14	16	14	16	Av.	14.8

º M = Mole; R = Rabbit, S = Sheep; L = Lodged

Table F2 Stand B

NVC: **MG7d *Lolium perenne* leys & related grasslands, *Lolium perenne-Alopecurus pratensis* grassland**
Alliance: ***Lolio-Plantaginion***
Order: ***Arrhenatheretalia***

Plot		6	7	8	19	20	23	26	29		
Holcus lanatus		7	9	9	5	6	6	6	8	V	(5-9)
Lolium perenne		4	5	4	8	7	7	4	4	V	(4-8)
Agrostis stolonifera		1	1	6	6	8	8	9	8	V	(1-9)
Cirsium arvense		3	3	1	2	2		3	3	V	(1-3)
Ranunculus repens		2	2	2	3	2	2			IV	(2-3)
Phleum pratense		2		2		2	2	2	1	IV	(1-2)
Cerastium fontanum		1	2	2		1	1			IV	(1-2)
Alopecurus pratensis		2	2	1					1	III	(1-2)
Festuca rubra		9	6	4						II	(4-9)
Urtica dioica				1			1		2	II	(1-2)
Dactylis glomerata		1	1						1	II	(1)
Rumex obtusifolius						1	1	1		II	(1)
Geranium dissectum		1	1				1			II	(1)
Juncus effusus		1		1						II	(1)
Carex hirta			1	1						II	(1)
Trifolium repens					2					I	(2)
Poa trivialis									1	I	(1)
Arrhenatherum elatius									1	I	(1)
Rumex crispus				1						I	(1)
Ranunculus acris			1							I	(1)
Trifolium pratense					1					I	(1)
Stellaria graminea				1						I	(1)
Taraxacum sp.			1							I	(1)
Bromus hordeaceus hordeaceus									1	I	(1)
Geranium molle				1						I	(1)
Veronica chamaedrys			1							I	(1)
Bryum caespiticium agg.			1							I	(1)
X *Festulolium loliaceum*				1						I	(1)
Syntrichia ruralis			1							I	(1)
Juncus bufonius			1							I	(1)
Anagallis arvensis		1								I	(1)
Sward height (cm)		16	12	13	13	15	26	14	13		
% Vascular plant cover		98	98	98	100	100	100	99	100		
% Plant litter		0	0	1	1	1	0	1	0		
% Bryophyte cover		0	+	0	0	0	0	0	0		
% Bare ground		2	2	1	0	0	0	1	0		
Activity º		-	M	MS	S	-	S	S	S		
No. of species		13	17	16	7	8	9	6	11	Av.	10.9

º M = Mole; R = Rabbit, S = Sheep; L = Lodged

Table F3 Stand C1

MG10b ***Holco-Juncetum effusi*** **Page 1980, *Juncus inflexus* sub-community**
Alliance: ***Calthion***
Order: ***Molinietalia***

Plot		**9**	**10**	**16**	**18**	**21**	**24**	**27**	**30**		
Agrostis stolonifera		8	9	8	8	8	9	7	8	V	(7-9)
Holcus lanatus		8	8	5	6	6	4	6	8	V	(4-8)
Lolium perenne		4	2	2	3	7	5	4	4	V	(2-7)
Ranunculus repens		2	2	2	3	3	3	2	2	V	(2-3)
Juncus effusus		4	4	7	5		2	1	4	V	(1-7)
Trifolium repens		1	3	2	2		3	3	2	V	(1-3)
Juncus inflexus				1	5	5	2	7	1	IV	(1-7)
Juncus articulatus			1	4	2		2	4	1	IV	(1-4)
Cerastium fontanum			1			2	2	2	1	IV	(1-2)
Deschampsia cespitosa			4	5	4					II	(4-5)
Cirsium arvense			1		2	3				II	(1-3)
Trifolium pratense		1		1				2		II	(1-2)
Ranunculus acris		1						1	1	II	(1)
Festuca rubra		2	1							II	(1-2)
Alopecurus pratensis		1	1							II	(1)
Rumex acetosa						1	1			II	(1)
Cardamine pratensis				1				1		II	(1)
Alopecurus geniculatus		1							1	II	(1)
Phleum pratense			1						1	II	(1)
Anthoxanthum odoratum		2								I	(2)
Lotus pedunculatus							2			I	(2)
Rumex crispus			1							I	(1)
Equisetum palustre			1							I	(1)
Carex disticha							1			I	(1)
Taraxacum sp.						1				I	(1)
Quercus robur seedling		1								I	(1)
Cirsium palustre								1		I	(1)
Sward height (cm)		18	22	50	52	16	17	56	14		
% Vascular plant cover		100	100	100	100	100	100	100	100		
% Plant litter		0	0	10	5	0	1	1	1		
% Bryophyte cover		0	0	0	0	0	0	0	0		
% Bare ground		0	0	0	0	0	0	0	0		
Activity º		-	S	L	-	-	S	SL	SL		
No. of species		13	15	11	10	9	12	13	12	Av.	11.9

º M = Mole; R = Rabbit, S = Sheep; L = Lodged

Table F4 Stand C2

NVC: **MG10b *Holco-Juncetum effusi* Page 1980, *Juncus inflexus* sub-community**
Alliance: ***Calthion***
Order: ***Molinietalia***

Plot		11	12	13	14	15	17	22	25	28	31			
Juncus articulatus		7	8	7	8	9	9	5	5	8	9		V	(5-9)
Holcus lanatus		7	7	7	7	4	5	8	8	5	6		V	(4-8)
Agrostis stolonifera		7	6	7	5	5	6	8	8	7	4		V	(4-8)
Ranunculus repens		3	3	2	2	2	3	3	2	2	2		V	(2-3)
Lolium perenne		4	3	4	3	2	1	3	3	3	3		V	(1-4)
Festuca rubra		5	4	4	4	2	2	4	2	3			V	(2-5)
Juncus inflexus		6	5	4	2	2	1	4	4	6			V	(1-6)
Trifolium repens		3	2	3	2		1	2	3	2	1		V	(1-3)
Cerastium fontanum		1	1	1	3		1	2	2	3	2		V	(1-3)
Ranunculus acris			1		1	2		1	2	2	1		IV	(1-2)
Juncus effusus			1	1			2	5	1				III	(1-5)
Anthoxanthum odoratum		1	4	2	1	1							III	(1-4)
Lotus pedunculatus		1						1		3	1		II	(1-3)
Poa trivialis			2	1							2		II	(1-2)
Alopecurus pratensis					1	1	1						II	(1)
Rumex acetosa						1			1		1		II	(1)
Trifolium pratense								2		2			I	(2)
Oxyrrhynchium hians		2									1		I	(1-2)
Cardamine pratensis						1	1						I	(1)
Equisetum palustre						1		1					I	(1)
Stellaria graminea					1		1						I	(1)
Deschampsia cespitosa							4						I	(4)
Carex riparia							2						I	(2)
Alopecurus geniculatus									2				I	(2)
Carex disticha			2										I	(2)
Lathyrus pratensis				2									I	(2)
Phleum pratense						1							I	(1)
Taraxacum sp.											1		I	(1)
Carex hirta									1				I	(1)
Rhytidiadelphus squarrosus		1											I	(1)
Cirsium arvense					1								I	(1)
Sward height (cm)		72	67	57	58	47	35	29	16	36	17			
% Vascular plant cover		100	100	100	99	100	100	100	100	100	100			
% Plant litter		1	1	1	1	1	0	0	0	0	1			
% Bryophyte cover		+	0	0	0	0	0	0	0	0	+			
% Bare ground		0	0	0	1	0	0	0	0	0	0			
Activity º		-	-	-	M	-	L	S	S	SL	SL			
No. of species		13	14	13	14	14	15	14	14	12	13		Av.	13.6

º M = Mole; R = Rabbit, S = Sheep; L = Lodged

Table F5 Stand D

NVC: **OV26e *Epilobium hirsutum* community, *Urtica dioica-Cirsium arvense* sub-community**
Alliance: ***Convolvulion***
Order: ***Convolvuletalia***

		32	**33**	**34**	**35**	**36**		
Urtica dioica		7	5	9	7	8	V	(5-9)
Epilobium hirsutum		7	8	5	7	4	V	(4-8)
Cirsium arvense		5	3	2	2	2	V	(2-5)
Galium aparine		2	1	1	2	5	V	(1-5)
Poa trivialis		1	2	1	2	3	V	(1-3)
Conium maculatum		1	4		1	4	IV	(1-4)
Arrhenatherum elatius		1	2	1	3		IV	(1-3)
Carex riparia		4	4				II	(4)
Deschampsia cespitosa					4		I	(4)
Calystegia sepium						4	I	(4)
Juncus effusus			1				I	(1)
Rumex crispus		1					I	(1)
Arctium minus agg				1			I	(1)
Sward height (cm)		110	160	115	120	165		
% Vascular plant cover		100	100	100	100	100		
% Plant litter		20	15	20	20	25		
% Bryophyte cover		0	0	0	0	0		
% Bare ground		0	0	0	0	0		
Activity		-	-	-	-	-		
No. of species		9	9	7	8	7	Av.	8.0

º M = Mole; R = Rabbit, S = Sheep; L = Lodged

Appendix G
Aquatic invertebrate site data and taxa recorded

PHYSICAL AND CHEMICAL PARAMETERS RECORDED FROM HALESWORTH, SUFFOLK: 16th JULY 2020								
	1	2	3	4	5	6	7	8
GRID REFERENCE SUFFIX	TM	TM	TM	TM	TM	TM	TM	TM
GRID REFERENCE EASTINGS	39120	39040	39188	39133	39056	39003	38966	39191
GRID REFERENCE NORTHINGS	76681	76630	76667	76581	76585	76568	76547	76584
WATER DEPTH	10	11	10	17	24	7	7	>50
WETTED WIDTH	150	150	200	100	150	50	50	600
FLOW	0	0	0	1	0	0	0	0
EMERGENT COVER (%)	100	90	40	10	95	95	95	95
LEMNA COVER (%)	40	90	0	0	75	5	0	0
PH	7.1	7.3	7.3	7	7.3	7.5	7.4	7.6
TURBIDITY	80	300	NotRecorded	100	23	30	NotRecorded	9
SHADE (%)	1	3	40	5	3	30	30	12
SUBSTRATE DEPTH	72	83	94	27	80	57	63	NotRecorded
FLOW: 0 = No flow, 1 = very little flow								

AQUATIC INVERTEBRATES RECORDED FROM HALESWORTH, SUFFOLK: 16th JULY 2020										
		Site	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Species	**Stage**	**Cons.Status Score**								
Planaria	Adults			1				1	1	
Dugesia lugubris?	Adult						1			
Oligochaeta	Various		54	64	1	510	4	2	4	12
Glossiphonia complanata	Juveniles	1								2
Helobdella stagnalis	Juveniles	1					3			
Acroloxus lacustris	Various	1					3	7		
Bathyomphalus contortus	Adults	2	1		10					
Bithynia tentaculata	Various	1	2	1			28	22		1
Hippeutis complanata	Adults	2		9			62	12		
Physa fontinalis	Various	1								3
Physella sp	Various					32				
Planorbis carinatus	Adults	1					2	4	2	
Planorbis sp	Juveniles		1				4	45		
Potamopyrgus antipodarum	Various					37				2
Radix balthica	Various	1	1	15			53	39		1
Stagnicola sp	Various	1	11	1	4	2	24	81	16	3
Valvata cristata	Adults	2	6	8	2		10	53		
Pisidium sp	Various	1	16	13		6		4		6
Sphaerium corneum	Various	1	7				1	3		54
Hydrachnellae	Adults								1	
Asellus aquaticus	Adults	1	15	160	28			8	13	8
Asellus sp	Juveniles		10		4		1		1	
Crangonyx pseudogracilis	Various		21	184	4		4	33	42	
Gammarus pulex	Various	1								10
Copepoda	Adults		1					2		
Ostracoda	Adults		3							
Simocephalus vetulus	Adults							4		
Pyrrhosoma nymphula	Nymphs	1					5			2
Aesnidae	Early instar						1			
Libellula sp	Early instar	1				1				
Sympetrum striolatum	Mature nymph	1					1			
Sympetrum sp	Nymph						1			
Limnephilus lunatus	Larvae	1					1	1		8
Limnephilidae	Larvae		4				1			
Corixidae	Nymph						1			
Nepa cinerea	Various	1	1	2					1	
Cataclysta lemnata	Larvae						5			
Dytiscini	Larvae		3					2		
Agabus bipustulatus	Adults	1		1						
Agabus sturmii	Adults	1			1					
Hydroporus angustatus	Adults	1		1				2		
Hydroporus palustris	Adults	1			2			1		
Hydroporus planus	Adults	1		1						
Ilybius ater	Adults	1	1					1	2	
Ilybius quadriguttatus	Adults	2						1		
Hydrophilidae	Larvae		1		2			2	3	
Anacaena limbata	Adults	1	1	1	1		1	8	3	
Enochrus sp	Incomplete adult						1			
Helophorus brevipalpis	Adults	1					1	6	1	
Hydrobius subrotundatus	Adults	1		3		1		2		
Laccobius bipunctatus	Adults	1		4			1			
Sphaeridium bipustulatum	Adults							1		
Scirtes hemisphaericus	Adults			2			2	5	6	
Scirtidae	Larvae			1			3	13		
Pilaria sp	Larvae		2							
Ptychoptera sp	Larvae	1						1		
Ceratopogonidae	Pupae					1				
Chironomini	Larvae		10		4	1		3	1	
Chironomus sp	Pupae					1				
Metriocnemus sp	Larvae					3				
Orthocladiinae	Larvae		2			3				
Psectrotanypus varius	Pupae					21				
Tanypodinae	Larvae		11			161	6	3	1	6
Tanytarsini	Larvae		5					1	1	
Chironomidae	Larvae				2					
Culex pipiens/torrentium	Larvae	1						1		
Culiseta annulata/subochrea	Larvae	1			232			252		
Culicidae	Larvae			2						
Culicidae	Pupae				4					
Dixella attica/autumnalis	Larvae	2			1				4	
Dixella autumnalis	Larvae	2					6			
Dixella serotina	Larvae				1					
Dixidae	Pupae				1					
Psychodidae	Larvae		2		2			6	1	1
Oxycera nigricornis	Larvae	2					1	1	1	
Stratiomys singularior?	**Larva**	**3**							**1**	
Tabanidae	Larvae	1					1	6	1	
Scatella sp	Larva			1						

VERTEBRATES										
Pungitius pungitius	Adults		1		4				4	
Lissotriton sp	Adults						1			
TERRESTRIAL INVERTEBRATES OR TERRESTRIAL LIFE-STAGES										
Succinea putris	Various		9	5	1		13	6	6	
Succineidae	Juveniles									6
Conocephalus dorsalis	Adults					1	1			
Eriophyes axillare	Galls						1			
Cicadella viridis	Adults						1	1	7	
Ischnodemus sabuleti	Various					1				
Drepana falcataria	Adult							1		
Ellipteroides lateralis	Adult male								1	
Erioptera flavata	Adults		3					3	2	
Helius flavus	Adults								1	
Ptychoptera minuta	Adult male				1					
Dixella autumnalis?	Adult						1			
Dixella serotina	Adult							1		
Eristalini	Larvae				2					
Agromyza alnivora	Larvae						1			
Phyllonorytor stettinensis	Larvae								1	
Pachygaster leachii	Adults				3					
Hercostomus aerosus	Adult male						1			
Camarota curvipennis	Adult								1	
Notiphila riparia	Adults		1				7			

Appendix H
Ecology and distribution of notable invertebrate species

DIPTERA (TRUE-FLIES)

Stratiomys singularior? Stratiomyidae Status: Least Concern

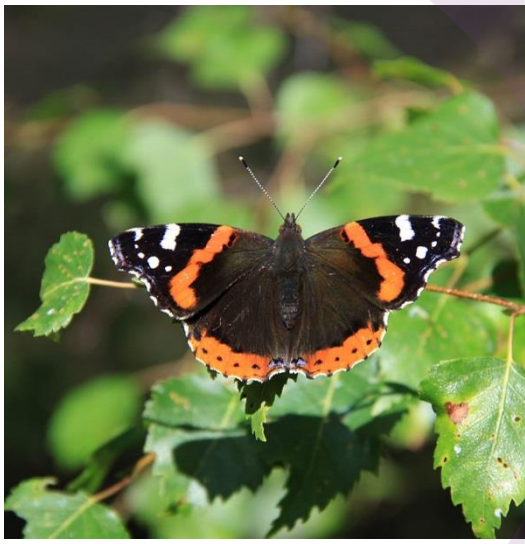
In Britain this soldierfly is found mainly on brackish coastal marshes where it occurs along ditches with such plants as sea club-rush, although it is not so strongly restricted on the continent or in Ireland. Its coastal distribution is southern, extending northward to the Humber and South Wales. Where it breeds persistently inland, there is usually a brackish influence as at Peterborough Brick Pits where there are very slightly brackish pools. Similarly, parts of the Norfolk Broads are mildly brackish because the main rivers are tidal and occasionally flood. The larvae can be frequent in ditches and ponds where they live in the shallow water at the margins and amongst dense floating vegetation. They have also been found crawling about out of the water on blanket-weed and mud beside shallow brackish lagoons and brackish ditches on grazing marshes.

APPENDIX C: PAKENHAM SITE 54 ECOLOGY BASELINE REPORT

EDF Energy

Sizewell C

Fen Meadow Compensation Sites: Pakenham Site 54 Baseline Ecology Report



Wood Group UK Limited – June 2021

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Document revisions

No.	Details	Date
1	Report of Work undertaken to date	10/06/21

Contents

1. Introduction

1.1 Background

The proposed development platform for Sizewell C will extend a short distance into the eastern margins of Sizewell Marshes Site of Special Scientific Interest. The toe of the batter of the proposed platform will define the extent of permanent land-take but, additional to that, ditch re-alignment is required which will take a limited amount of further land.

Based on National Vegetation Classification (NVC) survey data the main affected habitats are M22 *Juncus subnodulosus – Cirsium palustre* fen meadow, S26 *Phragmites australis - Urtica dioica* tall-herb fen, S4 *Phragmites australis* reedbed and some W5 *Alnus glutinosa – Carex paniculata* wet woodland.

Studies focussed on the provision of compensatory fen meadow habitat, particularly M22 *Juncus subnodulosus – Cirsium palustre* fen meadow, were reported in Wood (2018). Five sites were identified for further investigation, whilst 17 sites were put on hold subject to further assessment of the initial five sites. The five sites identified for further investigation (Wood (2018)) were:

- Site No. 10 – Aldecar Lane, Benhall;
- Site No. 11 – Watering Lane, Benhall;
- Site No. 28 – Halesworth;
- Site No. 33 – Stratford St Andrew; and
- Site No. 54 – Pakenham Fen.

Subsequently, one day site visits to Sites 10, 11, 28 and 54 were undertaken in April and May 2019. Site 33 was not visited as access had not been agreed at the time (Wood, 2019), however, following further consideration of the site characteristics and suitability for fen meadow creation, it was also concluded that the sites that were taken forward all provide greater potential for fen meadow creation than Site 33.

The one day site visits to Sites 10, 11, 28 and 54 comprised:

- A walkabout survey to identify areas where (1) the peat is currently influenced by groundwater or near-surface seepage; and (2) fen meadow species are present within or close to the site margins;
- A reconnaissance hand augering survey to identify general peat quality (substrate condition), sub-surface geological materials, presence of water table and areas of upwelling groundwater; and
- Consideration of broad options for water management and potential for changes to land management.

Findings were reported in Wood (2019). Sites 10, 28 and 54 were all identified as having potential for the development of fen meadow as follows:

- Site 10: primary locus 1.5ha, further area 0.7ha (Site 11 has relatively limited potential (primary locus of 0.5ha although part already supports fen meadow species, and further area of 1.2ha) but is close to Site 10, so warrants further consideration in that context);
- Site 28: primary locus 1.2ha, further area 1.3ha;
- Site 54 north: primary locus 3.2ha, further area 6.2ha; and

- Site 54 south: primary locus 1.7ha, further area: 4.3ha.

Subsequently EDF has progressed with detailed site conceptualisation and feasibility assessment work at Sites 10/11, 28 and 54.

The scope of the conceptualisation and feasibility assessment work can be summarised as follows:

- Ecological studies:
  - Desk based review of ecological data for the sites and surrounding area; and
  - Targeted ecological surveys.
- Hydrological studies:
  - Desk based review of available groundwater level data (including output from the Environment Agency model for high, low and average groundwater level conditions) and the seasonal variation in groundwater levels. Also, effects of groundwater abstraction on groundwater levels below the site;
  - Collection of topographic data;
  - Collection of surface water level and groundwater level data to determine the relationship between groundwater and surface water levels on site. Also detailed study of the existing and wider ditch network to determine potential for water management without risk to upstream receptors; and
  - Collection of hydrochemical data.

1.2 This report

The scope of the studies undertaken were defined following consideration of:

- The habitat types present on site defined from the one-day visit undertaken in the previous project phase;
- The types of ecological receptor that would be expected to occur in such habitats in Suffolk, based on professional judgement; and
- The potential activities and related impacts of creating fen meadow habitat, principally through raising water levels, on such sites.

The studies proposed comprise:

- A desk study;
- An extended Phase 1 habitat survey;
- A National Vegetation Classification (NVC) survey;
- A survey for signs of otter and water vole; and
- A survey of aquatic invertebrates of the ditches.

The desk study and extended Phase 1 habitat survey have been completed to date and are reported in this ecological baseline for Site 54 Pakenham (hereafter the 'Pakenham site' or 'the Site') (Figure 1.1). The results of the other studies will be reported when complete.

In this report, where possible, common species names are used in the text, though scientific names may also be used for clarity, particularly in naming the published community-types and in instances when the given

common names are not widely used. Common and scientific names of species referred to in this report are presented in Appendix A.

The structure of this report is as follows:

- Section 2 presents the methods and results of a desk study;
- Section 3 presents the methods and results of an extended Phase 1 habitat survey;

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jon.squire

591000 592000 593000 594000 595000 596000

271000 270000 269000 268000 267000 266000

Farmhouse
Chalet Bungalow
Heath Farm
Ixworth
A143
Woodstreet Farm
The Black Bourn
Stowlane
Kiln Farm
Mill Farm
Queach House
The Plains
Grimstone End
Lime Kiln Cottages
Old Hall Farm
A1088
Highfields Farm
Highfield Farm Cottages
Bridge Farm
Parkfield Cottage
Stowlangtoft
Beaumont House
Kartin House
Upper Town
Pakenham
Beaumont's Hall
Ixworth Road
Mere Farm
Bartonmere House
The Lodge
Nether Hall
Bella Vista House
Millfields Cottage
Grange Farm
Little Haugh Hall
Stanton Street
The Bungalow
The Old Rectory
Pakenham Stream
Pakenham
Great Green

Key

Site 54 boundary

River

0 250 500 750 1,000 m

Scale at A3: 1:20,000

Fen Meadow Compensation Sites
Pakenham Site 54
Baseline Ecology report

Figure 1.1
Site location plan

June 2021

wood.

2. Desk study

2.1 Method

A data-gathering exercise was undertaken in April 2021 to obtain information relating to statutory and non-statutory biodiversity sites (excluding sites designated for geological features of interest); species or habitats of principal importance for the conservation of biodiversity; legally protected and controlled species; and other conservation-notable habitats or species (see Boxes 2.1 and 2.2).

Box 2.1 – Designated Biodiversity Sites, and Priority Habitats and Species

Statutory Biodiversity Sites

- European sites: Important biodiversity sites designated under international law or treaties. European sites are any Special Area of Conservation (SAC) from the point at which the European Commission and the UK Government agree the site as a 'Site of Community Importance' (SCI); any classified Special Protection Area (SPA); any candidate SAC (cSAC); and (exceptionally) any other site or area that the Commission believes should be considered as an SAC but which has not been identified by the Government. This term is also commonly used when referring to potential SPAs (pSPAs), to which the provisions of Article 4(4) of Directive 2009/147/EC (the 'new wild birds directive') apply; and to possible SACs (pSACs) and listed Ramsar sites, to which the provisions of *The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019* (the Habitats Regulations) are applied as a matter of Government policy (NPPF para 118) when considering development proposals that may affect them;
- Sites of Special Scientific Interest (SSSIs): Nationally important sites notified under the *Wildlife and Countryside Act 1981* (as amended) that provide the best examples of the UK's flora, fauna, or geological or physiographical features (note, this assessment focuses on those sites notified for their biodiversity interest);
- National Nature Reserves (NNRs): Nationally important sites notified under the *National Parks and Access to the Countryside Act 1949* and the *Wildlife and Countryside Act 1981*; in practice most NNRs are SSSIs also; and
- Local Nature Reserves (LNRs): statutory sites that are designated under the *National Parks and Access to the Countryside Act 1949* with the objective of encouraging their use for the study, research or enjoyment of nature. If an LNR has no other statutory or non-statutory designation it is treated as being of borough/district-level importance for biodiversity (although it may be of greater socio-economic value).

Non-statutory Biodiversity Sites

Non-statutory biodiversity sites in Suffolk are known as County Wildlife Sites (CWS) or Potential CWS (pCWS) or Candidate Local Wildlife Sites (cLWS).

Other important habitats or species

Species or habitats of "*principal importance for the conservation of biodiversity*" are those listed by Natural England (NE) pursuant to Section 41 of the *Natural Environment and Rural Communities Act 2006* (as amended). These include those UK Biodiversity Action Plan (UK BAP) priority habitats and species that occur in England. They are commonly referred to as 'Section 41' or 'S.41' habitats or species.

Other conservation-notable habitats and species would include:

- Species listed as being of conservation concern in the relevant UK Red Data Book (RDB) or the Birds of Conservation Concern 4 Red List (Eaton *et al.* 2015);
- Ancient woodland (i.e. areas that have been under continuous woodland cover since at least 1600) on the Ancient Woodland Inventory (AWI);
- Nationally Rare and Nationally Scarce species in the UK, which are species recorded from, respectively, 1-15 and 16-100 hectads (10x10km squares of the UK national grid);
- Populations of birds comprising at least 1% of the relevant British breeding/wintering population (where data are available).
- Priority habitats and species listed in the Suffolk Biodiversity Action Plan (LBAP);
- Other species or assemblages such as large populations of animals considered uncommon or threatened in a wider context; and
- Important hedgerows as defined using the habitat criteria in *The Hedgerows Regulations 1997*.

Box 2.2 – Legally Protected and Controlled Species

Legal Protection

Many species of animal and plant receive some degree of legal protection. For the purposes of this report, legal protection refers to:

- Species included on Schedules 5 and 8 of the *Wildlife and Countryside Act 1981* (as amended), excluding species that are only protected in relation to their sale (see section 9[5] and 13[2]);
- Species included on Schedules 2 and 5 of *The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019*; and
- Badgers, which are protected under the *Protection of Badgers Act 1992*.

Further detail on the legislative protection afforded to species and sites is provided in Appendix B.

Legal Control

Schedule 9 of the *Wildlife and Countryside Act 1981* (as amended) lists species of animal that it is an offence to release or allow to escape into the wild (for example grey squirrel) and species of plant that it is an offence to plant or otherwise cause to grow in the wild (for example, Japanese knotweed).

Data were obtained for:

- Statutory designated sites within 2km of the Site boundary;
- Other statutory and non-statutory sites designated for their nature conservation interest within 1km;
- Habitats of principal importance for the conservation of biodiversity, or other conservation-notable habitats recorded within 1km; and
- Protected species, species of principal importance for the conservation of biodiversity, or other conservation-notable species recorded within 1km.

The geographical context of the Site was examined using the relevant Ordnance Survey 1:10,000 scale maps and freely-available aerial photographs, to identify key landscape features that may be important for protected or conservation-notable species, such as potential migration or dispersal routes, or any potential receptors of site-derived pollutants in the wider landscape.

The sources of desk study information were:

- MAGIC (the government environmental information partnership project) www.magic.gov.uk;
- Natural England (https://designatedsites.naturalengland.org.uk/);
- Joint Nature Conservation Committee (JNCC, http://jncc.defra.gov.uk/page-4); and
- Suffolk Biodiversity Information Service (https://www.suffolkbis.org.uk/biodiversity/speciesandhabitats).

2.2 Results

Designated Sites

There are no statutory designated sites present on Site but there is one statutory site within 2km. This is Pakenham Meadows SSSI which is located immediately to the east of the site, across the Pakenham Stream.

There are no non-statutory designated sites on-site but there are four non-statutory designated County Wildlife Sites within 1km.

The interest features of these sites are summarised in **Error! Reference source not found.** and the site l ocations are shown in Figures 2.1 and 2.2.

Table 2.1 Designated Sites and proximity to Pakenham Site 54

Designation	Distance from Site Boundary	Description
Statutory Designated Sites within 2km		
Pakenham Meadows SSSI	Immediately to the east.	The SSSI citation indicates that the meadow is unusually species rich, unimproved and poorly drained, and forms one of the best examples of its kind in the county. The small-scale complex mosaic of vegetation types present reflects the variation in soils from loam to peat. The meadow is also herb rich and contains a number of uncommon species, and the dykes provide a valuable additional habitat for invertebrates.
Non-Statutory Designated Sites within 1km		
Micklemere CWS	0.40 km north of the Site.	The CWS site consists of 10 riverside meadows, that lie underwater for much of the year. A sluice in the north west corner of the site is the only outlet but the river itself backs up into the ditches and floods the meadows. This constant flooding has created a large area of bare ground which when wet attracts large numbers of wetland birds. The remainder of the land, which does not flood, is rank grassland, which has been ungrazed for several years. The site supports good numbers of wetland birds throughout the year. Plant species at Micklemere are unexceptional.
Pakenham Fen Meadows CWS	0.10km south east of the Site.	The Site is divided into small fields, some of which have not been agriculturally improved and retain a diverse fen meadow flora, which is a Priority habitat. These areas support a good range of wetland plants and a number of uncommon Suffolk plants. The site also provides habitat opportunities for other wildlife, such as invertebrates.
Pakenham Wood CWS	0.60km south east of the Site.	The Site was at one time a Site of Special Scientific Interest (SSSI). However, in recent years much of the wood has been clear-felled and replanted with Corsican pine and larch affecting the wildlife value of the wood. Remnants of the rich woodland flora are confined to the wide woodland rides, which cross the wood.
Roadside Nature Reserve 133	0.65km north west of the Site.	Seeded in 1986 with meadow flowers and grasses.

Note: The site forms part of Nitrate Vulnerable Zones 2017 designations and SSSI Impact Risk Zones.

Priority Habitats

MAGIC indicates that four priority habitats are located within 1km of the Site, with three priority habitats identified as being present on-site (the nearest distance provided for each priority habitat):

- Coastal and floodplain grazing marsh (on Site);
- Deciduous woodland (on Site);
- Lowland meadows (immediately to the east); and
- Woodpasture and parkland (0.5km south).

Species Records

A summary of the key species records within 1km of the Site are presented in Table 2.2.

Table 2.2 Protected and conservation notable species within 1km[1] of Pakenham Site 54

Common Name	Distance of Record from Site (nearest)	Protection		Other Conservation Criteria (as identified on SBIS records)
		HR	WCA	
Mammals				
Brown Hare	0.2km north-west			✓ (S41)
Bat – brown long-eared	0.5km north-east	✓	✓	✓ (S41)
Bat – Pipistrelle	0.5km north-east	✓	✓	
Harvest Mouse	0.2km east			✓ (RL and S41)
Hedgehog	0.1km west			✓ (RL and S41)
Otter	0.4km east	✓	✓	✓ (RL and S41)
Water Vole	0.1km north-east		✓	✓ (RL and S41)
Birds				
Avocet +	0.4km north-east		✓*	✓ (RL)
Barn Owl	0.3km east		✓*	
Bewick's Swan +	0.4km north-east		✓*	
Black-tailed godwit	0.2km east			✓ (RL)
Black Tern +	0.4km north-east		✓*	
Black-winged Stilt	0.4km north-east		✓*	
Brambling +	0.1km south-east		✓*	
Bullfinch	0.1km south-east			✓ (S41)
Cuckoo	0.1km south-east			✓ (RL and S41)
Curlew	0.1km south-east			✓ (RL and S41)
Fieldfare +	0.5km south-west		✓*	✓ (RL)
Grasshopper Warbler	0.4km north-east			✓ (RL, S41)
Green Sandpiper +	0.4km north-east		✓*	
Greenshank +	0.4km north-east		✓*	
Grey Partridge	0.4km north-east			✓ (RL, S41)
Grey Wagtail	0.4km north-east			✓ (RL)
Hobby	0.1km south-east		✓*	

[1] Due to the differing levels of accuracy of location data provided (e.g. 2, 4, 6 and 10 figure grid references) and differences in location indicated by national grid reference relative to latitude and longitude, where necessary some interpretation of the likely location has been applied by additional reference to site name used.

Common Name	Distance of Record from Site (nearest)	Protection		Other Conservation Criteria (as identified on SBIS records)
		HR	WCA	
House Sparrow	On site (albeit only 4 figure grid reference provided)			✓ (RL, S41)
Kingfisher	0.3km east		✓*	
Lapwing	0.4km north-east			✓ (RL, S41)
Lesser Redpoll	0.4km north-east			✓ (RL, S41)
Linnet	0.4km north-east			✓ (RL S41)
Little Gull +	0.4km north-east		✓*	
Little Ringed Plover	0.4km north-east		✓*	
Marsh Harrier	0.1km south-east		✓*	
Marsh Tit	0.1km south-east			✓ (RL, S41)
Mediterranean Gull	0.4km north-east		✓*	
Merlin +	0.4km north-east		✓*	✓ (RL)
Mistle Thrush	0.4km north-east			✓ (RL)
Nightingale	0.4km north-east			✓ (RL)
Osprey +	0.4km north-east		✓*	
Peregrine	0.4km north-east		✓*	
Pintail	0.4km north-east		✓*	
Pochard	0.4km north-east			✓ (RL)
Red Kite	0.4km north-east		✓*	
Red-necked Phalarope +	0.4km north-east		✓*	✓ (RL)
Reed bunting	0.1km south-east			✓ (S41)
Redwing +	0.4km north-east		✓*	✓ (RL)
Ringed Plover	0.5km north-west			✓ (RL)
Ruff	0.4km north-east		✓*	✓ (RL)
Scaup +	0.4km north-east		✓*	✓ (RL, S41)
Skylark	0.1km south-east			✓ (RL and S41)
Song Thrush	0.5km south-west			✓ (RL)
Spotted Flycatcher	0.4km north-east			✓ (RL, S41)
Starling	0.4km north-east			✓ (RL S41)

Common Name	Distance of Record from Site (nearest)	Protection		Other Conservation Criteria (as identified on SBIS records)
		HR	WCA	
Temminck's Stint +	0.4km north-east		✓*	
Tree sparrow	0.3km south-west			✓ (RL, S41)
Turtle Dove	0.5km south-west			✓ (RL, S41)
Whimbrel	0.4km north-east		✓*	✓ (RL)
Whinchat	0.4km north-east			✓ (RL)
White-fronted Goose	0.4km north-east			✓ (RL)
White-tailed Eagle +	0.4km north-east		✓*	✓ (RL)
Woodcock	1km east			✓ (RL)
Woodlark	0.4km north-east		✓*	✓ (S41)
Wood Sandpiper +	0.4km north-east		✓*	
Yellow Wagtail	0.1km south-east			✓ (RL, S41)
Yellowhammer	0.1km south-east			✓ (RL, S41)
Herpetofauna				
Common Toad	0.3km north-east			✓(S41)
Great Crested Newt	0.3km west	✓	✓	✓ (S41)
Invertebrates				
Anaglyptus mysticus	0.6km south-west			✓ (NS)
Adonis ladybird	0.4km south-west			✓ (NS)
Cinnabar	0.5km north-west			✓ (S41)
Ptinus sexpunctatus	0.4km south-west			✓ (NS)
Red-tailed Mason Bee	0.5km north-west			✓ (NS)
Small heath	0.9km south			✓ (S41)
White admiral	0.7km south-east			✓ (RL, S41)
White-letter Hairstreak	0.1km north-east			✓ (RL, S41)
Vascular plants				
Dwarf spurge	0.8km south-east			✓ (RL)
Cornflower	1km north-east			✓ (S41)

* Schedule 1 (*Wildlife and Countryside Act 1981*)
+ Schedule 1 of the Wildlife and Countryside Act 1981 (as amended) affords additional protection to species during the breeding period in particular providing protection at nest sites. The species highlighted with a + are species which occur as wintering and passage

migrants but have not been identified as a breeding species within the search area and are considered unlikely to occur as a breeding species.
The other principle protective legislation and conservation designations for individuals of a species in England are:
WCA – *Wildlife and Countryside Act 1981* (as amended)
HR – *The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019*
ER – *The Eels (England and Wales) Regulations 2009*
S41 – Section 41 species; see Box 2.1
RL – Red list species; see Box 2.1
NR – Nationally Rare; See Box 2.1
NS – Nationally Scarce; See Box 2.1

There is also a record of ash, classed as Ancient Veteran Trees, north-west of the Site at NGR TL93116868.

Non-native Species / Notifiable Weeds

There were no records for species listed in Schedule 9 of the *Wildlife and Countryside Act 1981* (as amended) found on-site. However, the following Schedule 9 species were found within 1km (with the nearest record to Site):

- American mink 0.1km east;
- Bar-headed goose 0.6km north-east;
- Barnacle goose 0.3km south-west (nearest);
- Canada goose 0.3km south-west (nearest);
- Canadian waterweed 1km north-east;
- Chinese muntjac 0.7km north-east;
- Egyptian goose 0.3km south-west (nearest);
- Grey squirrel 0.7km south (nearest);
- Nuttall's waterweed 0.3km north-east;
- Ruddy duck 0.7km north-east (nearest);
- Ruddy shelduck 0.6km north-east (nearest)
- Snow goose 0.3km north-east (nearest); and
- White-tailed eagle 0.1km west (although record suggests Micklemere which is 0.4km north-east at its nearest). .

Water bodies

Twenty seven water bodies have been identified from ordnance survey mapping within 500m of the Site boundary, including a single waterbody on site in woodland at the southern end. These are shown on Figure 2.3 and listed in Table 2.3. The Site also contains a network of drains that are not specifically listed in the table.

Pakenham Stream forms the eastern site boundary, with a network of drains present on-site and within the wider area. Great crested newts are not typically found in rivers, and the wettest drains on site are likely to support fish, which would make them sub-optimal for great crested newts.

However, the on site pond, and those located to the west of the Site are not separated by a barrier to great crested newt migration.

Table 2.3 Water bodies within 500m of Pakenham Site 54

Water body	NGR	Distance and direction from Site	Description
W1	TL 9338 6956	279m north	Large waterbody, may contain fish.
W2	TL 9373 6959	479m north	Waterbody likely to be connected to drainage network and may contain fish.
W3	TL 9369 8315	425m north-east	Pond
W4	TL 9369 7414	350m north-east	Pond.
W5	TL 9369 6714	290m north-east	Pond
W6	TL 9369 6107	195m north-east	Large waterbody may contain fish.
W7	TL 9369 6904	268m north-east	Large waterbody may contain fish.
W8	TL 9368 4675	52m east	Waterbody likely to be connected to drainage network and may contain fish.
W9	TL 9368 5553	8m east	Pond
W10	TL 9368 6423	283m east	Pond
W11	TL 9368 6112	299m east	Large waterbody may contain fish.
W12	TL 9368 7707	478m east	Pond
W13	TL 9367 6797	379m east	Large waterbody may contain fish.
W14	TL 9367 2789	121m south-east	Large waterbody may contain fish.
W15	TL 9367 3879	291m south-east	Detached waterbody.
W16	TL 9367 1779	153m south-east	Waterbody likely to be connected to drainage network and may contain fish.
W17	TL 9267 9752	375m south	Waterbody likely to be connected to drainage network and may contain fish.
W18	TL 9267 8992	155m south-west	Large waterbody may contain fish.
W19	TL 9268 8932	63m west	Pond
W20	TL 9268 8370	283m west	Large waterbody may contain fish.
W21	TL 9327 6821	79 m east	Pond
W22	TL 9268 7783	314m west	Large waterbody may contain fish.
W23	TL 9268 8587	260m west	Large waterbody may contain fish.
W24	TL 9268 8991	203m west	Pond
W25	TL 9268 8391	255m west	Pond
W26	TL 9369 0242	372m north-west	Pond
W27	TL 9322 6805	49m east	Pond

590000 590500 591000 591500 592000 592500 593000 593500 594000 594500 595000 595500 596000

271500 271000 270500 270000 269500 269000 268500 268000 267500 267000 266500 266000

N

Abbey Farm
Allen's Farmhouse
Chalet Bungalow
A1088
Heath Farm
Ixworth
A143
Wyken Cot
Heath Cottages
Woodstreet Farm
Puttocks Cottage
White Clouds
Puttockshill
Stowlane
Kiln Farm
Mill Farm
Queach House
The Plains
Paltry Farm
Grimstone End
Lime Kiln Cottages
Amerhur House
Old Hall Farm
Highfields Farm
Pakenham Meadows
Ashmore Farm
Highfield Farm Cottages
West View
A143
A1088
Bridge Farm
Parkfield Cottage
Stowlangtoft
Beaumont House
Kartin House
Upper Town
Pakenham
Edgewood Cottage
Beaumont's Hall
Ixworth Road
Mere Farm
Bartonmere House
The Lodge
Nether Hall
Bella Vista House
Little Haugh Hall
Stanton Street
Green Lane Farm
Grange Farm
Millfields Cottage
The Bungalow
The Old Rectory
Great Green
Norton
Manor Farm
Moat Farm

Key

- Site 54 boundary
- 2km search area
- Site of Special Scientific Interest (SSSI)

0 250 500 750 1,000 1,250 m

Scale at A3: 1:22,000

Fen Meadow Compensation Sites:
Pakenham Site 54
Baseline Ecology Report

Figure 2.1
Statutory designated sites within 2km of the Site

May 2021

wood.

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591000 591500 592000 592500 593000 593500 594000 594500 595000

270500 270000 269500 269000 268500 268000 267500 267000

N

Micklemere

RNR 133

Pakenham Fen Meadow

Pakenham Fen Meadow

Pakenham Fen Meadow

Pakenham Wood

Key

Site 54 boundary

1km search area

County Wildlife Site (CWS)

0 250 500 750 m

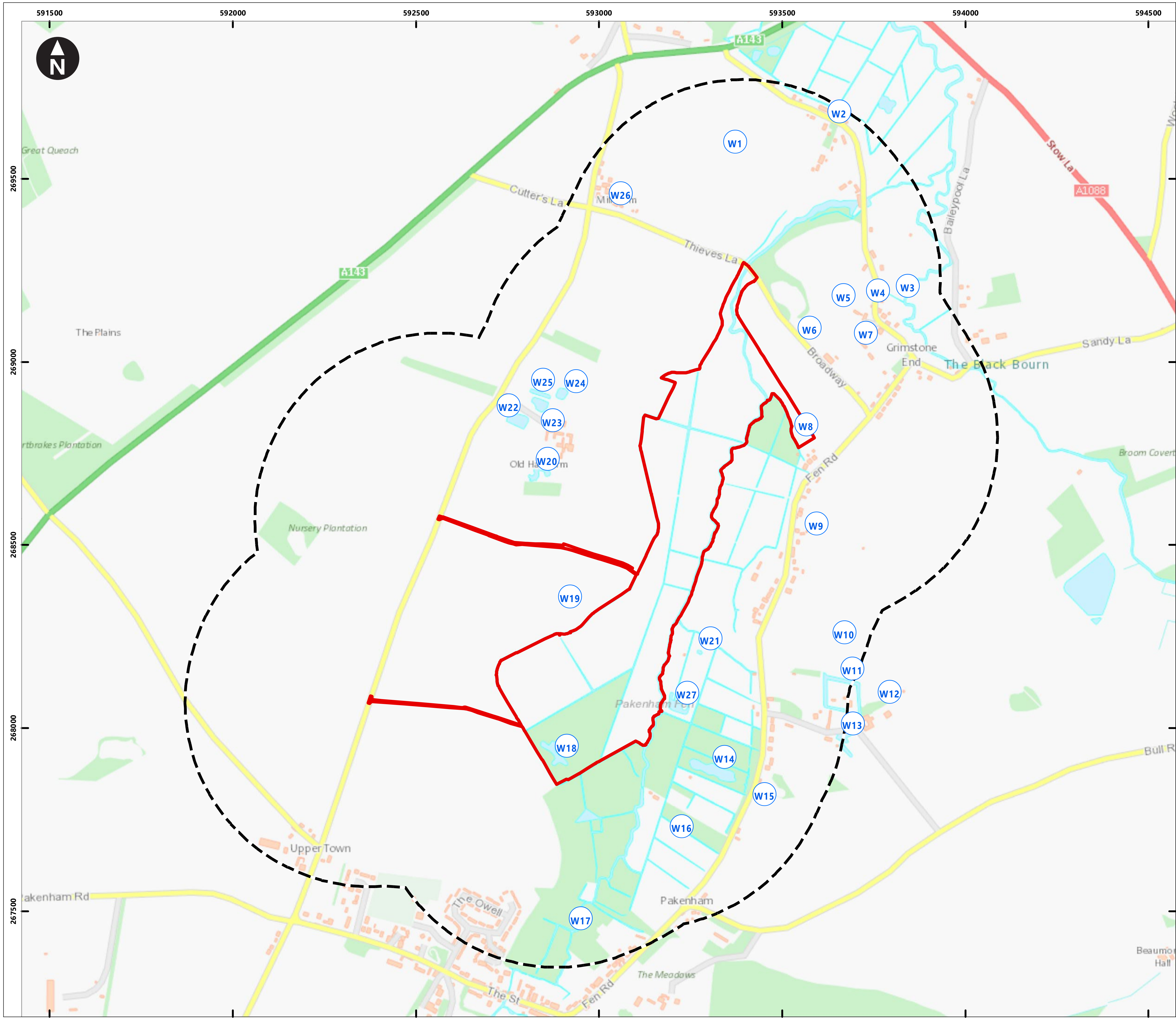
Scale at A3: 1:15,000

Fen Meadow Compensation Sites:
Pakenham Site 54
Baseline Ecology Report

Figure 2.2
Non-statutory designated Sites within 1km of the site

May 2021

wood.



Key

Site 54 boundary

Site 54 boundary 500m buffer

Waterbody

0 100 200 300 400 500 600 m

Scale at A3: 1:10,000

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Fen Meadow Compensation Sites:
Pakenham Site 54
Baseline Ecology Report

Figure 2.3
Waterbodies located with 500m of the site

May 2021

wood.

40773-WOOD-XX-XX-FG-OE-0026_S0_P01.1

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3. Extended Phase 1 Habitat Survey

3.1 Method

Habitats

A Phase 1 habitat survey of the Site and, where possible, a 30m buffer, was completed by a Wood Ecologist on 6th May 2021. During the survey, distinct habitats were identified, and any features of interest recorded and included on a Phase 1 habitat map as a target note (TN), in accordance with JNCC (2010).

Protected and Notable Species

As the standard Phase 1 habitat survey methodology is mainly concerned with vegetation communities, the survey was extended, in general accordance with IEA (1995), to allow for the provision of information on other ecological features, including identification of the presence, or potential presence, of legally protected or conservation notable species.

The methodologies used to establish the presence or potential presence of species and / or species groups are summarised below. Species or biological taxa included in the surveys were targeted due to the desk study and / or habitat types indicating potential for presence on the Site.

Great crested newt

Great crested newt is legally protected and is also a Species of Principal Importance.

The Site was assessed for its potential to support a population of this species. This assessment considered the presence of suitable aquatic and terrestrial habitats on site (the latter including foraging habitat, hibernacula and refugia). All accessible waterbodies were subject to Habitat Suitability Index HSI assessment (Oldham *et al.*, 2000), recording the context and features of them to generate a score relative to the likelihood of great crested newts using them

Reptiles

All species of British reptile are legally protected and are also Species of Principal Importance.

The Site was assessed for its potential to support populations of reptile species. This involved looking for potential foraging habitat, hibernacula, refugia and areas for basking (as described in Froglife, 1999).

Birds

All nesting birds are legally protected, some are afforded a higher level of protection when breeding, and many are also Species of Principal Importance.

The habitats on site were assessed for their potential to support important populations of breeding and wintering birds.

Badger

Badgers and their setts are legally protected.

The Site was searched for evidence of badger activity. This involved looking for setts, badger trails, snuffle holes, latrines and badger hairs. Furthermore, information was gathered about the suitability of habitats for

foraging badger on-Site and of suitable sett-digging habitat likely to be present within 30m of the Site (as described in Natural England, 2015).

Bats (all species)

All species of British bats and their roosts are legally protected and many are also Species of Principal Importance.

A general assessment was made for the potential of onsite trees to contain potential roost features for bats (e.g. rot and woodpecker holes, splits, cracks, and dense woody ivy on trees). Additionally, a general assessment was made as to whether habitats within and adjacent to the Site are likely to provide an important foraging resource and/or commuting route for bats (as described in Collins *et al*., 2016).

Dormouse

Dormouse is legally protected and is also a Species of Principal Importance.

The extent and quality of the habitats within and adjacent to the Site were assessed for their potential to support dormouse; in particular whether or not key food plants occurred and whether any of the habitats present are connected to large areas of suitable woodland (as described in Bright *et al*, 2006).

Otter

Otter is legally protected and is also a Species of Principal Importance.

The Site was assessed for its potential to provide habitat that could support otter. This involved considering the size and connectivity of any watercourse present on site (or within the vicinity) with regard to providing suitable foraging resources, as well as the presence of areas of woodland and other dense vegetation suitable for creation of holts, natal dens and/or laying-up areas (as described in Chanin, 2003).

Water vole

Water vole is legally protected and is also a Species of Principal Importance.

The Site was assessed for its potential to provide habitat that could support a population of water vole. This involved considering the size and connectivity of any watercourse present on site (or within the vicinity), as well as the potential presence of suitable foraging resources and burrowing substrate along the banks (as described in Strachan *et al*, 2011).

Invertebrates

A number of invertebrate species are legally protected and some are also Species of Principal Importance.

An assessment was made of the potential for habitats on site to support an assemblage of priority invertebrate species, by considering the provision of a mosaic of varied habitat and substrate types and nectar-rich flowering species.

Other priority faunal species

Drawing upon information that was collected during the desk study, an assessment was made of the potential for the Site to support any other legally protected and/or Species of Principal Importance.

Limitations

While every effort has been made to provide a comprehensive description of the Site, this survey does not constitute a full botanical survey. Nevertheless, it is considered that the survey is sufficient quality to capture the overall character of the Site and all of the major vegetation communities.

To determine presence or likely absence of protected species usually requires multiple visits at suitable times of the year. As a result, this survey focuses on assessing the potential of the Site to support habitats and species of note, which are considered to be of principal importance for the conservation of biodiversity with reference to those given protection under UK or European wildlife legislation. This survey therefore cannot be considered a comprehensive assessment of the ecological interest of the Site. However, it does provide an assessment of the ecological interest present on the day the Site was visited and highlights areas where further survey work may be required.

Due to the ground being waterlogged in places it was not possible to safely access all areas for survey. The greatest limitation was in the broadleaved woodland in the south-east (including WB18) and the grassland immediately to the north. Although this prevented a detailed species list being collected it did not prevent a general assessment of the habitat type, nor has it prevented an accurate assessment of further work required.

The data from this survey is generally considered valid for a maximum of two years. Therefore, if more than two years elapse prior to commencement of the works, a repeat survey might be required to ensure up-to-date information is available to inform decisions.

3.2 Results

Habitats

The habitats present on site comprise:

- Semi-natural broadleaved woodland;
- Parkland and scattered trees – broadleaved;
- Parkland and scattered trees – mixed;
- Semi-improved neutral grassland;
- Marsh/marshy grassland;
- Improved grassland;
- Swamp;
- Standing water;
- Running water;
- Intact hedge native species poor;
- Defunct hedge native species poor; and
- Bare ground.

Further details are provided below. Habitat distribution is illustrated on Figure 3.1, and target notes are presented in Appendix C.

Semi-natural broadleaved woodland

Wet broadleaved woodland, comprising a mixture of ages of tree, was well established in the south-east corner of the site. The soil was waterlogged (limiting the extent of the survey to the northern half where it could be safely accessed). Within the visible northern areas there was a limited understorey with a sparse ground flora, that included tufted hairgrass. To the south, although not accessible, the ground flora has a thin pond-sedge and tussock-sedge flora, with a thin reed cover. Tree species present in both areas were dominated by mature poplars, with occasional willow and alder, over patches of grey willow and with occasional hawthorn trees. A large pond was found in this area (see Standing water).

In the north of the woodland a fenced off area was used for a pheasant pen (Target Note 1, Figure 3.1). This area was cleared, and grasses had grown up in the space fenced off by Heras fencing.

Parkland and scattered trees broadleaved

Lines of semi-mature willow up to 4 m tall were present along some of the ditches. There were also several mature pedunculate oak trees in fields. These are estimated to be well over 100 years old, and had grown to around 15 m.

Parkland and scattered trees mixed

A short line (approximately 60 m) of mixed coniferous and broadleaved trees was present at the northern end of the site. This included Scots pine, willow species and Lombardy poplar.

Semi-improved neutral grassland

This habitat was found within the central portion of the site. It was dominated by hard rush and cock's-foot, which was quite tussocky in places. The fields are likely grazed but this does not appear to be limiting the rush growth, which had a sward height of up to 500 mm. Other species frequently found were dandelion, black thistle, meadow buttercup and more occasionally black sedge.

Marsh/marshy grassland

Marshy grassland was present on inundated soil in two locations: one towards the northern end and one in the south-west corner of the site. The habitat was dominated by sedges and rushes, including great wood-rush, black sedge, pendulous sedge, and hard rush. Grass species included sweet vernal grass and Yorkshire fog. Other species included water mint, marsh-marigold, meadowsweet, curled dock, sphagnum moss and cuckooflower. This grassland appeared relatively unmanaged at the time of the survey, in most areas, had grown to around 500 mm in height.

The northern patch graded into improved grassland with more dandelion, red dead-nettle, silverweed and fleabane present. There were patches of very boggy ground (Target Note 2, Figure 3.1), with other areas markedly drier (Target Note 3, Figure 3.1).

Improved grassland

This habitat covered much of the south-central area of the site, and it was also present at the very northern end. It was markedly drier than the marshy grassland and much of it appeared managed by grazing, and was no more than 100-250 mm tall. It was mostly dominated by annual meadow grass and cock's-foot with sections of abundant hard rush where the ground was damper and it graded into marsh/marshy grassland (e.g. Target Note 5, Figure 3.1) with meadow foxtail. In these areas the vegetation was up to 500 mm in height. Other species frequently found were spear thistle, dandelion, broad-leaved dock, purple dead-nettle, common mouse ear, daisy and meadow buttercup.

Swamp

To the north-east of the woodland was an area of sedge swamp (Target Note 4, Figure 3.1). Due to the ground conditions this could not be accessed at the time of the survey but during previous visits (January 2021) it consisted mainly of pond sedges with common reed colonising, and encroachment by grey willow.

Standing water

A network of ditches ran throughout the site. Some of these were completely open whilst others were partially covered by water mint. Water in most of the ditches was shallow, up to 250 mm deep. At the margins were water-loving herbs and trees including willow and black sedge. There was a culvert over one of the southern ditches to enable access to that end of the site (Target Note 6, Figure 3.1). At the southern end of the site, within the southern deciduous woodland block, was a large pond. This was largely open water, with some fringing common reed at the margins, and shading from overhanging trees.

Running water

The Pakenham Stream forms the eastern boundary of the site. It is maximum of 4-5 m wide and appears to be up to 1m deep.

Intact hedge, native species-poor

Functioning hedgerows were found along the boundary of the access tracks. These were dominated by hawthorn, itself supporting ivy, with occasional hornbeam and spindle. The hedges were more managed than those found on the main part of the site and have been maintained at around 2 m height.

Defunct hedge native species-poor

The majority of the hedgerows on the site appear unmanaged and the species within them (e.g. oak) have grown to their full height, creating gaps between the trees and shrubs. Each hedgerow had a fence running through or adjacent, to provide the boundary function that the hedge once would have. The hedgerows were hawthorn dominated with frequent bramble, hornbeam and oak. The hedges were generally around 3-4 m tall, though the mature trees had grown up to 15 m.

Bare ground

Bare ground was present on site, represented by the compacted earth tracks on the access routes and a cleared area in one of the fields (Target Note 7, Figure 3.1). Much of this was devoid of vegetation but the areas outside the wheel tracks (i.e. the centre and verges) was improved grassland with annual meadow grass, cock's-foot, common nettle and cow parsley.

Protected and notable species

Badger

No evidence of badgers was found during the survey, although they are likely to be present in the vicinity of the site, given its rural location, and they may use the site in future.

Bats (all species)

There were many mature oak and hornbeam trees in the hedgerows, woodland and individually in the fields, which were of sufficient age and size to support roosting bats. The habitats around these trees (hedgerows and linear water features) link them well to foraging areas increasing the likelihood bats roost in some of the trees.

The mixture of vegetation types and waterbodies is likely to support a large diversity and volume of invertebrates whether they roost on the site or offsite for example in nearby farm buildings. Hedgerows, ditches, lines of scattered trees and the stream adjacent to the site create good navigational aides for bats to commute along. Overall these features make up continuous high-quality habitats for bats to use and therefore the site is high suitability for foraging and commuting bats following the Bat Conservation Trust Guidance (Collins, 2016).

Nesting birds

There is general nesting bird potential in the woodland, the hedgerows and parkland and scattered trees, as well as the grassland that occur across the site. Cuckoo were heard calling throughout the site, and lapwing were seen in the grasslands at the northern end.

Great crested newt

The ditch network and single pond on site, and ponds off site, could potentially support breeding great crested newts. Great crested newts could use tree and hedgerow roots to hibernate. Potential refugia were present including two wood piles were found, one located in the pheasant pen (See Target Note 1, Figure 3.1) and one in the middle of the field (Target Note 8, Figure 3.1).

Reptiles

The habitats present on-site (grassland, hedgerows and water) provide foraging habitat, whilst the roots of trees and hedgerow along with the wood piles found at Target Notes 1 and 8 (Figure 3.1) provides suitable hibernation areas. Grass snake is often found in aquatic environments and the ditches provide a suitable foraging ground.

Hazel dormouse

There are no records of dormouse within 1 km of the site. The habitats on the site (woodland, some scattered trees and hedgerows) provide suitable foraging habitat albeit a limited diet given the lack of floral diversity noted.

Otter

The water bodies on and around the site provide habitats for otter to feed, and opportunities for them to build holts nearby. There is an otter record from near to the site indicating otter are likely in the area.

Water vole

The stream and ditches on and around the site provide a network of waterbodies where water voles could feed under cover and/or escape into the water as needed. Most of the banks had a steep profile such that water voles could access them without their burrows being regularly submerged. There is a water vole record from near to the site indicating they are likely in the area.

Other species – Terrestrial Invertebrates

The mix of habitats on-site including marshy grassland through to woodland provides a variety of niches for terrestrial invertebrates. A diverse community including notable species is possible.

Other species – Aquatic Invertebrates

The waterbodies on site would be expected to support a range of aquatic invertebrate species, potentially including some notable species.

Other priority faunal species

During the survey several brown hares (priority species) were seen in the fields.

Controlled species

During the survey no controlled species were noted. However, the presence of legally controlled species cannot be ruled out on the basis of this survey alone.

592500 593000 593500 594000

269000 268500 268000

N

A143

Old Hall Farm

Grimstone End

The Black Bourn

Broadway

Fen Rd

Pakenham Fen

1 2 3 4 5 6 7 8

Key

- Site 54 boundary
- Broadleaved woodland - semi-natural
- Neutral grassland - semi-improved
- Improved grassland
- Marsh/marshy grassland
- Swamp
- Standing water
- Bare ground
- Parkland and scattered trees - broad-leaved
- Parkland and scattered trees - mixed
- Running water
- Intact hedge native species poor
- Defunct hedge native species poor
- Parkland and scattered trees- broad-leaved
- Target note

0 100 200 300 m

Scale at A3: 1:6,000

Fen Meadow Compensation Sites:
Pakenham Site 54

Figure 3.1
Phase 1 habitat Plan

June 2021

wood.

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Appendix A
Species Scientific Name

Table A1 Species Names

Common name	Scientific name
Plants	
Annual meadow grass	*Poa annua*
Broad leaved dock	*Rumex obtusifolius*
Canadian waterweed	*Elodea canadensis*
Cock's-foot	*Dactylis glomerata*
Common mouse ear	*Cerastium fontanum*
Common nettle	*Urtica dioica*
Common water-starwort	*Callitriche stagnalis*
Cornflower	*Centaurea cyanus*
Cow parsley	*Anthriscus sylvestris*
Cuckooflower	*Cardamine pratensis*
Curled dock	*Rumex crispus*
Daisy	*Bellis perennis*
Dandelion	*Taraxacum agg.*
Dwarf spurge	*Euphorbia exigua*
Fleabane	*Pulicaria sp.*
Great wood-rush	*Luzula sylvatica*
Hard rush	*Juncus erectus*
Hawthorn	*Crataegus monogyna*
Hornbeam	*Carpinus betulus*
Lombardy poplar	*Populus nigra italica*
Marsh-marigold	*Caltha palustris*
Meadow buttercup	*Trifolium dubium*
Meadow foxtail	*Alopecurus pratensis*
Meadowsweet	*Filipendula ulmaria*

Common name	Scientific name
Nuttall's waterweed	*Elodea nuttalli*
Pedunculate oak	*Quercus robur*
Pendulous sedge	*Carex pendula*
Red dead-nettle	*Lamium purpureum*
Scots pine	*Pinus sylvestris*
Silverweed	*Argentina anserina*
Soft brome	*Bromus hordeaceus*
Spear thistle	*Cirsium vulgare*
Sphagnum moss	*Sphagnum sp*
Spindle	*Euonymus europaeus*
Sweet vernal grass	*Anthoxanthum odoratum*
Water mint	*Mentha aquatica*
Willow	*Salix sp*
Yorkshire fog	*Holcus lanatus*
Mammals	
American mink	*Mustela vison*
Badger	*Meles meles*
Brown Hare	*Lepus europaeus*
Bat – brown long-eared	*Plecotus auritus*
Bat – Pipistrelle	*Pipistrellus pipistrellus*
Chinese muntjac	*Muntiacus reevesi*
Dormouse	*Muscardinus avellanarius*
Grey squirrel	*Sciurus carolinensis*
Harvest Mouse	*Micromys minutus*
Hedgehog	*Erinaceus europaeus*
Otter	*Lutra lutra*
Water Vole	*Arvicola amphibius*
Birds	
Avocet +	*Recurvirostra avosetta*

Common name	Scientific name
Bar-headed goose	*Anser indicus*
Barn Owl	*Tyto alba*
Barnacle goose	*Branta leucopsis*
Bewick's Swan +	*Cygnus columbianus*
Black Tern +	*Chlidonias niger*
Black-tailed godwit	*Limosa limosa*
Black-winged Stilt	*Himantopus himantopus*
Brambling +	*Fringilla montifringilla*
Bullfinch	*Pyrrhula pyrrhula*
Canada goose	*Branta canadensis*
Cuckoo	*Cuculus canorus*
Curlew	*Numenius arquata*
Egyptian goose	*Alopochen aegyptiaca*
Fieldfare +	*Turdus pilaris*
Grasshopper Warbler	*Locustella naevia*
Green Sandpiper +	*Tringa ochropus*
Greenshank +	*Tringa nebularia*
Grey Partridge	*Perdix perdix*
Grey Wagtail	*Motacilla cinereal*
Hobby	*Falco Subbuteo*
House Sparrow	*Passer domesticus*
Kingfisher	*Alcedo atthis*
Lapwing	*Vanellus vanellus*
Lesser Redpoll	*Acanthis cabaret*
Linnet	*Linaria cannabina*
Little Gull +	*Hydrocoloeus minutus*
Little Ringed Plover	*Charadrius dubius*
Marsh Harrier	*Circus aeruginosus*
Marsh Tit	*Poecile palustris*

Common name	Scientific name
Mediterranean Gull	*Ichthyaetus melanocephalus*
Merlin +	*Falco columbarius*
Mistle Thrush	*Turdus viscivorus*
Nightingale	*Luscinia megarhynchos*
Osprey +	*Pandion haliaetus*
Peregrine	*Falco peregrinus*
Pheasant	*Phasianus colchicus*
Pintail	*Anas acuta*
Pochard	*Aythya farina*
Red Kite	*Milvus milvus*
Red-necked Phalarope +	*Phalaropus lobatus*
Redwing +	*Turdus iliacus*
Reed bunting	*Emberiza schoeniclus*
Ringed Plover	*Charadrius hiaticula*
Ruddy duck	*Oxyura jamaicensis*
Ruddy shelduck	*Tadorna ferruginea*
Ruff	*Calidris pugnax*
Scaup +	*Aythya marila*
Skylark	*Alauda arvensis*
Snow goose	*Chen caerulescens*
Song Thrush	*Turdus philomelos*
Spotted Flycatcher	*Muscicapa striata*
Starling	*Sturnus vulgaris*
Temminck's Stint +	*Calidris temminckii*
Tree sparrow	*Passer montanus*
Turtle Dove	*Streptopelia turtur*
Whimbrel	*Numenius phaeopus*
Whinchat	*Saxicola rubetra*
White-fronted Goose	*Anser albifrons*

Common name	Scientific name
White-tailed Eagle +	*Haliaeetus albicilla*
Wood Sandpiper +	*Tringa glareola*
Woodcock	*Scolopax rusticola*
Woodlark	*Lullula arborea*
Yellow Wagtail	*Motacilla flava*
Yellowhammer	*Emberiza citrinella*
Herpetofauna	
Common Toad	*Bufo bufo*
Great Crested Newt	*Triturus cristatus*
Invertebrates	
Anaglyptus mysticus	*Anaglyptus mysticus*
Adonis ladybird	*Hippodamia variegata*
Cinnabar	*Tyria jacobaeae*
Ptinus sexpunctatus	*Ptinus sexpunctatus*
Red-tailed Mason Bee	*Osmia bicolor*
Small heath	*Coenonympha pamphilus*
White admiral	*Limenitis Camilla*
White-letter Hairstreak	*Satyrium w-album*

Appendix B
Species Protection or Control Legislation

Great crested newts, bats, otter, dormouse

These species / species groups are listed in Schedule 5 of the *Wildlife and Countryside Act 1981* (as amended) and Schedule 2 of *The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019*. They are afforded full protection under Section 9(4) of the Act and Regulation 43 of the Regulations. These make it an offence, *inter alia*, to:

- Deliberately capture, injure or kill any such animal; and
- Deliberately disturb any such animal, including in particular any disturbance which is likely;
  - to impair its ability to survive, breed, or rear or nurture their young;
  - to impair its ability to hibernate or migrate; and
  - to affect significantly the local distribution or abundance of that species.
- Damage or destroy a breeding site or resting place of any such animal;
- Intentionally or recklessly disturb any of these animals while it is occupying a structure or place that it uses for shelter or protection (for bats this is taken to mean all bat roosts whether bats are present or not); or
- Intentionally or recklessly obstruct access to any place that any of these animals uses for shelter or protection.

In addition, five British bat species are listed on Annex II of the Habitats Directive. These are:

- Greater horseshoe bat (*Rhinolophus ferrumequinum*);
- Lesser horseshoe bat (*Rhinolophus hipposideros*);
- Bechstein's bat (*Myotis bechsteinii*);
- Barbastelle (*Barbastella barbastellus*); and
- Greater mouse-eared bat (*Myotis myotis*).

In certain circumstances where these species are found the Directive requires the designation of Special Areas of Conservation (SACs) by EC member states to ensure that their populations are maintained at a favourable conservation status. Outside SACs, the level of legal protection that these species receive is the same as for other bat species.

Badger

The *Protection of Badgers Act 1992* consolidates previous legislation (including the *Badgers Acts 1973* and the *Badgers (Further Protection) Act 1991*). It makes it an offence to:

- Kill, injure or take a badger;
- Attempt to kill, injure or take a badger; and
- To damage or interfere with a sett.

The 1992 Act defines a badger sett as "any structure or place which displays signs indicating current use by a badger".

Nesting Birds

With certain exceptions, all wild birds, their nests and eggs are protected by Section 1 of the *Wildlife and Countryside Act 1981* (as amended). Therefore, it is an offence, inter alia, to:

- Intentionally kill, injure or take any wild bird;
- Intentionally take, damage or destroy the nest of any wild bird while it is in use or being built; and
- Intentionally take or destroy the egg of any wild bird.

Bird species listed on Schedule 1 of the Act receive further protection, thus for these species it is also an offence to:

- Intentionally or recklessly disturb any bird while it is nest building, or is at a nest containing eggs or young; and
- Intentionally or recklessly disturb the dependent young of any such bird.

Reptiles

The four widespread species of reptile that are native to Britain, namely common or viviparous lizard (*Zootoca vivipara*), slow worm (*Anguis fragilis*), adder (*Vipera berus*) and grass snake (*Natrix natrix*), are listed in Schedule 5 of the *Wildlife and Countryside Act 1981* (as amended) and are afforded limited protection under Section 9 of this Act. This makes it an offence, inter alia, to:

- Intentionally kill or injure any of these species.

In addition sand lizard and smooth snake are listed in Schedule 5 of the *Wildlife and Countryside Act 1981* (as amended) and Schedule 2 of *The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019*: They are afforded full protection under Section 9(4) of the Act and Regulation 43 of the Regulations.

These make it an offence, inter alia, to:

- Deliberately capture, injure or kill any such animal;
- Deliberately disturb any such animal, in particular in such a way as to be likely to:
- Impair their ability to survive, breed or reproduce, or rear or nurture their young;
- Impair their ability to hibernate or migrate which could affect significantly the local distribution or abundance of that species;
- Damage or destroy a breeding site or resting place of any such animal;
- Intentionally or recklessly disturb any of these animals while it is occupying a structure or place that it uses for shelter or protection; or
- Intentionally or recklessly obstruct access to any place that any of these animals uses for shelter or protection.

The legislation applies to all life stages of these species.

Notifiable / Controlled Species

Schedule 9 of the *Wildlife and Countryside Act 1981* (as amended) lists species of animal that it is an offence to release or allow to escape into the wild (for example grey squirrel) and species of plant that it is an offence to plant or otherwise cause to grow in the wild (for example, Japanese knotweed).

Appendix C
Phase 1 Target Notes

Table C.1 Extended Phase 1 Survey Target Notes

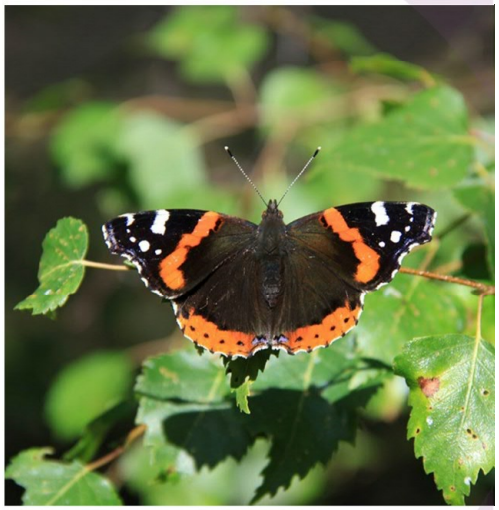
Target Note no.	Ordnance Survey Grid Reference	Description
1	TL9301268057	Pheasant pen adjacent to woodland, ground flora is dominated by grasses and there is a pile of dead wood inside suitable for invertebrates, amphibians and reptiles.
2	TL9293768175	Patch of very boggy grassland which includes water mint and common water-starwort.
3	TL9289968238	Patch of drier grassland dominated by soft brome
4	TL9305468116	Area not accessed during this visit due to H&S concerns. However when accessed in January 2021, it was reported to consist of pond sedges with frequent common reed and occasional grey willow.
5	TL9315968194	Damp area of improved grassland grading into marsh/marshy grassland dominated by hard rush
6	TL9279168012	Concrete culvert over ditch
7	TL9311368395	Cleared area of bare ground at the end of an access track
8	TL9317868541	Pile of logs which has been burned but still offers a refugia for amphibians or reptiles.

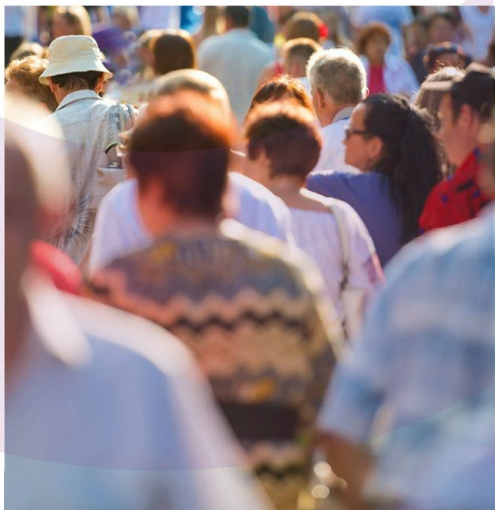
APPENDIX D: BENHALL SITE 10 & 11 - BASELINE HYDROGEOLOGICAL REPORT

EDF Energy

Sizewell C

Fen Meadow Compensation Site: Benhall Site 10 & 11 Baseline Hydrogeological Report





Wood Group UK Limited – June 2021

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Document revisions

No.	Details	Date
1	For Client Comment	29/01/21
2	Final	11/06/21

Contents

1. Introduction

1.1 Background

The proposed development platform for Sizewell C will extend a short distance into the eastern margins of Sizewell Marshes Site of Special Scientific Interest. The toe of the batter of the proposed platform will define the extent of permanent land-take but, additional to that, ditch re-alignment is required which will take a limited amount of further land.

Based on National Vegetation Classification (NVC) survey data the main affected habitats are M22 *Juncus subnodulosus – Cirsium palustre* fen meadow, S26 *Phragmites australis - Urtica dioica* tall-herb fen, S4 *Phragmites australis* reedbed and some W5 *Alnus glutinosa – Carex paniculata* wet woodland.

Studies focussed on the provision of compensatory fen meadow habitat, particularly M22 *Juncus subnodulosus – Cirsium palustre* fen meadow, were reported in Wood (2018). Five sites were identified for further investigation, whilst 17 sites were put on hold subject to further assessment of the initial five sites. The five sites identified for further investigation (Wood (2018)) were:

- Site No. 10 – Aldecar Lane, Benhall;
- Site No. 11 – Watering Lane, Benhall;
- Site No. 28 – Halesworth;
- Site No. 33 – Stratford St Andrew; and
- Site No. 54 – Pakenham Fen.

Subsequently, one day site visits to Sites 10, 11, 28 and 54 were undertaken in April and May 2019. Site 33 was not visited as access had not been agreed at the time (Wood, 2019), however, following further consideration of the site characteristics and suitability for fen meadow creation, it was also concluded that the sites that were taken forward all provide greater potential for fen meadow creation than Site 33.

The one day site visits to Sites 10, 11, 28 and 54 comprised:

- A walkabout survey to identify areas where (1) the peat is currently influenced by groundwater or near-surface seepage; and (2) fen meadow species are present within or close to the site margins;
- A reconnaissance hand augering survey to identify general peat quality (substrate condition), sub-surface geological materials, presence of water table and areas of upwelling groundwater; and
- Consideration of broad options for water management and potential for changes to land management.

Findings were reported in Wood (2019). Sites 10, 28 and 54 were all identified as having potential for the development of fen meadow as follows:

- Site 10: primary locus 1.5ha, further area 0.7ha (Site 11 has relatively limited potential (primary locus of 0.5ha although part already supports fen meadow species, and further area of 1.2ha) but is close to Site 10, so warrants further consideration in that context);
- Site 28: primary locus 1.2ha, further area 1.3ha;
- Site 54 north: primary locus 3.2ha, further area 6.2ha; and

- Site 54 south: primary locus 1.7ha, further area: 4.3ha.

Subsequently EDF has progressed with detailed site conceptualisation and feasibility assessment work at Sites 10/11, 28 and 54.

The scope of the conceptualisation and feasibility assessment work can be summarised as follows:

- Ecological studies:
  - Desk based review of ecological data for the Sites and surrounding area; and
  - Targeted ecological surveys.
- Hydrological studies:
  - Desk based review of available hydrogeological data;
  - Collection of topographic data;
  - Collection of surface water level and groundwater level data to determine the relationship between groundwater and surface water levels on site. Also detailed study of the existing and wider ditch network to determine potential for water management without risk to upstream receptors; and
  - Collection of hydrochemical data.

1.2 This Report

This report presents the hydrogeological baseline for Site 10/11 Benhall (hereafter the 'Benhall site' or 'the Site') (Figure 1.1).

The structure of this report is as follows:

- Section 2 presents the methods and sources of data gathering and a summary of survey work undertaken;
- Section 3 presents the baseline environmental characteristics of the Site;
- Section 4 presents an initial conceptual site model.

2. Data Gathering Methodology

2.1 Study Area

The geographical extent of the study area for this report focuses on the area within the Site boundary (Figure 1.1), together with relevant information obtained from a nominal 2km search area around the extension.

2.2 Desk Study Sources

A summary of the organisations that have supplied data, together with the nature of that data is summarised in Table 2.1 below.

Table 2.1 Sources of desk study information

Source	Data
Wood (and Subconsultants)	Details of soil core survey. Details of piezometry and exploration boreholes (Structural Soils Ltd). Details of gaugeboard installations (WSP UK Ltd). Topography of Proposed Development (WSP UK Ltd).
Ordnance Survey **OS, 1: 25,000, Explorer Sheet 212 Woodbridge & Saxmundham (Aldeburgh & Framlingham)**	Topography, relief, springs, wells, watercourses, surface waterbodies
Environment Agency (by enquiry)	Rainfall data for closest rain gauge - Benhall rain gauge. Flow data for Fromus at Benhall Bridge. Observation Borehole data for Crag borehole TM36/9311. Locations of licensed and deregulated surface water and groundwater abstractions and consented discharges.
Environment Agency (Online) **Catchment Data Explorer** http://environment.data.gov.uk/catchment-planning/ **Main Rivers Map** https://environment.maps.arcgis.com/apps/webappviewer/index.html?id=17cd53dfc524433980cc333726a56386 **East Suffolk WFD Management Area Abstraction Licencing Strategy** https://www.gov.uk/government/publications/cams-east-suffolk-abstraction-licensing-strategy	WFD waterbody status and objectives. River designations. Abstraction licensing strategies.
Centre for Ecology and Hydrology - National River Flow Archive On-line https://nrfa.ceh.ac.uk/data/station/meanflow/35013	River Alde at Farnham gauging station – flows, statistics, catchment daily rainfall, and catchment descriptors
Cranfield University Land Information System http://www.landis.org.uk/soilscapes/	Soil types

Source	Data
British Geological Survey (BGS) **British Geological Survey, 1996. Lowestoft. England and Wales Sheet 176. Solid and Drift Geology. 1:50 000. (Keyworth, Nottingham: British Geological Survey)** **British Geological Survey, 2000. Geology of the country around Lowestoft and Saxmundham: memoir for 1:50000 geological sheets 176 & 191 (England & Wales) (Author: Morlock et. al.)** **BGS Digital Mapping** **BGS Online** https://www.bgs.ac.uk/geoindex/	Geological mapping (1:50 000 scale). Geological sheet description. Stratigraphic and lithological information. Borehole locations.
BGS Major Aquifer Properties Manuals (Allen *et al.*, 1997) **BGS Minor Aquifer Properties Manuals (Jones *et al.*, 2000)**	Hydrogeological characteristics
MAGIC On-line http://magic.defra.gov.uk/MagicMap.aspx	Conservation sites, groundwater vulnerability map, aquifer designation map, Nitrate Vulnerable Zones, Source Protection Zones
Natural England https://designatedsites.naturalengland.org.uk/	Locations and citations of protected sites
Open Government Data On-line https://data.gov.uk/	Authorised and historic landfills
East Suffolk District Council	Information regarding private water supplies

2.3 Survey Work

2.3.1 Initial Survey

An initial hand augering survey was undertaken in April 2019 to identify general peat quality (substrate condition), sub-surface geological materials, presence of water table and areas of upwelling groundwater. Findings were reported in Wood (2019).

Following the findings of the Wood (2019) report a programme of hydrogeological monitoring was designed to enable collection of site specific baseline data, aid site conceptualisation and inform options for fen meadow compensation.

2.3.2 Installations and Monitoring

Following an initial site walkover to establish suitable monitoring locations in July 2020, a programme of installation works commenced on 5th October 2020 for a period of 3 weeks. Details are provided below and are presented in Figure 2.1.

Surface Water Monitoring

Five gaugeboards were installed between 12th and 16th October 2020 to allow monitoring of surface water levels in site watercourses / drains. All gaugeboards included stilling wells and water level data loggers. Installation reports are provided in Appendix A and a summary is given in Table 2.2 below.

Table 2.2 Summary of gaugeboard installations

Ref.	GPS Grid Ref.	Top of Gaugeboard Datum (mAOD*)	Gaugeboard Length (m)	Datalogger	Log Interval (minutes)
SNP-GB01	TM 38130 60235	3.73	1	OTT Orpheus Mini	15
SNP-GB02	TM 38249 60509	4.24	1	OTT Orpheus Mini	15
SNP-GB03	TM 38207 60658	4.8	1	OTT Orpheus Mini	15
SNP-GB04	TM 38350 60725	3.67	2	OTT Orpheus Mini	15
SNP-GB05	TM 38300 60618	4.71	2	OTT Orpheus Mini	15

*mAOD = metres above ordnance datum

A programme of monthly monitoring visits commenced in November 2020 to download and record surface water data at the gaugeboard locations and obtain in-situ water quality readings. Monthly spot flow gauging at selected watercourses and drains also commenced in November 2020.

Groundwater Monitoring

Ten groundwater monitoring points were installed at the Site between 5th and 23rd October 2020. Seven shallow dipwells were installed to measure groundwater levels in the shallow superficial near surface deposits and three piezometers were installed to measure groundwater levels in the underlying sands and gravels. Two of the sands and gravels piezometers are nested (within the same borehole) with a dipwell. Drilling logs are presented in Appendix B and an installation summary is provided in Table 2.3 below.

Each installation is fitted with a water level datalogger which will be downloaded on a quarterly basis. Water quality samples will also be collected quarterly and sent for laboratory analysis. In addition to the quarterly monitoring a programme of monthly monitoring will be undertaken to manually record groundwater levels and in-situ water quality readings.

The groundwater level data will give insight into the groundwater gradient across the Site and will help to identify vertical head gradients (if present) between aquifers.

Table 2.3 Summary of groundwater monitoring installations

Name	Drillers ID	NGR	Datum: Metal Cover (mAOD)	Ground Level (mAOD)	Depth (m bgl*)	Diameter (mm)	Notes
BHALL_1001_d	bh1001	TM3824360485	7.254	6.689	10	50	
BHALL_1001_s	ws1001	TM3823760625	4.177	3.906	3	19	
BHALL_1002_s	ws1002a	TM3828760508	4.671	4.347	3	19	

Name	Drillers ID	NGR	Datum: Metal Cover (mAOD)	Ground Level (mAOD)	Depth (m bgl*)	Diameter (mm)	Notes
BHALL_1003_s	ws1003	TM3824060487	4.207	3.931	3	19	
BHALL_1101_d	bh1101	TM3817360414	4.190	3.875	10	50	Nested with BHALL_1101_s
BHALL_1101_s	ws1101	TM3817360414	4.178	3.906	10	50	Nested with BHALL_1101_d
BHALL_1102_d	bh1102	TM3813060268	4.178	3.906	10	50	Nested with BHALL_1102_s
BHALL_1102_s	ws1102	TM3813060268	4.147	3.92	10	50	Nested with BHALL_1102_d
BHALL_1103_s	ws1103	TM3820260405	4.147	3.92		50	
BHALL_1104_s	ws1104	TM3810560190	4.252	3.952	3	50	

s = shallow; d = deep
*m bgl = metres below ground level

Topographic Survey

A topographic survey of the Site was conducted in November 2020. The purpose of the survey is to allow profiling of the land surface and channels so that water levels and ground levels can be related to a common datum to further inform potential water management options.

The survey involved eight long sections across the Site, five short ditch sections across watercourses / ditches, and a topographic grid of the primary locus area for fen meadow. The results of the survey are presented in Appendix C.

3. Baseline Environmental Characteristics

3.1 Site Description

The Benhall site (Figure 1.1) is located *c.*2.5 km south of the town of Saxmundham, between the village of Benhall to the north and the hamlet of Snape Watering to the south. The Benhall site is a narrow stretch of land that follows the modern north-south course of the River Fromus and forms a section of the floodplain on the western side of the River Fromus valley. The River Fromus marks the eastern extent of the Site. The River Fromus drains the margin of the East Anglian clay plateau and makes a gentle descent over Crag sands exposed on the valley sides to Snape, where it joins the River Alde *c.*2.5km south of the Site.

The site extends from the A1094 in the south to the Marsh Farm Caravan and Fishing Park, and associated water-filled valley excavations, in the north. The Site has previously been considered as two land packages, 10 and 11, north and south of the Benhall Sewage Treatment Works respectively. The Site covers an area of approximately 12.9 ha and is comprised of largely agricultural fields with mature riparian vegetation in parts.

A network of drains on the Site conveys water from the valley margin towards the River Fromus, discharging at three locations along the eastern boundary of the Site. In the southern half of the Site (Site 11) a non-flowing secondary cut-off channel runs roughly parallel to the main channel. This second channel is itself connected to valley margin drains and can connect to the River Fromus when water levels are high enough.

On the western side of the Site, at the northern end, the network of floodplain drains is joined by a tributary named 'The Canal' which drains from the west of the A12 road. The Canal skirts the northern and southern boundary of the sewage treatment works and discharges to the River Fromus. The Canal is the receiving watercourse for the Benhall Sewage Treatment Works discharge.

The redline boundary for the Site area is shown on Figure 1.1. Figure 1.1 also shows the primary locus area for fen meadow and potential additional area for fen meadow.

3.2 Landscape and Topography

The Site is positioned immediately adjacent to, and on the western flank of, the River Fromus which flows past the Site from north to south. Ordnance survey maps show that ground level at the western margin of the Site is *c.*5 mAOD, gently sloping eastward towards the River Fromus and southwards down valley, however, the floodplain is relatively flat. On the eastern boundary the River Fromus channel falls from around 4 mAOD in the north to 3 mAOD in the south of the Site.

The recent topographic survey of the Site (Appendix C) focused on the primary locus area for fen meadow along with long sections and ditch profiles. A topographic profile for the whole site has been extrapolated from the available data and is presented in Figure 3.1.

The recent topographic survey shows that at the northern boundary of Site 10 ground levels fall gently from 6.7 mAOD in the west near Aldecar Lane, flattening out to between 4.2 and 4.4 mAOD around the ditch network, rising to 5.1 mAOD at the bank of the River Fromus (Long Section BHALL_LS1 – Appendix C). To the south of this, in the area being considered for Fen meadow at Site 10, ground elevation is relatively flat and generally ranges between 3.8 and 4 mAOD. Water levels in the ditch network fall from 3.9 mAOD in the west, 3.65 mAOD in the central ditch, and 3.51 mAOD in the River Fromus (Long Section BHALL_LS2 – Appendix C).

The Canal divides Site 10 in the north and Site 11 in the South. The Canal approaches the site from the west where bed levels gently fall from 4.1 to 3.8 mAOD and a water depth of around 0.4 m at the time of the survey. The Canal swings south past the Benhall STW and beds level decline to 3.1 mAOD before again

turning east towards the River Fromus where bed levels decline further to 2.5 mAOD. The water depth in The Canal increases to around 0.9 m before the confluence with the Fromus.

At the potential fen meadow area in Site 11 (Long Section BHALL_LS4 and LS5 – Appendix C) the ground elevation generally ranges between 3.9 and 4.1 mAOD, rising at the banks of the western ditch and the River Fromus in the east. Water levels in the Western ditch fall from 3.65 to 3.2 mAOD north to south across this are of interest. The water level in the Fromus also reduces from 3.42 to 3.12 mAOD along this stretch.

Further south the cut-off meander channel has a bed level of 3.52 mAOD adjacent to a River Fromus water level of 2.90 mAOD. The ground level surrounding the cut-off meander is slightly higher at 3.7 to 4 mAOD and level rise further at the western edge of the Site to around 5.2 mAOD (Long Section BHALL_LS6 and LS7 – Appendix C).

The River Fromus has a bed level of 2.8 mAOD and a water level of 3.51 mAOD at the northern end of the Benhall site and this gently decreases downstream to a bed level of 2.3 mAOD and a water level of 2.9 mAOD at the southern end of the Benhall site.

3.3 Climate

Daily rainfall data for the period 1991 to 2019 has been supplied by the EA for the nearest raingauge at Benhall TBR which is located adjacent to the Site at Benhall STW (Figure 3.2). There are quite a few years with missing or suspect data but from the years with a full dataset the long-term average (LTA) rainfall is calculated to be 570 mm/a.

A long term time series (1961-2017) of catchment daily rainfall (CDR) data has also been downloaded from the Centre for Ecology and Hydrology (CEH) National River flow Archive (NRFA) website. The catchment averaged daily rainfall data have been derived from a 1km gridded rainfall dataset generated from all daily and monthly observed rainfall data available from the Met Office. Catchment daily rainfall data are shown graphically in Appendix E on a monthly and annual scale. The Benhall site is not captured by a CEH gauged catchment, therefore data from the adjacent catchment (*c.*2km west) on the River Alde at Farnham (35003) has been used for the purpose of this desk study due to its close proximity and similar catchment characteristics. The annual average rainfall value over the catchment for the River Alde at Farnham for the period 1961 to 2017 is 606 mm, which is slightly higher than the average calculated from the Benhall TBR data.

3.4 Hydrology

OS Mapping, data received from the Environment Agency, data from the CEH Website, the FEH Web Service, and information from site visits were used to characterise the baseline hydrology. The watercourses within the search are shown on Figure 3.2.

3.4.1 Main Rivers: River Fromus

The River Fromus demarks the eastern extent of the Benhall site (Figures 3.2). The River Fromus flows south past the Site and joins the River Alde at Snape, *c.*2.5km south of the Site. The River Fromus is defined as a main river:

"Main rivers are usually larger rivers and streams. Other rivers are called 'ordinary watercourses'. The Environment Agency carries out maintenance, improvement or construction work on Main Rivers to manage flood risk. Environment Agency powers to carry out flood defence work apply to main rivers only. Lead local flood authorities, district councils and internal drainage boards carry out flood risk management work on ordinary watercourses. The Environment Agency decides which watercourses are main rivers. It consults with

other risk management authorities and the public before making these decisions. The main river map is then updated to reflect these changes". Taken from the Environment Agency website (July 2020).

The Environment Agency have provided daily flow data for a permanent gauging station on the River Fromus at Benhall Bridge (Ref No. 35016), *c.*1.2km upstream of the Benhall site. Table 3.1 displays the catchment and flow parameters for the Benhall Bridge gauging station and a daily hydrograph is presented in Appendix E. Table 3.1 also shows catchment data for the River Alde at Farnham CEH (adjacent to River Fromus catchment) for reference.

Table 3.1 River Flows and Catchment Information

	35016 – Benhall Bridge (upstream of site)
NGR	TM 38786 61802
BFI (Base Flow Index)	0.36*
Q10 flow (m^3/s)	0.154
Q95 flow (m^3/s)	0.005
Mean flow (m^3/s)	0.059
Flow records for	1970 - 2020
	River Alde at Farnham CEH catchment data (adjacent to River Fromus catchment)**
NGR	TM 360 601
Catchment area (km^2)	63.9
Mean Annual Rainfall from CDR (mm)	606
Mean flow (m^3/s)	0.315
Mean annual catchment runoff (mean flow/catchment area) (mm/year)	155
Mean annual catchment runoff as % Rainfall	26

** calculated using the CEH prescribed 5 day minimum turning point method (IoH,1980)
*Source: National River Flow Archive, https://nrfa.ceh.ac.uk/data/station/meanflow/35003 08th January 2021.

3.4.2 Ordinary Watercourses

One ordinary watercourse named 'The Canal' drains from the west of the A12 road and passes through the centre of the Site before joining the River Fromus. The Canal is the receiving watercourse for the Benhall Sewage Treatment Works discharge.

Ditch Network

Water is distributed around the Site via a series of interconnected drainage ditches. Three of the ditches clearly drain to the River Fromus (W2, W5 and W11). There are no existing water level control structures in any of these drains. W1 is the ordinary water course that drains from the west of the A12 road and receives discharge from Benhall STW.

During the April 2019 site visit there was a lack of water along the secondary cut-off channel in the southern half of the Site (W13).

A summary of observation made in relation to the ditch network during a site visit by Wood in April 2019 are given in Table 3.2 and are shown on Figure 3.3.

Table 3.2 Ditch network observation summary

ID	Description	Width (m)	Freeboard (m)	Water depth (m)	Flow	Notes (from April 2019)	Water level (November 2020 Topographic Survey) (mAOD)
W1	Central N-S field drain	1-2	1	Shallow	Standing water. No apparent flow	The ditch drains to the north and then curves west to meet the western boundary ditch.	3.61
W2	'The Canal'. Ordinary watercourse	3	0.5	Shallow	Low flow to south	Sewage treatment works located to the west approx. 1m above water in ditch.	3.90
W3	Ditch connecting to northern drains	2	1	Boggy	No apparent flow	Ditch is nearly dry	3.78
W4	Connecting drain	2.5	1	0.3-0.5	No apparent flow	Culvert is approx. 0.5m diameter pipe. No apparent flow	3.52
W5	West to east drain	2.5	1-1.5	0.4	Flow from west to east	Flow was not obvious at the time of the visit.	3.49
W6	River Fromus	2.5	1.5-2	0.4	Flow from north to south	Steep bank on west side, much gentler bank on east side.	
W7	Drainage Ditch flowing west to east at southern end of site	2	1-1.5	0.2	Flow from west to east	Water was clearly flowing from west to east during the visit, converging with the River Fromus.	3.60
W8	Drainage ditch along western boundary (north)	1-3	1	0.5	No apparent flow	The ditch runs along the western boundary of the Site. It is connected to a moat, adjacent the Site to the west.	3.66
W9	Drainage ditch along western boundary (central)	2	1	0.5	No apparent flow	Connected to the River Fromus by a west-east ditch, but currently blocked by a large trunk so no flow. It appears that this drain may have originally continued southwards.	3.12

ID	Description	Width (m)	Freeboard (m)	Water depth (m)	Flow	Notes (from April 2019)	Water level (November 2020 Topographic Survey) (mAOD)
W10	Shallow scrape from west to east	3	0.3	n/a	Dry	The scrape is relatively shallow. It runs from the western boundary ditch (W8) to the River Fromus but is currently dry.	
W11	River Fromus (central)	3	1.5	0.4	Flow from north to south		3.00
W12	Culvert	0.9			No apparent flow	Vehicle crossing. No flow through culvert at time of visit. Connects with dry secondary river channel to south.	2.14
W13	Secondary river channel	5-6	0.5	n/a	No flow	Secondary channel runs roughly parallel to the River Fromus. Potentially periodically wet.	2.08
W14	River Fromus (south)	3	1.5	0.4	Flow from north to south		

Note: Dimensions are approximate. The ID field references label on Figure 3.3.

3.4.3 Surface Waterbodies

The River Fromus forms the eastern site boundary, with a network of drains present on-site and within the wider area which feed into the river. Information gathered from site visits and from OS maps indicate there are thirteen further waterbodies located off-site within 500m of the Site boundary (Table 3.3 and Figure 3.2).

Table 3.3 Water bodies within 500m of the Site

Water bodies	NGR	Distance and direction from Site	Description
W1	TM3853 6076	76m north	Large waterbody, may contain fish, and separated from site by drain linked to river.
W2	TM3859 6096	274m north	Large waterbody, may contain fish, and separated from site by drain linked to river.
W3	TM3849 6204	340m north	Pond separated from site by drain linked to river
W4	TM3865 6106	408m north	Waterbody likely to be connected to drainage network and may contain fish.
W5	TM3795 6104	390m north-west	Pond which is separated from Site by a minor road.
W6	TM3792 6094	272m north-west	Pond which is separated from Site by a minor road.

Water bodies	NGR	Distance and direction from Site	Description
W7	TM3831 6046	10m east	Large waterbody, may contain fish, and separated from site but the River Fromus.
W8	TM3826 6040	10m east	Pond, separated from site by the River Fromus
W9	TM3807 6031	40m east	Detached waterbody.
W10	TM3872 6047	395m east	Pond, separated from site by the River Fromus
W11	TM3822 6012	17m east	Pond, separated from site by the River Fromus
W12	TM3833 6008	82m east	Pond, separated from site by the River Fromus
W13	TM3820 5968	195m south-west	Detached waterbody separated from Site by the A1095 road.

3.4.4 Flood Risk

Fluvial flood risk

The Environment Agency Flood Map for Planning Service (2020), https://flood-map-for-planning.service.gov.uk (accessed 11/01/21) shows that the Benhall site is located within Flood Zone 3 (high probability of flooding). The site predominantly falls with the high risk category with a greater than 3.3% chance of flooding from rivers each year (Environment Agency Flood Warning Information Service (2018), https://flood-warning-information.service.gov.uk/long-term-flood-risk/map (accessed 11/01/20).

Surface water flood risk

The Environment Agency surface water flood risk map (Environment Agency Flood Warning Information Service (2018), https://flood-warning-information.service.gov.uk/long-term-flood-risk/map (accessed 11/01/20) indicates that flood risk from surface water flooding ranges from low risk to high risk across the Site. Low risk areas a generally associated with topographic high points across the Site such as the western extent of the Site.

Areas of medium to high risk are generally associated with topographic low points such as rivers, ditches and the cut-off channels in the southern part of the Site. The northern half of the Site has a higher proportion of high surface water flood risk, suggesting potential flooding of this land from the ditch network.

3.4.5 Surface Water Abstractions

There are two licensed surface water abstractions within 3km of the Proposed Development, details of which are given in Table 3.4 and their locations. Both surface water abstractions are for spray irrigation purposes. The Ham Farm licence abstracts water from the River Fromus at the eastern edge of the Site.

Table 3.4 Details of licensed surface water abstractions

Licence	Abstraction Name	Grid ref	Use	Point	Distance from site (km)	Max Daily Abstraction Quantity (Ml/d)
7/35/04/*S/0080	Burnt House Farm	ST35000400	Spray Irrigation - Direct	Marsh ditches	1.5 SSW	0.33
AN/035/0004/017	Ham farm	ST36000500	Spray Irrigation - Storage	River Fromus	0.0	5.18

3.4.6 Surface Water Discharges

The Environment Agency has indicated that there is one active discharge consent within 2 km of the Benhall site. A table of the location and type can be seen in Table 3.5, and the location (together with abstractions) is shown on Figure 3.2.

Table 3.5 Details of surface water discharges

Site Name	Discharge Consent No.	Operator	Discharge Grid Ref	Type	Receiving Water	Distance from Site (km)	Licenced Discharge Volume (Ml/d)
Benhall Water Recycling Centre	ASENF2052	Anglian Water Services Ltd	TM 3821 6056	Sewage Effluent	The Canal (minor tributary to River Fromus)	0.05	1.5

3.5 Soils

The Cranfield University Soilscapes website indicates that soils at and in the immediate vicinity of Site 10/ 11 consists of naturally wet, peaty, fen peat soils. The main risk to water protection is associated with the drainage of cultivated soils. Shallow groundwater and marginal ditches to most fields mean that the water resource is vulnerable to pollution from nutrients applied to the land. Drainage of peat containing sulphides will release extremely acid drainage water. The predominant land use is arable and horticulture.

3.5.1 Soil Survey

A shallow soil core survey was undertaken at the Benhall site on 09 April 2019. The surveys were split into Site 10 and Site 11, north and south of The Canal respectively. The transects are shown of Figure 3.4 and a summary of the soil survey is provided as a log of soil cores in Table 3.6 and 3.7; full site notes are given in Appendix D.

Site 10

Site 10 was sampled by four cores, which indicates the location of two zones suggested by the coring results. All four cores proved a sequence of silt loam over silty clay of peat within a depth of 125 cm. The upper surface of the silty clay is quite level across the Site, only varying between 21-28 cm below ground level (bgl).

Zone B is further away from the main channel and closer to the alderwood recorded from the western side of the Site. Both cores were located in shallow standing water and intense mottling was found almost at the ground surface. The vegetation indicates that water tends to sit at the surface into the first part of the growing season. Core 1 showed a strong groundwater response when the core reached peat at 72 cm bgl., with the water table rising to 10 cm bgl. No indication of groundwater was proved in core 2 as the core filled with standing water, however, it is assumed that a similar response to core 1 would be observed if the coring were repeated when the ground surface was dry. The groundwater is forced beneath the impermeable silty clay under sufficient pressure to allow a substantial rise through the core. It is noted that there had been little rainfall in the months preceding the survey.

Zone A was sampled by two cores which show a thinning of the silty clay in the vicinity of core 3 in the north of the Site and a thickening to the south and east. In comparison with Zone B, core 3 and 4 sample drier topsoil's where significant mottling is not encountered within the root zone. Notwithstanding, the water tables in both cores are more elevated than that initially recorded in Zone B.

Table 3.6 Site 10, Benhall – Log of soil cores

Core / Soil type	**1**	**2**	**3**	**4**
		cm bgl		
Silt loam	0	0	0	0
Silty clay	28	25	28	21
Peat	72	92	49	110
End of core	125	125	125	125
Mottling	2	2	41	44
Standing water	2	5		
Water table - initial	72	?	60	54
Water table - final	10	?	60	54

Site 11

Site 11 was sampled by three transects, which also indicates the location of three zones suggested by the coring results. Zone A consists of two small areas sampled along the margin between the sandy valley footslopes and the floodplain. Both cores have developed a peaty to humic topsoil.

Core 1 lies outside the historic floodplain with no evidence for sediment deposition. A comparatively shallow water table is indicative of near-surface groundwater flowing through sand. Core 6 has a thin (21 cm) band of silt loam over the subtending sands with no evidence of mottling. Within the body of sand, there is a shift from good oxygenation to poor at 35 cm, with manganiferous streaks present at a depth of 74 cm, which appears to be the water table level in this area.

Zone B is the riparian frontage of the floodplain. The variable intensities of mottling in the topsoil do not correspond well with the distribution of 'daisy lawns', but the three sample cores all proved thick beds of silty clay over the silt loam, with no subtending peat recorded. Core 4 did not prove clay until a depth of 85 cm, however, which may indicate substantial variations in the upper surface of the clay close to the main channel.

Depth to the water table in the sampled areas compared well with those of Zone A, suggesting that the bed of clay is maintaining the local water table near the main channel.

Zone C supports relatively thin layers of silt loam and silty clay over a bed of peat in the west of the Site, with the silty clay thickening eastwards between cores 7 and 8. There is also a change in the degree of topsoil waterlogging, with cores 5 and 7 exhibiting more impeded drainage than is the case in the area sampled by core 8. Core 5 – adjacent to core 6 – also recorded manganiferous streaks at the relatively shallow depth of 35 cm, in silt loam. Although the water table was not initially proved until a depth of 106 cm, it subsequently rose to near this level, 39 cm bgl. The water table was initially recorded in sands below the bed of peat; as the basal part of the peat was more degraded than the upper part this may indicate that the groundwater level is fluctuating through the lower part, though it may rise through the peat during periods of heavier rainfall.

Table 3.7 Site 11, Benhall – Log of soil cores

	Zone A		Zone B			Zone C		
Core / Soil type	**1**	**6**	**2**	**3**	**4**	**5**	**6**	**7**
				cm bgl				
Peaty top	0	0		0	0	0	0	
Humic silt loam		6	0					
Silt loam		14	20	2	3	5	4	0
Silty clay			38	33	85	28	31	21
Peat						45	41	94
Humic sands	4							
Sands	36	35				106		
End of core	91	125	125	125	125	125	125	125
Mottling	56	14	4	20	10	5	4	25
Manganiferous streaks		74				35		
Water table - initial	56	74	50	60	55	106	98	-
Water table - final	56	75	50	60	55	39	60	87

3.6 Geology

3.6.1 Superficial Deposits

BGS geological mapping indicates that the superficial deposits (Figure 3.6) underlying the Benhall site are Alluvial deposits of clay, silt, sand and gravel, associated with the River Fromus. Head deposits of clay, silt, sand and gravel are mapped at the western edge of the Alluvium close to the boundary of the Site. Quaternary sands and gravel of the Lowestoft Formation are present as the land surface gently rises beyond the floodplain of the River Fromus. Narrow bands of Crag sands are exposed on both sides of the River Fromus valley between the Alluvium / Head margins and the Lowestoft Sands. As the ground continues to

gently rise away from the valley the presence of Lowestoft Till is mapped and marks the separation of valleys in the locality, such as the neighbouring valley of the River Alde to the west.

3.6.2 Solid Geology

The solid geology (Figure 3.5) below the Site is the Quaternary Crag Group. BGS describe the Crag as mainly fine grained, locally shelly, micaceous sands with local rounded flint gravels. The sands are characteristically dark green from glauconite but weather bright orange with haematite 'iron pans'. The Crag is thought to have a thickness of 10-20 metres in the locality based on BGS borehole logs. To the south, including a small part of the Benhall site, the Crag is overlain by the younger Chillesford Church Sand Member comprising well sorted, fine-to medium-grained, micaceous, buff to pale brown, quartz sand.

The Crag lies unconformably on the London Clay Formation (Palaeogene) of the Thames Group. The London Clay Formation overlies the Harwich Formation or, where the Harwich Formation is absent, the Lambeth Group. The combined thickness of the Thames Group and Lambeth Group in this locality is thought be c. 25-30 metres in this locality based on local BGS borehole logs. The Lambeth Group lies unconformably over the Chalk Group.

A generalised geological succession for the local area is presented in Table 3.8.

Table 3.8 Simplified Stratigraphy of the Benhall site

Age	Group	Formation	Description
Quaternary		Alluvium	Silt, sand, clay, gravel
		Head	Peat, silt, sand, clay, gravel
		Lowestoft Formation	Diamicton. Chalky till, sandy silty clay. Located northwest of the Site.
			Sands and Gravels. Sands and gravels, silts and clays
	Crag Group	Norwich Crag Formation	Fine- to medium grained, micaceous sub-angular quartz sands, interbedded with clays. The sands are characteristically dark green from glauconite but weather bright orange with haematite 'iron pans'
Palaeogene	Thames Group	London Clay	Bioturbated or poorly laminated, blue-grey or grey-brown, slightly calcareous, silty to very silty clay, clayey silt and sometimes silt, with some layers of sandy clay.
	Lambeth Group	Reading Formation	Dominantly clay
Upper Cretaceous	Chalk Group	Chalk	Chalk, with or without flint and discrete limestone, marl (calcareous mudstone), sponge, calcarenite, phosphatic, hardground and fossil-rich beds.

3.6.3 BGS borehole logs

The closest geological log available to view online via the BGS website (TM35NE18) is based on a trial pit dug to 2.1m depth to the south of the A1094 road at the southern end of the Site. The log shows topsoil to 0.3m, Head moderate yellowish brown sand to 0.8m, yellow and orange fine to coarse grain glacial sand and gravel to 1.8m, and possible Chillesford Church Sand Member to >2.1m comprised of pale grey well sorted medium coarse sand.

The closest deeper borehole record is located 0.7km north of the Site (TM36SE5). Drilled to a depth of 76.8m it recorded 13.4m of glacial sands and gravels overlying 11.6m of Crag sands and clays. London Clay and Reading Beds were recorded between 25m and 50m, overlying the Chalk.

At a similar distance to the west of the Site, a borehole drilled to 59m (TM36SE131) recorded Crag (fine brown sand) between 1.5 and 15m deep, Clay to 39m deep, and Chalk to >59m deep.

A borehole drilled to 91.7m depth 1km northwest of the Site (TM36SE4) recorded Boulder Clay and sand to 14m, Crag to 22.6m, London Clay and Reading Beds to 45.7m, and Chalk to >91.7m.

On the eastern side of the River Fromus the closest deep borehole (TM36SE22) is located 1km north northeast and is drilled to a depth of 71.2m. This borehole records Crag to 20.7m, followed by London Clay and Reading Beds to 50m, and Chalk to >71.2m.

These borehole records are relatively consistent and highlight the variable cover of Till and Glacial Sands and Gravels in the River Fromus Valley.

3.6.4 Drilling programme

Geological information was recorded during the borehole drilling and installation programme between 5th and 23rd October 2020. Drilling logs are presented in Appendix B and a summary of the geology encountered is provided in Table 3.9 below. The monitoring network is shown in Figure 2.1.

Other boreholes in this locality have confirmed the presence of London Clay, Reading Beds and the Chalk, therefore the drilling programme focused on the shallower Superficial Deposits and the underlying Crag sands.

Three boreholes were drilled to a depth of 10m though the superficial Sands and Gravels. Crag was encountered at a depth of 7.7m in just one of the deeper boreholes (BHALL_1102_d) which is located close the western edge of the southern part of the Site. The other two deeper boreholes (BHALL_1101_d and BHALL_1001_d) both recorded the presence of Peat (2.3 to 4m thick).

Severn shallower dipwells were installed in the near surface deposits to a depth of 3m. Peat (*c.*0.6m thick) was only recorded in the southernmost dipwell (BHALL_1104_s).

Table 3.9 Summary of Benhall site geology

Name	Drillers ID	NGR	Ground Level (mAOD)	Drilled Depth (m bgl)	Depth to base of (m bgl)						Notes
					Topsoil	Alluvial Sands & Gravels	Peat	Alluvial Sand & Gravels	Crag	London Clay	
BHALL_1001_d	bh1001	TM 3824360485	3.906	10	0.31	1.6	5.7	10	-	-	Water seepage at 0.4m
BHALL_1001_s	ws1001	TM 38237 60625	4.347	3	0.7	3	-	-	-	-	Water seepage at 0.65m. Standing water at 0.48m.
BHALL_1002_s	ws1002a	TM 38287 60508	3.931	3	0.2	3	-	-	-	-	Water seepage at 0.32m. Standing water at 0.84m.
BHALL_1003_s	ws1003	TM 38240 60487	3.875	3	0.25	3	-	-	-	-	
BHALL_1101_d	bh1101	TM 38173 60414	3.906	10	0.3	2.45	4.8	10	-	-	Nested with BHALL_1101_s. Groundwater seepage at 1m. Wet at 2.3m
BHALL_1101_s	ws1101	TM 38173 60414	3.906	10	0.3	2.45	4.8	10	-	-	Nested with BHALL_1101_d. Groundwater seepage at 1m. Wet at 2.3m
BHALL_1102_d	bh1102	TM 38130 60268	3.920	10	0.9	7.7	-	-	10	-	Nested with BHALL_1102_s. Water strikes at 1m and 3.8m
BHALL_1102_s	ws1102	TM 38130 60268	3.920	10	0.9	7.7	-	-	10	-	Nested with BHALL_1102_d. Water strikes at 1m and 3.8m
BHALL_1103_s	ws1103	TM 38202 60405	3.952	3	0.2	3	-	-	-	-	Groundwater Seepage at 1.00m depth.
BHALL_1104_s	ws1104	TM 38105 60190	3.916	3	0.53	-	1.1	3	-	-	Groundwater struck at 0.80m depth, rising to 0.54m depth after 20 minutes

3.7 Hydrogeology

3.7.1 Aquifer designation

The Crag Formation is designated as a Secondary A aquifer. The Environment Agency describe Secondary A aquifer units as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

The Underlying Chalk Group is classified as a Principal aquifer which is characterised as consisting of layers of rock or drift deposits that have high intergranular and/ or fracture permeability, meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.

Groundwater resources are also assigned a vulnerability class based on soil type and the underlying geology. The groundwater resources in the area of the Proposed Development are mapped on the Magic web site[1] as Medium-High groundwater vulnerability.

3.7.2 Aquifer properties

Information on the hydraulic properties of the Crag near the Site has been obtained from BGS Major and Minor Property Manuals (BGS, 1997 and 2000) and from scanned borehole logs from BGS GeoIndex Onshore records online.

There are two Crag boreholes with associated aquifer property records identified within 2 km of the Benhall site. Borehole TM36SE125 200m west of the Site records a transmissivity value of 426 m^2/d; and 1.6km to the south an average Crag Transmissivity of 737 m^2/d is recorded at TM35NE92.

3.7.3 Springs

There are no springs identified within the vicinity if the Site on OS maps.

3.7.4 Groundwater levels and flow

Groundwater levels in the Crag were measured at Manor House (TM36/9311) 2.9km north of the Site between 1976 and 1999. During that period Crag Groundwater levels generally fluctuated between 9 and 10 mAOD and show typical seasonal variations.

The Hydrogeological Map of Southern East Anglia (Institute of Geological Sciences, 1981) maps both the Chalk and the Crag piezometric surface during August/September 1976. At the Benhall site the Crag levels are mapped slightly higher than the corresponding levels in the underlying Chalk, at approximately 6 mAOD and 4 mAOD respectively. Regional groundwater flow is towards the coast from west to east (Institute of Geological Sciences, 1981).

The soils core surveys carried out in April 2019 indicated that the initial water table was generally between 0.5m and 1 m bgl, rising to 0.4 and 0.1 m bgl at two locations after rest. The October 2020 drilling programme recorded similar rest ground water levels (0.48 to 0.84 m bgl).

Groundwater levels will be monitored at all installations listed in Table 2.3 for period of 12 months from November 2020 using electronic dataloggers set at 15 minute recording intervals.

[1] http://magic.defra.gov.uk/MagicMap.aspx

3.7.5 EA Regional Groundwater Modelling

The Environment Agency's North East Anglian Chalk (NEAC) Model has been developed through the Anglian Region Groundwater Strategy Framework. Data from the EA model have been made available to EDF Energy under a licence agreement for use in this study. The use of the regional groundwater model is the best available to cover the transient groundwater conditions that may affect the Site thus enabling better definition of long-term water level variation, drought conditions and the influence of fully licensed abstraction on water levels and flows.

The NEAC model comprises two main components:

- A recharge and runoff model that provides input data to the uppermost boundary of the groundwater flow model. This model uses the routing of rainfall, runoff and recharge (4R) code (Entec, 2006) to process the soil moisture balance, actual evapotranspiration (AE), interflow, runoff and recharge data on a daily time interval; and
- An eleven-layer groundwater model that simulates flow in the saturated zone, including the Sandringham Sands, Carstone, Chalk and Crag aquifers, as well as in the post-Chalk Eocene and Quaternary deposits. In the vicinity of Benhall, the layers representing pre-Chalk geology are inactive in the model.

The modelled representation of the observed geology is shown in Table 3.10. The model layers which are most relevant to this study are Layers 1-6.

Table 3.10 Geological Composition of Model Layers in NEAC

Layer Number	Description
1	Unconsolidated permeable recent and glacial deposits, e.g. Alluvium, Peat, River Terrace Deposits, upper Glacial Sands and Gravel.
2	Unconsolidated clays e.g. Glacial Till.
3	Unconsolidated sands and gravels which pre-date the Till e.g. lower Glacial Sands and Gravels, pre-glacial fluvial deposits (e.g. Bytham/Kesgrave Sands and Gravel), **Crag.**
4	London Clay.
5	Upper 20 m of saturated Chalk. The Lower London Tertiaries are also included in this layer where they exist in the model area.
6	Nominally, 80 m of saturated, 'lower' Chalk. The whole Chalk thickness (Layer 5 plus Layer 6) is nominally 100 m.

The Environment Agencies NEAC model extends over a total area of almost 15,500 km2; a common 200 m by 200 m fixed-mesh grid is used for both the 4R and MODFLOW components of the model, orientated parallel to the Ordnance Survey National Grid. The 4R and MODFLOW models were developed and calibrated on the basis of the field-based conceptual understanding and by comparison with observations of river flow and groundwater levels. The model simulation period is effectively between 1970 and 2018, nominally comprising monthly stress periods. For the purposes of providing input to the groundwater model the daily output from 4R is aggregated according to the number of days within each monthly stress period. The calibration status of the model in the vicinity of the Benhall Site (Alde and Ore catchment) is considered 'High'.

Modelled Groundwater Levels

Modelled groundwater levels for observation boreholes used in regional model calibration have been obtained to assess the overall performance of the groundwater model in the vicinity of the Benhall Site. Comparing the closest modelled and measured data for the observation borehole (OBH) at Manor House (TM36/9311) c. 1.1 km to the north-east of the site, shows that for the most part the historical modelling of the timing and magnitude of the seasonal and longer-term fluctuations of the Crag groundwater levels between is well represented, but the modelled groundwater level is approximately 1 m lower than the monitored Crag level. The modelled surface water flows of the River Fromus at Benhall Bridge show a reasonably good representation of the model, although some of the peaks are overrepresented in the model. It is noted in the calibration report that the observed data is suspect.

Modelled historic groundwater levels in the Crag show that the general flow of groundwater is from north-west to south-east and is deflected towards the River Fromus in all the modelled scenarios; 'dry' (August 1991), 'average' (May 1994) and 'wet' (March 2001) months with the Crag groundwater levels modelled at around 4 mAOD. As would be expected, groundwater levels are higher in the wet period (minimum at around ~ 4 mAOD), and lowest in the dry period (maximum at around ~ 4 mAOD).

The historic water table modelled at the site shows that the water table flow is generally from north-west to south in the wet and average periods, with water deflected towards the River Fromus. In the dry period, groundwater levels are from north to south following along the river corridor. The modelled water table is around 3 mAOD in the dry period, at around 4 mAOD in the average and wet periods.

The model shows that for the most part, the depth the water table in the model cells around between 0.9 m and 1.2 m below ground level in the example 'average' month. The modelled data indicated an average annual water level fluctuation of between 6 cm and 35 cm a year.

Comparing the historic modelled time series to theoretical Full Licensed (FL) abstraction conditions (where all abstractions are operating at maximum abstraction quantities throughout the modelled time series) indicates that FL abstraction would make very little difference to the water levels in the Crag at the site, with a very small reduction in the Crag groundwater levels of between 10 and 14 cm during the example 'dry' period.

3.7.6 Groundwater abstractions and protection zones

Licensed groundwater abstractions

The Environment Agency lists five groundwater abstraction licences within 2km of the Benhall site, as summarised in Table 3.11. No returns data has been provided by the Environment Agency. The locations of licensed groundwater abstractions within 2km of the Benhall Site are shown on Figure 3.7.

Three of these abstractions are sourced from the superficial deposits as multiple well points, whereas the two borehole abstractions take water from the Crag. The borehole at Ham Farm (7/35/04/*G/0095) is relatively close to, and upgradient of, the Site and therefore has the potential to impact groundwater levels on the Site, although an impact is likely to be minimal due to the relatively low abstraction quantities.

Table 3.11 Licensed groundwater abstractions within 2km of the Benhall site

Licence No.	Operator (Name)	Purpose	Description of Source	Aquifer	Max annual Abstraction Quantity (TCMA)	Max Daily Abstraction Quantity (Ml/d)	Distance from site (km)
7/35/04/*G/0001	Ham Farm	Spray Irrigation - Direct	20 well points	Sand & Gravels	33.40	0.46	0.7 S

Licence No.	Operator (Name)	Purpose	Description of Source	Aquifer	Max annual Abstraction Quantity (TCMA)	Max Daily Abstraction Quantity (Ml/d)	Distance from site (km)
7/35/04/*G/0090	Marsh Farm	Spray Irrigation - Direct	17 well points	Sand & Gravels	30.60	0.50	0.5 NE
7/35/04/*G/0094	Sink & Mill Farms	Spray Irrigation - Direct	19 well points	Sand & Gravels	22.70	0.82	0.7 W
7/35/04/*G/0095	Ham Farm	Spray Irrigation - Direct	Borehole	Crag	19.70	0.25	0.2 W
7/35/04/*G/0103	The Ramblers	Spray Irrigation - Direct	Borehole	Crag	6.88	0.05	1.8 WNW

Deregulated groundwater abstractions

The Environment Agency has provided details of three deregulated groundwater abstractions within 2km of the Benhall site. These abstractions are related to agricultural purposes of less than 20 m^3/d. The current status of these abstractions is not known.

Private water supplies

Records of private water supplies (unlicensed) are held by East Suffolk Council. East Suffolk Council have provided maps showing the locations of thirteen private water supplies within 2km of the Site. The supplies shown all abstract a volume of less than 10m^3 per day. The majority abstract less than 1m^3 per day. All are either a borehole or well supply. None of the listed supplies are close enough to the Site to be any interest for the purpose of this study.

Source protection zones

Groundwater source protections zones (SPZ) identified in relation to the Benhall site are shown on Figure 3.8. The Benhall site does not fall with a designated groundwater SPZ. The closest SPZ boundaries are some distance away (greater than 2km) from the Site and are associated with the covered reservoir to the northwest at Benhall Street, abstraction at Saxmundham to the north and public water supplies at Leiston to the northeast.

3.7.7 Nitrate Vulnerable zones

Nitrate Vulnerable Zones (NVZs) are areas designated as being at risk from agricultural nitrate pollution. The Benhall Site is located within an NVZ.

3.7.8 Groundwater quality

Groundwater quality will be monitored at all installations listed in Table 2.3 for period of 12 months with a mix of monthly in-situ water quality readings and quarterly water quality sampling and laboratory analysis for major determinands.

3.8 Water Framework Directive water body status

River Basin Management Plans (RBMPs) are drawn up for the eleven river basin districts in England and Wales as a requirement of the Water Framework Directive (WFD). The plans have been developed by the Environment Agency through consultations with organisations and individuals. The plans are designed to protect and improve the quality of the water environment, providing information on what needs to be done to tackle water issues, i.e., measures to improve water quality in rivers, lakes, estuaries, coasts and in groundwater. The Benhall site is located within the area covered by the Anglian RBMP (Environment Agency, 2015). River Basin Districts are divided into Management Catchments, which are further divided into Operational Catchments, within which there are sub-catchment water bodies.

With respect to surface water, the Benhall site is located in the River Fromus surface water body (GB105035045980) which has not been designated as artificial or heavily modified. In the 2019 WFD classification (Cycle 2) the water body had an overall classification of 'Poor' based on a 'Poor' ecological status and failing chemical status.

The ecological elements were classified as 'Poor' for fish and 'Good' for invertebrates and combined macrophytes and phytobenthos in the biological quality elements class. The hydrological regime and morphology 'Supports Good'. In the physico-chemical quality elements classification, dissolved oxygen is classified as 'Bad' and phosphate as 'Moderate', all other elements are 'High' (near natural conditions). Reasons for not achieving good status and reasons for deterioration include:

- For Invertebrates - Sewage discharge (continuous), poor soil management, poor livestock management
- For Fish – Transport drainage, ecological discontinuity (barriers), trade/industry discharge
- For Dissolved oxygen - Drought

The chemical status fails due to persistent chemicals, such as brominated flame retardants and mercury which is a common theme across much of England in the 2019 classifications.

In terms of groundwater, the Benhall site is located within the Waveney and East Suffolk Chalk & Crag groundwater body (GB40501G400600). In the 2019 WFD classification (Cycle 2) the Waveney and East Suffolk Chalk & Crag groundwater body was classified as at 'Poor' quantitative status due to the quantitative dependent surface water body status of 'Poor'. The groundwater chemical status was also classified as 'Poor'.

3.9 Water resources

The Benhall site lies within the Environment Agency's East Anglia (Map area 10) Abstraction Licencing Strategies (ALS) (CAMS process) area. The East Suffolk ALS covers a catchment area of approximately 1,364 km^2 and includes the Benhall site. Water availability is calculated at Assessment Points (APs) and AP6 is relevant to the Benhall site because it covers the River Fromus upstream of the confluence with the River Alde (NGR TM 38828 57670).

At AP6, to the south of the Benhall site, water is available for licensing at Q30 and Q50 flows but is restricted at Q70 and Q95 flows. Water becomes available for licensing at Q58 and there is a Hands-Off Flow (HOF) restriction of 5 Ml/d. Applications for new consumptive summer abstractions will not be accepted by the Environment Agency except during higher flows.

Groundwater management units (GWMUs) are assigned to the groundwater bodies (Principal aquifers) for the purposes of local groundwater availability assessment in ALSs. The Benhall site is located within the East Suffolk Chalk and Crag GWMU, where resource availability is designated as 'restricted water available' in the Fromus catchment. Opportunities for new consumptive groundwater licenses are very limited due to the

impact of abstraction on low flows in overlying surface water bodies and the level of resource available in the aquifers.

3.10 Designated conservation sites

There are no statutory designated sites present on-site, however, there is one within 2km: Gromford Meadow SSSI located 1.1km south of the Site.

The site falls within the Impact Risk Zone for Gromford Meadows SSSI, located 1.1km south, and also for the Alde-Ore Estuary and other nearby SSSI. Creation of fen meadow does not, however, fall within the criteria that would require consultation with Natural England in respect of risk to these SSSIs.

A compartment of Manor Farm CWS is located within the red line boundary, and a further compartment is located adjacent to the western Site boundary (Figure 2.1). There are a further three non-statutory designated sites within 1km. One, Foxburrow Wood CWS, is also designated as ancient woodland.

The interest features of the designated sites are summarised in Table 3.122 and locations are shown in Figures 3.9.

Table 3.12 Designated Nature Conservation Sites

Designation	Distance from Site Boundary	Description
Statutory Designated Sites within 2km		
Gromford Meadow SSSI	1.1km south.	The site consists of unimproved base-rich marsh on an alluvial soil with a high organic content. It borders the River Alde and is fed by springs. It is species-rich and contains a variety of characteristic fen meadow and marshland plants.
Non-Statutory Designated Sites within 1km		
Manor Farm Meadows CWS	The CWS consists of two meadows, one of which is located adjacent to the western site boundary and the second forms a small part of the north-western end of the Site.	The CWS site consists of small wet meadows which support good wet grassland flora typical of lowland grazing meadows (biodiversity priority habitat), with the wettest areas near the drains consisting of fen. The second meadow, part of which lies within the boundary of the Site, contains a richer flora with good colonies of southern march orchids and a greater diversity of marsh flowers. Floristic diversity has benefited from traditional grazing in the past, preventing it from becoming rank and overgrown, reducing diversity.
Benhall Green Meadows CWS	0.42km north	A series of meadows which form one of the largest remaining areas of flower-rich marsh in the Alde catchment. They are bordered by the River Fromus and contain a wide range of wet meadow plants. The site is managed by a combination of hay cutting and/or grazing.
River Fromus Marshes CWS	0.97km south	The site consists of complex habitats bordering the River Fromus at Gromford which include drier open areas of bracken with scattered oak standards, river banks with sallow and overhanging willows, managed areas which have been planted with oak and field maple, and wet marshland with old willows and willow/alder carr. A wet meadow located to the south of Gromford Meadow SSSI contains similar species rich flora.
Foxburrow Wood CWS (which includes two Ancient	0.74km south	The site is an ancient woodland on sandy soils with a variety of tree species including oak, ash beech (some very mature), hazel, field maple, hawthorn and hornbeam. The

Designation	Distance from Site Boundary	Description
woodland sites Foxburrow and Palent's Grove)		shrub layer includes elder and holly, and the ground flora includes ferns, bluebells and dog's-mercury.

3.11 Landfills

One authorised landfill lies within the search area (Figure 3.10), approximately 1.8km to the west of the Proposed Development at Storridge Lane (NGR ST 3183 0404).

There are also four historic landfills within 3km of the Proposed Development (Figure 3.10), with the closest 400m to the northeast of the Proposed Development at Batemans Pit (NGR ST 3420 0420).

4. Conceptual understanding

This section presents a summary of the conceptual understanding for the Benhall site and focuses on the main elements which will influence the feasibility of creating fen meadow habitat at this site. The conceptual model is illustrated by a schematic cross section (Figure 4.1) across the River Fromus valley through the centre of the northern part of the Site (site 10), showing the relationship between ground level, groundwater levels, surface water levels and logged geological strata.

The conceptual site model has been developed using all information presented in this desk study including results of the topographic survey and drilling logs for the groundwater monitoring installation points.

The conceptual model for Benhall site is outlined as follows:

- The Benhall site covers an area of 12.9 ha. The Site can be considered as two land packages, site 10 in the north and site 11 in the south. A primary locus area for fen meadow is identified in both sites, along with areas for potential additional fen meadow (Figure 1.1). Annual average rainfall is for the area is *c.*606 mm.
- The surface elevation across much of Site 10 and the northern half of Site 11 is relatively flat, generally between 3.8 and 4.0 mAOD. At the margins of the site the land surface rises to 6.7 mAOD in the northwest near Aldecar Lane and to 5.2 mAOD in the southwest. The lower half of Site 11 has a more well defined slope from west to east towards the River Fromus and contains a cut-off meander channel with a bed level of approximately 3.5 mAOD.
- The River Fromus forms the eastern boundary of the Site and flows from north to south.
- The Benhall site is located in Flood Zone 3 (high probability of flooding) and falls within the high risk category with a greater than 3.3% chance of flooding from the River Fromus each year.
- Site 10 and 11 are separated by an ordinary watercourse named 'The Canal' which originates to the west of the A12 road. The Canal passes at right angle past two sides of the Benhall Sewage Treatment works before turning east again and discharging to the River Fromus. The Canal is the receiving watercourse for the Benhall Sewage Treatment Works discharge.
- The Benhall site is criss-crossed by a network of land drainage ditches which discharge to the River Fromus at three locations across the site.
- Data obtained from the topographic surveys initially indicate that water levels coming on to the site from the west via the Canal are around 3.9 mAOD and on-site drainage ditches generally between 3.5 and 3.8 mAOD (November 2020). Ditch water level are slightly lower in the southern half of Site 11 (Ditch W12 and W13) which do not appear to be well connected to other ditches or to the River Fromus.
- The bedrock geology at the site is Crag sands (c.10-20m thick) overlying London Clay of the Thames Group. The combined thickness of the Thames Group and Lambeth Group in this locality is thought be c. 25-30 metres in this locality. The Lambeth Group lies unconformably over the Chalk Group.
- Alluvial deposits of clay, silt, sand and gravel directly overlie the Crag at the Benhall site and borehole logs indicate that they increase in thickness from around 7.7m in the south to >10m in the north of the Site. Head deposits of clay, silt, sand and gravel are mapped at the western edge of the Alluvium close to the boundary of the Site.

- Development of Peat has occurred in the northern half of Site 11 and in Site 10 and is encountered between 0.4 and 2.5 m below ground surface. The borehole logs indicate a peat thicknesses of up to 4 m thick in places (Piezometer BHALL_1001_d). with a thickness of 1.1m at borehole HAL_2803_d. Soils cores show that a silty clay layer is often present above the Peat which may hold a higher water level than that of the underlying sands and gravels. The basal part of the peat was more degraded than the upper part in some areas (Zone C Site 11) which may indicate that the groundwater level is fluctuating through the lower part, though it may rise through the peat during periods of heavier rainfall.
- The soils core surveys carried out in April 2019 indicated that the initial water table was generally between 0.5m and 1m below ground level, rising to 0.4 and 0.1m below ground level at two locations after rest. The rising groundwater levels indicates that water in the peat and sands and gravels beneath the silty clay layer near the surface has a positive hydrostatic pressure in some locations. The October 2020 drilling programme recorded similar rest ground water levels (0.48 to 0.84m). General groundwater flow is thought to be towards the River Fromus (west to east) but collected data from the surveys suggest a relatively flat water table at the Benhall site.
- The soil core surveys, drilling logs and topographic survey indicate that groundwater levels are in continuity with surface water levels in the on-site ditches. The River Fromus has a bed level of 2.8 mAOD and a water level of 3.51 mAOD at the northern end of the Benhall site and this gently decreases downstream to a bed level of 2.3 mAOD and a water level of 2.9 mAOD at the southern end of the Benhall site, indicating the potential for groundwater discharge to the river.
- There is a licenced surface water abstraction from the River Fromus on the edge of the Site 11 boundary (AN/035/0004/017), although this is toward the downstream end of the site away from the potential Fen Meadow areas. The groundwater abstraction at Ham Farm (7/35/04/*G/0095) is relatively close to (0.2km), and upgradient of, the Site and therefore has the potential to impact groundwater levels on the Site. The impact is likely to be minimal due to the relatively low abstraction quantities.
- The River Fromus is gauged at Benhall Bridge (Ref No. 35016), *c.*1.2km upstream of the Benhall site. The average flow is 0.059 m^3/s (5.1 Ml/d). The Benhall Sewage Treatment Works discharge to The Canal which flows through the Site and discharges to the River Fromus. The licensed discharge volume is 1.5 Ml/d.

Water levels will be continuously monitored at all on-site groundwater and surface water installations for period of 12 months from November 2020 to further develop and refine this conceptual understanding. Hydrochemical sampling (monthly in-situ readings and quarterly laboratory analysis) will also take place at selected installations to aid conceptualisation of water supply mechanisms to the site and to quantify the extent/variability of distinctive/essential chemistry (salinity/nutrient status/alkalinity) associated with ecological features.

5. References

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Figures

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262000 261000 260000 259000

N

Key

- Site 10 _11 boundary
- River
- Primary locus fen meadow
- Potential locus fen meadow

0 250 500 750 m

Scale at A3: 1:15,000

Fen Meadow Compensation Sites:
Benhall Site 10_11
Baseline Hydrogeological Report

Figure 1.1
Site location plan

January 2021

wood.

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The Canal

Honey Pot Lodge

Aldecar La

Manor Farm House

River Fromus

Watering La

Watering Fm or Watering Farm

Hillcrest

Monks Valley House

A1094

BHAL_LS1

SNP-GB04

GB04

SNP-GB03

GB03

DS1

BHALL_1001_s

SNP-GB05

GB05

DS3

BHAL_LS2

DS2

BHAL_LS3

DS4

SNP-GB02

GB02

BHALL_1002_s

BHALL_1003_s

BHALL_1001_d

BHAL_LS4

DS5

BHALL_1101_s

BHALL_1101_d

BHALL_1103_s

BHAL_LS5

BHALL_1102_d

BHALL_1102_s

SNP-GB01

GB01

BHAL_LS6

BHALL_1104_s

BHAL_LS7

BHAL_LS8

SF05

SNP-SF05

Key

- Site 10 _11 boundary
- River
- Gaugeboard
- Dipwell
- Piezometer
- Long section
- Cross section
- Ditch section

0 50 100 150 200 m

Scale at A3: 1:3,500

Fen Meadow Compensation Sites:
Benhall Site 10_11
Baseline Hydrogeological Report

Figure 2.1
Monitoring installations and topographic section lines

January 2021

wood.

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Key

Site 10 _11 boundary

River

Topographic contour (m)

Note: Topographic data on-site extrapolated from WSP November 2020 survey

0 50 100 150 200 250 300 m

Scale at A3: 1:5,000

Fen Meadow Compensation Sites:
Benhall Site 10_11
Baseline Hydrogeological Report

Figure 3.1
Site topography

January 2021

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W3
W1
W2
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W8
W9
W10
W11
W12
W13
SNP-GB04
SNP-GB03
SNP-GB05
SNP-GB02
SNP-GB01
SNP-SF05
Benhall Bridge GS
Benhall RG BENHAR
Benhall STW

River Fromus
Kiln La
Boundary House
Leekhill Plantation
Ash Belt
Main Rd
School La
B1121
Church Hill
The St
High Bank Cottages
Grays La
Enchanted Cottage
A12
Dunstall Covert
The Wilderness
Church Bungalow
Mitford Rd
Home Farm
Walnut Tree Farm
Stewart's Covert
Mitford House
Benhall Green
Mill La
Sandy La
Sternfield
Aldecar La
Red La
Park Rd
The Canal
Honey Pot Lodge
Meadowcroft
Rudley's Grove
The Old Police House
Manor Farm House
Warning La
Hillcrest
Mollett's Farm
A1094
Friday Street
Monks Valley House
Foxburrow Wood
Palant's Grove
Farnham Hall Farm House
Racewalk Covert
Botany Farm
Walk Barn Farm
Snape Watering
Farnham Rd

Key
- Site 10 _11 boundary
- River
- Waterbody
- Flow gauge
- Rain gauge
- Discharge
- Gaugeboard

0 100 200 300 400 500 600 m
Scale at A3: 1:10,000

Fen Meadow Compensation Sites:
Benhall Site 10_11
Baseline Hydrogeological Report

Figure 3.2
Hydrology - rain and flow gauges, rivers, ponds

January 2021

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Honey Pot Lodge

Aldecar La

Manor Farm House

Watering La

Watering Fm or Watering Farm

Hillcrest

Monks Valley House

A1094

W1

W2

W3

W4

W5

W6

W7

W8

W9

W10

W11

W12

W13

W14

Not present

Key

Site 10_11 boundary

Running water

W1 Ditch number

0 50 100 150 200 m

Scale at A3: 1:3,500

Fen Meadow Compensation Sites:
Benhall Site 10_11
Baseline Hydrogeological Report

Figure 3.3
Ditch network

January 2021

wood.

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Honey Pot Lodge

Aldecar La

Manor Farm House

Watering La

Watering Fm or Watering Farm

Hillcrest

Monks Valley House

Zone A

Zone B

Zone C

1

2

3

4

5

6

7

8

Key

Site 10_11 boundary

Zone boundary

Soil core sample location

0 50 100 150 200 m

Scale at A3: 1:3,500

Fen Meadow Compensation Sites:
Benhall Site 10_11
Baseline Hydrogeological Report

Figure 3.4
Soil core survey

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wood.

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N

Key

- Site 10 _11 boundary
- Discharge
- Dipwell
- Gaugeboard
- Piezometer

Bedrock geology

- RED CRAG FORMATION - SAND
- CRAG GROUP - SAND
- CHILLESFORD CHURCH SAND MEMBER - SAND

0 250 500 750 m

Scale at A3: 1:15,000

Fen Meadow Compensation Sites:
Benhall Site 10_11
Baseline Hydrogeological Report

Figure 3.5
Bedrock geology

January 2021

wood.

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262000 261000 260000 259000

N

The Canal

River Fromus

River Alde (fluvial)

River Ore (fluvial)

Key

- Site 10 _11 boundary
- Discharge
- Dipwell
- Gaugeboard
- Piezometer

Superficial geology

- ALLUVIUM - CLAY, SILT, SAND AND GRAVEL
- LOWESTOFT FORMATION - DIAMICTON
- LOWESTOFT FORMATION - CLAY AND SILT
- LOWESTOFT FORMATION - SAND AND GRAVEL
- HEAD - CLAY, SILT, SAND AND GRAVEL

Bedrock geology

- RED CRAG FORMATION - SAND
- CRAG GROUP - SAND
- CHILLESFORD CHURCH SAND MEMBER - SAND

0 250 500 750 m

Scale at A3: 1:15,000

Fen Meadow Compensation Sites:
Benhall Site 10_11
Baseline Hydrogeological Report

Figure 3.6
Superficial geology

January 2021

wood.

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261000 260000 259000 258000

N

7/35/04/*G/0103
7/35/04/*G/0090
7/35/04/*G/0095
7/35/04/*G/0094
AN/035/0004/017
7/35/04/*G/0001
7/35/04/*S/0080

The Canal
River Fromus
River Alde
River Alde (fluvial)
River Ore (fluvial)

Key

Site 10 _11 boundary

River

Groundwater abstraction (Non-PWS)

0 100 200 300 400 500 600 700 800 900 m

Scale at A3: 1:15,000

Fen Meadow Compensation Sites:
Benhall Site 10_11
Baseline Hydrogeological Report

Figure 3.7
Groundwater abstractions

January 2021

wood.

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263000 262000 261000 260000 259000 258000

N

Key

- Site 10 _11 boundary
- River
- Groundwater abstraction (Non-PWS)

Groundwater Source Protection Zone

- SPZ 1
- SPZ 2
- SPZ 3

7/35/04/*G/0103
7/35/04/*G/0090
7/35/04/*G/0095
7/35/04/*G/0094
AN/035/0004/017
7/35/04/*G/0001
7/35/04/*S/0080

River Alde (fluvial)
River Ore (fluvial)
The Canal
River Fromus
Tributary of River Alde, Friston

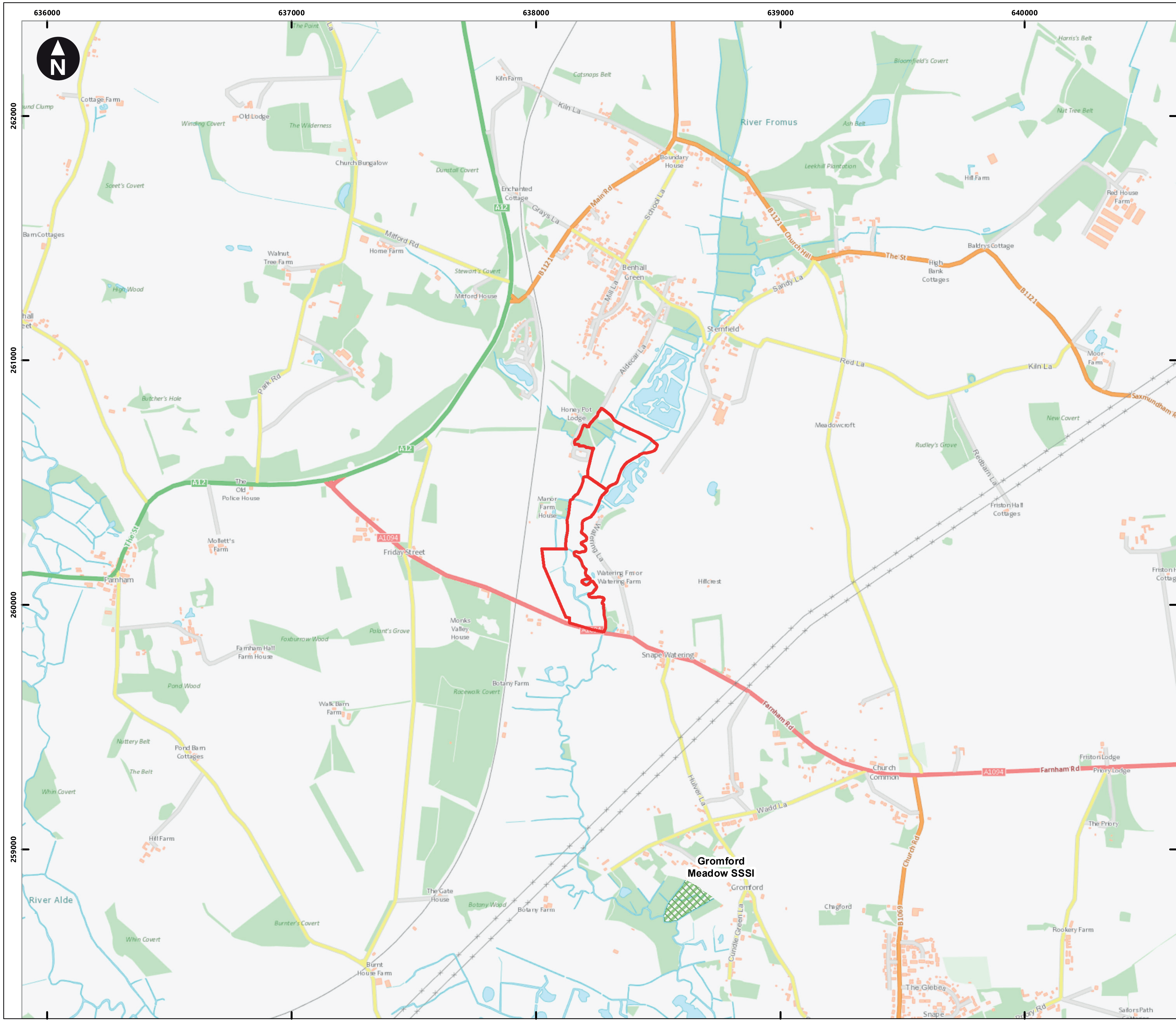
0 250 500 750 1,000 m
Scale at A3: 1:20,000

Fen Meadow Compensation Sites:
Benhall Site 10_11
Baseline Hydrogeological Report

Figure 3.8
Groundwater source protection zones

January 2021

wood.



Key

Site 10_11 boundary

Site of Special Scientific Interest (SSSI)

0 250 500 750 m

Scale at A3: 1:15,000

Fen Meadow Compensation Sites:
Benhall Site 10_11
Baseline Hydrogeological Report

Figure 3.9
Designated conservation sites

December 2020

wood.

40773-WOOD-XX-XX-FG-OW-0022_S0_P01.1

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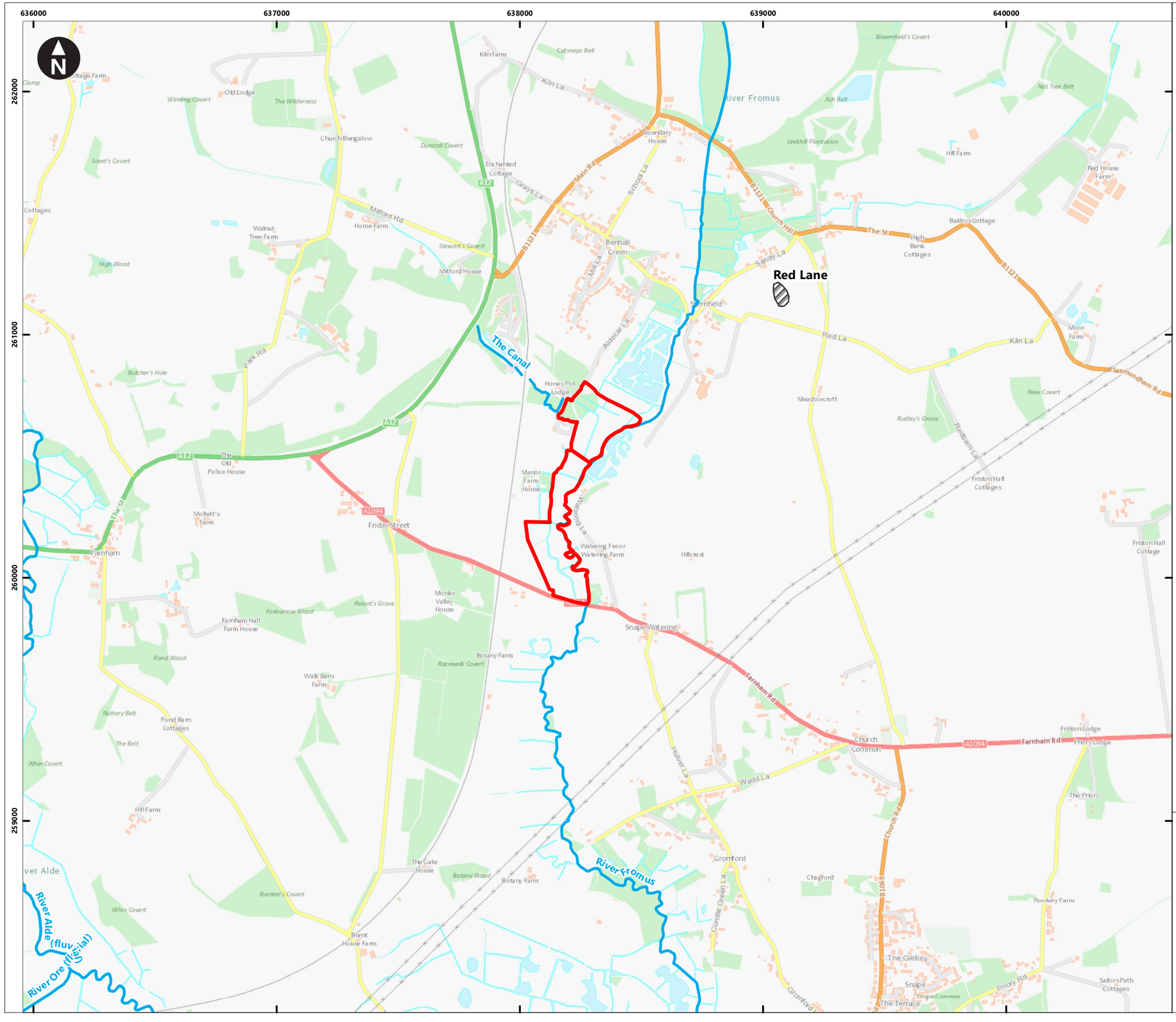
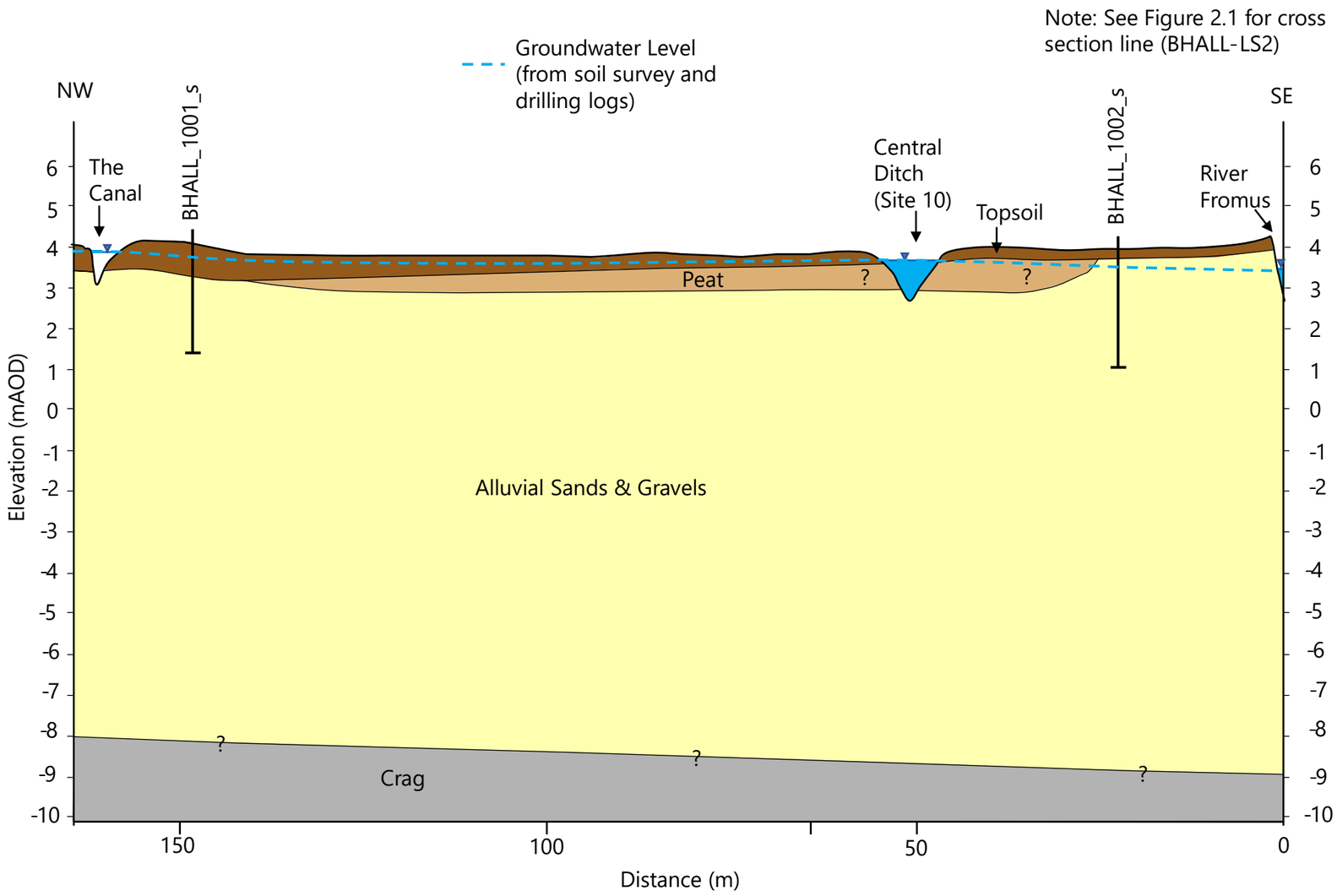


Fen Meadow Compensation Sites:
Benhall Site 10_11
Baseline Hydrogeological Report

Figure 3.10
Landfills

January 2021

wood.



Key

- Topsoil
- Peat
- Alluvial sand and gravels
- Crag
- Groundwater level

Fen Meadow Compensation Sites:
Benhall Site 10_11
Baseline Hydrogeological Report

Figure 4.1
Schematic cross section

January 2021

wood.

Appendix A
Gaugeboard Installation Report

SIZEWELL C – MONITORING INSTALLATION REPORT

TO	[redacted]	**FROM**	[redacted]
DATE	**24 November 2020**	**CONFIDENTIALITY**	**Confidential**
AUTHOR	[redacted]	**REVIEWED**	[redacted]
PROJECT	**70075143 - Sizewell C Hydrometric Monitoring**		
SUBJECT	**SIZEWELL C - FEN MEADOW MONITORING INSTALLATION REPORT**		

INTRODUCTION

This report documents the surface water level monitoring installations installed across two potential fen meadow compensation sites in Suffolk (Site 28 [Halesworth] and Sites 10/11 [Snape]) by WSP and OTT Hydrometry. This programme of works took place over the period 12th – 16th October 2020 and was undertaken as part of the Sizewell C Fen Meadow Strategy, on behalf Wood.

Access routes, monitoring equipment locations, data logger specifications and datum information is presented in this document.

INSTALLATION SUMMARY

Site 28 - Halesworth

A total of four gaugeboards (of which 3 include stilling wells and water level data loggers) were installed at Site 28 – Halesworth.

Site 28 - Halesworth				
Ref.	**HAL-GB01**	**HAL-GB02**	**HAL-GB03**	**HAL-GB04**
GPS Grid Ref.*	TM 39161 76703	TM 39185 76674	TM 39132 76581	TM 39080 76655
Gaugeboard Length (m)	1	1	2	1
Data Logger	OTT Orpheus Mini	OTT Orpheus Mini	OTT Orpheus Mini	n/a
Logger S/N	OM-453494	OM-453491	OM-453497	n/a
Sensor S/N	R806AF01010	R806BA01010	R6059601010	n/a
Range (m)	4	4	4	n/a
Cable Length (m)	3	3	4	n/a

Sites 10/11 Snape

A total of five gaugeboards (of which all 5 include stilling wells and water level data loggers) were installed at Sites 10/11 – Snape.

Sites 10/11 - Snape					
Ref.	**SNP-GB01**	**SNP-GB02**	**SNP-GB03**	**SNP-GB04**	**SNP-GB05**
GPS Grid Ref.*	TM 38130 60235	TM 38249 60509	TM 38207 60658	TM 38350 60725	TM 38300 60618
Gaugeboard Length (m)	1	1	1	2	2
Data Logger	OTT Orpheus Mini	OTT Orpheus Mini	OTT Orpheus Mini	OTT Orpheus Mini	OTT Orpheus Mini
Logger S/N	OM-453493	OM-453492	OM-453498	OM-453495	OM-453496
Sensor S/N	R806B601010	R8076501010	R8076A01010	R8068D01010	R806BD01010
Range (m)	4	4	4	4	4
Cable Length (m)	3	3	2.5	3	4

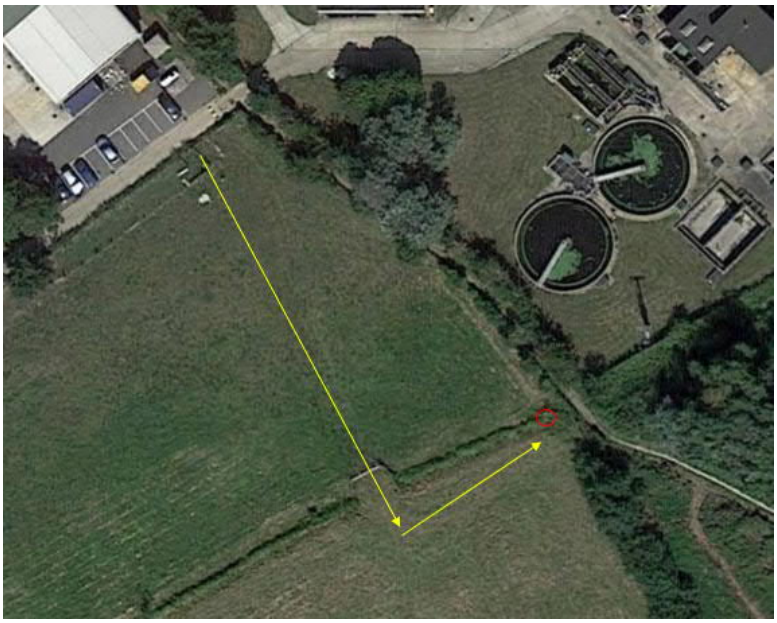
A full topographic survey of Site 28 – Halesworth, and Sites 10/11 Snape is planned shortly and this will include topo surveys of all of the above gaugeboard locations including gaugeboard datum elevations to enable water level data analysis relative to Ordnance Datum (mAOD).

*Please note that the GPS co-ordinates provided in the above tables are from hand held field GPS units with accuracy of +/- 15 metres recorded during the installation phase.

SITE 28 HALESWORTH – HAL-GB01

Installation Name: HAL-GB01		
Equipment Installed: OTT Orpheus Mini - OM-453494	**Logging Interval:** 15 minutes	**OS Grid Reference:** TM 39161 76703
Datum Level: Awaiting Survey	**Datum:** Base of Gaugeboard	**Gaugeboard Length**: 1m

Location Map:



Installation Notes: Deep water, significant vegetation.

SITE 28 HALESWORTH – HAL-GB02

Installation Name: HAL-GB02		
Equipment Installed: OTT Orpheus Mini - OM-453491	**Logging Interval:** 15 minutes	**OS Grid Reference:** TM 39185 76674
Datum Level: Awaiting Survey	**Datum:** Base of Gaugeboard	**Gaugeboard Length**: 1m

Location Map:

Installation Notes: Deep sediment.

SITE 28 HALESWORTH – HAL-GB03

Installation Name: HAL-GB03		
Equipment Installed: OTT Orpheus Mini - OM-453497	**Logging Interval:** 15 minutes	**OS Grid Reference:** TM 39132 76581
Datum Level: Awaiting Survey	**Datum:** Base of Gaugeboard	**Gaugeboard Length**: 2m

Location Map:

Installation Notes: Cable coiled within stilling well.

SITE 28 HALESWORTH – HAL-GB04

Installation Name: HAL-GB04		
Equipment Installed: N/A	**Logging Interval:** N/A	**OS Grid Reference:** TM 39080 76655
Datum Level: Awaiting Survey	**Datum:** Base of Gaugeboard	**Gaugeboard Length**: 1m

Location Map:

Installation Notes: Not logged.

SITES 10/11 SNAPE – SNP-GB01

Installation Name: SNP-GB01		
Equipment Installed: OTT Orpheus Mini - OM-453493	**Logging Interval:** 15 minutes	**OS Grid Reference:** TM 38130 60235
Datum Level: Awaiting Survey	**Datum:** Base of Gaugeboard	**Gaugeboard Length**: 1m

Location Map:

Installation Notes: Watch barbed wire at ankle level.

SITES 10/11 SNAPE – SNP-GB02

Installation Name: SNP-GB02		
Equipment Installed: OTT Orpheus Mini - OM-453492	**Logging Interval:** 15 minutes	**OS Grid Reference:** TM 38249 60509
Datum Level: Awaiting Survey	**Datum:** Base of Gaugeboard	**Gaugeboard Length**: 1m

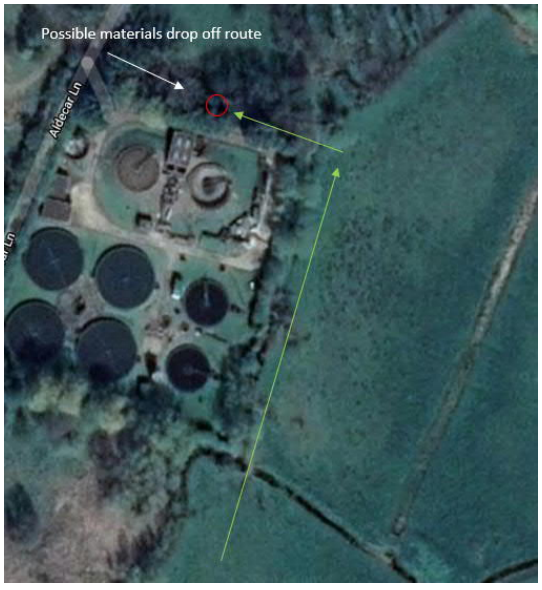
Location Map:

Installation Notes: Deep ditch.

SITES 10/11 SNAPE – SNP-GB03

Installation Name: SNP-GB03		
Equipment Installed: OTT Orpheus Mini - OM-453498	**Logging Interval:** 15 minutes	**OS Grid Reference:** TM 38207 60658
Datum Level: Awaiting Survey	**Datum:** Base of Gaugeboard	**Gaugeboard Length**: 1m

Location Map:



Installation Notes: Watch barbed wire fence.

SITES 10/11 SNAPE – SNP-GB04

Installation Name: SNP-GB04		
Equipment Installed: OTT Orpheus Mini - OM-453495	**Logging Interval:** 15 minutes	**OS Grid Reference:** TM 38350 60725
Datum Level: Awaiting Survey	**Datum:** Base of Gaugeboard	**Gaugeboard Length**: 2m

Location Map:

Installation Notes: Moved due to Water Voles at original location. Very deep water.

SITES 10/11 SNAPE – SNP-GB05

Installation Name: SNP-GB05		
Equipment Installed: OTT Orpheus Mini - OM-453496	**Logging Interval:** 15 minutes	**OS Grid Reference:** TM 38300 60618
Datum Level: Awaiting Survey	**Datum:** Base of Gaugeboard	**Gaugeboard Length**: 2m

Location Map:

Installation Notes: Springy reed layer in water column. Cable coiled within stilling well.

Appendix B
Drilling Logs – Groundwater Monitoring Installations

KEY TO EXPLORATORY HOLE LOGS - SUMMARY OF ABBREVIATIONS

ADDITIONAL NOTES

1. All soil and rock descriptions and legends in general accordance with BS EN ISO 14688-1, 14688-2, 14689-1, and BS5930:2015.
2. Material types divided by a broken line (- - -) indicates an unclear boundary.
3. Fracture spacings (If) quoted in the Description of Strata for specific strata or specific fracture sets are also quoted in mm, e.g. (25/80/230) referring to (Min/Avg/Max).
4. The data on any sheet within the report showing the AGS icon is available in the AGS format.

Structural Soils Ltd, Head Office - Bristol: The Old School, Stillhouse Lane, Bedminster, Bristol, BS3 4EB. Tel: 0117-947-1000, Fax: 0117-947-1004, Web: www.soils.co.uk, Email:admin@soils.co.uk.

STRUCTURAL SOILS

Contract Reference: **735270**

KEY TO EXPLORATORY HOLE LOGS - SUMMARY OF GRAPHIC SYMBOLS

WATER COLUMN SYMBOLS

First water strike, second water strike etc.

Standing water level following first strike, standing water level following second strike etc.


Seepage.


Standing water level recorded at documented date.

MATERIAL GRAPHIC LEGENDS


Clayey gravelly SAND


Clayey gravelly SAND with COBBLES


Clayey SAND


GRAVEL


Silty gravelly CLAY


Gravelly SAND


Gravelly SAND with COBBLES


PEAT


SAND


SAND with COBBLES


Sandy CLAY


Sandy silty CLAY


Silty sandy CLAY


Sandy GRAVEL


Sandy gravelly silty CLAY


Silty sandy gravelly CLAY


Sandy gravelly SILT


Sandy clayey SILT


Sandy SILT


Topsoil

INSTRUMENTATION SYMBOLS


Backfill


Bentonite seal


Concrete


Gravel filter


Sand filter


Upstanding cover


Plain pipe


Slotted pipe

STRUCTURAL SOILS

FINAL

BOREHOLE LOG

Contract:	Client:	Borehole:
Sizewell C Fenland Creation Area	**Wood Group UK Limited**	**BH1001**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735270	**20.10.20** End: **20.10.20**	**3.89**	**E:638244.0 N:260485.4**	**1** of **2**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
				≈		Grass over soft brown slightly sandy CLAY with frequent roots and rootlets. Sand is fine (TOPSOIL)	3.58	0.31	
						Soft brown mottled orangish brown silty CLAY with occasional roots and frequent rootlets (SUPERFICIAL DEPOSITS)	3.19	0.70	
						Soft dark brown slightly sandy organic to very organic clayey SILT with a mild organic odour. (ALLUVIUM)	2.29	(0.90) 1.60	
						Plastic blackish brown slightly sandy PSEUDO FIBROUS PEAT with wood fragments up to 80 mm and a strong organic odour. (PEAT)	0.09	(2.20) 3.80	
						Plastic blackish brown sandy PSEUDO FIBROUS PEAT with occasional wood fragments and a strong organic odour. (PEAT)	-1.81	(1.90) 5.70	
						Very soft blackish brown clayey sandy SILT with occasional coarse sand to medium gravel sized comminuted shell fragments an a mild organic odour. Sand is fine to medium (ALLUVIUM)		(2.50)	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth
20/10/20		10.00	10.00	200	

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

1. Position checked with Ground Penetrating Radar, CAT and Genny prior to excavation.
2. Inspection pit hand dug to 1.20m depth.
3. Water seepage at 0.40m
4. 50mm standpipe installed to 10.00m depth.

All dimensions in metres | Scale: **1:44**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 2000**	**D Hubbard**	**ATidswell**	

STRUCTURAL SOILS

FINAL

BOREHOLE LOG

Contract:	Client:	Borehole:
Sizewell C Fenland Creation Area	**Wood Group UK Limited**	**BH1001**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735270	**20.10.20** End: **20.10.20**	**3.89**	**E:638244.0 N:260485.4**	**2** of **2**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
							-4.31	8.20	
						Very soft grey clayey slightly sandy SILT with occasional medium to coarse sand sized comminuted shell fragments. (ALLUVIUM)		(1.80)	
						. . . 9.75m: becoming dark grey	-6.11	10.00	
						Borehole terminated at 10.00 m depth			

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

All dimensions in metres | Scale: **1:44**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 2000**	**D Hubbard**	**ATidswell**	

STRUCTURAL SOILS

FINAL

HAND AUGER LOG

Contract:	Client:	Position:
Sizewell C Fenland Creation Area	**Wood Group UK Limited**	**WS1001**

Contract Ref:	Date:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735270	**12.10.20**	**4.35**	**E:638237.5 N:260626.0**	**1** of **1**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
						Grass over soft brown silty sandy CLAY with frequent roots and rootlets. Sand is medium to coarse. (TOPSOIL)			
						. . . 0.15m: roots rare.		(0.70)	
						. . . 0.20m: pocket of yellowish brown coarse sand 30 mm diameter.	3.65	0.70	
						Soft brown silty slightly sandy CLAY with occasional rootlets. SAND is medium to coarse. (ALLUVIUM)	3.43	0.92	
						Soft brownish grey slightly sandy organic CLAY. Sand is fine to coarse. (ALLUVIUM)	3.23	1.12	
						Grey silty slightly gravelly coarse SAND with frequent organic matter and woody fragments. Gravel is fine to medium angular of flint and comminuted shell fragments. (ALLUVIUM)	3.05	1.30	
						Dark greyish brown silty coarse SAND with a high organic matter content frequent wood fragments and organic odour. (ALLUVIUM)	2.80	1.55	
						Soft blackish brown sandy slightly gravelly very organic SILT with occasional lenses of grey coarse sand up to 20 mm. Frequent wood fragments and organic odour. Sand is coarse gravel is fine to medium of flint and quartzitic sandstone. (ALLUVIUM)		(0.85)	
							1.95	2.40	
						Very soft blackish brown slightly sandy organic to very organic SILT with frequent lenses of grey coarse sand up to 20 mm and occasional wood fragments. Sand is coarse. (ALLUVIUM)		(0.35)	
						. . . 2.40-2.75m: locally pseudo fibrous peat.	1.60	2.75	
						Very soft dark blackish brown sandy very organic SILT with occasional lenses of grey coarse sand up to 10mm. Sand is coarse. (ALLUVIUM)	1.35	3.00	
						Terminated at 3.00 m depth			

General Remarks

1. Position checked with Ground Penetrating Radar, CAT and Genny prior to excavation.
2. Inspection pit hand dug to 1.30 m depth.
3. 0.65m Water seepage slow ingress
4. Standing water at 0.48 m
5. 50mm standpipe installed to 3.00m depth.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Inspection pit + Hand excavation	**Hand auger**	**ATidswell**	

STRUCTURAL SOILS

FINAL

HAND AUGER LOG

Contract:	Client:	Position:
Sizewell C Fenland Creation Area	**Wood Group UK Limited**	**WS1002A**

Contract Ref:	Date:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735270	**12.10.20**	**3.93**	**E:638287.5 N:260508.7**	**1** of **1**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
						Grass over soft greyish brown slightly sandy CLAY with frequent roots and rootlets. Sand is fine to medium. (TOPSOIL)	3.73	0.20	
						Firm brown to light brown mottled orangish brown silty CLAY with frequent rootlets. (SUPERFICIAL DEPOSITS)	3.03	(0.70) 0.90	
						Very soft dark greyish brown silty sandy organic CLAY with frequent rootlets and mild organic odour. Sand is fine to medium. (ALLUVIUM)	2.63	(0.40) 1.30	
						Very soft blackish brown silty slightly sandy organic CLAY with frequent woody fragments and mild organic odour. Sand is fine to coarse. (ALLUVIUM)	2.36	1.57	
						Very soft greyish brown silty sandy organic CLAY with woody fragments and organic odour. Sand is coarse. (ALLUVIUM)	1.55	(0.81) 2.38	
						Dark grey slightly silty fine to coarse predominantly coarse SAND. (ALLUVIUM)	1.41	2.52	
						Very soft dark blackish brown silty sandy organic CLAY with occasional woody fragments and a mild organic odour. Sand is coarse. (ALLUVIUM)	0.93	(0.48) 3.00	
						. . . 2.52m-3.00m: occasional lenses of grey coarse sand up to 20mm.			
						Trial pit terminated at 3.00m depth.			

General Remarks

1. Position checked with Ground Penetrating Radar, CAT and Genny prior to excavation.
2. Inspection pit hand dug to 1.20 m depth.
3. Water ingress at 0.32m
4. Standing water at 0.84 m
5. 19mm standpipe installed to 3.00m depth.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Inspection pit + Hand excavation	**Hand auger**	**ATidswell**	

STRUCTURAL SOILS

FINAL

HAND AUGER LOG

Contract:	Client:	Position:
Sizewell C Fenland Creation Area	**Wood Group UK Limited**	**WS1003**

Contract Ref:	Date:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735270	**13.10.20**	**3.88**	**E:638240.6 N:260487.5**	**1** of **1**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
						Grass over soft greyish brown silty slightly sandy CLAY with frequent rootlets and roots. Sand is fine to medium. (TOPSOIL)	3.63	0.25	
						Firm light brown silty slightly sandy CLAY with frequent rootlets. Sand is fine to coarse. (SUPERFICIAL DEPOSITS)	2.98	(0.65) 0.90	
						Soft to firm brown silty slightly sandy CLAY with frequent rootlets. Sand is fine to coarse (SUPERFICIAL DEPOSITS)	2.58	(0.40) 1.30	
						Blackish brown slightly sandy very organic clayey SILT with frequent wood fragments and a mild organic odour. Sand is fine to medium. (ALLUVIUM)	0.88	(1.70) 3.00	
						Terminated at 3.00 m depth			

General Remarks

1. Position checked with Ground Penetrating Radar, CAT and Genny prior to excavation.
2. Inspection pit hand dug to 1.20m depth.
3. 19mm standpipe installed to 3.00m depth.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Inspection pit + Hand excavation	**Hand auger**	**ATidswell**	

STRUCTURAL SOILS

FINAL

BOREHOLE LOG

Contract:	Client:	Borehole:
Sizewell C Fenland Creation Area	**Wood Group UK Limited**	**BH1101 / WS1101**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735270	**20.10.20** End: **20.10.20**	**3.91**	**E:638173.4 N:260414.2**	**1** of **2**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
						Grass over soft to firm dark brown slightly sandy silty CLAY with many rootlets. (TOPSOIL)	3.61	0.30	
						Firm light grey mottled orange to brown slightly sandy CLAY with many fine rootlets. (SUPERFICIAL DEPOSITS)	3.26	0.65	
						Soft to locally firm dark brown slightly sandy organic to very organic silty CLAY with woody fibrous fragments up to 30mm. (ALLUVIUM) . . . at 1.00m: seepage within inspection pit. . . . at 1.50m: Local increase in organic material wood fragments up to 40mmx15mm.		(1.80)	
						. . . below 2.30m: becoming 'wet'.	1.46	2.45	
						Very soft to soft dark brown pseudo-fibrous PEAT with much visible brown organic plant material up to 40mm long. (PEAT) . . . from 3.70m: becoming 'amorphous'.		(2.35)	
							-0.89	4.80	
						Light green-grey very silty fine SAND with occasional fine (<2mm) white shell fragments. (ALLUVIAL SAND)		(1.30)	
							-2.19	6.10	
						Soft light green-grey sandy clayey SILT with occasional fine white shell fragments. (ALLUVIUM) . . . from 7.20m: locally firm pockets (upto 200mmx200mm). . . . between 8.00m-8.90m: locally very soft.		(2.80)	
							-4.99	8.90	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth
20/10/20	08:45	1.00	-		1.00
20/10/20	11:00	10.00	10.00	200	

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

1. Position checked with Ground Penetrating Radar, CAT and Genny prior to excavation.
2. Inspection pit hand dug to 1.20m depth.
3. Groundwater seepage at 1.00m depth.
4. Dual 50mm standpipe installed to 2.40m and 10.00m depth: shallow pipe is referenced as WS1101.

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 2000**	**DHubbard**	**ADingle**	[redacted]

FINAL

STRUCTURAL SOILS

BOREHOLE LOG

Contract:	Client:	Borehole:
Sizewell C Fenland Creation Area	**Wood Group UK Limited**	**BH1101 / WS1101**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735270	**20.10.20** End: **20.10.20**	**3.91**	**E:638173.4 N:260414.2**	**2** of **2**

Samples and In-situ Tests				Water	Backfill & Instrumentation	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
						Light grey-brown very silty fine SAND. (ALLUVIAL SAND)		(0.50)	
						(stratum copied from 8.90m from previous sheet)	-5.49	9.40	
						Light brown/orange/grey silty very sandy GRAVEL. Gravel is angular to rounded fine to medium of flint. (ALLUVIAL GRAVEL)		(0.60)	
							-6.09	10.00	
						. . . below 9.50m: gravel is medium to coarse.			
						Borehole terminated at 10.00m depth.			

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 2000**	**DHubbard**	**ADingle**	

STRUCTURAL SOILS

FINAL

BOREHOLE LOG

Contract:	Client:	Borehole:
Sizewell C Fenland Creation Area	**Wood Group UK Limited**	**BH1102 / WS1102**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735270	**22.10.20** End: **22.10.20**	**3.92**	**E:638130.1 N:260268.7**	**1** of **2**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
				1 2		Grass over soft dark brow n sandy CLAY with many roots and rootlets. (TOPSOIL)		(0.90)	
							3.02	0.90	
						Soft dark brown to black slightly sandy organic to very organic clayey SILT. (ALLUVIUM) . . . from 2.30m: wood fragments up-to 70mmx20mm.		(2.90)	
				2			0.12	3.80	
						Dark brown and black sandy silty GRAVEL with some plant material. Gravel is angular to subrounded fine to coarse flint. (ALLUVIAL GRAVEL) . . . at 4.00m: coarse flint gravel.		(1.52)	
							-1.40	5.32	
						Orange to brown clayey SAND and GRAVEL. Gravel is angular to subrounded fine to medium rare coarse flint. (ALLUVIAL GRAVEL)	-1.48	5.40	
						Orange to brown clayey very gravelly SAND. Sand is fine to medium. Gravel is angular to subrounded fine to medium of flint. (ALLUVIAL SAND) . . . below: 5.70m: gravel content decreasing.		(0.95)	
							-2.43	6.35	
						Light green and orange to brown slightly clayey gravelly SAND. Gravel is angular to subangular fine to medium flint and white shell fragments. (ALLUVIAL SAND)		(0.75)	
							-3.18	7.10	
						Light green to brown clayey gravelly SAND with a low cobble content. Sand is fine to medium. Gravel is angular to subrounded fine to coarse of flint and sandstone. Cobbles are sandstone and flint. (ALLUVIAL SAND) . . . from 7.50m-7.70m: abundant shell fragments. . . . at 7.60m: cobble size clumps of grey gravelly SILT with flint gravels.		(0.60)	
							-3.78	7.70	
						Stiff grey mottled dark grey slightly sandy clayey SILT. (CRAG GROUP)		(2.30)	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth
22/10/20	09:10	1.00	-		1.00
22/10/20		3.80	3.80	200	3.80
22/10/20	13:00	10.00	10.00	200	

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

1. Position checked with Ground Penetrating Radar, CAT and Genny prior to excavation.
2. Inspection pit hand dug to 1.20m depth.
3. 2 no water strikes at 1.00m and 3.80m depth.
4. Dual 50mm standpipe installed to 3.00m and 10.00m depth:: shallow pipe is referenced as WS1102

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 2000**	**DHubbard**	**ADingle**	[redacted]

STRUCTURAL SOILS

FINAL

BOREHOLE LOG

Contract:	Client:	Borehole:
Sizewell C Fenland Creation Area	**Wood Group UK Limited**	**BH1102 / WS1102**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735270	End: **22.10.20**	**3.92**	**E:638130.1 N:260268.7**	**2** of **2**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
						Stiff grey mottled dark grey slightly sandy clayey SILT. (CRAG GROUP) *(stratum copied from 7.70m from previous sheet)* . . . at 9.00m: occasional white shell fragments.	-6.08	10.00	
						Borehole terminated at 10.00m depth.			

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 2000**	**DHubbard**	**ADingle**	[redacted]

STRUCTURAL SOILS

FINAL

BOREHOLE LOG

Contract:	Client:	Borehole:
Sizewell C Fenland Creation Area	**Wood Group UK Limited**	**WS1103**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735270	**21.10.20** End: **21.10.20**	**3.95**	**E:638202.4 N:260405.7**	**1** of **1**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
						Grass over soft to firm dark brown sandy CLAY. (TOPSOIL)	3.75	0.20	
						Firm orange brown mottled brown and grey slightly sandy CLAY with occasional rootlets. (SUPERFICIAL DEPOSITS)	3.25	(0.50) 0.70	
				≈		Soft to firm dark brown slightly sandy organic to locally very organic clayey SILT. (ALLUVIUM)		(2.30)	
						. . . from 2.00m-3.00m: locally sandy.			
						. . . below 2.350m: very soft.	0.95	3.00	
						Borehole terminated at 3.00m depth.			

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth
21/10/20	13:45	1.10	-		1.10
21/10/20	14:30	3.00	3.00	200	

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

1. Position checked with Ground Penetrating Radar, CAT and Genny prior to excavation.
2. Inspection pit hand dug to 1.20m depth.
3. Groundwater seepage at 1.00m depth.
4. 50mm standpipe installed to 3.00m depth.

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 2000**	**DHubbard**	**ADingle**	[redacted]

STRUCTURAL SOILS

FINAL

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Sizewell C Fenland Creation Area	**Wood Group UK Limited**	**WS1104**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735270	**08.10.20** End: **08.10.20**	**3.92**	**E:638105.4 N:260190.7**	**1** of **1**

Progress	Samples / Tests				Water	Backfill & Instrumentation	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results						
					1		Grass over soft dark brown occasionally mottled light brown slightly sandy slightly gravelly silty CLAY with frequent rootlets and roots and high organic matter. Sand is coarse.Gravel is angular medium of flint. (TOPSOIL)	3.67	0.25	
								3.39	(0.28) 0.53	
					1		Soft to very soft dark brown mottled light brown slightly sandy slightly gravelly silty CLAY with a high organic matter. Sand is coarse. Gravel is angular medium of flint. (SUPERFICIAL DEPOSITS)		(0.57)	
1.00 - 2.00 (85mm dia) 60% rec							Very soft dark blackish brown FIBROUS PEAT with medium organic odour. (PEAT)	2.82	1.10	
							. . . 0.53m-0.59m: clayey peat becoming slightly clayey peat.		(0.42)	
							Greyish brown silty gravelly fine to coarse predominantly coarse SAND. Gravel is angular to subangular fine to coarse of flint. (ALLUVIAL SAND)	2.40	1.52	
							Yellowish brown silty sandy angular to subrounded fine to coarse predominantly coarse GRAVEL of flint. Sand is fine to coarse. (ALLUVIAL SAND)	2.14	1.78	
								2.02	1.90	
							Creamish brown silty gravelly fine to coarse SAND. Gravel is angular to subangular fine to coarse of flint and chalk. (ALLUVIAL SAND)	1.60	(0.42) 2.32	
2.00 - 3.00 (85mm dia) 90% rec							Yellowish brown very slightly gravelly medium to coarse SAND. Gravel is angular fine of chalk. (ALLUVIAL SAND)	1.46	2.46	
							Yellowish brown grey and whitish sandy angular fine to coarse GRAVEL of flint and chalk. Sand is coarse (ALLUVIAL GRAVEL)	1.27	2.65	
							Yellowish brown slightly silty coarse SAND with rare angular fine to medium gravel of flint (ALLUVIAL SAND)		(0.35)	
							Yellowish brown slightly silty slightly gravelly coarse SAND. Gravel is angular to subangular fine to coarse of flint and chalk (ALLUVIAL SAND)	0.92	3.00	
							. . . 2.77m-2.80m: bed of angular to subrounded fine to medium gravel of flint.			
							Window sample hole terminated at 3.00m depth.			

Drilling Progress and Water Observations					
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

1. Position checked with Ground Penetrating Radar, CAT and Genny prior to excavation.
2. Inspection pit hand dug to 1.20m depth.
3. Response zone 0.80 m to 2.70m depth.
4. Hole collapsed to 2.90 m. On pulling casing, installation was lifted to 2.70 m
5. Groundwater struck at 0.80m depth, rising to 0.54m depth after 20 minutes.
6. 50mm standpipe installed to 2.90m depth.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Tracked window	**Dando Terrier**	**Jordan Evans**	**ATidswell**	[redacted]

Appendix C
Topographic Survey Results

Sizewell C Hydro Survey (Area 10&11 and Area 28)

TOPOGRAPHICAL SURVEY REPORT

December 2020

Wood Environment & Infrastructure Solutions UK Limited

TOPOGRAPHICAL SURVEY REPORT

Sizewell C Hydro Survey (Area 10&11 and Area 28) Topographical Transect Survey

TYPE OF DOCUMENT (VERSION) CONFIDENTIAL

PROJECT NO. Ref – 40773-WOOD
OUR REF. NO. 70078783

DATE: December 2020

WSP
7 Lochside View
Edinburgh Park
Edinburgh, Midlothian
EH12 9DH
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WSP.com

QUALITY CONTROL

Issue/revision	First issue	Revision 1	Revision 2	Revision 3
Remarks	Final	Appendices added		
Date	08.12.20	14/12/20		
Prepared by	[redacted]	[redacted]		
Signature	[redacted]	[redacted]		
Checked by	[redacted]	[redacted]		
Signature	[redacted]	[redacted]		
Authorised by	[redacted]	[redacted]		
Signature	[redacted]	[redacted]		
Project number	**70078783**	**70078783**		
Report number				
File reference				

REPORT CONTENTS

1 OVERVIEW

1.1 INTRODUCTION

In November 2020 WSP carried out a topographical survey over two sites (Area 10&11 and Area 28). These surveys included transects and a topographic survey on a 20mx20m grid over areas identified for primary locus area for fen meadow. Alongside this a survey of gauge boards and spot flow gauging locations was undertaken.
The survey was carried out in accordance with instructions and specifications as set out in the survey brief by Wood.

1.2 SURVEY SCOPE

Area 10&11

- 20x20m topographic grid and bank profiling of primary locus area for fen meadow.
- Survey of 8 Transects and 5 ditch profiles across the site.
- Survey of 5 spot flow gaugings and 5 gaugebaords locations along with 1 concrete dipwell. A cross section will be taken at each location along with position of flow meter and top of gaugeboard. Bed levels will also be taken 50m upstream and downstream at 10m intervals.

Area 28

- 20x20m topographic grid and bank profiling of primary locus area for fen meadow.
- Survey of 2 Transects and 8 ditch profiles across the site.
- Survey of 3 spot flow gaugings and 4 gaugeboard locations. A cross section will be taken at each location along with position of flow meter and top of gaugeboard. Bed levels will also be taken 50m upstream and downstream at 10m intervals.

1.3 PERSONNEL

- Principal Surveyor
- Project Surveyor
- Land Surveyor
- Graduate Surveyor

1.4 EQUIPMENT

- 2 x Leica Captivate GS08 GNSS Antenna with Leica CS20 Field Controller
- 1 x Leica TS16 Total station & CS20 Field Controller
- N4ce Survey Software

1.5 RISK ASSESSMENT

A client approved Risk Assessment was carried out prior to attending the site. The risk assessment can be found in appendix A. On attending the site, a daily dynamic risk assessment was carried out and any new risks found added and assessed on site. It was noted that in some areas silt levels were very deep, so extra care was taken around these areas. It was also noted before accessing site that there may be cattle in Area 28 so precautions were in place. Upon arrival it appeared the livestock had been moved.

1.6 TOPOGRAPHICAL SURVEY SUMMARY

Most topographical data was surveyed using Leica RTK rover units set at ±0.020m tolerance. Where Trees were present and RTK methods were not possible, temporary stations were installed and a total station used to continue surveying transects. Stations were installed using GPS for a minimum of 600 obs.

Water flow direction was labelled as best as possible. Stagnant water and with heavy reed cover meant it was often difficult to determine water flow direction. This has been noted on the CAD drawings.

Area 10&11

Transects

BHALL_LS1 - No land access east end of transect.
BHALL_LS2 - No land access east end of transect
BHALL_LS3 - No land access east end of transect
BHALL_LS4 - Transect was surveyed in its entirety
BHALL_LS5 - Transect was surveyed in its entirety
BHALL_LS6 - Transect was surveyed in its entirety
BHALL_LS7 - Transect was surveyed in its entirety
BHALL_LS8 - No land access north end of transect

Ditch sections

BHALL_DS1 - Section was surveyed in its entirety
BHALL_DS2 - Section was surveyed in its entirety
BHALL_DS3 - Section was taken approximately 5 metres north as it was unsafe to access where section was plotted
BHALL_DS4 - Section was surveyed in its entirety
BHALL_DS5 - Section was surveyed in its entirety

Topographic Survey

All of Area 11 was surveyed on a 20x20m grid. All of Area 10 was surveyed on 20x20m grid with the exception of an area to the south-west of the site that is marked in the CAD. This area was unsafe to access due deep silt.

Gaugeboards and Flow Meters

All gaugeboards and flow meters were surveyed including the concrete dipwell and a cross section taken at each location. Alongside this, bed levels were taken 50m upstream and downstream of the gauging station.

AREA 28

Transects

HAL_LS1 - Transect was surveyed in its entirety
HAL_LS2 - Transect was surveyed in its entirety

Ditch sections

BHALL_DS1 - Section was surveyed in its entirety
BHALL_DS2 - Section was surveyed in its entirety
BHALL_DS3 - Section was surveyed in its entirety
BHALL_DS4 - Section was surveyed in its entirety
BHALL_DS5 - Section was surveyed in its entirety
BHALL_DS6 - Section was surveyed in its entirety
BHALL_DS7 - No land access west end of transect
BHALL_DS8 - No land access west end of transect

Topographic Survey

All of Area 28 was surveyed on a 20x20m grid.

Gaugeboards and Flow Meters

All gaugeboards and flow meters were surveyed, and a cross section taken at each location. Alongside this, bed levels were taken 50m upstream and downstream of the gauging station.

1.7 DELIVERABLES

The deliverables for this report include:

- Both 2D and 3D AutoCad drawings
- Raw (x,y,z) triplets of all survey points

1.8 APPENDICES

A) Risk Assessment & Method Statement (RAMS)

T480: Site Visit Risk Assessment & Method Statement (RAMS)

A hard copy of this form should be available on site throughout the duration of our works

Project Number	70078783	**Project Name**	Sizewell C Hydro Suryey
Risk Assessment Ref	V2 17/11/20	**Assessment Completed By**	[redacted]
Risk Assessment Date	22/10/2020	**Assessment Authorised By**	[redacted]

1. Site Location, Access Arrangements
Site address and pertinent access details. Attach plans and maps to rear of document if needed (include hospital route map if pertinent)

The works are required on two sites, located some 16 miles apart. The locations are shown in Figures 1.1 and 1.2 and described as follows: Site 10/11 Sites 10/11 is located between Farnham to the west and Sternfield to the north east. The closest postcode to the site is IP17 1HN and the site is centred on NGR TM 38160 60336. The site comprises undeveloped agricultural land. The sites are accessed via private track off Aldecar Lane which leads to Manor House Farm and the nearby sewage treatment works.
Site 28
Located to the south of Halesworth and accessed at its southern end by a gate from the A144. The closest postcode to the site is IP19 8DY and the site is centred on NGR TM 39063 76589. The site comprises agricultural grazing land adjacent to the River Blythe. The river forms the sites eastern boundary. Several drainage ditches traverse the site. Historical mapping shows that, other than the formation of the drainage ditches, the site has been undeveloped since mapping of 1884.
A location plan of site is shown below.
Nearest A&E: Ipswich Hospital, Heath Road , Ipswich, Suffolk, IP4 5PD
Tel: +441473712233, 999
All employees must complete the WorkTogether mandatory self-assessment app every day to get clearance before leaving for the office, client office or site.
https://worktogetheruk.wspis.com/

2. Site Maps
Insert screen grab of appropriate site location map - highlight any constraints that are appropriate. Attach plans and maps to rear of document if needed.

Figure 1.1 - Sites 10 and 11

Figure 1.2 Site 28

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Risk Assessment Date	22/10/2020	**Assessment Authorised By**	[redacted]

3. Anticipated Works and Programme *Outline of the anticipated works (layman's explanation) & overview of programme as appropriate*	Wood Environment & Infrastructure Solutions are completing an environmental assessment for a fen meadow strategy for the proposed Sizewell C power station. WSP have been appointed to complete Task 2 of this assessment, a topographic Transect Survey. Across the two sites they are required to be grided, complete 11 long sections, 13 short ditch sections and bank profiling. It is proposed two survey teams of 2 surveyors will be assigned to this project as per our Safety, Health and Wellbeing best practices - WSP do not encourage lone working. Land access will be confirmed and arranged prior to accessing site. The survey will be carried out using a combination of Leica GNSS and, where required, Leica Total Station for grid and sections data capture. Surveys will be carried out during daylight hours with all surveyors working together (physical distancing) when operating on or near water. All team members entering or working near water are required to be First Aid Trained and are Cold Water Trained. A dynamic risk assessment will be made on the day looking at the depth and speed of the waterbody and if deemed unsafe, no work will take place and then reported. Safe access routes for all staff working on banks will also be identified by the safety team. Only then will a toolbox talk and safety brief be conducted to inform and discuss the planned activities, full RAMS will be signed by the whole team and the site agreed safe to work on. Appropriate PPE relevant to site requirements will be worn, including dry suits (and thermals where required), canoeing helmets and appropriate buoyancy aids/life jackets. **Timeframe and hours of work may be subject to change once a dynamic risk assessment has been carried out on day 1 to take into account of risks involved with Covid 19**

4. Contacts	**Name**	**Contact Number**	**Comments including Specific Buddy Arrangements**
Project Director	[redacted]		WSP Principal Engineer
Project Manager			**WSP, CSCS, DOMS, Streetworks, Cold Water Training, First Aid**
Senior Surveyor	[redacted]		WSP, CSCS, DOMS, Streetworks, Confined Space, Cold Water Training, First Aid
Surveyor	[redacted]		**WSP, CSCS, Streetworks, Confined Space, Cold Water Training, First Aid**
Surveyor	[redacted]		**WSP, CSCS, DOMS, Streetworks, Cold Water Training, First Aid**
Assistant Surveyor	[redacted]		WSP, CSCS, DOMS, Confined Space, Streetworks, Cold Water Training, First Aid
Assistant Surveyor	[redacted]		**WSP, CSCS, DOMS, Confined Space, Streetworks, First Aid**
Client	[redacted]		WSP Hydrogeologist - Ground and Water

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24/7 Incident Report Line - 0870 240 8822

Travel arrangements	The Topo survey team will be staying locally. Every effort will be made to reduce the need to stop during there travel including, filling up each vehicle with fuel in there home town and preparing lunch at home. Each surveyor will travel to site in separate vehicles complying with the Covid-19 guidelines. Vehicles will be chapter 8 compliant to access Traffic Management and to displayed a sign in the rear window stating - Covid-19 essential works.
COVID-19 Response	**COVID-19 Response and Actions to be Taken: All Government advice regarding physical distancing will be adhered to** •Keep at a distance of 2m or more from each other and members of the public. This applies particularly when using welfare facilities or getting food. •Staff to travel in separate vehicles to site. Where possible, mobilise from home. Upon arrival check the number of people on foot in the area. If numbers are high and close contact with members of the public is unavoidable remain in vehicle until the area becomes quieter. If the area remains busy / crowded contact project manager and consider rescheduling the survey. •Fill up with fuel in the local area before departure, to avoid having to stop an route, thus minimising spread to another area. Use disposable gloves whilst refuelling and try to pay at the pump. •Welfare facilities should be identified and confirmed that they are open. •You should take your lunch with you, to avoid going to shops. •Staff to wear appropriate gloves and dispose of/disinfect properly after use. If you wear your normal site gloves, wash them in antibacterial solution after site work. Disposable gloves should be removed by unpeeling one of them from the cuff with one hand, then unpeeling the other over the hand AND the first glove, and bagging both, then hand sanitising. •Avoid touching your face, with or without gloves. •Wash hands regularly throughout the day, especially before eating or drinking, using soap and water or 60% alcohol hand gel. Decide on the method before leaving for site, and make sure you have an adequate supply. •The survey team has access to wipes and hand sanitizer and will make use of both regularly throughout the day, both for personal use and to disinfect the equipment. Use anti-bacterial wipes to disinfect the equipment, if it is being shared. Try to minimise this by having your own set of equipment, if at all possible. •WSP survey staff will keep up to date with the latest government advice. Should relevant restrictions on movement come into place the survey team will demobilise from site. •Local residents may object to your presence- if so retreat from the situation. A heightened level of care will be taken during any interaction with the public. •Should WSP survey staff display coronavirus symptoms then they should return home immediately, and a decision made by the project manager, director and Safety Advisor will decide what further action to be taken. The WSP reporting policy will also be followed. •If carrying out a work activity would prevent physical distancing from being maintained approved face masks or face coverings shall be worn. •Upon arrival on site if you do not feel safe, you should leave site and return home.
Guidance	GNHS012-03: Risk Management - Site Activity Guidance

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Risk Assessment Ref	V2 17/11/20	**Assessment Completed By**	[redacted]
Risk Assessment Date	22/10/2020	**Assessment Authorised By**	[redacted]

Site Specific Risk Assessment

Significant Hazards	**Risk** *(Who might be harmed and how)*	**Site Specific Risk Assessments & Controls** *(What is being done to control the risk on this job?)*	**Risk Rating** See Matrix	**Risk Grading** *(automated)*
Covid-19	**COVID-19 is a new illness that can affect your lungs and airways. It's caused by a virus called coronavirus COVID-19 can result in death** **Staff, public** **Symptoms:** **• A new or continuous cough** **• High temperature** **• Shortness of breath** **• loss or change to your sense of smell or taste**	**All government advice regarding physical distancing will be adhered to.** **•Keep at a distance of 2m or more from each other and members of the public. This applies particularly when using welfare facilities or getting food.** **•Staff to travel in separate vehicles to site. Where possible, mobilise from home. Upon arrival check the number of people on foot in the area. If numbers are high and close contact with members of the public is unavoidable remain in vehicle until the area becomes quieter. If the area remains busy / crowded contact project manager and consider rescheduling the survey.** **•Fill up with fuel in the local area before departure, to avoid having to stop an route, thus minimising spread to another area. Use disposable gloves whilst refuelling and try to pay at the pump.** **•Welfare facilities should be identified and confirmed that they are open.** **•You should take your lunch with you, to avoid going to shops.** **•Staff to wear appropriate gloves and dispose of / disinfect properly after use. If you wear your normal site gloves, wash them in antibacterial solution after site work. Disposable gloves should be removed by unpeeling one of them from the cuff with one hand, then unpeeling the other over the hand AND the first glove, and bagging both, then hand sanitising. Further details and COVID-19 responses highlighted above.**	Seldom Moderate Injury Beyond First Aid/Disease	**Low Risk - Proceed**

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Risk Assessment Date	22/10/2020	**Assessment Authorised By**	[redacted]

Driving to Site	Employee and public Driving to and from site, risk of collision, Vehicle damage, RTA, disablement, death.	• Staff to read, understand and adhere to MCHS121 - Driving at Work. • Staff to have completed the permit to drive application on Driving Monitoring and e-learning courses. • Staff to drive in accordance with current safety standards and the law. • Plan Journey – allow enough time and ensure adequate fuel. • Check weather forecast before journey begins (the survey will be cancelled following prolonged rainfall and during inclement weather). • Charge all mobile phones for use in emergency. • Do not use mobile phone whilst driving (including Bluetooth or hands free equipment). • Carry out pre-journey checks (water levels / tyre pressure). • Take a break at least every 2 hours or as required. • Share the driving between staff. • DO NOT DRIVE WHEN TIRED. When travelling home after multiple evenings and mornings of surveying, stop for coffee/nap breaks, share driving.	Seldom Fatal Injury/Disease	**Moderate Risk - Proceed**

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Risk Assessment Date	22/10/2020	**Assessment Authorised By**	[redacted]

Manual handling; carrying equipment	Employee At risk of injury (muscle strain, sprain or tear, cuts, grazes or lacerations, back injury)	• Staff to read, understand and adhere to MCHS313 - Manual Handling. • Staff have all undertaken the manual handling training. • Staff only to lift what they are comfortable with. • Staff to utilise full team to move multiple loads while maintaining physical distancing • Staff should wear appropriate PPE to reduce/remove risk of injury. I.E. Boots, gloves, glasses, etc. • To prevent any injury and take breaks prevent fatigue. No heavy survey equipment permitted on slope, this shall remain at carriageway level or on suitable verge. • Only survey kit required on slope is a lightweight alloy detail pole (prism) approx. 1.5m length. Staff will be working at distances greater than 2m at all times. During any handling of heavy equipment 2 person working may be closer than the 2m requirement but will be of the minimum time required to carry out manual handling, expected to be for 30 Seconds and possibly up to 10 times per day. Once the equipment is moved one staff member will retreat to a distance >2m whilst the other carry's out the required work	Seldom Moderate Injury Beyond First Aid/Disease	**Low Risk - Proceed**

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Risk Assessment Date	22/10/2020	**Assessment Authorised By**	[redacted]

Road traffic while pedestrian	WSP Staff and members of the public	• Staff to read, understand and adhere to MCHS244 - Working on or Near Highways. •Staff mobilised to hold valid Streetworks tickets at both operator and supervisor levels. • Use pedestrian pavements /designated walkways where possible. • Be observant of road users. • Use crossings. • The following PPE will be worn at all times: High visibility jackets with reflective stripes complying with EN471 class 3, high visibility trousers with two reflective stripes complying with EN471 class 1, and safety boots with a steel mid sole and toecap complying with EN345. • When visiting site, undertake appropriate parking. • Face traffic when carrying out survey.	Seldom Fatal Injury/Disease	**Moderate Risk - Proceed**

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Risk Assessment Ref	V2 17/11/20	**Assessment Completed By**	[redacted]
Risk Assessment Date	22/10/2020	**Assessment Authorised By**	[redacted]

Slips, trips and falls	Employee Minor injury, lower/upper limb damage, bruising, impact injuries.	• Assess ground conditions before proceeding. Use predefined footpaths and tracks to access. • Additional care to be taken in wet and winter conditions - beware of ice patchs. • Inspect footware daily prior to starting work. Ensure boots have a sufficient tread. • Various covers, lids, cable trays, moss covered surfaces and other trip hazards may be present • Wear appropriate sturdy footwear whilst on site. I.E. safety wellingtons/boots or walking boots with toe caps and reinforced mid-sole as appropriate • Take extra care when ground is uneven.	Seldom Moderate Injury Beyond First Aid/Disease	**Low Risk - Proceed**

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Risk Assessment Date	22/10/2020	**Assessment Authorised By**	[redacted]

Cuts / grazes & Sharps	Employee Injury from puncture, impaling, infection including hepatitis, contamination from needles including HIV.	• A first aid kit should be carried at all times, all kit should be in date and fit for use as per MCHS321 - First Aid. • Wear appropriate PPE as detailed below including long-sleeved t-shirts • Care will be taken if required to cross any stiles, gates and fences. • Any cuts / grazes will be covered by waterproof glove / plasters. • Needles may be expected as some areas are out of public view. Due care and attention should be taken. • Wear reinforced sole safety boots at all times on site. • Avoid barbed wire fences where possible. • Never put your hands where you cannot see them. • Check body for cuts and abrasions. For ANY puncture wounds, seek medical attention immediately.	Seldom Minor Injury/First Aid/Disease	**Low Risk - Proceed**
Inclement weather	Employee Dehydration, fatigue, hyperthermia, hypothermia	• Check updated weather forecast on internet/radio prior to leaving for site. • Ensure appropriate clothing is available for the weather conditions, with a change of clothes/extra layers if necessary. • Carry adequate water. • Monitor the weather conditions when on site and retreat to a safe place of shelter as required and seek on site welfare facilities.	Seldom Minor Injury/First Aid/Disease	**Low Risk - Proceed**

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Interaction with the public	Employee & public Confrontation, harassment, assault	• Only areas with agreed access will be surveyed - if in doubt contact Fraser Bell. • Park your car in a sensible place to allow safe and suitable access and egress to/from site. • Do not obstruct gateways or access and egress to buildings used by other persons on site. • Members of the public will not be approached. If they do approach remain friendly at all times. Land owners may be approached if walking on their land or if attending meeting. • If staff are approached in an aggressive manner by any person they will remain calm and polite and leave the site immediately until the threat is no longer present. Retire to a vehicle and if required inform the police. • Always keep your charged mobile phone with you on site and ensure calling-in protocol is followed.	Seldom Moderate Injury Beyond First Aid/Disease	**Low Risk - Proceed**

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Illness or disease from vermin; illness, disease or injury from wild animals/insect bites/stings	Employee Disease, illness, injury, rash/itching, severe reactions, contamination, Ecoli, Leptospirosis	• Ensure hands are thoroughly washed after coming into contact with water. Wearing protective rubber gloves is advisable as a precaution, though thorough hand washing or sanitising before eating is adequate. • Staff to be aware of the symptoms and prevention measures for leptospirosis/Weil's disease & carry information cards at all times • Clean hands before eating/leaving site. • Cover up exposed skin to reduce likelihood of stings and bites. Long sleeved PPE to be worn at all times. • Staff should check themselves for ticks once off site and be aware of the symptoms and prevention measures for Lyme's disease. • Insect bites should be monitored to ensure they do not become infected. • It is the member of staff's responsibility to announce any known allergies prior to commencement of the survey and carry appropriate medication as required.	Seldom Moderate Injury Beyond First Aid/Disease	**Low Risk - Proceed**

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Vegetation	Employee Disease, illness, injury, rash/itching, severe reactions, environmental contamination	**Unlikely to be found on site but could be found in surrounding areas.** Giant Hogweed • Produces a poisonous sap that can cause blister and skin pigmentation. Himalayan Balsam • Presents no physical danger to either humans or animals but provides a significant ecological impact as it suppresses native flora and can lead to river bank erosion. Japanese Knotweed • The plant presents no physical danger to humans or animals but has significant ecological impact since it grows and spreads rapidly For plant description, refer to the factsheet kept in pool vehicle. These plants have a community protection notice. • Ensure skin is covered if required to approach giant hogweed • Where possible do not touch Himalayan balsam/Japanese knotweed to avoid spreading.	Seldom Moderate Injury Beyond First Aid/Disease	**Low Risk - Proceed**

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Use of Lasers	Employee Members of the public, eyesight damage and potential blindness	• Employees to avoid looking directly at laser beam and damaging eyesight. • Avoid curious members of public, operators or contractors. • No real requirement for laser during daylight hours and it will be ineffective. • Reflectorless pointing to be manually 'eyed in' by the surveyor using sight and laser off on site.	Seldom Moderate Injury Beyond First Aid/Disease	**Low Risk - Proceed**
Working near water, close to water or in water	Employee, Slips or falls into watercourses, injury, soaking leading to cold/shock/hypothermia, drowning or engulfment	• Staff to read, understand and adhere to MCHS243 - Working on or near water. • Approach any water with caution. Safe access routes to be determined. • Staff to stay behind safety barriers/fences at all times where at all possible. • If in any doubt - Do not enter. • No lone working will take place near water • All staff mobilised for supervision have attended Cold Water Safety Training (H&S HS415). • Surveyor to make own self assessment of water levels on day of work (and subsequent days if required) and is to consider depth, speed of current and volume, do not work in or near to water if judged at all to be a risk. • Minimum of 2 members of staff present when working on/near water at all times. Ensure that shore support is in place before beginning, with a safety throw line and the ability to call for additional aid if required. • Dry-suits (and thermals where appropriate) , canoeing helmets, gloves and buoyancy aids/life jackets will be worn at all times on/near water.	Unlikely Moderate Injury Beyond First Aid/Disease	**Moderate Risk - Proceed**

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Working at Height	WSP Staff and members of the public	• Includes open manhole covers/culvers/structures/steep drops/stairs etc. • Do not leave covers open on a public site. Adopt the open/close policy. • Take care on steep slopes • Do not work adjacent to unprotected drops.	1 4	**Moderate Risk - Proceed**

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Environmental Impacts		T-E200: Project Environmental Risk Tool (PET).xlsx	

Plan of Work *(Briefly identify the steps that are required to complete the task, taking into account the precautions identified above and the steps required in implementing them, to ensure the risks are eliminated or reduced. Include consideration of how you are getting to site where appropriate.)*	
Description of step or task	Before commencing work Surveyors must complete the WorkTogether mandatory self-assessment app every day to get clearance before leaving for the office, client office or site - https://worktogetheruk.wspis.com/. They should undertake a Dynamic Risk Assessment (Point of Work Risk Assessment (PoWRA) at each area prior to each survey visit. If the risks present on site are different to those assessed in this RAMS, or there is a deviation from the scope of works, a review should be undertaken to ensure it is safe to procede. Report the observations back to the project team to allow subsequent WSP staff on future visits to be briefed.

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Description of step or task	A control network will be established from which water course and structure survey will be referenced to. Control will consist of nails in hard standing or pegs in soft ground. The position of the control points will be chosen for optimum survey considerations, and adequate clearance from members of the public.
Description of step or task	Details of the topographic transect locations are shown in Figure 2.1 and 2.2 (see in attached document), summarised as follows: •Site 10/11 – 9 long sections, 5 short ditch sections, and 20 x 20m topographic grid and bank profiling of primary locus area for fen meadow •Site 28 - 2 long sections, 8 short ditch sections, and 20 x 20m topographic grid and bank profiling of primary locus area for fen meadow Transect and grids will be surveyed using RTK techniques except where vegetation obscures satellite visibility. Metric units shall be used throughout. RTK survey will be related directly to the E1 control station, and RTK rover units will be set to work to a ±0.020m tolerance, relative to the base station. Points on transect lines will be surveyed at a nominal interval of 20 metres in densely vegetated areas and 10 metres in open areas, with additional points to define changes in slope, changes in vegetation, boundary features and other crossings. For the topographic grids, a 20 x 20 m grid of topographic shots is required in the areas marked on figures 2.1 and 2.2 as primary locus area for fen meadow. This will include top of bank profiling where the grid crosses a water feature.
Description of step or task	The following water-related features along the transect line will be surveyed: • Top of banks of all water features (both sides); • Surface water level at the time of the survey for any water feature along the transect line (to be indicated by a solid line annotated with a date and time of the measurement); • Surveys shall extend (where safe) approximately 1m (safe arm's length) into the watercourse from the water's edge; • Bed level (soft bed) of ditches and surface water features where possible. It may not be necessary to obtain a depth level for deeper water features such as the River Fromus (Site 10/11) or River Blythe (Site 28) if they are not wadable or safe to enter; • Direction of flow of watercourses (indicated by arrows on the plan); • Culvert/Pipe dimensions and invert levels; • Beaches, mudbanks, reedbeds and any other features that affect the width of the channel; and • All underwater features, e.g. concrete/brick aprons, piling alignments, will be surveyed where identifiable.
Description of step or task	The survey will be conducted using a combination of total station measurement and GNSS observations where access and conditions permit. Use of the total station will involve the setting up of tripods over the control points. Observations will then be made, using a detail pole and prism to locate the required detail. Should conditions permit, a detail pole and GNSS receiver may be used, which would not involve the setting up of tripods.

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Description of step or task	Once the survey has been completed the equipment will be packed away and carried back to the vehicle via the same route that was used to access the site.
Description of step or task	Both 2D and 3D AutoCad drawings will be produced. In addition, raw (x,y,z) triplets of all survey points will be presented in csv format. Deliverables are to include a clear statement of any limitations and assumptions supported in a report of survey (a brief report of survey quoting accuracies, survey methods and any other relevant comments will be submitted with the survey drawings, PDF format).

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People *(List any specific people or skills/competencies that are required and any supporting documents (eg. CSCS cards))*

All surveyors to have a briefing before leaving for site

All surveyors to have an in date CSCS card as per MCHS212 - CSCS Cards

All surveyors entering the water will have undertaken cold water training

All surveyors driving for work will have undertaken the WSP internal permit to drive training.

All surveyors hold valid First Aid Training certificates

Plant, Equipment, Materials, Environment *(List the materials and equipment required to complete the activity and any additional supporting documents that may be required to demonstrate that equipment is safe, the environment is safe, etc)*

The following PPE must be worn by all personnel remaining on bank at all times:
• Safety Helmet/Canoeing helmet
• High Visibility long-sleeved jacket, waistcoat & trousers (NRSW Chapter 8). The surveyor shall decide whether wear either the jacket or waist coat. Whichever is worn; it must be fastened and not allowed to be open at the front.
• Safety Boots
• Life Jacket/buoyancy aid
• Packable (minimum 15m) Throw Line that team have been trained with and confident using
• Gloves
• Lifesystems Survival Bag & First Aid Kit
• Mobile phone or 2-way link radio
• Hand sanitizer, Anti-bac wipes and water

For those entering/potentially entering the water the following must be worn at all times:
• Dry suit inc sock (with thermals if required)
• Canoeing Helmet
• Safety boots for protection, grip when walking on river bed and protection for drysuit rubber socks
• Gloves
• Buoyancy aid/Life Jacket
• High Visibility Long-Sleeved vest UNDER lifejacket. (either under or over buoyancy aid)
• Hand sanitizer, Anti-bac wipes and water

First Aid Kit (one per survey team, to be carried at all times). Must include Lifesystems Survival Bag (orange). All first aid kit will be fit for use and in date as per MCHS321- First Aid.

Survey pack (one per survey team) to include:
• Hard copies of maps showing waterbody locations;
• Copy of RAMS with relevant telephone contact numbers;
• Inspection schedule, access letter, ID; and
• Survey Brief

Clothing, suitable for the weather conditions must be worn and a change of clothes to be carried within vehicle

Total station and detail pole	GNSS receiver
Tripods and prism targets	Level and staff
Notebook and pencils	Tape measure
Hand tools	Survey nails and ground markers

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Site Rules *(List any specific site rules or procedures to be followed, eg. Site Operator Permit to Work?)*

Appropriate PPE (as stated above) will be worn at all times.

Any land owners with specific requests must have those requests adhered to. Care must be taken when accessing third party land to avoid damage to crops, livestock or property.

No Personnel will enter the water without first having had a briefing from the site safety team and the team in place at the survey location.

Welfare Arrangements *(Outline the welfare arrangements in place (sanitary facilities, place to eat and drink, etc))*

Public Toilets Bakers Mews, Saxmundham IP17 1FX, UK - Surveyors to stagger breaks and maintain physical distancing at all time. Surveyors to provide hand sanitizer, soap, towels and toilet roll.

Nearest Supermarket - 1 Church St, Saxmundham IP17 1EP, United Kingdom

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RAMS Briefing *(Please ensure that, prior to signing on to this RAMS, you have the appropriate level of Site Safety Clearance (as part of your H&S Checklist) for the activity planned)*

Name	Signature	Date
[redacted]	[redacted]	21/11/2020
[redacted]	[redacted]	23/11/2020
[redacted]	[redacted]	23/11/20

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Dynamic Risk Assessment *(Take a few minutes on arrival at site before commencing the work activity to determine if there are additional hazards/changes?*

Are there any significant new risks?	Yes / No

If No, there is no requirement to identify specific hazards in the table below; if Yes, identify these hazards/risks and the necessary controls below

Significant Hazards	**Risk** *(Who might be harmed and how)*	**Site Specific Risk Assessments & Controls** (*What is being done to control the risk on this job?)*	**Risk Grading** Low/Medium/High

Comments / Other *(State any assumptions or exclusions/lessons learnt/observations or any technical and commercial implications)*

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Specific Actions in Case of Emergency *(As and where warranted detail any site specific requirements in case of emergency - procedure to follow, who to contact, where to go, etc - most pertinent for out of hours working - nights/weekends - or remote working)*

http://www.nhs.uk/service-search/accident-and-emergency-services/locationsearch/428#

In case of emergency phone 999 A&E (Tel: 01896 826000)

Nearest A&E: Ipswich Hospital, Heath Rd, Ipswich IP4 5PD, United Kingdom - Tel: +441473712233, 999

Assessor's Signature	[redacted]	**Authoriser's Signature** (Project Manager or Project Director)	[redacted]

(Insert Digital Signatures or hard copy sign and scan)

ZERO HARM

24/7 Incident Report Line - 0870 240 8822

Issue 3.8

B) Site 10&11 Topographic Survey

N

BHALL_LS1

BHALL_LS8
No access to river beyond this point

XS_SNPGB04

BHALL_LS1

WL 3.93
2411 1027

WL 3.49
2411 1353

WL 3.52
2411 1518

SNP-GB04

SNP-SF04

WL 3.61
2411 1031

WL 3.78
2411 1528

Trees

Grass

NOTES

Grid: Ordnance Survey Grid (OSTN15)
Datum: Ordnance Survey Datum (OSGM15)

SURVEY LEGEND

- Bottom of Bank/Batter
- Fence(Metal Rail)
- Fence(Post & Wire)
- Fence(Wooden Rail)
- Foliage
- Flow Direction
- Flow Meter
- String Line
- Top of Bank/Batter
- O/H Electricity
- O/H BT
- Verge Wood
- Borehole
- Gate
- Gate Post
- Top of Gaugeboard
- Outfall Pipe
- Post
- Tele Pole

REV.	DETAILS	DRN	CHKD	DATE
Rev1	Drawing amended to include section labels	IR	SS	12/01/2021

STATIONS

wsp
7 Lochside View, Edinburgh Park, Edinburgh, EH12 9DH
T+ 44 (0) 131 344 2300
wsp.com

Project / Drawing Title

Sizewell C Hydro Survey
Site 10&11
Topographical Survey

Scale	Size	Date
1:200	A0	10/12/2020
Drawn By	Checked By	Approved By
K Baillie	A Moffat	S Smith

Drawing Name / Number

SIZEWELL C HYDRO SURVEY
Site 10&11
TOPOGRAPHICAL SURVEY 3D
SHEET 1 OF 7

NOTES

Grid: Ordnance Survey Grid (OSTN15)
Datum: Ordnance Survey Datum (OSGM15)

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—	Bottom of Bank/Batter
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—	Fence(Wooden Rail)
—	Foliage
←	Flow Direction
—	Flow Meter
—	String Line
—	Top of Bank/Batter
—	O/H Electricty
—	O/H BT
—	Verge Wood
BH "x"m "y"m "z"m	Borehole
⋈	Gate
◎	Gate Post
+	Top of Gaugeboard
Outfall IL=m Dia=m	Outfall Pipe
◎ Post	Post
◎ TP	Tele Pole

REV.	DETAILS	DRN	CHKD	DATE
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Scale 1:200	Size A0	Date 10/12/2020
Drawn By K Baillie	Checked By A Moffat	Approved By S Smith

Drawing Name / Number

SIZEWELL C HYDRO SURVEY
Site 10&11
TOPOGRAPHICAL SURVEY 3D
SHEET 2 OF 7

N

BHALL_LS2

XS_SNPGB03

No access beyond security fence

BHALL_DS3

XS_SNPGB
Unable to de

BHALL_DS2

BHALL_LS3

XS_SNPGB02

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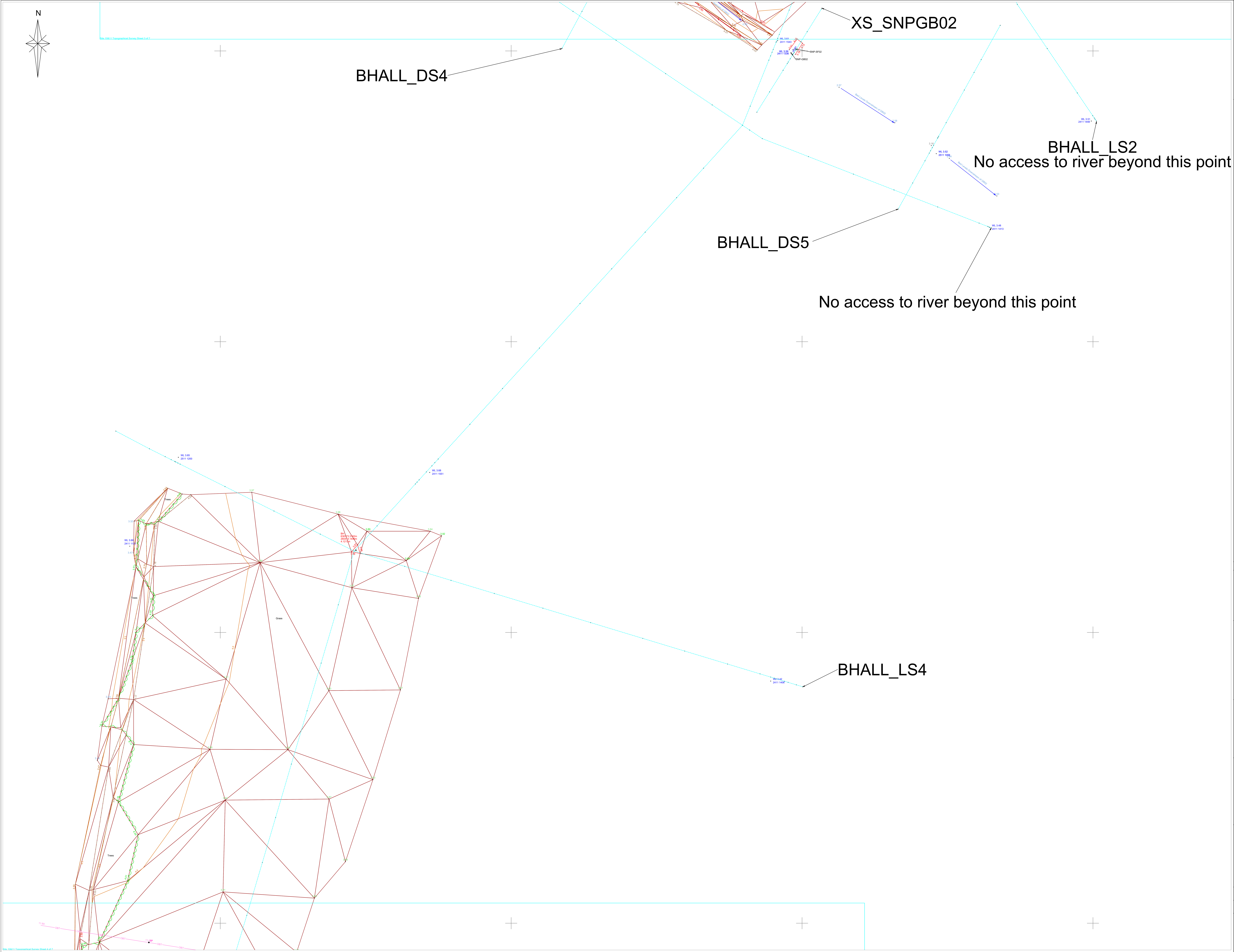
K Baillie	A Moffat	S Smith

Drawing Name / Number

SIZEWELL C HYDRO SURVEY
Site 10&11
TOPOGRAPHICAL SURVEY 3D
SHEET 3 OF 7



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- Post
- Tele Pole (TP)

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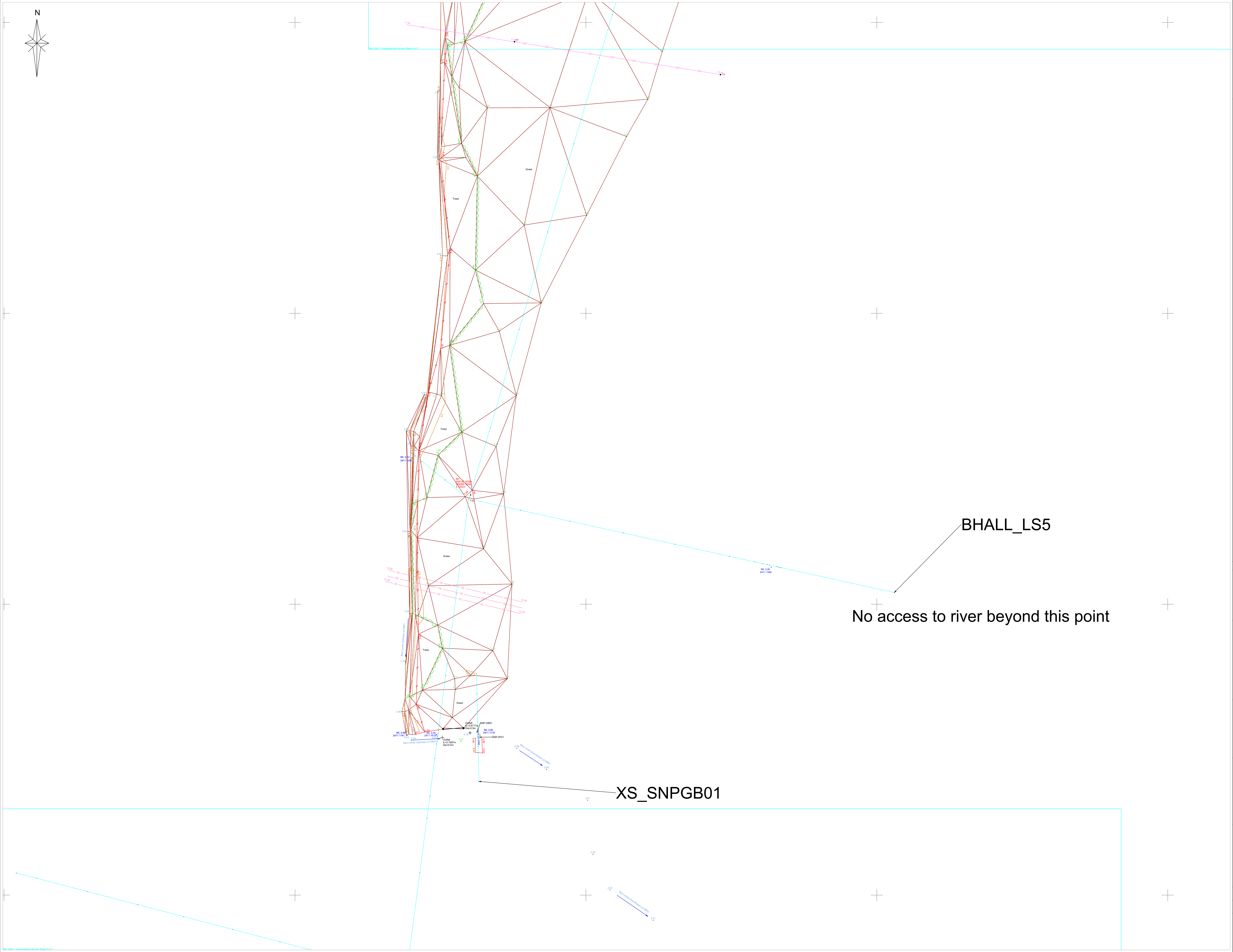
Drawn By	Checked By	Approved By
K Baillie	A Moffat	S Smith

Drawing Name / Number

SIZEWELL C HYDRO SURVEY
Site 10&11
TOPOGRAPHICAL SURVEY 3D
SHEET 4 OF 7



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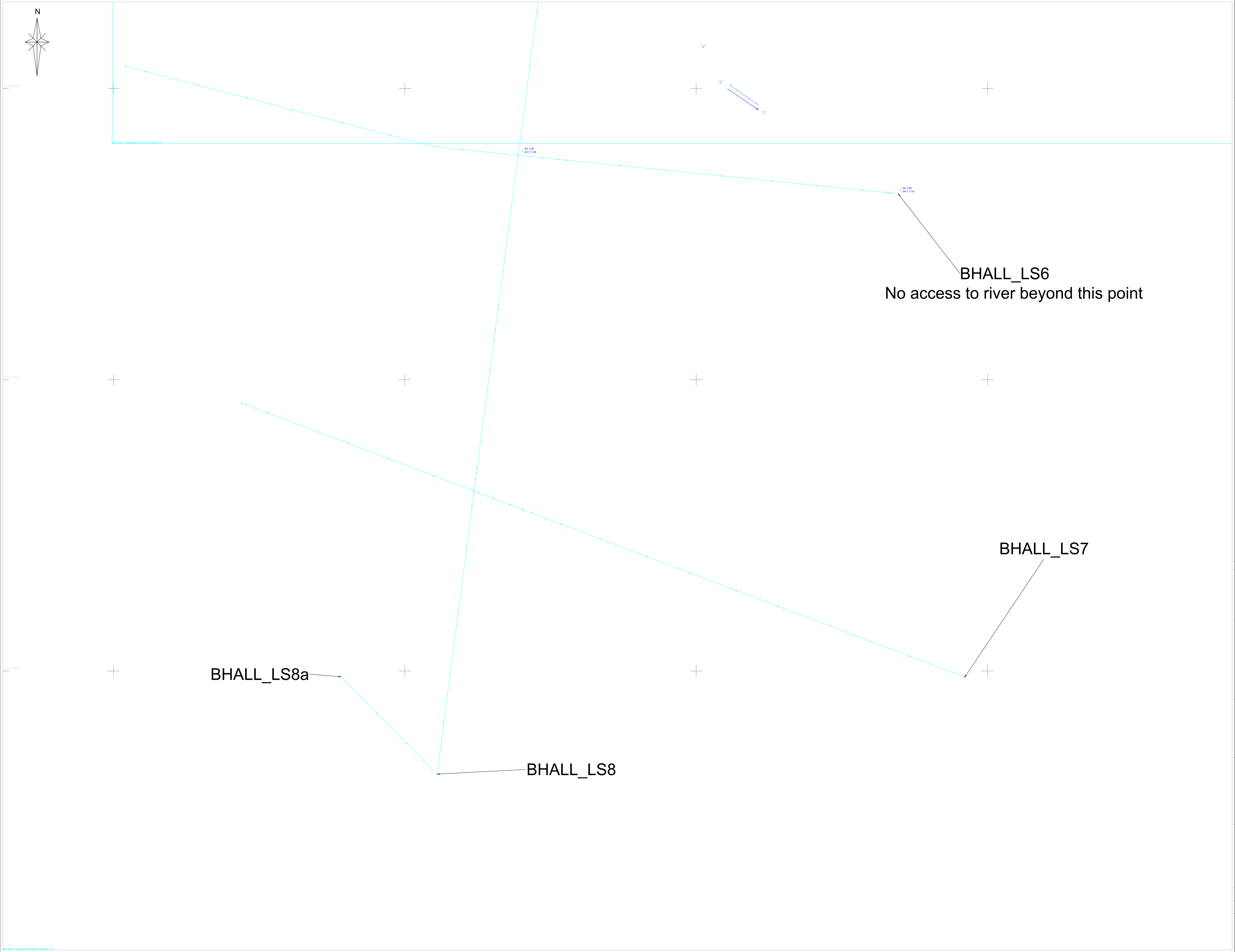
SIZEWELL C HYDRO SURVEY
Site 10&11
TOPOGRAPHICAL SURVEY 3D
SHEET 5 OF 7



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Project / Drawing Title

Sizewell C Hydro Survey
Site 10&11
Topographical Survey

Scale	Size	Date
1:200	A0	10/12/2020

Drawn By	Checked By	Approved By
K Baillie	A Moffat	S Smith

Drawing Name / Number

SIZEWELL C HYDRO SURVEY
Site 10&11
TOPOGRAPHICAL SURVEY 3D
SHEET 6 OF 7

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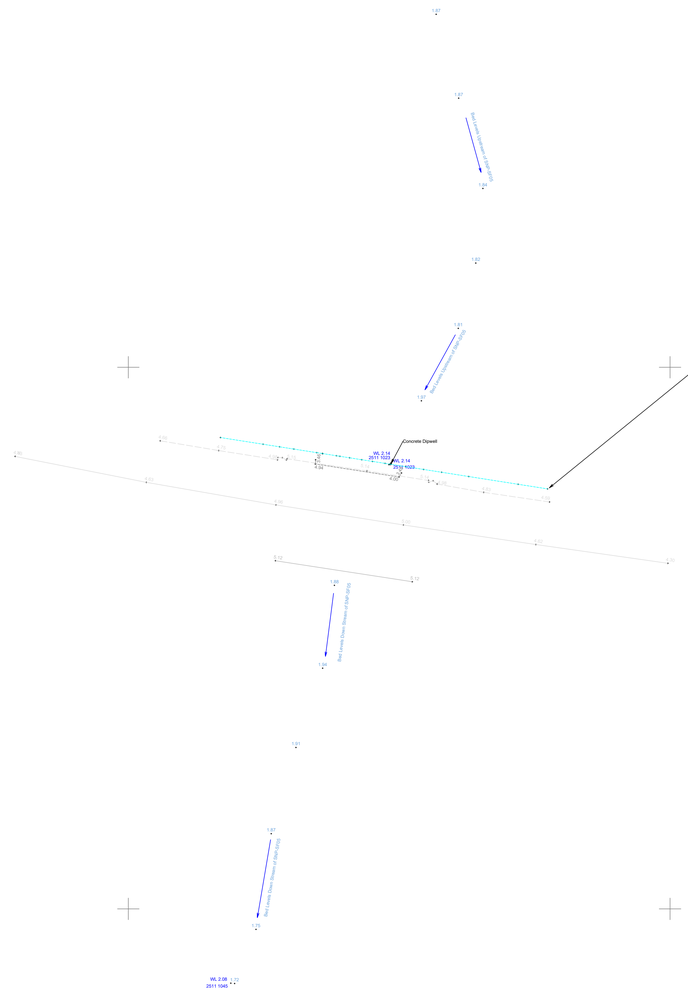

XS_SNPSF05

NOTES

Grid: Ordnance Survey Grid (OSTN15)
Datum: Ordnance Survey Datum (OSGM15)

SURVEY LEGEND

- Bottom of Bank/Batter
- Fence(Metal Rail)
- Fence(Post & Wire)
- Fence(Wooden Rail)
- Foliage
- Flow Direction
- Flow Meter
- String Line
- Top of Bank/Batter
- O/H Electricity
- O/H BT
- Verge Wood
- Borehole
- Gate
- Gate Post
- Top of Gaugeboard
- Outfall Pipe
- Post
- Tele Pole

REV.	DETAILS	DRN	CHKD	DATE
Rev1	Drawing amended to include section labels	IR	SS	12/01/2021

STATIONS

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Project / Drawing Title

Sizewell C Hydro Survey
Site 10&11
Topographical Survey

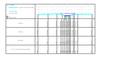
Scale	Size	Date
1:200	A0	10/12/2020
Drawn By: K Baillie	Checked By: A Moffat	Approved By: S Smith

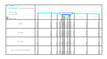
Drawing Name / Number

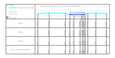
SIZEWELL C HYDRO SURVEY
Site 10&11
TOPOGRAPHICAL SURVEY 3D
SHEET 7 OF 7

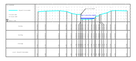
C) Site 10&11 Transects & Sections

Gauge Board/Dipwell Cross-sections









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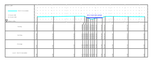

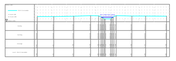

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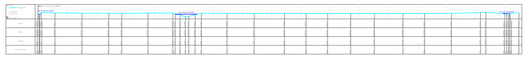

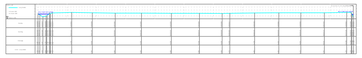

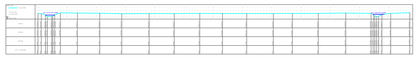

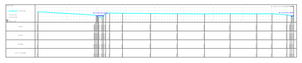

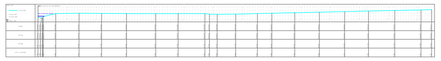

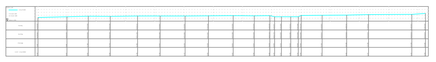

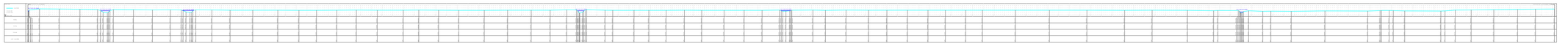

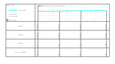

NOTES

Datum: Ordnance Survey Datum (OSGM15)

SURVEY LEGEND

REV.	DETAILS	DRN	CHKD	DATE

STATIONS

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Project / Drawing Title

Sizewell C Hydro Survey
Site 10&11
Topographical Survey

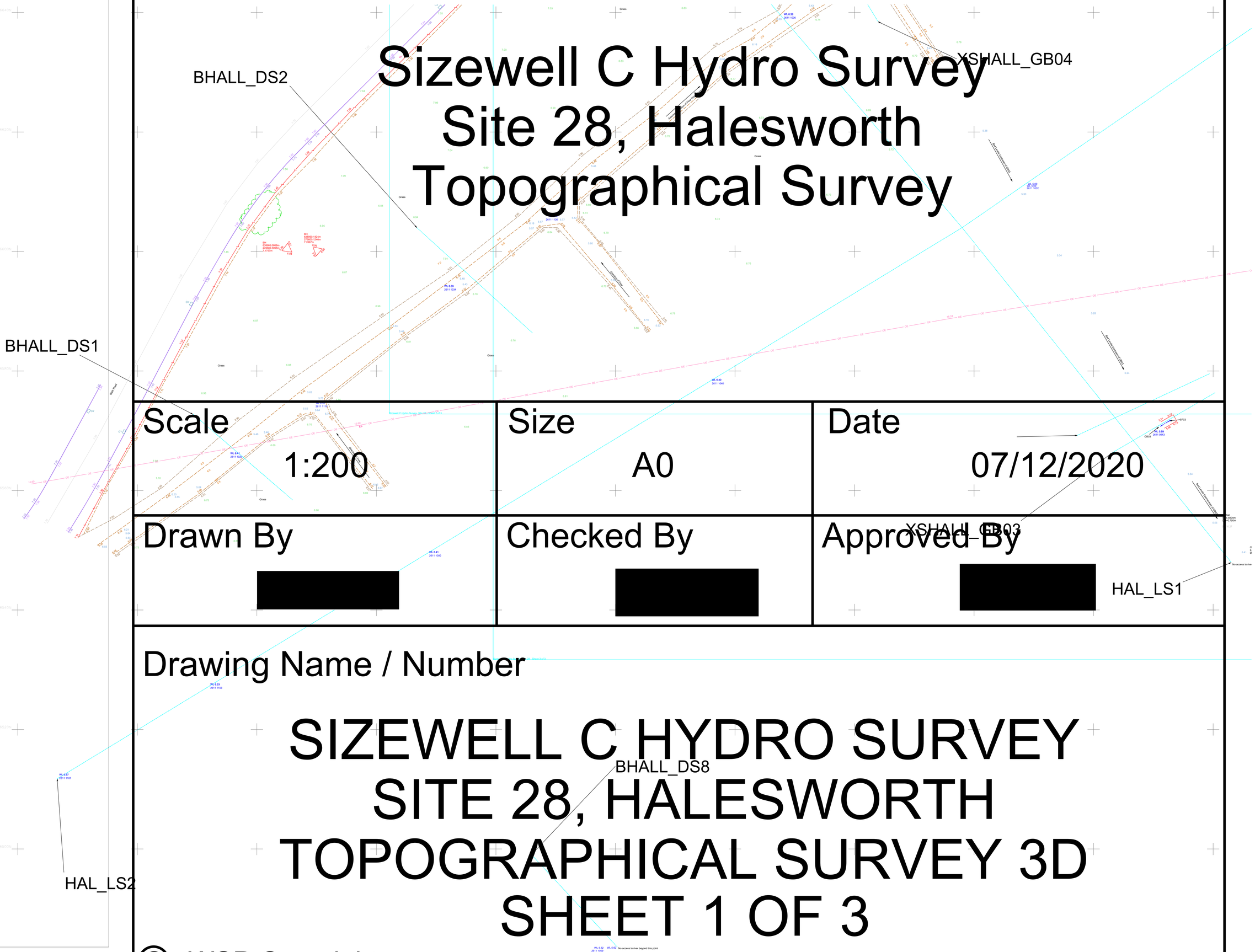
Scale	Size	Date
NTS	A0	10/12/2020
Drawn By	**Checked By**	**Approved By**
K Baillie	A Moffat	S Smith

Drawing Name / Number

SIZEWELL C HYDRO SURVEY
Site 10&11
TOPOGRAPHICAL SURVEY
SHEET 1 OF 1

D) Site 28 Topographic Survey

Sizewell C Hydro Survey
Site 28, Halesworth
Topographical Survey



Scale	Size	Date
1:200	A0	07/12/2020

Drawn By	Checked By	Approved By
[redacted]	[redacted]	[redacted]

Drawing Name / Number

SIZEWELL C HYDRO SURVEY
SITE 28, HALESWORTH
TOPOGRAPHICAL SURVEY 3D
SHEET 1 OF 3

Sizewell C Hydro Survey
Site 28, Halesworth
Topographical Survey

Scale	Size	Date
1:200	A0	07/12/2020
Drawn By	**Checked By**	**Approved By**
[redacted]	[redacted]	[redacted]

Drawing Name / Number

SIZEWELL C HYDRO SURVEY
SITE 28, HALESWORTH
TOPOGRAPHICAL SURVEY 3D
SHEET 2 OF 3

76540N

Sizewell C Hydro Survey
Site 28, Halesworth
Topographical Survey

Scale	Size	Date
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Drawn By	Checked By	Approved By
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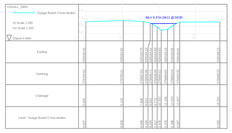
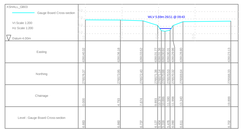
Drawing Name / Number

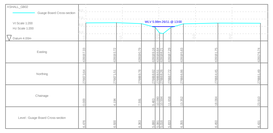
SIZEWELL C HYDRO SURVEY
SITE 28, HALESWORTH
TOPOGRAPHICAL SURVEY 3D
SHEET 3 OF 3

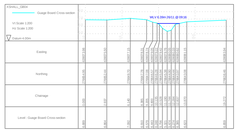
E) Site 28 Transects & Section

Guage Board Cross-sections

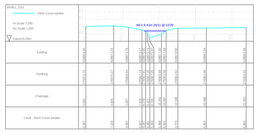


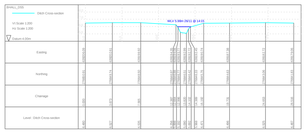


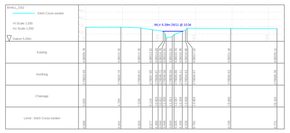


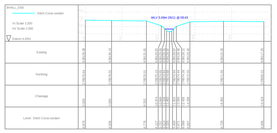


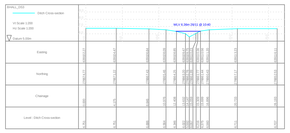
Ditch Cross-sections

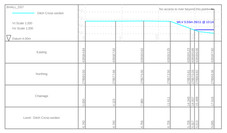


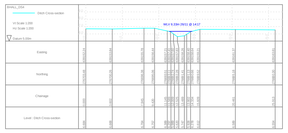


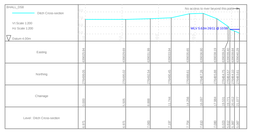




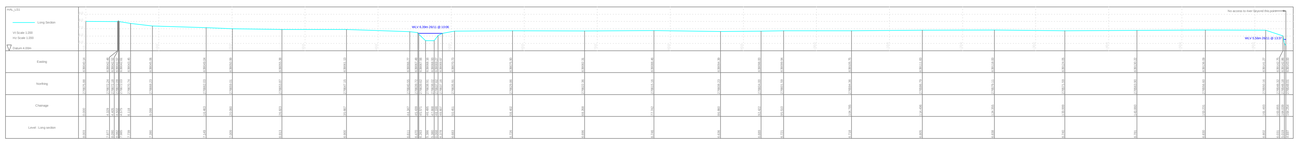


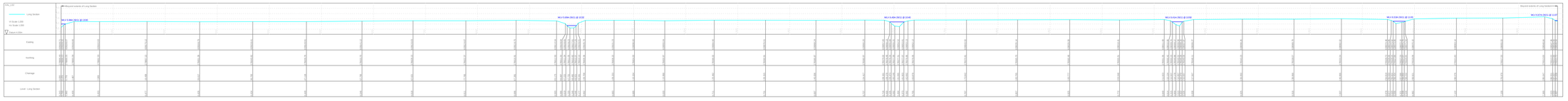






Long Sections





NOTES

Grid: OS Grid (OSTN15)
Datum: Ordnance Survey Datum (OSGM15)

SURVEY LEGEND

REV.	DETAILS	DRN	CHKD	DATE

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Project / Drawing Title

Sizewell C Hydro Survey
Site 28, Halesworth
Transects and Sections

Scale	Size	Date
1:200	A0	07/12/2020
Drawn By	**Checked By**	**Approved By**
I Ross	A Moffat	S Smith

Drawing Name / Number

SIZEWELL C HYDRO SURVEY
SITE 28, HALESWORTH
TRANSECTS AND SECTIONS
SHEET 1 OF 3

Appendix D
Soil Core Survey - April 2019

Site No. 10 – Soil core results

Core 1, TM3825160554
Location: Within an inundated area on the floodplain.
Vegetation: A wet area close to the *Agrostio-Ranunculetum repentis* inundation community (OV28a) in composition, with much Soft Rush joining Creeping Bent and Creeping Buttercup.
Standing water 2 cm.
Grey-brown silt loam with strong mottling from a depth of 2 cm bgl., fading with depth, to 28 cm bgl.
Grey silty clay – very wet and sticky to 72 cm bgl. Water table at 72 cm, rising to 10 cm.
Peat – hemic at surface, becoming sapric from c. 90 cm bgl.
End of core at 125 cm bgl.

Core 2, TM3829060639
Location: Within an inundated area of the floodplain.
Vegetation: Dominated by Creeping Bent and Creeping Buttercup, assigned to the *Agrostio-Ranunculetum repentis* inundation community (OV28)
Standing water 5 cm.
Grey-brown silt loam with strong mottling from a depth of 2 cm bgl., fading with depth, to 25 cm bgl.
Grey silty clay to 92 cm bgl.
Peat – hemic at surface but unknown at depth.
End of core at 125 cm.
Water table unknown as core backfilled by standing water.
Standing water as auger 1. Straight onto silt loam. Silty clay, stiff at 25cm. Sandy Peat at 92cm. Water backfilling hole from surface

Core 3, TM3839460656
Location: In a relatively elevated area of the floodplain with a firm, dry ground surface.
Vegetation: Dominated by Perennial Ryegrass with frequent Rough Meadow-grass and Meadow Foxtail and occasional Meadow Buttercup, Creeping Thistle and Lesser Celandine. Corresponds to the *Lolium perenne-Poa trivialis* leys of the *Lolio-Plantaginion* grassland (MG7b).
Brown silt loam to 28 cm bgl.
Grey-brown silty clay, mottled from 41 cm to 49 cm bgl.
Peat earthy to water table at 60 cm (no rise) then hemic
End of core at 125 cm bgl

Core 4, TM3831660562
Location: In an area of moist soil, apparently transition between the drier east and wetter west sides of the site.
Vegetation: Abundant Perennial Ryegrass with frequent Curled Dock; occasional Creeping Bent and Creeping Buttercup. Sward appears to be transitional between *Lolio-Plantaginion* grassland (MG7b) and the *Agrostio-Ranunculetum repentis* inundation community (OV28).
Brown silt loam with occasional mottles to 21 cm bgl.
Grey-brown silty clay, mottled from 44 cm to 56 cm bgl.; water table at 54 cm no rise.
Silty clay grey to 110 cm bgl.
Peat hemic
End of core at 125 cm bgl

Site No. 11 – Soil core results

Core 1, TM3820659951
Location: On 'degraded' footslope with transitional vegetation above secondary channel
Vegetation: Scattered Ragwort with Creeping Bent and Rough Meadow-grass; slightly damp immature grassland.

Shallow peaty top to 2 cm bgl.
Humic sands to 36 cm
Grey sand to 52 cm
Yellow sand from 52 cm, wet, mottling from 56 cm. Water table assumed from this depth.
End of core at 91 cm bgl.

Core 2, TM3824759954
Location: On floodplain between secondary and main channels at south of site
Vegetation: MG7b – Perennial Ryegrass with Rough Meadow-grass and White Clover. Some Creeping Buttercup indicates impeded drainage.

Humic silt loam to 20 cm bgl. Heavily mottled from c.4 cm.
Brown silt loam with less mottling to 38 cm bgl.
Mid grey silty clay with scattered mottles. Water table at 50 cm – no rise.
End of core at 125 cm

Core 3, TM3819660026
Location: Between secondary and main channels south of first connecting ditch.
Vegetation: MG7b short sward with frequent Daisy and White Clover, occasional Creeping Buttercup

Shallow peaty top to 2 cm bgl.
Brown silt loam (drier than core 2), with mottling from 20 cm to 33 cm bgl
Mid grey silty clay (with occasional inclusions of woody peat and sand); water table at 60 cm with no rise.
End of core at 125 cm

Core 4, TM3818860145
Location: North of cut-off meander in centre of floodplain.
Vegetation: As core 3: MG7b with low-growing Daisy-rich sward

Peaty top to 3 cm bgl.
Brown silt loam with occasional brick fragments. Only faintly mottled from 10 cm. Water table at 55 cm. At 85 cm …
Mid grey silty clay to end of core at 125 cm.
[N.B. thicker silt loam – former meander?]

Core 5, TM3814460121
Location: West of floodplain between secondary and main channels.
Vegetation: Seemingly MG7b with scattered jointed rush (frequent) and occasional Hard Rush, Marsh Horsetail and Meadow Buttercup.

Peaty top to 5 cm bgl.
Grey-brown silt loam heavily mottled to 28 cm bgl
Mid-grey silty clay with manganiferous streaks in central part (c. 35 cm) to 45 cm bgl
Peat – hemic throughout but more sapric towards base – to 106 cm when water table (rose to 39 cm)
Sand and gravel to end of core at 125 cm.

Core 6, TM3810360124
Location: West of secondary channel in broad declivity of sandy toeslope.
Vegetation: MG7b with occasional jointed rush and Marsh Horsetail. Rare Brown Sedge shoots.

Thicker peat top with sand inclusions to 6 cm
Humic silt loam (organic matter grading out) to 28 cm bgl.
Yellow sand, damp to 35 cm
Grey sand, wet with manganiferous streaks at c. 74 cm (Water table?). Stabilised at c. 75 cm at end.
End of core at 125 cm

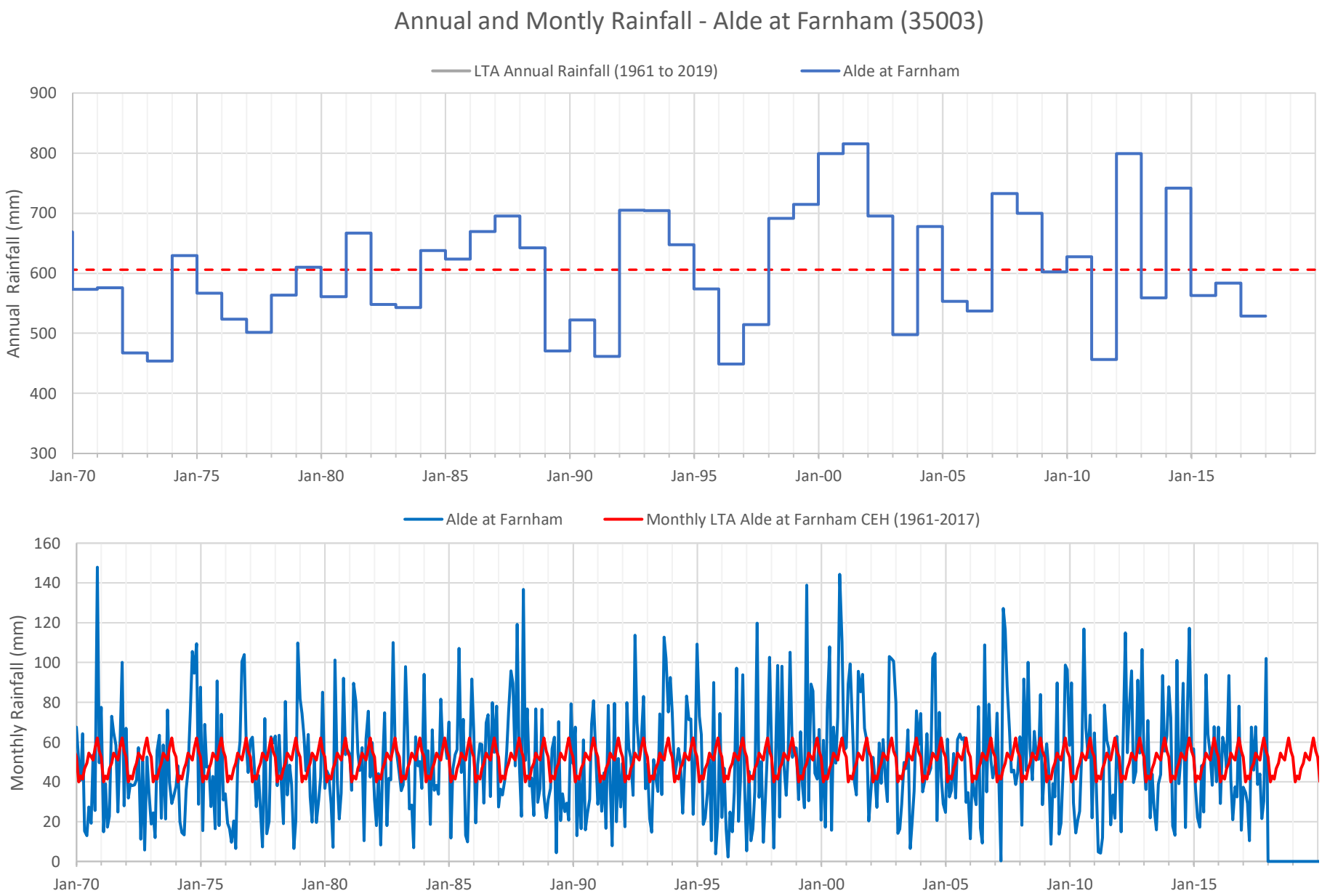
Core 7, TM3815260391
Location: At north of site near County Wildlife Site
Vegetation: Ryegrass-dominated sward with rare Marsh Horsetail, Water Mint and Lesser Celandine

Peaty top to 4 cm
Grey-brown silt loam with heavy mottling to 31cm bgl, diffuse boundary with
Silty clay grey to 41 cm
Peat – hemic with woody inclusions, slight sulphurous odour from c.100 cm; water table at 98 cm, rose to 60 cm.
End of core at 125 cm

Core 8, TM3820860387
Location: Northeast corner of site, nearer main channel.
Vegetation: MG7b species-poor with strong growth of ryegrass and meadow-grass dominant; occasional Meadow Foxtail and rare Meadow Buttercup

Brown silt loam with no mottling, to 28 cm
Grey brown silty clay, mottled from c.25 cm; becoming mid grey at c.60 cm, down to 94 cm bgl.
No water table within 125 cm, though wetter from 87 cm. Water table confirmed at that depth.
Peat – hemic/sapric – to end of core at 125 cm.

Appendix E
Rainfall, River Flow & Groundwater Level Data



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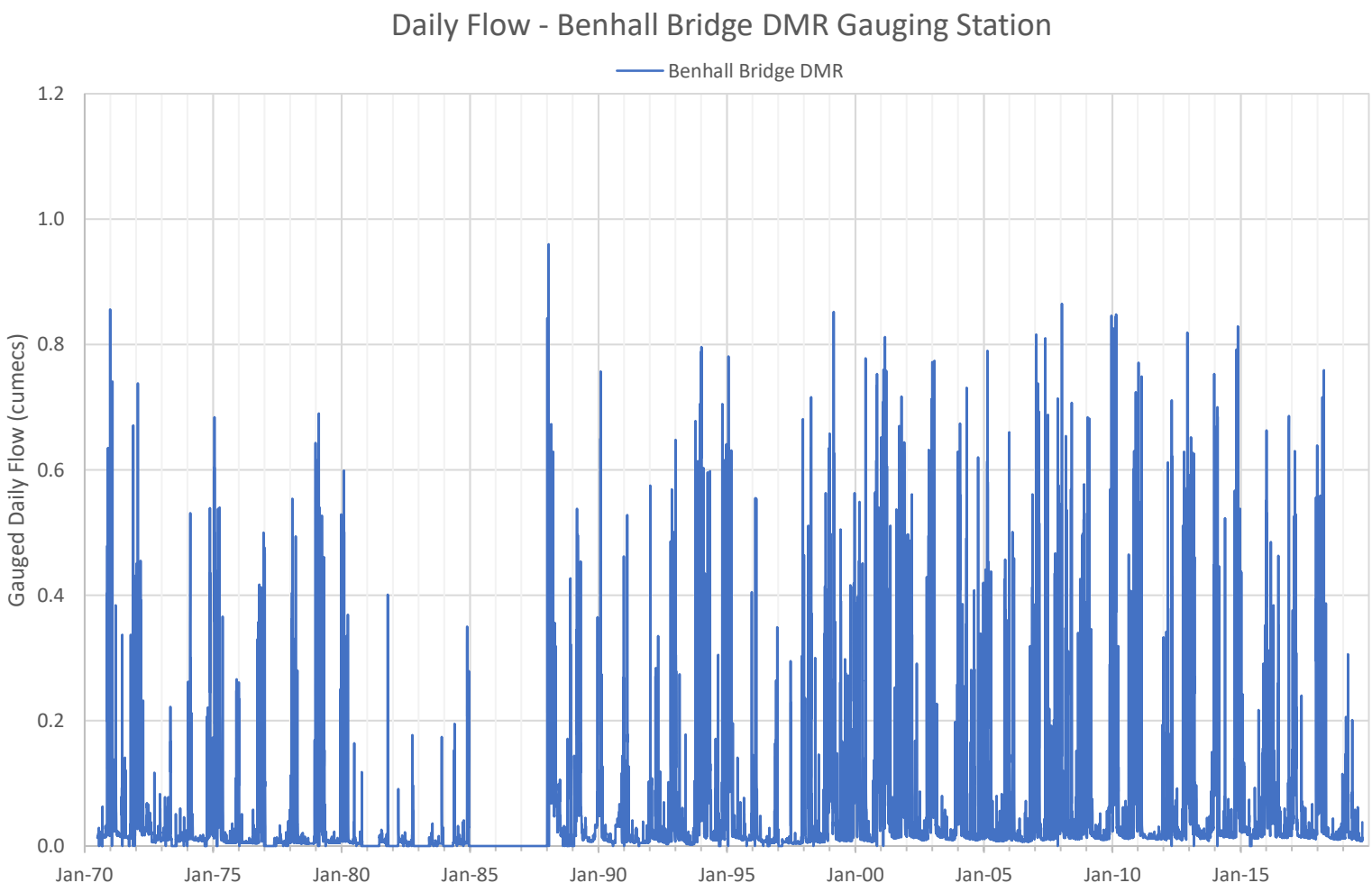

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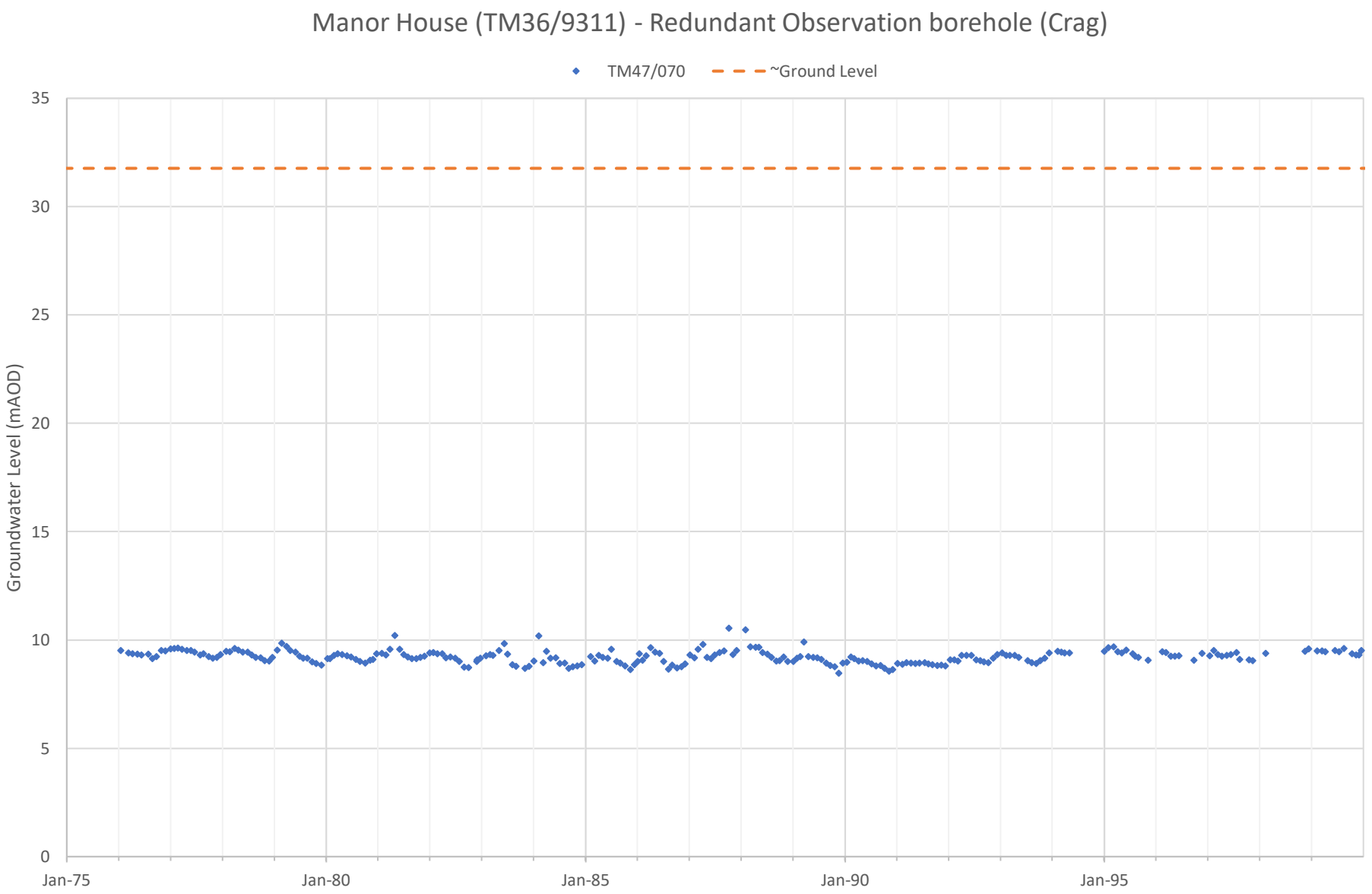

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APPENDIX E: WATER MONITORING SUMMARY – BENHALL SITE 10 & 11, NOVEMBER 2020 TO APRIL 2021

Technical note:
Sizewell C Fen Meadow Compensation
Water Monitoring Summary – Benhall Site 10 & 11
November 2020 to Present

1. Introduction

The technical note summarises water monitoring data collected between November 2020 to present at the Benhall Sites 10 and 11 (hereafter referred to as 'the Sites') which has been identified as a potential fen meadow development area. This technical note is a factual presentation of the data rather than an interpretive report.

Figure 1.1 shows a map of the Sites and the installations referred to in this technical note.

2. Groundwater Level Monitoring

Ten groundwater monitoring points were installed at the Sites between 5th and 23rd October 2020. Seven shallow dipwells were installed to measure groundwater levels in the shallow superficial near surface deposits and three piezometers were installed to measure groundwater levels in the underlying sands and gravels. Two of the sands and gravels piezometers are nested (within the same borehole) with a dipwell. An installation summary is provided in Table 2.1 below.

Table 2.1 Summary of groundwater monitoring installations

Name	Drillers ID	NGR	Datum: Metal Cover (mAOD)	Ground Level (mAOD)	Depth (m bgl*)	Diameter (mm)	Notes
BHALL_1001_d	bh1001	TM3824360485	7.254	6.689	10	50	
BHALL_1001_s	ws1001	TM3823760625	4.177	3.906	3	19	
BHALL_1002_s	ws1002a	TM3828760508	4.671	4.347	3	19	
BHALL_1003_s	ws1003	TM3824060487	4.207	3.931	3	19	
BHALL_1101_d	bh1101	TM3817360414	4.190	3.875	10	50	Nested with BHALL_1101_s
BHALL_1101_s	ws1101	TM3817360414	4.178	3.906	2.4	50	Nested with BHALL_1101_d
BHALL_1102_d	bh1102	TM3813060268	4.178	3.906	10	50	Nested with BHALL_1102_s

Name	Drillers ID	NGR	Datum: Metal Cover (mAOD)	Ground Level (mAOD)	Depth (m bgl*)	Diameter (mm)	Notes
BHALL_1102_s	ws1102	TM3813060268	4.147	3.92	3	50	Nested with BHALL_1102_d
BHALL_1103_s	ws1103	TM3820260405	4.147	3.92	3	50	
BHALL_1104_s	ws1104	TM3810560190	4.252	3.952	3	50	

s = shallow; d = deep
*m bgl = metres below ground level

Each installation is fitted with a water level datalogger which will be downloaded on a quarterly basis. Table 2.2 and 2.3 summarises the data collected between November 2020 and present for Site 10 and Site 11, respectively. BHALL_ 1002_s was entirely flooded in November 2020. In December 2020 BHALL_ 1003_s was flooded.

Table 2.2 Site 10 Groundwater Levels (m bgl and mAOD)

Date	BHALL_ 1001_d	BHALL_ 1001_s	BHALL_ 1002_s	BHALL_ 1003_s
m bgl				
19-20/11/20	0.837	0.423	0.033	0.042
09/12/20	0.569	0.376	-0.016	-0.03
13/01/21	0.79	0.78	0.04	0.33
17/02/21	0.386	0.316	-0.013	-0.024
10/03/21	0.365	0.746	0.416	0.415
27/04/21	0.45	0.96	0.88	0.89
mAOD*				
19-20/11/20	3.069	3.924	3.898	3.833
09/12/20	3.337	3.971	3.947	3.905
13/01/21	3.387	3.891	4.167	3.860
17/02/21	3.791	4.031	3.944	3.899
10/03/21	3.812	3.925	3.791	3.775
27/04/21	3.727	3.711	3.327	3.300

*m AOD = metres above ordnance datum
Note: negative m bgl value indicates positive hydrostatic pressure

Table 2.3 Site 11 Groundwater Levels (m bgl and mAOD)

Date	BHALL_ 1101_d	BHALL_ 1101_s	BHALL_ 1102_d	BHALL_ 1102_s	BHALL_ 1103_s	BHALL_ 1104_s
m bgl						
19-20/11/20	-0.052	-0.017	0.233	0.213	0.057	0.115
09/12/20	-0.077	-0.07	-0.106	0.135	-0.08	-0.017
13/01/21	0.1	0.1	0.38	0.41	0.36	0.36
17/02/21	-0.110	0.169	-0.042	-0.007	0.221	-0.125
10/03/21	0.155	0.305	0.386	0.422	0.418	0.330
27/04/21	0.83	1.05	0.81	0.52	0.77	0.36
mAOD*						
19-20/11/20	3.958	3.923	3.687	3.707	3.895	3.801
09/12/20	3.983	3.976	4.026	3.785	4.032	3.933
13/01/21	4.016	4.078	3.767	3.737	3.892	3.919
17/02/21	4.016	3.737	3.962	3.927	3.731	4.041
10/03/21	4.023	3.873	3.761	3.725	3.834	3.949
27/04/21	3.348	3.128	3.337	3.627	3.482	3.919

*m AOD = metres above ordnance datum
Note: negative m bgl value indicates positive hydrostatic pressure

3. Surface Water Level Monitoring

Five gaugeboards were installed between 12th and 16th October 2020 to allow monitoring of surface water levels across the site's watercourses / drains. All gaugeboards included stilling wells and water level data loggers. An installation summary is given in Table 3.1 below.

Table 3.1 Summary of gaugeboard installations

Ref.	GPS Grid Ref.	Top of Gaugeboard Datum (mAOD*)	Gaugeboard Length (m)	Datalogger	Log Interval (minutes)
SNP-GB01	TM 38130 60235	3.73	1	OTT Orpheus Mini	15
SNP-GB02	TM 38249 60509	4.24	1	OTT Orpheus Mini	15

Ref.	GPS Grid Ref.	Top of Gaugeboard Datum (mAOD*)	Gaugeboard Length (m)	Datalogger	Log Interval (minutes)
SNP-GB03	TM 38207 60658	4.8	1	OTT Orpheus Mini	15
SNP-GB04	TM 38350 60725	3.67	2	OTT Orpheus Mini	15
SNP-GB05	TM 38300 60618	4.71	2	OTT Orpheus Mini	15

*mAOD = metres above ordnance datum

Table 3.2 summarises the gaugeboard water level readings taken between November 2020 and present. The water level at all gaugeboard locations is continuously monitored and are downloaded on a monthly basis during spot gauging visit. Hydrographs of surface water levels are presented in Appendix B.

Table 3.2 Surface Water Levels (mAOD)

Date	SNP-GB01	SNP-GB02	SNP-GB03	SNP-GB04	SNP-GB05	SNP-SF05*
19-20/11/20	3.028	3.623	4.096	2.525	3.653	4.605
09/12/20	3.178	4.039	4.255	3.145	4.048	4.489
13/01/21	3.109	3.701	4.137	2.691	3.725	4.44
17/02/21	3.255	3.760	4.181	2.805	3.815	
10/03/21	2.952	3.651	4.104	2.488	3.666	4.709
08/04/21	2.933	3.61	4.09	2.404	3.621	4.668

*Manual reading from dip point (no gaugeboard or datalogger).

4. Spot Flow Gauging

Monthly spot flow gauging of five gaugeboard locations commenced in November 2020. Results to date are shown in Table 4.1 below. Negative flow readings in Table 4.1 indicate stagnant water where flow is not high enough to be measurable. An alternative gauging site is currently being considered as a substitute for SNP-SF04.

Table 4.1 Spot Flow (m^3/s)

Date	SNP-SF01	SNP-SF02	SNP-SF03	SNP-SF04	SNP-SF05
19-20/11/20	0.0015	0.0128	0.0012	No suitable location to gauge. Channel too deep to wade.	0.0718
09/12/20	0.0098	-0.0651	0.0207	No suitable location to gauge. Channel too deep to wade.	0.1909

Date	SNP-SF01	SNP-SF02	SNP-SF03	SNP-SF04	SNP-SF05
13/01/21	0.0036	0.0282	0.0047	No suitable location to gauge. Channel too deep to wade.	0.2646
17/02/21	0.0163	0.0470	0.0162	No suitable location to gauge. Channel too deep to wade.	Too deep to safely wade, severe flooding and significant snow meltwater from previous days.
10/03/21	0.0023	0.0324	0.0024	No suitable location to gauge. Channel too deep to wade.	0.0637
08/04/21	0.0024	0.0226	-0.0002	No suitable location to gauge. Channel too deep to wade.	0.0571

5. Water Quality Monitoring

In-situ water quality readings are collected from all groundwater and surface water installations on a monthly basis. In-situ water quality results are presented in Table 5.1 below.

In addition to this, water quality samples will also be collected quarterly at selected locations and sent for laboratory analysis. Quarterly sampling was undertaken in April 2021, with the next samples due to be collected in July 2021. The initial results for the quarterly sampling will be updated in this report after July 2021. In April 2021, SNP_1001_d could not be sampled due to a blockage and insufficient water.

Table 5.1 In-situ Water Quality Results

Date	Ref.	Temp (°C)	Diss. Oxygen (%)	Conductivity (SPC)	pH	Redox (ORP)	Turbidity (NTU)
19/11/20	BHALL_1001_d	12	4.2	1398	6.94	3.2	22.2
09/12/20	BHALL_1001_d	9.9	48.6	1362	6.97	-25.4	57
13/01/21	BHALL_1001_d	7.1	26.9	1244	6.91	134.2	19.5
17/02/21	BHALL_1001_d	7.20	42.90	1391.00	6.64	-115.30	96.70
10/03/21	BHALL_1001_d	7.60	41.90	1421.00	6.50	-101.30	9.96
27/04/21	BHALL_1001_d	11.6	30.3	1447	6.61	1001	19.3
20/11/20	BHALL_1001_s	cns	cns	cns	cns	cns	cns
09/12/20	BHALL_1001_s	cns	cns	cns	cns	cns	cns

Date	Ref.	Temp (°C)	Diss. Oxygen (%)	Conductivity (SPC)	pH	Redox (ORP)	Turbidity (NTU)
13/01/21	BHALL_1001_s	5.5	19.4	938	7.17	137.6	249
17/02/21	BHALL_1001_s	7.20	58.80	545.00	7.18	-111.90	78.20
10/03/21	BHALL_1001_s	6.90	59.00	1040.00	6.87	-51.10	51.92
19/11/20	BHALL_1002_s	9.6	35	804	7.68	-20.5	329.1
09/12/20	BHALL_1002_s	8.1	53	370.5	9.1	67.4	176.5
13/01/21	BHALL_1002_s	3.4	28.7	630	8.47	140.8	80.4
17/02/21	BHALL_1002_s	7.00	73.20	566.00	7.85	125.10	144.20
10/03/21	BHALL_1002_s	6.20	43.00	768.00	7.01	-13.00	157.77
19/11/20	BHALL_1003_s	12.1	32.2	1611	6.82	-70.2	137.05
09/12/20	BHALL_1003_s	7.5	63	588	7.46	32.8	192
13/01/21	BHALL_1003_s	7.7	23.4	947	6.72	137.2	>1050
17/02/21	BHALL_1003_s	6.30	58.50	434.30	7.50	110.00	164.50
10/03/21	BHALL_1003_s	6.10	52.50	668.00	6.95	-97.30	122.81
27/04/21	BHALL_1003_s	9.4	20.3	1268	6.54	95.8	259
19/11/20	BHALL_1101_d	11.4	3	1000	7.05	-120.9	13.34
09/12/20	BHALL_1101_d	8.4	19.9	1000	6.97	-88.8	94.2
13/01/21	BHALL_1101_d	8.7	17	910	7.07	137.9	40.3
17/02/21	BHALL_1101_d	7.70	31.80	985.00	6.97	-118.90	2.90
10/03/21	BHALL_1101_d	7.70	11.00	990.00	6.74	-72.80	8.70
27/04/21	BHALL_1101_d	10.5	20	956	5.89	85.3	136
19/11/20	BHALL_1101_s	10.8	3.4	1024	7.5	-142.3	19
09/12/20	BHALL_1101_s	8	30.9	1006	7.03	-101.6	16
13/01/21	BHALL_1101_s	6.6	34.1	919	7.13	143.7	289
17/02/21	BHALL_1101_s	7.90	35.30	992.00	6.95	-91.60	861.10
10/03/21	BHALL_1101_s	7.50	21.60	986.00	6.80	-73.10	124.32

Date	Ref.	Temp (°C)	Diss. Oxygen (%)	Conductivity (SPC)	pH	Redox (ORP)	Turbidity (NTU)
27/04/21	BHALL_1101_S	10.7	32.7	961	5.96	89.9	>1050
19/11/20	BHALL_1102_d	11.1	31.2	1187	10.05	-31.1	291.4
09/12/20	BHALL_1102_d	7.6	26	1012	8.16	-194.6	37.9
13/01/21	BHALL_1102_d	6.4	17.8	968	7.28	175.2	28.6
17/02/21	BHALL_1102_d	7.20	38.50	877.00	7.16	-102.60	51.00
10/03/21	BHALL_1102_d	7.20	39.50	1050.00	7.06	-52.80	181.53
27/04/21	BHALL_1102_d	11.2	35.2	1080	7.16	84.7	42.6
19/11/20	BHALL_1102_s	10.6	3.7	1318	7.46	-157.2	26.45
09/12/20	BHALL_1102_s	7.7	49.6	1252	7.16	87.2	41
13/01/21	BHALL_1102_s	7.1	19.1	1117	6.98	165.3	25.2
17/02/21	BHALL_1102_s	7.70	45.20	1090.00	7.06	-164.70	191.80
10/03/21	BHALL_1102_s	7.70	20.70	1158.00	6.78	-104.90	47.15
27/04/21	BHALL_1102_s	12.1	7.9	1056	7.39	72.6	>1050
19/11/20	BHALL_1103_s	11	3.6	1385	6.88	-146.8	71.24
09/12/20	BHALL_1103_s	7.7	48.9	1373	6.95	-109.9	156.7
13/01/21	BHALL_1103_s	6.3	11.9	1147	6.99	133.2	154
17/02/21	BHALL_1103_s	6.60	63.50	876.00	7.23	-86.90	38.00
10/03/21	BHALL_1103_s	6.60	37.00	1268.00	6.57	-75.10	65.10
19/11/20	BHALL_1104_s	11.1	6.5	1160	7.06	-134.9	54.4
09/12/20	BHALL_1104_s	7.6	40.3	953	6.89	241.9	50.1
13/01/21	BHALL_1104_s	6.9	22.8	886	6.95	199.1	78.2
17/02/21	BHALL_1104_s	9.00	42.20	906.00	7.17	-60.80	211.70
10/03/21	BHALL_1104_s	7.50	21.10	990.00	6.83	120.20	20.21
27/04/21	BHALL_FRO	9.8	87.2	964	7.44	113.3	12.5
27/04/21	BHALL_GB1	11.9	91.1	943	7.22	73.7	9.77

Date	Ref.	Temp (°C)	Diss. Oxygen (%)	Conductivity (SPC)	pH	Redox (ORP)	Turbidity (NTU)
27/04/21	BHALL_GB2	11.7	84.5	1511	7.46	111.5	16
27/04/21	BHALL_GB4	16.5	96	991	7.63	84.2	30.7
27/04/21	BHALL_GB5	8.5	29.6	1350	6.92	134.1	>1050
27/04/21	BHALL_SP5	12.5	113.2	1208	7.62	71.4	16.3
19/11/20	SNP-GB01	10	34.2	1022	7.28	41	1.9
09/12/20	SNP-GB01	5.5	60	1077	7.22	223	7.3
17/02/21	SNP-GB01	5.3	53.7	835	7.29	135.5	12.3
10/03/21	SNP-GB01	7.70	62.40	998.00	7.40	149.10	3.10
19/11/20	SNP-GB02	12.3	56.7	1618	7.46	88.1	4.45
09/12/20	SNP-GB02	5.2	95.4	836	7.85	81.3	64
17/02/21	SNP-GB02	8.1	81.5	1141	7.47	91.4	15.2
10/03/21	SNP-GB02	8.70	50.40	1664.00	6.93	1.30	262.78
20/11/20	SNP-GB03	5.6	56.9	1067	7.6	5.6	3.49
09/12/20	SNP-GB03	5	92.1	871	7.74	87.3	70.3
17/02/21	SNP-GB03	5.1	90.2	629	7.58	80.8	21
10/03/21	SNP-GB03	6.50	80.50	956.00	7.25	-77.20	26.41
20/11/20	SNP-GB04	5	41.7	1227	7.52	-21.4	10.1
09/12/20	SNP-GB04	5.3	88.6	888	7.67	92.2	42.1
17/02/21	SNP-GB04	7.2	73.9	875	7.49	121.9	36
10/03/21	SNP-GB04	6.10	62.70	1021.00	7.15	16.20	11.60
20/11/20	SNP-GB05	7.6	5.4	1581	7.09	-176.4	4.3
09/12/20	SNP-GB05	5.4	57.3	1006	7.49	86.3	4
17/02/21	SNP-GB05	7	67.3	857	7.47	127.1	22.4
10/03/21	SNP-GB05	5.80	30.70	1096.00	6.84	-9.00	55.26

Date	Ref.	Temp (°C)	Diss. Oxygen (%)	Conductivity (SPC)	pH	Redox (ORP)	Turbidity (NTU)
19/11/20	SNP-SF05	9.5	65.2	1037	7.52	178.7	3.82
09/12/20	SNP-SF05	4.9	82	1108	7.43	26.5	115
17/02/21	SNP-SF05	4.5	87	675	7.68	214.5	22.1
10/03/21	SNP-SF05	7.70	74.10	1084.00	7.26	203.70	7.43

cns = could not sample. Insufficient water / blockage

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SNP-GB04
SNP-SF04
SNP-GB03
SNP-SF03
BHALL_1001_s
SNP-GB05
SNP-SF02
BHALL_1002_s
SNP-GB02
BHALL_1003_s
BHALL_1001_d
BHALL_1101_s
BHALL_1101_d
BHALL_1103_s
BHALL_1102_s
BHALL_1102_d
SNP-GB01
SNP-SF01
BHALL_1104_s
SNP-SF05
SNP-SF05

Key

- Site boundary
- Gaugeboard
- Piezometer
- Dipwell
- Flow gauging

0 50 100 150 200 250 m

Scale at A3: 1:4,502

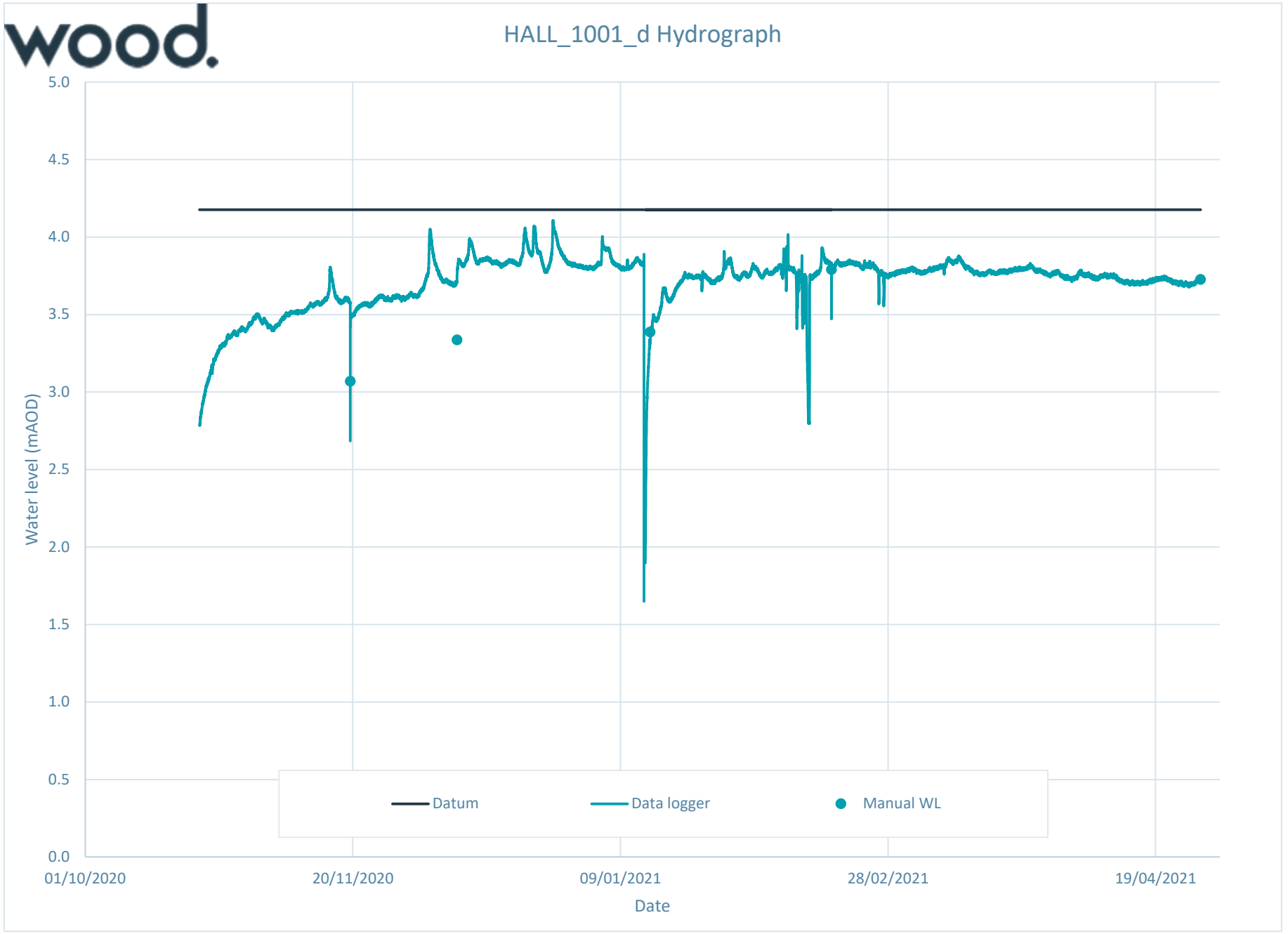
EDF Energy
Sizewell C
Fen Meadow Compensation Water Monitoring Summary

Figure 1.1
Monitoring locations
Site 10-11 Benhall

June 2021

wood.

Appendix A
Groundwater Hydrographs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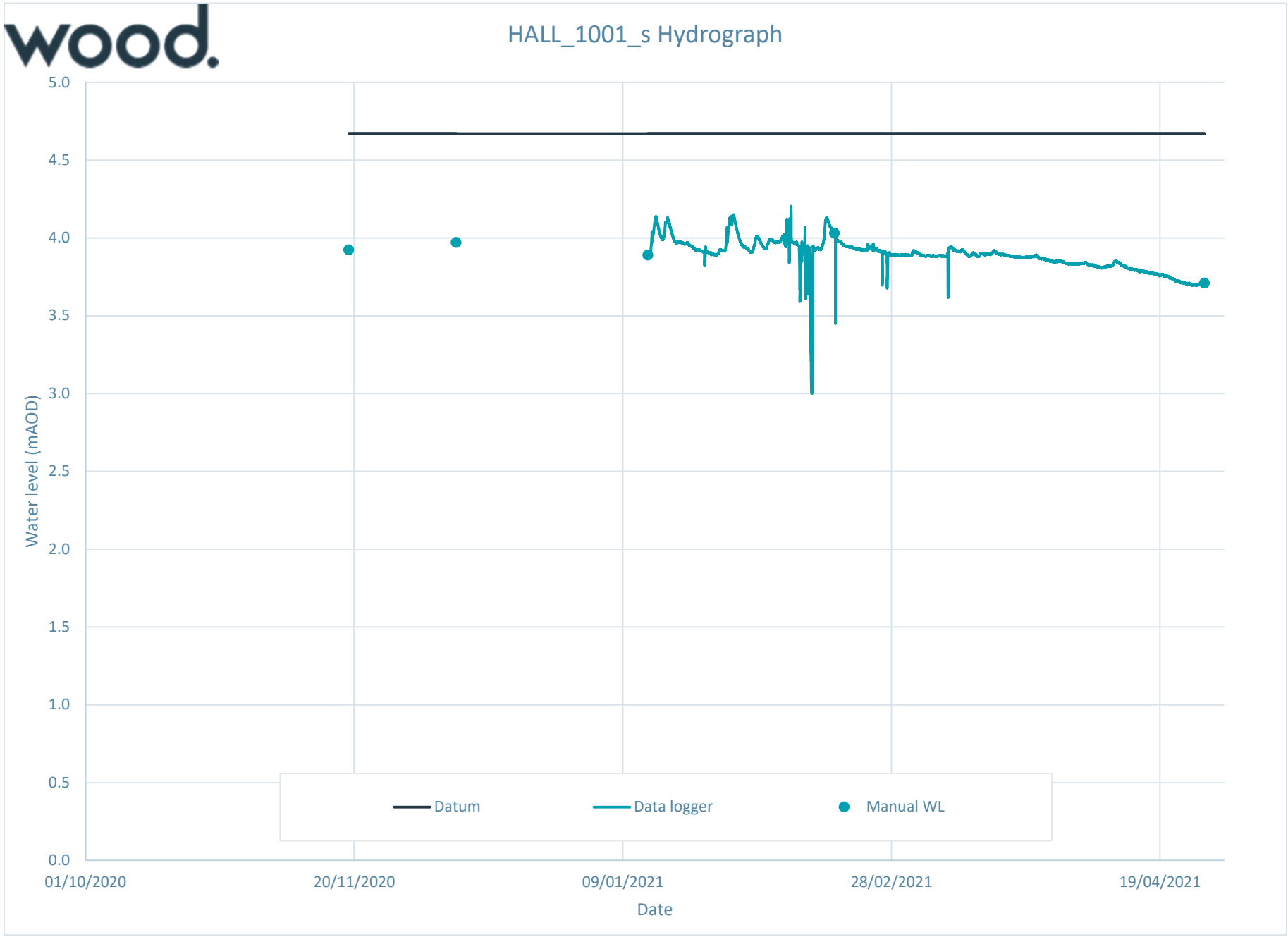
09/01/2021
28/02/2021
19/04/2021
Date
Datum
Data logger
Manual WL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Water level (mAOD)
Datum
Data logger
Manual WL
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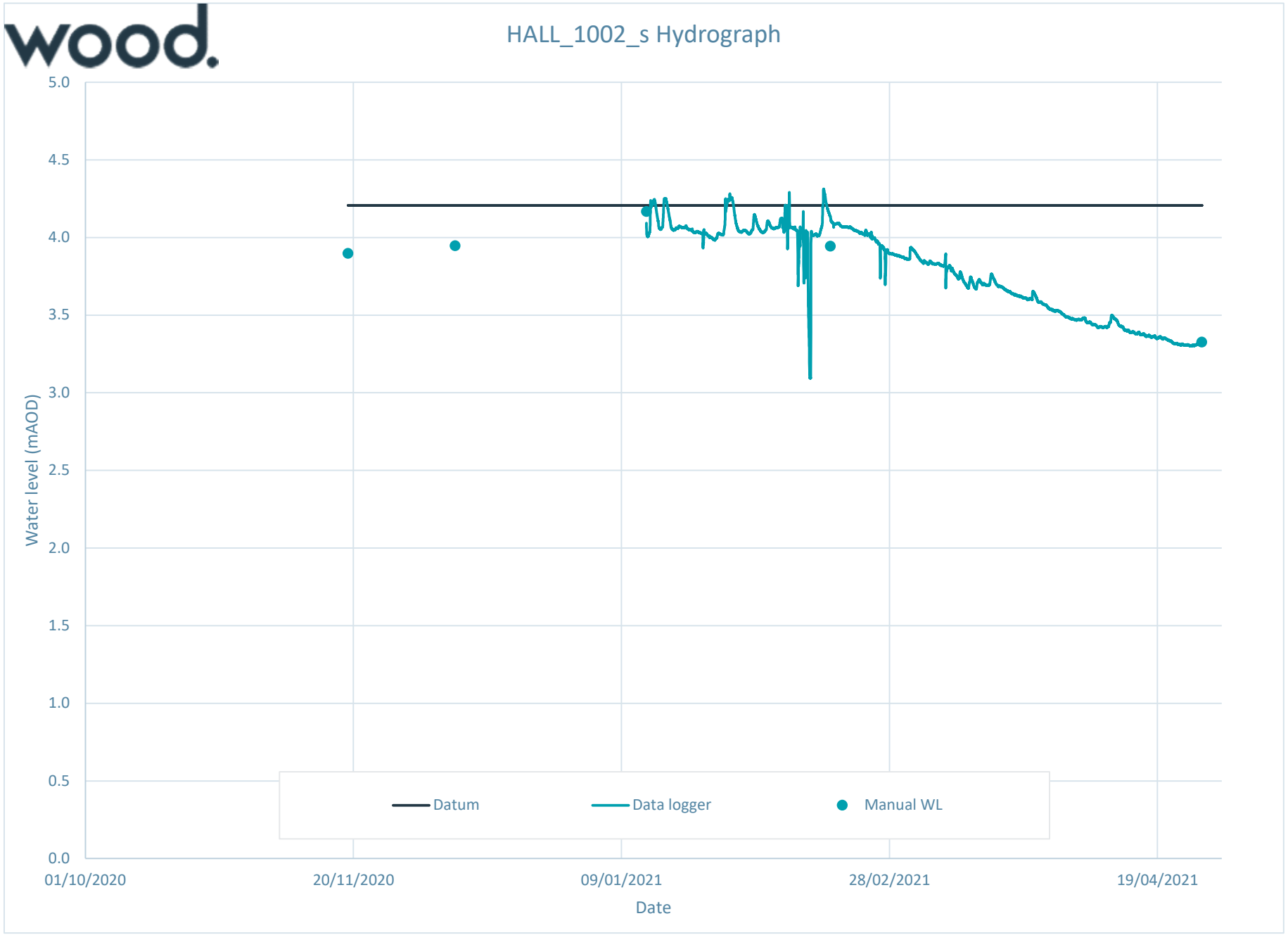
Date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Water level (mAOD)
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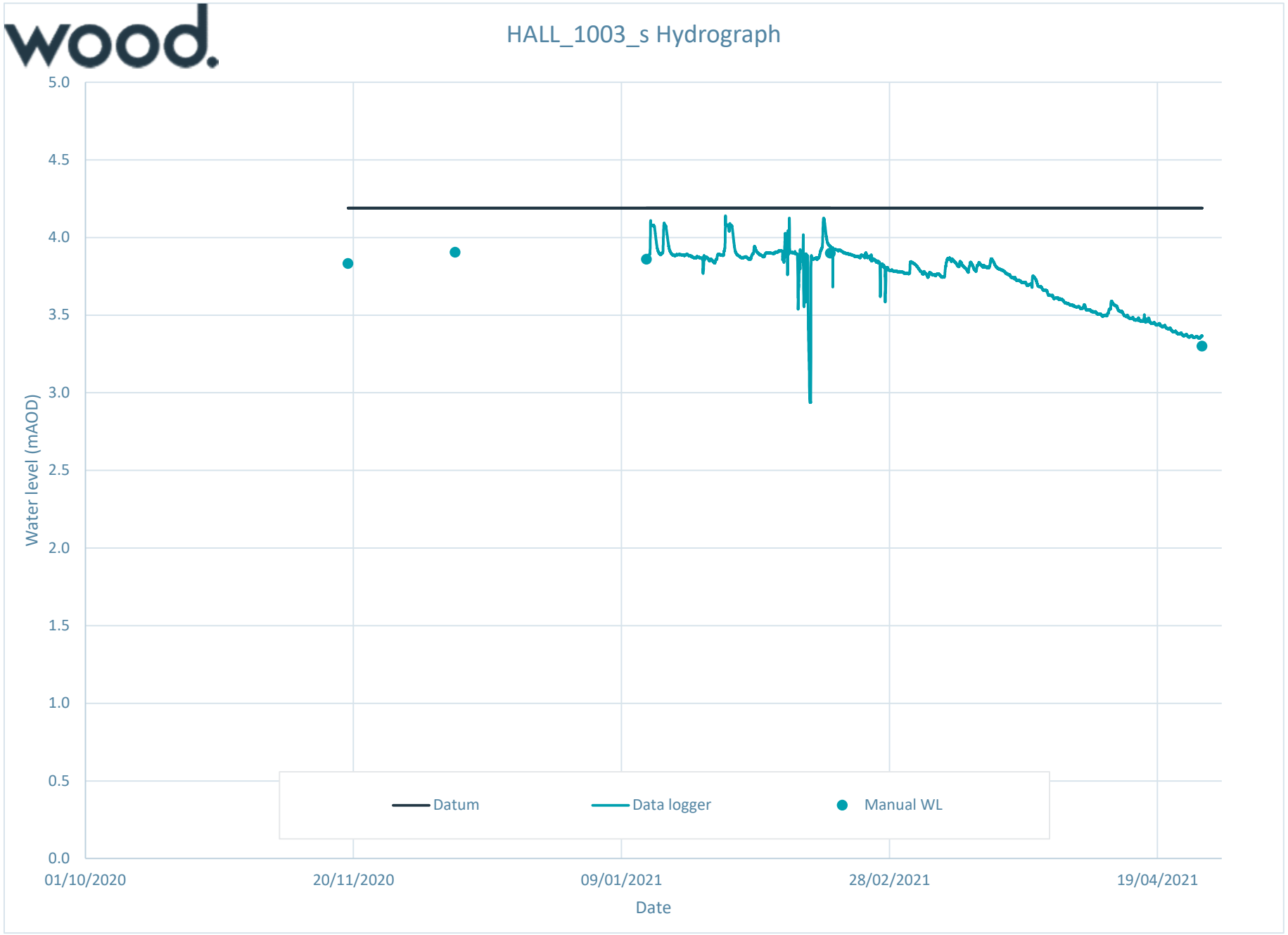
Data logger
Manual WL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Water level (mAOD)
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Data logger
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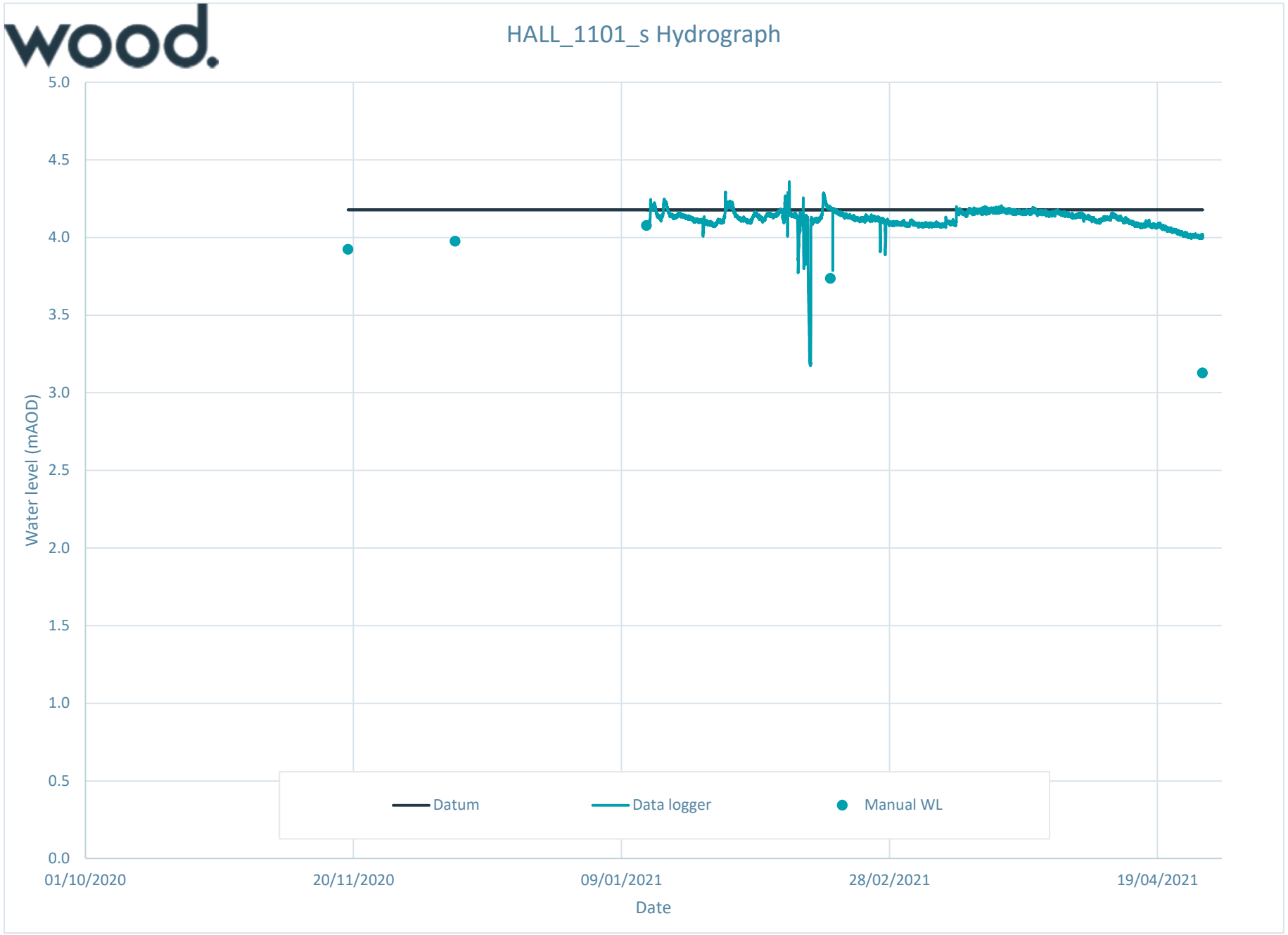
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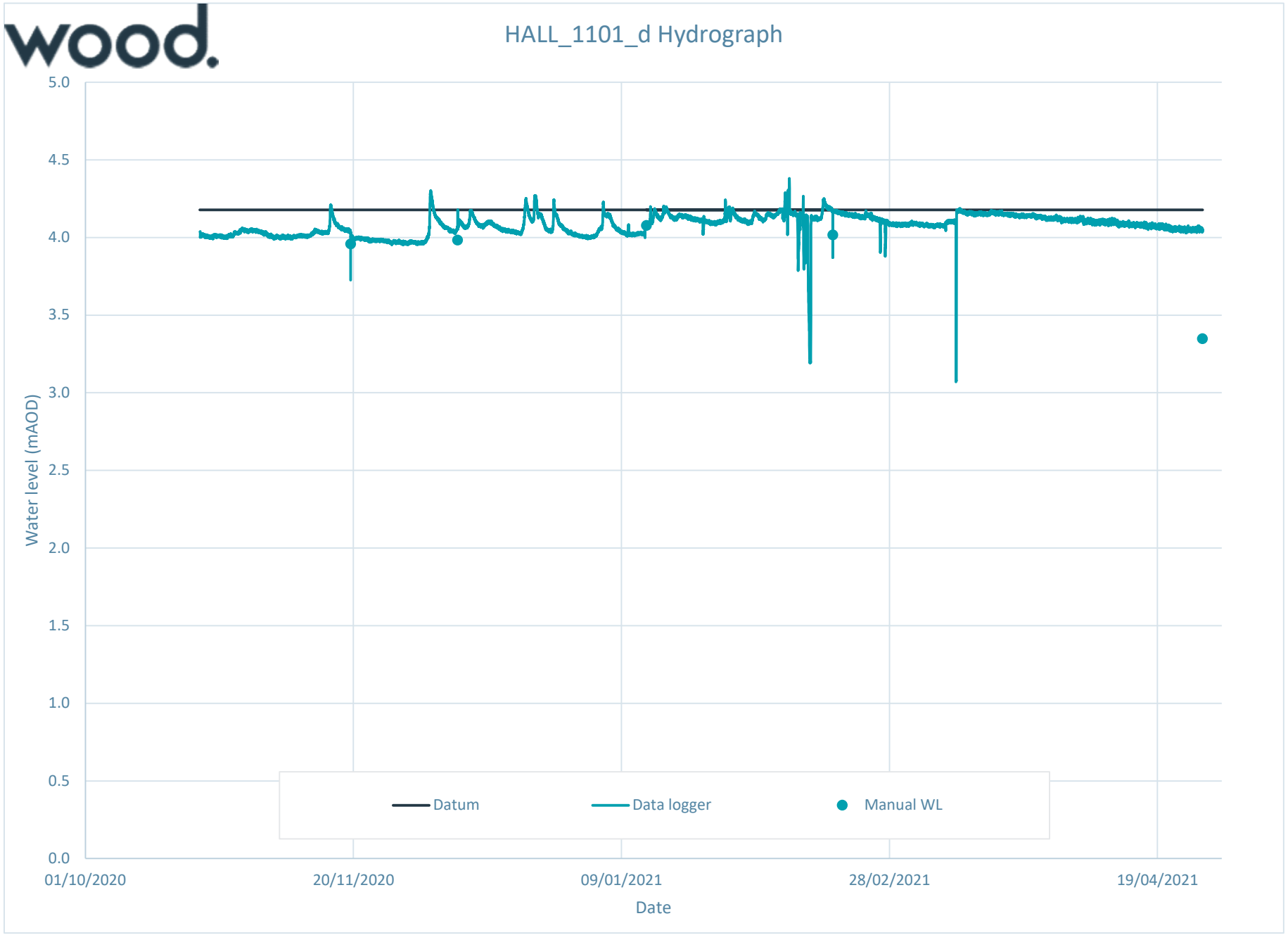
19/04/2021
Date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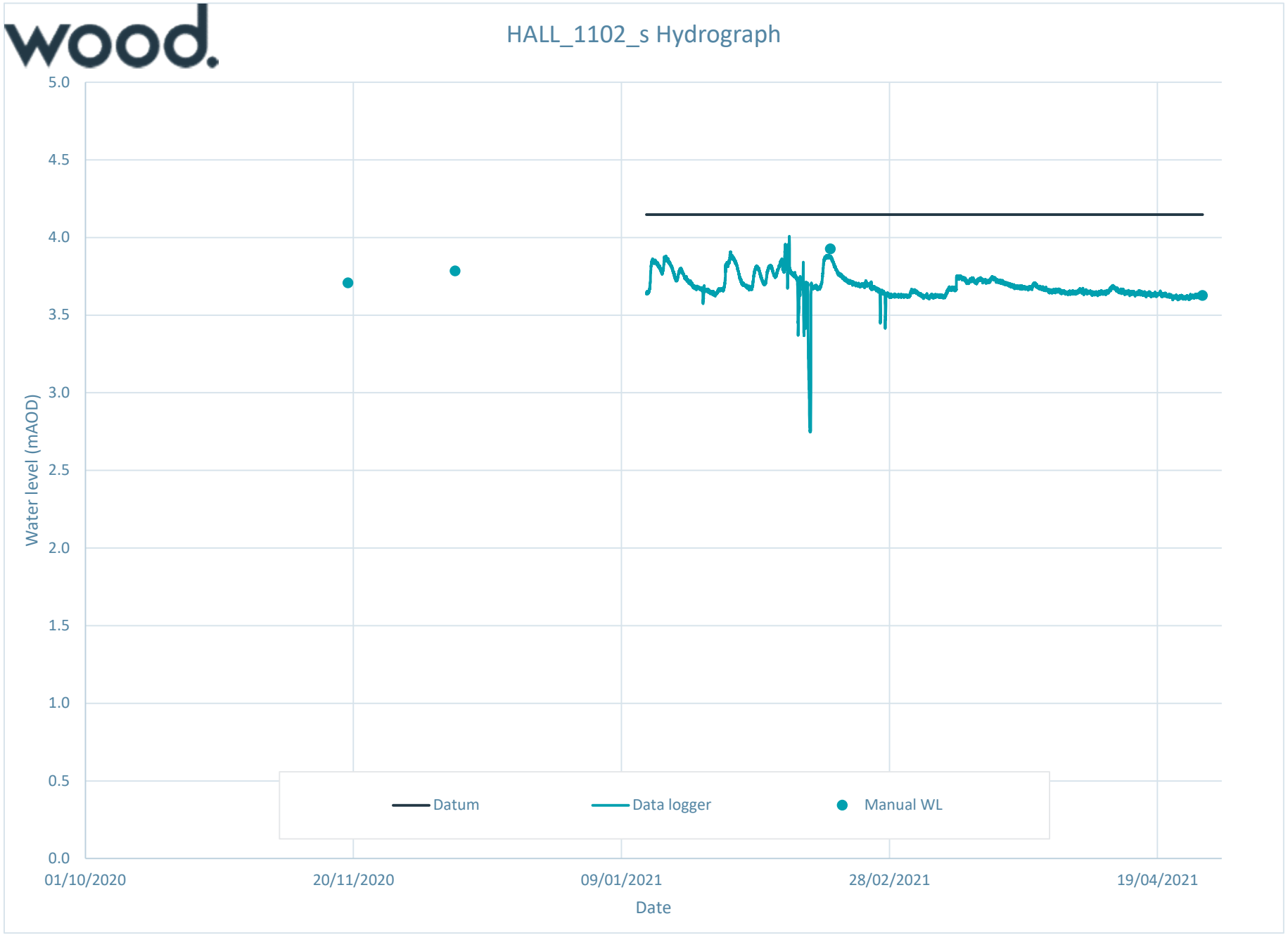
Water level (mAOD)
01/10/2020
20/11/2020
09/01/2021
28/02/2021
19/04/2021
Date
Datum
Data logger
Manual WL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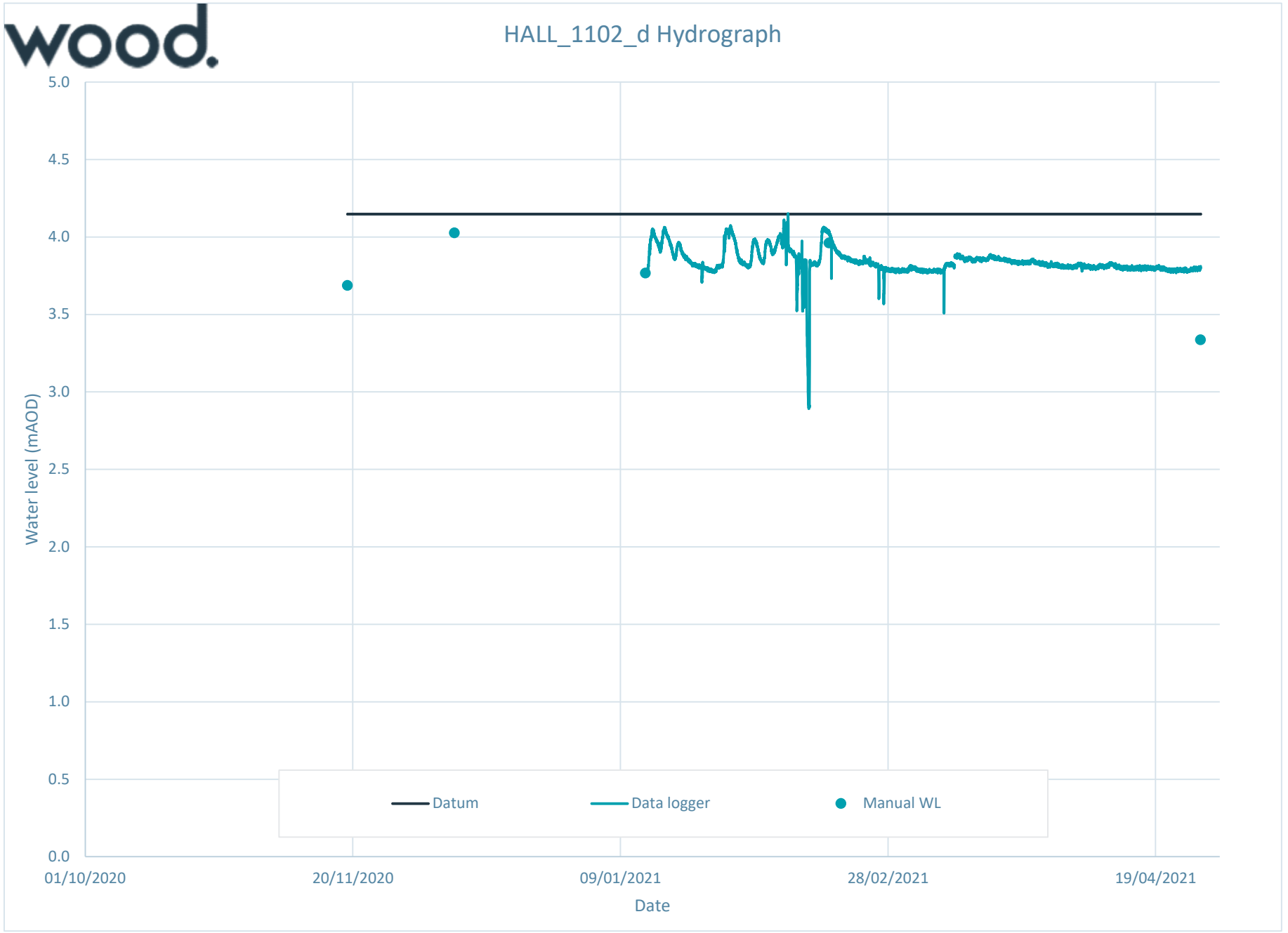
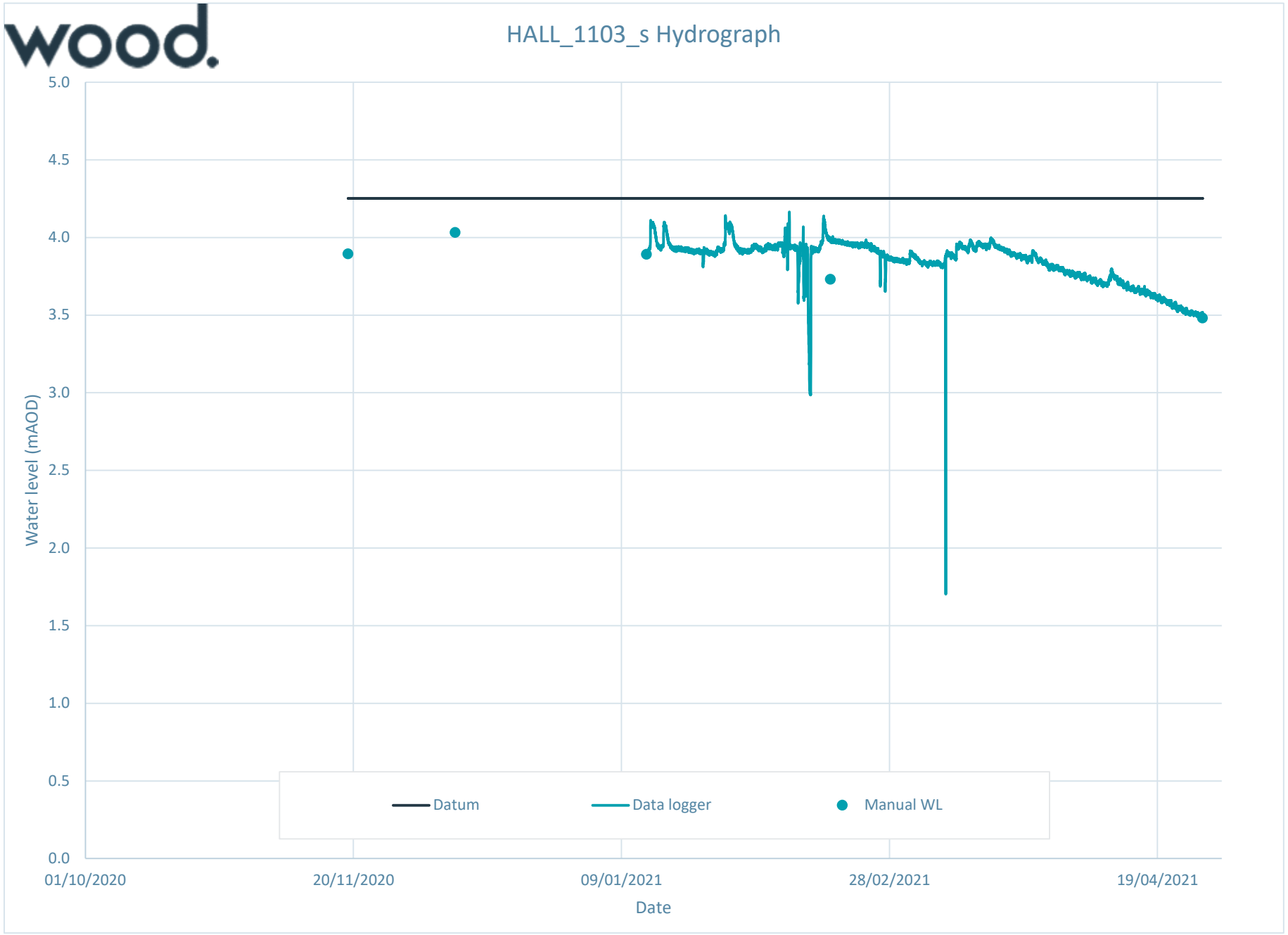
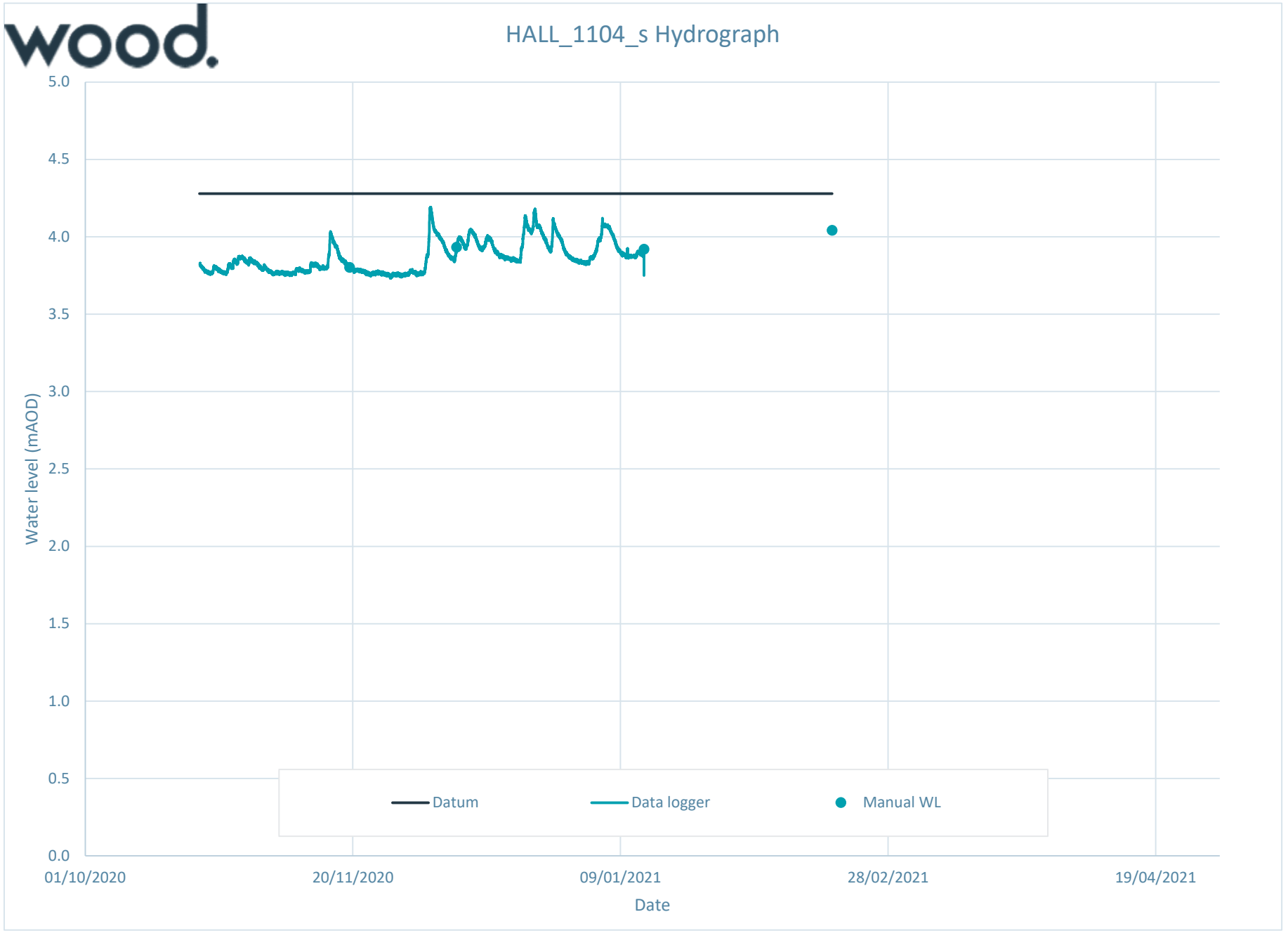
Water level (mAOD)
01/10/2020
20/11/2020
09/01/2021
28/02/2021
19/04/2021
Date
Datum
Data logger
Manual WL

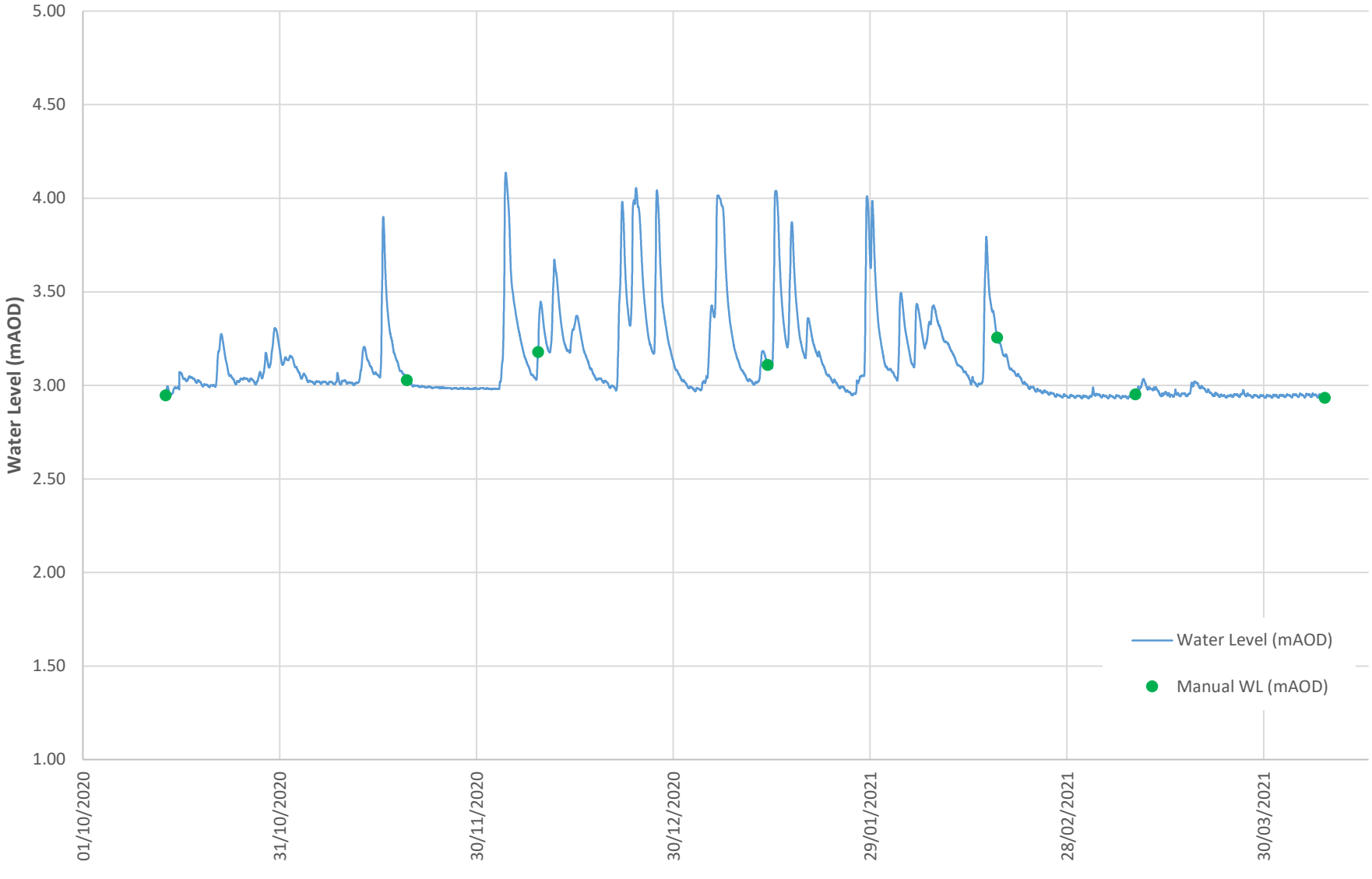

HALL_1102_d Hydrograph
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Water level (mAOD)
01/10/2020
20/11/2020
09/01/2021
28/02/2021
19/04/2021
Date
Datum
Data logger
Manual WL


HALL_1103_s Hydrograph
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Water level (mAOD)
01/10/2020
20/11/2020
09/01/2021
28/02/2021
19/04/2021
Date
Datum
Data logger
Manual WL

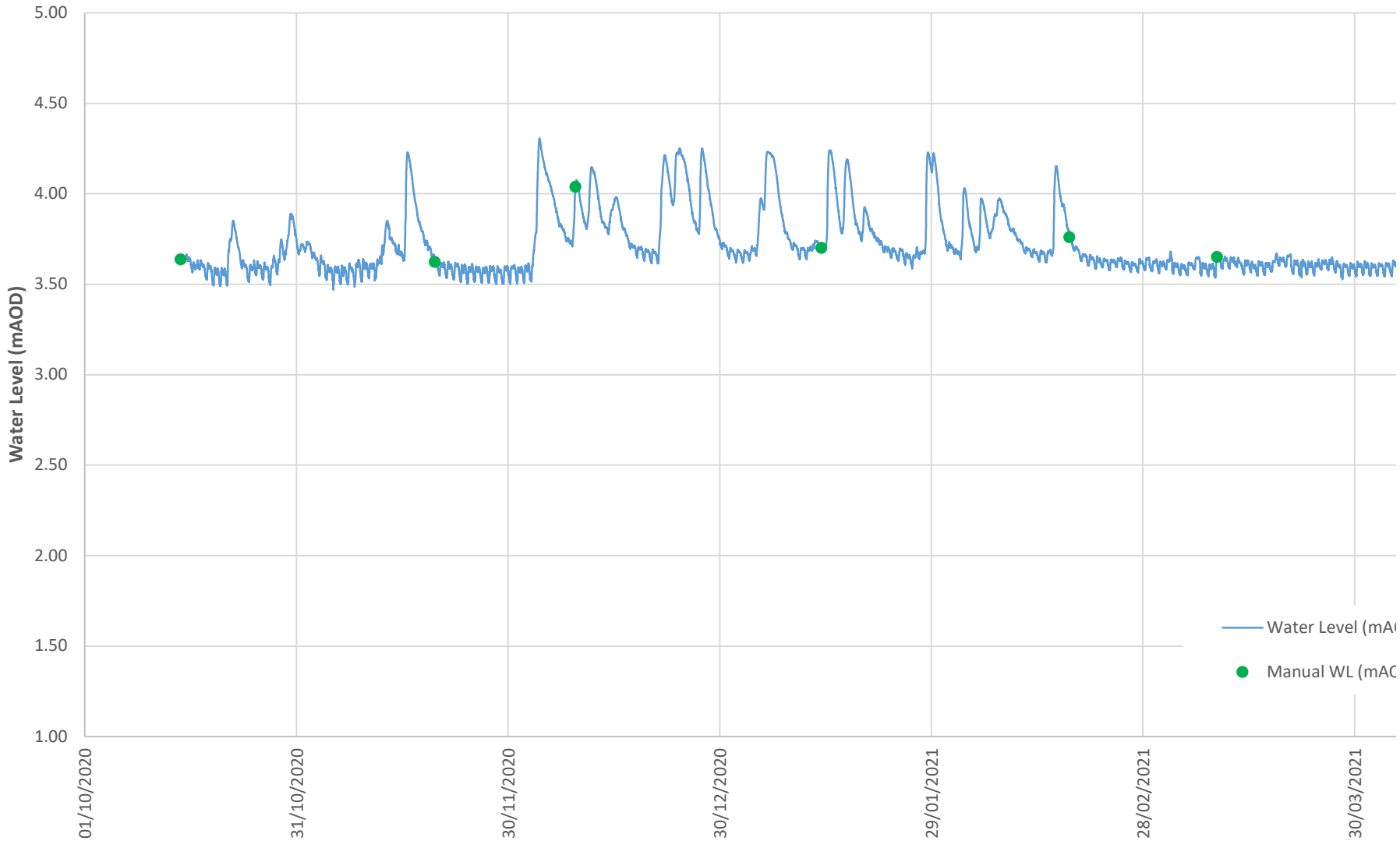

HALL_1104_s Hydrograph
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Water level (mAOD)
Datum
Data logger
Manual WL
01/10/2020
20/11/2020
09/01/2021
28/02/2021
19/04/2021
Date

Appendix B
Surface Water Hydrographs

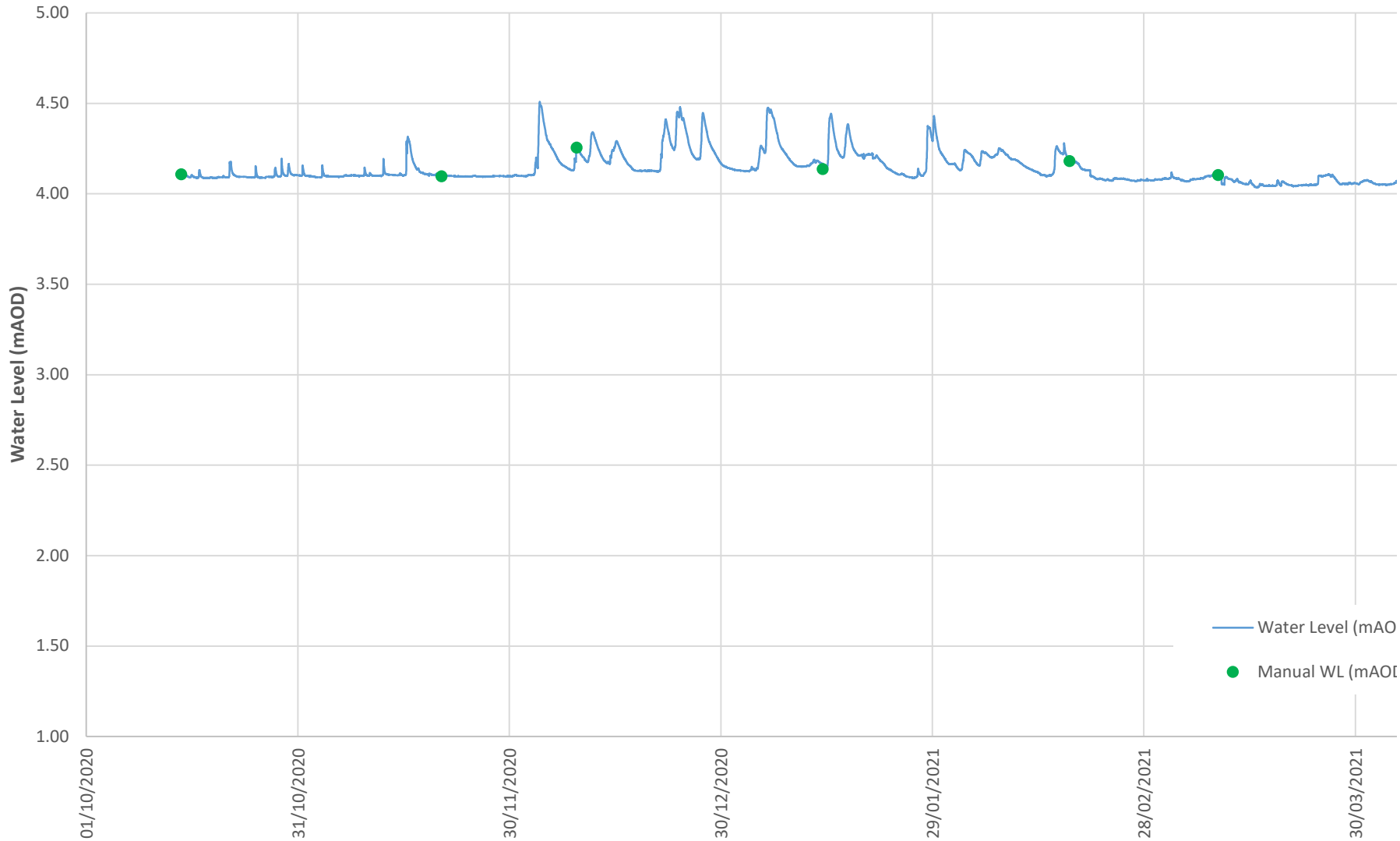
Snape Site 10 & 11 - SNP-GB01



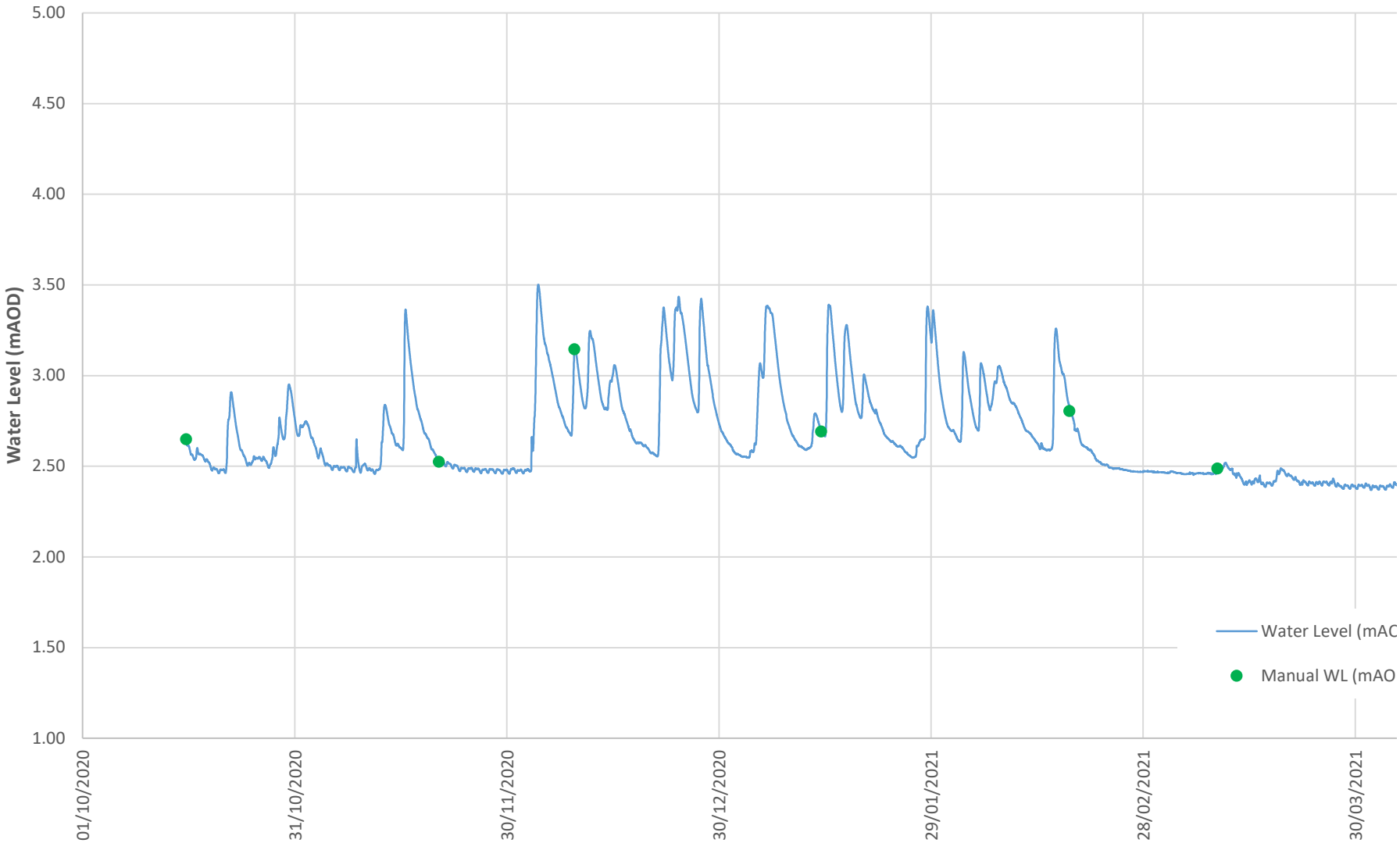
Snape Site 10 & 11 - SNP-GB02



Snape Site 10 & 11 - SNP-GB03



Snape Site 10 & 11 - SNP-GB04



Snape Site 10 & 11 - SNP-GB05