



The Sizewell C Project

9.108 Draft Wet Woodland Plan

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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 3.06ha of ‘wet woodland’ habitat from the Sizewell Marshes SSSI (Doc Ref. 9.8(A)). This permanent loss arises from the size and location of the SZC main platform to the north of the existing Sizewell B station. The loss of this area of wet woodland is therefore unavoidable.
- 1.1.2 The Sizewell Marshes SSSI citation sheet (Ref. 1) describes Sizewell Marshes as being ‘important for their large area of lowland, unimproved wet meadows which support outstanding assemblages of invertebrates and breeding birds’, and also that ‘In addition, several areas of reedbed dominated by Common Reed *Phragmites* and alder carr occur.’ In relation to the extensive ditch system, the citation notes that ‘the variety of ditch depths and widths, together with their fringing vegetation provide an important contribution to the site’s habitat value for invertebrates and birdlife’ and more generally ‘Sizewell Marshes are of exceptional interest for their invertebrate fauna, supporting a wide range of taxa and many nationally rare or scarce species.’
- 1.1.3 Whilst wet woodland is not a habitat for which the SSSI is specifically designated, the ‘exceptional ... invertebrate fauna’ is likely to be at least partly dependent on wet woodland habitats. Similarly, the combination of habitats including the open ditches, the unimproved fen meadows and the wet woodland, all present in close proximity is likely to be important in supporting the invertebrate interest. In Volume 2, Chapter 14 of the Environmental Statement (ES) [AS-033], wet woodland is noted as being nationally scarce habitat listed in Section 41 of the Natural Environment and Rural Communities (NERC) Act (Ref. 2) and the Suffolk Biodiversity Action Plan (BAP) (Ref. 3).
- 1.1.4 Coppicing of mature alder (*Alnus glutinosa*) trees within the wetlands is regularly undertaken as part of the ongoing management of the Sizewell Marshes SSSI, under existing site management arrangements, agreed with Natural England. This is undertaken to increase light levels to ditch habitats of importance to invertebrates and some plant species. The key point in the context of this Draft Wet Woodland Plan is that whilst individual alders are unlikely to be of importance in their own right, the presence of a mix of age classes of trees, including coppice regrowth, is of importance.
- 1.1.5 The DCO application submitted in May 2020 included an area of proposed wet woodland habitat in a new wetland area in the north-east of the main development site. This area of compensatory habitat provision would

comprise 0.7ha of wet woodland¹ and when successfully established would reduce the net loss of wet woodland habitat to approximately 2.36ha, for which no compensatory habitat was identified in the submitted application. Compensation for this residual net loss of 2.36ha of wet woodland habitat is the focus of the **Wet Woodland Strategy** (Doc Ref. 9.8(A)), and this draft plan and together with the on-site 0.7ha provision, this will ensure a total of at least 3.06ha of compensatory wet woodland habitats are provided.

- 1.1.6 The application for development consent includes within the draft order limits, three sites identified for delivery of compensatory fen meadow habitat listed below and illustrated in **Figures 1.1-1.3**²:

Fen Meadow compensation site at Benhall;

Fen Meadow compensation site at Halesworth;

Fen Meadow compensation site at Pakenham.

- 1.1.7 Wet woodland is already present on Benhall and Pakenham and therefore compensatory wet woodland habitat will be delivered on these sites. The **Wet Woodland Strategy** (Doc Ref. 9.8(A)) presents SZC Co's proposals for the provision of appropriate compensation measures for the loss of wet woodland habitat through the creation of compensatory wet woodland habitats. The **Wet Woodland Strategy** (Doc Ref. 9.8(A)) indicated that:

- The **Wet Woodland Plan** (Doc. Ref. 9.108) will define the management interventions required to create wet woodland habitats on the Benhall and Pakenham sites. The measures will include monitoring and any remedial interventions that may be required to ensure the successful delivery of wet woodland of SSSI quality at relevant sites. The Wet Woodland Plan will include local groundworks to provide a range of topographic levels and both fallen and standing deadwood would be provided to represent the variety of niches available to the invertebrate communities in the woodlands at Sizewell Marshes SSSI. It will be submitted to East Suffolk Council for approval in consultation with the relevant Statutory Nature Conservation Body pursuant to the DCO Requirement 14B.

- 1.1.8 Level 1 control documents will either be certified under the DCO at grant or annexed to the Deed of Obligation (DoO). All are secured and legally enforceable. Some Level 1 documents are compliance documents and must be complied with when certain activities are carried out. Other Level

¹ The 0.7ha of on-site wet woodland which will be created on the main development site is defined in the marsh harrier habitat report [\[REP2-119\]](#)

² Note that the order limits have recently been reduced at these three sites and these figures reflect the updated limits.

1 documents are strategies or draft plans which set the boundaries for a subsequent Level 2 document which is required to be approved by a body or governance group. The obligations in the DCO and DoO set out the status of each Level 1 document.

- 1.1.9 This plan is a Level 1 document. Pursuant to Requirement 14B of the dDCO, prior to any vegetation clearance within the Sizewell Marshes SSSI, a Wet Woodland Plan (a Level 2 document) will be submitted for approval by East Suffolk Council, in consultation with the relevant Statutory Conservation Body and such plan must be in general accordance with the **Wet Woodland Strategy** (Doc Ref. 9.8 (A)) and this draft plan.
- 1.1.10 Where further documents or details require approval, this document states which body or governance group is responsible for the approval and/or must be consulted. Any approvals by East Suffolk Council, Suffolk County Council or the MMO will be carried out in accordance with the procedure in Schedule 23 of the dDCO. The Deed of Obligation establishes the governance groups and sets out how these governance groups will run and, where appropriate, how decisions (including approvals) should be made. Any updates to these further documents or details must be approved by the same body or governance group and through the same consultation and procedure as the original document or details.
- 1.1.11 Where separate Level 1 or Level 2 control documents include measures that are relevant to the measures within this document, those measures have not been duplicated in this document, but cross-references have been included for context. Where separate legislation, consents, permits and licences are described in this document they are set out in the Schedule of Other Consents, Licences and Agreements (Doc Ref. 5.11) [REP3-011].
- 1.1.12 For the purposes of this document the term ‘SZC Co.’ refers to NNB Nuclear Generation (SZC) Limited (or any other undertaker as defined by the dDCO), its appointed representatives and the appointed construction contractors.
- 1.1.13 This Draft Wet Woodland Plan has been developed alongside, and draws on the information contained with, the **Draft Fen Meadow Plan** (Doc Ref. 9.64(A)) and the **Fen Meadow Strategy** (Doc Ref. 6.14 2.9D(A)) which are secured pursuant to Requirement 14A. The final Wet Woodland Plan approved pursuant to Requirement 14B will be produced alongside the final Fen Meadow Plan approved pursuant to Requirement 14A.
- 1.1.14 Both plans will be provided for review by the Ecology Working Group (as established by Schedule 11 of the DoO) prior to being submitted to East Suffolk Council pursuant to Requirements 14A and 14B.

- 1.1.15 SZC Co. must implement the final Wet Woodland Plan as approved.,

1.2 Status of the draft Wet Woodland Plan

- 1.2.1 This draft Wet Woodland Plan is considered, in combination with the Wet Woodland Strategy (Doc Ref. 9.8(A)), to provide sufficient detail to inform the Examining Authority, the Secretary of State and the other stakeholders as to the wet woodland proposals at each site.

- 1.2.2 The proposals presented herein have been informed by all data collected up to and including early July 2021. In relation to hydrology this means that a substantive portion of the data for summer period has informed the proposals. This is important as both groundwater and surface water levels are typically lowest in summer and these levels and related seasonal trends are likely to be amongst the most important variables in determining the potential for establishing new wet woodland on the two sites, alongside the compensatory fen meadow.

1.3 Environmental Statement and Shadow Habitat Regulations Assessment

- 1.3.1 The proposals described for the two locations will create some small scale and local changes to hydrology within the sites and there will be a need to undertake some shallow excavations. Some protected species are present and other receptors are present nearby, including, in some cases, designated sites or features. The appropriate applications will be made to Natural England for any licences required regarding the protected species.

- 1.3.2 The impacts at the three sites related to the creation of fen meadow habitats, two of which will also be used to provide compensatory wet woodland habitat, were considered in **Volume 2, Chapter 14** the **ES** [[AS-033](#)] and **Chapter 2** of the **ES addendum** [[AS-181](#)].

- 1.3.3 The wet woodland proposals described in this draft plan will have no adverse effects on integrity for any European Site. A note on the potential hydrological consequences on the Abbey Meadows compensation site at Snape of proposals at Benhall was submitted at Deadline 5 in response to the Written Representation by the RSPB (**Appendix L** of [[REP5-120](#)]). This concluded that there would be no adverse effect on integrity given the extent of the catchment, the effect on availability of water to the Abbey Farm compensation site.

1.4 Recreation of Wet Woodland Habitats

- 1.4.1 Based on National Vegetation Classification (NVC, Rodwell 1991 Ref. 4) survey data the wet woodland habitat within the Sizewell Marshes SSSI

which would be lost to permanent land take can be placed within the W5 woodland category [[AS-021](#)]. The defining characteristic, in what can be a habitat of relatively low floral diversity, is the presence of alder and this species is used as the key indicator of wet woodland establishment within the **Wet Woodland Strategy** (Doc Ref. 9.8(A)).

1.4.2 W5 *Alnus glutinosa* – *Carex paniculata* woodland is described as ‘A community of base-rich, moderately eutrophic, wet to waterlogged organic soils on topogenous or soligenous mires. It is associated with fen peats in open water transitions, flood-plain mires and basin mires where there is strong influence from base-rich ground waters’ (Ref. 5).

1.4.3 The **Wet Woodland Strategy** (Doc Ref. 9.8(A)) outlines the types of measure likely to be necessary to facilitate development of the compensatory habitat, as represented by ‘wet woodland which meets the definition of W5 within the NVC in respect of tree and shrub components’. Herbaceous species are only likely to achieve frequencies associated with W5 once the trees are more mature and canopy gaps enable colonisation and so are excluded from this definition and the relevant test.

1.4.4 Natural England consider the following points to be fundamental to the success and acceptability of the proposed compensation and they are therefore accounted for, in developing the final Wet Woodland Plan:

- high quality wet woodland will develop in the same situations as high quality fen meadow (i.e. the absence of elevated nutrients and permanently high water table albeit without cutting or grazing). Consequently, many of the same activities are likely to be required including topsoil removal if enriched; and
- it is noted that the re-establishment of natural hydrological regimes will provide the greatest likelihood of success and resilience in the establishment of wet woodland. Minimal water level controls will aid the restoration of natural flows and are likely to form an important part of the approach.

1.4.5 A number of techniques to be employed at the fen meadow sites, to create fen meadow, will also be relevant to the creation of wet woodland:

- **Topsoil removal.** Complete or partial topsoil removal will be undertaken within the context of sediment disposition, surface topography and valley flooding regimes, in order to reduce nutrient levels and increase the influence of groundwater on target species.
- **Rewetting from appropriate water sources.** Rewetting will be undertaken using groundwater-dominated sources to facilitate an

appropriate hydrological regime for the target vegetation. Sufficient control is likely to be required to minimise the impact of extreme events leading to flooding by nutrient-rich waters and/or periods of drought, within acceptable limits.

- **Habitat management.** An agreed annual programme of water and vegetation management will be established and undertaken at appropriate times. These operations – and their impact on the developing wet woodlands – will be set with a framework of acceptable limits. Appropriate monitoring will be maintained to enable effective and timely management of the habitat management programme to meet target conditions.

1.4.6 These techniques are deployed as relevant in the detailed proposals for the two sites set out in this draft plan. Following the Natural England advice reported above, the suitability of each site for fen meadow and wet woodland are treated as interchangeable and therefore where an area is considered suitable for fen meadow, it is also suitable for wet woodland.

1.5 Wet Woodland Establishment Management Measures and Monitoring

a) Wet Woodland Establishment Management Measures

1.5.1 The detailed proposals provided in Sections 2 and 3 of this draft Wet Woodland Plan are focussed on the establishment phase which will be undertaken in 'Year 1' of the works as outlined in the **Wet Woodland Strategy** (Doc Ref. 9.8(A)). These primarily comprise physical measures to be implemented to create the ground conditions to support habitats which will eventually develop into wet woodland as this spreads from adjacent areas of existing wet woodland at the sites.

1.5.2 In subsequent periods (years 2-5 and 6-10), measures outlined focus on monitoring and remedial measures (as detailed in **Wet Woodland Strategy** (Doc Ref. 9.8(A)) and on-going management approaches. These will need to remain flexible and be adjusted, annually if necessary, based on monitoring of habitat development. Progress will be reviewed annually and any adjustments to the habitat management approaches approved by the Ecology Working Group (established by Schedule 11 of the **DoO** (Doc. Ref. 8.17(G))). Any substantive changes of approach, which could ultimately impact the ability to deliver the quantum of the target habitat by Year 10, will need to be agreed by the Ecology Working Group.

b) Wet Woodland Monitoring

- 1.5.3 Given the expected extended periods likely required to establish wet woodland, the **Wet Woodland Strategy** (Doc Ref. 9.8(A)), secured by Requirement 14B, provides that monitoring will extend into the operational period of the power station to ensure the habitats are becoming established and being maintained in accordance with the relevant habitat objectives.
- 1.5.4 The frequency of monitoring during the construction and operational phases is set out in the **Wet Woodland Strategy** (Doc Ref. 9.8(A)), monitoring proposals are provided under the site specific sections of this plan.
- 1.5.5 In the event that any water control structure that could impede fish and eel passage is introduced at these habitat compensation areas, a suitable fish pass will be included in the design. Monitoring will be undertaken to ensure any such structures function as required and do not become a barrier to movement.
- 1.5.6 The monitoring detail for these sites will be set out in the final Wet Woodland Plan approved by East Suffolk Council pursuant to Requirement 14B.

1.6 Draft Plan Structure

- 1.6.1 There is a separate draft plan for the creation and establishment of wet woodland habitat at the two relevant sites. The draft plan is structured as follows:
- Section 2 - Benhall;
 - Section 3 – Pakenham;
 - Section 4 – Summary.

2 BENHALL

2.1 Site Baseline

2.1.1 The Summary of Investigations, Environmental Setting and Site Conceptual Model presented below are taken directly from the **Draft Fen Meadow Plan** (Doc Ref. 9.64(A)).

a) Summary of investigations

2.1.2 The investigations being undertaken at Benhall were summarised in the **Fen Meadow Plan Report 1 Baseline Report**, with the study reports provided as appendices [\[REP3-051\]](#) and [\[REP3-052\]](#). The studies have mostly been completed, as detailed in **Table 2.1** below.

Table 2.1: Status of studies as at July 2021

Site	Study	Status
Benhall	Ecology desk study	Completed in 2020
	Ecology field surveys	Phase 1 habitat survey NVC survey Water vole and otter survey Aquatic invertebrate survey of ditches All completed in 2020
	Hydrogeological desk study	Completed in 2021
	Installation of piezometers, dipwell, gaugeboards	Installed October 2020
	Topographic survey of site and installations	Completed 2020
	Water flow, level and quality monitoring	Commenced November 2020 for 1 year.

2.2 Environmental Setting

2.2.1 The **Fen Meadow Plan Report 1 Baseline Report** [\[REP3-051\]](#) and [\[REP3-052\]](#) summarised the findings of a series of baseline reports, provided as Appendices, that described the environmental setting of the Benhall site. The majority of the baseline information is not repeated in detail in this draft Wet Woodland Plan although a summary of the ecological setting is provided below and further hydrological monitoring data are now available so the Water Monitoring Summary – Benhall Site 10 & 11, November 2020

to April 2021, has been updated to July 2021 (**Appendix A to Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A))). The updated data have also been further interpreted to update the site conceptual model (**Section 2.3**).

2.2.2 Note that in 2019, two sites were identified, referred to as Site 10 (to the north) and Site 11 (to the south) and there was a gap between them. Subsequently, the site boundaries were revised to combine these sites and include the small parcel of land in between and the combined site was included in the application for development consent. Reference is now made to the northern, central and southern compartments (see **Figure 2.1**).

a) [Summary of Ecological Setting from Benhall Ecology Baseline report \[REP3-051\]](#)

2.2.3 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 Order Limits, and a further compartment is located adjacent to the western Site boundary. This latter compartment supports fen meadow habitat.

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

2.2.5 The site comprises poor semi-improved grassland, inundation vegetation, broadleaved wet woodland, scattered trees, flowing water, with fields divided either by hedges or ditches.

2.2.6 The habitats present on site were broadly categorised, during the NVC survey, as Floodplain and toe slope grasslands (of which three communities, including two rush pasture communities, supported suites of groundwater influenced and typical floodplain species), dry valley side grassland and wet woodland.

2.2.7 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.

2.2.8 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.

2.2.9 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).

2.2.10 The aquatic invertebrate fauna of the Benhall site comprises predominantly common and local species.

2.3 Site Conceptual Model

2.3.1 The initial site conceptual model is presented in the hydrogeological report (**Appendix D** of the **Fen Meadow Plan Report 1 Baseline Report** [[REP3-051](#) and [REP3-052](#)]). This section builds on the assessment provided in the conclusions of that report and all monitoring data collected and made available at the time of writing (July 2021). This section presents the findings on the relationship between ground level, groundwater levels, surface water levels and logged geological strata.

2.3.2 The Benhall site covers an area of 12.9 ha. The surface elevation across much of the northern compartment is relatively flat, generally between 3.8 and 4.0 mAOD (see LIDAR plots in **Appendix A** to **Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A))). 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 central and southern compartments have a more well-defined slope from west to east towards the River Fromus and contain a cut-off meander channel with a bed level of approximately 3.5 mAOD.

2.3.3 The River Fromus forms the eastern boundary of the Site and flows from north to south.

2.3.4 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 to be c. 25-30 metres in this locality. The Lambeth Group lies over the Chalk Group.

2.3.5 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.

2.3.6 The Site is split in two at the boundary of the northern and central compartments 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 (STW) discharge. The licensed discharge volume is 1.5 Ml/d.

- 2.3.7 On-site observations suggest that the Canal diverges to the north-east of the STW (downstream of the discharge point) and some water flows into the ditch network which flows northwards towards GB04.
- 2.3.8 The Benhall site contains a network of land drainage ditches which discharge to the River Fromus at three locations.
- 2.3.9 There is a licenced surface water abstraction from the River Fromus on the Site boundary (AN/035/0004/017), although this is toward the downstream end of the site away from the potential Fen Meadow areas.
- 2.3.10 Topographic surveys initially indicated 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 (Ditch W12 and W13) which do not appear to be well connected to other ditches or to the River Fromus.
- 2.3.11 The ditches in the northern compartment are monitored by GB03, 04 and 05 (**Figure 1.1** in **Appendix A** to **Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A))). The STW discharge is upstream of GB03. A plot of the water levels at the three gaugeboards and the groundwater level in the superficial deposits (BHALL_1001_s) shows that the water level at GB03 (which is located on the higher ground to the north-west) appears to be sustained (**Figure C3** in **Appendix A** to **Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A))), likely by discharges from the STW. A similar water level response is seen in the downstream gaugeboard at GB04 at the northern boundary of the Site showing the influence of the STW here. GB05 to the centre of the northern compartment, and the groundwater level monitoring well at BHALL_1001_s both show a similar seasonal response with reductions in water levels in mid-April and June and do not appear to be maintained by the discharge. On-site observations have confirmed that this central ditch in Site 10 is significantly drier with very little flow.
- 2.3.12 At the boundary of the southern and central compartments, the surface water levels are recorded by GB02. The water levels here show no decline in spring despite a drop in the nearby superficial deposits recorded in April and June (BHALL_1002_s and BHALL_1003_s). Again, this is likely to be the influence of the STW discharge to the Canal.
- 2.3.13 The monitored data available at GB01 suggests that water levels in this ditch are lower than the other watercourses on site. The levels are also lower than the surrounding groundwater levels (shown in the 1102 piezometer and 1104 dipwell), further reiterating earlier assumptions that this watercourse is not well connected to the other ditches on site. This ditch is linked to the River Fromus.

- 2.3.14 Development of peat has occurred in the northern and central compartments and peat is encountered between 0.4 and 2.5 m below ground surface. The borehole logs indicate a peat thickness of up to 4 m thick in places (Piezometer BHALL_1001_d) with a thickness of 1.1m at borehole HAL_2803_d. Soil 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.
- 2.3.15 The soil 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.
- 2.3.16 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.
- 2.3.17 There is a groundwater abstraction at Ham Farm (7/35/04/*G/0095) which is relatively close to (0.2km), and upgradient of, the Site and has the potential to impact groundwater levels on the Site. The impact is likely to be minimal due to the relatively low abstraction quantities.
- 2.3.18 The groundwater level plots shown in the monitoring note in **Appendix A to Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A)) show that the groundwater levels to the north (1001_s, 1002_s, 1003_s) and in the centre (1101_s and 1103_s) of the site in the superficial deposits present a similar pattern with a seasonal response to the dry April causing groundwater levels to decrease.
- 2.3.19 To the very south of the Site, there is less response to the dry April period in the superficial deposits (1102_s and 1104_s) with a flatter groundwater level hydrograph for these two locations (**Figure A3 in Appendix A to Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A))).

- 2.3.20 Some of the superficial deposit groundwater levels are showing groundwater levels above the ground level. Notably:
- At 1002_s and 1003_s groundwater levels are above surface in winter (January and early February) but the groundwater level decreases into spring, dropping below ground level (**Figures B3 and B4 in Appendix A to Fen Meadow Plan Draft 2** [Doc Ref. 9.64(A)]). This results in a depth to water table at these two sites of up to 0.6 m below ground level in spring. Levels in these superficial deposits recovered into early summer.
 - At 1104_s the groundwater level is above ground level periodically between November and February and declines to approximately 0.4 m below ground level into spring (**Figure B10 in Appendix A to Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A))).
- 2.3.21 There is an artesian groundwater level response in two of the Crag boreholes. The groundwater levels at 1101_d is above ground level for most of the monitored data series and at 1102_d the groundwater level goes above ground level periodically (**Figure A4 in Appendix A to Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A))).
- 2.3.22 The piezometer at 1001 (BHALL_1001_s for superficial deposits, BHALL_1001_d for Crag deposits) shows that the Crag groundwater levels increased slowly over the winter and have now remained static (~3.65 to 3.75 mAOD) since February **Figure A2 in Appendix A to Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A))). Conversely, the superficial deposits are showing more of a seasonal response. It is likely that the Crag here is partly confined. Water levels in the superficial deposits will be supported by the head in the Crag but there may be limited upward flow. It is suspected that the increase of Crag groundwater levels from October to January results from a rebound effect after the cessation of nearby pumping.
- 2.3.23 It is evident in the 1102 piezometer in the shallow and deep wells (1102_s and 1102_d respectively) that the timing and amplitude of the groundwater fluctuations align very well between the two geological strata (**Figure A4 and A5 in Appendix A to Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A))). The Crag groundwater level is above that in the superficial deposits, so it is plausible that there is a degree of hydraulic continuity with the Crag in this location which is supporting the water level in the superficial deposits at this location.
- 2.3.24 Slightly further north at 1101_s and 1101_d the results for the shallow (superficial) and deep (Crag) boreholes respectively show that the magnitude and timing of the fluctuations align well (**Figure A4 and A5 in Appendix A to Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A))), with the

levels marginally higher in the Crag than the superficial deposits, again supporting the theory that there may be some upward flow from the Crag here.

- 2.3.25 The lowest groundwater level and therefore maximum depth to water in the superficial deposits is listed in **Table 2.2**.

Table 2.2: Groundwater levels and depth to water table

Borehole ID	Ground level (mAOD)	Lowest observed groundwater level (mAOD)	Maximum depth to water table (m)	Highest observed groundwater level (mAOD)	Minimum depth to water table (m)*
BHALL_1001_d	3.91	2.28	1.63	3.98	-0.08
BHALL_1001_s	4.35	3.49	0.85	4.20	0.14
BHALL_1002_s	3.93	3.31	0.62	4.31	-0.38
BHALL_1003_s	3.88	3.29	0.59	4.14	-0.27
BHALL_1101_d	3.91	3.92	-0.01*	4.34	-0.44
BHALL_1101_s	3.91	3.83	0.08	4.24	-0.34
BHALL_1102_d	3.92	3.74	0.18	4.15	-0.23
BHALL_1102_s	3.92	3.50	0.42	4.01	-0.09
BHALL_1103_s	3.95	3.43	0.52	4.17	-0.21
BHALL_1104_s	3.92	3.60	0.32	4.19	-0.28

* negative depth to water table shows where groundwater levels are above ground level.

- 2.3.26 The groundwater and surface water data shows that the northern compartment of the Site demonstrate two slightly different hydrologic responses:

- In the northern compartment the superficial deposits fluctuate in response to seasonal climatic conditions. Surface water levels in The Canal, central east-west ditch and northern drainage outlet are maintained by the STW discharges. The same is not seen in the central Site 10 ditch which shows a decline in water levels due to its hydraulic continuity with the underlying deposits. The groundwater levels in the data available show that groundwater levels have been above ground level at times, but also extend to around 50-80cm below ground level during the spring and early summer. Further monitoring will be required to assess what happens over the rest of summer 2021

and into autumn. There appears to be limited connectivity with the River Fromus and the underlying Crag here. Groundwater levels in the superficial deposits have peaked at around 4.3 mAOD and have also dropped to around 3.3 mAOD.

- In central and southern compartments, there is a less pronounced impact to seasonal variations in the superficial deposits and it is likely that there is some upward flow from the Crag in the here. This is likely more pronounced at the southern end of the southern compartment.

2.3.27 There is some water quality data available for the Site, with more sampling planned over 2021. The data so far show the following:

- Nitrate concentrations are highest in the ditches to the south of the Site (GB1 and GB2 which measured 48.2 and 71.5 mg/l as NO₃ respectively). The concentrations are either below the limit of detection or low in the superficial deposits and underlying Crag.
- The Site generally has very low phosphate concentrations as would be expected, with most samples not showing anything above the level of detection. GB1, GB2 and SP5 locations shows phosphate concentrations at 0.057 mg/l, 11.4 mg/l and 4.77 mg/l respectively whilst the only detected level in groundwater was at 1102_s at 0.053 mg/l.

2.4 Suitability of the site for wet woodland creation

2.4.1 The Benhall site is described, in the **Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A)), as three compartments - north, central and south. The intention is to establish wet woodland adjacent to existing areas of this habitat. At Benhall this is alongside the northern compartment. Therefore the remainder of this section focuses on the northern compartment.

a) Northern Compartment

2.4.2 This compartment was identified in Wood, 2019 (Ref. 6 [[APP-258](#)]) as containing a primary locus for fen meadow in the south-western third (1.5ha) in which it was considered that there was good potential for water management to provide the necessary water to support the habitat. This primary locus area was bordered by a potential additional area for fen meadow (0.7ha), within which it was considered that more substantial intervention would likely be required to enable the development of fen meadow. The locations of these areas served to focus the detailed hydrological studies.

2.4.3

In 2021 the potential for fen meadow creation in this compartment has been reviewed based on the available results of the detailed studies, and the measures to deliver the necessary conditions for fen meadow and / or wet woodland, assessed based on the points presented below:

- Groundwater levels in the shallow deposits in the northern compartment are indicated to be maintained below ground level at the location of installation BHALL_1001_s. However, this is in an elevated location on a bund alongside the western ditch. Relative to the majority of the compartment, water levels are at about ground level over winter falling to, at most, 30cm below a typical ground level of 3.8m AOD (June 2021).
- The presence of relict ditches suggests that the compartment was historically wetter, presumably prior to drainage and at which time fen meadow habitats, or at least groundwater dependent fen meadow species, may have been present.
- Water levels in the central ditch (indicated by GB05) are below, but appear to reflect, those of the shallow groundwater, indicating a hydrological link between the two – with the central ditch potentially limiting the groundwater level in this compartment.
- The compartment is bordered to the west and south by the Canal. The main discharge from the Canal is to the Fromus however there appears currently to be a minor link between the Canal and the ditches within the compartment. Whilst water levels in the Canal, and River Fromus would not be controlled as part of this work due to potential effects off site, it is considered that water levels in the ditch network that drains this compartment can be controlled without adversely affecting areas or receptors off site.
- Groundwater nitrate concentrations are either below the limit of detection or low in the superficial deposits and underlying Crag, and the same applies to the presence of phosphate.
- During high flow events the River Fromus floods the compartment and also backs up the Canal, which is noted as having elevated nitrate and phosphate levels which are likely the result of discharge from the Benhall STW. Whilst river water quality, and that in the Canal, is not considered optimal for fen meadow habitats, during high flow events, nitrate and phosphate concentrations will be diluted and, as indicated in Section 1.5, Wheeler, Shaw and Tanner (2009, Ref. 7) note that the community can accommodate considerable eutrophication without change to its basic composition provided that active management continues.

- Soil data indicates the presence of peat at each of the cored locations, albeit at 50cm+ depth (Wood, 2019, Ref. 6 [[APP-258](#)]).
- A network of land drains is visible on LIDAR (see **Appendix A to Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A))). These will be reducing the groundwater levels and drying the fields. However, these can be blocked.

2.4.4 Based on the groundwater and surface water level data, and substrate type, it is concluded that it will be possible, by implementing measures detailed in Section 2.5, to provide groundwater influenced conditions in this northern area, potentially with a peaty or gley substrate, that have the potential to support wet woodland habitat.

2.4.5 Water levels in the Canal, and River Fromus to the east, would not be controlled to support these proposals. This is not required under the proposals and could lead to off-site impacts.

2.5 Proposed layout and features

a) Proposed layout – Northern Compartment

2.5.1 For the northern compartment the key aim of the proposals is to exert control over the drainage ditch network, reducing drainage from the compartment and sculpt the ground to create areas of shallow open water for wet woodland establishment.

2.5.2 Exerting control over the drainage ditch network will support groundwater levels in the shallow deposits such that they are maintained at, or just above, ground level (target approximately 3.85m AOD).

2.5.3 It is anticipated that 30-40cm of the surface material will need to be removed to deliver areas of shallow open water as the starting condition for wet woodland, subject to the results of focussed soil coring during the implementation stage.

2.5.4 The approach to establishment of wet woodland, as recommended by Natural England, will be to use natural regeneration from the adjacent wet woodland habitat. Natural regeneration and expansion of wet woodland is likely to be more resilient and have greater biodiversity than a planted woodland. Initially this regeneration is expected to include development of wet scrub and species such as grey willow (*Salix cinerea*) and alder would then be expected to colonise once the willows are established. Planting of wet woodland species will only be undertaken in agreement with the Ecology Working Group and only if it is apparent that natural regeneration of wet woodland has not been successful.

- 2.5.5 Both fallen and standing deadwood will be provided to represent the variety of niches available to the invertebrate communities in the woodlands at Sizewell Marshes SSSI. It is expected to be possible to source this either from the adjacent wet woodland habitat, or Sizewell Marshes SSSI, when areas of this habitat are lost during construction.
- 2.5.6 A 0.6ha area for wet woodland has been identified at the northern end of the area of proposed fen meadow in this compartment.
- 2.5.7 Site proposals are indicated on **Figure 2.1**.
- i. **Physical measures in northern compartment**
- 2.5.8 Physical measures proposed to be implemented in the northern compartment, relevant to the wet woodland creation, are:
- Controlling water levels by installing a finely adjustable water control structure on the ditch linking to the watercourse that forms the northern compartment boundary. The water control structure will support levels in summer but will also enable any river flood waters getting onto the compartment in winter to escape. The water control structure will be set to around 3.85-3.90 m AOD initially. This could be adjusted up or down, if required, based on effectiveness indicated through monitoring;
 - If confirmed that a culvert exists at the southern end of the central ditch, this will be blocked, as will a potential culvert, indicated on **Figure 2.1** on the south-eastern corner of the existing wet woodland;
 - Removing up to 30-40cm of soil;
 - Blocking or breaking up land drains, where encountered, to reduce drainage from the compartment;
 - Installation of stock proof fence to exclude stock access to areas of wet woodland habitat.
- b) **Habitat creation works**
- 2.5.9 Appropriate consents will be sought for structures and works where they are located within, or fall within specified distances of, ordinary or Main watercourses. These are set out in the **Schedule of Other Consents, Licences and Agreements** (Doc Ref. 5.11(B))
- 2.5.10 A temporary site compound will be established and access routes marked for the habitat creation works. Indicative locations for site compound and access routes, and notes on accessibility, are provided in **Figure 2.2**. Of

particular note is that a new bridge will be needed to cross the Canal to enable equipment to access the northern compartment.

- 2.5.11 Arisings will be removed from the floodplain, off-site.
- 2.5.12 The establishment works described above will be undertaken in late spring/summer, avoiding periods with the highest risk of surface inundation and the highest water tables that result in soft ground.
- 2.5.13 Working areas will be subject to ecological walkovers to confirm and update ecological constraints. Works to ditch banks will be micro-sited to avoid effects on water voles. A Protected Species Licence will be sought in the event that one is required, although, based on the reported ecological baseline [[REP3-051](#) and [REP3-052](#)] it is considered that effects requiring licensing can be avoided.
- 2.5.14 Activities will be controlled via measures set out in the **Code of Construction Practice** (Doc Ref. 8.11(E)) (secured by Requirement 2 of the **dDCO**).

2.6 Conservation management

- 2.6.1 Management measures during the establishment period (Year 1) and in Years 2-5 and 6-10 are summarised below.

a) Management units

- 2.6.2 Stock proof fence will be used to exclude stock from accessing the wet woodland from the fen meadow habitat creation area to the south. Proposed fence lines are indicated on **Figure 2.1**.

b) Wet Woodland Establishment period (Year 1)

- 2.6.3 The water control structure will require adjustment as appropriate, based on monitoring, to deliver the target water level conditions for the wet woodland (and fen meadow) habitat.
- 2.6.4 Should deleterious species establish in the wet woodland area these will be removed, or treated.
- 2.6.5 No other management is proposed.

c) Wet Woodland Management – Years 2-5 and 6-10

- 2.6.6 The water control structure will require adjustment as appropriate, based on monitoring, to deliver the target water level conditions for fen meadow habitat.

2.6.7 Should deleterious species establish in the wet woodland area these will be removed, or treated,.

2.6.8 No other management is proposed.

2.7 Monitoring

2.7.1 The effects on ground and surface water levels, and surface wetness, will be monitored for effectiveness using existing installations and observation.

2.7.2 An annual botanical assessment of the establishment of species in the area will be undertaken, including assessment of the presence of alder and grey willow in particular, as key wet woodland species.

2.7.3 Monitoring to ensure fish passage is not impeded will also be undertaken as appropriate.

2.7.4 Management of the water levels and habitats developing on site will be amended as required based on the monitoring results.

2.7.5 A monitoring report will be submitted to the EWG on an annual basis.

2.8 Area of Potential Wet Woodland

2.8.1 Based on the data available it is considered that implementing the proposed measures in the northern compartment will result in elevated water levels sufficient to create areas of shallow open water that will accommodate 0.6ha of wet woodland, alongside the proposed areas of fen meadow in that compartment.

3 PAKENHAM

3.1 Site Baseline

3.1.1 The Summary of Investigations, Environmental Setting and Site Conceptual Model presented below are taken directly from the **Draft Fen Meadow Plan** (Doc Ref. 9.64(A)).

a) Summary of investigations

3.1.2 The investigations being undertaken at Pakenham were summarised in **Fen Meadow Plan Report 1**, with the study reports available at the time provided as appendices [[REP3-051](#) and [REP3-052](#)]. Since the **Fen Meadow Plan Report 1** [[REP3-051](#) and [REP3-052](#)] was produced, the NVC survey and spring water vole and otter survey have been completed and therefore studies are now mainly complete, as detailed in Table 3.1.

Table 3.1: Status of studies as at July 2021

Site	Study	Status
Pakenham	Ecology desk study	Completed in 2021
	Ecology field surveys	Phase 1 habitat survey completed May 2021 NVC survey completed June 2021 Spring water vole and otter survey completed May 2021 Aquatic invertebrate survey undertaken late June 2021
	Hydrogeological desk study	Completed in 2021
	Installation of piezometers, dipwell, gaugeboards	Completed March 2021
	Topographic survey of site and installations	Undertaken March 2021
	Water flow, level and quality monitoring	Commenced April 2021 for 1 year

3.2 Environmental Setting

3.2.1 The **Fen Meadow Plan Report 1 Baseline Report** [[REP3-051](#) and [REP3-052](#)] summarised the findings of a series of baseline reports, provided as Appendices, that described the environmental setting of the Pakenham site. The majority of the baseline information is not repeated in detail in this Draft

Wet Woodland Plan although a summary of the ecological setting is provided below, accompanied by a summary of the results of the NVC and water vole/otter surveys, which are also provided in:

- Pakenham Site 54 Ecology Baseline (NVC and water vole/otter survey) in **Appendix C** to **Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A));

3.2.2 Further hydrological monitoring data are also now available and the Water Monitoring Summary – Pakenham Site 54, April 2021, has been updated with data to July 2021 (**Appendix D** to **Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A))). The updated data have also been further interpreted to update the site conceptual model (**Section 4.3**).

a) [Summary of Ecological Setting from Pakenham Ecology Baseline report \[REP3-051\]](#)

3.2.3 There are no statutory, or non-statutory, designated sites of nature conservation value within the Site. However, 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. Both of these designated sites contain fen meadow habitat.

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

3.2.5 The site comprises a mix of grassland (some of it marshy), semi-improved and improved grassland, broadleaved wet woodland, swamp, standing water and running water, with fields divided either by hedges or ditches.

b) [Pakenham Site 54 Ecology Baseline \(NVC and water vole/otter survey\) \(Appendix C\)](#)

i. [National Vegetation Classification \(NVC\) survey](#)

3.2.6 The NVC survey identified vegetation-types from six phytosociological groups within and on the margin of the floodplain. These vegetation types are assigned to the following NVC communities:

[Fen meadow](#)

- M22b *Juncus subnodulosus*-*Cirsium palustre* fen meadow, *Briza media*-*Trifolium* spp. sub-community; and
- M22a *Juncus subnodulosus*-*Cirsium palustre* fen meadow, Typical sub-community.

Rush pasture

- MG10b *Holcus lanatus*-*Juncus effusus* rush pasture, *Juncus inflexus* sub-community; and
- MG10b/S22c *Holcus lanatus*-*Juncus effusus* rush pasture, *Juncus inflexus* sub-community, grading to *Glyceria fluitans* water-margin vegetation, *Alopecurus geniculatus* sub-community.

Inundation grassland

- MG13 *Agrostis stolonifera*-*Alopecurus geniculatus* grassland.

Floodplain grassland

- MG7b/MG10b *Lolium perenne*-*Poa trivialis* ley grading to *Holcus lanatus*-*Juncus effusus* rush pasture, *Juncus inflexus* sub-community;
- MG7b *Lolium perenne*-*Poa trivialis* leys ; and
- MG7c *Lolium perenne*-*Alopecurus pratensis*-*Festuca pratensis* grassland.

Valley footslope grasslands

- MG7d *Lolium perenne*-*Alopecurus pratensis* grassland;
- MG7a *Lolium perenne*-*Trifolium repens* leys;
- MG1e *Arrhenatherum elatius* grassland, *Centaurea nigra* sub-community; and
- MG1a *Arrhenatherum elatius* grassland, *Festuca rubra* sub-community.

Fertile reed-fen

- S25a *Phragmites australis*-*Eupatorium cannabinum* tall-herb fen, *Phragmites australis* sub-community.

Poplar woodland

- W6b *Alnus glutinosa*-*Urtica dioica* woodland, *Salix fragilis* sub-community.

3.2.7 The grassland habitats present qualify as coastal and floodplain grazing marsh, whilst the woodland qualifies as deciduous woodland, both of which

are habitats of principal importance listed under Section 41 (S41) of the Natural Environment and Rural Communities (NERC) Act 2006.

ii. Otter and water vole survey

3.2.8 The Site contains suitable habitat and conditions to support both water vole and otter.

3.2.9 During the presence/absence survey, two water vole latrines were located (one on each of two ditches), as were two feeding stations (both on the same ditch) and small mammal runs on four ditches. No water vole burrows were identified however it is noted that due to unseasonably wet conditions encountered in spring 2021, some of the potential field signs identified during the survey may have been diluted or hidden by rising water levels etc. and hence water vole may make more use of the site than was recorded in May.

3.2.10 A number of otter spraints were recorded, all from the Pakenham Stream. No signs of otter presence were recorded from ditches on site.

3.3 Site Conceptual Model

3.3.1 The initial site conceptual model is presented in the hydrogeological report (Appendix H of the **Fen Meadow Plan Report 1 Baseline Report** [[REP3-051](#) and [REP3-052](#)]). This section builds on the assessment provided in the conclusions of that report and all monitoring data collected and made available at the time of writing (July 2021). This section presents the findings on the relationship between ground level, groundwater levels, surface water levels and logged geological strata.

3.3.2 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 toe-slope 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 running roughly south of the course of the River Sapiston (Black Bourn) and another which dissects the site which is filled with Glacial Till/ Boulder Clay.

3.3.3 Development of peat has occurred at the site and is encountered between 0.1 and 0.6 m bgl with a thickness of up to 2.9 m at borehole PAK-HA-2. Soil 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 south west corner, respectively.

- 3.3.4 The highest ground is to the west of the Site with elevations to over 32.5 mAOD. The catchment topography generally slopes towards the Pakenham Stream to the east, however, LiDAR data for the site shows that the central ditch which bisects the site is the low point at around 30 mAOD (see **Appendix D to Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A))). The Pakenham Stream to the east of the site is the main drainage channel for the wider catchment and there is a bund on the left bank which is at about 31.5 mAOD, although a low point is indicated by the LIDAR data (see **Appendix D to Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A))) immediately to the north of the footpath, where cattle gather to drink and have eroded the bank. Although not recorded in the available data, during initial visits this area of the site was noted to be under water, arising from flooding from the Stream. Generally, over the main central Pakenham Site the ground levels are between 30.5 and 31 mAOD.
- 3.3.5 The Pakenham site contains a network of land drainage ditches. The main ditch across the site runs from south to north parallel with the Pakenham Stream. This central ditch is bisected by a second west-east primary ditch; both ditches appear to be carriers for near-surface groundwater. There are several small boundary drains which appear to drain along the upland margin and run to the main central drain.
- 3.3.6 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 accessible during the topographic survey (water levels were very high in March 2021) was 29.9 mAOD. The Pakenham Stream is at a higher elevation than the central ditch, although there is still likely continuity between the Pakenham Stream and groundwater levels.
- 3.3.7 Site visits have identified a breach in the Pakenham Stream bank where the stream crosses over the west-east ditch, which is culverted at this location. The flow, from east to west, in to the site in this ditch, and subsequently in to the central ditch, is being supported by flow from Pakenham Stream via this breach.
- 3.3.8 The topographic survey indicated initially that water level in the central ditch 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.
- 3.3.9 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 in the regional groundwater model produced by the Environment Agency.

- 3.3.10 The water levels in the chalk borehole monitored on Site (BH-2_d,) shows that the piezometric surface of the Chalk is higher than ground level at between 33.25 mAOD in early spring (29th March 2021) and 32.4 mAOD by summer 2021 (12th July 2021). Ground level at BH2 is 32.22 mAOD. The groundwater level data at BH-2_d demonstrates that there has been a generally declining trend over the spring and early summer of 2021 (**Figure A4 in Appendix D to Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A))). BH-2_s which measures the water level in the superficial deposits at the same location shows a clear declining trend over the same period which aligns with that seen in BH-2_d (**Figure A4 in Appendix D to Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A))) indicating some hydraulic continuity of the near surface deposits with the underlying chalk. Groundwater levels are below ground level at 30.25 mAOD in early spring (29th March 2021) and 29.59 mAOD by summer 2021 (12th July 2021).
- 3.3.11 In the centre of the site, the central ditch has a water level around 30.4 mAOD (as monitored by GB01 and GB03, **Figure A3 in Appendix D to Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A))). There are no significant fluctuations in the observed data. The land to the east of the central ditch is mostly flat between 30.35 and 30.5 mAOD and very similar to the water levels in the ditch.
- 3.3.12 The ditch to the north-west of the central ditch has a higher water level (GB02) at 31.4 mAOD, most likely a function of the higher topography to the west of the site. The base of the ditch at GB02 is approximately 1.3 mAOD above the base of the central ditch.
- 3.3.13 The water levels in the near surface dipwells (PAK-HA-1 to PAK-HA-6) all show a similar hydrogeologic response (**Figure A3 in Appendix D to Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A))).
- 3.3.14 It is noted that the groundwater levels observed are generally similar between the central ditch (GB01 and GB03) and the surrounding boreholes closest to the ditch (HA-3, HA-4 and HA-6) and that groundwater levels here are close to ground level (**Figure A3 in Appendix D to Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A))).
- 3.3.15 Groundwater levels in PAK-HA-2 are significantly below ground level (~1-1.5m) (**Figure B14 in Appendix D to Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A))) and this is repeated in the soil core sample (Core 1) which shows no obvious water table to 1.25m bgl. Similar depth to water, and corresponding lower absolute water levels (in mAOD), are seen at PAK-

HA-1 and PAK-HA-5, reflecting local variability in behaviour of the superficial deposits.

- 3.3.16 To the north of the Site, the water levels in PAK-HA-1, PAK-HA-2 and PAK-HA-3 show a similar water level trend (**Figure A3** in **Appendix D** to **Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A))). PAK-HA-3 has a higher absolute level than the other two boreholes.
- 3.3.17 The surface water levels in the GB02 and GB04 are higher than the main central ditch, which is in part a function of the topography which is higher at these two locations. Water will therefore drain towards the central ditch and ultimately flow northwards.
- 3.3.18 The groundwater level response in PAK-BH-1 shows less pronounced fluctuations in the groundwater levels. BH-1 measures the groundwater conditions in the buried valley, and close to the surface water abstraction. BH1 is not considered to be in hydraulic continuity with the rest of the superficial deposits at the site.
- 3.3.19 The lowest groundwater level and therefore maximum depth to water in the superficial deposits is listed in **Table 3.2** below.

Table 3.2: Groundwater levels and depth to water table

Borehole ID	Ground level (mAOD)	Lowest observed groundwater level (mAOD)	Maximum depth to water table (m)	Highest observed groundwater level (mAOD)	Minimum depth to water table (m)*
PAK-BH-1	31.9	30.2	1.7	30.6	1.3
PAK-BH-2_d	32.2	32.4	-0.2*	33.2	-1.0*
PAK-BH-2_s	32.2	29.6	2.6	30.3	2.0
PAK-HA-1	30.7	29.2	1.5	29.8	0.9
PAK-HA-2	30.7	29.1	1.5	29.6	1.0
PAK-HA-3	30.6	30.2	0.4	30.6	0.0
PAK-HA-4	30.7	30.2	0.5	30.7	0.0
PAK-HA-5	30.9	29.5	1.4	30.1	0.8
PAK-HA-6	30.7	30.3	0.5	30.6	0.2

* negative depth to water table shows where groundwater levels are above ground level.

- 3.3.20 Anecdotal evidence suggests that the ground around HA-1 (current Fen Meadow) is damp underfoot. The groundwater data do not show this, which

implies that there is locally perched water table here which is currently not being measured, potentially due to layering in the peat. There is also potential for this area to be supported by winter flooding from Pakenham Stream and the on-site ditches.

3.3.21 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.

3.3.22 The soil cores also showed little in terms of 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.

3.3.23 The water quality data available to date shows the following:

- Nitrate concentrations are highest at BH2_S in the superficial deposits at 99.7 mg/l as NO₃. Concentrations are lower in the underlying chalk (BH2_D) which monitored nitrate at 33.7 mg/l as NO₃. Elsewhere concentrations are high at the nearby surface water monitoring point at GB03 (50.8 mg/l as NO₃) but low across the main central Pakenham dipwells (<2 mg/l as NO₃). The Pakenham Stream nitrate concentrations are at 36.4 mg/l as NO₃.
- The site generally has very low phosphate concentrations as would be expected, with most samples below detection limits. The Pakenham Stream shows phosphate concentrations at 0.958 mg/l, and elsewhere there are low concentrations at HA-2 (0.273 mg/l) and GB02 (0.602 mg/l).

3.4 Suitability of the site for wet woodland creation

3.4.1 The Pakenham site is discussed, in the **Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A)) as two compartments - north and south. The intention is to establish wet woodland adjacent to existing areas of this habitat. At Pakenham this is at the southern end of the southern compartment. Therefore the remainder of this section focuses on the southern compartment.

a) Southern Compartment

3.4.2 This compartment was identified in Wood, 2019 (Ref. 6 [[APP-258](#)]) as containing an arrow shaped area of primary locus for fen meadow bordering

the wet woodland at the southern end of the site (1.7ha). An area of fen meadow habitat is located immediately adjacent to the south-west of the primary locus to the north of the woodland as indicated (see Wood, 2019 (Ref. 6 [\[APP-258\]](#))). The area of primary locus was flanked by a more extensive potential additional area for fen meadow (4.3ha) within which it was considered that more substantial intervention would likely be required to enable the development of fen meadow. The locations of these areas served to focus the detailed hydrological studies now on-going.

3.4.3 In 2021, the potential for fen meadow creation in this compartment has been reviewed based on the available results of the detailed studies, and the measures to deliver the necessary conditions for fen meadow, assessed based on the points presented below:

3.4.4 In respect of the suitability for fen meadow and wet woodland in the area to the north and upslope of the existing woodland:

- Groundwater levels in the shallow deposits upslope of the primary locus area to the north of the woodland (and its boundary ditch that joins the main central ditch to the north of the woodland/reed fen area) fall significantly below ground level (almost 1.4m in PAK-HA-5), approaching 1m below the ditch water level (around 30.4m AOD). This depth to water reflects the results of Core 14 from a similar elevation reported in Wood, 2019 (Ref 6. [\[APP-258\]](#)), which did not strike water in a depth of 125cm. However, downslope of PAK-HA-5 Core 17 struck water at a depth of 63cm.
- The botanical community present in the field north of the woodland is a floodplain grassland, MG7b, which contains no obligate phreatophytes and only low numbers of non-obligate phreatophytes, suggesting that there is little groundwater influence at the surface.
- Upslope to the north of the woodland, substrate was found to be sand to 60cm in Core 14, and predominantly sands and gravels in the PAK-HA-5, however Core 17 downslope was found to be peat. To the east of the woodland Core 16 was earthy peat over marl and then peat. Substrate appears to be more appropriate for fen meadow on the lower margins of this field.
- There are some instances of elevated nitrate concentrations in groundwater at the northern end of the Pakenham site, although concentrations in most groundwater monitoring installations are low, with phosphate below the level of detection.
- Elevated nitrate concentrations have however been recorded from surface water samples, which likely reflects surrounding arable land

uses. Phosphate above the level of detection was also recorded from Pakenham Stream, indicating the presence of a sewage treatment works discharge upstream.

- As indicated for the northern compartment, the drainage system is complex and in general it is not possible to manipulate the levels. However, it is considered that:
 - The ditch separating the fen meadow from the floodplain grassland could be managed without affecting off-site receptors. Although not currently monitored, field observations suggest that it receives run-off, originating as groundwater, from the fen meadow compartment. As such it is expected that water quality would be good.
 - The ditch along the northern edge of the existing woodland could be controlled without affecting off-site receptors provided that this control occurred before it's confluence with the central ditch. This would reduce drainage from the area, at least from the south-western end of the field.
- No field drains are evident in this field on LIDAR data (**Appendix D to Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A))) in this field, although there is a suggestion of presence in the fen meadow field (running north-west to south-east), perhaps evidence of historic efforts to drain the area.

3.4.5 In respect of the suitability for fen meadow and wet woodland in the area to the east of the existing woodland:

- To the east of the existing woodland and the central ditch shallow water levels (PAK-HA-6) remain within 45cm of the ground surface, a similar elevation as the stream water level. Core 16 in the area struck water at 80cm below ground level. Core 15 in the same field, but to the north, struck water at 50cm below ground level.
- To the east of the existing woodland, the floodplain grassland is transitional rush pasture (MG7b/MG10b). This contains a very low number of obligate phreatophytes and a greater number of non-obligate phreatophytes, suggesting a greater current, or historic, groundwater influence at the surface.
- To the east of the woodland Core 16 was earthy peat over marl and then peat, whilst Core 15 was earthy peat over peat. Substrate appears to be appropriate for fen meadow in this field.

- This field is bordered by the central ditch to the west, and Pakenham Stream to the east. No water level control on these watercourses is considered possible without affecting off site receptors.
- There are some instances of elevated nitrate concentrations in groundwater at the northern end of the Pakenham site, although concentrations in most groundwater monitoring installations are low, with phosphate below the level of detection.
- Elevated nitrate concentrations have however been recorded from surface water samples, which likely reflects surrounding, arable, land uses. Phosphate above the level of detection was also recorded from Pakenham Stream, indicating the presence of a sewage treatment works discharge upstream.
- LIDAR data suggests the presence of land drains running parallel north-south between the central ditch and Pakenham Stream (**Appendix D to Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A))). It is likely, although they are not visible on LIDAR, that similar drains are present in the western compartment. These will be reducing groundwater levels and drying the field surface. However, these can be blocked.

3.4.6 Based on the data available, the substrate type is appropriate for wet woodland creation and, with implementation of the measures detailed in Section 4.5, it is considered that it will be possible to deliver groundwater influenced surface conditions to the east of the existing woodland.

3.5 Proposed layout and features

a) Proposed layout (Southern compartment)

3.5.1 The key aim of the proposals is to sculpt the ground to create areas of shallow open water for wet woodland establishment. Given the presence of marl in this area it is proposed that a greater depth be removed than proposed elsewhere, up to 60cm, to create areas of shallow open water, which are expected to be calcareous, as the starting condition for wet woodland, subject to the results of focussed soil coring at the time during the implementation stage.

3.5.2 The approach to establishment of wet woodland, as recommended by Natural England, will be to use natural regeneration from the adjacent wet woodland habitat. Natural regeneration and expansion of wet woodland is likely to be more resilient and have greater biodiversity than a planted woodland. Initially this regeneration is expected to include development of wet scrub and species such as grey willow (*Salix cinerea*) and alder would

then be expected to colonise once the willows are established. Planting of wet woodland species will only be undertaken in agreement with the Ecology Working Group and only if it is apparent that natural regeneration of wet woodland has not been successful.

- 3.5.3 Both fallen and standing deadwood will be provided to represent the variety of niches available to the invertebrate communities in the woodlands at Sizewell Marshes SSSI. It is expected to be possible to source this either from the adjacent wet woodland habitat, or Sizewell Marshes SSSI, when areas of this habitat are lost during construction.
- 3.5.4 A 1.76ha area for wet woodland will be created at the southern end of the area of proposed fen meadow in this compartment.
- 3.5.5 Site proposals are indicated on **Figure 3.1**.
- i. Physical measures
- 3.5.6 Physical measures proposed to be implemented in the southern compartment are:
- Sculpting the land between the central ditch and the Pakenham Stream to the east of the woodland, removing up to 60cm of soil; and
 - Blocking or breaking up of land drains, where encountered, to reduce drainage from the compartment to the east of the woodland.
- b) Habitat creation works
- 3.5.7 Appropriate consents will be sought for works where they fall within specified distances of, ordinary or Main watercourses. These are set out in the **Schedule of Other Consents, Licences and Agreements** (Doc Ref. 5.11(B))
- 3.5.8 A temporary site compound will be established and access routes marked for the habitat creation works. Indicative locations for site compound and access routes, and notes on accessibility, are provided in **Figure 3.2**.
- 3.5.9 Arisings will be removed from the floodplain, off-site.
- 3.5.10 Works will take place in late spring/summer, avoiding periods with the highest risk of surface inundation and the highest water tables that result in soft ground.
- 3.5.11 Working areas will be subject to ecological walkovers to confirm and update ecological constraints. Works to ditch banks will be micro-sited to avoid effects on water voles and otters. A Protected Species Licence will be

sought in the event that one is required, although, based on the reported ecological baseline [[REP3-051](#) and [REP3-052](#)] it is considered that effects requiring licensing can be avoided.

- 3.5.12 Activities will be controlled via implementation of measures in the **Code of Construction Practice** (Doc Ref. 8.11(E)) secured by Requirement 2 of the **dDCO** (Doc. Ref. 3.1(I)).

3.6 Conservation management

- 3.6.1 Management measures during the establishment period (Year 1) and in Years 2-5 and 6-10 are summarised below.

a) Management units

- 3.6.2 Stock proof fence will be used to exclude stock from accessing the wet woodland from the fen meadow habitat creation area to the north. Proposed fence lines are indicated on **Figure 3.1**.

b) Wet Woodland Establishment period (Year 1)

- 3.6.3 Should deleterious species establish in the wet woodland area these will be removed, or treated.

- 3.6.4 No other management is proposed.

c) Wet Woodland Management – Years 2-5 and 6-10

- 3.6.5 Should deleterious species establish in the wet woodland area these will be removed, or treated.

- 3.6.6 No other management is proposed.

3.7 Monitoring

- 3.7.1 The effects on ground and surface water levels, and surface wetness, would be monitored for effectiveness using existing installations and observation.

- 3.7.2 An annual botanical assessment of the establishment of species in the area will be undertaken, including assessment of the presence of alder and grey willow in particular, as key wet woodland species.

- 3.7.3 Management of the water levels and habitats developing on site will be amended as required based on the monitoring results.

- 3.7.4 A monitoring report will be submitted to the EWG on an annual basis.

3.8 Area of wet woodland

- 3.8.1 Based on the data available it is considered that implementing the proposed measures in the southern compartment will result in elevated water levels sufficient to create areas of shallow open water that will accommodate 1.76ha of wet woodland, alongside the proposed areas of fen meadow, to the north of the wet woodland, in that compartment.

4 SUMMARY

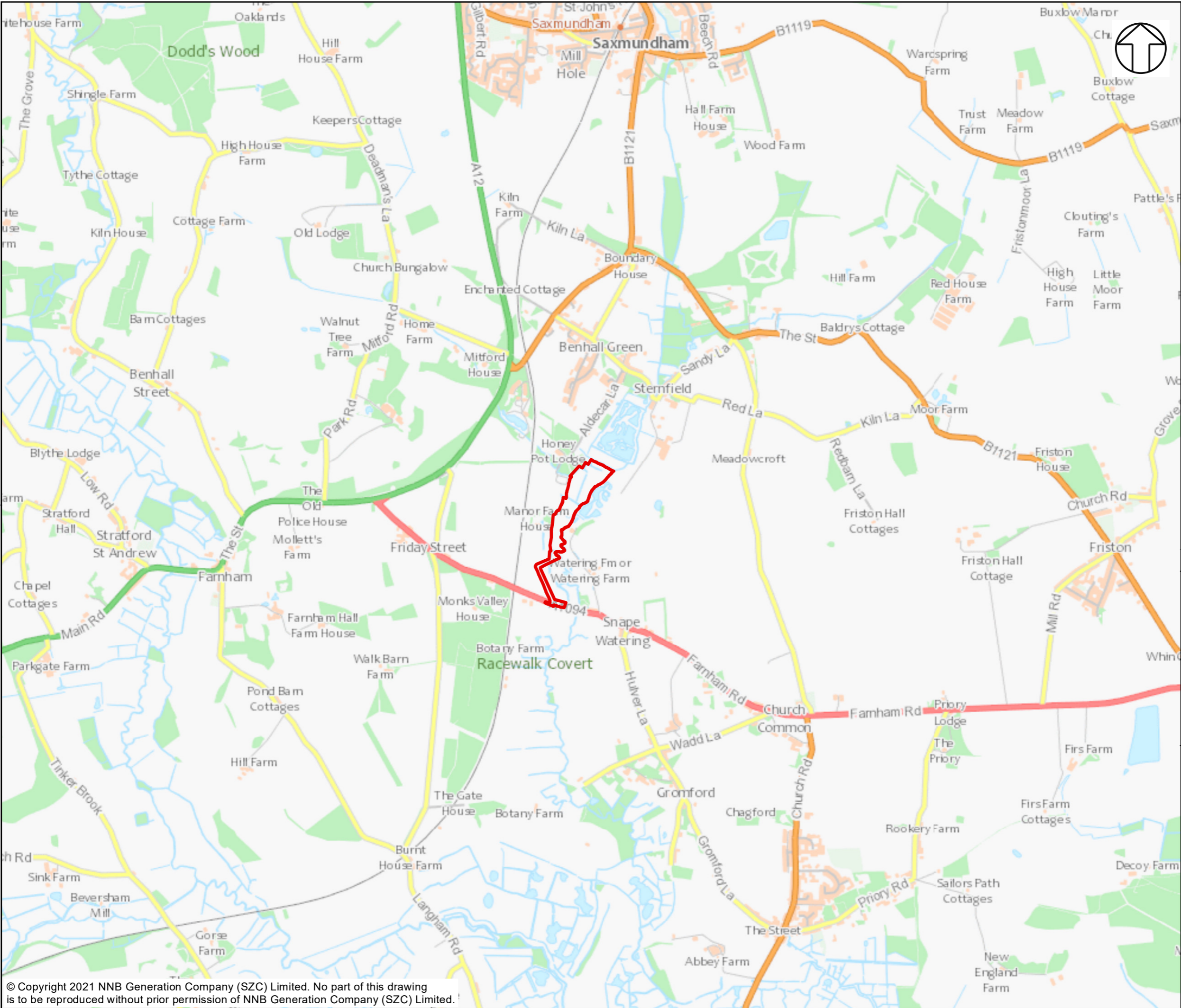
- 4.1.1 Implementation of proposals in this Draft Wet Woodland Plan are expected to deliver conditions that will support wet woodland, alongside the fen meadow habitats on both of the sites.
- 4.1.2 The proposals are intended to result in elevated water levels, creating the conditions for establishment of wet woodland habitat.
- 4.1.3 The proposals are therefore anticipated to deliver conditions suitable to support wet woodland habitat across the site areas summarised below:
- Benhall: 0.6 ha of wet woodland;
 - Pakenham: 1.76 ha of wet woodland.
- 4.1.4 In total therefore this is expected to deliver up to **2.36 ha** of wet woodland, in addition to the fen meadow habitats defined in the **Fen Meadow Plan Draft 2** (Doc Ref. 9.64(A)). A further 0.7ha will be delivered on the main development site, making a total of **3.06ha** of compensatory wet woodland to compensate for the loss of a similar area from the Sizewell Marshes SSSI.
- 4.1.5 The proposals have been prepared with reference to the data available to the beginning of July 2021 and data collection is on-going at each site. It remains possible therefore that future data may indicate the necessity to make minor adjustments to the proposals. However, the most likely changes that may be necessary will be to depths of sculpting indicated.

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FIGURES

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NOTES

KEY

Benhall site boundary

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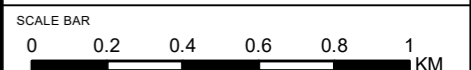
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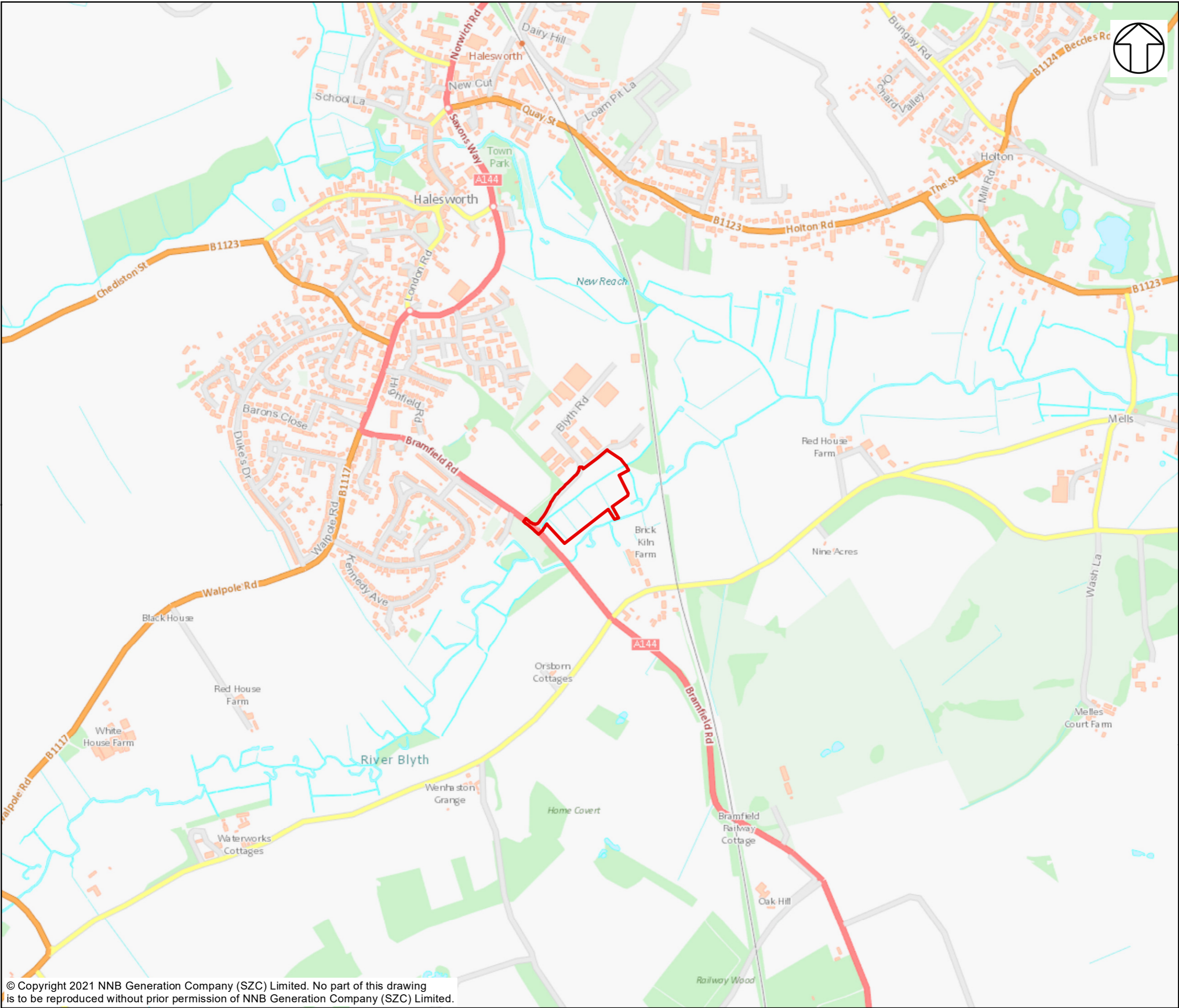
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WET WOODLAND PLAN

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FEN MEADOW COMPENSATION SITE
AT BENHALL

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FIGURE 1.1


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NOTES

KEY

 Halesworth site boundary

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PROJECT:
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DOCUMENT:
WET WOODLAND PLAN

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AT HALESWORTH

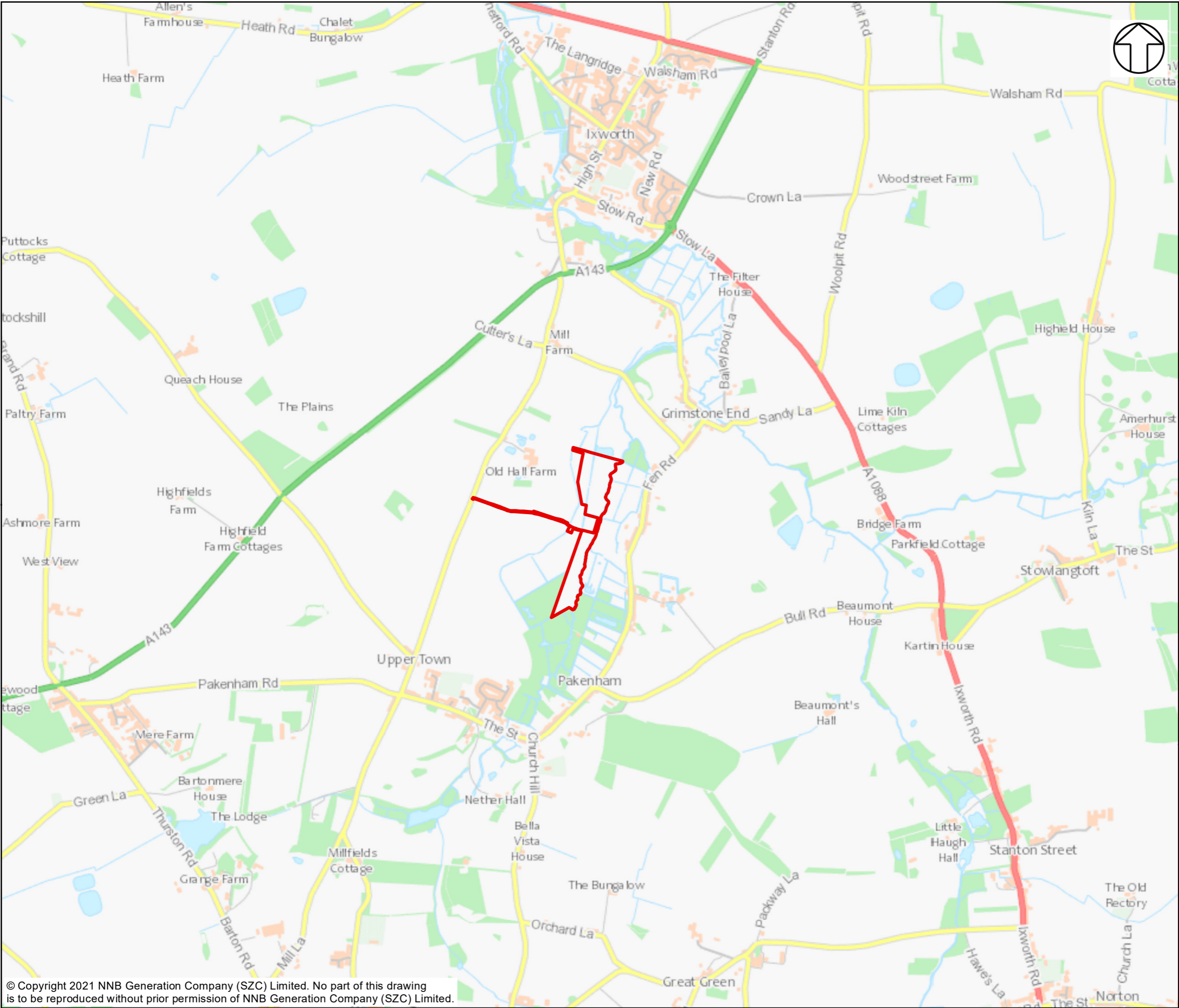
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NOTES

KEY

Pakenham site boundary

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DOCUMENT:
WET WOODLAND PLAN

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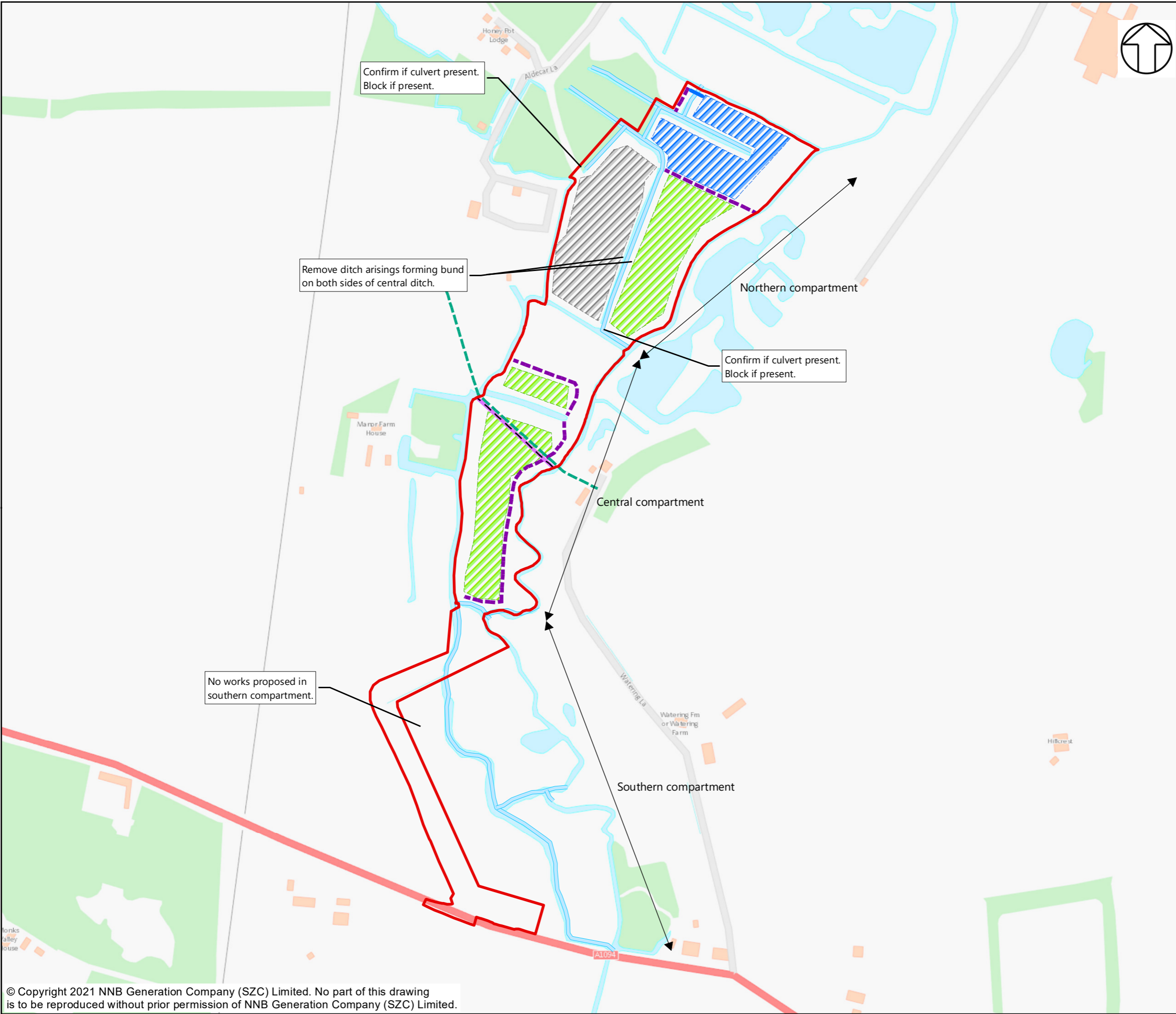
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NOTES

KEY

- Benhall site boundary
- River or drainage ditch
- Public footpath
- Footpath boardwalk
- Area for wet woodland
- Area of land sculpting to create habitat matrix
- Elevated groundwater levels only in this area
- Fenceline to manage stock access to/exclude stock from new habitat areas as appropriate
- Water control structure

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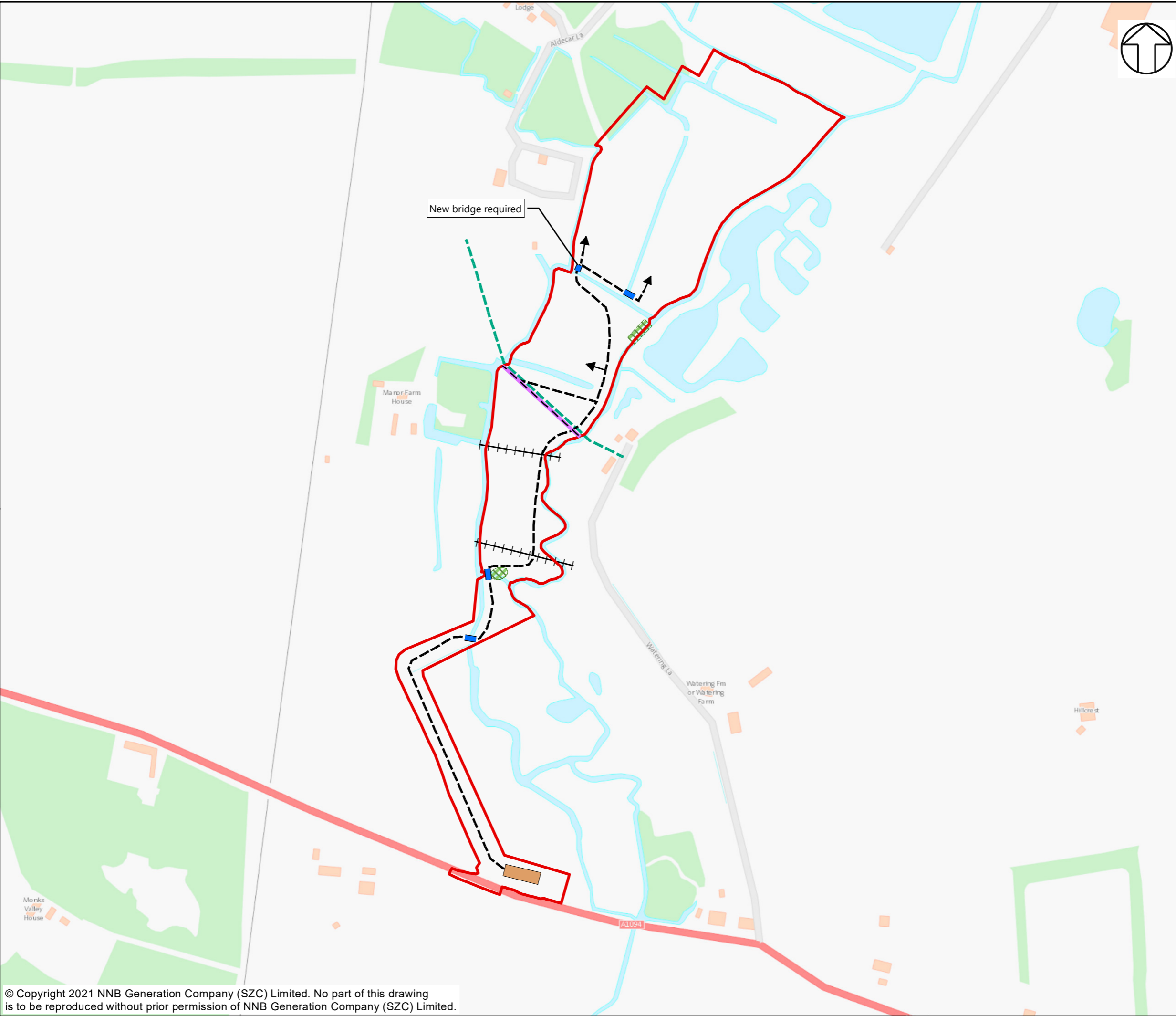
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FIGURE 2.1

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NOTES

KEY

- Benhall site boundary
- River or drainage ditch
- Public footpath
- Bridge
- Indicative access route
- Footpath boardwalk
- Power line
- Site compound
- Turning area
- Hogweed

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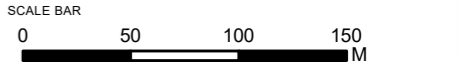
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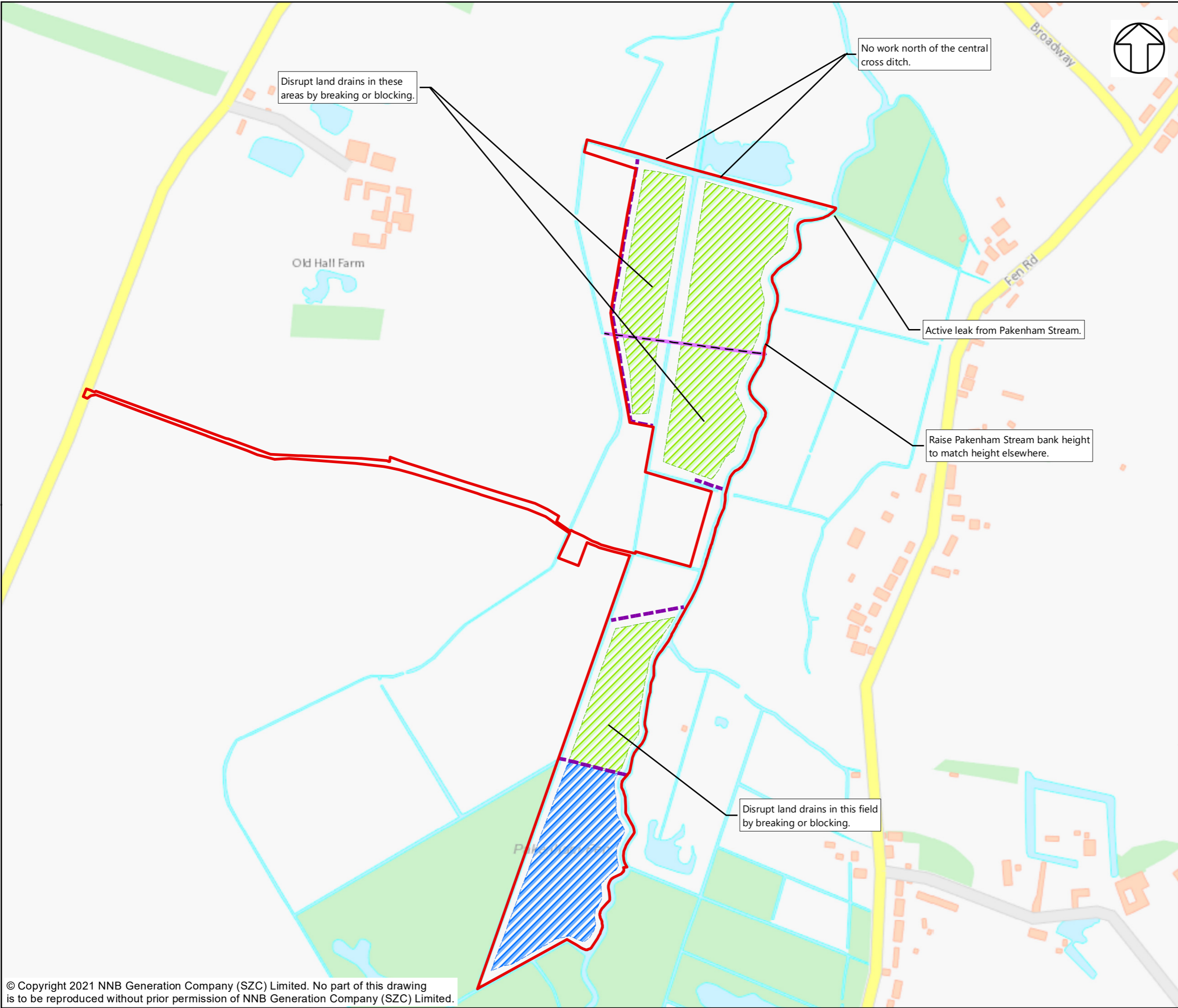
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FIGURE 2.2

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NOTES

KEY

- Pakenham site boundary
- River or drainage ditch
- Area for wet woodland
- Area of land sculpting to create habitat matrix
- Fenceline to manage stock access to/exclude stock from new habitat areas as appropriate
- Footpath boardwalk

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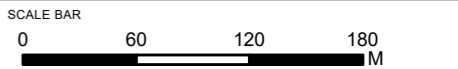
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SITE PROPOSALS (PAKENHAM)

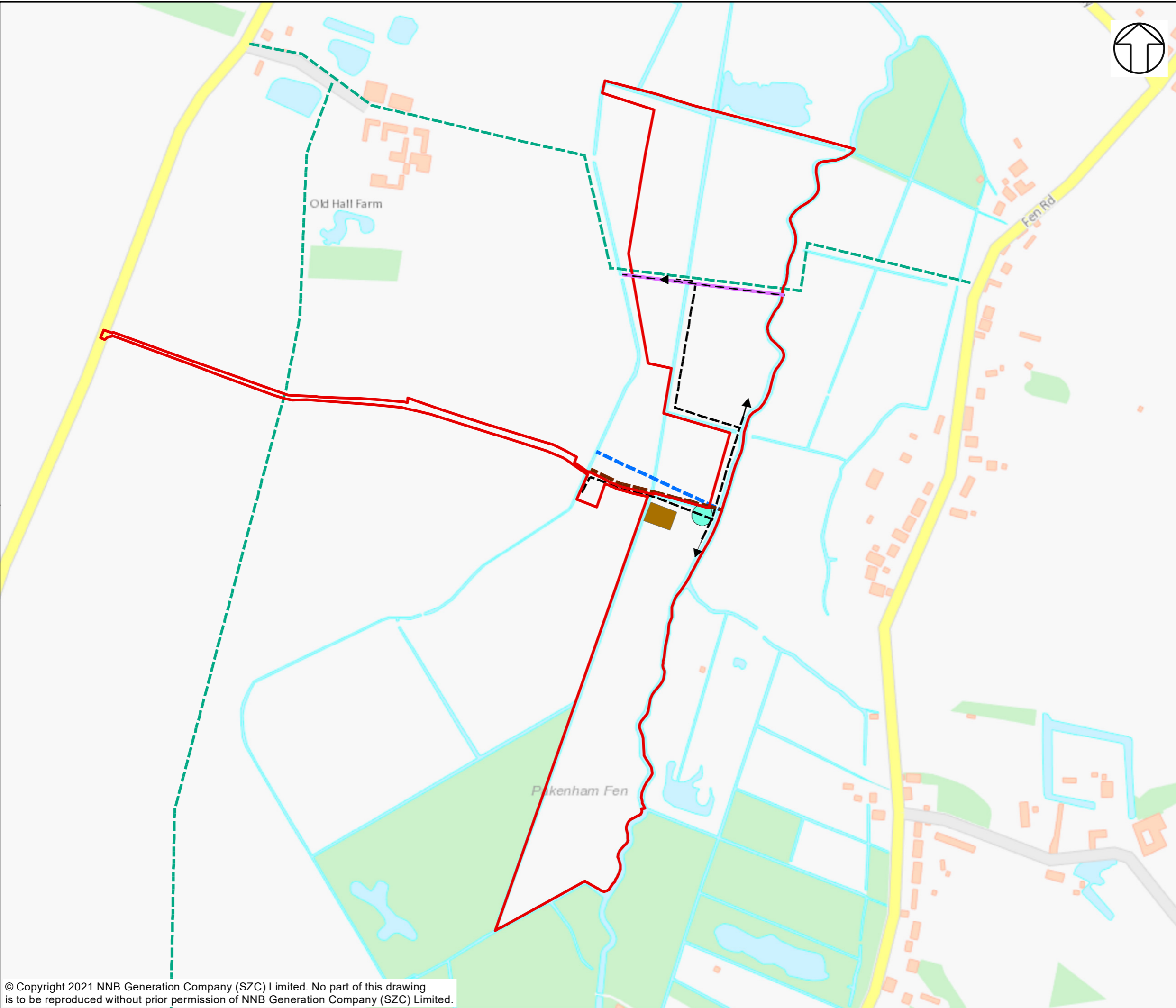
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FIGURE 3.1

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NOTES

KEY

- Pakenham site boundary
- River or drainage ditch
- Public footpath
- Indicative access route
- Approximate line of underground pipe
- Landowner boundary
- Footpath boardwalk
- Site compound
- Biosecurity point

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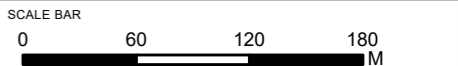
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FIGURE 3.2

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