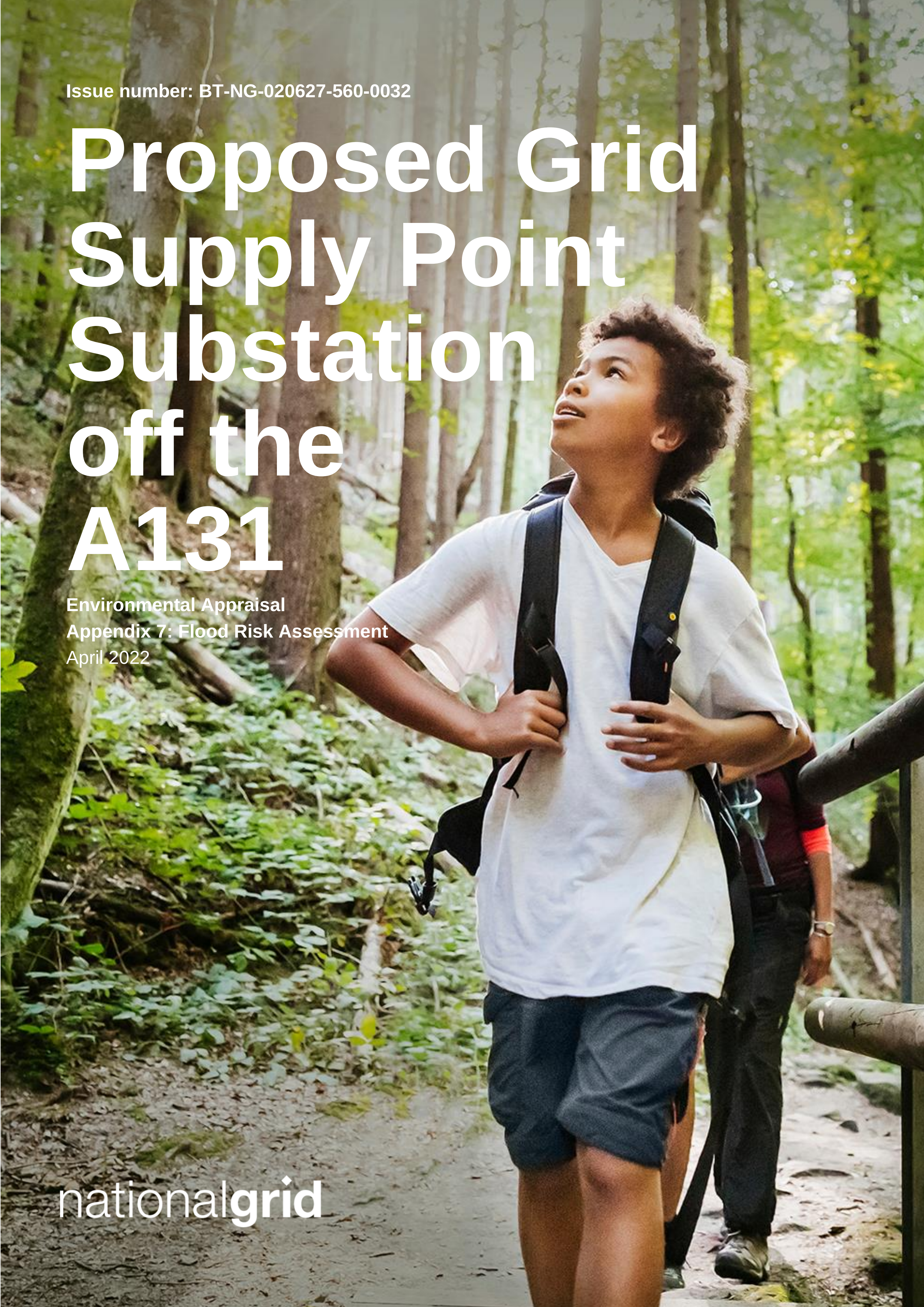

Issue number: BT-NG-020627-560-0032

Proposed Grid Supply Point Substation off the A131

Environmental Appraisal

Appendix 7: Flood Risk Assessment

April 2022

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Appendix 7: Flood Risk Assessment

1. Introduction

1.1 Purpose of this Document

1.1.1 This appendix sets out the Flood Risk Assessment (FRA) relevant to the proposed Grid Supply Point (GSP) substation described in Section 2 of the Environmental Appraisal and Section 4 of the Planning Statement. The site is located off the A131 and is shown in Figures 1-3 of the Environmental Appraisal.

1.1.2 The Environment Agency Flood Map for Planning (Rivers and Sea) (Environment Agency, 2021a) shows that the site is located in Flood Zone 1, with an annual chance of flooding from rivers and the sea less than 1 in 1,000 (0.1%). In line with requirements of the National Planning Policy Framework (NPPF) (Ministry of Housing, Communities and Local Government, 2021a) all proposals for new development in excess of 1 hectare in area in Flood Zone 1 should be supported by an appropriate FRA to consider the risk of flooding from all sources.

1.2 Aims and Objectives

1.2.1 The aim of this FRA is to address the requirements of national and local planning policy with respect to flood risk.

1.2.2 FRAs should be prepared to a level of detail proportionate to both the risk of flooding and the scale of the proposed development. Specific objectives of this FRA are therefore to:

- Assess the proposed GSP substation against the requirements of the NPPF; and
- Discuss the risk of flooding to the proposed GSP substation from all potential sources.

1.3 Terminology

1.3.1 Flood risk is a product of both the likelihood and consequences of flooding. Throughout this document, flood events are defined according to their likelihood of occurrence. Floods are described according to an ‘annual chance’, meaning the chance of a particular flood occurring in any one year. This is directly linked to the probability of a flood. For example, a flood with an annual chance of 1 in 100 (a 1 in 100 chance of occurring in any one year), has an annual probability of 1%.

1.4 Limitations

1.4.1 This report has been compiled from several sources which are suitable to undertake this FRA. The report is based on information available at the time of writing. Additional information may become available in the future which may have a bearing on the conclusions of this report.

2. Background

2.1 Site Location and Description

2.1.1 The site is located to the northeast of Wickham St Paul and to the southwest of Sudbury, centred at approximate National Grid Reference (NGR) TL 84405 37105. It is bounded by Butler's Wood to the north, Waldegrave Wood to the south and is surrounded by agricultural land on all other sides.

2.1.2 The site covers an area of approximately 7 hectares (ha) as shown on Figure A7.1. The site is predominantly occupied by agricultural land.

2.1.3 There is an agricultural drain/ditch that crosses the site in a north south orientation and flows along its northern boundary, in a westerly direction. This drainage ditch is crossed in two places within the site boundary by existing tracks. The locations of the existing crossings are indicated in Figure A7.1 and are shown to be between 7 and 8m wide by LiDAR data (see Section 2.2) and satellite imagery. Photographs of the drainage ditch are shown in Image A7.1.

2.1.4 The site is in the catchment of the Belchamp Brook which is a tributary of the River Stour. An unnamed watercourse is located 180m south-west of the site (shown in Figure A7.1) and discharges to the Belchamp Brook approximately 3km downstream of the site. The drainage ditches and watercourse shown in Figure A7.1 are 'ordinary watercourses' and the Belchamp Brook is a designated 'main river'. Main rivers are usually larger streams and rivers and the Environment Agency carries out maintenance, improvement or construction work on main rivers to manage flood risk. Other rivers are called 'ordinary watercourses and these are under the management of a local authority or Internal Drainage Board, known as the Lead Local Flood Authority (LLFA).

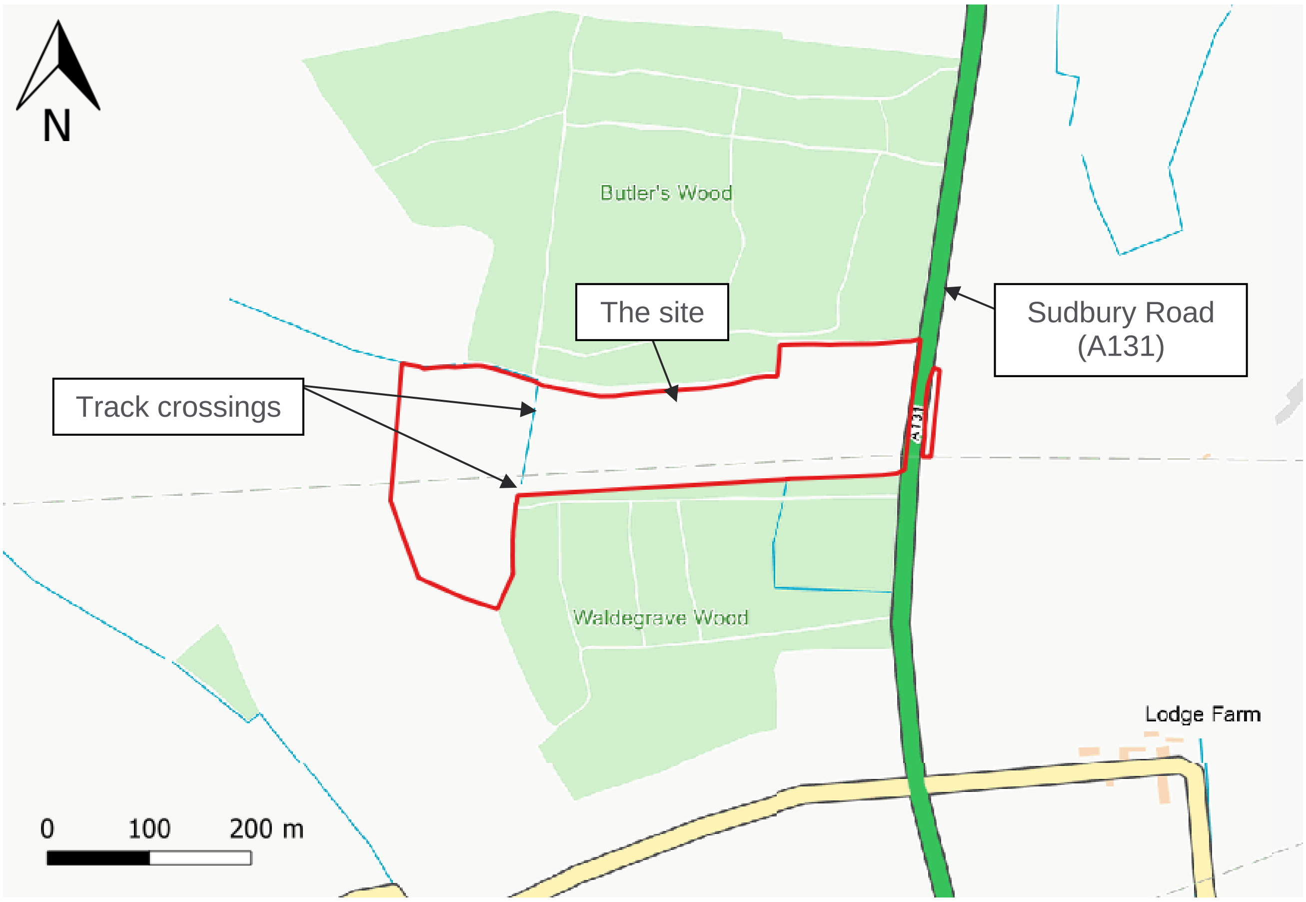

Figure A7.1: Site Location

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Image A7.1: Site Photographs

Drainage ditch crossing the site A) looking north towards Butler's Wood. B) looking south towards Waldegrave Woods

2.2 Topography

2.2.1 LiDAR data, shown in extract in Figure A7.3, indicates that ground levels across the site range from 76.5m Above Ordnance Datum (AOD) to 87.4mAOD. The site topography slopes downwards from east to west, with the highest ground levels onsite located adjacent to the A131 and the lowest along the drainage ditch that crosses the site.

2.2.2 There are drainage ditches that run along the edge of Butler's Wood and Waldegrave Wood, connected to the drainage ditch that crosses the site. The drainage ditches adjacent to the woodlands are over 1m deep while LiDAR data suggests that the drainage ditch that crosses the site is typically between 0.5m and 1m deep.

2.2.3 In the vicinity of the site, the prevailing topography typically slopes downwards from east to west away from the area of high ground around the A131, towards local watercourses. To the east of this area of high ground, the prevailing topography slopes downwards from west to east towards the River Stour.

Figure A7.3: Site Topography (filtered LiDAR shown)

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3. Planning Policy Context

3.1 NPPF and Flood Risk

3.1.1 The NPPF was first published in 2012 and most recently updated in 2021. Along with its accompanying Planning Practice Guidance (PPG) (Ministry of Housing, Communities and Local Government, 2021b), the NPPF sets out the government's planning policies for England and how these are expected to be applied. The principal aim of the NPPF is to achieve sustainable development. This includes ensuring that flood risk is taken into account at all stages of the planning process, avoiding inappropriate development in areas at risk of flooding and directing development away from those areas where risks are highest. Where development is necessary in areas of flooding, the NPPF aims to ensure that it is safe, without increasing flood risk elsewhere.

3.1.2 Early adoption of, and adherence to, the principles set out in the NPPF with respect to flood risk, should ensure that detailed designs and plans for developments take due account of flood risk and the need for appropriate mitigation, if required.

3.2 The Sequential and Exception Test

3.2.1 The NPPF identifies four Flood Zone classifications, detailed in Table 3.1.

Table 3.1: Flood Zones (PPG, Flood Risk and Coastal Change, Table 1)

Flood Zone	Annual Probability of Flooding (%)
1 Low Probability	Fluvial and Tidal <0.1%
2 Medium Probability	Fluvial 0.1 – 1.0 % Tidal 0.1 – 0.5 %
3a High Probability	Fluvial >1.0 % Tidal >0.5 %
3b The Functional Floodplain	Land where water has to flow or be stored in times of flood, identified by local authorities in Strategic Flood Risk Assessments. Fluvial and Tidal >5.0 % is recommended as a starting point for consideration, but it should not be defined solely by rigid probability parameters.

3.2.2 The NPPF specifies that the suitability of all new development in relation to flood risk should be assessed by applying the Sequential Test to demonstrate that there are no reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development proposed. The PPG provides further guidance on the compatibility of each land use classification in relation to each of the Flood Zones as summarised in Table 3.2.

Table 3.2: Flood Risk Vulnerability Classification (PPG, Flood Risk and Coastal Change, Table 3)

Flood Zone	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a	Exception Test required	×	Exception Test required	✓	✓
Zone 3b	Exception Test required	×	×	×	✓
Key: ✓ Development is appropriate × Development should not be permitted					

3.2.3 When a development site falls partly within multiple Flood Zones, the highest risk Flood Zone should be used when assessing development vulnerability as in Table 3.2.

3.2.4 If it is not possible for development to be located in zones with a lower risk of flooding, the Exception Test may have to be applied. For the Exception Test to be passed, it should be demonstrated that:

- The development would provide wider sustainability benefits to the community that outweigh the flood risk; and
- The development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

3.3 Flood Zone Classification

3.3.1 The Flood Map for Planning (Rivers and Sea) shows that the site of the proposed GSP substation is located in Flood Zone 1, equivalent to an annual chance of flooding from rivers less than 1 in 1,000 (0.1%).

3.4 Application of the Sequential and Exception Test

3.4.1 The proposed GSP substation is classified as 'essential infrastructure', with respect to flooding, in the NPPF. The site location in Flood Zone 1 therefore meets with the aims of the Sequential Test.

3.4.2 The site is therefore considered to be appropriate, on flood risk grounds, for the type of development proposed. The proposals pass the Sequential Test and application of the Exception Test is not required.

3.5 Need for an FRA

3.5.1 The NPPF states that development of 'essential infrastructure' is appropriate in Flood Zone 1. However, all applications for development proposals covering an area equal to or greater than 1 ha in Flood Zone 1 should be accompanied by an FRA. The remainder of this report therefore provides an assessment of flood risk to the proposed GSP substation site from all potential sources in line with the requirements of the NPPF and PPG.

4. Potential Sources of Flooding

4.1 Overview

4.1.1 In line with best practice, this section considers flood risk from the range of possible sources listed in Table 4.1 and identifies where further assessment is required and how any flood risk would be managed such flooding does not pose an onerous risk to the site in the context of the proposed GSP substation.

Table 4.1: Sources of Flooding

Sources of Flooding	Description
Flooding from rivers (fluvial)	Floodwater originating from a nearby watercourse when the amount of water exceeds the channel capacity of that watercourse
Flooding from the sea (tidal)	Flooding originating from the sea or a connected waterbody when seawater overflows onto land through extreme tidal conditions, storm surge or breach
Flooding from surface water (pluvial)	Flooding caused by intense rainfall exceeding the available infiltration and/or drainage capacity of the ground
Flooding from groundwater	Flooding caused when groundwater levels rise above ground level following prolonged rainfall
Flooding from sewers	Flooding originating from surface water, foul or combined drainage systems, typically caused by limited capacity or blockages
Flooding from reservoirs, canals, and other artificial sources	Failure of infrastructure that retains or transmits water or controls its flow

4.2 Flooding from Rivers

4.2.1 Two available sources of online mapping exist that consider the risk of flooding from rivers in the UK. The Environment Agency’s ‘Risk of Flooding from Rivers and Sea Map’ (Environment Agency, 2019) is based on the Environment Agency’s National Flood Risk Assessment (NaFRA), which takes account of modelled in-channel flood levels for watercourses and asset inspection information relating to raised flood defences where these exist. NaFRA maps consider the risk of overtopping or failure of raised defences or natural ground to provide a probabilistic assessment of the risk of flooding. This contrasts with the previously described Flood Map for Planning (Rivers and Sea), which is deterministic, and shows whether sites are ‘in’ or ‘out’ of given ‘Flood Zones’. The Flood Map for Planning ignores the presence of flood defences but highlights where defences exist. The Flood Map for Planning shows that the site does not benefit from flood defences.

4.2.2 The two online maps both suggest the site has an annual chance of flooding from rivers less than 1 in 1,000 (0.1%).

4.2.3 There are no records of flooding from rivers at the site according to the Environment Agency’s ‘Historic Flood Map’ (Environment Agency, 2018).

4.2.4 The drainage ditches within and bordering the site drain small catchment areas and are considered to have good flow conveyance capacity due to their slope and dimensions. Furthermore, the Risk of Flooding from Surface Water Map (see Section 4.4) does not highlight any widespread risk associated with these drainage ditches.

4.2.5 In summary, the site has a ‘very low’ risk of flooding from rivers, equivalent to an annual chance less than 1 in 1,000 (0.1%) and this source of flooding does not pose an onerous risk to the site in the context the proposed GSP substation, nor does it require further assessment in this FRA.

4.3 Flooding from the Sea

4.3.1 The watercourses in the vicinity of the site are inland and are not tidally influenced. The tidal limit of the River Stour, which the Belchamp Brook discharges to, is over 20km east of the site. Therefore, this source of flooding does not pose a risk to the site in the context the proposed GSP substation and this source of flooding is not considered further in this FRA.

4.4 Flooding from Surface Water

4.4.1 The Environment Agency’s Risk of Flooding from Surface Water Map (Environment Agency, 2019) is informed by ‘direct rainfall’ modelling undertaken at a high (2m) resolution. It illustrates those areas at higher risk of surface water flooding in topographically low spots which are down-gradient of sloping ground or in the topographic valleys associated with current or former watercourses. An extract of the map is shown in Figure A7.4.

4.4.2 The Risk of Flooding from Surface Water Map indicates that the majority of the site is at ‘very low risk’ of surface water flooding, equivalent to an annual chance of flooding less than 1 in 1,000 (0.1%). However, parts of the site are shown to be at higher risk of flooding from this source. The land along the northern boundary shown to be at higher risk of surface water flooding is coincident with the drainage ditch which runs adjacent to, and extends west of, Butler’s Wood (see Section 2.2). This drainage ditch is located immediately adjacent to, but out of, the site boundary.

4.4.3 Figure A7.4 indicates that there is a surface water flow path across the middle of the site which connects to the aformentioned drainage ditch. Along this surface water flow path land is shown to be at ‘medium risk’ (equivalent to an annual chance of flooding between 1 in 100 (1%) and 1 in 30 (3.3%)) and ‘low risk’ (equivalent to an annual chance of flooding between 1 in 1,000 (0.1%) and 1 in 100 (1%)) of surface water flooding. Only very small parts of the site are shown to be at ‘high risk’ of surface water flooding, equivalent to an annual chance of flooding greater than 1 in 30 (3.3%). Where flooding is shown within the site boundary for the ‘high risk’ event, floodwaters are typically predicted to be shallow, with depths less than 300mm.

4.4.4 There is no notable ‘ponding’ of surface water within the site boundary shown in the Risk of Flooding from Surface Water Map, which is to be expected given the site’s sloping topography.

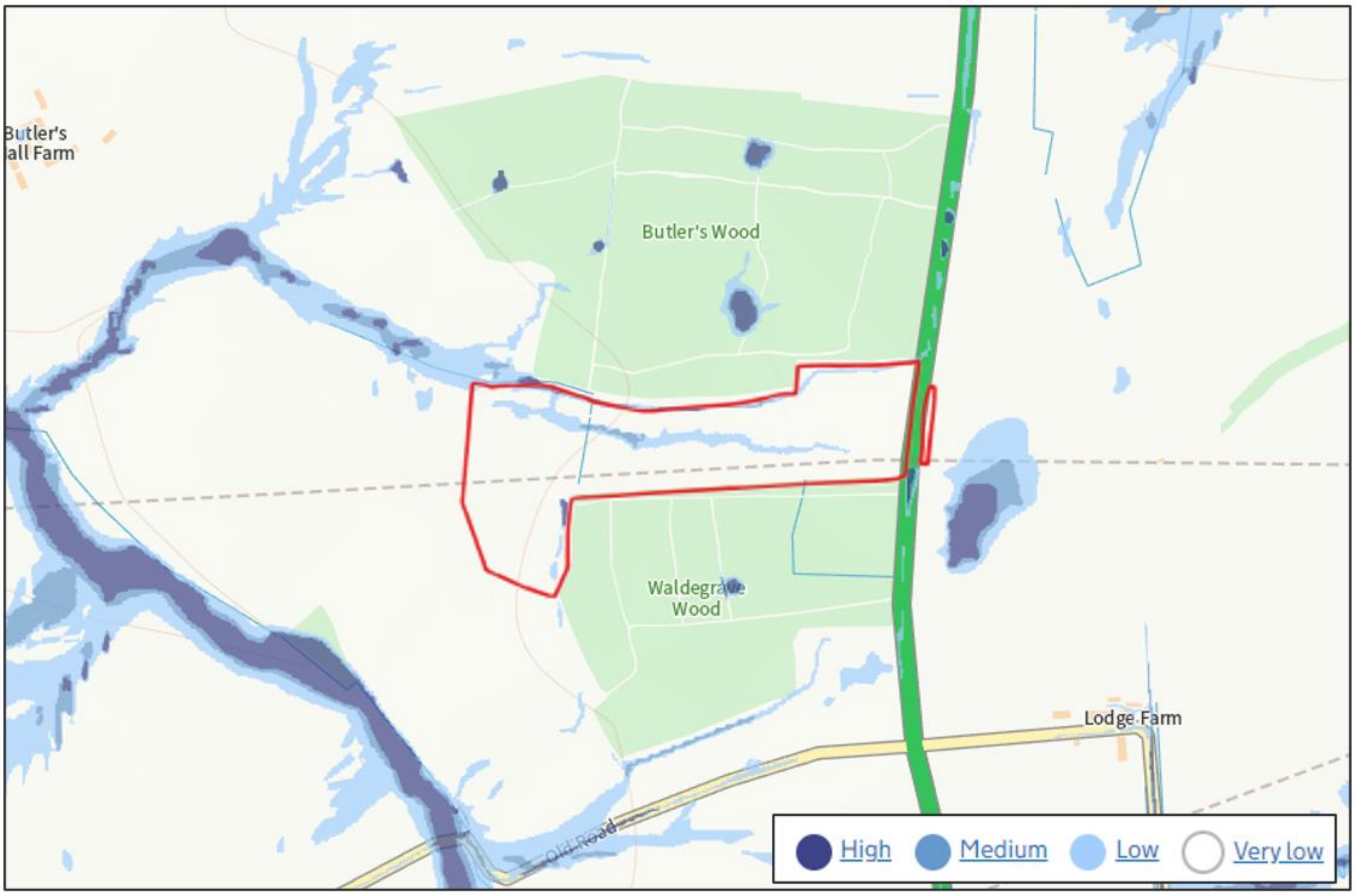

Figure A7.4: Risk of Flooding from Surface Water Map (site boundary outlined in red)
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4.4.5 The site is not located within an Internal Drainage Board (IDB) district (Association of Drainage Authorities, 2022) and is not located in a Critical Drainage Area (CDA) (URS Scott Wilson, 2011 & Essex County Council, 2017).

4.4.6 Consultation meetings have been undertaken as part of the wider reinforcement project with Essex County Council as the Lead Local Flood Authority (LLFA). No flood risk concerns were raised in relation to the proposed GSP substation during these meetings.

4.4.7 The land cover for the majority of the site is currently permeable (i.e. open grassland) and the proposed GSP substation will result in an increase in impermeable land cover at the site. Management of potential impacts on surface water flood risk during construction and operation of the proposed GSP substation are discussed in Section 5 of this FRA.

4.4.8 Overall, flooding from surface water does not pose an onerous risk to the site in the context of the proposed GSP substation, subject to the implementation of the surface water management measures discussed in Section 5.

4.5 Flooding from Groundwater

4.5.1 Groundwater flood risk is not as well-defined as other sources of flooding, and an assessment of risk often requires consideration of geological conditions. Groundwater flooding can occur from two general mechanisms: (i) ‘clearwater flooding’, where the water table in unconfined aquifers rises above the ground surface, associated with permeable bedrock such as Chalk and common in areas where ‘winterbourne’ streams are present, which may run dry for much of the year; and (ii) ‘river-groundwater interaction’, where river levels interact with permeable superficial deposits along river valleys, potentially flooding areas away from the river without necessarily overtopping the river banks.

4.5.2 According to British Geological Survey (BGS) online mapping (BGS, 2022a), the site is underlain by superficial Lowestoft Formation (Diamicton) deposits (classified as a ‘Secondary (undifferentiated)’ aquifer) above London Clay bedrock (an ‘Unproductive’ aquifer). Examination of local BGS borehole records[1] (BGS, 2022b), shows the presence of Chalk below the deep London Clay deposits. As noted in the Essex County Council Strategic Flood Risk Assessment (SFRA) (URS, 2012), the impermeable London Clay prevents groundwater rising from the deep Chalk aquifer to the surface. Secondary aquifers can support water supplies at a local rather than strategic scale and the absence of a Principal Aquifer suggests that the risk of clearwater flooding is remote.

4.5.3 The SFRA presents the ‘Areas Susceptible to Groundwater Flooding’ map, a relatively coarse map that indicates a percentage of each 1km grid cell where there is potential for groundwater to rise to the ground surface, largely based on underlying geology. The site is situated within a grid cell where <25% of the grid cell has this potential. The commentary in the SFRA states that the risk of groundwater flooding where London Clay is present is low but that the risk may be higher where river terrace gravels and superficial deposits are present. Superficial deposits are present at the site, but the glacial Diamicton deposits are typically reasonably impermeable.

4.5.4 According to the Essex County Council Preliminary Flood Risk Assessment (URS Scott Wilson, 2011) there have been no recorded incidents of groundwater flooding at the site or in its surroundings.

4.5.5 Overall, the site is at low risk of groundwater flooding. This source of flooding does not pose an onerous risk to the site in the context of the proposed GSP substation, and this source of flooding is not considered further in this FRA.

4.6 Flooding from Sewers

4.6.1 Flooding from sewers can result from lack of sewer capacity, blockages within the sewer network or failure of infrastructure such as pumps. Any area that benefits from sewerage infrastructure has a potential risk of flooding, but the likelihood and consequences are most likely increased by topographic constraints such as low spots or flow paths that could influence the behaviour of floodwater originating from sewers.

4.6.2 The PFRA presents mapping providing a high-level overview of sewer flooding incidents from the Thames Water and Anglian Water DG5 registers (registers of properties that have flooded as a result of the public sewer network), that record incidents of sewer flooding. There are no recorded incidents in the vicinity of the site or its surroundings. Given the rural nature of the site, this may be expected.

4.6.3 In the absence of site-specific information on sewer flooding, the Environment Agency’s Risk of Flooding from Surface Water Map can aid understanding of how a sewer burst could impact the site. The limited ‘ponding’ of surface waters within the site boundary shown by the Risk of Flooding from Surface Water Map, and the typically sloping topography of the site, would reduce effects of a sewer asset failure at the site.

4.6.4 Based on the available information it is concluded that the site has a low risk of sewer flooding. This source of flooding does not pose an onerous risk to the site in the context of

[1] TL83NW34, TL83NW35 and TL83NW42

the proposed GSP substation, and this source of flooding is not considered further in this FRA.

4.7 Flooding from Reservoirs, Canals and other Artificial Sources

4.7.1 The Environment Agency's Risk of Flooding from Reservoirs Map (Environment Agency, 2019) illustrates the potential flood extent if large, raised reservoirs were to fail and release the water that they hold. The map shows that the site is outside the extents of this flood envelope, and this form of flooding is therefore not considered to pose a risk to the site in the context of the proposed GSP substation.

4.7.2 The River Stour Navigation is located over 4km north-east of the site and at ground levels approximately 50m lower. It is therefore considered that the canal does not pose a flood risk to the site. There are no other canals in the vicinity of the site.

4.7.3 No other artificial sources of flood risk have been identified while preparing this FRA.

4.7.4 Based on the available information it is concluded that the site has a low risk of flooding from artificial sources. This source of flooding does not pose an onerous risk to the site in the context of the proposed GSP substation, and this source of flooding is not considered further in this FRA.

5. Surface Water Management

5.1 Planning Policy Requirements

5.1.1 The NPPF states (in paragraph 169) that *'Major developments should incorporate sustainable drainage systems* [SuDS] *unless there is clear evidence that this would be inappropriate'.*

5.1.2 Surface water should, as far as is practicable, be managed in a sustainable manner to mimic the existing surface water flow regime. Opportunities to reduce flood risk to the site itself and elsewhere, taking climate change into account, should be investigated. Opportunities should be sought to reduce the overall level of flood risk through appropriate application of SuDS.

5.1.3 The Essex County Council SuDS Design Guide (2020) (Essex County Council, 2020) recognises the importance of SuDS in managing flood risk throughout Essex and provides guidance on the types, application and future maintenance of SuDS; incorporating national and local SuDS standards.

5.2 During Construction

5.2.1 Good practice measures for the Water Environment are outlined in Annex 1 (Code of Construction Practice; CoCP) of Appendix 1 (Construction Environmental Management Plan; CEMP) of the Environmental Appraisal.

5.2.2 Runoff across the site will be controlled through a variety of methods including header drains, buffer zones around watercourses, on-site ditches, silt traps and bunding.

5.2.3 Where new or additional surfacing is required on any access tracks and compound areas, these will be permeable surfaces where ground conditions allow.

5.2.4 Land used temporarily will be reinstated where practicable (bearing in mind any restrictions on planting and land use) to its pre-construction condition and use. Boundary features will be reinstated to a similar style and quality to those that were removed, with landowner agreement. Existing land drainage regimes would also be reinstated following construction.

5.2.5 There is potential for temporary impacts on the flow regime of the drainage ditch that crosses the site when the underground cables, which part of the accompanying works and which do not form part of the planning application, are laid during construction. Once the cables are installed, they will be below bed and the drainage ditch would be retained. The access road, shown in Figure 2 of the Environmental Appraisal, adjoins the existing track as it crosses the drainage ditch. The construction works will be undertaken in accordance with a method statement, approved under temporary land drainage consent under the Land Drainage Act (1991).

5.3 During Operation

5.3.1 The drainage ditch that crosses the site would be retained. The access road, shown in Figure 2 of the Environmental Appraisal, adjoins the existing track as it crosses the drainage ditch. Appropriate surface water drainage measures will be incorporated into the detailed design for the access track.

5.3.2 Where new, permanent areas of impermeable land cover are created, the drainage design will be in accordance with the requirements of the Essex County Council SuDS Design Guide and will include allowances for climate change in accordance with current Environment Agency's requirements (Environment Agency, 2021b). The drainage infrastructure would provide the storage necessary to achieve discharges at greenfield rates and would not notably alter groundwater recharge patterns by transferring a large recharge quantites from one catchment to another.

5.3.3 The proposed GSP substation would include permanent surface and foul drainage systems for permanent areas of impermeable land, such as the access road and SGT bunds. For example, water collected from the SGT bunds and the roofs of buildings in western part of the proposed GSP substation shown on Figure 2 of the Environmental Appraisal will be routed to a soakaway. These would be protected from accidental oil discharges from the site by interceptor units. All remaining areas are likely to contain porous surfacing to allow surface water to naturally infiltrate without the need for formal drainage.

5.3.4 There would be no permanent discharges required but a waste/foul water system would be used on site, comprising short pipes from the amenities building to a cesspool that would be periodically emptied as required. Waste-water generated would be very limited given the site would be unmanned during operation and the waste-water would only come from occasional use of facilities in the amenity buildings.

5.3.5 Landscape mounding is proposed to the east and west of proposed GSP substation as part of the landscaping plans for the site. This will not impact any of the existing drainage ditches and would be located in an area shown to be at ‘very low risk’ of flooding on the Risk of Flooding from Surface Water Map. Therefore, the mound is not anticipated to have an impact on surface water flood risk.

6. Conclusions

6.1.1 This FRA has been prepared to support the planning application for the proposed GSP substation off the A131. The site is currently predominantly comprised of agricultural land. This FRA concludes the following:

- The site is located entirely within Flood Zone 1 on the Flood Map for Planning (Rivers and Sea).
- In accordance with the NPPF, the site is appropriate, on flood risk grounds, for the type of development proposed. The proposals pass the Sequential Test and application of the Exception Test is not required.
- No sources of flooding are considered to pose an onerous risk to the site in the context of the proposed GSP substation.
- The measures proposed to appropriately manage surface water during construction have been outlined in this FRA and all works will be carried out in line with land drainage consent requirements.
- Where new, permanent areas of impermeable land cover are created, the drainage design will be in accordance with the requirements of the Essex County Council SuDS Design Guide and will include allowances for climate change in accordance with current Environment Agency requirements (Environment Agency, 2021b). The drainage infrastructure would provide the storage necessary to achieve discharges at greenfield rates and would not notably alter groundwater recharge patterns by transferring large recharge quantity from one catchment to another.

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