# FIVE ESTUARIES OFFSHORE WIND FARM

## VOLUME 5, REPORT 3.2: FLOOD RISK ASSESSMENT – ONSHORE SUBSTATION

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# Volume 5, Report 3.2: Onshore Substation Flood Risk Assessment

## Five Estuaries Offshore Wind Farm

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Making Sustainability Happen

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# Executive Summary

1. SLR Consulting Limited (SLR) has been appointed by GoBe Consultants to evaluate the potential flood risk to Five Estuaries Offshore Wind Farm (VE) proposed onshore substation (OnSS). Development proposals comprise the construction of the main substation area, installing transformers, buildings, bunds, roads and the use of temporary areas adjacent as construction compounds.

2. This FRA has been prepared in accordance with the National Planning Policy Framework the National Planning Policy Framework (NPPF)[1] and the Planning Practice Guidance for Flood Risk and Coastal Change[2].

3. With reference to the Environment Agency's (EA) Flood Map for Planning[3], the site is located in Flood Zone 1, and will not flood up to and including the 1 in 1000-year (0.1%) scenario in both fluvial and tidal scenarios.

4. Groundwater and pluvial flood risk is considered to be low and assumed to be managed through drainage design included within the development proposals. These include the management of shallow groundwater tables via raised development (See Appendix A), managing existing and potential overland flows, minimising residual blockage risks up to and including the 1 in 100-year plus climate change scenario.

5. Finally, mapping and additional information indicates the site is not at risk from any artificial flood sources.

6. In conclusion, based on the information outlined within this Flood Risk Assessment, the perceived level of flood risk to and caused by the development is low and the development would be safe, without significantly increasing flood risk elsewhere.

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[1] National Planning Policy Framework. National Planning Policy Framework - GOV.UK, (Published March 0212, Revised December 2023), https://www.gov.uk/government/publications/national-planning-policy-framework--2

[2] Flood risk and coastal change guidance. Flood risk and coastal change - GOV.UK, (Published March 2014, Updated August 2022), https://www.gov.uk/guidance/flood-risk-and-coastal-change

[3] Environment Agency Flood Map for Planning https://flood-map-for-planning.service.gov.uk/ (December 2023)

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# Acronyms and Abbreviations

| | |
|---|---|
| AOD | Above Ordnance Datum |
| AEP | Annual Exceedance Probability |
| BGS | British Geological Survey |
| CoCP | Code of Construction Practice |
| DCO | Development Consent Order |
| DEFRA | Department of Food and Rural Affairs |
| DTM | Digital Terrain Model |
| EA | Environment Agency |
| FRA | Flood Risk Assessment |
| LLFA | Lead Local Flood Authority |
| MAGIC | Multi-Agency Geographic Information for the Countryside. |
| NGR | National Grid Reference |
| NNR | National Nature Reserve |
| NPPF | National Planning Policy Framework |
| OnSS | Onshore Substation |
| OWF | Offshore Wind Farm |
| PDZ | Policy Development Zones |
| PPG | Planning Practise Guidance |
| SFRA | Strategic Flood Risk Assessment |
| SPZ | Source Protection Zone |
| SSSI | Sites of Special Scientific Interest |
| SuDS | Sustainable Drainage Systems |
| VE | Five Estuaries |
| WTGs | Wind Turbine Generators |

# 1.0 Introduction

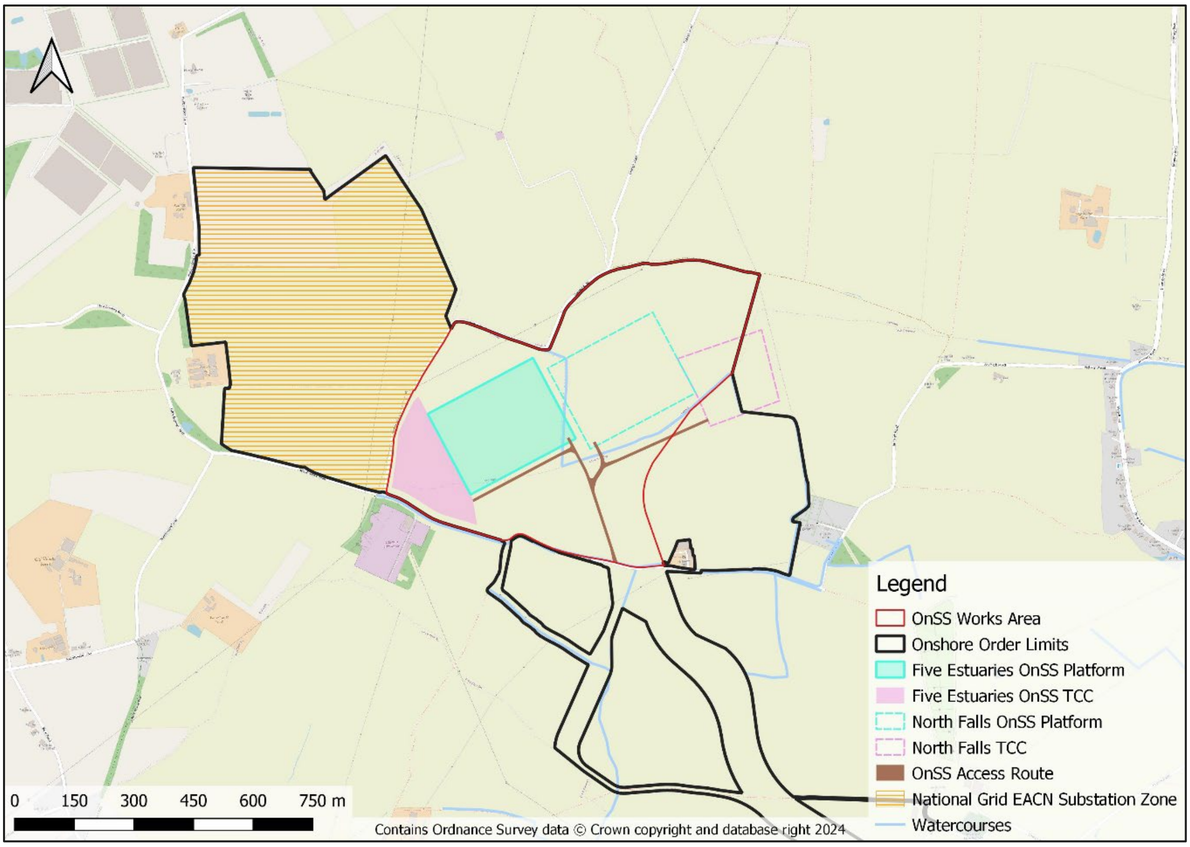
7. SLR Consulting Limited (SLR) has been appointed by GoBe Consultants on behalf of Five Estuaries Offshore Windfarm Ltd (the Applicant), to prepare a Flood Risk Assessment (FRA) for the proposed onshore substation (OnSS) of the Five Estuaries Offshore Wind Farm (VE) development. This report covers an area of land termed as the substation works area (the site).

8. This FRA has been completed in accordance with guidance presented within the National Planning Policy Framework (NPPF)[1] and its associated Planning Practice Guidance (PPG)[2], taking due account of current best practice documents relating to assessment of flood risk published by the British Standards Institution BS8533[4].

## 1.1 Context and Site Location

9. The site is situated within Tendring in Essex, 800m west of the village of Little Bromley. The nearest registered postcode to the site is CO11 2QA, centred around grid reference (NGR) 607984, 228546. An location plan detailing the substation works area is presented in Figure 1-1.

**Figure 1-1: Site Location Plan**



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10. VE is a proposed extension to the operational Galloper Offshore Wind Farm (OWF) which consists of 56 WTGs and supplies electricity to approximately 380,000 households annually. The VE wind turbine generators (WTGs) will be situated across two array areas to the east of the operational Galloper OWF. The array areas will be located

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[4] BS8533:2017, Assessing and managing flood risk in development: Code of Practice (December 2017)

approximately 37 km off the coast of Suffolk, England. Cables will connect the turbines to the offshore substation platforms and then export the power generated to shore where cables will run from the onshore landfall site along the onshore export cable corridor (ECC) to the OnSS, where the power will be uprated and transferred by cables to a new National Grid substation. This flood risk assessment will focus on the proposed OnSS. A separate Flood Risk Assessment has been prepared to cover the proposed onshore ECC.

11. The site is currently greenfield land, comprising multiple agricultural fields with boundaries characterised by denser vegetation and field boundary drains. The site is bounded to the south-west by the existing National Grid substation, with associated overhead powerlines connecting from the west and north-west. Field drains are present along the south-western boundary of the site along Ardleigh Road. These drains form part of the headwaters to Tenpenny Brook which is situated to the south of the site.

12. A field boundary drain is also present within the site passing through the eastern extent of the proposed OnSS platform. This drain currently flows east and then south, joining drainage on Ardleigh Road and passing south towards Tenpenny Brook.

### 1.1.1 Proposed Works

13. The proposed VE development includes the construction of a new onshore electrical substation. Specific zones for the various infrastructure elements are identified, comprising of:

- **Onshore substation area compound**
  The area in which the final OnSS will be located. The footprint assessed is required to allow for either Air-Insulated Switchgear (AIS) or Gas-Insulated Switchgear (GIS) technology.
- **Onshore substation construction zone**
  The area in which the final OnSS Temporary Construction Compound (TCC) will be located.
- **Onshore substation access zone**
  The area which will contain the final OnSS access route(s) (both construction and operational) north of Ardleigh Road.
- **Onshore substation mitigation / planting zone**
  The area within which screening planting, drainage and other ecological mitigations for the OnSS project will be undertaken.

14. The exact dimensions and locations of the elements within the site are to be confirmed. Indicative plans for the AIS and GIS substation layouts are contained within Volume 6, Part 3, Chapter 1: Onshore Project Description chapter of the Environmental Statement (ES).

15. The access roads are to be constructed from unbound granular material with a hardstanding surface. Conservatively, this is assumed to be effectively an impermeable surface. The access road will be retained as a permanent access road for the operational phase.

16. Elements of the operational platform are assumed to be impermeable where buildings are present or plinths are introduced to support electrical infrastructure. It is proposed that the platform is constructed from stone surfacing laid in accordance with National Grid Design Standards. This should have a minimum of 300mm deep unbound free

draining subbase overlaid by a minimum of 75mm of stone chippings to allow for storage of storm water until it can infiltrate into the surrounding soil.

17. The OnSS is adjacent to the proposed North Falls OWF project substation and the proposed National Grid's East Anglia Connection Node (EACN) substation area, both of which are currently underway with their respective consenting programmes. This co-locating of infrastructure has the potential for an increase in localised effects, but also provides greater opportunities for co-ordination on items such as site access, management of surface water runoff and mitigation planting. VE will continue engagement with the neighbouring projects on co-ordination on the respective schemes.

18. Further details on the proposed works can be seen on the OnSS layout drawings in Appendix A.

## 1.2 Background and Aims

19. The aim of the FRA is to assist the VE development in relation to flood risk and the potential for the onshore substation to be impacted by flooding, the impact of the works associated with establishing and operating the onshore substation, and proposed measures to be incorporated, mitigating any identified risk.  The assessment considers flood risk over the full life of the proposed OnSS.

20. The report has been produced in accordance with NPPF[1] and its associated PPG[2], in addition to Overarching National Policy Statement for Energy[5] (EN-1) and National Policy Statement for Electricity Networks[6] (EN-5), taking due account of current best practice documents relating to assessment of flood risk published by the British Standards Institution BS8533[4].

## 1.3 Data Sources Considered

21. In assessing the flood risk to the site, the following sources have been reviewed:

- Five Estuaries Scoping Report;
- Five Estuaries Preliminary Environmental Information Report (PEIR) and associated consultee responses;
- Mapping published on the EA's website;
    - Flood Map for Planning[3];
    - Long Term Flood Risk Information[7];
        - Risk of Flooding from Rivers and Sea;
        - Risk of Flooding from Reservoirs; and
        - Risk of Flooding from Surface Water.

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[5] Overarching National Policy Statement for Energy (EN-1), Department for Energy Security and Net Zero, November 2023, https://assets.publishing.service.gov.uk/media/65bbfbdc709fe1000f637052/overarching-nps-for-energy-en1.pdf, accessed February 2024

[6] National Policy Statement for Electricity Networks Infrastructure (EN-5), Department for Energy Security and Net Zero, November 2023, Electricity Networks National Policy Statement - EN-5 (publishing.service.gov.uk), accessed February 2024

[7] Environment Agency Long Term Flood Risk, https://www.gov.uk/check-long-term-flood-risk [Accessed: December 2023]

- British Geological Survey (BGS)[8] mapping for details of superficial and bedrock geology;
- Cranfield Soil and Agrifood Institute Soilscapes map viewer[9] for soil information;
- EA LiDAR data from the Department for Environment Food & Rural Affairs, https://environment.data.gov.uk/DefraDataDownload/?Mode=survey;
- Tendring District Council Strategic Flood Risk Assessment[10];
- Tendring District Council Strategic Flood Risk Assessment Addendum[11]; and
- Department for Environment, Food and Rural Affairs (DEFRA)'s Multi-agency geographic information for the countryside (MAGIC)[12] website.

### 1.3.1 Vulnerability Classification

22. PPG technical guidance classifies land uses into five categories;

- Essential Infrastructure
- Highly Vulnerable
- More Vulnerable
- Less Vulnerable; and,
- Water Compatible.

23. Works classified as *Essential Infrastructure* include infrastructure for electricity supply including generation, storage and distribution systems; including electricity generating power stations, grid and primary substations storage; and water treatment works that need to remain operational in times of flood.

### 1.3.2 Compatibility

24. Table 1-1 below is taken from Table 2 of the PPG technical guidance[2], and compares Flood Zones with the vulnerability classification in order to identify whether a development is appropriate in a particular location. As this project is classed as an *Essential Infrastructure* land use, the scheme is compatible with development in Flood Zones 1 and 2, and in Flood Zone 3 (subject to the development passing the Exception Test if located in Flood Zone 3).

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[8] British Geological Survey, Geoindex Onshore, https://geologyviewer.bgs.ac.uk/ [Accessed: December 2023]

[9] Soilscapes, Cranfield Soil and Agrifood Institute, Cranfield University, DEFRA, http://www.landis.org.uk/soilscapes/ [Accessed: December 2023]

[10] Strategic Flood Risk Assessment, JBA, March 2009

[11] Strategic Flood Risk Assessment Addendum, Essex County Council Flood Services, September 2017

[12] Magic Map Application, DEFRA, https://magic.defra.gov.uk/MagicMap.aspx [Accessed: December 2023]

**Table 1-1: Flood Risk Vulnerability Classification**

| Flood Risk Vulnerability Classification | Essential Infrastructure | Highly Vulnerable | More Vulnerable | Less Vulnerable | Water Compatible |
|---|---|---|---|---|---|
| Zone 1 | ✓ | ✓ | ✓ | ✓ | ✓ |
| Zone 2 | ✓ | Exception Test Required | ✓ | ✓ | ✓ |
| Zone 3a | Exception Test Required | x | Exception Test Required | ✓ | ✓ |
| Zone 3b (functional floodplain) | Exception Test Required | x | x | x | ✓ |
| Key: ✓ Development is appropriate x Development should not be permitted | | | | | |

### 1.3.3 Sequential Test

25. The Sequential Test ensures that a sequential, risk-based approach is followed to steer new development to areas with the lowest risk of flooding, taking all sources of flood risk and climate change into account. As the OnSS consists of an *Essential Infrastructure* land use and is located within Flood Zone 1, the Sequential Test is considered to have been met.

### 1.3.4 Exception Test

26. The OnSS consists of an *Essential Infrastructure* land use located within Flood Zone 1. As detailed in Table 1-1 above, development under the *Essential Infrastructure* category is considered to be acceptable within Flood Zone 1 without the application of the Exception Test. Therefore, the Exception Test is not considered to be required.

## 1.4 Climate Change

27. The NPPF requires that flood risk is considered over the lifetime of the development and therefore consideration needs to be given to the potential impacts of climate change.

28. In February 2016, the EA issued updated guidance on the impacts of climate change on flood risk in the UK to support NPPF. This EA guidance was most recently updated in May 2022 and advice sets out that peak rainfall intensity, sea level, peak river flow; offshore wind speed and extreme wave heights are all expected to increase in the future as a result of climate change. Consideration of the changes to these parameters should use the allowances outlined below based on the anticipated lifetime of the development. Given the inland location of the OnSS, only climate change allowances with regard to peak river flow and peak rainfall intensity are considered relevant to this assessment.

29. The climate change allowance guidance acknowledges that there is considerable uncertainty with respect to the absolute level of change that is likely to occur. As such, the document provides estimates of possible changes that reflect a range of different emission scenarios, over different epochs.

### 1.4.1 Anticipated Lifetime of Development

30. The NPPF practice guidance classifies land uses into five categories. Utilities infrastructure such as these works is classified as *Essential Infrastructure*. The onshore substation is to be designed for up to a 40-year design life. It is anticipated that the OnSS will be constructed by 2030 and will be operational up to 2070. This falls within the 2080s epoch (2070 to 2125), when considering climate change allowances for river flow and sea level rise, and the 2070s epoch (2061 to 2125) for peak rainfall intensity.

31. The temporary works will only be required during the construction phase and therefore have a design life of less than 5 years. Based on this, a reduced uplift for climate change will be applied for construction phase works.

### 1.4.2 Peak River Flow

32. Guidance states that for *Essential Infrastructure* development located in Flood Zone 1, the Central allowance should be considered. As per Table 1-2 below, for the Combined Essex Management Catchment in which the site is located, this equates to a 25% increase in peak flow by the 2080s, which corresponds to the proposed 40-year design life.

**Table 1-2: Peak River Flow Allowances by River Basin**

| River Basin District | Allowance Category | 2020s | 2050s | 2080s |
|---|---|---|---|---|
| Combined Essex Management Catchment Allowances | Central | 7% | 13% | **25%** |
| | Higher Central | 13% | 16% | 37% |
| | Upper End | 25% | 37% | 72% |

### 1.4.3 Peak Rainfall Intensity

33. For peak rainfall intensity the PPG guidance states that flood risk assessments for *Essential Infrastructure* developments with a 40-year design life, the Central allowance for the 2070’s epoch for both the 3.3% Annual Exceedance Probability (AEP) storm event and 1% AEP storm event should be used. In some locations the allowance for the 2050s epoch is higher than that for the 2070s epoch. If so, and development has a lifetime beyond 2061, use the higher of the two allowances.

34. It is noted that Essex County Council, in their role as the Lead Local Flood Authority (LLFA), take a conservative approach to flood and water management and therefore expect the Upper End figures for increases in peak rainfall intensity to be used. The use of the Upper End allowance and the selection of the higher of the allowance over the two epochs means that a maximum allowance for peak rainfall intensity is 45%.

**Table 1-3: Peak Rainfall Allowances by River Basin**

| Management Catchment | Annual Exceedance Probability (%) | Allowance Category | Total potential change anticipated for the 2050s | Total potential change anticipated for the 2070s |
|---|---|---|---|---|
| Combined Essex Management Catchment Allowances | 3.3 | Central | 20% | 20% |
| | | Upper End | 35% | 35% |
| | 1 | Central | 20% | 25% |
| | | Upper End | **45%** | 40% |

## 1.5 Local Planning Policy

### 1.5.1 Local Plan

35. Local plans set out a vision and a framework for the future development of an area, addressing needs and opportunities in relation to housing, the economy, community facilities, and infrastructure, as well as a basis for safeguarding the environment, adapting to climate change, and securing good design.

36. The Tendring District Local Plan[13] was adopted in January 2022. Policy PPL 1 outlines requirements that developments must meet with regards to flood risk management and states that there is a requirement to reduce the risk of flooding (all types) by securing the appropriate location and design of new development (including Sustainable Drainage Systems), having regard to the likely impact of climate change.

37. All new development within Flood Zones 2 and 3 must not result in a net loss of flood storage capacity, unless there is compensation on site or, if not possible, adjacent off-site capacity. Where possible opportunities should be sought to achieve an increase in floodplain storage. In addition, all development proposals will be considered against the NPPF's Sequential Test, to direct development toward sites at the lowest risk of flooding, unless they involve land specifically allocated for development on the Policies Maps or Local Maps. Where new development cannot be located in an area of lower flood risk and is otherwise sustainable, policy states that the Exception Test will be applied in accordance with the NPPF so that it is safe and meets wider sustainability needs.

38. The final statement of PPL1 is that 'All major development proposals should consider the potential for new Blue and Green Infrastructure to help mitigate potential flood risk and include such Green Infrastructure, where appropriate'.

39. Policy PPL 5 discusses water conservation, drainage and sewerage and states that all new development must make adequate provision for drainage and sewerage and should include Sustainable Drainage Systems (SuDS) as a means of reducing flood risk, improving water quality, enhancing the Green Infrastructure network and providing amenity and biodiversity benefits.

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[13] Tendring District Council https://www.tendringdc.gov.uk/localplan (Accessed December 2023)

40. The drainage strategy for the OnSS should therefore align with these requirements from the local plan in order to minimise flood risk and enhance the local environment.

### 1.5.2 Local Flood Risk Management Guidance

41. The Flood and Water Management Act 2010 requires all LLFA's in England to develop, maintain, apply, and monitor the application of, a strategy for local flood risk in their area. This strategy is to outline how they will seek to manage flooding from surface water runoff, ordinary watercourses, and groundwater. The Sustainable Drainage Systems Design Guide for Essex was published in February 2020. The guide sets out local objectives for the district which will ensure that the proposed OnSS design will utilise sustainable drainage and consider the future impact of climate change.

### 1.5.3 Strategic Flood Risk Assessment

42. A Strategic Flood Risk Assessment (SFRA) is a tool for planning authorities to identify and evaluate flood risk in their area. In March 2009, Tendring District Council published an SFRA[14] which fulfils the requirements of a Level 1 and Level 2 SFRA. An addendum to the SFRA was published in September 2017. The SFRA is intended by Tendring District Council to provide an overview of flood risk in the county and identify places where flood risk is a pertinent issue. A series of maps are appended to the SFRA[15] which have been reviewed as part of this FRA. The SFRA flood risk mapping shows the OnSS to be within an area at a low risk of fluvial flooding.

# 2.0 Baseline Context

## 2.1 Local Hydrology

43. There are no EA Statutory Main Rivers present within 2 km of the OnSS site. The closest Main Rivers are:

- the River Stour, to the north and northeast of the site;
- the headwaters of Salary Brook to the west of the site; and
- Tenpenny Brook to the south of the site.

44. The study area is situated at the head of the Holland Brook and Tenpenny Brook catchments, with surface water runoff to the northeast of the Site primarily draining via field ditches towards Holland Brook, starting as an ordinary watercourse near Little Bromley and draining in a south-easterly direction towards the coast. Surface water runoff from land within the OnSS working area drains south to field drainage along Ardleigh Road, towards Tenpenny Brook.

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[14] Tendring District Council SFRA https://legacy.tendringdc.gov.uk/sites/default/files/documents/planning/Planning_Policy/S2Examination/Evidence/EB7.1.5%20Tendring%20Strategic%20Flood%20Risk%20Assessment%202009.pdf, (Accessed December 2023)

[15] Tendring District Council SFRA Maps https://www.tendringdc.gov.uk/sites/default/files/documents/planning/planning%20policy/MAPS.pdf, (Accessed December 2023)

### 2.1.1 Ordinary Watercourses

45. The site contains existing field drains, ditches and irrigation channels, travelling in a south-to-south easterly direction. A significant drainage ditch is also located south of the site, running adjacent south of Ardleigh Road.

46. The headwaters of Tenpenny Brook are ordinary watercourses and subsequently become an EA Main River. The headwaters commence immediately to the south of Ardleigh Road near Norman’s Farm and run in a southerly direction. The discharge confluence of Tenpenny Brook is with Alresford Creek, which subsequently discharges to the River Colne.

47. Holland Brook is an ordinary watercourse and subsequently an EA Main River which commences at the village of Little Bromley to the east of the Site, running generally in a south-easterly direction towards the coast and ultimately discharging to the North Sea to the northeast of Holland-on-Sea.

## 2.2 Site Topography

48. Ground level data across the site has been obtained from 1m resolution aerial photogrammetry (LiDAR) data using a Digital Terrain Model (DTM).

49. Land within the OnSS working area extends across low lying topography, with a slight fall in a southeasterly direction. Maximum elevations tend to remain below 36 m Above Ordnance Datum (AOD).

## 2.3 Geological and Hydrogeological Features

### 2.3.1 Geology

50. The whole of the OnSS working area is underlain by Thames Group; clay, silt and sand bedrock from the Eocene era which is underlain by Chalk. The Thames Group lithology is characteristically impermeable, and the deposits are classified as unproductive aquifer. The underlying Chalk is classed as a Principal aquifer.

51. BGS records indicated that superficial deposits underlying the study area comprise solely of Quaternary cover sand – clay, silt and sand, overlaying Kelsgrove Catchment Subgroup – sand and gravels. These superficial deposits are of low sensitivity, comprising of Secondary B and secondary A aquifer respectively. BGS logs indicate that the sands and gravels are around 8.5m in thickness locally.

52. Ground investigation completed across the proposed VE OnSS area and the adjacent North Falls OnSS area, included the digging of 18 trial pits (11 across the VE OnSS site and 7 across the North Falls OnSS site) to depth of between 2.40 m and 3.30 m below ground level (bgl). All trial pits record Kesgrave Catchment Subgroup sands and gravels at or close to the surface, with several of the more northerly trial pits recording a thin (0.30m – 0.50m) horizon of Head deposits overlying the sands and gravels at surface, described as “slightly gravelly slightly clayey fine to coarse SAND”. The Kesgrave Catchment deposits are typically described as a “gravelly coarse SAND”. Kesgrave Catchment sands and gravels were recorded to the base of all trial pits.

53. Soilscapes data indicates that the OnSS working area covers one category of soils classified as “Slightly acid loamy and clayey soils with impeded drainage, with a loamy some clayey texture”.

### 2.3.2 Hydrogeology

54. The various classifications are described by the EA as follows:

- **Principal Aquifer**: layers of rock or drift deposits that have high intergranular and/or fracture permeability – meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.
- **Secondary A Aquifer**: permeable layers that can support local water supplies, and may form an important source of base flow to rivers.
- **Secondary B Aquifer**: lower permeability layers that may store and yield limited amounts of groundwater through characteristics like thin fissures and opening or eroded layers.
- **Secondary (undifferentiated)**: where it is not possible to apply either a Secondary A or B definition because of the variable characteristics of the rock type. These have only a minor value.
- **Unproductive Strata**: strata that are largely unable to provide usable water supplies and are unlikely to have surface water and wetlands ecosystems dependent on them.

55. Based on a review of BGS mapping and site investigation data, there are two potential aquifers present beneath the site:

- Shallow aquifers associated with the cover sand and underlying Kesgrave Catchment Subgroup, which are underlain by Thames Group deposits, will form a perched aquifer, none are directly underlain by the Chalk.
- The chalk aquifer present at depth beneath the Thames Group forms an extensive aquifer across south-east England however it is considered that there will be no hydraulic continuity with the superficial deposits as the Thames Group clays running beneath the OnSS working area will act as an aquitard between the shallow and deep aquifers.

56. The site is located within a Zone III (total catchment) groundwater Source Protection Zone (SPZ) which is likely to be associated with the extent of the underlying Chalk aquifer. As the land is within the SPZ designation, any proposed infiltration strategy will require agreement with the EA during subsequent design stages. However, at this stage the following assumption has been applied:

- SPZ III-Total Catchment: Infiltration permitted.

57. Examination of borehole records with water levels, available on the BGS website[8], indicate that groundwater levels within the superficial deposits are typically less than 5 m bgl with a range of between 2 m and 5 m bgl. The local flow within the superficial deposits will largely follow the local topography and potentially be influenced by any watercourses or field drains present within the vicinity.

58. The ground investigations indicate groundwater seepages in the base of most trial pits around the proposed OnSS location. This ground investigation data indicates groundwater levels typically between 2.3 m and 3.3 m bgl (32 m – 33 m AOD), although it should be noted that the investigations were completed in mid May and mid October respectively and therefore winter peak water levels will potentially be higher.

59. It is proposed that the OnSS subbase level is designed to remain higher than the levels at which groundwater has been encountered in the locality and the proposed surface water drainage features will be designed to ensure they remain above the groundwater

level. However, if groundwater were to be encountered within the OnSS subbase or construction compounds, an impermeable liner may be necessary to mitigate groundwater ingress and anchoring of the liner may be required to manage buoyancy.

## 2.4 Existing Site Drainage

60. Given the greenfield nature of the land underlying the site, there is no formal drainage infrastructure controlling runoff, apart from the presence of agricultural land drains beneath the site and local maintained field boundary drainage channels.

61. It is therefore assumed that during a rainfall event, surface water will infiltrate into the ground, or, if the soil is saturated, flow over the surface, ponding in topographic low points or following the topographic slope into local open field drains, ditches and watercourses.

# 3.0 Flood Risk Screening

62. A screening study has been completed to identify whether there are any potential sources of flooding at the site which may warrant further consideration. If required, any potential significant flooding issues identified in the screening study would then be considered in subsequent sections of the assessment.

63. There are a number of potential sources of flooding and these include:

- Flooding from rivers or fluvial flooding;
- Flooding from the sea or tidal flooding;
- Flooding from land/ surface water flooding;
- Flooding from groundwater;
- Flooding from sewers; and
- Flooding from reservoirs, canals, and other artificial sources.

64. The EA Flood Risk Mapping for Planning provides a dataset which categories flood risk over land from fluvial and/or tidal sources into three categories detailed below. Hydraulic models are used to produce this data where the presence of flood defences has not been included in the assessment of risk. As such, this mapping indicates the flood risk on land in the absence of defences. Conceptually it should be acknowledged that this data also does not consider finished floor levels of property and other flood sources, and thus the risk to specific properties would require further assessment. Details on the EA flood risk zones are as follows:

- **Flood Zone 1** – Land which has less than 1 in 1,000 (0.1%) AEP flooding from the river and/or sea each year. This is classified as a ‘low’ probability of flooding via these sources;
- **Flood Zone 2** – The land which has between a 1 in 1, 000 (0.1%) AEP and a 1 in 100 (1%) AEP chance of flooding from rivers each year; or a less than a 1 in 200 (0.5%) AEP but higher than a 1 in 1,000 (1%) AEP chance of flooding from the sea. This is classified as a ‘medium’ probability of flooding from these sources; and
- **Flood Zone 3** -The land which has a 1 in 100 (1%) AEP or greater chance of flooding each year from Rivers; or with a 1 in 200 (0.5%) AEP or greater chance of flooding each year from the sea. This is classified as a ‘high’ probability of flooding from these sources.

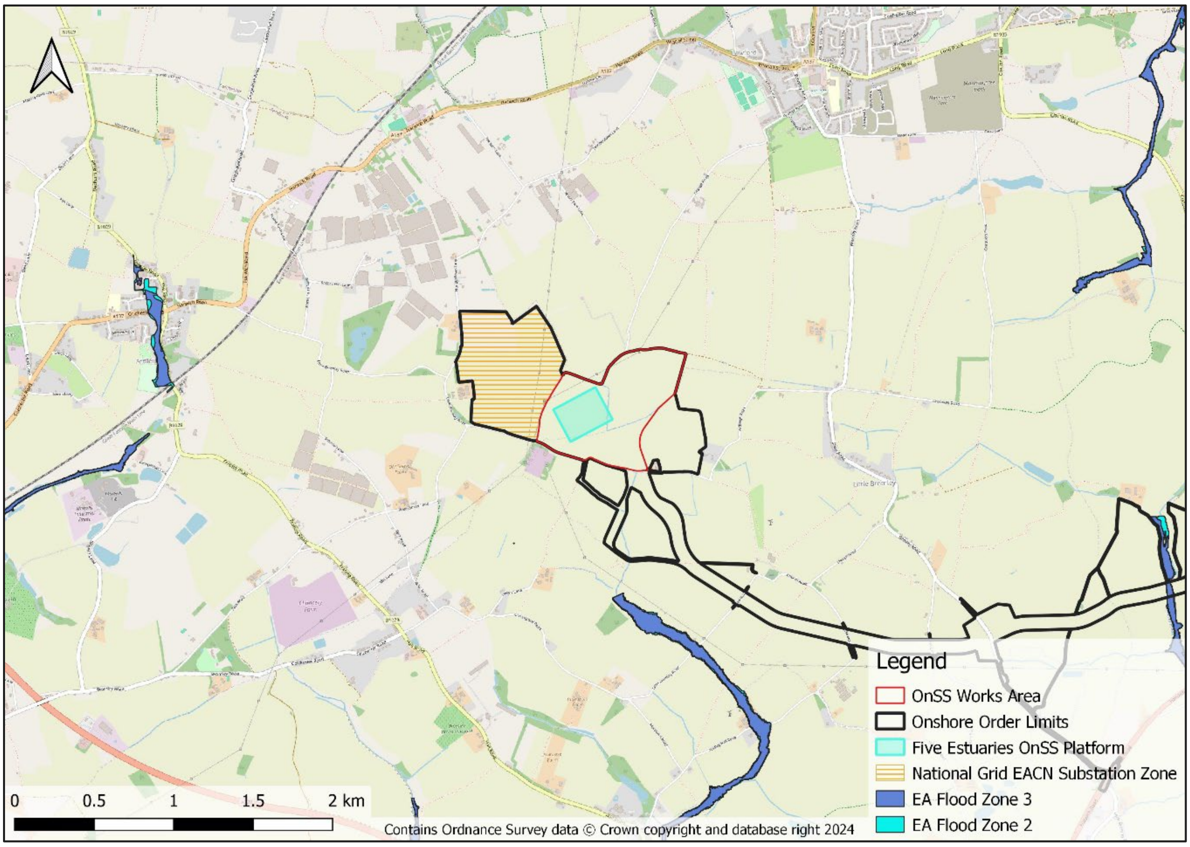
## 3.1 Flooding from Rivers or Fluvial Flooding

65. The site is classified as having a ‘low’ probability of fluvial flooding (less than 0.1% AEP) or classified as Flood Zone 1. The EA’s mapping demonstrates that the site will remain flood free up to and including the 0.1% AEP event fluvial flooding scenario. Fluvial flood risk is therefore considered to be ‘low’, and not assessed further.

## 3.2 Flooding from the Sea or Tidal Flooding

66. The site is at significant elevation and distance from the coast or tidal estuaries, and is not mapped to be at risk of tidal flooding up to and including the 0.1% AEP tidal scenario. Tidal flood risk is therefore considered to be negligible, and not assessed further.

**Figure 3-1: Extract of Environment Agency Flood Map for Planning**



Contains Ordnance Survey data © Crown copyright and database right 2024

## 3.3 Flooding from Surface Water or Overland Flow

67. Surface water modelling has been undertaken by the EA to establish areas at risk of surface water flooding. An extract of the resulting surface water flood map is reproduced in Figure 3-2.

68. The EA defines the surface water flood risk categories as:

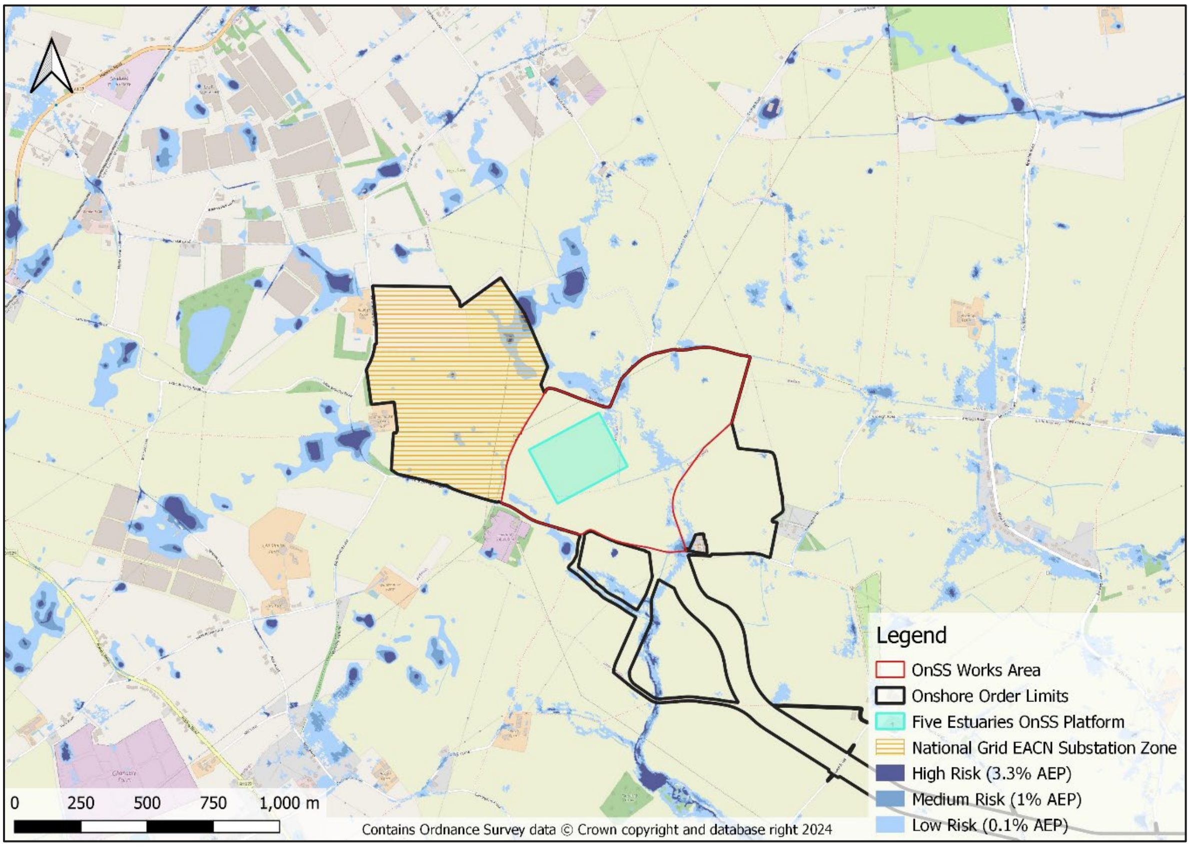
- Very Low: less than 0.1% AEP (1 in 1,000 chance) of flooding in any given year;
- Low: less than 1% AEP (1 in 100 chance) but greater than or equal to 0.1% AEP (1 in 1,000 chance) of flooding in any given year;
- Medium: between 1% AEP (1 in 100 chance) and 3.3% AEP (1 in 30 chance) of flooding in any given year; and
- High: greater than 3.3% AEP (1 in 30 chance) of flooding in any given year.

69. It should be noted that this information does not take into consideration, or include in modelling, any formal surface water drainage infrastructure installed beneath the ground surface.

70. According to surface water flood risk mapping provided by the EA, pooling of surface water in the 3.3% AEP 'high' risk scenario generally occurs in topographical depressions. Pooling in the same areas also occur in the 1% AEP 'medium' risk scenario, with a few additional pooling areas occurring. During the 0.1% AEP 'low' risk scenario, pooling develops into an overland flow route travelling south to southeast across the east of the site where OnSS development is proposed. It is assumed that overland flow will route

towards the field drain running adjacent to Ardleigh Road and subsequently to the head of Tenpenny Brook.

**Figure 3-2: Risk of Flooding from Surface Water**



71. During construction, potential changes to land cover may temporarily divert existing overland flow routes and may direct excess surface water created by construction activities into existing drainage networks. Management of this additional risk will be provided in the form of a temporary surface water drainage strategy for construction activities (See Appendix A and Appendix B). This strategy, secured through a DCO requirement, will be agreed through liaison with the LLFA (Essex County Council). This drainage strategy will adhere to SuDS principles.

72. In addition, a drainage strategy to manage surface water runoff during the operational phase of the development's lifetime, secured through a DCO requirement, is also proposed to mitigate any pluvial flood risk. Proposals include the installation of swales/ ponds and the raising of the ground level to minimise any potential flooding and to buffer drainage into the field drainage network southeast of the site.

73. There will be a residual risk of surface water flooding from culvert blockage, created during construction and operation phases of the site, because of a failure to regularly maintain drainage infrastructure. This is discussed further in Section 4.0: Mitigation. The residual risk is considered to be 'low' in this instance.

74. Therefore, while there is an indicated risk of surface water flooding on parts of the site, based upon the understanding that a formal surface water drainage system will be implemented during the construction phase and during the operational phase of the OnSS, there will be no direct pluvial risk to the site. All proposed surface water drainage will be secured through DCO requirements.

75. The surface water drainage system will also be designed in order to ensure that there is no direct flooding caused elsewhere, and no residual risk of flooding elsewhere, for all events up to and including the 1% AEP plus climate change rainfall event. This will form part of the detail design stage and will be secured by DCO requirement.

76. The risk of pluvial flooding to the site and off-site areas is therefore assessed as 'low' and is not considered further.

## 3.4 Groundwater Flooding

77. As detailed in Section 2.3, the BGS mapping indicates that the site is underlain by Thames Group clay, silt, sand and gravels, which are considered to be impermeable, however shallow aquifers are present associated with the cover sand and underlying Kesgrave Catchment Subgroup. These form a perched aquifer over the impermeable clay of the bedrock.

78. Groundwater levels within the superficial deposits are considered to be typically within a range of between 2 m and 5 m bgl. Site investigations confirm this understanding. The local flow within the superficial deposits will largely follow the local topography and is likely to be influenced by field drains present within and around the OnSS working area. This hydraulic continuity with surface water features means that groundwater levels are unlikely rise to the point where they would be expressed at ground level. Any increase in groundwater level would be limited by the connection to the surface water drainage features.

79. Based on this evidence, groundwater flooding risk is considered 'low' and is not considered further.

## 3.5 Flooding from Sewers

80. As outlined in Section 1.1, the site is agricultural land and is therefore unlikely to have significant formal sewerage infrastructure. Anglian Water utilities data (Annex A of the report in Appendix B) indicates that there are no formal sewer or mains networks within the OnSS working area.

81. Failure or surcharge (blocked or collapsed sewer, or burst main) of a utility network would result in the limited emergence of flood water at the surface, which would progress in accordance with the topographic gradient and be infiltrated to ground or pass to local surface water features draining away from the site.

82. The risk of flooding from sewers and water mains is therefore considered to be negligible and is not considered further.

## 3.6 Flooding from Reservoirs, Canals and Artificial Sources

83. According to the EA's online mapping, the site is at a very low risk level based upon this dataset as it is not in the vicinity to any reservoirs and is outside the potential flooding zone of influence.

84. The site is not within close proximity of any canals or artificial water sources and, as such, is not at risk of flooding in the event of a canal breach.

85. The risk of flooding from canals, reservoirs and artificial sources is assessed to be very low and will not be considered further.

## 3.7 Flooding from Infrastructure Failure

86. The site is not located within 2 km of any significant infrastructure such as coastal or fluvial flood defences. In addition, EA flood mapping does not include any flood extents involving an undefended fluvial or tidal scenario as a result of infrastructure failure. It is also indicative that, as the site is located within Flood Zone 1, the site will remain flood free in all scenarios up to and including the 0.1% AEP event fluvial and tidal scenarios.

87. During the construction and operation phase of the development, the site may have a residual risk of blockage and flooding from existing (or new) culverts if appropriate mitigation is not actioned. However, based on the development proposals provided, swales and ponds are proposed to attenuate any excess water creating during construction and operation phases of the site's lifespan, including minimising the residual culvert blockage risks through implementation of a management plan (Section 4.2).

88. Based on the evidence above, the risk of flooding as a result of infrastructure failure is very low. Provision of surface water drainage as part of the OnSS design is discussed further in Section 4.0.

## 3.8 Flood Risk Summary

89. A summary of the potential sources of flooding and the flood risk arising from them is presented in Table 3-1. Where flood risk is assessed to be low this is considered not significant.

**Table 3-1: Potential Flood Sources**

| Potential Flood Sources | Significant Flood Risk at Site (Y/N) |
|---|---|
| Rivers or Fluvial Flooding | N |
| Sea or Tidal Flooding | N |
| Surface Water or Pluvial Flooding | N |
| Groundwater | N |
| Sewers | N |
| Reservoirs, Canals and Artificial Sources | N |
| Infrastructure Failure | N |

# 4.0 Mitigation

90. Analysis following the flood risk screening shows that the site is not at significant risk of flooding from any source considered within this report. A residual risk of surface water flooding from development of the land and introduction of new culverts has been highlighted for the construction and operation phases of the site. The following measures will ensure that this residual risk is controlled.

## 4.1 Surface Water Drainage

91. Prior to commencement of the construction works, a number of surveys and studies will be undertaken to inform the development of the final surface water drainage design such as ecological surveys, geotechnical investigations and existing land drainage assessments. Consultation with the LLFA will also form part of the design process.

92. Surface water drainage requirements will be dictated by the final surface water drainage plan and will be designed to meet the requirements of the NPPF, NPS EN-1, NPS EN-5 and local guidance, with runoff limited through the use of SuDS and infiltration techniques, where feasible.

93. To demonstrate compliance with the SuDS discharge hierarchy, Infiltration testing is proposed during the design phase of the development, in line with the methodology in BRE Digest 365.

94. The surface water drainage plan will be developed and submitted to discharge a DCO requirement. The plan will be implemented to minimise water within the working areas, ensuring ongoing drainage of surrounding land and that there is no increase in surface water flood risk. Development of the plan will assess the current and proposed runoff rates, volume of storage required and the proposed approach for discharge of water from the site.

95. The surface water drainage system for the permanent works (transformers, buildings, internal roads, car parks and external access road) shall be designed and constructed so that flooding does not occur in any part of the site in any event up to and including the 3.3% AEP return period design storm flood frequency, with no flooding of the operational area during a 1% plus climate change return period design storm flood frequency. The upper climate change sensitivity of 45% will be applied as discussed in Section 1.4.3.

96. Since shallow groundwater may be present close to surface seasonally, the strategy at this early design stage is to identify the nearest watercourse to the OnSS working area and assume surface water runoff from all impermeable areas within the OnSS development is to be disposed of via outfall to the watercourse. This is considered to be a conservative approach to design and this strategy will be reviewed in further design stages once infiltration testing has been carried out.

97. A preliminary surface water drainage strategy, management and maintenance plan is currently proposed and included as part of the development proposals (Appendix B). Proposals comprise two surface water drainage phases: construction phase and operational phase.

### 4.1.1 Construction Phase Surface Water Management

98. In the outline design dour attenuation ponds are proposed (two could be permanent and two temporary) in the south to southwest of the site, to attenuate surface water outfalls created by VE and North Falls OnSS. In addition, swales are proposed to be installed

along the OnSS access road and adjacent, south of Ardleigh road. The attenuation ponds and swales are based on restricted runoff rates of the 1% AEP plus climate change surface water runoff scenario. It is noted that the Early Design report at Appendix B stipulates a 10% increase in peak rainfall intensity for the drainage design during the construction phase.

99. An additional watercourse diversion route may be proposed along the southern entrance of the site (adjacent to the swale), depending on the final design. (this would be subject to further discussion with Essex County Council and Tendring District Council).

100. Proposed outfall to the existing ordinary watercourse subject to consent to the details of the works from the LLFA under the protective provisions. Existing watercourse bed and seasonal water levels are to be confirmed by survey.

### 4.1.2 Operational Phase Surface Water Management

101. The attenuation ponds and swales are based on restricted runoff rates of the 1% AEP plus climate change surface water runoff scenario. It is noted that the Early Design report at Appendix B stipulates a 45% increase in peak rainfall intensity for the drainage design during the operational phase.

## 4.2 Management and Maintenance

102. Regular maintenance and clearing of debris from culverts and ponds is essential and planning for this may require consultation with the LLFA during the construction phase, the operational phase and decommissioning phase of the OnSS to ensure that no blockages are present.

103. It is recommended that the construction phase maintenance and management measures are incorporated into the CoCP, with records kept demonstrating compliance. All flood drainage culverts will be inspected for damage or debris following high periods of rainfall.

# 5.0 Conclusion

104. The site is located within fluvial and tidal Flood Zone 1, and not considered at risk of flooding from either source up to and including the 0.1% AEP 'low' risk scenario.

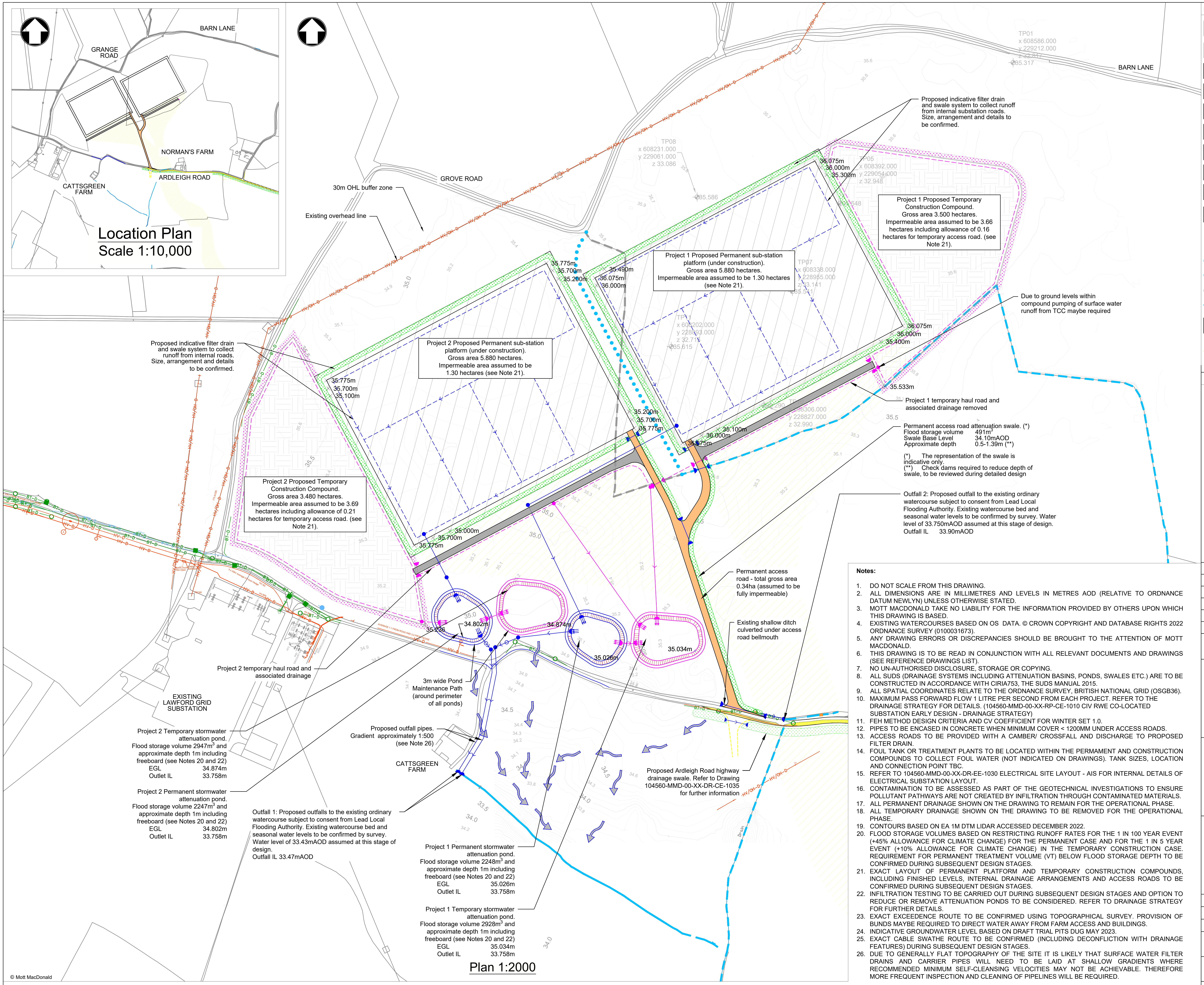
105. Groundwater and pluvial flood risk is considered to be low and assumed to be managed within drainage design included within the development proposals. These include the management of shallow groundwater tables via raised development (See Appendix A and Appendix B), managing existing and potential overland flows, minimising residual blockage risks up to and including the 1% AEP plus climate change scenario.

106. Finally, mapping and additional information indicates the site is not at risk from any artificial flood sources.

107. In conclusion, based on the information outlined within this Flood Risk Assessment, the perceived level of flood risk to and caused by the development is low and the development would be safe, without significantly increasing flood risk elsewhere.

# Appendix A

## Substation Early Design Drainage Layout Plans



## Location Plan
Scale 1:10,000

30m OHL buffer zone

Existing overhead line

Proposed indicative filter drain and swale system to collect runoff from internal substation roads. Size, arrangement and details to be confirmed.

Project 1 Proposed Temporary Construction Compound. Gross area 3.500 hectares. Impermeable area assumed to be 3.66 hectares including allowance of 0.16 hectares for temporary access road. (see Note 21).

Project 1 Proposed Permanent sub-station platform (under construction). Gross area 5.880 hectares. Impermeable area assumed to be 1.30 hectares (see Note 21).

Due to ground levels within compound pumping of surface water runoff from TCC maybe required

Proposed indicative filter drain and swale system to collect runoff from internal roads. Size, arrangement and details to be confirmed.

Project 2 Proposed Permanent sub-station platform (under construction). Gross area 5.880 hectares. Impermeable area assumed to be 1.30 hectares (see Note 21).

Project 2 Proposed Temporary Construction Compound. Gross area 3.480 hectares. Impermeable area assumed to be 3.69 hectares including allowance of 0.21 hectares for temporary access road. (see Note 21).

Project 1 temporary haul road and associated drainage removed

Permanent access road attenuation swale. (*)

| | |
|---|---|
| Flood storage volume | 491m$^3$ |
| Swale Base Level | 34.10mAOD |
| Approximate depth | 0.5-1.39m (**) |

(*) The representation of the swale is indicative only.
(**) Check dams required to reduce depth of swale, to be reviewed during detailed design

Outfall 2: Proposed outfall to the existing ordinary watercourse subject to consent from Lead Local Flooding Authority. Existing watercourse bed and seasonal water levels to be confirmed by survey. Water level of 33.750mAOD assumed at this stage of design.
Outfall IL 33.90mAOD

Permanent access road - total gross area 0.34ha (assumed to be fully impermeable)

Existing shallow ditch culverted under access road bellmouth

Project 2 temporary haul road and associated drainage

3m wide Pond Maintenance Path (around perimeter of all ponds)

Proposed outfall pipes. Gradient approximately 1:500 (see Note 26)

Project 2 Temporary stormwater attenuation pond.
Flood storage volume 2947m$^3$ and approximate depth 1m including freeboard (see Notes 20 and 22)

| | |
|---|---|
| EGL | 34.874m |
| Outlet IL | 33.758m |

Project 2 Permanent stormwater attenuation pond.
Flood storage volume 2247m$^3$ and approximate depth 1m including freeboard (see Notes 20 and 22)

| | |
|---|---|
| EGL | 34.802m |
| Outlet IL | 33.758m |

Outfall 1: Proposed outfalls to the existing ordinary watercourse subject to consent from Lead Local Flooding Authority. Existing watercourse bed and seasonal water levels to be confirmed by survey. Water level of 33.43mAOD assumed at this stage of design.
Outfall IL 33.47mAOD

Proposed Ardleigh Road highway drainage swale. Refer to Drawing 104560-MMD-00-XX-DR-CE-1035 for further information

Project 1 Permanent stormwater attenuation pond.
Flood storage volume 2248m$^3$ and approximate depth 1m including freeboard (see Notes 20 and 22)

| | |
|---|---|
| EGL | 35.026m |
| Outlet IL | 33.758m |

Project 1 Temporary stormwater attenuation pond.
Flood storage volume 2928m$^3$ and approximate depth 1m including freeboard (see Notes 20 and 22)

| | |
|---|---|
| EGL | 35.034m |
| Outlet IL | 33.758m |

## Plan 1:2000

Legend:

| | |
|---|---|
| ▨ | Permanent Substation Compound |
| 🟩 | Permanent swale/infiltration ditch (see Note 22) |
| 🟫 | Permanent Access Road (material to be confirmed) |
| ▨ | Permanent Access Overrun Area |
| 🟦 | Paved Area (tarmac) of the Permanent Access to Substation |
| ▨ | Permanent Pond and Grading |
| 🟪 | Temporary Access Road |
| ▨ | Temporary Construction Compound |
| ▨ | Temporary swale/infiltration ditch (see Note 22) |
| ▨ | Temporary Pond and Grading |
| ← | Design flow exceedence route (see note 23) |
| ━ | Existing Watercourse (see Note 4) |
| ╍ | Existing Ditch |
| ╍ | Existing Ditch, Planned to Fill In |
| ┈ | Permanent Ditch Diversion |
| ▨ | Proposed Cable Swathe Routes (see Note 25) |
| ─ | Cable Route Corridor Zone |
| ◗ | Permanent Headwall |
| ● | Permanent Catchpit |
| ○ | Catchpit with vortex flow control device (see Note 10) |
| ◗─◖ | Permanent Culvert Crossing |
| ─>─ | Permanent Carrier Pipe |
| - - -> - | Permanent Filter Drain Pipe |
| ─□─□─ | Permanent Fenceline |
| ◗ | Temporary Headwall |
| ● | Temporary Chamber |
| ─ | Temporary Carrier Pipe |
| - - - | Temporary Filter Drain/Ditch |
| ◗─◖ | Temporary Culvert Crossing |
| × xx.xxxm | Permanent/FGL Spot Level |
| — xx.xxxm — | LiDAR Contours |
| TPXX xx.xxxm | Ground Investigation Trial Pit Location |
| z xx.xxx | Existing Ground Water Level (see Note 24) |
| △ xx.xxx | Lowest proposed level in compound |
| ○ xx.xxx | Lowest existing ground level in pond |
| HV–D HV–D | High Voltage Utility |
| HV/OH–D | High Voltage Overhead Utility |
| BT–D BT–D | BT Utility |
| WTR–D | Buried Water Utility |

Reference drawings

OS map
SOCOTEC UK Draft Trial Pit Logs (Dug 19th May 2023)
Technics Digitised Utility Report Information
104560-MMD-00-XX-DR-CE-1004 - Site Layout/ Location Plan - AIS Option 2
104560-MMD-00-XX-DR-CE-1006 - AIS Substation Earthworks Plan and Long Section - Project 1 & 2
104560-MMD-00-XX-DR-CE-1007 - Temporary Compound Earthworks Plan and Long Section - Project 1
104560-MMD-00-XX-DR-CE-1009 - Temporary Compound Earthworks Plan and Long Section - Project 2
104560-MMD-00-XX-DR-CE-1015 - Permanent Access Layout
104560-MMD-00-XX-DR-CE-1017 - Temporary Accesses to Construction Compounds (Option 2) Layout
104560-MMD-00-XX-DR-EE-1030 - Electrical Site Layout - AIS
104560-MMD-00-XX-DR-CE-1061 - Permanent and Temporary Access Junction with Ardleigh Road

**Notes:**

1. DO NOT SCALE FROM THIS DRAWING.
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9. ALL SPATIAL COORDINATES RELATE TO THE ORDNANCE SURVEY, BRITISH NATIONAL GRID (OSGB36).
10. MAXIMUM PASS FORWARD FLOW 1 LITRE PER SECOND FROM EACH PROJECT. REFER TO THE DRAINAGE STRATEGY FOR DETAILS. (104560-MMD-00-XX-RP-CE-1010 CIV RWE CO-LOCATED SUBSTATION EARLY DESIGN - DRAINAGE STRATEGY)
11. FEH METHOD DESIGN CRITERIA AND CV COEFFICIENT FOR WINTER SET 1.0.
12. PIPES TO BE ENCASED IN CONCRETE WHEN MINIMUM COVER < 1200MM UNDER ACCESS ROADS.
13. ACCESS ROADS TO BE PROVIDED WITH A CAMBER/ CROSSFALL AND DISCHARGE TO PROPOSED FILTER DRAIN.
14. FOUL TANK OR TREATMENT PLANTS TO BE LOCATED WITHIN THE PERMAMENT AND CONSTRUCTION COMPOUNDS TO COLLECT FOUL WATER (NOT INDICATED ON DRAWINGS). TANK SIZES, LOCATION AND CONNECTION POINT TBC.
15. REFER TO 104560-MMD-00-XX-DR-EE-1030 ELECTRICAL SITE LAYOUT - AIS FOR INTERNAL DETAILS OF ELECTRICAL SUBSTATION LAYOUT.
16. CONTAMINATION TO BE ASSESSED AS PART OF THE GEOTECHNICAL INVESTIGATIONS TO ENSURE POLLUTANT PATHWAYS ARE NOT CREATED BY INFILTRATION THROUGH CONTAMINATED MATERIALS.
17. ALL PERMANENT DRAINAGE SHOWN ON THE DRAWING TO REMAIN FOR THE OPERATIONAL PHASE.
18. ALL TEMPORARY DRAINAGE SHOWN ON THE DRAWING TO BE REMOVED FOR THE OPERATIONAL PHASE.
19. CONTOURS BASED ON EA 1M DTM LIDAR ACCESSED DECEMBER 2022.
20. FLOOD STORAGE VOLUMES BASED ON RESTRICTING RUNOFF RATES FOR THE 1 IN 100 YEAR EVENT (+45% ALLOWANCE FOR CLIMATE CHANGE) FOR THE PERMANENT CASE AND FOR THE 1 IN 5 YEAR EVENT (+10% ALLOWANCE FOR CLIMATE CHANGE) IN THE TEMPORARY CONSTRUCTION CASE. REQUIREMENT FOR PERMANENT TREATMENT VOLUME (VT) BELOW FLOOD STORAGE DEPTH TO BE CONFIRMED DURING SUBSEQUENT DESIGN STAGES.
21. EXACT LAYOUT OF PERMANENT PLATFORM AND TEMPORARY CONSTRUCTION COMPOUNDS, INCLUDING FINISHED LEVELS, INTERNAL DRAINAGE ARRANGEMENTS AND ACCESS ROADS TO BE CONFIRMED DURING SUBSEQUENT DESIGN STAGES.
22. INFILTRATION TESTING TO BE CARRIED OUT DURING SUBSEQUENT DESIGN STAGES AND OPTION TO REDUCE OR REMOVE ATTENUATION PONDS TO BE CONSIDERED. REFER TO DRAINAGE STRATEGY FOR FURTHER DETAILS.
23. EXACT EXCEEDENCE ROUTE TO BE CONFIRMED USING TOPOGRAPHICAL SURVEY. PROVISION OF BUNDS MAYBE REQUIRED TO DIRECT WATER AWAY FROM FARM ACCESS AND BUILDINGS.
24. INDICATIVE GROUNDWATER LEVEL BASED ON DRAFT TRIAL PITS DUG MAY 2023.
25. EXACT CABLE SWATHE ROUTE TO BE CONFIRMED (INCLUDING DECONFLICTION WITH DRAINAGE FEATURES) DURING SUBSEQUENT DESIGN STAGES.
26. DUE TO GENERALLY FLAT TOPOGRAPHY OF THE SITE IT IS LIKELY THAT SURFACE WATER FILTER DRAINS AND CARRIER PIPES WILL NEED TO BE LAID AT SHALLOW GRADIENTS WHERE RECOMMENDED MINIMUM SELF-CLEANSING VELOCITIES MAY NOT BE ACHIEVABLE. THEREFORE MORE FREQUENT INSPECTION AND CLEANING OF PIPELINES WILL BE REQUIRED.

| Rev | Date | Drawn | Description | Ch'k'd | App'd |
|---|---|---|---|---|---|
| 05 | 04/03/2024 | CT | Updated to address client comment | TN | AFC |
| 04 | 24/01/2024 | YV | Updated to address client comments | JWD | AFC |
| 03 | 18/09/2023 | CT | Updated to address client comments | TN | AFC |
| 02 | 01/08/2023 | CT | Client's comments incorporated | TN | JW |
| 01 | 15/06/2023 | YV | Preliminary | AL | MB |

Status Stamp

PRELIMINARY

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Client
NORTH FALLS Offshore Wind Farm
FIVE ESTUARIES OFFSHORE WIND FARM

Title
# Co-located AIS Substations Early Design - Drainage Layout - Construction Phase - Option 2

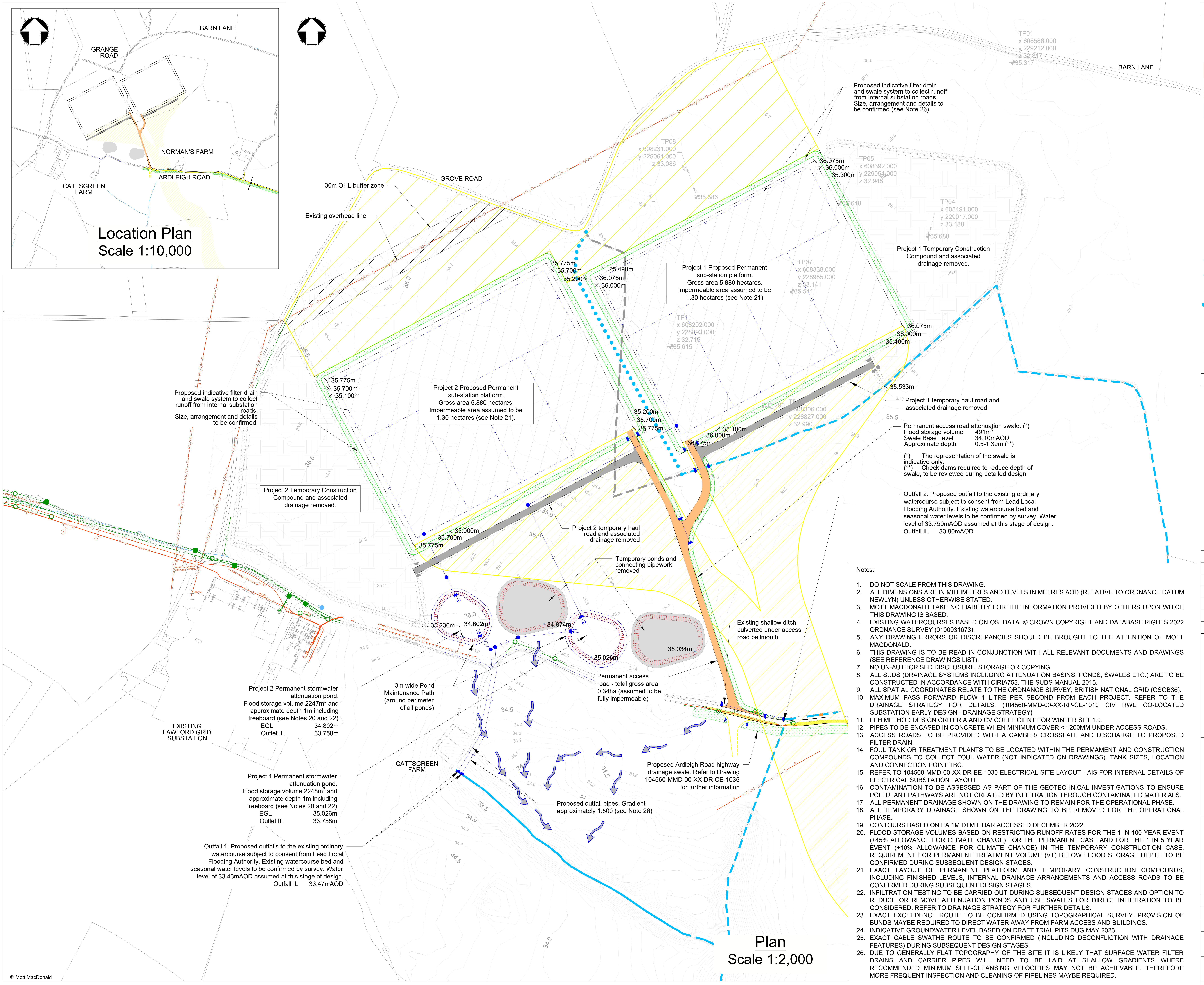
Sheet 01 of 01

| | | | | | |
|---|---|---|---|---|---|
| Designed | Charlotte Tyler | CT | Eng check | Amy Lambourne | AL |
| Drawn | Yani Vardarov | YV | Coordination | Andrea F. Crespo | AFC |
| Dwg check | Thomas North | TN | Approved | Matthew Barton | MB |

| | | |
|---|---|---|
| MMD Project Number<br>104560-001 | Scale at A1<br>As Indicated | Security<br>STD |
| Client Number<br>004809401-05 | | Suit. Code<br>S3 |
| Drawing Number<br>104560-MMD-00-XX-DR-CE-1013 | | Revision<br>05 |

1:2000 0 100m 200m

1:10,000 0 500m 1000m



Proposed indicative filter drain and swale system to collect runoff from internal substation roads. Size, arrangement and details to be confirmed (see Note 26)

Project 1 Proposed Permanent sub-station platform.
Gross area 5.880 hectares.
Impermeable area assumed to be 1.30 hectares (see Note 21)

Project 1 Temporary Construction Compound and associated drainage removed.

Project 2 Proposed Permanent sub-station platform.
Gross area 5.880 hectares.
Impermeable area assumed to be 1.30 hectares (see Note 21).

Proposed indicative filter drain and swale system to collect runoff from internal substation roads.
Size, arrangement and details to be confirmed.

Project 2 Temporary Construction Compound and associated drainage removed.

Project 1 temporary haul road and associated drainage removed

Project 2 temporary haul road and associated drainage removed

Temporary ponds and connecting pipework removed

Permanent access road attenuation swale. (*)

| | |
|---|---|
| Flood storage volume | 491m$^3$ |
| Swale Base Level | 34.10mAOD |
| Approximate depth | 0.5-1.39m (**) |

(*) The representation of the swale is indicative only.
(**) Check dams required to reduce depth of swale, to be reviewed during detailed design

Outfall 2: Proposed outfall to the existing ordinary watercourse subject to consent from Lead Local Flooding Authority. Existing watercourse bed and seasonal water levels to be confirmed by survey. Water level of 33.750mAOD assumed at this stage of design.
Outfall IL 33.90mAOD

Existing shallow ditch culverted under access road bellmouth

Permanent access road - total gross area 0.34ha (assumed to be fully impermeable)

3m wide Pond Maintenance Path (around perimeter of all ponds)

Project 2 Permanent stormwater attenuation pond.
Flood storage volume 2247m$^3$ and approximate depth 1m including freeboard (see Notes 20 and 22)

| | |
|---|---|
| EGL | 34.802m |
| Outlet IL | 33.758m |

Project 1 Permanent stormwater attenuation pond.
Flood storage volume 2248m$^3$ and approximate depth 1m including freeboard (see Notes 20 and 22)

| | |
|---|---|
| EGL | 35.026m |
| Outlet IL | 33.758m |

Outfall 1: Proposed outfalls to the existing ordinary watercourse subject to consent from Lead Local Flooding Authority. Existing watercourse bed and seasonal water levels to be confirmed by survey. Water level of 33.43mAOD assumed at this stage of design.
Outfall IL 33.47mAOD

Proposed Ardleigh Road highway drainage swale. Refer to Drawing 104560-MMD-00-XX-DR-CE-1035 for further information

Proposed outfall pipes. Gradient approximately 1:500 (see Note 26)

Legend:

| | | | |
|---|---|---|---|
| ▨ | Permanent Substation Compound | ◗ | Permanent Headwall |
| ▨ | Permanent swale/infiltration ditch (see Note 22) | ● | Permanent Catchpit |
| 🟧 | Permanent Access Road (material to be confirmed) | ○ | Catchpit with vortex flow control device (see Note 10) |
| ▨ | Permanent Access Overrun Area | ◗—◖ | Permanent Culvert Crossing |
| 🟦 | Paved Area (tarmac) of the Permanent Access to Substation | — | Permanent Carrier Pipe |
| ▨ | Permanent Pond and Grading | - -> - - -> - | Permanent Filter Drain Pipe |
| ▨ | Temporary Access Road | -□-□-□- | Permanent Fenceline |
| ▨ | Temporary Construction Compound | ◗ | Temporary Headwall |
| ▨ | Temporary swale/infiltration ditch (see Note 22) | ● | Temporary Chamber |
| ▨ | Temporary Pond and Grading | — | Temporary Carrier Pipe |
| ← | Design flow exceedence route (see note 23) | - - - - | Temporary Filter Drain/Ditch |
| — | Existing Watercourse (see Note 4) | ◗—◖ | Temporary Culvert Crossing |
| - - - | Existing Ditch | × xx.xxxm | Permanent/FGL Spot Level |
| - - - | Existing Ditch, Planned to Fill In | xx.xxxm | LiDAR Contours |
| • • • • | Permanent Ditch Diversion | TPXX xx.xxxm | Ground Investigation Trial Pit Location |
| ▨ | Proposed Cable Swathe Routes (see Note 25) | z xx.xxx | Existing Ground Water Level (see Note 24) |
| — | Cable Route Corridor Zone | △ xx.xxx | Lowest proposed level in compound |
| | | ○ xx.xxx | Lowest existing ground level in pond |
| | | —HV—D——HV—D— | High Voltage Utility |
| | | ——HV/OH—D—— | High Voltage Overhead Utility |
| | | —BT—D——BT—D— | BT Utility |
| | | ——WTR—D—— | Buried Water Utility |

Reference drawings

OS map
SOCOTEC UK Draft Trial Pit Logs (Dug 19th May 2023)
Technics Digitised Utility Report Information
104560-MMD-00-XX-DR-CE-1004 - Site Layout/ Location Plan - AIS Option 2
104560-MMD-00-XX-DR-CE-1006 - AIS Substation Earthworks Plan and Long Section - Project 1 & 2
104560-MMD-00-XX-DR-CE-1007 - Temporary Compound Earthworks Plan and Long Section - Project 1
104560-MMD-00-XX-DR-CE-1009 - Temporary Compound Earthworks Plan and Long Section - Project 2
104560-MMD-00-XX-DR-CE-1015 - Permanent Access Layout
104560-MMD-00-XX-DR-CE-1017 - Temporary Accesses to Construction Compounds (Option 2) Layout
104560-MMD-00-XX-DR-EE-1030 - Electrical Site Layout - AIS
104560-MMD-00-XX-DR-CE-1061 - Permanent and Temporary Access Junction with Ardleigh Road

Notes:

1. DO NOT SCALE FROM THIS DRAWING.
2. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS IN METRES AOD (RELATIVE TO ORDNANCE DATUM NEWLYN) UNLESS OTHERWISE STATED.
3. MOTT MACDONALD TAKE NO LIABILITY FOR THE INFORMATION PROVIDED BY OTHERS UPON WHICH THIS DRAWING IS BASED.
4. EXISTING WATERCOURSES BASED ON OS DATA. © CROWN COPYRIGHT AND DATABASE RIGHTS 2022 ORDNANCE SURVEY (0100031673).
5. ANY DRAWING ERRORS OR DISCREPANCIES SHOULD BE BROUGHT TO THE ATTENTION OF MOTT MACDONALD.
6. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT DOCUMENTS AND DRAWINGS (SEE REFERENCE DRAWINGS LIST).
7. NO UN-AUTHORISED DISCLOSURE, STORAGE OR COPYING.
8. ALL SUDS (DRAINAGE SYSTEMS INCLUDING ATTENUATION BASINS, PONDS, SWALES ETC.) ARE TO BE CONSTRUCTED IN ACCORDANCE WITH CIRIA753, THE SUDS MANUAL 2015.
9. ALL SPATIAL COORDINATES RELATE TO THE ORDNANCE SURVEY, BRITISH NATIONAL GRID (OSGB36).
10. MAXIMUM PASS FORWARD FLOW 1 LITRE PER SECOND FROM EACH PROJECT. REFER TO THE DRAINAGE STRATEGY FOR DETAILS. (104560-MMD-00-XX-RP-CE-1010 CIV RWE CO-LOCATED SUBSTATION EARLY DESIGN - DRAINAGE STRATEGY)
11. FEH METHOD DESIGN CRITERIA AND CV COEFFICIENT FOR WINTER SET 1.0.
12. PIPES TO BE ENCASED IN CONCRETE WHEN MINIMUM COVER < 1200MM UNDER ACCESS ROADS.
13. ACCESS ROADS TO BE PROVIDED WITH A CAMBER/ CROSSFALL AND DISCHARGE TO PROPOSED FILTER DRAIN.
14. FOUL TANK OR TREATMENT PLANTS TO BE LOCATED WITHIN THE PERMAMENT AND CONSTRUCTION COMPOUNDS TO COLLECT FOUL WATER (NOT INDICATED ON DRAWINGS). TANK SIZES, LOCATION AND CONNECTION POINT TBC.
15. REFER TO 104560-MMD-00-XX-DR-EE-1030 ELECTRICAL SITE LAYOUT - AIS FOR INTERNAL DETAILS OF ELECTRICAL SUBSTATION LAYOUT.
16. CONTAMINATION TO BE ASSESSED AS PART OF THE GEOTECHNICAL INVESTIGATIONS TO ENSURE POLLUTANT PATHWAYS ARE NOT CREATED BY INFILTRATION THROUGH CONTAMINATED MATERIALS.
17. ALL PERMANENT DRAINAGE SHOWN ON THE DRAWING TO REMAIN FOR THE OPERATIONAL PHASE.
18. ALL TEMPORARY DRAINAGE SHOWN ON THE DRAWING TO BE REMOVED FOR THE OPERATIONAL PHASE.
19. CONTOURS BASED ON EA 1M DTM LIDAR ACCESSED DECEMBER 2022.
20. FLOOD STORAGE VOLUMES BASED ON RESTRICTING RUNOFF RATES FOR THE 1 IN 100 YEAR EVENT (+45% ALLOWANCE FOR CLIMATE CHANGE) FOR THE PERMANENT CASE AND FOR THE 1 IN 5 YEAR EVENT (+10% ALLOWANCE FOR CLIMATE CHANGE) IN THE TEMPORARY CONSTRUCTION CASE. REQUIREMENT FOR PERMANENT TREATMENT VOLUME (VT) BELOW FLOOD STORAGE DEPTH TO BE CONFIRMED DURING SUBSEQUENT DESIGN STAGES.
21. EXACT LAYOUT OF PERMANENT PLATFORM AND TEMPORARY CONSTRUCTION COMPOUNDS, INCLUDING FINISHED LEVELS, INTERNAL DRAINAGE ARRANGEMENTS AND ACCESS ROADS TO BE CONFIRMED DURING SUBSEQUENT DESIGN STAGES.
22. INFILTRATION TESTING TO BE CARRIED OUT DURING SUBSEQUENT DESIGN STAGES AND OPTION TO REDUCE OR REMOVE ATTENUATION PONDS AND USE SWALES FOR DIRECT INFILTRATION TO BE CONSIDERED. REFER TO DRAINAGE STRATEGY FOR FURTHER DETAILS.
23. EXACT EXCEEDENCE ROUTE TO BE CONFIRMED USING TOPOGRAPHICAL SURVEY. PROVISION OF BUNDS MAYBE REQUIRED TO DIRECT WATER AWAY FROM FARM ACCESS AND BUILDINGS.
24. INDICATIVE GROUNDWATER LEVEL BASED ON DRAFT TRIAL PITS DUG MAY 2023.
25. EXACT CABLE SWATHE ROUTE TO BE CONFIRMED (INCLUDING DECONFLICTION WITH DRAINAGE FEATURES) DURING SUBSEQUENT DESIGN STAGES.
26. DUE TO GENERALLY FLAT TOPOGRAPHY OF THE SITE IT IS LIKELY THAT SURFACE WATER FILTER DRAINS AND CARRIER PIPES WILL NEED TO BE LAID AT SHALLOW GRADIENTS WHERE RECOMMENDED MINIMUM SELF-CLEANSING VELOCITIES MAY NOT BE ACHIEVABLE. THEREFORE MORE FREQUENT INSPECTION AND CLEANING OF PIPELINES MAYBE REQUIRED.

1:2000 0 100m 200m

1:10,000 0 500m 1000m

| Rev | Date | Drawn | Description | Ch'k'd | App'd |
|---|---|---|---|---|---|
| 06 | 08/03/2024 | YV | Updated to address client comments | TN | AFC |
| 05 | 04/03/2024 | CT | Updated to address client comments | TN | AFC |
| 04 | 24/01/2024 | YV | Updated to address client comments | JWD | AFC |
| 03 | 18/09/2023 | CT | Updated to address client comments | TN | AFC |
| 02 | 01/08/2023 | CT | Client's comments incorporated | TN | JW |
| 01 | 15/06/2023 | YV | Preliminary | AL | MB |

Status Stamp

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Client

NORTH FALLS
Offshore Wind Farm

FIVE ESTUARIES
OFFSHORE WIND FARM

Title

# Co-located AIS Substations Early Design - Drainage Layout - Operational Phase - Option 2

Sheet 01 of 01

| | | | | | |
|---|---|---|---|---|---|
| Designed | Charlotte Tyler | CT | Eng check | Amy Lambourne | AL |
| Drawn | Laura Snowden | LS | Coordination | Andrea F. Crespo | AFC |
| Dwg check | Thomas North | TN | Approved | Matthew Barton | MB |

| | | |
|---|---|---|
| MMD Project Number<br>104560-001 | Scale at A1<br>As Indicated | Security<br>STD |
| Client Number<br>004809399-06 | | Suit. Code<br>S3 |
| Drawing Number<br>104560-MMD-00-XX-DR-CE-1011 | | Revision<br>06 |

# Appendix B

## Substation Early Design Drainage Strategy

# Contractor Coversheet

| | | | |
|---|---|---|---|
| **Project Name:** | FE_NF_Mott Macdonald Co-Located Substation Studies | **Package No:** | PROJECTCODE 12 - Electrical Systems |

| | |
|---|---|
| **Document Title:** | Co-located Substations Early Design - Drainage Strategy |
| **Classification:** | Confidential |

| | | | |
|---|---|---|---|
| **Contractor Doc. No:** | 104560-MMD-00-XX-RP-CE-1010 | **Contractor Revision:** | 05 |
| **Date:** | 05/03/2024 | **Pages:** | 49 |

| | | | |
|---|---|---|---|
| **Employer Doc. No:** | 004809398-05 | **Employer Revision:** | NA |
| **Document Status:** | Preliminary | | |
| **Reason for Issue** | Review | | |

# CIV RWE Co-located Substation Early Design

## Drainage Strategy

March 2024

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# CIV RWE Co-located Substation Early Design

## Drainage Strategy

March 2024

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# Issue and Revision Record

| Revision | Date | Originator | Checker | Approver | Description |
|---|---|---|---|---|---|
| P01 | 15.06.2023 | C. Tyler /<br>T. North | A. Lambourne | A. F. Crespo | First draft drainage strategy |
| P02 | 31.07.2023 | C. Tyler | T. North | J. Weeks | Second issue |
| P03 | 18.09.2023 | C. Tyler | T. North | A. F. Crespo | Third issue following client comments |
| P04 | 24.01.2024 | C. Tyler | T. North | A. F. Crespo | Fourth issue |
| P05 | 04.03.2024 | C. Tyler | T. North | A. F. Crespo | Fifth Issue |

**Document reference:** 104560-MMD-00-XX-RP-CE-1010 | P05 |

**Information class: Standard**

# Contents

## Tables

## Figures

# Executive summary

North Falls and Five Estuaries have jointly procured Mott MacDonald to develop a co-located substation site to accommodate the onshore substations for both the windfarms. To support the design, a drainage strategy for the proposed works has been commissioned. This report provides a high-level assessment of the drainage strategy for the Co-Located scheme during its construction and operational stages. The aim of the strategy is to support the Development Consent Order (DCO) application for the substation development and enable early engagement with stakeholders.

Existing conditions such as geology, hydrology and existing flood risk have been considered to support the development of the drainage strategy. Sustainable Drainage Systems (SuDS) have been utilised to mitigate the impact of the development on both flow rate and water quality from the site, taking consideration of both the construction and operational phases.

Filter drains, swales and an attenuation volume (pond, detention basin or similar) have been proposed to manage runoff from the construction and operational sites. An attenuation volume has been sized to accommodate stormwater up to the 1 in 100-year design storm event (45% climate change allowance) once the site is operational. An additional, temporary attenuation volume hydraulically linked to the permanent has been sized in which the total volume is sufficient to accommodate the 5-year (10% climate change allowance) event for both the construction compound and permanent substations as a worst case. This secondary volume could be retained or filled in after completion of construction. This assessment is based on current available information regarding the proposed substation and construction compound site and any changes to these proposals will require the drainage strategy to be revised.

Given the residual risk and variability associated with flooding, the consultant takes no liability for, and gives no warranty against, actual flooding of any property (client’s or third party) or the consequences of flooding in relation to the outputs of this report. This report has been prepared in support of the DCO for the RWE Co-Located substation site only.

This drainage strategy includes an assessment of the predicted effects of climate change over the lifetime of the development. The assessment of the effects of climate change is based on the guidance provided by the Environment Agency (EA) in place at the date of this drainage strategy. These recommendations may change in the future, increasing the extent of predicted effects, and we would recommend that you seek further advice should this occur during the lifetime of the project.

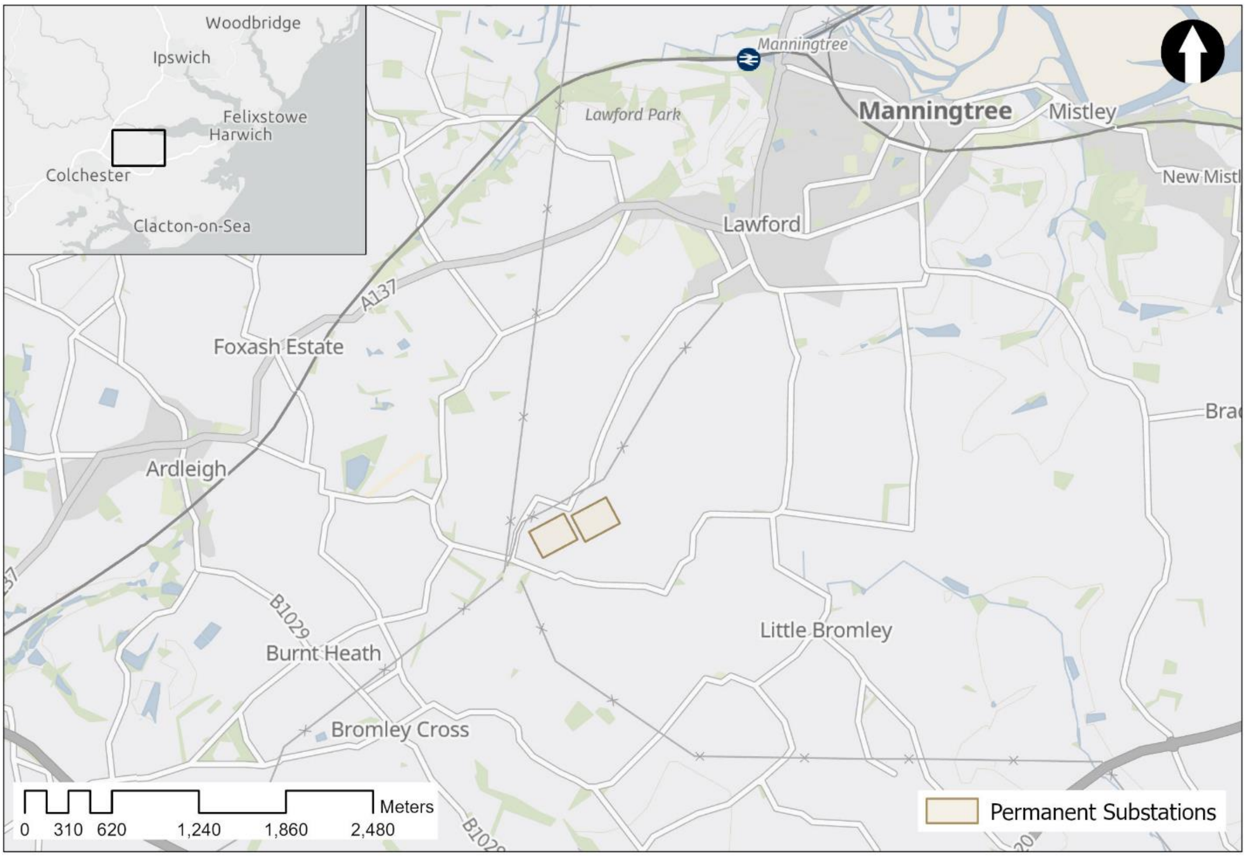
# 1 Introduction

Mott MacDonald has been commissioned by North Falls Offshore Wind Farm Ltd. and Five Estuaries Offshore Wind Farm Ltd. to undertake a drainage strategy for a proposed Co-Located onshore substation site to be used by both wind farms, hereafter referred to as 'the site'. Both projects are extensions of existing offshore wind farms that sit to the southeast of the British coast, in the North Sea. This report documents the proposed drainage strategy for the substation site and considers the likely impact of development on the existing surface water flow paths and field drainage networks.

## 1.1 Site Location

The proposed site is located near Little Bromley, a village within the Tendring District of Essex. The centre of the proposed development is at approximate grid reference TM 08105 28880 and the effective impermeable works cover an approximate area of 11ha. The nearest postcode is CO11 2ND and Colchester city is located approximately 5km southwest. The location of the site boundary is indicated in Figure 1-1. The site is constrained by Grange Road along its west and north border and Ardleigh Road along the south border. The eastern border is a field boundary.

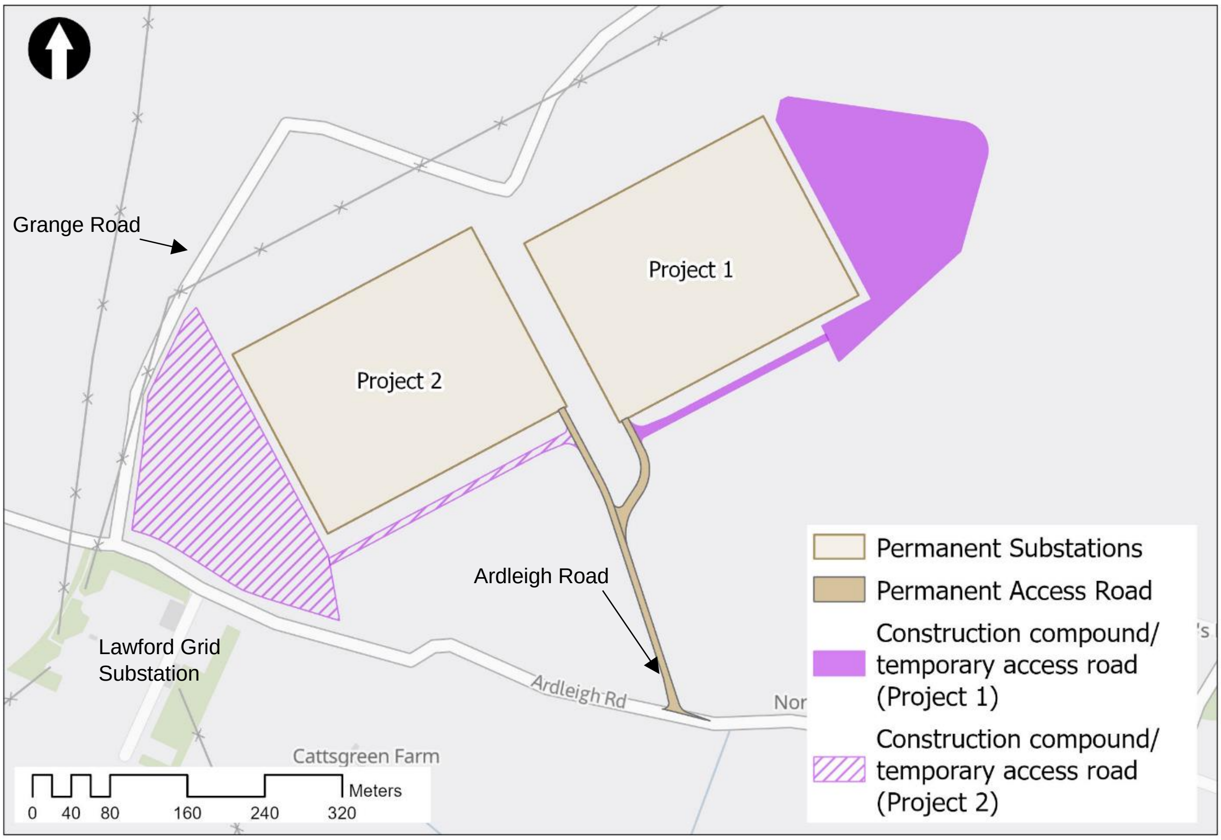
**Figure 1-1: Site location map**



Source: Contains OS Data © Crown Copyright and database right 2023

The intention of the Co-Located scheme is to locate the substations together to enable the possibility of some facility sharing, such as auxiliary generators, telecoms, meeting and messing facilities, storage, car parks etc., where feasible. For assurance of clear maintenance accountability, the drainage for the two projects have been considered under separate strategies. The location of the projects, identified hereafter as ‘Project 1’ and ‘Project 2’, is shown in Figure 1-2. A more detailed layout plan is shown in drawing 104560-MMD-00-XX-DR-CE-1004 (Co-Located Substation Early Design Site Layout/ Location Plan AIS Option 2).

**Figure 1-2: Site layout plan**



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## 1.2 Data Sources

The following data sources have been used for this assessment:

**Table 1.1: Data Sources**

| File Name | File Ref | Source | Data Received | Revision |
|---|---|---|---|---|
| OS Mapping | TL | Ordnance Survey | 2023 | N/A |
| Aerial maps, Openstreet maps, Magic Map Website | N/A | Bing Maps via AutoCAD Civil 3D, Environment Agency (EA) | 2022 | N/A |
| British Geological Survey (BGS) Website | N/A | BGS Website | 2022 | N/A |
| 3DES Aerial Survey | DES22057 FIVE ESTUARIES_REV1 | 3D engineering | August 2022 | Topographic drone survey |

| File Name | File Ref | Source | Data Received | Revision |
|---|---|---|---|---|
| Five Estuaries Wind Farm Onshore Substation Overall Site Layout - AIS | 104560-MMD-00-XX-DR-E-0006 | Mott MacDonald | September 2022 | 01 |
| Geotechnical and Geo-environmental Desk Study-S99 (inc. Envirocheck report) | 104560-MMD-00-XX-RP-C-0045 | Mott MacDonald | July 2022 | 01 |
| Co-Located Substation Early Design Site Layout/ Location Plan AIS Option 2 | 104560-MMD-00-XX-DR-CE-1004 | Mott MacDonald | January 2024 | P06 |
| LiDAR Composite DTM 1m | - | National LiDAR Programme | 2022 | 2022 |

## 1.3 Standards and Guidance

The following standards and guidance have been used for this assessment:

**Table 1.2: Standards and Guidance**

| Document Name | Document Reference | Publisher | Issue Date (Revision) | Date Accessed |
|---|---|---|---|---|
| The SuDS Manual | C753 | Construction Industry Research and Information Association | 2015 | 15 June 2023 |
| National Planning Policy Framework (NPPF) 2021 | NPPF | Ministry of Housing, Communities and Local Government, UK Government. | July 2021 | 15 June 2023 |
| Flood Risk and Coastal Change, Planning Practice Guidance 2022 | - | Department for levelling up, housing and communities | Aug 2022 | 15 June 2023 |
| Flood and Water Management Act 2010 | - | HM Government | April 2010 | 15 June 2023 |
| Essex County Council Local Flood Risk Management Strategy 2013 | - | Essex County Council | Oct 2018 | 15 June 2023 |
| Department of Environment, Food and Rural Affairs DEFRA’s non statutory technical standards | - | Department of Environment, Food and Rural Affairs, UK Government | March 2015 | 15 June 2023 |
| National Grid – Site Drainage | TS 2.10.09 | National Grid | June 2018 | 15 June 2023 |
| National Grid - Flood Defences for electricity substations | TS 2.10.13 | National Grid | June 2018 | 15 June 2023 |
| National Grid - Roadworks and Surfacing | TS 2.10.08 | National Grid | June 2018 | 15 June 2023 |

| Document Name | Document Reference | Publisher | Issue Date (Revision) | Date Accessed |
|---|---|---|---|---|
| Control of Water Pollution from Linear Construction Projects | CIRIA 648 | Construction Industry Research and Information Association | 2006 | 15 June 2023 |
| The Building Regulations 2010, Drainage and Waste Disposal | - | HM Government | 2015 | 15 June 2023 |
| The Sustainable Drainage Systems Design Guide for Essex | - | Essex County Council | 2020 | 17 July 2023 |

# 2 Existing Site

## 2.1 Site Description

The site is proposed to be constructed on undeveloped agricultural land. It is constrained by Grange Road along its west and north border and Ardleigh Road along the south border. The eastern border is a field boundary.

A review of aerial images identifies Lawford Grid Substation located directly adjacent to the site at the intersection between Ardleigh Road and Grange Road. This is shown in Figure 1-2. Overhead power lines cross the proposed site in the northwest corner which originate from Lawford Substation. South of Ardleigh Road, an overhead telecommunications line and drainage ditch have been identified. An unnamed drainage ditch is shown to the north of Ardleigh Road, believed to convey the surface water runoff from Normans Farm. The imagery further shows an existing unnamed ditch running from northwest of the site to the southeast of the site. This is shown in Figure 2-2.

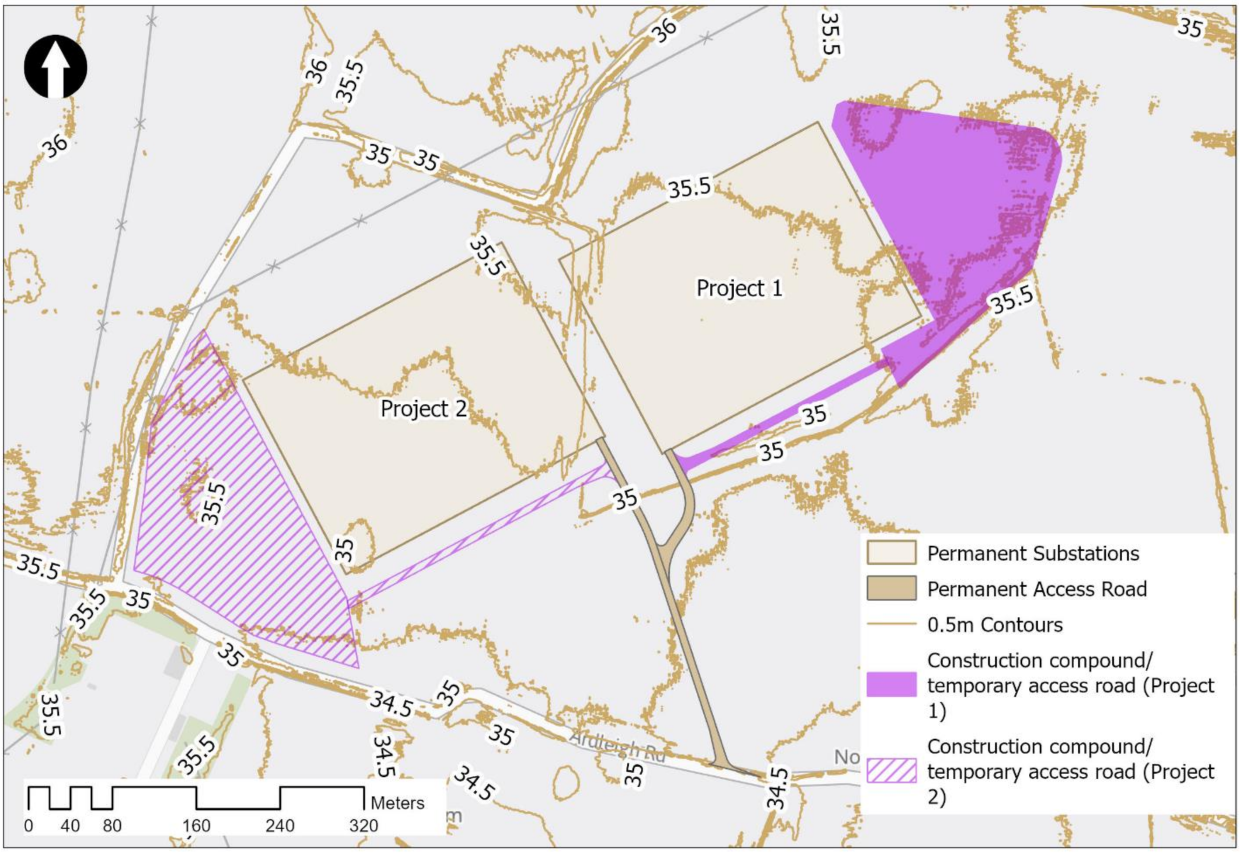
An ordinary watercourse originating near Cattsgreen Farm, located to the south of the site has been identified by a review of OS mapping and from site walkovers. The watercourse is a proposed discharge point for surface water runoff from the proposed development.

## 2.2 Topography

The site is generally flat agricultural land, with existing ground levels falling at a shallow gradient from northwest to southeast. Figure 2-1 shows the approximate site elevations based on LiDAR (1m DTM).

To the north of Ardleigh Road, where the locations of both substations are proposed, the LiDAR shows a maximum elevation of 36.0mAOD in the northwest corner and a minimum elevation of 34.5mAOD where it is bound by Ardleigh Road to the south. South of Ardleigh Road the ground slopes gently from a maximum elevation of 34.5mAOD at the north to a minimum of 33mAOD at the confluence of the unnamed ordinary watercourse and drainage ditch (shown in Figure 2-2).

**Figure 2-1: Site topography**



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For the majority of the site, the drainage strategy has been based on results of a drone survey undertaken by 3D engineering in August 2022. The survey data has an accuracy of 5cm rather than the 1m resolution of open-source LiDAR data and as such enabled a more informed understanding of ground topography and watercourse base levels. Following changes in design proposals since the survey was undertaken, there is a small section of the proposed access road that was not included in the survey. As such, open-source LiDAR was instead used for the drainage calculations for the proposed access road.  Additionally, a review of the survey has identified discrepancies at key watercourses within the site extents, it is understood this is due to vegetation at the time of the drone survey. In these instances, LiDAR was also used as primary source of topographic data.

Further topographic survey is required during the detailed design stage to provide specific level data at the locations of each project, the area of missing data at the new access road and the two proposed outfall locations.

## 2.3 Hydrology

Water features are classified by the Environment Agency as follows:

- Main River are rivers, larger streams and smaller watercourses of strategic drainage importance regulated by the Environment Agency.
- Ordinary Watercourses are rivers, streams, ditches, drains, sluices and so on which do not form part of a main river. There are two types of Ordinary Watercourses: those regulated by

Internal Drainage Boards which are usually are named; and those that are regulated by the Lead Local Flood Authorities which are usually unnamed.

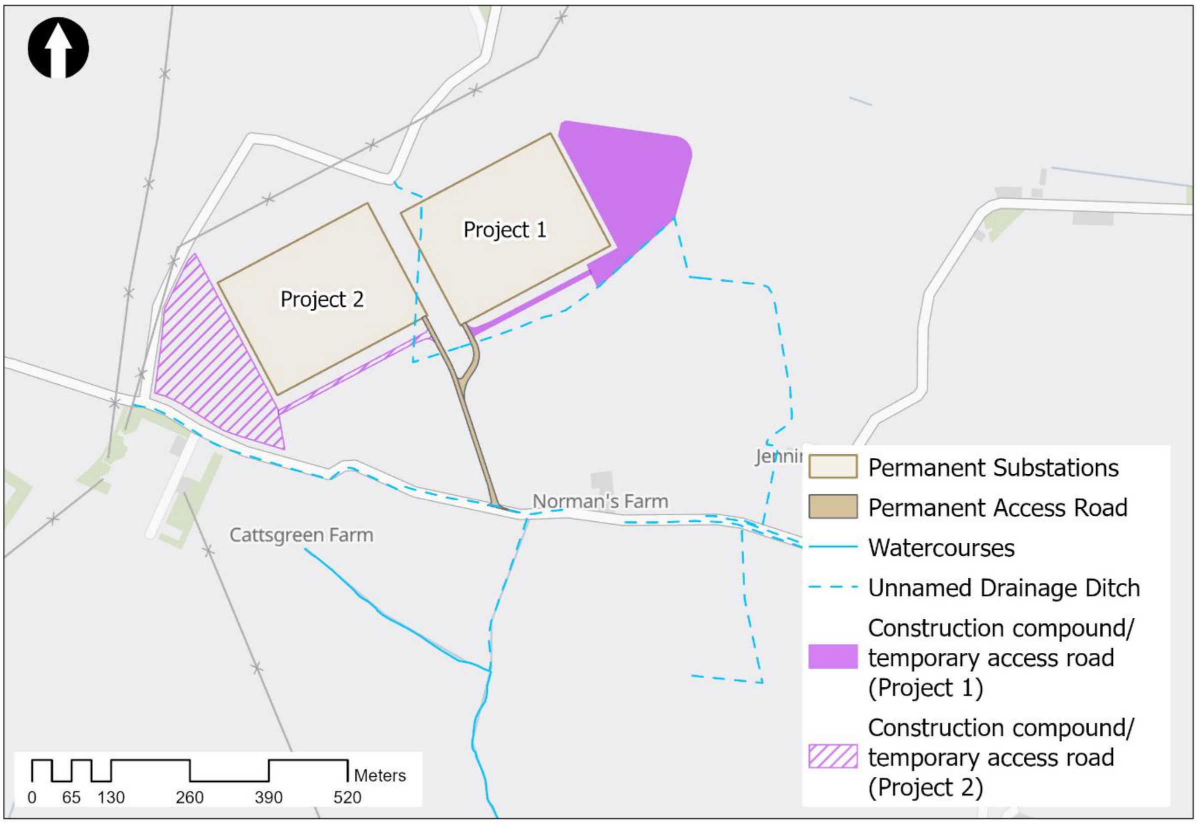
Figure 2-2 identifies the watercourses and other water features within the vicinity of the site. A review of OS mapping shows a shallow field drain runs along both the northern and the southern sides of Ardleigh Road, conveying water to an unnamed ordinary watercourse in the field south of the road. The unnamed ordinary watercourse is approximately 450m south of the Project 1 substation and 250m south of Project 2. The Tenpenny Brook is identified as a Main River approximately 2.1km downstream, but not within the area of the field directly south of the site. It is assumed that, at this location, a tributary river of the Tenpenny Brook is an Ordinary Watercourse.

Review of aerial imagery shows an unnamed watercourse runs through the proposed location of the Project 1 construction compound and both substations. Review of LiDAR shows the watercourse to be very shallow (less than 0.5m). It is assumed that similarly to the unnamed drainage ditch, the water is conveyed to the unnamed Ordinary Watercourse in the field south of Ardleigh Road.

There are no known watercourses regulated by an Internal Drainage Board in the area. For Ordinary Watercourses in Essex, outside an IDB area, the relevant authority is Essex County Council (ECC).

In any instance where an existing field drain is severed by the development, it will require diversion (in preference of truncation) to avoid the flooding of areas upstream. Further detail of this is provided in Section 5.4.7.

**Figure 2-2: Site hydrology**



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## 2.4 Geology

A site-specific ground investigation (GI) was undertaken in May 2023 through which the stratum of the ground can be understood. The GI comprised of 7 trial pits excavated at varying depths from 2.4m to 3.30m. The trial pits are located predominately within the Project 1 area, the location of the trial pits are shown on the drainage strategy drawings (Appendix B). The results of the investigation have been summarised below:

- Topsoil – A topsoil comprising of silty/sandy clay and rare gravel was observed in all trial pits from 0.00m below ground level (BGL) to base depths ranging between 0.20m BGL and 0.30m BGL.
- Cohesive superficial deposits – Of the 7 trial pits cohesive superficial deposits were observed in 4. The superficial deposits comprise soft to firm slightly sandy/slightly gravelly/silty clay were observed with top depths ranging between 0.20m BGL and 0.30m BGL, and base depths ranging between 0.30m BGL and 0.70m BGL.
- Granular superficial deposits - comprising slightly gravelly to gravelly/clayey sand, at top depths ranging between 0.30m BGL and 0.70m BGL to the base of the test trial pits.

## 2.5 Permeability

Soakaway testing results are pending and as such, potential infiltration rates are to be determined. In absence of this data, potential infiltration rates have been assumed based on the observed geology and the CIRIA C753 SuDS Manual Table 25, this is shown in Table 2.1: Infiltration Rates. The identified geology indicates that the varying layers of soil can be considered good infiltration media, with typical infiltration coefficients ranging from $1 \times 10^{-7}$ to $3 \times 10^{-2}$.

However, as it has not been possible to validate the use of infiltration at this stage, infiltration as a method of discharge has been discounted to provide a conservative approach. This will be reviewed in subsequent design stages once further ground investigation, including soakaway testing, has been undertaken.

**Table 2.1: Infiltration Rates**

| | Soil type/texture | ISO 14688-1 description | Typical infiltration coefficients (m/s) |
|---|---|---|---|
| **Good infiltration media** | gravel | Sandy GRAVEL | $3 \times 10^{-4} – 3 \times 10^{-2}$ |
| | sand | Slightly silty slightly clayey SAND | $1 \times 10^{-5} – 5 \times 10^{-5}$ |
| | loamy sand | Silty slightly clayey SAND | $1 \times 10^{-4} – 3 \times 10^{-5}$ |
| | sandy loam | Silty clayey SAND | $1 \times 10^{-7} – 1 \times 10^{-5}$ |
| **Poor infiltration media** | loam | Very silty clayey SAND | $1 \times 10^{-7} – 5 \times 10^{-6}$ |
| | silt loam | Very sandy clayey SILT | $1 \times 10^{-7} – 1 \times 10^{-5}$ |
| | chalk (structureless) | N/A | $3 \times 10^{-8} – 3 \times 10^{-6}$ |
| | sandy clay loam | Very clayey silty SAND | $3 \times 10^{-10} – 3 \times 10^{-7}$ |
| **Very poor infiltration media** | silty clay loam | – | $1 \times 10^{-8} – 1 \times 10^{-6}$ |
| | clay | – | $< 3 \times 10^{-8}$ |
| | till | Can be any texture of soil described above | $3 \times 10^{-9} – 3 \times 10^{-6}$ |
| **Other** | rock* (note mass infiltration capacity will depend on the type of rock and the extent and nature of discontinuities and any infill) | N/A | $3 \times 10^{-9} – 3 \times 10^{-5}$ |

Source: Replicated from CIRIA C753, 2015

## 2.6 Contaminated Land

A Geotechnical and Geo-environmental Desk Study (document reference 104560-MMD-00-XX-RP-C-0045) was undertaken independently for the Five Estuaries Windfarm Ltd and identified no significant source of contamination within the vicinity of the site. Historical mapping suggests that the site has not been previously developed on beyond farmland.

## 2.7 Groundwater

### 2.7.1 Source Protection Zones (SPZ)

The site is situated within a total catchment (Zone III) groundwater Source Protection Zone (SPZ), defined as the total area needed to support a groundwater abstraction source. Any disposal of surface water runoff via infiltration proposed at the site will require consent from the Environment Agency at subsequent design stages.

### 2.7.2 Groundwater Level

Groundwater seepages and/or strikes were encountered in all but one of the trial pits at depths ranging between 2.40m BGL and 3.30m BGL. The results have been summarised in Table 2.2 below.

**Table 2.2: Summary of groundwater levels**

| Trial Pit | Seepage mBGL | Comment |
|---|---|---|
| TP01 | 2.5 | Pit collapse at 3.30mBGL, slow inflow of water but unable to record water level properly due to collapse |
| TP04 | 2.5 | - |
| TP05 | 2.7 | Medium inflow water strike at 3mBGL |
| TP07 | 2.4 | Slow inflow water strike at 2.6mBGL |
| TP08 | 2.9 | Seepage caused pit to collapse though not enough water for sample |
| TP10 | 2.3 | Slow inflow water stroke at 2.4m BGL |
| TP11 | - | None recorded though dampness observed at 2.90mBGL |

In addition to the information obtained during the Ground Investigation, the Five Estuaries Geotechnical and Geo-environmental Desk Study (document reference 104560-MMD-00-XX-RP-C-0045) reviewed a series of boreholes within proximity to the site. A summary of the historical BGS boreholes reviewed within this report are provided below.

The boreholes have been selected based on their proximity to the site and their representation of the geology presented by the BGS 1:50,000 mapping, which shows the site to have Cover Sands present overlying the Kesgrave Catchment Subgroup. The selected boreholes and key information are shown in Table 2.3. Indicative locations of the selected boreholes are presented in Figure 2-3.

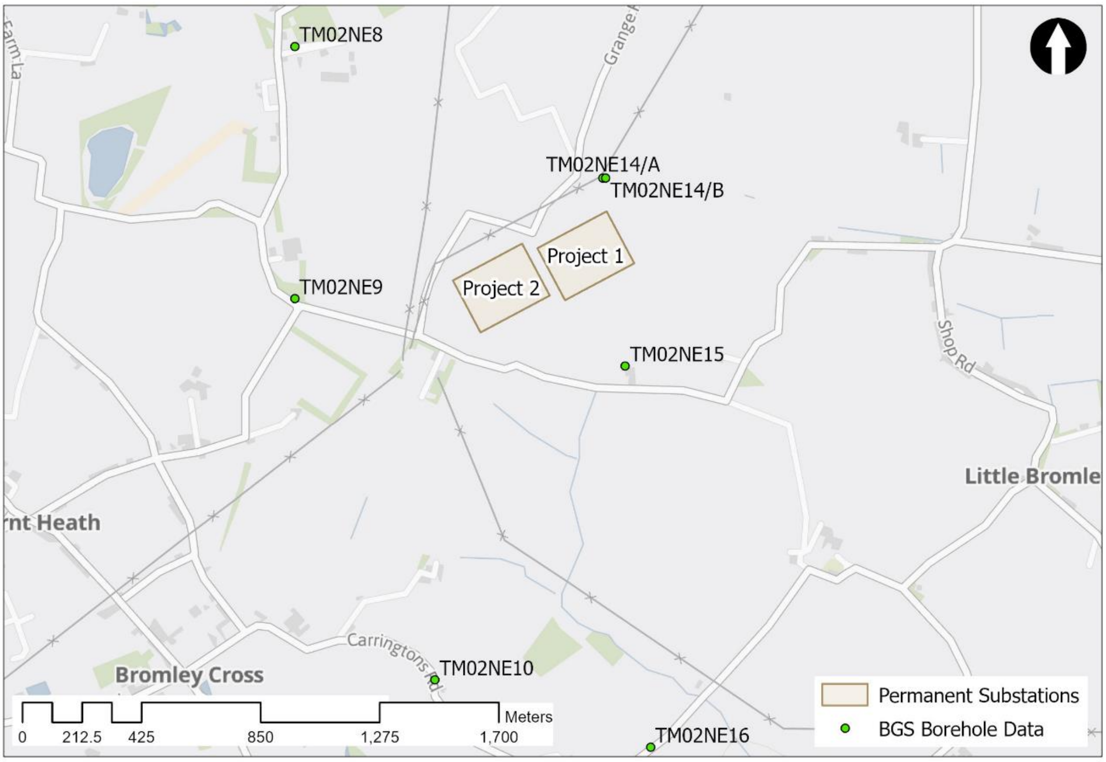
It should be noted that there are some additional boreholes present within the vicinity of the which have not been included within the below summary as they are of poor quality or do not contain any geological information associated with the anticipated strata at the site.

**Table 2.3: BGS borehole Summary**

| BGS Reference | Compass Direction | Eastings | Northings | Borehole Depth (mGL) | GWL (mBGL) |
|---|---|---|---|---|---|
| TM02NE14/A | N | 608360 | 229220 | 17.37 | 2.8 |
| TM02NE14/B | N | 608350 | 229220 | 7.62 | 2.8 |
| TM02NE15 | E | 608430 | 228550 | 10.1 | 2.7 |
| TM02NE16 | S | 608520 | 227190 | 9.40 | 1.5 |
| TM02NE9 | W | 607250 | 228790 | 9.90 | 4.0 |
| TM02NE10 | SW | 607750 | 227430 | 8.20 | 1.8 |
| TM02NE8 | NW | 607250 | 229690 | 10.70 | 6.1 |

*All compass directions taken with respect to the proposed works location in Figure 2-3: BGS borehole location plan.

**Figure 2-3: BGS borehole location plan**



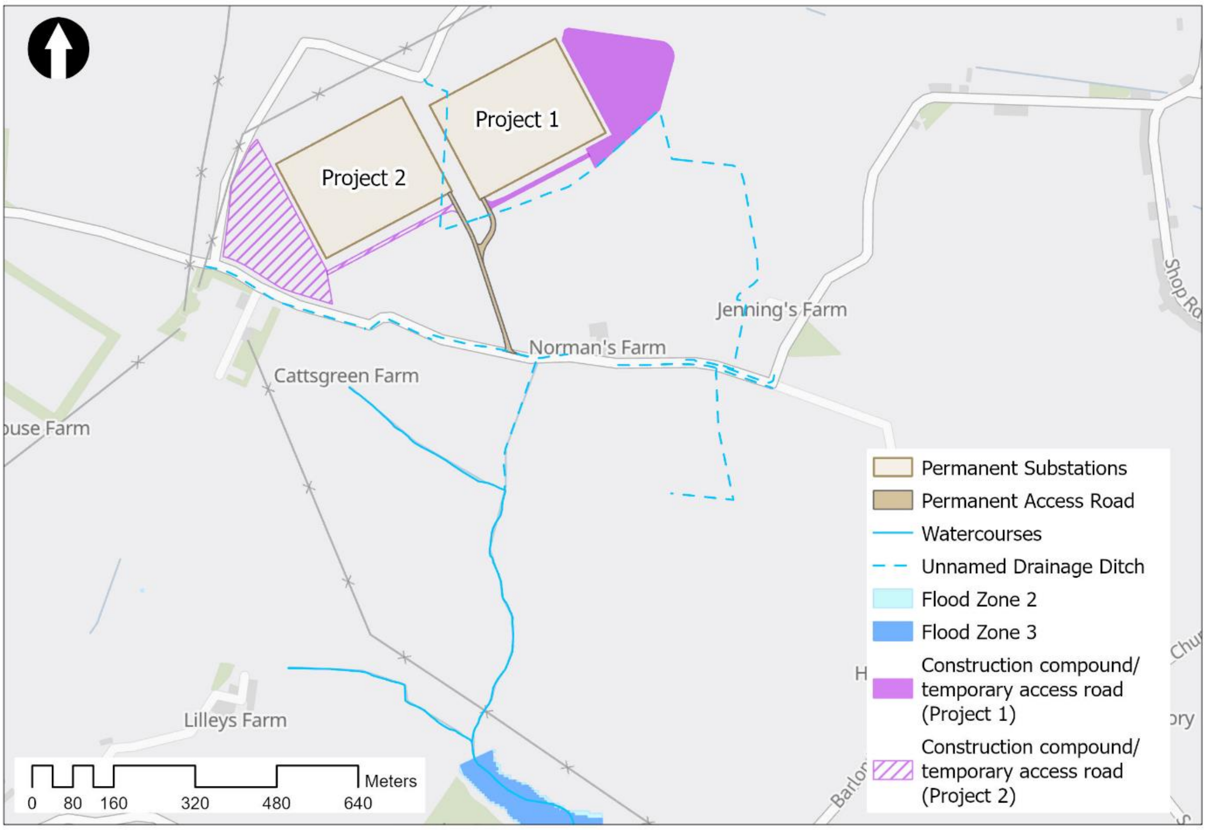
Source: Contains OS Data © Crown Copyright and database right 2022, Single Onshore Borehole Index. Single Onshore Borehole Index (SOBI) - British Geological Survey (bgs.ac.uk). Contains Ordnance Survey data © Crown copyright and database right 2022

## 2.8 Flood Risk

### 2.8.1 Tidal and fluvial

A review of the Environment Agency (EA) ‘Flood Map for Planning’ indicates that the site is located within Flood Zone 1, as shown in Figure 2-4. Areas classified as Flood Zone 1 are defined as having a probability of a flood event occurring less than 1 in 1000 years and are therefore considered to be at low risk of flooding from rivers and seas.

**Figure 2-4: Risk of tidal/fluvial flooding**



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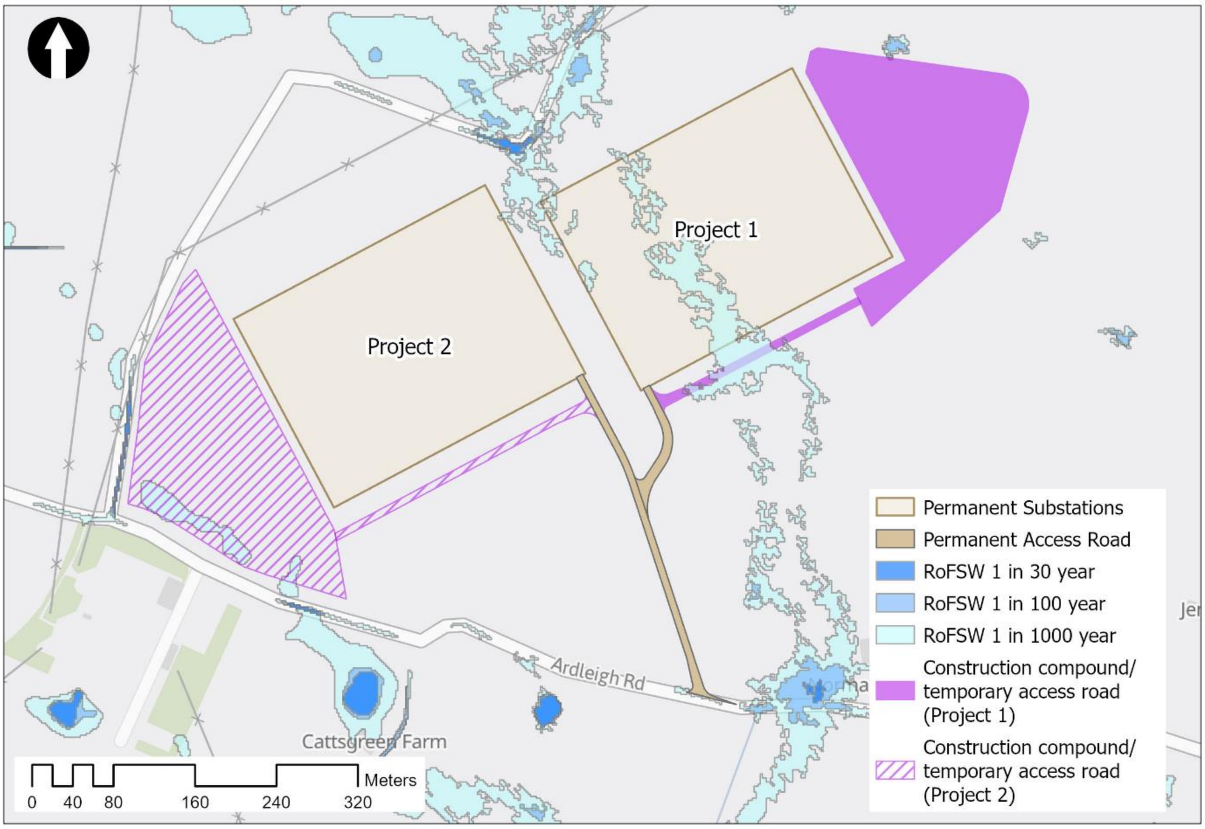
### 2.8.2 Surface Water

The EA ‘Risk of Surface Water Flooding’ dataset has been reviewed and can be seen in Figure 2-5. The mapping indicates that the site is predominately at low risk of flooding from surface water. There are however some visible, localised areas at risk of flooding in the 1 in 1000-year event. Notably, the centre of the Project 1 substation, the Project 2 temporary construction compound and a small section of the Project 1 temporary access road. In these instances, it has been observed from the LiDAR data that the ground is at a slight depression to the surrounding terrain, with the potential to result in pooling.

To facilitate the works, existing ground levels at the substations will be raised. Similarly, the lower ground in the footprint of the proposed construction compound will be raised and levelled. As such, the risk of surface water flooding in the 1 in 1000 year should decrease as a result of the works.

Where the site crosses existing ditches diversions or culverting will be required. Any increased risk of surface water flooding can be managed by these diversions to ensure flood risk is not increased for surrounding landowners.

**Figure 2-5: Risk of flooding from surface water**



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### 2.8.3 Groundwater

A Geotechnical and Geo-environmental Desk Study (document reference 104560-MMD-00-XX-RP-C-0045) was undertaken independently for the Five Estuaries Windfarm Ltd. Project and established the site to be within an area at negligible risk of groundwater flooding. The ground investigation results do however show groundwater to have been encountered at varying depths (detailed further in Section 2.7.2) and therefore consideration must be taken in design to ensure risk of groundwater flooding does not increase either to the site or third parties.

If shallow groundwater is present on the site an impermeable liner may be required to mitigate groundwater ingress into the drainage systems and anchoring of liners below the attenuation volumes (pond, detention basin or similar) may be necessary to prevent buoyancy.

### 2.8.4 Reservoir flooding

The EA’s Risk of Flooding from Reservoirs dataset indicates that the site is at a very low risk level based upon this dataset as it is not in close vicinity of any reservoirs and is outside the potential flooding zone of influence.

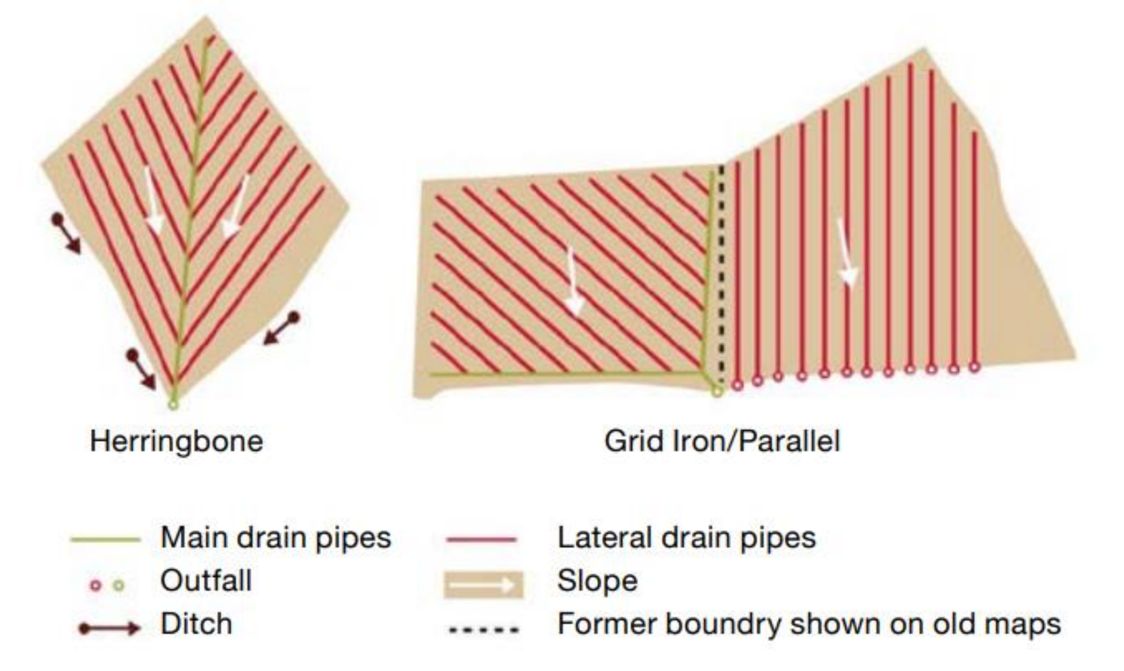
### 2.8.5 Existing drainage

Sewer records obtained from Anglian Water indicate that no sewers are present near to the site. See Appendix A of this report for outputs from the utility searches. The risk of sewer flooding is therefore considered to be very low.

Since the site is situated within an agricultural area, it is anticipated that there is existing drainage present in the form of field drainage. Locations and details of existing field drainage systems are unknown at this stage and a review of natural overland flow paths on steeply sloping ground has not been undertaken.

A field can contain a combination of different layouts or be drained irregularly as shown in Figure 2-6, depending on the surface slopes across the field. If smaller fields have been merged into one, the outfalls may be found at the low points of each original field and not the current field.

**Figure 2-6: Typical drainage layouts**



Source: Field drainage guide by Agriculture and Horticulture Development Board (AHDB), 2022.

### 2.8.6 Existing water mains

A review of Affinity Water records indicates the presence of an existing water main north of the entrance to Lawford Grid Substation. No further information on the water main such as pipe diameter is known at this stage. However, in the event of pipe failure, the general topography suggests that this will not cause flooding to the proposed site and the risk is therefore low.

# 3 Proposed Works

The proposed works for the Co-Located scheme are shown in the following drawing:

- Co-Located Substation Early Design Site Layout/ Location Plan AIS Option 2 (104560-MMD-00-XX-DR-CE-1004)

## 3.1 Temporary Works

For both projects, the temporary works consist of a construction compound and compound access road. The exact arrangements are subject to change but the anticipated areas for the compounds and associated access roads are listed in Table 3.1 below:

**Table 3.1: Construction compound areas**

| Construction Compound | Compound Area (ha) | Access road area (ha) |
|---|---|---|
| Project 1 | 3.50 | 0.16 |
| Project 2 | 3.48 | 0.21 |

The final internal arrangement for both compounds is still to be confirmed but is assumed to include areas of hardstanding, lay down, storage areas for construction materials and equipment, vehicle parking, welfare facilities, wheel wash facilities, workshop facilities and temporary fencing. The anticipated design life of the construction compound is 5 years and at this stage of design is considered 100% impermeable.

## 3.2 Permanent Works

For both projects, the permanent works comprise of a substation and substation access road. The permanent substations both have a gross plan area of 5.88ha with approximate dimensions of 280m by 210m. For the Co-Located scheme, only the Air-Insulated Switchgear (AIS) substation arrangement has been considered at this stage. The AIS arrangement includes a greater proportion of impermeable area than alternative options such as a Gas-Insulated Switchgear (GIS) arrangement and is therefore a conservative approach. Using the AIS arrangement, it has been concluded that of the 5.88ha gross plan area, approximately 1.3ha of that is impermeable. The preferred arrangement will be confirmed during a later design stage. The remainder of the overall site (approximately 4.6ha) will be laid with permeable crushed stone surfacing which will be free draining to direct rainfall, mimicking existing greenfield processes.

The shared permanent access road has an area of approximately 0.34ha. The exact material of the proposed road is to be confirmed at detailed design however the entirety of the area has been considered impermeable at this stage. The design life of both the substations and the permanent access road is 40 years with a 20-year first life maintenance.

# 4 Foul Water Drainage Strategy

The strategy of the foul drainage design is established via two independent networks:

- **Temporary foul water** for the construction compounds
- **Permanent foul water** for the substation buildings.

## 4.1 Temporary Foul Water

An independently managed foul water drainage system is proposed to serve the welfare and toilet facilities within the temporary construction compound.  It is assumed that the foul water will be contained on site and regularly pumped, emptied, and transported off site. This proposal does not require a formal piped foul drainage system on site or provision for an offsite connection.

## 4.2 Permanent Foul Water

There are proposed onsite welfare facilities for the substation associated with infrequent usage.

National Grid’s standard for Site Drainage, TS 2.10.09, states that foul water shall connect into the public sewage system wherever possible, otherwise suitably sized sewage treatment system should be provided with a float switch and high-level alarm.

Since there are no public sewers in the vicinity of the substation sites (according to the Anglian Water sewer records), it is not possible to make a foul connection to a public sewer. Utility searches are shown in Appendix A of this report.

A cess pool (blind tank) is therefore proposed for the substation site. The tank will be emptied periodically. The size of the tank will be confirmed during detailed design.

# 5 Surface Water Drainage Strategy

## 5.1 Overview

This section describes the detailed surface water drainage design strategy for the two proposed substations sites (Project 1 and 2). The principles outlined have been followed to produce the preliminary drainage drawings in Appendix B:

- 104560-MMD-00-XX-DR-CE-1011 Drainage Layout – Co-Located AIS Substations Early Design – Drainage Layout - Operational Phase – Option 2
- 104560-MMD-00-XX-DR-CE-1013 Drainage Layout – Co-Located AIS Substations Early Design – Drainage Layout - Construction Phase – Option 2

## 5.2 Design Guidance and Policy

The following guidance has been consulted in the development of the drainage strategy:

- Generic Electricity Substation Design Manual for Civil, Structural and Building Engineering:
    - Section 01 Oil Containment (TS 2.10.01);
    - Section 09 Site Drainage (TS 2.10.09);
    - Section 13 Flood Defences for Electricity Substations (TS 2.10.13);
- Flood and Water Management Act 2010
- The Building Regulations 2010 Drainage and waste disposal, document H
- National Planning Policy Framework (NPPF) 2021
- National Planning Practice Guidance 2021
- The SuDS Manual (C753)
- Essex County Council Local Flood Risk Management Strategy
- The Sustainable Drainage Systems Design Guide for Essex

The National Planning Practice Guidance (NPPG) outlines the Hierarchy of Drainage with clear aim for drainage systems to discharge surface runoff as high up the hierarchy as reasonably practicable:

1. Into the ground (infiltration)
2. To a surface water body
3. To a surface water sewer, highway drain or other drainage system
4. To a combined system

NPPF outlines guidance on the appropriate use of sustainable drainage systems (SuDS) to better manage the risk from surface water flooding as well as improving water quality, amenity, and biodiversity objectives. For new developments, NPPF states that flood risk mitigation is best achieved by:

- Controlling water at source through Sustainable Drainage Systems (SuDS)
- Considering exceedance flow routes when the capacity of the drainage system is exceeded.

The proposed drainage strategy seeks to improve the local runoff profile by implementing systems that either attenuate run-off or reduce peak flow rates on the existing flood profile.

## 5.3 Design Criteria

The National Grid TS 2.10.13 drainage requirements establish the minimum criteria for new site drainage.

- 1 in 30-year rainfall event – no flooding on site
- 1 in 100-year rainfall event – no flooding on operational area of the site (car parks may flood in this scenario)
- In both 1 in 30-year and 1 in 100-year scenarios, the design shall ensure that excess runoff from the drainage system does not impact adjacent third-party land.
- Where discharge consents or downstream capacity restrictions are in place the design shall restrict flows and incorporate attenuation to achieve the requirement.

National Grid guidance TS 2.10.09 requires the use of FEH rainfall method in the design of site drainage or substations. FEH13 rainfall data was obtained from the UK Centre for Ecology & Hydrology webservice for development of the drainage strategy.

The National Grid design criteria is shown to fulfil the drainage design criteria outlined in the Sustainable Drainage Systems Design Guide for Essex (ECC).

### 5.3.1.1 Climate Change

The Environment Agency provides guidance on allowance for climate change in the design of surface water management systems for new developments.

Table 5.1 and Table 5.2 show the rainfall climate change allowances for the Combined Essex Management Catchment, in which the site is located.

**Table 5.1: Environment Agency Peak rainfall climate change allowances (Combined Essex Management peak rainfall allowances) - 3.3% Annual exceedance rainfall event**

| | Central allowance | Upper end allowance |
|---|---|---|
| 2050s | 20% | 35% |
| 2070s | 20% | 35% |

**Table 5.2: Environment Agency Peak rainfall climate change allowances (Combined Essex Management peak rainfall allowances) -- 1% Annual exceedance rainfall event**

| | Central allowance | Upper end allowance |
|---|---|---|
| 2050s | 20% | 45% |
| 2070s | 25% | 45%* |

*Shown as 40% on the online mapping service, stated in guidance clarification that where the allowance for the 2070s epoch is less than the 2050s, the higher allowance should be used.

For a conservative design approach, the upper end design allowance for the 1 in 100-year rainfall event has been chosen for the permanent works. Where there is no clear guidance of climate change allowances for temporary works, a 10% allowance has been applied. The suitability of this for use is to be to be confirmed following consultation with the Lead Local Flood Authority (LLFA), The final design climate change allowances are shown in Table 5.3.

**Table 5.3: Application of climate change allowances**

| | Permanent Works | Temporary Works |
|---|---|---|
| Design Life (Years) | 40 | 5 |
| Climate Change Allowance (%) | 45 | 10 |

#### 5.3.1.2 Permanent Works

The permanent works are defined as the ‘normal’ features present at a substation and include transformers, buildings, internal roads, car parks and external access roads. The design life is 40 years with a 20-year first life maintenance.

The surface water drainage system shall be designed so that flooding does not occur in any part of the site during the 1 in 30-year return period storm. In line with conservative industry guidelines, no flooding will occur in operational areas during the 1 in 100-year return period and no flooding critical equipment during the 1 in 1000-year event. A climate change allowance of 45% is to be applied.

#### 5.3.1.3 Temporary Works

The temporary works includes both the access roads and construction compounds, and the design life is assumed to be 5 years. Resultingly, the temporary works will be designed to ensure no flooding occurs during the 1 in 5-year return period storm. A climate change allowance of 10% is to be applied, subject to agreement with the Lead Local Flood Authority (LLFA).

#### 5.3.1.4 Disposal of flows

The Environment Agency requires, in accordance with the Government’s PPG-TG document, that there should be no increase in the rate of surface water emanating from a newly developed site above that of any previous development. Furthermore, it is the joint aim of the Environment Agency and Local Planning Authorities, to actively encourage a reduction in the discharge of storm water as a condition of approval for new developments.

Since infiltration rates on the site are to be confirmed, the strategy at this stage is to identify the nearest watercourse and assume surface water runoff from all impermeable areas within the development is to be disposed of via outfall to the watercourse. This is to be reviewed once infiltration data is available.

## 5.4 Proposed Drainage Strategy

The proposed drainage strategy assesses each project as individual sites with separate drainage systems. For each project, the strategy is established via three independent networks summarised below. Further detail is given in subsequent sections.

- **Permanent surface water drainage network:** Considers surface runoff from within the substation plots, including transformers, buildings, internal roads and external access road.
- **Temporary surface water drainage network:** Considers temporary surfaces associated with the construction stage. Suitable pollution controls will be implemented by the contractor to manage the risk of contamination during construction.
- **Temporary and permanent land drainage network:** Considers the greenfield runoff from existing overland flow routes that intersect with the substation and construction compound platform.

### 5.4.1 Permanent Works

#### 5.4.1.1 Catchment Areas

Table 5.4 summarises the contributing permeable and impermeable areas associated with the permanent substations. The contributing areas have been taken from a typical substation (AIS) arrangement drawing (104560-MMD-00-XX-DR-E-0001 ELECTRICAL LAYOUT – AIS). It is proposed to attenuate and drain surface water runoff generated from each project independently, the total values shown is total per project. It is assumed that permeable surfaces are free drainage and therefore only impermeable areas contribute to the proposed drainage design.

**Table 5.4: Substation contributing areas**

| Project | Surface Type | Area (ha) |
|---|---|---|
| Building Area | Impermeable | 0.2913 |
| Oil Containing Plant Area | Impermeable | 0.1422 |
| Internal Access Roads | Impermeable | 0.8684 |
| Substation Permeable Area | Permeable | 4.5781 |
| **Total** | - | **5.88** |

Source: 104560-MMD-00-XX-DR-E-0001 ELECTRICAL LAYOUT - AIS

An additional 0.37ha of permanent access road is a further contributing area. Following topographic review, it has been considered most hydraulicly feasible for runoff from the permanent access road to be conveyed through a shared drainage network where maintenance accountabilities are shared between the two project owners. The total impermeable contributing area per project is summarised in Table 5.5 below.

**Table 5.5: Total contributing areas per project**

| Project Number | Design life | Section | Impermeable area (ha) |
|---|---|---|---|
| **P1** | Permanent | Substation | 1.30 |
| | Temporary | Construction compound | 3.50 |
| | Temporary | Temporary access road | 0.16 |
| **P2** | Permanent | Substation | 1.30 |
| | Temporary | Construction compound | 3.48 |
| | Temporary | Temporary access road | 0.21 |

| Project Number | Design life | Section | Impermeable area (ha) |
|---|---|---|---|
| **Shared** | Permanent | Permanent access road | 0.34 |

### 5.4.1.2 Transformers

All new transformers will be built in accordance with the National Grid guidance TS 2.10.01 - Oil Containment specification. Rainfall captured within the transformer's bund area will be intercepted by an oil discriminating pump connected to a new oil separator tank which will discharge separated water into the site surface water drainage system. For clarity of maintenance accountability, it is proposed for each project to have an individual oil separator tank.

### 5.4.1.3 Buildings and Internal Roads

Runoff from buildings roofs, internal roads and concrete platforms will be channelled into filter drains which will convey flow to the attenuation storage. Without adequate knowledge of infiltration rates, it is currently assumed that infiltration is not appropriate. There may be scope to reduce the attenuation requirements by incorporating infiltration features into the drainage design following further ground investigation. If appropriate, this will be implemented at detailed design.

### 5.4.1.4 External Access Road

Surface water runoff will be routed into a swale along one side of the shared external access road which will discharge into the existing drainage ditch north of Ardleigh Road. There will be a requirement for a permanent culvert of the existing ditch to enable construction of the permanent access road. There is scope to include infiltration at a later design stage if the results from further infiltration testing are favourable.

### 5.4.1.5 Permeable substation platform

The remaining substation site areas will be permeable. The finished platform surface is proposed to be stone surfacing laid in accordance with National Grid Design Standards and constructed of a minimum 450mm deep unbound free draining subbase overlain with a 300mm Type 3 Granular Material and a minimum 75mm top layer of stone chippings which will allow storage of storm water until it can infiltrate into the surrounding soil.

### 5.4.1.6 Land Drainage

Swales are proposed around the perimeter of the substation where overland flows are towards the substation site. Location and sizing of the swales will be developed when more detailed topographic information is available. Swales will be designed to attenuate flows where required to limit flows to the nearest watercourse to greenfield runoff rates. Watercourses that pass through the footprint of the construction works shall be diverted around the perimeter in new ditches which shall have capacity equal to or exceeding those of the existing ditches.

## 5.4.2 Temporary Works

The temporary works refer to the construction compound and associated features required during the construction phase of the project only. The following assumptions have been made:

- It is assumed that once the substations are built, all temporary works will be reinstated to their previous condition.

- A secondary attenuation volume will be installed for the duration of construction in order to attenuate runoff from both the construction and substation compounds whilst the latter is being constructed. The secondary attenuation volume could be filled in once the construction compound is decommissioned and connecting pipework removed. Alternatively, the additional volume could be retained to provide additional resilience.
- Runoff from the temporary works will be directed towards a network of temporary swales located around the perimeter of the compound. It will then be directed to the temporary and permanent attenuation volumes via a filter drain/pipe running along the length of the temporary haul road.
- The proposed temporary drainage system will require sufficient capacity to accommodate existing overland flow routes directed towards the compound by the local topography. This will be quantified at detailed design.
- As a result of the flat terrain across the site, the proposed drainage solution will comprise of a very shallow pipe network. This is shown in the drainage drawings (Appendix B). Consequently, more frequent inspections and maintenance of the system will be required. A pumped solution may also need to be considered at later stages of design once further topographical survey and hydraulic modelling has been undertaken.

#### 5.4.2.1 Construction Compound

As stated in section 3.1, the arrangement of the construction compound is yet to be confirmed but is assumed to include areas of hardstanding, lay down, storage areas for construction materials and equipment, vehicle parking, welfare facilities, wheel wash facilities, workshop facilities and temporary fencing.

Temporary swales are proposed along the perimeter of the compound to intercept and attenuate runoff before discharge to the attenuation volumes. It is acknowledged that areas of the construction compound will be at high risk of pollution/contamination and water quality will therefore need to be managed on a risk-based approach. High risk areas will be bunded and additional proprietary treatment provided before release to the network of swales. The swales will join at the head of the haul road and will be conveyed via filter drain/pipe to the attenuation volumes.

#### 5.4.2.2 Land Drainage

Proposed “clean” edge swales along the perimeter of the construction compound will absorb overland flow routes and divert to the nearest watercourse without flow rate restriction.

### 5.4.3 Post Development Discharge Rates

Infiltration rates at the site are currently unknown and disposal of flows via infiltration has therefore been assumed inappropriate at this stage. The current strategy is to discharge all surface water runoff from impermeable surfaces across the scheme at restricted rates into an unnamed ordinary watercourse located to the south of the overall site. This strategy is subject to change at detailed design upon completion of the ground investigation soakaway testing.

Discharge rates to the receiving watercourse are to be restricted from the developed site based on the estimated ‘greenfield’ runoff rate of the undeveloped site. This has been estimated using the HR Wallingford ‘Greenfield Estimation Tool’ using the IH124 runoff estimation approach. Where it is proposed that each project will have separate drainage systems with, the Greenfield Runoff Rates has been assessed for each project independently.

This greenfield runoff rates have been calculated to assess the total runoff from the impermeable areas of both projects to the receiving watercourse. The percentage of permeable land from the substation has been assumed from available drawings of the Air Insulated Switchgear (AIS) arrangement.

The runoff rates have been assessed for both the construction and operational phases of the project. In both cases, the greenfield runoff rate is shown to be less than 1 l/s. Essex County Council (ECC) as the Lead Local Flood Authority require flow restriction to the 1l/s or the 1 in 1-year greenfield rate, whichever is higher. Resultingly, a maximum flow rate of 1 l/s has been implemented into the design. Greenfield runoff calculations are shown in Appendix C.

Discharge will be controlled via a vortex flow control device so that total discharge from each project does not exceed the proposed 1l/s.

### 5.4.4 Proposed drainage features

MicroDrainage has been used to provide an initial estimate of attenuation storage volumes and associated attenuation feature dimensions required to limit surface water discharge from the site to 1 l/s. The key attenuation features are detailed in Table 5.6 and shown on the drainage drawings (Appendix B).

**Table 5.6: Proposed attenuation features**

| Project | Design life | Attenuation feature type |
|---|---|---|
| 1 | Permanent | Pond + Swale |
| 1 | Temporary | Pond |
| 2 | Permanent | Pond + Swale |
| 2 | Temporary | Pond |

#### 5.4.4.1 Attenuation ponds

It is proposed that both Project 1 and 2 will each have two attenuation volumes to accommodate runoff from the site. Storage volumes have been estimated using MicroDrainage Source Control and have been designed to restrict runoff to a maximum flow rate of 1 l/s from each substation site. Note that volumes stated below are based on an infiltration rate of zero and will be confirmed during detailed design. The permanent attenuation volume for each project is detailed in Table 5.7 below.

The attenuation volume will accommodate all flows associated with the permanent substation base. An additional permanent volume of water (below the outlet) is proposed which will facilitate the treatment of runoff by promoting dilution, settlement of silts and heavy metals and the removal of oxygen demanding material. The total capacity of the permanent attenuation volume will be confirmed during subsequent design stages.

The low greenfield runoff rates and known geology across the site (refer to sections 2.4 and 2.5) indicate high rates of infiltration. Opportunities to infiltrate will be assessed once ground investigation results have been received, with the aim to reduce attenuation volume requirements.

**Table 5.7: Permanent attenuation volume (Ponds)**

| Project | Attenuation volume ($m^3$) |
|---|---|
| 1 | 2248 |
| 2 | 2247 |

The temporary attenuation volume for each project is shown in Table 5.8. The proposed attenuation volume will accommodate the additional runoff during the construction phase (resulting from the increased impermeable area during this time). The combined capacity of both attenuation volumes is sufficient to accommodate the 5-year, 10% climate change design storm event and they will be connected via pipework. The temporary attenuation volume will be filled in upon completion of the construction phase and the associated pipework will be removed.

**Table 5.8: Temporary attenuation volume (required in addition to permanent)**

| Project | Attenuation volume ($m^3$) |
|---|---|
| 1 | 2928 |
| 2 | 2947 |

The requirement to line the attenuation volumes will be confirmed during subsequent design stages. Side slopes for the ponds will be a minimum 1:3 as recommended in the SuDS manual, The maximum flood storage depth is anticipated to be 1.0m with an allowance for freeboard, however the total depth will be dependent on the volume of permanent water retained below the outlet level and will be confirmed during subsequent design stages.

#### 5.4.4.2 Attenuation swale

A shared attenuation swale is proposed to accommodate runoff from the permanent access road. Storage volumes have been estimated using MicroDrainage Source Control and have been designed to restrict runoff below the 1 ll/s. CIRIA design guidance has then been used to design a swale that provides sufficient storage for the conservative upper bound volume requirements, with the resulting attenuation volume provided shown in Table 5.9

**Table 5.9 - Permanent swale attenuation volumes**

| Project | Attenuation volume ($m^3$) |
|---|---|
| 1/2 | 491 |

The proposed swale will be designed to effectively attenuate and treat runoff (see section 5.5) to ensure that runoff does not increase risk off pollutants entering the receiving watercourse. Side slopes for the swale will be a minimum 1:4 as preferred by Essex County Council with a maximum depth of 0.60m. Check dams will be required to reduce the depth (ranging from 0.5-1.9m) of the swale, to be reviewed during detailed design. The final swale dimensions and resulting attenuation volume will be confirmed upon confirmation of ground levels and infiltration rates.

### 5.4.5 Outfalls

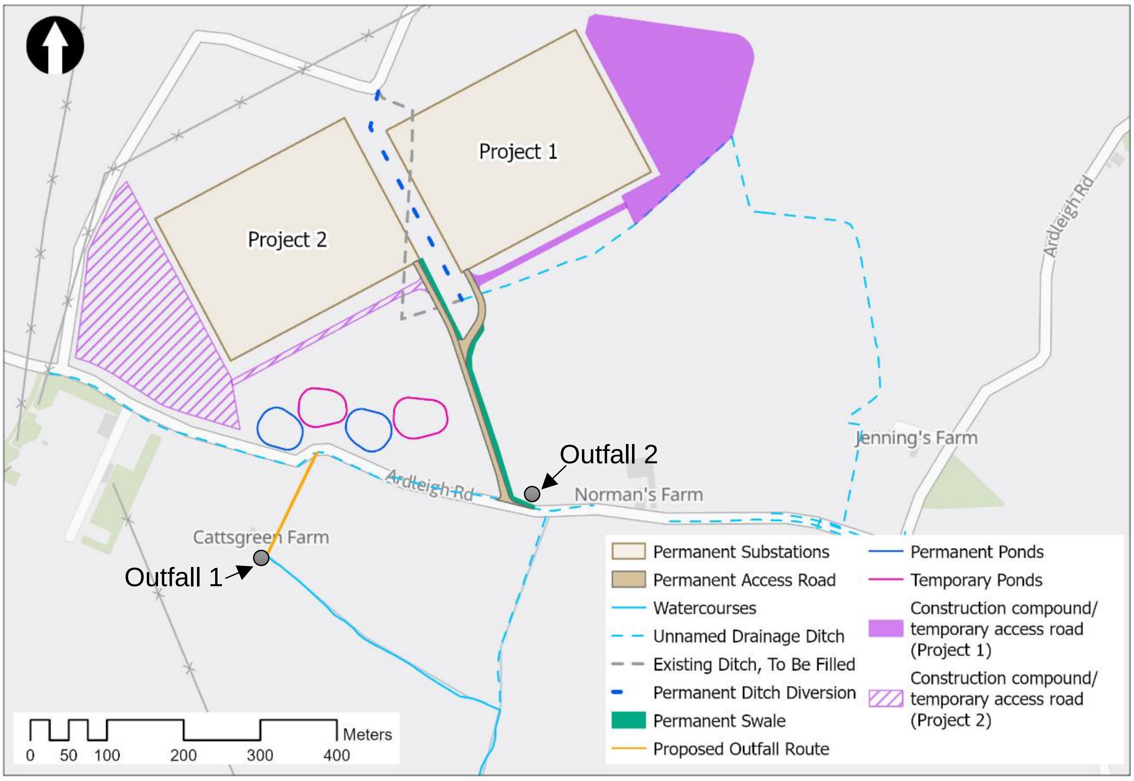
Existing ground topography (Figure 2-1) and mapping of existing watercourses (Figure 2-2) was reviewed to ensure that the final discharge locations match natural drainage routes. For the attenuation ponds, two outfall pipes are proposed to a single outfall location (but with individual headwalls) hereafter referred to as ‘Outfall 1’. A second outfall, ‘Outfall 2’, will convey the runoff from the permanent swale. The proposed outfall locations are shown in Figure 5-1.

For Outfall 1, the proposed receiving watercourse is the unnamed ordinary watercourse located south of Ardleigh Road. The proposed route to the watercourse has been shown indicatively on Figure 5-1 where it is represented by the orange line. This route has been selected as it provides the best opportunity for adequate cover in an area that is highly constrained by flat topography.

For Outfall 2, the proposed receiving watercourse is the unnamed drainage ditch north of Ardleigh road, understood to currently convey runoff from the adjacent Normans Farm to the unnamed ordinary watercourse located south of Ardleigh Road. The proposed outfall route will be direct from the swale to the watercourse. The existing culvert that conveys the water under Ardleigh Road should be verified for suitability for use in the scheme.

Ground levels for both proposed outfalls will need to be validated against results of further topographic survey.

**Figure 5-1: Proposed outfalls and route to receiving watercourse**



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The bed level of the receiving watercourse has not been confirmed but both LiDAR level data and drone survey results indicate that there is nominal fall to allow a gravity connection from the permanent attenuation volume to be made. The unnamed ordinary watercourse becomes the Tenpenny Brook further downstream. Discharging to the highway drainage ditches along Ardleigh Road has been discounted as the ditches are at a higher elevation than the attenuation volume outlets. Resultingly, the outfalls would need to be laid at a very shallow gradient and self-cleansing velocities will not be achieved. As such, more frequent inspections and maintenance will be required. A pumped solution may need to be considered at later stages of design once further drainage modelling has been undertaken.

It is generally accepted that headwalls will be constructed at all locations where a drainage system discharges to open water. Outfalls from the attenuation volume will have a headwall with a sluice gate. A high-level overflow will be installed in the event of design exceedance and details of this will be confirmed at detailed design.

### 5.4.6 Design Exceedance

Based on LiDAR information and the results of the 2022 drone survey, the design exceedance route from the attenuation ponds is south along the farm access track and then south-easterly to the watercourse. The design exceedance route from the swale is south along Ardleigh Road to the Outfall 1 watercourse.  This exceedance routes are shown in the drainage drawings in Appendix B. The route will need to be validated against ground topography once a full topographic survey has been undertaken. The provision of bunds may be necessary to ensure that flows are directed away from the access track and farm buildings.

### 5.4.7 Field Drainage Management

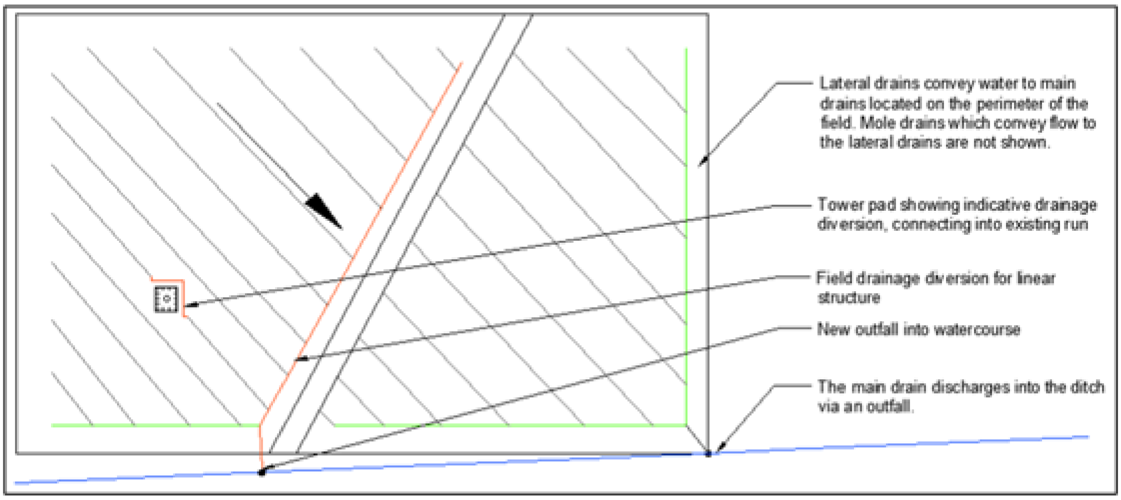
In any instance where an existing field drain is severed by the development, it will require diversion (in preference of truncation) to avoid the flooding of areas upstream.

Field drains can be diverted to accommodate new obstacles as shown in Figure 5-2. Land drains should be sealed or diverted, upslope or downslope, where they cross the site and care taken to ensure that the land upslope will not become flooded as a result.

Newly installed field drains should not drain working areas that have been stripped of topsoil. Where the drains may present a pollution risk, solid (not perforated) pipe should be used and in-line filters and sumps installed as documented in CIRIA 648 – ‘Control of Water Pollution from Linear Construction Projects’.

CIRIA 648 explains that the main contractor can be held responsible for the quality of water diverted through the works and discharged from an outfall during construction. The contractor must therefore be aware of activities upstream (such as muck spreading or ploughing) that may cause polluted water to enter the diverted land drains. It is proposed that attenuation/sediment control ponds are constructed on the line of the diversion, upstream of the receiving watercourse to balance run off rates and mitigate the risk of pollutants entering the watercourse.

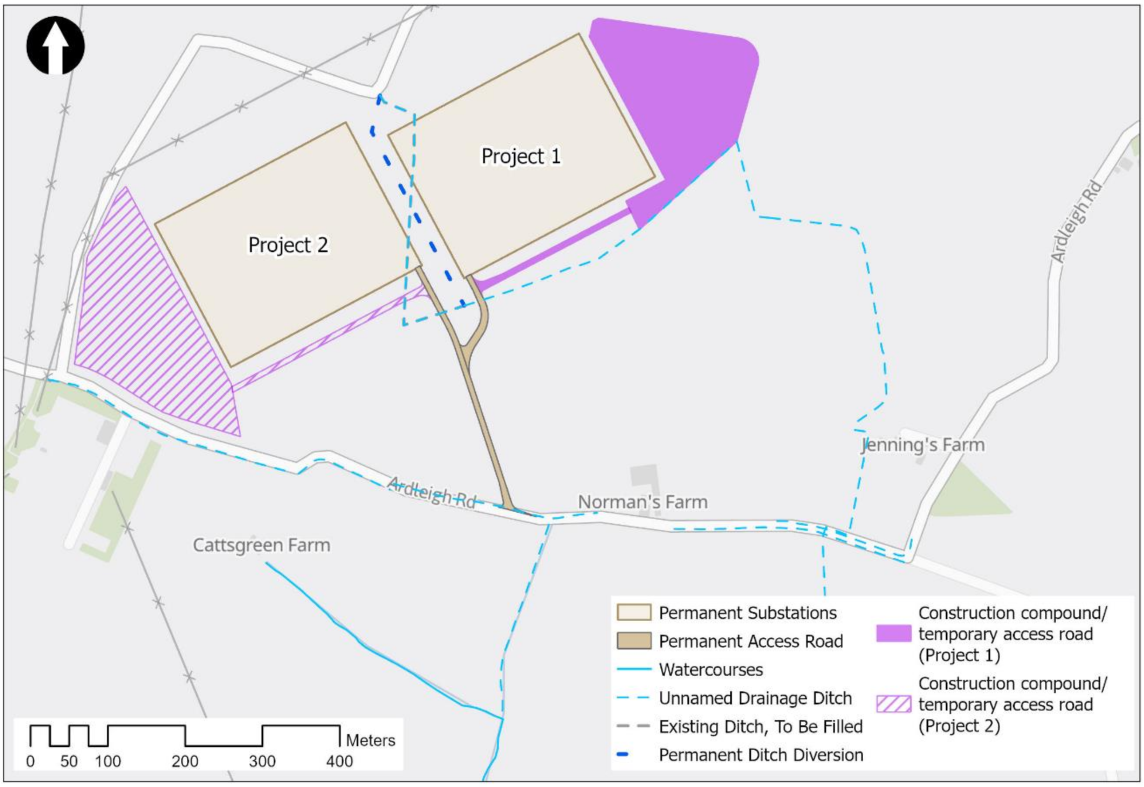
**Figure 5-2: Field Drainage Diversion Layout Example**



Source: Mott MacDonald, 2022

The proposed diversions for the scheme are shown in Figure 5-3.

**Figure 5-3: Proposed watercourse diversions**



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## 5.5 Water Quality

The proposed drainage system and treatment train is to be designed to comply with the water quality design criteria outlined in the CIRIA SuDS manual; the 'Simple Index Approach' will be applied to define the management of water quality from the proposed drainage systems as outlined in Section 26.7.1 'Water quality management: design methods'. This check will confirm that the proposed SuDS components comprising the drainage system provide adequate water quality control. The permanent platform, with the exception of oil filled equipment, which is discussed separately overleaf, is considered to be Medium risk as indicated in Table 5.10 (Table 26.2 of the SuDS Manual):

**Table 5.10: Pollution hazard indices for different land use classifications**

| Land use | Pollution hazard level | Total suspended solids (TSS) | Metals | Hydrocarbons |
|---|---|---|---|---|
| Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail) all roads except low traffic roads and trunk roads/motorways. | Medium | 0.7 | 0.6 | 0.7 |

Source: Table 26.2, CIRIA SuDS Manual 2015

The treatment train proposed includes swales / filter drains and an attenuation volume which provide the following mitigation indices (Table 5.11 and Table 5.12) which demonstrates adequate treatment.

**Table 5.11 - Scenario A: Indicative SuDS mitigation indices for discharges to surface waters**

| | Mitigation Indices | | |
|---|---|---|---|
| **Type of SuDS component** | **TSS** | **Metals** | **Hydrocarbons** |
| Swale | 0.5 | 0.6 | 0.6 |
| Attenuation Volume | 0.7 | 0.7 | 0.5 |
| **Total** | **1.2** | **1.3** | **1.1** |

Source: Table 26.3, CIRIA SuDS Manual 2015

**Table 5.12 - Scenario B: Indicative SuDS mitigation indices for discharges to surface waters**

| | Mitigation Indices | | |
|---|---|---|---|
| **Type of SuDS component** | **TSS** | **Metals** | **Hydrocarbons** |
| Filter drain | 0.4 | 0.4 | 0.4 |
| Attenuation Volume | 0.7 | 0.7 | 0.5 |
| **Total** | **1.1** | **1.1** | **0.9** |

Source: Table 26.3, CIRIA SuDS Manual 2015

The management of water quality from the temporary construction compound will be finalised upon confirmation of layout drawings which will enable the identification and categorisation of high-risk areas. It is anticipated that areas of the construction compound such as refuelling stations and wheel wash areas will require bunding and / or additional proprietary treatment before discharge to the wider drainage network.

In line with National Grid Standard TS 2.10.01, all transformers will have a totally sealed bund with a sump which has a water control unit to pump any water out. Rainfall captured within the transformer’s bund area will be intercepted by an oil discriminating pump connected to an oil separator tank or passed through a filtersepta® unit which will discharge separated water into the site surface water drainage system.

## 5.6 Summary

The drainage strategy outlined in this report has been designed in accordance with the design criteria established in National Grid drainage standards. The drainage strategy comprises of the following components:

- **Filter drains** to treat runoff from the internal access roads within the substation site and covey to swales at the boundary. There is scope to incorporate infiltration at detailed design.
- **Swales** around the perimeter of the construction and operational sites to capture runoff from the filter drains and to intercept overland flows directed towards the substation. A permanent swale running adjacent to the permanent access road to attenuate surface water runoff from the road.
- **Attenuation Ponds:** Both projects will have two attenuation ponds to treat and store runoff from both the construction and operational sites. Once construction has been completed and the land returned to its former state, one attenuation volume could be

filled. Discharge from the attenuation volumes to the receiving watercourse will be limited to 1l/s per project.

- **Outfall pipes:** Self cleansing velocities cannot be achieved due to the flat topography and restricted runoff rates. Resultingly, a rigorous maintenance plan will be required during the operational phase of the project. A pumped solution to be considered at detailed design.

The proposed strategy will provide sufficient protection for all operational areas of the site up to the 1 in 100-year design storm event including a 45% allowance for climate change. Basic checks have been undertaken to quantify the adequacy of treatment provided by the proposed strategy. The basis of design has followed the SuDS approach which is understood to achieve a multitude of benefits:

- Hydraulic Control – surface water runoff interception, peak flow control and volume control.
- Water Quality – filtration of sediment and fine particulates, and the removal of pollutants by filtration and phytoremediation.
- Amenity – improved health and wellbeing of those who live, commute, and work in the area, and improved resilience to the predicted effects of climate change.
- Biodiversity – creating and sustaining better places for nature.

The surface water drainage system shall be designed and detailed in accordance with current best practice and guidance and a SuDS Asset Management Plan shall be developed that sets out the regime for the maintenance of SuDS components and a schedule for each of the maintenance tasks.

# 6 Next Steps

This section provides a summary of the next steps required to progress the drainage strategy:

- **Topographical survey:** A detailed topographic study is required to quantify ground levels and contours in critical locations such as watercourse outfalls.
- **Further ground investigation:** Further ground investigation is required to determine infiltration rates at the site. This will determine the suitability of infiltration-based SuDS components which could be considered at detailed design. Infiltration testing shall follow the methodology outlined BRE Digest 365.
- **Existing field drains:** The location and other details of the existing field drainage systems needs to be confirmed to determine the necessity (and details) of possible diversion routes.
- **Proposed outfalls and discharge rates:** Engagement with Essex County Council (the Lead Local Flood Authority) to confirm the unnamed watercourse as the proposed outfall. Proposed discharge rates also require consultation and agreement.
- **Design criteria for temporary works:** confirm design criteria for flows from the temporary construction site and climate change allowances with Essex County Council (the LLFA).
- **Construction compound layout:** Further detail of the construction compound layout is required to develop the temporary drainage design, including size and location of filter drains and swales and the requirement for additional proprietary treatment and / or pumping.
- **Foul water drainage system:** Options for a cess pool or package treatment plant have been identified to store / treat foul water flows. Options for an independent sewerage treatment system within the permanent substation site will be developed at a later stage in consultation with RWE.
- **Design Exceedance Routes:** Confirm actual exceedance routes based on topographical survey and requirement for bunds or similar to direct flows away from third party assets.

# A. Anglian Water Sewer Records

Date: 10/03/22

Scale: 1:1250

Map Centre: 608427,228203

Data updated: 31/01/22

Our Ref: 802514 - 1

Wastewater Plan A0

This plan is provided by Anglian Water pursuant its obligations under the Water Industry Act 1991 sections 198 or 199. It must be used in conjunction with any search results attached. The information on this plan is based on data currently recorded but position must be regarded as approximate. Service pipes, private sewers and drains are generally not shown. Users of this map are strongly advised to commission their own survey of the area shown on the plan before carrying out any works. The actual position of all apparatus MUST be established by trial holes. No liability whatsoever, including liability for negligence, is accepted by Anglian Water for any error or inaccuracy or omission, including the failure to accurately record, or record at all, the location of any water main, discharge pipe, sewer or disposal main or any item of apparatus. This information is valid for the date printed. This plan is produced by Anglian Water Services Limited (c) Crown copyright and database rights 2022 Ordnance Survey 100022432.This map is to be used for the purposes of viewing the location of Anglian Water plant only. Any other uses of the map data or further copies is not permitted. This notice is not intended to exclude or restrict liability for death or personal injury resulting from negligence.

| | | | | | |
|---|---|---|---|---|---|
| Foul Sewer | — · — | | | | |
| Surface Sewer | – – – | Outfall* | ⋴ | Sewage Treatment Works | ▭ |
| Combined Sewer | — | | | | |
| Final Effluent | — · — | Inlet* | ⋺ | Public Pumping Station | ⬢ |
| Rising Main* | ‐‑‐‑ | | | | |
| Private Sewer* | - - - - | Manhole* | ● | Decommissioned Pumping Station | ⬢ |
| Decommissioned Sewer* | —⋀—⋀— | | | | |

*(Colour denotes effluent type)

utility.reports@technicsgroup.com

SP22209-1

love every drop
anglianwater

Date: 10/03/22

Scale: 1:1250

Map Centre: 608427,228003

Data updated: 31/01/22

Our Ref: 802514 - 2

Wastewater Plan A0

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Foul Sewer
Surface Sewer
Combined Sewer
Final Effluent
Rising Main*
Private Sewer*
Decommissioned Sewer*

Outfall* ∈
Inlet* ∋
Manhole* ●

Sewage Treatment Works ▭
Public Pumping Station ⬢
Decommissioned Pumping Station ⬢

*(Colour denotes effluent type)

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SP22209-2

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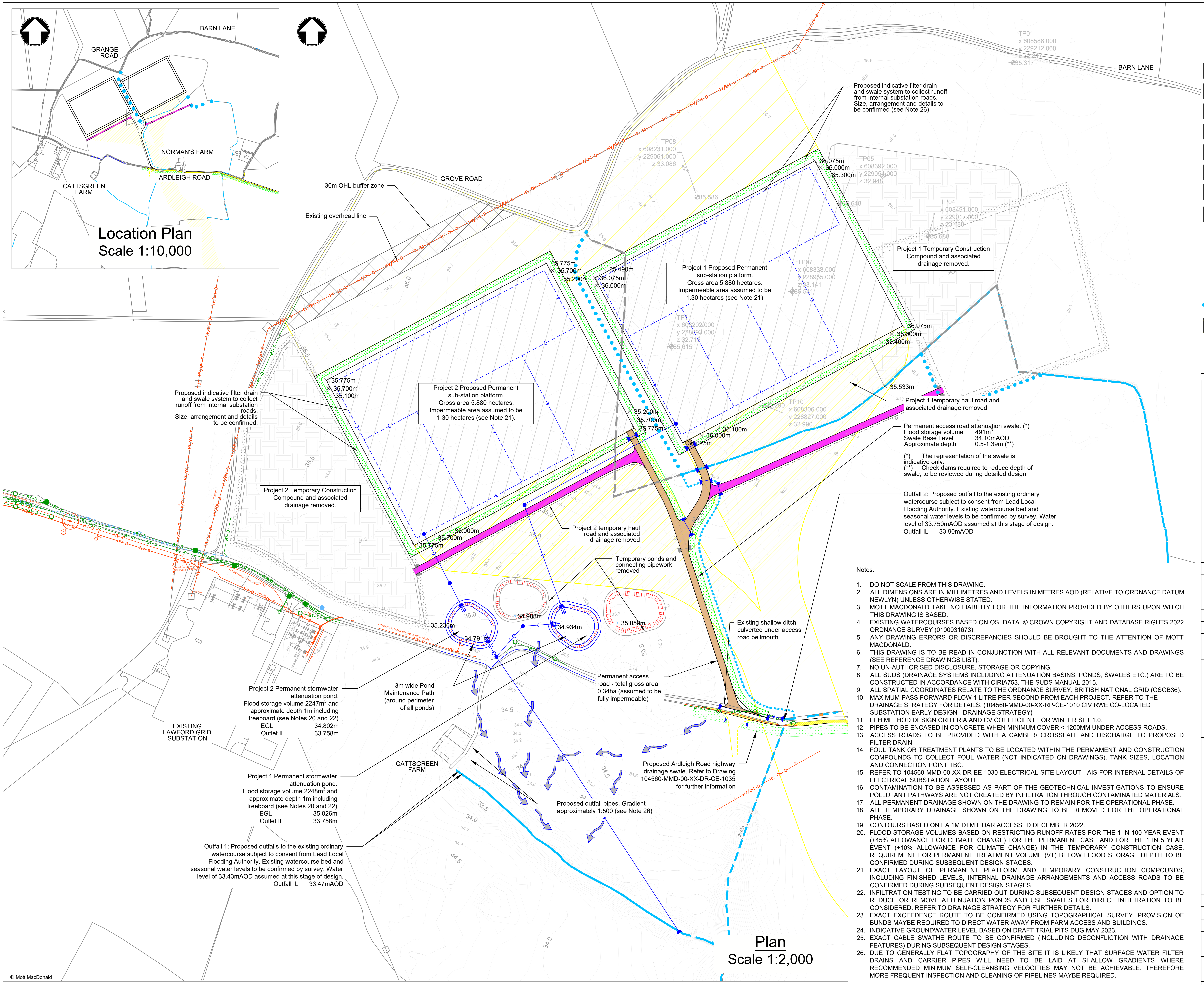
# B. Drainage Strategy Drawing



Legend:

| | | | |
|---|---|---|---|
| ▨ | Permanent Substation Compound | ◗ | Permanent Headwall |
| 🟩 | Permanent swale/infiltration ditch (see Note 22) | ● | Permanent Catchpit |
| 🟧 | Permanent Access Road (material to be confirmed) | ○ | Catchpit with vortex flow control device (see Note 10) |
| ▨ | Permanent Access Overrun Area | ⧓ | Permanent Culvert Crossing |
| 🟦 | Paved Area (tarmac) of the Permanent Access to Substation | ─ | Permanent Carrier Pipe |
| ▨ | Permanent Pond and Grading | - -›- - | Permanent Filter Drain Pipe |
| ▩ | Temporary Access Road | -□-□- | Permanent Fenceline |
| ▦ | Temporary Construction Compound | ◗ | Temporary Headwall |
| ▨ | Temporary swale/infiltration ditch (see Note 22) | ● | Temporary Chamber |
| ▨ | Temporary Pond and Grading | ─ | Temporary Carrier Pipe |
| ↶ | Design flow exceedence route (see note 23) | - - - | Temporary Filter Drain/Ditch |
| ─ | Existing Watercourse (see Note 4) | ⧓ | Temporary Culvert Crossing |
| - - - | Existing Ditch | × xx.xxxm | Permanent/FGL Spot Level |
| - - - | Existing Ditch, Planned to Fill In | — xx.xxxm — | LiDAR Contours |
| • • • | Permanent Ditch Diversion | TPXX xx.xxxm | Ground Investigation Trial Pit Location |
| ▨ | Proposed Cable Swathe Routes (see Note 25) | z xx.xxx | Existing Ground Water Level (see Note 24) |
| ─ | Cable Route Corridor Zone | △ xx.xxx | Lowest proposed level in compound |
| | | ○ xx.xxx | Lowest existing ground level in pond |
| | | —HV–D——HV–D— | High Voltage Utility |
| | | ——HV/OH–D—— | High Voltage Overhead Utility |
| | | —BT–D——BT–D— | BT Utility |
| | | ——WTR–D—— | Buried Water Utility |

Reference drawings

OS map
SOCOTEC UK Draft Trial Pit Logs (Dug 19th May 2023)
Technics Digitised Utility Report Information
104560-MMD-00-XX-DR-CE-1004 - Site Layout/ Location Plan - AIS Option 2
104560-MMD-00-XX-DR-CE-1006 - AIS Substation Earthworks Plan and Long Section - Project 1 & 2
104560-MMD-00-XX-DR-CE-1007 - Temporary Compound Earthworks Plan and Long Section - Project 1
104560-MMD-00-XX-DR-CE-1009 - Temporary Compound Earthworks Plan and Long Section - Project 2
104560-MMD-00-XX-DR-CE-1015 - Permanent Access Layout
104560-MMD-00-XX-DR-CE-1017 - Temporary Accesses to Construction Compounds (Option 2) Layout
104560-MMD-00-XX-DR-EE-1030 - Electrical Site Layout - AIS
104560-MMD-00-XX-DR-CE-1061 - Permanent and Temporary Access Junction with Ardleigh Road

Notes:

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9. ALL SPATIAL COORDINATES RELATE TO THE ORDNANCE SURVEY, BRITISH NATIONAL GRID (OSGB36).
10. MAXIMUM PASS FORWARD FLOW 1 LITRE PER SECOND FROM EACH PROJECT. REFER TO THE DRAINAGE STRATEGY FOR DETAILS. (104560-MMD-00-XX-RP-CE-1010 CIV RWE CO-LOCATED SUBSTATION EARLY DESIGN - DRAINAGE STRATEGY)
11. FEH METHOD DESIGN CRITERIA AND CV COEFFICIENT FOR WINTER SET 1.0.
12. PIPES TO BE ENCASED IN CONCRETE WHEN MINIMUM COVER < 1200MM UNDER ACCESS ROADS.
13. ACCESS ROADS TO BE PROVIDED WITH A CAMBER/ CROSSFALL AND DISCHARGE TO PROPOSED FILTER DRAIN.
14. FOUL TANK OR TREATMENT PLANTS TO BE LOCATED WITHIN THE PERMAMENT AND CONSTRUCTION COMPOUNDS TO COLLECT FOUL WATER (NOT INDICATED ON DRAWINGS). TANK SIZES, LOCATION AND CONNECTION POINT TBC.
15. REFER TO 104560-MMD-00-XX-DR-EE-1030 ELECTRICAL SITE LAYOUT - AIS FOR INTERNAL DETAILS OF ELECTRICAL SUBSTATION LAYOUT.
16. CONTAMINATION TO BE ASSESSED AS PART OF THE GEOTECHNICAL INVESTIGATIONS TO ENSURE POLLUTANT PATHWAYS ARE NOT CREATED BY INFILTRATION THROUGH CONTAMINATED MATERIALS.
17. ALL PERMANENT DRAINAGE SHOWN ON THE DRAWING TO REMAIN FOR THE OPERATIONAL PHASE.
18. ALL TEMPORARY DRAINAGE SHOWN ON THE DRAWING TO BE REMOVED FOR THE OPERATIONAL PHASE.
19. CONTOURS BASED ON EA 1M DTM LIDAR ACCESSED DECEMBER 2022.
20. FLOOD STORAGE VOLUMES BASED ON RESTRICTING RUNOFF RATES FOR THE 1 IN 100 YEAR EVENT (+45% ALLOWANCE FOR CLIMATE CHANGE) FOR THE PERMANENT CASE AND FOR THE 1 IN 5 YEAR EVENT (+10% ALLOWANCE FOR CLIMATE CHANGE) IN THE TEMPORARY CONSTRUCTION CASE. REQUIREMENT FOR PERMANENT TREATMENT VOLUME (VT) BELOW FLOOD STORAGE DEPTH TO BE CONFIRMED DURING SUBSEQUENT DESIGN STAGES.
21. EXACT LAYOUT OF PERMANENT PLATFORM AND TEMPORARY CONSTRUCTION COMPOUNDS, INCLUDING FINISHED LEVELS, INTERNAL DRAINAGE ARRANGEMENTS AND ACCESS ROADS TO BE CONFIRMED DURING SUBSEQUENT DESIGN STAGES.
22. INFILTRATION TESTING TO BE CARRIED OUT DURING SUBSEQUENT DESIGN STAGES AND OPTION TO REDUCE OR REMOVE ATTENUATION PONDS AND USE SWALES FOR DIRECT INFILTRATION TO BE CONSIDERED. REFER TO DRAINAGE STRATEGY FOR FURTHER DETAILS.
23. EXACT EXCEEDENCE ROUTE TO BE CONFIRMED USING TOPOGRAPHICAL SURVEY. PROVISION OF BUNDS MAYBE REQUIRED TO DIRECT WATER AWAY FROM FARM ACCESS AND BUILDINGS.
24. INDICATIVE GROUNDWATER LEVEL BASED ON DRAFT TRIAL PITS DUG MAY 2023.
25. EXACT CABLE SWATHE ROUTE TO BE CONFIRMED (INCLUDING DECONFLICTION WITH DRAINAGE FEATURES) DURING SUBSEQUENT DESIGN STAGES.
26. DUE TO GENERALLY FLAT TOPOGRAPHY OF THE SITE IT IS LIKELY THAT SURFACE WATER FILTER DRAINS AND CARRIER PIPES WILL NEED TO BE LAID AT SHALLOW GRADIENTS WHERE RECOMMENDED MINIMUM SELF-CLEANSING VELOCITIES MAY NOT BE ACHIEVABLE. THEREFORE MORE FREQUENT INSPECTION AND CLEANING OF PIPELINES MAYBE REQUIRED.

| Rev | Date | Drawn | Description | Ch'k'd | App'd |
|---|---|---|---|---|---|
| 05 | 04/03/2024 | CT | Updated to address client comments | TN | AFC |
| 04 | 24/01/2024 | YV | Updated to address client comments | JWD | AFC |
| 03 | 18/09/2023 | CT | Updated to address client comments | TN | AFC |
| 02 | 01/08/2023 | CT | Client's comments incorporated | TN | JW |
| 01 | 15/06/2023 | YV | Preliminary | AL | MB |

Status Stamp

PRELIMINARY

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Client

NORTH FALLS
Offshore Wind Farm

FIVE ESTUARIES
OFFSHORE WIND FARM

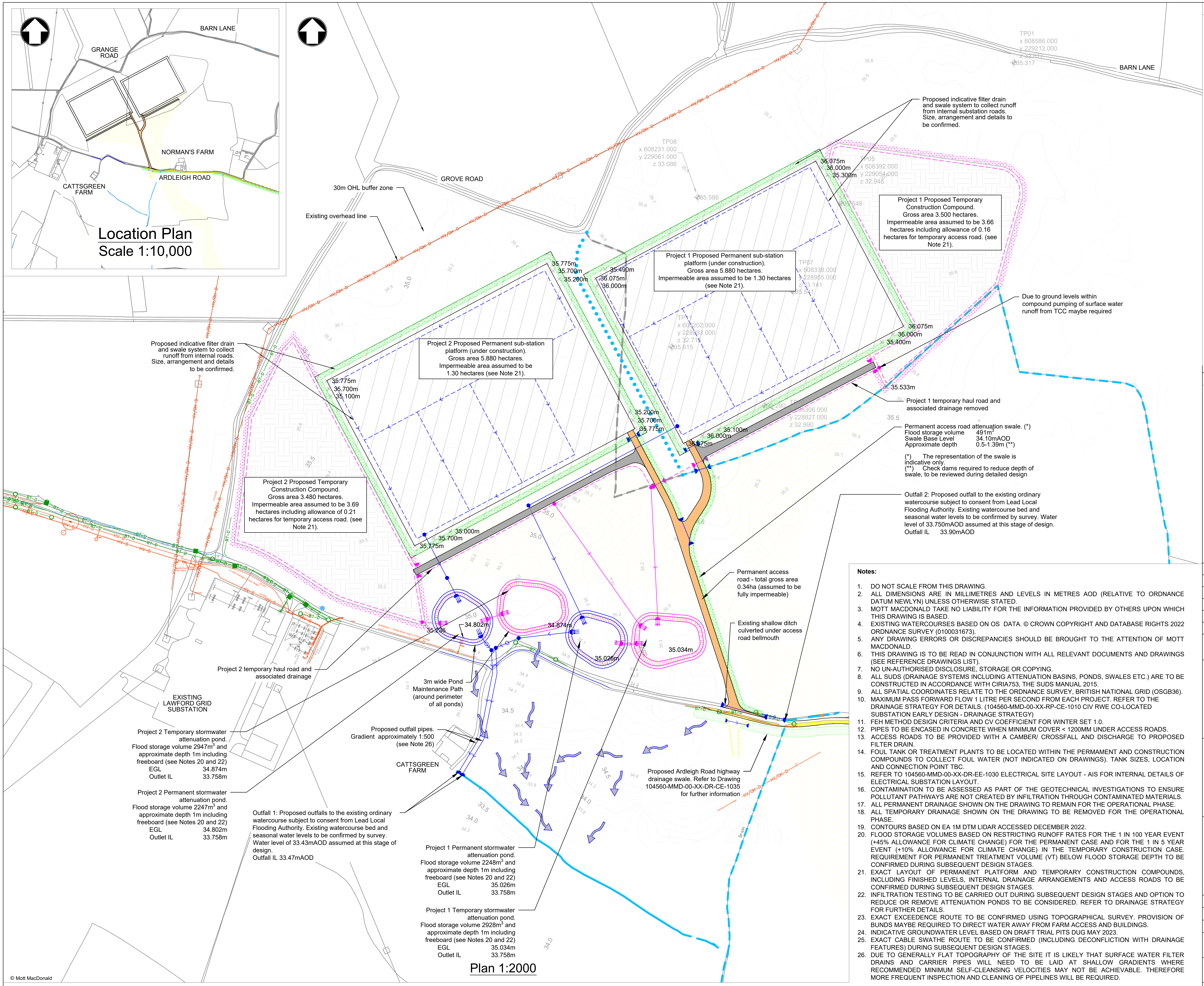
Title

# Co-located AIS Substations Early Design - Drainage Layout - Operational Phase - Option 2

Sheet 01 of 01

| | | | | | |
|---|---|---|---|---|---|
| Designed | Charlotte Tyler | CT | Eng check | Amy Lambourne | AL |
| Drawn | Laura Snowden | LS | Coordination | Andrea F. Crespo | AFC |
| Dwg check | Thomas North | TN | Approved | Matthew Barton | MB |

MMD Project Number: 104560-001
Scale at A1: As Indicated
Security: STD
Client Number: 004809399-04
Suit. Code: S3
Drawing Number: 104560-MMD-00-XX-DR-CE-1011
Revision: 05



30m OHL buffer zone

Existing overhead line

Proposed indicative filter drain and swale system to collect runoff from internal substation roads. Size, arrangement and details to be confirmed.

Project 1 Proposed Temporary Construction Compound.
Gross area 3.500 hectares.
Impermeable area assumed to be 3.66 hectares including allowance of 0.16 hectares for temporary access road. (see Note 21).

Project 1 Proposed Permanent sub-station platform (under construction).
Gross area 5.880 hectares.
Impermeable area assumed to be 1.30 hectares (see Note 21).

Due to ground levels within compound pumping of surface water runoff from TCC maybe required

Project 1 temporary haul road and associated drainage removed

Permanent access road attenuation swale. (*)

| | |
|---|---|
| Flood storage volume | 491m$^3$ |
| Swale Base Level | 34.10mAOD |
| Approximate depth | 0.5-1.39m (**) |

(*) The representation of the swale is indicative only.
(**) Check dams required to reduce depth of swale, to be reviewed during detailed design

Outfall 2: Proposed outfall to the existing ordinary watercourse subject to consent from Lead Local Flooding Authority. Existing watercourse bed and seasonal water levels to be confirmed by survey. Water level of 33.750mAOD assumed at this stage of design.
Outfall IL 33.90mAOD

Proposed indicative filter drain and swale system to collect runoff from internal roads. Size, arrangement and details to be confirmed.

Project 2 Proposed Permanent sub-station platform (under construction).
Gross area 5.880 hectares.
Impermeable area assumed to be 1.30 hectares (see Note 21).

Project 2 Proposed Temporary Construction Compound.
Gross area 3.480 hectares.
Impermeable area assumed to be 3.69 hectares including allowance of 0.21 hectares for temporary access road. (see Note 21).

Permanent access road - total gross area 0.34ha (assumed to be fully impermeable)

Existing shallow ditch culverted under access road bellmouth

Project 2 temporary haul road and associated drainage

3m wide Pond Maintenance Path (around perimeter of all ponds)

Proposed outfall pipes. Gradient approximately 1:500 (see Note 26)

Proposed Ardleigh Road highway drainage swale. Refer to Drawing 104560-MMD-00-XX-DR-CE-1035 for further information

Project 2 Temporary stormwater attenuation pond.
Flood storage volume 2947m$^3$ and approximate depth 1m including freeboard (see Notes 20 and 22)

| | |
|---|---|
| EGL | 34.874m |
| Outlet IL | 33.758m |

Project 2 Permanent stormwater attenuation pond.
Flood storage volume 2247m$^3$ and approximate depth 1m including freeboard (see Notes 20 and 22)

| | |
|---|---|
| EGL | 34.802m |
| Outlet IL | 33.758m |

Outfall 1: Proposed outfalls to the existing ordinary watercourse subject to consent from Lead Local Flooding Authority. Existing watercourse bed and seasonal water levels to be confirmed by survey. Water level of 33.43mAOD assumed at this stage of design.
Outfall IL 33.47mAOD

Project 1 Permanent stormwater attenuation pond.
Flood storage volume 2248m$^3$ and approximate depth 1m including freeboard (see Notes 20 and 22)

| | |
|---|---|
| EGL | 35.026m |
| Outlet IL | 33.758m |

Project 1 Temporary stormwater attenuation pond.
Flood storage volume 2928m$^3$ and approximate depth 1m including freeboard (see Notes 20 and 22)

| | |
|---|---|
| EGL | 35.034m |
| Outlet IL | 33.758m |

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8. ALL SUDS (DRAINAGE SYSTEMS INCLUDING ATTENUATION BASINS, PONDS, SWALES ETC.) ARE TO BE CONSTRUCTED IN ACCORDANCE WITH CIRIA753, THE SUDS MANUAL 2015.
9. ALL SPATIAL COORDINATES RELATE TO THE ORDNANCE SURVEY, BRITISH NATIONAL GRID (OSGB36).
10. MAXIMUM PASS FORWARD FLOW 1 LITRE PER SECOND FROM EACH PROJECT. REFER TO THE DRAINAGE STRATEGY FOR DETAILS. (104560-MMD-00-XX-RP-CE-1010 CIV RWE CO-LOCATED SUBSTATION EARLY DESIGN - DRAINAGE STRATEGY)
11. FEH METHOD DESIGN CRITERIA AND CV COEFFICIENT FOR WINTER SET 1.0.
12. PIPES TO BE ENCASED IN CONCRETE WHEN MINIMUM COVER < 1200MM UNDER ACCESS ROADS.
13. ACCESS ROADS TO BE PROVIDED WITH A CAMBER/ CROSSFALL AND DISCHARGE TO PROPOSED FILTER DRAIN.
14. FOUL TANK OR TREATMENT PLANTS TO BE LOCATED WITHIN THE PERMAMENT AND CONSTRUCTION COMPOUNDS TO COLLECT FOUL WATER (NOT INDICATED ON DRAWINGS). TANK SIZES, LOCATION AND CONNECTION POINT TBC.
15. REFER TO 104560-MMD-00-XX-DR-EE-1030 ELECTRICAL SITE LAYOUT - AIS FOR INTERNAL DETAILS OF ELECTRICAL SUBSTATION LAYOUT.
16. CONTAMINATION TO BE ASSESSED AS PART OF THE GEOTECHNICAL INVESTIGATIONS TO ENSURE POLLUTANT PATHWAYS ARE NOT CREATED BY INFILTRATION THROUGH CONTAMINATED MATERIALS.
17. ALL PERMANENT DRAINAGE SHOWN ON THE DRAWING TO REMAIN FOR THE OPERATIONAL PHASE.
18. ALL TEMPORARY DRAINAGE SHOWN ON THE DRAWING TO BE REMOVED FOR THE OPERATIONAL PHASE.
19. CONTOURS BASED ON EA 1M DTM LIDAR ACCESSED DECEMBER 2022.
20. FLOOD STORAGE VOLUMES BASED ON RESTRICTING RUNOFF RATES FOR THE 1 IN 100 YEAR EVENT (+45% ALLOWANCE FOR CLIMATE CHANGE) FOR THE PERMANENT CASE AND FOR THE 1 IN 5 YEAR EVENT (+10% ALLOWANCE FOR CLIMATE CHANGE) IN THE TEMPORARY CONSTRUCTION CASE. REQUIREMENT FOR PERMANENT TREATMENT VOLUME (VT) BELOW FLOOD STORAGE DEPTH TO BE CONFIRMED DURING SUBSEQUENT DESIGN STAGES.
21. EXACT LAYOUT OF PERMANENT PLATFORM AND TEMPORARY CONSTRUCTION COMPOUNDS, INCLUDING FINISHED LEVELS, INTERNAL DRAINAGE ARRANGEMENTS AND ACCESS ROADS TO BE CONFIRMED DURING SUBSEQUENT DESIGN STAGES.
22. INFILTRATION TESTING TO BE CARRIED OUT DURING SUBSEQUENT DESIGN STAGES AND OPTION TO REDUCE OR REMOVE ATTENUATION PONDS TO BE CONSIDERED. REFER TO DRAINAGE STRATEGY FOR FURTHER DETAILS.
23. EXACT EXCEEDENCE ROUTE TO BE CONFIRMED USING TOPOGRAPHICAL SURVEY. PROVISION OF BUNDS MAYBE REQUIRED TO DIRECT WATER AWAY FROM FARM ACCESS AND BUILDINGS.
24. INDICATIVE GROUNDWATER LEVEL BASED ON DRAFT TRIAL PITS DUG MAY 2023.
25. EXACT CABLE SWATHE ROUTE TO BE CONFIRMED (INCLUDING DECONFLICTION WITH DRAINAGE FEATURES) DURING SUBSEQUENT DESIGN STAGES.
26. DUE TO GENERALLY FLAT TOPOGRAPHY OF THE SITE IT IS LIKELY THAT SURFACE WATER FILTER DRAINS AND CARRIER PIPES WILL NEED TO BE LAID AT SHALLOW GRADIENTS WHERE RECOMMENDED MINIMUM SELF-CLEANSING VELOCITIES MAY NOT BE ACHIEVABLE. THEREFORE MORE FREQUENT INSPECTION AND CLEANING OF PIPELINES WILL BE REQUIRED.

1:2000 0 100m 200m

1:10,000 0 500m 1000m

Legend:

| | | | |
|---|---|---|---|
| ▨ | Permanent Substation Compound | ▶ | Permanent Headwall |
| ▨ | Permanent swale/infiltration ditch (see Note 22) | ● | Permanent Catchpit |
| ■ | Permanent Access Road (material to be confirmed) | ○ | Catchpit with vortex flow control device (see Note 10) |
| ▨ | Permanent Access Overrun Area | ▶—◀ | Permanent Culvert Crossing |
| ■ | Paved Area (tarmac) of the Permanent Access to Substation | —›— | Permanent Carrier Pipe |
| ▨ | Permanent Pond and Grading | - - › - - | Permanent Filter Drain Pipe |
| ■ | Temporary Access Road | —□—□—□— | Permanent Fenceline |
| ▨ | Temporary Construction Compound | ▶ | Temporary Headwall |
| ▨ | Temporary swale/infiltration ditch (see Note 22) | ● | Temporary Chamber |
| ▨ | Temporary Pond and Grading | —— | Temporary Carrier Pipe |
| ↶ | Design flow exceedence route (see note 23) | - - - - | Temporary Filter Drain/Ditch |
| —— | Existing Watercourse (see Note 4) | ▶—◀ | Temporary Culvert Crossing |
| - - - - | Existing Ditch | × xx.xxxm | Permanent/FGL Spot Level |
| - - - - | Existing Ditch, Planned to Fill In | — xx.xxxm — | LiDAR Contours |
| ········ | Permanent Ditch Diversion | TPXX xx.xxxm | Ground Investigation Trial Pit Location |
| ▨ | Proposed Cable Swathe Routes (see Note 25) | z xx.xxx | Existing Ground Water Level (see Note 24) |
| —— | Cable Route Corridor Zone | △ xx.xxx | Lowest proposed level in compound |
| | | ○ xx.xxx | Lowest existing ground level in pond |
| | | —HV–D——HV–D— | High Voltage Utility |
| | | ——HV/OH–D—— | High Voltage Overhead Utility |
| | | —BT–D——BT–D— | BT Utility |
| | | ——WTR–D—— | Buried Water Utility |

Reference drawings

OS map
SOCOTEC UK Draft Trial Pit Logs (Dug 19th May 2023)
Technics Digitised Utility Report Information
104560-MMD-00-XX-DR-CE-1004 - Site Layout/ Location Plan - AIS Option 2
104560-MMD-00-XX-DR-CE-1006 - AIS Substation Earthworks Plan and Long Section - Project 1 & 2
104560-MMD-00-XX-DR-CE-1007 - Temporary Compound Earthworks Plan and Long Section - Project 1
104560-MMD-00-XX-DR-CE-1009 - Temporary Compound Earthworks Plan and Long Section - Project 2
104560-MMD-00-XX-DR-CE-1015 - Permanent Access Layout
104560-MMD-00-XX-DR-CE-1017 - Temporary Accesses to Construction Compounds (Option 2) Layout
104560-MMD-00-XX-DR-EE-1030 - Electrical Site Layout - AIS
104560-MMD-00-XX-DR-CE-1061 - Permanent and Temporary Access Junction with Ardleigh Road

| Rev | Date | Drawn | Description | Ch'k'd | App'd |
|---|---|---|---|---|---|
| 05 | 04/03/2024 | CT | Updated to address client comment | TN | AFC |
| 04 | 24/01/2024 | YV | Updated to address client comments | JWD | AFC |
| 03 | 18/09/2023 | CT | Updated to address client comments | TN | AFC |
| 02 | 01/08/2023 | CT | Client's comments incorporated | TN | JW |
| 01 | 15/06/2023 | YV | Preliminary | AL | MB |

Status Stamp

PRELIMINARY

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Client

NORTH FALLS
Offshore Wind Farm

FIVE ESTUARIES
OFFSHORE WIND FARM

Title

# Co-located AIS Substations Early Design - Drainage Layout - Construction Phase - Option 2

Sheet 01 of 01

| | | | | | |
|---|---|---|---|---|---|
| Designed | Charlotte Tyler | CT | Eng check | Amy Lambourne | AL |
| Drawn | Yani Vardarov | YV | Coordination | Andrea F. Crespo | AFC |
| Dwg check | Thomas North | TN | Approved | Matthew Barton | MB |

MMD Project Number
104560-001

Scale at A1
As Indicated

Security
STD

Client Number
004809401-04

Suit. Code
S3

Drawing Number
104560-MMD-00-XX-DR-CE-1013

Revision
05

# C. Greenfield Runoff Calculations

# Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

**Calculated by:** Charlotte Tyler

**Site name:** Max Pond Values

**Site location:**

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

## Site Details

**Latitude:** 51.91791° N

**Longitude:** 1.01969° E

**Reference:** 449116241

**Date:** Jul 12 2023 15:38

## Runoff estimation approach

IH124

## Site characteristics

**Total site area (ha):** 5.9

## Methodology

**$Q_{BAR}$ estimation method:** Calculate from SPR and SAAR

**SPR estimation method:** Calculate from SOIL type

## Soil characteristics

| | Default | Edited |
|---|---|---|
| **SOIL type:** | 1 | 1 |
| **HOST class:** | N/A | N/A |
| **SPR/SPRHOST:** | 0.1 | 0.1 |

## Hydrological characteristics

| | Default | Edited |
|---|---|---|
| **SAAR (mm):** | 558 | 558 |
| **Hydrological region:** | 6 | 6 |
| **Growth curve factor 1 year:** | 0.85 | 0.85 |
| **Growth curve factor 30 years:** | 2.3 | 2.3 |
| **Growth curve factor 100 years:** | 3.19 | 3.19 |
| **Growth curve factor 200 years:** | 3.74 | 3.74 |

## Notes

### (1) Is $Q_{BAR}$ < 2.0 l/s/ha?

When $Q_{BAR}$ is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

### (2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

### (3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

## Greenfield runoff rates

| | Default | Edited |
|---|---|---|

| | | |
|---|---|---|
| $Q_{BAR}$ (l/s): | 0.76 | 0.76 |
| 1 in 1 year (l/s): | 0.65 | 0.65 |
| 1 in 30 years (l/s): | 1.75 | 1.75 |
| 1 in 100 year (l/s): | 2.43 | 2.43 |
| 1 in 200 years (l/s): | 2.84 | 2.84 |

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| ADDRESS | Five Estuaries Offshore Wind Farm Ltd<br>Windmill Hill Business Park<br>Whitehill Way, Swindon, SN5 6PB |
| COMPANY NO | Registered in England and Wales<br>company number 12292474 |