

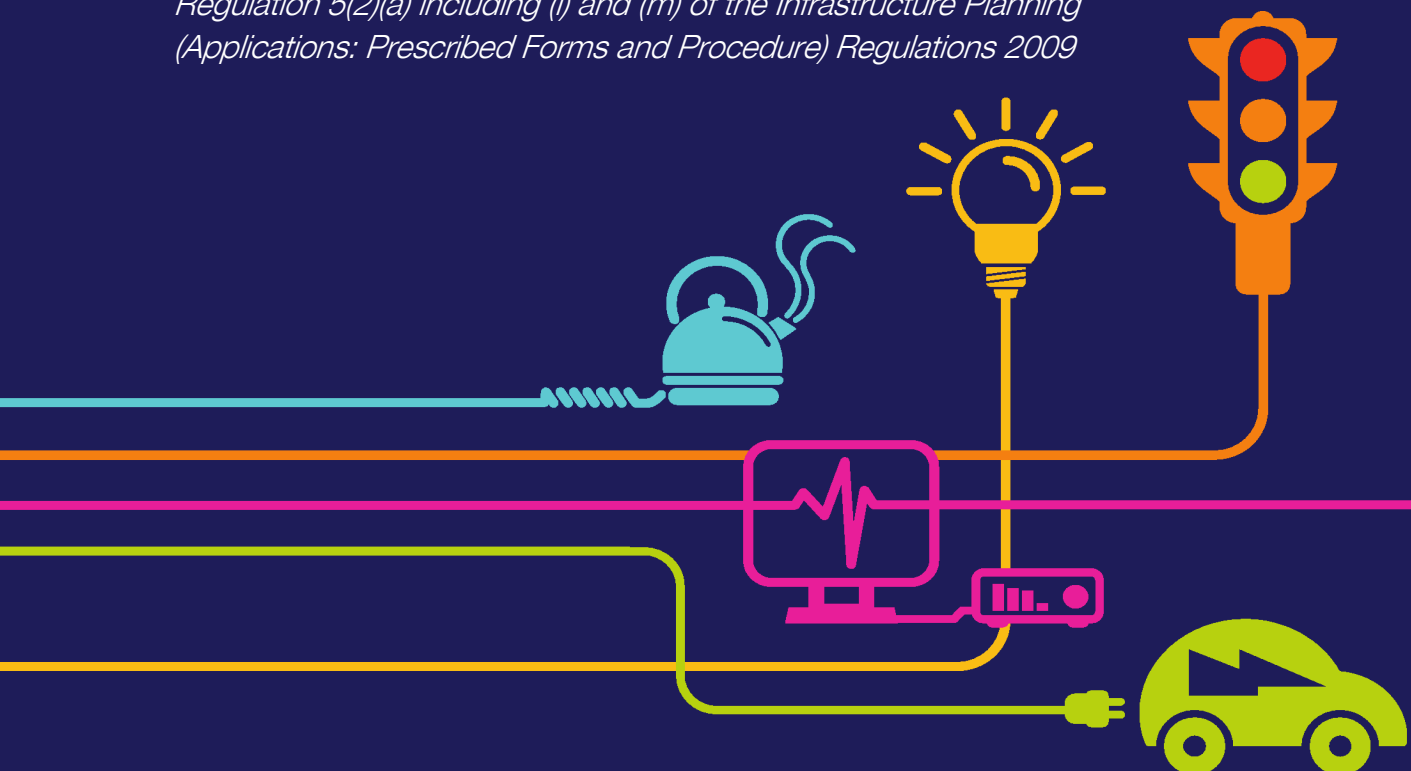
DOCUMENT 5.12.2.2

# Pentir Substation Extension Flood Consequences Assessment

## Chapter 12 – Appendix 2

National Grid (North Wales Connection Project)

*Regulation 5(2)(a) including (l) and (m) of the Infrastructure Planning  
(Applications: Prescribed Forms and Procedure) Regulations 2009*





**nationalgrid**

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# **North Wales Connection Project**

## **Volume 5**

### **5.12.2.2 Appendix 12.2 Pentir Substation Extension Flood Consequences Assessment**

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# 1 Introduction

## 1.1 CONTEXT

1.1.1 This Flood Consequences Assessment (FCA) accompanies an application by National Grid Electricity Transmission (plc) (National Grid) to seek powers to construct, operate and maintain a new 400,000 volt (400 kV) connection between Wylfa Substation and Pentir Substation, together with various associated development and other works (“The Proposed Development”). This document is the second of four FCA volumes, together comprising an appendix to Chapter 12 of the Environmental Statement: ‘Water Quality, Resources and Flood Risk’ (**Document 5.12**). The four FCA volumes comprise:

**Volume 1** Overarching FCA (**Document 5.12.2.1**)

**Volume 2** Pentir Substation Extension FCA (**Document 5.12.2.2**)

**Volume 3** Cable Sealing End Compounds and Tunnel Head Houses FCA (**Document 5.12.2.3**)

**Volume 4** Overhead Lines FCA (**Document 5.12.2.4**)

1.1.2 A list of references covering all volumes is included at the end of FCA Volume 1 (**Document 5.12.2.1**).

## 1.2 FCA SCOPE

1.2.1 This FCA Volume 2 comprises an FCA for the extension of Pentir Substation. The location of Pentir Substation is shown along with the Order Limits in Drawing **DCO\_DE-PS-01\_05**.

1.2.2 The geographical scope of FCA Volume 2 includes the operational site (see Drawing **DCO\_DE-PS-01\_05**), associated construction areas and temporary access tracks.

1.2.3 FCA Volume 2 has been prepared in accordance with the overall scope and methodology set out in FCA Volume 1 (**Document 5.12.2.1**).

### 1.3 PENTIR SUBSTATION OVERVIEW

- 1.3.1 Pentir Substation is located in north-west Gwynedd and is centred on Grid Reference to SH 559 677. The substation would be extended to the north-west, south-east and to the north-east with a total extension area of approximately 40,000 sq m, to accommodate the additional equipment required for the new connection. Design Plan DCO\_DE/PS/09\_04 Sheet 4 of 10 (**Document 4.13**) shows the maximum parameters within which Pentir Substation extension would be developed. An indicative layout which is subject to the parameters is shown on Design Plan DCO\_DE/PS/01\_05 Sheet 5 of 10 (**Document 4.13**). A detailed description of the substation works can be found in ES Chapter 3, Proposed Development Description (**Document 5.3**).
- 1.3.2 The proposed Pentir Substation Construction Compound is located to the north of the substation. The proposed construction compound is approximately 0.17 ha and is shown on Design Plan DCO\_DE/PS/01\_05 Sheet 5 of 10 (**Document 4.13**) and Figure 4.1 Construction Plans DCO\_F/CON/PS/05 Sheet 5 of 5 (**Document 5.4.1.1**). The Pentir Construction Compound as described in section 3.13.3 would also be utilised for the construction of the Pentir Substation extension.

### 1.4 APPLICABLE CROSS REFERENCES TO VOLUME 1

- 1.4.1 Reference should be made to FCA Volume 1 (**Document 12.5.2.1**) when reading this FCA Volume 2. Specifically, it should be consulted for additional information regarding the following:

**FCA policy and guidance** (FCA Volume 1, section 2.1 - 2.3)

**FCA definitions** (FCA Volume 1, section 2.4)

**Climate change requirements** (FCA Volume 1, section 2.5)

**Data sources** (FCA Volume 1, section 2.6)

**FCA consultation and scope** (FCA Volume 1, section 3)

**FCA methods** (FCA Volume 1, section 4)

**FCA mitigation** (FCA Volume 1, section 5)

### 1.5 VOLUME 2 STRUCTURE

- 1.5.1 The structure of this FCA Volume 2 is as follows:

- Section 1 Introduction:** sets out the context of this volume within the wider FCA, defines its scope and structure;
- Section 2 Study Area:** describes the physical characteristics of the area around the existing Pentir Substation;
- Section 3 Flood Hazard Identification:** describes the baseline flood hazards that may affect the Proposed Development, including potential changes in the baseline over the lifetime of the Proposed Development;
- Section 4 Receptor Flood Risk:** defines the main receptor groups that could be affected by the hazards identified in the previous section;
- Section 5 Flood Risk Assessment:** assesses flood risk to the main receptor groups and identifies mitigation measures;
- Section 6 Flood Risk Management:** describes the flood risk management measures to be adopted within the design, construction and operation of the Proposed Development; and
- Section 7 Summary and Conclusions:** summarises the main points arising from the FCA carried out in this volume.

## 2 Study Area

### 2.1 INTRODUCTION

2.1.1 This section describes the physical characteristics of the area around Pentir Substation, as shown in Sheet 13 of Figure 12.3 (**Document 5.12.1.3**).

### 2.2 CLIMATE

2.2.1 The climate at Pentir Substation is discussed in FCA Volume 4, section 2.2 (**Document 5.12.2.4**), and also in ES Chapter 12 Water Quality, Resources and Flood Risk (**Document 5.12**).

### 2.3 TOPOGRAPHY

2.3.1 The topography around Pentir Substation is shown in Figure 12.13 (**Document 5.12.1.13**). Ground level to the north-west of, and adjacent to, the existing site is approximately 109 mAOD, while to the south-east it is approximately 111 mAOD.

2.3.2 To the south-east of the site the land slopes down into the Afon Cegin valley. To the west, the land slopes down towards the Menai Strait, located approximately 3.5 km to the west of Pentir Substation. To the north, the land slopes down to a left bank tributary of the Nant-y-Garth. The highest point in the area is located 1.5 km to the south-west of Pentir Substation at 154 mAOD from where it slopes down to Pentir Substation.

### 2.4 GEOLOGY, HYDROGEOLOGY AND SOILS

2.4.1 The geology in the area of around the existing Pentir Substation is discussed in FCA Volume 4, section 2.4 (**Document 5.12.2.4**).

2.4.2 Pentir Substation is situated on a 'Secondary A' aquifer. This designation is for aquifers consisting of permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

2.4.3 The soil in the area around the existing Pentir Substation is classified as freely draining loam.

## 2.5 LAND USE

- 2.5.1 There are areas of woodland (mostly conifer plantation) immediately surrounding the existing Pentir Substation, with a larger area of conifer plantation extending northwards from the site. Elsewhere, agricultural grassland is the predominant land use in the wider surrounding area.

## 2.6 HYDROLOGY

- 2.6.1 As can be seen in Figure 12.10 (**Document 5.12.1.10**), the nearest watercourse to Pentir Substation intersects the south area of the existing substation site. This small watercourse flows into a left bank tributary of the Nant-y-Garth. A tributary of Afon Cegin is located 300 m to the south-east of the existing substation site.
- 2.6.2 The Greenfield runoff rate (QBAR) for Pentir Substation is 3.26 l/s/ha, as calculated using the UK SuDS online assessment tool (Ref 12.1.27).

## 3 Flood Hazard Identification

### 3.1 FLOOD HAZARD OVERVIEW

3.1.1 This section describes the baseline flood hazards that may affect the Pentir Substation extension. Section 3.2 provides a summary of flood hazard.

3.1.2 The approach to identifying flood hazards is provided in FCA Volume 1, section 4.3 (**Document 5.12.2.1**), where the hazards, methods, data and sources of information used are described.

3.1.3 A summary of external flood hazards that may affect the Proposed Development is presented in Table 3.1. Internal flood hazards are presented in Table 3.2. It should be noted that:

- Where the hazard is deemed to be negligible, this is highlighted and the hazard is considered no further in the assessment.
- Where the hazard is deemed to be low and there is supporting information to determine that no further assessment is required, then that hazard is not considered further in the assessment.
- Where the hazard is deemed to be negligible or low but there is no supporting information, that hazard is then considered further in this assessment.

<b>Table 3.1 Summary of external flood hazards</b>			
<b>Source</b>	<b>Hazard</b>	<b>Description</b>	<b>Subject to further assessment</b>
Fluvial	Negligible	Sheet 6 of <b>Document 5.12.1.10</b> shows that the Pentir Substation extension is not located near any DAM Zones B and C.	No
Surface Water	Negligible (construction only)	Sheet 6 of <b>Document 5.12.1.11</b> shows that none of the extended areas of Pentir Substation coincide with any mapped areas of surface water flood risk. <b>Document 5.12.1.11</b> shows surface water flood risk coinciding with two land drains, one to the immediate southwest of the existing substation, and one approximately 250m south of the existing substation.	No
Sewer	Negligible	There are no reported DCWW or Gwynedd Council sewer flooding incidents in the area of Pentir Substation.	No
Groundwater	Low (Construction Only)	Sheet 6 of <b>Document 5.12.1.12</b> shows that the BGS susceptibility to groundwater flooding mapping indicates that extended areas of Pentir Substation are located in Groundwater flood Zone B: 'potential for groundwater flooding of property situated below ground level'. There is an isolated area to the immediate south of Pentir Substation, coinciding with the aforementioned land drains, classed as Groundwater flood Zone C: 'Potential for groundwater flooding to occur at surface'. To the east of the site within the Order Limits, there is an area of Groundwater Flood Zone A: Limited potential for groundwater flooding to occur. Any increase in potential locally is associated with adjacent valley bottoms and would not affect the substation.	Yes

<b>Table 3.1 Summary of external flood hazards</b>			
<b>Source</b>	<b>Hazard</b>	<b>Description</b>	<b>Subject to further assessment</b>
Flooding from artificial sources	Negligible	While there is a small (0.5 km <sup>2</sup> area) surface water reservoir to the south-east of Pentir Substation there is a shallow valley to the north-east in which a small watercourse is located and flood water arising from a breach in the reservoir would be routed along this flowpath away from Pentir Substation.	No

<b>Table 3.2 Summary of internal flood hazard</b>			
<b>Source</b>	<b>Hazard</b>	<b>Description</b>	<b>Subject to further assessment</b>
Floodplain Displacement	Negligible	Sheet 6 of <b>Document 5.12.1.10</b> shows that Pentir Substation is not located near any NRW mapped fluvial flood risk Zones 2 and 3 or DAM Zone C.	No
Fluvial Flow Obstruction	Negligible	No elements of the construction or operational phases at Pentir Substation would result in activities in or near to watercourses.	No
Surface Water Flow Obstruction	Negligible	No risk due to the limited extent of surface water flood risk	No



<b>Table 3.2 Summary of internal flood hazard</b>			
<b>Source</b>	<b>Hazard</b>	<b>Description</b>	<b>Subject to further assessment</b>
Surface water flooding (internal)	Medium	Internal surface water flooding may arise as a result of inappropriate and/or insufficient water management measures being implemented for both the construction and operational sites, leading to uncontrolled runoff of surface water from the site, potentially resulting in localised flooding and also exacerbating the risk of flooding in nearby and receiving watercourses.	Yes

### **3.2 SUMMARY OF BASELINE FLOOD HAZARD**

- 3.2.1 There is a low risk of surface water and groundwater flooding to the southwest and south of the existing substation.

## 4 Receptor Flood Risk

### 4.1 INTRODUCTION

4.1.1 The methodology for identifying receptors is provided in FCA Volume 1, section 4.4 (**Document 5.12.2.1**). Receptors are combined into four receptor groups (RG1, RG2, RG3 and RG4) as described in Volume 1, section 4.4 (**Document 5.12.2.1**) and repeated below in Table 4.1.

4.1.2 In the following sections, the potential risk to receptor groups have been discussed in the context of there being no control and management measures in place (these are discussed in section 5).

**Table 4.1: Receptor groups applicable to the construction, operation and maintenance of Pentir substation**

Group	Type	Description	Flood risk vulnerability	Duration
RG1	Construction phase activities and temporary infrastructure	Personnel, plant and temporary infrastructure associated with the construction of the new infrastructure at Pentir Substation.	Essential Infrastructure <sup>1</sup> & Less Vulnerable <sup>2</sup>	Temporary
RG2	Operational phase infrastructure	Substation, office space, and car parking infrastructure that would remain for the lifetime of the infrastructure.	Essential Infrastructure <sup>1</sup> & Less Vulnerable <sup>2</sup>	Permanent

Table 4.1: Receptor groups applicable to the construction, operation and maintenance of Pentir substation				
Group	Type	Description	Flood risk vulnerability	Duration
RG3	Operational phase maintenance activities and temporary infrastructure	Personnel, plant and temporary infrastructure associated with inspection and periodic maintenance activities at Pentir Substation.	Essential Infrastructure <sup>1</sup> & Less Vulnerable <sup>2</sup>	Temporary
RG4	Third party receptors	Third-party people, property and infrastructure within or outside of the Order Limits, including agricultural land.	Variable – see detailed assessment of specific third party receptors in the respective FCA volumes (section 4).	Temporary / Permanent

## 4.2 RECEPTORS AFFECTED BY GROUNDWATER FLOOD HAZARD

### *Receptors Affected*

4.2.1 Receptor group RG1 are potentially affected by groundwater flooding. RG1 represents personnel, plant and temporary infrastructure during the construction phase. RG2, RG3 and RG4 are not affected due to the risk of groundwater flooding being low and confined to activities below ground level (see Table 3.1).

### *RG1 Groundwater Flood Risk*

4.2.2 As shown in section 3.1 groundwater only poses a risk during the construction phase for the Pentir Substation extension. The risk is assessed as low due to the likely shallow depth of groundwater. However, any Flood Management Plan (see section 5.2 and FM11 in Table 5.1 of FCA Volume 1, **Document 5.12.2.1**) would acknowledge the risk of groundwater flooding so that construction personnel could be alerted to its potential occurrence.

### 4.3 RECEPTORS AFFECTED BY SURFACE WATER FLOOD RISK (INTERNAL)

#### *Receptors affected*

- 4.3.1 Receptor groups RG1, RG2, RG3 and RG4 would be potentially affected by surface water flooding arising from the construction and operational phases. RG1 represents personnel, plant and temporary infrastructure during the construction phase. RG2 represents permanent infrastructure. RG4 represents third-party people, property and infrastructure within or outside of the Order Limits.

#### *RG1 Surface Water Flood Risk (Internal)*

- 4.3.2 RG1 receptors would be at risk at Pentir Substation if surface water runoff were not adequately managed in accordance with best practice. RG1 receptors would be particularly at risk given that the effects of inadequate water management would primarily be within the substation extension areas. Uncontrolled surface water runoff flow rates would generally be low and depths very small. However, where the topography allows, water could pond to appreciable depths at low points, with consequent increase in hazard.
- 4.3.3 This hazard would be mitigated by the robust design and implementation of a surface water management plan and drainage system (see section 5 and control and management measures in Table 5.1 of FCA Volume 1, **Document 5.12.1.1**).

#### *RG2 Surface Water Flood Risk (Internal)*

- 4.3.4 RG2 receptors would only be at risk in the absence of an effective drainage system. If discharges were not controlled then localised flash flooding could occur in the receiving watercourse. However, the drainage system at Pentir Substation would ensure that water discharged from the operational site to receiving watercourses would be controlled to the recommended Greenfield runoff rate.
- 4.3.5 This hazard would be mitigated by the robust design and implementation of a Drainage Management Plan (DMP) and drainage system (see section 5.2 and WE51-59 and WE510-511 in Table 5.1 of FCA Volume 1, **Document 5.12.2.1**). A summary of the proposed drainage arrangements for the Pentir Substation extension is provided in section 6.2.

*RG3 Surface Water Flood Risk (Internal)*

- 4.3.6 The risk to RG3 receptors (operation and maintenance activities during the operation phase) is as described under the RG2 receptor group.

*RG4 Surface Water Flood Risk (Internal)*

- 4.3.7 The principal RG4 third party receptor in the vicinity of Pentir Substation is the adjacent farmland, which could potentially be affected by inadequate management of surface water from the site.
- 4.3.8 RG4 receptors could also be impacted by direct overland flow. Uncontrolled surface water runoff would not pose a significant hazard as flow rates are generally low and depths are very small. However, where the topography allows, water could pond to appreciable depths at low points, with consequent increase in hazard to RG4 receptors.
- 4.3.9 This hazard would be mitigated by the robust design and implementation of a Drainage Management Plan (DMP) and drainage system (see section 5.2 and WE51-59 and WE510-511 in Table 5.1 of FCA Volume 1, **Document 5.12.2.1**). A summary of the proposed drainage arrangements for the extension to Pentir Substation is provided in section 6.2.

## 5 Flood Risk Assessment

### 5.1 INTRODUCTION

- 5.1.1 Having identified the applicable flood hazards in section 3 and presented hazards in the context of applicable receptors in section 4, this section combines the hazard and receptor information to summarise assessment of flood risk to the main receptor groups and specify appropriate mitigation measures.
- 5.1.2 As described in FCA Volume 1, section 5.2 (**Document 5.12.2.1**) this assessment assumes the incorporation within the design of all committed control and management measures during construction and operation.

### 5.2 SUMMARY OF FLOOD RISK

- 5.2.1 A summary of flood risk is provided in Table 5.1 where it can be seen that the applicable flood hazards are identified in the context of those potentially affected receptor groups. Appropriate mitigation is then prescribed in accordance with those control and management measures set out in FCA Volume 1, section 5 (**Document 5.12.2.1**).
- 5.2.2 The only applicable flood hazards identified are groundwater and surface water (internal). For all hazards it is possible to prescribe combinations of control and management measures that, when implemented in accordance with the procedures set out in FCA Volume 1, section 5 (**Document 5.12.2.1**), would ensure the risk of flooding as a result of the Proposed Development would be negligible.

Table 5.1: Flood risk assessment summary								
Flood Hazard	Location	Phase Affected	Summary Of Risk	Receptor Group(s) Affected	Mitigation Required	Exception Test Required	Further Assessment Required	Comment
Ground-water	Pentir Substation Extension	Construction only	Groundwater flooding is applicable only to the construction phase	RG1	FM11	No	No	The production of a robust Flood Management Plan (FMP) as part of <b>FM11</b> would mitigate this risk.
Surface Water (Internal)	Pentir Substation Extension	Construction and operational	Surface water and potential flooding of receiving watercourses arising from inadequate surface water management and drainage strategies	RG1	FM11	No	No	Multiple control and management measures are required including specification of appropriate drainage strategies ( <b>WE51-59, WE510-511</b> ) and provision of a robust FMP ( <b>FM11</b> ), and appropriate watercourse crossing design.
				RG2				
				RG3				
				RG4	WE51-59			
					WE510			
					WE511			



## 6 Flood Risk Management

### 6.1 INTRODUCTION

- 6.1.1 This section presents further details of the flood risk management measures that would be adopted, namely drainage (section 6.2). It concludes with a brief discussion of residual risk (section 6.3).

### 6.2 DRAINAGE

- 6.2.1 A detailed drainage design for the Pentir Substation extension will be provided as part of the DMP which is secured through Requirement 7 of the draft DCO (**Document 2.1**). The DMP will provide details of the proposed drainage design for the permanent extension areas, as well as the temporary construction compounds and access, and will adhere to the drainage principles set out in the CEMP (**Document 7.4**, measures **WE51-59** and **WE510-511**). Runoff rates will be limited using SuDS techniques (infiltration and/or attenuation to be confirmed) to greenfield QBAR rates for all storm events up to the 1% AEP plus climate change event. In line with the approach set out in FCA Volume 1, section 5.3 (**Document 5.12.2.2**), climate change allowances of 5% and 20% will be applied to extreme rainfall for the construction and operational phase drainage designs respectively. Hydraulic modelling will be used to accurately estimate attenuation requirements and to demonstrate that the proposed drainage designs are effective in limiting discharges to greenfield rates.

### 6.3 RESIDUAL RISK

- 6.3.1 Residual risk is that risk which remains after the flood risk management measures set out above have been taken into account.
- 6.3.2 The FMP (FM11) would address residual risk. Implementation of the FMP would ensure that any residual risk is proportionate to the scale, nature and location of the Proposed Development. NRW's and the LLFAs' approval of the FMP would be required prior to the commencement of construction and operational activities. The FMP is secured by Requirement 7 of the draft DCO (**Document 2.1**).

# 7 Summary and Conclusions

## 7.1 SUMMARY

- 7.1.1 This FCA Volume 2 has presented a detailed assessment of flood risk for the Pentir Substation extension for the construction and operational phases. This volume should be read in conjunction with FCA Volume 1 (**Document 5.12.2.1**) which provides the overarching planning, guidance, scoping and methodologies applicable to this Volume.
- 7.1.2 This FCA Volume 2 has shown that the extension to Pentir Substation would be at negligible risk during the construction and operation phases from the following external flood hazards: fluvial, surface water, sewer or artificial flood hazards.
- 7.1.3 Groundwater flooding was shown to be a potential hazard during the construction phase; however it would be adequately mitigated through the provision of a robust Flood Management Plan (FMP) as provided via control and management measure FM11.
- 7.1.4 Internal surface water flooding was shown to be a potential hazard during the construction and operational phases; however it would be adequately mitigated through the provision of a robust drainage strategy, as provided via control and management measures WE51-59 and WE510-511.
- 7.1.5 FCA Volume 2, section 5 has shown that in all instances where flood risk receptors may be impacted by an associated flood hazard, it has been appropriate to specify mitigation in accordance with the control and management measures outlined in FCA Volume 1, section 5.2 (**Document 5.12.2.1**) and that the incorporation of these measures in the detailed design and construction stages would be sufficient to mitigate any potential increase in flood risk.
- 7.1.6 FCA Volume 2 has confirmed that the substation extension is located in DAM Flood Zone A. As a result, neither the Sequential Test nor the Exception Test is applicable.
- 7.1.7 In summary, this FCA has demonstrated that the extension to Pentir Substation would be adequately protected from flooding during the construction and operational phases, and would not increase flood risk elsewhere.