



## **Thurrock Flexible Generation Plant**

**Environmental Statement Volume 6  
Appendix 15.1: Flood Risk Assessment**

Date: ~~November~~April 2020

**Environmental Impact Assessment**

**Environmental Statement**

**Volume 6**

**Appendix 15.1**

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<http://www.thurrockpower.co.uk>

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## Summary

This document provides a development-specific Flood Risk Assessment (FRA) in accordance with the requirements of the National Planning Policy Framework (NPPF) and Planning Practice Guidance (PPG ID7) for the proposed Thurrock Flexible Generation Plant.

## Qualifications

This document has been prepared by Jonathan Morley, an Associate Director, who has 14 years' experience of environmental impact assessment.

It has been checked by Ola Holmstrom who is a Chartered Engineer, with over 20 years' professional experience in consultancy in the UK.

# 1. Introduction

## 1.1 Background

- 1.1.1 A site-specific Flood Risk Assessment (FRA) has been prepared for the Thurrock Flexible Generation Plant (proposed development), specifically the main development site which is referred to as Zone A encompassing the proposed gas engine, battery storage and substation facilities, and Zone G associated with the causeway.
- 1.1.2 A review of the flood risk posed to the above-ground installation for gas connection to Feeder 18 (within Zone D3) has also been undertaken to aid in informing flood resilience requirements. It has been determined that the size and scale of development in Zone D3 would have negligible impact on the local hydrological regimes, as the majority of the development would be buried pipe with a small water-tight gas terminal projected above ground. In addition, appropriate flood resilience and/or resistance measures will be incorporated into the design to ensure critical infrastructure can remain operational.
- 1.1.3 The FRA has been produced in accordance with the Overarching National Policy Statement (NPS) for Energy EN-1, the National Planning Policy Framework (NPPF) and Planning Practice Guidance (PPG) ID7 and relevant local planning policies, a summary of each is presented in Section 3. The policies cover the requirements in respect to Nationally Significant Infrastructure Projects.
- 1.1.4 The FRA supports the Development Consent Order (DCO) application for the proposed development in accordance with the Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended). It also forms an appendix to Thurrock Flexible Generation Plant Environmental Statement Volume 3, Chapter 15: Hydrology and Flood Risk.
- 1.1.5 Developments that are designed without regard to flood risk may endanger lives, damage property, cause disruption to the wider community, damage the environment, be difficult to insure and require additional expense on remedial works.
- 1.1.6 Current guidance on development and flood risk (PPG: ID7 Flood risk and coastal change) identifies several key aims for a development to ensure that it is sustainable in flood risk terms. These aims are as follows:
- The development should not be at a significant risk of flooding and should not be susceptible to damage due to flooding;

- The development should not be exposed to flood risk such that the health, safety and welfare of the users of the development, or the population elsewhere, is threatened;
- Normal operation of the development should not be susceptible to disruption as a result of flooding;
- Safe access to and from the development should be possible during flood events;
- The development should not increase flood risk elsewhere;
- The development should not prevent safe maintenance of watercourses or maintenance and operation of flood defences;
- The development should not be associated with an onerous or difficult operation and maintenance regime to manage flood risk. The responsibility for any operation and maintenance required should be clearly defined;
- Future users of the development should be made aware of any flood risk issues relating to the development;
- The development design should be such that future users will not have difficulty obtaining insurance or mortgage finance, or in selling all or part of the development, as a result of flood risk issues;
- The development should not lead to degradation of the environment; and
- The development should meet all of the above criteria for its entire lifetime, including consideration of the potential effects of climate change.

1.1.7 The FRA is undertaken with due consideration of these sustainability aims.

1.1.8 The key objectives of the FRA are:

- To assess the flood risk to the proposed development and to demonstrate the feasibility of appropriately designing the development such that any residual flood risk to the development and users would be acceptable;
- To assess the potential impact of the proposed development on flood risk elsewhere and to demonstrate the feasibility of appropriately designing the development, such that the development would not increase flood risk elsewhere; and
- To satisfy the requirements of the NPS, the NPPF and PPG and DCO application guidance insofar as they require FRAs to be submitted in support of DCO applications.

## 1.2 Methodology

1.2.1 The proposed study area of the FRA follows the Thurrock Flexible Generation Plant hydrology and flood risk study area as defined in Volume 3, Chapter 15: Hydrology and Flood Risk. It includes a 1 km buffer around proposed development.

1.2.2 The buffers applied are considered appropriate for data collection taking into account the nature of proposed development and likely zone of influence on hydrological receptors.

1.2.3 In order to achieve the objectives outlined within 1.1.8, a staged approach was adopted in undertaking the FRA in accordance with NPS (EN-1), the NPPF and PPG. Initially, screening studies have been undertaken utilising publicly available information, records and data to identify whether there are any potential sources of flooding within Zone A and elsewhere in the proposed development hydrology and flood risk study area, which may warrant further consideration. Identified potential flooding issues are then assessed further within a specific flood risk section. The aims of the assessment are:

- to review all available information and provide a qualitative analysis of the flood risk to the proposed development; and
- to identify any impact of the proposed development on flood risk elsewhere.

### 1.3 Report structure

1.3.1 This report has the following structure:

- Section 1.4 identifies the sources of information that have been consulted in preparation of the FRA;
- Section 2 sets out relevant legislation, guidance and planning policy including requirements of the NPPF and PPG;
- Section 3 provides information pertinent to the site setting; and
- Section 4 provides the development specific FRA for the proposed permanent surface structures.

1.3.2 A hydrological review of the proposed development and a description of the flood risk management measures incorporated into the design of the proposed development are also presented below.

### 1.4 Information Sources

1.4.1 The information used in the preparation of report is set out in Table 1.1.

**Table 1.1: Information sources consulted during the preparation of the report.**

| Source                                      | Data   | Information consulted/provided   |
|---|--|--|
| Site setting and hydrology                  | Ordnance Survey (OS) 1:50,000 Landranger 177 East London, Billericay & Gravesend | Area information, rivers and other watercourses, general site environs, built environment  |
| Geology, hydrogeology                       | British Geological Survey (BGS, n.d.) 1: 50 000 digital mapping                  | Site and area geology, groundwater vulnerability.  |
| Environment Agency (EA)                     | EA – online mapping.   | Current flood risk, local flood defences, flood levels, supplementary geology and groundwater information.   |
| Local Planning Authority (LPA)              | Thurrock Borough Council   | Strategic Flood Risk Assessment, June 2018, Flood Zoning.  |
| Sewerage/Water                              | Essex & Suffolk Water.   | Private system, no public asset data.  |
| Flood Risk Assessment and Planning Guidance | NPPF (2019)<br>Planning Practice Guidance ID7<br>EA Fluvial Design Guide, 2009.  | Outlines Planning Policy requirements and outlines best practice guidelines for the generation of hydraulic models.  |
| Previous consultancy reports                | Thurrock Borough Council Level 1 Strategic Flood Risk Assessment (AECOM, 2018).  | Lead Local Flood Authority Flood Risk Assessment and mapping.  |
|   | South Essex Catchment Flood Management Plan Summary Report December 2009.        | The Catchment Flood Management Plan (CFMP) provides an overview of the flood risk in the South Essex area and sets out our preferred plan for sustainable flood risk management over the next 50 to 100 years. |

## 2. Legislation and Guidance

### 2.1 National Policies and Guidance

#### National Planning Policy Framework (February 2019).

- 2.1.1 The NPPF sets out Government planning policies for England and how these are expected to be applied. The framework acts as guidance for local planning authorities and decision-takers, both in drawing up plans and making decisions about planning applications.
- 2.1.2 Paragraphs 163 -165 set out the need for an appropriate assessment of flood risk on a site specific basis. Guidance on the minimum requirements for such an assessment is contained in PPG ID7.
- 2.1.3 The NPPF requires the application of a sequential, risk-based approach to determining the suitability of land for development in flood risk areas, and that flood risk assessment should be carried out to the appropriate degree, at all levels of the planning process.
- 2.1.4 Footnote 50 states that a site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in the future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.

#### Planning Practice Guidance, online.

- 2.1.5 PPG ID7 Flood Risk and Coastal Change provides guidance to ensure the effective implementation of the NPPF planning policy for development in areas at risk of flooding.

#### Climate Change

- 2.1.6 The NPPF sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. NPPF and supporting planning practice guidance on Flood Risk and Coastal Change explain when and how flood risk assessments should be used. This includes demonstrating how flood risk will be managed now and over the development's lifetime, taking climate change into account.

- 2.1.7 In February 2016 the Environment Agency (EA) published advice on climate change allowances to support NPPF, which was most recently updated on the ~~20<sup>th</sup>~~ ~~16<sup>th</sup>~~ of ~~July~~ ~~March~~ 2020 to account for the latest climate change projections within UKCP18. New guidance requires that flood risk assessments and strategic flood risk assessments, assess both the central and upper end allowances along with an extreme climate change scenario known as H++ to understand the range of impact.

- 2.1.8 Climate change allowances are predictions of anticipated change for:

- peak river flow
- peak rainfall intensity
- sea level rise
- offshore wind speed and extreme wave height

- 2.1.9 Different allowances for different epochs or periods of time over the next century are provided.

#### *Peak river flow allowances*

- 2.1.10 Peak river flow allowances show the anticipated changes to peak flow by river basin district.

- 2.1.11 The range of allowances is based on percentiles. A percentile is a measure used in statistics to describe the proportion of possible scenarios that fall below an allowance level. The 50th percentile is the point at which half of the possible scenarios for peak flows fall below it and half fall above it. The:

- central allowance is based on the 50th percentile
- higher central allowance is based on the 70th percentile
- upper end allowance is based on the 90th percentile

- 2.1.12 An allowance based on the 50th percentile is exceeded by 50% of the projections in the range. At the 70th percentile it is exceeded by 30%. At the 95th percentile it is exceeded by 5% of the projections in the range.

- 2.1.13 Table 2.1 below provides the peak river flow allowances for the Thames River basin district.

Table 2.1: Peak river flow allowances by river basin district (use 1961 to 1990 baseline).

| Allowance category       | Total potential change anticipated for the '2020s' (2015 to 2039) | Total potential change anticipated for the '2050s' (2040 to 2069) | Total potential change anticipated for the '2080s' (2070 to 2115) |
|--------------------------|---|---|---|
| Upper end H++            | 25% - 25%   | 35% - 40%   | 70% - 80%   |
| Upper end Higher central | 25% - 15%   | 35% - 25%   | 70% - 35%   |
| Higher central           | 15%   | 25%   | 35%   |
| Central                  | 10%   | 15%   | 25%   |

### Peak rainfall intensity allowance

- 2.1.14 Increased rainfall affects river levels and land and urban drainage systems.
- 2.1.15 For flood risk assessments the guidance indicates that an applicant should assess both the central and upper end allowances, present in Table 2.2 to understand the range of impact

Table 2.2: Change to extreme rainfall intensity compared to a 1961-90 baseline.

| Applies across all of England | Total potential change anticipated for '2020s' (2015- 39) | Total potential change anticipated for '2050s' (2040- 2069) | Total potential change anticipated for the '2080s' (2070-2115) |
|-------------------------------|---|---|--|
| Upper Estimate                | 10%   | 20%   | 40%  |
| Central Estimate              | 5%  | 10%   | 20%  |

### Sea level allowances

- 2.1.16 The guidance was updated in December 2019 account for UKCP18 and provides a range of allowances for each region and epoch or time frame for sea level rise. For the Thames river basin district to guidance identifies that the 'south east' sea level rise allowance should be used, which is shown in Table 2.3.

Table 2.3: Sea level allowance for each epoch in millimetres (mm) per year, with total sea level rise for each epoch in brackets (use 1981 to 2000 baseline) by river basin district.

| Area of England | Allowance  | 2000 to 2035 (mm) | 2036 to 2065 (mm) | 2066 to 2095 (mm) | 2096 to 2125 (mm) | Cumulative rise 2000 to 2125 (metres) |
|-----------------|------------|-------------------|-------------------|-------------------|-------------------|---------------------------------------|
| South east      | Higher End | 5.7 (200)         | 8.7 (261)         | 11.6 (348)        | 13.1 (393)        | 1.2                                   |
|                 | Upper End  | 6.9 (242)         | 11.3 (339)        | 15.8 (474)        | 18.2 (546)        | 1.6                                   |

- 2.1.17 The H++ scenario associated with sea level rise is a single total annual allowance of 1.9 m. There is no H++ value beyond 2100.
- 2.1.18 The climate change guidance notes that the allowances provided have been derived from national scale research. There may be cases where local evidence supports the use of other local climate change allowances.

## 2.2 Local Policies

### Thurrock Local Development Framework, Core Strategy and Policies for Management of Development. Development Plan Document Adopted December 2011

- 2.2.1 The Core Strategy is the central document of the Local Development Framework and sets out the vision, aims and strategy for spatial development in the Borough. It provides the framework for the formulation of the more detailed generic and site specific policies.
- 2.2.2 The policies relevant to hydrology are summarised below.

#### Policy CSTP25 – Addressing Climate Change

“IV. Developers must consider the potential effects of climate change on their development, including:

- i. Water conservation and drainage; ...
- iv. Flood risk from tidal, fluvial and surface water.”

#### CSTP27 – Management and Reduction of Flood Risk

“I. The Council will ensure that flood risk management is implemented and supported through effective land use planning. The Sequential, and where necessary Exception



*Test, as set out in PPS25 will be employed when allocating sites for development and an Emergency Plan for the Borough will be completed.*

*II. The Council will also continue to work collaboratively with the EA by supporting the area based policy approach adopted in the Thames Estuary 2100 Project. In particular the Council will seek to safeguard existing flood defences and new areas for flood defences, water storage and drainage areas, as well as seeking secondary defences for key assets.*

*III. The Council will support the work of the EA in the Environmental Enhancement Project for the Mucking Flats and Marshes to ensure the delivery of appropriate flood mitigation and environmental enhancement measures.*

*IV. The Council will work with the EA and other main stakeholders to ensure that fluvial and surface water flood risk is managed within Thurrock. This will include supporting the policies identified in the South Essex Catchment Flood Management Plan, such as identifying and safeguarding areas of land for existing and future areas of water storage in Policy Units 9, 10, 11 & 12 and in formulating System Asset Management Plans (SAMP) and the Integrated Urban Drainage Plans for Stanford-le-Hope, Tilbury and Purfleet. A Surface Water Management Plan will also be carried out to assist in the identification and mapping of areas susceptible to surface water flooding as recommended by Defra and the Pitt Review. Development proposals that will affect these locations will be expected to contribute towards infrastructure improvements in these locations to enable the development to proceed.*

*V. The Council will ensure that, where necessary, new development throughout the Borough contains space for water including naturalisation and environmental enhancement.*

*VI. Developers will be required to contribute towards flood risk management infrastructure where appropriate.*

*VII. Planning applications received for sites within Flood Zone 3 will be treated in accordance with PPS25, this policy and Policy PMD15.”*

**Policy PMD15 – Flood Risk Assessment**

2.2.3 Sites not covered by the Thurrock Sequential Test will be required to provide a site-specific Sequential Test to demonstrate compliance with PPS25 or any successor to be provided by the applicant. To reflect the nature of Thurrock’s defended floodplain, particular reference should be made to the hazard rating for each site where covered by the Thurrock Strategic Flood Risk Assessment (AECOM, 2018).

2.2.4 Only those applications classified under the ‘minor development’ or ‘changes of use’ categories will be exempt from applying the Sequential Test, but will still be expected to meet the requirements for Flood Risk Assessments and flood risk reduction as set out in Annex E of PPS25 and the associated Design and Sustainability Supplementary Planning Document.

2.2.5 Development proposals subject to the Exception Test in Thurrock must show that the following criteria have been met (in addition to FRA requirements outlined in PPS25):

- To assist with part a) of the Exception Test, reference should be made to the main assessment criteria outlined in the Thurrock Sustainability Appraisal and any opportunities to reduce the overall flood risk posed to the community, including schemes to make space for water;
- The FRA must demonstrate that the development will be ‘safe’, without increasing flood risk elsewhere, and where possible will reduce flood risk overall. For Thurrock, this will mean addressing the following points in particular:
- Flood hazard must be fully considered and reference should be made in the site-specific FRA to the SFRA, or site-specific modelling. This should be used to inform a sequential approach to planning within the site;
- Where it is deemed acceptable to reduce flood storage as a result of development, level for level compensation storage must be provided to ensure that there is no increased flood risk elsewhere;
- Where appropriate, an emergency plan for the development must be submitted that is consistent with the emergency plan for the area. This will include evidence that ‘more vulnerable’ development can achieve safe access/egress to a communal refuge point or unaffected area accessible to the emergency services. In highly exceptional cases where access/egress to a place of safe refuge cannot be achieved, these will be considered on their individual merits;
- Where appropriate, flood avoidance, flood resistance and flood resilience measures must be incorporated into the design of any development;
- Evidence that surface water management schemes, and other flood defence measures that are required on-site in order to allow a development to take place will be adequately maintained for the lifetime of that development by the site owner; and
- Evidence that the proposed development will not interfere with the potential for future maintenance or improvements to flood defences.

2.2.6 Developers may be required to provide Developer Contributions towards the improvement of Emergency Planning services and flood defence measures within Thurrock as part of flood management mitigation.

2.2.7 Developments will be expected to incorporate Sustainable Drainage Systems (SUDS) to reduce the risk of surface water flooding, both to the site in question and to the surrounding area. Where the potential for surface water flooding has been identified, site specific Flood Risk Assessments should ensure that suitable SUDS techniques are incorporated as part of the redevelopment.

## 3. Site Setting

### 3.1 Site Location

- 3.1.1 The main development site comprises an irregular shaped parcel of land covering approximately 20 ha in Thurrock, Essex. The site is split into two distinct fields (north and south) by a land drainage network.
- 3.1.2 Zone G includes a section of the Thames tidal flood defence, which would be cut to provide vehicle access to the foreshore and proposed causeway.
- 3.1.3 Further details of the site location and application boundary overall can be found in Volume 2, Chapter 2: Project Description of the Environmental Statement (ES).

### 3.2 Surrounding Area

- 3.2.1 The site sits within an area with mixed agricultural and industrial use, bound to the west and east by agricultural land, to the south by a National Grid substation with the River Thames and its associated mud and salt flats beyond, and to the north an embanked railway line with agricultural land beyond.

### 3.3 Existing Development

- 3.3.1 The site (Zone A) is presently utilised as agricultural land and Common Land with grazing rights.

### 3.4 Proposed Development

- 3.4.1 The application is for the development of a Flexible Generation Plant including the following main elements within Zone A. Full details are provided in Volume 2, Chapter 2: Project Description. An illustrative site layout with conceptual drainage design is shown in the Conceptual Drainage Strategy (application document A7.3).
- Gas engines, air pollutant control and cooling;
  - Substations;
  - Battery storage;
  - Gas connection compound;
  - Carbon Capture Ready area;
  - Underground electrical cabling connecting to the National Grid substation; and
  - Internal access roads.

- 3.4.2 As a consequence of the development there will be an increase in low permeability cover of approximately 6.35 ha.

- 3.4.3 To facilitate a gravity drainage system, it is proposed Zone A areas including the gas fired facility, battery storage and customer substation are to be raised to 2.0 m Above Ordnance Datum (AOD) as set out in the Conceptual Drainage Strategy (application document A7.3).

- 3.4.4 The proposed development will be lightly manned by 4-6 full-time equivalent staff during the majority of the operational phase, being largely remotely operated and monitored, with occasional access by around 20 contractors for maintenance.

### 3.5 Topographical Survey

- 3.5.1 A topographical survey of the site has been undertaken (Annex A) which indicates that the north field has a gentle slope from northwest with levels circa 1.4 m AOD to the south east level c.1.23 m AOD.

- 3.5.2 The south field has general slope from west to east from 1.55 m AOD to 1.3 m AOD. However, there are numerous localised areas of elevated land with levels ranging from 1.6 m AOD to 1.8 m AOD.

## 4. Flood Risk Assessment

### 4.1 Hydrological overview

- 4.1.1 The closest watercourse to the site is the EA designated main River Thames.
- 4.1.2 The River Thames drains a catchment area of over 12,000 km<sup>2</sup>, tidally influenced for about 90 km of its length all the way up to the town of Teddington in Middlesex.
- 4.1.3 The Thames has posed a risk of flooding to London for as long as the settlement has been there. As London has grown, the river has become more and more constrained by the urban development. The natural floodplain of the River Thames within London is now almost fully developed and is heavily dependent upon manmade flood defences to protect it against the risk of flooding.
- 4.1.4 The southern boundary of Thurrock Council administrative boundary sits immediately adjacent to the River Thames. Historically, the River Thames floodplain in this area was substantially wider than it is today and the dense urban area of Greater London heavily constrains the passage of the river corridor as it winds its way towards the sea.
- 4.1.5 The River Thames has been heavily modified over time with the growth of London, including the construction of raised defences along much of its length. As a result, the direct risk to Tilbury as a result of fluvial flooding alone from the River Thames is negligible. OS mapping indicates that the site is surrounded by a number of unnamed drains, shallow ditches and water features. Surface water within the main body of the site flows in a general southerly and easterly direction discharging into West Tilbury Main c.500 m to the east, finally outfalling into the Thames.
- 4.1.6 The majority of the site drains into channels which outfall into open land drains which border the site, eventually discharging into the River Thames.

### 4.2 Flood Risk

- 4.2.1 The EA (n.d.) flood zone mapping (Figure 4.1 and Annex B) indicates that the site is situated within undefended Flood Zone 2 and 3a, which is land assessed as having a 1 in 1,000 or greater annual probability of river and/or sea flooding.
- 4.2.2 EA Rivers and Sea flood mapping, which takes into account the effect of any flood defences that may be in this area, indicates the site is at low risk of fluvial or tidal flooding. Defined as areas with between 0.1% and 1% chance of flooding each year.

- 4.2.3 The Thurrock Borough Council SFRA Flood Map (AECOM, 2018) indicates the site is located within Flood Zone 3a (Volume 6, Appendix: 15.2: Flood Zones and Model Data). However, is afforded flood protection by defence with a 1 in 1,000 year standard of protection (SoP).



Figure 4.1:EA Planning Flood Zone map (September 2018).

### Fluvial Flooding

- 4.2.4 EA data and previous flood reporting outlines that water levels in the Thames Estuary is dominated by tidal forces, with fluvial flows within the catchment generating a minimal impact. Extreme tidal water levels are far higher than those resulting from a major fluvial events, therefore fluvial flood risk is not considered any further.

## Tidal Flooding

- 4.2.5 No above ground permanent assets or ground profiling is proposed within areas of designated floodplain (Flood Zone 3b) located to the north of the railway line, as shown on Thurrock Borough Council SFRA Level 2 flood zones (2018), reproduced in Volume 6, Appendix 15.2: Flood Zones and Model Data.
- 4.2.6 Taking into account the presence of tidal flood defence, which provide a SoP for events with up to a 1 in 1,000 year return period the tidal flood risk posed to the site is considered to be low.
- 4.2.7 Flood data extracted from the Thurrock Borough Council SFRA (AECOM, 2018) presents a number of model simulations including a tidal breach within flood defences in close proximity to the proposed development. The results are summarised in Table 4.1.
- 4.2.8 The breach location was informed by Thurrock Borough Council SFRA (see Volume 6, Appendix 15.2: Flood Zones and Model Data).

Table 4.1: Summary of breach model outputs (Tilbury2).

| Breach location | Run period             | Average Flood Level (m AOD) | Average Flood depth (m) | Hazard Rating | Time to Inundation (hours) |
|-----------------|------------------------|-----------------------------|-------------------------|---------------|----------------------------|
| TIL02           | 1 in 200 year (2116)   | 1.57                        | 0.25                    | Significant   | ➤ 20 hours                 |
|                 | 1 in 1,000 year (2116) | 1.80                        | 0.42                    | Significant   | ➤ 16 hours                 |
| TIL03           | 1 in 200 year (2116)   | 1.87                        | 0.50                    | Significant   | ➤ 16 hours                 |
|                 | 1 in 1,000 year (2116) | 2.85                        | 1.40                    | Extreme       | ➤ 16 hours                 |
| TIL04           | 1 in 1,000 year (2116) | 2.21                        | 0.80                    | Extreme       | ➤ 20 hours                 |
| TIL05           | 1 in 200 year (2016)   | 1.90                        | 0.46                    |               |                            |
|                 | 1 in 200 year (2116)   | 2.29                        | 0.91                    | Extreme       | ➤ 1 hour                   |
|                 | 1 in 1,000 year (2016) | 2.13                        | 0.69                    |               |                            |
|                 | 1 in 1,000 year (2116) | 2.45                        | 1.01                    | Extreme       | ➤ 1 hour                   |

- 4.2.9 It is noted that the Thurrock SFRA (2018) and supporting hydraulic modelling applied a medium emissions scenario (95th percentile) projections from UKCP09 to generate the extreme water levels with allowances for sea level rise for the 2116 scenarios. As identified in Section 2.1, on 17 December 2019 climate change sea level allowances were updated taking into account revised climate modelling projections in UKCP18. The updated sea level rise allowances are very similar to the previous allowances for the comparable 'Higher central' scenario from the previous UKCP09-based guidance but now provide an additional 'Upper end' scenario with possible greater sea level rise.
- 4.2.10 The maximum variation in projected sea level rise between the current and previous guidance is +0.39 m or +390 mm. This increase has therefore been added to the SFRA breach model flood levels for main development site (shown in Table 4.1 before addition) for the assessment of flood risk and design of appropriate resilience measures to account for the Upper End sea level climate change allowances as shown in Table 2.3. This approach represents a worst-case increase in potential flood depth, which is considered to be a proportionate and conservative approach in the absence of an up-to-date breach model taking into account UKCP18 available from the Thurrock Strategic Flood Risk Assessment for planning. The approach has been agreed with the Environment Agency via a consultation response on 09 April 2020, as detailed in the consultation table in Volume 3, Chapter 15.

4.2.11 Therefore, the modelled flood level for the closest a breach at location TIL05 for a worst-case in 1 in a 1,000 year 2116 event (approximately 2.45 m AOD) plus an additional allowance of 0.39 m (to account for the latest UKCP18 sea level rise), generating a flood total level of 2.84 m AOD, has been assessed as the mostly likely event to impact the site used in this assessment. It is proposed that the proposed development would incorporate flood resilience and/or resistance measures to ensure critical assets are afforded an appropriate level of flood protection to meet this level, as detailed in Section 6. This would also afford the proposed development flood resilience/resistance against the majority of all other model breach scenarios.

4.2.12 The SFRA identifies that there is a residual risk of a breach or failure of the lock gates during a tidal surge (TIL03) which could result in overtopping of the dock walls and flooding of the surrounding area. Model outputs indicate that a 'breach' or failure at TIL03 would lead to higher flood levels than those presented for TIL05. However, the TIL03 scenario represents Based on the SFRA breach model outputs, the worst-case scenario is a breach at location TIL03 during a 1 in 1,000 year 2116 event. This event represents a catastrophic passive failure in the operation of the Tilbury tidal barrier resulting with in tidal inundation of the vast majority of Tilbury and deemed highly unlikely, as the barrier protects over 5,000 properties locally.

~~4.2.13 However, model outputs indicate that at the onset of 'failure' of the barrier flood water would propagate northwards and eastwards from the breach firstly into Tilbury town centre before extending east towards the site. Given the site's location, on the eastern extent of the flood cell, it is likely to be one of the last places to be affected during a failure at TIL03, and therefore afforded plenty of warning time to action the evacuation plan. Although a failure at TIL03 is highly unlikely, flood resilience measures have been incorporated into the development design which takes into consideration a failure at TIL03 (3.24 mAOD, which is 2.85 mAOD plus 0.39 m for climate change) and is not considered to be a breach scenario that is reasonable to consider for the design of resilience measures. 4, which is m for~~

~~4.2.14 For both worst-case breach events (TIL05 and TIL03) an additional 300 mm has been taken into consideration associated with the potential future impacts of the H++ climate change scenario which generates flood levels of 3.14 mAOD and 3.54 mAOD respectively.~~

~~4.2.11~~

~~4.2.12 1.1 Therefore, the modelled flood level for a breach at location TIL05 in a 1,000 year 2116 event (approximately 2.45 m AOD) plus an additional allowance of 0.39 m to account for the latest UKCP18 sea level rise, generating a total level of 2.84 mAOD, has been used in this assessment. It is proposed that the proposed development would incorporate flood resilience and/or resistance measures to ensure critical assets are afforded an appropriate level of flood protection to meet this level, as detailed in Section 6. This would also afford the proposed development flood resilience/resistance against all other model breach scenarios.~~

### 4.3 Flood defences

4.3.1 The site is located within an area benefiting from flood defences (see Volume 6, Appendix 15.2: Flood Zones and Model Data). Areas benefiting from flood defences are defined as those areas which benefit from formal flood defences specifically in the event of flooding from rivers with a 1% (1 in 100) chance in any given year, or flooding from the sea with a 0.5% (1 in 200) chance in any given year.

4.3.2 EA records indicate that the standard of protection of the flood defences in close proximity to the site is 0.1% Annual Event Probability (AEP); designed to defend London up to a 1 in 1,000 year tidal flood event. The crest height of the flood defence wall protecting the site ranges from 6.48 m AOD to 6.70 m AOD.

4.3.3 The current condition grade for defences in the area ranges from fair to very poor, with the potential for severe defects resulting in complete performance failure, although it is noted that the EA has a duty to maintain these defences. The potential consequences of flood defence breach and design resilience measures have been assessed in Section 6.

4.3.4 Considerable investment has been made in the provision of the Thames Tidal Defences (TTD) to protect Greater London from tidal flooding. The tidal defences downstream of the Thames Barrier are maintained to a level of 7 m AOD, which, at the current time, provides a Standard of Protection (SoP) equivalent to the 0.1% AEP (1 in 1,000 year) tidal event. The EA is working with the Port of Tilbury on a £14 million project to replace the existing Tilbury flood defence barrier with a new dual function lock gate at the Port of Tilbury in Essex that will also act as a flood defence. The existing barrier built in 1981 forms part of the Thames defences that reduce flood risk to over 9,000 homes in the Purfleet, Grays and Tilbury area. The partnership project with the Port of Tilbury is due to complete in 2019/20.

### 4.4 Flooding from rising / high groundwater

4.4.1 Groundwater can be a problem at sites located on permeable strata, either superficial deposits such as river alluvium or bedrock such as fissured sandstone or limestone. Groundwater ingress can be a particular problem in alluvial sands and gravels during flooding where rising river levels cause rises in groundwater levels in deposits that are in hydraulic continuity with the river or flood water.

4.4.2 Geological mapping indicate that the site and surrounding area is underlain by Flandrian Alluvium comprising soft to firm consolidated, compressible silty clay, but can contain layers of silt, sand, peat and basal gravel. Seaford Chalk Formation and Newhaven Chalk Formation Composed of soft to medium hard, smooth white chalks with numerous marl seams and flint bands. A detailed assessment of the underlying geology is provided within Volume 3, Chapter 16: Geology, Hydrogeology and Ground Conditions.

4.4.3 Taking into account the above information and confidence limit, the risk of groundwater flooding is considered to be low.

### 4.5 Source Protection Zones

4.5.1 EA mapping shows the proposed development is site not located within a Source Protection Zone.

## 4.6 Surface water flooding

- 4.6.1 Surface water flooding is caused by rainfall generated overland flow, before the runoff enters a watercourse or sewer. In such events sewerage and drainage systems and surface watercourses may be entirely overwhelmed. Surface water flood risk is assessed by simulating an extreme rainfall event over a 6.5 hours duration designed to completely overwhelm urban drainage systems, with 2D modelling used to identify overland flow routes and areas where surface water will pond.
- 4.6.2 EA mapping (Figure 4.2) indicates that the majority of the site is at very low risk of surface water flooding.
- 4.6.3 However, localised areas within the assessment area (in blue) are at low to high risk, defined as having between 1 in 1000 (0.1%) and 1 in 100 (1%) chance of flooding in any year, and areas with a greater than 3.3% chance of flooding in any year respectively. These areas have been assessed to be associated with localised areas of low lying land.
- 4.6.4 Based on EA mapping and site observations the overall surface water flood risk to the site has been assessed to be low.

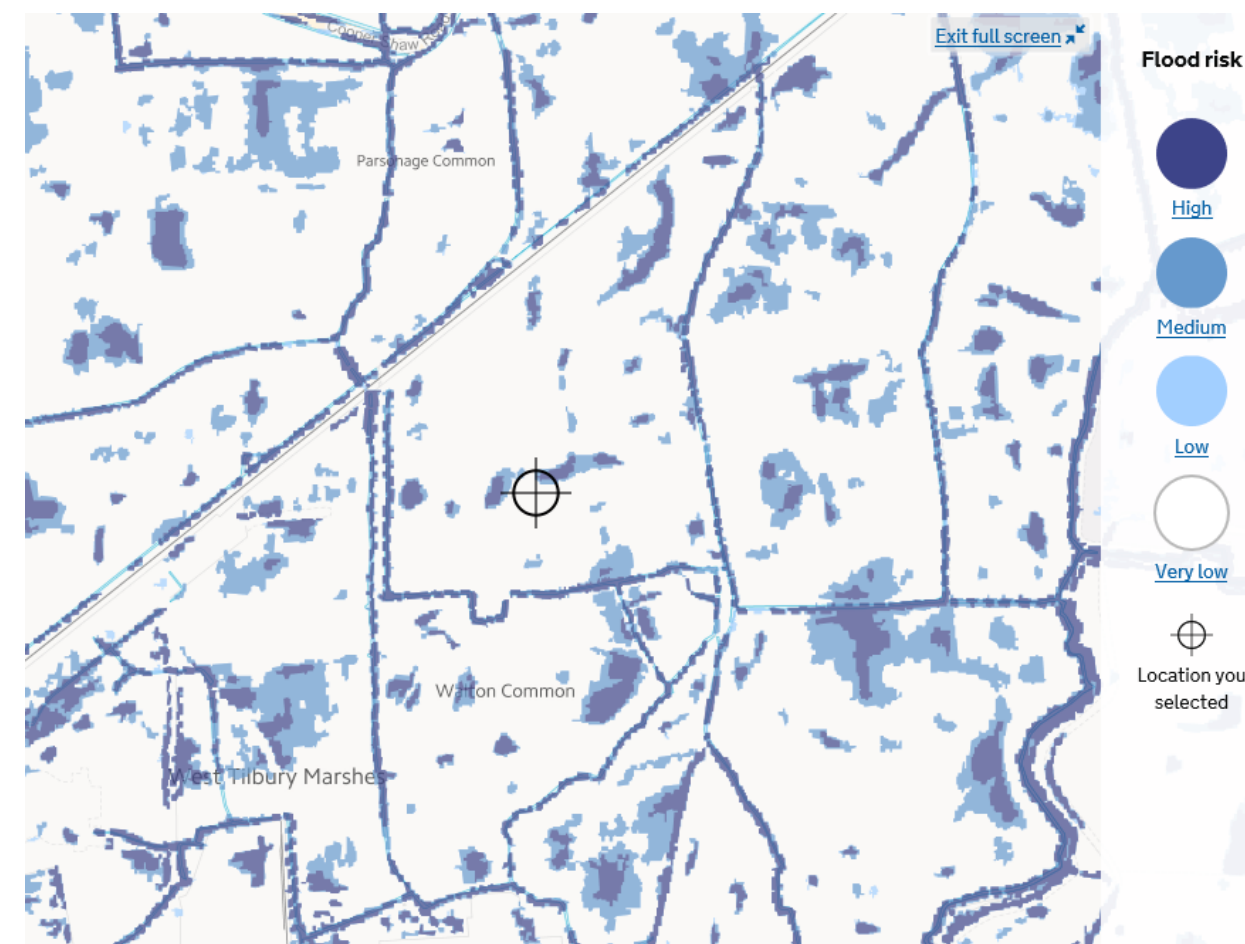


Figure 4.2: EA surface water risk map (September 2018).

## 4.7 Flood Warning Area

- 4.7.1 The site is located within a flood warning area. Full details on flood warning areas can be found at <https://flood-warning-information.service.gov.uk/warnings>.

## 4.8 Reservoir Failure Assessment

- 4.8.1 EA reservoir flood risk mapping shows that the site is not at risk of reservoir flooding.
- 4.8.2 The EA acknowledges that reservoir flood mapping indicates the 'worst case' extents and are very unlikely to happen, as this would require total loss of all water from the affected reservoir(s).

4.8.3 Generally, the safety of the reservoir is the responsibility of the owners or operators who are required to maintain an adequate degree of protection. This is achieved by carrying out regular inspections, risk assessments and through the production and maintenance of Reservoir Flood Plans.

## 4.9 Sewer/Water Main Failure Assessment

4.9.1 No drainage records are available for the site. The land is currently agricultural land and therefore it is assumed that land/field drainage systems will be present within the site area.

4.9.2 Under the DG 5 register requirements all water companies are obliged to keep a record of properties that have been affected by sewer flooding. The Thurrock Borough Council SFRA (AECOM, 2018) historical drainage/sewer flooding map indicates that there are no incidents of sewerage flooding within the immediate area of the site.

4.9.3 Taking into account the above the overall risk of flooding from sewerage failure is assessed as low.

## 4.10 Infrastructure Failure Assessment

4.10.1 No flooding due to infrastructure failure has been recorded for the site.

## 4.11 Historical flood events

4.11.1 Thurrock Borough Council SFRA (AECOM, 2018) notes that South Essex has been subject to two major flood events in 1928 and 1953. In January 1953, a major storm surge coincided with a high spring tide and resulted in the widespread flooding. Flood levels at Tilbury reached c.1.8 m above its predicted level and inundation depths were approximately 2-3 m.

4.11.2 The 1953 event led to the construction of an improved flood defence schemes at Purfleet, Grays, Tilbury, Tilbury Fort, Shell, Refinery, Canvey Island and the Holehaven and Benfleet barriers.

## 4.12 Present Flood Risk

4.12.1 The EA has confirmed that the site is located within Flood Zone 2 and 3, which is land assessed as having a 1 in 1,000 or greater annual probability of river and sea flooding.

4.12.2 Tidal flooding has been determined to pose the greatest risk to the site. Tidal defences are recorded to provide a SoP for tidal events with up to a 1 in 1,000 year return period. Therefore, the main flood risk to the site is as a consequence of a breach in local flood defences.

4.12.3 EA (n.d.) and the Thurrock 2018 SFRA (AECOM, 2018) mapping indicates the site is at flood risk due to fluvial flooding. The site is at low to medium risk of surface water and groundwater flooding.



## 5. Flood Risk Vulnerability Classification

### 5.1 Vulnerability Classification

5.1.1 In accordance with the Flood Risk Vulnerability Classification in Table 2 of the Planning and Practice Guidance Flood Risk and Coastal Change, Flexible Generation Plant is classified as 'Essential Infrastructure' development in flood risk terms.

5.1.2 The site is located within an area identified as Flood Zone 3a. Table 3 of Planning Practice Guidance (reproduced in Table 5.1 below) indicates that Essential Infrastructure uses are acceptable for locations in Flood Zone 3a, but subject to an Exception and Sequential test.

Table 5.1: Flood Risk Vulnerability and Flood Zone 'Compatibility'

| Flood Risk Vulnerability classification (see Table 3 of Planning Practice Guidance) | Essential Infrastructure | Water Compatible | Highly Vulnerable       | More Vulnerable         | Less Vulnerable |
|---|--------------------------|------------------|-------------------------|-------------------------|-----------------|
| Zone 1  | Yes                      | Yes              | Yes                     | Yes                     | Yes             |
| Zone 2  | Yes                      | Yes              | Exception test required | Yes                     | Yes             |
| Zone 3a   | Exception test required  | Yes              | No                      | Exception test required | Yes             |
| Zone 3b Functional Floodplain   | Exception test required  | Yes              | No                      | No                      | No              |

### 5.2 Sequential Test

5.2.1 The aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding. As part of this process the developer will need to provide evidence to the Local Planning Authority that there are no other reasonably available sites where the development could be located.

5.2.2 When considering alternatives sites, the geographical location for the search area needs to consider the functional arrangements of the proposed development.

5.2.3 The site selection exercise underpinning the choice of proposed development location is presented the Statement of Case and Green Belt Statement, application document A8.3.

## 6. Flood Management

### 6.1 Introduction

6.1.1 Section 4.2.6 notes that once the presence of existing tidal flood defences, which provide a 1 in 1,000 year SoP, are taken into account the fluvial and/or tidal risk is low.

6.1.2 Outputs from the Thurrock Borough Council SFRA breach model (AECOM, 2018), which accounts for a worst case scenario from the nearest a breach at location TIL05, indicates that flood depths at the main development site in the event of a breach are around 0.91 m and 1.01 m above existing ground level for the 1 in 200 year event and the 1 in 1,000 year event respectively, including climate change allowance based on UKCP09. These levels translate to 2.30 mAOD and 2.45 mAOD (see Table 4.1).

6.1.3 With the addition of 0.39 m to the flood depth to account for the greatest increase in sea level projected in EA guidance based on UKCP18 (see discussion in Section 4.2) the 1 in 1,000 year event level is 2.84 mAOD.

6.1.36.1.4 The potential impacts for a failure at the Tilbury Tidal barrier (TIL03) have also been considered, with flooding calculated to reach a level of 3.24 mAOD inclusive of 0.39 m for UKCP18 climate change.

6.1.5 Taking into account the essential infrastructure development designation, the following section summarises potential mitigation options to provide flood protection for the 1 in 1,000 year plus climate change breach scenario (3.242.84 mAOD). The design also includes a degree of flexibility to account for a potential H++ scenario (3.54 mAOD based on failure at TIL03).

6.1.46.1.6 The options provided are not exhaustive and are presented as a guide to further consideration during detailed design.

### 6.2 Mitigation Options

6.2.1 Mitigation options to reduce the exposure to flood risk have been designed in line with Flood Risks to People, Phase 2; Improving the Flood Performance of New Buildings and Planning Practice Guidance ID7 and are presented below.

6.2.2 Taking into account the proposed ground raising to achieve raised design to a 2 mAOD profile for drainage (see the Conceptual Drainage Strategy, application document A7.3) and modelled flood level (3.242.84 mAOD) the maximum potential flood depth for which further resilience could be required has been calculated to be 1.240.84 m.

6.2.3 To mitigate against the impacts of flooding on the development, the proposed design and build would include the following measures taken from ENA ETR138 Resilience to Flooding of Grid and Primary Substations (2018):

- development platform raise of the gas engines and battery units;
- use of flood resistant and resilient materials where practicable; and
- a flood evacuation plan (application document A8.5).

6.2.4 Current EA guidance 'Preparing a flood risk assessment: standing advice' recommends that the minimum ground floor levels of new developments are set at the 1 in 200 annual probability plus allowance for climate change, and at appropriate level for the lifetime of the proposed development. Based on the essential nature of the proposed development and in accordance with electricity industry guidance in ENA ETR138 (Energy Networks Association, 2018), a higher degree of protection may be required, which would be assessed on a cost-benefit basis by the applicant.

6.2.5 It is proposed that an initial 0.325 m of resilience is afforded by a development slab. The remaining 0.9459 m will be provided via additional flood resistance and resilience measures as follows.

### 6.3 Flood Protection Options

6.3.1 There are several flood risk management and mitigation measures that will be incorporated into the site design to provide additional flood resilience and resistance, including:

- Raising assets:
  - Raising assets above anticipated flood levels. This will be focussed primarily on external 'exposed' equipment.
- Bespoke building protection:
  - Elevating bunds surrounding transformers, cable ducts sealed with bentonite or with a fire resistant, waterproof system backing onto rubber insert sleeves. Air vents protected by a permanent rising flue. Doors reinforced and sealed, or building banded to provide appropriate protection. With specific reference to the gas engine housing it is proposed to adhere a low permeable waterproofing membrane to the outer wall (Figure 6.2) with buildings access via either a water sealed door or banded entrance (Figure 6.3 and Figure 6.4)

6.3.2 Examples illustrating typical measures that can be employed, drawn from the ETR138 guidance, are shown below.



Figure 6.1: Raised bund and access platform around a transformer (ENA ETR138 Annex 1)



Figure 6.3: Access to Substation entrance (ENA ETR138 Annex 1)



Figure 6.2: Exterior of building flood protection (ENA ETR138 Annex 1)



Figure 6.4: Exterior of building displaying flood protection and bunding to access and emergency exit doors (ENA ETR138 Annex 1)



Figure 6.5: removable flood panels (ENA ETR138 Annex 1)



Figure 6.7: Container walls filled with sand / stone (ENA ETR138 Annex 1)



Figure 6.6: Flood protection gates (ENA ETR138 Annex 1)



Figure 6.8: Raising bunding to critical plant using metal panelling (ENA ETR138 Annex 1)



Figure 6.9: Raising bunding to critical plant using metal panelling (ENA ETR138 Annex 1)



Figure 6.10: Temporary flood defence system (ENA ETR138 Annex 1)



Figure 6.11: Veneer walling and access steps

**6.3.3** The details of resilience measures to be applied to each structure or asset of the proposed development would be developed during detailed design. The design objective of providing up to 0.84 m resilience for critical infrastructure assets where appropriate (above the 2 mAOD proposed site level for applicable buildings and structures) could be secured via a suitably worded requirement within the Development Consent Order.

## 6.4 Extreme Climate Change Scenario (H++)

6.4.1 As outline above there are a number of practicable flood resilience and resistance measures which could be either designed-in to the development or deployed during an extreme tidal event to reach the calculated 1.24 m flood depth. Long-term flood resilience planning to achieve flood resilience/resistance to the H++ scenario which may result in an additional 300 mm flood risk has also considered. In the event a H++ scenario appears likely it would be practicable to increase the height of the low permeable membrane adhered to the gas engine housing. Furthermore, critical external equipment could be raised along with the containerised units. This may also include the use of demountable flood defences and/or individual asset protection.

## 6.5 Flood Compensation

6.5.1 As a consequence of the proposed ground profiling exercise, to 2 mAOD, there is potential for impacts on localised water flow regimes during an extreme flood event. A detailed analysis of the modelled outputs presented within the Thurrock SFRA has been undertaken. This identified that the flood cell within which the site is located covers an area of approximately 14 km<sup>2</sup>. It is proposed that c. 55,850 m<sup>2</sup> is raised to 2 mAOD, equivalent to c. 0.056 km<sup>2</sup>. This equates to c. 0.4% of the flood cell. The limited area of raising would have negligible impact on the flood model and could be potentially accounted for within models' margin of error, standard deviations, and/or errors in the models bathymetry/ground level data throughout the cell. However, a detailed assessment of the local topography has been undertaken, which identifies that in general the site has a slight slope to the northwest. Given the minimal ground raising being undertaken and also the prolonged nature of flood water inundation (hours) it is unlikely that the raising of the site would have significant impact on tidal flood propagation. Topographical data also records elevations along the northern boundary of the site, which are 200 mm to 300 mm higher than the development site itself. Therefore, any impacts of flood flows as a consequence of ground rising would be confined to the development site.

6.5.2 Based on the above, additional modelling to account for the proposed site profiling within the flood cell would not produce results up on which the impacts specific to the development could be reasonably quantified.

## 6.46.6 Flood Warning

6.4.16.6.1 The EA aims to provide several hours' notice prior to the issue of a Flood Warning. It is recommended that the site operator registers on the EA Flood Warning System and implements on site management strategies to ensure that they can communicate flood warnings efficiently in order that the site can be evacuated when construction or maintenance staff are present.

6.4.26.6.2 A Flood Evacuation Plan has been developed (application document A8.5). Staff training would also be required, with the plan including information on what to do upon receipt of a flood warning, together with evacuation procedures and routes.

6.4.36.6.3 Flood plans should be practiced regularly in order to minimise the risk to people.

6.4.46.6.4 Suitably trained staff would need to convey flood warning information and emergency procedures to occupants. All site personnel would be required to be familiar with the flood action plan. Appropriate signage across the site (i.e. exits and assembly points) should be installed.

6.4.56.6.5 Additional information on the EA Flood Warnings and advice can be found on the EA's website (<https://flood-warning-information.service.gov.uk/warnings>).

## 6.56.7 Safe Access/Egress

6.5.16.7.1 As noted in section 6.6, there is likely to be several hours warning before floodwater impact upon the site. As set out in the Flood Evacuation Plan (application document A8.5) there should be sufficient time to safely evacuate the site. Specific evacuation routes through the site itself to be confirmed at detailed design stage when the final site layout is confirmed.

6.5.26.7.2 As flood water propagates across the floodplain towards the site from the south and/or west it is proposed that personnel would evacuate the site on to Station Road and directed north towards West Tilbury Village Hall located within an area designated as Flood Zone 1.

6.5.36.7.3 The incorporation of flood resistance and resilience measures at the site, together with the implementation of a flood evacuation plan, would reduce the risk of damage and ensure the safety of occupants.

## 7. Drainage

### 7.1 Surface Water and Drainage Strategy

- 7.1.1 The sustainable management of surface water is an essential element of reducing future flood risk to the site and its surroundings.
- 7.1.2 Undeveloped sites generally rely on natural drainage to convey or absorb rainfall, the water soaking into the ground or flowing across the surface into watercourses.
- 7.1.3 The effect of development is generally to reduce the permeability of at least part of the site, which markedly changes the site's response to rainfall. Without specific measures to manage surface water the volume of water and peak flow rate are likely to increase. Inadequate surface water drainage arrangements can threaten the development itself and increase the risk of flooding to others.
- 7.1.4 Surface water arising from a developed site should as far as is practicable be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development while reducing the risk of flooding at the site and elsewhere, taking climate change into account.
- 7.1.5 A Conceptual Drainage Strategy has been produced for the development (application document A7.3).

### 7.2 Sustainable Drainage Options

- 7.2.1 The NPPF and associated Planning Practice Guidance ID7, CIRIA C753 SUDS Manual (2015) and also Local Authority Policy promotes sustainable water management through the use of SuDS. A hierarchy of techniques is identified:
- Prevention – the use of good site design and housekeeping measures on individual sites to prevent runoff and pollution (e.g. minimise areas of hard standing).
  - Source Control – control of runoff at or very near its source (such as the use of rainwater harvesting).
  - Site Control – management of water from several sub-catchments (including routing water from roofs and car parks to one/several large soakaways for the whole site).
  - Regional Control – management of runoff from several sites, typically in a detention pond or wetland.
- 7.2.2 The implementation of SuDS as opposed to conventional drainage systems, provides several benefits by:

- Reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream;
- Reducing the volumes and frequency of water flowing directly to watercourses or sewers from developed sites;
- Improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources;
- Reducing potable water demand through rainwater harvesting;
- Improving amenity through the provision of public open spaces and wildlife habitat; and
- Replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.

### 7.3 Surface Water Drainage Constraints

- 7.3.1 Constraints placed on the design of surface water drainage serving the proposed development are as follows:
- Surface water drainage discharge methods will be limited to either soakaway drainage (if proven to be viable via infiltration testing) or discharge to watercourse. Discharge to public sewer is deemed unviable;
  - Runoff from new development impermeable areas to be discharged at equivalent Greenfield runoff rates, requiring consideration of on-site surface water attenuation provision for extreme rainfall events; and
  - Below ground electricity supply and distribution cabling associated with the development may impose restrictions on location and depth of below ground surface water drainage pipework runs.
  - The proposed drainage system needs to provide resilience against occasional blockages or malfunction, and have minimal regular maintenance requirements.

### 7.4 Runoff Calculations

- 7.4.1 An assessment of the current and proposed runoff rates was undertaken to determine the surface water attenuation requirements for the site in line with The SuDS Manual (Ciria, 2015), which indicates that for previously developed sites the flow rate discharged from the site must not exceed that prior to the proposed development for the:
- 1 in 1 year event;
  - 1 in 30 year event; and
  - 1 in 100 year event.

7.4.2 The rates of runoff were determined using the current 'industry best practice' guidelines as outlined in the Interim Code of Practice for SuDS (National SuDS Working Group, 2004). The Defra/EA recommended methodology for sites up to 50 ha in area is the Institute of Hydrology Report (1993) 124 method (IoH 124). The runoff rates were calculated using the MicroDrainage software suite.

## 7.5 Current Runoff Rate

7.5.1 The site is presently covered by permeable agricultural land. The following parameters were incorporated into the existing site runoff calculations:

- Catchment Area: 20.00 ha (assume 100% permeable (landscaping) and 0% low permeable surfacing (hardstanding/buildings));
- Standardised Average Annual Rainfall (SAAR): 550 mm/year;
- Soil: 0.450; and
- Region No: 6.

7.5.2 RPS has also calculated the runoff rate specific to the change low permeable surfacing (Table 7.1).

Table 7.1: Runoff characteristics

| Annual Probability<br>(Return Period, years) | Current<br>Runoff (l/s) | Current<br>Runoff (l/s/ha) |
|--|-------------------------|----------------------------|
| 100% (1)                                     | 56.40                   | 2.82                       |
| QBAR urban                                   | 66.30                   | 3.315                      |
| 3.33% (30)                                   | 150.20                  | 7.51                       |
| 1% (100)                                     | 211.50                  | 10.58                      |
| 1% + 40% Climate Change                      | 296.10                  | 14.81                      |

Note: 40% added to rainfall data to account for long-term climate change

## 7.6 Attenuation Requirements

7.6.1 The attenuation volume required to restrict the surface water runoff rate from the additional low permeable surfacing to 56.4 l/s for a 1 in 100 year rainfall event plus climate change (+40%) has been determined using the industry standard MicroDrainage software suite incorporating the following parameters:

- Catchment Area: approximately 20.0 ha;

- Cv (proportion of rainfall forming surface water runoff): assume a factor of 75% for the development in summer, and 84% in winter (weighted average based on proposed land use);
- Runoff Rate: 56.4 l/s; and
- Assuming no infiltration losses.

7.6.2 The system was modelled within MicroDrainage as a tank/pond with controlled discharge via a hydrobrake outflow control. The MicroDrainage calculation sheets are included at Annex C.

7.6.3 The attenuation volume required to restrict runoff to 56.4 l/s from a 1 in 100 year storm event plus a 40% allowance for climate change has been determined to be approximately 20,100 m<sup>3</sup> for the site.

## 7.7 Proposed Surface Water Drainage

7.7.1 The proposed new surface water drainage system will be designed using current MicroDrainage analysis software, to take account of planning guidance, Lead Local Flood Authorities and EA guidance to prevent uncontrolled flooding off the site to surrounding areas.

7.7.2 Surface water runoff from the proposed development will be collected as follows:

- Permeable gravelled areas, unbound stone access roads and hardstanding – Runoff will be allowed to infiltrate naturally into the underlying geology; and
- Impermeable building roof areas – traditional gravity gutters and downpipes, connected into a surface water attenuation system.

7.7.3 Surface water runoff will be collected and discharged to a below ground gravity to the local surface water drainage network via an on-site surface water attenuation ponds totalling c. 26,790 m<sup>2</sup>, designed to provide detention of flows during low intensity rainfall events and enough storage (c. 20,100 m<sup>3</sup>) during extreme rainfall events, to prevent uncontrolled flooding of the site. The pond will assist with the removal of sedimentation from rainwater runoff, and the downstream outlet of the pond will include a sump / catchpit for removal of silt and debris.

7.7.4 Whilst focusing on water quantity, the proposed system will also provide benefits in terms of water quality and biodiversity. A water quality risk assessment will be carried out using the SuDS hazard mitigation indices in accordance with Chapter 26, of the CIRIA (2015) C753 SuDS Manual.



- 7.7.5 Discharge of surface water from the site will be controlled to greenfield runoff rates by use of a vortex (Hydrobrake) flow control device fitted to the first upstream manhole from the surface water drainage outfall.
- 7.7.6 Discharge points will be to an offsite existing watercourse to the west ~~and east~~ of the development site.
- 7.7.7 The location of the proposed attenuation can be seen in the Concept Drainage Plan (application document A2.10). Preliminary sizing of the attenuation pond has been calculated using the MicroDrainage software. From the calculations it is evident that the proposed storage is of sufficient size to accommodate runoff from the catchment area for all storms up to and including the 1 in 100 year rainfall event including a 40% allowance for climate change.

## 7.8 Construction Stage Drainage

- 7.8.1 During construction of the development, the building contractor will be responsible for management and disposal of rainwater runoff generated from the site in its temporary condition.
- 7.8.2 The contractor shall develop a formal site management plan, which will address pollution management and control in relation to site plant and vehicles, raw materials storage and waste generation, to ensure that all surface water runoff generated in the temporary condition will be free of contamination.
- 7.8.3 The site will be subject to topsoil strip and bulk earthworks to prepare the site to the correct level for development. The contractor shall provide temporary drainage measures to contain runoff within the development site boundary ensuring that this is sized appropriately, and that means to remove excess surface water are available for use at all times.
- 7.8.4 Surface water discharge from the site shall be passed to the receiving watercourse or soakaway ensuring that it is first passed via a silt filtration and removal device (Siltbuster) and that discharge will be via a controlled flow rate pump to the final receiving watercourse / soakaway at a rate no greater than the greenfield runoff rate for the site.

## 7.9 Water Quality / Pollution Control

- 7.9.1 The surface water drainage system will feature a number of SuDS measures that will be designed in accordance with CIRIA (2015) C753. As well as controlling the quantity of surface water run-off from the site, these features will also help to prevent the discharge of potential pollutants into the water environment downstream of the development.

## 8. Summary and Conclusions

### 8.1 Summary

8.1.1 A site-specific FRA in accordance with the NPPF and Planning Practice Guidance has been undertaken for the proposed development, focusing on the main flexible generation plant site (zone A) on a parcel of land off Station Road, Tilbury, Thurrock.

### 8.2 Flood Risk

8.2.1 EA and Thurrock Borough Council SFRA (AECOM, 2018) mapping shows that the proposed gas engine, battery storage and substation (Zone A), and causeway (Zone G) is entirely located in Flood Zone 3a and is consequently at 'high' risk of fluvial or tidal flooding before consideration of flood defences.

8.2.2 EA records identify that the proposed development is protected by flood defences with a standard of protection in excess of 1 in 1,000 years. Taking into account the presence of the tidal flood defences, the tidal flood risk posed to the site is considered to be low.

8.2.3 Based on breach model outputs supplied within the Thurrock 2018 SFRA report for the TIL05 breach location modelled for a 1 in 1,000 year 2116 event scenario, the residual flood risk to the proposed development as a consequence of defence failure is 1 m above existing ground level or 2.45 mAOD. Upon including an additional 0.39 m of sea level rise to account for UKCP18 climate change updates, the depth increases to c.1.39 m above ground level or 2.84 mAOD. A passive failure at the tilbury barrier (TIL03) would result in a flood level of 2.85 mAOD rising to 3.24 mAOD including sea level rise to account for UKCP18 climate change. Based on a potential H++ scenario the flood levels increase to 3.14 mAOD and 3.54 mAOD respectively.

8.2.4 SFRA records indicate the sites flooded most recently in January 1953, due to a major storm surge that coincided with a high spring tide.

8.2.5 The majority of the site is located at low susceptibility of surface water flooding. Isolated areas of low lying land are at medium to high risk of surface water flooding.

8.2.6 The susceptibility to groundwater flooding is low.

8.2.7 SFRA mapping indicate that no sewerage flooding incidents have been reported in close proximity to the site. The risk of flooding from sewerage failure is therefore considered to be low.

8.2.8 The risk of flooding from reservoir failure has been assessed as low.

8.2.9 Following profiling of the site to 2 m AOD, the residual flood risk to critical development assets will be ~~1.240-84~~ m. An initial ~~0.325~~ m of resilience will be offered by the development platform/construction slabs, with the remaining ~~0.9459~~ m comprising a mix of appropriate resilience/resistance measure incorporated into the site design.

8.2.10 The attenuation volume required to restrict runoff for low permeable surfacing to the greenfield 56.4 l/s runoff rate from a 1 in 100 year storm event plus a 40% allowance for climate change has been determined to be approximately 20,100 m<sup>3</sup> for the site. A Conceptual Drainage Strategy showing indicative arrangements for runoff attenuation has been produced (application document A7.3).

### 8.3 Conclusion

8.3.1 This FRA and supporting documentation illustrates that the application area is at risk of flooding from tidal sources, but meets the requirements of the NPSs, NPPF and Planning Practice Guidance taking into account the an allowance to meet UKCP18 climate projections.

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## Annex A: Topographical survey

## Annex B: Environment Agency Correspondence

## Annex C: MicroDrainage Outputs