Thurrock Flexible Generation Plant

Environmental Statement Volume 3
Chapter 15: Hydrology and Flood Risk

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Environmental Impact Assessment

Environmental Statement

Volume 3

Chapter 15

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Summary

This chapter reports the assessment of potential impacts on hydrology and flood risk, both to and from the proposed development. Supporting information on hydrology and flood risk can be found in the chapter appendices.

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 Purpose of this chapter

1.1.1 This chapter of the Environmental Statement (ES) presents the findings of Environmental Impact Assessment (EIA) work undertaken in relation to the potential impacts of the Thurrock Flexible Generation Plant (hereafter referred to as the proposed development) on hydrology and flood risk.

1.1.2 The ES is being published to accompany the application to the Planning Inspectorate (PINS) for development consent. This chapter considers the potential hydrology and flood risk impacts of the proposed development during its construction, operation and maintenance, and decommissioning phases.

1.1.3 Potential impacts of the proposed development on geology and ground conditions (including groundwater abstractions) are assessed in Volume 3, Chapter 16: Geology, Hydrogeology and Ground Conditions, whilst potential impacts on ecology and nature conservation are assessed in Volume 3, Chapter 9: Onshore Ecology.

1.1.4 This chapter summarises information from technical reports and publicly available data which are included at Volume 6, Appendix 15.1: Flood Risk Assessment, Appendix 15.2: Flood Zones and Model Data, and Appendix 15.3: Surface Water Abstraction Licences, Discharge Consents and Pollution Incidents.

1.1.5 In particular this ES chapter:

- presents the existing environmental baseline established from desk studies, surveys and consultation to date;
- presents the potential environmental effects on hydrology and flood risk arising from Thurrock Flexible Generation Plant, based on the information gathered and the analysis and assessments undertaken to date;
- identifies any assumptions and limitations encountered in compiling the environmental information; and
- highlights any necessary monitoring and/or mitigation measures that could prevent, minimise, reduce or offset the possible environmental effects identified in the EIA process.

1.2 Planning policy context

1.2.1 Planning policy on renewable energy Nationally Significant Infrastructure Projects (NSIPs), specifically in relation to hydrology and flood risk, is contained in the Overarching National Policy Statement (NPS) for Energy (EN-1) (Department of Energy and Climate Change (DECC), 2011a) and National Policy Statement for Fossil Fuel Electricity Generating Infrastructure (EN-2) (Department of Energy and Climate Change (DECC), 2011b).

1.2.2 Paragraph 4.8.6 (NPS EN-1) specifically identifies that applicants should have regard to climate change and should assess the resilience of their project to climate change. Summarised in Table 1.1

Table 1.1: Summary of NPS EN-1 and EN-2 provisions relevant to hydrology and flood risk.

Summary of NPS EN-1 and NPS EN-2 policy relevant to the assessment of hydrology and flood risk	How and where considered in the Environmental Statement
Climate change adaption	
Applicants for new energy infrastructure must take into account the potential impacts of climate change using the latest UK Climate Projections available at the time the Environmental Statement was prepared to ensure they have identified appropriate mitigation or adaptation measures. This should cover the estimated lifetime of the new infrastructure. Should a new set of UK Climate Projections become available after the preparation of the Environmental Statement, the decision maker should consider whether they need to request further information from the applicant (paragraph 4.8.6 NPS, EN-1).	The characterisation of the flood risk baseline and future baseline has been established using the Environment Agency (EA) Flood Map for Planners and Strategic Flood Risk Assessments, which take into account climate change. A site-specific flood risk assessment FRA has been undertaken for the proposed development in line with the National Planning Policy Framework (NPPF), Planning Practice Guidance (PPG) ID7 – Flood Risk and Coastal Change and includes a climate change allowance based on findings EA Climate Change allowances (February 2016, updated March 2020). Consideration of how climate change may affect the future baseline is given in Section 3.2.
New energy infrastructure will typically be a long-term investment and will need to remain operational over many decades, in the face of a changing climate. Consequently, applicants must consider the impacts of climate change when planning the location, design, build, operation and, where appropriate, decommissioning of new energy infrastructure. The ES should set out how the proposal will take account of the projected impacts of climate change. While not required by the EIA Directive, this information will be needed by the IPC. (paragraph 4.8.51, NPS EN-1).	A Flood Risk Assessments (FRA) has been prepared for the proposed development. The FRA forms Volume 6, Appendix 15.1: FRA.

Summary of NPS EN-1 and NPS EN-2 policy relevant to the assessment of hydrology and flood risk	How and where considered in the Environmental Statement
Flood risk	
Applications for energy projects of 1 ha or greater in Flood Zone 1 in England and all proposals for energy projects located on Flood Zone 2 and 3 in England should be accompanied by an FRA. An FRA will also be required where an energy project less than 1 ha may be subject to sources of flooding other than rivers and the sea (for example surface water), or where the EA, Drainage Board (DB) or other body have indicated that there may be drainage problems. The FRA should identify and assess the risks of all forms of flooding to and from the project and demonstrate how these flood risks will be managed, taking climate change into account (paragraph 5.7.4, of NPS EN-1).	An FRA has been prepared for the proposed development as the site exceeds 1 ha or is partially located within Flood Zone 2 and 3. The FRA is contained in Volume 6, Appendix 15.1: FRA.

Summary of NPS EN-1 and NPS EN-2 policy relevant to the assessment of hydrology and flood risk	How and where considered in the Environmental Statement
The minimum requirements for FRAs provided by applicants are that they should: • be proportionate to the risk and appropriate to the scale, nature and location of the project; • consider the risk of flooding arising from the project in addition to the risk of flooding to the project; • take the impacts of climate change into account, clearly stating the development lifetime over which the assessment has been made; • be undertaken by competent people, as early as possible in the process of preparing the proposal; • consider both the potential adverse and beneficial effects of flood risk management infrastructure, including raised defences, flow channels, flood storage areas and other artificial features, together with the consequences of their failure; • consider the vulnerability of those using the site, including arrangements for safe access; • consider and quantify the different types of flooding (whether from natural and human sources and including joint and cumulative effects) and identify flood risk reduction measures, so that assessments are fit for the purpose of the decisions being made; • consider the effects of a range of flooding events including extreme events on people, property, the natural and historic environment and river and coastal processes; • include the assessment of the remaining (known as 'residual') risk after risk reduction measures have been taken into account and demonstrate that this is acceptable for the particular project; • consider how the ability of water to soak into the ground may change with development, along with how the proposed layout of the project may affect drainage systems; • consider if there is a need to be safe and remain operational during a worst-case flood event over the development's lifetime; and • be supported by appropriate data and information, including historical information on previous events. (paragraph 5.7.5, NPS EN-1)	An FRA fulfilling the requirements stipulated within NPS EN-1 has been prepared. The FRA is contained in Volume 6, Appendix 15.1: FRA.
Further guidance can be found in Practice Guide which accompanies Planning Policy Statement 25 (PPS25) or successor documents (paragraph 5.7.6, NPS EN-1).	Planning Policy Statement 25 was withdrawn on 7 March 2014 and replaced by the PPG. An FRA has been prepared taking into account the requirements of NPPF and PPG ID7 on flood risk. The FRA is contained in Volume 6, Appendix 15.1: FRA.

Summary of NPS EN-1 and NPS EN-2 policy relevant to the assessment of hydrology and flood risk	How and where considered in the Environmental Statement
Applicants for the projects which may be affected by, or may add to, flood risk should arrange pre-application discussions with the EA and, where relevant other bodies such as DBs, sewerage undertakers, highways authority and reservoir owners and operators (paragraph 5.7.7, of NPS EN-1).	The EA and Essex County Council (Lead Local Flood Authority (LLFA)) have been consulted as detailed in Table 1.4.
Consultation on the assessment methodologies should be undertaken at early stages with the EA (paragraph 5.7.8, of NPS EN-1).	The EA and the LLFA have been consulted as detailed in Table 1.4.
Water quality and resources	
The applicant should undertake an assessment of the existing status of, and impacts of the proposed project on water quality, water resources and physical modifications to the water environment (paragraph 5.15.2, of NPS EN-1).	The baseline environment is described for the proposed development hydrology and flood risk study area. An assessment of the impacts on water quality, resources and physical characteristics is provided in paragraphs 3.1.1 to 3.1.57.
The Environmental Statement should in particular describe: • the existing quality of waters affected by the proposed project and the impacts of the proposed project on water quality, noting any relevant existing discharges, proposed new discharges and proposed changes to discharges; • existing water resources affected by the proposed project and the impacts of the proposed project on water resources, noting any relevant existing abstraction rates, proposed new abstraction rates and proposed changes to abstraction rates (including any impact on or use of mains supplies and reference to Catchment Abstraction Management Strategies); • existing physical characteristics of the water environment (including quantity and dynamics of flow) affected by the proposed project and any impact of physical modifications to these characteristics; and • any impacts of the proposed project on water bodies or protected areas under the Water Framework Directive (WFD) and Source Protection Zones (SPZs) around potable groundwater abstractions. (paragraph 5.15.3, NPS EN-1)	Baseline water quality and resources for the proposed development hydrology and flood risk study area are described in Section 3. Watercourses in the proposed development hydrology and flood risk study area have been identified and information on abstractions, discharges, pollution incidents and water quality has been obtained. The impacts on surface water courses are described in Section 4. The impacts on SPZs are covered in Volume 3, Chapter 16: Geology, Hydrogeology and Ground Conditions. A review of the WFD classifications for watercourses within the proposed development hydrology and flood risk study area has been undertaken (see Table 3.4).

1.2.3 NPS EN-1 also highlights a number of points relating to the determination of an application and in relation to mitigation. These are summarised in Table 1.2.

Table 1.2: Summary of NPS EN-1 and NPS EN-2 policy on decision making relevant to this chapter.

Summary of NPS EN-1 and NPS EN-2 policy on decision making (and mitigation) in relation to hydrology and flood risk	How and where considered in the Environmental Statement
Climate change adaption	
The decision maker should be satisfied that there are no features of the design of new energy infrastructure critical to its operation which may be seriously affected by more radical changes to the climate beyond that projected in the latest set of UK climate projections, taking account of the latest credible scientific evidence on, for example, sea level rise (for example by referring to additional maximum credible scenarios – i.e. from the Intergovernmental Panel on Climate Change or EA) and that necessary action can be taken to ensure the operation of the infrastructure over its estimated lifetime (paragraph 4.8.8, NPS EN-1).	The most recent climate change allowances from UKCP18 have been taken into in the characterisation of the baseline and future baseline environment. Climate change is also considered in the FRA (see Volume 6, Appendix 15.1: FRA).
Flood risk	
The decision maker should be satisfied that where relevant: the application is supported by an appropriate FRA; the Sequential Test has been applied as part of site selection; a sequential approach has been applied at the site level to minimise risk by directing the most vulnerable uses to areas of lowest flood risk; the proposal is in line with any relevant national and local flood risk management strategy; priority has been given to the use of Sustainable urban Drainage Systems (SuDS) (as required in the next paragraph on National Standards); and in flood risk areas the project is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed over the lifetime of the development (paragraph 5.7.9, NPS EN-1).	An FRA has been prepared, (see Volume 6, Appendix 15.1: FRA) which consider the flood risks from the proposed development. The FRA notes that the development is sequentially acceptable and been subject to an alternative sites assessment (Volume 2, Chapter 3: Consideration of Alternatives). The FRA has been undertaken in line with NPS EN-1, NPPF and PPG ID7 - Flood Risk and Coastal Change. A high-level drainage concept has also been prepared in line with SuDS, the key points of which are summarised in Volume 6, Appendix 15.1: FRA.
The decision maker will need to be satisfied that the proposed drainage system complies with any National Standards published by Ministers under Paragraph 5(1) of Schedule 3 to the Flood and Water Management Act 2010. In addition, the DCO, or any associated planning obligations, will need to make provision for the adoption and maintenance of any SuDS, including any necessary access rights to property. The decision maker should be satisfied that the most appropriate body is being given the responsibility for maintaining any SuDS, taking into account the nature and security of the infrastructure on the proposed site. The responsible body could include, for example, the applicant, the landowner, the relevant local authority, or another body, such as a DB (paragraph 5.7.10, NPS EN-1).	A high-level drainage concept has been prepared and supports Volume 6, Appendix 15.1: FRA. The proposed drainage strategies have been developed in accordance with the NPS, NPPF, PPG ID7 and the SuDS Manual, whereby sufficient attenuation storage is provided for 1 in 100 year plus climate change worst case storm event. Drainage provisions will be set out in an agreement with the relevant LLFA.

Summary of NPS EN-1 and NPS EN-2 policy on decision making (and mitigation) in relation to hydrology and flood risk	How and where considered in the Environmental Statement
The decision maker should not consent development in Flood Zone 2 in England unless it is satisfied that the Sequential Test requirements have been met. It should not consent development in Flood Zone 3 or Zone C unless it is satisfied that the Sequential and Exception Test requirements have been met. The technology-specific NPSs set out some exceptions to the application of the Sequential Test. However, when seeking development consent on a site allocated in a development plan through the application of the Sequential Test, informed by a strategic flood risk assessment, applicants need not apply the Sequential Test, but should apply the sequential approach to locating development within the site. (Paragraph 5.7.12, NPS EN-1).	The proposed development has been subject to an Alternative sites assessment (Volume 2, Chapter 3: Consideration of Alternatives). Therefore, on this basis, the Sequential Test is considered to be passed. The approach to flood risk and the assessment are described in the FRA (see Volume 6, Appendix 15.1: FRA volume 6,) and has been summarised in this chapter (see paragraph 2.2.7 to 2.2.9).
Preference should be given to locating projects in Flood Zone 1 in England. If there is no reasonably available site in Flood Zone 1, then projects can be located in Flood Zone 2. If there is no reasonably available site in Flood Zones 1 or 2, then nationally significant energy infrastructure projects can be located in Flood Zone 3 subject to the Exception Test. Consideration of alternative sites should take account of the policy on alternatives (paragraph 5.7.13, NPS EN-1).	The approach to flood risk and the assessment are described in the FRA (see Volume 6, Appendix 15.1: FRA) and has been summarised in this chapter (see paragraphs 2.2.7 to 2.2.9). Alternative sites are discussed in Volume 2, Chapter 3: Consideration of Alternatives.
The decision maker will find an Exception Test to be only appropriate for use where the Sequential Test alone cannot deliver an acceptable site, taking into account the need for energy infrastructure to remain operational during floods. It may also be appropriate to use it where as a result of the alternative site(s) at lower risk of flooding being subject to national designations such as landscape, heritage and nature conservation designations, for example Areas of Outstanding Natural Beauty, Sites of Special Scientific Interest (SSSIs) and World Heritage Sites it would not be appropriate to require the development to be located on the alternative site(s) (paragraph 5.7.15, NPS EN-1).	The approach to flood risk and the assessment are described in the FRA (see Volume 6, Appendix 15.1: FRA) and has been summarised in this chapter (see paragraphs 2.2.7 to 2.2.9). Alternative sites are discussed in Volume 2, Chapter 3: Consideration of Alternatives.
If an Exception Test is required, the decision maker will have to be satisfied that all three elements of the test will have to be passed for development to be consented. For the Exception Test to be passed: • "*It must be demonstrated that the project provides wider sustainability benefits to the community that outweigh flood risk;* • *The project should be on developable, previously developed land or, if it is not on previously developed land, that there are no reasonable alternative sites on developable, previously developed land subject to any exceptions set out in the technology-specific NPSs; and* • *An FRA must demonstrate that the project will be safe, without increasing flood risk elsewhere subject to the exception below and, where possible, will reduce flood risk overall*". (paragraph 5.7.16, NP EN-1)	An Exception Test is not required as the Sequential Test demonstrated that the proposed development is considered acceptable as described in the FRA (see Volume 6, Appendix 15.1: FRA) and Volume 2, Chapter 3: Consideration of Alternatives.

Summary of NPS EN-1 and NPS EN-2 policy on decision making (and mitigation) in relation to hydrology and flood risk	How and where considered in the Environmental Statement
To satisfactorily manage flood risk, arrangements are required to manage surface water and the impact of the natural water cycle on people and property. The term SuDS refers to the whole range of sustainable approaches to surface water drainage management including, where appropriate: • source control measures including rainwater recycling and drainage; infiltration devices to allow water to soak into the ground, that can include: • individual soakaways and communal facilities; • filter strips and swales, which are vegetated features that hold and drain water downhill mimicking natural drainage patterns; • filter drains and porous pavements to allow rainwater and runoff to infiltrate into permeable material below ground and provide storage if needed; • basins ponds and tanks to hold excess water after rain and allow controlled discharge that avoids flooding; and • flood routes to carry and direct excess water through developments to minimise the impact of severe rainfall flooding. Site layout and surface water drainage systems should cope with events that exceed the design capacity of the system, so that excess water can be safely stored on or conveyed from the site without adverse impacts. The surface water drainage arrangements for any project should be such that the volumes and peak flow rates of surface water leaving the site are no greater than the rates prior to the proposed project, unless specific off-site arrangements are made and result in the same net effect. It may be necessary to provide surface water storage and infiltration to limit and reduce both the peak rate of discharge from the site and the total volume discharged from the site. There may be circumstances where it is appropriate for infiltration facilities or attenuation storage to be provided outside the project site, if necessary through the use of a planning obligation (paragraph 5.7.18 to 5.7.22, NPS EN-1).	Drainage strategies have been developed in accordance with the NPS, NPPF, PPG ID7 and the SuDS Manual, whereby sufficient attenuation storage is provided for 1 in 100 year plus climate change worst case storm event The approach to flood risk is presented in Volume 6, Appendix 15.1: FRA and has been summarised in this chapter (see paragraph 2.2.7 to 2.2.9).
The sequential approach should be applied to the layout and design of the project. More vulnerable uses should be located on parts of the site at lower probability and residual risk of flooding. Applicants should seek opportunities to use open space for multiple purposes such as amenity, wildlife habitat and flood storage uses. Opportunities should be taken to lower flood risk by reducing the built footprint of previously developed sites and using SuDS. Essential energy infrastructure which has to be located in flood risk areas should be designed to remain operational when floods occur. In addition, any energy projects proposed in Flood Zone 3b the Functional Floodplain (where water has to flow or be stored in times of flood), or Zone C2 in Wales, should only be permitted if the development will not result in a net loss of floodplain storage, and will not impede water flows. The receipt of and response to warnings of floods is an essential element in the management of the residual risk of flooding. Flood warning and evacuation plans should be in place for those areas at an identified risk of flooding. The applicant should take advice from the emergency services when producing an evacuation plan for a manned energy project as part of the FRA. Any emergency planning documents, flood warning and evacuation procedures that are required should be identified in the FRA (paragraph 5.7.23 to 5.7.25, NPS EN-1).	The drainage design will incorporate drainage measures in line with the requirements of NPS EN-1 and the NPPF. The approach to flood risk and the proposed outline drainage strategy is presented in Volume 6, Appendix 15.1: FRA and has been summarised in this chapter (see paragraph 2.2.7 to 2.2.9).
Water quality and resources	
The decision maker should satisfy itself that a proposal has regard to the River Basin Management Plans and meets the requirements of the WFD and its daughter directives, including those on priority substances and groundwater. The specific objectives for particular river basins are set out in River Basin Management Plans. The decision maker should also consider the interactions of the proposed project with other plans such as Water Resources Management Plans (WRMPs) and Shoreline/Estuary Management Plans (paragraph 5.15.6, NPS EN-1).	The assessment and the proposed mitigation measures have taken into account the requirements of the River Basin Management Plan and WFD to ensure all potential impacts on the water environment are mitigated to within acceptable levels (see Table 2.6).
The decision maker should consider whether appropriate requirements should be attached to any development consent and/or planning obligations entered into to mitigate adverse effects on the water environment (paragraph 5.15.7, NPS EN-1).	This has been described and considered in relation to the site flood risk and hydrology within the assessment of the proposed development.

Summary of NPS EN-1 and NPS EN-2 policy on decision making (and mitigation) in relation to hydrology and flood risk	How and where considered in the Environmental Statement
The decision maker considers whether mitigation measures are needed over and above any which may form part of the project application. A construction management plan may help codify mitigation at that stage. The risk of impacts on the water environment can be reduced through careful design to facilitate adherence to good pollution control practice. For example, designated areas for storage and unloading, with appropriate drainage facilities, should be clearly marked. The impact on local water resources can be minimised through planning and design for the efficient use of water, including water recycling (paragraphs 5.15.8 to 5.15.10, NPS EN-1).	The approach to flood risk is presented in Volume 6, Appendix 15.1: FRA and has been summarised in this chapter (see paragraph 2.2.7 to 2.2.9). Appropriate mitigation measures are set out in Table 2.6 and a Code of Construction Practice (CoCP) (Document A8.6 accompanying the DCO application).

National Planning Policy Framework

1.2.4 The National Planning Policy Framework (NPPF) (Ministry of Housing, Communities & Local Government, 2019) 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.

1.2.5 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 (see below).

1.2.6 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.

1.2.7 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 EA as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in 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

1.2.8 PPG ID7 Flood Risk and Coastal Change (Ministry of Housing, Communities and Local Government, 2014) provides guidance to ensure the effective implementation of the NPPF planning policy for development in areas at risk of flooding.

Local policy

1.2.9 Key provisions of the Thurrock Local Development Framework, Core Strategy policies are set out in Table 1.3, along with details as to how these have been addressed within the assessment.

Table 1.3: Summary of other relevant policies relevant to hydrology and flood risk.

Summary of local planning polices relevant to the assessment of hydrology and flood risk	How and where considered in the ES
Thurrock Local Development Framework, Core Strategy and Policies for Management of Development. Development Plan Document	
CSTP27 – Management and Reduction of Flood Risk • 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. • 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. • 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. • 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 [Department for Environment, Food and Rural Affairs] 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. • The Council will ensure that, where necessary, new development throughout the Borough contains space for water including naturalisation and environmental enhancement. • Developers will be required to contribute towards flood risk management infrastructure where appropriate. • Planning applications received for sites within Flood Zone 3 will be treated in accordance with PPS25, this policy and Policy PMD15.	The approach to flood risk is presented in Volume 6, Appendix 15.1: FRA and has been summarised in this chapter (see paragraph 2.2.7 to 2.2.9). Alternative sites are discussed in Volume 2, Chapter 3: Consideration of Alternatives.
Policy PMD15 – Flood Risk Assessment • 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. • 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 SPD. • 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 [Strategic Flood Risk Assessment], 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; • Evidence that the proposed development will not interfere with the potential for future maintenance or improvements to flood defences. • 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. • 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.	The approach to flood risk is presented in Volume 6, Appendix 15.1: FRA and has been summarised in this chapter (see paragraph 2.2.7 to 2.2.9). Alternative sites are discussed in Volume 2, Chapter 3: Consideration of Alternatives

1.3 Legislation

1.3.1 The Applicant and their appointed contractors will comply with legislation associated with the construction of the proposed development. An outline of relevant legislation specific to hydrology and flood risk is provided below.

Flood and Water Management Act 2010

1.3.2 The Flood and Water Management Act 2010 implements the recommendations from Sir Michel Pitt's Review of the floods in 2007 and places a series of responsibilities on councils. The main aim of the Act is to improve flood risk management.

1.3.3 The Act designates councils as a LLFA with a ‘lead’ role in managing flood risk from surface water, groundwater and ordinary watercourses across their jurisdictional area. This involves closely working with partners involved in flood and water management, namely the EA, Thurrock Borough Council and Essex County Council.

Land Drainage Act 1991

1.3.4 Under Section 23 of the Land Drainage Act 1991 (LDA 1991) consent is required from the relevant IDB for any works likely to obstruct, or affect the flow of, a watercourse. The relevant drainage authorities in respect of the proposed development are the EA and Essex CC (LLFA). Section 66 of the LDA 1991 makes provisions for the creation of byelaws considered necessary for securing the efficient working of the drainage system. Under the byelaws consent is required from the relevant drainage authority for any development within a particular distance of a drainage work.

Water Resources Act 1991

1.3.5 The Water Resources Act 1991 (WRA 1991) makes provision for the creation of byelaws by the EA. Paragraph 5 of Schedule 25 allows for the EA to create byelaws for flood defence and drainage purposes. Paragraph 6 allows for byelaws for purposes of fisheries functions to be made. Paragraph 6A makes provision for the creation of fisheries byelaws for marine or aquatic environmental purposes.

The Environmental Permitting (England and Wales) Regulations 2016

1.3.6 Schedule 25 of the Environmental Permitting (England and Wales) Regulation 2016 applies in relation to flood risk activity in, over or under a watercourse. Under the regulations, consent is required from the EA to undertake works or to erect structures within 8 m of a non-tidal water body (and 16 m of a tidal body).

1.4 Consultation

1.4.1 Key issues raised during scoping and consultation to date specific to hydrology and flood risk are listed in Table 1.4, together with details of how these issues have been considered in the production of this ES and cross-referenced to where this information may be found.

Table 1.4: Key points raised during scoping and consultation to date.

Date	Consultee and type of response	Issues raised	Response to issues raised and/or where considered in this chapter
20 September 2018	The Planning Inspectorate Scoping Opinion	Thames Estuary 2100 (TE2100) plan The Inspectorate has had regard to the consultation response from the EA regarding the TE2100 plan for maintaining or improving the current standards of flood protection on the estuary. The Applicant should make effort to consult with the EA regarding interactions between the Proposed Development and the TE2100. Where significant environmental effects are likely these should be assessed.	Project consultants have been in continued consultation with the EA, as demonstrated in Table 1.4. Volume 6 Appendix 15.1: FRA and the AECOM Concept Design of Causeway for Delivery of AILs (October 2019) considers of works within Zone G and that on the flood defences associated within the proposed causeway.
		Data If any additional site-specific hydrological data is acquired from site reconnaissance or consultation with another body, this information should be included.	Data sources utilised to inform the chapter are presented in Table 2.1, Volume 6 Appendix 15.1: FRA, 15.2: Flood Zones and Model Data and 15.3: Surface Water Abstraction Licences, Discharge Consents and Pollution Incidents.
		Scope of the assessment The Inspectorate notes that only 'temporary changes' to surface water flows within Flood Zone 3 during construction will be assessed. The Scoping Report does not define the term 'temporary changes'. For the avoidance of doubt any likely significant effects resulting from changes to surface water flows within Flood Zone 2 during relevant stages of construction should be assessed.	Temporary impacts are associated with short term construction and decommissioning works. Further assessment is undertaken on the long term impacts associated with the operation of the proposed development over its lifetime.
		Scope of the assessment As the proposed development is located within Flood Zone 3, an assessment of whether the proposed development can remain safe and operational during a worst-case flood event should be undertaken and included.	A review of the flood levels taking into account local flood defences as well as the residual flood risk as a consequence of a breach has been undertaken (section 3.1) and impacts assessed in Section 4. The flood resilience and defences to be included as part of the proposed development are outlined in Table 2.6.
		Loss of floodplain storage The proposed development is situated within a floodplain storage area, but the Scoping Report has not stated whether the proposed development will result in a net loss of floodplain storage. The ES should quantify and assess the impacts from the proposed development to floodplain storage.	No above ground structures or ground profiling is proposed within the area designated as flood zone 3b.
		Water Framework Directive (WFD) bodies. Paragraph 8.154 of the Scoping Report confirms that the assessment will consider potential impacts on WFD water bodies. The Applicant's attention is drawn to the Inspectorate's Advice Note Eighteen: The WFD in this regard. The Applicant should make effort to discuss and agree the approach to the assessment of water quality and the need for additional sampling (further to that set out in Table 8.6 of the Scoping Report) with the EA. The ES should explain the relationship between the proposed development and any relevant water bodies in relation to the current relevant River Basin Management Plan. If the decision regarding the cooling water infrastructure cannot be made prior to submission of the DCO application, the ES should describe and assess all possible scenarios likely to result in significant effects on relevant water bodies.	A review of local surface water bodies and associated WFD status is outlined in paragraphs 2.2.3 to 2.2.4 and impacts assessed in Section 4. A detailed WFD assessment is presented in Volume 6, Appendix 17.3: Water Framework Directive Assessment.

Date	Consultee and type of response	Issues raised	Response to issues raised and/or where considered in this chapter
		Methodology for: • probability of harm; and • magnitude of impact. The Scoping Report does not define the term 'probability of harm' or describe how a probability of harm will be assigned to receptors. The ES should provide a definition of this term and include a detailed description of the methodology used to determine the 'probability of harm' to a receptor. Scoping Report paragraph 8.157 states that the significance of predicted effects will be determined in part by the magnitude of predicted impact. The methodology used to determine the magnitude of the predicted impact should also be set out within the ES.	The assessment methodology utilised to inform the assessment is detailed in Section 2 and has taken in taken probability of harm based on the EA's Hazard Rating classifications.
		Flood Risk Assessment (FRA) All potential sources of flooding which could result in likely significant effects should be assessed in the ES.	A development specific FRA to support the DCO is presented in Volume 6, Appendix 15.1: FRA. The Section 4 includes an assessment of flood risk.
		Drainage The Scoping Report indicates that a drainage strategy including new drainage features will be developed.	A development specific FRA to support the DCO is presented in Volume 6, Appendix 15.1: FRA. A high-level drainage concept is presented in Volume 6, Appendix 15.1: FRA, which is consistent with the Conceptual Drainage Strategy (application document A7.3).
		Climate change allowance Any uncertainties or assumptions encountered when using the climate change model to assess impacts to water resources and flood risk should be stated.	Climate change is reviewed in section 3.2 and impacts associated with climate change included within the development specific FRA is presented in Volume 6, Appendix 15.1: FRA.
		Future baseline The Scoping Report does not state the timeframe for the future baseline. The Inspectorate assumes that the timeframe for the future baseline will be the 12 month construction period from 2021-2022; however, this should be clearly stated.	Section 3.2 outlines the timeframe for the future baseline in relation to climate change and discussed further in Volume 2, Chapter 4: Environmental Impact Assessment Methodology.
		Mitigation measures The Scoping Report (paragraph 8.161) refers to the sufficiency of proposed mitigation. Paragraph 3.11 of the Scoping Report does state that Sustainable Drainage (SuDS) feature will be used as a mitigation measure to prevent surface water flooding. The location of SuDS and an assessment of their efficacy should be included.	Designed-in mitigation measures are presented in Table 2.6. A high-level drainage concept is presented in Volume 6, Appendix 15.1: FRA, which is consistent with the Conceptual Drainage Strategy (application document A7.3).
		Tidal flood risk The Scoping Report does not address any potential changes in tidal flooding caused by the Proposed Development.	Volume 6 Appendix 15.1: FRA and the AECOM Concept Design of Causeway for Delivery of AILs (application document A7.8) considers works within Zone G and impact on the flood defences associated within the proposed causeway.
		Public highway adjustments The Inspectorate notes that the public highway adjustments have not been referenced within the aspect chapter. An assessment into how water resources and flood risk may be affected by the public highway adjustments taking into account relevant guidance should be included. If any mitigation measures are required to prevent significant effects occurring to the water resources and flood risk arising from the public highway adjustments, a description and efficacy assessment of the proposed mitigation measures should be included.	The public highway adjustments discussed at the time of scoping are no longer proposed.

Date	Consultee and type of response	Issues raised	Response to issues raised and/or where considered in this chapter
05 September 2018	EA EIA Scoping Response	Flood Risk The EIA scoping report (section Water Resources and Flood Risk pages 103-107) highlights that a Flood Risk Assessment (FRA) is required and will consider risks to the proposed development from flooding as well as the potential for the proposed development to increase flood risk elsewhere. A Flood Response Plan (FRP) will be required for the proposed development. The FRP should account for all sources of flooding experienced at the site with the correct actions specified for the given inundation time. It should be drawn up in close liaison with Thurrock Council's Emergency Planner, the Emergency Services and us to ensure it includes appropriate actions related to potential site circumstance and that it is compliant with the wider emergency plans for the District.	A high-level drainage concept is presented in Volume 6, Appendix 15.1: FRA and a Flood Evacuation Plan has been prepared (application document A8.5)
		Environmental Permitting Regulations 2016 A Flood Risk Activity Permit will be required for any works in, under, over or within 8 metres (m) from a fluvial main river and 16m from a tidal main river and from any flood defence structure.	The Applicant proposes to disapply the requirements to obtain a FRAP and to address this through the DCO provisions.
		Thames Estuary 2100 Plan / TEAM2100 A point to clarify in section 8.145 is that we have permissive powers available to us via section 165 of the Water Resources Act 1991 as amended by the Floods and Water Management Act 2010 which allow us to maintain and improve existing works as well as to construct new works on a designated main river watercourse or tidal flood defence.	Noted
		Future Thames Flood Barrier We would therefore expect to see consideration given to how the TE2100 plan requirements can be taken into account as part of this proposal. Given the proposed nature of the application the impact of a future barrier maybe minimal, but we would welcome further discussions on how to incorporate space for any potential future barrier within the proposals. We are unlikely to have any construction or operational need over land along this frontage for over 40 years. We acknowledge that the proposed lifespan of the development and so this may not be an issue however we would be pleased to provide any further information you may require from us to help facilitate our aspirations under the TE2100 plan.	Volume 6 Appendix 15.1: FRA and the AECOM Concept Design of Causeway for Delivery of AILs (application document A7.8) considers of works within Zone G and that on the flood defences associated within the proposed causeway
		Water Quality We believe Water Framework Directive (WFD) risk assessments should be a standalone chapter within the EIA/ES, containing all relevant supporting detail, not simply references to other parts of the ES. The evidence presented in a WFD assessment needs to be an integral part of the WFD document.	A review of local surface water bodies and associated WFD status is outlined in paragraphs 2.2.3 to 2.2.4 and impacts assessed in Section 4. A WFD assessment is presented in Volume 6, Appendix 17.3: Water Framework Directive Assessment.
06 September 2018	Essex County Council Scoping Response	Lead Local Flood Authority – Flood and Water Management If a surface water drainage strategy is to be developed in discussions with the EA, Essex County Council as a neighbouring LLFA and Risk Management Authority (RMA) should be included in these discussions. This should be clearly identified and the role that will be played should be transparent from the earliest opportunity. Paragraph 8.158 – Essex County Council as LLFA wishes to be consulted in relation to water quality. The impact on groundwater and groundwater movement should be included in the assessments. The assessments should also consider infiltration potential. Pluvial flood risk should be explicitly considered and be presented as a separate section of the ES. At present it appears to be focused on fluvial flood risk.	The Applicant's consultant has forwarded a number of email correspondence to Essex County Council and associated SuDS department. To date no response has been received. A development specific FRA is presented in Volume 6, Appendix15.1: Flood Risk Assessment. Impacts to groundwater have been assessed in Volume 3, Chapter 16: Geology, Hydrogeology and Ground Conditions.

Date	Consultee and type of response	Issues raised	Response to issues raised and/or where considered in this chapter
29 August 2018	Thurrock Borough Council Scoping Response	Flood Risk We acknowledge the EIA Scoping Report submitted dated July 2018 by RPS Group. From emergency planning perceptive, two main areas of interest to us in this development were: • Flood Risk- Section 8.143-8.162 of the scoping report proposed to consider the effects of flood risk during the construction, operation and decommission phase which will be outlined in the Flood Risk Assessment (FRA). • Emergency Management Response Plan- Section 9.5 of the scoping report will considered the off-site impacts. We conclude that the scoping report document has covered these two areas.	Flood risk during the construction, operation and decommission phases has been assessed in Section 4 and a development specific FRA is presented in Volume 6, Appendix 15.1: Flood Risk Assessment.
August 2018	Applicant's consultants (RPS)	Essex CC environmental information request	No response.
August 2018	EA and LPA Meeting	Consultation meeting with EA, LLFA (Essex County Council) and Thurrock Brough Council. Outline project, proposed methodology for addressing flood risk. No significant issues raised.	No response required.
July 2018	Applicant's consultants (RPS)	EA environmental information request	EA response August 2018. Flood data, flood zone mapping, flood defence records, historical flood extents and event information.
September 2018	Applicant's consultants (RPS)	EA environmental information request. Main River outfalls	EA response September 2018. Outfall levels and locations
October 2018	Canal & River Trust Consultation Letter.	*"The Trust has reviewed your proposals, and on the basis that they appear unlikely to have any impact on our waterways we have no comment to make at this time."*	No response required.
November 2018	EA Consultation Response	We [EA] note that table 1.1 states that the latest climate change projections should be applied at the time the Environmental Statement (ES) is prepared. As this consultation is to inform the preparation of the ES, it is likely that this will be prepared when the updated climate change projections (UKCP18) have been released. These are expected to be released in November 2018 and should be used in support of the application.	A review of the EA climate change requirements has been undertaken via the GOV.UK website [https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances, accessed October 2019] which identifies that climate change allowances have not yet been updated, and based on UKCP09.
		The FRA should show what will happen in that event [climate change] and provide an assessment of whether this could be mitigated for. Please note that the lifetime of development should also include any time required for the decommissioning element of the development, should there be one for this application.	Flood risk during the construction, operation and decommission phases has been assessed in Section 4 and a development specific FRA is presented in Volume 6, Appendix 15.1: Flood Risk Assessment.
		We note that it is intended to cross West Tilbury Main Sewer with the access road. Further detail will need to be submitted in relation to the type of crossing. We welcome the decision to cross main river crossings (such as West Tilbury Main) with trenchless techniques when installing the pipeline.	Details to be secured as a protective provision of the DCO.
		Mitigation options should be explored further within any future FRA submission, where it should be detailed how it shall be ensured that the development will remain operational and safe at all times, for both the design (0.5% annual probability) and extreme (0.1% annual probability) flood events, inclusive of climate change.	Flood risk during the construction, operation and decommission phases has been assessed in Section 4 and a development specific FRA is presented in Volume 6, Appendix 15.1: Flood Risk Assessment.

Date	Consultee and type of response	Issues raised	Response to issues raised and/or where considered in this chapter
		The FRA should refer to the most up-to-date version of the SFRA (dated June 2018) for the most accurate information, and then detail how the flood risk shall be managed	Flood risk during the construction, operation and decommission phases has been assessed in Section 4 and a development specific FRA, which has had regard to the most recent SFRA produced by Thurrock Borough Council, is presented in Volume 6, Appendix 15.1: FRA.
October 2019	EA Consultation Response	No Water Framework Directive (WFD) compliance assessment has been produced to date. We cannot advise the works will comply with WFD objectives until we have received and reviewed your WFD assessment for both the construction and the dredging works. Whilst an indicative volume for the dredge has been provided, this does not of itself constitute an argument or evidence for WFD compliance on water quality grounds.	A detailed WFD assessment is presented in Volume 6, Appendix 17.3: Water Framework Directive Assessment.
		The choice of dredge method will also influence the arguments for WFD compliance on water quality grounds. This is because the amount of sediment mobilised during the dredge and thus the transfer of sediment contaminants to water column is related to the choice of non-dispersive vs dispersive methods, rate of dredge, and timing of the dredge relative to ambient (seasonally dependent) water quality. We [EA] may condition dredges upriver from Tilbury to use non-dispersive methods, if undertaken between the period of June- August inclusive. This is due to the higher risk of poor water quality, low dissolved oxygen, in the summer months. This may also be affected by storm sewage inputs in the upper estuary after rainfall.	A detailed WFD assessment is presented in Volume 6, Appendix 17.3: Water Framework Directive Assessment.
		A WFD assessment will be required to be submitted in support of a marine licence application(s) or the issue of a Deemed Marine Licence if submitted via the National Significant Infrastructure Project route. For the dredge component, compulsory sediment chemistry analyses will be required as part of the licensing process. The results for these analyses will be expected to be used to inform the argument for WFD compliance. We [EA] would expect to see consideration given to existing baseline concentrations of the Environmental Quality Standards Directive (EQSD)/WFD substances in the waterbody, before the uplift in concentrations and predicted final concentration relative to the EQS limits applicable are calculated by reference to the contaminant levels present in the sediment being disturbed.	A detailed WFD assessment is presented in Volume 6, Appendix 17.3: Water Framework Directive Assessment.
		We will require further information in relation to the impact of the causeway on the flood defences in the area. In particular: Section 4.3 - Further detail on top of that provided will be required to satisfy us ahead of proposal being fully acceptable. Drop boards installed by the applicant will only be considered a temporary solution for the period of the works. Following completion of the works the we will require the drop boards to be removed and the flood wall to be reinstated. Figure 2 - Arrangement of the causeway will need to be modified to suit when transitioning across the embankment part of the tidal defence Plan of Causeway - The alignment of causeway appears to have been changed. This now clashes with a proposal from National Grid for a new surface water outfall. This should be considered in future development of the plans.	Details of the proposed causeway and flood defence alterations design are provided in the Concept Design of Causeway for Delivery of AILs (application document A7.8). Provision of further details can be secured as a protective provision of the DCO. Surface water outfall conflict has not been identified by National Grid in consultation to date. The proposed causeway is to the east of the existing National Grid compound on RWE (former Tilbury B Power Station) site.

Date	Consultee and type of response	Issues raised	Response to issues raised and/or where considered in this chapter
April 2020	EA Consultation Response	The Applicant sought advice on appropriate methodology to include a suitable allowance for climate change in order that the most recent UKCP18 tidal levels are accounted for. The Applicant noted that the Thurrock SFRA (2018) and supporting hydraulic modelling indicated that the medium emissions scenario (95th percentile) projections from UKCP09 were applied to generate the extreme water levels with allowances for sea level rise for the 2116 scenarios. The SFRA report references the GOV.UK website (https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances). Subsequently, on the 17th December 2019 climate change sea level allowance where 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 but now provide an 'Upper end' scenario with possible greater sea level rise. The maximum variation in projected sea level rise between the current and previous guidance is 0.39 m or 390 mm. In order to achieve a resilience level that accounts for the Upper End sea level climate change allowances (1.6 m) up to 2115 the applicant proposes to apply +390mm to the proposed design flood resilience level for critical infrastructure on the site.	Response – EA 09 April 2020. *We [the EA] confirm that that their [the Applicant's] approach to allowing for UKCP18 climate change is acceptable given that this is a residual risk situation. The difference of 0.39m is similar to what we're seeing everywhere on the coast (0.31m difference for coastal 2018 modelling).* *We [the EA] accept that their [the Applicant's] approach represents resilience to 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 2018 Strategic Flood Risk Assessment.* A development-specific FRA is presented in Volume 6, Appendix 15.1: Flood Risk Assessment which presents an assessment of flood levels including the addition of 0.39 m to account for the worst-case climate change allowances based on UKCP18.

2. Assessment Approach

2.1 Guidance / standards

2.1.1 The assessment of hydrology and flood risk value and determination of effect significance has been undertaken with reference to the Design Manual for Roads and Bridges (DMRB) Guidance (2019) Volume 11 Environmental Assessment Section 1 to 4.

2.2 Baseline Study

Desktop study

2.2.1 Information on hydrology and flood risk within the proposed development hydrology and flood risk study area was collected through a detailed desktop review of existing studies and datasets. These are summarised in Table 2.1.

Table 2.1: Summary of key desktop reports.

Title	Source	Year	Author
BGS 1:50,000 and 1:10,000 digital geological mapping	BGS via Groundsure GeoInsight Report	2018	BGS
SPZs/Aquifer Designations	EA via Groundsure EnviroInsight Report Correspondence with the EA	2018	GroundSure EA
Groundsure Environmental Search (Ref: RPS_542618).	Groundsure	September 2018	Groundsure Limited
Climate data	Met Office	2018	Met Office
Water Resource Management Plan	Anglian Water	2014	Anglian Water
Flood Zone and Watercourse Map	EA	2018	EA
Thames Estuary 2100, Managing flood risk through London and the Thames estuary TE2100 Plan	EA	November 2012	EA
Thames river basin district river basin management plan.	EA	December 2015	EA
South Essex Catchment Flood Management Plan	EA	December 2009	EA
Thurrock Local Flood Risk Management Strategic Environment Assessment Screening report	Thurrock Borough Council	December 2014	JBA Consulting
Thurrock Local Flood Risk Management Strategy	Thurrock Local Flood Risk Management Strategy Final December 2015	December 2015	Thurrock Borough Council
South Essex Catchment Plan 2015-2018	South Essex Catchment Partnership	2015	South Essex Catchment Partnership
Thurrock Brough Council Strategic Flood Risk Assessment Level 1 Final Report June 2018	Thurrock Borough Council	2018	AECOM

Identification of designated sites

2.2.2 A review of desktop reports, publicly available information and data requests (as identified in Table 2.1) did not identify any hydrologically designated sites within the proposed development hydrology and flood risk study area. Watercourses designated for their ecological interest are identified in Volume 3, Chapter 9: Onshore Ecology.

Water Framework Directive

2.2.3 The current overall WFD status for watercourses potentially affected by the proposed development has been identified via the publicly available EA's (2016a) Catchment Data Search. The open access database provides the most up to date (2016) Current Status classifications for a number of main rivers within the Thames, Essex South River Basin District and the proposed development hydrology and flood risk study area. The WFD classification is not site specific but classifies a defined river reach based on site samples.

2.2.4 For surface waters, the WFD objectives are based on the ecological and chemical status of the waterbody (i.e. the predicted future status if technically feasible measures are implemented). These measures are required to prevent deterioration in the current status of the waterbody and (once implemented) produce more benefits than they cost to implement. The date to achieve the objective status is determined by the type of measures which are needed in order to improve the status of the waterbody (i.e. the cost of the measures (are they affordable) and the time taken for the status to improve once the measures have been implemented).

2.2.5 To address consultation responses with respect to works within Zone G (Proposed Causeway) WFD assessment has been undertaken and presented in Volume 6, Appendix 17.3: Water Framework Directive Assessment.

Site specific surveys

2.2.6 In order to inform the EIA, site-specific surveys were undertaken. This comprised a walkover survey undertaken as part of the hydrological characterisation of the main development area and a visual inspection of local watercourses.

Flood Risk Assessment

2.2.7 The Gas Engine and Battery Storage facilities will each cover an area of more than 1 hectare (ha), and the cable and pipeline corridor will pass through areas designated as Flood Zone 2 and 3. In accordance with the guidance in the NPPF (and PPG ID7 – Flood Risk and Coastal Change) and NPS EN-1 site-specific FRAs have been undertaken. This is included in Volume 6, Appendix 15.1: FRA.

2.2.8 The key components of the site specific FRAs are as follows:

- Review of publicly available EA documentation, local flood management plans and future flood management schemes;
- Review of Strategic FRAs;
- Assessment of the flood risk to the existing conditions and future conditions;
- A site-specific assessment of flood risk at the proposed Gas Engine and Battery Storage facilities, and cable and pipeline corridors; and
- A hydrological assessment of the surface water flows for the proposed Gas Engine and Battery Storage facilities, and cable and pipeline corridors.

2.2.9 The approach of the FRA for the proposed development was agreed with the EA and Thurrock Council.

2.2.10 The FRA also takes due consideration of works within Zone G and that on the flood defences associated within the proposed causeway.

2.2.11 Whilst the proposed development pipeline corridor will exceed 1 ha when considering the full length of the assessment corridor, which will cross areas at risk flooding (Flood Zone 2 and 3). Given that the pipeline would be below ground the potential impact on permanent flood risk is negligible. The report identifies locations where the corridor crosses areas assessed as Flood Zones 2 and 3 (i.e. crossing locations of main rivers and ordinary watercourses) and outlines appropriate design-in mitigation measures to manage flood risks.

2.3 Study Area

2.3.1 The proposed development hydrology and flood risk study area is shown on Figure 2.1 and comprises a 250 m buffer around the proposed development (namely the Thurrock Flexible Generation Plant (Gas Engines and Battery Storage), the causeway, the electrical cable corridor, the gas pipeline connection corridor), as well as the storage areas, compounds and permanent access road. The proposed development hydrology and flood risk study area also includes a 1 km buffer area around the proposed development's Gas Engines and Battery Storage facilities.

2.3.2 The 250 m buffer is considered appropriate for data collection taking into account the nature of the development and likely zone of influence on hydrological receptors. Given the landscape surrounding the proposed development and local land use activities, it would be difficult to ascertain the exact source of any impacts on water quality beyond 250 m. The 1 km buffer for the proposed development Gas Engines and Battery Storage facilities was chosen to identify any existing assets, infrastructure or receptors that have the potential to be affected by the long-term presence of infrastructure constructed above ground in terms of flood risk.

2.4 Uncertainties and/or data limitations

2.4.1 The assessment within this chapter is based on publicly available data obtained from the EA, Thurrock Borough Council, Essex County Council and commercial data supply companies, as well as additional information supplied from stakeholders during the scoping and consultation stages. The information has been supplemented with publicly available data, Groundsure searches and public consultation such that it is considered sufficient to characterise the baseline environment.

2.4.2 It is also noted that the EA Flood Zone risk maps do not take into account the impact of local flood defences and climate change on flooding, and do not provide information on flood depth, speed or volume of flow. The maps do not show flooding from other sources such as groundwater, direct runoff from fields or overflowing sewers. However, a detailed review of the Thurrock Borough Council SFRA (AECOM, 2018) and associated model results has been undertaken with a description of sources of flooding provided in the FRA (see Volume 6, Appendix 15.1: FRA), such that sufficient baseline information is available.

2.4.3 The assessment is limited by a lack of detailed information on:

- Flow data for watercourses and drainage channels; and
- Water quality data for specific locations.

2.4.4 Notwithstanding the above, overall a moderate to high level of certainty has been applied to the baseline and assessment presented in this chapter. Where available, catchment data regarding water quality has been used to inform the assessment. The information which was available is considered sufficient to establish the baseline within the proposed development hydrology and flood risk study area, therefore, there are no data limitations that would affect the conclusions of this assessment.

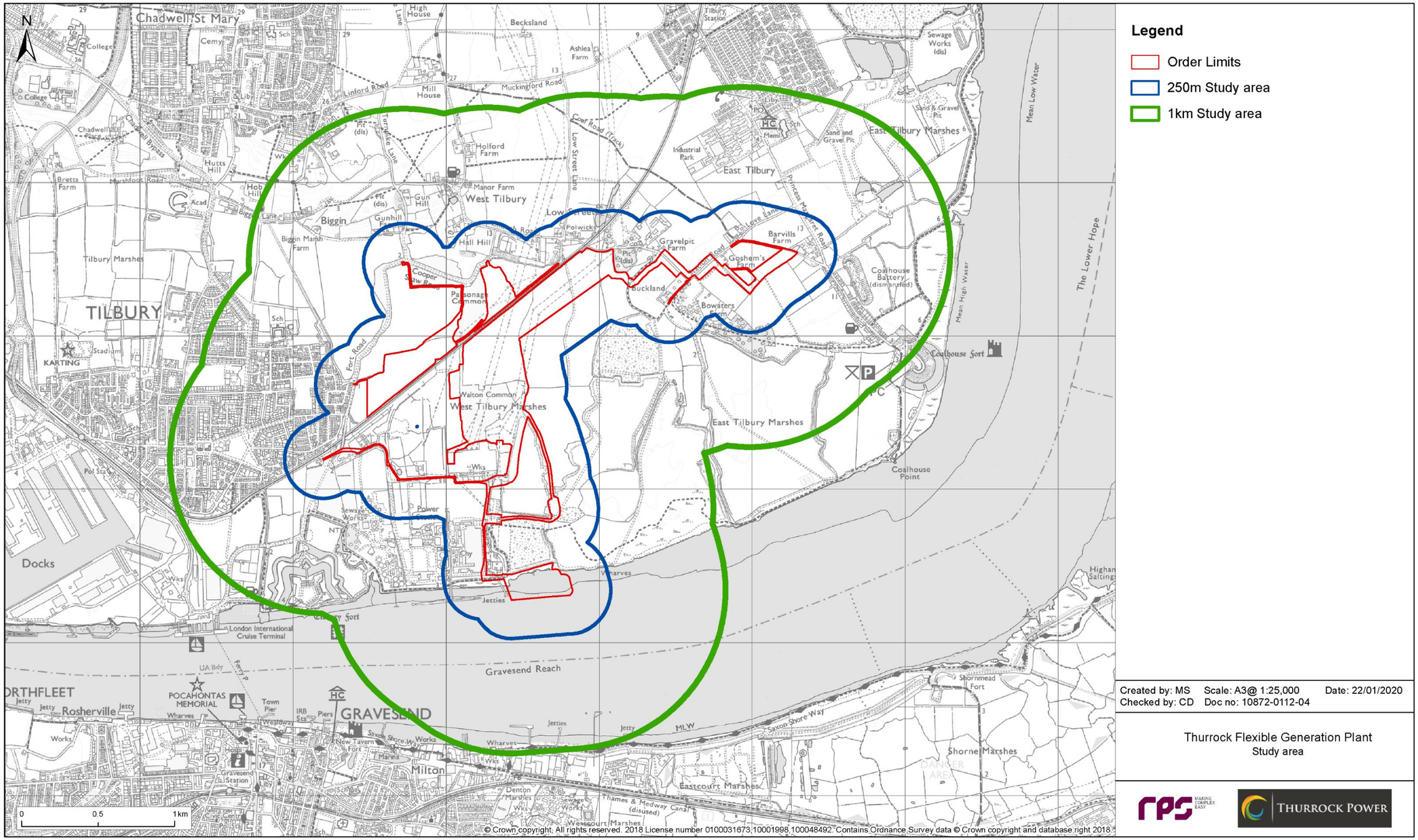

Figure 2.1: Hydrology and flood risk study area.

2.5 Impact assessment criteria

2.5.1 The significance of an effect is determined based on the magnitude of an impact and the sensitivity of the receptor affected by the impact of that magnitude. This section describes the criteria applied in this chapter to characterise the magnitude of potential impacts and sensitivity of receptors. The terms used to define magnitude and sensitivity are based on those used in the DMRB methodology (Highways England *et al.*, 2019), which is described in further detail in LA 104 Environmental assessment and monitoring.

2.5.2 The criteria for defining magnitude in this chapter are outlined in Table 2.2.

Table 2.2: Definition of terms relating to the magnitude of an impact.

Magnitude of impact	Definition used in this chapter
Major	Total loss of ability to carry on activities. Impact is of extended temporal or physical extent and of long-term duration (i.e., up to 10 years duration).
	Significant observable degradation in water resource quality and/or increase in flood risk (i.e., up to 10 years duration).
Moderate	Loss of or alteration to significant portions of key components of current activity. Impact is of moderate temporal or physical extent and of medium-term duration (i.e., up to 5 years).
	Observable degradation in water resource quality and/or increase in flood risk (i.e., up to 5 years).
Minor	Small reduction in baseline conditions, leading to a reduction in level of activity that may be undertaken. Impact is of limited temporal or physical extent and of short-term duration (i.e., up to 2 years).
	Degradation in water resource quality and/or slight increase in flood risk (i.e., up to 2 years).
Negligible	Very small reduction in baseline condition. Physical extent of impact is negligible and of short-term duration (i.e., less than 1 year).
	No observable degradation in water resource quality and/or flood risk (i.e., less than 1 year).
No change	No change from baseline conditions.

2.5.3 The criteria for determining the significance of effects is a two-stage process that involves defining the sensitivity of the receptors and the magnitude of the impacts on those receptors. This section describes the criteria applied in this chapter to assign values to the sensitivity of receptors and the magnitude of potential impacts. The terms used to define sensitivity and magnitude are based on those used in the DMRB methodology (Highways England *et al.*, 2019), which is described in further detail in LA 104 Environmental assessment and monitoring. The criteria for defining sensitivity in this chapter are outlined in Table 2.3.

Table 2.3: Definition of terms relating to the sensitivity of the receptor.

Sensitivity	Definition used in this chapter
Very High	Receptor is high value or critical importance to local, regional or national economy. Receptor is highly vulnerable to impacts that may arise from the project and recoverability is long term or not possible. Surface water: WFD Current Overall Status of High. Flood risk: Land within Flood Zone 3 or more than one hundred residential properties protected from flooding by flood defence infrastructure or by natural floodplain storage.
High	Receptor is of moderate value with reasonable contribution to local, regional or national economy. Receptor is generally vulnerable to impacts that may arise from the project and recoverability is slow and/or costly. Surface water: WFD Current Overall Status of Good. Flood risk: Land within Flood Zone 3 and/or 2 or between one and one hundred residential properties or industrial premises protected from flooding by flood defence infrastructure or by natural floodplain storage.
Medium	Receptor is of minor value with small levels of contribution to local, regional or national economy. Receptor is somewhat vulnerable to impacts that may arise from the project and has moderate to high levels of recoverability. Surface water: WFD Current Overall Status of Moderate. Flood risk: Flood plain within Flood Zone 2 and/or 1 or limited constraints and a low probability of flooding of residential and industrial properties.
Low	Receptor is of low value with little contribution to local, regional or national economy. Receptor is not generally vulnerable to impacts that may arise from the project and/or has high recoverability. Surface water: WFD Current Overall Status of Poor. Flood risk: Flood plain within Flood Zone 2 and/or 1 or limited constraints and a very low probability of flooding of residential and industrial properties.
Negligible	Receptor is of negligible value with no contribution to local, regional or national economy. Receptor is not vulnerable to impacts that may arise from the project and/or has high recoverability. Surface water: WFD Current Overall Status of Bad. Flood risk: Area

2.5.4 The significance of the effect upon hydrology and flood risk is determined by correlating the magnitude of the impact and sensitivity of the receptor. The particular method employed for this assessment is presented in Table 2.4. Where a range of significance is presented in Table 2.4, the final assessment for each effect is based upon expert judgement.

2.5.5 For the purpose of this assessment, any effects with a significance level of minor or less are considered to be **not significant** in EIA terms.

Table 2.4: Matrix used for the assessment of the significance of an effect.

		Magnitude of impact				
Sensitivity of receptor		***No change***	***Negligible***	***Minor***	***Moderate***	***Major***
	Negligible	No change	Negligible	Negligible or minor	Negligible or minor	Minor
	Low	No change	Negligible or minor	Negligible or minor	Minor	Minor or moderate
	Medium	No change	Negligible or minor	Minor	Moderate	Moderate or major
	High	No change	Minor	Minor or moderate	Moderate or major	Major or substantial
	Very high	No change	Minor	Moderate or major	Major or substantial	Substantial

2.6 Maximum design envelope parameters for assessment

2.6.1 The engineering design assumptions are presented in line with the ‘maximum design envelope’ approach (base scheme design). For each element of this chapter The maximum design envelope parameters identified in Table 2.5 have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group.

2.6.2 The assessment parameters are based on the design of the proposed gas engines, causeway, battery storage, cable route, pipeline route and permanent access roads described in Volume 2, Chapter 2: Project Description. The assessment considers a realistic maximum design envelope based on the maximum scale of the elements and as a result no effects greater significance than those assessed are likely.

2.7 Impacts scoped out of the assessment

2.7.1 No potential impacts are proposed to be scoped out.

Table 2.5: Maximum design envelope parameters assessed.

Potential impact	Maximum design scenario	Justification
Construction		
The construction of permanent assets may lead to increased flood risk	Main development site (Zone A) buildings and low permeable (hardstand) surfacing up to 6.35 ha in total Above ground installation for NTS connection (National Grid gas connection compound within Zone D3) buildings and low permeable (hardstand) surfacing up to 0.25 ha in total Permanent access road (within Zones C and G) use low permeable surfacing	Reasonable maximum low-permeability area would generate greatest surface runoff rate with potential to increase flood risk compared to greenfield rate
	Ground floor/base height of buildings and other structures of main development site (Zone A) to be set at 2.0 mAOD.	The design level set for drainage, which forms the initial level to which further resilience measures would be added where required to ensure assets are designed to be flood resilient and/or resistant to remain operational during a major flood event, including a breach in flood defences.
Temporary construction may lead to increased flood risk	Gas pipeline construction: 23 m wide working corridor; pipeline crosses all fields of 'Zone D'; total length up to 3 km Access road(s) for construction: 20 m wide working corridors; routes not shared with gas pipe Up to 2 ha in Zone C used for laydown or temporary construction compounds. Sea wall flood defence at head of causeway has opening made with slot-in gate to provide access to the causeway.	Reasonable maximum low-permeability areas within working zones for temporary construction would generate greatest surface runoff rate with potential to increase flood risk compared to greenfield rate during construction period. Cut though tidal flood defence providing a pathway for tidal flood water to shoreside of flood defence.
Construction may cause risk of leaks and spills to surface watercourses	Storage of fuel and refuelling or minor maintenance of construction plant within main development site (Zone A)	Reasonable maximum design scenario as Zone A would be the main working area for construction
The impacts of trenchless construction techniques may affect major surface watercourses	Trenchless techniques used for surface watercourse crossings by gas pipeline and underground cable.	The maximum design scenario for indirect effects to surface water quality would result from the use of trenchless techniques. Trenchless crossing techniques present a risk of indirectly contaminating surface watercourses where they are hydraulically connected with surface runoff caused by spillages and the movement of sediment.
The impacts of open cut, temporary bridging and culverts may affect surface watercourses	Temporary bridging or culverting of surface watercourse crossings for construction access, remaining in place for up to six year construction programme	The maximum design scenario for disturbance to surface water resources would result from the use of temporary bridging and culverts; open cut crossings are not proposed.
The construction of permanent assets may affect field drainage and irrigation	Up to 500 m of existing field drainage channels and surface water systems removed permanently	A loss of the drainage network would lead to the backing up of field drainage channels and surface water systems leading to potential surcharging and flood risk.
Operation and maintenance		
The impact of flexible generation plant operation and maintenance may affect main or ordinary surface watercourses	Up to one major maintenance period (duration three weeks) and four minor maintenance visits (duration one week) per annum	Storage of potentially contaminating substances and frequency of maintenance or repair activities are reasonable maximum design scenario for risk of surface watercourse contamination

Potential impact	Maximum design scenario	Justification
The impact of pipeline maintenance may affect main or ordinary surface watercourses	No excavation or machinery access required for routine inspection of pipeline. Possible repair or replacement of any pipeline section not planned during operating lifetime; unplanned repair or maintenance maximum design scenario no greater than construction	Reasonable maximum design scenario based on applicant's expected operation of pipeline infrastructure
Decommissioning		
The impacts of decommissioning may affect temporary flood risk.	Removal of all infrastructure including areas of hardstanding and flood attenuation, with the exception of buried pipeline and cable assets.	The removal of attenuation storage associated with the development could affect flood risk as it would take the natural environment a period of time to re-establish itself and regenerate to providing natural attenuation.
The impacts of decommissioning may affect main surface watercourses.	Removal of all infrastructure including areas of hardstanding and flood attenuation, with the exception of buried pipeline and cable assets.	The maximum design scenario for water quality of main watercourses during decommissioning is the removal of all associated infrastructure as this presents the greatest disturbance and potential risk of sediment and contaminants being released. It is not expected that buried pipeline assets would be removed.
The impacts of decommissioning may affect ordinary watercourses.	Removal of all infrastructure including areas of hardstanding and flood attenuation, with the exception of buried pipeline and cable assets.	The maximum design scenario for water quality of main watercourses during decommissioning is the removal of all associated infrastructure as this presents the greatest disturbance and potential risk of sediment and contaminants being released. It is not expected that buried pipeline assets would be removed.

2.8 Measures adopted as part of Thurrock Flexible Generation Plant

2.8.1 Potential impacts to the water environment will be avoided, where practicable, through careful consideration of the drainage design, construction techniques and operational best practices of the gas, battery facility and associated infrastructure. The EA and LLFA will be consulted through the construction work and planning process to ensure appropriate permits and consents are in place. Designed-in construction mitigation measures are outlined below and set out in the CoCP (application document A8.6).

2.8.2 As part of the design process, a number of design mitigation measures have been proposed to reduce the potential for impacts on hydrology and flood risk. These measures are considered standard industry practice for this type of development and therefore have been incorporated in the base scheme design as assessed within the potential impacts. The designed-in measures are listed in Table 2.6.

Table 2.6: Designed-in measures.

Measures adopted as part of Thurrock Flexible Generation Plant	Justification
Construction phase	

Best Practice Guidance
Construction work would be undertaken in accordance with the Code of Construction Practice (application document A8.6), and guidance including:
• Defra and EA (2018) guidance for discharges to surface water and groundwater: environmental permits;
• EA and Defra (2019) Flood risk activities: environmental permits;
• Defra and EA (2015) guidance for oil storage regulations for businesses;
• EA Pollution Prevention Guidance, which have been withdrawn. However, still provide useful best practice guidance:
  • EA (2014a) Pollution Prevention Guidance Note 6: Pollution Prevention Guidelines – Working at Construction and Demolition Sites;
  • EA (2014b) Pollution Prevention Guidance Note 5: – Working in, near or liable to affect watercourses;
• CIRIA (2001) Control of Water Pollution from Construction Sites – Guidance for Consultants and Contractors;
• CIRIA (2015a) SuDS Manual, including the following measures:
  • Prevent surface water being affected during earthwork operations. No discharge to surface watercourses will occur without permission from the EA;
  • Wheel washers and dust suppression measures to be used as appropriate to prevent the migration of pollutants;
  • Regular cleaning of roads of any construction waste and dirt to be carried out;
• CIRIA (2015b) Environmental good practice on site guide;
• CIRIA (2006a) Control of water pollution from linear construction projects: technical guidance;
• CIRIA (2006b) Control of water pollution from linear construction projects: site guide;
Defra and EA (2005) Flood Risk Assessment Guidance for New Development, Phase 2.
	To accord with guidance and best practice for constructional works

Best Practice Pollution Prevention Measures Refuelling of machinery would be undertaken within designated areas away from existing watercourses and where spillages can be easily contained. Machinery would be routinely checked to ensure it is in good working condition. Any tanks and associated pipe work containing oils and fuels will be double skinned and be provided with intermediate leak detection equipment. The following mitigation measures for the protection of surface water during construction activates would be implemented: • A briefing for all staff highlighting the importance of water quality, the location of watercourses and pollution prevention included within the site induction; • Areas with prevalent run-off to be identified and drainage actively managed, e.g. through bunding and / or temporary drainage; • Areas at risk of spillage, such as vehicle maintenance areas and hazardous substance stores (including fuel, oils and chemicals) to be bunded and carefully sited to minimise the risk of hazardous substances entering the drainage system or the local watercourses. Additionally, the bunded areas will have impermeable bases to limit the potential for migration of contaminants into groundwater following any leakage / spillage. Bunds used to store fuel, oil etc. to have a 110% capacity of the volume of fuel, oil etc. to be stored; • Disturbance to areas close to watercourses reduced to the minimum necessary for the work; • Excavated material to be placed in such a way as to avoid any disturbance of areas near to the banks of watercourses and any spillage into the watercourses; • Construction materials to be managed in such a way as to effectively minimise the risk posed to the aquatic environment; and • Plant machinery and vehicles to be maintained in a good condition to reduce the risk of fuel leaks. Micro-routing or appropriate construction techniques will be employed where required.	To accord with guidance and best practice for constructional works.
Measures to Manage Runoff Measures will include the use of settling tanks or ponds to remove sediment and the installation of pre-installed culvert (flume) pipes in the watercourse under the construction accesses and haul road. The pipe would be of suitable size to accommodate the water volumes and flows, or temporary bridging may be installed. The accesses and haul roads would be removed at the end of the construction programme and measures would be implemented to ensure that watercourses, including their banks, are reinstated to their previous condition where possible.	To reduce the risk of surface water pollution
Flood defence works The tidal defence will maintain the current standard of protection with crest levels for embankments and tidal doors set to equal existing defence levels during the period of construction.	To address the NPPF, EA and Essex County Council surface water run-off requirements.
Flood risk	To reduce flood risk during construction

Measures adopted as part of Thurrock Flexible Generation Plant	Justification
Measures will be implemented to ensure that the risk of flooding is not increased during construction. Temporary construction compound(s) will be constructed using permeable material underlain by a permeable geotextile membrane, Surface water runoff will be intercepted via a temporary drainage system. The system will manage surface runoff from the construction compound in terms of both flow rate and water quality in accordance with local policies. In terms of the gas pipeline and underground cable crossings, all major watercourses will be crossed using trenchless techniques. Access roads and temporary crossings required for vehicular access during construction will provide culverts to maintain existing ditch flows. A method statement for the proposed crossing methodologies will be developed during the detailed design stage.	
Operation and maintenance phase	
Flood Defences Following completion of construction, the defences will be maintained to a crest level matching the existing defences but allowing for a future crest level increase to provide the required future standard of protection. Detailed design will be agreed with the EA and MMO (as appropriate).	To address the NPPF, EA and Essex County Council surface water run-off requirements.
Flood Resilience and Resistance The design of Thurrock Flexible Generation plant will incorporate flood resilience and/or resistance measures to ensure critical assets are afforded an appropriate level of flood protection to approximately 2.5 m AOD. The appropriate measures and their design will be confirmed at the detailed design stage but may include raising the critical assets above the anticipated flood levels and/or bespoke building protection (e.g. elevating bunds around transformers, sealing cable ducts with bentonite, reinforcing and sealing doors, or providing bunding around buildings).	To address the NPPF, EA and Essex County Council surface water run-off requirements
Operational Outline Drainage Strategy Thurrock Flexible Generation plant will include areas of low permeability surfacing, which will increase the rate of surface water run-off. A surface water management will be prepared to ensure the existing run-off rates to the surrounding water environment are maintained at pre-development rates. The detailed design of the surface water management strategy would be based on a series of infiltration / soakaway tests carried out on proposed development gas and battery facility and the worst-case attenuation volumes outlined in the FRA. The tests would be undertaken prior to construction and in accordance with the BRE Digest 365 Guidelines (Stephen Garvin, 2016). The strategy would ensure that the mean annual run-off rate is maintained at the current greenfield run-off rate.	To address the NPPF, EA and Essex County Council surface water run-off requirements.
Operational practices within Thurrock Flexible Generation Plant will incorporate measures to prevent pollution to include emergency spill response procedures, based on guidance in e.g.: • Defra and EA (2018) guidance for discharges to surface water and groundwater: environmental permits; and • EA *et. al* (2018) Best practice guidance Pollution Prevention Guidelines: Dealing with Spills: PPG22 (withdrawn, use as guidelines).	To reduce the risk of surface water pollution

3. Baseline environment

3.1 Current baseline

3.1.1 The proposed development lies entirely within the administrative area of Thurrock Borough Council, characterised as an industrial and agricultural landscape in the vicinity of the proposed development, where much of the land is drained for agriculture.

3.1.2 The Main Development Site (Zone A) encompasses c.20 ha of agricultural land. Zone A is split into two distinct fields, north and south, by a central ditch that bisects it. The north field is defined to the north by an agricultural field leading to railway line embankment, and to the east, south and west by a field drainage network. A localised isolated field drain arches around the perimeter of the site directing runoff to a channel which flows in a general southerly direction on the western boundary of the site. Water within this channel is shown to discharge into EA designated main river West Tilbury Main c.500 m to the east of Zone A.

3.1.3 The southern field is bound on all side by field drainage with a gentle slope falling southwards.

3.1.4 The proposed development hydrology and flood risk study area runs through the Thames River Basin District and Mardyke operational catchment (as designated by the EA), which covers 44 km^2 from Basildon in the north to Dartford in the south. The river basin district is a rough split of rural and urban setting.

3.1.5 The closest EA designated Main River is West Tilbury Main located c.500 m east of the proposed development. West Tilbury Main is fed by a complex network of ordinary watercourses, drainage ditches and irrigation channels with many falling within the 1 km buffer of the proposed development and associated infrastructure. The channel flows in a general southerly direction towards the River Thames and discharges into the Thames c.1.5 km to the southeast of the proposed development.

3.1.6 Zone G incorporates the proposed causeway assess point through the existing EA tidal flood defence. The defence has been assessed by the EA to be of low quality, requiring upgrade/maintenance.

3.1.7 The access roads and proposed pipeline route cross a number of designated Main Rivers and ordinary watercourses, including West Tilbury Main Drain.

3.1.8 Responsibility for ordinary watercourses which feed West Tilbury Main Drain fall under the jurisdiction of Essex County Council acting as the Lead Local Flood Authority (LLFA) under the Water and Flood Management Act 2010 and Land Drainage Act 1991.

3.1.9 Further descriptions of the key hydrological and flood risk characteristics within the study areas are set out below.

Hydrological setting

3.1.10 The proposed development hydrology and flood risk study area includes a number of catchments associated with EA designated main rivers and local authority ordinary watercourses. Definitions of these hydrological features are provided below, and their locations are identified below:

- Main rivers – watercourses where the EA has permissive powers over their management; and
- Ordinary watercourses – includes rivers, streams, ditches, drains which do not form part of a main river and are managed by Essex County Council as the LLFA.

3.1.11 The main water feature in close proximity to the proposed development is the River Thames.

River Thames

3.1.12 The River Thames drains a catchment area of over 12,000 km^2, tidally influenced for about 90 km of its length all the way up to the town of Teddington in Middlesex.

3.1.13 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.

3.1.14 The southern boundary of Thurrock Borough Council's 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.

3.1.15 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 the proposed development as a result of fluvial flooding alone from the River Thames is negligible. Ordnance Survey mapping indicates that the proposed development is surrounded by a number of unnamed drains, shallow ditches and water features. Surface water within the main body of the proposed development flows in a general southerly direction to drainage channels which defined field boundaries.

3.1.16 The majority of the proposed development drains into artificial channels which outfall into open land drains which border the proposed development, eventually discharging into the River Thames.

West Tilbury Main

3.1.17 West Tilbury Main flows in a general southerly direction c.500 m to the east of the site at closest orientation.

3.1.18 The channel is feed by a number of irrigation and field drainage channels to the north of the proposed development, culverted beneath the embanked railway line. The channel is then fed further by a number of streams in close proximity to the proposed development before out falling into the River Thames at -1 m above ordnance datum (AOD) Newlyn (N) at Bowaters Sluice. The EA notes that the sluice has suffered from subsidence and the centre of the pipe is lower than the ends. Investigation works are ongoing as part of the TEAM2100 programme.

Unnamed watercourses/stream

3.1.19 The proposed development hydrology and flood risk study area covers a number of existing field drains, ditches and irrigation channels. The majority of the surface water channels crossed are privately owned and maintained. Several channels fall under the jurisdiction of the LLFA or EA and therefore, fall under the requirements of the Environmental Permitting Regulations 2016. The crossing schedule (Table 3.3) identifies all crossings within the study area.

Fluvial and Tidal Flood Risk

3.1.20 The EA Flood Zone risk maps use four categories to describe the risk of flooding. These categories are set out in Table 3.1 below.

Table 3.1: EA Flood Zone definitions

Flood Zone	Flood Zone definition
Flood Zone 1	This land comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%).
Flood Zone 2	This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% - 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5 – 0.1%) in any year.
Flood Zone 3(a)	This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
Flood Zone 3(b)	This zone comprises land where water has to flow or be stored in times of flood.

3.1.21 The EA flood zone mapping (Volume 6, Appendix 15.2: Flood Zones and Model Data) indicates that the majority of the proposed development is situated within undefended Flood Zone 2 and 3a.

3.1.22 Volume 6, Appendix 15.2: Flood Zones and Model Data shows the EA flood zone risk map for the proposed development hydrology and flood risk study area. The maps are the first stage in identifying the flood risk for a particular location and depict the ‘no defence’ scenario. A description of other flood sources (i.e. groundwater, direct runoff from fields or overflowing sewers) is presented in Volume 6, Appendix 15.1: FRA.

3.1.23 The flood maps (see Volume 6, Appendix 15.2: Flood Zones and Model Data) indicate that over 90% of the proposed development and flood risk study area is located within NPPF Undefended Flood Zone 2 and 3, medium to high risk of flooding.

3.1.24 EA flood risk from rivers or the sea maps indicate that the Zone A is at low risk of flooding, defined the area having between 0.1% and 1% chance of flooding. This takes into account the effect of any flood defences in the area.

Flood defences

3.1.25 The proposed development is located within an area benefiting from flood defences (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.

3.1.26 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 6.66 m AOD for the eastern defences to 6.86 m AOD for the western defences. The defence includes a minimum freeboard of 630 mm and 120 mm above the 1 in 200 and 1 in 1,000 year tidal events respectively.

3.1.27 The EA record 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 Volume 6, Appendix 15.1: FRA.

3.1.28 Considerable investment has been made in the provision of the Thames Tidal Defences 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.

3.1.29 The South Essex Catchment Flood Management Plan (CFMP) (EA, 2009) indicates that the Scheme is located within an area designated as CFMP Policy Option 4 defined as… *"Areas of low, moderate or high flood risk where we [EA] are already managing the flood risk effectively but where we may need to take further actions to keep pace with climate change."*

Fluvial Flooding

3.1.30 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 event, therefore fluvial flood risk is not considered any further.

Tidal Flooding

3.1.31 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 (AECOM, 2018) Level 2 flood zones, Volume 6, Appendix: 15.2: Flood Zones and Model Data.

3.1.32 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.

3.1.33 Flood level data for key locations within the Zone A for a number of model simulations including a tidal breach within flood defences in close proximity to the proposed development has been extracted from the Thurrock Borough Council SFRA (AECOM, 2018). A summary of the average flood levels associated with each model scenario is presented in Table 3.2.

3.1.34 The breach location was informed by Thurrock Council SFRA (Volume 6, Appendix 15.2: Flood Zones and Model Data) and represents the 'worst-case' breach scenario for the proposed development.

Table 3.2: Summary of Breach model outputs (Tilbury2).

Breach location	Run period	Average Flood Level (mAOD)	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	Not provided	Not provided
	1 in 200 year (2116)	2.29	0.91	Extreme	➢ 1 hour
	1 in 1,000 year (2016)	2.13	0.69	Not provided	Not provided
	1 in 1,000 year (2116)	2.45	1.01	Extreme	➢ 1 hour

3.1.35 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. 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.

3.1.36 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 3.2 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 3.7. 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 Table 1.4.

3.1.37 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 failure in the Tilbury tidal barrier with tidal inundation of the vast majority of Tilbury. It is therefore deemed highly unlikely and is not considered to be a breach scenario that is reasonable to consider for the design of resilience measures.

3.1.38 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 Appendix 15.1. This would also afford the proposed development flood resilience/resistance against all other model breach scenarios.

Table 2.6Existing Drainage

3.1.39 The proposed development crosses a number of existing field drains, ditches and irrigation channels. The majority of the surface water channels crossed are privately owned and maintained. Several channels fall under the jurisdiction of the Essex County Council or EA and therefore, fall under the requirements of the LDA 1991.

3.1.40 Zone A of the Thurrock Flexible Generation Plant is utilised as common land and agricultural land, which is drained by a complex network of buried land drains. Full details of these networks have not been established at this stage.

3.1.41 Schedule 25 of the Environmental Permitting (England and Wales) Regulations 2016 stipulate that consent is required from the relevant authority for any works within 8 m of a non-tidal water body (8 m starts from the toe of any flood defence of raised embankment) and 16 m of a tidal body. Consenting requirements to be incorporated as Protective Provisions within the DCO.

3.1.42 Asset management plans indicate that the proposed development would cross Anglian Water owned and maintained infrastructure at a number of locations.

3.1.43 Drainage Byelaws indicate that;

"no person shall cause or permit he flow of any drain or watercourse in the ground to be obstructed or diverted, or open shut or otherwise move or operate any sluice or similar apparatus." Thurrock Council Byelaws for pleasure ground, public walks and open spaces, Arrangement of Byelaws Part 1.

3.1.44 The byelaws also indicate that no obstructions should be placed within 8 m of the edge of a watercourse. Consent will be sought from the LLFA and/or EA for any obstruction which may need to be placed within the 8 m restriction of a watercourse.

3.1.45 Gas pipeline, underground electricity export cable and access road construction works will cross watercourses. Table 3.3 lists the crossings and the watercourse type. No surface water flow data has been provided by consultees for rivers and streams in the study area.

3.1.46 Watercourse crossings will be designed in line with the requirements of the EA and LLFA. In accordance with the Environmental Permitting (England and Wales) Regulations 2016, no works within 8 m from the top of the bank or toe of a flood defence will be undertaken on any watercourse without prior consent from the relevant stakeholder (i.e. the EA or LLFA) and subject to requirements or protective provisions within the DCO.

3.1.47 As presented within Table 3.3, trenchless techniques (which will be used for gas pipeline and electricity cable crossings of watercourses) will be used to cross the majority of surface water locations, including designated Main Rivers. Culverts will be used where temporary or permanent vehicular access across watercourses is required.

Table 3.3:Summary of surface water crossing locations and techniques

Crossing Location	Main/ Ordinary watercourse	Operator (Consenting Body)	Crossing method
8a	Watercourse	LLFA	HDD
8d	Watercourse	LLFA	HDD
11a	Watercourse - EA Main River	EA	HDD
12b	Watercourse	LLFA	HDD

15a	Watercourse	LLFA	HDD
16b	Watercourse - EA Main River	EA	HDD
16c	Watercourse - EA Main River	EA	Culvert
19b	Watercourse	EA	HDD
21a	Watercourse	LLFA	HDD
26b	Watercourse	LLFA	Culvert
30a	Watercourse	EA	Culvert
40a	Sea wall	EA	Gateway in wall
53a	Watercourse	LLFA	Re-route
66a	Watercourse	LLFA	Culvert
67a	Watercourse	LLFA	Culvert
68a	Watercourse	LLFA	HDD
68b	Watercourse	LLFA	Culvert
69	Watercourse	LLFA	Culvert

Surface water flood risk

3.1.48 EA surface water mapping indicates that Zone A, which encompasses the proposed development's gas engines, battery facility and associated infrastructure, is shown to be on the whole at very low risk from surface water flooding. There are a number of isolated areas within Zone A which are at low to medium risk of surface water flooding. Given the localised natures of the flood risk, these areas have been assessed to be associated with low lying areas of the site.

Surface water abstractions

3.1.49 The abstraction licence records, taken from Groundsure data records, indicate that there are no surface water abstractions within the hydrology and flood risk study area.

Private water supply

3.1.50 Groundsure records identify a number of groundwater abstractions within the hydrology and flood risk study area. Private water abstractions in the hydrology and flood risk study area are typically from groundwater resources and are identified in Volume 6, Appendix: 15.3: Surface Water Abstraction Licences, Discharge Consents and Pollution Incidents.

Discharge consents

3.1.51 Discharges of liquid effluent or waste water into surface waters are regulated by the EA using discharge consents and environmental permits. A review of Groundsure data identified approximately one active consented discharge to surface waters within the proposed development hydrology and flood risk study area. The licence is for the discharge of treated sewage/effluent from Tilbury 275kV Substation 14, west of the proposed development.

3.1.52 Although the volume and parameters of the discharges are regulated (via the discharge consents and permits), the quality of the receiving surface water may potentially be affected.

3.1.53 The details and locations of the discharge consents and permits are provided within Volume 6, Appendix 15.3: Surface Water Abstraction Licences, Discharge Consents and Pollution Incidents.

Pollution incidents

3.1.54 Pollution incident mapping has been used to identify if the quality of watercourses, within the proposed development hydrology and flood risk study area, may have been affected by pollution. A review of Groundsure data identified approximately 15 pollution incidents in the hydrology and flood risk study area, 13 of the incidents were reported as category 4 (no impact) with 4 recorded as a category 3 (minor), see Volume 6, Appendix 15.3: Surface Water Abstraction Licences, Discharge Consents and Pollution Incidents. This is defined by the EA, under the common incident classification scheme, as a substantiated incident with no impact to water quality (Further details regarding the common incident classification scheme provided by the EA (2016b)).

Surface water quality

3.1.55 Table 3.4 lists the watercourses and associated WFD classification grade within the hydrology and flood risk study area. The objective dates in Table 3.4 are explained as follows:

- 2015: status matches the predicted future status or potential. The main environmental objective is to prevent deterioration in status between 2015 and 2021.
- 2021: there is confidence that as a result of the programme of measures, the water body will improve from its 2015 status to achieve the predicted future status by 2021. The environmental objective is for water bodies and elements to make an improvement from the reported 2015 status to achieve the predicted future status by 2021.

- 2027: the deadline for achieving the status or potential has been extended to 2027. For a 2027 date, there is currently not enough confidence that the improvement in status can be achieved by an earlier date.

Table 3.4: WFD water quality data (EA, 2018).

Name of Catchment	Waterbody Specific	Waterbodies present within the proposed development hydrology and flood risk study area	Objective Status (2015)	Current Overall Status (2016) Objective
Essex South	Mardyke	West Tilbury Main.	Moderate	Moderate (Ecological Moderate, Chemical Good).
Thames	Thames Middle	N/A	Moderate	Moderate (Ecological Moderate, Chemical Fail).

3.1.56 In summary, the records show that the watercourses within the hydrology and flood risk study area have a WFD status of Moderate. However, all lower status waterbodies have objectives to improve, with most aiming to achieve Moderate to Good status by 2027, and many of the measures needed to achieve the improvement in status are either already in place or will be in place by 2021.

3.1.57 A full description of the WFD classification process and associated River basin management planning ministerial guidance and standards is provided online, available from https://environment.data.gov.uk/catchment-planning/help.

3.2 Future baseline

3.2.1 The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 requires that "*an outline of the likely evolution thereof without implementation of the development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge*" is included within the Environmental Statement.

3.2.2 In the event that the proposed development does not come forward, an assessment of the future baseline conditions has been carried out and is described within this section.

3.2.3 The main impact on the hydrology and flood risk future baseline is associated with the potential effects of climate change, which may impact on future peak river flow rates, rainfall intensity and sea levels. A summary of potential climate change allowances as outlined by the EA (February 2016, updated February 2019) is presented below.

Climate change

3.2.4 In February 2016 the Environment Agency (EA) published advice on climate change allowances to support NPPF, which was most recently updated on the 16th of 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 to understand the range of impact.

3.2.5 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

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

Peak river flow allowances

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

3.2.8 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

3.2.9 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.

3.2.10 Table 3.5 below provides the peak river flow allowances for the Thames River basin district.

Table 3.5: 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	25%	35%	70%
Higher central	15%	25%	35%
Central	10%	15%	25%

Peak rainfall intensity allowance

3.2.11 Increased rainfall affects river levels and land and urban drainage systems.

3.2.12 For flood risk assessments the Applicant should assess both the central and upper end allowances, present in Table 3.6 to understand the range of impact

Table 3.6: 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

3.2.13 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 and is shown in Table 3.7.

Table 3.7: 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

3.2.14 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.

4. Assessment of Effects

4.1 Construction phase

4.1.1 The impacts of construction of the proposed development have been assessed on hydrology and flood risk. The potential environmental impacts arising from the construction of the proposed development are listed in Table 2.5 along with the maximum design scenario, against which each construction phase impact has been assessed.

4.1.2 A description of the potential effect on hydrology and flood risk receptors caused by each identified impact is given below.

The construction of permanent assets may lead to increased flood risk.

Magnitude of impact

4.1.3 The proposed development is situated within a mainly industrial and rural area, with limited residential properties within the surrounding area. The sensitivity of the receptor is therefore, considered to be medium.

4.1.4 The proposed development has been assessed as being at high risk of flooding from tidal sources in the event of a breach in defences. The proposed development areas are located on land presently defined as ‘greenfield’ with no hard standing. The proposed gas engine and battery facilities including the permanent access road has been assessed as at risk of flooding from tidal sources. A worst case 100% increase in low permeable surfacing as a consequence of the proposed development gas and battery facility would directly impact local flood risk.

4.1.5 The increase in low permeable area would increase surface water runoff rates, in turn increasing channel flows and as a consequence flood risk. Construction of the proposed development gas and battery facility would require a degree of ground re-profiling and foundations excavation.

4.1.6 The excavation of the foundations and levelling associated with the proposed development is likely to change the natural hydrological characteristics of the site. The combination of construction works and the increase in low permeable surfacing could increase the surface water runoff rates, in turn increasing the flood risk to surrounding receptors.

4.1.7 The impacts on flood risk from the temporary change in runoff are only likely to affect the surrounding local receptors and, assuming that designed-in and construction measures (see Table 2.6) are implemented, there is unlikely to be any observable degradation in flood risk. The magnitude is therefore, considered to be **negligible**.

Sensitivity of the receptor

4.1.8 The proposed development is situated within a mainly industrial and rural setting, with limited residential properties within the surrounding area. Due to the presence of substantial tidal flood defences and limited residential properties within the study area, the land adjoining the hydrology and flood risk study area is of low vulnerability, high recoverability and low value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

4.1.9 The sensitivity for the rest of the study area is considered to be **low** and the magnitude of the impact is deemed to be **negligible**. The effect will, therefore, be of **negligible** significance, which is not significant in EIA terms.

Temporary construction may lead to increased flood risk

Magnitude of impact

4.1.10 To provide access to the causeway a cut through the existing tidal flood defence is required. The gap generate by the cut will provide a pathway for tidal water to egress landward and potential flood land shore side of the defence. Flood protection measures will be incorporated into the engineering design to manage potential flood risk and maintain the current standard (1 in 1,000 year) of protection afforded by the tidal flood defences.

4.1.11 Temporary construction compound(s) may be required to house construction vehicles, workers and associated equipment. Any temporary compound will be constructed using permeable material underlain by a permeable geotextile membrane. Surface water runoff will be intercepted via a temporary drainage system. The system will manage surface water runoff from the construction compound in terms of both flow rate and water quality, in accordance with local policies and relevant permits.

4.1.12 West Tilbury Drain and a number of smaller drains will be crossed by the access road from Station Road.

4.1.13 In other parts of the study area, impacts on flood risk would arise from any temporary change in runoff over the areas affected during construction, such as construction compounds, haul road, construction accesses, as well as the cable and pipeline corridors. Designed-in measures (as set out in Table 2.6) will be implemented to ensure the risk of flooding is not increased (e.g. permeable gravel overlying a permeable geotextile membrane of an appropriate standard for construction compounds, haul road and construction accesses and drainage features to maintain land drainage flow). In terms of gas pipeline and underground cable crossings, all major watercourse crossings would be undertaken using trenchless techniques such as HDD. Access roads and temporary crossings required for vehicular access during construction will provide culverts to maintain existing ditch flows. A method statement for the proposed crossing methodologies will be developed during the detailed design stage.

4.1.14 The impacts on flood risk from the temporary change in tidal flood protection measures and runoff are only likely to affect the surrounding local receptors and, assuming that designed-in and construction measures (see Table 2.6) are implemented, there is unlikely to be any observable degradation in flood risk. The magnitude is therefore, considered to be **negligible**.

Sensitivity of the receptor

4.1.15 The proposed development is situated within a mainly industrial and rural setting, with limited residential properties within the surrounding area. Due to the presence of substantial tidal flood defences and limited residential properties within the study area, the land adjoining the proposed development hydrology and flood risk study area is of low vulnerability, high recoverability and low value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

4.1.16 The sensitivity for the rest of the Thurrock Flexible Generation Plant hydrology and flood risk study area is considered to be **low** and the magnitude of the impact is deemed to be **negligible**. The effect will, therefore, be of **negligible** significance, which is not significant in EIA terms

The impacts of trenchless construction techniques may affect major surface watercourses

Magnitude of impact

4.1.17 The impacts on major watercourses from construction activities involving the use of trenchless techniques and associated machinery could lead to an increase in turbid runoff, bentonite breakouts during drilling and spillages/leaks of fuel, oil etc. affecting nearby watercourses. There is the potential for this to impact on water quality and therefore cause a reduction in the WFD classification.

4.1.18 Similarly, the proposed development cable and pipeline corridor itself could act as a drainage channel, leading to runoff from construction areas and affecting nearby watercourses. However, the construction process will include measures to intercept runoff and ensure that discharges are controlled in quality and volume causing no degradation in WFD classification. This would include the use of settling tanks or ponds to remove sediment, temporary interceptors and a hydraulic brake, as set out in Table 2.6. The impact is predicted to be of local spatial extent, short term duration, intermittent occurrence and high reversibility. The magnitude is therefore, considered to be **negligible.**

Sensitivity of receptor

4.1.19 As noted in 2.2.3 taking a precautionary approach in assuming all watercourses have achieved ‘Good’ status at the time when construction begins, the surface watercourses within the Thurrock Flexible Generation Plant hydrology and flood risk study area have been assessed with a WFD status of ‘Good’. The watercourses crossed via trenchless techniques are therefore, considered to be highly vulnerable in relation to WFD classification status, but of moderate recoverability and moderate value in relation to the local economy. The sensitivity of the receptor is therefore, considered to be **high**.

Significance of the effect

4.1.20 Overall, the sensitivity of the receptor is considered to be **high** and the magnitude of the impact is deemed to be **negligible**. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

Construction may cause risk of leaks and spills to surface watercourses

Magnitude of impact

4.1.21 The construction of the proposed gas engine and battery facility will involve the use of chemicals, oils and greases and therefore, there is the potential for spillages to occur which may affect the water quality of ordinary watercourses.

4.1.22 With the incorporation of mitigation measures outlined in Table 2.6, the impact to ordinary watercourses are predicted to be of local spatial extent only impacting on surrounding receptors, short term duration, intermittent occurrence and reversible. The magnitude is therefore, considered to be **negligible**.

Sensitivity of receptor

4.1.23 The ordinary watercourses in the vicinity of the proposed gas engine and battery facility are considered to be of high vulnerability, moderate recoverability and moderate value. The sensitivity of the receptor is therefore, considered to be **high**.

Significance of the effect

4.1.24 Overall, the sensitivity of the receptors is considered to be **high** and the magnitude of the impact is deemed to be **negligible**. The effect on main and ordinary watercourses will therefore be of **minor adverse** significance, which is not significant in EIA terms.

Future monitoring

4.1.25 No hydrology and flood risk monitoring to test the predictions made within the operation and maintenance phase impact assessment is considered necessary.

The impacts of open cut, temporary bridging and culverts may affect surface watercourses.

Magnitude of impact

4.1.26 A number of minor watercourses and drains may be crossed by the proposed development, within which would be located up to one temporary haul road. Associated construction could lead to damage to the banks along the watercourses, an increase in turbid runoff, spillages/leaks of fuel, oil etc. and an alteration in surface water flow pathways that could affect nearby watercourses. Similarly, the proposed development cable and pipeline corridor itself could act as a drainage channel, leading to runoff from construction affecting nearby watercourses.

4.1.27 Mitigation measures to reduce and manage runoff in terms of volume and quality have been outlined in Table 2.6 and the CoCP (application document A8.6) and would be developed further in the final CoCP post consent. A method statement for the proposed crossing methodologies will be developed during the detailed design stage. The measures include the use of settling tanks or ponds to remove sediment and the installation of pre-installed culvert (flume) pipes in the watercourse under the construction accesses and haul road. The pipe would be of suitable size to accommodate the water volumes and flows, or temporary bridging may be installed. The accesses and haul roads would be removed at the end of the construction programme and measures would be implemented to ensure that watercourses, including their banks, are reinstated to their previous condition where possible.

4.1.28 The impact is predicted to be of local spatial extent, short term duration, intermittent occurrence and high reversibility. The magnitude is therefore, considered to be **negligible**.

Sensitivity of receptor

4.1.29 Minor watercourses' WFD status is determined by the WFD classifications of surrounding main waterbodies. Taking this into consideration, the minor watercourses are considered to be of high vulnerability, moderate recoverability and moderate value. The sensitivity of the receptor is therefore, considered to be **high**.

Significance of the effect

4.1.30 Overall, the sensitivity of the setting is considered to be **high** and the magnitude of the impacts is deemed to be **negligible**. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

The construction of permanent assets may affect field drainage and irrigation.

Magnitude of impact

4.1.31 The impact on drainage pipeline infrastructure from open cut and trenchless techniques (where required) during the construction phase could temporarily disrupt local drainage infrastructure, impacting on water quality, potential flow rates and local water supply networks.

4.1.32 The routing and refinement of the proposed development has taken into account the location of major services utilities, but the presence of local drainage (e.g. soakaways) cannot be discounted as it is not always mapped by regulators.

4.1.33 Discussions with utility services and other service companies will be undertaken at the detailed design stage to confirm the location of local services. Micro-routing or appropriate construction techniques will be employed where required.

4.1.34 Any impacts of construction which affect drainage supply infrastructure are likely to cause temporary disruption of water supply to residents/businesses in the local surrounding area. The impact would be of limited temporal extent and short-term duration. It is predicted that any impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of receptor

4.1.35 Drainage pipeline infrastructure comprises water supply pipelines operated by Anglian Water, which are considered to have a moderate value and contributes to the local and regional economy. It is vulnerable to the construction impacts of the proposed development and its recoverability may be costly. The sensitivity of the receptor is therefore considered to be **high**.

Significance of the effect

4.1.36 Overall, the sensitivity of the setting is considered to be **high** and the magnitude of the impact is deemed to be **minor**. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms. This is due to the short-term duration of the impact that receptors in the local area (i.e. local residents and businesses) would be affected with regards to water supply.

Temporary construction may affect field drainage and irrigation.

Magnitude of impact

4.1.37 The impact on field drainage and irrigation from open cut techniques during the construction phase could temporarily affect surface water flow pathways, impacting on water quality and potential flow rates.

4.1.38 The removal of field drains within the proposed development may cause a backup on surrounding field drains, in turn increasing the flood risk to the site and surrounding receptors. Measures to manage surface water flows include the restoration of any affected field drainage and techniques to disrupt surface water runoff along the construction corridors for access roads and gas pipeline. These measures are included in Table 2.6.

4.1.39 With the incorporation of appropriate construction mitigation techniques, the impact is predicted to be of local spatial extent with a minor shift away from existing hydrological environment of local receptors, short term duration, intermittent occurrence and reversible, with field drains to be re-established where appropriate. It is predicted that any impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of receptor

4.1.40 Field drains are considered to be of moderate vulnerability along the cable and pipeline corridor, moderate to high recoverability and minor value. The sensitivity of the receptor is therefore considered to be **medium**.

Significance of the effect

4.1.41 Overall, the sensitivity of the receptor is considered to be **medium** and the magnitude of impact is deemed to be **minor**. The effect will therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Future monitoring

4.1.42 No hydrology and flood risk monitoring is considered necessary.

4.2 Operational and maintenance phase

4.2.1 The impacts of the proposed development's operation and maintenance phase have been assessed on hydrology and flood risk conditions. The potential environmental impacts arising from the operation and maintenance of the proposed development are listed in Table 2.5 along with the maximum design scenario against which each operation and maintenance phase impact has been assessed.

4.2.2 A description of the potential effect on hydrology and flood risk receptors caused by each identified impact is given below.

Impacts of operation may lead to increased flood risk.

Magnitude of impact

4.2.3 Following construction and during the operation phase, the proposed gas engine and battery facility would result in an increase in low-permeable surface area, causing an increase to surface water run-off rates. However, with the incorporation of design mitigation (set out in Table 2.6 of this chapter) runoff will be intercepted and discharged at the current greenfield rate.

4.2.4 The proposed gas engine and battery facility has been subject to an FRA (Volume 6, Appendix 15.1: FRA) in order to meet the requirements of planning policy and best practice. The proposed gas engine and battery facility would be designed to ensure no increase in the greenfield rate of runoff. With the incorporation of mitigation measures outlined in Table 2.6 and the outline drainage concept within the FRA, it has been determined that there will be no change from the baseline hydrological environment. The National Grid gas connection compound in zone D3 will comprise minimal above-ground equipment and is not considered to affect flood risk, as set out in the FRA.

4.2.5 As the Thurrock Flexible Generation Plant electricity export cable and gas pipeline will be underground and access roads will incorporate drainage to ensure existing land drainage flow is maintained, it is determined that there will be no increase in flood risk due to operation and maintenance of the cable or pipeline.

4.2.6 The magnitude of impact is therefore considered to be **negligible**.

Sensitivity of receptor

4.2.7 The proposed development is located within NPPF and Planning Practice Guidance ID7 Flood Zone 2 and 3, defined as at medium to high risk of fluvial / tidal flooding.

4.2.8 The proposed development is situated within a mainly rural area, with limited residential properties within the surrounding area. The sensitivity of the receptor is therefore, considered to be **medium**.

4.2.9 The main development site is located within Flood Zone 3 but benefiting from flood defences with in excess of a 1 in 1,000 year SoP and therefore at low risk of flooding. The land adjoining the proposed development are of low flood risk vulnerability within the rural landscape, high recoverability and low value with limited residential property in the vicinity. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of the effect

4.2.10 Overall, the sensitivity of the receptor is considered to be **medium** and the magnitude of the impact is deemed to be **negligible** due to the incorporation of mitigation measures and an outline drainage strategy. The effect will therefore, be of **negligible** significance, which is not significant in EIA terms.

The impact of flexible generation plant operation and maintenance may affect main or ordinary surface watercourses

Magnitude of impact

4.2.11 The operation of the proposed gas engine and battery facility will involve routine maintenance. Maintenance may involve the use of chemicals, oils and greases and therefore, there is the potential for spillages to occur which may affect the water quality of ordinary watercourses.

4.2.12 With the incorporation of mitigation measures outlined in Table 2.6, the impact to ordinary watercourses are predicted to be of local spatial extent only impacting on surrounding receptors, short term duration, intermittent occurrence and reversible. The magnitude is therefore, considered to be **negligible**.

Sensitivity of receptor

4.2.13 The ordinary watercourses in the vicinity of the proposed gas engine and battery facility are considered to be of high vulnerability, moderate recoverability and moderate value. The sensitivity of the receptor is therefore, considered to be **high**.

Significance of the effect

4.2.14 Overall, the sensitivity of the receptors is considered to be **high** and the magnitude of the impact is deemed to be **negligible**. The effect on main and ordinary watercourses will therefore be of **minor** adverse significance, which is not significant in EIA terms.

Future monitoring

4.2.15 No hydrology and flood risk monitoring to test the predictions made within the operation and maintenance phase impact assessment is considered necessary.

The impact of pipeline maintenance may affect main or ordinary surface watercourses

Magnitude of impact

4.2.16 The operation of the gas pipeline will involve routine maintenance. Maintenance may involve the use of chemicals, oils and greases and therefore, there is the potential for spillages to occur which may affect the water quality of ordinary watercourses.

4.2.17 With the incorporation of mitigation measures outlined in Table 2.6, the impact to ordinary watercourses are predicted to be of local spatial extent only impacting on surrounding receptors, short term duration, intermittent occurrence and reversible. The magnitude is therefore, considered to be **negligible**.

Sensitivity of receptor

4.2.18 The ordinary watercourses in the vicinity of the gas pipeline are considered to be of high vulnerability, moderate recoverability and moderate value. The sensitivity of the receptor is therefore, considered to be **high**.

Significance of the effect

4.2.19 Overall, the sensitivity of the receptors is considered to be **high** and the magnitude of the impact is deemed to be **negligible**. The effect on main and ordinary watercourses will therefore be of **minor** adverse significance, which is not significant in EIA terms.

Future monitoring

4.2.20 No hydrology and flood risk monitoring within the operation and maintenance phase, other than any requirements of the Environmental Permit, is considered necessary.

4.3 Decommissioning phase

4.3.1 The impacts of decommissioning the proposed development have been assessed on hydrology and flood risk receptors. The potential impacts arising from the decommissioning exercise are listed in Table 2.5 along with the maximum design scenario against which each decommissioning phase impact has been assessed.

4.3.2 A description of the potential effects on hydrology and flood risk receptors caused by each identified impact is given below.

The impacts of decommissioning may affect temporary flood risk.

Magnitude of impact

4.3.3 The decommissioning of the proposed development will involve the demolition of buildings and could include removal of foundations and the attenuation storage provided during construction and operation. The natural attenuation of the sites will be restored over time.

4.3.4 The impacts of decommissioning of the Thurrock Flexible Generation Plant components will be reduced through the incorporation of management measures (outlined in Table 2.6), including emergency spill response procedures including clean up and remediation of contaminated soils, appropriate water proofing of exposed cable ducts and the continued maintenance of on-site drainage and therefore are predicted to be of local spatial extent, short term duration, intermittent and high reversibility indicating that any impacts on decommissioning which affect flood risk vulnerability are likely to only affect the surrounding local receptors. The magnitude is therefore, considered to be **minor**.

Sensitivity of receptor

4.3.5 The proposed development is situated within a mainly industrial and rural area, with limited residential properties within the surrounding area and protected by tidal flood defences with in excess of a 1 in 1,000 year SoP. Land is assessed a low vulnerability, high recoverability and low value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of the effect

4.3.6 Overall the magnitude of impact is considered **minor** and the sensitivity of receptors is considered **low**. The effect of decommissioning on flood risk will therefore be of **minor** adverse significance, which is not significant in EIA terms.

The impacts of decommissioning may affect main surface watercourses

4.3.7 The effects of decommissioning activities are expected to be the same or similar to the effects from construction. Overall, it is predicted that magnitude impact would be **negligible** and sensitivity receptor **high** resulting in an effect of **minor** adverse significance, which is not significant in EIA terms (see Section 2.5).

Future monitoring

4.3.8 No hydrology and flood risk monitoring to test the predictions made within the decommissioning phase impact assessment is considered necessary.

The impacts of decommissioning may affect ordinary watercourses

4.3.9 The effects of decommissioning activities are expected to be the same or similar to the effects from construction. Overall, it is predicted that magnitude impact would be **negligible** and sensitivity receptor **high** resulting in an effect of **minor** adverse significance, which is not significant in EIA terms (see Section 2.5).

Future monitoring

4.3.10 No hydrology and flood risk monitoring is considered necessary.

4.4 Cumulative effects

4.4.1 Cumulative effects are those arising from impacts of the proposed development in combination with impacts of other proposed or consented development projects that are not yet built or operational. An assessment of cumulative effects for Hydrology and Flood Risk has been made and is reported in Volume 4, Chapter 28.

4.5 Transboundary effects

4.5.1 A screening of transboundary impacts has been carried out and is presented in Volume 6, Appendix 4.1: Transboundary Impacts Screening Note. This screening exercise identified that there was no potential for significant transboundary effects with regard to hydrology and flood risk from Thurrock Flexible Generation Plant upon the interests of other EEA States.

4.6 Inter-related effects

4.6.1 Inter-relationships are considered to be the impacts and associated effects of different aspects of the construction, operation or decommissioning of Thurrock Flexible Generation Plant on the same receptor. The following assessments have been made and a description of the likely inter-related effects on hydrology and flood risk is provided in Volume 5, Chapter 31: Summary of Inter-Related Effects.

Project lifetime effects

4.6.2 Assessment of the potential for effects that occur during more than one stage of the development's lifetime (construction, operation or decommissioning) to interact such that they may create a more significant effect on a receptor than when assessed in isolation for each stage

Receptor-led effects

4.6.3 Assessment of the potential for effects via multiple environmental or social pathways to interact, spatially and temporally, to create a greater inter-related effect on a receptor than is predicted for each pathway (in its respective topic chapter) individually.

5. Conclusion and summary

5.1.1 The Thurrock Flexible Generation Plant hydrology and flood risk study area is shown on EA flood maps as being located within Flood Zone 2 and 3 (i.e. medium to high probability of flooding). However, the proposed development benefits from flood defences providing a SoP in excess of 1 in 1,000 years. EA flood risk from rivers or the sea maps, which includes defences, indicates that the proposed development Zone A is at risk of flooding. The Applicant has reviewed the risk of flooding as a result of a modelled breach in flood defences for a number of return periods. Results indicate the Zone A would be at risk of residual flooding to a depth of 0.84 m AOD, and so appropriate resilience and/or resistance measures, such as raised door sills, will be incorporated into the design.

5.1.2 The proposed development hydrology and flood risk study area includes a number of catchments associated with EA designated main rivers and ordinary watercourses (see Volume 6, Appendix 15.2: Flood Zones and Model Data).

5.1.3 Although construction has the potential to cause a degradation of water quality to main and ordinary watercourses through increase in soil erosion and accidental release of sediment, appropriate mitigation measures have been identified within this chapter and within the Outline CoCP (application document A8.6) to minimise potential impacts. Furthermore, trenchless techniques will be used to cross main rivers for gas pipeline and electricity export cable construction. The effect is considered to be of minor adverse significance.

5.1.4 The operation of the development has the potential to increase the surface water runoff rate from the proposed gas engine, battery storage facility and associated above ground infrastructure, in turn increasing the flood risk to the site and the surrounding areas. Appropriate operational management measures will be incorporated into the construction process in order to mitigate against any increase in runoff, including an outline drainage strategy. The effects during the operation and maintenance phase are therefore considered to be of negligible significance.

5.1.5 The operation of the proposed gas engine, battery storage facility and associated above ground infrastructure would involve routine maintenance of key elements. Maintenance may involve the use of chemicals, oils and greases and therefore, there is the potential for spillages to occur which may affect the water quality of ordinary watercourses. Operational practices will involve management plans including spill procedures, clean up and remediation of contaminated water runoff and water quality monitoring (if required) in order to mitigate against any decrease in water quality status. This will be controlled via the Environmental Permit for the facility. The effects of operation maintenance are therefore considered to be of minor adverse significance.

5.1.6 An FRA has been prepared for the proposed gas engine, causeway, battery storage facility and associated above ground infrastructure. The FRA indicates the site is located at tidal flooding risk from a breach in flood defences, low risk of surface water flooding and at no risk of flooding from reservoir failure. The proposed development has been defined as ‘Essential infrastructure’ and suitable for the present Flood Zones including climate change. 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.

5.1.7 The FRA demonstrates that appropriate mitigation measures will reduce the adverse impacts caused by the proposed development and an appropriate drainage strategy (which has been prepared as a Conceptual Drainage Strategy, application document A7.3) will be incorporated into the Thurrock Flexible Generation Plant design to attenuate any increase in surface water runoff. The FRA therefore demonstrates that the Thurrock Flexible Generation Plant meets the requirements of NPS EN-1 and the NPPF.

5.1.8 The decommissioning of the proposed development will involve the demolition of buildings and could include removal of foundations and the attenuation storage provided during construction and operation. The impacts of decommissioning of the proposed development components will be reduced through the incorporation of management measures (outlined in Table 2.6). The effect is considered to be of minor adverse significance.

Table 5.1: Summary of potential environment effects, mitigation and monitoring.

Description of impact	Measures adopted as part of the project	Magnitude of impact	Sensitivity of receptor	Significance of effect	Additional measures	Residual effect	Proposed monitoring
Construction							
The construction of permanent assets may lead to increased flood risk	Construction measures, surface water drainage scheme, best practice measures (see Table 2.6)	Negligible	Low	Negligible (not significant in EIA terms)	None.	Negligible (not significant in EIA terms)	None
Temporary construction may lead to increased flood risk	Construction measures, surface water drainage scheme, best practice measures (see Table 2.6)	Negligible	Low	Negligible (not significant in EIA terms)	None.	Negligible (not significant in EIA terms)	None
Construction may cause risk of leaks and spills to surface watercourses	Construction measures (see Table 2.6).	Negligible	High	Minor Adverse (not significant in EIA terms)	None	Minor Adverse (not significant in EIA terms)	None
The impacts of trenchless construction techniques may affect major surface watercourses	Surface water drainage scheme, pollution prevention measures, best practice measures (see Table 2.6).	Negligible	High	Minor Adverse (not significant in EIA terms)	None	Minor Adverse (not significant in EIA terms)	None
The impacts of open cut, temporary bridging and culverts may affect surface watercourses	Surface water drainage scheme, pollution prevention measures, best practice measures (see Table 2.6)	Negligible	High	Minor Adverse (not significant in EIA terms)	None	Minor Adverse (not significant in EIA terms)	None
The construction of permanent assets may affect field drainage and irrigation	Surface water drainage scheme, pollution prevention measures, best practice measures (see Table 2.6)	Minor	High	Minor Adverse (not significant in EIA terms)	None	Minor Adverse (not significant in EIA terms)	None
Temporary construction may affect field drainage and irrigation	Surface water drainage scheme, pollution prevention measures, best practice measures (see Table 2.6).	Minor	Medium	Minor Adverse (not significant in EIA terms)	None	Minor Adverse (not significant in EIA terms)	None
Operation							
The impacts of operation and maintenance may lead to increased flood risk.	Operational measures (see Table 2.6).	Negligible	Low to Medium	Minor Adverse (not significant in EIA terms)	None	Minor Adverse (not significant in EIA terms)	None
The impact of flexible generation plant operation and maintenance may affect main or ordinary surface watercourses	Surface water drainage scheme, pollution prevention measures, best practice measures (see Table 2.6)	Negligible	High	Minor Adverse (not significant in EIA terms)	None	Minor Adverse (not significant in EIA terms)	None

Description of impact	Measures adopted as part of the project	Magnitude of impact	Sensitivity of receptor	Significance of effect	Additional measures	Residual effect	Proposed monitoring
The impact of pipeline maintenance may affect main or ordinary surface watercourses	Surface water drainage scheme, pollution prevention measures, best practice measures (see Table 2.6)	Negligible	High	Minor Adverse (not significant in EIA terms)	None	Minor Adverse (not significant in EIA terms)	None
Decommissioning							
The impacts of decommissioning may affect temporary flood risk.	Decommissioning measures (see Table 2.6)	Minor	Low	Minor Adverse (not significant in EIA terms)	None	Minor Adverse (not significant in EIA terms)	None
The impacts of decommissioning may affect main surface watercourses.	Decommissioning measures (see Table 2.6).	Negligible	High	Minor Adverse (not significant in EIA terms)	None	Minor Adverse (not significant in EIA terms)	None
The impacts of decommissioning may affect ordinary watercourses.	Decommissioning measures (see Table 2.6).	Negligible	High	Minor Adverse (not significant in EIA terms)	None	Minor Adverse (not significant in EIA terms)	None

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