Thurrock Flexible Generation Plant

Preliminary Environmental Information Report
Chapter 16: Geology, Hydrogeology and Ground Conditions

Date: September 2018

Environmental Impact Assessment

Preliminary Environmental Information Report

Volume 3

Chapter 16

Report Number: OXF10872

Version: Final

Date: September 2018

This report is also downloadable from the Thurrock Flexible Generation Plant website at:
http://www.thurrockpower.co.uk

Prepared by: Liz Holland

Checked by: Jim Lightbown

Thurrock Power Ltd

1st Floor

145 Kensington Church Street

London W8 7LP

Table of Contents

List of Tables

List of Figures

Summary

This chapter reports on the Geology, Hydrogeology and Ground Conditions aspects of the proposed development. It is supported by a Phase 1 Preliminary Risk Assessment, which is provided as Volume 6, Appendix 16.1.

Qualifications

This document has been prepared by Liz Holland, a Fellow of the Geological Society, who has nine years' experience working in the environmental sector, specialising in contaminated land assessments.

It has been checked by Jim Lightbown, a Chartered Environmentalist and Scientist of CIWEM, who has 15 years' experience working in the contaminated land sector, within consultancies and within a regulatory body.

1. Introduction

1.1 Purpose of this chapter

1.1.1 This chapter of the Preliminary Environmental Information Report (PEIR) presents the findings of Environmental Impact Assessment (EIA) work undertaken to date concerning the potential impacts of Thurrock Flexible Generation Plant on Geology, Hydrogeology and Ground Conditions.

1.1.2 The PEIR is being published to inform pre-application consultation. Following consultation, comments on the PEIR will be reviewed and taken into account in preparation of the Environmental Statement (ES) that will accompany the application to the Planning Inspectorate (PINS) for development consent.

1.1.3 This chapter includes an assessment of the baseline conditions informed through the collation of data from a range of sources, including published data sources and a technical report, as provided in Volume 6, Appendix 16.1: Phase 1 Preliminary Risk Assessment.

1.1.4 Mitigation measures are outlined for the construction phase; the proposed development once completed and operational; and the decommissioning phase. Likely significant effects of the proposed development relative to baseline conditions are then assessed.

1.1.5 In particular, this PEIR chapter:

- presents the existing environmental baseline established from desk studies, surveys and consultation to date;
- presents the potential environmental effects on geology, hydrogeology and ground conditions 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

National Policy Statements

1.2.1 Planning policy for energy generation Nationally Significant Infrastructure Projects (NSIPs), specifically in relation to Geology, Hydrogeology and Ground Conditions, is contained in the Overarching National Policy Statement (NPS) for Energy (EN-1; DECC, 2011a) and the NPS for Fossil Fuel Electricity Generating Infrastructure (EN-2, DECC, 2011b).

1.2.2 NPS EN-1 and NPS EN-2 include guidance on what matters are to be considered in the assessment. These are summarised in Table 1.1 below.

Table 1.1: Summary of NPS EN-1 and EN-2 provisions relevant to this chapter.

Summary of NPS EN-1 and NPS EN-2 provision	How and where considered in the PEIR
Geology	
Where the development is subject to EIA the applicant should ensure that the Environmental Statement clearly sets out the effects on internationally, nationally and locally designated sites of ecological or geological conservation importance (paragraph 5.3.3 of NPS EN-1).	The PEIR identifies internationally, nationally and locally designated sites of geological importance within the study area. Information provided in Section 3.1.5 indicates that no designated geological sites would be directly affected.
The applicant should show how the project has taken advantage of opportunities to conserve and enhance biodiversity and geological conservation interests (paragraph 5.3.4 of NPS EN-1).	Opportunities to avoid effects have been taken during the site selection process and are set out in Volume 2: Chapter 3: Consideration of Alternatives.
Ground Conditions	
For developments on previously developed land, applicants should ensure that they have considered the risk posed by land contamination (Paragraph 5.10.8 of NPS EN-1).	The PEIR considers the risk posed by land contamination in Section 4.
Infrastructure development can have adverse effects resulting in groundwater or protected areas failing to meet environmental objectives established under the Water Framework Directive (WFD) 146 (Paragraph 5.15.1 of NPS EN-1).	Assessment of ground disturbance is undertaken specifically on Secondary A Aquifers and on the Principal Aquifer in Section 4.

Summary of NPS EN-1 and NPS EN-2 provision	How and where considered in the PEIR
Where the project is likely to have effects on the water environment, the applicant should undertake an assessment of the existing status of, and the impacts of the proposed project on water quality, water resources and physical characteristics of the water environment. In particular the Environmental Statement should describe, 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 (paragraphs 5.15.2 and 5.15.3 of NPS EN-1).	Impacts on SPZs and water bodies protected under the WFD are assessed in Section 4.
Hydrogeology	
Where the project is likely to have effects on the water environment, the applicant should undertake an assessment of the existing status of, and impacts of the proposed project on, water quality, water resources and physical characteristics of the water environment (paragraph 5.15.4).	The risk of potential impacts on the water environment will be reduced through design to facilitate adherence to good pollution control practice, as discussed in Section 2.8.

1.2.3 NPS EN-1 and NPS EN-2 also highlight a number of factors relating to the determination of an application and in relation to mitigation. These are summarised in Table 1.2 below.

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)	How and where considered in the PEIR
Geology	
Decision making should ensure that appropriate weight is attached to designated sites of international, national and local importance and to geological interests within the wider environment (paragraph 5.3.8 of NPS EN-1). Sites of Special Scientific Interest (SSSIs) and National Nature Reserves should be given a high degree of protection (paragraph 5.3.10 of NPS-EN1).	The assessment provided in this chapter considers designated sites.
Development consent will not normally be granted where development within or outside an SSSI is likely to have an adverse effect on an SSSI, except where the benefits (including need) clearly outweigh the impacts on the features for which the SSSI is designated or the broader impacts on the national network of SSSIs. Decision makers should use requirements and/or planning obligations to mitigate the harmful aspects of the development and where possible to ensure the conservation and enhancement of the site's geological interest (paragraph 5.3.11 of NPS EN-1).	The nearest SSSI is Mucking Flats and Marshes, located approximately 770 m east of Zone E. However, this feature is over 2.5 km from the main development site.
Decision making should give due consideration to regional or local designations for sites of regional and local biodiversity and geological interest, which include Regionally Important Geological Sites, Local Nature Reserves and Local Geological Sites (paragraph 5.3.13 of NPS EN-1).	No county or local geological sites have been identified within 250 m of the application site. No significant effects on such sites are anticipated.
Ground Conditions	
The applicant should demonstrate that during construction they will seek to ensure that activities will be confined to the minimum areas required for the works (paragraph 5.3.18 of NPS EN-1).	The design takes into account that construction activities will be confined to the minimum areas required for work (see Volume 2, Chapter 2: Project Description and Chapter 3: Consideration of Alternatives). Appropriate mitigation measures in relation to geology and ground conditions are set out in Table 2.6.

Other Relevant Policies

1.2.4 A number of other policies are relevant to geology, hydrogeology and ground conditions. These include:

- National Planning Policy Framework (Ministry of Housing, Communities and Local Government, 2018); The NPPF acts as policy for local planning authorities and decision-takers, both in drawing up plans and determining planning applications. Local planning authorities may determine the need for assessment and remediation of sites during the planning process. The Environment Agency (EA) is responsible for the management of groundwater resources in England and Wales, and for the control of groundwater abstractions under the planning and permitting regimes.
- Thurrock's Core Strategy and Policies for Management of Development (as amended) Adopted January 2015 (Thurrock Council, 2015). Policy PMD1 – Minimising Pollution and Impacts on Amenity, Health, Safety and the Natural

Environment. This policy states that *"Development will not be permitted where it would cause or is likely to cause unacceptable effects on […] iv. the natural environment".*

1.3 Legislation

European Legislation

1.3.1 The European Water Framework Directive (2000/60/EC) came into force in December 2000 and became part of UK law in December 2003. The directive aims to protect and enhance the quality of surface freshwater; groundwater; groundwater dependant ecosystems; estuaries; and coastal waters out to one mile from low-water.

1.3.2 The Groundwater Daughter Directive (2006/118/EC) includes provisions for assessing groundwater chemical status and criteria for groundwater pollution trend identification.

National Legislation

1.3.3 The Environment Act 1995 (Section 57) amends the Environmental Protection Act 1990 and makes provisions for a risk based framework for the identification, assessment and management of contaminated land within the UK. The provisions of the Act came into effect in April 2000.

1.3.4 Part 2A is implemented by the Contaminated Land (England) Regulations (CLR) 2006 and the Contaminated Land (England) (Amendment) Regulations 2012.

1.3.5 The Part 2A regime is aimed at ensuring that actions taken with respect to contaminated land are directed by a technically well-founded assessment of risk that considers the 'contaminant-pathway-receptor' scenario (contaminant linkage). Under the legislation, contaminated land is defined as:

"…any land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that:

(a) 'Significant harm' is being caused or there is a significant possibility of such harm being caused; or

(b) Significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused."

1.3.6 Significant harm is defined in the guidance according to risk-based criteria and must be the result of pollutant linkages.

1.3.7 A source, pathway and receptor must be present to complete the pollutant linkage and for a potentially significant risk to exist. As such, the presence of contamination in itself does not necessarily indicate a need for remedial action. Accordingly, a site can only be considered 'contaminated' when a risk to the environment or human health is present due to the presence of a 'source-pathway-receptor' linkage. In such circumstances and where there is a significant risk posed to human health and/ or the environment, the above Act states that local planning authorities must adopt a 'suitable for use' approach. This means that the approach to remediating a site is dictated by the site's proposed end use.

1.4 Consultation

1.4.1 Key issues raised during scoping and consultation to date specific to geology, hydrogeology and ground conditions are listed in Table 1.3, together with how details of how these issues have been considered in the production of this PEIR and cross-references to where this information may be found.

Table 1.3: Key points raised during scoping and consultation to date.

Date	Consultee and type of response	Points raised	How and where addressed
September 2018	The Planning Inspectorate – Scoping Opinion	Description of baseline conditions for the entirety of the application site should be included within the ES.	A description of the application site is provided in Section 2 of the Phase 1 Preliminary Risk Assessment included at Volume 6, Appendix 16.1.
		The baseline description should include reference to sites of geological importance.	Reference to these features is provided in paragraph 3.1.5 below.
		Landfill locations should be presented on a figure in the ES to aid understanding.	This is provided as Figure 3.1.

2. Assessment Approach

2.1 Guidance

2.1.1 The assessment has had regard to relevant guidance, including:

- Defra Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance (Defra, 2012): The guidance details the responsibilities of the Local Planning Authority (LPA) in prioritising the inspection of sites under Part 2A of the Environmental Protection Act and sets out a revised framework for assessing risk associated with land contamination. Guidance on remediation is also presented and the document introduces the necessity for cost-benefit analysis when assessing appropriate remedial techniques;
- Contaminated Land Report 11 (Environment Agency, 2004): Model procedures for the management of land contamination have been developed by the EA and are presented in Contaminated Land Report 11 (CLR 11). This provides the technical framework for applying a risk management process when dealing with land affected by contamination. The framework presented in CLR 11 forms the basis of the risk assessment approach adopted in this chapter.

2.1.2 The methodology for the assessment of baseline ground conditions and contamination at the site follows the phased approach presented in CLR 11. The baseline characterisation of the site has enabled the development of a Conceptual Site Mode (CSM), which identifies the existing ground conditions using the source-pathway-receptor pollutant linkage approach:

- Source: Potential contaminant sources;
- Pathway: The mechanism by which the source may affect a receptor; and
- Receptor: Identified features that may be affected, based on the sensitivity of the site.

2.1.3 The assessment considers the potential risk to environmental receptors and the pathways by which the receptors may be affected. This includes an evaluation of the probability of harm occurring, taking into account potential sources of contamination and receptors that may be affected by such contamination.

2.1.4 The significance of predicted effects likely to occur during the construction and operational phases of the proposed developments has been determined by consideration of the sensitivity of the receptors that may be affected and the magnitude of the predicted impact.

2.1.5 The process and objective of this assessment is to focus on those aspects of the proposed developments that are likely to give rise to 'significant' effects on the environment relative to the baseline conditions. With respect to contaminated land, a 'significant' effect is determined in accordance with Part 2A of the Environmental Protection Act 1990, introduced by Section 57 of the Environmental Act 1995, and is based on the presence of a significant 'source-pathway-receptor' pollutant linkage

2.2 Baseline study

2.2.1 The information collected as part of the Phase 1 Preliminary Risk Assessment has been used to inform the baseline conditions, this report is provided as Volume 6, Appendix 16.1.

2.2.2 The characterisation of baseline conditions has also been informed by publicly available information provided by the following sources:

- Environment Agency;
- British Geological Survey (BGS);
- The Coal Authority; and
- Natural England.

2.2.3 Publicly available information from The Essex Field Club has been reviewed, with regards to geological sites of regional and local importance.

Desktop study

2.2.4 Information on geology, hydrogeology and ground conditions within the study area was collected through a detailed desktop review of existing studies and datasets. These are summarised at Table 2.1 below.

Table 2.1: Summary of key desktop reports.

Title	Source	Year	Author
Hydrogeology	Sheet 15 – Hydrogeological Map of the Dartford (Kent) District	1968	BGS (published by predecessor body the Institute of Geological Sciences)
BGS 1:50,000 and 1:10,000 digital geological mapping	BGS via Groundsure GeoInsight Report	2018	BGS
Borehole records	BGS website - http://mapapps2.bgs.ac.uk/geoindex/home.html	2018	BGS

Title	Source	Year	Author
SPZ/Aquifer Designations	EA via Groundsure Enviro Insight Report	2018	EA
Geological Descriptions	BGS website http://mapapps.bgs.ac.uk/geologyofbritain/home.html	2018	BGS
Geological Sites in Essex	The Essex Field Club http://www.essexfieldclub.org.uk	2018	The Essex Field Club
County Geodiversity Sites	Thurrock Biodiversity Study 2006 – 2011	2007	Thurrock Council
Waterbodies designated under WFD	http://environment.data.gov.uk/catchment-planning/	2018	EA
Environmental Permits	EA and Local Authority via Groundsure Enviro Insight Report	2018	N/A
Landfill sites	EA and Local Authority via Groundsure Enviro Insight Report	20158	N/A

Site specific surveys

2.2.5 The baseline characterisation provided by the desktop survey is considered sufficient to inform the assessment and therefore no site-specific surveys have been undertaken to inform the assessment for geology, hydrogeology and ground conditions.

2.2.6 It is noted that, during the consultation process, no requirements to undertake intrusive investigations in advance of the submission of the application were requested by the Environmental Health Officer at Thurrock Council or by the EA.

2.2.7 An intrusive investigation will be undertaken during the detailed design stage, the scope of which will be agreed with the relevant authorities prior to commencing works.

2.3 Study area

2.3.1 The study area for data collection for this topic comprises the site and a data search buffer of up to 250 m. This enables the identification of off-site potential sources of contaminants of concern and other factors which may have influenced site conditions. The extent of the study area is shown on Figure 2.1.

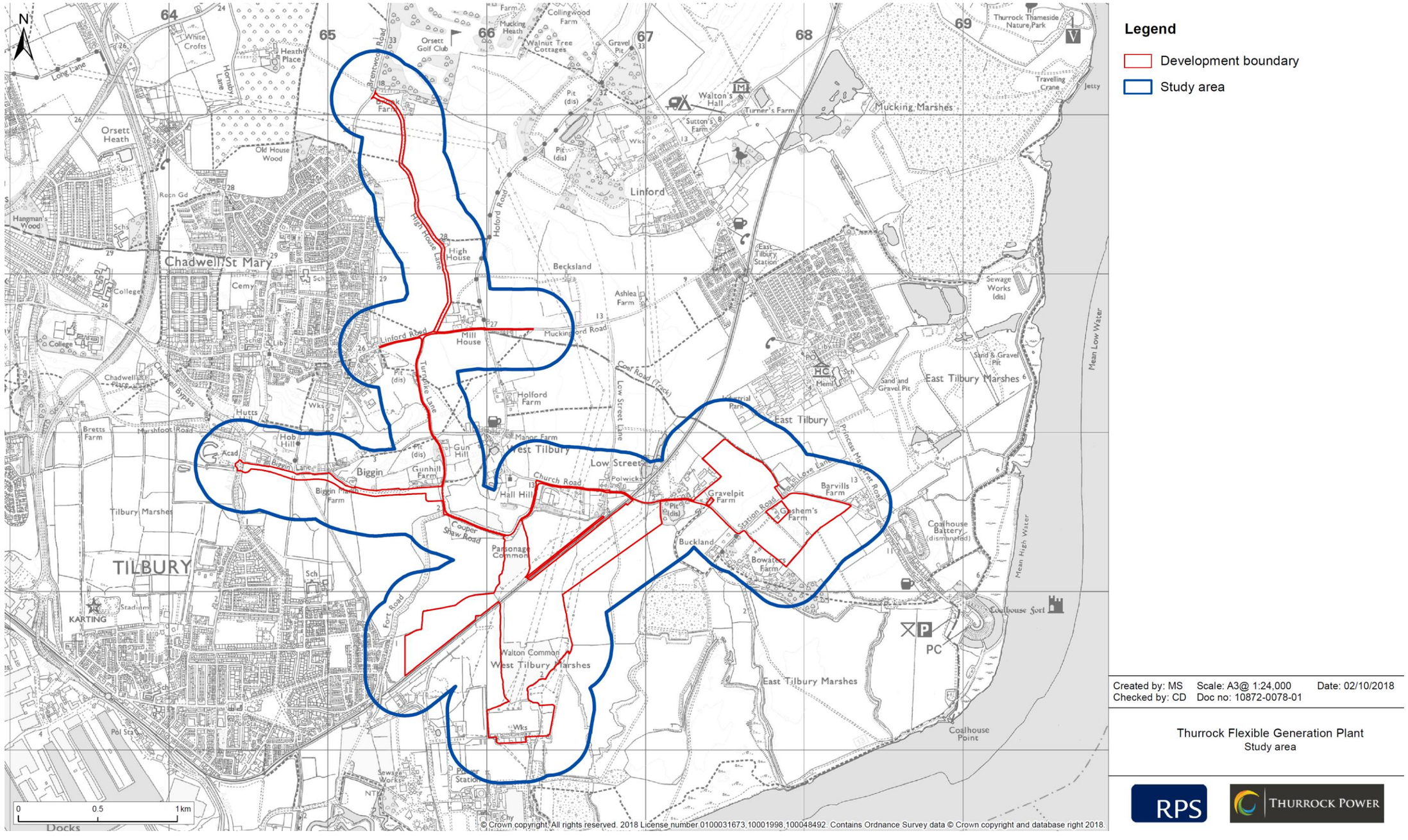


Figure 2.1: Extent of Study Area.

2.4 Uncertainties and/or data limitations

2.4.1 The baseline data are based on information collated as part of the desk study and consultation process. It is recognised that these data may not be exhaustive. For example, it was recommended in the Phase 1 Preliminary Risk Assessment (Volume 6, Appendix 16.1) that limited environmental sampling of soil, groundwater and ground gas be undertaken (focusing on the potentially infilled areas of ground, landfills and any peat layers within the Alluvium).

2.4.2 The recommended site investigation is not considered to be required to inform the assessment process (rather, to inform detailed design). However, the below assessment of effects, and their significance, of the development, as it applies to this topic, has been thoroughly carried out based on the information currently available, which is considered to be sufficient to inform a robust assessment for planning purposes.

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. 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, which is described in further detail in Volume 2, Chapter 4: Environmental Impact Assessment Methodology.

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

Table 2.2: Criteria for magnitude of impact.

Magnitude of impact	Definition used in this chapter
Major	The potential to result in major harm to human health; severe medium-term or localised permanent reduction in the quality of any classified groundwater; the potential for a major medium term detrimental effect upon animal or plant populations (adverse).
	Major improvement in human health; local or regional scale improvement in the quality of potable groundwater or a surface water resource of local, regional or national importance; major beneficial effects upon animal and plant populations (beneficial).
Moderate	The potential for moderate temporary or minor chronic harm to human health; severe temporary or localised permanent reduction in the quality of any classified groundwater the potential for a moderate temporary detrimental effect upon animal or plant populations (adverse).
	Moderate improvement in human health; local or regional scale improvement in the quality of any classified groundwater; moderate beneficial effects upon animal and plant populations (beneficial).
Minor	The potential for temporary slight/minor harm to human health; localised reduction in the quality of any classified groundwater which would be fully reversible with time or widespread reversible reduction in the quality of groundwater used only for commercial or industrial abstractions; the potential for a minor, localised and reversible detrimental effect on animal or plant populations (adverse).
	Slight improvement in human health (or slight reduction in existing human health risk factors); minor local scale improvement in the quality of any classified groundwater and/or a moderate or notable improvement in the quality of groundwater resources used only for commercial or industrial abstraction; minor beneficial effects upon animal and plant populations (beneficial).
Negligible	Very minor loss or detrimental alteration to one or more features (adverse).
	Very minor benefit to or positive addition of one or more features (beneficial).
No change	No change from baseline conditions

2.5.3 The criteria for defining sensitivity in this chapter are outlined in Table 2.3.

Table 2.3: Criteria for receptor sensitivity.

Sensitivity	Definition used in this chapter
Very High	Designated SSSI, potable groundwater and occupants of residential properties
High	Local Geodiversity Sites (LGS), Principal Aquifer, occupants of commercial/industrial properties, ecologically/chemically important surface watercourses and geological resources
Medium	Non designated geological exposures and Secondary Aquifers
Low	Unproductive strata
Negligible	Previously disturbed land

2.5.4 The significance of the effect upon geology, hydrogeology and ground conditions is determined by correlating the magnitude of the impact and the sensitivity of the receptor. The particular method employed for this assessment is presented in Table 2.4. Where a range of significance of effect 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 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. These parameters have been identified based on the overview description of the development provided in Volume 2, Chapter 2: Project Description, including all potential development options where these are under consideration by the applicant.

2.6.2 Effects of greater adverse significance are not predicted to arise should any other development scenario within the project design envelope be taken forward in the final design scheme.

2.7 Impacts scoped out of the assessment

2.7.1 No potential impacts been scoped out of the assessment for geology, hydrogeology and ground conditions.

Table 2.5: Maximum design envelope parameters assessed.

Potential impact	Maximum design scenario	Justification
Construction		
Potential for earthworks to mobilise unexpected ground contamination or create preferential pathways to groundwater	Main development site area 18.5 ha	Reasonable maximum design scenario for works areas with ground disturbance and depth of excavations, affecting potential to encounter ground contamination
	Main development site foundations extend to peat layer where present Piling is required and continuous flight auger or impact piling methods may be used	
	Gas pipeline construction: 20 m wide working corridor and trench 4 m deep; pipeline crosses all fields of 'Zone D'; total length up to 3 km	
	Access road(s) for construction: 20 m wide working corridor(s); route(s) not shared with gas pipe	
	NTS connection above-ground installation: 50 m x 50 m compound	
Potential for construction activity to cause soil or groundwater contamination	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
Operation and maintenance		
Potential for operational and maintenance activity to cause soil or groundwater contamination	Up to 600 m^3 of engine lubricating oil and 60 m^3 of engine coolant (containing glycol antifreeze) would be stored on site. Reagent for the selective catalytic reduction (SCR) air pollution control (APC) system for the gas engines would also be stored: depending on SCR technology selected this may be either urea or ammonia solution. If ammonia solution is used, which is a hazardous substance, no more than 50 t at no more than 25% concentration would be stored on site. 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 soil or groundwater contamination
Decommissioning		
Potential for deconstruction activity to cause soil or groundwater contamination	Disassembly of development equipment *in situ* and demolition of structures	On-site disassembly of equipment and demolition of structures would have greatest potential for soil or groundwater contamination due to spills, leaks of waste generated

2.8 Measures adopted as part of Thurrock Flexible Generation Plant

2.8.1 A number of measures have been designed in to the Flexible Generation Plant to reduce the potential for impacts on geology, hydrogeology and ground conditions. These are listed in Table 2.6.

Table 2.6: Designed-in measures.

Measures adopted as part of Thurrock Flexible Generation Plant	Justification
Construction	
Adherence to the Code of Construction Practice, provided in Volume 5, Appendix 2.2.	Provides control measures to limit the potential adverse impacts on the environment.
A site investigation will be undertaken, prior to the commencement of the construction phase.	To ensure that any required mitigation measures are implemented for the development.
Based on the findings of the site investigation, a remedial options appraisal and remediation strategy will be developed to address any areas of ground or groundwater contamination assessed as requiring remediation. Any remediation works are likely to be undertaken early in the redevelopment process.	To ensure that any risks to identified receptors, can be managed appropriately.
Provision of a written scheme to deal with any contamination of land, to include procedures if previously unidentified contamination of land or groundwater is discovered during construction.	To ensure procedures are in place to deal with any contamination issues in a timely manner.
Provision of a Piling Risk Assessment (should this be required). The assessment will be undertaken in accordance with relevant EA guidance, including Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention (National Groundwater & Contaminated Land Centre report NC/99/73, May 2001).	To reduce the potential for creating preferential pathways to deeper strata.
Good environmental practices will be implemented based on current legal responsibilities and guidance on good environmental management in: CIRIA C532 Control of Water Pollution from Construction Sites – Guidance for Consultants and Contractors (2001); and CIRIA C648 Control of Water Pollution from Linear Construction Projects (2006)	To reduce the potential risk of pollution incidents occurring.
Measures to prevent and control spillage of oil, chemicals and other potentially harmful liquids will be implemented. Designated areas for the unloading, storage and handling of materials and products will be clearly marked. This will be undertaken in accordance with The Control of Pollution (Oil Storage) (England) Regulations 2001. Refuelling of machinery will be undertaken within designated areas where spillages can be easily contained. Machinery will be routinely checked to ensure it is in good working condition; and any tanks and associated pipe work containing oils and fuels will be double skinned and be provided with intermediate leak detection equipment and spill kits.	To reduce the potential risk of pollution incidents occurring.
Any leaks or spillages of potentially polluting substances to be contained, collected and then removed from site in an appropriate manner e.g. use of absorbent material, bunding or booms. An emergency action plan would be formulated which all site personnel would be required to adhere to.	To reduce the potential risk of pollution incidents occurring.
Ground workers will be provided with appropriate risk assessments, which will address the potential for contaminated soil to be encountered. Appropriate Personal Protective Equipment (PPE) (e.g. disposable coveralls, gloves and particulate/vapour masks) should be provided to protect ground workers in the event that contaminated soils and/or groundwater are encountered.	To protect human health receptors.

Measures adopted as part of Thurrock Flexible Generation Plant	Justification
Operation	
The development will be operated in accordance with an Environmental Permit and will have a managed surface drainage system with oil interceptors, bunding and spill kits in case of accidents. It is noted that up to 600 m^3 of engine lubricating oil and 60 m^3 of engine coolant (containing glycol antifreeze) would be stored on site. Reagent for the selective catalytic reduction (SCR) air pollution control (APC) system for the gas engines would also be stored. Depending on SCR technology selected, this may be either urea or ammonia solution. These substances would be stored in tanks with appropriate containment bunds to ensure no release to soil or the surface water drainage system in the event of a spillage or tank leak. If ammonia solution is used (which is a hazardous substance), no more than 50 t at no more than 25% concentration would be stored on site, i.e. below the threshold at which the proposed development would be a lower-tier Control of Major Accident Hazards (COMAH) site or require a Hazardous Substances Consent.	To reduce the potential risk of pollution to soil and groundwater receptors.
Decommissioning	
Decommissioning practices to incorporate measures to prevent pollution of soils and groundwater. This will include emergency spill response procedures. The measures will follow a similar approach to those set out for the construction phase.	To reduce the potential risk of pollution to soil and groundwater receptors.

3. Baseline environment

3.1 Current baseline

Site History and Site Reconnaissance

3.1.1 The majority of the site has historically comprised undeveloped rural (likely agricultural) land traversed by a number of land drains. From c.1955, electricity transmission lines with poles and pylons were shown within Zone A and Zone C. From c.1967 to c.1973, a works was indicated to be present in south of Zone B.

3.1.2 At the time of the site visit, the majority of the site (excluding Zone B) was in agricultural use, predominantly as cultivated fields. Zone B comprised an active substation. Aside from the fly tipping located in Zone I no waste storage was noted on-site, nor was any chemical or oil storage observed. Access was not available to the HGV trailers stored in the southeast corner of Zone D. No buildings were noted on the accessed areas of the site. No visual evidence of contamination was identified during the site walkover.

3.1.3 Further details regarding the site reconnaissance and history are included in Sections 2.1 and 2.2 of the Phase 1 Preliminary Risk Assessment as provided in Volume 6, Appendix 16.1.

Published Geological Mapping

3.1.4 Based on BGS mapping (1:50,000-scale), the stratigraphic sequence beneath the site is indicated to be as follows:

Table 3.1: Description of Geological Strata.

Strata	Description & approximate thickness
Artificial ground	Made Ground may be present beneath Zone B.
Head deposits (Zones D & E)	Head deposits are indicated to be present from ground level across parts of Zones D & E. This stratum generally comprises clay, silt, sand and gravel. Likely to be a few metres in thickness.
Alluvium (Zones A, B, C, F & I)	Alluvium is indicated to be present from ground level across Zones A, B, C, F & I. This stratum generally comprises clay, silt, sand and peat. Likely to be approximately 10 m to 15 m in thickness.
Taplow Gravel Member (Zone D)	This stratum is indicated to be present from ground level beneath parts of Zone D. It generally comprises sand and gravel, likely to be a few metres in thickness beneath the site. This stratum is likely to be present beneath the Alluvium across Zones A, B, C, F & I.
Lynch Hill Gravel Member (Zone D)	This stratum is indicated to be present from ground level beneath parts of Zone D. This stratum generally comprises sand and gravel likely to be a few metres in thickness beneath the site.
Thanet Formation (Zones D & E)	This stratum generally comprises fine grained sand likely to be up to 30 m in thickness beneath the site.
White Chalk Subgroup (all zones)	This stratum generally comprises white chalk. Likely to be of significant thickness beneath the site.

Geological Sites of Interest

3.1.5 Information from The Essex Field Club has been reviewed regarding geological sites of national, regional and local importance. No active sites have been identified within approximately 250 m of the application site.

Hydrogeology

3.1.6 The majority of the site is indicated to be located above a Secondary Undifferentiated Aquifer relating to the Head and Alluvium deposits. These formations have varying characteristics in different locations.

3.1.7 Secondary A Aquifers relating to the Taplow Gravel Member, Lynch Hill Gravel Member and Thanet Formation are indicated to be located below Zones D and E (Thanet Formation only). These formations are formed of permeable layers capable of supporting water supplies at a local scale, in some cases forming an important source of base flow to rivers. The Taplow Gravel Member is indicated to be present beneath the Alluvium in Zones A, B, C, F & I.

3.1.8 A Principal Aquifer relating to the White Chalk Subgroup is indicated to be located below the superficial deposits (and Thanet Formation in Zone D and E) across the entire site. These formations provide a high level of water storage and may support water supply and / or river base flow on a strategic scale.

3.1.9 According to EA data, the majority of the site, including the main development site (Zone A), is not located in a groundwater Source Protection Zone (SPZ). The north of Zone D and the north eastern corners of Zone E and Zone C are located within a groundwater SPZ 3 (Total Catchment). The total catchment is the total area needed to support removal of water from the borehole, and to support any discharge from the borehole.

3.1.10 Under the Water Framework Directive, the EA's local River Basin Management Plan classifies groundwater chemical quality within the Essex Gravel beneath Zone D and E of the site as 'poor' quality (as of 2016). Groundwater chemical quality (as of 2016) within the South Essex Thurrock Chalk located below Zones A, B, C, F and I was classified as having 'good' chemical quality, as was the South Essex Lower London Tertiaries located below Zone C and parts of Zone I. However, as part of the EA's response to the EIA Scoping Report, reference was made to the South Essex Thurrock Chalk groundwater body currently being at 'poor' status.

3.1.11 Information provided by the EA indicates that there are records of five active licensed groundwater abstractions within 2 km of the site. The nearest of these is located approximately 85 m north west of the site and is utilised for general farming & domestic use, including spray irrigation. The nearest potable water supply is located approximately 160 m to the west. Further information on groundwater abstractions is provided in Section 2.3 of the Phase 1 Preliminary Risk Assessment, as provided in Volume 6, Appendix 16.1.

Hydrology

3.1.12 Numerous drainage ditches are located on site and within the surrounding area. However, no watercourses which are classified within a River Basin Management Plan published by the EA under the European Water Framework Directive (2000) have been identified within 1 km of the site.

3.1.13 Information provided by the EA indicates that there is a record of one active licensed surface water abstraction within 2 km of the site. The license holder for the abstraction is C. H. Cole & Sons, for an abstraction recorded approximately 1,770 m north west of the site, from a ditch tributary of the River Thames for spray irrigation (storage) uses.

Sensitive Land Uses

3.1.14 Natural England data indicate that there is one ecologically sensitive site, which constitutes an environmental receptor as defined within Table 1 of the DEFRA Environmental Protection Act 1990: Part 2A - Contaminated Land Statutory Guidance (2012), located within a 1 km radius of the site. This relates to Mucking Flats and Marshes Site of Special Scientific Interest (SSSI) located approximately 770 m to the east of Zone E. However, given that this feature is over 2.5 km from the main development site, it is not considered to represent a potential receptor.

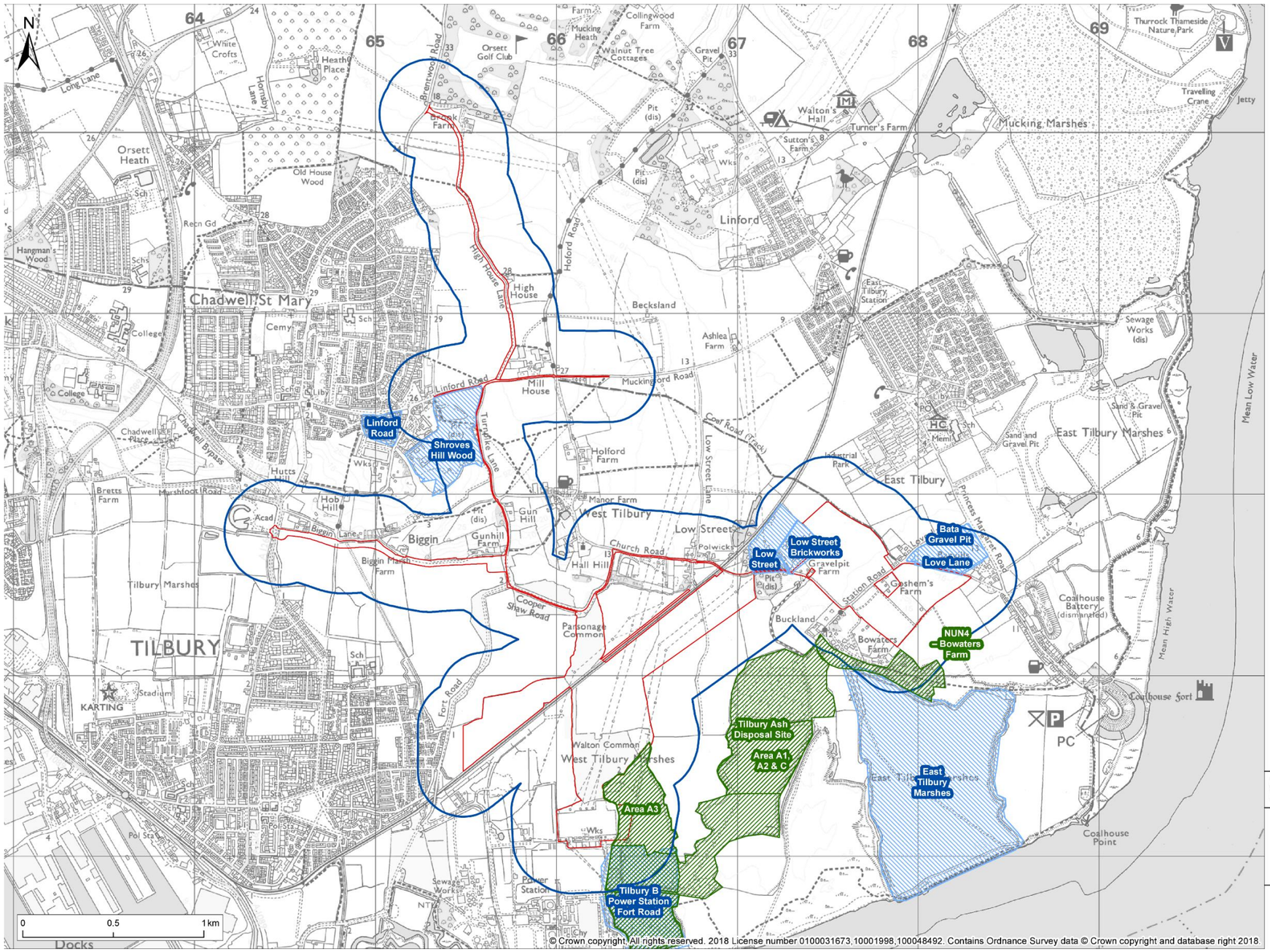
Waste Sites

3.1.15 Information provided by a number of sources (EA, BGS, local authority) shows that there are six recorded licensed or known historical landfill sites and four waste treatment / transfer sites recorded within 250 m of the site. These are summarised within Table 3.2 below. Their locations are shown in Figure 3.1.

Table 3.2: Landfills and Waste Sites.

Approx. Distance and Direction	License Details	Waste Type and Details
Landfill Sites		
On site - east of Zone B	Tilbury Power Station 1963 to present day . Known as the Tilbury ash disposal site.	Industrial waste (factory curtilage) – pulverised fuel ash.
Adjacent to Zone D	Leemans and Readman (known as Low Street Brickworks) – 1956 to 1977	Industrial, commercial (brickworks) Thurrock Council has record of a pit inspection from 28 July 1956 which notes that the filling of a pong had been done using waste foundry sand from the Readymetal Company. Condition 1 of THU/442/75 stated that no refuse other than refuse of the descriptions specified below shall be deposited on the site without the further consent of the Council and Thurrock Borough Council being first sought and obtained – clay, excavated materials, building site clearance materials and waste concrete blocks excluding liquid, toxic, putrescible and water soluble materials
Adjacent to Zone D	Low Street – 1969 to 1976	Non-hazardous industrial and commercial
Adjacent to Zone E	Aylett Gravel Limited (known as Princess Margaret Road landfill (Love Lane)) – 1934 to 1988	Inert, industrial, commercial
10m north Zone E	Bata Gravel Pit	Not provided
40m Zone D	Bowaters Farm – 1968 to unknown end date. Reclamation status – satisfactory	Inert (including decomposed refuse)
30m south Zone B	National Power Plc - issued 1978	Inert

Approx. Distance and Direction	License Details	Waste Type and Details
185m southwest Zone B	East Tilbury Marshes (William Cory and Son Limited) – 1932 to 1991	Industrial, commercial, household, liquid sludge Thurrock Council has a record of this site being operated from 1979 until the mid-1990s. Waste types included household hazardous solids and liquids.
Scrap Yards & Waste Transfer / Treatment Sites		
10m south Zone B	RWE Npower Plc, Tilbury B Power Station – issued 2001	Industrial waste landfill (factory curtilage) – pulverised fuel ash
45m northwest Zone D	Lester Reclaim Spares Ltd, Unit 9, Station Road – issued 2004	End of life vehicle facility
50m southwest Zone D	J S Trucks Ltd, Low Street Brickworks, Station Road – issued 1998, effective 2004	Metal recycling site (vehicle dismantler)
100m northwest Zone D	Mayer Parry Recycling Ltd, Station Road – issued 1994, modified 2009	Metal recycling site



Legend

- Development boundary
- Study area
- Authorised landfill site
- Historic landfill

Created by: MS Scale: A3@ 1:24,000 Date: 04/10/2018
Checked by: CD Doc no: 10872-0079-03

Thurrock Flexible Generation Plant
Landfill

Figure 3.1: Landfill and Waste Sites.

Other Issues

3.1.16 The BGS has provided information regarding non-coal mining associated with the site. It is reported that small scale underground mining may have occurred; mine adits, shafts and tunnels may be present. The potential for localised difficult ground conditions are at a level where they should be considered.

Outline Conceptual Site Model

3.1.17 An outline Conceptual Site Model (CSM) has been developed, based on the information gathered as part of the Phase 1 Preliminary Risk Assessment. The CSM has been used to identify potential sources, pathways and receptors (i.e. potential pollutant linkages) on site. Further details on the CSM are provided in Section 3 of Volume 6, Appendix 16.1: Phase 1 Preliminary Risk Assessment.

3.1.18 A limited number of potential pollutant linkages were identified, that could be made active upon the redevelopment of the site, particularly in consideration of the main application site. It was recommended that limited, targeted environmental sampling of soil, groundwater and ground gas be undertaken (focusing on the potentially infilled areas of ground, landfills and any peat layers within the Alluvium). This could be undertaken in conjunction with the geotechnical investigation that will likely be required to further define the geotechnical properties of strata underlying the site prior to construction.

Receptors (Environmental Sensitivity)

3.1.19 Although the facility is not expected to have a full-time workforce on site during operation, staff will be required to visit site to undertake inspection, maintenance or repair work. As such the site workers are considered to be sensitive receptors. The off-site human health receptors associated with Tilbury Power Station and Tilbury Sewage Treatment Works, located to the south of Zone B; and a metal recycling works (located adjacent to the north west of Zone D) are considered to be sensitive receptors.

3.1.20 Construction workers are considered to be sensitive receptors.

3.1.21 Head deposits and Alluvium are indicated to be present from ground surface across the majority of the application site, including the main development site. These strata are classified as Secondary Undifferentiated Aquifers and are considered to be sensitive receptors.

3.1.22 Parts of Zone D and Zone E are directly underlain by the Taplow Gravel Member or Lynch Hill Gravel Member. These strata are classified as Secondary A Aquifers and are therefore considered to be sensitive receptors.

3.1.23 While the main development site is indicated to be underlain by the White Chalk Subgroup (a Principal Aquifer), the relatively thick, likely low permeability Alluvium will provide a high level of protection to the underlying groundwater within this aquifer. However, service corridors and/or subterranean infrastructure corridors or piling activities could act as preferential pathways for the migration of any potential contaminants of concern which could impact the White Chalk Subgroup. Therefore, this aquifer is considered to be a sensitive receptor.

3.1.24 The drainage ditches, located both on site and the surrounding area are considered to be sensitive receptors.

3.2 Future baseline

3.2.1 The future baseline in relation to geology, hydrogeology and ground conditions is unlikely to differ significantly from that described above as part of the current baseline. It is considered that the application site would remain as predominantly open fields and therefore there would not be any significant change.

Climate change

3.2.2 The Met Office UK Carbon Projections ('UKCP09') dataset[1] provides probabilistic projections of change in climatic parameters over time for 25 km grid squares across the UK. Projected changes during low, medium and high future global greenhouse gas emissions scenarios have been reviewed for the period from 2020 up to 2069, encompassing the potential six year construction and 35 year operational periods of the proposed development.

3.2.3 The likely ranges of change in climatic parameters including precipitation, temperature, wind speed, humidity and frequency of extreme weather are not considered to materially affect the future baseline described above for geology, hydrogeology and ground conditions or increase the sensitivity of receptors to impacts beyond that described in Section 4.

[1] CP09 is presently being updated to CP18, expected to be published in November 2018 (Met Office, 2018). CP09 remains the most up-to-date available data and remains an appropriate tool for adaptation planning (Met Office, 2017).

4. Assessment of Effects

4.1 Construction phase

4.1.1 The potential impacts of the development associated with geology, hydrogeology and ground conditions have been assessed against the maximum design scenario.

4.1.2 A description of the potential effect on geology, hydrogeology and ground conditions receptors cause by each identified impact is provided in the following sections.

Potential for earthworks to mobilise unexpected ground contamination or create preferential pathways to groundwater

Magnitude of impact

4.1.3 The construction phase will include a number of intrusive activities including: earthworks, piling and construction of service corridors and/or subterranean infrastructure corridors. These activities could include general ground disturbance, establishment of haul routes and removal of vegetation. Any existing sources of contaminants of concern could be mobilised by the physical disturbance and/or removal of materials.

4.1.4 The main development site comprises agricultural land and is not therefore considered to represent a potentially significant source of contaminants of concern. However, off-site potentially infilled areas of ground and/or landfills could represent sources of contaminants of concern.

4.1.5 Piling activities could cause the potential mobilisation of contaminants of concern within shallow soils and groundwater into the deeper aquifers. However, there are not considered to be any significant on site sources of contaminants of concern. In addition, the proposed use of continuous flight auger piling is considered to pose the least risk of groundwater pollution.

4.1.6 Potential direct impacts may occur to the Secondary Aquifers and the deeper Principal Aquifer. However, the Secondary Aquifers are likely to considered to be of a variable nature, comprising varying proportions of clay, silt, sand and gravel. In particular, the likely significant thickness of Alluvium beneath the main development site will limit the potential for the vertical and/or lateral migration of any contaminants of concern.

4.1.7 The impact type is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptors directly. With the adoption of the measures adopted in Table 2.6 and the Code of Construction Practice (provided in Volume 5, Appendix 2.2), the magnitude is therefore considered to be **minor**.

Sensitivity of the receptor

4.1.8 During the construction phase, the following receptors are relevant to this likely impact:

- construction workers;
- off-site human health receptors;
- groundwater (including the Secondary Undifferentiated Aquifers, Secondary A Aquifers and Principal Aquifer); and
- surface watercourses.

4.1.9 Construction workers are deemed to be of high vulnerability, not recoverable and high value. The sensitivity of the receptor is therefore, considered to be **high**.

4.1.10 Off-site human health receptors, including with those associated with Tilbury Power Station, Tilbury Sewage Treatment Works and the metal recycling works are deemed to be of high vulnerability, not recoverable and high value. The sensitivity of the receptor is, therefore, considered to be **high**.

4.1.11 Given that the Alluvium and Head deposits are classified as Secondary Undifferentiated Aquifers, they are considered to be of low to medium vulnerability, moderate recoverability and low to medium value. The sensitivity of the receptor is, therefore, considered to be **low to medium**.

4.1.12 The Secondary A Aquifers, relating to the Taplow Gravel Member, Lynch Hill Gravel Member and Thanet Formation, are considered to be of medium vulnerability, moderate recoverability and medium value. The sensitivity of the receptor is, therefore, considered to be **medium**.

4.1.13 The White Chalk Subgroup Principal Aquifer is considered to be of medium vulnerability beneath the likely lower permeability Alluvium and high vulnerability beneath the Secondary A Aquifers; slow recoverability; and high value. The sensitivity of the receptor is, therefore, considered to be **high**. The north of Zone D and the north eastern corners of Zone E and Zone C are located within a groundwater SPZ 3 (Total Catchment). Superficial deposits are indicated to overlie the Thanet Formation and White Chalk Subgroup in these areas and would therefore provide a degree of attenuation to the vertical migration of any contaminants of concern.

4.1.14 Drainage ditches are considered to be of low to medium vulnerability, low to moderate recoverability and low to medium value. The sensitivity of the receptor is therefore, considered to be **low to medium**.

Significance of effect

4.1.15 Overall, it is predicted that **minor** impact on the **low to high** sensitivity receptors would result in a **negligible to minor adverse** effect, which is not significant in EIA terms.

4.1.16 There may also be a minor beneficial effect if any previously unidentified contamination is identified and remediated as part of the construction works.

4.1.17 It should be noted that in the absence of site investigation data, as discussed in Section 2.4, a conservative (worst case) position has been adopted for the purposes of assessment.

Further mitigation or enhancement

4.1.18 No significant adverse effects have been predicted and no further mitigation is considered to be required.

Residual effect

4.1.19 It is predicted that the **minor** impact on the **low to high** sensitivity receptors would result in a **negligible to minor adverse** residual effect, which is not significant in EIA terms.

Potential for construction activity to cause soil or groundwater contamination

Magnitude of impact

4.1.20 Construction activities could potentially cause contamination to underlying soils and groundwater. The use of heavy machinery and/or the storage and use of hazardous materials may result in accidental emissions to ground. This is most likely to be associated with the storage of fuel or accidental leakage from vehicles during construction (including refuelling). Accidental spillage or leakage of hazardous materials would detrimentally impact soil quality and may ultimately impact groundwater.

4.1.21 The impact type is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptors directly. With the adoption of the measures adopted in Table 2.6 and the Code of Construction Practice (provided in Volume 5, Appendix 2.2), the magnitude is considered to be **negligible**.

Sensitivity of the receptor

4.1.22 During the construction phase, the following receptors are relevant to this likely impact:

- groundwater (including the Secondary Undifferentiated Aquifers, Secondary A Aquifers and Principal Aquifer); and
- surface watercourses.

4.1.23 Given that the Alluvium and Head deposits are classified as Secondary Undifferentiated Aquifers, they are considered to be of low to medium vulnerability, moderate recoverability and low to medium value. The sensitivity of the receptor is, therefore, considered to be **low to medium**.

4.1.24 The Secondary A Aquifers, relating to the Taplow Gravel Member, Lynch Hill Gravel Member and Thanet Formation, are considered to be of medium vulnerability, moderate recoverability and medium value. The sensitivity of the receptor is, therefore, considered to be **medium**.

4.1.25 The White Chalk Subgroup Principal Aquifer is considered to be of medium vulnerability beneath the likely lower permeability Alluvium and high vulnerability beneath the Secondary A Aquifers; slow recoverability; and high value. The sensitivity of the receptor is, therefore, considered to be **high**. The north of Zone D and the north eastern corners of Zone E and Zone C are located within a groundwater SPZ 3 (Total Catchment). Superficial deposits are indicated to overlie the Thanet Formation and White Chalk Subgroup in these areas and would therefore provide a degree of attenuation to the vertical migration of any contaminants of concern.

4.1.26 Drainage ditches are considered to be of low to medium vulnerability, low to moderate recoverability and low to medium value. The sensitivity of the receptor is, therefore, considered to be **low to medium**.

Significance of effect

4.1.27 Overall, it is predicted that the **negligible** impact on the **low to high** sensitivity receptors would result in a **negligible to minor adverse** effect, which is not significant in EIA terms.

Further mitigation or enhancement

4.1.28 No significant adverse effects have been predicted and no further mitigation is considered to be required.

Residual effect

4.1.29 It is predicted that the **negligible** impact on the **low to high** sensitivity receptors would result in a **negligible to minor adverse** residual effect, which is not significant in EIA terms.

Future monitoring

4.1.30 Given the measures proposed in Table 2.6 (comprising a site investigation, remedial options appraisal and remediation strategy (if required) and provision of a written scheme to deal with any previously unidentified contamination of land), no additional future monitoring is considered to be necessary.

4.2 Operational and maintenance phase

Pollution of Soils and/or Controlled Waters

Magnitude of impact

4.2.1 Operational impacts are considered to be unlikely, as the proposed development will be operated in accordance with an Environmental Permit and will have a managed surface drainage system with oil interceptors, bunding and spill kits in case of accidents. Operations would be limited to any maintenance works, which could include the accidental spillage of polluting materials.

4.2.2 The impact type is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptors directly. With the adoption of the measures adopted in Table 2.6, the magnitude is therefore considered to be **negligible**.

Sensitivity of the receptor

4.2.3 During the construction phase, the following receptors are relevant to this likely impact:

- groundwater (including the Secondary Undifferentiated Aquifers, Secondary A Aquifers and Principal Aquifer); and
- surface watercourses (including drainage ditches and attenuation areas).

4.2.4 Given that the Alluvium is classified as a Secondary Undifferentiated Aquifer, it is considered to be of low to medium vulnerability, low to moderate recoverability and medium value. The sensitivity of the receptor is, therefore, considered to be **low to medium**.

4.2.5 The underlying Secondary A Aquifers, relating to the Taplow Gravel Member and Thanet Formation, are considered to be of medium vulnerability, moderate recoverability and medium value. The sensitivity of the receptor is, therefore, considered to be **medium**.

4.2.6 The White Chalk Subgroup Principal Aquifer is considered to be of medium vulnerability beneath the likely lower permeability Alluvium; slow recoverability; and high value. The sensitivity of the receptor is, therefore, considered to be **high**. The main development site is not located within a groundwater SPZ.

4.2.7 Drainage ditches and attenuation areas are considered to be of low to medium vulnerability, low to moderate recoverability and low to medium value. The sensitivity of the receptor is, therefore, considered to be **low to medium**.

Significance of effect

4.2.8 Overall, it is predicted that the **negligible** impact on the **low to high** sensitivity receptors would result in a **negligible to minor adverse** effect, which is not significant in EIA terms.

Further mitigation or enhancement

4.2.9 No significant adverse effects have been predicted and no further mitigation is considered to be required.

Residual effect

It is predicted that the **negligible** impact on the **low to high** sensitivity receptors would result in a **negligible to minor adverse** residual effect, which is not significant in EIA terms**.**

Future monitoring

4.2.10 No future monitoring is considered to be required for the operational and maintenance phase as this will be carried out in accordance with an Environmental Permit.

4.3 Decommissioning phase

4.3.1 There is potential for deconstruction activities to cause soil or groundwater contamination. On-site disassembly of equipment and demolition of structures would have greatest potential for soil or groundwater contamination due to spills, leaks or waste generated.

4.3.2 The effects of decommissioning activities are expected to be similar to the effects from construction.

Pollution of Soils and/or Controlled Waters

Magnitude of Impact

4.3.3 The impact type is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptors directly. With the adoption of the measures adopted in Table 2.6, the magnitude is therefore considered to be **negligible**.

Sensitivity of the receptor

4.3.4 During the decommissioning phase, the following receptors are relevant to this likely impact:

- groundwater (including the Secondary Undifferentiated Aquifers, Secondary A Aquifers and Principal Aquifer); and
- surface watercourses (including drainage ditches and attenuation areas).

4.3.5 Given that the Alluvium is classified as a Secondary Undifferentiated Aquifer, it is considered to be of low to medium vulnerability, low to moderate recoverability and medium value. The sensitivity of the receptor is, therefore, considered to be **low to medium**.

4.3.6 The underlying Secondary A Aquifers, relating to the Taplow Gravel Member and Thanet Formation, are considered to be of medium vulnerability, moderate recoverability and medium value. The sensitivity of the receptor is, therefore, considered to be **medium**.

4.3.7 The White Chalk Subgroup Principal Aquifer is considered to be of medium vulnerability beneath the likely lower permeability Alluvium; slow recoverability; and high value. The sensitivity of the receptor is, therefore, considered to be **high**. The main development site is not located within a groundwater SPZ.

4.3.8 Drainage ditches and attenuation areas are considered to be of low to medium vulnerability, low to moderate recoverability and low to medium value. The sensitivity of the receptor is, therefore, considered to be **low to medium.**

Significance of effect

4.3.9 Overall, it is predicted that the **negligible** impact on the **low to high** sensitivity receptors would result in a **negligible to minor adverse** effect, which is not significant in EIA terms

Further mitigation or enhancement

4.3.10 No significant adverse effects have been predicted and no further mitigation is considered to be required.

Residual effect

It is predicted that the **negligible** impact on the **low to high** sensitivity receptors would result in a **negligible to minor adverse** residual effect, which is not significant in EIA terms.

Future monitoring

4.3.11 No future monitoring is considered to be required for the decommissioning phase.

4.4 Transboundary effects

4.4.1 A screening of transboundary impacts has been carried out and is presented in Volume 5, Appendix 4.2: Transboundary Impacts Screening Note. This screening exercise identified that there was no potential for significant transboundary effects with regard to geology, hydrogeology and ground conditions from Thurrock Flexible Generation Plant upon the interests of other EEA States.

4.5 Inter-related effects

4.5.1 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 Geology, Hydrogeology and Ground Conditions is provided in Volume 4, Chapter 17: Summary of Inter-Related Effects.

Project lifetime effects

4.5.2 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

4.5.3 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. Cumulative Effects Assessment

5.1 Introduction

5.1.1 The process of identifying other consented or proposed developments and screening to create a shortlist of those having potential for cumulative effects with Thurrock Flexible Generation Plant is described in Volume 2, Chapter 4*:* Environmental Impact Assessment Methodology and Volume 5, Appendix 4.1: Cumulative Developments and Screening. Appendix 4.1 lists the shortlisted cumulative developments and the tier they have been assigned (guiding the weight that the decision-maker may place on each development's likelihood of being realised) in accordance with PINS Guidance Note 17.

5.1.2 Cumulative developments shortlisted are those that have potential to contribute impacts affecting receptors also affected by the proposed development (for example, contributing significant additional traffic to the same road links), or that introduce additional sensitive receptors (for example, new residences or a school closer to the proposed development than existing), or both.

5.1.3 The cumulative effects assessment for geology, hydrogeology and ground conditions has been undertaken in two stages, reported as follows. In the first stage, cumulative effects of the proposed development have been considered in an overall scenario where the land surrounding the proposed development could be largely transformed by three adjacent NSIP developments and the possible expansion of nearby residential and employment uses to the east. This is referred to as the 'max development' scenario.

5.1.4 In the second stage, cumulative effects with specific individual development projects have been assessed where these would affect a particular environmental pathway or receptor for geology, hydrogeology and ground conditions. Only shortlisted developments with potential cumulative effects specific to geology, hydrogeology and ground conditions are assessed in this chapter.

5.2 Cumulative effects in 'max development' scenario

5.2.1 Three NSIP developments are proposed on land adjacent to and in some cases overlapping with the Thurrock Flexible Generation Plant application boundary. The Tilbury2 port expansion adjacent to the west is at examination stage (Tier 1). The Tilbury Energy Centre (TEC) power station to the south and Lower Thames Crossing (LTC) motorway and link road to the east and north are both at EIA scoping stage (Tier 2).

5.2.2 Outline planning permission has been granted for several residential and mixed-use developments expanding Linford and East Tilbury in the direction of Thurrock Flexible Generation Plant (Tier 1).

5.2.3 Should all of these developments proceed, Thurrock Flexible Generation Plant's main development site would be closely surrounded on all sides by the temporary or permanent works areas of the NSIPs. Its gas connection point to Feeder 18 could be adjacent to the expanded outskirts of East Tilbury and also potentially to the TEC gas connection, and the pipeline route could cross land to be developed for the LTC.

5.2.4 The Thurrock Core Strategy (2015) allocates land for possible strategic employment provision and sustainable economic growth to the west of the proposed development and to the east where there is existing industry at East Tilbury. Thurrock Borough Council is drafting a new Local Plan to replace the Core Strategy. The Issues and Options (Stage 2) consultation document proposals map of July 2018 (withdrawn temporarily due to recent NPPF changes) suggested possible zones for residential and commercial/employment development in areas east of the proposed development, where this would be facilitated by the Lower Thames Crossing project. However, these Tier 3 development possibilities are afforded only limited weight due to the early stage of this local plan development process.

5.2.5 In the 'max development' scenario set out in Sections 5.2.1 to 5.2.4 above, the Geology, Hydrogeology and Ground Conditions cumulative effects of Thurrock Flexible Generation Plant are not considered to be significant. As on the basis of the information available, only negligible to minor adverse effects have been identified in relation to ground conditions and contamination associated with the proposed development. The proposed development is therefore not considered to represent a significant risk in terms of contaminated soil and/or groundwater. Therefore, it is not considered that Thurrock Flexible Generation Plant would contribute to any significant adverse cumulative effects in relation to ground conditions and contamination.

5.3 Cumulative effects with specific developments

Construction phase

5.3.1 Only shortlisted individual projects within the 250 m buffer study area of the main development site have been considered within this section. There is only one relevant project, which relates to the demolition of Tilbury B Power Station and all associated buildings and infrastructure (16/00186/DMI).

5.3.2 Given that there are not likely to be any construction works undertaken as part of specific developments within the study area, there are not considered to be any cumulative effects, which could cause disturbance and potentially impact identified receptors.

Operational and maintenance phase

5.3.3 Indirect impacts may occur from accidental spillages of chemicals during maintenance work at the main development site. However, any such spillages would not be relevant to demolition works of Tilbury B Power Station.

Decommissioning phase

5.3.4 Direct impacts may occur to identified receptors during the decommissioning phase, however, these are receptors would not be of relevance to the demolition of Tilbury B Power Station.

6. Conclusion and summary

6.1.1 This assessment of the effects, and their significance, of the development as it applies to contaminated land has been thoroughly carried out based on the information currently available.

6.1.2 It is considered that if any risks are identified as part of the site investigation work, then these can be appropriately controlled through the completion of any recommended mitigation measures and the implementation of environmental management practices during the construction works.

6.1.3 Mitigation measures would be adopted during the construction phase (including the CoCP), therefore the magnitude of any impacts through the disturbance and mobilisation of any previously unidentified ground contamination would be negligible to minor. Potential impacts arising from the construction phase would be expected to be localised and short term. Consequently, it is concluded that the likely significance of effects would be negligible to minor adverse during the construction phase. There may also be a minor beneficial effect if any previously unidentified contamination is identified and remediated. Such effects would not be significant in EIA terms.

6.1.4 Potential impacts arising from the operational phase would be expected to be localised and intermittent. Overall, the significance of effects would be negligible to minor adverse for the operational phase, which would not be significant in EIA terms. Environmental compliance during the operational phase will be monitored under the Environmental Permit.

6.1.5 Potential impacts arising from the decommissioning phase would be expected to be localised and intermittent. Overall, the significance of effects would be negligible to minor adverse for the operation of the proposed development, which would not be significant in EIA terms.

6.1.6 A summary of potential environmental effects, mitigation and monitoring is provided in Table 6.1.

6.1.7 The proposed development is not considered to make a significant contribution to any cumulative adverse effects on soils or groundwater, as the sources of future contaminants of concern are limited.

6.1.8 No effects have been identified that would be considered significant in terms of the EIA Regulations.

6.2 Next Steps

6.2.1 At this stage, no additional site specific surveys are considered to be necessary to produce the final ES chapter.

Table 6.1: Summary of potential environment effects, mitigation and monitoring.

Description of impact	Measures adopted as part of the project	Magnitude of impact	Sensitivity of receptors	Significance of effect	Additional measures	Residual effect	Proposed monitoring
Construction							
Potential for earthworks to mobilise unexpected ground contamination or create preferential pathways to groundwater	Adherence to good environmental practices (see Table 2.6)	Minor	Low to high	Negligible to minor adverse (not significant in EIA terms)	None	N/A	None
Potential for construction activity to cause soil or groundwater contamination	Adherence to good environmental practices (see Table 2.6)	Negligible	Low to high	Negligible to minor adverse (not significant in EIA terms)	None	N/A	None
Operation							
Pollution of Soils and/or Controlled Waters	The development will be operated in accordance with an Environmental Permit and will have a managed surface drainage system with oil interceptors, bunding and spill kits in case of accidents	Negligible	Low to high	Negligible to minor adverse (not significant in EIA terms)	None	N/A	None
Decommissioning							
Impacts of decommission may cause contamination of Secondary Aquifers, the Principal Aquifer and drainage ditches	Adherence to good environmental practices (see Table 2.6)	Minor	Low to high	Negligible to minor adverse (not significant in EIA terms)	None	N/A	None

7. References

Construction Industry Research and Information Association (CIRIA) (2001) C532 Control of Water Pollution from Construction Sites – Guidance for Consultants and Contractors

Construction Industry Research and Information Association (CIRIA) (2006) C648 Control of Water Pollution from Linear Construction Projects

Ministry of Housing, Communities and Local Government (2018) National Planning Policy Framework

Department for Environment, Food & Rural Affairs (DEFRA) (2012) Environmental Protection Act 1990: Part 2A - Contaminated Land Statutory Guidance

Environment Agency (2004) Contaminated Land Report 11

Environment Agency (2001) Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention - National Groundwater & Contaminated Land Centre report NC/99/73

Thurrock Council (2015) Thurrock's Core Strategy and Policies for Management of Development (as amended)