

Chapter 15: Water Resources, Flood Risk, Drainage and Ground Conditions

WATER RESOURCES, FLOOD RISK, DRAINAGE AND GROUND CONDITIONS	
AUTHOR	RMA Environmental
SUPPORTING APPENDIX	ES Volume 3: Appendix: Water Resources, Flood Risk, Drainage and Ground Conditions Annex 1: Legislation and Planning Policy; Annex 2: Phase 1 Contamination Assessment Report (RMA Environmental; 2022); and Annex 3: Flood Risk Assessment and Surface Water Drainage Strategy (RMA Environmental Ltd; 2022).
KEY CONSIDERATIONS	The key impacts of the Proposed Development which are considered to be potentially significant with regard to Water Resources, Flood Risk, Drainage and Ground Conditions are as follows: • Potential contamination from general construction-related activities; • Potential remobilisation and creation of contaminant pathways via leaching and/or via migration to groundwater and surface water as a result of construction activities; • Potential for building materials and infrastructure, construction/demolition workers and adjacent site users (human health) to be exposed to UXO and potential leaching/pollution from existing UXO on soils, hydrogeology and hydrology; • Potential for demolition and construction workers to be exposed to landfill/ground gas; • Potential for demolition and construction workers coming into direct contact with contaminated soils and/or contaminated groundwater and/or surface water; • Potential for off-site users and occupants inhaling, ingesting or coming into dermal contact with windblown contaminated dust. • Potential contamination from routine site operation and/or accidental releases; • Potential effects of existing ground conditions or any residual contaminants on building materials and infrastructure for the Proposed Development; • Potential for future site users coming into direct contact with contaminated soils and groundwater; • Potential impact on minerals safeguarding beneath the site during the construction and operational phases; and • Potential for services maintenance staff and proposed planting coming into direct contact with contaminated soils.
CONSULTATION	An EIA Scoping Report was prepared and submitted to Gravesham Borough Council (GBC) on the 11th August 2022 requesting a Scoping Opinion from GBC. A copy of the EIA Scoping Report is provided in ES Volume 3, Appendix: EIA Methodology – Annex 1. A Scoping Opinion was received on 16th September 2022 and is provided in ES Volume 3, Appendix: EIA Methodology – Annex 2. The Scoping Opinion noted: • That water resources, flood risk and drainage should be scoped into the EIA - this has been included within this ES chapter; • It is proposed that site drainage and flooding are also addressed within the CEMP. This is captured within the Outline CEMP (see ES Volume 3, Appendix: Demolition and Construction – Annex 1) and ES Volume 1, Chapter 18: Environmental Mitigation and Monitoring Schedule; • The application should consider whether the application should be supported by or contain a commitment to a Flood Risk Management Plan and the incorporation of flood resilient design features. This is included within the Flood Risk Assessment (FRA) which is included as ES Volume 3, Appendix: Water Resources, Flood Risk, Drainage and Ground Conditions - Annex 3; • The Scoping Opinions states that it is strongly advised that the EA are consulted using their paid pre-application advice service. This has been undertaken and is referenced below. • It is also recommended that the Applicant engages with Kent County Council as Lead Local Flood Authority and this has also been undertaken and is referenced within in the FRA (ES Volume 3, Appendix: Water Resources, Flood Risk, Drainage and Ground Conditions - Annex 3); • The Scoping Opinion confirms that this area is served by Southern Water and the Applicant is advised to engage with them regarding capacity and how connections are to be provided. This is captured within ES Volume 1, Chapter 18: Environmental Mitigation and Monitoring Schedule; and • The Scoping Opinion refers to a comment from Health and Safety Executive (HSE) which confirms that the development is located within the safeguarding zone of an HSE licensed explosives site at Port of Tilbury London Limited, Essex. This has been considered within this ES chapter. Consultation has been undertaken with the Environment Agency (EA) throughout the design of the Proposed Development. This has included initial pre-application advice with regard to flood levels, flood defences and Finished Floor Levels (FFLs) of the proposed buildings. Further information with regard to EA consultation is included within the FRA (ES Volume 3, Appendix: Water Resources, Flood Risk, Drainage and Ground Conditions - Annex 3). A Contaminated Land Enquiry was undertaken with GBC and this has been incorporated into the Phase 1 Land Contamination Assessment (ES Volume 3, Appendix: Water Resources, Flood Risk, Drainage and Ground Conditions - Annex 2) and the baseline section of this ES chapter. Pre-application Consultation has also been undertaken with Kent County Council (KCC) who act as the Lead Local Flood Authority (LLFA) and a copy of this consultation is included within Appendix C

	of ES Volume 3, Appendix: Water Resources, Flood Risk, Drainage and Ground Conditions - Annex 3. This includes advice with regards to groundwater condition, flood risk, surface water management and drainage assets, with further detail provided below: • The LPA highlighted many constraints associated with the site which would result in discharging runoff via infiltration being unfeasible. These being the fact the site is located within a Source Protection Zone (SPZ) 2, that there is likely to be shallow groundwater on the site (less than 3 m below ground), the site could be contaminated and that the site is underlain by soluble chalks which could result in geohazards; and • The LPA agreed that “<i>subject to it being demonstrated that infiltration is not feasible we accept an unrestricted outflow to the river Ebbsfleet dependent on it being demonstrated that tidal lock is not a concern</i>”.
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ASSESSMENT METHODOLOGY

Outline Assessment Methodology

Defining the Baseline

Current Baseline Conditions

15.1 The methodology employed in this assessment has been largely desk-based and a review of the site and surrounding area has been based on the following reports:

- A Phase 1 Contamination Assessment Report (RMA Environmental; 2022) included within **ES Volume 3, Appendix: Water Resources, Flood Risk, Drainage and Ground Conditions - Annex 2** (hereafter referred to as the ‘Phase 1 Report’). The objective of the Phase 1 Report was to gather information on site conditions and to identify any potential risks of ground contamination resulting from historical or current land uses on or in close proximity to the site, this included a site visit which was undertaken on 29th June 2022;
- A Groundsure Environmental Database Report for the site and surrounding area which is included within Appendix A of the Phase 1 Report (**ES Volume 3, Appendix: Water Resources, Flood Risk, Drainage and Ground Conditions - Annex 2**); and
- A Flood Risk Assessment and Surface Water Drainage Strategy (RMA Environmental; 2022) (hereafter referred to as the ‘FRA and Drainage Strategy’), included within **ES Volume 3, Appendix: Water Resources, Flood Risk, Drainage and Ground Conditions - Annex 3**.

Evolution of the Baseline

15.2 The principal factor with regard to the evolution or change to the current baseline conditions in relation to ground conditions is climate change. Should the Proposed Development not come forward, an increase in rainfall intensity (based on UK Climate Change predictions) as a result of climate change is likely to alter the quality of controlled waters by increasing/altering pollutant pathways within groundwater and soils. This assessment has considered the existing baseline with regard to surface water and groundwater quality and resources and the predicted water quality or resource status or objectives for future years as defined by the EA for the relevant river or groundwater catchment.

15.3 If all other cumulative schemes as identified in **ES Volume 1, Chapter 2: EIA Methodology** came forward in the absence of the Proposed Development, then there would be a minor beneficial impact on the surrounding area and negligible impact on the site. This is because, in accordance with the mandatory legislative requirements of Part IIA of the Environmental Protection Act, 1990 and associated planning conditions, any contamination and associated risks at individual development sites would be identified by the relevant applicants to ensure that each development would be ‘suitable for use’. Sites where contamination may be present will be required to undertake intrusive investigation and risk assessment and in some cases, a remediation strategy will be required that could result in a minor beneficial impact on ground conditions. If nearby cumulative sites are remediated and free from contamination, this would result in there being a negligible risk of remobilisation of contamination from offsite sources to the Proposed Development.

Impact Assessment Methodology

Flood Risk and Drainage

15.4 It was confirmed in the Scoping Opinion that the impacts on water resources, flood risk and drainage are scoped into the EIA, in particular reference to the fact that the site is located within Flood Zone 3a (area benefitting

from flood defences) and there is a residual risk from tidal inundation during a breach event and the potential for surface water runoff to increase during both the construction and operational phases due to the increase in impermeable surface areas. The Scoping Opinion also makes reference to water infrastructure and associated capacity enquiries with Southern Water.

- 15.5** A Flood Risk Assessment (FRA) and Surface Water Drainage Strategy (RMA Environmental; 2022) has been prepared for the outline planning application and this is included as **ES Volume 3, Appendix: Water Resources, Flood Risk, Drainage and Ground Conditions - Annex 3**.
- 15.6** The FRA confirms that the majority of the site is located within Flood Zone 3 (high risk) and there are small areas located within Flood Zone 2 (medium risk) throughout the site; however, the site is shown to be located within an area benefitting from flood defences for its operational lifetime, based on the proposed increases to defence levels. However, during a breach event, the site could flood to a maximum depth of 3.19 m in the 2100 epoch.
- 15.7** The site is not affected by the 1%, 0.1% or 1% plus 35% climate change AEP fluvial flood events and, therefore, the site is not located within future fluvial Flood Zone 3.
- 15.8** According to BGS Groundwater flooding susceptibility mapping, the site has up to a 'high risk of groundwater flooding'. Given the chalk aquifer underlying the site as well as gravels and the proximity of the site to the River Thames, it should be considered, as a worst case scenario, that groundwater levels are relatively shallow on site. With this in mind, it is considered that any risk of groundwater flooding can be mitigated alongside the measures proposed to protect the site from tidal flooding.
- 15.9** The majority of the site has a very low risk from surface water flooding with some isolated areas with a low, medium and high flood risk of surface water flooding throughout the site. The low surface water flood risk is beyond the 1% AEP design event; therefore, no mitigation is required for this surface water flood event. With the adoption of the drainage strategy, it is considered that medium and high surface water flood risk would not adversely affect the proposed development and the surface water flood risk is considered to be less significant than the tidal risk.
- 15.10** A number of mitigation and Design Code measures have been included and proposed and full details of these are included within the FRA (**ES Volume 3, Appendix: Water Resources, Flood Risk, Drainage and Ground Conditions - Annex 3**), these are as follows:
- All Finished Floor Levels of the 'more vulnerable' land uses will be raised 600 mm above the 2100 tidal breach flood level (design flood level). There will be some areas where reception areas and entrances will be required to be located at ground level, below the flood level; however, the most vulnerable uses in these areas will be raised above the flood levels where appropriate (i.e. bedrooms and habitable rooms). The areas below the design flood level will include internal safe access/egress to an area above the flood level should a breach flood event occur. Flood resilience measures are proposed for the 'less vulnerable' uses and other ground floor areas, with the aim of providing additional protection.
 - During the design breach flood event, the access route has a maximum hazard rating of a 'danger for all'. However, should sufficient flood warning be given, it would be possible to evacuate occupants of the property to land located outside the breach zone, which is situated adjacent to the eastern boundary along Stonebridge Road, approximately 35 m to the west of the site along Galley Hill Road and approximately 150 m to the south-east of the site along High Street. Should sufficient flood warning not be possible, then an internal safe refuge would be available within each unit with a floor level at least 600 mm above the 0.5% breach flood levels in the year 2115. Additionally, safe refuge areas would be available on the podium levels for example around the football stadium.
 - The River Thames tidal flood wall is located outside of the application site and therefore these defences are not within the Applicant's control and any future upgrades to the defences are not included within the proposed development outline application. However, futureproofing of the site and the flood defences has been duly considered in the development design, with the inclusion of a 19 m set back (standard being 16 m) that is free from any built development in the northern extent of the site up to the northern boundary. There is commitment within this application to provide new flood defences within the 19 m set back to meet the Thames Estuary 2100 (TE2100) standards. Given the outline nature of the proposal, details with regard to the design, existing condition and structure of the current defences will be provided at the reserved matters stage.

- Due to the lack of information and documentation, including specific and clear as-built survey information of the culvert, coupled with the inaccessibility of the area in question and it not being accessible, the exact alignment of the culvert is currently unknown. Given the outline nature of the proposed scheme, a detailed culvert survey will be undertaken at the reserved matters stage (controlled by a suitably worded planning condition). This is considered a reasonable, proportionate approach given the flexibility within the design. However, an indicative resolution is proposed which includes the diversion of the culvert along the road to the west of the site. The realignment details would be confirmed following a detailed survey of the culvert to understand its depth, width and condition and this will stipulate the any realignment route. This approach would provide a betterment when compared to the existing scenario as there will be opportunities to widen the culvert, increasing its capacity thereby reducing flood risk at the site. This approach would also ensure that there is a suitable 8 m easement predominantly free of built development to allow for access and maintenance. Opportunities for de-culverting and partial deculverting will also be considered following the culvert survey that will be undertaken at reserved matters stage;
- As reported in the Outline CEMP (**ES Volume 3, Appendix: Demolition and Construction – Annex 1**) and **ES Volume 1, Chapter 18: Environmental Mitigation and Monitoring Schedule**, during each phase of the Proposed Development, a construction compound will implement a drainage system designed and managed to comply with BS6031:2009 'The British Standard Code of Practice for Earthworks', which details methods that should be considered for the general control of drainage on construction sites. Further advice is contained within the British Standard Code of Practice for Foundations (BS8004, 2015). All necessary drainage works would be installed to ensure that there would be no increase in surface water runoff as set out in the accompanying Drainage Strategy (**ES Volume 3, Appendix: Water Resources, Flood Risk, Drainage and Ground Conditions - Annex 3**). As each element of the Proposed Development is constructed, surface water attenuation measures will be implemented at the same time to ensure that there will be no uncontrolled increase in surface water discharge during construction.
- A surface water drainage strategy is proposed and full details of this are included within Annex 3 of this ES chapter. The strategy proposes to discharge to tidal waters unattenuated (as agreed by the LLFA) and incorporate a range of SuDs features including
 - Runoff from the roofs of residential buildings will be harvested and re-used, thereby reducing discharge to sewers;
 - Runoff from podium areas will be attenuated in low-profile attenuation tanks (e.g. RoofBloxx by ACO);
 - Runoff from the roof of the football stadium will be captured for re-use in a low-profile tank beneath the pitch;
 - All other buildings will be provided with green roofs incorporating low-profile attenuation tanks; and
 - Park areas will be profiled to provide attenuation for rainfall events in excess of the 30 year return period rainfall event.
- The incorporation of two large parks (17% of site area), green roofs (7% of site area) and rainwater harvested roofs (8% of site area) will significantly reduce the amount of impermeable area within the site, which will in turn reduce the peak runoff rate. The final rate of discharge will be determined on completion of the design of the proposed pumping stations. The rate will be a compromise between the attenuation storage required and the capacity of the pumps.
- It is anticipated that any increase in water demand will be reduced by the incorporation of appropriate water-saving devices, wherever practicable. The buildings will be designed to maximise water efficiency through measures such as rainwater and/or greywater harvesting, where possible. Water butts could be installed to residential properties to provide water for external irrigation, with larger rainwater harvesting units for commercial and industrial development, where appropriate.
- The foul drainage demand is expected to significantly increase due to the Proposed Development increasing the employment floor space, residential development and light industrial land uses when compared to the existing site use. At this stage, the exact arrangement of the private network inside the

site boundary has not been established and will be developed further at the detailed design stage. Furthermore, since the publication of the connections and development charging rules in April 2018, drainage authorities in England are obligated to provide a point of connection and undertake any mitigation or improvement works and network reinforcements, where necessary. These will be programmed once planning consents are granted.

- 15.11** Based on the mitigation measures that have been proposed and the design measures included within the Proposed Development, it is considered that there will be a Negligible effect (Not Significant) on flood risk and drainage as a result of the Proposed Development. These topics are therefore not considered further within this ES chapter. Further details in terms of the flood risk and drainage measures that have been proposed can be found within the FRA and Surface Water Drainage Strategy (**ES Volume 3, Appendix: Water Resources, Flood Risk, Drainage and Ground Conditions - Annex 3**).

Demolition and Construction

- 15.12** There is no specific quantitative assessment methodology for ground conditions impact assessments. However, the scale and nature of each potential impact (and thus whether it is considered a significant effect or not) for demolition and construction activities associated with the Proposed Development has been assessed using an approach which is broadly based on the established methodology from the Transport Analysis Guidance (TAG) Environmental Impact Assessment 2015¹ and this document gives guidance on environmental impact appraisals. As well as this, the source – pathway – receptor model approach as described in Land Contamination Risk Management (LCRM)² has been used. Further details on how scale and nature of each potential impact is defined (and thus whether it is considered a significant effect or not) are set out below.

- 15.13** The assessment of demolition and construction effects is based on the demolition and construction methodology of the Proposed Development, as described within **ES Volume 1, Chapter 5: Demolition and Construction**.

- 15.14** This chapter has taken into consideration the indicative phasing shown in **ES Volume 1, Chapter 5: Demolition and Construction**.

Completed Development

- 15.15** As with the demolition and construction phase, the scale and nature of each potential impact (and thus whether it is considered a significant effect or not) during the operation of the Proposed Development has been assessed using an approach which is broadly based on the established methodology from the TAG Environmental Impact Assessment 2015. As well as this, the source – pathway – receptor model approach as described in CLR11 has been used.

- 15.16** The assessment of operational effects is based on the Proposed Development as described in **ES Volume 1, Chapter 4: The Proposed Development**.

Outline Planning Application

- 15.17** This assessment of ground conditions has used the maximum parameters in relation to the location and depths of piling and foundations to ensure that a reasonable worst-case scenario is assessed for the outline elements of the Proposed Development. It has been assumed, based on the maximum parameters of building footprints and set out in **ES Volume 1, Chapter 5: Demolition and Construction**, that piling depths will penetrate to a maximum depth of 30m below ground level and into the underlying chalk aquifer beneath the site.

- 15.18** By assessing the maximum parameters with regards to the locations and depths of piling, this ES chapter is assessing the reasonable worst-case scenario in relation to the potential for likely significant effects associated with ground conditions.

Assumptions and Limitations

- 15.19** The assessment of potential effects has been largely based on the findings of the Phase 1 Report, which is included in **ES Volume 3, Appendix: Water Resources, Flood Risk, Drainage and Ground Conditions - Annex 2**. With any report of this nature (i.e. non-intrusive study), it is not possible to completely rule out the presence of contaminated ground, so this has been considered as relevant throughout this ES chapter.

- 15.20** The study area is defined as that of generally within a 2km radius of the site, as determined by best practice; however, some data provided by the Groundsure Report has a smaller radius. The search area used is stated in the assessment, where relevant.

- 15.21** When referring to data from third-party reports and web-based data searches, the distances and directions are quoted directly. These are based on reference points within the site and, therefore, it is possible that some of the data locations are at a slightly different distance and/or direction from the closest part of the site boundary.

- 15.22** It has not been possible to undertake any intrusive site investigation at this stage at the site; this is not only because of the active and busy operational nature of the site (as an established and highly active industrial area) but also the associated access restrictions with vehicle traffic, and localised operations.

Methodology for Defining Effects

Receptors and Receptor Sensitivity

- 15.23** The sensitivity or importance of ground condition receptors has been established on the basis of their use, proximity to the site, existing quality or resource value and consideration of potential pollutant pathways (as set out in **Table 15.1**).

Table 15.1: Definition of Receptor Sensitivity

Receptor Sensitivity	Receptor Type	Sensitivity Details
High	Soils and Geology	- No known area of contamination present (i.e. Greenfield). - Within a Mineral Safeguard Area for the mineral resource that underlies the site.
	Hydrology	Water Framework Directive (WFD) catchment classification of 'High' or 'Good'
	Hydrogeology	- Principal Aquifer - Groundwater Source Protection Zone (SPZ) 1 - Current aquifer chemical quality of 'Good' - Shallow groundwater (i.e. 10 m bgl or less).
	Human Health	- Demolition/construction workers and service maintenance workers involved directly in groundworks - Future occupants with residential gardens, use of allotment and access to public areas of soft landscaping - Adjacent site users (residential dwellings) within less than 100 m of the Proposed Development
	Proposed Planting*	Planting and areas of soft landscaping and exposed soils are proposed within the site.
	Building Materials and Infrastructure	Residential – related infrastructure and services to be utilised by people
Medium	Soils and Geology	Potential areas of contamination present (i.e. Brownfield)
	Hydrology	WFD catchment classification of 'Moderate'
	Hydrogeology	- Secondary A or B Aquifer - Groundwater SPZs 2 or 3 - Current aquifer chemical quality of 'Good (deteriorating)'
	Human Health	- Demolition/construction workers and service maintenance workers involved around groundworks - Future occupants only utilising commercial or industrial land-uses, car parking or other areas of hardstanding - Adjacent site users (residential dwellings) between 100m and 500m of the Proposed Development
	Building Materials and Infrastructure	Commercial or industrial-related infrastructure, where services are not required to be utilised by people
Low	Soils and Geology	Known areas of contamination present (i.e. Brownfield with contamination)
	Hydrology	WFD catchment classification of 'Poor' or 'Bad'
	Hydrogeology	Unproductive Strata, i.e. Non-Aquifer

¹ Department for Transport. (December 2015). TAG Unit A3 Environmental Impact Appraisal. Transport Analysis Guidance

² Environment Agency (2019). Land Contamination Risk Management Guidance.

Receptor Sensitivity	Receptor Type	Sensitivity Details
		- Not located under groundwater SPZ - Current aquifer chemical quality 'poor' or 'poor (deteriorating)'.
	Human Health	- Demolition/construction workers and service maintenance workers on-site but not involved with any groundworks - Land with no access for people - Adjacent site users (residential dwellings) more than 1 km away from of the Proposed Development
	Building Materials and Infrastructure	Infrastructure with no requirement for services (such as highways, railways)

Magnitude of Impact

- 15.24** Evaluation for the magnitude of the potential changes in ground conditions has been established based on the TAG Environmental Impact Assessment 2015 methodology (refer to **Table 15.2**).

Table 15.2: Methodology of Assessing Magnitude of Change

Magnitude of Impact	Criteria for Assessing Impact
Major	Total loss or major/substantial alteration to key elements/features of the baseline (pre-development) conditions such that the post development character/composition/attributes will be fundamentally changed. An acute or chronic adverse effect on human health, defined as 'significant harm' by the <i>Environment Protection Act 1990</i> Part 2A Contaminated Land Statutory Guidance.
Moderate	Loss or alteration to one or more key elements/features of the baseline conditions such that post development character/composition/attributes of the baseline will be materially changed. An acute or chronic adverse effect on human health, but not likely to be defined as 'significant harm'.
Minor	A minor shift away from baseline conditions. Change arising from the loss / alteration will be discernible/detectable. The underlying character/composition/attributes of the baseline condition will be similar to the pre-development circumstances/situation. A preventable, non-permanent adverse effect on human health.
Negligible	Very little change from baseline conditions. Change barely distinguishable, approximating to a 'no change' situation. No adverse effect on human health or the environment.

Defining the Effect

- 15.25** The potential effects have been identified through consideration of both the sensitivity of the receptor and the magnitude of the impact and given an effect scale of Negligible, Minor, Moderate or Major based on the matrix in **Table 15.3** below.

Table 15.3: Effect Significance Matrix

Magnitude	Sensitivity		
	High	Medium	Low
Major	Major	Moderate to Major	Minor to Moderate
Moderate	Moderate to Major	Minor to Moderate	Minor
Minor	Minor to Moderate	Minor	Negligible to Minor
Negligible	Negligible	Negligible	Negligible

- 15.26** The nature of the effect is then defined as either beneficial or adverse. Effects that are considered to be adverse are those that have a detrimental effect on existing baseline conditions, human health and the Proposed Development (i.e., landscaping and infrastructure). Effects that are considered to be beneficial are those that result in an improvement on existing baseline conditions. This is determined from referring to the tables above.

- 15.27** It is important to consider the geographic extent of the effect and this is defined as being one of the following:

- Local: which are those affecting the site and neighbouring receptors;

- District: which are those affecting receptors within the local planning authority boundary (i.e., Gravesham Borough Council (GBC));
- Regional: which are those affecting the region of Kent; or
- National: which are those that could affect different parts of the country.

- 15.28** The duration of each effect is considered as either being 'temporary', i.e. the effects last the duration of construction/demolition and then would no longer be significant; or 'permanent', i.e. the effect would last for the duration of the operational lifetime of the development or longer.

- 15.29** Each effect considered is defined as being either 'short-term', 'medium-term' or 'long-term' these being one of the following:

- Short-term: typically, being from a few months up to three years in duration;
- Medium-term: this would cover a duration of around one to ten years; and
- Long-term: this would cover a duration in excess of ten years.

- 15.30** Each considered effect has been defined as being either a 'direct' or an 'indirect' effect on the receptor. A direct effect is one in which would result without any intervening factors and an indirect effect is an effect which would not be caused directly or would result from other factors.

Categorising Likely Significant Effects

- 15.31** Where the predicted effects are Minor, Moderate or Major Adverse (or Beneficial) in scale, these are considered significant. Mitigation measures have been identified where possible to eliminate or reduce adverse effects to an acceptable level. The residual effects (post mitigation) are discussed in the final subsection of this chapter. Effects that are categorised as Negligible are not considered to be significant.

BASELINE CONDITIONS

- 15.32** The site currently comprises a mix of industrial warehouses and yards, as well as Ebbsfleet football stadium. The site reconnaissance included within the Phase 1 Report (**ES Volume 3, Appendix: Water Resources, Flood Risk, Drainage and Ground Conditions - Annex 2**) has been reviewed and this confirms the following (the photos of the site visit are included within Appendix C of the Phase 1 Report):

- The site comprises of a number of different business facilities ranging from commercial premises to industrial premises;
- An electricity substation is located along the western boundary of the site and this appears contained and well maintained;
- There are a number of materials storage yards including sealed skips associated with commercial enterprises such as a storage yard for the builders' merchants located in the north of site and storage facilities located in the east of the site associated with the aggregate processing facility. These were mostly well maintained and managed, although some areas showed moderate evidence of hydrocarbon spills and emissions of dust and other particulates (principally from the aggregate facility);
- There are several car showrooms and a Shell fuel station and car wash facilities located in the south-western extent of the site. Underground fuel tanks will be present at the fuel station. It is assumed that surface water runoff from the forecourt area of the fuel station and the car washing facility will discharge to foul sewer;
- A waste storage bin area was present adjacent to the football ground;
- There is untarmacked ground adjacent to the football ground which showed some evidence of hydrocarbon spills on the ground;
- A bus maintenance depot is located in the central north-eastern extent of the site. There was moderate to high evidence of hydrocarbon staining seen on the ground and in yard areas; and
- Overall, the site comprises of a number of potentially contaminative land uses and materials which could potentially pose a risk to sensitive receptors. Although the majority of storage areas and yards looked to be well maintained and managed, the risk of soil and/groundwater contamination cannot be ruled out.

The site was heavily trafficked with heavy goods vehicles frequently driving along the roads as a consequence of the industrial nature of the site. It is important to note that the 19 ha site also facilitates occupation of some several hundred employees in a number of offices overseeing these 'operational uses' and forms part of an active habitable employment area.

Soils and Geology

Historical Potentially Contaminative Land Uses

- 15.33** The Phase 1 Report (**ES Volume 3, Appendix: Water Resources, Flood Risk, Drainage and Ground Conditions - Annex 2**) confirms that there are a number of potentially contaminative former land uses that have occupied the site. The earliest historical map is from 1865 and this shows that the north-eastern part of the site was occupied by a cement mill and kiln, a windmill located in the north-west of the site, 'Botany Bay' is located in the centre of the site and 'Stone Bridge' is located within the south of the site. By 1932 a Football Ground known as 'Gravesend and Northfleet FC' is located in the centre of the site and there are a number of tramways/railway tracks through the site. By the 1970s, a depot is shown in the northern extent of the site which includes a number of tanks and buildings on site. By the 1990s, an 'industrial estate' is located in the south-eastern corner of the site and the 'depot' in the north of the site is referred to as 'sand and gravel works and 'warehouse'. An 'electricity substation' is located in the north-western extent of the site. The industrial estate comprises of (but is not limited to) two garages, a service station, depot and electricity substation.
- 15.34** Overall, when reviewing the Groundsure Report³, it is reported that there are 94 records of historical potentially contaminative industrial land uses located on site.
- 15.35** Based on the industrial land uses that occupied the site, there is the potential that asbestos, heavy metals, Polycyclic Aromatic Hydrocarbons (PAHs), Polychlorinated Biphenyls (PCBs) and other hydrocarbons are present on site.
- 15.36** Within a 250 m radius of the site, there are 266 recorded historical contaminative land uses that include railway infrastructure, mills, works and depots as well as unspecified tanks and pits.
- 15.37** There are 25 records of historical tanks on site; these are mostly located in the northern extent of the site associated with the cement works and the later depot buildings. A 'gas works' is also referenced in the Groundsure Report, although it is not clear where on site this is located. There are a further 88 tanks located within a 250m radius of the site, the closest of which is located 3m south-east of the site.
- 15.38** According to the Groundsure report, there are 11 records of historical energy features on site; the majority of these are described as electricity substations but there are also electricity transformers and gasometers recorded on site. These substations are dotted throughout the site, but particular reference is in relation to the substations located in the north-western corner of the site and the far south-eastern corner. There are a further 10 electricity features relating to electricity substations recorded to be located within 250m radius of the site.
- 15.39** There are two records of historical garages located in the southern extent of the site, referred to as a 'service station' and 'garage' from 1993 mapping. There are no other records of any other historical garages located within 250m of the site.

Current Potentially Contaminative Land Uses

- 15.40** The Groundsure Report identifies that there are 53 records of current potentially contaminative industrial uses within the site. These include (but are not limited to) electricity substation, pylons, tanks, Ebbsfleet industrial estate, concrete production, unspecified works and factories, sand and gravel extractions and materials, petrol and fuel stations and commercial and industrial company including printing solutions, construction supplies and vehicle repair testing and servicing. There are a further 63 industrial land uses within a 250 m radius of the site, the closest of which is recorded to be located 7m south-east of the site and comprises a vehicle cleaning service centre.
- 15.41** There is one Control of Major Accident Hazards (COMAH) record associated with Britannia Refined Metals Ltd which is located just outside the north-western boundary of the site. The COMAH record is currently in operation and is classified as an upper tier site which reflects an increasing potential for major accidents to occur in the absence of robust risk control systems.
- 15.42** There are two British pit records on site which are located on the northern boundary of the site. These are marine sand and gravel and crushed road and are both actively extracting minerals or, in the case of wharfs and rail depots, is actively handing minerals.

- 15.43** There are also 23 surface ground workings on site which relate to ponds, heaps, unspecified wharfs and ground workings taken from the historical mapping. This could result in a risk of ground gas being present on site.

Environmental Permits, Licences, Pollution Incidents, Waste and Designated Sites

- 15.44** The one hazardous substance storage site within a 250 m radius of the site is recorded to be located 23m north of the site and was an approved application for the storage of various hazardous materials. No enforcement was notified for this activity.
- 15.45** There are three historical licensed industrial activities (IPC) within a 250m radius of the site. These are all in relation to Britannia Refined Metals Ltd which is located 18m north of the site for the process of non-ferrous metals.
- 15.46** There are three records of Part A (1) licensed industrial activities within a 150m radius. The closest is associated with Britannia Refined Metals for non-ferrous metals processing. The remaining two records are associated within Urban Reserve Limited located 215m south-west of the site for a new 'medium combustion plant'.
- 15.47** There are seven records of Part A (2) licensed pollution releases on site and these are summarised below:
- Part B permit for metal coating processes from North Kent Shotblasting and no enforcements were notified (historical);
 - Part B permit for road stone coating processes from North Kent Roadstone Ltd and no enforcements were notified (current);
 - Part B permit for waste oil burner from Hudsons Ltd and no enforcements were notified (new legislation applies);
 - Part B permit for use of bulk cement from CPI Mortars Ltd and no enforcements were notified (current);
 - Part B permit for use of bulk cement from Brett Concrete and no enforcements were notified (current);
 - Part B permit for timber manufacturer from N.T.C. Lumber Southern Ltd and no enforcements were notified (historical); and
 - Part B permit for unloading of petrol into storage at service stations from Shell Northfleet Station and no enforcements were notified (current).
- 15.48** There are two recorded pollution incidents relating to the site. The first was recorded in 2001 for 'contaminated water' from 'vehicle and plant washings' which had a Category 3 (minor) impact on water. The second record was from 2002 and was classified as 'oils and fuels' which had a Category 3 (minor) impact on land.

Unexploded Ordnance

- 15.49** As detailed within the Phase 1 Report, Zetica produce unexploded bomb risk maps for sites within the UK and review of these has confirmed that the site is located within an area with a high risk of Unexploded Ordnance (UXO).
- 15.50** The EIA Scoping Opinion (**ES Volume 3, Appendix: EIA Methodology – Annex 2**) refers to a comment from the Health and Safety Executive (HSE) which confirms that the development is located within the safeguarding zone of an HSE licensed explosives site at Port of Tilbury London Limited, Essex. The north-eastern portion of the site fronts the River Thames and lies opposite the Port of Tilbury within the Thurrock Borough Council area. Directly opposite, around 930 metres distant, is the main lock entrance to the dock complex, through which ships enter the impounded docks at times dependent on the tide.

Geology

- 15.51** According to the British Geological Survey (BGS) online viewer⁴, the majority of the site is underlain by the superficial deposits of Alluvium comprising clay, silt, sand and gravel. The eastern and western boundary of the site is underlain by the superficial deposits of Head comprising clay, silt, sand and gravel and a few areas along the eastern boundary and north-western corner are not underlain by any superficial geology. From reviewing the BGS 1:50,000 map series England and Wales Sheet 271 for Dartford, it shows that Kempton Park Gravels are located beneath the Alluvium deposits underlying the site.
- 15.52** The site is entirely underlain by the bedrock geology of the Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation comprising chalk.

³ Groundsure Location Intelligence. (2022) *Enviro and Geo Insight*.

⁴ British Geological Survey. *Geology Viewer*. Available at: [BGS Geology Viewer \(BETA\)](https://www.bgs.gov.uk/geology-viewer/)

15.53 The BGS 1:50,000 map series England and Wales Sheet 271 for Dartford also confirms that the site is located in an area of previously worked ground.

15.54 BGS mapping indicates an available borehole record located in the centre of the site, (TQ67SW791) which was drilled to a depth of 21.34m. Groundwater was not recorded to be encountered within this borehole which had the following geological sequence:

- Drift deposits (4.28m thick); and
- Chalk and flints (at least 17.06m thick).

15.55 The Groundsure Report confirms that the site is underlain by artificial deposits of made ground and worked ground specifically in the northern extent of the site. The Groundsure report confirms that there is a mix of artificial ground permeability on site with a maximum permeability of 'very high'.

Mineral Safeguarding

15.56 As reported within the Groundsure Report and given the current land uses on site, there are two British pit records on in the northern extent of the site. These comprise of marine sand and gravel and crushed road and are both actively extracting mineral produce or, in the case of wharfs and rail depots, are actively handling minerals.

15.57 The Gravesham Borough Council Mineral Safeguarding Areas map which forms part of the Kent Minerals and Waste Local Plan indicates that the site is located within the Gravesham Borough Council urban boundary/village confines and the Sub - Alluvial River Terrace Deposits Mineral safeguard area.

15.58 Mineral Safeguarding Areas cover the known locations of specific mineral resources that are (or may in future be) of sufficient economic value to warrant protection for future generations.

15.59 Robins Wharf is occupied by Brett Aggregates and Aggregate Industries. The wharf is a shared facility for the importation of aggregates for direct sale or supply into added value products. At this location, CPI Mortars and North Kent Roadstone, produce readymix concrete and asphalt for sale into local markets. Aggregates, concrete and asphalt are transported to the end user by Heavy Goods Vehicles which utilise the local and strategic road network to arrive at their location.

15.60 A Minerals Infrastructure Assessment has been undertaken and is submitted with the planning application. This draws upon the site's current uses in reference to Mineral Safeguarding.

Radon

15.61 The site is in an area where between 1% and 3% of properties are above the Action Level for radon according to the Groundsure Report; however, no radon protection measures are considered to be necessary for the Proposed Development.

Hydrogeology

Aquifer Classification

15.62 The superficial deposits of Alluvium and the superficial deposits of Head are classified as Secondary (Undifferentiated) Aquifers; this classification: *"has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type"*.

15.63 The Kempton Park Gravels that underlie the Alluvium and Head Deposits are classified by the EA as Secondary A Aquifers; these are defined as: *"permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers"*.

15.64 The Lewes Nodular Chalk Formation is classified by the EA as a Principal Aquifer; these are defined as "layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer".

Groundwater Quality

15.65 The northern half of the site falls within the Water Framework Directive (WFD) 'West Kent Darent and Cray Chalk' groundwater operational catchment which had a chemical status of 'poor' in 2019 and has an objective of 'good' for 2027.

15.66 The southern half of the site falls within the Water Framework Directive (WFD) 'North Kent Medway Chalk' groundwater operational catchment which had a chemical status of 'poor' in 2019 and has an objective of 'good' for 2027.

Groundwater Depths

15.67 From reviewing BGS mapping, there is one available borehole record located in the centre of the site (TQ67SW791); groundwater was not encountered within this borehole which was dug to a depth of 21.34m below ground level (mbgl).

15.68 A review has been undertaken of other nearby boreholes and a borehole located approximately 200m south-west of the site along the railway line (TQ67SW865) was dug to a depth of 10m and this encountered groundwater at 5.70m bgl within the upper chalk. Two adjacent borehole records (TQ67SW580 and TQ67SW599) encountered groundwater at 4.60m bgl and 5.10m bgl.

15.69 Pre-application consultation has been undertaken with KCC and this is included in Appendix C of **ES Volume 3: Appendix: Ground Conditions - Annex 3**. This states that the *"site conditions identified from mapping show the underlying geology as Upper Chalk with groundwater likely to be seated at less than 3m below the ground surface, which may be subject to seasonal variation"*.

15.70 Given the chalk aquifer underlying the site as well as gravels and the proximity of the site to the River Thames, it should be considered, as a worst case scenario, that groundwater levels are relatively shallow on site.

Designation, Abstraction and Discharges

15.71 The site is located within a groundwater Source Protection Zone (SPZ) specifically a Zone 2 Outer Protection Zone which has the following definition:

"This zone is defined by the 400-day travel time from a point below the water table. Additionally, this zone has a minimum radius of 250 or 500 metres, depending on the size of the abstraction. The travel time is derived from consideration of the minimum time required to provide delay, dilution and attenuation of slowly degrading pollutants".

15.72 The LLFA pre-application consultation included within Appendix C of **ES Volume 3: Appendix: Ground Conditions - Annex 3** states that *"the site is situated within a SPZ2 zone indicating the groundwater may be vulnerable to contamination"*.

15.73 There are no recorded licensed groundwater abstractions within the site or within a 250m radius of the site.

Hydrology

Hydrological Features

15.74 Ebbsfleet, a culverted 'main river'⁵, flows through the south-eastern part of the site in a northerly direction and enters Robins Creek to the north-east of the site. This ultimately flows into the River Thames which is located along the north-eastern boundary and is classified as a 'main river'. Throughout this chapter reference will be made to the 'surface waters', this is referring to the River Thames, Robins Creek and Ebbsfleet.

15.75 Ebbsfleet is an open watercourse up until 130m south of the site where it meets Thames Way, it is then culverted beneath the railway line and through the site before becoming an open watercourse at Robins Creek.

15.76 Swanscombe Marshes (which is located within the Swanscombe Peninsula Site of Special Scientific Interest) are located directly north-west of the site and these comprise areas of marshland and a number of local land drains.

Surface Water Quality

15.77 The site is reported to be located within the surface water body catchment known as the 'Lower Medway Operational Catchment' which is made up of a total of three waterbodies, two of which have a 'moderate' ecological status and one which has a 'good' ecological status as of 2019. They are all reported to have 'failed' chemical status for surface waters as of 2019. When reviewing the EA's 'objectives' data for the operational

⁵ Main river is defined by the EA as any watercourse that contributes significantly to the hydrology of a catchment

catchment, two of the waterbodies have an ecological objective of 'good' and one of 'moderate' and all three waterbodies have an objective of 'good' for their chemical status.

- 15.78** The part of the River Thames that flows adjacent to the site is located within the WFD 'Thames Middle Catchment' which has an overall ecological status of 'moderate' for water quality and a chemical quality rating of 'fail'.

Designations, Abstraction and Discharges

- 15.79** According to the Groundsure Report (**ES Volume 3, Appendix: Ground Conditions - Annex 2**), there are no licensed surface water abstractions within the site. There is one licensed surface water abstraction which is still active and this is located 55m north-east for mineral washing from the tidal River Thames at Swanscombe. This abstraction has an annual volume of 45,500m³ of surface water with a maximum daily volume of 375m³.

Human Health

- 15.80** There is the potential for existing contamination to be present within the soils, geology and controlled waters (hydrology and hydrogeology) on site, due to the previous (and current) land uses on site and within the surrounding area.
- 15.81** Due to the nature of the Proposed Development, demolition and construction workers will be involved directly within the groundworks.
- 15.82** Existing residential development is located less than 100m from the site and, therefore, adjacent site users are considered to be sensitive to potential windblown contaminative dust.
- 15.83** It is necessary to consider any introduced receptors once the Proposed Development is operational and, in this case, future site users and occupants will have access to residential gardens and public areas of soft landscaping. Considering that there is the potential for existing contamination to be present on site, the sensitivity of these receptors has been considered.
- 15.84** Any proposed planting on site could be exposed to potential existing contamination.
- 15.85** New residential and commercial infrastructure will be installed as part of the Proposed Development.

Conceptual Site Model

- 15.86** The Phase 1 Report includes an outline conceptual model based on the source-pathway-receptor approach described in CLR11 and this is summarised below:

Potential Contamination Sources

- 15.87** Following review of the baseline conditions, the main sources of contamination that have been identified at the site or in close proximity to the site are as follows:
- Historical contamination within the soils and groundwater on site has the potential to contain contaminants such as asbestos, heavy metals, radiation, PAHs, PCBs and other hydrocarbons;
 - Contamination as a result of existing industrial buildings and yards on site (including electricity substations, tanks, fuel stations), has the potential to contain contaminants such as asbestos, heavy metals, PAHs, PCBs and other hydrocarbons;
 - Potential for ground gas to be present on site due to significant historic ground workings on site which has the potential to cause elevated concentrations of carbon dioxide and methane;
 - Potential for UXO to be present on site; and
 - Historical and current contamination from off-site land uses include wharfs, factories and railway infrastructure, tanks, waste and landfill sites and substations which have the potential to contain contaminants such as heavy metals, other inorganic substances as well as a range of hydrocarbons and asbestos.

Potential Contamination Pathways

- 15.88** The principal potential contamination pathways identified, both within the site and surrounding area, that are considered relevant in relation to the site are as follows:
- Horizontal and vertical migration of contaminants within the permeable strata of the gravels (Secondary A Aquifer), and Chalk (Principal Aquifer) due to construction works (i.e. piling). It is assumed that piling

depths will penetrate to a maximum depth which could potentially penetrate below the gravels and into the underlying chalk;

- Migration of contaminants through surface water runoff to the surface waters either directly or via the drainage system;
- Migration of contaminants via leaching into subsoils;
- Demolition / construction workers and future site users and service staff coming into direct contact (dermal, ingestion and inhalation) with potentially contaminated soils or groundwater;
- Adjacent site users ingesting / inhaling potentially contaminated windblown dust during demolition/construction;
- Buildings and infrastructure being affected by an accumulation of ground gas;
- Potential for building materials and infrastructure, construction/demolition workers and adjacent site users (human health) to be exposed to UXO and potential leaching/pollution from existing UXO on soils, hydrogeology and hydrology;
- Construction workers, service repair workers and future site users coming into direct contact with accumulation of ground gases; and
- Plant uptake of contamination in soft landscaped and private garden areas.

RECEPTORS AND RECEPTOR SENSITIVITY

Existing Receptors

- 15.89** Table 15.4 identifies the existing receptors within and surrounding the site and defines their sensitivity to environmental impact.

Table 15.4 Existing Site Receptors and Sensitivity

Receptors		Sensitivity
Soils and Geology	Superficial Deposits (Made ground, Alluvium, Gravels)	High – from the assessment of baseline conditions at the site, it is concluded that there is the potential for contamination to be present within the superficial deposits underlying the site. The site is shown to be located within the <i>Gravesham Borough Council urban boundary/village confines and the Sub - Alluvial River Terrace Deposits</i> Mineral Safeguard Area
	Bedrock Geology (Chalk)	Medium – from the assessment of baseline conditions at the site, it is concluded that there is the potential for contamination to be present within the bedrock geology underlying the site.
	Soils (including planting)	Medium – from the assessment of baseline conditions at the site, it is concluded that there is the potential for contamination to be present in soils on the site.
Hydrology	Surface Water (Ebbsfleet, Robins Creek and River Thames)	High – The site is located within the 'Lower Medway Operational Catchment' which is made up of a total of three waterbodies, two of the waterbodies have an ecological objective of 'good' and one of 'moderate' and all three waterbodies have an objective of 'good' for their chemical status.
Hydrogeology	Groundwater (Gravels and chalk)	High – The northern half of the site is in the 'West Kent Darent and Cray Chalk' groundwater operational catchment and the southern half of the site in 'North Kent Medway Chalk' groundwater operational catchment, both of which had a have an objective of 'good' chemical status for 2027. It is also expected that there is shallow groundwater at the site and the site is also located within a SPZ 2.
Human Health	Demolition/Construction Workers	High – Demolition/construction workers will be involved directly in groundworks
	Adjacent Site Users	High – Adjacent site users are considered to be sensitive receptors to potentially windblown contaminated soils/dust.
Infrastructure	Infrastructure	High – There are buried services and infrastructure present on site.

Introduced

15.90 Table 15.5 below identifies the Proposed Development's introduced receptors and defines their sensitivity to potential impacts from the Proposed Development.

Table 15.5 Introduced Site Receptors and Sensitivity

Receptors		Sensitivity
Human health	Future Site Users	High – Future occupants will have access to residential gardens and public areas of soft landscaping.
	Service Maintenance Staff	High – Service staff will be exposed to potentially contaminated soils.
Proposed Planting	Proposed Landscaping Planting	High – Areas of soft landscaping, exposed soils and planting are proposed on site.
Infrastructure	Building Materials and Infrastructure	High – New residential and commercial infrastructure installed as part of the Proposed Development and new building foundations.

POTENTIAL EFFECTS

Demolition and Construction

15.91 During the demolition and construction works associated with the Proposed Development, there is the potential for following effects to occur with regards to ground conditions:

- Potential contamination from general construction-related activities;
- Potential remobilisation and creation of contaminant pathways via leaching and/or via migration to groundwater and the surface waters as a result of construction activities;
- Potential for building materials and infrastructure, construction/demolition workers and adjacent site users (human health) to be exposed to UXO and potential leaching/pollution from existing UXO on soils, hydrogeology and hydrology;
- Potential for demolition and construction workers and adjacent site users to be exposed to landfill/ground gas;
- Potential for demolition and construction workers coming into direct contact with contaminated soils and/or contaminated groundwater and/or surface water;
- Potential for off-site users and occupants inhaling, ingesting or coming into dermal contact with windblown contaminated dust; and
- Potential impact on minerals safeguarding beneath the site during the construction and operational phase of the Proposed Development.

15.92 These are discussed in more detail below.

Potential Contamination from General Construction Related Activities.

15.93 The operation of demolition/construction vehicles and general construction activities give rise to the potential for soils, superficial deposits (made ground, alluvium and gravels), bedrock geology (chalk), groundwater and the surface waters to become contaminated with both chemical contaminants such as hydrocarbons and chemicals and physical contaminants such as waste, silt and other construction materials. There is also the potential for the redistribution of contaminated material to other parts of the site via construction plant.

15.94 As discussed previously, groundwater is expected to be relatively shallow and located within the gravels and/or chalk underlying the site (likely within the first 3m bgl). Piling depths of the buildings will extend beyond 3m bgl (to a maximum depth of 30m) and therefore there is a risk of groundwater becoming contaminated from construction vehicles and activities.

15.95 The Ebbsfleet main river flows through the south-eastern extent of the site into Robins Creek and ultimately into the River Thames which is located along the north-eastern boundary of the site and is also classified as a 'main river'. There is a risk that both the River Ebbsfleet and the River Thames including Robin's Creek could

be exposed to contamination. This could arise from general construction-related activities as untreated surface water runoff and overland flow can directly enter the river or enter via existing site drainage infrastructure untreated. As well as this, contaminated soils and dust could remobilise and enter the watercourses via dust generation.

15.96 Assuming that there are no mitigation measures in place, the magnitude of impact of contamination arising from general construction-related activities is considered to be Moderate for soils (medium sensitivity), superficial deposits (high sensitivity) and bedrock geology (medium sensitivity), groundwater (high sensitivity) and the surface waters (River Thames, Robins Creek and Ebbsfleet) (high sensitivity). The scale of effect of contamination arising from general construction activities is therefore considered to be Minor to Moderate Adverse for soils and bedrock geology and Moderate to Major Adverse (Significant) for superficial deposits, groundwater and surface water.

15.97 The impact will be local in extent, temporary in duration, short-term and direct.

Potential Remobilisation and Creation of Contaminant Pathways via Leaching and/or via Migration to Surface Waters and Groundwater as a Result of Construction/ Demolition Activities

15.98 As established in the baseline section of this ES chapter, there is the potential for contamination to be present on site due to the historical (and current) industrial land uses that have occupied the site.

15.99 Construction and demolition works would disturb the ground at the site, from activities such as localised site levelling, excavation of foundations, piling and construction of drainage routes. All of these activities have the potential to remobilise existing contamination with the geology, soils and groundwater as well as create contamination pathways to groundwater and to the surface waters.

15.100 For the buildings on site, it is estimated that any piling is likely to penetrate through the made ground, Alluvium (Secondary Undifferentiated), Gravels (Secondary A) and into the underlying chalk (Principal Aquifer). Should the made ground or any of the underlying strata be contaminated, there is a risk of this contamination being remobilised to the underlying aquifers and via vertical migration could reach the surface waters.

15.101 During construction, the soils are more likely to be exposed and therefore there is a heightened risk that leaching of contaminants and/or infiltration of rainwater via the soils could remobilise any contaminants within the top soil and result in contamination of the underlying soils and aquifers.

15.102 When considering the above, it is concluded that the magnitude of impact for the potential remobilisation and creation of contaminant pathways to soils and groundwater via horizontal and/or vertical migration and leaching is considered to be moderate. As groundwater is a high sensitivity receptor, the scale of effect is considered to be Moderate to Major Adverse (Significant) for groundwater and Moderate Adverse (Significant) for soils (medium sensitivity).

15.103 The River Thames is located along the northern boundary of the site and the Ebbsfleet River runs along the eastern boundary of the site. Due to the close proximity of these hydrological features, there is the potential for contaminant pathways to be created to surface waters during activities such as the foundation excavation.

15.104 The magnitude of impact for the potential remobilisation and creation of contaminant pathways to the surface waters is considered to be major. As hydrology is a high sensitivity receptor, the scale of effect is considered to be Major Adverse (Significant) for hydrology.

15.105 The impacts of potential remobilisation and creation of contaminant pathways on both groundwater and the surface water will be at district level, temporary in duration, short-term and direct.

Potential for Building Materials and Infrastructure, Construction/Demolition Workers and Adjacent Site Users (human health) to be Exposed to UXO and Potential Leaching/Pollution from Existing UXO on Soils, Hydrogeology and Hydrology;

15.106 As detailed within the Phase 1 Report (ES Volume 3, Appendix: Ground Conditions - Annex 2) and in the baseline section above, the site is located within an area with a high risk of Unexploded Ordnance (UXO).

15.107 Any construction and demolition workers, adjacent site users and existing building material could become exposed to UXO during construction/demolition works and the potential severity of this could be fatal if not managed appropriately.

15.108 There is also a potential risk of pollution occurring should a UXO incident occur as well as potential leaching and pollution from the UXO into soil, groundwater and the surface waters.

- 15.109** Although not directly associated with UXO, there is a potential risk of the site being affected by licensed explosives as the development is located within the safeguarding zone of an HSE licensed explosives site at the Port of Tilbury which is located on the opposite side of the River Thames. If planning permission were granted, HSE may need to review the licence which may impact on the viability of the licensed explosives site. This could not only have an impact on the development site itself but also the Port of Tilbury's licensing.
- 15.110** Therefore, the magnitude of impact of the potential for UXO exposure to human health, building materials and infrastructure, soils, groundwater and surface water is considered to be major. As construction and demolition workers, adjacent site users, building materials and infrastructure, groundwater and surface waters are classified as high sensitivity receptors, the scale of the potential effect, should UXO be present, is considered to be Major Adverse (Significant).
- 15.111** Soils are classified as medium sensitivity receptors and therefore the scale of effect is considered to be Moderate to Major Adverse (Significant).
- 15.112** The impact will be local in extent, temporary in duration, short-term and direct.

Potential for Demolition and Construction Workers and Adjacent Site Users Being Exposed to Landfill/Ground Gas

- 15.113** There are 23 records of surface ground workings on site which relate to ponds, heaps, unspecified wharfs and ground workings taken from the historical mapping. This could result in a risk of ground gas being present on site.
- 15.114** Construction and demolition workers and adjacent site users could become exposed to ground gas during the re-levelling within the site and excavation of foundations. The potential severity of this could be fatal, if not managed appropriately.
- 15.115** As well as this, excavation of contaminated soils on site, could give rise to the creation of vapours and nuisance odours, having an adverse effect on construction/demolition workers.
- 15.116** Therefore, the magnitude of impact for the potential for ground gas contamination is considered to be major. As construction and demolition workers and adjacent site users are classified as a high sensitivity receptor, the scale of potential effect, should ground gas be present within the site, is considered to be Major Adverse (Significant).
- 15.117** The impact will be local in extent, temporary in duration, short-term and direct.

Potential for Demolition and Construction Workers Coming into Direct Contact with Contaminated Soils and/or Groundwater and/or Surface Water

- 15.118** As set out within the baseline conditions section of this ES chapter, there is the potential for contamination on-site; this is due to the presence of historic and current potentially contaminative land uses (such as railway infrastructure, garages, service stations, industrial land uses) which can be a source of a wide range of contaminants on site (e.g. asbestos, hydrocarbons and heavy metals).
- 15.119** There are also a number of potentially contaminative historic and current land uses surrounding the site which can be a source of a wide range of contaminants (i.e. general hydrocarbons, metals and PAHs).
- 15.120** During demolition and construction of the Proposed Development, workers will disturb the ground through works such as excavations for foundations, piling, site levelling and construction of services and drainage routes. This could result in workers inhaling, ingesting or coming into dermal contact with potentially contaminated soils and/or dust from off-site sources. Construction and demolition workers could also come in contact with potentially contaminated surface water and groundwater from both on-site and off-site sources. This exposure could result in an adverse effect on workers' health and well-being.
- 15.121** When there are no mitigation measures in place, the magnitude of impact for the potential for demolition and construction workers coming into direct contact with contaminated soils is considered to be a moderate. As construction/demolition workers are classified as a high sensitivity receptor, the scale of effect is considered to be Moderate to Major Adverse (Significant).
- 15.122** The impact will be local in extent, temporary in duration, short-term and direct.

Potential for Off-Site Users and Occupants Inhaling, Ingesting or Coming into Dermal Contact with Windblown Contaminated Dust

- 15.123** As detailed above, due to the historical and current land uses on site and within the surrounding area, it is considered likely that the site is contaminated with heavy metals, hydrocarbons and asbestos.

- 15.124** Potentially contaminated dust could be generated within the site if exposed during the demolition and construction works, particularly during dry and/or windy weather. Users (of occupied areas of the site), neighbouring uses, and the general public have the potential to be impacted by dust generation. Residential dwellings are located in close proximity to the site (<100 m) as well as a number of commercial and industrial land uses. Demolition and construction works will disturb the ground and off-site users could potentially inhale, ingest or come into dermal contact with potentially contaminative windblown contaminated dust.
- 15.125** When there are no mitigation measures in place, the magnitude of impact for the potential for offsite users coming into contact with windblown contaminated dust is considered to be a minor. As offsite users and occupants are classified as a high sensitivity receptor the scale of effect is considered to be Minor to Moderate Adverse (Significant).
- 15.126** The impact will be local in extent, temporary in duration, short-term and direct.

Potential Impact on Minerals Safeguarding Beneath the Site

- 15.127** Mineral Safeguarding Areas cover the known locations of specific mineral resources that are (or may in future be) of sufficient economic value to warrant protection for future generations.
- 15.128** As reported within the Groundsure reports and given the current land uses on site, there are two British pit records on in the northern extent of the site. These comprise of marine sand and gravel and crushed road and are both actively extracting mineral produce or, in the case of wharfs and rail depots, are actively handling minerals.
- 15.129** When reviewing the GBC Mineral Safeguarding Areas map which forms part of the Kent Minerals and Waste Local Plan, the site is located within the Gravesham Borough Council urban boundary/village confines and the Sub – Alluvial River Terrace Deposits Mineral safeguard area. As reported in the Minerals Infrastructure Assessment submitted with the planning application, Kent County Council has confirmed that a mineral resource assessment is not required. Given the current urban nature of the proposed development site, safeguarded minerals have been addressed in the Planning Statement rather than in a separate report on the basis that the site's location within the designated Urban Area nullifies the designation.
- 15.130** The proposed mixed use non-mineral development would comprise of the demolition of all buildings and structures within the redline boundary. Consequently, this would include the loss of the safeguarded wharf and all of the associated minerals-related activity, readymix concrete and asphalt plants. However, in accordance with Policy DM 8, a proposal for non-minerals development resulting in the loss of the safeguarded facility has been considered against Criterion 6 and 7 of Policy DM8, although it is noted that only one of these criteria needs to be met. Given that there appears to be sufficient capacity across Kent's other safeguarded wharves, the potential benefits of the proposed development indicate that the need for development overrides the presumption for safeguarding and in such circumstances any redevelopment of the site would accord with policy.
- 15.131** Based on the conclusions of the Minerals Infrastructure Assessment, the magnitude of impact for the potential impact on minerals safeguarding beneath the site on the underlying geology is considered to be Negligible. As superficial geology is classified as a high sensitivity receptor the scale of effect is considered to be Negligible and no mitigation measures are required (Not Significant).

Completed Development

- 15.132** During the operation phase of the Proposed Development, there is the potential for the following effects to occur with regards to ground conditions:
- Potential contamination from routine site operations and/or accidental releases;
 - Potential effects of existing ground conditions or any residual contaminants on building materials and infrastructure for the Proposed Development;
 - Potential landfill/ground gas generation;
 - Potential for future site users and proposed planting coming into direct contact with contaminated soils and groundwater; and
 - Potential for services maintenance staff coming into direct contact with contaminated soils.
- 15.133** These are discussed in more detail below.

Potential Contamination from Routine Site Operation and / or Accidental Releases

- 15.134** The Proposed Development could have the potential to contaminate soil, superficial deposits (made ground, Alluvium and Gravels), bedrock geology (chalk), groundwater and surface waters (River Thames, Robins Creek and Ebbsfleet) from a number of sources. The range of potential contaminants present within the site will vary dependent on the land use proposed. The site will be utilised for residential and commercial land uses and, as such, the typical range of potential contaminants will be limited to hydrocarbons (from vehicles), as well as small quantities of general household and cleaning chemicals.
- 15.135** The majority of maintenance chemicals are likely to be stored internally and, as such, would be contained within the foul drainage system and would not affect the underlying soils or geology.
- 15.136** The Proposed Development includes areas of exposed soils such as landscaping and residential amenity spaces; clean soils will be used within these areas to ensure there are no adverse effects on sensitive receptors. However, there is the potential for soil and superficial deposits and bedrock geology to become contaminated from routine site operation and/or accidental releases. There is the potential for surface waters to become contaminated as a result of untreated runoff entering site drainage or via overland flow. Should potentially contaminated surface water infiltrate into the ground within areas of exposed soils on site, then there is a risk that groundwater could become contaminated.
- 15.137** Based on the above, the magnitude of impact is considered to be Moderate for soils (medium sensitivity), superficial deposits (high sensitivity), bedrock geology soils (medium sensitivity) and groundwater (high sensitivity). Therefore, the effect is considered to be Minor to Moderate Adverse (Significant) for soils and bedrock geology and is Moderate to Major Adverse (Significant) for superficial deposits, groundwater and surface waters.
- 15.138** The impact will be local in extent, permanent in duration, long-term and direct.

Potential Effects of Existing Ground Conditions or any Residual Contaminants on Building Materials and Infrastructure for the Proposed Development

- 15.139** As established within the baseline section of this ES chapter, there is risk of historic contamination of the site due to previous land uses. Therefore, the risk of existing ground contamination potentially affecting existing and introduced below-ground structures such as concrete foundations, sheet piles or service pipelines cannot be ruled out. If present, organic contaminants have the potential to permeate into water supplies and sulphate minerals can impact buried concrete.
- 15.140** Therefore, the magnitude of impact of existing ground conditions or residual contaminants on infrastructure and building materials is considered to be minor. As infrastructure is a high sensitivity receptor, the effect is Minor to Moderate Adverse (Significant)
- 15.141** The impact will be local in extent, permanent in duration, long-term and direct.

Potential Landfill/Ground Gas Generation

- 15.142** There are 23 records of surface ground workings on site which relate to ponds, heaps, unspecified wharfs and ground workings taken from the historical mapping. This could result in a risk of ground gas being present on site.
- 15.143** There are no basements proposed on site, in a worst-case scenario there is the possibility of ground gas accumulating within the ground floors of the buildings and this could cause a potential explosion risk which could cause damage to infrastructure. Ground gas accumulation could also adversely affect occupants and future site users and in the worst case could be fatal, particularly within confined spaces.
- 15.144** Therefore, the magnitude of impact of the potential for ground gas contamination is considered to be major. As human health and infrastructure are high sensitivity, the scale of effect is considered to be Major Adverse (Significant) for human health and infrastructure.
- 15.145** The impact will be local in extent, permanent in duration, long-term and direct.

Potential Future Site Users and Proposed Planting Coming into Direct Contact with Contaminated Soils and Groundwater

- 15.146** There is the potential for the soils and groundwater to be contaminated with various contaminants such as hydrocarbons, metals and asbestos. The Proposed Development includes residential amenity and play areas and landscaped areas at ground level for future site users and includes the addition of trees and proposed

planting. Future site users such as occupants of the dwellings, could be exposed to contaminants via dermal contact, inhalation, ingestion of soil and soil dust within the areas of public open space and play areas.

- 15.147** Any contaminated soils or groundwater could also have an effect on any proposed planting and landscaping via plant uptake.
- 15.148** Therefore, the magnitude of impact of the potential for future site users and proposed planting coming into direct contact with contaminated soils and or groundwater is considered to be moderate. Future site users and proposed planting are considered to be a highly sensitive receptor and therefore the scale of effect is considered to be Moderate to Major Adverse (Significant).
- 15.149** The impact will be local in extent, permanent in duration, medium-term and direct.

Potential for Services/Maintenance Staff Coming into Direct Contact with Contaminated Soils and Groundwater.

- 15.150** As stated above, there is the potential for the soils and groundwater to be contaminated with various contaminants such as hydrocarbons, metals and asbestos. Services maintenance staff handling soils when installing or working on buried services could be exposed to potential contaminants within the soil.
- 15.151** Therefore, the magnitude of impact of the potential for services maintenance workers coming into direct contact with contaminated soils is considered to be minor. Service maintenance staff are considered to have a high sensitivity and therefore, the scale of effect is considered to be Minor to Moderate Adverse (Significant).
- 15.152** The impact will be local in extent, permanent in duration, medium-term and direct.

MITIGATION, MONITORING AND RESIDUAL EFFECTS

- 15.153** This section discusses mitigation and any relevant monitoring requirements for the potential adverse effects identified within this ES chapter.

Demolition and Construction Mitigation

Potential Contamination from General Construction Related Activities

- 15.154** As discussed in the potential effects section of this ES chapter, there is the potential for a Minor to Moderate Adverse (significant) effect on soils and bedrock geology and a Moderate to Major Adverse effect on superficial deposits, groundwater and surface waters as a result of the potential contamination from general construction-related activities.
- 15.155** A Construction Environment Management Plan (CEMP) will be implemented and will include the following standard measures to ensure there are no adverse impacts on the environment as a result of the demolition and construction phase of the Proposed Development:
- Proper maintenance of demolition/construction vehicles in accordance with good site practices to reduce the risk of hydrocarbon contamination and will only be active when required;
 - Construction materials will be stored, handled and managed with due regard to the sensitivity of the local aquatic environment and thus the risk of accidental spillage or release will be minimised;
 - Any existing debris located within the area of the proposed works would be removed before the start of construction and after completion of the proposed works;
 - Any excavated material or spoil stored on site will be located within an area surrounded by a bund to ensure that, should a heavy rainfall event occur, then there will be no risk of soil washout entering the river via a surface water flow pathway;
 - In accordance with the Control of Pollution (Oil Storage) (England) Regulations 2001, any tanks storing more than 200 litres of oil will have secondary bunding and any above ground storage tanks will be located on a designated area of hardstanding;
 - Oil interceptors will be regularly inspected, cleaned and maintained. Full records will be kept of inspections, maintenance works and measures undertaken to sustain equipment performance. These provisions should ensure no significant impacts occur on water quality. The use of settlement facilities will aid the removal of any contaminated particulate material that might be derived from construction materials;

- The construction drainage system will be designed and managed to comply with BS6031:2009 'The British Standard Code of Practice for Earthworks', which details methods that should be considered for the general control of drainage on construction sites. Further advice is contained within the British Standard Code of Practice for Foundations (BS8004: 2015);
 - The risk of redistributing any potential contamination around the site (i.e. from residual soil contamination or similar on construction vehicles) will be minimised by designating clean and dirty work areas to prevent cross-contamination;
 - Vehicles and equipment will be washed down in specially designated areas and ensuring that areas of hard standing at access and egress points are cleaned at appropriate intervals and wash off into the ground or surface waters is prevented;
 - Good site working practices for construction and maintenance workers will be enforced such that impacts from potential contamination are minimised. The contractor on site will be responsible for implementing these requirements. This will include requiring the use of appropriate Personal Protective Equipment (PPE) and provision of welfare facilities to assist in maintaining good hygiene levels with segregation of certain activities (such as eating and drinking) from the designated dirty areas; and
 - Dust suppression measures will be outlined within the CEMP such as ensuring sand and other aggregates are stored in bunded area and, where possible, not allowed to dry out, avoid dry sweeping of large areas and ensure surfacing equipment is only operated with any manufacturer's dust measurements in place.
- 15.156** The CEMP will be controlled by a suitably worded planning condition. An Outline CEMP has been submitted in support of the planning application (**ES Volume 3, Appendix: Demolition and Construction – Annex 1**), whereby the future detailed CEMP(s) will need to adhere with the framework principles outlined within this Outline CEMP, as set out in **ES Volume 1, Chapter 5: Demolition and Construction**.
- 15.157** With these mitigation measures in place, it is considered that the residual effect would be **Negligible (Not Significant)** on the soils, superficial deposits, bedrock geology, surface waters, groundwater and soils.
- Potential Remobilisation and Creation of Contaminant Pathways via Leaching and/or via Migration to surface water and groundwater as a Result of Construction/ Demolition activities*
- 15.158** As discussed in the potential effects section of this ES chapter, there is the potential for a Moderate to Major Adverse (Significant) effect on groundwater, a Moderate Adverse (Significant) effect for soils and a Major Adverse (Significant) effect for hydrology as a result of the potential remobilisation and creation of contaminant pathways.
- 15.159** In order to verify contamination conditions on site, a comprehensive intrusive investigation will be undertaken on site and recommendations will be provided based on the analysis of results. This will be secured by a suitably worded planning condition attached to any planning consent and will assist in deriving the final risk assessment for the site which will identify if there any specific remediation or mitigation measures required to be implemented. Intrusive site investigation could not have been completed to support the planning application due to the busy operational nature of the existing site.
- 15.160** A strategy for dealing with any contamination identified and information will be prepared and agreed with GBC. The remediation and/or mitigation strategy and verification report will also be prepared and agreed. It is considered that it will be possible to eliminate or minimise all significant pollutant linkages to an acceptable level with appropriate remediation and control measures (such as capping of contaminated soils).
- 15.161** An appropriate foundation works risk assessment including a piling method statement will be prepared to inform the foundation design for the various elements of the Proposed Development and an appropriate quality assurance and control regime would be implemented. This would ensure that the contamination source or pathway (or both) would be removed. The piling method statement will ensure that all infrastructure, including below ground utility services, are considered within the piling method statement. It is proposed that the remediation and/or mitigation strategy, verification report and foundations works risk assessment will be dealt with via a suitably worded planning condition.
- 15.162** If, during the demolition and construction works, unexpected contamination is encountered then GBC will be notified and no further development will be carried out until an addendum to the remediation implementation and verification method statement has been submitted to and approved in writing by the GBC.
- 15.163** Any imported material required for the construction of the Proposed Development will undergo verification testing prior to being used on site to ensure that it is suitable quality.
- 15.164** With these mitigation measures in place, the residual effect has been assessed as **Negligible (Not Significant)** on the surface water, groundwater and soils.
- 15.165** If contamination is found on site following the intrusive site investigations and remediated to meet appropriate land use criteria, then this would give rise to a **Minor Beneficial (Significant)** effect when compared to the existing site use on soils, groundwater and surface water.
- Potential for Building Materials and Construction/Demolition Workers and Adjacent Site Users to be Exposed to UXO and Potential Leaching/Pollution from Existing UXO*
- 15.166** As discussed in the potential effects section of this ES chapter, there is the potential for a Major Adverse (Significant) effect on construction and demolition workers, adjacent site users, building materials and infrastructure, groundwater and surface waters as a result of the potential for UXO exposure and a Moderate to Major Adverse (Significant) effect for soils as a result of the potential for UXO exposure.
- 15.167** A UXO survey will be undertaken prior to any excavation works to define the level or risk and recommend appropriate mitigation measures. This will be secured by a suitably worded planning condition attached to any planning consent. This will be undertaken by a UXO specialist prior to any works being undertaken at the site. Should any UXO be identified, then this will be removed by a suitably qualified contractor.
- 15.168** Should any UXO be identified on site, then the immediate area surrounding the UXO will be tested for potential leaching and/or pollution and from here a remediation strategy will be prepared, agreed and employed prior to any further works on site.
- 15.169** It is confirmed that the applicant will consult with the Port of Tilbury licence holder in reference to the HSE licensed explosive sites to ensure any potential impact on the licence with HSE is reduced and mitigated where reasonable to do so.
- 15.170** With these mitigation measures in place, the residual effect on construction and demolition workers (human health), building materials and infrastructure and on soils, hydrology and hydrogeology has been assessed as **Negligible (Not Significant)**.
- Potential for Demolition and Construction Workers and Adjacent Site Users Being Exposed to Landfill/Ground Gas*
- 15.171** As discussed in the potential effects section of this ES chapter, there is the potential for a Major Adverse (Significant) effect on construction and demolition workers and adjacent site users as a result of the potential for ground gas contamination.
- 15.172** Ground gas monitoring will be included within the intrusive investigations that will be undertaken prior to the demolition and construction phase of the Proposed Development. Following this, a Gas Risk Assessment will be prepared and agreed with GBC and, if necessary, a ground gas mitigation strategy will be prepared, agreed and employed as recommended by the CIRIA Report 665⁶ 'Assessing risks posed by hazardous ground gases in buildings' (commercial land uses) and the National House Builders Council (NHBC) 'Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present' (residential uses). This will be secured via a suitably worded planning condition attached to any planning consent.
- 15.173** With these mitigation measures in place, it is considered that the residual effect on construction/demolition workers and adjacent site users has been assessed as **Negligible (Not Significant)**.
- Potential for Demolition and Construction Workers Coming into Direct Contact with Contaminated Soils and/or Groundwater and/or Surface Water*
- 15.174** As discussed in the potential effects section of this ES chapter, there is the potential for a Moderate to Major Adverse (Significant) effect on construction and demolition workers coming into direct contact with contaminated soils.

⁶ CIRIA. Assessing risks posed by hazardous ground gases to buildings (C665D)

- 15.175** The intrusive investigation will include a final risk assessment for the site to identify if there are any significant pollutant linkages that will require specific remediation or mitigation measures to be implemented prior to the commencement of construction works.
- 15.176** The findings of the site investigation will then be reported to GBC and a strategy for dealing with any contamination identified will be prepared and agreed. The methodologies for the remediation or mitigation of potential contamination that may be present are well understood and, therefore, it is considered that it will be possible to eliminate or minimise all significant pollutant linkages to an acceptable level with appropriate remediation and control measures prior to construction. Should a remedial strategy be implemented, a verification process (verification plans and reporting to GBC and the EA) will be undertaken to confirm that the strategy has remediated the soils to a level acceptable for the intended end use of the site (based on site specific criteria).
- 15.177** Any asbestos-containing materials will be managed in accordance with The Control of Asbestos Regulations (2012)⁷ which will prevent cross contamination of site soils during any demolition and construction works and protect workers from exposure to asbestos. Where required, materials would be handled by a specialist contractor.
- 15.178** With these mitigation measures in place, it is considered that the residual effect has been assessed as **Negligible (Not Significant)**.

Potential for Off-Site Users and Occupants Inhaling, Ingesting or Coming into Dermal Contact with Windblown Contaminated Dust

- 15.179** As discussed in the potential effects section of this ES chapter, there is the potential for a Minor to Moderate Adverse (Significant) effect on infrastructure and building materials as a result of existing ground conditions or residual contaminants.
- 15.180** Dust suppression measures will be outlined within the CEMP such as ensuring sand and other aggregates are stored in bunded areas and, where possible, not allowed to dry out, avoid dry sweeping of large areas and ensure surfacing equipment is only operated with any manufacturer's dust measurements in place.
- 15.181** With these mitigation measures in place, the residual effect has been assessed as **Negligible (Not Significant)**.

Completed Development Mitigation

Potential Contamination from Routine Site Operation and / or Accidental Releases

- 15.182** As discussed in the potential effects section of this ES chapter, there is the potential for a Minor to Moderate Adverse (Significant) effect on soils and bedrock geology and a Moderate to Major Adverse (Significant) effect on superficial deposits, groundwater and surface water as a result of contamination from routine site operation and accidental releases.
- 15.183** A suitable surface water drainage strategy has been submitted for the Proposed Development (**ES Volume 3, Appendix: Water Resources, Flood Risk, Drainage and Ground Conditions - Annex 3**) which will control and treat any runoff prior to its discharge.
- 15.184** It is considered that infiltration-based SuDS features would not be appropriate for this site and this would be determined through testing at the detailed design stage. The surface water drainage strategy proposes sub-catchments A and B will have a pumped discharge into Robin's Creek and sub-catchment C will drain via gravity into Robins Creek via a swale. The proposed SuDS features will include rainwater harvesting, low-profile attenuation tanks, green roofs and profiled park areas.
- 15.185** One of the guiding principles of SuDS is the appropriate management of water quality and the use of pollution prevention techniques to improve the quality of runoff from developed sites. The SuDS Manual recommends the use of a management train whereby a series of consecutive treatment stages are employed to remove pollutants from runoff.
- 15.186** The recommended number of treatment stages is dependent on the type of development and sensitivity of the discharge receptor and the mitigation indices of proposed SuDS features. Surface water requiring treatment will come from the roofs, access road, driveways and parking areas. In this instance, mitigation with an index or combined indices of more than 0.7 for Total Suspended Solids (TSS), 0.6 for metals and 0.7 for hydrocarbons

is acceptable (refer to Appendix G of **ES Volume 3, Appendix: Water Resources, Flood Risk, Drainage and Ground Conditions - Annex 3**).

- 15.187** The permeable paving, tree pits and swales will meet the water quality requirements required for the Proposed Development.
- 15.188** With these mitigation measures in place, it is considered that the residual effect will be **Negligible (Not Significant)**.
- 15.189** By providing water quality treatment to the surface water runoff, the magnitude of impact on hydrology (River Thames) is Negligible to Minor Beneficial and therefore the effect has been assessed as **Negligible to Minor Beneficial (Not Significant to Significant)** on surface waters (a high sensitivity receptor) when compared to the existing surface water treatment regime.

Potential Effects of Existing Ground Conditions or any Residual Contaminants on Building Materials and Infrastructure for the Proposed Development.

- 15.190** As discussed in the potential effects section of this ES chapter, there is the potential for a Minor to Moderate Adverse (Significant) effect on infrastructure and building materials as a result of existing ground conditions or residual contaminants.
- 15.191** The intrusive investigation that will be undertaken prior to any works on the site will be assessed with regard to any potential contaminants on site (i.e. hydrocarbons, pH and water-soluble sulphate) which could affect building materials or buried services. The results of this will then allow the determination of the appropriate concrete class in accordance with BRE Special Digest 1 (2003).
- 15.192** For the majority of the site, Polyvinyl Chloride (PVC) or Polyethylene (PE) plastic water supply pipes are likely to be suitable. This will be confirmed with the appropriate water supplier prior to installation of the potable network infrastructure. Where any pollutant linkages are identified, remediation, avoidance or the use of other appropriate materials will be implemented.
- 15.193** With these mitigation measures in place, the residual effects has been assessed as **Negligible (Not Significant)**.

Potential Landfill/Ground Gas Generation

- 15.194** As discussed in the potential effects section of this ES chapter, there is the potential for a Major Adverse (Significant) effect on human health and infrastructure as a result of potential for ground gas contamination.
- 15.195** Gas monitoring will be undertaken prior to any demolition and construction works and following this, a Gas Risk Assessment will be prepared and agreed with the GBC and, if necessary, a ground gas mitigation strategy will be prepared, agreed and employed as recommended by the CIRIA Report 665 'Assessing risks posed by hazardous ground gases in buildings' (commercial land uses) and the National House Builders Council (NHBC) 'Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present' (residential uses). This will be secured via a suitably worded planning condition attached to any planning consent.
- 15.196** With these mitigation measures in place, the residual effect has been assessed as **Negligible (Not Significant)**.

Potential for Future Site Users and Proposed Planting Coming into Direct Contact with Contaminated Soils and Groundwater.

- 15.197** As discussed in the potential effects section of this ES chapter, there is the potential for a Moderate to Major Adverse (Significant) effect on future site users and proposed planting coming into direct contact with contaminated soils and or groundwater.
- 15.198** The findings of the intrusive investigation will be reported to GBC and a remediation and/or mitigation strategy and verification report will be prepared and agreed. The investigation will include the areas proposed as exposed soils to confirm that soil quality is appropriate for end users.
- 15.199** The intrusive investigation results will also be assessed in relation to the proposed planting on site to ensure the ground conditions are suitable. Where necessary, planting and trees will be planted in above ground planters and using clean soils.

⁷ Control of Asbestos Regulations (2012). Available at: <https://www.legislation.gov.uk/uksi/2012/632/contents/made>

15.200 With these mitigation measures in place, the residual effect has been assessed as **Negligible (Not Significant)**.

Potential for Services Maintenance Staff Coming into Direct Contact with Contaminated Soils

15.201 As discussed in the potential effects section of this ES chapter, there is the potential for a Minor to Moderate Adverse (Significant) effect on services maintenance workers coming into direct contact with contaminated soils.

15.202 As above, the findings of the intrusive investigation and remediation and/or mitigation strategy and verification report will be prepared and agreed. The investigation will include the areas proposed as exposed soils (Riverside Park) to confirm that soil quality is appropriate for end users.

15.203 There will also be the implementation of good site working practices for maintenance workers as part of employer/company health and safety responsibilities. With this implemented, it will ensure that impacts from potential contamination are minimised. This will include the use of appropriate Personal Protective Equipment (PPE) and any buried services will be constructed in corridors of clean material such that any future maintenance would be undertaken in clean soils, where possible.

15.204 With these mitigation measures in place, the residual effect has been assessed as **Negligible (Not Significant)**.

RESIDUAL EFFECTS

15.205 All of the residual effects resulting from the Proposed Development, are presented in **Table 15.6**, identifying whether the effect is significant or not.

Table 15.6: Residual Effects

Receptor	Description of the Residual Effect	Scale and Nature	Significant / Not Significant	Geo	D I	P T	St Mt Lt
Demolition and Construction							
Soils	Potential Contamination from General Construction Activities	Negligible	Not Significant	L	D	T	St
Superficial Deposits							
Bedrock Geology							
Groundwater							
Surface water							
Groundwater	Remobilisation and creation of contaminant pathways via Leaching and/or via Migration to surface water and Groundwater as a Result of Construction/ Demolition activities	Negligible (Potentially Minor Beneficial following remediation)	Not Significant (Significant)	L	D	T	St
Surface water							
Human Health (construction workers and adjacent site users)	Potential for Building Materials and Construction/Demolition Workers and Adjacent Site Users to be Exposed to UXO and Potential Leaching/Pollution from Existing UXO	Negligible	Not Significant	L	D	T	St
Building Materials and Infrastructure							
Soils							
Groundwater							
Surface Water							
Human Health (construction workers and adjacent site users)	Potential for Demolition and Construction Workers and Adjacent Site Users Being Exposed to Landfill/Ground Gas	Negligible	Not Significant	L	D	T	St

Receptor	Description of the Residual Effect	Scale and Nature	Significant / Not Significant	Geo	D I	P T	St Mt Lt
Human Health (construction workers)	Potential for Demolition and Construction Workers Coming into Direct Contact with Contaminated Soils and/or Groundwater and/or Surface Water	Negligible	Not Significant	L	D	T	St
Human Health (adjacent site users)	Potential for Off-Site Users and Occupants Inhaling, Ingesting or Coming into Dermal Contact with Windblown Contaminated Dust	Negligible	Not Significant	L	D	T	St
Superficial Deposits	Potential Impact on Minerals Safeguarding Beneath the Site	Negligible	Not Significant	L	D	T	St
Completed Development							
Soils	Potential Contamination from Routine Site Operation	Negligible	Not Significant	L	D	P	Lt
Superficial Deposits							
Bedrock Geology							
Groundwater		Negligible to Minor Beneficial	Not Significant - Significant	L	D	P	Lt
Surface Water							
Building Materials and Infrastructure	Effects of Existing Ground Conditions on Construction Materials for the Proposed Development	Negligible	Not Significant	L	D	P	Lt
Human Health (future site users)	Ground Gas Generation	Negligible	Not Significant	L	D	P	Lt
Building Materials Infrastructure							
Human Health (future site users)	Future Site Users and Planting Coming into Direct Contact with Contamination	Negligible	Not Significant	L	D	P	Lt
Proposed Planting							
Human Health (service staff)	Services Maintenance Staff Coming into Direct Contact with Contamination	Negligible	Not Significant	L	D	P	Lt
Notes: Residual Effect Scale = Negligible / Minor / Moderate / Major Nature = Beneficial or Adverse Geo (Geographic Extent) = Local (L), Borough (B), Regional (R), National (N) D = Direct / I = Indirect P = Permanent / T = Temporary St = Short Term / Mt = Medium Term / Lt = Long Term N/A = not applicable / not assessed							

ASSESSMENT OF THE FUTURE ENVIRONMENT

Evolution of the Baseline

15.206 If all other cumulative schemes as identified in **ES Volume 1, Chapter 2: EIA Methodology** came forward in the absence of the Proposed Development, then it is considered that this would have a minor beneficial impact on the surrounding area baseline conditions and a negligible impact on the site. If nearby cumulative sites are

remediated and free from contamination, this would result in a negligible risk of remobilisation of contamination from off-site sources to the site itself.

Cumulative Effects Assessment

- 15.207** As set out in **ES Volume 1, Chapter 2: EIA Methodology**, the cumulative effects assessment considers the potential for cumulative effects to arise as a result of the Proposed Development in-combination with the defined 'Tier 1' (schemes which meet the defined criteria with regards to scale and distance from the site and have full planning consent, a resolution to grant consent, or have been submitted but not yet consented where considered appropriate) and 'Tier 2' (major planning applications and decisions which have not yet been submitted for approval, and are at varying stages in the pre-application stage) cumulative schemes.
- 15.208** The cumulative schemes described in **ES Volume 1, Chapter 2: EIA Methodology** have been considered within the assessment of cumulative effects.
- 15.209** The potential for contamination and associated risks and effects at individual development sites would be identified by the applicants of all cumulative schemes to ensure that each development would be 'suitable for use' in accordance with the mandatory legislative requirements of Part IIA of the Environmental Protection Act, 1990 and associated planning conditions.
- 15.210** Sites where contamination may be present will be required to undertake intrusive investigation and risk assessment and it is likely that the relevant planning authority would require a site-specific CEMP, to avoid detrimental effects to sensitive receptors. Where significant pollutant linkages are identified for the site or other local cumulative schemes, a subsequent remediation strategy and verification plan will be required. Therefore, it can be considered in some cases that the implementation of a remediation strategy within sites with contamination could result in a minor beneficial impact on ground conditions.
- 15.211** In terms of water quality, new or cumulative schemes will have to incorporate appropriate pollution control measures to protect the underlying groundwater and/or local surface waters through planning conditions enforced by the GBC (and other relevant local planning authorities) and/or discharge consents enforced by the EA.
- 15.212** As all new developments are required to meet these criteria; the cumulative impact of site-specific remediation will improve general ground conditions at the local scale, leading to a **Negligible to Minor Beneficial (Significant)** effect.

LIKELY SIGNIFICANT EFFECTS

- 15.213** Following the implementation of the mitigation measures set out in this ES chapter, it is considered that there are no significant adverse effects resulting from the Proposed Development on ground conditions, including water quality.
- 15.214** There is the potential that a **Minor Beneficial (Significant)** effect could arise as a result of the Proposed Development, should the site investigation determine existing contamination on site, this will be remediated and therefore provide a beneficial impact when compared to the existing site conditions. Similarly, providing an appropriate Surface Water Drainage Strategy to treat surface water runoff will result in a Negligible to **Minor Beneficial (Significant)** effect on hydrology when compared to the existing surface water treatment regime.
- 15.215** There are no additional or new significant effects resulting from the Proposed Development in combination with the relevant cumulative schemes.