Conceptual Site Model and Environmental Setting and Site Design

Deposit for Recovery

EPR/VP3821SV

The Wave London

Meridian Way, Enfield

N9 0AR

The Wave London Ltd

2309 R02: Issue 1

April 2025

GEMCO

Green Earth Management Co Ltd

Title	Environmental Setting and Site Design, The Wave London EPR/VP3821SV
Prepared for	The Wave London Ltd Main Road Easter Compton Bristol BS35 5RE
Confidentiality, copyright and reproduction	Commercially Confidential This document has been prepared by Green Earth Management Company Ltd in connection with a contract to supply goods and/or services and is submitted only on the basis of strict confidentiality. The contents must not be disclosed to third parties other than in accordance with the terms of the contract.
File reference	2309
Report number	R02 ESSD Issue 1
Date	28th April 2025
Prepared by	Green Earth Management Company Limited Suite 3 Broomfield Park Coggeshall Road Earls Colne Essex CO6 2JX

	Name	Signature	Date
Author:	**C. Unsworth**	Charles Unsworth	28th April 2025
Reviewer:	**D. Robson**	Diane Robson	28th April 2025
Authorised by:	**D. Robson**	Diane Robson	28th April 2025

Issue Record						
Project No	2309					
Project Name	The Wave, London					
Client	The Wave London Ltd					
EA Reference	EPR/VP3821SV					
Report Title	Conceptual Site Model and Environmental Setting and Site Design Report					
Report No.	**Author**	**Reviewer**	**Date of Issue**	**Issue No.**	**Details of Changes**	**Distribution**
R02	CU	DR	28/4/2025	1	First Issue	The Wave London; Environment Agency

CONTENTS

REPORT TABLES

FIGURES AND APPENDICES

1 INTRODUCTION

1.1. Report Context

Green Earth Management Company Limited (GEMCO) was commissioned by The Wave London Ltd (the Client) to prepare an environmental permit application (the Application, EA reference is EPR/VP3821SV) to support the redevelopment and construction of an outdoor artificial surfing lake and associated amenity and infrastructure.

As part of the Application, it is necessary to compile an Environmental Setting and Site Design (ESSD) report in accordance with current Environment Agency guidance available via the www.gov.uk website.

This report conceptualises the Site in terms of the potential source pathway and receptors relationships to identify the various risk assessments required to support the Application and subsequent operations. These risk assessments and relevant engineering and environmental controls are presented in the relevant sections below

A hydrogeological risk assessment (HRA) and environmental risk assessment (ERA) have also been carried out in accordance with the guidance.

A masterplan of the current proposal is presented at Appendix 1.

1.2. Proposed Development

The Wave London have been involved in pre-application discussions with the London Borough of Enfield (LBE), the Greater London Authority and other key stakeholders which are at an advanced stage. The planning application will be for the following: -

Redevelopment of existing golf course and construction of a surfing complex comprising:

(1) Outdoor surf lake (Use Class F2);
(2) two-storey clubhouse including terraces, with café, surf shop, health and well-being facilities, changing facilities, offices (Use Class E), surfing operations and solar panels;
(3) external plant, machine and store rooms structures for surf generation (Sui Generis);
(4) renewal and alteration of existing campsite and the provision of additional accommodation and ancillary buildings (Sui Generis) with communal space;
(5) use of land for pop up temporary outdoor events, with associated temporary structures;
(6) free standing shelter with viewing deck;
(7) engineering works including mounding and bunds;
(8) public park, view point structure, pavilion and external play areas;
(9)Pop up seasonal structures;
(10) leisure facilities involving a pump track, skate bowl, sports courts, skate routes and external play areas; and
(11) associated soft and hard landscaping, boundaries, lighting, flood lighting, parking and access routes.

Submission is scheduled for Spring 2025.

1.3. Proposed Waste Recovery/Developmental Operations

The construction of the surf lake, ancillary buildings and associated landforms requires excavation within the former permit boundary to create the lake and placement of soils to form the required land profile and levels associated with the remaining areas of the development, including the mounds, bunds and construction platforms. A earthworks cut & fill exercise is required to engineer and reprofile the Application Site to the required levels for construction (Item 7 above) .

The Site comprises an historic landfill former infilled land and therefore a waste recovery operation/permit is required to permit the re-use of waste materials in the permanent works.

A Waste Recovery Plan (*Ref. GEMCO 2309 R01 WRP Issue 2, dated 10th March 2025*) has been submitted and agreed with the Environment Agency 11th March 2025.

1.3.1. Cut & Fill and Volumes

Overall, on the basis of the proposed earthworks (top of proposed surf lake at 15.75mAOD), presented at Appendix 2, the cut volume is to be 35,631m^3, with an estimated 4,401m^3 loss of material from removal of hazardous waste (876m^3) for disposal, or segregation of hardcore for recycling as aggregate (3525m^3).

The fill volume required is 31,800m^3, therefore the Mass Balance is a deficit of 570m^3.

It is important to note that no excavation or placement of waste or recovered material is proposed within/below the groundwater as part of the recovery operations.

The estimated total volume of the entire waste deposit is in the order of 1,500,000m^3. The total cut volume (roughly 36,000m^3) represents about 2.4% of the total volume of the deposit, and therefore is considered unlikely to substantially affect the overall Site condition.

1.4. References, Previous Reports, and Guidance

This ESSD has been produced in conjunction with available data as presented in the reports listed in Section 7 (by Norwest Holt, R.1, Hydrock, R.2 and R.3, and GEMCO, R.4 and R.5), plus Environment Agency Guidance (also listed at Section 7). In particular:

- Landfill operators: environmental permits: What to include in your environmental setting and site design report (R.6);
- Landfill operators: environmental permits, Plan the environmental setting of your site (R.7);
- Waste recovery plans and deposit for recovery permits (R.8); and
- Waste Classification Technical Guidance (R.8).

In addition:

- The Waste Framework Directive, 2008/98/EC (2018/851), Article 3 and Annex II (R.13); and
- Department for the Environment Food and Rural Affairs Waste Hierarchy Guidance (R.14).

With regards to Section 2, further detail can be found in the GEMCO HRA, reference 2309 R04, Issue 1. (R.4).

2 SITE SETTING

2.1. Location and Access

The Site (also referred to as the Application Site) is located on the central and southern portion the Lee Valley Golf Course and Camping and Caravan Park, Meridian Way, Enfield, London N9 0AR. The Site is centred on British National Grid TQ 36185, 94216 (Figure 1).

Access to the Site is from Meridian Way (A1055) to the east.

2.2. Application Site Boundaries

The Application Site boundary is shown on Figure 2

2.3. Site Context

The Site was subject to mineral extraction of the superficial Kempton Park Gravel formation (between 1910-1960s), which was infilled and restored to a golf course by the 1970s, with the campsite added in the 1990s.

The Site comprises part of the Lee Valley Golf Course and Camping and Caravan Park. The golf course covers the majority of the Site with the camping ground in the north. The Application Site occupies an area of approximately 22.8 hectares.

The Site topography has three (3no.) plateaus; at and to the south of the campsite (17-18mAOD), in the south of the Site (14-15mAOD), and along the eastern extent (11-12mAOD). The general topographical trend is sloping down to the south/southeast, however to the north of the campsite the landform significantly drops into a bowl (with a lake in the centre) at around 10mAOD. There are artificial undulations and bunds throughout the golf course, and the highest point of the Site is a large bund to the south of the campsite at 22mAOD. A topographic survey is included in Appendix 3.

The Site is within a significantly built-up area in North London, which includes dwellings to the southwest beyond Picketts Lock Lane (built in 1960s), and to the west beyond Meridian Way.

Commercial and industrial sites are to the north and south, including a large sewage works (Deephams Sewage Treatment Works) beyond Picketts Lock Lane to the south, and builders' merchants/yards to the southeast. To the west is the Lee Valley Athletics Centre (built in 2010s), commercial spaces (including cinema, built in late 1990s through 2000s) and parking. See Appendix 4.

Historic commercial and industrial sites in the surrounding area included gas works (950m north), a linoleum/chemical works (500m north), and a lead works (750m west).

2.4. Historic Extraction and Landfilling On-Site

There is an historic landfill recorded on-site, covering the whole of the Application Site area plus the wider golf course to the north, and extending westward. The record is referred to as Conduit Lane (Ref. 8EN017), operated by Sir Alfred McAlpine and Son (Northern) Limited, which accepted inert waste, household waste, and liquid sludge between December 1979 and December 1985.

2.5. Site History

Gravel pits first appear in the centre of the Site in 1910, expanding in the 1930s over the majority of the Site and extending off-site to the west. The pits seem to have been infilled in the 1950/60s (contradicting landfill records, see Section 2.3.2) and restored to a golf course by the 1970s. The campsite was added in the 1990s.

The area to the north of the Site (northern section of the current golf course, 350 – 450m north-west of the subject site) was a sewage works by the 1890s, which expanded in the 1900s and again between the 1930s and 1960s to occupy the whole area to the north of the Site. The sewage works was cleared for gravel extraction works during the late 1970/80s, and the area was recorded as a golf course by the 1990s.

A creosote works is shown just off-site to the west in 1910, disappearing by the mid-1930s following the westward expansion of the on-site gravel pits.

A gas works was 950m north in the 1860s, which expanded in the 1930s - 1960s, and was removed by 2014.

By the 1890s there was a linoleum works around 500m north of the Site, and a White Lead Works around 750m west of the Site. This area evolved to include chemical works, stone works, timber yard and cabinet works through the 1920s – 1960s and then to closer to its current layout in the 1970s – 80s.

By the 1890s there was a small sewage works around 600m to the south which expanded over time to encompass the whole of area between the railway and canal around 80m south of the Site.

Construction of the William Girling Reservoir to the east of the Site started in 1936 and completed by 1951.

More recent developments in the surrounding area include the Picketts Lock Centre just west of the Site (late 1990s) and the cinema/event centre complex (2000s). The athletic centre was added by around 2010.

2.6. Geological Setting

The local and regional geological setting based on BGS records are summarised in the table below:

Table 2.1. Geological Setting.

Lithology	Information
Artificial Ground	
Infilled/worked Ground	Backfilled/deposited material - Present across the whole of the Application Site area except for the eastern margin (see below).
Made Ground (undivided/unspecified)	Present to the north (wider golf course and lake area), to the west between the Site and Meridian Way, and along the east margin of the Site.
Superficial Geology	
Alluvium (clay, silt, sand, gravel)	Present across the Lee Valley basin, indicated on the eastern margin of the Site.
Kempton Park Gravel (KPG, Sand and gravel)	Underlies the Alluvium in the Lee Valley basin. Indicated across the entire site except for on the eastern margin of the Site.
Bedrock Geology	
London Clay Formation (clay silt and sand)	Underlies superficial deposits in the entire surrounding area, outcropping at the surface to the east of the Lee Valley. Typically, brown/blue silty clay.
Lambeth Group	Mottled clay with sand and pebble beds.

Table 2.1. Geological Setting.	
Lithology	**Information**
Thanet Sand	Fine grained glauconitic sand.
White Chalk Subgroup	Chalk.

Only one (1no.) borehole is identified within the Application Site in the BGS borehole database, at the very north end (BGS ID: 12709960) at British National Grid 536150,194530. The log indicates made ground to 6.5m, logged as an (illegible) thickness of clay overlying "ash, clinkers, tin etc." No water was struck.

A number of boreholes are recorded north of the Application Site in the wider golf course area, and beyond to the west and to the south (Appendix 5). In summary, the boreholes to the north of the Site encountered:

- Made ground to 3.35mbgl;
- Alluvial deposits were only identified on the eastern side of the golf course;
- Generally, around 4-5mbgl to the base of the Kempton Park Gravel, overlying London Clay; and
- The base of the London Clay (where proven / encountered) was at around 12 – 14mbgl.

Boreholes to the west and south of the Site encountered:

- 'Ballast' / made ground (sand clay/sandy gravel with brick, clinker and ash etc) to 3-5mbgl;
- Sandy clay (recorded as alluvium, but potentially KPG) to 4.5 – 5.5mbgl;
- Sand and gravel/sandy gravel deposits to 5 – 6.5mbgl; and
- London Clay to >12mbgl.

All records indicate resting ground water levels at around 1.2 – 1.8mbgl.

The Groundsure report indicates extensive historic ground workings throughout the Site and the wider golf course area to the north. The surrounding area includes gravel extraction pits and unspecified ground workings/pit and cuttings which have been backfilled.

Prior to any gravel extraction and backfilling the Site geology would likely have comprised sandy clay overlying around 6m of Kempton Park sand and gravel, in turn overlying London Clay, Lambeth Group, Thanet Sand, and Chalk. The Kempton Park sand and gravel was the target of the gravel extraction activities.

2.7. Hydrogeological Setting

The hydrogeological setting is summarised in in the table below:

Table 2.2. Hydrogeological Setting.		
Superficial Geology	Alluvium	Secondary 'A' Aquifer
	Kempton Park Gravel Member	Secondary 'A' Aquifer
Bedrock Geology	London Clay	Unproductive Strata
	Lambeth Group and Thanet Formation	Secondary 'A' Aquifer
	Chalk	Principal Aquifer

The southeastern-most corner of the Site is marginally within a groundwater Source Protection Zone (SPZ) Zone II (Outer) – associated with a Zone 1 (Inner Zone) 301m to the southeast. See Appendix 5.

The Zone II noted above also extends to the south-west of the Site around 250m from the Site at closest (associated with a number of SPZ I's to the south) and there are further SPZ II's around 350m north-east and 700m north of the Site.

There are no groundwater abstraction licenses located within 500m of the Site.

Between 500-1000m, there are six (6no.) active licensed groundwater abstraction licenses (closest 783m to southeast). All are Potable Water abstractions for Thames Water (North London Artificial Recharge Scheme, NLARS) which extract from the Thanet Sand and Chalk aquifers.

These abstraction licenses do not appear to correlate with the location of the SPZ centres.

2.7.1. Groundwater Flow Direction and Hydraulic Gradient

Groundwater flow in the shallow aquifer is expected to be generally north to south with a minor east to west component, however the flow has likely been significantly disrupted by to the removal of the Kempton Park deposit and replacement with clay or clayey (i.e. lower permeability) infill material, as well as the reservoir to the east (puddle clay core etc) and the geology to the west.

Little information is available to confidently determine the hydraulic gradient in the wider area. On-site data is also inconsistent, possibly due to the influence of the heterogenous deposit, but indicates a general gradient in the shallow aquifer of north to south (1:900) and very minorly west to east (1:4000).

On-site groundwater data indicates reasonably good hydraulic conductivity within the waste deposit.

Groundwater flow in the deep aquifers (Thanet/Chalk) is poorly defined and likely to be relatively complex. No inferences can be made from the SI data, however based on what might be expected considering hydrogeological principals and SPZ maps, it is likely to be toward the southeast on a regional level.

With regard to potential hydraulic connectivity between the shallow and deep aquifers, no significant hydraulic connection between them would be expected given the significant thickness (10-14m at minimum) of the London Clay aquiclude between the made ground and the Thanet/Chalk.

2.8. Hydrological Setting

Enfield Ditch (sometimes identified as Pymmes Brook) runs north-south in the east of the Site around 40m from the boundary. The brook/ditch joins other drainage channels to the south of the Site. The Groundsure (R.2)indicates it as water-bearing year-round in normal conditions, however the ditch has been observed to be dry during site inspections.

To the east of the Site, parallel to the east boundary, is the River Lee Navigation, which has a main canal and an overflow channel to the east with a tow path in between. The water level in the canal is around 11.0mAOD. There is also a lake (Ponders End Lake) to the north in the golf course (formed by extraction activities in 1980s) which measures roughly 315m x 220m with a water level of 10.8mAOD.

The William Girling Reservoir (WGR) is east of the canal (90m from the Site) beyond a large embankment (top at around 21mAOD). The WGR has a volume of approximately 16M m^3, with the water level in the reservoir at around 18mAOD and a mean depth of 12.2m. It therefore follows that the base of the reservoir is around 6mAOD. The depth to the reservoir base is consistent with the top of the London Clay as recorded by on-site SI data (5-7mAOD, Section 3.2.3).

The WGR was constructed between 1936 and 1951 and includes a puddle clay core in the embankments which is 3.7m wide at the base and extends into the underlying London Clay. The northwest corner was reinforced with sheet piles in 2020.

2.8.1. Surface Water Abstractions

There is one (1no.) active potable water abstraction within 500m of the Site, 198m north at Keids Weir.

The next nearest is 784m southeast (Chingford Supply Channel/ River Lee Diversion), however it is noted that this is on the eastern side of the reservoir, well upstream of where any surface water flowing past the Site would meet that watercourse.

2.8.2. Discharge Consents

There is one (1no.) licensed discharge consent on-site for 'miscellaneous discharges – surface water' to the Enfield Ditch, for the Picketts Lock Leisure Centre which was revoked in 1994 – the location is consistent with the ditch on-Site to the east of the campsite area. This should also not have had a significant impact on the Site if the discharge operated properly, and in any case was revoked in 1994.

The closest off-site discharge consents are 68m south (sewage discharges to the Enfield Ditch), and 102m south (process effluent) to a tributary of Enfield Ditch at Deephams Sewage Treatment Works.

Further trade and sewage discharges are located 150m-480m from the Site.

2.8.3. Surface Water Quality

Information on surface water quality, procured from Defra's Catchment Data Explorer (R.9) and Water Quality Archive (R.10) is summarised in the table below:

Table 2.3. Surface Water Quality.							
Surface Water Body Reference	**ID**	**Easting/ Northing**	**Ecological Rating**	**Biological Quality**	**Physicochemical Quality**	**Specific Pollutants**	**Chemical rating**
Lee Navigation Enfield Lock to Tottenham Locks	GB 10603-8027 950	537482/ 194974	Poor	Poor	Moderate (ammonia High)	High	Fail[1]
Enfield Ditch & Salmon Brooks (Deephams STW to Tottenham Locks)	GB 10603-8027 910	534707/ 189464; 535649/ 192146	Moderate	Poor	Moderate (ammonia High)	High	Fail[1]
[1]Failed due to Poly-brominated Diphenyl Ethers (PBDE), which failed by default as they are not tested for. Priority Hazardous Substances, Priority Substances, and 'Other Pollutants' were otherwise 'Good'.							

The Lee Navigation Lock to Tottenham Locks sample was obtained from a channel to the east of the WGR. The Enfield Ditch & Salmon Brooks sample(s) were obtained from Salmons Brook to the south of the Site near the A406, and where Salmon Brook meets the Lee Navigation further south beneath the A503.

2.8.4. Flooding

The EA Flood Map for Planning service (R.11) indicates that the majority of the Site is Zone 1 (low risk).

Areas of Flood Zones 2 and 3 are shown along the south-eastern margin of the Site (low-lying areas).

2.9. Environmental Setting

2.9.1. Extraction, Landfill and Waste Sites

The Site is an historic landfill, see section 2.4.

There are four (4no.) records 'ground workings and refuse heaps' on-site from the 1930s, and records of potentially infilled land between the 1920s and 1960s.

Only the infilled ground recorded on-site is likely to have a significant direct impact on the Site. Other sites may affect the general 'background' conditions, in particular the water quality in the wider area.

2.9.2. Environmentally Sensitive Areas

The Site (and surrounding area) is within a Nitrate Vulnerable Zone (NVZ) and the London Area Greenbelt. The reservoir 44m to the east of the Site is part of the Chingford Reservoirs SSSI.

No other environmentally sensitive areas were identified within 500m of the Site.

2.9.3. Air Quality Management Areas

The Site is in the Enfield AQMA for PM10 (24-hour mean) and NO2 (annual mean).

2.9.4. Environmental Permits, Industrial Land Use Records, and Registry Entries

No significant environmental permits (in the context of this assessment) have been identified on-site.

Various historical land uses/features include on-site gravel pits/ground workings, on-site/nearby creosote and varnish works, sewage treatment works and other unspecified commercial/industrial activities.

All are consistent with the Site history, and do not offer any new source of potential contamination. The Site is currently a golf course and campsite which is unlikely to be a significant contamination source.

2.10. Climate

The Site is in North London, which has a temperate oceanic climate.

London in general is vulnerable to climate change from sea level rise and drought, the latter resulting in water shortages (R.20, R.21). The UK average annual rainfall has not changed since records began (18th century), however there has been a trend shift to increased winter rainfall, and summer droughts (R.22).

Met office data indicates an average annual precipitation (1991 – 2020) of 660mm for the 12 x 12km grid square which includes the Site (Grid ID: BK-88, R.23).

Nearly half of all rainfall is lost to evapotranspiration, with the remaining running into surface waters and percolating into the ground, known as Effective Rainfall (R.22).

3 SITE INVESTIGATIONS

3.1.1. Ground Conditions and Contamination

The Site Investigation data (R.2,R.3) has proven the made ground to 4.4m – 11.0mbgl (9.4m-5.3mAOD), generally thicker to the north, coincident with the higher ground, and thinnest near the eastern boundary.

The made ground is infill material used to restore the former gravel pits, generally comprising cohesive and granular soil with variable quantities of brick and concrete, ash, glass etc, typical of inert construction wastes. There is no distinguishable vertical or spatial pattern to the deposition or variations of the material. Potential Asbestos Containing Materials (ACMs) were frequently identified as random isolated pieces.

Most potential chemical contaminants were below the Tier 1 RTC (commercial or park) – or where there were exceedances these were rare or sporadic. The following exceeded RTC (POSpark and / or Comm):

- Cyanide - 1no sample;
- Metals – Lead (rarely), Cadmium (rarely), Mercury (rarely);
- PAH - BaA, BbF, BaP and DiA. 20no of 141no samples exceed the Inert WAC criteria (100mg/kg);
- TPH - No individual TPH species exceeded RTC in any sample, but the Hazard Index was >1 (1.69) in 1no sample which also had by far the highest total TPH concentration (22,103mg/kg);
- 23no samples exceed the 500mg/kg inert WAC criteria for Mineral Oil (total TPH C_{10}-C_{40});
- BTEX was well below the RTC, including inert WAC.

No clear vertical or spatial pattern to the contaminant distributions. The contamination is nonetheless consistent with the type and age of the deposited material (>40 years old).

A detailed review of the made ground materials and contamination can be found in the GEMCO HRA (R.4).

The made ground was underlain by residual KPG soils and/or London Clay at around 8-11mbgl (5-7m AOD). The London Clay was 10-19m thick, overlying Lambeth and/or Thanet. Chalk was not encountered.

3.1.2. Groundwater

Groundwater strikes were recorded between 8.1m - 11.3m AOD. Resting water levels were between 10.4m and 11.7m AOD (see cross sectional drawings at Appendix 2).

On-site groundwater data indicates reasonably good hydraulic conductivity within the made ground with a hydraulic gradient from north to south (11.0mAOD to 10.5mAOD, gradient around 1:900).

No significant hydraulic connection between the shallow and deep aquifer is expected given the significant thickness (10m-14m at minimum) of London Clay between the made ground and the Thanet/Chalk.

3.1.3. Surface Water

Surface water quality data (R.19) indicates that the Lee Navigation and Enfield Ditch (sometimes marked Pymmes Brook on historic plans) are of poor quality. On the basis of the available information, and with consideration of the conceptual site (ground) model (CSM), it is considered that the Site is unlikely to present a significant risk to controlled waters. Regional factors are likely to be more significantly influencing the surface water quality.

4 SOURCE TERM

4.1. General

The source-term has been characterised by a review of site investigation data pertaining to the Site. The ground conditions encountered during the investigations are discussed in Section XX. Findings of the investigation have shown that there are sources of contamination in the made ground present at the Site. Table 3.1 below summarises the potential sources of contamination:

Table 4.1. Potential Sources of Contamination.	
Potential Source	**Potential Contaminants**
On-site: Made Ground / Deposited materials	Asbestos, Hydrocarbons (TPH/PAH), Organic/Inorganic compounds, ground gas, metals
On/off-Site: Current and Historical Activities (commercial and industrial sites, incl. sewage treatment works, builders yard, chemical and gas works, creosote works, railway sidings, gravel works etc)	Metals, Hydrocarbons, Organic and Inorganic compounds, solvents, phenols, pH, asbestos, ground gas, VOC/SVOC
Off-Site: Regional groundwater conditions	Ammonium, Dissolved metals, Hydrocarbons (TPH/PAH)

4.2. Made Ground (in current condition)

Within the context of the proposed development and waste recovery operations the primary source of contamination is the made ground / deposited material.

Contamination of the made ground soil has been identified by site investigations, which included asbestos, metals, hydrocarbons, and organic determinands (Section 2.7), however the risk in the context of the proposal is generally low.

On the basis of the groundwater and surface water sampling and analysis undertaken the made ground soil does not appear to currently be having a significant impact on controlled waters.

By extension, it is considered that the made ground / contamination within the made ground and potentially also in the residual KPG is unlikely to have significant potential to leach at levels likely to affect the controlled waters environment in the context of the cut and fill proposals (note that no excavation or fill works are proposed at or below the groundwater level).

Materials recovered from the deposit are to be remediated/reengineered and re-used within the cut & fill / waste recovery operation such that only non-hazardous and inert materials will be re-laid as fill in order to minimise the reliance on importing material and render the Site suitable for the intended end use.

Materials placed will be subject to compliance testing to ensure they are suitable for use, and none will be placed below the groundwater table. The table at Appendix 6 details the limit values for waste acceptable for re-use at the Site. Materials failing the compliance testing or which cannot be remediated will be removed from the Site to an appropriate disposal facility.

Inert waste does not undergo significant physical, chemical, or biological processes, and so leachate is not expected to be produced, and direct contact with the material is implausible by end users. The reengineer material is therefore not considered to present a significant contamination source in the final development.

4.3. Current and Historic On-Site and Off-Site Activities

A number of current and historic activities either on- or close to the Site were identified by the desk study review, as presented in Section 2, including:

- Historic railway sidings, creosote works, sewage treatment works, and gravel workings etc;
- Builders yard to the southeast, development of the Pickets Lock Centre to the west; and
- Current use as a golf course and campsite.

It is considered that where these may have had an impact, they would be reflected in the Site soils and / or in the groundwater conditions at the Site, which have been well characterised by the SI.

Any residues of the older historic on-site activities – e.g. the creosote works, railway tracks – will have largely been 'overwritten' by the extraction and disposition processes, but could have left localised effects.

It is considered that the sewage works formerly present to the immediate north of the Site may have contributed to or affected the nature of the fill at the Site but that this will also be already accounted for in the soil conditions identified by the Site investigations. No potential contamination attributable to the current Site use has been identified.

The sewage works may have impacted on the groundwater conditions locally and the wider area including the subject site which is immediately down hydraulic gradient, and thus has been proposed as a potential source for elevated ammonium concentrations. If this were / is the case however it would be expected that the primary source (materials / soils directly associated with the sewage works) would have been largely removed by the gravel extraction works.

Within the wider area, the historic chemical and gas works sites etc may have affected (and be reflected in) the historic composition of the waste deposited, but will again be already accounted for by the conditions identified by the Hydrock investigation. Similarly, any associated impact on the groundwater quality at the Site would likely be a regional and would also be reflected in the current groundwater sampling results.

Overall, these off-site and regional potential contamination sources are not considered relevant or significant in the context of the current assessment. The dominant contamination signature is likely to be from the infilling of the subject site (which will overwrite to a large degree any previous site activities).

4.4. Groundwater (as a source)

The groundwater at the Site has been characterised by the site investigations.

There are no potable water groundwater abstractions within 500m of the Site, and the abstractions within 1km exclusively source water from the Chalk or Thanet bedrock to which there is no on-site pathway due to the underlying London Clay aquiclude.

Whilst there are a number of contaminant species that are elevated above the adopted screening levels in the groundwater, these generally appear to be related to off-site / regional effects, or to be sporadic and not consistently related to site conditions.

Overall, the groundwater and surface water monitoring and risk assessments indicated that the Site groundwater was unlikely to have an impact on the wider controlled waters environment.

4.5. Proposed Development

The proposed development is outlined in Section 1 of this report and is briefly an amenity facility with the main attraction being an outdoor artificial surfing lake with other amenity uses and associated infrastructure.

The proposed permitted activities are R5, R11 and R13.

4.5.1. Proposed Waste Types

The waste code for the majority of the waste currently encountered on-site is 17-05-04 (soil and stones; non-hazardous) with lesser quantities of 17-05-03 (soil and stones; hazardous), but other waste types may be present. The list of permitted wastes is presented in Table 5.1 below.

The waste material at the Application Site was described as made ground/ construction material, variable in composition (R.3). It was estimated that 64% of made ground soils encountered were SHW Class 1 material and 36% Class 2 material (R.17).

Excavated waste will undergo treatment to remove asbestos, hydrocarbon (above hazardous waste threshold) and degradable materials such as wood, but also to recover inert material to create aggregate e.g., concrete, masonry and brick.

Wastes deposited in the permanent works will classify as non-hazardous / inert soils and stones, List of Waste Code - 17.05.04.

4.5.2. Volumes / Quantities of Waste

Overall, on the basis of the proposed earthworks (top of proposed surf lake at 15.75mAOD), presented at Appendix 2, the cut volume is to be 35,631m3, with an estimated 4,401m3 loss of material from removal of hazardous waste (876m3) for disposal, or segregation of hardcore for recycling as aggregate (3525m3).

The fill volume required is 31,800m3, therefore the Mass Balance is a deficit of 570m3.

It is important to note that no excavation or placement of waste or recovered material is proposed within/below the groundwater as part of the recovery operations.

The estimated total volume of the entire waste deposit is in the order of 1,500,000m3. The total cut volume (roughly 36,000m3) represents about 2.4% of the total volume of the deposit, and therefore is considered unlikely to substantially affect the overall Site condition.

4.5.3. Chemical Characteristics of Waste for Use in Permanent Works

The limit values for compliance / acceptance are based on the findings of the GEMCO HRA (R.4) and the suitable for use levels (S4UL R.20, for amenity or commercial end use) The waste acceptance criteria are presented in Appendix 6.

5 PATHWAYS

5.1. General

With consideration of the geological, hydrogeological and hydrological setting and discussion with regard aquifer connectivity etc. in the previous sections, the principal potential mechanisms / pathways for migration of potential contaminants from the Site are considered to be:

- Infiltration of rainfall and surface water run-off;
- Leaching of contaminants in the waste body;
- Vertical and lateral migration in the unsaturated zone to the saturated zone;
- Lateral migration in the groundwater, and migration between superficial and bedrock aquifers;
- Migration into Surface Water Receptors from the Groundwater;
- Migration within surface waters; and
- Man-made subsurface pathways.

The pathways are discussed in more detail in the following sections.

5.2. Infiltration of Rainfall and Surface Water Run-Off

Currently the Site is dominantly soft standing and this is expected to remain the case in the proposed development except for the Wave Cove itself the immediate surroundings.

It is expected that rainfall will be accounted for by infiltration and evapotranspiration.

Given the generally low rainfall for the region (Section 2.10) evapotranspiration is likely to be the dominant effect with minimal surface percolation through the soils likely to occur. This is supported by the generally minimal levels of perched waters encountered by the Site Investigation.

More intense periods of rainfall will likely result in surface water flows that would be manged by the surface water drainage (SUDs) or result in surface water flows that by-pass the Site soils. The Site topography (generally sloping down to the southeast/east, and north) will likely result in significant surface water being captured by Enfield Ditch along the east boundary, and Ponders End Lake to the north.

Overall infiltration through the surface soils is therefore generally expected to be minimal.

New buildings and hardstandings added within the development may potentially result in increased/ concentrated run-off and infiltration in some areas. This would be managed by the Site layout and drainage design. Overall, it is considered that this would not be significant in the context of the development.

There is some potential for an increase in local infiltration / run-off during the development works, particularly the cut and fill operations, due to the exposure of underlying soils and potential for the works to create areas of pooling, resulting in an increased possibility that rainfall would collect and infiltrate quicker and more directly to the water table. The works however must be managed to avoid this.

Further, where potential contamination hotspots are identified this soil must be managed to mitigate the possibility of exacerbating any impacts.

5.3. Leaching of contaminants in the waste body

Whilst no leachate data has been produced by the SI, it is considered that the potential for significant leachate generation is nonetheless limited – potential contaminant concentrations in the Site soils are generally low or only sporadically elevated and in particular the groundwater data indicate that leaching of contaminants from the Site soils is generally (very largely) minimal (not significant).

This is consistent with the type of fill identified (i.e. soils and 'inert type' construction and demolition type fill), and with the age of the fill - since it has been present since the 1950s / 60s and the most easily leachable components will have already naturally attenuated.

The potential for the leaching of significant contaminants is therefore very low.

5.4. Vertical and Lateral Migration in the Unsaturated Zone

The only significant water input to the Site will be rainfall to the Site.

As discussed at Section 2.10, the rainfall in the region is low, and evapotranspiration from soil surfaces are likely to dominate during much of the year. This limits the potential for leachate generation in the unsaturated zone and also limits the driver for migration of that leachate.

Lateral migration in the Unsaturated Zone is likely only over relatively short distances in perched water, potentially over low-permeability (clay) layers in the made ground.

The SI data did not indicate any significant perched waters, possibly in part due to minimal recharge from rainfall, so these are not expected to be major driver of leachate/migration.

5.5. Migration in the Groundwater and between Aquifers

Per Section 2.4.3, groundwater flow in the shallow aquifer is expected to be generally north to south, with potentially a minor easterly component, but limited in the area of the Site due to geological factors.

The groundwater flow in the deep aquifer is poorly defined but likely toward the southeast on a regional level, however direct hydraulic continuity with / vertical migration to the bedrock aquifers is unlikely due to the London Clay interlayer acting as a hydraulic barrier (aquiclude), protecting the Thanet and Chalk.

Based on the above, the need to precisely define the groundwater flow in the deep aquifer is not considered to be required.

Monitoring wells installed by the Site Investigation are unlikely to provide a significant pathway between the upper and lower aquifer bodies. Regardless these must be decommissioned properly in line with Agency guidance when they are no longer required.

5.6. Migration into Surface Water Receptors from the Groundwater

The groundwater level at the Site and the water levels in the River Lee Navigation canal are very similar.

It is likely that there is some hydraulic connectivity between the groundwater and the canal – although the latter is likely to have been lined to some degree when the canal was created to maintain the water levels between the locks, and which may still act to minimise the hydraulic connection.

Additionally lower in the reach between locks (which the Site is, being just above Picketts Lock) it is possible that the canal levels are maintained slightly higher than the natural levels in the water course would be without locks (hence the need for the locks) which would suggest any leaking of the canal lining would be outwards (i.e. from the canal to the groundwater).

The groundwater and surface water sampling data do not suggest any significant impact on the surface water quality in the canal which supports a lack of connectivity.

There will also be a significant degree of dilution of any groundwater entering the canal (if indeed any significant amount does).

5.7. Migration within Surface Waters

Any contamination entering the River Lee Navigation would migrate downstream. It would be expected however that there would be a high degree of dilution and that it would be hard to differentiate any effects downstream from those potentially through impact from other sites.

It is further noted that on the basis of the comparison of the groundwater and surface water monitoring data it does not appear that there is any significant discernible effect on the canal in the vicinity of the Site, and it follows that there would be none downstream that would be attributable to the Site.

Enfield Ditch is a relatively minor ditch / shallow water course, which will likely dominantly receive surface runoff which has had limited/no contact with the made ground soils.

Migration of water between the Site and the William Girling Reservoir to the east is considered to be very unlikely due to the engineering construction of the reservoir, with the embankment puddle clay core toeing into the London Clay. Furthermore, the water levels in the reservoir are significantly higher than those the River Lee Navigation and the Site, so any flow would likely be out of the reservoir rather than into it.

5.8. Man-Made Subsurface Pathways

It is not expected that significant infiltration drainage / soakaways that would concentrate infiltration of surface water run-off in particular areas of the Site will be used. It is expected that infiltration of water into the Site will be dominantly though the Site surface in a dispersed in a similar manner to the current situation.

Site investigation monitoring wells are considered to be unlikely to provide a pathway to the underlying aquifers, but must nonetheless be decommissioned in line with EA guidance once no longer required.

No significant underground utilities are known on-site. Irrigation apparatus may be in place for the maintenance of the golf course; however, these are likely to be shallow features (<1m bgl).

6 RECEPTORS

6.1. General

On the basis of the review, the principal potential receptors that might be affected by the Site are:

- Shallow groundwater within the Made Ground/Secondary 'A' aquifer; and
- Off-site surface waters (River Lee Navigation, Ponders End Lake, and lakes/reservoirs and connecting water courses downstream of the Site).

Potential receptors of Enfield Ditch, William Girling Reservoir, and deep aquifers below the London Clay are considered very unlikely to be affected (and will not be included in the CSM).

It is further considered that the receptors the same pre-, during and post- development.

6.2. Shallow Groundwater in the Made Ground and KPG

Shallow groundwater within the Made Ground body / the Secondary 'A' aquifer (KPG) is considered to be the primary groundwater receptor for contamination. Specifically, on-site and immediately beyond the Site. The wider groundwater environment is not considered to be a significant receptor.

The Kempton Park Gravel has been mined from the Site (only small residual KPG soils remaining), and replaced with inert fill. No significant leachable contamination has been identified in the fill thus far.

Only reengineered materials which conform to inert waste classification criterion are to be placed - inert wastes do not contain leachable hazardous or non-hazardous substances likely to cause pollution. In addition, no materials are to be laid below the water table, and no significant perched waters are expected.

Further detail on this assessment is presented in the Hydrogeological Risk Assessment (HRA, R.4).

6.3. Off-site Surface Waters

The primary potential surface water receptors have been identified as River Lee Navigation Canal, Ponders End Lake to the north, and reservoirs, connecting water courses, and lakes downstream of the Site.

In summary, it is considered that there is limited possibility for surface waters to be affected by any potential contamination at the Site. Further detail on this assessment is presented in the HRA (R.4).

The River Lee Navigation is likely protected by lining, and no evidence of degradation of the watercourse quality has been identified. Ponders End Lake is hydraulically upgradient. Downstream watercourse quality in wider area is likely to be influenced to a greater extent by regional factors.

6.4. Amenity

Dust, noise, traffic and to a lesser degree odours, have been identified as potential nuisance issues to human health and amenity from the Site and operations. Scavenging birds and animals, and insects are considered very low risk as the wastes do not contain significant quantities of putrescible waste types.

7 CONCEPTUAL SITE MODEL AND RISK ASSESSMENT

7.1. General

On the basis of the available background information and discussion in the preceding sections, the Conceptual Site Model and Risk Assessments are summarised in tabular form in Tables 3.2 - Table 3.4.

The CSM and Risk Assessments are considered for the following scenarios:

- **Current scenario (Table 7.1)** –
  Based on the available background information and the Site investigation data. Considering the current landform and known contamination conditions;
- **Construction phase (Table 3.3)** –
  Considering factors during the cut & fill works (i.e. excavation, stockpiling/treatment, and relocation/placement of soils, and the processes used to achieve this, exposure of contaminated soils/hotspots; temporary landforms which may result in pooling of water, changes in run-off patterns, and/or increased infiltration if not managed appropriately; increased exposure of soils to water/infiltration and potential for increased leaching of contaminants (data suggests this will be minimal / not significant);
- **Post-development (Table 3.4)** –
  New landform and development layout (achieved through re-use of site soils within a waste recovery plan). It is considered that the risk profile is essentially the same as the current scenario – materials re-used on site to create the required landform will have been moved only to equivalent situations (i.e. waste soils from above the water table will have been placed at other locations above the water table and subject to similar hydrogeological and hydrological considerations). Placement of a landscaping soils will potentially improve the risk scenario as surface water run-off will not interact with the made ground (expected to be limited anyway).

The risks identified have been assessed in the Environmental Risk Assessment (Appendix 5).

A cross section of the Site is presented at Appendix 2.

7.2. Current Scenario

Table 7.1. Conceptual Site Model – Current Scenario.

Source	Pathway	Receptor	Harm	Probability	Consequence	Magnitude	Justification	Risk Management	Residual Risk
Contaminated made ground/ deposited material	Vertical/ lateral migration into surface water / groundwater	Shallow groundwater, off-site surface waters	Reduction of water quality, damage to aquatic life	Low	Medium	Low	Non-hazardous materials, no significant leachate, limited water in shallow waste mass	Inactive site - Baseline condition – no controls in place	Low
On-site Activities	Infiltration, surface run-off, vertical/ lateral migration into surface/ ground-water	Shallow groundwater, off-site surface waters	Reduction of water quality, damage to aquatic life	Low	Low	Low	Limited contamination from previous uses. Limited contamination from current use, limited infiltration	Baseline condition – no controls in place	Low
Off-site Activities	Vertical/ lateral migration to surface/ ground-water, man-made subsurface	Shallow groundwater, off-site surface waters	Reduction of water quality, damage to aquatic life	Low	Low	Low	Limited contamination from previous uses. Limited contamination from current use, limited infiltration	Baseline condition – no controls in place	Low
Groundwater	Migration between aquifers and into surface waters	Shallow groundwater, off-site surface waters	Reduction of water quality, damage to aquatic life	Low	Medium	Low	Groundwater quality related to off-site/regional effects. Limited hydraulic continuity between shallow and deep aquifers	Baseline condition – no controls in place	Low

Table 7.1. Conceptual Site Model – Current Scenario.									
Source	**Pathway**	**Receptor**	**Harm**	**Probability**	**Consequence**	**Magnitude**	**Justification**	**Risk Management**	**Residual Risk**
Gas Emissions	Gas migrating laterally through waste deposit	Local human population and local environment	Respiratory irritation, illness nuisance. Risk of explosion and injury	Low	High	Medium	Methane generally <1%. Carbon dioxide recorded >5%, however probability of exposure is low. CS2 protection recommended by preliminary GRA	Baseline condition – no controls in place. Low risk gas regime	Low

7.3. Construction Phase Assessment

Table 7.2. Conceptual Site Model – Construction Phase Assessment.

Source	Pathway	Receptor	Harm	Probability	Consequence	Magnitude	Justification	Risk Management	Residual Risk
Dust	Air transport (wind-blown), inhalation, deposition.	Local human population. Residential properties at Picketts Lock Lane. Commercial/ industrial premises, SSSI	Respiratory irritation and illness, Nuisance (dust on cars etc), disturbance, smothering of local flora/fauna	Medium	Medium	Medium	Mainly non-hazardous / low in organic matter, degradable or putrescible material however, asbestos is present. Activities may produce dust from movement of vehicles and tipping operations especially in dry and also windy weather. Potential for run-off and siltation of habitats etc. Emissions to air may cause harm to and deterioration of nature conservation sites	Baseline asbestos air monitoring prior to starting, and will be monitored throughout the operations. Activities managed and operated in accordance with a management system and located away from receptors where possible.	Low
Litter	Air transport (wind-blown), deposition.	Local human population	Nuisance, loss of amenity and harm to animal health.	Low	Low	Very Low	Wastes have very low litter content. Waste types if compliant with the rules should have a low risk of litter from contraries in the waste.	Management system to remove and contain any litter to prevent it being deposited at the Site or to leave the Site boundaries.	Very Low
Odour	Air transport	Local human population	Nuisance, loss of amenity	Very Low	Very Low	Very Low	Waste mainly inert and therefore should not be odorous.	Management system procedure to prevent non-permitted wastes and rogue loads.	Very Low

Table 7.2. Conceptual Site Model – Construction Phase Assessment.									
Source	**Pathway**	**Receptor**	**Harm**	**Probability**	**Consequence**	**Magnitude**	**Justification**	**Risk Management**	**Residual Risk**
Noise and Vibration	Noise through the air and vibration through the ground.	Local human population, SSSI	Nuisance, loss of amenity, disturbance/ loss of sleep.	Medium	Medium	Medium	Local residents often sensitive to noise and vibration but there is usually low potential for exposure.	Noise and vibration included in management plan. Use of silenced machinery where possible and specific working hours, siting of operations as far as practically possible from receptors.	Low
Pests (flies, scavenging animals/birds etc).	Air transport and over land	Local human population and local environment	Human health, nuisance, loss of amenity	Low	Medium	Low	Wastes are limited to mainly inert wastes that are not normally attractive to pests.	Risk limited by permitted waste types and site system	Low
Spillage of liquids, including oil	Run-off to surface waters/drains	Surface waters close to and downstream of site	Acute effects: to fish and aquatic invertebrates	Low	Medium	Medium	Potential for spillage from any fuel and oil storage for machinery or directly from machinery operating on the Site	Management system to identify how materials will be safely stored and machinery/ plant maintained. All liquids provided with secondary containment to minimise risk. Spill kits to be provided	Low

Table 7.2. Conceptual Site Model – Construction Phase Assessment.									
Source	**Pathway**	**Receptor**	**Harm**	**Probability**	**Consequence**	**Magnitude**	**Justification**	**Risk Management**	**Residual Risk**
Fire	Air transport (smoke/ash). Firewater run-off to drains/ ditches	Local human population (incl. firefighters, staff) and environment, surface water	Respiratory irritation, nuisance to local population. Injury. Pollution of water or land	Low	Medium	Low	Permitted waste types are inert / non-hazardous with a very low-risk of combustion. Site machinery and fuels and oils are more of a risk but quantities would typically be low.	Management system / site security measures to identify and minimise risks from unauthorised access, and appropriate storage of flammable material (fuel etc)	Low
Exposure of contaminated soil	Infiltration Leachate, run-off	Groundwater and surface water	Degradation of groundwater/ surface water quality. Acute effects: to fish and aquatic invertebrates	Medium	Medium	Medium	Permitted waste types are mainly inert and no significant perched water or leachate. Potential for altered landform to create additional/concentrated areas of pooling or focused runoff as well as additional exposure of made ground material	Good onsite management practices must be detailed in the management system for controlling and containing water and leachate generated on the Site.	Low
Groundwater	Transport through soil/groundwater	Groundwater and surface water, SSSI	Chronic effects of contaminated water	Medium	Medium	Medium	Permitted waste types are mainly inert or non-hazardous. Old waste deposits may be disturbed however no significant leachate or contamination detected at the Site.	Activity located away from watercourse, no deposition below groundwater table	Low

7.4. Post-development

Table 7.3. Conceptual Site Model – Post-development.

Source	Pathway	Receptor	Harm	Probability	Consequence	Magnitude	Justification	Risk Management	Residual Risk
Made Ground, Engineered/ remediated material	Groundwater	Groundwater		Medium	Low	Medium	Only non-hazardous materials / inert to be placed. Limited leachate in existing fill. No placement below water table. Placed materials capped by landscaping soil (topsoil etc).	Compliance with waste acceptance criteria	Low
On-site Activities	Infiltration to groundwater, run-off to surface water	Groundwater, surface water	Degradation of water quality, acute harm to aquatic life	Low	Medium	Low	Surface waters managed by drainage system and green spaces. Infiltration unlikely to generate significant leachate	Compliance with waste acceptance criteria	Low
Groundwater	Migration between aquifers and into surface waters	Shallow groundwater, off-site surface waters	Reduction of water quality, damage to aquatic life	Low	Medium	Low	Groundwater quality related to off-site/regional effects. Limited hydraulic continuity between shallow and deep aquifers	Baseline condition – no controls in place	Low
Gas emission	Gas migrating laterally through waste deposit	Local human population and local environment	Respiratory irritation, illness nuisance. Risk of explosion and injury	Low	High	Medium	Low gas generation and low probability of exposure. Engineering (compaction and removal of biodegradable material) of materials would reduce production and migration potential	Protection measures managed as part of land contamination condition	Low

8 POLLUTION CONTROL MEASURES

8.1. Site Engineering

The DfR operations form part of a re-development of an existing golf course and campsite to provide an outdoor amenity facility with the main attraction being a man-made outdoor surfing lake.

With regard to pollution control measures, two scenarios area applicable:

1. During operational phase; and
2. In the completed development.

Waste for re-use will be chemically tested to ensure that concentrations of contaminants are at acceptable levels in accordance with the Waste Acceptance Procedure. Waste to be re-used will be non-hazardous and will not pose risks to controlled waters in the context of their placement in the permanent works.

Wastes deposited in the permanent works will classify as non-hazardous / inert soils and stones, List of Waste Code - 17.05.04. Hazardous waste will not be re-deposited in the permanent works.

As the wastes used in the permanent works will be largely at surface or above ground and will be engineering in accordance with the civil / structural engineering specifications, it is not considered necessary to include engineered attenuation layers in the site design.

8.2. Operational Phase

8.2.1. Excavation

The waste recovery operations involve the excavation of waste to create the required landform for construction. The main feature, being the Wave Pool (see Appendix 1 Development Proposals), which will result in the removal of some 20,000$m^{3,}$ further excavations are required for attenuation ponds, car parking and roads, bringing the total excavation to 35,632m^3.

Soils (waste) will be excavated in a phased manner and transported to the dedicated stockpiling area.

In order to minimise dust and soil run-off, the maximum quantity of soil in the stockpiling area (awaiting treatment) is 2,500m^3 and the maximum storage height for stockpiles will be 2.5m.

Untreatable and unacceptable wastes will be transferred to an appropriate (dedicated) skip for subsequent disposal off-site to ensure no cross contamination with soils treated and ready for reuse.

8.2.2. Waste Treatment and Re-Use

Prior to re-use the waste will undergo a treatment process involving the sorting, screening and segregation to remove and / or reduce contamination from asbestos fragments, hydrocarbons and geotechnically deleterious components such as wood, textile, metal and timber. Residual wastes, such as ACM fragments, timber etc., from the treatment process will be disposed off-site.

Only suitable materials complying with waste acceptance criteria will be re-used in the permanent works. The treated wastes will be used predominantly in the creation of the development platform for the main building and the construction of visual / acoustic attenuation mounds (above ground).

8.2.3. Site Infrastructure

Designated areas will be established for welfare facilities and site worker parking, material storage, and soil treatment/quarantine areas (see Site Infrastructure Plan at Appendix 2).

Material storage is largely related to operational materials i.e. fuels, which will be stored within the plant and equipment storage area shown on The Site Infrastructure Plan. Storage will comply with the Oil Storage Regulations 2001 and include a double-bunded fuel tank with a secondary containment of no less than 110% of the maximum contents. The tank will be placed on a secondary drip tray.

It is considered unnecessary to install a full specification engineered containment or drainage system however, the waste will be treated and stored in an engineered containment system as detailed in Appendix 2. This will include an impermeable geotextile overlain by suitable aggregate. Perimeter soil mounds with a sealed, bunded perimeter containment to prevent run-off. From the stockpiles.

Any run-off [from periods of precipitation] from the stockpile will be collected in the base of the system and re-circulated through the soils within the treatment area.

The treatment zone has been located as far as practically possible from sensitive receptors to minimise nuisance of noise and dust.

The quarantine area will be constructed with an impermeable membrane with soil bunds around, and be able to accommodate 250m^3 of soil. The volume of 250m^3 is considered appropriate as it represents around 0.5 day of excavation, during which time appropriate measures will have been taken to cease operations and divert out of spec or untreatable wastes.

8.2.4. Site Engineering

No basal or side slope artificial liner is considered to be necessary as the Site.

8.2.5. Restoration

Placed soils are to be ultimately covered with subsoil and topsoil, providing an additional barrier to the made ground material. These soils are to be used in the final restoration/landscaping of the Site.

The landscaping proposal also incorporates the creation of raised screening mounds, primarily in the south of the Site. These features are to provide noise and visual attenuation from the Site to potentially sensitive receptors to the south (dwellings on Picketts Lock Lane).

It is anticipated that the final upper restoration layer will be a minimum 300mm thick.

8.2.6. Groundwater Control

No works (excavation or deposition) are proposed to take place below the water table, and no water abstraction or discharge is required as part of the works.

No pathway is present to deeper aquifers from which potable water is abstracted due to the underlying London Clay. Groundwater control is therefore not a consideration.

8.2.7. Surface Water Management

Water management system for the proposed site includes collection ditches, treatment ponds drainage and discharge of water

A combination of filter trenches, grips, and swales will be installed around the treatment area to intercept overland water flows or run off from the treatment area. These features will slow the flow and reduce the particulate load of surface water.

Material stockpiles will be appropriately sealed at the end of every working day

It is not considered that rainwater or run-off will create a significant risk/pathway based on the findings of the HRA.

8.2.8. Leachates

The risk of encountering leachates is considered to be low in the CSM, as no significant leachate was identified by the site investigation, the process does not include any liquids, and excavations are not likely to encounter groundwater [due to depth to the groundwater table], and therefore soil moisture levels are considered to be reasonably low.

In the unlikely event that any leachates or leachable materials arise as a result of the process, they will be directed through a series of catch pits and possibly oil/water separator, as required, to remove contaminants before disposal or re-circulation through the waste for treatment.

If disposal to sewer is required this will be with the consent of the appropriate statutory authority.

8.2.9. Security

The Site is currently accessible on-foot from the west boundary near the athletics centre and from the wider golf course. Vehicular access points are at the caravan park/golf club and near the athletics centre (secured by barriers, bollards, and gates).

The east boundary has natural barriers from the river/canal, and the south from terrain and vegetation.

During the proposed earthworks the Site will be made secure with the use of appropriate fencing and hoarding to provide security from unwanted access, and thus reduce the likelihood of vandalism and arson, and visual/noise screening.

8.3. Completed Development

All Wastes re-used in the development will comply with robust waste acceptance criteria and be non-hazardous and compliant with inert waste acceptance leachability criteria to ensure the deposited waste do not pose a risk to controlled waters, human health, amenity and ecological receptors.

Surface water from the scheme will be managed through a management scheme agreed via the planning application. with the LLFA. There are no other anticipated sources of pollution requiring on-going controls.

8.4. Aftercare

Proposed use following completion of the work is effectively a park with commercial spaces and temporary accommodation.

As a deposit for recovery, there is no closure plan / closure process.

Proposed aftercare includes post-completion monitoring of ground gas, groundwater and surface water for an appropriate period, as outlined in Section 9.

9 MONITORING

9.1. Weather Monitoring

Weather data (wind direction, precipitation etc) is freely and easily accessible from online resources which includes monitoring stations in the local area (London Borough of Enfield), including Met Office, Weather Underground and Yr.no. These resources may also be used for forecasting.

Historical data can also be obtained from nearby weather stations such as London City Airport.

Weather records are to be recorded and monitored on a daily basis during the cut & fill and remediation works to ensure works are undertaken as appropriate, or suspended for inclement weather events.

9.2. Existing Gas and Groundwater Monitoring

Eight (8no.) gas and groundwater monitoring wells were installed by Hydrock as part of their site investigation. The boreholes extend variously into the waste, London Clay, and Thanet. A borehole location plan (by Hydrock) is included at Figure 3.

Gas monitoring has been undertaken by Hydrock. Six (6no.) monitoring visits were undertaken over a three-month period. In summary, concentrations of methane were typically below 1%, and carbon dioxide between 5% and 10%. Flow was generally negligible (<0.2 l/hr).

The contaminated land gas risk assessment provisionally classified the Site as Characteristic Situation 2 (CS2 in accordance with BS8485).

At this stage the risk of gas migration from the Site is considered to be low. The gas regime identified is typical of an inert waste, and unlikely to be worsened by the Site activity, and in fact is likely to be bettered due to the removal of biodegradable/putrescible materials and reengineering (compaction).

In the final build, the risk is considered to be low on the basis of limited exposure within a parkland/commercial scenario (short exposure).

9.2.1. Proposed Ground Gas Monitoring

Gas monitoring is proposed simultaneous with groundwater monitoring during the operational phase for compliance monitoring purposes at an appropriate timescale in accordance with LFTGN03 (R.25).

It is proposed to recommission existing wells for the monitoring of gas concentrations where possible, however the current condition of the existing wells with respect to suitability for further monitoring is yet to be determined. It may be necessary to drill new wells (in-waste and/or perimeter) as appropriate.

A schematic drawing for the construction/design of any new wells is included at Figure 4.

The pre-commencement data may be used for the design of any gas protection systems in the build.

Surplus existing boreholes will be appropriately decommissioned. Boreholes used for post-operation monitoring will also be decommissioned once monitoring has been completed.

9.3. Groundwater and Leachate Monitoring

Leachate and groundwater are not actively monitored at the Site. The risk assessments do not indicate that significant leachate is being generated (i.e. there is no significant impact from the Site on the groundwater at the Site), and there is no significant pathway to the deeper aquifers from which drinking water is sourced.

The application is for re-use of waste soils derived from the Site within a cut and fill program to form the required development platform. No waste soils will be imported. No works are proposed below the water table (excavation or placement) with no potential for significantly altering their potential leachability.

On the basis of the risk assessments, the risk to groundwater presented by the application site is low. However, due to the sensitivity of the Site location and proximity to the River Lee Navigation it is considered that additional groundwater monitoring is required (including pre-commencement).

With consideration of the EPR 2016, it is considered that there is no requirement for leachate monitoring.

9.3.1. Proposed Groundwater Monitoring

It is necessary to monitor up-gradient and down-gradient groundwater levels and groundwater quality, comprising one (1no) up-gradient and two (2no) downgradient monitoring wells relative to the Application Site – in accordance with the LFD/LFTGN02 (R.26, R.27). Assuming the existing apparatus is serviceable, it is proposed to monitor as follows:

Table 9.1. Proposed Monitoring Locations for Groundwater Compliance.

Borehole Reference	Relative Site Location	Rationale	Frequency
BH101/102	North (campsite)	Upstream (inflow region)	One occasion prior to commencement; Monthly for 3no. months during works; Quarterly thereafter until 12 months post-completion (assuming no breaches).
BH109	West boundary, northwest of wave pool	Upstream of wave pool, cross gradient	
BH104A/BH106	East / northeast of pool		
BH111	South	Downstream/ outflow region	
BH115	Southeast		

It is not considered necessary to monitor wells which extend below the London Clay.

In order to comply with the Landfill Directive, it is necessary to set groundwater quality compliance limits (formerly 'trigger values'). Compliance limits are discussed at Section 6 of HRA.

Surplus existing boreholes will be appropriately decommissioned. Boreholes used for post-operation monitoring will also be decommissioned once monitoring has been completed.

9.4. Surface Water Monitoring

Surface waters are not actively monitored at the Site.

The risk to surface waters is considered low or very low and surface water monitoring is not considered necessary.

9.5. Amenity Monitoring

No amenity monitoring has been undertaken at the Site.

Dust suppression measures will be implemented and would involve dampening of stockpiles of materials stored on site and haul roads.

9.5.1. Dust monitoring

Dust is proposed to be monitored at five (5no.) locations, as shown on the Site Infrastructure Plan presented at Appendix 2, to be positioned at the Site perimeter between the works areas and sensitive receptors (primarily human health, i.e. residential areas to the south, southwest, west and northwest).

Records of wind direction and a qualitative assessment of wind strength prior to the commencement of treatment works will be made in the daily log. Visual monitoring of emissions will also be undertaken throughout the waste treatment processes.

Monitoring will be conducted each operational day following startup of the treatment plant and then once more throughout the day by the Site Manager. Records of this monitoring will be made in the Site diary.

Dust gauges will be analysed every 14-20 days.

The treatment areas are to be positioned to mitigate the effects of noise on the surrounding localities as far as practicable. Plant used are to meet UK & European dB Noise levels and will be regularly checked/ maintained to ensuring that the noise levels are within the parameters.

9.6. Subsidence and Settlement/Earthworks Monitoring

Earthworks will be controlled by an earthworks design specification report which will include details material placement and requirements of testing to control settlement and compaction.

Re-used materials will undergo both in-situ and laboratory acceptability testing to ensure compliance with the earthwork's specification.

A post completion topographic survey will be carried out on completion of the deposition.

10 SITE CONDITION REPORT

10.1. Requirements of a Site Condition Report

As the entirety of the area within the environmental permit boundary is subject to the permanent deposition of waste, it is considered that a Site Condition Report (SCR) is not required.

Notwithstanding the above, an Environmental Management System (EMS) will be implemented during operations to ensure that any likelihood of contamination to land, surface water and groundwater will be reduced as far as practicably possible.

11 REFERENCES

R.1. Norwest Holst Soil Engineering. Ground Investigation at Picketts Lock HPC. Ref: F13229, May 2004;
R.2. Hydrock Consultants Ltd. Desk Study Report, The Wave, London. Ref: WAV-HYD-DS-RP-GE-1000-S0-P1, September 2018;
R.3. Hydrock Consultants Ltd. Site Investigation Report, The Wave, London: Siteworks Phase 1 Area. Ref.: WAV-HYD-XX-XX-RP-GE-1000-S2-P02, November 2019;
R.4. Green Earth Management Company (GEMCO) Ltd, Hydrogeological Risk Assessment, Environmental Permit Application, Deposit for Recovery at The Wave London, Enfield, Ref 2309 R03 Issue 1, March 2025;
R.5. Green Earth Management Company (GEMCO) Limited, Waste Recovery Plan, The Wave London, Ref 2309 R01 Issue 1, February 2025;
R.6. Environment Agency, Guidance, Landfill operators: environmental permits: What to include in your environmental setting and site design report, 30 January 2020, updated 17 January 2024;
R.7. Environment Agency, Guidance, Environmental permits, Plan the environmental setting of your site, January 2020, January 2024;
R.8. Environment Agency, Guidance, Waste recovery plans and deposit for recovery permits, June 2023;
R.9. Department for Environment Food & Rural Affairs, Catchment Data Explorer, 2025, https://environment.data.gov.uk/catchment-planning/;
R.10. Department for Environment Food & Rural Affairs, Water Quality Archive, 2025, https://environment.data.gov.uk/water-quality/view/explore?search=&area=10-36&samplingPointType.group=F&loc=536572%2C196670&_limit=500
R.11. Environment Agency: Flood Map for Planning (2025) https://flood-map-for-planning.service.gov.uk/
R.12. Environment Agency, Guidance, Waste Classification Technical Guidance, October 2021;
R.13. The Waste Framework Directive, 2008/98/EC (2018/851), Article 3 & Annex II, 2018 (adopted 2020);
R.14. Department for the Environment Food and Rural Affairs, Waste Hierarchy Guidance, June 2011;
R.15. UK Centre for Ecology and Hydrology, https://eip.ceh.ac.uk/apps/lakes/detail.html?wbid=41659;
R.16. British Geological Survey (BGS) Borehole Record – BGS ID 12709960, March 1976, https://api.bgs.ac.uk/sobi-scans/v1/borehole/scans/items/12709960;
R.17. Manual of Contract Documents for Highway Work, Volume 1 Specification for Highways Works Series 600, Earthworks, February 2016;
R.18. Gov.uk, Flood map for planning - https://flood-map-for-planning.service.gov.uk/;
R.19. Defra Catchment Data Explorer, https://environment.data.gov.uk/catchment-planning;
R.20. Nathanial C.P., et al. (2015). The LQM/CIEH S4ULs for Human Health Risk Assessment. Land Quality Press, Nottingham;
R.21. Christian Aid, Scorched Earth, The impact of drought on 10 world cities, May 2022;
R.22. HR Wallingford, Updated projections of future water availability for the third UK Climate Change Risk Assessment, Technical Report, MAR6025-RT002-R05-00, July 2020;
R.23. Environment Agency, The state of the environment: water resources, May 2018;
R.24. Met Office, Climate Data Portal, Annual Precipitation Observations 1991-2020, 12km, https://climatedataportal.metoffice.gov.uk/datasets/f6ed302049894ee8b230215a3efa9c19_0/explore?location=51.602238%2C-0.018044%2C11.99;
R.25. Environment Agency, LFTGN03: Guidance on the management of landfill gas (2014);
R.26. Council Directive 1999/31/EC on the Landfill of Waste (The Landfill Directive), June 2011;
R.27. Environment Agency, LFTGN02: Guidance on Monitoring of Landfill Leachate, Groundwater & Surface Water (2014);

https://www.gov.uk/guidance/landfill-operators-environmental-permits/what-to-include-in-your-environmental-setting-and-site-design-report

https://www.gov.uk/guidance/landfill-operators-environmental-permits/plan-the-environmental-setting-of-your-site#conceptual-site-model

Figure 1

Site Location Plan

Figure 2

Application Site Plan

Figure 3

Monitoring Well Construction Schematic

Appendix 1

The Wave London Masterplan Development Pack

Appendix 2

GEMCO Drawings

Site infrastructure Plan
Sensitive Receptor Plan
Cross Sections

Appendix 3

Topographic Survey

Appendix 4

Pertinent Site Investigation Information

Appendix 5

Environmental Risk Assessment

Appendix 6

Waste Acceptance / Compliance Limit Values

Appendix 7

TCM Certificate