2.5 Hydrogeology

2.5.1 The aquifer designation is set out below.

2.5.2 **Table 3. Aquifer Designation & Permeability**

Formation	Aquifer Designation	Permeability
Kempton Park Gravel Member	Secondary (A) Aquifer	Permeable layers capable of storage and transmission of groundwater.
London Clay Formation	Unproductive Strata	Low permeability preventing storage and transmission of groundwater.

2.5.3 The site is not situated within a groundwater Source Protection Zone.

3.0 DEVELOPMENT FLOOD RISK

3.1.1 A comprehensive assessment of present day and future flood risk to the Site both prior to and post development has been undertaken using the latest publicly available data and correspondence with relevant private third parties as appropriate.

3.2 Historical Flood Events

3.2.1 The EA's Historical Flood Map (Figure 7) and the SFRA (LBRT, 2021) do not indicate the occurrence of any recorded historical flood events in the vicinity of the Site. It should be noted that whilst no instances of historical flooding have been recorded, it is possible that historic flooding may have occurred but not been recorded.

3.2.2 A Section 19 flooding report(s) was produced by the Lead local Flood Authority (METIS, 2023) to assess the source and impacts of flooding in the July 2021 flood event. However, there are no records of flooding at or within the vicinity of the Site.

3.3 River (Fluvial), Sea (coastal) or Estuarine Flooding

3.3.1 The Site has been identified as at Very Low risk from estuarine flooding.

3.3.2 Estuarine flooding is a product of both fluvial and tidal flooding mechanisms where convergence between rivers and coastal waters occurs within the intertidal zone. Typically, the nature of estuarine flooding transitions from a fluvial dominance in the upstream reaches of the intertidal zone to tidal dominance in the downstream reaches of the intertidal zone.

3.4 Baseline estuarine Flood Risk

3.4.1 According to the EA's Flood Map for Planning (Figure 6), the Site is located within estuarine Flood Zones 1 to 3 and is therefore classified as having a Low to High probability of estuarine flooding from the nearby watercourse, the River Thames.

3.4.2	As defined in the NPPF (2023), without accounting for the presence of any flood defences, land located within Flood Zone 1 is considered to have a Low (<0.1%)/ Flood Zone 2 is considered to have a Medium (>0.1% to <1%) / Flood Zone 3 is considered to have a High (>1% - fluvial or 0.5 % tidal) risk of flooding within any given year.
3.4.3	As such, development classified as "Water-Compatible" and "Less Vulnerable" land uses are suitable for this zone with "More Vulnerable" and "Essential Infrastructure" potentially requiring an Exception test to be passed prior to development taking place.
3.5	**Flood Risk Including the Benefit of Defences**
3.5.1	The baseline probability of flooding for a given site, indicated by the EA's Flood Map for Planning Purposes, may be reduced by the presence of intervening flood defences, resulting in an 'actual' risk of flooding lower than that indicated by baseline modelling. As such, the EA's 'Risk of Flooding from Rivers and Sea' mapping (Figure 7) presents the flood risk to the Site from rivers and the sea, accounting for the presence and intended operation of flood defence infrastructure.
3.5.2	The risk rating is subject to the present condition and standard of protection of any defences and long-term maintenance/ upgrading of these defences and/or proposed defences to ensure that the current standard of protection is maintained throughout the lifetime of the development. However, the residual risk to the Site in the event of failure/ removal of these defences throughout the lifetime of the development should also be considered.
3.5.3	The Site is located within an area identified by the EA as an area where there is a 'Reduction in Risk of Flooding from Rivers and Sea due to Defences' (formerly 'Areas Benefitting from Defences').
3.5.4	Flood defences have been identified on the (watercourse(s)), comprised of a wall located approximately 15m to the north of the Site.
3.5.5	Information from the EA relating to the flood defences is outlined below.
3.5.6	• According to the EA (2024) the flood defences in place for this area are designed to provide protection during a 1 in 1000 year flood event, with a minimum crest level of 5.94 mAOD. • The EA normally inspects defences twice a year and although it does not classify the current condition of the defences in this instance, it is assumed the defences are in good condition, as they form part of the wider River Thames defences.
3.5.7	The flood defences are associated with wider protection offered by the Thames Barrier, which provides protection to the tidal River Thames against estuarine flooding up to and including a 1 in 1000 year flood event. The Thames Barrier requires regular maintenance and due to the predicted increase in flood events for which the barrier must be closed, the opportunity for maintenance will be reduced. To ensure sufficient maintenance periods are scheduled, some instances in which the barrier would normally shut will have to be allowed through and therefore flood levels upriver of the barrier will increase and the tidal flood walls are due to be raised in step between present day, 2065 and 2100 to ensure the current standard of protection is maintained.

3.6 **Model Data**

3.6.1 As the Site is located within the EA's estuarine floodplain, modelled flood elevation data was obtained from the EA and has been used to assess flood risk and to provide recommendations for mitigation for the proposed development, where applicable.

3.6.2 The flood data has been provided as in-channel water levels which are compared with flood defence crest heights to determine the likelihood of overtopping. In addition, there is a residual risk associated with a breach in the River Thames flood defences. Although this is considered extremely unlikely, the flooding extent and level of flooding in the event of a breach have been provided and compared with Site ground levels.

3.7 **Modelled Present-Day estuarine Risk**

3.7.1 The present-day effects of flood water from the River Thames overtopping and breaching the River Thames flood defences are described below.

3.7.2 The in-channel flood data has been related to the Site as the in-channel node point is located at a cross section to the Site, this is in-channel node point 2.17.

3.7.3 Breach scenario flood data is extracted from 2D raster grids which include flood levels within the wider surrounding floodplain.

3.7.4 ***Table 4. Modelled Present-Day Estuarine Flood Levels compared with flood defence crest heights and on-site ground and building floor levels.***

Levels (mAOD)	**Modelled in-channel Flood Levels (mAOD)**	**Modelled 2005 Breach Scenario**
	1 in 200 year	**1 in 200 year**
	5.170	5.216
On-Site ground levels (mAOD)	5.68 – 6.72	
Flood defence crest height (mAOD)	5.94	
Building Finished Floor Level (mAOD)	6.68 - 6.71	
Flood depths (m)	No Flooding	No flooding

3.7.5 The modelled data confirms there would be no flooding affecting the Site or the building in either the present-day overtopping or breach flood scenario events.

3.8 **Modelled Future estuarine Risk**

3.8.1 The EA's FMfP and RoFRaS mapping only presents the present day flooding risks at the Site and does not account for climate change. The EA's can however provide this on request, as part of their detailed model dataset.

3.8.2 The EA's Flood risk assessments: climate change allowances guidance (Published 19 February 2016 and updated May, 2022) have been used to inform a suitable increase in sea level rise for the proposed development. The updated guidance confirms 'More Vulnerable' developments are required to undertake a Basic assessment approach accounting for the impacts of climate change upon the future 'design flood level'. In this instance though, the EA's model provides the modelled flood level including an appropriate climate change allowance required to assess the development proposals.

3.8.3 ***Table 5. Modelled Future Estuarine Flood Levels compared with flood defence crest heights and on-site ground and building floor levels.***

Levels (mAOD)	**Modelled in-channel Flood Levels (mAOD)**	**Modelled 2005 Breach Scenario**
	1 in 200 year	**1 in 200 year**
	6.00	5.998
Onsite ground levels (mAOD)	5.68 – 6.72	
Proposed Flood defence crest height (mAOD)	6.55	
Onsite flood depths (m)	No flooding	0.32
Building Finished Floor Level (mAOD)	6.68 to 6.71	
Building Flood depths (m)	No Flooding	No flooding

3.8.4 It is clear from the modelled results that there would be no flooding on the Site, as a result of overtopping of the River Thames flood defences. However, there could be flooding on the Site in the unlikely event of a breach in the flood defences. This would result in shallow external flooding, but would not impact internal areas of the building or the entrance into the building or the Site.

3.9 **Surface Water (Pluvial) Flooding**

3.9.1 Surface water flooding occurs when intense rainfall exceeds the infiltration capacity of the ground and overwhelms the drainage systems. It can occur in most locations even at higher elevations and at significant distances from river and coastal floodplains.

3.10	**Present-Day Pluvial Risk**
3.10.1	According to the EA's Risk of Flooding from Surface Water (pluvial) flood mapping (Figure 14), the Site is currently at a Very Low risk of pluvial flooding. This equates to a <0.1% chance of pluvial flooding in any given year.
3.10.2	The SFRA does not indicate the occurrence of reported incidents of historical surface water flooding within 100 m of the Site. The SWMP confirms the Site is not located within a Critical Drainage Area.
3.11	**Future Pluvial Risk**
3.11.1	Paragraph 002 of the National Planning Practice Guidance (August, 2022) requires consideration of the 1% AP (1 in 100 year) event, including an appropriate allowance for climate change and is considered as the 'design flood event'.
3.11.2	As the Site is located within the London Management Catchment and the proposed development is classed as More Vulnerable, where the proposed lifespan is approximately 100 years, the Upper End (40%) allowance is required to determine a suitable climate change factor to apply to rainfall data.
3.11.3	As there are no modelled 1 in 100 year + climate change pluvial flooding scenarios, the EA's low risk (0.1% annual chance) event has been used as a proxy. The Site would remain unaffected in this scenario and therefore the risks of pluvial flooding are Very Low over the developments lifespan.
3.12	**Groundwater Flooding**
3.12.1	Groundwater flooding occurs when the storage capacity of below ground aquifers is exceeded due to excessive rainfall and or high fluvial/tidal levels, resulting in the emergence of groundwater at the surface. Due to the nature and mechanisms of groundwater flooding, the period over which groundwater flooding impacts upon an affected area can be significantly longer than other sources of flooding.
3.13	**Present Day Risk**
3.13.1	The Ambiental Risk Analytics Groundwater Flooding Map (Figure 13) indicates that there is a Moderate likelihood of groundwater emergence above the ground surface during a 1 in 100 year event.
3.13.2	Mapped classes within the screening map combine likelihood, possible severity and the uncertainty associated with predicting the subsurface system. The map is a national scale screening tool to prompt site-specific assessment where the impact of groundwater flooding would have significant adverse consequences. Mapping limitations and a number of local factors may reduce groundwater flood risk to land and property even where it lies within mapped groundwater flood risk zones, which do not mean that groundwater floods will occur across the whole of the risk area.

3.13.3	A site-specific assessment has been undertaken to refine the groundwater risk screening information on the basis of site-specific datasets (see Section 3) including BGS borehole data, site investigation and the EA's fluvial and tidal floodplain data (where available) to develop a conceptual groundwater model. The risk rating is refined further using the vulnerability of receptors including occupants and the existing and proposed Site layout, including the presence of basements and buried infrastructure. The presence of any nearby or on-Site surface water features such as drainage ditches, which could intercept groundwater have also been considered. The risks can be higher for basements, buried infrastructure and soakaway systems which may be affected by high groundwater levels, although the presence of a basement.
3.13.4	According to a review of hydrogeological conditions in the vicinity of the Site, the site is underlain by permeable superficial deposits overlying low permeability bedrock. It is therefore possible that a groundwater table is present underneath the Site within the superficial deposits which could potentially emerge at the Site in the event of prolonged rainfall and high tidal levels.
3.13.5	Although the potential for groundwater emergence at the Site has been identified, the local topography is such that the existing development threshold and essential access/ egress routes are at a higher level than surrounding ground levels. As such, groundwater emergence will preferentially occur in lower lying areas in the vicinity of the Site (subject to local variations in hydrogeological conditions).
3.13.6	This may affect buried infrastructure such as existing on-site drainage pipework, although this is relatively simple to mitigate.
3.14	**Future Risk**
3.14.1	Climate change predictions suggest an increase in the frequency and intensity of extremes in groundwater levels. Rainfall recharge patterns will vary regionally resulting in changes to average groundwater levels. A rise in peak river levels will lead to a response of increased groundwater levels in adjacent aquifers subject to the predicted climate change increases in peak river level for the local catchment. Sea level rises of between 0.4m and 1m are predicted by 2100, leading to a rise in average groundwater levels in the adjacent coastal aquifer systems, and potential increases in water levels in the associated drainage systems. The 'backing up' of groundwater levels from both coast and tidal estuary locations may extend a significant distance inland and affect infrastructure previously constructed above average groundwater levels.
3.14.2	The impact of climate change on groundwater levels beneath the Site is linked to the predicted risk in both peak river levels and sea levels and also the variation in rainfall recharge which is uncertain.
3.14.3	When considering the level of risk indicated by baseline mapping and accounting for local hydrogeological conditions and site-specific context, the risk of groundwater flooding to the existing and proposed development and associated essential infrastructure/ access and egress routes during a 1 in 100 year event are considered to be Low.
3.15	**Flooding from Artificial Sources**
3.15.1	Artificial sources of flood risk include waterbodies/ watercourses or conveyance systems that have been constructed or heavily modified by human activity, such as sewers, canals and reservoirs. As such, the flood risk from artificial sources is typically associated with breaches or operational failure of infrastructure but can also be influenced by natural hydrological processes.

3.16	**Sewer Flooding**
3.16.1	Clean water supply and wastewater removal infrastructure is comprised of piped networks to distribute water to and from private houses or industrial, commercial or institution establishments and other usage points. In urban areas, this represents a particular risk of flooding due to the large amount of water supply infrastructure, its condition and the density of buildings. The risks of flooding to properties from burst water mains cannot be readily assessed.
3.16.2	If more information regarding the condition and history of the water supply infrastructure within the vicinity of the Site is required, then it is advisable to contact the local water supplier, Thames Water.
3.16.3	The SFRA and SWMP reports (METIS Consulting, 2021) do not contain any information regarding the occurrence of sewer flooding events affecting the Site.
3.16.4	When considering the level of risk indicated by available sewer flooding records, the risk of sewer flooding to the existing and proposed development and associated essential infrastructure/ access and egress routes is considered to be **Low.**
3.17	**Canal Flooding**
3.17.1	According to Ordnance Survey (OS) mapping, there are no canals within 500 m of the Site.
3.18	**Culverts and Bridges**
3.18.1	Watercourses which are culverted or flow under bridges may be at an elevated risk of blockage by debris.
3.18.2	Culverts and bridges have been identified in the vicinity of the Site along watercourses that have been identified to potentially pose a flood risk to the Site. A bridge is located approximately 324m downstream of the Site and a culverted watercourse approximately 57m east of the Site.
3.18.3	These structures are unlikely to pose an elevated flood risk to the Site should they become partially or fully blocked, even when river levels are normal or in high flow, as they are a significant distance from the Site and they are likely to have a significant design capacity to accommodate the residual risks. Thus, they are not considered to present a residual risk to the Site.
3.18.4	When considering the level of risk associated with flooding due to blockage of nearby culverts and bridges to the existing and proposed development, associated essential infrastructure and access and egress routes is considered to be **Low.**
3.19	**Reservoir Flooding**
3.19.1	According to the EA's Risk of Flooding from Reservoir mapping the Site at risk of flooding from reservoirs (Figure 17) (EA, 2024). The risk of reservoir flooding is related to the failure of a large reservoir (holding over 25,000 m^3 of water) and is based on the worst-case scenario. Reservoir flooding is extremely unlikely to occur (EA, 2024).

3.19.2	The Site is considered to be at risk of flooding from the Lower Thames Reservoirs (Queen Elizabeth, Queen Mary and Staines Reservoirs) in the event of a breach during wet day conditions, when there is a fluvial contribution. However, as the reservoirs are highly regulated and if they were to breach would impact several thousand residential and commercial properties, and the combination of a wet day and a breach is a joint probability, a breach and resultant flooding are considered extremely unlikely.
3.19.3	When considering the level of risk associated with reservoir flooding to the existing and proposed development, associated essential infrastructure and access and egress routes is considered to be **Low.**
3.19.4	The risk of flooding to the Site from all artificial sources has been considered and has been determined to be **Low.**

4.0 DEVELOPMENT SUITABILITY

4.1	**National Policy and Guidance for Development In 'At Risk' Areas**
4.1.1	The development proposals have been assessed within the context of the existing and proposed risks (including climate change) and relevant national policy as stipulated by the NPPG (2022) and NPPF (2023) to determine the suitability of the development in principle.
4.2	**Sequential and Exceptions Test**
4.2.1	The aims of the national planning policies are achieved through application of the Sequential Test and in some cases the Exception Test, as stipulated by the NPPF (2023) and associated NPPG (2022).
4.2.2	Suitability of the proposed development, and whether the Sequential and Exception Tests are required, is based on the Flood Zone the Site is located within and the flood risk vulnerability classification of the existing and proposed development. Some developments may contain different elements of vulnerability and the highest vulnerability category should be used, unless the development is considered in its component parts.
4.2.3	The application is considered a 'Change of Use' of the existing building from commercial to residential and in line with Paragraph 174 of the NPPF (2023), it is not subject to the Sequential or Exception Tests.
4.2.4	Paragraph 174 of the NPPF (2023) states: *"Applications for some minor development and changes of use [60] should not be subject to the sequential or exception tests but should still meet the requirements for site-specific flood risk assessments set out in footnote 59.*

4.2.5 ***Table 6. Flood risk vulnerability and flood zone incompatibility for new developments (taken from NPPG, 2022)***

Vulnerability Class / Flood Zone	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1 – low probability	✓	✓	✓	✓	✓
Zone 2 – medium probability	✓	✓	Exception test required	✓	✓
Zone 3a - high probability	Exception test required	✓	X	Exception test required*	✓
Zone 3b –functional flood plain	Exception test required	✓	X	X	X

* As the development proposals are for **the change of use of the existing building** the Sequential and Exception Tests are not required.

4.3 Flood Risk Standing Advice

4.3.1 The Environment Agency's Flood Risk Standing Advice (FRSA) is applicable when considering any relevant vulnerable developments (i.e. more vulnerable, less vulnerable and water compatible), advice on the points should be followed:

- Surface water management;
- Access and evacuation; and
- Floor levels.

4.4 Surface Water Management

4.4.1 Plans for the management of surface water need to meet the requirements set out in either the local authority's:

- Surface water management plan where available; OR
- Strategic flood risk assessment.

4.4.2 They also need to meet the requirements of the approved building regulations Part H: drainage and water disposal. Read section H3 rainwater drainage.

4.4.3 Planning permission is required to use a material that can't absorb water (e.g. impermeable concrete) in a front garden larger than $5m^2$.

4.4.4	**No changes are being made to external areas, which may change their permeability to rainfall runoff. Where any changes are made, these are likely to be relatively minor and can be connected into the existing drainage network.**
4.5	**Access and Evacuation**
4.5.1	Details of emergency escape plans should be provided for any parts of a building that are below the estimated flood level.
4.5.2	Plans should show: • Single storey buildings or ground floors that don't have access to higher floors can access a space above the estimated flood level, e.g. higher ground nearby; • Basement rooms have clear internal access to an upper level, e.g. a staircase; • Occupants can leave the building if there's a flood and there's enough time for them to leave after flood warnings.
4.5.3	**The development building and access routes into the Site are not impacted by flooding, even in the unlikely event of a breach in the River Thames flood defences, so occupants would be safe to access and egress the Site for the lifetime of the development. There are also upper floor areas if these are required to be used.**
4.6	**Floor Levels**
4.6.1	The following should be provided: • Average ground level of your site • Ground level of the access road(s) next to your building • Finished floor level of the lowest room in your building
4.6.2	Finished floor levels should be a minimum of whichever is higher of 300mm above the: • Average ground level of the site • Adjacent road level to the building • Estimated river or sea flood level
4.6.3	**The building FFL's are set at 6.68-6.71 mAOD, this is 0.682m above the maximum 2100 breach flood level of 5.998 mAOD.**
4.6.4	You should also use construction materials that have low permeability up to at least the same height as finished floor levels.
4.6.5	If you cannot raise floor levels to meet the minimum requirement, you will need to: • Raise them as much as possible • Consider moving vulnerable uses to upper floors • Include extra flood resistance and resilience measures

4.6.6	When considering the height of floor levels, you should also consider any additional requirements set out in the SFRA. Flood water can put pressure on buildings causing structural issues. If your design aims to keep out a depth of more than 600mm of water, you should get advice from a structural engineer. They will need to check the design is safe.
4.7	**Extra Flood Resistance and Resilience Measures**
4.7.1	Follow the guidance in this section for developments in flood risk areas where you cannot raise the finished floor levels to the required height. You should design buildings to exclude flood water where possible and to speed recovery in case water gets in.
4.7.2	Make sure your flood resilience plans for the development follow the guidance in the CIRIA Property Flood Resilience Code of Practice. Please note that the code of practice uses the term 'recovery measures'. In this guide we use 'resilience measures'.
4.7.3	Flooding can affect the structural stability of buildings. If your building design would exclude more than 600mm of flood water, you should get advice from a structural engineer. They will need to check the design is safe. Only use resistance measures that will not cause structural stability issues during flooding. If it is not possible to safely exclude the estimated flood level, exclude it to the structural limit then allow additional water to flow through the property.
4.7.4	The design should be appropriately flood resistant and resilient by: • Using flood resistant materials that have low permeability to at least 600mm above the estimated flood level • Making sure any doors, windows or other openings are flood resistant to at least 600mm above the estimated flood level • Using flood resilient materials (for example lime plaster) to at least 600mm above the estimated flood level • By raising all sensitive electrical equipment, wiring and sockets to at least 600mm above the estimated flood level • Making it easy for water to drain away after flooding such as installing a sump and a pump • Making sure there is access to all spaces to enable drying and cleaning • Ensuring that soil pipes are protected from back-flow such as by using non-return valves
4.7.5	Temporary or demountable flood barriers are not appropriate for new buildings. Only consider them for existing buildings when: • There is clear evidence that it would be inappropriate to raise floor levels and include passive resistance measures • An appropriate flood warning or other appropriate trigger is available

5.0 FLOOD MITIGATION

	Based on the flood risk identified at the Site, the national and local policies and guidance and proposed development, the following mitigation measures should be considered to reduce the risk of flooding to the proposed/ existing development.
5.1	**Rivers (Fluvial) Flood Mitigation Measures**
5.1.1	As the Site is not identified as being at risk of flooding from fluvial sources, mitigation measures are not required.
5.2	**Sea (Coastal/Tidal) Flood Mitigation Measures**
5.2.1	As the Site is not identified as being at risk of flooding from the sea, mitigation measures are not required. The FFL's of the existing property are already set higher than the maximum 2100 breach scenario flood level.
5.3	**Surface Water (Pluvial) Flood Mitigation Measures**
5.3.1	As the Site is not identified as being at risk of pluvial flooding, mitigation measures are not required.
5.3.2	The existing on-site drainage networks on the Site have not been surveyed to assess their condition or capacity, but it is recommended these are maintained in perpetuity with the development to ensure their condition and capacity are maximised.
5.4	**Groundwater Flooding Mitigation Measures**
5.4.1	As the groundwater table could be relatively shallow beneath the Site, particularly when the River Thames water levels are high, non-return flap valves on the existing foul and surface water sewer lines should be considered.
5.4.2	If these mitigation measures are implemented this could reduce the flood risk to the development from Low to Very Low.
5.5	**Artificial Flooding Mitigation Measures**
5.5.1	Artificial flooding occurs when the failure of infrastructure or human intervention results in flooding. Artificial sources include reservoirs, canals, water retention ponds, docks and other artificial structures such as sewers, culverts and bridges.
5.6	**Sewer Flood Mitigation Measures**
5.6.1	Whilst the Site has not been identified as at risk of sewer flooding, it is advised that regular maintenance of the existing/ proposed on-Site drainage system is undertaken to prevent blockages (e.g., clearance of silt traps and debris, remediation/ replacement of damaged pipework) and following heavy rainfall.