12. Surface Water Drainage and Flood Risk

Introduction

12.1 This Chapter, prepared by Waterman Infrastructure & Environment Limited (Waterman), presents an assessment of the likely significant effects of the Development on flood risk and surface water drainage, together with the likely significant effects of the Development on the capacity of foul and potable water supply infrastructure. The likely significant effect on groundwater quality resulting from potential ground contamination is assessed separately in **Chapter 11: Ground Conditions and Contamination**.

12.2 This Chapter provides a description of the methods used in the assessment and a description of the relevant baseline conditions of the Site and surrounding area. This is followed by an assessment of the likely significant effects of the Development during demolition, alteration, refurbishment and construction (the Works), and once the Development is completed and operational. Mitigation measures are identified, where appropriate, to avoid, reduce or offset any likely significant adverse effects identified and / or enhance any likely beneficial effects. Taking account of the mitigation measures, the nature and likely significance of residual effects are described.

12.3 This Chapter is supported by the following appendices:

- **Appendix 12.1**: Flood Risk Assessment (FRA), prepared by Hydro-Logic;
- **Appendix 12.2**: Drainage Strategy, prepared by Waterman;
- **Appendix 12.3**: Condition Survey of the Flood Defence Wall report, prepared by Waterman;
- **Appendix 12.4**: The Malting Wall Assessment, prepared by Waterman; and
- **Appendix 12.5**: Flood Defence wall Liaison Summary Note, prepared by Waterman.

Assessment Methodology and Significance Criteria

Assessment Methodology

12.4 The FRA and the Drainage Strategy were used to inform the baseline conditions of the Site and likely significant effects of the Development on surface water resources and flood risk. These reports were undertaken in accordance with the National Planning Policy Framework (NPPF)[1] and in consultation with statutory consultees including London Borough of Richmond Upon Thames (LBRuT), Environment Agency (EA), Port of London Authority (PLA) and Thames Water. A summary of the methodology is provided as follows. Full details are provided in **Appendix 12.1** and **Appendix 12.2**.

12.5 In respect of the assessment of the outline component of the Development (Development Area 2), the assessment set out within this Chapter has considered the maximum allowable spatial parameters sought for approval. This would give rise to the most intrusive ground works and the maximum amount of impermeable land cover so can be considered to reflect a 'worst-case' assessment for issues such as groundwater flooding and surface water flooding. That said, based on professional and expert judgement, it is unlikely that the minimum allowable spatial parameters sought for approval would give rise to materially different flood risk effects. This is because the scale of Works that would be required for both the maximum and minimum allowable parameters would be similar and the sensitive receptors likely to be affected by flooding would be the same.

Baseline Data Collection and Sources

12.6 The relevant baseline conditions of the Site and surroundings were established using the following sources of information:

- the Environment Agency's (EA) online flood maps and hydraulic base modelling for the River Thames;
- Ordnance Survey (OS) maps, topographical surveys and British Geological Society (BGS) maps;
- on-Site surface water drainage records to review the existing drainage infrastructure;
- the Preliminary Environmental Risk Assessment and the Environmental Risk Assessment in relation to ground conditions and contamination prepared by Waterman (refer to **Appendix 11.1** and **11.2**) and the AECOM Environmental Site Assessment Reports[2,3,4];
- a visual inspection of the Site to establish the condition of the Site including drainage;
- review of the Condition Survey of the Flood Defence Wall report (**Appendix 12.3**) and The Malting Wall Assessment (**Appendix 12.4**) undertaken by Waterman;
- consultation with the EA and Thames Water to obtain historical reports on flooding incidents and sewer records; and
- a review of relevant local planning policy documents.

Flood Risk Assessment

12.7 An FRA (refer to **Appendix 12.1**) has been undertaken by Hydro-Logic, in accordance with the requirements of the National Planning Policy Framework (NPPF)[1] and the accompanying technical guidance[5]. The purpose of the FRA is to identify all potential sources of flooding at the Site, determine the risk posed by these flooding sources to the Development and to predict the likely effect on flood risk that the Development poses to surrounding receptors. Tidal, fluvial, pluvial (surface water), sewer, groundwater and artificial, flood risks have been considered in the FRA, with allowances made for the likely effects of climate change, where relevant. In addition to breach modelling provided by the EA, Hydro-logic undertook further breach modelling, as requested by LBRuT following the FRA Scoping Level FRA (refer to Appendix B and C of **Appendix 12.1**), as part of the FRA to establish the effect that the Development may have on flood extents resulting from breach analysis.

12.8 As the Section 278 works would include highway re-modelling works (refer to **Chapter 5: The Proposed Development**), there would be no change of land-use or impact on ground levels in this part of the Site. There are accordingly, no flood risk implications of this part of the Site and it is not considered further in the FRA. The geographical coverage of the FRA is therefore considered to be appropriate and robust for the purposes of the assessment.

Drainage Strategy

12.9 Consideration is also given in the FRA to surface water drainage to ensure the Development does not increase the risk of flooding at off-Site locations. Accordingly, a drainage strategy for the Development has been prepared by Waterman (refer to **Appendix 12.2**). This sets out the proposed surface water runoff rates, together with the type and volume of attenuation proposed. The drainage strategy has been used to inform the FRA and the qualitative assessment presented in this Chapter, which has been based on professional judgement.

12.10 The foul water flow rates of the Development were calculated by Waterman. Based on the calculated foul water discharge rates of the Development a qualitative assessment has been

undertaken using professional judgement to assess the likely significant effects of the Development on foul water capacity.

12.11 The Drainage Strategy has been developed for the Stag Brewery component of the Site only. The part of the Site which will require Section 278 works is highway land and all drainage aspects are the responsibility of the local highway authority. The surface water run-off from the highway drainage would be discharged to the sewer as existing and would not be attenuated. As a result, the Section 278 works at Chalkers Corner are not included in the Drainage Strategy, this is an appropriate and robust approach.

Potable Water Demand

12.12 A qualitative assessment of the likely significant effects of increased demand on the capacity of potable water supply infrastructure at the Site has been undertaken. The assessment is based upon available published information from Thames Water and calculations of the Development's likely potable water demand prepared by the Applicant's Building Services Engineers (Hoare Lea).

Significance Criteria

12.13 **Table 12.1** includes the criteria used for the classification of the receptors, whilst **Table 12.2** provides the magnitude of the change.

12.14 In accordance with **Chapter 2: EIA Methodology**, the relative significance of the likely and residual effects considered in this Chapter are based upon the scale of significance presented in **Table 12.1**.

Table 12.1 Receptors Sensitivity Criteria

Receptor	Sensitivity	Commentary
Surface water bodies	Low	High Status under the WFD-UK regulation[6].
	Medium	Moderate to Poor Status under the WFD-UK regulation.
	High	Bad Status under the WFD-UK regulation.
Surface and foul water sewers	Low	Private drainage infrastructure in rural areas.
	Medium	Private drainage infrastructure in urbanised areas.
	High	Public drainage infrastructure in urbanised and rural areas.
Water mains	Low	Private water supply infrastructure in rural areas.
	Medium	Private water supply infrastructure in urbanised areas.
	High	Public water supply infrastructure in urbanised and rural areas.
Aquifer	Low	Non-productive strata
	Medium	Secondary Aquifer
	High	Principal Aquifer
Groundwater quality	Low	Outside a Source Protection Zone
	Medium	Source Protection Zone III
	High	Source Protection Zone I & II
Flood risk receptors	Low	Rural artefacts
	Medium	Commercial properties / Construction Site
	High	Residential properties

Table 12.2: Magnitude of Change

Significance Criteria	Description of Criteria
Unchanged	No appreciable change in flood risk. No change to demand surface and/or foul water infrastructure. No change to demand on the capacity of water supply and the existing water supply infrastructure. No change in the in the controlled water quality.
Low	Minor local-scale increases/reductions in flood risk. Increase in surface and / or foul water discharge which would require modifications to existing infrastructure / Temporary local scale reduction in demand on surface and / or foul water infrastructure. Increase in water supply which would place additional pressure on existing local supplies and existing water supply infrastructure / Temporary local scale reduction in water supply demand and temporary increase in the capacity of existing infrastructure. Minor change in the controlled water quality.
Medium	Moderate local-scale or minor regional-scale increases / reductions in flood risk. Increase in surface and / or foul water discharge which would place undue pressure on existing infrastructure / Minor permanent reduction in demand on surface and / or foul water infrastructure. Increase in water supply which would place undue pressure on existing local supplies and existing water supply infrastructure. Permanent local scale reduction in water supply demand and permanent increase in the capacity of existing infrastructure. Moderate change in the controlled water quality.
High	Significant local-scale or moderate to significant regional-scale increases/reductions in flood risk. Increase in surface and / or foul water discharge which would require new infrastructure / Major permanent reduction in demand on surface and / or foul water infrastructure. Increase in water supply which would exceed the water resource capacity of the region and therefore require new sources e.g. application of an abstraction licence / Permanent regional scale reduction in water supply demand and permanent increase in the capacity of existing infrastructure. Major change in the controlled water quality.

Table 12.3: Significance of the Effects Criteria

	Magnitude of the Impacts			
Receptors Sensitivity	**High**	**Medium**	**Low**	**Unchanged**
High	*Major*	*Moderate*	*Medium/Minor*	*Insignificant*
Medium	*Moderate*	*Medium*	*Minor/Insignificant*	*Insignificant*
Low	*Medium*	*Minor*	*Insignificant*	*Insignificant*

Baseline Conditions

Topography

12.15 The Site is generally flat with no significant variations in the topographical gradient. The LiDAR map indicates that it is lowest to the east of the Site (4 to 6 m AOD) and highest in the north-west of the Site (8 to 10 m AOD).

Geology

12.16 The geology beneath the Site, summarised in **Table 12.4**, was established from previous ground investigations by Dames and Moore (1995), CRA (2003), Aecom (September 2015), Waterman (2016), BGS records, and the findings of the Waterman Ground Investigation undertaken in the eastern part of the Site. Further details of the underlying geology are described in **Chapter 11: Ground Conditions and Contamination**, **Appendix 11.1** and **Appendix 11.2**.

Table 12.4: Geological Sequence Beneath the Site

Stratum	Area Covered	Estimated Thickness (m)	Typical Description
Hardstanding	Entire Site (excluding the playing fields).	0.25 - 0.8	Tarmac or reinforced concrete floor slab at surface level. Encountered as two or three separate layers up to 0.5 m thick, each separated by up to 0.5 m Made Ground in eastern area.
Made Ground	Entire Site.	0.4 - 2.7	Predominantly coarse sand and gravel, including pieces of brick and minor amounts of black clinker. Rare pipe fragments.
Alluvium	Entire Site.	0.3 - 1.5	Soft brown grey slightly gravelly clay. Gravel is fine to coarse flint.
Kempton Park Gravel Formation	Entire Site.	1.4 - 3.9	Clayey, silty sand with varying gravel content with areas of soft, brown, sandy clay. Gravel is sub-angular to rounded, fine to coarse flint.
London Clay Formation	Entire Site.	73	Stiff grey to brown clay, with occasional pockets of silt and sand.
Lambeth Group	Entire Site.	15 - 20	Clay, some silty or sandy, with sands and gravels.
Thanet Formation	Entire Site.	5 - 10	Fine grained sand that can be clayey and glauconitic. Flints at the base of the formation.
Chalk Group	Entire Site.	Not proven.	Chalk and flints.

Hydrology and Hydrogeology

12.17 The nearest surface water to the Site is the River Thames, directly adjacent to the north of the Site (Development Area 1). The section of River Thames nearest to the Site is also known as the Middle Thames, which is located within the Thames River Basin Management Area. It has been assessed by the EA as having an overall 'Moderate' status, with a 'Moderate' grading ecological status and 'Fail' grading for chemical quality. The River Thames at this location forms part of the River Thames and Tidal Tributaries Site of Metropolitan Importance for nature conservation. On this basis the River is considered to be a surface water quality receptor of 'Medium' sensitivity.

12.18 The EA's Aquifer Designation Map[7] indicates that the Alluvium and Kempton Park Gravel Formation underlying the Site are classified as a Secondary A Aquifer (minor aquifer). These are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. As such, these aquifers are considered to have a 'Medium' sensitivity.

12.19 Based on available information, it is anticipated that shallow groundwater in the Alluvium and Kempton Park Gravel Formation is in hydraulic continuity with the River Thames directly adjacent to the Site.

12.20 The London Clay Formation is an Unproductive Stratum. The Lambeth Group and Thanet Formation are both also classed as Secondary A Aquifers, with the Chalk Formation at depth a Principal Aquifer. Principal aquifers provide significant quantities of drinking water and water for business needs, and may also support rivers, lakes and wetlands. As such, the secondary aquifers are considered to have a 'Medium' sensitivity and principal aquifer is considered to have a 'High' sensitivity.

12.21 According to the EA, the Site is not located within a groundwater Source Protection Zone. Groundwater vulnerability is therefore classified as 'Low'.

Groundwater Level

12.22 Previous Site Investigations by AECOM in September 2015[3] for the Site and subsequently Waterman in October 2016 for the east part of the Site (refer to **Appendix 11.2**) observed broadly consistent groundwater levels generally 2 m AOD in the east part of the Site (east of Ship Lane) and 1.3 m AOD in the west part of the Site (west of Ship Lane). Occasional perched levels were also observed at different locations across the Site. The 2015 monitoring results indicate the inferred groundwater flow direction to be to the west.

12.23 Tidal effects from the River Thames on groundwater levels were also assessed. The assessment indicates that groundwater levels of the northern boundary of the east part of the Site had a very subdued response to tidal variation.

Groundwater Abstractions

12.24 There are two recorded historical groundwater abstractions within the Site boundary. These wells were drilled circa 1830, extended to 101m and 121m below ground level and drew groundwater from the Chalk Group aquifer. A further two groundwater abstractions are recorded within a 1km radius of the Site. The closest of these is located 219m north of the Site at Dukes Meadow Golf Club, drawing groundwater from the Chalk Group aquifer for irrigation of the playing green. The further abstraction is located 643m north-east, also at Dukes Meadow Golf Club for irrigation purposes. There are no Environmental Permits for discharges to groundwater recorded within 1km of the Site.

Tidal and Fluvial Flood Risk

12.25 The EA have provided maps of the flood zone which shows that the east and south of the Site is located within Flood Zone 3 (high probability of tidal flooding), and the north-east of the Site is located in Flood Zone 2 (medium probability of tidal flooding). The principal source of flood risk to the Site is from the River Thames, which is entirely from tidal flooding, with no fluvial component. As such, the risk of fluvial flooding is very low and has not been considered further within this Chapter.

12.26 Despite being located within an area at a medium to high probability of tidal flooding, the Site is protected up to the 1 in 1000-year standard by the River Thames defences. The Thames Estuary 2100 Plan (TE2100)[8], would ensure that the River Thames defences are not overtopped for the lifetime of any redevelopment on the Site. Furthermore, the Site currently benefits from tidal flood defences along the river frontage. These are formed from the Site boundary walls and the Maltings building.

12.27 Given the Site is protected by the River Thames flood defences, the risk of tidal flooding is considered to be low.

Breach

12.28 Despite the Site being defended from tidal flooding, the EA require assessment of the residual risk of flooding to the Site should the defences fail (breach).

12.29 The EA have provided their breach modelling maps and levels (refer to **Appendix 12.1**) which show that some parts of the Site could be affected if the defences were to fail. EA modelling indicates that in this scenario the Site could be subject to a future peak flood level of 6.03 m AOD by the year 2100. The further breach modelling undertaken by Hydro-logic for the Development is presented later in this Chapter.

Surface Water (Pluvial) Flood Risk

12.30 Pluvial flooding occurs when natural and engineered systems lack capacity to manage the volume of rainfall. Pluvial flooding can occur in urban areas during an extreme, high intensity, low duration summer rainfall event which overwhelms the local surface water drainage systems. This flood water would then be conveyed via overland flow routes based on the local topography.

12.31 Review of the EA's Risk of Flooding from Surface Water map indicates that most of the Site is at a 'very low' risk of surface water flooding. However, there are some areas, generally in the south of the Site, that are shown to be at a 'low' to 'high' risk of flooding.

12.32 In the low-risk scenario, greater depths of surface water flooding are predicted in Lower Richmond Road adjacent to the Watney's Sports Ground playing fields (300 to 900 mm) and in Mortlake Green, south of Lower Richmond Road (in excess of 900 mm). Some of the surface water flooding on Lower Richmond Road may be linked to blocked gully incidents.

12.33 For the high-risk scenario, predicted surface water flooding is restricted to the carriageway of the Upper Richmond Road and the adjacent park and is of shallow depth.

12.34 Although surface water and foul sewers are laid under the Site, Thames Water have confirmed that there is no recorded history of sewer flooding at the Site (in their response to Waterman dated January 2016), extracts from which are shown in Appendix E of **Appendix 12.1**.

12.35 Given the generally 'very low' risk of surface water flooding and the lack of pluvial flooding history, it is considered that the risk of pluvial flooding from surcharged sewers or overland surface water runoff is low.

Groundwater Flood Risk

12.36 As previously described, groundwater levels are generally 2 m AOD in the east part of the Site (east of Ship Lane) and 1.3 m AOD in the west part of the Site (west of Ship Lane), with occasional perched groundwater levels.

12.37 LBRuT have confirmed that they hold no record of any flooding reports at Mortlake High Street, Lower Richmond Road, Ship Lane or Williams Lane, other than blocked gully reports.

12.38 Given that LBRuT hold no records of historical groundwater flooding within and surrounding the Site, groundwater flooding at the Site is considered to be low over the majority of the Site. However, in the far east of the Site, there is some uncertainty over the relative influence of the mechanisms controlling groundwater flow through the Site - either through the high permeability Kempton gravels and / or groundwater flows in the underlying minor aquifer.

Flood Risk from Artificial Sources

12.39 The Site has a potential risk of flooding from the Queen Elizabeth II reservoir and the Queen Mary reservoir in Surrey. This could occur if the reservoirs were to fail, causing water to flood over the western and southern parts of the Site. However, these reservoirs are located over 20 km upstream of the Site and are managed and maintained by Thames Water. All large reservoirs must be inspected and supervised by reservoir panel engineers. The EA are the enforcement authority for the Reservoirs Act 1975[9] who ensure that reservoirs are inspected regularly and essential maintenance and safety work is carried out. This would ensure that the embankments are maintained to a high standard, reducing the associated flood risk.

12.40 There are no other artificial bodies of water in proximity to the Site, resultantly the risk of flooding from artificial sources is very low. Consequently, flood risk from artificial sources has not been considered further in this Chapter.

Sensitivity of the Flood Risk Receptors

12.41 Since the Development will introduce a range of uses including residential, educational and commercial uses, the sensitivity of the receptors is anticipated to be 'High' to 'Medium' once the Development is completed and operational.

Infrastructure

Flood Defences

12.42 The formal River Thames defences within and in the vicinity of the Site are made up of a combination of walls, existing buildings and raised ground levels.

12.43 EA correspondence (refer to **Appendix 12.5**) indicates that the present day statutory flood defence level at the Site is 5.94m AOD.

12.44 Defence record drawings confirm that the defences adjacent to the Site vary in construction. In some locations, the defences consist of the remaining exterior walls of historic buildings (where the windows have been bricked up). For example, the brick wall of the Maltings Building within the Site behind the towpath, forms part of the flood defence wall. A Site visit confirmed that in some locations the walls themselves are considerably taller than the statutory defence height (5.94m AOD). A short section of the tidal defences is also formed in an informal basis by Ship Lane, as it rises away from the River Thames in a southerly direction. On occasion, Ship Lane and the adjacent towpath within the north of the Site can become flooded at high tide, as noted during a previous walkover of the Site by Waterman (refer to **Appendix 12.1**).

12.45 Stop-logs (hydraulic engineering control elements) are located in Bull's Alley. The stop-log arrangement at Bull's Alley enables maintenance vehicles to access the river to clear debris on the foreshore. Given this regular usage, it is anticipated that this location would be regularly inspected and maintained.

12.46 The current condition of the defences is rated by the EA as 2 which is 'good' on a scale of 1 (very good) to 5 (very poor). However, a flood defence wall condition survey (**Appendix 12.3**) undertaken by Waterman in September 2016 for a 368 m stretch of the River Thames wall along the northern boundary of the Site found the flood defence wall to be in a poor to fair condition. Due to the nature of the existing defences it is likely that some areas would need to be replaced as part of any development proposals coming forward.

Existing Foul Drainage

12.47 Thames Water sewer records (refer to Appendix B of **Appendix 12.2**) indicate that several sewers are present near to and beneath the Site, as indicated in **Table 12.5**. Given these sewers are public (rather than private) these are considered to be 'High' importance / sensitivity.

Table 12.5: Existing Sewers Associated with the Site

Location	Sewer
Crossing through the north-west of the Site.	225mm diameter Thames Water foul sewer.
Within north-west of the Site.	Two Thames Water foul rising mains.
Along north-eastern boundary of the Site along the Thames towpath.	686mm diameter combined Thames Water sewer.
West of the Site along Williams Lane.	900mm diameter Thames Water surface water sewer.
South of the Site along Lower Richmond Road.	600mm diameter Thames Water surface water sewer.
	750mm diameter and 225mm diameter Thames Water foul water sewer.
Centre of the Site along Ship Lane.	600mm diameter Thames Water surface water sewer.
	225mm diameter Thames Water foul water sewer.

12.48 Following review of the existing on-Site drainage records for the Site (refer to Appendix C of **Appendix 12.2**) it is understood that existing drainage scenario is as follows:

- existing foul flows discharge to the Thames Water sewer network;
- existing surface water flows from the north-east of the Site discharge into the Thames via an existing outfall; and
- existing surface water flows from the remainder of the Site discharge to the Thames Water sewer network at various connection points.

12.49 Based on an area of 5.89 ha currently draining into the Thames Water network, the existing discharge rate was calculated to be 841 litres per second (l/s). The existing foul discharge rate has been calculated using the water consumption method at 14.4 l/s.

Potable Water Supply and Demand

12.50 Thames Water is responsible for public water supply within in, and in the locality of the Site. There are water distribution mains surrounding the Site including those running alongside Thames Bank (north-west of the Site), Williams Lane (western boundary of the Site), Ship Lane (running north-south within the centre of the Site) and Lower Richmond Road / Mortlake High Street (south of the Site). A trunk main also runs along Lower Richmond Road / Mortlake High Street.

12.51 As the existing Site is currently vacant (with the exception of temporary office / filming uses), there is currently no significant on-Site demand for potable water and therefore there is no existing water demand rate for the Site.

Likely Significant Effects

The Works

Groundwater Flow and Flooding

12.52 With reference to **Chapter 5: The Proposed Development** and **Chapter 6: Development Programme, Demolition, Alteration, Refurbishment and Construction**, the bottom of the proposed basement slab within the east part of the Site (east of Ship Lane) would be set at 0.76 m AOD. This is around 1.25 m below the typical groundwater level of 2 m AOD. The basement levels under Building B01 (cinema) are locally lower at -1.635m AOD, therefore, also below the typical groundwater level by 3.64 m. Whilst locally, some higher groundwater levels have been observed up to 3 m AOD, although these are believed to be perched water tables that reflect local interventions.

12.53 The proposed foundation design for all buildings within the detailed element of the Site would comprise a 1 m deep piled raft, with the exception of the proposed cinema area which would be founded in 1 m deep local pile caps with 1 m deep ground beams. Below the foundations, all buildings would have an expanse of piles (3 to 5 per column) that would be 600mm in diameter and extending down up to 25m in length. However, as the piles would be relatively small in diameter (up to 600mm), groundwater flow would be able to continue to move around the new piles.

12.54 The maximum depth of the proposed basement within the west part of Site (west of Ship Lane), would be set at 2.45m AOD. All proposed buildings in the western part of the Site would be above the observed groundwater levels of September 2015, therefore the Works would not impede or interfere with any groundwater flows in this part of the Site.

12.55 The new flood defence wall would be formed within the north of the Site. This would comprise a sheet pile wall with an in-situ reinforced concrete capping beam. The toe level of the sheet pile wall would be set at -1 m AOD. Given the flood defence wall piling works would be undertaken immediately next to the River Thames, and groundwater at this location is in hydraulic continuity with the river, groundwater flow would not be impeded by these works.

12.56 In view of the above, perched groundwater could be encountered during the excavation works required to construct the basement within the east part of the Site (east of Ship Lane). This could lead to the ingress of groundwater and potential flooding of excavated areas. The potential effect from increased flood risk from groundwater during construction, however, would be temporary and highly localised on-Site. It is therefore not considered likely that the excavation works would lead to an increase in flood risk from groundwater beyond the Site. Taking a precautionary approach, it is anticipated that during excavation of the basement within the east part of the Site (east of Ship Lane) in the absence of mitigation there would be a **temporary**, **short** to **medium-term**, **local**, **adverse effect** of **minor significance** in respect of groundwater flooding.

Surface Water (Pluvial) Flood Risk

12.57 Construction works, including earthworks, removal of some soft landscaping and trees, storage of waste stockpiles, sewer diversions and temporary Site drainage, would have the potential to give rise to changes in the surface water run-off regimes particularly during periods of heavy rainfall. The diversions would need to be undertaken prior to the commencement of the basement construction and would require formal liaison with Thames Water.

12.58 In the absence of mitigation, the risk of surface water flooding from overland sources could increase, as discharge rates may not be controlled, and overland surface water run-off could

potentially be diverted away from the existing sewers and towards areas at higher risk of surface water flooding (such as Lower Richmond Road and Mortlake Green). A temporary change in Site conditions, and in surface water drainage regimes, could give rise to a **temporary**, **short to medium term**, **local**, **adverse effect** of **minor significance**.

Flood Defence Wall

12.59 The Development does not propose any direct work to the River Thames. Nonetheless, statutory exclusion zones from the River Thames and approval of relevant consents for sewer diversion works would be agreed with the EA and other appropriate bodies in advance of the Works.

12.60 The Works, including work to the flood defence wall and the construction compounds, would be located behind the existing flood defence wall, within the Site, ensuring that access to the flood defence wall from the towpath is maintained. This would ensure that access to the flood defence wall for inspection and maintenance would not be hindered during the Works. As such the likely effect on access to the flood defence wall during the Works would be **insignificant**.

12.61 As set out previously, the new flood defence walls comprise a sheet pile wall with an in-situ reinforced concrete capping beam behind the existing flood defence wall. The existing flood defence wall would be lowered in certain areas. However, this would be undertaken after the new flood defence wall has been built, which would be set at a minimum of 6.70 m AOD, well above the current statutory level of 5.94 m AOD. In parts, the wall would be lowered at 6.13 m AOD but would be topped by a 1.1 m high glass balustrade, with an effective crest at 7.23 m AOD. Temporary defences would also provide the required level of protection until any replacements are in place and the Works would be undertaken when there is no practical risk of tidal flooding. The alignment of the new flood defence wall would be either identical to the existing alignment, or set further into the Site. Accordingly, there would be no loss of flood plain storage. All such work would be undertaken in conjunction with the EA to ensure necessary approvals for design and constructional sequence through Environmental Permits. As such, the likely effect of remodelling the flood defence wall on flooding during the Works would be **insignificant**.

Foul and Potable Water Infrastructure Capacity

12.62 Wastewater generation from the Works would include effluent from sanitary facilities, as well as sediment-laden water from excavations, washing down and wheel wash facilities. It is expected that foul water generated at the Site during excavation and construction would be drained via the existing Thames Water combined sewers in the surrounding area. This would result in a minor temporary increase in foul water flows to the Thames Water network, although due to the low volumes expected this is expected to be **insignificant**.

12.63 The Works may require significant volumes of water supply for sanitary facilities for staff, wheel washing and the washing down of construction areas. This is considered to have a **temporary**, **short** to **medium term**, **local**, **adverse effect** of **minor significance** on water supply and demand.

Existing Drainage Infrastructure

12.64 Vibration from piling and excavations could have the potential to lead to water main bursts or sewer collapse. However, the Development would comply with all necessary easements, and where these are not possible, appropriate diversions would occur.

12.65 The 225 mm diameter Thames Water foul sewer crossing the Site would be diverted as shown on the drainage plan in **Appendix E** in **Appendix 12.2**. The two rising mains only service the existing uses within the Site (now redundant and disused), and would be abandoned. An easement of 4 m

is allowed for in respect of the combined sewer along the north-eastern boundary of the Site. This would ensure there would be no physical effect to the combined sewer as it conveys off-Site flows.

12.66 Although appropriate easements and sewer diversions would be in place and agreed with Thames Water, in the absence of mitigation, vibration effects from piling and excavation works could result in a **temporary**, **short to medium term**, **local**, **adverse effect** of **moderate significance**.

Completed Development

Tidal Flood Risk

Risk to Occupants of the Development

12.67 Whilst the Site is located in a tidal flood zone, the land raising and setting of finished floor levels (FFLs) within the Development associated with the Site would ensure that the majority of occupiable floorspace of the Development would be at a safe level. This means that even in the event of overtopping of defences or a breach, the TE2100 levels would not encroach on the residential accommodation, all of which is set at a minimum of 7.03 m AOD, well above the reference flood level of 6.03 m AOD by 2100. The principal streets have been set at a minimum level of 6.03 m AOD in the east part of the Site (east of Ship Lane) and 6.30 m AOD in the west part of the Site (west of Ship Lane). Given this level of protection, residents would have no need for emergency egress from the Site due to flood conditions. The Development associated with the S278 Works would not be occupiable. As such, land raising would not be required at this part of the Site.

12.68 Despite the above, there are some exceptions where occupiable floorspace within the Development would be below the reference flood level of 6.03 m AOD. The exceptions would be as follows:

- **Building 1 (Cinema) & B06 (Retail):** the proposed FFL for the cinema and retail area would be set at 5.565 m AOD, however, since the proposed leisure and retail uses have a shorter design life, it is appropriate to use modelled flood levels for 2065. Interpolation for this date gives a reference flood level specific to this location of around 5.52 m AOD, which is lower than the FFL and so the risk posed by tidal flooding is deemed acceptable. This building has two basement levels; Basement Level 1 gives access to three Cinema screens plus WCs, whilst Basement Level 2 is for Plant Rooms. The entrances to the Basement are at 5.565m AOD which is above the local flood level. In addition, egress is possible from the basement levels via steps terminating at the cinema foyer at 5.565m AOD. As such, the risk posed by tidal flooding is deemed acceptable;
- **Building 4 (The Maltings):** the FFL for the ground floor has been constrained by the existing historic building which would be retained, altered and refurbished as part of the Development. The FFL for the flexible use space on the ground floor would be set at 4.74 m AOD, well below the reference flood level. Furthermore, the exits from the residential properties on the upper floors of the Maltings would be at 5.53 m AOD, also below the reference flood level. However, a survey of the Maltings wall undertaken by Waterman (**Appendix 12.4**) showed the wall to have sufficient capacity to resist the increase in water level that occurs when the river rises to the 2100 flood defence levels. There is no practical risk of a breach affecting this area, given that the relevant tidal defences are provided by landscaped areas or steps. Notwithstanding this negligible risk of breach, safe access/egress from The Maltings to land above the reference flood level would be available as the maximum depth of water would be 0.50 m of standing water. As such, the risk posed by tidal flooding is deemed acceptable;

- **Building 5 (Hotel lobby and bar):** the hotel lobby and bar are at a level of 5.15 m AOD, slightly below the reference flood level for this location of 5.52 m AOD. However, access to the hotel lobby and bar would be available via steps from the hotel lobby to reception, which would be set at the 2100 reference flood level of 6.03 m AOD;
- **Building 6 (flexible use):** flexible use space would be provided at ground level with a FFL set at 5.22 mAOD. This is lower than the reference flood level for this location of 5.52 m AOD. The low risk of residual flooding has been addressed in the design. There is access via steps to higher levels within each of the ground floor units via small number of steps.
- **Building 9 (Boathouse):** most of the ground floor would be at 4.90 m AOD in order to provide a facility for boat storage and access to the River. Some club house facilities would also be provided at this level. However, a raised area, designated as the Club Room (at 6.70 m AOD), will maintain the tidal defensive line. The boat house storage facility beneath the boat club terrace would have a hatch in the terrace surface as a means of escape during a flood event. The residential entrance lobby, deemed a 'more vulnerable' use, would be set at 6.03 m AOD and therefore be located at a safe level.
- **Building 10 (Retail & substation):** some flexible use space along the southern elevation would have a FFL of 5.20 m AOD to 5.40 m AOD, lower than the reference level at this location. However there would be access via steps to levels at 6.03 m AOD within the unit. This building would also contain a sub-station, with a FFL also at 6.03 m AOD, which would need to be protected from residual risk of flooding. There would be a single point of access to the facility via a secure, flood proof door. As such, the risk posed by tidal flooding is deemed acceptable; and
- **Basement car park:** The entrance to the eastern basement from Mortlake High Street would be around 5.3 m AOD and below the reference flood level. Consequently, there would be a residual risk from any breach in the vicinity of Bull's Alley. However, it should be noted that the basement would not be for habitation and the other entry / exit ramp to the basement located along Ship Lane would be located above the reference flood level.

12.69 In summary, the Development would be designed to ensure all residential accommodation and most of the non-residential accommodation would be safe from tidal flooding. Exceptions lie with Building 9 (the Boathouse) and one entrance to the basement car park located within the east part of the Site (east of Ship Lane), However, the land uses within Building 9 and the basement car park that would be at risk from tidal flooding would not be intended for habitation. As such, the Development is likely to result in an **insignificant** to **long-term, local adverse** effect of **minor significance** in respect of flood risk from tidal sources on occupants of the Development.

Off-Site Risk

12.70 It is a fundamental principle of the NPPF that redevelopment should not cause any adverse flood risk to others. The EA was consulted between 2016 to 2019 as to whether any flood storage compensation would be required for Development. The response is provided in **Appendix C** of **Appendix 12.1** which states:

"*We can confirm that as the site is only at risk of tidal flooding flood storage compensation will not be required.*"

12.71 As noted in **Chapter 5: The Proposed Development**, the defences along the river frontage would be significantly upgraded. As such, the Development would reduce the risk of a breach.

12.72 The modelling undertaken as part of the FRA (refer to **Appendix D** of **Appendix 12.1**) has shown a general reduction in flood extent and depths compared with the EA modelling. Furthermore, the

proposed elevated nature of the Site could provide a safe refuge for residents of low-lying neighbouring properties that would be at a greater risk from flooding than the Development in the highly unlikely event that the defences would be breached.

12.73 Given that the Development would improve the defences along river frontage and would provide elevated ground levels that could provide a safe refuse for surrounding residents, the Development would have a **long-term**, **local**, **beneficial effect** of **minor significance** on tidal flood risk to surrounding receptors.

Surface Water (Pluvial) Flooding

12.74 Surface water runoff from the north-east of the Site would discharge by gravity to the River Thames (adjacent to the northern boundary of the Site) via three outfalls (one existing and two new). As the River Thames is tidal at this location, direct discharge to the river would be unrestricted. Surface water runoff from the remainder of the Site would discharge via gravity to the Thames Water sewer network in the surrounding highways, at 70% reduction of the existing rate (equivalent to 249 l/s), beyond the 50% flow reduction originally required by LBRuT for the 2018 Planning Applications. The GLA have confirmed that this approach is acceptable (refer to **Appendix D** of **Appendix 12.2**). The surface water run-off from the highway drainage associated with the Chalkers Corner part of the Site would discharge to the sewer as existing and would not be attenuated.

12.75 Based on a restriction to 249.0 l/s, approximately 2,669 m^3 of attenuation storage would be required, accounting for a 40% increase in rainfall intensity due to climate change. The required attenuation is provided through the incorporation of underground attenuation tanks, permeable paving, and rain gardens. The location and provision of attenuation is set out in **Table 12.4**.

Table 12.4: Attenuation Provision Across the Development

Attenuation	Location Within the Site	Attenuation Provided (m^3)
1 (porous surfacing)	Surrounding the school building (porous macadam surfacing and artificial stone flag paving with aggregate subbase underlain by geo-cellular crates).	892
2	North of the school sports pitch, west of Ship Lane (two tanks in series).	100
3	Courtyard between Buildings 18 and 19 (four tanks).	465
4 (offline tank)	Below tree pits, north-west of Building 18, west of Ship Lane (two tanks in series).	369
5	Below tree pits, in between Buildings 13 and 14, west of Ship Lane.	499
6	In between Buildings 1 and 6, east of Ship Lane.	143
8	Below tree pits, in between Buildings 5 and 6, east of Ship Lane.	117
9	Below tree pits, in between Buildings 5 and 10, east of Ship Lane.	84
TOTAL		**2,669**

12.76 The attenuation tanks would be located outside of the basement extents and below the extents of the proposed tree pits. Surface water from these tanks would be pumped into the adjacent Thames Water sewers. This would avoid the risks associated with the Thames Water sewers surcharging, which could back-up into the low-lying basement tanks and potentially cause over-flow into the basement rooms.

12.77 Appropriate treatment would be incorporated into the drainage system to ensure that the quality of water discharged is acceptable. This would be achieved through the incorporation of green roofs, permeable paving, rain gardens, and rainwater harvesting. If required, a biomat filtration system, downstream defender or other hard engineered solution could also be incorporated to ensure discharge is appropriately treated.

12.78 The above would result in a reduction in the volume and peak rate of surface runoff from the Site and hence a reduction in flood risk elsewhere compared to the current situation. Consequently, the inclusion of sustainable drainage systems (SuDS) and the management of surface water would likely result in a **long-term**, **local**, **beneficial** and of **minor significance** effect on surface water flooding.

12.79 As discussed earlier, there is a lack of pluvial flooding history in the vicinity of the Site and the existing risk of flooding to the Site from surcharged sewers or overland surface water runoff is very low. This is unlikely to change with the Development in place. Accounting for the above, including the inherent design mitigation to avoid sewer surcharging, the Development would have an **insignificant** effect on sewer surcharging flooding.

Groundwater Flow and Flooding

12.80 As described previously, the basement east of Ship Lane in the Site would sit within and below the typical groundwater level of 2 m AOD. However, once the Development is operational, this encroachment is unlikely to pose any groundwater flood risk, either on-Site or off-Site as the basement would be designed to be suitably waterproofed for the lifetime of the Development.

12.81 Furthermore, it was observed that the groundwater flow paths were to the west and south-west and away from the River Thames. It was inferred that the levels in the Thames, averaged over a tidal cycle of around 2 m AOD, were providing the 'source' for the associated hydraulic gradient. Any projection of the basement into this saturated area would not lead to any increase in groundwater levels off-Site. A small reduction on the southern side of the Development is the most likely response, but this would not be significant.

12.82 In view of the above, the likely effect of groundwater flooding both on-Site and off-Site would be **insignificant**.

Flood Defence Wall

Access to the Flood Defence Wall

12.83 The Development does not include any works to the River Thames channel or river walls. The proposal provides a minimum 4 m clear access route on the Development side for any access that may be required (as per the existing situation and as agreed with the EA via a meeting held on 26th September 2016, refer to the meeting minutes in **Appendix 12.5**), however the actual standoff is considerably more than this. Access is also available to the defences from the towpath.

12.84 The boat house storage facility beneath the boat club terrace in Building 9 would be accessed via a hatch at terrace surface to provide safe access to the flood defence wall for maintenance and repairs for EA staff at this location.

12.85 A minimum 4 m clearance and safe access to repair and maintain the flood defence wall would be provided, therefore, the effect of the Development once completed and operational on access to the flood defence wall would be **insignificant**.

Change in Flood Risk from Upgrading Tidal Defences

12.86 As previously described, the crest level of the remodelled defences would be set at a minimum of 6.70 m AOD. This is the level recommended in the TE2100 Plan for 2100. It is therefore well above the current statutory level and obviates the need for any raising to be undertaken for the foreseeable future. Furthermore, the flood wall would be topped in some places a 1.1 m high glass balustrade, with an effective crest level of 7.23 m AOD.

12.87 The risk of breach in this entire section of remodelled flood wall is effectively eliminated by the ground raising behind the defences. This provides a very robust defence, requiring only limited maintenance. The alignment is either identical to the existing alignment, or behind the existing alignment, within the Site. As such, there would be no loss of flood-plain storage.

12.88 Part of the defences are formed by The Maltings, as they have been for many years. The survey of the Maltings wall undertaken by Waterman (**Appendix 12.4**) showed the wall to have sufficient capacity to resist the increase in water level that occurs when the river rises to the 2100 flood defence levels. The level of the window sills on the northern elevation of the Maltings would be set to 6.7 m AOD, above the future statutory flood defence level as per the TE2100 Plan and in line with the EA's comments in July 2019 (refer to **Appendix 12.5**). The windows would be well above the present day statutory defence level of 5.94m AOD, thus providing protection now and in the future.

12.89 Building 9 (boat house) would provide a continuous line of defence of 6.7 m AOD to Bull's Alley, with no windows or openings below this level. The EA confirmed in January 2020 that the continuous line of defence is acceptable (refer to **Appendix 12.5**). Furthermore, it is anticipated that the stop-logs at Bull's Alley are regularly inspected and maintained, given the regular usage to access the river to clear debris on the foreshore. As such, the risk of breach is considered unlikely at this location.

12.90 In summary, the Development is considered to result in a significant reduction in flood risk. This would be partly due to the greater integrity of the defences, and partly due to likely lower incidence of breach at the stop-logs in Bull's Alley. The modelling undertaken as part of the FRA has shown a general reduction in flood extent and depths compared with the EA modelling. As such, the likely effect of tidal flooding as a result of upgrading the tidal defences as part of the Development would be **long-term**, **local**, **beneficial** and of **minor significance**.

Change in Foul Water Drainage Capacity

12.91 The Development would introduce new land uses on the Site resulting in an increase in foul water discharges from the Site. As set out in **Appendix 12.2**, the proposed foul discharge rates have been calculated using the water consumption method at 25.1 l/s, an increase of 10.7 l/s than existing. On-site drainage records indicate that in the existing situation some surface water flows are directed to the Thames Water foul sewer. As a result of the Development, all surface water flows into the foul sewage system would be removed.

12.92 The proposed foul drainage would be designed in accordance with BS EN 752 – Drain and Sewer Systems Outside Buildings[10], BS EN 12056 – Gravity Drainage Systems Inside Buildings[11], and Approved Document H of Building Regulations[12].

12.93 It is understood that foul flows from the existing Site discharge to the Thames Water foul network in the surrounding highways. It is proposed to mimic this scenario, with new connections into the sewers on Mortlake High Street, Lower Richmond Road, Ship Lane, and Williams Lane according to the proposed building layout. The indicative connection points are shown within Appendix E of **Appendix 12.2**.

12.94 As part of the 2018 Planning Applications, Thames Water have previously confirmed (Appendix B of **Appendix 12.2**) that there is capacity for the proposed surface and foul flows. The Development proposals have changed since then, with the Development resulting in a decrease for surface water and slight increase for foul water than existing, thus it is not anticipated that there would be an issue relating to capacity.

12.95 Existing connections would be re-used where feasible. If new connections are required, these would be made to the public sewer system through a Section 106 Agreement with Thames Water, under the Water Industry Act 1991[13] (separate from a planning S106 agreement).

12.96 Accordingly, it is considered likely that the Development would have an **insignificant** effect upon the capacity of foul water drainage infrastructure and sewage treatment works.

Change in Potable Water Demand

12.97 There are no existing uses on the Site that demand significant quantities of potable water (as described in **Chapter 2**, the EIA does not consider the temporary uses on Site as the current baseline conditions). The Development would introduce new land uses on the Site resulting in an increase in potable water demand on the Site.

12.98 New water supplies would be required to serve cold water storage plant in each group of buildings of the Development. The water supply rate is based on a tank-fill rate of 4 hours, with combined potable water flow rates for each group of building as follows:

- Buildings 1 to 4 - 2.5l/s;
- Buildings 5 to 8 - 2.8l/s;
- Buildings 9 to 11 - 2 l/s;
- Buildings 13 to 19 - 6.4 l/s; and
- Buildings 20 and 21 (townhouses) - each would be provided with their own domestic mains water supply.

12.99 Each retail unit would be provided with their own mains water supply, each with circa 0.5l/s capacity. Commercial buildings (cinema, office, school, community centres etc) would each have their own water supply, ranging from 0.5l/s to 1.5l/s depending on fit out requirements. Each group of buildings would also require its own fire supply to serve sprinkler plantrooms.

12.100 The Thames Water 'Water Resource Management Plan 2020-2100' (October 2019)[14] indicates that over a forecast period to 2100, there is likely to be a significant demand on water supply in the London catchment (the London Water Resource Zone (WRZ) in the Thames Water supply area). To address this, Thames Water has prepared a detailed plan which aims to ensure that sufficient supply is available to meet demand during the plan period. This involves a variety of measures including the replacement of Water Mains to reduce leakage, compulsory metering and encouraging the use of water efficiency measures. Developing new water resources would also be required and schemes planned by Thames Water comprise a number of groundwater schemes, artificial recharge schemes, aquifer storage and recovery schemes, water reuse schemes, and water transfer schemes from neighbouring water companies and further afield to ensure availability of supply.

12.101 As a result of the above measures, water demand should be met within London until at least 2100. The demand supply forecast provided by Thames Water which takes into account an increase in population within the London WRZ, thus the additional demand on water resources resulting from the Development would likely be accommodated. Consequently, the likely effect of the Development on potable water demand would likely be **insignificant**.

Mitigation Measures and Likely Residual Effects

The Works

Groundwater Flow and Flooding

12.102 The construction of the basement within the east part of the Site (east of Ship Lane) would involve excavation to below likely groundwater levels. Appropriate dewatering and disposal, using standard techniques such as sumps and pumps would likely be required. This would mitigate the risk of groundwater flooding during excavation works and result in an **insignificant** likely residual effect.

Surface Water (Pluvial) Flood Risk

12.103 The Site-specific Construction Environmental Management Plan (CEMP) developed for the Works (refer to **Chapter 6: Development Programme, Demolition, Alteration, Refurbishment and Construction**) would include temporary measures to control surface water runoff from the Site. Such measures would include the provision of adequate drainage to manage surface water run-off. Construction of the drainage system should be designed and managed to comply with BS 6031:2009 'The British Standard Code of Practice for Earthworks'[15], which details methods that should be considered for the general control of drainage on construction sites. Discharge rates and volumes of water discharged would be agreed with the EA and Thames Water. Where appropriate, cut-off drainage would be provided around the Site during the Works when there is no on-Site drainage network in place.

12.104 As set out in **Chapter 11: Ground Conditions and Contamination**, temporary stockpiling of materials would be located away from the Thames and drains, and drums and barrels would be stored in designated bunded safe areas within the Site compound to reduce the risk of silt and pollutants entering the surface water drainage system.

12.105 Following the implementation of these measures, the anticipated likely residual effect of surface water flooding during the Works would be **insignificant**.

Flood Defence Wall

12.106 Given that the flood defence wall would still be accessible from the towpath side during the Works as all Works would be behind the existing flood defence wall within the Site, no mitigation would be required and the anticipated likely residual effect on access to the flood defence wall during the Works would remain **insignificant**.

12.107 The existing flood defence wall would be lowered in certain areas, however, this would be undertaken after the new flood defence wall has been built, and would still be above the statutory flood defence level. Temporary defences would also provide the required level of protection until any replacements are in place and the Works would be undertaken when there is no practical risk of tidal flooding. All such work would be undertaken in conjunction with the EA to ensure necessary approvals for design and constructional sequence through Environmental Permits. As such, no mitigation would be required and the likely residual effect of remodelling the flood defence wall on flooding during the Works would remain **insignificant**.

Foul and Potable Water Infrastructure Capacity

12.108 The likely effects of the Works upon wastewater were identified as being of insignificance. Therefore, no mitigation measures are considered necessary, and the likely residual effect would remain as per the likely effect. That is, **insignificant**.

12.109 To reduce the water demand of the Development during the Works, all relevant contractors would be required to investigate opportunities to minimise and reduce the use of water in accordance with the CEMP. These would include:

- selection and specification of equipment;
- implementation of staff-based initiatives such as turning off taps, plant and equipment when not in use;
- use of recycling water systems in functions such as wheel washes and toilets;
- rainwater harvesting system for equipment and vehicle washing; and
- where possible, water from excavation would be used for dust suppression during construction.

12.110 Water consumption throughout the Works would be monitored, either through sub-metering or utility bills to allow a comparison against best practice benchmarks. With these control measures in place, the likely residual effects of the Work upon potable water supply would be **insignificant**.

Existing Drainage Infrastructure

12.111 As set previously and within **Appendix 12.2**, easements would be provided to ensure existing drainage infrastructure is not impacted upon. The CEMP would set out measures to ensure that the existing sewers are adequately protected and / or diverted in line with best practice. Requirement for asset protection measures during the Works would be confirmed with Thames Water during the future design stages. The adoption of appropriate piling methods, which would be detailed in the CEMP, would ensure vibration levels are kept to a minimum and would not affect existing below ground infrastructure.

12.112 Following the implementation of these measures, the anticipated likely residual effect on existing drainage infrastructure would be **insignificant**.

Completed Development

Tidal Flood Risk

Risk to Occupants of the Development

12.113 As previously described, the Development would be designed to ensure occupants are safe from tidal flooding. Some areas of the Development, including Building B9 (the Boathouse) and one entrance to the basement car park located in the east part of the Site (east of Ship Lane), would require further mitigation for residual flooding (although it should be noted that these areas would not be used for habitation). Further mitigation would be as follows:

- a self-activating flood barrier would be required for the entrance to the eastern basement car park from Mortlake High Street;
- flood proof doors and / or demountable barriers for access from the Community Boathouse (Building B09) to the river foreshore; and

- as previously stated, the boat house storage facility beneath the boat club terrace would have a hatch in the terrace surface as a means of escape during a flood event. A ladder and/or handrails would be provided to further facilitate escape, with details to be agreed post planning.

12.114 In addition, a tidal flood gate would be required at Ship Lane at some point in the future to account for future flood levels and to ensure the integrity of the tidal defences (refer to later in this Chapter).

12.115 Given the level of flood protection provided by the inherent design of the Development and mitigation measures above, future residents should have no need for emergency egress from the Site due to flood conditions. However, in line with the pre-application response from LBRuT, a Flood Emergency Plan has been prepared and submitted as an appendix to the FRA (Appendix G of **Appendix 12.1**). The Plan identifies a safe route from the Site to land that is wholly outside Flood Zone 3.

12.116 In view of the above, the likely residual risk of tidal flooding (and therefore likely residual effect) to future occupants would therefore be **insignificant**.

Off-Site Risk

12.117 As stated previously, the Development would not result in an increase in flood risk to receptors surrounding the Site and via the proposed elevated ground levels may even provide a safe place of refuge from flooding for residents of low-lying neighbouring properties. As such, the likely residual risk of off-Site tidal flooding (and therefore likely residual effect) would remain **long-term**, **local**, **beneficial effect** of **minor significance**.

Surface Water (Pluvial) Flooding

12.118 The inclusion of SuDS and the management of surface water would likely result in a **long-term**, **local**, **beneficial** effect of **minor significance** on surface water flooding, both on and off-Site by reducing the level of surface water discharge to Thames Water sewers to 70% of the existing rate. A maintenance programme of key drainage infrastructure should be put in place to ensure that these beneficial likely effects are maintained as the likely residual effect (refer to **Appendix 12.2** for further details on frequency and type of maintenance required for the SuDS).

12.119 As stated previously, the risk of flooding from surcharging sewers would be insignificant and no mitigation would be required. The likely residual effect of flooding from surcharging sewers once the Development is completed and operational would therefore be **insignificant**.

Groundwater Flows and Flooding

12.120 The completed Development is not expected to significantly alter or displace the existing groundwater flows beneath the Site and thus the risk of groundwater flooding off-Site is not expected to increase. Furthermore, given the proposed basements would be appropriately waterproofed, the basements would be unlikely to flood. No mitigation measures are therefore considered necessary. Consequently, the likely residual effects of the Development once completed and occupied would be **insignificant** in respect of groundwater flows and flooding.

Flood Defence Wall

Access to the Flood Defence Wall

12.121 Considering that the completed Development would have an **insignificant** effect on access to the flood defence wall, no mitigation measures would be required, and the likely residual effect would

remain **insignificant**. A ladder and / or handrails would be provided with the hatch for access to the boat house storage facility in Building 9, with details to be agreed post planning.

Change in Flood Risk from upgrading Tidal Defences

12.122 As described above, the upgrades to the flood defence wall would improve the performance of the defences when compared to the existing situation. There is a future requirement for a tidal flood gate on Ship Lane, to ensure the integrity of the tidal defences. Without this gate, peak water levels would be able to propagate along Ship Lane. This would only be required at some point in the future. However, a suitable location has already been earmarked in the Development. Since this is a public highway, the way in which this is to be achieved would need to be discussed and agreed with LBRuT. It is likely that this would be provided using a demountable barrier, but the precise details of location and operation would need to be established in detailed design, likely as part of a suitably worded planning condition.

12.123 The likely residual effect on upgrading the tidal flood defences would therefore be **long-term**, **local**, **beneficial** and of **moderate significance**. Furthermore, the Development would not prejudice future raising of the defences at Bull's Alley should this be required.

Change in Foul Water Drainage Capacity

12.124 The Development is likely to result in an insignificant effect in respect of the capacity of foul water drainage. As such, no mitigation measures are required, and the residual effect would remain as per the likely effect. That is, **insignificant**.

Change in Potable Water Demand

12.125 The Development is likely to result in an insignificant effect in respect of potable water demand. As such, no mitigation measures are required, and the residual effect would remain as per the likely effect. That is, **insignificant**.

Summary

12.126 **Table 12.5** summarises the likely significant effects, mitigation measures, and likely residual effects identified within this Chapter.

Table 12.5: Summary of Likely Significant Effects, Mitigation Measures and Likely Residual Effects

Issue	Likely Significant Effect	Mitigation Measures	Likely Residual Effect
The Works			
Groundwater flood risk from excavation works of eastern basement.	**Temporary**, **short** to **medium-term**, **local**, **adverse** and of **minor significance**.	Dewatering of excavation activities, to be undertaken through an Environmental Permit.	**Insignificant**.
Surface water (pluvial) flood risk.	**Temporary**, **short** to **medium-term**, **local**, **adverse** and of **minor significance**.	Implementation of CEMP to ensure appropriate adequate drainage and to manage surface water run-off.	**Insignificant**.
Access to the flood defence wall.	**Insignificant**.	No mitigation required.	**Insignificant**.

Issue	Likely Significant Effect	Mitigation Measures	Likely Residual Effect
Tidal flood risk during remodelling of the flood defence wall.	**Insignificant**.	None required, to be undertaken through an Environmental Permit.	**Insignificant**.
Foul water infrastructure capacity.	**Insignificant**.	No mitigation required.	**Insignificant**.
Increase in potable water demand.	**Temporary**, **short** to **medium-term**, **local**, **adverse effect** of **minor significance**.	Implementation of CEMP to include measures to monitor and reduce water consumption.	**Insignificant**.
Existing drainage infrastructure.	**Temporary**, **short** to **medium-term**, **local**, **adverse** and of **moderate significance**.	Implementation of CEMP to ensure existing drainage is protected and appropriate piling methods are used to minimise vibration.	**Insignificant**.
Completed Development			
Tidal flood risk to future occupants of the Development.	**Insignificant** to **long-term, local adverse** and of **minor significance**.	A self-activating flood barrier would be required for the entrance to the eastern basement car park from Mortlake High Street. Flood proof doors and / or demountable barriers would be required for access from the Community Boathouse (Building B9) to the river foreshore. Hatch with ladder and / or handrails to access the boat storage facility below the terrace level.	**Insignificant**.
Tidal flood risk to off-Site receptors.	**Long-term**, **local**, **beneficial effect** and of **minor significance**.	No mitigation required.	**Long-term**, **local**, **beneficial effect** of **minor significance**.
Surface water (pluvial) flood risk.	**Long-term**, **local**, **beneficial** and of **minor significance**.	No mitigation required, maintenance programme to be implemented to ensure beneficial effects are maintained.	**Long-term**, **local**, **beneficial** and of **minor significance**.
Flood risk from sewers surcharging	**Insignificant**.	No mitigation required.	**Insignificant**.
Groundwater flood risk.	**Insignificant**.	No mitigation required.	**Insignificant**.
Access to the flood defence wall.	**Insignificant**.	No mitigation required.Hatch with ladder and / or handrails to access the boat storage facility below the terrace level.	**Insignificant**.

Issue	Likely Significant Effect	Mitigation Measures	Likely Residual Effect
Change in tidal flood risk from upgrading the tidal defences (flood defence wall).	**Long-term**, **local**, **beneficial** and of **minor significance**.	A flood proof gate would be required at some point in the future at Ship Lane to account for future flood levels. This shall be delivered through an appropriately worded - planning condition.	**Long-term**, **local**, **beneficial** and of **moderate significance**.
Change in foul water drainage capacity.	**Insignificant**.	No mitigation required.	**Insignificant**.
Change in potable water demand.	**Insignificant**.	No mitigation required.	**Insignificant**.

References

1 Ministry of Housing, Communities & Local Government (2021): 'National Planning Policy Framework'.

2 AECOM (2015); 'Stag Brewery: Phase 1 Environmental Site Assessment. For AB InBev UK Ltd', July 2015.

3 AECOM (2015); 'Stag Brewery: Phase 2 Environmental Site Assessment. For AB InBev UK Ltd', September 2015.

4 AECOM (2015); 'Stag Brewery: Groundwater Sampling Point Decommissioning Report. For AB InBev UK Ltd', February 2016.

5 Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities & Local Government (2021): 'Planning Practice Guidance – Flood Risk and Coastal Change'.

6 Her Majesty's Stationery Office (2017); The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017.

7 The Environment Agency's Aquifer Designation Map. www.environment-agency.gov.uk;accessed online December 2021.

8 Environment Agency (2011): 'Thames Estuary 2100 Plan (TE2100)'.

9 Her Majesty's Stationery Office (1975): Reservoirs Act 1975, Her Majesty's Stationery Office, London.

10 British Standards (2008): BS EN 752:2017 'Drain and Sewer Systems Outside Buildings. Sewer system management'.

11 British Standards (2000): BS EN 12056-2:2000 'Gravity Drainage Systems Inside Buildings – Sanitary pipework, layout and calculation'.

12 Ministry of Housing, Communities & Local Government (2010): 'Drainage and waste disposal: approved Document H', Approved Documents and Building regulation.

13 The Stationery Office (1991): Water Industry Act 1991, The Stationery Office, Norwich.

14 Thames Water (2019): 'Water Resources Management Plan 2020-2100, October 2019.

15 British Standards (2009): BS 6031:2009 'The British Standard Code of Practice for Earthworks', December 2009.