Chapter 13: Water Resources and Flood Risk

WATER RESOURCES AND FLOOD RISK	
AUTHOR	ARUP
SUPPORTING APPENDIX	ES Volume 3, Appendix: Water Resources and Flood Risk: • Annex 1: Legislation and Policy; and • Annex 2: TWUL Sewer Impact Study (2019) and TWUL Potable Water Supply Impact Study (2015)
KEY CONSIDERATIONS	This ES chapter presents an assessment of the potential impacts and associated likely effects of the Proposed Development on flood risk and surface water runoff, including rate and water quality. The assessment also takes into consideration the potential effects of the Proposed Development on the capacity of the potable water supply and foul and surface water drainage networks, and the potential impacts on the stability and maintenance of the dock wall structure. Groundwater is addressed as a water resource, but not in terms of water quality. It should be noted that a discussion of the potential effects on water quality from potential ground contamination is presented in the Ground Contamination Preliminary Risk Assessment submitted as a standalone document with the Outline Planning Application (OPA). This ES chapter describes the methods used to assess the potential effects of the Proposed Development and the relevant baseline conditions currently existing at the Site and surrounding area. The potential effects of the Proposed Development are assessed, and the likely significant residual effects determined, taking into account mitigation measures that are required to prevent, reduce or offset any likely significant adverse effects identified.
CONSULTATION	As discussed in **ES Volume 1, Chapter 2: EIA Methodology,** consideration has been given in this assessment to the EIA Scoping Opinion provided by the LBTH and consultees in respect to the Proposed Development. In addition, there has been consultation with Thames Water Utilities Ltd (TWUL), the EA and CRT regarding the development of the Canary Wharf Estate. The key aspects of these discussions of relevance to North Quay are summarised below. **London Borough of Tower Hamlets (LBTH)** The Local Authority has provided the following scoping opinion on the proposed scheme: "*The Applicant is to confirm if there are any changes to the extent of Application Site from existing as any further encroachment into the dock will require flood storage compensation.* *The Proposed Development should ensure surface water runoff is reduced as far as possible and it should be outlined how this is to be achieved. LBTHs Sustainable Drainage Proforma must be submitted as part of the application*." **Environment Agency (EA)** A Product 8 report was requested for the Site which was received in April 2020. The Product 8 data provides information on the flood risk posed to the Site in the event of a flood defence breach, it forms the basis of the site specific Flood Risk Assessment. The Product 8 report is appended to the FRA. Feedback from the EA (dated February 2017) confirms that the Flood Risk Assessment submitted by Arup (for the Withdrawn 2017 Scheme) for review was considered acceptable. The correspondence is appended to the FRA. In April 2017, the EA confirmed that they agree with the results of the hydraulic modelling undertaken to demonstrate that the impact of the Withdrawn 2017 Scheme on future flood water levels would be negligible. Furthermore, they confirmed that no flood storage compensation was required for the Withdrawn 2017 Scheme. The correspondence is appended to the FRA. In January 2020, the EA responded to a request for an EIA Scoping Opinion for the Proposed Development. They provided a detailed list of considerations relating to flood risk, accessible water spaces, and biodiversity they expected to be taken into account within the EIA and the FRA. **Canal & River Trust (CRT)** A meeting was held with CRT on 26th October 2016. The Withdrawn 2017 Scheme was presented to CRT and they confirmed that the extent of the promenade structure over the dock was acceptable. CRT at that time confirmed that in principle it is acceptable for uncontaminated surface water runoff to be discharged into the dock from the Withdrawn 2017 Scheme. It was agreed that another meeting would be held as the design develops. In January 2020, CRT provided an EIA Scoping Opinion consultation response letter, in relation to Water Resources, they stated that they had no objection to the proposal to exclude geoenvironmental or water resources from the scope of the EIA. In June 2020, CRT commented as follows regarding the proposal to discharge surface water to the docks:- *"We have no objection in principle to surface water being discharged to the docks 'as far as possible' but this will be subject to our approval of technical details, including (but not limited to) the design of surface water outfalls, and a commercial agreement. The Trust would need to examine the flood storage implications as part of the mandatory procedure for reviewing applications to discharge. Trust policy is not to accept increased flood risk. We note that you assume that any discharge of the upper aquifer (if necessary) will need to be agreed with us in advance. This is correct. For the avoidance of doubt it also relates to the lower aquifer – should any discharge from it be required."* **Thames Water Utilities Limited (TWUL)** There has been historic consultation between TWUL and Arup regarding the impact of Canary Wharf developments, including this Site, on their potable water supply and sewer network. In 2014, TWUL undertook impact modelling to assess the impacts of these developments on TWUL assets and identified that upgrades to the network would be required to cater to the new developments. The impact modelling was updated in January 2019 taking into account phasing of the development, and excluding some developments that were considered in the previous study. It concluded that that there is sufficient capacity in the Thames Water combined sewer network to accommodate the flows from the Proposed Development. In April 2020, Max Fordham provided the peak foul water flows that are expected to discharge to the combined sewer in Aspen Way. These were based on the Indicative Scheme. TWUL confirmed that they are in the process of undertaking an Integrated Water Management Strategy for the Isle of Dogs with the GLA and the LBTH. TWUL confirmed that development at the Site is included in this assessment and the peak flows provided by Max Fordham are in line with those previously provided for development at the Site, both in terms of peak flows and across the various phases of development.

ASSESSMENT METHODOLOGY

Outline Application Methodology

13.1 The Applicant is seeking outline planning permission for comprehensive mixed-use redevelopment of the Site. This technical assessment has generally assessed the Indicative Scheme (Scenario 5 as set out in **ES Volume 1, Chapter 2: EIA Methodology**) for Water Resources and Flood Risk, as this scenario is considered a good representation of the likely and worst-case impacts and effects for potable water and foul water connections for the viable mix of uses set out in the Development Specification and detailed within **ES Volume 1, Chapter 4: Proposed Development**. The Indicative Scheme enables water demands and foul water production rates to be determined, and therefore to be consulted on with Thames Water Utilities Limited (TWUL). The rates are unlikely to vary significantly to the Indicative Scheme when considering the viable mixes of development. Furthermore, TWUL take a conservative approach to modelling future infrastructure needs so variations at a development level (i.e. the Proposed Development) are unlikely to change the level of environmental impact and effects on water resources and related infrastructure requirements.

13.2 Surface water discharges off-site to the public sewer are limited to the greenfield rate so are independent of the variations in the massing elements that could come forward under the OPA, and the quantum of surface water discharging to the docks is also not sensitive to these variations, because of the significant storage capacity in the docks.

13.3 Where it is not considered that the Indicative Scheme represents a reasonable worst case, the Parameter Plans have been assessed and the following information has formed the basis of the assessment for this ES Chapter:

- The new false quay and marine deck will occupy the entire area that the existing false quay structure occupies and extend into the North Dock as far as the redline boundary extends to the south east; and
- The Site levels will be taken as those defined in the Flood Risk Assessment in line with Parameter Plan NQMP-PP-012 Existing Site Levels and NQMP-PP-013 Proposed Site Levels.

13.4 The construction assessment has been based upon the information presented within **ES Volume 1, Chapter 5: Enabling and Construction Works**.

Defining the Baseline

13.5 The study area for this assessment has been defined based on the sensitive receptors that are adjacent and in close proximity to the Site, these include:

- The Site (within the redline planning boundary);
- Aspen Way (A1261) to the north;
- Upper Bank Street to the east;
- North Dock to the south; and
- Hertsmere Road to the west.

13.6 The baseline conditions of the Site and its surroundings have been established through a review of information gathered from the following sources, which includes relevant current and historical data:

- Asset Location Search maps and sewer records provided by TWUL of local foul and surface water drainage and potable water supply network[1] (received August 2016);
- Flood Zone maps on EA website[2] (visited April 2020);
- LBTH Strategic Flood Risk Assessment (November 2016)
- Site-specific Groundsure report[3] (received April 2020), which provides environmental, geological and historical data, including information on EA abstraction licences and discharge consents;
- Information related to the hydrogeology and groundwater of the Site contained in the North Quay Development Geotechnical Desk Study Report undertaken by Arup [4](April 2020);
- Crossrail Banana Wall Stability Study undertaken by Arup[5] (January 2007);
- Topographic survey by Canary Wharf Contractors Limited (CWCL) identifying surface water drainage infrastructure in Upper Bank Street [6](February 2001);
- Historic water quality data for North Dock (from monitoring carried out since 2008 to present);
- TWUL Sewer Impact Study: Proposed Connection at Canary Wharf Isle of Dogs – Foul and Surface Water System [7] (January 2019);
- TWUL Modelling Tasks – 9 Sites, Canary Wharf Development Modelling Report[8] (Atkins, January 2015);
- CRT Bathing Water Quality Survey[9] (dated January 2017);
- EA Product 8 Report for the Site[10] (received April 2020); and
- Arup Technical Note[11] (dated March 2017) summarising the impact of encroachment of the promenade into the Docks on the water levels in the Docks and the wider River Thames. The current Proposed Development hasn't materially changed in terms of the design of the decking structure that would support the proposed promenade. Therefore, the technical note is still considered relevant.

13.7 A qualitative desk-based assessment has been undertaken to ascertain the likely flood risk and drainage issues relevant to the Site and the Proposed Development. The assessment has been based upon the findings of the site-specific Flood Risk Assessment[12] for the Proposed Development (Arup, June 2020), which has been prepared in accordance with the requirement of the NPPF and supporting PPG. The FRA outlines the potential sources and risk of flooding onsite including tidal, fluvial, surface water, groundwater and pluvial sources and is submitted as a standalone document as part of the Outline Planning Application (OPA).

Evolution of the Baseline

13.8 A qualitative approach has been taken to define the evolved baseline. The change in each receptor will be described based on the existing baseline and knowledge/professional judgment of how this is likely to change over the next few years considering recent trends, the latest and evolving planning policy for each feature and knowledge/professional judgment of how infrastructure upgrades are being implemented locally.

Impact Assessment Methodology

Enabling and Construction

13.9 The assessment covers potential impacts relating to the enabling works and construction of the Proposed Development and looks at the range of activities which will take place during the construction period that

[1] *TWUL, 2016. Asset Location Search Maps and Sewer Records.*
[2] *EA, 2020. Flood Map for Planning [Available: http://maps.environment-agency.gov.uk/wiyby/wiybyController?topic=floodmap&layerGroups=default&lang=_e&ep=map&scale=7&x=531500&y=181500]*
[3] *Groundsure, 2020. Site Specific Groundsure Report.*
[4] *Arup, 2020. North Quay Development Geotechnical Desk Study.*
[5] *Arup, 2007. Crossrail Banana Wall Stability Study.*
[6] *CWCL, 2001. Topographical Survey.*
[7] *TWUL, 2019. Sewer Impact Study.*
[8] *Atkins, 2015. Canary Wharf Development Modelling Report.*
[9] *CRT, 2017. Bathing Water Quality Survey.*
[10] *EA, 2020. Product 8 Report.*
[11] *Arup, 2014. Isle of Dogs – Dock Water Level Assessment.*
[12] *Arup, 2020. North Quay Flood Risk Assessment.*

could have a potential impact on receptors, and the standard measures which are put in place to protect receptors and mitigate any adverse effects. If an effect is deemed adverse, then appropriate mitigation measures have been recommended to minimise any negative impact.

13.10 The potential impacts and associated likely effects have been considered for the following aspects of the Proposed Development:

- Potable water supply;
- Foul and surface water drainage;
- Groundwater;
- Flood risk; and
- Rate and quality of surface water runoff.

13.11 A source, pathway, receptor model[13] has been adopted for this assessment. A source pathway receptor model is used to describe hazard risk. The source is defined as where the hazard comes from; the pathway describes how the hazard travels from the source to the receptor, and the receptor is what is effected by the hazard.

13.12 In addition, the assessment of enabling and construction works effects is based on the indicative enabling and construction programme, methodology and phasing of the Proposed Development as described within **ES Volume 1, Chapter 5: Enabling and Construction Works.**

Phasing

13.13 This assessment covers potential impacts relating to the phasing of the Proposed Development. The impacts and therefore likely effects on receptors as a result of the phasing will be temporary.

13.14 The potential impacts and associated likely effects relating to phasing have been considered for the following aspects of the Proposed Development:

- Potable water supply;
- Foul and surface water drainage; and
- Rate and quality of surface water runoff.

13.15 As with the construction section, a source-pathway-receptor model will be used to determine the environmental impact of phasing.

Completed Development

13.16 The assessment covers potential impacts relating to the operation of the Proposed Development once construction has been completed. The impacts resulting from the completed Proposed Development will be permanent.

13.17 The potential impacts and associated likely effects have been considered for the following aspects of the Proposed Development:

- Potable water supply;
- Foul and surface water drainage;
- Rate and quality of surface water runoff;
- Groundwater as a water resource in terms of quantum, including abstractions; and
- Flood risk, including the existing dock wall in its capacity as a flood defence.

13.18 The assessment does not cover groundwater quality. This is covered in the Ground Contamination Preliminary Risk Assessment report submitted as part of the OPA.

13.19 A source, pathway, receptor model has been adopted for this assessment.

Assumptions and Limitations

13.20 The assessment is based on the information available from the sources listed in the baseline characterisation.

13.21 The following assumptions have been made:

- The design life of the Proposed Development has been assumed to be 60 years for any Commercial (Retail/Office/Hotel/Leisure/Community) and 100 years for any Residential use. This is in line with the EA's understanding of the design life of a development;
- The NPPF requires that the overall level of flood risk in the study area is reduced through the layout and form of the Proposed Development and the appropriate application of SuDS;
- For the Site, it has been agreed with the EA and the CRT that the most sustainable approach to surface water drainage is to discharge runoff from uncontaminated areas (building roofs not covered by intensive green roof, and landscaping not trafficked by vehicles) directly to North Dock by a series of new outfalls over the existing listed banana wall; and
- In addition, the London Plan states that unrestricted flow rates can be discharged directly to the Docks or River Thames. This approach has been accepted by the EA and CRT. For the part of the Site where there is a requirement to discharge to the public TWUL sewer along Aspen Way, runoff will be limited at the 'greenfield' runoff rates for the 1 in 30 year and 1 in 100 year (plus 40 % allowance for climate change) events. This approach has been agreed with TWUL and is being taken into account as part of the Integrated Water Management Strategy being developed by TWUL alongside the LBTH and the GLA.

Methodology for Defining Effects

13.22 There is not an industry standard for the assessment of water resources and flood risk impacts and effects. Therefore, it has been necessary to employ an approach based on professional judgement in order to determine the significance of the likely effects.

13.23 The process outlined below has been followed to assess the potential effects of the Proposed Development on water resources and flood risk:

[13] Environment Agency, 2010. Flood, Coastal & Environmental Risk Management, Fluvial Flood Risk Guidance

- The baseline conditions of the Site are defined, including the sensitivity and value of receptors;
- The main assessment of the potential effects has then been undertaken for the construction period and once the Proposed Development is operational; and
- Consideration given to the appropriate mitigation measures required to address adverse likely effects identified by the assessment.

13.24 In this assessment the significance of an effect is based on the magnitude of the impact on the affected receptor and on the value and/or sensitivity of the affected receptor.

Receptors and Receptor Sensitivity

13.25 Using this approach, receptors are characterised in terms of their sensitivity and their value. The sensitivity of a receptor refers to its ability to absorb change/impact without the baseline being altered. Its value is its importance on a local, regional or national scale or its rarity. Value may be indicated by status afforded through legislation and/or policy. The definitions for the value/sensitivity of a receptor, with specific examples for particular aspects of the water environment, are shown in Table 13.1.

Table 13.1 Definition of Receptor Sensitivity / Value

Value/Sensitivity Of Receptor	Criteria	Flood Risk	Water Resources	Drainage	Water Supply
High	Feature with a high quality and/or rarity. The receptor is of international or national importance and may be protected by legislation. The receptor is sensitive to change with no ability to absorb impacts without changing the baseline. There may already be existing pressures on the receptor, such that a small shift compared to the baseline could result in significant/permenant change.	Flood Zone 3b – Functional floodplain	Current or target waterbody status identified as high by River Basin Management Plan (RBMP)	Strategic regional off-site sewerage networks	Strategic regional off-site water supply networks
Medium	Feature with a medium quality and/or rarity. The receptor is of national or regional importance and may be protected by legislation. The receptor has limited ability to absorb changes to the baseline without compromising its value. There may already be existing pressures on the receptor, such that a moderate shift compared to the baseline could result in significant/ permenant change.	Flood Zone 3a – High probability of flooding	Current or target waterbody status identified as good by RBMP	Regional off-site sewerage networks	Regional off-site water supply networks
Low	Feature with a low quality and/or rarity.	Flood Zone 2 – Medium	Current or target waterbody	Local off-site	Local off-site water supply networks
	The receptor is of regional or local importance. It may be protected by regional or local policy. The receptor has a moderate ability to absorb change without its value being compromised. Existing pressures are such that a shift compared to the baseline will not cause significant/ permenant change to the receptor.	probability of flooding	status identified as moderate by RBMP	sewerage networks	
Very Low	Feature with a very low quality and/or rarity. The receptor is only of local importance. The receptor is able to absorb impacts without resulting in changes to the baseline that affect its value.	Flood Zone 1 – Low probability of flooding	Current or target waterbody status identified as poor by RBMP, or feature is not defined as a waterbody under the Water Framework Directive.	No local on-site sewerage networks present	No local on-site water supply networks present

Magnitude of Impact

13.26 The magnitude of impact is related to the scale, extent and persistence of the impact on a receptor.

13.27 The criteria for defining the magnitude of potential impacts represent the anticipated nature of change in the environment, compared to the baseline, and the effects of the impact upon a sensitive receptor. The criteria are set out in Table 13.2.

Table 13.2 Criteria Defining Magnitude of Impact

Magnitude Of Impact	Criteria
High	Permanent change, over the whole development area and beyond (i.e. strategic or regional scale) to key characteristics or features of receptor. Noticeable change in the baseline condition. Effects certain or likely to occur.
Medium	Permanent or temporary change, over the majority of the development area and potentially beyond, to key characteristics or features of the receptor. Noticeable change in the baseline condition. Effects certain or likely to occur.
Low	Permanent or temporary (during the project duration) change, over a limited/local area, to key characteristics or features of the receptor. Effects would possibly occur.
Very Low	Permanent or temporary (for part of the project duration) change, or barely discernible change for any length of time, over a small area, to key characteristics or features of receptor. Effects unlikely or rarely to occur.

Defining the Effect

Effect Nature

13.28 Effects are assessed as being beneficial or adverse. Beneficial effects are those that will have a positive effect, whilst adverse effects are those which will have a negative impact on the receptor.

Effect Scale

13.29 The overall effect criteria used for the purposes of this assessment is identified in Table 13.3.

Table 13.3 Matrix to Determine the Scale of Effect

Magnitude Of Impact	Value/Sensitivity Of Receptor			
	High	**Medium**	**Low**	**Very Low**
High	Major	Major to moderate	Moderate to minor	Negligible
Medium	Major to moderate	Moderate	Minor	Negligible
Low	Moderate to minor	Minor	Minor to negligible	Negligible
Very Low	Negligible	Negligible	Negligible	Negligible

Effect Duration

13.30 The following terms are used to identify the time-scale of effects:

- Short-term: 0-5 years;
- Medium-term: 5-25 years; and
- Long-term: 25 years and beyond.
- During operation, the above timescales are considered to be from the end of construction.

Categorising Likely Significant Effects

13.31 Mitigation measures would be required for adverse effects identified by the matrix above as 'major', 'major to moderate', 'moderate' or 'moderate to minor' (shaded cells in Table 13.4), although all adverse effects would be mitigated where feasible. Effects which are Major to Moderate are deemed to be Significant, while the effects which are Minor and Negligible are deemed as Not Significant.

BASELINE CONDITIONS

Current Baseline Conditions

Geology

13.32 The 1:50,000 geological sheets of the study area provided within the site-specific Groundsure report[14] show the Site to be underlain by drift deposits of Alluvium overlying River Terrace Gravels of recent origin. These in turn overlie the Lambeth Group (formerly known as the Woolwich and Reading Beds). The Lambeth Group overlies the Thanet Sand Formation and, at depth, the Upper Cretaceous Chalk. It is common for the interface of deposits to be variable in depth since it represents a geologically unconformable surface. Data obtained from a previous ground investigations of the Site and surrounding area[15] revealed the presence of Made Ground, the source of which is unknown but may be associated with the backfill of the existing dock walls surrounding the Site.

Hydrogeology

13.33 Unless stated otherwise, the following information regarding the hydrogeology of the Site is based on information provided within the site-specific Groundsure report and the 2020 Arup Geotechnical Desk Study Report.

13.34 The general hydrogeological setting for the Isle of Dogs (in which the Site is located) consists of two aquifers, the upper aquifer, within the Alluvium and Terrace Gravel strata, and the lower aquifer comprising the Lower Lambeth Sand, Thanet Sand and Chalk. The Chalk is the main aquifer of the region. The upper and lower aquifers are hydraulically separated by the relatively impermeable Lambeth Clay aquitard. In the locality of the Site the Lambeth Clay is believed to be approximately 3m to 7m thick.

13.35 Abstraction of water from the deep aquifer over the past 200 years has severely depressed the water level in the chalk aquifer. However, since about 1965, the quantity of water pumped out has been reduced and the water level in the deep aquifer has started to rise to its original level. This can be attributed to a combination of circumstances, including the loss of many wells during World War 2, and the introduction of licensing controls on private abstractions.

13.36 The water levels within the Made Ground and Terrace Gravel strata within the upper aquifer are predominantly influenced by two main water sources, the tidal River Thames and the constant water level maintained within the adjacent docks. The River Thames is considered to have limited influence on groundwater within the Site. The dock water levels are therefore more influential on the groundwater levels within and around the Site than the River Thames. The groundwater levels within the upper aquifer have been derived from standpipes installed during 2001 and 2016 ground investigations.

13.37 Groundwater contours for the lower aquifer in the general Canary Wharf area have been derived from monitoring groundwater levels throughout on-going de-watering exercises since 1988 at Canary Wharf. Significant dewatering of the Canary Wharf area took place for the construction of Canary Wharf Crossrail station and various developments across the Canary Wharf estate.

Dock Water Quality Monitoring

13.38 The Docks of Canary Wharf are considered to be a heavily modified watercourse. The Docks have been identified within the Tower Hamlets Local Plan as a Site of Importance for Nature Conservation (SINC), these are areas designated for their importance for wildlife and for people to experience nature. CRT monitor the water quality on a monthly basis. The monitoring data includes three sampling locations for the dock water in North Dock. Currently the 'Bathing Water Quality Survey' monitoring regime, undertaken by Environmental Scientifics Group (ESG) for CRT, includes one sampling point located in the North Dock.

13.39 The historic data shows that the average temperature value recorded in North Dock was approx. 11.0°C with a temperature range from 5 to 20°C. This is very similar to temperatures recorded in Blackwall Basin,

[14] *Groundsure, April 2020. Site Specific Groundsure Report.*

[15] *Arup, December 2020. North Quay Geotechnical Desk Study.*

but lower than those recorded in South Dock (approx. 14.8°C on average). It is necessary to preserve the natural temperature regime of the docks to limit adverse impacts. The most recent sample from North Dock was recorded as 6.32°C, which is on the lower end of the historic temperature range recorded.

13.40 The average level of dissolved oxygen (DO) in the dock water is above 7mg/l, which is considered to be 'high' according to UKTAG guidance on the European Water Framework Directive[16]. High levels of DO are an indicator of good water quality. The most recent sample from North Dock was recorded as 10.36mg/l, which exceeds the threshold for a sample that is considered to be 'high' in dissolved oxygen.

13.41 The water quality is generally good in the Docks when considered against Bathing Water Standards. and the latest sample from North Dock was rated as 'good' in the 'Bathing Water Quality Survey'[17] conducted by ESG. However, historic pollution incidents have shown that the baseline is responsive to changes in water quality caused by discharges into the Docks.

Dock Walls

13.42 The West India and Millwall Dock systems are connected to the River Thames to the east and west of the southern basin of West India Docks. Water flows out of the eastern side of the southern basin of West India Dock via a lock system to the Blackwall reach of the River Thames. Inflow of water to the docks is through a connection with the western side of the southern basin to the River Thames Limehouse Reach, with the water level being maintained by impounding pumps at this point. There is relatively little flow of water between the Millwall Inner Dock and West India Docks.

13.43 A part of the North Dock is located within the south of the Site. Towards the south of the Site, underneath the existing false quay is a historic quay wall known as the Banana Wall which has Grade I Listed structure status. It is the oldest of the quay walls constructed between 1799 and 1802. It is of brick construction and is 1.8 to 2.0 m thick and formed in a banana shape with counterforts approximately every 4.5m. These counterforts are approximately 900mm[2] Historical information shows that wooden timber piles extend vertically from the toe of the wall and are approximately 3m in length, however none have been found as part of historical investigations.

13.44 Banana walls were constructed to form the West India Middle Docks retaining the ground level of the surrounding wharfs. The Banana Wall is a concave structure, shaped to accommodate ships' hulls. It is understood that the dock is lined with puddle clay and backfilled with Terrace Gravel. The Banana Wall at the Site performs a dual function. The wall serves to retain the ground levels outside the dock, and also acts as a flood defence. In addition, the dock walls prevent loss of the dock water into the upper aquifer in the Terrace Gravel.

13.45 A report was prepared by Arup in January 2007 for Crossrail on the stability of the North Dock Banana Wall. Since this date there have been no works to or near to the wall which would alter the stability of the Banana Wall, therefore the study is still applicable. This study concluded (as have previous studies undertaken by Arup on the Banana Wall) that the stability of the wall is questionable with respect to modern day design standards and that no additional loading should be applied.

Existing False Quay

13.46 There is also an existing false quay structure that extends over North Dock on the southern area of the Site. This consists of concrete slab supported on a concrete beam resting on concrete filled cylinder piles extending into the River Terrace Deposits beneath the dock.

Tidal and Fluvial Flood Risk

13.47 The Site is located in the floodplain of the River Thames. According to the EA's Flood Zone Maps[18] the Site is located in Flood Zone 2 and 3. However, the Site is located in an area protected from flooding by the River Thames Tidal Defences and the Thames Barrier.

13.48 The EA Product 8 Report for the Site refers to a historic flood event to the north of the Site. The area was subject to tidal flooding on the night of the 6th and morning of the 7th January 1928. There was overtopping in the area during a storm surge (which coincided with high fresh water flows). An approximate level in the Thames at the time was +5.03 m AOD.

13.49 The stretch of the River Thames closest to the Site is tidal. The water level ranges from +3.8 m AOD at mean high water spring tide to -2.85 m AOD at mean low water spring tide.

13.50 Within the Product 8 Report received in April 2020, the EA has confirmed that the following extreme water levels apply to the River Thames at the entrance to the Isle of Dogs docks:

- Maximum likely water level up to 2100 is +5.17 m AOD; and
- Maximum likely water level beyond 2100 is +5.66 m AOD.

13.51 As a result of the above advise, the EA has indicated that, at some stage in the near to medium term, they will require riparian owners to increase the level of flood protection provided by the defences in their ownership. The revised defence levels currently being projected by their modelling work indicate that:

- by 2065 the flood defence levels around Canary Wharf will need to rise to +5.70 m AOD
- by 2100 the flood defence levels around Canary Wharf will need to rise to +6.20 m AOD.

13.52 For the docks as a whole around Canary Wharf, the statutory flood defence level is +5.23 m AOD. This level provides protection to a nominal 1 in 1,000 year return period (or the 0.1 % annual probability of exceedance) to the year 2070. The Site is lowest at the north-west corner (+3.8 m AOD) where it ties into Aspen Way. The Site rises towards North Dock which is at a level of approximately +5.3 m AOD (level of top of the Banana Wall as indicated by information gathered by Arup for the Geotechnical desk study).

13.53 The normal water level in the dock is maintained between +3.8 m AOD and +4.23 m AOD, rising above this level when the CRT decide to over-impound for operational reasons or when the dock is used for flood storage. If the CRT over-impound, the water level in the docks reaches a level of +4.55m AOD. The existing

[16] *UK Technical Advisory Group on the Water Framework Directive, April 2008. [Available: https://www.wfduk.org/sites/default/files/Media/Environmental%20standards/Environmental%20standards%20phase%201_Finalv2_010408.pdf]*

[17] *Environmental Scientifics Group (ESG) Ltd, February 2017. Bathing Water Quality Survey: On 30 January 2017: Report R3055.*

[18] *Environment Agency, May 2020, Flood Map for Planning [Available: https://flood-map-for-planning.service.gov.uk/]*

ground water level behind the North Dock wall varies due to the influence of the North Dock water level, local dewatering for construction and to a small extent the tidal River Thames.

13.54 Based on consultation with the EA, they confirmed that the risk of Canary Wharf being flooded is extremely low. They believe that the most likely cause of flooding in the Canary Wharf area would be a river wall collapse combined with a slightly higher than normal tidal surge but where the barrier is left open (if the surge is smaller than a certain size, the Thames Barrier will not be closed).

13.55 The likelihood of the river wall collapsing along the River Thames is considered to be extremely low. The EA inspects the river walls along the Thames twice each year and the condition of each section is rated. In addition, all construction work within 16m of a River Thames flood defence structure requires Flood Risk Management Consent from the EA. This is a process that ensures the works are designed and built to the appropriate standard.

13.56 Based on the EA's Product 8 Report for the Site, the worst-case prediction of the most likely flood for the northern half of the Isle of Dogs (containing Canary Wharf) results from numerous breaches around the Isle of Dogs. The flooded areas are limited by the topography and the quantity of water available to flood. Under this scenario, the Canary Wharf Estate itself is not expected to flood, but there are two events that might affect access to and from the Site:

- A breach of the river wall to the west of the northern part of the Isle of Dogs; and
- A breach of the river wall to the east of the northern part of the Isle of Dogs.

Pluvial and Surface Water Flood Risk

13.57 1100 year or greater surface water flood event. The LBTH Level 2 SFRA[19] reports the majority of the Site as having a predicted flood depth of less than 100 mm in a 1 % Annual Exceedance Probability (AEP) rainfall event and only sporadic areas with flood depth up to 250mm for the same event with a 'very low hazard' rating. The Site is not located in any of the LBTH's Critical Drainage Areas.

13.58 Overall the risk of surface water flooding at Canary Wharf is assessed to be low. Canary Wharf have a relatively new and well-maintained surface water drainage network. The network is privately owned and the majority of the network discharges directly to the docks or the River Thames so there are limited third party interfaces. Based on consultations, in the view of the EA and the CRT, there is considerable capacity in the docks for additional surface water. The Canary Wharf Group conducts routine checks of drains and the outfalls of buildings using CCTV, and also cleans/clears them regularly.

Groundwater Flood Risk

13.59 The LBTH SFRA state that the Site may be at risk of elevated groundwater levels although no records of groundwater flooding have been recorded. It is recommended that the susceptibility of the Site to groundwater flooding is verified. If the Site or parts of the Site are shown to be at risk, development proposals would need to consider Site ground conditions and groundwater levels over the lifetime of the development. In particular, the design of any underground structures or services and foundations.

Flood Risk from Infrastructure Failure

13.60 The SFRA has considered the potential flood risk to the LBTH following a breach of a major reservoir in London. Aspen Way and a part on the north-west of the Site is affected by a failure of the King George's Reservoir. However, the levels along Aspen Way to the north of the Site are such that in the event of reservoir breach, water will flow along the highway towards the north-west, towards Limehouse Link and away from the Site.

13.61 Records from TWUL, as presented in the LBTH Level 2 SFRA, show there have been no reported incidents of sewer flooding on the Site.

Existing Drainage Infrastructure

13.62 Plant records from TWUL do not identify an existing foul or surface water discharge from the Site to their network. There are temporary building structures currently located on the Site. These are served by temporary drainage infrastructure. TWUL records show a large (1500mm) diameter combined sewer in Aspen Way, identified as North Quay Sewer. This does not pass through the Site. There is no information from TWUL currently available regarding the invert levels of the nearest manholes in Aspen Way; however, previous geotechnical desk studies suggest the invert level of the sewer is between -2 and -3mAOD. TWUL has identified this asset as being part of its strategic network.

13.63 Topographic surveys carried out by CWCL show private surface water drainage in Upper Bank Street to the east of the Site.

13.64 There has been historic consultation between TWUL and Arup regarding the impact of Canary Wharf developments, including this Site. In 2014, TWUL undertook impact modelling to assess the impacts of these developments on TWUL assets and identified that upgrades to the sewer network would be required to cater to the new developments. The impact modelling was updated in January 2019 taking into account phasing of the development. It concluded that that there is sufficient capacity in the sewer network to accommodate the flows from the Proposed Development. This has subsequently been verified in recent consultation with TWUL in June 2020.

Water Supply

13.65 Plant records from TWUL do not show an existing water supply to the Site; however, there are existing buildings adjacent to the Site which are served by TWUL potable mains. In addition, there are temporary buildings currently located on the Site. The temporary buildings currently on site are served by a temporary potable water supply. TWUL records show a pair of 300mm diameter trunk mains in Aspen Way, which pass through the north of the Site. There is another 800mm diameter trunk main along Aspen Way to the north of the pair of smaller trunk mains. TWUL has identified assets in Aspen Way as part of its strategic

[19] *London Borough of Tower Hamlets, November 2016. London Borough of Tower Hamlets Strategic Flood Risk Assessment [Available: https://www.towerhamlets.gov.uk/Documents/Planning-and-building-control/Strategic-Planning/Local-Plan/Evidence_base_2016_Local_Plan/SFRA_REG_18_Finalcompressed.pdf]*

network. A 200mm diameter and a 150mm diameter distribution main are connected to Billingsgate Market from the pair of 300mm diameter trunk mains.

Water Abstractions

13.66 The Groundsure Report has records for nine water abstraction permits located within 1000m of the Site. The permit end dates have not been supplied.

13.67 Groundwater abstractions for the purpose of dewatering have been identified by the Groundsure Report, the details of these are as follows:

- Westferry Road, Canary Wharf - Borehole (518m from the Site);
- Westferry Road, Canary Wharf - Borehole (523m from the Site); and
- Westferry Road, Canary Wharf - Borehole (560m from the Site).

13.68 There are no surface water abstraction points within 1,000m of the site, however there is one active potable extraction point within 1,000m of the site:

- Britannia International Hotel, Isle of Dogs E14 – Borehole (605 m from the Site).

13.69 The Site does not lie within a Source Protection Zone (SPZ) for public water supply abstraction and none are present within 1000m. The River Thames, to which the Site is hydraulically linked, is designated a marine nature reserve and the Docks of Canary Wharf are a Site of Importance for Nature Conservation (SINC). There are no other nature conservation sites within 1km of the Site.

Licenced Discharges to Controlled Waters

13.70 The Groundsure Report records six unexpired licenced discharge points to controlled waters located within 500m of the Site.

13.71 The locations of the unexpired discharge consents are as follows:

- Canary Wharf, Isle of Dogs (On Site);
- Canary Wharf, Isle of Dogs (250m from the Site);
- Canary Wharf, Isle of Dogs (368m from the Site);
- Wood Wharf, Isle of Dogs (408m from the Site);
- The International Hotel, Marsh Wall (465m from the Site); and
- Wood Wharf, Isle of Dogs (471m from the Site).

Climate Change Considerations

13.72 The Site is likely to be significantly affected by future climate change. The likely changes to the baseline include:

- Reduced reliability of water supply; and
- Increased occurrence of high intensity rainfall events.

13.73 As a result of future changes to the baseline:

- Increased flood risk is accounted for by using TE2100 design flood levels as advised by the EA in their Product 8 report for the Site; and
- High intensity rainfall events may result in increased risk of surface water flooding. In line with the updated NPPG guidance[20] (as of October 2019) this is accounted for by using an appropriate climate change allowance.

RECEPTORS AND RECEPTOR SENSITIVITY

Existing Receptors

13.74 The sensitivity / value of the existing receptors identified for the Site and surrounding area is defined in Table 13.4.

Table 13.4 Analysis of Existing Sensitive Receptors

Feature	Receptor	Value/ Sensitivity	Basis Of Definition
Surface water drainage	TWUL Aspen Way Trunk Sewer	High	TWUL has identified this asset as being part of their strategic network. This is based on consultation with TWUL.
	The Docks (quantum of water discharged)	Low	The EA and the CRT have confirmed that there is considerable capacity for additional surface water within the docks. This is known to Arup through historic consultation regarding developments on the wider Canary Wharf estate.
Foul water	TWUL Aspen Way Trunk Sewer	High	TWUL has identified this asset as being part of their strategic network. This is based on consultation with TWUL.
Ground water quantity and flow rates	Upper aquifer	Very Low	This is a localised feature which does not lie within the EA's Source Protection Zone.
	Lower aquifer	Medium	This is an important resource to London in terms of water abstractions.
Water quality	The Docks	Medium	The water body has been heavily modified. It is not a designated conservation area and is only of local importance. However, the balance between dock water quality parameters is such that a change to the baseline can have a significant effect on water quality. This is based on Arup's professional judgement and previous experience of monitoring the dock water quality.
Potable Water Supply	TWUL primary supply pipeline from Aspen Way	High	TWUL has identified this asset as being part of their strategic network. This is based on consultation with TWUL.

[20] *NPPG, 2016. Flood risk assessments: climate change allowances [Available: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances]*

Feature	Receptor	Value/ Sensitivity	Basis Of Definition
Tidal and Surface Water Flooding	Existing local population and infrastructure affected by a change in flood risk	Medium	The Site is not in the functional floodplain. However, within the Site boundary, there is a section of the existing dock wall, which forms part of the flood defences along the River Thames.

Introduced Receptors

13.75 The new sensitive receptors to be considered as a result of the Proposed Development are as defined in Table 13.5:

Table 13.5 Analysis of New Sensitive Receptors

FEATURE	RECEPTOR	VALUE/ SENSITIVITY	BASIS OF DEFINITION
Tidal, Surface Water and Groundwater Flooding	Proposed Development and its occupants	Medium	The Site is not in the functional floodplain. However, within the Site boundary, there is a section of the existing dock wall, which forms part of the flood defences along the River Thames. There will be a proposed basement located within the Upper Aquifer, where there are groundwater flows.

POTENTIAL EFFECTS

Enabling and Construction

13.76 This section assesses the potential effects of the Proposed Development during the enabling and construction phase for each of the identified sensitive receptors. It is expected that the duration of the works for the entire development proposals for North Quay will be approximately 8 years.

The Docks (Water Quality)

13.77 There are a number of typical construction activities that pose a hazard to the Dock water quality. However, with a Construction Environmental Management Plan (CEMP) in place the majority of the impacts would be Negligible. The CEMP will follow the LBTH Code of Construction Practice[21] and the Canal & River Trust Code of Practice[22] and will be secured by planning condition.

13.78 Potentially hazardous liquids are likely to be stored and handled on-site, e.g. fuels and chemicals used during construction. This is a short-term impact. In line with standard best practice measures which will be set out in the CEMP. In the event of fuel/chemicals finding a pathway into the Docks, there would be a temporary, adverse effect on the Dock water quality. However, because this impact is considered unlikely to occur its magnitude is very low. Therefore, the effect on Dock water quality (medium sensitivity) will be **Negligible** (not significant).

13.79 Construction works result in areas of soil being exposed. During a rainfall event, sediment and other pollutants (including litter and construction debris) could be washed into the Docks. This is a short-term impact that could result in a temporary, adverse effect on the Dock water quality, particularly turbidity. However, with the appropriate site controls in place (which would be covered within the CEMP), the occurrence of this is unlikely. Therefore, the magnitude of the impact occurring will be very low and the effect on the Dock water quality (medium sensitivity) will be **Negligible** (not significant).

13.80 Piling activity in the water poses a hazard to water quality. However, appropriate piling techniques will be used, as outlined in the CEMP, to mitigate risk. A rotary bored pile technique is proposed. This involves installing a steel tube and casting the concrete pile inside the tube. This method mitigates the risk of dock water contamination by minimising vibrations and thereby reducing the disturbance of silt on the dock bed, as well as the steel tube preventing migration of concrete and excavated material into the dock water. In addition, the piling technique used will be agreed with the EA and CRT prior to undertaking the works. Therefore, the effect on the Dock water quality will be **Negligible** (not significant).

13.81 Local dewatering of the Upper Aquifer is being considered as a method to manage movements in the secant wall during excavation (to be confirmed at detailed design stage). Generally, groundwater discharge generated by construction activity on Canary Wharf developments is discharged to the Docks. This is a short-term impact, which, if the composition of the discharge from this activity was significantly different to that in the Dock, could have an adverse, temporary effect on the baseline Dock water quality (albeit not a significant effect). This could result in disruption to the Dock ecosystem and is addressed within the Preliminary Ecological Assessment submitted as part of this planning application.

13.82 A potential beneficial effect from local dewatering of the Upper Aquifer is that the dissolved oxygen content in the Upper Aquifer groundwater is relatively high. Localised pollution of the Dock water by dewatered groundwater discharge to the Docks is possible; however, because the groundwater discharge would be controlled (discharged in limited quantities and at a limited rate) the impact is considered to be low. A discharge permit will need to be obtained from the EA and permission to discharge sought from CRT. Groundwater will be discharged in line with the conditions of the permit and a monitoring regime will be agreed with the EA. The effect of a very low impact on Dock Water Quality (medium sensitivity) is therefore considered to be **Negligible** (not significant).

TWUL Aspen Way Trunk Sewer (Foul and Surface Water)

13.83 Works undertaken to connect the Proposed Development to the public foul and surface water sewer would be designed and constructed taking account of TWUL's requirements. Surface water flows will be reduced to the greenfield runoff rate. In addition, the foul discharges produced during construction would be small in comparison to those during operation. There would be a very low impact on the TWUL Aspen Way Trunk Sewer (high sensitivity) and therefore the effect is assessed as **Negligible** (not significant).

[21] *London Borough of Tower Hamlets, 2006. Code of Construction Practice. [Available:https://www.towerhamlets.gov.uk/Documents/Consumer-affairs/Investigation,-inspections-and-monitoring/Monitoring/cocp.pdf]*

[22] *Canal & River Trust, 2020. Code of Practice for Works Affecting the Canal & River Trust [Available: https://canalrivertrust.org.uk/media/original/35862-code-of-practice-2020-part-1-general-information.pdf?v=70d9d4]*

Upper and Lower Aquifers (Groundwater)

13.84 Local dewatering of the Upper Aquifer is being considered as a method to manage movements in the secant wall during excavation. If this were to take place, localised, short-term draw-down of groundwater levels would occur. This would lead to a very low impact on the Upper Aquifer (very low sensitivity) as a source of water because there are currently no local abstractions from this aquifer. Therefore, the effect of this will be **Negligible** (not significant).

13.85 There are existing local abstractions from the Lower Aquifer. The piled foundations will extend into the Lower Aquifer which would be permanently located here, but this will not impede groundwater flow. Therefore, there will be a very low impact on the Lower Aquifer (medium sensitivity) and the effect will be **Negligible** (not significant).

TWUL Primary Potable Supply (Potable Water)

13.86 Since the Site has previously been used for temporary buildings and as a construction laydown area to support the construction of the Crossrail station, there is infrastructure in place to supply a temporary potable water supply to the Site. In addition, water demand during construction would not be significant when compared to the demand of the Proposed Development. Therefore, construction activity (very low impact) is assessed as having a **Negligible** (not significant) effect on the potable water supply (high sensitivity).

Existing Local Population and Infrastructure at Risk of Flooding (Tidal and Surface Water Flooding)

13.87 The North Dock Banana Wall acts as a tidal defence and damage to the dock wall during the demolition of the existing quay and construction of the new basement or promenade structure would result in the flood protection to the Site and adjacent areas being compromised. The physical effect on the wall itself would be adverse and permanent and the effect on flood risk would last until the dock wall underwent repair.

13.88 However, the intention is to use non-percussive piling, which would be outlined in the CEMP secured via a planning condition, to install the new false quay structure, and the new basement secant wall will take the load off the existing Banana Wall. In addition, a monitoring strategy will be put in place to check that the piling works do not result in damage to the Banana Wall. If damage or unacceptable movement occurs, appropriate remediation work will be undertaken. Therefore, damage to the wall is very unlikely, meaning that the impact on the flood risk to the existing infrastructure and local population (medium sensitivity) will be very low and the effect will be **Negligible** (not significant).

13.89 Some construction activities, such as wheel washing, would increase the volume of surface water runoff from the Site in the short-term. However, the volume is likely to be small and therefore the impact is of a very low magnitude. In addition, activities will comply with the LBTH Construction Code of Practice[23], and Pollution Prevention Guidance[24] and this would form part of the CEMP. The effect on flood risk will be **Negligible** (not significant).

13.90 Under existing conditions, precipitation falling on the Site would usually flow overland to the Docks to the south, or be picked up by road drainage in the north-east corner of the Site. To a lesser extent, some precipitation would infiltrate the ground. During construction, the situation would be no different to the existing condition. Works may result in local low-spots and localised ponding of water may take place during a rainfall event. The temporary surface water drainage strategy will comply with the LBTH Construction Code of Practice, and Pollution Prevention Guidance. Construction works on surface water flood risk (medium sensitivity) will have a very low impact and therefore be a **Negligible** effect (not significant).

Phasing

The Docks (Water Quality and Surface Water Drainage)

13.91 The surface water drainage strategy (as detailed in the FRA) for the Site is to, where possible, discharge the majority of surface water runoff, falling on roofs and soft landscaping, directly to the Docks. As each phase of the Proposed Development is completed, the contributing areas will begin to discharge into the dock, the quantity of surface water discharging will be at a maximum once the Proposed Development is fully operational. As discussed within the Completed Development section of this ES chapter, the discharge of surface water to the Docks results in a direct, long-term, permanent, minor beneficial effect in terms of water quality, due to the increased flushing and aeration of the dock water. Therefore, the impact on North Dock water quality (medium sensitivity) will be low and the effect will be **Negligible** (Not Significant).

TWUL Aspen Way Trunk Sewer (Foul and Surface Water)

13.92 TWUL completed a sewer impact study which concluded that their network had sufficient capacity to take surface and foul flows from the completed Proposed Development. This is subject to the surface water flows being restricted to the greenfield runoff rate. As the completed Proposed Development will have a higher rate of foul discharge than during the phasing and the surface water is being limited to an agreed rate, the impact on the TWUL Aspen Way Trunk Sewer (high sensitivity) will be very low and the effect will be **Negligible** (Not Significant)

TWUL Primary Potable Supply (Potable Water)

13.93 As the phasing of the Proposed Development progresses, the operational potable water demands will come into effect for the completed buildings and any construction potable demand will stop. As the demands resulting from construction are negligible in comparison to the operational demand, the water demand of the Site is expected to be 25.75l/s (based on the Indicative Scheme) which will be at a maximum when the Proposed Development is completely operational.

13.94 TWUL have indicated during consultation that prior to the Proposed Development going ahead, reinforcement of their potable water supply infrastructure would have to be undertaken to support the potable water demands of the completed Proposed Development. This is considered within the Completed

[2323] *Canal & River Trust, 2020. Code of Practice for Works Affecting the Canal & River Trust [Available: https://canalrivertrust.org.uk/media/original/35862-code-of-practice-2020-part-1-general-information.pdf?v=70d9d4]*

[24] *Environment Agency, 2007. Pollution Prevention Guidelines Works or Maintenance in or Near Water [Available: https://webarchive.nationalarchives.gov.uk/20140328095328/http://cdn.environment-agency.gov.uk/pmho1107bnkg-e-e.pdf]*

Development section of this ES chapter, providing the operational demands are met, the impact of the phasing on the TWUL Primary Potable Supply (high sensitivity) is **Negligible** (Not Significant)

Completed Development

13.95 This section assesses the potential impacts and likely associated effects of the completed Proposed Development during its operation. The potential effects related to flood risk are based on the conclusions of the site-specific FRA, which is submitted as a standalone report as part of the OPA.

The Docks (Surface Water)

13.96 The key principle of the surface water drainage strategy for the Proposed Development (as set out in the Site-Specific Flood Risk Assessment) is to discharge the majority of surface water runoff, falling on roofs and soft landscaping, directly to the Docks. Areas trafficked by vehicles will not be discharged to the Docks as they will have unacceptable levels of contamination and will be discharged to the TWUL sewer in Aspen Way. Areas of soft landscaping will be introduced at Ground Level, and Level 01. The existing Site is entirely impermeable therefore, the amount of permeable area would, at least, be the same as existing and there will be no less infiltration than previously. Indeed, discharge of surface water to the Docks results in a direct, long-term, permanent, minor beneficial effect in terms of water quality, due to the increased flushing and aeration of the dock water. Therefore, the completed development will have a very low impact on the Docks water quality (medium sensitivity) and the effect will be **Negligible** (low significance).

13.97 Areas of green roof have been included in the Proposed Development. Green roofs are classified as extensive or intensive. Extensive green roofs require little maintenance as they do not usually need artificial irrigation or the use of fertilisers. Extensive green roofs are generally self-sustaining after they have been established. As such, runoff from these types of roofs will be discharged to the docks. Intensive green roofs, on the other hand, have greater maintenance requirements as they are irrigated and require the application of fertilisers. Due to the risk of contamination, runoff from intensive green roofs will be discharged to the TWUL sewer in Aspen Way. Therefore, the impact on North Dock water quality (medium sensitivity) will be low and the effect will be **Negligible** (Not Significant).

TWUL Aspen Way Trunk Sewer (Foul and Surface Water)

13.98 The estimated peak foul discharge from the Proposed Development based on the Indicative Scheme is 64.32l/s. This will be discharged to the Aspen Way Trunk Sewer.

13.99 The Proposed Development levels are such that not all the surface water runoff can be conveyed via gravity to the Docks. In addition, as mentioned earlier, some of the surface water runoff, falling on vehicle-trafficked areas, will not be conveyed to the Docks to avoid contamination. Where rainfall cannot be discharged to the Docks for these reasons, it will need to be pumped to the public sewer at the greenfield runoff rate. The surface water drainage strategy includes for the provision of below-ground attenuation tanks in the landscape areas, before discharging to the Aspen Way trunk sewer.

13.100 TWUL has undertaken a sewer impact study, the results of which were received in January 2019, it found that there is sufficient capacity within its network to accommodate surface and foul flows from the Proposed Development. In June 2020, Max Fordham consulted with TWUL to confirm the above peak foul discharge rate is accepted and in line with their long-term planning. TWUL confirmed that this is the case. Therefore, the impact on the TWUL sewer (high sensitivity) will be very low and the effect will be **Negligible**. (Not Significant).

Upper and Lower Aquifers (Groundwater)

13.101 The proposed basement construction will sit within the Upper Aquifer, which has been identified as being of very low sensitivity/value. A beneficial, long-term impact is that once constructed, the basement wall will create a barrier between the Upper Aquifer and North Dock. A beneficial, permanent effect of this will be a nominal reduction of water leaking from the Docks into the Upper Aquifer. However, the volume is such that this effect is **Minor Beneficial** (Not Significant).

13.102 The proposed basement structure will not impede groundwater flows of abstractions from the Lower Aquifer, which has medium value/sensitivity, due to the depth of the dig being restricted to the Upper Aquifer. There is therefore no impact on the Lower Aquifer (very low sensitivity) and the effect on abstractions from the Lower Aquifer can be considered **Negligible** (Not Significant)

TWUL Primary Potable Supply (Potable Water)

13.103 The peak potable water demand for the Proposed Development based on the Indicative Scheme is 25.75l/s. TWUL have indicated during consultation that prior to the Proposed Development going ahead, reinforcement of their potable water supply infrastructure would have to be undertaken. Without the upgrades, TWUL would not be able to meet the demand of the Proposed Development. Therefore, due to the strategic nature of the potable supply network, there is a medium impact on the TWIL primary potable supply (high sensitivity) and the effect will be **Moderate Adverse** (Significant).

Existing Local Population and Infrastructure at Risk of Flooding (Tidal and Surface Water Flooding)

13.104 The assessment of the impact of the Proposed Development on flood risk to the existing local population and infrastructure is based on the findings of the site-specific FRA appended to the ES (**ES Volume 3, Appendix: Water Resources and Flood Risk**).

13.105 Currently there is an existing false quay structure that occupies approximately 670m^3 of flood storage volume within the docks. The existing false quay deck structure would be demolished and replaced with a new marine deck structure. If possible, the existing marine piles would be reused. If it is not possible to reuse the existing marine piles, new piles will be constructed in the dock to support the proposed new marine deck structure. In this case, it is proposed that the existing marine piles be retained to minimise construction activity in the dock water. The proposed marine deck structure and piles, in addition to the retained marine piles, will occupy approximately 3,230m^3 of flood storage. Therefore, there is a loss of flood storage due to the proposed marine deck structure and piles of 2,560m^3. Hydraulic modelling has been undertaken to demonstrate the impact of the flood storage loss on the future flood water levels in the West India Docks. The modelling has demonstrated that the dock water levels will increase by 0.1mm. This is well below the threshold that has been agreed with the EA. Therefore, this change to the baseline is barely discernible and therefore the effect on flood risk to the existing local population and infrastructure is considered

Negligible. The EA has confirmed that the impact is low and therefore effect is **Negligible** (Not Significant) and that no further mitigation measures are required.

13.106 The dock wall will be raised to cater for the TE2100 design levels, with the promenade level being set at a minimum of +5.8mOD. The raising of the dock edge due to the Proposed Development will have a long-term effect on the flood resilience of the local area, leading to a **Moderate Beneficial** effect (Significant).

13.107 The proposed promenade structure has been designed to span over the existing dock wall, such that no load is applied to the Banana Wall. In addition, the basement secant wall will take load off the Banana Wall. Therefore, the structural integrity of the dock wall, in its capacity as a tidal defence, will be enhanced such that the effect on flood risk to the existing local population and infrastructure (medium sensitivity) is assessed as **Minor Beneficial** (Not Significant). In addition, access to the dock wall within the Site boundary does not change compared with the existing condition.

Proposed Development and Occupants at Risk of Flooding (Tidal and Surface Water Flooding)

13.108 The dock wall will be raised to cater for the TE2100 design levels, with the ground floor level being set at a minimum of +5.8mOD. This provides sufficient freeboard to buildings and occupants on the south side of the Proposed Development. Therefore, the impact on the Proposed Development (medium sensitivity) would be very low such that the effect would be **Negligible** (Not Significant).

13.109 The north-east corner of the Site is currently susceptible to surface water flooding. The proposed mitigation is in the form of flood walls and temporary flood barriers have been incorporated to protect the north-east part of the Proposed Development. The temporary flood barriers would be erected at the entrance to the basement in the event of a flood given prior notice is provided by an early flood warning system. More information on the flood walls and barriers can be found in the Site-Specific Flood Risk Assessment. Through this mitigation, the effect of flood risk on the Proposed Development (Medium Sensitivity) would be very low and is therefore the impact is considered to be **Negligible** (Not Significant)

13.110 An outline drainage strategy has been developed for the Proposed Development (presented in the Site Specific Flood Risk Assessment), the design intent is that where possible surface water runoff should be discharged into the North Dock. Discharging directly to the docks has the following advantages:

- Discharging surface water to the docks reduces the loading on the public sewer in Aspen Way; and
- Clean surface water acts to flush the dock system which benefits water quality in the docks.

13.111 Where surface water cannot be discharged into the docks, due either to the risk of contamination (e.g., road runoff or intensive green roofs) or because of hydraulic constraints, it will be conveyed to the existing combined TWUL sewer on Aspen Way as follows:

- Any soft-landscaped areas to the north of the Proposed Development are too far to discharge to the Docks via gravity and so will drain to buried geo-cellular attenuation tanks before being discharged to the Aspen Way sewer at the greenfield runoff rate;
- Areas of green roof that cannot be discharged to the Docks for reasons relating to water quality will be discharged to the Aspen Way sewer; and
- Runoff from the access road, which ramps down into the basement at a level of +2.7mOD) will be stored in a storm pumping station before it is pumped to the high-level attenuation and then discharged to the Aspen Way sewer at the greenfield runoff rate.

13.112 The requirement for a pumping station is due to the Proposed Development levels; the access road as it enters the basement is lower than Aspen Way, such that if the two were hydraulically connected by a drainage system, flooding along Aspen Way could back up and cause flooding of the development area.

13.113 Foul effluent from any above ground accommodation would be discharged by gravity to the public foul sewer in Aspen Way. Foul effluent any basement levels (plant rooms, car parks, cavity wall drainage, off-loading bays and all other waste drainage requirements) would be discharged by a number of small foul pumping stations located at various points within the basement.

13.114 With this drainage strategy in place, the effect on surface water flood risk will be improved compared to the existing situation at the Site. Therefore, the impact on the surface water flood risk (medium sensitivity) is low, so the effect is assessed as being **Minor Beneficial** (Not Significant)

MITIGATION MEASURES, MONITORING AND RESIDUAL EFFECTS

Enabling and Construction Mitigation

13.115 There are no effects that require mitigation or monitoring above the best practice measures already proposed. These should be clearly set out in the CEMP. These include:

- Storage tank/contained facilities would be appropriately bunded within designated areas to reduce the likelihood of spills occurring;
- Location of storage as far as practicable from the Dock to reduce the likelihood of any spills leaking or being washed into the Docks;
- Use of silt treatment measures within the docks;
- Appropriate temporary drainage measures to surface water runoff and contain silt/contaminants;
- Permits will be obtained from the EA and CRT prior to discharging surface water and groundwater into the docks; and
- Appropriate piling techniques will be used to limit the impact on existing structures and minimise vibration to prevent release of contamination into the docks.

Phasing Mitigation

13.116 There are no effects identified requiring mitigation or monitoring occurring as a result of the phasing of the development.

Completed Development Mitigation

13.117 The effect on the strategic potable supply network has been identified as being a Moderate Adverse effect as TWUL have confirmed in consultation that major works would need to be carried out to cater for the increased demand due to the Proposed Development (in conjunction with the other developments planned in the Isle of Dogs area). The Applicant has undertaken consultation with TWUL and commissioned TWUL to undertake a detailed network impact study. TWUL are still in the process of finalising this study but have

confirmed that the Proposed Development is included for in their long-term planning. TWUL have standard charges for upgrading their infrastructure. Therefore, the residual effect on the potable water supply network is considered to be **Negligible** (not significant) after this mitigation.

13.118 No other adverse effects are expected in relation to the Completed Proposed Development, and therefore no further mitigation or monitoring measures are proposed.

Residual Effects

13.119 Table 13.6 provide a tabulated summary of the outcomes of the Water Resources and Flood Risk Impact Assessment of the Proposed Development.

Table 13.6 Residual Effects

Receptor	Description Of Residual Effect	Nature Of Residual Effect*				
		Significance**	+ -	D I	P T	ST MT LT
Demolition and Construction						
Dock water quality	Reduced water quality due to spills of potentially hazardous liquids on site	Negligible	N/A	D	T	St
	Reduced water quality due to sediments/ debris washed into docks from construction site	Negligible	N/A	D	T	St
	Reduced water quality due to piling activity in the dock	Negligible	N/A	D	T	St
	Reduced water quality due to groundwater discharge into docks	Negligible	-	D	T	St
Ground Water - Lower Aquifer and Upper Aquifer	Effect of foundations on abstractions	Negligible	N/A	D	T	St
TWUL Aspen Way sewer	Foul discharges from construction activities increase load on sewer	Negligible	N/A	D	T	St
TWUL potable water supply	Construction activities increase demand on potable water supply	Negligible	N/A	D	T	
Flood risk to existing population and infrastructure	Effect of non-percussive piling methods on dock wall stability and therefore on flood risk	Negligible	N/A	I	P	Mt
	Increased surface water runoff due to construction activity	Negligible	N/A	D	T	St
	Localised surface water ponding.	Negligible	N/A	D	T	St
Completed Development						
Dock water quality	Increased flushing and aeration of the docks resulting from the discharge of surface water runoff from the Proposed Development	Minor Beneficial	+	D	T	St
	Effect on dock water quality of discharging green roofs to the docks	Negligible	N/A	D	T	St
Groundwater - Lower Aquifer and Upper Aquifer	Basement perimeter wall causing reduction of water leaking from docks into Upper Aquifer.	Minor Beneficial	+	D	P	Lt
	Basement construction does not extend into Lower Aquifer so does not effect abstractions.	Negligible (no impact)	N/A			
Flood risk to existing population and infrastructure	Loss of flood storage from Proposed Development. The assessed significance has been confirmed by the EA as Negligible.	Negligible	N/A	D	P	Lt
	Raising of dock edge improves flood resilience.	Moderate Beneficial	+	D	P	Lt
Flood risk to Proposed Development and occupants	Raising of dock walls and incorporating flood wall and temporary barriers into proposed flood strategy means that flood risk to Proposed Development is being managed.	Negligible	N/A	D	P	Lt
	Proposed deck structure overhanging dock wall does not compromise stability. Proposed secant wall reduces loading on dock wall.	Minor Beneficial	+	I	P	Lt
Surface Water Drainage	The proposed surface water drainage strategy would be an improvement on the existing site condition and therefore on surface water flood risk	Minor Beneficial	+	I	P	Lt

Receptor	Description Of Residual Effect	Nature Of Residual Effect*				
		Significance**	+ -	D I	P T	ST MT LT
TWUL strategic potable supply network	Once the reinforcement of the potable network has been carried out to accommodate the Proposed Development the residual effect is Negligible.	Negligible	N/a	D	P	Lt
TWUL strategic sewer network	Thames Water have confirmed they have capacity within their Network to accomodate flows from the Proposed Development.	Negligible	N/a	D	P	Lt
Notes: * - = Adverse/ + = Beneficial; D = Direct/ I = Indirect; P = Permanent/ T = Temporary; St- Short term/ Mt – Medium term / Lt – Long term. **Negligible/Minor/Moderate/Major						

CLIMATE CHANGE

13.120 This section outlines the impact of climate change on the receptors identified within this assessment, and how climate change could impact the magnitude of the impacts and likely effects on these receptors.

13.121 For surface water flooding, the changing rainfall patterns lead to more intense storm events which will more frequently overwhelm the existing drainage infrastructure leading to higher incidences of surface water flooding. In line with NPPF guidance, the surface water drainage system on the Site has been designed to accommodate flows from storms up to a 1 in 100 year event including 40% allowance for climate change by providing sufficient on site attenuation so that there is no flooding is generated for storms of this intensity and duration.

13.122 The analysis of the impacts and likely effects of tidal and fluvial flooding on the Proposed Development area within this ES chapter is based on the existing information pertaining to flood levels received from the EA. It is understood that these flood levels have been determined from modelling carried out by the EA based on the TE2100 study, and as such, incorporate a provision for climate change based on the latest Defra guidance.

ASSESSMENT OF THE FUTURE ENVIRONMENT

Evolution of the Baseline Scenario

13.123 Dewatering rates currently impacting the groundwater are likely to reduce over time and groundwater levels will natural rise as a result. Other than this impact, the baseline geology and hydrogeology of the Site is not expected to change significantly over time.

13.124 The quality of the water in the Isle of Dogs docks is expected to be maintained over the foreseeable future because any new discharge into the Docks is subject to review and approval by the EA and CRT. Additionally, continuous monitoring and maintenance is carried out by CRT and Canary Wharf Group.

13.125 Without the Proposed Development, there will be an increase in the risk of fluvial and tidal flooding to the Site in the future due to the impact that climate change may have on extreme rainfall, river flood flows and storm surges. The Site will be shielded from these impacts to some extent because it is protected by the Thames Barrier but the proposed land raising will not occur if the Proposed Development did not come forward.

13.126 Heavier rainfall patterns occurring as a result of climate change have the potential to overwhelm existing surface water drainage infrastructure, meaning surface water flooding events could occur more frequently in the future.

13.127 As the cumulative schemes come into operation there will be greater demand for potable water and increased pressure on the foul water network. This is all predicted by TWUL in their impact modelling for this part of London so the baseline for the Site is unlikely to change significantly.

Cumulative Effects Assessment

13.128 The cumulative effects of the cumulative schemes, as presented in **ES Volume 1, Chapter 2: EIA Methodology** and **ES Volume 3, Appendix: Introduction and EIA Methodology**, have been taken into consideration.

Enabling and Construction

The Docks (Water Quality and Surface Water Drainage

13.129 The effect on dock water quality is **Negligible** (Not Significant) since any discharges from the site to the docks would be controlled under the EA permits and conditions from CRT. These conditions put in place would suitably protect the water course from any detrimental impact.

TWUL Aspen Way Trunk Sewer (Foul and Surface Water)

13.130 There will be a **Negligible** effect on the TWUL Aspen Way sewer because having submitted the development plans to Thames Water, they have confirmed through an impact study that they have sufficient capacity within their network to receive the flows from the Proposed Development while taking into account wider redevelopment with the surrounding area.

Upper and Lower Aquifers (Groundwater)

13.131 There is a **Negligible** effect on Lower Aquifer abstractions by dewatering activity would be managed by the EA licencing process.

TWUL Primary Potable Supply (Potable Water)

13.132 There is a **Negligible** effect on the TWUL potable water supply since the demands are likely to be insignificant. In addition, TWUL have confirmed that they have accounted for the Proposed Development in their Integrated Water Management Strategy for the Isle of Dogs.

Flood Risk

13.133 The flood risk to existing population and infrastructure is **Negligible** (Not Significant) since the cumulative schemes would be permitted by the LBTH in line with their Local Plan for managing development. Which require all new developments to ensure that their scheme does not increase flood risk elsewhere.

Completed Development

Groundwater

13.134 It is considered that that there would be a **Negligible** (Not Significant) cumulative effect on the groundwater regime at the Site since any dewatering activities and / or abstractions at the sites of cumulative schemes would be regulated by the EA.

Surface Water

13.135 Further development may increase the amount of impermeable surfacing and therefore increase the amount of surface water runoff to be discharged to the sewer network. TWUL and EA regulations would ensure surface water runoff from new developments does not cause adverse effects through the use of their statutory powers. Therefore, the cumulative effects on the Docks and the TWUL strategic sewer network would be **Negligible** (Not Significant**).**

Foul Water

13.136 Further new developments are likely to increase foul water discharges to the TWUL network. The operational effects would therefore be cumulative and would further reduce the available capacity in the network causing increased risk of sewer flooding. However, new connections into the network are regulated by TWUL to avoid the sewers becoming overloaded. Therefore, the cumulative effects on the TWUL strategic sewer network would be **Negligible** (Not Significant)**.**

Potable Water Supply

13.137 Further new developments are likely to increase demand on the TWUL potable water supply. The operational effects would be cumulative and would put further pressure on the TWUL potable network. However, TWUL's planned strategic upgrades will take account of significant new developments in the Isle of Dogs area. Therefore, the cumulative effects on the TWUL potable water network would be **Negligible** (Not Significant)**.**

Dock Water Quality

13.138 The water quality of the Docks is regulated by the EA and CRT. The drainage strategy for the Proposed Development as described in this chapter would not adversely affect the water quality in the docks. Other future developments would need to adopt a similar strategy, with agreement from CRT and the EA. Therefore, the cumulative effects on the Dock water quality would be **Negligible** (Not Significant)**.** .

13.139 Discharge of surface water to the Docks results in a direct, long-term, permanent, minor beneficial effect in terms of water quality, due to the increased flushing and aeration of the dock water. Given that the sensitivity of the Docks has been assessed as medium and the impact magnitude is very low, the significance of this is deemed to be **Negligible** (Not Significant)**.**

Flooding

13.140 NPPF guidance states that flood risk to developments must not be increased from the existing situation, and that flood risk to the surrounding area must not be increased due to the Proposed Development. Developers of cumulative schemes must therefore ensure that flood risk is addressed and as such there would be a **Negligible** effect to existing people and infrastructure for flood risk, as well as flood risk to the Proposed Development and its occupants.

LIKELY SIGNIFICANT ENVIRONMENTAL EFFECTS

13.141 Given that TWUL have confirmed that the Proposed Development and associated phasing is accounted for in their Integrated Water Management Plan for the Isle of Dogs, there are no likely significant effects on water resources and flood risk.

13.142 There are, however, beneficial effects and a Moderate Beneficial (Significant) effect on flood risk to existing population and infrastructure because the Site will become more resilient to flooding as a result of the proposed ground level raising. This protects the Site and surrounding land to a higher level of flood protection than is currently the case.

COMPARISON AGAINST THE INDICATIVE SCHEME

13.143 For the purposes of this ES chapter, the Indicative Scheme has been used as a basis for the assessment because from a water resources and flood risk perspective it is considered reasonable to assume this is a worst case as explained in the Assessment Methodology section.

13.144 The maximum extents of the marine deck structure has been applied, the size of this is relevant to the flood risk of the area and has been discussed within this ES chapter due to the potential displacement of dock water. However, a calculation has been undertaken which shows that the maximum possible size of the structure only displaces enough water to increase the dock water level by 0.1mm. This value is already below the threshold set by the EA, therefore the impact of the marine deck structure would remain Negligible if its size was reduced.