13 Water Resources, Drainage and Flood Risk

Replacement Environmental Statement

Volume I

13 Water Resources, Drainage and Flood Risk

Preface – Update 2015

- This replacement November 2015 Environmental Statement (hereafter referred as the 'November 2015 Replacement ES' or 'this Replacement ES') takes into account the design changes to the Blossom Street project (refer *Chapter 4: Proposed Development*) that have occurred since the submission of the application in December 2014 ES and concludes if any changes to the likely significant effects occur as a result of those changes. This Replacement ES consolidates the environmental assessment of the design changes into a single ES, presenting commentary (under the heading 'Update 2015') for the design changes in the March 2015 ES Addendum (the 'March 2015 ES Addendum') by blue text, and the design changes arising from the current design changes by red text. Where relevant, text removed will be denoted by strike-through, e.g. ~~effect~~), and updated tables and figures will be denoted by the suffix 'A' (e.g. Table 2.10A).
- This Replacement ES adopts the following terminology to describe the development descriptions and design changes:
    - Proposed Development: description of the development presented in the December 2014 ES;
    - Revised Scheme: description of the scheme incorporating the design changes to the Proposed Development in March 2015 (the design changes referred as the 'March 2015 amendments'), assessed within the March 2015 ES Addendum;
    - Amended Proposed Development: description of the development incorporating the current design changes to the Revised Scheme (the design changes referred as the 'November 2015 amendments'), to be assessed within the November 2015 Replacement ES.
- Further details in regard to the approach taken in this November 2015 Replacement ES are outlined in *Chapter 2: EIA Methodology*.

Introduction

13.1 This chapter of the Environmental Statement (ES) reports the findings of an assessment of the potential effects of the Proposed Development on water resources, drainage and flood risk within the boundary of the Site and in the immediate surrounding area.

13.2 This chapter identifies key water resources and features, allocates an importance to these receptors, identifies the direct and indirect effects of the Proposed Development on these resources. Potential effects are considered in the context of the existing Site conditions; demolition and construction phase; and once the Proposed Development is complete and operational. The need for mitigation measures to prevent, reduce or off-set any significant adverse environmental effects is addressed and any residual effects are identified.

13.3 This chapter has been prepared by AKT II and is supported by a Flood Risk Assessment (FRA), which is presented in ***ES Volume III: Appendix H)***.

13.4 The Environment Agency (EA), London Borough of Tower Hamlets (LBTH) and Thames Water Utilities Limited (TWUL) have been consulted in the preparation of this chapter. In addition, a variety of data sources have been consulted and are acknowledged as appropriate in the following sections of this chapter.

Legislation and Planning Framework

National Legislation

13.5 The Water Resources Act (1991) (as amended) (Ref. 13-1) sets out the relevant regulatory controls that provide protection to water bodies and water resources. The Water Resources Act (1991) was amended by the introduction of the Water Act (2003) (Ref. 13-2) which modernised the regulation of water resources and water abstraction. The Water Resources Act (1991) is supported by:

- The Environment Act (1995) (Ref. 13-3), which established the Environment Agency (EA); and
- The Environmental Protection Act (1990) (Ref. 13-4), which provides for integrated pollution control.

13.6 The Water Act (2003) governs the control of water abstraction, discharge to water bodies, water impoundment, conservation and drought provision. The Water Resources Act (1991) originally excluded dewatering from engineering activities; however, the Water Act (2003) now lists this activity as requiring a 'Temporary' or 'Transfer' licence.

13.7 The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 (Ref. 13-3) transposed the EU Water Framework Directive (WFD) (2000/60/EC) (Ref. 13-5) into law in England and Wales. The purpose of the Directive is to establish a framework for Member States to prepare regulations for the protection of inland surface waters (rivers and lakes), transitional waters (estuaries), coastal waters and groundwater .

13.8 A number of other regulations also support and implement the statutory law described above, including for example:

- The Anti-Pollution Works Regulations (1999) (Ref. 13-7);
- The Control of Pollution (Oil Storage) (England) Regulations (2001) (Ref. 13-8);
- Water Resources (Environmental Impact Assessment) (England and Wales) Regulations (2003) (Ref. 13-9);
- The Groundwater Regulations (England and Wales) (2009) (Ref. 13-10) which transposed the EU Groundwater Directive (2006) (2006/118/EC) (Ref. 13-11) into UK law;
- The Environmental Damage Regulations (2009) (Ref. 13-12);
- The Water Resources Act (Amendment) (England & Wales) Regulations (2009) (Ref. 13-13);
- The Environmental Permitting (England and Wales) Regulations (2010) (Ref. 13-14) which control discharge of water to surface water and groundwater; and
- Water Supply (Water Quality) Regulations (2000) (Ref. 13-15).

13.9 The Flood and Water Management Act (2010) (Ref. 13-16) is largely aimed at delivering the recommendations of the Pitt Review (Ref. 13-17) which arose as a result of the environmental damage caused by the floods in 2007. The Flood and Water Management Act implements the recommendations from The Pitt Review including:

- *"Sustainable drainage systems (SuDS) must be the first choice for drainage for all new developments, and the SuDS Approval Body within the Lead Local Flood Authority, which is either the Unitary Authority or the County Council, have a duty to adopt the SuDS (subject to approval); and*
- *It introduces changes to the rights to connect to sewers. Automatic connection rights are to be restricted only to adopted sewer schemes constructed to the new National Sewer Standard or approved SuDS schemes constructed to the new National SuDS Standard, consultation on which has recently been undertaken."*

13.10 Some elements of the Flood and Water Management Act are yet to come into force, including:

- Section 32 and Schedule 3 – Sustainable Drainage Systems;
- Section 33 and Schedule 4 – Reservoirs; and
- Section 42 – Agreements on New Drainage Systems.

National Policy and Guidance

National Planning Policy Framework (2012)

13.11 The National Planning Policy Framework (NPPF) (Ref. 13-18) supersedes and replaces a number of planning policy statements that were applicable to the water environment including *Planning Policy Statement 25* (PPS25): Development and Flood Risk (Ref. 13-19) and *PPS23: Planning and Pollution Control* (Ref. 13-20). The information within PPS25 has been archived and is now replaced by the Planning Practice Guidance – Flood Risk and Coastal Change (Ref. 13-21).

13.12 The NPPF sets out 12 planning principles as guidance for local councils for the creation of their local plan. The following principles are directly applicable to the water environment (para. 17):

- *"Meeting the challenge of climate change, flooding and coastal change – support the transition to a low carbon future in a changing climate taking full account of (inter alia) flood risk and coastal change; and*
- *Conserving and enhancing the natural environment – development should minimise pollution and other adverse impacts on the local and natural environment and should plan positively for the creation, protection, enhancement and management of networks of biodiversity and green infrastructure."*

13 Water Resources, Drainage and Flood Risk

13.13 The NPPF states that Local Plans are the key to delivering sustainable development that reflects the vision and aspirations of local communities. Local Plans must be supported by a Strategic Flood Risk Assessment (SFRA) and develop policies to manage flood risk, taking account of advice from the EA. Local Plans should apply a sequential, risk-based approach to considering the location of development to avoid flood risk to people and property where possible, and manage any residual risk, taking account of the impacts of climate change (para. 100).

13.14 Paragraph 103 states: "When determining planning applications, local planning authorities should only consider development appropriate in flood risk areas where, informed by a site-specific flood risk assessment following the Sequential Test, and if required the Exception Test, it can be demonstrated that:

- *"Within the site, the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location;*
- *Development is appropriately flood resilient and resistant, including safe access and escape routes where required, that any residual risk can be safely managed, including by emergency planning; and it gives priority to the use of sustainable drainage systems"*.

Planning Practice Guidance (2014)

13.15 The Planning Practice Guidance (Ref. 13-21) supersedes and replaces the PPS25 following an external review of government planning practice guidance. The guidance retains key elements of PPS25 and is a web-based resource which brings together planning practice guidance for England in an accessible and usable way. The Planning practice guidance will be updated as needed and users will be informed of any changes.

13.16 With respect to water resources and flood risk, local planning authorities should ensure that they:

- Prevent both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by, unacceptable levels of land, air, water or noise pollution;
- Ensure several SuDS techniques, covering the whole range of sustainable approaches to surface drainage management, are incorporated into new developments; and
- Ensure new development is planned to avoid increased vulnerability to impacts arising from climate change.

Regional Policy and Guidance

The London Plan (2011)

13.17 The London Plan (Ref. 13-23) includes a number of key policies aimed to assist protection of the water environment during redevelopment and construction.

13.18 Policies of relevance to water resources and flood risk within the context of the Proposed Development include:

- *Policy 2.18 Green Infrastructure –*
  - *The promotion of SuDS will improve water resources, flood mitigation and reduce flood risk;*
- *Policy 5.3 Sustainable Design and Construction –*
  - *Promotes high standards of design in new developments to improve environmental performance;*
- *Policy 5.11 Green Roof and Development Site Environs –*
  - *Major developments should include roof, wall and site planting in their design to achieve sustainable urban drainage by absorbing rainfall and thereby reduce flooding associated with surface water runoff;*
- *Policy 5.13 Sustainable Drainage –*
  - *Developments should utilise SuDS, aim to achieve greenfield run off rates and manage surface water runoff close to source;*
- *Policy 5.14 Water Quality and Wastewater Infrastructure –*
  - *Aims to protect and improve water quality and ensure adequate and appropriate sewerage infrastructure; and*
- *Policy 5.15 Water Use and Supplies –*
  - *Developments should minimise the use of treated water by incorporating water saving measures such as reducing water consumption from 161 litres per day (l/d) to 105 l/d in residential development. The use of water harvesting and grey water recycling schemes is to be promoted.*

Revised Early Minor Alterations to the London Plan (2013)

13.19 Within the Revised Early Minor Alterations to the London Plan (REMA) (Ref. 13-24), all of the policies of relevance to the water environment (as presented in paragraph 13.18 above) were considered to be wholly consistent with the NPPF and therefore are retained without further modification.

Draft Further Alterations to the London Plan (2014)

13.20 The Draft Further Alterations to the London Plan (Ref. 13-25) are not anticipated to have any effect on the content or recommendations of this chapter.

Supplementary Planning Guidance – Sustainable Design and Construction (April 2014)

13.21 Sections 3.4.13 and 4.6.3 of the Sustainable Design and Construction Supplementary Planning Guidance (SPG) (Ref. 13-26) indicates that the essential standards for reducing water pollution and flooding require that all developments use SuDS wherever practical, and achieve 50% attenuation of the undeveloped site's surface water runoff at peak times. In this context, 'the undeveloped site' is taken to be the Site prior to the Development (i.e. the existing site). The Mayor's preferred standards would achieve 100% attenuation of the undeveloped site's surface water runoff at peak times.

The Mayor's Water Strategy (2011)

13.22 The Mayor's Water Strategy (Ref. 13-27) details ways in which present water resources could be used more effectively in order to tackle problems such as water supply, wastewater generation and flood risk across London. Actions of relevance to water resources and flood risk for the Site are:

- *Action 5: Aims to make property more water efficient. The strategy aims to raise awareness of efficient commercial (non-domestic) water use and encourages commercial users to set internal targets and best practice benchmarks for water use reduction. TWUL estimates that, overall, commercial demand will grow by 8% over the next 25 years. The policy recognises that a significant proportion of commercial water use is from the services sector (for example 16% from hotels, bars and restaurants) and it therefore holds significant potential to save water; and*
- *Action 18: Encourages the use of green roofs, rainwater harvesting, grey water recycling and sustainable drainage to relieve the pressures on the drainage systems, thereby reducing flood risk and water demand.*

London Regional Flood Risk Appraisal (2009)

13.23 The London Regional Flood Risk Appraisal (RFRA) Ref. 13-30) was published in October 2009 and seeks to ensure that the overall flood risk in Greater London does not increase. The RFRA contains 19 recommendations to be implemented by the EA and other agencies. The recommendations of particular relevance to the Proposed Development include:

- *Recommendation 5: Developments should reduce surface water discharge in line with Policy 5.13 of the London Plan (2011);*
- *Recommendation 6: Regeneration and redevelopment of London's fluvial river corridors offer a crucial opportunity to reduce flood risk. SFRAs and policies should focus on making the most of this opportunity through appropriate location, layout and design of development as set out in PPS25 and the Thames Catchment Flood Management Plan. In particular, opportunities should be sought to: set back development from the river edge to enable sustainable and cost effective flood risk management options; ensure that the buildings with residual flood risk are designed to be flood compatible or flood resilient; use open spaces within developments which have a residual flood risk to act as flood storage areas; and*

- *Recommendation 8: Organisations responsible for development with large roof areas should investigate providing additional surface water run-off storage.*

Local Policy and Guidance

LBTH Core Strategy (2010)

13.24 Relevant policies within the LBTH Core Strategy (Ref. 13-28) include:

- SP04 - Creating a Green and Blue Grid:
  - The Council will expect all development to minimise current and future flood risk and the adverse effects on people. In particular:
    - The Sequential Test must be utilised to assess and determine the suitability of land for development based on flood risk;
    - All new development that has to be located in a high risk flood zone must demonstrate that it is safe and passes the Exceptions Test (in accordance with NPPF);
    - Development across the borough should not increase the risk and impact of flooding;
    - Developments in areas of Flood Risk 2 and 3a should ensure the application of flood-resilient design; and,
    - All new developments must aim to increase the amount of permeable surfaces, including SUDS, to improve drainage and reduce surface water run-off.
- SP11 - Working Towards a Zero-Carbon Borough:
  - Requires developments to make the fullest possible contribution to the mitigation of and adaptation to climate change. The Council will tackle climate change by requiring developments to be designed and constructed to take account of the increasing risks of flooding and minimise their vulnerability to a changeable climate.
- SO3 - Achieving Wider Sustainability –
  - Tower Hamlets will achieve environmental, social and economic development simultaneously; the improvement of one will not be to the detriment of another. Where tradeoffs between competing objectives are unavoidable, these will be transparent and minimised. This will be realised by:
    - Minimising the use of natural resources.
    - Working pro-actively to protect and enhance the quality of the environment.
    - Improving air, land and water quality by minimising air, noise, land and water pollution…*".*

LBTH Managing Development Document (2013)

13.25 Relevant development policies within the LBTH Managing Development Document (MDD) (Ref. 13-29) include:

- Policy DM13 Sustainable Drainage:
  - Requires developments to reduce water consumption, runoff and discharge and minimise current and future flood risk and the adverse effects of flooding on people by implementing the following measures:
    - Development will be required to show how it reduces the amount of water usage, runoff and discharge from the site, through the use of appropriate water reuse and SuDS techniques;
    - In order to reduce the amount of water being discharged from sites, this policy requires development to both reduce the amount of water being used and reduce the run-off from hard surfacing;
    - Development should in the first instance seek to maximise the reuse of water through onsite grey water recycling and reduce the amount of water use through low flow water technologies;
    - Development should demonstrate that surface water will be controlled as near to its source as possible; and
    - All development should provide details of these provisions and how they will be incorporated. Specifically a Water and Drainage Strategy should be provided for major development.
- Policy DM29 Achieving a Zero Carbon Borough and Addressing Climate Change:
  - States that the Council will require the implementation of sustainable design and construction measures by:
    - Implementing the London Plan sustainable design and construction policies to ensure developments incorporate sustainable measures, including, but not limited to, making the most effective use of resources such as water and aggregates, sourcing building materials sustainably, reducing pollution and waste, promoting recycling and conserving the natural environment; and
    - That sustainable design assessment tools, such as the Code for Sustainable Homes and BREEAM, are used to ensure the development achieves the highest levels of sustainable design and construction.

LBTH Strategic Flood Risk Assessment (2012)

13.26 The Strategic Flood Risk Assessment (SFRA) (2012) (Ref. 13-31) was prepared to support the LBTH in spatial planning decisions that are required to inform the development plans comprising the Local Development Framework (LDF). During preparation of the SFRA existing information was reviewed and additional modelling was undertaken to identify the level of flood risk posed in the Borough. The SFRA reported that there was a residual tidal flood risk in the event of a breach in the flood defences along the River Thames, but there is limited historical information with regards to surface and sewer flooding in the LBTH.

LBTH Surface Water Management Plan

13.27 The Surface Water Management Plan (SWMP) for the LBTH outlines the preferred surface water management strategy for the borough. The SWMP describes flooding from sewers, drains, groundwater, and runoff from land, small watercourses and ditches that occurs as a result of heavy rainfall. The SWMP outlines the Critical Drainage Areas (CDA) within the LBTH.

LBTH Code of Construction Practice (2006)

13.28 The London Borough of Tower Hamlets (LBTH) has their own Code of Construction Practice (CoCP) which must be followed by all contractors working on new developments (Ref. 13-52) with specific reference to water resource matters. The CoCP provides guidance and mitigation measures for works within the construction site.

Other Relevant Policy and Guidance

Environment Agency Pollution Prevention Guidance Notes

13.29 The Environment Agency's Pollution Prevention Guidance Notes (PPGs) provide advice on statutory responsibilities and good environmental practice. The PPGs of particular relevance to the Proposed Development include:

- *PPG 1: General Guide to the Prevention of Pollution* (Ref. 13-32) which provides an introduction to pollution prevention and the pollution prevention guidance notes;
- *PPG 2: Above Ground Oil Storage Tanks* (Ref. 13-33) which provides guidance to those responsible for the storage of oil on construction sites. The document provides guidance on location, bunding, protection and operation of oil stored in addition to maintenance and brief guidance on dealing with spills;
- *PPG 3: Use and* Design *of Oil Separators in Surface Water Drainage Systems* (Ref. 13-34), which provides guidance on when oil separators are appropriate and what size and type of separator are required;

- *PPG 6: Working at Construction* or *Demolition Sites* (Ref. 13-35) is a document that mirrors much of PPG 5 Works and Maintenance in or Near Water but with particular emphasis on the situations likely to occur at demolition and construction sites;
- *PPG 7: Refuelling* Activities (Ref. 13-36), which provides information on the correct delivery, storage and dispensing of fuel to help reduce the risk of pollution; and
- *PPG 21: Pollution* Incident *Response Planning* (Ref. 13-37) assists those developing site-specific pollution incident response plans to prevent and mitigate damage to the environment caused by accidents such as spillages and fires.

Construction Industry Research and Information Association Guidance

13.30 *Guidance C532 – Control of Water Pollution from Construction Sites* (Ref. 13-38) brings together the EA guidance but goes into greater detail with regard to sources of water on construction sites, pollutants and pathways. In addition, it provides guidance on planning for the type and location of suitable control measures.

13.31 *Guidance C697 – The SuDS Manual* (Ref. 13-39) provides best practice guidance on the planning, design, construction, operation and maintenance of SuDS to facilitate their effective implementation within developments.

Legislation and Planning Framework - Update 2015

March 2015 ES Addendum

13.32 Since the submission of the December 2014 ES, there have been no changes to legislation or planning policy relevant to water resources and flood risk that affect the assessment in the December 2014 ES.

November 2015 Amendments

The London Plan (2015)

13.33 The adoption of the FALP in March 2015 resulted in the consolidation of changes to the London Plan (2011) to become the 'London Plan (2015)' (Ref. 13-64). The London Plan (2015) also incorporates the REMA, which were published in October 2013.

13.34 No changes were made to the policy affecting the assessment as part of the adoption of the London Plan 2015 and does not alter the overarching content of the policy review undertaken as part of the December 2014 ES.

Minor Alterations to the London Plan (2015)

13.35 On 11th May 2015 the Mayor of London published for six weeks public consultation (11th May to 22nd June) two sets of Minor Alterations to the London Plan – on Housing Standards and on Parking Standards (Ref. 13-65). Both sets of minor alterations were to be considered at a public examination, commencing on 21st October 2015.

13.36 These minor alterations have been prepared to bring the London Plan in line with new national housing standards and car parking policy. These alterations do not propose any significant changes to the policy relevant for the assessment.

Assessment Methodology and Significant Criteria

Consultation

13.37 LBTH has been consulted throughout the evolution of the Proposed Development. The scope of the water resources, drainage and flood risk assessment for the EIA was set out in the EIA Scoping Report submitted to LBTH on July 2014. The EIA Scoping Opinion identified a list of the information to be accounted for within the assessment. These have been addressed within this Chapter (refer below) or where topics have not been addressed, reasons are provided.

13.38 Matters addressed include:

Table 13.1 Matters raised within Scoping Opinion

Topic	Reference in Chapter/Application Documentation
London Borough of Tower Hamlets	
Reference needs to be made to the Surface Water Management Plan as the Site is on the boundary of a Critical Drainage Area	Refer '*Baseline Conditions - Flood Risk*' section
The site is in Flood Zone 1, so no sequential/ exemption test will be required	Refer '*Baseline Conditions*' section
The proposed development proposes to keep all surfaces impermeable, with no reference to SUDs. The ES will need to include an explanation as to why the use of SUDs has been discounted	Refer '*Environmental Design and Management – Operation – Drainage Design*' section
Mitigation should also consider best practice guidance to reduce pollution incidents, for example the Environment Agency (EA) Pollution Prevention Guidelines	Refer '*Potential Effects and Mitigation Measures*' section Refer '*Mitigation and Monitoring Measures*' section
City of London	
The EIA should include full assessment of the potential impact of the development on surface water, sewer and ground water flood risk in the surrounding area.	Refer '*Potential Effects and Mitigation Measures*' section
Environment Agency	
The Environment Agency cannot identify any environmental constraints on this site, as the site is not in a Flood Zone or a Source Protection Zone or near to a watercourse	Refer '*Baseline Conditions*'
Thames Water	
It is unclear as to how the buildings will be constructed. Thames Water would therefore recommend that any EIA report should be expanded to consider the following. - the developments demand for water supply and network infrastructure; - the developments demand for Sewage Treatment and network infrastructure; - the surface water drainage requirements and flood risk; - any piling methodology and will it adversely affect neighbouring utility services; and - There are sewers and water mains located within the development site area. The proposed EIA should include information on how these assets will be protected during construction, and also as a result of any vehicle movement within and accessing the site.	Refer '*Potential Effects and Mitigation Measures*' section Refer '*Mitigation and Monitoring Measures*' section
Fire Authority	
The Brigade has requested that information on access and water supplies of the proposed development is provided so that observations can be made	Refer '*Potential Effects and Mitigation Measures*' section

13.39 Given the Scoping Opinion received, the baseline conditions for this assessment have been established through a desk study and consultation with the following bodies:

- The Environment Agency (EA);
- Thames Water Utilities Limited (TWUL); and
- The LBTH.

13.40 A summary of the consultation response is presented in Table 13.2. All correspondence is presented in ***ES Volume III: Appendix H***.

Table 13.2 Summary of Consultation with Key Stakeholders

Consultees	Form of Consultation	Information acquired for assessment
Environment Agency (Development Control and External Relations)	• EA website search (July 2014) • Flood Risk Maps (July 2014)	• Flood extent maps and flood water levels, • Groundwater quality, • Areas susceptible to surface water flooding
	• Email (Sept. 2013) • Information Request for Water Resources via Envirocheck report (Sept. 2013)	• Abstraction licenses and Discharge consents, • Aquifer designation, • Groundwater vulnerability, • Pollution incidents, • Source protection zone maps, • WFD classifications
London Borough of Tower Hamlets Council	• SFRA (January 2012) • Website search for Information related to Drainage and Flood Risk	• Flood history, • Risk of flooding from the Site, • Flood zone, • Local drainage requirement.
Thames Water	• Email (July 2014) • Information Request for Sewer Flooding and Asset Location Search (July 2014)	• Flood history enquiry and risk of flooding from the Proposed Development or surrounding area, • The utility network, including the maps of waterworks and mains/sewer immediately adjacent to the Site affected by construction / piling works.

13.41 Data has also been collected from the following sources:

- British Geological Survey (BGS) Map (Ref. 13-40);
- Landmark Envirocheck Report (Ref. 13-41);
- EA Groundwater Vulnerability Map (Ref. 13-42) ;
- Flood Map – Environment Agency website (Ref. 13-42);
- TWUL Asset Location Search (Ref. 13-43);
- BGS borehole records (Ref. 13-44);
- Site-specific Desk Study and Ground Investigation Report (March 2014) (Ref. 13-44) (presented ***ES Volume III: Technical Appendix F)***; and
- Ground Investigation Report (October 2014) (***Ref. 13-44***) (presented ***ES Volume III: Technical Appendix H***).

13.42 A Flood Risk Assessment (FRA) has also been prepared and is presented in ***ES Volume III: Technical Appendix H***. The FRA assesses sources of flood risk using available data on flood zones and modelled flood levels of the River Thames. Other potential sources of flood risk such as surface water run-off, overland flow and groundwater have also been taken into account.

Assessment Methodology

Approach to the Assessment

13.43 The methodology used to assess the baseline conditions and the potential impacts to water resources, including flood risk, as a result of the Proposed Development has involved the following stages:

- Identification of potential surface water and groundwater resources that may be potential receptors and determination of their importance;
- Preparation of a conceptual model of the Site, identifying feasible pollution sources and pathways during the demolition and construction works and once the Proposed Development is completed and operational;
- Assessment of the magnitude of change of the potential impacts of the Proposed Development on these receptors and the evaluation of the change relative to the quality and quantity (importance) of the receptors, enabling the determination of the effect and significance;
- Identification of suitable and appropriate mitigation measures for all key stages of the Proposed Development (i.e. demolition, construction and operation). An assessment is made of the significance of any residual effects.

Significance Criteria

Effect Significance Terminology Overview

13.44 The assessment of effect significance outlined within the below sections is consistent with the terminology and criteria outlined within ***Chapter 2: EIA Methodology*** of this ES. The terminology used to describe the sensitivity of resources / receptors and magnitude of the impact will be as follows, and is further described in the '*Evaluating Effects and Significance – Water Resources*' section of this chapter

- High (note: for the purposes of this assessment, 'very high' is also assigned in relation to receptor sensitivity);
- Medium;
- Low; and
- Very Low.

13.45 The classification of effect will be in accord with the effect matrix detailed in ***Chapter 2: EIA Methodology***. The key terminology to be used to describe the classification of effects is as follows:

- Major;
- Moderate;
- Minor; and
- Negligible.

13.46 The effect matrix provided within ***Chapter 2: EIA Methodology*** is reproduced within Table 13.3 below.

Table 13.3 Classification of Effects Significance Framework

Receptor Sensitivity	Magnitude of Change			
	High	**Medium**	**Low**	**Very Low**
V. High / High	Major	Major	Moderate	Minor
Medium	Major	Moderate	Minor	Negligible
Low	Moderate	Minor	Negligible	Negligible
Very Low	Minor	Negligible	Negligible	Negligible

13.47 The nature of the effects identified may be either adverse (negative) or beneficial (positive).

13.48 An effect can be temporary or permanent, with effects quantified temporarily as being short-term (0-5 years), medium term (6-10 years) or long-term (>10 years).

13.49 Following the classification of an effect using this methodology, a clear statement is then made as to whether the effect is significant or not significant. As a general rule, the following criteria is applied:

- 'Moderate' or 'major' are deemed to be '**significant**'.
- 'Minor' are considered to be '**not significant**', although they may be a matter of local concern; and
- 'Negligible' effects are considered to be '**not significant**' and not a matter of local concern.

Evaluation of Effects and Significance –Water Resources

13.50 The significance criteria used for the assessment of effects on water resources and flood risk has been based on the methodology given in the Department for Transport's document '*The Water Environment Sub-Objective*' Transport Analysis Guidance (TAG) UNIT 3.3.11 (Ref. 13-46), which brings together the '*New Approach to Transport Appraisal (NATA)*' document (Ref. 13-47) and the '*Guidance on the*

Methodology for Multi-Modal Studies (GOMMMS)' document (Ref. 13-48). These definitions take into account the sensitivity and vulnerability of the water resource and the nature of the Proposed Development activities.

13.51 The methodology was further expanded within the publication 'Practical Methodology for Determining the Significance of Effects on the Water Environment' in 2005 (Ref. 13-49) which standardises the application of the methodology so that it is less subjective. It is this specific method that has been used in this assessment.

13.52 Three stages have been followed to assess the effects on water resources, drainage and flood risk:

- A level of importance (or sensitivity) is assigned to the receptor based on a number of attributes such as water supply, biodiversity, transport and dilution of waste products, recreation, and conveyance (refer Table 13.5). Where other receptors and attributes are identified which fall outside those listed within Table 13.5, professional judgement and available information has been used to determine their importance.
- The magnitude of the potential effect is determined based on the criteria outlined in Table 13.4 and the assessor's knowledge of the Proposed Development; and
- Comparison of the importance of the resource and magnitude of the impact enables the assessment of the potential effect on the water resource receptor (Table 13.3).

Table 13.4 Terms Used to Describe the Magnitude of the Impact on the Receptor

Magnitude	Criteria	Example
Very High / High	Results in loss of attribute	• Loss of European Commission (EC) designated Salmonid fishery; • Change in WFD classification of a waterbody; • Compromised employment source; • Loss of flood storage/increased flood risk; • Pollution of potable source of abstraction; and • Considerable effect on a significant soil or geological unit.
Medium	Results in and effect that changes the integrity of an attribute or loss of part of an attribute	• Loss in productivity of a fishery; • Contribution of a significant proportion of the effluent in the receiving waterbody, but insufficient to change its WFD classification; • Reduction in the economic value of the feature; and • A limited effect on a significant soil or geological unit.
Low	Results in a minor effect on an attribute	• Measurable change in attribute, but of limited size and/or proportion.
Very Low	Results in an effect on attribute but of insufficient magnitude to affect the use /integrity	• Discharges to watercourse but no significant loss in quality, fishery productivity or biodiversity; • No significant effect on the economic value of the feature; • No increase in flood risk; and • No loss in integrity of ground conditions.

Note: Criteria adapted from Mustow, Burgess and Walker 2005 (Ref. 13-45)

Table 13.5 Terms Used to Describe the Importance of the Receptor / Resource

Feature	Attribute/ Service	Indicator of Quality	Measure	Grading	Importance Level of the Receptor / Resource
River	Water Supply	Chemical Water Quality	WFD River Basin Management Plans (RBMP) Chemical Classification	Classified	High (H)
				Not classified	Low (L)
		Industrial/ agricultural abstractions	Location and volume of abstraction	All abstractions within 1km up/down stream:	
				>1,000 m^3/day	Very High (VH)
				500 – 1,000 m^3/day	H
				50 – 499 m^3/day	Medium (M)
				<50 m^3/day	L
		Drinking water supply	Classification defined within Surface Waters (Abstraction for Drinking Water) (Classification) Regulations 1996, No. 3001	DW1 or DW2 within critical travel time for pollution downstream	VH
				DW3 within critical travel time downstream	H
				Not designated	M/L
	Biodiversity	Ecological Quality	WFD RBMP Ecological Classification	Classified	H
				Not classified	L
		Fisheries quality	Fisheries status as defined within the Freshwater Fish Directive 78/659/EEC	Designated salmon fishery	VH – H
				Designated cyprinid fishery	H – M
				Undesignated fishery	M – L
				Not a fishery	L
	Transport & dilution of waste products	Surface Water/ effluent discharges	Type of discharges with reference to the EC Dangerous Substances (76/464/EEC) & Daughter Directives	All discharges within 1 km up/down stream:	
				List I discharge	VH-H
				List II discharge	M
				Other discharge/no discharge	M/L
	Recreation	Riverside access	Presence/ absence of route and importance	National trail/cycleway/other route	VH
				Regional trail	H
				Definitive footpath /bridleway	M
				No route	L
		Presence of clubs/ recreation use	Presence/ absence	Club/recreation use present	VH – H/M
				No club/recreation use	L
	Conveyance of flow & material	Presence of watercourse	Size of watercourse	Main river >10 m wide	VH
				Main river <10 m wide	M
				Ordinary watercourse >5 m wide	M
				Other	L
Floodplain	Flooding	Flood Risk	Return period	Flood Zone 3b	VH
				Flood Zone 3a	H
				Flood Zone 2	M
				Flood Zone 1	L
Groundwater	Water Supply	Industrial/ agricultural abstractions	Location and volume of abstraction	All abstractions within 1km:	
				> 1,000 m^3/day	VH
				500 – 1,000 m^3/day	H

Feature	Attribute/ Service	Indicator of Quality	Measure	Grading	Importance Level of the Receptor / Resource
				50 – 499 m^3/day	M
				<50 m^3/day	L
		Drinking water supply	Presence of potable public supply or private water supply within zone of influence of development	Public supply	VH
				Private water supply >10 m^3/day or serves >50 people	H
				Other public water supply	M
				No supply	L
		Groundwater vulnerability	Source Protection Status	Zone 1	VH
				Zone 2	H
				Zone 3	M
			Classification of Aquifer vulnerability	Principal Aquifer with H, I or U soils	VH
				Secondary Aquifer with H or U soils/	H
				Principal Aquifer with L soils	M
				Secondary Aquifer with I soils	M
				Secondary Aquifers with L soils or Unproductive Strata	L
	Conveyance of flood flows	Acceptance Potential of flood flows	Soil type / groundwater table levels	Gravels with low water table (>1 m below infiltration point)	VH
				Sands with low water table	H
				All soil types with high water table	M
				Clay	L

Note: Adapted from Mustow, Burgess and Walker 2005; Key: VH – Very High; H – High; M – Medium; L – Low; DW – Drinking Water

Assessment Methodology and Significance Criteria - Update 2015

March 2015 ES Addendum

13.53 The methodology for assessing the likely significant effects has not changed from that presented in the December 2014 ES.

November 2015 Amendments

13.54 There have been no changes to be made to the assessment methodology from that considered in the December 2014 ES or for the March 2015 ES Addendum. The methodology is considered to remain valid for the purposes of assessing the Amended Proposed Development.

Baseline Conditions

13.55 The following description of the baseline conditions is derived from the following reports, which are presented in ***ES Volume III: Technical Appendix H***:

- Site-Specific Desk Study and Ground Investigation Report (March 2014) (Ref. 13-44);
- Ground Investigation Report (October 2014) (Ref. 13-44); and
- A Flood Risk Assessment (FRA).

Hydrology

Surface Water Resources

13.56 The River Thames lies approximately 1.5km south of the Site. Environment Agency Maps show that there are no major surface watercourses located within 1.5km radius of the Site. Although the Site is not directly linked to the River Thames through surface water connections, there is an indirect pathway to the River Thames via the TWUL sewer network, which discharges into the River Thames via combined sewer overflows (CSOs). The River Thames is therefore taken forward as a receptor as part of this impact assessment as it is potentially a receptor for spills from CSOs.

Geology and Hydrogeology

Geology

13.57 The Site has been developed and used since the mid-17th century and as such buried foundations, services and other obstructions above those provided by the existing buildings should be anticipated. Following the information gained for the BGS boreholes (Ref. 13-44), it is assumed that the strata on Site is comprised of Made Ground over superficial Terrace Gravel which in turn overlays London Clay, Lambeth Group, Thanet Sands and finally Chalk. A Ground Investigation has been carried out in order to determine the ground conditions specific to the Site and described in the following sections.

13.58 Within older urban areas, much of the surface has been partially or wholly disturbed by human activity and is known as 'made ground'. The BGS boreholes indicate that Made Ground in the vicinity of the Site has a variable thickness of up to approximately 3 m, predominantly comprising re-worked clayey and silty sand.

13.59 The Terrace Gravel is typically medium dense to dense orange brown, very sandy (medium to coarse), fine to coarse, flint gravel.

13.60 London Clay is a stiff to very stiff fissured clay which is generally characterised by low hydraulic conductivity. Horizontal discontinuities are sometimes encountered within the stratum, such as sand or silt lenses or bands of claystones.

13.61 The Lambeth Group typically comprises stiff to hard multicoloured clays, dense silts and sands. The sands are contain layers of mottled clay. Thanet Beds generally consist of very dense clayey green fine-grained sand. They are a very strong material and provide a high bearing resistance, however they become weaker with depth.

13.62 The Upper Chalk is typically a very fine grained white limestone.

13.63 Based on a review of published geological maps for the Site (Ref. 13-40) and the Geotechnical Desk Study (Ref. 13-44), the geological sequence on-site from ground level down is presented in Table 13-6:

Table 13.6 Expected Geological Strata Underlying the Site (Indicative Only)

Stratum	Level at top of strata (mAOD)	Estimated Thickness (m)
Made Ground	15.0 to 14.3	2.6 to 3.1
Taplow Terrace Gravel Deposits	12.1 to 11.6	4 to 6
London Clay Formation	6.5 to 6	25 to 30
Lambeth Group	-3.3 to -17.3	15 to 20
Thanet Sand Formation	Not proven	Approx. 5
Upper Chalk	Not proven	200

Hydrogeology

Groundwater

13.64 According to the Envirocheck Superficial Aquifer Map (New designation) (Ref. 13-41), the Site is underlain by a Secondary A Superficial Aquifer which is likely to be associated with the underlying Terrace Gravels.

13.65 According to the Bedrock Aquifer map shown in (Ref. 13-41), the Site is underlain by a Bedrock Secondary B Aquifer. Table 13-7 below contains a summary of the hydrogeological properties of the anticipated geology underlying the Site.

Table 13.7 EA Classification and Anticipated Aquifer Potential for Strata Underlying the Site

Stratum	Hydrogeological Significance	Anticipated Aquifer Potential
Made Ground	Variable material that may contain some perched water	Variable
Taplow Terrace Gravels	Has potential to transmit significant quantities of water. Due to the underlying impermeable clay below it is likely to contain perched groundwater	Secondary A Aquifer
London Clay	The London Clay is an aquitard and therefore will not contain significantly large quantities of groundwater.	Unproductive Stratum
Lambeth Group	The Lambeth Group is unlikely to contain significantly large quantities of groundwater; however the lower part of the stratum may contain ground water where the material has less clay content.	Unproductive Stratum
Thanet Sand Formation	This strata is highly permeable and is likely to be in hydraulic continuity with the underlying Chalk.	Principal Aquifer
Upper Chalk	Chalk strata contains large quantities of water and is often used for water abstraction	Principal Aquifer

13.66 A review of the EA website indicates that the Site overlies a Secondary A Aquifer associated with the underlying superficial deposits (Alluvium and River Terrace Gravels). The status of Secondary Undifferentiated Aquifers has been assigned in cases where it has not been possible to attribute either Category A or B to a rock type. Secondary Aquifers are considered to be moderately vulnerable to pollutants due to permeability. The thickness of the superficial deposits is in the region of 4m to 6m.

13.67 The London Clay formation, underlies the River Terrace Gravel deposits. These are defined as unproductive strata which are rock layers or drift deposits with low permeability that have negligible effect on water supply or river base flow. Unproductive strata are considered to have low vulnerability to pollutants, due to limited permeability (Ref. 13-42). The thickness of the London Clay is in the region of 25m to 30m.

13.68 The Lambeth Group (up to approximately 20m thick) is classed as an unproductive stratum.

13.69 The Thanet Sands (approximately 5m thick) and the underlying Chalk are classed as Principal Aquifers (approximately 65m below ground level).

13.70 The Chalk deposits are layers of rock or drift deposits that have inter-granular and/or fracture permeability and can often provide a high level of water storage. The Chalk deposits beneath the Site are understood to form a highly productive Principal Aquifer capable of supporting large groundwater abstractions, including those for public supply, depending upon the quality of the water. This is the Principal Aquifer of the Thames region and is found across most of London, confined beneath the London Clay, which acts as an impermeable barrier between shallow and deep groundwater sources and affords protection to the deep groundwater from surface pollutants. The aquifer may support water supply and/or river base flow on a strategic scale.

13.71 A review of the published groundwater vulnerability map (Ref. 13-42) for the Site suggests that soils overlying the Secondary Undifferentiated Aquifer have been assigned soil leaching potential class 'HU'. This indicates a high leaching potential (as a worst case scenario) due to the limited amount of data available within any urban area. Soils of a high leaching potential are considered to have little ability to attenuate diffuse source pollutants and to allow liquid discharges to move rapidly to underlying strata and to shallow groundwater.

13.72 The Secondary A Aquifers; (Taplow Terrace Gravels) is considered to be of **High** importance with regards to groundwater vulnerability.

13.73 Due to their high permeability, the Principal Aquifer (Thanet Sand Formation and Upper Chalk) are considered to be highly vulnerable to pollutants, and therefore have an importance rating of **Very High**.

Shallow Groundwater

13.74 Groundwater was recorded in one of the boreholes (BGS records) and the groundwater level was recorded at approximately 8.8 m below ground level. It is anticipated that perched groundwater will be present within the Terrace Gravel Stratum and confined groundwater will be present in the Thanet Sand stratum, which will have a hydraulic connectivity with the underlying Chalk.

13.75 The cessation of water abstraction from the chalk after the mid-1960s for industrial purposes caused groundwater levels to rise throughout the London basin. The General Aquifer Research Development and Investigation Team (GARDIT) was subsequently developed in order to minimise and ultimately halt the groundwater rise, but the EA's view is that rising groundwater no longer poses a problem and underground infrastructure is no longer threatened by inundation. Groundwater levels are subjected to variations caused by changes in the local drainage conditions and also by seasonal effects.

13.76 A review of the EA's website (Ref. 13-42) indicates that the hydrogeology of the Site is expected to comprise perched groundwater in the Alluvium and River Thames Terrace (Gravel) Deposits. These shallow aquifers are separated from the Lambeth Group / London Clay (classed as Unproductive Strata) and Thanet Sand / Chalk aquifers (classed as a Principal Aquifer).

13.77 The London Clay formation, underlying the River Terrace deposits, is classified by the EA as unproductive strata. These are defined as rock layers or drift deposits with low permeability that has negligible impact for water supply or river base flow. Unproductive strata are considered to have low vulnerability to pollutants, due to limited permeability (Ref. 13-42).

13.78 Review of the published groundwater vulnerability map for the Site suggests that soils overlying the London clay have been assigned soil leaching potential class 'HU', indicating a high leaching potential as a worst case scenario due to the limited amount of data available within any urban area. Soils of a high leaching potential are considered to have little ability to attenuate diffuse source pollutants and to allow liquid discharges to move rapidly to underlying strata and to shallow groundwater. Due to the limited number of observations the EA assumes, unless proven otherwise, a worst case vulnerability classification for soils in urban areas.

13.79 The Secondary Undifferentiated aquifer (River Terrace Gravels) has been given a rating of **High** importance in relation to the vulnerability of the underlying aquifers and the classification of the overlying soils.

13 Water Resources, Drainage and Flood Risk

Deep Groundwater

13.80 London lies in a basin with deep groundwater contained within the Thanet Sand and the deeper Chalk stratigraphy. The chalk strata contains large quantities of water and is often used for water abstraction. The nearest groundwater abstraction is located 150m to the north of the Site and is from the Upper Chalk major aquifer. The London Clay provides a confining layer separating the superficial deposits from the underlying Upper Chalk major aquifer, and forms a barrier for the migration of groundwater and potential contamination reaching the Chalk aquifer.

13.81 As previously discussed, the Chalk deposits are layers of rock or drift deposits that have inter-granular and/or fracture permeability and can often provide a high level of water storage and form a highly productive Principal Aquifer capable of supporting large abstractions, including those for public supply, depending upon the quality of the water. They may support water supply and/or river base flow in a strategic scale. The Principal Aquifer is found across most of London, confined beneath the London Clay, which acts as an impermeable barrier between shallow and deep groundwater sources and affords protection to the deep groundwater from surface pollutants.

13.82 The water quality of the Chalk aquifer is reported to be relatively poor (Ref. 13-42). This is due to extremely slow percolation of the water through the chalk aquifer from its area of recharge in the North and South Downs. Although the London Clay protects the deep groundwater from surface pollutants, meaning that concentrations of nitrates, phosphates and total organic carbon are low, the combined effect of high residence times of pollutants and saline intrusion has produced relatively poor groundwater quality under Central London. Groundwater has been found to be contain magnesium, sodium, chloride and sulphate. The water is therefore likely to be of a non-potable standard without treatment.

13.83 However due to the high permeability of the Chalk deposits, the Principal Aquifers are considered to be highly vulnerable to pollutants, and relative to the classification of the overlying soils, have a rating of **Very High** importance.

Groundwater Source Protection Zones

13.84 The Site does not lie within a source protection zone for water abstraction. The nearest source protection zone (Zone II) lies approximately 1.5km north west of the Site located in Finsbury.

Groundwater Abstractions

13.85 The Envirocheck report identifies 36 groundwater abstraction licences within 1km of the Site. These are predominately for commercial/industrial/public services; and drinking.

13.86 The importance of groundwater beneath the Chalk for the purpose of abstraction is considered to be of **Very High** in relation to industrial abstraction and drinking water supply.

Flood Risk

13.87 According to the LBTH Strategic Flood Risk Assessment (SFRA) (Ref. 13-31) the highest water level in the River Thames during the 1 in 200 year tidal cycle with storm surcharge under the present day operation of the Thames Barrier is in the order of 5.0m AOD, which is much lower than the proposed levels of the Site. The finished floor levels of the Proposed Development will be designed to range between 13.8m AOD and 14.2m AOD at ground floor level with basement levels between the range of 9.2m and 8.5m AOD.

13.88 The Site lies within Flood Zone 1 and is assessed as having less than 0.1% (1 in 1000) annual probability of flooding from fluvial or tidal sources. However, as part of the Site lies on the boundary of a CDA, an FRA is required in accordance with the NPPF. The FRA has been undertaken and is contained within ***ES Volume III: Technical Appendix H***.

13.89 Based on the Site lying within Flood Zone 1, flood risk is considered to be of **low** importance.

13.90 Groundwater flooding, caused by the emergence of water originating from sub-surface permeable strata, is often highly localised in low lying areas which are underlain by permeable aquifers. After a prolonged period of rainfall, a considerable rise in the water table can result in inundation for extended periods of time.

13.91 The risk of groundwater emergence at the Site is considered to be low due to the depth to the perched groundwater and presence of predominantly impermeable surfaces at ground level (although, perched groundwater may be in contact with the existing basement levels in the buildings).

13.92 The LBTH SFRA indicates that only one incident of groundwater flooding has been reported close to the Site. Borehole information from areas in the locality of the Site indicates that there is likely to be perched groundwater within the alluvial deposits underlying the Site.

13.93 The LBTH Surface Water Management Plan indicates that the Site is at the boundary of a CDA. The SWMP has an overall plan that prioritises CDAs shown to be at highest risk. However, the Site is not identified as being within one of these groups and the LBTH SFRA does not mention any historical surface water flooding incidents in the E1 postcode area.

13.94 The LBTH SFRA states that relatively few localised flooding incidents have been observed over recent years and the SFRA historical sewer flooding map (Ref. 13-32) indicates that between one to five properties were subject to flooding from sewers within the E1 postcode area within which the Site falls (in reference to the sewer flooding map) prior to June 2010, although the locations of these properties in relation to the Site are not known. Given the low number of flooding events arising from the sewers, the Site is therefore considered to be at a low risk of flooding from sewers.

13.95 The risk of flooding from reservoirs and artificial sources have been considered in the site specific FRA (***ES Volume III: Appendix H1*** of this ES) Environment Agency Map (Ref. 13-42) which shows the extent of flooding from reservoirs does not show any flooding in the vicinity of the Site.

13.96 The LBTH SFRA indicates that there are four canals located within the LBTH and a number of docks and basins, each controlled by lock gates and/or weirs to maintain water levels. Due to the regular inspection and maintenance which is carried out by British Waterways, and the distance of the Site from these artificial water resources, the risk of flooding is considered to be **very low**. Therefore, the Site is considered to be at negligible risk of flooding from artificial sources (canals, reservoirs).

Infrastructure

Water Supply

13.97 The majority of London's water supplies come from the River Thames and the River Lee, with about 70 per cent of all the water taken from the Thames upstream of Teddington Weir. It is then stored in reservoirs around the capital. The remainder is abstracted from the chalk aquifer underneath London. The EA's consultation on 'Identifying Areas of Water Stress for the UK' (Ref. 13-59) identifies London as an area of serious water stress.

13.98 TWUL supplies water to London. In May 2008, TWUL produced its Draft Water Resource Management Plan (WRMP) (Ref. 13-60), which sets out forecasts for supply and demand and identifies the measures proposed to meet consumers' needs over the next 25 years. TWUL subsequently adjusted its forecasts from the original WRMP in 2009 to account for the change in economic climate (Ref. 13-61). As part of the production of the WRMP, TWUL took into account the projected growth within each Water Resource Zone (WRZ). The forecasts of future population and properties are based on underlying source data from Government census data, strategic planning documents, past trends and local authorities' forecasts of future population and household numbers. TWUL based its forecasts on a combination of these sources together with an expert external consultant's view of the most likely scenarios for population growth.

13.99 An assessment of population growth for the London WRZ indicates that there will be a rise of 1.3 million people in the London WRZ to 2035. Approximately 94% of the population of the London WRZ is within Greater London. These population rises will be accompanied by increases in new households which TWUL estimated that there will be approximately 26,700 new households per year in London.

13.100 The revised forecasts indicated that the London WRZ will have a deficit of –343.9 mega litres per day (Ml/d) by 2035. TWUL aims to reach a surplus in the target headroom through the introduction of management measures, predominantly leakage reduction of 177Ml/d by 2035. In addition to the mains replacement programme and a 'find and fix' policy, water demand will be controlled through compulsory metering of 77% of households in the region by 2025.

13 Water Resources, Drainage and Flood Risk

13.101 During periods of prolonged low rainfall leading to a serious drought, water supply is largely sustained by groundwater abstraction from the catchment's Principal Aquifers and baseflow within rivers. It generally takes two consecutive years of low winter rainfall to sufficiently reduce groundwater levels to cause a serious risk to London's water supply (Ref. 13-62). Because of its importance as the nation's capital and size of population, drought management of the London WRZ plays the central and pivotal role in the TWUL Drought Plan. The Mayor's Water Strategy recognises the strain on this resource (Ref. 13-63).

13.102 As TWUL has undertaken an assessment on the impact of population growth within the London WRZ, it is considered that the effect of the Proposed Development on water demand is covered within the TWUL assessments and adequate provision has been made to accommodate the projected growth. The water resources used that supply the London WRZ are considered to be of **high** importance.

13.103 The local TWUL water supply network (distribution mains) is a pathway for the transport of potable water from the water treatment works to the Site.

13.104 The Utilities Survey Plans indicate that the Site is bounded by Blossom Street, Fleur De Lis Street, Folgate Street and Norton Folgate. All streets include Thames Water Authority mains water supplies as follows:

- Blossom Street – 125mm diameter main;
- Fleur De Lis Street – 180mm diameter main;
- Folgate Street – 180mm diameter main; and
- Norton Folgate – 180mm/225mm diameter main.

Foul and Surface Water Drainage

13.105 There is an extensive existing combined drainage infrastructure network around the Site. The Thames Water Utilities Ltd (TWUL) asset map shows a number of networks and branches of public combined sewers running through the Site. However, the extent of the private surface water drainage network on Site is currently unknown. The known public sewer networks on the roads surrounding the Site consist of six distinct main lines:

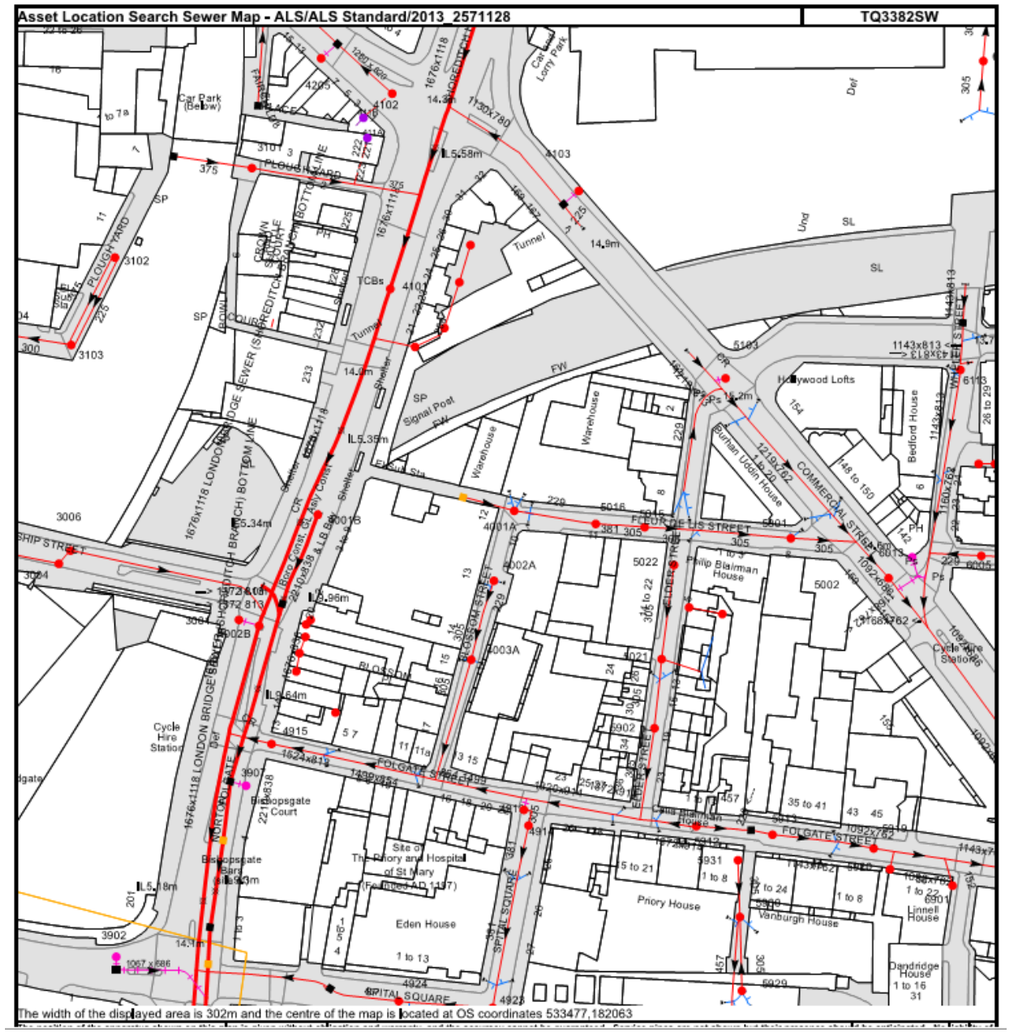
- Two (2210 x 838mm and 1676 x 1118mm) combined sewers running parallel to one another under Norton Folgate to the west;
- A (1524 x 813mm) combined sewer in Folgate Street to the south;
- A 305mm diameter combined sewer in Blossom Street to the east;
- The head of a 225mm diameter combined sewer at the north east corner of the Site, running eastward in Fleur de Lis Street; and
- The head of a 225mm diameter combined sewer at the north east corner of the Site running northwards in Elder Street connecting with a public combined sewer in Commercial Street.

13.106 The 2210 x 838mm combined sewer on Shoreditch High Street/Norton Folgate is noted as approximately 3.5m deep, and the 1676 x 1118mm combined sewer is noted as approximately 8.5m deep. The 1524mm x 813mm combined sewer on Folgate Street is noted as approximately 3.22m deep. The TWUL Asset Location Map is presented in (Figure 13-1) below.

13.107 All surface water from the Site currently discharges into one of the above mentioned public sewers without any form of attenuation. Some of the down pipes from the roofs discharge directly onto the hardstanding footways, surface water then runs off into the gullies in the roads. The remaining roof and hard paved areas discharge via below ground piped connections directly into the public sewers.

13.108 Although not directly a water resource, the local TWUL drainage network is a pathway for the transport of surface water and wastewater and associated pollutants to the River Thames, as well as a potential source of flood risk and is therefore considered to be of **high** importance.

Figure 13.1 TWUL Asset Location Map



Summary of Sensitivity of Resources / Receptors

13.109 From the review of the baseline conditions, the below Table 13.8 presents the resources / receptors likely to be affected by the Proposed Development and their importance (i.e. sensitivity).

Table 13.8 Importance of Water Resources / Receptors

Receptor / Resource	Importance
Secondary A aquifer – Groundwater vulnerability	High
Principal aquifer (Groundwater vulnerability, Abstractions)	Very High
Fluvial and Tidal Flood Risk	Low
TWUL Water Infrastructure	High
River Thames – (Water Quality, Fisheries, Supply / Abstractions)	Very High

Baseline Conditions - Update 2015

March 2015 ES Addendum

13.110 There are no changes to baseline conditions that were described in the December 2014 ES.

November 2015 Amendments

13.111 It is considered that there have not been any material changes to the baseline conditions since the submission of the December 2014 ES and March 2015 ES Addendum, and that the baseline prepared for the December 2014 ES remains valid for the consideration of the likely impacts arising from the Amended Proposed Development.

Environmental Design and Management

13.112 The way that potential environmental impacts have been or will be avoided, prevented, reduced or off-set through design and / or management of the Proposed Development are outlined below and have been taken into account as part of the assessment of the potential effects. Proposed environmental enhancements are also described where relevant.

13.113 The design and management measures which have been accounted for in the assessment of effects during both the demolition and construction and operational phases are outlined below.

Demolition and Construction

- The main challenges with Site S1 are that for the deep portion of basement at Buildings S1 and S1c, a temporary coffer dam may need to be formed using sheet piles to allow dewatering to be carried out. This will be determined following the results of the site investigation to determine the level of the water table and whether dewatering will be required. It may be possible to use a well system if the groundwater flow is not extensive.
- The Preliminary Contamination Assessment (PCA) report (Ref. 13-55) (***ES Volume III: Appendix A; ES Volume III: Appendix H***) prepared for the Site concluded that historic activities undertaken have the potential to cause a moderate level of soil contamination. The report proposed a Phase II Site Investigation and Remediation Strategy. This will involve a written programme of investigation / survey work and should areas of contamination be identified, a Remediation Strategy for the soils on-site, or if required their appropriate removal. This would involve either off-site treatment and/or disposal off-site to be agreed as appropriate in advance of any remediation work. Should a Remediation Strategy be implemented, a verification process (i.e. verification plans and reporting to the LBTH and the EA) will be undertaken to confirm that the strategy has remediated the soils to a level acceptable for the intended use of the Site.

Operation

Drainage Infrastructure Design Measures

- Proposed finished floor levels of the building will be designed to range between 13.8m AOD and 14.2m AOD at ground floor level, with basement levels between 7.90m and 11.6m AOD (to underside of basement slab).
- It is assumed that any foul water drainage from ground floor level and above will be drained by gravity in order to minimise the amount of pumping required. Until the levels of the existing connections and public sewers are confirmed it is assumed that the upper and lower basement level will be pumped to the drains. An allowance is therefore made for pumping foul water from below the lower basement level slab up to high level in the basement to allow it to discharge by gravity to the public sewer.
- In accordance with the requirements of EA PPG3 (*Use and design of oil separators in surface water drainage systems*) a petrol interceptor is required for areas that are being used as loading bays and for regular vehicle deliveries. Petrol interceptors should also be installed in delivery bays/refuse store on-site.

Water Supply Design

13.114 The intent in terms of water use for the Proposed Development is to provide supplies commensurate with ensuring BREEAM 'Excellent' is achieved for the commercial office use and Code for Sustainable Homes Level 4 is achieved for the residential part of the development. In order to achieve these standards, measures will be put in place for example dual flush WC's, low flow sanitary fitting brassware and low water use white goods.

13.115 The design of the water supply systems for the Proposed Development includes the provision of bulk storage together with variable speed pump sets and associated distribution. The allowance for bulk storage will ensure that the impact on the existing Thames Water Authority is kept to a minimum by allowing storage tank refilling over a 12 hour period thereby greatly limiting the instantaneous demand on the water supply network.

Disposal Methods including Site Management, Source Control and Site Control

Site Management and Source Control

13.116 Site management procedures which will be used to limit or prevent surface water runoff and pollution include:

- Minimising the impermeable areas within the Site;
- Frequent maintenance of impermeable surfaces; and
- Minimising the use of de-icing products.

13.117 Source control techniques will be used where possible to control runoff at source in smaller catchments and provide effective pollution control and treatment, thereby improving the quality of the effluent discharged to the receiving waters. Examples of source control measures include: soft landscaping, bio-retention green/brown/blue roof, permeable paving.

13.118 Where source control techniques do not provide adequate protection to the receiving watercourses in terms of flood protection and pollution control, control at the Site may be required. However, it is possible to provide sufficient protection to the Site with only source control in this instance.

Drainage Design

13.119 The following drainage hierarchy has been taken into account when preparing the surface water drainage strategy:

1. Store water for later use;
2. Use infiltration techniques such as porous surfaces in non-clay area;
3. Attenuate rainwater in ponds or open water features for gradual release to a watercourse;
4. Attenuate rainwater by storing in tanks or sealed water features for gradual release to a watercourse;
5. Discharge rainwater direct to a watercourse;

6. Discharge rainwater to a surface water drain; and
7. Discharge rainwater to a combined sewer.

13.120 The type and range of SUDS must be developed as part of the drainage design but an initial appraisal of the Site suggests that there are various constraints present at the Site, which include:

- Archaeological restrictions;
- Conservation area requirements and
- Unknown Thames Water sewer levels.

13.121 It is proposed to discharge surface water arising on the Site from the Proposed Development to the same sewers that the existing buildings on-site currently discharge to, although at a reduced rate.

13.122 A Conceptual Drainage Strategy has been developed for the Proposed Development and presented within the FRA (Ref. 13-54) (refer ***ES Volume III: Appendix H***).

13.123 The FRA includes discharging surface water to the TWUL drainage / sewer network at a reduced rate, approximately 50% less than the existing Site run-off rates. Surface water generated on-site will be collected and channelled to a below ground attenuation tank system

13.124 The feasible disposal option for limiting surface water flows at the Site will be through the use of geocellular below ground attenuation tanks, with a limited outflow to the adjacent sewers (Ref. 13-54).

13.125 The tables below presents the approximate tank volumes for each Site required for a range of discharge rates under the 1 in 100 year (plus 30% climate change) storm event (Ref. 13-54).

Table 13.9 S1 - Surface Water Discharge Rates & Storage Volumes

Discharge Condition	Discharge Rate	Storage Volume Required
Mitigate climate change only (Absolute minimum)	124 litres/sec	65 m^3
50% (London Plan requirement)	62 litres/sec	110 m^3
Pre-development 1-year peak flow rate	43 litres/sec	140 m^3
Greenfield (Environment Agency's preferred rate)	2.3 litres/sec	360 m^3

Table 13.10 S2 - Surface Water Discharge Rates & Storage Volumes

Discharge Condition	Discharge Rate	Storage Volume Required
Mitigate climate change only (Absolute minimum)	48 litres/sec	25 m^3
50% (London Plan requirement)	24 litres/sec	45 m^3
Pre-development 1-year peak flow rate	17 litres/sec	55 m^3
Greenfield (Environment Agency's preferred rate)	0.9 litres/sec	140 m^3

Table 13.11 S3 - Surface Water Discharge Rates & Storage Volumes

Discharge Condition	Discharge Rate	Storage Volume Required
Mitigate climate change only (Absolute minimum)	38 litres/sec	20 m^3
50% (London Plan requirement)	19 litres/sec	40 m^3
Pre-development 1-year peak flow rate	13 litres/sec	45 m^3
Greenfield (Environment Agency's preferred rate)	0.7 litres/sec	55 m^3

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13.126 No further environmental design and / or management measures were considered.

November 2015 Amendments

13.127 The November 2015 Amendments constitute a small section of roof being redesigned. However, the nature and scale of the change is not considered to alter the overall impermeable area that was used to design the drainage strategy considered as part of the December 2014 ES and subsequent March 2015 ES Addendum. Consequently, no further environmental design and / or management measures have been considered.

Potential Effects and Mitigation Measures

13.128 The following section details the assessment of potential impacts and resulting effects on the water environment from the demolition and construction phase, and during the operational phase of the Proposed Development.

Site Preparation, Demolition and Construction Effects

13.129 Details regarding the demolition and construction phase are presented in ***Chapter 5: Demolition and Construction*** of this ES.

13.130 Throughout the demolition and construction phase of the Proposed Development, there are potential sources of pollution / contamination that may potentially affect water resource receptors. For each of the key sources, there are particular 'triggers' – these are on-site actions that cause the potential impacts.

13.131 Pollution sources arising from demolition and construction works that could affect water resource receptors comprise the following:

- Creation of preferential pathways and disturbance to groundwater;
- Disturbance of existing drainage systems and water supply networks;
- Disturbance of contaminated land (if present);
- Leaks and spillages from oils/hydrocarbons;
- Suspended sediments; and
- Concrete and cement products.

13.132 Other activities associated with the construction phase comprise:

- Additional water demand; and
- Additional wastewater generation.

Preferential Pathways and Disturbance to Groundwater

13.133 Consideration should be given to the possibility of encountering shallow groundwater in and around the perimeter of the site during excavations for foundations and proposed basements. Ground water levels recorded at the Site ranged from approximately 4.53 m below ground level at S1 to 8m below ground level at B2. It is therefore anticipated that perched groundwater will be present within the Taplow Terrace Gravel Strata.

13.134 Excavation can provide a direct pathway for pollutants to reach shallow groundwater, resulting in an adverse impact (medium term) of medium magnitude locally on the Secondary A aquifer. The effect pre-mitigation would be **major adverse**.

13.135 London Clay may act as an impermeable barrier between shallow and deep groundwater sources and thereby afford protection to the deep groundwater from surface pollutants.

13.136 In order to reduce the movement of potential contamination via these pathways, a number of mitigation measures can be undertaken and are outlined within the '*Mitigation and Monitoring Measures*' section. Below is a summary of the measures proposed:

- Geotextile bunding to isolate and minimise the ingress of surface water runoff;
- Decommissioning of boreholes;
- Isolation of the area around the pilings from surface water;
- Dewatering may be required; and
- Water from excavations to be disposed of appropriately.

13.137 The adoption of these mitigation measures would reduce the magnitude of potential impacts, resulting in a likely residual **minor adverse** effect.

Disturbance of Existing Drainage Systems and Water Supply Network

13.138 During the demolition and construction phase, the TWUL combined sewage network surrounding the Site will be expected to transport surface water, sewerage and wastewater generated (with consent from TWUL).

13.139 Disturbance of the existing drainage network on the Site increases the potential for pollutants being re-released in an uncontrolled manner. Pathways include infiltration, vertical and lateral preferential pathways, surface water runoff and the drainage network. This could potentially have:

- An adverse impact (short term) of low magnitude on the Secondary A aquifer, resulting in a likely **moderate adverse** effect; and
- An adverse impact (short term) of very low magnitude on the Principal Aquifer, resulting in a likely **minor adverse** effect.

13.140 Damage to the TWUL on-site water supply network could potentially cause an uncontrolled release of drinking water from the network would have an adverse impact on the local water supply and could lead to pressure issues and the interruption to water supply to surrounding properties. This could have an adverse impact (short term) of low magnitude on the wider TWUL water resources, resulting in a likely **moderate adverse** effect.

13.141 A number of mitigation measures can be implemented on the Site to avoid or reduce potential effects to existing drainage systems and the water supply network, and are outlined within the '*Mitigation and Monitoring Measures*' section. Below is a summary of the measures proposed:

- All existing utilities will be identified and marked;
- Use of signs to warn of utility infrastructure;
- Damage to be immediately repaired; and
- An Emergency Response Plan will be produced.

13.142 The mitigation measures described above would reduce the magnitude of the potential impacts and the likelihood of pollutants arising, and restrict their passage to controlled waters. This would reduce the likely residual effects on existing drainage systems and water supply network to **minor adverse**.

Disturbance of Contaminated Land

13.143 Disturbance of potentially contaminated soils during the demolition and construction works may adversely affect shallow groundwater within the Secondary A Aquifer and the River Thames (via the TWUL sewer network).

13.144 The Preliminary Contamination Assessment (PCA) report (Ref. 13-55) (***ES Volume III: Appendix A; ES Volume III: Appendix H***) prepared for the Site concluded that historic activities undertaken have the potential to cause a moderate level of soil contamination (in the absence of mitigation), with the potential for disturbance and the re-mobilisation of contaminants into surface water (via surface water runoff and the drainage network) or groundwater (via preferential pathways or infiltration) during the construction activities. Examples of pathways with the potential to cause impacts as a result of disturbance of contaminated land include:

- Piling foundations and activities have the potential to create pathways for contaminants;
- Groundwater from any required dewatering of excavations may be discharged directly to the local sewerage network, where discharging directly may serve to introduce potential contamination from contaminated sediment / groundwater; and
- Increased use of water during demolition and construction works (i.e. dust suppression, wheel washing) may lead to increased surface water run-off, posing a risk to the Secondary A Aquifer.

13.145 These activities could have an adverse, localised impact (medium term) of low magnitude on the Secondary A Aquifer, resulting in a likely **moderate adverse** effect.

13.146 Due to the location of the deep aquifer beneath the impermeable London Clay, there is potential for undiscovered areas of contamination to have an adverse, localised impact (medium term) of very low magnitude on the Principal Aquifer, resulting in a likely **minor adverse** effect on the Principal Aquifer.

13.147 As surface water from the Site currently drains into the TWUL sewer network, it is anticipated that any contaminants would be diluted within the sewer network and ultimately within the River Thames itself. The effect of dilution is considered to reduce the potential for an adverse impact (short term) of very low magnitude on the River Thames water quality via combined sewer outfall (CSO) discharges, resulting in a likely **minor adverse** effect. Similarly, there would also be potential for an adverse impact (short term) of very low magnitude on the River Thames abstraction and fisheries, resulting in a likely **minor adverse** effect.

13.148 It is proposed as part of the Proposed Development for a Phase II Site Investigation to be undertaken, involving investigation and remediation processes. A number of additional mitigation measures can also be employed to either avoid or mitigate the impact of disturbance of contaminated ground are outlined within the '*Mitigation and Monitoring Measures*' section. Below is a summary of the measures proposed:

- Appropriate handling and disposal of pile arisings during foundation works; and
- Drainage of surface run-off and de-watering effluents to settling tanks to remove suspended solids prior to discharge.

13.149 Taking into account adoption of appropriate construction methodology and mitigation measures, this would reduce the magnitude of impact associated with the presence of areas of contaminated land on-site to very low (short term), resulting in a likely residual **minor adverse** effect on the following resources: River Thames water quality, Secondary A aquifer and the Principal Aquifer.

13.150 Should the contaminated soils be removed during the preparatory ground works, basement and foundation excavations of the Proposed Development, this would likely to result in beneficial residual effects to the local environment, through reducing net contaminant loading at the Site and surrounding area.

Leaks and Spillages

13.151 The main source for oils and hydrocarbons at the Site is likely to arise from spillages and leaks (small quantities) associated with plant and machinery and from fuel storage. The pathways for oils and hydrocarbons to reach receptors are via surface water runoff, the drainage network and through infiltration.

13.152 The release of oils and fuel can result in a reduction in the quality of local groundwater. If oils are released into the River Thames via CSOs, the result can be fatal to fish and other aquatic organisms, the creation of oily surface films on water and a reduction in the quality of industrial and potable abstractions. Oils also bind to sediments, strata and organisms and can form emulsions that float on the water surface and upon breakdown the action of microbes can lower the dissolved oxygen content of the water.

13.153 Due to the distance of the Site from the River Thames and the dilution provided within the sewer network and River Thames itself, it is considered that there would be an impact of very low magnitude (short term) on the River Thames (i.e. water quality, fisheries) via CSO discharges, resulting in a likely **minor adverse** effect.

13.154 The main pathway for oils and hydrocarbons to impact the groundwater environment is via infiltration through soft landscaped areas and via preferential pathways. Preferential pathways are routes by which contaminants can move much more readily than in the remainder of the subsurface and may result from alterations to the ground, structures or naturally occurring processes.

13.155 This could have an adverse localised impact of low magnitude (medium term) on the Secondary A Aquifer, resulting in a likely **moderate adverse** effect. Due to the location of the deep aquifer beneath the impermeable London Clay, this is likely to have an impact on the Principal Aquifer of very low magnitude (short term), resulting in a likely **minor adverse** effect.

13.156 Measures can be taken to protect controlled waters from the release of oils and hydrocarbons at the Site and are outlined within the '*Mitigation and Monitoring Measures*' section. Below is a summary of the measures proposed:

- Oils and hydrocarbons will be stored in designated locations on an impermeable base that has no outflow;
- Plant and machinery will be kept away from the drainage system and will have drip trays beneath;
- Discharge of surface run-off and de-watering effluents via oil interceptors; and
- An Emergency Response Plan will be produced.

13.157 Implementation of these mitigation measures would reduce the potential impact to very low magnitude (medium term) on the Secondary A Aquifer, resulting in a likely **minor adverse** effect.

Suspended Sediments

13.158 Potential sources of suspended sediments during the demolition and construction phase include excavations, exposed ground and stockpiles, grouting, plant and wheel washing and dust and sediment generated during these works. The main pathway for suspended sediments to reach water receptors is through surface water runoff during rainfall events or when areas are being washed down. This may cause sediment-laden water to enter the local drainage network, cause blockages, and reach the River Thames via CSOs.

13.159 Suspended sediments can result in the suffocation of fish, smothering of plants, reduced levels of light within water bodies and decreased water quality surface water abstractions. Any organic matter contained within the sediment can increase the biological oxygen demand (BOD) of the water and result in a lowering of the amount of dissolved oxygen (DO) in the water with subsequent effects on aquatic life. Suspended sediments are also a major transport mechanism for low-solubility contaminants that can bind to sediment particles and enter water bodies resulting in adverse impacts to the receiving water.

13.160 The release of potentially polluted suspended sediments could have the following potential effects (pre-mitigation):

- an adverse, localised impact (short term) of medium magnitude on flood risk (through deposition and build-up of sediment in the local drainage/sewer network, resulting in potential blockages and localised flooding), resulting in a localised **minor adverse** effect; and
- an adverse impact of low magnitude (medium term) on the Secondary A Aquifer, resulting in a **moderate adverse** effect; and
- an adverse impact of very low magnitude (medium term) on the Principal Aquifer, resulting in a likely **minor adverse** effect.

13.161 Due to the dilution provided within the sewer network and the river itself, it is considered that there could be potential for an impact of very low magnitude (short term) on the River Thames (i.e. water quality, fisheries) via CSO discharges, resulting in a likely **minor adverse** effect.

13.162 A number of mitigation measures can be employed at the Site to prevent the release of suspended sediments and reduce the magnitude of the potential impacts to very low. These comprise:

- Site access points will be regularly cleaned;
- Earth movement will be controlled;
- Contained wheel wash facilities will be used; and
- Drainage of surface run-off and de-watering effluents to settling tanks.

13.163 Adoption of these mitigation measures would minimise the likelihood of uncontrolled release of sediment, reducing the magnitude of the potential impacts to very low (short term) on surrounding receptors / resources, resulting in the likely effects:

- **Negligible** effect on Flood risk;
- **Minor Adverse** effect on the Secondary A Aquifer;
- **Minor Adverse** effect on the Principal Aquifer; and
- **Minor Adverse** effect on the River Thames.

Concrete and Cement Products

13.164 Concrete and cement products are highly alkaline and their release into controlled waters could have an adverse impact on fauna in controlled waters and on the water quality in general, resulting in a poor taste and an increase in pH above the legal drinking water standards (Ref. 13-15).

13.165 Construction processes that can result in the release of concrete and cement include on-site concrete mixing and washing down of areas where mixing has taken place. This leads to large quantities of wastewater runoff which can flow into the surface water drainage system or infiltrate into the ground.

13.166 The release of concrete and cement products could have the following potential effects (pre-mitigation):

- An adverse impact of medium magnitude (short term) on the local flood risk (through blockage of the local drainage / sewer network), resulting in a likely **minor adverse** effect;
- An adverse impact of low magnitude (medium term) on the Secondary A aquifer, resulting in a likely **moderate adverse** effect; and
- An adverse impact of very low magnitude (medium term) is anticipated on the Principal Aquifer, resulting in a likely **minor adverse** effect.

13.167 Due to the distance of the Site from the River Thames and dilution that would be provided within the sewer network and the river itself, it is considered that there could be potential for an impact of very low magnitude (short term) on the River Thames (i.e. water quality, fisheries) via CSO discharges, resulting in a likely **minor adverse** effect..

13.168 A number of mitigation measures can be employed at the Site to prevent the release of suspended sediments and reduce the magnitude of the potential impacts to very low. These include:

- Concrete will be pre-mixed and delivered from an off-site source;
- Mixing and handling of wet concrete on-site in designated impermeable areas; and
- Designated impermeable area for washing down or equipment cleaning.

13.169 Adoption of these mitigation measures would minimise the likelihood of uncontrolled release of sediment, reducing the magnitude of the potential impacts to very low (short term) on surrounding receptors / resources, resulting in the likely effects:

- **Negligible** effect on Flood risk;
- **Minor Adverse** effect on the Secondary A Aquifer;
- **Minor Adverse** effect on the Principal Aquifer; and
- **Minor Adverse** effect on the River Thames.

Water Demand

13.170 Processes during the demolition and construction phase which may require significant volumes of water supply include mixing (especially relating to concrete) supply for washing down and potable water for sanitary facilities for site staff. The most intensive use of water, for the mixing of concrete, can be done off-site where possible and therefore will not affect water supply to the Site.

13.171 It is expected that water supply to the Site during the enabling works and construction phase will be provided by the existing TWUL network and an application to use an existing water supply for building purposes would be made to TWUL.

13.172 Water demand for demolition and construction processes may represent a short-term increase in supply volumes to the Site.

13.173 This could have a potential adverse impact of low magnitude (short term) on water supply infrastructure locally, resulting in a **moderate adverse** effect (pre-mitigation).

13.174 Water saving measures will be adopted where possible in line with the LBTHs CoCP, thereby reducing the impact on the water supply network. Means of reducing water consumption include:

- Selection of equipment to reduce demand;
- Staff-based initiatives;
- Use of recycling water systems; and

- Use of a rainwater harvesting system.

13.175 Implementation of these mitigation measures would reduce the potential impact to very low magnitude (short term) on the TWUL network, resulting in a likely **minor adverse** effect.

13.176 Water supply for construction will be agreed with TWUL prior to the commencement of construction activities. If TWUL grant the application for water supply for building purposes, then the potential impact on the TWUL network is considered to be **negligible**.

Wastewater Generation

13.177 Wastewater generation on demolition and construction sites includes effluent from sanitary facilities provided on-site, and sediment-laden water from washing down and wheel wash facilities. It is expected that foul water generated at the Site will be drained via the existing TWUL combined sewers in the surrounding area, following treatment (if required).

13.178 If dewatering is required during excavations, then abstracted water may then be discharged to the local drainage network, following sediment removal, or collected and disposed of via a licensed waste operator (refer measures outlined in '*Mitigation and Monitoring Measures*' section).

13.179 The demolition and construction activities may result in increases in the volume of wastewater generated, potentially increasing pressure on the local sewer network capacity and increase flood risk. It can also lead to a potential increase in the volume of water discharged into the River Thames via CSOs.

13.180 The rate at which the Site can discharge to the drainage/sewer network is restricted by the size of the existing sewer connections. If wastewater is generated at a greater volume than it can be discharged to the sewer network, then it will be stored or tankered off-site.

13.181 The wastewater generation could have an adverse impact of very low magnitude (short term) on flood risk and an adverse impact (short term) of very low magnitude on the River Thames. This would result in a **negligible** effect (pre-mitigation) on flood risk and a **minor adverse** effect (pre-mitigation) on the River Thames.

13.182 The use of water efficient fixtures and fittings and the use of mitigation measures to prevent silty water ingress (i.e. settling tanks, as discussed under 'Suspended Sediments') can help to reduce the volume and improve the flow of water within the drainage network. Adoption of water efficient fixtures and mitigation measures would also reduce the potential flood risk by reducing the volume discharged via CSOs.

13.183 Adoption of these measures would result in a likely residual **negligible** effect on flood risk and a likely residual **minor adverse** effect on the River Thames.

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13.184 The foundation and pile depths for the Revised Scheme have not changed since the December 2014 Scheme. Therefore the mitigation measures and residual demolition and construction effects reported in the December 2014 ES remain valid.

November 2015 Amendments

13.185 Taking into account the nature and scale of the proposed November 2015 Amendments, it is not considered that the Amended Proposed Development would result in any new or change to the likely effects and significance concluded within the December 2014 ES and March 2015 ES Addendum.

13.186 It is considered that the likely residual effects concluded in the December 2014 ES and March 2015 ES Addendum remain valid.

Table 13.12 Demolition and Construction Potential Sources of Contamination - Associated Triggers,Features, Pathways/ Mechanisms and Potential Effects

Source / Process	Triggers	Water Resources Receptor	Pathways/ Mechanisms	Potential Impacts (Pre-mitigation)
Creation of Preferential Pathways and Disturbance to Groundwater	Piling, excavations and other subsurface works, dewatering of excavations.	Principal Aquifer (Vulnerability, Abstractions)	Piling through the London clay strata	Opening up the Principal Aquifer to risk of pollution incidents, leading to a reduction in water quality for abstraction.
		Shallow ground water / Secondary Undifferentiated Aquifer	Creation of preferential pathways, driving of contaminants down into the Secondary A Aquifer.	Pollution and degradation of water quality of underlying Secondary Undifferentiated Aquifer
			Encountering shallow groundwater/ Secondary Undifferentiated Aquifer	Disturbance of shallow groundwater flows/ Secondary Undifferentiated Aquifer
			Lowering the groundwater table (i.e. reducing moisture content within foundation soils).	Disturbance of shallow groundwater flows.
Existing Drainage Systems and Water Supply Network	Disturbance of existing on-site and off-site drainage systems and water supply network.	TWUL Utilities and Infrastructure	Physical Damage	Uncontrolled release of potable water, drainage or sewage, and localised flooding,
			TWUL water supply network	Pressure issues with water supply and supply ceasing to local area.
		Shallow ground water / Secondary Undifferentiated Aquifer.	Infiltration (vertical and lateral migration of pollutants) into local geology and hydrogeology.	Contamination of substrata from foul drainage and resultant pollution and degradation of water quality of underlying Secondary Undifferentiated Aquifer
		Principal Aquifer (Vulnerability, Abstractions)	Infiltration (vertical and lateral migration of pollutants) into local geology and hydrogeology.	Contamination of Made Ground and soils and resultant pollution and degradation of water quality of underlying Principal Aquifer
On-Site Historical Land Contamination	Disturbance of contaminated land through subsurface works, principally piling activities.	Shallow ground water / Secondary Undifferentiated Aquifer	Creation of preferential pathways. Infiltration (vertical and lateral migration of pollutants) into local geology and hydrogeology.	Mobilisation of contaminated Made Ground and soils and resultant pollution and degradation of water quality of underlying Secondary Undifferentiated Aquifer
		Principal Aquifer	Creation of preferential pathways. Infiltration (vertical and lateral migration of pollutants) into local geology and hydrogeology.	Mobilisation of contaminated Made Ground and soils and resultant pollution and degradation of water quality of underlying Principal Aquifer
		River Thames	Runoff of contaminated soils/dust into the River Thames via the TWUL sewer network	Pollution of River Thames via discharge from CSOs
Leaks and Spillages	Underground and above ground fuel tanks. Improper storage of diesel, other fuels, oils, lubricants and coolants; irregular maintenance of plant equipment and on-site vehicles; improper use of diesel, other fuels and oils. Improper storage, handling and disposal of general waste from welfare facilities and demolition/construction activities, and hazardous waste (including contaminated soil if defined as hazardous waste).	Shallow ground water / Secondary Undifferentiated Aquifer	Infiltration (vertical and lateral migration of pollutants) into local geology and hydrogeology.	Contamination of Made Ground and soils and resultant pollution and degradation of water quality of underlying Secondary Undifferentiated Aquifer
		Principal Aquifer	Infiltration (vertical and lateral migration of pollutants) into local geology and hydrogeology.	Contamination of Made Ground and soils and resultant pollution and degradation of water quality of underlying Principal Aquifer
		River Thames	Runoff into River Thames via the TWUL sewer network	Pollution of River Thames via discharge from CSOs
Suspended Sediments	Waste water from demolition/construction activities e.g. dust suppression techniques and wheel washing. Exposed ground, excavations and stockpiles (could also contain contaminated material e.g. soils). Grouting works.	River Thames, flood risk	Surface water run off (during rainfall events or when areas are being washed down). Ingress via branches off the main sewers and/or damaged drains.	Increased sediment loading to local sewer network– risk of blockages which could cause flooding. Pollution of River Thames via discharge from CSOs
		Shallow ground water / Secondary Undifferentiated Aquifer.	Infiltration (vertical and lateral migration of pollutants) into local geology and hydrogeology.	Contamination of substrata from foul drainage and resultant pollution and degradation of water quality of underlying Secondary Undifferentiated Aquifer
		Principal Aquifer	Infiltration (vertical and lateral migration of pollutants) into local geology and hydrogeology.	Contamination of Made Ground and soils and resultant pollution and degradation of water quality of underlying Principal Aquifer
Concrete and Cement	Concrete and cement products - concrete mixing and washing down of areas where mixing has taken place.	Shallow ground water / Secondary Undifferentiated Aquifer	Infiltration (vertical and lateral migration of pollutants) into local geology and hydrogeology.	Contamination of substrata and resultant pollution and degradation of water quality of underlying Secondary Undifferentiated Aquifer
		Principal Aquifer (Vulnerability, Abstractions)	Infiltration (vertical and lateral migration of pollutants) into local geology and hydrogeology.	Contamination of substrata and resultant pollution and degradation of water quality of underlying Principal Aquifer, impacting upon abstractions and groundwater vulnerability
		River Thames, flood risk	Runoff into the TWUL sewer network	Increased loading to local sewer network – risk of blockages which could cause flooding and the potential for pollution of existing drainage and sewer network. Pollution of River Thames via discharge from CSOs
Water Demand	Increase in water demand from activities such as dust suppression techniques, wheel washing; construction techniques; and workers / on-site welfare facilities.	TWUL Water Resources	n/a	Increased pressure on local TWUL water resources (River Thames and deep groundwater).
Wastewater Generation	Increase in waste water discharged off-site due to effluent from sanitary facilities provided on-site, sediment laden water from excavations and washing down / wheel wash facilities.	River Thames, flood risk	TWUL sewer network	Increased loading to local sewer network – risk of flooding Pollution of River Thames via discharge from CSOs.

Effects Once the Site is Operational

13.187 The Proposed Development may potentially affect the features and attributes of water resource receptors. In line with the methodology used for the demolition and construction phase assessment, for each source during the completed / operational development, there are particular 'triggers'. The likely pathways between the source and the associated water resources feature or attribute have been identified. These sources, triggers, features / attributes, and pathways are shown in Table 13-17. The likely effect (pre-mitigation) has been stated, and is the result of the interaction between the source and the water resources feature, via a defined pathway.

13.188 Pollution sources arising from operation of the Proposed Development, which could affect surface and groundwater comprise the following:

- Leaks and Spillages. Contamination from in-situ materials (from below ground structures); and
- Flood risk.

13.189 Other activities associated with the completed and operational Proposed Development comprise:

- Additional water demand; and
- Additional wastewater generation.

Leaks and Spillages

13.190 Typical sources of pollution from developments include oil leaks and petrol spillages from vehicles or storage facilities. Pollutants can be mobilised in surface water runoff and enter the surface water drainage network. The release of chemicals in this way is anticipated to be in quantities that are relatively small and dilution will be occur within the environment (for example, in surface water runoff, the receiving drainage/sewer network, and River Thames).

13.191 In the event that pollutants enter the on-site drainage system, there is a risk of them entering the River Thames through CSOs associated with the drainage network. Due to the low volume of any potential spill and the dilution provided, it is considered that there would be a potential impact of very low magnitude (short term), resulting in a likely **minor adverse** effect (pre-mitigation) on the River Thames Water Quality (via CSO discharges).

13.192 The main pathway for these pollutants to impact the groundwater environment is via preferential pathways. However, due to the majority of the Site containing impermeable surfaces, it is anticipated that there is the potential for an localised adverse impact of low magnitude (short term), resulting in a likely **moderate adverse** effect (pre-mitigation) on the underlying Secondary A Aquifer.

13.193 During operation of the Proposed Development, there is a risk of a spillage of contaminating material (for example fuels and oils) potentially being released to ground. These risks can be managed by operational measures such as:

- implementing delivery control procedures;
- Drainage system will have cut-off measures;
- An Emergency Response Plan;
- Education / information on waste treatment provided to staff and occupants; and
- Interceptors with the drainage network in accord with EA guidance.

13.194 Following the implementation of the these mitigation measures, the potential impact would be of very low magnitude, resulting in likely a residual **minor adverse** effect on the River Thames (i.e. water quality, fisheries, etc), and a likely residual **minor adverse** effect on the underlying groundwater..

Contamination from In-Situ Materials

13.195 Below ground structures, such as the drainage network, basements and foundations can present a source of pollution to groundwater, through water coming into contact with the materials used in foundations and basements and leaks from drainage networks. This could have a potential adverse impact of low magnitude (short term) on the Secondary A, resulting in a likely **moderate adverse** effect (pre-mitigation).

13.196 During the construction of foundations, damp-proof membranes will be incorporated. Such materials would therefore not be exposed to underground strata or groundwater.

13.197 It is envisaged that all the proposed drainage/service runs will be surrounded by appropriate granular bedding materials and located above the static level of any shallow groundwater. Some confirmatory tests of the new drainage systems may be carried out in accordance with statutory requirements. The drainage network installed as part of the Proposed Development will be constructed to meet with Building Regulations 2000, Part H (Ref. 13-53).

13.198 Due to the presence of a basement across the majority of the footprint of the Site, the Proposed Development will result in no significant permeable areas remaining on-site.

13.199 Given the above mitigation measures, it is considered that there would be an impact of very low magnitude (short term), resulting in a likely **minor adverse** effect on the Secondary A Aquifer.

Water Demand

13.200 The Site is currently occupied by a number of disused warehouses and commercial buildings. Due to the change of use to include residential properties, commercial offices, and retail units within the Site, the Proposed Development will increase the demand on the TWUL water supply network above that of the existing development. The intent of the design is therefore to limit instantaneous demand on the local water authorities network by providing a full days water storage for the development and allowing a graduated refill rate over a 12 hour period.

13.201 An indication of the proposed water demand volumes have been calculated as follows:

- 8,505 litres/day for residential use (based on an estimated occupancy of 81 residents at 105 litres/person/day);
- 53,000 litres/day for commercial office use (based on an estimated occupancy of c.2,650 staff with a water usage of 20 litres/person/day);

13.202 The retail units in the scheme are not currently defined in terms of usage type (e.g. book store, clothing store, restaurant, etc.). Supplies to these units will not be provided and it will be the responsibility of each retail tenant to apply to Thames Water for their own independent supply direct from the street should they require a supply.

13.203 All sanitary fitments for use within both the residential and commercial parts of the development will be selected with appropriate flow restriction devices together with low / dual flush WC's and low water use white goods (residential) to ensure water use is restricted to a CfSH Level 4 compliant scheme for the residential parts of the development, and to achieve BREEAM Excellent for the commercial offices. Allowing for a 12 hour refill, the total combined water storage for the entire commercial and residential use equates to an instantaneous flow rate of 1.478 litres/second which should significantly limit any impact on the Thames Water Authority mains network.

13.204 It is anticipated that the Proposed Development is expected to increase the water demand. However, the potential for mains water pressure reduction in the area should not impact the development and equally, the development is not expected to impact local water pressures in the mains. To avoid impacting mains pressures, the intention is to locate the storage at basement level meaning water storage infill is not reliant on mains pressure. With Thames Water's ability to legally lower mains pressures to 1.0bar, water services systems are designed to accommodate this low pressure should Thames Water decide to lower system pressures in the future.

13.205 The water demand calculations take into account the use of water efficient fixtures and fittings, and therefore adhere to the London Plan's water consumption aspiration of 105 l/person/day in relation to residential usage.

13.206 As TWUL has undertaken an assessment on the impact of projected housing / commercial / population growth within the London WRZ at a strategic level, it is considered that the likely effects of the Proposed Development on water demand is covered within the TWUL assessments and provision has been made to accommodate projected housing / commercial / population growth.

13.207 In the longer-term it is the duty of TWUL to ensure the supply of adequate wholesome water in accordance with the Water Industry Act 1991. TWUL will however be consulted to assess the water requirements of the Proposed Development ensuring a solution that has TWUL agreement. TWUL may choose to undertake network testing on behalf of the developer to determine that the water can be supplied to the Site without causing stress on the local water supply network.

13.208 As the TWUL WRMP has taken into account the impact of population growth at a strategic level within the London WRZ, it is considered that the Proposed Development in terms of water demand is to result in a likely negligible effect on TWUL water resources.

Waste Water Drainage (Foul and Surface)

13.209 The foul water and surface water generated on-site will be discharged into the TWUL drainage / sewer network. As there would be a significant increase in floorspace for office, retail and residential dwellings in the new scheme, it is considered that the proposed peak discharge rates will be much greater than the discharge rates from the existing buildings on-site, particularly given that many of the existing buildings are vacant or derelict.

13.210 A Conceptual Drainage Strategy has been developed for the Proposed Development and presented within the FRA (refer ***ES Volume III: Appendix H***). A summary of the strategy, including discharge rates and storage volumes, is presented.

13.211 This report includes discharging surface water to the TWUL drainage / sewer network at a reduced rate, approximately 50% less than the existing Site run-off rates. Surface water generated on-site will be collected and channelled to a below ground attenuation tank system with an approximate storage volume of 195m^3 (storage volume of at least 110m^3 at S1, 45m^3 for S2 and 40m^3 for S3) This storage volume will accommodate runoff generated by the 1 in 100 year storm event with an allowance for the effects of climate change to meet the London Plan requirement.

13.212 The anticipated increase in foul flows at the Proposed Development will be partially offset by the reduction (approximately 50%) in the rate of surface water discharged to the drainage / sewer network, as it is proposed to discharge surface water at a restricted rate to the TWUL system. The installation of water efficient fixtures and fittings can help further reduce the volume of foul water generated on-site.

13.213 The reduction in surface water flows therefore to the sewer network is considered to have a potential impact of low magnitude (long term) resulting in a **moderate beneficial** effect on the capacity of local drainage / sewer infrastructure.

13.214 As the predicted reduction in surface water runoff is likely to reduce pressure on the drainage / sewer network, it is therefore anticipated that the increased peak foul flows will have a potential beneficial impact of medium magnitude, resulting in a likely **minor beneficial** effect for flood risk (TWUL sewer capacity).

13.215 The corresponding potential impact on the River Thames (i.e. water quality, fisheries, supply and abstractions) arising from the impact on the drainage network (via the CSOs) is considered to be of very low magnitude, resulting in a likely **minor beneficial** effect.

13.216 Given the above, it is anticipated that the construction of the 32km TWUL Thames Tideway Tunnel will begin post determination of the application for the Proposed Development. The Thames Tideway Tunnel scheme will increase the capacity of London's sewer network by 1.5 million m^3. The Tunnel will run beneath the River Thames from west London to Beckton, intercepting storm sewage from 34 sewer overflow points, and will function as a storage and transfer tunnel, carrying sewage to Beckton sewage treatment works (STW) (Ref. 13-57). Construction is provisionally scheduled for completion by 2020. In the long-term, this will increase the capacity of the TWUL's sewer network and enable it to accommodate additional flows from the brownfield redevelopment sites across London.

13.217 Taking into account TWUL's statutory responsibilities, as well as the potential for Thames Tunnel to come forward, it is considered that the overall long term residual effect of the Proposed Development on the drainage network and on the River Thames is therefore expected to be beneficial.

13.218 Beckton STW has now been improved and will provide sufficient treatment to cope with London's growing population to at least 2021, whilst delivering improved quality effluent to meet water quality requirements. The improvements now enable the treatment of 60% more sewage than it did previously. This increase also provides sufficient treatment of existing flows and storm flows transferred to the STW via the new Thames Tideway Tunnels (Ref. 13-57).

Effects Once the Site is Operational – Update 2015

March 2015 ES Addendum

13.219 The surface water drainage strategy for the December 2014 Scheme will not be materially different to the Revised Scheme and will be refined as part of the detailed design stage. The strategy is compliant with the NPPF and the Mayor's essential priorities of the London Plan and therefore will remain as having an effect of minor beneficial significance on flood risk (i.e. no change from the December 2014 ES).

13.220 The calculations for water demand as assessed in the December 2014 Scheme are presented below:

- 8,505 litres/day for residential use (based on an estimated occupancy of 81 residents at 105 litres/person/day); and
- 53,000 litres/day for commercial office use (based on an estimated occupancy of c.2,650 staff with a water usage of 20 litres/person/day).

13.221 As the employee numbers have been reduced by 10 for the Revised Scheme the water demand assessment presented in the December 2014 ES represents the worst case scenario. Therefore the effect is considered to remain negligible on TWUL water resources.

November 2015 Amendments

13.222 It is not considered that surface water drainage strategy presented within the December 2014 ES and accounted for within the March 2015 ES Addendum requires amendments taking into account the nature and scale of the proposed November 2015 Amendments. Whilst the November 2015 Amendments propose a reduction in commercial floor area, it is considered that the strategy remains compliant with the NPPF and the Mayor's essential priorities of the London Plan and will remain as having an effect of minor beneficial significance on flood risk.

13.223 The November 2015 Amendments also have the potential of reducing the estimated number of staff occupying the Site by 60 persons (includes the reduction of 10 persons estimated arising from the Revised Scheme presented in the March 2015 ES Addendum), down from the initial estimated occupancy assessed in the December 2014 ES of c. 2,650. It is considered that estimated scale of the reduction of staff occupancy is negligible and that the assessment and conclusions presented in the December 2014 ES (and March 2015 ES Addendum) represents the worst case scenario.

13.224 It is considered that the likely residual effects concluded in the December 2014 ES and March 2015 ES Addendum remain valid.

Table 13.13 Completion and Occupation of the Proposed Development - Associated Sources, Triggers, Features, Pathways/ Mechanisms and Potential Effects

Source	Triggers	Water Resources Feature / Attribute	Pathways/ Mechanisms	Potential Effects (Pre-mitigation)
Leaks and Spillages	Improper storage of diesel, other fuels, oils, lubricants and coolants; and improper use of diesel, other fuels and oils. Vehicles using the Application Site access routes and on-site car parks. Vehicle washing. Improper storage, handling and disposal of general and hazardous waste from proposed Site uses and activities.	Shallow ground water / Secondary A Aquifer	Infiltration (vertical and lateral migration of pollutants) into local geology and hydrogeology.	Contamination of Made Ground and soils and resultant pollution and degradation of water quality of underlying Secondary A aquifer.
		River Thames	Infiltration and/or runoff into the local sewer network.	Pollution of River Thames via discharge from CSOs.
In-situ Materials	Presence of below ground structures, such as the drainage network, basements and foundations can present a source of pollutants to groundwater.	Shallow ground water / Secondary A Aquifer	Groundwater coming into contact with the materials used in foundations and basements and leaks from drainage networks.	Pollution and degradation of water quality of underlying Secondary A aquifer.
On-site conditions which cause surface water runoff (flood risk)	Increase in surface water run-off to local drainage / sewer network from on-site structures and impermeable surfaces.	Flood Risk, River Thames	TWUL sewer network	Increased pressure on the local sewer network capacity could result in a flood risk to the local surrounds.
On-site uses which require water use	Increase in water usage from proposed on-site uses / activities.	Existing TWUL water resources	TWUL water supply network.	Increased pressure on local TWUL water supply resources.
On-site uses which produce waste water	Increase in waste water discharged off-site from proposed on-site uses / activities.	Flood Risk, River Thames	TWUL sewer network	Increase in pressure on the local sewer network capacity (flood risk). Surcharging of system and discharges via CSOs.

Mitigation and Monitoring Measures

13.225 From the assessment, this section outlines the mitigation measures proposed, that are over-and-above the environmental design and management measures identified previously. Where appropriate, future monitoring and / or environmental management required to verify the predictions and/or fine tune mitigation measures, or ensure the potential effects are adequately controlled, are also outlined.

13.226 The mitigation measures identified for both the demolition and construction, and operational phases, are outlined below.

Demolition and Construction

13.227 There are numerous sources of contamination and construction processes that have the potential to affect water resources. The proposed mitigation measures (outlined below) will be implemented and managed through the:

- Construction Environmental Management Plans (CEMP),
- Site Waste Management Plans (SWMP),
- Emergency Response Plans (ERP), and
- Health and Safely Plans (H&SP).

13.228 These plans will all be completed prior to the commencement of construction activities. The mitigation measures implemented will be reviewed regularly to best suit the practices being undertaken across the Site and to ensure that these remain in line with industry best practice, the GLA's SPG for Sustainable Design and Construction (Ref. 13-26), and the LBTH Code of Construction Practice (CoCP) document (Ref. 13-52).

Preferential Pathways and Disturbance to Groundwater

- The use of geotextile bunding to isolate and minimise the ingress of surface water runoff to non-decommissioned boreholes or exposed surface water drainage pipes;
- Decommissioning of boreholes to the satisfaction of EA and contacting the EA if dewatering of excavations is required;
- Isolation of the area around the pilings from surface water until piling is complete and pile casing during piling could also be considered;
- Groundwater is likely to be encountered during establishment of the basement and core foundations, therefore dewatering may be required. Groundwater from dewatering of the excavations may be discharged directly to the local sewerage network, after obtaining a water discharge permit; and
- Water from excavations to be disposed of either to the local sewer network if uncontaminated and via settlement ponds or alternative measures to remove silt, or disposed of off-site via a licences waste operator.

Disturbance of Existing Drainage Systems and Water Supply Network

- All existing utilities will be identified and marked prior to works commencing;
- Signs will be used to warn of the presence of utility infrastructure;
- Any damage to the drainage network will be immediately repaired; and
- An emergency response plan will be produced to ensure spillages and leakages are immediately contained.

Disturbance of Contaminated Land

- All piling related works will be carried out in accordance with EA Guidance Note on Piling / Penetrative Ground Improvement Methods on Land Affected by Contamination;
- In contaminated soils are encountered at the position where piling is due to be undertaken, then these materials should be removed prior to piling in order to prevent the dragging of contaminated soils with the piles to depth;
- Contaminated soil requiring disposal will be excavated and kept spate from other soil and waste materials in protected temporary stockpiles prior to disposal.

Leaks and Spillages

- Wherever possible (determined through the scheme design), plant and machinery will be kept away from the drainage system and will have drip trays beneath oil tanks/engines/gearboxes/hydraulics which will be checked and emptied regularly via a licensed waste disposal operator;
- Following the discharge of surface run-off and de-watering effluents to settling tanks the drainage would be routed to oil interceptors prior to discharge to sewer; and
- An emergency response plan will be produced, which site staff will have read and understood. On-site provisions will be made to contain a serious spill or leak through the use of booms, bunding and absorbent material.

Suspended Sediments

- Cut-off ditches and/or geotextile silt-fences which will be installed around excavations or exposed ground and stockpiles to prevent the uncontrolled release of sediments from the Site;
- Site access points which will be regularly cleaned to prevent build-up of dust and mud;
- Earth movement will be controlled to reduce the risk of construction silt combining with the Site run-off;
- Properly contained wheel wash facilities will be used where required, to isolate sediment rich run-off; and
- Drainage of surface run-off and de-watering effluents to settling tanks to remove suspended solids prior to discharge to sewer or removal via a licences waste operator.

Concrete and Cement Products

- The majority of concrete used will be pre-mixed and delivered from an off-site source, thereby negating the need to mix concrete on-site and reducing the creation of alkaline wastewater;
- Wherever possible, any mixing and handling of wet concrete on-site will be undertaken in designated impermeable areas, away from any drainage channels or surface water; and
- A designated impermeable area will be used for any washing down or equipment cleaning associated with concrete or cementing processes and wastewater will be discharged to the foul drainage system or contained and removed by tanker to a suitable discharge location via a licences waste operator.

Water Demand

- Selection and specification of equipment to reduce the amount of water required;
- Implementation of staff-based initiatives such as turning off taps, plant and equipment when not in use both on-site and within site offices;
- Use of recycling water systems such as wheel washes, site toilets hand wash; and
- Use of a rainwater harvesting system for use in equipment and vehicle washing.

Wastewater Generation

- If dewatering is required during excavations, then abstracted water may then be discharged to the local drainage network, following sediment removal, or collected and disposed of via a licensed waste operator;
- The installation of water efficient fixtures and fittings can help further reduce the volume of foul water generated on-site.

Operation

Leaks and Spillages

- Implementing control procedures during delivery or movement of service materials;
- The drainage system will have cut-off measures that will allow a spill to be contained within the Site, so that it can be effectively controlled and managed without leading to off-site effects;
- An Emergency Response Plan will be put in place;
- Education / information on waste treatment / emergency events/spills etc. can be provided to the building servicing staff and building occupants as appropriate; and

- Interceptors would be used in association with the drainage network in high-risk areas as defined in Pollution Prevention Guidance 03: '*Use and Design on Oil Separators in Surface Water Drainage Systems*' (Ref. 13-34).

Contamination from In-Situ Materials

- Damp-proof membranes will be incorporated so that materials would not be exposed to underground strata or groundwater;
- Drainage/service runs will be surrounded by appropriate granular bedding materials and located above the static level of any shallow groundwater. Some confirmatory tests of the new drainage systems may be carried out in accordance with statutory requirements;
- The drainage network installed as part of the Proposed Development will be constructed to meet with Building Regulations 2000, Part H.

Water Demand

- Water efficient fixtures and fittings.

Waste Water Drainage (Foul and Surface)

- The installation of water efficient fixtures and fittings can help further reduce the volume of foul water generated on-site.

Mitigation and Monitoring Measures - Update 2015

March 2015 ES Addendum

13.229 No additional mitigation measures or changes to those measures identified previously are assessed as being required to alleviate the impacts associated with the proposed changes.

November 2015 Amendments

13.230 No additional mitigation measures or changes to those measures identified previously are assessed as being required to alleviate the impacts associated with the November 2015 Amendments.

Residual Effects and Conclusions

Residual Effects – Update 2015

13.231 Table 13-14 ~~summarises the potential residual effects of the Proposed Development on water resources, drainage and flood risk~~ below presents the residual effects following the assessment of the Amended Proposed Development.

Table 13.14 Summary of Residual Effects on Water Resources, Drainage and Flood Risk

Resource / Receptor	Effect (incorp. environmental design & management)	Mitigation and Monitoring	Residual Effect (incorp. mitigation & monitoring)	Significance Conclusion
Demolition and Construction				
Secondary A – Groundwater Vulnerability				
Preferential pathways and disturbance to groundwater	Major Adverse	Yes	**Minor Adverse**	**Not Significant**
Disturbance of existing drainage systems and water supply network	Moderate Adverse	Yes	**Minor Adverse**	**Not Significant**
Disturbance of contaminated land	Moderate Adverse	Yes	**Minor Adverse**	**Not Significant**
Leaks and Spillages	Moderate Adverse	Yes	**Minor Adverse**	**Not Significant**
Suspended sediments	Moderate Adverse	Yes	**Minor Adverse**	**Not Significant**
Concrete and cement products	Moderate adverse	Yes	**Minor Adverse**	**Not Significant**
Principal Aquifer – Groundwater Vulnerability, Abstractions				
Disturbance of existing drainage systems and water supply network	Minor Adverse	Yes	**Minor Adverse**	**Not Significant**
Disturbance of contaminated land	Minor Adverse	Yes	**Minor Adverse**	**Not Significant**
Leaks and Spillages	Minor Adverse	Yes	**Minor Adverse**	**Not Significant**
Suspended sediments	Minor Adverse	Yes	**Minor Adverse**	**Not Significant**
Concrete and cement products	Minor Adverse	Yes	**Minor Adverse**	**Not Significant**
Fluvial and Tidal Flood Risk				
Suspended sediments	Minor adverse	Yes	**Negligible**	**Not Significant**
Concrete and cement products	Minor adverse	Yes	**Negligible**	**Not Significant**
Wastewater generation	Negligible	Yes	**Negligible**	**Not Significant**
TWUL Water Infrastructure / Resources				
Disturbance / damage of existing drainage systems and water supply network	Moderate Adverse	Yes	**Minor Adverse**	**Not Significant**
Water Demand	Moderate Adverse	Yes	**Minor Adverse**	**Not Significant**
River Thames – Water Quality / Fisheries / Abstractions				
Disturbance of contaminated land	Minor Adverse		**Minor Adverse**	**Not Significant**
Leaks and Spillages	Minor Adverse		**Minor Adverse**	**Not Significant**
Suspended sediments	Minor Adverse		**Minor Adverse**	**Not Significant**
Concrete and cement products	Minor Adverse		**Minor Adverse**	**Not Significant**
Wastewater generation	Minor Adverse		**Minor Adverse**	**Not Significant**
Completed and Operational				
Secondary A Aquifer – Groundwater Vulnerability				
Leaks and Spillages	Moderate Adverse	Yes	**Minor Adverse**	**Not Significant**
Contamination from in-situ materials	Moderate Adverse	Yes	**Minor Adverse**	**Not Significant**
Principal Aquifer – Groundwater Vulnerability, Abstractions				
N/A				
Flood Risk				
Waste Water Drainage (Foul and Surface)	Minor Beneficial	Yes	**Minor Beneficial**	**Not Significant**

Resource / Receptor	Effect (incorp. environmental design & management)	Mitigation and Monitoring	Residual Effect (incorp. mitigation & monitoring)	Significance Conclusion
TWUL Water Infrastructure / Resources				
Water Demand	Negligible	Yes	**Negligible**	**Not Significant**
Waste Water Drainage (Foul and Surface)	Moderate Beneficial	Yes	**Moderate Beneficial**	**Significant**
River Thames – Water Quality / Fisheries/Abstractions				
Leaks and Spillages	Minor Adverse	Yes	**Minor Adverse**	**Not Significant**
Waste Water Drainage (Foul and Surface)	Minor Beneficial	Yes	**Minor Beneficial**	**Not Significant**

Conclusion – Update 2015

13.232 Overall, the Amended Proposed Development does not result in any changes to the water resource, drainage and flood risk effects and significance presented in the December 2014 ES and March 2015 ES Addendum. As such, the conclusions set out within the March 2015 ES Addendum and the December 2014 ES remain valid.

Effect Interactions and Cumulative Effects Assessment

Assessment of Combined Effect of Individual Effects on a Single Receptor

13.233 The combined effect of individual effects occurs when a single receptor is affected by more than one effect at any point in time. An exercise which tabulates the residual effects identified within this ES chapter against relevant receptors and identifies the potential for combined cumulative effects has been undertaken.

13.234 Reference should be made to ***Chapter 16: Effect Interactions*** of this ES for further details.

Assessment of Cumulative Effect of the Proposed Development with Other Development Schemes

13.235 This section of the chapter assesses the potential effects of the Proposed Development in combination with the potential effects of other development schemes within the surrounding area, as listed within ***Chapter 2: EIA Methodology*** of this ES.

Demolition and Construction Effects

13.236 Potential cumulative effects to water resources, drainage and flood risk during demolition and construction are associated with the generation of sediments and the release into the combined sewer drainage network; spillage and leakage of oils and fuels; leakage of wet concrete; cement and disturbance of contaminated land; and foul drainage.

13.237 It is assumed that during the demolition and construction of the identified cumulative developments, that best practice measures (as identified within this ES chapter) will be implemented at these other development sites. Implementation of the mitigation measures to manage and control these impacts would reduce the magnitude and significance of any effects to a minimum.

13.238 As a result of these control measures utilised in the Proposed Development and in the schemes considered within this cumulative effects assessment, and the likelihood that not all the development sites will be under construction at the same time any cumulative effect on water resources, drainage and flood risk is considered to be **negligible** to **minor adverse**.

Operational Effects

13.239 The Proposed Development will have a beneficial impact on the surface water runoff generated at the Site due to implementation of the proposed drainage strategy.

13.240 Surface water runoff from the schemes considered within this cumulative assessment will also need to meet the essential standards of the London Plan requiring attenuation to 50% of the existing peak runoff. If this can be achieved on the surrounding other development sites, then an overall beneficial cumulative effect will be observed (**minor beneficial** significance) to the local flood risk associated with the TWUL sewer network. This could result in a **minor beneficial** effect on the River Thames by contributing to the reduction of the number of spills from CSOs.

13.241 An increase in water supply requirements at the Site, coupled with increased requirements at other developments in the vicinity may put pressure on sources of water supply resources in the area. As TWUL has undertaken an assessment on the effect of projected population growth within the London WRZ, it is considered that the likely effect of the Proposed Development on water demand is covered within the TWUL assessments undertaken and therefore considered that adequate provision has been made to accommodate the projected growth of other development sites. As a result, the likely cumulative effects resulting from an increase in water demand are considered to be **negligible**.

Assessment of Cumulative Effect of the Site with Other Development Schemes - Update 2015

March 2015 ES Addendum

13.242 Cumulative impacts were assessed as negligible to minor adverse during demolition and construction and negligible to minor beneficial once the Proposed Development is completed and occupied in the December 2014 ES. As the list of cumulative schemes remains unchanged, the Cumulative Impact Assessment presented in the December 2014 ES remains valid.

November 2015 Amendments

13.243 The updated cumulative scheme list, including new projects that have forward since the preparation of the March 2015 ES Addendum and amended applications for projects already accounted for in the assessment, has been considered in terms of any change in the potential impacts and likely effects. Taking into account the location of the additional schemes and their proximity to the Site, and that the schemes adopt industry standard best practice measures and compliance with policy, it is considered that the cumulative assessment and conclusions set out within the March 2015 ES Addendum and the December 2014 ES remain valid for this Replacement ES.

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