

12. Water Resources and Flood Risk

12.1 Introduction

- 12.1.1 This Chapter provides a statement of conformity with regard to the potential water resources and flood risk impacts arising from the Scheme with Phase 1A (North) in place (the 'Development'). This statement of conformity is provided pursuant to the s.73 ES to inform decision making of the Phase 1A (North) RMAs.
- 12.1.2 The Chapter considers the detailed design of the River Brent alteration and diversion works, highway improvements, as well as that of the improvements to Clitterhouse Playing Fields Part 1, Claremont Park, Plots 53 and 54 and Temporary Bus Station and Bus Stops. Since the granting of the 2014 Permission the design team has engaged in regular dialogue with the Environment Agency (EA) and LBB regarding the detailed proposals for the Scheme.
- 12.1.3 The following technical material has been provided in support of this Chapter:
- **Appendix 12.1: s.73 Flood Risk Assessment (FRA) and Water Framework Directive Assessment;**
 - **Appendix 12.2: Planning Condition Report 33.2 Water Use Principles;**
 - **Appendix 12.3: Highways Agency Water Risk Assessment Tool; and**
 - **Appendix 12.4: Thames Water Sewer Impact Study for Proposed Development at Brent Cross, Cricklewood – Foul and Surface Water System**
- 12.1.4 An updated Flood Risk Assessment and other supporting further studies are being prepared by URS which will be submitted for approval by the Environment Agency in 2015, post-RMA submission.

12.2 Policy, Legislation and Guidance

- 12.2.1 There have been no significant changes to policy, legislation or guidance since the s.73 ES was prepared which have a material effect on the approach to, or findings of the assessment. A review of material published or amended since October 2013 is set out below for reference.

National Planning Practice Guidance

- 12.2.2 The National Planning Practice Guidanceⁱ (NPPG) was launched on the 6th March 2014 and provides a web-based resource in support of the National Planning Policy Frameworkⁱⁱ (NPPF). The NPPG has been amended to include greater emphasis on the importance of brownfield land use and provides updated guidance with regards to flood risk assessment. Section 7 of the NPPG provides guidance and advice on how Local Planning Authorities and Developers should take account of the risks associated with flooding and coastal change in plan-making and the application process. In summary, the guidance retains the key principles of the NPPF Technical Guidance, and therefore the changes have no material effect on the approach or findings of the s.73 ES assessment.

Draft Further Alterations to the London Plan

- 12.2.3 The public examination of the draft Further Alterations to the London Plan (FALP)ⁱⁱⁱ commenced on 1st September 2014. There are no implications for flood risk or water resources in the FALP, and hence there is no impact on the approach of findings of the s.73 ES assessment.

London Plan Supplementary Planning Guidance

- 12.2.4 The London Plan Supplementary Planning Guidance (SPG) – Sustainable Design and Construction^{iv} was published in April 2014. The SPG serves to update the standards that were developed for the Mayor's SPG on Sustainable Design and Construction in 2006 with a list of 'Mayor's Priorities' and best practice approaches for sustainable design and construction. The 'Mayor's Priorities' of relevance to detailed design includes the following, although the changes have no material impact on the approach or findings of the s.73 ES assessment.
- Developers should maximise all opportunities to achieve greenfield runoff rates in their developments;
 - When designing their schemes developers should follow the drainage hierarchy set out in London Plan policy 5.13; and
 - Developers should design Sustainable Urban Drainage Systems (SuDS) into their schemes that incorporate attenuation for surface water runoff as well as habitat, water quality and amenity benefits.

12.3 Relevant Phase 1A (North) RMAs Details

- 12.3.1 Key elements of the Phase 1A (North) RMAs of relevance to water resources and flood risk are set out below. These elements were approved in outline as part of the 2014 Permission and therefore assessed in the s.73 ES.

Infrastructure: River Brent Alteration & Diversion Works

- 12.3.2 The key component of the Phase 1A (North) Infrastructure RMA is the alteration and realignment of the River Brent. These works encompass the stretch of the River Brent between the M1 slip road onto the A406 North Circular in the west and the A41 Brent Cross flyover in the east. The 2014 Permission allows for reconfiguration of the channel south of the Brent Cross Shopping Centre to allow creation of the pedestrianised High Street North, while also providing an attractive resource for the new and existing community and reducing the current flooding problems. The principles of the proposals were set out in Section 5 of the Revised Development Specification Framework (RDSF) and were shown on Parameter Plan 011 which formed part of the s.73 Application and included as **Figure 12.1** for ease of reference.
- 12.3.3 Works to the river involve modification around existing and proposed highway infrastructure and a diversion south in a new channel. The approved Parameter Plan 011 showed the new alignment of the river, the location of a new Riverside Park and the general location of new vehicular and pedestrian/cyclist bridges. Principles of the detailed design of the River Brent works are provided in the Revised Design & Access Statement and in Section 3.1 of the Revised Design Guidelines which accompanied the s.73 Application.

- 12.3.4 The design principles for the realignment of the River Brent remain the same as per the s.73 ES. The river is to consist of a three stage channel; a low-flow channel, a second stage channel that contains design flows up to and including the 5 year return period flood and a third stage that incorporates design flows up to and including the 100 year return period flood plus climate change. The realignment work has been designed to reduce local flood risk and improve water quality and aquatic ecology.
- 12.3.5 The re-aligned channel will comprise three stages within the river corridor; a low-flow channel (Stage 1), a higher channel stage (Stage 2) to contain the 1 in 5 year design event flows, and an upper channel stage (Stage 3) to contain the 1 in 100 year plus climate change design flood event.
- 12.3.6 The detailed designs for the works to the River Brent have been developed in consultation with the Environment Agency (Environment Agency).
- 12.3.7 The s.73 ES concluded that realignment of the River Brent and the removal of the current confined concrete channel within the Site represents a significant positive improvement over the current situation and has the potential to have a moderate significant positive impact upon the status of the watercourse, providing appropriate designs and controls are applied.
- 12.3.8 The river is split into three reaches for the purposes of realignment and will be delivered in stages as described in Chapter 2 and illustrated on **Figures 2.9, 2.10 and 2.11**.

Delivery and Construction

- 12.3.9 It is anticipated that the river construction will be delivered in stages. These stages were described in the Construction Impact Assessment (CIA) Addendum which accompanied the s.73 ES set out how the river works would be delivered in stages (included as **Appendix 2.2**).
- 12.3.10 The first stage will principally involve alterations to the eastern section around the new eastern roundabout, created as a result of the A406 / A41 modifications and particularly the new slip road off the A406 (as per the CIA Addendum in **Appendix 2.2**), as well as around the western roundabout and River Brent Nature Park 5. The eastern section will be completed in line with the A41 / A406 junction works. The exact nature of the staged delivery of the river reaches has yet to be determined, but this information will be finalised as part of the detailed design and will be submitted to the Environment Agency and LBB for approval in June 2015.

Infrastructure – Other Elements

- 12.3.11 The following additional Phase 1A (North) infrastructure elements are also of relevance in terms of assessing drainage and flood risk impacts:
- Primary and secondary routes: new roads, junctions and routes to link the Scheme to the existing infrastructure;
 - Existing public surface water and foul sewers;
 - Bridge structures: construction of replacement Templehof Bridge (A406) (B1), new River Brent bridges, creation of the Living Bridge (B7) and a new pedestrian and cycle bridge at the M1 junction (B6); and
 - Temporary Bus Station and Bus Stops (Plots 114 and 113 respectively).

- 12.3.12 A series of existing surface water and foul sewers extend through the Phase 1 development area. Existing sewers that accommodate flows from the wider catchment will generally be diverted to follow the alignment of new roads in order to avoid conflict with proposed bridges and buildings and thereby enable easements to be maintained.
- 12.3.13 New highway drainage networks are proposed to intercept and attenuate surface water runoff from sections of extended highway, new roads and bridges. These networks are generally proposed to discharge directly to the River Brent. However, limited sections of highway drainage are proposed to discharge surface water to existing public surface water sewers, where it is impractical to discharge surface water directly to an existing watercourse by gravity. Sustainable Drainage Systems are proposed to be incorporated within highway drainage networks to ensure; firstly, that peak discharge rates are not increased for rainfall events with a return period of up to and including 1 in 100 years; and secondly, that contaminants are removed from surface water runoff before it is discharged to the River Brent. The dense urban nature of the development, kerbed nature of proposed adopted roads and impermeable nature of the underlying strata precludes the use of filter drains, porous paving and soakaways. However, suitable systems have been identified, which include detention basins within landscaped areas and oversized pipes with separators and filtration chambers in densely developed areas of the site. This approach complies with the requirements of the s.73 ES and the Flood Water Management Act.
- 12.3.14 The temporary bus station and bus stops at Plot 114 and 113 respectively, will be formed within areas of the site that are currently occupied by existing car parks. The topographical survey indicates that the existing surface water drainage systems that intercept surface water from the car parks incorporate petrol interceptors. These existing pollution prevention measures will enable hydrocarbon contaminants to be removed from surface water before it is discharged to the River Brent in the event that a small spillage occurs at the Temporary Bus Station.
- 12.3.15 Drainage systems for proposed structures aim to ensure that surface water is intercepted in order to control flow widths adjacent to the channel. Approval in Principle documents have been produced for each of the new structures, which are included within the Phase 1A (North) RMAs and include details of proposed drainage for each structure.

Open Space

- 12.3.16 The Phase 1A (North) RMAs contain the major areas of open spaces within the Scheme. Features which are of relevance to the assessment for drainage and water resources include the detailed design of the Central Brent Riverside Park, Claremont Park and the Clitterhouse Playing Fields Improvements Part 1. Clitterhouse Stream falls into the Clitterhouse Playing Fields Improvements Part 2 which are not part of the Phase 1A (North) RMAs.
- 12.3.17 The Design Development Report for Claremont Park, which has been prepared to support the RMA, indicates that the impermeable area will be increased and that Sustainable Drainage Systems will be provided to intercept, attenuate and improve the quality of runoff from the new park. Surface water runoff from the new paved areas within the park will be discharged to an existing 150mm diameter surface water sewer that formerly accommodated runoff from the roof of an existing industrial building, which will be demolished to allow the park to be extended. A cascading system of Sustainable Drainage Systems will be provided to enable the peak discharge rate to be restricted

to the minimum practical rate of 5 litres per second (l/s). Filter drains will be provided on the low side of each footpath or paved area to intercept and improve the quality of runoff at source before it is attenuated within a series of depressions within landscaped areas. Further attenuation storage will also be provided within porous sub-base underlying low lying activity areas to allow rainfall from events with a return period of 1 in 100 years plus climate change to be managed within the park. These features will ensure that the peak discharge rate from the playing fields is not increased and that potential contaminants are removed.

12.3.18 The Design Development Report for the Clitterhouse Playing Fields indicates that the existing playing fields will be reconfigured and remodelled to improve amenity value and drainage. New drainage systems will be installed to enable surface water runoff from proposed paths and pitches to be intercepted, attenuated and conveyed to the Clitterhouse Stream. This drainage system will be designed to ensure that existing peak discharge rates to the existing watercourse will not be increased. Habitats surrounding Clitterhouse Stream would be enhanced through the creation of damp grassland on the embankments.

Plots 53 and 54

12.3.19 Sustainable Drainage Systems will be provided to restrict runoff from Plots 53 and 54 to the minimum practical rate of 5l/s, as this part of the Development will be constructed on a greenfield site. Sustainable Drainage Systems are proposed to be provided within parking areas in the form of permeable paving overlying storage cells that are wrapped in an impermeable membrane. This drainage system will enable contaminants to be removed through filtration and for surface water runoff generated by rainfall events with return periods of up to and including 1 in 100 years + 30% climate change to be stored on site before being discharged to the existing adopted surface water sewer that extends along Brent Terrace as shown in **Figure 12.2**.

12.3.20 In order to meet the site-wide commitment set out in the s73 Application to reuse 10% of rainwater falling on the site, rainwater harvesting systems will be provided to intercept rainwater falling on roofs of buildings constructed within Plots 53 and 54. This system will be sized in order to meet the demand for irrigation and cleansing in order to reduce the demand for non-potable water and the additional volume of surface water that will be discharged to the existing surface water sewer. Further details regarding water usage in the buildings to be constructed on Plots 53 and 54 are provided in **Appendix 12.2: Planning Condition Report 33.2 Water Use Principles**.

12.3.21 The buildings that are proposed to be constructed on Plots 53 and 54 comprise three storeys and piled foundations are likely to be adopted as the foundation solution due to the relatively high loads and presence of made ground and clay underlying the site. New buildings or structures that are constructed within 3m of an existing public sewer asset will be subject to a Building Over/Close to agreement. The piling design will be subject to review as part of the Building Over/Close to agreement and predevelopment and post development CCTV surveys will be provided to check that piling works will not affect the structural integrity of the public sewer asset. Piling will be designed in accordance with the requirements of Thames Water; firstly, as driven piles will not be proposed within 10m of an existing sewer asset; and secondly, as piles that are proposed to be installed closer than 10m from an existing sewer asset will be drilled/augered and the outside face of the piles will be offset at least 1.5m from outside face of the sewer asset.

Other Details

- 12.3.22 In addition to the above, consideration has been given to other relevant details now available, including the Site Specific Remediation Strategies (SSRS) (refer to **Appendix 15.2** and **Chapter 15: Ground Conditions** for further details). A shading study of the River Brent has also been reviewed with regard to the detailed design of the roads and bridges and the potential impacts on the watercourse (included at **Appendix 17B.2: River Brent Shading Study**).
- 12.3.23 Further consideration of the above matters have been given within this Chapter to the detailed design brought forward via the Phase 1A (North) RMAs and whether this has an effect upon the conclusions of the s.73 ES.

Consenting Process

- 12.3.24 Works within 8m of the banks of the River Brent require Flood Defence Consent (FDC) under The Water Resources Act 1991^v. This requirement is separate from the planning process. All of the proposed realignment works and bridges will require FDC from the Environment Agency (River Brent) and LBB (Clitterhouse Stream). Consent applications will be submitted to the Environment Agency in mid-2015, following completion of the detailed design. Works on the river cannot commence until approval has been granted.

12.4 Assessment Methodology

- 12.4.1 There have been no significant changes to planning policy, legislation or guidance which materially affect the approach to the water resources and flood risk assessment presented in s.73 ES.
- 12.4.2 The methodology and significance criteria presented in the s.73 ES Water Resources and Flood Risk Chapter therefore remain valid.
- 12.4.3 Following a review of the major roads section based on the Design Manual for Roads and Bridges (DMRB)^{vi} the methodology and significance criteria which applies specifically to this section has been further developed in respect of highways.

Significance Criteria for Highways

- 12.4.4 The same process is followed whereby a level of importance (very high to low) is assigned to the water resource receptors based on a combination of attributes and on receptors to flood risk based on the vulnerability of the receptor to flooding.
- 12.4.5 The magnitude of the impact/change using the assessor's knowledge of the proposed development is then assigned to each receptor.
- 12.4.6 Comparison of the importance of the resource and magnitude of the impact (for both potential and residual) results is then made based on an assessment of the overall potential effect on the water resource or flood risk receptor (**Table 12.1**). Each identified effect (both potential and residual) will be classed as major, moderate, minor or negligible and beneficial or adverse.

Table 12.1 Classification of Effects

Magnitude of Potential Impact	Importance of the Resource			
	Very High	High	Medium	Low
High	Major	Major	Moderate	Minor
Medium	Major	Moderate	Minor	Negligible
Low	Moderate	Minor	Negligible	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

12.4.7 Overall it is not considered that the above classification effects gives rise to any likely significant effects which have not already been identified and assessed in the s.73 ES.

Further Studies

12.4.8 Further studies are being undertaken to inform the Environment Agency FDC consenting process and although these are not available within the current RMA submission, it is expected that the following reports will be submitted to the Environment Agency and LBB in June 2015:

- **Updated Flood Risk Assessment (FRA)** – an FRA was prepared and submitted as part of the s.73 ES as Document BXC 16. This document is provided at **Appendix 12.1** for ease of reference although remains unchanged from the version which accompanied the s.73 Application. The FRA will be updated to take into account the final design of the river realignment and the latest hydraulic modelling. This report will also satisfy Planning Condition 45.4 of the 2014 Permission;
- **Geomorphological Assessment** – this report will update a ‘River Naturalisation Preliminary Design’ technical note already provided to the Environment Agency and will be completed alongside the detailed design. It will demonstrate that the River Brent realignment is sustainable. This report will satisfy Planning condition 44.4 of the 2014 Permission;
- **Welsh Harp Reservoir Impact Assessment** – this report will update surface and groundwater quality datasets, establish the baseline environmental conditions in the Welsh Harp Reservoir and provide a water quality impact assessment for the Welsh Harp Reservoir. Any mitigation measures that are needed to ensure the reservoir environment is not adversely affected by the construction or proposed Scheme will be incorporated into the report. This report will satisfy Planning Condition 44.6 of the 2014 Permission;
- **Updated Water Framework Directive (WFD) Assessment** – a WFD Assessment was presented as part of the s.73 ES as Appendix D for the FRA (BXC 16). This document is provided at **Appendix 12.1** for ease of reference although remains unchanged from the version which accompanied the s.73 Application. The WFD Assessment will be updated to take into account the final design of the river realignment, the latest hydraulic design and surface water and groundwater monitoring data. This report will satisfy planning condition 44.10 of the 2014 Permission;
- **Controlled Waters Risk Assessment** – a controlled water risk assessment will be appended to the Site Specific Remediation Strategy and as part of the Code for Construction Practice (CoCP), which is to be completed during the detailed design stage. This report will satisfy planning condition 44.2; and,

- **Clitterhouse Playing Fields Drainage Study** – this study will look the proposed drainage strategy at the Clitterhouse Playing Fields to ensure that runoff rates are not increased above existing rates. This study will be completed in early 2015.
- **Thames Water Network Impact Assessment** – this assessment will examine the hydraulic performance of the existing adopted sewer network in order to establish any potential impacts caused by additional foul and surface water flows generated by Phase 1 of the Development (all sub-phases of Phase 1) and the Development as a whole. The assessment will also identify mitigation measures that are required to ensure that the risk of sewer flooding and the frequency at which Combined Sewer Overflows operate is not increased. Thames Water has completed a Network Impact Assessment for Phase 1, which is included within **Appendix 12.4** and identifies the potential effects and mitigation measures that are described in Section 12.7. Thames Water is currently completing the Network Impact Assessment for the Full Site (i.e. the Development) and the conclusions of the assessment are likely to be published during 2015.

Limitations/Constraints

12.4.9 As set out above, a number of studies are not available for inclusion within this Report due to the detailed design and FDC process programme running behind the RMA. These reports are expected to be completed and submitted for approval to the Environment Agency and LBB in June 2015. The focus of the studies to be submitted will be continual water quality monitoring of the surface water and groundwater and updated hydraulic modelling. The Environment Agency already undertakes samples from these waterbodies and additional samples have been collected as part of one-off studies. Overall, it is deemed that the aforementioned studies will not give rise to likely significant effects which have not already been identified and assessed in the s.73 ES. The studies being undertaken will deal with more detailed matters and provide more detailed data.

12.5 Consultation

12.5.1 LBB provided a Scoping Opinion in December 2014 (**Appendix 4.2**) which contained the following comments on the proposed scope and approach to the Water Resources and Flood Risk Chapter of this ES Further Information Report:-

- Previous ES findings should be reviewed and updated in light of the detailed designs and further studies on drainage and water resources that have been carried out;
- Given uncertainty regarding the SAB framework (pending Defra comment) it is recommended that project partners agree on ownership and maintenance protocols for SuDS practice to ensure that developers have certainty and confidence for implementing SuDS to the greatest possible extent;
- The ES (should read ES Further Information Report) should be expanded to consider the developments demand for water supply, sewage treatment and surface water drainage requirements and whether the demand can be met; and
- The piling methodology should be considered to determine whether it will affect neighbouring utility services.

- 12.5.2 Responses to these points are provided in **Table 4.1** of this Report and addressed within this Chapter where appropriate.
- 12.5.3 The Environment Agency, Thames Water, Highways Agency, Transport for London and LBB have been engaged in discussions throughout the development of the detailed design process to ensure the proposals meet with their environmental and policy standards and requirements. These consultations have indicated that separate surface water drainage systems are required to enable opportunities for SuDS to be maximised, as described below:-
- Surface water runoff from new development plots may be discharged to existing adopted surface water sewers, providing that SuDS are provided on plot to improve the quality of runoff and to restrict peak discharge rates to the permissible rates defined within the Thames Water Network Impact Assessment (Refer to **Appendix 12.4**);
 - New highway drainage systems should be provided wherever possible to intercept, attenuate and improve the quality of surface water from extended or new highways, before it is discharged to an existing watercourse, such as the River Brent or Clitterhouse Stream. Separate highway drainage systems should be provided for each Highway Authority, which will not discharge to one another, in order to ensure that maintenance responsibilities are clearly defined.

12.6 Baseline Conditions

- 12.6.1 The baseline conditions have been reviewed to determine whether there have been any significant changes since the s.73 ES was prepared. This review included baseline information available since the s.73 ES was prepared such as the Site Specific Remediation Strategies, as they include additional groundwater quality data obtained as part of ground investigation in 2014 and further information on the developing construction strategy (refer to **Chapter 15: Ground Conditions** and **Appendix 15.2** for further details). Other baseline information presented in the s.73 ES is considered to remain valid unless otherwise stated. The results of the baseline review are presented below.

Surface Water Quality and Sensitivity

- 12.6.2 No further surface water monitoring has been undertaken since the s.73 submission, therefore there is no change in the baseline water quality or sensitivity previously identified.

Groundwater

- 12.6.3 The Site Specific Remediation Strategies (**Appendix 15.2**) present the groundwater sample results taken during borehole drilling in ground investigation work in 2014. The groundwater samples from across the Site indicate the presence of elevated levels of Copper, Nickel and Zinc, Poly Aromatic Hydrocarbons (PAHs) and Total Petroleum Hydrocarbons (TPHs) within the shallow groundwater. This contamination has been reported in previous monitoring results and potential impacts and mitigation measures considered. Therefore, there is no change in the water quality or sensitivity identified within the s.73 ES.

Flooding and Flood Risk

- 12.6.4 The main sources of flooding to the Site are from the River Brent and the Clitterhouse Stream. Both of these watercourses were modelled post-realignment and the results presented in the s.73 FRA. Post re-alignment, the Site could be considered as Flood Zone 1, as all flow can be contained by the proposed channel, up to and including the 1 in 100 year flood, inclusive of climate change. There have therefore been no changes to the baseline hydraulic model since the s.73 FRA.

Summary

- 12.6.5 In summary, there have been no significant changes to the water environment within the study area since the s.73 Application. There have been no changes to the baseline data made available on the Environment Agency website^{vii}. Additional groundwater samples taken as a result of the borehole drilling do not change the conclusions previously presented in the s.73 ES. No further surface water monitoring has been undertaken since the s.73 ES. Continuous monthly water quality and level monitoring along the River Brent for surface water and groundwater receptors commenced in October 2014 and the results from this will be included within the detailed design reports to be published in 2015.

12.7 Assessment and Mitigation

Construction

Potential Impacts

- 12.7.1 The Indicative Construction Programme (ICP) and the Construction Impact Assessment (CIA) Addendum which accompanied the s.73 Application and formed the basis of the assessment of construction impacts remain unchanged (taking into account Planning Condition 4.2 of the 2014 Permission). Consideration is given below to whether the construction assessment of short term impacts activities presented within the s.73 ES remains valid.

Pollution and Spill Risk

- 12.7.2 Pollution and spill risk impacts identified within the s.73 ES remain valid, as the additional design details associated with Phase 1A (North) do not present any significant new risks. This applies also to the Temporary Bus Station and Bus Stops, as they will be formed on areas of existing car park that are drained by existing surface water drainage systems that incorporate petrol interceptors, which are capable of removing hydrocarbon contaminants.

Watercourse Realignment and Restoration Works

- 12.7.3 The details of how the phased realignment of the watercourse will be conducted, particularly with regard to construction of the new channel and removal of the existing channel, will be progressed during detailed design. The detailed design reports will be submitted to the Environment Agency and LBB for approval in June 2015.

- 12.7.4 The Site Specific Remediation Strategies (**Appendix 15.2**) indicate that the new channel excavation is likely to be constructed by over digging the channel and then backfilling to create a trapezoidal shape. Part of the existing river channel, in particular Reach 2, will require infilling. As a result there is the potential to reuse on-site fill for these areas.
- 12.7.5 The s.73 ES stated that “*With regard to the mobilisation of contamination, in addition to impacts associated with channel excavation, the potential risks highlighted in terms of the presence of polluted groundwaters and sediments will be addressed*”. This will be addressed through a Controlled Water Risk Assessment which will be appended to final Remediation Strategies (to be submitted in 2015 to discharge pre-commencement condition 31.2) and as part of the Code of Construction Plan (CoCP), which be completed during the detailed design stage. In order to reduce the risks of water degradation and the surrounding habitats, the new channel will need to be isolated from contaminated groundwater and soils. Current options being considered to protect the watercourse during construction include permanent driven sheet pile walls to cut off groundwater or continuous dewatering during excavations. Quantities of contaminated soil removed will also be minimised. To further protect the watercourse the proposed design of the realigned river incorporates L-shaped cut-off walls and an impermeable lining on the river bed, therefore contaminated groundwater will be separated from the river channel (refer to **Chapter 15: Ground Conditions** and **Appendix 15.2: Site Specific Remediation Strategies** for further details).
- 12.7.6 The outcome of this work does not change the conclusions or impacts presented in the s.73 ES, as the above impacts were previously identified and mitigation measures proposed.

Flooding

- 12.7.7 The s.73 ES assessment and findings with regard to flood risk remains valid as there has been no change in the baseline data available and no significant update to the hydraulic model.

Emergency and Unforeseen Events

- 12.7.8 The emergency and unforeseen events identified in the s.73 ES remain valid as there have been no new significant impacts identified as a result of the detailed design of the Phase 1A (North) RMAs and Temporary Bus Station and Bus Stops.
- 12.7.9 Following a review of legislation, policy and guidance, baseline and the developing Phase 1A (North) detailed design, it can be confirmed that the potential construction impacts on water resources and flood risk impacts presented in the s.73 ES Water Resources and Flood Risk Chapter remain valid.

Mitigation

- 12.7.10 No other new or different construction mitigation measures beyond those identified in the s73 ES have been identified as a result of the detailed design of Phase 1A (North) of the Development.

Residual Impacts

- 12.7.11 The residual impacts of construction remain as identified in Table 12.5 of s.73 ES and no new or different residual construction impacts have been identified as a result of the detailed design of the Phase 1A (North) RMAs, including the Temporary Bus Station and Bus Stops.

Operation

Potential Impacts

Pollution and Spill Risk from Highways

- 12.7.12 Surface water runoff from extended highways and new roads will be intercepted, attenuated and treated by a new highway drainage network, before it is discharged to the River Brent or Clitterhouse Stream, as described above.
- 12.7.13 An assessment of the potential ecological impacts of routine highway runoff on surface waters has been undertaken using the Highways Agency Water Risk Assessment Tool (HAWRAT) to determine whether there is an environmental risk and if pollution mitigation measures are required. Extracts from the assessment are included within **Appendix 12.3**.
- 12.7.14 The results of this assessment indicate that soluble pollutants associated with acute pollution impacts expressed as Even Mean Concentrations (EMCs) for dissolved copper and zinc in the runoff and in the River Brent are within acceptable limits. However, there is potential for sediment bound pollutants to accumulate at downstream structures or to affect the Brent Reservoir SSSI if a traditional highway drainage system is provided with no pollution prevention features.
- 12.7.15 A cascading system of Sustainable Drainage Systems is therefore proposed to be incorporated within the highway drainage network to intercept sediment, remove contaminants and to enable peak discharge rates to be attenuated. Attenuation storage is proposed either in the form of detention basins within landscaped areas of the Site, which are located within or adjacent to the M1/A406 and the eastern and western roundabout, or in the form of oversized pipes within areas of the Site that are densely developed. Proposed pollution control features include catchpits to intercept sediment at source and proprietary separators and filtration systems (such as First Defence Vortex Separators and Up-Flo filters) in advance of outfalls to open water storage features or to the River Brent.
- 12.7.16 Spillage containment facilities will also be provided at the strategic junctions in order to prevent contaminated runoff from a major accidental spillage from reaching the River Brent or Clitterhouse Stream. These features are likely to be formed using offline storage tanks that are situated upstream of an isolation valve to enable contaminated runoff to be contained within the highway drainage network, upstream of open storage features and the receiving watercourse.
- 12.7.17 There are therefore no changes to the likely permanent pollution and spill risk impacts reported in the s.73 ES as a result of the detailed design of Phase 1A (North).

Impacts associated with Additional Flows discharged to Public Sewers

- 12.7.18 Surface water drainage for development plots will be designed as per Planning Condition 44.5, “any Sustainable Urban Drainage System to be submitted for approval in accordance with Condition 1.27 in relation to each Phase or Sub-Phase shall be integral to the site and ensures a commitment to 25% reduction in surface runoff of current 1 in 100 year flow plus 30% for climate change through incorporation of SUDS features, such as Green and Brown Roofs, detention basins, gravelled areas, swales, permeable paving and pipe storage. It must be demonstrated that SuDS have been maximised across the site, with justification provided if targets set in the London Plan cannot be met.

The system must treat water pollution in line with Section C of Defra's National Standards for Sustainable Drainage Systems with regard to specific hazards and receptor."

- 12.7.19 The land that will be occupied by Plots 53 and 54 and Claremont Park was formerly open space and sustainable drainage systems are proposed in the form of porous paving overlying storage cells to allow peak runoff rates from each plot to be restricted to the minimum practical rate of 5 l/s. The detailed drainage design for these plots therefore takes into account all relevant legislation and guidance and the 2014 Sustainable Design and Construction SPG^{viii}.
- 12.7.20 Surface runoff new paved areas and pitches situated within the Clitterhouse Playing Fields and Claremont Park will be attenuated within Sustainable Drainage Systems to ensure that the peak rate of discharge to the Clitterhouse Stream and existing surface water drainage network will not be increased.
- 12.7.21 Foul water and attenuated surface water generated by Phase 1 of the Development will be discharged to existing public sewers that extend through the Site, which will be diverted along new roads to ensure that easements are maintained when new buildings or structures are constructed as part of subsequent phases of the development. Thames Water has undertaken a Network Impact Assessment for the first phase of Development (rather than Phase 1A (North) in isolation), which establishes potential impacts caused by the cumulative effect of foul and surface water flows (Refer to **Appendix 12.4**).
- 12.7.22 The Phase 1 Network Impact Assessment indicates that the additional foul flows from the Phase 1 development have potential to increase the spill volume during the 1 in 5 year return period design event at two of the CSOs on the downstream network, notably Abbeydale Road CSO (519128 183492) and Cricklewood Broadway CSO (523407 186309).
- 12.7.23 The Phase 1 Network Impact Assessment also indicates that the additional surface water flows generated by Phase 1 of the Development have potential to generate the following potential impacts if Sustainable Drainage Systems are provided on development plots to restrict the peak runoff to 75% of the unrestricted discharge:-
- A potential increase in top water level and flooding volume in the area near the Railway Depot, as the surface water sewer that will receive flow from Plots 46 and 82 is predicted to experience an increase in top water level in the region of 500mm. Consequently, the available freeboard within this sewer is reduced significantly. Three manholes on the surface water network, which are situated immediately upstream of the railway line crossing, are predicted to have a significant increase in predicted flooding during the 1 in 20 year return period event if mitigation measures are not provided.
 - Marginal increase in risk of surface water flooding at two manholes in the vicinity of Grampian Gardens.
- 12.7.24 Thames Water has identified the following indicative network improvement options to mitigate potential impacts within the existing public foul sewer network:-
- Provision of a flow control within manhole TQ20869506, which is located to the rear of No 146 Braemar Avenue, to utilise available storage within the existing sewer and limit the peak pass forward flow to avoid an increase in spill volume at the Abbeydale Road Combined Sewer Overflow;

- Provision of a high level spill weir within manhole TQ20869506 to prevent a detrimental increase in the upstream top water level;
- Provision of a flow control within manhole TQ22868903, which is located in the footpath adjacent to the Wing VIP building on Edgware Road, to utilise available storage within the existing sewer and limit the peak pass forward flow to avoid an increase in spill volume at the Cricklewood Broadway Combined Sewer Overflow.

12.7.25 Thames Water has identified the following indicative network improvement options to mitigate potential impacts within the existing public surface water sewer network:-

- Provide Sustainable Drainage Systems to restrict surface water runoff from Plots 46 (Claremont Primary School) and 82 (Park Depot) to 40% of the unrestricted peak discharge;
- Provide Sustainable Drainage Systems to restrict surface water runoff from Plots 53 and 54 on Brent Terrace to 5l/s;
- Provide Sustainable Drainage Systems to restrict surface water runoff from all other development plots in Phase 1 to 75% of the unrestricted peak discharge;
- Provide large diameter manholes on the surface water network at two locations in Grampian Gardens to provide approximately 2 cubic metres of additional network storage.

12.7.26 These network improvements are intended to ensure that existing water quality impacts are not worsened in order to reduce the Development impact to **negligible**.

12.7.27 Thames Water are also undertaking a Network Impact Assessment for the whole Site, which will identify the extent of network improvements that are required to enable the existing public foul and surface water sewers to accommodate the foul and surface water discharge from the entire Development.

Modifications to Existing Abstractions and Discharges

12.7.28 The Phase 1A (North) RMAs include no changes of relevance to this assessment therefore the s.73 ES remains valid.

Watercourse Realignment and Restoration Works

Assessment of Realigned Reaches of the River Brent

12.7.29 Overall, taking into the detailed design of the three Reaches, the river realignment and the restoration works will result in a moderate significant, positive impact. This conclusion remains the same as that of the s.73 ES.

Solar Shading

12.7.30 Potential shading impacts of the 2014 Permission on the River Brent were identified as minor adverse in the s.73 ES. A shading study has been undertaken using computer modelling to identify and assess the potential shading impacts of the roads and bridges on the River Brent. A copy of the full report can be found at **Appendix 17B.2**. The findings of this report are that the watercourse will experience shaded areas (areas which receive less than 2 hours of sunlight) where the bridges cross over the river. The conclusions of this report do not alter those presented in the s.73 ES which were that no significant adverse impacts are expected to occur.

Flooding

Localised Flooding

- 12.7.31 The detailed design of the Phase 1A (North) RMAs has no material impact on the potential for localised flooding. Overall the s.73 FRA concluded that with the new channel in place, there was no significant flood risk impact upon the surrounding areas upstream or downstream.
- 12.7.32 The hydraulic model runs undertaken to inform the detailed design development for the proposed realignment showed that there are no out of bank flows along the realignment sections at any return period modelled. The maximum stage water level modelled remains within the river corridor throughout the realignment and there is therefore only a negligible on-site flood risk, i.e. the Site can be considered Flood Zone 1 following the re-alignment works. The modelling indicated that there was a reduction in maximum water levels (m AOD) between the existing and proposed model scenarios at higher return period events along the reach upstream of the realignment. There are some increases in maximum water levels seen at the lower return period events, however, these only constitute increases within the channel, and do not increase the flood risk to upstream adjacent land uses. The Environment Agency was consulted on these levels during preparation of the s.73 FRA. The resultant flood extents, depths and hazard classifications onto the A406 North Circular Road upstream of the Site during the larger events are reduced. Downstream of the river realignment data extracted from the model results shows that the maximum water levels observed at this location are almost identical in both the existing and proposed channel alignments.
- 12.7.33 The additional channel storage provision along the reaches to the east and west of the re-alignment was shown to result in a decrease in the flood extents and depths of flooding upon the A406 (North Circular). The proposed channel therefore provides overall betterment both on and off Site in terms of flood risk.
- 12.7.34 Further detailed hydraulic modelling will be carried out and will be included as part of the Updated to be issued in June 2015 as part of the FDC process. Overall, the likely significant impacts identified in the s.73 FRA and s.73 ES will remain valid as the basic design parameters of the realignment remain the same. Both documents are therefore considered to remain valid for the purposes of granting of the Phase 1A (North) RMAs.
- 12.7.35 The River Brent crossings were designed to incorporate a soffit level clear span and elevated a minimum of 600mm above the 1 in 100 year flood level, including climate change. The s.73 ES stated *“providing that the bridges are constructed in accordance with the parameters set out in Section 4 of the DSF, no impacts to flooding are anticipated.”* All detailed bridge designs comply with this requirement; as such no impacts to flooding are anticipated and therefore the conclusions and assessment of impacts of the s.73 ES do not change.

Ground Level Alterations

- 12.7.36 The detailed design of the Phase 1A (North) RMAs will include ground level alterations in some locations. In some cases there have been variations from those presented in the 2014 Permission, as detailed in **Chapter 24**. The s.73 FRA reported that changes in site levels will not have a detrimental impact on the Site or to third parties and the impact is therefore **negligible**. Following a detailed review of the proposed site levels including Clitterhouse Playing Fields (see **Figure 13.1**) and the impact of level changes are considered to be consistent with the s.73 ES, i.e. negligible.

Water Resource Use

12.7.37 The impacts on water resource use remain unchanged by the Phase 1A (North) RMAs details and no further relevant information is available. The connections and demand of Plots 53 and 54 do not alter the findings of the s.73 ES.

Water Framework Directive Assessment

12.7.38 A WFD Assessment was included as part of the s.73 FRA (BXC 16). This report is included at **Appendix 12.1** for reference but will be updated to take account of the detailed design and hydraulic modelling of the realigned watercourse, as required by the Environment Agency. The report will be submitted to the Environment Agency and LBB in June 2015. The findings of this report will remain in line with the conclusions already presented in the s.73 ES.

12.7.39 Overall, following a review of legislation, policy and guidance, baseline and the developing Phase 1A (North) detailed design, it can be confirmed that the assessment of potential operational impacts presented in the s.73 ES Water Resources and Flood Risk Chapter remains valid. This is because there have been no significant changes to legislation, policy and guidance or to the baseline since the s.73 ES was prepared; and the results of the further assessment of water resources and flood risk undertaken in relation to the Phase 1A (North) detailed design accord with the assumptions of the assessment undertaken at outline stage and presented in the s.73 ES. Further studies are ongoing, but are not expected to identify any significant environmental impacts beyond those previously identified in the s.73 ES or s.73 FRA.

Mitigation

12.7.40 No new or different mitigation measures beyond those identified in the s.73 ES have been identified as a result of the detailed design development. Further details of the design will be subject to approval by the Environment Agency as part of the FDC process.

Residual Impacts

12.7.41 The residual impacts of the operational Development with Phase 1A (North) in place remain as identified in Table 12.5 of s.73 ES and no new or different residual impacts have been identified as a result of the detailed design of the Phase 1A (North) RMAs or changes in baseline conditions.

12.8 Summary

12.8.1 No new or different potential impacts, mitigation or residual impacts arising from the Development have been identified in respect of Water Resources and Flood Risk, and all of these remain as identified and assessed in the s.73 ES.

References

- ⁱ Communities and Local Government, (2014); 'National Planning Practice Guidance'
- ⁱⁱ Department for Communities and Local Government (DCLG) (2012); National Planning Policy Framework, Communities and Local Government Publications
- ⁱⁱⁱ Greater London Authority (2014); 'Draft Further Alterations to the London Plan'
- ^{iv} Greater London Authority, (2014); 'Supplementary Planning Guidance – Sustainable Design and Construction'
- ^v HMSO, (1991); 'The Water Resources Act'
- ^{vi} The Highways Authority (2009) Design Manual for Roads and Bridges, Road Drainage and the Water Environment, Volume 11, Section 3, Part 10, HD 45/09
- ^{vii} Environment Agency Website
- ^{viii} Greater London Authority, (2014); 'Supplementary Planning Guidance – Sustainable Design and Construction'