Isle of Dogs and South Poplar Integrated Water Management Plan

Main Report

Greater London Authority

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Quality Information

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01 EXECUTIVE SUMMARY

1.1 Introduction

The scale of growth planned for the Isle of Dogs and South Poplar to 2041 poses a significant challenge for the delivery of water services infrastructure in the area. Much of the existing infrastructure is close to, or already at capacity; and flood risk and water quality are key concerns in many parts of the area.

A targeted approach to water infrastructure provision is required in order to ensure the water services needs of the area can continue to be met, and to reduce the scale of investment required to provide new infrastructure. The Isle of Dogs and South Poplar Integrated Water Management Plan (IWMP) provides this targeted approach, setting out a framework for how water services infrastructure provision should be considered differently in order to reduce impacts on existing infrastructure.

The IWMP recommends water infrastructure measures which make better use of available water and which integrate the existing water environment, water supply needs, wastewater disposal and flood risk management using sustainable solutions. This approach supports the aims of Good Growth[1] and the creation of sustainable communities and demonstrates how the requirements of key water and flood risk policies within the Tower Hamlets Local Plan and the wider London Plan can be met.

1.2 Study Drivers

The measures proposed in the IWMP have been developed from an understanding of the local constraints and opportunities, as well as the following four key drivers identified in local, London-wide and national policies and strategies:

- **Increasing resilience** through provision of reliable water services and reducing the impact of flooding.
- Supporting the delivery of **Net Gain and Urban Greening** through making space for water.
- Providing **sustainable drainage** to minimise and reduce flood risk and improve water quality.
- **Protecting and enhancing the water environment**.

1.3 Study Area Definition and Constraints

Based on a mixture of planning zones and identified infrastructure constraints, the IWMP divides the study area into six IWMP Zones as detailed in Table 1-1 and Figure 1-1. These Zones have been used to identify water solutions and form the IWMP.

Table 1-1 IWMP Zone Names

IWMP Zone Reference	IWMP Zone Name
Zone 1	South Poplar
Zone 2	Canary Wharf
Zone 3/4	South Quay and Crossharbour
Zone 5	Island Gardens
Zone 6A	Core Area Action Plan (AAP) Area
Zone 6B	Wider Area Action Plan (AAP) Area

[1] Good Growth by design is the London Mayor's plan to create a city that works for all Londoners. https://www.london.gov.uk/what-we-do/regeneration/advice-and-guidance/about-good-growth-design

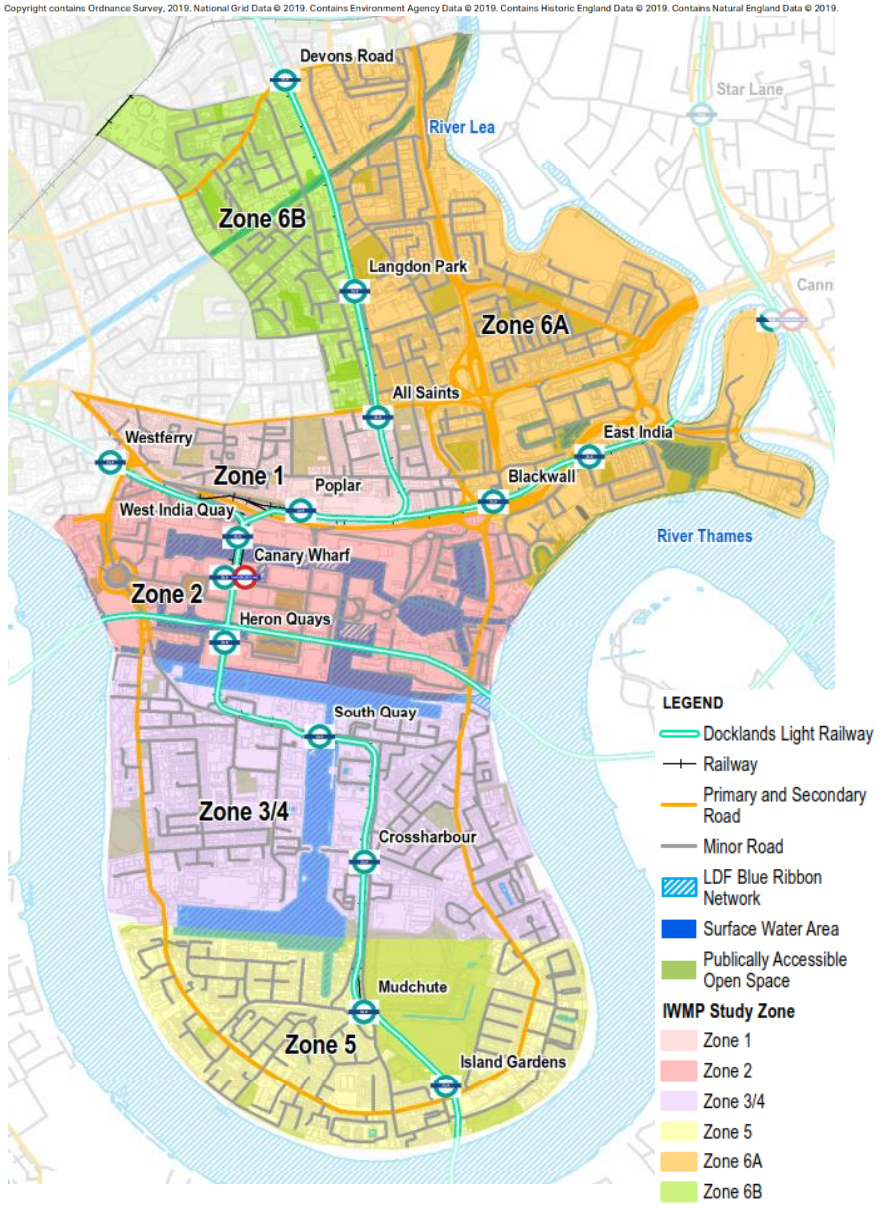


Figure 1-1 Zones for the IWMP (Appendix A Figure 2)

Water balance calculations were undertaken for the study area and within each Zone, and demonstrate that by 2041, demand for potable water in the study area will increase by 55% if specific new measures are not adopted. Wastewater flows to sewer will also increase by a similar amount if measures are not implemented to offset the impact through reductions in surface water volumes entering the sewer system.

The IWMP outlines several key constraints in the study area:

- **Constrained sewers:** sewer networks receiving both surface water from rainfall and wastewater from property are severely constrained in key locations. There is an increased risk of sewer flooding in all zones (particularly Island Gardens and South Poplar).
- **Lack of water resources:** Across London, the difference between total demand for water and available water by 2044 will increase to over 360 million litres a day if new supply solutions and water efficiency are not delivered.
- **Limited supply capacity:** Water supply networks to the study area are constrained and will need provision of significant sized water mains in order to meet future demand for potable water. This need for investment can be reduced by increasing water efficiency and minimising use of potable water for non-potable uses.

Significant opportunity is also identified in the study area:

- There are several **key waterbodies** accessible in the majority of Zones providing opportunities to remove surface water from the constrained sewer system and provide a means for water to be stored and reused.
- In the South Poplar, South Quay and Crossharbour, and Canary Wharf Zones, the mix of development affords **opportunity for water to be re-used** between residential and commercial property.
- Much of the proposed development will be located in high density developments in close proximity to one another, affording **opportunity for shared infrastructure** such as separated surface water systems and community-based re-use schemes.

1.4 Solutions and Recommendations

Based on the identified constraints and water balance issues, several measures and approaches were developed.

To guide developers and stakeholders in the adoption of measures proposed, a hierarchy of IWMP requirements has been developed. These have been shaped by local constraints, study drivers and the policies associated with them. A developer checklist has been produced based on the hierarchy (Appendix E).

Hierarchy of IWMP requirements	
1) Minimise residential water demand through best practice fixtures and fittings and achieve BREEAM excellent for commercial property. 2) Reuse water within development (greywater or rainwater) to meet minimum water use target set for the study area.	**First Consideration:** Demand reduction (both required)
3) Attenuate rainwater in green infrastructure prior to discharge (for example green roofs, swales, etc). 4) Use integrated sustainable drainage to meet Urban Greening Factor (UGF) policy requirements. 5) Discharge to ground where possible. 6) Discharge surface water to the docks, River Lea or River Thames.	**Second Consideration:** Green Infrastructure (both preferred)
7) Discharge surface water to surface water sewer at greenfield runoff rate (via attenuation). 8) Discharge surface water to combined sewer at greenfield runoff rate (via attenuation).	**Hierarchy for surface water discharge** (select most feasible option near top of list)

Several measures are not specific to any given location and have been recommended at a study wide level. These measures are detailed in Table 1-2.

Assessments within each Zone were also completed identifying location specific measures which should be adopted and taken forward. These are detailed in Table 1-3 and Figure 1-2 (Appendix A Figure 11).

Study wide and Zone-specific measures have been prioritised as follows:

- High Priority: would have the greatest benefit for some of the biggest constraints and have a clearer delivery mechanism.
- Medium Priority: options which will have significant benefit on their own but are likely to require multi-stakeholder involvement to deliver.
- Low Priority: options with long lead in times, uncertain delivery mechanisms and/or would need to form a suite of measures to address a constraint.
- Quick wins: measures which are relatively straightforward and quick to implement.

If adopted, the measures would greatly reduce the demand for new potable water, reducing the scale of upgrades required in the water supply infrastructure system and contributing significantly to securing London's water supply.

Pressure on the existing combined sewer would be drastically reduced through a significant lowering of the rate of discharge and removal of large volumes of surface water from the system which are currently limiting the capacity of the sewer system. This would subsequently allow the sewer system to be able to receive and manage the significant increase in foul water discharges which planned development will generate, without increasing the risk of sewer flooding in Critical Drainage Areas[2] and reducing the need for combined sewer system upgrades.

The mix of proposed measures would also facilitate the provision of multi-functional spaces, where water becomes a key part of the urban landscape and supports an increase in urban greening.

To ensure the measures are taken forward as appropriate, an IWMP Working Group of key stakeholders should be convened to deliver the next steps set out in the IWMP. This includes a series of supporting studies and policy development which will facilitate delivery of the priority measures.

[2] Areas of surface water and sewer flood risk as defined in LBTH Surface Water Management Plan.

Table 1-2 Prioritised study-wide measures and approaches

Measure/Approach	Rationale	Priority	Priority Justification
Develop a demand offset policy	A study-wide demand target of a maximum consumption of 90 litres per person for all new residential property; where this is not achieved by developers, a section 106 (s106) contribution will need to be paid. Accrued s106 payments would be used to fund water efficiency and re-use retrofit projects in the study area. This will require developers to include water re-use rather than relying solely on efficient fixtures and fittings to deliver water efficiency. The requirement to consider re-use is set out in policy SI13 (B1) and SI (C3) of the London Plan and policy D.ES5 and S.ES1 of the Local Plan.	High	A demand offset mechanism would be implementable by LBTH and could have a significant effect in minimising future demand for potable water.
Develop a greenfield run-off rate offset policy	All development should be required to achieve greenfield run-off rates for discharge of surface water through the provision of either on-site Sustainable Drainage Systems (SuDS) or community SuDS schemes. Where greenfield rates cannot be achieved, a s106 contribution will be paid. Accrued s106 payments would be used to fund retrofit SuDS measures within public realm or other council owned land to reduce overall discharge volumes and rates to the sewer system serving the study area.	High	A runoff offset mechanism would be implementable by LBTH[3] and would have a significant effect in offsetting the impact of additional foul discharge to the combined sewer system serving the study area.
Strategic multi-plot surface water networks in advance of development	In many identified locations, multiple development plots would benefit from separated surface and foul water discharge with the provision of strategic surface water sewers linking new development and discharging to the docks or watercourses. These systems could be developed and adopted by third party providers, supported by a mechanism by which developers contribute to the costs as development comes online.	Medium	Separated systems would facilitate more development connecting to surface water options and significantly reduce pressure on the combined sewer system but would require multi-stakeholder agreements regards funding and ownership.
Combine below ground surface water storage and re-use	Where developers propose the use of below ground storage as attenuation to reduce surface water runoff rates, they should be required to combine it with re-use of the stored water for non-potable uses, or to demonstrate why this is not feasible.	Low	All below ground storage acting to serve non-potable needs would bring benefit as part of a wider suite of re-use solutions.
Strategic dock attenuation	There is potential for the combined dock system to provide strategic attenuation for multiple plots adjacent to the waterbodies, particularly for some of the high density, space constrained development. Some plot-based attenuation via SuDS would be required to manage the quality of discharge, but additional storage could be provided by the docks for this purpose. This could reduce the reliance on pumping into the dock system from the River Thames in order to maintain water levels. Further study is required into the feasibility of this option.	Low	A dock-side attenuation system could bring substantial benefit but would require further detailed study to determine scope including protection of water quality during the summer.
New Appointment or Variation (NAV) advice	NAVs are limited companies which are licenced by the water industry regulator to provide water and wastewater services in an area previously served by an incumbent water company. NAVs can provide water and wastewater services to large plots or a group of plots, providing and managing a range of integrated SuDS, wastewater treatment and re-use for non-potable supply and charging occupiers directly for water and wastewater services; in this way, they provide integrated services which are not often provided by the incumbent monopolised market. Via the Council's infrastructure co-ordinator service, contacts with NAVs should be made available to developers where strategic re-use and integrated surface water management solutions are identified in the IWMP as being feasible.	Quick Win	Advice can be easily incorporated into LBTH's current infrastructure co-ordinator service.

[3] Such a mechanism also has precedent for the Old Kent Road Opportunity Area in London Borough of Southwark.

SuDS and Urban Greening	Further guidance should be provided to developers on how landscaping and water management via SuDS can deliver both urban greening policy requirements and water and flood risk policy requirements. Drainage engineers and landscape architects should be encouraged to jointly develop landscape plans and drainage strategies using the guidance.	Quick Win	An advice document would be relatively simple and quick to produce and would influence and support developers in increasing integrated SuDS uptake.
Dual plumbing	All new development should be encouraged to design for dual plumbing (potable and non-potable pipework systems) in order to provide improved future resilience. Dual plumbing would allow buildings to be connected to sources of re-used water as they are developed or brought on-line within the study area in the future, supporting the development of a market for re-used water.	Quick Win	Encouraging developers to adopt dual plumbing for future resilience would be relatively simple to promote.

Table 1-3 Zone Specific Measures (cross referenced with Figure 1-2 (Appendix A Figure 11))

Zone	Measure	Description	Stakeholders and next steps	Label on Figure 1-2	Priority	Priority Justification
Zone 1: South Poplar	Community based rainwater harvesting along the A1261	Re-use of rainwater captured via commercial and residential units for train washing in the underlying train care depot.	- Developers consider installation of RWH and dual plumbing for non-potable supply. - LBTH to broker agreement between building occupiers and Train Care depot for RWH reuse.	1.1	High	Significant opportunity to develop a viable re-use supply and demand system.
	Surface water discharge to River Thames or North Dock	The development plots along the A1261 can be linked to a joint surface water system with plots in Zone 2 (Canary Wharf) including options to discharge to the docks or the River Thames. Opportunities to combine with linear SuDS based systems following green infrastructure routes.	- Developers contribute to SuDS element of option. - LBTH encourage developer discussions with NAVs to provide solution. - Thames Water consider ownership of surface water sewer and discharge infrastructure.	1.4	High	Significant opportunity to remove surface water from the sewer system with adoption options for piped network via Thames Water.
	Strategic surface water attenuation: Rosefield Gardens and Poplar Recreation Ground	Provision of strategic SuDS serving multiple plots (including potential sites for long-term growth to 2041) through landscaped depressions linked to underground attenuation.	- LBTH to undertake studies to investigate feasibility with parks team/LLFA. - Future developers to collaborate to deliver attenuation and flood management feature with LBTH.	1.2, 1.3	Medium	Relatively straightforward measure to implement, but ownership and scale would depend on growth locations post 2031.
	Gravity fed greywater systems in high rise buildings	Collection and re-use of greywater from higher rise residential blocks for commercial non-potable uses on lower levels.	- Developers consider installation of GWR and dual plumbing for non-potable supply.	1.1	Medium	Opportunity to significantly reduce potable demand but would require investment and cross-plot collaboration by developers and building management teams.
Zone 2: Canary Wharf	Integrated re-use systems – Wood Wharf	Significant mixed-use development providing opportunity for mixture of greywater and/or rainwater collection via residential property and re-used for commercial and other non-residential non-potable uses.	- Developer installs GWR/RWH and dual plumbing for non-potable supply.	2.2	High	Significant opportunity to develop a viable re-use supply and demand system due to single development ownership.
	Surface water outfalls	Most large development plots have a feasible location to discharge attenuated surface water to a water body to reduce discharge volumes to the constrained combined sewer system. This includes outfalls to the River Thames for the large plot to the west; Zone 1 linked sewer systems and an outfall to the North Dock or Thames for development to the north, and to the South Dock or River Thames for Wood Wharf.	- LBTH encourage developer discussions with NAVs to provide solution. - Thames Water consider ownership of surface water sewer and discharge infrastructure if more than one development. - Developers provide individual surface water discharges when adjacent to Dock system in liaison with CRT.	2.1, 2.3	Medium	Significant opportunity to remove surface water from the sewer system however, provision and adoption of the multi-plot system would need to be agreed along with discharge agreement to the dock system with CRT.

Zone	Measure	Description	Stakeholders and next steps	Label on Figure 1-2	Priority	Priority Justification
	Combined surface water attenuation and re-use	High density development is likely to require some underground storage to achieve reduction in runoff rates – significant non-potable demand means such systems should combine attenuation with re-use via dual plumbed buildings as standard.	- Developers ensure tanked attenuation is installed with infrastructure and systems to allow water to be reused. - Developers consider installation of dual plumbing.	2.1, 2.2	Low	All below ground storage acting to serve non-potable needs would bring benefit as part of a wider suite of re-use solutions.
Zone 3/4: South Quay and Crossharbour	Greywater re-use – South Dock and Millwall Inner Dock	Large scale residential and commercial mixed development means greywater re-use systems are more likely to be commercially viable and can be developed with residential greywater feeding non-potable demand for multiple residential and commercial buildings all in proximity.	- Developers consider installation of RWH and dual plumbing for non-potable supply. - LBTH to broker agreement between building occupiers or owner/occupiers for use between buildings. - LBTH encourage developer discussions with NAVs to provide solution.	3.1	Medium	Opportunity to significantly reduce potable demand but would require investment and cross-plot collaboration by developers and building management teams.
	Rainwater harvesting for irrigation – Millharbour Village Park	Development proposed for plots around Millwall Inner Dock should provide rainwater collection and storage for use as irrigation water to the proposed Millharbour Village Park and other landscaped areas.	- Developers install RWH.	3.2	High	Significant opportunity to develop a viable re-use system.
	Surface water discharge to River Thames and Docks	Most large development plots have a feasible location to discharge attenuated surface water to a water body to reduce discharge volumes to the constrained sewer system. This includes outfalls to the River Thames for the plot to the east and all development plots alongside the docks; these could be via multi-plot surface water systems and have the potential for some attenuation to be provided by the dock system.	- LBTH encourage developer discussions with NAVs to provide solution. - Thames Water consider ownership of surface water sewer and discharge infrastructure if more than one development. - Developers provide individual surface water discharges when adjacent to Dock system in liaison with CRT.	3.8, 3.9	Medium	Significant opportunity to remove surface water from the sewer system however, provision and adoption of the multi-plot system would need to be agreed along with discharge agreement to the dock system with CRT.
	Strategic surface water attenuation: John McDougal Gardens, future Millharbour Village Park and St Johns Park	Provision of strategic SuDS serving multiple plots (including potential sites for long-term growth to 2041) through landscaped SuDS features and, in some cases, discharge to the River Thames or docks.	- LBTH to undertake studies to investigate feasibility with parks team/LLFA. - Future developers to collaborate to deliver attenuation and flood management feature with LBTH - Thames Water consider feasibility of owning sewer and discharge infrastructure elements to reduce pressure on combined system.	3.3, 3.5	Medium	Relatively straightforward measure to implement, but ownership and scale would depend on growth locations post 2031.
	Docklands Light Railway (DLR) - SuDS	The DLR corridor is elevated across this zone, and there is potential to disconnect surface water downpipes from the combined sewer system to link to surface water collection (via SuDS), attenuation and discharge systems for proposed major redevelopment plots.	- DLR/Tfl to work with LBTH, CRT and Thames Water to identify opportunities to disconnect DLR drainage and combine with development plots to provide SuDS and alternative surface water discharge location.	-	Low	Good opportunity to provide multi-functional SuDS and reduce sewer discharge volumes as part of a wider suite of measures.

Zone	Measure	Description	Stakeholders and next steps	Label on Figure 1-2	Priority	Priority Justification
Zone 5: Island Gardens	Strategic surface water attenuation: Mudchute Farm, Millwall Park and Island Gardens	Long-term growth locations should make use of significant opportunity within greenspaces within the Zone to provide landscaped SuDS supporting multiple plots, with some locations such as Island Gardens likely to support a discharge to the Thames via SuDS based attenuation.	- LBTH to undertake studies to investigate feasibility with parks team/LLFA. - Future developers to collaborate to deliver attenuation and flood management feature with LBTH. - Thames Water consider feasibility of owning sewer and discharge infrastructure elements to reduce pressure on combined system.	5.2	Medium	Relatively straightforward measure to implement, but ownership and scale would depend on growth locations post 2031.
	Surface Water Discharge	In this Zone there are opportunities to discharge surface water to the River Thames and the Millwall Outer Dock.	- LBTH to work with Thames Water and CRT to identify discharge opportunities. - Thames Water to consider feasibility of providing surface water sewers and outfalls to the docks or Thames.	5.3, 5.4, 5.5	Low	Potential for significant reduction in surface water discharge but may require long lead in time depending on where development comes forward post 2031.
Zone 6A: Core Area AAP	Multi-plot surface water discharge to river systems	Several large development plots are located adjacent to the River Thames and River Lea. Plots north of the A1261 could be linked via a gravity-based strategic surface water system to increase the number of plots which could discharge this way and significantly reduce discharge to the combined sewer.	- Developers contribute to SuDS element of option. - LBTH encourage developer discussions with NAVs to provide solution. - Thames Water consider ownership of surface water sewer and discharge infrastructure.	6A.1, 6A.2, 6A.3, 6A.4	High	Significant opportunity to remove surface water from the sewer system with adoption options for piped network via Thames Water.
	Surface water discharge – east of zone	A large mixed-use development is proposed east of East India Dock Basin – several surface water discharge locations are feasible for this plot, including the Basin, the River Lea and the River Thames.	- Developer to develop outfall solution.	6A.7	High	Significant opportunity to remove surface water from the sewer system with adoption options for piped network via Thames Water.
	Greywater or rainwater re-use – mixed use development	There are several large plots located riverside of the River Lea and River Thames where significant mixed-use development provides opportunity for greywater and/or rainwater collection via residential property, with treatment and re-use for commercial and other non-residential non-potable uses.	- Developers consider installation of RWH/GWR and dual plumbing for non-potable supply. - LBTH to broker agreement between building occupiers or owner/occupiers for use between buildings. - LBTH encourage developer discussions with NAVs to provide solution.	6A.5	Medium	Opportunity to significantly reduce potable demand but would require investment and cross-plot collaboration by developers and building management teams.
Zone 6B: Wider AAP	Integrated re-use systems – north and south of Zone	Large mixed-use plots provide significant opportunity for commercially viable community-based greywater and/or rainwater re-use systems to provide non-potable demand for all building types (if combined with dual plumbing).	- Developers consider installation of RWH/GWR and dual plumbing for non-potable supply. - LBTH to broker agreement between building occupiers or owner/occupiers for use between buildings. - LBTH encourage developer discussions with NAVs to provide solution.	6B.4, 6B.5	Medium	Opportunity to significantly reduce potable demand but would require investment and cross-plot collaboration by developers and building management teams.

Zone	Measure	Description	Stakeholders and next steps	Label on Figure 1-2	Priority	Priority Justification
	Strategic surface water attenuation: Furze Green and Alton Street.	Future long-term development to 2041 which comes forward around Furze Green and Alton Street should consider strategic landscaped SuDS in these open spaces, potentially taking the form of wide and shallow depressions linked to below ground cellular storage for additional attenuation.	- LBTH to undertake studies to investigate feasibility with parks team/LLFA. - Future developers to collaborate to deliver attenuation and flood management feature with LBTH.	6B.1, 6B.2, 6B.3	Medium	Relatively straightforward measure to implement, but ownership and scale would depend on growth locations post 2031.

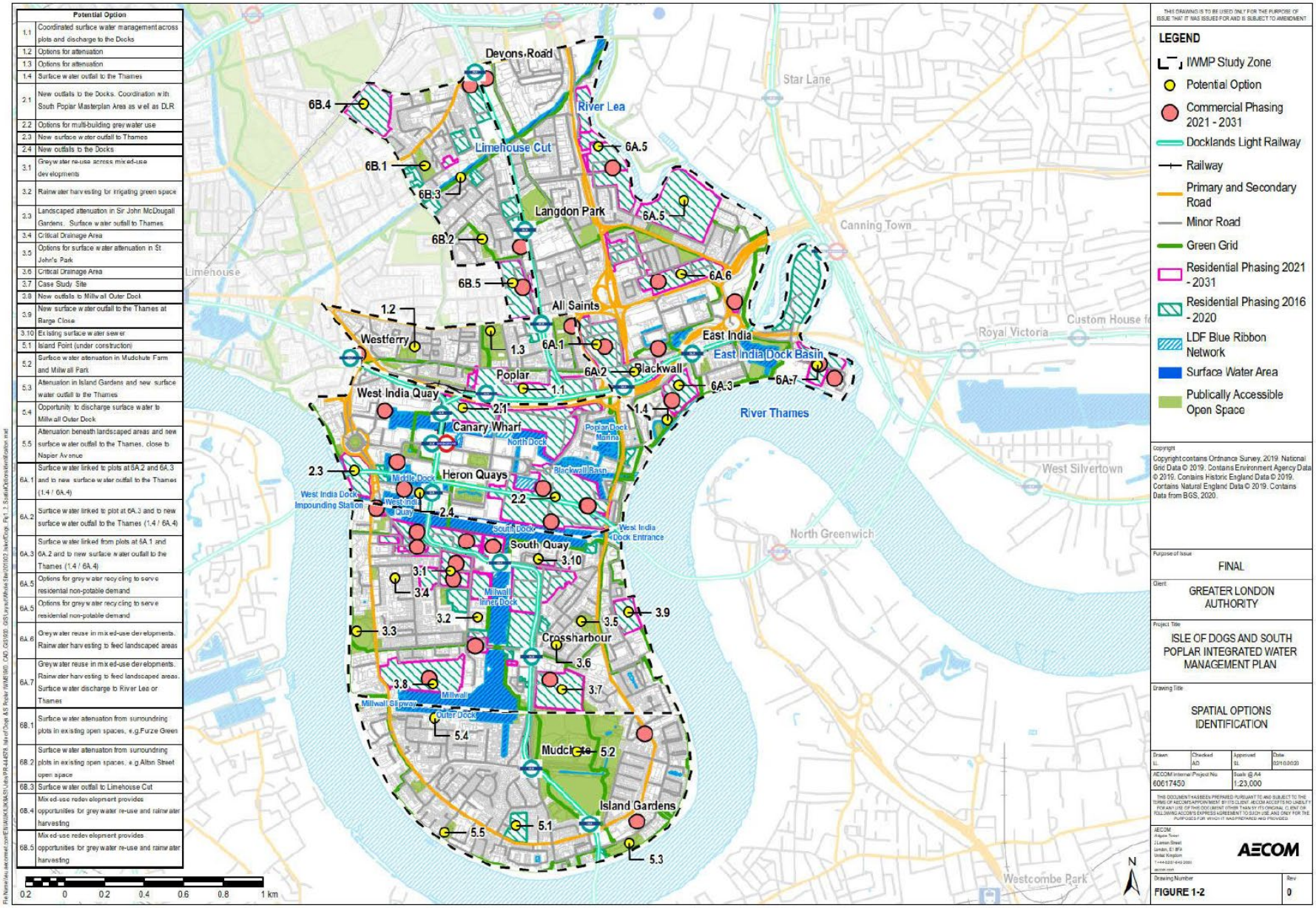


Figure 1-2 Summary of Measures (Appendix A Figure 11)

02 INTRODUCTION

The Isle of Dogs and South Poplar (IoDSP) Opportunity Area has been identified as one of London's primary growth areas with high-density development expected to deliver many of the homes and jobs that London needs.

Unmanaged, this growth will exert pressure on water services infrastructure and the water environment. An Integrated Water Management Plan (IWMP) has been developed to set a clear framework for how water solutions should be delivered in an integrated and sustainable way.

2.1 Objectives

The principle objective of the IWMP is to provide a clear framework for guiding delivery of sustainable water services infrastructure and demonstrate how impacts on the water environment can be managed to support the aims of Good Growth[4] and the creation of sustainable communities.

The IWMP will form a key evidence source for the Integrated Utilities Delivery Plan for the London Borough of Tower Hamlets (LBTH) and acts as a tool to guide developers, planning officers and development control officers to meet and deliver on the development management policies within the Tower Hamlets Local Plan and the wider London Plan in relation to water management.

The Problem

Improvements to wastewater networks (sewers), drainage and potable water supply are required to manage the impact of additional growth and there is a need to ensure that flood risk to the area is managed, and if possible reduced. Additionally, there is need to consider the quality of water features in the area, including the tidal River Thames and the historic docks.

An integrated approach to water management is advocated for Opportunity Areas in London to realise multiple benefits from water management solutions proposed. Considering each element of water management in isolation (for example flood risk, or water supply) often overlooks the potential for cross-cutting solutions that can provide multiple benefits in a more efficient way (refer to Figure 2-1).

The Solution

Taking an integrated approach involves considering how the whole water cycle can be managed locally to be sustainable and to make infrastructure capacity available to accommodate development. This is done by considering how water management solutions can be combined, seeking to make use of water sources considered as waste (excess rainfall, or foul water) as resources to reduce potable demand and abstraction from the natural environment, reduce flood risk and increase capacity in wastewater infrastructure.

The IWMP approach provides a framework of suggested solutions at a strategic level. This strategic approach supports infrastructure providers, such as water companies, in planning for investment and at the same time supports developers in understanding what they need to do to deliver development in the most sustainable way from a water management perspective whilst also adhering to water related planning policy.

The IWMP forms part of the planning and development management policy framework and acts as guidance for planners, developers and infrastructure providers involved in water management provision.

[4] Good Growth by design is the London Mayor's plan to create a city that works for all Londoners. https://www.london.gov.uk/what-we-do/regeneration/advice-and-guidance/about-good-growth-design

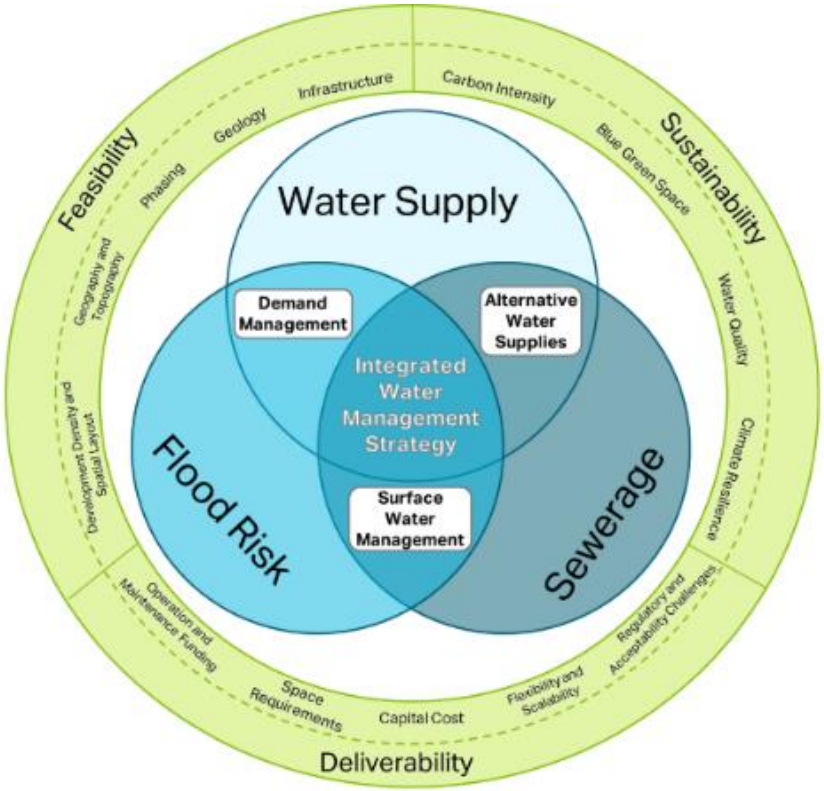


Figure 2-1 Schematic of integrated water management

2.2 Stakeholder Group

The IWMP has been commissioned by the Greater London Authority (GLA) and a Steering Group was established including representatives from GLA; LBTH infrastructure planning and regeneration teams; the Environment Agency; and Thames Water Utilities Ltd (TW).

Meetings were also held with LBTH development management team and South Poplar masterplan team, Canary Wharf Group (CWG), Canal & River Trust (CRT), Transport for London (TfL) and Docklands Light Railway (DLR) throughout the development of the IWMP to support the understanding of the study area and the identification of suitable options.

2.3 Legislative and Policy Context

Study Drivers

This IWMP has been prepared in the context of existing legislation, policy and guidance across a range of instruments creating clear drivers for better, more integrated water management for new development.

Technical Appendix B sets out in detail the main drivers identified alongside each legislative or policy source which is material to that driver. In summary the key drivers identified are:

- **Resilience**: Growing population, climate and land use change creates a clear need to provide resilient water supplies, wastewater services and development resilient to flood impacts.
- **Net Gain and Urban Greening**: Sustainable management of water has a key role to play in contributing to biodiversity net gain, improvement in flood risk (flood management net gain) and supporting London Plan policy requirements on urban greening by making space for water, and integrating it into development
- **Sustainable drainage**: development must be designed to manage and reduce surface water flood risk whilst maximising opportunity for wider benefits.
- **Protect and Enhance the Water Environment**: development must support protection of the water environment in order to provide natural resilience, thereby allowing the natural environment to continue to clean drinking water.

Policy Requirements

The drivers identified manifest in a range of planning policy requirements at the regional level (London Plan[5]) and local level (LBTH Local Plan[6]). These planning policies

[5] Greater London Authority – London Plan, Intend to Publish Version (2019).

[6] London Borough of Tower Hamlets – Tower Hamlets Local Plan 2031 (2020).

have shaped the approach to the identification of water management measures considered within the IWMP.

The aim of the IWMP is to provide a framework for clear guidance on how development should be steered to:

- Address any water supply and wastewater constraints;
- meet local policy requirements with respect to water, flood risk and urban greening;
- address the key water and flood risk drivers identified in legislation and policy at the national level.

The IWMP therefore creates a useful resource to developers, and development control officers in determining what is required from new development to ensure that the local infrastructure and environment constraints, national requirements, as well as London-wide and local requirements for water and flood risk management are met.

Importance of Urban Greening

The intend to publish London Plan (2019) expects urban greening to be a fundamental element of the design and master planning process, adopting a specific measurable requirement for urban greening as part of major development, known as the 'Urban Greening Factor' or 'UGF' (Policy G5).

Policy G5 identifies that 'nature-based sustainable drainage' is one of the key measures by which the UGF targets can be met and therefore the integration of landscape, green infrastructure and sustainable water management plays a key part in this IWMP.

2.4 IWMP Structure

This report provides an overview of the IWMP and is supported by a series of technical appendices which expand on the themes within the report or provide detail of the analysis and wider evidence base that supports each aspect of the IWMP.

This report is structured as follows:

Section 2: Study Area Context – a summary of planned growth, and a review of the water infrastructure, study area constraints and opportunities for water management in the area.

Section 3: Water Balance Assessment – a quantification of the current and future flow of water and wastewater within the study area to inform option identification.

Section 4: Study-Wide Approaches – water management actions, options and approaches that are common across the whole IWMP study area.

Section 5: Zone Level Options and Delivery - setting out the potential spatially specific options that could be taken forward, considering local constraints and opportunities within each study Zone and delivery requirements.

Section 6: Recommendations and Next Steps – summary of the high-level delivery requirements, key recommendations, and next steps.

Technical Appendix A – **Study Area Mapping**

Technical Appendix B – **Legislation and Policy Review**

Technical Appendix C – **Water Balance Assessment**

Technical Appendix D – **Options Details and Case Studies**

Technical Appendix E - **Developer Checklist**

03 STUDY AREA CONTEXT

Opportunities for improving water management within the study area must be built on a sound understanding of the existing infrastructure provision and its ownership, study area characteristics, and projections for planned growth.

This Section should be read with reference to the mapping included in Technical Appendix A.

3.1 Geographical Scope

The study area for the IWMP includes:

- the IoDSP Opportunity Area, comprising five distinct planning zones;
- the Core Area of the LBTH East of the Borough Area Action Plan (AAP) area; and,
- a part of the Wider Area of the LBTH East of the Borough AAP area.

The key planning designations making up the study area are illustrated in Figure 3-1 which, when combined, represent the study area boundary for the IWMP.

For the purpose of identifying measures and options, the study area was divided into water management areas based on topography and the planning zones informing the study area boundary. This created six IWMP Zones upon which the plan has been developed as shown in Table 3-1 and Figure 3-2. Impacts on infrastructure and water environment outside of the study area have been considered as part of the baseline and options assessment.

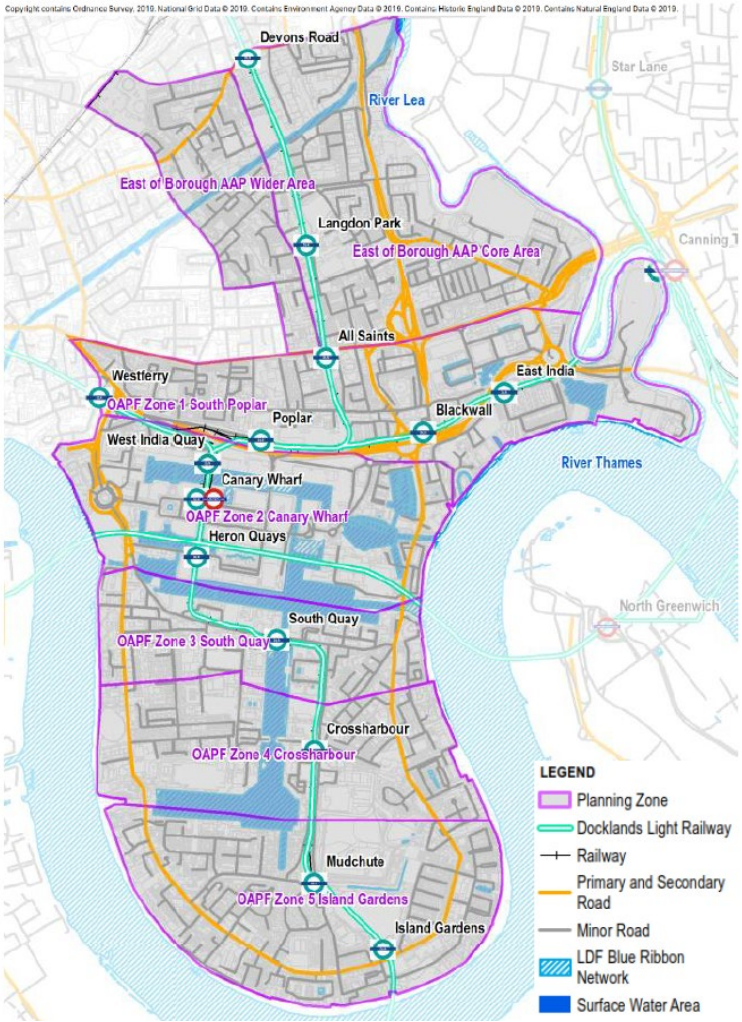


Figure 3-1 Planning components of the IWMP study area (Appendix A Figure 1)

Figure 3-2 Zones for the IWMP (Appendix A Figure 2)

Table 3-1 IWMP Zone Names

IWMP Zone Reference	IWMP Zone Name
Zone 1	South Poplar
Zone 2	Canary Wharf
Zone 3/4	South Quay and Crossharbour
Zone 5	Island Gardens
Zone 6A	Core AAP Area
Zone 6B	Wider AAP Area

3.2 Development Maximum Scenarios

Housing Growth Scenarios

In order to understand the scale of growth and redevelopment anticipated for the area, the development trajectories from the IoDSP OAPF and phasing information provided by LBTH have been used to determine the spatial distribution and maximum development scenarios up to 2041. In the region of 56,500 new dwellings are proposed, as summarised in Table 3-2. This refers to the planning OAPF and AAP areas, rather than the IWMP zones.

Table 3-2 Growth scenarios for OAPF and APP areas

OAPF and APP Planning Zones	Maximum Total Housing development up to 2031 (LBTH Capacity and Phasing Analysis)	Total Housing development up to 2041 (in accordance with the maximum growth scenario in the OAPF)	Total Housing assessed
Zone 1 South Poplar	8,300	1,000	9,300
Zone 2 Canary Wharf	8,800	2,300	11,100
Zone 3 South Quay	9,100	4,100	13,300
Zone 4 Crossharbour	5,100	9,400	14,500
Zone 5 Island Gardens	200	600	800
AAP Core Area	4,400	1,200	5,600
AAP Wider Area	1,900	100	2,000
TOTAL	**37,800**	**18,700**	**56,500**

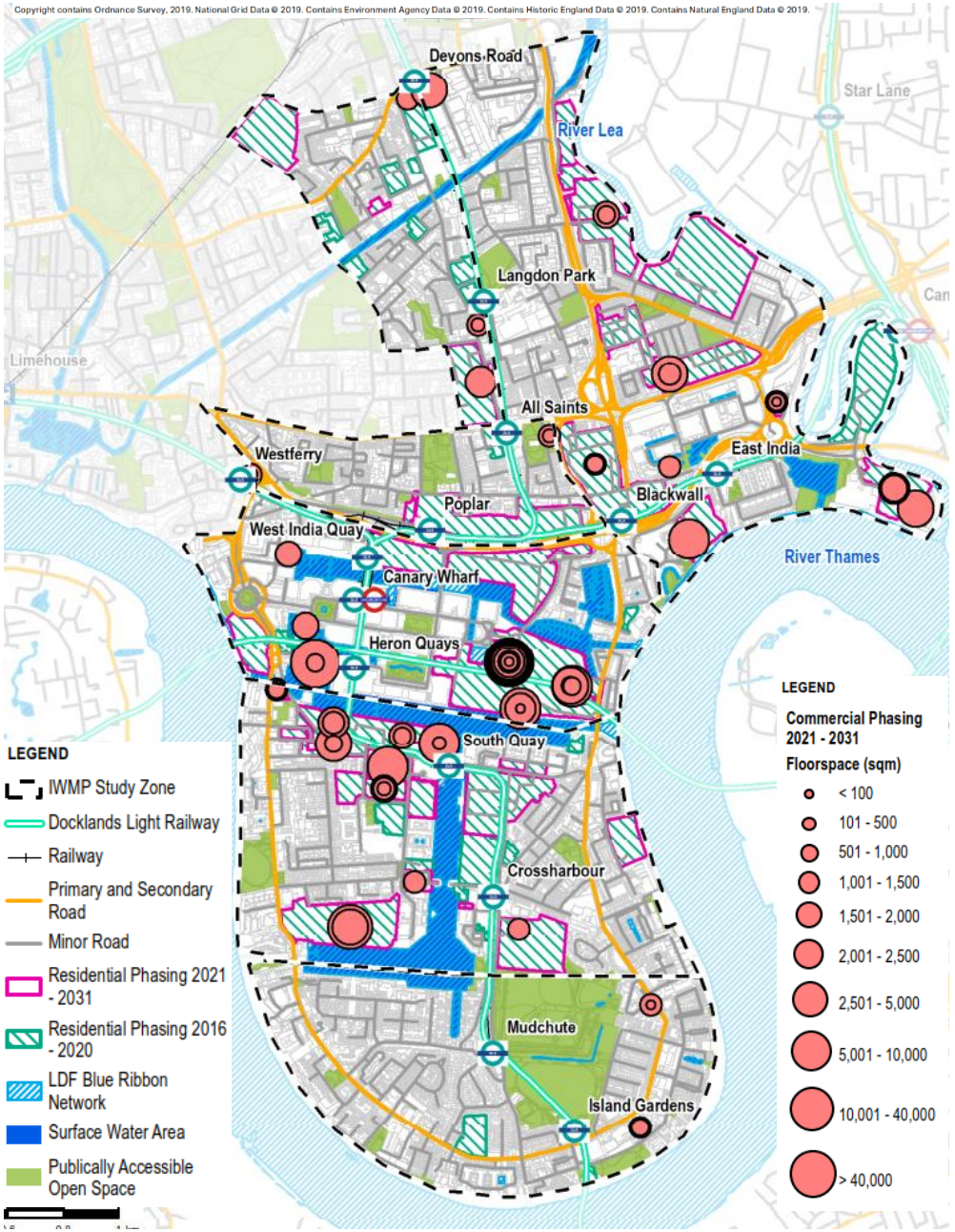


Figure 3-3 LBTH Housing and Commercial Phasing Information (Appendix A Figure 10)

Period 2016 – 2031

The phasing information from LBTH identifies the anticipated phasing of housing growth from 2016 to 2031 in relation to specific development plots and is shown in

Figure 3-3. These include developments already under construction alongside proposed plots with extant planning permission and proposed sites to be allocated. Build-out phasing information was available for the specific locations up to 2031.

Figure 3-3 shows the sites that will be delivered between 2016 and 2020, and those that are due to be delivered from 2021 to 2031. To assist in identifying water management measures which could still be implemented for development yet to be completed, assessment of options focuses on sites with phasing still to be delivered between 2021 and 2031. Of the 37,800 dwellings proposed to 2031, in the region of 10,000 have already been completed leaving 27,800 still to be phased beyond 2021.

Period 2031-2041

For longer term growth between 2031 and 2041, specific site locations and likely extent of plots have not been identified. Estimated housing numbers are provided on an aggregated zone level based on the maximum growth scenario set out in the OAPF for each planning zone.

This difference in spatial information between shorter term growth and longer term has influenced the approach to water management options considered in this IWMP. This facilitated a more strategic, and less spatially specific appraisal of options for the longer-term growth from 2031 to 2041.

Commercial Floorspace

LBTH have supplied approximate locations of commercial phasing up to 2031, as shown in

Figure 3-3 and Table 3-3, however details of development plots have not been provided.

Table 3-3 Commercial growth scenarios

OAPF and APP Planning Zones	Commercial Development Floorspace (m^2) to 2031
OAPF 1 South Poplar	77,300
OAPF 2 Canary Wharf	407,500
OAPF 3 South Quay	43,300
OAPF 4 Crossharbour	37,000
OAPF 5 Island Gardens	2,400
AAP Core Area	19,200
AAP Wider Area	5,200
TOTAL	**591,900**

3.3 Study Area Characteristics

The physical characteristics of the study area present opportunities and constraints for the management of water in the area. This section considers the topography and underlying geological conditions, the risk of flooding, as well as the water environment and features and the presence of blue and green spaces.

Topography

Across the Isle of Dogs, ground levels vary from 2-10m AOD. Ground levels are higher around the edge of the island and around the dock systems, at approximately 6m AOD. The A1206 road that runs around the edge of the island further inland is at a lower level of 3 m AOD. A notable high point within the Isle of Dogs includes Mudchute Park, located at 6-10m AOD. The ground levels across the Canary Wharf area are shown to be at 10m AOD, which is due to the artificial character of the ground levels in this location. The street level is at the podium and there are substantial sections where the street level plate overhangs the open water of the dock system.

The low points in Crossharbour and Island Gardens correspond to those areas that have been identified as Critical Drainage Areas (CDAs) in the London Borough of Tower Hamlets Surface Water Management Plan (SWMP)[7]. In these areas, surface water is unable to drain sufficiently during heavy or intense rainfall and water either ponds or flows over the ground surface. In the LBTH SWMP, CDAs represent significant areas of surface water and sewer flood risk.

North of Canary Wharf and the A1261 Aspen Way, ground levels generally rise towards Poplar and Bromley-by-Bow and the very northern fringe of the study area is located at ~9-10m AOD. The exception to this is Aberfeldy Village, which is located at 2-3m AOD, and is also identified as a CDA.

Within areas of flat topography, there is less potential for fully connected, above ground gravity-based drainage. This limits the potential for Sustainable Drainage Systems (SuDS) features to be linked and provide conveyance to the point of discharge in addition to their attenuation functions. It also reduces the area of land which can be drained to surface water bodies (as opposed to discharge to the sewer system) without the need for pumped systems.

Figure 3-4 LiDAR Topography (Appendix A Figure 3)

[7] CDAs are mapped for each IWMP Zone in Section 06

Geology and Hydrogeology

The geology and underlying soil of the study area, along with the potential for land contamination, influences how much potential there is for surface water to be managed via infiltration into the ground.

The near surface superficial geology consists largely of alluvium associated with the River Thames underlying IWMP Zones 2, 3/4, and most of Zone 5. These strata are a mix of clay, silt, sand and peat and are therefore low in permeability and not reliable for infiltration-based SuDS. The Kempton Park Gravel member is predominant within Zones 1, 6a and 6b along with the Taplow Gravel member to the north; these strata locally may offer potential for infiltration as part of an overall sustainable drainage strategy.

The bedrock geology is a mix of:

- London Clay - covering Zone 6a (AAP Core Area) Zone 6b (AAP Wider Area) and Zone 1 (South Poplar);
- Lambeth Group – covering Zone 2 (Canary Wharf), Zone 3/4 (South Quay and Crossharbour) and the eastern half of Zone 5 (Island Gardens); and,
- Thanet Sands – covering the western half of Zone 5 (Island Gardens).

London Clay and Lambeth Group bedrock limit the potential for deeper infiltration measures and whilst the Thanet Sands outcrop offers a higher degree of permeability, it is overlain by the less permeable Alluvium and is shallow with London Clay underlying the stratum.

Groundwater levels will also vary across the study area and will be influenced by tidal river levels in the River Thames and River Lea making strategic-scale infiltration a limited option for the IWMP.

Blue Green Network

The study area has a significant network of blue-green infrastructure and a key aim within the LBTH Local Plan[8] is to build upon and improve this network in line with the LBTH Green Grid Strategy, Open Space Strategy and Water Spaces Study[9].

The Green Grid including blue infrastructure is shown in Figure 3-5 and includes interconnected water spaces and features, such as the docks (and associated basins), the Tidal Thames, the Tidal River Lea and the Limehouse Cut. These features provide significant opportunity for integrated water management solutions through options for discharge (and hence sewer separation), re-use, heat recovery and integration of the urban environment with high quality recreational space. However, they also pose a degree of flood risk to development and hence integration of water management solutions is required to manage, minimise, and where possible reduce the risk of flooding from these sources. In addition, integrated solutions are required to also ensure protection, and where possible, improvement in the water quality of these water spaces and features.

The Green Grid provides a potential opportunity whereby maintenance and development of green corridors and open spaces could act as areas for strategic attenuation of surface water or conveyance routes for linear SuDS features as part of the provision of green infrastructure.

River Systems

The River Thames forms the boundary of much of the study area in the south and the River Lea borders the north eastern extent. Both watercourses provide opportunity for direct discharge for development options in these locations where topography and location allow.

Both watercourses are classified as main rivers, for which the Environment Agency is the Risk Management Authority (with respect to flood risk) in accordance with the Flood and Water Management Act (FWMA) and also the competent authority under the requirements of the Water Framework Directive. The Environment Agency are therefore a key statutory body with respect to solutions linked to the watercourses.

The rivers present a significant tidal and fluvial flood risk to the study area, with most of the study area classified as Flood Zone 3, i.e. land having a 1 in 200 or greater annual probability of tidal flooding each year (0.5% annual exceedance probability (AEP)), as shown in Appendix A Figure 5.

The network of tidal defences (including the Thames Barrier) provide protection for flood events with a 1 in 1000 annual probability (0.1% AEP) and the long-term plan as set out in the Thames Estuary 2100 Plan[10] is to maintain this standard of protection to 2100, including for the effects of climate change.

[8] Local Plan Policy S.OWS1 – creating a network of open spaces, and D.OWS3 – open space and green grid networks.
9 LUC (2017) – Tower Hamlets Water Space Study.

10 Environment Agency (2012) Thames Estuary 2100 Plan.

Residual flood risk, in the event of a breach or overtopping of the defences, is still a key consideration and development is required to provide mitigation measures with respect to this risk as set out in the LBTH Strategic Flood Risk Assessment[11]. This includes ensuring finished floor levels are set above predicted modelled flood levels should a breach or overtopping of defences occur; this creates opportunity for SuDS and rainwater harvesting systems comprising elements of sealed underground attenuation or storage which make use of the below ground space created (See section 05).

Both watercourses are currently impacted by the discharge of untreated wastewater from the wider combined sewer network during periods of heavy rainfall. The Thames Tideway Tunnel is due for completion in 2024 and is being constructed to minimise discharge of untreated wastewater to the River Thames and River Lea.

Figure 3-5 Blue Green Network (Appendix A Figure 4)

11 AECOM (2016) London Borough of Tower Hamlets – Strategic Flood Risk Assessment (Level 1).

Dock System

In addition to the river systems, the extensive system of docks waterspace, consisting of the West India Docks and Blackwall Basin, is a central feature of the South Poplar and Isle of Dogs study area. The CRT is the guardian of the Docks waterspace. The Environment Agency will also need to agree any permissions and permitting regarding the docks for discharge arrangements and are the competent authority for the Water Framework Directive (WFD), which protects both designated and non-designated water environments.

West India Docks incorporates the Entrance Lock, South Dock, North Dock, Millwall Inner and Outer Docks and West India Quay as shown in Figure 3-6.

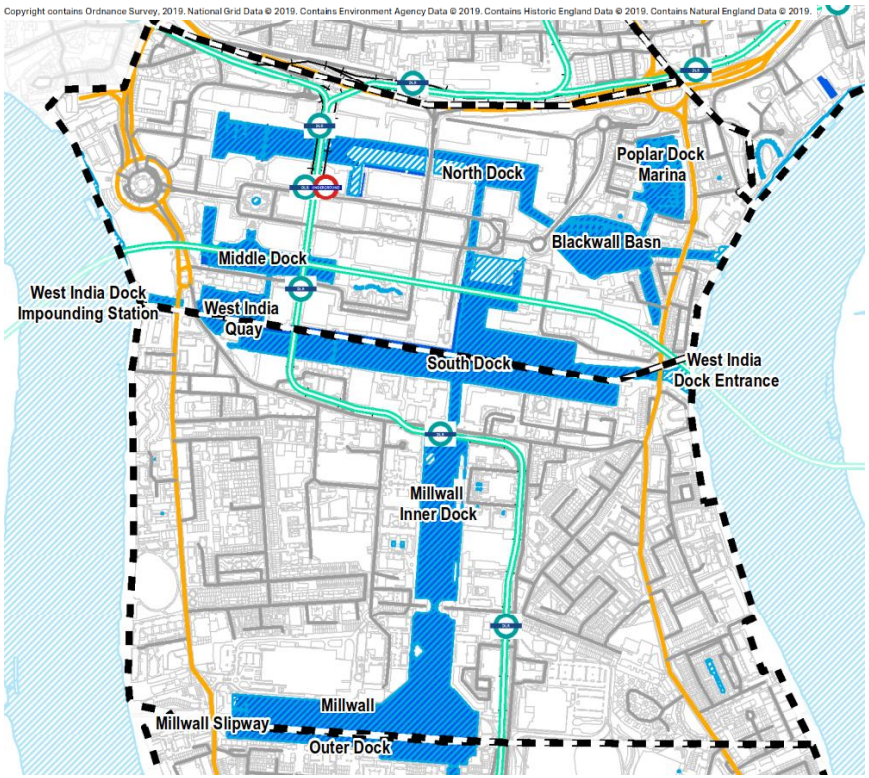


Figure 3-6 CRT Dock System and extent of Docklands Light Railway

The West India Dock Entrance Lock is located to the east of the South Dock where the lock gates allow vessels to pass between the docks and the Thames on the east of the Isle of Dogs. The CRT also manages the Impounding Station on the western side of the Isle of Dogs near Canary Wharf. It houses the pumps that feed West India Docks with water from the Thames.

Currently, the CRT dock system relies on water from the Thames to be pumped into the docks to ensure that the docks are fed to a water level sufficient for their normal operation.

Docklands Light Railway Underline

The Docklands Light Railway (DLR) passes through the study area, as shown in Figure 3-5.

The DLR, which was built in 1987, is owned by TfL and run by a franchisee. The ownership of land around the DLR tracks and stations varies according to location and conditions. For viaducts, DLR generally owns the viaduct structures and the airspace above them (all buildings must be constructed and maintained without any over-sailing either above or alongside the DLR viaduct). DLR does not generally own the airspace or ground below the viaducts, except for the ground on which the columns sit, however it owns contractual land rights, referred to as 'protection zones' normally running five metres either side of the boundary fence or viaduct edge. These protection zone rights will exist independent of development proposals or planning permissions. These land rights generally limit land uses within the protection zone to road, pathway or cycleway, landscaping and car parking

As part of the wider regeneration LBTH are seeking opportunities to reactivate the space under the DLR, for example for landscaping, planting, parkour or open gyms. The DLR Underline is a speculative idea that has been developed for a 1km long linear park under the DLR viaduct in South Quay on the Isle of Dogs.

The OAPF Local Connections Strategy describes the desire to improve the DLR and public realm interface. There is a strong emphasis on exploring opportunities to improve the relationship of the DLR infrastructure to the street, including:

- "Improvements to the public realm around and beneath DLR stations to capitalise on their place-making potential,
- Activation of the space beneath the DLR viaducts to make more of these as a feature and an integrated part of the street,
- Upgrading or creating connections over the tracks at grade or beneath the DLR viaduct to break down barriers to pedestrian and cycle movement".

Furthermore, the Mayor's Transport Strategy[12] commits to removing 50,000 m^2 of impermeable surface on TfL network draining to main sewer each year.

The consideration of the DLR network and environs therefore provides a key opportunity for options as part of the IWMP.

3.4 Water Infrastructure

Infrastructure Providers

Thames Water Utilities Ltd is the appointed water and sewerage undertaker covering London and is responsible for the provision of public water supply and wastewater services in the study area.

In addition to Thames Water, the Millharbour Village redevelopment within the study area (IWMP Zone 3/4) is operated by a NAV[13] (new appointment or variation) inset provider and the Canary Wharf Group (CWG) own and operate the water supply and sewer network within the Canary Wharf Estate within IWMP Zone 2, as shown in Figure 3-7.

The CWG operate a range of assets within their estate, including some surface water sewers which discharge to the Dock system, as well as greywater recycling for two office blocks and a proposed greywater and rainwater combined re-use system for the new Wood Wharf redevelopment in IWMP Zone 2. Thames Water provide bulk water supplies to both the CWG and the NAV and receive combined and foul wastewater discharge into their network for onward treatment and discharge.

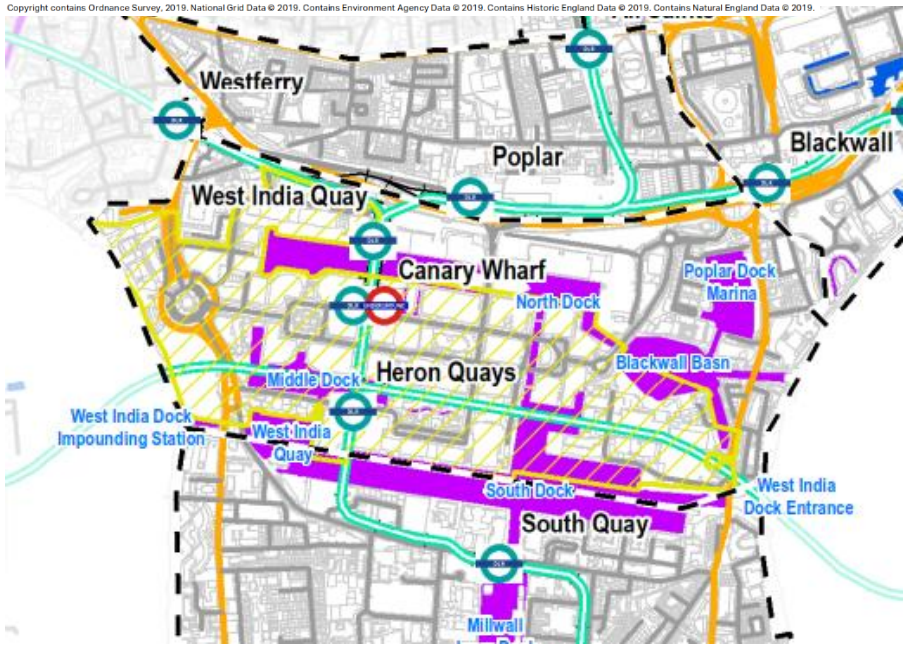


Figure 3-7 Land in Canary Wharf Group's Ownership (yellow hatch) (Appendix A Figure 7)

Water and Wastewater Networks

A Development Infrastructure Funding Study (DIFS) was completed for the IoDSP Opportunity Area[14] which identified current constraints on the potable water supply network as well as the wastewater drainage network (foul and surface water referred to as the sewer network) under Thames Water ownership and operation as summarised in the following sections.

[12] https://www.london.gov.uk/sites/default/files/mayors-transport-strategy-2018.pdf
[13] A NAV is licenced by the water industry regulator Ofwat to provide water services in an area previously supplied by the incumbent monopoly market

[14] PBA with Cushman & Wakefield, Gardiner & Theobald. November 2017. Isle of Dogs and South Poplar Development Infrastructure Funding Study.

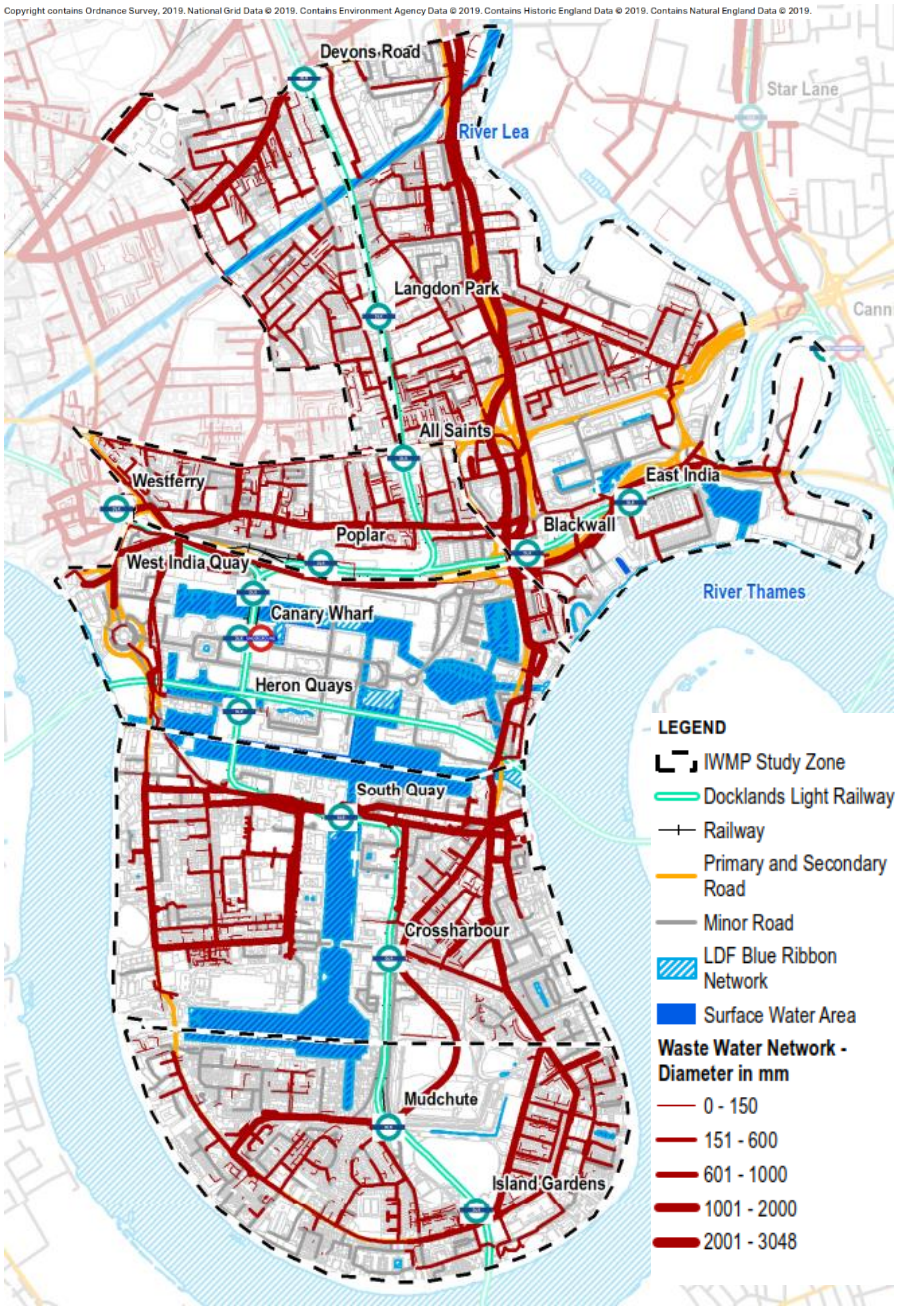


Figure 3-8 Thames Water Sewer Network (Appendix A Figure 8)

Wastewater Infrastructure

The majority of the study area is served by combined sewers (Figure 3-8) taking both foul wastewater from property and excess surface water drained from property, roads, and public realm during and after rainfall events.

A main gravity combined sewer flows from IWMP Zone 5 to the South of the Isle of Dogs, along Westferry Rd and Manchester Rd. This main sewer is connected at Marsh Wall Roundabout to two lateral combined sewers which convey water along Spindrift Avenue, East Ferry Road and Marsh Wall. The combined network is also connected at this location with the Thames Water pumping station on Stewart Street; in operation since the 1980s. The pumping station is a combined sewer overflow (CSO) that becomes active during periods of heavy or prolonged rain when the main combined sewer network fills up with surface water and the station pumps excess water directly to the River Thames to prevent sewer flooding. Under normal (dry weather flow) conditions, the combined sewer conveys the flows along Blackwall Tunnel Northern Approach to Abbey Mills Pumping Station and onward to Beckton Wastewater Treatment Works.

The CSO on Stewart Street will not be intercepted by the Thames Tideway Tunnel; therefore, the overflow will continue to be in operation and hence continue to act as a pollution source to the River Thames. Separation of the sewer system into separate foul and surface water networks for new development is therefore an option to reduce both sewer flood risk and pollution risk from the combined system.

Capacity

The DIFS identified that sewer capacity is an existing issue that can contribute to localised flooding, particularly in the CDAs and would limit the potential for connection of new property with significant increases in foul flow.

As part of the drainage and wastewater management plan, Thames Water have completed a baseline assessment of the hydraulic capacity of the combined sewer network using the capacity assessment framework (CAF). This shows sewers surcharge in a 1 in 2-year rainfall event.

Outputs of TW's hydraulic assessment of the sewer network capacity are demonstrated in Figure 3-9.

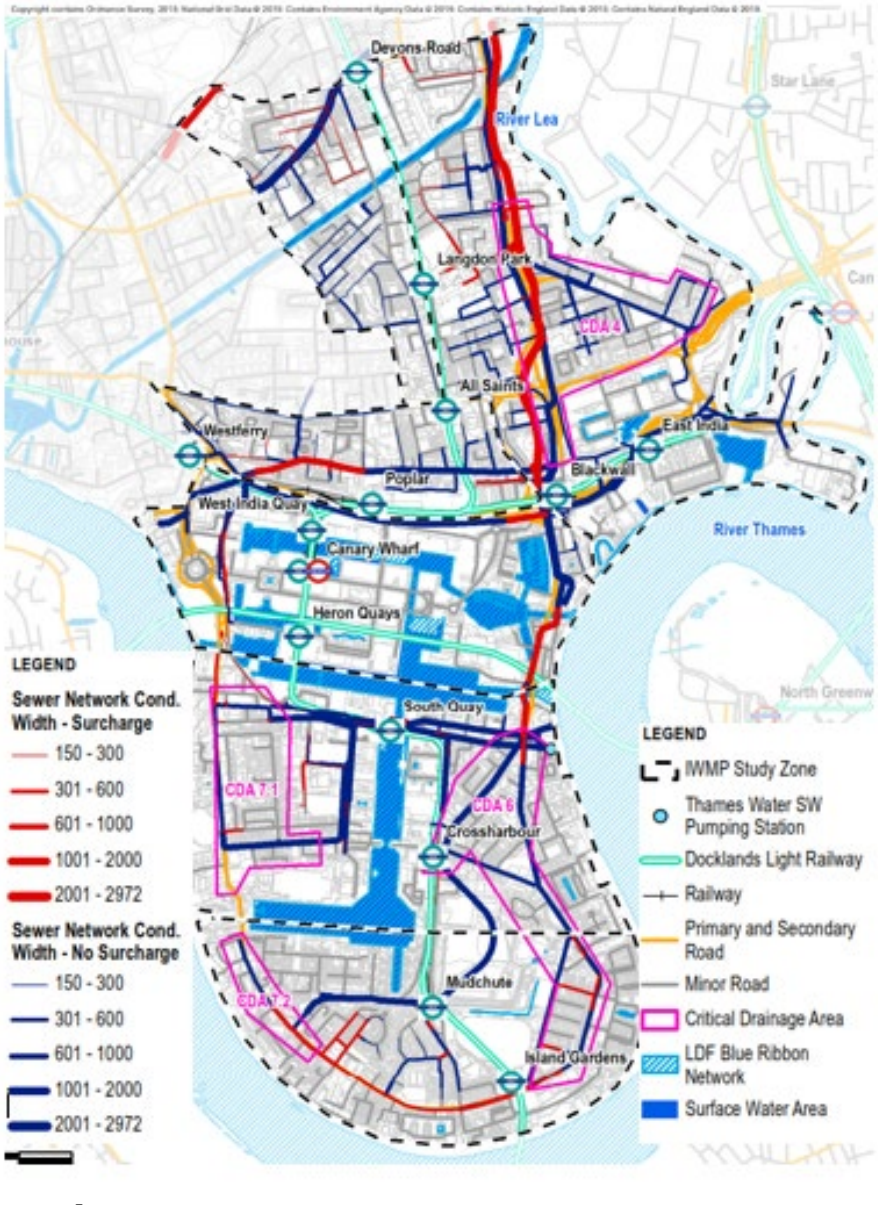


Figure 3-9 Thames Water Sewer Network Capacity Assessment (Appendix A Figure 9)

The image shows the results during a test 2-year event, highlighting in red those pipes where capacity is exceeded, resulting in potential for sewer flooding, under these conditions. The gravity pipe flowing north away from the combined sewer overflow pump station on the eastern edge of the study area exceeds capacity (surcharging) under the test event. However, other parts of the Island also suffer from surcharged operation. The expected foul loads flow from the sites that are predicted to come online in the next ten years within Zones 1 to 5 would increase the maximum additional foul discharge by 233 l/s compared to the present-day flows (this is an increase of 60%).

Surcharging is shown to occur in the CDAs identified in the study area. However, there is also surcharging shown to occur in areas that have not been identified as CDAs.

The combined nature of the sewer system limits the capacity for additional foul water discharges from new property, increasing the risk of sewer flooding. The significant volume of planned growth would add large volumes of foul water to the combined system, as described in the water balance outputs contained in Section 04). To offset this, it is essential that future development manages surface water input to the combined systems, ideally in terms of reduced volume, but as a minimum in terms of discharge rate.

A reduction in surface water discharge rates, or complete removal of surface water from the combined system provides opportunity to offset the expected increase in foul flows from new development, but also to reduce the frequency of operation of the CSO sewer and reduce sewer and surface water flood risk throughout the study area. The network capacity issue is particularly an issue for IWMP Zones 1 to 5. Zones 6a and 6b have less infrastructure capacity pressure but should still focus on the need to reduce discharge runoff rates to a minimum in line with planning policy.

It is a key aim of this IWMP to set out a clear framework for how surface water reduction to the sewer system can be achieved.

Water supply

Water Resources Availability

Water resource availability for the study area is managed by Thames Water. Thames Water have as statutory duty to manage the long-term provision of water supplies and a process for how they will achieve this is documented via Water Resource Management Plans (WRMP) produced every 5 years. Thames Water's current WRMP[15]

[15] Thames Water (2019) Water Resources Management Plan.

was approved[16] in 2020 and sets out how the company will meet demand up to 2045 (and at a strategic level to 2100) through a series of water demand management measures and new water resource supply schemes. Thames Water manages supply to the study area as part of a large integrated supply zone referred to as the London Water Resource Zone (WRZ). The London WRZ covers the majority of Greater London and all customers within this area share linked resource units and strategic supply infrastructure and as such, experience the same risk of supply failure.

Figure 3-10 taken from the WRMP, demonstrates the forecast gap between water available for supply (blue) and demand for water (orange) across the London WRZ if no water management interventions are made to 2100. The figure shows the combined effect of increasing demand over time, alongside decreasing availability of water supplies. The decrease in available supply is principally caused by two key factors: the effects of climate change reducing river flow and/or groundwater levels; and, a need to reduce the volume of water currently abstracted from rivers and aquifers to leave more for environmental and ecological needs.

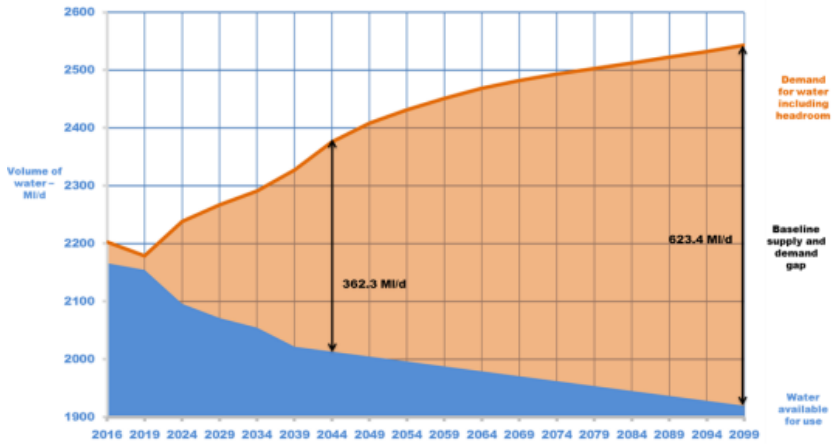


Figure 3-10 London WRZ – difference between available supply and demand projections to 2100

By 2044, it is predicted that there will be a shortfall of 362 million litres a day (approximately 15% of the anticipated total demand) across the London WRZ. Figure 3-11 sets out the range of factors resulting in this deficit and illustrates the proportional contribution each factor makes to the overall deficit total.

Figure 3-11 Relative effect of contributing factors to the projected deficit in supply for the Thames Water customers

The biggest factor is projected population increase in London, but the effects of climate change on demand and available water is also critical and the need to reduce some abstraction of raw water to protect the environment also has a significant effect.

The WRMP includes several actions to mitigate the forecast deficit. There remains unmitigated deficit which indicates the scale of the water supply issues facing the study area (and across London) as a result of a changing climate and substantial population growth.

Demand management interventions are a key part of Thames Water's management plan, and this demonstrates the importance of ensuring development control policy supports the agenda of minimising demand for water from new development.

Water Supply Network

In addition to London-wide water resources supply issues, the DIFS for the Opportunity Area identified current constraints on the transmission of treated water to the study area via the potable water supply network. Thames Water has identified that there is insufficient capacity in its networks to serve long term growth beyond 2031 and that significant network upgrades would be required. Thames Water would need to provide strategic reinforcement from its Coppermills Treatment Works into the area. This would require approximately 11 km of new strategic mains consisting of new pipelines ranging from 300 mm to 900 mm in diameter[14].

[16] WRMPs are approved by the Secretary of State for Environment, Food and Rural Affairs.

The timing and phasing of the provision of this strategic infrastructure by TW can be influenced by introducing measures to reduce demand across the study area. It is therefore a key aim of this IWMP to set out a clear framework for how water demand can be reduced to minimise strategic infrastructure intervention.

3.5 Summary

The Isle of Dogs and South Poplar study area is low lying and characterised by a number of water spaces; the docks systems throughout the central part of the Isle of Dogs, the River Thames and River Lea and the Limehouse Cut. These water systems provide opportunity to deliver integrated water management solutions.

The area is heavily developed and served predominantly by a combined sewer network which is already shown to be at capacity in some areas resulting in increased flood risk and limiting the potential for unmitigated discharge of foul and surface water from new development. Measures are required to minimise foul discharge and offset the increase in foul by removing surface water, or reducing its rate of discharge to the combined system

The future demand for water in the London Water Resource Zone is predicted to continue to outstrip availability, predominantly as a result of the future growth in population, but also as a result of changing climate, and the need to reduce abstraction of water to protect the environment. Water supply infrastructure serving the study area is also close to capacity and would need significant upgrades to serve the full quantum of growth proposed.

Significant growth and redevelopment are planned for the Isle of Dogs and South Poplar area, and those with responsibility for managing water supply and the water environment will need to work together with developers to facilitate an integrated approach to the use and management of water in the area as new development takes place.

04 WATER BALANCE ASSESSMENT

As part of the IWMP, calculations have been undertaken to broadly characterise and quantify the water cycle flows across the study area and the anticipated changes to these as a result of planned growth. This supports the most appropriate selection of water management measures in each zone identified in the IWMP.

4.1 Assessment Aims

This section provides a summary of the findings of the water balance calculations. The water balance considers all flows of water into and out of the study area and compares these flows for the current baseline and after all development has taken place.

The primary aim is to identify where these flows of water can be managed to reduce flood risk, potable water demand and sewer constraints, as well as provide opportunity for betterment in line with policy. The water balance calculations, assumptions and full technical methodology is documented in detail in Technical Appendix C.

4.2 Approach

As noted in Section 3.2, the data on anticipated housing growth made available for the IWMP by LBTH for the years 2016 to 2031 comprises specific sites; however for growth anticipated for the years 2031-2041, the quantum of growth is taken from the maximum growth scenario set out in the IoDSP OAPF rather than specific sites identified by LBTH. As a result, the water balance for each zone covers the period up to 2031; whereas the water balance for the whole study area covers the period up to 2041.

Flows have been estimated on both a daily and an annual scale to consider the area–wide balance between input and output of water. The two predominant inflows to the urban cycle are:

- The natural hydrological flows, which originate as rainfall and exit the system through groundwater infiltration, evapotranspiration and urban runoff.
- The centralised water supply, which is imported from outside the area boundary, and consumed or discharged through the wastewater system.

Each of the flows described in Table 4-1 have been estimated for each of the zones as well as the study area as a whole in the pre-development and post-development state. These estimates have been developed based on the best information available; however, it should be noted that they are based on assumptions to inform strategic assessment and should not be regarded as basis for design.

Table 4-1 Urban Water Cycle Flows

Flow	Definition
Rainfall	The volume of natural precipitation falling over the development area over an average year.
Roof water	The quantity of rainwater which falls directly on rooftops within the development areas. This has been split from storm water generated across other surfaces due to the differing water quality characteristics.
Stormwater	Runoff from the urban environment generated during rainfall events. This consists predominately of runoff from impervious areas. This flow has been split from roof water above; however, within the current system, both roof water and storm water are combined in most zones before entering the drainage system.
Losses	Losses of water from the water balance, including evapotranspiration (water which is returned to the atmosphere through the processes of evaporation and transpiration of vegetation) and infiltration (the proportion of rainwater which infiltrates through the soil).
Potable water	High quality, drinking standard water supplied for uses within the home, including water used for drinking and use in the kitchen and bathroom. Within this analysis, potable water has been assumed as necessary for all household uses except toilet flushing and washing machine s.
Non-Potable Water	Water which is utilised for low contact uses including irrigation and toilet flushing. In general, this water is not required to be of the same quality as that used for potable uses. Under the current (baseline) scenario, water for all uses is supplied from the centralised, potable system.
Grey Water	Wastewater generated from use in hand basins, baths and showers. Grey water generally excludes water used in toilets, the kitchen or for cleaning use, which has a greater concentration of contaminants.
Black Water	Wastewater generated from toilets, kitchen and laundry use. This has a higher concentration of contaminants than grey water. Under the current scenario both black water and grey water are combined and disposed to the drainage system.

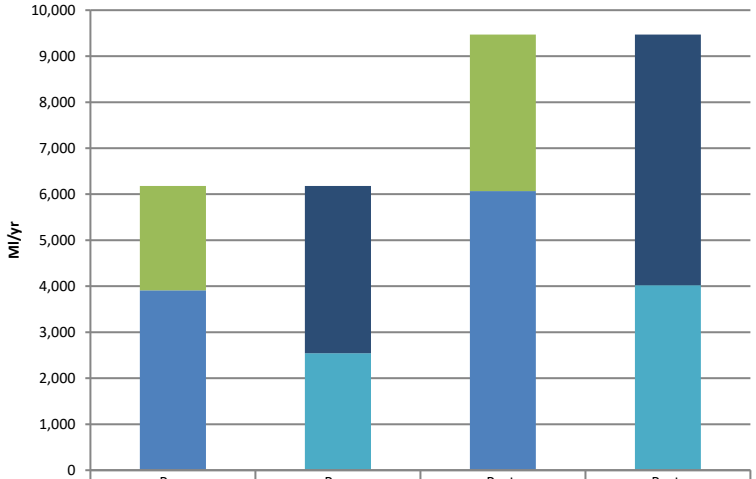
4.3 Water Balance Results

Figure 4-1 and Figure 4-2 show the outputs of the water balance calculations for the study areas a whole (with growth up to 2041).

The proposed development across the zones will lead to a substantial increase in the demand for water (potable demand will increase by 55%) and subsequent generation of wastewater. There is also an increase in the proportion of rainfall falling on rooftops. The amount of water leaving as stormwater runoff is shown to decrease marginally, but only if new development achieves greenfield runoff rates. Which demonstrates the importance of measures to minimise runoff rates and volumes.

As Figure 4-1 and Figure 4-2 illustrate, without intervention, the proposed development across the study area will significantly increase demand on the regional water supply and wastewater assets. A key finding from the analysis is that greywater generated post-development would be sufficient to meet the non-potable demand across the study area.

Figure 4-1 Comparison of water demands and foul water generation (2041)



	Pre-Development Demands	Pre-Development Discharges	Post-Development Demands	Post-Development Discharges
Blackwater Generated		3636.31		5447.59
Greywater Generated		2542.44		4023.45
Non-Potable Demand	2269.77		3404.82	
Potable Demand	3908.98		6066.22	

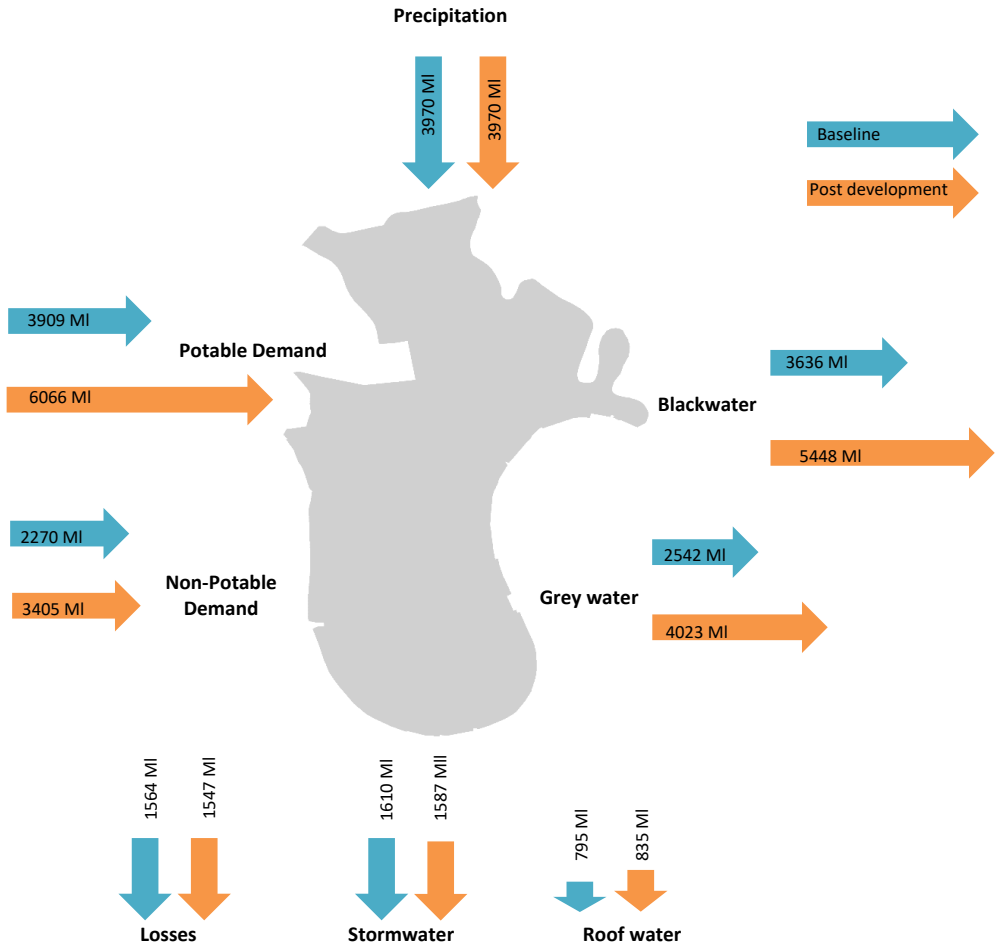


Figure 4-2 Annual Water Balance for the whole study area Pre and Post Development (2041)

4.4 Attenuation vs. Non-Potable Demand

Calculations have been undertaken to determine how the volume of rainwater attenuated from rooftop runoff compares to the non-potable demand in each zone assuming all roof water could be collected, stored and supplied to development. This information is useful for the IWMP to inform the feasibility of using rainwater harvesting approaches to deliver benefits for the area.

As part of the analysis, calculations have been undertaken to determine the number of days over the 10-year period that the future attenuated rooftop runoff could (1) meet demand; (2) partially meet demand; and, (3) not meet any demand using the last 10 years of rainfall records; this is shown in Table 4-2 and graphically in Figure 4-3.

Details of the assumptions that have been made during this analysis are described in Technical Appendix C.

Table 4-2 Study Area Wide Attenuation vs. Non-Potable Demand Results

Year	No. of days demand is met	% time demand is met	No. of days demand is partially met	% time demand is partially met	No. of days demand is not met	% time demand is not met
2009	38	10%	170	47%	157	43%
2010	21	6%	187	51%	157	43%
2011	20	5%	169	46%	176	48%
2012	42	12%	178	49%	0	0%
2013	27	7%	184	50%	154	42%
2014	36	10%	168	46%	161	44%
2015	18	5%	172	47%	175	48%
2016	0	0%	159	44%	206	56%
2017	23	6%	162	44%	180	49%
2018	0	0%	165	45%	200	55%
Average % over 10 years		**6%**		**47%**		**47%**
Max. Attenuation over 10 year period: 36,387.96 m^3						
Non potable demand: 11,449.00 m^3/day						

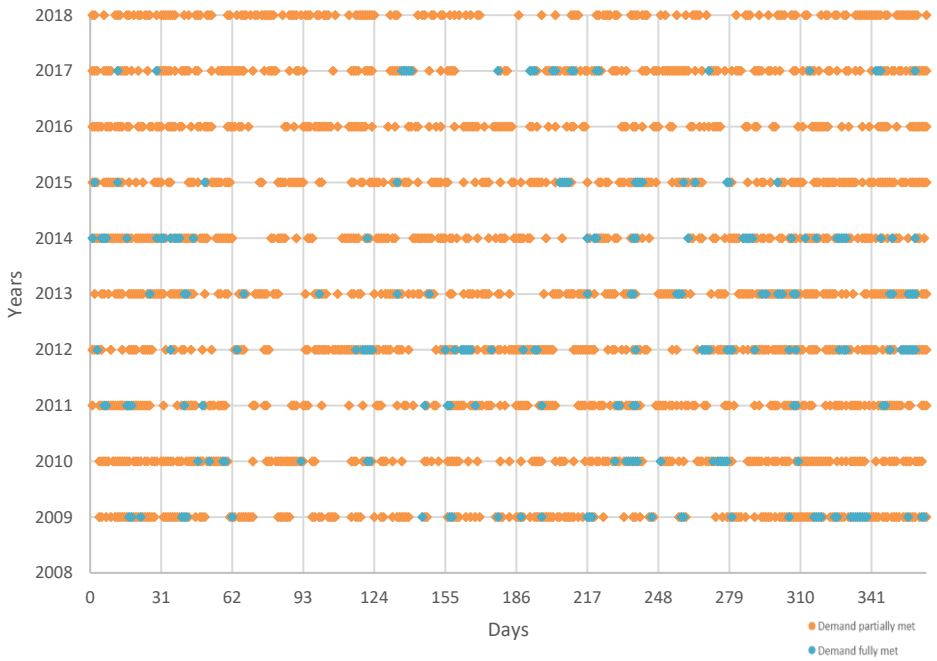


Figure 4-3 Study Area Wide Attenuation vs. Non-Potable Demand Results

Findings from the analysis for the whole study area show that over a 10 year period, the demand for non-potable water is only met by the available rainfall 6% of the time, and during 43% of the time, the demand for non-potable water is not met by the available rainfall. Outputs from UKCP18 climate modelling suggest that the percentage of time that demand would not be met by rainwater harvesting will increase during summer months in the future due to more frequent periods of warmer, drier weather.

This provides a useful indication that rainwater harvesting options based on roof water capture cannot be considered a reliable option for meeting non-potable water demand in this study area. Rainwater harvesting options should still be included within the pool of options for effective water management, particularly where it can be combined with greywater systems or SuDS attenuation systems; however, greywater recycling techniques offer a more reliable and climate resilient source of non-potable water.

The variation across zones is presented in Table 4-3 which shows that in Zones 6A and 6B in the northern part of the study area the demand is met more often on average, than in the densely developed centre of the island; this presents greater opportunity for rainwater harvesting to reduce demand in these zones and this is reflected in the option recommendations for these Zones in section 06.

Table 4-3 Summary of the average % of time (over 10 years) that attenuation meets non-potable demand

Zone	Average % of time (over 10 years) that the Demand is met.	Average % of time (over 10 years) that the Demand is not met.
Zone 1 South Poplar	18	41
Zone 2 Canary Wharf	1	43
Zone 3/4 South Quay Crossharbour	10	42
Zone 5 Island Gardens	28	39
Zone 6A AAP Core Area	43	35
Zone 6B AAP Wider Area	44	35

4.5 Summary

Without intervention, the proposed growth and redevelopment across the study area will significantly increase demand on the regional water supply and wastewater assets.

Analysis of rainfall data and water balance calculations identifies that rainwater harvesting options based on roof water capture cannot be considered a reliable option for meeting non-potable demand in the study area. They should still be considered in combination with greywater systems or SuDS attenuation systems.

Greywater recycling is considered to be a more reliable and climate resilient option for the study area, with analysis showing that greywater generated post-development would be sufficient to meet the non-potable demand across the study area.

05 STUDY-WIDE APPROACHES AND PRINCIPLES

Some of the solutions identified within the IWMP are applicable on a study area-wide basis, either as design principles, or measures which require a consistent policy approach for all proposed development in the study area. This Section presents the approaches and principles which are common to all the zones. Zone specific solutions are presented in Section 06.

5.1 Policy Based IWMP Requirements

The appraisal of potential water management options has been framed against a hierarchical list of IWMP policy-based requirements, shown in Table 5-1, which is based on the planning policy context and the key infrastructure and environmental constraints outlined in previous sections.

These requirements have been developed to support compliance with water, flood risk and urban greening related planning policies as well as to address significant local constraints in the study area. Principally, they have been developed around the drainage hierarchy in London Plan policy S13, while also incorporating other London Plan and Local Plan policy requirements.

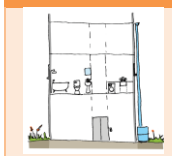
The hierarchy of IWMP requirements has been used to present a preferential set of measures that should be considered by developers (applicable study-wide or in each Zone) in order to meet policy requirements and address the local infrastructure and water environment capacity issues.

It identifies where the local constraints and opportunities influence the preferential implementation of suggested water management measures and this should act as a reference point for developers when designing for water and flood risk management in their proposals. Options near the top of the hierarchy considered not feasible by developers should be clearly demonstrated within their planning applications.

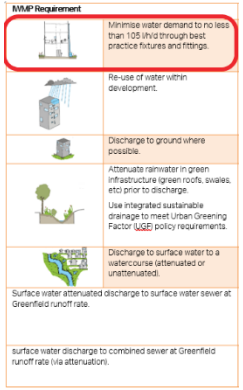
The IWMP option assessment for the study area as a whole (this section) and individual zones (Section 06) has been presented in order to discuss those options at the top of the requirement hierarchy to make it easy for developers and consenting officers to understand the priority measures which need to be considered.

The full set of regional and local policy linked to the IWMP is provided in Technical Appendix B.

Table 5-1 Hierarchy of IWMP requirements and policy context

IWMP Requirements		London Plan Intend to Publish Version – policy	Tower Hamlets Local Plan 2031 policy
	1. Minimise water demand to no greater than 105 l/h/d through best practice fixtures and fittings (residential) and achieve BREEAM excellent standard for WAT 01 category (commercial).	SI 5 / C1 – minimise water use through design for 105 litres per head per day through efficient fixtures and fittings	D.ES6 / 1 – new development must achieve maximum water use of 105 litres per head per day S.ES1 / 1d – development will be supported which reduces water use
	2. Re-use of water within development.	SI 13 / B1- reuse of rainwater top of the drainage hierarchy SI 5 / C3 – incorporate recycling measures (including retrofitting) to achieve lower water consumption and future proof development	D.ES5 / 1 – development required to reduce risk of surface water flooding, including through use of appropriate water reuse techniques S.ES1 / 1 – development will be supported which minimises the use of natural resources (i.e. water demand reduction)
	3. Discharge to ground where possible.	SI 13 / B2 – 2nd on the drainage hierarchy	
	4. Attenuate rainwater in green infrastructure (green roofs, green walls, swales, etc) prior to discharge. Use integrated sustainable drainage to meet Urban Greening Factor (UGF) policy requirements.	SI 13 / B3 – 3rd on the drainage hierarchy SI 13 / D – drainage should promote multi-benefits (biodiversity, water quality) G5 A – Major development should include urban greening including nature-based sustainable drainage	D.ES5 / 2 – development required to demonstrate surface water will be controlled as near to source as possible using the sustainable drainage systems hierarchy D.ES3 /1a – development is required to enhance biodiversity through maximising provision of 'living building' elementsD.ES3 / 1c – development is required to incorporate measures to enhance biodiversity
	5. Discharge surface water to a watercourse (attenuated or unattenuated).	SI 13 / B4 – 4th on the drainage hierarchy	D.ES6 / 2 – development required to minimise the pressure on the combined sewer network
6. Surface water discharge to surface water sewer (via attenuation) at Greenfield runoff rate for all design storms including climate change allowance.		SI 13 / B - developments should aim to achieve greenfield runoff rates SI 13 / B5 – 5th on the drainage hierarchy	D.ES6 / 2 – development required to minimise the pressure on the combined sewer network D.ES5 / 3 – development is required to achieve greenfield runoff rates in critical drainage areas
7. Surface water discharge to combined sewer (via attenuation) at Qbar Greenfield runoff rate for all design storms including climate change allowance.		SI 13 / B - developments should aim to achieve greenfield runoff rates SI 13 / B6 – 5th on the drainage hierarchy	D.ES5 / 3 – development is required to achieve greenfield runoff rates in critical drainage areas

5.2 Water Demand Management



Top of the IWMP requirement hierarchy is reduction in water demand for new property via the provision of efficient fixtures and fittings.

The key drivers are contributing to resilience and protecting and enhancing the water environment. Accordingly, policy S15 of the London Plan and Local Plan policies D.ES6 and S.ES1 set clear requirements, including the need for new residential development to achieve a target use of 105/l/h/d and for commercial property to meet at least BREEAM excellent standard for the WAT 01 water category.

Table 5-2 provides an approach to demonstrate how this target can be met for residential property. The approach has been developed based on the criteria for Water Technology list[17] guidance provided by WRAP[18] and the Water Efficiency Calculator for New Dwellings included in Part G of the Building Regulations[19].

Table 5-2 Fittings Approach to achieve 105 l/h/d

Water Fitting	Maximum consumption		Capacity / flow rate	Use factor	Fixed use (l/p/d)	Consumption (l/h/d)
WC	4/2.6 litres dual flush	Full flush	4	1.46		5.84
		Part flush	2.6	2.96		7.696
Basin taps	4 l/min		4	1.58	1.58	7.9
Shower	8 l/min		8	4.37		34.96
Bath	160 litres		160	0.11		17.6
Kitchen/utility room sink taps	6 l/min		6	0.44	10.36	13
Washing Machine	7.0 kilogram		7	2.1	0	14.7
Dishwasher	0.9 l/place setting		0.9	3.6	0	3.24
Total						104.9 l/h/d

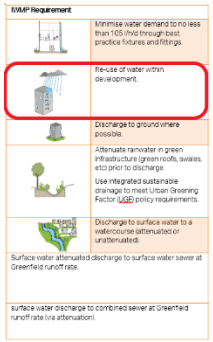
For commercial property, the BREEAM Wat 01 calculator needs to be used specific to the development type proposed in order to assess the efficiency of the building's domestic water consuming components. The emphasis in BREEAM is on the need for efficiency of fixtures and fittings related to domestic uses (toilets, taps, showers, dishwashers etc) prior to the consideration of re-use.

[17] Defra, January 2019, Enhanced capital allowance scheme for water: Water Technology Criteria List. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/794384/wtl-criteria-list.pdf

[18] WRAP, Achieving water efficiency on projects Information Sheet. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/794384/wtl-criteria-list.pdf

[19] Building Regulations 2010 (BR 2010) Part G (2016 Edition) Water Efficiency Calculator for New Dwellings.

Water Re-Use Approaches



Drivers

The reuse of water, either through capture and reuse of rainwater, or recycling of greywater (or a combination of both) is second on the hierarchy list of IWMP requirements.

Reused water should be used to meet the non-potable demand for water for new development. Non-potable water is defined for this plan as water used in toilet flushing, irrigation and washing machine use.

The baseline for the IWMP clearly defines the unique pressures on water infrastructure created by the scale of development proposed in the study area, the wider availability of water resources and the potential impacts of climate change. Minimising demand for water is a key part of the identified study drivers of delivering resilience and protecting and enhancing the water environment. It also meets specific policy requirements SI13 (B1) and SI 15 (C3) of the London Plan, and D.ES5 and S.ES1 of the Local Plan which all refer to the requirement to incorporate (or consider the inclusion of) water reuse.

Water Re-use Options

This section sets out high level principles for approaches to re-use that can be adopted study wide. Section 06 provides zone specific recommendations based on current known mix, intensity and location of development in each zone.

Re-use Types

There are two main options for provision of re-used water for non-potable purposes: rainwater harvesting or greywater recycling; the systems can be provided separately or combined.

Rainwater Harvesting: collection of rainfall runoff from roofs, storing and re-using for non-potable uses in buildings or for irrigation.

Rainwater harvesting has been identified as a less reliable source of supply for the level of expected non-potable demand in the study area (see Section 04); however, rainwater harvesting has several benefits which means it should be considered at the plot specific level.

As well as below ground storage and pumped systems, rainwater harvesting systems can also be above ground, gravity fed in combination with green/blue roofs; this reduces operational costs. Given the scale of high-rise development in the study area, this presents a distinct advantage. Systems are also often compact and easy to install as well as only requiring minimal treatment prior to re-use.

Storage attenuation required for reducing surface water runoff (either as green infrastructure-based SuDS or engineered below ground storage tanks) can be combined with use of the water for non-potable demand. Re-use and attenuation tanks can be combined using smart systems which monitor for rainfall events and manage discharge of stored water via automated valve control, holding back as much water as possible until the storage is required again for the next heavy rainfall event. This means that surface water stored for flood risk management purposes can be made available as a resource for non-potable demand as an integrated solution.

Such a system can reduce standard rainwater harvesting system costs by up to 50% as the attenuation volume is already required to meet flood management policy requirements. Additionally, smart monitoring systems can be built into the attenuation features even if not then used for re-use as they will still operate as attenuation features, providing future resilience. Such a system has been installed at Southbank Place in Lambeth (See Appendix D). It is recommended that this is set as a requirement for all developers where they propose to use below ground storage to meet runoff rate requirements unless they can demonstrate it is not viable.

Greywater Recycling: collection of wastewater from showers, sinks, and baths (greywater), treating it, storing it and reusing it for non-potable purposes within buildings

Advances in treatment technology mean that greywater systems are no longer reliant on chemicals for treatment, with biomechanical systems[20] now able to treat greywater to meet relevant British Standards. Systems can also be compact and relatively simple to install in new buildings.

[20] Combination of filter, aerobic treatment and membranes.

Section 04 of the IWMP sets out that greywater recycling offers greater potential than rainwater harvesting to reliably meet non-potable demands across the study area, providing greater resilience for climate change where summer rainfall volumes are predicted to be lower, and rainfall events less frequent.

The greater reliability of yield for greywater recycling systems creates opportunity for sharing of treated water for non-potable use between buildings. Many office-based commercial buildings do not generate sufficient greywater as a single unit to meet the demand for non-potable water within that building; whereas high rise residential buildings can generate more treated greywater than is required for non-potable demand. Given the scale of proposed high density, high rise residential buildings in close proximity to commercial property in the study area, a clear opportunity exists for sharing of treated water supplies, creating a potential market for non-potable water.

A further advantage is that greywater treatment systems can be combined with rainwater harvesting systems, which is potentially beneficial for commercial property where greywater generation may not meet demand. Such a system has been installed at 10 Fenchurch Street in the City of London (See Appendix D).

Compared to rainwater harvesting only systems, there is a larger plumbing cost associated with greywater systems, as they also require a dual pipe collection system to separate grey water from black water in foul flows, as well as the dual pipe system for potable and non-potable supply.

Community based systems

For both rainwater harvesting and greywater recycling, systems can be developed for individual buildings, plots or as community systems with centralised treatment centres with distribution networks serving several plots.

Such systems are not commonly developed and adopted by incumbent, monopoly water companies; however these systems can be built and run by limited companies called NAVs (new appointments and variations) or sometimes referred to as inset providers, which have been appointed by the water industry regulator Ofwat to provide water services to customers in an area which was previously provided by the incumbent company. NAVs will build, operate and maintain the systems and in turn charge building occupiers for non-potable water supplies; they are subject to the same regulation, duties and responsibilities as the previous statutory water company. NAVs are actively encouraged by Ofwat[21] as they provide competition in a monopolistic market, encourage innovation and can often serve a site at lower cost.

Water Demand Reduction Requirement

Planning policy related to water reuse in both the London Plan and the Local Plan requires re-use to be considered for new development. The relevant policies are set out in detail in Appendix B and include requirements for developers to consider re-use to support water demand management and wastewater reduction drivers. In order build on the policy requirement to consider it, an IWMP requirement has been developed for all new residential units to meet a consumption target of 90 l/h/d for water supplied by the water company. This would encourage the uptake of reused water systems because such a target would generally require some of the non-potable water demand for residential property to be provided by re-used water sources[22].

Data on the analysis of water demand undertaken as part of the water balance (see section 04 and Appendix C) shows that approximately 30 l/h of daily water demand in residential property is for non-potable uses when including washing machine use. Assuming a base demand of 105 l/h/d is achieved for new residential units through the efficient fixtures and fittings approach, a re-use system which was able to meet demand for all non-potable uses would result in a total potable demand of 75 l/h/d. However, the water balance calculations demonstrated that to meet all of the non-potable demand all of the time (and meet a 75 l/h/d potable demand), greywater systems would need to be installed sufficient to meet all new development needs. In many cases, rainwater systems would be easier and cheaper to adopt and install compared to greywater and so, a less stringent target of 90 l/h/d has been set to allow rainwater harvesting to be considered despite not always being able to meet all non-potable demand, increasing the range of re-use systems which can be considered for each development plot.

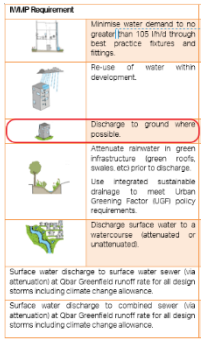
Demand Offsetting Obligations

In order to ensure the target is implementable, an offset approach has been developed for new development in the IoDSP area to allow developers to pay into a section 106 fund where they demonstrate they are unable to implement re-use measures which meet the proposed targets and underlying planning policy requirements.

[21] https://www.ofwat.gov.uk/regulated-companies/markets/nav-market/

[22] The only policy-based water consumption target is for 105 l/h/d as set out in the London Plan and Local Plan which can be achieved via efficient fixtures and fittings rather than through re-use for non-potable supply.

A supplementary study should be undertaken to develop an offset price (see Section 07 – Recommendations); however developers will be expected to pay a price for every litre (per head) of demand they are unable to achieve between the planning policy requirement of 105 l/h/d and the proposed IWMP target of 90 l/h/d. The total price to pay would be based on a standard occupancy rate and the number of units per planning application.



5.3 Infiltration Potential

As set out in Section 0, the superficial and bedrock geology does not generally support infiltration as a strategic scale attenuation or discharge option.

At a plot scale, infiltration could have the potential to provide some attenuation and volume reduction as part of a wider SuDS and landscaping approach to surface water management.

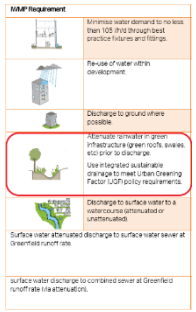
In order to maximise the use of infiltration across the study area, all developments should investigate infiltration potential through physical testing on site in line with the recommendations of the BRE Digest 365 Soakaway Design guide. The results of the tests will allow developers to identify if infiltration is suitable for their sites and potentially reduce the volume of runoff to offsite catchments. This may yield only small gains in reduction of surface volumes directed offsite but could resolve design issues associated with small catchments on the side of developments away from main surface water outfall opportunities.

Where infiltration is shown to be feasible, land contamination may be a risk to groundwater quality given the historic land uses on the site; therefore, contamination risk and suitable remediation measures need to be considered before proposing infiltration systems as part of developers' sustainable drainage strategies.

Areas where geology may be more favourable for infiltration have been identified in the zone-specific report sections (Section 06).

5.4 Use of SuDS

The use of SuDS systems to attenuate stormwater is a key requirement of the IWMP for all development proposals, being fourth on the hierarchy list of IWMP requirements. It is also a key requirement to offset the increase in foul discharge to 2041 which could significant increase flood risk.



The degree to which such systems are applied will depend on the discharge options available for surface water. In some cases, development plots will have the potential to connect directly to the River Thames or River Lea which, due to their tidal nature, can accept unattenuated discharge. However, storage for tidal locking (preventing gravity discharge) is expected to be a requirement and provision of SuDS is the optimum way to provide this storage, meet planning policy requirements and provide water quality benefits prior to discharge. Developments with no option but to discharge to the existing sewer system will be expected to meet greenfield runoff rates using SuDS as the means to achieve this.

Irrespective of the final discharge point of each development, planning policy drives the consideration of attenuation of rainwater using multi-beneficial green infrastructure prior to discharge (London Plan SI 13 and D.ES3 and D.ES5 of the Local Plan) and this supports compliance with related urban greening policy requirements (G5 of the London Plan). This section sets out SuDS approach guidance which is applicable on a study wide basis for all development proposals

On-Plot Approach

Many of the proposed development plots will incorporate new open spaces, revised road layouts and public amenity space with an emphasis on linking areas of growth with strategic green corridors and access routes as part of the green grid initiative. Where there are opportunities for strategic scale SuDS (particularly for development post 2031) either for conveyance or storage (or both), these have been highlighted in section 06 (Spatial Option identification). However, the general approach to surface water management and SuDS provision is focused on the following elements:

- Maximise on-plot source control measures through installation of green and blue-green roofs (link to water re-use requirements), bio-retention systems and permeable surfaces.
- Installation of spatially appropriate SuDS, permeable surfacing and green infrastructure for conveyance of runoff and to provide public realm attenuation. Seek opportunity to provide above ground attenuation for large development plans within public open space as part of masterplanning.

- Residual attenuation requirements met through either underground systems on plot or potentially shared local scale above ground attenuation features within areas with potential for strategic storage.

The provision of enough attenuation to achieve greenfield rates will release capacity within the existing combined sewer network, enabling the accommodation of additional foul flows generated by the development.

Technical Appendix D includes further detail on these SuDS types, how they work and the benefits and disbenefits associated with them.

SuDS, Landscape Design and Urban Greening

The current planning process requires developers to submit a landscape design separately from a drainage design. In order to have a fully integrated water management system within dense urban areas that meets both water-based and urban greening policy, landscape designs need to have water and flood risk management embedded within them. The provision of integrated soft SuDS is key to this aim as well as meeting several planning policy requirements in the process; however, the multiple benefits that can be delivered through 'soft' SuDS are not always recognised.

Soft SuDS can be defined as:

'above ground attenuation and conveyancing features that retain water at the surface (either permanently or following rainfall events) and are composed of 'soft' landscape materials such as wildflower grasses, herbaceous planting, shrubs and trees.'

In some cases, 'soft' SuDS features can offer opportunities for filtering of pollutants without the need for mechanical interceptors and are cheaper and easier to maintain than traditional drainage systems, as they can be accessed from the surface and require landscape operations, rather than complex engineering operations. Additional benefits of planted attenuation features include biodiversity net gain, amenity/provision of green space and contribution to urban greening.

For example, in dense urban areas where land availability is in short supply, the use of rills and rain gardens can provide attenuation and conveyancing that also contributes to biodiversity and urban greening, while the creation of SuDS on podium decks is now possible through crate/tank solutions providing opportunities for rainwater storage and re-use.

The use of podium decks within the IoDSP has the potential to unlock several issues surrounding development in a defended Flood Zone 3 area where finished floor levels need to be raised above modelled breach levels. Podium decks allow the developer to raise the levels within the plot, typically between high-rise buildings to ensure at grade access and egress to buildings while retaining the possibility of a largely flat vista from the buildings. This raised area is then planted to create a green and pleasant environment between the buildings and, when suitably designed, can include a significant portion of the attenuation volume needed to address the surface water discharge constraints for the plot. Keeping attenuated runoff within the elevated podium decks can then lead to the potential for rainwater harvesting systems to manage the irrigation requirements of the green space as well as feed the wider community. The attenuated runoff also embodies higher potential energy by being at a higher level, meaning that it can be piped to further outfalls while minimising the need for pumping.

Ponds and other open water features are now more common within urban settings as designers have arrived at solutions that allow open water features to be used in urban landscape design.

Plate 5-1 Streetside rill, London.[23]

Further information and case studies are provided in Appendix D. Furthermore, the LBTH Local Biodiversity Action Plan[24] provides guidance on the types of biodiversity enhancements that could be combined with SuDS schemes.

5.5 Docks Attenuation

Many of the identified development plots proposed within the Isle of Dogs to 2031 have potential to connect attenuated surface water to discharge to the dock system rather than discharge to the combined sewer. This is also likely to be the case for some development to come forward post 2031 in Zones 1 to 5.

The spatially specific opportunities to achieve this are identified in Section 06 alongside opportunities for development to discharge to other water bodies in the study area

Since 2000 approximately 25% of the water space in the docks has been lost to development, which has reduced the capacity of the system. Further loss should not be allowed as new development comes forward.

Dock Discharge Requirement

The CRT already accept discharges of surface water from developments into the dock system via a charging mechanism. Section 3.2 sets out how the dock system is managed by CRT, with water pumped from the tidal Thames to the docks to maintain the required water level for navigation and operational purposes.

CRT have a number of discharge agreements with historic and proposed sites around the dock system (particularly the South Dock), including the Canary Wharf Group, and have confirmed that further discharges would be acceptable based on individual agreements and charging processes; CRT have indicated that an additional total area of 15,000 m^2 will discharge surface water to the dock system once new agreements are in place. Further discharges of surface water could reduce the volume of water which needs to be pumped from the Thames into the docks and/or reduce the frequency of when pumping is required. This would have specific benefits in terms of reducing energy required for pumping, as well as reducing the burden on the combined sewer system and onward transmittal to Beckton STW (via Abbey Mills pumping station).

The assumption is that attenuation would be provided for these discharges to reduce runoff rates and to provide storage for high tide conditions. However, the dock system also provides opportunity to provide strategic attenuation for multiple development plots by acting as a balancing pond, taking discharge unattenuated from connected plots.

The target water level indicated by the CRT in the docks is approximately 4.00 mAOD. The CRT also indicated that the existing docks were built to a level that could allow surface water levels to rise to 4.80 mAOD, potentially providing freeboard for a significant volume of surface water storage. There is potential for this volume to be utilised via a smart system of water level monitoring and rainfall monitoring, similar to the system being adopted by Glasgow City Council and Scottish Canals[25]. Sensor and predictive weather technology could be used to provide early warning of wet weather allowing water levels to be lowered in the dock system in advance of both high tide and significant rainfall events.

Such a system would require detailed modelling analysis to determine the capacity of the system to accept surface water volumes from development, to identify the development which could benefit and to determine the impact on flood risk (refer to Section 07 Recommendations). It is therefore considered a potential strategic option for development post 2031; for zone specific opportunities for discharge to the docks (Section 06) it has been assumed that at least some degree of attenuation will be required.

Water Quality Considerations

Discharges to the docks would need to consider water quality as part of the drainage system design and it is recommended that pre and post scheme water quality monitoring is completed. Water in the dock system has long residence times increasing susceptibility to the risk of algal blooms. Nutrient enrichment (particularly from nitrogen) is an important consideration in tidal waterbodies. As the study area is in an Air Quality Management Area, there is a minor risk that nitrogen may be deposited

[23] Source: www.flickr.com Thames 21 (CC BY-ND 2.0)
[24] https://www.towerhamlets.gov.uk/Documents/Environmental-protection/Tower_Hamlets_Local_Biodiversity_Action_Plan_2019_24.pdf

[25] http://www.glasgowcityregion.co.uk/article/9857/Pioneering-new-digital-surface-water-drainage-system

from the atmosphere onto hard surfaces which could then be picked up by surface water drained and discharged to surface water features.

Attenuation via green infrastructure-based SuDS (such as swales, bio-retention and rain gardens) would act to mitigate this risk through a reduction in nutrients and other pollutant loadings as well as reducing discharge of sediment load to the docks. It is therefore recommended that discharges to the dock system are subject to some degree of attenuation prior to discharge for water quality reasons as well as reduction in flood risk and that the opportunity for using the docks for strategic attenuation considers how water quality would be managed as part of further studies.

There may also be opportunity to consider the use of large-scale floating ecosystems[26] in the docks to offset any increase in nutrients which could also serve as a significant biodiversity enhancement.

5.6 Greenfield Runoff Offset

Local Plan Policy D.ES5 requires all development located within CDAs to achieve greenfield runoff rate and volume. Where development is unable to discharge to a surface water body and proposed to discharge to the combined sewer, achievement of greenfield runoff rates is essential in the IWMP area to ensure that the increase in foul water discharge can be sustainably managed. An IWMP requirement has therefore been developed that all development (not just CDAs) should aim to achieve greenfield runoff rates. Developments within the study area which do not achieve greenfield runoff rates, and which propose to discharge to sewer, should make an offset contribution.

Through proposed drainage strategies, developers will be expected to demonstrate the volume of attenuation required in order to meet greenfield runoff requirements for their site for all storm events up to the 1% AEP with a suitable allowance for climate change. They should then set out the volume of attenuation they are able to provide. For every m^3 of attenuation storage which cannot be provided by the developer, but which is required to meet greenfield runoff rates, they will be expected to pay an offset charge per m^3 via a section 106 contribution.

Accrued offset contributions will then be utilised by LBTH to provide retrofit SuDS systems within the study area as a means to reduce surface water runoff rates and/or volumes within the wider combined sewer network.

LBTH will then seek opportunity to deliver retrofit SuDS systems, often in conjunction with the other functions and services which the council provides, including:

- Regeneration projects, traffic calming and footway schemes: through enhancements to existing public realm and highway verges and changes to raised planted areas (e.g. installation of permeable paving, and introduction of rain gardens).
- Refurbishment of large estates.
- School projects: installation of measures in extensive external spaces and hard standing areas, providing additional educational benefit.
- Creating storage areas in open spaces (parks and shared community spaces etc).

[26] https://www.biomatrixwater.com/floating-ecosystems/

5.7 Other Study-Wide Options

Docklands Light Railway Disconnection

There is approximately 6km of DLR track within the IWMP study area, much of which is elevated at viaduct level.

The track is currently served by drainage connected to the Thames Water combined sewer system. Disconnecting the surface water drainage and finding alternative ways to manage the surface water runoff provides a key opportunity to reduce the load on the combined sewer and provide a more sustainable approach to surface water management for the DLR.

DLR Underline

The space underneath the elevated sections of the DLR has the potential to be used for a range of public uses, including public realm, open space and event space. LBTH are undertaking pilot exercises as part of the extensive mixed-use redevelopment at Marsh Wall West and the Crossharbour DLR station improvement works. The vision for these spaces is to provide public realm that serves social, economic and environmental purposes.

These spaces offer a key opportunity to change the way that surface water in the public realm is managed and to connect the DLR track drainage to SuDS systems.

Delivery Mechanisms

TfL DLR are responsible for improvements to the railway. There is a capital replacement budget that is managed through a 10 Year Plan, as well as a 25 Year 'Look Ahead' which considers how the railway will be kept running in the longer term.

The maintainer also has a responsibility to invest and undertake works to prolong the life of an asset.

Some of the drainage infrastructure associated with the DLR is hard to access which has hindered successful maintenance in the past, for example downpipes located within the columns supporting the track. There is a programme of works to move infrastructure on to the outside of the columns to facilitate easier maintenance. This creates an opportunity for DLR to build on this work and start to remove downpipe connections to the combined sewer, and instead connect to SuDS.

Plans are underway for improvements to the Crossharbour DLR Station including wider interchange with buses, integration with the District Centre and enhancing sense of place and removal of embankments and hard landscaping around the station environs .

Figure 5-1 Crossharbour station environs

The station is located approximately 130m to the east of Millwall Outer Dock. There is therefore a potential opportunity for a strategic SuDS system to be implemented in this location that connects the DLR track drainage and public realm to Millwall Outer Dock. Furthermore, this system could be used by subsequent connecting development plots in this location to connect to, such as Selsdon Way creating partnership funding opportunities.

In addition, there are large areas beneath the DLR viaduct at Crossharbour that could be redeveloped using rain gardens, soft landscaping, bioretention basins and shallow gradient storage features to attenuate stormwater prior to release to the docks. Such measures would improve the amenity of the area and the visual appeal as well as providing surface water management benefits.

Figure 5-2 Example of a bioretention basin in public realm[27]

Similar schemes could be considered by TfL DLR elsewhere in the study area, particularly those locations around which future redevelopment is concentrated and where there is a nearby connection to the dock system. The Local Connections Strategy identifies station public realm upgrades including Westferry, Poplar, Blackwall, South Quay, Crossharbour and Mudchute.

Case Study Example: Sydney Metro

A new metro train line in Sydney, which incorporates a 4.2km elevated viaduct component, includes the following water catchment and reuse initiatives incorporated into the design:

- The use of Water Sensitive Urban Design practices with a multi-tiered urban water cycle management strategy that seeks to retain as much storm water as possible to support plants, local ground water and integrated wetland features.
- Harvest and recycle water from station canopies for reuse during operations or in the surrounding landscape precinct landscapes using a modular underground water storage tank.
- Use of grass or vegetated swales to capture stormwater drainage.

Case Study Example: The Miami Underline

The Miami Underline is a project to transform the land beneath Miami's Metrorail into a 10-mile linear park. This is an example of using the space beneath the viaduct for multiple uses including landscaping and planting to improve biodiversity. Such features can also deliver surface water management benefits.

Figure 5-3 Example of soft landscaping in the Miami Underline

Heat Recovery from Sewers

The southern parts of the study area comprising most of Zones 3/4 and 5 are drained by a network of combined sewers that all join together and pass through a single system near the eastern end of South Dock, adjacent to the combined sewer overflow pump station.

The planned developments in the next 10 years for these Zones will result in significant increases in the foul load to the existing system. In addition to the increase in foul load, the proposals through this IWMP should result in a significant reduction in the surface water load to the combined drains. The resultant combined drainage system will therefore comprise of a larger percentage of foul water and the location of the pump station serving the combined sewer overflow should be investigated to include a system that could extract heat from the combined sewer to sell to the nearby properties via district heating systems.

The pumping station site already includes infrastructure to lift storm overflow water from the deep sewer to the overflow system which could be used to feed a new heat recovery system in the vicinity. This would also ensure that the pumps serving the CSO

[27] https://www.rms.nsw.gov.au/business-industry/partners-suppliers/documents/centre-for-urban-design/water-sensitive-urban-design-guideline.pdf

are operated more often, reducing the ongoing maintenance liability that is inherent to seldom-used systems.

5.8 Infrastructure Delivery and Coordination

A core principle of the IWMP is that water management infrastructure is provided in a coordinated manner. Improvements to water infrastructure should be considered in coordination with provision of other infrastructure taking place in the study area (e.g. energy, waste, road improvements) in order to reduce disruption, deliver cost savings and provide joined up utility provision.

There are two main ways this may be realised;

- Ensuring that water management measures are retrofitted as part of any future infrastructure improvements. For example, taking an opportunity to provide a new rain garden as part of public realm maintenance works, or as part of an upgrade to a railway station frontage; or including new SuDS or tree pits as part of planned road resurfacing works;
- Coordination of larger infrastructure works to enable a 'dig once' approach; e.g. when a road is due to be closed for installation of a new gas main, new surface water sewers are installed at the same time.

Within each IWMP Zone, locations where there could be opportunities for coordinated delivery of water management measures have been noted (Section 06). These have been identified from the GLA's Infrastructure Mapping Application, as well as meetings with the wider stakeholder group and the site walkover.

It is crucial that the recommendations of the IWMP are considered as part of other plans and projects that are commencing within the study area, to facilitate ongoing options development and delivery. Such projects include masterplans, biodiversity and green infrastructure plans, place making and street planning work. Where such projects are known and have been identified during the preparation of the IWMP, these are also flagged in each zone as appropriate.

5.9 Summary

As part of the IWMP, a hierarchy of requirements for water management (Table 5-1) has been established based on the planning policy context and the key environmental and infrastructure constraints and opportunities in the study area. Options have been identified which will assist developers and stakeholders to deliver on these requirements.

A number of the options and approaches identified are applicable across the whole study area and these are detailed and prioritised in Table 5-3 below. Measures have been prioritised as follows:

- High Priority: would have the greatest benefit for some of the biggest constraints and have a clearer delivery mechanism.
- Medium Priority: options which will have significant benefit on their own but are likely to require multi-stakeholder involvement to deliver.
- Low Priority: options with long lead in times, uncertain delivery mechanisms and/or would need to form a suite of measures to address a constraint.
- Quick wins: measures which are relatively straightforward and quick to implement.

This section has also identified the following additional measures:

- Coordinating plans for the DLR underline and future alterations to drainage from the DLR network to deliver SUDS systems that can be used by multiple plots.
- Taking opportunities for heat recovery from the sewer network.

This Section has also highlighted that improvements to water infrastructure should be considered in coordination with provision of other infrastructure taking place in the study area (e.g. energy, waste, road improvements) in order to reduce disruption, deliver cost savings and provide joined up utility provision.

Table 5-3 Prioritised study-wide measures and approaches summary

Measure/Approach	Rationale	Priority	Priority Justification
Develop a demand offset policy	A study-wide demand target of a maximum consumption of 90 litres per person for all new residential property; where this is not achieved by developers, a section 106 (s106) contribution will need to be paid. Accrued s106 payments would be used to fund water efficiency and re-use retrofit projects in the study area. This will require developers to include water re-use rather than relying solely on efficient fixtures and fittings to deliver water efficiency. The requirement to consider re-use is set out in policy SI13 (B1) and SI (C3) of the London Plan and policy D.ES5 and S.ES1 of the Local Plan.	High	A demand offset mechanism would be implementable by LBTH and could have a significant effect in minimising future demand for potable water.
Develop a greenfield run-off rate offset policy	All development should be required to achieve greenfield run-off rates for discharge of surface water through the provision of either on-site Sustainable Drainage Systems (SuDS) or community SuDS schemes. Where greenfield rates cannot be achieved, a s106 contribution will be paid. Accrued s106 payments would be used to fund retrofit SuDS measures within public realm or other council owned land to reduce overall discharge volumes and rates to the sewer system serving the study area.	High	A runoff offset mechanism would be implementable by LBTH[28] and would have a significant effect in offsetting the impact of additional foul discharge to the combined sewer system serving the study area.
Strategic multi-plot surface water networks in advance of development	In many identified locations, multiple development plots would benefit from separated surface and foul water discharge with the provision of strategic surface water sewers linking new development and discharging to the docks or watercourses. These systems could be developed and adopted by third party providers, supported by a mechanism by which developers contribute to the costs as development comes online.	Medium	Separated systems would facilitate more development connecting to surface water options and significantly reduce pressure on the combined sewer system but would require multi-stakeholder agreements regards funding and ownership.
Combine below ground surface water storage and re-use	Where developers propose the use of below ground storage as attenuation to reduce surface water runoff rates, they should be required to combine it with re-use of the stored water for non-potable uses, or to demonstrate why this is not feasible.	Low	All below ground storage acting to serve non-potable needs would bring benefit as part of a wider suite of re-use solutions.
Strategic dock attenuation	There is potential for the combined dock system to provide strategic attenuation for multiple plots adjacent to the waterbodies, particularly for some of the high density, space constrained development. Some plot-based attenuation via SuDS would be required to manage the quality of discharge, but additional storage could be provided by the docks for this purpose. This could reduce the reliance on pumping into the dock system from the River Thames in order to maintain water levels. Further study is required into the feasibility of this option.	Low	A dock-side attenuation system could bring substantial benefit but would require further detailed study to determine scope including protection of water quality during the summer.
New Appointment or Variation (NAV) advice	NAVs are limited companies which are licenced by the water industry regulator to provide water and wastewater services in an area previously served by an incumbent	Quick Win	Advice can be easily incorporated into LBTH's current infrastructure co-ordinator service.

[28] Such a mechanism also has precedent for the Old Kent Road Opportunity Area in London Borough of Southwark

	water company. NAVs can provide water and wastewater services to large plots or a group of plots, providing and managing a range of integrated SuDS, wastewater treatment and re-use for non-potable supply and charging occupiers directly for water and wastewater services; in this way, they provide integrated services which are not often provided by the incumbent monopolised market. Via the Council's infrastructure co-ordinator service, contacts with NAVs should be made available to developers where strategic re-use and integrated surface water management solutions are identified in the IWMP as being feasible.		
SuDS and Urban Greening	Further guidance should be provided to developers on how landscaping and water management via SuDS can deliver both urban greening policy requirements and water and flood risk policy requirements. Drainage engineers and landscape architects should be encouraged to jointly develop landscape plans and drainage strategies using the guidance.	Quick Win	An advice document would be relatively simple and quick to produce and would influence and support developers in increasing integrated SuDS uptake.
Dual plumbing	All new development should be encouraged to design for dual plumbing (potable and non-potable pipework systems) in order to provide improved future resilience. Dual plumbing would allow buildings to be connected to sources of re-used water as they are developed or brought on-line within the study area in the future, supporting the development of a market for re-used water.	Quick Win	Encouraging developers to adopt dual plumbing for future resilience would be relatively simple to promote.

06 SPATIAL OPTIONS IDENTIFICATION

Potential spatially specific water management options are presented in this section as a roadmap to guide implementation of the most feasible options in each study zone whilst allowing for adaptability to suit specific development proposals. The options roadmap is supported by a detailed case study for one development plot to demonstrate how the options could be delivered in practice.

6.1 Option Approach

Potential options for each zone are presented in accordance with the hierarchy of IWMP requirements to aid developers and planners in implementing the recommendations of the plan. A summary of the requirements and their order of preference is shown in Box 6-1.

Case Study

The Crossharbour District Centre plot in Zone 3/4 has been chosen as a case study due to a combination of the proposed mix of development, proposed development density, likely site layouts and the geographic opportunities and constraints.

This combination presents the potential for measures to be delivered as per the IWMP requirements hierarchy but also demonstrates how initial constraints typically faced by developers can be overcome, such as a land locked location, access to combined sewers only and proximity to an area already prone to surface water and sewer flooding.

Hierarchy of IWMP requirements	
1) Minimise residential water demand through best practice fixtures and fittings and achieve BREEAM excellent for commercial property. 2) Reuse water within development (greywater or rainwater) to meet minimum water use target set for the study area.	**First Consideration:** Demand reduction (both required)
3) Attenuate rainwater in green infrastructure prior to discharge (for example green roofs, swales, etc). 4) Use integrated sustainable drainage to meet Urban Greening Factor (UGF) policy requirements.	**Second Consideration:** Green Infrastructure (both preferred)
5) Discharge to ground where possible. 6) Discharge surface water to the docks, River Lea or River Thames. 7) Discharge surface water to surface water sewer at greenfield runoff rate (via attenuation). 8) Discharge surface water to combined sewer at greenfield runoff rate (via attenuation).	**Hierarchy for surface water discharge** (select most feasible option near top of list)

Box 6-1 Summary of IWMP requirements hierarchy

6.2 Zone 1 South Poplar

Zone Summary

Location

The South Poplar Zone in the northern part of the Isle of Dogs is bounded on the south by the A1261 Aspen Way dual carriageway and in the north by the A13 East India Dock Road.

Growth

Table 6-1 summarises the projected growth for Zone 1 and shows that almost half of the plots earmarked for redevelopment by 2031 have been completed or are under construction. There are three main plots where housing development is expected to come forwards beyond 2021, one of which, in combination with two other sites in Zone 2, forms the South Poplar Masterplan area. A further 1,007 housing units are planned for 2031-2041.

Table 6-1 Summary of projected growth in IWMP Zone 1

Housing	Units
2016 – 2031 Phasing: Complete / under construction	**2,200**
2016 – 2031 Phasing: Yet to be constructed. Key sites include: - 2 Trafalgar Way, E14 (Infinity Towers, formerly Helix) - 82 West India Dock Road - Aspen Way Site Allocation (Tower Hamlets College and TfL site)	**2,800**
2031-2041 maximum growth scenario*	**1,000**
Commercial floorspace (2021 – 2031)	**77,300 square metres**

*Note, the boundary of the OAPF Zone 1 and IWMP Zone 1 are slightly different, as described in Section 3.1.

Constraints and Opportunities

The South Poplar Zone has the following specific constraints and opportunities:

- Over half of the medium term planned growth is still to be delivered, offering potential for identified measures to be implemented.
- The Zone benefits from significant transport links including the A1261, the East India Dock Road, the A102 and the DLR corridor. While these transport links form barriers to potential cross-plot drainage, they also provide opportunities in the form of linear corridors that could be followed with new drainage infrastructure to outfalls such as the River Thames and the docks.
- The Zone includes large plots (Point 1 on Figure 6-2) already earmarked for redevelopment that are adjacent to other large plots within IWMP Zone 2, allowing for connectivity between zones for surface water drainage and re-use.
- The Zone included a large landscaped area which could be used to accommodate surface water attenuation.

Water Balance

The key changes in the Water Balance for Zone 1 are shown in Figure 6-1.

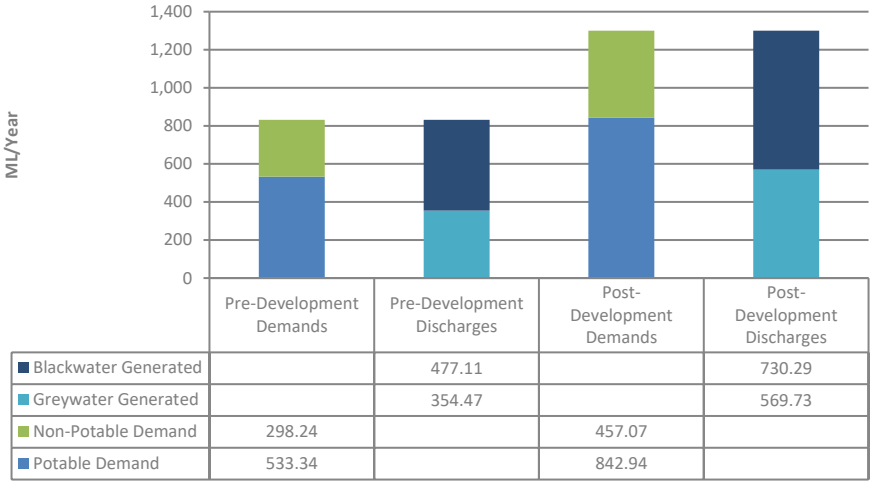


Figure 6-1 Zone 1 Water Balance Summary

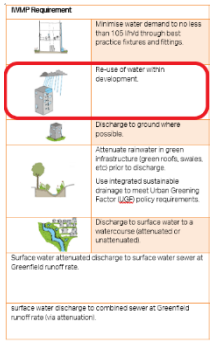
- Over the 10-year period analysed, the average amount of time that attenuated rainfall meets non-potable demand in Zone 1 is 18%, and 41% of the time the demand is not met.
- Greywater generated post development would meet all non-potable demand in the Zone.

- Without mitigation, peak foul water discharge will increase by 53%.

Re-use and Demand Reduction

There is potential for re-use to be delivered strategically in the zone with the following options:

- The plots along the northern boundary of the A1261 (Point 1 Figure 5-2) have the potential for significant benefit through community-based water resource systems. One such plot is the Traincare Depot which is to be redeveloped with a deck installed above to provide space for commercial and residential properties. This would allow surface water captured on the above units to be routed to tanks that could be used for train washing in the underlying Depot, resulting in reductions in potable water usage and removing volume from the surface water discharge infrastructure.
- Due to density of development up to 2031, attenuation required prior to discharge is likely to lead to some degree of tank storage which could be used in conjunction with new rainwater harvesting technologies. These systems use weather prediction inputs to allow tank volumes to be maximised, effectively using surface water attenuation tanks to double up as rainwater harvesting tanks. Within this Zone, the systems could be implemented to deliver harvested rainwater to infrastructure management companies that require water for maintenance of landscaped areas as well as the Traincare Depot.
- The quantum and density of development within the Zone is such that it will potentially allow for commercially viable grey water recycling systems to feed commercial properties with recycled grey water from residential properties. Development is likely to be high-rise, with the residential properties primarily within the higher parts of the buildings and commercial properties below. This could allow for grey water recycling systems to be installed within the middle floors of the buildings, potentially removing the need to pump recycled water to the underlying commercial properties but feeding them via gravity instead.



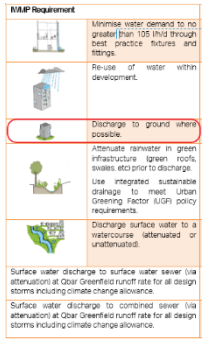
Demand Offset - Retrofit Potential

Accrued s106 contributions from the demand offset obligations could be used extensively in this zone to install retrofit water efficiency measures and potential retrofit rainwater harvesting schemes.

A significant percentage of the land use not subject to development before 2031 is council owned and includes several housing estates as well as the Our Lady and St Joseph Catholic Primary School.

Surface Water Management

Infiltration



The superficial Kempton park Gravel member underlies the northern section of this Zone and offers the potential for infiltration-based SuDS to be included as part of the drainage strategy delivery.

However, the strategic potential for large scale attenuation via infiltration will be limited by the underlying clay geology and the influence of tidal levels on groundwater in the superficial deposits.

Developers in the northern section of this Zone should look to consider infiltration potential via physical testing on site in line with the recommendations of the BRE Digest 365 Soakaway Design guide and using trial pit and borehole log information. Test results will allow developers to identify if infiltration is suitable for their sites and potentially reduce the volume of runoff to offsite catchments.

Proposed Options Zone 1 South Poplar

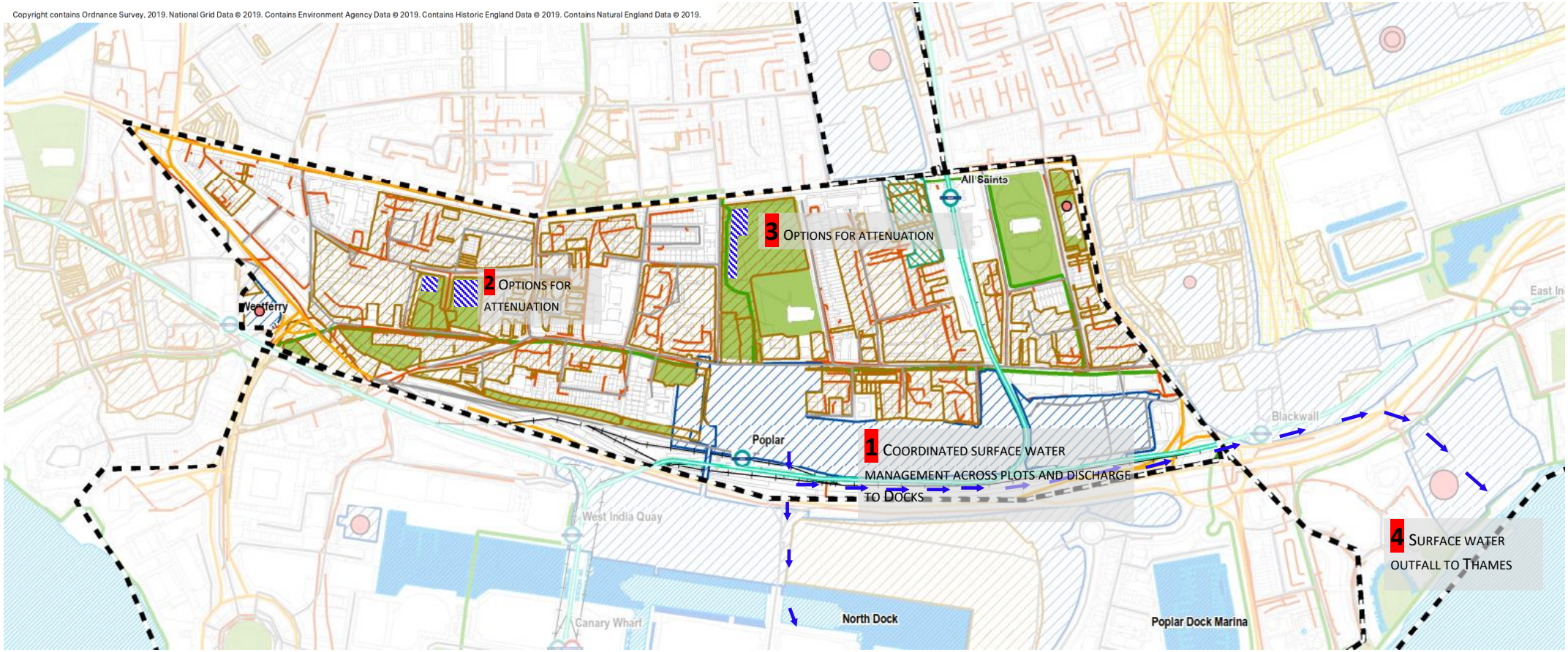
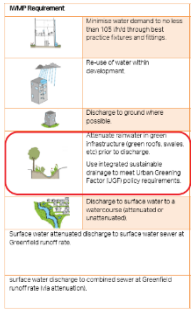


Figure 6-2 Schematic of Options for Zone 1 South Poplar

Rainwater Attenuation in Green Infrastructure



The Zone includes two large open landscaped areas which currently serve as recreational space (Points 2 and 3 in Figure 6-2).

These could be made to operate as they presently do with the added benefit of providing significant attenuation and water quality enhancement to improve surface water drainage in the local vicinity. They could present significant strategic SuDS solutions for development which may come forward in these locations post 2031.

On the central west side of the Zone, Rosefield Gardens (Point 2 Figure 5-2) occupies an area of approximately 6000 m^2 with at least a third of the area as open lawn space with some play equipment. The area is at grade with the surrounding roads. Thames Water records show that the area is only served by combined sewers. Surface water from adjoining properties and roads could be directed either to new underground surface water attenuation systems such as cellular storage tanks; or preferably above ground storage could be derived for extreme events by creating depressions in the landscaped areas where water could pond periodically before receding in the underground system after the storm has subsided (see Figure 6-3). Based on the available open areas with the garden and a depth of tank of 1m, an approximate storage volume of 1000m^3 could be mobilised while allowing space for services that may be present.

The Poplar Recreation Ground located in the northern part of the Zone (Point 3 in Figure 6-2) is an area larger than the Rosefield Garden but is already occupied by several buildings and sports pitches as well as large, established trees. The potential for underground storage in this area is therefore less compared to Rosefield gardens; however, the north western part of the Ground could accommodate up to 500 m^3 of storage in above and below ground storage if the land available was shaped to suit the levels.

Any use of the existing green spaces for attenuation of surface water from adjoining plots will require close cooperation between developers, the green space landowners and the LBTH. However, such mechanisms should be encouraged and incentivised through the LBTH to ensure that land use is maximised.

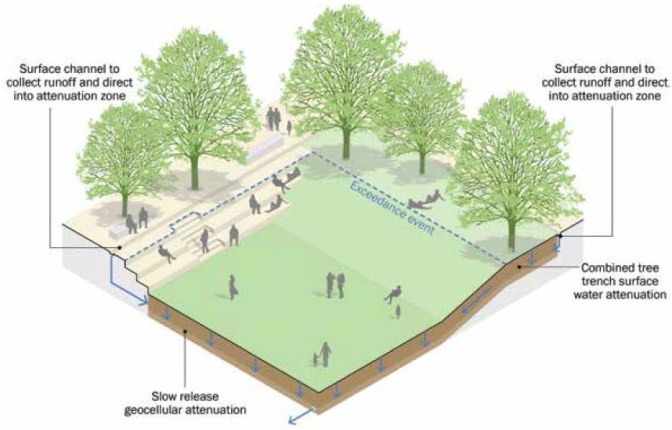
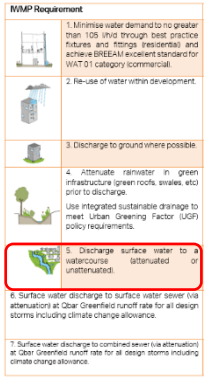


Figure 6-3 Example of Multi-functional civic space providing exceedance storage SuDS Manual C753

Discharge to Surface Water Body



This Zone is land-locked and therefore does not have immediate access for outfalls to waterbodies. However, several large development areas are highlighted in Figure 6-2, which could benefit from cross-plot routes for surface water drainage to new outfalls.

The large plots along the southern edge of the Zone (Point 1 in Figure 6-2) are adjacent to other large plots within Zone 2 which are themselves immediately adjacent to the North Dock within Canary Wharf. All these plots could therefore be linked through surface water drainage infrastructure adopted by either a management company set up by the various plot developers, Thames Water[29] or the Council. For the case of adoption by Thames Water, a solution to the fee required in perpetuity by the Canal and River Trust would need to be found as this currently precludes Thames Water from adopting any drainage infrastructure that outfalls to the Docks.

[29] Thames Water would not adopt SuDS features but could adopt piped surface water drainage elements

The Zone is crossed by the elevated railway operated by the DLR as well as the A1261 along the east-west axis. Beyond the eastern end of this transport corridor, access to the River Thames can be gained via a large car park and a dock called the Blackwall Yard. This area is due for redevelopment as part of Zone 6A and therefore could serve as a link for the installation of a new surface water outfall directly to the River Thames (Point 4 in Figure 6-2).

The outfall would bring an opportunity to Thames Water to install strategic surface water drainage under the transport corridor to serve the new developments in Zone 1 and 6A as well as any adjoining plots that may already have separate drainage networks. In addition, the surface water connections from the elevated railway could be disconnected from the combined sewers and re-directed to the new surface water sewer. The land occupied by the elevated railway could be used to provide underground storage linked with shallow linear depressions to create conduits of drainage along the railway corridor. These could take the form of individual rain gardens or more extensive swales laid alongside the railway and road corridor (See Figure 6-4 as an example). In sections where space is at a premium, the above ground green SuDS features may be replaced with sections of underground drainage pipes which could be installed in gravel trenches to act as filter drains to accept hardstanding runoff.

Figure 6-4 Example of swale providing a vegetated corridor. SuDS Manual C753.

Discharge to Docks

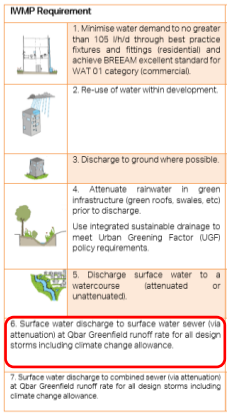
In order to achieve the outfalls to the North Dock, further engagement with the CRT will be required. The process of applying for a new outfall to any dock controlled by the CRT is currently dealt with by the CRT on a case by case basis, with negotiations based on cost and benefit to the CRT. By imposing discharge rate limits to the applicants, the CRT can also ensure that they receive water at a suitable rate to manage the water levels in the wider dock system.

Discharge to Watercourse

The discharge opportunity to the River Thames (Point 4 in Figure 6-2) will be subject to agreement between various plot developers unless Thames Water are able to introduce the new surface water sewer infrastructure in advance of the connection points being required by the developers. Such strategic infrastructure will require input and cooperation from the Council.

The benefits would be a source of revenue to Thames Water and reduced costs over time to dispose combined sewer effluent via pumping stations and treatment plants. This will also free up much needed capacity within the combined sewer network for foul water from the proposed developments. In addition, the developers would have access to a system that may be able to accept surface water runoff at rates higher than the Qbar greenfield runoff rate if they are able to cater for surcharge conditions in the new surface water sewer due to tidal level in the River Thames.

Discharge to Sewer



The sewer system currently serving the zone is a combined sewer and there are no existing surface water only sewers for connection.

Developers in this zone should only connect to the combined sewer where they have demonstrated that it is not feasible to connect to the docks or the River Thames via plot specific or strategic, multi plot systems, and where they have demonstrated that opportunities for rainwater attenuation via landscaping have been maximised.

Additionally, developers should maximise any opportunity for infiltration unless demonstrated via testing that this is infeasible.

Option Delivery

Linking new surface water infrastructure across multiple plots to Zone 2 and the North Dock.

This will require:

- Levels within plots on Zone 1 to be raised to allow gravity discharge to plots on Zone 2 and eventually to North Dock.
- Attenuation within each plot (using green infrastructure-based SuDS where possible) to ensure controlled discharge at Qbar greenfield runoff rates to North Dock.
- A study of the levels and construction of the A1261 to determine if a suitable gravity connection can be made under it.
- Discussions and agreement with the CRT to determine if a gravity outfall to the North Dock will be acceptable.
- Discussions and agreement with Thames Water to install and maintain the non-SuDS sewer network infrastructure in perpetuity or with the Council to do the same. In both cases the issue of an ongoing fee for discharge to the North Dock would need to be agreed with the CRT.
- If neither Thames Water nor the Council are able to provide the infrastructure and maintain it, then the Plot developers would need to broker an agreement with the CRT.

Linking new surface water infrastructure across multiple plots to Zone 6A and a new outfall to River Thames:

- Ground levels along the travel corridor formed by the A1261 and the elevated DLR railway will need to be assessed for installation of a gravity sewer.
- Thames Water would need to be consulted and would need to deliver the new sewer elements ahead of new developments coming online.
- The Environment Agency would need to be consulted for an agreement for the new outfall to the River Thames.
- The DLR should be consulted to determine if they will provide space for the infrastructure to be installed under the elevated railway. This may be through a trade-off to reconnect the drainage from their elevated railway to the new sewer.
- Thames Water could adopt and maintain the pipe in perpetuity (non-SuDS elements only).
- Plot developers would need to ensure the quality of the discharge to the new sewer to avoid pollution of the River Thames.
- Plot developers would need to provide sufficient attenuation to suit requirements of Thames Water, at the very least providing a system that would not result in flooding due to the tidal nature of the proposed outfall.

Placing attenuation within the existing green areas to deal with future development (post 2031) and reduce flow rates to existing combined sewers via attenuation:

- The ownership of the green areas would need to be ascertained; both highlighted green areas are owned by the Council, therefore works may be able to progress more easily than if privately owned.
- An assessment would be needed of the existing green areas to determine space available for drainage features. This may include tree root assessments, current land uses, underlying utilities and topographical levels.
- An assessment of the adjacent developments would be needed to seek to match the need for attenuation with the available space. If available space outstrips need, drainage from surrounding public roads could be diverted to reduce the strain on public combined sewers through reduced flow rates from the roads.
- The maintenance of the infrastructure would depend on the nature of the drained areas: where properties are drained LBTH may be the most likely candidate for adoption/ maintenance of the SuDS elements, with Thames Water adopting the pipe network. Where roads are drained, the highways authority may need to take on the new infrastructure.

Plot developers to provide rainwater harvesting for train cleaning:

- Through the planning process, the plot developer for the Traincare depot should be encouraged to provide proposals that will include rainwater harvesting to supply the underlying depot.
- This may be achieved through the imposition of potable water supply limits for the commercial processes involved with the depot and financial contributions to the systems.

Plot developers to provide grey water recycling from residential high-rise buildings to lower level commercial properties:

- Through the planning process, the plot developers should be encouraged to provide proposals that will include grey water recycling to commercial and residential properties. This will require dual supply plumbing and separated black and grey wastewater drainage.
- This may be achieved through the imposition of potable water supply limits for the commercial processes involved with the depot and s106 offset contributions where limits are not met.

Opportunities for Coordinated Delivery

As described in Section 5.8, a core principle of the IWMP is that improvements to water infrastructure should be considered in coordination with provision of other infrastructure taking place in the study area (in order to reduce disruption, deliver cost savings and provide joined up utility provision). The following opportunities have been identified in Zone 1:

- Coordinated delivery of upgrades to energy infrastructure (gas main) and installation of a new surface water sewer along Aspen Way.
- Station public realm improvements are planned at Westferry and Poplar and the redevelopment of plots in South Poplar will intersect the DLR underline. Opportunities should be sought to disconnect downpipes from the DLR track and integrate with SuDS within the public realm.
- Plans for road resurfacing should include SuDS and maximise opportunities for roadside landscaping and improvements to the public realm.
- The findings and recommendations of the IWMP should be used to inform the South Poplar Masterplan which covers the plots on North Quay, New College Site, Billingsgate Market and 2 Trafalgar Way.
- Interventions close to flood assets (for example Thames Tidal Defences) provide opportunities to coordinate with the Environment Agency Isle of Dogs Asset Management Strategy as part of the Thames Estuary 2100 Plan.

6.3 Zone 2 Canary Wharf

Zone Summary

Location

Zone 2 is located amongst several docks and cross waterways and is defined by a significant number of high-rise buildings and bridges connecting the parcels of land between the docks with the surrounding area.

Growth

Several large plots on the periphery of the Zone are earmarked for re-development, two of which form part of the South Poplar Masterplan area (Billingsgate market. North Quay – Point 1 in Figure 6-6).

Table 6-2 summarises the growth in Zone 2, highlighting that, of the plots to be redeveloped by 2031, 5,229 units have already been completed or are under construction and 3,613 units remain. There are also proposals for 407,547 square metres of commercial floorspace in this period.

Table 6-2 Summary of growth in Zone 2

Housing	Units
2016 – 2031 Phasing: Complete / under construction	**5,200**
2016 – 2031 Phasing: Yet to be constructed. Key sites include: - Billingsgate Market Site Allocation - Land at North East Junction of Manilla Street and Tobago Street - North Quay, Aspen Way, London E14 5LQ - Riverside South Site Allocation	**3,600**
2031-2041 maximum growth scenario	**2,300**
Commercial floorspace (2021 – 2031)	**407,500 square metres**

Constraints and Opportunities

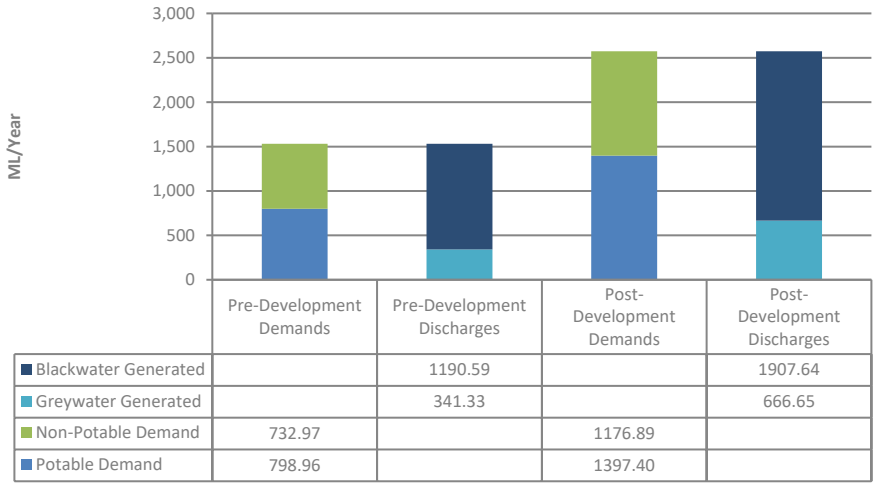
The Canary Wharf Zone has the following specific constraints and opportunities:

- 60% of the medium-term development planned to 2031 is already completed or under construction, which limits the potential for strategic options to be developed for much of the growth.
- Some plots are adjacent to either the River Thames or the docks with direct connection potential. In addition, street level plates overhanging the water are proposed for many of the key development plots offering a direct route to discharge.
- Increased surface water discharge to the docks could reduce the need for pumping by the CRT.
- The water level expected at the docks may be too high to drain some development plots. Land may need to be raised or pumps may be needed to lift surface water to levels sufficient to allow discharge to the docks.
- The proposed developments are composed of a mixture of residential and commercial properties, providing the opportunity to grey water recycling and rainwater harvesting across plots.

Water Balance

The key changes in the Water Balance for Zone 2 are shown in Figure 6-5.

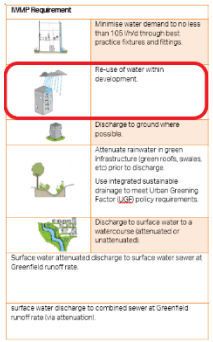
- Over the 10-year period analysed, attenuated rainfall is calculated to meet non-potable demand in Zone 2 only 1% of the time, on average. 43% of the time the demand is not met at all.
- Due to the scale of proposed development, greywater volumes generated post development would not be sufficient to meet all non-potable demand; therefore, a combination of rainwater harvesting and greywater recycling would be required.
- Peak foul water discharge will increase by 100%



	Pre-Development Demands	Pre-Development Discharges	Post-Development Demands	Post-Development Discharges
Blackwater Generated		1190.59		1907.64
Greywater Generated		341.33		666.65
Non-Potable Demand	732.97		1176.89	
Potable Demand	798.96		1397.40	

Figure 6-5 Water Balance Summary for Zone 2

Re-use and demand reduction



There is potential for re-use to be delivered strategically in the zone with the following options:

- Proposed commercial / non-residential land uses present significant opportunity for the development on the south east corner of Canary Wharf (Point 2 Figure 5-6), where up to 3,100 residential units may be constructed together with significant commercial offerings including a hotel, retail and financial establishments, leisure and community facilities. Such mixed-use sites brought forward through a single developer provide the possibility of integrating community-based solutions such as multi-building grey water recycling systems and combined rainwater and attenuation systems. Using community-based systems in the case of the Canary Wharf plots would be beneficial since the area is part of the CWG ownership, making bespoke maintenance and management companies a more achievable target for cross-building applications.
- Due to density of development up to 2031, attenuation required prior to discharge is likely to require some degree of tank storage which could be linked to weather prediction software and equipment to maximise the space in the tanks for storage of water as rainwater re-use potential or discharge prior to the next predicted storm. Such systems could be applied to the parts of the Zone that include landscape areas where harvested rainwater can be used for irrigation as well as to feed residential units.
- Greywater recycling potential from the anticipated scale of residential units could meet significant demand from the commercial units, potentially providing in excess of 150 m^3 of recycled water per day which could feed toilets across the developments.

Proposed Options Zone 2 Canary Wharf

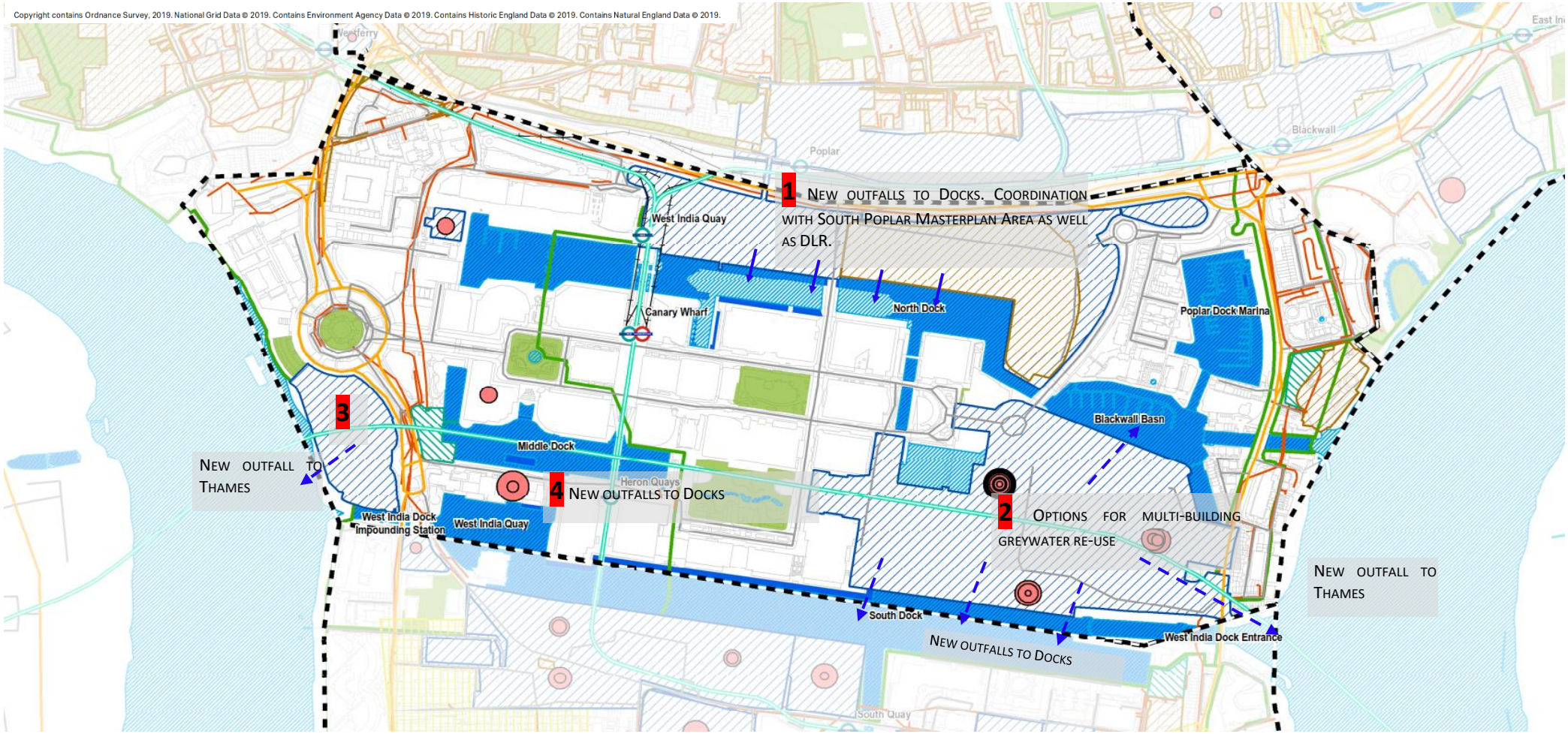
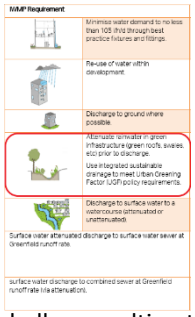


Figure 6-6 Schematic of Options for Zone 2 Canary Wharf

Demand offset Retrofit Potential

The use of accrued s106 contributions from the demand offset obligations would be limited in this Zone; however, there is potential to consider offering grants for the extensive range of non-residential building owners and occupiers to install water efficiency measures and retrofit of rainwater harvesting or recycling systems

Surface Water Management



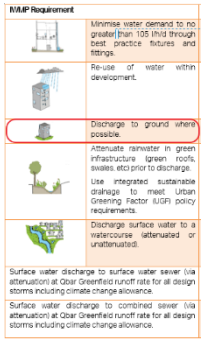
Since the Zone is heavily built up and is likely to see an increase in high-rise structures, the use of roof-level storage (green/ blue roofs, podium deck storage) and wall gardens should be encouraged to provide amenity space as well as surface water attenuation.

Through the planning process, developers should consider the provision of roof level drainage systems that will keep rainwater at-source and only release it to the underground infrastructure at reduced rates. This will allow underground drainage to be shallower, ultimately leading to outfalls less constrained by tidal effects.

Where podium decks or low roofs are provided, emphasis should also be placed on enhancing the space to include amenity features as well as rainwater attenuation. This could be derived using rain gardens, planted areas where depth of substrate is designed to accommodate the vegetation and a design that encourages end users to access and use the green spaces rather than surround them with paths that generate more surface water runoff.

Figure 6-7 Example of green roof. SuDS Manual C753.

Infiltration



The Zone is underlain by low permeability Alluvium. Combined with the variable permeability of the underlying Lambeth Group, this means opportunities for local or large scale attenuation via infiltration will be limited.

Developers should still be encouraged to consider infiltration potential via physical testing on site in line with the recommendations of the BRE Digest 365 Soakaway Design guide as there may be potential for localised infiltration depending on soil and ground conditions.

Rainwater Attenuation in Green Infrastructure

The Zone is characterized by high rise buildings set in close proximity to each other with little remaining space between each tower. Development density in this zone therefore precludes the option for strategic SuDS integrated with green infrastructure serving multiple plots. However, there is scope for proposals to maximise green infrastructure SuDS solutions.

Typically, the existing ground levels are raised through the use of podium decks to address the need for elevated access/ egress routes associated with breach events in defended Flood Zone 3 areas. Therefore, the limited external spaces need to be maximized to address the surface water management needs of the site. The masterplan for the development to the south east of the Zone will likely include less than 9% landscaped areas.

For the remaining space between the high-rise buildings, developments should demonstrate that early collaboration of drainage engineers and Landscape designers is realised to achieve designs capable of providing surface water management close to the source of the water and at as high a level as possible to reach gravity outfalls and avoid pumping. Shallow linear depressions along paved courtyards can be introduced (See Figure Figure 6-8) through carefully finished levels design to bring the water environment into view during rainstorms and create interest for users as well as convey runoff to dedicated outfalls. Rills can provide a means of surface water disposal near surface, with an element of near-source attenuation while providing interesting amenity spaces with the potential for more varied planting. They also provide a means

of naturally segregating building facades from busy pedestrian areas without the need for handrails/ barriers.

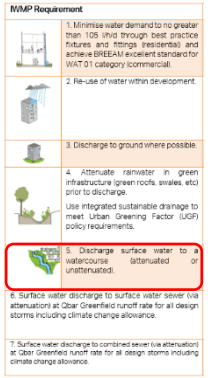
Figure 6-8 Example of drainage channels and rills. SuDS Manual C753.

Developers should be encouraged to target the use of above ground surface water features such as rain gardens, permeable paving, ponds and rills that fit well within urban developments and help to bring the water environment into the everyday surroundings of the future users of the sites, improving the quality of amenity spaces.

Where possible, podium decks should be designed to hold the majority of surface water attenuation by providing cellular system in excess of the standard 150mm thick layer usually provided. Through appropriate design, attenuation depths of 500mm overlaid with a minimum of 600mm of growing media could achieve podium decks suitable for growing more than just shrubs and bedding plants. This will have an impact on the structural load for proposed podium decks but will ultimately lead to benefits through reduced underground tanks, significantly enhanced amenity spaces and access to outfall points that would otherwise be too shallow to reach without pumping.

Discharge to surface water body

Discharge to Docks



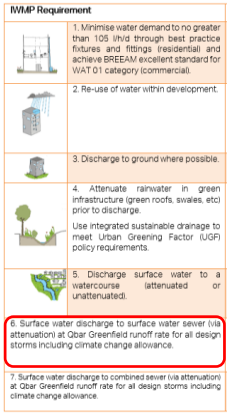
The water level in the Docks is expected to be set at approximately 4.00mAOD, with an allowance of up to 800mm freeboard, based on information received from the CRT. Therefore, developers will need to make every effort to provide above ground drainage systems to ensure that they can outfall to the Docks without the need for pumping.

The developments within the north and east of the Zone (Points 1 and 2 in Figure 6-6) are ideally located to receive new outfalls to the Docks, particularly where street level plates overhanging over the water ate proposed. These large developments should be encouraged to approach the CRT to investigate the possibility of providing multiple connections to North and South docks in order to reduce the length of drainage runs from the upstream ends of the development plots to the Docks. Connections to the Blackwall Basin may also be possible, subject to water levels. This would reduce the likelihood of pumping being required to achieve connections for surface water disposal.

Discharge to Watercourse

The two largest developments within the Zone are located at either end of the Zone (Point 2 and 3 in Figure 6-6) and are therefore adjacent to the River Thames. They can provide outfalls to the River Thames with the benefit that discharge may not need to be attenuated fully to greenfield runoff rates, subject to tidal constraints and water quality. Details of a potential outfall to the River Thames have been prepared by Thames Water for the developer at the plot numbered 2 in Figure 6-6.

Discharge to Sewer



The strategic sewer system (operated by Thames Water) currently serving the Zone is a combined sewer. The CWG own and operate the sewer system within their estate and this includes a combination of separate foul and surface water systems as well as combined.

Developers should look to connect to existing surface water sewers within the CWG curtilage where this is possible, if not proposing new surface water sewers for discharge.

Developers in this Zone should only then connect to the Thames Water operated combined sewer where they have demonstrated that it is not feasible to connect to the docks or the River Thames via plot specific or strategic, multi plot systems, and where they have demonstrated that opportunities for rainwater attenuation via landscaping have been maximised. Additionally, developers should maximise any opportunity for infiltration unless demonstrated via testing that infiltration is not feasible.

Wider Options

The Zone includes access to several docks which are operated by the Canal and River Trust. The North and South docks could provide a source of water for heat exchange purposes, allowing developments to make use of the water as a resource to cool buildings during the summer months. This would reduce the carbon footprint of the buildings but would require careful design of the systems to ensure that the overall temperature of the docks was not adversely affected.

Several such systems are already in place with existing properties having contacted the CRT. However, details of how this approach can be taken and controls on the overall state of the docks should be driven by LBTH in conjunction with the CRT through clear guidance on how to engage the stakeholders and apply for such systems. This would be best achieved through development of a thermal model of the docks to simulate the effects of each new application in turn and determine the suitability of each new application on behalf of the CRT.

Option Delivery

Riverside South Site Allocation:

The plot (Point 3 in Figure 6-6) should be developed with the aim of providing a new dedicated surface water network with an outfall to the River Thames, providing attenuation to counteract the effects of high tide. The Environment Agency will need to be approached by the developer to ensure that the proposals will fit with their requirements in terms of scour protection and water quality.

If the plot is to be developed and sold to various parties, then Thames Water could be approached to adopt the surface water network (non-SuDS elements) to facilitate long term maintenance. If this is the case, early review of the network by the LBTH should be allowed to determine if the network can include sections of drains capable of accepting additional runoff from plots that may be developed in the future that are upstream from this development. If the plot will be built as a single curtilage, Thames Water adoption should still be encouraged although it is more likely that a maintenance company will need to be appointed to ensure long-term maintenance.

Wood Wharf:

The remaining phases of the proposed development (Point 2 in Figure 6-6) should be designed to include significant greywater recycling as well as rainwater harvesting systems to reduce the dependency on potable water supplies and take advantage of the opportunity available through private ownership of land and infrastructure by the CWG over the wider area. Providing community-based systems will allow economies of scale to be applied to the recycling systems and to balance flows between residential and commercial properties which use water at different times and in different quantities.

The suggestions for the plot on the west end also apply. However, if a connection to the River Thames with a new surface water outfall is not feasible, then connections to the South Dock or the Blackwall Basin should be sought through the CRT. This will likely lead to the requirement for more attenuation storage as the CRT will request discharge to the Docks at reduced rates.

Based on the previous developments within the CWG land holding, it is expected that this Plot will also be developed with private drainage systems in mind and therefore

maintenance of the drainage system will be via a dedicated company rather than through Thames Water.

Plots on Northern Boundary of Zone:

The plots along the northern boundary (Point 1 in Figure 6-6) are along North Dock and therefore could make use of outfalls directly to North Dock. However, the opportunity exists that these plots could also act as links for other plots in Zone 1 further north (Point 1 in Figure 6-6) that could benefit from connections to the Docks too. This will require installation of surface water infrastructure crossing multiple plots as well as public highways. The preferred route of adoption and maintenance of the piped sewer network elemnets will be via Thames Water. However, maintenance by a NAV or by the LBTH may be required if Thames Water cannot come to an agreement with the CRT for the costs associated with new connections to the Docks. NAVs would also be able to adopt and maintain the above ground SuDS elements of the surface water system.

Opportunities for Coordinated Delivery

As described in Section 5.8, a core principle of the IWMP is that improvements to water infrastructure should be considered in coordination with provision of other infrastructure taking place in the study area (in order to reduce disruption, deliver cost savings and provide joined up utility provision. The following opportunities have been identified in Zone 2:

- Where new surface water discharge connections are made to North Dock as part of the redevelopment of the plot at North Quay, this should be coordinated with disconnecting the DLR track in this area (including West India Quay Station) and discharging to the Dock (Point 4 in Figure 6-6).
- Plans for road resurfacing should include SuDS and maximise opportunities for roadside landscaping and improvements to the public realm.
- Interventions close to flood assets (for example Thames Tidal Defences) provide opportunities to coordinate with the Environment Agency Isle of Dogs Asset Management Strategy as part of the Thames Estuary 2100 Plan.
- The findings and recommendations of the IWMP should be used to inform the South Poplar Masterplan which covers the plots on North Quay, New College Site, Billingsgate Market and 2 Trafalgar Way (Point 1 in Figure 6-6).

6.4 Zone 3/4 South Quay and Crossharbour

Zone Summary

Location

This Zone is characterised by Millwall Inner Dock running north-south and Millwall Outer Dock running east-west in the centre of the Zone and the large number of high-rise buildings along the banks of the dock. However, it also includes a significant footprint on the eastern and western edges of the Zone containing residential streets with rows of terraced houses.

Growth

Table 6-3 Summary of growth for Zone 3/4

Housing	Units
2016 – 2031 Phasing: Complete / under construction	8,700
2016 – 2031 Phasing: Yet to be constructed. Key sites include: - 225 Marsh Wall, Marsh Wall, E14 - 30 Marsh Wall, E14 - 49-59 Millharbour, 2-4 Muirfield Crescent And 23-39 Pepper Street - 50 Marsh Wall, 63-69 and 68-70 Manilla Street, E14 - 54 Marsh Wall, London, E14 9TP - ASDA, 151 East Ferry Road - Cross Harbour Town Centre SA - Boatmans House, 2 Selsdon Way, E14 9LA - Land between Marsh Wall, Byng Street and Manilla Street - Mastmaker - Part of Millharbour Site Allocation - Skylines Village - Limeharbour Site Allocation	5,500
2031-2041 maximum growth scenario	13,500
Commercial floorspace (2021 – 2031)	80,300

Table 6-3 summarises the growth projected for this zone. 8,685 housing units have already been provided via plots that are complete of under construction. Table 6-3 identifies the plots that are yet to be constructed to provide 5,540 housing units by 2031. Up to 80,347 square metres of commercial floorspace are to be provided in this same timeframe.

Constraints and Opportunities

The South Quay and Crossharbour Zone has the following specific constraints and opportunities:

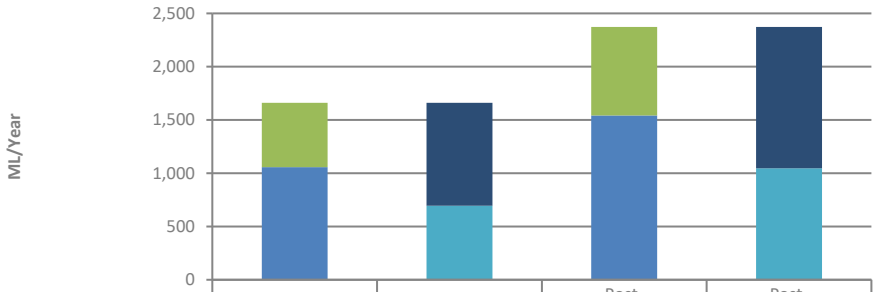
- 61% of the medium-term development planned to 2031 is already completed or under construction, which limits the potential for strategic options to be developed for much of the medium-term growth;
- Over 13,000 residential units are envisaged post 2031 which means IWMP requirements and strategic option recommendations can be considered for a significant volume of growth still to be committed;
- A large proportion of the medium-term plots are adjacent to either the River Thames or the docks with direct connection potential. In addition, street level plates overhanging the dock water are proposed for many of the key development plots offering a direct route to discharge
- Increased surface water discharge to the docks could reduce the need for pumping by the CRT.

The water level expected at the docks may be too high to drain some development plots. Land may need to be raised or pumps may be needed to lift surface water to levels sufficient to allow discharge to the docks.

- The proposed developments are composed of a mixture of residential and commercial properties, providing the opportunity for grey water recycling and rainwater harvesting across plots.

Water Balance

The key changes in the Water Balance for Zone 3/4 are shown in Figure 6-9.

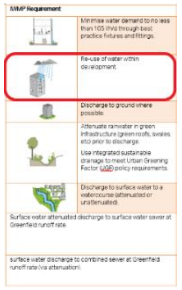


	Pre-Development Demands	Pre-Development Discharges	Post-Development Demands	Post-Development Discharges
Blackwater Generated		965.45		1326.38
Greywater Generated		694.94		1046.73
Non-Potable Demand	603.04		830.40	
Potable Demand	1057.35		1542.71	

Figure 6-9 Water Balance Summary for Zone 3/4

- Over the 10-year period analysed, the average amount of time that attenuated rainfall meets non-potable demand in Zone 3/4 is 08%. 42% of the time the demand is not met at all.
- The volume of greywater generated post development will be sufficient to meet non-potable demands.
- Peak foul water discharge will increase by 37%.

Re-use and demand reduction



There is potential for re-use to be delivered strategically in the zone with the following options:

- The areas along the southern edge of South Dock and the north western edge of Millwall Inner Dock (known as Millharbour Village) are earmarked for re-development which will include a significant component of commercial properties alongside the residential plots (Point 1 Figure 5-10). The introduction of greywater harvesting systems to each building through the construction of dedicated collection and distribution pipework will allow for a reduction in potable water supply to the developments.
- As a minimum, developers should be encouraged to ensure buildings are fitted with dual pipework as standard to provide readiness for community-based greywater recycling systems which can be introduced later.

Millharbour Village will include a park located on the western bank of Millwall Inner Dock (Point 2 Figure 5-10). This park will require water for irrigation together with all other landscaped areas in the vicinity. The developments will provide a source of harvested rainwater that could be piped and stored for use as irrigation supply, thereby reducing the need for potable water.

Proposed Options Zone 3/4 South Quay Crossharbour

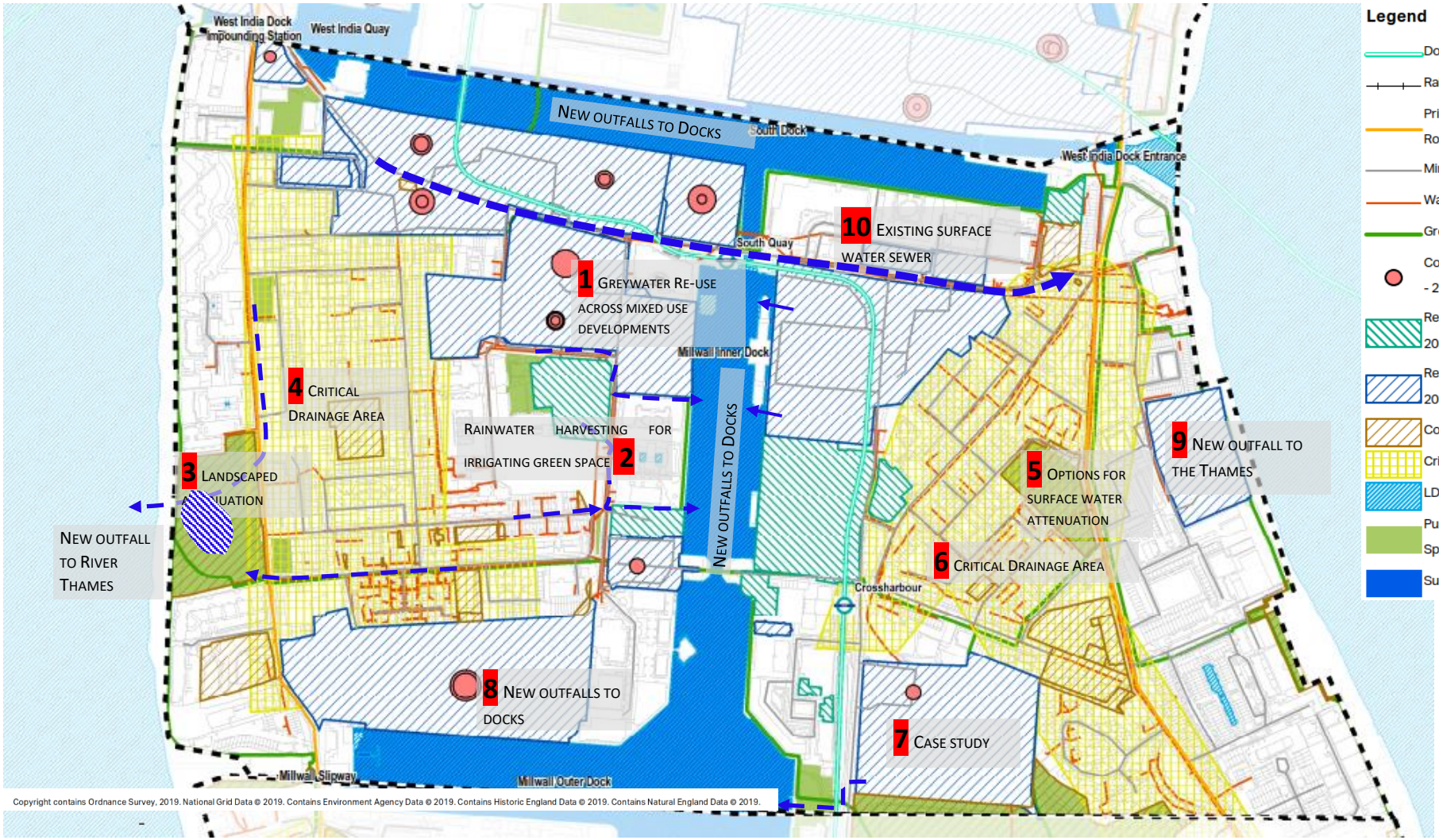


Figure 6-27 Schematic of Options for Zone 3/4 South Quay Crossharbour

Demand Offset Retrofit Potential

There are several opportunities to use accrued s106 contributions from the demand offset obligations in this Zone to install retrofit water efficiency measures and potential retrofit rainwater harvesting schemes, including:

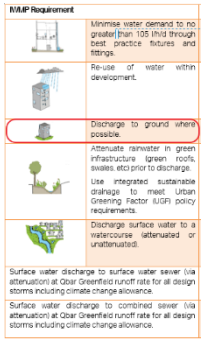
- Cubitt Town Junior School;
- Seven Mills Primary School;
- Arnhem Wharf Primary School; and
- Tiller Leisure Centre;

Working in conjunction with Thames Water, there is significant potential to co-ordinate and co-fund water demand reduction initiatives such the smarter homes visit in large areas of the zone, including Cubitt Town, east of the A1206 and property around St John's park.

Grants could also be made available to the numerous non-residential developments to incorporate water efficient fittings and retrofit re-use schemes

Surface Water Management

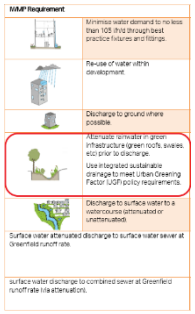
Infiltration



The Zone is underlain by low permeability Alluvium. The combination of the variable permeability of the underlying Lambeth Group with the influence of tide on groundwater levels, means opportunities for local or large-scale attenuation via infiltration will be limited.

Developers should still be encouraged to consider infiltration potential via physical testing on site in line with the recommendations of the BRE Digest 365 Soakaway Design guide as there may be potential for localised infiltration depending on soil and ground conditions.

Rainwater Attenuation in Green Infrastructure



Sir John McDougall Gardens, located on the western side of the Zone (Point 3 on Figure 6-10) is one of only a few remaining areas within the Zone that comprises open space and is primarily laid to lawn, with a ring of trees around the edges. This green space is located immediately adjacent to an area designated as a CDA due to the ground levels being generally lower than the flood defence infrastructure on the perimeter of the Island. Therefore, Sir John McDougall Gardens are ideally suited for the installation of drainage infrastructure combined with landscape design to provide attenuation volumes to deal with surface water runoff that the Critical Drainage Area is unable to cope with. It could also act as a long-term strategic option for development post 2031 where regeneration may occur in the west of the Zone. The green space should be re-landscaped to provide underground surface water attenuation which could be overlain with depressions in ground levels that could fill during large storm events.

Figure 6-11 Example of geocellular units being constructed. SuDS Manual C753.

Attenuation provided in the gardens could be drained by gravity to the River Thames located immediately west of the garden. A backup pumped system could be linked to the storage which would only be used during high tide coincident with large rainfall events. Such a system would remove the dependency of several properties in the area on the combined Thames Water network and could link to combine multiple plots to offer a more sustainable method for surface water disposal. The infrastructure could

eventually be developed to accept more properties in the wider area (Critical Drainage Area – Point 4 Figure 6-10) by scaling up the storage in the gardens to take up most of the area under the open lawn space.

The Millharbour Village development includes a large landscaped park at the edge of Millwall Inner Dock (Point 2 Figure 6-10) and therefore provides the conduit for attenuation to be provided under the surface of the park for surface water attenuation. In addition, due to its proximity to the Dock, the park could be used to further integrate landscape design with drainage infrastructure through the installation of swales that could receive surface water from the surrounding properties (proposed and existing) and discharge attenuated surface water to the Docks at a level suitable for the water level in the Dock. Such infrastructure would also require the development plots on the perimeter to adopt near-surface or above ground drainage infrastructure to ensure they are able to meet the shallow infrastructure in the park without pumping.

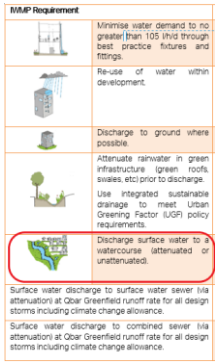
A number of detailed suggestions for enhancement of drainage design to complement landscape philosophy across the large mixed-use development to the east of the Millwall Outer Dock (Point 7 Figure 6-10) are included in the case study in Section 6.8).

St John's Park, located in the heart of the residential area located at the junction of Plevna Street and Manchester Road (in the east of the Zone – Point 5 Figure 6-10) is ideally located to receive surface water attenuation features such as dry detention basins, swales and rain gardens at the surface, all supported by underground cellular storage or tanks to accept surface water during large storms. This could act as a long-term strategic option for development post 2031 where regeneration may occur in the east of the zone. The addition of the surface features would enhance the park and create interesting features for local residents to visit while providing capacity in an area that lies at low ground levels and suffers from surface water flooding (CDA – Point 6 Figure 6-10). The captured rainwater could be re-used in an area-wide rainwater harvesting scheme that would benefit the park as well as surrounding properties.

The DLR elevated railway corridor crosses the Zone from north to south and passes by a significant number of the major plots currently being considered for redevelopment. The opportunity exists to disconnect the drainage networks serving the elevated railway from the combined sewers and reconnect them to dedicated surface water systems that could be installed by the plot developers, where suitable adoption and maintenance routes can be ascertained. In return, the DLR may be able to re-allocate part of the land sterilized by the elevated railway for use as drainage corridors where linear green infrastructure SuDS in combination with surface water drains can be placed to link several plots to the new outfalls to the Docks or the River Thames.

Discharge to Surface Water Body

Discharge to Docks



A large development site known as the Westferry Printworks lies on the northern bank of the Millwall Outer Dock (Point 8 Figure 6-10). The dock could receive new surface water outfalls to capture all surface water from the development, removing the reliance on the combined sewer networks. The significant extent of development plot bordering the dock bank allows for shorter and more frequent outfall locations, promoting the use of at-surface drainage features such as swales and rills (Figure 6-12) to drain the development site without the need for pumping. This approach also provides significant amenity and water quality enhancements.

Figure 6-12 Example of rills that convey runoff along the surface. SuDS Manual C753.

Numerous plots are due for re-development along the eastern and western banks of the Millwall Inner Dock and will benefit from outfalls to the dock for surface water disposal. Where plots are adjacent to each other and only one is in direct contact with the bank of the Dock, facilities should be provided to create corridors. This allows the surface water infrastructure to be routed from the further plots via the edge plots to the nearest connection to the Dock. In this manner, more plots can be connected to the docks and the sections of the piped network serving more than one curtilage can

be adopted by Thames Water. The large number of developments that could drain to the Millwall Inner Dock make land-based green infrastructure SuDS and/or large-scale floating ecosystems in the Millwall Docks particularly important to manage water quality in this location.

The introduction of access routes to the docks at an early stage in masterplanning will allow such drainage routes to be secured and kept free of built development, allowing them to act as corridors where drainage can be routed together with any of other services required to the dock edges. To facilitate this process, a reduced contribution to the s106 contributions expected from the downstream plots could be implemented by the LBTH. New developments on the southern banks of South Dock should also be treated in the same manner to encourage the creation and use of surface outfalls to docks and discourage surface water connections to the combined Thames Water sewers. However, new surface water drainage connections to the Docks will require approval to discharge from CRT and the Environment Agency.

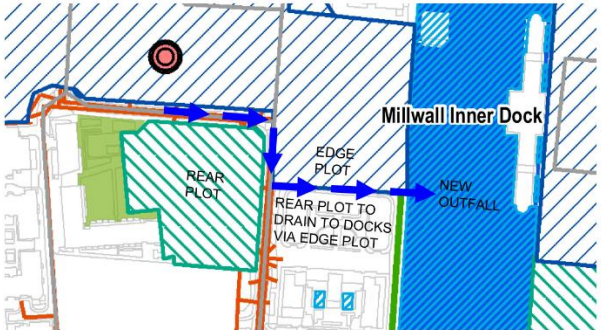


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Figure 6-13 Example of connectivity of plots to reach outfalls to Docks

The plot location known as Crossharbour District Centre to the east of the Millwall Outer Dock (Point 7 Figure 6-10) will receive a significant number of new residential properties together with a new commercial development which will strain the local combined drainage network. The opportunity exists to provide a new separate drainage system that will capture all surface water from the development and direct it to a new outfall to the dock via a landscaped area at the northern end of Undine Road. The commercial development may also be used to capture roof runoff to provide rainwater for re-use in the adjacent residential properties. A system of simple weir connections could be implemented to allow the installation of the communal rainwater harvesting tank to be installed within the residential area but fed from the commercial property until the system was full, at which point the unwanted extra runoff could be directed to the new surface water outfall. This would ensure a plentiful supply of rainwater to the residential properties without increasing the risk of flooding. See section 6.8 for details of this plot as reviewed through a specific case study within this IWMP.

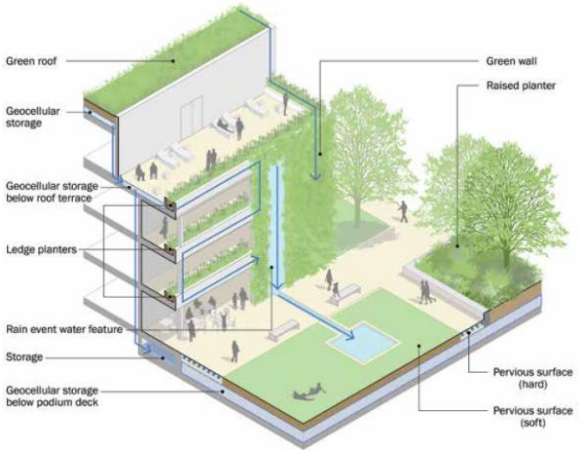


Figure 6-14 Example of multi-functional use of elevated surfaces. SuDS Manual C753.

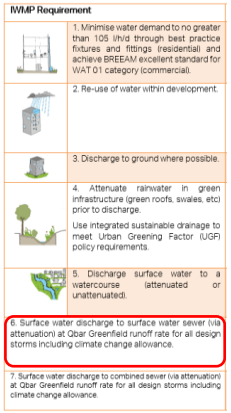
Discharge to Watercourse

As described under the green infrastructure discussion for this Zone, Sir John McDougall Gardens, located on the western edge of the Zone (Point 3 Figure 6-10) could be used for surface water attenuation from any new regeneration areas to the east of the green space with ultimate discharge to the River Thames. The residential properties to the east of the green space are in an area designated as a CDA due to the fact that they lie at ground levels lower than the surrounding areas. Generally, the residential area is at 2.00mAOD whereas the surrounding areas lie at about 4.00mAOD. In addition, the CDA relies on discharge to Thames Water sewers that all lead to combined drains linked to a CSO. Therefore, the LPA in conjunction with Thames Water could collaborate to deliver attenuation within the green space linked to a gravity outfall to the River Thames for low tide instances backed up by a pumped system

during high tide. This would provide an outfall to the River Thames for numerous properties in the CDA.

On the eastern side of the Zone, Barge Close (Point 9 Figure 6-10) provides access to the River Thames immediately adjacent to a new development and therefore has the potential to allow for the installation of an outfall that would serve the new development as well as other developments that may be brought forward post 2031 for the nearby areas. Such an outfall would also provide a connection to the River Thames for areas in and around Manchester Road that are potentially constrained by low ground level compared to the tide levels.

Discharge to Sewer



The sewer system currently serving the zone is largely combined sewer. However, a large surface water sewer owned and maintained by Thames Water exists in the vicinity of Marsh Wall (Point 10 Figure 6-10) and receives runoff from the plot immediately east and west of Millwall Inner Dock as well as plots along the southern bank of South Dock. The surface water sewer is connected to the Thames Water combined system at the confluence of several large combined sewers near the Marsh Wall Roundabout on the eastern end of the Isle of dogs. The system is also connected in this area to the combined sewer overflow pump station. The downstream end of the surface water sewer is very deep and is not suitable for connection to the nearby South Dock. However, an investigation should be made to determine the extent of this sewer that could be connected to South Dock to divert as much surface water to South Dock as possible and relieve pressure on the combined sewer system.

Developers in this zone should only connect to the sewer system (the surface water main sewer or direct to combined) where they have demonstrated that it is not feasible to connect to the docks or the River Thames via plot specific or strategic, multi plot systems (as set out in this section), and where they have demonstrated that opportunities for rainwater attenuation via landscaping have been maximised. Additionally, developers should maximise any opportunity for infiltration unless demonstrated via testing that infiltration is not feasible.

In line with Local Plan policy D.ES5, developments within CDAs to the east and west of the Zone will be expected to meet greenfield runoff rates to manage the risk of surface water flooding in the wider area. Where this is not possible, developers will be expected to pay into the proposed drainage offset scheme to support delivery of retrofit SuDS within the wider study area.

Wider Options

With a large number of developments coming forward at the edge of the Millwall Inner and Outer Docks, there is a potential for several of these to include heat exchange units that could use the water in the Docks as a cooling source in the summer months.

In order to achieve this, a study would need to be conducted to ascertain the suitability of the current installation to act as part of a heat recovery installation and would also need to identify a suitable customer base to provide the heat to. Such heat recovery systems are generally best used as district heating systems that provide low temperature heat to residential or commercial properties and would need investment in a network of distribution pipes.

Option Delivery

Sir John McDougall Gardens

The green space known as Sir John McDougall Gardens (Point 3 Figure 6-10) should be studied by the LBTH and Thames Water to ascertain its potential to accept drainage infrastructure as a strategic outfall for surface water to the River Thames from the Critical Drainage Area east of the gardens (Point 4 Figure 6-10).

Disconnecting DLR drainage from combined system

Where DLR elevated railway lines pass within or adjacent to plots for re-development, the drainage systems should be integrated to allow disconnection of the elevated railway drainage from the combined sewers and reconnection to dedicated surface water networks. In addition, the elevated railway corridors should be investigated to determine where they can be used as primary drainage routes for new surface water infrastructure to outfalls to the Docks.

Strategic drainage corridors

Where possible, developers with plots adjacent to the Millwall Inner and Outer Docks should be encouraged to provide strategic drainage corridors within their plots to allow upstream connection of other plots to the strategic networks leading to outfall points

to the Docks. In particular, the Millharbour village development which includes a large park on the western bank of Millwall Inner Dock (Point 2 Figure 5-10), should be developed with cognisance of integrated drainage and landscape designs to ensure that it can operate in a way to deliver enhanced amenity spaces as well as adequate drainage infrastructure to deal with runoff from the plots in the vicinity.

Dual pipe buildings to enable greywater recycling

Large, mixed-use developments such as Millharbour Village and those along the southern bank of South Dock should include dual piped buildings to allow greywater recycling systems to be installed. Where possible, multi-building installations should be brought forward to make use of economies of scale. See section 6.8 for case study options provided for the Crossharbour District Centre plot.

Opportunities for Coordinated Delivery

As described in Section 5.8, a core principle of the IWMP is that improvements to water infrastructure should be considered in coordination with provision of other infrastructure taking place in the study area (in order to reduce disruption, deliver cost savings and provide joined up utility provision). The following opportunities have been identified in Zone 3/4:

- Where new surface water discharge connections are made to South Dock or Millwall Inner Dock as part of the redevelopment of plots in Marsh Wall, this should be coordinated with disconnecting the DLR track in this area and discharging to the docks.
- Opportunities for coordination between the new / upgraded bridge connection at South Dock and dock edge upgrades to provide an east-west link across the peninsular identified in the Local Connections Strategy[30].
- The Local Connections Strategy identifies upgrades to Millharbour to provide a high level of service for pedestrians and cyclists. This should be coordinated with installation of SuDS and urban greening features in this location.
- Station public realm improvements at South Quay, Crossharbour.
- Interventions close to flood assets (for example Thames Tidal Defences) provide opportunities to coordinate with the Environment Agency Isle of Dogs Asset Management Strategy as part of the Thames Estuary 2100 Plan.

[30] TfL, 2018 Isle of Dogs and South Poplar Local Connections Strategy.

6.5 Zone 5 Island Gardens

Zone Summary

Location

This Zone consists mostly of residential properties lower than four storeys in height in the areas north of the main road (A1206). The A1206 passes through the zone in a semi-circle as it travels from east to west following the curvature of the island's southern bank along the River Thames. The areas south of the road include slightly larger residential properties, with blocks of flats generally reaching 8 storeys. The A2106, typically at 2 mAOD, is lower compared to the surrounding areas which are closer to the 4 mAOD level. The areas further inland from the main road are in general either at the same level as the road or climb to a high point in Mudchute Park Farm.

Growth

This Zone has very low levels of proposed growth compared to the rest of the study area. In particular, the short to medium term growth is minimal and already complete or under construction. Approximately 600 units are likely to come forward in the longer term (post 2031).

Table 6-4 Summary of growth in Zone 5

Housing	Units
2016 – 2031 Phasing: Complete / under construction	**200**
2016 – 2031 Phasing: Yet to be constructed	**0**
2031-2041 maximum growth scenario	**600**
Commercial floorspace (2021 – 2031)	**2,400**

Constraints and Opportunities

- Opportunities exist for discharge to waterbodies, particularly for any development post 2031 south of the Millwall Outer Dock
- Opportunities for direct connection to the River Thames are available for growth post 2031, but likely to be limited to the smaller spatial extent on the river side of the A2106. The relatively low ground levels along the main road act as a barrier to most gravity connections to the River Thames from areas further inland of the main road. In addition, where outfalls are required, existing jetties may obstruct the construction of potential outfalls
- Millwall Park green offers potential for strategic green-infrastructure based SuDS and attenuation within the park could be linked to an outfall through the Island Gardens area on the River Thames bank at the south east corner of the Zone.

Water Balance

The key changes in the Water Balance for Zone 5 are shown in Figure 6-15.

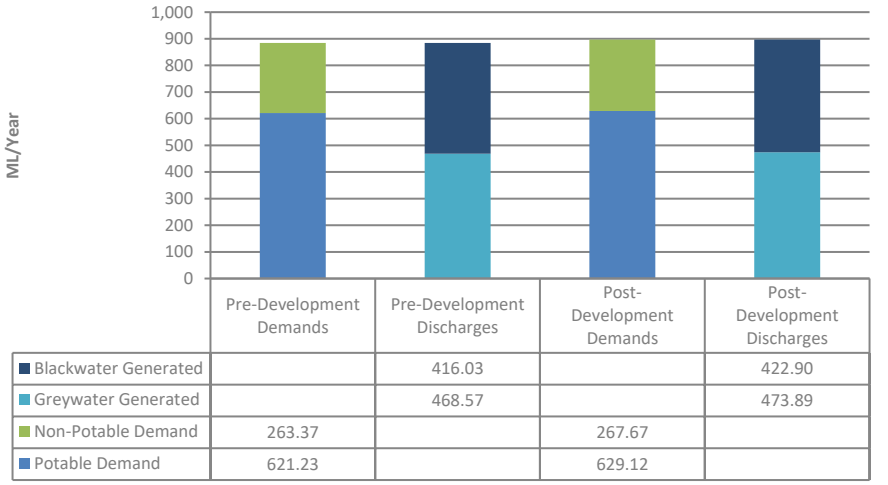


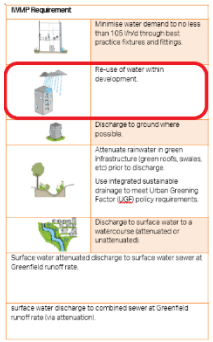
Figure 6-15 Water Balance Summary for Zone 5

- Over the 10-year period analysed, the average amount of time that attenuated rainfall meets non-potable demand in Zone 5 is 28%. 39% of the time the demand is not met at all and for the rest of the time, some of the daily demand can be met. Rainwater harvesting is therefore a more feasible option in this zone compared to other zones due to lower density of development.
- Greywater generated would be sufficient to meet non-potable demand across the Zone

- Growth is lower in this Zone, meaning there is less impact on the local sewer network and water supply network with only a small increase in demand.
- Peak foul water discharge will only increase by 2%.

Re-use and demand reduction

There is potential for re-use to be delivered strategically in the Zone.



The Zone is characterised by small cul-de-sac roads lined with terraced houses. With the high demand on housing in the area, it is likely that new developments will mimic the Island Point (Point 1 Figure 5-16) development currently under construction in the Zone, with apartment blocks set around courtyards that provide amenity space for residents.

New developments can be geared towards rainwater harvesting to reduce demand on potable water supplies for irrigation and external use with a view to reduce surface water volumes to the combined sewers. In addition, greywater recycling units set in multiple building plots to maximise efficiency and provide water for toilet flushing can be implemented to further reduce potable water demand.

Demand Offset potential

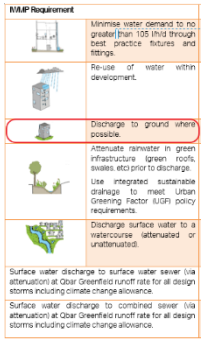
There are opportunities to use accrued s106 contributions from the demand offset obligations in this Zone to install retrofit water efficiency measures and potential retrofit rainwater harvesting schemes, on council owned buildings (e.g. Harbinger Primary School).

The most significant opportunity would be to work in conjunction with Thames Water to co-ordinate and co-fund water demand reduction initiatives such the smarter homes visit in large areas of the Zone, which consists of large residential areas.

Grants could also be made available to the numerous non-residential developments to incorporate water efficient fittings and retrofit re-use schemes.

Surface water management

Infiltration



The Zone is underlain by low permeability Alluvium and, given the proximity to the River Thames, groundwater levels will be significantly influenced by tidal levels. Additionally, in the eastern section of the Zone, the superficial geology is underlain by the variably permeable Lambeth Group; this means opportunities for local or large-scale attenuation via infiltration will be limited.

In the western section, the Thanet Sand bedrock underlies the alluvium, presenting the potential for deeper soakaway options; however, feasibility will be limited by the tidal influence on groundwater levels.

Development from 2031 onwards, within the western section of the zone in particular, should consider infiltration potential via physical testing on site in line with the recommendations of the BRE Digest 365 Soakaway Design guide and trial pits or boreholes, as there may be potential for localised infiltration depending on soil and ground conditions and the local groundwater level.

Proposed Options Zone 5 Island Gardens

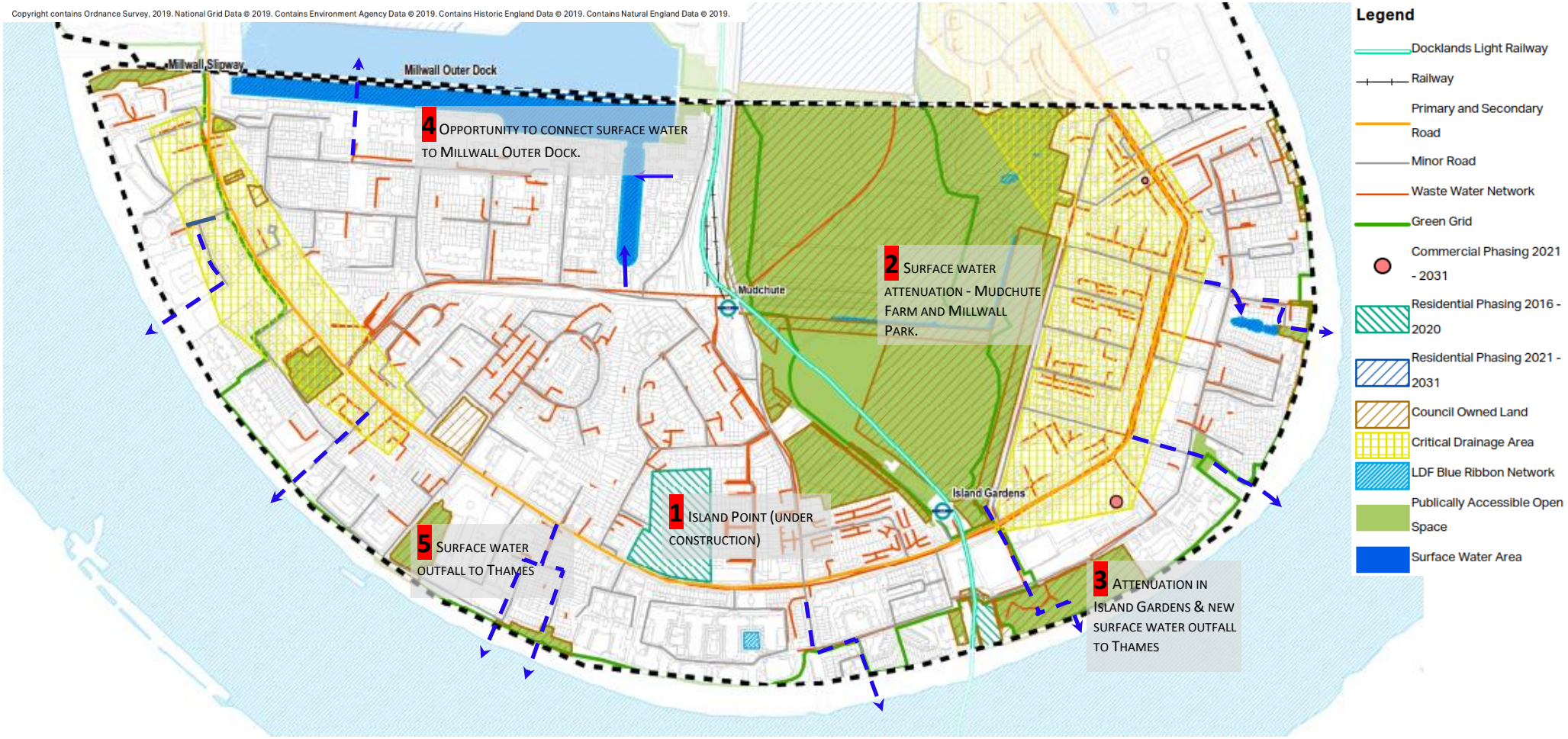
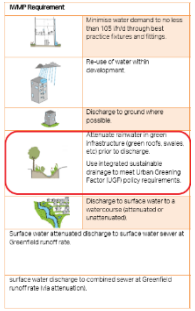


Figure 6-16 Schematic of Options for Zone 5 Island Gardens

Rainwater Attenuation in Green Infrastructure



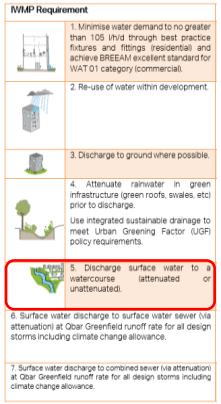
The Zone includes the largest area of open space on the Isle of Dogs, consisting of Mudchute Farm and Millwall Park (Point 2 in Figure 6-16). The land occupied by Mudchute Farm is located at up to 12 mAOD and is therefore unlikely to be useful for surface water attenuation; however, an old ditch referred to colloquially as "the Newtie" is located in the South-West corner of Mudchute Farm and options to restore this and link to feature surface water management should be considered.

Millwall Park is generally lower and may be able to accommodate surface water attenuation for developments post 2031 that may come forward in areas north of the Park. This may be in the form of swales along the edges of the Park which may be suitable to accommodate surface water runoff from nearby roads. Alternatively, underground cellular storage tanks supplemented with depressions above ground could also be implemented.

The southern end of Millwall Park links to Island Gardens via Douglas Path and Stebondale Street (Point 3 in Figure 6-16). Island Gardens is a publicly accessible open space that could be used to link Millwall Park to the River Thames via a new surface water outfall. Such infrastructure could provide a means of draining runoff from Manchester Road and the surrounding properties, subject to the ground levels in the area. The Island Gardens green space could be re-developed to provide underground attenuation overlaid with over-ground depressions for surface water during extreme events coupled with a pump station to deal with excess surface water during high tide events.

Discharge to Surface Water Body

Discharge to Docks



The Zone includes an area of land adjacent to Millwall Outer Dock (Point 4 in Figure 6-16). There may be opportunities in this location to connect surface water infrastructure to the Millwall Outer Dock. A study of the area is recommended in order to identify the ground levels and determine if the infrastructure could be successfully installed. Based on the existing layout of the access routes in the area, a number of potential locations for new surface water outfalls are shown in Figure 6-16; however these will be subject to the available access routes.

Discharge to Watercourse

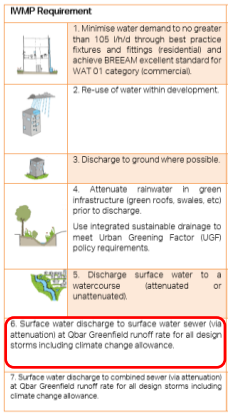
The Zone is bordered on the south by the River Thames. However, very few properties discharge surface water to the River and instead include connections to the combined sewers.

For new developments along the River Thames (riverside of the A1206), there is potential for new outfalls to connect plots to the Thames; however, it would be beneficial for the Council to investigate the possibility of providing outfalls in conjunction with Thames Water at strategic locations along the River Thames Bank within the Zone to pre-empt the need for outfalls before development plans arise. These outfalls could be located in areas where public roads and footpaths already extend to the riverside and access is available. The accesses will in turn provide a corridor for surface water infrastructure to be laid inland to provide connection points for properties which already have separate drainage systems on plot as well as any road drainage system that may be at suitable levels. Any such outfalls will need to include non-return valves to ensure they do not allow ingress of river water during high tide events.

Several such potential locations are shown on Figure 6-16 which should be investigated to determine feasibility. In particular, Napier Avenue leading to Masthouse Terrace Pier (Point 5 in Figure 6-16) could provide an outfall location together with the potential for

space for attenuation storage under an existing landscaped area immediately adjacent to the bank of the River Thames.

Discharge to sewer



The sewer system currently serving the Zone is a combined sewer. There are no identified surface water sewers in this zone

Developers in this Zone should only connect to the combined sewer system where they have demonstrated that it is not feasible to connect to the docks or the River Thames via plot specific or strategic, multi plot systems, and where they have demonstrated that opportunities for rainwater attenuation via landscaping have been maximised. Additionally, developers should maximise any opportunity for infiltration unless demonstrated via testing that infiltration is not feasible.

In line with Local Plan policy D.ES5, developments within CDAs to the east and west of the Zone will be expected to meet greenfield runoff rates to manage the risk of surface water flooding in the wider area. Where this is not possible, developers will be expected to pay into the proposed drainage offset scheme to support delivery of retrofit SuDS within the wider study area.

Wider Options

As part of any strategic SuDS delivery in Mudchute Farm and Millwall Park, these areas should be considered for wider nature-based attenuation solutions to control runoff which contributes to the CDA in the south east of the Zone. The current topography and largely impermeable alluvium acts as a source of surface water flood risk to the area defined by the CDA, where the combined sewer system may become overwhelmed in larger, more intense rainfall events.

Option Delivery

While few opportunities exist within this Zone that could span from developments that are already in development, several measures could be put in place to begin to form the basic infrastructure that could address the future needs of the Zone.

New surface water outfalls

The majority of the central part of the Zone, north of the A1206 Manchester Road, is built at significantly lower ground levels compared to the areas south of the same road and along the River Thames. Therefore, the potential for discharge of surface water from the central area to the River is not likely to be feasible in the short term. However, for those areas between the River Thames and the A1206 Manchester Road, the opportunity exists to begin to form outfalls through each development that comes forward. When these arise, the LBTH should provide a mechanism to allow developers to seek rewards for providing new surface water outfalls capable of being tapped into by plots not immediately on the riverbank. This endeavour should be supported by Thames Water as it will be possible for Thames Water to adopt the piped network systems serving more than one curtilage and earn revenue from the plots connected.

Attenuation in Millwall Park

Millwall Park is a very large open green space that also lies at low ground levels compared to the rest of the Zone and therefore should be investigated by the LBTH to identify potential areas that could be re-developed to include attenuation, either above or below ground, to provide capacity for surrounding plots. The system should then be connected to an outfall through Island Gardens to the River Thames. Such a system could be installed by the Council with the pipe network and outfall adopted by Thames Water as and when more properties become connected to it.

Opportunities for Coordinated Delivery

As described in Section 5.8, a core principle of the IWMP is that improvements to water infrastructure should be considered in coordination with provision of other infrastructure taking place in the study area (in order to reduce disruption, deliver cost savings and provide joined up utility provision). The following opportunities have been identified in Zone 5:

- Coordinated delivery of potential future upgrades to energy infrastructure (gas main) and installation of a new surface water sewer along East Ferry Road, and the A1206 which follows the southern edge of the Zone.
- Plans for road resurfacing should include SuDS and maximise opportunities for roadside landscaping and improvements to the public realm.
- The Local Connections Strategy identifies station public realm improvements at Mudchute including cycle parking and a redesigned public space to enhance the relationship to Millwall Park. This should be coordinated with the

installation of SuDS measures and urban greening features to improve the ability of the environment to respond to surface water runoff. Opportunities should be sought to disconnect downpipes from the DLR track and integrate with SuDS within the public realm as well as connection to Millwall Outer Dock.

- Interventions close to flood assets (for example Thames Tidal Defences) provide opportunities to coordinate with the Environment Agency Isle of Dogs Asset Management Strategy as part of the Thames Estuary 2100 Plan.

6.6 Zone 6A Riverside AAP Core Area

Zone Summary

Location

This Zone is bounded on the east by the River Lea and crossed by several major roads including the A12, A13 and A1261. The southern edge of the Zone is adjacent to the River Thames. The western boundary of the Zone is formed by the Docklands Light Railway track that travels north from the railway depot.

Growth

Table 6-5 summarises the planned and completed development in Zone 6A. Two thirds of the planned housing units for this zone have been completed or are under construction, leaving 2,186 units that are projected to be delivered before 2031. An additional 19,205 square metres of commercial floorspace is also to be delivered by 2031.

Most of the development plots that remain for redevelopment comprise industrial sites along the eastern boundary of the Zone, along the western bank of the River Lea, with the other plots located along the bank of the River Thames and around the junction of the A12 and the A13.

Table 6-5 Summary of growth in Zone 6A

Housing	Units
2016 – 2031 Phasing: Complete / under construction	**4,400**
2016 – 2031 Phasing: Yet to be constructed. Key sites include: - Ailsa Street Site Allocation - Ailsa Wharf, Ailsa Street, London - Gillender Street (southern part) - Leven Road Gas Works	**2,200**
2031-2041 maximum growth scenario	**1,200**
Commercial floorspace (2021 – 2031)	**19,200**

Constraints and Opportunities

- Much of the medium-term growth is located in proximity to the River Lea or River Thames, offering potential for direct river discharge.
- However, much of the medium-term growth (75%) is either already completed or under construction limiting potential for strategic development of IWMP solutions.

Water Balance

The key changes in the Water Balance for Zone 6A are shown in Figure 6-17.

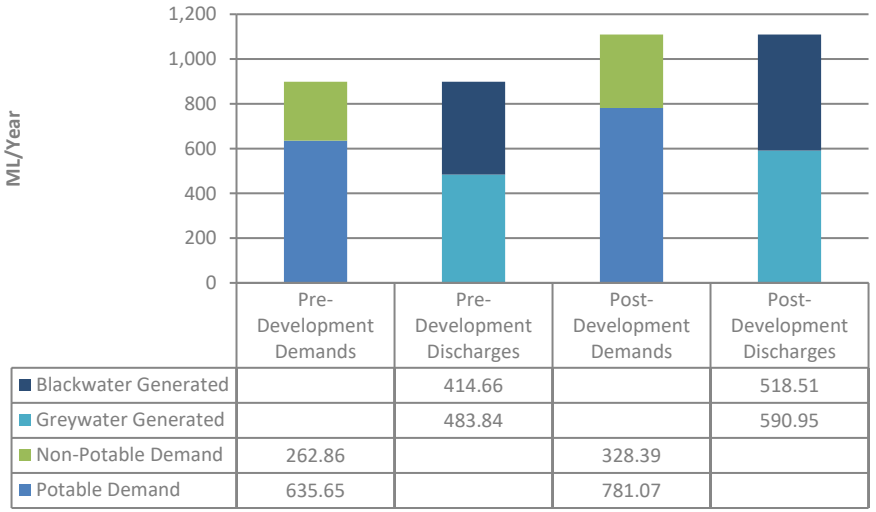


Figure 6-17 Water Balance Summary for Zone 6A

- Over the 10-year period analysed, the average amount of time that attenuated rainfall meets non-potable demand in Zone 6A is 43%. 35% of the time the demand is not met at all.
- Greywater generation would be sufficient to meet non-potable demand in the Zone.
- Peak foul water discharge will increase by 25%.

Proposed Options Zone 6A AAP Core Area

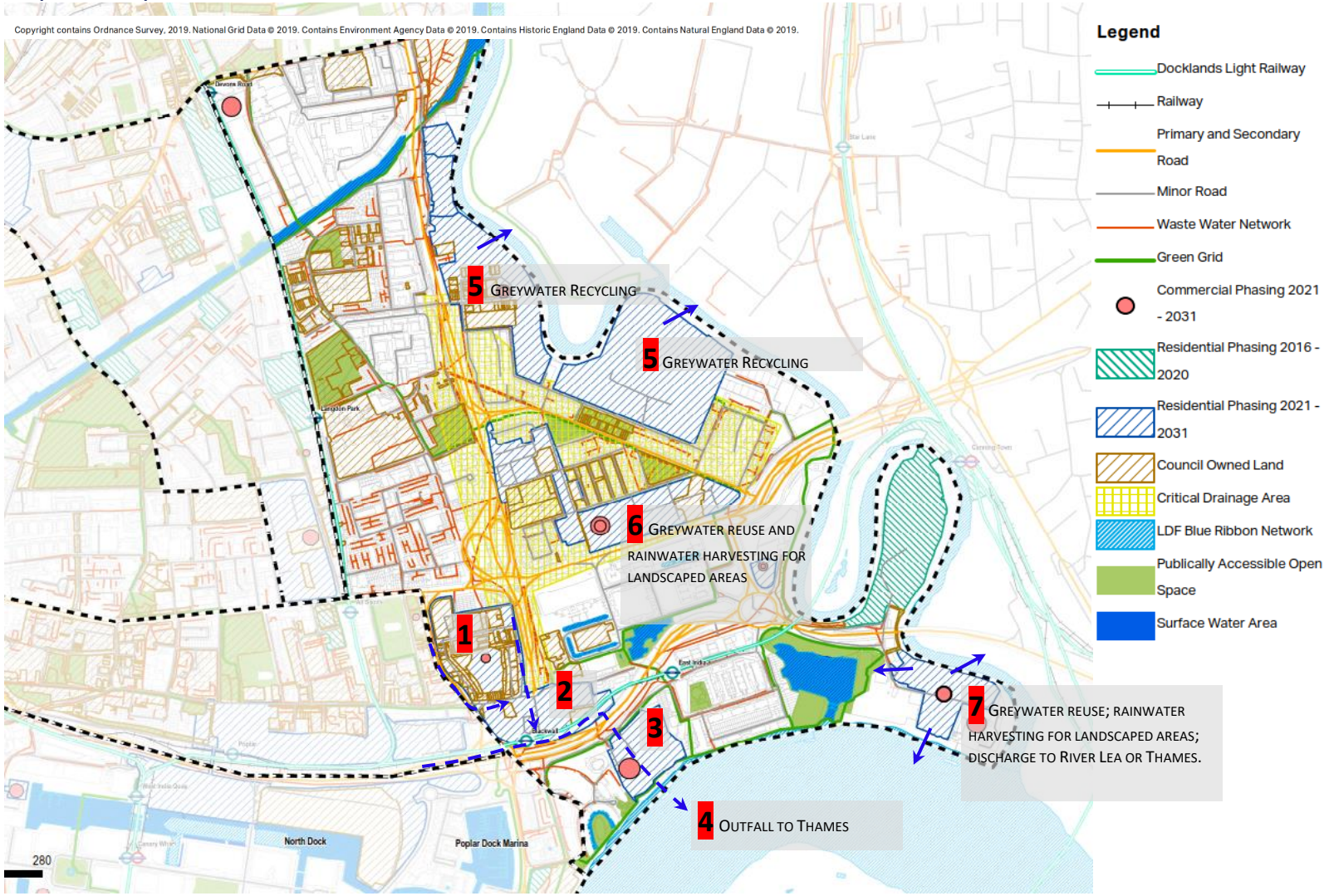
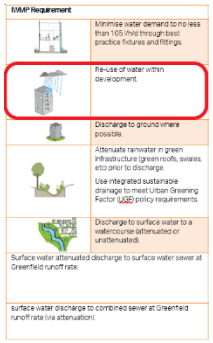


Figure 6-18 Schematic of Options for Zone 6A AAP Core Area

Re-use and Demand Reduction



There is potential for re-use to be delivered strategically in the zone with the following options:

Three large plots within the Zone include an element of commercial development as well as residential properties (Points 3,6 and 7 in Figure 6-18). These plots should consider inclusion of rainwater harvesting systems to feed landscaped areas in the residential areas from the roofs of the commercial buildings.

The plots to be developed along the River Lea (Point 5 in Figure 6-18) will primarily include residential properties which will require a significant supply of potable water. In order to address this need, it will be beneficial for plot developers to consider greywater recycling.

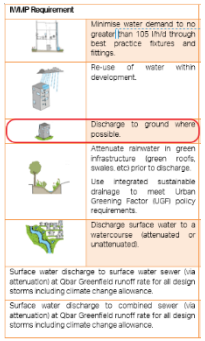
Demand Offset Potential

There are opportunities to use accrued s106 contributions from the demand offset obligations in this Zone to install retrofit water efficiency measures and potential retrofit rainwater harvesting schemes on council owned buildings including: the main offices of the Council; Culloden Primary Academy; Manorfield Primary School and Manor Primary School. There are also several council estates of residential property which offer specific advantage to provide property level retrofit water re-use schemes or community-based options.

Grants could also be made available to the numerous non-residential developments to incorporate water efficient fittings and retrofit re-use schemes.

Surface Water Management

Infiltration

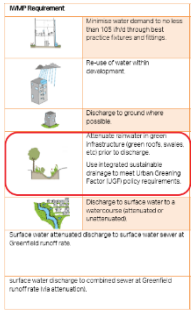


The majority of the Zone to the east of the Blackwall Tunnel Northern Approach is underlain by low permeability Alluvium and underlain by London Clay bedrock meaning infiltration drainage solutions are unlikely to be feasible.

West of the tunnel approach, the superficial geology is largely Kempton Park Gravel member or Taplow Gravel member underlain by London Clay. Local infiltration may be feasible in some locations as part of a wider sustainable drainage strategy. However, the permeability of the superficial deposits is likely to be variable, owing to the presence of the Langley Silt member (consisting of clay and silt) which has much lower permeability.

Developers west of the tunnel approach should consider infiltration potential via physical testing on site in line with the recommendations of the BRE Digest 365 Soakaway Design guide and trial pits or boreholes, as there may be potential for localised infiltration depending on soil and ground conditions.

Rainwater Attenuation in Green Infrastructure



All developments within the plots will need to carefully select landscape design features that will complement the drainage solutions to ensure that both disciplines work in unison to deliver plots that use every opportunity to maximise the available space.

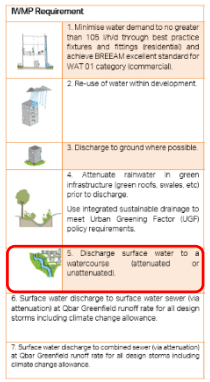
In particular, the plots in the centre of the Zone (Point 6 on in Figure 6-18) are within a low-lying area and will struggle to obtain gravity connections to the surrounding watercourses. Therefore, the LPA should put emphasis on these plots to be designed with landscaped areas that will include a significant portion of green infrastructure such as rills, rain gardens as well as elevated podium decks with planted surfaces and attenuation within the substrate. Should connection to the watercourses by gravity not be possible, connection to the combined sewers will likely be the only choice. Therefore, the volume of runoff as well as the rate will need to be addressed through the planning process.

Limiting the rate of runoff to the Qbar greenfield rate will provide a high degree of restriction of surface water discharge but this will need to be coupled with SuDS

features that promote evapotranspiration through planting as well as active volume reduction systems such as rainwater harvesting systems. Plot developers should be encouraged to use rainwater harvesting systems that are coupled with smart technology to manage rainwater held within conventional attenuation systems during periods of low rainfall for use on the development and release the excess runoff in preparation for upcoming storm events through weather prediction software. These systems can maximise use of storage and minimise developer cost by ensuring that they do not need to install two sets of attenuation volumes.

Discharge to Surface Waterbody

East India Dock Basin



The East India Dock Basin is located on the eastern end of the Zone adjacent to a large mixed-use development (Point 7 on Figure 6-18). Should the plot developer not be able to achieve gravity connections to the adjacent River Thames or River Lea, the opportunity exists for the plot developer to investigate if the Lee Valley Regional Park Authority will consider the construction of outfalls to the Basin to serve at least part of the development to avoid the need for pumping (See Figure 5-18). The plot is located on a peninsula adjacent to the confluence of the River Lea and River Thames and therefore will need to be built in a manner to address issues associated with significant tide level changes, including attenuation during high tides when gravity connections cannot be achieved. Therefore, providing multiple outfalls to the surrounding receptors (including the Basin) will minimise drainage network lengths resulting in shallower pipework and attenuation.

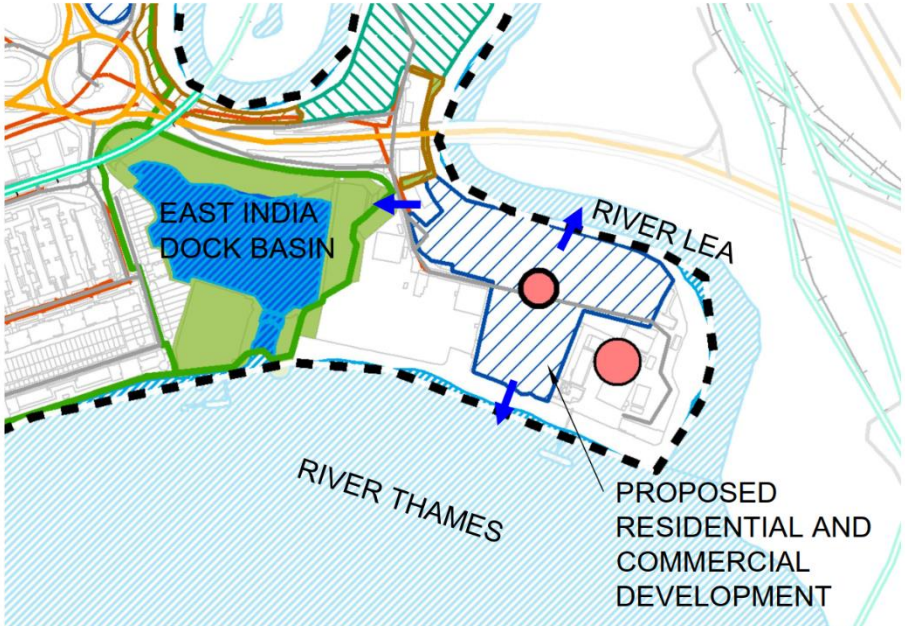


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Figure 6-19 East plot with multiple outfall options

Discharge to Watercourse

A significant portion of the developments are immediately adjacent to the River Lea and the River Thames. These sites would benefit from the installation of new surface water outfalls to the rivers. In particular, the two plots south and west of the junction of the A12 and A13 (Points 1 and 2 Figure 6-20) and between the A1261 and the River Thames (Points 3 on Figure 6-20) should be linked to allow surface water to flow from the plot north of the A1261 via the plot on the bank of the River Thames to offer a new sustainable outfall (Point 4 Figure 6-20) to discharge directly to the River Thames. The DLR elevated railway following the same new surface water corridor could then connect to the same surface water network after being disconnected from the combined sewer system.

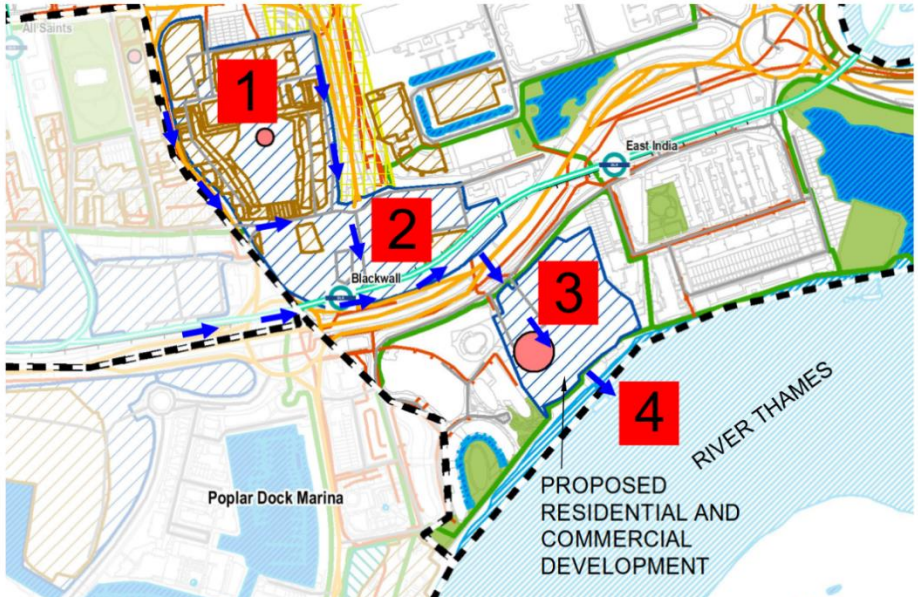

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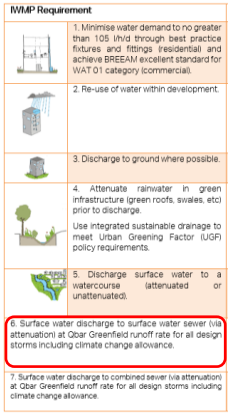
Figure 6-20 Southern Plots with outfall to River Thames

The large cluster of plots along the western bank of the River Lea (Point 5 Figure 6-20) offer potential for drainage solutions that maximise the use of large cumulative plots by pooling their allocations for landscaped areas and developing common solution to promote at-grade drainage features such as detention basins, swales and rills. This will allow surface water drainage to be managed above ground in a manner to reduce drainage installation depth and therefore reduce the need for oversized attenuation and pumping for high tide events.

Figure 6-21 Example of urban hard surfaced off-line detention basin. SuDS Manual C753.

The central part of the Zone, between the A12, the B125 and the A13 (Point 6, Figure 6-18), is an area that lies at low ground level compared to the surrounding areas. Therefore, landscape architecture and drainage design will need to work hand in hand at each of the proposed plots to ensure that surface water is captured and attenuated at high levels within the ground to provide the potential for discharge to features other than the existing combined sewers. Emphasis on rainwater harvesting systems with integrated weather prediction installations will be needed to reduce the volume of runoff to be discharged.

Discharge to sewer



The drainage system currently serving the zone is a combined sewer. There are no identified surface water sewers in this zone.

Developers in this Zone should only connect to the combined sewer system where they have demonstrated that it is not feasible to connect to the docks or the River Thames via plot specific or strategic, multi plot systems, and where they have demonstrated that opportunities for rainwater attenuation via landscaping have been maximised. Additionally, developers should maximise any opportunity for infiltration unless demonstrated via testing that infiltration is not feasible.

In line with Local Plan policy D.ES5, developments within the CDA in the central section of this Zone will be expected to meet greenfield runoff rates to manage the risk of surface water flooding in the wider area. Where this is not possible, developers will be expected to pay into the proposed drainage offset scheme to support delivery of retrofit SuDS within the wider study area.

Option Delivery

Plot developers should provide grey water recycling from residential high-rise buildings to lower level commercial properties:

- Through the planning process, the plot developers should be encouraged to provide proposals that will include grey water recycling to commercial and residential properties. This will require dual supply plumbing and separated black and grey wastewater drainage.
- This may be achieved through the imposition of potable water supply limits for the commercial processes involved with the depot and s106 offset contributions where limits are not met.

Plot developers should adhere to strict discharge rates and provide integrated Landscape and Drainage design philosophy:

- For the plots with the central part of the Zone, all developments will be required to deliver sufficient attenuation to ensure that offsite runoff rates do not exceed Qbar greenfield rates for all design storms.
- In addition, developments will need to demonstrate that masterplan layouts have been prepared with landscape design and drainage integrated in a manner to provide SuDS features that promote the reduction of surface water runoff via evapotranspiration.

Facilitate liaison for developers by enhancing LBTH LPA provisions for interface with Environment Agency:

- The Environment Agency will need to be consulted on each outfall. In order to facilitate this process, the LPA should provide a dedicated resource via the planning process to facilitate the link between the Environment Agency and the plot developers.
- This will ensure that developers are able to access the required resource in a timely manner to suit their programme and are less inclined to resort to the easier approach of connecting all drainage to the combined sewers.

Facilitate discussions between adjoining plot developers to promote multi-plot drainage systems with integrated landscape (SuDS) offerings:

- Through the planning process, LBTH should seek to engage the developers for residential plots along the River Lea to consider providing strategic drainage networks that cross through the plots and connect to the River Lea.
- This will ultimately provide connection points for other plots further upstream and will enable Thames Water to adopt the pipe networks and maintain them in perpetuity.

LBTH to engage Thames Water to investigate potential for surface water sewer and outfall to River Thames:

- The mixed-use plot along the southern edge of the Zone is located on the bank of the River Thames and also adjoins the A1261 Aspen Way. This plot has the potential for the creation of a new outfall to the River Thames that will support the installation of a new surface water sewer that could be installed under the A1261 or the adjacent DLR elevated railway.
- The LBTH, the DLR and Thames Water have the opportunity to approach the plot developer and provide assistance to deliver this new infrastructure to accept surface water runoff from plots within the Zone as well as this earmarked for development in eastern end of Zone 1.
- The DLR elevated railway and parts of the A1261 highway could be re-developed to include a new corridor for the surface water sewer underground together with SuDS features above ground such as swales and filter drains with a view to provide a means of attenuating and cleaning runoff from the elevated railway and the surrounding highways before discharge to the new surface water sewer.
- Any capacity generated for surface water by this sewer would remove the same capacity constraint from the combined sewers in the vicinity.

Opportunities for Coordinated Delivery

As described in Section 5.8, a core principle of the IWMP is that improvements to water infrastructure should be considered in coordination with provision of other infrastructure taking place in the study area (in order to reduce disruption, deliver cost savings and provide joined up utility provision). The following opportunities have been identified in Zone 6A:

- Station public realm improvements are planned at Blackwall. Opportunities should be sought to disconnect downpipes from the DLR track and integrate with SuDS within the public realm.
- Plans for road resurfacing should include SuDS and maximise opportunities for roadside landscaping and improvements to the public realm.
- Coordinated delivery of potential upgrades to energy infrastructure (gas main) and installation of a new surface water sewer along East India Dock Road.
- Opportunities should be sought to coordinate with work underway as part of the East of Borough Area Action Plan to improve planting, drainage and water quality in this zone.
- Interventions close to flood assets (for example Thames Tidal Defences) provide opportunities to coordinate with the Environment Agency Isle of Dogs Asset Management Strategy as part of the Thames Estuary 2100 Plan.

6.7 Zone 6B AAP Wider Area

Zone Summary

Location

This Zone consists of a mixture of terraced residential properties, buildings with residential flats and some commercial plots over an area that is intersected by the Limehouse Cut. This man-made watercourse is a navigational route linking the River Lea with the River Thames and the Regents Canal via the Limehouse Basin.

Growth

Table 6-6 summarises the growth projected for Zone 6B. It identifies that there are 1,146 housing units yet to be constructed by 2031 as well as 5,155 square metres of commercial floorspace.

Table 6-6 Summary of growth in Zone 6B

Housing	Units
2016 – 2031 Phasing: Complete / under construction	**500**
2016 – 2031 Phasing: Yet to be constructed. Key sites include: - Bow Common - Bow Common Lane - Chrisp Street Market	**1,100**
2031-2041 maximum growth scenario	**100**
Commercial floorspace (2021 – 2031)	**5,200**

Water Balance

The key changes in the Water Balance for Zone 6A are shown in Figure 6-23.

- Over the 10-year period analysed, the average amount of time that attenuated rainfall meets non-potable demand in Zone 6B is 44%. 35% of the time the demand is not met at all. This presents greater opportunity for rainwater harvesting to meet non-potable demand in this Zone, compared to the rest of the study area.
- Peak foul water discharge will increase by 27%.

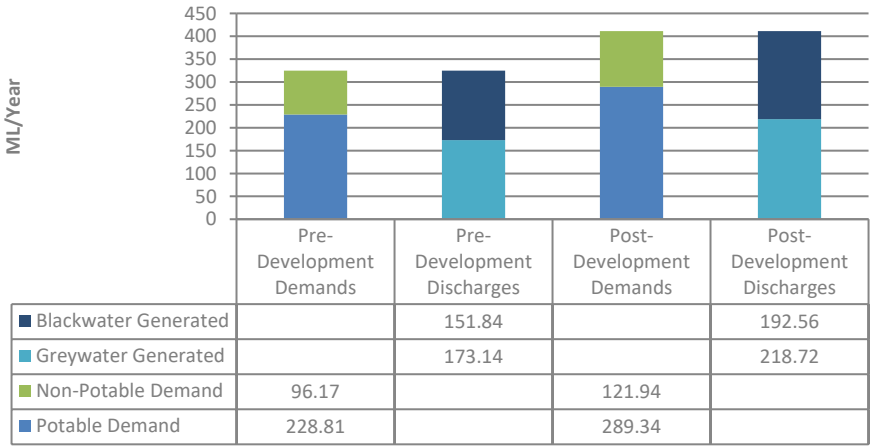


Figure 6-22 Water Balance Summary for Zone 6B

Constraints and Opportunities

The AAP Wider Area Zone has the following specific constraints and opportunities:

- There are limited options for surface water discharge to a waterbody.
- The Limehouse cut may offer opportunities for discharge for adjacent plots; however, CRT have advised the Cut also operates as an overflow path for the River Lea during high tide and high fluvial flow events which reduces capacity to receive surface water runoff into the Cut.
- Approximately 70% of the short to medium term growth has yet to be constructed, hence is subject to current progress through planning, there is potential for development to consider some of the IWMP requirements.
- The development plots highlighted for the next 10 years are dispersed in a manner that reduces the potential for cross-plot drainage solutions.
- There are a number of open spaces which present options for green infrastructure-based SuDS for growth post 2031.

Proposed Options Zone 6B AAP Wider Area

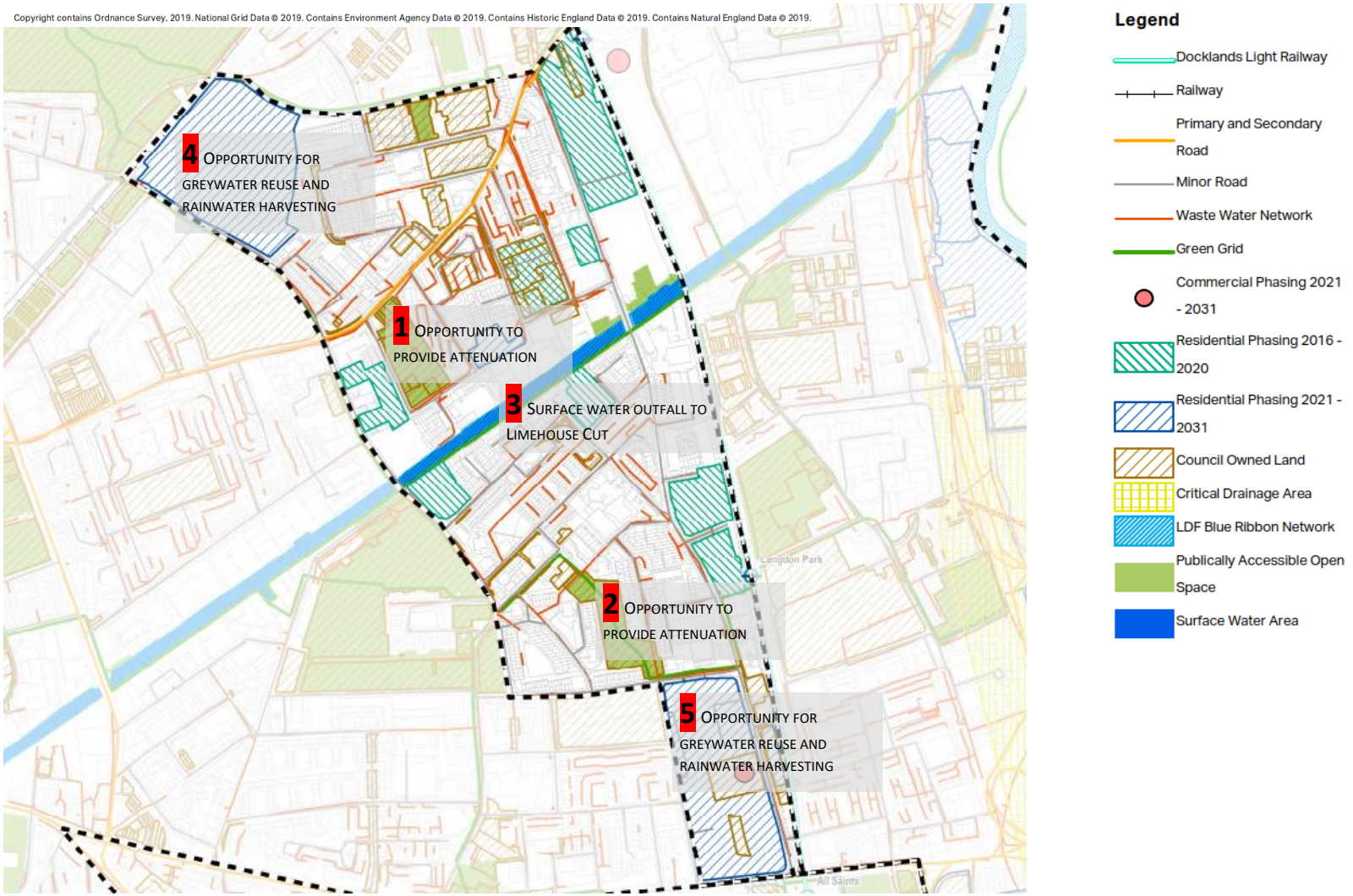
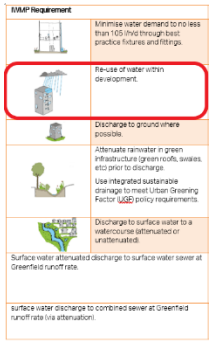


Figure 6-23 Schematic of Options Zone 6B AAP Wider Area

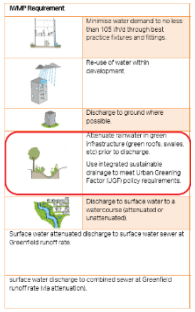
Re-use and demand reduction



There is potential for re-use to be delivered strategically in the Zone.

The Zone is only served by Thames Water combined sewers and does not have significant access to watercourses or Docks for surface water discharge other than the limited potential offered by the Limehouse cut. Therefore, the provision of rainwater harvesting, and greywater recycling systems will be an important factor in reducing peak surface water runoff to the combined drains while providing significant reduction in dependency on potable water supplies.

The large residential plot known as Bow Common Gas Works (Point 4 in Figure 6-23) to the north western end of the Zone will potentially comprise residential and commercial properties with leisure, office space and education elements and the large development at the southern end of the Zone (Point 5 in Figure 6-23) will comprise a mix of residential and commercial properties as well as a section of Council owned development. Such large developments have the potential for integrating recycling systems to reduce the impact on the potable water supplies by making better use of the rainfall runoff.



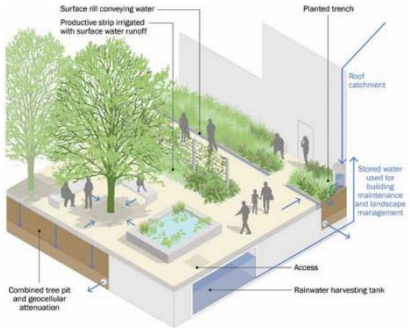


Figure 6-24 Example of rainwater harvesting system combined with surface water attenuation. SuDS Manual 753

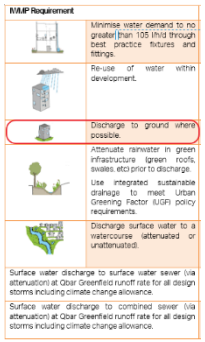
Demand offset potential

There are opportunities to use accrued s106 contributions from the demand offset obligations in this Zone to install retrofit water efficiency measures and potential retrofit rainwater harvesting schemes, on council owned buildings including: St Saviours School. There are some council estates of residential property which offer specific advantage to provide property level retrofit water re-use schemes or community-based options.

Grants could also be made available to the numerous non-residential developments to incorporate water efficient fittings and retrofit re-use schemes

Surface water management

Infiltration



The superficial geology underlying the Zone consist of Kempton Park Gravel member to the south and Taplow Gravel member to the north. The entire Zone bedrock consists of London Clay. Local infiltration may be feasible in some locations as part of a wider sustainable drainage strategy; however, the permeability of the superficial deposits is likely to be variable, owing the presence of the Langley Silt member (consisting of clay and silt) which has much lower permeability.

Developers in this Zone should consider infiltration potential via physical testing on site in line with the recommendations of the BRE Digest 365 Soakaway Design guide and trial pits or boreholes, as there may be potential for localised infiltration depending on soil and ground conditions.

Rainwater Attenuation in Green Infrastructure

Existing open spaces such as Furze Green (Point 1 in Figure 6-23) and Alton Street Open Space (Point 2 in Figure 6-23) could be used to accommodate surface water attenuation features drained from potential development plots adjacent to the open spaces – this includes plots for short to medium term growth as well as development locations which may come forward post 2031.

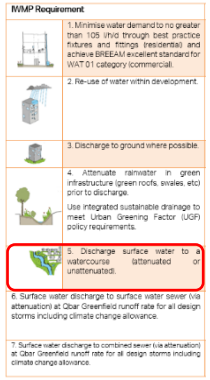
The attenuation features could be linked to rainwater harvesting systems that would be used to maintain the open spaces as well as feed back to the adjacent properties where required (see Figure 6-24). The attenuation could take the form of wide and shallow depressions in the ground, constructed with permeable materials at the base to allow infiltration to underlying cellular storage systems or filter drains. The entire arrangement could be made to discharge via flow control devices designed to limit pass

forward flow to lesser rates than currently in place, providing betterment to the downstream combined sewers.

The above ground depressions could then be formed and planted in a manner to provide amenity space during dry periods, potentially disguised as stepped, shallow seating areas set into the landscape for residents.

Discharge to Surface Waterbody

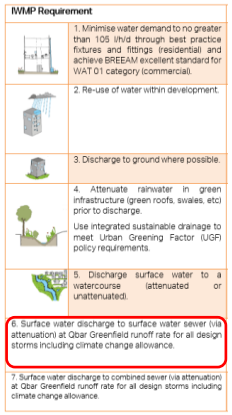
Discharge to Watercourse



The Limehouse Cut (Point 3 in Figure 6-23) is operated as an overflow channel as well as a navigational route to protect from high water level conditions in the River Lea. CRT have indicated that during normal conditions, capacity would be available for discharges, but further capacity assessment would be required to determine whether discharges could be accepted during all conditions (when high fluvial flows in the Lea and high tides coincide with heavy rainfall events)

However, the CRT may accept new outfalls to this water body under specific circumstances. Negotiations between the plot developers and the CRT should be encouraged by the LPA to facilitate the process of creating new outfalls from prospective developments along the Limehouse Cut banks. It is likely that significant attenuation will be required to reduce runoff rates to Qbar greenfield prior to discharge, in turn providing the opportunity for rainwater harvesting by using the attenuation tanks to feed the system using integrated weather prediction software.

Discharge to Sewer



The sewer system currently serving the Zone is combined sewer. There are no identified surface water sewers in this zone.

Developers in this Zone should only connect to the combined sewer system where they have demonstrated that it is not feasible to connect to the Limehouse Cut or the River Lea via plot specific or strategic, multi plot systems, and where they have demonstrated that opportunities for rainwater attenuation via landscaping have been maximised. Additionally, developers should maximise any opportunity for infiltration unless demonstrated via testing that infiltration is not feasible.

Option Delivery

Reducing potable water usage

LBTH to require developers to provide rainwater harvesting and greywater recycling systems to address the need to reduce potable water usage on plots.

Water re-use in mixed use developments

Where mixed use developments are brought forward, LBTH to require developers to review the potential for different elements of the development to provide water re-use for other parts.

Attenuation in green space

LBTH to investigate the potential for existing green spaces to be used for attenuation for new developments that may arise in the vicinity, integrating the required infrastructure engineering with as much landscape design as possible to provide amenity benefit to residents.

Outfalls to Limehouse Cut

LBTH to facilitate outfalls to Limehouse Cut for adjacent developments through discussions with CRT.

Reducing discharge to combined sewer system

All developments discharging to combined sewers to provide sufficient attenuation within SuDS features to achieve discharge rates no greater than Qbar greenfield rates for all design storms.

Opportunities for Coordinated Delivery

As described in Section 5.8, a core principle of the IWMP is that improvements to water infrastructure should be considered in coordination with provision of other infrastructure taking place in the study area (in order to reduce disruption, deliver cost savings and provide joined up utility provision). The following opportunities have been identified in Zone 6B:

- Opportunities should be sought to coordinate with work underway as part of the East of Borough Area Action Plan to improve planting, drainage and water quality in this zone.
- Plans for road resurfacing should include SuDS and maximise opportunities for roadside landscaping and improvements to the public realm.
- Potential delivery of upgrades to energy infrastructure (gas main) along Violet Road and/or Bow Common Lane could be coordinated with installation of new surface water sewers.

6.8 Case Study

Plot Selection

The Crossharbour District Centre plot (the Site) in Zone 3/4 has been chosen as a case study plot to demonstrate how measures could be implemented to accord with the IWMP requirement hierarchy. This has been based on details of specific plot proposals such as density, development mix, topography and proposed numbers of units.

Site Details

The site is currently subject to planning application PA/19/02534 submitted to LBTH providing details of a mixed-use site known as the Crossharbour District Centre.

The Site is approximately 4.61ha in area, and currently comprises an existing self-service petrol filling station, supermarket and associated car parking.

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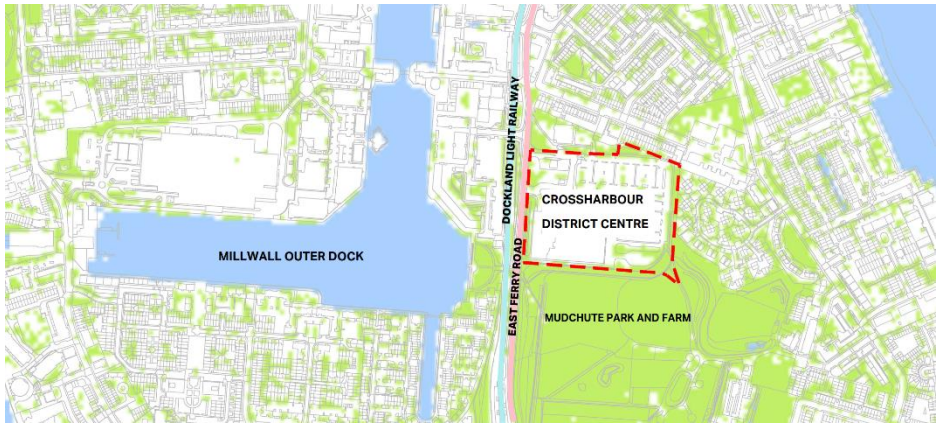

Figure 6-25 Crossharbour District Centre plot location

The development has been chosen as a suitable study case to demonstrate how such a site within the IMWP Study Area can be developed in a manner to maximise opportunities for integrated water management whilst also tackling the constraints that are common to the Study Area. The key features are:

- The Site will comprise a significant extent of raised podium deck with high rise buildings located above. This arrangement is typical of the Flood Zone 3 area within the Study Area and presents substantial opportunities that should be tapped into with respect to integrated water management.
- The Site will comprise a mix of residential and commercial units which should be able to complement each for rainwater harvesting and grey water re-use.
- The Site is landlocked and does not have direct access to a clear discharge point to a watercourse but does have indirect opportunities for surface water discharge which could be considered.
- It is located upstream of a Critical Drainage Area which means the area contributes flows related to a wider area at risk of surface water and sewer flooding.
- It has no access to surface water sewers but does have access to a combined sewer.

Site Proposals

Information on the development proposals has been taken from the planning portal and expanded to provide context to the case study as follows:

- The Site proposals are for up to 2,015 residential units. Based on meeting the policy target of 105 l/h/d, this would be expected to generate a demand for potable water of 635 m^3 per day based on an average of 3 residents per unit.
- Up to 1,447 of those units could be constructed within proposed high-rise towers in the development and using an average of 3 persons per unit, there is a potential for up to 130 m^3 per day of grey water to be generated.
- The proposals include for 15,738 m^2 for a new hypermarket.
- The entire site will comprise impermeable surfacing, resulting in the need to drain all surfaces. No areas will be landscaped at ground level. The majority of the site will be overlain by a podium deck.
- Foul water discharge would be expected to increase from 5.4 l/s to 106.29 l/s based on estimated development population.

- With the implementation of 4,364 m^3 attenuation, surface water discharge would decrease from an estimated existing runoff rate of 548.9 l/s down to 21 l/s (three times the Qbar Greenfield runoff rate).

Implementation of Measures

Re-use of Water

It is estimated that up to 130 m^3 of greywater could be generated by the new high rise towers. This water could feed non-potable demand for the residential units as well as the neighbouring commercial units such as the proposed bus parking (bus washing) and petrol filling station (private vehicle washing). These commercial units would not generate sufficient grey water (from sanitary purposes) to meet their non-potable demand, but a plot based system to collect, treat and distribute greywater from residential as well as commercial units would be able to meet multiple demands across the Site.

The Site will also include up to 496m^3 of storage volume as blue roofs. These roofs could be reconfigured to integrate weather prediction software and equipment to allow the volume to be mobilised during dry spells for storage from previous storms, allowing rainwater to be used to irrigate the extensive podium spaces in the design.

Grey water recycling and rainwater harvesting would both lead to a reduction in potable water demand and use of surface water as a resource instead of a waste product.

Discharge to Ground

The site is located over alluvial superficial deposits overlying Lambeth Group bedrock. The permeability of the alluvium is low, and the deeper Lambeth Group has a high variability of permeability, often with perched water table associated with irregular sand bodies within the clay. This combination of geology, alongside contamination risk, means wide scale infiltration SuDS are unlikely to be suitable as a reliable form of attenuation and discharge across the Site.

Integrated Sustainable Drainage

The Crossharbour District Centre masterplan shows extensive areas of paving overlying relatively flat podium deck spaces as well as steeper areas connecting the podium decks to the surrounding roads. The proposed drainage strategy suggests the use of storage within the podium decks (1,215 m^3) as well as blue roofs (496 m^3) and underground storage tanks (2,653 m^3).

Figure 6-26 Potential alternative SuDS options

Rainwater within the development could be used as a resource to enhance the proposed landscape design and provide amenity spaces that embrace this resource rather than aiming to pass it through the development as quickly as possible.

Figure 6-26 shows how the external paved surfaces could be developed to include large depressions for surface water attenuation during extreme events (over the 30-year event) and during exceedance storms (over the 100-year event and climate change allowance). These depressions could be used in conjunction with underground but on-podium deck storage in a solution with deeper crates than 300mm to provide significant storage using cheaper and more readily available crate systems.

In addition, features such as planted shallow water features (rills, paved swales, etc) could be included to showcase the use of rainwater within the development while providing an element of additional capacity for surface water storage. These could be used to convey water above ground to large but shallow ponds within the paved areas. The ponds could include an element of permanent water for amenity and interest to the passing pedestrians.

Discharge to Surface Waterbody

The proposed development is not located in an area immediately adjacent to a surface water body. However, the south western corner of the Site is located across East Ferry Road to a green area which itself adjoins the Millwall Outer Dock. A section of DLR railway separates the Site from the green area but the two areas are linked via a pedestrian underpass under the railway.

In order to address the capacity issues associated with the public combined sewers and to provide a more sustainable means of surface water disposal, large parts of the private surface water drainage network (especially those serving the raised areas of the Site and podium decks) could be directed to a new outfall across East Ferry Road and through the existing underpass. This would require the developer to work with either Thames Water to adopt a section of new sewer built outside the Site boundary to an outfall into Millwall Outer Dock or to work with the Local Council to facilitate cross-site drainage systems.

Provision of such a mechanism through public bodies such as the LBTH could unlock several development areas and provide sustainable drainage solutions as well as a means of delivering surface water at a managed rate to the Docks to reduce the need for pumping by the CRT.

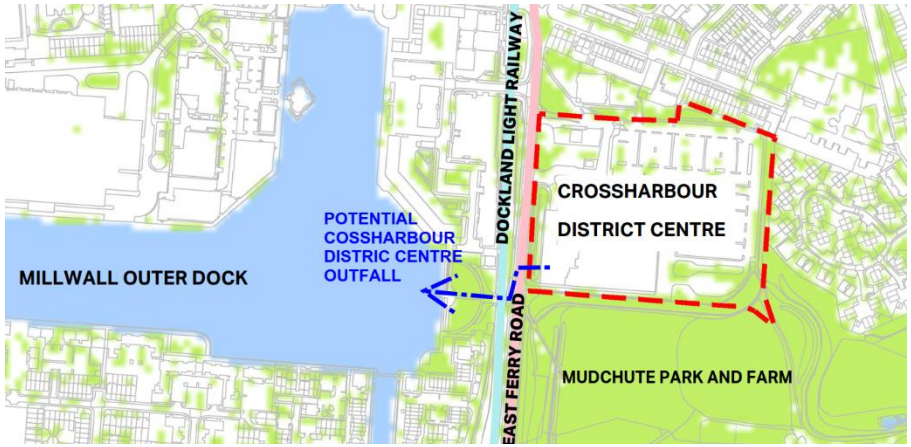

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Figure 6-27 Outfall to Dock

The proposed podium deck areas around the development are, on average, set at approximately 5.00 m AOD, with the blue roofs set at levels significantly above this level. Given the location of the Site and raised levels, an opportunity exists for surface water to be kept at elevated levels and drained to any point on Site that would be suitable to allow a gravity connection to the Millwall Dock. Such an opportunity would result in reduction in flood risk to the public combined sewers for a Critical Drainage Area immediately north of the Site as well as provide significant savings to the development for surface water discharge to public combined sewers.

07 RECOMMENDATIONS AND NEXT STEPS

The IWMP identities a range of study wide and spatially specific options that could be delivered to support the IWMP requirements. A summary of the high-level delivery requirements, recommendations and next steps are included in this section.

7.1 Developer Checklist

In order to support developers in understanding the IWMP requirements, why they are needed and how they can be delivered, a developer checklist has been produced to support the IWMP. This is included in Technical Appendix E.

7.2 Study-wide Solution Delivery

The following delivery requirements are not spatially specific and should be implemented for all development in the study area in order to meet the IWMP requirements and address the infrastructure and capacity issues identified in Section 03.

Water Re-use

All new development should be expected to provide water reuse, either through rainwater harvesting, grey-water recycling or a combination of both approaches demonstrating that residential demand is no greater than 90 l/h/d, and commercial development meets BREAM Excellent rating for WAT 01. To support this, the following actions and requirements are recommended:

- LBTH should set up a s106 or CIL legal agreement to support the proposed offset policy where developers unable to meet the proposed water demand targets, can pay an offset charge per litre per head. This will require:
- A separate study to identify a reasonable and proportionate price per litre per head that developers must pay for every litre per head they are unable to meet between 90 l/h/d and the 105 l/h/d demand as set out in planning policy; and
- A separate study to identify and pursue options to develop water efficiency and water use reduction schemes via retrofit within the study area, such that accrued offset contributions can be used to deliver water use reduction. This study should be completed in combination with Thames Water to maximise opportunity to dovetail with the company's current demand reduction measures and schemes being delivered as part of their WRMP commitments.
- LBTH should seek discussions with potential NAV water providers who could support early discussions with developers to provide multi-plot or community-based system via the council's infrastructure co-ordinator service. NAVs can provide both treatment facilities and distribution networks and would provide these services via annual charges separate to charges made by Thames Water who currently serve the study area. The CWG is an example of how this system could be operated.
- All development should be encouraged to provide dual plumbing systems for potable and non-potable supply. Future resilience is a key aim of providing sustainable water infrastructure to the study area and this will ensure that future sources of re-used water can be retrofitted and supplied to buildings, even where developers opt for the offset payment scheme (see subsequent sub-section)
- All new development granted planning permission where water re-use is proposed should be subject to a planning condition requiring annual performance reporting of residential and commercial water use to demonstrate that the residential and commercial targets continue to be achieved.

Dual Piping Costs

All development being built with a dual pipe will allow buildings to be retrofitted to any future community based strategic re-use systems that may be developed by Thames Water, or other water NAVs that come forward in the study area, even where a developer relies on the offset fund to meet the IWMP requirement. This has been adopted, for example, by the local authority in San Francisco to support resilience and aid to generate a market for treated water supply.

The following details have been compiled using test case buildings that are likely to be typical of the study area:

- For a new residential building of 15 storeys containing 112 units of various sizes serving approximately 380 people, the estimated additional cost of installing a rainwater harvesting system (including dual pipework to the feed the building toilets) will be approximately £2.03 per square foot of development space. This equates to between 0.7% to 1.0% increase in cost.
- For the same building and population, the installation of a greywater recycling system would cost an additional £2.65 per square foot of development space. This equates to between 1.0% to 1.25% increase in cost.
- In comparison, for the construction of a new 11 storey commercial building with 16000m^2 of gross internal floor space, the addition of dual pipework and greywater recycling system to feed the toilets would cost an additional £1.49 per square foot of development space. This equates to between 0.3% to 0.5% increase in cost.

These costs do not include Main Contractor costs which will add an additional 20%-25% as well as costs associated with the loss of developable space to accommodate the additional systems.

However, the costs do not reflect the savings that would be brought to the end-users through reduced potable water rates nor do they quantify the overarching betterments that would ensue from obtaining and piping potable water from outside the study area to the new developments.

Providing resilience is a key driver for water management in the study area and London-wide. Thames Water are delivering a new initiative called 'smart plumbing' with an aim to reduce single supply source reliance. Provision of non-potable demand from local sources can be a key contributor to this initiative helping to deliver resilience in the round.

Accrued Offset Funds

The s106 charge would be accrued into pooled fund which could be used to fund a programme of retrofit water demand reduction measures in the study area. This fund could be used to:

- Fund retrofit re-use systems to council owned property such as social housing or schools.
- Co-fund water demand reduction programmes alongside Thames Water such as the smarter homes visit.
- Provide grants to non-domestic entities to retrofit re-use systems into offices and commercial buildings.

The study-wide approach to re-use requires developers to include dual pipe water supply systems: defined as one pipe system to supply potable water uses with a separate system for non-potable supply.

Surface Water Management

The IWMP has set out several surface water management options which are viable within each Zone (as well as study wide approaches) which meet the hierarchical IWMP requirements aligned with key drivers and planning policy. The following sets out details of actions and requirements recommended to facilitate the adoption of these measures and approaches.

Maximising Green-Infrastructure Based SuDS

LBTH should consider developing a developer guidance document to encourage the integration of landscape design and surface water management and facilitate adoption of above ground water management within site layout and landscape plans. Such an approach is key to developers maximising the use of limited public realm and open space (within high density developments) to achieve surface water management, flood risk as well as urban greening policy requirements.

For developments where the proposed site boundary exceeds a pre-determined threshold value, LBTH should consider developing a minimum target for landscaped areas to comprise of features that deal with surface water disposal such as ponds, swales, dry detention basins, rain gardens and rills.

As with re-use, NAVs[31] should be engaged as part of the infrastructure co-ordinator service provided by LBTH to consider provision of integrated water infrastructure provision. As well as provision of water re-use treatment and distribution infrastructure, NAVs can also provide multi-plot drainage infrastructure including the use of nature-based SuDS solutions, particularly where they can be used for dual purposing such as surface water attenuation and subsequent re-use on a strategic scale. This provides an advantage over the use of Thames Water as the incumbent provider as Thames Water will only adopt piped elements of surface water systems and not the above ground features of an holistic SuDS system

Minimising Discharge Volumes to Sewer

The IWMP has identified that many of the proposed development plots in the next 10 years, and some potential spatial options post 2031, have opportunity to discharge surface water to either the dock system, the River Lea, the River Thames or the Limehouse Cut.

To maximise potential for delivery of surface water discharge, multi-plot systems would need to be considered and investigated and this would require multi-stakeholder input, including further investigation and continued dialogue.

It is recommended that an IWMP Continuation Working Group is established consisting of the CRT, Thames Water, LBTH[32], TfL DLR, the GLA and potential in-set providers. The group should be set specific objectives as follows:

- Develop a mechanism which would allow strategic, multi-plot surface water systems to be funded and provided in advance of contributions from developers to encourage developers to commit to separated discharge. Thames water will be the main stakeholder that will allow LBTH to drive change to the approach taken on the delivery of drainage schemes through the provision or adoption of new piped surface water drainage networks and outfalls. Thames Water receives applications for connections from all plot developers and can be given the opportunity to request that plot developers reduce the peak rate and volume of discharge to their public networks through implementation of similar requirements in planning policy; this can be achieved by the provision of SuDS before connection to the new surface water sewer network. A joint approach between Thames Water and the LBTH will allow developers to factor in suitable budgets to their projects early on during the concept stages; it can also aid to develop guidance on which elements of new surface water systems that Thames Water would be willing to adopt (the piped network and outfalls).
- Determine whether the dock system could provide strategic attenuation storage volume for multiplot discharges and whether this could lead to a positive cost-benefit with respect to reducing the need to pump water into the system from the tidal River Thames. This would require further study to determine the overall dock capacity, and to assess the limitations of in-combination flood events via joint probability analysis. Further study would also be required to understand the cumulative impacts on the water and ecological quality of these systems.
- Consider further study and investigations to assess the capacity of the Limehouse Cut to receive attenuated discharges, including the effect of in combination flood events
- Identify and support delivery of opportunities for new and retrofit schemes made possible via the reuse and proposed discharge offset mechanisms.

A further recommendation is that there should be a requirement for all developers where they propose to use below ground storage to install measures to allow this water to be re-used for non-potable purposes unless they can demonstrate it is not viable or non-potable needs are met from other sources.

Minimising Discharge Rates to Sewer

Given the nature of development sites within the Study Area (largely high rise buildings with large areas of raised podium deck providing significant storage potential at high level compared to existing ground levels), it is unlikely that any development plot could be brought forward with suitable evidence that demonstrates that space is not available for attenuation to be implemented to reduce runoff rates to Qbar greenfield rates, particularly when drainage is designed as part of the overall space planning strategy rather than an addition to an already developed masterplan.

[31] A list of NAVs can be found on Ofwats website: https://www.ofwat.gov.uk/regulated-companies/markets/nav-market/

[32] Including representatives from the Lead Local Flood Authority, the Local Planning Authority, The Highways Team, The parks team, regeneration Teams, and Strategic Planners.

Where discharge to a surface waterbody is not achievable, greenfield runoff rates to the sewer system will need to be achieved at each proposed plot. To support this, an offset payment mechanism will need to be developed by LBTH.

LBTH will need to develop a s106 or CIL legal agreement to support the proposed offset policy where developers unable to meet greenfield runoff rates, can pay an offset charge per cubic metre of storage they are unable to provide, but which would be needed to otherwise meet greenfield runoff rates on site. This will require:

- A separate study to identify a reasonable and proportionate price per cubic metre of storage that developers must pay; and
- A linked study to identify and pursue options to deliver either new or retrofit SuDS schemes to reduce surface water discharge to the combined sewer in the study area. Because the study is drained to the same point (Beckton WwTW via Abbey Mills pumping station) such schemes would directly offset the runoff rates not achieved on individual sites.
- The accrued money could be used to fund (or part fund) strategic surface water sewers for development still to be delivered up to 2031, and for new allocations coming forward post 2031.

The developer should be expected (via drainage strategies submitted to the LLFA) to demonstrate the attenuation storage feasibility. The offset study will need to develop a clear set of directives to advise the developer to allow them to make this assessment and to allow the LLFA and LPA at LBTH to review and comment on the submission. This should include:

- A proposed site plan showing the areas that will not receive buildings where attenuation could be installed: This should show the proposed attenuation volumes and depths, the forms of attenuation (tanks, ponds, swales, etc), together with constraints that preclude the increase in area usage for drainage features.
- Details of the proposed buildings to show roof space: demonstrating the use (or lack of) space to accommodate features such as green/blue roofs and podium decks.
- Details of a drainage network and the limitation in level to allow gravity connections to prospective discharge points.
- Clear calculations showing the attenuation volume required to achieve greenfield runoff rates, the attenuation volumes proposed and the difference between the two.

On Site Drainage Infrastructure Design

All proposed developments should install separate drainage systems up to their site boundaries, terminated with demarcation chambers prior to off-site connection. This will ensure that, where a developer has demonstrated no other options for discharge are available (other than combined sewer connection) that eventual separate connections to new public surface water systems can be made when the latter become available.

DLR Integration

The IMWP has highlighted the potential for the current DLR line to provide benefit through a combination of disconnection of the train line and station drainage from the sewer system and repurposing the space (including public realm) below the raised sections of the system.

It is recommended that TfL DLR form part of the IWMP Continuation Working Group and supports further study into how the space below the system could be incorporated into strategic SuDS provision which reduces discharge to sewer, but also provides potential for development plot connection to strategic SuDS and discharge to the dock system.

Heat Recovery

The study area provides potential options to develop heat recovery systems with the potential to input a significant contribution to community-based heat distribution systems. Further study is recommended to determine the feasibility of these options.

The planned developments will result in significant increases in the foul load to the existing system. In addition to the increase in foul load, the proposals through this IWMP should result in a significant reduction in the surface water load to the combined drains. The resultant combined drainage system will therefore comprise of a larger percentage of foul water and the location of the pump station serving the combined sewer overflow should be investigated to include a system that could extract heat from the combined sewer to sell to the nearby properties via district heating systems.

The pumping station site already includes infrastructure to lift storm overflow water from the deep sewer to the overflow system which could be used to feed a new heat recovery system in the vicinity. This would also ensure that the pumps serving the CSO are operated more often, reducing the ongoing maintenance liability that seldom-used systems inherently have.

As well as provision of attenuation storage, the docks offer potential to provide a source of heat recovery on a strategic scale. CRT are currently in discussion with developers to consider potential for this, and it is recommended that a strategic dock-wide study is undertaken to explore the potential benefit of such a system and whether it could have a detrimental impact on the environmental quality of the dock water.

7.3 Spatially Specific Delivery

The zone specific measures are summarised in Table 7-1 and Figure 1-2 (Appendix A Figure 11). This includes a prioritisation of the measures and details in the stakeholders and steps required to deliver each option.

Table 7-1 Zone Specific Measures

Zone	Measure	Description	Stakeholders and next steps	Label on Figure 1-2	Priority	Priority Justification
Zone 1: South Poplar	Community based rainwater harvesting along the A1261	Re-use of rainwater captured via commercial and residential units for train washing in the underlying train care depot.	- Developers consider installation of RWH and dual plumbing for non-potable supply. - LBTH to broker agreement between building occupiers and Train Care depot for RWH reuse.	1.1	High	Significant opportunity to develop a viable re-use supply and demand system.
	Surface water discharge to River Thames or North Dock	The development plots along the A1261 can be linked to a joint surface water system with plots in Zone 2 (Canary Wharf) including options to discharge to the docks or the River Thames. Opportunities to combine with linear SuDS based systems following green infrastructure routes.	- Developers contribute to SuDS element of option. - LBTH encourage developer discussions with NAVs to provide solution. - Thames Water consider ownership of surface water sewer and discharge infrastructure.	1.4	High	Significant opportunity to remove surface water from the sewer system with adoption options for piped network via Thames Water.
	Strategic surface water attenuation: Rosefield Gardens and Poplar Recreation Ground	Provision of strategic SuDS serving multiple plots (including potential sites for long-term growth to 2041) through landscaped depressions linked to underground attenuation.	- LBTH to undertake studies to investigate feasibility with parks team/LLFA. - Future developers to collaborate to deliver attenuation and flood management feature with LBTH.	1.2, 1.3	Medium	Relatively straightforward measure to implement, but ownership and scale would depend on growth locations post 2031.
	Gravity fed greywater systems in high rise buildings	Collection and re-use of greywater from higher rise residential blocks for commercial non-potable uses on lower levels.	- Developers consider installation of GWR and dual plumbing for non-potable supply.	1.1	Medium	Opportunity to significantly reduce potable demand but would require investment and cross-plot collaboration by developers and building management teams.
Zone 2: Canary Wharf	Integrated re-use systems – Wood Wharf	Significant mixed-use development providing opportunity for mixture of greywater and/or rainwater collection via residential property and re-used for commercial and other non-residential non-potable uses.	- Developer installs GWR/RWH and dual plumbing for non-potable supply.	2.2	High	Significant opportunity to develop a viable re-use supply and demand system due to single development ownership.
	Surface water outfalls	Most large development plots have a feasible location to discharge attenuated surface water to a water body to reduce discharge volumes to the constrained combined sewer system. This includes outfalls to the River Thames for the large plot to the west; Zone 1 linked sewer systems and an outfall to the North Dock or Thames for development to the north, and to the South Dock or River Thames for Wood Wharf.	- LBTH encourage developer discussions with NAVs to provide solution. - Thames Water consider ownership of surface water sewer and discharge infrastructure if more than one development. - Developers provide individual surface water discharges when adjacent to Dock system in liaison with CRT.	2.1, 2.3	Medium	Significant opportunity to remove surface water from the sewer system however, provision and adoption of the multi-plot system would need to be agreed along with discharge agreement to the dock system with CRT.

Zone	Measure	Description	Stakeholders and next steps	Label on Figure 1-2	Priority	Priority Justification
	Combined surface water attenuation and re-use	High density development is likely to require some underground storage to achieve reduction in runoff rates – significant non-potable demand means such systems should combine attenuation with re-use via dual plumbed buildings as standard.	- Developers ensure tanked attenuation is installed with infrastructure and systems to allow water to be reused. - Developers consider installation of dual plumbing.	2.1, 2.2	Low	All below ground storage acting to serve non-potable needs would bring benefit as part of a wider suite of re-use solutions.
Zone 3/4: South Quay and Crossharbour	Greywater re-use – South Dock and Millwall Inner Dock	Large scale residential and commercial mixed development means greywater re-use systems are more likely to be commercially viable and can be developed with residential greywater feeding non-potable demand for multiple residential and commercial buildings all in proximity.	- Developers consider installation of RWH and dual plumbing for non-potable supply. - LBTH to broker agreement between building occupiers or owner/occupiers for use between buildings. - LBTH encourage developer discussions with NAVs to provide solution.	3.1	Medium	Opportunity to significantly reduce potable demand but would require investment and cross-plot collaboration by developers and building management teams.
	Rainwater harvesting for irrigation – Millharbour Village Park	Development proposed for plots around Millwall Inner Dock should provide rainwater collection and storage for use as irrigation water to the proposed Millharbour Village Park and other landscaped areas.	- Developers install RWH.	3.2	High	Significant opportunity to develop a viable re-use system.
	Surface water discharge to River Thames and Docks	Most large development plots have a feasible location to discharge attenuated surface water to a water body to reduce discharge volumes to the constrained sewer system. This includes outfalls to the River Thames for the plot to the east and all development plots alongside the docks; these could be via multi-plot surface water systems and have the potential for some attenuation to be provided by the dock system.	- LBTH encourage developer discussions with NAVs to provide solution. - Thames Water consider ownership of surface water sewer and discharge infrastructure if more than one development. - Developers provide individual surface water discharges when adjacent to Dock system in liaison with CRT.	3.8, 3.9	Medium	Significant opportunity to remove surface water from the sewer system however, provision and adoption of the multi-plot system would need to be agreed along with discharge agreement to the dock system with CRT.
	Strategic surface water attenuation: John McDougal Gardens, future Millharbour Village Park and St Johns Park	Provision of strategic SuDS serving multiple plots (including potential sites for long-term growth to 2041) through landscaped SuDS features and, in some cases, discharge to the River Thames or docks.	- LBTH to undertake studies to investigate feasibility with parks team/LLFA. - Future developers to collaborate to deliver attenuation and flood management feature with LBTH - Thames Water consider feasibility of owning sewer and discharge infrastructure elements to reduce pressure on combined system.	3.3, 3.5	Medium	Relatively straightforward measure to implement, but ownership and scale would depend on growth locations post 2031.
	Docklands Light Railway (DLR) - SuDS	The DLR corridor is elevated across this zone, and there is potential to disconnect surface water downpipes from the combined sewer system to link to surface water collection (via SuDS),	- DLR/Tfl to work with LBTH, CRT and Thames Water to identify opportunities to disconnect DLR drainage and combine with development plots to provide SuDS and	-	Low	Good opportunity to provide multi-functional SuDS and reduce sewer

Zone	Measure	Description	Stakeholders and next steps	Label on Figure 1-2	Priority	Priority Justification
		attenuation and discharge systems for proposed major redevelopment plots.	alternative surface water discharge location.			discharge volumes as part of a wider suite of measures.
Zone 5: Island Gardens	Strategic surface water attenuation: Mudchute Farm, Millwall Park and Island Gardens	Long-term growth locations should make use of significant opportunity within greenspaces within the Zone to provide landscaped SuDS supporting multiple plots, with some locations such as Island Gardens likely to support a discharge to the Thames via SuDS based attenuation.	- LBTH to undertake studies to investigate feasibility with parks team/LLFA. - Future developers to collaborate to deliver attenuation and flood management feature with LBTH. - Thames Water consider feasibility of owning sewer and discharge infrastructure elements to reduce pressure on combined system.	5.2	Medium	Relatively straightforward measure to implement, but ownership and scale would depend on growth locations post 2031.
	Surface Water Discharge	In this Zone there are opportunities to discharge surface water to the River Thames and the Millwall Outer Dock.	- LBTH to work with Thames Water and CRT to identify discharge opportunities. - Thames Water to consider feasibility of providing surface water sewers and outfalls to the docks or Thames.	5.3, 5.4, 5.5	Low	Potential for significant reduction in surface water discharge but may require long lead in time depending on where development comes forward post 2031.
Zone 6A: Core Area AAP	Multi-plot surface water discharge to river systems	Several large development plots are located adjacent to the River Thames and River Lea. Plots north of the A1261 could be linked via a gravity-based strategic surface water system to increase the number of plots which could discharge this way and significantly reduce discharge to the combined sewer.	- Developers contribute to SuDS element of option. - LBTH encourage developer discussions with NAVs to provide solution. - Thames Water consider ownership of surface water sewer and discharge infrastructure.	6A.1, 6A.2, 6A.3, 6A.4	High	Significant opportunity to remove surface water from the sewer system with adoption options for piped network via Thames Water.
	Surface water discharge – east of zone	A large mixed-use development is proposed east of East India Dock Basin – several surface water discharge locations are feasible for this plot, including the Basin, the River Lea and the River Thames.	- Developer to develop outfall solution.	6A.7	High	Significant opportunity to remove surface water from the sewer system with adoption options for piped network via Thames Water.
	Greywater or rainwater re-use – mixed use development	There are several large plots located riverside of the River Lea and River Thames where significant mixed-use development provides opportunity for greywater and/or rainwater collection via residential property, with treatment and re-use for commercial and other non-residential non-potable uses.	- Developers consider installation of RWH/GWR and dual plumbing for non-potable supply. - LBTH to broker agreement between building occupiers or owner/occupiers for use between buildings. - LBTH encourage developer discussions with NAVs to provide solution.	6A.5	Medium	Opportunity to significantly reduce potable demand but would require investment and cross-plot collaboration by developers and building management teams.

Zone	Measure	Description	Stakeholders and next steps	Label on Figure 1-2	Priority	Priority Justification
Zone 6B: Wider AAP	Integrated re-use systems – north and south of Zone	Large mixed-use plots provide significant opportunity for commercially viable community-based greywater and/or rainwater re-use systems to provide non-potable demand for all building types (if combined with dual plumbing).	- Developers consider installation of RWH/GWR and dual plumbing for non-potable supply. - LBTH to broker agreement between building occupiers or owner/occupiers for use between buildings. - LBTH encourage developer discussions with NAVs to provide solution.	6B.4, 6B.5	Medium	Opportunity to significantly reduce potable demand but would require investment and cross-plot collaboration by developers and building management teams.
	Strategic surface water attenuation: Furze Green and Alton Street.	Future long-term development to 2041 which comes forward around Furze Green and Alton Street should consider strategic landscaped SuDS in these open spaces, potentially taking the form of wide and shallow depressions linked to below ground cellular storage for additional attenuation.	- LBTH to undertake studies to investigate feasibility with parks team/LLFA. - Future developers to collaborate to deliver attenuation and flood management feature with LBTH.	6B.1, 6B.2, 6B.3	Medium	Relatively straightforward measure to implement, but ownership and scale would depend on growth locations post 2031.