Great George Street, Liverpool

Flood Risk Assessment

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1.0 Introduction

1.1 Project Background

Curtins was appointed by Great George Street Developments Ltd Limited to provide a Flood Risk Assessment (FRA) a proposed development on land to the west of Great George Street, Liverpool, Merseyside, L1 5.

The FRA has been undertaken in accordance with the requirements of the National Planning Policy Framework (NPPF) and supporting Planning Practice Guidance and following initial consultation with United Utilities.

1.2 Structure of the Report

The report is structured as follows:

Section 1	Introduction and report structure
Section 2	Presents National and local flood risk and drainage planning policy.
Section 3	Provides background information relating to the development site, the development proposals, ground conditions and existing site access arrangements.
Section 4	Assesses the potential sources of flooding to the development site
Section 5	Presents flood risk mitigation measures based on the findings of the assessment.
Section 6	Addresses the effect of the proposed surface water runoff and presents an illustrative surface water drainage scheme to ensure that surface water is sustainably managed and flood risk is not increased elsewhere.
Section 7	Presents a strategy for ensuring that foul water generated from the development is sustainably managed
Section 8	Presents a summary of key findings
Section 9	Presents recommendations

2.0 Planning Policy and Guidance

2.1 National Planning Policy

The aim of the NPPF is to ensure that flood risk is taken into account at all stages in the planning process and is appropriately addressed

2.1.1 Sequential Test

Paragraph 100 of the NPPF states that *'inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk but where development is necessary, making it safe without increasing flood risk elsewhere'*.

This policy is implemented through the application of the flood risk Sequential Test which aims to steer new development to areas with the lowest probability of flooding.

2.2 Local Planning Policy and Guidance

All local authorities are required to produce a Local Plan with the aim of providing a more flexible planning system that adapts to changing priorities and which seeks to secure sustainable development. It is shaped by the National Planning Policy Framework.

Within Liverpool City Council, planning applications are currently decided upon primarily by using the policies of the Unitary Development Plan (UDP), a statutory document which is a one of the documents that sits within the Local Plan. The UDP will gradually be replaced when the Liverpool Local Plan, currently at independent examination stage, is adopted and until this time the UDP policies will still be used to determine planning applications.

In respect to flood risk and drainage, the Local Plan submission is supported by:

- Strategic Flood Risk Assessment[1]

In addition, Liverpool City Council have also produced a Local Flood Risk Management Strategy[2] in its role of Lead Local Flood Authority (LLFA) which provides guidance for developers.

[1] Liverpool City Council Level 1 Strategic Flood Risk Assessment Final Report, April 2018

[2] Local Flood Risk Management Strategy, Liverpool City Council, 2017. https://liverpool.gov.uk/council/strategies-plans-and-policies/roads-and-transport/local-flood-risk-management-and-drainage/local-flood-risk-management-strategy/

2.3 Requirements for Sustainable Drainage Systems

Planning applications for major developments[3] are required[4] to provide Sustainable Drainage Systems (SuDS) for the management of surface water runoff, unless demonstrated to be inappropriate[5] or disproportionately expensive.

SuDS aim to mimic natural drainage and can achieve multiple objectives such as removing pollutants from urban runoff at source, controlling surface water runoff from developments, and ensuring that flood risk is not increased downstream. Combining water management with green space can provide amenity and biodiversity enhancement.

In considering a development that includes a sustainable drainage system, the local planning authority will want to be satisfied that the proposed minimum standards of operation are appropriate, that there are clear arrangements in place for ongoing maintenance and where possible provide multifunctional benefits.

Technical Standards[6] published by DEFRA advise that surface water drainage systems should be designed so that:

- Flooding does not occur on any part of the site for a 1 in 30 annual probability rainfall event, unless an area is designed to hold and/or convey water as part of the design; and
- Flooding does not occur in any part of a building during a 1 in 100 annual probability event; and
- Flows resulting from rainfall in excess of a 1 in 100 annual probability rainfall event are managed in exceedance routes that minimise the risks to people and property, so far as is reasonably practicable.
- For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.
- Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably

[3] Developments of 10 dwellings or more; or equivalent non-residential or mixed development (as set out in Article 2(1) of the Town and Country Planning (Development Management Procedure) (England) Order 2010).
[4] Written Statement (HCWS161) made by the Secretary of State for Communities and Local Government (Mr Eric Pickles) on 18 December 2014.
[5] Paragraph 082 (Reference ID: 7-082-20150323) of the Planning Practice Guidance outlines how a sustainable drainage system might be judged to be inappropriate.
[6] Non-Statutory Technical Standards for Sustainable Drainage Systems, Defra, March 2015

practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.

- Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body, the runoff volume must be discharged at a rate that does not adversely affect flood risk.
- The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30-year rainfall event.
- The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100-year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.
- The design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100-year rainfall event are managed in exceedance routes that minimise the risks to people and property.

2.4 Consents

An Environmental Permit for Flood Risk Activities may be required from the Environment Agency (EA) for work;

- in, under, over or near a main river (including where the river is in a culvert)
- on or near a flood defence on a main river
- in the floodplain of a main river
- on or near a sea defence

Further information can be found by visiting the following website:
https://www.gov.uk/guidance/flood-risk-activities-environmental-permits

Land drainage consent may be required from the lead local flood authority or internal drainage board for work to an ordinary watercourse. Undertaking activities controlled by local Byelaws (made under the Water Resources Act 1991) also requires the relevant consent.

Any works which may have an impact on the existing public sewer network must be agreed with United Utilities prior to commencing in the format of a written consent.

Further information can be found by visiting the following website:
https://www.unitedutilities.com/builders-developers/wastewater/connecting-to-a-public-sewer/

2.5 Relevant Documents

The FRA has been informed by the following documents:

- Liverpool City Council Level 1 Strategic Flood Risk Assessment Final Report, April 2018
- Local Flood Risk Management Strategy, Liverpool City Council, 2017
- Topo Survey
- Architects Proposed Site Layout Drawings

3.0 Site Details and Proposed Development

3.1 Site Location

The site is located on land to the west of Great George Street, Liverpool. The Ordnance Survey National Grid Reference is 335153mE 389314mN as shown in Figure 3-1 below.

Figure 3-1 – Site Location

3.2 Existing and Proposed Development

The 1.50ha site is currently un-occupied. Historically, the site has been developed, primarily with residential properties up to recent times when these have been demolished and the site reclaimed as open space. Visual site survey, a topographic survey and a review of the United Utilities sewer records confirm that there remains significant highway and drainage infrastructure on the site in addition to several buildings and associated hardstanding.

The site is therefore considered part brown-field and part green-field, in accordance with guidance provided in Appendix C of Liverpool City Council's Local Flood Risk Management Strategy.

The proposed development is for the construction of a number buildings comprising residential apartments and mixed commercial space together with subterranean car parking spaces and hard and soft landscaping. The proposed site layout at ground level is indicated in Figure 3-2 as the Site Key Plan by architects Brock Carmichael.

Figure 3-2 – Proposed Site Layout (Brock Carmichael Drawing 17.011 SK(02)000. Aug 28)

The NPPF Planning Practice Guidance classifies residential development as 'More Vulnerable' and commercial as 'Less Vulneable'.

3.3 Waterbodies in the Vicinity of the Site

The River Mersey is classed as 'Main River' and flows in a south-north direction approximately 0.5km to the west of the site.

3.4 Existing Public Sewerage Infrastructure

The local public sewer network is owned and operated by United Utilities (UU). An extract of UU's asset records is provided in Figure 3-3 (refer to Appendix C for full record).

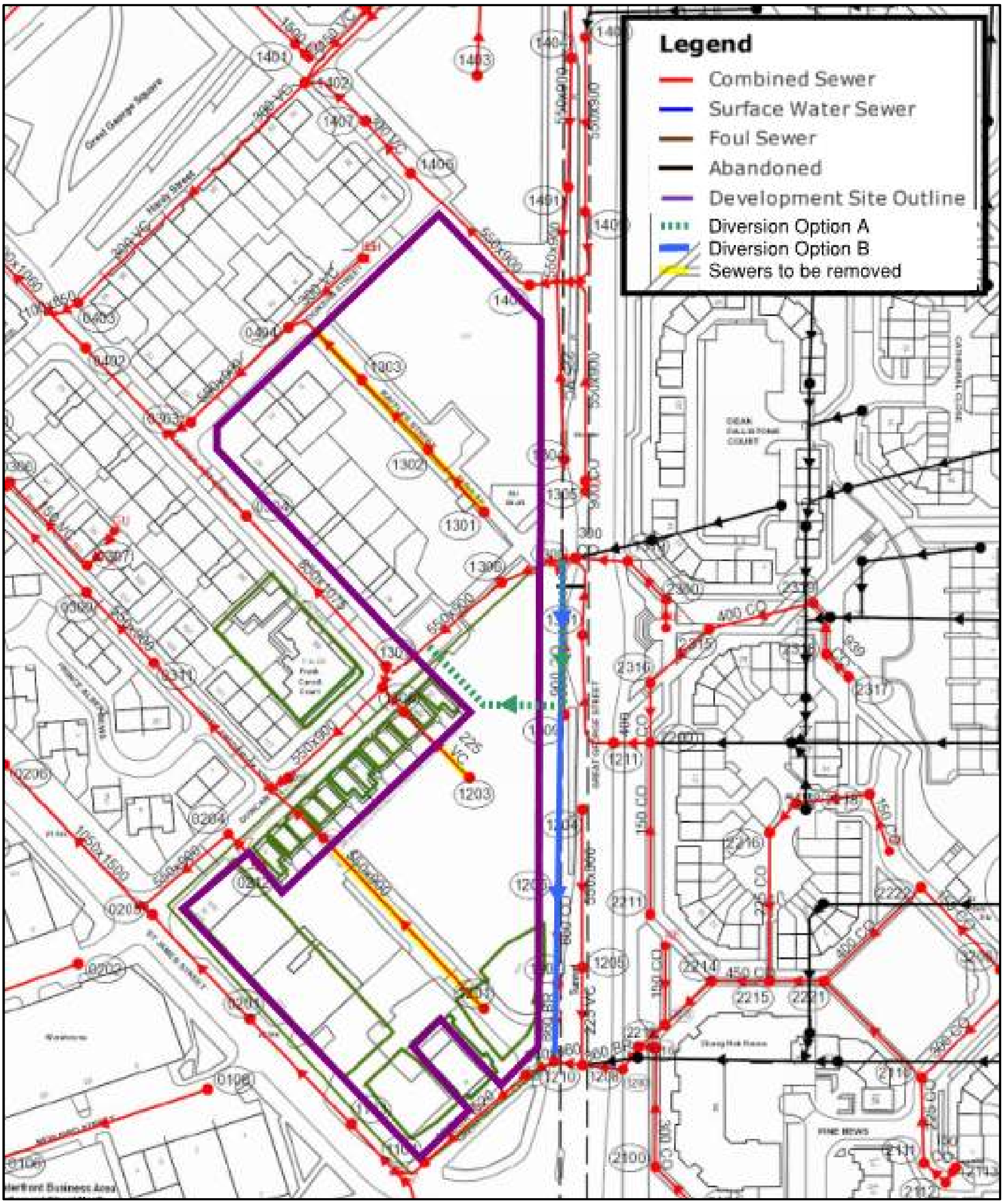

Figure 3-3 – Extract of United Utilities Sewer Records

The position of the UU apparatus shown by the sewer records indicates the general position and nature of their apparatus. The accuracy of this information cannot be guaranteed and a CCTV and connectivity survey to determine the exact location and depths below ground level of apparatus should be undertaken prior to the commencement of any detailed design or construction work.

A number of UU assets are to be removed where they cross the site as part of the development proposal. These are the remains of the positive drainage system serving the previous development on the site.

A sewer diversion will also be required to facilitate the development. The diversion entails rerouting a 550mm x 900mm combined sewer with currently flows from Great George Street and along the pedestrian access to the northern end of Duncan Street.

At this stage, two possible diversion routes have been identified and are shown in Figure 3-3 above.

Option A is to divert the sewer between UU MH1300 and MH1308, taking a route between proposed buildings on the site to connect back into the same branch of the sewer system.

Option B is to reroute the sewer south along Great George Street to connect into UU MH1210, picking the existing 900mm combined sewer connected to MH1300. This option will also pick flows up from an existing 860mm concrete combined sewer in Great George Street currently discharging into MH1210.

The diversion will require approval from United Utilities under a Section 185 agreement.

3.5 Ground Conditions

British Geological Survey (BGS) mapping indicates the site is underlain by a combination of Helsby Sandstone and Tarporely Siltstone. No superficial depots are identified.

A phase 2 Geo-environmental assessment, undertaken in 2015 for an adjacent site. Intrusive sampling was undertaken to advanced depths across the site. The pertinent results are summarised below:

- Made ground to approximately 3.0m to 4.0m below ground level (bgl)
- Medium medium dense to dense orange brown slightly gravelly SAND 3.0m bgl to 5.5m bgl
- Helsby Sandstone formation below 5.5m bgl.
- Termination depths 3.0m bgl ~15.0m bgl.
- No groundwater strikes or observation in any borehole or trial pit.
- Soakaway drainage not viable due to significant thickness of made ground.

3.6 Site Levels

The latest topographic survey relates to a local datum (AAD). This datum is 25m higher than Ordnance Datum Newlyn (ODN).

Site levels are generally shown to be in the region of 53.00m AAD to 47.06m AAD. The topographic survey indicates the site generally falls both north to south and east to west. Initially the site rises from the northern extent from 51.20m AAD to around 53.00m AAD then reducing to 48.80m AAD at the southern extent. The lowest westerly elevations fall at around 47.20 mAAD.

3.7 Access and Egress

There are several historic access points to the site, with vehicular access primarily off Duncan Street, Grenville Street and Raffles Street. The proposed site looks to retain vehicular access to the underground car parks in a similar manner. Pedestrian access would also be directly off Great George Street.

4.0 Review of Flood Risk

4.1 Flood Zone Designation

Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences. The NPPF Planning Practice Guidance defines Flood Zones as follows:

Flood Zone 1 (Low Probability): Land having a less than 1 in 1,000 annual probability of river or sea flooding.

Flood Zone 2 (Medium Probability): Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding.

Flood Zone 3a (High Probability): Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding.

Flood Zone 3b (Functional Floodplain): This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. The Flood Zones are shown on the EA Flood Map for Planning (Rivers and Sea). The Planning Practice Guidance states that the Zones shown on the EA Flood Map do not take account of the possible impacts of climate change and consequent changes in the future probability of flooding. According to the EA Flood Map for Planning (Rivers and Sea) (Figure 3) the site is located in Flood Zone 1. Detailed Map 11 of Liverpool City Council's Level 1 Strategic Flood Risk Assessment reaffirms the Flood Zone 1 designation.

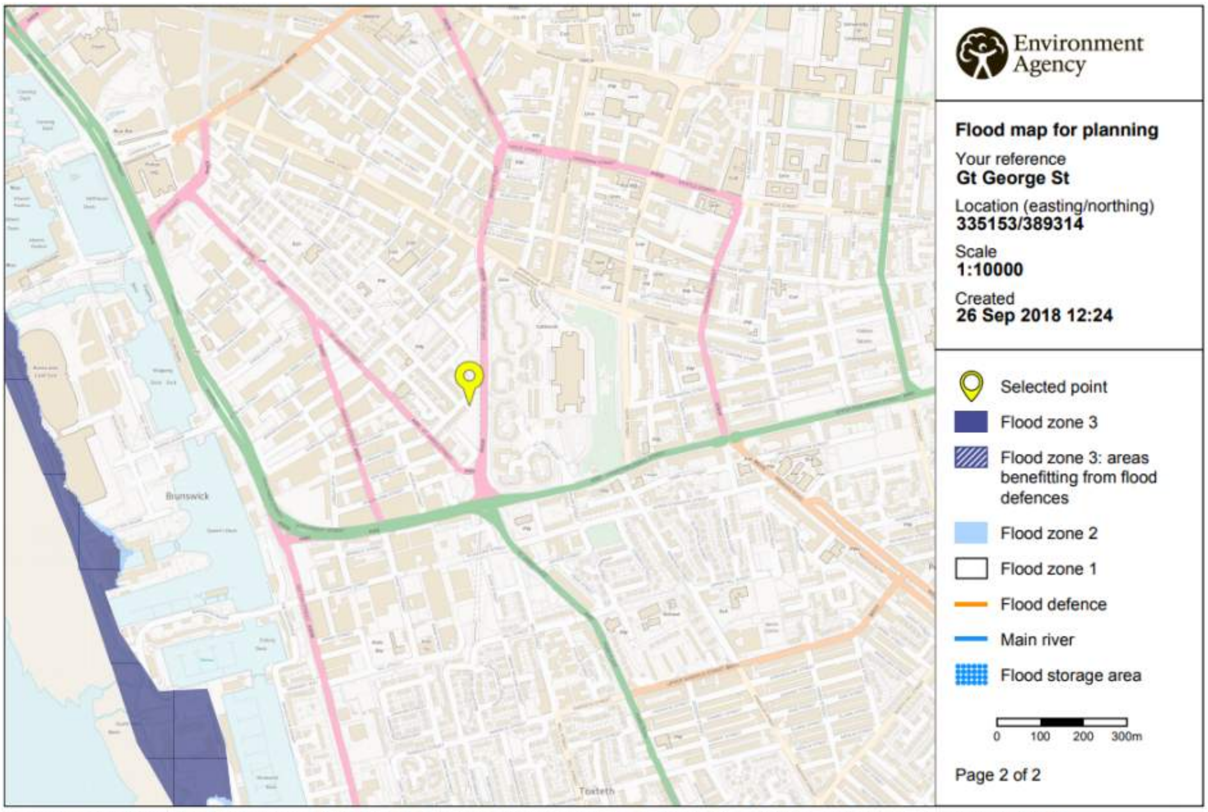

Figure 4-1 – Environment Agency Flood Map for Planning (Rivers and Sea)

4.2 Sequential Test

The proposed development site is situated in Flood Zone 1 and therefore satisfies the requirements of the Sequential Test.

4.3 Fluvial Flood Risk – River Mersey

As discussed in Section 4.2, the nearest watercourse is approximately 0.5km west of the site. The site is located in Flood Zone 1, and therefore considered to be outside the 1 in 1,000 annual probability event fluvial / tidal flood outline. Furthermore, Light Detection and Ranging (LiDAR) Digital Terrain Model (DTM) data indicates the ground levels at Wapping Dock on the River Mersey, due west of the site are around 7.00m AOD (32.00m AAD using site survey levels), some 15m below the lowest site levels. The risk of fluvial flooding is assessed to be low.

4.4 Surface Water Flood Risk

Surface water flooding comprises pluvial flooding and flooding from sewers and highway drains and gulleys.

4.4.1 Risk of Pluvial Flooding

Pluvial flooding results from rainfall-generated overland flow, before the runoff enters any watercourse or sewer, or where the sewerage/drainage systems and watercourses are overwhelmed and therefore unable to accept surface water. Pluvial flooding is usually associated with high intensity rainfall events but may also occur with lower intensity rainfall where the ground is saturated, developed or otherwise has low permeability resulting in overland flow and ponding within depressions in the topography. Flooding of land and/or property can also occur when the capacity of the sewer/drainage system is overwhelmed by heavy rainfall, becomes blocked or is of inadequate capacity or where the normal discharge of sewers and drains through outfalls is impeded by high water levels in receiving waters. The EA Risk of Flooding from Surface Water map (Figure 4-2) indicates that the site is at very low risk of surface water flooding with the exception of a small area in the southern part of the site where the risk remains low.

Residual flood risk from this source will be addressed through the mitigation measures as detailed in Section 5 and the surface water drainage strategy in Section 6.

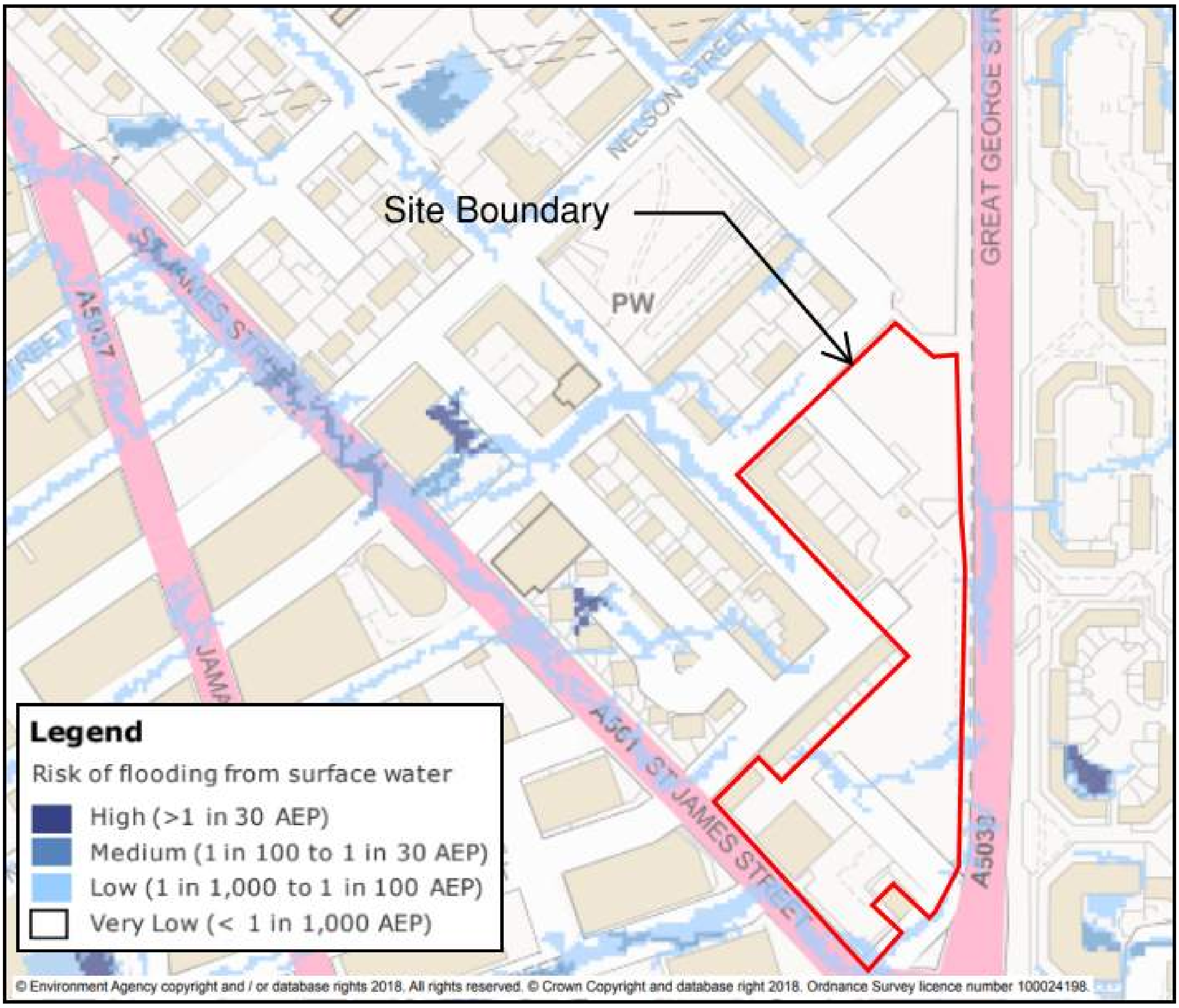

Figure 4-2 – Environment Agency Flood Risk from Surface Water

4.5 Flood Risk from Reservoirs Canals and Other Artificial Sources

The EA Risk of Flooding from Reservoirs map (Figure 4) indicates the site is not at risk of reservoir flooding. There are no canals located within the immediate vicinity of the site. The EA Risk of Flooding from Reservoirs map indicates that the site is not at risk of flooding from such sources. The site is therefore not assessed to be at risk of flooding from reservoirs, canals or other artificial sources.

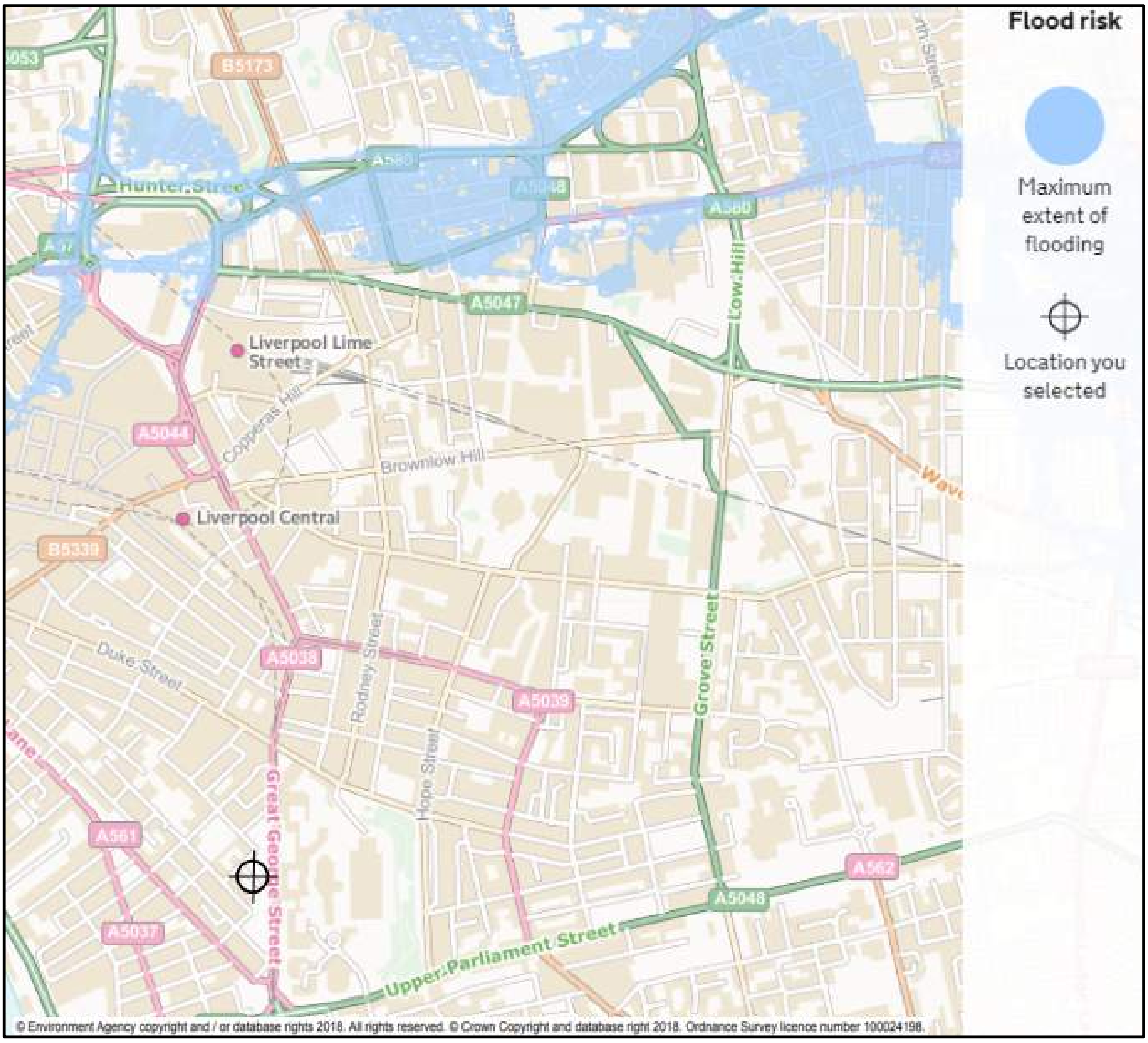

Figure 4-3 – Environment Agency Flood Risk from Reservoirs

4.6 Flood Risk from Groundwater

Groundwater flooding generally occurs during intense, long-duration rainfall events, when infiltration of rainwater into the ground raises the level of the water table until it exceeds ground levels. It is most common in low-lying areas overlain by permeable soils and permeable geology, or in areas with a naturally high water table.

According to the Phase 2 Geo-environmental report for the adjacent site, no groundwater was present in the deepest borehole, terminated 15m bgl. The results of the intrusive site investigation indicate that the site is not at flood risk from groundwater.

5.0 Flood Risk Mitigation Measures

5.1 Flood Mitigation

The residual risk of flooding from surface water will be mitigated through the implementation of measures proposed in the following section of this report.

5.1.1 Finished Floor Levels

Ground floor finished floor levels should be set a minimum of 0.15m above adjacent ground levels following reprofiling of the site.

Access to underground car parking should consider a ramp with crest height 0.15m above adjacent ground levels following reprofiling of the site.

This will enable any potential overland flows to be conveyed safely across the site without affecting property in accordance with the approach promoted in government policy[7]

[7] Making Space for Water, Taking forward a new Government strategy for flood and coastal erosion risk management in England, March 2005, Dept for Environment, Food and Rural Affairs.

6.0 Surface Water Management

6.1 Disposal of Surface Water

In accordance with the NPPF Planning Practice Guidance[8], surface water runoff should be disposed of according to the following hierarchy:

1. Into the ground (infiltration)
2. To a surface water body
3. To a surface water sewer, highway drain, or another drainage system
4. To a combined sewer

Ground water flood hazard is assessed as very low however, as discussed in Section 3.5, the disposal of surface water is not feasible due to both the depth of made ground and the below ground construction. There are no surface water bodies or surface water drainage systems in the vicinity of the site. It will therefore be necessary to discharged surface water from the site to the combined public sewer

It is therefore proposed the surface water drainage from the site is attenuated to run-off rates as determined in accordance with guidance provided in Appendix C of Liverpool City Council's Local Flood Risk Management Strategy[9].

6.2 Peak Flow Control

The limiting discharge for the proposed development has been determined by taking the site as a combination of greenfield run-off and 30% betterment on the current 1:2 year event for the existing hardstanding areas still present on site as discussed in Section 3.2.

There rates are then matched for the following conditions:

- 1 in 2-yr rainfall event
- 1 in 30-yr rainfall event
- 1 in 100-yr rainfall event plus a 30% allowance for climate change.

The site has been divided into the two zones, Zone 2 and Zone 3 as indicated on the architects plan layout (Figure 3-2).

[8] Paragraph 080, Reference ID: 7-080-20150323
[9] Local Flood Risk Management Strategy, Liverpool City Council, 2017. https://liverpool.gov.uk/council/strategies-plans-and-policies/roads-and-transport/local-flood-risk-management-and-drainage/local-flood-risk-management-strategy/

An assessment of the existing impermeable area runoff has been undertaken using Modified Rational[10] calculation method to rates for the 2-yr 15 minute duration event. Greenfield rates were determined for the remaining catchment area using IH124[11]. Full calculations are provided in Appendix A.

6.2.1 Zone 2 Flow Estimates

- The total area of Zone 2 is **0.848 ha**
- Existing impermeable area as of September 2017 is **0.207 ha**
- Greenfield area as of September 2017 is **0.641 ha**

Discharge rate from existing development on site:

- Peak discharge for 2- yr 15 minute event is **25.3 l/s**
- A 30% reduction in accordance with LCC surface water management guidance gives an allowable discharge of **17.71 l/s**

Greenfield rates were determined for the remaining catchment area:

- Q1 Year – **3.2 l/s**
- Q30 Year - **6.3 l/s**
- Q100 Year - **7.7 l/s**

Proposed discharge rates for Zone 2 are as follows:

- Q1 Year - 3.2 l/s + 17.71 l/s = **21 l/s**
- Q30 Year - 6.3 l/s + 17.71 l/s = **24 l/s**
- Q100 Year- 7.6 l/s + 17.71 l/s = **25 l/s**

6.2.2 Zone 3 Flow Estimates

- The total area of Zone 3 is **0.650 ha**
- Existing impermeable area as of September 2017 is **0.264 ha**
- Greenfield area as of September 2017 is **0.386 ha**

Discharge rate from existing development on site:

- Peak discharge for 2- yr 15 minute event is **32.3 l/s**
- A 30% reduction in accordance with LCC surface water management guidance gives an allowable discharge of **22.61 l/s**

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[10] Design and Analysis of Urban Storm Drainage-The Wallingford Proceedure, V4 Modified Rational Method, HR Wallingford, Wallingford, 1981
[11] Institute of Hydrology Report No. 124 Flood estimation for small catchments, DCW Marshall & A C Bayliss, Insitiute of Hydrology, June 1994.

Greenfield rates were determined for the remaining catchment area:

- Q1 Year – **1.93 l/s**
- Q30 Year - **3.77 l/s**
- Q100 Year - **4.61 l/s**

Proposed discharge rates for Zone 3 are as follows:

- Q1 Year - 1.93 l/s + 22.61 l/s = **24.5 l/s**
- Q30 Year - 3.77 l/s + 22.61 l/s = **26.4 l/s**
- Q100 Year- 4.61 l/s + 22.61 l/s = **27.2 l/s**

6.3 Managing Surface Water within the Development

The surface water drainage system must be designed so that:

- Flooding does not occur on any part of the site for a 1 in 30 annual probability rainfall event, unless an area is designed to hold and/or convey water as part of the design;
- Flooding does not occur in any part of a building during a 1 in 100 annual probability event; and
- Flows resulting from rainfall in excess of a 1 in 100 annual probability rainfall event are managed in exceedance routes that minimise the risks to people and property, so far as is reasonably practicable.

Based on the proposed site plan, the description of the development proposals and published guidance[12], the development proposals would be considered as dense commercial. It is therefore determined that 100% of the site area will be impermeable following redevelopment. No allowance is required to account for Urban Creep. The total estimated impermeable areas post-development is therefore calculated to be:

- Zone 2 – 0.848 ha
- Zone 3 – 0.650 ha

The surface water attenuation requirements have been estimated using the UkSuDS surface water storage volume estimation tool[13] by HRW Wallingford for each Zone separately. UkSUDS input and output data is provided in Appendix B.

As the proposed development will not provide an additional area to store water onsite for events in excess of the 30-yr event, the required storage volume has been sized to store the 1 in 100 annual

[12] Urban Drainage, 3rd Edition, Butler, D and Davies, JW, Spon Press, 2011 Section 11.3.2, page 247/248
[13] http://www.uksuds.com/drainage-calculation-tools/surface-water-storage

probability rainfall event including a 30% increase in rainfall intensity in order to allow for climate change in accordance with LCC guidance[14].

For Zone 2, assuming a peak discharge rate of 21 l/s a total storage volume of **368m³** would be required.

For Zone 3, assuming a peak discharge rate of 24.5 l/s a total storage volume of **227m³** would be required.

In addition, the following specific aspects of the drainage basin are subject to change:

- The storage volume does not take into account the storage capacity provided within the on-site surface water pipe conveyance system and potential additional source and site control SuDS features. As such, the required volume would be expected to change at detailed design.

6.4 Surface Water Drainage Layout

The storage volume could be accommodated within a number of tanks located around the site in areas below the proposed ground levels as indicated in Figure 6-1. Typically, storage using 1m deep tanks would require a plan are within each zone of 368m² and 227m² respectively. This configuration would provide flexibility to discharge to the public sewer at a number of location due to the relative shallow depth in relation to the public sewers.

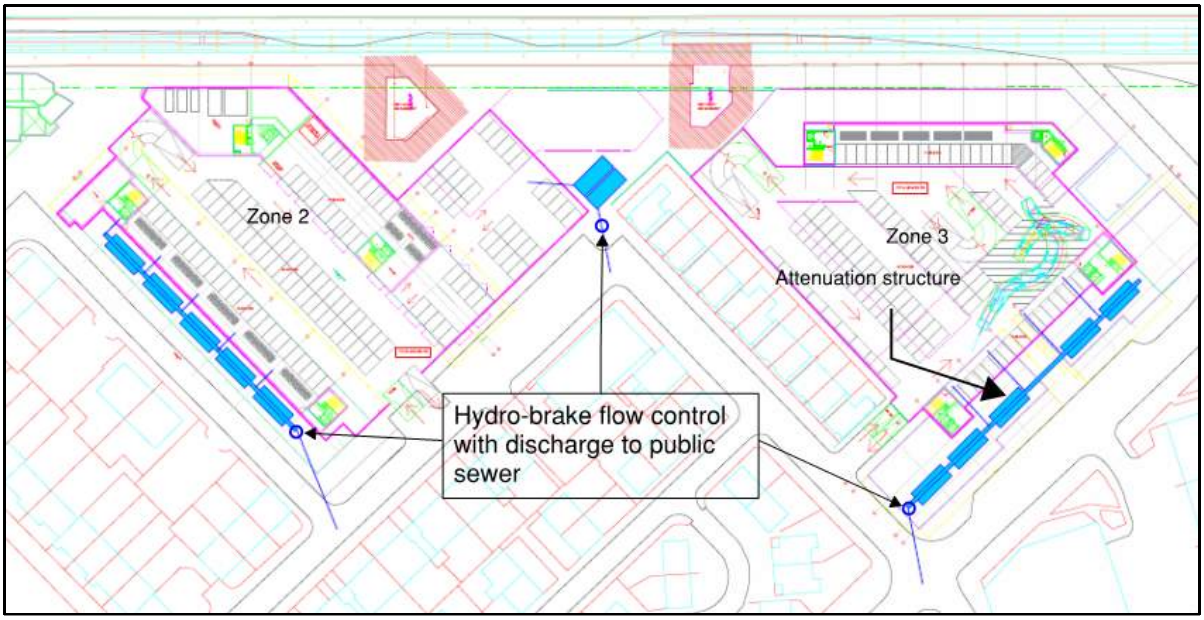

Figure 6-1 – Indicative attenuation structure layout

[14] Local Flood Risk Management Strategy, Liverpool City Council, 2017. https://liverpool.gov.uk/council/strategies-plans-and-policies/roads-and-transport/local-flood-risk-management-and-drainage/local-flood-risk-management-strategy/

Alternatively, attenuation could be provided beneath the basement level of the development. This would however restrict the locations where a gravity connection to the public sewer could be made. Should this be a preferred option, the attenuation system may also require a pumped discharge.

6.5 Maintenance of SuDS

SuDS elements within the curtilage of the site would be the responsibility of the owner of the development.

Pipe network, designed to Sewers for Adoption (7th edition) standard, may be adopted by UU, including the attenuation tanks and hydrobrake(s) subject to agreement. Other SuDS features, should these be incorporated may be maintained by a management company.

An indicative maintenance schedule for the attenuation system is presented in Table 2.

Table 6-1 - Maintenance Requirements

Schedule	Required action	Frequency
Detention basin		
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/ or internal forebays	Annually, or as required
Remedial maintenance	Repair/rehabilitation of inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually and after large storms
	Survey inside of tank for sediment build up and remove if necessary	Every 5 years or as required

Schedule	Required action	Frequency
Flow Control Devices - Hydro Brake		
Routine maintenance	Inspection	Quaterly
	Litter / debris removal	Monthly or as required
Occasional maintenance	Sediment removal	6 monthly
Remedial maintenance	Repair (as a result of damage or vandalism)	As requried

6.6 Summary

The purpose of this FRA is to demonstrate that a surface water drainage strategy is feasible for the site given the development proposals and the land available. The proposals provide the opportunity for the inclusion of SuDS elements, ensuring that there will be no increase in surface water runoff from the proposed development. The storage calculations may be refined at the detailed design stage and a final decision made on the types of storage to be provided.

7.0 Foul Water Loadings

7.1 Residential Development

The peak foul flow rate from the proposed residential development is estimated to be 23 litres per second, based on 503 proposed residential units on the site, using the approach set out in Sewers for Adoption (7th Edition). The above approach assumes a total foul water loading of 4,000 litres/dwelling/day based on the following assumptions:

- Occupancy rate of 3 persons per dwelling
- Domestic loading of 200 litres per person per day
- An infiltration allowance of 10%
- An average to peak dry weather flow rate conversion factor of 6. It is generally accepted that the Sewers for Adoption approach is conservative and overestimates loadings from new developments. A more realistic estimate of the peak foul flow rate can be derived using the calculation procedure presented by Urban Drainage (3rd Edition). This approach is based on the following assumptions:
- Occupancy rate of 2.3 persons per dwelling[15]
- Domestic loading of 150 litres per person per day[16]
- An infiltration allowance of 10%
- An average to peak dry weather flow rate conversion factor of 4.

Application of this latter approach provides a peak flow rate of 9 litres per second. Notwithstanding the above, it is recognised that many water companies including United Utilities, tend to apply the more conservative Sewers for Adoption approach.

7.2 Commercial Development

The peak foul flow rate from the proposed commercial development is estimated to be 0.75 litres per second, based on a site area of 1.5ha, using the approach set out in Sewers for Adoption (7th Edition). The above approach assumes a total foul water loading of 0.5 litres/second/hectare of developable land.

[15] 2011 Census: Population and household estimate for the United Kingdom, March 2011
[16] British Water, Code of Practice, Flows and Loads – 4, 2013

7.3 New Foul Water Connections

New foul drainage connections will be required for the site. As discussed in Section 3.4, there is an extensive public sewer system around the perimeter of the site. It is probable that a number of new connections will be required, with the total derived peak flow rate distributed to different outfall locations. Details of foul drainage will be provided at detail design stage and connection points agreed with UU prior to construction.

8.0 Summary

This Flood Risk Assessment and Drainage Strategy been prepared for Great George Street Development Ltd and relates to the proposed development of land to the west of Great George Street, Liverpool, Merseyside, L1 5.

According to the EA Flood Map for Planning (Rivers and Sea) the proposed development is located outside of the 1 in 1,000 annual probability flood outline and is therefore defined by the NPPF as being situated within Flood Zone 1.

As the site is in Flood Zone 1, the flood risk Sequential Test is deemed to have been addressed and the Exception Test need not be addressed.

The flood risk from fluvial sources has been assessed to be negligible.

Flood risk from surface water is very low, with the exception of a small area in the southern half of the site where risk is deemed low.

Residual risk of surface water flooding will be mitigated by setting Finished Floor Levels at a minimum of 0.15 m above adjacent ground levels following reprofiling of the site.

Groundwater flood risk has been assessed to be very low as is the risk posed by reservoirs, canals and other sources.

Surface water runoff from the developed site can be sustainably managed in accordance with the NPPF and local policy.

Foul water generated from the developed site would require a new connections to the public sewer around the site.

9.0 Recommendations

This Flood Risk Assessment and Drainage Strategy has demonstrated that the proposed development may be completed without conflicting with the requirements of the NPPF subject to the following:

- Finished floor levels to be set 150mm above adjacent ground levels
- The detailed drainage design, developed in accordance with the principles set down in this FRA, should be submitted to and approved by the local planning authority prior to the commencement of development.

10.0 Appendices

Appendix A **Run-off rate Calculation**

Appendix B **Surface Water Storage Estimates**

Appendix C **United Utilities Asset Records**

Appendix A Site Runoff Calculations

PEAK RATE OF RUN-OFF CALCULATION **ZONE 2**

Design Brief

The following Peak Rate of Run-off calculations have been undertaken to determine peak run-off from the brownfield portions of the site. These calculations are for the **Peak Rate of Run-Off** requirements only. **Volume of Run-Off** calculations should be undertaken seperately using catchment descriptors and the FEH methodology.

Background Information & References

Runoff from the site is calculated using the Modified Rational Method as outlined in the Wallingford proceedure, based on rainfall depths provided in the Flood Studies Report (FSR).

An allowance has been made for the effects of climate change in accordance with the guidance provided in Table 5 of the Technical guidance to the National Planning Policy Framework. Based on the design life of the proposed development of 100 years, an increase in runoff of 30**%** has been used in the calculations for the post-development peak rate of run-off.

The following references have been used in the preparation of these calculations:

- Design and Analysis of Urban Storm Drainage-The Wallingford Proceedure, V4 Modified Rational Method
- Designing for Exceedance in Urban Drainage - good practice, CIRIA Report C635, 2006
- Flood Estimation Handbook (FEH)
- Flood Studies Report (FSR), Volume 1, Hydrological Studies, 1993
- Flood Studies Supplementary Report No 2 (FSSR2), The Estimation of Low Return Period Floods
- Flood Studies Supplementary Report No 14 (FSSR14), Review of Regional Growth Curves, 1983
- Table 2 of the Government Guidance Flood risk assessments: climate change allowances
- The SuDS Manual Version 5 including errata 2016, CIRIA Report C753, 2015

Results Summary

Post development results indicate a 310.2% increase in peak discharge as a direct result of the proposed development. The results include a without climate change case to enable direct comparison with the pre-development case. Post-development (Climate change) demonstrates the increase by applying a 30% increase to peak runoff.

	Peak Rate of Run-Off (Litres/sec)		
Event	Pre-development (Brownfield Site)	Post-development	Post-development (Climate change)
Q1	19.6	80.3	104.4
Q2	25.3	103.8	134.9
Q10	39.2	160.6	208.8
Q30	48.1	197.1	256.3
Q100	62.2	255.3	331.9

Job Title:	**Great George Street, Lverpool**				
Job No:	B068801				
Made by:	CJS	**Checked:**	CJS	**Sheet No.**	2
Date:	24/09/2018	**Date:**	24/09/2018	**of**	4

PRE-DEVELOPMENT PEAK RATE OF RUN-OFF

Total site impermeable area, A = **2068** m^2

M5-60 rainfall depth **20** mm — *[Flood Studies Report (NERC, 1975)]*

Ratio M5-60/M5-2Day, r **0.40** — *[The Wallingford Proceedure - V4 Modified Rational Method, Fig A.2 (Hydraulics Research, 1983)]*

Storm Duration 15 mins — Anticipated critical duration for the site - usually 15 minutes

Duration factor, Z1 0.63333333 — *[The Wallingford Proceedure - V4 Modified Rational Method, Fig A.3b (Hydraulics Research, 1983)]*

M5-15 rainfall depth = 12.66666667 mm

Return period ratio, Z2

M1-15	0.62
M2-15	0.80
M10-15	1.23
M30-15	1.512
M100-15	1.958

[The Wallingford Proceedure - V4 Modified Rational Method, Table A1 (Hydraulics Research, 1983)]

Rainfall

	Depth (mm)	**Intensity, i (mm/hr)**
M1-15	7.8	31
M2-15	10.1	40
M10-15	15.6	62
M30-15	19.2	77
M100-15	24.8	99

Peak discharge, Qp = Cv Cr i A

Where:

Cv = Volumetric Runoff Coefficient
Cr = Routing Coefficient
i = Rainfall intensity (mm/hour)

Cv = 0.84
Cr = 1.3

Peak Runoff

	Litres/sec
Q1	19.6
Q2	25.3
Q10	39.2
Q30	48.1
Q100	62.2

ESTIMATION OF QBAR (BROWNFIELD RUNOFF RATE)

See Table 2.39 for region curve ordinates

Use FSSR2 Growth Curves to estimate Qbar

Region = **10**

Return period	Ordinate	
1	0.87	Ordinate from FSSR2
2	0.93	
5	1.19	
10	1.38	
25	1.64	
30	1.68	Linear interpolation b/w 25 and 50 yr RP
50	1.85	
100	2.08	
200	2.24	Linear interpolation b/w 100 and 500 yr RP
500	2.73	
1000	3.04	

Qbar

Ordinate used	Litres/sec
1 year	22.5
2 year	27.2
10 year	28.4
30 year	28.6
100 year	29.9

Existing Brownfield Runoff, Qbar = 27.3 l/s

Using the average Qbar derived from five ordinates.

Job Title:	**Great George Street, Lverpool**				
Job No:	B068801				
Made by:	CJS	**Checked:**	CJS	**Sheet No.**	4
Date:	24/09/2018	**Date:**	24/09/2018	**of**	4

ESTIMATION OF QBAR (BROWNFIELD PEAK RATE OF RUN-OFF)

Total site proposed impermeable area, A = **8483** m^2

	Rainfall	
	Depth (mm)	**Intensity, i (mm/hr)**
M1-15	7.8	31
M2-15	10.1	40
M10-15	15.6	62
M30-15	19.2	77
M100-15	24.8	99

Peak discharge, Qp = Cv Cr i A

Cv = 0.84
Cr = 1.3

Peak Runoff

	Litres/sec
Q1	80.3
Q2	103.8
Q10	160.6
Q30	197.1
Q100	255.3

Qbar

Ordinate used	Litres/sec
1	92.3
2	111.6
10	116.4
30	117.2
100	122.7

Post development Qbar = 112.0 l/s

DETERMINATION AND APPLICATION OF AN ALLOWANCE FOR CLIMATE CHANGE

An allowance should be made for the effects of climate change in accordance with the guidance provided in Table 2 of the Government Guidance Flood risk assessments: climate change allowances
https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances
Climate change allowance dependant upon design life of development

Design life	**100**	years	Development date	**2018**	to	**2118**
Allowance	**70%**	for	peak river flow			
	30%	for	peak rainfall intensity			
Therefore take	**30%**	to account for future climate change (LCC Requirement)				

Table 2 peak rainfall intensity allowance in small and urban catchments (use 1961 to 1990 baseline)

Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	10%	20%	40%
Central	5%	10%	20%

Job Title:	**Great George Street, Lverpool**				
Job No:	B068801				
Made by:	CJS	**Checked:**	CJS	**Sheet No.**	1
Date:	24/09/2018	**Date:**	25/09/2018	**of**	4

PEAK RATE OF RUN-OFF CALCULATION **ZONE 3**

Design Brief

The following Peak Rate of Run-off calculations have been undertaken to determine peak run-off from the brownfield portions of the site. These calculations are for the **Peak Rate of Run-Off** requirements only. **Volume of Run-Off** calculations should be undertaken seperately using catchment descriptors and the FEH methodology.

Background Information & References

Runoff from the site is calculated using the Modified Rational Method as outlined in the Wallingford proceedure, based on rainfall depths provided in the Flood Studies Report (FSR).

An allowance has been made for the effects of climate change in accordance with the guidance provided in Table 5 of the Technical guidance to the National Planning Policy Framework. Based on the design life of the proposed development of 100 years, an increase in runoff of 30**%** has been used in the calculations for the post-development peak rate of run-off.

The following references have been used in the preparation of these calculations:

- Design and Analysis of Urban Storm Drainage-The Wallingford Proceedure, V4 Modified Rational Method
- Designing for Exceedance in Urban Drainage - good practice, CIRIA Report C635, 2006
- Flood Estimation Handbook (FEH)
- Flood Studies Report (FSR), Volume 1, Hydrological Studies, 1993
- Flood Studies Supplementary Report No 2 (FSSR2), The Estimation of Low Return Period Floods
- Flood Studies Supplementary Report No 14 (FSSR14), Review of Regional Growth Curves, 1983
- Table 2 of the Government Guidance Flood risk assessments: climate change allowances
- The SuDS Manual Version 5 including errata 2016, CIRIA Report C753, 2015

Results Summary

Post development results indicate a 221% increase in peak discharge as a direct result of the proposed development. The results include a without climate change case to enable direct comparison with the pre-development case. Post-development (Climate change) demonstrates the increase by applying a 30% increase to peak runoff.

	Peak Rate of Run-Off (Litres/sec)		
Event	**Pre-development (Brownfield Site)**	**Post-development**	**Post-development (Climate change)**
Q1	25.0	80.3	104.4
Q2	32.3	103.8	134.9
Q10	50.0	160.6	208.8
Q30	61.4	197.1	256.3
Q100	79.5	255.3	331.9

PRE-DEVELOPMENT PEAK RATE OF RUN-OFF

Total site impermeable area, A = **2643** m^2

M5-60 rainfall depth **20** mm
Ratio M5-60/M5-2Day, r **0.40**

[Flood Studies Report (NERC, 1975)]
[The Wallingford Proceedure - V4 Modified Rational Method, Fig A.2 (Hydraulics Research, 1983)]

Storm Duration 15 mins

Anticipated critical duration for the site - usually 15 minutes

Duration factor, Z1 0.63333333

[The Wallingford Proceedure - V4 Modified Rational Method, Fig A.3b (Hydraulics Research, 1983)]

M5-15 rainfall depth = 12.66666667 mm

Return period ratio, Z2

M1-15	0.62
M2-15	0.80
M10-15	1.23
M30-15	1.512
M100-15	1.958

[The Wallingford Proceedure - V4 Modified Rational Method, Table A1 (Hydraulics Research, 1983)]

Rainfall

	Depth (mm)	**Intensity, i (mm/hr)**
M1-15	7.8	31
M2-15	10.1	40
M10-15	15.6	62
M30-15	19.2	77
M100-15	24.8	99

Peak discharge, Qp = Cv Cr i A

Where:
Cv = Volumetric Runoff Coefficient
Cr = Routing Coefficient
i = Rainfall intensity (mm/hour)

Cv = 0.84
Cr = 1.3

Peak Runoff

	Litres/sec
Q1	25.0
Q2	32.3
Q10	50.0
Q30	61.4
Q100	79.5

Job Title:	**Great George Street, Lverpool**				
Job No:	B068801				
Made by:	CJS	**Checked:**	CJS	**Sheet No.**	3
Date:	24/09/2018	**Date:**	25/09/2018	**of**	4

ESTIMATION OF QBAR (BROWNFIELD RUNOFF RATE)

See Table 2.39 for region curve ordinates

Use FSSR2 Growth Curves to estimate Qbar

Region = **10**

Return period	**Ordinate**
1	0.87
2	0.93
5	1.19
10	1.38
25	1.64
30	1.68
50	1.85
100	2.08
200	2.24
500	2.73
1000	3.04

Ordinate from FSSR2

Linear interpolation b/w 25 and 50 yr RP

Linear interpolation b/w 100 and 500 yr RP

Qbar

Ordinate used	Litres/sec
1 year	28.8
2 year	34.8
10 year	36.3
30 year	36.5
100 year	38.2

Existing Brownfield Runoff, Qbar = 34.9 l/s

Using the average Qbar derived from five ordinates.

ESTIMATION OF QBAR (BROWNFIELD PEAK RATE OF RUN-OFF)

Total site proposed impermeable area, A = **8483** m^2

	Rainfall Depth (mm)	Rainfall Intensity, i (mm/hr)
M1-15	7.8	31
M2-15	10.1	40
M10-15	15.6	62
M30-15	19.2	77
M100-15	24.8	99

Peak discharge, Qp = Cv Cr i A

Cv = 0.84
Cr = 1.3

Peak Runoff

	Litres/sec
Q1	80.3
Q2	103.8
Q10	160.6
Q30	197.1
Q100	255.3

Qbar

Ordinate used	Litres/sec
1	92.3
2	111.6
10	116.4
30	117.2
100	122.7

Post development Qbar = 112.0 l/s

DETERMINATION AND APPLICATION OF AN ALLOWANCE FOR CLIMATE CHANGE

An allowance should be made for the effects of climate change in accordance with the guidance provided in Table 2 of the Government Guidance Flood risk assessments: climate change allowances
https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances
Climate change allowance dependant upon design life of development

Design life	**100**	years	Development date **2018** to **2118**
Allowance	**70%**	for	peak river flow
	30%	for	peak rainfall intensity
Therefore take	**30%**		to account for future climate change (LCC Requirement)

Table 2 peak rainfall intensity allowance in small and urban catchments (use 1961 to 1990 baseline)

Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	10%	20%	40%
Central	5%	10%	20%

Greenfield runoff estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Chris Scott
Site name:	Great George St
Site location:	Liverpool

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance “Preliminary rainfall runoff management for developments”, W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site coordinates

Latitude:	53.39700° N
Longitude:	2.97666° W
Reference:	6429422
Date:	2018-09-25T11:02:42

Methodology	IH124

Site characteristics

Total site area (ha)	0.642

Methodology

Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type

	Default	Edited
SOIL type	4	4
HOST class	---	---
SPR/SPRHOST	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm)	810	810
Hydrological region	10	10
Growth curve factor: 1 year	0.87	0.87
Growth curve factor: 30 year	1.7	1.7
Growth curve factor: 100 year	2.08	2.08

Notes:

(1) Is Q_{BAR} < 2.0 l/s/ha?

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consents are usually set at 5.0l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set in which case blockage work must be addressed by using appropriate drainage elements

(3) Is SPR/SPRHOST ≤ 0.3?

Greenfield runoff rates

	Default	Edited
Qbar (l/s)	3.68	3.68
1 in 1 year (l/s)	3.2	3.2
1 in 30 years (l/s)	6.25	6.25
1 in 100 years (l/s)	7.65	7.65

Greenfield runoff estimation for sites

www.uksuds.com | Greenfield runoff tool

HR Wallingford
Working with water

Calculated by:	Chris Scott
Site name:	Great George Street Z3
Site location:	Liverpool

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance “Preliminary rainfall runoff management for developments”, W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site coordinates

Latitude:	53.39699° N
Longitude:	2.97648° W
Reference:	6434283
Date:	2018-09-25T11:32:14

Methodology	IH124

Site characteristics

Total site area (ha)	0.387

Methodology

Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type

	Default	Edited
SOIL type	4	4
HOST class	---	---
SPR/SPRHOST	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm)	810	810
Hydrological region	10	10
Growth curve factor: 1 year	0.87	0.87
Growth curve factor: 30 year	1.7	1.7
Growth curve factor: 100 year	2.08	2.08

Notes:

(1) Is Q_{BAR} < 2.0 l/s/ha?

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consents are usually set at 5.0l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set in which case blockage work must be addressed by using appropriate drainage elements

(3) Is SPR/SPRHOST ≤ 0.3?

Greenfield runoff rates

	Default	Edited
Qbar (l/s)	2.22	2.22
1 in 1 year (l/s)	1.93	1.93
1 in 30 years (l/s)	3.77	3.77
1 in 100 years (l/s)	4.61	4.61

Appendix B Surface water Storage Volume Assessment

Surface water storage requirements for sites

www.uksuds.com | Storage estimation tool

HR Wallingford — Working with water

Calculated by:	Chris Scott
Site name:	Great George Street
Site location:	Liverpool

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). It is not to be used for detailed design of drainage systems. It is recommended that hydraulic modelling software is used to calculate volume requirements and design details before finalising the drainage scheme.

Site coordinates

Latitude:	53.39699° N
Longitude:	2.97649° W
Reference:	6431856
Date:	2018-09-25T11:00:16

Methodology	IH124

Site characteristics

Total site area (ha)	0.85
Significant public open space (ha)	0
Area positively drained (ha)	0.85
Pervious area contribution (%)	0
Impermeable area (ha)	0.85
Percentage of drained area that is impermeable (%)	100
Impervious area drained via infiltration (ha)	0
Return period for infiltration system design (year)	100
Impervious area drained to rainwater harvesting systems (ha)	0
Return period for rainwater harvesting system design (year)	10
Compliance factor for rainwater harvesting system design (%)	66
Net site area for storage volume design (ha)	0.85
Net impermeable area for storage volume design (ha)	0.85

* Where rainwater harvesting or infiltration has been used for managing surface water runoff such that the effective impermeable area is less than 50 % of the 'area positively drained', the 'net site area' and the estimates of Qbar and other flow rates will have been reduced accordingly.

Design criteria

Volume control approach	Flow control to max of 2 l/s/ha or

	Default	Edited
Climate change allowance factor	1.4	1.4
Urban creep allowance factor	1	1
Interception rainfall depth (mm)	5	5
Minimum flow rate (l/s)	21.38	21.38

Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type

	Default	Edited
Qbar total site area (l/s)	4.87	--
SOIL type	4	4
HOST class	N/A	N/A
SPR	0.47	0.47

Hydrology

	Default	Edited
SAAR (mm)	810	810
M5-60 Rainfall Depth (mm)	20	20
'r' Ratio M5-60/M5-2 day	0.4	0.4
Rainfall 100 yrs 6 hrs	63	
Rainfall 100 yrs 12 hrs	83.16	
FEH/FSR conversion factor	1.08	1.08
Hydrological region	10	
Growth curve factor: 1 year	0.87	0.87
Growth curve factor: 10 year	1.38	1.38
Growth curve factor: 30 year	1.7	1.7
Growth curve factor: 100 year	2.08	2.08

Site discharge rates

	Default	Edited
Qbar total site area (l/s)	4.87	4.87
Qbar net site area (l/s)	4.87	4.87
1 in 1 year (l/s)	21.4	21.4
1 in 30 years (l/s)	21.4	21.4
1 in 100 years (l/s)	21.4	21.4

Estimated storage volumes

	Default	Edited
Interception storage (m^3)	34	34
Attenuation storage (m^3)	334	334
Long term storage (m^3)	0	0
Treatment storage (m^3)	102	102
Total storage *(excluding treatment)* (m^3)	368	368

HR Wallingford
Working with water

Surface water storage requirements for sites

www.uksuds.com | Storage estimation tool

Calculated by:	Chris Scott
Site name:	Great George Street Z3
Site location:	Liverpool

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). It is not to be used for detailed design of drainage systems. It is recommended that hydraulic modelling software is used to calculate volume requirements and design details before finalising the drainage scheme.

Site coordinates

Latitude:	53.39699° N
Longitude:	2.97648° W
Reference:	6434291
Date:	2018-09-25T11:41:38

Methodology	IH124

Site characteristics

Total site area (ha)	0.65
Significant public open space (ha)	0
Area positively drained (ha)	0.65
Pervious area contribution (%)	0
Impermeable area (ha)	0.65
Percentage of drained area that is impermeable (%)	100
Impervious area drained via infiltration (ha)	0
Return period for infiltration system design (year)	10
Impervious area drained to rainwater harvesting systems (ha)	0
Return period for rainwater harvesting system design (year)	10
Compliance factor for rainwater harvesting system design (%)	66
Net site area for storage volume design (ha)	0.65
Net impermeable area for storage volume design (ha)	0.65

* Where rainwater harvesting or infiltration has been used for managing surface water runoff such that the effective impermeable area is less than 50 % of the 'area positively drained', the 'net site area' and the estimates of Qbar and other flow rates will have been reduced accordingly.

Design criteria

Volume control approach	Flow control to max of 2 l/s/ha or

	Default	Edited
Climate change allowance factor	1.4	1.4
Urban creep allowance factor	1.0	1.0
Interception rainfall depth (mm)	5	5
Minimum flow rate (l/s)	24.67	24.67

Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type

	Default	Edited
Qbar total site area (l/s)	3.72	--
SOIL type	4	4
HOST class	N/A	N/A
SPR	0.47	0.47

Hydrology

	Default	Edited
SAAR (mm)	810	810
M5-60 Rainfall Depth (mm)	20	20
'r' Ratio M5-60/M5-2 day	0.4	0.4
Rainfall 100 yrs 6 hrs	63	
Rainfall 100 yrs 12 hrs	83.16	
FEH/FSR conversion factor	1.08	1.08
Hydrological region	10	
Growth curve factor: 1 year	0.87	0.87
Growth curve factor: 10 year	1.38	1.38
Growth curve factor: 30 year	1.7	1.7
Growth curve factor: 100 year	2.08	2.08

Site discharge rates

	Default	Edited
Qbar total site area (l/s)	3.72	3.72
Qbar net site area (l/s)	3.72	3.72
1 in 1 year (l/s)	24.7	24.7
1 in 30 years (l/s)	24.7	24.7
1 in 100 years (l/s)	24.7	24.7

Estimated storage volumes

	Default	Edited
Interception storage (m^3)	26	26
Attenuation storage (m^3)	201	201
Long term storage (m^3)	0	0
Treatment storage (m^3)	78	78
Total storage *(excluding treatment)* (m^3)	227	227

Appendix C United Utilities Asset Records

Luke Dimeck

51-55
Tithebarn Street,
Liverpool,
L2 2SB

FAO:

How to contact us:

United Utilities Water Limited
Property Searches
Haweswater House
Lingley Mere Business Park
Great Sankey
Warrington
WA5 3LP

Telephone: 0370 7510101

E-mail: propertysearches@uuplc.co.uk

Your Ref: 068801 - Great George Street
Our Ref: UUPS-ORD-51082
Date: 21/08/2018

Dear Sirs

Location: 15A GREAT GEORGE SQUARE, LIVERPOOL, L1 5DY

I acknowledge with thanks your request dated 17/08/2018 for information on the location of our services.

Please find enclosed plans showing the approximate position of United Utilities' apparatus known to be in the vicinity of this site.

The enclosed plans are being provided to you subject to the United Utilities terms and conditions for both the wastewater and water distribution plans which are shown attached.

If you are planning works anywhere in the North West, please read United Utilities' access statement before you start work to check how it will affect our network. http://www.unitedutilities.com/work-near-asset.aspx .

I trust the above meets with your requirements and look forward to hearing from you should you need anything further.

If you have any queries regarding this matter please contact us .

Yours Faithfully,

Karen McCormack
Property Searches Manager

TERMS AND CONDITIONS - WASTERWATER AND WATER DISTRIBUTION PLANS

These provisions apply to the public sewerage, water distribution and telemetry systems (including sewers which are the subject of an agreement under Section 104 of the Water Industry Act 1991 and mains installed in accordance with the agreement for the self construction of water mains) (UUWL apparatus) of United Utilities Water Limited "(UUWL)".

TERMS AND CONDITIONS:

- This Map and any information supplied with it is issued subject to the provisions contained below, to the exclusion of all others and no party relies upon any representation, warranty, collateral contract or other assurance of any person (whether party to this agreement or not) that is not set out in this agreement or the documents referred to in it.
- This Map and any information supplied with it is provided for general guidance only and no representation, undertaking or warranty as to its accuracy, completeness or being up to date is given or implied.
- In particular, the position and depth of any UUWL apparatus shown on the Map are approximate only. UUWL strongly recommends that a comprehensive survey is undertaken in addition to reviewing this Map to determine and ensure the precise location of any UUWL apparatus. The exact location, positions and depths should be obtained by excavation trial holes.
- The location and position of private drains, private sewers and service pipes to properties are not normally shown on this Map but their presence must be anticipated and accounted for and you are strongly advised to carry out your own further enquiries and investigations in order to locate the same.
- The position and depth of UUWL apparatus is subject to change and therefore this Map is issued subject to any removal or change in location of the same. The onus is entirely upon you to confirm whether any changes to the Map have been made subsequent to issue and prior to any works being carried out.
- This Map and any information shown on it or provided with it must not be relied upon in the event of any development, construction or other works (including but not limited to any excavations) in the vicinity of UUWL apparatus or for the purpose of determining the suitability of a point of connection to the sewerage or other distribution systems.
- No person or legal entity, including any company shall be relieved from any liability howsoever and whensoever arising for any damage caused to UUWL apparatus by reason of the actual position and/or depths of UUWL apparatus being different from those shown on the Map and any information supplied with it.
- If any provision contained herein is or becomes legally invalid or unenforceable, it will be taken to be severed from the remaining provisions which shall be unaffected and continue in full force and affect.
- This agreement shall be governed by English law and all parties submit to the exclusive jurisdiction of the English courts, save that nothing will prevent UUWL from bringing proceedings in any other competent jurisdiction, whether concurrently or otherwise.

United Utilities Water Limited
Registered In England & Wales No. 2366678
Registered Office Haweswater House, Lingley Mere Business Park,
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The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. United Utilities Water will not accept liability for any loss or damage caused by the actual position being different from those shown.

Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad
8702	14.06	CO	11.71	225			VC	56.2534	1 in 44
8611	13.9	CO	8.83	550			BR	37.64306	
8632		FO		100			VC	6.389265	
8631		FO		100			VC	13.37076	
8612	14.07	CO	9.91	550			BR	30.87006	
8406	16.97	CO	13.27	550			BR	8.595242	
8509	16.87	CO	12.41	550			BR	10.63015	
8508	16.51	CO	13.17	550			BR	65.05383	1 in 38
1705	24.89	CO	21.19	980			BR	108.9083	1 in 22
1703	26.12	CO	22.35	560			VC	5.09902	
1702	26.3	CO	23	920			BR	6.324555	
9702	16.08	CO	12.19	225			VC	56.93856	
9706		CO	0	225			VC	60.03333	
9704	17.95	CO	14.05	550			CO	35.8469	1 in 52
2704	28.59	CO	24.91	560			BR	12.36932	1 in 124
2604	33.69	CO	31.09	620			BR	22.09072	
3701	33.34	CO	29.99	580			BR	29.83287	
2703	33.03	CO	29.62	850			BR	1	
4702	40.69	CO	36.92	570			BR	11.18034	
8630		FO		100			VC	5.281023	
9601	15.2	CO	12.2	750			BR	53.08326	
9703	17.03	CO	14.28	750			BR	65.76473	1 in 32
9602	18.25	CO	12.73	560			BR	35.60899	
0602	21.68	CO	16.14	600			BR	24.04163	1 in 16
3607		CO		150			VC	17.28122	
3703	37.06	CO	32.5	840			BR	2.236068	
4601	41.28	CO	37.7	560			BR	29.61419	1 in 35
4603	40.16	CO	36.1	920			BR	4.123106	
1508		CO		150			VC	24.65391	
1603	25.5	CO	20.2	900			CO	42.1834	1 in 162
0605	22.11	CO	18.63	300			VC	29.69848	1 in 26
1605	23.88	CO	20.33	225			VC	55.17246	1 in 34
0603	22	CO	19.87	640			BR	29	1 in 16
0604	22.49	CO	19.41	550			BR	16.97056	
1601	26.01	CO	21.27	930			BR	21.63331	1 in 40
1509		CO	0	550			BR	16.27882	
1704	26.01	CO	21.86	900			BR	40.85346	
1606	26.85	CO	22.95	570			VC	23.19558	
1523	27.65	CO	0	580			BR	41	
1614	26.87	CO	22.72	570			BR	15	
1612	27.33	CO	22.96	580			BR	38	1 in 83
2601	32.9	CO	29.18	560			VC	17	
2602	34.31	CO	31.97	380			BR	19.41649	
2603	34.09	CO	31.41	620			BR	25.17936	1 in 79
3504	38.88	CO	34.71	700			BR	116.559	
9511		CO	0	550			BR	74.23325	
9505	18.61	CO	15.47	600			BR	22.92576	
9506		CO	0	550			BR	41.73149	
9502	17.56	CO	14.82	600			BR	8	
9510		CO	0	550			BR	36.06938	
0505	19.98	CO	16.29	550			BR	20.51828	
0504	20.52	CO	16.37	580			BR	8.944272	1 in 224
9514		CO	0	550			CO	2.370591	
0601	19.03	CO	13.16	530			BR	7.211102	
1406	25.65	CO	21.61	300			VC	19.84943	1 in 29
1407	24.88	CO	20.92	300			VC	21.27882	1 in 44
1511	26.01	CO	23.44	300			VC	52.3259	1 in 18
1401	24.04	CO	21.09	1500			BR	64.3506	
0501	22.22	CO	17.71	950			BR	54.45181	
1522		CO	0	300			VC	17.69181	
1512	26	CO	20.32	570			BR	8.485281	
0503	23.35	CO	18.87	920			BR	41.72529	
1527	26.42	CO	22.76	550			CO	61.57558	1 in 34
1524	24.62	CO	19.91	580			BR	34.65545	
1525	24.5	CO	20.97	570			BR	28.31969	1 in 79
1529	24.05	CO		150			VC	29.10305	
0502	23.47	CO	20.59	570			BR	10.09902	1 in 6
1501	24.44	CO	19.94	920			BR	41.79674	1 in 39
0509		CO		225			VC	15.51677	
0402	22.21	CO	18.31	900			BR	56.59211	1 in 36
9402	19.48	CO	15.78	600			BR	5	
9404	20.03	CO	15.59	900			BR	39.62326	1 in 54
0401	20.87	CO	16.72	900			BR	25.6125	
9406	18.3	CO	14.79	900			CO	4	
9407		CO	0	610			CO	24.75884	
9405		CO		100			VC	9.094901	
9413		CO		100			VC	5.31494	
9408	18.75	CO	15.3	600			BR	5.830952	
1302	25.87	CO	22.67	550			BR	27.58623	1 in 79
0404	24.32	CO	21.32	550			BR	38.8973	1 in 19
1303	25.15	CO	22.32	550			BR	28.7304	1 in 29
0403	22.07	CO	17.54	100			BR	8.830952	
1402	24.25	CO	20.4	300			VC	90.52071	1 in 32
2318		CO	0	400			CO	15.99649	
1391	27.41	CO	23.57	550			CO	23.02776	
2319		CO	0	400			CO	30.89677	
2300		CO	0	150			CO	15.451	
1300		CO	0	550			BR	7.071068	
1319		CO	0	300			CO	15.32267	
1305	27.84	CO	24.07	550			BR	57.60555	
1304	27.82	CO	23.73	225			VC	54.03703	
4301		CO	0	800			CO	50	
1405		CO	0	550			BR	47.0257	
1491	28.3	CO	23.65	550			BR	27.16615	
1409	28.4	CO	23.6	550			BR	21.27203	
4401	44.46	CO	42.6	800			CO	39.82462	1 in 47
1408	28.1	CO	23.77	550			BR	50	1 in 294
1404	28.14	CO	23.61	550			BR	37.01351	
3404	44.25	CO	41.76	800			CO	33.60059	1 in 15
1403		CO	0	300			VC	23.02173	
1514	27.9	CO	23.48	550			BR	36.01389	
3403	44.23	CO	39.48	550			BR	63.78088	
1518	28.04	CO	23.84	550			BR	46	
1507	27.67	CO	21.62	550			BR	15.65248	
3505		CO	0	900			CO	5	
9303	20.63	CO	13.53	1060			BR	45.96738	
0300		CO	0	550			BR	43.8072	
0307		CO		150			VC	32.46465	
9306	19.97	CO	0	1470			BR	13.40312	
9310		CO	0	1060			BR	71.44928	
9307	20.63	CO	14.53	300			BR	24.08319	
0306		CO		150			VC	5.790543	
0302	21.28	CO	17.5	550			BR	15.81139	
0301	21.1	CO	15.25	900			CO	12.72792	
9308		CO	0	600			BR	23.34524	
9401	18.52	CO	13.94	900			BR	10	
9403	19.37	CO	14.85	900			BR	45.35431	1 in 52
1306	26.82	CO	22.29	550			BR	43.28828	1 in 31
1307	25.07	CO	20.87	850			BR	58.73214	1 in 50
0304	23.82	CO	19.68	900			BR	66.48311	1 in 49
1301	26.64	CO	22.71	550			BR	24.08319	1 in 602
0303	23.27	CO	19.2	550			BR	7.211102	
0204	23.18	CO	19.39	550			BR	32.64989	
0201	22.77	CO	15.27	1050			CO	41.03657	1 in 80
0205	23.97	CO	20.36	550			BR	5.841619	
1202	26.18	CO	22.58	550			BR	20.51828	
1308	25.18	CO	21.01	550			BR	37.48975	1 in 69
1201	25.62	CO	21.96	550			BR	67.20863	
1392	25.56	CO	23.83	225			VC	9.219544	1 in 4
1307	25.07	CO	20.87	550			BR	3	
1203	24.22	CO	22.47	225			VC	26.87006	
1210		CO	0	540			BR	8.944272	
1207	26.34	CO	22.15	860			BR	22.02271	
1208	26.22	CO	21.96	540			BR	8.062258	
1206	26.65	CO	22.38	860			CO	27	1 in 117
1309	27.14	CO	23.28	900			CO	40	
1205		CO	0	225			VC	28	
1200	26.66	CO	23.56	860			BR	11.75709	
1204	26.91	CO	22.47	550			CO	45	
2200		CO	0	150			CO	10.554	
1216	28.85	CO	24.2	860			BR	7.774371	1 in 35
2212	28.93	CO	26.42	300			CO	5.064375	
2213	29.1	CO	26.54	150			CO	9.949501	1 in 4
2211		CO	0	150			CO	49.09002	
2316		CO	0	400			CO	17.19501	
2315		CO	0	400			CO	22.74018	
2214	29.7	CO	26.86	500			CO	18.19489	
2214	29.7	CO	26.86	500			CO	18.19489	1 in 57
2215	30.31	CO	27.15	450			CO	16.66042	1 in 57
2221	30.9	CO	27.42	450			CO	15.69865	1 in 58
2216		CO	0	225			CO	42.50404	
2217		CO	0	225			CO	11.50836	
2218		CO	0	150			CO	20.9861	
2222		CO	0	400			CO	38.59746	
2110	32.75	CO	30.77	300			CO	39.29472	1 in 25
2317		CO	0	939			CO	9.158447	
9203	18.02	CO	14.94	750			BR	62.03225	1 in 31
9206	18.56	CO	14.71	550			BR	34	
9204	19.49	CO	15.85	750			BR	36.41253	1 in 40
9304	19.92	CO	0	550			BR	42.48529	
9202	19.95	CO	16.1	750			BR	54.08429	1 in 34
0207	20.82	CO	16.87	750			BR	49.64981	1 in 51
9205	20.04	CO	17.75	300			VC	38.62642	
0206		CO	0	1050			BR	40.31129	
0202	21.3	CO	17.59	750			BR	50.94191	1 in 34
0203	22.06	CO	14.76	1050			BR	60.19177	
3111	39.9	CO	37.23	150			CO	32.29836	1 in 21
2113		CO	0	150			CO	5.223716	
2112		CO	0	150			CO	8.365442	
2111		CO	0	225			CO	24.34349	
3112	37.5	CO	35.63	225			CO	12.74281	1 in 16
3113	36.77	CO	34.83	225			CO	57.77978	1 in 92
3205	35.26	CO	32.19	300			CO	37.8465	1 in 27
3202		CO		150			VC	5.924923	
3207		CO	0	150			CO	11.94235	
3200	36	CO	34.2	300			CO	18.01743	1 in 28
3206		CO	0	150			CO	32.5165	
0103	22.08	CO	19.12	750			BR	39.57174	
1114		CO	0	1200			VC	33.95585	
0101	19.56	CO	15.59	750			BR	4.123106	
0104	21.79	CO	17.74	750			BR	59.77458	1 in 28
0117	19.46	CO	15.62	550			VC	6.324555	
0116	19.69	CO	17.2	550			VC	31.62278	1 in 20
0103	22.08	CO	19.1	1200			VC	10	1 in 7
1102	23.67	CO	20	750			BR	34.83659	1 in 40
1105	24.37	CO	19.53	550			BR	12.36932	
0116	19.69	CO	17.2	550			VC	8.246211	
0107	19.77	CO	17.3	550			BR	8.246211	
1104	24.05	CO	15.83	1090			BR	1.414214	
0108	22.51	CO	19.35	750			BR	63.24555	1 in 26
1103	23.59	CO	15.56	1050			CO	41.72529	1 in 144
1209	25.52	CO	0	550			BR	18.43909	
2107	30.21	CO	28.79	225			CO	34.47991	1 in 56
2108	30.74	CO	29.31	150			CO	12.4553	1 in 28
2106	29.6	CO	28.17	225			CO	19.9826	1 in 45
1106	25.54	CO	20.46	550			BR	7.81025	
1107	25.52	CO	21.57	580			BR	2.236068	
2105	29.16	CO	27.73	225			CO	27.10929	1 in 49
2104	28.72	CO	27.1	300			CO	16.60805	
2100	28.25	CO	26.73	300			CO	34.21967	1 in 110
4105	40.09	CO	33.02	1050			CO	39.3197	

Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad
4103	39.4	CO	34.9	225			VC	2.236068	
3102	36.78	CO	32.04	1050			CO	37.65634	1 in 26
3100	34.5	CO	33	150			CO	62.83612	1 in 17
2109		CO	0	150			CO	14.02872	
9102	16.81	CO	13.62	800			BR	39.22212	
9104	17.17	CO	13.37	750			BR	17.08801	
9103	17.97	CO	14.77	750			BR	50.59644	1 in 46
9105	18.39	CO	14.48	750			BR	34.17601	1 in 31
9101	16.99	CO	14.02	550			BR	30.08322	1 in 39
0106	20.09	CO	16.89	750			BR	68.86483	1 in 32
9201	20.03	CO	17.41	550			BR	12.08305	
8302	18.29	CO	15.19	375			CO	115.2085	
9305	19.06	CO	15.7	750			BR	49.20366	1 in 45
8207	16.81	CO	12.61	500			BR	24.59675	1 in 30
8303	17.7	CO	14.6	800			BR	47.857	1 in 31
4602	40.17	CO	36.03	560			BR	9.055386	

LEGEND

	Abandoned	Foul	Surface Water	Combined
Public Sewer				
Private Sewer				
Section 104				
Rising Main				
Sludge Main				
Overflow				
Water Course				
Highway Drain				

All point assets follow the standard colour convention:
red - combined blue - surface water
brown - foul purple - overflow

- Manhole
- HS Head of System
- ES Extent of Survey
- RE Rodding Eye
- IN Inlet
- DP Discharge Point
- HY Vortex
- PE Penstock
- WO Washout Chamber
- VA Valve
- AV Air Valve
- NRV Non Return Valve
- SO Soakaway
- GU Gully
- CA Cascade
- FM Flow Meter
- HA Hatch Box
- OI Oil Interceptor
- SM Summit
- DS Drop Shaft
- OP Orifice Plate
- Side Entry Manhole
- Outfall
- Screen Chamber
- IC Inspection Chamber
- Bifurcation Chamber
- LH Lamp Hole
- T Junction / Saddle
- CA Catchpit
- VC Valve Chamber
- Vent Column
- Vortex Chamber
- Penstock Chamber
- Network Storage Tank
- Sewer Overflow
- WwTW Ww Treatment Works
- Ww Pumping Station
- ST Septic Tank
- CK Control Kiosk
- Change of Characteristic

MANHOLE FUNCTION

FO Foul
SW Surface Water
CO Combined
OV Overflow

SEWER SHAPE

CI Circular TR Trapezoidal
EG Egg AR Arch
OV Oval BA Barrel
FT Flat Top HO HorseShoe
RE Rectangular UN Unspecified
SQ Square

SEWER MATERIAL

AC Asbestos Cement
BR Brick
PE Polyethylene
RP Reinforced Plastic Matrix
CO Concrete
CSB Concrete Segment Bolted
CSU Concrete Segment Unbolted
CC Concrete Box Culverted
PSC Plastic / Steel Composite
GRC Glass Reinforced Plastic
DI Ductile Iron
PVC Polyvinyl Chloride
CI Cast Iron
SI Spun Iron
ST Steel
VC Vitrified Clay
PP Polypropylene
PF Pitch Fibre
MAC Masonry, Coursed
MAR Masonry, Random
U Unspecified

Address or Site Reference:

15A GREAT GEORGE SQUARE,
LIVERPOOL,
L1 5DY

Scale: 1:1250 **Date:** 21/08/2018

Sheet: 1 of 1

Printed by: Property Searches

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helping life flow smoothly

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