Planning Application Submission – February 2014

Flood Risk Assessment

Consultant: RSK LDE Ltd

Latchmere House – Scheme 1

Berkeley Homes (Central London) Ltd

Berkeley
Designed for life

Berkeley Homes (Central London) Ltd

Latchmere House – Scheme 1

Flood Risk and Drainage Assessment

132034 - R1(3) - FRA

DECEMBER 2013

RSK

RSK GENERAL NOTES

Project No.: 132034 - R1(3) - FRA

Site Name: Latchmere House – Scheme 1

Report Title: Flood Risk and Drainage Assessment

Client: Berkeley Homes (Central London) Ltd

Date: December 2013

Office: Hemel Hempstead

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	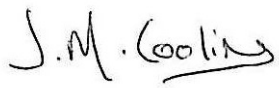		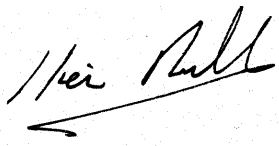
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	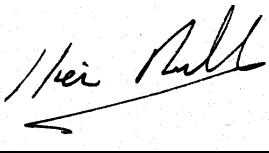		
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1 INTRODUCTION

RSK Land and Development Engineering Ltd were commissioned by Berkeley Homes (Central London) Ltd (the client) to carry out a Flood Risk Assessment (FRA) for Latchmere House, Richmond, TW10 5HH (the site). The assessment is in support of a planning submission for the redevelopment of the site from a former HM Prison to residential dwellings.

The development application has now been split into two schemes. This report addresses Scheme 1, which is for *"redevelopment of the Latchmere House site to provide 73 residential units, associated parking and landscaping, and retained access via Church Road."* Scheme 2 is addressed in an additional report with reference 132034-R2(0)-FRA.

The purpose of the FRA is to establish the flood risk associated with the proposed development and to propose suitable mitigation, if required, to reduce the risk to a more acceptable level.

The assessment has been prepared in accordance with the National Planning Policy Framework (NPPF) [(Ref. 1)] and its accompanying technical guidance document [(Ref. 2)], the Interim Code of Practice for Sustainable Drainage Systems (ICPSDS) [(Ref. 3)] and British Standards (BS) 8533-2011 Assessing and Managing Flood Risk in Development Code of Practice [(Ref. 4)], with site-specific advice and information from the Environment Agency (EA), the Local Planning Authority, the planners, the architects and the client.

The NPPF sets out the criteria for development and flood risk by stating 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. The key definitions are:

- "Areas at risk of flooding" means land within Flood Zones 2 and 3; or land within Flood Zone 1 which has critical drainage problems and which has been notified to the local planning authority by the EA.
- "Flood risk" means risk from all sources of flooding - including from rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

For this site, the key aspects that require the assessment are:

- The EA's indicative flood map shows that the site lies within Flood Zone 1 (low risk of tidal and fluvial flooding) outside the area of flooding associated with the River Thames to the west of the site boundary.
- A review of the impact of other sources of flooding associated with surface water, sewer and groundwater flooding.

- The site area is 3.5782ha and requires a surface water drainage assessment and strategy.

The comments given in this report and opinions expressed are subject to RSK Group Service Constraints provided in **Appendix A**.

2 CONTEXT AND SCOPE OF WORK

The scope of work relating to an FRA is based on the guidance provided in Section 10 of NPPF [(Ref. 1)] and its accompanying technical guidance [(Ref. 2)].

A site-specific FRA must demonstrate that the development will be safe for its lifetime (in this case 100 years for residential development) taking account of the vulnerability of its users without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall. The scope of this assessment therefore comprises the following elements:

- To review plans, planning information and other studies to determine the existing site conditions;
- To obtain information on the hydrology and hydrological regime in and around the site;
- To obtain the views of the EA, including scope, location and impacts;
- To evaluate the flood risk to site from tidal, fluvial, surface water, groundwater and sewerage sources;
- To assess the impact on the site from climate change effects and anticipated increases in rainfall over a 100 year period for residential uses;
- To review site surface water drainage based on the proposed layout and to determine the extent of infrastructure required;
- To determine the extent of new flooding provision and the influence on the site;
- To review site foul water drainage and report on a drainage strategy to accommodate new development flows;
- To prepare a report including calculations and summaries of the source information and elements reviewed.

Appendix B of this report provides clarity of the scope of site-specific Flood Risk Assessment and includes extracts from NPPF technical guidance [(Ref. 2)], ICPSDS [(Ref. 3)] and BS 8533-2011 [(Ref. 4)].

3 SITE DESCRIPTION

3.1 Site Location

Site Name: Latchmere House and HM Remand Centre

Site Address: Church Road, Richmond, Surrey, TW10 5HH

Site National Grid Reference: 518510^{N}, 171310^{E}

The site is situated in a largely residential area to the west of Richmond Park and to the south of Ham Common. The site is located approximately 2.7 miles to the south of Richmond town centre and 1.8 miles to the north of Kingston town centre. The site spans the northern boundary of the Royal Borough of Kingston upon Thames and the south-eastern boundary of the London Borough of Richmond upon Thames.

Figure 1 shows a site location map.

3.2 Site Land Use

The site is a decommissioned Ministry of Justice prison, vacant since 2011. The total site area is 3.5782ha[1] and comprises Latchmere House – a locally listed 3-storey Victorian mansion house - a number of detached buildings, access roads, parking areas, hardstanding areas including a large 'parade ground' and soft landscaped areas.

Figure 2 shows the existing site layout and topographic survey.

The approximate land uses of the existing site are as follows:

Table 3.1: Existing Land Uses

Land Use	Existing Development (m^2)
Total Site Area	35,782
Building Footprint[2]	6,460 (18%)
Hardstanding	12,333 (34%)
Soft Landscaping	16,989 (48%)

[1] The total site area of 3.5782ha (35,782m^2) has been calculated based on the redline boundary provided by the architect (drawing BKH04_P_101_Rev. 1, dated 06.12.13). Note: This area does not include the separate area in the northwest of the site as illustrated in drawing BKH04_P_101_Rev.1 and subsequent Figures of this report as the footprint of this area is unknown and its small area is deemed insignificant to contribute to the surface water drainage strategy.

[2] Note: The total existing building footprint does not include the existing garage (in the west of site) as the garage area partly falls outside of the redline boundary.

3.3 Site Topography

The site topographic survey was undertaken by Laser Surveys. A significant part of the site is relatively flat with an elevation varying between 8.50 and 9.50 metres above ordnance datum (m AOD). There is a gentle fall at the eastern end (to 7.90m AOD) and to the north (to 8.10m AOD).

3.4 Site Geology

Based on British Geological Survey (BGS) records for the area (BGS online mapping tool) there are underlying superficial deposits of Kempton Park Gravel. This is a relatively permeable layer of river terrace gravel deposits to depths of typically 6 metres below ground level (m bgl). The bedrock geology consists of the London Clay Formation.

Numerous BGS boreholes are noted in the area, the closest to site being boreholes TQ17SE210 Ham Common to the east and TQ17SE243 Parkgate Farm Housing Development 3 to the southeast. The borehole records indicate that water was struck at 1.52m bgl and 6.50m bgl respectively.

Listers Geotechnical Consultants carried out a site-specific Ground Investigation report in September 2012 (Ref. 5). Made Ground was encountered from ground level to a maximum depth of 1.10m bgl. Kempton Park Gravel, consisting of sand and gravel, was encountered beneath the Made Ground to the full depth of the investigation at a maximum depth of 6.00m bgl. The report states the following about contamination on site *"Nothing significant but contingency should be allowed for, for isolated pockets encountered during construction".*

3.5 Site Hydrogeology

Hydrogeological information has been obtained from the EA's online mapping service. Kempton Park Gravel is classified as a Secondary A Aquifer whilst London Clay is non-productive strata. The site does not lie within a Groundwater Source Protection Zone. The site lies in a Groundwater Vulnerability Zone (GVZ) rated Minor Aquifer High. The eastern site boundary borders a GVZ rated Major Aquifer Low.

Listers undertook permeability testing as part of the Ground Investigation (Ref. 5). The results indicate that the Secondary A Kempton Park Gravel Aquifer beneath the site has a 'very good' soil permeability in the order of $1x10^{-3}$m/s to $5x10^{-4}$m/s. **Table 3.2** provides the measured averages during permeability testing.

Table 3.2: Listers' Permeability Testing

Borehole Number	Average Permeability (m/s)	Permeability (m/hr)
CT15	1.57×10^{-3}	5.65
CT 5	8.30×10^{-4}	2.99
CT 4	5.83×10^{-4}	2.10
Average	**9.94×10^{-4}**	**3.58**

The average infiltration rate for the site is taken as 9.94x10-4m/s (3.5796m/hr).

Listers encountered groundwater at depths ranging from 3.00m bgl to 3.50m bgl. There are no groundwater abstraction licenses within 1000m of the site.

3.6 Site Hydrology

There is a small pond of approximately 29m^2 in the centre of the site to the north of the A Block.

There are numerous ponds and drains within Richmond Park to the east of the site as close as 150m. Ham Bottom ditch is located approximately 450m to the north of the site.

The River Thames is located approximately 700m to the southwest of the site, flowing in a north direction. The upstream tidal extent of the River Thames is at Teddington Weir, which is located approximately 1.8km to the northwest of the site.

Beverley Brook, a tributary of the Thames, is located approximately 3km to the east of the site. The River Crane, also a tributary of the Thames, is located approximately 4km to the northwest of the site.

Longford River, an artificial distributary waterway that diverts water from the River Colne in west London to Bushy Park (and subsequently to the Thames), is located approximately 3km to the southwest of the site.

4 DEVELOPMENT PROPOSALS

The proposed development with respect to the latest masterplan (drawing BKH04_P_101_Rev.1, dated 06.12.13 as presented as **Figure 3**) comprises the following:

- Retention and renovation of Latchmere House;
- 73 no. residential units including 7 apartments in Latchmere House;
- Associated gardens, car parking and garages;
- Access roads; and
- Areas of soft landscaping in the northeast and southeast.

Table 4.1 compares the approximate areas of land use types for the existing and proposed developments.

Table 4.1: Comparison of Existing and Proposed Site Land Uses

Land Uses	Existing Development (m^2)	Proposed Development (m^2)
Total Site Area	35,782	35,782
Building Footprint	6,460 (18%)	6,929 (19%)
Hardstanding	12,333 (34%)	8,940 (25%)
Soft Landscaping	16,989 (48%)	19,913 (56%)

Overall, the proposed development will result in a decrease in impermeable area by 2,924m^2 (8%).

5 LEGISLATION AND POLICY CONTEXT

5.1 National

Table 5.1: National Legislation and Policy Context

Legislation	Key Provisions
National Planning Policy Framework (2012)	The aims of planning policy on development and flood risk are to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall.
Flood and Water Management Act 2010	The Flood and Water Management Act aims to implement the findings of the 2007 Pitt Review and co-ordinate control of drainage and flood issues. There are a number of increased responsibilities within the Act that affect adoption of Sustainable Drainage Systems (SuDS) and the role of the EA to expand on the mapping data they provide. The implementation of SuDS features has many beneficial impacts on the treatment of surface water during remediation works.
Water Resources Act 1991	Section 24 - The EA is empowered under this Act to maintain and improve the quality of 'controlled' waters Section 85 - It is an offence to cause or knowingly permit pollution of controlled waters Section 88 - Discharge consents are required for discharges to controlled waters
Water Framework Directive (2000)	The Water Framework Directive (WFD) requires all inland and coastal waters to reach 'good' chemical and biological status by 2015. Flood risk management is unlikely to have a significant impact on chemical water quality except where maintenance works disturb sediment (such as de-silting) or where pollutants are mobilised from contaminated land by floodwaters. The main impact of the WFD on flood risk management, both now and in the future, relates to the ecological quality of water bodies. Channel works, such as straightening and deepening, or flood risk management schemes that modify geomorphological processes can change river morphology. The WFD aims to protect conservation sites identified by the EC Habitats Directive and Birds Directive that have water-related features, by designating them as 'protected sites'.

5.2 Regional Policy

The London Plan

The London Plan (July 2011) [Ref. 6] is the regional spatial strategic plan for London, setting out a fully integrated economic, environmental, transport and social framework for the development of London to 2031. The main policies relating to flood risk management in London are outlined in the **Table 5.2** below.

Table 5.2: The London Plan Policy Context

Policy Document	Key Provisions
London Plan	**Policy 5.12 Flood Risk Management** Development proposals must comply with the flood risk assessment and management requirements set out in PPS25 [now NPPF], the Thames Estuary 2100 (TE2100) Plan and Catchment Flood Management Plans (CFMP) over the lifetime of the development. Developments which are required to pass the Exceptions Test must address flood resilient design and emergency planning by demonstrating that: • the development will remain safe and operational under flood conditions • a strategy of safe evacuation and/or safely remaining in the building is followed under flood conditions • key services including electricity, water etc. will continue to be provided under flood conditions • buildings are designed for quick recovery following a flood.
	Policy 5.13 Sustainable Drainage Development should utilise sustainable drainage systems (SuDS), unless there are practical reasons for not doing so. Development should aim to achieve Greenfield runoff rates in line with the following drainage hierarchy: • store rainwater for re-use • use infiltration techniques, such as porous surfaces in non-clay areas • attenuate rainwater in ponds or open water features for gradual release • attenuate rainwater by storing in tanks or sealed water features for gradual release • discharge rainwater direct to a watercourse • discharge rainwater to a surface water sewer/drain • discharge rainwater to the combined sewer. Drainage should be designed and implemented in ways that also deliver other policy objectives of the London Plan, including water use efficiency and quality, biodiversity, amenity and recreation.
Supplementary Planning Guidance on Sustainable Design and Construction (May 2006) [Ref. 7]	**SPG 2.4.4 Water Pollution and Flooding** Essential Standard • Use of SuDS measures, wherever practical, to achieve 50% attenuation of the undeveloped site's surface water runoff at peak times

Policy Document	Key Provisions
	Mayor's Preferred Standard • Use of SuDS to achieve 100% attenuation of the undeveloped site's surface water runoff at peak times

5.3 Local Policy

London Borough of Kingston upon Thames Local Development Framework

The LDF superseded the Unitary Development Plan in 2012. Relevant policies contained within the DPDs are outlined in **Table 5.3** below.

Table 5.3: Local Development Framework Policy Context

Policy Document	Key Provisions
Core Strategy (April 2012) (Ref. 8)	**CS1 Climate Change Mitigation** Ensure that new development is designed and built to contribute to climate change mitigation by planning for increased flood risk.
	CS2 Climate Change Adaptation The Council will work in partnership with the EA and other stakeholders to address flooding from the River Thames and its tributaries and surface water flooding.
	DM1 Sustainable Design and Construction Standards Residential developments are encouraged to meet the Code for Sustainable Homes categories on surface water runoff.
	DM4 Water Management and Flood Risk A FRA is required for development within Flood Zone 1 of over 1ha. Development proposals should include SuDS, where possible, in line with the London Plan's drainage hierarchy. The development should also demontrate that there will be no adverse impacts on the quantity and quality of water resources. The development should take into account the impacts of climate change, the NPPF, the local Strategic Flood Risk Assessment (SFRA) and the Surface Water Management Plan (SWMP).

London Borough of Richmond upon Thames Local Development Framework

The Local Development Framework (LDF) superseded the Unitary Development Plan in 2011. The LDF incorporates a number of Local Development Plan Documents (DPDs). The DPDs, in conjunction with national planning policy and the London Plan, set out the strategy for managing development in the Borough. Relevant policies contained within the DPDs are outlined in **Table 5.3** below.

Table 5.3: Local Development Framework Policy Context

Policy Document	Key Provisions
Core Strategy (April 2009) (Ref. 9)	**CP1 Sustainable Development** Development will need to incorporate sustainable flood measures to protect vulnerable areas from flooding of the River Thames and its tributaries.
	CP3 Climate Change Development should be designed to take into account the future impacts of climate change.
Development Management Plan (November 2011) (Ref. 10)	**Policy DM SD 6: Flood Risk** Development will apply the Sequential Test and, if appropriate, the Exception Test. **Policy DM SD 7: Sustainable Drainage** Development will follow the drainage hierarchy when disposing of surface water and must utilise SuDS wherever practical. Any runoff must be reduced to Greenfield runoff rates wherever feasible. When discharging runoff to a public sewer, developers must check that capacity exists within the network. **Policy DM SD 9: Protecting Water Resources and Infrastructure** Developments must achieve a high standard of water efficiency.

6 SOURCES OF INFORMATION

6.1 Environment Agency

Flood Zone Map

The relevant guidance note from the Environment Agency is available online through the following link. The guidance note relevant to the site is Guidance Note 1, which relates to undertaking a FRA for sites greater than 1ha and including how the site will manage surface water runoff.

http://www.environment-agency.gov.uk/research/planning/93498.aspx

The EA do not have the detailed modelling to provide a Product 4 data set for the site area. The EA flood zone mapping service for England and Wales is available online at the following link:

http://www.environment-agency.gov.uk/homeandleisure/floods/

The latest EA flood map is presented as **Figure 4**. The site lies wholly within Flood Zone 1. Flood Zone 1 comprises land assessed as having less than a 1 in 1000 year annual probability of fluvial or tidal flooding (<0.1%) in any year. This places the site within an area of 'low' risk of fluvial and tidal flooding.

Pre-Application Enquiry

The EA confirmed that the site within Flood Zone 1, where the risk of flooding from rivers is classified as low. However, the FRA must consider surface water runoff and groundwater flooding.

The development should manage surface water runoff in line with the London Plan.

Complete correspondence is contained in **Appendix C**.

6.2 Relevant Studies

Relevant studies are summarised below with relevant flood risk sources presented in **Section 7**.

Strategic Flood Risk Assessments

Title: Royal Borough of Kingston upon Thames Strategic Flood Risk Assessment, Level 1 and 2, April 2011 [Ref. 11]

Title: London Borough of Richmond upon Thames Strategic Flood Risk Assessment, Level 1 Update, August 2010 [Ref. 12]

The principle aim of a SFRA is to map all forms of flood risk in the Borough in order to provide an evidence base to locate new development. The SFRA contains information and maps detailing flood sources and risks.

Relevant maps contained within the SFRAs can be found at the following links:

Kingston SFRA:

http://www.kingston.gov.uk/sfra_level1and2.pdf

Richmond SFRA:

http://www.richmond.gov.uk/home/environment/planning/planningpolicy/local_development_framework/local_development_framework_research/flood_risk_assessment.htm

Preliminary Flood Risk Assessment

Title: London Borough of Richmond upon Thames Preliminary Flood Risk Assessment, May 2011 [Ref. 13]

A Preliminary Flood Risk Assessment (PFRA) is the first part of the planning cycle for flood risk management as set out in the Flood Risk Regulations (2009), which implement the requirements of the European (EU) Floods Directive (2007). The EU Floods Directive aims to provide a consistent approach to managing flooding across Europe.

The PFRA considers local sources of flooding that the Lead Local Flood Authority is responsible for, including: ordinary watercourses; surface water; groundwater; and sewers where flooding is wholly or partially caused by rainwater or other precipitation entering or affecting the system. Information is gathered from existing sources on past floods and flood models to identify Flood Risk Areas. The PFRA forms part of the wider Drain London project.

Surface Water Management Plan

Title: London Borough of Richmond upon Thames and Royal Borough of Kingston upon Thames First Edition Surface Water Management Plan, August 2009 [Ref. 14]

Title: London Borough of Richmond upon Thames Surface Water Management Plan, July 2011 [Ref. 15]

A SWMP outlines a long-term action plan for the sustainable management of local surface water flood risk.

Catchment Flood Management Plan

Title: Thames Catchment Flood Management Plan, Summary Report, December 2009 *(Ref. 16)*

The CFMP gives an overview of the flood risk from inland sources across each river catchment and recommend ways of managing those risks now and over the next 50 to 100 years.

Thames Estuary 2100 Plan

Title: TE2100 Plan, November 2012 *(Ref. 17)*

The TE2100 Plan sets out the strategic direction for managing flood risk in the Thames estuary to the end of the century and beyond.

Other Planning Documents

Title: Latchmere House and HM Remand Centre Planning Brief, March 2013 *(Ref. 18)*

The Planning Brief was jointly prepared by Kingston and Richmond Boroughs' Councils to provide the prospective landowner with planning guidance. The Brief outlines relevant planning policy.

6.3 Drainage

Public Sewers

Sewer details have been referenced from sewer record plans obtained from Thames Water, as shown in **Appendix D**. All levels are quoted in metres Ordnance Newlyn Datum.

There are no public sewers within the site boundary. It appears that the site is served by separate foul and surface water systems. A foul sewer is located to the northeast of the site on Church Road whilst surface water sewer systems are located in residential areas to the south, east and west of the site.

A number of water supply mains are also located in the vicinity of the site.

A pre-development enquiry was sent to Thames Water ion February 2013, the response to which is also contained within **Appendix D**.

Private Drainage

Historical foul drainage maps indicate that the site buildings drain to the northeast.

Soakage tests carried out as part of Listers Ground Investigation report (Ref. 5) indicate it is probable that the surface water infiltrates into the ground via soakaways given the very good permeability of the underlying Kempton Park Gravel.

Internal Drainage Boards

There are no known Internal Drainage Boards covering the site area.

7 SOURCES OF FLOOD RISK

7.1 Criteria

In accordance with NPPF [(Ref. 1)] and advice from the EA, a prediction of the flood sources and levels is required along with the effects of climate change from the present to the design life of the development (100 years). To consider the effects of climate change, Table 5 of NPPF Technical Guidance [(Ref. 2)] recommends consideration of a 30% increase in rainfall intensity and 20% increase in peak river flows over the development's design life.

The flood risk elements that need to be considered for any site are defined in BS 8533-2011 [(Ref. 4)] as the "Forms of Flooding" and are listed as:

- Flooding from Rivers (fluvial flood risk)
- Flooding from the Sea (tidal flood risk)
- Flooding from the Land (surface water flood risk)
- Flooding from Groundwater
- Flooding from Sewers (sewer and drain exceedance, pumping station failure etc)
- Flooding from Reservoirs, Canals and other Artificial Structures.

The following section reviews each of these in respect of the site.

7.2 Fluvial Flood Risk

The EA flood map (**Figure 4**) shows the site to be located in Flood Zone 1, representing less than a 1 in 1000 year probability of flooding or 'low' flood risk from fluvial sources. The nearest Main River to the site, the River Thames, is located approximately 700m to the southwest of the site and thus is not deemed to represent a flood risk to the site.

Both Kingston and Richmond SFRAs confirm that the site lies in Flood Zone 1. Maps contained in these SFRAs indicate that neither the River Thames, River Crane nor Beverley Brook present a flood risk to the site. Richmond PFRA does not allude to any instances of fluvial flooding associated with ordinary watercourses in Richmond Park and Ham Common.

Within the TE2100 Plan, the site falls on the edge of Action Area 1, Policy Unit Richmond (Teddington to Kew). This area consists of a relatively narrow floodplain along the River Thames comprising largely residential properties and garden/parks. The fluvial flood risk associated with the River Thames is 1% per annum (Thames Barrier controlled). The flood depth in the event that the Barrier fails is up to 3m, which would not impact upon the site.

The flood risk from fluvial sources is **low**.

7.3 Tidal Flood Risk

The site is located in Flood Zone 1, representing less than a 1 in 1000 year probability of flooding or 'low' flood risk from tidal sources. The tidal extent of the River Thames is at Teddington Weir, which is located approximately 1.8km to the northwest of the site.

According to the TE2100 Plan, the number of properties at risk of tidal flooding from the tidal Thames is small. The tidal flood risk is 0.1% per annum (Thames Barrier controlled). The flood depth in the event that the Barrier fails is up to 2m, which would not impact upon the site.

The recommended flood risk management policy for Richmond policy unit is P3 - to continue with existing or alternative actions to manage flood risk. The existing flood risk management system comprises the Thames Barrier, secondary defences along the Thames frontage and flood forecasting/warning. There are no fluvial-specific defences but the tidal defences provide a degree of fluvial protection. The area is also covered by the Thames Landscape Strategy Hampton to Kew.

The site itself does not fall within a priority evacuation/refuge area and neither does property in the site area contain building resilience/resistance as part of TE2100 Plan.

The flood risk from tidal sources is **low**.

7.4 Surface Water Flood Risk

Intense rainfall can create conditions where the local infiltration and drainage capacity is insufficient to cope with the volume of water and so water flows overland. Surface water flooding can also occur due to a reduction in the capacity of a drainage system due to some form of blockage.

The topography of the site indicates that any excess surface water on the site would drain to the areas of lower ground in the east (7.90m AOD) and to the north (8.10m AOD). The wider area in Kingston Borough is largely located at a lower ground level. In Richmond Borough, Richmond Park falls towards the site, however it is likely that surface water would be retained within the Park.

There are no records of historical surface water flood events on the site or surrounding site area. The site does not lie within a Critical Drainage Area, however Richmond SFRA 'Areas Susceptible to Surface Water Flooding' map indicates that the site lies within an area with 'intermediate susceptibility' to surface water flooding. Richmond PFRA maps model a 0.1-0.25m and 0.5-1.0m depth of surface water flooding in the south of the site during a 1 in 100 year and 1 in 200 year rainfall event respectively. These events both equate accordingly to a 'moderate (danger for some)' surface water flood hazard. According to Kingston SFRA, there is a risk of surface water flooding to the southwest of the site during a 1 in 30 year storm event.

The predicted affects of climate change - more intense summer rainfall events and higher winter rainfall - could increase the risk of surface water flooding.

The surface water flood risk to the site is considered to be **low/moderate**.

7.5 Flooding from Groundwater

Groundwater flooding occurs when the water held underground rises to a level where it breaks the surface in areas away from usual channels and drainage pathways. Groundwater flooding typically occurs following long periods of sustained intense rainfall and is typically associated with low-lying areas underlain by permeable aquifers.

There is evidence (based on SFRA maps) of groundwater flooding associated with superficial deposits of gravels approximately 2km to the north of the site. Evidence of historical groundwater flooding in Kingston Borough is relatively limited.

Climate change could increase the risk of groundwater flooding as a result of increased precipitation filtering into the groundwater body. If winter rainfall becomes more frequent and heavier, groundwater levels may increase. Higher winter recharge may however be balanced by lower recharge during the predicted hotter and drier summers. This is less likely to cause a significant change to flood risk than from other sources, since groundwater flow is not as confined. It is probable that any locally perched aquifers may be more affected, but these are likely to be isolated. The change in flood risk is likely to be low.

The groundwater flood risk to the site is considered to be **low**.

7.6 Flooding from Sewers

Flood events occur when the capacity of a sewer is exceeded either due to a blockage in the sewer system or excess surface water runoff entering the system. Richmond and Kingston is generally served by separate foul and surface water sewer networks. The sewers are typically designed to accommodate up to a 1 in 30 year rainfall event, however, according to Richmond SWMP, Thames Water informed the London Borough of Richmond upon Thames Scrutiny Task Group (created to provide a report into the 2007 flood event) that the sewer system across the Borough is only designed to accommodate a 1 in 10 or 1 in 15 year storm event.

There were 11-20 sewer flood records in Richmond (according to Thames Water DG5 register as of June 2010) and 39 overloaded sewers in Kingston (according to Thames Water DG5 register as of August 2009) however details of the locations are not available.

The impact of climate change is likely to be negative regarding flooding from sewers. Increased rainfall and more frequent flooding put existing sewer and drainage systems under additional pressure resulting in the potential for more frequent surcharging and potential flooding. This would increase the frequency of local sewer flooding but not significant in terms of the proposed development.

The risk of groundwater flooding is considered to be **low**.

7.7 Flooding from Reservoirs, Canals and Artificial Structures

Flood events can occur from a sudden release of large volumes of water from reservoirs, canals and artificial structures. The EA Reservoir flooding map is

reproduced as **Figure 5**. The map indicates that the site is not at risk from reservoir flooding. The nearest areas at risk of reservoir flooding are approximately 900m to the north and 600m to the southwest of the site.

Reservoirs can be managed over time, controlling inflow/outflow of water and therefore there is the capacity to control the effects of climate change. Increased rainfall has the potential to increase base flow, but this should be minimal. It is unlikely that there will be a substantial change to the risk of flooding for this site.

There are no canals in the site area. The small pond on the existing site will not be retained as part of the development proposals. A number of ponds and drainage ditches are located in Ham Common and Richmond Park however given their small size and distance from site these are considered to present a low risk to the site.

The risk of flooding from the above sources is considered to be **low**.

8 PLANNING CONTEXT

8.1 Application of Planning Policy

Section 10 of NPPF [(Ref. 1)] includes measures specifically dealing with development planning and flood risk using a sequential characterisation of risk based on planning zones and the EA flood map. The main study requirement is to identify the flood zones and vulnerability classification relevant to the proposed development, based on an assessment of current and future conditions.

8.2 Land Use Vulnerability

NPPF Technical Guidance [(Ref. 2)] includes a list of appropriate land uses in each flood zone dependent on vulnerability to flooding. The tables are contained in **Appendix E** and Table 3 is reproduced as **Table 8.1** below.

Table 8.1: Flood Risk Vulnerability and Flood Zone 'Compatibility'

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	Zone 1	Appropriate	Appropriate	Appropriate	Appropriate	Appropriate
	Zone 2	Appropriate	Appropriate	Exception Test Required	Appropriate	Appropriate
	Zone 3a	Exception Test Required	Appropriate	Should not be permitted	Exception Test Required	Appropriate
	Zone 3b functional floodplain	Exception Test Required	Appropriate	Should not be permitted	Should not be permitted	Should not be permitted

The site's proposed residential development is classed as 'More Vulnerable' development. This classification of development is appropriate for areas within Flood Zone 1 subject to the implementation of an appropriate surface water drainage strategy. A surface water drainage strategy is considered in **Section 9**.

8.3 Sequential and Exception Tests

The Sequential Test is required at all stages of the planning process to steer new development to areas with the lowest probability of flooding (Flood Zone 1). As shown in **Table 8.1**, the proposed development is located in Flood Zone and passes the Sequential Test. The Exception Test - where there are no reasonably available sites for new development in Flood Zone 1 and development is subsequently proposed within Flood Zones 2 or 3a - is not applicable to the site.

9 SURFACE WATER DRAINAGE ASSESSMENT

9.1 Scope

NPPF and the London Plan state that SuDS should be considered wherever practical. Building Regulations Part H [(Ref. 19)] requires that the first choice of surface water disposal should be to discharge to an adequate soakaway or infiltration system, where practicable. If this is not reasonably practicable then discharge should be to a watercourse, the least favourable option then being to a sewer. Infiltration techniques should therefore be applied wherever they are appropriate.

In accordance with the London Plan, the surface water drainage strategy should seek to implement the SuDS hierarchy and aspire to achieve reductions in surface water runoff rates to Greenfield rates (Preferred Standard). As a minimum, the proposed surface water drainage strategy should achieve the Essential Standard set out in the London Plan to reduce runoff to 50% of existing rates if the Greenfield rate is not practicable.

As development will be located in Flood Zone 1 and is greater than 1ha in size, the EA requires such development to focus on the management of surface water runoff. This section discusses the potential quantitative effects of the development on both the risk of surface water flooding on-site and elsewhere within the catchment, as well as the type of potential SuDS features that could be incorporated as part of the masterplan.

9.2 Pre-Development Situation

The existing site is considered to consist of approximately 18,793m^2 (52%) impermeable land (see **Section 3.2**). It is assumed that all runoff from the site either infiltrates into the ground or enters the public surface water sewers to the south, east and west of the site (see **Section 6.3**). It is probable that the existing site drains into the ground since there is reference to soakaways on the on-site foul drainage plan.

In terms of the initial estimate of the potential runoff from the site, the pro-rata Institute of Hydrology (IoH) 124 method [(Ref. 20)] has been used to estimate the existing surface water runoff from the site. The results are shown in **Table 9.1** below. Additional information is contained in **Appendix F.**

Table 9.1: IoH Surface Water Runoff Calculations (existing hardstanding)

Return Period	Peak Flow (l/s)
QBAR urban	14.5
1 in 1 year peak flow	12.4
1 in 30 year peak flow	27.2
1 in 100 year peak flow	32.8

As a pre-developed site, an additional method of calculating the surface water runoff from impermeable areas is the Rational Method.

Rational Method:

$Q = C \times i \times A$

where C - is the runoff coefficient with a value of 0.95

i - is the design rainfall intensity which is at 0.014l/s/m^2 (14l/s/ha) from Part H of the Building Regulations (paragraph 3.8 Approved Document H3, 2010) (Ref. 19)

A - is the impermeable area (m^2)

$Q = 0.95 \times 0.014 \times 18{,}793$

Q = 249.95 l/s

This method assumes that all surface runoff is immediately directed into the public sewer network surrounding the site and therefore does not account for natural attenuation and possible infiltration across the site's permeable areas.

9.3 Limiting Discharge for Design

For the range of annual flow rate probabilities up to and including the 1 in 100 year event, including an appropriate allowance for climate change, the developed rate of runoff into a watercourse or other receiving water body should be no greater than the existing rate of runoff for the same event.

Due to the favourable ground conditions on site (see **Section 3.5**) there will be no off-site discharge, as all surface water will discharge to ground.

This also conforms with the Thames Water response contained within **Appendix D**, which states that the surrounding public surface water sewers are overloaded.

9.4 Sustainable Drainage Options

In order to define the proposed post-development drainage solution the use of SuDS for surface water management and the disposal of surface water runoff has been considered in this assessment. The options available are based upon guidance given in the CIRIA publication 'The SuDS Manual' (Ref. 21) and the London Plan (Ref. 6).

A SuDS system aims to mimic natural systems whereby water is held close to the source, then released slowly over time. This acts to both reduce peak discharge and to promote the settlement of sediment thereby improving the water quality of any resulting discharge. The final SuDS strategy for this site will be designed in line with the SuDS hierarchy as in Policy 5.13 Sustainable Drainage in the London Plan (see **Section 5.2**).

9.5 Post-Development Situation

9.5.1 Quick Store Estimates

To determine the approximate volume of attenuation storage that would be required on-site, the WinDes 'Quick Storage' calculation has been used undertaken for the two proposed catchments, based on a conservative total post-development impermeable area of approximately 15,869m^2 (~44%). An infiltration coefficient of 3.5796m/hr has been used. Full calculations can be found in **Appendix G.** This is an approximation of the storage requirement and as such provides a range of storage volumes. These volumes can be later revised at detail design stage by the introduction of specific flow control methods. A summary is shown in **Table 9.5** below.

Table 9.5: Summary of Required Attenuation Volumes

Flood Event	Approximate Storage (m^3)	
	Northern Catchment	Southern Catchment
1 in 30 year event	6 - 62	16. - 161
1 in 100 year event	7 - 81	20 - 212
1 in 100 year event + climate change	10 - 106	26 - 277

As previously mentioned in Section 3.5 and 9.3, no off-site discharge will occur. An infiltration rate of 9.94x10^{-4}m/s (3.5796m/hr) has been used in these calculations.

An approximate total storage volume of 62m^3 for the northern catchment and 161m^3 for the southern catchment, would be required for the site in order to contain all surface water runoff below ground within the site for up to the 1 in 30 year storm event. A total storage volume of 106m^3 for the northern catchment and 277m^3 for the southern catchment would be needed for a 1 in 100 year storm event plus a 30% allowance for climate change.

9.5.2 Proposed Drainage Strategy

Given the suitability of the ground conditions, all surface water on the developed site is discharged to ground via soakage features. The majority of runoff from roofs is discharged directly to individual trench soakaways within back gardens, which have been located at least 5m from any buildings. Due to the proposed site layout, it has not been possible to locate trench soakaways within all gardens and therefore some runoff from roofs will enter the network within the road system. Runoff from the roads will pass through permeable paving and swale features (for treatment purposes) before entering infiltration basins that will allow water to discharge to ground. The site has been split into two catchment areas with infiltration basins at the downstream end of both.

The strategy has been designed to accommodate the 1 in 30 year event below ground (northern catchment: approximately 78m^3, excess of 62m^3 and southern catchment: approximately 168m^3, excess of 161m^3). This will be accommodated within the individual trench soakaways for the buildings and permeable paving/geocellular storage beneath the infiltration basins to accommodate runoff from the roads.

For more extreme storm events, up to the 1 in 100 year plus 30% climate change event, runoff will be attenuated on site within the infiltration basins. A preliminary design of these basins indicate that they only have water above ground during these extreme events (more than 1 in 30 year event). Due to the site topography, the surface water drainage pipework will be up to 2m below ground level at the inlet to the basins and therefore these have been designed to fill the geocells and gravel trench before filling the basin (i.e. filled from below). The two basins have been designed in the Windes 'Source Control' as features to accommodate the 1 in 100 year plus climate change volume from the roads only. As there will be an overflow from the buildings for this larger storm event, the basins sizes have been increased to ensure that this extra volume can be accommodated in the basins and an approximate 280-300mm freeboard has been allowed for.

Groundwater levels have been measured at 3-3.5m bgl (Section 3.5) and the features have a preliminary design which provides at least a 1m buffer to the groundwater table.

It should be noted that the northern part of the main access road into the site is assumed to drain as per its existing arrangement, as no changes are proposed for this area. Therefore this impermeable area has not been included in the calculations.

An indicative proposed SuDS layout is shown as **Figure 6**. It should be noted that the inclusion and feasibility of the above outline proposals would need to be confirmed at the detailed design stage following a review of the final site layout.

9.6 Foul Water Drainage Strategy

Thames Water plans as contained within **Appendix D**, illustrate that there is an existing 150mm diameter foul sewer to the north east of the site skirts the near side of Church Road just outside the site boundary. This sewer gravitates eastwards to a pumping station a short distance downstream at the junction with Latchmere Lane. At manhole no 5401 on this run, the sewer depth is approximately 2.4 metres. This increases to 2.8 metres close to the pumping station.

Direct correspondence with Thames Water states *"there is adequate capacity in the sewer for your foul drainage proposals"* (see **Appendix D**). Therefore the proposed foul water strategy for this site connects into the existing public network.

According to surveys of the previously developed site, there appears to be an existing connection to the public network through the trees in the north of the site. Therefore, **Figure 7** illustrates an indicative foul water plan that utilises this existing connection. Detailed design of the foul water network is outside the scope of this report and will need to be developed during the detailed design stage.

10 CONCLUSIONS AND RECOMMENDATIONS

The conclusions and key recommendations from this FRA have been summarised in **Table 11** below.

Table 11: Flood Risk Assessment Summary

1.	Development description and location
1a	What type of development is proposed and where will it be located? • A 3.58ha residential development on the site of Latchmere House.
1b	What is its vulnerability classification? • Residential use is considered as 'More Vulnerable' in accordance with NPPF Technical Guidance.
1c	Is the proposed development consistent with the Local Development Documents? • The development will incorporate SuDS features in line with the London Plan and the LDF of both Kingston and Richmond Boroughs.
1d	Provide evidence that the Sequential Test or Exception Test has been applied in the selection of this site for this type of development? • The 'More Vulnerable' classified site is located within an area of low fluvial flood risk (Flood Zone 1) and is therefore considered appropriate in terms of flood risk and is deemed to satisfy the Sequential Test.
2.	**Definition of the flood hazard**
2a	What source of flooding could affect the site? • Surface water • Sewer flooding
2b	Describe how flooding could occur? • Overland flow and surcharge of sewers.
2c	What are the existing surface water drainage arrangements for the site? • The site is served by a private drainage network believed to connect to Thames Water foul and surface water sewers off-site.
3.	**Probability**
3a	Which flood zone is the site within? • Flood Zone 1
3b	If there is a Strategic Flood Risk Assessment covering this site, what does it show? • The site lies in both Kingston and Richmond Boroughs thus is covered in two SFRAs, both of which confirm that the site lies within Flood Zone 1. There have been no historical instances of fluvial, tidal, surface water, sewer or groundwater flooding on the site.

3c	What is the probability of the site flooding taking account of the contents of the SFRA of any further site-specific assessment? • Low
3d	What are the existing rates and volumes of runoff generated by the site? • IoH 124 calculations indicate existing discharge rates vary between 12.4 and 32.8l/s for return periods up to and including the 1 in 100 year plus climate change event. • The Rational Method indicates that the site currently generates 249.9l/s.
4.	**Climate Change**
4a	How is flood risk at the site likely to be affected by climate change? • Climate change will increase rainfall by 30%, which may result in increased surface water flooding. However, various design features could be incorporated into the site layout to mitigate against flooding from this source.
5.	**Detailed development proposals**
5a	Demonstrate, where appropriate, how land uses most sensitive to flood damage have been placed within the site that are at least risk of flooding. • The whole site is located within Flood Zone 1.
6.	**Flood risk management measures**
6a	How will the site be protected from flooding, including the potential of climate change, over the development's lifetime? • SuDS features have been outlined that can be designed to attenuate surface water up to the 1 in 100 year plus climate change event on site.
7.	**Off site impacts**
7a	How will it be ensured that the proposed development and the measures to protect the site from flooding will not increase flood risk elsewhere? • SuDS features should be adopted to ensure that surface water runoff from the site is managed.
8.	**Residual risks**
8a	What flood related risks will remain after the implementation of measures to protect the site from flooding? • Any blockage of sewers during extreme fluvial flood events.
8b	How, and by whom, will these risks be managed over the lifetime of the development? • Site management teams will maintain on-site private drains • Thames Water will manage public sewers • The EA will manage local Main Rivers.

11 REFERENCES

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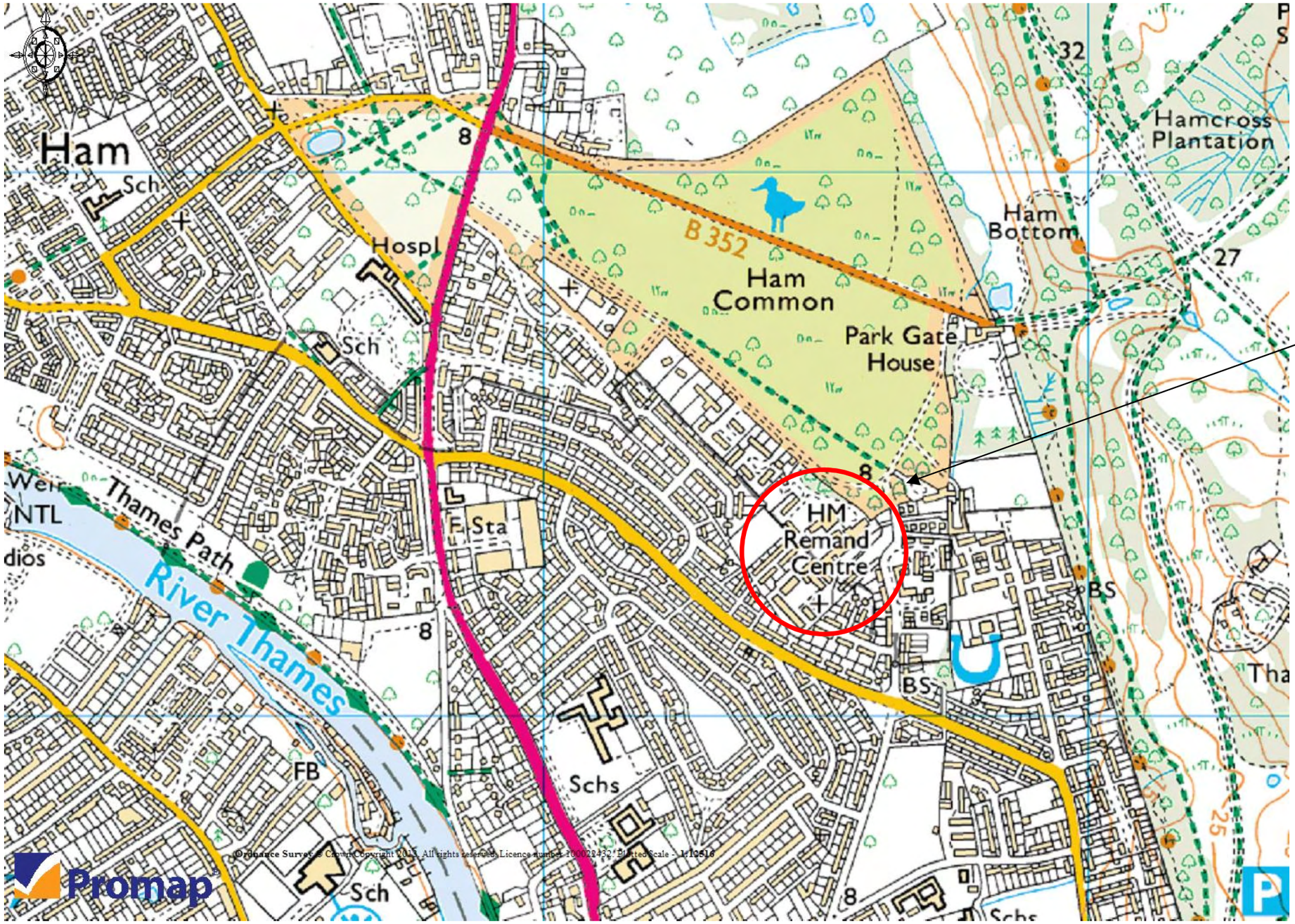
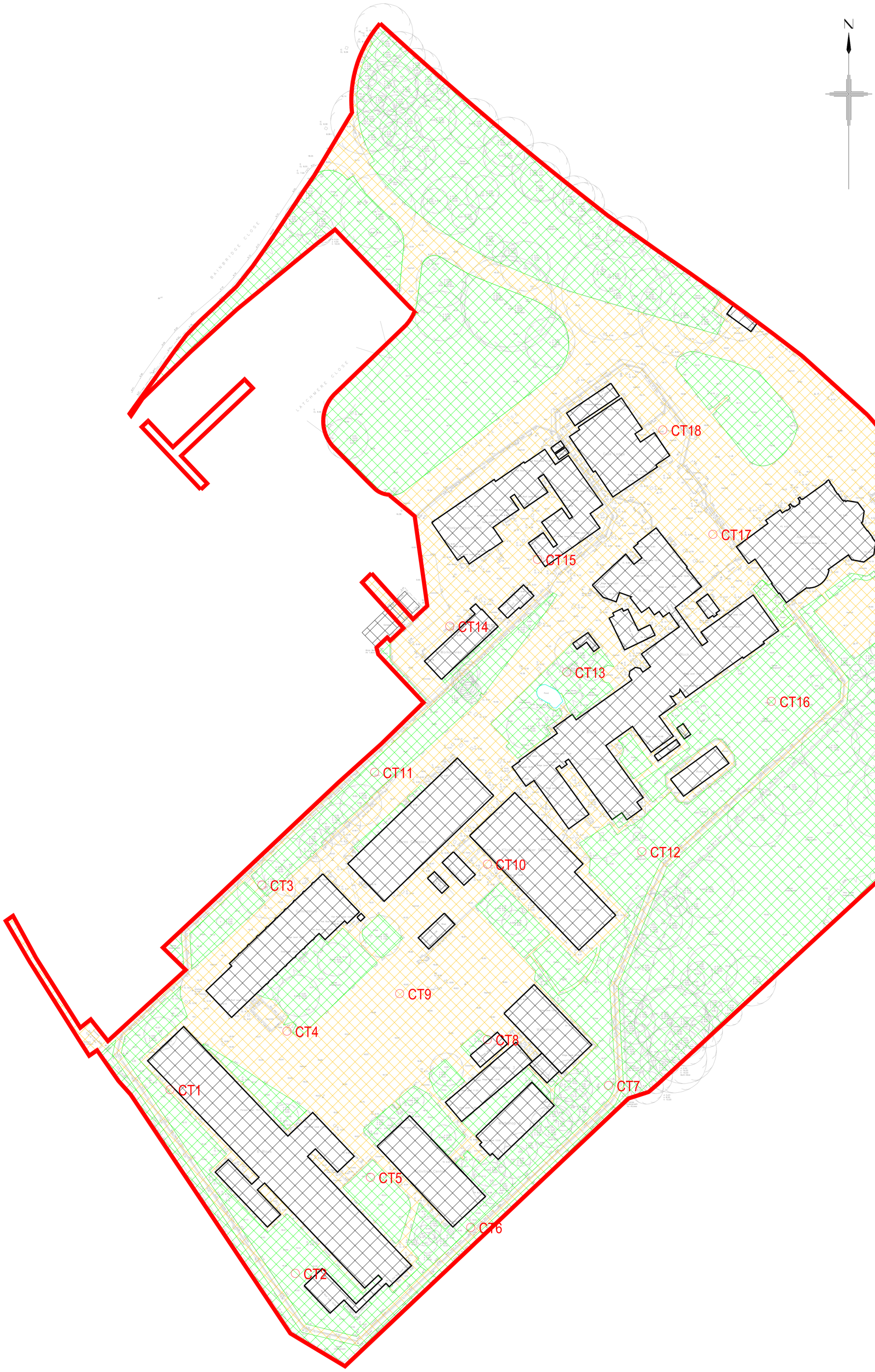
21. CIRIA “The SUDS Manual” C697, March 2007.

FIGURES



RSK	**SITE LOCATION PLAN**	**Client:**	Berkeley Homes (Central London) Ltd	**Figure No:**	1
		Site:	Latchmere House	**Job No:**	132034
		Scale:	NTS	**Source:**	Promap



CIVIL / STRUCTURAL DESIGN RISK MANAGEMENT

Abnormal or unusual residual risks associated with the design outcomes shown on this drawing are:-

Topographical survey taken from Laser Surveys "Latchmere House" drawing no. L5526/2 dated August 2012.
Borehole locations from Listers' Ground Investigation report.

RSK LDE LTD has followed its Design Risk Management process for Hazard Elimination and Risk reduction in developing the designs shown on this drawing.
Abnormal or unusual residual risks may be shown above where it is considered that such risk may not normally be expected by competent persons engaged on work of this nature or type.

LEGEND

- SITE BOUNDARY
- BUILDINGS
- HARDSTANDING
- SOFT LANDSCAPING
- WATER BODY
- CT 15 — BOREHOLE LOCATIONS

FIGURE 2

Rev.	Date	Amendment	Drawn	Chkd.	Appd.
R1	28.08.13	FIRST ISSUE	RA	JC	KR

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Client: Berkeley Homes (Urban Renaissance) Ltd

Project Title: LATCHMERE HOUSE

Drawing Title: EXISTING SITE LAYOUT AND TOPOGRAPHIC SURVEY

Drawn	Date	Checked	Date	Approved	Date
RA	28.08.13	JC	28.08.13	KR	28.08.13

Scale	Orig Size	Dimensions
1:500	A1	m

Project No.	Drawing File
132034	10-01 Site layout

Drawing No.	Rev.
10-01	R1

File Location: K:\132034 - LATCHMERE PLANNING SUPPORT\GRAPHIC\FLOOD RISK\10-01 EXISTING LAYOUT INC TOPO (2007).DWG

CIVIL / STRUCTURAL DESIGN RISK MANAGEMENT

Abnormal or unusual residual risks associated with the design outcomes shown on this drawing are:-

1. Proposed masterplan layout taken from MAA Architects drawing no. BKH04-P_101 Rev. 1, dated September 2013 (Rev. 1 dated 06.12.13).

RSK LDE LTD has followed its Design Risk Management process for Hazard Elimination and Risk reduction in developing the designs shown on this drawing.
Abnormal or unusual residual risks may be shown above where it is considered that such risk may not normally be expected by competent persons engaged on work of this nature or type.

LEGEND

- SITE BOUNDARY
- INDICATIVE PROPOSED CATCHMENT BOUNDARY
- PROPOSED BUILDINGS
- PROPOSED IMPERMEABLE AREA
- PROPOSED PERMEABLE AREA

FIGURE 3

Rev.	Date	Amendment	Drawn	Chkd.	Appd.
P4	10.12.13	UPDATED WITH LATEST LAYOUT	JC	KR	KR
P3	26.09.13	UPDATED WITH LATEST LAYOUT	JC	KR	KR
P2	20.09.13	UPDATED WITH LATEST LAYOUT	JC	KR	KR
P1	16.09.13	FIRST ISSUE	JC	KR	KR

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Client
Berkeley Homes (Central London) Ltd

Project Title
LATCHMERE HOUSE

Drawing Title
PROPOSED SITE LAYOUT
- SCHEME 1

Drawn	Date	Checked	Date	Approved	Date
JC	13.08.13	KR	03.09.13	KR	03.09.13

Scale	Orig Size	Dimensions
1:500	A1	m

Project No.	Drawing File
132034	40-01(S1) Proposed layout

Drawing No.	Rev.
40-01(S1)	P4

Scale
0 5 10 15 20 25m

File Location: K:\132034 - LATCHMERE PLANNING SUPPORT\GRAPH\FLOOD RISK\40-01(S1) PROPOSED LAYOUT AND SUDS (P5).DWG

Environment Agency

Enter a postcode or place name: Go

Other topics for this area... Risk of Flooding from Rivers and Sea

Risk of Flooding from Rivers and Sea

Map legend

Click on the map to see what is the Risk of Flooding at a particular location.

Flood Maps

- Flooding from rivers or sea without defences
- Extent of extreme flood
- Flood defences (Not all may be shown*)
- Areas benefiting from flood defences (Not all may be shown*)
- Main rivers

Map of X: 518,341.49; Y: 171,554.99 at scale 1:15,000

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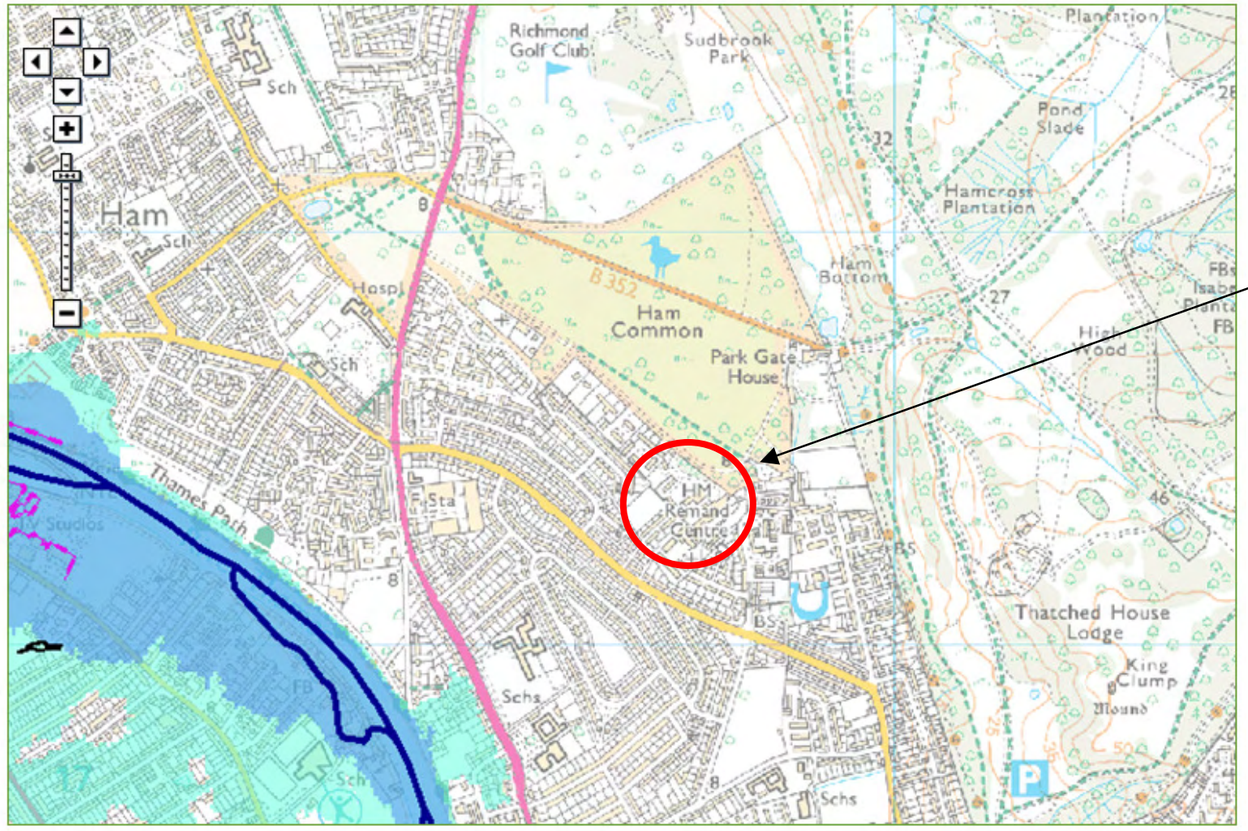


RSK	**ENVIRONMENT AGENCY RIVER AND SEA FLOOD ZONE MAP**	**Client:** Berkeley Homes (Central London) Ltd	**Figure No:** 4
		Site: Latchmere House	**Job No:** 132034
		Scale: NTS	**Source:** Environment Agency

Environment Agency

Enter a postcode or place name: TW10 5HH Go

Other topics for this area... Risk of Flooding from Reservoirs

Risk of Flooding from Reservoirs

Map legend

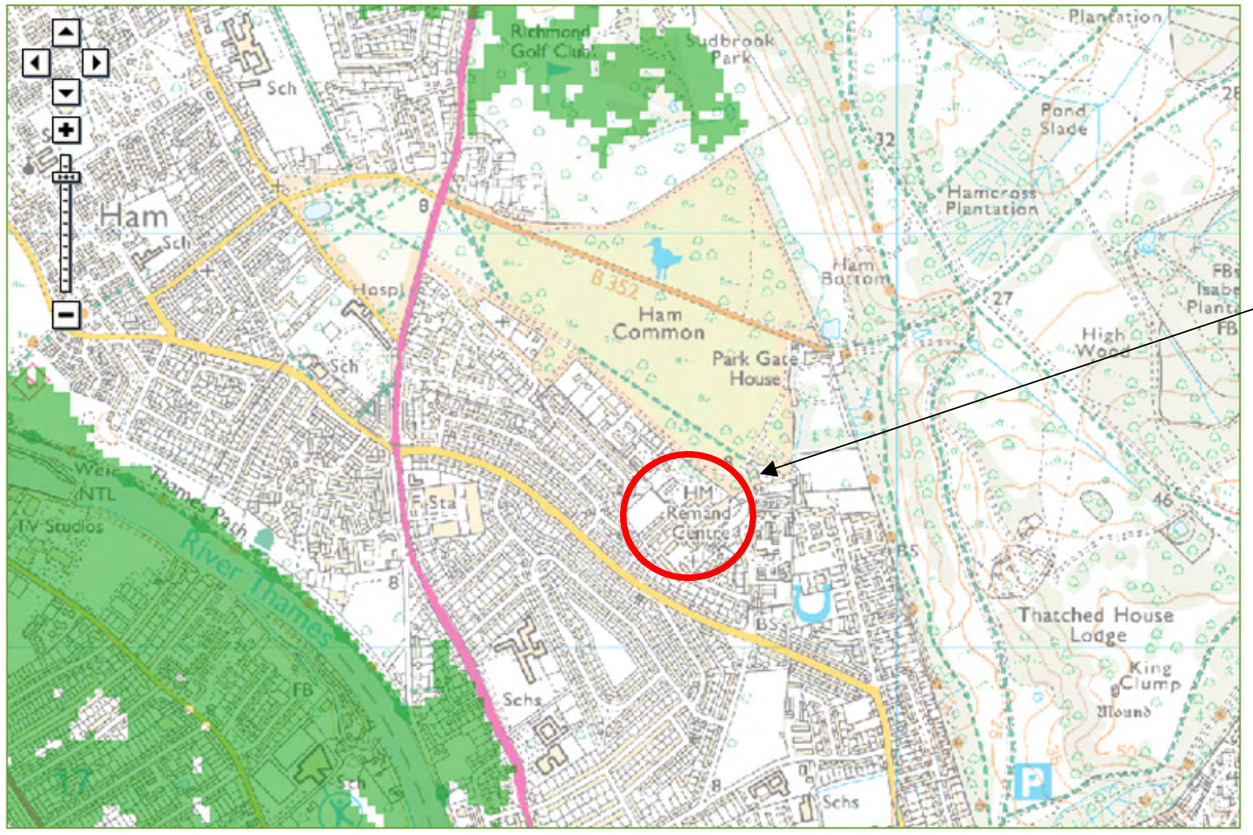
Click within the extent of flooding to see which reservoirs affect this area

Risk of Flooding from Reservoirs

Maximum extent of flooding

TW10 5HH at scale 1:15,000

Data search Text only version



RSK	**ENVIRONMENT AGENCY RESERVOIR FLOOD MAP**	**Client:** Berkeley Homes (Central London) Ltd	**Figure No:** 5
		Site: Latchmere House	**Job No:** 132034
		Scale: NTS	**Source:** Environment Agency

CIVIL / STRUCTURAL DESIGN RISK MANAGEMENT

Abnormal or unusual residual risks associated with the design outcomes shown on this drawing are:-

1. Proposed masterplan layout taken from MAA Architects drawing no. BKH04-P_101 Rev. 1, dated September 2013 (Rev. 1 dated 06.12.13).

RSK LDE LTD has followed its Design Risk Management process for Hazard Elimination and Risk reduction in developing the designs shown on this drawing.
Abnormal or unusual residual risks may be shown above where it is considered that such risk may not normally be expected by competent persons engaged on work of this nature or type.

LEGEND

- SITE BOUNDARY
- PROPOSED BUILDINGS
- INDICATIVE SURFACE WATER DRAINAGE NETWORK
- FIN DRAIN

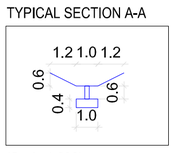
Basin 2
1:5 side slopes
0.3m deep
10m² cellular storage below (0.4m deep)
(~300mm freeboard when include extreme volumes from buildings)

Basin 1
1:2 side slopes
0.6m deep
150m² cellular storage below (0.4m deep)
(~300mm freeboard when include extreme volumes from buildings)

Section A-A

Section B-B

TYPICAL SECTION A-A



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TYPICAL SECTION B-B

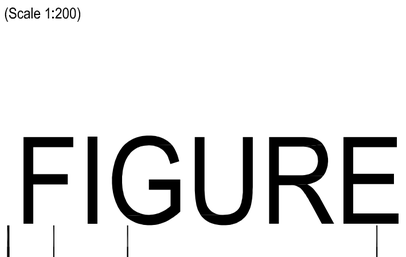

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FIGURE 6

Rev.	Date	Amendment	Drawn	Chkd.	Appd.
P5	10.12.13	UPDATED WITH LATEST LAYOUT	JC	KR	KR
P4	26.09.13	UPDATED WITH LATEST LAYOUT	JC	KR	KR
P3	20.09.13	UPDATED WITH LATEST LAYOUT	JC	KR	KR
P2	03.09.13	REVISED SUDS LAYOUT	JC	KR	KR
P1	19.08.13	FIRST ISSUE	JC	KR	KR

SUDS Components

Source Control

Infiltration Devices (soakaways)	Infiltration devices temporarily store runoff from a development and allow it to percolate into the ground. Excavation or trench that can be filled with filter material. Can be made of pre-cast concrete or polyethylene rings/perforated storage structures that are then backfilled with granular material.
Pervious surfaces	Pervious surfaces allow rainwater to infiltrate through the surface into an underlying storage layer, where water is stored before infiltration to the ground, reuse, or discharge to surface water. Porous surface replaces traditional impermeable surfaces.

Area Control

Modular Storage	Modular plastic geocellular systems with a high void ratio that can be used to create a below ground infiltration (soakaway) or storage structure.

Regional Control

Infiltration basin	Infiltration basins are depressions in the surface that are designed to store runoff and infiltrate the water to the ground. They may also be landscaped to provide aesthetic and amenity value.

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Client: Berkeley Homes (Central London) Ltd

Project Title: LATCHMERE HOUSE

Drawing Title: INDICATIVE SUDS LAYOUT - SCHEME 1

Drawn	Date	Checked	Date	Approved	Date
JC	19.08.13	KR	19.08.13	KR	19.08.13

Scale	Orig Size	Dimensions
1:500	A1	m

Project No.	Drawing File
132034	40-01(S1) Proposed layout

Drawing No.	Rev.
40-04-1(S1)	P5

Scale: 0 5 10 15 20 25m

File Location: K:\132034 - LATCHMERE PLANNING SUPPORT\GRAPH\FLOOD RISK\40-01(S1) PROPOSED LAYOUT AND SUDS (P5).DWG

CIVIL / STRUCTURAL DESIGN RISK MANAGEMENT

Abnormal or unusual residual risks associated with the design outcomes shown on this drawing are:-

1. Proposed masterplan layout taken from MAA Architects drawing no. BKH04-P_101 Rev. 1, dated September 2013 (Rev. 1 dated 06.12.13).

RSK LDE LTD has followed its Design Risk Management process for Hazard Elimination and Risk reduction in developing the designs shown on this drawing.
Abnormal or unusual residual risks may be shown above where it is considered that such risk may not normally be expected by competent persons engaged on work of this nature or type.

LEGEND

- SITE BOUNDARY
- PROPOSED BUILDINGS
- THAMES WATER PUBLIC FOUL WATER SEWER NETWORK
- INDICATIVE FOUL WATER DRAINAGE NETWORK

Connection into Thames Water public network via existing connection - subject to approval

150mmØ

FIGURE 7

Rev.	Date	Amendment	Drawn	Chkd.	Appd.
P3	10.12.13	UPDATED WITH LATEST LAYOUT	JC	KR	KR
P2	26.09.13	UPDATED WITH LATEST LAYOUT	JC	KR	KR
P1	16.09.13	FIRST ISSUE	JC	KR	KR

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Client

Berkeley Homes (Central London) Ltd

Project Title

LATCHMERE HOUSE

Drawing Title

INDICATIVE FOUL WATER DRAINAGE STRATEGY - SCHEME 1

Drawn	Date	Checked	Date	Approved	Date
JC	16.09.13	KR	16.09.13	KR	16.09.13

Scale	Orig Size	Dimensions
1:500	A1	m

Project No.	Drawing File
132034	40-01(S1) Proposed layout

Drawing No.	Rev.
40-04-2(S1)	P3

Scale 0 5 10 15 20 25m

File Location: K:\132034 - LATCHMERE PLANNING SUPPORT\GRAPHIC\FLOOD RISK\40-01(S1) PROPOSED LAYOUT AND SUDS (P5).DWG

APPENDIX A

RSK Service constraints

RSK GROUP
SERVICE CONSTRAINTS

1. This drainage design carried out in connection with the report (together the "Services") were compiled and carried out by RSK LDE Ltd (RSK) for Berkeley Homes (Central London) Ltd (the "client") in accordance with the terms of a contract between RSK and the client dated January 2012. The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable Civil Engineer at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.

2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.

3. Unless otherwise agreed the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.

4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the Site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date hereof, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.

5. The passage of time may result in changes in Site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.

6. The observations and conclusions described in this report are based solely upon the Services, which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the Site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.

7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walk-over survey of the Site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the Site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.

8. The phase II or intrusive environmental Site investigation aspects of the Services is a limited sampling of the Site at pre-determined borehole and soil vapour locations based on the operational configuration of the Site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and RSK] [based on an understanding of the available operational and historical information,] and it should not be inferred that other chemical species are not present.

9. Any Site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the Site.

APPENDIX B

Technical Guidance Notes

National Planning Policy Framework Technical Guidance Note (March 2012)

Site-specific Flood Risk Assessments

As set out in the NPPF, local planning authorities should only consider development in flood risk areas appropriate where informed by a Site-specific FRA. This should identify and assess the risks of all forms of flooding to and from the development and demonstrate how these flood risks will be managed so that the development remains safe throughout its lifetime, taking into account climate change. Those proposing developments should take advice from the emergency services when producing an evacuation plan for the development as part of the flood risk assessment.

BS 8533-2011 Assessing and Managing Flood Risk in Development Code of Practice (Nov 2011)

Assessing the risk of flooding

4.1 General

A detailed, development-based flooding investigation should be undertaken to determine:

a) the likelihood and consequence of flooding in and around the development, from all sources;
b) how the development might alter the existing flooding regime, potentially increasing the risk of flooding elsewhere; and
c) the design measures needed to manage the risk of flooding in and around the development.

NOTE a detailed, development-based flooding investigation to be prepared and submitted to the planning authority as part of the planning application. By producing the flood investigation at such an early stage, it can be used to influence the conceptual layout and design of the development and reduce (or avoid) the risk of flooding.

4.2 Site information

Before undertaking a detailed assessment of the risk of flooding, information about the Site and surroundings should be obtained, including:

a) details of existing infrastructure (e.g. reservoirs, canals, culverts, flood risk management infrastructure and/or drainage infrastructure);
b) details of existing raised flood risk management infrastructure (e.g. the level of protection afforded by them and their condition);
c) evidence of historical flooding;
d) topographic mapping including local features (e.g. boundary walls and hedges); and
e) information on site ground conditions.

Assessing the risk of flooding to the development Site and beyond

The risk of flooding associated with a proposed development should be assessed as the combination of the likelihood of flooding and its consequence. The following factors should be assessed:

a) how likely, and to what extent, the Site might flood and the nature of that flood hazard;
b) the consequence of flooding (e.g. damage to property, injury to people or loss of life); and
c) the impact that the development could have on flooding elsewhere.

The assessment of flood risk should quantify the risk of flooding, both to and from the Site, from the following:

1) tidal and fluvial flooding;
2) surface water flooding;
3) flooding due to surcharging of sewers and drains;
4) groundwater flooding; and
5) flooding caused by the failure of infrastructure.

Interim Code of Practice for Sustainable Drainage Systems (July 2004)

Drainage impact assessments

The drainage impact assessment (DIA) or drainage assessment (DA) will ensure that consideration is given to the impact of the proposed development on the catchment. It should be submitted with the first planning application for developments that require waste or surface water to be drained.

The DIA is Site-specific, and guidance on the completion of the assessment recommends the implementation of a drainage system that provides the best environmental protection and states that sustainable drainage systems (SUDS) are the preferred method of surface water drainage.

The basic requirements for a drainage impact assessment include:

- an examination of drainage patterns including overland flood pathways during extreme events;
- a concept drawing of the development proposal;
- a brief summary of how the drainage design provides SUDS techniques (in accordance with CIRIA guidance);
- a summary of SUDS to be incorporated;
- soil classification for the Site;
- evidence of soil porosity Sites (where possible at Site of infiltration devices);
- consideration of ground and groundwater conditions;
- calculation for runoff flow for the range of critical rainfall events;
- attenuation and treatment designed for a relevant return period rainfall events;
- wastewater drainage proposals;
- confirmation of maintenance responsibility; and
- a copy of letter from sewerage undertaker giving location of nearest public sewer and confirmation of their availability for servicing the Site.

APPENDIX C

Environment Agency Correspondence

creating a better place

Environment Agency

Ross Armstrong
RSK ENSR Land and Development Engineering Ltd
18 Frogmore Road Industrial Estate
Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

Our ref: SL/2013/111596/01-L01
Your ref: 132034 HMP Latchmere

Date: 3 September 2013

Dear Ross

It is proposed to redevelop the site to accommodate approximately 70 residential dwellings.

Site at HMP; Latchmere House, Church Road, Richmond, Surrey.

Thank you for consulting us at the pre-application stage. Having reviewed the information submitted we would like to highlight the following issues and opportunities.

- Surface water drainage
- Groundwater and contaminated land.

The proposed site is in Flood Zone 1, where the risk of flooding from rivers is classified as low. However, as the development is greater than 1 Hectare, a Flood Risk Assessment is still required but should be focused on the management of surface water run-off.

Development that increases the amount of impermeable surfaces can result in an increase in surface water run-off, which in turn can result in an increase in flood risk both on site and elsewhere within the catchment. In addition, the site may also still be at risk from other sources of flooding (e.g. groundwater and overland runoff), which are not considered in the mapping of Flood Zones.

As detailed in Policy 5.13 of the London Plan, developments should utilise sustainable urban drainage systems (SuDS), achieve Greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible in line with the following drainage hierarchy:

1 store rainwater for later use
2 use infiltration techniques, such as porous surfaces in non-clay areas
3 attenuate rainwater in ponds or open water features for gradual release
4 attenuate rainwater by storing in tanks or sealed water features for gradual release
5 discharge rainwater direct to a watercourse
6 discharge rainwater to a surface water sewer/drain
7 discharge rainwater to the combined sewer.

Drainage should further be designed and implemented in ways that deliver other policy objectives of the London Plan, including water use efficiency and quality, biodiversity, amenity and recreation.

We also recommend you contact the Lead Local Flood Authorities [LLFA] – The London Borough of Richmond upon Thames and the Royal Borough of Kingston upon Thames regarding this proposal and refer to their Surface Water Management Plans.

As a result of the Flood and Water Management Act 2010, the LLFA are responsible for local flood risk (i.e. surface runoff, ground water and ordinary watercourse).

You may also wish to consider contacting the appropriate relevant water/sewerage undertaker for the area. They may be able to provide some knowledge on the risk of flooding from other sources.

We note that the proposed method for dealing with surface water is infiltration. Whilst we welcome this approach, percolation tests must be undertaken, and soakaways designed and constructed in accordance with the guidelines stipulated in BRE Digest 365.

The site must be able to contain the 1 in 100 year critical storm including an allowance for climate change for the lifetime of the development and demonstrate that there is no property flooding from this event. Where soakaways do not accommodate the critical storm, overland flow and storage areas must be designed within the layout of the site.

There must also be at least 1m between the maximum anticipated groundwater level and the base of the infiltration system. If the surface of an infiltration system is too close to the water table, a rise in water levels during particularly wet periods could cause groundwater to enter the infiltration system, reducing the amount of storage available. Groundwater entering the infiltration system would also result in direct discharge from that infiltration system into groundwater, which may contravene permitting requirements and environmental legislation.

Potential for Land Contamination

We will need a Preliminary Risk Assessment (PRA) to assess if land contamination may be present at the site. This should be submitted with the planning application. The PRA needs to include information on *past and current uses, if sensitive controlled waters receptors are present and if the site could pose a pollution risk.* The PRA should also consider if any aspects of the proposed development could pose a pollution risk should contamination be present (i.e. deep drilling to facilitate the installation of foundation piles, site drainage). Further work such as an intrusive site investigation may be required depending on the findings of the PRA.

We recommend that developers should:

1. Follow the risk management framework provided in CLR11, 'Model Procedures for the Management of Land Contamination', when dealing with land potentially affected by contamination;

2. Refer to our 'Guiding Principles for Land Contamination' documents for the type of information that should be included in a PRA;

3. Refer to our 'Groundwater Protection: policy and practice (GP3)' documents.

Of the drainage options for a site, infiltration techniques (primarily soakaways) pose the highest risk of polluting the groundwater. Some general information is provided below in relation to the use of infiltration techniques. Ultimately, any drainage design must be protective of the groundwater and in line with our 'Groundwater Protection: policy and practice (GP3)' for the use of infiltration techniques to be approved.

- If contamination is present in areas proposed for infiltration, we will require the removal of all contaminated material and provision of satisfactory evidence of its removal;
- The point of discharge should be kept as shallow as possible. Deep bored infiltration techniques are not acceptable;
- The distance between the point of discharge and the groundwater table should be a minimum of five metres;
- Only clean, uncontaminated water should be discharged into the ground.

Advice for developers
We have updated our advice for developers and it is now a joint agency document with advice from Environment Agency, Natural England and Forestry Commission, it's available to view on our website
http://www.environment-agency.gov.uk/business/sectors/136252.aspx

I trust that our comments are of use, if you have any questions please contact me.

Yours sincerely

Joe Martyn
Planning Advisor

Direct dial 0203 263 8087
Direct e-mail joseph.martyn@environment-agency.gov.uk

Please note that the view expressed in this letter by the Environment Agency is a response to a pre application enquiry only and does not represent our final view in relation to any future planning application made in relation to this site. We reserve the right to change our position in relation to any such application. You should seek your own expert advice in relation to technical matters relevant to any planning application before submission

APPENDIX D

Thames Water Sewer Records

CommercialDW Drainage and Water Enquiry Water Map-CDWS/CDWS Standard/2012_2168534

The width of the displayed area is 500m

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Based on the Ordnance Survey Map with the Sanction of the controller of H.M. Stationery Office, License no. WU298557 Crown Copyright Reserved.

CommercialDW Drainage and Water Enquiry Sewer Map- CDWS/CDWS Standard/2012_2168534

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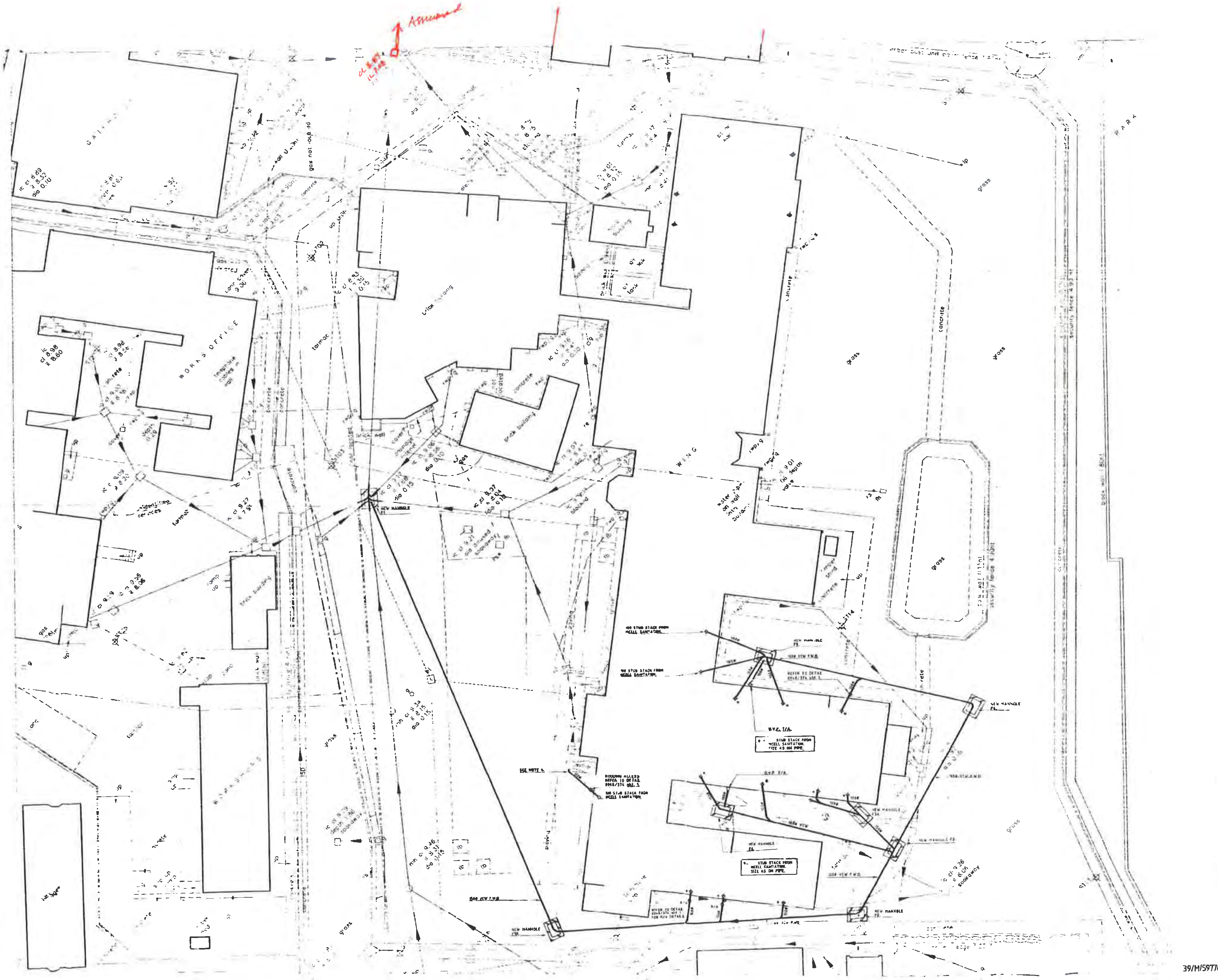


6 THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE FOLLOWING DRAWINGS:-

PH/1948/2
PH/1948/3
PH/1948/4
PH/1948/5

1 THE CONTRACTOR IS TO EXPOSE THE BUILDING FOOTINGS [illegible] FOR INSPECTION BY THE S.O. AND THE ENGINEER PRIOR [illegible] ANY DRAINAGE WORKS.

2 THE CONTRACTOR IS TO ESTABLISH THE LOCATION OF ANY EXISTING DRAINAGE, SERVICES AND CONSTRAINTS PRIOR TO [illegible] NEW DRAINAGE.

3 [illegible] INFORMATION ONLY, AND ARE INDICATIVE OF THE SERVICES [illegible]

4 [illegible] ALSO WITH CLASS B ENGINEERING BRICKWORK. BROKEN OR DAMAGED COVERS ARE TO BE REPLACED WITH NEW TO THE [illegible] SPECIFICATION AS SPECIFIED IN THE MANHOLE SCHEDULE.

5 THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT AVAILABLE STRUCTURAL [illegible] DRAWINGS AND THE SPECIFICATION.

6 ANY ERRORS OR OMISSIONS OR POINTS OF CLARIFICATION WILL BE REFERRED BACK TO THE S.O. FOR HIS [illegible]

7 ALL EXISTING SERVICES TO BE TRACED AND VERIFIED AS [illegible] BE GIVEN TO THE HEAD OF WORKS SERVICES BEFORE ANY [illegible] ARE DISCONNECTED.

8 FINAL ROUTES OF SERVICES TO BE DETERMINED AND AGREED ON SITE WITH THE HEAD OF WORKS SERVICES [illegible] ON THIS DRAWING ARE INDICATIVE OF THE DESIGN INTENT.

9 ALL SYSTEMS TO BE TESTED & WITNESSED AS [illegible] ACCORDANCE WITH THE SPECIFICATION PRIOR TO BEING COVERED.

10 THE CONTRACTOR IS TO ENSURE THAT [illegible] BEFORE HAND IN WRITING WITH THE HEAD OF WORKS [illegible]

11 THE CONTRACTOR SHALL NEATLY CUT THROUGH THE BUILDINGS STRUCTURAL SLAB TO INSTALL THE DRAINAGE AND SHALL BACKFILL WITH CONCRETE AFTER [illegible]

139969

RECORD DRAWING

CIVIL AND [illegible]
ENGINEERS

'A' WING.
UNDERGROUND FOUL WATER
DRAINAGE LAYOUT.

39/M/59774

PH/1948/1

Developer Services Waste - Provinces

Your ref
Our ref DE/JB/RM/1010766230
Name J.Boerio
Phone 0203 577 9018
Fax
E-Mail jim.boerio@thameswater.co.uk

RSK Group
16 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RW

1 March 2013

attn:- Kevin Ravenhill

Dear Sirs

Proposed Development at:- HM Prison, Latchmere House, Church Road, Richmond, Surrey TW10 5HH

Thank you for your predevelopment enquiry of 6th February 2013.

I understand you have a copy of the local sewer map showing the location size and depth of the sewers in the vicinity of your site.

The drainage system is separate.

There is adequate capacity in the sewer for your foul drainage proposals.

The sewers are already overloaded with surface water.
Your surface water should drain therefore to soakaways as you propose. The ground should be suitable but you must make your own tests. Failing this your surface water discharge should be restricted to a rate of 5 Litres per second. There should be no flooding of the surface in a 30 year storm.

Access roads and open car parks should drain via deep trapped gullies to the surface water system.

Underground car parks if involved should drain via petrol interceptor to the foul system.

Basements if involved depending on depth, may need pumping or protection against back surges in the public sewer.

Trade effluent discharges will require a license from Thames Water.

Thames Water Utilities Ltd
Clearwater Court
Vastern Road
Reading RG1 8DB
T 0845 850 2777
F
I www.thames-water.com

Your connection to the public sewer should be by manhole due to the number of properties involved.

In due course you will need to submit a formal application for sewer connections. I should be grateful if you would contact our help line on 0845 850 2777 or go to our web site www.thameswater.co.uk navigating to developers at the top then developer services and new sewer connections at the side to obtain an application form.

Yours faithfully

J. Boerio
Developer Services Engineer

APPENDIX E

NPPF Technical Guidance: Flood Zones and Land Use Vulnerability

Within the NPPF Technical Guidance, each flood zone has a list of appropriate land uses dependent on vulnerability to flooding. The flood zones are described in Table 1: Flood Zones reproduced below. (Note: These flood zones refer to the probability of river and sea flooding, ignoring the presence of defences).

NPPF Technical Guidance Table 1: Flood Zones

Zone 1 - Low Probability
Definition
This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%)
Appropriate uses
All uses of land are appropriate in this zone
FRA requirements
For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a FRA. This need only be brief unless the factors above or other local considerations require particular attention.
Policy aims
In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage techniques. Sustainable drainage systems cover the whole range of sustainable approaches to surface drainage management. They are designed to control surface water run off close to where it falls and mimic natural drainage as closely as possible.
Zone 2 - Medium Probability
Definition
This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%) or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year.
Appropriate uses
Essential infrastructure and the water-compatible, less vulnerable and more vulnerable uses, as set out in Table 2, are appropriate in this zone. The highly vulnerable uses are *only* appropriate in this zone if the Exception Test is passed.
FRA requirements
All development proposals in this zone should be accompanied by a FRA.
Policy aims
In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage systems.

Zone 3a - High Probability
Definition
This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
Appropriate uses
The water-compatible and less vulnerable uses of land (Table 2) are appropriate in this zone. The highly vulnerable uses should not be permitted in this zone. The more vulnerable and essential infrastructure uses should only be permitted in this zone if the Exception Test is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood.
FRA requirements
All development proposals in this zone should be accompanied by a FRA.
Policy aims
In this zone, developers and local authorities should seek opportunities to: • reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage systems; • relocate existing development to land in zones with a lower probability of flooding; and • create space for flooding to occur by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage.
Zone 3b High Probability
Definition
This zone comprises land where water *has* to flow or be stored in times of flood. Local Planning Authorities should identify in their SFRAs areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. But land which would flood with an annual probability of 1 in 20 (5%) or greater in any year, or is designed to flood in an extreme (0.1%) flood, should provide a starting point for consideration and discussions to identify the functional floodplain.
Appropriate uses
Only the water-compatible uses and the essential infrastructure listed in Table 2 that has to be there should be permitted in this zone. It should be designed and constructed to: • remain operational and safe for users in times of flood; • result in no net loss of floodplain storage; • not impede water flows; and • not increase flood risk elsewhere. Essential infrastructure in this zone should pass the Exception Test.
FRA requirements
All development proposals in this zone should be accompanied by a FRA.
Policy aims
In this zone, developers and local authorities should seek opportunities to: • reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage systems; and • relocate existing development to land with a lower probability of flooding.

The vulnerability classes are related to the sensitivity of the development to flooding and also consider the risk to people, property and services. The vulnerability classification Table 2 from NPPF Technical Guidance is reproduced below.

NPPF Technical Guidance Table 2: Flood Risk Vulnerability Classification

Vulnerability classes	Description
Essential Infrastructure	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk, • Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. • Wind turbines
Highly Vulnerable	• Police stations, Ambulance stations and Fire stations and Command Centres and telecommunications installations required being operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent.[1] (where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as "Essential Infrastructure"[2])
More Vulnerable	• Hospitals. • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels. • Non–residential uses for health services, nurseries and educational establishments. • Landfill and Sites used for waste management facilities for hazardous waste.[3] • Sites used for holiday or short-let caravans and camping, ***subject to a specific warning and evacuation plan***.

Less Vulnerable	• Police, ambulance and fire stations which are ***not*** required to be operational during flooding • Buildings used for: shops; financial, professional and other services; restaurants and cafes; hot food takeaways; offices; general industry; storage and distribution; non–residential institutions not included in 'more vulnerable'; and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment works which do ***not*** need to remain operational during times of flood • Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).
Water-compatible Development	• Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel workings. • Docks, marinas and wharves. • Navigation facilities. • MOD defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, ***subject to a specific warning and evacuation plan.***

APPENDIX F

IoH-124 Surface Water Runoff Calculations

ICP SUDS Mean Annual Flood

Input

Return Period (years)	2	Soil	0.300
Area (ha)	3.578	Urban	0.520
SAAR (mm)	607	Region Number	Region 6

Results l/s

QBAR Rural	5.5
QBAR Urban	14.5
Q2 years	14.2
Q1 year	12.4
Q30 years	27.2
Q100 years	32.8

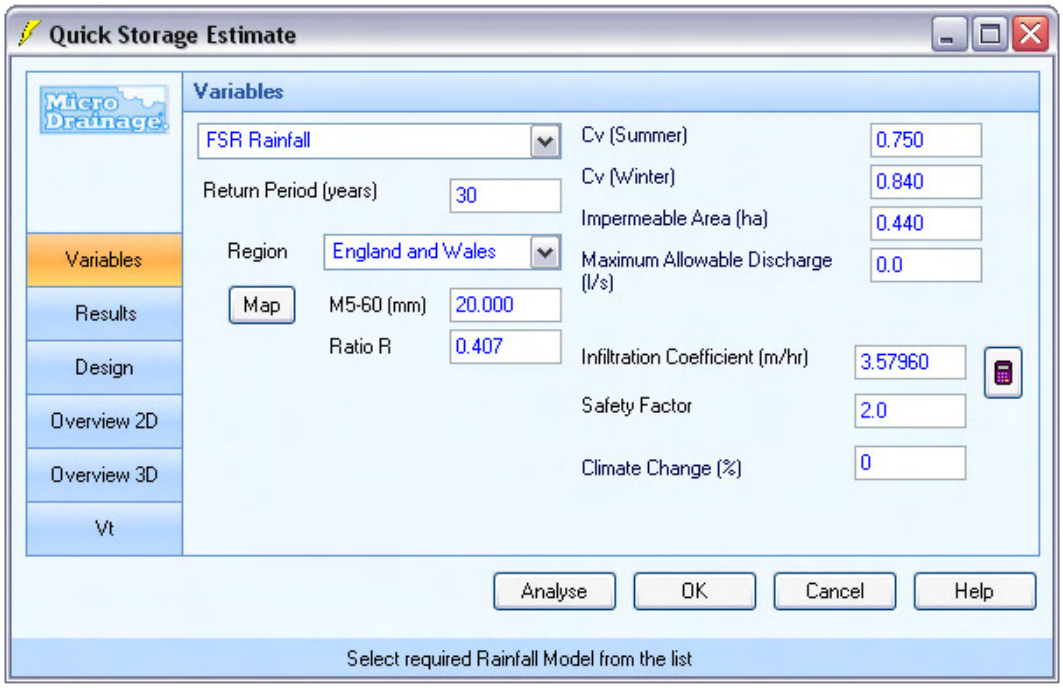
APPENDIX G

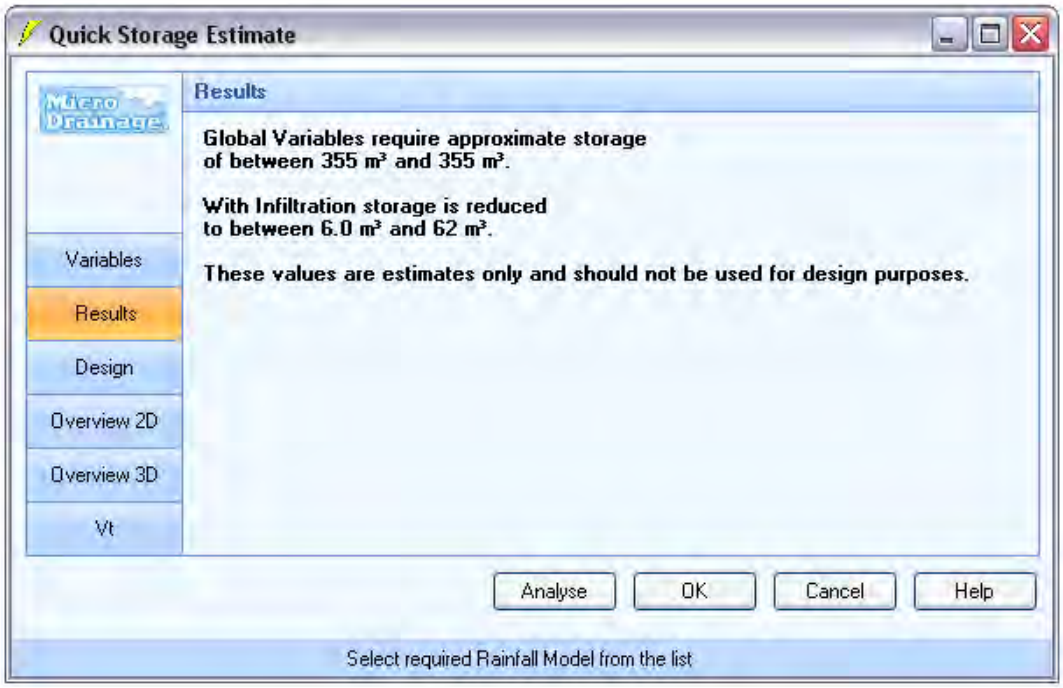
WinDes Quick Storage Calculations

Quick Store Estimates (P3)
- Latchmere

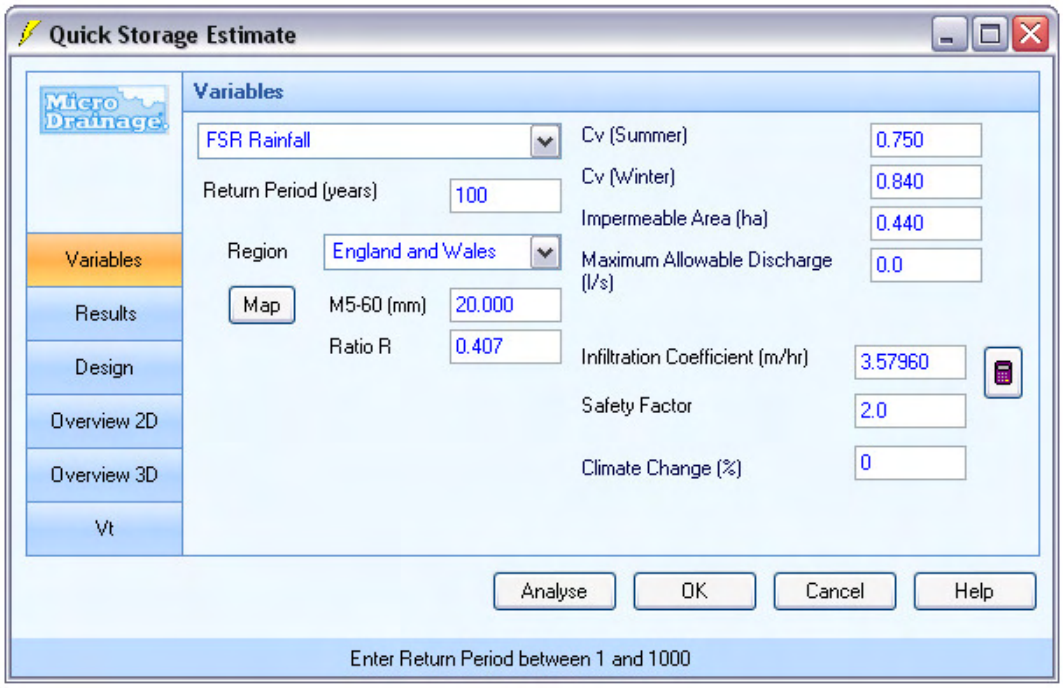
Northern Catchment

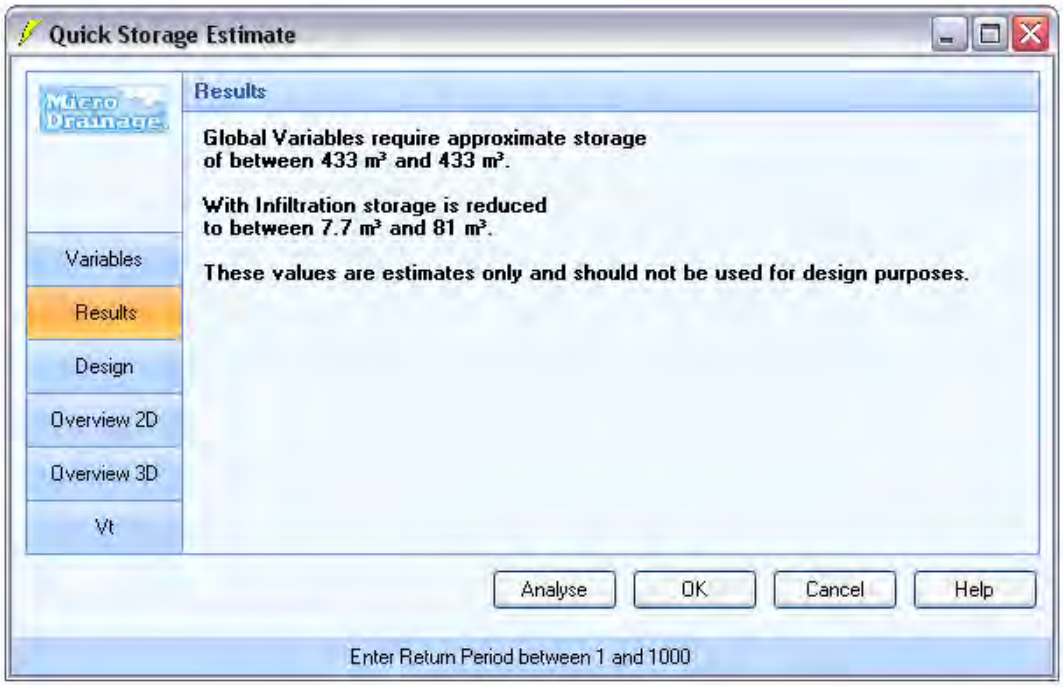
1 in 30 year



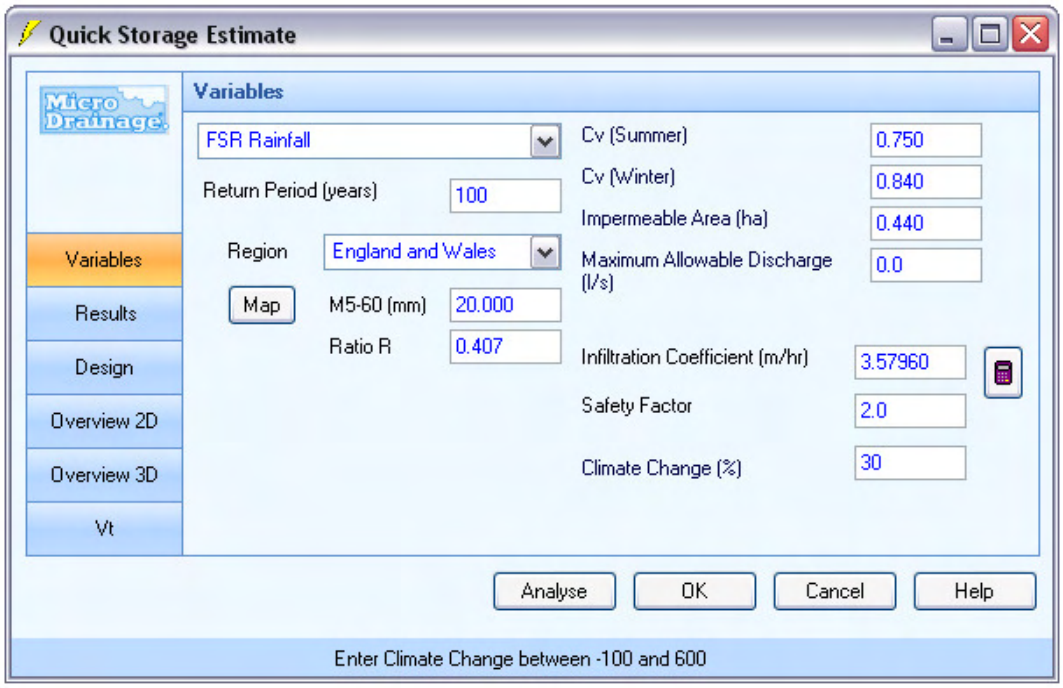


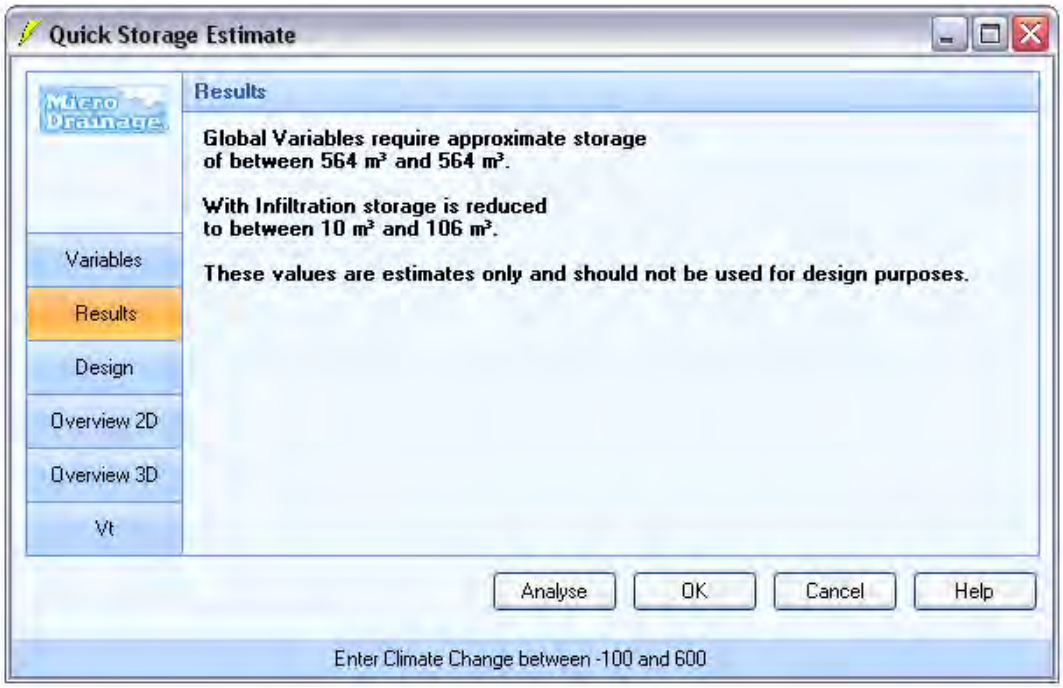
1 in 100 year


Quick Storage Estimate
Micro Drainage
Variables
Variables
Results
Design
Overview 2D
Overview 3D
Vt
FSR Rainfall
Return Period (years)
100
Region
England and Wales
Map
M5-60 (mm)
20.000
Ratio R
0.407
Cv (Summer)
0.750
Cv (Winter)
0.840
Impermeable Area (ha)
0.440
Maximum Allowable Discharge (l/s)
0.0
Infiltration Coefficient (m/hr)
3.57960
Safety Factor
2.0
Climate Change (%)
0
Analyse
OK
Cancel
Help
Enter Return Period between 1 and 1000


Quick Storage Estimate
Micro Drainage
Results
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Global Variables require approximate storage of between 433 m³ and 433 m³.
With Infiltration storage is reduced to between 7.7 m³ and 81 m³.
These values are estimates only and should not be used for design purposes.
Analyse
OK
Cancel
Help
Enter Return Period between 1 and 1000

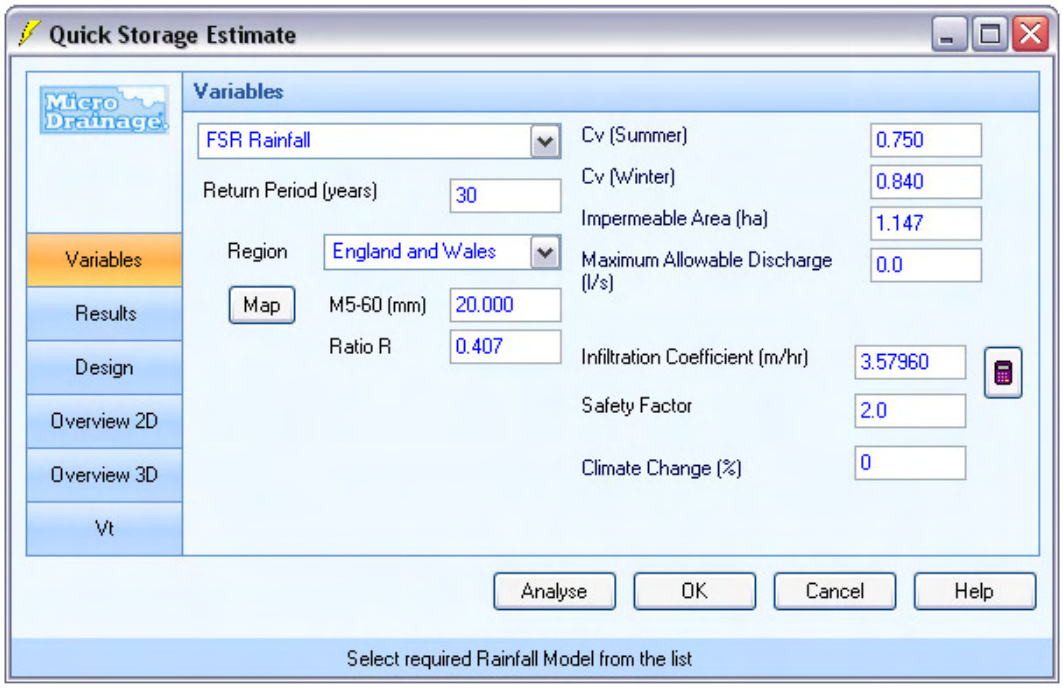
1 in 100 year plus 30% climate change

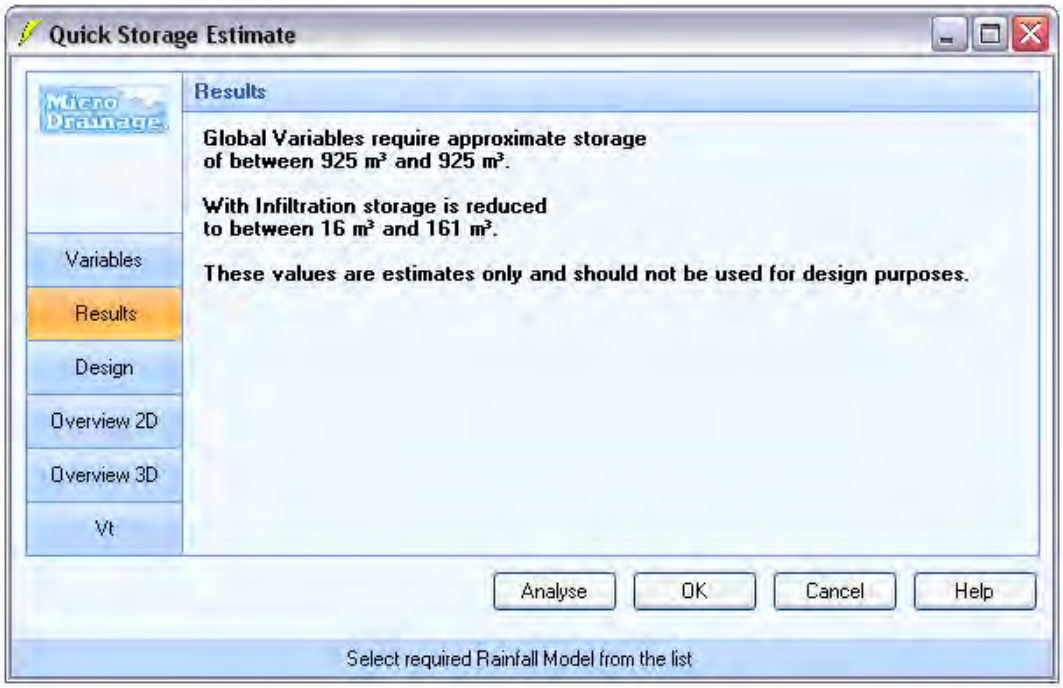




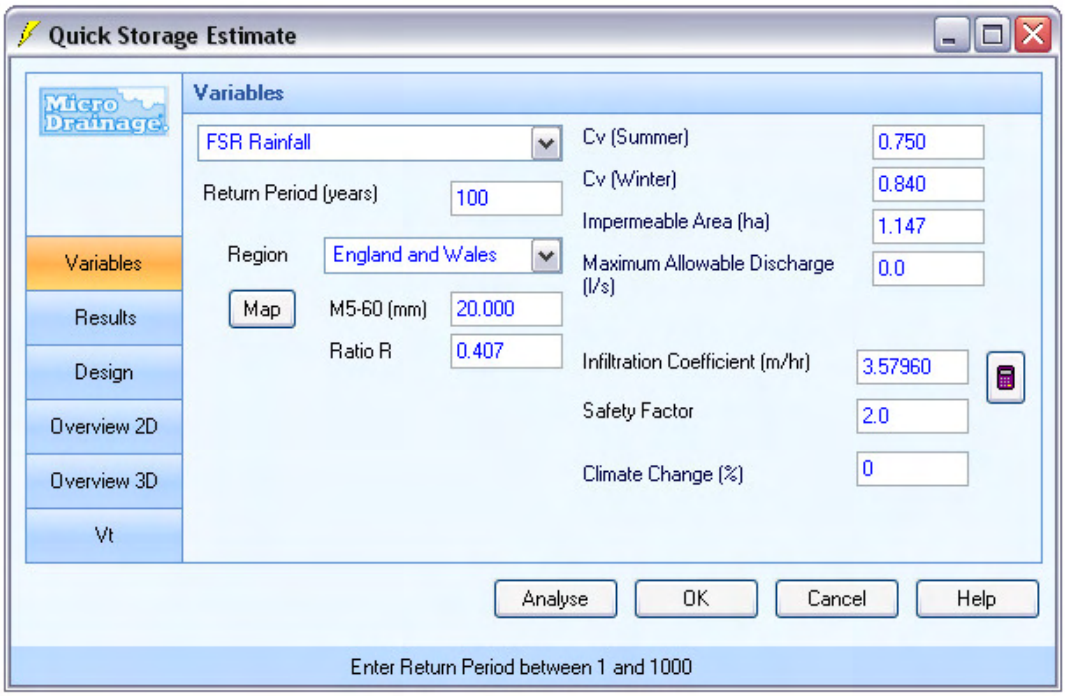
Southern Catchment

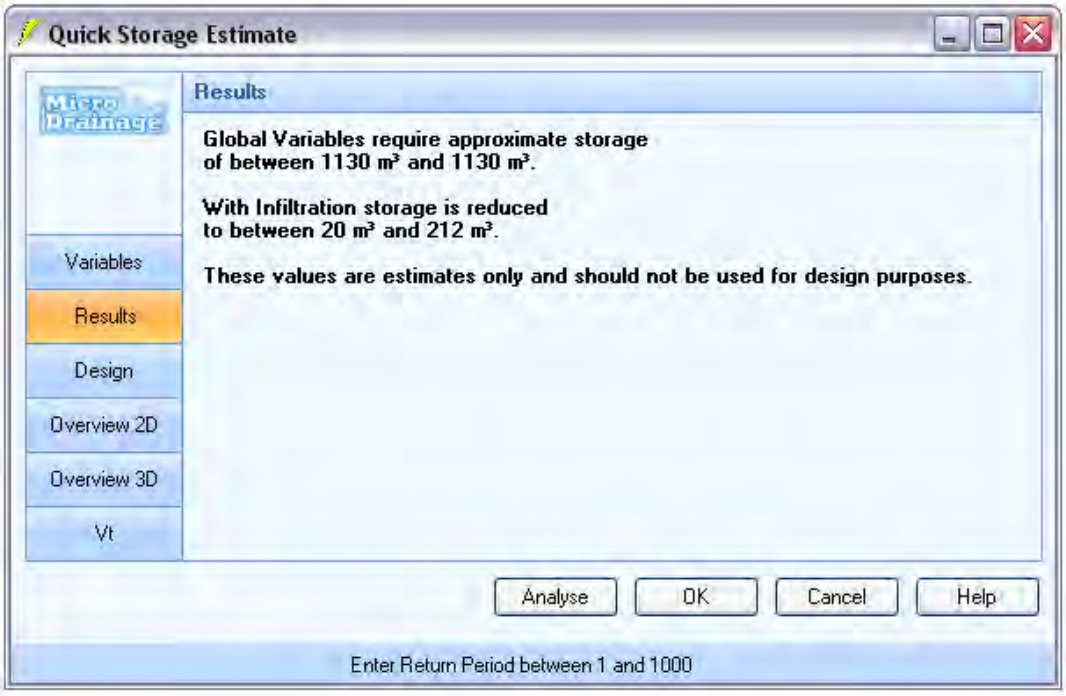
1 in 30 year





1 in 100 year


Quick Storage Estimate
Micro Drainage
Variables
FSR Rainfall
Return Period (years) 100
Region England and Wales
Map
M5-60 (mm) 20.000
Ratio R 0.407
Cv (Summer) 0.750
Cv (Winter) 0.840
Impermeable Area (ha) 1.147
Maximum Allowable Discharge (l/s) 0.0
Infiltration Coefficient (m/hr) 3.57960
Safety Factor 2.0
Climate Change (%) 0
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Analyse
OK
Cancel
Help
Enter Return Period between 1 and 1000


Quick Storage Estimate
Micro Drainage
Results
Global Variables require approximate storage of between 1130 m³ and 1130 m³.
With Infiltration storage is reduced to between 20 m³ and 212 m³.
These values are estimates only and should not be used for design purposes.
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Analyse
OK
Cancel
Help
Enter Return Period between 1 and 1000

1 in 100 year plus 30% climate change