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Richmond upon Thames College, Egerton Road, Twickenham TW2 7SJ

Flood Risk Assessment & Foul and Surface Water Drainage Strategy

MLM. Group

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1 Introduction

MLM Consulting Engineers Limited (MLM) has been appointed by Clarion Housing Association Ltd to undertake a Flood Risk Assessment (FRA) and Foul and Surface Water Drainage Strategy for the proposed development at Richmond upon Thames College, Egerton Road, Twickenham TW2 7SJ.

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This report has been completed in accordance with the National Planning Policy Framework (NPPF) and its accompanying Planning Practice Guidance (PPG). The report contains information on the proposed drainage strategy and an assessment of flood risk to the development, from on and off-site sources, and to off-site receptors caused by the development of the site.

The site is shown on the Environment Agency (EA) Flood map for planning (see Figure 1, and Appendix C) to lie in Flood Zone 1 (low risk). Flood Zone 1 is the area described as having a less than 0.1% annual probability (AEP) of river or sea flooding. All classes of land use are considered acceptable in this flood zone.

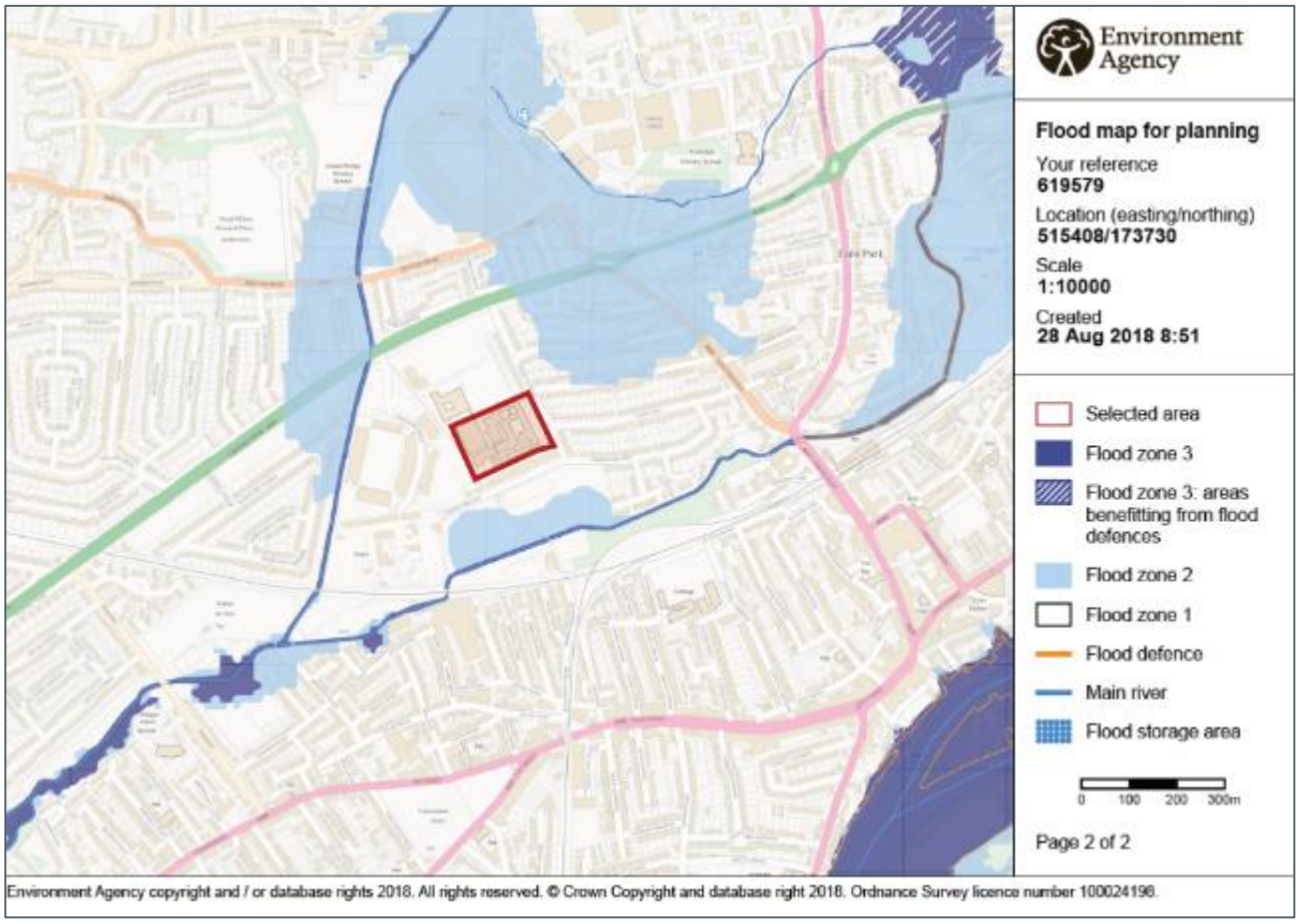

Figure 1 – EA Flood map for planning

The Sequential Test, the aim of which is to steer new development to the areas with the lowest probability of flooding is met and the Exception Test is not required as the site is located within Flood Zone 1.

This report includes a surface water drainage strategy for the site which sets out how the proposals will manage surface water without increasing off-site flood risk. The report also discusses the use of SuDS treatment techniques for the attenuation and removal of pollutants prior to discharge. The surface water drainage strategy has been prepared in accordance with the guidelines set out in the London Borough of Richmond upon Thames *Planning Guidance Document: Delivering SuDS in Richmond* (2015), CIRIA *753 The SuDS Manual* (C753) and the DEFRA *Non-statutory technical standards for sustainable drainage systems* dated March 2016.

This report concludes that in flood risk context, the design proposals are safe and appropriate for the site and its occupants and do not increase the risk of off-site flooding.

2 Site Description

2.1 Existing Site

The site covers an area of approximately 2 hectares. It currently comprises part of Richmond upon Thames College located to the East of Marsh Farm Lane, to the West of Egerton Road, and to the North of Craneford Way (site boundary shown in Figure 2). The site is centred on approximate Ordnance Survey (OS) grid reference 515400, 173756.

Figure 2 – Existing site location plan – Site boundary shown in red

The existing site comprises mixed commercial or education buildings and access roads associated with Richmond upon Thames College, which extend off site to the north. The area to the north of the site is also proposed for redevelopment but does not form part of the site boundary fort his report. The site is bound in the south by residential properties, and is located in an area of largely residential use. Current access to the site can be gained directly from Egerton Road to the east, from a path extending from Craneford Way in the south west, from Marsh Farm Lane to the west, and from the existing college which extends off site to the north.

2.1.1 Topography

A review of the topographical survey of the site (see Appendix A) reveals that the site is relatively flat, with a shallow fall from west to east. Ground levels on site generally range between 9.15 metres Above Ordnance Datum (mAOD) and 9.40 mAOD. Small localised areas including the southern corner and the central north of the site, reach topographical highs of around 9.53 mAOD. The lowest elevations at the site are on soft landscaped areas along the southern and eastern peripheries where ground levels reach lows ranging between 8.79 mAOD and 9.05 mAOD.

The surrounding area generally slopes from west to east as shown by the SFRA Topographical map shown in Figure 3 (see Appendix D).

Figure 3 – SFRA Topographical Levels Map, site location bound in red

2.1.2 Geology

British Geological Survey (BGS) mapping shows the site is underlain by London Clay Formation bedrock comprising Clay and Silt (Figure 4), and Kempton Park Gravel Member superficial deposits formed of sand and gravel (Figure 5).

Figure 4 – BGS Online Geology Map - Bedrock

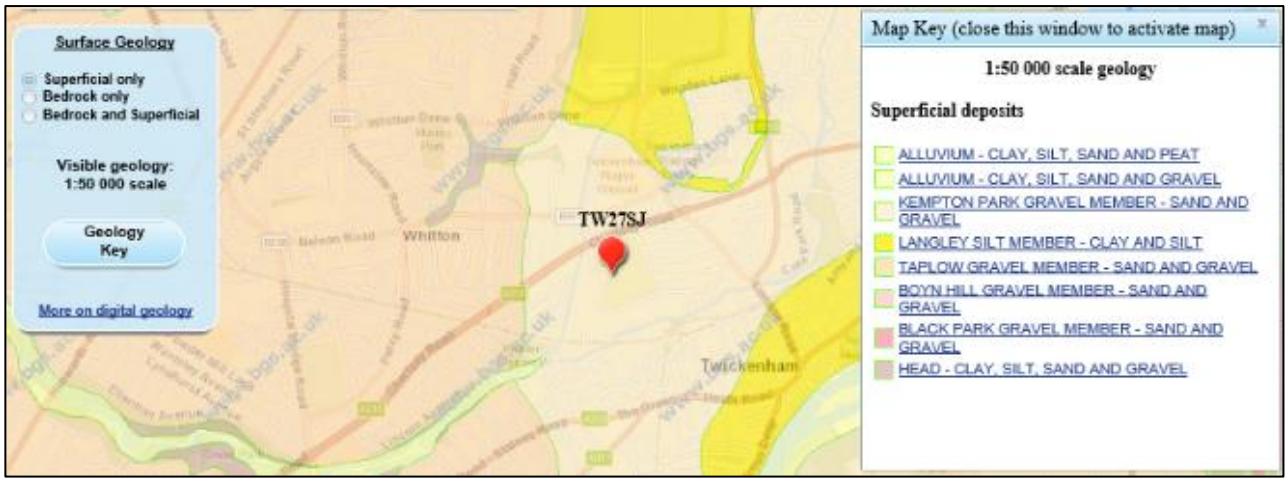

Figure 5 – BGS Online Geology Map – Superficial Deposits

2.1.3 Hydrology

There are three watercourses located within a 500m radius of the site. These include the Duke of Northumberland's River located approximately 200m west of the site, the River Crane located approximately 170m south of the site, and a tributary of the River Crane located approximately 480m north east of the site.

2.2 Proposed Site

It is proposed to demolish the existing buildings occupying the site, and redevelop the site for residential use, with access roads, car parking, and a communal landscaped area in the centre (see proposed plans in Appendix B). Proposed main access to the site is from the north westerly corner and south easterly corner. An extract of the ground floor proposed site plan is shown below in Figure 6.

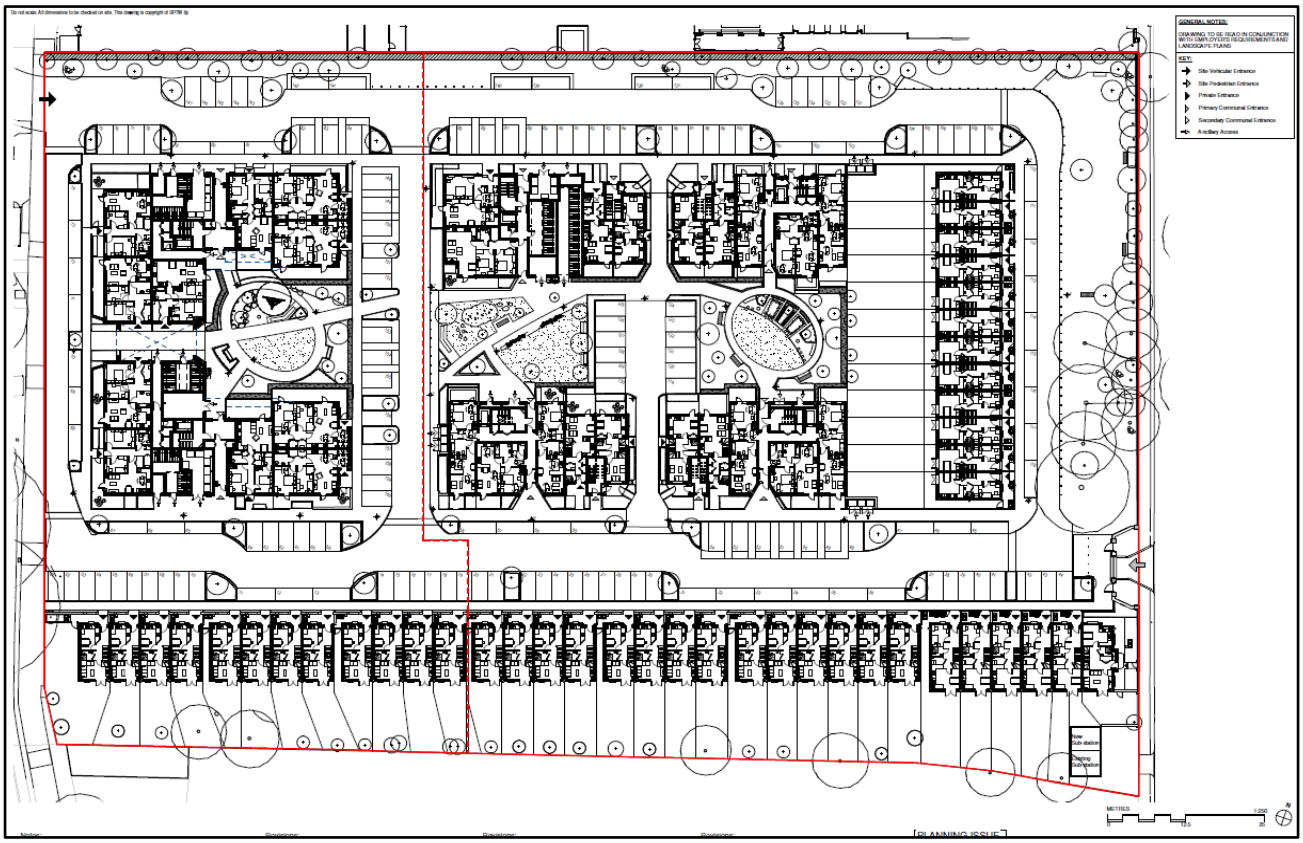
Figure 6 – BPTW Ground floor proposed site plan – 18-103 D600

The proposed residential site is classified as 'More Vulnerable' in accordance with *Table 2: Flood Risk Vulnerability Classification* of the PPG. As the site is located in Flood Zone 1 the development is shown to be appropriate in accordance with *Table 3: Flood risk vulnerability and flood zone 'compatibility'* of the PPG. The Sequential Test is met and no Exception Test is required because the site is located in Flood Zone 1.

3 Policy Context

3.1 National Planning Policy Framework (July 2018)

The National Planning Policy Framework (NPPF) was enacted on 27 March 2012 and updated on July 2018; Chapter 14 establishes the Planning Policy relating to flood risk management. The Technical Guide to the NPPF has been superseded by the Planning Practice Guidance (PPG) in March 2014, however, there are no changes to any policies relating to flood risk.

The main focus of the policy is to direct development towards areas of the lowest practicable flood risk to ensure that all development is safe, without increasing flood risk elsewhere. The main considerations are:

- Applying the Sequential Test, and if necessary, apply the Exception Test;
- Safeguarding from development land that is required for current and future flood management;
- Using opportunities offered by new development to reduce the causes and impacts of flooding; and
- Where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to facilitate the relocation of development, including housing, to more sustainable locations.

The NPPF states that a FRA is required "for proposals of 1 hectare or greater in Flood Zone 1; all proposals for new development (including minor development and change of use) in Flood Zones 2 and 3, or in an area within Flood Zone 1 where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding".

3.2 Flood and Water Management Act (2010)

The Flood and Water Management Act 2010 defines clearer roles and responsibilities for the implementation of sustainable drainage (SuDS) in developments, by requiring drainage systems to be approved against a set of draft national standards.

In December 2014 the government set out changes to planning that apply to major development from 6 April 2015. This change confirmed that in considering planning applications, the Local Planning Authority (LPA) should consult the relevant Lead Local Flood Authority (LLFA) on the management of surface water to satisfy themselves that the proposed minimum standards of operation are appropriate and ensure through the use of planning conditions or planning obligations that there are clear arrangements in place for ongoing maintenance over the lifetime of the development.

On 15 April 2015, the LLFA became a statutory consultee on surface water and SuDS proposals.

3.3 London Borough of Richmond upon Thames Strategic Flood Risk Assessment (2016)

The London Borough of Richmond upon Thames Strategic Flood Risk Assessment (SFRA):

- Collates known sources of flooding that may affect existing and/or future development within the Borough;
- Delineates areas that are considered functional floodplain and categorises other areas at risk of flooding in according with the National Planning Policy Framework;
  - Functional Floodplain: Land with >5% AEP
  - Flood Zone 3a (High): Land with >1% AEP from rivers, or >0.5% AEP from the sea
  - Flood Zone 2 (Medium): Land with 1% - 0.1% AEP from rivers, or 0.5% - 0.1% AEP from the sea
  - Flood Zone 1 (Low): Land with <0.1% AEP from rivers or seas.
- Recommends appropriate land uses within flood affected areas in order to avoid unduly placing people or property at risk of flooding, and;

- Recommends possible flood mitigation solutions that may be integrated into development designs to minimise the risk to property and life should a flood occur.

3.4 The London Borough of Richmond upon Thames Surface Water Management Plan (2011)

The London Borough of Richmond upon Thames Surface Water Management Plan (SWMP) outlines the preferred surface water management strategy for the Borough including consideration of sewers, drains, groundwater, and runoff from land, small watercourses, and ditches that occurs as a result of heavy rainfall. The SWMP identifies Local Flood Risk Zones (LFRZs) where flooding affects houses, businesses, or infrastructure. LFRZs at more significant risk are delineated into Critical Drainage Areas (CDAs) representing one or more LFRZs as well as the contributing catchment area and features that influence the predicted flood extent.

Seven CDAs have been identified in the London Borough of Richmond upon Thames. According to SWMP mapping the site is located within Critical Drainage Area Group8_001. Within CDA Group8_001 overall pluvial risks show linkages with the fluvial system, particularly the Beverly Brook and the River Crane. Local geology and limited capacity in combined sewers can contribute to the complex and interlinked mechanisms of flooding within CDAs.

4 Flood Risk

4.1 Tidal & Fluvial Flooding

Tidal flooding is typically the result of extreme tidal conditions caused by severe weather which may cause a storm surge where water is pushed onshore through elements such as high winds and other storms. Fluvial flooding occurs when excessive rainfall over an extended period of time or heavy snow melt causes a river to exceed its capacity.

The site is shown on the EA *Flood Map for Planning* (see Figure 1 above) to lie in the low probability flood zone (Flood Zone 1). In addition, an Environment Agency enquiry response dated 31/07/2018 (see Appendix C), confirms that the site is located within a Flood Zone 1.

The EA stated that because this site does not fall within an area at risk of flooding from rivers or the sea, they do not hold any detailed flood modelling data. In addition, the EA do not hold records of historic flood events from rivers and/or the sea affecting the area local to this site.

The site and immediately adjoining access roads are not at any significant risk of flooding from either a tidal or fluvial source.

4.2 Surface Water from Off-Site

Surface water is defined as rainwater (including snow and other precipitation) which is on the surface of the ground (whether or not it is moving), and has not entered a watercourse, drainage system, or public sewer. There is always a potential risk of surface water flooding from very high intensity rainfall events exceeding the capacity of drainage systems and causing flooding, especially in urban areas. Surface water run-off can be channelled either by natural features such as valley lines or by artificial features such as highways, towards low points in the topography. If surface water is not able to flow away from the low points then pluvial flooding can occur as a result of pooling surface water.

According to SWMP mapping the site is located within Critical Drainage Area Group8_001. However, the SWMP provides no specific evidence to suggest that the site would be affected by any of the specific factors expected to raise the risk of surface water flooding within certain parts of this CDA.

As a result of the topography of the surrounding area as discussed in Section 2.1.1, surface water could be shed towards the site from the west.

The GOV.UK *Flood risk from surface water – Extent of flooding* map (see Figure 7) shows that the majority of the site is at a very low risk of surface water flooding, with some small localised areas in the north at a low risk of surface water flooding. Areas at very low risk have less than a 0.1% annual probability of flooding. Areas at low risk have between a 0.1% and 1% annual probability of flooding. Flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast, and local features can also greatly affect the chance and severity of flooding. In addition, GOV.UK surface water mapping does not take account of any drainage features in the area.

Figure 7 – GOV.UK Flood Risk from Surface Water – Extent of Flooding Map

The GOV.UK maps show further detail in relation to the likelihood of surface water flooding at the site; these maps have been reviewed and the risk is summarised in Table 1.

Table 1 – Risk of surface water flooding on-site

Risk	Depth (mm)
Low	Below 300 to 300 – 900mm
Medium	N/A
High	N/A

The GOV.UK low risk: depth map (see Figure 8) shows that there is a low risk of surface water flooding of up to 300mm in the north of the site, including an area enclosed by buildings. Low risk means that this land may have between a 0.1% and 1% annual probability of flooding.

Figure 8 - GOV.UK Flood Risk from Surface Water – Low Risk: Depth Map

The GOV.UK Medium risk: depth map (see Figure 9) shows no surface water flood risk at the site.

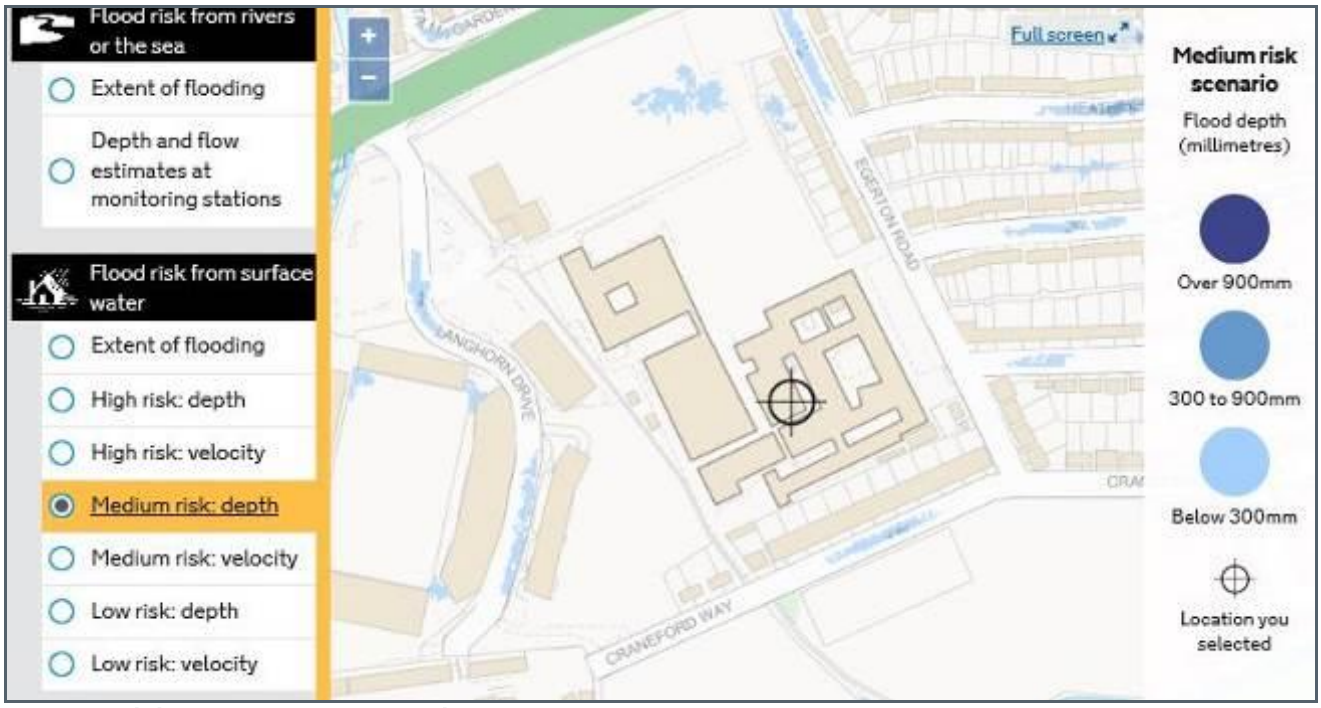

Figure 9 - GOV.UK Flood Risk from Surface Water - Medium Risk: Depth Map

Part of the area at risk appears to be located in an enclosed courtyard which is being demolished as part of the proposal. Since there will no longer be an enclosed courtyard, the associated surface water flood risks might also be removed. To mitigate against any residual surface water flood risks, where possible, finished floor levels of the buildings in the north east of the site within the area at low risk of surface water flooding should be raised above the surrounding ground levels with falls away from buildings. This advice applies equally to all proposed buildings on the site. This design measure should mitigate against any residual risk of localised ponding or overland surface water flow from entering the proposed buildings.

Assuming the above mitigation advice is implemented, the buildings proposed at the site will not be at any significant risk of flooding from surface water generated on site or off-site.

4.3 Surface Water from On-Site

The proposed development of the site will decrease the impermeable surfacing at the site. The decrease in impermeable area provides betterment on the existing situation by the reduction in volume of surface water run-off.

It is proposed that on-site surface water will be collected and intercepted by utilising permeable paving for the access roads and parking areas and traditional roof drainage, although the plans include for up to 80% of the roof areas for the flats to be green roofs. Surface water will then be directed to underground attenuation. Water will be discharged at the site at a controlled rate for the 1 in 100 year +40% climate change rainfall event. See Section 4 for further information on the surface water drainage strategy). There will be no uncontrolled off-site discharge in the design event.

Mitigation techniques such as careful design of levels should still be undertaken to ensure that any overland flows are directed around the proposed buildings, and by ensuring that any low ground levels adjacent to the buildings have a suitable overland flood flow route and do not rely entirely on piped drainage systems.

Assuming the advice given above is carried out in the design, the site is considered to be at a low risk of flooding from this source.

4.4 Infrastructure Flooding

Thames Water (TW) sewer records as shown in Figure 10 (see Appendix E for the full version) show that combined and surface water sewer mains are located along Egerton Road to the east of the site, and Craneford Way to the south of the site. In addition the topographical and utilities survey of the site (Appendix A) shows a site internal network of foul and surface water drainage servicing the existing buildings.

The SFRA historical sewer flooding map (Appendix D) shows that the site is located in a postcode area where 1-5 sewer floods have occurred. No further information was available on localities of incidents.

If surcharging or blockage of the sewers/drains did occur on or in proximity to the site, it is possible that there may be localised surface water flooding at or surrounding the site. However, the probability of sewer flooding occurring is typically low. As discussed above in Section 4.2, design of ground levels with falls away from buildings should mitigate the residual risk of sewer flooding at the site. Overall the site is considered to be at a low risk of flooding from infrastructure.

Figure 10 – Thames Water Sewer Records Extract

4.5 Water Bodies

There are no water bodies (lakes, large ponds, reservoirs etc.) within the immediate vicinity of the site that appear likely to pose a risk to the site.

The GOV.UK *Flood risk from reservoirs – Extent of flooding* map (see Figure 11) shows that the site is not at risk of flooding from reservoir failure.

Figure 11 - GOV.UK *Flood risk from reservoirs – Extent of flooding* map

The site is considered to be at low risk of flooding from water bodies.

4.6 Groundwater

Groundwater flooding can be defined as the emergence of groundwater at the ground surface away from perennial river valleys or the rising of groundwater into man-made ground under conditions where the 'normal' range of groundwater levels and groundwater flows is exceeded. Periods of abnormally high rainfall can result in groundwater flooding of basements and the emergence of groundwater at the ground surface, causing damage to property and infrastructure. Local knowledge of groundwater flooding is patchy and can be unreliable, and often groundwater flooding is not identified as a distinct event, being masked by surface water floods.

Groundwater flooding susceptibility mapping from BGS as contained within the SFRA shows where groundwater flooding could occur, but does not indicate the relative risk or likelihood that it will occur. Figure 12 below shows the site is located within an area where there is the potential for groundwater flooding to occur at the surface.

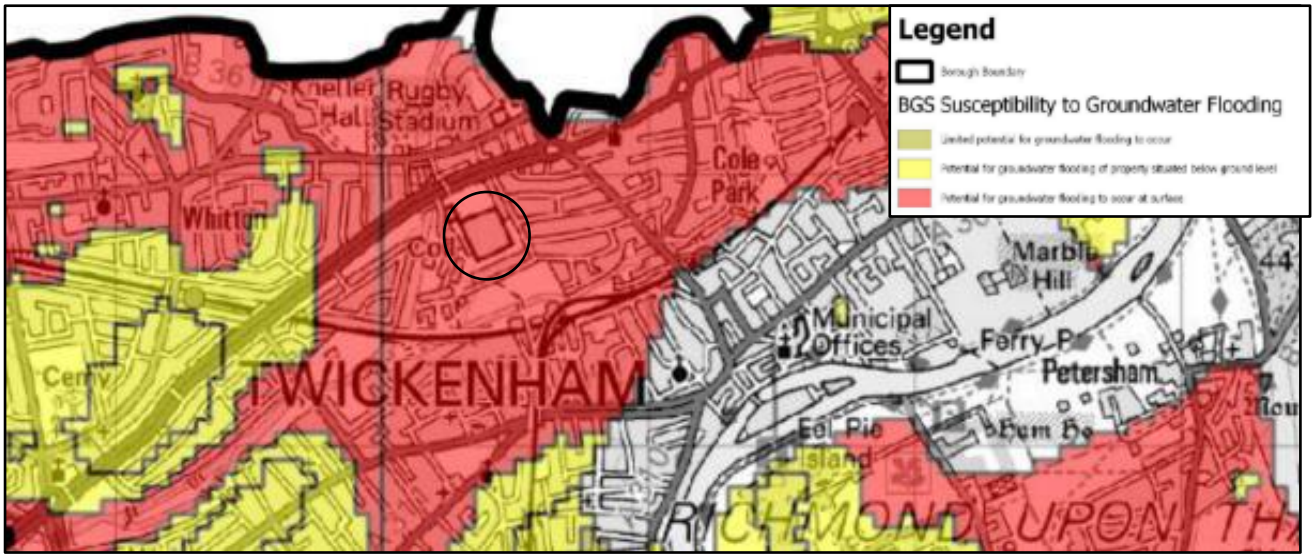

Figure 12 – BGS/SFRA Susceptibility to Groundwater Flooding Map

The MAGIC *Groundwater Vulnerability Map* provides an assessment of the vulnerability of groundwater in overlying superficial rocks, and those that comprise the underlying bedrock, to a pollutant discharged at ground level based on the hydrological, geological, hydrogeological and soil properties within a one kilometre square grid. The mapping provides some further indication as to whether the site is likely to be at risk of groundwater flooding. Figure 13 shows the site is underlain by a Major Aquifer High. These areas are able to easily transmit pollution to groundwater. They are characterised by high-leaching soils and the absence of low-permeability superficial deposits. These areas usually provide a high level of water storage and may support water supply and/or river base flow.

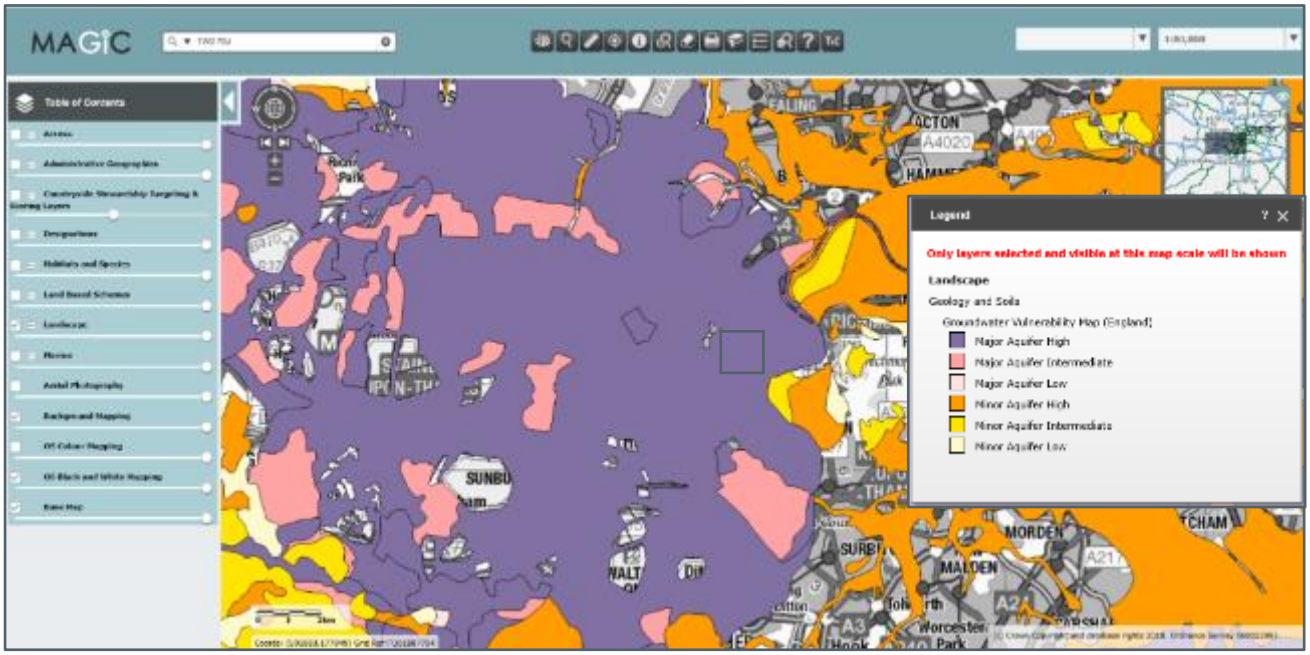

Figure 13 – MAGIC: Groundwater Vulnerability Map

In the event that groundwater were to express at the surface then certain design measures could reduce the risk of groundwater at the surface flooding buildings, which would reduce the severity of flooding to buildings and the risks posed to occupants from this source.

Levels at the site should be designed carefully to direct any overland flows away from and around buildings, entrances and access routes where possible. Design measures are likely to include falls away from buildings, and design ensuring that any low ground levels adjacent to the building have a suitable overland flood flow route and do not rely entirely on piped drainage systems.

4.7 Flood Risk Summary

The site has been assessed as not being at any significant risk of flooding from river and tidal sources, water bodies, and infrastructure. The site has been assessed as being at some minor potential risk of flooding from surface water and groundwater flooding.

To mitigate against the risk of surface water flooding and groundwater flooding, finished floor levels to the north east of the site should be raised above surrounding ground levels with falls away from openings such as doorways. To mitigate against the risk of groundwater flooding at the site, development of basements should generally be avoided.

The site should be designed with falls away from the buildings and entrances, and suitable overland flood flow routes around buildings.

5 Surface Water Drainage Strategy

5.1 Existing Surface Water Drainage

The existing site is brownfield land and covered in majority by hardstanding and buildings, with some of soft landscaping in the southern and eastern peripheries. Existing surface water run-off from the roof and hardstanding areas is collected via a series of rain water pipes and gullies and it appears to be directed to the Thames Water surface water sewer located on Egerton Road at an unrestricted rate as there is no evidence of flow balancing or control measures.

5.2 Proposed Surface Water Drainage

The proposed development is a Residential Phase of the redevelopment of Richmond upon Thames College. The site is split into two Phases. The development will lead to a decrease in impermeable area at the site, and as such will decrease the volume and rate of surface water run-off from the site.

The Sustainable Drainage Systems (SuDS) hierarchy requires that surface water run-off is preferably controlled and re-used wherever possible. In the event that it cannot be re-used it should be disposed of to a receptor in the order described in Building Regulations Part H and CIRIA 697 The SuDS Manual:

- via infiltration,
- to watercourse, and finally,
- to sewers.

The underlying ground conditions of clay are not likely to be suitable for the use of infiltration drainage. There are no watercourses in the immediate vicinity of the site to which surface water may be discharged. It is therefore proposed to ultimately discharge surface water from the site using a new connection to the Thames Water sewer located along Chertsey Road to the north of the site, via a proposed surface water network through phases located to the north of the site as outlined by the Atkins Drainage Strategy Note (Appendix F). Surface water will be attenuated on-site prior to a restricted off-site discharge which provides betterment on the existing regime.

Discharge of the surface water run-off should be restricted to greenfield rates and can discharge via gravity to the outfall. The assumed greenfield discharge rate has been calculated by Atkins and is provided in their Drainage Strategy Note (Appendix F). Relevant information is summarised below in Table 2. However the design discharge rate from this site to the site-wide system is 5l/s as specified in the Atkins strategy.

Table 2 - Greenfield run-off rates 1.97 ha

Return Period (Years)	Greenfield run-off (l/s)
1	2.7
QBAR	3.2
30	7.3
100	10.3

The surface water drainage strategy drawing is provided in Appendix F. Rainwater pipes and permeable paving convey the surface water run-off to underground geo-cellular attenuation crates located beneath car parking areas across the site. Open attenuation basins are not suitable due to lack of space. The attenuation has been sized to attenuate the flows from the site in the 1% AEP rainfall event inclusive of 40% climate change allowance (see MicroDrainage Calculations in Appendix F). The proposed discharge rate from the site has been restricted to 5 l/s in line with the strategy drawing for the wider masterplan area, see Atkins drawing 5137894-ATK-00-XX-SK-C-0010 in Appendix B.

Policy DM SD 7 'Sustainable Drainage of the London Borough of Richmond Upon Thames Local Development Framework Development Management Plan (adopted November 2011) states that for all development proposals any discharge should be reduced to greenfield run-off rates wherever feasible.

However as this site is part of the wider masterplan development the discharge rate for the entire site is to be limited to a rate of 10 l/s.

A Pre-Development enquiry outlining the above proposed discharge rate was submitted to Thames Water by Atkins, and details were approved in principle by Thames Water (see Thames Water Formal Response, Appendix E). As the proposed strategy provides betterment to the current situation it is thought that this will be acceptable.

The Planning Guidance Document *Delivering SuDS in Richmond (February 2015),* states that SuDS should provide an adequate level of treatment pollution. The level of treatment required depends on the pollution hazard indices for the sub-catchment, and that it must be demonstrated that the proposed system mitigation indices exceed the required pollution hazard indices ultimately in accordance with the SuDS Manual. The table below discusses types of SuDS (based upon C753) and whether they could be utilised at this site.

Table 3 - SuDS site suitability

SuDS Component	Suitability	Description
Green roofs	✓	Proposed for 70-80% of flat roofs.
Soakaways	×	Unlikely to be suitable due to the underlying geological conditions and potential high water table.
Rainwater harvesting systems	✓	Could be utilised for WC flushing etc. to reduce the use of potable water for the development, subject to financial viability.
Filter strips	✓	Potentially suitable land located along the northern and eastern peripheries of the development.
Filter trenches	✓	Potentially suitable land located around roads and pavement serving the development.
Infiltration trenches	✓	Potentially suitable land located around roads and pavement serving the development.
Swales	✓	Potentially suitable land located along the northern and eastern peripheries of the development, if space permits.
Bio retention	✓	Could be used to provide water for soft landscaped areas, although space is limited.
Pervious pavements	✓	Proposed for collection and attenuation/conveyance of surface water from private hard paved areas, subject to detailed design.
Geocellular systems	✓	Proposed to provide attenuation for surface water from roofs and car parking areas.
Infiltration basins	×	Unlikely to be suitable due to the underlying geological conditions, and size and type of development, insufficient space.
Attenuation basins	×	Not suitable due to size and type of development, insufficient space.
Ponds	×	Not suitable due to size and type of development, insufficient space.
Stormwater wetlands	×	Not suitable due to size and type of development, insufficient space.

Proprietary Devices	✓	Proposed to provide treatment.
Rain gardens	✓	Could be utilised to prevent run-off from small events from certain small elements of the development leaving the site.

At this stage the design of the site has not been finalised and the precise types of SuDS features is not fixed; this will be undertaken at detailed design stage. It is therefore not feasible to demonstrate treatment in line with Chapter 26 of C753, however, it is possible to provide an example of how it may work.

The site is proposed for residential use; the appropriate pollution hazard indeces for the land uses from Table 26.2 of C753 are shown in Figure 14 below:

TABLE 26.2 Pollution hazard indices for different land use classifications

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways[1]	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1]	High	0.8[2]	0.8[2]	0.9[2]

Figure 14 – Table 26.2 of C753

The maximum pollution hazard indices are therefore 0.5 for TSS, 0.4 for Metals and 0.4 for Hydrocarbons. Mitigation should be achieved through a minimum of two treatment stages and be based on the SuDS Mitigation Indices given in Table 26.3 of C753 (see Figure 15).

TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters

Type of SuDS component	Mitigation indices[1] TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4[2]	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond[4]	0.7[2]	0.7	0.5
Wetland	0.8[3]	0.8	0.8
Proprietary treatment systems[5,6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Figure 15 – Table 26.3 of C753

If permeable paving, and a proprietery device are utilised with the outfall discharging to the Thames Water surface water drainage network, the mitigation for each of the pollutants would be:

Table 4 – Pollutant mitigation

Pollutant / Mitigation	TSS	Metals	Hydrocarbons
1 Permeable paving	0.7	0.6	0.7
2 Proprietery Device#	0.25	0.20	0.4
Total	**0.95**	**0.80**	**1.1**

2nd stage of treatment indices values halved as CIRIA guidance.

The proposed mitigation therefore provides a greater level of treatment than required from the sources identified in Figure 13 (Table 26.2 of C753).

The final choice of SuDS treatment train elements will be decided at detailed design, however, the surface water drainage strategy drawing in Appendix F shows the use of permeable paving, and a proprietary device to achieve the minimum level of treatment for surface water run-off.

To ensure that the SuDS features remain optimised and fully functional during the lifetime of the development, thus preventing an increase in the flood risk both within the site and elsewhere, maintenance of the system is crucial across the short, medium and long term timescales. It is proposed that the below ground SuDS features are to be maintained by the site owner(s) / occupiers as part of the on-going maintenance regime of the site.

6 Foul Water Drainage Strategy

6.1 Existing foul water drainage

A review of the topographical/utilities survey and Thames Water asset maps suggests that foul from the site currently drains to the Thames Water foul manhole (MH 5701B) on Egerton Road east of the site.

6.2 Proposed foul water drainage

Separate foul networks have been designed for Phase 1 and Phase 2 of the development. The foul network for Phase 1 drains via gravity, and re-uses the existing foul connection point in the south east of the site (as shown on the drawing in Appendix F). The foul network for Phase 2 drains via gravity to a pumping station located to the north west of Phase 2 (see Appendix F for pumping station location drawing) which Atkins drawing states is to be adopted by Thames Water.

See Appendix F for Foul Strategy drawing.

7 Conclusions

MLM Consulting Engineers has been appointed by Barton Willmore to undertake a Flood Risk Assessment (FRA) report to support the proposed residential redevelopment of the land at Richmond upon Thames College, Egerton Road, Twickenham TW2 7SJ.

According to the Environment Agency the site is shown to lie in the low probability flood risk area from rivers and seas (Flood Zone 1), and no historical flood events have been recorded from these sources as affecting the site or immediately surrounding area.

The site has been assessed as not being at any significant risk of flooding from river and tidal sources, water bodies, and infrastructure. The site has been assessed as being at some risk of flooding from surface water and groundwater flooding.

To mitigate against any possible residual risks of surface water flooding in the north east of the site in the post development scenario, where possible, finished floor levels should be raised above surrounding ground levels. To mitigate against the risk of groundwater flooding at the site, development of basements should generally be avoided, however if basements are proposed then further assessment should be undertaken and special design measures such as tanking should be implemented in their design. The site should be designed with falls away from the buildings and entrances, and suitable overland flood flow routes around buildings.

The underlying ground conditions of clay are not likely to be suitable for the use of infiltration drainage; there is also not enough space on-site to accommodate the use of soakaways due to the minimum 5 m off-set required from buildings. There are no watercourses in the immediate vicinity of the site to discharge surface water to. It is therefore proposed to ultimately discharge surface water to the Thames Water sewer located along Chertsey Road to the north of the site, through a proposed surface water network north of the site which has been designed by others. Surface water will be intercepted and collected on site via permeable paving and rainwater pipes and attenuated on-site using attenuation crates and oversized pipes prior to a restricted off-site discharge which provides betterment on the existing situation.

The surface water drainage for the site is proposed to discharge at a maximum of 5l/s for the 1 in 100 year +40% climate change rainfall event, to the proposed surface water network which serves the development to the north. Micro drainage calculations have been undertaken to determine the attenuation volume for the 1% AEP rainfall event inclusive of 40% climate change.

Opportunities should be investigated to incorporate SuDS into the development where practicable.

Careful thought should be given to level design on the site in accordance with normal good practice to ensure that there is no likely flooding caused by overland flow and that any overland flow is directed around buildings in the event of a failure of the piped drainage system.

The site is located in Flood Zone 1 and is suitable for development. The surface water can be collected and attenuated on-site and discharged to the existing sewer at no increased off-site flood risk.

Appendix A - Existing Site

Site Location Plan

3 Sixty Measurement drawing 07404-01 – Site Plan