1 – 9 SANDYCOMBE ROAD
NORTH SHEEN, RICHMOND TW9 2EP

FLOOD RISK ASSESSMENT

FOR

GOLDCREST LAND PLC

November 2016

Our Ref: HLEF47380/002R

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This report has been prepared in the RPS Group Quality Management System to British Standard EN ISO 9001:2008

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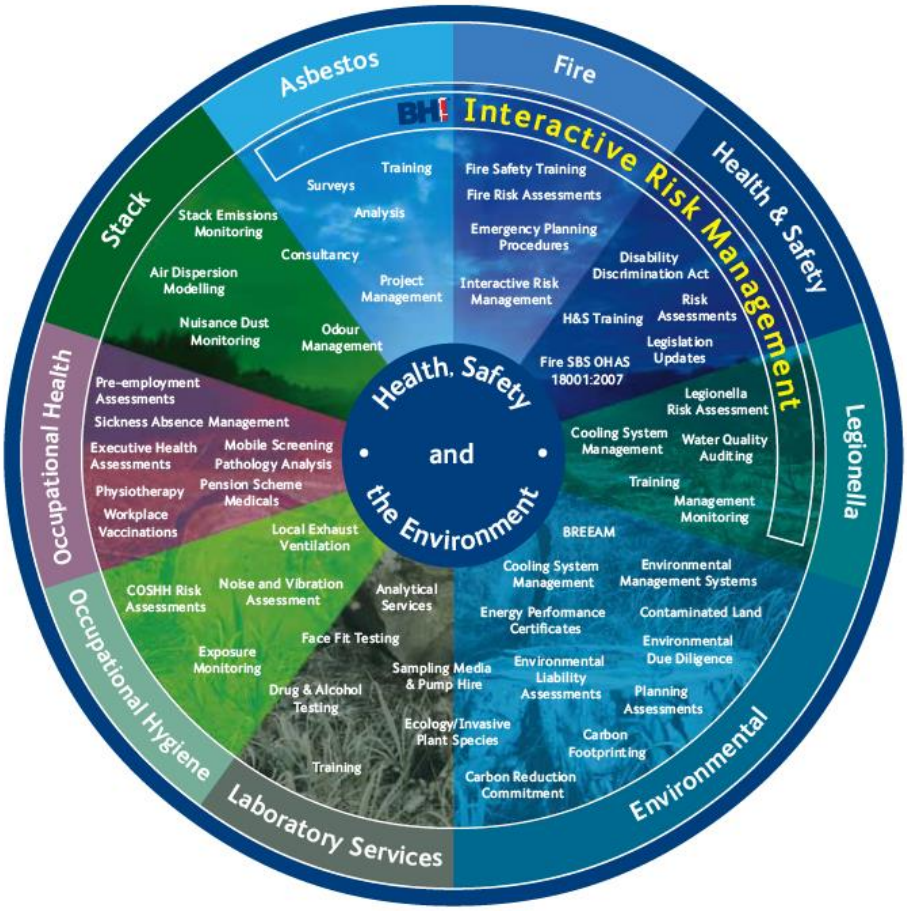

RPS HEALTH, SAFETY & ENVIRONMENT

General Notes

1. The following notes should be read in conjunction with the report:

2. This report contains only that available factual data for the site, which was obtained from the sources, described in the text. These data were related to the site on the basis of the location information made available to RPS by the client.

3. The assessment of the site is based on information supplied by the client. Relevant information was also obtained from other sources.

4. The report reflects both the information provided to RPS in documents made available for review and the results of observations and consultations by RPS staff.

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1 INTRODUCTION

1.1 RPS was commissioned to undertake a Flood Risk Assessment (FRA) of *1 – 9 Sandycombe Road, North Sheen, Richmond, TW9 2EP* in relation to the proposed redevelopment of the site to provide B1 commercial use and residential flats.

1.2 The aim of the FRA is to outline the potential for the site to be impacted by flooding, the impacts of the proposed development on flooding in the vicinity of the site, and the proposed measures which could be incorporated into the development to mitigate the identified risk. The report has been produced in accordance with the guidance detailed in the National Planning Policy Framework (NPPF) and the associated Planning Practice Guidance (PPG). Reference has also been made to the CIRIA SUDS manual (C753), the London Borough of Richmond upon Thames (LBRuT) Strategic Flood Risk Assessment (SFRA) and the LBRuT Surface Water Management Plan (SWMP).

1.3 The site is not located within an Internal Drainage Board (IDB) District.

1.4 This report is not intended to provide formal details of the final drainage design for the development. However, it provides information regarding the capabilities of the conceptual surface water drainage strategy to meet the requirements of the NPPF.

1.5 The desk study was undertaken by reference to information provided / published by the following bodies:

- EA
- British Geological Survey (BGS)
- Ordnance Survey (OS)
- Thames Water (TW)

2 PLANNING POLICY CONTEXT

National Planning Policy

2.1 The PPG released in March 2014, advises of the requirements for a site specific Flood Risk Assessment (FRA) for any of the following cases:

- All proposals (including minor development and change of use) located within the EA designated floodplain, recognised as either Flood Zone 2 (medium probability) or Flood Zone 3 (high probability);
- All proposals greater than 1ha in an area located in Flood Zone 1 (low probability);
- All proposals within an area which has critical drainage problems (as notified to the Local Planning Authority by the EA); and
- Where proposed development may be subject to other sources of flooding.

2.2 In a written statement to Parliament on 18th December 2014, the Secretary of State for Communities and Local Government strengthened existing planning policy on sustainable drainage, making it clear that sustainable drainage systems should be provided in new developments, unless demonstrated to be inappropriate. The statement requires that:

'in considering planning applications, local planning authorities should consult the relevant lead local flood authority on the management of surface water; 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. The sustainable drainage system should be designed to ensure that the maintenance and operation requirements are economically proportionate'.

2.3 These changes will took effect from 6 April 2015. This policy applies to all developments of 10 homes or more and to major commercial development.

2.4 Defra published their 'Non-statutory technical standards for sustainable drainage systems', in support of the above policy changes, in March 2015.

2.5 The EA published guidance on 'Flood Risk Assessments: climate change allowances' in February 2016, detailing the new climate change allowances to be considered with respect to fluvial watercourses and rainfall intensity

Regional Planning Policy

2.6 The development site is within the LBRuT which is covered by The London Plan, as amended March 2015. The London Plan contains various policies pertaining to flood risk and drainage, the relevant aspects of which are reproduced below.

Policy 5.11 Green roofs and development site environs

2.7 This policy promotes the use of green roofs and walls where feasible, to deliver objectives including sustainable urban drainage amongst other wider environmental and sustainability benefits.

Policy 5.12 Flood risk management

2.8 This Policy states that '*the Mayor will work with all relevant agencies including the Environment Agency to address current and future flood issues and minimise risks in a sustainable and cost effective way'.*

2.9 *'Development proposals must comply with the flood risk assessment and management requirements set out in the NPPF over the lifetime of the development and have regard to measures proposed in Thames Estuary 2100 and Catchment Flood Management Plans.'*

2.10 The Policy sets out requirements for developments for which the NPPF Exception Test is applicable and developments adjacent to flood defences.

Policy 5.13 Sustainable drainage

2.11 This policy states '*development should utilise sustainable urban drainage systems (SUDS) unless there are practical reasons for not doing so, and should aim to 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:*

- *store rainwater for later 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; and*
- *discharge rainwater to the combined sewer.*

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

2.12 The London Plan is supported by the Supplementary Planning Guidance: Sustainable Design and Construction, April 2014. In relation to Surface Water Flooding and Sustainable Drainage, the guidance states that developers should design Sustainable Drainage Systems (SuDS) that incorporate attenuation for surface water runoff. The minimum expectation is to achieve 50% attenuation of the undeveloped site's surface water run off at peak times. The Mayor's priority is to achieve greenfield runoff rates. Development on greenfield sites must maintain a greenfield runoff rate. Development on previously developed sites should have a runoff rate no greater than three times the calculated greenfield runoff rate.

Local Planning Policy

2.13 The LBRuT Core Strategy contains the following Policies relating to flood risk and drainage:

2.14 CP3 Climate Change - Adapting to the Effects

'3.A Development will need to be designed to take account of the impacts of climate change over its lifetime, including:

- *Water conservation and drainage*
- *The need for Summer cooling*
- *Risk of subsidence*
- *Flood risk from the River Thames and its tributaries*

3.B Development in areas of high flood risk will be restricted, in accordance with PPS25, and using the Environment Agency's Catchment Flood Management Plan, Borough's Strategic Flood Risk Assessment and site level assessments to determine risk.'

2.15 The LBRuT Development Management Plan contains the following Policies relating to flood risk and drainage:

2.16 Policy DM SD 6 - Flood Risk

'Development will be guided to areas of lower risk by applying the Sequential Test as set out in paragraph 3.1.35. Unacceptable developments and land uses will be restricted in line with PPS25 and as outlined below. Developments and Flood Risk Assessments must consider all sources of flooding and the likely impacts of climate change.

Where a Flood Risk Assessment is required and in addition to the Environment Agency's normal floodplain compensation requirement, attenuation areas to alleviate fluvial and/or surface water flooding must be considered where there is an opportunity. The onus is on the

applicant/developer for proposals on sites of 10 dwellings or 1000sqm of non-residential development or more to provide evidence and justification if attenuation areas cannot be used.

In areas at risk of flooding, all proposals on sites of 10 dwellings or 1000sqm of non-residential development or more are required to submit a Flood Warning and Evacuation Plan.

2.17 The policy also states that for sites in Flood Zone 1 there are '*no land use restrictions'*, that the Sequential and Exception Tests are '*not applicable*' and that a Flood Risk Assessment is '*required for sites greater than 1 ha'* and *'required for all other development proposals where there is evidence of a risk from other sources of flooding, including surface water, ground water and sewer flooding.'*

2.18 *Policy DM SD 7 – Sustainable Drainage*

All development proposals are required to follow the drainage hierarchy when disposing of surface water and must utilise Sustainable Drainage Systems (SuDS) wherever practical. Any discharge should be reduced to greenfield run-off rates wherever feasible.

When discharging surface water to a public sewer, developers will be required to provide evidence that capacity exists in the public sewerage network to serve their development.

2.19 LBRuT has also published a guidance document for the incorporation of SuDS at the site entitled 'Delivering SuDS in Richmond'. This FRA report has been undertaken with due consideration of the guidance detailed within.

2.20 The LBRuT Strategic Flood Risk Assessment (SFRA) identifies and maps flood risk from all sources at a borough-wide scale as well as providing guidance on producing site specific FRAs. Relevant information from the SFRA has been referenced throughout this report. The following information was included with respect to developments in Flood Zone 1:

- *'there are no restrictions placed on land use within Zone 1 Low Probability'*
- *'local drainage issues should not affect decision making with respect to the allocation (or otherwise) of sites within LBRuT and it is considered unreasonable to restrict future development within areas that may have suffered a localised flooding incident in years past.'*
- '*Implement SuDS to ensure that runoff from the site (post redevelopment), as a minimum, is not increased. A reduction in site runoff should be sought, aiming to achieve greenfield run-off rates, or reduce run-off rates by at least 50% over current levels.'*

2.21 The LBRuT Surface Water Management Plan (SWMP) assesses the risk of surface water flooding within Richmond and identifies options to manage risk to acceptable level. Relevant information from the SWMP has been reproduced throughout this report.

3 CONSULTATION

3.1 The site is not located within an IDB District.

3.2 The public sewer network within the vicinity of the site is operated by TW. A pre-development enquiry has been made to TW who confirmed that discharge to the mains surface water sewer is acceptable provided that discharge via soakaways or to a watercourse is not feasible. In this instance a 50% reduction in discharge rates should be achieved. The closest surface water sewer was identified to be beneath Sandycombe Road to the northwest of the site. The pre-development enquiry is included as Appendix A. The conceptual surface water attenuation scheme presented in the FRA (see section 10) is intended to demonstrate that a feasible surface water attenuation solution can be achieved on the site to meet the requirements of the NPPF. The detailed drainage design for the proposed development will be finalised in consultation with Thames Water at detailed design stage.

4 SITE DESCRIPTION

Site Description

4.1 The site is located at National Grid Reference TQ 19021 75793. It is roughly triangular in shape, occupying an area of approximately 0.15 hectares. A site location plan is provided in Figure 1.

4.2 The site is currently occupied by five commercial units and associated external areas. A soakaway is present in the north of the site.

4.3 Access to the site is from Sandycombe Road to the west.

4.4 The site is currently occupied 20% by building footprint, 64% by hardstanding and 16% by soft landscaping.

Surrounding Land Uses

4.5 There are no designated sensitive areas (e.g. Special Area of Conservation (SAC), Special Protection Area (SPA) or Site of Special Scientific Interest (SSSI)) within close proximity to the site.

Topography

4.6 A Topographic Survey of the site was undertaken by Midland Surveys (May 2015, ref. 22511). Site levels are indicated to generally be between 6.90m and 7.00m AOD. The topographic survey is located in Appendix B.

4.7 Sandycombe Road slopes down towards the north. It is noted that Sandycombe Road is generally at a higher elevation (9.95m AOD adjacent to the south of the site) than the subject site, which has been levelled to its lowest point. The London Overground line adjacent to the east of the site is at lower elevation c. 5.50m AOD.

5 PROPOSED DEVELOPMENT

5.1 It is proposed to redevelop the site to provide commercial space at ground and partial first floor levels, with residential flats arranged over first through fourth floors. Development plans are shown in Appendix C. A total of 20 residential units will be provided between two core areas. A biodiverse roof is proposed for the building.

5.2 Vehicular and pedestrian access to the site will continue to be from Sandycombe Road to the west.

5.3 Access to the residential properties would be from two entrance points at ground floor level.

5.4 Following redevelopment the site would be occupied approximately 40% by building footprint, 42% by hardstanding and 18% by soft landscaping.

5.5 The proposed commercial use of the site is classified as 'less vulnerable' within the PPG and the residential use is classified as 'more vulnerable'.

5.6 It is anticipated that surface water runoff will pass to the existing surface water sewer. The acceptable discharge rate to the existing mains sewer will need to be agreed with Thames Water in consultation with the Lead Local Flood Authority. Thames Water has advised that a 50% reduction in runoff rates from the site would be required, in order to discharge to the sewer beneath Sandycombe Road to the northwest of the site.

5.7 The potential to provide surface water attenuation, including the use of Sustainable Drainage Systems (SuDS), has been considered as part of the preliminary design process (see Section 10 – Surface Water Management).

6 HYDROLOGICAL SETTING

Nearby Watercourses

6.1 Reference to Ordnance Survey Mapping indicates that the nearest surface water feature is a paddling pool 290m northeast of the site associated with North Sheen Recreation Ground. The River Thames is located approximately 1.25km northeast of the site. It flows in an easterly direction and is tidally influenced.

6.2 No artificial watercourses or significant artificial features (e.g. canals, reservoirs) have been identified within 1km of the site.

6.3 The Environment Agency flood map (available online) indicates that the site is located within Flood Zone 1, whereby the annual probability of flooding from fluvial / tidal sources is classified as less than 1 in 1000. The Environment Agency Flood Map is provided in Figure 2.

Flood Risk Classification

6.4 The EA flood map (available online) indicates that the site is located within Flood Zone 1, whereby the annual probability of flooding from fluvial or tidal sources is classified as less than 1 in 1000. The nearest area of floodplain to the site is 325m to the southeast. The EA Flood Map is provided in Figure 2.

6.5 The EA Risk of Flooding from Surface Water map (available online) indicates that the site is at a 'very low' risk of surface water flooding. This corresponds with an annual probability of flooding that is less than 1 in 1000. The railway line adjacent to the east of the site is indicated to be at a 'medium' risk of surface water flooding, whereby the annual probability is greater than 1 in 100 but less than 1 in 30.

6.6 EA mapping also indicates that the site is not located within an area potentially at risk from reservoir flooding.

6.7 The LBRuT SFRA was updated in March 2016. It provides an overview of flood risk from various sources within the borough. Information of relevance to this assessment is summarised below:

- Generally, Richmond has a moderate surface water flooding risk. Groundwater flooding was found to present a relatively low risk. Certain areas of the Borough have a high reservoir and fluvial or tidal flood risk, although much of the tidally affected area is defended by the Thames Tidal Defences.
- The site is indicated to be located within Flood Zone 1, whereby the annual probability of fluvial flooding is less than 1 in 1000.

- No localised drainage issues were identified within close proximity of the site.
- A groundwater flooding incident was recorded to have occurred 375m north of the site, no further details were provided. No other flooding incidents (from fluvial, surface water or groundwater sources) were recorded to have occurred within 500m of the site.
- Records were provided of blocked gully incidents, the nearest occurred 330m northwest of the site. No further details were provided.
- The site is situated upon deposits where there is '*the potential for groundwater flooding to occur at the surface*'.
- Between 1 and 5 sewer flooding incidents were recorded by Thames Water in the area of the subject site between 2005 and 2015.
- Mapping of a 1 in 100 year rainfall event indicates that a linear area along the eastern boundary of the site could be subject to flood depths of up to 0.6m [RPS notes that this appears to be misaligned with the adjacent railway line].

6.8 The LBRuT SWMP was published in March 2011. It provides an overview of flood risk from various sources within the borough. Information of relevance to this assessment is summarised below:

- No ordinary or culverted watercourses are recorded within 750m of the subject site.
- The site is located within a Critical Drainage Area (CDA). There are eight CDAs which fall at least partially within the borough of Richmond. CDA 'Group8_004', in which the site is located, relates to a large area of East Sheen and Mortlake. The subject site is located at the very northern extent of this CDA.
- During a 1 in 100 year plus climate change rainfall event, surface water flood depths are indicated to be up to 0.5m at the subject site. This corresponds to a flood hazard of 'danger for some'. In the south of the site, flood depths could reach 1.0m, however, the resolution of the mapping limits the interpretation of the data.
- The site is located within an area where the suitability of infiltration SuDS is uncertain and therefore where site investigation would be required.
- A groundwater flooding incident was recorded by the EA approximately 375m north of the site. Occasional water seepage was recorded in the basement of this property in 2007.
- The site is located on permeable superficial deposits which have an increased potential for elevated groundwater.

- Flooding was recorded on Worple Street and Richmond Road in July 2007, however, further details are not available. Both are located at least 1.5km from the site.

7 HYDROGEOLOGICAL SETTING

7.1 Reference to the British Geological Survey online mapping (1:50,000 scale) indicates that the site is underlain by the Kempton Park Gravel Formation, comprising sand and gravel. This is underlain by the London Clay Formation, comprising clay and silt.

7.2 A BGS borehole log located 70m southeast of the site indicates approximately the presence of approximately 2.30m of Made Ground, underlain by approximately 5.75m of sandy gravel and then the London Clay Formation. The groundwater resting level was recorded at 4.35m below ground level (bgl).

7.3 The soils are described as 'freely draining slightly acid loamy soils' by the National Soils Research Institute.

7.4 According to the Environment Agency's online Groundwater Vulnerability Mapping, the Kempton Park Gravels at the surface are classified as a Secondary A Aquifer. These formations are formed of permeable layers capable of supporting water supplies at a local scale, in some cases forming an important source of base flow to rivers.

7.5 Reference to the Environment Agency's online groundwater Source Protection Zone maps indicates that the site is not located within a groundwater Source Protection Zone.

8 EXISTING DRAINAGE / WATER MAINS

8.1 Reference to Thames Water plans of public sewers (shown in Appendix D) indicates that a 225mm diameter surface water sewer is located beneath Sandycombe Road to the northwest of the site. The site is likely served by a 450mm diameter foul water sewer which runs in a southerly direction beneath Sandycombe Road to the west of the site.

8.2 A manhole associated with the surface water sewer is located 15m northwest of the site. It is indicated to have a cover level of 6.41m AOD and an invert level of 5.07m AOD.

8.3 Thames Water has advised that the property is not recorded as being at risk of internal flooding due to overloaded public sewers.

8.4 Reference to water network plans provided by Thames Water indicates that the site is served by a 4 inch (c.100mm diameter) water main beneath Sandycombe Road to the west of the site.

9 FLOOD RISK AND MITIGATION

9.1 The key sources of flooding that could potentially impact the site are discussed below:

Fluvial / Tidal Flooding

9.2 The EA Flood Map (see Figure 2) indicates that the site is located within Flood Zone 1. The annual probability of flooding is classified as less than 1 in 1000.

9.3 Given the location of the site within an area of Flood Zone 1, dry access and egress is available for the site during a 1 in 1000 year tidal flood event.

9.4 As the site is not located within a fluvial floodplain there is no requirement to provide floodplain compensation as part of the redevelopment.

9.5 The PPG details the suitability of different land uses within each flood zone. The proposed land uses are classified as 'less vulnerable' and 'more vulnerable' and such uses are generally considered appropriate within Flood Zone 1.

Proposed Mitigation

9.6 No mitigation is required in relation to flooding from fluvial or tidal sources.

Flooding from sewers

9.7 Sewer flooding can occur during periods of heavy rainfall when a sewer becomes blocked or is of inadequate capacity. The site is currently served by a foul water sewer located beneath Sandycombe Road to the west of the site (detailed in Section 8).

9.8 Thames Water have advised that there are no records of sewer flooding at the subject site and no localised drainage issues have been recorded in close proximity to the subject site.

9.9 In the event of sewer surcharging, water would likely flow in a northerly direction away from the subject site, following local topography.

9.10 The discharge rate to the existing sewer will be agreed with Thames Water to ensure that there is capacity to receive discharge from the site without significantly increasing flood risk.

9.11 Thames Water has advised that there is sufficient capacity to accommodate additional foul flows from the new development. In addition, surface water will be permitted to discharge to the nearby sewer provided a 50% reduction in runoff is achieved.

Proposed Mitigation

9.12 In line with good practice and as a precautionary measure, it is recommended that finished floor levels are raised 150mm above surrounding ground levels.

Surface water flooding (overland flow)

9.13 This can occur during intense rainfall events, when water cannot soak into the ground or enter drainage systems.

9.14 According to the SWMP the site is located within a Critical Drainage Area. RPS notes that this relates to a large geographic area and that the site is located just inside the CDA boundary. Whilst mapping in both the SFRA and in particular the SWMP indicate the site is at an elevated risk of surface water flooding, EA online mapping is of a finer resolution and is more up-to-date. The EA's mapping identifies the site itself to be at a 'very low' risk of surface water flooding and indicates that it is in fact the railway line adjacent to the east of the site which is at risk of surface water flooding. The Topographic Survey supports this as it indicates that the railway is at a lower elevation than the site itself and appears to be located somewhat within a valley.

9.15 In the event of overland flow, water would likely either travel in a northerly direction along Sandycombe Road or in a easterly direction, following local topography, rather than ponding at the subject site. In addition, the SFRA does not report any localised drainage issues within close proximity of the site. Therefore whilst the site falls within a CDA, it is not considered to be at a significant risk of surface water flooding.

9.16 Surface water flooding from on-site sources is considered in Section 10 of this report.

Proposed Mitigation

9.17 In line with good practice and as a precautionary measure, it is recommended that finished floor levels are raised 150mm above surrounding ground levels.

9.18 In addition, SuDS techniques will be incorporated to provide a reduction in surface water runoff from the site, improving local flood risk (see Section 10 for details).

Groundwater flooding

9.19 This can occur in low-lying areas when groundwater levels rise above surface levels, or within underground structures. BGS mapping indicates that the site is underlain by the Kempton Park Gravel Formation and subsequently the London Clay Formation.

9.20 A nearby BGS borehole log indicates a groundwater resting level of 4.35m bgl and therefore indicates the absence of significant quantities of shallow groundwater. In addition, no

groundwater flooding incidents were recorded at ground level within the immediate vicinity of the site in either the SFRA or SWMP.

Proposed Mitigation

9.21 Given the absence of any proposed basement levels at the subject site, no mitigation is required in relation to flooding from groundwater.

Other Sources

9.22 There is a limited risk of flooding occurring as a result of a break in a water main. The locations of the water mains in the immediate vicinity of the site are described in Section 8. In the event of a burst water main on Sandycombe Road, water would likely follow local topography and flow in a northerly direction, rather than ponding at the subject site.

9.23 The risk of flooding associated with reservoirs, canals and other artificial structures is considered to be low given the absence of any such structures in the site vicinity.

Proposed Mitigation

9.24 In line with good practice and as a precautionary measure, it is recommended that finished floor levels are raised 150mm above surrounding ground levels.

Event Exceedence and Residual Risk

9.25 The mitigation measures proposed as part of the development scheme are considered appropriate to mitigate against any residual risks or event exceedence scenarios.

10 SURFACE WATER MANAGEMENT

Introduction

10.1 Richmond local policy states that SuDS should be used wherever practical in developments and that greenfield discharge rates should be achieved, where feasible. This is in line with the London Plan which requires developments to achieve a minimum 50% reduction in surface water run-off rates, with an aim to achieve greenfield runoff rates.

10.2 Under the PPG, SuDS should be provided for major developments unless demonstrated to be inappropriate. The non-statutory technical standards for SuDS (Defra, March 2015) states that the peak runoff rate from the development for the 1 in 1 year and 1 in 100 year rainfall event should not exceed the equivalent greenfield rate for greenfield developments, or the pre-development rate for previously developed sites. Where reasonably practicable, the runoff volume from the development for the 1 in 100 year, 6 hour rainfall event should be constrained to the greenfield volume for greenfield developments, and the pre-development volume for previously developed sites.

10.3 Using Micro-Drainage WinDes modelling, the QBAR greenfield discharge rate from the site has been calculated as 0.2 litres / second. On the basis that greenfield runoff rates should be targeted where feasible and also to ensure a self-cleansing system, a target discharge rate of 2 litres / second is considered appropriate.

10.4 Surface water calculations have been undertaken using Windes Micro-drainage modelling to establish the attenuation requirement in order to achieve the aforementioned runoff rate. The proposed impermeable area is 1211m^2. In order to attenuate runoff from the site during a 1 in 100 year plus 40% climate change event, whilst meeting the required runoff rate of 2 litres / second, it has been calculated that 58.4m^3 of attenuation would be required. The micro-drainage calculations used to calculate this requirement are provided in Appendix E.

Consideration of Sustainable Drainage Systems

10.5 The potential for the use of SuDS has been considered at this stage.

Swales, detention basins and ponds

10.6 The proposed development site occupies an area of approximately 0.15 hectares and is within a built up area of London. Due to space restrictions it is not feasible to incorporate open storage features such as swales, detention basins or ponds into the development scheme.

Soakaways

10.7 Reference to BGS mapping indicates that the site is underlain by Kempton Park Gravels, which are likely to be of a relatively high permeability. The soils are described as 'freely draining slightly acid loamy soils' by the National Soils Research Institute. Given the reported geological conditions beneath the site, it is considered that soakaways could provide a feasible method for the disposal of surface water runoff from the site. This is confirmed by the existence of a soakaway at present. However, it is noted that a 20m buffer in which infiltration SuDS should not be used is required from railway lines and a 5m buffer is required from the edge of highways. Therefore, whilst a soakaway is currently present at the site, RPS notes that structural integrity issues will preclude the continued use of soakaways at the site.

Rainwater Harvesting

10.8 The attenuation benefits provided through the use of rainwater harvesting are considered to be limited, and would only be realised when the tanks were not full. Therefore, these techniques are not considered to offer the potential to provide any significant reduction in surface water runoff rates.

Green Roofs

10.9 It is proposed to incorporate green roofs totalling an area of 327m^2 into the building design. This will provide storage of water within the growing substrate and also increase local biodiversity.

Porous / Permeable Paving

10.10 It is proposed that almost all hardstanding areas at the site will be permeably paved, totalling 438m^2. Storage would be provided within the sub-grade material prior to controlled discharge to the receiving stormwater sewer.

Modular Underground Attenuation Tanks

10.11 It is not proposed to incorporate an underground attenuation tank at the site.

Conceptual Surface Water Attenuation Scheme

10.12 On the basis of the calculations above, a total attenuation volume of 58.4m^3 will be required to achieve the required reduction in run-off. It is proposed to incorporate permeable paving across the main hardstanding area at the site. With a depth of 450mm and working to a 30% void ratio, sufficient attenuation will be provided within the substrate of the paving to provide the necessary attenuation. A conveyance system, comprising a perforated pipe, will be required to transport water to the outfall point. Outfall from the substrate will be by gravity, restricted by a flow control device (e.g. Hydrobrake) to a rate of 2 l/s, to the nearby surface water sewer (see Appendix F).

Windes modelling has shown that the paving will provide storage up to and including the 1 in 100 year plus climate change event, with no surcharging of the system expected.

10.13 It is noted that it is also proposed to incorporate 327m^2 of green roofs at the site, which would provide additional attenuation and additionally slow down the entry of water into the permeable paving system. The additional benefits provided by the green roofs would be quantified at detailed design stage.

10.14 Following the Drainage Hierarchy, the potential for storage and infiltration of runoff has been considered. Storage within open features and infiltration methods are not feasible given the site constraints. However, storage will be provided within the sub-grade beneath the permeable paving and in the green roofs for gradual release. These methods will ensure that runoff is managed as close to the source as possible. In the absence of a nearby watercourse, runoff will be discharged to the nearby surface water sewer which is also in accordance with the Hierarchy. Thames Water has advised that there is capacity to take surface water flows from the development.

10.15 Overall, the proposed development will meet local, regional and national planning policy requirements through incorporating green roofs and permeable paving to achieve a discharge rate of 2 litres / second. This has been achieved through source control techniques in line with the Drainage Hierarchy. As a result of the proposed measures, there will be a significant reduction in runoff rates and therefore flood risk within the local area, helping to alleviate pressure in the CDA.

Maintenance of Sustainable Drainage Systems

10.16 A Maintenance Plan is included in Appendix G stipulating a schedule for the inspection and maintenance of SuDS components to ensure efficient operation over the lifetime of the development.

Event Exceedence

10.17 The proposed indicative surface water drainage concept provides storage up to the 1 in 100 year plus climate change event. In an event exceeding this magnitude, detailed drainage design will identify mitigation measures to ensure that the resulting above-ground flooding will be confined to temporary shallow flooding of the on-site road network and will not affect the buildings on site or significantly increase flood risk to off-site locations.

10.18 Event exceedence planning will be undertaken as part of the final design process. Suitable mitigation measures will be incorporated into the development to ensure water is retained on-site should surcharging of on-site drains occur during extreme rainfall events.

11 SEQUENTIAL TEST AND EXCEPTION TEST

Sequential Test

11.1 The NPPF requires the Local Authority to apply the Sequential Test in consideration of new development. The aim of the Test is to steer new development to areas at the lowest probability of flooding. Given that the subject site has not been allocated as one of the Council's proposed future development sites, it has not been specifically assessed within the SFRA. Therefore the Sequential Test is based on the EA Flood Zones and information contained within the SFRA.

11.2 The site is located within Flood Zone 1 and is therefore classified to be at a low risk of fluvial and tidal flooding. Whilst the site is located within an identified CDA, EA mapping indicates that the site itself is at a 'very low' risk of flooding. This is considered to supersede the mapping in the SFRA and SWMP as it is more up to date and of a finer resolution. No significant risks were identified in relation to any of the other sources assessed. Therefore, the site is considered to pass the Sequential Test.

The Exception Test

11.3 According to Table 3 of the PPG to the NPPF, 'less vulnerable' and 'more vulnerable' developments are considered appropriate within Flood Zone 1 without the requirement to apply the Exception Test. Therefore, application of the Exception Test is not required for the proposed development.

12 SUMMARY AND CONCLUSIONS

12.1 The aim of the FRA is to outline the potential for the site to be impacted by flooding, the potential impacts of the development on flooding both onsite and in the vicinity, and the proposed measures which can be incorporated into the development to mitigate the identified risks. The report has been produced in accordance with the guidance detailed in the NPPF. Reference has also been made to the CIRIA SUDS manual (C753), the SFRA and the SWMP.

12.2 The potential flood risks to the site, and the measures proposed to mitigate the identified risks, are summarised in the table below:

Source of flooding	Identified Risk			Mitigation proposed	Residual risk		
	L	M	H		L	M	H
Fluvial	✓			None required.	✓		
Tidal	✓			None required.	✓		
Sewers	✓			Elevate finished ground floor levels by 150mm (best practice).	✓		
Surface Water	✓			Elevate finished ground floor levels by 150mm (best practice).	✓		
Groundwater	✓			None required.	✓		
Other Sources (e.g. reservoirs, water mains)	✓			None required.	✓		

12.3 The site is located within Flood Zone 1 and is therefore considered to be at a low risk from fluvial or tidal sources. Although the site is located within an identified CDA, reference to EA surface water mapping indicates that the site is at a 'very low' risk of surface water flooding. However, as a precautionary measure, and in line with best practice, it has been recommended that finished ground floor levels are elevated 150mm above surrounding ground levels to mitigate against ingress of water into the building during extreme scenarios. No significant risks have been identified in relation to flooding from other (non-pluvial) sources.

12.4 The inclusion of green roofs and permeable paving will reduce the rate of runoff from the site to 2 litres / second, the minimum discharge rate to ensure a self-cleansing drainage system, in line with local, regional and national planning policy guidance. Therefore an improvement will be made to local surface water flood risk.

12.5 It has been demonstrated that the development meets the Sequential Test imposed under the NPPF.

12.6 Overall, it has been demonstrated that the development would be safe, without increasing flood risk elsewhere, and that a positive reduction in flood risk would be achieved through the inclusion of permeable paving and green roofs.

FIGURES

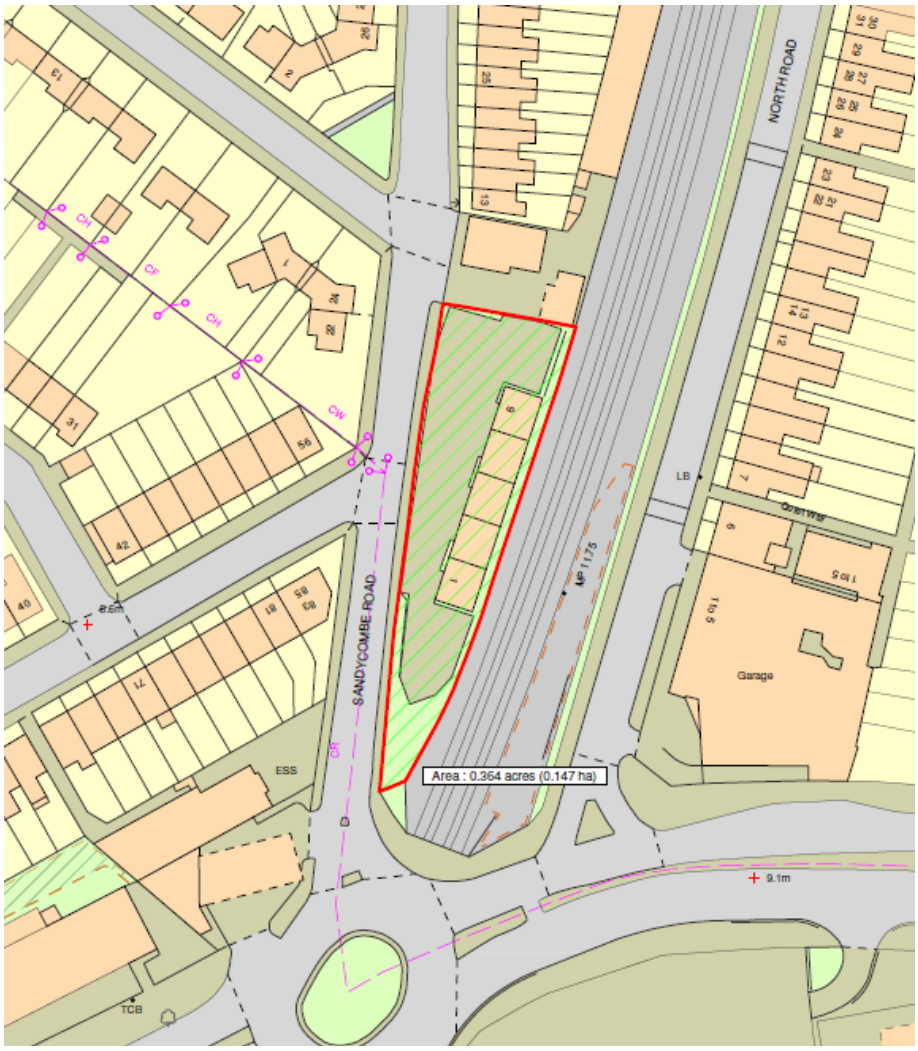


Figure 1: Site Location Plan

Map Date: Current

Scale: Not to scale

RPS
35 New Bridge Street
London
EC4V 6BW

☎ 020-7280-3240
www.rpsgroup.com

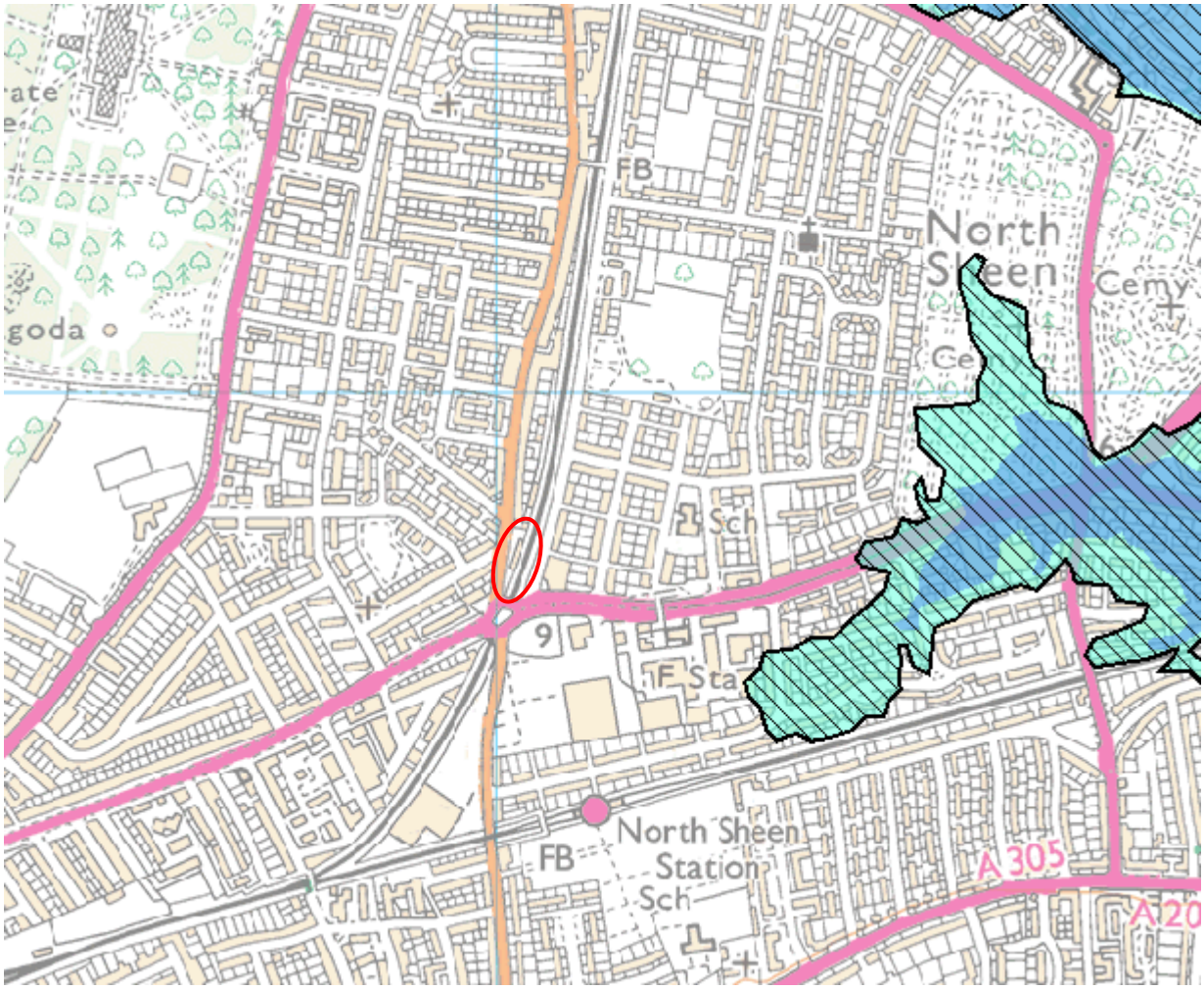


Figure 2: Environment Agency Flood Map

Map Date: Current

Scale: Not to scale

RPS
35 New Bridge Street
London
EC4V 6BW

☎ 020-7280-3240
www.rpsgroup.com

APPENDIX A

Thames Water Pre-Development Enquiry

Developer Services

Mr S Devas
Goldcrest Land PLC
3 Hurlingham Business Park
Sulivan Road
SW6 DU

Your ref
Our ref 1013286678
Name Natalya Collins
Phone 0800 009 3921
Email developer.services@thameswater.co.uk

18 November 2015

Dear Mr Devas

Pre-development enquiry relating to development proposals at 1-9 Sandycombe Road Richmond

I refer to your recent pre-development enquiry relating to development proposals, comprising 21 to 25 new dwelling units, at 1-9 Sandycombe Road Richmond.

I can confirm that the public foul sewer has sufficient capacity to accommodate the additional foul flows anticipated from the new development. No surface water will be permitted to connect to the foul sewer.

In accordance with the Building Act 2000 clause H3.3. any positive connection to a public surface water sewer will only be consented when it can be demonstrated that the hierarchy of disposal methods have been examined and proven to be impracticable. The disposal hierarchy being:- 1st Soakaways; 2nd Watercourses; 3rd surface water sewer. If connection to the sewer is the only realistic means of surface water disposal from the site, in order to comply with the London plan, you should look to reduce the current discharge rate by 50% and set this as the new maximum discharge rate controlled by a Hydrobrake or similar method. Thames Water will expect you to comply with this requirement. The closest SW sewer (225mm) is located at the road junction NW of the site

Consent, under S106 of the Water Industry Act 1991, to connect to the public sewer system(s) must be obtained at the appropriate time.

Please note that the views expressed by Thames Water in this letter is in response to this pre development enquiry only and may not represent our final views on any future planning applications made in relation to this site.

We reserve the right to change our position in relation to any such planning applications should circumstances dictate.

Yours sincerely

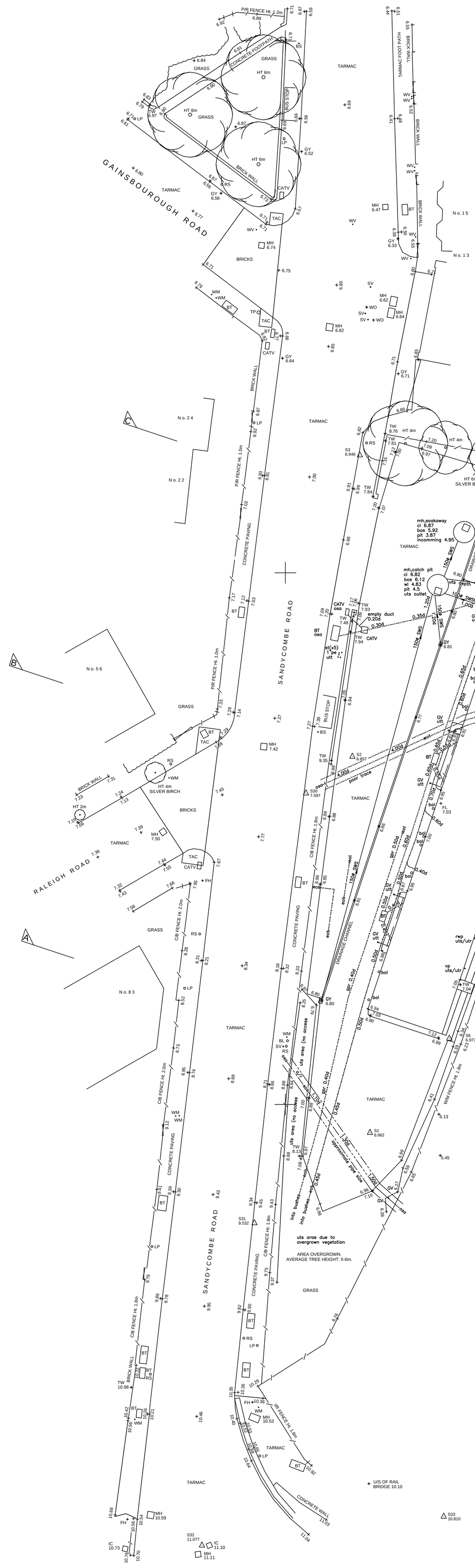
Lance Cooper
Developer Services

Thames Water
Developer Services
3rd Floor West
Clearwater Court
Vastern Road
Reading
RG1 8DB

T 0800 009 3921
I www.thameswater.co.uk

APPENDIX B

Topographic Survey



NOTES

GENERAL NOTES :-

THE TPOPOGRAPHICAL SURVEY WAS SUPPLIED BY A THIRD PARTY SO THERFORE MIDLAND SURVEY DONT ACCEPT ANY RESPONSIBLILITY FOR THE SURVEY ACCURACY.

THIS DRAWING HAS BEEN PRODUCED WITH A PLOT SCALE ACCURACY OF 1:200

SERVICE COVERS INDICATED WHERE VISIBLE. PIPE INVERTS / DETAILS SURVEYED FROM SURFACE INSPECTION ONLY. GENERALLY DAMAGED COVERS AND COVERS WITHIN HIGHWAYS WILL NOT BE LIFTED

TREE SPECIES SHOULD BE CONFIRMED BY TREE SPECIALIST IF CRITICAL.

OVERHEAD CABLES ARE INDICATED USING REMOTE SURVEY METHODS AND ARE SUBJECT TO SEASONAL VARIATION, AND SHOULD BE TREATED AS APPROXIMATE.

SERVICE COVERS LOCATED UNDER PARKED VEHICLES/MOBILE STRUCTURES MAYBE OMITTED.

BURIED SERVICE COVERS WILL NOT BE INDICATED.

UTILITY NOTES

THE WATER SUPPLY TO THE UNITS ARE 1"PE WHICH ARE UNABLE TO TRACE USING GROUND PENETRATING RADAR AND RADIO DETECTION, THEY ARE FED FROM THE STOP TAPS INDICATED ON THE DRAWING IN THE PATH.

THE GAS SUPPLIES TO THE UNITS ARE PE AND UNABLE TO TRACE USING BOTH GROUND PENETRATING RADAR AND RADIO DETECTION.ROUTE IS UNKNOWN.

NO RECORDS SUPPLIED.

CERTAIN AREAS INSIDE THE SURVEY AREA ARE UNABLE TO SURVEY DUE TO OVERGROWN VEGETATION AND LACK OF ACCESS.

UTILITY SURVEY KEY :-
(WHERE APPLICABLE)

- ELECTRIC CABLE
- WATER PIPE
- FOUL SEWER
- STORM SEWER
- COMBINED SEWER
- DUCTS
- CABLE TELEVISION
- DATA CABLE
- TELECOM CABLE
- GAS PIPE
- FUEL PIPE
- UNIDENTIFIED SERVICE
- OTHER

ABBREVIATIONS :-

mh – manhole cover	eot – end of trace	
ic – inspection chamber	utl – unable to lift	
cl – cover level	uts – unable to survey	tfr – taken from records
il – invert level	a/r – assumed route	utt – unable to trace
bd – back drop	ni/ts – not located trench scar	utr – unable to rod

DISCLAIMER :-

Electromagnetic techniques have been used in the location of underground services. The results are not infallible and trial excavations should be carried out to confirm service identification, positions and particularly depths, where these are critical. The completeness of the underground services information cannot be guaranteed.

This method of survey does not differentiate between live and dead services, and as such all services should be treated as live. This drawing may not include the location of all public services that may cross the site, therefore the relevant service drawings should be obtained from the appropriate utility company and used in conjunction with this drawing.

Private service pipes and cables in highways are not shown, but there presence should be anticipated.

Additional below ground structures or obstructions not shown on this drawing may be present. Reference should be made to historical plans and as–built drawings. Excavations in the vicinity of services should be carried out with due diligence ref: HSG47 document avoiding dangers from underground services

Pipe diameters noted in mm

TANK INFORMATION :-
(WHERE APPLICABLE)

DISUSED PUMP ISLANDS' AND TANKS' FEEDS ARE NOT SHOWN AS NO INFORMATION IS HELD FOR THESE OLD SERVICE RUNS

FUEL LINES AND VAPOUR LINES ARE SHOWN AS A SCHEMATIC PLAN AND DO NOT REPRESENT ACCURATE POSITION.

TANK No	FUEL GRADE	CAPACITY LITRES	PUMPS ISLANDS
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

NORTH POINT :-
(WHERE APPLICABLE)

INDICATIVE NORTH

SHEET LAYOUT :-
(WHERE APPLICABLE)

A0–SHEET 12345/12

A1–SHEET 12345/12

A2–SHEET 12345/12

MIDLAND SURVEY LTD

HEAD OFFICE
Cromwell House, Westfield Road, Southam, Warwickshire, CV47 0JH.
Tel: 01926 810811 Fax 01926 810812
E–Mail: mail@midlandsurvey.co.uk
www.midlandsurvey.co.uk

Client	RPS GROUP
Project	1–9 SANDYCOMBE ROAD, NORTH SHEEN, RICHMOND, LONDON, TW9 2EP
Title	UTILITY SURVEY
Date	MAY 2015
Scale	1:200@A1
Dwg No	22511
Surveyor	T.H
Checked	A.H

Revisions

TOPOGRAPHICAL (LAND) SURVEYORS / UTILITY SURVEYORS
BUILDING MEASUREMENT SURVEYORS / 3D LASER SCANNING

Accredited Contractor www.chas.gov.uk
constructionLine
THE SURVEY ASSOCIATION

APPENDIX C

Development Plans

Scale 1:200

0 4000 8000 12000 16000 20000

N

This line measures 100mm when this drawing is printed @ A1

rev	date	description

07/11/2016 18:18:35

Project
1-9 Sandycombe Rd TW9 2EP

Status
Planning

Drawing Title
Block Plan - Proposed

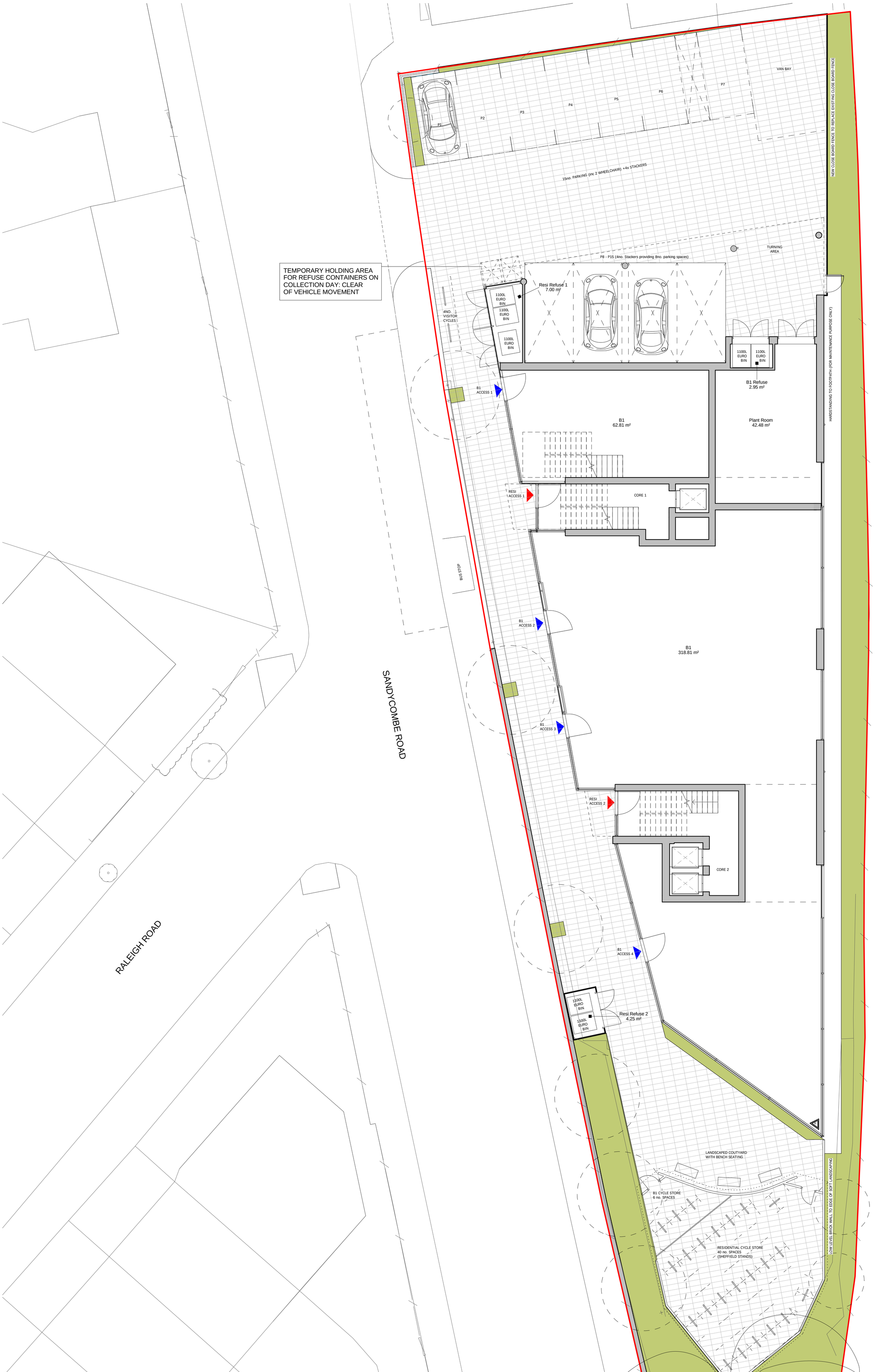
Date: NOV 2016

Scale: 1 : 200

Drawing #:
P03 050

GOLDCREST architects

3 Hurlingham Business Park
Sulivan Road SW6 3DU
T 0207 731 7111
F 0207 371 7782
E architects@goldcrestland.com



rev	date	description

Scale 1:100

0 2000 4000 6000 8000 10000

N

This line measures 100mm when this drawing is printed @ A1

07/11/2016 18:19:43

Project
1-9 Sandycombe Rd TW9 2EP

Status
Planning

Drawing Title
Ground Floor - Proposed

Date: NOV 2016

Scale: 1 : 100

Drawing #:
P03 100

GOLDCREST architects

3 Hurlingham Business Park
Sulivan Road SW6 3DU
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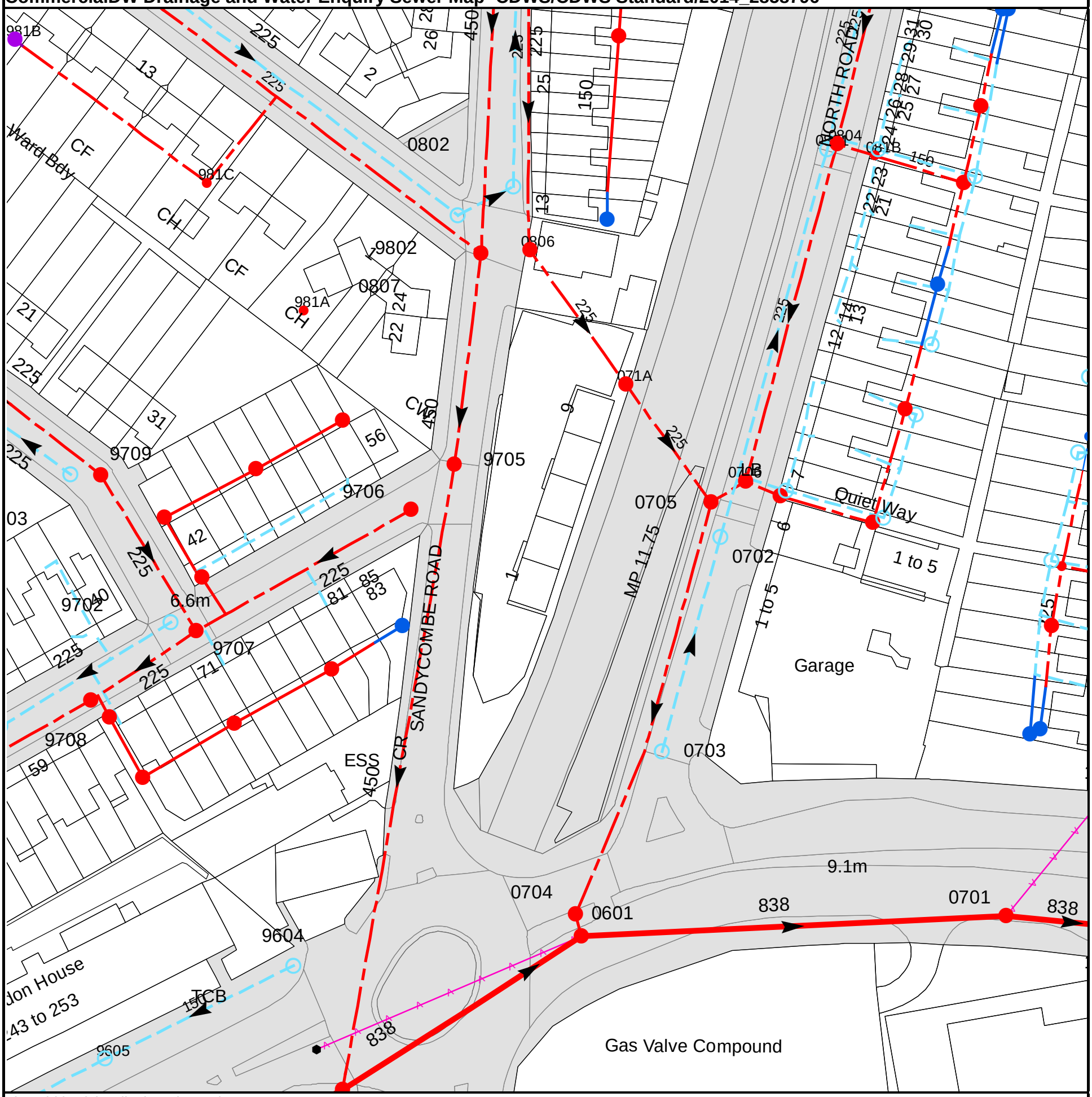
F 0207 371 7782
E architects@goldcrestland.com

APPENDIX D

Thames Water Sewer Plans

CommercialDW Drainage and Water Enquiry Sewer Map- CDWS/CDWS Standard/2014_2858796



The width of the displayed area is 200m

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. 100019345 Crown Copyright Reserved.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates no survey information is available.

Manhole Reference	Manhole Cover Level	Manhole Invert Level
081B	n/a	n/a
0801	6.52	5.51
08YV	n/a	n/a
0804	6.52	3.37
08ZT	n/a	n/a
08VZ	n/a	n/a
08ZW	n/a	n/a
18WP	n/a	n/a
17XP	n/a	n/a
17VS	n/a	n/a
0702	7.15	5.72
07ZX	n/a	n/a
07ZP	n/a	n/a
0705	7.14	3.1
07ZW	n/a	n/a
07YZ	n/a	n/a
0706	6.89	3.18
17VV	n/a	n/a
17WX	n/a	n/a
07ZS	n/a	n/a
07ZY	n/a	n/a
071A	n/a	n/a
18RV	n/a	n/a
08YP	n/a	n/a
08ZQ	n/a	n/a
0806	6.65	3.4
08WQ	n/a	n/a
08ZS	n/a	n/a
08YW	n/a	n/a
981B	n/a	n/a
9703	n/a	n/a
9709	n/a	n/a
97YX	n/a	n/a
97YV	n/a	n/a
981C	n/a	n/a
97YY	n/a	n/a
981A	n/a	n/a
97YZ	n/a	n/a
9706	n/a	n/a
9705	n/a	n/a
9802	6.66	5.26
0807	6.78	n/a
0802	6.41	5.07
9605	9.74	9.04
9604	10.77	9.73
97XV	n/a	n/a
97XW	n/a	n/a
97XT	n/a	n/a
9708	n/a	n/a
9707	n/a	n/a
9702	n/a	n/a
97XX	n/a	n/a
9601	n/a	-4.18
97XZ	n/a	n/a
0704	10.8	n/a
0601	10.66	-4.24
0703	9.39	7.16
0701	n/a	-4.3
17WT	n/a	n/a
17XS	n/a	n/a
17XQ	n/a	n/a

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Sewer Key - Commercial Drainage and Water Enquiry

Public Sewer Types (Operated & Maintained by Thames Water)

Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

Air Valve

Dam Chase

Fitting

Meter

Vent Column

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

Control Valve

Drop Pipe

Ancillary

Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

Outfall

Undefined End

Inlet

Other Symbols

Symbols used on maps which do not fall under other general categories

Public/Private Pumping Station

Change of characteristic indicator (C.O.C.I.)

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

Other Sewer Types (Not Operated or Maintained by Thames Water)

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

Proposed

Abandoned Sewer

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.

2) All measurements on the plans are metric.

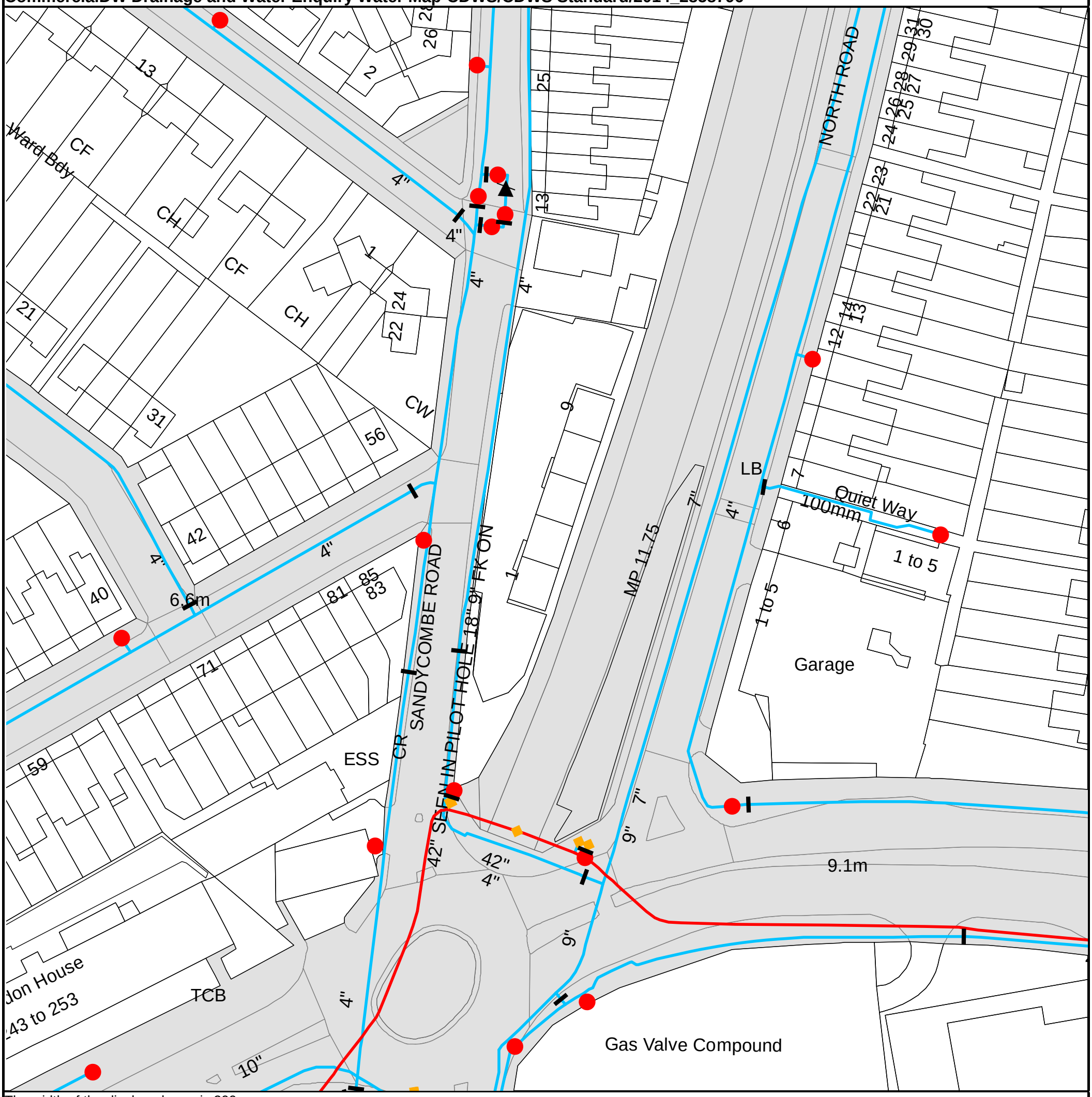
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.

4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.

5) 'na' or '0' on a manhole level indicates that data is unavailable.

6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Searches on 0118 925 1504.

CommercialDW Drainage and Water Enquiry Water Map-CDWS/CDWS Standard/2014_2858796



The width of the displayed area is 200m

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.

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Waterworks Key - Commercial Drainage and Water Enquiry

Water Pipes (Operated & Maintained by Thames Water)

4"

Distribution Main: The most common pipe shown on water maps. With few exceptions, domestic connections are only made to distribution mains.

16"

Trunk Main: A main carrying water from a source of supply to a treatment plant or reservoir, or from one treatment plant or reservoir to another. Also a main transferring water in bulk to smaller water mains used for supplying individual customers.

3" SUPPLY

Supply Main: A supply main indicates that the water main is used as a supply for a single property or group of properties.

3" FIRE

Fire Main: Where a pipe is used as a fire supply, the word FIRE will be displayed along the pipe.

3" METERED

Metered Pipe: A metered main indicates that the pipe in question supplies water for a single property or group of properties and that quantity of water passing through the pipe is metered even though there may be no meter symbol shown.

Transmission Tunnel: A very large diameter water pipe. Most tunnels are buried very deep underground. These pipes are not expected to affect the structural integrity of buildings shown on the map provided.

Proposed Main: A main that is still in the planning stages or in the process of being laid. More details of the proposed main and its reference number are generally included near the main.

PIPE DIAMETER	DEPTH BELOW GROUND
Up to 300mm (12”)	900mm (3’)
300mm - 600mm (12” - 24”)	1100mm (3’ 8”)
600mm and bigger (24” plus)	1200mm (4’)

Valves

- General Purpose Valve
- Air Valve
- Pressure Control Valve
- Customer Valve

Hydrants

- Single Hydrant

Meters

- Meter

End Items

Symbol indicating what happens at the end of a water main.

- Blank Flange
- Capped End
- Emptying Pit
- Undefined End
- Manifold
- Customer Supply
- Fire Supply

Operational Sites

- Booster Station
- Other
- Other (Proposed)
- Pumping Station
- Service Reservoir
- Shaft Inspection
- Treatment Works
- Unknown
- Water Tower

Other Symbols

- Data Logger

Other Water Pipes (Not Operated or Maintained by Thames Water)

Other Water Company Main: Occasionally other water company water pipes may overlap the border of our clean water coverage area. These mains are denoted in purple and in most cases have the owner of the pipe displayed along them.

Private Main: Indiates that the water main in question is not owned by Thames Water. These mains normally have text associated with them indicating the diameter and owner of the pipe.

APPENDIX E

Micro-Drainage Windes Modelling Assessment

ICP SUDS Mean Annual Flood

Input

Return Period (years) 100 SAAR (mm) 600 Urban 0.000
Area (ha) 0.121 Soil 0.300 Region Number Region 6

Results l/s

QBAR Rural 0.2
QBAR Urban 0.2

Q100 years 0.6

Q1 year 0.2
Q30 years 0.4
Q100 years 0.6

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	100.223	0.223	1.9	14.9	O K
30 min Summer	100.281	0.281	1.9	18.8	O K
60 min Summer	100.322	0.322	1.9	21.6	O K
120 min Summer	100.331	0.331	1.9	22.2	O K
180 min Summer	100.320	0.320	1.9	21.4	O K
240 min Summer	100.306	0.306	1.9	20.5	O K
360 min Summer	100.276	0.276	1.9	18.5	O K
480 min Summer	100.249	0.249	1.9	16.7	O K
600 min Summer	100.224	0.224	1.9	15.0	O K
720 min Summer	100.201	0.201	1.9	13.4	O K
960 min Summer	100.160	0.160	1.9	10.7	O K
1440 min Summer	100.101	0.101	1.8	6.8	O K
2160 min Summer	100.051	0.051	1.6	3.4	O K
2880 min Summer	100.030	0.030	1.4	2.0	O K
4320 min Summer	100.011	0.011	1.1	0.8	O K
5760 min Summer	100.002	0.002	0.9	0.1	O K
7200 min Summer	100.000	0.000	0.8	0.0	O K
8640 min Summer	100.000	0.000	0.7	0.0	O K
10080 min Summer	100.000	0.000	0.6	0.0	O K
15 min Winter	100.253	0.253	1.9	17.0	O K
30 min Winter	100.321	0.321	1.9	21.5	O K
60 min Winter	100.373	0.373	1.9	25.0	O K
120 min Winter	100.390	0.390	1.9	26.1	O K
180 min Winter	100.375	0.375	1.9	25.1	O K
240 min Winter	100.355	0.355	1.9	23.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	76.035	0.0	17.2	24
30 min Summer	49.499	0.0	22.4	37
60 min Summer	30.811	0.0	27.9	64
120 min Summer	18.615	0.0	33.7	108
180 min Summer	13.715	0.0	37.3	138
240 min Summer	10.995	0.0	39.8	172
360 min Summer	8.034	0.0	43.7	240
480 min Summer	6.428	0.0	46.7	308
600 min Summer	5.404	0.0	49.0	372
720 min Summer	4.687	0.0	51.0	436
960 min Summer	3.743	0.0	54.3	560
1440 min Summer	2.723	0.0	59.3	798
2160 min Summer	1.979	0.0	64.6	1144
2880 min Summer	1.577	0.0	68.6	1484
4320 min Summer	1.143	0.0	74.7	2208
5760 min Summer	0.910	0.0	79.3	2936
7200 min Summer	0.762	0.0	83.0	0
8640 min Summer	0.659	0.0	86.1	0
10080 min Summer	0.583	0.0	88.8	0
15 min Winter	76.035	0.0	19.3	24
30 min Winter	49.499	0.0	25.1	37
60 min Winter	30.811	0.0	31.3	64
120 min Winter	18.615	0.0	37.8	118
180 min Winter	13.715	0.0	41.8	150
240 min Winter	10.995	0.0	44.6	186

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
360 min Winter	100.312	0.312	1.9	20.9	O K
480 min Winter	100.269	0.269	1.9	18.0	O K
600 min Winter	100.230	0.230	1.9	15.4	O K
720 min Winter	100.195	0.195	1.9	13.1	O K
960 min Winter	100.137	0.137	1.9	9.2	O K
1440 min Winter	100.065	0.065	1.7	4.4	O K
2160 min Winter	100.027	0.027	1.4	1.8	O K
2880 min Winter	100.012	0.012	1.1	0.8	O K
4320 min Winter	100.000	0.000	0.8	0.0	O K
5760 min Winter	100.000	0.000	0.6	0.0	O K
7200 min Winter	100.000	0.000	0.5	0.0	O K
8640 min Winter	100.000	0.000	0.5	0.0	O K
10080 min Winter	100.000	0.000	0.4	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
360 min Winter	8.034	0.0	48.9	262
480 min Winter	6.428	0.0	52.3	332
600 min Winter	5.404	0.0	54.9	400
720 min Winter	4.687	0.0	57.2	464
960 min Winter	3.743	0.0	60.8	586
1440 min Winter	2.723	0.0	66.4	812
2160 min Winter	1.979	0.0	72.4	1144
2880 min Winter	1.577	0.0	76.9	1500
4320 min Winter	1.143	0.0	83.7	0
5760 min Winter	0.910	0.0	88.8	0
7200 min Winter	0.762	0.0	92.9	0
8640 min Winter	0.659	0.0	96.4	0
10080 min Winter	0.583	0.0	99.5	0

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.121

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.040	4	8	0.041	8	12	0.040

Model Details

Storage is Online Cover Level (m) 101.000

Tank or Pond Structure

Invert Level (m) 100.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	67.0	0.600	67.0	1.200	0.0	1.800	0.0	2.400	0.0
0.100	67.0	0.700	67.0	1.300	0.0	1.900	0.0	2.500	0.0
0.200	67.0	0.800	67.0	1.400	0.0	2.000	0.0		
0.300	67.0	0.900	67.0	1.500	0.0	2.100	0.0		
0.400	67.0	1.000	67.0	1.600	0.0	2.200	0.0		
0.500	67.0	1.100	0.0	1.700	0.0	2.300	0.0		

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0067-2000-1000-2000
Design Head (m)	1.000
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	67
Invert Level (m)	99.950
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	2.0	Kick-Flo®	0.599	1.6
Flush-Flo™	0.296	1.9	Mean Flow over Head Range	-	1.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.6	0.800	1.8	2.000	2.7	4.000	3.8	7.000	4.9
0.200	1.9	1.000	2.0	2.200	2.9	4.500	4.0	7.500	5.1
0.300	1.9	1.200	2.2	2.400	3.0	5.000	4.2	8.000	5.2
0.400	1.9	1.400	2.3	2.600	3.1	5.500	4.4	8.500	5.4
0.500	1.8	1.600	2.5	3.000	3.3	6.000	4.6	9.000	5.5
0.600	1.6	1.800	2.6	3.500	3.5	6.500	4.7	9.500	5.7

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	100.430	0.430	1.9	28.8	O K
30 min Summer	100.558	0.558	1.9	37.4	O K
60 min Summer	100.670	0.670	1.9	44.9	O K
120 min Summer	100.743	0.743	1.9	49.8	Flood Risk
180 min Summer	100.752	0.752	1.9	50.4	Flood Risk
240 min Summer	100.736	0.736	1.9	49.3	Flood Risk
360 min Summer	100.699	0.699	1.9	46.8	O K
480 min Summer	100.665	0.665	1.9	44.6	O K
600 min Summer	100.632	0.632	1.9	42.4	O K
720 min Summer	100.601	0.601	1.9	40.2	O K
960 min Summer	100.532	0.532	1.9	35.6	O K
1440 min Summer	100.403	0.403	1.9	27.0	O K
2160 min Summer	100.261	0.261	1.9	17.5	O K
2880 min Summer	100.166	0.166	1.9	11.1	O K
4320 min Summer	100.071	0.071	1.7	4.7	O K
5760 min Summer	100.036	0.036	1.5	2.4	O K
7200 min Summer	100.021	0.021	1.3	1.4	O K
8640 min Summer	100.012	0.012	1.1	0.8	O K
10080 min Summer	100.006	0.006	1.0	0.4	O K
15 min Winter	100.487	0.487	1.9	32.6	O K
30 min Winter	100.632	0.632	1.9	42.4	O K
60 min Winter	100.762	0.762	1.9	51.0	Flood Risk
120 min Winter	100.853	0.853	1.9	57.2	Flood Risk
180 min Winter	100.872	0.872	1.9	58.4	Flood Risk
240 min Winter	100.861	0.861	1.9	57.7	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	138.153	0.0	31.3	25
30 min Summer	90.705	0.0	41.1	40
60 min Summer	56.713	0.0	51.5	68
120 min Summer	34.246	0.0	62.1	124
180 min Summer	25.149	0.0	68.4	182
240 min Summer	20.078	0.0	72.8	230
360 min Summer	14.585	0.0	79.4	288
480 min Summer	11.622	0.0	84.3	354
600 min Summer	9.738	0.0	88.3	422
720 min Summer	8.424	0.0	91.7	492
960 min Summer	6.697	0.0	97.2	626
1440 min Summer	4.839	0.0	105.3	874
2160 min Summer	3.490	0.0	114.1	1236
2880 min Summer	2.766	0.0	120.4	1568
4320 min Summer	1.989	0.0	130.0	2252
5760 min Summer	1.573	0.0	137.0	2944
7200 min Summer	1.311	0.0	142.7	3672
8640 min Summer	1.129	0.0	147.5	4400
10080 min Summer	0.994	0.0	151.5	5136
15 min Winter	138.153	0.0	35.1	25
30 min Winter	90.705	0.0	46.1	39
60 min Winter	56.713	0.0	57.6	68
120 min Winter	34.246	0.0	69.5	122
180 min Winter	25.149	0.0	76.6	178
240 min Winter	20.078	0.0	81.6	234

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
360 min Winter	100.815	0.815	1.9	54.6	Flood Risk
480 min Winter	100.772	0.772	1.9	51.8	Flood Risk
600 min Winter	100.728	0.728	1.9	48.8	Flood Risk
720 min Winter	100.683	0.683	1.9	45.8	O K
960 min Winter	100.591	0.591	1.9	39.6	O K
1440 min Winter	100.387	0.387	1.9	25.9	O K
2160 min Winter	100.190	0.190	1.9	12.8	O K
2880 min Winter	100.091	0.091	1.8	6.1	O K
4320 min Winter	100.029	0.029	1.4	1.9	O K
5760 min Winter	100.013	0.013	1.1	0.8	O K
7200 min Winter	100.004	0.004	0.9	0.3	O K
8640 min Winter	100.000	0.000	0.8	0.0	O K
10080 min Winter	100.000	0.000	0.7	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
360 min Winter	14.585	0.0	89.0	302
480 min Winter	11.622	0.0	94.5	376
600 min Winter	9.738	0.0	98.9	454
720 min Winter	8.424	0.0	102.7	532
960 min Winter	6.697	0.0	108.9	684
1440 min Winter	4.839	0.0	118.0	934
2160 min Winter	3.490	0.0	127.7	1276
2880 min Winter	2.766	0.0	134.9	1588
4320 min Winter	1.989	0.0	145.5	2216
5760 min Winter	1.573	0.0	153.5	2936
7200 min Winter	1.311	0.0	159.8	3672
8640 min Winter	1.129	0.0	165.2	0
10080 min Winter	0.994	0.0	169.8	0

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.121

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.040	4	8	0.041	8	12	0.040

Model Details

Storage is Online Cover Level (m) 101.000

Tank or Pond Structure

Invert Level (m) 100.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	67.0	0.600	67.0	1.200	0.0	1.800	0.0	2.400	0.0
0.100	67.0	0.700	67.0	1.300	0.0	1.900	0.0	2.500	0.0
0.200	67.0	0.800	67.0	1.400	0.0	2.000	0.0		
0.300	67.0	0.900	67.0	1.500	0.0	2.100	0.0		
0.400	67.0	1.000	67.0	1.600	0.0	2.200	0.0		
0.500	67.0	1.100	0.0	1.700	0.0	2.300	0.0		

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0067-2000-1000-2000
Design Head (m)	1.000
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	67
Invert Level (m)	99.950
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

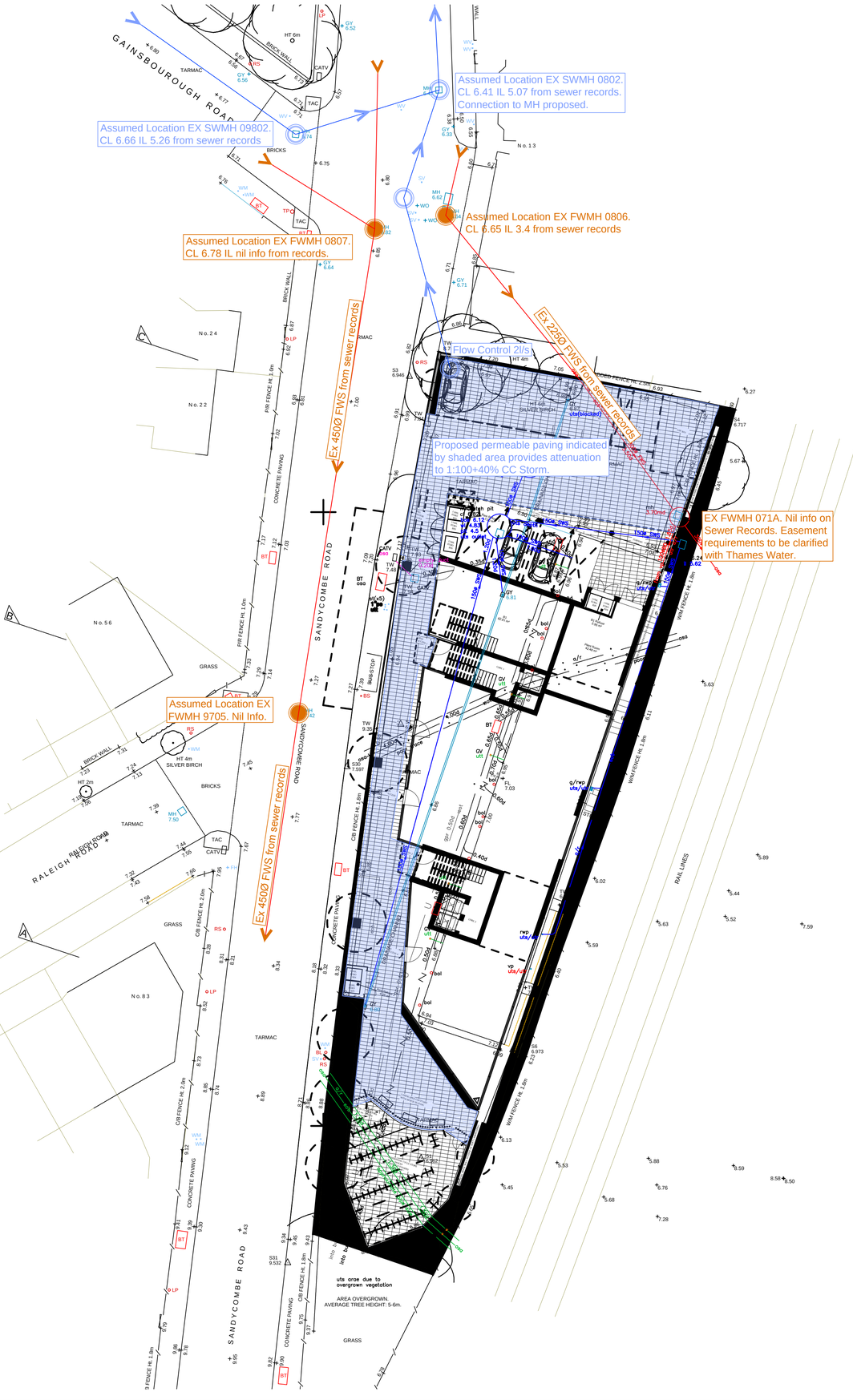
Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	2.0	Kick-Flo®	0.599	1.6
Flush-Flo™	0.296	1.9	Mean Flow over Head Range	-	1.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.6	0.800	1.8	2.000	2.7	4.000	3.8	7.000	4.9
0.200	1.9	1.000	2.0	2.200	2.9	4.500	4.0	7.500	5.1
0.300	1.9	1.200	2.2	2.400	3.0	5.000	4.2	8.000	5.2
0.400	1.9	1.400	2.3	2.600	3.1	5.500	4.4	8.500	5.4
0.500	1.8	1.600	2.5	3.000	3.3	6.000	4.6	9.000	5.5
0.600	1.6	1.800	2.6	3.500	3.5	6.500	4.7	9.500	5.7

APPENDIX F

Conceptual Surface Water Attenuation Plan



Notes

1. This drawing has been prepared in accordance with the scope of RPS's appointment with its client and is subject to the terms and conditions of that appointment. RPS accepts no liability for any use of this document other than by its client and only for the purposes for which it was prepared and provided.
2. If received electronically it is the recipients responsibility to print to correct scale. Only written dimensions should be used.

This drawing illustrates a sketch proposal only and as such is subject to detailed site investigation including ground conditions/contaminants, drainage, design and planning/density negotiations. The layout maybe based upon an enlargement of an OS sheet or other small scale plans and its accuracy will need to be verified by survey. Full risk analysis under the CDM Regulations has not been undertaken.

PRELIMINARY

Existing impermeable area = 1287m².
Surface water runoff from development restricted to 2l/s as practical minimum rate. Proposed impermeable area = 1211m². Proposed 327m² 'green roof' 438m² permeable paving proposed. 450mm depth permeable structure, assumed 30% void ratio. Provides attenuation for 1:100+40% CC storm (max volume 58.4m³. Subject to detailed levels design. Proposed outfall to ex SWMH 0802 subject to Detailed Levels and Drainage Design, and agreement with Thames Water.

Potential Green Roof Volume discounted for conceptual design purposes. Illustrated strategy is illustrative only and subject to detailed designs. Potential attenuation provision in permeable paving subject to detailed design including design gradients. Detailed designs and Thames Water requirements may require consideration of alternative strategy.

Rev	Description	Date	Initial	Checked
B	Updated to latest layout. Green roof area amended.	14.11.16	OP	
A	Updated to latest site layout. Volumes and areas adjusted to suit. .	14.10.16	LW	OP

For guidance only. Do not scale off this drawing

1:20 - 0 200mm 400mm 600mm 800mm 1000 1200 1400 1600 1800 2000
1:100 - 0 1m 2m 3m 4m 5m 6m 7m 8m 9m 10m
1:50 - 0 1m 2m 3m 4m 5m
1:5 - 0 100mm 200mm 300mm 400mm 500mm

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Client: Goldcrest Land PLC

Project: Sandycombe Road

Title: Indicative Surface Water Drainage Strategy

Status	Drawn By	PM/Checked by
Preliminary	OP	-

Job Ref	Scale @ A1	Date Created
SCR	1:200	03.12.15

Drawing Number	Rev
SK1	B

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APPENDIX G

SuDS Maintenance Plan

SuDS Maintenance Plan

This Maintenance Plan has been produced in order to ensure that the SuDS incorporated at the site remain functional for the lifetime of the development. This will ensure a continued reduction in local flood risk through the attenuation of surface water run-off on-site. It is proposed to provide 438m^2 of permeable paving and 327m^2 of green roofs at the site. These measures have been shown to provide a significant reduction in surface water run-off rates compared to the pre-development scenario. This plan demonstrates that the maintenance and operation requirements of the SuDS are economically proportionate to the development.

Type of SuDS	Illustration	Maintenance required	Regularity	Indicative cost
Green roofs	 Green roofs comprise a multi-layered system that covers the roof of a building or podium structure with vegetation cover / landscaping. The roof is likely to consist of an impermeable layer, or substrate or growing medium and a drainage layer.	Litter and debris removal	Monthly	£30 / month
		Weed removal	6 monthly	£60 / roof
		Inspection of bare patches and replacement of plants	6 monthly	£150 / roof
		Indicative annual maintenance cost - £2,500 per year for first 2 years for covered roof with sedum mat, £600 per year after. - £1,250 per year for first 2 years for covered roof with biodiverse roof, £150 per year after		
Permeable paving		Brushing and vacuuming the paving to remove any obstructions	4 monthly	Can be undertaken by residents / management time as part of landscape maintenance
		Stabilise and mow contributing areas and removal of weeds	Monthly, or as deemed necessary	As above

Type of SuDS	Illustration	Maintenance required	Regularity	Indicative cost
Permeable paving	Permeable surfacing is formed of material that is itself impervious to water but, by virtue of voids formed through the surface, allows infiltration through the pattern of voids. The water can be temporarily stored before infiltration to the ground, reused, or discharged to a watercourse or other drainage system. Surfaces with an aggregate sub-base can provide good water quality treatment.	Remedial work to any depressions or broken blocks	When required	c. £500 - £1000
		Rehabilitation of surface and upper sub-structure where significant clogging occurs	When required	c. £500 - £1000
		Replacement of filter material	Every 20-25 years	c. £3,000 - £5,000
		Indicative annual maintenance cost - £0.5 - £1 / m^3 of storage volume		

This document was compiled with reference to the Ciria Susdrain website, the CIRIA SuDS Manual (2007) and to 'Cost estimation for SUDS - summary of evidence' (Environment Agency, March 2015) and references therein.

APPENDIX H

LBRuT SuDS Checklist

Treatment – Improving the quality of water by physical, chemical and/or biological means.
Watercourse – A term including all rivers, streams, ditches, drains, cuts, culverts, dykes, sluices, and passages through which water flows.

Water table (or groundwater table) – The point where the surface of groundwater can be detected. The water table may change with the seasons and the annual rainfall.

Appendix 1:

DESIGN ASSESSMENT CHECKLIST: SCHEME

Table 1: Scheme Design Assessment Checklist

Requirements			
Site ID	1-9 SANDYCOMBE ROAD		
Site Location and co-ordinates	NORTH SHEEN, TW9 2EP / TQ 19021 75793		
Site description	Brownfield Commercial	Drawing Reference(s)	FRA Appendices E-G
Date of assessment	14/10/2016	Specification Reference	
Type of development	Residential & commercial	Site Area	0.147ha

	SuDS Manual Page Ref*	Y	N	Summary of details	Comments / Remedial actions
PRINCIPLES					
Is the runoff managed at or close to its source, wherever possible? If not, give reasons.	790	✓		Green roofs & permeable paving delay runoff flows → infiltration not possible	
Is the runoff managed at or close to the surface, wherever possible? If not, give reasons e.g. infiltration systems are being used to manage the runoff.	21/28	✓		Water stored in permeable paving substrate prior to discharge to sewer	
Where the drainage system serves more than one property, is public space used and integrated with the drainage system in an appropriate and beneficial way ? If not, give reasons.	20	✓		Permeable paving incorporated in entrance / car park areas	
Have the opportunities afforded by the drainage system in terms of green infrastructure, biodiversity, urban design, climate adaptation and amenity provision been maximised?	20	✓		Green roofs provide biodiversity & aesthetic benefits. Permeable paving incorporated into urban design.	
Has an appropriate SuDS Management train been provided?	27/575	✓		Interception and primary treatment provided by permeable paving & green roofs.	
Are the operating and maintenance requirements of the drainage system adequately defined?	252/430	✓		see Maintenance plan in Appendix G of FRA	
Is operation and maintenance achievable at an acceptable cost?	" "	✓		" "	
POINT OF DISCHARGE					
Does the design meet the following discharge hierarchy 1. Infiltration is preferred where it is safe and acceptable to do so; 2. If infiltration is not possible discharge to water course; 3. Discharge to sewer as last resort.	41	✓		1) Infiltration not permittable due to railway / highway adjacent 2) No nearby watercourse 3) Agreed with Thames Water	
If infiltration is used: Confirm that an acceptable infiltration assessment has been undertaken and submitted?				N/A	

	SuDS Manual Page Ref*	Y	N	Summary of details	Comments / Remedial actions
If discharge is to sewer, rather than a surface water body, provide justification.		✓		Infiltration not feasible & no nearby waterbody	
If discharge to a sewerage asset is proposed, has evidence been provided that the design criteria have been agreed with the sewerage undertaker and that an appropriate connection detail has been agreed?	41	✓		See Appendix A of FRA (TW confirmed capacity available)	
Have adequate and appropriate exceedance routes been provided and are they protected from future development?	47/48		✓	Tbc at detailed design	
INTERCEPTION					
Does the scheme design demonstrate on-site retention of approximately the first 5mm of runoff from impermeable surfaces for most events?	59		✓	Tbc at detailed design	
How is Interception to be delivered (e.g. infiltration, green roofs, permeable pavements, vegetated surfaces, bespoke design - provide details)?		✓		Interception provided by green roofs, permeable paving & vegetated surfaces	
PEAK FLOW RATE CONTROL					
Does the design demonstrate control of the 1 year, critical duration site event to the equivalent 1 year greenfield peak flow rate or below?	46	✓		1 year event restricted to 2 l/s - minimum flow for a system self-cleaning	
Does the design demonstrate control of the 100 year, critical duration site event to the equivalent 100 year greenfield peak flow rate or below?	46	✓		100 year event... " "	
Do the design calculations take account of future development (urban creep) and climate change?	47	✓		Includes climate change allowances, urban creep n/a as flats	
VOLUMETRIC CONTROL (FOR THE 100 YEAR, 6 HOUR EVENT)					
Does the design demonstrate that, for the 100 year 6 hour event: *Either:* The discharged site runoff volume is not greater than the equivalent greenfield runoff volume? *Or:* The discharged site runoff volume over and above the equivalent greenfield runoff volume (i.e. the Long Term Storage Volume) is discharged at a rate < 2 l/s/ha (or another rate that is considered acceptable in not negatively impacting flood risk of the receiving water body) *Or:* Peak flow rates from the site are restricted to 2 l/s/ha or Qbar, whichever is the greater ha (or another rate that is considered acceptable in not negatively impacting flood risk of the receiving water body).	45		✓	Unable to restrict volumes as infiltration techniques can't be used. However, runoff rates ~~CANNOT BE~~ are to be significantly reduced.	
WATER QUALITY TREATMENT					
Is the receiving water body (surface or groundwater) environmentally sensitive (E.g. Groundwater Source Protection Zone? What is its designation? Are any implications for drainage design clearly defined?				N/A	

	SuDS Manual Page Ref*	Y	N	Summary of details	Comments / Remedial actions
Does the design include an appropriate treatment strategy that ensures: 1. Sediment is trapped and retained on site in accessible and maintainable areas? 2. Has a sufficient number of drainage components been provided in series prior to discharge? 3. Suitable pollution removal capability e.g. % TSS removal (where this is a requirement of the SAB)	575 58	✓		Treatment provided in permeable paving and green roof substrates. Maintenance of areas included in Plan (Appendix G). Both have low TSS values	
FUNCTIONALITY				(uses)	
Are the design features sufficiently durable to ensure structural integrity over the system design life (residential 100 years and commercial 60 years), with reasonable maintenance requirements?	252/430	✓		See Appendix G of FRA	
Are all parts of the SuDS system outside any areas of flood risk? If not, provide justification and evidence that performance will not be adversely affected.	47	✓		See FRA	
Is pumping a requirement for operation of the system? If yes, provide justification and set out operation and maintenance/adoption arrangements.				N/A	
Has runoff and flooding from all sources (both on and off site) been considered and taken into account in the design?	47	✓		Site not at risk of flooding, local topography slopes away from site, so avoids ponding	
Are 1 in 30 year flows fully conveyed within the SuD system ?	47	✓		See Appendix E of FRA	
Are 1 in 100 year flows contained or stored on-site within safe exceedance storage areas and flow paths? Note some approving authorities may require greater return periods.	46	✓		See Appendix E of FRA; 1 in 100 year plus climate change fully accomodated	
CONSTRUCTABILITY					
Has an acceptable construction method statement been submitted and approved?	679/80		✓	To be provided at detailed design stage	
MAINTAINABILITY					
Has an acceptable Maintenance Plan been submitted and approved?	252/430	✓		See Appendix G of FRA	
INFORMATION PROVISION					
Do the design proposals include sufficient provision for community engagement and awareness raising?	717		✓	Information would be provided to relevant parties upon completion	

(*) to be added on completion of SuDS Manual update

SYSTEM DESIGN ACCEPTABILITY	Summary details including any changes required	Acceptable (Y/N)	Date changes made
Acceptable: Minor changes required: Major changes required / re-design:			