FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY

Proposed Redevelopment of Woking Football Stadium and Residential Development

Woking Football Stadium
Kingfield Road
Woking
GU22 9AA

Prepared for:
Woking Football Club

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1 INTRODUCTION

Background

1.1 RMA Environmental Limited was commissioned by Woking Football Club to prepare a Flood Risk Assessment (FRA) to support a full planning application for the redevelopment of Woking Football Club including new residential development.

1.2 This FRA has been prepared in accordance with the National Planning Policy Framework (NPPF), associated Planning Practice Guidance (PPG) and Environment Agency (EA) standing advice on flood risk for new development.

Site Location and Land Use

1.3 The site is currently occupied by a football stadium (Woking Football Club); a collection of large-footprint, low-rise buildings, including the Woking Snooker Centre; David Lloyd Leisure Centre (including tennis courts), Woking Gymnastics Club; car parking; and a small number of residential properties (81 Westfield Avenue, Hoe View, Park View and 1-6 Kingfield Road) situated in the north of the site.

1.4 The site extends to an area of approximately 5.0 hectares (ha) and is located at National Grid Reference TQ 00566 57330 (refer to Figure 1.1).

1.5 The site is bordered by the following land uses:

- Kingfield Road and residential dwellings are located adjacent to the northern boundary of the site;
- Westfield Avenue forms the western boundary of the site, beyond this is further residential development and Hoe Stream;
- residential dwellings are located along the eastern boundary of the site, a small pond is also located approximately 40 m east of the site;
- a ‘sports facility’ including playing fields form the southern boundary and residential buildings form the south-western boundary of the site; and
- the surrounding area is mostly urbanised with residential development.

1.6 Access to the site is currently via Kingfield Road to the north of the site. Further details on site topography, geology and hydrology are set out in Section 2.

Proposed Development

1.7 The Proposed Development comprises the redevelopment of the site, following the demolition of all existing buildings and structures, to provide a replacement stadium with ancillary facilities, including flexible retail, hospitality and community spaces, independent retail floorspace (Classes A1/A2/A3), a medical centre (Class D1) and vehicle parking, plus

residential accommodation comprising of 1,048 dwellings (Class C3) within 5 buildings of varying heights of between 3 and 10 storeys (and undercroft and part basement levels) on the south and west sides of the site, together with provision of new accesses from Westfield Avenue to car parking, associated landscaping and the provision of a detached residential concierge building.

1.8 Refer to the proposed development layout included within Appendix A.

Requirements for a Flood Risk Assessment

1.9 The requirements for FRA are provided in the NPPF and associated PPG. Paragraph 163 of the NPPF (2018) requires that a site-specific FRA should be submitted with planning applications for all sites greater than 1 ha in Flood Zone 1; for sites of any size within Flood Zones 2 or 3; in an area within Flood Zone 1 which has critical drainage problems; in an area within Flood Zone 1 which is identified in a strategic flood risk assessment as being at increased flood risk in the future; or an area within Flood Zone 1 that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.

1.10 Flood Zone 1 is defined as land with little or no flood risk (an annual exceedance probability [AEP] of flooding of less than 0.1%); Flood Zone 2 is defined as having a medium flood risk (an AEP of between 0.1% and 0.5% for tidal areas or 0.1% and 1.0% for rivers); and Flood Zone 3 is defined as high risk (with an AEP of greater than 0.5% for tidal areas or greater than 1.0% for rivers).

1.11 FRAs should describe and assess all flood risks (from rivers, the sea, surface water, reservoirs, sewers and groundwater) to and from the development and demonstrate how they will be managed, including an evaluation of climate change effects.

Consultation

1.12 Consultation has been undertaken with the following consultees and further details of these consultations are included within Section 3 and 4 of this FRA:

- a product 4 request has been undertaken with the EA to obtain the most up to date flood data for the site;
- direct consultation in the form of a meeting and email correspondence has been undertaken with Katherine Waters at Woking Borough Council (who are acting at the Lead Local Flood Authority) to determine modelled flood extents for the Hoe Valley Restoration Scheme and the scope of the surface water drainage strategy; and
- a pre-development enquiry has been undertaken with Thames Water to determine the location of sewers within the site and surrounding are and if there is sufficient capacity within the local foul sewerage system to supply the development.

2 BASELINE ENVIRONMENTAL CONDITIONS

Topography

2.1 A topographical survey of the site is included as Appendix B and this identifies that the site slopes in a north-westerly direction. The lowest recorded level is at 24.01 m above ordnance datum (AOD) in the north-western corner of the site and the highest recorded level is at 25.88 mAOD and is located in the far south-westerly corner of the site.

Hydrology

2.2 There is one 'main river'[1] within a 500 m radius of the site. This is identified as the Hoe Stream which is located approximately 45 m north-west of the site and flows in a north-easterly direction.

2.3 There are no other significant watercourses or water bodies within the surrounding area.

Geology and Hydrogeology

2.4 As reported on the British Geological Survey (BGS) online Geology of Britain Viewer, the site is underlain by the superficial deposits of Kempton Park Gravel comprising sand and gravel. This is further underlain by the bedrock geology of the Bagshot formation comprising sand.

2.5 The EA classify the superficial and bedrock geology as Secondary A Aquifers; these are defined as "*permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers*."

2.6 The far south-eastern part of the site is underlain by the bedrock geology of the London Clay Formation comprising clay silt and sand and this is classified by the EA as unproductive Strata; these are defined as *"rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow."*

2.7 The site is not located within a groundwater Source Protection Zone (SPZ).

[1] Main river is defined by the EA as any watercourse that contributes significantly to the hydrology of a catchment.

3 EXTERNAL FLOOD RISK

Flooding Mechanisms

3.1 The EA's flood map for planning (refer to Figure 3.1) indicates that the site lies entirely within Flood Zone 1 (low risk). Land located within Flood Zones 2 and 3 (medium and high risk, respectively) is located approximately 15 m to the north-west. Due to its close proximity to the site, it is necessary to assess the risk of climate change on the flood extents for the site's operational lifetime (estimated at 100 years). This is discussed further below.

3.2 The EAs risk of flooding from surface water flood maps identify that the majority of the site is at very low surface water flood risk (each year, this area has a chance of flooding of less than 1 in 1000 (0.1%)). There are only minimal areas with up to high surface water flood risk (each year, this area has a chance of flooding of greater than 1 in 30 (3.3%)) located within the north-west and southern areas of the site. This is discussed further below.

3.3 The Woking Borough Council (WBC) Strategic Flood Risk Assessment (SFRA) Volume 2 Technical Report (Nov 2015) identifies that the majority of the site is located within an area "*limited potential for groundwater flooding to occur*". The south-eastern corner of the site, however, is within an area with "*potential for groundwater flooding to occur at the surface".* This is discussed further below.

3.4 The WBC's SFRA identifies that the site lies within a postcode area with 33 records of sewer flooding. This is discussed further below.

3.5 A review of the SFRA and EA flood maps, has identified that there are no other significant sources of flooding at the site, i.e. from reservoirs.

Historic Flooding

3.6 The WBC SFRA (Capita Symonds, 2015) includes a map showing historical fluvial flood events within the borough. This identified that the northern extent of the site was affected by the winter 2013/2014 flood extents as well as the September 1968 flood event.

3.7 The January 2003 flood event flooded the sports ground and playing field directly south of the site.

3.8 The EA's historic flood map (included in Appendix C) identifies one record of historic fluvial flooding for the site dated from 1968. Mapping of the event identifies that fluvial flooding extended approximately 85 m into the northern part of the site.

Fluvial Flooding

3.9 As detailed above, the EA's flood map for planning (refer to Figure 3.1) indicates that the site lies entirely within Flood Zone 1 (low risk); however, the site is located 15 m from land located within Flood Zones 2 and 3 (medium and high risk, respectively), therefore, it is necessary to assess the risk of climate change on the flood extents for the site's operational lifetime (estimated at 100 years).

3.10 Detailed flood data has been obtained from the EA and modelled flood extents are derived from the Hoe Stream Flood Alleviation Scheme mapping (Hoe Stream model (Mayford to Wey confluence) (2014)), carried out using 2D modelling software (ISIS-Tuflow). This data is included within Appendix C of this report and identifies that the site benefits from flood defences along the Hoe Stream.

3.11 Consultation with WBC, who are acting as the Lead Local Flood Authority (LLFA) for the site, has identified that WBC and the EA have been working in partnership to design and implement the Hoe Valley Restoration Scheme and that this involves updating the 2014 modelling and this model is due to be published shortly. WBC have provided the output mapping for the defended scenario including climate change scenarios and the in-channel defended and undefended flood levels incorporation into this FRA (refer to Appendix C). The in-channel flood levels are summarised in Table 3.1 below.

Table 3.1: In-channel flood levels from the updated Hoe Stream Modelling

Return Period	Peak Water Level (mAOD)	
	Defended Scenario	Undefended Scenario
Q100	24.71	24.66
Q100 cc35%	25.08	25.02
Q100 cc70%	25.35	25.28

3.12 As detailed above (and from reviewing the EA's spatial flood defence data), the site benefits from flood defences along the Hoe Stream. Table 3.2 below summarises details of the flood defences that are adjacent to the site.

Table 3.2: EA Flood Defence Data for the site

Type of defence	Location to the site at its closest point	Crest Level (mAOD)		Design standard (Condition)
		DS	US	
Flood embankment (part of the Hoe Stream FAS)	26 m west and extend for 823 m south along the Hoe Stream	25.60	26.00	100 years (Poor)
Reinforced Concrete Flood Wall (Hoe Stream FAS RC17)	20 m north and extends for 50 m north along the Hoe Stream	25.45	25.45	100 years (Fair)
Earth Flood Embankment (Hoe Stream FAS 1j)	50 m north and extends for 58 m north along the Hoe Stream	25.25	25.25	100 years (Good)
Earth Flood Embankment (Hoe Stream FAS 4b)	70 m north and extends for 220 m north along the Hoe Stream	25.90	25.25	100 years (Fair)

3.13 The EA's Guidance on climate change allowances (2016) states that for sites situated within EA Flood Zone 1, the central allowance should be used when determining the impact of climate change on flood risk.

3.14 The site falls within the Thames river basin district and the central allowance for the year 2115 is 25%. The updated EA modelling data for the site includes the 35% and 70% climate change scenarios and therefore, for the purpose of this report (and as a conservative measure) the 35% climate change scenario has been considered when determining the impacts of climate change on the proposed development.

3.15 From reviewing Table 3.1 and 3.2 above, the crest levels of the fluvial flood defences are approximately 0.17 m to 0.82 m above the defended modelled 100-year flood level with 35% allowance for climate change and, therefore, it is concluded that the flood defences would provide protection for the operational lifetime of the development.

Worst-Case Scenario

3.16 The undefended 100-year flood event with a 35% allowance for climate change (25.02 mAOD) has been used as the worst-case scenario for the proposed development. It is important to note that this scenario is assuming that all flood defences within Woking were to breach during a 100-year flood event, which is considered to be improbable. A breach in the flood defences protecting the site would result in a lower flood risk to the site when compared to the undefended scenario; however, in the absence of breach modelling, the 100 year with 35% climate change allowance level is being used as a conservative measure.

3.17 During this flood event, the site would flood to a maximum depth of 1 m which would occur in the northern part of the site. The central part of the site will remain dry; however, some of the southern extent of the site would experience shallow flooding to depths up to 0.2 m as flood water would flow down Kingfield Road and enter the site from the south-east.

3.18 All residential development is proposed to be located approximately 1.5 m above existing ground level. The lowest residential finished floor level (which is located within Block 1 in the north-west of the site) is 25.5 mAOD; this is 480 mm above the undefended 100-year event with 35% climate change level and therefore, should this event occur, a safe refuge would be provided within the residential dwellings. Any land uses below this flood level are classified as 'less vulnerable' land uses.

3.19 Based on the above, it is concluded that the site will be provided protection from flooding by the flood defences along the Hoe Stream for its operational lifetime (assumed to be 100 years). In the very unlikely event of a breach of the defences for the 100 years 35% climate change event, then part of the site will be flooded to a maximum depth of 1 m. However, all residential development is located a significant freeboard above this flood level providing a safe refuge for future occupants.

Surface Water Flooding

3.20 The EA's risk of flooding from surface water mapping identifies that most of the site has a very low risk of surface water flooding, as does much of the surrounding area. Very low surface water flood risk is defined where *"each year, this area has a chance of flooding of less than 1 in 1000 (0.1%)."*

3.21 There are small areas of low surface water flood risk located within the north-western corner of the site as well as in the south. Low surface water flood risk is defined where *"each year, this area has a chance of flooding between 1 in 1000 (0.1%) and 1 in 100 (1%)".*

3.22 There are very limited areas of medium and high surface water flood risk in the north-western and southern areas of the site. Medium surface water flood risk is defined where *"each year, this area has a chance of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%)".* High surface water flood risk is defined where "*each year, this area has a chance of flooding of greater than 1 in 30 (3.3%)*".

3.23 The EA's mapping indicates that the areas of surface water flood risk on site are limited in size and do not appear to constitute any flow paths (i.e. they originate within the site boundary). The extents of medium/high surface water flood risk are located with existing areas of hardstanding surrounding the buildings and is ultimately ponded water. Post-development, it is considered that any ponding of surface water in extreme events will be re-distributed to the new low points within the site (i.e. areas of open space and roads) and managed by the surface water drainage strategy.

3.24 The EA's surface water flood risk mapping shows what "*happens when rainwater does not drain away through the normal drainage systems or soak into the ground but lies on or flows over the ground instead*." It is noted that this type of flooding is difficult to predict and was based on the best information available to the EA regarding ground levels and drainage.

3.25 Surface water flood risk is deemed to be less significant than the fluvial flood risk and, consequently, would also be mitigated by measures outlined for the fluvial risk below as well as being reduced through the implementation of the proposed drainage strategy.

Groundwater Flooding

3.26 As previously stated, the majority of the site is located within an area "*limited potential for groundwater flooding to occur*" and the south-eastern corner of the site is within an area with "*potential for groundwater flooding to occur at the surface".*

3.27 From reviewing the borehole records on site included within the Geo-Environmental and Geotechnical Assessment (Ground Investigation) Report, it is identified that groundwater is located at a level of between 22.22 and 23.26 m AOD which ranges between 1.7 m bgl and 2.87 m bgl within the Kempton Park Gravel that underlies the site (refer to Figure 3.2). The borehole data indicate a hydraulic gradient in a northerly direction towards to Hoe Stream, as expected.

3.28 The proposed development involves the construction of five residential blocks up to ten storeys high and the inclusion of a new football stadium. The two southern blocks (Block 4 and Block 5) include a lower ground level and a basement level. The three western blocks (Blocks 1, 2 and 3) comprise of just a lower ground level. The lowest proposed finished floor levels (FFL) of the lower ground level for all of the blocks is 22.50 mAOD. The proposed FFL of the basement levels is 20.50 m ADO. There are no basement levels proposed for the football stadium.

3.29 From reviewing the borehole records on site, in the area in which the western blocks are situated, groundwater was encountered between 22.22 and 23.26 mAOD. The proposed FFL of the lower ground level within these blocks is 22.50 m AOD and therefore the lower ground level will be located partially below groundwater level.

3.30 Groundwater depths within the area where the two southern blocks are proposed are identified to be between 22.87 and 23.16 mAOD. The proposed FFL for the basements within these blocks is 20.50 m AOD and therefore, they will be located primarily within the Kempton Park Gravel.

3.31 The land uses proposed within the lower ground level and basement level within the residential blocks will be used for parking uses only and in accordance with Table 2 of the NPPF, these land uses are classified as 'less vulnerable' to flooding.

3.32 Based on the above, it is considered likely that the lower ground level and basement levels of the residential blocks would extend below the anticipated groundwater levels. Considering that the footprint of the blocks are relatively small and there are only one-storey basement levels proposed, the volume of displaced groundwater may result in a rise in groundwater level locally; however it is considered that this would not increase the risk of groundwater emergence at the surface. The Kempton Park Gravel Formation is a Secondary A Aquifer with a relatively high transmissivity which would allow vertical and lateral migration of surface water.

3.33 Therefore, the risk of groundwater flooding affecting the proposed development and the potential to increase groundwater flood risk is deemed to be low.

Sewer Flooding

3.34 The Woking Borough Council historic flood records within the SFRA (2015) show that the site lies within a postcode area with 33 records of overloaded sewer flooding. However, the exact magnitude, extent and location of these flooding incidents are not recorded.

Mitigation Measures

Groundwater Flooding

3.35 It is recommended that the construction of the basements incorporates flood resistant techniques to ensure that the basement would remain free from groundwater ingress. Techniques may include the likes of a cofferdam around the perimeter of the basement to prevent lateral movement of groundwater, dewatering of the excavation for the development and retaining walls within the basement levels are likely to be required.

Sewer Flooding

3.36 Mitigation against sewer flooding could be achieved through the provision of non-return valves which prevent water entering the properties from drains or sewers. Non-return valves can be installed with gravity sewers or drains, within the site's private sewer system. Further information is provided in the CIRIA publication *'Low cost options for revention of flooding from sewers'*.

Safe Access/Egress

3.37 Access/egress to the site is via Kingfield Road to the north of the site and via Westfield Avenue located along the western boundary of the site.

3.38 As previously stated, the site will be provided protection via the flood defences along the Hoe Stream for its operational lifetime and, therefore, safe access/egress via Westfield Avenue along the western boundary is readily achievable.

3.39 During the worst-case scenario, (i.e. the undefended 100-year flood event with 35% allowance for climate change (25.02 mAOD)), Kingfield Road and the northern extent of Westfield Avenue would flood to a maximum depth of 1 m. The central area of the site would remain dry.

3.40 All residential development is located approximately 1.5 m above the existing ground level and at least 480 mm above the undefended 100-year event with 35% climate change level. Therefore, should this event occur, a safe refuge would be provided within all of the residential dwellings.

3.41 On this basis, it is concluded that future occupants of the development would be safe during the design flood event for the operational lifetime of the development.

3.42 The future occupants of the site would be required to sign up to the EA's flood warning service for the Hoe Stream, to ensure that sufficient warning is provided in the event of an extreme flood. This will ensure that, should the EA issue a flood warning for the area, all occupants would have sufficient time to leave the site.

3.43 The home owners will be responsible for acting on flood warnings and the procedures to be followed in the event of a flood. These measures will be set in a Flood Evacuation Plan, which would be submitted to the EA and Council for approval prior to commencement of the proposed development.

Land Use Vulnerability

3.44 Table 2 of the NPPF PPG sets out a schedule of land uses based on their vulnerability or sensitivity to flooding. As set out in Table 2, the proposed residential development is classified as a land use that is 'more vulnerable' and the commercial development is classified as 'less vulnerable' to flooding.

3.45 The site is currently located within Flood Zone 1 (low risk) and from receiving detailed flood data from the EA, the site is protected by flood defences for its operational lifetime. During the worst-case scenario (the undefended 100 year flood event with 35% allowance for climate change), parts of the site will be located within future Flood Zone 2 and 3 and the lower ground level and basements will flood; however, these comprise of car parking areas and all residential 'more vulnerable' development will be located at least 480 mm above the flood level.

3.46 Referring to Table 3 of the PPG, all land uses are considered appropriate within Flood Zone 1, however, the Sequential Test would need to be passed for any proposed development in Flood Zones 2 or 3a.

3.47 The Woking Borough Council Site Allocations Development Plan Document (November 2018) identifies that the site is allocated for regeneration under *Policy UA44: Woking Football Club, Woking Gymnastic Club, Woking Snooker Club, Westfield Avenue, Woking, GU22 9AA.* The Policy identifies how the site is allocated for a mixed-use development to include a replacement football stadium, residential including affordable housing and commercial retail uses. There are a number of key requirements identified within the policy that the development must address, those associated with drainage and flood risk are as follows:

- *Due to the built-up nature of the site and surrounding area surface water flooding should be mitigated in the design of the development; and*
- *Development to meet relevant Sustainable Drainage Systems requirements at the time of planning application for the development of the site.*

3.48 Considering that the site is currently located within Flood Zone 1 (low risk) and is identified within the Woking Borough Council Site Allocations Development Plan, the development should be deemed appropriate in planning policy terms in its proposed location.

4 DRAINAGE ASSESSMENT

Introduction

4.1 This drainage strategy has been prepared in accordance with Defra's *"Non-statutory technical standards for sustainable drainage systems"* (March 2015) to ensure that the proposed development does not increase flood risk to the site or elsewhere and where practicable reduces flood risk over the lifetime of the development.

4.2 Peak rainfall intensity is expected to increase as a result of climate change and, as such, storage calculations have included a 40% increase in rainfall depths in accordance with current climate change guidance.

4.3 The surface water drainage strategy has been prepared by Tier Consult in association with RMA Environmental Ltd and is provided in Appendix D.

Summary

4.4 The site currently comprises of Woking football stadium, a leisure centre comprising tennis courts, a snooker club, gymnasium, various sports halls and car parking area and residential dwellings.

4.5 Falling head permeability tests have been undertaken within the existing wells on site to determine whether infiltration is feasible. Due to logistical reasons and considering that the Kingfield site is still operational, BRE365 compliant infiltration testing was not practicable on site at this time. The falling head permeability test results are included in Appendix D of this report. This testing confirmed that there is low potential for infiltration across most of the site. Hoe Stream is located just 40 m north-west of the site and it is proposed to maintain the existing connections on site and discharge surface water into the surface water sewer on Westfield Road which ultimately discharges to Hoe Stream.

4.6 Table 4.1 provides an overview of the feasibility of a range of Sustainable Drainage Systems (SuDS) techniques which are considered in accordance with the SuDS hierarchy in order to identify the most appropriate for the proposed development.

Table 4.1: Type and Feasibility of SuDS

Technique	Comments	Feasibility	Utilised	
Green roofs	Requires flat or minimal slope roofs. Limited value for runoff attenuation in comparison with other techniques.	Feasible	✓	Green roofs are proposed on residential blocks, where practicable.
Soakaways and infiltration trenches	Require infiltration rates of 1 x 10^{-6} m/s or greater. Shallow soakaways or infiltration trenches would be required where groundwater is shallow (i.e. less than 2.0 mbgl).	Not Feasible	x	Falling head tests have been completed and infiltration rates and groundwater depth are not suitable for soakaways.

Technique	Comments	Feasibility	Utilised	
Infiltration basins / swales	Are widely applicable for attenuation and treatment of surface runoff by infiltration into the ground. Require slope of no more than 4-10% and can act as a substitute for soakaways where groundwater is shallow.	Not Feasible	x	Falling head tests have been completed and infiltration rates and groundwater depth are not suitable for soakaways.
Bio-retention – landscaped infiltration areas	Primarily used to remove pollutants from runoff and due to their shallow nature are not as effective at runoff attenuation as other SUDS techniques.	Feasible	✓	Runoff from surfaces will be diverted to tree pits and rain gardens with excess runoff being diverted to the positive drainage system.
Permeable pavement	Ideally requires a level site and favourable underlying ground conditions. May be suitable in areas of relatively flat topography. Can be linked with geocellular storage or a porous sub-base.	Feasible	✓	Lined permeable paving will be used for non-adopted areas.
Non-infiltration swales	Used in the same way as carrier ditches or storage bunds. Shallow swales can be used for conveyance and/or storage.	Not Feasible	x	Insufficient space is available within the layout as a result of economic constraints (refer to Para 4.6)
Filter drains	These are normally used adjacent to areas of car parking or roads and convey runoff via flow through an engineered substrate.	Feasible	x	Not proposed.
Balancing ponds or attenuation basins	These are permanent ponds or basins that provide storage. These are appropriate for most sites but require suitable space.	Not Feasible	x	Insufficient space is available within the layout as a result of economic constraints (refer to Para 4.6)
Geo-cellular storage	Geo-cellular storage or similar sub-base medium beneath car parking areas and/or other areas of hardstanding and/or other forms of underground attenuation.	Feasible	✓	Storage provided within roads and permeable paving above the tanks will provide additional storage and appropriate treatment for runoff from road surface

4.7 The site at Kingfield Road has been designed to enable the development of a new football stadium with a capacity of 9,026 seats. In order to enable the redevelopment of the football stadium and make it financially sustainable, the site must incorporate a certain quantum of residential development. Given the economic and technical constraints on this site, insufficient space is available within the layout for above ground SuDS features, such as swales and ponds. Falling head tests have been completed and confirmed that infiltration rates and groundwater depths are not suitable for soakaways, however, green roofs are proposed on all residential blocks and bio-retention areas incorporating tree pits and rain gardens are also to be provided, where possible. Lined permeable paving will be also be used to improve the quality of runoff.

4.8 The rate of discharge to the public sewer will be controlled by a hydro-brake. Refer to drawings t_19_2157-55-01 within Appendix D of this report.

4.9 The drainage arrangement for the proposed development will limit runoff for all events up to and including the 100 year plus 40% climate change to Qbar i.e. to a rate of 15 l/s.

4.10 Full details of the proposed surface water drainage strategy are provided in Appendix D.

Designing for Exceedance Events

4.11 If the proposed drainage system were to become blocked or an event above the design event occur, then exceedance flows would be routed along the road network towards the northern boundary onto Kingfield Road and ultimately into Hoe Stream (refer to Figure 4.1). This would mimic what would occur on the site in its existing condition and would ensure that the proposed development is safe during an exceedance event.

4.12 To account for the possibility of surcharge in the receiving public surface water sewer, the model outputs have been included within Appendix D of this report and the outfall from the model has been surcharged to 23.02 m AOD (the soffit level at the point of connection). This confirmed that there is no flooding within the site during the surcharged condition.

Long Term Maintenance of SuDS

4.13 Where SuDS features serve more than one property, it would be the responsibility of the developer to either maintain the SuDS features themselves or to negotiate with and secure the agreement of a third party to maintain the sustainable drainage system.

4.14 The maintenance requirements of the proposed SuDS features for use in the drainage strategy are detailed in the SuDS Manual and would be carried out accordingly.

Foul Drainage

4.15 Consultation with Thames Water (refer to Appendix E) identifies the location of sewers in the vicinity of the Site. This has identified that there are foul sewers along Westfield Avenue to the west of the site.

4.16 Consultation with Thames Water was undertaken to determine if there is sufficient capacity within the local foul sewerage system (refer to Appendix E). This concluded that the foul sewerage network does not currently have enough capacity to serve the development. Therefore, Thames Water are required to carry out detailed modelling work and potential off-site reinforcement to ensure the necessary improvement are in place prior to the development going ahead.

4.17 It should be noted that since the publication of the new connections and development charging rules in April 2018, drainage authorities in England are obligated to provide a point of connection and undertake any mitigation or improvement works and network reinforcements, where necessary. These will be programmed once planning consents are granted. Therefore, it is recommended that Thames Water should be consulted following planning consent so this detailed network modelling can be undertaken.

5 CONCLUSIONS

5.1 The requirements for Flood Risk Assessment are provided in the National Planning Policy Framework and its associated Planning Practice Guidance, together with the Environment Agency's Guidance Notes. This policy and associated guidance have been followed in the preparation of this FRA.

5.2 The EA's flood map for planning identifies that the entire site lies within Flood Zone 1 (low risk). Land located within Flood Zones 2 and 3 (medium and high risk, respectively) is located approximately 15 m to the north-west and, therefore, it is necessary to assess the risk of climate change on the flood extents for the site's operational lifetime (estimated at 100 years).

5.3 WBC and the EA have been working in partnership to design and implement the Hoe Valley Restoration Scheme and that this involves updating the 2014 modelling and this model is due to be published shortly. WBC have provided the output mapping for the defended scenario including climate change scenarios and this concludes that the crest levels of the fluvial flood defences are approximately 0.17 m to 0.82 m above the defended modelled 100-year flood level with 35% allowance for climate change and, therefore, it is concluded that the flood defences would provide protection for the operational lifetime of the development.

5.4 The undefended 100-year flood event with a 35% allowance for climate change (25.02 mAOD) has been used as the worst-case scenario for the proposed development and during this flood event, the site would flood to a maximum depth of 1 m which would occur in the northern part of the site. The central part of the site will remain dry; however, some of the southern extent of the site would experience shallow flooding to depths up to 0.2 m as flood water would flow down Kingfield Road and enter the site via the south-east.

5.5 All residential development is proposed to be located approximately 1.5 m above the existing ground level and this is at a minimum 480 mm above the undefended 100-year event with 35% climate change level. Therefore, should this event occur, a safe refuge would be provided within the residential dwellings. Any land uses below this flood level are classified as 'less vulnerable' land uses.

5.6 When referring to surface water flood mapping, most of the site has a very low to low risk of surface water flooding. There are very limited areas of medium and high surface water flood risk in the north-western and southern areas of the site; however, these areas are limited in size and do not constitute any flow paths (i.e. they originate within the site boundary). The extents of medium/high surface water flood risk are located with existing areas of hardstanding surrounding the buildings and is ultimately ponded water. Post-development, any ponding of surface water in extreme events will be re-distributed to the new low points within the site (i.e. areas of open space and roads), as well as being reduced through the implementation of the proposed drainage strategy.

5.7 From reviewing the borehole records on site included within the Ground Investigation report, groundwater is located between 1.7 and 2.87 m bgl within the Kempton Park Gravel. When assessing groundwater levels and FFLs of the basement and lower ground level, it is considered likely that the lower ground level and basement levels of the residential blocks would extend below the anticipated groundwater levels.

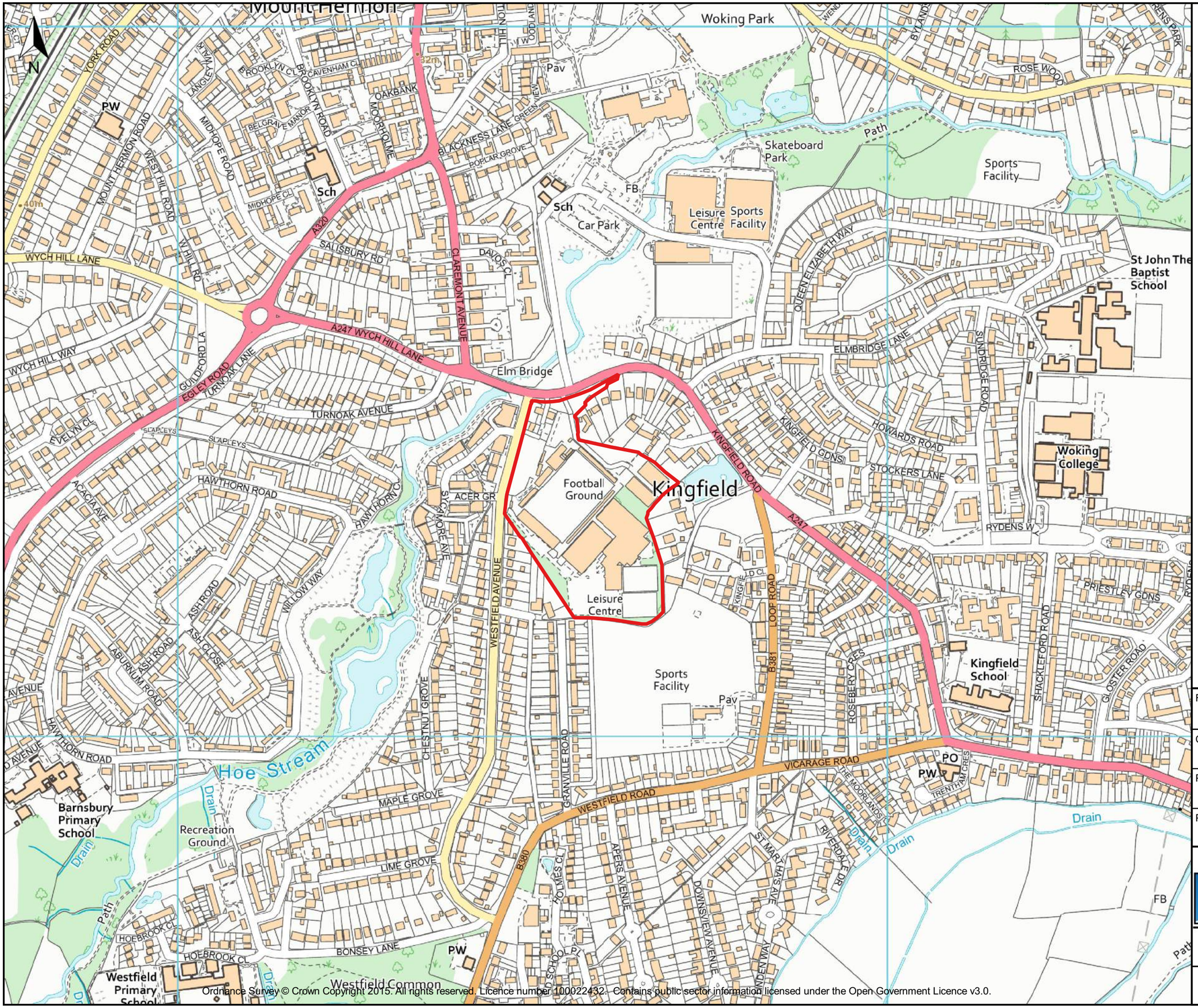
5.8 Considering that the footprints of the blocks are relatively small and there is only one-storey basement levels proposed, the volume of displaced groundwater may result in a small rise in groundwater level locally; however, it is considered unlikely that the risk of groundwater emergence at the surface would be increased. It is recommended that the construction of the basements incorporate flood resistant techniques to ensure that they would remain free from groundwater ingress.

5.9 The WBC historic flood records show that the site lies within a postcode area with 33 records of overloaded sewer flooding. However, the exact magnitude, extent and location of these flooding incidents are not recorded. Mitigation against sewer flooding could be achieved through the provision of non-return valves which prevent water entering the properties from drains and sewers.

5.10 The proposed drainage strategy comprises of green roofs, lined permeable paving and geo-cellular tanks and would ensure that surface water runoff rates for the proposed development would be limited to 15 l/s. Surface water runoff would discharge into the public sewer along Kingfield Road which ultimately drains to the Hoe Stream. Attenuation would be provided for all return periods up to and including the 1 in 100 year event inclusive of a 40% allowance for climate change.

5.11 This FRA has therefore demonstrated that the proposed development will be safe and that it would not increase flood risk elsewhere. The proposed land uses are classified as ‘more vulnerable’ and ‘less vulnerable’ development which are considered appropriate in relation to the flood risk vulnerability classifications set out in Table 3 of the NPPF. The development should therefore be considered acceptable in planning policy terms.

Figures



Key

Red Line Boundary

Figure 1.1: **Site Location Plan**

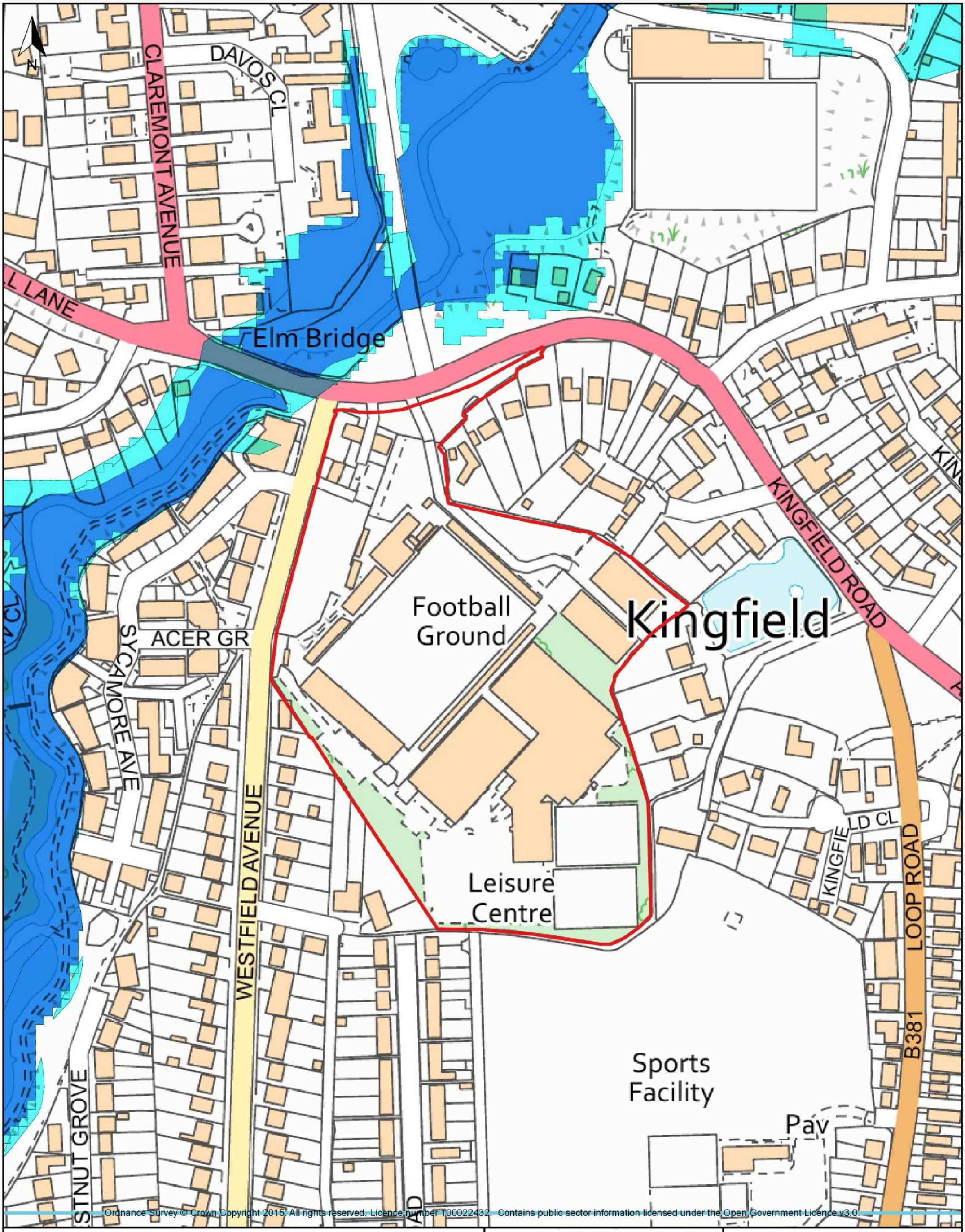
Client: **Woking Football Club**

Project: **Woking Sites EIA**

Project No.: **C1947**

RMA ENVIRONMENTAL

Drawn:	Checked:	Date:	Scale:
MS	RM	08/11/2019	1:5,000@A3



Key

- Red Line Boundary
- EA Flood Zone 2
- EA Flood Zone 3

Figure 3.1: **EA's Flood Map for Planning**

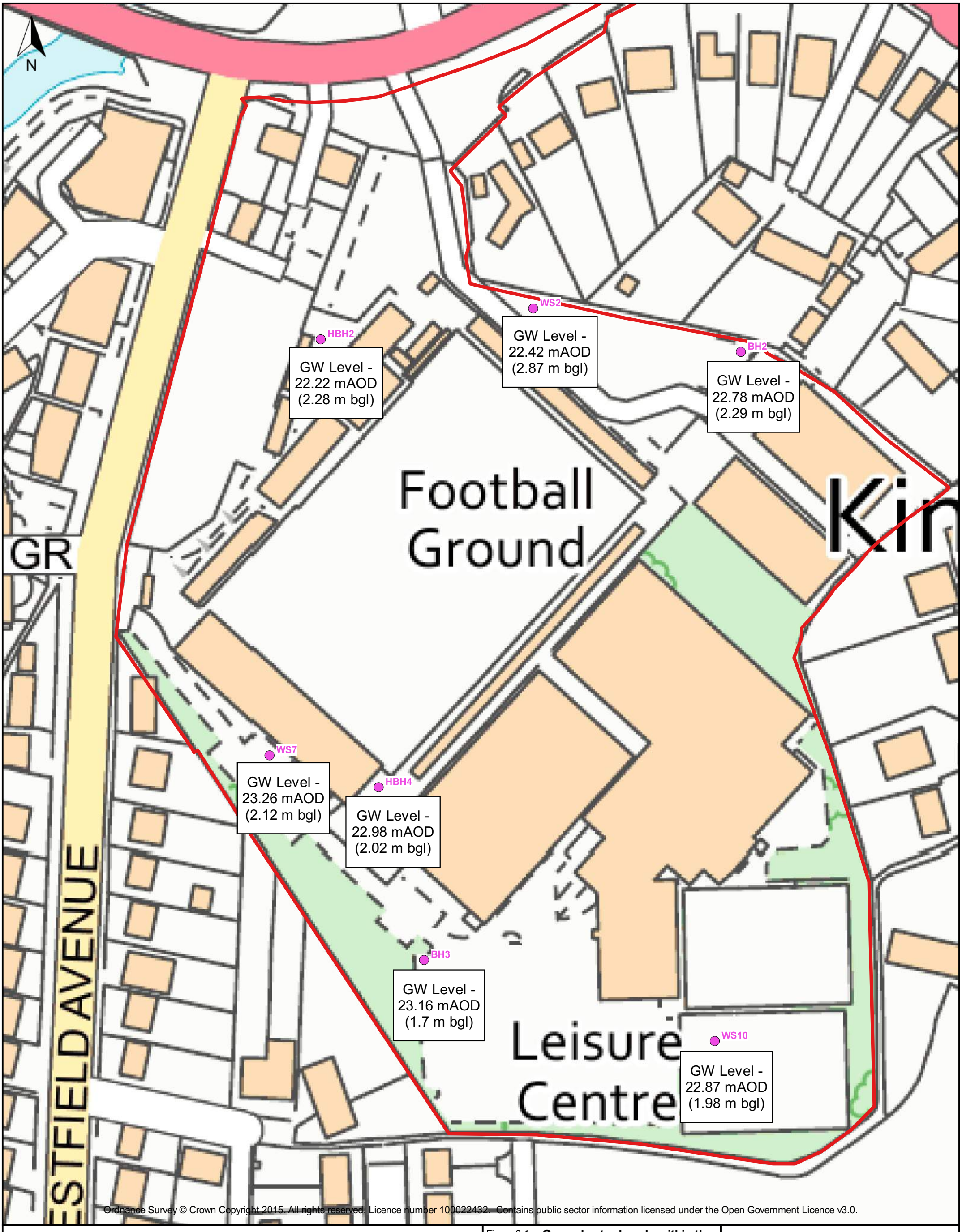
Client: **Woking Football Club**

Project: **Woking FC FRA**

Project No.: **C1947**

RMA ENVIRONMENTAL

Drawn:	Checked:	Date:	Scale:
MS	RM	08/11/2019	1:2,000@A3



Key

- Red Line Boundary
- Borehole Locations

Figure 3.1: **Groundwater Levels within the Site**

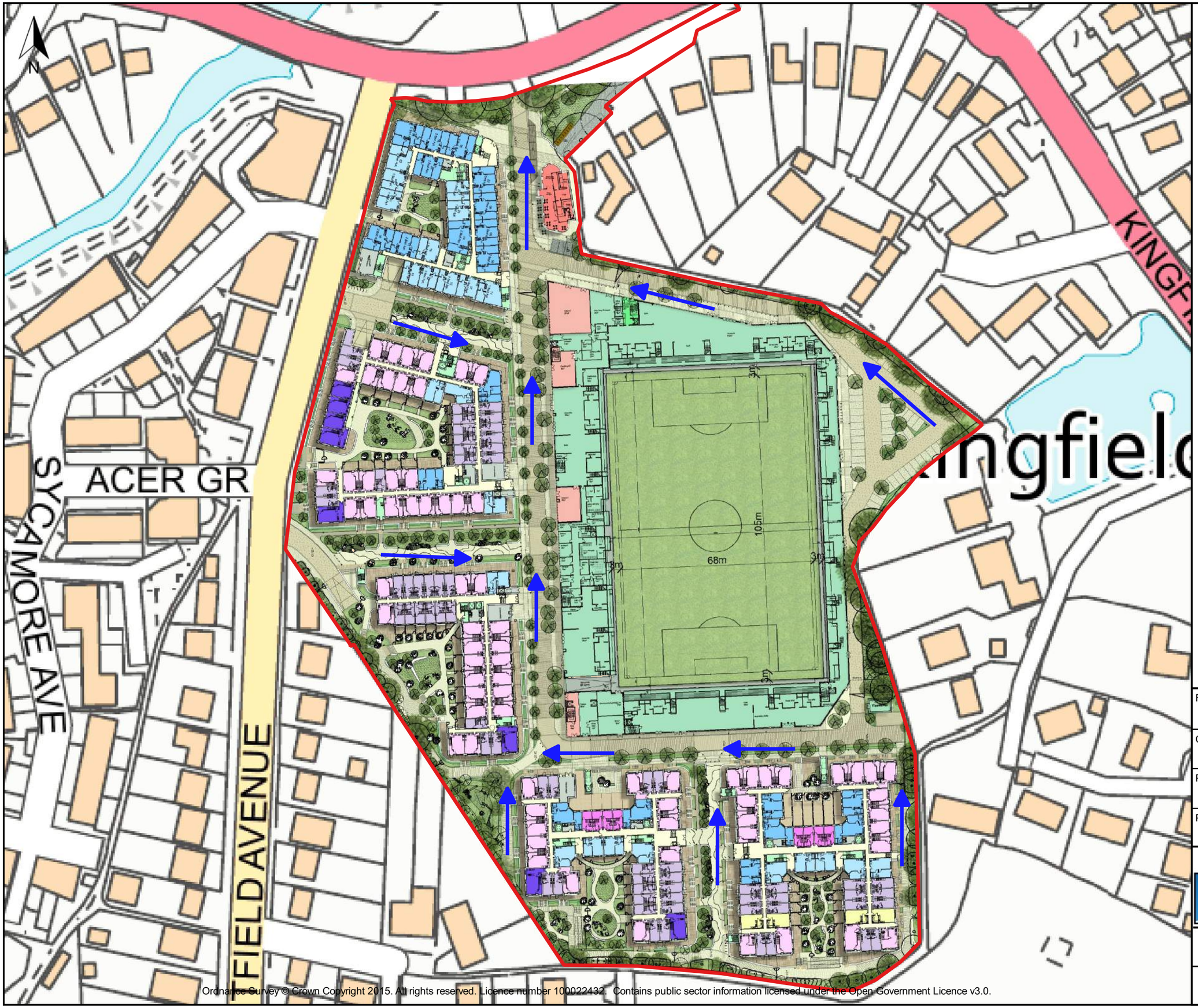
Client: **Woking Football Club**

Project: **Woking FC EIA**

Project No.: **C1947**

RMA ENVIRONMENTAL

Drawn:	Checked:	Date:	Scale:
MS	RM	08/11/2019	1:1,000@A3



Key

- Red Line Boundary
- Surface Water Flow Path

Figure 4.1:	**Surface Water Flow Paths in an Exceedance Event**
Client:	**Woking Football Club**
Project:	**Woking FC**
Project No.:	**C1947**

RMA ENVIRONMENTAL

Drawn:	Checked:	Date:	Scale:
MS	RM	08/11/2019	1:1,250@A3

Appendix A: Proposed Development Layout

KEY

- STUDIO APARTMENT
- 1 BEDROOM APARTMENT
- 1 BEDROOM DUPLEX / TOWNHOUSE
- 2 BEDROOM APARTMENT
- 2 BEDROOM TOWNHOUSE
- 2 BEDROOM UPPER DUPLEX
- 2 BEDROOM LOWER DUPLEX
- 3 BEDROOM APARTMENT / TOWNHOUSE
- COMMUNITY CONCIERGE
- COMMERCIAL AREA
- DOCTORS AND DENTIST FACILITY
- STADIUM

0 10 20m 40m

SCALE @ 1:500

LeachRhodesWalker Architects

Ground Floor West 50 Dearmans Place Manchester M3 5LH t 0161 833 0211 e info@lrw.co.uk www.lrw.co.uk

7884 Cardinal Court Inc. Woking Football Club : PROPOSED GROUND FLOOR (COLOUR)

Scale: **1:500@A1** Auth By: **CJG** Drawn By: **AM** Date: **05.09.19** Dwg No: **7884-L(00)79L**

Appendix B: Topographical Survey

Notes

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KEY

- Bottom of slope / batter
- Building
- Ditch bottom
- Dropped Kerb
- Edge of change in surface
- Eaves and Ridge 2D
- Fence
- Foliage (Outline)
- Hedge
- Kerb
- PIPE Pipe String
- Road Centre Line
- Road Line
- Hedge Rootline
- Road Markings
- RS Road Sign board
- String ground level
- Top of slope / batter
- Track
- Track Centre
- TP Telegraph pole
- Verge
- Wall
- Wall Centre
- Bush
- GP Gate
- Road Markings (Max Speed)
- TREE "HT=" Tree
- Bol Bollard
- TEL Telephone cover
- Box
- FH Fire Hydrant
- GP Gate post point
- Gulley Square
- Gulley Round
- Inspection cover
- MH CL= Manhole
- Mkr Marker post (unidentified)
- MH CL= Manhole (circle)
- Water meter
- RS Road sign
- VP Vent pipe
- FWS
- SWS

SURVEY STATIONS : NATIONAL GPS NETWORK SF=1.000

Name	Easting	Northing	Height
STNA	500693.763	157360.084	25.061
STNB	500662.358	157388.931	24.883
STNC	500678.005	157341.832	24.933
STND	500628.144	157386.011	25.011
STNE	500584.978	157393.662	25.456
STNF	500531.649	157432.296	24.328
STNG	500511.581	157370.206	24.526
STNH	500540.184	157463.148	24.348
STNJ	500482.708	157469.316	24.657
STNK	500511.917	157485.234	24.699
STNL	500470.270	157412.111	24.381
STNM	500494.314	157403.409	24.794
STNN	500481.581	157358.820	24.806
STNP	500501.914	157357.845	24.471
STNQ	500446.070	157345.328	24.475
STNR	500461.439	157320.920	24.774
STNS	500560.969	157218.161	24.927
STNT	500624.855	157174.342	25.116
STNU	500668.169	157245.988	26.823
STNV	500664.846	157289.694	24.988
STNW	500523.136	157236.184	26.140
STNX	500585.416	157304.405	25.333
STNY	500614.228	157336.457	25.023
STNZ	500629.702	157351.352	24.983
STND1	500616.244	157351.434	25.055
STNF1	500559.016	157402.599	24.936
STNP1	500508.390	157348.881	H=25.001

Revision	Description	Drawn	Checked	Date
A	UPDATED SURVEY FOLLOWING MINOR AMENDMENTS.	NC	SGB	15-10-2018

Preliminary ☐ Information ☐ Tender ☐ Construction ☐ As Built ☐

Woods Hardwick
Architects, Engineers and Development Consultants

Title: WOKING FOOTBALL CLUB AND DAVID LLOYD GYM
WOKING

Details: TOPOGRAPHIC SURVEY
SHEET 1 of 3

Scale 1-200 @ A0 Date 26-09-2018 Drawn NC Chk SGB

0189-7-851A

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F. +44 (0)1234 353034
mail@woodshardwick.com
www.woodshardwick.com

Please consider the environment before printing this drawing

1:200

KEY

- Bottom of slope / batter
- Building
- Ditch bottom
- Dropped Kerb
- Edge of change in surface
- Eaves and Ridge 2D
- Fence
- Foliage (Outline)
- Hedge
- Kerb
- Pipe String (PIPE "W"Ø)
- Road Centre Line
- Road Line
- Hedge Rootline
- Road Markings
- Road Sign board (RS)
- String ground level
- Top of slope / batter
- Track
- Track Centre
- Telegraph pole (TP)
- Verge
- Wall
- Wall Centre
- Bush
- Gate (GP)
- Road Markings (Max Speed) (30)
- Tree (TREE H="HT")
- Bollard (Bol)
- Telephone cover (TEL)
- Box
- Fire Hydrant (FH)
- Gate post point (GP)
- Gulley Square
- Gulley Round (G)
- Inspection cover
- Manhole (MH CL=)
- Marker post (unidentified) (Mkr)
- Manhole (circle) (MH CL=)
- Water meter
- Road sign (RS)
- Vent pipe (VP)
- FWS
- SWS

Notes

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STNP1	500508.390	157348.881	25.001
STNT1	500627.508	157160.977	25.402
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STNT3	500684.536	157194.713	25.215
STNW1	500543.744	157271.978	25.106

Revision	Desciption	Drawn	Checked	Date
A	UPDATED SURVEY FOLLOWING MINOR AMENDMENTS.	NC	SGB	15-10-2018

Preliminary / Information / Tender / Construction / As Built

Woods Hardwick
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F. +44 (0)1234 353034
mail@woodshardwick.com
www.woodshardwick.com

Title: WOKING FOOTBALL CLUB AND DAVID LLOYD GYM WOKING

Details: TOPOGRAPHIC SURVEY SHEET 2 of 3

Scale: 1-200 @ A0 | Date: 26-09-2018 | Drawn: NC | Chk: SGB

0189-7-852A

1:200 — 0m 2m 4m 8m 12m 20m

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Notes

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Revision	Desciption	Drawn	Checked	Date
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Details: TOPOGRAPHIC SURVEY SHEET 3 of 3

Scale 1-200 @ A0 Date 26-09-2018 Drawn NC Chk SGB

0189-7-853A

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Appendix C: EA Flood Data

Product 4 (Detailed Flood Risk) for Woking Football Club
Our Ref: THM_116387

Product 4 is designed for developers where Flood Risk Standing Advice FRA (Flood Risk Assessment) Guidance Note 3 Applies. This is:

i) "all applications in Flood Zone 3, other than non-domestic extensions less than 250 sq metres; and all domestic extensions", and

ii) "all applications with a site area greater than 1 ha" in Flood Zone 2.

Product 4 includes the following information:

Ordnance Survey 1:25k colour raster base mapping;
Flood Zone 2 and Flood Zone 3;
Relevant model node locations and unique identifiers (for cross referencing to the water levels, depths and flows table);
Model extents showing *defended* scenarios;
FRA site boundary (where a suitable GIS layer is supplied);
Flood defence locations (where available/relevant) and unique identifiers; (supplied separately)
Flood Map areas benefiting from defences (where available/relevant);
Flood Map flood storage areas (where available/relevant);
Historic flood events outlines (where available/relevant, not the Historic Flood Map) and unique identifiers;
Statutory (Sealed) Main River (where available within map extents);

A table showing:

i) Model node X/Y coordinate locations, unique identifiers, and levels and flows for *defended* scenarios.

ii) Flood defence locations unique identifiers and attributes; (supplied seperately)

iii) Historic flood events outlines unique identifiers and attributes; and

iv) Local flood history data (where available/relevant).

Please note:

If you will be carrying out computer modelling as part of your Flood Risk Assessment, please request our guidance which sets out the requirements and best practice for computer river modelling.

This information is based on that currently available as of the date of this letter. You may feel it is appropriate to contact our office at regular intervals, to check whether any amendments/ improvements have been made. Should you re-contact us after a period of time, please quote the above reference in order to help us deal with your query.

This information is provided subject to the enclosed notice which you should read.

This letter is not a Flood Risk Assessment. The information supplied can be used to form part of your Flood Risk Assessment. Further advice and guidance regarding Flood Risk Assessments can be found on our website at:

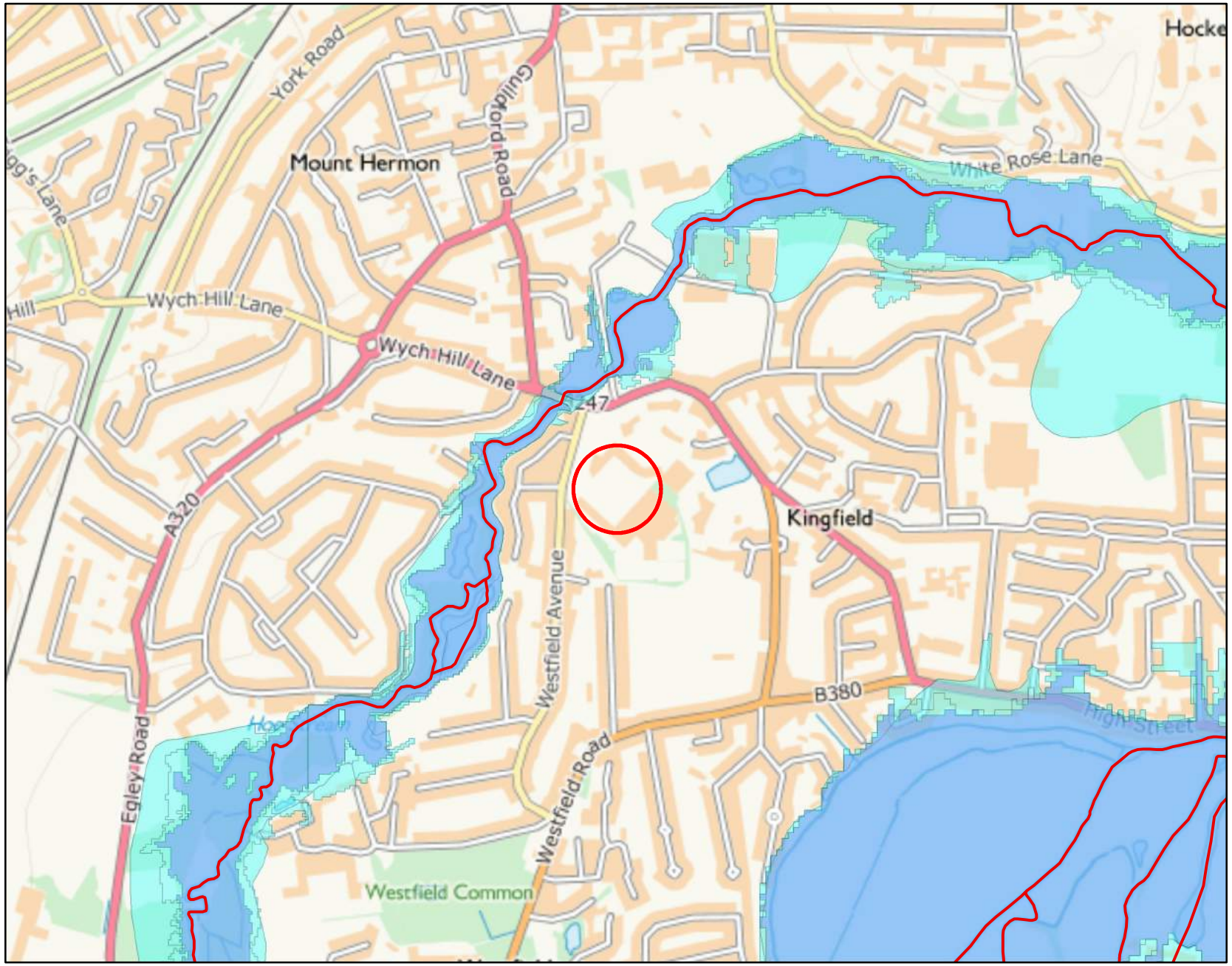
https://www.gov.uk/guidance/flood-risk-assessment-local-planning-authorities

If you would like advice from us regarding your development proposals you can complete our pre application enquiry form which can be found at:

https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion

Red Kite House, Howbery Park, Wallingford, Oxon OX10 8BD
Customer services line: 08708 506 506
Email: WTenquiries@environment-agency.gov.uk

Flood Map for Planning centred on Woking Football Club
Created on 25/02/2019 REF: THM_116387



Environment Agency

Kilometres

0 0.25 0.5

Legend

- Main River
- Flooding from rivers or sea (FZ3)
- Extent of extreme flood (FZ2)

Flooding from rivers or sea without defences (Flood Zone 3) shows the area that could be affected by flooding:
- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

The Extent of an extreme flood (Flood Zone 2) shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occurring each year.

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Defence information

THM_116387

Defence Location:	Hoe Stream FAS
Description:	This location is offered protection from the Hoe Valley Scheme. This consists of flood walls and embankments running from Westfield Primary School through to Woking Leisure Centre. These defences are currently maintained by the Environment Agency. The scheme offers protection up to 1 in 100 protection (1% chance of occurring annually) and includes an allowance for climate change. There are no other defences planned in the area.

Model information

THM_116387

Model: Hoe Stream (Mayford to Wey confluence) 2014

Description: The information provided is from the Hoe Stream Flood Alleviation Scheme mapping completed in April 2014. The study was carried out using 2D modelling software (ISIS-Tuflow).

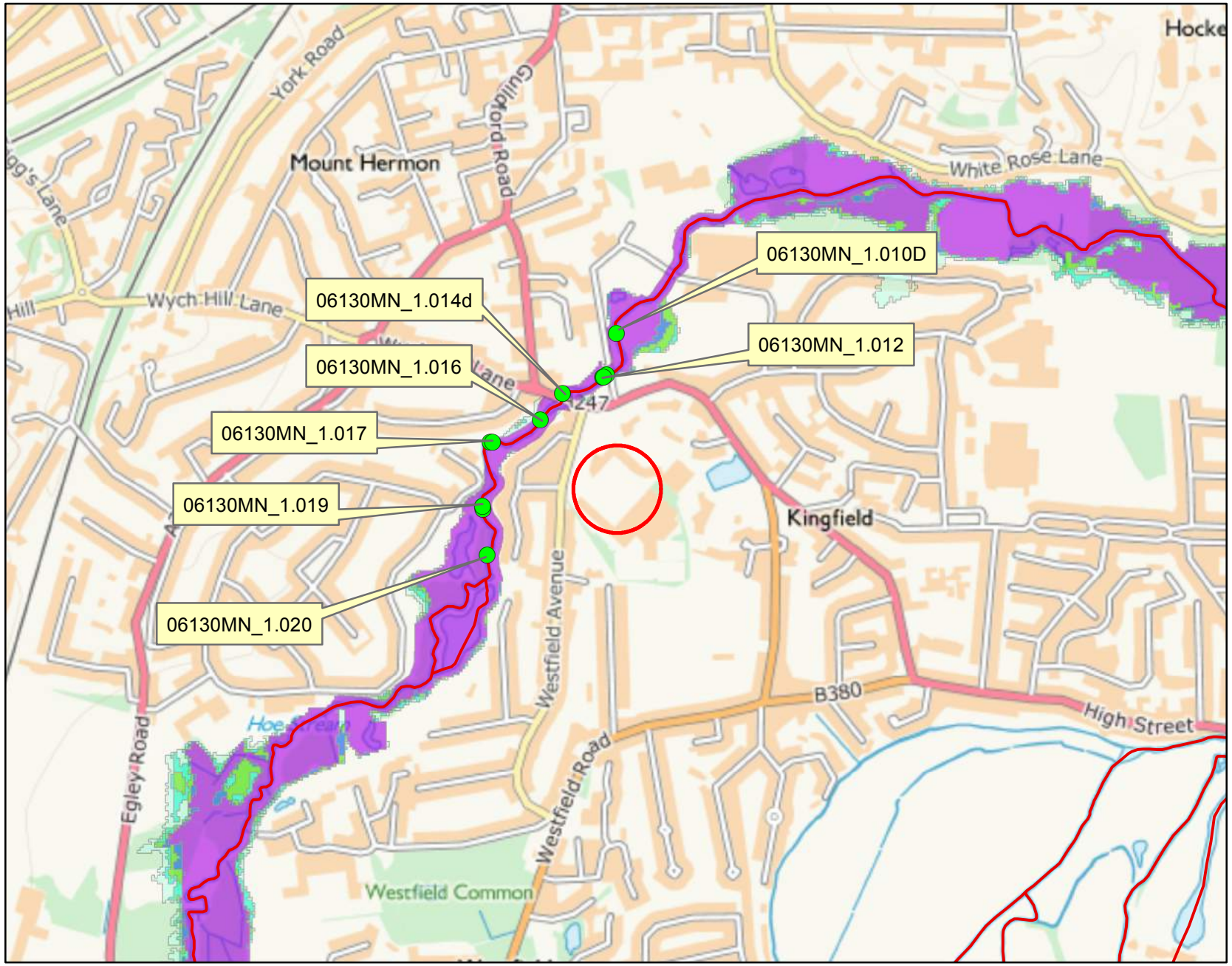
The mapping and modelling was split into two sections, Purbright to Mayford and Mayford to the Wey confluence.

Model design runs:
1 in 5 / 20% Annual Exceedance Probability (AEP); 1 in 20 / 5% AEP; 1 in 75 / 1.3% AEP; 1 in 100 / 1% AEP, 1 in 100+20% / 1% AEP plus 20% increase in flows and 1 in 1000 / 0.1% AEP.

Mapped outputs:
1 in 5 / 20% AEP; 1 in 20 / 5% AEP; 1 in 75 / 1.3% AEP; 1 in 100 / 1% AEP and 1 in 1000 / 0.1% AEP.

Model accuracy:
Levels ± 250mm

FRA Map centred on Woking Football Club
Created on 25/02/2019 REF: THM_116387



Environment Agency

Kilometres

0 0.25 0.5

Legend

- Hoe Stream Model Node Data
- Main River
- 20% AEP Flood Outline
- 5% AEP Flood Outline
- 1% AEP Flood Outline
- 1%+20% AEP Flood Outline
- 0.1% AEP Flood Outline

AEP = Annual Exceedance Probability
The probability of a flood of a particular magnitude, or greater, occuring in any given year

Where available climate change extents have been calculated with an additional flow added to an AEP event. An example of how this is written is 1%+20% AEP.

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Modelled in-channel flood flows and levels

THM_116387

The modelled flood levels and flows for the closest most appropriate model node points for your site that are within the river channel are provided below:

				Flood Levels (mAOD)				
Node label	Model	Easting	Northing	20% AEP	5% AEP	1% AEP	1% AEP (+20% increase in flows)	0.1% AEP
06130MN_1.010D	Hoe Stream (Mayford to Wey confluence) 2014	500553	157612	23.77	23.87	24.01	24.21	24.42
06130MN_1.012	Hoe Stream (Mayford to Wey confluence) 2014	500528	157533	23.84	23.94	24.09	24.28	24.49
06130MN_1.014d	Hoe Stream (Mayford to Wey confluence) 2014	500456	157504	23.91	24.02	24.16	24.36	24.58
06130MN_1.016	Hoe Stream (Mayford to Wey confluence) 2014	500417	157457	23.90	24.01	24.16	24.36	24.58
06130MN_1.017	Hoe Stream (Mayford to Wey confluence) 2014	500327	157417	24.08	24.19	24.34	24.55	24.78
06130MN_1.019	Hoe Stream (Mayford to Wey confluence) 2014	500314	157298	24.30	24.38	24.52	24.70	24.92
06130MN_1.020	Hoe Stream (Mayford to Wey confluence) 2014	500322	157216	24.36	24.45	24.58	24.76	24.97

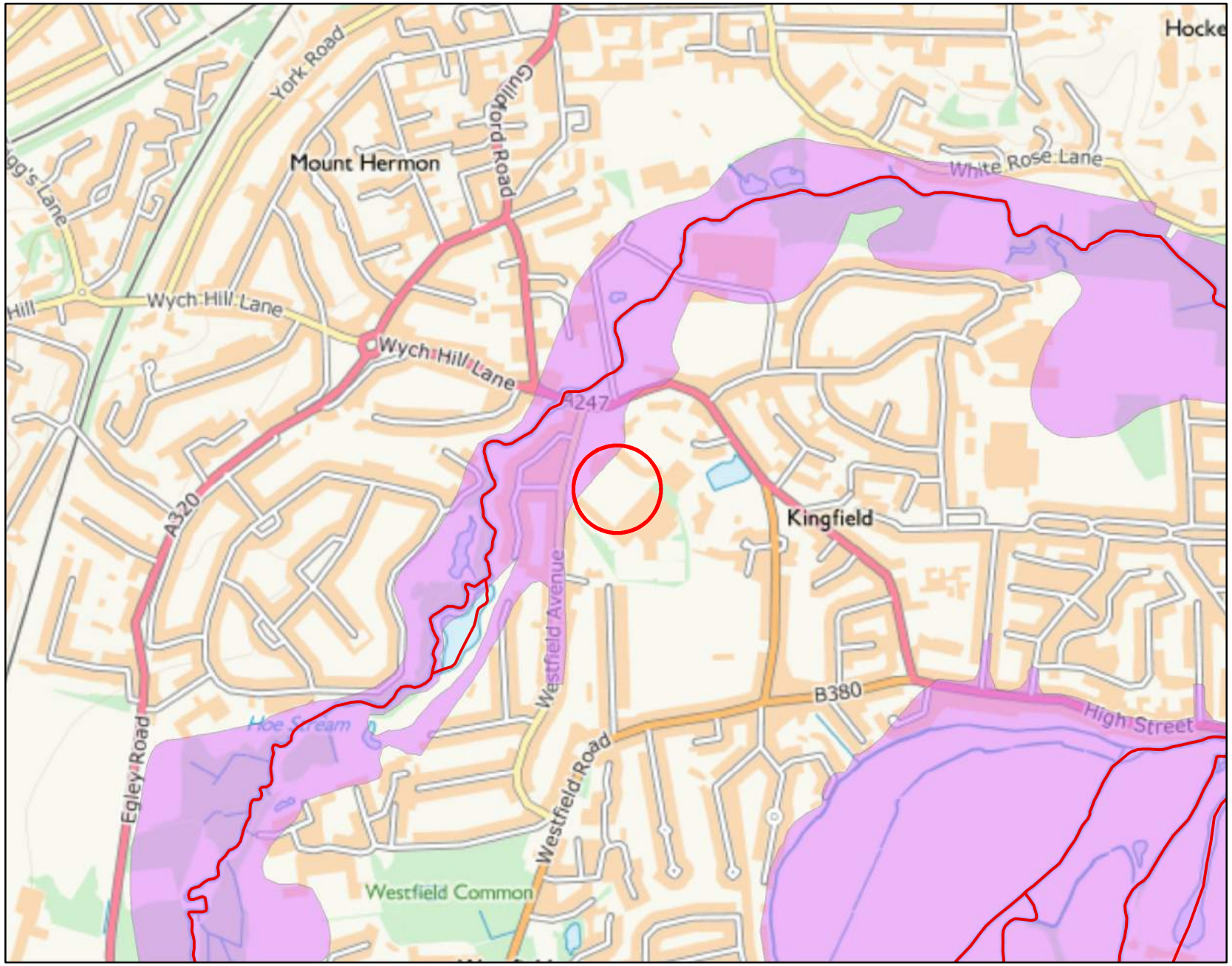
				Flood Flows (m3/s)				
Node label	Model	Easting	Northing	20% AEP	5% AEP	1% AEP	1% AEP (+20% increase in flows)	0.1% AEP
06130MN_1.010D	Hoe Stream (Mayford to Wey confluence) 2014	500553	157612	15.17	16.64	18.90	22.08	25.87
06130MN_1.012	Hoe Stream (Mayford to Wey confluence) 2014	500528	157533	12.77	14.29	16.74	20.67	25.64
06130MN_1.014d	Hoe Stream (Mayford to Wey confluence) 2014	500456	157504	16.31	18.55	22.08	27.42	33.92
06130MN_1.016	Hoe Stream (Mayford to Wey confluence) 2014	500417	157457	16.32	18.55	22.08	27.44	33.92
06130MN_1.017	Hoe Stream (Mayford to Wey confluence) 2014	500327	157417	11.85	12.24	12.93	14.12	15.47
06130MN_1.019	Hoe Stream (Mayford to Wey confluence) 2014	500314	157298	14.29	15.48	17.39	20.38	24.04
06130MN_1.020	Hoe Stream (Mayford to Wey confluence) 2014	500322	157216	8.91	9.20	10.17	11.63	13.67

Note:

Due to changes in guidance on the allowances for climate change, the 20% increase in river flows should no longer to be used for development design purposes. The data included in this Product can be used for interpolation of levels as part of an intermediate level assessment.

For further advice on the new allowances please visit
https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Historic Flood Map centred on Woking Football Club
Created on 25/02/2019 REF: THM_116387



Environment Agency

Kilometres

0 0.25 0.5

Legend

Main River

year

1968

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Historic flood data

THM_116387

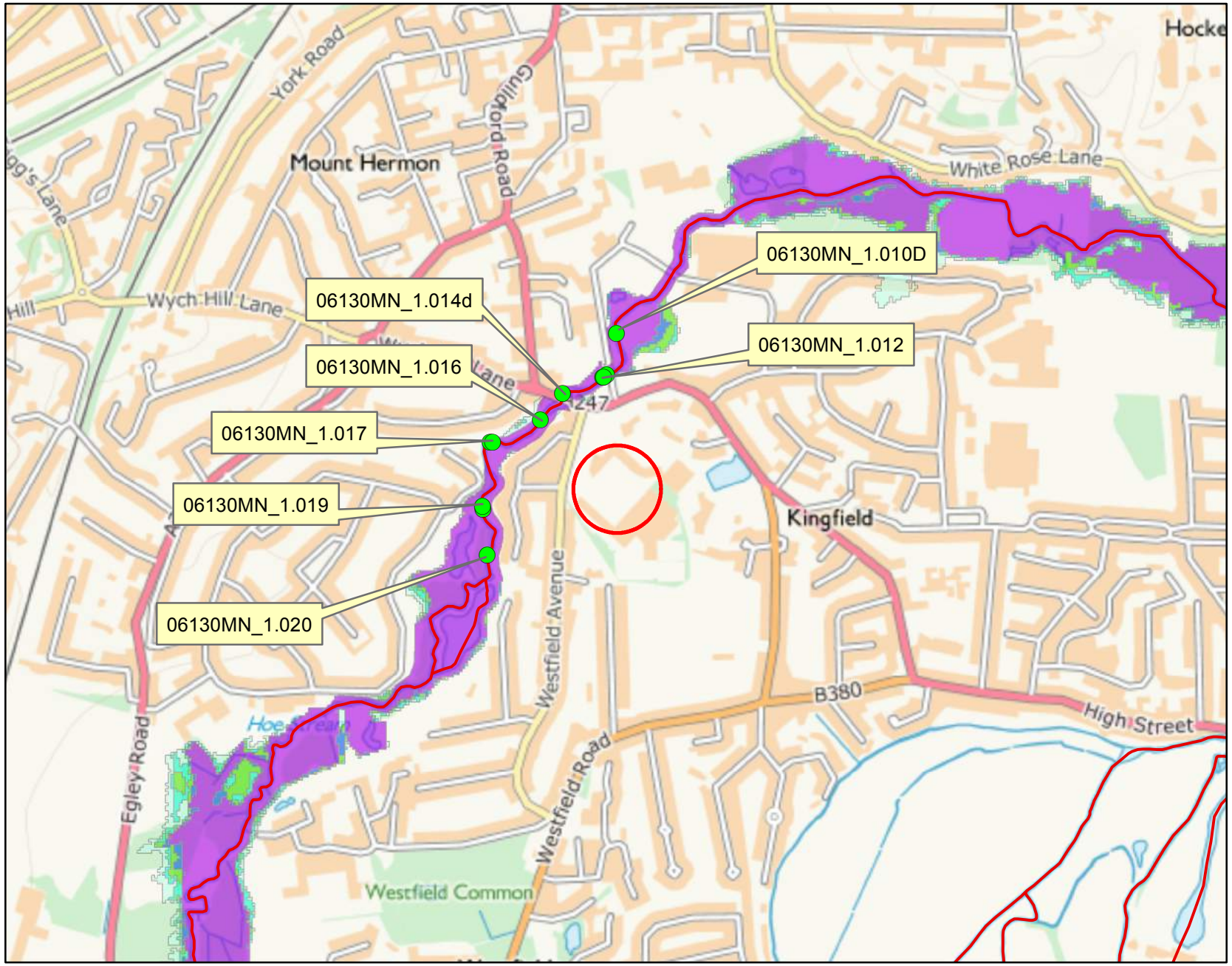
Our records show that the area of your site has been affected by flooding.
Information on the floods that have affected your site is provided in the table below:

Flood Event Code	Flood Event Name	Start Date	End Date	Source of Flooding	Cause of Flooding
EA0619680900220a	06SeptemberAutumn1968	01/01/1968	12/12/1968	main river	channel capacity exceeded (no raised defences)

Please note the Environment Agency maps flooding to land not individual properties. Floodplain extents are an indication of the geographical extent of a historic flood. They do not provide information regarding levels of individual properties, nor do they imply that a property has flooded internally.

Start and End Dates shown above may represent a wider range where the exact dates are not available.

FRA Map centred on Woking Football Club
Created on 25/02/2019 REF: THM_116387



Environment Agency

Kilometres

0 0.25 0.5

Legend

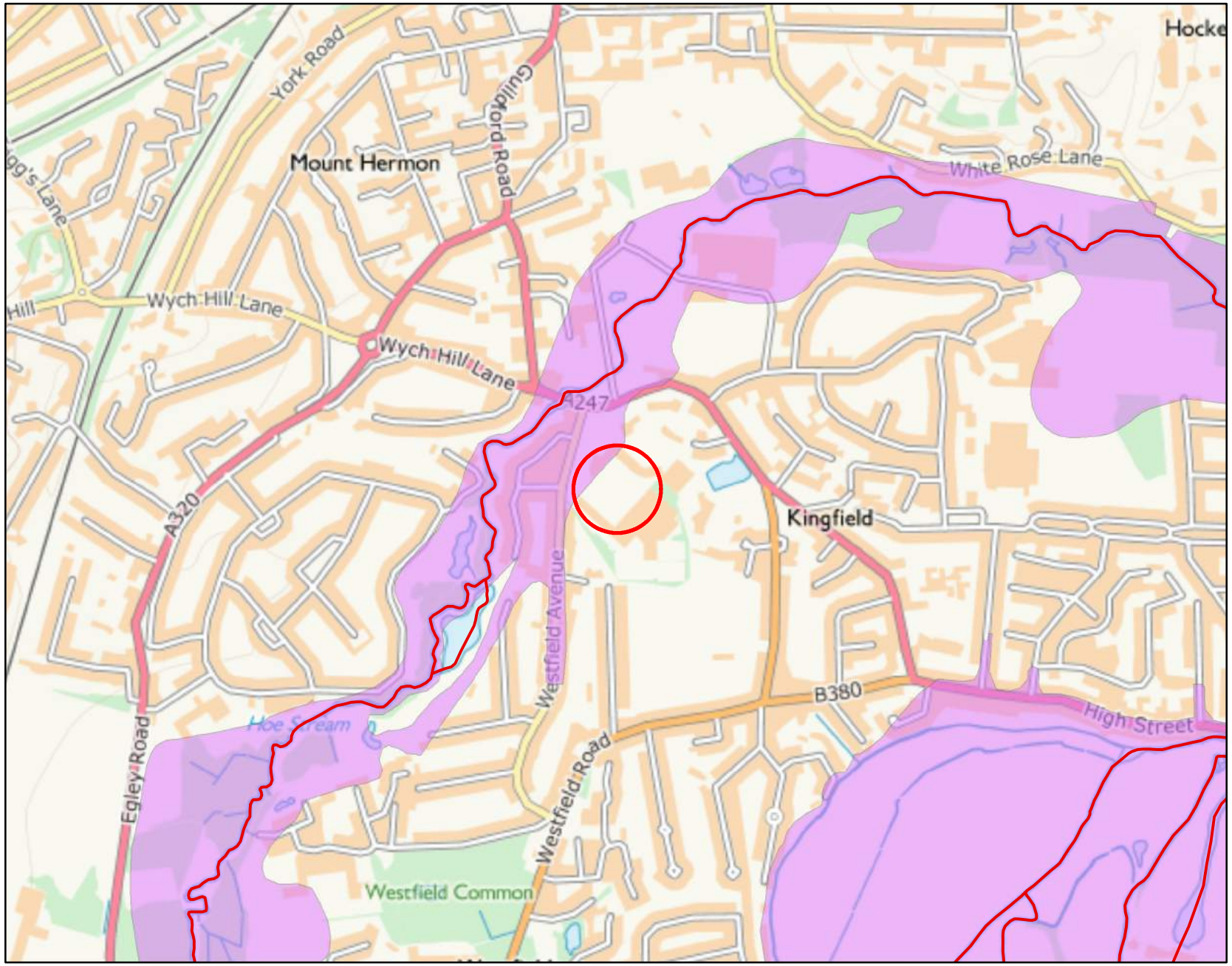
- Hoe Stream Model Node Data
- Main River
- 20% AEP Flood Outline
- 5% AEP Flood Outline
- 1% AEP Flood Outline
- 1%+20% AEP Flood Outline
- 0.1% AEP Flood Outline

AEP = Annual Exceedance Probability
The probability of a flood of a particular magnitude, or greater, occuring in any given year

Where available climate change extents have been calculated with an additional flow added to an AEP event. An example of how this is written is 1%+20% AEP.

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Historic Flood Map centred on Woking Football Club
Created on 25/02/2019 REF: THM_116387



Environment Agency

Kilometres

0 0.25 0.5

Legend

Main River

year

1968

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Woking
Kingsfield Road

Flood Risk

Key

- Hoe Stream 5 year
- Hoe Stream 20 Year
- Hoe Stream 100 Year
- HS 100 Year plus CC70

ordinary watercourses

FUNCTION

- Former Ditch
- Highways
- Land Drainage
- Private
- SW Extent_1_in_30_year
- SW Extent_1_in_100_year
- SW Extent_1_in_1000_year

N

SCALE 1:1,973

40 20 0 40 Metres

Engineering
Woking Borough Council
Civic Offices
Gloucester Square
Woking, Surrey GU21 6YL

Melissa Seymour

From: Katherine Waters <Katherine.Waters@woking.gov.uk>
Sent: 06 August 2019 15:43
To: Melissa Seymour
Subject: RE: Hoe Stream Model Update

Afternoon Melissa,

I have just been sent the undefended levels as follows:

Defended water levels are in the Table below:

Return Period	Peak Water Level (mAOD)
0100	24.71
0100cc35	25.08
0100cc70	25.35

The Climate Change levels actually overtop the defence opposite the site which would increase the probability of a breach scenario occurring at this location as this is a soft embankment. In addition the 70% goes around the defence through Queen Elizabeth Way and up to wards the football club along Kingfield Road.

There cannot be a loss of flood storage for the climate change scenario and any changes in the flow routes the development causes must not affect other areas.

Kind Regards

Katherine Waters
Drainage and Flood Risk Engineer

Woking Borough Council, Civic Offices, Gloucester Square, Woking, Surrey, GU21 6YL
T: +44 (0)1483 743725 | www.woking.gov.uk
For general enquiries, please call Woking Borough Council's Contact Centre on 01483 755855

From: Melissa Seymour <Melissa.seymour@rma-environmental.co.uk>
Sent: 31 July 2019 11:48
To: Katherine Waters <Katherine.Waters@woking.gov.uk>
Subject: RE: Hoe Stream Model Update

Morning Katherine,

Would you be able to get back to me on the below approach and provide me with the draft Hoe stream modelling defended 100 year + 35% CC flood level and the defended 100 year + 70 CC flood level?

I would really apprceiate it if you could get back to me on this this week as our deadline is fast approaching.

Many Thanks,
Melissa

From: Melissa Seymour
Sent: 16 July 2019 15:40
To: Katherine Waters <Katherine.Waters@woking.gov.uk>
Cc: Rob Murdock <rob.murdock@rma-environmental.co.uk>
Subject: RE: Hoe Stream Model Update

Hi Katherine,

Thank you for providing us with the draft defended flood mapping and the draft undefended flood levels for the Woking FC site which are based on the new Hoe Stream draft flood modelling. We understand that given that this modelling is draft and is likely to be published in the near future, the draft results of this modelling need to be considered for the proposed planning application.

Following a review of this data and your meeting with Rob, it is proposed that the site will consider mitigation measures for the **defended 100 year + 35% CC event** and the **defended 100 year + 70 CC flood event**, based on the draft mapping you provided.

It is considered that the undefended flood scenarios are unlikely to occur and are a residual flood risk to the site. However, the undefended flood levels will be considered in terms of how they will impact the scheme and the safety of access/egress of future occupants on site.

It is important to note that each block is proposing car parking at semi-basement level and this ensures that all more vulnerable land uses (residential uses) will be located above both the defended and undefended flood levels providing an area of safe refuge during the unlikely event of a failure of the flood defences.

I welcome your comments on the above approach and I hope this approach is considered acceptable to the LLFA. Please if you have any queries on this, do not hesitate to get in touch.

Please would you also be able to provide us with the draft Hoe stream modelling **defended 100 year + 35% CC flood level** and the **defended 100 year + 70 CC flood level** for the site as we currently only have the draft mapping of these scenarios.

I look forward to hearing from you shortly.

Many thanks,
Melissa

From: Katherine Waters <Katherine.Waters@woking.gov.uk>
Sent: 10 July 2019 17:05
To: Melissa Seymour <Melissa.seymour@rma-environmental.co.uk>
Cc: Rob Murdock <rob.murdock@rma-environmental.co.uk>
Subject: RE: Hoe Stream Model Update

Hi Melissa,

Can you let me know what your queries are and I'll see if I can get answers for you. The consultants time is paid for through the project and I need to ensure that the project costs do not go up with additional charges beyond that agreed. As you are aware as this would be additional work from the project scope the project would get the consultants hourly charge out rate for the additional time spent.

If there are any queries with the mapping and the levels the difference would be the levels provided are the undefended levels whilst the map I provided is the defended level. This is due to the fact the defence can be over top and breach opposite the site.

Please see below the water levels relevant to the Football Club Site. These are still draft as we are awaiting the EA to sign them off officially.

Kind Regards

Katherine Waters
Drainage and Flood Risk Engineer

Woking Borough Council, Civic Offices, Gloucester Square, Woking, Surrey, GU21 6YL
T: +44 (0)1483 743725 | www.woking.gov.uk
For general enquiries, please call Woking Borough Council's Contact Centre on 01483 755855

From: Matthew Savill
Sent: 08 July 2019 16:36
To: Katherine Waters <Katherine.Waters@woking.gov.uk>
Subject: RE: Hoe Stream Model Update

Hi Katherine,

Requested water levels are found in the table below. These are taken from model node 1.016:

Return Period	Peak Water Level
0100	24.66
0100cc35	25.02
0100cc70	25.28
1000	25.09

Kind Regards

Matt

Matt Savill
Senior Flood Risk Engineer

Appendix D: Drainage Strategy

PURPOSE

The purpose of this Design Statement is to describe how the surface water drainage strategy for the proposed redevelopment of the Woking Football Club site will manage runoff in a manner that will mitigate the risk of flooding and pollution to the environment.

SCOPE

This design addresses runoff from areas within the red line boundary for the planning application.

DESIGN CONSTRAINTS

A ground investigation has been carried out. A combination of high groundwater levels and low percolation rates indicates that infiltration will not be feasible. Refer to the main body of the report for a description of the ground investigations carried out at the site.

There is limited information on the drainage arrangements for the existing site. However, the topographic survey shows a significant proportion of the site draining to soakaway. Given the age of the development and the likely limitations on the performance of soakaways a precautionary approach to the likely rate of discharge from the site has been adopted and it is proposed to limit the peak rate of discharge from the site to the 30year greenfield rate.

DESIGN STANDARDS

The proposed surface water drainage system is to be designed to ensure that all runoff from the 100year rainfall event plus a 40% increase in rainfall intensity is managed in accordance with DEFRA's Technical Standards for Sustainable Drainage Systems.

DESIGN - STRATEGY

It is proposed to attenuate runoff prior to discharge to the public surface water sewer. Attenuation will be provided in:

- green roofs;
- the granular material beneath permeable paving;
- lined geocellular tanks.

The rate of discharge to the public sewer will be controlled by means of a Hydro-Brake.

The proposed drainage layout is shown on drawing SK001 in Appendix B.

DESIGN - DETAIL

Volumetric Control

The MicroDrainage software suite has been used to model the performance of the proposed drainage system. The model and simulation results are included in Appendix A.

Treatment Design

The pollution treatment requirements for the site have been established using the Simple Index Approach set out in Table 26.1 of the SUDS Manual.

Pollution hazard levels have been derived From Table 26.2 and are shown in the following table.

Land Use	**Pollution Hazard Level**	**Total Suspended Solids (TSS)**	**Metals**	**Hydro-Carbons**
Roads with more than 300 vehicle movements/day	Medium	0.7	0.6	0.7
Residential roofs	Very low	0.2	0.2	0.05

Table 1 – Pollution Hazard Indices

The following table shows how runoff from the above areas will be treated. The figure in brackets is the target level of treatment.

Land Use	**Treatment**	**Total Suspended Solids (TSS)**	**Metals**	**Hydro-Carbons**
Roads with more than 300 vehicle movements/day	Permeable paving	0.7 (0.7) OK	0.6 (0.6) OK	0.7 (0.7) OK
Residential roofs	Bioretention areas (i.e. rain gardens and tree pits)	0.2 (0.8) OK	0.2 (0.8) OK	0.05 (0.8) OK

Table 2 – Proposed SuDS Mitigation Indices

Comparing the pollution hazard indices in Table 1 with the mitigation indices in Table 2 indicates that the proposed treatment measures are appropriate for the site use.

Compliance with Technical Standards for Sustainable Drainage Systems

The following sections describe how the proposed surface water drainage system meets the requirements of the DEFRA document Non-Statutory Technical Standards for Sustainable Drainage Systems.

S1 *Where the drainage system discharges to a surface water body that can accommodate uncontrolled surface water discharges without any impact on flood risk from that surface water body (e.g. the sea or a large estuary) the peak flow control standards (**S2** and **S3** below) and volume control technical standards (**S4** and **S6** below) need not apply*

There are no water bodies in the vicinity of the proposed development that are capable of accommodating uncontrolled runoff without increasing flood risk.

S2 *For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.*

Not applicable – brownfield site.

S3 *For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.*

The proposed development flows will be restricted to QBar (refer to Appendix 1)

S4 *Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event.*

Not applicable – brownfield site.

S6 *Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with **S4** or **S5** above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.*

Without extensive testing of the existing drainage system it is not possible to estimate the volume of runoff from the existing site. However, it is likely that the soakaways have been designed to accommodate runoff from events up to only the 10year return period. Most of the runoff from more-extreme events is likely to flow overland to Westfield Avenue and the A427.

S7 *The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event.*

The drainage system has been designed such that runoff from all events up to the 100year +40% will be stored below ground level. Refer to the MicroDrainage outputs in Appendix A.

S8 *The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.*

See S7 above.

S9 *The design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100 year rainfall event are managed in exceedance routes that minimise the risks to people and property.*

Refer to Section 4.10 in the main body of the report.

S10 *Components must be designed to ensure structural integrity of the drainage system and any adjacent structures or infrastructure under anticipated loading conditions over the design life of the development taking into account the requirement for reasonable levels of maintenance.*

Where practicable the drainage system will be located beyond the zone of influence of adjacent foundations. Where this is not practicable, foundations will be designed to allow for the replacement of the drainage system without the need for special support.

S11 *The materials, including products, components, fittings or naturally occurring materials, which are specified by the designer must be of a suitable nature and quality for their intended use.*

The surface water system will be designed in accordance with the SuDS Manual. The design will allow for replacement of component parts without long-term detriment to the performance of the system.

S12 *Pumping should only be used to facilitate drainage for those parts of the site where it is not reasonably practicable to drain water by gravity.*

Runoff will generally be disposed of by means of gravity. The only exception will be the need for a small submersible pump to deal with any rain falling on the vehicular ramp down to the basement.

S13 *The mode of construction of any communication with an existing sewer or drainage system must be such that the making of the communication would not be prejudicial to the structural integrity and functionality of the sewerage or drainage system.*

Connections to the existing drainage system will be made only by appropriately qualified and licensed contractors.

S14 *Damage to the drainage system resulting from associated construction activities must be minimised and must be rectified before the drainage system is considered to be completed.*

See S13 above.

APPENDIX A

CALCULATIONS

1. QBar Calculations
2. MicroDrainage printout for proposed drainage system - 100year +40% rainfall event
3. MicroDrainage printout for existing drainage system - 100year +40% rainfall event plus 1.12 m surcharge at outfall manhole

1. QBar Calculations

ICP SUDS Mean Annual Flood

Input

Return Period (years)	2	Soil	0.450
Area (ha)	3.410	Urban	0.000
SAAR (mm)	700	Region Number	Region 6

Results l/s

QBAR Rural	15.0
QBAR Urban	15.0
Q2 years	13.2
Q1 year	12.7
Q30 years	34.0
Q100 years	47.8

2. MicroDrainage printout for existing drainage system - 100year +40% rainfall event

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.450	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	150	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.639	4-8	2.333	8-12	1.632	12-16	0.138

Total Area Contributing (ha) = 4.742

Total Pipe Volume (m³) = 592.205

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	70.228	0.300	234.1	0.018	4.00	0.0	0.600		o	300	Pipe/Conduit	
S1.001	66.764	0.300	222.5	0.115	0.00	0.0		0.020	o	300	Pipe/Conduit	
S2.000	76.098	0.254	300.0	0.137	4.00	0.0	0.600		o	300	Pipe/Conduit	
S3.000	30.000	1.000	30.0	0.162	4.00	0.0	0.600		o	300	Pipe/Conduit	
S4.000	30.000	1.000	30.0	0.250	4.00	0.0	0.600		o	300	Pipe/Conduit	
S1.002	58.058	0.100	580.6	0.059	0.00	0.0		0.020	→[↓]		Cellular Storage	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	150.00	5.14	24.000	0.018	0.0	0.0	0.0	1.02	72.3	7.3
S1.001	150.00	7.01	23.700	0.133	0.0	0.0	0.0	0.60	42.1«	54.0
S2.000	150.00	5.41	23.700	0.137	0.0	0.0	0.0	0.90	63.8	55.7
S3.000	150.00	4.17	24.700	0.162	0.0	0.0	0.0	2.88	203.7	65.8
S4.000	150.00	4.17	24.700	0.250	0.0	0.0	0.0	2.88	203.7	101.6
S1.002	141.09	8.36	23.400	0.741	0.0	0.0	0.0	0.72	597.3	283.1

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S5.000	30.000	1.000	30.0	0.083	4.00	0.0	0.600		o	300	Pipe/Conduit	
S6.000	30.000	1.000	30.0	0.269	4.00	0.0	0.600		o	300	Pipe/Conduit	
S7.000	14.331	0.300	47.8	0.109	4.00	0.0	0.600		o	300	Pipe/Conduit	
S1.003	72.731	0.100	727.3	0.095	0.00	0.0		0.020	→[↓]		Cellular Storage	
S8.000	30.000	1.000	30.0	0.084	4.00	0.0	0.600		o	300	Pipe/Conduit	
S9.000	30.000	1.000	30.0	0.139	4.00	0.0	0.600		o	300	Pipe/Conduit	
S10.000	73.079	0.200	365.4	0.210	4.00	0.0	0.600		o	300	Pipe/Conduit	
S1.004	69.812	0.100	698.1	0.093	0.00	0.0		0.020	→[↓]		Cellular Storage	
S11.000	30.000	1.000	30.0	0.192	4.00	0.0	0.600		o	300	Pipe/Conduit	
S12.000	30.000	1.000	30.0	0.272	4.00	0.0	0.600		o	300	Pipe/Conduit	
S13.000	46.226	0.150	308.2	0.088	4.00	0.0	0.600		o	300	Pipe/Conduit	
S1.005	32.870	1.000	32.9	0.041	0.00	0.0		0.020	→[↓]		Cellular Storage	
S14.000	30.000	1.400	21.4	0.101	4.00	0.0	0.600		o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S5.000	150.00	4.17	24.750	0.083	0.0	0.0	0.0	2.88	203.7	33.7
S6.000	150.00	4.17	24.750	0.269	0.0	0.0	0.0	2.88	203.7	109.3
S7.000	150.00	4.10	23.750	0.109	0.0	0.0	0.0	2.28	161.2	44.3
S1.003	127.23	10.25	23.300	1.297	0.0	0.0	0.0	0.64	554.7	446.9
S8.000	150.00	4.17	24.450	0.084	0.0	0.0	0.0	2.88	203.7	34.1
S9.000	150.00	4.17	24.745	0.139	0.0	0.0	0.0	2.88	203.7	56.5
S10.000	150.00	5.49	23.700	0.210	0.0	0.0	0.0	0.82	57.7«	85.3
S1.004	116.78	12.01	23.200	1.823	0.0	0.0	0.0	0.66	594.4	576.6
S11.000	150.00	4.17	24.700	0.192	0.0	0.0	0.0	2.88	203.7	78.0
S12.000	150.00	4.17	24.700	0.272	0.0	0.0	0.0	2.88	203.7	110.5
S13.000	150.00	4.87	23.700	0.088	0.0	0.0	0.0	0.89	62.9	35.7
S1.005	115.91	12.17	23.100	2.416	0.0	0.0	0.0	3.35	5816.9	758.4
S14.000	150.00	4.15	24.700	0.101	0.0	0.0	0.0	3.41	241.1	41.0

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S15.000	30.000	1.400	21.4	0.185	4.00	0.0	0.600		o	300	Pipe/Conduit	
S16.000	49.457	0.200	247.3	0.025	4.00	0.0		0.020	o	300	Pipe/Conduit	
S16.001	16.775	0.068	246.7	0.028	0.00	0.0		0.020	o	300	Pipe/Conduit	
S16.002	37.834	0.100	378.3	0.145	0.00	0.0		0.075	o	300	Pipe/Conduit	
S16.003	30.730	0.150	204.9	0.029	0.00	0.0		0.020	→[↓]		Cellular Storage	
S16.004	98.965	0.450	219.9	0.085	0.00	0.0		0.020	→[↓]		Cellular Storage	
S17.000	69.464	0.172	403.9	0.690	4.00	0.0		0.020	o	450	Pipe/Conduit	
S17.001	50.000	0.123	406.5	0.100	0.00	0.0		0.020	o	450	Pipe/Conduit	
S18.000	50.000	0.123	406.5	0.100	4.00	0.0		0.020	o	450	Pipe/Conduit	
S17.002	35.912	0.103	348.7	0.300	0.00	0.0		0.020	oo	450	Double Pipe	
S17.003	8.952	0.058	154.3	0.300	0.00	0.0	0.600		o	300	Pipe/Conduit	
S1.006	48.207	0.050	964.1	0.222	0.00	0.0		0.020	→[↓]		Cellular Storage	
S1.007	53.954	0.230	234.6	0.016	0.00	0.0	0.600		o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S15.000	150.00	4.15	24.700	0.185	0.0	0.0	0.0	3.41	241.1	75.2
S16.000	150.00	5.46	23.850	0.025	0.0	0.0	0.0	0.57	40.0	10.2
S16.001	150.00	5.95	23.650	0.053	0.0	0.0	0.0	0.57	40.0	21.5
S16.002	121.78	11.12	23.582	0.198	0.0	0.0	0.0	0.12	8.6«	65.3
S16.003	119.44	11.53	23.482	0.227	0.0	0.0	0.0	1.27	1410.2	73.4
S16.004	112.54	12.83	23.450	0.312	0.0	0.0	0.0	1.27	1826.6	95.1
S17.000	150.00	6.00	23.600	0.690	0.0	0.0	0.0	0.58	92.2«	280.3
S17.001	148.98	7.44	23.428	0.790	0.0	0.0	0.0	0.58	91.9«	318.7
S18.000	150.00	5.44	23.456	0.100	0.0	0.0	0.0	0.58	91.9	40.6
S17.002	140.81	8.40	23.161	1.190	0.0	0.0	0.0	0.62	198.5«	453.8
S17.003	139.85	8.52	23.058	1.490	0.0	0.0	0.0	1.26	89.3«	564.3
S1.006	106.52	14.12	23.000	4.726	0.0	0.0	0.0	0.62	1141.9«	1363.4
S1.007	102.82	15.00	22.950	4.742	0.0	0.0	0.0	1.02	72.3«	1363.4

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.007	S	24.780	22.720	22.720	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 7
Number of Online Controls 2 Number of Storage Structures 14 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.450		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S30, DS/PN: S17.003, Volume (m³): 15.8

Unit Reference	MD-SHE-0050-1500-1900-1500
Design Head (m)	1.900
Design Flow (l/s)	1.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	50
Invert Level (m)	23.058
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.900	1.5	Kick-Flo®	0.442	0.8
Flush-Flo™	0.219	0.9	Mean Flow over Head Range	-	1.1

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	0.9	0.800	1.0	2.000	1.5	4.000	2.1	7.000	2.7
0.200	0.9	1.000	1.1	2.200	1.6	4.500	2.2	7.500	2.8
0.300	0.9	1.200	1.2	2.400	1.7	5.000	2.3	8.000	2.9
0.400	0.9	1.400	1.3	2.600	1.7	5.500	2.4	8.500	3.0
0.500	0.8	1.600	1.4	3.000	1.8	6.000	2.5	9.000	3.1
0.600	0.9	1.800	1.5	3.500	2.0	6.500	2.6	9.500	3.2

Hydro-Brake® Optimum Manhole: S29, DS/PN: S1.007, Volume (m³): 89.3

Unit Reference	MD-SHE-0164-1500-1750-1500
Design Head (m)	1.750
Design Flow (l/s)	15.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	164
Invert Level (m)	22.950
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.750	15.0	Kick-Flo®	1.087	12.0
Flush-Flo™	0.514	15.0	Mean Flow over Head Range	-	13.1

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	5.9	0.400	14.8	0.800	14.4	1.400	13.5	2.000	16.0
0.200	13.0	0.500	15.0	1.000	13.1	1.600	14.4	2.200	16.7
0.300	14.3	0.600	14.9	1.200	12.5	1.800	15.2	2.400	17.4

Hydro-Brake® Optimum Manhole: S29, DS/PN: S1.007, Volume (m³): 89.3

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)
2.600	18.1	4.000	22.2	5.500	25.9	7.000	29.1	8.500	32.0
3.000	19.4	4.500	23.5	6.000	27.0	7.500	30.1	9.000	32.8
3.500	20.9	5.000	24.7	6.500	28.1	8.000	31.0	9.500	33.7

Storage Structures for Storm

Porous Car Park Manhole: S2, DS/PN: S1.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	20.0
Membrane Percolation (mm/hr)	1000	Length (m)	108.5
Max Percolation (l/s)	602.8	Slope (1:X)	200.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	24.400	Membrane Depth (mm)	400

Cellular Storage Pipe: S1.002

Manning's N	0.020	Infiltration Coefficient Side (m/hr)	0.00000
Invert Level (m)	23.400	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	85.0	0.0	0.600	85.0	0.0	0.601	0.0	0.0

Porous Car Park Manhole: S9, DS/PN: S7.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	7.5
Membrane Percolation (mm/hr)	1000	Length (m)	96.0
Max Percolation (l/s)	200.0	Slope (1:X)	200.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	24.200	Membrane Depth (mm)	400

Cellular Storage Pipe: S1.003

Manning's N	0.020	Infiltration Coefficient Side (m/hr)	0.00000
Invert Level (m)	23.300	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	110.0	0.0	0.600	110.0	0.0	0.601	0.0	0.0

Porous Car Park Manhole: S13, DS/PN: S10.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	15.0
Membrane Percolation (mm/hr)	1000	Length (m)	67.0
Max Percolation (l/s)	279.2	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	24.200	Membrane Depth (mm)	400

Cellular Storage Pipe: S1.004

Manning's N	0.020	Infiltration Coefficient Side (m/hr)	0.00000
Invert Level (m)	23.200	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	110.0	0.0	0.600	110.0	0.0	0.601	0.0	0.0

Porous Car Park Manhole: S17, DS/PN: S13.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	15.0
Membrane Percolation (mm/hr)	1000	Length (m)	67.0
Max Percolation (l/s)	279.2	Slope (1:X)	250.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	24.200	Membrane Depth (mm)	400

Cellular Storage Pipe: S1.005

Manning's N	0.020	Infiltration Coefficient Side (m/hr)	0.00000
Invert Level (m)	23.100	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	100.0	0.0	0.600	100.0	0.0	0.601	0.0	0.0

Porous Car Park Manhole: S23, DS/PN: S16.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	20.0
Membrane Percolation (mm/hr)	1000	Length (m)	100.0
Max Percolation (l/s)	555.6	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	24.200	Membrane Depth (mm)	400

Cellular Storage Pipe: S16.003

Manning's N	0.020	Infiltration Coefficient Side (m/hr)	0.00000
Invert Level (m)	23.482	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	60.0	0.0	0.600	60.0	0.0	0.601	0.0	0.0

Cellular Storage Pipe: S16.004

Manning's N	0.020	Infiltration Coefficient Side (m/hr)	0.00000
Invert Level (m)	23.450	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	250.0	0.0	0.600	250.0	0.0	0.601	0.0	0.0

Cellular Storage Manhole: S30, DS/PN: S17.003

Invert Level (m)	23.058	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	4500.0	0.0	0.300	4500.0	0.0	0.301	0.0	0.0

Cellular Storage Pipe: S1.006

Manning's N	0.020	Infiltration Coefficient Side (m/hr)	0.00000
Invert Level (m)	23.000	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	155.0	0.0	0.600	155.0	0.0	0.601	0.0	0.0

Porous Car Park Manhole: S29, DS/PN: S1.007

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	21.0
Membrane Percolation (mm/hr)	1000	Length (m)	141.0
Max Percolation (l/s)	822.5	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	23.800	Membrane Depth (mm)	400

Time Area Diagram for Green Roof at Pipe Number S3.000 (Storm)

Area (m³) 1620 Evaporation (mm/day) 2
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.029439	32	36	0.005944	64	68	0.001200	96	100	0.000242
4	8	0.024102	36	40	0.004866	68	72	0.000982	100	104	0.000198
8	12	0.019733	40	44	0.003984	72	76	0.000804	104	108	0.000162
12	16	0.016156	44	48	0.003262	76	80	0.000659	108	112	0.000133
16	20	0.013228	48	52	0.002671	80	84	0.000539	112	116	0.000109
20	24	0.010830	52	56	0.002187	84	88	0.000441	116	120	0.000089
24	28	0.008867	56	60	0.001790	88	92	0.000361			
28	32	0.007259	60	64	0.001466	92	96	0.000296			

Time Area Diagram for Green Roof at Pipe Number S5.000 (Storm)

Area (m³) 830 Evaporation (mm/day) 2
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.015083	32	36	0.003045	64	68	0.000615	96	100	0.000124
4	8	0.012349	36	40	0.002493	68	72	0.000503	100	104	0.000102
8	12	0.010110	40	44	0.002041	72	76	0.000412	104	108	0.000083
12	16	0.008278	44	48	0.001671	76	80	0.000337	108	112	0.000068
16	20	0.006777	48	52	0.001368	80	84	0.000276	112	116	0.000056
20	24	0.005549	52	56	0.001120	84	88	0.000226	116	120	0.000046
24	28	0.004543	56	60	0.000917	88	92	0.000185			
28	32	0.003719	60	64	0.000751	92	96	0.000152			

Time Area Diagram for Green Roof at Pipe Number S8.000 (Storm)

Area (m³) 840 Evaporation (mm/day) 2
Depression Storage (mm) 15 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.015264	4	8	0.012497	8	12	0.010232	12	16	0.008377

Time Area Diagram for Green Roof at Pipe Number S8.000 (Storm)

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
16	20	0.006859	44	48	0.001691	72	76	0.000417	100	104	0.000103
20	24	0.005615	48	52	0.001385	76	80	0.000341	104	108	0.000084
24	28	0.004598	52	56	0.001134	80	84	0.000280	108	112	0.000069
28	32	0.003764	56	60	0.000928	84	88	0.000229	112	116	0.000056
32	36	0.003082	60	64	0.000760	88	92	0.000187	116	120	0.000046
36	40	0.002523	64	68	0.000622	92	96	0.000153			
40	44	0.002066	68	72	0.000509	96	100	0.000126			

Time Area Diagram for Green Roof at Pipe Number S11.000 (Storm)

Area (m³) 1920 Evaporation (mm/day) 2
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.034890	32	36	0.007044	64	68	0.001422	96	100	0.000287
4	8	0.028566	36	40	0.005767	68	72	0.001164	100	104	0.000235
8	12	0.023388	40	44	0.004722	72	76	0.000953	104	108	0.000192
12	16	0.019148	44	48	0.003866	76	80	0.000781	108	112	0.000158
16	20	0.015677	48	52	0.003165	80	84	0.000639	112	116	0.000129
20	24	0.012835	52	56	0.002591	84	88	0.000523	116	120	0.000106
24	28	0.010509	56	60	0.002122	88	92	0.000428			
28	32	0.008604	60	64	0.001737	92	96	0.000351			

Time Area Diagram for Green Roof at Pipe Number S14.000 (Storm)

Area (m³) 1010 Evaporation (mm/day) 2
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.018354	32	36	0.003706	64	68	0.000748	96	100	0.000151
4	8	0.015027	36	40	0.003034	68	72	0.000613	100	104	0.000124
8	12	0.012303	40	44	0.002484	72	76	0.000501	104	108	0.000101
12	16	0.010073	44	48	0.002034	76	80	0.000411	108	112	0.000083
16	20	0.008247	48	52	0.001665	80	84	0.000336	112	116	0.000068
20	24	0.006752	52	56	0.001363	84	88	0.000275	116	120	0.000056
24	28	0.005528	56	60	0.001116	88	92	0.000225			
28	32	0.004526	60	64	0.000914	92	96	0.000184			

Time Area Diagram for Green Roof at Pipe Number S17.000 (Storm)

Area (m³) 6900 Evaporation (mm/day) 3
Depression Storage (mm) 8 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.125387	28	32	0.030920	56	60	0.007625	84	88	0.001880
4	8	0.102658	32	36	0.025315	60	64	0.006243	88	92	0.001539
8	12	0.084049	36	40	0.020726	64	68	0.005111	92	96	0.001260
12	16	0.068814	40	44	0.016969	68	72	0.004185	96	100	0.001032
16	20	0.056340	44	48	0.013893	72	76	0.003426	100	104	0.000845
20	24	0.046127	48	52	0.011375	76	80	0.002805	104	108	0.000692
24	28	0.037766	52	56	0.009313	80	84	0.002297	108	112	0.000566

Time Area Diagram for Green Roof at Pipe Number S17.000 (Storm)

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
112	116	0.000464	116	120	0.000380						

Time Area Diagram for Green Roof at Pipe Number S1.007 (Storm)

Area (m³) 160 Evaporation (mm/day) 2
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.002908	32	36	0.000587	64	68	0.000119	96	100	0.000024
4	8	0.002380	36	40	0.000481	68	72	0.000097	100	104	0.000020
8	12	0.001949	40	44	0.000393	72	76	0.000079	104	108	0.000016
12	16	0.001596	44	48	0.000322	76	80	0.000065	108	112	0.000013
16	20	0.001306	48	52	0.000264	80	84	0.000053	112	116	0.000011
20	24	0.001070	52	56	0.000216	84	88	0.000044	116	120	0.000009
24	28	0.000876	56	60	0.000177	88	92	0.000036			
28	32	0.000717	60	64	0.000145	92	96	0.000029			

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 7
Number of Online Controls 2 Number of Storage Structures 14 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 20.000	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.450	Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	1	+0%	100/15 Summer				24.039	-0.261
S1.001	S2	120 Winter	1	+0%	100/15 Summer				23.761	-0.239
S2.000	S2	15 Winter	1	+0%	100/15 Summer				23.822	-0.178
S3.000	S3	60 Winter	1	+0%					24.736	-0.264
S4.000	S4	15 Winter	1	+0%					24.793	-0.207
S1.002	S6	15 Winter	1	+0%	100/120 Winter				23.466	-0.535
S5.000	S7	60 Winter	1	+0%					24.774	-0.276
S6.000	S8	15 Summer	1	+0%					24.846	-0.204
S7.000	S9	15 Summer	1	+0%	100/180 Winter				23.825	-0.225
S1.003	S10	15 Winter	1	+0%	100/120 Winter				23.375	-0.526
S8.000	S11	720 Winter	1	+0%					24.455	-0.295
S9.000	S12	15 Winter	1	+0%					24.813	-0.232
S10.000	S13	15 Winter	1	+0%	30/15 Summer				23.865	-0.135
S1.004	S14	30 Winter	1	+0%	100/120 Winter				23.273	-0.528
S11.000	S15	60 Winter	1	+0%					24.739	-0.261
S12.000	S16	15 Winter	1	+0%	100/15 Summer				24.797	-0.203
S13.000	S17	30 Winter	1	+0%	100/120 Winter				23.772	-0.228
S1.005	S18	480 Winter	1	+0%	100/120 Winter				23.244	-0.457
S14.000	S19	60 Winter	1	+0%					24.725	-0.275
S15.000	S20	15 Winter	1	+0%					24.772	-0.228
S16.000	S21	15 Winter	1	+0%	30/15 Summer				23.913	-0.237
S16.001	S22	60 Winter	1	+0%	30/15 Summer				23.801	-0.149
S16.002	S23	60 Winter	1	+0%	30/15 Summer				23.798	-0.084
S16.003	S24	60 Winter	1	+0%					23.485	-0.598
S16.004	S25	30 Winter	1	+0%					23.452	-0.599
S17.000	S26	120 Winter	1	+0%	100/15 Winter				23.729	-0.321
S17.001	S27	180 Winter	1	+0%	100/30 Summer				23.562	-0.316
S18.000	S29	15 Winter	1	+0%					23.582	-0.324
S17.002	S27	15 Winter	1	+0%	100/15 Summer				23.339	-0.272
S17.003	S30	1440 Winter	1	+0%	100/1440 Winter				23.125	-0.233

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.04		2.6	OK	
S1.001	S2	0.000	0.09		3.8	OK	
S2.000	S2	0.000	0.35		21.2	OK	
S3.000	S3	0.000	0.03		6.0	OK	
S4.000	S4	0.000	0.21		38.8	OK	
S1.002	S6	0.000	0.10		56.6	OK	
S5.000	S7	0.000	0.02		3.1	OK	
S6.000	S8	0.000	0.23		41.7	OK	
S7.000	S9	0.000	0.11		15.0	OK	
S1.003	S10	0.000	0.15		78.6	OK	
S8.000	S11	0.000	0.00		0.6	OK	
S9.000	S12	0.000	0.12		21.6	OK	
S10.000	S13	0.000	0.57		31.4	OK	
S1.004	S14	0.000	0.16		89.2	OK	
S11.000	S15	0.000	0.04		7.1	OK	
S12.000	S16	0.000	0.23		42.2	OK	
S13.000	S17	0.000	0.13		7.4	OK	
S1.005	S18	0.000	0.00		24.3	OK	
S14.000	S19	0.000	0.02		3.7	OK	
S15.000	S20	0.000	0.13		28.7	OK	
S16.000	S21	0.000	0.09		3.6	OK	
S16.001	S22	0.000	0.10		3.7	OK	
S16.002	S23	0.000	0.87		7.5	OK	
S16.003	S24	0.000	0.01		8.6	OK	
S16.004	S25	0.000	0.01		12.0	OK	
S17.000	S26	0.000	0.18		15.8	OK	
S17.001	S27	0.000	0.19		17.3	OK	
S18.000	S29	0.000	0.17		15.5	OK	
S17.002	S27	0.000	0.33		62.6	OK	
S17.003	S30	0.000	0.01		0.7	OK	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.006	S28	480 Winter	1	+0%	100/60 Summer				23.242	-0.359
S1.007	S29	480 Winter	1	+0%	30/15 Summer				23.236	-0.014

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.006	S28	0.000	0.02		18.2	OK	
S1.007	S29	0.000	0.21		14.1	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 7
Number of Online Controls 2 Number of Storage Structures 14 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 20.000	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.450	Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	30	+0%	100/15 Summer				24.063	-0.237
S1.001	S2	15 Winter	30	+0%	100/15 Summer				23.922	-0.078
S2.000	S2	15 Winter	30	+0%	100/15 Summer				23.913	-0.087
S3.000	S3	15 Winter	30	+0%					24.762	-0.238
S4.000	S4	15 Winter	30	+0%					24.853	-0.147
S1.002	S6	360 Winter	30	+0%	100/120 Winter				23.526	-0.475
S5.000	S7	15 Winter	30	+0%					24.793	-0.257
S6.000	S8	15 Winter	30	+0%					24.909	-0.141
S7.000	S9	15 Winter	30	+0%	100/180 Winter				23.864	-0.186
S1.003	S10	360 Winter	30	+0%	100/120 Winter				23.526	-0.375
S8.000	S11	120 Winter	30	+0%					24.488	-0.262
S9.000	S12	15 Winter	30	+0%					24.854	-0.191
S10.000	S13	15 Winter	30	+0%	30/15 Summer				24.188	0.188
S1.004	S14	360 Winter	30	+0%	100/120 Winter				23.522	-0.279
S11.000	S15	15 Winter	30	+0%					24.767	-0.233
S12.000	S16	15 Winter	30	+0%	100/15 Summer				24.861	-0.139
S13.000	S17	15 Winter	30	+0%	100/120 Winter				23.862	-0.138
S1.005	S18	480 Winter	30	+0%	100/120 Winter				23.514	-0.187
S14.000	S19	15 Winter	30	+0%					24.744	-0.256
S15.000	S20	15 Winter	30	+0%					24.817	-0.183
S16.000	S21	15 Winter	30	+0%	30/15 Summer				24.245	0.095
S16.001	S22	30 Winter	30	+0%	30/15 Summer				24.225	0.275
S16.002	S23	30 Winter	30	+0%	30/15 Summer				24.212	0.330
S16.003	S24	480 Winter	30	+0%					23.512	-0.571
S16.004	S25	480 Winter	30	+0%					23.512	-0.539
S17.000	S26	60 Winter	30	+0%	100/15 Winter				23.889	-0.161
S17.001	S27	60 Winter	30	+0%	100/30 Summer				23.725	-0.153
S18.000	S29	15 Winter	30	+0%					23.661	-0.245
S17.002	S27	15 Winter	30	+0%	100/15 Summer				23.497	-0.114
S17.003	S30	1440 Winter	30	+0%	100/1440 Winter				23.229	-0.129

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.09		6.3	OK	
S1.001	S2	0.000	0.72		29.8	OK	
S2.000	S2	0.000	0.78		47.6	OK	
S3.000	S3	0.000	0.08		15.0	OK	
S4.000	S4	0.000	0.51		95.2	OK	
S1.002	S6	0.000	0.06		31.0	OK	
S5.000	S7	0.000	0.04		7.8	OK	
S6.000	S8	0.000	0.55		102.4	OK	
S7.000	S9	0.000	0.31		41.5	OK	
S1.003	S10	0.000	0.09		48.2	OK	
S8.000	S11	0.000	0.03		6.4	OK	
S9.000	S12	0.000	0.29		52.9	OK	
S10.000	S13	0.000	1.40		77.3	SURCHARGED	
S1.004	S14	0.000	0.10		58.4	OK	
S11.000	S15	0.000	0.10		17.7	OK	
S12.000	S16	0.000	0.56		103.6	OK	
S13.000	S17	0.000	0.57		33.4	OK	
S1.005	S18	0.000	0.01		53.5	OK	
S14.000	S19	0.000	0.04		9.5	OK	
S15.000	S20	0.000	0.32		70.4	OK	
S16.000	S21	0.000	0.19		7.4	SURCHARGED	
S16.001	S22	0.000	0.30		11.5	SURCHARGED	
S16.002	S23	0.000	2.11		18.1	SURCHARGED	
S16.003	S24	0.000	0.01		8.0	OK	
S16.004	S25	0.000	0.00		7.8	OK	
S17.000	S26	0.000	0.71		63.9	OK	
S17.001	S27	0.000	0.76		67.7	OK	
S18.000	S29	0.000	0.40		35.5	OK	
S17.002	S27	0.000	0.88		167.2	OK	
S17.003	S30	0.000	0.02		0.9	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.006	S28	480 Winter	30	+0%	100/60 Summer				23.512	-0.089
S1.007	S29	480 Winter	30	+0%	30/15 Summer				23.489	0.239

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.006	S28	0.000	0.02		23.1	OK	
S1.007	S29	0.000	0.22		15.0	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 7
Number of Online Controls 2 Number of Storage Structures 14 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 20.000	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.450	Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	100	+40%	100/15 Summer				24.443	0.143
S1.001	S2	15 Winter	100	+40%	100/15 Summer				24.425	0.425
S2.000	S2	15 Winter	100	+40%	100/15 Summer				24.321	0.321
S3.000	S3	15 Winter	100	+40%					24.783	-0.217
S4.000	S4	15 Winter	100	+40%					24.929	-0.071
S1.002	S6	480 Winter	100	+40%	100/120 Winter				24.296	0.295
S5.000	S7	15 Winter	100	+40%					24.811	-0.239
S6.000	S8	15 Summer	100	+40%					25.048	-0.002
S7.000	S9	480 Winter	100	+40%	100/180 Winter				24.265	0.215
S1.003	S10	480 Winter	100	+40%	100/120 Winter				24.298	0.397
S8.000	S11	60 Summer	100	+40%					24.512	-0.238
S9.000	S12	15 Winter	100	+40%					24.899	-0.146
S10.000	S13	15 Winter	100	+40%	30/15 Summer				24.243	0.243
S1.004	S14	480 Winter	100	+40%	100/120 Winter				24.302	0.501
S11.000	S15	30 Winter	100	+40%					24.791	-0.209
S12.000	S16	15 Summer	100	+40%	100/15 Summer				25.018	0.018
S13.000	S17	480 Winter	100	+40%	100/120 Winter				24.238	0.238
S1.005	S18	480 Winter	100	+40%	100/120 Winter				24.300	0.599
S14.000	S19	15 Winter	100	+40%					24.763	-0.237
S15.000	S20	15 Winter	100	+40%					24.865	-0.135
S16.000	S21	15 Winter	100	+40%	30/15 Summer				24.317	0.167
S16.001	S22	15 Winter	100	+40%	30/15 Summer				24.279	0.329
S16.002	S23	60 Winter	100	+40%	30/15 Summer				24.258	0.376
S16.003	S24	720 Winter	100	+40%					24.033	-0.050
S16.004	S25	720 Winter	100	+40%					24.032	-0.019
S17.000	S26	60 Winter	100	+40%	100/15 Winter				24.339	0.289
S17.001	S27	60 Winter	100	+40%	100/30 Summer				24.023	0.145
S18.000	S29	1440 Winter	100	+40%					23.797	-0.109
S17.002	S27	1440 Winter	100	+40%	100/15 Summer				23.797	0.186
S17.003	S30	1440 Winter	100	+40%	100/1440 Winter				23.797	0.439

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.14		9.8	SURCHARGED	
S1.001	S2	0.000	1.42		59.1	SURCHARGED	
S2.000	S2	0.000	1.37		84.1	SURCHARGED	
S3.000	S3	0.000	0.16		29.5	OK	
S4.000	S4	0.000	0.94		173.2	OK	
S1.002	S6	0.000	0.10		56.2	SURCHARGED	
S5.000	S7	0.000	0.08		15.1	OK	
S6.000	S8	0.000	1.00		184.7	OK	
S7.000	S9	0.000	0.29		38.5	SURCHARGED	
S1.003	S10	0.000	0.14		73.4	SURCHARGED	
S8.000	S11	0.000	0.08		14.1	OK	
S9.000	S12	0.000	0.52		96.3	OK	
S10.000	S13	0.000	1.51		83.8	SURCHARGED	
S1.004	S14	0.000	0.15		86.4	SURCHARGED	
S11.000	S15	0.000	0.20		37.6	OK	
S12.000	S16	0.000	1.01		186.2	SURCHARGED	
S13.000	S17	0.000	0.22		13.1	SURCHARGED	
S1.005	S18	0.000	0.03		130.9	SURCHARGED	
S14.000	S19	0.000	0.08		18.4	OK	
S15.000	S20	0.000	0.59		128.2	OK	
S16.000	S21	0.000	0.38		14.8	SURCHARGED	
S16.001	S22	0.000	0.84		31.6	SURCHARGED	
S16.002	S23	0.000	2.22		19.1	SURCHARGED	
S16.003	S24	0.000	0.01		9.4	OK	
S16.004	S25	0.000	0.04		62.0	OK	
S17.000	S26	0.000	1.35		121.1	SURCHARGED	
S17.001	S27	0.000	1.53		135.8	SURCHARGED	
S18.000	S29	0.000	0.03		2.6	OK	
S17.002	S27	0.000	0.16		30.9	SURCHARGED	
S17.003	S30	0.000	0.01		0.8	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.006	S28	720 Winter	100	+40%	100/60 Summer				24.031	0.430
S1.007	S29	720 Winter	100	+40%	30/15 Summer				24.031	0.781

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.006	S28	0.000	0.11		111.8	SURCHARGED	
S1.007	S29	0.000	0.22		15.0	SURCHARGED	

3. MicroDrainage printout for existing drainage system - 100year +40% rainfall event plus 1.12 m surcharge at outfall manhole

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.450	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	150	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.639	4-8	2.333	8-12	1.632	12-16	0.138

Total Area Contributing (ha) = 4.742

Total Pipe Volume (m³) = 592.205

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	70.228	0.300	234.1	0.018	4.00	0.0	0.600		o	300	Pipe/Conduit	
S1.001	66.764	0.300	222.5	0.115	0.00	0.0		0.020	o	300	Pipe/Conduit	
S2.000	76.098	0.254	300.0	0.137	4.00	0.0	0.600		o	300	Pipe/Conduit	
S3.000	30.000	1.000	30.0	0.162	4.00	0.0	0.600		o	300	Pipe/Conduit	
S4.000	30.000	1.000	30.0	0.250	4.00	0.0	0.600		o	300	Pipe/Conduit	
S1.002	58.058	0.100	580.6	0.059	0.00	0.0		0.020	→[↓]		Cellular Storage	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	150.00	5.14	24.000	0.018	0.0	0.0	0.0	1.02	72.3	7.3
S1.001	150.00	7.01	23.700	0.133	0.0	0.0	0.0	0.60	42.1«	54.0
S2.000	150.00	5.41	23.700	0.137	0.0	0.0	0.0	0.90	63.8	55.7
S3.000	150.00	4.17	24.700	0.162	0.0	0.0	0.0	2.88	203.7	65.8
S4.000	150.00	4.17	24.700	0.250	0.0	0.0	0.0	2.88	203.7	101.6
S1.002	141.09	8.36	23.400	0.741	0.0	0.0	0.0	0.72	597.3	283.1

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S5.000	30.000	1.000	30.0	0.083	4.00	0.0	0.600		o	300	Pipe/Conduit	
S6.000	30.000	1.000	30.0	0.269	4.00	0.0	0.600		o	300	Pipe/Conduit	
S7.000	14.331	0.300	47.8	0.109	4.00	0.0	0.600		o	300	Pipe/Conduit	
S1.003	72.731	0.100	727.3	0.095	0.00	0.0		0.020	→[↓]		Cellular Storage	
S8.000	30.000	1.000	30.0	0.084	4.00	0.0	0.600		o	300	Pipe/Conduit	
S9.000	30.000	1.000	30.0	0.139	4.00	0.0	0.600		o	300	Pipe/Conduit	
S10.000	73.079	0.200	365.4	0.210	4.00	0.0	0.600		o	300	Pipe/Conduit	
S1.004	69.812	0.100	698.1	0.093	0.00	0.0		0.020	→[↓]		Cellular Storage	
S11.000	30.000	1.000	30.0	0.192	4.00	0.0	0.600		o	300	Pipe/Conduit	
S12.000	30.000	1.000	30.0	0.272	4.00	0.0	0.600		o	300	Pipe/Conduit	
S13.000	46.226	0.150	308.2	0.088	4.00	0.0	0.600		o	300	Pipe/Conduit	
S1.005	32.870	1.000	32.9	0.041	0.00	0.0		0.020	→[↓]		Cellular Storage	
S14.000	30.000	1.400	21.4	0.101	4.00	0.0	0.600		o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S5.000	150.00	4.17	24.750	0.083	0.0	0.0	0.0	2.88	203.7	33.7
S6.000	150.00	4.17	24.750	0.269	0.0	0.0	0.0	2.88	203.7	109.3
S7.000	150.00	4.10	23.750	0.109	0.0	0.0	0.0	2.28	161.2	44.3
S1.003	127.23	10.25	23.300	1.297	0.0	0.0	0.0	0.64	554.7	446.9
S8.000	150.00	4.17	24.450	0.084	0.0	0.0	0.0	2.88	203.7	34.1
S9.000	150.00	4.17	24.745	0.139	0.0	0.0	0.0	2.88	203.7	56.5
S10.000	150.00	5.49	23.700	0.210	0.0	0.0	0.0	0.82	57.7«	85.3
S1.004	116.78	12.01	23.200	1.823	0.0	0.0	0.0	0.66	594.4	576.6
S11.000	150.00	4.17	24.700	0.192	0.0	0.0	0.0	2.88	203.7	78.0
S12.000	150.00	4.17	24.700	0.272	0.0	0.0	0.0	2.88	203.7	110.5
S13.000	150.00	4.87	23.700	0.088	0.0	0.0	0.0	0.89	62.9	35.7
S1.005	115.91	12.17	23.100	2.416	0.0	0.0	0.0	3.35	5816.9	758.4
S14.000	150.00	4.15	24.700	0.101	0.0	0.0	0.0	3.41	241.1	41.0

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S15.000	30.000	1.400	21.4	0.185	4.00	0.0	0.600		o	300	Pipe/Conduit	
S16.000	49.457	0.200	247.3	0.025	4.00	0.0		0.020	o	300	Pipe/Conduit	
S16.001	16.775	0.068	246.7	0.028	0.00	0.0		0.020	o	300	Pipe/Conduit	
S16.002	37.834	0.100	378.3	0.145	0.00	0.0		0.075	o	300	Pipe/Conduit	
S16.003	30.730	0.150	204.9	0.029	0.00	0.0		0.020	→[↓]		Cellular Storage	
S16.004	98.965	0.450	219.9	0.085	0.00	0.0		0.020	→[↓]		Cellular Storage	
S17.000	69.464	0.172	403.9	0.690	4.00	0.0		0.020	o	450	Pipe/Conduit	
S17.001	50.000	0.123	406.5	0.100	0.00	0.0		0.020	o	450	Pipe/Conduit	
S18.000	50.000	0.123	406.5	0.100	4.00	0.0		0.020	o	450	Pipe/Conduit	
S17.002	35.912	0.103	348.7	0.300	0.00	0.0		0.020	oo	450	Double Pipe	
S17.003	8.952	0.058	154.3	0.300	0.00	0.0	0.600		o	300	Pipe/Conduit	
S1.006	48.207	0.050	964.1	0.222	0.00	0.0		0.020	→[↓]		Cellular Storage	
S1.007	53.954	0.230	234.6	0.016	0.00	0.0	0.600		o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S15.000	150.00	4.15	24.700	0.185	0.0	0.0	0.0	3.41	241.1	75.2
S16.000	150.00	5.46	23.850	0.025	0.0	0.0	0.0	0.57	40.0	10.2
S16.001	150.00	5.95	23.650	0.053	0.0	0.0	0.0	0.57	40.0	21.5
S16.002	121.78	11.12	23.582	0.198	0.0	0.0	0.0	0.12	8.6«	65.3
S16.003	119.44	11.53	23.482	0.227	0.0	0.0	0.0	1.27	1410.2	73.4
S16.004	112.54	12.83	23.450	0.312	0.0	0.0	0.0	1.27	1826.6	95.1
S17.000	150.00	6.00	23.600	0.690	0.0	0.0	0.0	0.58	92.2«	280.3
S17.001	148.98	7.44	23.428	0.790	0.0	0.0	0.0	0.58	91.9«	318.7
S18.000	150.00	5.44	23.456	0.100	0.0	0.0	0.0	0.58	91.9	40.6
S17.002	140.81	8.40	23.161	1.190	0.0	0.0	0.0	0.62	198.5«	453.8
S17.003	139.85	8.52	23.058	1.490	0.0	0.0	0.0	1.26	89.3«	564.3
S1.006	106.52	14.12	23.000	4.726	0.0	0.0	0.0	0.62	1141.9«	1363.4
S1.007	102.82	15.00	22.950	4.742	0.0	0.0	0.0	1.02	72.3«	1363.4

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S1	25.200	1.200	Open Manhole	1200	S1.000	24.000	300				
S2	25.200	1.500	Open Manhole	1200	S1.001	23.700	300	S1.000	23.700	300	
S2	25.200	1.500	Open Manhole	1500	S2.000	23.700	300				
S3	26.000	1.300	Open Manhole	1200	S3.000	24.700	300				
S4	26.000	1.300	Open Manhole	1200	S4.000	24.700	300				
S6	25.000	1.600	Open Manhole	1800	S1.002	23.400		S1.001	23.400	300	
								S2.000	23.446	300	
								S3.000	23.700	300	
								S4.000	23.700	300	
S7	26.000	1.250	Open Manhole	1200	S5.000	24.750	300				
S8	26.000	1.250	Open Manhole	1200	S6.000	24.750	300				
S9	25.000	1.250	Open Manhole	1200	S7.000	23.750	300				
S10	25.000	1.700	Open Manhole	1800	S1.003	23.300		S1.002	23.300		
								S5.000	23.750	300	149
								S6.000	23.750	300	149
								S7.000	23.450	300	
S11	26.000	1.550	Open Manhole	1200	S8.000	24.450	300				
S12	26.000	1.255	Open Manhole	1200	S9.000	24.745	300				
S13	25.000	1.300	Open Manhole	1200	S10.000	23.700	300				
S14	25.000	1.800	Open Manhole	1800	S1.004	23.200		S1.003	23.200		
								S8.000	23.450	300	
								S9.000	23.745	300	244
								S10.000	23.500	300	
S15	26.000	1.300	Open Manhole	1200	S11.000	24.700	300				
S16	26.000	1.300	Open Manhole	1200	S12.000	24.700	300				
S17	25.000	1.300	Open Manhole	1200	S13.000	23.700	300				
S18	25.000	1.900	Open Manhole	1800	S1.005	23.100		S1.004	23.100		
								S11.000	23.700	300	299
								S12.000	23.700	300	299
								S13.000	23.550	300	149
S19	26.000	1.300	Open Manhole	1200	S14.000	24.700	300				
S20	26.000	1.300	Open Manhole	1200	S15.000	24.700	300				
S21	25.000	1.150	Open Manhole	1500	S16.000	23.850	300				
S22	25.000	1.350	Open Manhole	1500	S16.001	23.650	300	S16.000	23.650	300	
S23	25.000	1.418	Open Manhole	1500	S16.002	23.582	300	S16.001	23.582	300	
S24	25.000	1.518	Open Manhole	1800	S16.003	23.482		S16.002	23.482	300	
S25	25.000	1.668	Open Manhole	1800	S16.004	23.450		S16.003	23.332		
S26	25.000	1.400	Open Manhole	1500	S17.000	23.600	450				
S27	25.000	1.572	Open Manhole	1500	S17.001	23.428	450	S17.000	23.428	450	
S29	25.000	1.544	Open Manhole	1500	S18.000	23.456	450				
S27	25.000	1.839	Open Manhole	1500	S17.002	23.161	450	S17.001	23.305	450	144
								S18.000	23.333	450	172
S30	25.000	1.942	Open Manhole	1800	S17.003	23.058	300	S17.002	23.058	450	
S28	25.000	2.900	Open Manhole	2100	S1.006	23.000		S1.005	22.100		

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
								S14.000	23.300	300	
								S15.000	23.300	300	
								S16.004	23.000		
								S17.003	23.000	300	
S29	24.700	1.750	Open Manhole	1800	S1.007	22.950	300	S1.006	22.950		
S	24.780	2.060	Open Manhole	0		OUTFALL		S1.007	22.720	300	

No coordinates have been specified, layout information cannot be produced.

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o		S1	25.200	24.000	0.900	Open Manhole	1200
S1.001	o	300	S2	25.200	23.700	1.200	Open Manhole	1200
S2.000	o	300	S2	25.200	23.700	1.200	Open Manhole	1500
S3.000	o	300	S3	26.000	24.700	1.000	Open Manhole	1200
S4.000	o	300	S4	26.000	24.700	1.000	Open Manhole	1200
S1.002	→[↓]		S6	25.000	23.400	0.999	Open Manhole	1800
S5.000	o	300	S7	26.000	24.750	0.950	Open Manhole	1200
S6.000	o	300	S8	26.000	24.750	0.950	Open Manhole	1200
S7.000	o	300	S9	25.000	23.750	0.950	Open Manhole	1200
S1.003	→[↓]		S10	25.000	23.300	1.099	Open Manhole	1800
S8.000	o	300	S11	26.000	24.450	1.250	Open Manhole	1200
S9.000	o	300	S12	26.000	24.745	0.955	Open Manhole	1200
S10.000	o	300	S13	25.000	23.700	1.000	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	70.228	234.1	S2	25.200	23.700	1.200	Open Manhole	1200
S1.001	66.764	222.5	S6	25.000	23.400	1.300	Open Manhole	1800
S2.000	76.098	300.0	S6	25.000	23.446	1.254	Open Manhole	1800
S3.000	30.000	30.0	S6	25.000	23.700	1.000	Open Manhole	1800
S4.000	30.000	30.0	S6	25.000	23.700	1.000	Open Manhole	1800
S1.002	58.058	580.6	S10	25.000	23.300	1.099	Open Manhole	1800
S5.000	30.000	30.0	S10	25.000	23.750	0.950	Open Manhole	1800
S6.000	30.000	30.0	S10	25.000	23.750	0.950	Open Manhole	1800
S7.000	14.331	47.8	S10	25.000	23.450	1.250	Open Manhole	1800
S1.003	72.731	727.3	S14	25.000	23.200	1.199	Open Manhole	1800
S8.000	30.000	30.0	S14	25.000	23.450	1.250	Open Manhole	1800
S9.000	30.000	30.0	S14	25.000	23.745	0.955	Open Manhole	1800
S10.000	73.079	365.4	S14	25.000	23.500	1.200	Open Manhole	1800

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.004	→[↓]		S14	25.000	23.200	1.199	Open Manhole	1800
S11.000	o	300	S15	26.000	24.700	1.000	Open Manhole	1200
S12.000	o	300	S16	26.000	24.700	1.000	Open Manhole	1200
S13.000	o	300	S17	25.000	23.700	1.000	Open Manhole	1200
S1.005	→[↓]		S18	25.000	23.100	1.299	Open Manhole	1800
S14.000	o	300	S19	26.000	24.700	1.000	Open Manhole	1200
S15.000	o	300	S20	26.000	24.700	1.000	Open Manhole	1200
S16.000	o	300	S21	25.000	23.850	0.850	Open Manhole	1500
S16.001	o	300	S22	25.000	23.650	1.050	Open Manhole	1500
S16.002	o	300	S23	25.000	23.582	1.118	Open Manhole	1500
S16.003	→[↓]		S24	25.000	23.482	0.917	Open Manhole	1800
S16.004	→[↓]		S25	25.000	23.450	0.949	Open Manhole	1800
S17.000	o	450	S26	25.000	23.600	0.950	Open Manhole	1500
S17.001	o	450	S27	25.000	23.428	1.122	Open Manhole	1500
S18.000	o	450	S29	25.000	23.456	1.094	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.004	69.812	698.1	S18	25.000	23.100	1.299	Open Manhole	1800
S11.000	30.000	30.0	S18	25.000	23.700	1.000	Open Manhole	1800
S12.000	30.000	30.0	S18	25.000	23.700	1.000	Open Manhole	1800
S13.000	46.226	308.2	S18	25.000	23.550	1.150	Open Manhole	1800
S1.005	32.870	32.9	S28	25.000	22.100	2.299	Open Manhole	2100
S14.000	30.000	21.4	S28	25.000	23.300	1.400	Open Manhole	2100
S15.000	30.000	21.4	S28	25.000	23.300	1.400	Open Manhole	2100
S16.000	49.457	247.3	S22	25.000	23.650	1.050	Open Manhole	1500
S16.001	16.775	246.7	S23	25.000	23.582	1.118	Open Manhole	1500
S16.002	37.834	378.3	S24	25.000	23.482	1.218	Open Manhole	1800
S16.003	30.730	204.9	S25	25.000	23.332	1.067	Open Manhole	1800
S16.004	98.965	219.9	S28	25.000	23.000	1.399	Open Manhole	2100
S17.000	69.464	403.9	S27	25.000	23.428	1.122	Open Manhole	1500
S17.001	50.000	406.5	S27	25.000	23.305	1.245	Open Manhole	1500
S18.000	50.000	406.5	S27	25.000	23.333	1.217	Open Manhole	1500

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S17.002	oo	450	S27	25.000	23.161	1.389	Open Manhole	1500
S17.003	o	300	S30	25.000	23.058	1.642	Open Manhole	1800
S1.006	→[↓]		S28	25.000	23.000	1.399	Open Manhole	2100
S1.007	o	300	S29	24.700	22.950	1.450	Open Manhole	1800

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S17.002	35.912	348.7	S30	25.000	23.058	1.492	Open Manhole	1800
S17.003	8.952	154.3	S28	25.000	23.000	1.700	Open Manhole	2100
S1.006	48.207	964.1	S29	24.700	22.950	1.149	Open Manhole	1800
S1.007	53.954	234.6	S	24.780	22.720	1.760	Open Manhole	0

Surcharged Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.007	S	24.780	22.720	22.720	0	0

Datum (m) 22.720 Offset (mins) 0

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
1	1.100	25	1.100	49	1.100	73	1.100	97	1.100	121	1.100	145	1.100	169	1.100
2	1.100	26	1.100	50	1.100	74	1.100	98	1.100	122	1.100	146	1.100	170	1.100
3	1.100	27	1.100	51	1.100	75	1.100	99	1.100	123	1.100	147	1.100	171	1.100
4	1.100	28	1.100	52	1.100	76	1.100	100	1.100	124	1.100	148	1.100	172	1.100
5	1.100	29	1.100	53	1.100	77	1.100	101	1.100	125	1.100	149	1.100	173	1.100
6	1.100	30	1.100	54	1.100	78	1.100	102	1.100	126	1.100	150	1.100	174	1.100
7	1.100	31	1.100	55	1.100	79	1.100	103	1.100	127	1.100	151	1.100	175	1.100
8	1.100	32	1.100	56	1.100	80	1.100	104	1.100	128	1.100	152	1.100	176	1.100
9	1.100	33	1.100	57	1.100	81	1.100	105	1.100	129	1.100	153	1.100	177	1.100
10	1.100	34	1.100	58	1.100	82	1.100	106	1.100	130	1.100	154	1.100	178	1.100
11	1.100	35	1.100	59	1.100	83	1.100	107	1.100	131	1.100	155	1.100	179	1.100
12	1.100	36	1.100	60	1.100	84	1.100	108	1.100	132	1.100	156	1.100	180	1.100
13	1.100	37	1.100	61	1.100	85	1.100	109	1.100	133	1.100	157	1.100	181	1.100
14	1.100	38	1.100	62	1.100	86	1.100	110	1.100	134	1.100	158	1.100	182	1.100
15	1.100	39	1.100	63	1.100	87	1.100	111	1.100	135	1.100	159	1.100	183	1.100
16	1.100	40	1.100	64	1.100	88	1.100	112	1.100	136	1.100	160	1.100	184	1.100
17	1.100	41	1.100	65	1.100	89	1.100	113	1.100	137	1.100	161	1.100	185	1.100
18	1.100	42	1.100	66	1.100	90	1.100	114	1.100	138	1.100	162	1.100	186	1.100
19	1.100	43	1.100	67	1.100	91	1.100	115	1.100	139	1.100	163	1.100	187	1.100
20	1.100	44	1.100	68	1.100	92	1.100	116	1.100	140	1.100	164	1.100	188	1.100
21	1.100	45	1.100	69	1.100	93	1.100	117	1.100	141	1.100	165	1.100	189	1.100
22	1.100	46	1.100	70	1.100	94	1.100	118	1.100	142	1.100	166	1.100	190	1.100
23	1.100	47	1.100	71	1.100	95	1.100	119	1.100	143	1.100	167	1.100	191	1.100
24	1.100	48	1.100	72	1.100	96	1.100	120	1.100	144	1.100	168	1.100	192	1.100

Surcharged Outfall Details for Storm

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
193	1.100	252	1.100	311	1.100	370	1.100	429	1.100	488	1.100	547	1.100	606	1.100
194	1.100	253	1.100	312	1.100	371	1.100	430	1.100	489	1.100	548	1.100	607	1.100
195	1.100	254	1.100	313	1.100	372	1.100	431	1.100	490	1.100	549	1.100	608	1.100
196	1.100	255	1.100	314	1.100	373	1.100	432	1.100	491	1.100	550	1.100	609	1.100
197	1.100	256	1.100	315	1.100	374	1.100	433	1.100	492	1.100	551	1.100	610	1.100
198	1.100	257	1.100	316	1.100	375	1.100	434	1.100	493	1.100	552	1.100	611	1.100
199	1.100	258	1.100	317	1.100	376	1.100	435	1.100	494	1.100	553	1.100	612	1.100
200	1.100	259	1.100	318	1.100	377	1.100	436	1.100	495	1.100	554	1.100	613	1.100
201	1.100	260	1.100	319	1.100	378	1.100	437	1.100	496	1.100	555	1.100	614	1.100
202	1.100	261	1.100	320	1.100	379	1.100	438	1.100	497	1.100	556	1.100	615	1.100
203	1.100	262	1.100	321	1.100	380	1.100	439	1.100	498	1.100	557	1.100	616	1.100
204	1.100	263	1.100	322	1.100	381	1.100	440	1.100	499	1.100	558	1.100	617	1.100
205	1.100	264	1.100	323	1.100	382	1.100	441	1.100	500	1.100	559	1.100	618	1.100
206	1.100	265	1.100	324	1.100	383	1.100	442	1.100	501	1.100	560	1.100	619	1.100
207	1.100	266	1.100	325	1.100	384	1.100	443	1.100	502	1.100	561	1.100	620	1.100
208	1.100	267	1.100	326	1.100	385	1.100	444	1.100	503	1.100	562	1.100	621	1.100
209	1.100	268	1.100	327	1.100	386	1.100	445	1.100	504	1.100	563	1.100	622	1.100
210	1.100	269	1.100	328	1.100	387	1.100	446	1.100	505	1.100	564	1.100	623	1.100
211	1.100	270	1.100	329	1.100	388	1.100	447	1.100	506	1.100	565	1.100	624	1.100
212	1.100	271	1.100	330	1.100	389	1.100	448	1.100	507	1.100	566	1.100	625	1.100
213	1.100	272	1.100	331	1.100	390	1.100	449	1.100	508	1.100	567	1.100	626	1.100
214	1.100	273	1.100	332	1.100	391	1.100	450	1.100	509	1.100	568	1.100	627	1.100
215	1.100	274	1.100	333	1.100	392	1.100	451	1.100	510	1.100	569	1.100	628	1.100
216	1.100	275	1.100	334	1.100	393	1.100	452	1.100	511	1.100	570	1.100	629	1.100
217	1.100	276	1.100	335	1.100	394	1.100	453	1.100	512	1.100	571	1.100	630	1.100
218	1.100	277	1.100	336	1.100	395	1.100	454	1.100	513	1.100	572	1.100	631	1.100
219	1.100	278	1.100	337	1.100	396	1.100	455	1.100	514	1.100	573	1.100	632	1.100
220	1.100	279	1.100	338	1.100	397	1.100	456	1.100	515	1.100	574	1.100	633	1.100
221	1.100	280	1.100	339	1.100	398	1.100	457	1.100	516	1.100	575	1.100	634	1.100
222	1.100	281	1.100	340	1.100	399	1.100	458	1.100	517	1.100	576	1.100	635	1.100
223	1.100	282	1.100	341	1.100	400	1.100	459	1.100	518	1.100	577	1.100	636	1.100
224	1.100	283	1.100	342	1.100	401	1.100	460	1.100	519	1.100	578	1.100	637	1.100
225	1.100	284	1.100	343	1.100	402	1.100	461	1.100	520	1.100	579	1.100	638	1.100
226	1.100	285	1.100	344	1.100	403	1.100	462	1.100	521	1.100	580	1.100	639	1.100
227	1.100	286	1.100	345	1.100	404	1.100	463	1.100	522	1.100	581	1.100	640	1.100
228	1.100	287	1.100	346	1.100	405	1.100	464	1.100	523	1.100	582	1.100	641	1.100
229	1.100	288	1.100	347	1.100	406	1.100	465	1.100	524	1.100	583	1.100	642	1.100
230	1.100	289	1.100	348	1.100	407	1.100	466	1.100	525	1.100	584	1.100	643	1.100
231	1.100	290	1.100	349	1.100	408	1.100	467	1.100	526	1.100	585	1.100	644	1.100
232	1.100	291	1.100	350	1.100	409	1.100	468	1.100	527	1.100	586	1.100	645	1.100
233	1.100	292	1.100	351	1.100	410	1.100	469	1.100	528	1.100	587	1.100	646	1.100
234	1.100	293	1.100	352	1.100	411	1.100	470	1.100	529	1.100	588	1.100	647	1.100
235	1.100	294	1.100	353	1.100	412	1.100	471	1.100	530	1.100	589	1.100	648	1.100
236	1.100	295	1.100	354	1.100	413	1.100	472	1.100	531	1.100	590	1.100	649	1.100
237	1.100	296	1.100	355	1.100	414	1.100	473	1.100	532	1.100	591	1.100	650	1.100
238	1.100	297	1.100	356	1.100	415	1.100	474	1.100	533	1.100	592	1.100	651	1.100
239	1.100	298	1.100	357	1.100	416	1.100	475	1.100	534	1.100	593	1.100	652	1.100
240	1.100	299	1.100	358	1.100	417	1.100	476	1.100	535	1.100	594	1.100	653	1.100
241	1.100	300	1.100	359	1.100	418	1.100	477	1.100	536	1.100	595	1.100	654	1.100
242	1.100	301	1.100	360	1.100	419	1.100	478	1.100	537	1.100	596	1.100	655	1.100
243	1.100	302	1.100	361	1.100	420	1.100	479	1.100	538	1.100	597	1.100	656	1.100
244	1.100	303	1.100	362	1.100	421	1.100	480	1.100	539	1.100	598	1.100	657	1.100
245	1.100	304	1.100	363	1.100	422	1.100	481	1.100	540	1.100	599	1.100	658	1.100
246	1.100	305	1.100	364	1.100	423	1.100	482	1.100	541	1.100	600	1.100	659	1.100
247	1.100	306	1.100	365	1.100	424	1.100	483	1.100	542	1.100	601	1.100	660	1.100
248	1.100	307	1.100	366	1.100	425	1.100	484	1.100	543	1.100	602	1.100	661	1.100
249	1.100	308	1.100	367	1.100	426	1.100	485	1.100	544	1.100	603	1.100	662	1.100
250	1.100	309	1.100	368	1.100	427	1.100	486	1.100	545	1.100	604	1.100	663	1.100
251	1.100	310	1.100	369	1.100	428	1.100	487	1.100	546	1.100	605	1.100	664	1.100

Surcharged Outfall Details for Storm

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
665	1.100	724	1.100	783	1.100	842	1.100	901	1.100	960	1.100	1019	1.100	1078	1.100
666	1.100	725	1.100	784	1.100	843	1.100	902	1.100	961	1.100	1020	1.100	1079	1.100
667	1.100	726	1.100	785	1.100	844	1.100	903	1.100	962	1.100	1021	1.100	1080	1.100
668	1.100	727	1.100	786	1.100	845	1.100	904	1.100	963	1.100	1022	1.100	1081	1.100
669	1.100	728	1.100	787	1.100	846	1.100	905	1.100	964	1.100	1023	1.100	1082	1.100
670	1.100	729	1.100	788	1.100	847	1.100	906	1.100	965	1.100	1024	1.100	1083	1.100
671	1.100	730	1.100	789	1.100	848	1.100	907	1.100	966	1.100	1025	1.100	1084	1.100
672	1.100	731	1.100	790	1.100	849	1.100	908	1.100	967	1.100	1026	1.100	1085	1.100
673	1.100	732	1.100	791	1.100	850	1.100	909	1.100	968	1.100	1027	1.100	1086	1.100
674	1.100	733	1.100	792	1.100	851	1.100	910	1.100	969	1.100	1028	1.100	1087	1.100
675	1.100	734	1.100	793	1.100	852	1.100	911	1.100	970	1.100	1029	1.100	1088	1.100
676	1.100	735	1.100	794	1.100	853	1.100	912	1.100	971	1.100	1030	1.100	1089	1.100
677	1.100	736	1.100	795	1.100	854	1.100	913	1.100	972	1.100	1031	1.100	1090	1.100
678	1.100	737	1.100	796	1.100	855	1.100	914	1.100	973	1.100	1032	1.100	1091	1.100
679	1.100	738	1.100	797	1.100	856	1.100	915	1.100	974	1.100	1033	1.100	1092	1.100
680	1.100	739	1.100	798	1.100	857	1.100	916	1.100	975	1.100	1034	1.100	1093	1.100
681	1.100	740	1.100	799	1.100	858	1.100	917	1.100	976	1.100	1035	1.100	1094	1.100
682	1.100	741	1.100	800	1.100	859	1.100	918	1.100	977	1.100	1036	1.100	1095	1.100
683	1.100	742	1.100	801	1.100	860	1.100	919	1.100	978	1.100	1037	1.100	1096	1.100
684	1.100	743	1.100	802	1.100	861	1.100	920	1.100	979	1.100	1038	1.100	1097	1.100
685	1.100	744	1.100	803	1.100	862	1.100	921	1.100	980	1.100	1039	1.100	1098	1.100
686	1.100	745	1.100	804	1.100	863	1.100	922	1.100	981	1.100	1040	1.100	1099	1.100
687	1.100	746	1.100	805	1.100	864	1.100	923	1.100	982	1.100	1041	1.100	1100	1.100
688	1.100	747	1.100	806	1.100	865	1.100	924	1.100	983	1.100	1042	1.100	1101	1.100
689	1.100	748	1.100	807	1.100	866	1.100	925	1.100	984	1.100	1043	1.100	1102	1.100
690	1.100	749	1.100	808	1.100	867	1.100	926	1.100	985	1.100	1044	1.100	1103	1.100
691	1.100	750	1.100	809	1.100	868	1.100	927	1.100	986	1.100	1045	1.100	1104	1.100
692	1.100	751	1.100	810	1.100	869	1.100	928	1.100	987	1.100	1046	1.100	1105	1.100
693	1.100	752	1.100	811	1.100	870	1.100	929	1.100	988	1.100	1047	1.100	1106	1.100
694	1.100	753	1.100	812	1.100	871	1.100	930	1.100	989	1.100	1048	1.100	1107	1.100
695	1.100	754	1.100	813	1.100	872	1.100	931	1.100	990	1.100	1049	1.100	1108	1.100
696	1.100	755	1.100	814	1.100	873	1.100	932	1.100	991	1.100	1050	1.100	1109	1.100
697	1.100	756	1.100	815	1.100	874	1.100	933	1.100	992	1.100	1051	1.100	1110	1.100
698	1.100	757	1.100	816	1.100	875	1.100	934	1.100	993	1.100	1052	1.100	1111	1.100
699	1.100	758	1.100	817	1.100	876	1.100	935	1.100	994	1.100	1053	1.100	1112	1.100
700	1.100	759	1.100	818	1.100	877	1.100	936	1.100	995	1.100	1054	1.100	1113	1.100
701	1.100	760	1.100	819	1.100	878	1.100	937	1.100	996	1.100	1055	1.100	1114	1.100
702	1.100	761	1.100	820	1.100	879	1.100	938	1.100	997	1.100	1056	1.100	1115	1.100
703	1.100	762	1.100	821	1.100	880	1.100	939	1.100	998	1.100	1057	1.100	1116	1.100
704	1.100	763	1.100	822	1.100	881	1.100	940	1.100	999	1.100	1058	1.100	1117	1.100
705	1.100	764	1.100	823	1.100	882	1.100	941	1.100	1000	1.100	1059	1.100	1118	1.100
706	1.100	765	1.100	824	1.100	883	1.100	942	1.100	1001	1.100	1060	1.100	1119	1.100
707	1.100	766	1.100	825	1.100	884	1.100	943	1.100	1002	1.100	1061	1.100	1120	1.100
708	1.100	767	1.100	826	1.100	885	1.100	944	1.100	1003	1.100	1062	1.100	1121	1.100
709	1.100	768	1.100	827	1.100	886	1.100	945	1.100	1004	1.100	1063	1.100	1122	1.100
710	1.100	769	1.100	828	1.100	887	1.100	946	1.100	1005	1.100	1064	1.100	1123	1.100
711	1.100	770	1.100	829	1.100	888	1.100	947	1.100	1006	1.100	1065	1.100	1124	1.100
712	1.100	771	1.100	830	1.100	889	1.100	948	1.100	1007	1.100	1066	1.100	1125	1.100
713	1.100	772	1.100	831	1.100	890	1.100	949	1.100	1008	1.100	1067	1.100	1126	1.100
714	1.100	773	1.100	832	1.100	891	1.100	950	1.100	1009	1.100	1068	1.100	1127	1.100
715	1.100	774	1.100	833	1.100	892	1.100	951	1.100	1010	1.100	1069	1.100	1128	1.100
716	1.100	775	1.100	834	1.100	893	1.100	952	1.100	1011	1.100	1070	1.100	1129	1.100
717	1.100	776	1.100	835	1.100	894	1.100	953	1.100	1012	1.100	1071	1.100	1130	1.100
718	1.100	777	1.100	836	1.100	895	1.100	954	1.100	1013	1.100	1072	1.100	1131	1.100
719	1.100	778	1.100	837	1.100	896	1.100	955	1.100	1014	1.100	1073	1.100	1132	1.100
720	1.100	779	1.100	838	1.100	897	1.100	956	1.100	1015	1.100	1074	1.100	1133	1.100
721	1.100	780	1.100	839	1.100	898	1.100	957	1.100	1016	1.100	1075	1.100	1134	1.100
722	1.100	781	1.100	840	1.100	899	1.100	958	1.100	1017	1.100	1076	1.100	1135	1.100
723	1.100	782	1.100	841	1.100	900	1.100	959	1.100	1018	1.100	1077	1.100	1136	1.100

Surcharged Outfall Details for Storm

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
1137	1.100	1175	1.100	1213	1.100	1251	1.100	1289	1.100	1327	1.100	1365	1.100	1403	1.100
1138	1.100	1176	1.100	1214	1.100	1252	1.100	1290	1.100	1328	1.100	1366	1.100	1404	1.100
1139	1.100	1177	1.100	1215	1.100	1253	1.100	1291	1.100	1329	1.100	1367	1.100	1405	1.100
1140	1.100	1178	1.100	1216	1.100	1254	1.100	1292	1.100	1330	1.100	1368	1.100	1406	1.100
1141	1.100	1179	1.100	1217	1.100	1255	1.100	1293	1.100	1331	1.100	1369	1.100	1407	1.100
1142	1.100	1180	1.100	1218	1.100	1256	1.100	1294	1.100	1332	1.100	1370	1.100	1408	1.100
1143	1.100	1181	1.100	1219	1.100	1257	1.100	1295	1.100	1333	1.100	1371	1.100	1409	1.100
1144	1.100	1182	1.100	1220	1.100	1258	1.100	1296	1.100	1334	1.100	1372	1.100	1410	1.100
1145	1.100	1183	1.100	1221	1.100	1259	1.100	1297	1.100	1335	1.100	1373	1.100	1411	1.100
1146	1.100	1184	1.100	1222	1.100	1260	1.100	1298	1.100	1336	1.100	1374	1.100	1412	1.100
1147	1.100	1185	1.100	1223	1.100	1261	1.100	1299	1.100	1337	1.100	1375	1.100	1413	1.100
1148	1.100	1186	1.100	1224	1.100	1262	1.100	1300	1.100	1338	1.100	1376	1.100	1414	1.100
1149	1.100	1187	1.100	1225	1.100	1263	1.100	1301	1.100	1339	1.100	1377	1.100	1415	1.100
1150	1.100	1188	1.100	1226	1.100	1264	1.100	1302	1.100	1340	1.100	1378	1.100	1416	1.100
1151	1.100	1189	1.100	1227	1.100	1265	1.100	1303	1.100	1341	1.100	1379	1.100	1417	1.100
1152	1.100	1190	1.100	1228	1.100	1266	1.100	1304	1.100	1342	1.100	1380	1.100	1418	1.100
1153	1.100	1191	1.100	1229	1.100	1267	1.100	1305	1.100	1343	1.100	1381	1.100	1419	1.100
1154	1.100	1192	1.100	1230	1.100	1268	1.100	1306	1.100	1344	1.100	1382	1.100	1420	1.100
1155	1.100	1193	1.100	1231	1.100	1269	1.100	1307	1.100	1345	1.100	1383	1.100	1421	1.100
1156	1.100	1194	1.100	1232	1.100	1270	1.100	1308	1.100	1346	1.100	1384	1.100	1422	1.100
1157	1.100	1195	1.100	1233	1.100	1271	1.100	1309	1.100	1347	1.100	1385	1.100	1423	1.100
1158	1.100	1196	1.100	1234	1.100	1272	1.100	1310	1.100	1348	1.100	1386	1.100	1424	1.100
1159	1.100	1197	1.100	1235	1.100	1273	1.100	1311	1.100	1349	1.100	1387	1.100	1425	1.100
1160	1.100	1198	1.100	1236	1.100	1274	1.100	1312	1.100	1350	1.100	1388	1.100	1426	1.100
1161	1.100	1199	1.100	1237	1.100	1275	1.100	1313	1.100	1351	1.100	1389	1.100	1427	1.100
1162	1.100	1200	1.100	1238	1.100	1276	1.100	1314	1.100	1352	1.100	1390	1.100	1428	1.100
1163	1.100	1201	1.100	1239	1.100	1277	1.100	1315	1.100	1353	1.100	1391	1.100	1429	1.100
1164	1.100	1202	1.100	1240	1.100	1278	1.100	1316	1.100	1354	1.100	1392	1.100	1430	1.100
1165	1.100	1203	1.100	1241	1.100	1279	1.100	1317	1.100	1355	1.100	1393	1.100	1431	1.100
1166	1.100	1204	1.100	1242	1.100	1280	1.100	1318	1.100	1356	1.100	1394	1.100	1432	1.100
1167	1.100	1205	1.100	1243	1.100	1281	1.100	1319	1.100	1357	1.100	1395	1.100	1433	1.100
1168	1.100	1206	1.100	1244	1.100	1282	1.100	1320	1.100	1358	1.100	1396	1.100	1434	1.100
1169	1.100	1207	1.100	1245	1.100	1283	1.100	1321	1.100	1359	1.100	1397	1.100	1435	1.100
1170	1.100	1208	1.100	1246	1.100	1284	1.100	1322	1.100	1360	1.100	1398	1.100	1436	1.100
1171	1.100	1209	1.100	1247	1.100	1285	1.100	1323	1.100	1361	1.100	1399	1.100	1437	1.100
1172	1.100	1210	1.100	1248	1.100	1286	1.100	1324	1.100	1362	1.100	1400	1.100	1438	1.100
1173	1.100	1211	1.100	1249	1.100	1287	1.100	1325	1.100	1363	1.100	1401	1.100	1439	1.100
1174	1.100	1212	1.100	1250	1.100	1288	1.100	1326	1.100	1364	1.100	1402	1.100	1440	1.100

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 7
Number of Online Controls 2 Number of Storage Structures 14 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.450		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S30, DS/PN: S17.003, Volume (m³): 15.8

Unit Reference	MD-SHE-0050-1500-1900-1500
Design Head (m)	1.900
Design Flow (l/s)	1.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	50
Invert Level (m)	23.058
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.900	1.5	Kick-Flo®	0.442	0.8
Flush-Flo™	0.219	0.9	Mean Flow over Head Range	-	1.1

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	0.9	0.800	1.0	2.000	1.5	4.000	2.1	7.000	2.7
0.200	0.9	1.000	1.1	2.200	1.6	4.500	2.2	7.500	2.8
0.300	0.9	1.200	1.2	2.400	1.7	5.000	2.3	8.000	2.9
0.400	0.9	1.400	1.3	2.600	1.7	5.500	2.4	8.500	3.0
0.500	0.8	1.600	1.4	3.000	1.8	6.000	2.5	9.000	3.1
0.600	0.9	1.800	1.5	3.500	2.0	6.500	2.6	9.500	3.2

Hydro-Brake® Optimum Manhole: S29, DS/PN: S1.007, Volume (m³): 89.3

Unit Reference	MD-SHE-0164-1500-1750-1500
Design Head (m)	1.750
Design Flow (l/s)	15.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	164
Invert Level (m)	22.950
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.750	15.0	Kick-Flo®	1.087	12.0
Flush-Flo™	0.514	15.0	Mean Flow over Head Range	-	13.1

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	5.9	0.400	14.8	0.800	14.4	1.400	13.5	2.000	16.0
0.200	13.0	0.500	15.0	1.000	13.1	1.600	14.4	2.200	16.7
0.300	14.3	0.600	14.9	1.200	12.5	1.800	15.2	2.400	17.4

Hydro-Brake® Optimum Manhole: S29, DS/PN: S1.007, Volume (m³): 89.3

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)
2.600	18.1	4.000	22.2	5.500	25.9	7.000	29.1	8.500	32.0
3.000	19.4	4.500	23.5	6.000	27.0	7.500	30.1	9.000	32.8
3.500	20.9	5.000	24.7	6.500	28.1	8.000	31.0	9.500	33.7

Storage Structures for Storm

Porous Car Park Manhole: S2, DS/PN: S1.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	20.0
Membrane Percolation (mm/hr)	1000	Length (m)	108.5
Max Percolation (l/s)	602.8	Slope (1:X)	200.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	24.400	Membrane Depth (mm)	400

Cellular Storage Pipe: S1.002

Manning's N	0.020	Infiltration Coefficient Side (m/hr)	0.00000
Invert Level (m)	23.400	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	85.0	0.0	0.600	85.0	0.0	0.601	0.0	0.0

Porous Car Park Manhole: S9, DS/PN: S7.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	7.5
Membrane Percolation (mm/hr)	1000	Length (m)	96.0
Max Percolation (l/s)	200.0	Slope (1:X)	200.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	24.200	Membrane Depth (mm)	400

Cellular Storage Pipe: S1.003

Manning's N	0.020	Infiltration Coefficient Side (m/hr)	0.00000
Invert Level (m)	23.300	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	110.0	0.0	0.600	110.0	0.0	0.601	0.0	0.0

Porous Car Park Manhole: S13, DS/PN: S10.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	15.0
Membrane Percolation (mm/hr)	1000	Length (m)	67.0
Max Percolation (l/s)	279.2	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	24.200	Membrane Depth (mm)	400

Cellular Storage Pipe: S1.004

Manning's N	0.020	Infiltration Coefficient Side (m/hr)	0.00000
Invert Level (m)	23.200	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	110.0	0.0	0.600	110.0	0.0	0.601	0.0	0.0

Porous Car Park Manhole: S17, DS/PN: S13.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	15.0
Membrane Percolation (mm/hr)	1000	Length (m)	67.0
Max Percolation (l/s)	279.2	Slope (1:X)	250.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	24.200	Membrane Depth (mm)	400

Cellular Storage Pipe: S1.005

Manning's N	0.020	Infiltration Coefficient Side (m/hr)	0.00000
Invert Level (m)	23.100	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	100.0	0.0	0.600	100.0	0.0	0.601	0.0	0.0

Porous Car Park Manhole: S23, DS/PN: S16.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	20.0
Membrane Percolation (mm/hr)	1000	Length (m)	100.0
Max Percolation (l/s)	555.6	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	24.200	Membrane Depth (mm)	400

Cellular Storage Pipe: S16.003

Manning's N	0.020	Infiltration Coefficient Side (m/hr)	0.00000
Invert Level (m)	23.482	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	60.0	0.0	0.600	60.0	0.0	0.601	0.0	0.0

Cellular Storage Pipe: S16.004

Manning's N	0.020	Infiltration Coefficient Side (m/hr)	0.00000
Invert Level (m)	23.450	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	250.0	0.0	0.600	250.0	0.0	0.601	0.0	0.0

Cellular Storage Manhole: S30, DS/PN: S17.003

Invert Level (m)	23.058	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	4500.0	0.0	0.300	4500.0	0.0	0.301	0.0	0.0

Cellular Storage Pipe: S1.006

Manning's N	0.020	Infiltration Coefficient Side (m/hr)	0.00000
Invert Level (m)	23.000	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	155.0	0.0	0.600	155.0	0.0	0.601	0.0	0.0

Porous Car Park Manhole: S29, DS/PN: S1.007

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	21.0
Membrane Percolation (mm/hr)	1000	Length (m)	141.0
Max Percolation (l/s)	822.5	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	23.800	Membrane Depth (mm)	400

Time Area Diagram for Green Roof at Pipe Number S3.000 (Storm)

Area (m³) 1620 Evaporation (mm/day) 2
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.029439	32	36	0.005944	64	68	0.001200	96	100	0.000242
4	8	0.024102	36	40	0.004866	68	72	0.000982	100	104	0.000198
8	12	0.019733	40	44	0.003984	72	76	0.000804	104	108	0.000162
12	16	0.016156	44	48	0.003262	76	80	0.000659	108	112	0.000133
16	20	0.013228	48	52	0.002671	80	84	0.000539	112	116	0.000109
20	24	0.010830	52	56	0.002187	84	88	0.000441	116	120	0.000089
24	28	0.008867	56	60	0.001790	88	92	0.000361			
28	32	0.007259	60	64	0.001466	92	96	0.000296			

Time Area Diagram for Green Roof at Pipe Number S5.000 (Storm)

Area (m³) 830 Evaporation (mm/day) 2
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.015083	32	36	0.003045	64	68	0.000615	96	100	0.000124
4	8	0.012349	36	40	0.002493	68	72	0.000503	100	104	0.000102
8	12	0.010110	40	44	0.002041	72	76	0.000412	104	108	0.000083
12	16	0.008278	44	48	0.001671	76	80	0.000337	108	112	0.000068
16	20	0.006777	48	52	0.001368	80	84	0.000276	112	116	0.000056
20	24	0.005549	52	56	0.001120	84	88	0.000226	116	120	0.000046
24	28	0.004543	56	60	0.000917	88	92	0.000185			
28	32	0.003719	60	64	0.000751	92	96	0.000152			

Time Area Diagram for Green Roof at Pipe Number S8.000 (Storm)

Area (m³) 840 Evaporation (mm/day) 2
Depression Storage (mm) 15 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.015264	4	8	0.012497	8	12	0.010232	12	16	0.008377

Time Area Diagram for Green Roof at Pipe Number S8.000 (Storm)

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
16	20	0.006859	44	48	0.001691	72	76	0.000417	100	104	0.000103
20	24	0.005615	48	52	0.001385	76	80	0.000341	104	108	0.000084
24	28	0.004598	52	56	0.001134	80	84	0.000280	108	112	0.000069
28	32	0.003764	56	60	0.000928	84	88	0.000229	112	116	0.000056
32	36	0.003082	60	64	0.000760	88	92	0.000187	116	120	0.000046
36	40	0.002523	64	68	0.000622	92	96	0.000153			
40	44	0.002066	68	72	0.000509	96	100	0.000126			

Time Area Diagram for Green Roof at Pipe Number S11.000 (Storm)

Area (m³) 1920 Evaporation (mm/day) 2
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.034890	32	36	0.007044	64	68	0.001422	96	100	0.000287
4	8	0.028566	36	40	0.005767	68	72	0.001164	100	104	0.000235
8	12	0.023388	40	44	0.004722	72	76	0.000953	104	108	0.000192
12	16	0.019148	44	48	0.003866	76	80	0.000781	108	112	0.000158
16	20	0.015677	48	52	0.003165	80	84	0.000639	112	116	0.000129
20	24	0.012835	52	56	0.002591	84	88	0.000523	116	120	0.000106
24	28	0.010509	56	60	0.002122	88	92	0.000428			
28	32	0.008604	60	64	0.001737	92	96	0.000351			

Time Area Diagram for Green Roof at Pipe Number S14.000 (Storm)

Area (m³) 1010 Evaporation (mm/day) 2
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.018354	32	36	0.003706	64	68	0.000748	96	100	0.000151
4	8	0.015027	36	40	0.003034	68	72	0.000613	100	104	0.000124
8	12	0.012303	40	44	0.002484	72	76	0.000501	104	108	0.000101
12	16	0.010073	44	48	0.002034	76	80	0.000411	108	112	0.000083
16	20	0.008247	48	52	0.001665	80	84	0.000336	112	116	0.000068
20	24	0.006752	52	56	0.001363	84	88	0.000275	116	120	0.000056
24	28	0.005528	56	60	0.001116	88	92	0.000225			
28	32	0.004526	60	64	0.000914	92	96	0.000184			

Time Area Diagram for Green Roof at Pipe Number S17.000 (Storm)

Area (m³) 6900 Evaporation (mm/day) 3
Depression Storage (mm) 8 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.125387	28	32	0.030920	56	60	0.007625	84	88	0.001880
4	8	0.102658	32	36	0.025315	60	64	0.006243	88	92	0.001539
8	12	0.084049	36	40	0.020726	64	68	0.005111	92	96	0.001260
12	16	0.068814	40	44	0.016969	68	72	0.004185	96	100	0.001032
16	20	0.056340	44	48	0.013893	72	76	0.003426	100	104	0.000845
20	24	0.046127	48	52	0.011375	76	80	0.002805	104	108	0.000692
24	28	0.037766	52	56	0.009313	80	84	0.002297	108	112	0.000566

Time Area Diagram for Green Roof at Pipe Number S17.000 (Storm)

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
112	116	0.000464	116	120	0.000380						

Time Area Diagram for Green Roof at Pipe Number S1.007 (Storm)

Area (m³) 160 Evaporation (mm/day) 2
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.002908	32	36	0.000587	64	68	0.000119	96	100	0.000024
4	8	0.002380	36	40	0.000481	68	72	0.000097	100	104	0.000020
8	12	0.001949	40	44	0.000393	72	76	0.000079	104	108	0.000016
12	16	0.001596	44	48	0.000322	76	80	0.000065	108	112	0.000013
16	20	0.001306	48	52	0.000264	80	84	0.000053	112	116	0.000011
20	24	0.001070	52	56	0.000216	84	88	0.000044	116	120	0.000009
24	28	0.000876	56	60	0.000177	88	92	0.000036			
28	32	0.000717	60	64	0.000145	92	96	0.000029			

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 7
Number of Online Controls 2 Number of Storage Structures 14 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 20.000	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.450	Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	1	+0%	100/15 Summer				24.039	-0.261
S1.001	S2	120 Winter	1	+0%	100/15 Summer				23.761	-0.239
S2.000	S2	15 Winter	1	+0%	100/15 Summer				23.822	-0.178
S3.000	S3	60 Winter	1	+0%					24.736	-0.264
S4.000	S4	15 Winter	1	+0%					24.793	-0.207
S1.002	S6	15 Winter	1	+0%	100/120 Winter				23.466	-0.535
S5.000	S7	60 Winter	1	+0%					24.774	-0.276
S6.000	S8	15 Summer	1	+0%					24.846	-0.204
S7.000	S9	15 Summer	1	+0%	100/120 Winter				23.825	-0.225
S1.003	S10	1440 Winter	1	+0%	100/120 Winter				23.395	-0.506
S8.000	S11	720 Winter	1	+0%					24.455	-0.295
S9.000	S12	15 Winter	1	+0%					24.813	-0.232
S10.000	S13	15 Winter	1	+0%	30/15 Summer				23.865	-0.135
S1.004	S14	1440 Winter	1	+0%	100/120 Winter				23.395	-0.406
S11.000	S15	60 Winter	1	+0%					24.739	-0.261
S12.000	S16	15 Winter	1	+0%	100/15 Summer				24.797	-0.203
S13.000	S17	30 Winter	1	+0%	100/120 Winter				23.772	-0.228
S1.005	S18	1440 Winter	1	+0%	30/960 Winter				23.395	-0.306
S14.000	S19	60 Winter	1	+0%					24.725	-0.275
S15.000	S20	15 Winter	1	+0%					24.772	-0.228
S16.000	S21	15 Winter	1	+0%	30/15 Summer				23.913	-0.237
S16.001	S22	60 Winter	1	+0%	30/15 Summer				23.801	-0.149
S16.002	S23	60 Winter	1	+0%	30/15 Summer				23.798	-0.084
S16.003	S24	60 Winter	1	+0%	100/360 Winter				23.485	-0.598
S16.004	S25	30 Winter	1	+0%	100/360 Winter				23.452	-0.599
S17.000	S26	120 Winter	1	+0%	100/15 Winter				23.729	-0.321
S17.001	S27	180 Winter	1	+0%	100/30 Summer				23.562	-0.316
S18.000	S29	15 Winter	1	+0%	100/1440 Winter				23.582	-0.324
S17.002	S27	15 Winter	1	+0%	100/15 Summer				23.339	-0.272
S17.003	S30	1440 Winter	1	+0%	100/1440 Winter				23.139	-0.219

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.04		2.6	OK	
S1.001	S2	0.000	0.09		3.8	OK	
S2.000	S2	0.000	0.35		21.2	OK	
S3.000	S3	0.000	0.03		6.0	OK	
S4.000	S4	0.000	0.21		38.8	OK	
S1.002	S6	0.000	0.10		56.6	OK	
S5.000	S7	0.000	0.02		3.1	OK	
S6.000	S8	0.000	0.23		41.7	OK	
S7.000	S9	0.000	0.11		15.0	OK	
S1.003	S10	0.000	0.02		8.7	OK	
S8.000	S11	0.000	0.00		0.6	OK	
S9.000	S12	0.000	0.12		21.6	OK	
S10.000	S13	0.000	0.57		31.4	OK	
S1.004	S14	0.000	0.02		8.8	OK	
S11.000	S15	0.000	0.04		7.1	OK	
S12.000	S16	0.000	0.23		42.2	OK	
S13.000	S17	0.000	0.13		7.4	OK	
S1.005	S18	0.000	0.00		9.3	OK	
S14.000	S19	0.000	0.02		3.7	OK	
S15.000	S20	0.000	0.13		28.7	OK	
S16.000	S21	0.000	0.09		3.6	OK	
S16.001	S22	0.000	0.10		3.7	OK	
S16.002	S23	0.000	0.87		7.5	OK	
S16.003	S24	0.000	0.01		8.6	OK	
S16.004	S25	0.000	0.01		12.0	OK	
S17.000	S26	0.000	0.18		15.8	OK	
S17.001	S27	0.000	0.19		17.3	OK	
S18.000	S29	0.000	0.17		15.5	OK	
S17.002	S27	0.000	0.33		62.6	OK	
S17.003	S30	0.000	0.01		0.8	OK	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.006	S28	1440 Winter	1	+0%	30/480 Winter				23.395	-0.206
S1.007	S29	1440 Winter	1	+0%	1/180 Winter				23.395	0.145

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.006	S28	0.000	0.01		14.0	OK	
S1.007	S29	0.000	0.22		14.9	SURCHARGED	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 7
Number of Online Controls 2 Number of Storage Structures 14 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 20.000	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.450	Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	30	+0%	100/15 Summer				24.063	-0.237
S1.001	S2	15 Winter	30	+0%	100/15 Summer				23.922	-0.078
S2.000	S2	15 Winter	30	+0%	100/15 Summer				23.913	-0.087
S3.000	S3	15 Winter	30	+0%					24.762	-0.238
S4.000	S4	15 Winter	30	+0%					24.853	-0.147
S1.002	S6	1440 Winter	30	+0%	100/120 Winter				23.748	-0.253
S5.000	S7	15 Winter	30	+0%					24.793	-0.257
S6.000	S8	15 Winter	30	+0%					24.909	-0.141
S7.000	S9	15 Winter	30	+0%	100/120 Winter				23.864	-0.186
S1.003	S10	1440 Winter	30	+0%	100/120 Winter				23.748	-0.153
S8.000	S11	120 Winter	30	+0%					24.488	-0.262
S9.000	S12	15 Winter	30	+0%					24.854	-0.191
S10.000	S13	15 Winter	30	+0%	30/15 Summer				24.188	0.188
S1.004	S14	1440 Winter	30	+0%	100/120 Winter				23.755	-0.046
S11.000	S15	15 Winter	30	+0%					24.767	-0.233
S12.000	S16	15 Winter	30	+0%	100/15 Summer				24.861	-0.139
S13.000	S17	15 Winter	30	+0%	100/120 Winter				23.862	-0.138
S1.005	S18	1440 Winter	30	+0%	30/960 Winter				23.780	0.079
S14.000	S19	15 Winter	30	+0%					24.744	-0.256
S15.000	S20	15 Winter	30	+0%					24.817	-0.183
S16.000	S21	15 Winter	30	+0%	30/15 Summer				24.245	0.095
S16.001	S22	30 Winter	30	+0%	30/15 Summer				24.225	0.275
S16.002	S23	30 Winter	30	+0%	30/15 Summer				24.212	0.330
S16.003	S24	1440 Winter	30	+0%	100/360 Winter				23.751	-0.332
S16.004	S25	1440 Winter	30	+0%	100/360 Winter				23.751	-0.300
S17.000	S26	60 Winter	30	+0%	100/15 Winter				23.889	-0.161
S17.001	S27	60 Winter	30	+0%	100/30 Summer				23.725	-0.153
S18.000	S29	15 Winter	30	+0%	100/1440 Winter				23.661	-0.245
S17.002	S27	15 Winter	30	+0%	100/15 Summer				23.497	-0.114
S17.003	S30	1440 Winter	30	+0%	100/1440 Winter				23.241	-0.117

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.09		6.3	OK	
S1.001	S2	0.000	0.72		29.8	OK	
S2.000	S2	0.000	0.78		47.6	OK	
S3.000	S3	0.000	0.08		15.0	OK	
S4.000	S4	0.000	0.51		95.2	OK	
S1.002	S6	0.000	0.02		9.0	OK	
S5.000	S7	0.000	0.04		7.8	OK	
S6.000	S8	0.000	0.55		102.4	OK	
S7.000	S9	0.000	0.31		41.5	OK	
S1.003	S10	0.000	0.02		11.3	OK	
S8.000	S11	0.000	0.03		6.4	OK	
S9.000	S12	0.000	0.29		52.9	OK	
S10.000	S13	0.000	1.40		77.3	SURCHARGED	
S1.004	S14	0.000	0.04		21.2	OK	
S11.000	S15	0.000	0.10		17.7	OK	
S12.000	S16	0.000	0.56		103.6	OK	
S13.000	S17	0.000	0.57		33.4	OK	
S1.005	S18	0.000	0.01		60.5	SURCHARGED	
S14.000	S19	0.000	0.04		9.5	OK	
S15.000	S20	0.000	0.32		70.4	OK	
S16.000	S21	0.000	0.19		7.4	SURCHARGED	
S16.001	S22	0.000	0.30		11.5	SURCHARGED	
S16.002	S23	0.000	2.11		18.1	SURCHARGED	
S16.003	S24	0.000	0.00		3.3	OK	
S16.004	S25	0.000	0.03		59.1	OK	
S17.000	S26	0.000	0.71		63.9	OK	
S17.001	S27	0.000	0.76		67.7	OK	
S18.000	S29	0.000	0.40		35.5	OK	
S17.002	S27	0.000	0.88		167.2	OK	
S17.003	S30	0.000	0.01		0.7	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.006	S28	1440 Winter	30	+0%	30/480 Winter				23.810	0.209
S1.007	S29	1440 Winter	30	+0%	1/180 Winter				23.801	0.551

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.006	S28	0.000	0.08		83.6	SURCHARGED	
S1.007	S29	0.000	0.22		15.0	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 7
Number of Online Controls 2 Number of Storage Structures 14 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 20.000	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.450	Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	100	+40%	100/15 Summer				24.443	0.143
S1.001	S2	15 Winter	100	+40%	100/15 Summer				24.425	0.425
S2.000	S2	15 Winter	100	+40%	100/15 Summer				24.321	0.321
S3.000	S3	15 Winter	100	+40%					24.783	-0.217
S4.000	S4	15 Winter	100	+40%					24.929	-0.071
S1.002	S6	360 Winter	100	+40%	100/120 Winter				24.295	0.294
S5.000	S7	15 Winter	100	+40%					24.811	-0.239
S6.000	S8	15 Summer	100	+40%					25.048	-0.002
S7.000	S9	360 Winter	100	+40%	100/120 Winter				24.264	0.214
S1.003	S10	360 Winter	100	+40%	100/120 Winter				24.294	0.393
S8.000	S11	60 Summer	100	+40%					24.512	-0.238
S9.000	S12	15 Winter	100	+40%					24.899	-0.146
S10.000	S13	1440 Winter	100	+40%	30/15 Summer				24.259	0.259
S1.004	S14	360 Winter	100	+40%	100/120 Winter				24.294	0.493
S11.000	S15	30 Winter	100	+40%					24.791	-0.209
S12.000	S16	15 Summer	100	+40%	100/15 Summer				25.018	0.018
S13.000	S17	1440 Winter	100	+40%	100/120 Winter				24.257	0.257
S1.005	S18	360 Winter	100	+40%	30/960 Winter				24.290	0.589
S14.000	S19	15 Winter	100	+40%					24.763	-0.237
S15.000	S20	15 Winter	100	+40%					24.865	-0.135
S16.000	S21	15 Winter	100	+40%	30/15 Summer				24.317	0.167
S16.001	S22	15 Winter	100	+40%	30/15 Summer				24.279	0.329
S16.002	S23	60 Winter	100	+40%	30/15 Summer				24.258	0.376
S16.003	S24	1440 Winter	100	+40%	100/360 Winter				24.257	0.174
S16.004	S25	1440 Winter	100	+40%	100/360 Winter				24.257	0.206
S17.000	S26	60 Winter	100	+40%	100/15 Winter				24.339	0.289
S17.001	S27	1440 Winter	100	+40%	100/30 Summer				24.026	0.148
S18.000	S29	1440 Winter	100	+40%	100/1440 Winter				24.026	0.120
S17.002	S27	1440 Winter	100	+40%	100/15 Summer				24.026	0.415
S17.003	S30	1440 Winter	100	+40%	100/1440 Winter				24.026	0.668

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.14		9.8	SURCHARGED	
S1.001	S2	0.000	1.42		59.1	SURCHARGED	
S2.000	S2	0.000	1.37		84.1	SURCHARGED	
S3.000	S3	0.000	0.16		29.5	OK	
S4.000	S4	0.000	0.94		173.2	OK	
S1.002	S6	0.000	0.12		67.8	SURCHARGED	
S5.000	S7	0.000	0.08		15.1	OK	
S6.000	S8	0.000	1.00		184.7	OK	
S7.000	S9	0.000	0.24		32.0	SURCHARGED	
S1.003	S10	0.000	0.19		100.1	SURCHARGED	
S8.000	S11	0.000	0.08		14.1	OK	
S9.000	S12	0.000	0.52		96.3	OK	
S10.000	S13	0.000	0.10		5.5	SURCHARGED	
S1.004	S14	0.000	0.22		125.9	SURCHARGED	
S11.000	S15	0.000	0.20		37.6	OK	
S12.000	S16	0.000	1.01		186.2	SURCHARGED	
S13.000	S17	0.000	0.05		2.7	SURCHARGED	
S1.005	S18	0.000	0.03		154.6	SURCHARGED	
S14.000	S19	0.000	0.08		18.4	OK	
S15.000	S20	0.000	0.59		128.2	OK	
S16.000	S21	0.000	0.38		14.8	SURCHARGED	
S16.001	S22	0.000	0.84		31.6	SURCHARGED	
S16.002	S23	0.000	2.22		19.1	SURCHARGED	
S16.003	S24	0.000	0.00		6.0	SURCHARGED	
S16.004	S25	0.000	0.04		62.4	SURCHARGED	
S17.000	S26	0.000	1.35		121.1	SURCHARGED	
S17.001	S27	0.000	0.23		20.4	SURCHARGED	
S18.000	S29	0.000	0.03		2.6	SURCHARGED	
S17.002	S27	0.000	0.16		30.9	SURCHARGED	
S17.003	S30	0.000	0.02		0.9	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.006	S28	1440 Winter	100	+40%	30/480 Winter				24.257	0.656
S1.007	S29	1440 Winter	100	+40%	1/180 Winter				24.257	1.007

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.006	S28	0.000	0.11		109.9	SURCHARGED	
S1.007	S29	0.000	0.22		14.9	SURCHARGED	

APPENDIX B
DRAWINGS

T_19_2157-55-01 Rev P4 Proposed Drainage Layout
T_19_2157-55-03 SUDS Construction Details_P2

OIL SEPARATORS - PO65/1CSC
PROPOSED 'SPEL PURACEPTOR' CLASS 1 FULL RETENTION PETROL/OIL SEPARATOR ALLOW FOR A 250mm THK GRADE C28/35 CONCRETE BED AND 250mm THK SURROUND ON 450mm THK DfT TYPE 1 SUB-BASE TOGETHER WITH A SOLAR POWERED AUDIBLE AND VISUAL SEPARATOR ALARM SECURED TO A 750SQ x 150mm THK GRADE C28/35 CONCRETE BASE ON 300mm THK DfT TYPE 1 SUB-BASE. EXACT LOCATION OF SEPARATOR ALARM AND SEPARATOR VENT PIPE TO BE AGREED. INSTALLATION TO BE IN ACCORDANCE WITH THE MANUFACTURES REQUIREMENTS.

ALL PARKING SPACES TO COMPRISE OF A PERMEABLE CONSTRUCTION COMPLETE WITH A TANKED SUBBASE TO AID IN FILTERING SURFACE WATER AND IMPROVING WATER QUALITY. REFER TO DRAWING 55-03 FOR DETAILS.

TREE PROTECTION ZONE PLAN INDICATED, SEWERS TO BE RELOCATED IF TREE OFFICER REQUIRES ALTERATION TO THE TPZ PLAN

TREE PROTECTION ZONE PLAN INDICATED, SEWERS TO BE RELOCATED IF TREE OFFICER REQUIRES ALTERATION TO THE TPZ PLAN

ALL PARKING SPACES, CARRIAGEWAYS AND PUBLIC REALM AREAS TO COMPRISE OF A PERMEABLE CONSTRUCTION WITH A TYPE 3 MOT SUB-BASE TO AID IN FILTERING SURFACE WATER AND IMPROVING WATER QUALITY. REFER TO DRAWING 55-03 FOR DETAILS.

ALL PARKING SPACES TO COMPRISE OF A PERMEABLE CONSTRUCTION COMPLETE WITH A TANKED SUBBASE TO AID IN FILTERING SURFACE WATER AND IMPROVING WATER QUALITY. REFER TO DRAWING 55-03 FOR DETAILS.

SWMH 1.1
1200Ø Conc
CL 25.000
IL 23.700
D400

SWMH 1.0
1200Ø Conc
CL 25.200
IL 24.000
B125

SWMH 6.03
1800Ø Conc
CL 25.000
IL 23.482
D400

SWMH 6.02
1800Ø Conc
CL 25.000
IL 23.582
D400

SWMH 6.01
1800Ø Conc
CL 25.000
IL 23.650
D400

SWMH 6.00
1500Ø Conc
CL 25.000
IL 23.850
D400

SWMH 6.04
1500Ø Conc
CL 25.000
IL 23.450
D400

SWMH 1.02
1800Ø Conc
CL 25.000
IL 23.400
D400

SWMH 2.0
1500Ø Conc
CL 25.200
IL 23.700
D400

SWMH 1.03
1800Ø Conc
CL 25.000
IL 23.300
D400

SWMH 3.0
1500Ø Conc
CL 25.000
IL 23.700
D400

SWMH 17.02
PROVIDE A VORTEX FLOW CONTROL DEVICE TO THE OUTFALL PIPE TO RESTRICT THE FORWARD FLOW TO 1.5 LITRES PER SECOND WITHA HEAD OF 1.85m
MD-SHE-0050-1500-1900-1500
CL 24.300
IL 23.058
D400

SWMH 1.007
PROVIDE A VORTEX FLOW CONTROL DEVICE TO THE OUTFALL PIPE TO RESTRICT THE FORWARD FLOW TO 15.0 LITRES PER SECOND WITH A HEAD OF 0.60m
MD-SHE-0164-1500-1750-1500
CL 24.300
IL 23.058
D400

SWMH 1.07
1800Ø Conc
CL 24.700
IL 22.950

SWMH 1.06
1800Ø Conc
CL 25.000
IL 23.000
D400

SWMH 1.05
1800Ø Conc
CL 25.000
IL 23.100
D400

SWMH 1.04
1800Ø Conc
CL 25.000
IL 23.200
D400

SWMH 5.0
1500Ø Conc
CL 25.000
IL 23.700
D400

SWMH 4.0
1500Ø Conc
CL 25.000
IL 23.700
D400

2000m² POROUS SURFACINGS CONNECTING TO SWMH 6.02 AT 24.20

2170.0m² POROUS SURFACINGS CONNECTING TO SWMH 1.1 AT 24.40

720.0m² POROUS SURFACINGS CONNECTING TO SWMH 3.0 AT 24.20

2920m² POROUS SURFACINGS CONNECTING TO SWMH 1.07 AT 23.80

1005.0m² POROUS SURFACINGS CONNECTING TO SWMH 5.0 AT 24.20

1005.0m² POROUS SURFACINGS CONNECTING TO SWMH 4.0 AT 24.20

300Ø 1:247 (16.002 L=37.834m)

300Ø 1:247 (16.00 L=16.775m)

300Ø 1:247 (16.00 L=49.457m)

300Ø 1:234 (1.00 L= 70.228m)

300Ø 1:222.5 (1.001 L= 66.764m)

300Ø 1:300 (2.000 L= 76.098m)

300Ø 1:30 (3.000 L=30.0m) Green Roof

300Ø 1:30 (4.000 L=30.0m)

300Ø 1:30 (5.000 L=30.0m) Green Roof

300Ø 1:62.3 (6.000 L=30.0m)

300Ø 1:30 (8.000 L=30.0m) Green Roof

300Ø 1:30 (9.000 L=30.0m)

300Ø 1:30 (11.000 L=30.0m) Green Roof

300Ø 1:30 (12.000 L=30.0m)

300Ø 1:30 (14.000 L=30.0m) Green Roof

300Ø 1:30 (15.001 L=30.0m)

300Ø 1:308 (11.00 L= 46.224m)

300Ø 1:234.61 (1.001 L=53.954)

300Ø 1:365 (10.00 L= 73.079m)

4500 1 / 50 (17.003 L= 50.0m)

17.003 4500m² x 0.30m DEEP CELLULAR TANK TO PROVIDE 1282.5m³

16.004 250m² x 1.65m DEEP CELLULAR TANK TO PROVIDE 742.5m³

15.002 60.0m² x 0.6m DEEP CELLULAR TANK TO PROVIDE 34.2m³

1.001 60.0m² x 0.60m DEEP CELLULAR TANK TO PROVIDE 34.20m³

1.002 85m² x 0.60m DEEP CELLULAR TANK TO PROVIDE 48.45m³

1.003 110.0m³ x 0.6m DEEP CELLULAR TANK TO PROVIDE 62.70m³

1.004 110.0m³ x 0.60m DEEP CELLULAR TANK TO PROVIDE 62.70m³

1.006 155m³ x 0.6m DEEP CELLULAR TANK TO PROVIDE 88.35m³

Green Roof 160m² to SWMH 1.07

Thames Water 300Ø SW Drain

EX. TW MH No. 4551 CL 24.780 IL 22.720

Thames Water Sludge Main

Notes

1. THE WORKS SHALL BE IN ACCORDANCE WITH THE NATIONAL BUILDING SPECIFICATION.
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16. ALL LEVELS ARE IN METRES UNO & TO OS DATUM.

LEGEND:

- EXISTING SURFACE WATER SEWER
- EXISTING FOUL WATER PUBLIC SEWER
- PROPOSED SURFACE WATER DRAIN (TYPICALLY 150Ø UNLESS NOTED OTHERWISE)
- PROPOSED 'TRITON' SURFACE WATER ATTENUATION SYSTEMS FOR THE 1 IN 30 YEAR EVENT
- PROPOSED SURFACE WATER PRECAST CONCRETE MANHOLE
- PROPOSED SURFACE WATER POLYPROPYLENE INSPECTION CHAMBER
- EXISTING 'ACO' LINEAR DRAINAGE CHANNEL COMPLETE WITH SUMP OUTLET
- PROPOSED FOUL WATER DRAIN (TYPICALLY 100Ø UNLESS NOTED OTHERWISE)
- PROPOSED FOUL PRECAST CONCRETE MANHOLE
- PROPOSED FOUL POLYPROPYLENE INSPECTION CHAMBER
- PROPOSED 150Ø LAND DRAIN
- PROPOSED BIO-RETENTION AREA

Rev	Date	By	Description	Chk	App
P4	25.04.20	JH	SWMH1.07 HYDROBRAKE DETAILS UPDATED	WNL	PJB
P3	23.04.20	JH	SW NETWORK FINALISED TO LLFA COMMENTS	WNL	PJB
P2	22.04.20	JH	SW DISCHARGE RATE AMENDED TO 15.0L/S	WNL	PJB
P1	15-04-20	JCB	ISSUED FOR INFORMATION	JH	PJB

Status
PRELIMINARY

Tier Consult Ltd.
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T: 01244 684900

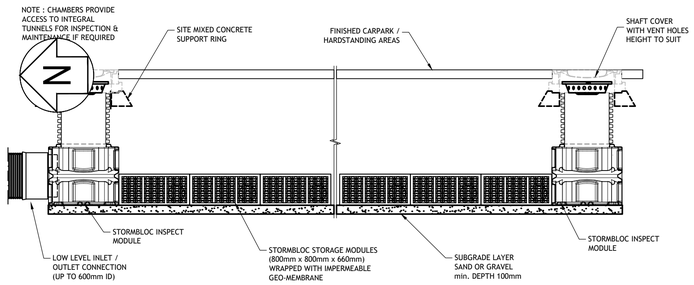
Client
GOLDEV WOKING LTD

Project
CARDINAL COURT INC
WOKING FOOTBALL CLUB

Title
PROPOSED DRAINAGE STRATEGY

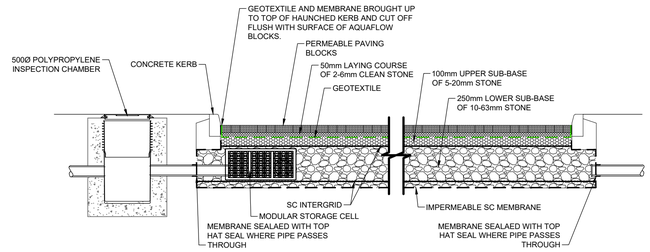
Scale	Drawn	Revision
1:500@A1	JCB	P4
Date	Checked	
APRIL 2020	JH	

Drawing No :
T_19_2157 55-01



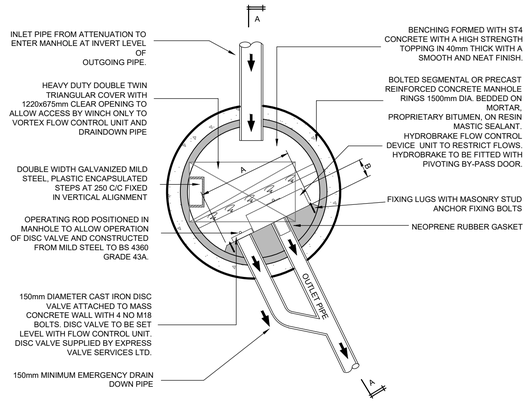
TYPICAL SECTION THROUGH STORMBLOC UNIT

Scale 1:25



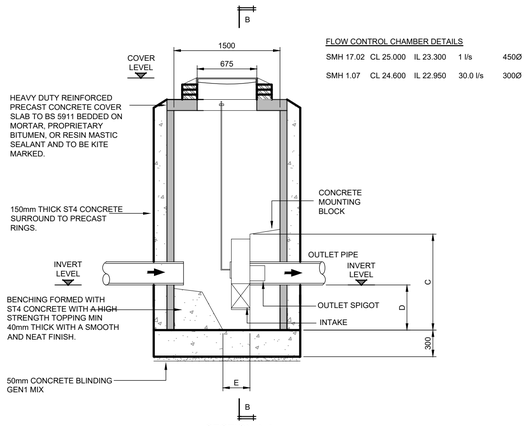
TYPICAL PERMEABLE PAVING DETAIL

SCALE 1:25



TYPICAL HYDROBRAKE CHAMBER

SCALE 1:25

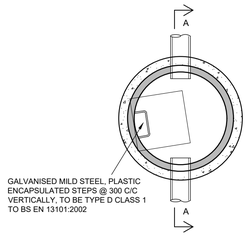


FLOW CONTROL CHAMBER DETAILS

SMH 17.02	CL 25.000	IL 23.300	1 l/s	450Ø
SMH 1.07	CL 24.600	IL 22.950	30.0 l/s	300Ø

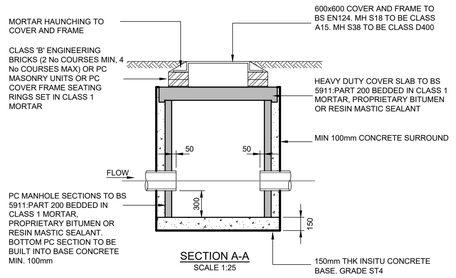
SECTION A-A

SCALE 1:25



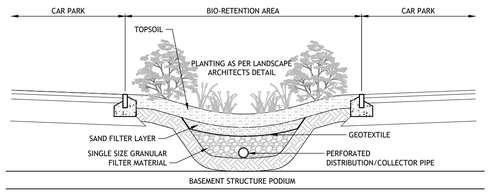
TYPICAL CATCHPIT DETAIL

SCALE 1:25



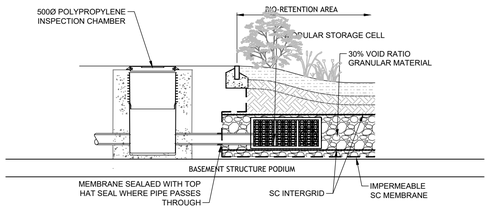
SECTION A-A

SCALE 1:25



TYPICAL BIO-RETENTION DETAIL

SCALE 1:25



BIO-RETENTION ATTENUATION FACILITY

SCALE 1:25

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Legend

Rev	Date	By	Description	Chk	App
P2	22.04.20	WNL	ISSUED FOR INFORMATION	JH	PJB
P1	15.04.20	JCB	ISSUED FOR INFORMATION	JH	PJB

Status
PRELIMINARY

Tier Consult Ltd.
Richmond House,
Sandpiper Court,
Chester Business Park,
Chester | CH4 9QZ
T: 01244 684900

Client
GOLDEV WOKING LTD

Project
CARDINAL COURT INC
WOKING FOOTBALL CLUB

Title
SUDS CONSTRUCTION DETAILS

Scale	Drawn	Revision
AS SHOWN@A1	JCB	P2
Date	Checked	
APR 2020	JH	

Drawing No :
T_19_2157-55-03

Wayne Gold
Goldev Woking Ltd

JOMAS ASSOCIATES LTD
6-9 The Square
Stockley Park
Uxbridge
UB11 1FW

Tel: 0843-289-2187
Fax: 0872-115-4505

www.jomasassociates.com
info@jomasassociates.com

P1381J1460/PSw

02/07/2019

Dear Wayne,

WOKING FOOTBALL CLUB, KINGFIELD ROAD, WOKING, SURREY, GU22 9AA: SOIL INFILTRATION TESTING

Jomas attended the above-mentioned site under instruction by Goldev Woking Ltd on 21st June 2019 to carry out falling head permeability tests within the boreholes previously installed on the site.

A full list of previous reports undertaken for the site by Jomas are detailed in Table 1 below:

Table 1: Previous Reports - Jomas

Title	Author	Reference	Date
Desk Study / Preliminary Risk Assessment Report For Woking Football Club, Laithwaite Community Stadium, Kingfield Road, Kingfield, Woking, GU22 9AA	Jomas Associates Ltd	P1381J1460/AM Final V1.0	17 August 2018
Woking Football Club, Laithwaite Community Stadium, Kingfield Road, Woking, GU22 9AA Geo-Environmental Scoping Letter	Jomas Associates Ltd	P1381j1460/Amm	18 April 2019
Geo-Environmental & Geotechnical Assessment (Ground Investigation) Report, Woking Football Club, Laithwaite Community Stadium, Kingfield Road, Woking, GU22 9AA	Jomas Associates Ltd	P1381J1460/AMM Final V1.0	30 April 2019

This phase of work did not involve any further intrusive investigation works.

Ground Conditions

Full logs of the ground conditions observed on site are included in Appendix 2 of the ground investigation report, however, a summary of the ground conditions is provided below:

Table 2: Ground Conditions Previously Encountered

Stratum and Description	Encountered from (m bgl)	Base of strata (m bgl)	Thickness range (m)
Asphalt. (MADE GROUND)	0.0	0.05 – 0.20	0.05 – 0.20
Brown sandy gravelly clay with rootlets. Sand is fine. Gravel consists of flint, concrete, brick and asphalt fragments. (MADE GROUND – Topsoil) Encountered in WS4 and WS5 only	0.0	0.30 – 0.50	0.30 – 0.50
Black to brown slightly clayey sandy gravel. Sand is fine to medium. Gravel consists of flint, brick, concrete, asphalt, glass and ceramic fragments. (MADE GROUND)	0.05 – 0.30	0.30 – 1.10	0.18 – 1.15
Black to brown clayey gravelly sand. Sand is medium. Gravel consists of fine to coarse flint and asphalt fragments. (MADE GROUND)	0.30 – 1.10	0.70 – 1.40	0.25 – 0.90
Loose to very dense orange to grey silty clayey very gravelly SAND. Sand is fine. Gravel consists of flint. (KEMPTON PARK GRAVEL)	0.30 – 1.40	2.00 – 4.15	0.70 – 3.20
Medium to very dense grey silty SAND. Sand is medium to coarse. (BAGSHOT FORMATION)	2.00 – 3.60	3.75 – 25.00	0.85 – 22.30

Falling Head Permeability Tests

The determination of permeability of the underlying ground was undertaken by carrying out insitu falling head tests. These were carried out to conform with the methodology for falling head permeability test formerly outlined in BS: 5930 (1999) and recently in BS EN ISO 22282-2.

Copies of the results and calculations are appended to this letter.

Falling head permeability tests were carried out in 2no. historically installed boreholes. Jomas has not been provided with details of these installs. It is assumed that the hole had been drilled with 150mm casing. Similarly, the installation is assumed to be 1m of plain pipe with slotted to the base of the well at 4.3m (HBH2) and 5.9m (HBH4)

1No test lasting for approximately 1hour was undertaken in each location, the results of these tests are summarised below with the full calculation and result sheets appended to this letter.

Hole ID	Calculated Permeability (m/s)	Indicative Permeability*	Indicative Drainage Conditions*
HBH2	4.05×10^{-5}	Low	Good
HBH4	2.15×10^{-4}	Medium	Good
WS2	2.66×10^{-6}	Low	Poor
WS7	6.11×10^{-7}	Very Low	Poor
WS10	9.84×10^{-7}	Very Low	Poor
BH2	9.31×10^{-7}	Very Low	Poor
BH3	1.32×10^{-5}	Low	Good

*After Casagrande and Fadum (1940)

We trust that this is satisfactory for your current needs, however please do not hesitate to contact the udnersigned if we can be of further assistance on either this or any other project.

Yours sincerely,

Peter Swettenham BSc (Hons) MSc PgCert CEnv MIEnvSc

Principal Geotechnical Engineer

Enc.

Appendix 1 – Figures

Appendix 2 – Infiltration Rates – Results and Calculations

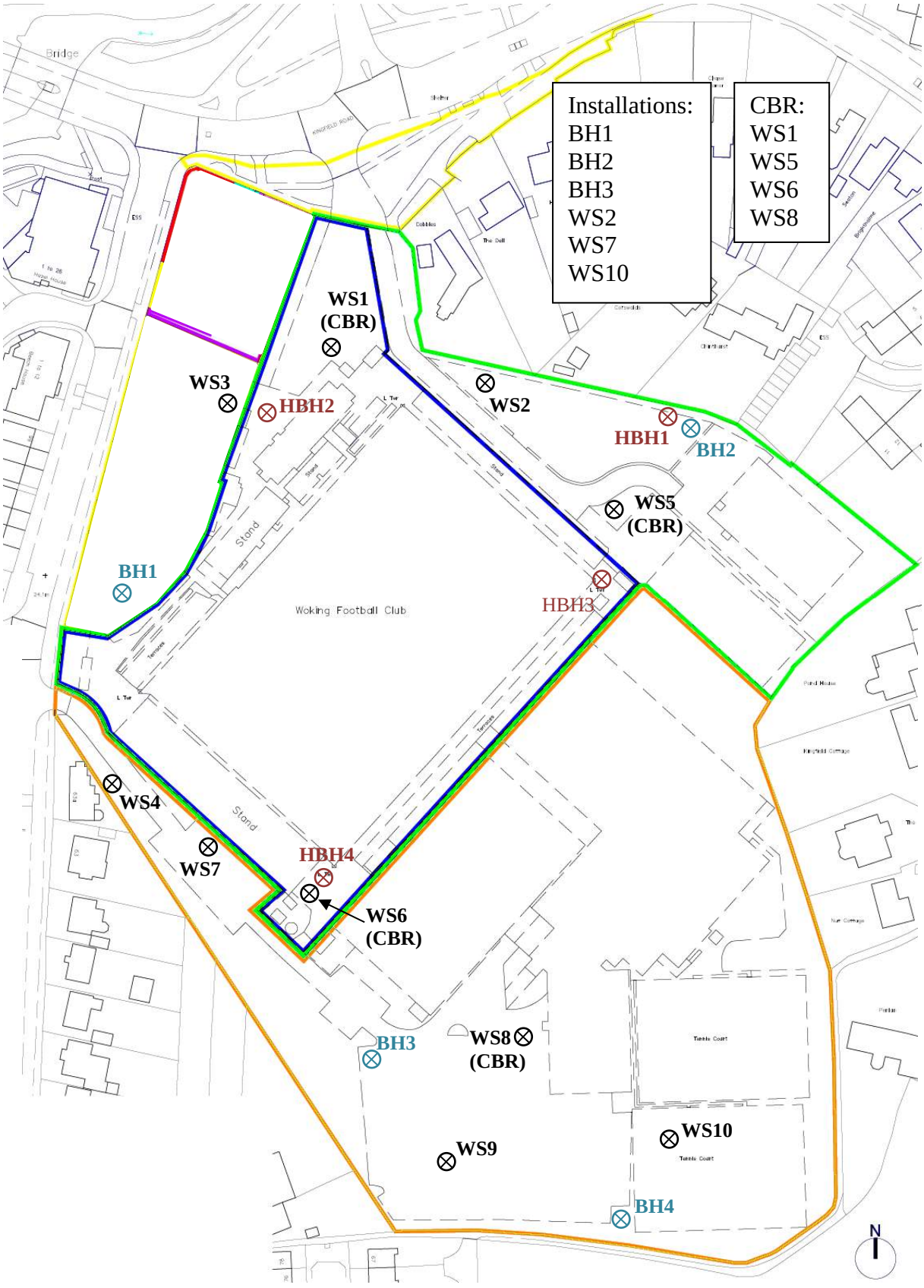
JOMAS ASSOCIATES LTD 6-9 The Square, Stockley Park, Uxbridge, UB11 1FW www.jomasassociates.com 0843-289-2187 info@jomasassociates.com

APPENDIX 1 – FIGURES

JOMAS ASSOCIATES LTD
T: 0843 289 2187

Project Name	Kingfield Road, Woking	**Client**	Goldev Woking Ltd
Project No.	P1381J1460	**Date**	March 2019
Title	Exploratory Holes	**Prepared By**	JLW

⊗ Windowless Sampler Borehole ⊗ Cable Borehole ⊗ Historical Borehole



APPENDIX 2 – INFILTRATION RATES – RESULTS AND CALCULATIONS

FALLING HEAD TEST RECORD

Client	Wayne Gold	**Ground Level**		**Hole Nr**	HBH2
Site	Kingsfield Road, Woking	**Nat Grid Co-ordinates**		**Project Nr**	P1381J1460
Date	21/06/2019	**Engineer**	JPB		

Borehole Dimensions

Borehole Diameter (m)	
Standpipe Diameter (m)	0.150
Length of Slotted Pipe (m)	3.30
F (Intake Factor)	Type D
	6.55E+00
A (Cross-sectional Area)	0.0177

Well Installation Details (mbgl)

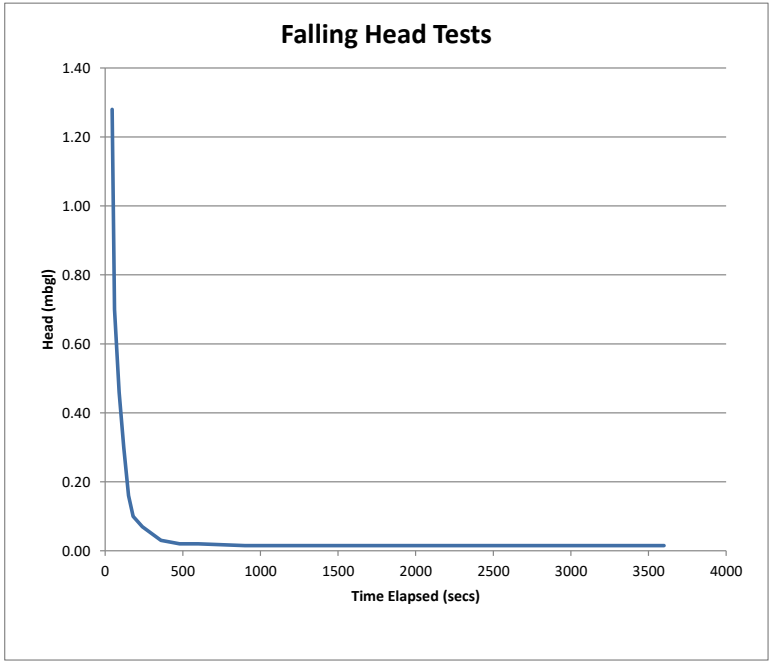
Hole assumed to have been drilled with 150mm casing
Installation assumed to be 1m of plain pipe with slotted to the base of the well at 4.3m

Ground Conditions

Standing Water Level (mbgl): 2.28

	TEST 1		TEST 2		TEST 3	
Elapsed time	**Depth to Water**	**Head**	**Depth to Water**	**Head**	**Depth to Water**	**Head**
secs	**mbgl**	**m**	**mbgl**	**m**	**(Dw) mbgl**	**(Dg) m**
0	1.00	1.28				
30	1.58	0.70				
45	1.82	0.46				
60	1.98	0.30				
90	2.12	0.16				
120	2.18	0.10				
150	2.21	0.07				
180	2.23	0.05				
240	2.25	0.03				
300	2.26	0.02				
360	2.26	0.02				
420	2.26	0.02				
480	2.26	0.02				
540	2.27	0.01				
600	2.27	0.01				
900	2.27	0.01				
1200	2.27	0.01				
1800	2.27	0.01				
2400	2.27	0.01				
3000	2.27	0.01				
3600	2.27	0.01				

	TEST 1	TEST 2	TEST 3
t1 (sec)	30		
t2 (sec)	240		
t2-t1 (sec)	210		
h1 (m)	0.7		
h2 (m)	0.03		
Permeability -k - (m/sec)	**4.05E-05**		



Remarks:

Approved By: PSw

FALLING HEAD TEST RECORD

Client	Wayne Gold	**Ground Level**		**Hole Nr**	HBH4
Site	Kingsfield Road, Woking	**Nat Grid Co-ordinates**		**Project Nr**	P1381J1460
Date	02/11/2015	**Engineer**	JPB		

Borehole Dimensions

Borehole Diameter (m)	
Standpipe Diameter (m)	0.150
Length of Slotted Pipe (m)	6.00
F (Intake Factor)	Type A 3.00E-01
A (Cross-sectional Area)	0.0177

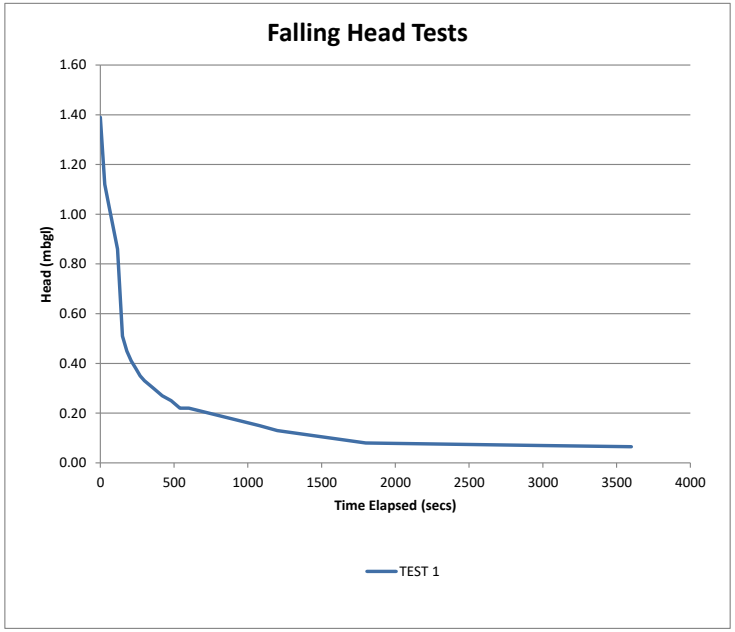
Well Installation Details (mbgl)

Hole assumed to have been drilled with 150mm casing
Installation assumed to be 1m of plain pipe with slotted to the base of the well at 4.3m

Ground Conditions

Standing Water Level (mbgl): 2.02

	TEST 1		TEST 2		TEST 3	
Elapsed time	**Depth to Water**	**Head**	**Depth to Water**	**Head**	**Depth to Water**	**Head**
secs	**mbgl**	**m**	**mbgl**	**m**	**(Dw) mbgl**	**(Dg) m**
0	0.63	1.39				
30	0.90	1.12				
60	0.99	1.03				
117	1.16	0.86				
150	1.51	0.51				
180	1.57	0.45				
210	1.61	0.41				
240	1.64	0.38				
270	1.67	0.35				
300	1.69	0.33				
360	1.72	0.30				
420	1.75	0.27				
480	1.77	0.25				
540	1.80	0.22				
600	1.80	0.22				
1080	1.87	0.15				
1200	1.89	0.13				
1800	1.94	0.08				
2400	1.95	0.08				
3000	1.95	0.07				
3600	1.96	0.06				



	TEST 1	TEST 2	TEST 3
t1 (sec)	30		
t2 (sec)	420		
t2-t1 (sec)	390		
h1 (m)	1.1		
h2 (m)	0.27		
Permeability -k - (m/sec)	**2.15E-04**		

Remarks:

Approved By: PSw

FALLING HEAD TEST RECORD

Client	Wayne Gold	**Ground Level**		**Hole Nr**	WS2
Site	Kingsfield Road, Woking	**Nat Grid Co-ordinates**		**Project Nr**	P1381J1460
Date	21/06/2019	**Engineer**	JPB		

Borehole Dimensions

Borehole Diameter (m)	
Standpipe Diameter (m)	0.100
Length of Slotted Pipe (m)	2.00
F (Intake Factor)	Type D
	4.13E+00
A (Cross-sectional Area)	0.0079

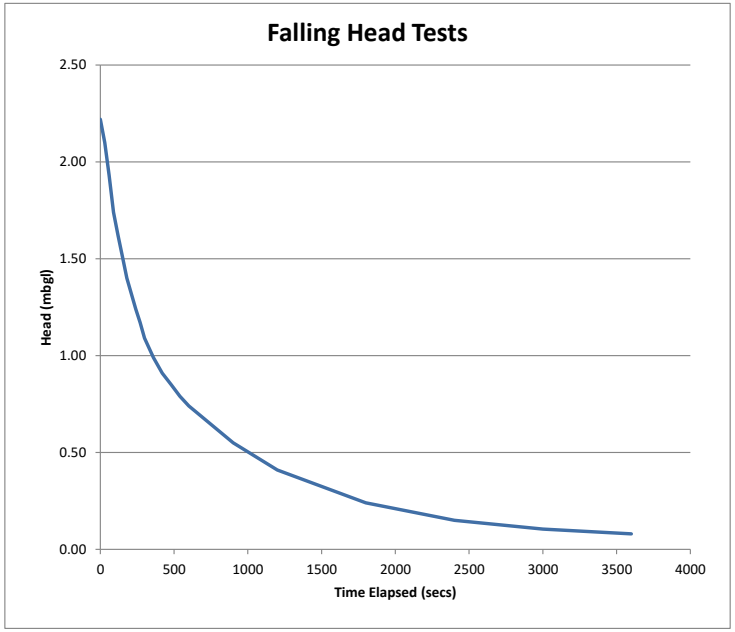
Well Installation Details (mbgl)

0 - 1m Plain pipe with bentonite surround
1m - 3m slotted with gravel surround
3.0m - 4.45m backfilled with arisisngs

Ground Conditions

Standing Water Level (mbgl): 2.87

	TEST 1		TEST 2		TEST 3	
Elapsed time	**Depth to Water**	**Head**	**Depth to Water**	**Head**	**Depth to Water**	**Head**
secs	**mbgl**	**m**	**mbgl**	**m**	**(Dw) mbgl**	**(Dg) m**
0	0.65	2.22				
30	0.77	2.10				
60	0.94	1.93				
90	1.13	1.74				
120	1.25	1.62				
150	1.36	1.51				
180	1.47	1.40				
240	1.63	1.24				
270	1.70	1.17				
300	1.78	1.09				
360	1.88	0.99				
420	1.96	0.91				
480	2.02	0.85				
540	2.08	0.79				
600	2.13	0.74				
900	2.32	0.55				
1200	2.46	0.41				
1800	2.63	0.24				
2400	2.72	0.15				
3000	2.77	0.11				
3600	2.79	0.08				
	TEST 1		**TEST 2**		**TEST 3**	
t1 (sec)	30				120	
t2 (sec)	1200					
t2-t1 (sec)	1170					
h1 (m)	2.1					
h2 (m)	0.41					
Permeability -k - (m/sec)	**2.66E-06**					



Remarks:

Approved By: PSw

FALLING HEAD TEST RECORD

Client	Wayne Gold	**Ground Level**		**Hole Nr**	WS7
Site	Kingsfield Road, Woking	**Nat Grid Co-ordinates**		**Project Nr**	P1381J1460
Date	21/06/2019	**Engineer**	JPB		

Borehole Dimensions

Borehole Diameter (m)	
Standpipe Diameter (m)	0.100
Length of Slotted Pipe (m)	3.15
F (Intake Factor)	Type D
	5.66E+00
A (Cross-sectional Area)	0.0079

Well Installation Details (mbgl)

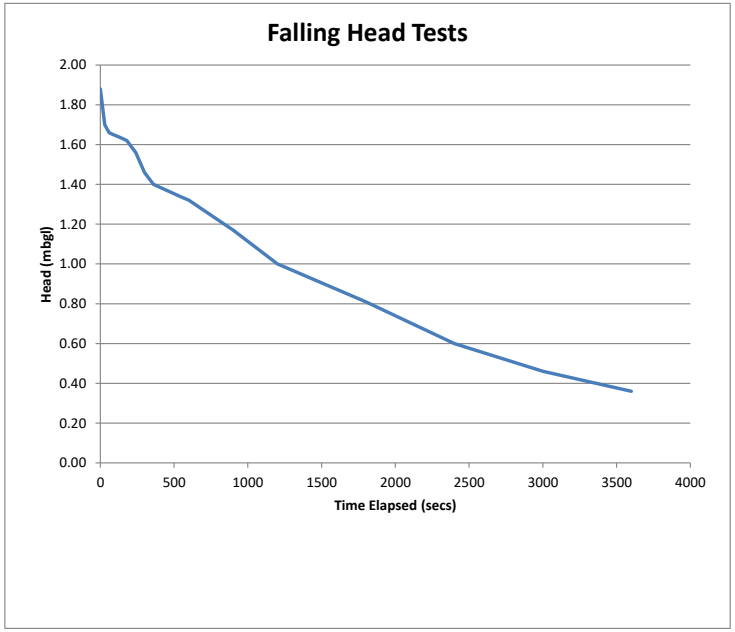
0 - 1m Plain pipe with bentonite surround
1m - 4.15m slotted with gravel surround

Ground Conditions

Standing Water Level (mbgl): 2.12

	TEST 1		TEST 2		TEST 3	
Elapsed time	**Depth to Water**	**Head**	**Depth to Water**	**Head**	**Depth to Water**	**Head**
secs	**mbgl**	**m**	**mbgl**	**m**	**(Dw) mbgl**	**(Dg) m**
0	0.24	1.88				
30	0.42	1.70				
60	0.44	1.68				
90	0.46	1.66				
120	0.47	1.65				
150	0.48	1.64				
180	0.49	1.63				
210	0.50	1.62				
240	0.56	1.56				
270	0.66	1.46				
300	0.72	1.40				
360	0.74	1.38				
420	0.76	1.36				
480	0.78	1.34				
600	0.80	1.32				
900	0.95	1.17				
1200	1.12	1.00				
1800	1.31	0.81				
2400	1.52	0.60				
3000	1.66	0.46				
3600	1.76	0.36				

	TEST 1	TEST 2	TEST 3
t1 (sec)	30		
t2 (sec)	3000		
t2-t1 (sec)	2970		
h1 (m)	1.7		
h2 (m)	0.46		
Permeability -k - (m/sec)	**6.11E-07**		



Remarks:

Approved By: PSw

FALLING HEAD TEST RECORD

Client	Wayne Gold	**Ground Level**		**Hole Nr**	WS10
Site	Kingsfield Road, Woking	**Nat Grid Co-ordinates**		**Project Nr**	P1381J1460
Date	21/06/2019	**Engineer**	JPB		

Borehole Dimensions

Borehole Diameter (m)	
Standpipe Diameter (m)	0.100
Length of Slotted Pipe (m)	2.95
F (Intake Factor)	Type D
	5.40E+00
A (Cross-sectional Area)	0.0079

Well Installation Details (mbgl)

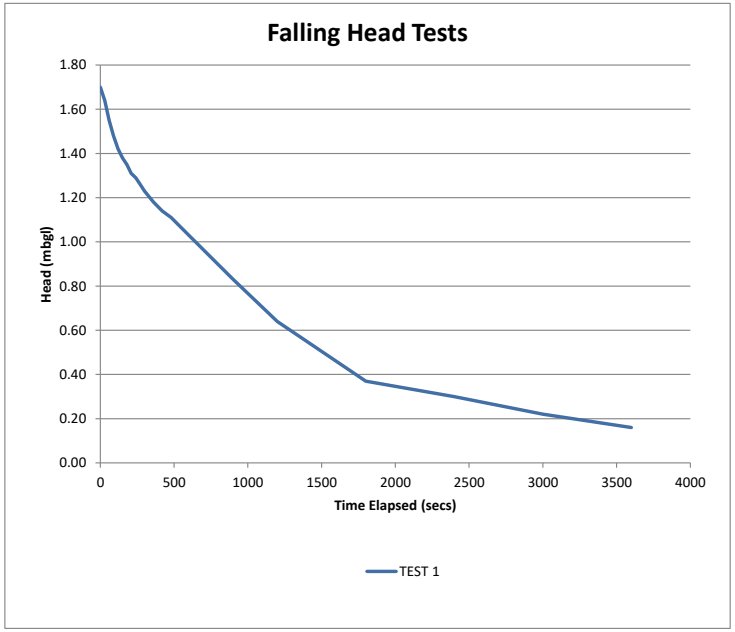
0 - 1m Plain pipe with bentonite surround
1m - 3.95m slotted with gravel surround

Ground Conditions

Standing Water Level (mbgl): 1.98

	TEST 1		TEST 2		TEST 3	
Elapsed time	**Depth to Water**	**Head**	**Depth to Water**	**Head**	**Depth to Water**	**Head**
secs	**mbgl**	**m**	**mbgl**	**m**	**(Dw) mbgl**	**(Dg) m**
0	0.28	1.70				
30	0.34	1.64				
60	0.43	1.55				
90	0.50	1.48				
120	0.56	1.42				
150	0.60	1.38				
180	0.63	1.35				
210	0.67	1.31				
240	0.69	1.29				
270	0.72	1.26				
300	0.75	1.23				
360	0.80	1.18				
420	0.84	1.14				
480	0.87	1.11				
600	0.95	1.03				
900	1.15	0.83				
1200	1.34	0.64				
1800	1.61	0.37				
2400	1.68	0.30				
3000	1.76	0.22				
3600	1.82	0.16				

	TEST 1	TEST 2	TEST 3
t1 (sec)	30		
t2 (sec)	3000		
t2-t1 (sec)	2970		
h1 (m)	1.6		
h2 (m)	0.22		
Permeability -k - (m/sec)	**9.84E-07**		



Remarks:

Approved By: PSw

FALLING HEAD TEST RECORD

Client	Wayne Gold	**Ground Level**		**Hole Nr**	BH2
Site	Kingsfield Road, Woking	**Nat Grid Co-ordinates**		**Project Nr**	P1381J1460
Date	21/06/2019	**Engineer**	JPB		

Borehole Dimensions

Borehole Diameter (m)	
Standpipe Diameter (m)	0.150
Length of Slotted Pipe (m)	5.00
F (Intake Factor)	Type D
	8.78E+00
A (Cross-sectional Area)	0.0177

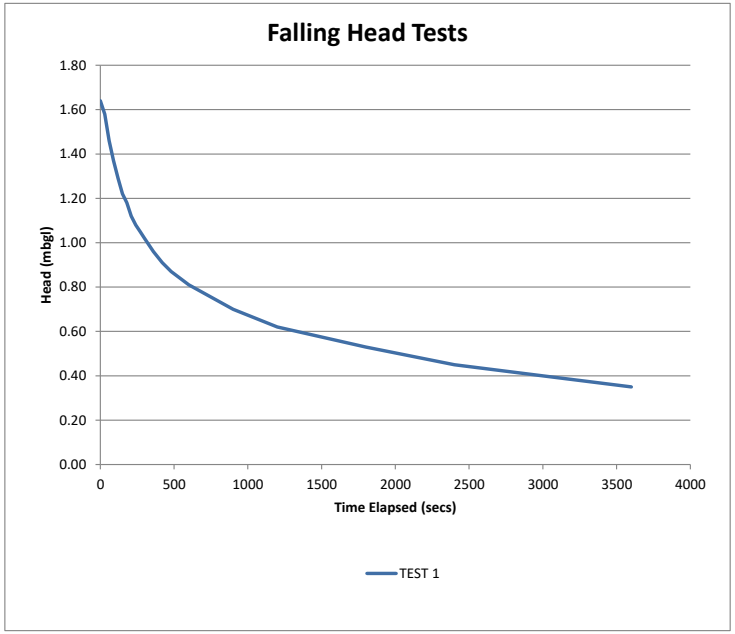
Well Installation Details (mbgl)

0 - 1m Plain pipe with bentonite surround
1m - 6m slotted with gravel surround
6.0m - 25m backfilled with arisisngs

Ground Conditions

Standing Water Level (mbgl): 2.29

	TEST 1		TEST 2		TEST 3	
Elapsed time	**Depth to Water**	**Head**	**Depth to Water**	**Head**	**Depth to Water**	**Head**
secs	**mbgl**	**m**	**mbgl**	**m**	**(Dw) mbgl**	**(Dg) m**
0	0.65	1.64				
30	0.71	1.58				
60	0.83	1.46				
90	0.92	1.37				
120	1.00	1.29				
150	1.07	1.22				
180	1.11	1.18				
210	1.17	1.12				
240	1.21	1.08				
270	1.24	1.05				
300	1.27	1.02				
360	1.33	0.96				
420	1.38	0.91				
480	1.42	0.87				
600	1.48	0.81				
900	1.59	0.70				
1200	1.67	0.62				
1800	1.76	0.53				
2400	1.84	0.45				
3000	1.89	0.40				
3600	1.94	0.35				



	TEST 1	TEST 2	TEST 3
t1 (sec)	30		
t2 (sec)	3000		
t2-t1 (sec)	2970		
h1 (m)	1.58		
h2 (m)	0.40		
Permeability -k - (m/sec)	**9.31E-07**		

Remarks:

Approved By: PSw

FALLING HEAD TEST RECORD

Client	Wayne Gold	**Ground Level**		**Hole Nr**	BH3
Site	Kingsfield Road, Woking	**Nat Grid Co-ordinates**		**Project Nr**	P1381J1460
Date	21/06/2019	**Engineer**	JPB		

Borehole Dimensions

Borehole Diameter (m)	
Standpipe Diameter (m)	0.150
Length of Slotted Pipe (m)	4.00
F (Intake Factor)	Type D
	7.49E+00
A (Cross-sectional Area)	0.0177

Well Installation Details (mbgl)

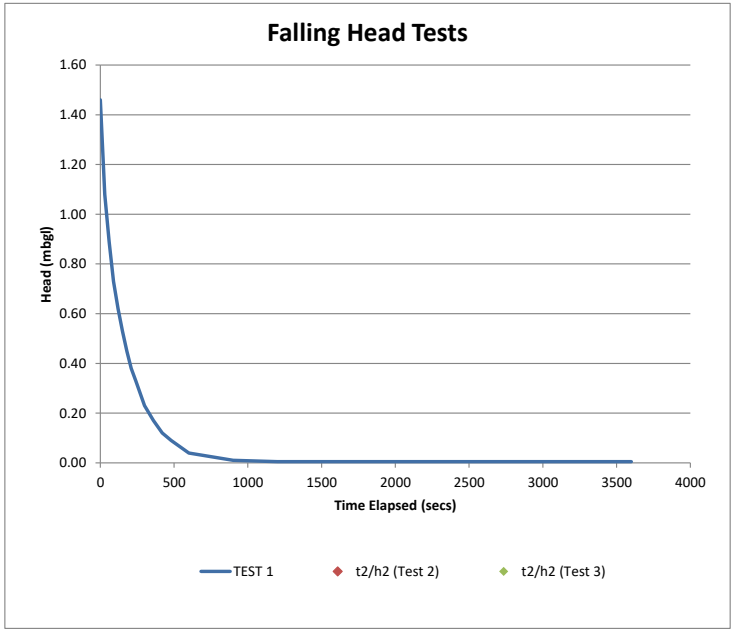
0 - 1m Plain pipe with bentonite surround
1m - 5m slotted with gravel surround
5.0m - 25m backfilled with arisisngs

Ground Conditions

Standing Water Level (mbgl): 1.7

	TEST 1		TEST 2		TEST 3	
Elapsed time	**Depth to Water**	**Head**	**Depth to Water**	**Head**	**Depth to Water**	**Head**
secs	**mbgl**	**m**	**mbgl**	**m**	**(Dw) mbgl**	**(Dg) m**
0	0.24	1.46				
30	0.62	1.08				
60	0.81	0.89				
90	0.97	0.73				
120	1.08	0.62				
150	1.17	0.53				
180	1.25	0.45				
210	1.32	0.38				
240	1.37	0.33				
270	1.42	0.28				
300	1.47	0.23				
360	1.53	0.17				
420	1.58	0.12				
480	1.61	0.09				
600	1.66	0.04				
900	1.69	0.01				
1200	1.70	0.00				
1800	1.70	0.00				
2400	1.70	0.00				
3000	1.70	0.00				
3600	1.70	0.00				

	TEST 1	TEST 2	TEST 3
t1 (sec)	30		
t2 (sec)	360		
t2-t1 (sec)	330		
h1 (m)	1.08		
h2 (m)	0.17		
Permeability -k - (m/sec)	**1.32E-05**		



Remarks:

Approved By: PSw

Appendix E:
Thames Water Sewer Records

Melissa Seymour
RMA Environmental Ltd
Suite 4 Swallow Court
Devonshire Gate
Tiverton
Devon
EX16 7EJ

Ref DS6062108

31 May 2019

Pre-planning enquiry: Capacity concerns

Dear Melissa

Thank you for providing information on your development at Woking Football Club comprising up to 1200 residential units with 25,000 sq ft of retail.

We have completed an initial assessment of the foul water flows based on the information submitted in your application and have concluded that our sewerage network will not have enough capacity to meet the needs of your development at this time.

To ensure we make the appropriate upgrades or 'off-site reinforcement' to serve your development, we'll need to carry out modelling work, design a solution and build the necessary improvements. This work would be at our cost.

Once we've begun modelling, we may need to contact you to discuss the point of connection to the sewer. Please note that we'll pay the cost of covering any extra distance if the connection needs to be made at a point further away than the nearest practicable point of at least the same diameter.

How long could modelling and reinforcement take?

Typical timescales for a development of your size are:

Modelling: 8 months
Design: 6 months
Construction: 10 months
Total: 24 months

If the time you're likely to take from planning and construction through to first occupancy is longer than this, we'll be able to carry out the necessary upgrades in time for your development. If it's shorter, please contact me on the number below to discuss the timing of our activities.

What do you need to tell us before we start modelling?

We're responsible for funding any modelling and reinforcement work.
We need, though, to spend our customers' money wisely, so we'll only carry out modelling once we're confident that your development will proceed.

To have this confidence, we'll need to know that you **own the land and have either outline or full planning permission**. Please email this information to us as soon as you have it.

If you'd like us to start modelling work ahead of this assurance, we can do this if you agree to underwrite the cost of modelling and design. That means we'll fund the work, but you agree to pay the cost if you don't achieve first occupancy within five years.

I've attached an example of our underwriting agreement. Please call me on the number below if you'd like to discuss this or want to request a copy of the agreement to complete.

If the modelling shows we need to carry out reinforcement work, then before we start construction we'll need you to supply us with notification that you've confirmed your F10 – Notification of construction project - submission to the Health and Safety Executive.

Surface Water

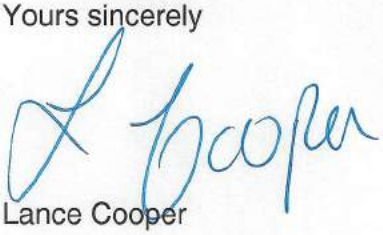
Please note that discharging surface water to the public sewer network should only be considered after all other methods of disposal have been investigated and proven to not be viable. In accordance with the Building Act 2000 Clause H3.3, positive connection to a public sewer will only be consented when 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 Sewers.

Only when it can be proven that soakage into the ground or a connection into an adjacent watercourse is not possible would we consider a restricted discharge into the public surface water/combined sewer network.

In considering your surface water needs, we support the use of sustainable drainage on development sites. You'll need to show the local authority and/or lead local flood authority how you've considered the surface water hierarchy that we've included.

If we haven't heard from you by the end of July, we'll contact you, so you can confirm whether you can provide the confidence we need. If so, we'll be able to start modelling if you still need it but we won't do so until you've confirmed that you need it. If you've any further questions, please contact me on 02035779224.

Yours sincerely



Lance Cooper

Thames Water Developer Services

Asset location search

Property Searches

Groundwise Searches Ltd
Suite 8 Chichester House
45Chichester Road
SOUTHEND ON SEA
SS1 2JU

Search address supplied Woking Football Club
Woking
GU22 9PF

Your reference 23397DM

Our reference ALS/ALS Standard/2019_3949961

Search date 8 February 2019

Keeping you up-to-date

Notification of Price Changes

From 1 September 2018 Thames Water Property Searches will be increasing the price of its Asset Location Search in line with RPI at 3.23%.

For further details on the price increase please visit our website: www.thameswater-propertysearches.co.uk
Please note that any orders received with a higher payment prior to the 1 September 2018 will be non-refundable.

Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13

searches@thameswater.co.uk
www.thameswater-propertysearches.co.uk

0845 070 9148

searchcode

Asset location search

Property Searches

Search address supplied: Woking Football Club, Woking, GU22 9PF

Dear Sir / Madam

An Asset Location Search is recommended when undertaking a site development. It is essential to obtain information on the size and location of clean water and sewerage assets to safeguard against expensive damage and allow cost-effective service design.

The following records were searched in compiling this report: - the map of public sewers & the map of waterworks. Thames Water Utilities Ltd (TWUL) holds all of these.

This searchprovides maps showing the position, size of Thames Water assets close to the proposed development and also manhole cover and invert levels, where available.

Please note that none of the charges made for this report relate to the provision of Ordnance Survey mapping information. The replies contained in this letter are given following inspection of the public service records available to this company. No responsibility can be accepted for any error or omission in the replies.

You should be aware that the information contained on these plans is current only on the day that the plans are issued. The plans should only be used for the duration of the work that is being carried out at the present time. Under no circumstances should this data be copied or transmitted to parties other than those for whom the current work is being carried out.

Thames Water do update these service plans on a regular basis and failure to observe the above conditions could lead to damage arising to new or diverted services at a later date.

Contact Us

If you have any further queries regarding this enquiry please feel free to contact a member of the team on 0845 070 9148, or use the address below:

Thames Water Utilities Ltd
Property Searches
PO Box 3189
Slough
SL1 4WW

Email: searches@thameswater.co.uk
Web: www.thameswater-propertysearches.co.uk

Asset location search

Property Searches

Waste Water Services

Please provide a copy extract from the public sewer map.

Enclosed is a map showing the approximate lines of our sewers. Our plans do not show sewer connections from individual properties or any sewers not owned by Thames Water unless specifically annotated otherwise. Records such as "private" pipework are in some cases available from the Building Control Department of the relevant Local Authority.

Where the Local Authority does not hold such plans it might be advisable to consult the property deeds for the site or contact neighbouring landowners.

This report relates only to sewerage apparatus of Thames Water Utilities Ltd, it does not disclose details of cables and or communications equipment that may be running through or around such apparatus.

The sewer level information contained in this response represents all of the level data available in our existing records. Should you require any further Information, please refer to the relevant section within the 'Further Contacts' page found later in this document.

For your guidance:

- The Company is not generally responsible for rivers, watercourses, ponds, culverts or highway drains. If any of these are shown on the copy extract they are shown for information only.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an ‘as constructed’ record. It is recommended these details be checked with the developer.

Clean Water Services

Please provide a copy extract from the public water main map.

With regard to the fresh water supply, this site falls within the boundary of another water company. For more information, please redirect your enquiry to the following address:

Affinity Water Ltd
Tamblin Way
Hatfield
AL10 9EZ
Tel: 0845 7823333

For your guidance:

- Assets other than vested water mains may be shown on the plan, for information only.
- If an extract of the public water main record is enclosed, this will show known public water mains in the vicinity of the property. It should be possible to estimate the likely length and route of any private water supply pipe connecting the property to the public water network.

Payment for this Search

A charge will be added to your suppliers account.

Further contacts:

Waste Water queries

Should you require verification of the invert levels of public sewers, by site measurement, you will need to approach the relevant Thames Water Area Network Office for permission to lift the appropriate covers. This permission will usually involve you completing a TWOSA form. For further information please contact our Customer Centre on Tel: 0845 920 0800. Alternatively, a survey can be arranged, for a fee, through our Customer Centre on the above number.

If you have any questions regarding sewer connections, budget estimates, diversions, building over issues or any other questions regarding operational issues please direct them to our service desk. Which can be contacted by writing to:

Developer Services (Waste Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

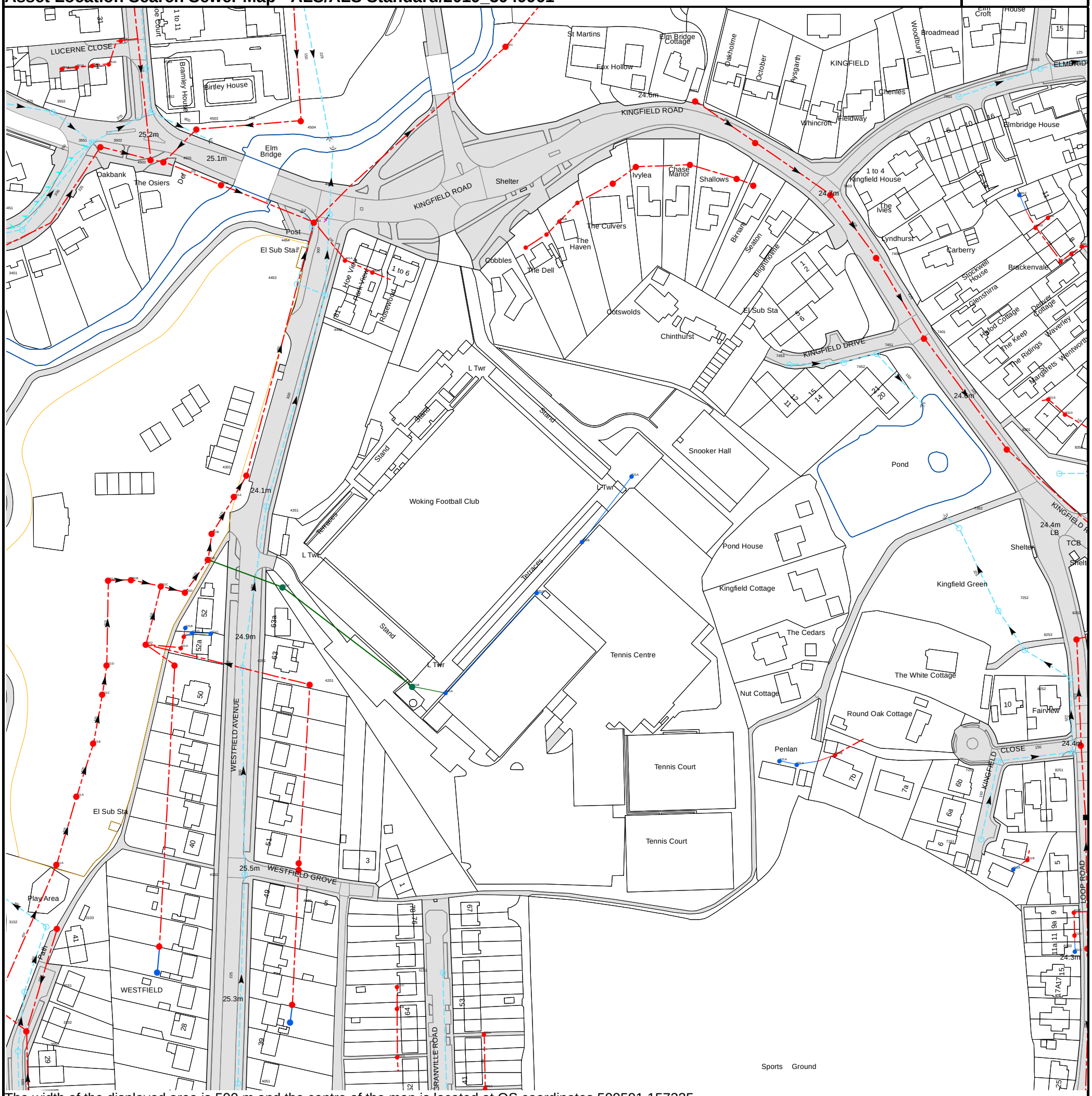
Clean Water queries

Should you require any advice concerning clean water operational issues or clean water connections, please contact:

Developer Services (Clean Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

Asset Location Search Sewer Map - ALS/ALS Standard/2019_3949961



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 500591,157325

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.

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

Manhole Reference	Manhole Cover Level	Manhole Invert Level
621A	n/a	n/a
7453	25.11	24.33
721A	n/a	n/a
721B	n/a	n/a
7452	24.98	24.22
7451	24.85	24.15
7402	24.82	23.15
7401	24.66	23.04
7352	24	23.54
7252	24.11	23.55
7251	24.61	24.14
8301	24.49	n/a
8253	24.32	23.6
831E	n/a	n/a
8352	24.24	23.27
841E	n/a	n/a
831D	n/a	n/a
8252	24.57	23.71
8251	24.49	23.81
8202	24.66	n/a
8203	24.43	n/a
831C	n/a	n/a
841F	n/a	n/a
841G	n/a	n/a
841D	n/a	n/a
841I	n/a	n/a
841C	n/a	n/a
7403	24.83	23.26
6405	n/a	n/a
6404	n/a	n/a
6502	n/a	n/a
651A	n/a	n/a
6501	24.57	23.99
7551	n/a	n/a
8553	24.14	22.79
431E	25.526	21.147
421C	n/a	n/a
431B	24.798	21.127
441B	n/a	n/a
431A	24.52	21.12
4301	24.37	21.17
4351	24.31	23.14
431F	n/a	n/a
4453	24.31	22.84
4504	n/a	n/a
4454	n/a	n/a
4401	24.87	21.345
4452	24.29	22.87
4451	24.58	22.72
441A	n/a	n/a
541A	n/a	n/a
5501	24.4	20.81
5401	n/a	n/a
531A	n/a	n/a
5402	n/a	n/a
541B	n/a	n/a
6401	n/a	n/a
631B	n/a	n/a
6402	n/a	n/a
631A	n/a	n/a
6403	n/a	n/a
321B	25.567	21.377
4202	25.73	21.15
421E	n/a	n/a
421D	n/a	n/a
421B	n/a	n/a
431D	25.347	21.175
431C	25.554	21.205
331A	25.963	21.268
331B	25.824	21.247
3451	26.55	24.36
4501	25.27	21.96
4502	25.44	22.05
3502	25.45	22.3
3551	25.46	22.96
4503	25.35	22.68
3552	26.05	n/a
4552	25.45	22.42
351A	n/a	n/a
4553	26.1	23.13
351B	n/a	n/a
351C	n/a	n/a
351D	n/a	n/a
351E	n/a	n/a
3051	21.79	20.74
3151	n/a	n/a
3102	24.76	23.29
3152	22.86	21.6
311A	25.774	21.473
3103	24.62	23.88
8101	24.35	n/a

Manhole Reference	Manhole Cover Level	Manhole Invert Level
811C	n/a	n/a
8102	24.37	23.13
811D	n/a	n/a
811E	n/a	n/a
811A	44.85	44.115
811B	n/a	n/a
7151	24.89	24.41
501A	n/a	n/a
4051	25.53	24.23
511A	n/a	n/a
41ZS	n/a	n/a
511B	n/a	n/a
41ZR	n/a	n/a
511C	n/a	n/a
5151	25.77	24.83
41ZW	n/a	n/a
41ZV	n/a	n/a
4151	25.43	n/a
4101	25.33	23.81
41ZT	n/a	n/a
321A	25.914	21.421
321C	25.643	21.341
521A	n/a	n/a
521B	n/a	n/a
4201	n/a	n/a
4251	24.98	23.4
321D	25.738	21.32
42ZY	n/a	n/a
421A	n/a	n/a

ALS Sewer Map Key

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 Insight on 0845 070 9148.

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2. Provision of service will be in accordance with all legal requirements and published TWUL policies.
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- promotes the best practise and quality standards within the industry for the benefit of consumers and property professionals
- enables consumers and property professionals to have confidence in firms which subscribe to the code, their products and services.

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TPOs Contact Details

The Property Ombudsman scheme
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43-55 Milford Street
Salisbury
Wiltshire SP1 2BP
Tel: 01722 333306
Fax: 01722 332296
Web site: www.tpos.co.uk
Email: admin@tpos.co.uk

You can get more information about the PCCB from www.propertycodes.org.uk

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