



ANDREW FIREBRACE PARTNERSHIP
STRUCTURAL AND CIVIL ENGINEERING CONSULTANTS

FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY

Andrew Firebrace Partnership Structural & Civil Engineering Consultants
Stable Barn, Park End, Swaffham Bulbeck, Cambridge, CB25 0NA.
Tel: 01223 811572 Fax: 01223 812 719 Email: info@afpconsult.co.uk

The President and Trustees of Huggens College

Huggens College, College Road, Northfleet, Gravesend, Kent DA11 9DL

March 2024

AFP

Quality Assurance

Site name: Huggens College, College Road, Northfleet, Gravesend, Kent DA11 9DL

Client name: The President and Trustees of Huggens College

Type of report: Flood Risk Assessment and Drainage Strategy

Job Reference: 23/0538

File Path: G:\2023 Jobs\230538 (PJA) Huggens College, College Road, Northfleet, Gravesend\11.0 Job Information and reports

Prepared by: Chris Auber Bsc (Hons) IEng MICE

Position Associate Civil Engineer

Date March 2024

Checked by: Paul Austin Bsc (Hons) CEng MStructE MICE

Position Director

Date March 2024

Approved by: Paul Austin Bsc (Hons) CEng MStructE MICE

Position Director

Date March 2024

Rev	Date	Details	Prepared by	Checked by	Approved by
P1	March 2024	Draft issue for planning	CGA	PA	PA
P2	April 2024	Updated with external comments/revised layout	CGA	PA	PA

Table of Contents

1	Executive Summary	1
2	Introduction	4
3	Development Description and Location	6
4	Flood Hazards.....	12
5	Flood Risk Management Measures.....	18
6	Surface Water Drainage Strategy	19
7	Foul Water Drainage Strategy	37
8	Off Site Impacts.....	38
9	Maintenance Management.....	39
10	Overview.....	45

Appendices

Appendix 1 Topographical Survey

Appendix 2 Proposed Masterplan

Appendix 3 Soakage Test Report

Appendix 4 Proposed Drainage Strategy

Appendix 5 Surface Water Drainage Impermeable Areas and Hydraulic Network Modelling Calculations

Appendix 6 Southern Water Correspondence

Appendix 7 LLFA Pre-app Meeting Minutes

1 Executive Summary

- 1.1 Andrew Firebrace Partnership have been commissioned by The President and Trustees of Huggens College to prepare a Flood Risk Assessment and Drainage Strategy in accordance with the National Planning Policy Framework (NPPF, December 2023), Department for Levelling Up, Housing and Communities (DLUHC, March 2023) and associated Planning Practice Guidance (PPG, 2024) as well as the Local Authority SuDS Officer Organisation (LASOO) Non-Statutory Technical Standards for Sustainable Drainage Practice Guidance. This report will form part of the supporting information submitted for a full planning application for the demolition of existing buildings and the erection of 96 retirement living apartments (Use Class C3), together with the extension of the existing chapel and the provision of associated communal facilities and external amenity space, lodge keeper's and guest accommodation, back-of-house facilities, parking, bicycle/mobility scooter parking, and associated works including the creation of a secondary, emergency access from College Road.
- 1.2 The site for the proposed development is located off College Road to the north-west of the centre of Northfleet and approximately 20 miles from Greater London and comprises 96 retirement living apartments, landscaping, open space amenity provision, vehicular and pedestrian accesses with associated infrastructure. Access to the land is gained via the existing access road off College Road to the south-east of the site. The boundary itself is defined by masonry brick walls, close boarded fencing and palisades. Ground levels are generally flat across the site with a slight fall in a north easterly direction which becomes steeper towards the north-east corner of the site with levels ranging from 22.30mAOD in the south-west to 17.80mAOD in the north-east with an overall site gradient of approximately 1:34.
- 1.3 The existing site is considered to be 23% impermeable brownfield land consisting of roads, buildings and hardstanding/footpaths which is understood to drain via a positive surface water sewer network to assumed buried soakaways and 77% permeable greenfield landscaped areas, consisting of free draining unmade land, which is allowed to infiltrate and/or run-off into the adjacent unmade permeable areas.
- 1.4 The site is considered to be at a low risk of flooding from fluvial and tidal flooding and is located within the Environment Agency's (EA) Flood Risk Zone 1. The site is also considered to be at low risk of flooding from all other sources.
- 1.5 Therefore, the focus of this report will be to manage the risk of surface water flooding to the site and existing downstream development by the following methods:

- The sites topography will be exploited by the drainage strategy in the light of SuDS principles, to ensure that no overland flows can develop whilst ensuring mitigation and resistance measures are taken to provide a minimum depth of freeboard of 150mm between the ground and finish floor levels.
 - An appropriate Surface Water Drainage Strategy should be incorporated into the development design as detailed within Section 6 of this report;
- 1.6 The British Geological Survey (BGS) digital geological map of Great Britain at 1:50,000 scale, indicates that the site's geology comprises mainly of:
- Superficial Deposits – Boyn Hill Gravel Member (Sand and Gravel)
 - Bedrock Geology – Lewes Nodular Chalk Formation (Chalk)
- 1.7 BRE Digest 365 Soakaway tests have been carried out by Southern Testing (February 2024) and have provided infiltration rates ranging from 1.63×10^{-5} m/s to 1.35×10^{-4} m/s, recorded at four soakaway test pit locations, refs. TP1, TP2, TP3 and TP4 at depths of 2.0mbgl each and suggest that high intensity soakaway devices will be suitable for the site. Therefore, in accordance with the recommended design guidance the lowest values for each soakaway test location will be used for each corresponding infiltration device in that location, therefore infiltration rates of 1.63×10^{-5} m/s, 1.35×10^{-4} m/s, 2.35×10^{-5} and 1.83×10^{-5} m/s recorded at locations TP1, TP2, TP3 and TP4 will be used for these preliminary surface water design purposes.
- 1.8 Due to the presence of a chalk bedrock, consideration will need to be given to the risk of solution features and as such soakaways should be sited no closer than 10.0m to buildings/structures.
- 1.9 Groundwater was not also encountered during any of the soakaway trial pit excavations or the groundwater monitoring well installed at a depth of 3.1m.
- 1.10 The surface water drainage strategy will comprise raingardens, filter drains, a geo-cellular soakaway tanks, infiltration basins and permeable surfacing with type 3 sub-bases by utilising infiltration drainage techniques with storage capacity to accommodate the critical 1 in 100 year plus climate change storm Annual Expected Probability (AEP) events.
- 1.11 The foul water drainage strategy will comprise a gravity sewer system connecting into the existing public foul water sewer system located within College Road, subject to completing a Section 106 agreement with Southern Water.

- 1.12 The proposed development is classified as 'More Vulnerable' development and is located within a Flood Risk Zone 1 area. Therefore, in accordance with the NPPF Technical Guidance Development, the Sequential and Exception tests are not required to be undertaken by the Local Planning Authority, as part of the planning process.
- 1.13 The report demonstrates that the development site:
- Is located within Flood Zone 1 and is at a low risk of flooding from all other sources.
 - Is not subject to the Sequential and Exception Tests during the planning process;
 - Will incorporate a Sustainable Surface Water Drainage Strategy to drain the proposed development's impermeable area and will ensure that the flood risk is not increased, whilst providing the necessary pollution control and water quality improvements;
 - Will reduce the overall flood risk to the area by the onsite management of surface water, adopting storage and infiltration of surface water flows and will therefore have no increase on surface water flood risk at the site;
 - Will incorporate a suitable Foul Water Drainage Strategy to drain the proposed development and ensure flood risk is not increased;
 - Will incorporate a suitable Maintenance Management plan for all of the SuDS and piped drainage systems for the lifetime of the development.

2 Introduction

- 2.1 Andrew Firebrace Partnership have been commissioned by The President and Trustees of Huggens College to prepare a Flood Risk Assessment and Drainage Strategy in accordance with the National Planning Policy Framework (NPPF, December 2023), Department for Levelling Up, Housing and Communities (DLUHC, March 2023) and associated Planning Practice Guidance (PPG, 2024) as well as the Local Authority SuDS Officer Organisation (LASOO) Non-Statutory Technical Standards for Sustainable Drainage Practice Guidance. This report will form part of the supporting information submitted for a full planning application for the demolition of existing buildings and the erection of 96 retirement living apartments (Use Class C3), together with the extension of the existing chapel and the provision of associated communal facilities and external amenity space, lodge keeper's and guest accommodation, back-of-house facilities, parking, bicycle/mobility scooter parking, and associated works including the creation of a secondary, emergency access from College Road.
- 2.2 The purpose of this report is to provide site specific information on the flood risks associated with the application site and to present appropriate mitigation measures for the proposed development as well as site specific information on the types of SuDS available with a suggested sustainable surface and foul water drainage strategy to serve the development. This is to enable the site to obtain planning consent for a residential development, without an objection from the Local Planning Authority (LPA) or their consultees and so that the site, its occupants and the surrounding development is at the minimum risk of flooding.
- 2.3 The preparation of this site specific Flood Risk Assessment and Drainage Strategy report required references to be made to the following various sources including the Kent Minerals and Waste Local Plan Strategic Flood Risk Assessment (SFRA) (June 2013), Kent Local Flood Risk Management Strategy 2017-2023, Thameside Stage 1 Surface Water Management Plan – Final Report (May 2013), Kent County Council (KCC) Preliminary Flood Risk Assessment Report (PFRA) (September 2011), Gravesham Local Plan Core Strategy and Policies Map (Adopted September 2014) and 'A guide for master planning sustainable drainage into developments' (www.kent.gov.uk/environment-waste-and-planning/flooding-and-drainage/sustainable-drainage-systems#tab-2,3,4) as well as the Environment Agency's published flood modelling data and website for obtaining the published information on various sources of flood risk and groundwater zonings.
- 2.4 Consultation was deemed necessary with the LLFA KCC, Flood Risk Team and a record of the meeting minutes has been included within this report and provided within Appendix 7. The items discussed in the meeting have been considered as part of the overall drainage strategy proposals for the development.

- 2.5 This document has been prepared for the titled project, or named part thereof, and should not be relied upon or used for any other project or part as the case may be, without an independent check being made on it. Andrew Firebrace Partnership shall not be liable for any third party data used in the production of this document or for the consequences of using this document other than for the purpose for which it was commissioned, and any user and any other person using or relying on this document for such other purpose, agrees and will be such use or reliance be taken to confirm this agreement to indemnify Andrew Firebrace Partnership for all loss or damage resulting therefrom.

3 Development Description and Location

Location

- 3.1 The site for the proposed development is located off College Road to the north-west of the centre of Northfleet and approximately 20 miles from Greater London. Its boundary is shown in Figures 3.1 and 3.2 (centred on National Grid Reference: 561702, 174605; and the nearest postcode is: DA11 9DL).

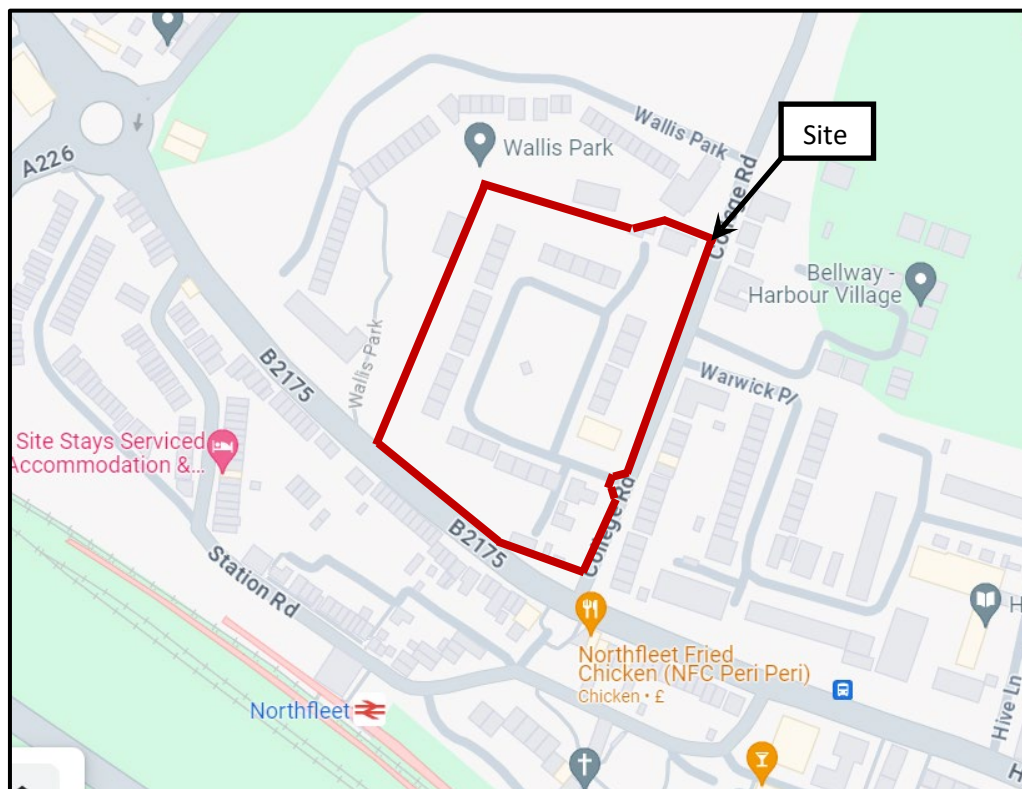


Figure 3.1 Small scale site location plan of the site



Figure 3.2 Aerial photo of the proposed development site

Existing Site Layout

- 3.2 The development boundary as identified in Figure 3.2 above encloses an area of approximately 1.73 ha and is bounded by the 'Wallis Park' residential estate to the north and west, College Road to the east and the B2175 (High Street) road to the south. The boundary itself is defined by masonry brick walls, close boarded fencing and palisades around the perimeter of the site.
- 3.3 A topographical survey of the existing site layout has been undertaken to GPS Datum as shown in Appendix 1. The site comprises existing buildings and roads associated with its existing assisted use. Access to the land is gained via the existing access road off College Road to the south-east of the site.
- 3.4 The site has overall dimensions of approximately 109m wide by 135m long. Ground levels are generally flat across the site with a slight fall in a north easterly direction which becomes steeper towards the north-east corner of the site with levels ranging from 22.30mAOD in the south-west to 17.80mAOD in the north-east with an overall site gradient of approximately 1:34.
- 3.5 The existing site is considered to be 23% impermeable brownfield land consisting of roads, buildings and hardstanding/footpaths which is understood to drain via a positive surface water sewer network to

assumed buried soakaways and 77% permeable greenfield landscaped areas, consisting of free draining unmade land, which is allowed to infiltrate and/or run-off into the adjacent unmade permeable areas.

Proposed Development

- 3.6 The proposed development comprises 96 retirement living apartments, landscaping, open space amenity provision, vehicular and pedestrian accesses with associated infrastructure, as shown on the proposed indicative masterplan within Appendix 2 and Figure 3.3 below.
- 3.7 The impermeable area of the site has been calculated to be 6,344m² (0.634 ha) which is approximately 37% of the total site area (1.73 ha) and will be transformed into built up areas of 2-3 storey one bedroom apartments, communal facilities, private roads and footways, off-street parking, private gardens and landscaped amenity areas.
- 3.8 The impermeable areas have been split into six catchments with each catchment served by a separate surface water network and soakaway with the parking bays providing additional permeable paved areas, as shown within Appendix 5, and can be summarised below:
- Soakaway 1: 1,110m² (0.111 ha, rounded up)
 - Soakaway 2: 1,734m² (0.173 ha, rounded up)
 - Soakaway 3: 1,107m² (0.111 ha, rounded up)
 - Soakaway 4: 894m² (0.089 ha, rounded up)
 - Permeable Surfacing 1: 818m² (0.082, rounded up)
 - Permeable Surfacing 2: 143m² (0.014, rounded up)
 - Permeable Surfacing 3: 538m² (0.054, rounded up)

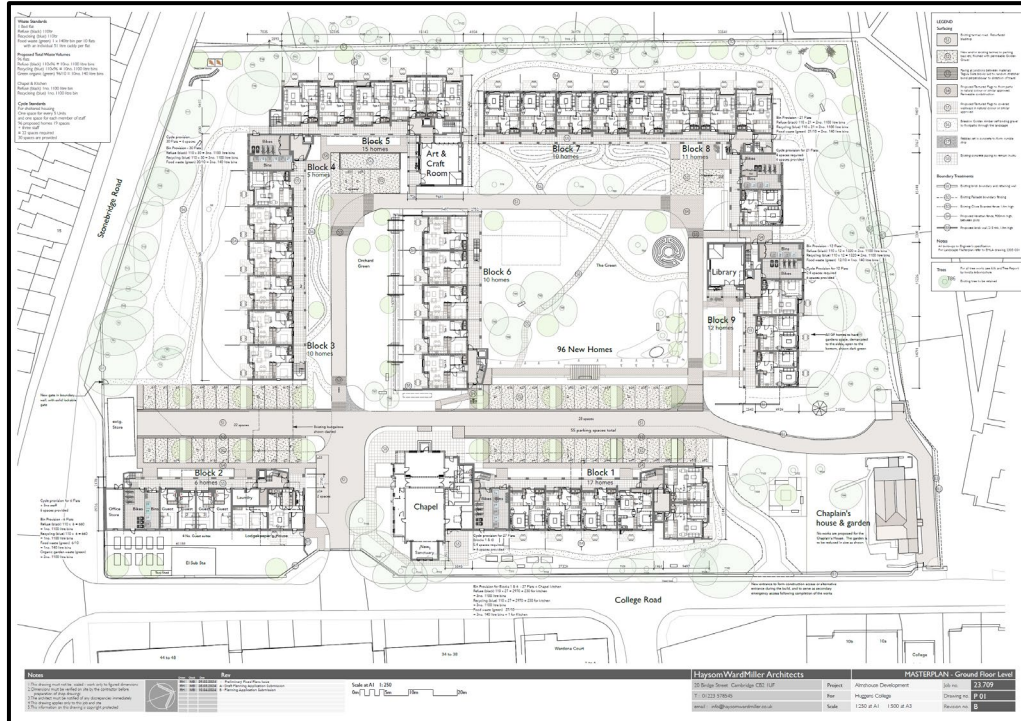


Figure 3.3 Proposed Masterplan

Flood Zone Delineation

3.9 The Environment Agency's (EA) indicative flood maps are shown in Figure 3.4 below and demonstrates that the proposed development is located within Flood Zone 1.

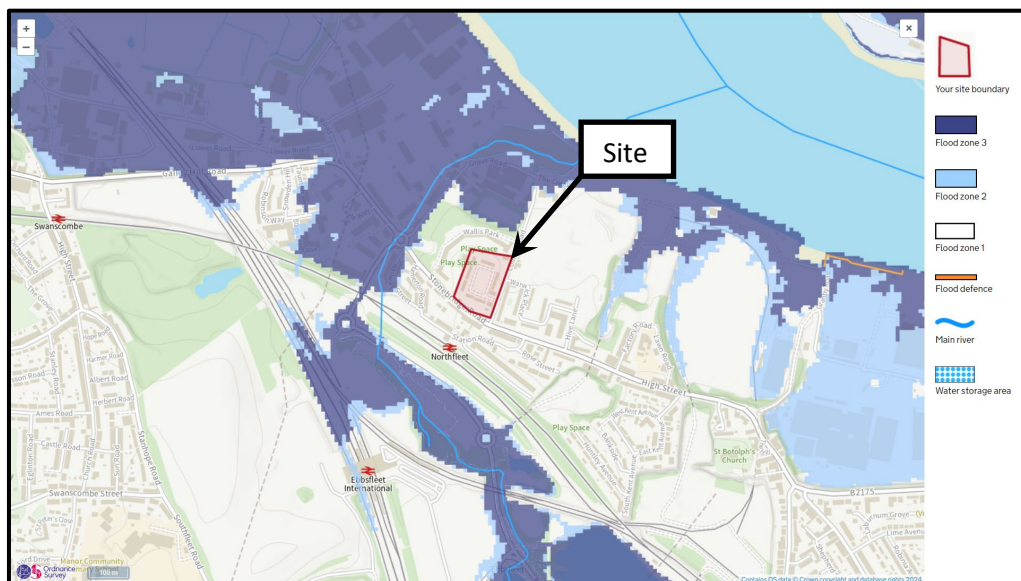


Figure 3.4 – Environment Agency Indicative Flood Mapping

- 3.10 The Environment Agency's classification of Flood Zone 1 is flood events greater than the 1 in 1000 year (0.1%>) AEP event and is considered to be at a very low risk of fluvial and tidal flooding.

Vulnerability Classification

- 3.11 Table 2 of the Technical Guidance to the NPPF provides a detailed list of the types of development falling into the vulnerability classifications. This list is recognised as not being exhaustive and provides guidance on the various uses and their subsequent flood risk vulnerability classification.
- 3.12 The allocation site is intended for residential development, and therefore the flood risk classification indicates that this site falls within the **More Vulnerable** classification.

Sequential and Exception Tests

- 3.13 The proposed development is classified as 'More Vulnerable' development and is located within a Flood Risk Zone 1 area. Therefore, in accordance with the NPPF Technical Guidance Development, the Sequential and Exception tests are not required to be undertaken by the Local Planning Authority, as part of the planning process.

Geology and Hydrogeology

- 3.14 The British Geological Survey (BGS) digital geological map of Great Britain at 1:50,000 scale, indicates that the site's geology comprises mainly of:
- Superficial Deposits – Boyn Hill Gravel Member (Sand and Gravel)
 - Bedrock Geology – Lewes Nodular Chalk Formation (Chalk)
- 3.15 BRE Digest 365 Soakaway tests have been carried out by Southern Testing (February 2024), as shown within Appendix 3 and have provided infiltration rates ranging from 1.63×10^{-5} m/s to 1.35×10^{-4} m/s, recorded at four soakaway test pit locations, refs. TP1, TP2, TP3 and TP4 at depths of 2.0mbgl each and suggest that high intensity soakaway devices will be suitable for the site. Therefore, in accordance with the recommended design guidance the lowest values for each soakaway test location will be used for each representative infiltration device in that location, therefore infiltration rates of 1.63×10^{-5} m/s, 1.35×10^{-4} m/s, 2.35×10^{-5} and 1.83×10^{-5} m/s recorded at locations TP1, TP2, TP3 and TP4 will be used for these preliminary surface water design purposes.
- 3.16 Due to the presence of a chalk bedrock, consideration will need to be given to the risk of solution features and as such soakaways should be sited no closer than 10.0m to buildings/structures.

- 3.17 Groundwater was not also encountered during any of the soakaway trial pit excavations or the groundwater monitoring well installed at a depth of 3.1m.
- 3.18 The site is also shown to be located within a Source Protection Zone 2 – Outer Protection Zone with no groundwater abstractions located within 500m of the site and an assessment of the BGS hydrological map indicates groundwater flow is to the north towards the River Thames estuary (approximately 400m north of the site). Groundwater was encountered within two nearby BGS boreholes, TQ67SW349 at 16 feet or 4.88mbgl (max. observed water level) and TQ67SW368 at 19 feet or 5.79mbgl within the chalk bedrock formation.

4 Flood Hazards

Source of Flooding

Fluvial

- 4.1 Fluvial flooding is caused by rivers and occurs when the river channel capacity is exceeded by the flow. Most rivers have a natural floodplain which in built-up areas is sometimes encroached upon by development.
- 4.2 The EA's Indicative Fluvial & Tidal Flood Mapping as shown within Figure 3.4 above demonstrates that the proposed development site is located within Flood Zone 1. Therefore, the development is considered to be at a very low risk of flooding from this source.

Tidal

- 4.3 Tidal flooding from the sea occurs when high tides and storm surges raise the level of tidal waters above the level of the shore or estuary bank and where subsequent wave heights can create overtopping of the sea defences.
- 4.4 As shown within Figure 3.4 above, the proposed development site is located within Flood Zone 1 in accordance with Table 1 of the NPPF Technical Guidance Document. Therefore, the development is also considered to be at very low risk of flooding from this source.

Overland Flow

- 4.5 Overland flows expose development areas to flooding risks during high intensity storm rainfalls when surface water does not have enough time to soak into the ground or enter the man-made drainage system at a quick enough rate due to a rapid increase in the volume of water. Where this occurs, the excess water can flow across land and potentially cause flooding.
- 4.6 The EA's Indicative Surface Water Flood Mapping as shown in Figure 4.1 below demonstrates that the majority of the site has a very low risk of overland surface water flooding, with only small, isolated pockets of low to medium risk located towards the south and north-east corner of the site.
- 4.7 Very Low risk is classified as storm events less than the 1 in 1000 year (0.1% AEP), Low risk is classified as storm events of between 1 in 100 year (1% AEP) and 1 in 1000 year (0.1% AEP), Medium risk is classified as storm events of between 1 in 30 year (3.33% AEP) and 1 in 100 year (1% AEP) and High risk is classified as storm events greater than 1 in 30 year (3.33% AEP).

- 4.8 Potential flood depths are shown below 300mm deep within the low to medium risk areas, located towards the north-eastern corner and south of the site and are mainly attributed to local site features rather than forming a significant overland surface water flood risk concern and as such unlikely to affect the development proposals and can therefore, be considered low risk.



Figure 4.1 – Environment Agency Indicative Surface Water Flood Mapping

- 4.9 However, to mitigate against any potential future overland surface water flood flow and to allow for modelling error above, the following steps have been considered within the site design:
- The sites topography will be exploited by the drainage strategy in the light of SuDS principles, to ensure that no overland flows can develop whilst ensuring mitigation and resistance measures are taken to provide a minimum depth of freeboard of 150mm between the ground and finish floor levels.
 - An appropriate Surface Water Drainage Strategy should be incorporated into the development design as detailed within Section 6 of this report;

Artificial Sources

- 4.10 Non-natural or artificial sources of flooding can include reservoirs, canals and lakes where water is retained above the natural ground level and flooding may occur as a result of the facility being overwhelmed and/or as a result of dam or bank failure. A large reservoir is one that holds over 25,000m³ of water, equivalent to approximately 10 Olympic sized swimming pools.
- 4.11 The EA Indicative Reservoir Flood Mapping, as shown in Figure 4.2 below demonstrates that the proposed development site is located outside an area of potential risk of a breach of Reservoir flooding. Therefore, the development is considered to be at very low risk of flooding from this source.



Figure 4.2 – Environment Agency Indicative Reservoir Flood Mapping

Sewers

- 4.12 Flooding from sewers occurs when the quantity of water flowing into the sewers exceeds the capacity of the sewer and backs up to an extent where it floods out of manholes and/or gullies. Alternatively, and more commonly, sewers flood when a blockage occurs in a pipe.

4.13 The Southern Water asset mapping shown within Appendix 6 demonstrates that the immediate surrounding area contains only foul water sewers, and is located downstream of the development and as such should not pose a risk to this site. The development is therefore considered to be at very low risk of flooding from this source.

4.14 Furthermore, flood mitigation measures described in Section 5, and a suitable sustainable Surface Water Drainage Strategy described in Section 6 will further reduce the future impact from this form of flooding.

Groundwater

4.15 The rainwater soaking into high grounds can raise the groundwater table at areas with relatively low ground levels, posing flooding risks to structures associated with such components as basements or detention ponds, although this is dependent upon the ground conditions of the site.

4.16 Groundwater was not encountered during any of the soakaway trial pit excavations or within a ground water monitoring well installed at a depth of 3.1m. Further investigation into the BGS borehole logs identifies groundwater was encountered within two boreholes, TQ67SW349 at 16 feet or 4.88mbgl (max. observed water level) and TQ67SW368 at 19 feet or 5.79mbgl within the chalk bedrock formation.

4.17 A review of the Kent County Council PFRA Susceptibility to Groundwater Flooding map (September 2011), also indicates that the site has a negligible susceptibility for groundwater flooding to occur (based on the BGS Groundwater Flood Susceptibility mapping). The development is therefore considered to be at a low risk of flooding from this source.

4.18 Furthermore the EA flood mapping service assesses the groundwater flood risk as unlikely in this area.

Description of Flooding

4.19 The site is considered to be at a low risk of flooding from all of the above sources. Therefore, the focus of this report will be to mitigate any potential future overland surface water flooding by implementing appropriate mitigation measures and a Surface Water Drainage Strategy using SuDS techniques. However, flood risk from other sources will not be overlooked and mitigation measures put forward where appropriate.

Kent and Gravesham Local Development Surface Water Strategy and Policies

4.20 A review of the Kent Minerals and Waste Local Plan Strategic Flood Risk Assessment (SFRA) (June 2013), Kent Local Flood Risk Management Strategy 2017-2023, Thameside Stage 1 Surface Water Management Plan – Final Report (May 2013), Kent County Council (KCC) Preliminary Flood Risk Assessment Report (PFRA) (September 2011) and Gravesham Local Plan Core Strategy and Policies Map (Adopted September

2014) raised the following relevant additional site specific flood risk and drainage policies associated with the land.

4.21 The Gravesham District Council Local Core Strategy '*Policy CS18: Climate Change*', states that:

Flood Risk

- 5.14.36 *With the exception of the previously developed sites along the Thames Riverside (see Policies CS03, CS04 and CS05) and those other regeneration sites which have already been evaluated in accordance with the sequential and exception tests at the application stage, development will be directed sequentially to those areas at least risk of flooding.*
- 5.14.37 *Proposals in areas at risk of flooding must be accompanied by a Flood Risk Assessment (in accordance with national policy and Environment Agency standing guidance as appropriate) and a Flood Risk Management Plan (if required) to demonstrate that they are adequately defended and safe over their lifetime. Planning permission will be refused for schemes which do not pass the sequential and exception tests.*
- 5.14.38 *The Council will prioritise the maintenance, improvement or replacement of flood defence infrastructure over other land uses where relevant. In addition to meeting their own flood defence and management needs, the Council will expect new development to take advantage of opportunities to reduce the causes and impacts of flooding from all sources where it is technically and financially feasible.*

Water Quality

- 5.14.39 *As part of its approach to climate change and environmental improvement, the Council will have regard to the delivery of the Water Framework Directive and associated Thames River Basin Management Plan objectives to support water bodies being progressively improved to "good" status over the plan period.*

Sustainable Drainage and Surface Water Run-Off

- 5.14.40 *The Council will seek to minimise the impact of drainage from new development on waste water systems. In particular, the Council will:*
 - *Require that surface water run-off from all new development has, as a minimum, • no greater adverse impact than the existing use; and*
 - *Require the use of Sustainable Drainage*

Access and Egress

- 4.22 In accordance with the NPPF and the NPPF Technical Guidance Document, access and egress to the site during a range of storm events should be considered with preference being over dry land, however where this is not possible evacuation should fall within the white cells as classified within Table 13.1 of FD2320_TR2.
- 4.23 The proposed developed is located within Flood Zone 1 with only isolated pockets of low to medium risk of overland surface water flooding and a low risk from all other sources. The use of appropriate mitigation measures implemented into the site design with access and egress conditions available at all times to the south-east of the site via the existing road access, will ensure that the site is classified as safe and unlikely to require the assistance of the emergency services.

5 Flood Risk Management Measures

- 5.1 To enable the site to be considered in line with the NPPF and the Technical Guidance, appropriate flood mitigation measures need to be in place. The measures laid out below are put forward as those that will be incorporated during the detailed design and operation of the development.

Overland Flooding and General Level Regime

Finished Floor Levels

- 5.2 The Finished Floor Levels (FFLs) of the proposed buildings will be determined by their link to the onsite highways and external ground levels and will be set a minimum of 150mm above the levels of the adjacent footways and roads, as also illustrated in Appendix 4. This will ensure that should flooding occur as a result of a sewer blockage or overland flow, flood waters will be attenuated on the low lying areas and will not affect the proposed buildings.

External Levels

- 5.3 All proposed new hardstanding areas will be designed to fall away from the proposed buildings so that in the event of a sewer surcharging or an overland flood flow event occurring, the flood water will not enter the buildings but will instead flood any external areas and discharge into the surface water drainage system.

Surface Water Drainage Strategy

- 5.4 The surface water drainage strategy for the proposed development will be carried out in accordance with Section 6 of this report and in conjunction the LLFA requirements.

Detailed Design

- 5.5 It is proposed that any mitigation measure set out in this report is controlled by conditions to the planning consent which will be approved by the LPA and their consultees.

6 Surface Water Drainage Strategy

Surface Water Run-off Rate

- 6.1 The existing site is considered to be 23% impermeable brownfield land consisting of roads, buildings and hardstanding/footpaths which is understood to drain via a positive surface water sewer network to assumed buried soakaways and 77% permeable greenfield landscaped areas, consisting of free draining unmade land, which is allowed to infiltrate and/or run-off into the adjacent unmade permeable areas.
- 6.2 In accordance with the technical guidance within HR Wallingford, the existing brownfield run-off flow rates for the positively drained area of the site is approximately 0.392 ha (23% of the total site area) and are shown within Table 6.1 below. Flow rates have been calculated using the Causeway Flow software version 10.8 (ReFH2 Method) with and without the effects of climate change.

Return Period	Existing Discharge Rate (l/s)	Existing Discharge Rate with 20% CC (l/s)	Existing Discharge Rate with 45% CC (l/s)
1 in 1 year	0.2	0.24	0.29
QBAR	0.3	0.36	0.44
1 in 30 year	0.7	0.84	1.02
1 in 100 year	1.0	1.2	1.45

Table 6.1 Existing Brownfield Site Run-off Flow Rates

- 6.3 The existing greenfield runoff volume for the 1 in 100 year 6 hour event can also be calculated by the Causeway Flow software and the volume generated by the existing site is 44m³.

The Basis for the SuDS Strategy

- 6.4 The surface water drainage system will be provided in accordance with the Building Regulations (2010) Part H hierarchal drainage discharge approach, NPPF and the PPG in the following order:
- Shallow Infiltration (i.e. Soakaways, Permeable Paving)
 - Watercourse (River or Ditch)
 - Sewers (Underground Piped System)
 - Deep Infiltration > 2.0m (i.e. Borehole Soakaways)

- 6.5 The development will incorporate SuDS that suits the site conditions and location. However, all sites have constraining factors which mean that certain SuDS solutions may be restricted. A summary of the potential SuDS options for the site are included in Table 6.2 below.

Type of SuDS component	Suitability	Comments
Soakaways	✓	It is considered that high intensity soakage methods are feasible at the site in various areas across the site as a method of downstream infiltration storage for the building roofs and existing roads with the underlying geology consisting of good draining subsoils, as discussed within section 3.15, however they are limited in their removal of pollutants and water quality benefits for draining roads and parking bays.
Porous paving (storage) and/or Filter Strips	✓	Could be considered as a method of shallow infiltration storage within the parking bays, whilst also benefitting from the filtration layers of the permeable construction to improve water quality.
Rainwater Harvesting	✓	Could be considered as part of the Architects proposals with rainwater butts proposed on the downpipes of the buildings.
Rain Gardens	✓	Could be considered as part of the Architects proposals with rain gardens used as source control and surface water run-off treatment for the roads and building roofs.
Swales	✓	Could be considered as part of a SuDS management train to channel flows, however given the layout of the development proposals, it is considered that rain gardens offer a more effective solution in this instance with greater water quality improvement benefits.
Attenuation/Infiltration Basins (above ground storage)	✓	Could be considered as a primary method of downstream shallow infiltration discharge storage to drain the building roofs, roads and car parks with the underlying geology consisting of good draining subsoils, as discussed within section 3.15. Whilst also benefitting from the grass filtration and sediment bay construction to improve downstream water quality offering biodiversity and amenity benefits.
Below ground storage geo-cellular systems	✓	Could be considered alongside an above ground SuDs device as a way of providing additional below ground storage.

Flow control devices	✓	A flow control device (e.g. a Hydro-brake or similar) is feasible in line with a storage facility with a discharge to a watercourse, sewer pipe or as part of a controlled cascading surface water SuDS management train.
Green Roofs/Brown Roofs/Blue Roofs	*	Not included in the client and architect design proposals.

Table 6.2 SuDS Options

Key:

- ✓ *Suitable for use in the scheme*
- * *Possibly suitable for use – not included in the client and architect design proposal at present*
- x *Unlikely to be suitable for use*

Climate Change

- 6.6 There is one element of climate change that will affect flood risk at the application site which is the peak rainfall intensity. Using the DEFRA website '*climate change allowances for peak river flow in England*' (data.gov.uk) climate change is dependent upon the life span of the development. For a site intended for residential use in the region of Kent - Medway Management Catchment, it is considered to take the range of 2061 to 2125 (2070s epoch) which equates to a lifespan of 37 – 101 years.
- 6.7 The “central” estimate will result in an increase to the peak rainfall intensity of 20% which has been incorporated into the surface water drainage strategy described below.
- 6.8 The “upper” estimate will result in an increase to the peak rainfall intensity of 35% (1 in 30 year AEP storm events) and 45% (1 in 100 year AEP storm events) and has also been considered in these proposals.

Surface Water Treatment

- 6.9 Consideration of surface water treatment is to be included to ensure compliance in accordance with the European Union’s ‘Water Framework Directive’.

Urban Creep

- 6.10 In accordance with the Local Authority SuDS Officer Organisation (LASOO) Non-Statutory Technical Standards for Sustainable Drainage Practice Guidance an allowance for the conversion of permeable surfaces of front/back gardens to impermeable surfacing over time should be accommodated for the life time of the development.

6.11 Urban creep has not been included within our impermeable area calculations, as it is not subject to the above criteria, as confirmed by the LLFA and shown within Appendix 7.

6.12 Therefore, the total design impermeable area of the site is 0.634 ha.

Infiltration Drainage

6.13 In accordance with the Building Regulations (2010) Part H hierarchical drainage discharge approach, NPPF and the PPG, infiltration drainage has been considered during the early stages of the development drainage strategy. The geology findings, as discussed within section 3.15 confirms that infiltration SuDS drainage techniques are feasible at the site and as such will be considered as the primary surface water discharge mechanism for this development.

6.14 An infiltration surface water system incorporating safety factors of 3.0, 5.0 and 10.0 in accordance with Table 25.2 and Section 20.5 of the CIRIA document C753 'The SuDS Manual', has been utilised as part of the proposed developments preliminary surface water drainage design to simulate the gradual silting up effects of the pervious surfaces and storage facilities over their design life and the risk of the feature failing in the future.

6.15 The preliminary surface water drainage strategy and associated hydraulic network design calculations can be seen within Appendix 4 and 5 respectively.

6.16 The above design has been based on the following design criteria:

- The worst case infiltration rates of 1.63×10^{-5} m/s, 1.35×10^{-4} m/s, 2.35×10^{-5} and 1.83×10^{-5} m/s recorded at locations TP1, TP2, TP3 and TP4 will be used to represent the soakaways, infiltration basins and permeable parking bays in each of the representative test locations has been used for these preliminary design purposes.
- 4 no. geo-cellular soakaway tanks have been designed to store, attenuate and infiltrate the surface water run-off from the proposed developments impermeable areas.
- The infiltration basin has been designed to store, attenuate and infiltrate the surface water run-off from the proposed developments impermeable areas, which will also provide additional water quality, biodiversity and amenity benefits.
- The parking bay facilities will be served by permeable surfacing (i.e. permeable paving/asphalt and/or a gravel filled plastic grid system) and provides an effective way of storing and treating rainfall run off from trafficked areas whilst reducing flow rates.

- Rain gardens drain and attenuate the existing rainwater downpipes from the buildings and roads and create additional surface water run-off storage, as well as creating bio-diversity and water quality benefits into the development proposals, however for the purposes of this preliminary design the storage attenuation volumes generated have not been included within the overall sites storage requirements.
- Rainwater butts have also been considered within the overall water re-use strategy at the site with butts proposed on each of the appropriate downpipes on the buildings.
- Water quality and pollution control aspects have been considered within the design via the use of permeable surfacing, rain gardens, filter drains and an infiltration basin which removes the necessary oil, metals and silts from entering the environmentally sensitive aquifer.
- The infiltration drainage system contains the critical 1 in 100 year storm event with a 20% increase in rainfall intensity to allow for the effect of climate change and consideration given to the 45% increase in rainfall intensity;
- The long term maintenance and ownership of the attenuation drainage system should be established early on during the design process.

6.17 Based on the above design the proposed development will not increase flood risk and will store and infiltrate surface water within the site. Using the latest FEH22 rainfall data catchment characteristics, four geo-cellular soakaway tanks, an infiltration basin, rain gardens, filter drains and permeable surfacing sub-base storage have been considered and designed as part of the developments surface water management system. Therefore, the surface water networks and design Causeway Flow output can be summarised within Tables 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9 and 6.10 below.

Return Period	Storage Volume (m ³)	Proposed Outflow Rate (l/s)	Water Depth (m)
1 in 2 year	20.0	0.3	0.251
1 in 2 year + 20% CC	25.0	0.3	0.313
1 in 2 year + 35% CC	29.3	0.3	0.367
1 in 10 Year	37.0	0.3	0.464
1 in 30 year	50.3	0.4	0.631

1 in 30 year + 20% CC	62.9	0.4	0.788
1 in 30 year + 35% CC	72.4	0.4	0.907
1 in 100 year	74.3	0.4	0.931
1 in 100 year + 20% CC	91.9	0.4	1.152
1 in 100 year + 45% CC	115.6	0.5	1.449

Table 6.3 Proposed Soakaway 1 Storage Volumes and Outflow Rates

Return Period	Storage Volume (m ³)	Proposed Outflow Rate (l/s)	Water Depth (m)
1 in 2 year	28.5	0.6	0.256
1 in 2 year + 20% CC	36.2	0.6	0.325
1 in 2 year + 35% CC	41.9	0.6	0.377
1 in 10 Year	53.9	0.7	0.484
1 in 30 year	73.5	0.7	0.658
1 in 30 year + 20% CC	90.3	0.7	1.564
1 in 30 year + 35% CC	90.3	0.7	1.603
1 in 100 year	90.3	0.7	1.600
1 in 100 year + 20% CC	90.5	0.7	1.706
1 in 100 year + 45% CC	90.7	0.7	1.936

Table 6.4 Proposed Soakaway 2 Storage Volumes and Outflow Rates

Return Period	Storage Volume (m ³)	Proposed Outflow Rate (l/s)	Water Depth (m)
1 in 2 year	17.1	0.5	0.182
1 in 2 year + 20% CC	21.7	0.5	0.230
1 in 2 year + 35% CC	25.1	0.5	0.266
1 in 10 Year	33.0	0.5	0.350

1 in 30 year	44.8	0.6	0.475
1 in 30 year + 20% CC	55.6	0.6	0.590
1 in 30 year + 35% CC	64.0	0.6	0.679
1 in 100 year	64.3	0.6	0.683
1 in 100 year + 20% CC	81.1	0.6	0.861
1 in 100 year + 45% CC	102.1	0.7	1.084

Table 6.5 Proposed Soakaway 3 Storage Volumes and Outflow Rates

Return Period	Storage Volume (m ³)	Proposed Outflow Rate (l/s)	Water Depth (m)
1 in 2 year	11.9	0.6	0.128
1 in 2 year + 20% CC	14.9	0.6	0.161
1 in 2 year + 35% CC	17.2	0.6	0.186
1 in 10 Year	23.1	0.7	0.250
1 in 30 year	31.8	0.7	0.343
1 in 30 year + 20% CC	39.7	0.7	0.429
1 in 30 year + 35% CC	45.8	0.7	0.494
1 in 100 year	45.0	0.7	0.486
1 in 100 year + 20% CC	56.6	0.7	0.611
1 in 100 year + 45% CC	71.7	0.8	0.774

Table 6.6 Proposed Soakaway 4 Storage Volumes and Outflow Rates

Return Period	Storage Volume (m ³)	Proposed Outflow Rate (l/s)	Water Depth (m)
1 in 2 year	0.0	0.0	0.000
1 in 2 year + 20% CC	0.0	0.0	0.000
1 in 2 year + 35% CC	0.0	0.0	0.000

1 in 10 Year	0.0	0.0	0.000
1 in 30 year	0.0	0.0	0.000
1 in 30 year + 20% CC	0.5	0.1	0.001
1 in 30 year + 35% CC	7.8	0.7	0.012
1 in 100 year	8.3	0.8	0.012
1 in 100 year + 20% CC	21.3	2.0	0.031
1 in 100 year + 45% CC	37.7	3.2	0.055

Table 6.7 Proposed Infiltration Basin Storage Volumes and Outflow Rates

Return Period	Storage Volume (m ³)	Proposed Outflow Rate (l/s)	Water Depth (m)
1 in 2 year	10.8	0.6	0.189
1 in 2 year + 20% CC	13.4	0.7	0.211
1 in 2 year + 35% CC	15.7	0.7	0.230
1 in 10 Year	21.0	0.7	0.273
1 in 30 year	28.6	0.7	0.335
1 in 30 year + 20% CC	36.0	0.7	0.396
1 in 30 year + 35% CC	41.5	0.7	0.441
1 in 100 year	40.8	0.7	0.436
1 in 100 year + 20% CC	51.6	0.7	0.524
1 in 100 year + 45% CC	65.9	0.7	0.641

Table 6.8 Permeable Surfacing 1 Storage Volumes and Outflow Rates

Return Period	Storage Volume (m ³)	Proposed Outflow Rate (l/s)	Water Depth (m)
1 in 2 year	1.5	0.2	0.092
1 in 2 year + 20% CC	1.9	0.2	0.102

1 in 2 year + 35% CC	2.1	0.2	0.108
1 in 10 Year	2.9	0.2	0.127
1 in 30 year	4.0	0.2	0.154
1 in 30 year + 20% CC	5.0	0.2	0.177
1 in 30 year + 35% CC	5.9	0.2	0.197
1 in 100 year	5.5	0.2	0.189
1 in 100 year + 20% CC	7.0	0.2	0.223
1 in 100 year + 45% CC	9.1	0.2	0.272

Table 6.9 Permeable Surfacing 2 Storage Volumes and Outflow Rates

Return Period	Storage Volume (m ³)	Proposed Outflow Rate (l/s)	Water Depth (m)
1 in 2 year	6.8	0.5	0.159
1 in 2 year + 20% CC	8.3	0.5	0.176
1 in 2 year + 35% CC	9.8	0.5	0.191
1 in 10 Year	13.0	0.5	0.225
1 in 30 year	17.9	0.5	0.275
1 in 30 year + 20% CC	22.5	0.6	0.323
1 in 30 year + 35% CC	26.2	0.6	0.361
1 in 100 year	25.3	0.6	0.351
1 in 100 year + 20% CC	32.0	0.6	0.422
1 in 100 year + 45% CC	40.7	0.6	0.511

Table 6.10 Permeable Surfacing 3 Storage Volumes and Outflow Rates

- 6.18 The volume and size of the geo-cellular soakaway tanks, infiltration basin and permeable surfacing sub-base storage have been based on the worst case storm of 1 in 100 year plus climate change AEP events.

6.19 Consideration has also been made within the design to accommodate an additional 1 in 10 year AEP storm event where the SuDS storage device half empty times exceeds 24 hours (1440 mins). A summary of the SuDS devices and revised depth requirements, where applicable have been provided below within Table 6.11.

SuDS Feature	Node Ref.	Half empty time within 24 hours (mins)	1 in 10 year AEP storm event water depth (m)	1 in 30 year AEP storm event water depth (m)	New revised depth requirement (m)	Freeboard (m)
Soakaway	Soakaway 1	2853	0.464	0.631	1.095 < 1.600, therefore ok.	0.505
Soakaway	Soakaway 2	Not calculated but assumed to exceed.	0.484	0.658	1.142 < 1.300 (0.8m deep tank and 0.5m deep basin, therefore ok.	0.158
Soakaway	Soakaway 3	1608	0.350	0.475	0.825 < 1.200 therefore ok.	0.375
Soakaway	Soakaway 4	889 < 1440 therefore ok.	-	-	-	-
Infiltration Basin	Infiltration Basin	180 < 1440 therefore ok.	-	-	-	-
Permeable Surfacing	Permeable Surfacing 1	422 < 1440 therefore ok.	-	-	-	-
Permeable Surfacing	Permeable Surfacing 2	Not recorded but assumed to be ok.	-	-	-	-
Permeable Surfacing	Permeable Surfacing 3	310 < 1440 therefore ok.	-	-	-	-

Table 6.11 Proposed SuDS half drain times assessment

- 6.20 Therefore, there is sufficient depth and capacity within the proposed geo-cellular soakaway tanks, infiltration basin and permeable surfacing sub-base storage to accommodate further storm events over a 24 hour period.
- 6.21 It is understood that the main roads and footways running through the site are assumed to be maintained as private and won't be offered for adoption to Kent County Council (ECC) under a Section 38 Agreement.
- 6.22 The storm water falling on road surfaces is at risk of being polluted and therefore it is proposed to treat its quality as outlined below in general terms (under the heading of "Pollution Control and Water Quality").
- 6.23 It is expected that during dry periods of the year the infiltration basin will be dry and fully useable as public open space with facility to include flora and fauna to promote wildlife and biodiversity as well as mental and physical wellbeing for the residents.

Soakaways

- 6.24 Soakaways, as shown within Figure 13.1 of the CIRIA SuDS Manual C753 and provided within Figure 6.1 below, are excavations that are filled with a void forming material that allows the temporary storage of water before it soaks into the ground. Many small soakaways are now constructed with geo-cellular units available from builders merchants pre-wrapped in geotextile. The geo-cellular units provide good overall storage capacity compared to rubble, and they allow the size of the structure required for any application to be minimised. The locations of the soakaways are to the west, south and centre of the site where there is a sufficient 10.0m build-off easement from the buildings/structures.

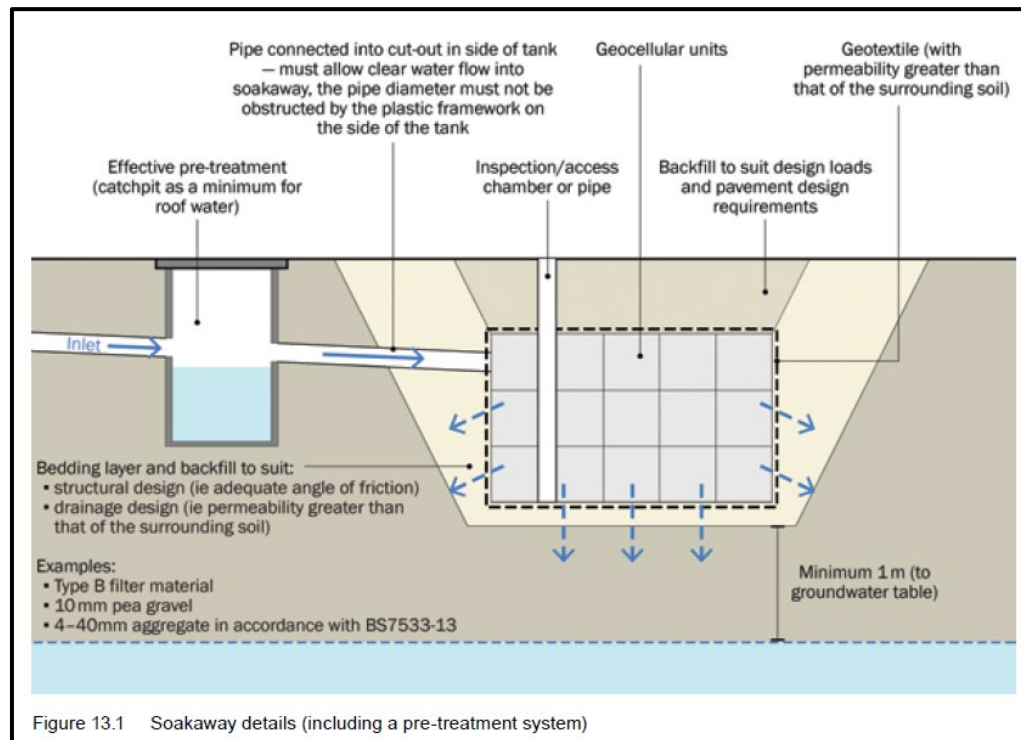


Figure 6.1 – Typical Geo-cellular Soakaway Tank

Infiltration Basins

6.25 Infiltration basins, as shown within Figure 13.4 of the CIRIA SuDS Manual C753 and provided within Figure 6.2 below are designed to be dry for the majority of the time whereas retention ponds typically retain a certain amount of water to add to the biodiversity. These features would also serve the following purposes:

- they can mitigate risk of groundwater and overland surface water flooding triggered outside the site of the proposed developments impacting on the proposed development site.
- Due to the topography of the site and the natural drainage approach, infiltration basins have been utilised as a means of above ground surface water storage attenuation and as a means of a surface water treatment facility on the site.

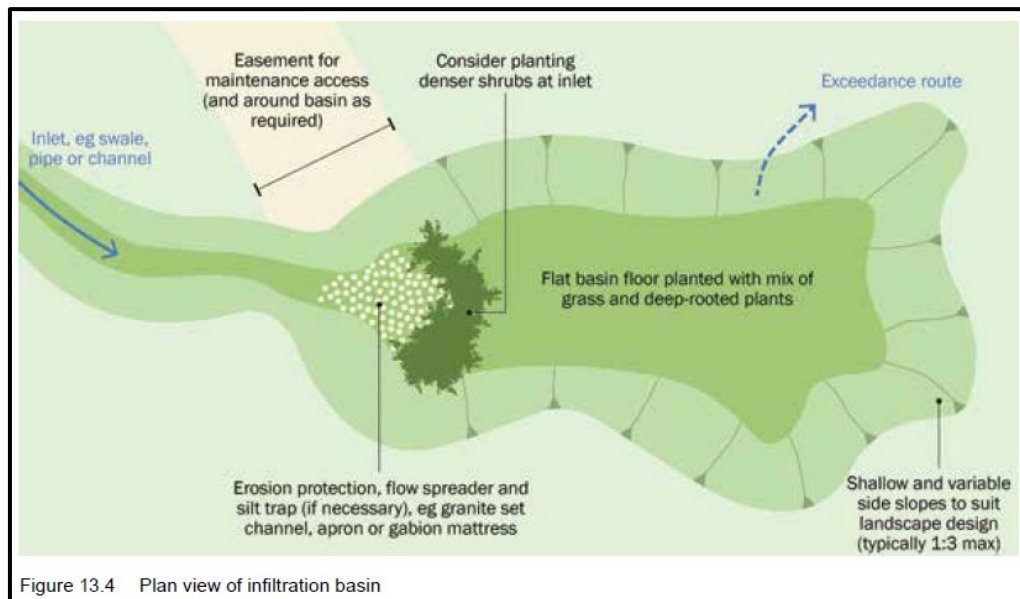


Figure 6.2 – Typical Infiltration Basin

Permeable Surfacing

- 6.26 Permeable surfacing, as shown within Figure 20.14 of the CIRIA SuDS Manual C753 and provided within Figure 6.3 below, allows surface water to drain through the surfacing to mimic the greenfield condition. Storage layers of granular fill can be provided below the surfacing for attenuation and filter layers to remove potential surface contaminants and collected via a perforated pipe underdrain. The location for permeable surfacing would be the private parking bays and this has been assessed as a possible means of providing additional attenuation and water quality improvements for the development.

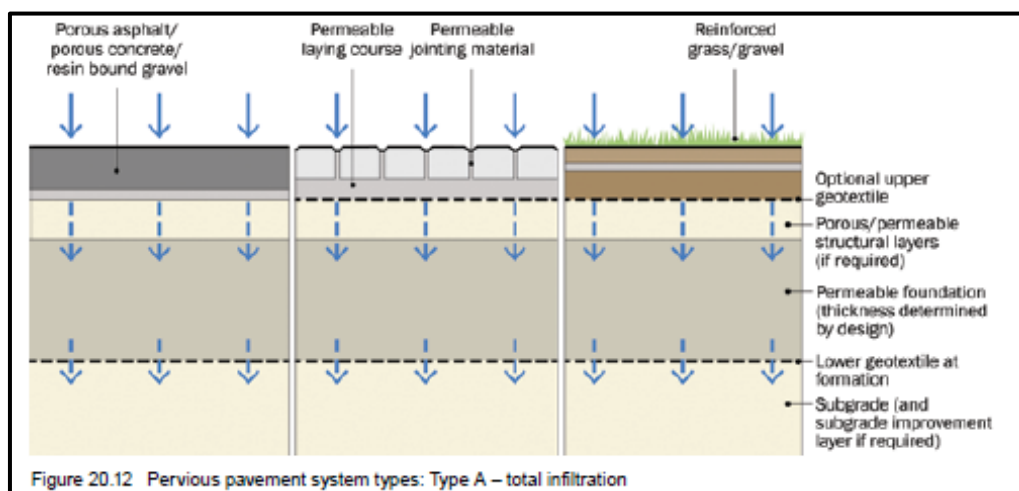


Figure 6.3 – Typical Permeable Surfacing (Type A – total infiltration)

Rain Gardens / Bioretention Systems

- 6.27 Rain gardens and bioretention systems, as shown within Figures 18.1 and 18.2 of the CIRIA SuDS Manual C753 and provided within Figures 6.4 and 6.5 below are typically mixed soil systems with underdrains and make use of the vegetation and layers of filter media to promote anaerobic digestions to remove nutrients. Small systems that serve part of a single property (roof or driveway) are less engineered than full bioretention components. In simple rain gardens, filter and drainage layers are generally replaced by a thin (200-500mm) layer of compost /sand-amended native soils or specified soil mixes (engineered soils). They usually have a simple inflow where rainwater enters the garden and they have a maximum depth of standing water of 150mm. They can have an above ground overflow where excess water exits, although in some instances a simple underdrain may be more effective than providing a small control structure. The location of rain gardens/bioretention systems would be around the central ring road and in some gardens areas of the buildings.

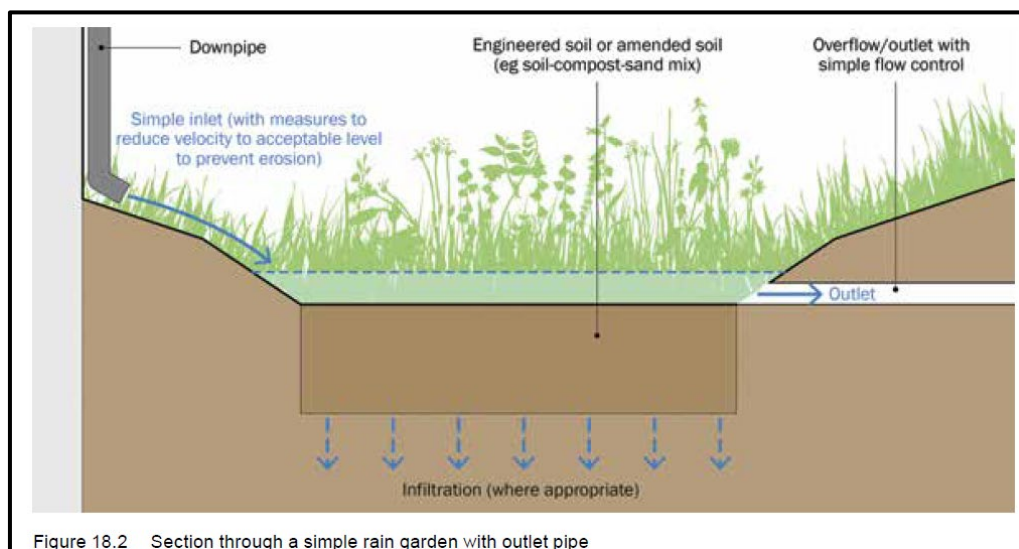


Figure 6.4 – Typical Rain Garden Section

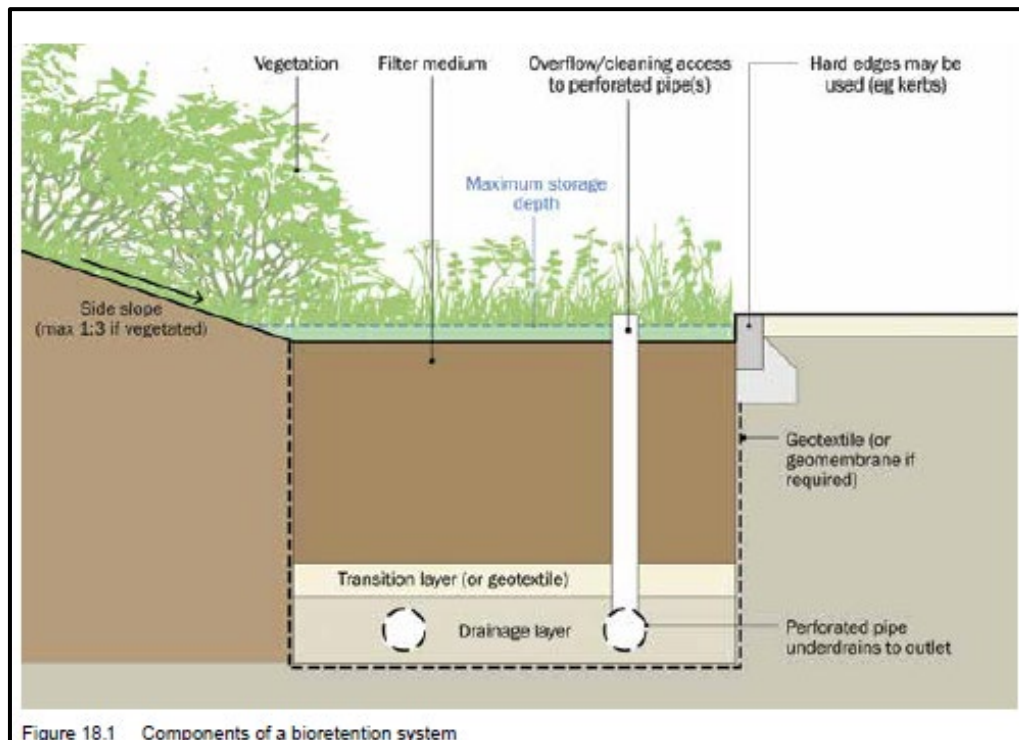


Figure 6.5 – Typical Bioretention Section

Filter Drains

- 6.28 Filter drains, as shown within Figure 16.2 of the CIRIA SuDS Manual C753 and provided within Figure 6.4 below are shallow trenches filled with stone/gravel that create temporary subsurface storage for the attenuation, conveyance and filtration of surface water runoff. The stone may be contained in a simple trench lined with a geotextile, geomembrane or other impermeable liner, or within a more structural facility such as a concrete trough. Filter drains may be lined (if required) or may allow infiltration depending on the suitability of the underlying soils and the protection they afford to the groundwater. The locations of filter drains are around the buildings where other above ground SuDS features are not feasible and/or practical for use.

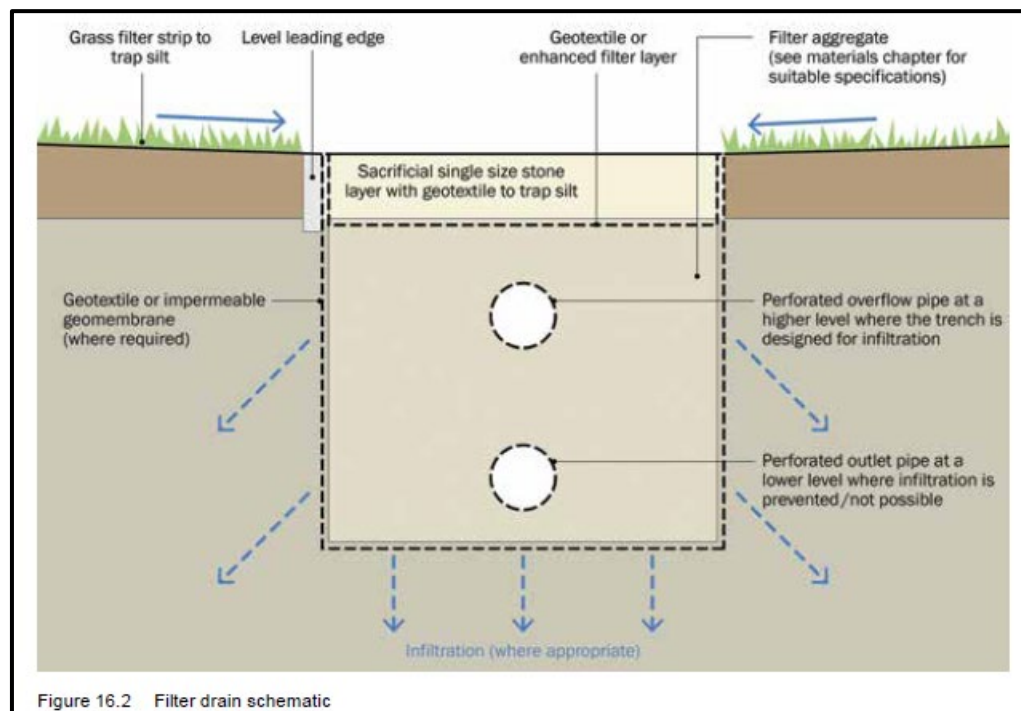


Figure 6.4 – Typical Filter Drain

Peak Rate and Volume of Run-off

- 6.29 In conjunction with LASOO, ref. 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 should 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.
- 6.30 The sites total surface water discharge drains into the ground via infiltration SuDS techniques, therefore there is no exceedance in the peak rate of run-off from the site.
- 6.31 In conjunction with LASOO, ref. S5. Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.
- 6.32 The sites total surface water discharge drains into the ground via infiltration SuDS techniques, therefore there is no exceedance in the volume of run-off from the site.

Greenfields

- 6.33 The rainwater falling on landscaped areas are assumed to be clean and able to filter to ground without any specific engineering measures required and reflect the existing Greenfield condition. Drainage problems over such areas include standing water but this is normally tolerated and considered a nuisance, rather than an engineering problem.

Exceedance of Design Event

- 6.34 Consideration is given to the consequences of exceeding the 1% AEP annual expected probability storm (see also Appendix 4 – Proposed Drainage Strategy, indicating the flood flow events at the site). In this situation SuDS apparatus and connecting drain runs may reach capacity and overflow. However, the resultant effect of temporary standing water on some hardstanding areas is considered a low risk. The hardstanding will be detailed so as to ensure there is no risk of standing water entering the building. Further guidance can be found in the CIRIA document C635 'Designing for Exceedance in Urban Drainage – Good Practice'.

Pollution Control and Water Quality

- 6.35 Pollution control measures should be put in place during the detailed design, in accordance with The SuDS Manual C753, Chapter 26 - Table 26.2. It is assumed that a residential development consisting of less than 300 traffic movements per day will provide pollution hazard indices, as shown in Table 6.12 below.

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential roofs	Very low	0.2	0.2	0.05
Individual property driveways, residential carparks, low traffic roads (e.g. cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (e.g. schools, offices) i.e. < 300 traffic movements/day.	Low	0.5	0.4	0.4

Table 6.12 Pollution Hazard Indices

- 6.36 The chosen suitable SuDS components in Table 6.2 will provide the following mitigation indices to groundwater only, as provided within Table 26.4 of The SuDS Manual C753 and summarised within Table 6.13 below.

Type of SuDS component	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Bioretention underlain by a soil with good contaminant attenuation potential of at least 300mm in depth (rain gardens)	0.8	0.8	0.8
A soil with good contaminant attenuation potential of at least 300mm in depth (infiltration basin)	0.4	0.3	0.3
Infiltration trench (where a suitable depth of filtration material is included that provides treatment, ie graded gravel with sufficient smaller particles but not single size coarse aggregate such as 20mm gravel) underlain by a soil with good contaminant attenuation potential of at least 300mm in depth (filter drains)	0.4	0.4	0.4
Constructed permeable pavement (where a suitable filtration layer is included that provides treatment, and including a geotextile at the base separating the foundation from the subgrade) underlain by a soil with good contaminant attenuation potential of at least 300mm in depth (also refer to Table 26.4, Notes 2 and 3 within CIRIA C753) (permeable surfacing)	0.7	0.6	0.7
Total Mitigation Indices	2.30 (+1.60)	2.10 (+1.50)	2.20 (+1.75)

Table 6.13 Pollution Mitigation Indices for discharges to Groundwater

6.37 Thus, it can be seen that the pollution mitigation indices for rain gardens, filter drains, permeable surfacing and infiltration basins in Table 6.10 above exceed the pollution hazard indices for the designated very low to low risk land use in all of the pollution hazard levels for TSS, Metals and Hydro-carbons and subsequently meets the required standards.

Legal Agreements

6.38 It is understood that a Section 104 Agreement (of the Water Industry Act 1991) sewer application will not be made for the surface water SuDS proposals.

7 Foul Water Drainage Strategy

Private and Public Drainage Sewers

- 7.1 There are private foul/combined water sewers serving the existing site which run south-eastwards and connect with the public 150mm and 200mm diameter VC foul water sewers and manholes running along College Road, as shown within Appendix 6. The existing private and public sewers located within the site should provide viable connection points to serve the new development.
- 7.2 A pre-development enquiry has been submitted to Southern Water and its findings have been included within Appendix 6. It is understood that there is capacity at the local Water Recycling Centre (WRC) to accommodate the volume of foul water generated by the development and available capacity within the local foul water sewer network running within College Road and the B2175 (High Street).
- 7.3 A calculated peak flow rate of 0.9 l/s has also been determined by Southern Water at manhole reference TQ61747507 to serve the site.
- 7.4 A proposed Foul Water Drainage Strategy has been provided, as shown within Appendix 4 – Proposed Drainage Strategy and includes the provision of a preliminary foul water gravity sewer system.

Legal Agreements

- 7.5 A Section 106 Agreement (of the Water Industry Act 1991) sewer applications will be made for the foul water proposals in accordance with the design requirements of the latest DCG at the detailed design stage.

8 Off Site Impacts

Impact of Development on Hydrological Morphology

- 8.1 The application site is located within Flood Zone 1 and therefore the proposed development will not be located within the fluvial flow path of any watercourse and will not occupy any critical floodplain storage.
- 8.2 Therefore, the development will have no significant impact on the hydrological morphology of the surrounding area.

Impact of Surface Water Drainage

- 8.3 The proposed development provides approximately 0.634 ha of impervious land. The surface water drainage strategy, detailed within Section 6 of this report, proposes infiltration storage of surface water flows within geo-cellular soakaway tanks, an infiltration basin and permeable surfaced sub-bases, together with attenuation storage within rain gardens and filter drains and will therefore have no impact from surface water flooding to the surrounding area.
- 8.4 Therefore, there will be no increase in risk of surface water flooding to the site, its occupants or existing surrounding development.

9 Maintenance Management

Maintenance Responsibility

- 9.1 The maintenance and repair of the existing public sewer network surrounding the site is the responsibility of Southern Water and is outside the control of the developer or the future occupants.
- 9.2 The maintenance of the below ground pipes, manholes, geo-cellular soakaway tanks, infiltration basin, rain gardens and filter drains will be the responsibility of the client/developer/management company.
- 9.3 The maintenance of the private road and permeable parking bays will also be the responsibility of the client/developer/management company.
- 9.4 Please also note that with the implementation of Schedule 3 of the Flood and Water Management Act 2010. It is understood that SuDs Approval Bodies (SABs) are due to come into force in 2024 and as such the maintenance responsibilities of the SuDs structures may lie with the LLFA and as such this maintenance management plan may be updated accordingly to suit at the detailed design stages.

Maintenance Regime

- 9.5 The recommended maintenance regime (based on the criteria within CIRIA C753) for the chosen surface water SuDS drainage system is set out in Tables 9.1, 9.2, 9.3, 9.4, 9.5 and 9.6 below.

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Remove sediment and debris from inspection chambers and flow control chambers, where applicable.	Annually
	Cleaning of gutters and any filters on downpipes.	Annually
	Remove any root ingress.	As required
Occasional Maintenance	CCTV survey of drains to check alignment, cracking and joint displacement.	10-year intervals

Table 9.1 Drainage Pipes Maintenance Schedule

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

Table 9.2 Geo-cellular Soakaway Tank Maintenance Schedule

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Remove litter, debris and trash	Monthly
	Cut grass – for landscaped areas and access routes	Monthly (during growing season) or as required
	Cut grass – meadow grass in and around basin	Half yearly: spring (before nesting season) and autumn
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Reseed areas of poor vegetation growth	Annually, or as required

Occasional Maintenance	Prune and trim trees and remove cuttings	As required
	Remove sediment from pre-treatment system when 50% full	As required
Remedial Actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realign the rip-rap	As required
	Repair or rehabilitate inlets, outlets and overflows	As required
	Rehabilitate infiltration surface using scarifying and spiking techniques if performance deteriorates	As required
	Relevel uneven surfaces and reinstate design levels	As required
Monitoring	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and pre-treatment systems for silt accumulation; establish appropriate silt removal frequencies	Half yearly
	Inspect infiltration surfaces for compaction and ponding	Monthly

Table 9.3 Infiltration Basin Maintenance Schedule

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface).	Once a year, after autumn leaf fall, or reduced frequency as required, based on site specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment

Occasional Maintenance	Stabilise and mow contributing and adjacent areas.	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying.	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving.	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material.	As required
	Rehabilitation of surface and upper substructure by remedial sweeping.	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection.	Monthly for three months after installation.
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action.	Three-monthly, 48 hours after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies.	Annually
	Monitor inspection chambers.	Annually

Table 9.4 Permeable Surfacing Maintenance Schedule

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices.	Monthly (or as required)
	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage.	Monthly
	Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies.	Six monthly
	Remove sediment from pre-treatment devices.	Six monthly, or as required

Occasional Maintenance	Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (e.g. NJUG 2007 or BS 3998:2010).	As required or if bare soil is exposed over 10% or more of the swale treatment area
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium.	Five yearly, or as required
	Clear perforated pipework of blockages.	As required

Table 9.5 Filter Drain Maintenance Schedule

Maintenance Schedule	Required Action	Frequency
Regular Inspections	Inspect infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels in underdrain (if appropriate) to determine if maintenance is necessary	Quarterly
	Check operation of underdrains by inspection of flows after rain	Annually
	Assess plants for disease infection, poor growth, invasive species etc and replace as necessary	Quarterly
	Inspect inlets and outlets for blockage	Quarterly
Regular Maintenance	Remove litter and surface debris and weeds	Quarterly (or more frequently for tidiness or aesthetic reasons)
	Replace any plants, to maintain planting density	As required
	Remove sediment, litter and debris build-up from around inlets or from forebays	Quarterly to biannually
Occasional Maintenance	Infill any holes or scour in the filter medium, improve erosion protection if required	As required
	Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch	As required
Remedial Actions	Remove and replace filter medium and vegetation above	As required but likely to be > 20 years

Table 9.6 Bioretention systems (Rain Gardens) Maintenance Schedule

- 9.6 The maintenance regime recommended above is put in place to minimise the risk of blockages occurring and to prevent water surcharging from the inspection chambers and manholes. However, the final maintenance regime should be undertaken during the detailed design stage to ensure the proposal suits the final design of the surface water drainage system. If flooding from the drainage system occurs, then the cause should be identified immediately and dealt with by the maintenance company and if considered appropriate, the maintenance regime should be adapted to ensure the cause of flooding does not occur again in the future.

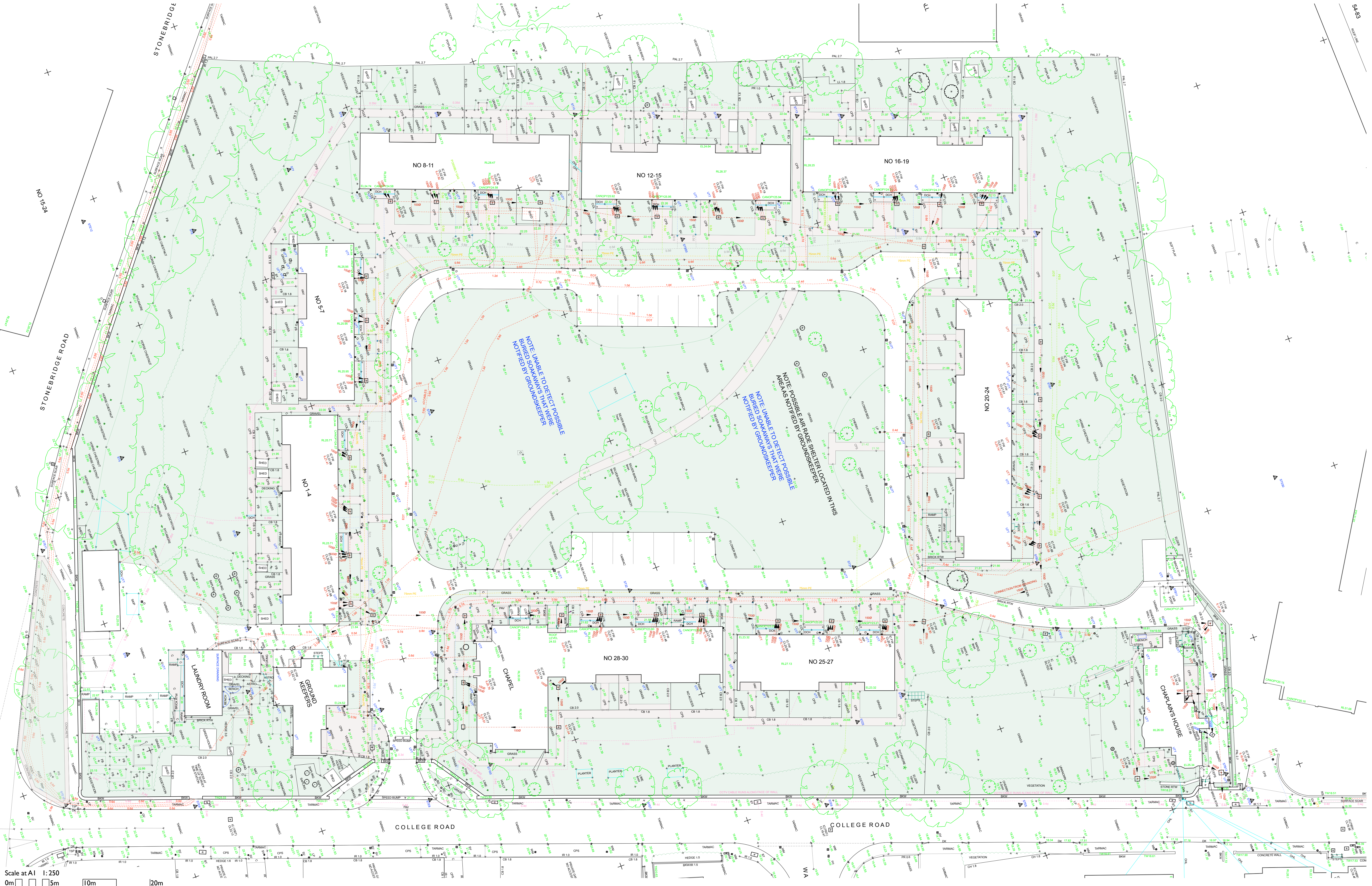
10 Overview

- 10.1 This Flood Risk and Drainage Assessment has been prepared in accordance with the National Planning Policy Framework (NPPF, December 2023), Department for Levelling Up, Housing and Communities (DLUHC, March 2023) and associated Planning Practice Guidance (PPG, 2024) as well as the Local Authority SuDS Officer Organisation (LASOO) Non-Statutory Technical Standards for Sustainable Drainage Practice Guidance.
- 10.2 The report demonstrates that the development site:
- Is located within Flood Zone 1 and is at a low risk of flooding from all other sources.
 - Is not subject to the Sequential and Exception Tests during the planning process;
 - Will incorporate a Sustainable Surface Water Drainage Strategy to drain the proposed development's impermeable area and will ensure that the flood risk is not increased, whilst providing the necessary pollution control and water quality improvements;
 - Will reduce the overall flood risk to the area by the onsite management of surface water, adopting storage and infiltration of surface water flows and will therefore have no increase on surface water flood risk at the site;
 - Will incorporate a suitable Foul Water Drainage Strategy to drain the proposed development and ensure flood risk is not increased;
 - Will incorporate a suitable Maintenance Management plan for all of the SuDS and piped drainage systems for the lifetime of the development.
- 10.3 Therefore, the proposed development is considered appropriate from a flood risk and drainage perspective subject to the implementation of the recommended surface water and flood risk management measures put forward as part of this report.

Appendices

Appendix 1

Topographical Survey



Notes

1:This drawing must not be scaled - work only to figured dimensions

2:Dimensions must be verified on site by the contractor before preparation of shop drawings

3:The architect must be notified of any discrepancies immediately

4:This drawing applies only to this job and site

5:This information on this drawing is copyright protected

Revs

29.02.2024

A- Plan reconfigured for A1

Drawn

Check

Date

HaysomWardMiller Architects		Topographical Survey	
20 Birdge Street Cambridge CB2 1UF		Project	Huggens College Almshouses
T: 01 223 578545		For	Huggens College
email: info@haysomwardmiller.co.uk		Scale	1:250 at A1 1:500 at A3
		Job no.	23.709
		Drawing no.	EX 02
		Revision no.	A

Appendix 2

Proposed Masterplan

Waste Standards
1 Bed flat
Refuse (black) 110ltr
Recycling (blue) 110ltr
Food waste (green) 1 x 140ltr bin per 10 flats
with an individual 51 litre caddy per flat

Proposed Total Waste Volumes
96 flats
Refuse (black) 110x96 = 10no. 1100 litre bins
Recycling (blue) 110x96 = 10no. 1100 litre bins
Green organic (green) 96/10 = 10no. 140 litre bins

Chapel & Kitchen
Refuse (black) 1no. 1100 litre bin
Recycling (blue) 1no. 1100 litre bin

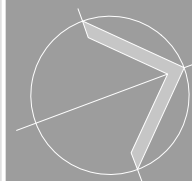
Cycle Standards
For sheltered housing
One space for every 5 Units
and one space for each member of staff
96 proposed homes 19 spaces
+ three staff
= 22 spaces required
30 spaces are provided

- LEGEND**
- Surfacing**
- S1 Existing tarmac road. Resurfaced blacktop
 - S2 New and/or existing tarmac to parking bays etc. finished with permeable Golden Gravel
 - S3 Paving at junctions between materials Tegula Slate blocks laid to random stretcher bond perpendicular to direction of travel
 - S4 Proposed Textured Flags to front paths in natural colour or similar approved. Permeable construction
 - S5 Proposed Textured Flags to covered walkways in natural colour or similar approved
 - S6 Breedon Golden Amber self binding gravel to footpaths through the landscape
 - S7 Pebbles set in concrete to form rumble strip
 - S8 Existing concrete paving to remain in-situ
- Boundary Treatments**
- B1 Existing brick boundary and retaining wall
 - B2 Existing Palisade boundary fencing
 - B3 Existing Close Boarded fence 1.8m high
 - B4 Proposed Venetian fence, 900mm high, between plots
 - B5 Proposed brick wall, 215 thk, 1.8m high
- Notes**
All build-ups to Engineer's specification
For Landscape Masterplan refer to EHLA drawing, 2305 C01
- Trees**
For all tree works see AIA and Tree Report by Inivicta Arboriculture
T86 Existing tree to be retained



Notes

- 1: This drawing must not be scaled - work only to figured dimensions
- 2: Dimensions must be verified on site by the contractor before preparation of shop drawings
- 3: The architect must be notified of any discrepancies immediately
- 4: This drawing applies only to this job and site
- 5: This information on this drawing is copyright protected



Drawn	Check	Date	Rev
RH	MB	29.02.2024	- Preliminary Fixed Plans Issue
RH	MB	28.03.2024	A - Draft Planning Application Submission
RH	MB	10.04.2024	B - Planning Application Submission

Scale at A1 1:250

0m 5m 10m 20m

HaysomWardMiller Architects

20 Biridge Street Cambridge CB2 1UF

T: 01223 578545

email: info@haysomwardmiller.co.uk

MASTERPLAN - Ground Floor Level

Project Almshouse Development

For Huggens College

Scale 1:250 at A1 1:500 at A3

Job no. 23.709

Drawing no. P 01

Revision no. B

Appendix 3

Soakage Test Report



Soakage Test Report

Project Name: Huggens College

Location: College Road, Northfleet, Kent, DA11 9DL

Client: The President and Trustees of Huggen's College

Project ID: J15643

Report Date: 21 February 2024

Report Issue: 1

Author	G J Dibben BEng (Hons)	
Check / Review	Jon Race BSc MSc CGeol FGS	

For and on behalf of Southern Testing Laboratories Limited

DOCUMENT HISTORY AND STATUS

Issue No.	Date	Purpose or Status	Author	Check / Review
1	21.02.2024	First Issue	GD	JNR

TABLE OF CONTENTS

A	INTRODUCTION	1
1	Authority	1
2	Location	1
3	Investigation Brief	1
4	Scope	1
B	SITE SETTING	1
5	Geological Records	1
C	FIELDWORK	2
6	Strategy and Method	2
7	General Site Description	2
8	Weather Conditions	3
9	Soils as Found	3
10	Groundwater Observations	3
D	TEST RESULTS	3
11	Soakage Test Results	3

TABLE OF APPENDICES

APPENDIX A

Site Plans and Exploratory Hole Logs

APPENDIX B

In-Situ Test Methods and Results

A INTRODUCTION

1 Authority

Our authority for carrying out this work is contained in our completed Project Order Form from The President and Trustees of Huggen's College dated 11th January 2024, relating to our quote Q23-1230-1.

2 Location

The site is located approximately 2 km north of the A2/A2260 road junction in Northfleet, Kent. The approximate National Grid Reference of the site is TQ 61700 74608. The site location is indicated on Figure 1 within Appendix A.

3 Investigation Brief

In accordance with the Client's instructions, and our quotation, the following was included in our brief for this soakage investigation:

4 No. soakage tests were carried out on site using the BRE365 method.

4 Scope

This factual report presents our exploratory hole logs and test results only.

A Detailed UXO risk assessment was supplied to us by 1st Line Defence for Andrew Firebrace Partnership Limited in advance of the investigation works being undertaken. The assessment was made with specific regard to the proposed investigation works and its conclusions may not be appropriate to other activities.

As with any site there may be differences in soil conditions between exploratory hole positions.

This report is not an engineering design and the figures and calculations contained in the report should be used by the Engineer, taking note that variations will apply, according to variations in design loading, in techniques used, and in site conditions. Our figures therefore should not supersede the Engineer's design.

The findings and opinions conveyed via this investigation report are based on information obtained from a variety of sources as detailed within this report, and which Southern Testing Laboratories Ltd. believes are reliable. Nevertheless, Southern Testing Laboratories Ltd. cannot and does not guarantee the authenticity or reliability of the information it has obtained from others.

The investigation was conducted and this report has been prepared for the sole internal use and reliance of The President and Trustees of Huggen's College and their appointed Engineers. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Southern Testing Laboratories Ltd. If an unauthorised third party comes into possession of this report they rely on it at their peril and the authors owe them no duty of care and skill.

The recommendations contained in this report are made in respect of the particular context of the investigation as described in the report and may not be appropriate to alternative development schemes. This report should be considered in its entirety and Southern Testing Laboratories Ltd accepts no responsibility for and excludes liability in respect of any omission or alteration made by others, and any use of the report for any purpose other than that for which it was produced.

B SITE SETTING

5 Geological Records

No formal desk study has been carried out, but reference has been made to both online and published geological maps to put the site into context.

5.1 Geology

The British Geological Survey Map No 271 (Dartford, 1998) indicates that the site geology consists of Boyn Hill Gravel over Undifferentiated Chalk (mostly Seaford Chalk).

5.1.1 Boyn Hill Gravel Member

The Boyn Hill Gravel Member comprises deposits of sands and gravels with subordinate layers of finer grained clayey and silty sands. Lenses of silt, clay or peat may also be present. This is one of the older members of a sequence of River Terrace Deposits associated with the Thames. These gravels were laid down in a large braided river channel and can be quite variable in their composition.

River Terrace Deposits were commonly worked in the past, often on a piecemeal basis in 'borrow pits' as well as larger mineral workings. Old pits may have been infilled with poor quality or waste materials, and can contain contamination.

5.1.2 White Chalk Group

The Seaford Chalk Formation comprises a fairly homogeneous white chalk with regular and conspicuous flint bands. These flints are commonly laterally very continuous and traceable over large distances. Some of the flints can be very large. A few marl seams are present within the lower parts of the formation.

The White Chalk outcrop in particular is frequently highly fractured and highly permeable, and usually has good infiltration characteristics. On the other hand, Chalk Head, highly weathered Chalk and Chalk under a low permeability superficial cover may have very poor infiltration characteristics.

Chalk is slightly soluble in water and, while it has excellent bearing properties when unweathered, this solubility can lead to deep weathering and softening, and the upper layers of chalk often have an irregular boundary with overlying strata

The Chalk may be softened by solution to a depth of 5 to 15 metres and bearing capacities and engineering properties improve with depth. Where there is an outcrop of impermeable soil overlying the chalk there may be a dramatically increased solution effect due to concentrated surface water flow to the Chalk close to the outcrop boundary.

Solution features are common in the Chalk, and these can present significant difficulties to development on affected sites.

C FIELDWORK

6 Strategy and Method

The strategy adopted for the soakage testing comprised the following:

Activity / Method	Purpose	Max Depth Range (mbgl)	Installations / Notes
TP1-4 8 Ton Tracked Excavator	Trial pit to investigate the shallow ground conditions and allow for assessment of soakage potential using the BRE365 method.	2.0	BRE365 Soakage tests gravel filled
BH1-4 Sedi-sampler	Rotary Flight Auger borehole to determine presence of groundwater.	3.1	

Exploratory hole locations were specified by the Client and are shown in Figure 2 in Appendix A.

In-situ test method descriptions employed are given in Appendix B together with the test results.

7 General Site Description

The site is an assisted residential area comprising single-storey residential dwellings with associated single-storey buildings, parking and road access. A large grass covered area was located in the centre of the site. Access to the site was via College Road; adjacent to the east. Stonebridge Road bordered the site to the south. Greenspace associated with a residential area bordered the site to the north and west.

8 Weather Conditions

The fieldwork was carried out between 12th and 14th February 2024, at which time the weather was generally overcast with occasional showers. The rainfall during the three months preceding the investigation was average for the time of year.

9 Soils as Found

The soils encountered are described in detail in the attached exploratory hole logs (Appendix A), but in general comprised a covering of Topsoil over Made Ground, over Boyn Hill Gravel Member. A summary is given below.

Depth (m)	Thickness (m)	Soil Type	Description
GL – 0.2/0.3	0.2 – 0.3	Topsoil	Grass over brown/dark brown sandy occasionally gravelly SILT/CLAY. Sand is fine to coarse. Gravel comprises fine to coarse angular to rounded flint.
0.2/0.3 – 0.8/1.0	0.5 – 0.8	Made Ground	(TP2-4 only) Brown/orangish brown clayey gravelly fine to coarse grained SAND/SILT. Gravel comprises fine to coarse angular to rounded flint and chalk.
0.2/1.0 – 2.0+	1.8+ - 1.0+	Boyn Hill Gravel	Friable brown/orange gravelly fine to coarse grained SAND or sandy gravelly CLAY. Gravel comprises fine to coarse angular to rounded flint and chalk.

10 Groundwater Observations

Rotary Flight Auger boreholes were drilled to 3.1mbgl adjacent to each of the trial pit locations to install groundwater monitoring wells to determine the presence of groundwater. No groundwater was encountered in any of the boreholes.

D TEST RESULTS

11 Soakage Test Results

The BRE paper DG365, Ref [22] describes a method for site testing to determine soil infiltration rates at the proposed site of a soakaway. The in-situ test method is described in Appendix B.

A total of four soakage tests were carried out across the site, at the locations shown on the attached site plan Figure 2, Appendix A. The full results of the soakage tests are presented within Appendix B.

The DG365 Ref [22], states that each pit should be allowed to drain three times to near empty, with filling on the same or consecutive days.

The infiltration rate from each trial hole is summarised in the table below. The soakage rate in this report is expressed as $\ell/m^2/\text{minute}$, which is a convenient rate to use. The BRE use a unit of m/sec , which is the value in $\ell/m^2/\text{minute}$ divided by 60,000.

Test ID	Test Depth (mbgl)	Design Infiltration Rate		Notes
		$\ell/m^2/\text{minute}$	m/sec	
TP1	2.0	0.977	1.63×10^{-5}	
TP2	2.0	8.08	1.35×10^{-4}	Two emptyings only
TP3	2.0	1.41	2.35×10^{-5}	Two emptyings only
TP4	2.0	1.10	1.83×10^{-5}	Two emptyings only

Note: The Design Infiltration Rate is the lowest of the three tests

Where three fillings have not been carried out, a reduction factor should be applied to the result to provide a design infiltration rate.

The tests generally showed good soakage rates across the site.

Soakaways should not normally be constructed closer than 10 m to buildings.

11.1 General Guidance on Design of Soakaways

Any soakaway scheme may require the approval of the Environment Agency, Building Control and, where applicable, the adopting Highways Authority.

Soakaways are used to store the immediate surface water run-off from hard surfaced areas, such as roof or carparks, and allow for efficient infiltration into the adjacent soil. They should be designed to discharge their stored water sufficiently quickly to provide the necessary capacity to receive run-off from a subsequent storm. The time taken for discharge depends upon the soakaway shape and size, and the surrounding soil's infiltration characteristics.

Groundwater levels can vary considerably from season to season and year to year, often rising in wet or winter weather, and falling in periods of drought. As such, a high groundwater table may affect the storage capacity of soakaways. In addition, it should be noted that an unsaturated zone may be required between the base of soakaways and the groundwater table, by the Environment Agency. Longer term monitoring may be required to establish actual groundwater levels as part of the planning approval process.

The design of soakaways can be square, circular (conventional) or trench excavations, and may be rubble filled, perforated precast concrete ring units, plastic cells or any similar structure that collects rainwater and run-off and allow discharge directly into the ground. Depending on the geological conditions, and depth at which suitable infiltration is achieved, soakaways can also be deep bored.

Long-term maintenance and inspection must be considered during the design and construction process. Maintenance of silt traps, gully pots and interceptors will improve the long-term performance of soakaways. The use of wet well chambers within the soakaway system can further assist in pollutant trapping and extending the operating life of soakaways.

Risk of pollution to the quality of groundwater must be considered as part of the design.

Generally, roof and surface run-off should not significantly impact on groundwater quality and subject to appropriate approvals from the Environment Agency could be discharged directly to soakaways. However, although again subject to approvals from the Environment Agency, paved surface run-off for larger trafficked areas should generally be passed through a suitable form of oil interception device prior to discharge to the soakaway.

Care must be taken to ensure that the discharge of large volumes of surface run-off into the soil does not disrupt the existing sub-surface drainage patterns. Similarly in areas of sloping topography, consideration should be given to the siting of soakaways to avoid potential discharge and or flooding of down slope areas.

REFERENCES

- [1] Building Research Establishment (BRE), "DG365 Soakaway Design," 2016.
- [2] BSI Standards, "BS 5930:2015+A1:2020 Code of practice for ground investigations," 2020.
- [3] BSI Standards, "BS 3882:2015 Specification for Topsoil," 2015.
- [4] CIRIA, "C574 Engineering in Chalk," 2002.
- [5] R. N. Mortimore, Logging the Chalk, 2014.
- [6] NHBC, "NHBC Standards Plus," [Online]. Available:
<http://www.nhbc.co.uk/Builders/ProductsandServices/TechZone/nhbcstandards/>.



APPENDIX A

Site Plans and Exploratory Hole Logs





Contains Ordnance Survey Data © Crown Copyright and Database Right 2024

Site:	Huggens College, College Road, Northfleet, Kent, DA11 9DL.	Project ID	J15643
Figure 1	Site Location Plan	Date:	15/02/2024



NB: Positions of exploratory holes / test positions are only indicative unless dimensioned.

Site:	Huggens College, College Road, Northfleet, Kent, DA11 9DL	Project ID	J15643
Figure 2	Site Investigation Layout Plan	Date:	15/02/2024

Key to Exploratory Hole Logs, Plans and Sections

Backfill Symbols		Pipe Symbols		Principal Soil Types		Principal Rock Types		Drilling Records	
Arisings		Plain Pipe		Topsoil		Mudstone		Water Strike	
Concrete		Slotted Pipe		Made Ground		Claystone		Depth Water Rose	
Blacktop		Piezometer		Clay		Siltstone		Total Core Recovery (%) [TCR]	
Bentonite		Piezometer Tip		Silt		Sandstone		Solid Core Recovery (%) [SCR]	
Gravel Filter		Filter Tip		Sand		Limestone		Rock Quality Index (%) RQD]	
Sand Filter		Extensometer		Gravel		Chalk		Fracture Index (fractures / m) [FI]	
		Inclinometers		Peat					

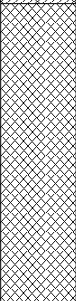
All soil and rock descriptions are in general accordance with BS5930 2015, BS EN ISO 14688-1:2002+A1:2013 and BS EN ISO 14689-1:2003. Chalk descriptions are also based on CIRIA C574 and "Logging the Chalk – R.N. Mortimer 2015". The Geology Code is only provided where a positive identification of the sample strata has been made.

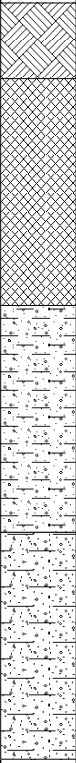
Location / Method Identifiers		In-situ Test Location / Method	
BH	Borehole (undefined)	DP	Dynamic Probe
CP	Cable Percussive	CPT	Cone Penetration Test
RC	Rotary Core	CBR	In-situ CBR Test
RO	Rotary Open Hole	DCP	CBR using Dynamic Cone Penetrometer
ODC	Rotary ODEX/Symmetrix drilling cased	CBRT	CBR using TRL Probe
CP+RC	Cable Percussive to Rotary Core	PB	Plate Bearing Test
SNC	Sonic	SPT (S)	Standard Penetration Test (Split Barrel Sampler)
CFA	Continuous Flight Auger	SPT (C)	Standard Penetration Test (Solid Cone)
FA	Flight Auger	N	SPT Result
VC	Vibro Core	-/-	Blows/Penetration (mm) after seating drive
WLS+RC	Windowless (Dynamic) Sampler to Rotary Core	-*/-	Total Blows / Penetration (mm)
WLS	Windowless Sampler	()	Extrapolated Value
WS	Window Sampler	PPT	Perth Penetration (In-House Method - Equivalent N Value)
HA	Hand Auger	HP / UCS	Strength from Hand Penetrometer (kN/m ²)
C	Road / Pavement Core	IVN	Strength from Hand Vane ((kN/m ²) P = peak, R = residual
IP	Inspection Pit (Hand Excavation)	PID	Photo Ionisation Detector (ppm)
TP	Trial Pit (Machine Excavated)	MEXE	Mexi-Cone CBR (%)
OP	Observation Pit (Supported Excavation Hand or Machine)		

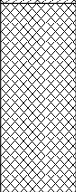
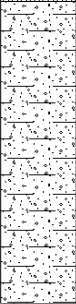
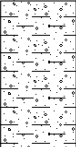
Samples / Test Type	
B	Bulk Sample
BLK	Block Sample
C	Core Sample
CBRS	CBR Mould Sample
D	Small Disturbed Sample
ES	Environmental Sample (Soil)
EW	Environmental Sample (Water)
GS	Environmental Sample (Gas)

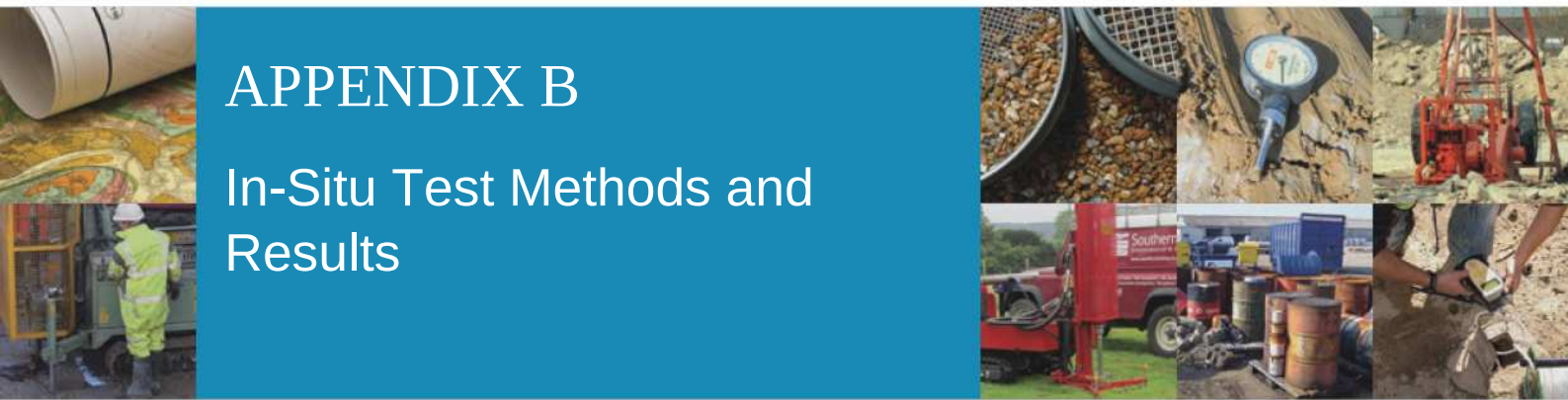
Samples / Test Type	
SPTLS	Standard Penetration Test Split Barrel Sample
TW	Thin Wall Push In Sample (e.g. Shelby Sampler)
U	Undisturbed Open Drive Sample (blows to take)
UT	Thin Wall Undisturbed Open Drive Sample (blows to take)
W	Water Sample (Geotechnical)
SP	Sample from Stockpile
P	Piston Sample
AMAL	Amalgamated Sample

				Start - End Date:		Project ID:		Hole Type:		TP1	
				13/02/2024		J15643		TP		Sheet 1 of 1	
Client:		The President and Trustees of Huggen's College				Co-ordinates:		Level (m AOD)		Logger:	
Project Name:						Huggen's College		Location:		College Road, Northfleet, Kent, DA11 9DL.	
		Samples and Insitu Testing		Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description			
		Depth (m bgl)	Type								
					(0.20)		0.20	Dark brown silty CLAY with abundant rootlets.			
					(1.80)		2.00	Orangish brown clayey gravelly SAND. Gravel comprises fine and medium chalk and fine to coarse angular to rounded flint.			
								1.20m: Chalk and flint gravel becoming more abundant.			
								Pit terminated at 2.00m			
											
											
											
											
											
											
											
											
											
											
											
											
											
											
											
											
											
											
											

				Start - End Date:		Project ID:		Hole Type:		TP2	
				13/02/2024		J15643		TP		Sheet 1 of 1	
Client:		The President and Trustees of Huggen's College				Co-ordinates:		Level (m AOD)		Logger:	
Project Name:										GD	
Project Name:		Huggen's College				Location:		College Road, Northfleet, Kent, DA11 9DL.			
Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description				
Depth (m bgl)	Type	Results									
				(0.20)		0.20	Grass over brown clayey sandy SILT with rootlets. Sand is fine to coarse. Brown clayey sandy gravelly SILT. Sand is fine to coarse. Gravel comprises fine to coarse angular to rounded flint, brick and chalk with occasional brick cobbles. MADE GROUND 0.60m - 0.70m: concrete cobbles and boulder.				
				(0.80)		1.00	Brown sandy gravelly CLAY. Sand is fine to coarse. Gravel comprises fine and medium angular to rounded flint and chalk. 1.10m: Brick structure encountered. Orangish brown sandy gravelly CLAY. Sand is fine to coarse. Gravel comprises fine to coarse angular to rounded flint and chalk. Pale brown gravelly CLAY. Gravel comprises fine to coarse angular to rounded flint. Orangish brown clayey gravelly fine to coarse grained SAND. Gravel comprises fine to coarse angular to rounded flint and chalk with occasional flint cobbles.				
				(0.20)		1.20					
				(0.10)		1.30					
				(0.20)		1.50					
				(0.50)		2.00	Pit terminated at 2.00m				
Pit Dimension (m)		Pit Stability:		Stable		Water Strikes					
		Weather:				Depth (m)		Date/Time		Remarks	
Width:	0.60	Remarks: Dry and stable on completion.									
Length:	1.60										
Depth:	2.00										
Status:		FINAL		Log Print Date and Time:		20/02/2024 03:17		Log Approved By:		JNR	

				Start - End Date:		Project ID:		Hole Type:		TP3	
				13/02/2024		J15643		TP		Sheet 1 of 1	
Client:		The President and Trustees of Huggen's College				Co-ordinates:		Level (m AOD)		Logger:	
Project Name:										GD	
Project Name:		Huggen's College				Location:		College Road, Northfleet, Kent, DA11 9DL.			
Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description				
Depth (m bgl)	Type	Results									
				(0.20)		0.20	Grass over brown clayey sandy gravelly SILT with rootlets. Sand is fine to coarse. Gravel comprises fine to coarse angular to rounded flint. Brown clayey gravelly fine to coarse grained SAND. Gravel comprises fine to coarse angular to rounded flint, brick and chalk with rare metal and slate. MADE GROUND 0.60m: Concrete cobble 0.70m - 0.80m: Abundant brick fragments. Friable brown slightly sandy gravelly CLAY with occasional rootlets. Sand is fine to coarse. Gravel comprises fine and medium angular to rounded flint and chalk. Orange clayey gravelly fine to coarse grained SAND. Gravel comprises fine to coarse angular to rounded flint. 1.80m - 2.00m: Brown weathered chalk inclusion recovered as chalk putty. Pit terminated at 2.00m				
				(0.60)							
				(0.60)							
				(0.60)							
				(0.60)							
Pit Dimension (m)		Pit Stability:		Stable		Water Strikes					
		Weather:				Depth (m)		Date/Time		Remarks	
Width:	0.55	Remarks: Dry and stable on completion.									
Length:	1.40										
Depth:	2.00										
Status:		FINAL		Log Print Date and Time:		20/02/2024 03:17		Log Approved By:		JNR	

				Start - End Date:		Project ID:		Hole Type:		TP4										
				13/02/2024		J15643		TP		Sheet 1 of 1										
Client:		The President and Trustees of Huggen's College				Co-ordinates:		Level (m AOD)		Logger:										
Project Name:										GD										
Project Name:		Huggen's College				Location:		College Road, Northfleet, Kent, DA11 9DL.												
Samples and Insitu Testing			Level (m AOD)	Thickness (m)	Legend	Depth (m bgl)	Stratum Description													
Depth (m bgl)	Type	Results																		
				(0.30)		0.30	Grass over brown clayey sandy SILT with rootlets and rare timber. Sand is fine to coarse.													
							(0.50)		0.80	Orangish brown clayey gravelly SAND. Gravel comprises fine to coarse angular to rounded flint, brick and chalk. MADE GROUND 0.40m - 0.50m: Possible coal/clinker										
										(0.80)		1.60	Orangish brown clayey gravelly fine to coarse grained SAND. Gravel comprises fine to coarse angular to rounded flint and chalk.							
													(0.40)		2.00	Friable orange sandy gravelly CLAY with occasional rootlets. Sand is fine to coarse. Gravel comprises fine to coarse angular to rounded flint and occasional fine and medium chalk and rare flint cobble.				
																Pit terminated at 2.00m				
Pit Dimension (m)		Pit Stability:		Stable		Water Strikes														
		Weather:				Depth (m)		Date/Time		Remarks										
Width:	0.55	Remarks: Dry and stable on completion.																		
Length:	1.50																			
Depth:	2.00																			
Status:		FINAL		Log Print Date and Time:		20/02/2024 03:17		Log Approved By:		JNR										

A collage of six images related to geotechnical testing. Top left: A large white pipe. Top middle: A close-up of a soil sample in a sieve. Top right: A pressuremeter being used on a soil surface. Middle left: A worker in a high-visibility suit operating a piece of machinery. Middle right: A red truck with 'Southern' written on its side, parked next to various equipment and barrels. Bottom right: A person using a tool to work on a soil sample.

APPENDIX B

In-Situ Test Methods and Results

B

Soil and Rock Descriptions

All soil and rock descriptions are in general accordance with BS5930 Ref [4].

Anthropogenic soils ('made ground' or 'fill') describe materials which have been placed by man and can be divided into those composed of reworked natural soils and those composed of or containing man-made materials. 'Fill' is used to describe material placed in a controlled manner and 'made ground' is used to describe materials placed without strict engineering control.

The classification of materials such as topsoil is based on visual description only and should not be interpreted to mean that the material complies with criteria used in BS 3882 Ref [33].

Chalk descriptions are based on CIRIA C574 Ref [34] and Mortimore Ref [35].

The geology code is only provided on logs where a positive identification of the sample strata has been made.

Soakage Tests (after BRE DG365 2016)

The BRE DG365 Ref [22] paper on soakaway design allows for the design of trench soakaways as well as traditional square and circular soakaways.

The test to measure the soil infiltration rate is carried out in pits which are excavated to the full depth of the proposed soakaway. The trial pits are filled and allowed to drain to empty or near empty, three times, on the same day or on consecutive days. Water levels are recorded against time. Where the sides are unstable the pit should be filled with granular material to provide stability during the test.

Calculated soakage rates are expressed as l/m²/minute, which is a convenient rate to use. The BRE use a unit of m/sec, which is the value in l/m²/minute divided by 60,000.

Soakage Test (after NHBC Standards Chapter 5.3)

The above test Ref [21] refers to small-scale soakage tests that can be performed in areas with restricted access e.g. occupied houses, or where disturbance is to be kept to a minimum. The aim is to measure the time it takes for a set quantity of water to drain from a standard sized excavation. The results from which are used to design a soakaway chamber. However, if the test results prove inconclusive, it may be advisable to retest the soils using the larger scale BRE DG365 test method Ref [22].

The procedure involves drilling a 150 mm diameter hole to a depth of 1.5m or more. Perforated casing is installed in the hole with a sand filter surround. Water is added to a depth of 300 mm, and a record kept of the falling water level.

The test result is expressed as the time in minutes for the water level to drop the full 300 mm, and required soakaway sizes and depths are obtained from graphs in NHBC 5.3. If the water does not completely soak away in the time available then a graphical plot of water level versus logarithm of time is prepared. The test time is then obtained by extrapolation.

Percolation Tests (EA PPG4 & Building Regulations Part H2)

The above test refers to small-scale soakage tests that can be performed in areas with restricted access e.g. occupied houses, or where disturbance is to be kept to a minimum. The aim is to measure the time it takes for a set quantity of water to drain from a standard sized excavation.

The procedure is essentially for design of septic tank discharge to subsurface irrigation systems and involves digging at least two holes 300mm square to a depth of at least 300mm below the proposed invert level of the infiltration pipe. The test holes should be pre-soaked overnight. The following day the holes are filled to a depth of at least 300mm and the time for the water to seep away from 75% full to 25% full is recorded. The time in seconds divided by 150 gives the percolation value, Vp. The test should be carried out at least three times and the average value taken.

Rotary Drilling – Hollow Stem Flight Auger

This equipment is supported on a small tracked mounted rig and can be used in areas of restricted access. The rig can be used for the sampling of soils and for the installation of monitoring wells.

Spiral flight augers drill into the soil by rotary action. Soil is transported to the surface up the spiral flights of the augers and the action causes some mixing of the soils. This may be minimised by advancing the borehole in steps and withdrawing the augers without rotation. Only disturbed soil samples would be available using this technique, Class 5 or 4 at best.

Using flight augers constructed with a hollow internal stem. When the augers are drilled into the ground a continuous sample can be retained. The recovery and degree of disturbance to the sample is influenced by the nature of the ground encountered. These flights can also be used for the installation of monitoring wells in unstable soils, where a cased borehole is not possible.

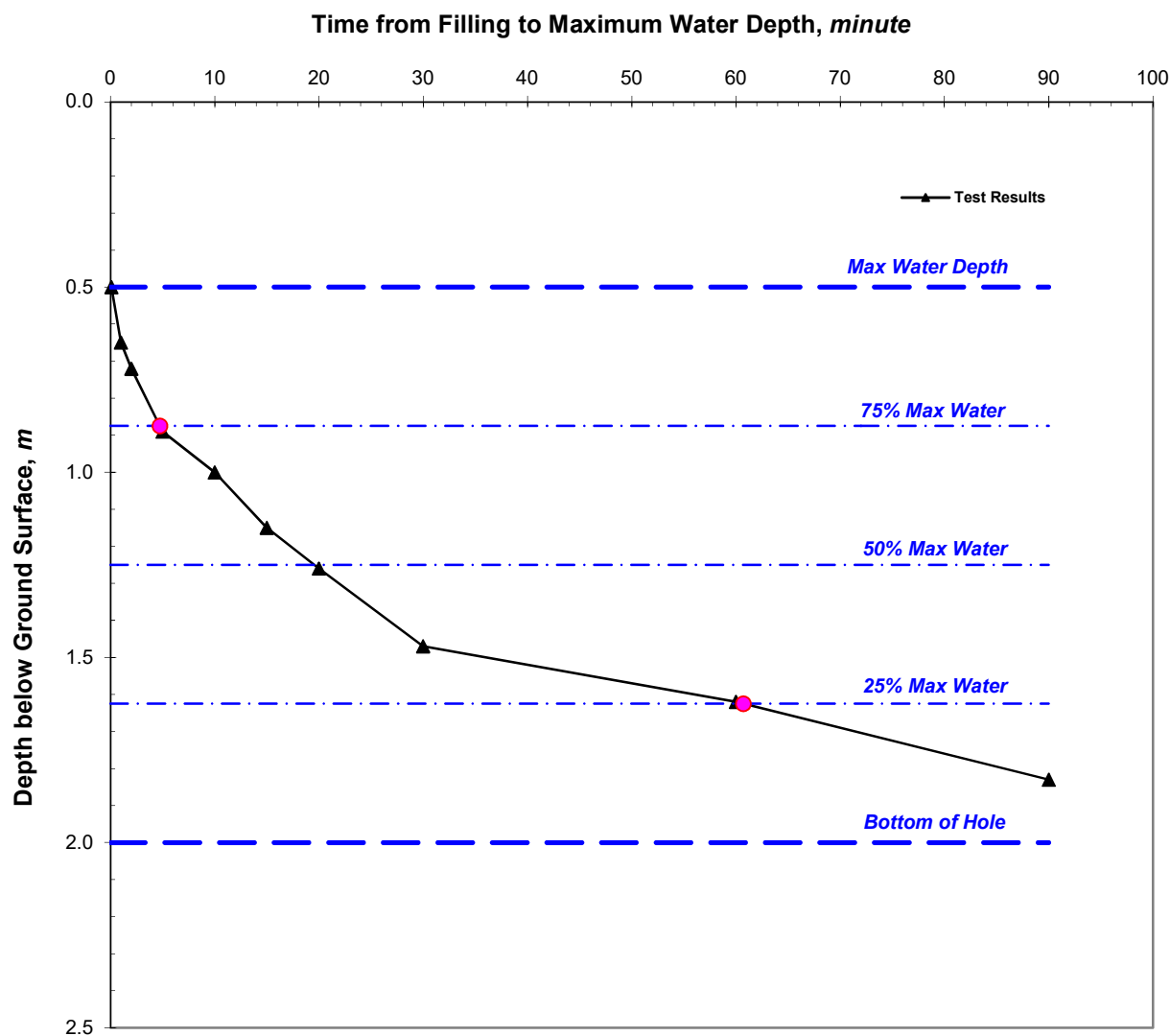
Summary Sheet

Results of BRE Digest DG365 Soakage Tests

Site : Huggens College, College Road, Northfleet					Job No : J15652		
Client : The President and Trustees of Huggen's College					O S Reference : TQ 61700 74608		
Tested By : JB				Engineer: GD		Test Date : 13/Feb/2024	
Hole No	Test No	Hole Depth <i>m</i>	Soakage Rate for Each Test <i>litre/m²/min</i>	Soakage Rate for Each Hole <i>litre/m²/min m/sec</i>		Water Level at Finish of Test	Remarks
TP1	No 1	2.00	0.977	0.977	1.63E-5	Nearly empty pit.	
TP1	No 2	2.00	1.11			Nearly empty pit.	
TP1	No 3	2.00	1.88			Nearly empty pit.	
TP2	No 1	2.00	11.30	8.08	1.35E-4	Empty pit.	
TP2	No 2	2.00	8.08			Nearly empty pit.	
TP3	No 1	2.00	1.41	1.41	2.35E-5	Empty pit.	600L used
TP3	No 2	2.00	7.47			Nearly empty pit.	600L used
TP4	No 1	2.00	1.98	1.10	1.83E-5	Nearly empty pit.	600L used
TP4	No 2	2.00	1.10			Nearly empty pit.	400L used
Mean Value of All Calculated Soakage Rates :				2.89 <i>litre/m²/min</i>	4.82E-5 <i>m/sec</i>		

BRE Digest DG365 Soakage Test

Test Hole No: TP1
Test No: Test No 1 (Initial)



Pit Length, m	1.400	Depth to Water at Start of Test, m	0.500
Pit Width, m	0.550	Max Water Dropdown during Test, m	1.330
Depth to Pit Base, m	2.000	Total Soakage Test Time, min	90.0
Depth to Top of Permeable Soils, m		Mean Internal Discharge Area, m ²	3.695
Depth to Groundwater Surface, m		Discharge Rate, litre/min	3.611
Depth to Top of Granular Fill, m	0.400	Soakage Rate, litre/m ² /min	0.977
Voids Assumed for Granular Fill, %	35%	BRE Soil Infiltration Rate, m/sec	1.63E-05

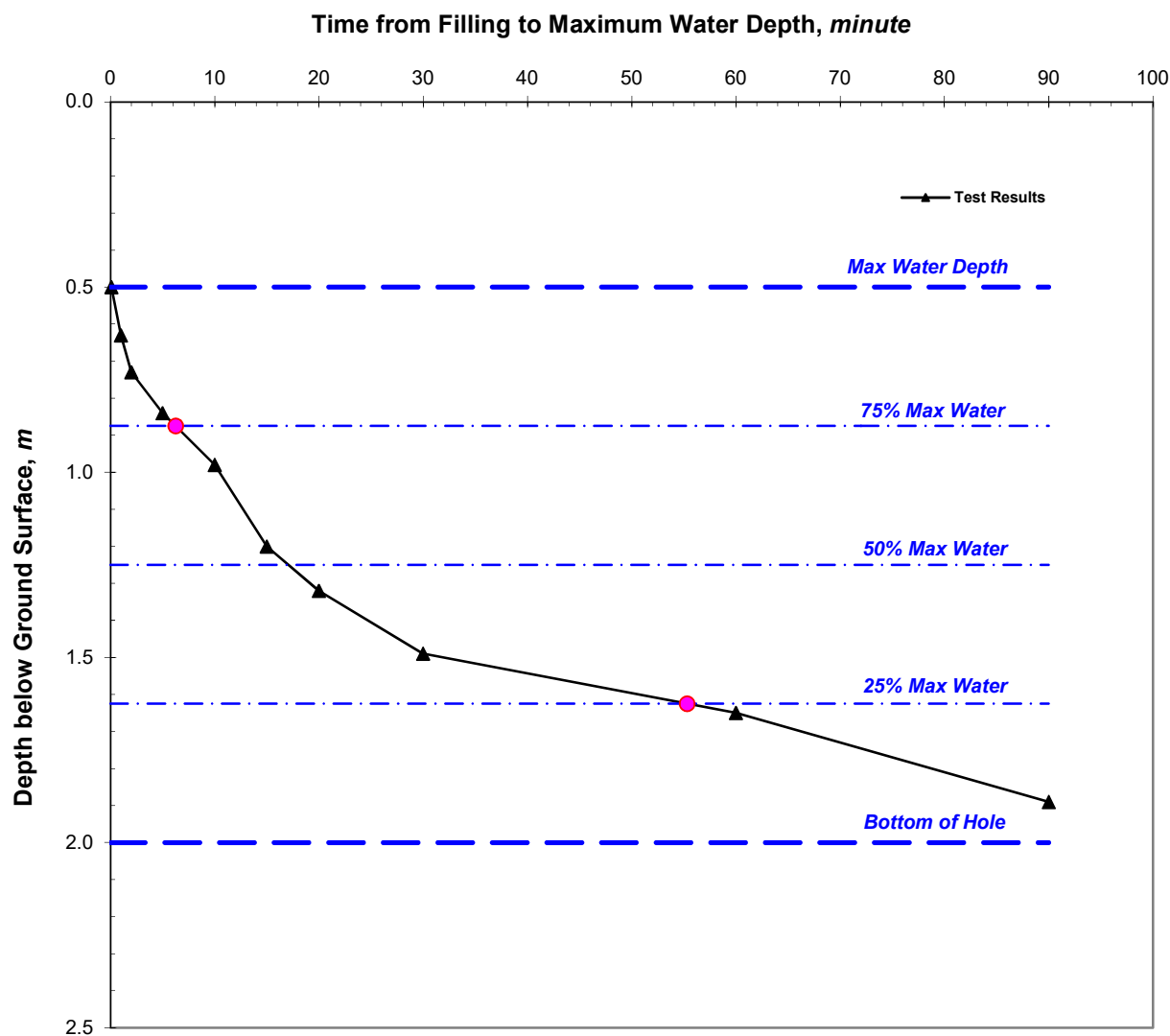
Comments:

Pit was nearly emptied at finish of test.

Client: The President and Trustees of Huggen's College	Job No: J15652	Test Date: 14/Feb/2024
Site: Huggens College, College Road, Northfleet	Tested By: JB	Engineer: GD Fig. S1

BRE Digest DG365 Soakage Test

Test Hole No: TP1
Test No: Test No 2 (Repeated)



Pit Length, m	1.400	Depth to Water at Start of Test, m	0.500
Pit Width, m	0.550	Max Water Dropdown during Test, m	1.390
Depth to Pit Base, m	2.000	Total Soakage Test Time, min	90.0
Depth to Top of Permeable Soils, m		Mean Internal Discharge Area, m ²	3.695
Depth to Groundwater Surface, m		Discharge Rate, litre/min	4.120
Depth to Top of Granular Fill, m	0.400	Soakage Rate, litre/m ² /min	1.11
Voids Assumed for Granular Fill, %	35%	BRE Soil Infiltration Rate, m/sec	1.86E-05

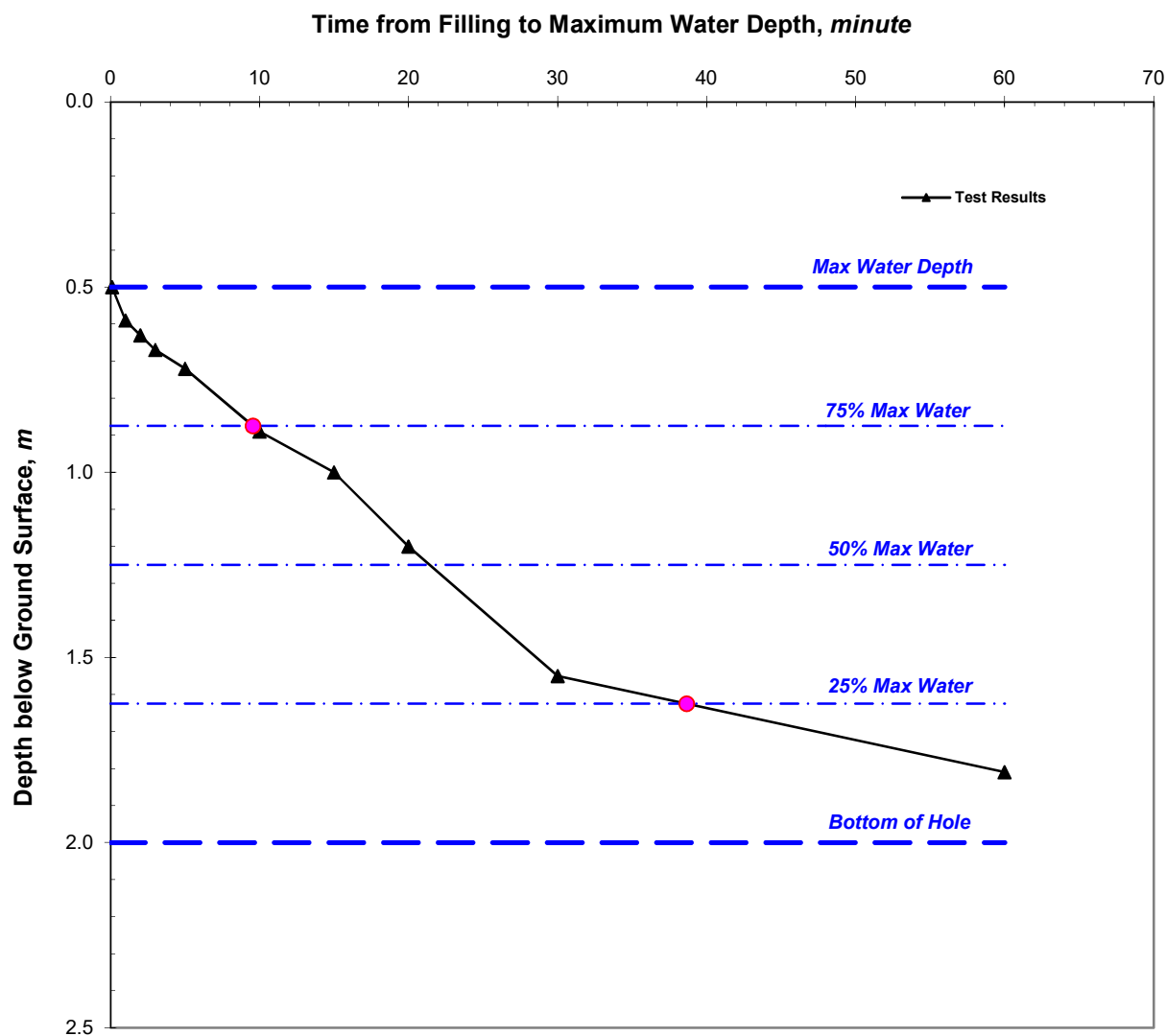
Comments:

Pit was nearly emptied at finish of test.

Client: The President and Trustees of Huggen's College	Job No: J15652	Test Date: 14/Feb/2024
Site: Huggens College, College Road, Northfleet	Tested By: JB	Engineer: GD Fig. S2

BRE Digest DG365 Soakage Test

Test Hole No: TP1
Test No: Test No 3 (Repeated)



Pit Length, <i>m</i>	1.400	Depth to Water at Start of Test, <i>m</i>	0.500
Pit Width, <i>m</i>	0.550	Max Water Dropdown during Test, <i>m</i>	1.310
Depth to Pit Base, <i>m</i>	2.000	Total Soakage Test Time, <i>min</i>	60.0
Depth to Top of Permeable Soils, <i>m</i>		Mean Internal Discharge Area, <i>m</i> ²	3.695
Depth to Groundwater Surface, <i>m</i>		Discharge Rate, <i>litre/min</i>	6.947
Depth to Top of Granular Fill, <i>m</i>	0.400	Soakage Rate, <i>litre/m</i> ² / <i>min</i>	1.88
Voids Assumed for Granular Fill, %	35%	BRE Soil Infiltration Rate, <i>m/sec</i>	3.13E-05

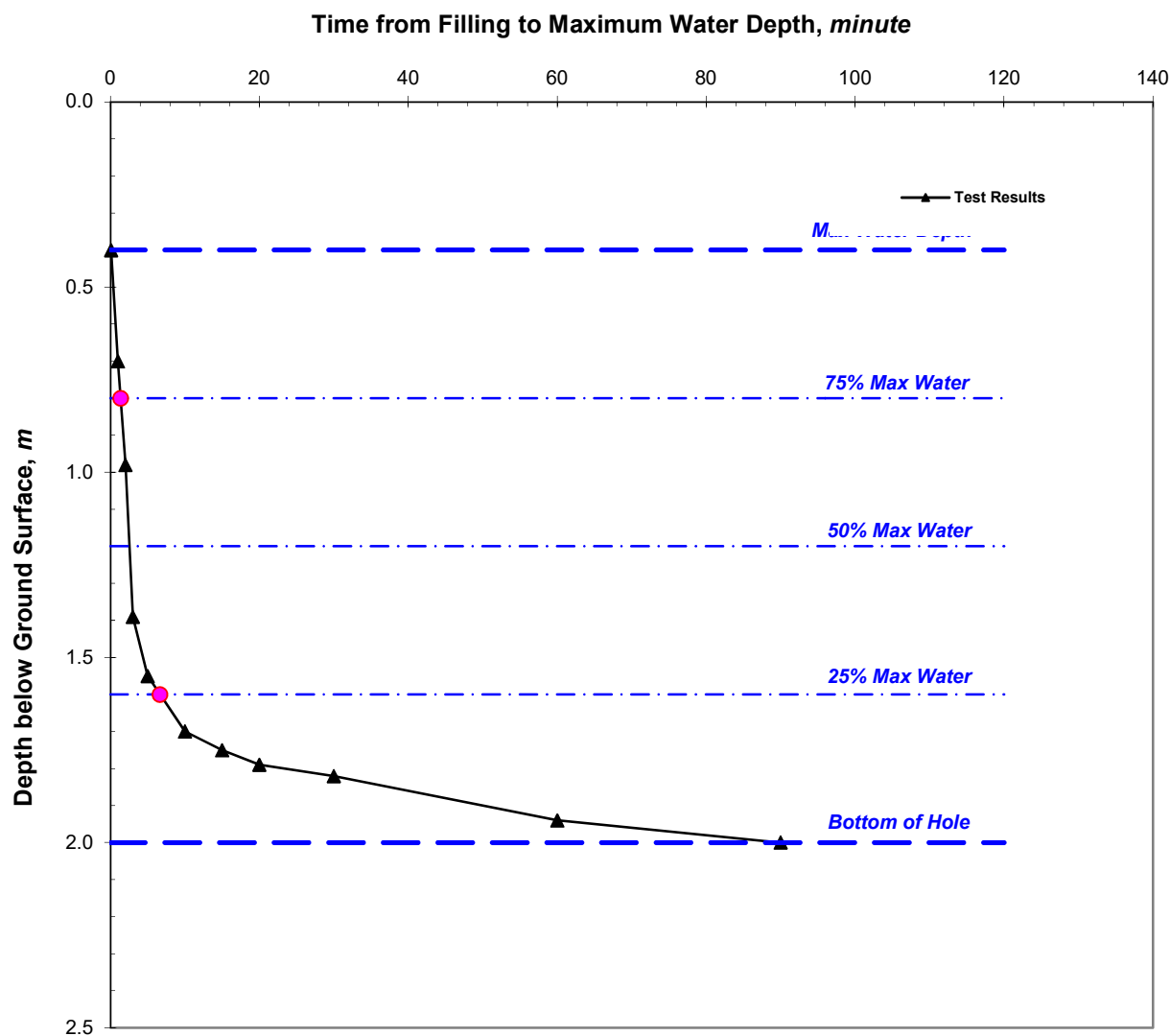
Comments:

Pit was nearly emptied at finish of test.

Client: The President and Trustees of Huggen's College	Job No: J15652	Test Date: 14/Feb/2024
Site: Huggens College, College Road, Northfleet	Tested By: JB	Engineer: GD Fig. S3

BRE Digest DG365 Soakage Test

Test Hole No: TP2
Test No: Test No 1 (Initial)



Pit Length, m	1.600	Depth to Water at Start of Test, m	0.400
Pit Width, m	0.600	Max Water Dropdown during Test, m	1.600
Depth to Pit Base, m	2.000	Total Soakage Test Time, min	120.0
Depth to Top of Permeable Soils, m		Mean Internal Discharge Area, m ²	4.480
Depth to Groundwater Surface, m		Discharge Rate, litre/min	50.626
Depth to Top of Granular Fill, m	0.500	Soakage Rate, litre/m ² /min	11.30
Voids Assumed for Granular Fill, %	35%	BRE Soil Infiltration Rate, m/sec	1.88E-04

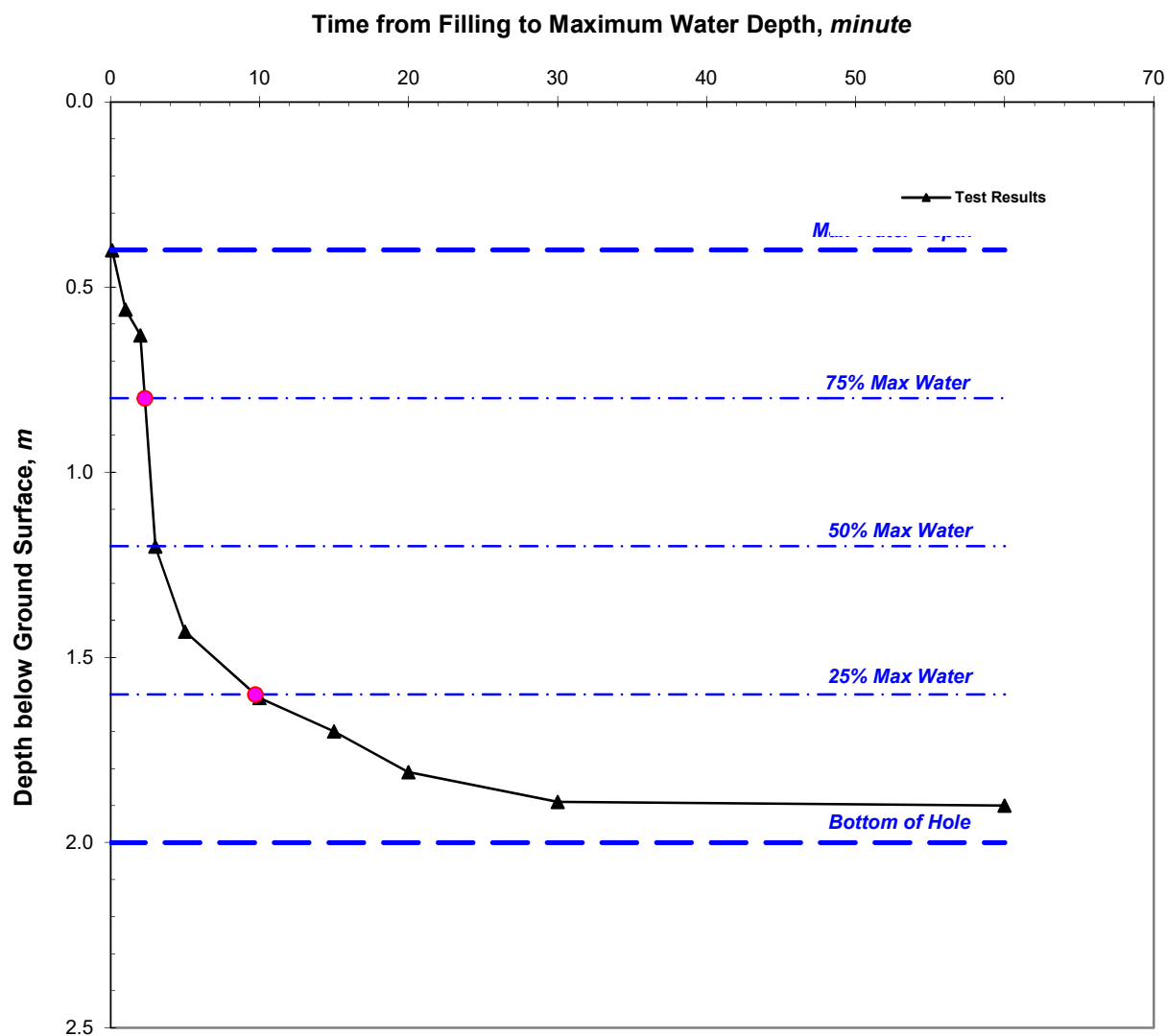
Comments:

Pit was emptied at finish of test.

Client: The President and Trustees of Huggen's College	Job No: J15652	Test Date: 14/Feb/2024
Site: Huggens College, College Road, Northfleet	Tested By: JB	Engineer: GD Fig. S4

BRE Digest DG365 Soakage Test

Test Hole No: TP2
Test No: Test No 2 (Repeated)



Pit Length, m	1.600	Depth to Water at Start of Test, m	0.400
Pit Width, m	0.600	Max Water Dropdown during Test, m	1.500
Depth to Pit Base, m	2.000	Total Soakage Test Time, min	60.0
Depth to Top of Permeable Soils, m		Mean Internal Discharge Area, m ²	4.480
Depth to Groundwater Surface, m		Discharge Rate, litre/min	36.207
Depth to Top of Granular Fill, m	0.500	Soakage Rate, litre/m ² /min	8.08
Voids Assumed for Granular Fill, %	35%	BRE Soil Infiltration Rate, m/sec	1.35E-04

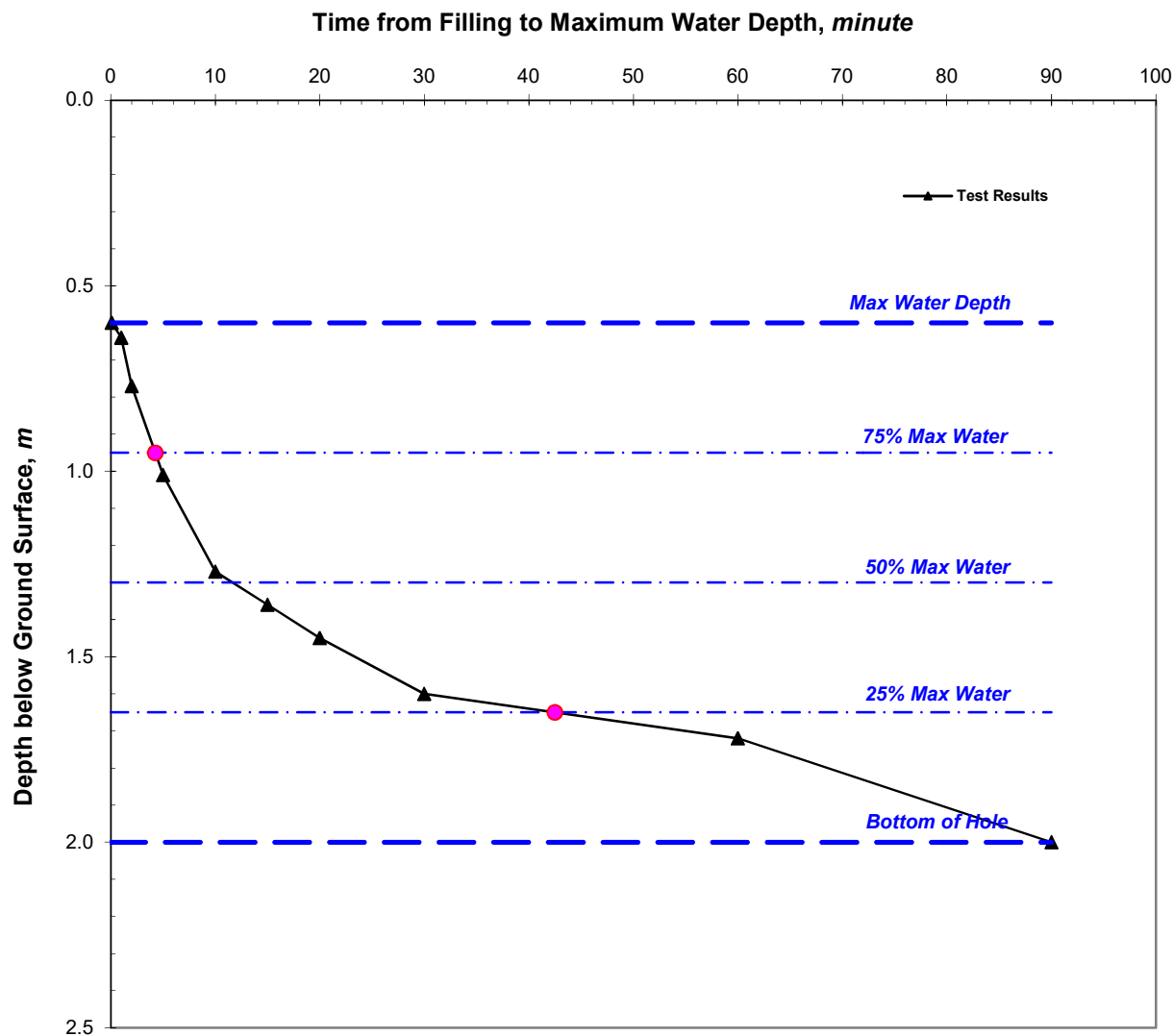
Comments:

Pit was nearly emptied at finish of test.

Client: The President and Trustees of Huggen's College	Job No: J15652	Test Date: 14/Feb/2024
Site: Huggens College, College Road, Northfleet	Tested By: JB	Engineer: GD Fig. S5

BRE Digest DG365 Soakage Test

Test Hole No: TP3
Test No: Test No 1 (Initial)



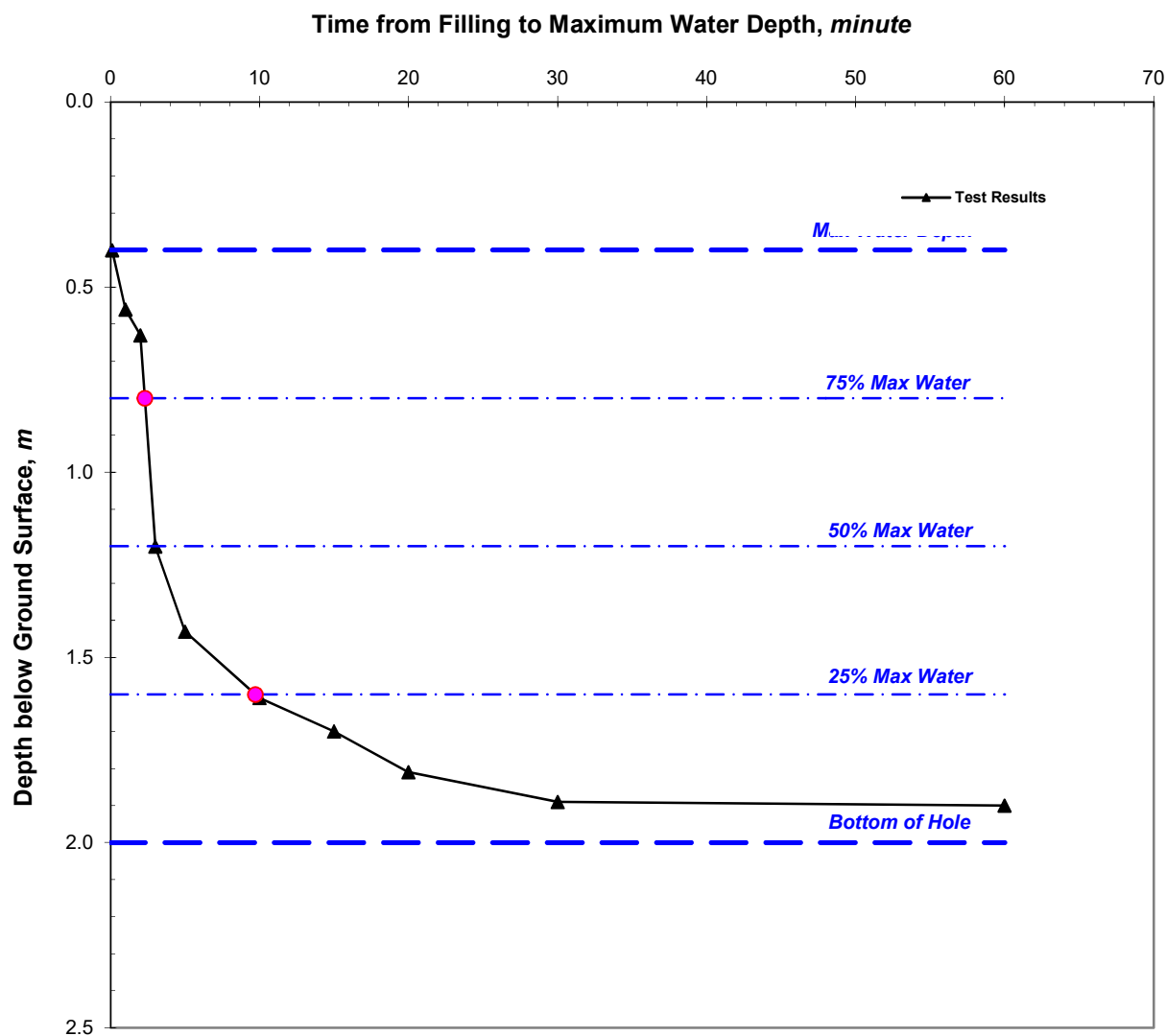
Pit Length, m	1.400	Depth to Water at Start of Test, m	0.600
Pit Width, m	0.550	Max Water Dropdown during Test, m	1.400
Depth to Pit Base, m	2.000	Total Soakage Test Time, min	90.0
Depth to Top of Permeable Soils, m		Mean Internal Discharge Area, m ²	3.500
Depth to Groundwater Surface, m		Discharge Rate, litre/min	4.932
Depth to Top of Granular Fill, m	0.100	Soakage Rate, litre/m ² /min	1.41
Voids Assumed for Granular Fill, %	35%	BRE Soil Infiltration Rate, m/sec	2.35E-05

Comments: 600L used
Pit was emptied at finish of test.

Client: The President and Trustees of Huggen's College	Job No: J15652	Test Date: 14/Feb/2024
Site: Huggens College, College Road, Northfleet	Tested By: JB	Engineer: GD Fig. S6

BRE Digest DG365 Soakage Test

Test Hole No: TP3
Test No: Test No 2 (Repeated)



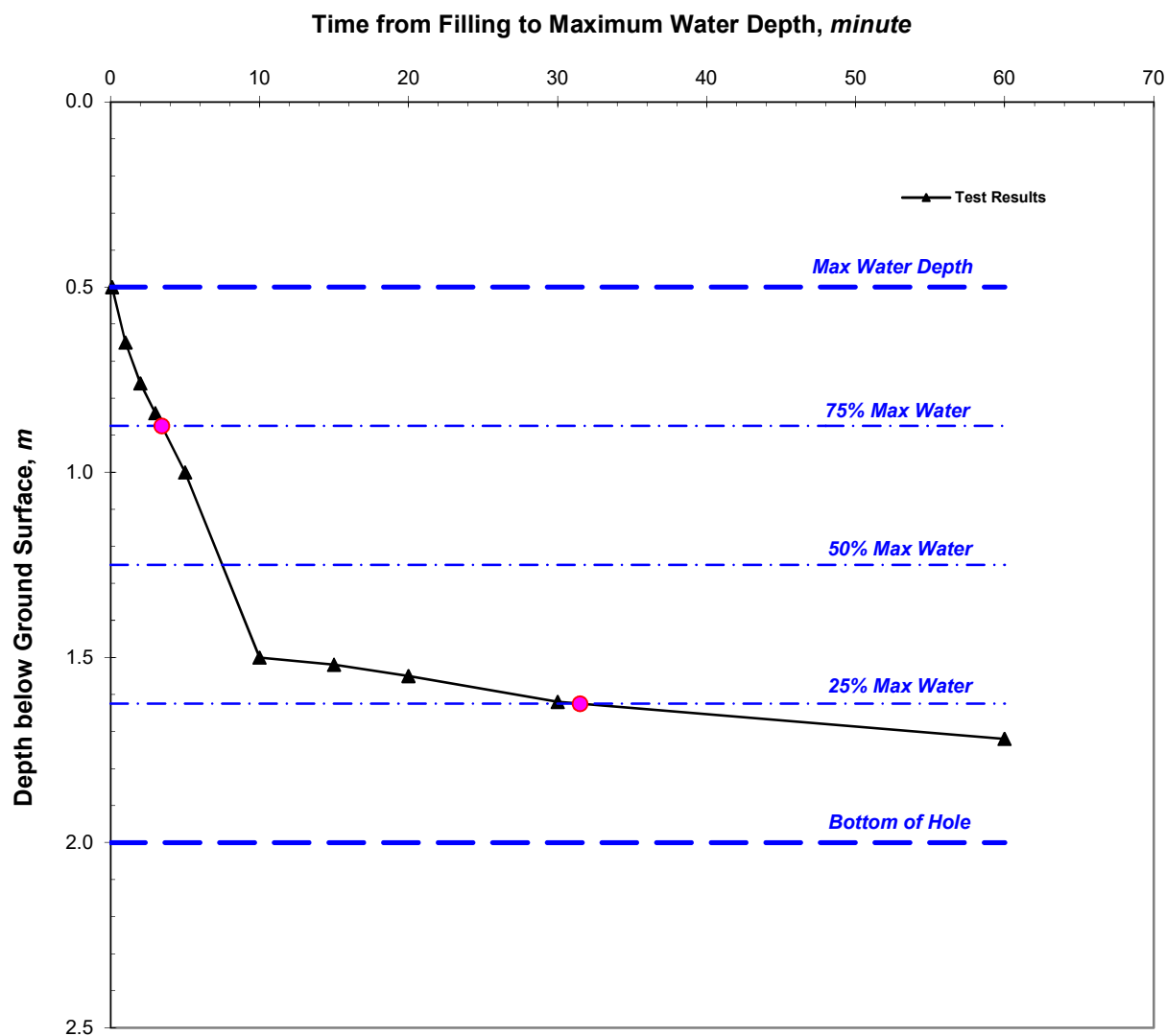
Pit Length, m	1.400	Depth to Water at Start of Test, m	0.400
Pit Width, m	0.550	Max Water Dropdown during Test, m	1.500
Depth to Pit Base, m	2.000	Total Soakage Test Time, min	60.0
Depth to Top of Permeable Soils, m		Mean Internal Discharge Area, m ²	3.890
Depth to Groundwater Surface, m		Discharge Rate, litre/min	29.041
Depth to Top of Granular Fill, m	0.100	Soakage Rate, litre/m ² /min	7.47
Voids Assumed for Granular Fill, %	35%	BRE Soil Infiltration Rate, m/sec	1.24E-04

Comments: 600L used
Pit was nearly emptied at finish of test.

Client: The President and Trustees of Huggen's College	Job No: J15652	Test Date: 14/Feb/2024
Site: Huggens College, College Road, Northfleet	Tested By: JB	Engineer: GD Fig. S7

BRE Digest DG365 Soakage Test

Test Hole No: TP4
Test No: Test No 1 (Initial)



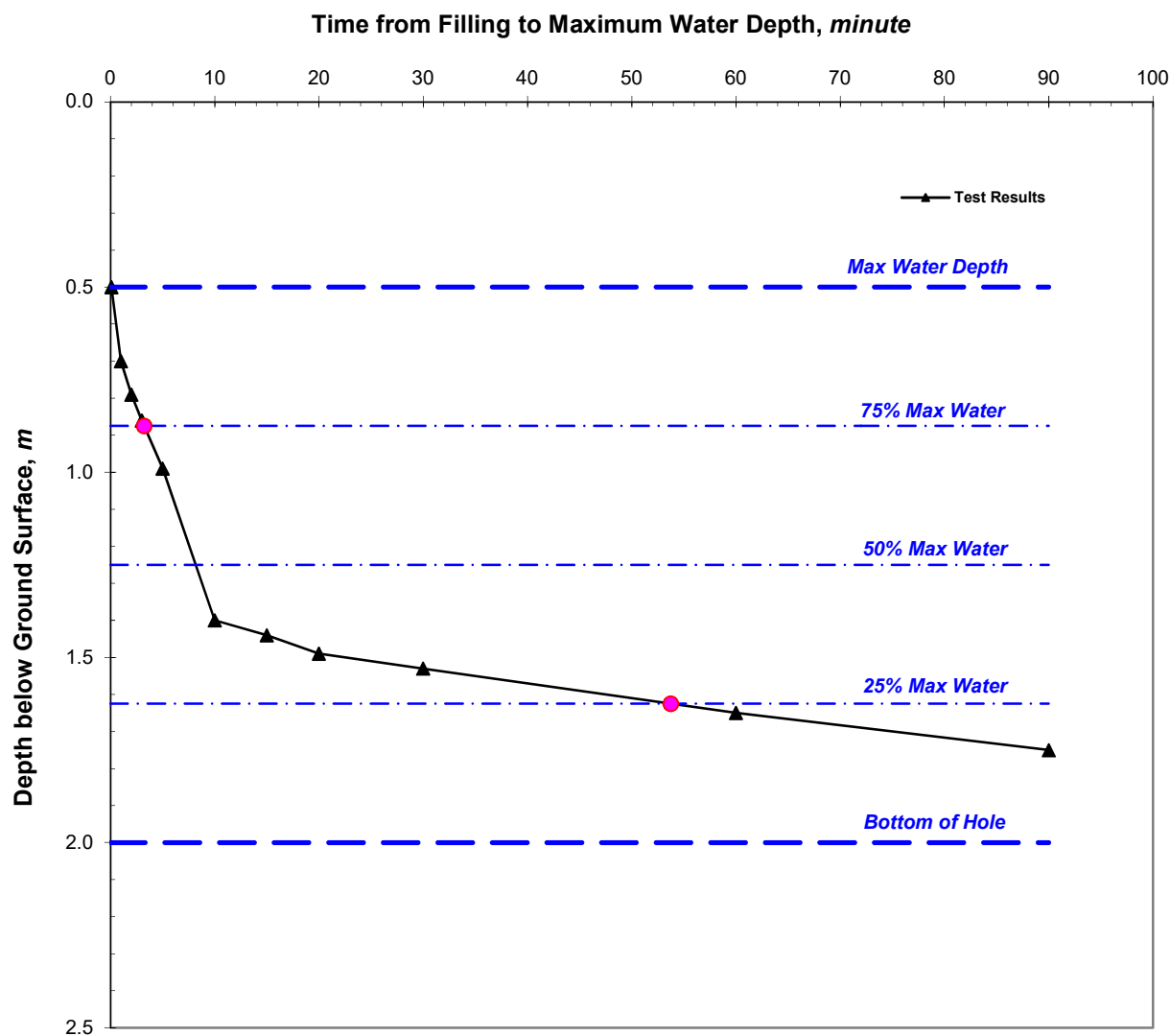
Pit Length, m	1.500	Depth to Water at Start of Test, m	0.500
Pit Width, m	0.550	Max Water Dropdown during Test, m	1.220
Depth to Pit Base, m	2.000	Total Soakage Test Time, min	60.0
Depth to Top of Permeable Soils, m		Mean Internal Discharge Area, m ²	3.900
Depth to Groundwater Surface, m		Discharge Rate, litre/min	7.717
Depth to Top of Granular Fill, m	0.400	Soakage Rate, litre/m ² /min	1.98
Voids Assumed for Granular Fill, %	35%	BRE Soil Infiltration Rate, m/sec	3.30E-05

Comments: 600L used
Pit was nearly emptied at finish of test.

Client: The President and Trustees of Huggen's College	Job No: J15652	Test Date: 13/Feb/2024
Site: Huggens College, College Road, Northfleet	Tested By: JB	Engineer: GD Fig. S8

BRE Digest DG365 Soakage Test

Test Hole No: TP4
Test No: Test No 2 (Repeated)



Pit Length, m	1.500	Depth to Water at Start of Test, m	0.500
Pit Width, m	0.550	Max Water Dropdown during Test, m	1.250
Depth to Pit Base, m	2.000	Total Soakage Test Time, <i>min</i>	90.0
Depth to Top of Permeable Soils, m		Mean Internal Discharge Area, <i>m</i> ²	3.900
Depth to Groundwater Surface, m		Discharge Rate, <i>litre/min</i>	4.287
Depth to Top of Granular Fill, m	0.400	Soakage Rate, <i>litre/m</i> ² / <i>min</i>	1.10
Voids Assumed for Granular Fill, %	35%	BRE Soil Infiltration Rate, <i>m/sec</i>	1.83E-05

Comments: 400L used
Pit was nearly emptied at finish of test.

Client: The President and Trustees of Huggen's Co	Job No: J15652	Test Date: 13/Feb/2024
Site: Huggens College, College Road, Northfleet	Tested By: JB	Engineer: GD Fig. S9



Southern Testing
Environmental & Geotechnical

ST Consult
Environmental & Geotechnical



Head Office
East Grinstead
Tel: 01342 333100
enquiries@southerntesting.co.uk

ST Consult Midlands
Northampton
Tel: 01604 500020
creaton@stconsult.co.uk

ST Consult Thames Valley
Hannington
Tel: 01635 800 950
hannington@stconsult.co.uk

ST Consult North West
Warrington
Tel: 01925 661 735
warrington@stconsult.co.uk



FS 28280 EMS 506775 OHS 506776



Appendix 4

Proposed Drainage Strategy

GENERAL NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ENGINEERS, ARCHITECTS AND SPECIALISTS DRAWINGS AND SPECIFICATIONS.
2. ANY GRID LINES, BUILDING LINES, ETC. ARE TO BE SET OUT IN ACCORDANCE WITH THE RELEVANT ARCHITECT'S PLAN.
3. DIMENSIONS ARE NOT TO BE SCALED FROM THIS DRAWING, EITHER MANUALLY OR ELECTRONICALLY.
4. DIMENSIONS MARKED * ARE SUBJECT TO CONFIRMATION BY SITE MEASUREMENT BEFORE CONSTRUCTION COMMENCES.
5. ANY DIMENSIONAL DISCREPANCIES ON THIS DRAWING ARE TO BE REFERRED TO THE ENGINEER BEFORE THE AFFECTED WORK PROCEEDS.
6. ALL CALCULATIONS AND DRAWINGS ARE PREPARED ON THE ASSUMPTION THAT THE WORKS WILL BE UNDERTAKEN BY A WELL-ESTABLISHED COMPETENT BUILDING CONTRACTOR, FULLY EXPERIENCED IN CARRYING OUT PROJECTS OF THIS NATURE AND THAT THE WORKS ON SITE WILL BE SUPERVISED AND ADMINISTERED BY A SUITABLY EXPERIENCED PERSON.
7. ALL WORKS SHOULD BE CARRIED OUT IN ACCORDANCE WITH THE LATEST EDITION OF:
 - RELEVANT BRITISH STANDARDS AND CODES OF PRACTICE.
 - NATIONAL SPECIFICATION FOR STRUCTURAL STEELWORK.
 - NHBC STANDARDS
 - AS APPLICABLE AND IN ACCORDANCE WITH GOOD BUILDING PRACTICE.
8. IN PARTICULAR, THE CONTRACTOR IS SOLELY RESPONSIBLE FOR CARRYING OUT THE WORKS IN A SAFE MANNER, ALL DUE ATTENTION BEING GIVEN TO STABILITY DURING DEMOLITION AND NEW BUILDING WORK, ADEQUATE SHORING, PROPPING AND THE LIKE SHOULD BE PROVIDED, WHICH SHOULD REMAIN IN PLACE UNTIL THE NEW STRUCTURE IS IN PLACE AND MORTAR PACKING AND MASONRY MORTAR HAS HARDENED.

PERMEABLE SURFACING 2 TO ARCHITECTS SPECIFICATIONS (CBR VALUE ASSUMED AS 5% TBC ON SITE (REFER TO CONTRACTORS DETAILS). SUBBASE, 300mm MIN. THICK D0/3 - MATERIAL SIZE 5-20mm COURSE AGGREGATE (IDEALLY GRANITE TYPE) PROVIDING MIN. 30% VOID

SOAKAWAY 2
• 1.0x0.5x0.4 CELLULAR STORAGE UNITS (AQUACELL ECO TYPE) TO BE USED FOR THE NEW SOAKAWAY.
• TOTAL AREA OF SOAKAWAY = 18.0m x 6.5m x 0.8m DEEP (2 CRATES DEEP) WITH MINIMUM COVER OF 0.5m BETWEEN G.L. AND TOP OF CRATES. TOTAL CRATES NUMBER = 234
• THE PIT TO BE SURROUNDED BY TERRAM 1000 OR SIMILAR APPROVED. SOAKAWAY TO BE LOCATED 10.0m (MIN.) FROM BUILDINGS AND 2.5m (MIN.) FROM BOUNDARIES.
• SURFACE WATER SOAKAWAY FOR STORM EVENTS UP TO AND INCLUDING 1 IN 100 YEARS PLUS 45% CLIMATE CHANGE.
ASSUMED GROUND LEVEL = 22.00m (TBC)
SOAKAWAY TOP LEVEL = 20.85m (TBC)
SOAKAWAY INLET = 20.70m (TBC)
SOAKAWAY BASE LEVEL = 20.05m (TBC)

SOAKAWAY 1
• 1.0x0.5x0.4 CELLULAR STORAGE UNITS (AQUACELL R-TYPE) TO BE USED FOR THE NEW SOAKAWAY.
• TOTAL AREA OF SOAKAWAY = 7.0m x 1.6m DEEP (4 CRATES DEEP) WITH MINIMUM COVER OF 0.5m BETWEEN G.L. AND TOP OF CRATES. TOTAL CRATES NUMBER = 168
• THE PIT TO BE SURROUNDED BY TERRAM 1000 OR SIMILAR APPROVED. SOAKAWAY TO BE LOCATED 10.0m (MIN.) FROM BUILDINGS AND 2.5m (MIN.) FROM BOUNDARIES.
• SURFACE WATER SOAKAWAY FOR STORM EVENTS UP TO AND INCLUDING 1 IN 100 YEARS PLUS 45% CLIMATE CHANGE.
ASSUMED GROUND LEVEL = 22.10m (TBC)
SOAKAWAY TOP LEVEL = 20.65m (TBC)
SOAKAWAY INLET = 20.50m (TBC)
SOAKAWAY BASE LEVEL = 19.05m (TBC)

PERMEABLE SURFACING 3 TO ARCHITECTS SPECIFICATIONS (CBR VALUE ASSUMED AS 5% TBC ON SITE (REFER TO CONTRACTORS DETAILS). SUBBASE, 525mm MIN. THICK D0/3 - MATERIAL SIZE 5-20mm COURSE AGGREGATE (IDEALLY GRANITE TYPE) PROVIDING MIN. 30% VOID

BRE DIGEST 365 SOAKAWAY INFILTRATION DESIGN RATES	
REFERENCE	INFILTRATION RATE (m/s)
TP01	1.63 x 10 ⁻⁵
TP02	1.35 x 10 ⁻⁴
TP03	2.35 x 10 ⁻⁵
TP04	1.83 x 10 ⁻⁵

DRAINAGE NOTES

1. ALL DRAINAGE CONSTRUCTION, MATERIALS AND WORKMANSHIP SHALL COMPLY WITH BUILDING REGULATIONS PART "H", BSEN 752, AND NHBC STANDARDS. ALL DRAINAGE PRODUCTS TO BE CE MARKED.
2. LOCATIONS OF ALL FW AND SW OUTLETS FROM BUILDINGS ARE TO BE CHECKED AGAINST THE ARCHITECTS DRAWINGS TO ENSURE COMPATIBILITY PRIOR TO THE SITE WORKS COMMENCING.
3. CONTRACTOR TO SCAN FOR AND EXPOSE ALL EXISTING UNDERGROUND SERVICES (GAS, WATER, ELECTRICITY, COMMUNICATIONS ETC.) PRIOR TO ANY EXCAVATION WORKS.
4. THE CONTRACTOR IS TO EXPOSE AND VERIFY THE EXISTING PIPE SIZES AND LEVELS AND CONFIRM TO THE ENGINEER ANY DISCREPANCIES PRIOR TO COMMENCEMENT OF WORKS.
5. COVER LEVELS SHOWN ARE APPROXIMATE ONLY AND SHALL TIE INTO PROPOSED FINISHED SURFACE LEVELS.
6. PIPEWORK TO BE U-PVC TO BSEN 1401-1 OR CLAYWARE TO BSEN 295-1, FLEXIBLY JOINTED BY HEPCORTH OR EQUAL.
7. FW PIPEWORK TO BE LAID AT MINIMUM 1:60 GRADIENTS. SW PIPEWORK TO BE LAID AT MINIMUM 1:80 GRADIENTS UNLESS SHOWN OTHERWISE.
8. ALL PIPEWORK IS TO BE 100mm DIA. UNLESS NOTED OTHERWISE.
9. INSPECTION CHAMBERS NOTED ARE TO BE HEPCORTH POLYPROPYLENE INSPECTION CHAMBERS (PPIC), 300mm DIAMETER UP TO 600mm DP OR 475mm DIAMETER UP TO 1200mm DP. INSTALLED WITH 150mm CONCRETE BED AND SURROUND TO MANUFACTURERS RECOMMENDATIONS. CHAMBERS TO HAVE ROUND, LOCKABLE DUCTILE IRON COVER AND FRAME TO SUIT LOADINGS.
10. MANHOLES TO BE PRECAST CONCRETE SECTIONS TO BS5911-1 AND BSEN 1916 INSTALLED ON 225mm THICK CONCRETE BASE WITH 150mm CONCRETE SURROUND. CONCRETE JOINTS TO BE SEALED WITH BUTYL RESIN SEALANT. STEP IRONS TO BE PROVIDED WHERE DEPTH IS GREATER THAN 1200mm. PRECAST CONCRETE COVER SLAB TO PROVIDE CLEAR OPENING FOR ACCESS COVER. INVERTS FORMED WITH CHANNEL PIPES. BENCHING TO SLOP 1:12 WITH A 20mm THK. HIGH STRENGTH CONCRETE TOPPING.
11. ROCKER PIPES (600mm LONG) TO BE PROVIDED AS CLOSE AS PRACTICABLE TO ALL CHAMBERS/MANHOLES AND FOUNDATIONS/WALLS.
12. LOADING GRADES FOR COVERS TO BSEN 124 TO BE A15 (PEDESTRIAN USE ONLY) B125 (LIGHT TRAFFIC USE) AND C250 (HEAVY TRAFFIC USE).
13. PIPEWORK BEDDING IN LANDSCAPE AREAS WHERE COVER IS LESS THAN 600mm AND IN TRAFFICKED AREAS WHERE COVER IS LESS THAN 900mm TO BE 150mm CONCRETE BED AND SURROUND OF GENI CONCRETE. PIPEWORK BEDDING IN LANDSCAPE AREAS WHERE COVER IS MORE THAN 600mm AND IN TRAFFICKED AREAS WHERE COVER IS MORE THAN 900mm TO BE 100mm GRANULAR BED AND SURROUND OF NOMINAL 10mm SIZE PEA GRAVEL.
14. WHERE PIPES PASS THROUGH STRUCTURES A FLEXIBLE JOINT SHALL BE PROVIDED WITHIN 150mm OF THE STRUCTURE EDGE WITH A SHORT ROCKER PIPE INSTALLED THEREAFTER. THE PIPE PENETRATION SHALL BE FORMED USING OVERSIZED PVC DUCTING WITH UNCOMPRESSED INSULATION MATERIAL PACKING THE VOID.
15. CONTRACTOR SHALL OBTAIN ALL APPROVALS AND INSPECTIONS FROM BUILDING CONTROL, ANGLIA WATER SERVICES (SECTION 106 PARTS 1 & 2 FOR PUBLIC SEWER CONNECTION) AND LOCAL HIGHWAY AUTHORITY (FOR WORKS IN PUBLIC HIGHWAY) PRIOR TO COMMENCING SITE WORKS.
16. ALL NEW DRAINAGE WORK TO BE AIR/WATER TESTED FOR INTEGRITY AS REQUIRED BY BUILDING CONTROL.
17. EXISTING SEWERS/DRAINS ARE TO BE KEPT OPERATIONAL AT ALL TIMES DURING THE WORKS.
18. REFER TO THE ARCHITECTS DRAWINGS FOR ADDITIONAL DRAINAGE REQUIREMENTS AND SETTING OUT.

LEGEND

- EXISTING PRIVATE FOUL WATER DRAIN
- EXISTING PRIVATE FW DRAIN TO BE REMOVED
- NEW FOUL PIPE LOCATION
- NEW FOUL WATER PIPES & MANHOLE
- NEW RAINWATER PIPE LOCATIONS
- EXISTING GULLY TO BE RE-USED
- NEW SURFACE WATER SEWER & MANHOLE (PPIC)
- 1500 PERFORATED PIPE FOR COLLECTION
- SILT TRAP
- RODDING EYE
- SOAKAWAY TANK (POLYSTYRENE OR SIMILAR)
- PERMEABLE SURFACING (TO ARCHITECTS DETAILS)
- RAIN GARDEN (TO ARCHITECTS DETAILS)
- INFILTRATION BASIN
- SITE BOUNDARY
- 10.0m CHALK BUILD-OFF ZONE
- INDICATIVE FLOOR LEVEL
- EXCEEDANCE FLOOD FLOW ROUTING

P2	12/04/24	PERMEABLE PARKING AREAS REVISD
P1	28/03/24	PRELIMINARY ISSUE FOR COMMENTS
Rev	Date	Description
STATUS		
PRELIMINARY		
AFP ANDREW FIREBRACE PARTNERSHIP STRUCTURAL & CIVIL ENGINEERING CONSULTANTS Stable Barn, Park End, Swaffham Bulbeck, Cambridge CB25 0NA. Tel: 01223 811572 Fax: 01223 812719 E-mail: info@afpconsult.co.uk		
CLIENT	The President and Trustees of Huggens College	
PROJECT	Huggens College Re-Development College Road, Northfleet, Kent DA11 9DL	
TITLE	Proposed Drainage Strategy Sheet 1 of 2	
DRAWN	CGA	CHECKED PA
SCALES	1:250@A1	DATE March 2024
Andrew Firebrace Partnership Limited		ACAD FILE NO. 23.0538.100.DWG
23/0538/SK01		REV P2
DRG No.		©copyright

DRAINAGE STRATEGY (SHEET 1 OF 2)
(SCALE 1:250)

GENERAL NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ENGINEERS, ARCHITECTS AND SPECIALISTS DRAWINGS AND SPECIFICATIONS.
2. ANY GRID LINES, BUILDING LINES, ETC. ARE TO BE SET OUT IN ACCORDANCE WITH THE RELEVANT ARCHITECT'S PLAN.
3. DIMENSIONS ARE NOT TO BE SCALED FROM THIS DRAWING, EITHER MANUALLY OR ELECTRONICALLY.
4. DIMENSIONS MARKED * ARE SUBJECT TO CONFIRMATION BY SITE MEASUREMENT BEFORE CONSTRUCTION COMMENCES.
5. ANY DIMENSIONAL DISCREPANCIES ON THIS DRAWING ARE TO BE REFERRED TO THE ENGINEER BEFORE THE AFFECTED WORK PROCEEDS.
6. AFP CALCULATIONS AND DRAWINGS ARE PREPARED ON THE ASSUMPTION THAT THE WORKS WILL BE UNDERTAKEN BY A WELL-ESTABLISHED COMPETENT BUILDING CONTRACTOR, FULLY EXPERIENCED IN CARRYING OUT PROJECTS OF THIS NATURE AND THAT THE WORKS ON SITE WILL BE SUPERVISED AND ADMINISTERED BY A SUITABLY EXPERIENCED PERSON.
7. ALL WORKS SHOULD BE CARRIED OUT IN ACCORDANCE WITH THE LATEST EDITION OF:
 - RELEVANT BRITISH STANDARDS AND CODES OF PRACTICE.
 - NATIONAL SPECIFICATION FOR STRUCTURAL STEELWORK.
 - NHBC STANDARDS
8. - AS APPLICABLE AND IN ACCORDANCE WITH GOOD BUILDING PRACTICE.
9. - IN PARTICULAR, THE CONTRACTOR IS SOLELY RESPONSIBLE FOR CARRYING OUT THE WORKS IN A SAFE MANNER, ALL DUE ATTENTION BEING GIVEN TO STABILITY DURING DEMOLITION AND NEW BUILDING WORK, ADEQUATE SHORING, PROPPING AND THE LIKE SHOULD BE PROVIDED, WHICH SHOULD REMAIN IN PLACE UNTIL THE NEW STRUCTURE IS IN PLACE AND MORTAR PACKING AND MASONRY MORTAR HAS HARDENED.

SOAKAWAY 2

- 1.0x0.5x0.4 CELLULAR STORAGE UNITS (AQUACELL ECO TYPE) TO BE USED FOR THE NEW SOAKAWAY.
- TOTAL AREA OF SOAKAWAY = 18.0m x 6.5m x 0.8m DEEP (2 CRATES DEEP) WITH MINIMUM COVER OF 0.5m BETWEEN G.L. AND TOP OF CRATES. TOTAL CRATES NUMBER = 234
- THE PIT TO BE SURROUNDED BY TERRAM 1000 OR SIMILAR APPROVED. SOAKAWAY TO BE LOCATED 10.0m (MIN.) FROM BUILDINGS AND 2.5m (MIN.) FROM BOUNDARIES.
- SURFACE WATER SOAKAWAY FOR STORM EVENTS UP TO AND INCLUDING 1 IN 100 YEARS PLUS 45% CLIMATE CHANGE.

ASSUMED GROUND LEVEL = 22.00m (TBC)
SOAKAWAY TOP LEVEL = 20.85m (TBC)
SOAKAWAY INLET = 20.70m (TBC)
SOAKAWAY BASE LEVEL = 20.05m (TBC)

PERMEABLE SURFACING 2 TO ARCHITECTS SPECIFICATIONS (CBR VALUE ASSUMED AS 5% TBC ON SITE (REFER TO CONTRACTORS DETAILS)).
SUBBASE: 300mm MIN. THICK Do13 - MATERIAL SIZE 5-20mm COURSE AGGREGATE (IDEALLY GRANITE TYPE) PROVIDING MIN. 30% VOID

BRE DIGEST 365 SOAKAWAY INFILTRATION DESIGN RATES	
REFERENCE	INFILTRATION RATE (m/s)
TP01	1.63 x 10 ⁻⁵
TP02	1.35 x 10 ⁻⁴
TP03	2.35 x 10 ⁻⁵
TP04	1.83 x 10 ⁻⁵

DRAINAGE NOTES

1. ALL DRAINAGE CONSTRUCTION, MATERIALS AND WORKMANSHIP SHALL COMPLY WITH BUILDING REGULATIONS PART "H", BSEN 752, AND NHBC STANDARDS. ALL DRAINAGE PRODUCTS TO BE CE MARKED.
2. LOCATIONS OF ALL FW AND SW OUTLETS FROM BUILDINGS ARE TO BE CHECKED AGAINST THE ARCHITECT'S DRAWINGS TO ENSURE COMPATIBILITY PRIOR TO THE SITE WORKS COMMENCING.
3. CONTRACTOR TO SCAN FOR AND EXPOSE ALL EXISTING UNDERGROUND SERVICES (GAS, WATER, ELECTRICITY, COMMUNICATIONS ETC.) PRIOR TO ANY EXCAVATION WORKS.
4. THE CONTRACTOR IS TO EXPOSE AND VERIFY THE EXISTING PIPE SIZES AND LEVELS AND CONFIRM TO THE ENGINEER ANY DISCREPANCIES PRIOR TO COMMENCEMENT OF WORKS.
5. COVER LEVELS SHOWN ARE APPROXIMATE ONLY AND SHALL TIE INTO PROPOSED FINISHED SURFACE LEVELS.
6. PIPEWORK TO BE U-PVC TO BSEN 1401-1 OR CLAYWARE TO BSEN 295-1, FLEXIBLY JOINTED BY HEPCORTH OR EQUAL.
7. FW PIPEWORK TO BE LAID AT MINIMUM 1:60 GRADIENTS. SW PIPEWORK TO BE LAID AT MINIMUM 1:80 GRADIENTS UNLESS SHOWN OTHERWISE.
8. ALL PIPEWORK IS TO BE 100mm DIA. UNLESS NOTED OTHERWISE.
9. INSPECTION CHAMBERS NOTED ARE TO BE HEPCORTH POLYPROPYLENE INSPECTION CHAMBERS (PPIC), 300mm DIAMETER UP TO 600mm DP OR 475mm DIAMETER UP TO 1200mm DP INSTALLED WITH 150mm CONCRETE BED AND SURROUND TO MANUFACTURERS RECOMMENDATIONS. CHAMBERS TO HAVE ROUND, LOCKABLE DUCTILE IRON COVER AND FRAME TO SUIT LOADINGS.
10. MANHOLES TO BE PRECAST CONCRETE SECTIONS TO BS5911-1 AND BSEN 1916 INSTALLED ON 225mm THICK CONCRETE BASE WITH 150mm CONCRETE SURROUND. CONCRETE JOINTS TO BE SEALED WITH BUTYL RESIN SEALANT. STEP IRONS TO BE PROVIDED WHERE DEPTH IS GREATER THAN 1200mm. PRECAST CONCRETE COVER SLAB TO PROVIDE CLEAR OPENING FOR ACCESS COVER. INVERTS FORMED WITH CHANNEL PIPES. BENCHING TO SLOP 1:12 WITH A 20mm THK. HIGH STRENGTH CONCRETE TOPPING.
11. ROCKER PIPES (600mm LONG) TO BE PROVIDED AS CLOSE AS PRACTICABLE TO ALL CHAMBERS/MANHOLES AND FOUNDATIONS/WALLS.
12. LOADING GRADES FOR COVERS TO BSEN 124 TO BE A15 (PEDESTRIAN USE ONLY) B125 (LIGHT TRAFFIC USE) AND C250 (HEAVY TRAFFIC USE).
13. PIPEWORK BEDDING IN LANDSCAPE AREAS WHERE COVER IS LESS THAN 600mm AND IN TRAFFICKED AREAS WHERE COVER IS LESS THAN 900mm TO BE 150mm CONCRETE BED AND SURROUND OF GENT CONCRETE. PIPEWORK BEDDING IN LANDSCAPE AREAS WHERE COVER IS MORE THAN 600mm AND IN TRAFFICKED AREAS WHERE COVER IS MORE THAN 900mm TO BE 100mm GRANULAR BED AND SURROUND OF NOMINAL 10mm SIZE PEA GRAVEL.
14. WHERE PIPES PASS THROUGH STRUCTURES A FLEXIBLE JOINT SHALL BE PROVIDED WITHIN 150mm OF THE STRUCTURE EDGE WITH A SHORT ROCKER PIPE INSTALLED THEREAFTER. THE PIPE PENETRATION SHALL BE FORMED USING OVERSIZED PVC DUCTING WITH UNCOMPRESSED INSULATION MATERIAL PACKING THE VOID.
15. CONTRACTOR SHALL OBTAIN ALL APPROVALS AND INSPECTIONS FROM BUILDING CONTROL, ANGLIA WATER SERVICES (SECTION 106 PARTS 1 & 2 FOR PUBLIC SEWER CONNECTION) AND LOCAL HIGHWAY AUTHORITY (FOR WORKS IN PUBLIC HIGHWAY) PRIOR TO COMMENCING SITE WORKS.
16. ALL NEW DRAINAGE WORK TO BE AIR/WATER TESTED FOR INTEGRITY AS REQUIRED BY BUILDING CONTROL.
17. EXISTING SEWERS/DRAINS ARE TO BE KEPT OPERATIONAL AT ALL TIMES DURING THE WORKS.
18. REFER TO THE ARCHITECTS DRAWINGS FOR ADDITIONAL DRAINAGE REQUIREMENTS AND SETTING OUT.

LEGEND

- EXISTING PRIVATE FOUL WATER DRAIN
- EXISTING PRIVATE FW DRAIN TO BE REMOVED
- NEW FOUL PIPE LOCATION
- NEW FOUL WATER PIPES & MANHOLE
- NEW RAINWATER PIPE LOCATIONS
- EXISTING GULLY TO BE RE-USED
- NEW SURFACE WATER SEWER & MANHOLE (PPIC)
- 1500 PERFORATED PIPE FOR COLLECTION
- SILT TRAP
- RODDING EYE
- SOAKAWAY TANK (POLYSTYROM OR SIMILAR)
- PERMEABLE SURFACING (TO ARCHITECTS DETAILS)
- RAIN GARDEN (TO ARCHITECTS DETAILS)
- INFILTRATION BASIN
- SITE BOUNDARY
- 10.0m CHALK BUILD-OFF ZONE
- INDICATIVE FLOOR LEVEL
- EXCEEDANCE FLOOD FLOW ROUTING

EXISTING ACCESS TO BE USED FOR EMERGENCIES ONLY. DRAINAGE TO REMAIN UNCHANGED AS PART OF THE DEVELOPMENT PROPOSALS.

PERMEABLE SURFACING 1 TO ARCHITECTS SPECIFICATIONS (CBR VALUE ASSUMED AS 5% TBC ON SITE (REFER TO CONTRACTORS DETAILS)).
SUBBASE: 650mm MIN. THICK Do13 - MATERIAL SIZE 5-20mm COURSE AGGREGATE (IDEALLY GRANITE TYPE) PROVIDING MIN. 30% VOID

INFILTRATION BASIN (OVERFLOW FROM SOAKAWAY 2 ONLY)

- TOTAL PLAN AREA 909.3m² AT 0.5m DEEP MAX.
- MAX. STORAGE VOL. 143.6m³
- MIN. FREEBOARD: 0.3m
- MIN. FALLS 1 IN 4 (CIRIA C753 'THE SUDS MANUAL')
- GRASSSED, USABLE OPEN SPACE DURING DRY PERIODS.

ASSUMED GROUND LEVEL = 22.00m (TBC)
BASIN INLET = 21.60m (TBC)
BASE LEVEL = 21.50m (TBC)

SOAKAWAY 3

- 1.0x0.5x0.4 CELLULAR STORAGE UNITS (AQUACELL ECO TYPE) TO BE USED FOR THE NEW SOAKAWAY.
- TOTAL AREA OF SOAKAWAY = 14.0m x 7.0m x 1.2m DEEP (3 CRATES DEEP) WITH MINIMUM COVER OF 0.5m BETWEEN G.L. AND TOP OF CRATES. TOTAL CRATES NUMBER = 196
- THE PIT TO BE SURROUNDED BY TERRAM 1000 OR SIMILAR APPROVED. SOAKAWAY TO BE LOCATED 10.0m (MIN.) FROM BUILDINGS AND 2.5m (MIN.) FROM BOUNDARIES.
- SURFACE WATER SOAKAWAY FOR STORM EVENTS UP TO AND INCLUDING 1 IN 100 YEARS PLUS 45% CLIMATE CHANGE.

ASSUMED GROUND LEVEL = 21.60m (TBC)
SOAKAWAY TOP LEVEL = 20.65m (TBC)
SOAKAWAY INLET = 20.50m (TBC)
SOAKAWAY BASE LEVEL = 19.45m (TBC)

SOAKAWAY 4

- 1.0x0.5x0.4 CELLULAR STORAGE UNITS (AQUACELL R-TYPE) TO BE USED FOR THE NEW SOAKAWAY.
- TOTAL AREA OF SOAKAWAY = 13.0m x 7.5m x 0.8m DEEP (2 CRATES DEEP) WITH MINIMUM COVER OF 0.75m BETWEEN G.L. AND TOP OF CRATES. TOTAL CRATES NUMBER = 195
- THE PIT TO BE SURROUNDED BY TERRAM 1000 OR SIMILAR APPROVED. SOAKAWAY TO BE LOCATED 10.0m (MIN.) FROM BUILDINGS AND 2.5m (MIN.) FROM BOUNDARIES.
- SURFACE WATER SOAKAWAY FOR STORM EVENTS UP TO AND INCLUDING 1 IN 100 YEARS PLUS 45% CLIMATE CHANGE.

ASSUMED GROUND LEVEL = 19.20m (TBC)
SOAKAWAY TOP LEVEL = 18.45m (TBC)
SOAKAWAY INLET = 18.30m (TBC)
SOAKAWAY BASE LEVEL = 17.65m (TBC)

EXISTING FOUL/COMBINED WATER SEWER DRAIN RUN CONNECTS TO A PUBLIC FOUL WATER SEWER WITHIN COLLEGE ROAD. ANY NEW CONNECTIONS SUBJECT TO A S106 'INDIRECT' AGREEMENT WITH SOUTHERN WATER.

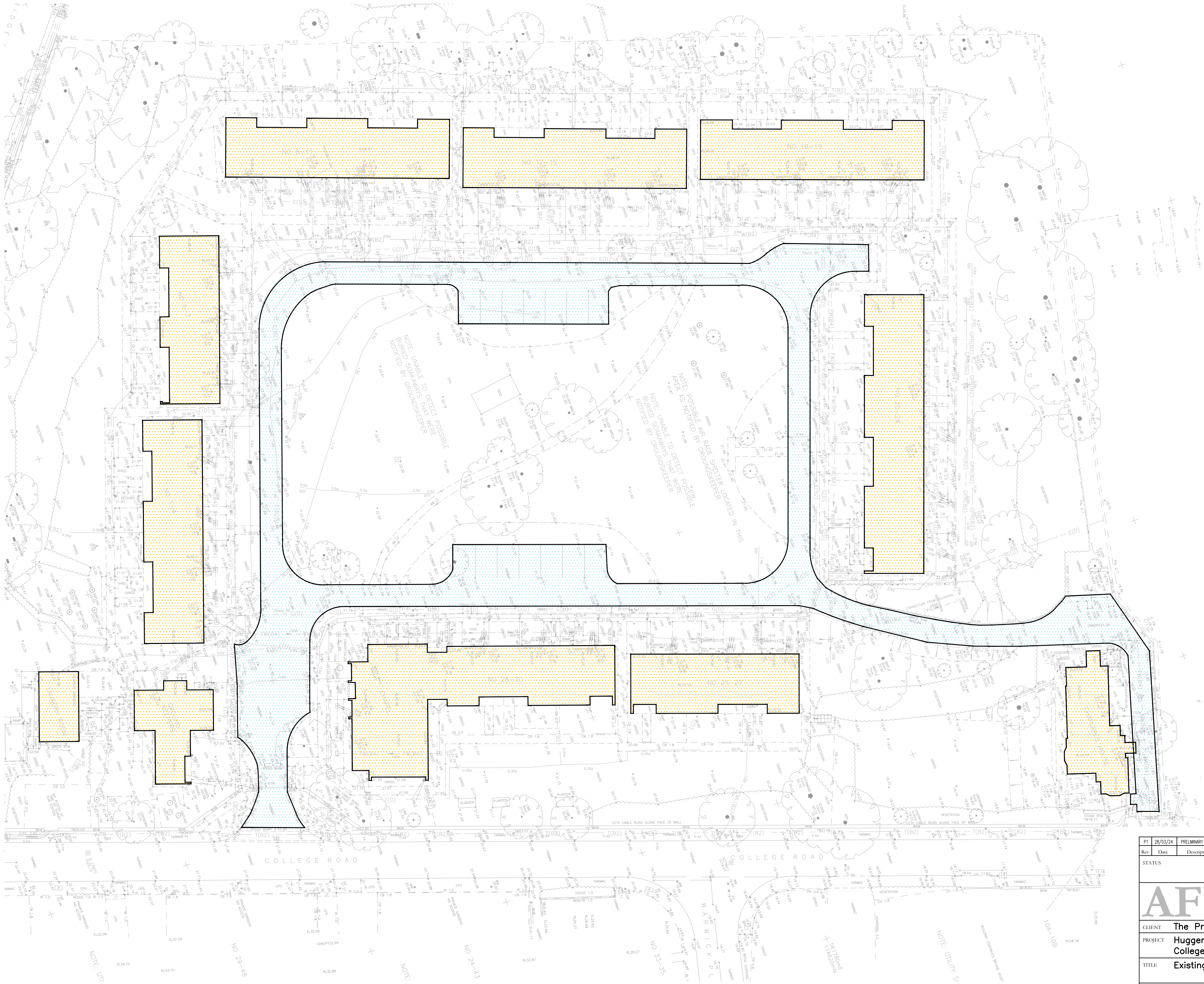
EXISTING SITE ACCESS TO REMAIN UNCHANGED AS PART OF THE DEVELOPMENT PROPOSALS. EXISTING GULLIES DRAIN TO THE EXISTING SEWERS.

DRAINAGE STRATEGY (SHEET 2 OF 2)
(SCALE 1:250)

P2	12/04/24	PERMEABLE PARKING AREAS REVISED
P1	28/03/24	PRELIMINARY ISSUE FOR COMMENTS
Rev	Date	Description
STATUS		
PRELIMINARY		
AFP ANDREW FIREBRACE PARTNERSHIP STRUCTURAL & CIVIL ENGINEERING CONSULTANTS Stable Barn, Park End, Swaffham Bulbeck, Cambridge CB25 0NA. Tel: 01223 811572 Fax: 01223 812719 E-mail: info@afpcps.co.uk		
CLIENT	The President and Trustees of Huggens College	
PROJECT	Huggens College Re-Development College Road, Northfleet, Kent DA11 9DL	
TITLE	Proposed Drainage Strategy Sheet 2 of 2	
DRAWN	CGA	CHECKED PA
SCALES	1:250@A1	DATE March 2024
Andrew Firebrace Partnership Limited		ACAD FILE No. 23.0538.100.DWG
23/0538/SK02		REV P2
		Copyright

Appendix 5

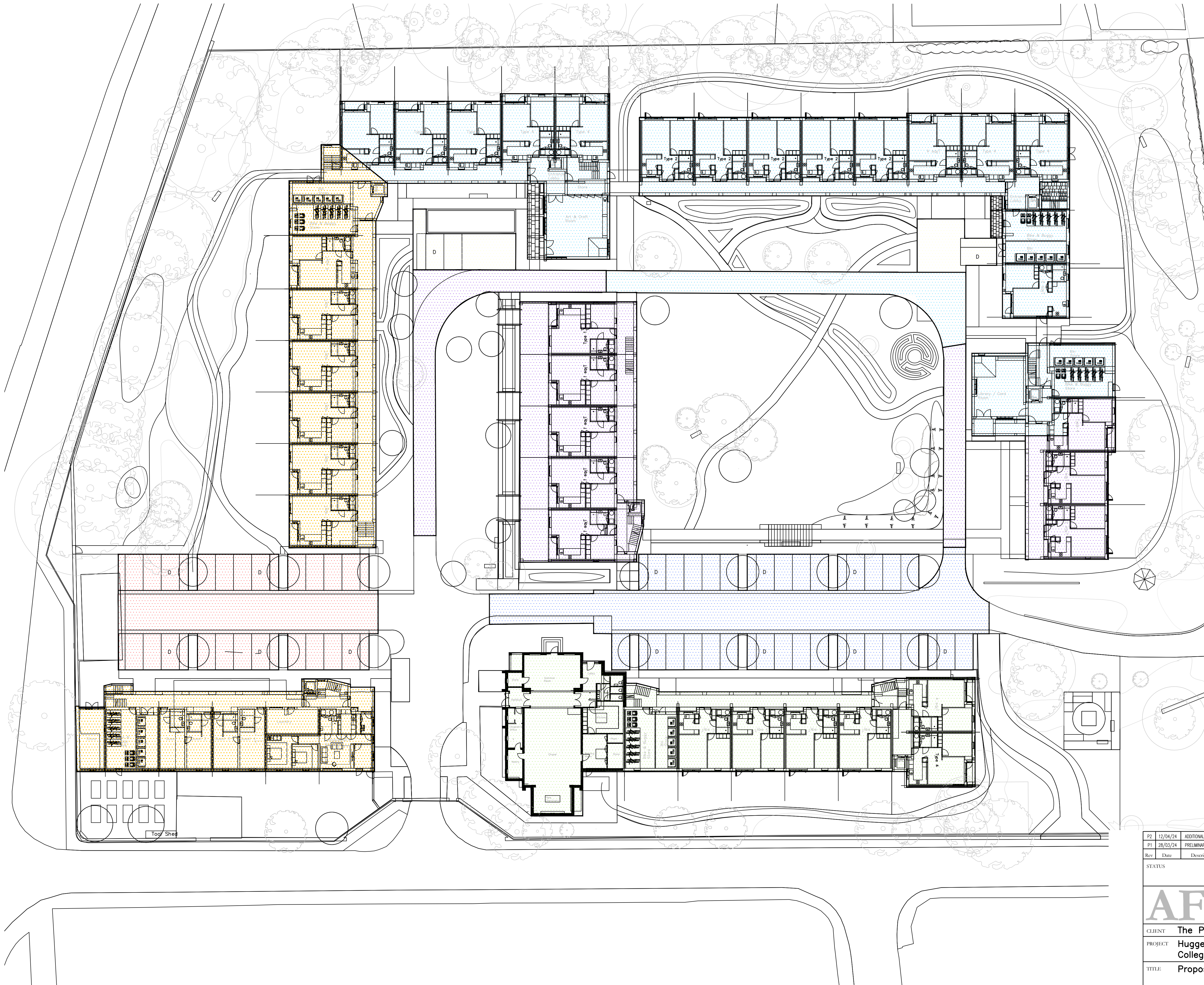
Surface Water Drainage Impermeable Areas and Hydraulic Network Modelling Calculations



EXISTING IMPERMEABLE AREAS		
TYPE OF AREA	AREA COLOUR	AREA (H)
BUILDING ROOFS		0.240
ROADS AND HARDSTANDING		0.152
TOTAL		0.392

P1	28/03/24	PRELIMINARY ISSUE FOR COMMENTS	
Rev	Date	Description	
STATUS		PRELIMINARY	
AFP ANDREW FIREBRACE PARTNERSHIP STRUCTURAL & CIVIL ENGINEERING CONSULTANTS Stable Barn, Park End, Swaffham Bulbeck, Cambridge CB25 0NA. Tel: 01223 811572 Fax: 01223 812719 E-mail: info@afpcnslts.co.uk			
CLIENT	The President and Trustees of Huggens College		
PROJECT	Huggens College Re-Development College Road, Northfleet, Kent DA11 9DL		
TITLE	Existing Impermeable Areas		
DRAWN	CGA	CHECKED	PA
SCALES	1:250@A1	DATE	March 2024
Andrew Firebrace Partnership Limited		ACAD FILE No. 23.0538.100.DWG	
		DRG No.	REV
		23/0538/SK03	P1
		©Copyright	

EXISTING IMPERMEABLE AREAS
(SCALE 1:250)



PROPOSED IMPERMEABLE AREAS		
TYPE OF AREA	AREA COLOUR	AREA (H0)
SOAKWAY 1		0.111
SOAKWAY 2		0.173
SOAKWAY 3		0.111
SOAKWAY 4		0.089
PERMEABLE SURFACING 1		0.082
PERMEABLE SURFACING 2		0.014
PERMEABLE SURFACING 3		0.054
TOTAL		0.634

PROPOSED IMPERMEABLE AREAS
(SCALE 1:250)

P2	12/04/24	ADDITIONAL PERMEABLE SURFACING AREA ADDED
P1	28/03/24	PRELIMINARY ISSUE FOR COMMENTS
Rev	Date	Description
STATUS		
PRELIMINARY		
AFP ANDREW FIREBRACE PARTNERSHIP STRUCTURAL & CIVIL ENGINEERING CONSULTANTS Stable Barn, Park End, Swaffham Bulbeck, Cambridge CB25 0NA. Tel: 01223 811572 Fax: 01223 812719 E-mail: info@afpcconsult.co.uk		
CLIENT	The President and Trustees of Huggens College	
PROJECT	Huggens College Re-Development College Road, Northfleet, Kent DA11 9DL	
TITLE	Proposed Impermeable Areas	
DRAWN	CGA	CHECKED PA
SCALES	1:250@A1	DATE March 2024
Andrew Firebrace Partnership Limited	ACAD FILE No. 23.0538.100.DWG	23/0538/SK04
		REV P2
		©Copyright

Rainfall Methodology	FEH-22	Maximum Time of Concentration (mins)	30.00	Preferred Cover Depth (m)	1.200
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0	Include Intermediate Ground	✓
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00	Enforce best practice design rules	x
CV	0.950	Connection Type	Level Soffits		
Time of Entry (mins)	5.00	Minimum Backdrop Height (m)	9.999		

Max Width (mm)	Diameter (mm)	Max Width (mm)	Diameter (mm)	Max Width (mm)	Diameter (mm)	Max Width (mm)	Diameter (mm)
374	1200	499	1350	749	1500	900	1800

Max Depth (m)	Diameter (mm)	Max Depth (m)	Diameter (mm)
1.500	1050	99.999	1200

Shape	Circular	Auto Increment (mm)	75	Velocity	Colebrook-White
Barrels	1	Follow Ground	x	ks (mm) / n	0.600

100 | 150

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
Soakaway 1	0.111		22.100		3.050
Soakaway 2	0.173	5.00	22.000	1200	1.550
Soakaway 3	0.111	5.00	21.600	1200	2.150
Soakaway 4	0.089		19.200		1.550
Infiltration Basin	0.000	5.00	22.000	1200	0.400
Permeable Surfacing 1	0.082		21.000		0.730

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
Permeable Surfacing 2	0.014		22.100		0.430
Permeable Surfacing 3	0.054		22.000		0.655

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	Soakaway 2	Infiltration Basin	14.000	0.600	20.450	21.600	-1.150	-12.2	150	5.23	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.000	17.7	29.7	1.400	0.250	0.173	0.0	150	0.000

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	14.000	-12.2	150	Circular_Default Sewer Type	22.000	20.450	1.400	22.000	21.600	0.250

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	Soakaway 2	1200	Manhole	Private	Infiltration Basin	1200	Manhole	Private



Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
Soakaway 1	22.100	3.050						
Soakaway 2	22.000	1.550	1200					
				0	1.000	20.450	150	
Soakaway 3	21.600	2.150	1200					
Soakaway 4	19.200	1.550						
Infiltration Basin	22.000	0.400	1200		1	1.000	21.600	150
Permeable Surfacing 1	21.000	0.730						
Permeable Surfacing 2	22.100	0.430						
Permeable Surfacing 3	22.000	0.655						

Simulation Settings

Rainfall Methodology	FEH-22	Skip Steady State	x	1 year (l/s)	0.2	Check Discharge Volume	✓
Summer CV	0.950	Drain Down Time (mins)	240	2 year (l/s)	0.3	100 year 360 minute (m³)	44
Winter CV	0.950	Additional Storage (m³/ha)	0.0	30 year (l/s)	0.7		
Analysis Speed	Normal	Check Discharge Rate(s)	✓	100 year (l/s)	1.0		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0	30	20	0	0
2	20	0	0	30	35	0	0
2	35	0	0	100	0	0	0
10	0	0	0	100	20	0	0
30	0	0	0	100	45	0	0

Pre-development Discharge Rate

Site Makeup	Brownfield	Include Baseflow	✓	Q 2 year (l/s)	0.3
Brownfield Method	Greenfield	Positively Drained Area (ha)	0.392	Q 30 year (l/s)	0.7
Greenfield Method	ReFH2	Betterment (%)	0	Q 100 year (l/s)	1.0
Region	England, Wales, NI	Q 1 year (l/s)	0.2		

Pre-development Discharge Volume

Site Makeup	Brownfield	Include Baseflow	✓	Betterment (%)	0
Brownfield Method	Greenfield	Positively Drained Area (ha)	0.392	Runoff Volume (m³)	44
Greenfield Method	ReFH2	Return Period (years)	100		
Region	England, Wales, NI	Storm Duration (mins)	360		

Node Soakaway 1 Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.05868	Porosity	0.95	Pit Width (m)	7.000	Inf Depth (m)	
Side Inf Coefficient (m/hr)	0.05868	Invert Level (m)	19.050	Pit Length (m)	12.000	Number Required	1
Safety Factor	5.0	Time to half empty (mins)	2853	Depth (m)	1.600		

Node Soakaway 2 Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.08460	Porosity	0.95	Pit Width (m)	6.500	Inf Depth (m)	
Side Inf Coefficient (m/hr)	0.08460	Invert Level (m)	20.050	Pit Length (m)	18.000	Number Required	1
Safety Factor	5.0	Time to half empty (mins)		Depth (m)	0.800		

Node Soakaway 3 Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.08460	Porosity	0.95	Pit Width (m)	7.000	Inf Depth (m)	
Side Inf Coefficient (m/hr)	0.08460	Invert Level (m)	19.450	Pit Length (m)	14.000	Number Required	1
Safety Factor	5.0	Time to half empty (mins)	1608	Depth (m)	1.200		

Node Soakaway 4 Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.06588	Porosity	0.95	Pit Width (m)	7.500	Inf Depth (m)	
Side Inf Coefficient (m/hr)	0.06588	Invert Level (m)	17.650	Pit Length (m)	13.000	Number Required	1
Safety Factor	3.0	Time to half empty (mins)	889	Depth (m)	0.800		

Node Infiltration Basin Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.08460	Safety Factor	5.0	Invert Level (m)	21.500
Side Inf Coefficient (m/hr)	0.08460	Porosity	1.00	Time to half empty (mins)	180

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	675.8	675.8	0.500	909.3	927.5

Node Permeable Surfacing 1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.05868	Porosity	0.30	Width (m)	20.157	Depth (m)	0.650
Side Inf Coefficient (m/hr)	0.05868	Invert Level (m)	20.270	Length (m)	20.157	Inf Depth (m)	
Safety Factor	10.0	Time to half empty (mins)	422	Slope (1:X)	100.0		

Node Permeable Surfacing 2 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.05868	Porosity	0.30	Width (m)	11.942	Depth (m)	0.300
Side Inf Coefficient (m/hr)	0.05868	Invert Level (m)	21.670	Length (m)	11.942	Inf Depth (m)	
Safety Factor	10.0	Time to half empty (mins)		Slope (1:X)	100.0		

Node Permeable Surfacing 3 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.05868	Porosity	0.30	Width (m)	17.950	Depth (m)	0.525
Side Inf Coefficient (m/hr)	0.05868	Invert Level (m)	21.345	Length (m)	17.950	Inf Depth (m)	
Safety Factor	10.0	Time to half empty (mins)	310	Slope (1:X)	100.0		

Other (defaults)

Entry Loss (manhole)	0.250	Entry Loss (junction)	0.000	Apply Recommended Losses	x
Exit Loss (manhole)	0.250	Exit Loss (junction)	0.000	Flood Risk (m)	0.450

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 15 minute summer	107.081	30.300	2 year 180 minute winter	15.890	6.291
2 year 15 minute winter	75.145	30.300	2 year 240 minute summer	19.650	5.193
2 year 30 minute summer	68.309	19.329	2 year 240 minute winter	13.055	5.193
2 year 30 minute winter	47.936	19.329	2 year 360 minute summer	15.137	3.895
2 year 60 minute summer	44.651	11.800	2 year 360 minute winter	9.839	3.895
2 year 60 minute winter	29.665	11.800	2 year 480 minute summer	11.906	3.147
2 year 120 minute summer	30.644	8.098	2 year 480 minute winter	7.910	3.147
2 year 120 minute winter	20.359	8.098	2 year 600 minute summer	9.700	2.653
2 year 180 minute summer	24.446	6.291	2 year 600 minute winter	6.628	2.653

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 720 minute summer	8.586	2.301	2 year +20% CC 360 minute summer	18.164	4.674
2 year 720 minute winter	5.771	2.301	2 year +20% CC 360 minute winter	11.807	4.674
2 year 960 minute summer	6.938	1.827	2 year +20% CC 480 minute summer	14.288	3.776
2 year 960 minute winter	4.596	1.827	2 year +20% CC 480 minute winter	9.492	3.776
2 year 1440 minute summer	4.943	1.325	2 year +20% CC 600 minute summer	11.640	3.184
2 year 1440 minute winter	3.322	1.325	2 year +20% CC 600 minute winter	7.953	3.184
2 year 2160 minute summer	3.493	0.965	2 year +20% CC 720 minute summer	10.304	2.761
2 year 2160 minute winter	2.407	0.965	2 year +20% CC 720 minute winter	6.925	2.761
2 year 2880 minute summer	2.897	0.777	2 year +20% CC 960 minute summer	8.326	2.192
2 year 2880 minute winter	1.947	0.777	2 year +20% CC 960 minute winter	5.515	2.192
2 year 4320 minute summer	2.230	0.583	2 year +20% CC 1440 minute summer	5.931	1.590
2 year 4320 minute winter	1.469	0.583	2 year +20% CC 1440 minute winter	3.986	1.590
2 year 5760 minute summer	1.887	0.483	2 year +20% CC 2160 minute summer	4.191	1.158
2 year 5760 minute winter	1.221	0.483	2 year +20% CC 2160 minute winter	2.888	1.158
2 year 7200 minute summer	1.656	0.422	2 year +20% CC 2880 minute summer	3.477	0.932
2 year 7200 minute winter	1.069	0.422	2 year +20% CC 2880 minute winter	2.337	0.932
2 year 8640 minute summer	1.496	0.382	2 year +20% CC 4320 minute summer	2.676	0.700
2 year 8640 minute winter	0.965	0.382	2 year +20% CC 4320 minute winter	1.762	0.700
2 year 10080 minute summer	1.381	0.352	2 year +20% CC 5760 minute summer	2.264	0.580
2 year 10080 minute winter	0.891	0.352	2 year +20% CC 5760 minute winter	1.466	0.580
2 year +20% CC 15 minute summer	128.497	36.360	2 year +20% CC 7200 minute summer	1.987	0.507
2 year +20% CC 15 minute winter	90.174	36.360	2 year +20% CC 7200 minute winter	1.283	0.507
2 year +20% CC 30 minute summer	81.971	23.195	2 year +20% CC 8640 minute summer	1.795	0.458
2 year +20% CC 30 minute winter	57.523	23.195	2 year +20% CC 8640 minute winter	1.158	0.458
2 year +20% CC 60 minute summer	53.581	14.160	2 year +20% CC 10080 minute summer	1.657	0.423
2 year +20% CC 60 minute winter	35.598	14.160	2 year +20% CC 10080 minute winter	1.069	0.423
2 year +20% CC 120 minute summer	36.772	9.718	2 year +35% CC 15 minute summer	144.560	40.905
2 year +20% CC 120 minute winter	24.431	9.718	2 year +35% CC 15 minute winter	101.445	40.905
2 year +20% CC 180 minute summer	29.335	7.549	2 year +35% CC 30 minute summer	92.217	26.094
2 year +20% CC 180 minute winter	19.069	7.549	2 year +35% CC 30 minute winter	64.714	26.094
2 year +20% CC 240 minute summer	23.580	6.231	2 year +35% CC 60 minute summer	60.279	15.930
2 year +20% CC 240 minute winter	15.666	6.231	2 year +35% CC 60 minute winter	40.048	15.930

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year +35% CC 120 minute summer	41.369	10.933	10 year 15 minute summer	215.327	60.930
2 year +35% CC 120 minute winter	27.485	10.933	10 year 15 minute winter	151.106	60.930
2 year +35% CC 180 minute summer	33.002	8.493	10 year 30 minute summer	137.654	38.951
2 year +35% CC 180 minute winter	21.452	8.493	10 year 30 minute winter	96.599	38.951
2 year +35% CC 240 minute summer	26.527	7.010	10 year 60 minute summer	90.411	23.893
2 year +35% CC 240 minute winter	17.624	7.010	10 year 60 minute winter	60.067	23.893
2 year +35% CC 360 minute summer	20.435	5.259	10 year 120 minute summer	56.138	14.836
2 year +35% CC 360 minute winter	13.283	5.259	10 year 120 minute winter	37.297	14.836
2 year +35% CC 480 minute summer	16.074	4.248	10 year 180 minute summer	43.040	11.076
2 year +35% CC 480 minute winter	10.679	4.248	10 year 180 minute winter	27.977	11.076
2 year +35% CC 600 minute summer	13.095	3.582	10 year 240 minute summer	33.857	8.947
2 year +35% CC 600 minute winter	8.947	3.582	10 year 240 minute winter	22.494	8.947
2 year +35% CC 720 minute summer	11.592	3.107	10 year 360 minute summer	25.506	6.564
2 year +35% CC 720 minute winter	7.790	3.107	10 year 360 minute winter	16.580	6.564
2 year +35% CC 960 minute summer	9.367	2.466	10 year 480 minute summer	19.816	5.237
2 year +35% CC 960 minute winter	6.205	2.466	10 year 480 minute winter	13.165	5.237
2 year +35% CC 1440 minute summer	6.673	1.788	10 year 600 minute summer	16.031	4.385
2 year +35% CC 1440 minute winter	4.485	1.788	10 year 600 minute winter	10.954	4.385
2 year +35% CC 2160 minute summer	4.715	1.303	10 year 720 minute summer	14.135	3.788
2 year +35% CC 2160 minute winter	3.249	1.303	10 year 720 minute winter	9.500	3.788
2 year +35% CC 2880 minute summer	3.911	1.048	10 year 960 minute summer	11.405	3.003
2 year +35% CC 2880 minute winter	2.629	1.048	10 year 960 minute winter	7.555	3.003
2 year +35% CC 4320 minute summer	3.011	0.787	10 year 1440 minute summer	8.079	2.165
2 year +35% CC 4320 minute winter	1.983	0.787	10 year 1440 minute winter	5.430	2.165
2 year +35% CC 5760 minute summer	2.547	0.652	10 year 2160 minute summer	5.677	1.569
2 year +35% CC 5760 minute winter	1.649	0.652	10 year 2160 minute winter	3.912	1.569
2 year +35% CC 7200 minute summer	2.236	0.570	10 year 2880 minute summer	4.685	1.256
2 year +35% CC 7200 minute winter	1.443	0.570	10 year 2880 minute winter	3.149	1.256
2 year +35% CC 8640 minute summer	2.019	0.515	10 year 4320 minute summer	3.553	0.929
2 year +35% CC 8640 minute winter	1.303	0.515	10 year 4320 minute winter	2.340	0.929
2 year +35% CC 10080 minute summer	1.864	0.475	10 year 5760 minute summer	2.967	0.760
2 year +35% CC 10080 minute winter	1.203	0.475	10 year 5760 minute winter	1.920	0.760

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
10 year 7200 minute summer	2.580	0.658	30 year 2880 minute summer	6.161	1.651
10 year 7200 minute winter	1.665	0.658	30 year 2880 minute winter	4.140	1.651
10 year 8640 minute summer	2.313	0.590	30 year 4320 minute summer	4.596	1.202
10 year 8640 minute winter	1.493	0.590	30 year 4320 minute winter	3.027	1.202
10 year 10080 minute summer	2.123	0.541	30 year 5760 minute summer	3.777	0.967
10 year 10080 minute winter	1.370	0.541	30 year 5760 minute winter	2.445	0.967
30 year 15 minute summer	285.576	80.808	30 year 7200 minute summer	3.243	0.827
30 year 15 minute winter	200.404	80.808	30 year 7200 minute winter	2.093	0.827
30 year 30 minute summer	184.026	52.073	30 year 8640 minute summer	2.878	0.734
30 year 30 minute winter	129.141	52.073	30 year 8640 minute winter	1.857	0.734
30 year 60 minute summer	121.260	32.045	30 year 10080 minute summer	2.617	0.668
30 year 60 minute winter	80.562	32.045	30 year 10080 minute winter	1.689	0.668
30 year 120 minute summer	73.317	19.376	30 year +20% CC 15 minute summer	342.691	96.970
30 year 120 minute winter	48.710	19.376	30 year +20% CC 15 minute winter	240.485	96.970
30 year 180 minute summer	55.732	14.342	30 year +20% CC 30 minute summer	220.832	62.488
30 year 180 minute winter	36.227	14.342	30 year +20% CC 30 minute winter	154.970	62.488
30 year 240 minute summer	43.698	11.548	30 year +20% CC 60 minute summer	145.511	38.454
30 year 240 minute winter	29.032	11.548	30 year +20% CC 60 minute winter	96.674	38.454
30 year 360 minute summer	32.894	8.465	30 year +20% CC 120 minute summer	87.981	23.251
30 year 360 minute winter	21.382	8.465	30 year +20% CC 120 minute winter	58.452	23.251
30 year 480 minute summer	25.626	6.772	30 year +20% CC 180 minute summer	66.878	17.210
30 year 480 minute winter	17.025	6.772	30 year +20% CC 180 minute winter	43.473	17.210
30 year 600 minute summer	20.802	5.690	30 year +20% CC 240 minute summer	52.438	13.858
30 year 600 minute winter	14.213	5.690	30 year +20% CC 240 minute winter	34.838	13.858
30 year 720 minute summer	18.403	4.932	30 year +20% CC 360 minute summer	39.473	10.158
30 year 720 minute winter	12.368	4.932	30 year +20% CC 360 minute winter	25.658	10.158
30 year 960 minute summer	14.941	3.934	30 year +20% CC 480 minute summer	30.751	8.127
30 year 960 minute winter	9.897	3.934	30 year +20% CC 480 minute winter	20.430	8.127
30 year 1440 minute summer	10.665	2.858	30 year +20% CC 600 minute summer	24.962	6.828
30 year 1440 minute winter	7.168	2.858	30 year +20% CC 600 minute winter	17.056	6.828
30 year 2160 minute summer	7.498	2.072	30 year +20% CC 720 minute summer	22.084	5.919
30 year 2160 minute winter	5.166	2.072	30 year +20% CC 720 minute winter	14.842	5.919

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year +20% CC 960 minute summer	17.930	4.721	30 year +35% CC 480 minute summer	34.595	9.142
30 year +20% CC 960 minute winter	11.877	4.721	30 year +35% CC 480 minute winter	22.984	9.142
30 year +20% CC 1440 minute summer	12.798	3.430	30 year +35% CC 600 minute summer	28.082	7.681
30 year +20% CC 1440 minute winter	8.601	3.430	30 year +35% CC 600 minute winter	19.187	7.681
30 year +20% CC 2160 minute summer	8.998	2.487	30 year +35% CC 720 minute summer	24.844	6.659
30 year +20% CC 2160 minute winter	6.200	2.487	30 year +35% CC 720 minute winter	16.697	6.659
30 year +20% CC 2880 minute summer	7.393	1.981	30 year +35% CC 960 minute summer	20.171	5.311
30 year +20% CC 2880 minute winter	4.968	1.981	30 year +35% CC 960 minute winter	13.361	5.311
30 year +20% CC 4320 minute summer	5.515	1.442	30 year +35% CC 1440 minute summer	14.398	3.859
30 year +20% CC 4320 minute winter	3.632	1.442	30 year +35% CC 1440 minute winter	9.676	3.859
30 year +20% CC 5760 minute summer	4.533	1.160	30 year +35% CC 2160 minute summer	10.122	2.797
30 year +20% CC 5760 minute winter	2.934	1.160	30 year +35% CC 2160 minute winter	6.975	2.797
30 year +20% CC 7200 minute summer	3.892	0.993	30 year +35% CC 2880 minute summer	8.317	2.229
30 year +20% CC 7200 minute winter	2.512	0.993	30 year +35% CC 2880 minute winter	5.589	2.229
30 year +20% CC 8640 minute summer	3.453	0.881	30 year +35% CC 4320 minute summer	6.205	1.622
30 year +20% CC 8640 minute winter	2.229	0.881	30 year +35% CC 4320 minute winter	4.086	1.622
30 year +20% CC 10080 minute summer	3.141	0.801	30 year +35% CC 5760 minute summer	5.099	1.305
30 year +20% CC 10080 minute winter	2.027	0.801	30 year +35% CC 5760 minute winter	3.301	1.305
30 year +35% CC 15 minute summer	385.527	109.091	30 year +35% CC 7200 minute summer	4.379	1.117
30 year +35% CC 15 minute winter	270.545	109.091	30 year +35% CC 7200 minute winter	2.826	1.117
30 year +35% CC 30 minute summer	248.436	70.299	30 year +35% CC 8640 minute summer	3.885	0.991
30 year +35% CC 30 minute winter	174.341	70.299	30 year +35% CC 8640 minute winter	2.507	0.991
30 year +35% CC 60 minute summer	163.700	43.261	30 year +35% CC 10080 minute summer	3.533	0.901
30 year +35% CC 60 minute winter	108.759	43.261	30 year +35% CC 10080 minute winter	2.280	0.901
30 year +35% CC 120 minute summer	98.978	26.157	100 year 15 minute summer	366.288	103.647
30 year +35% CC 120 minute winter	65.759	26.157	100 year 15 minute winter	257.044	103.647
30 year +35% CC 180 minute summer	75.238	19.361	100 year 30 minute summer	238.146	67.387
30 year +35% CC 180 minute winter	48.907	19.361	100 year 30 minute winter	167.120	67.387
30 year +35% CC 240 minute summer	58.992	15.590	100 year 60 minute summer	158.143	41.792
30 year +35% CC 240 minute winter	39.193	15.590	100 year 60 minute winter	105.066	41.792
30 year +35% CC 360 minute summer	44.407	11.427	100 year 120 minute summer	94.619	25.005
30 year +35% CC 360 minute winter	28.866	11.427	100 year 120 minute winter	62.863	25.005

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year 180 minute summer	71.953	18.516	100 year +20% CC 30 minute summer	285.775	80.864
100 year 180 minute winter	46.771	18.516	100 year +20% CC 30 minute winter	200.544	80.864
100 year 240 minute summer	56.664	14.975	100 year +20% CC 60 minute summer	189.771	50.151
100 year 240 minute winter	37.646	14.975	100 year +20% CC 60 minute winter	126.079	50.151
100 year 360 minute summer	43.261	11.132	100 year +20% CC 120 minute summer	113.543	30.006
100 year 360 minute winter	28.121	11.132	100 year +20% CC 120 minute winter	75.435	30.006
100 year 480 minute summer	34.162	9.028	100 year +20% CC 180 minute summer	86.343	22.219
100 year 480 minute winter	22.696	9.028	100 year +20% CC 180 minute winter	56.125	22.219
100 year 600 minute summer	28.031	7.667	100 year +20% CC 240 minute summer	67.997	17.970
100 year 600 minute winter	19.153	7.667	100 year +20% CC 240 minute winter	45.176	17.970
100 year 720 minute summer	25.010	6.703	100 year +20% CC 360 minute summer	51.913	13.359
100 year 720 minute winter	16.809	6.703	100 year +20% CC 360 minute winter	33.745	13.359
100 year 960 minute summer	20.531	5.406	100 year +20% CC 480 minute summer	40.994	10.834
100 year 960 minute winter	13.600	5.406	100 year +20% CC 480 minute winter	27.236	10.834
100 year 1440 minute summer	14.765	3.957	100 year +20% CC 600 minute summer	33.637	9.201
100 year 1440 minute winter	9.923	3.957	100 year +20% CC 600 minute winter	22.983	9.201
100 year 2160 minute summer	10.359	2.863	100 year +20% CC 720 minute summer	30.012	8.044
100 year 2160 minute winter	7.138	2.863	100 year +20% CC 720 minute winter	20.170	8.044
100 year 2880 minute summer	8.443	2.263	100 year +20% CC 960 minute summer	24.637	6.488
100 year 2880 minute winter	5.674	2.263	100 year +20% CC 960 minute winter	16.320	6.488
100 year 4320 minute summer	6.148	1.607	100 year +20% CC 1440 minute summer	17.717	4.748
100 year 4320 minute winter	4.049	1.607	100 year +20% CC 1440 minute winter	11.907	4.748
100 year 5760 minute summer	4.939	1.264	100 year +20% CC 2160 minute summer	12.431	3.435
100 year 5760 minute winter	3.197	1.264	100 year +20% CC 2160 minute winter	8.565	3.435
100 year 7200 minute summer	4.147	1.058	100 year +20% CC 2880 minute summer	10.131	2.715
100 year 7200 minute winter	2.676	1.058	100 year +20% CC 2880 minute winter	6.809	2.715
100 year 8640 minute summer	3.605	0.920	100 year +20% CC 4320 minute summer	7.378	1.929
100 year 8640 minute winter	2.327	0.920	100 year +20% CC 4320 minute winter	4.859	1.929
100 year 10080 minute summer	3.222	0.822	100 year +20% CC 5760 minute summer	5.927	1.517
100 year 10080 minute winter	2.079	0.822	100 year +20% CC 5760 minute winter	3.836	1.517
100 year +20% CC 15 minute summer	439.546	124.376	100 year +20% CC 7200 minute summer	4.976	1.269
100 year +20% CC 15 minute winter	308.453	124.376	100 year +20% CC 7200 minute winter	3.211	1.269

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +20% CC 8640 minute summer	4.326	1.104	100 year +45% CC 600 minute winter	27.771	11.117
100 year +20% CC 8640 minute winter	2.792	1.104	100 year +45% CC 720 minute summer	36.265	9.719
100 year +20% CC 10080 minute summer	3.866	0.986	100 year +45% CC 720 minute winter	24.372	9.719
100 year +20% CC 10080 minute winter	2.495	0.986	100 year +45% CC 960 minute summer	29.770	7.839
100 year +45% CC 15 minute summer	531.118	150.288	100 year +45% CC 960 minute winter	19.720	7.839
100 year +45% CC 15 minute winter	372.714	150.288	100 year +45% CC 1440 minute summer	21.409	5.738
100 year +45% CC 30 minute summer	345.311	97.711	100 year +45% CC 1440 minute winter	14.388	5.738
100 year +45% CC 30 minute winter	242.323	97.711	100 year +45% CC 2160 minute summer	15.021	4.151
100 year +45% CC 60 minute summer	229.307	60.599	100 year +45% CC 2160 minute winter	10.350	4.151
100 year +45% CC 60 minute winter	152.346	60.599	100 year +45% CC 2880 minute summer	12.242	3.281
100 year +45% CC 120 minute summer	137.198	36.257	100 year +45% CC 2880 minute winter	8.227	3.281
100 year +45% CC 120 minute winter	91.151	36.257	100 year +45% CC 4320 minute summer	8.915	2.331
100 year +45% CC 180 minute summer	104.331	26.848	100 year +45% CC 4320 minute winter	5.871	2.331
100 year +45% CC 180 minute winter	67.818	26.848	100 year +45% CC 5760 minute summer	7.162	1.833
100 year +45% CC 240 minute summer	82.163	21.713	100 year +45% CC 5760 minute winter	4.636	1.833
100 year +45% CC 240 minute winter	54.587	21.713	100 year +45% CC 7200 minute summer	6.013	1.534
100 year +45% CC 360 minute summer	62.728	16.142	100 year +45% CC 7200 minute winter	3.881	1.534
100 year +45% CC 360 minute winter	40.775	16.142	100 year +45% CC 8640 minute summer	5.228	1.334
100 year +45% CC 480 minute summer	49.535	13.091	100 year +45% CC 8640 minute winter	3.374	1.334
100 year +45% CC 480 minute winter	32.910	13.091	100 year +45% CC 10080 minute summer	4.672	1.192
100 year +45% CC 600 minute summer	40.645	11.117	100 year +45% CC 10080 minute winter	3.015	1.192

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.95%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	Soakaway 1	456	19.301	0.251	2.3	20.0444	0.0000	OK
360 minute winter	Soakaway 2	344	20.306	-0.144	4.5	28.5001	0.0000	OK
360 minute summer	Soakaway 3	312	19.632	0.182	4.4	17.1044	0.0000	OK
360 minute summer	Soakaway 4	256	17.778	0.128	3.6	11.8896	0.0000	OK
15 minute summer	Infiltration Basin	1	21.500	-0.100	0.0	0.0000	0.0000	OK
240 minute summer	Permeable Surfacing 1	180	20.459	0.189	4.3	10.8011	0.0000	OK
240 minute summer	Permeable Surfacing 2	164	21.762	0.092	0.7	1.5240	0.0000	OK
360 minute summer	Permeable Surfacing 3	240	21.504	0.159	2.2	6.7979	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
480 minute winter	Soakaway 1	Infiltration		0.3			
360 minute winter	Soakaway 2	1.000	Infiltration Basin	0.0	0.000	0.000	0.0000
360 minute winter	Soakaway 2	Infiltration		0.6			
360 minute summer	Soakaway 3	Infiltration		0.5			
360 minute summer	Soakaway 4	Infiltration		0.6			
15 minute summer	Infiltration Basin	Infiltration		0.0			
240 minute summer	Permeable Surfacing 1	Infiltration		0.6			
240 minute summer	Permeable Surfacing 2	Infiltration		0.2			
360 minute summer	Permeable Surfacing 3	Infiltration		0.5			

Results for 2 year +20% CC Critical Storm Duration. Lowest mass balance: 99.95%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
720 minute winter	Soakaway 1	675	19.363	0.313	2.0	24.9727	0.0000	OK
480 minute winter	Soakaway 2	456	20.375	-0.075	4.3	36.1707	0.0000	OK
360 minute winter	Soakaway 3	344	19.680	0.230	3.5	21.6707	0.0000	OK
360 minute summer	Soakaway 4	264	17.811	0.161	4.3	14.9168	0.0000	OK
15 minute summer	Infiltration Basin	1	21.500	-0.100	0.0	0.0000	0.0000	OK
360 minute summer	Permeable Surfacing 1	256	20.481	0.211	3.9	13.4312	0.0000	OK
180 minute summer	Permeable Surfacing 2	124	21.772	0.102	1.0	1.8857	0.0000	OK
240 minute summer	Permeable Surfacing 3	176	21.521	0.176	3.4	8.3423	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
720 minute winter	Soakaway 1	Infiltration		0.3			
480 minute winter	Soakaway 2	1.000	Infiltration Basin	0.0	0.000	0.000	0.0000
480 minute winter	Soakaway 2	Infiltration		0.6			
360 minute winter	Soakaway 3	Infiltration		0.5			
360 minute summer	Soakaway 4	Infiltration		0.6			
15 minute summer	Infiltration Basin	Infiltration		0.0			
360 minute summer	Permeable Surfacing 1	Infiltration		0.7			
180 minute summer	Permeable Surfacing 2	Infiltration		0.2			
240 minute summer	Permeable Surfacing 3	Infiltration		0.5			

Results for 2 year +35% CC Critical Storm Duration. Lowest mass balance: 99.95%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute winter	Soakaway 1	585	19.417	0.367	2.6	29.2737	0.0000	OK
480 minute winter	Soakaway 2	464	20.427	-0.023	4.9	41.9269	0.0000	OK
360 minute winter	Soakaway 3	344	19.716	0.266	3.9	25.0751	0.0000	OK
360 minute summer	Soakaway 4	280	17.836	0.186	4.8	17.1975	0.0000	OK
15 minute summer	Infiltration Basin	1	21.500	-0.100	0.0	0.0000	0.0000	OK
360 minute summer	Permeable Surfacing 1	264	20.500	0.230	4.4	15.6919	0.0000	OK
360 minute summer	Permeable Surfacing 2	232	21.778	0.108	0.8	2.1136	0.0000	OK
360 minute summer	Permeable Surfacing 3	256	21.536	0.191	2.9	9.8112	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
600 minute winter	Soakaway 1	Infiltration		0.3			
480 minute winter	Soakaway 2	1.000	Infiltration Basin	0.0	0.000	0.000	0.0000
480 minute winter	Soakaway 2	Infiltration		0.6			
360 minute winter	Soakaway 3	Infiltration		0.5			
360 minute summer	Soakaway 4	Infiltration		0.6			
15 minute summer	Infiltration Basin	Infiltration		0.0			
360 minute summer	Permeable Surfacing 1	Infiltration		0.7			
360 minute summer	Permeable Surfacing 2	Infiltration		0.2			
360 minute summer	Permeable Surfacing 3	Infiltration		0.5			

Results for 10 year Critical Storm Duration. Lowest mass balance: 99.95%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute winter	Soakaway 1	585	19.514	0.464	3.2	37.0662	0.0000	OK
480 minute winter	Soakaway 2	464	20.534	0.084	6.0	53.8868	0.0000	OK
360 minute winter	Soakaway 3	352	19.800	0.350	4.9	32.9593	0.0000	OK
240 minute winter	Soakaway 4	232	17.900	0.250	5.3	23.1309	0.0000	OK
15 minute summer	Infiltration Basin	1	21.500	-0.100	0.0	0.0000	0.0000	OK
240 minute winter	Permeable Surfacing 1	232	20.543	0.273	4.9	21.0074	0.0000	OK
180 minute summer	Permeable Surfacing 2	136	21.797	0.127	1.5	2.8795	0.0000	OK
240 minute summer	Permeable Surfacing 3	204	21.570	0.225	4.8	13.0422	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
600 minute winter	Soakaway 1	Infiltration		0.3			
480 minute winter	Soakaway 2	1.000	Infiltration Basin	0.0	0.000	0.000	0.0710
480 minute winter	Soakaway 2	Infiltration		0.7			
360 minute winter	Soakaway 3	Infiltration		0.5			
240 minute winter	Soakaway 4	Infiltration		0.7			
15 minute summer	Infiltration Basin	Infiltration		0.0			
240 minute winter	Permeable Surfacing 1	Infiltration		0.7			
180 minute summer	Permeable Surfacing 2	Infiltration		0.2			
240 minute summer	Permeable Surfacing 3	Infiltration		0.5			

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.95%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute winter	Soakaway 1	915	19.681	0.631	2.9	50.3472	0.0000	OK
600 minute winter	Soakaway 2	585	20.708	0.258	6.5	73.4752	0.0000	SURCHARGED
480 minute winter	Soakaway 3	464	19.925	0.475	5.0	44.7797	0.0000	OK
360 minute winter	Soakaway 4	344	17.993	0.343	5.0	31.7514	0.0000	OK
15 minute summer	Infiltration Basin	1	21.500	-0.100	0.0	0.0000	0.0000	OK
240 minute winter	Permeable Surfacing 1	236	20.605	0.335	6.3	28.5647	0.0000	OK
120 minute summer	Permeable Surfacing 2	118	21.824	0.154	2.6	4.0227	0.0000	OK
240 minute summer	Permeable Surfacing 3	240	21.620	0.275	6.2	17.9259	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
960 minute winter	Soakaway 1	Infiltration		0.4			
600 minute winter	Soakaway 2	1.000	Infiltration Basin	0.0	0.000	0.000	0.1232
600 minute winter	Soakaway 2	Infiltration		0.7			
480 minute winter	Soakaway 3	Infiltration		0.6			
360 minute winter	Soakaway 4	Infiltration		0.7			
15 minute summer	Infiltration Basin	Infiltration		0.0			
240 minute winter	Permeable Surfacing 1	Infiltration		0.7			
120 minute summer	Permeable Surfacing 2	Infiltration		0.2			
240 minute summer	Permeable Surfacing 3	Infiltration		0.5			

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.95%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute winter	Soakaway 1	930	19.838	0.788	3.5	62.8639	0.0000	OK
720 minute winter	Soakaway 2	705	21.614	1.164	6.8	90.2929	0.0000	FLOOD RISK
480 minute winter	Soakaway 3	472	20.040	0.590	6.0	55.6224	0.0000	OK
360 minute winter	Soakaway 4	352	18.079	0.429	6.0	39.7069	0.0000	OK
720 minute winter	Infiltration Basin	705	21.501	-0.099	0.4	0.5368	0.0000	OK
360 minute winter	Permeable Surfacing 1	344	20.667	0.396	5.6	36.0289	0.0000	OK
180 minute winter	Permeable Surfacing 2	172	21.847	0.177	1.6	5.0176	0.0000	OK
240 minute winter	Permeable Surfacing 3	236	21.668	0.323	5.0	22.4806	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
960 minute winter	Soakaway 1	Infiltration		0.4			
720 minute winter	Soakaway 2	1.000	Infiltration Basin	-1.6	-0.138	-0.088	0.1317
720 minute winter	Soakaway 2	Infiltration		0.7			
480 minute winter	Soakaway 3	Infiltration		0.6			
360 minute winter	Soakaway 4	Infiltration		0.7			
720 minute winter	Infiltration Basin	Infiltration		0.1			
360 minute winter	Permeable Surfacing 1	Infiltration		0.7			
180 minute winter	Permeable Surfacing 2	Infiltration		0.2			
240 minute winter	Permeable Surfacing 3	Infiltration		0.6			

Results for 30 year +35% CC Critical Storm Duration. Lowest mass balance: 99.95%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute winter	Soakaway 1	945	19.957	0.907	3.9	72.3582	0.0000	OK
480 minute winter	Soakaway 2	336	21.653	1.203	10.5	90.3372	0.0000	FLOOD RISK
720 minute winter	Soakaway 3	705	20.129	0.679	4.9	63.9953	0.0000	OK
360 minute winter	Soakaway 4	352	18.144	0.494	6.8	45.7805	0.0000	OK
600 minute winter	Infiltration Basin	555	21.512	-0.088	2.9	7.8415	0.0000	OK
480 minute winter	Permeable Surfacing 1	456	20.711	0.441	5.0	41.4775	0.0000	OK
240 minute winter	Permeable Surfacing 2	224	21.867	0.197	1.4	5.8792	0.0000	OK
360 minute winter	Permeable Surfacing 3	344	21.706	0.361	4.1	26.1520	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
960 minute winter	Soakaway 1	Infiltration		0.4			
480 minute winter	Soakaway 2	1.000	Infiltration Basin	3.4	0.288	0.193	0.1377
480 minute winter	Soakaway 2	Infiltration		0.7			
720 minute winter	Soakaway 3	Infiltration		0.6			
360 minute winter	Soakaway 4	Infiltration		0.7			
600 minute winter	Infiltration Basin	Infiltration		0.7			
480 minute winter	Permeable Surfacing 1	Infiltration		0.7			
240 minute winter	Permeable Surfacing 2	Infiltration		0.2			
360 minute winter	Permeable Surfacing 3	Infiltration		0.6			

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.95%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	Soakaway 1	1380	19.981	0.931	2.9	74.2612	0.0000	OK
720 minute winter	Soakaway 2	480	21.650	1.200	7.7	90.3331	0.0000	FLOOD RISK
720 minute winter	Soakaway 3	705	20.133	0.683	4.9	64.3404	0.0000	OK
480 minute winter	Soakaway 4	456	18.136	0.486	5.3	45.0160	0.0000	OK
960 minute winter	Infiltration Basin	735	21.512	-0.088	2.7	8.2903	0.0000	OK
480 minute winter	Permeable Surfacing 1	456	20.706	0.436	4.9	40.7901	0.0000	OK
240 minute summer	Permeable Surfacing 2	200	21.859	0.189	2.1	5.5140	0.0000	OK
480 minute summer	Permeable Surfacing 3	400	21.696	0.351	4.9	25.2501	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
1440 minute winter	Soakaway 1	Infiltration		0.4			
720 minute winter	Soakaway 2	1.000	Infiltration Basin	3.2	0.271	0.180	0.1370
720 minute winter	Soakaway 2	Infiltration		0.7			
720 minute winter	Soakaway 3	Infiltration		0.6			
480 minute winter	Soakaway 4	Infiltration		0.7			
960 minute winter	Infiltration Basin	Infiltration		0.8			
480 minute winter	Permeable Surfacing 1	Infiltration		0.7			
240 minute summer	Permeable Surfacing 2	Infiltration		0.2			
480 minute summer	Permeable Surfacing 3	Infiltration		0.6			

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.95%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	Soakaway 1	1380	20.202	1.152	3.5	91.9197	0.0000	OK
480 minute summer	Soakaway 2	280	21.756	1.306	18.7	90.4528	0.0000	FLOOD RISK
960 minute winter	Soakaway 3	930	20.311	0.861	4.8	81.1237	0.0000	OK
600 minute winter	Soakaway 4	570	18.261	0.611	5.4	56.5908	0.0000	OK
960 minute winter	Infiltration Basin	675	21.531	-0.069	5.6	21.2525	0.0000	OK
600 minute winter	Permeable Surfacing 1	570	20.794	0.524	5.0	51.6220	0.0000	OK
360 minute summer	Permeable Surfacing 2	280	21.893	0.223	1.9	6.9696	0.0000	OK
600 minute winter	Permeable Surfacing 3	555	21.767	0.422	3.3	32.0350	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
1440 minute winter	Soakaway 1	Infiltration		0.4			
480 minute summer	Soakaway 2	1.000	Infiltration Basin	9.7	0.737	0.547	0.1535
480 minute summer	Soakaway 2	Infiltration		0.7			
960 minute winter	Soakaway 3	Infiltration		0.6			
600 minute winter	Soakaway 4	Infiltration		0.7			
960 minute winter	Infiltration Basin	Infiltration		2.0			
600 minute winter	Permeable Surfacing 1	Infiltration		0.7			
360 minute summer	Permeable Surfacing 2	Infiltration		0.2			
600 minute winter	Permeable Surfacing 3	Infiltration		0.6			

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 99.95%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	Soakaway 1	1410	20.499	1.449	4.2	115.6025	0.0000	OK
180 minute summer	Soakaway 2	108	21.986	1.536	44.4	90.7137	0.0000	FLOOD RISK
960 minute winter	Soakaway 3	930	20.534	1.084	5.8	102.1053	0.0000	OK
600 minute winter	Soakaway 4	585	18.424	0.774	6.5	71.6532	0.0000	OK
960 minute summer	Infiltration Basin	615	21.555	-0.045	12.9	37.6710	0.0000	OK
720 minute winter	Permeable Surfacing 1	690	20.911	0.641	5.3	65.8821	0.0000	OK
360 minute winter	Permeable Surfacing 2	336	21.942	0.272	1.5	9.0638	0.0000	OK
600 minute winter	Permeable Surfacing 3	570	21.856	0.511	4.0	40.6902	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
1440 minute winter	Soakaway 1	Infiltration		0.5			
180 minute summer	Soakaway 2	1.000	Infiltration Basin	21.9	1.491	1.241	0.1780
180 minute summer	Soakaway 2	Infiltration		0.7			
960 minute winter	Soakaway 3	Infiltration		0.7			
600 minute winter	Soakaway 4	Infiltration		0.8			
960 minute summer	Infiltration Basin	Infiltration		3.2			
720 minute winter	Permeable Surfacing 1	Infiltration		0.7			
360 minute winter	Permeable Surfacing 2	Infiltration		0.2			
600 minute winter	Permeable Surfacing 3	Infiltration		0.6			

Appendix 6

Southern Water Correspondence

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
4610		4.04	0.00	
4611		0.00	0.00	
5706		3.91	0.00	
6804		0.00	0.00	
6904		0.00	0.00	
6905		0.00	0.00	
0204	F	29.83	28.63	
0209	F	30.36	29.12	
0210	F	30.79	29.50	
0211	F	31.08	29.83	
0212	F	31.64	30.23	
0213	F	33.76	32.61	
0301	F	29.83	0.00	
0302	F	29.58	28.01	
0303	F	30.01	29.11	
0304	F	29.96	28.91	
0305	F	30.37	10.37	
0306	F	29.91	29.01	
0307	F	30.34	10.34	
0308	F	30.08	30.07	
0309	F	30.00	29.09	
0310	F	30.51	29.74	
0311	F	30.50	28.80	
0312	F	30.92	29.84	
0313	F	30.75	30.18	
0314	F	27.69	26.75	
0315	F	0.00	0.00	
0401	F	26.51	25.65	
0402	F	26.34	25.84	
0403	F	27.91	26.22	
0404	F	29.02	27.70	
0405	F	27.77	26.06	
0406	F	28.63	25.43	
0407	F	29.27	18.47	
0408	F	29.49	28.21	
0409	F	27.72	25.95	
0410	F	29.63	18.17	
1203	F	30.41	29.47	
1212	F	31.36	30.23	
1213	F	31.34	30.39	
1215	F	32.52	31.83	
1216	F	33.15	33.14	
1217	F	33.90	32.94	
1220	F	32.74	31.54	
1223	F	33.89	32.96	
1301	F	28.97	0.00	
1304	F	31.05	31.04	
1305	F	30.71	10.66	
1306	F	30.20	30.19	
1308	F	30.34	10.31	
1401	F	26.04	23.14	
1403	F	24.89	23.86	
1404	F	26.83	22.88	
1405	F	26.32	0.00	
1406	F	27.82	26.24	
1408	F	0.00	0.00	
1409	F	0.00	0.00	
1410	F	0.00	0.00	
1411	F	0.00	0.00	
1412	F	0.00	0.00	
1501	F	0.00	0.00	
1502	F	0.00	0.00	
1601	F	0.00	0.00	
1602	F	0.00	0.00	
1603	F	0.00	0.00	
1604	F	0.00	0.00	
1605	F	0.00	0.00	
1606	F	0.00	0.00	
1607	F	0.00	0.00	
1704	F	7.85	5.70	
1801	F	8.21	8.20	
1802	F	9.82	8.48	
1803	F	9.66	9.06	
1805	F	8.22	6.30	
2701	F	6.52	3.90	
2702	F	5.95	3.71	
2801	F	5.34	3.07	
2802	F	4.26	0.00	
2803	F	4.71	0.00	
2804	F	5.19	4.05	
2805	F	8.27	0.00	
2806	F	5.96	4.91	
2807	F	7.53	0.00	
2808	F	7.90	6.53	
2809	F	7.52	7.16	
2810	F	8.25	7.55	
2811	F	8.61	8.13	
2812	F	8.50	7.82	
2813	F	8.15	7.68	
2814	F	6.83	0.00	
2815	F	5.55	5.19	
2816	F	5.51	5.11	
2817	F	0.00	0.00	
2818	F	5.21	0.00	
2819	F	4.64	4.27	
2820	F	0.00	0.00	
2821	F	0.00	0.00	
2823	F	5.02	0.00	
2824	F	0.00	0.00	
2825	F	4.57	0.00	
3701	F	3.41	1.54	
3801	F	3.39	1.49	
3802	F	3.41	1.70	
3803	F	3.61	1.83	
3901	F	4.51	1.84	

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
3904	F	4.88	2.51	
4501	F	6.80	5.18	
4602	F	5.48	2.75	
4603	F	3.30	1.51	
4604	F	3.29	1.70	
4605	F	5.39	3.76	
4606	F	5.71	4.24	
4607	F	3.23	2.06	
4609	F	3.47	2.77	
4613	F	0.00	0.00	
4701	F	3.76	-0.21	
4702	F	2.98	0.94	
4703	F	3.09	0.00	
4801	F	3.19	1.24	
5501	F	14.25	11.18	
5503	F	15.10	13.50	
5504	F	16.60	14.90	
5505	F	17.41	16.57	
5506	F	17.47	16.87	
5507	F	15.85	14.10	
5508	F	16.40	14.60	
5509	F	18.27	15.24	
5510	F	20.46	20.45	
5511	F	19.64	0.00	
5512	F	19.59	18.89	
5513	F	19.97	19.57	
5514	F	16.91	15.21	
5515	F	15.90	15.36	
5516	F	11.75	9.42	
5517	F	11.83	10.36	
5518	F	13.67	11.37	
5519	F	13.04	12.33	
5520	F	13.14	12.40	
5521	F	9.87	8.63	
5522	F	10.55	9.74	
5523	F	19.51	0.00	
5601	F	17.60	15.76	
5602	F	17.63	15.87	
5606	F	7.00	5.49	
5607	F	12.71	10.00	
5608	F	12.74	10.82	
5609	F	14.51	12.59	
5610	F	7.91	5.80	
5701	F	4.01	0.01	
5702	F	3.96	0.01	
5703	F	4.96	0.00	
5704	F	4.13	0.31	
5801	F	5.03	0.73	
6401	F	17.07	14.50	
6402	F	22.60	21.23	
6403	F	21.99	20.45	
6404	F	20.62	19.26	
6405	F	21.05	19.80	
6406	F	17.16	16.34	
6407	F	18.03	16.00	
6408	F	16.78	14.28	
6409	F	15.64	14.01	
6410	F	22.73	21.58	
6411	F	15.63	13.96	
6412	F	20.60	18.97	
6413	F	21.56	20.46	
6414	F	22.70	21.33	
6501	F	18.56	17.40	
6502	F	18.56	17.76	
6503	F	18.23	17.85	
6504	F	18.47	18.05	
6505	F	21.06	11.10	
6506	F	18.78	18.33	
6507	F	18.94	18.41	
6508	F	19.16	18.50	
6509	F	19.75	19.01	
6510	F	19.94	19.27	
6511	F	20.66	20.01	
6512	F	20.77	20.42	
6513	F	18.81	18.26	
6514	F	18.56	17.49	
6515	F	18.56	17.76	
6601	F	0.00	0.00	
6602	F	0.00	0.00	
6603	F	0.00	0.00	
6604	F	0.00	0.00	
6605	F	17.59	0.00	
6606	F	17.62	16.52	
6801	F	5.28	0.73	
6802	F	4.78	1.01	
6803	F	4.73	0.00	
6901	F	4.73	1.28	
6902	F	4.87	4.86	
6903	F	4.76	4.08	
7301	F	18.40	16.66	
7302	F	18.49	16.30	
7303	F	17.67	16.22	
7304	F	14.32	13.57	
7305	F	18.09	15.94	
7306	F	18.90	11.45	
7307	F	17.62	14.54	
7308	F	13.75	11.72	
7309	F	13.43	12.17	
7401	F	17.61	16.43	
7402	F	22.72	22.71	
7403	F	21.96	20.59	
7404	F	22.56	21.70	
7405	F	20.92	18.45	
7406	F	18.30	17.13	
7407	F	21.54	18.23	

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
7408	F	24.28	23.48	
7409	F	18.47	16.87	
7410	F	23.23	10.83	
7411	F	22.57	21.45	
7412	F	0.00	0.00	
7413	F	0.00	0.00	
7414	F	0.00	0.00	
7415	F	0.00	0.00	
7501	F	20.49	19.71	
7502	F	0.00	0.00	
7503	F	0.00	0.00	
7504	F	0.00	0.00	
7505	F	0.00	0.00	
7506	F	21.65	0.00	
7507	F	22.12	12.86	
7508	F	21.85	20.60	
7509	F	21.90	20.85	
7510	F	20.40	19.58	
7511	F	20.49	18.84	
7512	F	20.24	18.29	
7601	F	19.46	13.92	
7602	F	19.87	17.54	
7603	F	20.07	17.69	
7604	F	16.34	15.22	
7605	F	16.31	15.56	
7606	F	16.82	15.95	
7607	F	17.31	16.77	
7608	F	16.65	15.50	
7609	F	17.69	15.90	
7610	F	17.62	16.12	
7701	F	0.00	0.00	
7702	F	0.00	0.00	
7703	F	0.00	0.00	
7704	F	17.60	0.00	
7705	F	17.62	16.67	
7902	F	4.32	1.61	
8301	F	13.36	12.50	
8302	F	24.34	23.10	
8303	F	22.82	21.38	
8304	F	23.07	15.72	
8305	F	24.72	22.72	
8306	F	23.40	21.93	
8307	F	23.06	22.32	
8308	F	18.34	14.88	
8309	F	17.69	15.69	
8310	F	23.30	21.10	
8311	F	23.90	0.00	
8401	F	24.71	10.76	
8402	F	26.01	24.28	
8403	F	0.00	0.00	
8501	F	20.47	18.29	
8502	F	20.80	18.66	
8503	F	21.24	19.01	
8504	F	21.30	19.09	
8505	F	22.24	19.28	
8506	F	22.67	19.40	
8507	F	22.45	20.35	
8508	F	22.66	21.36	
8509	F	21.68	19.73	
8510	F	21.81	19.97	
8511	F	22.68	21.63	
8512	F	0.00	0.00	
8513	F	21.98	21.97	
8514	F	22.48	20.64	
8515	F	21.12	20.01	
8516	F	21.16	20.16	
8517	F	21.86	20.87	
8518	F	20.49	19.51	
8519	F	20.64	19.84	
8520	F	20.67	20.08	
8521	F	20.87	20.30	
8522	F	21.44	20.57	
8523	F	21.55	20.87	
8524	F	21.61	20.98	
8801	F	4.35	2.11	
9401	F	27.22	10.54	
9402	F	27.41	25.63	
9403	F	26.69	24.79	
9501	F	0.00	0.00	
9502	F	0.00	0.00	
9503	F	0.00	0.00	
9504	F	0.00	0.00	
9505	F	21.75	0.00	
9506	F	0.00	0.00	
9507	F	0.00	0.00	
9508	F	22.32	0.00	
9509	F	21.79	21.22	
9701	F	0.00	-0.01	
9801	F	5.23	2.39	
9802	F	7.17	2.57	
9803	F	7.40	5.20	
9804	F	8.76	4.36	
9805	F	9.97	5.57	
9806	F	0.00	7.39	
9807	F	7.82	7.23	
3751	S	3.55	2.45	
3752	S	3.49	2.05	
3753	S	3.26	0.00	
3754	S	3.58	1.92	
3850	S	3.90	2.70	
3851	S	3.83	0.00	
3853	S	3.55	2.48	
3854	S	3.41	0.00	
3855	S	4.24	0.00	
3856	S	0.00	0.00	



Chris Auber
Stable Barn
Park End
Swaffham Bulbeck
Cambridgeshire
CB25 0NA

Your ref

Our ref

12728

Date

24 November 2023

Contact

Tel 0330 303 0119

Dear Mr Auber,

Level 1 Capacity Check Enquiry: Huggens College, College Road, Northfleet, Gravesend, Kent, DA11 9DL.

We have completed the capacity check for the above development site and the results are as follows:

Foul Water

There is currently adequate capacity in the local sewerage network to accommodate a foul flow of **0.9 l/s** for the above development at manhole reference TQ6174**7507**. Please note that no surface water flows (existing or proposed) can be accommodated within the existing foul sewerage system unless agreed by the Lead Local Flood Authority in consultation with Southern Water, after the hierarchy Part H3 of Building Regulations has been complied with.

Connecting to our network

It should be noted that this information is only a hydraulic assessment of the existing sewerage network and does not grant approval for a connection to the public sewerage system. A formal Sewer Connection (S106) application is required to be completed and approved by Southern Water Services. To make an application visit: developerservices.southernwater.co.uk

Please note the information provided above does not grant approval for any designs/drawings submitted for the capacity analysis. The results quoted above are only valid for 12 months from the date of issue of this letter.



Please get in touch via the Get Connected customer dashboard if you have any queries.

Yours sincerely,

Future Growth Planning Team
Developer Services

southernwater.co.uk/developing-building/planning-your-development

Appendix 7

LLFA Pre-app Meeting Minutes



PRE-APPLICATION MEETING

Meeting Minutes

Date/Time : 1 March 2024, 2pm

Location : MS Teams

Attendees: Emily Neale – KCC
Daniel Hoare – KCC
Chris Auber – AFP Consulting
Emily Haysom - Bidwells

Site Location: Huggens College, College Road, Northfleet, Kent DA11 9DL

LPA District N/A

reference:

KCC reference: NON/2024/099333

Discussion Items

- A concept plan was discussed for the construction of 99 new residential units for retirement purposes.
- The LLFA understood that there is little fall across the site except for a slope at the southeastern corner of the site to Chaplain's house.
- The preliminary vision for drainage serving site would consist of a variety of above ground features such as rain gardens, swales, a bog garden and a basin with a possible bund around the edge of the center green.
- A site investigation has been undertaken Southern Testing with the results of this provided within a report. The conclusions drawn from the report is that infiltration within the Boyn Hill Gravel Member is possible and evidenced through the supporting soakage tests carried out. Whilst confirmation that infiltration is possible on site, an advisory of locating soakaways at 10m away from foundations is made and the depth to groundwater has not been proven (tests extending down to 3.1m only). A minimum of 1m separation is required from the base of any infiltration feature and the ground water level.

KCC accept the use of permeable paving systems to manage runoff from the parking areas on site. It is viewed that this may provide sufficient treatment of surface water runoff given the expanse of parking provided. However, our assessment of suitable levels of pollution treatment is viewed through the

guidance stipulated within the CIRIA SuDs manual 2015 part E section 26. Upon a planning submission, we would request demonstration that this has been followed/ adhered to.

- During the discussion, a number of options for drainage features were discussed. This included our recommendation of considering a french drain running parallel to the residential block (minding 10m separation distance). This feature would be envisaged to only receive roof runoff and should therefore not require any pollution treatment prior. Planting on top of the filter drain is permissible as discharge from the roof runoff can be made directly into the trench.
- Further to the inclusion of a french drain/ filter trench, an additional option would be the addition of swales with the french drain underneath. With space constraints on site arising from the expanse of development, root protection areas and separation distance, this option could provide further storage, whilst taking up the same space.
- The idea of a shallow basin within the central greenspace was discussed. This basin would currently be viewed as being no deeper than 0.5m and would extend across much of the space. Consideration of the level of attenuation provided is needed to confirm if additional methods are required. Additional attenuation could be provided through a below ground cellular soakaway. This would be dependent however upon the overall depth to groundwater. A further trial pit/ borehole is advised to confirm this depth.
- Some of the SuDs features could have an impermeable membrane and be used as treatment and conveyance to the basin instead.
- KCC noted on the Topographic drawing that reference was made to an Air Rade Shelter on site and was highlighted by the groundskeeper. It is understood that this may be anecdotal and there does not seem to be any evidence of it. KCC would advise confirming if this feature is present and if so identifying the expanse/ extent of the feature. The presence of this could prevent the inclusion of SuDS features in that area.
- For the assessment on the drainage system through modelling, the latest climate change allowances to apply to the design are 35% for the 30 year return (3.3%) and 45% for the 100 year (1%). A CV value of 0.95 should also ideally be applied to the analysis.
- Due to the area being for retirement purposes, we would view that this proposal does not need the urban creep factor to be considered.
- The site is in a source protection zone. Consultation with the Environment Agency early in the planning process is recommended to identify any constraints or

specific requirements in this area that may impact the proposed SuDs methods.

- KCC suggested the idea of individual plot soakaways, therefore every homeowner has their own soakaway plot to manage, and the roads can go to basin.
- KCC LLFA are open to further discussions once narrowing down of options has taken place.

AFP