



SITE SPECIFIC FLOOD RISK ASSESSMENT & SUDS ASSESSMENT

Kesson House, Northfleet, Gravesend

Impact Developments Gravesend Ltd

April 2024 Rev B

Project no: 62338

Document Review Sheet: -

Document
prepared by: - Oliver Shaw AMCIHT
on behalf of Richard Jackson Ltd

Date: - 11th August 2023

Document
checked by: - Martin Doughty BEng (Hons) CEng FICE FCIHT MAPM
on behalf of Richard Jackson Ltd

Date: - 11th August 2023

Document
Approved by: - Martin Doughty BEng (Hons) CEng FICE FCIHT MAPM
on behalf of Richard Jackson Ltd

Date: - 11th August 2023

Document Status

DRAFT

☐

FINAL

☒

Revision Status

Issue	Date	Description	Prepared	Checked	Approved
A	10.10.23	Updated Layout and Drainage	OCS	MJD	MJD
B	08.04.24	Updated Layout and Drainage	OCS	MJD	MJD

This document has been prepared for the sole use of Impact Developments Gravesend Ltd, is copyright and its contents should not be relied upon by others without the written authority of Richard Jackson Ltd. If any unauthorised third party makes use of this report they do so at their own risk and Richard Jackson Ltd owe them no duty of care or skill.

All information provided by others is taken in good faith as being accurate, but Richard Jackson Ltd cannot, and does not, accept any liability for the detailed accuracy, errors or omissions in such information.

Title: SITE SPECIFIC FLOOD RISK ASSESSMENT & SUDS ASSESSMENT
Project: Kesson House, Northfleet, Gravesend
Client: Impact Developments Gravesend Ltd
Project No.: 62338

Contents:-

1. INTRODUCTION	2
2. EXISTING SITE CONDITIONS	2
3. PROPOSED DEVELOPMENT	3
4. SITE SPECIFIC FLOOD RISK ASSESSMENT	4
5. SURFACE WATER MANAGEMENT.....	5
6. RESIDUAL RISK	11
7. CONCLUSIONS	12
8. LIMITATIONS.....	12

Figures & Drawings

Figure 1	Site Location Plan
Figure 2	Extent of Fluvial and Tidal Flooding
Figure 3	Extent of Surface Water Flooding
62338-PP-001B	Impermeable Areas Plan
62338-PP-002B	Surface Water & Foul Water Drainage Strategy

Appendices

Appendix A	Existing Site Plan and Demolitions
Appendix B	Topographical Survey
Appendix C	Borehole Data
Appendix D	Southern Water Sewer Records
Appendix E	Proposed Site Plan
Appendix F	Flood Map for Planning
Appendix G	KCC Drainage Summary Sheet & Asset Record Sheet
Appendix H	FEH Data
Appendix I	Quick Storage Calculations
Appendix J	Flow Calculations
Appendix K	Drainage Maintenance Regime

1. INTRODUCTION

- 1.1. Richard Jackson Ltd has been appointed by Impact Developments Gravesend Ltd to undertake a Flood Risk Assessment (FRA) and SuDS design for the redevelopment of a site off East & West Kent Avenue, Northfleet for 30 proposed dwellings.
- 1.2. This FRA is in accordance with the National Planning Policy Framework (NPPF), CIRIA SuDS Manual 2015, Planning Practice Guidance (PPG) on Flood Risk and Coastal Change, and the Kent County Council (KCC) Lead Local Flood Authority (LLFA) 'Design Guide' & 'Drainage and Planning Policy' document (2019).
- 1.3. The copyright of this report is vested in Richard Jackson Ltd. The client or its appointed representatives may copy this report in connection with the development described herein. However, it should be noted that this report shall not be copied or distributed in any other form by any other party or used for any other purpose without the written consent of Richard Jackson Ltd.

2. EXISTING SITE CONDITIONS

Site Location

- 2.1. The site is located on approximately 0.31Ha of land to the southwest of East & West Kent Ave, Northfleet. The site has an approximate OS grid reference of 562140, 174232 and a postcode of DA11 9HL. The site is located within a residential area with access proposed off East & West Kent Avenue. The site location plan can be found within **Figure 1**.
- 2.2. The existing site constitutes brownfield land of the former Kesson House care home. Development proposals include the partial demolition of the existing Kesson House building to conversion of 10 No supported living apartments with an additional 20 No flats proposed within 2 new flat blocks. The existing site plan showing demolitions can be found within **Appendix A**.

Topography

- 2.3. The topography of the site indicates that the site falls from its southern boundary at 34.5m AOD and falls in a northerly direction to its northern boundary at 33.0m AOD. The site appears to be situated at the top of a hill with land falling in all directions away from the site. The topographical survey for the site can be found within **Appendix B**.

Ground Conditions

- 2.4. Initial inspections into the ground conditions of the site have been examined using online mapping, which suggests likely freely draining soils are present. Local borehole data for areas nearby the site on a similar topographical level (29.5m AOD) indicate that upper stratum of sandy clay is present to a depth of about 2m below ground level underlain by chalk. Groundwater was not encountered down to a depth of about 0m AOD indicating a minimum depth

of about 33.0m. Local ground conditions indicate the site is likely to have good infiltration rates. The borehole data can be found in **Appendix C**.

- 2.5. Soakage testing for the site is not available and can be obtained at a later planning/design stage to confirm the site's likely good infiltration rates. KCC LLFA Design Guide indicates a minimum 1×10^{-5} m/s infiltration rate would be acceptable for considered infiltration SuDS.

Existing Sewers

- 2.6. The local sewer network is operated by Southern Water. A 300mm foul sewer is present traversing the entire site and is approximately 23m deep. Additional 150mm foul sewer connections are made to this sewer from the existing Kesson House drainage and from nearby dwellings along East & West Kent Avenue. No surface water sewers are present within the vicinity of the site, supporting evidence that the site is likely to have good infiltration rates. The sewer records can be found within **Appendix D**.
- 2.7. Foul sewers traversing the site are to remain as part of the development proposals with some upstream foul drainage connections from the existing Kesson House to be removed and replaced with new connections.

3. PROPOSED DEVELOPMENT

- 3.1. The proposed development is for the partial demolition of the existing Kesson House building to conversion of 10 No supported living apartments with an additional 20 No flats proposed within 2 new flat blocks. The proposed site plan can be found within **Appendix E**.
- 3.2. Residential Development is defined by the NPPF as being 'More Vulnerable' to flood risk. A lifetime of 100 years has been assumed for the purposes of this assessment.
- 3.3. The site lies within Flood Zone 1 indicating a low probability of flooding from rivers and the sea. 'More Vulnerable' development is considered appropriate for sites within Flood Zone 1. The flood map for planning can be found within **Appendix F**.

Climate Change

- 3.4. NPPF guidance states the use of climate change allowances for the development.
- 3.5. A factor of 45% climate change (Upper end allowance) is expected for the 2050s epoch, which is to be taken in accordance with NPPF guidance, and will be used for the drainage strategy.

4. SITE SPECIFIC FLOOD RISK ASSESSMENT

- 4.1. There are five main sources of flooding that have the potential to affect the development and have been considered for the proposed site.

Fluvial and Tidal Flooding

- 4.2. The site is located approximately 700m from the River Thames and therefore the fluvial flooding has been assessed. The proposed development is not affected by flooding from fluvial or tidal sources as shown in **Figure 2**.

Groundwater Flooding

- 4.3. The site is within a Zone 2 Outer Protection Zone for groundwater extraction and is covered by a 'High' unproductive level of aquifer. Water runoff will be adequately treated before discharging into the ground, discussed later. Additionally, SuDS components can be lined with an impermeable geomembrane, if required, to prevent groundwater flooding within the drainage network though this is not deemed necessary as the groundwater level at the site is significantly low (0m AOD), as monitored earlier.

Surface Water Flooding

- 4.4. The surface water flooding for the site has been examined from the High Risk (1 in 30-year event) up to the Low Risk (1 in 1000-year event) scenarios. The proposed development does not receive any flooding from overland surface water flows as shown in **Figure 3**.

Reservoir and Artificial Flooding

- 4.5. No local reservoirs are located nearby the site and the development is not affected by flooding from reservoirs.

Overloading of Existing Drainage Network

- 4.6. No surface water sewers are present within the vicinity of the site and therefore no connection to a local surface water sewer is proposed and overloading of existing surface water networks is considered negligible.

5. SURFACE WATER MANAGEMENT Overview

- 5.1. It is expected that the existing Kesson House roof runoff discharges directly to the ground as there are no surface water sewers, this could be confirmed at a later date if required. The proposed roof runoff from the redeveloped Kesson House building is included within this proposed surface water network.
- 5.2. The redevelopment of the site will incorporate SuDS principles for surface water disposal. Since the site is likely to possess suitable infiltration properties, proposals for on-site ground infiltration are proposed.
- 5.3. Geocellular crates and raingardens have been proposed within the open space areas to attenuate the roof drainage. Permeable paving is proposed for attenuation of all roads/drives.
- 5.4. The completed KCC 'Drainage Strategy Summary' and 'Asset Record Sheet' for the site are shown in **Appendix G**.
- 5.5. This development includes residential roofs which are defined by Table 26.2 of the SuDS manual as being a low pollution hazard, the proposed site use will generate fewer than 300 traffic movements per day and therefore falls into the low traffic road category for pollution hazard requiring treatment indices of:

Table 5.1 – Pollution Hazard Indices (Table 26.2 SuDS Manual 2015)

Land Use	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential Roof	0.2	0.2	0.05
*Low Trafficked Roads	0.5	0.4	0.4

*A low trafficked road is considered to have <300 traffic movements/day, i.e. up to 50 dwellings at 6 movements per day.

Surface Water Quality Control

- 5.6. Surface water quality has been considered for the proposed development in accordance with the SuDS Manual and is shown in **Table 5.2** below:

Table 5.2 – Proposed SuDS Mitigation Indices (Tables 26.2-26.4 of SuDS Manual 2015)

Land Use	SuDS Component	TSS Comparison	Metals Comparison	Hydrocarbons Comparison
Flat Roof/Path Areas	Geocellular Crates and Contaminant Soil	*0.4	*0.3	*0.3
Kesson House Roof	Raingarden / Bioretention Area	0.8	0.8	0.8
Comparison		0.4 > 0.2	0.3 > 0.2	0.3 > 0.05
**Roads and Drives	Permeable Paving	0.7	0.6	0.7
Comparison		0.7 > 0.5	0.6 > 0.4	0.7 > 0.4

*Figures taken for 300mm depth of good contaminant attenuation soil within SuDS Manual.

**The roads and drives within the development are considered to have less than 300 movements per day and are treated as low trafficked roads.

NOTE: The worst-case comparison is made in each case.

- 5.7. All roads/drives within the development are proposed as permeable paving for pollution control. Geocellular crates do not provide the adequate level of pollution treatment therefore a catchpit has been proposed upstream of the crates to trap suspended solids. A minimum of 300mm surround soil has also been proposed around the crates, where required, to treat the runoff of metals and hydrocarbons prior to groundwater discharge for the roof runoff.
- 5.8. The above table demonstrates that the correct level of pollution control is provided within the proposed SuDS components.

Impermeable Areas

- 5.9. The existing site has an impermeable area of approximately 0.21ha. The proposed site includes for an impermeable area of 0.196ha. Urban extensions are not anticipated for the site due to the use of flats therefore urban creep allowance has not been applied. The impermeable area of the site accounts for all roof and road areas as well as some path areas and represents a slight decrease in total impermeable area and expected runoff compared to the existing site. The impermeable 57m² path area on the sides and front of the northern flat block is disregarded and considered to be accommodated in the nearby open space areas.
- 5.10. The proposed drainage network and modelling will assume a robust assessment accounting for 100% of the impermeable areas within the network. The impermeable areas plan for the site can be found on **Drawing 62338-PP-001B**.

FEH Data

- 5.11. The most up to date FEH22 data has been used for the site's drainage proposals. The site's FEH data can be found within **Appendix H**.

Permeable Paving

- 5.12. Permeable paving is proposed for all road and parking areas (and a path area, discussed later) within the development to treat and attenuate all road runoff. Most of the proposed paving falls towards the centre of the road to aid in water collection and is on a typical 1 in 80 to 1 in 100 crossfall. The permeable paving would infiltrate water directly into the ground through well graded open fill at 30% voids with the exception to areas of paving within 5m of a building, which are lined with an impermeable geomembrane to prevent infiltration in accordance with the KCC design guide.

Proposed Storage Calculations based on Impermeable Areas

- 5.13. Preliminary calculations of the required storage for the proposed development have been used to inform the drainage strategy. The calculations assume a minimum infiltration rate of 1×10^{-5} m/s, as indicated within KCC guidance, and are shown in **Appendix I** and **Table 5.3** below. The 1 in 100 year storm event or 1.0% Annual Exceedance Probability (AEP) has been used to assess the storage requirements on the development site.

Table 5.3 – Quick Storage Calculations

Network	Areas	**Total Impermeable Area (m ²)	Storm Event + Climate Change (CC) %	Required Storage (See Appendix I)
A	Flat Block B	0.026Ha	1 in 100-year event plus 45% CC	*20m ³
B	Half of Kesson House Roof	0.011Ha	1 in 100-year event plus 45% CC	*8.5m ³
C	Remaining Kesson House Roof + Flat Block A	0.056Ha	1 in 100-year event plus 45% CC	*42.5m ³

*The figure is taken as an average of the values within Appendix I.

**Figures taken from Drawing 62338-PP-001B.

NOTE: All storage requirements are based on an infiltration rate of 1×10^{-5} m/s.

- 5.14. The above figures are indicative and, from previous experience, represent a more robust storage requirement for the site. The provision of SuDS storage proposed is described within the following paragraphs.

Network A

- 5.15. Aquacell Eco Crates are proposed within the open space area on the western boundary of the site to attenuate the roof runoff from Flat Block B. Each aquacell crate unit is specified as 1m x 0.5m size with 0.4m depth and 95% porosity. Minimum cover of 0.5m is provided in accordance with the manufacturer's specification for all crate areas. 300mm depth of good contaminant soil is proposed underneath the crates for pollution control, where required, but has not been accounted for within the storage volume.

- 5.16. Due to the locality of the nearby garage to the west of the site, the area of infiltration from the crates has been reduced to allow a minimum 5m distance from the garage.
- 5.17. The area of crates is a total of 25.5m² at 1.2m depth, totalling 29.07m³ of storage.

Network B

- 5.18. Another area of aquacell crates is proposed for part of the Kesson House roof area and is a total of 6m² at 0.8m depth, totalling 4.56m³ of storage.
- 5.19. A raingarden is proposed to the rear of the Kesson House building. The raingarden would be landscaped with associated planting of 13m² with 1.0m depth of underlying good attenuation potential soil at 30% voids, totalling approximately 3.9m³ of storage. A maximum 1.0m depth is stated within the KCC guidance. Any overflow of water would be directed into the surface water sewer network with an eventual outfall to the area of crates.
- 5.20. Further volume could be contained within the raingardens up to a depth of 150mm within the paved upstand. In this case, the 13m² raingarden could contain a further 1.95m³ of storage (13m² x 0.15m) if required as stated with the KCC guidance.

Network C

- 5.21. Areas of aquacell crates are proposed for the remaining roof area of Kesson House and Flat Block A. The crates total 36m² at 1.2m depth, total 41.04m³ of storage.
- 5.22. Permavoid crates are proposed further upstream as offline storage between the Flat Blocks and will therefore be lined with an impermeable geomembrane to prevent infiltration influence on the building foundations. Each permavoid crate unit is specified as 0.708m x 0.354m size with 0.15m depth and 95% porosity. The crates can accommodate higher loading when compared with the aquacell crates and therefore 0.2m cover is proposed.
- 5.23. The area of permavoid crates is a total of 17.5m² at 0.45m depth, totalling 7.5m³ of storage.
- 5.24. An area of path south of Flat Block A is proposed as permeable paving at 36m² and 0.5m depth with a carrier pipe, totalling 5.4m³.
- 5.25. A summary of the proposed storage volumes are shown in **Table 5.4** below:

Table 5.4 – Proposed Storage Volumes

Network	Required Storage (See App I)	SuDS Component	Total Storage Provided
A	*20m ³	Crates of 25.5m ² at 1.2m depth	29.07m ³
B	*8.5m ³	Raingarden of 13m ² at 1.0m depth	3.9m ³
		Crates of 6m ² at 0.8m depth	4.56m ³
C	*42.5m ³	Crates of 36m ² at 1.2m depth	41.04m ³
		Permavoid of 17.5m ² at 0.45m depth	7.5m ³
		Permeable path of 36m ² at 0.5m depth	5.4m ³

*The figure is taken as an average of the values within Appendix I.

NOTE: The storage values provided for Networks A & C are likely to be higher than the required storage estimates as some storage is lined with an impermeable membrane.

Surface Water Modelling

- 5.26. The proposed surface water drainage network and SuDS attenuation components have been modelled using Flow and the positioning of the SuDS components are shown on **Drawing 62338-PP-002B**. Roof drainage has been distributed into 3 separate networks:
- Network A (Western Site) – 0.026Ha
 - Network B (Eastern Site) – 0.011Ha
 - Network C (Central Site) – 0.056Ha
- 5.27. The contributing impermeable areas on **Drawing 62338-PP-001B** across the surface water networks are summarised within **Appendix J** including the surface water modelling Flow output.
- 5.28. The drainage Networks A-C have been assessed for the 1 in 1, 1 in 30 and the 1 in 100-year event with/without climate change (CC) at 45% in accordance with KCC guidance. The calculations show that the water for the 1 in 100-year storm with 45% CC can be fully accommodated within the drainage networks with no flooding expected.
- 5.29. In addition, all FFLs of the site are at least 300mm above the maximum expected water level for the 1 in 100-year storm with 45% CC storm event within the nearby network.

Half Drain Down Times

- 5.30. KCC Guidance states that storage components should half drain within 24 hours for up to the 1 in 30-year event. Capacity for subsequent storm events for all networks are shown in **Table 5.5** below:

Table 5.5 – 1 in 30 Year Return Period Storage

Network	Available Volume (See Table 5.4)	1 in 30 Year Storm Volume	Available Capacity for Subsequent Storm
A	29.07m ³	*14.5m ³	14.57m ³
B	8.46m ³	*4.4m ³	4.06m ³
C	53.94m ³	*24.1m ³	29.84m ³

*Figures are taken from the Node Volumes within Appendix J for the 1 in 30-year outputs.

- 5.31. It is demonstrated within the above that Networks A & C have available capacity for a subsequent 1 in 30-year event immediately succeeding another 1 in 30-year event and would not flood.
- 5.32. Network B would require an additional 0.34m³ (4.4 - 4.06) of storage, which is able to be compensated within the 3m length of 375mm pipe totalling 0.34m³ of storage or otherwise could be accommodated within the 150mm raingarden upstand.

Permeable Paving

- 5.33. KCC Guidance states that storage components should half drain within 24 hours for up to the 1 in 30-year event. Permeable Paving outputs across the site indicate that half drain down times of up to 313 mins are expected and therefore conforms with KCC Guidance.
- 5.34. It is demonstrated in **Table 5.6** below that results for the 1 in 100-year event plus 45% CC indicate permeable paving depths across the site are typically 300mm-400mm.

Table 5.6 – Permeable Paving Flow Outputs

Paving Area	Details	Total Impermeable Area	Maximum Water Level for 1% AEP + 45% CC and Volume	Maximum Water Level for 3.33% AEP and Volume
A	11m width, 1 in 100 slope	0.035Ha	0.232m (*21.7m ³)	0.118m (*9.7m ³)
B	Typical 5m width, 1 in 100 slope	0.022Ha	0.363m (*19.2m ³)	0.161m (*8.2m ³)
C	Typical 10m width, 1 in 100 slope	0.019Ha	0.269m (*13.5m ³)	0.137m (*5.9m ³)
D	Typical 7.6m width, 1 in 25 slope	0.022Ha	0.394m (*16.4m ³)	0.253m (*7.2m ³)

NOTE: Calculations assume a 1×10^{-5} m/s infiltration rate.

*Figures are taken from the Node Volumes within Appendix J for the 1 in 100 & 1 in 30-year outputs for each Permeable Paving Area.

- 5.35. Results for the 1 in 30-year storm events reach volumes below half the total volume contained within each permeable paving area for the 1 in 100-year event plus 45% CC and therefore the permeable paving has adequate

volume to fully contain a 1 in 30-year event immediately succeeding a prior 1 in 30-year storm, if required.

Proximity of Drainage to Buildings

- 5.36. Pipe 1.002C is to be constructed and maintained between the foundations of Flat Block B and Kesson House in accordance with the Sewerage Sector Guidance App C. A minimum gap of 1.45m is present between the buildings (after allowing for 300mm foundation widths). The 150mm pipe has an invert level of about 32.570m AOD in the vicinity of the foundations and is located about 0.65m from the southern Flat Block foundations, with an expected foundation base level of about 32.55m AOD (1m deep) and also 0.65m from the Kesson House foundations. Viewing the existing topographical survey data, the likely existing foundation base level of Kesson House is approximately 32.60m AOD. It is demonstrated that the pipe allows for about a 600mm clearance from both foundations loading influences.

Foul Water

- 5.37. The foul water for the proposed Block of Flats is to discharge to the existing 150mm Southern Water foul sewer located on the site, at its northeastern end. The existing 150mm foul sewer further connects to the deeper foul sewer within East Kent Avenue. The proposed foul sewer will discharge by gravity and its positioning is shown on **Drawing 62338-PP-002B**.
- 5.38. The foul sewer connection from the existing Kesson House is to remain with its point of connection to the existing foul sewer at the southwestern corner of the site. The sewer is to be re-laid within the proposed parking off the development's proposed access road.
- 5.39. A Pre-Planning Enquiry can be submitted to Southern Water at a later planning/design stage to confirm the acceptance of the site's foul discharge flows, which are likely to replicate existing flows.

SuDS Maintenance

- 5.40. For the development proposed, the permeable paved road will be the responsibility of the landowner or management company as appropriate. Each area of geocellular crates and raingarden will be maintained by the owner/landlord(s) of the Block of Flats or Kesson House or otherwise maintained by a management company. A schedule for this maintenance plan is shown within **Appendix K**.

6. RESIDUAL RISK

- 6.1. The residual risks of flooding at the site include:
- Surface water flooding under more extreme events exceeding the capacity of the network. Water would be directed away from dwellings and towards the permeable paved road and grassed areas. Exceedance flows are shown on **Drawing 62338-PP-002B**;

- Groundwater flooding entering the network. The groundwater level is likely to be much lower than the ground level of the site and therefore groundwater flooding is considered negligible.

7. CONCLUSIONS

- 7.1. Richard Jackson Ltd has reviewed the site flood risk and drainage strategy for the proposed site at East and West Kent Avenue, Northfleet. This FRA has also reviewed the relevant planning policy for the site with respect to flood risk and SuDS design and it is considered that the proposals comply with policy.
- 7.2. The development is situated in Flood Zone 1 and is appropriate for development for that zone according to NPPF guidance. Therefore, a sequential approach and exception test are not applied to the proposals.
- 7.3. The surface water strategy has been designed to appropriately accommodate all associated flows for up to a 1 in 100 year (1.0% AEP) plus 45% climate change event in accordance with KCC LLFA guidance.

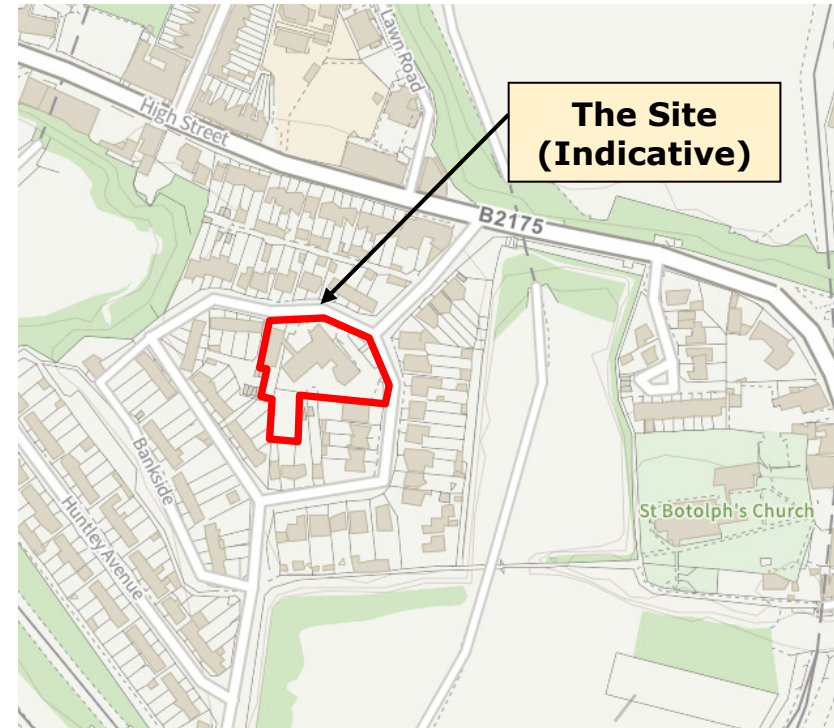
8. LIMITATIONS

- 8.1. This report has been produced for the sole use of Impact Developments Gravesend Ltd. Its contents should not be relied upon by others without the written authority of Richard Jackson Limited. If any unauthorised third party makes use of this report, they do so at their own risk and Richard Jackson Limited owes them no duty of care or skill.
- 8.2. All information provided by others is taken in good faith as being accurate, but Richard Jackson Limited cannot, and does not, accept any liability for the detailed accuracy, errors or omissions in such information.

FIGURES & DRAWINGS



REPRODUCED FROM ORDNANCE SURVEY MAP WITH THE PERMISSION OF THE
CONTROLLER OF HIS MAJESTY'S STATIONARY OFFICE. ©
CROWN COPYRIGHT RICHARD JACKSON LTD – ACC No. 100002572



Kesson House, Northfleet, Site Location Grid Reference
562140, 174232 and Postcode DA11 9HL

Client:

**Impact Developments
Gravesend Ltd**

Drawing Title:

**Site Location Plan
(Indicative)**

Job Title:

**Kesson House, Northfleet,
Gravesend**

Date:

06.07.23

Job No:

62338

Dwg No:

**Fig. 1
(NTS)**

 **Richard Jackson**
Engineering Consultants

4 The Old Church, St Matthews Road, Norwich, NR1 1SP
Tel. 01603 230240
www.richardjackson.uk.com



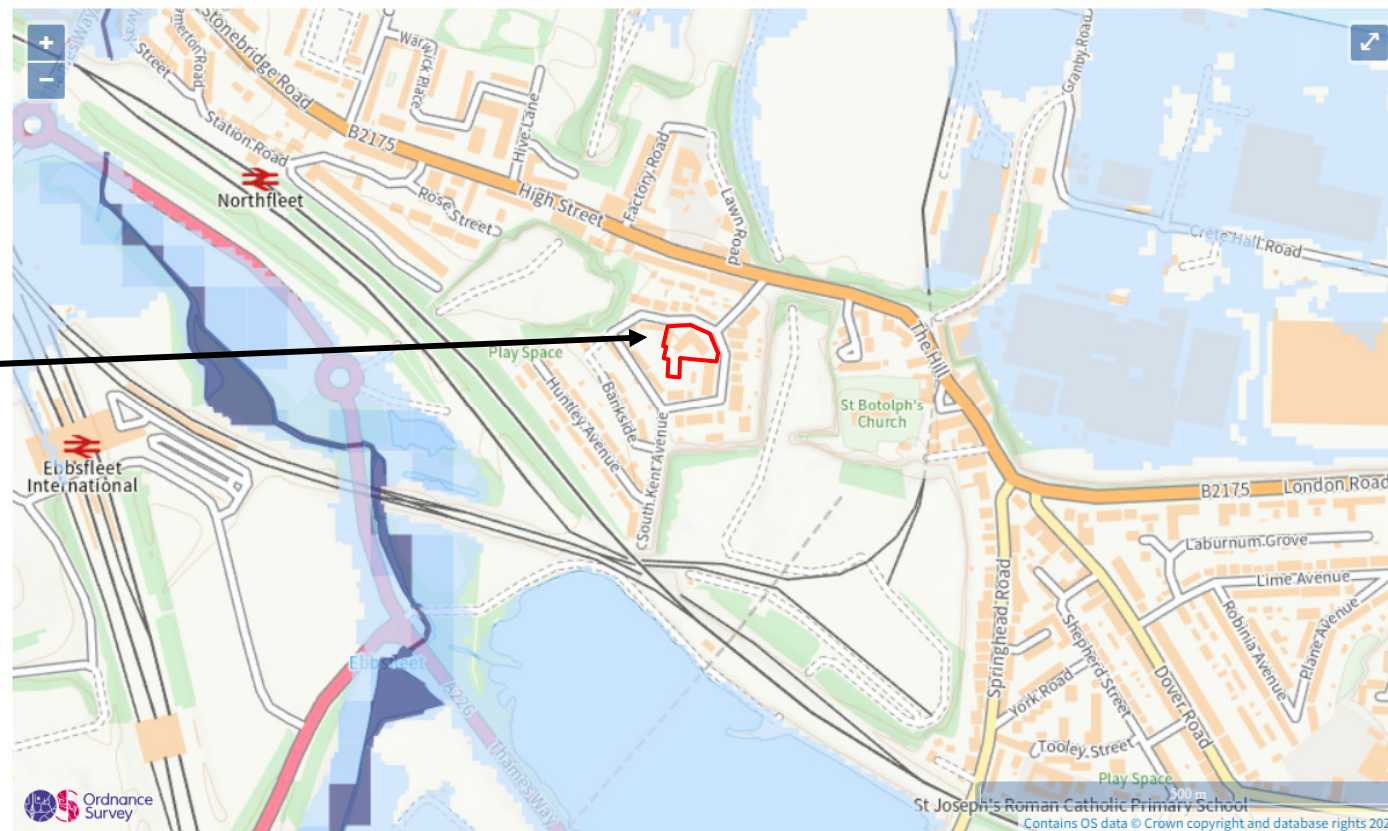
Flood risk

Extent of flooding

Location

Enter a place or postcode

The Site



Extent of flooding from rivers or the sea

● High ● Medium ● Low ● Very low

REPRODUCED FROM ORDNANCE SURVEY MAP WITH THE PERMISSION OF THE
CONTROLLER OF HER MAJESTY'S STATIONARY OFFICE, ©
CROWN COPYRIGHT RICHARD JACKSON LTD – ACC No. 100002572

Client: Impact Developments Gravesend Ltd		Drawing Title: Extent of Fluvial and Tidal Flooding		 Richard Jackson Engineering Consultants 4 The Old Church, St Matthews Road, Norwich, NR1 1SP Tel. 01603 230240 www.richardjackson.uk.com
Job Title: Kesson House, Northfleet, Gravesend	Date: 06.07.23	Job No: 62338	Dwg No: Fig. 2 (NTS)	



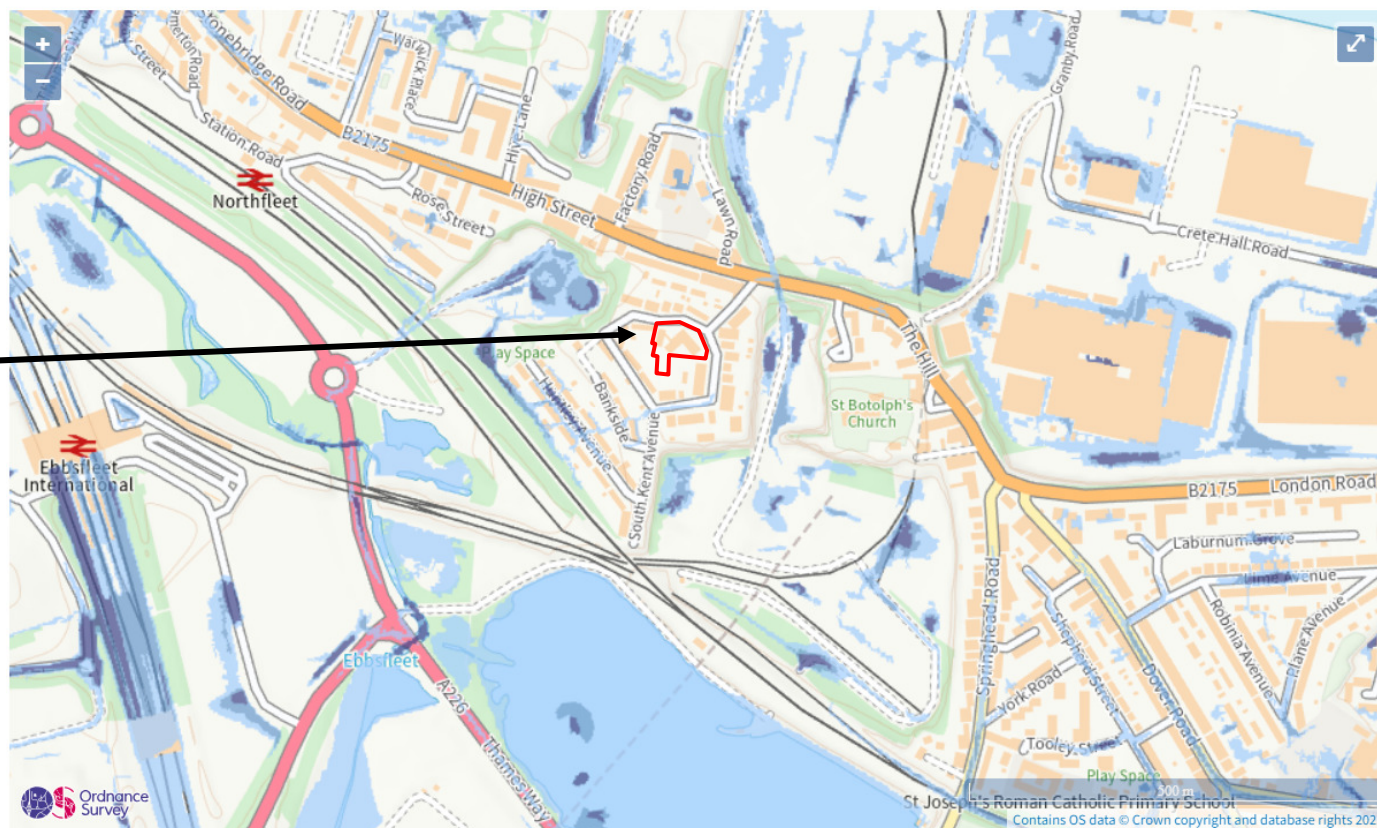
Flood risk

Extent of flooding

Location

Enter a place or postcode

The Site



Extent of flooding from surface water

High Medium Low Very Low

REPRODUCED FROM ORDNANCE SURVEY MAP WITH THE PERMISSION OF THE
CONTROLLER OF HER MAJESTY'S STATIONARY OFFICE, ©
CROWN COPYRIGHT RICHARD JACKSON LTD - ACC No. 100002572

Client:

**Impact Developments
Gravesend Ltd**

Drawing Title:

**Extent of Surface Water
Flooding**

Job Title:

**Kesson House, Northfleet,
Gravesend**

Date:

06.07.23

Job No:

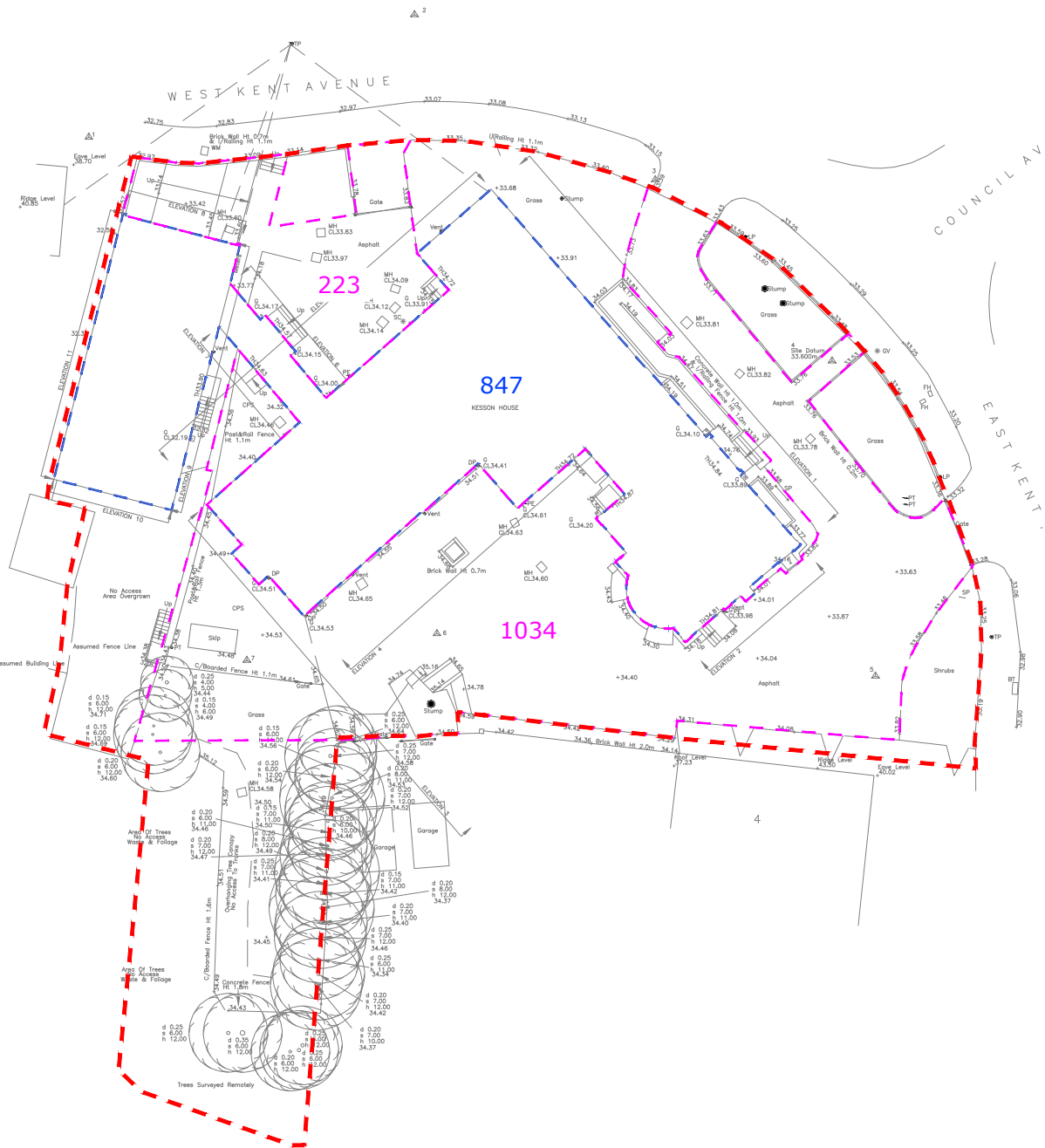
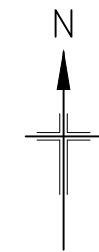
62338

Dwg No:

**Fig. 3
(NTS)**

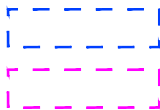
Richard Jackson
Engineering Consultants

4 The Old Church, St Matthews Road, Norwich, NR1 1SP
Tel. 01603 230240
www.richardjackson.uk.com



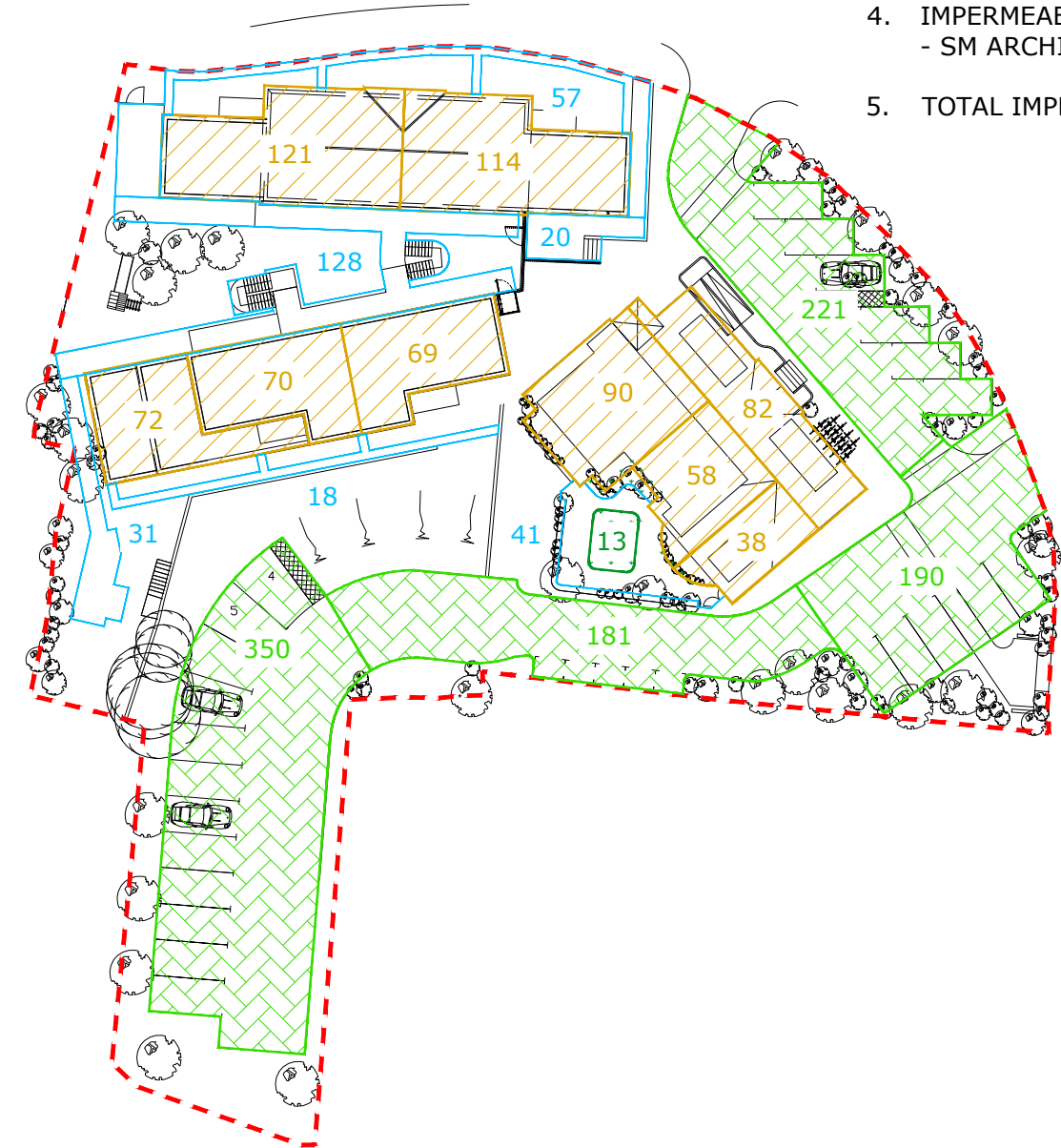
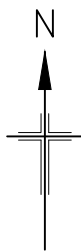
EXISTING IMPERMEABLE AREAS

KEY:

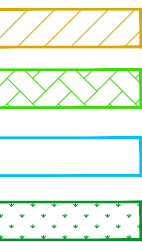


EXISTING IMPERMEABLE ROOF AREA, m² SHOWN - TOTAL 847m²

EXISTING IMPERMEABLE SURFACED AREA, m² SHOWN - TOTAL 1257m²



PROPOSED IMPERMEABLE AREAS



PROPOSED IMPERMEABLE ROOF AREA, m² SHOWN - TOTAL 714m²

PROPOSED PERMEABLE ROAD AREA, m² SHOWN - TOTAL 942m²

PROPOSED IMPERMEABLE PAVED AREA, m² SHOWN - TOTAL 296m²

PROPOSED BIORETENTION AREA, m² SHOWN - TOTAL 13m²

NOTES:

1. ALL DIMENSIONS ARE IN METRES UNLESS INDICATED OTHERWISE. ALL IMPERMEABLE AREAS ARE SHOWN TO THE NEAREST m².
2. ALL LEVELS ARE IN METRES AND RELATE TO ORDNANCE SURVEY DATUM.
3. ALL LAND BOUNDARIES REQUIRE CHECKING.
3. DRAWING BASED ON TOPOGRAPHICAL SURVEY COMPLETED BY LASER SURVEYS DRAWING L10392/1 TO L10392/7 DATED JUNE 2021.
4. IMPERMEABLE AREAS BASED ON ROOF PLAN BY ATELIER - SM ARCHITECTS LTD A-21251-P-03-204 P7.
5. TOTAL IMPERMEABLE AREA TO BE DRAINED IS 1964m².

B	10.04.24	UPDATED LAYOUT	OCS	MJD
A	10.10.23	UPDATED LAYOUT	OCS	MJD
REV	DATE	DESCRIPTION	DRAWN	CHKD

REVISIONS

This drawing is to be read in conjunction with all other Engineer's drawings and all other project information. Any discrepancy between the Engineer's drawings and other project information is to be reported to the Engineer immediately.



Project
KESSON HOUSE, NORTHFLEET,
GRAVESEND

Title
IMPERMEABLE AREAS PLAN

Client
IMPACT DEVELOPMENTS
GRAVESEND LTD

Scale	Drawn	Date
1:500 @A3	OCS	01/08/23
Job Manager	Checked	Approved
MJD	MJD	MJD

847 The Crescent, Colchester, Essex CO4 9YQ
Unit 06C130, 6th Floor, 1 St. Katherine's Way, London, E1W 1UN
5 Quern House, Mill Court, Great Shelford, Cambs CB22 5LD
4 The Old Church, St. Matthews Road, Norwich, Norfolk NR1 1SP
The Wheelhouse, Bonds Mill, Stonehouse, Gloucestershire GL10 3RF

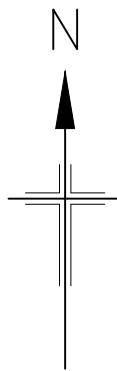
Tel: 01206 228800
Tel: 020 7448 9910
Tel: 01223 314794
Tel: 01603 230240
Tel: 01172 020070

Email Address: mail@rj-uk.com
Website: http://www.rj-uk.com

Drawing No.	Revision
62338-PP-001	B

Drawing Status	INFORMATION	APPROVAL	COSTING
TENDER	CONSTRUCTION	AS CONSTRUCTED	

DO NOT SCALE



INDICATIVE SITE BOUNDARY
(RED DASHED)

PATH AREA ACCOMMODATED
IN LANDSCAPING

PERMEABLE PAVING AREA D
(PURPLE) TO BE 0.4m DEPTH. SEE
CROSS SECTION FOR DETAILS

EXISTING FOUL SEWER
TO BE RE-LAID

FLAT BLOCK A
FFL: 33.650

FLAT BLOCK B
FFL: 33.650

KESSON HOUSE
EXISTING FFL: 34.763

NON-INFILTRATING
PERMEABLE PAVING OF 36m²
AT 0.5m DEPTH. SEE CROSS
SECTION FOR DETAILS

NON-INFILTRATING PERMAVOID
CRATES OF 17.5m² AT 0.45m
DEPTH WITH MINIMUM 0.2m COVER

AQUACELL CRATE AREAS TO
DRAIN FLAT BLOCK A AND
KESSON HOUSE. TOTAL
AREA: 36m² AT 1.2m
DEPTH AND 0.7m COVER

EXISTING FOUL SEWER
TO BE REMOVED

AQUACELL CRATES TO DRAIN
FLAT BLOCK B. TOTAL AREA:
25.5m² AT 1.2m DEPTH AND
0.5m COVER

SOUTHWEST CORNER OF
CRATES TO BE LINED WITH
IMPERMEABLE MEMBRANE
DUE TO PROXIMITY OF
OFF-SITE GARAGE

FOUL SEWER TO BE
RE-LAID IN PROPOSED
ROAD AS SHOWN

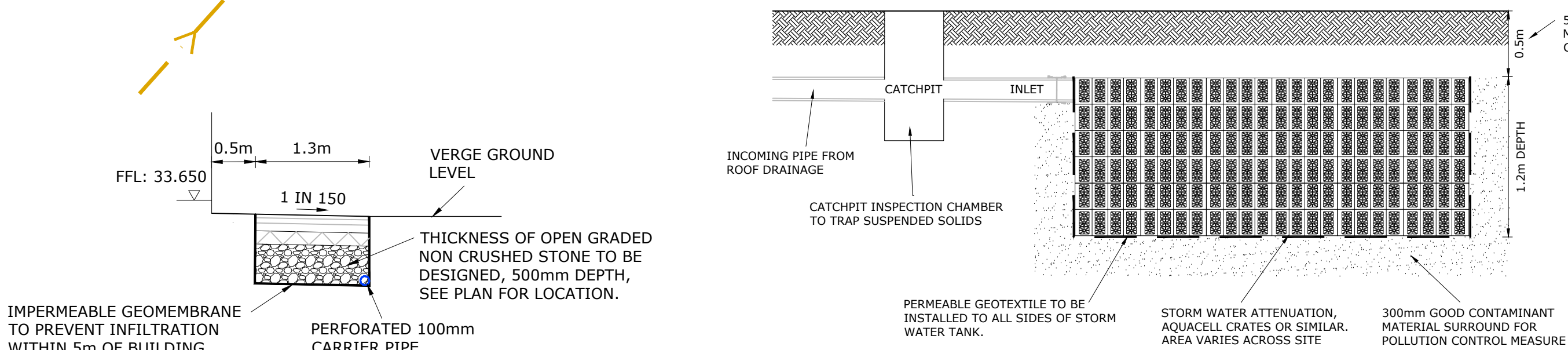
13m² RAINGARDEN/BIORETENTION
FEATURE OF 1.0m SOIL DEPTH &
AQUACELL CRATES OF 6m² AT
0.8m DEPTH AND 0.5m COVER TO
DRAIN KESSON HOUSE

PERMEABLE PAVING TO BE
LINED WITH IMPERMEABLE
GEOMEMBRANE WITHIN 5m
OF BUILDING

PERMEABLE PAVING AREA B
(PINK) TO BE 0.375m DEPTH.
DRAINS BLUE PATH AREA
SHOWN NORTH. SEE CROSS
SECTION FOR DETAILS

EXISTING FOUL SEWER OF
20m DEPTH ACROSS THE SITE

PERMEABLE PAVING AREA A
(GREEN) TO BE 0.25m DEPTH. SEE
CROSS SECTION FOR DETAILS

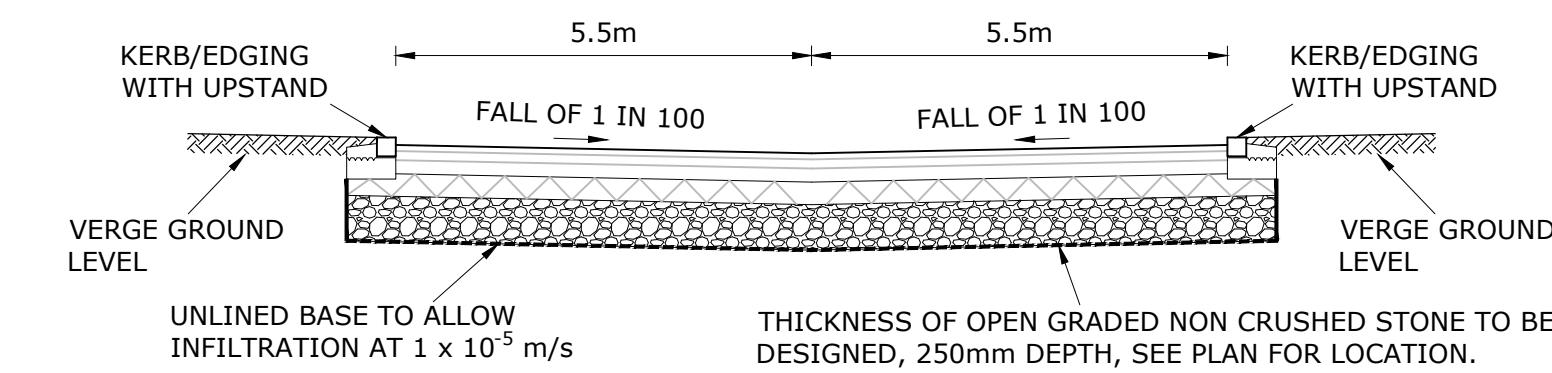


PERMEABLE PAVING CROSS SECTION

SCALE NTS

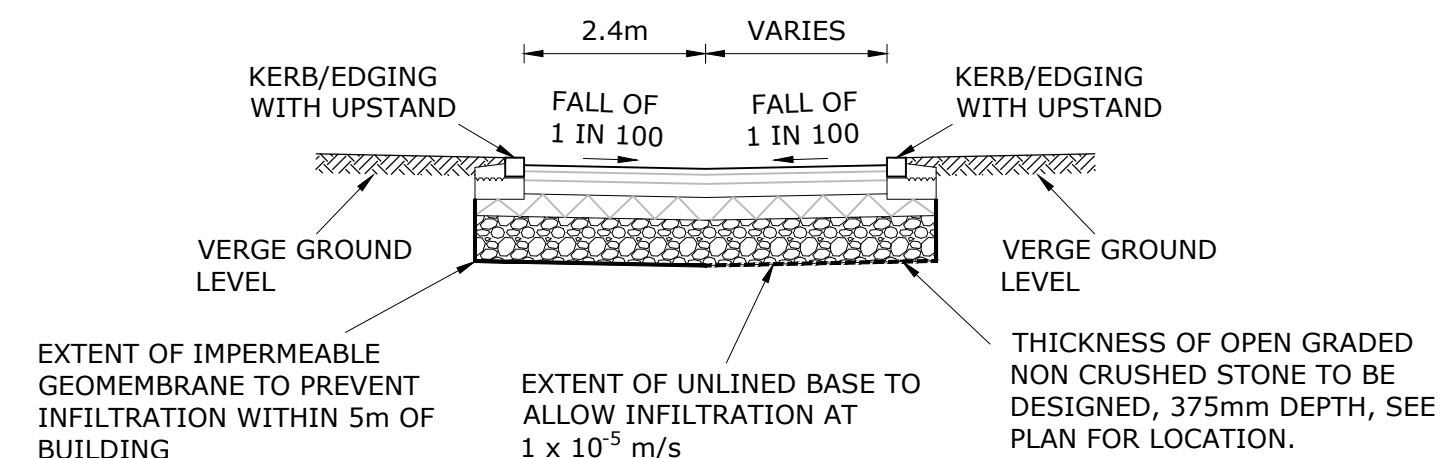
TYPICAL CELLULAR CRATE WITH CATCHPIT CROSS SECTION

SCALE NTS



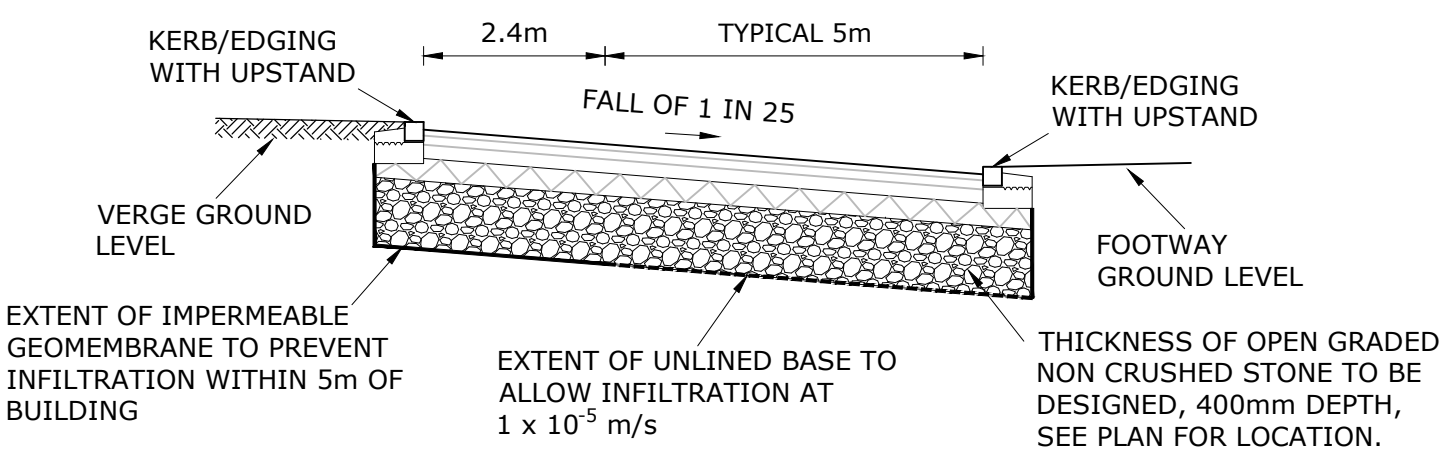
TYPICAL PERMEABLE PAVING CROSS SECTION - AREA A

SCALE NTS



TYPICAL PERMEABLE PAVING CROSS SECTION - AREA B & C

SCALE NTS



TYPICAL PERMEABLE PAVING CROSS SECTION - AREA D

SCALE NTS

NOTES:

1. ALL DIMENSIONS ARE IN METRES UNLESS INDICATED OTHERWISE. ALL LEVELS ARE IN METRES ABOUT ORDNANCE SURVEY DATUM.
2. ALL LAND BOUNDARIES REQUIRE CHECKING.
3. DRAWING BASED ON TOPOGRAPHICAL SURVEY COMPLETED BY LASER SURVEYS DRAWING L10392/1 TO L10392/7 DATED JUNE 2021.
4. ALL DRAINAGE DESIGNED FOR 1 IN 100 YEAR EVENT PLUS 45% CLIMATE CHANGE.
5. ALL DRAINAGE IS DESIGNED ON A MINIMUM INFILTRATION RATE OF 1×10^{-5} m/s ACCEPTABLE TO KCC.
6. DRAINAGE DESIGN BASED ON ROOF PLAN BY ATELIER - SM ARCHITECTS LTD A-21251-P-03-204 P7.
7. ALL LANDSCAPING TO BE REMOVED WITHIN 5m OF DRAINAGE INFRASTRUCTURE. INFILTRATING SUDS COMPONENTS DESIGNED TO BE 5m FROM BUILDINGS.
8. ALL 100% OF IMPERMEABLE AREAS ARE ACCOUNTED FOR WITHIN THE DRAINAGE NETWORK INCLUDING THE EXISTING KESSON HOUSE AREA OF WHICH ITS EXISTING DRAINAGE IS TO BE CONFIRMED.
9. IMPERMEABLE AREAS BASED ON THE DATA AS INDICATED ON THIS DRAWING, CHANGES TO THE LAYOUT WILL RESULT IN CHANGES TO THE DRAINAGE SYSTEM.
10. ALL FINISHED FLOOR LEVELS ARE DESIGNED 300mm ABOVE THE MAXIMUM EXPECTED WATER LEVEL FOR THE 1 IN 100 YEAR EVENT WITH 45% CLIMATE CHANGE WITHIN THE NEARBY SYSTEM.
11. WHERE NECESSARY, THE PERMEABLE PAVING WILL REQUIRE CHECK DAMS TO MAINTAIN SUFFICIENT DEPTH TO PROVIDE ADEQUATE STORAGE, THIS CAN BE COMPLETED AT DETAILED DESIGN STAGE.

KEY:

PIPE DETAILS: 1.000C 16m - 100/150
(PIPE No LENGTH(m) - GRADIENT/DIAMETER(mm))

CL COVER LEVEL
IL INVERT LEVEL
MH1219 SOUTHERN WATER MANHOLE REFERENCE
SW SURFACE WATER
FW FOUL WATER
S1A SURFACE WATER MANHOLE REFERENCE
F1 FOUL WATER MANHOLE REFERENCE
FFL FINISHED FLOOR LEVEL
RWP RAINWATER PIPE

PROPOSED SW SEWER AND MH

INDICATIVE RWP CONNECTION

PROPOSED FW SEWER AND MH

EXISTING FW SEWER TO REMAIN AND MH

EXISTING FW SEWER TO BE RE-LAID/REMOVED

IMPERMEABLE ROOF AREA

IMPERMEABLE SURFACE AREA

UNLINED PERMEABLE PAVING
(GROUND INFILTRATION)

LINED PERMEABLE PAVING
(NO INFILTRATION)

UNLINED GEOCELLULAR CRATES

LINED GEOCELLULAR CRATES

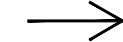
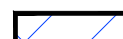
RAINGARDEN/BIORETENTION FEATURE

EXCEEDANCE FLOW

DIRECTION OF FALL

LOW POINT OF PERMEABLE PAVING

LEVEL OF ROAD/PATH (mAOD)



B	10.04.24	UPDATED LAYOUT AND DRAINAGE	OCS	MJD
A	10.10.23	UPDATED LAYOUT AND DRAINAGE	OCS	MJD
REV	DATE	DESCRIPTION	DRAWN	CHKD

REVISIONS

This drawing is to be read in conjunction with all other Engineer's drawings and all other project information. Any discrepancy between the Engineer's drawings and other project information is to be reported to the Engineer immediately.



Project
**KESSON HOUSE, NORTHFLEET,
GRAVESEND**

Title
**SURFACE WATER & FOUL WATER
DRAINAGE STRATEGY**

Client
**IMPACT DEVELOPMENTS
GRAVESEND LTD**

Scale 1:200 @ A1	Drawn OCS	Date 01/08/23
Job Manager MJD	Checked MJD	Approved MJD

847 The Crescent, Colchester, Essex CO4 9YQ
Unit 06C130, 6th Floor, 1 St. Katherine's Way, London, E1W 1UN
5 Quern House, Hill Court, Great Shefford, Cambs CB22 5LD
4 The Old Church, St. Matthews Road, Norwich, Norfolk NR1 1SP
The Wheelhouse, Bonds Mill, Stonehouse, Gloucestershire GL10 3RF

Tel: 01206 228800
Tel: 020 7448 9910
Tel: 01223 334794
Tel: 01603 230240
Tel: 01172 020070

Email Address: mail@rj.co.uk
Website: http://www.rj.co.uk

Drawing No.
62338-PP-002

Revision
B

Drawing Status
☒ INFORMATION
☐ TENDER

☐ APPROVAL
☐ CONSTRUCTION

☐ COSTING
☐ AS CONSTRUCTED

APPENDIX A

Client:

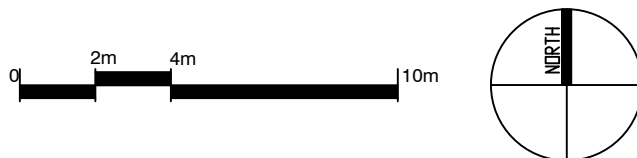
IMPACT DEVELOPMENTS GRAVESEND Ltd.

Notes:

1. Do not scale from this drawing.
2. Site verify all dimensions and levels prior to construction.
3. Report all discrepancies to the Drawing Originator immediately.
4. This drawing is to be read in conjunction with all relevant documents and drawings.

[illegible]

FOR ELEVATIONS REFER TO DRAWING;
A-21251-P-ML-101



Drawing Originator

atelier - sm (architects)
CHARTERED ARCHITECTS & DESIGNERS

atelier - sm (architects) Ltd
11, Essex House, Station Lane, Upminster, RM14 2SJ
+44 (0)1708 988 295 Email: info@atelier-sm.co.uk

Drawing Status

PRELIMINARY

Project Name

KESSON HOUSE

Drawn by ATELIER	Drawn Date -	Checked by -	Checked Date -
---------------------	-----------------	-----------------	-------------------

Scale
1:200 @ A1

Title	Original drawing sheet is A1
-------	------------------------------

GENERAL ARRANGEMENT EXISTING SITE PLAN SHOWING DEMOLITIONS

Discipline	Project	Subject	Area	Drawing Number	Revision
A	-21251-	P	- 00	- 100	-

APPENDIX B

DATUM NOTES

GRID ORIGIN IS BASED UPON SURVEY STATION 4 FIXED TO THE ORDNANCE SURVEY NATIONAL GRID BY LEICA SMARTNET GPS NETWORK. A SCALE FACTOR OF 1 APPLIES TO THIS DRAWING.
IN MEASURED DISTANCES ON THE GROUND WITHOUT GPS WILL BE THE SAME AS THOSE MEASURED ON THIS DRAWING.
LEVELS ARE RELATED TO THE ORDNANCE SURVEY GPS ACTIVE NETWORK AND TRANSFORMED USING THE OSDAT15 & OSTN15 MODEL.
SITE BENCH MARK ESTABLISHED IS LOCATED AT :- STATION 4
VALUE GIVEN AS 33.600m
SURVEY CONTROL STATIONS SHOWN

ABBREVIATIONS (where applicable)

AV	Air Valve	MH	Munhole Cover
BK	Brick	MS	Milestone
BL	Ballard	MT	Meter
BS	Bus Stop	MY	Mercury
BT	British Telecom	OB	Overhead
CB	Control Box	DM	Down
CLB	Close Boarded	PMW	Paving
CL	Cover Level	PS	Post Box
CLK	Chainlink	PE	Pipe
CL	Column	PM	Parking Meter
Conc	Concrete	P/R	Post and Rail
CP	Catch Pit	PT	Post
CPS	Concrete Paving Slabs	P/W	Post and Wire
CATV	Cable Television	RE	Rodding Eye
IC	Drainage Channel	RCT	Retaining
BP	Brain Pipe	RS	Road Sign
EC	Electricity Cover	RSJ	Rollled Steel Joist
ER	Earthing Rod	SC	Stop Cock
FB	Floor Bed	SK	Skew
F	Fence	SP	Signpost
PH	Fire Hydrant	ST	Silt Trap
FL	Floor Level	SV	Stop Valve
FP	Flag Pole	SVC	Security Video Camera
GP	Gate Post	TCL	Telephone Call Box
GV	Gas Valve	TK	Tank
GT/G	Gully	TL	Traffic Light
HT	Height	TP	Telegraph Pole
IC	Inspection Cover	UG	Underground
IL	Invert Level	UT	Unable to Trace Further
IN	Interceptor	UTL	Unable to Lift
L/R	Iron Railings	VP	Vent Pipe
KD	Kerb Ductlet	WL	Water Level
LB	Litter Bin	WM	Water Meter
LP	Lamp Post	WD	Wash Duct

B Floor to Beam Height in cms
C Floor to Ceiling Height in cms
Cr Floor to Crown Height in cms
D Floor to Door Head Height in cms
FC Floor to False Ceiling Height in cms
FF False Floor Level
H Floor to Head Height in cms
S Floor to Sill Height in cms
Spr Floor to Springer Height in cms

NOTES

- Drainage pipe sizes (where shown) have been gauged from the surface for safety reasons and should be regarded as approximate only.
- Tree species (where shown) should be treated with caution and expert identification is advised.
- Although this is a digital survey the accuracy and amount of detail shown is only commensurate with the graphical scale of mapping as specified. Care should be exercised when working to larger scales.
- Visible features in the vicinity of the boundaries as shown above, may not represent the extent of legally conveyed ownership.
- Whilst every effort has been made to achieve accuracy on this plan, CRUCIAL clearance dimensions, levels and invert levels should be checked prior to design and construction.
- Kerb levels have been taken in the bottom of the channel.
- Areas of dense undergrowth cannot be surveyed in detail, these areas will be shown in outline only and marked as 'dense undergrowth' on the plan.

SHEET LAYOUT

NOT TO SCALE

**KESSON HOUSE
COUNCIL AVENUE
GRAVESEND
DA11 9HN**

TOPOGRAPHICAL SURVEY

SURVEYED FOR IMPACT DEVELOPMENTS GRAVESEND LTD
11 ESSEX HOUSE
STATION ROAD
UPMINSTER
NR14 4ST

SURVEYOR EF
DATE JUNE 2021

NO	DATE	REVISION	DRAWING NO	L	10392/1	REV	0
			SCALE	1	: 200@A1		
			SEE ALSO DWG NOS	L			
			SHEET	1	of 1		
			REF NO	L	10392		

APPENDIX C



Richard Jackson
Engineering Consultants

REF: 62338
SHEET: 1
DATE: 10.08.23



HOLST & CO. LTD. TQ67SW-356
SITE INVESTIGATION DEPT.
5-7, NEW YORK ROAD 6198, 7437
LEEDS, 2

Contract No. 19007/F958

Borehole No. T1 (1)

Location Northfleet

Ground Level 96.71

Client A P C M Ltd

Date 4th June 1968

BOREHOLE LOG

STRATA	Legend	Depth below Ground Level	Thickness of Strata	Type of Sample	c lb/sq. ft.	ϕ deg.	m.c %	y lb/cu. ft.	N
Concrete		1'0"	1'0"	2'0" □	500	10	19.2	127	
Fill:- Soft light brown very sandy clay		12'0"	11'0"	7'0" I 12'0" I					2
Fill:- Brick and ash with sandy clay		19'0"	7'0"	17'0" I 20'0" □					12
Chalk with flints			77'0"	25'3" □ 30'6" I 36'0" I 41'3" I 47'0" I 52'0" I 57'6" □ 62'9" I 68'0" I	11730	0	30	120	17
									16
									15
									17
									32
					6000	0	30.1	120	
									26
									27

Water Struck at NONE ENCOUNTERED

Maximum Observed Water Level

Undisturbed Sample □
Disturbed Sample ○
Water Sample △
Penetration Test I

c = Cohesion
 ϕ = Angle of Internal Friction
m.c = Moisture Content
y = Bulk Density
N = Standard Penetration Value

Water levels are subject to seasonal or tidal variation and should not be taken as constant



HOLST & CO. LTD. TQ67SW-356
SITE INVESTIGATION DEPT.
5-7, NEW YORK ROAD 6198, 7437
LEEDS, 2

Contract No. 19007/F958

Location Northfleet

Client A PMC M Ltd

Borehole No. T1 (2)

Ground Level 96.71

Date 4th June 1968

BOREHOLE LOG

STRATA	Legend	Depth below Ground Level	Thickness of Strata	Type of Sample	c lb/sq. ft.	ϕ deg.	m.c %	γ lb/cu. ft.	N
Chalk with flints			73'9"	□	7270	0	28.7	121	
			79'6"	□	5320	0	29.7	115	
			84'6"	□	7350	0	30.5	119	
			89'9"	□	5080	0	30.1	122	
			94'6"	□	6040	0	28.3	119	
		96'9"							

Water Struck at NONE ENCOUNTERED

Maximum Observed Water Level

Undisturbed Sample □
Disturbed Sample ○
Water Sample △
Penetration Test I

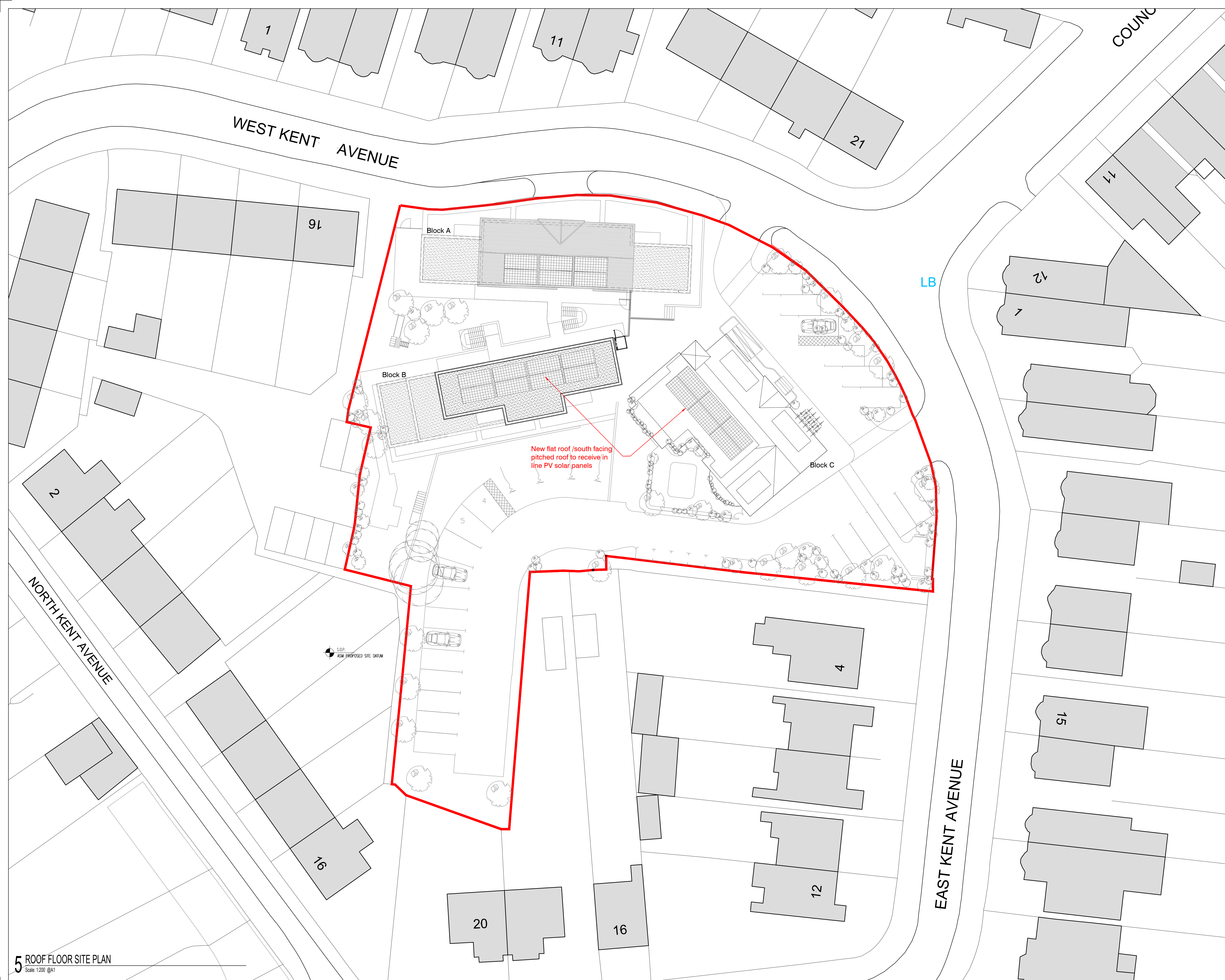
c = Cohesion
 ϕ = Angle of Internal Friction
m.c = Moisture Content
 γ = Bulk Density
N = Standard Penetration Value

Water levels are subject to seasonal or tidal variation and should not be taken as constant

British Geological Survey NATURAL ENVIRONMENT RESEARCH COUNCIL						Site CTRL GI DATA - Entire NDATA19 data set			Trial Pit Number TP8117	
Excavation Method Trial Pit		Dimensions		Ground Level (mOD) 9.59		Client UR/LCE		Job Number Issue 1		
		Location 561991 E 174017 N		Dates 12/08/1997		Engineer RLE		Sheet 1/1		
Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description		Legend	Water	
0.40 0.40 0.60 0.60 0.60 1.00 1.00 1.00	D2 B1 C3 K4 V5 D8 C6 B7			9.39 9.09 8.29	0.20 (0.30) 0.50 (0.80) 1.30	Dark grey black very silty (ash) sandy (fine to coarse) angular fine and medium SILTSTONE GRAVEL;.(MADE GROUND) Grey slightly silty sandy (fine to coarse) subangular medium and coarse LIMESTONE GRAVEL;.(MADE GROUND) Yellow weakly cemented silty sandy (fine to coarse) angular to rounded fine to coarse FLINT GRAVEL with many cobbles;.(MADE GROUND);At 2.00m; metal pipe (possible two) 200mm diameter.				
2.00 2.00 2.00	D11 C9 B10				(2.30)	Stiff, orange brown slightly sandy (fine to coarse) CLAY with a little angular to rounded fine to coarse flint gravel;.(Probable MADE GROUND);Below 2.00m; with a little subangular fine to coarsechalk gravel and occasional cobbles of flint;Below 3.00m; becoming sandy (fine to coarse).				
3.00 3.00	B12 D13									
4.00 4.00 4.00 4.00 4.00	C14 K15 B16 D17 V18			5.99 5.59	3.60 (0.40) 4.00	Yellow brown clayey fine to coarse SAND with much angular to rounded fine to coarse flint gravel;.(HEAD)				
						Complete at 4.00m				
Plan					Remarks					
					1. Prior to Trial Pitting a Cable Avoidance Tool (CAT) survey was carried out. ;2. Groundwater wasnotapparent during excavation.;3. The sides of the trial pit remained stable during excavation.;4. On completion the trial pit was backfilled with compacted arisings.					
					Scale (approx)		Logged By		Figure No.	
					1:50		SMC/jw			

APPENDIX D

APPENDIX E



Client:

IMPACT DEVELOPMENTS GRAVESEND Ltd.

Notes:

1. Do not scale from this drawing.
2. Site verify all dimensions and levels prior to construction.
3. Report all discrepancies to the Drawing Originator immediately.
4. This drawing is to be read in conjunction with all relevant documents and drawings.

Revisions

[illegible]

Drawing Originator

atelier - sm (architects)
CHARTERED ARCHITECTS & DESIGNERS

atelier - sm (architects) Ltd
Suite 10/11, Essex House, Station Lane, Upminster, RM14 2SJ
Tel: +44 (0)1708 988 295 Email: info@atelier-sm.co.uk

Drawing Status

PLANNING ISSUE

Project Name

KESSON HOUSE

Drawn by
ATELIER

Scale
1:200 @ A1

Title	Original drawing sheet is A1
-------	------------------------------

GENERAL ARRANGEMENT ROOF PLAN

Discipline	Project	Subject	Area	Drawing Number	Revision
A	-21251-	P	- 03	- 204	P7

APPENDIX F

Flood map for planning

Your reference
<Unspecified>

Location (easting/northing)
562137/174217

Created
5 Jul 2023 15:47

Your selected location is in flood zone 1, an area with a low probability of flooding.

You will need to do a flood risk assessment if your site is **any of the following**:

- bigger than 1 hectare (ha)
- In an area with critical drainage problems as notified by the Environment Agency
- identified as being at increased flood risk in future by the local authority's strategic flood risk assessment
- at risk from other sources of flooding (such as surface water or reservoirs) and its development would increase the vulnerability of its use (such as constructing an office on an undeveloped site or converting a shop to a dwelling)

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

Flood risk data is covered by the Open Government Licence **which** sets out the terms and conditions for using government data. <https://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/>

Use of the address and mapping data is subject to Ordnance Survey public viewing terms under Crown copyright and database rights 2022 OS 100024198. <https://flood-map-for-planning.service.gov.uk/os-terms>



Flood map for planning

Your reference
<Unspecified>

Location (easting/northing)
562137/174217

Scale
1:2500

Created
5 Jul 2023 15:47

-  Selected area
-  Flood zone 3
-  Flood zone 2
-  Flood zone 1
-  Flood defence
-  Main river
-  Water storage area

0 20 40 60m

APPENDIX G

Appendix C. Drainage Strategy Summary



1. Site details	
Site/development name	Kesson House, Northfleet, Gravesend
Address including post code	As above, DA11 9HL
Grid reference	E 562140 N 174232
LPA reference	
Type of application	Outline ☒ Full ☐ Discharge of Conditions ☐ Other ☐
Site condition	Greenfield ☐ Brownfield ☒

2. Existing drainage		Document/Plan where information is stated:	
Total site area (ha)	0.31	FRA Para 2.1, 5.2, 5.9	
Impermeable area (ha)	0.196		
Final discharge location	Infiltration ☒ Watercourse ☐ Sewer ☐ Tidal reach/sea ☐		
Greenfield discharge rate (l/s)	QBAR (l/s) N/A		
for existing site area	1 in 1 year (l/s)	N/A	N/A
	1 in 30 year (l/s)	N/A	
	1 in 100 year (l/s)	N/A	
3. Proposed drainage areas		Document/Plan where information is stated:	
Impermeable area (ha)	Roof	0.0714	FRA Drawing 62338-PP-001B
	Highway/road	0.0942	
	Other paved areas	296	
	Total	19.2	
Permeable area (ha)	Open space	0.0013	
	Other permeable areas	0	
	Total	0.196	
Final discharge location	Infiltration ☒ Infiltration rate 1×10^{-5} m/s Watercourse ☐ Sewer ☐ Tidal reach/sea ☐	FRA Para 5.13.	
Climate change allowance included in design	20% ☐ 30% ☐ 40% ☐ 45% ☒	FRA Para 3.5	

4. Post-Development Discharge rates, without mitigation			Document/Plan where information is stated:
Developed discharge rates (l/s)	1 in 1 year	N/A	N/A.
	1 in 30 year	N/A	
	1 in 100 year	N/A	
	1 in 100 year + CC	N/A	
5. Post-Development Discharge rates, with mitigation			Document/Plan where information is stated:
Describe development drainage strategy in general terms: Full on-site infiltration scheme permeable paving for roads crates + raingardens for roofs.			FRA Para 5.3
(a) No control required, all flows infiltrating ☒			
(b) Controlled developed discharge rates (l/s)	1 in 1 year	N/A	N/A
	1 in 30 year	N/A	
	1 in 100 year	N/A	
	1 in 100 year + CC	N/A	
6. Discharge Volumes			Document/Plan where information is stated:
	Existing volume (m ³)	Proposed volume (m ³)	N/A
1 in 1 year	N/A	N/A	
1 in 30 year	N/A	N/A	
1 in 100 year	N/A	N/A	
1 in 100 year + CC	N/A	N/A	

All information presented above should be contained within the attached Flood Risk Assessment, Drainage Strategy or Statement and be substantiated through plans and appropriate calculations.

Form completed by	Oliver Shaw
Qualifications	AMC/MT
Company	Richard Jackson Ltd
Telephone	01603 230240
Email	olivershaw@rj.uk.com
On behalf of (client's details)	Impact Developments Gravesend Ltd
Date	10/04/24.

Appendix D. Drainage Asset Record Sheet for Verification Report

IDENTIFICATION	Type of Structure or Feature	Permeable Paving
	Location Name	Kesson House, Northfleet, Gravesend
	Drawing Identifier	Oliver Shaw
MANAGEMENT/ OWNERSHIP	Owners Name / Company	TBC
	Address of owner	TBC
	Owners Contact Number	TBC
	Maintained By	Management company TBC
	Adoption proposed	☐ YES ☒ NO
	Name of Adopting Authority	N/A
	Estimated Date of Adoption	N/A
ASSET DETAILS	National Grid Reference (NGR)	562140, 174232
	Cover Level	from 34.5 to 33.5
	Invert Level	from 34.05 to 32.95
	Max volume	Total volume approx 71m ³
	Height	N/A
	Diameter/Width	Average road width 6m
	Length	Total length 110m
	Depth	From 0.3 - 0.4m
	Designed Flow Rate	N/A, 1×10^{-5} m/s rate
	Any Additional Uses	N/A

Appendix D. Drainage Asset Record Sheet for Verification Report

IDENTIFICATION	Type of Structure or Feature	Grates AquaCell, permavoid or similar
	Location Name	Kesson House, Northfleet, Gravesend
	Drawing Identifier	Oliver Shaw
MANAGEMENT/ OWNERSHIP	Owners Name / Company	TBC
	Address of owner	TBC
	Owners Contact Number	TBC
	Maintained By	Management Company TBC
	Adoption proposed	☐ YES ☒ NO
	Name of Adopting Authority	N/A
	Estimated Date of Adoption	N/A
ASSET DETAILS	National Grid Reference (NGR)	562140, 174232
	Cover Level	From 34.2 to 33.0
	Invert Level	From 32.85 to 31.3
	Max volume	Total volume approx 74m ³
	Height	N/A
	Diameter/Width	Varies
	Length	Varies
	Depth	From 0.45 - 1.20m
	Designed Flow Rate	N/A, 1×10^{-5} m/s rate
	Any Additional Uses	N/A.

APPENDIX H

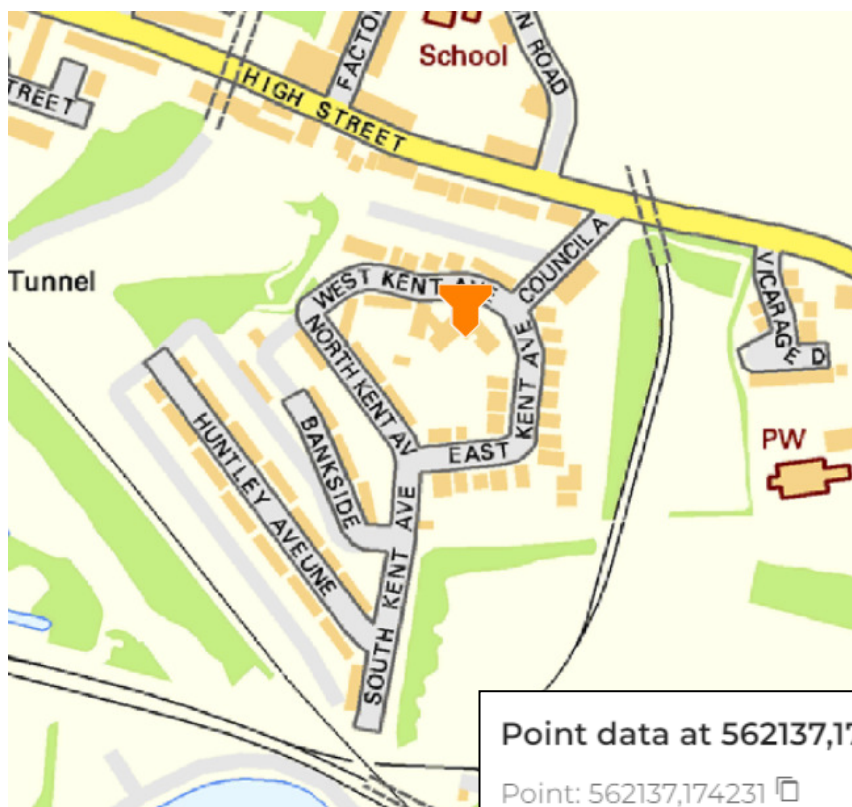
Cambridge : 01223 314794 ☐
Colchester : 01206 228800 ☐
London : 020 7448 9910 ☐
Norwich : 01603 230240 ☐

CONTRACT: Kesson House, Northfleet, Gravesend
ELEMENT: FEH Data

REF: 62338
SHEET: 1
DATE: 10.08.23

FEH Data

Screenshot of FEH data set



Point data at 562137,174231



Point: 562137,174231 

Tag: 62338

 Rainfall

 Export

Descriptor

Value

NGR

TQ 62137 74231

BFIHOST

0.938

BFIHOST19

0.92

PROPWET

0.27

SAAR6190

546 mm

APPENDIX I

Cambridge : 01223 314794 ☐
 Colchester : 01206 228800 ☐
 London : 020 7448 9910 ☐
 Norwich : 01603 230240 ☐

CONTRACT: Kesson House, Northfleet, Gravesend
 ELEMENT: Quick Storage Calculations

REF: 62338
 SHEET: 1
 DATE: 08.04.24

Quick Storage Calculations

Network A

Storage Estimate

Return Period (years)	100
Climate Change (%)	45
Impermeable Area (ha)	0.026
Peak Discharge (l/s)	0.000
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	0.03600
Required Storage (m³)	Calc
from	52
to	52
With infiltration (m³)	
from	10
to	30

Network B

Storage Estimate

Return Period (years)	100
Climate Change (%)	45
Impermeable Area (ha)	0.011
Peak Discharge (l/s)	0.000
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	0.03600
Required Storage (m³)	Calc
from	22
to	22
With infiltration (m³)	
from	4
to	13

Network C

Storage Estimate

Return Period (years)	100
Climate Change (%)	45
Impermeable Area (ha)	0.056
Peak Discharge (l/s)	0.000
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	0.03600
Required Storage (m³)	Calc
from	112
to	112
With infiltration (m³)	
from	21
to	64

APPENDIX J

Area= KESSON HOUSE, NORTHFLEET

Flat Block B - Network A

Pipe	Length	Roof area	Other Area	Total Area	Total Ha	Notes	Node entering	CL
1.000A	18.00	69	0	69	0.007		S1A	
1.001A	4.50	142	49	191	0.019	49m ² Paving	S2A	
Totals		211	49	260	0.026			

Kesson House - Network B

Pipe	Length	Roof area	Other Area	Total Area	Total Ha	Notes	Node entering	CL
1.000B	3.00	96	13	109	0.011	13m ² Raingarden	S1B	
Totals		96	13	109	0.011			

Remaining Roof Areas - Network C

Pipe	Length	Roof area	Other Area	Total Area	Total Ha	Notes	Node entering	CL
1.000C	16.00	121	128	249	0.025	128m ² Paving	S1C	
1.001C	7.00	114	20	134	0.013	20m ² Paving	S2C	
2.000C	8.50	82	0	82	0.008		S3C	
1.002C	10.00	0	0	0	0.000		S4C	
1.003C	5.00	90	0	90	0.009		S5C	
Totals		407	148	555	0.056			



Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
S1A	0.007	5.00	33.500	1200	0.650
S2A	0.019	5.00	33.500	1200	0.830
CRATES A	0.000		33.000		0.630

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	Link Type	T of C (mins)	Rain (mm/hr)
1.000A	S1A	S2A	18.000	0.600	32.850	32.670	0.180	100.0	100	Circular	5.39	50.0
1.001A	S2A	CRATES A	4.500	0.600	32.670	32.370	0.300	15.0	100	Circular	5.43	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)
1.000A	0.769	6.0	1.3	0.550	0.730	0.007	0.0	31	0.605
1.001A	2.005	15.7	4.7	0.730	0.530	0.026	0.0	37	1.743

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)
1.000A	18.000	100.0	100	Circular	33.500	32.850	0.550	33.500	32.670	0.730
1.001A	4.500	15.0	100	Circular	33.500	32.670	0.730	33.000	32.370	0.530

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000A	S1A	1200	Manhole	Adoptable	S2A	1200	Manhole	Adoptable
1.001A	S2A	1200	Manhole	Adoptable	CRATES A		Junction	

Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S1A	33.500	0.650	1200				
				0	1.000A	32.850	100
S2A	33.500	0.830	1200				
				1	1.000A	32.670	100
				0	1.001A	32.670	100



Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
CRATES A	33.000	0.630		1	1.001A	32.370	100
				°			

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	240	Check Discharge Volume	x

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 %)
2	0	0	0
30	0	0	0
100	0	0	0
100	45	0	0

Node CRATES A Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.03600	Safety Factor	3.0	Invert Level (m)	31.300
Side Inf Coefficient (m/hr)	0.03600	Porosity	0.95	Time to half empty (mins)	4038

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	25.5	11.5	1.200	25.5	28.3	1.201	0.0	28.3

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	S1A	11	32.880	0.030	1.2	0.0406	0.0000	OK
15 minute summer	S2A	10	32.708	0.038	4.5	0.0602	0.0000	OK
720 minute winter	CRATES A	675	31.544	-0.826	0.4	5.9104	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	S1A	1.000A	S2A	1.2	0.516	0.199	0.0422
15 minute summer	S2A	1.001A	CRATES A	4.4	1.675	0.281	0.0119
720 minute winter	CRATES A	Infiltration		0.0			

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	S1A	10	32.901	0.051	3.2	0.0690	0.0000	OK
15 minute summer	S2A	10	32.740	0.070	12.0	0.1117	0.0000	OK
1440 minute summer	CRATES A	1410	31.893	-0.477	0.8	14.3673	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	S1A	1.000A	S2A	3.2	0.637	0.522	0.0892
15 minute summer	S2A	1.001A	CRATES A	11.8	2.100	0.751	0.0253
1440 minute summer	CRATES A	Infiltration		0.1			

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	S1A	10	32.910	0.060	4.1	0.0806	0.0000	OK
15 minute summer	S2A	10	32.759	0.089	15.3	0.1415	0.0000	OK
2880 minute winter	CRATES A	2640	32.153	-0.217	0.4	20.6660	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	S1A	1.000A	S2A	4.1	0.649	0.671	0.1102
15 minute summer	S2A	1.001A	CRATES A	15.0	2.146	0.951	0.0314
2880 minute winter	CRATES A	Infiltration		0.1			

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	S1A	12	33.139	0.289	6.0	0.3886	0.0000	SURCHARGED
15 minute summer	S2A	11	33.003	0.333	19.9	0.5298	0.0000	SURCHARGED
960 minute winter	CRATES A	945	32.853	0.483	1.4	29.0821	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	S1A	1.000A	S2A	5.7	0.783	0.952	0.1408
15 minute summer	S2A	1.001A	CRATES A	19.0	2.426	1.205	0.0352
960 minute winter	CRATES A	Infiltration		0.1			



Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Depth (m)
S1B	0.011	5.00	34.400	1.000
CRATES B	0.000		34.400	1.035

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	Link Type	T of C (mins)	Rain (mm/hr)
1.000B	S1B	CRATES B	3.500	0.600	33.400	33.365	0.035	100.0	375	Circular	5.03	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)
1.000B	1.812	200.1	2.0	0.625	0.660	0.011	0.0	26	0.588

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)
1.000B	3.500	100.0	375	Circular	34.400	33.400	0.625	34.400	33.365	0.660

Link	US Node	Node Type	DS Node	Node Type
1.000B	S1B	Junction	CRATES B	Junction

Manhole Schedule

Node	CL (m)	Depth (m)	Connections	Link	IL (m)	Dia (mm)
S1B	34.400	1.000	◦			
			0	1.000B	33.400	375
CRATES B	34.400	1.035	1	1.000B	33.365	375
			◦			

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	240	Check Discharge Volume	x

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 %)
2	0	0	0
30	0	0	0
100	0	0	0
100	45	0	0

Node S1B Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.03600	Safety Factor	3.0	Invert Level (m)	33.400
Side Inf Coefficient (m/hr)	0.03600	Porosity	0.30	Time to half empty (mins)	

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	12.9	12.9	1.000	12.9	26.7	1.001	0.0	26.7

Node CRATES B Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.03600	Safety Factor	3.0	Invert Level (m)	33.100
Side Inf Coefficient (m/hr)	0.03600	Porosity	0.95	Time to half empty (mins)	1263

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	6.0	6.0	0.800	6.0	14.8	0.801	0.0	14.8

Results for 2 year Critical Storm Duration. Lowest mass balance: 90.28%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	S1B	328	33.442	0.042	0.3	0.1719	0.0000	OK
360 minute winter	CRATES B	328	33.441	0.076	0.3	1.9463	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	
360 minute winter	S1B	1.000B	CRATES B	0.3	0.378	0.002	0.0399	
360 minute winter	S1B	Infiltration		0.0				
360 minute winter	CRATES B	Infiltration		0.0				

Results for 30 year Critical Storm Duration. Lowest mass balance: 90.28%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
720 minute summer	S1B	705	33.680	0.280	0.8	1.1437	0.0000	OK
720 minute summer	CRATES B	705	33.680	0.315	1.5	3.3039	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 summer	S1B	1.000B	CRATES B	1.5	0.378	0.007	0.3271	
720 minute summer	S1B	Infiltration		0.1				
720 minute summer	CRATES B	Infiltration		0.0				

Results for 100 year Critical Storm Duration. Lowest mass balance: 90.28%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute summer	S1B	645	33.856	0.456	1.0	1.8665	0.0000	SURCHARGED
960 minute summer	CRATES B	645	33.856	0.491	0.7	4.3112	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 summer	S1B	1.000B	CRATES B	0.7	0.376	0.003	0.3860	
960 minute summer	S1B	Infiltration		0.1				
960 minute summer	CRATES B	Infiltration		0.0				

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 90.28%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute summer	S1B	900	34.370	0.970	2.2	3.9660	0.0000	FLOOD RISK
600 minute winter	CRATES B	570	34.360	0.995	2.8	4.5629	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 summer	S1B	1.000B	CRATES B	3.1	0.338	0.016	0.3860	
1440 minute summer	S1B	Infiltration		0.1				
600 minute winter	CRATES B	Infiltration		0.0				



Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
S1C	0.025	5.00	33.500	1200	0.650
S2C	0.013	5.00	33.500	1200	0.810
S3C	0.008	5.00	34.100	1200	0.650
S4C	0.000	5.00	34.100	1200	1.480
S5C	0.009	5.00	34.000	1200	1.480
CRATES C1	0.000		34.200	1200	2.025
CRATES C2	0.000		34.200		2.050

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	Link Type	T of C (mins)	Rain (mm/hr)
1.000C	S1C	S2C	16.000	0.600	32.850	32.690	0.160	100.0	150	Circular	5.27	50.0
1.001C	S2C	S4C	7.000	0.600	32.690	32.620	0.070	100.0	150	Circular	5.38	50.0
2.000C	S3C	S4C	8.500	0.600	33.450	33.365	0.085	100.0	150	Circular	5.14	50.0
1.002C	S4C	S5C	10.000	0.600	32.620	32.520	0.100	100.0	150	Circular	5.55	50.0
1.003C	S5C	CRATES C1	4.000	0.600	32.520	32.480	0.040	100.0	150	Circular	5.61	50.0
1.004C	CRATES C1	CRATES C2	5.000	0.600	32.175	32.150	0.025	200.0	150	Circular	5.73	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)
1.000C	1.005	17.8	4.5	0.500	0.660	0.025	0.0	51	0.838
1.001C	1.005	17.8	6.9	0.660	1.330	0.038	0.0	65	0.941
2.000C	1.005	17.8	1.4	0.500	0.585	0.008	0.0	29	0.606
1.002C	1.005	17.8	8.3	1.330	1.330	0.046	0.0	72	0.989
1.003C	1.005	17.8	9.9	1.330	1.570	0.055	0.0	80	1.031
1.004C	0.707	12.5	9.9	1.875	1.900	0.055	0.0	101	0.783

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)
1.000C	16.000	100.0	150	Circular	33.500	32.850	0.500	33.500	32.690	0.660
1.001C	7.000	100.0	150	Circular	33.500	32.690	0.660	34.100	32.620	1.330
2.000C	8.500	100.0	150	Circular	34.100	33.450	0.500	34.100	33.365	0.585
1.002C	10.000	100.0	150	Circular	34.100	32.620	1.330	34.000	32.520	1.330
1.003C	4.000	100.0	150	Circular	34.000	32.520	1.330	34.200	32.480	1.570
1.004C	5.000	200.0	150	Circular	34.200	32.175	1.875	34.200	32.150	1.900

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000C	S1C	1200	Manhole	Adoptable	S2C	1200	Manhole	Adoptable
1.001C	S2C	1200	Manhole	Adoptable	S4C	1200	Manhole	Adoptable
2.000C	S3C	1200	Manhole	Adoptable	S4C	1200	Manhole	Adoptable
1.002C	S4C	1200	Manhole	Adoptable	S5C	1200	Manhole	Adoptable
1.003C	S5C	1200	Manhole	Adoptable	CRATES C1	1200	Manhole	Adoptable
1.004C	CRATES C1	1200	Manhole	Adoptable	CRATES C2		Junction	

Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
S1C	33.500	0.650	1200					
				0	1.000C	32.850	150	
S2C	33.500	0.810	1200		1	1.000C	32.690	150
				0	1.001C	32.690	150	
S3C	34.100	0.650	1200					
				0	2.000C	33.450	150	
S4C	34.100	1.480	1200		1	2.000C	33.365	150
				2	1.001C	32.620	150	
				0	1.002C	32.620	150	
S5C	34.000	1.480	1200		1	1.002C	32.520	150
				0	1.003C	32.520	150	
CRATES C1	34.200	2.025	1200		1	1.003C	32.480	150
				0	1.004C	32.175	150	
CRATES C2	34.200	2.050			1	1.004C	32.150	150

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	240	Check Discharge Volume	x

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 %)
2	0	0	0
30	0	0	0
100	0	0	0
100	45	0	0

Node S1C Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	32.875
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	17.5	17.5	0.450	17.5	27.0	0.451	0.0	27.0

Node S1C Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	32.850	Slope (1:X)	150.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)		Depth (m)	0.500
Safety Factor	2.0	Width (m)	28.000	Inf Depth (m)	
Porosity	0.30	Length (m)	1.300		

Node CRATES C1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.03600	Safety Factor	3.0	Invert Level (m)	32.150
Side Inf Coefficient (m/hr)	0.03600	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	31.0	31.0	1.200	31.0	76.6	1.201	0.0	76.6

Node CRATES C2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.03600	Safety Factor	3.0	Invert Level (m)	32.150
Side Inf Coefficient (m/hr)	0.03600	Porosity	0.95	Time to half empty (mins)	1063

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	5.0	5.0	1.200	5.0	21.8	1.201	0.0	21.8

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.73%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	S1C	12	32.891	0.041	4.3	0.7477	0.0000	OK
15 minute summer	S2C	12	32.747	0.057	4.8	0.0826	0.0000	OK
15 minute summer	S3C	10	33.479	0.029	1.4	0.0398	0.0000	OK
15 minute summer	S4C	12	32.684	0.064	6.0	0.0718	0.0000	OK
15 minute summer	S5C	11	32.595	0.075	7.5	0.0944	0.0000	OK
240 minute winter	CRATES C1	236	32.435	0.260	2.0	8.6794	0.0000	SURCHARGED
240 minute winter	CRATES C2	236	32.435	0.285	0.3	1.3524	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	S1C	1.000C	S2C	2.9	0.617	0.163	0.0800
15 minute summer	S2C	1.001C	S4C	4.8	0.720	0.268	0.0463
15 minute summer	S3C	2.000C	S4C	1.4	0.584	0.076	0.0197
15 minute summer	S4C	1.002C	S5C	6.0	0.758	0.339	0.0797
15 minute summer	S5C	1.003C	CRATES C1	7.4	0.895	0.415	0.0330
240 minute winter	CRATES C1	1.004C	CRATES C2	0.3	0.305	0.025	0.0880
240 minute winter	CRATES C1	Infiltration		0.1			
240 minute winter	CRATES C2	Infiltration		0.0			

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.73%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	S1C	12	32.925	0.075	11.5	1.7403	0.0000	OK
15 minute summer	S2C	12	32.862	0.172	14.0	0.2498	0.0000	SURCHARGED
15 minute summer	S3C	10	33.498	0.048	3.7	0.0666	0.0000	OK
600 minute winter	S4C	585	32.850	0.230	1.8	0.2602	0.0000	SURCHARGED
600 minute winter	S5C	585	32.850	0.330	2.2	0.4136	0.0000	SURCHARGED
600 minute winter	CRATES C1	585	32.850	0.675	2.2	21.3809	0.0000	SURCHARGED
600 minute winter	CRATES C2	585	32.850	0.700	0.3	3.3253	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	S1C	1.000C	S2C	8.8	0.752	0.498	0.2108
15 minute summer	S2C	1.001C	S4C	13.2	0.824	0.745	0.1232
15 minute summer	S3C	2.000C	S4C	3.6	0.768	0.205	0.0403
600 minute winter	S4C	1.002C	S5C	1.8	0.586	0.102	0.1760
600 minute winter	S5C	1.003C	CRATES C1	2.2	0.654	0.122	0.0704
600 minute winter	CRATES C1	1.004C	CRATES C2	0.3	0.282	0.024	0.0880
600 minute winter	CRATES C1	Infiltration		0.2			
600 minute winter	CRATES C2	Infiltration		0.0			

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.73%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute winter	S1C	915	33.037	0.187	0.9	5.0553	0.0000	SURCHARGED
960 minute winter	S2C	915	33.037	0.347	1.4	0.5041	0.0000	SURCHARGED
15 minute summer	S3C	10	33.505	0.055	4.7	0.0762	0.0000	OK
960 minute winter	S4C	915	33.037	0.417	1.7	0.4718	0.0000	SURCHARGED
960 minute winter	S5C	915	33.037	0.517	2.0	0.6480	0.0000	SURCHARGED
960 minute winter	CRATES C1	915	33.037	0.862	1.9	27.1012	0.0000	SURCHARGED
960 minute winter	CRATES C2	915	33.037	0.887	0.4	4.2138	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	S1C	1.000C	S2C	0.9	0.449	0.051	0.2817
960 minute winter	S2C	1.001C	S4C	1.4	0.550	0.079	0.1232
15 minute summer	S3C	2.000C	S4C	4.6	0.819	0.261	0.0482
960 minute winter	S4C	1.002C	S5C	1.7	0.566	0.094	0.1760
960 minute winter	S5C	1.003C	CRATES C1	1.9	0.602	0.109	0.0704
960 minute winter	CRATES C1	1.004C	CRATES C2	0.4	0.279	0.028	0.0880
960 minute winter	CRATES C1	Infiltration		0.2			
960 minute winter	CRATES C2	Infiltration		0.1			

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 99.73%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	S1C	1380	33.340	0.490	1.0	13.7336	0.0000	FLOOD RISK
1440 minute winter	S2C	1380	33.340	0.650	1.4	0.9441	0.0000	FLOOD RISK
15 minute summer	S3C	10	33.519	0.069	6.9	0.0949	0.0000	OK
1440 minute winter	S4C	1380	33.340	0.720	1.6	0.8145	0.0000	SURCHARGED
1440 minute winter	S5C	1380	33.340	0.820	1.8	1.0277	0.0000	SURCHARGED
1440 minute winter	CRATES C1	1380	33.340	1.165	1.8	36.3684	0.0000	SURCHARGED
1440 minute winter	CRATES C2	1380	33.340	1.190	0.3	5.6532	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	S1C	1.000C	S2C	0.9	0.434	0.050	0.2817
1440 minute winter	S2C	1.001C	S4C	1.3	0.503	0.071	0.1232
15 minute summer	S3C	2.000C	S4C	6.8	0.901	0.383	0.0641
1440 minute winter	S4C	1.002C	S5C	1.5	0.523	0.085	0.1760
1440 minute winter	S5C	1.003C	CRATES C1	1.8	0.552	0.099	0.0704
1440 minute winter	CRATES C1	1.004C	CRATES C2	0.3	0.298	0.023	0.0880
1440 minute winter	CRATES C1	Infiltration		0.3			
1440 minute winter	CRATES C2	Infiltration		0.1			

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	Cover Level (m)	Depth (m)
PPA	0.035	34.395	0.400

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	240	Check Discharge Volume	x

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 %)
2	0	0	0
30	0	0	0
100	0	0	0
100	45	0	0

Node PPA Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.03600	Invert Level (m)	33.995	Slope (1:X)	100.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	115	Depth (m)	0.250
Safety Factor	5.0	Width (m)	31.500	Inf Depth (m)	
Porosity	0.30	Length (m)	5.500		

Node PPA Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.03600	Invert Level (m)	33.995	Slope (1:X)	100.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	115	Depth (m)	0.250
Safety Factor	5.0	Width (m)	31.500	Inf Depth (m)	
Porosity	0.30	Length (m)	5.500		

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute summer	PPA	82	34.051	0.056	2.8	3.0967	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
120 minute summer	PPA	Infiltration	0.3
120 minute summer	PPA	Infiltration	0.3

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	PPA	116	34.113	0.118	4.7	9.6678	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
120 minute winter	PPA	Infiltration	0.3
120 minute winter	PPA	Infiltration	0.3

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	PPA	172	34.149	0.154	4.4	13.3778	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
180 minute winter	PPA	Infiltration	0.3
180 minute winter	PPA	Infiltration	0.3

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute winter	PPA	232	34.227	0.232	5.3	21.7012	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
240 minute winter	PPA	Infiltration	0.3
240 minute winter	PPA	Infiltration	0.3

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	Cover Level (m)	Depth (m)
PPB	0.022	34.276	0.525

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	240	Check Discharge Volume	x

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 %)
2	0	0	0
30	0	0	0
100	0	0	0
100	45	0	0

Node PPB Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	33.751	Slope (1:X)	100.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)		Depth (m)	0.375
Safety Factor	5.0	Width (m)	36.000	Inf Depth (m)	
Porosity	0.30	Length (m)	2.500		

Node PPB Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.03600	Invert Level (m)	33.751	Slope (1:X)	100.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	281	Depth (m)	0.375
Safety Factor	5.0	Width (m)	36.000	Inf Depth (m)	
Porosity	0.30	Length (m)	2.500		



Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute summer	PPB	192	33.817	0.066	1.2	2.9696	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
240 minute summer	PPB	Infiltration	0.2



Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	PPB	344	33.912	0.161	1.3	8.1530	0.0000	OK
Link Event (Upstream Depth)		US Node	Link	Outflow (l/s)				
360 minute winter		PPB	Infiltration	0.2				



Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute summer	PPB	600	33.979	0.228	1.7	11.8282	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
600 minute summer	PPB	Infiltration	0.2

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
720 minute winter	PPB	690	34.114	0.363	1.5	19.2405	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
720 minute winter	PPB	Infiltration	0.2

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	Cover Level (m)	Depth (m)
PPC	0.019	33.801	0.450

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	240	Check Discharge Volume	x

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 %)
2	0	0	0
30	0	0	0
100	0	0	0
100	45	0	0

Node PPC Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	33.351	Slope (1:X)	100.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)		Depth (m)	0.300
Safety Factor	5.0	Width (m)	17.500	Inf Depth (m)	
Porosity	0.30	Length (m)	2.400		

Node PPC Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.03600	Invert Level (m)	33.351	Slope (1:X)	100.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	174	Depth (m)	0.300
Safety Factor	5.0	Width (m)	17.500	Inf Depth (m)	
Porosity	0.30	Length (m)	8.400		

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute summer	PPC	224	33.424	0.073	0.8	2.2112	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
360 minute summer	PPC	Infiltration	0.3

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute summer	PPC	204	33.488	0.137	2.3	5.8589	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
240 minute summer	PPC	Infiltration	0.3



Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute summer	PPC	240	33.529	0.178	3.0	8.2422	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
240 minute summer	PPC	Infiltration	0.3

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	PPC	344	33.620	0.269	2.1	13.4834	0.0000	OK
		Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)			
		360 minute winter	PPC	Infiltration	0.3			

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	Cover Level (m)	Depth (m)
PPD	0.022	33.500	0.550

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	240	Check Discharge Volume	x

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 %)
2	0	0	0
30	0	0	0
100	0	0	0
100	45	0	0

Node PPD Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	33.158	Slope (1:X)	25.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)		Depth (m)	0.400
Safety Factor	5.0	Width (m)	29.000	Inf Depth (m)	
Porosity	0.30	Length (m)	2.400		

Node PPD Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.03600	Invert Level (m)	32.950	Slope (1:X)	25.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	313	Depth (m)	0.400
Safety Factor	5.0	Width (m)	29.000	Inf Depth (m)	
Porosity	0.30	Length (m)	5.200		



Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute summer	PPD	168	33.106	0.156	1.2	2.7762	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
240 minute summer	PPD	Infiltration	0.2



Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	PPD	172	33.203	0.253	2.2	7.1534	0.0000	OK
Link Event		US Node		Link	Outflow (l/s)			
(Upstream Depth)								
180 minute winter		PPD		Infiltration	0.3			

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute summer	PPD	420	33.251	0.301	1.7	10.0793	0.0000	OK
Link Event		US Node		Link	Outflow			
(Upstream Depth)					(l/s)			
600 minute summer		PPD		Infiltration	0.3			

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	PPD	440	33.344	0.394	2.0	16.3622	0.0000	OK
Link Event (Upstream Depth)		US Node	Link	Outflow (l/s)				
480 minute winter		PPD	Infiltration	0.3				

APPENDIX K

Title: SITE SPECIFIC FLOOD RISK ASSESSMENT
 Project: Kesson House, Northfleet, Gravesend
 Client: Impact Developments Gravesend Ltd
 Project No.: 62338

SuDS Feature	Action	Frequency	Responsibility
Permeable Paved Highway	Brush and vacuum Remove weeds Reinstate and repair Monitor and inspect	Yearly As required As required Annually	Landowner / Management Company
Permeable Paved Path near Flat Block	Brush and vacuum Remove weeds Reinstate and repair Monitor and inspect	Yearly As required As required Annually	Landlord(s) of Block of Flats
Crates for Block of Flats or Kesson House	As per manufacturer's specification	As per manufacturer's specification	Landlord(s) of Block of Flats or Kesson House / Management Company
Raingarden or Bioretention systems	Remove litter Infill holes Remove and replace material and plants Monitor and inspect	Quarterly As required As required but likely >20 years Quarterly	Landlord(s) of Kesson House / Management Company



Colchester
01206 228800



London
020 7448 9910



Norwich
01603 230240



Cambridge
01223 314794



Bristol
01172 020070

www.rj.uk.com