TECHNICAL NOTE

Job Name: St. Mary's Grove Garages, Richmond

Job No: 332511103

Note No: TN001

Date: May 2022

Prepared By: Elizabeth Edney

Subject: **Surface Water Drainage Assessment**

1. Introduction

1.1. This Note outlines the existing and proposed surface water drainage arrangements for the re-development of the St. Mary's Grove garages in Richmond-upon-Thames.

1.2. Stantec has many years of experience in, amongst other areas, the assessment of flood risk, hydrology, flood defence and river engineering. The authors and reviewers of this Note are experienced engineers and are members of the Chartered Institution of Water and Environmental Management (CIWEM).

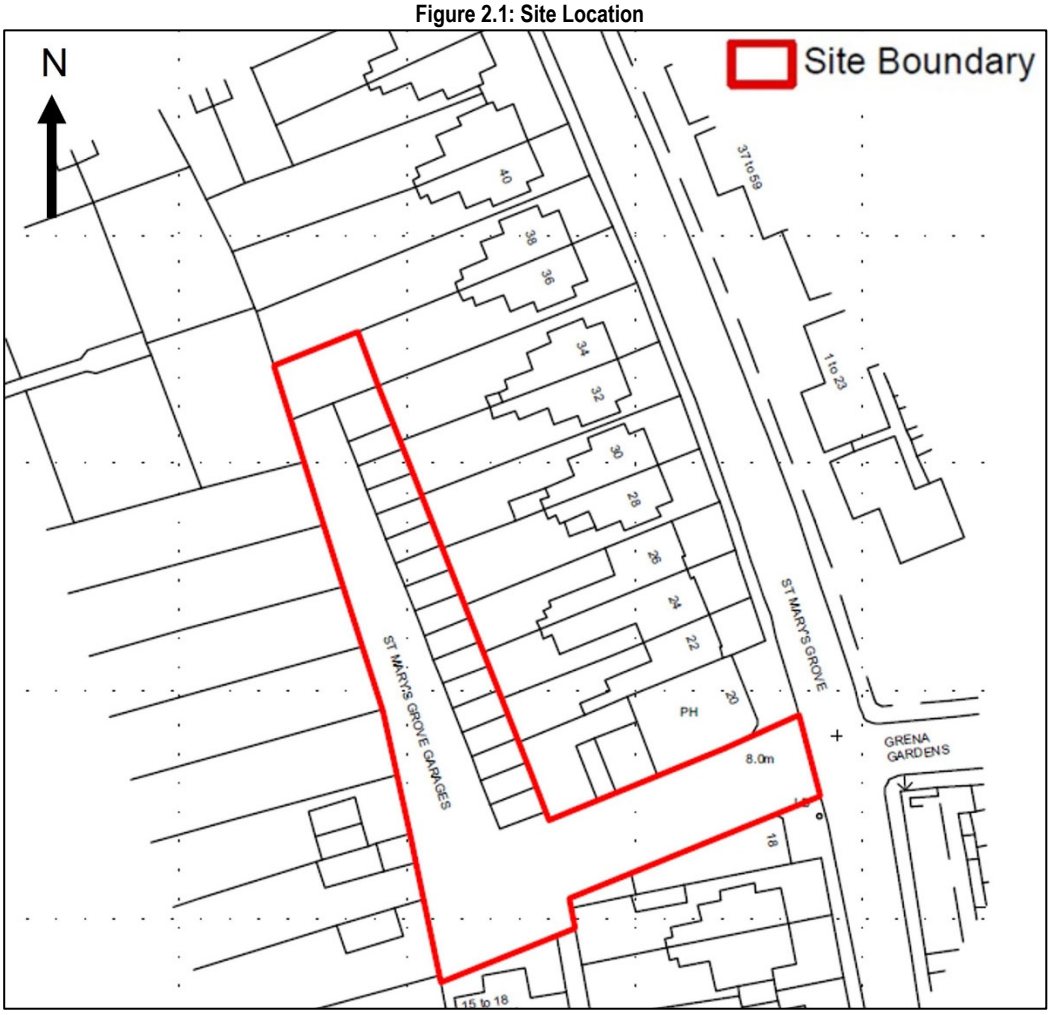
1.3. This Note has been prepared in accordance with the relevant national, regional and local planning policy, and statutory authority guidance as follows:

- National policy contained within the **National Planning Policy Framework (NPPF)** updated July 2021 with reference to Section 14 'Meeting the challenge of climate change, flooding and coastal change;
- The **NPPF Planning Practice Guidance (PPG)** released in March 2014 ('Flood Risk and Coastal Change' section) and most recently updated in August 2021;
- The **Environment Agency (EA) 'Flood Risk Assessments: Climate Change Allowances'** guidance, released in February 2016 and last updated May 2022;
- The '**London Plan; The Spatial Development Strategy for Greater London March 2021**', with specific reference to Policy SI 12 'Flood Risk Management' and Policy 5.13 'Sustainable Drainage';
- The **DEFRA 'Non-Statutory Technical Standards for Sustainable Drainage Systems'**, dated March 2015;
- **CIRIA SuDS Manual C753**, dated November 2015; and
- The '**London Borough of Richmond-upon-Thames Local Plan'** adopted July 2018, with specific reference to Policy LP21 'Flood Risk and Sustainable Drainage'.

2. Site Setting and Proposals

2.1. The site is 0.115 hectares (ha) in area and is located on Grena Gardens off St. Mary's Grove in the London Borough of Richmond-upon-Thames (LBR) (OS grid reference site centre 518,745m E; 175,202m N; nearest postcode TW9 1UY) – see **Figure 2.1** overleaf.

Figure 2.1: Site Location



2.2. The site is mostly impermeable and currently consists of an access road leading to garages and a small parking area. A small area of grass is present in the northern part of the site equating to 64 square metres (sqm).

2.3. The site is bordered by gardens of adjacent residential properties and is accessed from the east via St. Mary's Grove.

2.4. The site topographic survey undertaken by Twickenham Surveys in May 2012 (to an arbitrary datum of 10.00m) is provided in **Appendix TN001-A** and shows the following:

- The access road into the site slopes from 10.39m within the site to approximately 9.95m at the junction with St. Mary's Grove;
- The remainder of the site is relatively flat with levels ranging from 10.65m along the southern boundary to 9.20m along the northern boundary.

2.5. The proposals are for the demolition of the garages and the construction of 5 no. self-contained elderly person dwellings (including 4 no. wheelchair accessible units) with retained access road from St. Mary's Grove, disabled parking bay and landscaping as shown on the drawings by Clive Chapman Architects in **Appendix TN001-B**.

3. Existing Surface Water Drainage Regime

3.1. The topographic survey in **Appendix TN001-A** shows the presence of a drainage channel within the site which receives surface water runoff from the car parking spaces along the southern edge of the site and a small area immediately north of the channel. The remainder of the site slopes northwards and drains into a second drainage channel in the northern part of the site.

3.2. Two soakaways are present to the west of the garages which have a layer of sludge and have likely not been cleared or maintained frequently. It is likely that the drainage channels within the site drain to the southern soakaway however no connections are shown.

3.3. The access road onto St. Mary's Grove slopes from west to east and drains into the highway drainage system on St. Mary's Grove.

3.4. The existing impermeable area is 0.109ha. The area access road that will be retained and will continue to drain to the highway drainage system is approximately 260sqm (0.026ha). The total existing impermeable area that drains to the existing soakaways is 0.083ha.

3.5. The brownfield runoff rates, and volume have been calculated using the Modified Rational Method and are provided in **Table 3.1**. A copy of the calculations is provided in **Appendix TN001-C**.

Return Period	Brownfield Runoff Rate 0.083ha (l/s)
1 in 1 year	8.5
1 in 2 year	11.0
1 in 30 year	20.9
1 in 100 year	27.1

Table 3.1: Summary of Existing Surface Water Runoff Rates

Return Period	Existing Brownfield Runoff Volume 0.083ha (m^3)
1 in 100 year	59.6

Table 3.2: Existing Surface Water Runoff Volumes 100 Year 360 Minute Rainfall Event

4. Surface Water Drainage Discharge Destination

4.1. The NPPF recognises that flood risk and other environmental damage can be managed by minimising changes in the volume and rate of surface water runoff from development sites and recommends that priority be given to the use of SuDS in new development.

4.2. As the intention of SuDS is to mimic the natural drainage regime of the undeveloped site, the NPPF PPG states the following (consistent with the Building Regulations H3 hierarchy):

> ***...the aim should be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable:***
> ***- into the ground (infiltration),***
> ***- to a surface water body,***
> ***- to a surface water sewer, highway drain or another drainage system,***
> ***- to a combined sewer***

4.3. This is expanded by the London Plan March 2021 SuDS hierarchy as follows:

> ***i) Rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation)***
>
> ***ii) Rainwater for infiltration to ground or close to source***
>
> ***iii) Rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens)***
>
> ***iv) Rainwater discharge direct to a watercourse (unless not appropriate)***
>
> ***v) Controlled rainwater discharge to a surface water sewer or drain***
>
> ***vi) Controlled rainwater discharge to a combined sewer.***

4.4. The hierarchy is considered in order below:

i) Rainwater use as resource

4.5. Green roofs will be used over the roof area (0.016ha) as shown on the plan in **Appendix TN001-B**. It may also be feasible to incorporate rainwater butts but for the purposes of this assessment, this has been omitted from any attenuation volume calculations, since the capacity within the system is not guaranteed for any particular storm. The indicative rainwater downpipes are shown on **Stantec drawing 332511103/SK01** in **Appendix TN001-D**.

ii) Discharge to Ground (Infiltration)

4.6. The online British Geological Survey (BGS) viewer indicates that the area of the site is underlain by the **Kempton Park Gravel Member (Sand and Gravel)** over the **London Clay Formation (Clay and Silt)**.

4.7. A BGS borehole located approximately 150m to the north-east of the site (BGS ref. 18478303) indicates that the ground conditions in the area are as follows:

- Made Ground (brown clayey silty **SAND** with some **GRAVEL**) to 0.80metres below ground level (m bgl);
- Soft brown sandy **CLAY** to 1.50m bgl, with some fine to medium flint **GRAVEL** from 1.00-1.50m bgl;
- Silty to fine to coarse **SAND** to 2.80m bgl;
- Medium dense brown fine to coarse **SAND** with some **GRAVEL** and flint to 3.90m bgl;
- Medium dense brown slightly clayey silty fine to coarse **SAND** and fine to coarse **GRAVEL** to 5.00m bgl;
- Very sandy **GRAVEL** to 6.00m bgl;
- Stiff fissured grey-brown **CLAY** to 15.00m bgl (base of borehole).

4.8. Groundwater was struck at 3.00m bgl rising to 2.70m bgl.

4.9. The above information and the presence of existing soakaway drainage at the site would indicate that the soils would have a permeability that is suitable for infiltration drainage. Given the presence of groundwater at depth, any infiltration drainage features would need to be no greater than 1.5m in depth.

4.10. An infiltration rate of 1 x 10^{-5} m/s (0.036m/hr) has been assumed as a conservative approach for the sizing of the proposed infiltration drainage features at the site. The infiltration rate at the site will need to be confirmed by intrusive site testing at the detailed design stage.

iii) Attenuation in Green Infrastructure Features

4.11. Sufficient space is not available for the use of open infiltration basins due to the requirement for a minimum 5 metre easement from the proposed building and the boundary with adjacent properties.

4.12. The use of rainwater gardens/planters adjacent to the residential units themselves and within landscaped areas is feasible and this will be considered further at the detailed design stage.

5. Proposed Runoff Rates and Volumes

5.1. The DEFRA '*Non-statutory Technical Standards for Sustainable Drainage Systems*' (2015) states the following in relation to surface water runoff and volume control for previously developed sites:

> "***S3*** *For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.*
>
> ***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 the redevelopment for that event.*
>
> ***S6*** *Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with* ***S4*** *or* ***S5*** *above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.*"

5.2. The proposed impermeable area has been calculated as 0.070ha (including green roof areas). The existing impermeable area is 0.083ha and therefore there will be a reduction in impermeable area and therefore runoff rates/volumes from the site post re-development before further mitigation is considered.

5.3. The London Plan 2021 Policy 5.13 'Sustainable Drainage' states that:

> "*B Development proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible.*"

5.4. The greenfield runoff rates have been calculated using the Institute of Hydrology (IoH)/ICP SuDS Method for an area of 1ha and are provided in **Appendix TN001-C**. It is proposed to dispose of surface water runoff from the proposed development via infiltration. The proposed 'filtration' rate through the sub-base is 1.0 l/s.

5.5. The attenuation volumes provided at the site are discussed in **Section 6**.

6. Surface Water Drainage – Proposed Approach

6.1. The proposals are for the demolition of the garages and the construction of 5 no. self-contained elderly person dwellings (including 4 no. wheelchair accessible units) with retained access road from St. Mary's Grove, disabled parking bay and landscaping as shown on the drawings by Clive Chapman Architects in **Appendix TN001-B**.

6.2. The London Plan 2021 Policy 5.13 'Sustainable Drainage' states that:

> "*C Development proposals for impermeable surfacing should normally be resisted unless they can be shown to be unavoidable, including on small surface was such as front gardens and driveways.*
>
> *D Drainage should be designed and implemented in ways that promote multiple benefits including increased water use efficiency improved water quality and enhanced biodiversity, urban greening, amenity and recreation.*"

6.3. The proposed surface water drainage arrangements are shown on **Stantec drawing 332511103/SK01** in **Appendix TN001-D**.

6.4. It is proposed to incorporate 0.016ha of green roof over most of the unit roof areas and permeable surfacing with underlying storage across the external hard standing and disabled parking bay in the central part of the site, with infiltration to ground through the base of the sub-base. The downpipes from all roof areas will connect to the sub-base beneath the permeable surfacing. The permeable pavement sub-base will consist of a layer of stone with a 30% porosity (250mm depth) to provide water quality treatment before runoff filtrates to the underlying 150mm cellular layer with a 95% porosity.

6.5. The access road and parking spaces to be retained in the south-western part of the site (0.016ha) will remain at existing levels/tarmac surfacing and will continue to drain to the existing drainage channel in the area. The drainage channel will be connected to the sub-base beneath the adjacent permeable surfacing. The remainder of the existing access road (0.026ha) will also remain at existing levels/tarmac surfacing and continue to drain as existing to St. Mary's Grove.

6.6. The volume of attenuation utilised within the permeable pavement for the 1 in 100 annual probability +40% allowance for climate change rainfall event is approximately 38m^3. The green roof potentially has an attenuation volume of approximately 11m^3 based on an assumed 80mm depth of drainage layer with a 90% porosity.

6.7. The MicroDrainage results in **Appendix TN001-D** also demonstrate that there is no flooding of the proposed surface water drainage system up to and including the 1 in 100 annual probability +40% allowance for climate change rainfall event. In the event of a rainfall event greater than the design rainfall event, the external hard standing will be laid to fall away from the proposed units so that surface water runoff would be conveyed to/pond in the paved and landscaped areas to mitigate against the residual risk of surface water ingress in an extreme rainfall event.

7. Water Quality and Maintenance

7.1. The sources of surface water runoff from the proposed development will be from the roof areas which will consist of green roofs, footpaths which will not be subject to vehicular traffic and the disabled parking bay which will be subject to light vehicular movements. The external hardstanding draining into the central part of the site will consist of permeable surfacing which will provide appropriate water quality treatment through filtration through the stone sub-base layer before surface water runoff is infiltrated to ground through the base of the underlying cellular sub-base layer.

7.2. All rainwater downpipe sumps should be inspected at least monthly to remove any build-up of silt and debris.

7.3. Typical maintenance tasks and frequency for the permeable pavements and green roofs as taken from the CIRIA SuDS Manual C753 are shown in Table 7.1 and Table 7.2. The proposed surface water drainage system will be managed by the Habinteg Housing Group once constructed.

Permeable Paving	
Regular Maintenance	**Frequency**
Cleaning: Brush regularly and remove sweepings from all hard surfaces. Clean inlets	Monthly
Occasional Tasks	**Frequency**
Brush and Vacuum Surface	End of winter (April) to collect winter debris Mid - summer to collect dust, flower and grass type deposits. After autumn leaf fall (November)
Remedial Work	**Frequency**
Monitor effectiveness of permeable pavement (use an observation well) and when water does not infiltrate immediately advise client	Monthly for the first 6 months of operation, then as required.

Table 7.1: Typical Maintenance Tasks and Frequency for Permeable Pavements

Green Roof	
Regular Maintenance	**Frequency**
Remove debris and litter to prevent clogging of inlet drains and interference with plant growth	Six monthly and annually
Replace dead plant as required during establishment (i.e. year one)	Monthly (but usually responsibility of manufacturer)
Post establishment, replace dead plants as required (where <5% coverage)	Annually (in autumn)
Remove fallen leaves and debris from deciduous plant foliage, and nuisance/invasive vegetation	Six monthly or as required
Inspections	**Frequency**
Inspect all components including soil substrate, vegetation, drains, irrigation systems (if applicable), membranes & roof structure for proper operation, integrity of waterproofing & structural stability	Annually and after severe storms
Inspect drain inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drainage system	Annually and after severe storms
Inspect underside of roof for evidence of leakage	Annually and after severe storms
Remedial Work	**Frequency**
Stabilise erosion channels if these have formed	As required
Repairs to drainage inlets/outlets	As required

Table 7.2: Typical Maintenance Tasks and Frequency for Green Roofs

8. Summary

8.1. The proposed surface water drainage system has been designed to comply with national policy and London Plan requirements. The site currently drains via infiltration to on-site soakaways with minimal water quality treatment.

8.2. The proposed surface water drainage strategy will incorporate SuDS techniques including green roofs, rain gardens where feasible and permeable pavements across the new external hardstanding in the central part of the site. Downpipes from the proposed roof areas will connect to the permeable pavement sub-base via rainwater diffuser units with infiltration through the underlying sub-base. Filtration through the permeable pavement sub-base will provide an appropriate level of water quality treatment.

8.3. Intrusive testing will be undertaken at the detailed design stage to confirm ground conditions, groundwater levels and infiltration rates for the site.

DOCUMENT ISSUE RECORD

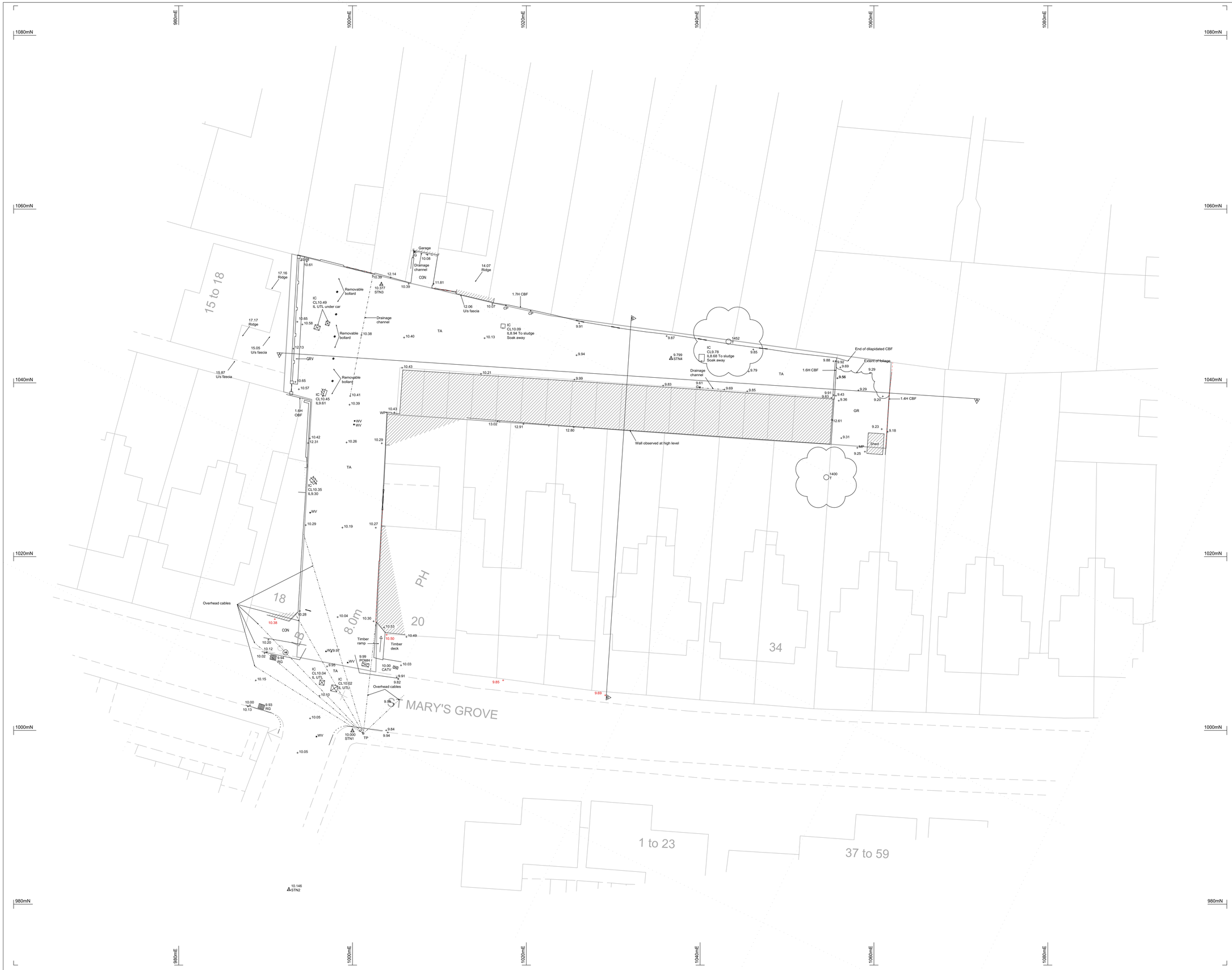
Technical Note No	Rev	Date	Prepared	Reviewed	Approved
332511103/TN001	-	04/05/22	E Edney	J.N Pulsford	J.N Pulsford
332511103/TN001	A	23/05/22	E Edney	J.N Pulsford	J.N Pulsford

T: +44 (0)118 9500 761 E: PBA.Reading@stantec.com

TECHNICAL NOTE

Appendix TN001-A

Drawing 1272LSa by Twickenham Surveys dated May 2012



NOTES

All dimensions are to be checked on site by the contractor before any work is commenced.
In the case of apparent discrepancy refer immediately to surveyors.
The accuracy and completeness of this survey is dependent on the original survey brief including the scale intended.
The type and extent of information and the survey accuracy will have been matched to the client's original requirements.
Twickenham Surveys accepts no responsibility or liability to later users without prior consent.
The detail of this survey was established for a brief requiring a 1:200 plot. It is therefore suitable for plotting or planning/designing at scales of 1:200 or smaller.
The survey grid is not related to Ordnance Survey National Grid.
Level positions are indicated by a cross.
Levels relate to TBM STN1 10.000m nailhead as shown on plan.
This survey did not include locating underground services and equipment.
Tree girths are representative only and reference should be made to the tree schedule if included in the survey brief.
Levels are taken on b/s kerb unless otherwise indicated.

LEGEND

AV Air valve
BB Bellaha beacon
Bdy Boundary
BL Bed level
BRV Brick paviors
BS Bus stop
BT British Telecom Cover
BU Buoancy aid
BWF Barbed wire fence
CATV Cable television cover
CBF Close boarded fence
CL Cover level
CLF Chain link fence
CO Crossover
CON Concrete
Corr Corrugated
CP Concrete post
CPF Chestnut paling fence
CPS Concrete paving slabs
Cul Culvert
ELMH Electricity manhole
EP Electricity pole
EPy Electricity pylon
ER Earth rod
FB Flowerbed
FH Fire hydrant
FHMk Fire hydrant marker
FL Floor level
FMH Foul water manhole
FS Flagstaff
G Gulley
GR Grass
GRV Gravel
GV Gas valve
H High
IC Inspection chamber
IL Invert level
IRF Iron railing fence
KIG Kerb inlet gulley
LB Letter box
LH Lamp hole
LP Lamp post
MH Manhole
MP Metal post
OBF Open boarded fence
OF Outfall
OSBM Ordnance Survey bench mark
POMH Post Office manhole
PS Pub sign
PWF Post and wire fence
RG Road gulley
RS Road sign
RTW Retaining wall
SMH Surface water manhole
SP Signpost
STP Standpipe
STN Survey station
SV Sluice valve
TA Tarmac
TBM Temporary bench mark
TCB Telephone call box
TP Telegraph pole
T Tree
VP Vent pipe
WL Water level
WM Water meter
WMF Wire mesh fence
WP Wooden post
WV Water valve
YG Yard gulley
Bollard
Borehole
Bush
Deciduous tree spread
Double gate
Electricity pylon
Gate
Letter box
Pine tree spread
Road sign
Service box
Telephone call box
Trial pit
Waste bin

INDICATIVE N

TOPOGRAPHICAL SURVEY

ST MARYS GROVE
GARAGES
RICHMOND

Drawing No. : 1272LSa
Scale : refer grid
Date : MAY 2012
Drawn by : WH/JWHD
Checked by : JWHD

TWICKENHAM SURVEYS
LAND AND BUILDING SURVEYORS
CENTRAL HOUSE
124 HIGH STREET
HAMPTON HILL
MIDDLESEX TW12 1NS
T-020 8614 4480 F-020 8977 6579
mail@twickenhamsurveys.co.uk
www.twickenhamsurveys.co.uk

TECHNICAL NOTE

Appendix TN001-B

Drawing SMGG21-02 by Clive Chapman Architects dated May 2022

SITE LAYOUT & ROOF PLAN

ACCOMMODATION SCHEDULE

SELF-CONTAINED DWELLINGS FOR THE OVER 65s
4 No. 1 BED / 2 PERSON WHEELCHAIR ACCESSIBLE M4(3) UNITS @ 60M²
1 No. 1 BED / 2 PERSON ACCESSIBLE & ADAPTABLE UNIT WITH WET ROOM M4(2) @ 50M²
5 No. UNITS TOTAL

PARKING:
1 No. BLUE BADGE DISABLED PARKING BAY (ELECTRIC CHARGING)
2 No. VISITOR BAYS

NOTE:
DRY RISER REQUIRED FOR FIRE BRIGADE ACCESS.
EXISTING NEIGHBOUR GATE AND GARAGE ACCESS RETAINED.
BOUNDARY FENCE REPLACEMENT SUBJECT TO CONSULATION WITH NEIGHBOURS.

NORTH

BAR SCALE
0 1 2 3 4 5M

ST MARY'S GROVE

9.99
10.10
CL10.02
CL10.04
10.15
9.82
OVERHEAD CABLES
9.91
CATV 10.00
10.03
9.95
9.94
10.02
10.12
10.20
POMH 9.99
B
9.97
DECK
10.50
RAMP
10.49
10.53
MAIN ENTRANCE
10.30
10.04
10.28
10.38
34
20
18
BAY 1
SIDE ENTRANCE
'THE MITRE' PUBLIC HOUSE
REFUSE & RECYCLING PICKUP POINT FOR COLLECTION DAYS (TO BE MOVED BY CARETAKER)
BAY 2
SIDE ENTRANCE
10.29
10.27
GATES
CL10.35
IL9.30
GATE
C
E
D
A
EXISTING GARAGE WALL 2.75M - 2.9M REPLACED WITH NEW BRICK WALL 2.85 - 3.35M SIMILAR TO EXISTING GARAGE WALL
NEW CLOSE 1.8M BOARDED FENCE
9.25
9.18
9.23
9.20
9.29
EXISTING 1.4M CLOSE BOARDED FENCE REPLACED WITH 1.8M SUBJECT TO CONSULTATION WITH NEIGHBOURS
PRIVATE GARDEN
GRAVEL GUTTER
PV PANELS
ROOFLIGHT
ASHP COWL
WILD FLOWER' EXTENSIVE GREEN ROOF
1B/2P M4(2)
1B/2P M4(3)
1B/2P M4(3)
1B/2P M4(3)
1B/2P M4(3)
RAMP
LOWER CANOPY
ROOFLIGHT
RAMP
LOWER CANOPY
ROOFLIGHT
GATE
EXISTING 1.7M CLOSEBOARDED FENCES REPLACED WITH 1.8M SUBJECT TO CONSULTATION WITH NEIGHBOURS
EXISTING GATE No.27 RETAINED
LINE OF EXISTING GARAGES TO BE DEMOLISHED
EXISTING GATE No.25 RETAINED
EXISTING GATE No.23 RETAINED
EXISTING GATE No.21 RETAINED
EXISTING GATE No.19 RETAINED
EXISTING GATE No.17 RETAINED
SEATING & RAISED BRICK BED 'SHADE PLANTING'
RAISED BRICK BED 'VEG PATCH'
COMMUNAL ROTARY DRYERS
STEEL WIRES & WALL CLIMBERS
BIKE STAND
CP
CP
ACTIVITY LAWN & MOUND
EV
BIN STORE ENCLOSURE 3 x 240L 1 x 360L
RIDGE 14.07
U/S FASCIA 12.06
DRIVE & GARAGE No.15 RETAINED
11.81
DRIVE & GARRAGE No.13 RETAINED
10.08
G
GARAGE ACCESS RETAINED
10.39
12.14
10.39
STEEL WIRES & WALL CLIMBERS
GATE
EXISTING GATE No.11 RETAINED
B
GARAGE
EXISTING HIGH LEVEL WINDOW
GARAGE
10.29
WP
10.26
12.31
10.42
DEMARKED FOOTPATH
10.39
CL10.45
IL9.61
10.41
EXISTING TOBF 6H
10.57
10.65
EXISTING GATE TO ALMSHOUSES & COMMUNAL GARDEN RETAINED
12.13
10.38
6000
10.58
10.65
EXISTING PARKING RETAINED
U/S FASCIA 15.05
RIDGE 17.16
A
10.61
10.68

Project	ST MARY'S GROVE GARAGES, RICHMOND, TW9
Drawing	SITE LAYOUT & ROOF PLAN
Drawing No.	SMGG21-02
Scale	1:100 @ A1
Date	11.05.2022

CLIVE CHAPMAN
ARCHITECTS
SUSTAINABILITY CONSULTANTS
4 EEL PIE ISLAND
TWICKENHAM MIDDX
TW1 3DY
TELEPHONE 020 8891 4837
EMAIL INFO@CCAR.CO.UK
WEBSITE WWW.CCAR.CO.UK

TECHNICAL NOTE

Appendix TN001-C

Brownfield Runoff Rates & Volume 0.083ha

Greenfield Runoff Rates 1ha

Brownfield Runoff Rates
Modified Rational Method

Project Title	St. Mary's Grove Garages, Richmond	
Project No	332511103	100

Existing Site Condition

Rainfall Model		FSR	
Storm Duration		15.0	mins
Global Time of Entry		5.0	mins
Volumetric Runoff Coefficient	**Cv**	0.90	
Routing Coefficient	**Cr**	1.30	
Contributing Area	**A**	0.083	ha

	Average Rainfall Intensity, i (mm/hr)	Runoff Rate , Q (l/s)
1 in 1 Year	31.5	**8.5**
1 in 2 Year	40.7	**11.0**
1 in 30 Year	77.3	**20.9**
1 in 100 Year	100.4	**27.1**

Rainfall intensity extracted from MicroDrainage rainfall profiles (v.2020.1)

Based on the Modified Rational Method as described in CIRIA C753 - The SuDS Manual 2015

EQ. 24.5 **Modified rational method equation to determine peak flow rates**

$$Q = 2.78\,C\,i\,A$$

where:

Q = design event peak rate of runoff (l/s)

C = non-dimensional runoff coefficient which is dependent on the catchment characteristics

$$C = C_V\,C_R$$

where C_v = volumetric runoff coefficient

C_R = dimensionless routing coefficient

i = rainfall intensity for the design return period (in mm/hr) and for a duration equal to the "time of concentration" of the network

A = total catchment area being drained (ha)

Note: 2.78 is a conversion factor to address the rainfall unit being in mm/hr.

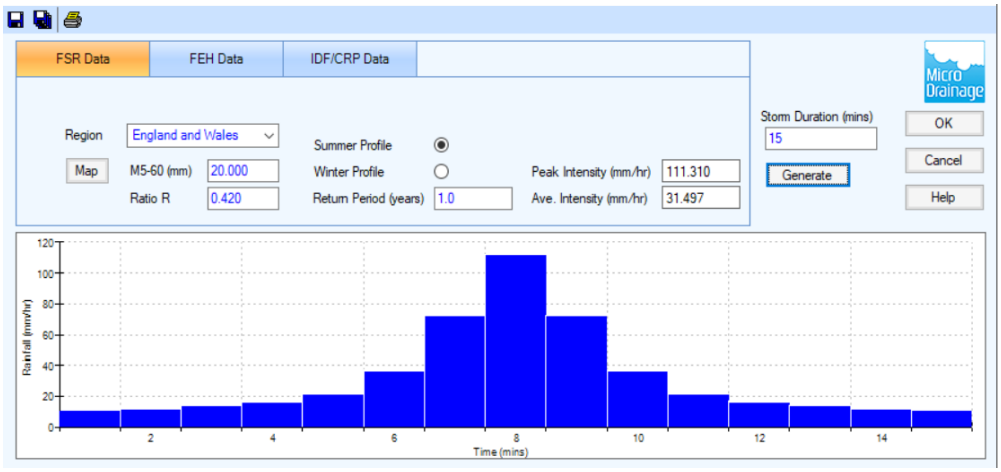
Runoff Volume 100yr 6hour storm

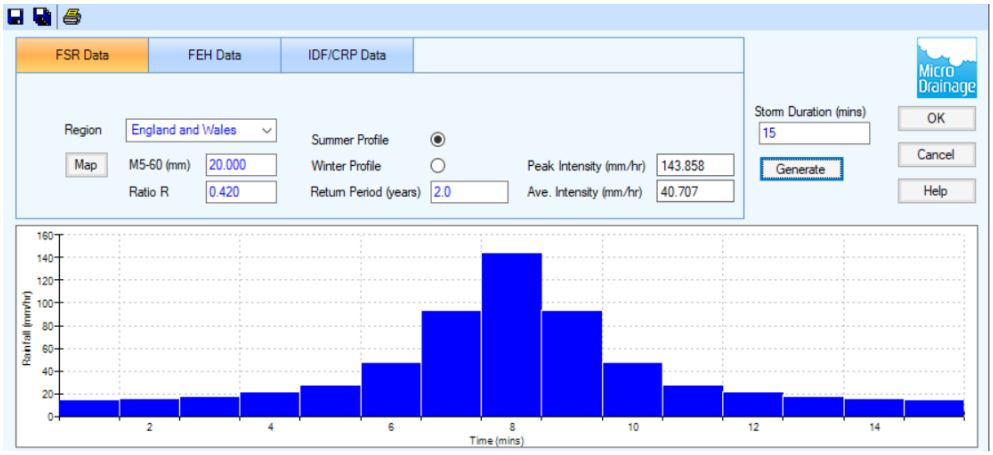
Rainfall intensity 6 hour storm	10.22	mm/hr

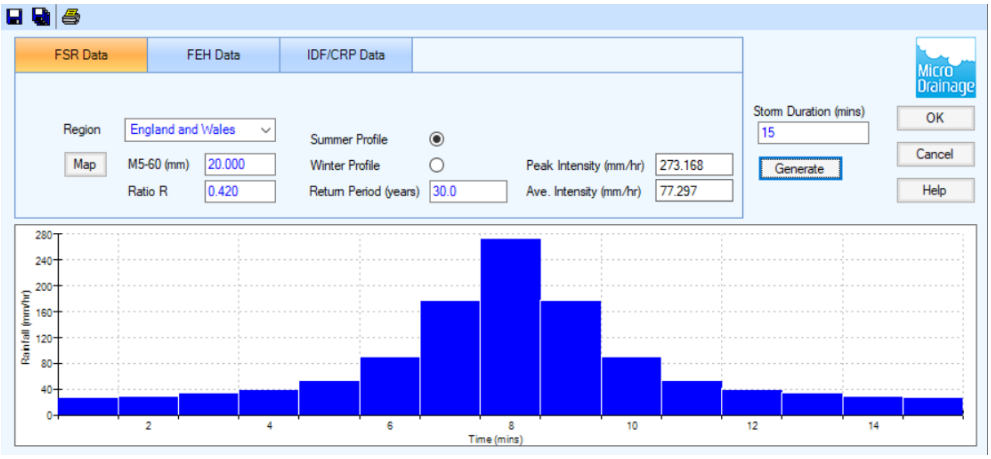
Runoff Volume (m^3)	**59.6**

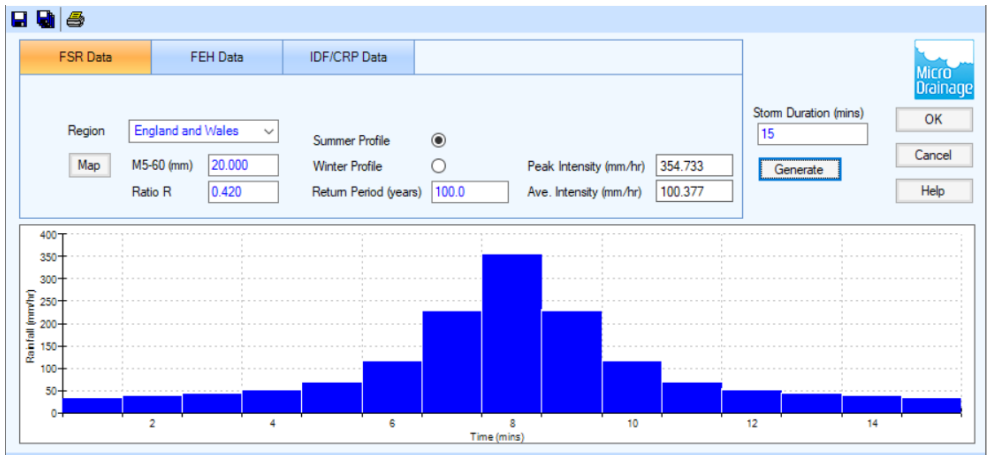
DOCUMENT ISSUE RECORD

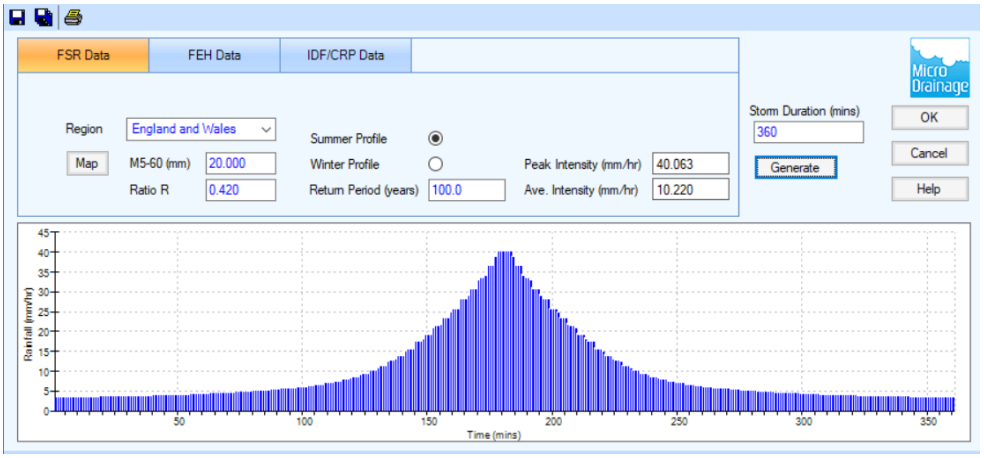
Rev	Comments	Prepared	Date	Checked	Date
-	Original calculation	E Edney	19/04/2022	J Pulsford	27/04/2022


FSR Data
FEH Data
IDF/CRP Data
Region
England and Wales
Map
M5-60 (mm)
20.000
Ratio R
0.420
Summer Profile
Winter Profile
Return Period (years)
1.0
Peak Intensity (mm/hr)
111.310
Ave. Intensity (mm/hr)
31.497
Storm Duration (mins)
15
Generate
OK
Cancel
Help
Micro Drainage
Rainfall (mm/hr)
Time (mins)


FSR Data
FEH Data
IDF/CRP Data
Region
England and Wales
Map
M5-60 (mm)
20.000
Ratio R
0.420
Summer Profile
Winter Profile
Return Period (years)
2.0
Peak Intensity (mm/hr)
143.858
Ave. Intensity (mm/hr)
40.707
Storm Duration (mins)
15
Generate
OK
Cancel
Help
Micro Drainage
Rainfall (mm/hr)
Time (mins)


FSR Data
FEH Data
IDF/CRP Data
Region
England and Wales
Map
M5-60 (mm)
20.000
Ratio R
0.420
Summer Profile
Winter Profile
Return Period (years)
30.0
Peak Intensity (mm/hr)
273.168
Ave. Intensity (mm/hr)
77.297
Storm Duration (mins)
15
Generate
OK
Cancel
Help
Micro Drainage
Rainfall (mm/hr)
Time (mins)


FSR Data
FEH Data
IDF/CRP Data
Region
England and Wales
Map
M5-60 (mm)
20.000
Ratio R
0.420
Summer Profile
Winter Profile
Return Period (years)
100.0
Peak Intensity (mm/hr)
354.733
Ave. Intensity (mm/hr)
100.377
Storm Duration (mins)
15
Generate
OK
Cancel
Help
Micro Drainage
Rainfall (mm/hr)
Time (mins)


FSR Data
FEH Data
IDF/CRP Data
Region
England and Wales
Map
M5-60 (mm)
20.000
Ratio R
0.420
Summer Profile
Winter Profile
Return Period (years)
100.0
Peak Intensity (mm/hr)
40.063
Ave. Intensity (mm/hr)
10.220
Storm Duration (mins)
360
Generate
OK
Cancel
Help
Micro Drainage
Rainfall (mm/hr)
Time (mins)

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.300
Area (ha)	1.000	Urban	0.000
SAAR (mm)	600	Region Number	Region 6

Results l/s

QBAR Rural	1.5
QBAR Urban	1.5
Q100 years	4.9
Q1 year	1.3
Q30 years	3.4
Q100 years	4.9

TECHNICAL NOTE

Appendix TN001-D

Stantec sketch 332511103/SK01

MicroDrainage Source Control outputs

Summary of Results for 1 year Return Period

Half Drain Time : 110 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	8.485	0.015	0.3	2.7	O K
30 min Summer	8.490	0.020	0.4	3.7	O K
60 min Summer	8.497	0.027	0.5	4.9	O K
120 min Summer	8.501	0.031	0.6	5.7	O K
180 min Summer	8.503	0.033	0.6	6.1	O K
240 min Summer	8.504	0.034	0.7	6.3	O K
360 min Summer	8.505	0.035	0.7	6.4	O K
480 min Summer	8.504	0.034	0.7	6.3	O K
600 min Summer	8.503	0.033	0.6	6.2	O K
720 min Summer	8.503	0.033	0.6	6.0	O K
960 min Summer	8.501	0.031	0.6	5.6	O K
1440 min Summer	8.497	0.027	0.5	5.0	O K
2160 min Summer	8.493	0.023	0.5	4.2	O K
2880 min Summer	8.490	0.020	0.4	3.7	O K
4320 min Summer	8.486	0.016	0.3	3.0	O K
5760 min Summer	8.484	0.014	0.3	2.5	O K
7200 min Summer	8.482	0.012	0.2	2.2	O K
8640 min Summer	8.480	0.010	0.2	1.9	O K
10080 min Summer	8.479	0.009	0.2	1.7	O K
15 min Winter	8.485	0.015	0.3	2.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	31.497	0.0	18
30 min Summer	20.396	0.0	38
60 min Summer	12.800	0.0	62
120 min Summer	7.865	0.0	110
180 min Summer	5.886	0.0	140
240 min Summer	4.785	0.0	170
360 min Summer	3.558	0.0	236
480 min Summer	2.873	0.0	302
600 min Summer	2.433	0.0	368
720 min Summer	2.124	0.0	434
960 min Summer	1.715	0.0	560
1440 min Summer	1.268	0.0	808
2160 min Summer	0.938	0.0	1172
2880 min Summer	0.758	0.0	1532
4320 min Summer	0.560	0.0	2252
5760 min Summer	0.452	0.0	2992
7200 min Summer	0.383	0.0	3696
8640 min Summer	0.335	0.0	4416
10080 min Summer	0.298	0.0	5152
15 min Winter	31.497	0.0	18

Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	8.490	0.020	0.4	3.7	O K
60 min Winter	8.497	0.027	0.5	4.9	O K
120 min Winter	8.501	0.031	0.6	5.8	O K
180 min Winter	8.503	0.033	0.6	6.1	O K
240 min Winter	8.504	0.034	0.7	6.2	O K
360 min Winter	8.503	0.033	0.6	6.1	O K
480 min Winter	8.502	0.032	0.6	5.9	O K
600 min Winter	8.501	0.031	0.6	5.6	O K
720 min Winter	8.499	0.029	0.6	5.4	O K
960 min Winter	8.497	0.027	0.5	4.9	O K
1440 min Winter	8.492	0.022	0.4	4.1	O K
2160 min Winter	8.488	0.018	0.4	3.3	O K
2880 min Winter	8.485	0.015	0.3	2.8	O K
4320 min Winter	8.482	0.012	0.2	2.1	O K
5760 min Winter	8.479	0.009	0.2	1.7	O K
7200 min Winter	8.478	0.008	0.2	1.5	O K
8640 min Winter	8.477	0.007	0.1	1.3	O K
10080 min Winter	8.476	0.006	0.1	1.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	20.396	0.0	38
60 min Winter	12.800	0.0	62
120 min Winter	7.865	0.0	114
180 min Winter	5.886	0.0	144
240 min Winter	4.785	0.0	180
360 min Winter	3.558	0.0	252
480 min Winter	2.873	0.0	322
600 min Winter	2.433	0.0	390
720 min Winter	2.124	0.0	456
960 min Winter	1.715	0.0	588
1440 min Winter	1.268	0.0	840
2160 min Winter	0.938	0.0	1208
2880 min Winter	0.758	0.0	1560
4320 min Winter	0.560	0.0	2280
5760 min Winter	0.452	0.0	3056
7200 min Winter	0.383	0.0	3816
8640 min Winter	0.335	0.0	4504
10080 min Winter	0.298	0.0	5040

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.900
Region	England and Wales	Cv (Winter)	0.900
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.420	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Green Roof

Area (m³)	156	Evaporation (mm/day)	3
Depression Storage (mm)	5	Decay Coefficient	0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.002835	32	36	0.000572	64	68	0.000116	96	100	0.000023
4	8	0.002321	36	40	0.000469	68	72	0.000095	100	104	0.000019
8	12	0.001900	40	44	0.000384	72	76	0.000077	104	108	0.000016
12	16	0.001556	44	48	0.000314	76	80	0.000063	108	112	0.000013
16	20	0.001274	48	52	0.000257	80	84	0.000052	112	116	0.000010
20	24	0.001043	52	56	0.000211	84	88	0.000043	116	120	0.000009
24	28	0.000854	56	60	0.000172	88	92	0.000035			
28	32	0.000699	60	64	0.000141	92	96	0.000028			

Time Area Diagram

Total Area (ha) 0.054

Time From:	(mins) To:	Area (ha)
0	4	0.054

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Model Details

Storage is Online Cover Level (m) 9.000

Complex Structure

Cellular Storage

Invert Level (m) 8.470 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.03600 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	194.0	194.0	0.151	0.0	205.8
0.150	194.0	205.8			

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	19.4
Max Percolation (l/s)	53.9	Slope (1:X)	300.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	8.620	Cap Volume Depth (m)	0.250

Summary of Results for 30 year Return Period

Half Drain Time : 172 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	8.516	0.046	0.9	8.4	O K
30 min Summer	8.532	0.062	1.0	11.4	O K
60 min Summer	8.549	0.079	1.0	14.5	O K
120 min Summer	8.561	0.091	1.0	16.7	O K
180 min Summer	8.563	0.093	1.0	17.2	O K
240 min Summer	8.563	0.093	1.0	17.2	O K
360 min Summer	8.562	0.092	1.0	17.0	O K
480 min Summer	8.559	0.089	1.0	16.5	O K
600 min Summer	8.556	0.086	1.0	15.9	O K
720 min Summer	8.552	0.082	1.0	15.2	O K
960 min Summer	8.545	0.075	1.0	13.8	O K
1440 min Summer	8.531	0.061	1.0	11.2	O K
2160 min Summer	8.518	0.048	0.9	8.8	O K
2880 min Summer	8.511	0.041	0.8	7.5	O K
4320 min Summer	8.502	0.032	0.6	5.9	O K
5760 min Summer	8.497	0.027	0.5	4.9	O K
7200 min Summer	8.493	0.023	0.4	4.2	O K
8640 min Summer	8.490	0.020	0.4	3.7	O K
10080 min Summer	8.488	0.018	0.3	3.3	O K
15 min Winter	8.516	0.046	0.9	8.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	77.297	0.0	26
30 min Summer	49.920	0.0	38
60 min Summer	30.811	0.0	64
120 min Summer	18.462	0.0	122
180 min Summer	13.543	0.0	164
240 min Summer	10.827	0.0	194
360 min Summer	7.872	0.0	258
480 min Summer	6.278	0.0	324
600 min Summer	5.265	0.0	390
720 min Summer	4.558	0.0	456
960 min Summer	3.628	0.0	586
1440 min Summer	2.628	0.0	828
2160 min Summer	1.902	0.0	1172
2880 min Summer	1.511	0.0	1536
4320 min Summer	1.091	0.0	2252
5760 min Summer	0.866	0.0	2992
7200 min Summer	0.724	0.0	3696
8640 min Summer	0.625	0.0	4416
10080 min Summer	0.552	0.0	5144
15 min Winter	77.297	0.0	26

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	8.532	0.062	1.0	11.4	O K
60 min Winter	8.549	0.079	1.0	14.5	O K
120 min Winter	8.561	0.091	1.0	16.7	O K
180 min Winter	8.563	0.093	1.0	17.1	O K
240 min Winter	8.562	0.092	1.0	17.0	O K
360 min Winter	8.559	0.089	1.0	16.4	O K
480 min Winter	8.554	0.084	1.0	15.5	O K
600 min Winter	8.549	0.079	1.0	14.5	O K
720 min Winter	8.543	0.073	1.0	13.5	O K
960 min Winter	8.532	0.062	1.0	11.5	O K
1440 min Winter	8.518	0.048	0.9	8.8	O K
2160 min Winter	8.507	0.037	0.7	6.9	O K
2880 min Winter	8.501	0.031	0.6	5.7	O K
4320 min Winter	8.493	0.023	0.5	4.2	O K
5760 min Winter	8.489	0.019	0.4	3.4	O K
7200 min Winter	8.486	0.016	0.3	2.9	O K
8640 min Winter	8.483	0.013	0.3	2.5	O K
10080 min Winter	8.482	0.012	0.2	2.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	49.920	0.0	38
60 min Winter	30.811	0.0	62
120 min Winter	18.462	0.0	118
180 min Winter	13.543	0.0	172
240 min Winter	10.827	0.0	200
360 min Winter	7.872	0.0	270
480 min Winter	6.278	0.0	344
600 min Winter	5.265	0.0	414
720 min Winter	4.558	0.0	482
960 min Winter	3.628	0.0	608
1440 min Winter	2.628	0.0	836
2160 min Winter	1.902	0.0	1212
2880 min Winter	1.511	0.0	1584
4320 min Winter	1.091	0.0	2288
5760 min Winter	0.866	0.0	3024
7200 min Winter	0.724	0.0	3816
8640 min Winter	0.625	0.0	4496
10080 min Winter	0.552	0.0	5152

Summary of Results for 100 year Return Period

Half Drain Time : 216 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	8.533	0.063	1.0	11.6	O K
30 min Summer	8.556	0.086	1.0	15.9	O K
60 min Summer	8.579	0.109	1.0	20.1	O K
120 min Summer	8.598	0.128	1.0	23.6	O K
180 min Summer	8.603	0.133	1.0	24.5	O K
240 min Summer	8.603	0.133	1.0	24.4	O K
360 min Summer	8.600	0.130	1.0	24.0	O K
480 min Summer	8.596	0.126	1.0	23.3	O K
600 min Summer	8.592	0.122	1.0	22.5	O K
720 min Summer	8.588	0.118	1.0	21.7	O K
960 min Summer	8.578	0.108	1.0	19.9	O K
1440 min Summer	8.559	0.089	1.0	16.4	O K
2160 min Summer	8.537	0.067	1.0	12.3	O K
2880 min Summer	8.522	0.052	1.0	9.6	O K
4320 min Summer	8.510	0.040	0.8	7.4	O K
5760 min Summer	8.503	0.033	0.6	6.1	O K
7200 min Summer	8.498	0.028	0.5	5.2	O K
8640 min Summer	8.495	0.025	0.5	4.5	O K
10080 min Summer	8.492	0.022	0.4	4.1	O K
15 min Winter	8.533	0.063	1.0	11.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	100.377	0.0	30
30 min Summer	65.356	0.0	43
60 min Summer	40.510	0.0	64
120 min Summer	24.265	0.0	122
180 min Summer	17.749	0.0	180
240 min Summer	14.138	0.0	218
360 min Summer	10.220	0.0	278
480 min Summer	8.120	0.0	342
600 min Summer	6.789	0.0	408
720 min Summer	5.862	0.0	476
960 min Summer	4.647	0.0	608
1440 min Summer	3.345	0.0	866
2160 min Summer	2.405	0.0	1216
2880 min Summer	1.901	0.0	1556
4320 min Summer	1.363	0.0	2252
5760 min Summer	1.075	0.0	2992
7200 min Summer	0.894	0.0	3696
8640 min Summer	0.769	0.0	4416
10080 min Summer	0.677	0.0	5144
15 min Winter	100.377	0.0	30

Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	8.556	0.086	1.0	15.9	O K
60 min Winter	8.579	0.109	1.0	20.1	O K
120 min Winter	8.598	0.128	1.0	23.5	O K
180 min Winter	8.603	0.133	1.0	24.4	O K
240 min Winter	8.602	0.132	1.0	24.4	O K
360 min Winter	8.597	0.127	1.0	23.5	O K
480 min Winter	8.592	0.122	1.0	22.5	O K
600 min Winter	8.586	0.116	1.0	21.3	O K
720 min Winter	8.579	0.109	1.0	20.0	O K
960 min Winter	8.564	0.094	1.0	17.4	O K
1440 min Winter	8.539	0.069	1.0	12.7	O K
2160 min Winter	8.518	0.048	0.9	8.8	O K
2880 min Winter	8.509	0.039	0.8	7.2	O K
4320 min Winter	8.499	0.029	0.6	5.3	O K
5760 min Winter	8.493	0.023	0.5	4.2	O K
7200 min Winter	8.489	0.019	0.4	3.5	O K
8640 min Winter	8.487	0.017	0.3	3.0	O K
10080 min Winter	8.485	0.015	0.3	2.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	65.356	0.0	43
60 min Winter	40.510	0.0	66
120 min Winter	24.265	0.0	120
180 min Winter	17.749	0.0	176
240 min Winter	14.138	0.0	228
360 min Winter	10.220	0.0	286
480 min Winter	8.120	0.0	360
600 min Winter	6.789	0.0	434
720 min Winter	5.862	0.0	506
960 min Winter	4.647	0.0	644
1440 min Winter	3.345	0.0	894
2160 min Winter	2.405	0.0	1208
2880 min Winter	1.901	0.0	1560
4320 min Winter	1.363	0.0	2296
5760 min Winter	1.075	0.0	3000
7200 min Winter	0.894	0.0	3744
8640 min Winter	0.769	0.0	4408
10080 min Winter	0.677	0.0	5096

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 268 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	8.549	0.079	1.0	14.5	O K
30 min Summer	8.577	0.107	1.0	19.7	O K
60 min Summer	8.605	0.135	1.0	24.9	O K
120 min Summer	8.680	0.210	1.0	29.3	O K
180 min Summer	8.705	0.235	1.0	30.8	O K
240 min Summer	8.708	0.238	1.0	31.0	O K
360 min Summer	8.698	0.228	1.0	30.4	O K
480 min Summer	8.686	0.216	1.0	29.7	O K
600 min Summer	8.670	0.200	1.0	28.8	O K
720 min Summer	8.642	0.172	1.0	27.9	O K
960 min Summer	8.611	0.141	1.0	25.9	O K
1440 min Summer	8.590	0.120	1.0	22.0	O K
2160 min Summer	8.562	0.092	1.0	17.0	O K
2880 min Summer	8.541	0.071	1.0	13.1	O K
4320 min Summer	8.518	0.048	0.9	8.9	O K
5760 min Summer	8.510	0.040	0.8	7.3	O K
7200 min Summer	8.504	0.034	0.7	6.3	O K
8640 min Summer	8.500	0.030	0.6	5.5	O K
10080 min Summer	8.497	0.027	0.5	4.9	O K
15 min Winter	8.549	0.079	1.0	14.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	120.453	0.0	33
30 min Summer	78.427	0.0	47
60 min Summer	48.611	0.0	68
120 min Summer	29.118	0.0	122
180 min Summer	21.298	0.0	182
240 min Summer	16.966	0.0	240
360 min Summer	12.264	0.0	298
480 min Summer	9.745	0.0	358
600 min Summer	8.147	0.0	424
720 min Summer	7.035	0.0	492
960 min Summer	5.577	0.0	626
1440 min Summer	4.015	0.0	888
2160 min Summer	2.885	0.0	1256
2880 min Summer	2.281	0.0	1612
4320 min Summer	1.635	0.0	2252
5760 min Summer	1.290	0.0	3000
7200 min Summer	1.073	0.0	3744
8640 min Summer	0.923	0.0	4416
10080 min Summer	0.812	0.0	5144
15 min Winter	120.453	0.0	33

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	8.577	0.107	1.0	19.7	O K
60 min Winter	8.605	0.135	1.0	24.9	O K
120 min Winter	8.679	0.209	1.0	29.3	O K
180 min Winter	8.704	0.234	1.0	30.7	O K
240 min Winter	8.708	0.238	1.0	30.9	O K
360 min Winter	8.692	0.222	1.0	30.0	O K
480 min Winter	8.674	0.204	1.0	29.0	O K
600 min Winter	8.636	0.166	1.0	27.8	O K
720 min Winter	8.614	0.144	1.0	26.5	O K
960 min Winter	8.598	0.128	1.0	23.6	O K
1440 min Winter	8.568	0.098	1.0	18.1	O K
2160 min Winter	8.533	0.063	1.0	11.6	O K
2880 min Winter	8.517	0.047	0.9	8.7	O K
4320 min Winter	8.505	0.035	0.7	6.4	O K
5760 min Winter	8.498	0.028	0.5	5.1	O K
7200 min Winter	8.493	0.023	0.5	4.3	O K
8640 min Winter	8.490	0.020	0.4	3.7	O K
10080 min Winter	8.488	0.018	0.3	3.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	78.427	0.0	47
60 min Winter	48.611	0.0	68
120 min Winter	29.118	0.0	120
180 min Winter	21.298	0.0	178
240 min Winter	16.966	0.0	232
360 min Winter	12.264	0.0	316
480 min Winter	9.745	0.0	374
600 min Winter	8.147	0.0	448
720 min Winter	7.035	0.0	522
960 min Winter	5.577	0.0	666
1440 min Winter	4.015	0.0	936
2160 min Winter	2.885	0.0	1276
2880 min Winter	2.281	0.0	1584
4320 min Winter	1.635	0.0	2292
5760 min Winter	1.290	0.0	3008
7200 min Winter	1.073	0.0	3744
8640 min Winter	0.923	0.0	4432
10080 min Winter	0.812	0.0	5144

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

Half Drain Time : 332 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	8.564	0.094	1.0	17.4	O K
30 min Summer	8.598	0.128	1.0	23.6	O K
60 min Summer	8.687	0.217	1.0	29.7	O K
120 min Summer	8.780	0.310	1.0	35.1	O K
180 min Summer	8.814	0.344	1.0	37.1	O K
240 min Summer	8.823	0.353	1.0	37.6	O K
360 min Summer	8.813	0.343	1.0	37.1	O K
480 min Summer	8.801	0.331	1.0	36.3	O K
600 min Summer	8.785	0.315	1.0	35.4	O K
720 min Summer	8.768	0.298	1.0	34.5	O K
960 min Summer	8.732	0.262	1.0	32.4	O K
1440 min Summer	8.651	0.181	1.0	28.1	O K
2160 min Summer	8.592	0.122	1.0	22.4	O K
2880 min Summer	8.566	0.096	1.0	17.6	O K
4320 min Summer	8.531	0.061	1.0	11.2	O K
5760 min Summer	8.517	0.047	0.9	8.6	O K
7200 min Summer	8.510	0.040	0.8	7.3	O K
8640 min Summer	8.505	0.035	0.7	6.4	O K
10080 min Summer	8.501	0.031	0.6	5.7	O K
15 min Winter	8.564	0.094	1.0	17.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	140.528	0.0	36
30 min Summer	91.498	0.0	50
60 min Summer	56.713	0.0	72
120 min Summer	33.971	0.0	124
180 min Summer	24.848	0.0	182
240 min Summer	19.793	0.0	240
360 min Summer	14.308	0.0	318
480 min Summer	11.369	0.0	380
600 min Summer	9.505	0.0	442
720 min Summer	8.207	0.0	506
960 min Summer	6.506	0.0	644
1440 min Summer	4.684	0.0	910
2160 min Summer	3.366	0.0	1296
2880 min Summer	2.661	0.0	1648
4320 min Summer	1.908	0.0	2332
5760 min Summer	1.505	0.0	2992
7200 min Summer	1.252	0.0	3704
8640 min Summer	1.076	0.0	4416
10080 min Summer	0.947	0.0	5144
15 min Winter	140.528	0.0	36

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	8.598	0.128	1.0	23.6	O K
60 min Winter	8.686	0.216	1.0	29.7	O K
120 min Winter	8.779	0.309	1.0	35.1	O K
180 min Winter	8.813	0.343	1.0	37.1	O K
240 min Winter	8.823	0.353	1.0	37.6	O K
360 min Winter	8.813	0.343	1.0	37.0	O K
480 min Winter	8.792	0.322	1.0	35.8	O K
600 min Winter	8.772	0.302	1.0	34.7	O K
720 min Winter	8.748	0.278	1.0	33.3	O K
960 min Winter	8.697	0.227	1.0	30.3	O K
1440 min Winter	8.602	0.132	1.0	24.2	O K
2160 min Winter	8.559	0.089	1.0	16.4	O K
2880 min Winter	8.529	0.059	1.0	10.9	O K
4320 min Winter	8.511	0.041	0.8	7.5	O K
5760 min Winter	8.503	0.033	0.6	6.0	O K
7200 min Winter	8.497	0.027	0.5	5.0	O K
8640 min Winter	8.493	0.023	0.5	4.3	O K
10080 min Winter	8.491	0.021	0.4	3.8	O K

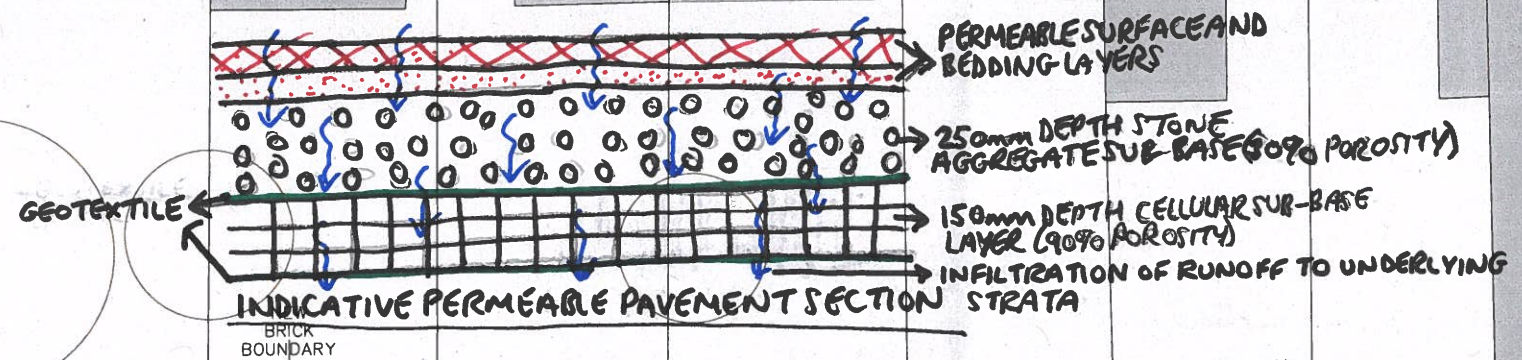
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	91.498	0.0	50
60 min Winter	56.713	0.0	72
120 min Winter	33.971	0.0	122
180 min Winter	24.848	0.0	178
240 min Winter	19.793	0.0	234
360 min Winter	14.308	0.0	340
480 min Winter	11.369	0.0	390
600 min Winter	9.505	0.0	462
720 min Winter	8.207	0.0	538
960 min Winter	6.506	0.0	684
1440 min Winter	4.684	0.0	966
2160 min Winter	3.366	0.0	1340
2880 min Winter	2.661	0.0	1644
4320 min Winter	1.908	0.0	2292
5760 min Winter	1.505	0.0	3000
7200 min Winter	1.252	0.0	3744
8640 min Winter	1.076	0.0	4496
10080 min Winter	0.947	0.0	5144

332511103/SK01 ST. MARY'S GROVE GARAGES PROPOSED SURFACE WATER DRAINAGE

SITE LAYOUT & ROOF PLAN

KEY

- 0.026HA TO DRAIN AS EXISTING TO ST. MARY'S GROVE
- 0.016HA TO DRAIN TO EXISTING DRAINAGE CHANNEL (TO BE CONNECTED TO SUB-BASE BENEATH PERMEABLE SURFACING.
- PROPOSED PERMEABLE SURFACING WITH UNDERLYING SUB-BASE
- OVERLAND/EXCEEDANCE FLOW ROUTE
- EXISTING DRAINAGE CHANNEL
- PROPOSED PERMEABLE SURFACE UNDER ROOF CANOPY
- INDICATIVE RAINWATER DOWNPIPE CONNECTION TO SUB-BASE BENEATH PERMEABLE SURFACING



INDICATIVE PERMEABLE PAVEMENT SECTION

ACCOMMODATION SCHEDULE

SELF-CONTAINED ELDERLY PERSON DWELLINGS
4 No. 1 BED / 2 PERSON WHEELCHAIR ACCESSIBLE M4(3) UNITS @ 60M²
1 No. 1 BED / 2 PERSON ACCESSIBLE & ADAPTABLE UNIT WITH WET ROOM M4(2) @ 50M²
5 No. UNITS TOTAL

PARKING:
1 No. BLUE BADGE DISABLED PARKING BAY (ELECTRIC CHARGING)

NOTE:
DRY RISER REQUIRED FOR FIRE BRIGADE ACCESS.
EXISTING NEIGHBOUR GATE AND GARAGE ACCESS RETAINED.

NORTH

BAR SCALE
0 2 4 6 8 10M

Project	ST MARY'S GROVE GARAGES, RICHMOND, TW9
Drawing	SITE LAYOUT & ROOF PLAN
Drawing No.	SMGG21-SK09
Scale	1:100 @ A1
Date	22.04.22

CLIVE CHAPMAN
ARCHITECTS
SUSTAINABILITY CONSULTANTS
4 EEL PIE ISLAND
TWICKENHAM, MIDDX
TW1 3DY
TELEPHONE 020 8891 4837
EMAIL INFO@CCAR.CO.UK
WEBSITE WWW.CCAR.CO.UK