AMA Consulting Engineers

Chris Christou
CEng MIstructE
Director

Richard Russell
CEng MIstructE
Director

# Sustainable Drainage Strategy

## for the

# Outbuilding to Rear of 67c Camlet Way, Hadley Wood, EN4 0NL

*Enfield Council*
*Planning Reference: 22/01601/HOU*
*Lead Local Flood Authority – Enfield Council*

Prepared by: Christos Christou Beng CEng MIStructE
Project No. 23091
Revision 00

| *Revision* | *Prepared by* | *Checked by* | *Date* | *Status* |
|---|---|---|---|---|
| 02 | CC | RR | 06/11/23 | Preliminary |

AMA Consulting Engineers Ltd
6A Nesbitts Alley
Barnet
EN5 5XG
t: +44(0)20 8361 5827
w: www.amaci.co.uk

AMA Consulting Engineers

**Chris Christou**
CEng MIstructE
Director

**Richard Russell**
CEng MIstructE
Director

## Contents



**AMA Consulting Engineers Ltd**
6A Nesbitts Alley
Barnet
EN5 5XG
t: +44(0)20 8361 5827
w: www.amaci.co.uk

AMA Consulting Engineers

Chris Christou
CEng MIstructE
Director

Richard Russell
CEng MIstructE
Director

## 1.0 Introduction

i. 67c Camlet Way is a substantial detached villa on the North side of Camlet Way Barnet. It is proposed to consider a small single storey out building for recreation at the end of the rear garden.

ii. With the increase in urban development, it was realised that the traditional collection of ever larger volumes of surface water into public sewers was not sustainable and that measures were required to control the amount of water discharged off-site and to improve the quality of the water discharged.

iii. The UK Government sets out a National Planning Policy Framework for England and to support decision making provides guidance in a document "Guidance-Flood risk and coastal change this includes requirements for Sustainable Drainage Systems (SuDS)" Paragraph 51 states:

*"Why are sustainable drainage systems important?*

*Sustainable drainage systems are designed to control surface water run off close to where it falls and mimic natural drainage as closely as possible. They provide opportunities to:*

*reduce the causes and impacts of flooding;*

*remove pollutants from urban run-off at source;*

*combine water management with green space with benefits for amenity, recreation and wildlife."*

iv. The Planning Consent 23/01458/HOU contained the following condition No 5.

5 The development shall not commence until a SUDS strategy and a Groundwater Flood Risk Assessment has been submitted to and approved in writing by the Local Planning Authority. A Groundwater FRA should include:

- Onsite geological investigation
- Depth to groundwater and relative depth of the basement level
- Identification of groundwater flow routes, and demonstration that the proposed basement will not impact these
- Measures to reduce the impact of the basement on groundwater flows and flooding

Reason: To ensure the sustainable management of water, minimise flood risk, minimise discharge of surface water outside of the curtilage of the property and ensure that the drainage system will remain functional throughout the lifetime of the development in accordance with Policy CP28 of the Core Strategy, DMD Policy 61, and Policy SI 5 of the London Plan and the NPPF and to maximise opportunities for sustainable development, improve water quality, biodiversity, local amenity and recreation value.

v. The London Plan 2021 contains the following policy:

*Policy SI.13 Sustainable drainage Policy*
*Planning decisions*

A Development should utilise sustainable urban drainage systems (SUDS) unless there are *practical reasons for not doing so, and should aim to achieve greenfield run- off rates and ensure that surface water run-off is managed as close to its source as possible in line with the following drainage hierarchy:*

AMA Consulting Engineers

Chris Christou
CEng MIstructE
Director

Richard Russell
CEng MIstructE
Director

1. *store rainwater for later use*
2. *use infiltration techniques, such as porous surfaces in non-clay areas*
3. *attenuate rainwater in ponds or open water features for gradual release*
4. *attenuate rainwater by storing in tanks or sealed water features forgradual release*
5. *discharge rainwater direct to a watercourse*
6. *discharge rainwater to a surface water sewer/drain*
7. *discharge rainwater to the combined sewer.*

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

vi. This document is not a flood risk assessment (FRA). One has been prepared by Jomas Associates and is included within the Appendix I. Based on the Jomas Report, the site is at low risk from identified potential sources of flooding. The development can be constructed and operated safely in flood risk terms without being at significant risk or increasing flood risk elsewhere and is therefore considered NPPF compliant.

## 2.0 Proposed Sustainable Drainage Scheme

i. This document describes a proposed SuDS Scheme for the project showing the SuDS elements and proposing a discharge rate. Hydraulic calculations are provided for the SuDS elements. This scheme has been prepared with the proposed development plans and may be subject to design development once the construction details are known.

## 3.0 Management and Maintenance

i. The SuDS described in this document will be within a single house development and management and maintenance will be the responsibility of the owner.

ii. For the continued efficiency and effectiveness of the SuDS system maintenance is required. A schedule of anticipated maintenance is included. London Borough of Enfield suggest a laminated drawing with the schedule on the back be prepared.

## 4.0 Constraints and Opportunities

i. The site area is 70m$^2$ or 0.007 hectare, all of which is rear garden, the predevelopment drained area is 0 sq m and the post development drained area 70m$^2$.

ii. The Enfield Borough Planning Geological map indicates that the superficial geology is London Clay, which is consistent with site investigation of nearby properties.

iii. The Enfield Borough Watercourses map shows that there are no open bodies or watercourses close to the site.

iv. The site falls from the road towards the rear garden. The new outhouse will be constructed level with the rear boundary of the garden with a low retaining wall to the remaining garden.

AMA Consulting Engineers Ltd
6A Nesbitts Alley
Barnet
EN5 5XG
t: +44(0)20 8361 5827
w: www.amaci.co.uk

Consulting Engineers

Chris Christou
CEng MIstructE
Director

Richard Russell
CEng MIstructE
Director

v. There is no scope for surface features such as swales ponds or similar.

vi. Flow rates will be limited to:
- Q Bar 1 for storms up to a 1 year return period controlled by an orifice plate.
- Q Bar 100 for all storms up to a 100 year return period with a 6 hour event controlled by the rate of an electric lift pump.

vii. Areas of paving will be permeable over stone drainage layer to provide water quality treatment. The drainage blanket will be supplemented by a geocell tank to provide attenuation drainage. The surface water will be pumped to the existing surface water manholes at the side of the house.

## 5.0 Applications of the Hierarchy of Drainage Control

| Ref | Hierarchy | Discussion on Suitability | Suitable | Adopted |
|---|---|---|---|---|
| 1 | *store rainwater for later use* | Not practical | No | No |
| 2 | *use infiltration techniques, such as porous surfaces in non-clay areas* | Clay area, not viable | No | No |
| 3 | *attenuate rainwater in ponds or open water features for gradual release* | Not viable due to small external spaces | No | No |
| 4 | *attenuate rainwater by storing in tanks or sealed water features for gradual release* | Surface Water to be stored in geocell tank the rear yard and slowly through a vortex device | Yes | Yes |
| 5 | *discharge rainwater direct to a watercourse* | None available. | No | No |
| 6 | *discharge rainwater to a surface water sewer/drain* | None available. | Yes | Yes |
| 7 | *discharge rainwater to the combined sewer.* | The public sewers are combined | No | No |

## 5.0 SuDS Treatment Train and Water Quality

i. Water falling on roofs will drain through rainwater pipes into the stone drainage blanket under the permeable paving. To minimise the risk of silt flowing into the stone drainage rainwater pipes where possible will flow onto the permeable paving.

ii. The stone tanks will treat the runoff water.

iii. Here are the indices from the Index Based Analysis using The Simple Index Method as Chapter 26 of the SuDS Manual.

| Ref | Source | Pollution Indices T26.2 SuDS Manual | | | |
|---|---|---|---|---|---|
| | Land Use | Pollution Risk Level | TTS | Metals | Hydrocarbons |

Consulting Engineers

Chris Christou
CEng MIstructE
Director

Richard Russell
CEng MIstructE
Director

| | | | | | |
|---|---|---|---|---|---|
| A | Residential Roofs | Very Low | 0.2 | 0.2 | 0.05 |
| B | Courtyard/Pedestrian | Low | 0.5 | 0.4 | 0.4 |

iv. It is proposed to provide both green roofs off and stone tanks under permeable paving.

| Ref | Source | Pollution Indices T26.3 SuDS Manual | | |
|---|---|---|---|---|
| | SuDS Component | TTS | Metals | Hydrocarbons |
| A | Permeable Paving | 0.7 | 0.6 | 0.7 |

v. It can be seen that the treatment index for either of the SuDS components is bigger than the pollution hazard index.

## 6.0 Amenity and Biodiversity

i. The SuDS itself does not provide amenity but by allowing the outbuilding to be built additional recreation is provided.

## 7.0 Description of Sustainable Drainage System

i. The surface water drainage system is shown on drawings 23091-130100-P1.
ii. For flows up to a 1 in 1 year storm $Q_{bar1in1}$ = 0.03 l/s
iii. For storms up to a 100 + climate change $Q_{bar1in00}$ = 0.1 l/s
iv. Permeable paving will be between the outbuilding and the retaining wall. A stone drainage blanket is provided under the permeable paving as a storage tank to contain the storm water up to a 1 in 100 Year storm with uplift for climate change in conjunction with a geocell tank.
v. These attenuation tanks drain to a manhole with a baffle and orifice plate, details of which are attached to the hydraulic calculations. And from there to a package pump chamber.
vi. The drainage system is designed to intercept the first 5 mm of any rainfall to reduce the total volume of surface water discharged from site over the year as a whole. Interception will be provided by the green roofs, and the permeable pavement with the stone tank under the parking court.

## 8.0 Hydraulic Calculations and Parameters

i. The calculations are attached, parameters are based on the Enfield Design Guide.
ii. $Q_{bar\ rural}$ is calculated in accordance with the "Flood estimation for small catchments Marshall DCW and Bayliss AC. IOH Report No.124. Institute of hydrology, Wallingford, 1994," see spread sheet.

Consulting Engineers

Chris Christou
CEng MIstructE
Director

Richard Russell
CEng MIstructE
Director

| | | |
|---|---|---|
| $Q_{bar}$ Rural | 0.33 | l/s |
| $Q_{bar}$ 1 Year Return | 0.03 | l/s |
| $Q_{bar}$ 30 Year Return | 0.08 | l/s |
| $Q_{bar}$ 100 Year Return | 0.1 | l/s |

iii. CvCr are taken as 1.1.
iv. The uplift for Climate Change was considered in the range 20% Centre to 40% Upper (NPPF) and a value of 40% was selected given the sensitivity of the site.
v. The volume to be stored is considered by balancing storm inflows and limited outflows with a hydrograph based on the Wallingford Modified Rational Method.
vi. The flow/head characteristics of the orifice flow control device are used in calculating storage volumes.
vii. The volume of storage is not increased for Urban Creep by 10%.
viii. The total volume required is 6.1 cu m. No reduction is made for the interception storage.
ix. Time to empty after the 100 Year +CC storm is 6.2 hours.
x. Abstracted from the spreadsheets in the hydraulic calculations the comparative flow and volumes are tabulated below.
xi. Table of flows:

| Storm | Flow | | |
|---|---|---|---|
| Return Period | Proposed $Q_{peak}$ | Greenfield $Q_{bar}$ | Existing $Q_{peak}$ |
| Years | l/s | l/s | l/s |
| 1 | 0.03 | 0.03 | 0 |
| 30 | 0.08 | 0.08 | 0 |
| 100 | 0.1 | 0.1 | 0 |
| Add for CC | 40% | | |
| 100 + CC | 0.1 | | |

xii. Table of volumes:

| Storm | | Existing | After Development | | |
|---|---|---|---|---|---|
| Return Period | Duration | Run Off Volume | Run Off Volume | Reduction in Run Off | Attenuation Volume Required |
| Years | Mins | $m^3$ | $m^3$ | | $m^3$ |
| 1 | 15 | 0.03 | 0.54 | | 1.25 |
| 30 | 240 | 1.13 | 3.08 | | 2.1 |
| 100 | 360 | 2.26 | 4.38 | | 4.3 |
| 100+CC | 360 | - | 6.13 | | 6.1 |

Chris Christou
CEng MIstructE
Director

Richard Russell
CEng MIstructE
Director

## 9.0 Exceedance Flows

Exceedance flows will be as existing with any exceedance flowing behind the outbuilding and onto the field to the rear of the property. A sketch is included in the calculations.

## 10.0 Management of the SuDS

i. The SuDS is intended to be simple and robust.
ii. The system will need to be managed by the building owner.
iii. Further guidance on management of SuDS can be found in the SuDS Manual published by CIRIA as Report C735. It is available as a free download from http://www.ciria.org/Resources/Free_publications/SuDS_manual_C753.aspx

## 11.0 Maintenance of the SuDS

i. A SuDS maintenance table is attached below.
ii. SuDS maintenance may be considered to be:
    - Regular maintenance, including inspections,
    - Occasional maintenance, and
    - Remedial maintenance.
iii. Items described as regular or occasional can be included in the landscape maintenance. Items described as remedial may require design and result in a capital expenditure.
iv. The frequency of maintenance may require to be ascertained after the system has been in use.
v. Where SuDS elements need to be replaced then the design drawings should be used to specify replacement material.
vi. At the end of construction this schedule will be updated as required, combined with a plan and laminated for maintenance team.

Consulting Engineers
Chris Christou
CEng MIstructE
Director
Richard Russell
CEng MIstructE
Director

## 12.0 Maintenance Schedule

| Ref | SuDS Element | Activity | Frequency | Type & Notes |
|---|---|---|---|---|
| 1 | Gullies & Drainage Channels | Inspect to check for sediment and empty if full | Annually or as required | Routine/Occasional Material removed should be disposed of as contaminated. |
| 2 | Underground drains | Pipes to be cleaned if blocked | As required | Occasional |
| 3 | Orifice Plate | Inspect for blocked flow control unit in Spring and Autumn. Unblock if necessary. | When Blocked | Routine/Remedial |
| 4 | Package Pump Unit | Maintenance | Annual | Routine by specialist contractor |
| 5 | Package Pump Unit | Attendance on pump failure | If pump alarm sounds/lights up | Occasional by specialist contractor |
| 6 | Permeable Paving | Sweep and remove debris and leaf litter | Monthly or more often as required | Regular Maintenance |
| 7 | Permeable Paving | Vacuum clean | 5 yearly | Regular Maintenance |
| 8 | Permeable Paving | Lift and relay | Intervals of 20 years approximately | Remedial Maintenance |
| 9 | Stone Drainage Blanket | Lifted, cleaned of silt and re-laid. | After 20 to 40 years anticipated | Remedial Maintenance Trial area be exposed and checked when paving re-laid. Material removed should be disposed of as contaminated. |

AMA Consulting Engineers

Chris Christou
CEng MIstructE
Director

Richard Russell
CEng MIstructE
Director

## 13.0 Attached Documents

Appendix A – Enfield Proforma

Appendix B – SuDS drainage Scheme Drawings

Appendix C – Areas

Appendix D – Exceedance

Appendix E – Hydraulic Calculations

Appendix F – Existing Building CCTV Drainage Survey

Appendix G – Architectural Existing and Proposed Drawings

Appendix I – Groundwater Flood Risk Assessment

AMA Consulting Engineers

Appendix A – Enfield Proforma

Chris Christou
CEng MIstructE
Director

Richard Russell
CEng MIstructE
Director

AMA Consulting Engineers Ltd
6A Nesbitts Alley
Barnet
EN5 5XG
t: +44(0)20 8361 5827
w: www.amaci.co.uk

GREATERLONDONAUTHORITY

| 1. Project & Site Details | |
|---|---|
| Project / Site Name (including sub-catchment / stage / phase where appropriate) | outbuilding to the Rear of 67c Camlet Way |
| Address & post code | 67c Camlet Way, Hadley Wood, EN4 0NL |
| OS Grid ref. (Easting, Northing) | E 525822 |
| | N 197779 |
| LPA reference (if applicable) | |
| Brief description of proposed work | Outbuilding to the rear of 67c Camlet Way |
| Total site Area | 70 $m^2$ |
| Total existing impervious area | 0 $m^2$ |
| Total proposed impervious area | 70 $m^2$ |
| Is the site in a surface water flood risk catchment (ref. local Surface Water Management Plan)? | No |
| Existing drainage connection type and location | Public sewer |
| Designer Name | Christos Christou |
| Designer Position | Engineer |
| Designer Company | AMA Consulting Engineers |

| 2. Proposed Discharge Arrangements | | |
|---|---|---|
| **2a. Infiltration Feasibility** | | |
| Superficial geology classification | London Clay | |
| Bedrock geology classification | London Clay | |
| Site infiltration rate | n/a m/s | |
| Depth to groundwater level | m below ground level | |
| Is infiltration feasible? | No | |
| **2b. Drainage Hierarchy** | | |
| | *Feasible (Y/N)* | *Proposed (Y/N)* |
| 1 store rainwater for later use | N | N |
| 2 use infiltration techniques, such as porous surfaces in non-clay areas | N | N |
| 3 attenuate rainwater in ponds or open water features for gradual release | N | N |
| 4 attenuate rainwater by storing in tanks or sealed water features for gradual release | Y | Y |
| 5 discharge rainwater direct to a watercourse | N | N |
| 6 discharge rainwater to a surface water sewer/drain | Y | Y |
| 7 discharge rainwater to the combined sewer. | N | N |
| **2c. Proposed Discharge Details** | | |
| Proposed discharge location | ection to existing manhole at side of the exi | |
| Has the owner/regulator of the discharge location been consulted? | No | |

ENFIELD Council

GREATERLONDONAUTHORITY

LoDEG

## 3. Drainage Strategy

**3a. Discharge Rates & Required Storage**

| | *Greenfield (GF) runoff rate (l/s)* | *Existing discharge rate (l/s)* | *Required storage for GF rate ($m^3$)* | *Proposed discharge rate (l/s)* |
|---|---|---|---|---|
| *Qbar* | 0.33 | | | |
| *1 in 1* | 0.03 | 0 | 1.25 | 0.03 |
| *1 in 30* | 0.08 | 0 | 2.1 | 0.08 |
| *1 in 100* | 0.1 | 0 | 4.3 | 0.1 |
| *1 in 100 + CC* | | | 6.1 | 0.1 |
| *Climate change allowance used* | 40% | | | |

| | |
|---|---|
| 3b. Principal Method of Flow Control | Orifice plate + constant flow via pump |

**3c. Proposed SuDS Measures**

| | *Catchment area ($m^2$)* | *Plan area ($m^2$)* | *Storage vol. ($m^3$)* |
|---|---|---|---|
| Rainwater harvesting | 0 | | 0 |
| Infiltration systems | 0 | | 0 |
| Green roofs | 0 | 0 | 0 |
| Blue roofs | 0 | 0 | 0 |
| Filter strips | 0 | 0 | 0 |
| Filter drains | 0 | 0 | 0 |
| Bioretention / tree pits | 0 | 0 | 0 |
| Pervious pavements | 70 | 20 | 0 |
| Swales | 0 | 0 | 0 |
| Basins/ponds | 0 | 0 | 0 |
| Attenuation tanks | 0 | | 6.4 |
| **Total** | **70** | **20** | **6.4** |

## 4. Supporting Information

| **4a. Discharge & Drainage Strategy** | *Page/section of drainage report* |
|---|---|
| Infiltration feasibility (2a) – geotechnical factual and interpretive reports, including infiltration results | See SuDS report section 5, page 5 |
| Drainage hierarchy (2b) | See SuDS report section 5, page 5 |
| Proposed discharge details (2c) – utility plans, correspondence / approval from owner/regulator of discharge location | See section 8, page 7 & Appendices |
| Discharge rates & storage (3a) – detailed hydrologic and hydraulic calculations | See appendix |
| Proposed SuDS measures & specifications (3b) | See drawings in appendix |
| **4b. Other Supporting Details** | *Page/section of drainage report* |
| Detailed Development Layout | See drawings in appendix |
| Detailed drainage design drawings, including exceedance flow routes | See drawings in appendix |
| Detailed landscaping plans | Not available |
| Maintenance strategy | See SuDS report, section 11, page 8 |
| Demonstration of how the proposed SuDS measures improve: | |
| a) water quality of the runoff? | See SuDS report section 5, page 5 |
| b) biodiversity? | See SuDS report section 6, page 6 |
| c) amenity? | See SuDS report section 6, page 6 |

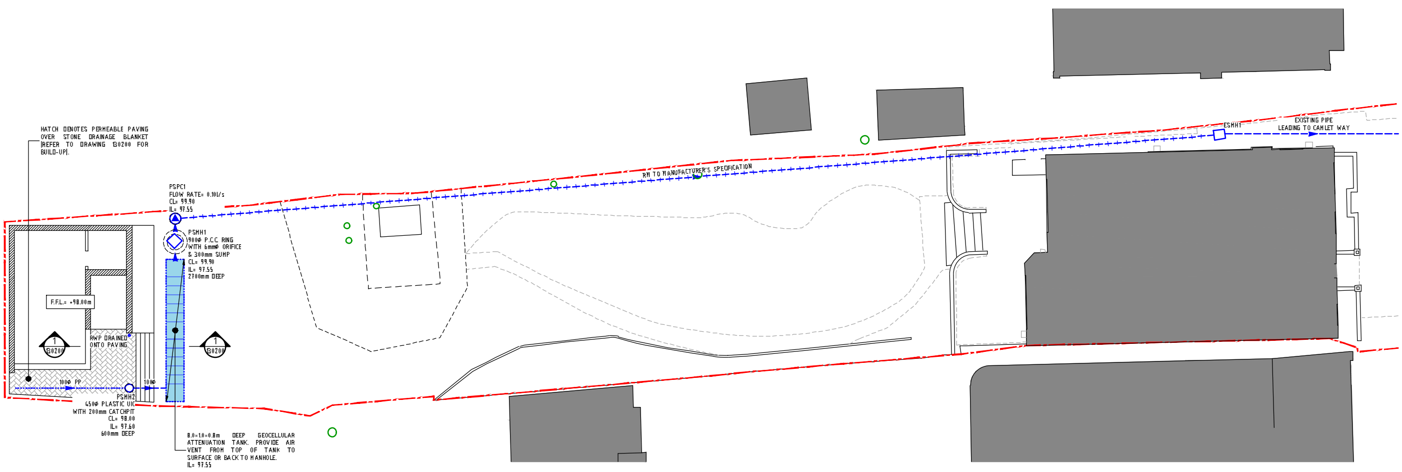
Consulting Engineers

Appendix B – SuDS drainage Scheme Drawings

Chris Christou
CEng MIstructE
Director

Richard Russell
CEng MIstructE
Director

AMA Consulting Engineers Ltd
6A Nesbitts Alley
Barnet
EN5 5XG
t: +44(0)20 8361 5827
w: www.amaci.co.uk




## MAINTENANCE SCHEDULE

| SuDS ELEMENT | ACTIVITY | FREQUENCY | NOTES |
|---|---|---|---|
| GULLIES & DRAINAGE CHANNELS | INSPECT TO CHECK FOR SEDIMENT AND EMPTY IF FULL | ANNUALLY OR AS REQUIRED | ROUTINE/OCCASIONAL. MATERIAL REMOVED SHOULD BE DISPOSED OF AS CONTAMINATED |
| UNDERGROUND DRAINS | PIPES TO BE CLEANED IF BLOCKED | AS REQUIRED | OCCASIONAL |
| ORIFICE PLATE | INSPECT FOR BLOCKED ORIFICE IN SPRING AND AUTUMN. UNBLOCK IF NECESSARY | WHEN BLOCKED | ROUTINE/REMEDIAL |
| PACKAGE PUMP UNIT | MAINTENANCE | ANNUALLY | ROUTINE BY SPECIALIST CONTRACTOR |
| PACKAGE PUMP UNIT | ATTENDANCE ON PUMP FAILURE | IF PUMP ALARM SOUNDS/LIGHTS UP | OCCASIONAL BY SPECIALIST CONTRACTOR |
| PERMEABLE PAVING | SWEEP CLEAN OF LEAVES AND DEBRIS | MONTHLY OR MORE OFTEN AS REQUIRED | REGULAR MAINTENANCE |
| PERMEABLE PAVING | VACUUM CLEANING THE SURFACE | 5 YEARLY | REGULAR MAINTENANCE |
| PERMEABLE PAVING | LIFT AND RELAY | INTERVALS OF APPROXIMATELY 20 YEARS | REMEDIAL MAINTENANCE |
| STONE DRAINAGE BLANKET | LIFTED, CLEANED OF SILT AND RE-LAID | AFTER 20 TO 40 YEARS ANTICIPATED | REMEDIAL MAINTENANCE. TRIAL AREA TO BE EXPOSED AND CHECKED BEFORE PAVING RELAID. MATERIAL REMOVED SHOULD BE DISPOSED OF AS CONTAMINATED |

## DRAINAGE SPECIFICATION

1. FOUL DRAINS ARE TO BE 100mm NOMINAL DIAMETER LAID AT A GRADIENT NOT FLATTER THAN 1:70 U.N.O
2. DRAINS ARE TO BE CONSTRUCTED USING FLEXIBLE UPVC PIPES TO BS4660 OR VITRIFIED CLAY PIPES TO BS 65 WITH FLEXIBLE JOINTS BEDDED AND BACKFILLED IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATIONS AND BS 8301.
3. 100mm RIGID PIPES WITH LESS THAN 300mm COVER OR PIPES OF 150mm OR GREATER DIAMETER WITH LESS THAN 600mm COVER ARE TO BE SURROUNDED BY 150mm OF CONCRETE WITH MOVEMENT JOINTS PROVIDED AT EVERY PIPE JOINT.
4. FLEXIBLE PIPES WITH LESS THAN 600mm COVER ARE TO BE SURROUNDED WITH CONCRETE OR TO HAVE CONCRETE PAVING SLABS LAID AS BRIDGING ABOVE THE PIPE. PIPES UNDER BUILDINGS ARE TO BE SURROUNDED WITH 100mm MIN. OF GRANULAR MATERIAL.
5. ACCESS TO DRAINS MAY PROVIDED BY VITRIFIED CLAY, GRP OR POLYPROPYLENE INSPECTION CHAMBERS TO BS 7158, OR MANHOLES CONSTRUCTED USING CLASS B ENGINEERING BRICKS TO BS 3921, OR PRECAST CONCRETE SECTIONS TO BS 5911, SURROUNDED WITH 150mm OF CONCRETE MINIMUM DIMENSIONS TO CONFORM TO TABLE 8 OF BS 8301. COVERS AND FRAMES FOR MANHOLES/INSPECTION CHAMBERS MUST COMPLY WITH THE APPROPRIATE LOADING GRADE OF BS 497 OR BS 5911.
6. PROVIDE GULLIES AND RWP'S WITH RODDABLE ACCESS
7. ALL PIPES THAT CONNECT TO MAIN RUN DRAINAGE MANHOLES TO BE FIXED 'CROWNS ADJACENT'
8. CONCRETE BEDDING & SURROUND TO BE MIX TYPE GEN 1 TO TABLE 6 OF BS 5328-PART 2 U.N.O. IF A DIFFERENT 'GEN' MIX IS SPECIFIED IT WILL BE TO THE ABOVE TABLE.
9. ALL RWP'S TO CONNECT INTO RODDABLE GULLIES.

## DRAWING NOTES

1. UNDER THE COPYRIGHT DESIGN AND PATENTS ACT 1988 THIS DRAWING IS THE COPYRIGHT OF AMA CONSULTING ENGINEERS AND MUST NOT BE COPIED OR REPRODUCED IN WHOLE OR PART, BY ANY METHOD WHATSOEVER, WITHOUT THE PRIOR WRITTEN APPROVAL OF AMA CONSULTING ENGINEERS.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE SPECIFICATION AND ALL OTHER RELEVANT DRAWINGS.
3. DO NOT SCALE FROM THIS DRAWING USE FIGURED DIMENSIONS ONLY. DO NOT TAKE DIMENSIONS FROM ELECTRONIC COPIES WITHOUT REFERENCE TO AMA CONSULTING ENGINEERS IN EVERY INSTANCE.
4. ALL MATERIALS AND WORKMANSHIP ARE TO COMPLY WITH THE RELEVANT CURRENT BRITISH STANDARDS' AND, WHERE REQUIRED BY THE EMPLOYER, TO NHBC STANDARDS.

## DRAINAGE NOTES

NOTATION KEY

- FOUL WATER PIPE RUN
- FOUL WATER RISING MAIN
- FOUL WATER MANHOLE OR INSPECTION CHAMBER
- FOUL WATER PUMPING CHAMBER
- SURFACE WATER PIPE RUN
- SURFACE WATER RISING MAIN
- SURFACE WATER MANHOLE OR INSPECTION CHAMBER
- SURFACE WATER PUMPING CHAMBER

| | |
|---|---|
| SVP: | SOIL AND VENT PIPE |
| RWP: | RAIN WATER PIPE |
| SS: | STUB STACK |
| LD: | LINEAR DRAIN (ACO OR EQUIVALENT) |
| RE: | RODDING EYE |
| VBD: | VERTICAL BACKDROP |
| PP: | PERFORATED PIPE |
| TG: | TRAPPED GULLY |
| PSMH: | PROPOSED SURFACE WATER MANHOLE |
| PFMH: | PROPOSED FOUL WATER MANHOLE |
| PSPC: | PROPOSED SURFACE WATER PUMP CHAMBER |
| PFPC: | PROPOSED FOUL WATER PUMP CHAMBER |

| REV | DETAIL | Dr | Ch | DATE |
|---|---|---|---|---|
| P01 | Preliminary | JL | CC | 2023/10/18 |
| P02 | Preliminary | JL | CC | 2023/11/03 |

Client Name: Mr & Mrs Sallas

Project Name: 67c Camlet Way, Barnet, EN4 0NL

Drawing Title: Drainage G.A. Sheet 1

AMA Project N° 23091

Drawn By: JL | Checked By: CC

First Issued: Oct 2023 | Scale @ A1: 1:100

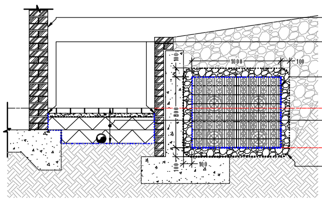
Status: S2 | Revision: P02

AMA Consulting Engineers
6A Nesbitts Alley, Hadley, Barnet, EN5 5XG
+44(0)20 8361 6827
www.amacl.co.uk

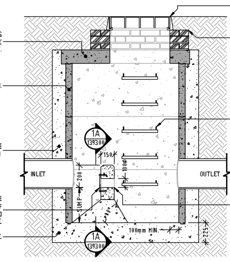
BIM Document Ref.: 23091 - AMA - 01 - 00 - DR - D - 130100

PROJECT N° - ORIGINATOR - VOLUME - LEVEL - FILE TYPE - ROLE - DRAWING N°

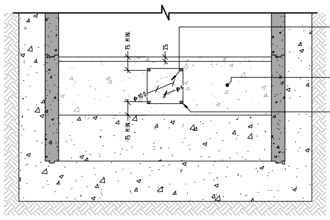
## SECTION 1-1
NOT TO SCALE



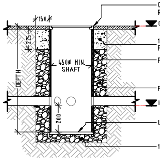

## DETAIL 3: PRECAST CONCRETE MANHOLE WITH ORIFICE PLATE (P.C.C. RING WITH F.C.U.) 3.0 - 6.0m DEEP
NOT TO SCALE



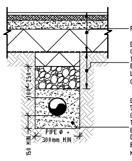

## SECTION 1A-1A
1:10 @ A1/1:20 @ A3



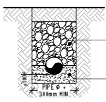

## DETAIL 2: UNIVERSAL INSPECTION CHAMBER (UIC) CATCH-PIT 0.6 - 1.2m DEEP
NOT TO SCALE



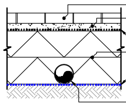

## BEDDING CONSTRUCTION FOR DRAINAGE UNDER ROADS, CARPARKS & PUBLIC FOOTWAYS
NOT TO SCALE



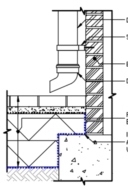

## BEDDING CONSTRUCTION FOR DRAINAGE UNDER LANDSCAPING
NOT TO SCALE




## PERMEABLE PAVING OVER 300mm DEEP DRAINAGE BLANKET BUILD-UP (SECTION)
1:10 @ A1/1:20 @ A3




## RWP DISCHARGING ONTO PAVING DETAIL (ELEVATION)
1:10 @ A1/1:20 @ A3




DRAWING NOTES

1. UNDER THE COPYRIGHT DESIGN AND PATENTS ACT 1988 THIS DRAWING IS THE COPYRIGHT OF AMA CONSULTING ENGINEERS AND MUST NOT BE COPIED OR REPRODUCED IN WHOLE OR PART, BY ANY METHOD WHATSOEVER, WITHOUT THE PRIOR WRITTEN APPROVAL OF AMA CONSULTING ENGINEERS.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE SPECIFICATION AND ALL OTHER RELEVANT DRAWINGS.
3. DO NOT SCALE FROM THIS DRAWING USE FIGURED DIMENSIONS ONLY. DO NOT TAKE DIMENSIONS FROM ELECTRONIC COPIES WITHOUT REFERENCE TO AMA CONSULTING ENGINEERS IN EVERY INSTANCE.
4. ALL MATERIALS AND WORKMANSHIP ARE TO COMPLY WITH THE RELEVANT CURRENT BRITISH STANDARDS' AND, WHERE REQUIRED BY THE EMPLOYER, TO NHBC STANDARDS.

| REV | DETAIL | Dr | Ch | DATE |
|---|---|---|---|---|
| P01 | Preliminary | JL | CC | 2023/10/18 |

Client Name: Mr & Mrs Sallas

Project Name: 67c Camlet Way, Barnet, EN4 0NL

Drawing Title: Drainage Sections & Details Sheet 1

AMA Project N°: 23091

Drawn By: JL | Checked By: CC

First Issued: Oct 2023 | Scale @ A1: As Noted

Status: S2 | Revision: P01

AMA

6A Nesbitts Alley, Hadley, Barnet, EN5 5XG
+44(0)20 8361 6827
www.amacl.co.uk

BIM Document Ref: 23091 - AMA - 01 - ZZ - DR - D - 130200

PROJECT N° - ORIGINATOR - VOLUME - LEVEL - FILE TYPE - ROLE - DRAWING N°

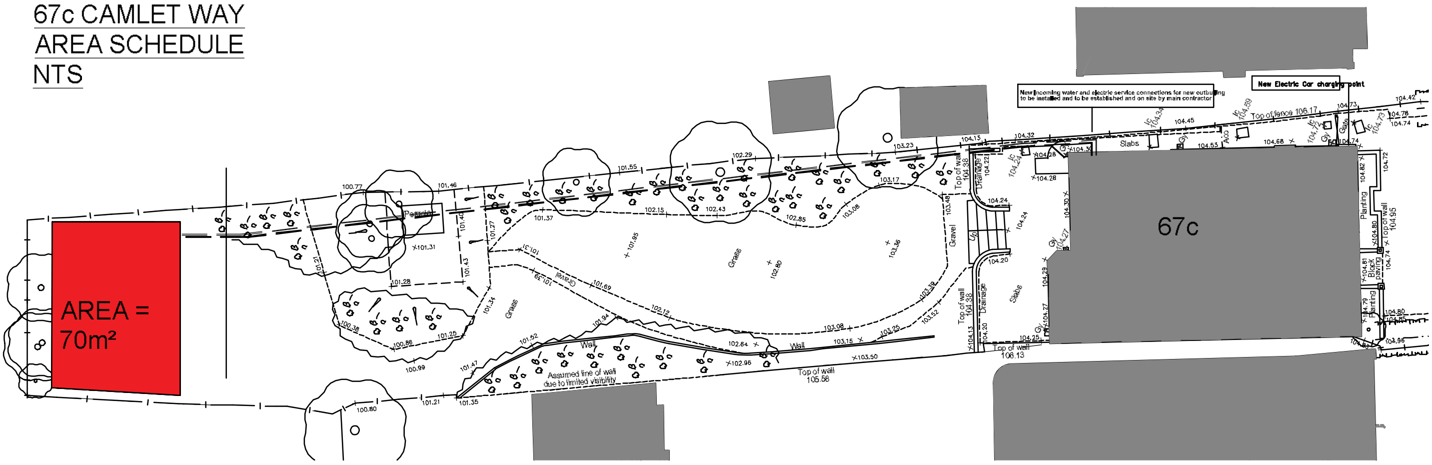
AMA Consulting Engineers

Appendix C – Areas

Chris Christou
CEng MIstructE
Director

Richard Russell
CEng MIstructE
Director

67c CAMLET WAY
AREA SCHEDULE
NTS



Consulting Engineers

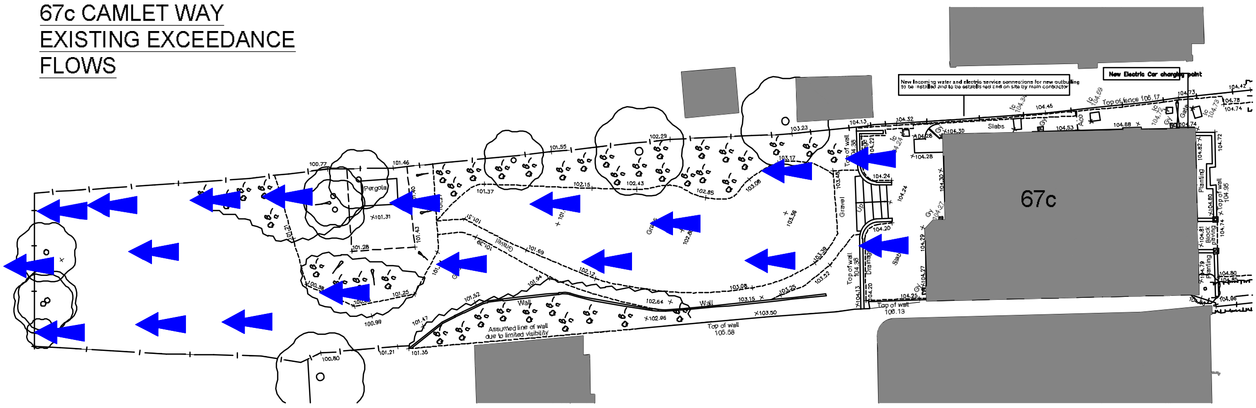
Appendix D – Exceedance

Chris Christou
CEng MIstructE
Director

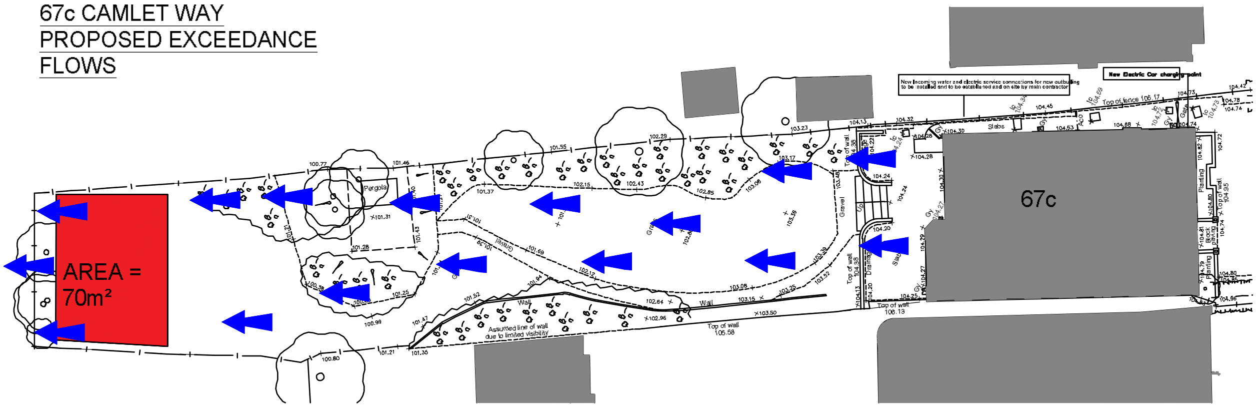
Richard Russell
CEng MIstructE
Director

AMA Consulting Engineers Ltd
6A Nesbitts Alley
Barnet
EN5 5XG
t: +44(0)20 8361 5827
w: www.amaci.co.uk

67c CAMLET WAY
EXISTING EXCEEDANCE
FLOWS




67c CAMLET WAY
PROPOSED EXCEEDANCE
FLOWS



AMA Consulting Engineers

Chris Christou
CEng MIstructE
Director

Richard Russell
CEng MIstructE
Director

Appendix E – Hydraulic Calculations

AMA Consulting Engineers Ltd
6A Nesbitts Alley
Barnet
EN5 5XG
t: +44(0)20 8361 5827
w: www.amaci.co.uk

AMA Consulting Engineers
a: 6a Nesbitts Alley, London, EN5 5XG
t: +44(0)20 8381 6827
e: ama@amact.co.uk
w: www.amact.co.uk

| | | | | |
|---|---|---|---|---|
| Project | 67c Camlet Way | Overall Site Information | | |
| Client | Mr & Mrs Sallas | Made by | Date | Project No |
| Description | Overall Site Information | CC | 12-10-23 | 23091 |
| | | Checked | Revision | |
| SuDs Storage v1.0 | | CC | 0 | |

## 1.0 - SCHEDULE OF AREAS

| | | | | |
|---|---|---|---|---|
| Total Area of the Entire Site | $A_{site}$ | 70 | $m^2$ | |
| Pre-Development Pervious Area | $A_{pre,pervious}$ | 70 | $m^2$ | |
| Pre-Development Impervious Area | $A_{pre,impervious}$ | 0 | $m^2$ | $A_{pre,impervious} = A_{site} - A_{pre,pervious}$ |
| Post-Development Pervious Area | $A_{post,pervious}$ | 0 | $m^2$ | |
| Post-Development Impervious Area | $A_{post,impervious}$ | 70 | $m^2$ | $A_{post,impervious} = A_{site} - A_{post,pervious}$ |

## 2.0 - LOCATION SPECIFIC HYDROLOGICAL DATA

### 2.1 - SITE LOCATION

| | | |
|---|---|---|
| Site Location in UK | England and Wales | For assessment of J factors for hydraulic curves<br>Wallingford Table 6.1 |

### 2.2 - WALLINGFORD COEFFICIENTS

| | | | | |
|---|---|---|---|---|
| Rainfall Intensity for Storm with 5 Year Return Period and 60min Duration | M5-60 | 20 | mm | Obtained from UKSUDs Website using IH124 Method |
| Ratio Between the M5-60 and the M5-2day Storm Intensity | r | 0.40 | --- | Obtained from UKSUDs Website using IH124 Method |

### 2.3 - FLOOD ESTIMATE FOR SMALL CATCHMENT AREAS

| | | | | |
|---|---|---|---|---|
| Winter Rainfall Acceptance Potential (Soil Type) | WRAP | 4 | --- | Obtained from UKSUDs Website using IH124 Method |
| Soil Runoff Coefficient | SPR | 0.47 | --- | Obtained from UKSUDs Website using IH124 Method |
| Standard Annual Average Rainfall | SAAR | 682 | mm | Obtained from UKSUDs Website using IH124 Method |

### 2.4 - INCREASE FOR CLIMATE CHANGE

| | | | | |
|---|---|---|---|---|
| Percentage Increase on Rainfall Intensity i | High (Upper) | 40% | --- | National Planning Policy Framework (NPPF) Guidance Table 2 for 50-95 Year Life |

### 2.5 - URBAN CREEP

| | | | | |
|---|---|---|---|---|
| Uplift on Storage | Omit | N/A | --- | Applies to developments with houses only<br>Refer to lead local flood authority (LLFA)<br>Typical value is 10% |

## 3.0 - OUTFLOW CONTROL METHOD FROM STORAGE TANK

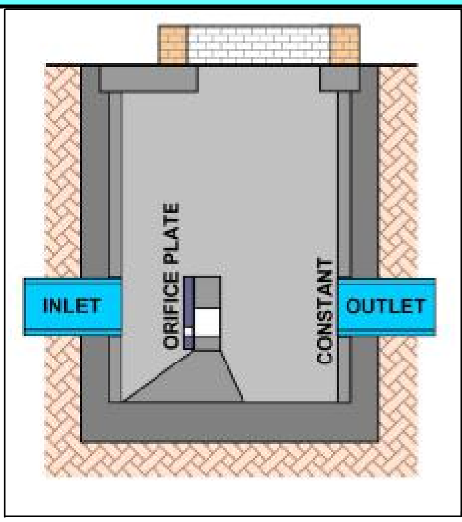
### 3.1 - PRIMARY FLOW CONTROL DEVICE

| | | | |
|---|---|---|---|
| Primary Flow Control Device (Installed on a Weir within the Flow Control Manhole) | | Orifice Plate | |
| Diametre of the Orifice | d | 6.0 | mm |
| Thickness of the Orifice Plate | t | 5.00 | mm |
| Number of Orifices | $n_{orifice}$ | 1 | --- |
| Number of Outlets | $n_{outlet}$ | 1 | --- |
| Coefficient of Discharge | $C_d$ | 0.6 | --- |
| Height of the Weir | $H_{WEIR}$ | 0.2 | m |

***Max Flow Rate Q = 0.03l/s (for a max head of 0.2m)***

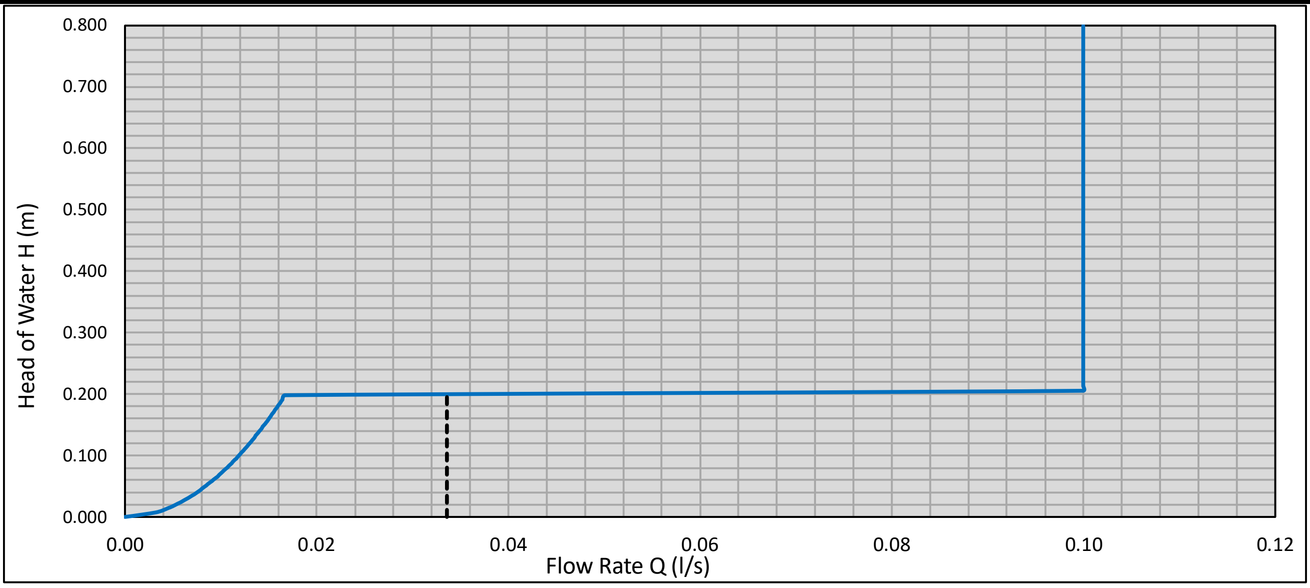
### 3.2 - SECONDARY OUTFLOW CONTROL DEVICE

| | | | |
|---|---|---|---|
| Outflow Control Device (Installed on Outflow Pipe within Flow Control Manhole) | | Constant | |
| Rate of Constant Outflow | Q | 0.100 | l / s |




***Section Through Flow Control Manhole***

**4.0 - OUTFLOW HYDRAULIC CURVE (FLOW RATE PLOTTED AGAINST HEAD OF WATER IN THE FLOW CONTROL MANHOLE)**




***Dashed line denotes where flow transitions from being controlled by the orifice plate on the weir to being controlled by the final outflow device***

AMA Consulting Engineers
a: 8a Nesbitts Alley, London, EN5 5XG
t: +44(0)20 8361 6827
e: ama@amacl.co.uk
w: www.amacl.co.uk

| | | | | |
|---|---|---|---|---|
| Project | 67c Camlet Way | Calculation of Runoff QBAR | | |
| Client | Mr & Mrs Sallas | Made by | Date | Project No |
| Description | Qbar/Existing/Proposed Flows & Volumes | CC | 12-10-23 | 23091 |
| | | Checked | Revision | |
| SuDs Storage v1.0 | | CC | 0 | |

## 1.0 - SITE INFORMATION

| | | | | |
|---|---|---|---|---|
| Area of the Site | $A_{site}$ | 70.0 | $m^2$ | User Input - Defined Previously and now expressed in multiple units |
| | | 0.000070 | $km^2$ | |
| | | 0.0070 | hectares | |
| Pre-Development Pervious Area | $A_{pre,pervious}$ | 70.0 | $m^2$ | User Input - Defined Previously and now expressed in multiple units |
| | | 0.000070 | $km^2$ | |
| | | 0.0070 | hectares | |
| Post-Development Pervious Area | $A_{post,pervious}$ | 0.0 | $m^2$ | User Input - Defined Previously and now expressed in multiple units |
| | | 0.000000 | $km^2$ | |
| | | 0.0000 | hectares | |
| Soil Runoff Coefficient | SPR | 0.47 | --- | User Input - Defined Previously |
| Standard Annual Average Rainfall | SAAR | 682.0 | mm | User Input - Defined Previously |

## 2.0 - CALCULATION OF RUNOFF RATE FOR DIFFERENT SITE DEVELOPMENT STAGES: $QBAR_{rural}$

| | | | | |
|---|---|---|---|---|
| Greenfield Site (using A = $A_{site}$) | $QBAR_{RURAL,GF}$ | 0.0000 | $m^3$ / s | for: 50 hectares ≤ A < 200 hectares |
| | | 0.033 | l / s | $QBAR_{rural} = 0.00108 * A^{0.89} \times SAAR^{1.17} \times SPR^{2.17}$ |
| | | | | for: A < 50 hectares |
| Pre-Development Pervious Area (using A = $A_{pre,pervious}$) | $QBAR_{RURAL,Pre}$ | 0.0000 | $m^3$ / s | $QBAR_{rural} = 0.00108 * [(A/0.5) * 0.5^{0.89}] * SAAR^{1.17} * SPR^{2.17}$ |
| | | 0.033 | l / s | A is area in units of $km^2$ in these formulas |
| | | | | $QBAR_{rural}$ Formula from: "Flood estimation for small catchments" |
| Post-Development Pervious Area (using A = $A_{post,pervious}$) | $QBAR_{RURAL,Post}$ | 0.0000 | $m^3$ / s | Marshall DCW and Bayliss AC. IOH Report No.124. Institute of hydrology, Wallingford, 1994 |
| | | 0.000 | l / s | $QBAR_{rural}$ is in units of $m^3$ / s |

## 3.0 - HYDROMETRIC AREA & RUNOFF RATE QBAR

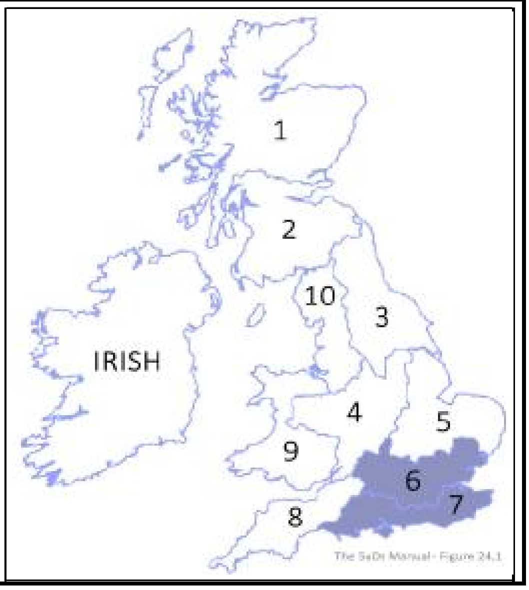
**Hydrometric Area for the Site:** 6 & 7

### 3.1 - GROWTH CURVES AND RUNOFF FOR HYDROMETRIC AREA: 6 & 7

| Return Period | Growth Factor | Greenfield $QBAR_{,GF}$ l/s | Pre-Development $QBAR_{,Pre}$ l/s | Post-Development $QBAR_{,Post}$ l/s |
|---|---|---|---|---|
| 1 Year | ***0.85*** | 0.03 | 0.03 | 0.00 |
| 2 Years | 0.88 | 0.03 | 0.03 | 0.00 |
| 5 Years | 1.28 | 0.04 | 0.04 | 0.00 |
| 10 Years | 1.62 | 0.05 | 0.05 | 0.00 |
| 25 Years | 2.14 | 0.07 | 0.07 | 0.00 |
| 30 Years | ***2.4*** | 0.08 | 0.08 | 0.00 |
| 50 Years | 2.62 | 0.09 | 0.09 | 0.00 |
| 100 Years | ***3.19*** | 0.10 | 0.10 | 0.00 |
| 500 Years | ***4.49*** | 0.15 | 0.15 | 0.00 |

*Growth Factor from SuDs Manual - Table 24.2*

*QBAR = QBAR $_{rural}$ * Growth Factor*



| 4.0 - CALCULATE RAINFALL INTENSITY FOR DIFFERENT STORM RETURN PERIODS (OVER SET DURATIONS) | | | | |
|---|---|---|---|---|
| Storm Duration for 1 in 1 Year Storm | D | 5 | minutes | User Input |
| Storm Duration for 1 in 30 Year Storm | D | 5 | minutes | User Input |
| Storm Duration for 1 in 100 Year Storm | D | 5 | minutes | User Input |
| | | | | |
| Rainfall Intensity for Storm with 5 Year Return Period and 60min Duration | M5-60 | 20.0 | mm | User Input - Defined Previously |
| Ratio Between the M5-60 and the M5-2day Storm Intensity | r | 0.4 | --- | User Input - Defined Previously |
| | | | | |
| **4.1 - 1 in 1 Year Storm of Duration D = 5 minutes** | | | | |
| Return Period of Storm | T | 1 | Years | |
| Wallingford Factor | $Z_1$ | 0.371 | --- | From Wallingford Modified Rational Method Equation 6.1 |
| Rainfall Intensity for 1 in 5 Year Storm with Duration D = 5 minutes | M5-5 | 7.411 | mm | M5-5 = Z1 * M5-60 |
| J Factors for England and Wales | $J_0$ | 1699 | $x10^{-4}$ | From Wallingford Modifed Rational Method Table 6.1 |
| | $J_1$ | 2800 | $x10^{-6}$ | From Wallingford Modifed Rational Method Table 6.1 |
| | $J_2$ | 114000 | $x10^{-9}$ | From Wallingford Modifed Rational Method Table 6.1 |
| $C_r$ Factor | $C_r$ | 0.197 | --- | Cr = J0 + (J1 * M5-5) + (J2 * M5-5^2) |
| Wallingford Factor | $Z_2$ | 0.615 | --- | $Z_2$ = interpolated from Table 6.2 or 6.3 (Wallingford) |
| Rainfall Intensity for 1 in 1 Year Storm with Duration D = 5 minutes | M1-5 | 4.559 | mm | M1-5 = Z2 * M5-5 |
| | | | | |
| **4.2 - 1 in 30 Year Storm of Duration D = 5 minutes** | | | | |
| Return Period of Storm | T | 30 | Years | |
| Wallingford Factor | $Z_1$ | 0.371 | --- | From Wallingford Modified Rational Method Equation 6.1 |
| Rainfall Intensity for 1 in 5 Year Storm with Duration D = 5 minutes | M5-5 | 7.411 | mm | M5-5 = Z1 * M5-60 |
| J Factors for England and Wales | $J_0$ | 1699 | $x10^{-4}$ | From Wallingford Modifed Rational Method Table 6.1 |
| | $J_1$ | 2800 | $x10^{-6}$ | From Wallingford Modifed Rational Method Table 6.1 |
| | $J_2$ | 114000 | $x10^{-9}$ | From Wallingford Modifed Rational Method Table 6.1 |
| $C_r$ Factor | $C_r$ | 0.197 | --- | Cr = J0 + (J1 * M5-5) + (J2 * M5-5^2) |
| Wallingford Factor | $Z_2$ | 1.454 | --- | $Z_2$ = exp( Cr * [ln(T) - 1.5 ] ) |
| Rainfall Intensity for 1 in 30 Year Storm with Duration D = 5 minutes | M30-5 | 10.776 | mm | M30-5 = Z2 * M5-5 |
| | | | | |
| **4.3 - 1 in 100 Year Storm of Duration D = 5 minutes** | | | | |
| Return Period of Storm | T | 100 | Years | |
| Wallingford Factor | $Z_1$ | 0.371 | --- | From Wallingford Modified Rational Method Equation 6.1 |
| Rainfall Intensity for 1 in 5 Year Storm with Duration D = 5 minutes | M5-5 | 7.411 | mm | M5-5 = Z1 * M5-60 |
| J Factors for England and Wales | $J_0$ | 1699 | $x10^{-4}$ | From Wallingford Modifed Rational Method Table 6.1 |
| | $J_1$ | 2800 | $x10^{-6}$ | From Wallingford Modifed Rational Method Table 6.1 |
| | $J_2$ | 114000 | $x10^{-9}$ | From Wallingford Modifed Rational Method Table 6.1 |
| $C_r$ Factor | $C_r$ | 0.197 | --- | Cr = J0 + (J1 * M5-5) + (J2 * M5-5^2) |
| Wallingford Factor | $Z_2$ | 1.843 | --- | $Z_2$ = exp( Cr * [ln(T) - 1.5 ] ) |
| Rainfall Intensity for 1 in 100 Year Storm with Duration D = 5 minutes | M100-5 | 13.659 | mm | M100-5 = Z2 * M5-5 |

## 5.0 - CALCULATE RUNOFF FROM IMPERVIOUS AREAS

### 5.1 - 1 in 1 Year Storm of Duration D = 5 minutes

| | | | | |
|---|---|---|---|---|
| Volumetric Runoff Coefficient | $C_v$ | 0.600 | --- | CIRIA SuDS Guide - Equation 24.5 |
| Dimensionless Routing Coefficient | $C_R$ | 1.67 | --- | CIRIA SuDS Guide - Equation 24.5 |
| Rainfall Intensity | i | 54.710 | mm/hr | i = M1-5 converted into mm per hour |
| Pre-Development Impervious Area | $A_{pre,impervious}$ | 0.0000 | hectares | User Input - Defined Previously |
| Post-Development Impervious Area | $A_{post,impervious}$ | 0.0070 | hectares | User Input - Defined Previously |
| Peak Flow Rate Pre-Development (Runoff) | $Q_{pre}$ | 0.00 | l / s | $Q_{pre} = 2.78 * C_v * C_R * i * A_{pre,impervious}$ |
| Peak Flow Rate Post-Development (Runoff) | $Q_{post}$ | 1.06 | l / s | $Q_{post} = 2.78 * C_v * C_R * i * A_{post,impervious}$ |

### 5.2 - 1 in 30 Year Storm of Duration D = 5 minutes

| | | | | |
|---|---|---|---|---|
| Volumetric Runoff Coefficient | $C_v$ | 0.600 | --- | CIRIA SuDS Guide - Equation 24.5 |
| Dimensionless Routing Coefficient | $C_R$ | 1.67 | --- | CIRIA SuDS Guide - Equation 24.5 |
| Rainfall Intensity | i | 129.316 | mm/hr | i = M30-5 converted into mm per hour |
| Pre-Development Impervious Area | $A_{pre,impervious}$ | 0.0000 | hectares | User Input - Defined Previously |
| Post-Development Impervious Area | $A_{post,impervious}$ | 0.0070 | hectares | User Input - Defined Previously |
| Peak Flow Rate Pre-Development (Runoff) | $Q_{pre}$ | 0.00 | l / s | $Q_{pre} = 2.78 * C_v * C_R * i * A_{pre,impervious}$ |
| Peak Flow Rate Post-Development (Runoff) | $Q_{post}$ | 2.52 | l / s | $Q_{post} = 2.78 * C_v * C_R * i * A_{post,impervious}$ |

### 5.3 - 1 in 100 Year Storm of Duration D = 5 minutes

| | | | | |
|---|---|---|---|---|
| Volumetric Runoff Coefficient | $C_v$ | 0.600 | --- | CIRIA SuDS Guide - Equation 24.5 |
| Dimensionless Routing Coefficient | $C_R$ | 1.67 | --- | CIRIA SuDS Guide - Equation 24.5 |
| Rainfall Intensity | i | 163.914 | mm/hr | i = M100-5 converted into mm per hour |
| Pre-Development Impervious Area | $A_{pre,impervious}$ | 0.0000 | hectares | User Input - Defined Previously |
| Post-Development Impervious Area | $A_{post,impervious}$ | 0.0070 | hectares | User Input - Defined Previously |
| Peak Flow Rate Pre-Development (Runoff) | $Q_{pre}$ | 0.00 | l / s | $Q_{pre} = 2.78 * C_v * C_R * i * A_{pre,impervious}$ |
| Peak Flow Rate Post-Development (Runoff) | $Q_{post}$ | 3.19 | l / s | $Q_{post} = 2.78 * C_v * C_R * i * A_{post,impervious}$ |

## 6.0 - SUMMARY OF RUNOFF RATES (RUNOFF FLOW RATES)

| | | | | |
|---|---|---|---|---|
| Percentage Increase for Climate Change | CC | 40% | % | User Input - Defined Previously |

| Return Period | Storm Duration D | Greenfield Runoff Rate | Pre-Development Runoff Rate | Post-Development Runoff Rate | Allowable Runoff Rate | Betterment vs Pre-Dev |
|---|---|---|---|---|---|---|
| | Minutes | l / s | l / s | l / s | l / s | % |
| 1 in 1 Year | 5 | 0.03 | 0.03 | 1.06 | 0.03 | 0% |
| 1 in 30 Years | 5 | 0.08 | 0.08 | 2.52 | 0.08 | 0% |
| 1 in 100 Years | 5 | 0.10 | 0.10 | 3.19 | 0.10 | 0% |
| 1 in 100 Years + Climate Change | 5 | --- | --- | 4.47 | 0.10 | |
| | User Input | = QBAR | $= QBAR_{pre} + Q_{pre}$ | $= QBAR_{post} + Q_{post}$ $= QBAR_{post} + (Q_{post} *$ (1+CC)) | User Input | $=(1 - (RO_{Allow} / RO_{Pre-Dev})) * 100$ |

| 7.0 - CALCULATE RAINFALL INTENSITY FOR DIFFERENT STORM RETURN PERIODS (OVER SET DURATIONS) | | | | |
|---|---|---|---|---|
| Storm Duration for 1 in 1 Year Storm | D | 15 | minutes | User Input - Defined Previously |
| Storm Duration for 1 in 30 Year Storm | D | 240 | minutes | User Input - Defined Previously |
| Storm Duration for 1 in 100 Year Storm | D | 360 | minutes | User Input - Defined Previously |
| | | | | |
| Rainfall Intensity for Storm with 5 Year Return Period and 60min | M5-60 | 20.0 | mm | User Input - Defined Previously |
| Ratio Between the M5-60 and the M5-2day Storm Intensity | r | 0.4 | --- | User Input - Defined Previously |

| 7.1 - 1 in 1 Year Storm of Duration D = 15 minutes | | | | |
|---|---|---|---|---|
| Return Period of Storm | T | 1 | Years | |
| Wallingford Factor | $Z_1$ | 0.630 | --- | From Wallingford Modified Rational Method Equation 6.1 |
| Rainfall Intensity for 1 in 5 Year Storm with Duration D = 15 minutes | M5-15 | 12.594 | mm | M5-15 = Z1 * M5-60 |
| J Factors for England and Wales | $J_0$ | 1644 | $x10^{-4}$ | From Wallingford Modifed Rational Method Table 6.1 |
| | $J_1$ | 5831 | $x10^{-6}$ | From Wallingford Modifed Rational Method Table 6.1 |
| | $J_2$ | -134300 | $x10^{-9}$ | From Wallingford Modifed Rational Method Table 6.1 |
| $C_r$ Factor | $C_r$ | 0.217 | --- | Cr = J0 + (J1 * M5-15) + (J2 * M5-15^2) |
| Wallingford Factor | $Z_2$ | 0.615 | --- | $Z_2$ = interpolated from Table 6.2 or 6.3 (Wallingford) |
| Rainfall Intensity for 1 in 1 Year Storm with Duration D = 15 minutes | M1-15 | 7.748 | mm | M1-15 = Z2 * M5-15 |

| 7.2 - 1 in 30 Year Storm of Duration D = 240 minutes | | | | |
|---|---|---|---|---|
| Return Period of Storm | T | 30 | Years | |
| Wallingford Factor | $Z_1$ | 1.445 | --- | From Wallingford Modified Rational Method Equation 6.1 |
| Rainfall Intensity for 1 in 5 Year Storm with Duration D = 240 minutes | M5-240 | 28.906 | mm | M5-240 = Z1 * M5-60 |
| J Factors for England and Wales | $J_0$ | 1644 | $x10^{-4}$ | From Wallingford Modifed Rational Method Table 6.1 |
| | $J_1$ | 5831 | $x10^{-6}$ | From Wallingford Modifed Rational Method Table 6.1 |
| | $J_2$ | -134300 | $x10^{-9}$ | From Wallingford Modifed Rational Method Table 6.1 |
| $C_r$ Factor | $C_r$ | 0.221 | --- | Cr = J0 + (J1 * M5-240) + (J2 * M5-240^2) |
| Wallingford Factor | $Z_2$ | 1.521 | --- | $Z_2$ = exp( Cr * [ln(T) - 1.5 ] ) |
| Rainfall Intensity for 1 in 30 Year Storm with Duration D = 240 minutes | M30-240 | 43.979 | mm | M30-240 = Z2 * M5-240 |

| 7.3 - 1 in 100 Year Storm of Duration D = 360 minutes | | | | |
|---|---|---|---|---|
| Return Period of Storm | T | 100 | Years | |
| Wallingford Factor | $Z_1$ | 1.599 | --- | From Wallingford Modified Rational Method Equation 6.1 |
| Rainfall Intensity for 1 in 5 Year Storm with Duration D = 360 minutes | M5-360 | 31.985 | mm | M5-360 = Z1 * M5-60 |
| J Factors for England and Wales | $J_0$ | 2644 | $x10^{-4}$ | From Wallingford Modifed Rational Method Table 6.1 |
| | $J_1$ | -1621 | $x10^{-6}$ | From Wallingford Modifed Rational Method Table 6.1 |
| | $J_2$ | 3150 | $x10^{-9}$ | From Wallingford Modifed Rational Method Table 6.1 |
| $C_r$ Factor | $C_r$ | 0.216 | --- | Cr = J0 + (J1 * M5-360) + (J2 * M5-360^2) |
| Wallingford Factor | $Z_2$ | 1.954 | --- | $Z_2$ = exp( Cr * [ln(T) - 1.5 ] ) |
| Rainfall Intensity for 1 in 100 Year Storm with Duration D = 360 minutes | M100-360 | 62.507 | mm | M100-360 = Z2 * M5-360 |

## 8.0 - CALCULATE RUNOFF FROM IMPERVIOUS AREAS

### 8.1 - 1 in 1 Year Storm of Duration D = 15 minutes

| | | | | |
|---|---|---|---|---|
| Volumetric Runoff Coefficient | $C_v$ | 0.600 | --- | CIRIA SuDS Guide - Equation 24.5 |
| Dimensionless Routing Coefficient | $C_R$ | 1.67 | --- | CIRIA SuDS Guide - Equation 24.5 |
| Rainfall Intensity | i | 30.991 | mm/hr | i = M1-15 converted into mm per hour |
| Pre-Development Impervious Area | $A_{pre,impervious}$ | 0.0000 | hectares | User Input - Defined Previously |
| Post-Development Impervious Area | $A_{post,impervious}$ | 0.0070 | hectares | User Input - Defined Previously |
| Peak Flow Rate Pre-Development (Runoff) | $Q_{pre}$ | 0.00 | l / s | $Q_{pre} = 2.78 * C_v * C_R * i * A_{pre,impervious}$ |
| Peak Flow Rate Post-Development (Runoff) | $Q_{post}$ | 0.60 | l / s | $Q_{post} = 2.78 * C_v * C_R * i * A_{post,impervious}$ |

### 8.2 - 1 in 30 Year Storm of Duration D = 240 minutes

| | | | | |
|---|---|---|---|---|
| Volumetric Runoff Coefficient | $C_v$ | 0.600 | --- | CIRIA SuDS Guide - Equation 24.5 |
| Dimensionless Routing Coefficient | $C_R$ | 1.67 | --- | CIRIA SuDS Guide - Equation 24.5 |
| Rainfall Intensity | i | 10.995 | mm/hr | i = M30-240 converted into mm per hour |
| Pre-Development Impervious Area | $A_{pre,impervious}$ | 0.0000 | hectares | User Input - Defined Previously |
| Post-Development Impervious Area | $A_{post,impervious}$ | 0.0070 | hectares | User Input - Defined Previously |
| Peak Flow Rate Pre-Development (Runoff) | $Q_{pre}$ | 0.00 | l / s | $Q_{pre} = 2.78 * C_v * C_R * i * A_{pre,impervious}$ |
| Peak Flow Rate Post-Development (Runoff) | $Q_{post}$ | 0.21 | l / s | $Q_{post} = 2.78 * C_v * C_R * i * A_{post,impervious}$ |

### 8.3 - 1 in 100 Year Storm of Duration D = 360 minutes

| | | | | |
|---|---|---|---|---|
| Volumetric Runoff Coefficient | $C_v$ | 0.600 | --- | CIRIA SuDS Guide - Equation 24.5 |
| Dimensionless Routing Coefficient | $C_R$ | 1.67 | --- | CIRIA SuDS Guide - Equation 24.5 |
| Rainfall Intensity | i | 10.418 | mm/hr | i = M100-360 converted into mm per hour |
| Pre-Development Impervious Area | $A_{pre,impervious}$ | 0.0000 | hectares | User Input - Defined Previously |
| Post-Development Impervious Area | $A_{post,impervious}$ | 0.0070 | hectares | User Input - Defined Previously |
| Peak Flow Rate Pre-Development (Runoff) | $Q_{pre}$ | 0.00 | l / s | $Q_{pre} = 2.78 * C_v * C_R * i * A_{pre,impervious}$ |
| Peak Flow Rate Post-Development (Runoff) | $Q_{post}$ | 0.20 | l / s | $Q_{post} = 2.78 * C_v * C_R * i * A_{post,impervious}$ |

## 9.0 - SUMMARY OF RUNOFF VOLUME

| | | | | |
|---|---|---|---|---|
| Percentage Increase for Climate Change | CC | 40% | % | User Input - Defined Previously |
| Percentage Increase for Urban Creep | UC | 0% | % | User Input - Defined Previously |

| Return Period | Storm Duration D | Greenfield Runoff Volume | Pre-Development Runoff Volume | Post-Development Runoff Volume |
|---|---|---|---|---|
| | Minutes | $m^3$ | $m^3$ | $m^3$ |
| 1 in 1 Year | 15 | 0.03 | 0.03 | 0.54 |
| 1 in 30 Years | 240 | 1.13 | 1.13 | 3.08 |
| 1 in 100 Years | 360 | 2.26 | 2.26 | 4.38 |
| 1 in 100 Years + Climate Change | 360 | --- | --- | 6.13 |
| | User Input | = QBAR * D | $= (QBAR + Q_{pre}) * D$ | $= (QBAR + [Q_{pre}*(1+UC)]) * D$<br>$= (QBAR + [Q_{pre}*(1+CC)*(1+UC)]) * D$ |

**Total Runoff Volumes shown above do not account for any off site discharge**

AMA Consulting Engineers
t: +44(0)20 8361 6827

| | | | | |
|---|---|---|---|---|
| Project | 67c Camlet Way | Storage Tank Sizing | | |
| Client | Mr & Mrs Sallas | Made by | Date | Project No |
| Description | Storage Tank Sizing | CC | 12-10-23 | 23091 |
| | | Checked | Revision | |
| SuDs Storage v1.0 | | CC | 0 | |

## 1.0 - INPUT STORAGE TANK DIMENSIONS

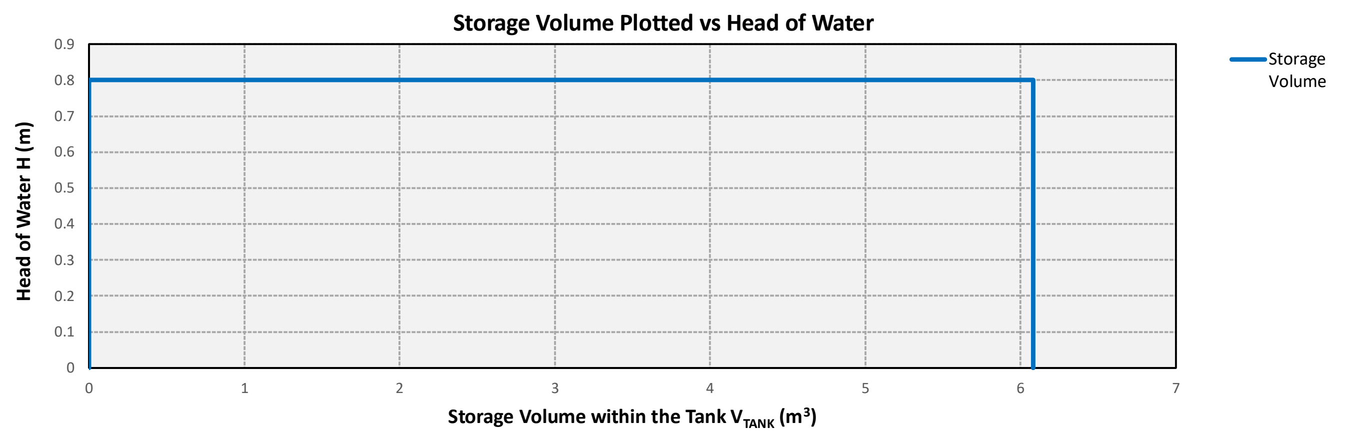
| Position in the Ground | Description of the Individual Storage Tank | Height of the Individual Storage Tank | Plan Area of the Tank | Type of Storage Tank | Max Head of Water (Cumulative) | Voids Ratio | Effective Plan Area | Storage Volume |
|---|---|---|---|---|---|---|---|---|
| | | $H_{TANK}$ | $A_{TANK}$ | | H | $R_{VOIDS}$ | $A_{eff}$ | $V_{TANK}$ |
| | | m | $m^2$ | | m | | $m^2$ | $m^3$ |
| Deepest | TANK 1 | 0.800 | 8.000 | Geocell | 0.80 | 95% | 7.60 | 6.080 |
| | | | | None | | | | |
| | | | | None | | | | |
| | | | | None | | | | |
| | | | | None | | | | |
| | | | | None | | | | |
| | | | | None | | | | |
| | | | | None | | | | |
| | | | | None | | | | |
| | | | | None | | | | |
| | | | | None | | | | |
| | | | | None | | | | |
| | | | | None | | | | |
| | | | | None | | | | |
| | | | | None | | | | |
| | | | | None | | | | |
| | | | | None | | | | |
| | | | | None | | | | |
| | | | | None | | | | |
| Shallowest | | | | None | | | | |

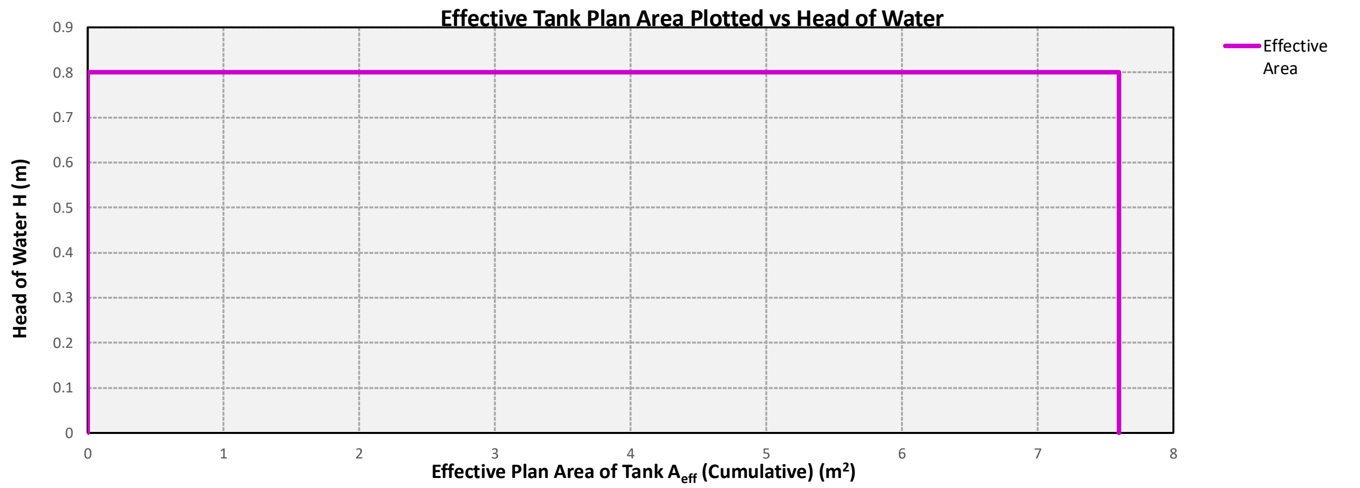
Total Storage Available $V_{TOTAL}$ $(m^3)$: **6.080**

$A_{eff} = A_{TANK} * R_{VOIDS}$  $V_{TANK} = H_{TANK} * A_{TANK} * R_{VOIDS}$  $V_{TOTAL} = \Sigma V_{TANK}$

Maximum Head of Water Available from all the Individual Storage Tanks $H_{TOTAL}$ (m): **0.800**

## 2.0 - PLOT STORAGE VOLUME



AMA Consulting Engineers

| | | | |
|---|---|---|---|
| Project | 67c Camlet Way | **Hydraulic Curve - 1 in 1 Year Storm** | |
| Client | Mr & Mrs Sallas | Made by / Date | Project No |
| Description | 1 in 1 Year Storm Event (Storage Tank Discharge) | CC / 12-10-23 | 23091 |
| | | Checked | Revision |
| SuDs Storage v1.0 | | CC | 0 |

## 1.0 - INPUT DATA

| | | | | |
|---|---|---|---|---|
| Return Period of Storm Event | T | 1 | Years | User Input |
| Ratio Relating to the Type of Rainfall Expected | r | 0.4 | --- | User Input - Defined Previously |
| Site Location | England and Wales | | | User Input - Defined Previously |
| Rainfall Intensity for Storm with 5 Year Return Period and 60min Duration | M5-60 | 20 | mm | User Input - Defined Previously |

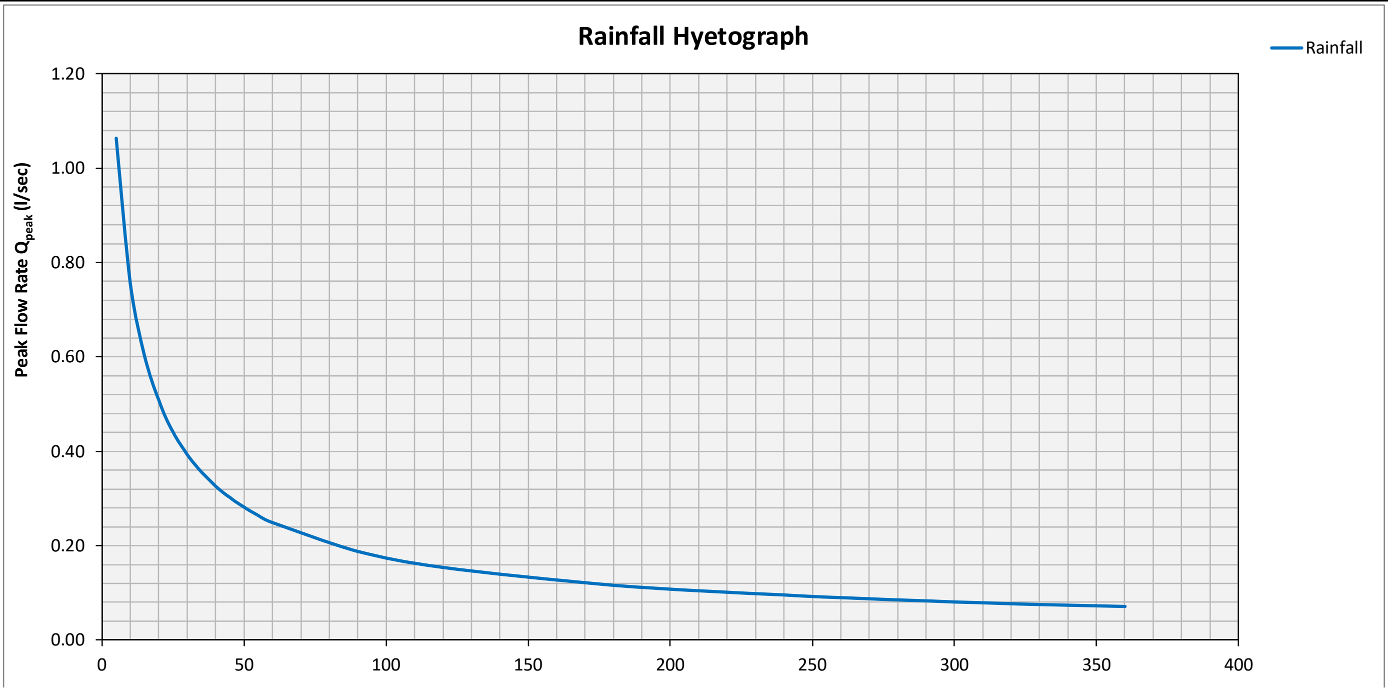
## 2.0 - AREAS USED FOR VOLUME CALCULATIONS AND ALLOWANCE FOR CLIMATE CHANGE

| | | | | |
|---|---|---|---|---|
| Area of the Site used for Storage Calculations | Post-Development Impervious | | | |
| | Apost,impervious | 70 | $m^2$ | User Input - Defined Previously |
| Allowance for Urban Creep | UC | 0% | % | |
| Final Area Used for Hydraulic Calculations | $A_{final}$ | 70 | $m^2$ | Afinal = Apost,impervious * (1 + Urban Creep%) |
| Percentage Increase on Rainfall Intensity for Climate Change | CC | 0% | % | No increase for Climate Change for 1 in 1 Year Storm |
| Volumetric Runoff Coefficient | $C_v$ | 0.60 | --- | User Input - Defined Previously |
| Dimensionless Routing Coefficient | $C_R$ | 1.67 | --- | User Input - Defined Previously |

## 3.0 - PLOT HYDRAULIC CURVE (RAINFALL ON THE SITE AND DISCHARGE FROM THE STORAGE TANK)

| Duration | WATER LANDING ON THE SITE FROM THE RAINFALL EVENT | | | | | | | | | | | | STORAGE TANK OUTFLOW | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wallingford Factor | Rainfall Intensity | J Factors | | | $C_r$ Factor | Wallingford Factor | Rainfall Intensity for 1 Year Storm | Rainfall Intensity for M1-D | Rainfall Intensity for M1-D + Climate Change | Peak Flow Rate | Run Off Volume Over Time Step | Head of Water in Storage Tank | Outflow from Storage Tank | Discharge from Storage Tank | Storage Volume |
| D | $Z_1$ | M5-D | $J_0$ | $J_1$ | $J_2$ | $C_r$ | $Z_2$ | M1-D | i | $i_{climate,change}$ | $Q_{peak}$ | $V_{runoff}$ | H | $Q_{outflow}$ | $V_{outflow}$ | $V_{storage}$ |
| mins | --- | mm | $x10^{-4}$ | $x10^{-6}$ | $x10^{-9}$ | --- | --- | mm | mm/hr | mm/hr | l / sec | $m^3$ | m | l / sec | $m^3$ | $m^3$ |
| 5 | 0.371 | 7.411 | 1699 | 2800 | 114000 | 0.197 | 0.615 | 4.559 | 54.710 | 54.710 | 1.06 | 0.319 | 0.000 | 0.000 | 0.01 | 0.309 |
| 10 | 0.530 | 10.591 | 1644 | 5831 | -134300 | 0.211 | 0.611 | 6.473 | 38.840 | 38.840 | 0.76 | 0.453 | 0.041 | 0.008 | 0.01 | 0.441 |
| 15 | 0.630 | 12.594 | 1644 | 5831 | -134300 | 0.217 | 0.615 | 7.748 | 30.991 | 30.991 | 0.60 | 0.542 | 0.058 | 0.009 | 0.01 | 0.527 |
| 20 | 0.703 | 14.058 | 1644 | 5831 | -134300 | 0.220 | 0.618 | 8.690 | 26.069 | 26.069 | 0.51 | 0.608 | 0.069 | 0.010 | 0.02 | 0.590 |
| 25 | 0.761 | 15.217 | 1644 | 5831 | -134300 | 0.222 | 0.621 | 9.448 | 22.674 | 22.674 | 0.44 | 0.661 | 0.078 | 0.010 | 0.02 | 0.640 |
| 30 | 0.809 | 16.179 | 1644 | 5831 | -134300 | 0.224 | 0.625 | 10.107 | 20.215 | 20.215 | 0.39 | 0.708 | 0.084 | 0.011 | 0.02 | 0.683 |
| 35 | 0.850 | 17.005 | 1644 | 5831 | -134300 | 0.225 | 0.628 | 10.679 | 18.308 | 18.308 | 0.36 | 0.748 | 0.090 | 0.011 | 0.03 | 0.720 |
| 40 | 0.887 | 17.730 | 1644 | 5831 | -134300 | 0.226 | 0.631 | 11.187 | 16.780 | 16.780 | 0.33 | 0.783 | 0.095 | 0.012 | 0.03 | 0.752 |
| 45 | 0.919 | 18.379 | 1644 | 5831 | -134300 | 0.226 | 0.634 | 11.643 | 15.524 | 15.524 | 0.30 | 0.815 | 0.099 | 0.012 | 0.03 | 0.780 |
| 50 | 0.948 | 18.966 | 1644 | 5831 | -134300 | 0.227 | 0.636 | 12.060 | 14.472 | 14.472 | 0.28 | 0.844 | 0.103 | 0.012 | 0.04 | 0.806 |
| 55 | 0.975 | 19.504 | 1644 | 5831 | -134300 | 0.227 | 0.638 | 12.444 | 13.575 | 13.575 | 0.26 | 0.871 | 0.106 | 0.012 | 0.04 | 0.829 |
| 60 | 1.000 | 20.000 | 1644 | 5831 | -134300 | 0.227 | 0.640 | 12.800 | 12.800 | 12.800 | 0.25 | 0.896 | 0.109 | 0.012 | 0.05 | 0.850 |
| 90 | 1.120 | 22.394 | 1644 | 5831 | -134300 | 0.228 | 0.650 | 14.547 | 9.698 | 9.698 | 0.19 | 1.018 | 0.112 | 0.013 | 0.07 | 0.950 |
| 120 | 1.209 | 24.186 | 1644 | 5831 | -134300 | 0.227 | 0.657 | 15.884 | 7.942 | 7.942 | 0.15 | 1.112 | 0.125 | 0.013 | 0.09 | 1.020 |
| 180 | 1.344 | 26.871 | 1644 | 5831 | -134300 | 0.224 | 0.667 | 17.936 | 5.979 | 5.979 | 0.12 | 1.256 | 0.134 | 0.014 | 0.14 | 1.114 |
| 240 | 1.445 | 28.906 | 1644 | 5831 | -134300 | 0.221 | 0.676 | 19.529 | 4.882 | 4.882 | 0.09 | 1.367 | 0.147 | 0.014 | 0.19 | 1.173 |
| 270 | 1.489 | 29.774 | 1644 | 5831 | -134300 | 0.219 | 0.679 | 20.219 | 4.493 | 4.493 | 0.09 | 1.415 | 0.154 | 0.015 | 0.22 | 1.195 |
| 300 | 1.528 | 30.568 | 2644 | -1621 | 3150 | 0.218 | 0.681 | 20.821 | 4.164 | 4.164 | 0.08 | 1.457 | 0.157 | 0.015 | 0.25 | 1.210 |
| 330 | 1.565 | 31.302 | 2644 | -1621 | 3150 | 0.217 | 0.683 | 21.367 | 3.885 | 3.885 | 0.08 | 1.496 | 0.159 | 0.015 | 0.27 | 1.222 |
| 360 | 1.599 | 31.985 | 2644 | -1621 | 3150 | 0.216 | 0.684 | 21.876 | 3.646 | 3.646 | 0.07 | 1.531 | 0.161 | 0.015 | 0.30 | 1.230 |

**Maximum Volume to be Stored in Storage Tank $m^3$: 1.230**



Duration of Storm Event D (minutes)

| 4.0 - FORMULAS USED IN SECTION 3.0 | | | |
|---|---|---|---|
| Variable | | | Formula |
| **Water Landing on the Site from the Rainfall Event** | Wallingford Factor | $Z_1$ | $$Z_1 = \frac{\exp\left( \ln(D) + \ln\left[1.06^{\frac{M5-60}{48r}}\right] + \left[\ln\left(\frac{721}{1150}\right) + \frac{\ln\left(\frac{48r}{1.08}\right)}{\ln\left(\frac{721}{13}\right)}\right] \right)}{M5\text{-}60}$$ From Wallingford Equation 6.1. Duration D is specified in Hours |
| | Rainfall Intensity for Storm with 5 Year Return Period and Duration D (mm) | M5-D | M5-D = $Z_1$ * M5-60 Wallingford Equation 6.1 |
| | J Factors | $J_0$, $J_1$, $J_2$ | From Wallingford Modifed Rational Method Table 6.1 |
| | $C_r$ Factor | $C_r$ | $C_r = J_0 + (J_1 * M5\text{-}60) + (J_2 * M5\text{-}60^2)$ Wallingford Equation 6.3 |
| | Wallingford Factor - Wallingford Equation 6.2 | $Z_2$ | $Z_2$ = interpolated from Table 6.2 or 6.3 T = Return period of storm (years) Wallingford Equation 6.2 (rearranged) |
| | Rainfall Intensity for 1 Year Storm of Duration D | M1-D | M1-D = M5-D * $Z_2$ Wallingford Equation 6.2. In units of mm |
| | Rainfall Intensity for M1-D | i | i = M1-D * (60 / D) Same as M1-D but in units of mm/hr |
| | Rainfall Intensity for M1-D + Climate Change | $i_{climate,change}$ | $i_{climate,change}$ = I * (1 + percentage increase) mm/hr |
| | Peak Flow Rate | $Q_{peak}$ | $Q_{peak} = i_{climate,change} * A_{site} * (1/1000) * (1/3600) * 1000$ litres/second |
| | Runoff Volume Over Time Step | $V_{runoff}$ | $V_{runoff} = Q_{peak} * D * (1/1000) * 60$ (D specified in minutes) $m^3$ |
| **Storage Tank Outflow** | Head of Water in Storage Tank | H | Calculated by assuming the first 5 minutes of rain is stored and then using this volume of stored water to determine a head from the sizing of the storage tank |
| | Outflow from Storage Tank | $Q_{outflow}$ | Once the head of water in the tank is known the outflow can be worked out from the orifice equation or from the data from the Hydrobrake flow curves |
| | Discharge from Storage Tank | $V_{outflow}$ | A running total of the outflor from the storage tank |
| | Storage Volume | $V_{storage}$ | The difference between the outflowing water and the inflowing water from the tank |

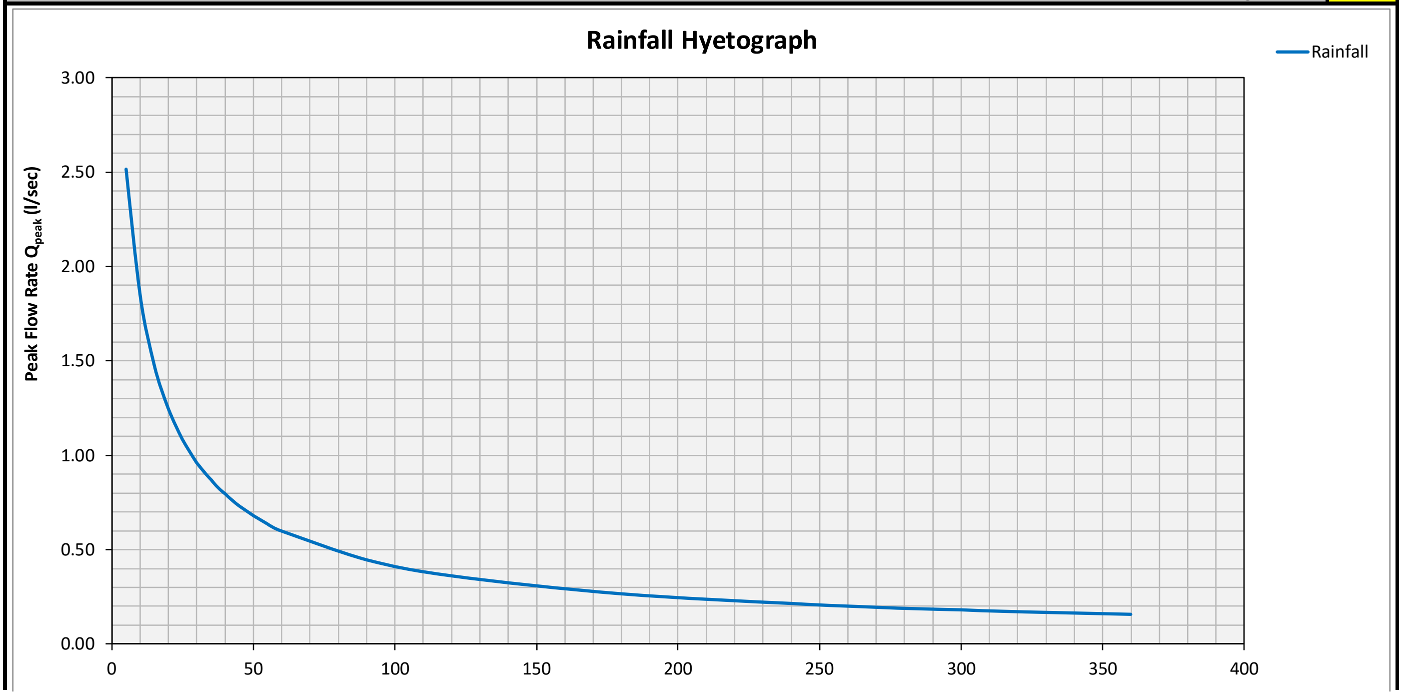
AMA Consulting Engineers

| | | | | | |
|---|---|---|---|---|---|
| Project | 67c Camlet Way | Hydraulic Curve - 1 in 30 Year Storm | | | |
| Client | Mr & Mrs Sallas | Made by | Date | Project No | |
| Description | 1 in 30 Year Storm Event (Storage Tank Discharge) | CC | 12-10-23 | 23091 | |
| | | Checked | Revision | | |
| SuDs Storage v1.0 | | CC | 0 | | |

| 1.0 - INPUT DATA | | | | |
|---|---|---|---|---|
| Return Period of Storm Event | T | 30 | Years | User Input - Valid Range 5-100 Years |
| Ratio Relating to the Type of Rainfall Expected | r | 0.4 | --- | User Input - Defined Previously |
| Site Location | England and Wales | | | User Input - Defined Previously |
| Rainfall Intensity for Storm with 5 Year Return Period and 60min Duration | M5-60 | 20 | mm | User Input - Defined Previously |
| **2.0 - AREAS USED FOR VOLUME CALCULATIONS AND ALLOWANCE FOR CLIMATE CHANGE** | | | | |
| Area of the Site used for Storage Calculations | Post-Development Impervious | | | |
| | Apost,imperviou | 70 | $m^2$ | User Input - Defined Previously |
| Allowance for Urban Creep | UC | 0% | % | |
| Final Area Used for Hydraulic Calculations | $A_{final}$ | 70 | $m^2$ | Afinal = Apost,impervious * (1 + Urban Creep%) |
| Percentage Increase on Rainfall Intensity for Climate Change | CC | 0% | % | No increase for Climate Change for 1 in 30 Year Storm |
| Volumetric Runoff Coefficient | $C_v$ | 0.60 | --- | User Input - Defined Previously |
| Dimensionless Routing Coefficient | $C_R$ | 1.67 | --- | User Input - Defined Previously |

## 3.0 - PLOT HYDRAULIC CURVE (RAINFALL ON THE SITE AND DISCHARGE FROM THE STORAGE TANK)

| Duration | WATER LANDING ON THE SITE FROM THE RAINFALL EVENT | | | | | | | | | | | | | STORAGE TANK OUTFLOW | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wallingford Factor | Rainfall Intensity | J Factors | | | $C_r$ Factor | Wallingford Factor | Rainfall Intensity for 100 Year Storm | Rainfall Intensity for M30-D | Rainfall Intensity for M30-D + Climate Change | Peak Flow Rate | Run Off Volume Over Time Step | Head of Water in Storage Tank | Outflow from Storage Tank | Discharge from Storage Tank | Storage Volume | |
| D | $Z_1$ | M5-D | $J_0$ | $J_1$ | $J_2$ | $C_r$ | $Z_2$ | M30-D | i | $i_{climate,change}$ | $Q_{peak}$ | $V_{runoff}$ | H | $Q_{outflow}$ | $V_{outflow}$ | $V_{storage}$ | |
| mins | --- | mm | $x10^{-4}$ | $x10^{-6}$ | $x10^{-9}$ | --- | --- | mm | mm/hr | mm/hr | l / sec | $m^3$ | m | l / sec | $m^3$ | $m^3$ | |
| 5 | 0.371 | 7.411 | 1699 | 2800 | 114000 | 0.197 | 1.454 | 10.776 | 129.316 | 129.316 | 2.51 | 0.754 | 0.000 | 0.000 | 0.01 | 0.744 | |
| 10 | 0.530 | 10.591 | 1644 | 5831 | -134300 | 0.211 | 1.494 | 15.822 | 94.930 | 94.930 | 1.85 | 1.108 | 0.098 | 0.012 | 0.01 | 1.094 | |
| 15 | 0.630 | 12.594 | 1644 | 5831 | -134300 | 0.217 | 1.509 | 19.009 | 76.035 | 76.035 | 1.48 | 1.331 | 0.144 | 0.014 | 0.02 | 1.313 | |
| 20 | 0.703 | 14.058 | 1644 | 5831 | -134300 | 0.220 | 1.519 | 21.352 | 64.056 | 64.056 | 1.25 | 1.495 | 0.173 | 0.016 | 0.02 | 1.472 | |
| 25 | 0.761 | 15.217 | 1644 | 5831 | -134300 | 0.222 | 1.525 | 23.209 | 55.701 | 55.701 | 1.08 | 1.625 | 0.194 | 0.017 | 0.03 | 1.597 | |
| 30 | 0.809 | 16.179 | 1644 | 5831 | -134300 | 0.224 | 1.530 | 24.749 | 49.499 | 49.499 | 0.96 | 1.732 | 0.210 | 0.100 | 0.06 | 1.675 | |
| 35 | 0.850 | 17.005 | 1644 | 5831 | -134300 | 0.225 | 1.533 | 26.069 | 44.690 | 44.690 | 0.87 | 1.825 | 0.220 | 0.100 | 0.09 | 1.737 | |
| 40 | 0.887 | 17.730 | 1644 | 5831 | -134300 | 0.226 | 1.535 | 27.225 | 40.837 | 40.837 | 0.79 | 1.906 | 0.229 | 0.100 | 0.12 | 1.788 | |
| 45 | 0.919 | 18.379 | 1644 | 5831 | -134300 | 0.226 | 1.537 | 28.254 | 37.673 | 37.673 | 0.73 | 1.978 | 0.235 | 0.100 | 0.15 | 1.830 | |
| 50 | 0.948 | 18.966 | 1644 | 5831 | -134300 | 0.227 | 1.539 | 29.184 | 35.021 | 35.021 | 0.68 | 2.043 | 0.241 | 0.100 | 0.18 | 1.865 | |
| 55 | 0.975 | 19.504 | 1644 | 5831 | -134300 | 0.227 | 1.540 | 30.031 | 32.762 | 32.762 | 0.64 | 2.102 | 0.245 | 0.100 | 0.21 | 1.895 | |
| 60 | 1.000 | 20.000 | 1644 | 5831 | -134300 | 0.227 | 1.541 | 30.811 | 30.811 | 30.811 | 0.60 | 2.157 | 0.249 | 0.100 | 0.24 | 1.919 | |
| 90 | 1.120 | 22.394 | 1644 | 5831 | -134300 | 0.228 | 1.542 | 34.521 | 23.014 | 23.014 | 0.45 | 2.416 | 0.253 | 0.100 | 0.42 | 1.999 | |
| 120 | 1.209 | 24.186 | 1644 | 5831 | -134300 | 0.227 | 1.539 | 37.229 | 18.615 | 18.615 | 0.36 | 2.606 | 0.263 | 0.100 | 0.60 | 2.009 | |
| 180 | 1.344 | 26.871 | 1644 | 5831 | -134300 | 0.224 | 1.531 | 41.146 | 13.715 | 13.715 | 0.27 | 2.880 | 0.264 | 0.100 | 0.96 | 1.923 | |
| 240 | 1.445 | 28.906 | 1644 | 5831 | -134300 | 0.221 | 1.521 | 43.979 | 10.995 | 10.995 | 0.21 | 3.079 | 0.253 | 0.100 | 1.32 | 1.761 | |
| 270 | 1.489 | 29.774 | 1644 | 5831 | -134300 | 0.219 | 1.516 | 45.146 | 10.032 | 10.032 | 0.20 | 3.160 | 0.232 | 0.100 | 1.50 | 1.663 | |
| 300 | 1.528 | 30.568 | 2644 | -1621 | 3150 | 0.218 | 1.513 | 46.248 | 9.250 | 9.250 | 0.18 | 3.237 | 0.219 | 0.100 | 1.68 | 1.560 | |
| 330 | 1.565 | 31.302 | 2644 | -1621 | 3150 | 0.217 | 1.510 | 47.264 | 8.593 | 8.593 | 0.17 | 3.308 | 0.205 | 0.097 | 1.85 | 1.456 | |
| 360 | 1.599 | 31.985 | 2644 | -1621 | 3150 | 0.216 | 1.507 | 48.206 | 8.034 | 8.034 | 0.16 | 3.374 | 0.192 | 0.016 | 1.88 | 1.493 | |
| Maximum Volume to be Stored in Storage Tank $m^3$ | | | | | | | | | | | | | | | | 2.009 | |



Duration of Storm Event D (minutes)

## 4.0 - FORMULAS USED IN SECTION 3.0

| Variable | | | Formula |
|---|---|---|---|
| **Water Landing on the Site from the Rainfall Event** | Wallingford Factor | $Z_1$ | $$Z_1 = \frac{\exp\left( \ln(D) - \ln\left[1.06\frac{M5\text{-}60}{46r}\right] - \left[\ln\left(\frac{721}{1150}\right) \times \frac{\ln\left(\frac{46r}{1.06}\right)}{\ln\left(\frac{721}{16}\right)}\right]\right)}{M5\text{-}60}$$ From Wallingford Equation 6.1. Duration D is specified in Hours |
| | Rainfall Intensity for Storm with 5 Year Return Period and Duration D (mm) | M5-D | $M5\text{-}D = Z_1 * M5\text{-}60$ Wallingford Equation 6.1 |
| | J Factors | $J_0, J_1, J_2$ | From Wallingford Modifed Rational Method Table 6.1 |
| | $C_r$ Factor | $C_r$ | $C_r = J_0 + (J_1 * M5\text{-}60) + (J_2 * M5\text{-}60^2)$ Wallingford Equation 6.3 |
| | Wallingford Factor - Wallingford Equation 6.2 | $Z_2$ | $Z_2 = \exp( C_r * [\ln(T) - 1.5 ] )$ T = Return period of storm (years) Wallingford Equation 6.2 (rearranged) |
| | Rainfall Intensity for 30 Year Storm of Duration D | M30-D | $M30\text{-}D = M5\text{-}D * Z_2$ Wallingford Equation 6.2. In units of mm |
| | Rainfall Intensity for M30-D | i | i = M30-D * (60 / D) Same as M30-D but in units of mm/hr |
| | Rainfall Intensity for M30-D + Climate Change | $i_{climate,change}$ | $i_{climate,change}$ = I * (1 + percentage increase) mm/hr |
| | Peak Flow Rate | $Q_{peak}$ | $Q_{peak} = i_{climate,change} * A_{site} * (1/1000) * (1/3600) * 1000$ litres/second |
| | Runoff Volume Over Time Step | $V_{runoff}$ | $V_{runoff} = Q_{peak} * D * (1/1000) * 60$ (D specified in minutes) $m^3$ |
| **Storage Tank Outflow** | Head of Water in Storage Tank | H | Calculated by assuming the first 5 minutes of rain is stored and then using this volume of stored water to determine a head from the sizing of the storage tank |
| | Outflow from Storage Tank | $Q_{outflow}$ | Once the head of water in the tank is known the outflow can be worked out from the orifice equation or from the data from the Hydrobrake flow curves |
| | Discharge from Storage Tank | $V_{outflow}$ | A running total of the outflor from the storage tank |
| | Storage Volume | $V_{storage}$ | the tank |

AMA Consulting Engineers
e: ama@amad.co.uk
w: www.amad.co.uk

| | | | |
|---|---|---|---|
| Project | 67c Camlet Way | Hydraulic Curve - 1 in 100 Year Storm | | |
| Client | Mr & Mrs Sallas | Made by | Date | Project No |
| Description | 1 in 100 Year Storm Event (Storage Tank Discharge) | CC | 12-10-23 | 23091 |
| | | Checked | Revision | |
| SuDs Storage v1.0 | | CC | 0 | |

## 1.0 - INPUT DATA

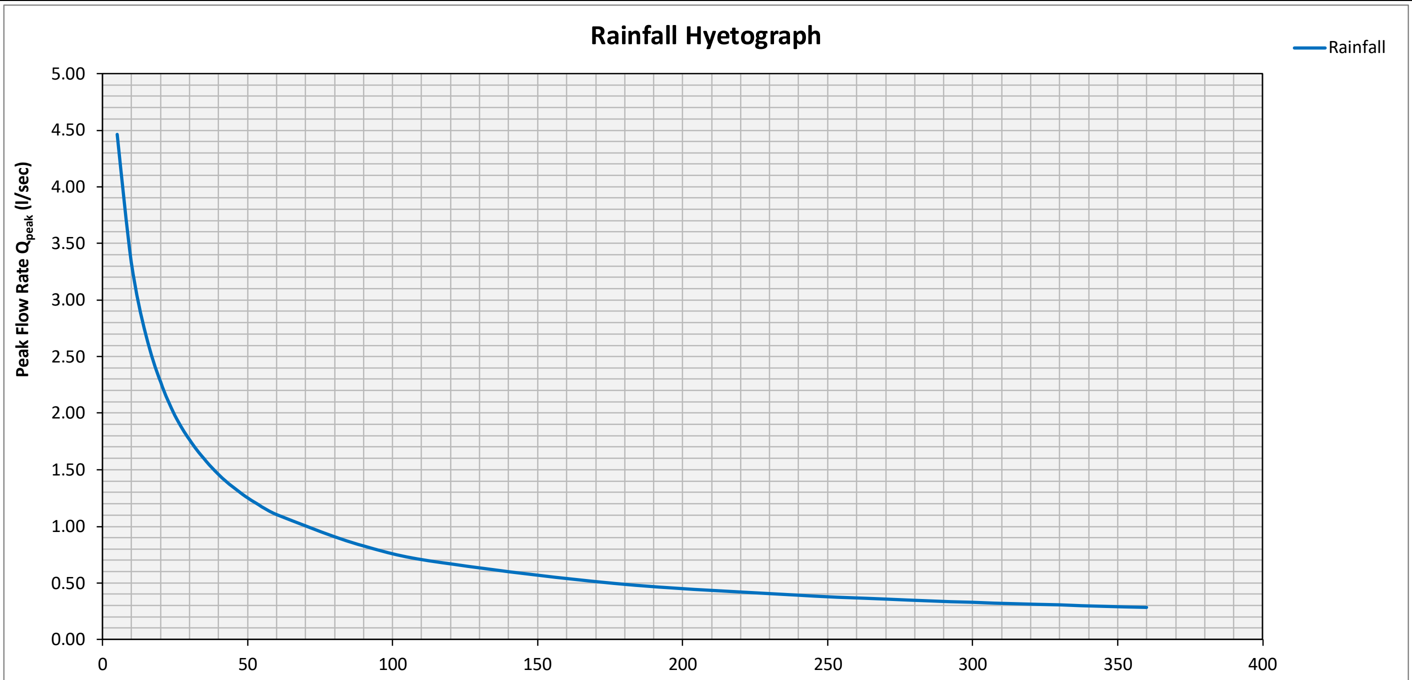
| | | | | |
|---|---|---|---|---|
| Return Period of Storm Event | T | 100 | Years | User Input - Valid Range 5-100 Years |
| Ratio Relating to the Type of Rainfall Expected | r | 0.4 | --- | User Input - Defined Previously |
| Site Location | England and Wales | | | User Input - Defined Previously |
| Rainfall Intensity for Storm with 5 Year Return Period and 60min Duration | M5-60 | 20 | mm | User Input - Defined Previously |

## 2.0 - AREAS USED FOR VOLUME CALCULATIONS AND ALLOWANCE FOR CLIMATE CHANGE

| | | | | |
|---|---|---|---|---|
| Area of the Site used for Storage Calculations | Post-Development Impervious | | | |
| | Apost,impervious | 70 | $m^2$ | User Input - Defined Previously |
| Allowance for Urban Creep | UC | 0% | % | |
| Final Area Used for Hydraulic Calculations | $A_{final}$ | 70 | $m^2$ | Afinal = Apost,impervious * (1 + Urban Creep%) |
| Percentage Increase on Rainfall Intensity for Climate Change | CC | 40% | % | User Input - Defined Previously (NPPF Table 2) |
| Volumetric Runoff Coefficient | $C_v$ | 0.60 | --- | User Input - Defined Previously |
| Dimensionless Routing Coefficient | $C_R$ | 1.67 | --- | User Input - Defined Previously |

## 3.0 - PLOT HYDRAULIC CURVE (RAINFALL ON THE SITE AND DISCHARGE FROM THE STORAGE TANK)

| Duration | WATER LANDING ON THE SITE FROM THE RAINFALL EVENT | | | | | | | | | | | | STORAGE TANK OUTFLOW | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wallingford Factor | Rainfall Intensity | J Factors | | | $C_r$ Factor | Wallingford Factor | Rainfall Intensity for 100 Year Storm | Rainfall Intensity for M100-D | Rainfall Intensity for M100-D + Climate Change | Peak Flow Rate | Run Off Volume Over Time Step | Head of Water in Storage Tank | Outflow from Storage Tank | Discharge from Storage Tank | Storage Volume |
| D | $Z_1$ | M5-D | $J_0$ | $J_1$ | $J_2$ | $C_r$ | $Z_2$ | M100-D | i | $i_{climate,change}$ | $Q_{peak}$ | $V_{runoff}$ | H | $Q_{outflow}$ | $V_{outflow}$ | $V_{storage}$ |
| mins | --- | mm | $x10^{-4}$ | $x10^{-6}$ | $x10^{-9}$ | --- | --- | mm | mm/hr | mm/hr | l / sec | $m^3$ | m | l / sec | $m^3$ | $m^3$ |
| 5 | 0.371 | 7.411 | 1699 | 2800 | 114000 | 0.197 | 1.843 | 13.659 | 163.914 | 229.479 | 4.46 | 1.339 | 0.000 | 0.000 | 0.01 | 1.329 |
| 10 | 0.530 | 10.591 | 1644 | 5831 | -134300 | 0.211 | 1.926 | 20.400 | 122.399 | 171.359 | 3.33 | 1.999 | 0.175 | 0.016 | 0.01 | 1.984 |
| 15 | 0.630 | 12.594 | 1644 | 5831 | -134300 | 0.217 | 1.959 | 24.670 | 98.681 | 138.153 | 2.69 | 2.418 | 0.261 | 0.100 | 0.04 | 2.373 |
| 20 | 0.703 | 14.058 | 1644 | 5831 | -134300 | 0.220 | 1.979 | 27.822 | 83.465 | 116.851 | 2.27 | 2.727 | 0.312 | 0.100 | 0.07 | 2.652 |
| 25 | 0.761 | 15.217 | 1644 | 5831 | -134300 | 0.222 | 1.993 | 30.321 | 72.770 | 101.879 | 1.98 | 2.971 | 0.349 | 0.100 | 0.10 | 2.867 |
| 30 | 0.809 | 16.179 | 1644 | 5831 | -134300 | 0.224 | 2.002 | 32.395 | 64.789 | 90.705 | 1.76 | 3.175 | 0.377 | 0.100 | 0.13 | 3.040 |
| 35 | 0.850 | 17.005 | 1644 | 5831 | -134300 | 0.225 | 2.009 | 34.168 | 58.575 | 82.004 | 1.59 | 3.349 | 0.400 | 0.100 | 0.16 | 3.184 |
| 40 | 0.887 | 17.730 | 1644 | 5831 | -134300 | 0.226 | 2.015 | 35.720 | 53.580 | 75.012 | 1.46 | 3.501 | 0.419 | 0.100 | 0.19 | 3.306 |
| 45 | 0.919 | 18.379 | 1644 | 5831 | -134300 | 0.226 | 2.019 | 37.099 | 49.465 | 69.252 | 1.35 | 3.636 | 0.435 | 0.100 | 0.22 | 3.411 |
| 50 | 0.948 | 18.966 | 1644 | 5831 | -134300 | 0.227 | 2.022 | 38.341 | 46.010 | 64.414 | 1.25 | 3.757 | 0.449 | 0.100 | 0.25 | 3.503 |
| 55 | 0.975 | 19.504 | 1644 | 5831 | -134300 | 0.227 | 2.024 | 39.472 | 43.060 | 60.285 | 1.17 | 3.868 | 0.461 | 0.100 | 0.28 | 3.584 |
| 60 | 1.000 | 20.000 | 1644 | 5831 | -134300 | 0.227 | 2.025 | 40.510 | 40.510 | 56.713 | 1.10 | 3.970 | 0.472 | 0.100 | 0.31 | 3.655 |
| 90 | 1.120 | 22.394 | 1644 | 5831 | -134300 | 0.228 | 2.028 | 45.405 | 30.270 | 42.378 | 0.82 | 4.450 | 0.481 | 0.100 | 0.49 | 3.955 |
| 120 | 1.209 | 24.186 | 1644 | 5831 | -134300 | 0.227 | 2.023 | 48.923 | 24.461 | 34.246 | 0.67 | 4.794 | 0.520 | 0.100 | 0.67 | 4.120 |
| 180 | 1.344 | 26.871 | 1644 | 5831 | -134300 | 0.224 | 2.006 | 53.891 | 17.964 | 25.149 | 0.49 | 5.281 | 0.542 | 0.100 | 1.03 | 4.247 |
| 240 | 1.445 | 28.906 | 1644 | 5831 | -134300 | 0.221 | 1.985 | 57.367 | 14.342 | 20.078 | 0.39 | 5.622 | 0.559 | 0.100 | 1.39 | 4.227 |
| 270 | 1.489 | 29.774 | 1644 | 5831 | -134300 | 0.219 | 1.974 | 58.763 | 13.059 | 18.282 | 0.36 | 5.759 | 0.556 | 0.100 | 1.57 | 4.184 |
| 300 | 1.528 | 30.568 | 2644 | -1621 | 3150 | 0.218 | 1.967 | 60.113 | 12.023 | 16.832 | 0.33 | 5.891 | 0.551 | 0.100 | 1.75 | 4.136 |
| 330 | 1.565 | 31.302 | 2644 | -1621 | 3150 | 0.217 | 1.960 | 61.357 | 11.156 | 15.618 | 0.30 | 6.013 | 0.544 | 0.100 | 1.93 | 4.078 |
| 360 | 1.599 | 31.985 | 2644 | -1621 | 3150 | 0.216 | 1.954 | 62.507 | 10.418 | 14.585 | 0.28 | 6.126 | 0.537 | 0.100 | 2.11 | 4.011 |
| Maximum Volume to be Stored in Storage Tank $m^3$ | | | | | | | | | | | | | | | | 4.247 |



Duration of Storm Event D (minutes)

| 4.0 - FORMULAS USED IN SECTION 3.0 | | | |
|---|---|---|---|
| **Variable** | | | **Formula** |
| **Water Landing on the Site from the Rainfall Event** | Wallingford Factor | $Z_1$ | $$Z_1 = \frac{\exp\left( \ln(D) + \ln\left[1.06\frac{M5\text{-}60}{49r}\right] + \left[\ln\left(\frac{721}{1152}\right) \times \frac{\ln\left(\frac{48r}{1.06}\right)}{\ln\left(\frac{721}{16}\right)}\right]\right)}{M5\text{-}60}$$ From Wallingford Equation 6.1. Duration D is specified in Hours |
| | Rainfall Intensity for Storm with 5 Year Return Period and Duration D (mm) | M5-D | M5-D = $Z_1$ * M5-60 — Wallingford Equation 6.1 |
| | J Factors | $J_0$, $J_1$, $J_2$ | From Wallingford Modifed Rational Method Table 6.1 |
| | $C_r$ Factor | $C_r$ | $C_r = J_0 + (J_1 * M5\text{-}60) + (J_2 * M5\text{-}60^2)$ — Wallingford Equation 6.3 |
| | Wallingford Factor - Wallingford Equation 6.2 | $Z_2$ | $Z_2 = \exp( C_r * [\ln(T) - 1.5 ] )$ — T = Return period of storm (years) Wallingford Equation 6.2 (rearranged) |
| | Rainfall Intensity for 100 Year Storm of Duration D | M100-D | M100-D = M5-D * $Z_2$ — Wallingford Equation 6.2. In units of mm |
| | Rainfall Intensity for M100-D | i | i = M100-D * (60 / D) — Same as M100-D but in units of mm/hr |
| | Rainfall Intensity for M100-D + Climate Change | $i_{climate,change}$ | $i_{climate,change}$ = I * (1 + percentage increase) — mm/hr |
| | Peak Flow Rate | $Q_{peak}$ | $Q_{peak} = i_{climate,change} * A_{site} * (1/1000) * (1/3600) * 1000$ — litres/second |
| | Runoff Volume Over Time Step | $V_{runoff}$ | $V_{runoff} = Q_{peak} * D * (1/1000) * 60$ (D specified in minutes) — $m^3$ |
| **Storage Tank Outflow** | Head of Water in Storage Tank | H | Calculated by assuming the first 5 minutes of rain is stored and then using this volume of stored water to determine a head from the sizing of the storage tank |
| | Outflow from Storage Tank | $Q_{outflow}$ | Once the head of water in the tank is known the outflow can be worked out from the orifice equation or from the data from the Hydrobrake flow curves |
| | Discharge from Storage Tank | $V_{outflow}$ | A running total of the outflor from the storage tank |
| | Storage Volume | $V_{storage}$ | The difference between the outflowing water and the inflowing water from the tank |

AMA Consulting Engineers

a: 6a Nesbitts Alley, London, EN5 5XG
t: +44(0)20 8361 6827
e: ama@amacl.co.uk
w: www.amacl.co.uk


| | | | | |
|---|---|---|---|---|
| Project | 67c Camlet Way | Design Storms | | |
| Client | Mr & Mrs Sallas | Made by | Date | Project No |
| Description | Design Storms | CC | 12-10-23 | 23091 |
| | | Checked | Revision | |
| SuDs Storage v1.0 | | CC | 0 | |

## 1.0 - SITE INFO (WALLINGFORD INPUTS)

| | | |
|---|---|---|
| Return Period T | 100 | Years |
| Site Location | England and Wales | |
| r | 0.40 | --- |
| M5-60 | 20 | mm |

## 2.0 - AREA USED FOR RUNOFF CALCULATION

| | | |
|---|---|---|
| Area of Used in Calculations | Post-Development Impervious | |
| Chosen Area: Apost,impervious | 70 | $m^2$ |
| Include Allowance for Urban Creep | Omit | |
| Multiplier for Urban Creep | 1.00 | --- |
| Final Area Used in Calculations | 70 | $m^2$ |
| | 0.00007 | $km^2$ |
| | 0.00700 | hectares |

## 3.0 - CLIMATE CHANGE INCREASE

| | | |
|---|---|---|
| Include Increase for Climate Change | YES | |
| Multiplier for Climate Change Increase | 1.4 | Multiplier |

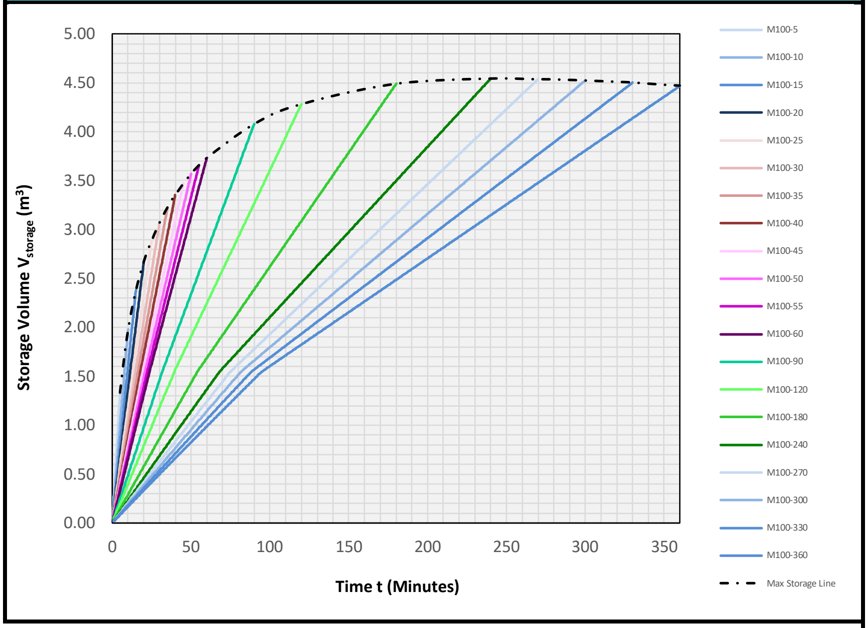
## 4.0 - ROUTING COEFFICIENTS

| | | |
|---|---|---|
| Volumetric Runoff Coefficient | 0.60 | --- |
| Dimensionless Routing Coefficient | 1.67 | --- |

## 5.0 - SUMMARY OF DESIGN STORM RESULTS

| Storm Type | Duration | Peak Flow Rate | Max Storage Volume |
|---|---|---|---|
| | D | $Q_{peak}$ | $V_{storage}$ |
| | minutes | l / sec | $m^3$ |
| M100-5 | 5 | 4.46 | 1.34 |
| M100-10 | 10 | 3.33 | 1.98 |
| M100-15 | 15 | 2.69 | 2.38 |
| M100-20 | 20 | 2.27 | 2.67 |
| M100-25 | 25 | 1.98 | 2.89 |
| M100-30 | 30 | 1.76 | 3.07 |
| M100-35 | 35 | 1.59 | 3.23 |
| M100-40 | 40 | 1.46 | 3.36 |
| M100-45 | 45 | 1.35 | 3.47 |
| M100-50 | 50 | 1.25 | 3.57 |
| M100-55 | 55 | 1.17 | 3.66 |
| M100-60 | 60 | 1.10 | 3.74 |
| M100-90 | 90 | 0.82 | 4.08 |
| M100-120 | 120 | 0.67 | 4.29 |
| M100-180 | 180 | 0.49 | 4.49 |
| M100-240 | 240 | 0.39 | 4.54 |
| M100-270 | 270 | 0.36 | 4.54 |
| M100-300 | 300 | 0.33 | 4.53 |
| M100-330 | 330 | 0.30 | 4.50 |
| M100-360 | 360 | 0.28 | 4.47 |
| Max Storage Volume ($m^3$) | | | 4.54 |

## 6.0 - GRAPH SHOWING STORAGE VOLUME PLOTTED AGAINST TIME FOR ALL DESIGN STORMS

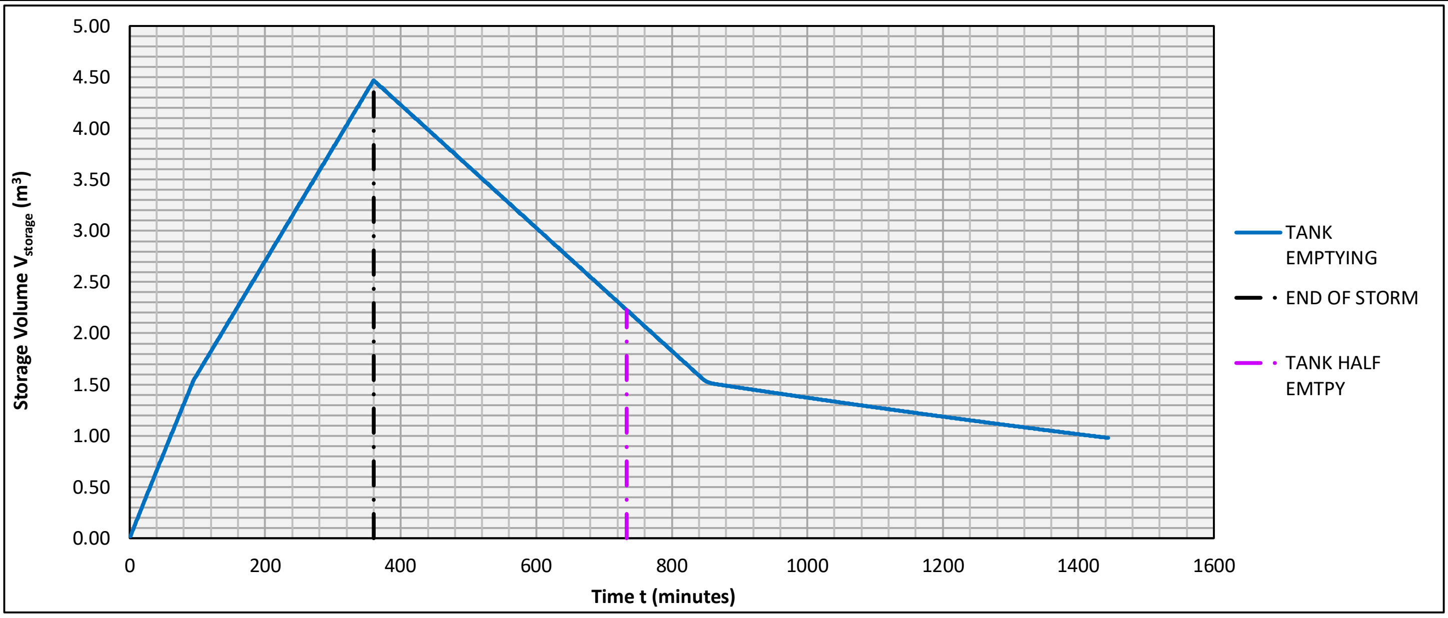


AMA Consulting Engineers
6a Nesbitts Alley, London, EN5 5XG
t: +44(0)20 8361 6827
e: ama@amacl.co.uk
w: www.amacl.co.uk

| | | | | | |
|---|---|---|---|---|---|
| Project | 67c Camlet Way | Time for Storage Tank to Empty | | | |
| Client | Mr & Mrs Sallas | Made by | Date | Project No | |
| Description | Storage Tank Emptying Time | CC | ###### | 23091 | |
| | | Checked | Revision | | |
| *SuDs Storage v1.0* | | CC | 0 | | |

| 1.0 - INPUT DATA | | | | |
|---|---|---|---|---|
| Return Period of Storm Event | T | 100 | Years | User Input - Valid Range 5-100 Years |
| Ratio Relating to the Type of Rainfall Expected | r | 0.4 | --- | User Input - Defined Previously |
| Site Location | England and Wales | | | User Input - Defined Previously |
| Rainfall Intensity for Storm with 5 Year Return Period and 60min Duration | M5-60 | 20 | mm | User Input - Defined Previously |
| **2.0 - AREAS USED FOR VOLUME CALCULATIONS AND ALLOWANCE FOR CLIMATE CHANGE** | | | | |
| Area of the Site used for Storage Calculations | Post-Development Impervious | | | |
| | Apost,impervious | 70 | $m^2$ | User Input - Defined Previously |
| Allowance for Urban Creep | UC | 0% | % | |
| Final Area Used for Hydraulic Calculations | $A_{final}$ | 70 | $m^2$ | Afinal = Apost,impervious * (1 + Urban Creep%) |
| Include Increase in Rainfall Intensity for Climate Change? | Include | | | |
| Percentage Increase on Rainfall Intensity for Climate Change | CC | 40% | % | User Input - Defined Previously |
| Volumetric Runoff Coefficient | $C_v$ | 0.60 | --- | |
| Dimensionless Routing Coefficient | $C_R$ | 1.67 | --- | |
| **3.0 - CHOSEN STORM DURATION** | | | | |
| Storm Duration | D | 360 | minutes | 6hrs |
| Peak Flow Rate | $Q_{peak}$ | 0.28 | l / s | |
| Flow Rate into the Storage Tank | Q | 0.02 | $m^3$ / min | $Q = Q_{peak} * 60 * (1/1000)$ |
| **4.0 - TIME FOR TANK TO EMPTY** | | | | |
| Percentage of Tank Full After 24hrs (includes storm duration within 24hr period) | $T_{empty}$ | 22% | % | |
| Time for Tank to Empty to 50% After Storm Ends | $T_{50\%}$ | 373 | minutes | 6.22hrs |

**5.0 - PLOTTING TANK OUTFLOW**



| | |
|---|---|
| **Calculated by:** | Christos Christou |
| **Site name:** | 67c Camlet Way |
| **Site location:** | 67c Camlet Way |

## Site Details

| | |
|---|---|
| **Latitude:** | 51.66559° N |
| **Longitude:** | 0.17953° W |
| **Reference:** | 1845460825 |
| **Date:** | Oct 12 2023 16:24 |

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). It is not to be used for detailed design of drainage systems. It is recommended that hydraulic modelling software is used to calculate volume requirements and design details before finalising the design of the drainage scheme.

## Site characteristics

| | |
|---|---|
| **Total site area (ha):** | 0.1 |
| **Significant public open space (ha):** | 0 |
| **Area positively drained (ha):** | 0.1 |
| **Impermeable area (ha):** | 0.1 |
| **Percentage of drained area that is impermeable (%):** | 100 |
| **Impervious area drained via infiltration (ha):** | 0 |
| **Return period for infiltration system design (year):** | 10 |
| **Impervious area drained to rainwater harvesting (ha):** | 0 |
| **Return period for rainwater harvesting system (year):** | 10 |
| **Compliance factor for rainwater harvesting system (%):** | 66 |
| **Net site area for storage volume design (ha):** | 0.1 |
| **Net impermable area for storage volume design (ha):** | 0.1 |
| **Pervious area contribution to runoff (%):** | 30 |

* where rainwater harvesting or infiltration has been used for managing surface water runoff such that the effective impermeable area is less than 50% of the 'area positively drained', the 'net site area' and the estimates of $Q_{BAR}$ and other flow rates will have been reduced accordingly.

## Design criteria

| | |
|---|---|
| **Climate change allowance factor:** | 1.4 |

## Methodology

| | |
|---|---|
| **esti** | IH124 |
| **$Q_{BAR}$ estimation method:** | Calculate from SPR and SAAR |
| **SPR estimation method:** | Calculate from SOIL type |

## Soil characteristics

| | Default | Edited |
|---|---|---|
| **SOIL type:** | 4 | 4 |
| **SPR:** | 0.47 | 0.47 |

## Hydrological characteristics

| | Default | Edited |
|---|---|---|
| **Rainfall 100 yrs 6 hrs:** | -- | 63 |
| **Rainfall 100 yrs 12 hrs:** | -- | 94.71 |
| **FEH / FSR conversion factor:** | 1.23 | 1.23 |
| **SAAR (mm):** | 682 | 682 |
| **M5-60 Rainfall Depth (mm):** | 20 | 20 |
| **'r' Ratio M5-60/M5-2 day:** | 0.4 | 0.4 |
| **Hydological region:** | 6 | 6 |
| **Growth curve factor 1 year:** | 0.85 | 0.85 |
| **Growth curve factor 10 year:** | 1.62 | 1.62 |
| **Growth curve factor 30 year:** | 2.3 | 2.3 |
| **Growth curve factor 100 years:** | 3.19 | 3.19 |
| **$Q_{BAR}$ for total site area (l/s):** | 0.47 | 0.47 |

| | | | | |
|---|---|---|---|---|
| Urban creep allowance factor: | 1.1 | $Q_{BAR}$ for net site area (l/s): | 0.47 | 0.47 |
| Volume control approach | Use long term storage | | | |
| Interception rainfall depth (mm): | 5 | | | |
| Minimum flow rate (l/s): | 2 | | | |

Chris Christou
CEng MIstructE
Director

Richard Russell
CEng MIstructE
Director

Appendix G – Architectural Existing and Proposed Drawings

AMA Consulting Engineers Ltd
6A Nesbitts Alley
Barnet
EN5 5XG
t: +44(0)20 8361 5827
w: www.amaci.co.uk


01 Existing Block Plan
1:500@A3

| Key: |
| --- |
| Site Boundary |

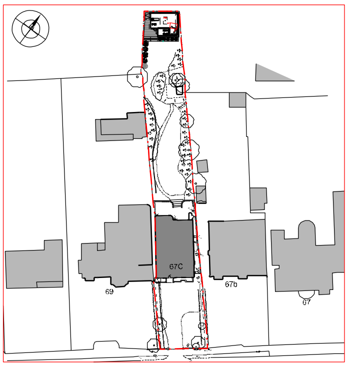
All dimensions must be checked and PAPA Architects Ltd are to be informed of any discrepancies prior to construction. Any DWG's issued by PAPA Architects Ltd are to be read in conjunction with the associated PDF versions. This drawing and any or the details therein remain the copyright of PAPA Architects Ltd. All drawings prepared by PAPA Architects are not to be used for any submissions, area schedule calculations or used by any other persons or companies other than PAPA Architects Ltd unless written consent has been given by PAPA Architects Ltd.

0 5 10 15 20 25m

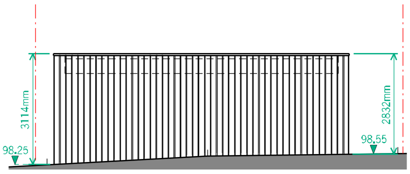
| Rev | Date | Description | Chk |
| --- | --- | --- | --- |


PAPA ARCHITECTS
222 Archway Road, Highgate, London N6 5AX
w: papaarchitects.co.uk t: +44 20 8348 8411

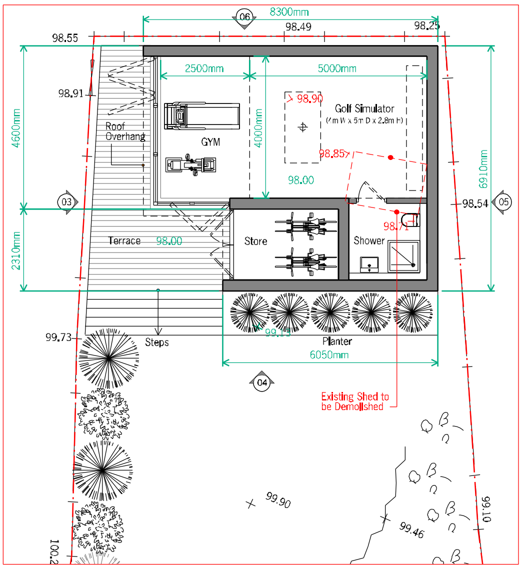

| Drawing Title: | | | Project Name: | | Client: | |
| --- | --- | --- | --- | --- | --- | --- |
| Existing Block Plan | | | 67C Camlet Way, EN4 0NL | | Mr & Mrs Sallas | |
| Project No: | Drawing No: | Rev: | Scale: | Status | Date: | Drawn: |
| | 100-900 | P01 | 1:500@A3 | | | |



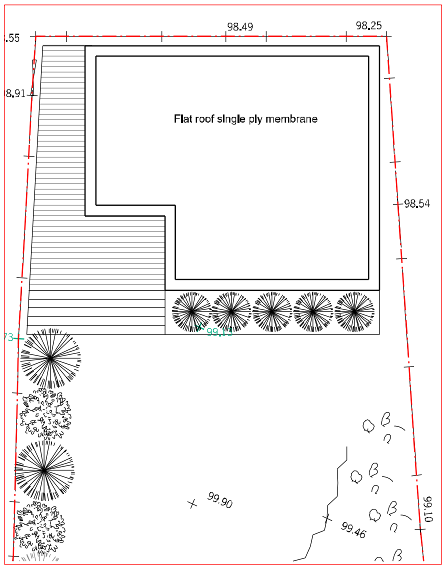

00 Site Plan
NTS@A3



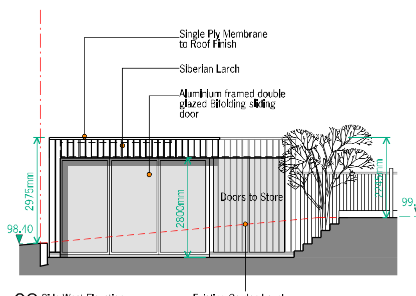

06 Rear Elevation
1:100@A3




01 Ground Floor Plan
1:100@A3




02 Roof Plan
1:100@A3

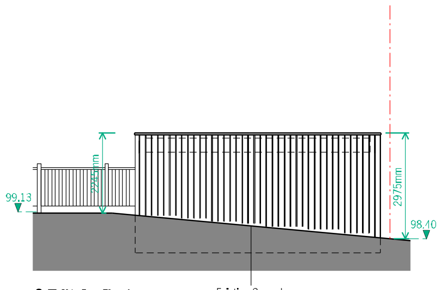



03 Side West Elevation
1:100@A3

Existing Garden Level Reduced to make Level


04 Front Elevation
1:100@A3

Existing Garden Level Reduced to make Level




05 Side East Elevation
1:100@A3

Existing Ground



0 1 2 3 4 5m

| Rev | Date | Description | Chk |
|---|---|---|---|

Key:
Site Boundary

PAPA ARCHITECTS
222 Archway Road, Highgate, London N6 5AX
w: paparchitects.co.uk t: +44 20 8348 8411

| Drawing Title: | | | Project Name: | | Client: | |
|---|---|---|---|---|---|---|
| Outbuilding Plan and Elevations | | | 67C Camlet Way, EN4 0NL | | Mr & Mrs Sallas | |
| Project No: | Drawing No: | Rev: | Scale: | Status | Date: | Drawn: |
| | 300-100 | P02 | 1:100@A3 | | | |

Appendix I – Groundwater Flood Risk Assessment

Chris Christou
CEng MIstructE
Director

Richard Russell
CEng MIstructE
Director