

SHERBOURNE STREET TRADING ESTATE CHEETAM HILL, MANCHESTER

SUSTAINABLE DRAINAGE STRATEGY

Job Number: FRA 22 1081

Date: June 2022

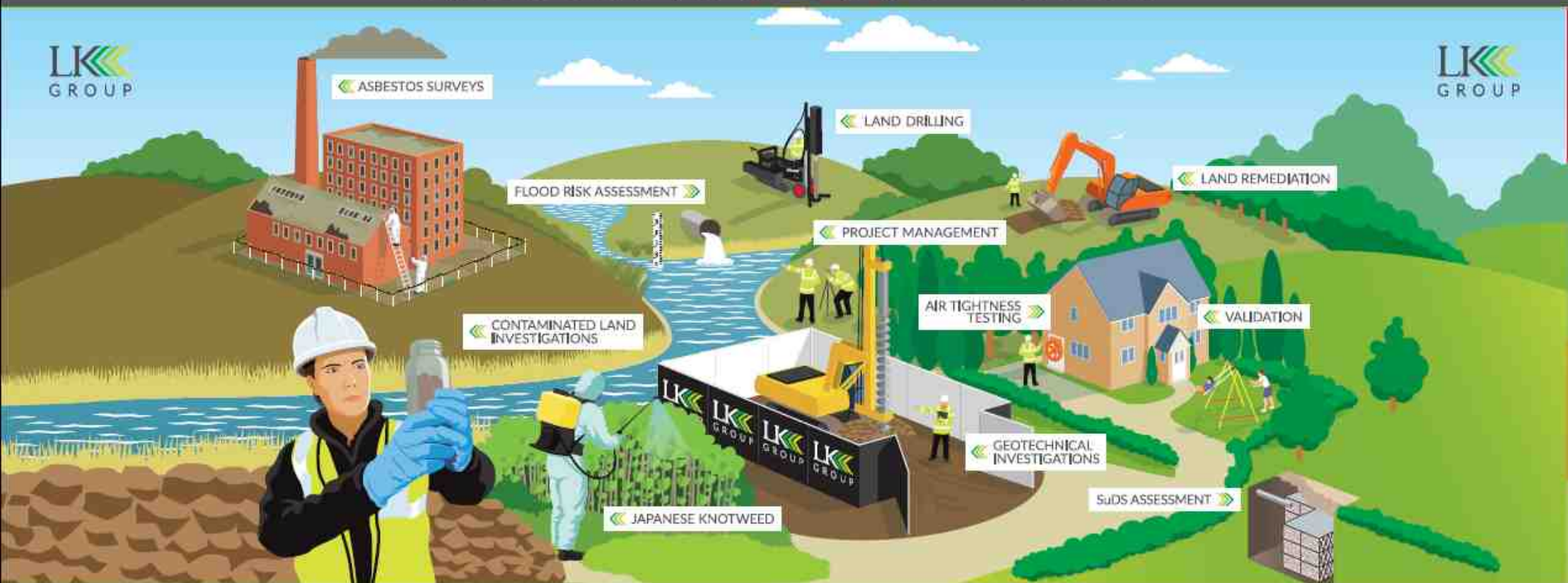
Client: Denhill Radnor Ltd



INCREASING LAND VALUE

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LK Consult			
Document Verification			
Site Address	Sherbourne Street Trading Estate, Cheetham Hill Manchester, M8 8LR		
Report Title	Sustainable Drainage Strategy		
Job Number	FRA 22 1081	Document Ref.	FRA 22 1081 - R0
Date Issued	June 2022	Report Version	R0
Prepared By	Mark Jones - Associate	Reviewed By	Jenna Lowe – Graduate Flood Risk Assessor

Revision Record			
Revision No.	Date	Nature of Revision	Approved By

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EXECUTIVE SUMMARY

Scope and Background

This Sustainable Drainage (SuDS) Strategy has been undertaken by LK Consult Ltd (LKC) to support a planning application for the development of land at Sherbourne Street Trading Estate, Cheetham Hill. The development comprises of commercial warehousing and parking.

LKC has prepared this SuDS Strategy in line with the NPPF and Technical Guidance where appropriate.

Consultations

Manchester City Council – Lead Local Flood Authority (LLFA) and United Utilities (UU) have been contacted during the preparation of this report.

The Environment Agency (EA) website has been utilised to assess if there are any limitations that may affect the form of SuDS that may be appropriate to this site. The records show that the site is within Flood Zone 1.

Drainage Strategy

The ground conditions beneath the site are recorded as Glacial Till - Devensian Superficial Deposits over Sandstone Bedrock which have been confirmed by the BGS in their borehole records. There is a slope towards the southern site boundary. The site is enclosed by Sherbourne Street to the west an access road to further commercial buildings to the south and east. To the north are the buildings for a faith school. There is a slight slope towards the south, but the site is relatively flat.

Therefore, the outline drainage strategy considers the use of an infiltration-based SuDS not to be feasible. It is assumed that surface water runoff arising from the development will discharge into the adjacent sewer within Sherbourne Street to the west of the site.

There will be a slight increase in impermeable area drained to the existing adjacent public combined sewer. No formal drainage system was observed where a connection could be made. The flows from the site should be restricted to an acceptable level to the Lead Local Flood Authority and United Utilities.

In considering the potential drainage options for the site at present it is assumed that surface water runoff arising from the development will discharge into the existing drainage system adjacent to the southern site boundary.

The proposed development will slightly increase the proportion of the site covered by impermeable surfaces and will therefore generate more runoff. Attenuation will therefore be required.

The most effective strategy, in line with the SuDS management train, would be to have a detention facility within the car park area.

The flows from the site should be restricted to an acceptable level to the Lead Local Flood Authority and UU.

The estimated volume can be stored within the site boundary.

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1 Introduction

1.1 Background

LK Consult Ltd (LKC) were commissioned by Denhill Radnor Ltd to carry out a Sustainable Drainage Strategy for the Sherbourne Trading Estate. The report was undertaken in support of a planning application to redevelop the site from the former large warehouses to smaller commercial retail units.

The report will consider the impact of the development on surface water runoff accounting for climate change. The sustainable drainage assessment in Section 4 will provide an overview of the SuDS techniques which could be considered on the site.

This preliminary SuDS assessment complies with the principles presented in the Draft National Standards for Sustainable Drainage Systems (Defra, 2015)¹ and the Planning Practice Guidance (PPG) March 2014². The sustainable drainage assessment is presented with reference to the hydrological and hydrogeological context of the development.

The report findings are based upon professional judgement and are summarised below. The report includes baseline data from the Environment Agency (EA), rainfall data from the Wallingford Studies and Hydrogeological information from the British Geological Survey (BGS). The assessment will summarise and refer to these datasets in the text.

Drainage on the site has been assessed by considering the following key constraints:

- » Topography of the site.
- » Local water features and hydrological context.
- » Underlying geology, soil types and permeability.
- » Layout and geometry of the proposed development.

¹ Non-statutory Technical Standards for Sustainable Drainage Systems – DEFRA March 2015

² Planning Practice Guidance – Department for Communities and Local Government July 2021

1.2 Site Details

A summary of the general site details is presented in Table 1-1. Plans, Drawings and Figures are provided in Appendix A. Figure 1 indicates the site location and boundary. Figure 2 indicates the proposed development.

Site Details	
Location	Sherbourne Street opposite Cheetham Park, Cheetham Hill, Manchester, M8 8LR. Centred at approximate National Grid Reference 384015E 400220N.
Area	Approximately 0.23ha
Topography	54.65 metres above ordnance datum (AOD) in the northeast of the site and 54.01mAOD in the southwest. Site is sloping down gently to the west.
Current Land Use	<u>Site</u> Hardstood former warehouse bases and access road. Some vegetation has established around the edges since the warehouses were demolished. The site is bounded by chain link fencing. <u>Surrounding Area/ Boundary Treatment</u> North: Religious school buildings. East: Commercial Units. South: Warehousing and commercial units. West: Cheetham Park.
Proposed Development	Construction of commercial and over the counter retail units. Access will be from Sherbourne Street.

Table 1-1: Summary of site details.

2 Site Setting

2.1 Environmental Setting

LKC has undertaken a review of public domain information including British Geological Survey data, Environment Agency data, historical mapping, and aerial photography to provide a summary of the environmental setting of the site. This is summarised in Table 2-1 below.

Summary of the Environmental Setting			
Geology	Superficial		Till, Devensian – Diamicton.
	Bedrock		Chester Formation – Sandstone.
	BGS Boreholes		BH Ref: SD80SW227, 170m northeast: Made ground to 0.60m, brown/grey sandy Clay to 1.09m, hard red/brown boulder Clay to 5.57m compact brown silty Sand to 6.27m (water struck at 6.09mbgl). BH Ref: SJ89NW42, 260m southwest: Ash to 0.61m, Clay to 5.49m, running Sand to 8.23m and hard Clay to 12.50m. BH Ref: SJ89NW3458, 250m southeast: Ash, bricks, and stones to 0.90m, very stiff brown silty and sandy Clay with grey fissures and stone inclusions to 3.90m and firm to stiff brown silty and sandy Clay with stone and coals inclusions to 8.25m.
	Defra Soilscape Mapping		The type of soil has been identified as slowly permeable seasonally wet acid loamy and clayey.
Hydrogeology	Aquifer Designation	Superficial	Secondary Undifferentiated Aquifer.
		Bedrock	Principal Aquifer.
	Source Protection Zone (SPZ)		Site not within an SPZ.
Flood Zone	The site is within Fluvial Flood Zone 1.		
	Very Low risk, with annual probability of flooding from rivers and the sea of less than 0.1% (1 in 1000).		
Hydrology	All adjacent and internal surface water		There are no open or adjacent watercourses in close proximity to the site. Fairy Brook is located 62m east of the site.
Site History			The site was formally utilised for a clay pit until the 1960's before being converted to warehousing and storage before the buildings were demolished around 2005.

Table 2-1: Summary of the Environmental Setting.

2.2 Site Reconnaissance

A site reconnaissance was undertaken in May 2022.

Relevant features identified on site are summarised below:

- The site is mostly surfaced with the concrete flooring from the former warehousing.
- The hardstanding is generally level being slightly raised above Sherbourne Street.
- Site slopes gradually to the southwest.
- Site is bounded by a concrete panel and chain-link fencing.

- » There are three existing accesses to the site from Sherbourne Street.
- » No sign of positive drainage observed on site.
- » Highway gullies observed within the adjacent highways.

Relevant photographs are provided in Plate 2-1.



Plate 2-1: Site photographs.

2.3 Site Levels

A topographic survey of the site was not provided, therefore opensource LiDAR levels have been extracted to OS GPS datum, and information is included on the drawings in Appendix B. The site falls to the west and south. The existing concrete slabs are laid horizontally with a fall down to Sherbourne Street at the western edge of the site.

3 Consultation

Information from consultees is summarised in Table 3-1 below.

Relevant correspondence is provided in Appendix C.

Source	Details	
Manchester City Council (LLFA)	Information Provided: There is a culverted watercourse, Fairy Brook, approximately 62m to the east of the site. The site is within a Critical Drainage Area and the flows from site should be reduced by 50%.	
United Utilities (UU)	Sewer Map	No surface water sewers running parallel to the site's boundary along Sherbourne Street. A deep 640mm by 950mm combined sewer flows south under Sherbourne Street.
	Likely conditions for connecting into their sewerage system	UU would request conditions for a separate system with only foul draining to foul / combined sewers and surface water draining to soakaway/SuDS, watercourse or surface water sewer. All surface water flow from the proposed development should drain in-line with the drainage hierarchy, as outlined in Paragraph 80 of the National Planning Practice Guidance. UU Developer Services was contacted regarding sewer flooding history for the site. UU confirmed that they did not have any record of internal or external sewer flooding of properties in the vicinity of the site as a result of overloaded sewers. Surface water runoff generated from this development should discharge to the ground via infiltration system where feasible. If not feasible, UU will consider a connection to the 640mm by 950mm combined sewer located in Sherbourne Street at a pass forward flow to be agreed by the Lead Local Flood Authority. UU request that any agreed rate does not exceed 5l/s. Foul flow from this site will be allowed to drain into the public combined sewer system. UU's preferred point of discharge would be to the 640mm by 950mm combined sewer located in Sherbourne Street at an unrestricted rate.

Table 3-1: Summary of Consultee Information.

4 Sustainable Drainage Strategy

4.1 Introduction

The NPPF recognises that flood risk and other environmental damage can be managed by minimising changes in the volume and rate of surface run-off from development sites through the use of Sustainable Drainage Systems (SuDS), this being complementary to the control of development within the floodplain.

SuDS will not alleviate flooding in an area prone to flooding; however, properly designed SuDS have the potential to prevent the surface water runoff from new development worsening the flood risk. The effective disposal of surface water from development is a material planning consideration in determining proposals for the development and use of land.

The accepted principles are that surface water arising from a developed area should, as far as practicable, be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development, while reducing the flood risk to the site itself and elsewhere, taking climate change into account.

The Building Regulations Requirement H3³ stipulates that rainwater from roofs and paved areas is carried away from the surface to discharge to one of the following, listed in order of priority:

- an adequate soakaway or other adequate infiltration system,
- a watercourse or, where that is not practicable,
- a sewer.

The concept of a sustainable drainage system has been incorporated into the outline drainage strategy for the study area in order to comply with the Flood and Water Management Act 2010⁴.

Suitability of different SuDS will be governed by prevailing site conditions, such as the type and scale of development, topography, ground conditions (soil permeability, ground stability, depth to water table), local hydrogeology and risk of groundwater contamination (presence of sensitive aquifers and source protection zones) etc.

4.2 Sustainable Drainage Hierarchy

4.2.1 Infiltration

The Groundwater Source Protection Zone mapping from the EA website shows that the site is not within any identified protection zones. A summary of the British Geological Survey superficial and bedrock aquifer descriptions and classifications supplemented by local records is shown in Table 4-1 below:

Classification	Description	Aquifer Classification	Recorded Water Table Depth	Soakaway Potential
Glacial Till Deposits	Silty, sandy gravelly clay with sand lenses	Secondary (Undifferentiated)	Approx. 6.09mbgl	Poor
Chester Formation Bedrock.	Sandstone.	Principal.	N/A.	Good.

Table 4-1: Geological and Hydrogeological Setting.

³ Building Regulations part H3 2010: Approved Document, Drainage and Waste Disposal.

⁴ Flood and Water Management Act 2010: UK Government.

Infiltration methods such as soakaways are unlikely to be feasible given the sandy Clay and Boulder Clay beneath the site, but this may be investigated further at the detailed design stage, if required.

There is a slope over the site and surrounding area which indicates that groundwater in the vicinity of the site would likely drain towards the southwest.

4.2.2 Watercourses

There are no observable watercourses within or near the boundary of the site. Currently surface water from the site runs overland to the southwest.

4.2.3 Public Sewer

There is a combined sewer running adjacent to the site in Sherbourne Street.

4.3 Surface Water Drainage Strategy

Following the assessment of the site settings and existing constraints to the development. The drainage options relating to the final discharge of surface water for this section of the site are listed in Table 4-2 in order of priority within the NPPF:

Option No:	Drainage Solution	Most feasible solution	Reasoning
a	Soakaway/Infiltration	2	Low permeability and Site Constraints.
b	Connection to Watercourse	N/A	No known watercourses within or adjacent to the site and would require third party access and EA/LLFA consent.
c	Discharge into a sewer	1	A connection into the 640mm by 950mm combined sewer located in Sherbourne Street would be possible – subject to approval from LLFA and connection consent from UU.

Table 4-2: Drainage options.

Table 4-3 provides a summary of the SuDS options appraisal with consideration of CIRIA C697 (The SUDS Manual)⁵ for the development:

SuDS Option	Appropriate to Development	Comments
Soakaways	X	Due to the nature of the ground conditions, the use of infiltration systems may not be feasible.
Infiltration basin	X	Depressions that store and dispose of water via infiltration. May not be appropriate given the ground conditions.
Sand filter	X	Treatment devices using sand beds as filter media.
Filter strip	X	Engineered filters that use vegetation to remove and treat runoff. The filter strip is sloped to allow sheet flow across the vegetated strip. A filter strip offers no storage and is used solely to remove pollutants from surface water.
Filter drains	X	Linear trenches filled with a permeable granular material, often with a perforated pipe in the base of the trench.
Detention basin	X	Dry depressions designed to hold water for a specific retention time.
Swales	X	Swales are shallow grass-lined channels that provide capacity for conveying flows at a controlled rate into ponds and watercourses.
Rainwater harvesting	*	Rainwater harvesting collects the rain which falls onto roofs, then stores it in a tank until required for a non-potable use. In the process, a volume of water is kept out of the storm-water management system, thereby helping to reduce flooding risks.
Green roofs	*	Green roof installations can help to reduce surface water runoff from roof areas depending on the system specified. Green roofs are not currently included in the development proposals.
Geo-cellular storage systems	✓	Modular block systems can be used to provide an underground storage facility. Any geo-cellular storage systems should be lined with a geo-membrane to provide attenuation storage.
Permeable Pavements – with granular and geo-cellular storage systems	✓	Permeable pavements allow inflow of rainwater into underlying construction. Any geo-cellular storage systems would have to be lined with an impermeable membrane to provide storage rather than infiltration for runoff from highways.
Ponds	X	Attenuation ponds can be used to offset the increase in surface water flows attributable to increased area of hard standing, in order to minimise the risk of flooding to and from the proposed development. Ponds will attenuate the surface water flow prior to discharging to the public surface water sewers. The storage volume afforded by these features should not include any permanent water in the pond.
Oversized Pipes	✓	Oversizing the pipes that make up the on-site drainage network is a cost-effective method for providing attenuation storage within the network. Such systems could be considered on the parts of the development where gradients are relatively flat.
Tanks	✓	Prefabricated underground tanks could be considered at the detailed design stage in order to provide storage to attenuate surface water runoff.
Flow control devices	✓	The peak flow rates will be controlled by flow control devices e.g. hydrobrake style flow control systems, and restricted orifices. Flow control devices enable the discharge to be restricted to a constant rate from the development.

Table 4-3: Summary of the SuDS options appraisal.

Notes

✓ Suitable for use given the nature and scale of the development

* Possibly suitable for use – not included in the client and architect design proposal at present

X Not suitable

⁵ CIRIA C697 - The SUDS Manual. London 2015

4.4 Surface Water Attenuation Requirements

In line with the correspondence with Manchester City Council, the flow from this development should be reduced by the minimum of 50% from the existing runoff rates for estimating the attenuation volumes required.

It is estimated from the supplied plan (see Appendix A) that the site will have the following designated areas (Table 4-4).

Existing Designated Areas	Plot Area
Total area (ha)	0.23
Existing Impermeable Area (ha)	0.21
Green Infrastructure (ha)	0.02
Proposed Catchment	
Impermeable Area (ha)	0.23
Permeable Area (ha)	0.00

Table 4-4: Assumed plot areas.

Table 4-4 shows the assumed areas included within the calculations.

It can be seen that there is an increase in impermeable area from the existing usage to the proposed. This is likely to require attenuation to reduce the proposed flow off site to a level which is acceptable to the LLFA and to UU, including an allowance for climate change.

4.4.1 Attenuation Estimate

Surface water storage and runoff estimations based on the HR Wallingford procedure have been undertaken for the development and the output report is presented in Appendix E.

For the contributing catchment an estimate has been produced assuming a developable area of the entire 0.23ha plot. This gives the following runoff rates and attenuation requirements for this section based on the Wallingford method:

Existing Runoff rates:

»»	Q_{bar} :	27.0 l/s
»»	1 in 1-year runoff rate:	19.0 l/s
»»	1 in 30-year runoff rate:	47.7 l/s
»»	1 in 100-year runoff rate:	60.3 l/s

The flow rate reduction by 50% will give the following runoff rates:

»»	Q_{bar} :	13.5 l/s
»»	1 in 1-year runoff rate:	9.5 l/s
»»	1 in 30-year runoff rate:	23.9 l/s
»»	1 in 100-year runoff rate:	30.2 l/s

United Utilities has specified an allowable discharge rate of up to 5l/s to their adjacent combined drain. This would provide more than the 50% betterment on the existing brownfield discharge rates.

The following attenuation has been estimated for the development using 5l/s runoff rates and utilises the FSR methodology⁶ as:

⁶ Flood Studies Report Wallingford NERC 1975.

- » Attenuation storage volume: **33.8 m³** (1 in 30-year event)
- » Retention on site volume: **66.2 m³** (1 in 100 year + 20% Climate Change)
- » Retention on site volume: **82.5 m³** (1 in 100 year + 40% Climate Change)

Attenuation storage aims to limit the peak rate of runoff from the development to 5l/s before discharge to public sewer. As the flow from the development would be reduced there should be little change in the flows that enter the public sewer and thus the risk of flooding as a result from the development should not increase the risk of flooding off-site.

The attenuation required for a 1 in 30-year storm event, requires a storage volume of **33.8 m³** and for the 1 in 100-year event, a retention capacity of between **66.2 m³** and **82.5 m³** will be required from on-site storage as well as SuDS systems. All volumes can be stored within the site boundary and discharges will be limited by flow control devices to the adjacent sewer.

4.5 Site Specific SuDS

The use of attenuation SuDS are deemed to be the most feasible and practical option for the development. The attenuation tank or similar will provide the required storage volume to limit peak runoff arising from the development.

Utilisation of a flow control device at the end of the system will control the peak flow rates.

The use of permeable paving may be viable dependant on the detailed design of the proposed development. If this drainage technique is considered to be feasible then it will reduce the requirement for attenuation as it will reduce the contributing impermeable area. The permeable paving will also provide some level of water treatment reducing effects of pollution in runoff on the environment.

Assuming that the outline drainage strategy is acceptable to the Local Authority, a more detailed design can be presented and agreed with the appropriate regulatory bodies during the detailed design phase.

4.6 Maintenance and Management Plan

The SuDS maintenance and inspections responsibility rests with the owners or could be arranged through appointment of a site management company.

Alternatively, by using an approved form of attenuation tank constructed to adoptable standards along with the new sewer connection can be offered for S104 adoption with United Utilities.

4.7 Foul Drainage

The foul water could be discharged by gravity into the 640mm by 950mm combined sewer located in Sherbourne Street as relative levels indicate that this will be feasible in terms of fall.

5 Conclusion

The site formally contained a number of warehouse buildings. The proposal is to construct a number of over the counter commercial units with car parking contained in a central area.

An assessment of the site settings and existing constraints in conjunction with the development proposals have resulted in the following recommendations for the safe development of the site:

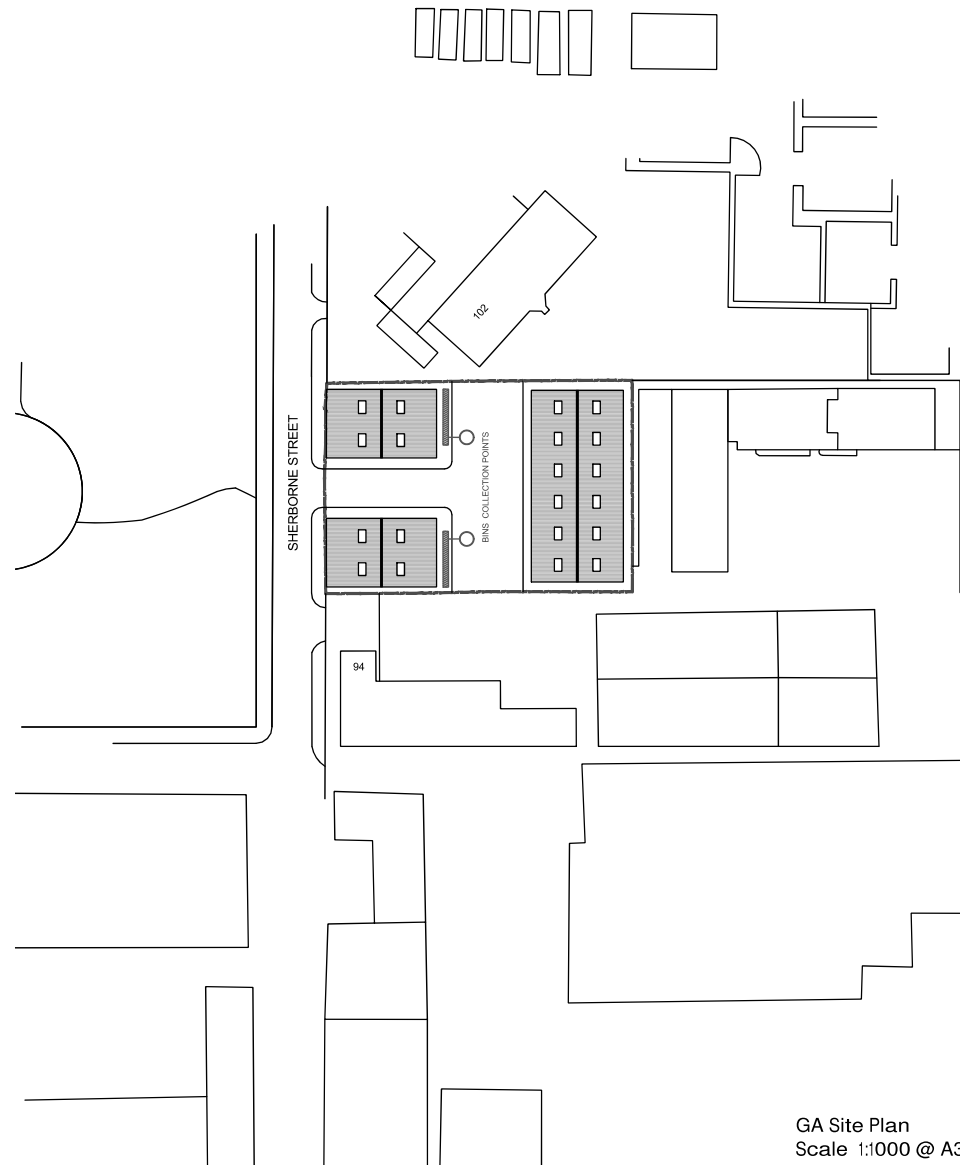
- » Giving the existing ground conditions on site, the use of infiltration SuDS for surface water disposal will not be practical.
- » The attenuation required for a 1 in 30-year storm event, requires a storage volume of **33.8 m³** and for the 1 in 100-year event, a retention on site of between **66.2 m³** and **82.5 m³** will be required from on-site storage as well as SuDS systems.
- » There is no existing connection of the site to the adjacent public sewers. The pre-development advice enquiry received from United Utilities considered that a flow rate of up to 5l/s would be acceptable if infiltration proved to be impractical.
- » All proposed outflow connections from the development should be agreed with the Lead Local Planning Authority and United Utilities.

APPENDIX A

FIGURES, PLANS AND DRAWINGS



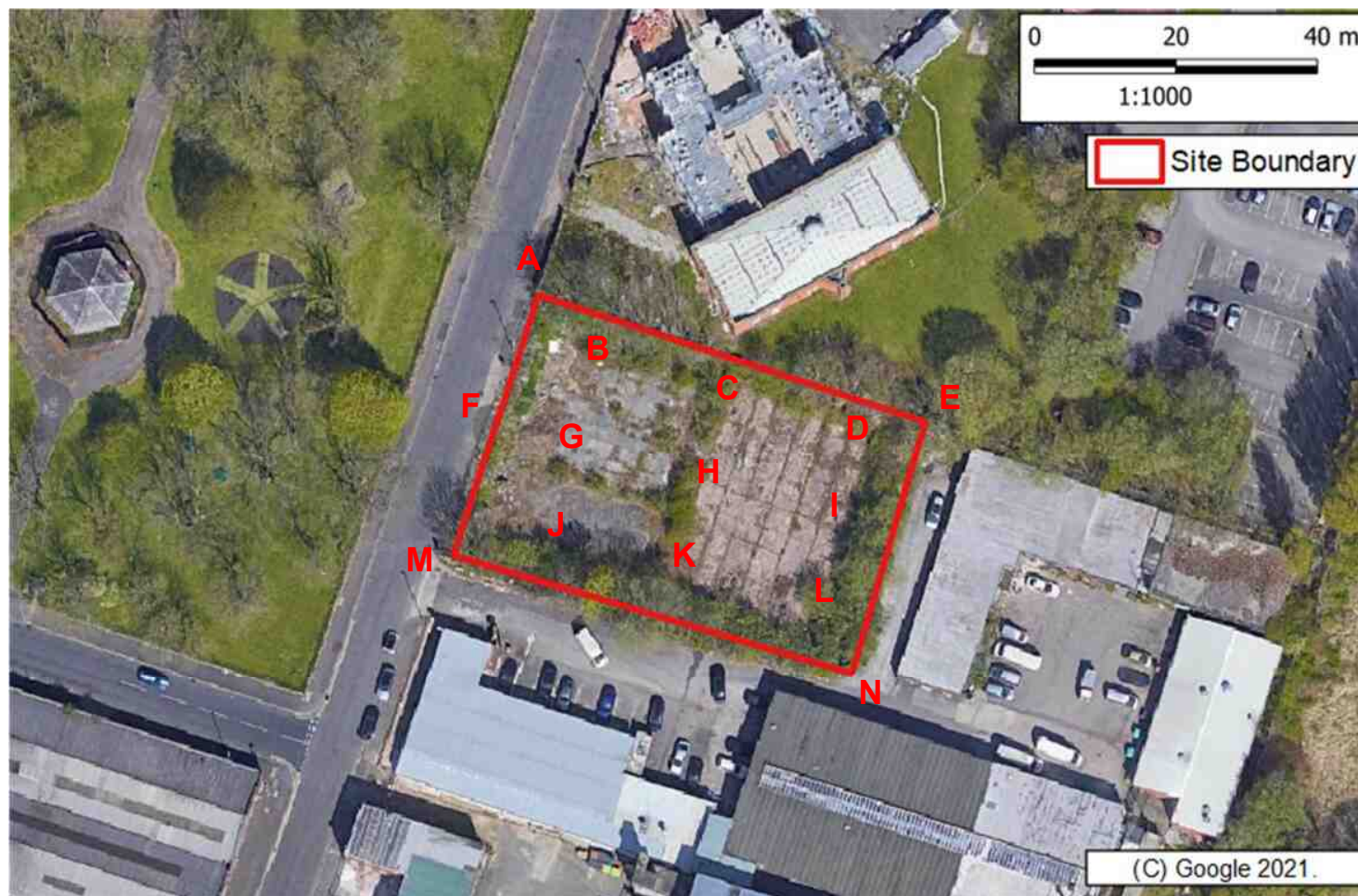
Client: Denhill Radnor Ltd				Title: Site Location & Boundary Plan		LK CONSULT	
Site: Sherbourne Street				Scale (see scale bar): 1:10,000 & 1:2,000 @ A4			
Job No.: LKC 21 1180	Drawn By: FP	Checked By: CB	Drawn: May 2021	Figure: 1	Revision:		



client name		
World Metal Recycling Ltd		
project		
Sherborne Street – Wearhouses		
drawing		
GA Site Plan		
project number		scale
ENQ1701504		1/1000 @ A3
drawing number	rev	issue status
001	–	PLANNING
This drawing is to be read in conjunction with all related drawings. All dimensions must be checked and verified on site before commencing any work or producing shop drawings. The originator should be notified immediately of any discrepancy. This drawing is copyright and remains the property of Studio Tashkeel Architecture Ltd		

APPENDIX B

SITE INFORMATION



LiDAR Elevation Key

(m AOD)

A = 54.25

B = 54.23

C = 54.43

D = 54.65

E = 55.34

F = 53.72

G = 54.01

H = 54.02

I = 54.30

J = 54.01

K = 54.23

L = 54.75

M = 53.32

N = 53.54

HOLST & CO. LTD.

SITE INVESTIGATION DEPT.

5-7, NEW YORK ROAD

LEEDS, 2

Contract No. M1946/F1261

Location Cheetham Hill

Client Manchester City Architect

Borehole No. 4

Ground Level

Date 3.7.69

BOREHOLE LOG

STRATA	Legend	Depth below Ground Level	Thickness of Strata	Type of Sample	c lb/sq. ft.	ϕ deg.	m.c. %	γ lb/cu. ft.	N
Made Ground: Road sets		2'0"	2'0"	2'6"					
Brown/grey sandy clay		3'6"	1'6"	☐ 2720	0	37.1	127		
Hard red/brown boulder clay				☐ 7'0"	4550	8	16.9	134	
			14'9"	☐ 3'6"	3500	0	38.9	131	
		18'3"		☐ 17'6"	3700	0	16.4	128	
Compact brown silty sand		20'6"	2'3"	☐ 23'0"					
Dark brown laminated clay		23'0"	2'6"	☐ Unsuitable for test			19.5	133	
Compact brown sandy silt			6'0"	☐ 26'9"	1610	0	19.9	130	
		29'0"		☐ 30'0"	1790	0	21.1	125	
Stiff grey laminated clay and silt with pockets of wet brown silty sand			11'0"	☐ 35'0"	870	12	22.3	121	
		40'0"		☐ 38'6"	580	17	19.2	118	

Water Struck at 20'0"

Maximum Observed Water Level 16'0"

Undisturbed Sample ☐
 Disturbed Sample ☐
 Water Sample Δ
 Penetration Test I

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

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

SECTION OF

manhole **SJ 49 NW 42, 43**Maps: One-inch..... Six-inch 104 N.W.E. County Lancs

Height above O.D..... Latitude..... Longitude.....

Communicated by..... Date of sinking.....

Made by..... Dip of Strata.....

No. 60.
43Sherbourne St.

Ashes Clay

Clay.

Running Sand.

Hard clay (Pothole.)

← - Water line →

Thickness.

Depth from Surface.

0.61	2	-	0.61	2	-
4.88	16	-	5.49	18	-
2.74	9	-	8.23	27	-
4.27	14	-	12.50	41	-

No. 61
No. 13
42Sherbourne St.

Clay

Sand

Clay.

8.53	28	-	8.53	28	-
0.61	2	-	9.14	30	-
4.57	15	-	13.72	45	-

5589 NW 3458
8428 9994

DATE	CASING DEPTH (m)	WATER LEVEL MORNING & EVENING	DEPTH OF STRATA BELOW GL	REDUCED LEVEL	DESCRIPTION	Nº AND TYPE OF SAMPLE	SAMPLE DEPTH / PENETRATION FROM	TO	Nº OF BLOWS	LEGEND
2.3.83			0.05		H.R.A.					
			0.15		Setts					
			0.40		Concrete					
			0.90		Ashes, bricks, stones etc.	D1	0.5			
					Very stiff brown silty and sandy CLAY with grey fissures and stone inclusions.	D2	1.0	1.95		
						U1	1.5			
						D3	2.5			
						U2	3.0			
3.90										
2.3.82	6.00	Dry	8.25		Firm to stiff brown silty and sandy CLAY with stone and coal inclusions.	D4	4.0	4.95		
						U3	4.5			
						D5	5.50			
						U4	6.0			
						D6	7.0			
						U5	7.5			
						D7	8.25			

SAMPLE TEST KEY	D - DISTURBED SAMPLE	B - BULK SAMPLE	U - UNDISTURBED SAMPLE
	S - SPT SAMPLE	W - WATER SAMPLE	

ALL DEPTHS AND REDUCED LEVELS IN (m) UNLESS OTHERWISE STATED.

Trial hole excavated to 1.0m b.g.l.
Borehole backfilled on completion, no final overnight water level observed.

5589 ~ 3457
8425 9988

ALL DEPTHS AND REDUCED LEVELS IN (m) UNLESS OTHERWISE STATED.	
REMARKS	Trial hole excavated to 1.0m below ground level. Borehole backfilled on completion, no final overnight water level obtained.

APPENDIX C

CONSULTEE CORRESPONDENCE

Lead Local Flood Authority

Highways Service
Growth and Neighbourhoods Directorate
Manchester City Council
PO Box 532
Town Hall
Manchester
M60 2LA

Email: floodriskmanagement@manchester.gov.uk

DATE:06/06/2022

Dear Sir or Madam,

RE: Our Ref: MCC031/05/2022

We acknowledge with thanks your payment for our LLFA data screen service.

Please find enclosed plan showing the results of the data screen. The position of features shown on this plan is approximate only and is given in accordance with the best information currently available.

The enclosed plan cannot be used to substitute a competent site investigation.

The enclosed plan is being provided to you subject to Manchester City Council's terms and conditions which are shown attached.

I trust the above meets your requirements and look forward to hearing from you should you need anything further.

If you have any queries regarding this matter, please do not hesitate to contact us.

Yours Faithfully,



Neil Bayliss-Rowe, Highways Development Control & Flood Risk Manager, Lead Local Flood Authority

TERMS AND CONDITIONS – LLFA DATA SCREEN

These provisions apply to LLFA data supplied by Manchester City Council (“MCC”).

TERMS AND CONDITIONS:

- This data Map and any information supplied with it is issued subject to the provisions contained below, to the exclusion of all others and no party relies upon any representation, warranty, collateral contract or other assurance of any person (whether party to this agreement or not) that is not set out in this agreement or the documents referred to in it.
- MCC has taken all reasonable care to compile this data Map. This data Map and any information supplied with it is provided for general guidance only and MCC makes no representation, undertaking or warranty of any kind as to its accuracy, completeness or being up to date is given or implied.
- In particular, the position of any culverted assets shown on the data Map are approximate only. MCC strongly recommends that a comprehensive site investigation is undertaken in addition to reviewing this data Map to determine and ensure the precise location of any assets. The exact location, positions and depths should be obtained by an appropriate survey which may include but shall not be limited to GPR and CCTV.
- The data screened may be modified over time without notice and therefore this data Map is issued subject to any removal or change in location of the same. The onus is entirely upon you to confirm whether any changes to the data Map have been made subsequent to issue and prior to any works being carried out.
- This data Map and any information shown on it or provided with it must not be relied upon in the event of any development, construction or other works (including but not limited to any excavations) or for the purpose of determining the suitability of a point of connection to discharge.
- No person or legal entity, including any company shall be relieved from any liability howsoever and whensoever arising from damages of any kind caused to assets by reason of the actual position and/or existence of assets being different from those shown on the data Map and any information supplied with it.
- If any provision contained herein is or becomes legally invalid or unenforceable, it will be taken to be severed from the remaining provisions which shall be unaffected and continue in full force and affect.
- This agreement shall be governed by English law and all parties submit to the exclusive jurisdiction of the English courts, save that nothing will prevent MCC from bringing proceedings in any other competent jurisdiction, whether concurrently or otherwise.

DATA SCREEN SYMBOLOGY

Bridge

-  Good
-  Fair
-  Poor
-  Very Poor
-  Unknown

Trash Screen

-  Good
-  Fair
-  Poor
-  Very Poor
-  Unknown

Culvert Orifice

-  Very Good
-  Good
-  Fair
-  Poor
-  Very Poor
-  Unknown

Culvert Conduit

-  CCTV surveyed
-  Not CCTV surveyed
-  Ordinary Watercourse Conduit
-  MCC SuDS
-  MCC Flood Incident Points
-  MCC Section 19 Report
-  MCC Flood Incident Polygons
-  MCC Local Authority Boundary

Supplementary Information where available:

Critical Drainage Area – The site is within the Conurbation Core (CDA)

Flood Incidents –

MCC Flood Incident Polygon:

There are no recorded flood incident polygons with close proximity to the site.

MCC Flood Incident Points (within close proximity to the site):

There are no recorded flood incident points with close proximity to the site.

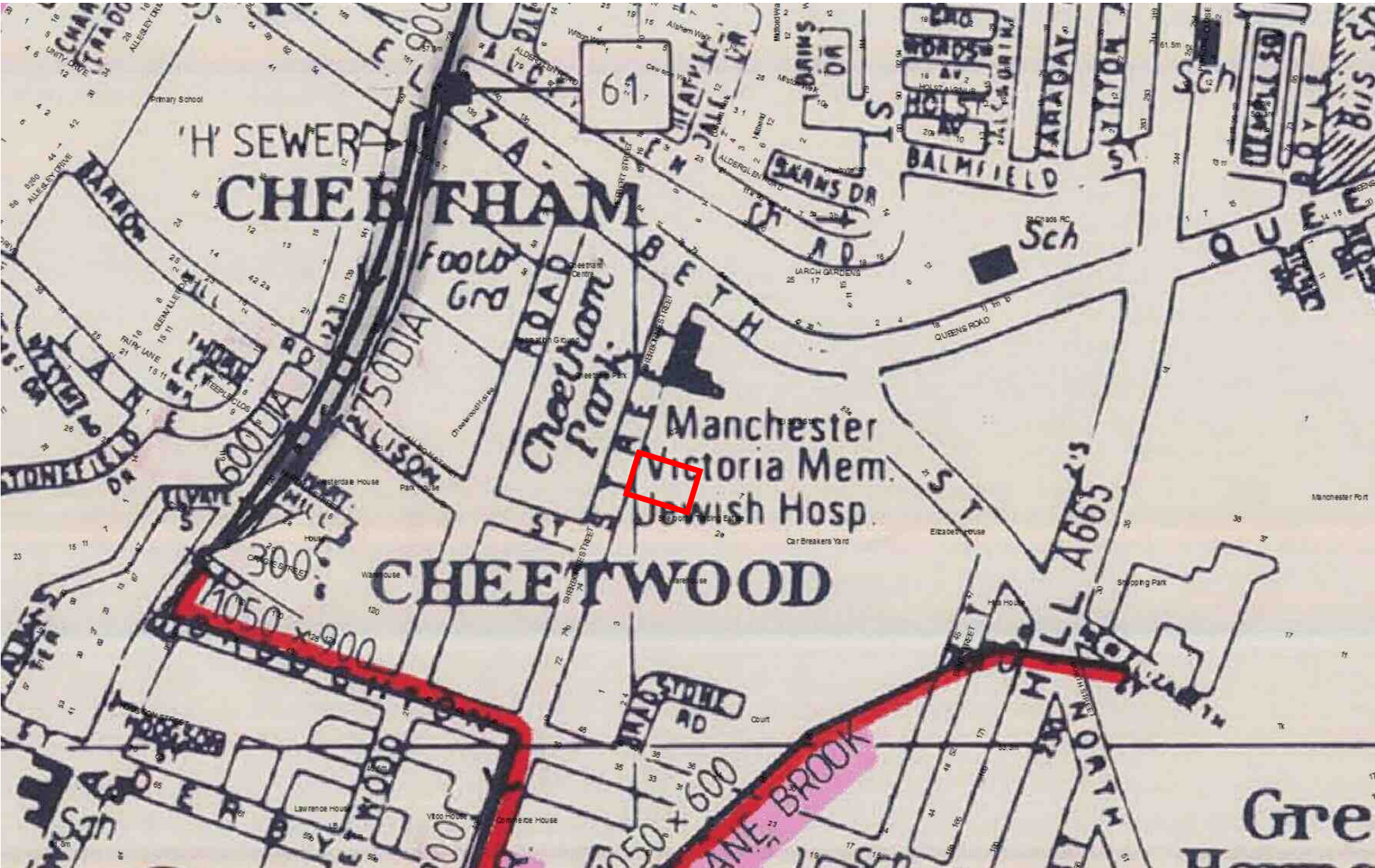
Culvert Conduits – The Fairy Lane Brook culvert (size unknown) is shown to be located approximately 62m to the East of the site. The dashed orange line of the culvert illustrates the section of the culvert which has been investigated as part of a historic planning application and has been confirmed to not be positioned within the location shown on the attached map.

The River Irwell Tributary (Strangeways) culvert (600mm diameter) is shown to be located approximately 170m to the North West of the site. Another length of the River Irwell Tributary (Strangeways) culvert (size unknown) is shown to be located approximately 160m to the South West of the site.

Survey and Design Archive – Extract from the 1984 survey of major drainage is included.

Any other information – The site would benefit from an assessment of surface water flood risk, main rivers & associated assets, fluvial flood risk, historic events & flood warning areas. We recommend the applicant screens appropriate EA datasets during their investigation.

Historic 1984 Mapping:





MANCHESTER
CITY COUNCIL

LLFA DATA SCREEN

Address/Site Ref:
Sherborne Street

Our Ref: **MCC031/05/2022**

Author: Manchester City Council LLFA

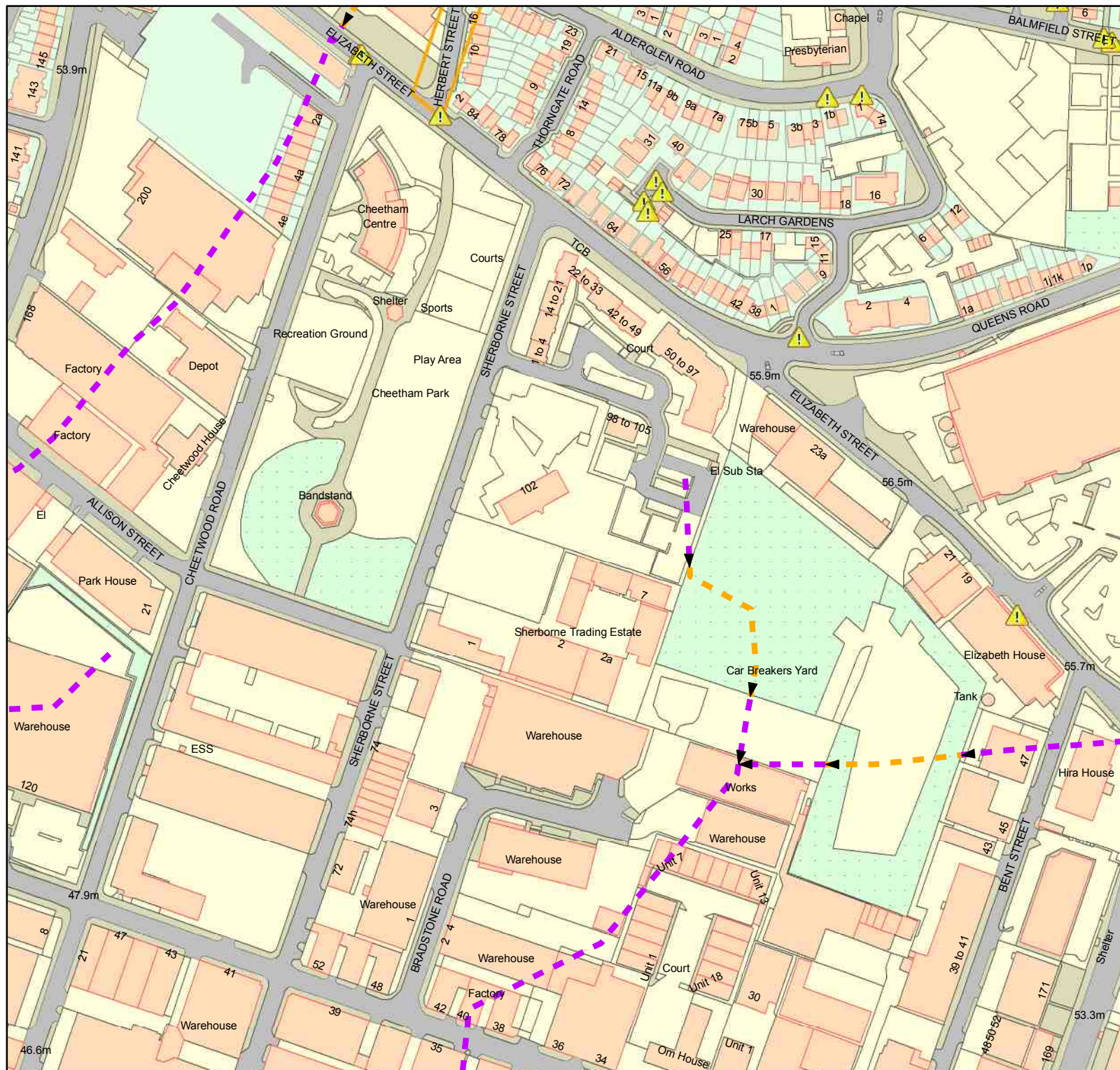
Date: 06/06/2022

Scale: 1:2,627

The position of features shown on this plan is approximate only and is given in accordance with the best information currently available. Manchester City Council will not accept liability for any loss or damage caused by the actual position being different from those shown.

0 15 30 60
Meters

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and database right 2021.



Mark Jones

From: wastewaterdeveloperservices@uuplc.co.uk
Sent: 07 June 2022 12:19
To: LK SuDS & Floods
Subject: Pre Development Enquiry for: Sherbone Street Trading Estate UU Reference Number : 02251314

Good morning Jenna,

Pre Development Enquiry for: Sherbone Street Trading Estate UU Reference Number : 02251314

We have carried out an assessment of your application which is based on the information provided. This pre-development advice on your drainage strategy will be valid for 12 months. Your drainage strategy will need to be reviewed by other competent authorities as part of the planning process, and we advise that you carry out the necessary site investigations to confirm the viability of your proposals.

If your investigations require access to our public sewer network, we ask that you contact our network engineers with a request for an access certificate via our main contact telephone number 0345 6723 723 or refer to the link below:

<https://www.unitedutilities.com/builders-developers/working-near-our-assets/>

Foul Water

Foul flow from this site will be allowed to drain into the public foul water/combined sewer system.

Our preferred point of discharge would be to the 640x950mm diameter public combined sewer within Sherborne Street located to the West of your proposed development at an unrestricted rate.

If you are able to identify an alternative, more suitable point of discharge, we request that you contact us at your earliest convenience so that we can assess suitability.

In accordance with our infrastructure plans we may ask you to change your point of connection. Therefore please contact us when you are ready to formalise your drainage proposals, we would suggest before you submit for Full Planning.

Surface Water

All surface water flow from the proposed development should drain in-line with the drainage hierarchy, as outlined in Paragraph 80, (Reference ID: 7-080-20150323), of the National Planning Practice Guidance. We also recommend you prioritise the use of multi-functional sustainable drainage systems for the management of surface water in accordance with national planning policy.

Generally, the aim should be to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable.

This is outlined as follows, in order of priority:

1. **into the ground (infiltration);**
2. **to a surface waterbody;**
3. **to a surface water sewer or highway drain;**
4. **to a combined sewer.**

For guidance, The [North West SuDS Pro-Forma](#) provides information on the appropriate evidence required at each stage of the hierarchy, to demonstrate how each level has been discounted.

The Lead Local Flood Authority has responsibility for all surface water drainage concerns and their input to your proposal is critical. You should also consider whether it is necessary to discuss your proposal with the Environment Agency, or Internal Drainage Board (if operating in your area).

The Local Planning Authority are the determining authority for any application for planning permission and the appropriate authority for determining cost viability of a proposed drainage scheme, such assessments are outside of the jurisdiction of United Utilities.

Infiltration

Surface water runoff generated from this development should discharge to the ground via infiltration system where feasible.

A detailed evidence based feasibility assessment must be carried out in line with Chapter 25 of the CIRIA SuDS Manual 2015 to determine whether infiltration is a suitable method of surface water disposal.

Particular attention must be paid to Ground Water Source Protection Zones to ensure that the risk of pollution to these valuable resources is not compromised. Details can be obtained from the government website:

<https://www.gov.uk/guidance/groundwater-source-protection-zones-spzs#find-groundwater-spzs>

If your site is in a Groundwater Source Protection Zone, you should have regard to the Environment Agency's approach to Groundwater Protection. Information on this is available via the link below:

<https://www.gov.uk/government/publications/groundwater-protection-position-statements>

Please note that such a location could have implications for the principle of your development and the need for additional mitigating measures to protect the groundwater environment and public water supply in the detailed design of your site.

Highway Drainage

If an evidence based assessment has been carried out and confirms that infiltration is not feasible, we recommend that you investigate the possibility of draining surface water to the highway drain where this ultimately discharges to a watercourse, by contacting the relevant Highway Authority.

Public Sewer

In accordance with the hierarchy of drainage options within the National Planning Practice Guidance, both discharge to ground via infiltration and discharge to a waterbody should be discounted prior to consideration of discharging surface water to the public sewer system. Evidence should be provided to demonstrate how these have been discounted, as outlined in the North West SuDS pro-forma.

Once evidence is provided as outlined above, United Utilities will consider a connection to the 640x950mm diameter public combined sewer within Sherborne Street located West of the proposed site at a pass forward flow to be agreed by the Lead Local Flood Authority. United Utilities request that any agreed rate does not exceed 5l/s.

As a Water Company, we have no obligation to accept highway drainage into our public sewer network. However, should your proposals include runoff from highways, we would request that consideration is given to SuDS components that deliver source control are incorporated within the design of the scheme to reduce the volume and

frequency of discharges of these flows to the public sewer.

Levels

For low-lying sites, (where the ground level of the site or the level of a basement is below the ground level at the point where the drainage connects to the public sewer), care should be taken to ensure that the property is not at increased risk of flooding. If these circumstances exist, we recommend that you contact us to discuss further. It could affect the detailed design of your site and result in the need to incorporate appropriate mitigating measures in your drainage scheme.

Land drainage / Overland flows / track drainage

United Utilities have no obligation, and furthermore we do not accept land drainage, overland flows or track drainage into the public sewerage network under any circumstances

Existing Wastewater Assets Crossing the Site

We have reviewed our records and can confirm that there does not appear to be any charted public sewers located within the boundary of proposed development. However, due to the accuracy of the records and the public sewer transfer legislation in 2011, not all public sewers are shown on our records so we would ask that you proceed with caution and carry out your own site investigation works. If any uncharted sewers are identified while carrying out your works we would ask that you contact United Utilities at the earliest opportunity so that we can offer guidance and update our records.

Existing Water Assets Crossing the Site

It is the developer responsibility to identify utilities on-site. Where clean water assets are shown on our records, we recommend that you contact our Water Pre-Development Team, via the following email address: DeveloperServicesWater@uuplc.co.uk. Further information for this service can be found on our website via the link below:

<https://www.unitedutilities.com/builders-developers/larger-developments/pre-development/water-pre-dev/>

Historic Flooding

I can confirm that we have no current record of sewer flooding on our DG5 register within the vicinity of the proposed development. The DG5 register is a register of properties that have flooded as a result of hydraulic inadequacy of the public sewer network.

Please note that United Utilities Water Limited (UUV) can only record and check flooding events which are reported to us and we have to comply with our Regulators instructions on the qualification of flooding events to place on the register.

Our response does not include:

- any sewer flooding events caused by blockages or collapses which are the result of third party actions, natural events or other actions over which UUV has no control and not a facet of sewer capacity; or
- any historical sewer flooding events that have been removed from the register as a result of investment in our infrastructure.

Connection Application

Although we may discuss and agree discharge points and rates in principle, please be aware that you will have to apply for a formal sewer connection. This is so that we can assess the method of construction, Health & Safety requirements and to ultimately inspect the connection when it is made. Details of the application process and the form itself can be obtained from our website by following the link below:

<https://www.unitedutilities.com/builders-developers/wastewater-services/sewer-connections/sewer-connection/>

We recommend that the detailed design should confirm the locations of all utilities in the area and ensure that any proposed drainage solution considers routing and clash checks where required.

If we can be of any further assistance please don't hesitate to contact us further.

Kind regards,



Ashleigh Bellerby
Assistant Developer Engineer
Developer Services & Metering
Customer Services
T: 07826891650
unitedutilities.com

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----- Original Message -----

From: seweradoptions@uuplc.co.uk [seweradoptions@uuplc.co.uk]

Sent: 07/06/2022 09:30

To: flooding@thelkgroup.com

Subject: Our reference - 02251314



Good Morning,

Thank you for your pre development enquiry, this has now been passed to our engineer and they will respond to you directly.

If you would like to discuss this by phone, please give me a call between 8am and 6pm Monday to Friday, I'm on 0345 072 6067 ext. . Alternatively, you can reply to this email and I will get back to you as soon as possible.

Kind regards,
Tonicha Wilde

Did you know we now have a live chat facility available to you between 8am and 5pm Monday to Friday. Just click on the link on our webpage and one of our advisors will be

APPENDIX D

CALCULATIONS

MasterDrain
SW

The LK Group www.thelkgroup.com		Eton Business Park, Eton Hill Road, Radcliffe M26 2ZS Tel: 0161 763 7200 email: m.jones@thelkgroup.com		Job No.		
				Sheet no. 1		
				Date 14/06/22		
Project Qbar				By	Checked	Reviewed
Title Peak runoff calculations for Sherbourne Street						

Area data:-

FSR data

M5-60 = 18.1

Soil index = 0.45

WRAP value = 4

r = 0.35

SAAR = 950

Nat grid = SD8400

Site data:-

Ret. period (yrs) = 2.333

Time of entry = 7.00

Impervious area drained = 2100 m²

Site slope = Mild <2% (1:50)

Length of overland flow = 0.00

ToC = 7.0 mins

Overland flow time = 0.0 mins

Pervious area drained = 200 m²

Soil type = Medium textured

Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 74.0%

Rainfall rate = 57.1 mm/Hr

UCWI = 98.5

Runoff rate (gross) = 27.0 l/s

Methods

Runoff factor (RF) = 74.0, calculated from:-

Runoff factor = $(0.829 \times \text{PIMP}) + (25 \times \text{SOIL}) + (0.078 \times \text{UCWI}) - 20.7$

where

PIMP = $\text{Impervious Area} \times 100 / (\text{Impervious Area} + \text{Pervious Area})$

UCWI = Calculated value for Wetness Index

Calculations produced by MasterDrain Surface Water design program

MasterDrain
SW

The LK Group www.thelkgroup.com		Eton Business Park, Eton Hill Road, Radcliffe M26 2ZS Tel: 0161 763 7200 email: m.jones@thelkgroup.com		Job No.		
				Sheet no. 1		
				Date 14/06/22		
Project 1 in 1 year				By	Checked	Reviewed
Title Peak runoff calculations for Sherbourne Street						

Area data:-

FSR data

M5-60 = 18.1

Soil index = 0.45

WRAP value = 4

$r = 0.35$

SAAR = 950

Nat grid = SD8400

Site data:-

Ret. period (yrs) = 1

Time of entry = 10.00

Impervious area drained = 2100 m²

Site slope = Mild <2% (1:50)

Length of overland flow = 0.00

ToC = 10.0 mins

Overland flow time = 0.0 mins

Pervious area drained = 200 m²

Soil type = Clay

Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 74.0%

Rainfall rate = 40.1 mm/Hr

UCWI = 98.5

Runoff rate (gross) = 19.0 l/s

Methods

Runoff factor (RF) = 74.0, calculated from:-

$\text{Runoff factor} = (0.829 \times \text{PIMP}) + (25 \times \text{SOIL}) + (0.078 \times \text{UCWI}) - 20.7$

where

$\text{PIMP} = \frac{\text{Impervious Area} \times 100}{\text{Impervious Area} + \text{Pervious Area}}$

UCWI = Calculated value for Wetness Index

Calculations produced by MasterDrain Surface Water design program

MasterDrain
SW

The LK Group www.thelkgroup.com		Eton Business Park, Eton Hill Road, Radcliffe M26 2ZS Tel: 0161 763 7200 email: m.jones@thelkgroup.com		Job No.	
				Sheet no. 1	
				Date 14/06/22	
Project 30 year event				By	Checked
Title Peak runoff calculations for Sherbourne Street					

Area data:-

FSR data

M5-60 = 18.1

Soil index = 0.45

WRAP value = 4

r = 0.35

SAAR = 950

Nat grid = SD8400

Site data:-

Ret. period (yrs) = 30

Time of entry = 6.00

Impervious area drained = 2100 m²

Site slope = Mild <2% (1:50)

Length of overland flow = 0.00

ToC = 6.0 mins

Overland flow time = 0.0 mins

Pervious area drained = 200 m²

Soil type = Medium textured

Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 74.0%

Rainfall rate = 100.8 mm/Hr

UCWI = 98.5

Runoff rate (gross) = 47.7 l/s

Methods

Runoff factor (RF) = 74.0, calculated from:-

Runoff factor = $(0.829 \times \text{PIMP}) + (25 \times \text{SOIL}) + (0.078 \times \text{UCWI}) - 20.7$

where

PIMP = $\text{Impervious Area} \times 100 / (\text{Impervious Area} + \text{Pervious Area})$

UCWI = Calculated value for Wetness Index

Calculations produced by MasterDrain Surface Water design program

MasterDrain
SW

The LK Group www.thelkgroup.com		Eton Business Park, Eton Hill Road, Radcliffe M26 2ZS Tel: 0161 763 7200 email: m.jones@thelkgroup.com		Job No.		
				Sheet no. 1		
				Date 14/06/22		
Project 100yr event		Title Peak runoff calculations for Sherbourne Street		By	Checked	Reviewed

Area data:-

FSR data

M5-60 = 18.1

Soil index = 0.45

WRAP value = 4

r = 0.35

SAAR = 950

Nat grid = SD8400

Site data:-

Ret. period (yrs) = 100

Time of entry = 6.00

Impervious area drained = 2100 m²

Site slope = Mild <2% (1:50)

Length of overland flow = 0.00

ToC = 6.0 mins

Overland flow time = 0.0 mins

Pervious area drained = 200 m²

Soil type = Medium textured

Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 74.0%

Rainfall rate= 127.5 mm/Hr

UCWI = 98.5

Runoff rate (gross)= 60.3 l/s

Methods

Runoff factor (RF) = 74.0, calculated from:-

Runoff factor = $(0.829 \times \text{PIMP}) + (25 \times \text{SOIL}) + (0.078 \times \text{UCWI}) - 20.7$

where

PIMP = $\text{Impervious Area} \times 100 / (\text{Impervious Area} + \text{Pervious Area})$

UCWI = Calculated value for Wetness Index

Calculations produced by MasterDrain Surface Water design program



MasterDrain
SW

The LK Group

www.thelkgroup.com

Eton Business Park,
Eton Hill Road,
Radcliffe M26 2ZS
Tel: 0161 763 7200
email: m.jones@thelkgroup.com

Job No.

Sheet no. **1**

Date **14/06/22**

Project **30 year event**

Title **Storage calcs for Sherbourne Street**

By

Checked

Reviewed

Data:-

FSR Hydrology:-

Location = Sherbourne Street

M5-60 (mm) = 18.1

Soil index = 0.45

Return period = 30

UCWI = 100.8

Grid reference = SD8400

r = 0.35

SAAR (mm/yr) = 950

WRAP = 4

Climate change = 0

Clayey, or loamy over clayey soils with an impermeable layer at shallow depth.

Runoff factor (RF) = 81.0, calculated from:-

Runoff factor = $(0.829 \times \text{PIMP}) + (25 \times \text{SOIL}) + (0.078 \times \text{UCWI}) - 20.7$

where

PIMP = $\text{Impervious Area} \times 100 / (\text{Impervious Area} + \text{Pervious Area})$

UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 2300 m²

Total area (TA) = 2300 m²

Mean disch. rate = 5.000 l/s

Additional flow = 0.00 l/s

Pervious area = 0 m²

Equiv area = 1863 m² (TA x RF).

Areal reduction factor = 1.000

Climate change factor = 0

Calculated data:-

Time to max = 57.0 mins

Rainfall at max = 28.78 mm/hr

Pipeline storage = 0.0 m³

Offline storage = 0.0 m³

Calculated storage volume = 33.8 m³

Allowed discharge rate = 5.000 l/s

Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours

Rainfall rate = 8.00 mm/hr

Calculated storage volume = 0.0 m³

Allowed discharge rate = 5.000 l/s

Rainfall intensities calculated using the Wallingford Procedure

Storage lengths for initial calculation (x 1.1, 1.2, 1.3 or 1.5 as above if required) :-

Diam	Len	Diam	Len	Ovoid	Len	Box culvert	Len
100	4309.4	1125	34.0	400 x 600	188.0	500 x 500	135.4
150	1915.3	1200	29.9	600 x 900	81.9	500 x 750	90.2
225	851.2	1275	26.5	800 x 1200	46.0	500 x 1000	67.7
300	478.8	1350	23.6			750 x 1000	45.1
375	306.4	1425	21.2			750 x 1200	37.6
450	212.8	1500	19.2			750 x 1500	30.1
525	156.3	1575	17.4			1000 x 1000	33.8
600	119.7	1650	15.8			1000 x 1200	28.2
675	94.6	1725	14.5			1000 x 1500	22.6
750	76.6	1800	13.3			1000 x 1800	18.8
825	63.3	1875	12.3			1000 x 2000	16.9
900	53.2	1950	11.3			1500 x 1500	15.0
975	45.3	2025	10.5			1500 x 1800	12.5
1050	39.1	2100	9.8			1500 x 2000	11.3



MasterDrain
SW

Data:-

The LK Group

www.thelkgroup.com

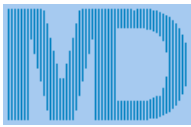
Eton Business Park,
Eton Hill Road,
Radcliffe M26 2ZS
Tel: 0161 763 7200
email: m.jones@thelkgroup.com

Job No.		
Sheet no. 2		
Date 14/06/22		
By	Checked	Reviewed

Project	30 year event
Title	Storage calcs for Sherbourne Street

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	80.0	24.988	3.000	21.988
20	56.0	34.516	6.000	28.516
30	44.0	40.563	9.000	31.563
40	36.0	45.087	12.000	33.087
50	31.0	48.737	15.000	33.737
60	28.0	51.814	18.000	33.814
70	25.0	54.485	21.000	33.485
80	23.0	56.851	24.000	32.851
90	21.0	58.979	27.000	31.979
100	20.0	60.914	30.000	30.914
110	18.0	62.691	33.000	29.691
120	17.0	64.335	36.000	28.335
130	16.0	65.865	39.000	26.865
140	15.0	67.296	42.000	25.296
150	15.0	68.641	45.000	23.641
160	14.0	69.910	48.000	21.910
170	13.0	71.111	51.000	20.111
180	13.0	72.252	54.000	18.252
190	12.0	73.337	57.000	16.337
200	12.0	74.372	60.000	14.372
210	12.0	75.362	63.000	12.362
220	11.0	76.310	66.000	10.310
230	11.0	77.220	69.000	8.220
240	10.0	78.094	72.000	6.094
250	10.0	78.935	75.000	3.935
260	10.0	79.745	78.000	1.745
270	10.0	80.527	81.000	0.000
280	9.0	81.282	84.000	0.000
290	9.0	82.012	87.000	0.000
300	9.0	82.719	90.000	0.000
310	9.0	83.403	93.000	0.000
320	8.0	84.066	96.000	0.000
330	8.0	84.736	99.000	0.000
340	8.0	85.395	102.000	0.000
350	8.0	86.040	105.000	0.000
360	8.0	86.670	108.000	0.000
370	8.0	87.286	111.000	0.000
380	7.0	87.890	114.000	0.000
390	7.0	88.480	117.000	0.000
400	7.0	89.059	120.000	0.000
410	7.0	89.627	123.000	0.000
420	7.0	90.184	126.000	0.000
430	7.0	90.730	129.000	0.000
440	7.0	91.267	132.000	0.000
450	7.0	91.794	135.000	0.000
460	6.0	92.312	138.000	0.000
470	6.0	92.821	141.000	0.000
480	6.0	93.321	144.000	0.000
490	6.0	93.813	147.000	0.000
500	6.0	94.298	150.000	0.000
510	6.0	94.775	153.000	0.000
520	6.0	95.244	156.000	0.000
530	6.0	95.707	159.000	0.000
540	6.0	96.163	162.000	0.000
550	6.0	96.612	165.000	0.000
560	6.0	97.054	168.000	0.000
570	6.0	97.491	171.000	0.000
580	5.0	97.921	174.000	0.000
590	5.0	98.346	177.000	0.000
600	5.0	98.765	180.000	0.000

Storage volume (m³) = 33.8 m³



MasterDrain
SW

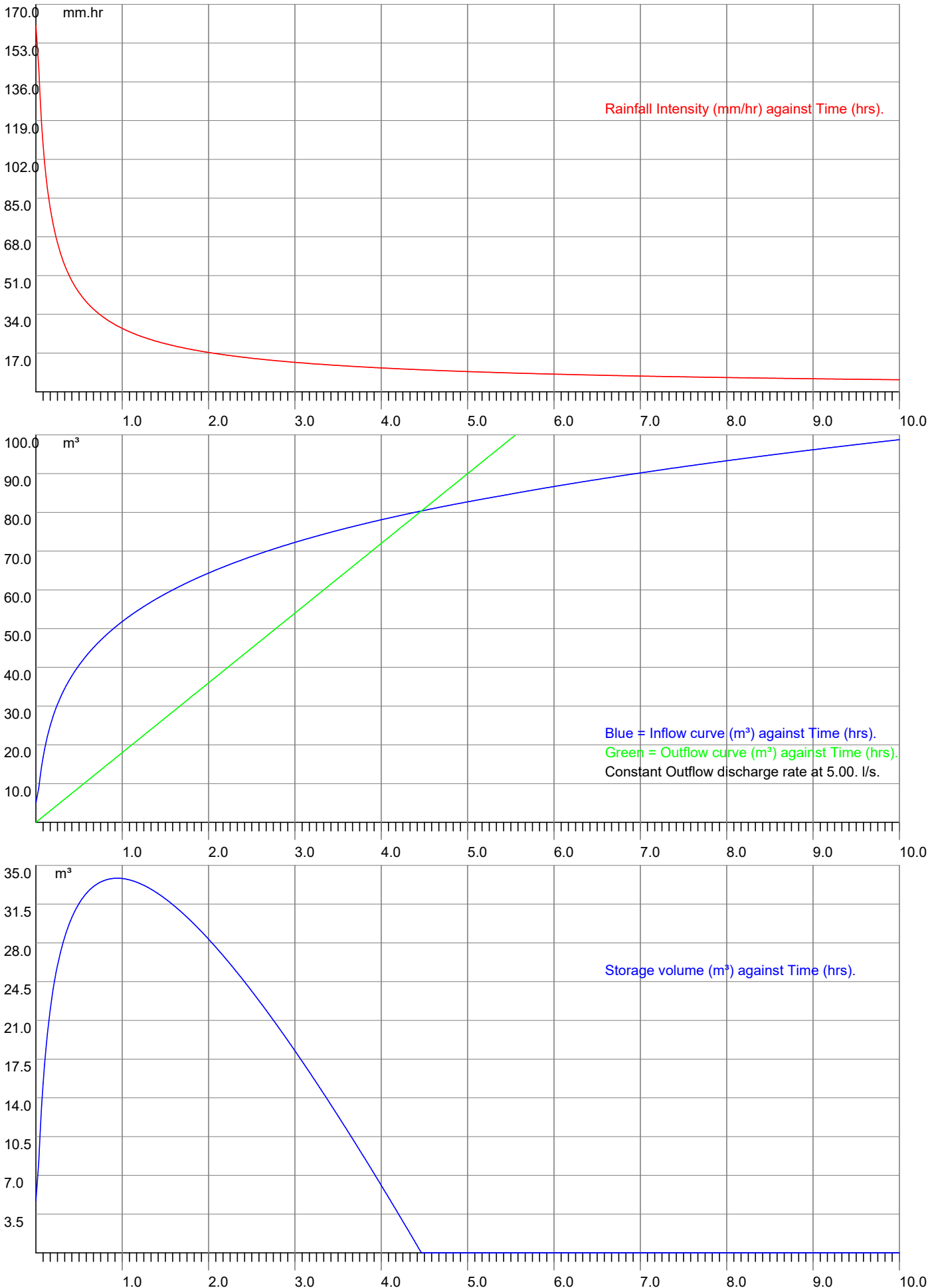
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Project **30 year event**
Title **Storage calcs for Sherbourne Street**





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Project	100yr + 20% event
Title	Storage calcs for Sherbourne Street

Data:-

FSR Hydrology:-

Location = Sherbourne Street

M5-60 (mm) = 18.1

Soil index = 0.45

Return period = 100

UCWI = 100.8

Grid reference = SD8400

r = 0.35

SAAR (mm/yr) = 950

WRAP = 4

Climate change = 20

Clayey, or loamy over clayey soils with an impermeable layer at shallow depth.

Runoff factor (RF) = 81.0, calculated from:-

Runoff factor = $(0.829 \times \text{PIMP}) + (25 \times \text{SOIL}) + (0.078 \times \text{UCWI}) - 20.7$

where

PIMP = Impervious Area * 100 / (Impervious Area + Pervious Area)

UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 2300 m²

Total area (TA) = 2300 m²

Mean disch. rate = 5.000 l/s

Additional flow = 0.00 l/s

Pervious area = 0 m²

Equiv area = 1863 m² (TA x RF).

Areal reduction factor = 1.000

Climate change factor = 20

Calculated data:-

Time to max = 97.0 mins

Rainfall at max = 31.63 mm/hr

Pipeline storage = 0.0 m³

Offline storage = 0.0 m³

Calculated storage volume = 66.2 m³

Allowed discharge rate = 5.000 l/s

Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours

Rainfall rate = 12.00 mm/hr

Calculated storage volume = 25.0 m³

Allowed discharge rate = 5.000 l/s

Rainfall intensities calculated using the Wallingford Procedure

Storage lengths for initial calculation (x 1.1, 1.2, 1.3 or 1.5 as above if required) :-

Diam	Len	Diam	Len	Ovoid	Len	Box culvert	Len
100	8424.8	1125	66.6	400 x 600	367.5	500 x 500	264.6
150	3744.4	1200	58.5	600 x 900	160.0	500 x 750	176.4
225	1664.2	1275	51.8	800 x 1200	90.0	500 x 1000	132.3
300	936.1	1350	46.2			750 x 1000	88.2
375	599.1	1425	41.5			750 x 1200	73.5
450	416.0	1500	37.4			750 x 1500	58.8
525	305.7	1575	34.0			1000 x 1000	66.2
600	234.0	1650	30.9			1000 x 1200	55.1
675	184.9	1725	28.3			1000 x 1500	44.1
750	149.8	1800	26.0			1000 x 1800	36.8
825	123.8	1875	24.0			1000 x 2000	33.1
900	104.0	1950	22.2			1500 x 1500	29.4
975	88.6	2025	20.5			1500 x 1800	24.5
1050	76.4	2100	19.1			1500 x 2000	22.1



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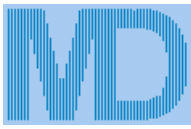
Project **100yr + 20% event**

Title **Storage calcs for Sherbourne Street**

Data:-

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	124.0	38.369	3.000	35.369
20	86.0	53.707	6.000	47.707
30	68.0	63.465	9.000	54.465
40	57.0	70.773	12.000	58.773
50	49.0	76.661	15.000	61.661
60	44.0	81.615	18.000	63.615
70	40.0	85.902	21.000	64.902
80	36.0	89.686	24.000	65.686
90	33.0	93.076	27.000	66.076
100	31.0	96.147	30.000	66.147
110	29.0	98.956	33.000	65.956
120	27.0	101.543	36.000	65.543
130	26.0	103.940	39.000	64.940
140	24.0	106.173	42.000	64.173
150	23.0	108.262	45.000	63.262
160	22.0	110.224	48.000	62.224
170	21.0	112.072	51.000	61.072
180	20.0	113.818	54.000	59.818
190	20.0	115.472	57.000	58.472
200	19.0	117.043	60.000	57.043
210	18.0	118.537	63.000	55.537
220	18.0	119.961	66.000	53.961
230	17.0	121.321	69.000	52.321
240	16.0	122.621	72.000	50.621
250	16.0	123.866	75.000	48.866
260	15.0	125.059	78.000	47.059
270	15.0	126.205	81.000	45.205
280	15.0	127.306	84.000	43.306
290	14.0	128.365	87.000	41.365
300	14.0	129.384	90.000	39.384
310	14.0	130.367	93.000	37.367
320	13.0	131.314	96.000	35.314
330	13.0	132.294	99.000	33.294
340	13.0	133.265	102.000	31.265
350	12.0	134.213	105.000	29.213
360	12.0	135.139	108.000	27.139
370	12.0	136.044	111.000	25.044
380	12.0	136.930	114.000	22.930
390	11.0	137.796	117.000	20.796
400	11.0	138.644	120.000	18.644
410	11.0	139.475	123.000	16.475
420	11.0	140.290	126.000	14.290
430	11.0	141.088	129.000	12.088
440	10.0	141.872	132.000	9.872
450	10.0	142.641	135.000	7.641
460	10.0	143.396	138.000	5.396
470	10.0	144.138	141.000	3.138
480	10.0	144.867	144.000	0.867
490	10.0	145.583	147.000	0.000
500	9.0	146.288	150.000	0.000
510	9.0	146.981	153.000	0.000
520	9.0	147.663	156.000	0.000
530	9.0	148.334	159.000	0.000
540	9.0	148.995	162.000	0.000
550	9.0	149.646	165.000	0.000
560	9.0	150.287	168.000	0.000
570	9.0	150.919	171.000	0.000
580	8.0	151.542	174.000	0.000
590	8.0	152.156	177.000	0.000
600	8.0	152.761	180.000	0.000

Storage volume (m³) = 66.2 m³



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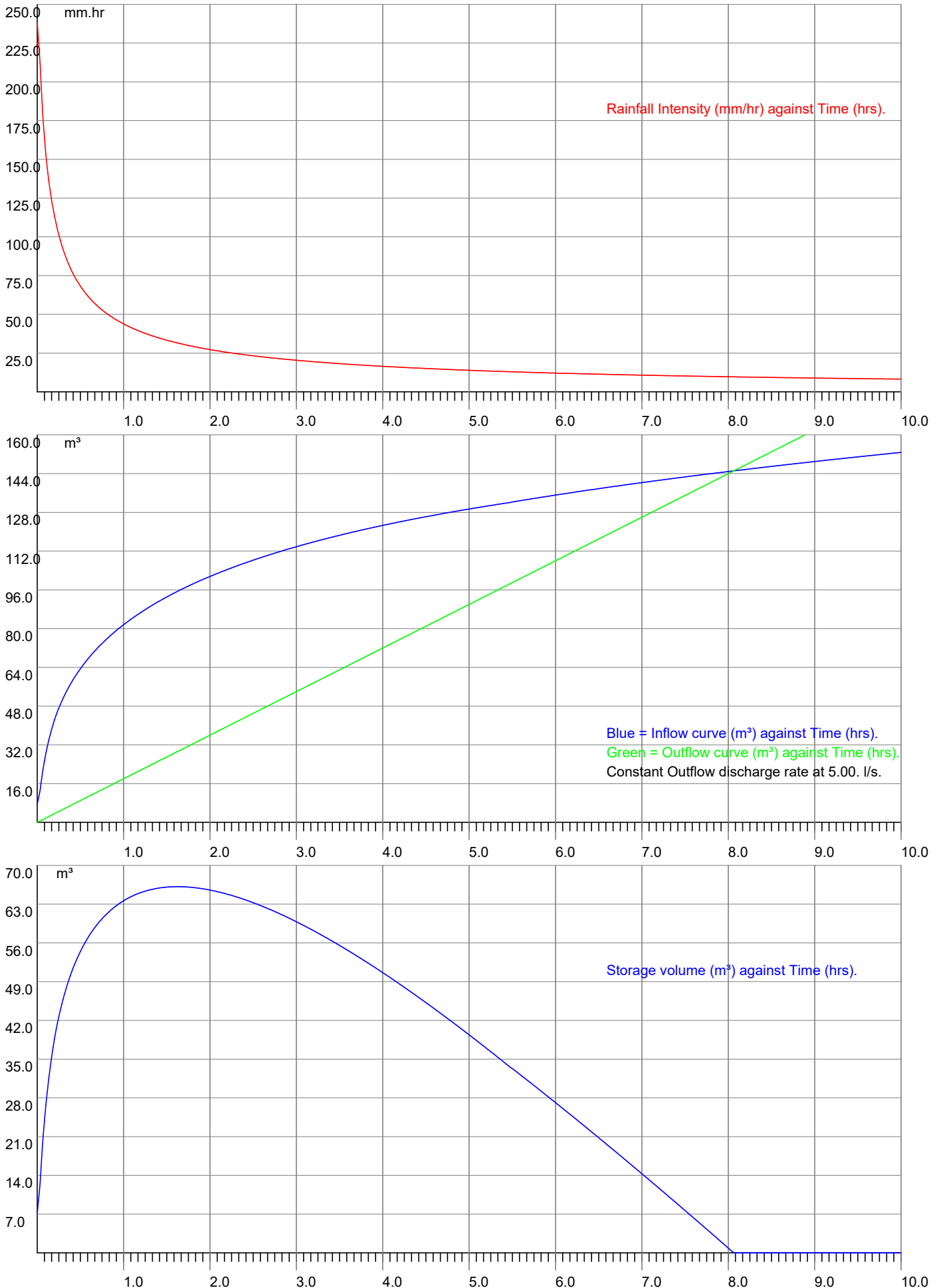
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Project **100yr + 20% event**
Title **Storage calcs for Sherbourne Street**





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Project **100 year +40% event**

Title **Storage calcs for Sherbourne Street**

Data:-

FSR Hydrology:-

Location = Sherbourne Street

M5-60 (mm) = 18.1

Soil index = 0.45

Return period = 100

UCWI = 100.8

Grid reference = SD8400

r = 0.35

SAAR (mm/yr) = 950

WRAP = 4

Climate change = 40

Clayey, or loamy over clayey soils with an impermeable layer at shallow depth.

Runoff factor (RF) = 81.0, calculated from:-

Runoff factor = $(0.829 \times \text{PIMP}) + (25 \times \text{SOIL}) + (0.078 \times \text{UCWI}) - 20.7$

where

PIMP = Impervious Area * 100 / (Impervious Area + Pervious Area)

UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 2300 m²

Total area (TA) = 2300 m²

Mean disch. rate = 5.000 l/s

Additional flow = 0.00 l/s

Pervious area = 0 m²

Equiv area = 1863 m² (TA x RF).

Areal reduction factor = 1.000

Climate change factor = 40

Calculated data:-

Time to max = 116.0 mins

Rainfall at max = 32.56 mm/hr

Pipeline storage = 0.0 m³

Offline storage = 0.0 m³

Calculated storage volume = 82.5 m³

Allowed discharge rate = 5.000 l/s

Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours

Rainfall rate = 14.00 mm/hr

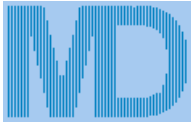
Calculated storage volume = 47.7 m³

Allowed discharge rate = 5.000 l/s

Rainfall intensities calculated using the Wallingford Procedure

Storage lengths for initial calculation (x 1.1, 1.2, 1.3 or 1.5 as above if required) :-

Diam	Len	Diam	Len	Ovoid	Len	Box culvert	Len
100	10504.7	1125	83.0	400 x 600	458.3	500 x 500	330.0
150	4668.8	1200	72.9	600 x 900	199.5	500 x 750	220.0
225	2075.0	1275	64.6	800 x 1200	112.2	500 x 1000	165.0
300	1167.2	1350	57.6			750 x 1000	110.0
375	747.0	1425	51.7			750 x 1200	91.7
450	518.8	1500	46.7			750 x 1500	73.3
525	381.1	1575	42.3			1000 x 1000	82.5
600	291.8	1650	38.6			1000 x 1200	68.7
675	230.6	1725	35.3			1000 x 1500	55.0
750	186.8	1800	32.4			1000 x 1800	45.8
825	154.3	1875	29.9			1000 x 2000	41.2
900	129.7	1950	27.6			1500 x 1500	36.7
975	110.5	2025	25.6			1500 x 1800	30.6
1050	95.3	2100	23.8			1500 x 2000	27.5



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Data:-

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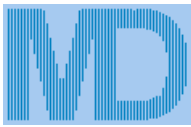
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Project **100 year +40% event**

Title **Storage calcs for Sherbourne Street**

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	144.0	44.764	3.000	41.764
20	101.0	62.658	6.000	56.658
30	79.0	74.043	9.000	65.043
40	66.0	82.568	12.000	70.568
50	58.0	89.438	15.000	74.438
60	51.0	95.218	18.000	77.218
70	46.0	100.219	21.000	79.219
80	42.0	104.633	24.000	80.633
90	39.0	108.588	27.000	81.588
100	36.0	112.172	30.000	82.172
110	34.0	115.449	33.000	82.449
120	32.0	118.467	36.000	82.467
130	30.0	121.264	39.000	82.264
140	28.0	123.869	42.000	81.869
150	27.0	126.306	45.000	81.306
160	26.0	128.594	48.000	80.594
170	25.0	130.751	51.000	79.751
180	24.0	132.788	54.000	78.788
190	23.0	134.718	57.000	77.718
200	22.0	136.550	60.000	76.550
210	21.0	138.293	63.000	75.293
220	20.0	139.955	66.000	73.955
230	20.0	141.541	69.000	72.541
240	19.0	143.058	72.000	71.058
250	19.0	144.510	75.000	69.510
260	18.0	145.902	78.000	67.902
270	18.0	147.239	81.000	66.239
280	17.0	148.523	84.000	64.523
290	17.0	149.759	87.000	62.759
300	16.0	150.948	90.000	60.948
310	16.0	152.094	93.000	59.094
320	15.0	153.200	96.000	57.200
330	15.0	154.342	99.000	55.342
340	15.0	155.476	102.000	53.476
350	14.0	156.582	105.000	51.582
360	14.0	157.662	108.000	49.662
370	14.0	158.718	111.000	47.718
380	14.0	159.751	114.000	45.751
390	13.0	160.762	117.000	43.762
400	13.0	161.752	120.000	41.752
410	13.0	162.721	123.000	39.721
420	13.0	163.671	126.000	37.671
430	12.0	164.603	129.000	35.603
440	12.0	165.517	132.000	33.517
450	12.0	166.415	135.000	31.415
460	12.0	167.296	138.000	29.296
470	12.0	168.161	141.000	27.161
480	11.0	169.011	144.000	25.011
490	11.0	169.847	147.000	22.847
500	11.0	170.669	150.000	20.669
510	11.0	171.478	153.000	18.478
520	11.0	172.273	156.000	16.273
530	11.0	173.056	159.000	14.056
540	10.0	173.827	162.000	11.827
550	10.0	174.587	165.000	9.587
560	10.0	175.335	168.000	7.335
570	10.0	176.072	171.000	5.072
580	10.0	176.799	174.000	2.799
590	10.0	177.515	177.000	0.515
600	10.0	178.222	180.000	0.000

Storage volume (m³) = 82.5 m³



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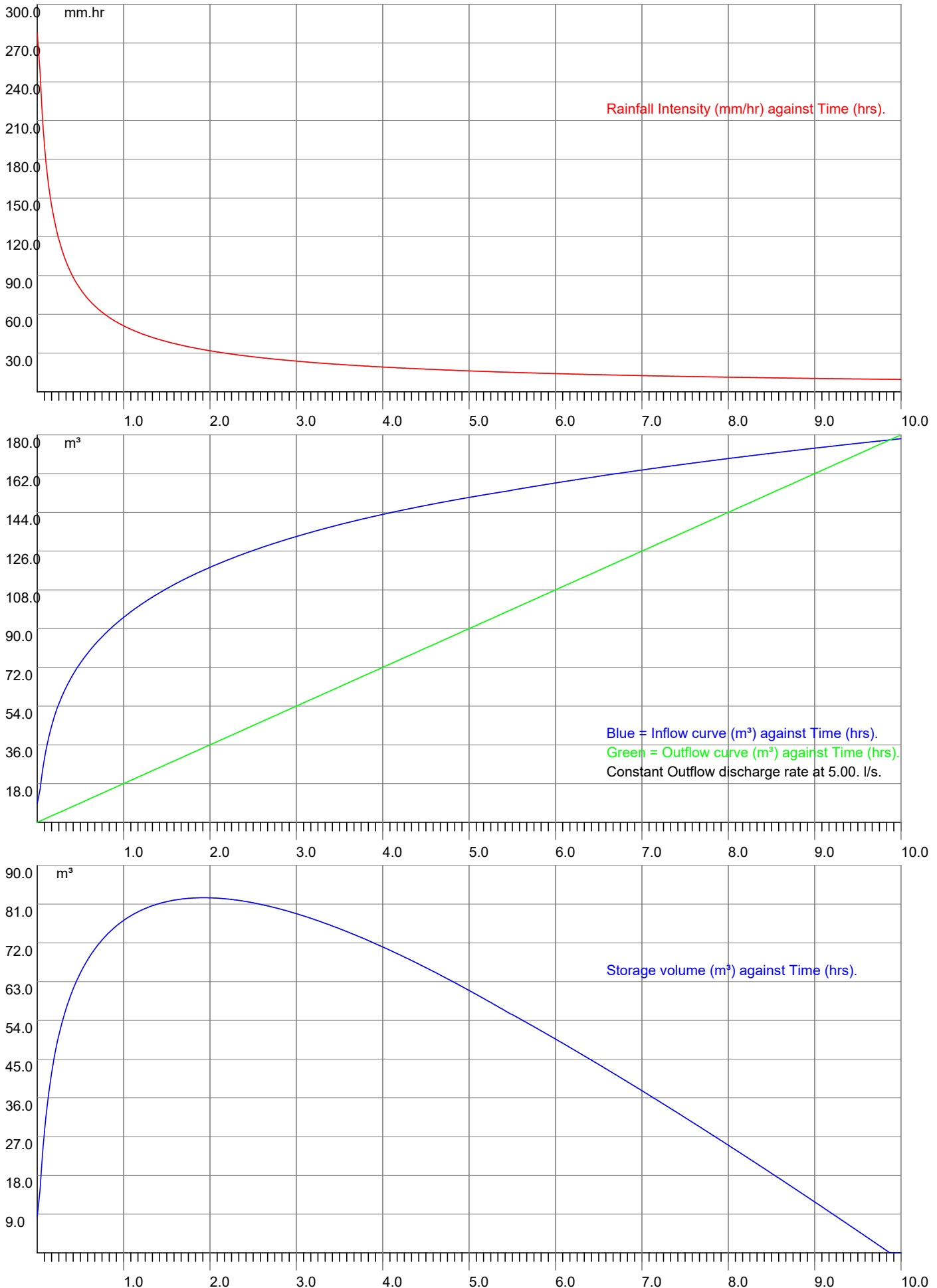
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Project **100 year +40% event**
Title **Storage calcs for Sherbourne Street**





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Project **100 year +40% event**

Title **Storage calcs for Sherbourne Street**

Explanatory notes for Peak Flow Storage

- 1) This system uses the rainfall intensity/ duration curve calculated using either the Wallingford or FEH method as selected.
- 2) The balance is calculated from the inflow minus the outflow.
- 3) The storage volume is the maximum value of the balance curve.
- 4) This method was described by Davis (1963) - see Butler & Davies, 2nd edition, p294
- 5) References to 'storm duration' relate only to the hydrograph method (qv).
- 6) There are always 600 steps in the calculation process, thus a 'run' time of 10 hours will be sampled every minute,

Explanatory notes for Hydrograph Storage

- 1) The user has the choice of Summer or Winter curves
- 2) The mean intensity varies with the duration of the storm curve
- 3) There are always 120 steps in the calculation process, irrespective of storm duration.
- 4) The balance is calculated from the inflow minus the outflow.
- 5) The storage volume is the sum of the balance values for each step.
- 6) Varying durations should be tried to find the maximum storage value - this can be narrowed down very closely.

*Modelling using the flow characteristics of the restrictor is available using Vortex Control modelling function. Please be aware that this function needs the full design data file to function.

Why do the two methods give different results?

The rainfall characteristics for each method are very different.

The Peak flow (using the Intensity/Duration/Frequency curve) does not model the actual rainfall. This curve is joined points which represent the mean intensity of a storm at a given duration i.e. a value of 19.5 mm/hr for a 60 minute storm indicates that over the sixty minute period, the mean intensity was 19.5 mm/hr. The calculation method samples the IDF curve for a given location and frequency (Return Period) and calculates the storage for that rate and duration less the outflow volume. The maximum value is displayed as the 'worst case' storage. The outflow volume is constant throughout the process at the specified discharge rate.

The hydrograph method uses a standard curve for either Winter or Summer storms. Traditionally these are symmetrical about the central peak. UK rainfall does not fit into this convenient curve, so the calculations are dealing with a stylised set of data. The mean intensity for the storm is calculated from the IDF curve and applied to the curve data, calculating the storage for that step less the outflow volume. The final storage volume is the sum of the storage for all the steps. The outflow volume varies with the hydraulic head on the control device using flow equations provided by the control manufacturer. This is a far more accurate method than the peak flow method and often results in bigger storage volumes.

It can be seen that these two methods are very different, and the user may have the choice of which result to use. This is not an exact science, though is often treated as such by those that do not understand the principles of the calculations.

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