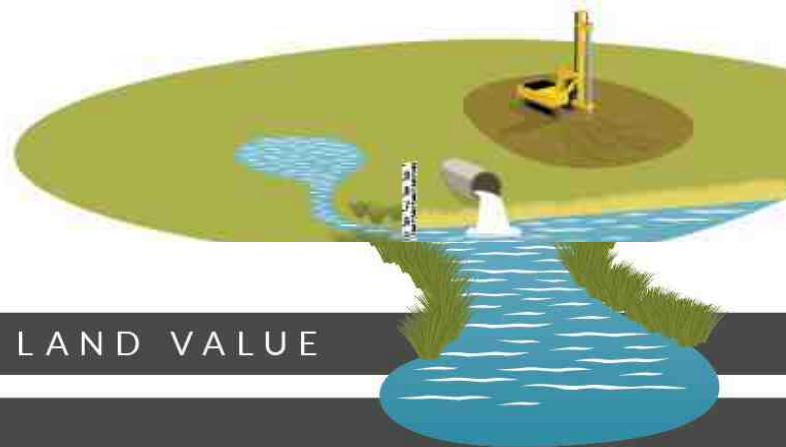


BRADSTONE ROAD, CHEETHAM HILL

SUSTAINABLE DRAINAGE STRATEGY

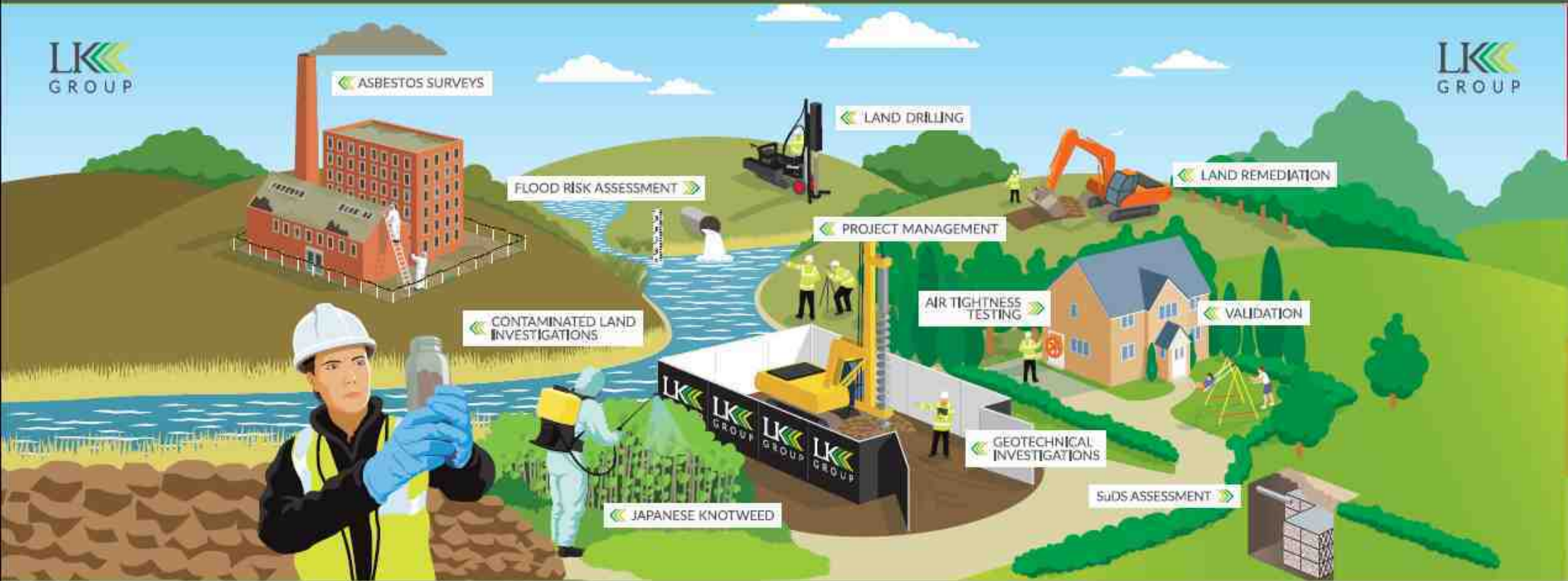
Job Number: FRA 21 1144
Date: December 2021
Client: NN Holding Ltd

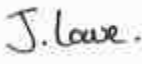


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LK Consult			
Document Verification			
Site Address	Land off Bradstone Road, Cheetham Hill, Manchester		
Report Title	Sustainable Drainage Strategy		
Job Number	FRA 21 1144	Document Ref.	FRA 21 1144- R0
Date Issued	December 2021	Report Version	R0
Prepared By	Jenna Lowe – Graduate Flood Risk Assessor	Signature	
Reviewed By	Mark Jones - Associate	Signature	

Revision Record			
Revision No.	Date	Nature of Revision	Approved By

DISCLAIMER

This report has been prepared by LK Consult (LKC) who have exercised such professional skill, care and diligence as may reasonably be expected of a properly qualified and competent consultant, experienced in preparing reports of a similar scope.

However, to the extent that the report is based or relies upon information contained in records, reports or other materials provided to LKC, which have not been independently produced or verified, LKC gives no warranty, representation or assurance as to the accuracy or completeness of such information.

This report is prepared solely for the benefit of NN Holdings Ltd. It may not be relied upon by or submitted to a third party for their reliance for the purposes of valuation, mortgage, insurance and regulatory approval, until all invoices have been settled in full.

Those using this information in subsequent assessments or evaluations do so at their own risk.

EXECUTIVE SUMMARY

Scope and Background

This Sustainable Drainage (SuDS) Strategy has been undertaken by LK Consult Ltd (LKC) to support a future planning application for the development of land at Bradstone Road, Cheetham Hill, Manchester. The development comprises three warehouses with ancillary storage and HGV parking.

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

Consultations

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.

Mitigation

Design

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 an access road (Bradstone Road), commercial properties to the south and west, and a Car Breakers Yard to the north and east.

There will be an 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 the southern site boundary.

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

The outline drainage strategy considers the use of attenuation-based SuDS to be feasible with a discharge to the combined public sewer adjacent to the southwestern boundary of the site. Therefore, the most effective strategy, in line with the SuDS management train, would be to have a detention system at the western boundary towards the southwest corner. The required tank or similar has been estimated to be **101.4 m³** for the 1 in 30-year greenfield flow restriction.

Similarly, the estimated volume to be retained on site for the 1 in 100-year storm event including the allowance for climate change is between **189.6 m³** and **232.9 m³**.

The estimated volume can be stored within the site boundary.

Contents

EXECUTIVE SUMMARY **iv**

1	Introduction	1
1.1	Background	1
1.2	Site Details	2
2	Site Setting	3
2.1	Vulnerability	3
2.2	Environmental Setting	3
2.3	Site Reconnaissance	4
2.4	Site and Access Levels	4
3	Consultation	5
4	Sustainable Drainage Strategy	6
4.1	Introduction	6
4.2	Infiltration	6
4.3	Watercourses	7
4.4	Public Sewer	7
4.5	Other Sewers	7
4.6	Surface Water Drainage Strategy	7
4.7	Surface Water Attenuation Requirements	9
4.8	Foul Drainage	10
5	Conclusion	11

Appendices

Appendix A:	Figures, Plans and Drawings
Appendix B:	Site Information
Appendix C:	Environment Agency Data
Appendix D:	Consultee Correspondence
Appendix E:	Calculations

1 Introduction

1.1 Background

LK Consult Ltd (LKC) were commissioned by NN Holdings Ltd to carry out a Sustainable Drainage Strategy for land off Bradstone Road, Cheetham Hill. The report was undertaken in support of a future planning application to redevelop the site for commercial use.

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 April 2014

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. Figures 1 and 2 indicate the site location and boundary. Figure 3 indicates the proposed development.

Site Details	
Location	End of Bradstone Road, off Broughton Street, Cheetham Hill, M8 8WA. Centred at approximate National Grid Reference 384130E, 400130N.
Area	Approximately 0.49Ha.
Topography	55 metres above ordnance datum (AOD) in the north of the site and 54mAOD in the southwest of the site. The site is sloping to the south.
Current Land Use	<u>Site</u> The site consists of a derelict and severely fire-damaged property to the east, a paved access road and car parking to the west and part of an overgrown former breakers yard to the north. The site is bounded by metal fencing. <u>Surrounding Area/ Boundary Treatment</u> North: Trees, Rough Grasslands and Car Breakers Yard. East: Rough Grasslands and Car Breakers Yard. South: Warehouse Units, Metal Fencing and Car Parking. West: Commercial Properties.
Proposed Development	Demolishment of the current vacant property and the construction of three warehouses with ancillary storage and HGV parking. Access will be from Bradstone Road.

Table 1-1: Summary of site details.

2 Site Setting

2.1 Vulnerability

As an initial phase in identifying which Sustainable Drainage System is appropriate for the site, LKC has consulted the Environment Agency's (EA) website Flood Zone Mapping.

The Flood Zone Mapping indicates the site as being within Flood Zone 1 in the PPG (paragraph 065, Table 1).

The proposed development is for a commercial/non-residential end use, and this is classified within the 'Less Vulnerable' category in the PPG (paragraph 066, Table 2).

2.2 Environmental Setting

LKC have previously undertaken a Preliminary Risk Assessment for the site³ (CL-602-LKC 21 1508-01, November 2021) and pertinent environmental information for the site 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 north: Made ground to 2.00m, brown/grey sandy clay to 3.60m, hard red/brown boulder clay to 18.30m, compact brown silty sand to 20.60m. 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. BH Ref: SJ89NW3457, 250m east: Ash, brick pieces and stones to 0.85m and stiff brown silty and sandy clay with soft and very stiff zones, grey fissures, stone, and coal inclusions to 8.25m.
	Defra Soilscape Mapping	The type of soil has been identified as slowly permeable seasonally wet acid loamy and clayey.
Hydrogeology	Superficial	Secondary (Undifferentiated) Aquifer.
	Bedrock	Principal Aquifer. Not within a Source Protection Zone.
Hydrology	All adjacent and internal surface water	There are no open or adjacent watercourses in close proximity to the site.
Site History		Between 1892 and 1953 the historical mapping showed that the site incorporated a clay pit and Brickworks by 1994 these were derelict.

Table 2-1: Summary of the Environmental Setting.

³ Phase 1 Preliminary Risk Assessment (PRA) report by LK Consult (Ref: CL-602-LKC 21 1508-01, dated November 2021)

2.3 Site Reconnaissance

A site reconnaissance was undertaken on 9th November 2021 and photographs are provided in Appendix B.

Relevant features identified on site are summarised below:

- » Hardstood ground covers the majority of the site to the north and west and the site is encased by metal fencing with barbed wire.
- » Parts of the site are surfaced but are in poor condition.
- » The site slopes towards the southwest and the access road.
- » The site is currently disused and overgrown with vegetation and established trees.
- » A two-storey building was observed to the east of the site which has significant fire damage and was in a state of disrepair.
- » Metal storage containers were observed to the southeast of the site boundary encased by metal fencing with barbed wire.
- » Large quantities of fly tipping are present across the whole site.
- » Access to the site is via Bradstone Road to the southwest of the site.
- » An existing gulley drain was observed on the site towards the southwestern site boundary.

2.4 Site and Access Levels

A topographic survey of the site has been undertaken to OS GPS datum, and information is included on the drawings in Appendix A. The site has an elevation ranging from 55m AOD to 54m AOD respectively. The final site levels and ground floor levels of the warehouses have not yet been determined. The proposed access would join Bradstone Road at around 54m AOD.

3 Consultation

Information from consultees (Environment Agency (EA), Manchester City Council and United Utilities) is summarised in Table 3-1 below.

Relevant correspondence / information is provided in Appendices C (EA) and D (others).

Source	Details	
Environment Agency	Flood Zone 1: very low risk, with annual probability of flooding from rivers and the sea of less than 0.1% (1 in 1000).	
	Modelled levels for River Irk Nearest Node: ea013_Model_Irk_00013	Level of 33.85m for a 1% annual probability event. Level of 35.79m for a 0.1% annual probability event. Level of 33.50m for a 4% (1 in 25 years) annual probability event. Level of 34.11m for a 1% annual probability event + 20% increase in flow.
Manchester City Council (LLFA)	The site is within a critical drainage area and will require a 50% reduction in runoff No further information provided at the date of writing.	
United Utilities (UU)	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 with flows restricted to greenfield runoff rates equivalent to 'Qbar' (Mean annual flow rate). UU would also request for a condition to prevent development within 3m either side of the sewer running adjacent to the site. UU stated that there are unlikely to be any issues discharging surface water into the surface water sewer at a rate of 5l/s based on the greenfield runoff rate. UU state that current modelling data suggests that the receiving sewer begins to show low level flooding on a 1 in 50 rainfall event. Therefore, ground levels across the site should be set at a minimum of 51.7m AOD and finished floor levels are set to a minimum 51.850m AOD.
	sewer map	There is a 375mm diameter combined public sewer running parallel to the site's southwestern boundary on Bradstone Road which is accessible via a manhole. The public combined sewer is running in a western direction.

Table 3-1: Summary 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 H3⁴ 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 2010⁵.

4.2 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 - Devensian Superficial Deposits.	Diamicton - Silty, sandy gravelly clay with sand lenses.	Secondary (Undifferentiated).	N/A.	Poor.
Chester Formation Bedrock.	Sandstone.	Principal.	N/A.	Good.

Table 4-1: Geological and Hydrogeological Setting.

⁴ Building Regulations part H3 2010: Approved Document, Drainage and Waste Disposal.

⁵ Flood and Water Management Act 2010: UK Government.

Infiltration methods such as soakaways are unlikely to be feasible, 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 surface water in the vicinity of the site would drain towards the south.

4.3 Watercourses

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

4.4 Public Sewer

There is a combined public sewer running adjacent to the west of the site in Bradstone Road.

4.5 Other Sewers

There is an existing surface water collection system serving the surrounding developments and the site.

4.6 Surface Water Drainage Strategy

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	Comments
a	Soakaway/Infiltration	2	Borehole records suggest that made ground is present to a depth of 2.00m and brown/grey sandy Clay is present to a depth of 3.60m indicating low permeability
b	Connection to Watercourse	N/A	There are no watercourses within or adjacent to the site.
c	Discharge into a sewer	1	The depth of the combined sewer to the western site boundary and levels at the southwestern corner indicate that a connection is possible – subject to approval from Manchester City Council (LLFA) and 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)⁶ 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. A filter strip offers no storage and is used solely to remove pollutants from surface water.
Filter drains	*	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. Rainwater harvesting systems are currently not included in the development proposals.
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, to minimise the risk of flooding to and from the proposed development. 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 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

⁶ CIRIA C697 - The SUDS Manual. London 2015

4.7 Surface Water Attenuation Requirements

From correspondence with United Utilities the flow should be limited to a 'greenfield scenario' 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 Areas	Plot Area
Total area (ha)	0.49
Impermeable Area (ha)	0.49
Permeable Area (ha)	0.00
Proposed Catchment	
Developable Area (ha)	0.49
Impermeable split (ha)	0.49
Permeable split (ha)	0.00

Table 4-4: Assumed plot areas.

Table 4-4 shows the assumed split in area 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 existing flow off site to a level which is acceptable to the LLFA and to UU.

4.7.1 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.

This gives the following runoff rates and attenuation requirements for this section based on the Wallingford method:

» Q_{bar} existing:	44.2 l/s
» 1 in 1-year existing runoff rate:	69.2 l/s
» 1 in 30-year existing runoff rate:	111.2 l/s
» 1 in 100-year existing runoff rate:	140.6 l/s

For a 50% reduction in flows off the site this would give the following runoff rates:

» Q_{bar} :	22.1 l/s
» 1 in 1-year runoff rate:	34.6 l/s
» 1 in 30-year runoff rate:	55.6 l/s
» 1 in 100-year runoff rate:	70.3 l/s

As there is limited capacity in the local drainage network United Utilities has specified an allowable discharge rate of up to 5l/s to their adjacent public combined drain.

All runoff estimates, and subsequent storage estimates are included in Appendix E.

The following attenuation has been estimated for the development using the 5l/s runoff rate and utilises the FSR methodology⁷ as:

⁷ Flood Studies Report Wallingford NERC 1975.

- Attenuation storage volume: **101.4 m³** (1 in 30-year event)
- Retention on site volume: **189.6 m³** (1 in 100 year + 20% Climate Change)
- Retention on site volume: **232.9 m³** (1 in 100 year + 40% Climate Change)

Attenuation storage aims to limit the peak rate of runoff from the development to the corresponding greenfield runoff for a range of annual flow rate probabilities before discharging to a watercourse. As the flow from the development would be restricted to the greenfield equivalent there should be little change in the flows that enter the unnamed watercourse 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 **101.4 m³** and for the 1 in 100-year event, a storage capacity of between **189.6 m³** and **232.9 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 on Bradstone Road.

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 area.

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.

4.8 Foul Drainage

An unrestricted foul drainage connection to the combined drain in Bradstone Road would be acceptable to United Utilities.

5 Conclusion

The site is currently derelict and contains a disused with a two-storey collapsing and severely fire-damaged building to the southeast and hardstanding and some scrub vegetation around the edges of the area. The proposal is to demolish the two-storey building and to construct three warehouses with ancillary storage and HGV parking.

There is a suspected existing connection of the site to the public combined sewer in Bradstone Road due to the presence of gullies and downpipes within the site.

A pre-development advice received from United Utilities considered a flow rate of 5l/s would be acceptable if infiltration proved to be impractical. The pre-development advice also stated that current sewer modelling data suggests that the receiving sewer begins to show low level flooding on a 1 in 50 rainfall event. Therefore, ground levels across the site must be set at a minimum of 51.70m AOD and finished floor levels must be set to a minimum 51.85m AOD. The lowest site level is of the order of 54mAOD, therefore should not be affected by this source of flooding.

A combination of the constraints on the site and the ground conditions indicate that infiltration may not be practical. Nearby boreholes indicate that made ground is present up to 2.00m and brown and grey sandy clay is below which suggests low permeability of the ground. The site is also considered to be too constrained due to the proximity of the adjacent road and properties for the use of soakaways.

All proposed outflow connections from the development should be agreed with the Local Planning Authority and United Utilities.

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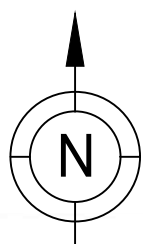
APPENDIX A

FIGURES, PLANS AND DRAWINGS

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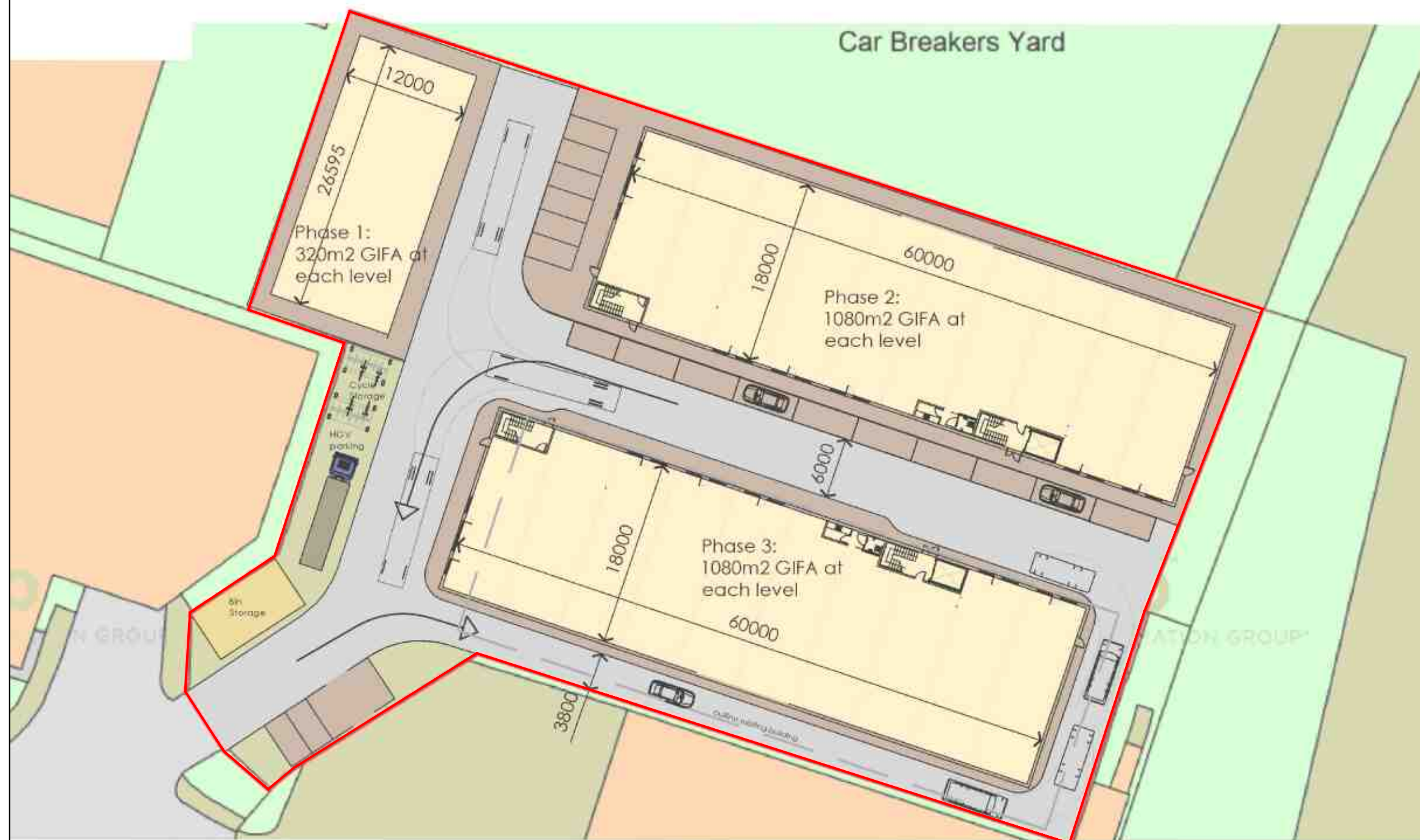


Client: Me And My Property				Title: Site Location & Boundary Plan			
Site: Bradstone Road, Manchester				Scale (see scale bar): 1:25,000 & 1:1,000 @ A4			
Job No.: LKC 21 1508	Drawn By: MP	Checked By: CB	Drawn: November 2021	Figure: 1	Revision:		



KEY

 Site Boundary

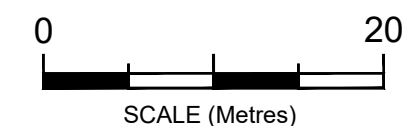


Sampling Locations and features annotated by LK Consult Ltd are approximate and are based upon observed measurements unless otherwise stated. Do not scale from this drawing and work from marked dimensions only. All dimensions and features should be confirmed on site by the Contractor. Where this drawing includes information provided to LK Consult Ltd by others, LK Consult Ltd gives no warranty, representation or assurance as to the accuracy of such information.



Client: Me And My Property			
Site: Bradstone Road, Manchester			
Title: Proposed Development Plan			
Job No.: LKC 21 1508	Scale (See Scale Bar): See Scale Bar	Figure: 2	Revision:
Drawn By: AC	Checked By: MP	Drawn: Nov 2021	

Extract from: FOB Design
Drawing Ref: Feasibility Study Plan, No.SK 01, Rev:D (July 2021)



APPENDIX B

SITE INFORMATION

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Geology 1:50,000 Maps Legends

Artificial Ground and Landslip

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	WMGR	Infilled Ground	Artificial Deposit	Not Supplied - Holocene
	MGR	Made Ground (Undivided)	Artificial Deposit	Not Supplied - Holocene
	WGR	Worked Ground (Undivided)	Void	Not Supplied - Holocene
	SLIP	Landslide Deposit	Unknown/Unclassified Entry	Not Supplied - Quaternary

Superficial Geology

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	ALV	Alluvium	Clay, Silt, Sand and Gravel	Not Supplied - Holocene
	TILLD	Till, Devensian	Diamicton	Not Supplied - Devensian
	GFSDD	Glaciofluvial Sheet Deposits, Devensian	Sand and Gravel	Not Supplied - Devensian
	GFDUD	Glaciofluvial Deposits, Devensian	Sand and Gravel	Not Supplied - Devensian
	HMGDD	Hummocky (Moundy) Glacial Deposits, Devensian	Sand and Gravel	Not Supplied - Devensian
	RTD1	River Terrace Deposits, 1	Sand and Gravel	Not Supplied - Quaternary
	PEAT	Peat	Peat	Not Supplied - Quaternary

Bedrock and Faults

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	CHES	Chester Formation	Sandstone	Not Supplied - Olenekian
	MM	Manchester Marls Formation	Mudstone	Not Supplied - GUADALUPIAN
	CS	Collyhurst Sandstone Formation	Sandstone	Not Supplied - Cisuralian
	HA	Halesowen Formation	Mudstone, Siltstone and Sandstone	Not Supplied - Westphalian
	HTS	Holt Town Sandstone Bed	Sandstone	Not Supplied - Westphalian
	GML	Great Mine Limestone	Limestone	Not Supplied - Westphalian

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	WDR	Worsley Delf Rock	Sandstone	Not Supplied - Westphalian
	PUCM	Pennine Upper Coal Measures Formation	Mudstone, Siltstone and Sandstone	Not Supplied - Westphalian
	NHSS	Newton Heath Sandstone	Sandstone	Not Supplied - Westphalian
	PMCM	Pennine Middle Coal Measures Formation	Mudstone, Siltstone and Sandstone	Not Supplied - Westphalian
	ETM	Etruria Formation	Sandstone and Mudstone	Not Supplied - Westphalian
		Faults		
		Rock Segments		



Geology 1:50,000 Maps

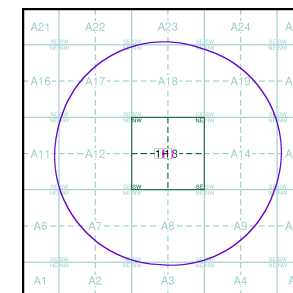
This report contains geological map extracts taken from the BGS Digital Geological map of Great Britain at 1:50,000 scale and is designed for users carrying out preliminary site assessments who require geological maps for the area around the site. This mapping may be more up to date than previously published paper maps.

The various geological layers - artificial and landslip deposits, superficial geology and solid (bedrock) geology are displayed in separate maps, but superimposed on the final 'Combined Surface Geology' map. All map legends feature on this page. Not all layers have complete nationwide coverage, so availability of data for relevant map sheets is indicated below.

Geology 1:50,000 Maps Coverage

Map ID: 1
Map Sheet No: 085
Map Name: Manchester
Map Date: 2010
Bedrock Geology: Available
Superficial Geology: Not Available
Artificial Geology: Not Available
Faults: Not Supplied
Landslip: Not Available
Rock Segments: Not Supplied

Geology 1:50,000 Maps - Slice A



Order Details:

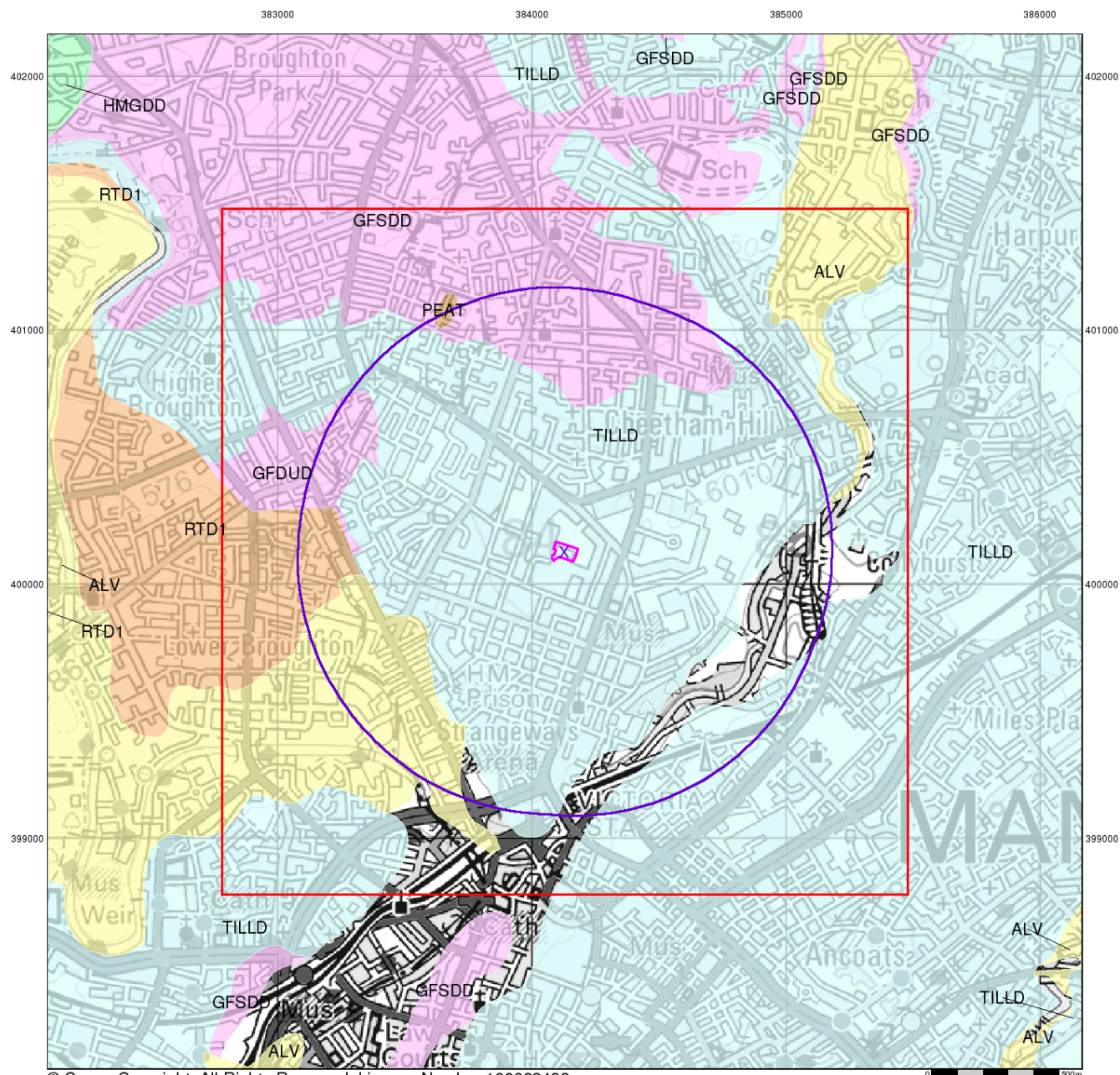
Order Number: 287168804_1_1
Customer Reference: LKC 21 1508
National Grid Reference: 384130, 400130
Slice: A
Site Area (Ha): 0.51
Search Buffer (m): 1000

Site Details:

Bradstone Road, Manchester, M8 8WA

Landmark
INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.ernirocheck.co.uk



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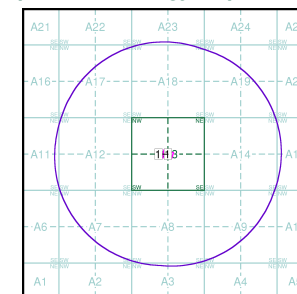
Superficial Geology

Superficial Deposits are the youngest geological deposits formed during the most recent period of geological time, the Quaternary, which extends back about 1.8 million years from the present.

They rest on older deposits or rocks referred to as Bedrock. This dataset contains Superficial deposits that are of natural origin and 'in place'. Other superficial strata may be held in the Mass Movement dataset where they have been moved, or in the Artificial Ground dataset where they are of man-made origin.

Most of these Superficial deposits are unconsolidated sediments such as gravel, sand, silt and clay, and onshore they form relatively thin, often discontinuous patches or larger spreads.

Superficial Geology Map - Slice A



Order Details:

Order Number: 287168804_1_1
 Customer Reference: LKC 21 1508
 National Grid Reference: 384130, 400130
 Slice: A
 Site Area (Ha): 0.51
 Search Buffer (m): 1000

Site Details:

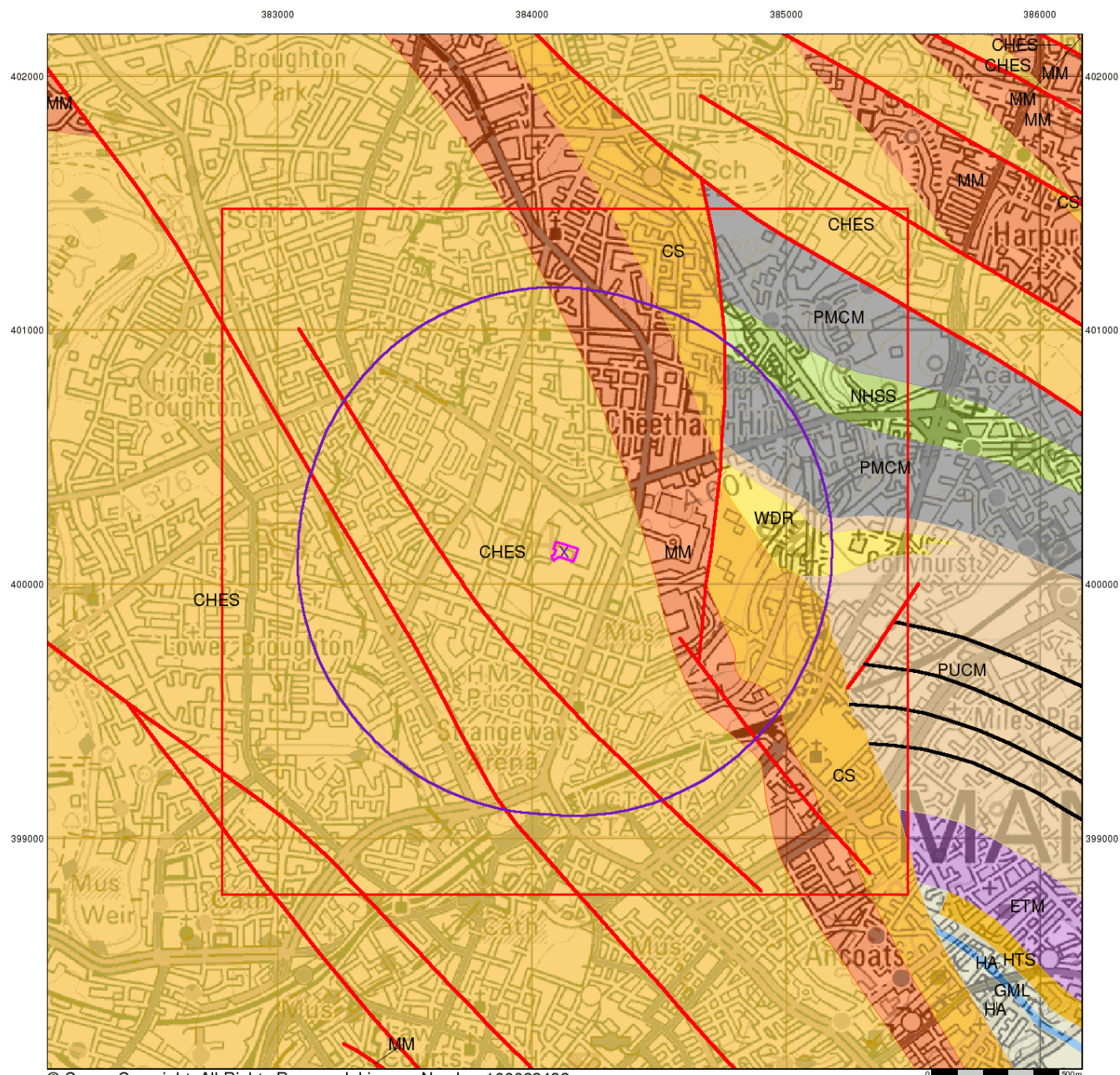
Bradstone Road, Manchester, M8 8WA



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v15.0 02-Nov-2021

Page 3 of 5



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Bedrock and Faults

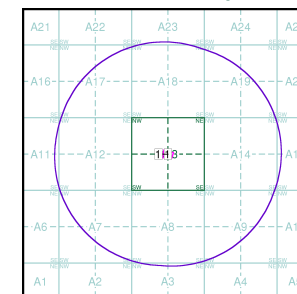
Bedrock geology is a term used for the main mass of rocks forming the Earth and are present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water.

The bedrock has formed over vast lengths of geological time ranging from ancient and highly altered rocks of the Proterozoic, some 2500 million years ago, or older, up to the relatively young Pliocene, 1.8 million years ago.

The bedrock geology includes many lithologies, often classified into three types based on origin: igneous, metamorphic and sedimentary.

The BGS Faults and Rock Segments dataset includes geological faults (e.g. normal, thrust), and thin beds mapped as lines (e.g. coal seam, gypsum bed). Some of these are linked to other particular 1:50,000 Geology datasets, for example, coal seams are part of the bedrock sequence, most faults and mineral veins primarily affect the bedrock but cut across the strata and post date its deposition.

Bedrock and Faults Map - Slice A



Order Details:

Order Number: 287168804_1_1
 Customer Reference: LKC 21 1508
 National Grid Reference: 384130, 400130
 Slice: A
 Site Area (Ha): 0.51
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Bradstone Road, Manchester, M8 8WA



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 Fax: 0844 844 9951
 Web: www.envirocheck.co.uk

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	-

MANCHESTER CITY COUNCIL
CITY ENGINEER AND SURVEYORS DEPARTMENT

5589NW 3458
8428 9994

SITE INVESTIGATION FOR Main Drainage		DATE COMMENCED 2.3.83
LOCATION Cheetham Hill Road	REF. 83/2	BORING METHOD Cable Percussive
BOREHOLE N° 10		BORING DIAMETER 150mm
GRID REFERENCE SJ 99946 84367		SCALE:

DATE	CASING DEPTH (m)	WATER LEVEL MORNING & EVENING	DEPTH OF STRATA BELOW GL	REDUCED LEVEL	DESCRIPTION	N° AND TYPE OF SAMPLE	SAMPLE DEPTH / PENETRATION FROM TO	N° 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		
			3.90		Very stiff brown silty and sandy CLAY with grey fissures and stone inclusions.	D2 U1 D3 U2	1.0 1.5 2.5 3.0	1.95 3.45	
2.3.82	6.00	Dry	8.25		Firm to stiff brown silty and sandy CLAY with stone and coal inclusions.	D4 U3 D5 U4 D6 U5 D7	4.0 4.5 5.50 6.0 7.0 7.5 8.25	4.95 6.45 7.95	

WATER OBSERVATIONS DURING BORING				WATER LEVEL IN CASED / UNCASD BOREHOLE ON COMPLETION		
DEPTH OF WATER ENTRY (m)	ESTIMATED SEE PAGE	STANDING LEVEL (m)	DEPTH OF CASING WHEN SEALED (m)	DATE	WATER LEVEL	DEPTH OF CASING
None						

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

NOTE: WHERE FULL 0.3 PENETRATION HAS NOT BEEN ACHIEVED, THE NUMBER OF BLOWS FOR THE QUOTED PENETRATION IS GIVEN (NOT N-VALUE)

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

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

5589 ~ 3457
8425 9988

REMARKS	Trial hole excavated to 1.0m below ground level.
	Borehole backfilled on completion, no final overnight water level obtained.



Photograph 1:
View of the site
access via
Broughton Street.



Photograph 2:
View of the site
from the south
showing fly tipping,
fire damage and
vegetated land
towards the
northern boundary.



Photograph 3:
View of fly tipping
and brick structure
towards the
western boundary.



Photograph 4:
View of the site
from the northern
boundary showing
the fire damaged
building and slight
slope towards the
southern boundary.



Photograph 5:
View of the
extensive fire
damage to the
current building,
pooling surface
water and rubble.



Photograph 6:
View of the site
towards the
northern boundary
showing
revegetated
ground, bushes,
and trees.

APPENDIX C

ENVIRONMENT AGENCY DATA

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Flood map for planning

Your reference
Bradstone

Location (easting/northing)
384208/400075

Created
8 Dec 2021 9:30

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

This means:

- you don't need to do a flood risk assessment if your development is smaller than 1 hectare and not affected by other sources of flooding
- you may need to do a flood risk assessment if your development is larger than 1 hectare or affected by other sources of flooding or in an area with critical drainage problems

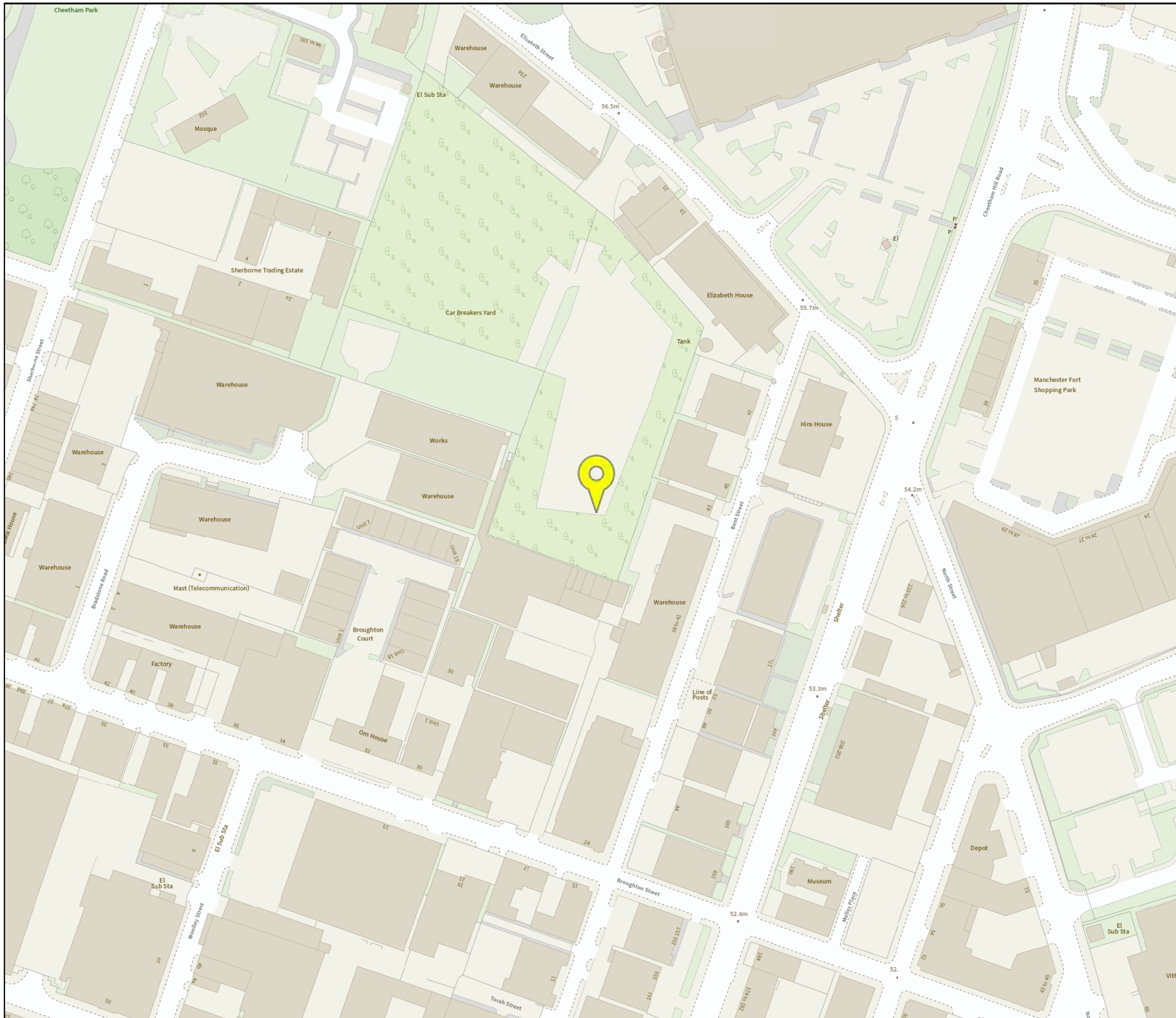
Notes

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

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

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

Use of the address and mapping data is subject to Ordnance Survey public viewing terms under Crown copyright and database rights 2021 OS 100024198. <https://flood-map-for-planning.service.gov.uk/os-terms>



Flood map for planning

Your reference
Bradstone

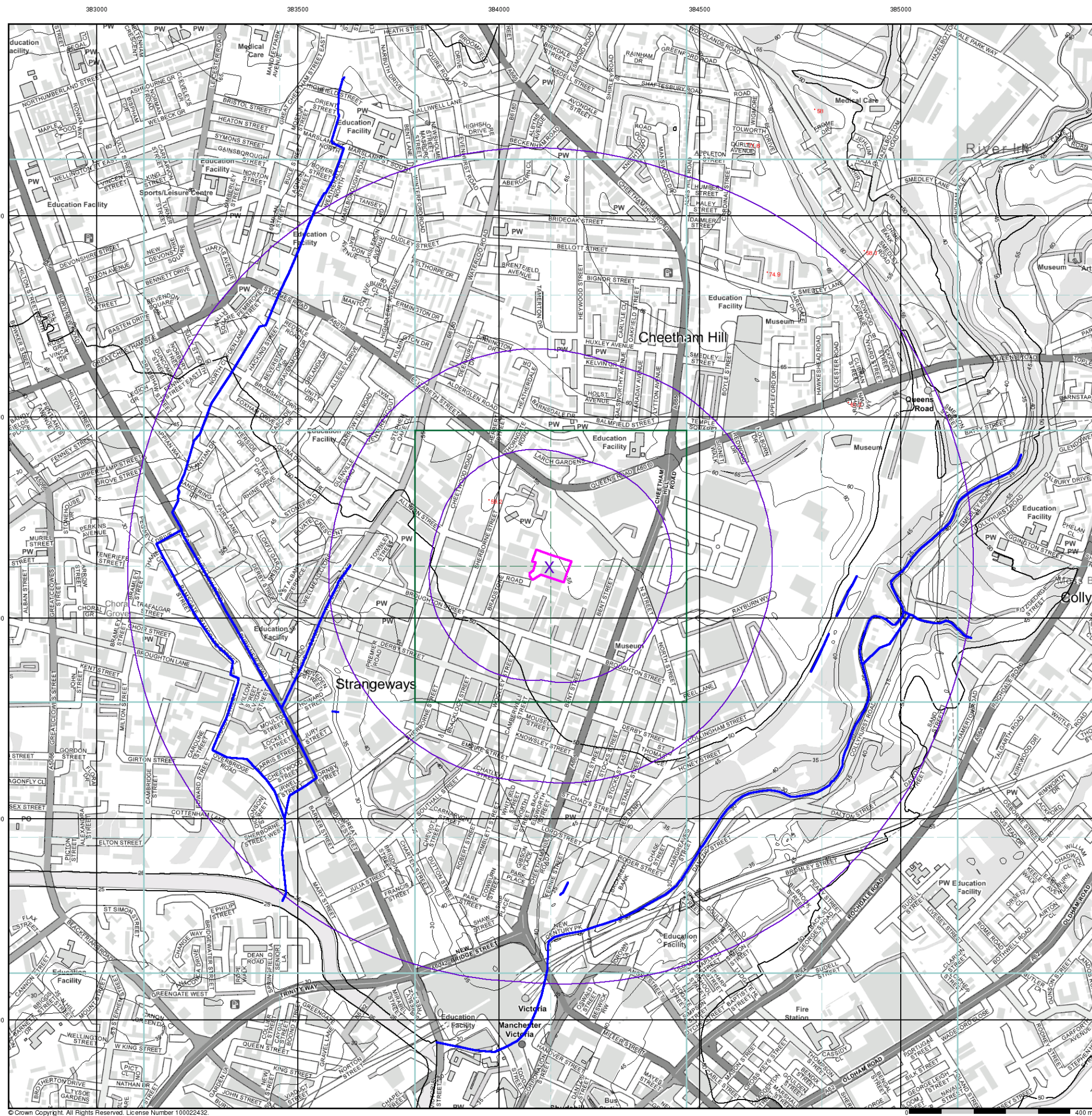
Location (easting/northing)
384208/400075

Scale
1:2500

Created
8 Dec 2021 9:30

-  Selected point
-  Flood zone 3
-  Flood zone 3: areas benefitting from flood defences
-  Flood zone 2
-  Flood zone 1
-  Flood defence
-  Main river
-  Flood storage area


0 20 40 60m



General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

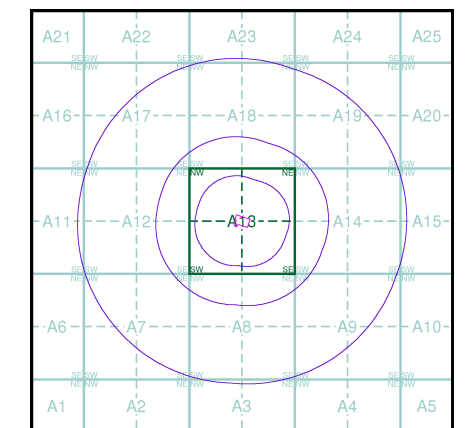
OS Water Network Data

- | | |
|--------------|-------------------------|
| Canal | Drain |
| Reservoir | Other |
| Foreshore | Lake |
| Marsh | Transfer |
| Tidal River | Lock Or Flight Of Locks |
| Inland River | Sea |

Contours (height in meters)

- Standard Contour 105 100 95
- Master Contour
- Spot Height 167.3
- MLW Mean Low Water
- MHW Mean High Water

OS Water Network Map - Slice A



Order Details

Order Number: 287168804_1_1
Customer Ref: LKC 21 1508
National Grid Reference: 384130, 400130
Slice: A
Site Area (Ha): 0.51
Search Buffer (m): 1000

Site Details

Bradstone Road, Manchester, M8 8WA



Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

UNIT 1, 2-4, BRADSTONE ROAD, MANCHESTER, M8 8WA**Rivers and sea risk****Very low risk**

Very low risk means that each year this area has a chance of flooding of less than 0.1%.

Surface water risk**Low risk**

Low risk means that each year this area has a chance of flooding of between 0.1% and 1%.

Lead local flood authorities (LLFA) manage the risk from surface water flooding and may hold more detailed information. Your LLFA is **Manchester**.

Reservoir risk

There is no risk of reservoir flooding

Groundwater risk

No risk of groundwater flooding

APPENDIX D

CONSULTEE CORRESPONDENCE

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Jenna Lowe

From: Perry, Graham <Graham.Perry@uuplc.co.uk>
Sent: 17 November 2021 21:27
To: LK SuDS & Floods
Cc: Wastewater Developer Services
Subject: Pre Development Enquiry for : Bradstone Road Manchester M8 8WA UU reference Number : 4200044981

Pre Development Enquiry for: Bradstone Road Manchester M8 8WA UU reference Number : 4200044981

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 3723223 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 375mm diameter public combined sewer within Bradstone Rd 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.

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 375mm diameter public combined sewer within Bradstone Rd 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.

Please be aware that current modelling data suggests that the receiving sewer begins to show low level flooding on a 1 in 50 rainfall event. Please ensure that ground levels across the site are set at a minimum of 51.7m AOD and finished floor levels are set to a minimum 51.850m AOD

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.

Please refer to the link below to obtain full details of the processes involved with sewer diversions:

<https://www.unitedutilities.com/builders-developers/larger-developments/wastewater/sewer-diversions/>

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/>

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/larger-developments/wastewater/sewer-connections/>

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,

Graham Perry



Graham Perry
Development Engineer
Developer Services
M: 07557 577548
T: 01925 679405
unitedutilities.com

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www.unitedutilities.com/subsidiaries

LKGroup**Unit 29 Eton Business Park
Eton Hill Road, Radcliffe
Radcliffe, Greater
M26 2ZS****FAO:****How to contact us:****United Utilities Water Limited
Property Searches
Haweswater House
Lingley Mere Business Park
Great Sankey
Warrington
WA5 3LP****Telephone: 0370 7510101****E-mail: propertysearches@uuplc.co.uk****Your Ref: FRA 21 1144 - Bradstone Road
Our Ref: UUPS-ORD-342909
Date: 10/11/2021****Dear Sirs****Location: 1D BRADSTONE ROAD, MANCHESTER, M8 8WA**

I acknowledge with thanks your request dated 09/11/2021 for information on the location of our services.

Please find enclosed plans showing the approximate position of United Utilities' apparatus known to be in the vicinity of this site.

The enclosed plans are being provided to you subject to the United Utilities terms and conditions for both the wastewater and water distribution plans which are shown attached.

If you are planning works anywhere in the North West, please read United Utilities' access statement before you start work to check how it will affect our network. <http://www.unitedutilities.com/work-near-asset.aspx>.

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

If you have any queries regarding this matter please [contact us](#).

Yours Faithfully,



Karen McCormack
Property Searches Manager

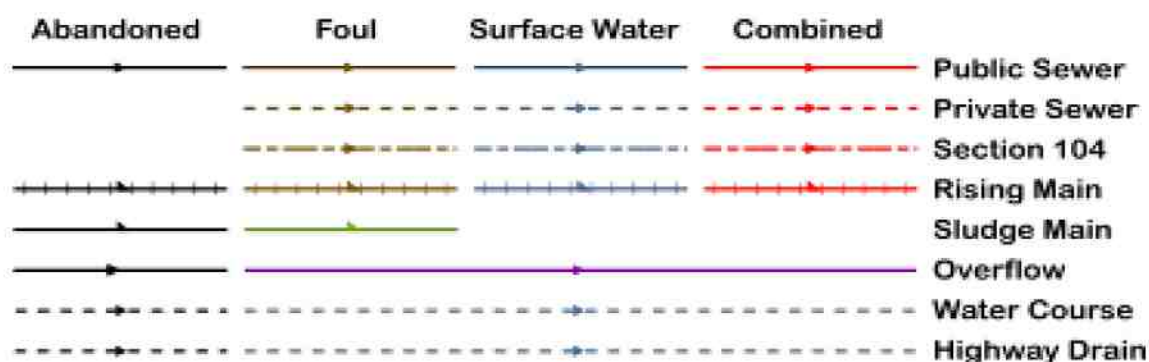
TERMS AND CONDITIONS - WASTEWATER AND WATER DISTRIBUTION PLANS

These provisions apply to the public sewerage, water distribution and telemetry systems (including sewers which are the subject of an agreement under Section 104 of the Water Industry Act 1991 and mains installed in accordance with the agreement for the self construction of water mains) (UUWL apparatus) of United Utilities Water Limited "(UUWL)".

TERMS AND CONDITIONS:

- This 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.
- This Map and any information supplied with it is provided for general guidance only and no representation, undertaking or warranty as to its accuracy, completeness or being up to date is given or implied.
- In particular, the position and depth of any UUWL apparatus shown on the Map are approximate only. UUWL strongly recommends that a comprehensive survey is undertaken in addition to reviewing this Map to determine and ensure the precise location of any UUWL apparatus. The exact location, positions and depths should be obtained by excavation trial holes.
- The location and position of private drains, private sewers and service pipes to properties are not normally shown on this Map but their presence must be anticipated and accounted for and you are strongly advised to carry out your own further enquiries and investigations in order to locate the same.
- The position and depth of UUWL apparatus is subject to change and therefore this 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 Map have been made subsequent to issue and prior to any works being carried out.
- This 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) in the vicinity of UUWL apparatus or for the purpose of determining the suitability of a point of connection to the sewerage or other distribution systems.
- No person or legal entity, including any company shall be relieved from any liability howsoever and whensoever arising for any damage caused to UUWL apparatus by reason of the actual position and/or depths of UUWL apparatus being different from those shown on the 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 UUWL from bringing proceedings in any other competent jurisdiction, whether concurrently or otherwise.

Wastewater Symbolology



All point assets follow the standard colour convention:

red – combined	brown - foul
blue – surface water	purple - overflow

Manhole	Side Entry Manhole
HS Head of System	Outfall
ES Extent of Survey	Screen Chamber
RE Rodding Eye	IC Inspection Chamber
IN Inlet	Bifurcation Chamber
DP Discharge Point	LH Lamp Hole
VV Vortex	T Junction / Saddle
PE Penstock	Catchpit
WO Washout Chamber	VC Valve Chamber
VA Valve	Vent Column
AV Air Valve	Vortex Chamber
NR Non Return Valve	PC Penstock Chamber
SO Soakaway	T Network Storage Tank
GU Gully	V Sewer Overflow
CA Cascade	WTW Ww Treatment Works
FM Flow Meter	Ww Pumping Station
HA Hatch Box	ST Septic Tank
OI Oil Interceptor	CK Control Kiosk
SM Summit	
DS Drop Shaft	Change of Characteristic
OP Orifice Plate	



Scale: 1:1250
Date: 10/11/2021

SEWER RECORDS



Water for the North West

Address or Site Reference: 1D BRADSTONE ROAD, MANCHESTER, M8 8WA

Printed by: Property Searches

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

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APPENDIX E

CALCULATIONS

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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 06/12/21		
By	Checked	Reviewed

Project	30 yr event
Title	Storage calcs for Bradstone Road

Data:-

FSR Hydrology:-

Location = Bradstone Road

M5-60 (mm) = 18.1

Soil index = 0.45

Return period = 30

UCWI = 100.8

Grid reference = SD8401

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

UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 4900 m²

Total area (TA) = 4900 m²

Mean disch. rate = 5.000 l/s

Additional flow = 0.00 l/s

Pervious area = 0 m²

Equiv area = 3969 m² (TA x RF).

Areal reduction factor = 1.000

Climate change factor = 0

Calculated data:-

Time to max = 138.0 mins

Rainfall at max = 15.64 mm/hr

Pipeline storage = 0.0 m³

Offline storage = 0.0 m³

Calculated storage volume = 101.4 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 = 75.0 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	12910.0	1125	102.0	400 x 600	563.2	500 x 500	405.5
150	5737.8	1200	89.7	600 x 900	245.2	500 x 750	270.3
225	2550.1	1275	79.4	800 x 1200	137.9	500 x 1000	202.8
300	1434.4	1350	70.8			750 x 1000	135.2
375	918.0	1425	63.6			750 x 1200	112.6
450	637.5	1500	57.4			750 x 1500	90.1
525	468.4	1575	52.0			1000 x 1000	101.4
600	358.6	1650	47.4			1000 x 1200	84.5
675	283.3	1725	43.4			1000 x 1500	67.6
750	229.5	1800	39.8			1000 x 1800	56.3
825	189.7	1875	36.7			1000 x 2000	50.7
900	159.4	1950	34.0			1500 x 1500	45.1
975	135.8	2025	31.5			1500 x 1800	37.5
1050	117.1	2100	29.3			1500 x 2000	33.8



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Data:-

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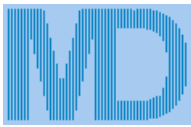
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Project	30 yr event
Title	Storage calcs for Bradstone Road

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	80.0	53.236	3.000	50.236
20	56.0	73.534	6.000	67.534
30	44.0	86.417	9.000	77.417
40	36.0	96.055	12.000	84.055
50	31.0	103.830	15.000	88.830
60	28.0	110.387	18.000	92.387
70	25.0	116.077	21.000	95.077
80	23.0	121.118	24.000	97.118
90	21.0	125.650	27.000	98.650
100	20.0	129.774	30.000	99.774
110	18.0	133.560	33.000	100.560
120	17.0	137.061	36.000	101.061
130	16.0	140.321	39.000	101.321
140	15.0	143.370	42.000	101.370
150	15.0	146.236	45.000	101.236
160	14.0	148.939	48.000	100.939
170	13.0	151.498	51.000	100.498
180	13.0	153.927	54.000	99.927
190	12.0	156.240	57.000	99.240
200	12.0	158.445	60.000	98.445
210	12.0	160.554	63.000	97.554
220	11.0	162.574	66.000	96.574
230	11.0	164.511	69.000	95.511
240	10.0	166.373	72.000	94.373
250	10.0	168.165	75.000	93.165
260	10.0	169.892	78.000	91.892
270	10.0	171.557	81.000	90.557
280	9.0	173.166	84.000	89.166
290	9.0	174.722	87.000	87.722
300	9.0	176.227	90.000	86.227
310	9.0	177.685	93.000	84.685
320	8.0	179.098	96.000	83.098
330	8.0	180.524	99.000	81.524
340	8.0	181.929	102.000	79.929
350	8.0	183.302	105.000	78.302
360	8.0	184.645	108.000	76.645
370	8.0	185.958	111.000	74.958
380	7.0	187.243	114.000	73.243
390	7.0	188.502	117.000	71.502
400	7.0	189.735	120.000	69.735
410	7.0	190.945	123.000	67.945
420	7.0	192.131	126.000	66.131
430	7.0	193.295	129.000	64.295
440	7.0	194.438	132.000	62.438
450	7.0	195.561	135.000	60.561
460	6.0	196.664	138.000	58.664
470	6.0	197.748	141.000	56.748
480	6.0	198.815	144.000	54.815
490	6.0	199.863	147.000	52.863
500	6.0	200.896	150.000	50.896
510	6.0	201.912	153.000	48.912
520	6.0	202.912	156.000	46.912
530	6.0	203.897	159.000	44.897
540	6.0	204.868	162.000	42.868
550	6.0	205.825	165.000	40.825
560	6.0	206.768	168.000	38.768
570	6.0	207.698	171.000	36.698
580	5.0	208.615	174.000	34.615
590	5.0	209.519	177.000	32.519
600	5.0	210.412	180.000	30.412

Storage volume (m³) = 101.4 m³



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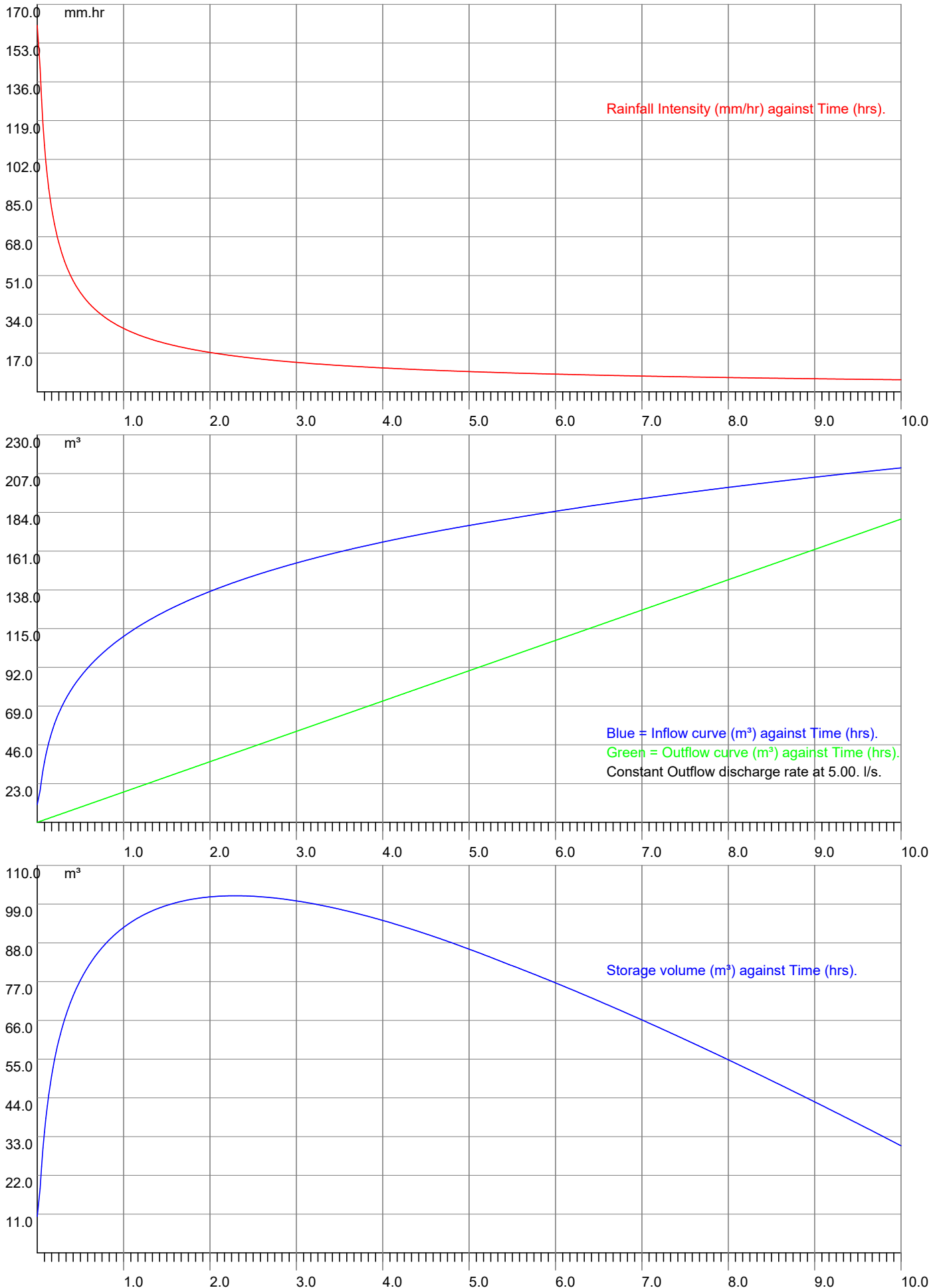
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Project **30 yr event**

Title **Storage calcs for Bradstone Road**





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Project **30 yr event**

Title **Storage calcs for Bradstone Road**

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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Project	100yr +20%
Title	Storage calcs for Bradstone Road

Data:-

FSR Hydrology:-

Location = Bradstone Road

M5-60 (mm) = 18.1

Soil index = 0.45

Return period = 100

UCWI = 100.8

Grid reference = SD8401

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 = 4900 m²

Total area (TA) = 4900 m²

Mean pump disch. rate = 5.000 l/s

Additional flow = 0.00 l/s

Pervious area = 0 m²

Equiv area = 3969 m² (TA x RF).

Areal reduction factor = 1.000

Climate change factor = 20

Calculated data:-

Time to max = 217.0 mins

Rainfall at max = 17.74 mm/hr

Pipeline storage = 0.0 m³

Offline storage = 0.0 m³

Calculated storage volume = 189.6 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 = 178.8 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	24141.8	1125	190.8	400 x 600	1053.2	500 x 500	758.3
150	10729.7	1200	167.7	600 x 900	458.6	500 x 750	505.5
225	4768.8	1275	148.5	800 x 1200	257.9	500 x 1000	379.1
300	2682.4	1350	132.5			750 x 1000	252.8
375	1716.8	1425	118.9			750 x 1200	210.6
450	1192.2	1500	107.3			750 x 1500	168.5
525	875.9	1575	97.3			1000 x 1000	189.6
600	670.6	1650	88.7			1000 x 1200	158.0
675	529.9	1725	81.1			1000 x 1500	126.4
750	429.2	1800	74.5			1000 x 1800	105.3
825	354.7	1875	68.7			1000 x 2000	94.8
900	298.0	1950	63.5			1500 x 1500	84.3
975	254.0	2025	58.9			1500 x 1800	70.2
1050	219.0	2100	54.7			1500 x 2000	63.2



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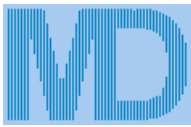
Project	100yr +20%
Title	Storage calcs for Bradstone Road

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Data:-

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	124.0	81.744	3.000	78.744
20	86.0	114.419	6.000	108.419
30	68.0	135.208	9.000	126.208
40	57.0	150.777	12.000	138.777
50	49.0	163.322	15.000	148.322
60	44.0	173.875	18.000	155.875
70	40.0	183.008	21.000	162.008
80	36.0	191.070	24.000	167.070
90	33.0	198.292	27.000	171.292
100	31.0	204.836	30.000	174.836
110	29.0	210.819	33.000	177.819
120	27.0	216.331	36.000	180.331
130	26.0	221.438	39.000	182.438
140	24.0	226.195	42.000	184.195
150	23.0	230.645	45.000	185.645
160	22.0	234.825	48.000	186.825
170	21.0	238.762	51.000	187.762
180	20.0	242.482	54.000	188.482
190	20.0	246.006	57.000	189.006
200	19.0	249.352	60.000	189.352
210	18.0	252.535	63.000	189.535
220	18.0	255.569	66.000	189.569
230	17.0	258.466	69.000	189.466
240	16.0	261.236	72.000	189.236
250	16.0	263.888	75.000	188.888
260	15.0	266.431	78.000	188.431
270	15.0	268.871	81.000	187.871
280	15.0	271.217	84.000	187.217
290	14.0	273.473	87.000	186.473
300	14.0	275.645	90.000	185.645
310	14.0	277.737	93.000	184.737
320	13.0	279.756	96.000	183.756
330	13.0	281.843	99.000	182.843
340	13.0	283.912	102.000	181.912
350	12.0	285.932	105.000	180.932
360	12.0	287.905	108.000	179.905
370	12.0	289.834	111.000	178.834
380	12.0	291.720	114.000	177.720
390	11.0	293.565	117.000	176.565
400	11.0	295.373	120.000	175.373
410	11.0	297.143	123.000	174.143
420	11.0	298.878	126.000	172.878
430	11.0	300.580	129.000	171.580
440	10.0	302.249	132.000	170.249
450	10.0	303.887	135.000	168.887
460	10.0	305.496	138.000	167.496
470	10.0	307.076	141.000	166.076
480	10.0	308.629	144.000	164.629
490	10.0	310.156	147.000	163.156
500	9.0	311.657	150.000	161.657
510	9.0	313.133	153.000	160.133
520	9.0	314.586	156.000	158.586
530	9.0	316.016	159.000	157.016
540	9.0	317.424	162.000	155.424
550	9.0	318.811	165.000	153.811
560	9.0	320.177	168.000	152.177
570	9.0	321.523	171.000	150.523
580	8.0	322.850	174.000	148.850
590	8.0	324.158	177.000	147.158
600	8.0	325.448	180.000	145.448

Storage volume (m³) = 189.6 m³



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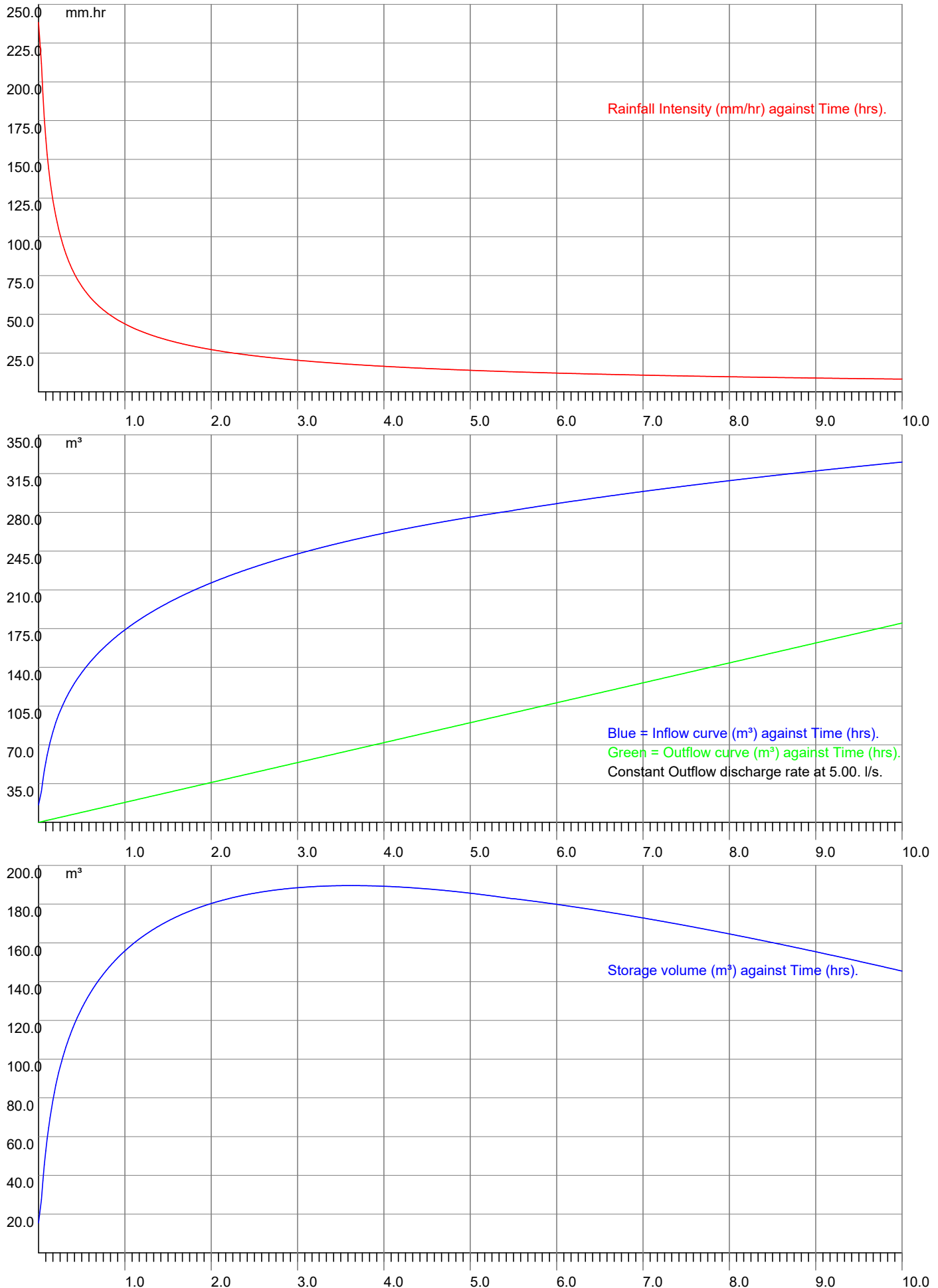
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Project **100yr +20%**
Title **Storage calcs for Bradstone Road**





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Project **100yr +20%**

Title **Storage calcs for Bradstone Road**

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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Sheet no. **1**

Date **06/12/21**

Project **100year + 40%**

Title **Storage calcs for Bradstone Road**

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Data:-

FSR Hydrology:-

Location = Bradstone Road

M5-60 (mm) = 18.1

Soil index = 0.45

Return period = 100

UCWI = 100.8

Grid reference = SD8401

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 = 4900 m²

Total area (TA) = 4900 m²

Mean pump disch. rate = 5.000 l/s

Additional flow = 0.00 l/s

Pervious area = 0 m²

Equiv area = 3969 m² (TA x RF).

Areal reduction factor = 1.000

Climate change factor = 40

Calculated data:-

Time to max = 252.0 mins

Rainfall at max = 18.50 mm/hr

Pipeline storage = 0.0 m³

Offline storage = 0.0 m³

Calculated storage volume = 232.9 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 = 227.1 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	29655.8	1125	234.3	400 x 600	1293.7	500 x 500	931.5
150	13180.4	1200	205.9	600 x 900	563.3	500 x 750	621.0
225	5857.9	1275	182.4	800 x 1200	316.8	500 x 1000	465.7
300	3295.1	1350	162.7			750 x 1000	310.5
375	2108.9	1425	146.0			750 x 1200	258.7
450	1464.5	1500	131.8			750 x 1500	207.0
525	1075.9	1575	119.5			1000 x 1000	232.9
600	823.8	1650	108.9			1000 x 1200	194.1
675	650.9	1725	99.7			1000 x 1500	155.2
750	527.2	1800	91.5			1000 x 1800	129.4
825	435.7	1875	84.4			1000 x 2000	116.4
900	366.1	1950	78.0			1500 x 1500	103.5
975	312.0	2025	72.3			1500 x 1800	86.2
1050	269.0	2100	67.2			1500 x 2000	77.6



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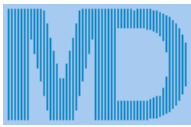
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Project	100year + 40%
Title	Storage calcs for Bradstone Road

Data:-

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	144.0	95.367	3.000	92.367
20	101.0	133.489	6.000	127.489
30	79.0	157.743	9.000	148.743
40	66.0	175.906	12.000	163.906
50	58.0	190.542	15.000	175.542
60	51.0	202.855	18.000	184.855
70	46.0	213.509	21.000	192.509
80	42.0	222.915	24.000	198.915
90	39.0	231.340	27.000	204.340
100	36.0	238.975	30.000	208.975
110	34.0	245.956	33.000	212.956
120	32.0	252.386	36.000	216.386
130	30.0	258.344	39.000	219.344
140	28.0	263.894	42.000	221.894
150	27.0	269.086	45.000	224.086
160	26.0	273.962	48.000	225.962
170	25.0	278.555	51.000	227.555
180	24.0	282.896	54.000	228.896
190	23.0	287.007	57.000	230.007
200	22.0	290.911	60.000	230.911
210	21.0	294.624	63.000	231.624
220	20.0	298.164	66.000	232.164
230	20.0	301.543	69.000	232.543
240	19.0	304.775	72.000	232.775
250	19.0	307.869	75.000	232.869
260	18.0	310.836	78.000	232.836
270	18.0	313.683	81.000	232.683
280	17.0	316.420	84.000	232.420
290	17.0	319.051	87.000	232.051
300	16.0	321.585	90.000	231.585
310	16.0	324.027	93.000	231.027
320	15.0	326.382	96.000	230.382
330	15.0	328.817	99.000	229.817
340	15.0	331.231	102.000	229.231
350	14.0	333.588	105.000	228.588
360	14.0	335.889	108.000	227.889
370	14.0	338.139	111.000	227.139
380	14.0	340.340	114.000	226.340
390	13.0	342.493	117.000	225.493
400	13.0	344.601	120.000	224.601
410	13.0	346.667	123.000	223.667
420	13.0	348.691	126.000	222.691
430	12.0	350.676	129.000	221.676
440	12.0	352.624	132.000	220.624
450	12.0	354.535	135.000	219.535
460	12.0	356.412	138.000	218.412
470	12.0	358.256	141.000	217.256
480	11.0	360.067	144.000	216.067
490	11.0	361.848	147.000	214.848
500	11.0	363.599	150.000	213.599
510	11.0	365.322	153.000	212.322
520	11.0	367.017	156.000	211.017
530	11.0	368.685	159.000	209.685
540	10.0	370.328	162.000	208.328
550	10.0	371.946	165.000	206.946
560	10.0	373.540	168.000	205.540
570	10.0	375.110	171.000	204.110
580	10.0	376.658	174.000	202.658
590	10.0	378.184	177.000	201.184
600	10.0	379.689	180.000	199.689

Storage volume (m³) = 232.9 m³



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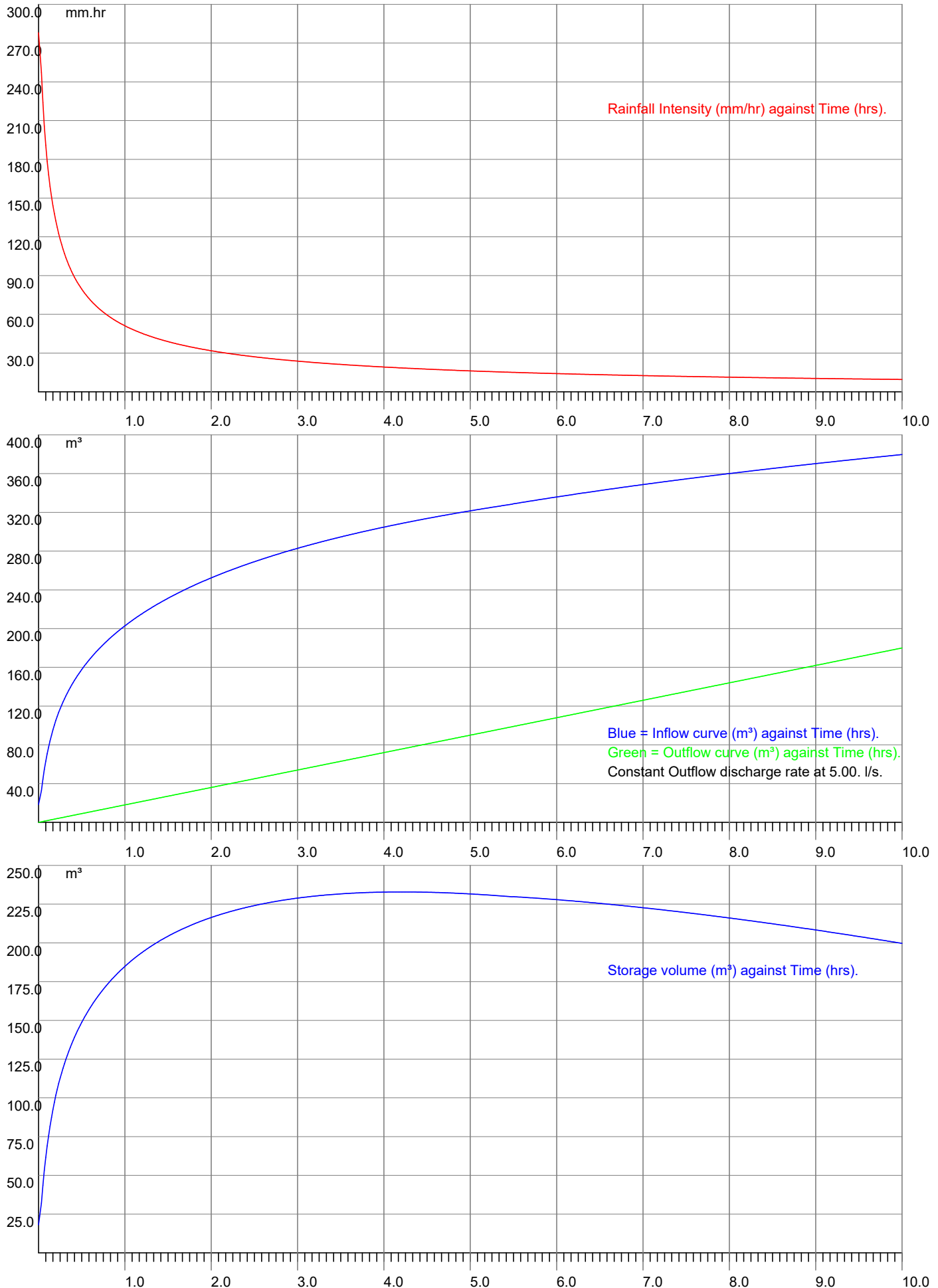
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Job No.		
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Date 06/12/21		
By	Checked	Reviewed

Project **100year + 40%**
Title **Storage calcs for Bradstone Road**





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Sheet no. 4		
Date 06/12/21		
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Project **100year + 40%**

Title **Storage calcs for Bradstone Road**

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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Job No.		
Sheet no. 1		
Date 06/12/21		
By	Checked	Reviewed

Project **Qbar event existing**

Title **Peak runoff calculations for Bradstone Road**

Area data:-

FSR data

M5-60 = 18.1

Soil index = 0.45

WRAP value = 4

r = 0.35

SAAR = 950

Nat grid = SD8401

Site data:-

Ret. period (yrs) = 2.333

Time of entry = 7.00

Impervious area drained = 4900 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 = 0 m²

Soil type = Clay

Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 81.0%

Rainfall rate = 57.1 mm/Hr

UCWI = 98.5

Runoff rate (gross) = 62.9 l/s

Methods

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

Calculations produced by MasterDrain Surface Water design program



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Job No.		
Sheet no. 1		
Date 06/12/21		
By	Checked	Reviewed

Project	Bradstone Road 1 in 1yr
Title	Peak runoff calculations for Bradstone Road

Area data:-

FSR data

M5-60 = 18.1

Soil index = 0.45

WRAP value = 4

r = 0.35

SAAR = 950

Nat grid = SD8401

Site data:-

Ret. period (yrs) = 1

Time of entry = 10.00

Impervious area drained = 4900 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 = 0 m²

Soil type = Clay

Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 81.0%

Rainfall rate = 40.1 mm/Hr

UCWI = 98.5

Runoff rate (gross) = 44.2 l/s

Methods

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

UCWI = Calculated value for Wetness Index

Calculations produced by MasterDrain Surface Water design program



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Job No.		
Sheet no. 1		
Date 06/12/21		
By	Checked	Reviewed

Project	Existing 30yr event
Title	Peak runoff calculations for Bradstone Road

Area data:-

FSR data

M5-60 = 18.1

Soil index = 0.45

WRAP value = 4

r = 0.35

SAAR = 950

Nat grid = SD8401

Site data:-

Ret. period (yrs) = 30

Time of entry = 6.00

Impervious area drained = 4900 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 = 0 m²

Soil type = Clay

Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 81.0%

Rainfall rate = 100.8 mm/Hr

UCWI = 98.5

Runoff rate (gross) = 111.2 l/s

Methods

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

UCWI = Calculated value for Wetness Index

Calculations produced by MasterDrain Surface Water design program



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Job No.		
Sheet no. 1		
Date 06/12/21		
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Project **100yr event existing**

Title **Peak runoff calculations for Bradstone Road**

Area data:-

FSR data

M5-60 = 18.1

Soil index = 0.45

WRAP value = 4

r = 0.35

SAAR = 950

Nat grid = SD8401

Site data:-

Ret. period (yrs) = 100

Time of entry = 6.00

Impervious area drained = 4900 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 = 0 m²

Soil type = Clay

Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 81.0%

Rainfall rate = 127.5 mm/Hr

UCWI = 98.5

Runoff rate (gross) = 140.6 l/s

Methods

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

UCWI = Calculated value for Wetness Index

Calculations produced by MasterDrain Surface Water design program

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