

STATION WORKS, BURY ROAD, RADCLIFFE

SUSTAINABLE DRAINAGE STRATEGY

Job Number: FRA 22 1128

Date: October 2022

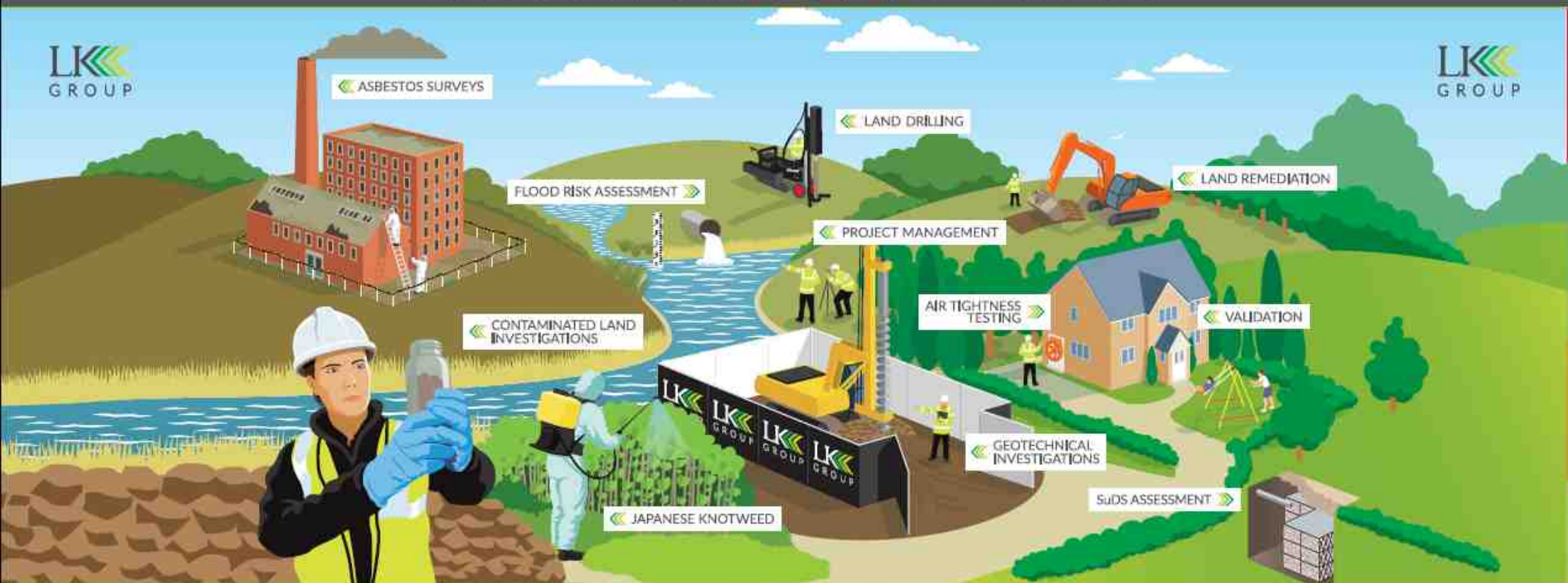
Client: Paul Cook Developments (Whitehaven) Ltd



INCREASING LAND VALUE

LK
GROUP

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LK Consult			
Document Verification			
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Report Title	Sustainable Drainage Strategy		
Job Number	FRA 22 1128	Document Ref.	FRA 22 1128 - R0
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Prepared By	Jenna Lowe - Flood Risk Engineer	Reviewed By	Mark Jones - Associate

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 the former Station Works, Bury Road, Radcliffe. The development comprises residential properties, soft landscaping, and car parking.

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

Consultations

Bury Council – Lead Local Flood Authority (LLFA) and United Utilities (UU) have been contacted during 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 maps show that the site is partially within Flood Zones 2 and 3.

Drainage Strategy

The ground conditions beneath the site are recorded as Glaciofluvial Sheet Deposits consisting of Sand and Gravel over Pennine Middle Coal Measures Formation which have been confirmed by BGS records. The site is relatively flat with a mild decline towards the southeast.

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 public sewer on the western boundary of the site.

The most effective strategy, in line with the SuDS management train, would be to have a detention facility at the western boundary.

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

The proposed development will marginally decrease the proportion of the site covered by impermeable surfaces and will therefore generate less runoff. Attenuation will be required to allow for climate change.

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 Environmental Setting	3
2.2 Site Reconnaissance	4
2.3 Site Levels	7
3 Consultation	8
4 Sustainable Drainage Strategy	9
4.1 Introduction	9
4.2 Sustainable Drainage Hierarchy	9
4.3 Surface Water Attenuation Requirements	12
4.4 Site Specific SuDS	13
4.5 Foul Drainage	14
5 Conclusion	15

Appendices

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

1 Introduction

1.1 Background

LK Consult Ltd (LKC) were commissioned by Paul Cook Developments (Whitehaven) Ltd to carry out a Sustainable Drainage Strategy for the former Station Works, Bury Road. The report was undertaken in support of a future planning application to redevelop the site for residential 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 amended September 2022

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	The former Station Works, Bury Road, Radcliffe, Bury, M26 2UA. Centred at approximate National Grid Reference 378945E, 407670N.
Area	Approximately 0.54 Ha.
Topography	70.48 metres above ordnance datum (AOD) in the north of the site and 69.25m AOD in the southeast of the site. The site is sloping down gently from the north towards the southeast.
Current Land Use	<u>Site</u> Hardstood ground across the majority of the site and overgrown vegetation towards the north and west boundaries. Site bounded by existing wall and railings with Heras fencing to the west. <u>Surrounding Area/ Boundary Treatment</u> North: Newbridge Close, residential properties and Crow Trees Farm Brook. East: Commercial/Industrial unit and vehicle storage. South: Garage and Residential properties. West: Bury Road, commercial and residential properties.
Proposed Development	Residential properties to include soft landscaping and car parking. Access will be from Bury Road.

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		Glaciofluvial Sheet Deposits, Devensian (Sand and Gravel).
	Bedrock		Pennine Middle Coal Measures Formation (Mudstone, Siltstone and Sandstone).
	BGS Boreholes		BH Ref: SD70NE25, 210m N: Soil and Gravel to 2.43m, Marl to 18.78m, blue Rock to 21.21m.
	Defra Soilscape Mapping		Type 17 – Slowly permeable seasonally wet acid loamy and clayey soils.
Hydrogeology	Aquifer Designation	Superficial	Secondary A Aquifer.
		Bedrock	Secondary A Aquifer.
	Source Protection Zone (SPZ)		Site not within an SPZ.
Flood Zone (EA)	The majority of the site is within Flood Zone 1: Very Low risk, with annual probability of flooding from rivers and the sea of less than 0.1% (1 in 1000). The site is partially within Flood Zone 2 towards the centre: Low risk, with annual probability of flooding of 0.1 to 1.0% from rivers and 0.1 to 0.5% from the sea towards the centre of the site. A small section of the north eastern corner is within Flood Zone 3: Medium risk of flooding with an annual probability of flooding of 1.0% or greater from rivers, and 0.5% or greater from the sea.		
Hydrology	All adjacent and internal surface water		Crofters Brook watercourse is located to the northeast of the site and partially runs through the site. This is partially culverted when it flows to the east of the site. The Manchester, Bolton, and Bury Canal (North) is located approximately 315m to the west of the site.
Site History		Historical mapping indicates that from 1890 the site consisted of a Mineral Water Works. A bowling green was located immediately south of the site. Residential properties located within the immediate vicinity of the site and the Radcliffe East Fork (railway) was located to the west of the site. Multiple reservoirs were located approximately 350m to the east of the site associated with the Works. From 1938 the site was repurposed as a Station Works and was present until the last available public mapping in 1965. Presently, the site is vacant with an industrial unit to the east.	

Table 2-1: Summary of the Environmental Setting.

2.2 Site Reconnaissance

A site reconnaissance was undertaken in August 2022 and further photographs are below.

Relevant features identified on site are summarised below:

- The site entrance is off Bury Road to the west. The majority of the site consists of hardstanding paved ground. Overgrown vegetation is present towards the northern and western boundaries.
- The site is currently used to store vehicles associated with the adjacent industrial unit but is otherwise unoccupied.
- The site is relatively flat with a slight decline towards the southern boundary.
- The site is bounded by residential and commercial properties to the north and west, residential properties to the south, and an industrial unit to the east.
- Towards the northeast of the site there is an open ordinary watercourse which partially crosses the site boundary and flows adjacent to the eastern boundary.
- The watercourse is partially culverted towards the eastern boundary but is open towards the northeast.
- The watercourse is a main river, maintained by the Environment Agency and includes the Newbridge Close debris screen adjacent to the site.
- Downpipes were observed on the adjacent industrial unit and a drainage gully was observed adjacent to the roller shutter door on the unit.
- Further drainage gullies were observed within the access road and Bury Road to the west of the site.

Relevant photographs are provided in Plate 2-1.

	
Photograph 1: View across the site towards western boundary.	Photograph 2: View across the site towards the north. Site is relatively flat due to the former building floor slabs.
	
Photograph 3: Overgrown vegetation towards the northwest of site and concrete surfacing.	Photograph 4: View facing northeast and access to the debris screen on the watercourse.
	
Photograph 5: Access to the debris screen and channelised part of the watercourse towards the northeast of site.	Photograph 6: Crofters Beck watercourse towards the north eastern boundary.

Plate 2-1: Site photographs.

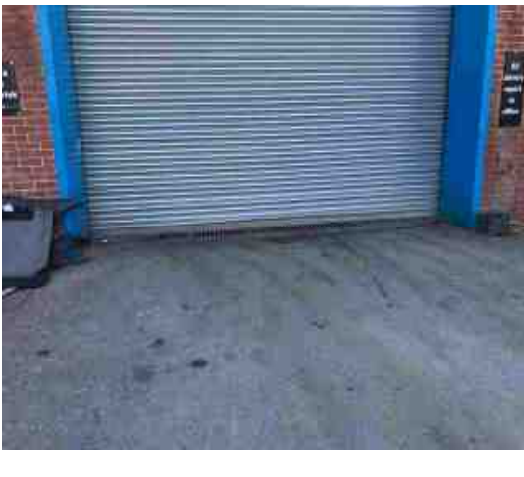
	
Photograph 7: Commercial/Industrial unit in the east and existing downpipes, that appear to enter the building.	Photograph 8: Roller shutter door on commercial unit and drainage gully.
	
Photograph 9: Site access road off Bury Road to the west.	Photograph 10: Bury Road adjacent to west of site.
	
Photograph 11: View of centre of site. Concrete surfacing currently used to store vehicles. Site relatively flat.	Photograph 12: Downpipe on the existing industrial unit going underground.

Plate 2-1 (continued): Site photographs.

2.3 Site Levels

A topographic survey of the site has been undertaken to OS GPS datum, and information is included on the drawings in Appendix B. The site elevation ranges from 70.48m AOD in the north to 69.25m AOD in the southeast. The site gently slopes towards the southeast. Access will be from Bury Road at approximately 69.86m AOD.

3 Consultation

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

Relevant correspondence is provided in Appendix C.

Source	Details	
Bury Council (LLFA)	Correspondence with Bury Council states that the site is not within a Critical Drainage Area and the UDP does not contain any SUDs policies and therefore NPPF para 167 would apply. There were significant flood events in 2015 and 2020 in Radcliffe but these did not affect the site. Also, the Environment Agency are installing flood defences along the River Irwell between Close Park and Lower Hinds to the south of the site.	
United Utilities (UU)	Sewer Map	No surface water sewers within the immediate vicinity of the site. There is a 300mm diameter public combined sewer to the west of the site in Bury Road running in a southerly direction.
	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. 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 300mm diameter public combined sewer located in Bury Road 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. UU recommend contacting the LLFA and EA to discuss a point of discharge to the open watercourse to the east of the site. 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 300mm diameter public combined sewer within Bury Road to the west of the site at an unrestricted rate. 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.

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
Glaciofluvial Sheet Deposits	Gravel band over marl.	Secondary A	N/A	Limited
Pennine Middle Coal Measures Formation	Sandstone, Mudstone and Siltstone	Secondary A	N/A	Limited

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 impermeable marl beneath the shallow gravel and the proximity of the watercourse where it is likely to interact with the layer of gravel, 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 southeast.

4.2.2 Watercourses

There is an open watercourse running partially adjacent to the site towards the north eastern corner which then continues behind the commercial building flowing towards the south.

4.2.3 Public Sewer

There is a public combined sewer running adjacent to the site in Bury Road towards the west.

4.2.4 Other Sewers

There are manholes and gullies shown on the topographical survey within the site, but these were not accessible during the site visit. It is unknown were these discharge too and it is suggested that the feasibility of making use of these connections is investigated within the detailed design as they could possibly be connected historically through the 3rd party land or the public sewer.

4.2.5 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	3	Not likely to be feasible due to the impermeably ground below the gravel band and likely shallow water table due to its interaction with the watercourse, this would limit the operation of a soakaway. It may increase the flood risk and structural strength of any adjacent roads and shallow foundations.
b	Connection to Watercourse	2	Connection to the watercourse which partially flows adjacent to the northeast of the site would probably require to be a pumped solution as it is at the higher end of the site. Connections to the watercourse to the southeast would require 3 rd party access as it moves away from the site boundary towards Hoyles Court to the east and would require EA and LLFA consent. The trash screen may affect the pumped outfall and make pumping an unfeasible option.
c	Discharge into a sewer	1	A connection into the 300/375mm diameter combined water sewer in Bury Road to the west 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.
Filter strip	✓	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	✓	Linear trenches filled with a permeable granular material, often with a perforated pipe in the base of the trench.
Detention basin	*	Dry depressions designed to hold water for a specific retention time.
Swales	✓	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	*	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

4.3 Surface Water Attenuation Requirements

In line with local guidance, 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).

Designated Areas	Plot Area
Total area (ha)	0.54
Existing Impermeable Area (ha)	0.45
Green Infrastructure (ha)	0.09
Contributing Catchment	
Developable Area (ha)	0.54
Impermeable Area (ha)	0.40
Permeable Area (ha)	0.14

Table 4-4: Assumed plot areas.

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

It can be seen that there is a reduction in impermeable area from the existing usage to the proposed. This development 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.

4.3.1 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 D.

For the contributing catchment an estimate has been produced assuming an impermeable area of 0.40ha and a permeable area of 0.14ha. This gives the following runoff rates and attenuation requirements for this section based on the Wallingford IH 124 method:

» Q_{bar} :	4.030 l/s
» 1 in 1-year greenfield runoff rate:	4.422 l/s
» 1 in 30-year greenfield runoff rate:	6.763 l/s
» 1 in 100-year greenfield runoff rate:	8.454 l/s

The existing runoff flows have been estimated below:

» Q_{bar} :	58.0 l/s
» 1 in 1-year peak runoff rate:	41.0 l/s
» 1 in 30-year peak runoff rate:	102.2 l/s
» 1 in 100-year peak runoff rate:	129.2 l/s

This reduced by 50% would give the following rates:

» Q_{bar} :	29.0 l/s
» 1 in 1-year peak runoff rate:	20.5 l/s
» 1 in 30-year peak runoff rate:	51.1 l/s
» 1 in 100-year peak runoff rate:	64.6 l/s

UU has specified an allowable discharge rate of up to 5l/s to their adjacent combined sewer. Therefore, the 5l/s rate has been utilised.

UU has specified an allowable discharge rate of 5l/s to their adjacent combined sewer in Bury Road.

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

- » Attenuation storage volume: **83.9 m³** (1 in 30-year event)
- » Retention on site volume: **159.2 m³** (1 in 100 year + 20% Climate Change)
- » Retention on site volume: **196.3 m³** (1 in 100 year + 40% Climate Change)

Attenuation storage aims to limit the peak rate of runoff from the development to the 5l/s rates before discharging to the sewer. As the flow from the development would be reduced there should be little change in the flows that enter the 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 **83.9 m³** and for the 1 in 100-year event, a storage capacity of between **159.2 m³** and **196.3 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 sewer to the west of the site.

4.4 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.

There are areas where conveyance systems such as swales may be utilised to intercept overland flow and to convey any water to the existing watercourse in the northeast and along the eastern boundary. This will provide an effective pre-treatment of suspended solids through filtration and sedimentation and will also provide ecological and amenity benefits.

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.

⁶ Flood Studies Report Wallingford NERC 1975.

4.5 Foul Drainage

The foul water could be discharged by gravity into the 300mm diameter combined sewer in Bury Road to the west of the site as relative levels indicate that this will be feasible in terms of fall. The combined manhole has a recorded invert level of 66.58m AOD which appears to be low enough to provide a suitable connection point.

5 Conclusion

The majority of the site is currently concrete hardstood ground with overgrown vegetation towards the north. The proposal is to develop residential properties including soft landscaping and car parking.

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:

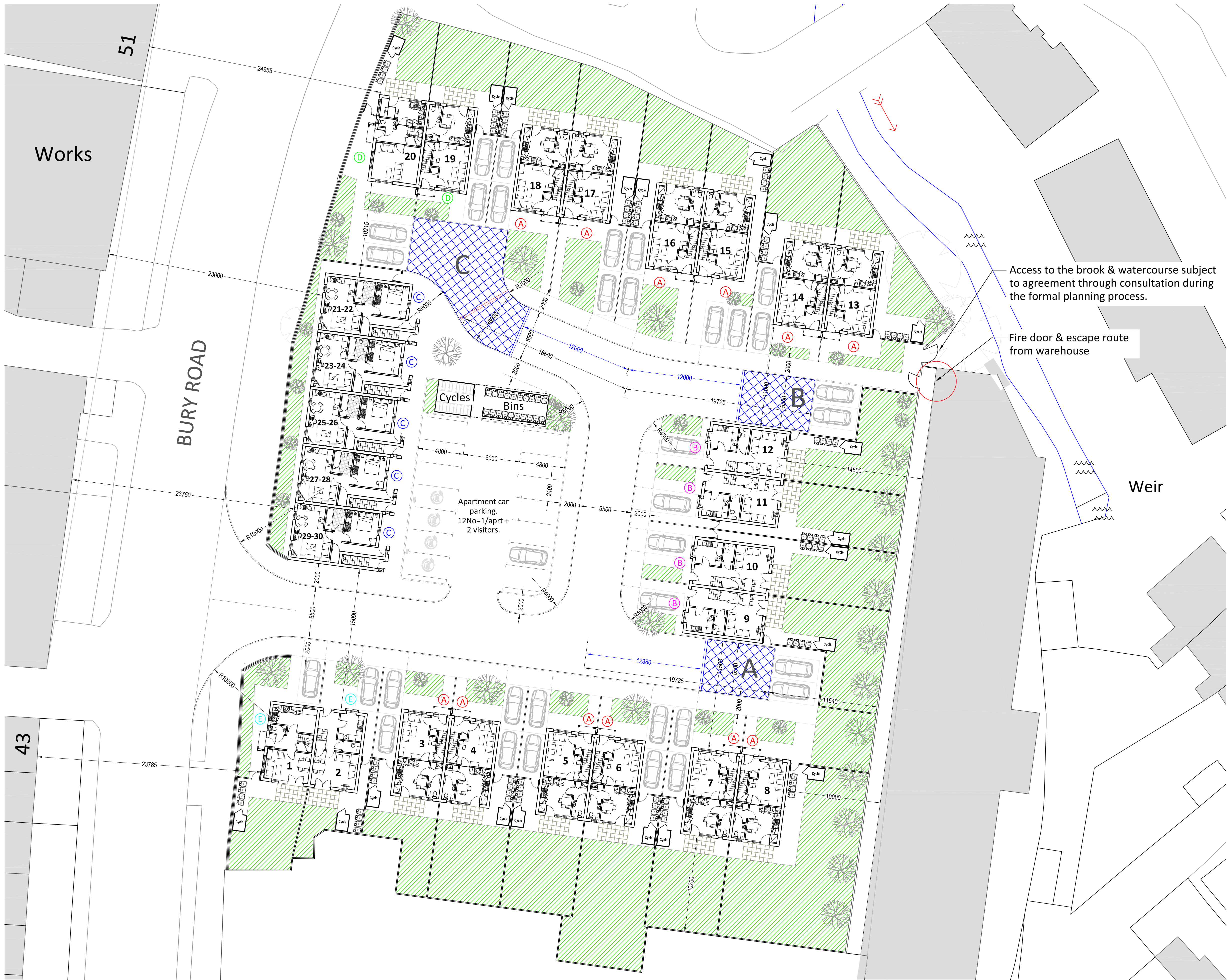
- » The site is considered to be too constrained due to the existing topography and proximity of the adjacent properties for the use of soakaway.
- » The recorded geology on site would indicate that infiltration may not be practical. This may be investigated at the detailed design stage by means of undertaking permeability testing.
- » The attenuation required for a 1 in 30-year storm event, requires a storage volume of **83.9m³** and for the 1 in 100-year event, a storage capacity of between **159.2m³** and **196.3m³** will be required from on-site storage as well as SuDS systems.
- » The suitability and depth of a potential connection into the onsite sewer to the west of the site should be confirmed on site.
- » A pre-development advice enquiry received from United Utilities considered that a flow rate of 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: Paul Cook Developments Ltd				Title: Site Location & Boundary Plan				
Site: Station Works, Bury Road, Radcliffe				Scale (see scale bar): 1:25,000 & 1:2,000 @ A4				Figure: 1
Job No.: FRA 22 1128	Drawn By: JL	Checked By: MJ	Drawn: Aug 2022	Revision:				



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Contractors are to check all levels & dimensions on site prior to site works commencing & report discrepancies to the Designers.

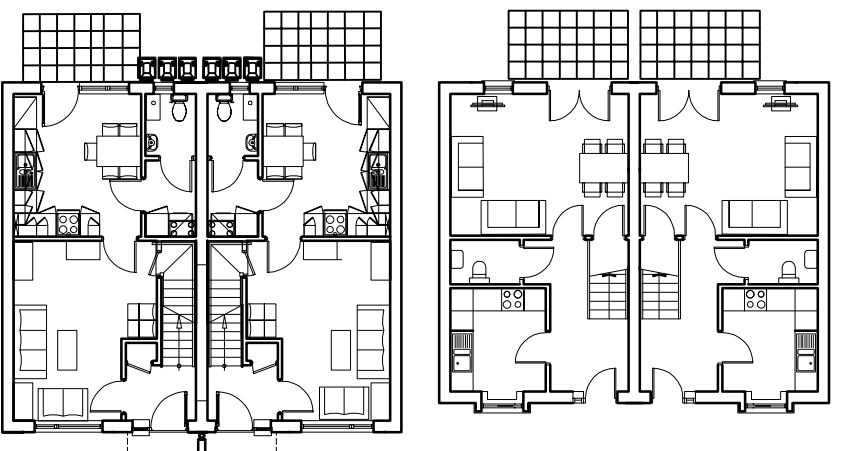
DO NOT SCALE FROM THIS DRAWING

PLANNING

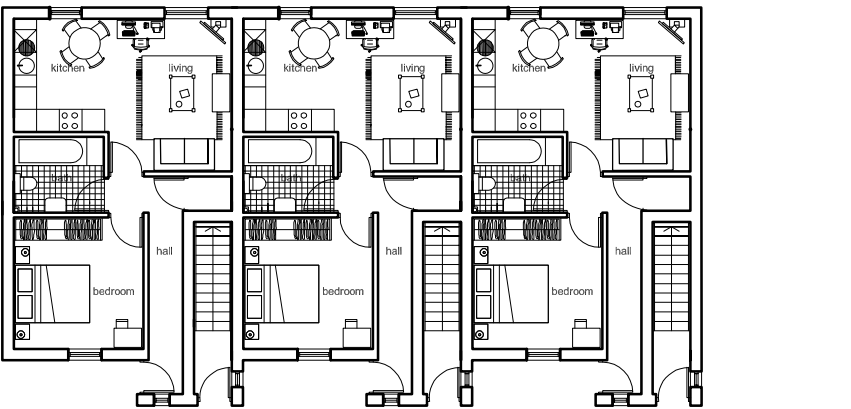
ACCOMMODATION SCHEDULE:

- A - 12 No. 3 Bed Units
- B - 4 No. 2 Bed Units
- C - 10 No. 1 Bed Units
- D - 2 No. 3 Bed Units
- E - 2 No. 2 Bed Units

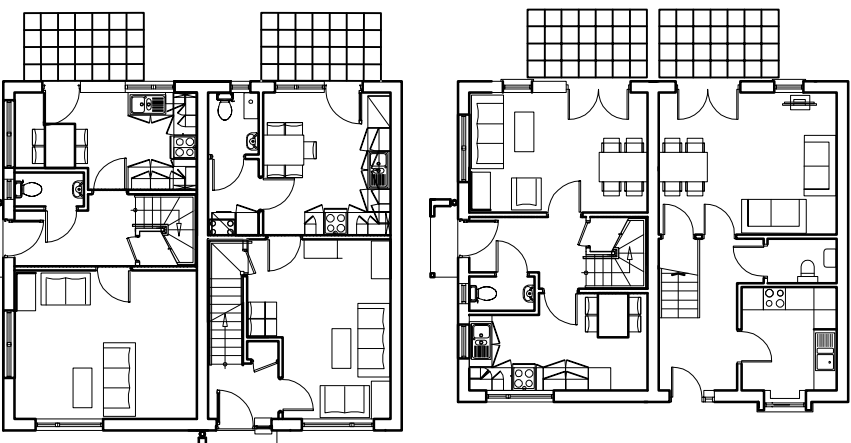
Totalling 30 Units.



Ground floor plan
A 3 bed 4p (81.5M2)
B 2 bed 3p (71M2) x 6No



Ground floor plan
C 1 bed 1p (46M2-ex staircase)



Ground floor plan
D 3 bed 4p (81.5M2)
E 2 bed 3p (71M2)

G	Layout amended to address Highway comments in relation to estate road adoption requirements.	TR	CM	19.07.22
F	Layout amended in response to initial comments received from the planning officer.	CM	TR	24.03.22
E	Plan layout amended to reflect Jigsaw Homes Group accommodation schedule.	DD	TR	07.01.22
D	Plan layout amended to reflect Jigsaw Homes Group drawing received 13.10.21.	CM	TR	06.05.21

Rev	Description	By	Chk	Date
Project:	Station works. Bury rd, Radcliffe, M26 2UA.			
Title:	Proposed Site Plan			
Client:	Paul Cook Developments / Jigsaw Homes			
Drawn By:	DD	Checked By:	BJ/TR	on 07/01/22
Original Size:	A1	Project Number:	22049	
Drawing Number:	SI-00-DR- A-0002	REV	G	

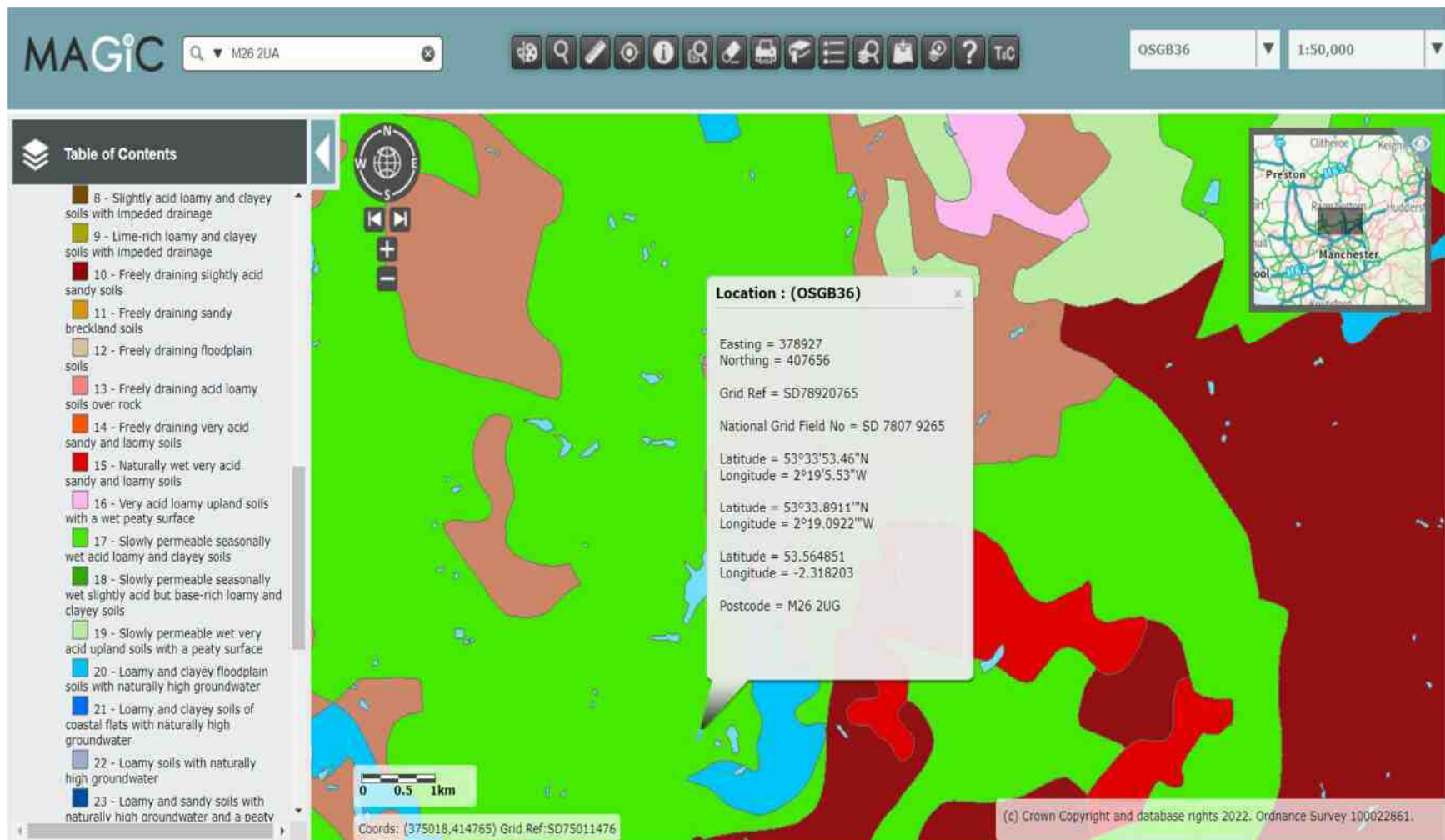


APPENDIX B

SITE INFORMATION







Defra Soilscape Mapping - (c) Crown Copyright and database rights 2021. Ordnance Survey 100022861



British
Geological
Survey

Version 2.0.6.6

BGS ID: 18402 : BGS Reference: SD70NE25

British National Grid (27700) : 378966,407887

[Report an issue with this borehole](#)

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< Prev

Page 1 of 16

Next >

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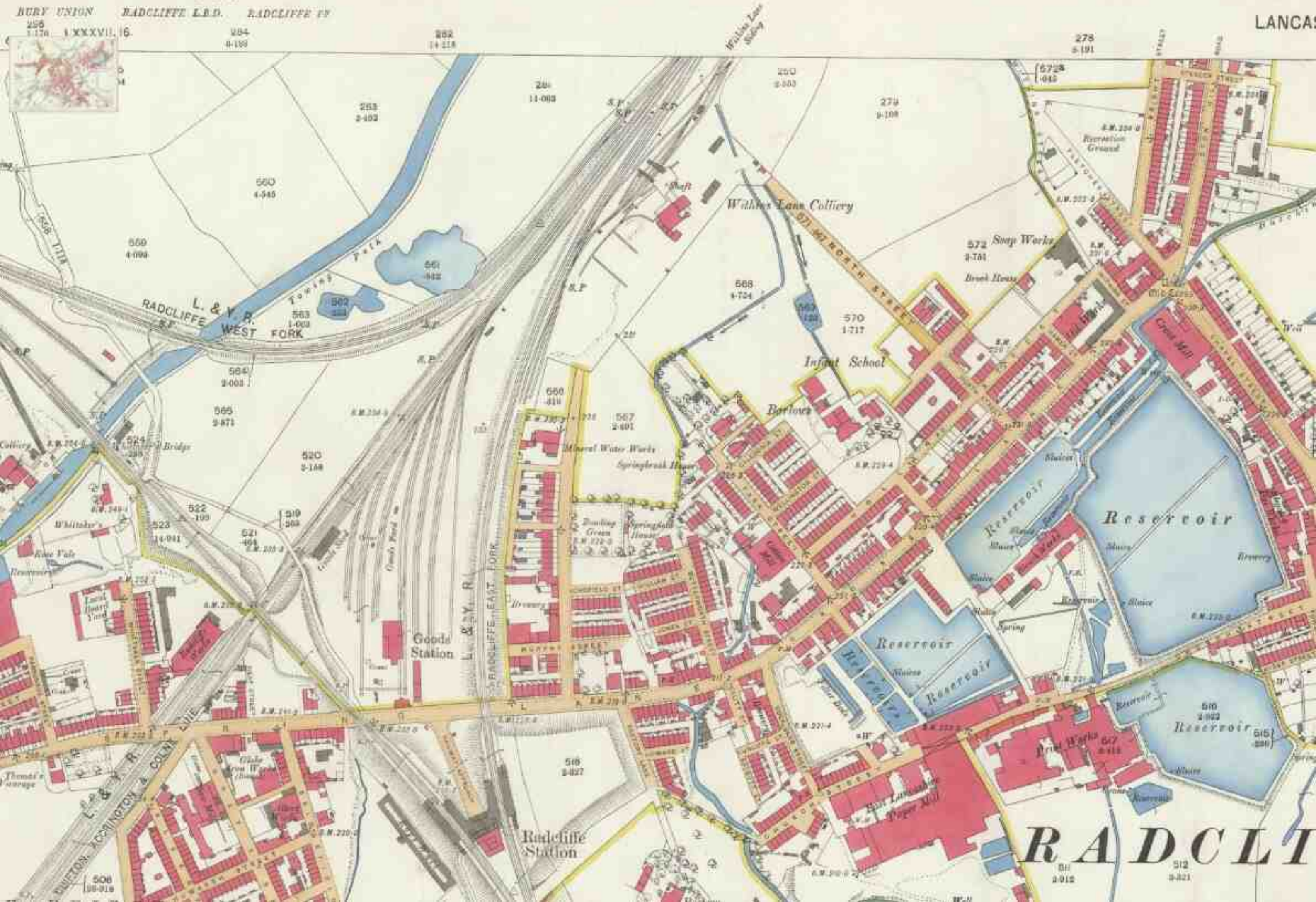
Section from Lane 250 E.

SD 70 NE 25

SECTION OF PIT AT WITHINS.

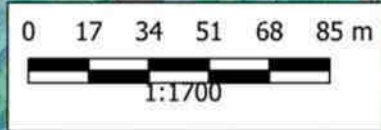
					Ft.	In.	Ft.	In.
1	Soil and gravel	...	...	...	8	0		
2	Marl	...	...	...	53	8		
3	Blue Rock	...	...	...	8	0		
4	Floor	...	...	...	1	2		
5	Blue Rock	...	...	...	5	9		
6	Floor	...	...	...	1	0		
7	Soft Rock	...	...	...	1	9		
8	Metal	...	...	...	8	0		
9	COAL	...	...	...		5		
10	Warrant	...	...	...	2	10		
11	Soft Rock	...	...	...	9	0		
12	COAL	...	...	...	1	1		
13	Warrant	...	...	...	2	5		
14	Rocky Warrant	...	...	...	1	4		
15	Rock	...	...	...	9	6		
16	Strong Metal	...	...	...	4	0		
17	Slate Floor	...	...	...	1	2		
18	COAL	...	...	...	2	0		
19	Warrant	...	...	...	2	8		
20	Strong Rocky Warrant	...	...	...	3	6		
21	Strong Grey Metal	...	...	...	14	0		
	WHITE MINE							
22	COAL	...	...	...		3		
	Warrant	...	...	...	2	4		
	Dark Grey Metal	...	...	...		9		
	COAL	...	...	...	1	6		
23	Soft Doughing	...	...	...		6		
24	Warrant	...	...	...	3	4		
25	Rock Bands	...	...	...	4	9		
26	Rock	...	...	...	3	4		

27	Rock Bands	...	...	...	...	3	10
28	Burr	...	...	...	...	1	0
29	Flaggy Rock	...	...	...	...	4	7
30	Strong Blue Metal	...	...	...	...	6	0



APPENDIX C

CONSULTEE CORRESPONDENCE



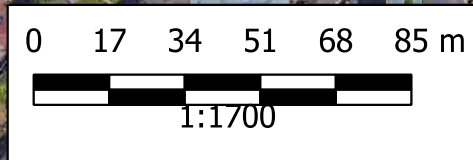
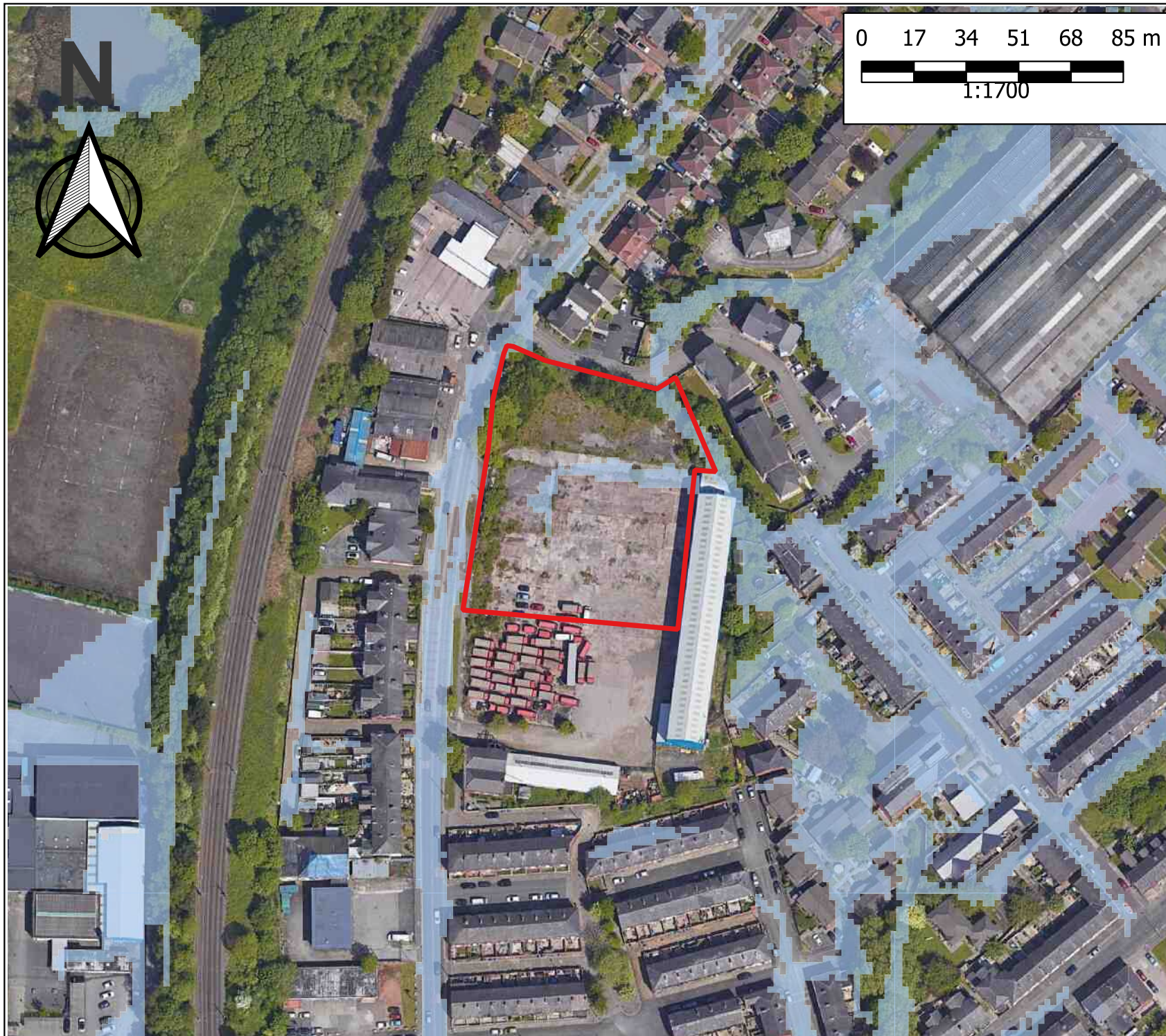
KEY

-  Site Location
-  Flood Zone 2
-  Flood Zone 3

Sampling locations and features indicated by LK Consult Ltd are approximate and are based upon observed measurements unless otherwise stated. Do not scale 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			
Paul Cook Developments Ltd			
Station Works, Bury Road, Radcliffe			
Title			
Flood Zones Map			
Plot No.	Scale (see notes box)	Figure	Rev
FRA 22 1128	1:1700 @ A4		
Drawn By	Issued By	Date	
JL	MJ	Sept 2022	



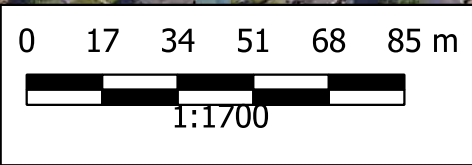
KEY

 Site Location

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Client: Paul Cook Developments Ltd			
Site: Station Works, Bury Road, Radcliffe			
Title: Low Surface Water Risk			
Job No.: FRA 22 1128	Scale (see scale bar): 1:1700 @ A4	Figure:	Rev:
Drawn By: JL	Checked By: MJ	Drawn: Sept 2022	



KEY



Site Location

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.

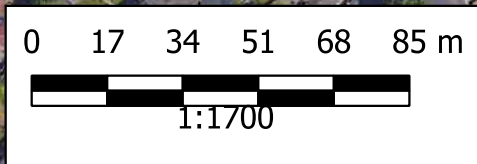


Client: Paul Cook Developments Ltd

Site: Station Works, Bury Road, Radcliffe

Title: Medium Surface Water

Job No:	Scale (see scale bar):	Figure:	Rev:
FRA 22 1128	1:1700 @ A4		
Drawn By:	Checked By:	Drawn:	
JL	MJ	Sept 2022	



KEY



Site Location

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:
Paul Cook Developments Ltd

Site:
Station Works, Bury Road, Radcliffe

Title:
High Surface Water Risk

Job No: FRA 22 1128	Scale (see scale bar): 1:1700 @ A4	Figure:	Rev:
Drawn By: JL	Checked By: MJ	Drawn: Sept 2022	

LKGroup**Unit 29 Eton Business Park
Unit 29, Eton Business Park,
Radcliffe, Greater Manchester
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 22 1128
Our Ref: UUPS-ORD-422451
Date: 16/08/2022****Dear Sirs****Location: FERRARI ELECTRO PLATING STATION WORKS BURY ROAD, RADCLIFFE,
MANCHESTER, M26 2UA**

I acknowledge with thanks your request dated 11/08/2022 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.



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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Reho	Cover	Func	Invert	Size x	Size y	Shape	Mat	Length	Grad
8801	69.58	CO	0	225	150	VC	42.68344	1 in 152	
1803		CO	0	150	150	VC	12.98003		
0513		SW	0	225	150	VC	1.65886		
1612		FO	0	150	150	VC	3.95334		
6301	69.26	CO	0	300	300	VC	22.4722		
6313		CO	0	150	150	VC	28.1753		
0400		CO	0	480		GRP	13.92839		
1631		SW	0	100	100	VC	5.77665		
1611		FO	0	150	150	VC	7.21221		
1638		FO	0	100	100	VC	16.37066		
0904		CO	0	150	150	VC	39.35459		
1620		CO	0	150	150	VC	1.64361		
1618		SW	0	100	100	VC	5.45248		
9901		CO	0	100	100	PVC	5.427787		
6301	69.26	CO	66.79	300	300	VC	10.63644		
1602	69.75	CO	65.28	225	225	VC	23.76973	1 in 792	
2812		CO	0	150	150	VC	127.2871	1 in 122	
1622		CO	0	225	225	VC	9.367454		
8509		CO	0	100	100	VC	8.02363		
1625		CO	0	100	100	VC	5.122041		
1619		CO	0	100	100	VC	17.84468		
9600	66.64	CO	66.47	100	100	VC	24.05119	1 in 69	
1615		SW	0	150	150	VC	6.020794		
9406	66.02	CO	62.79	300	300	VC	31.257	1 in 120	
9523		FO	0	100	100	VC	5.912383		
1627		FO	0	100	100	VC	4.969507		
1613		CO	0	225	225	VC	4.819112		
1613		FO	0	100	100	VC	3.789912		
1639		SW	0	100	100	VC	25.20953		
7302	69.27	CO	65.01	375	375	VC	43.9559	1 in 48	
0601	68.69	CO	65.45	450	450	VC	4.24264	1 in 141	
0900	71.73	CO	68.85	300	300	VC	81.21576	1 in 162	
0512		SW	0	225	225	VC	16.75016		
9406	71.77	CO	70	300	300	VC	18	1 in 120	
1404	67.44	CO	62.38	450	450	CO	21.93171		
8511		CO	0	150	150	VC	17.54462		
9502	68.04	CO	65.98	300	300	VC	23.76973	1 in 95	
1403	66.59	CO	0	225	225	VC	2.828427		
1632		SW	0	100	100	VC	35.30529		
7306		CO	0	375	375	VC	29.8307		
2500	69.59	CO	66.72	375	375	VC	23.32581		
1601	69.38	CO	67.18	225	225	VC	12.04159	1 in 23	
0406	66.65	SW	0	225	225	VC	20.24846		
1700	69.45	CO	66.84	375	375	VC	25.45584	1 in 134	
1610		FO	0	100	100	PVC	9.195436		
1701	69.38	CO	66.73	375	375	VC	12.04159	1 in 120	
1702		CO	0	225	225	VC	23.34524		
8516		CO	0	150	150	VC	21.53264		
1901	70.09	CO	69.07	100	100	VC	24.05119	1 in 105	
2709		CO	0	150	150	VC	13.45362		
9408		CO	0	700	700	BR	15.91139		
9301	66.57	CO	61.73	750	750	BR	68.68042	1 in 1717	
9402	67.38	CO	62.95	600	600	CO	27.19615	1 in 123	
0908	67	CO	64.66	375	375	VC	23.34524	1 in 24	
1400	66.73	CO	65.77	150	150	VC	25.07987	1 in 28	
6308		SW	0	100	100	VC	4.175962		
8510		CO	0	100	100	VC	4.123905		
1609		FO	0	100	100	VC	22.0621		
8801		VC	0	150	150	VC	9.96827		
1503	69.14	CO	67.18	225	225	VC	4.24264		
0700	70.57	CO	67.67	300	300	VC	40.67788	1 in 58	
9501	68.45	CO	66.11	300	300	VC	24.31105	1 in 221	
1626		CO	0	100	100	VC	15.78613		
8604	69.24	CO	66.28	375	375	VC	3.162278		
1506		CO	0	225	225	VC	39.89897		
8601		CO	0	100	100	VC	31.31672		
9524		FO	0	100	100	VC	4.041868		
1603	69.7	CO	65.93	100	100	BR	12.72752		
9437		CO	0	150	150	VC	1.638657		
0905		SW	0	150	150	VC	25		
9407	66.43	CO	61.8	720	720	BR	16.55295	1 in 828	
8603	69.24	CO	66.24	375	375	CO	31.0509	1 in 61	
1604		CO	0	150	150	VC	6.437564		
1502		CO	0	225	225	VC	31.82766		
0800	70.2	CO	68.01	225	225	VC	125.1599	1 in 122	
8602	69.41	CO	67.38	225	225	VC	42.10701	1 in 69	
8605	69.33	CO	67.49	225	225	VC	43	1 in 42	
0321	64.3	CO	60.14	225	225	VC	16.07633	1 in 8	
0405	66.13	CO	65.25	375	375	BR	39.84972	1 in 69	
0321	64.3	CO	0	100	100	DI	5.605835		
0511		FO	0	150	150	VC	38.29667		
0303	64.11	CO	62.33	300	300	VC	26.83263	1 in 383	
9503	67.46	CO	65.59	300	300	VC	60.0797	1 in 94	
9318		SW	0	520	520	VC	75.97862		
0500	68.77	CO	65	450	450	VC	12.04159		
0404	65.65	CO	65.55	225	225	BR	19.52486	1 in 125	
8404	66.94	CO	62.73	600	600	CO	50.24938	1 in 144	
0600	68.7	CO	65.6	450	450	VC	13.03147	1 in 124	
2803	69.77	CO	66.14	300	300	VC	35.4663		
1300	66.73	CO	0	300	300	VC	57.08233		
0625		CO	0	100	100	VC	2.867101		
0527		CO	0	150	150	VC	9.16421		
0509	67.75	CO	65.43	300	300	VC	40.16217	1 in 54	
1501	69.23	CO	65.57	400	400	BR	62.62587	1 in 44	
0306	64.85	CO	61.84	450	450	VC	11.40175		
0402	66.02	CO	63.6	375	375	VC	22.13594		
0528		FO	0	150	150	VC	9.241051		
8501	67.91	CO	64.54	375	375	VC	23.08879	1 in 17	
0701		CO	0	225	225	VC	20.24846		
0701	70.31	CO	67.19	300	300	VC	43.17406	1 in 149	
2803	69.54	CO	67.29	225	225	VC	48.05326		
0407	66.6	CO	65.88	225	225	VC	56.67202		
9525		CO	0	225	225	VC	7.051814		
0912		CO	0	225	225	VC	2.13323		
9404	66.08	CO	62.19	225	225	BR	3.605551	1 in 0	
9904		CO	0	225	225	VC	22.73517		
1306	65.21	SW	63.47	660	660	BR	2.236586	1 in 13	
0801	71.29	CO	68	300	300	VC	131.6548	1 in 1013	
0504		SW	0	150	150	VC	51.45984		
1302	65.12	CO	62.22	450	450	CO	4.095195		
0604	66.35	CO	66.77	225	225	VC	24.05119	1 in 83	
0603	66.3	CO	66.43	225	225	VC	24.83940		
0401	65.35	CO	62.67	600	600	BR	3.162278		
0605	66.68	CO	65.17	450	450	VC	23.43075	1 in 180	
0302	63.93	CO	62.06	450	450	CO	71.07758	1 in 7108	
9401		SW	0	520	520	VC	43.60946		
0602	66.69	CO	65.37	450	450	CO	19.84943		
9910		CO	0	150	150	VC	18.86963		
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0307	64.93	SW	62.78	300	300	VC	30.01321	1 in 90	
0425		CO	0	150	150	VC	3.34184		
0413		CO	0	225	225	VC	21.24771		
0308	64.44	SW	61.9	300	300	VC	6.101373		
0300	64.88	CO	62.24	450	450	CO	34.15951	1 in 213	
0624		CO	0	150	150	VC	9.824987		
2701	69.31	CO	66.29	450	450	VC	16.27882		
9602		CO	0	150	150	VC	8.62991		
0606		SW	0	300	300	VC	8.602325		
9506	67.4	CO	0	300	300	VC	25		
0901	71.46	CO	68.33	300	300	VC	51.73973	1 in 185	
2705	69.05	CO	66.71	225	225	VC	22.62742		
1508		CO	0	450	450	VC	12.04159		
0626		CO	0	150	150	VC	3.054772		
1401	65.98	CO	64.87	150	150	VC	19.31321		
1600	69.28	CO	65.79	375	375	VC	107.0561	1 in 282	
0520		FO	0	100	100	VC	13.21856		
0912		CO	0	225	225	VC	25.79207		
1900	70.2	CO	68.4	300	300	VC	57.98276	1 in 290	
9906		PVC	0	100	100	VC	3.957944		
6403		CO	0	300	300	VC	28.16026		
9402	65.27	CO	62.19	900	900	CO	25.70992	1 in 112	
8302	69.27	CO	66.61	375	375	CO	43.01163	1 in 44	
9302	65.47	CO	62	450	4				

Jenna Lowe

From: wastewaterdeveloperservices@uuplc.co.uk
Sent: 25 August 2022 20:14
To: Jenna Lowe
Subject: SuDS QUERY - FRA 22 1128 - Station Works, Bury Road, Radcliffe - Uu Ref. 02664735

Good evening Jenna,

Pre Development Enquiry for: Station Works, Bury Road, Radcliffe, M26 2UA UU Reference Number : 02664735

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 300mm diameter public combined sewer within Bury Road 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.

Waterbody

If an evidence based assessment has been carried out and confirms that infiltration is not feasible, we recommend that you contact the Lead Local Flood Authority and/or Environment Agency to discuss a point of discharge to the open ordinary watercourse located east of the proposed site.

We would encourage you to identify and engage with any third party landowner and riparian owner to agree access and discharge rights to the water body if this is not in your ownership.

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

Given that there is a more sustainable method of draining the site to the watercourse located to the east, it is assumed that a connection to the public sewer is not required.

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

Sewer Adoptions

You have indicated on your application form that you intend to put the sewers forward for adoption (including any SuDS components that can come within the meaning of a sewer).

United Utilities assess adoption applications based on the current Design & Construction Guidance and local practices which have now replaced 'Sewers For Adoption 6th Edition'.

We recommend that you submit a pre design assessment to the sewer adoption mailbox (SewerAdoptions@uuplc.co.uk) stating pre design assessment in the title

Please refer to links below to obtain further guidance:

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

Site drainage must be designed in accordance with Building Regulations, National Planning Policy, and local flood authority guidelines, we would recommend that you speak and make suitable agreements with the relevant statutory bodies.

If you intend to put forward your wastewater assets for adoption by United Utilities, the proposed detail design will be subject to a technical appraisal by an Adoption Engineer as we need to be sure that the proposals meet the requirements set out in the Design & Construction Guidance. The proposed design should give consideration to long term operability and give United Utilities a safe and cost effective proposal for the lifetime of the assets. In these cases, we strongly recommend that no construction commences until the detailed drainage design, submitted as part of the Section 104 application, has been assessed and accepted in writing by United Utilities. Any work carried out prior to the technical assessment being approved is done entirely at the developer's own risk and could be subject to change.

SuDS

If your development proposal incorporates any SuDS component(s) which interact with a sewer network you plan on offering for adoption to United Utilities; contact should be made with our technical team at your earliest convenience, please complete the 'Section 104 pre-application form : ' and include as much relevant detail as you can. These discussions can help prevent delays later in the development process.

Section 104 Pre application form (1b)

As per the sewerage sector guidance, all SuDS should be designed in accordance with the standards within the Design & construction guidance & the CIRIA SuDS manual (C753)

Codes For Adoption

The new Codes for Adoption are outlined on the Water UK Website. The link below takes you to their webpage:

<https://www.water.org.uk/technical-guidance/developers-services/codes-for-adoption/>

A free copy of the new Design & Construction Guidance can be downloaded via the link below:

<https://www.water.org.uk/sewerage-sector-guidance-approved-documents/>

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/>

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,

Shoaib.



Water for the North West

Shoaib Tauqeer

Developer Engineer

Developer Services & Metering

M: 07876745601

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Did you know we now have a live chat facility available to you Mon to Friday 8 -5pm. You just click on the orange live chat box on our webpage and one of our advisors will be ready to chat to you and help you with your enquiry <https://www.unitedutilities.com/builders-developers/> or you can email us at developerserviceswater@uuplc.co.uk

Coronavirus

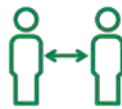
Prevent the spread



Wash your
hands



Disinfect
common surfaces



Practise social
distancing



FEVER +
COUGH

Stay home if you
have symptoms

[Click for our message to customers](#)

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

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

Sent: 18/08/2022 14:25

To: j.lowe@thelkgroup.com

Subject: SuDS QUERY - FRA 22 1128 - Station Works, Bury Road, Radcliffe - Uu Ref. 02664735

Good Afternoon,

Thank you for contacting United Utilities.

I have passed your details to our engineer who will respond in due course.

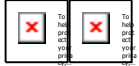
Kind Regards,



Louise Dack

Customer Advisor Advanced
Developer Services & Metering
Customer Services
T: 01925 233063 (33063 internal)
unitedutilities.com

Did you know we now have a live chat facility available to you Mon to Friday 8 -5pm. You just click on the orange live chat box on our webpage and one of our advisors will be ready to chat to you and help you with your enquiry <https://www.unitedutilities.com/builders-developers/> or you can email us at WastewaterDeveloperServices@uuplc.co.uk



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Jenna Lowe

From: Smith, Frances <F.Smith@bury.gov.uk>
Sent: 17 August 2022 19:09
To: Jenna Lowe
Cc: Southgate, Andrew
Subject: RE: SuDS QUERY - FRA 22 1128 - Station Works, Bury Road, Radcliffe

Hi Jenna,

In response to your email below, please note the following:

- The Environment Agency are installing flood defences along the River Irwell between Close Park and Lower Hinds. EA will be able to provide detailed information regarding these defences;
- There were significant flood events in 2015 and 2020 in Radcliffe;
- The site is not within a Critical Drainage Area
- The UDP does not contain any SUDs policies and therefore NPPF para 167 would apply.

Andy will be able to advise in relation to ordinary watercourses and sewers in the area and highway drainage restrictions and records.

I hope the above helps.

Regards

Fran

From: Jenna Lowe <j.lowe@thelkgroup.com>
Sent: 11 August 2022 16:12
To: Smith, Frances <F.Smith@bury.gov.uk>; Southgate, Andrew <A.M.Southgate@bury.gov.uk>; Development Control <Development.Control@bury.gov.uk>; Planning Policy <Planning.Policy@bury.gov.uk>
Subject: SuDS QUERY - FRA 22 1128 - Station Works, Bury Road, Radcliffe

Dear Sir/Madam,

LK Consult Ltd. has been commissioned to undertake a Sustainable Drainage Strategy (SuDS) for a site located at Station Works, Bury Road, Radcliffe, M26 2UA, centred at approximate National Grid Reference 378922E, 407648N.

The area of interest appears to be partially within Flood Zone 2.

The site location is attached to this email.

To complete the SUDs, we would be grateful if you could supply us with the following, if available, for the vicinity of the site:

- Details of any flood defences in the immediate area, including their extent, crest levels (and datum), assumed level of standard, construction and maintenance regime, as well as any other structures which may influence the local hydraulics.

- Records of any historic flood events and potential sources of flooding from rivers, land drainage, groundwater, foul and surface water sewers on site and in the area.
- Any restrictions applied to ordinary watercourses and sewers in the area.
- Highway drainage restrictions and records.
- Indications if the site is within the Critical Drainage Area.
- Policies that may relate to Sustainable Drainage Systems (SuDS).

If you have any queries, please do not hesitate to get in touch.

We are, of course, happy to pay your reasonable charge for this service. Please let me know by return what information is available, what the charge will be, and we will pay the relevant fees by debit card as soon as possible.

Any advice or recommendations you may have regarding the potential discharges from the development of this site would also be appreciated.

We will be in contact with all other relevant authorities to get a more complete understanding of the issues in the area.

Regards,
Jenna



Jenna Lowe MSc, BSc. (Hons)
Flood Risk Engineer
0161 763 7200 | 07467 957756
Manchester | London | Swindon | Liverpool | Glasgow
www.thelkgroup.com

I N C R E A S I N G L A N D V A L U E

APPENDIX D

CALCULATIONS



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Job No.		
Sheet no. 1		
Date 12/09/22		
By	Checked	Reviewed

Project	Greenfield Runoff Station Works, Bury	
Title	Greenfield Runoff Station Works, Bury	

Hydrological Data:-

FSR Hydrology:-

Location	=	STATION WORKS	Grid reference	=	SD 7807
M5-60 (mm)	=	18.8	r	=	0.32
Soil runoff	=	0.45	SAAR (mm/yr)	=	1100
WRAP	=	4	Area	=	England & Wales
Hydrological area	=	10	Hydrological zone	=	7

Soil classification for WRAP type 4

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

Design data:-

Area = 0.0054 Km² - 0.54 Ha - 5400 m²

Calculation method:-

Runoff is calculated from:-

$$Q_{BAR(rural)} = 0.00108 \text{ AREA}^{0.89} \cdot \text{SAAR}^{1.17} \cdot \text{SOIL}^{2.17}$$

where

AREA = Site area in Km²
 SAAR = Standard Average Annual Rainfall (mm/yr)
 SOIL = Soil value derived from Winter Rainfall Acceptance Potential
 Q_{BAR(rural)} = Runoff (cumecs)

Q_{BAR(rural)} is then multiplied by a growth factor - GC(T) - for different storm return periods derived from EA publication W5-074/A.

Calculated data:-

For areas less than 50Ha, a modified calculation which multiplies the 50Ha runoff value by the ratio of the site area to 50Ha is used
 Reducing factor used for these calculations is 0.011

Mean Annual Peak Flow $Q_{BAR(rural)} = 4.03 \text{ l/s}$



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Date 12/09/22		
By	Checked	Reviewed

Project **Greenfield Runoff Station Works, Bury**

Title **Greenfield Runoff Station Works, Bury**

Values for $Q_{BAR(rural)}$

Ret. per. 1yr	m ³ /hr	l/s	l/s/ha	Ret. per. 100yr+20%	m ³ /hr	l/s	l/s/ha
2yr	13.478	3.744	6.933	100yr+30%	39.564	10.990	20.352
5yr	17.536	4.871	9.020	100yr+40%	42.607	11.835	21.917
10yr	19.999	5.555	10.288	200yr	34.781	9.661	17.892
30yr	24.347	6.763	12.524	200yr + 30%	45.216	12.560	23.259
50yr	26.811	7.447	13.791	500yr	39.564	10.990	20.352
100yr	30.434	8.454	15.655	1000yr	44.056	12.238	22.663

Growth factors -

1yr	2yr	5yr	10yr	30yr	50yr	100yr	200yr	500yr	1000yr
0.85	0.93	1.21	1.38	1.68	1.85	2.10	2.40	2.73	3.04

The above is based on the Institute of Hydrology Report 124
to which you are referred for further details (see Sect 7).
Note that the 200 and above year growth curves were taken from W5-074.



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Job No.		
Sheet no. 1		
Date 12/09/22		
By	Checked	Reviewed

Project	Qbar Existing Runoff Station Works, Bury
Title	Qbar Existing Runoff Station Works, Bury

Area data:-

FSR data

M5-60 = 18.8

Soil index = 0.45

WRAP value = 4

$r = 0.32$

SAAR = 1100

Nat grid = SD 7807

Site data:-

Ret. period (yrs) = 2.33

Time of entry = 7.00

Impervious area drained = 4500 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 = 900 m²

Soil type = Clay

Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 68.0%

Rainfall rate = 56.9 mm/Hr

UCWI = 111.1

Runoff rate (gross) = 58.0 l/s

Methods

Runoff factor (RF) = 68.0, 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



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Job No.		
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Date 12/09/22		
By	Checked	Reviewed

Project **1 Year Existing Runoff Station Works, Bury**

Title **1 Year Existing Runoff Station Works, Bury**

Area data:-

FSR data

M5-60 = 18.8

Soil index = 0.45

WRAP value = 4

$r = 0.32$

SAAR = 1100

Nat grid = SD 7807

Site data:-

Ret. period (yrs) = 1

Time of entry = 10.00

Impervious area drained = 4500 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 = 900 m²

Soil type = Clay

Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 68.0%

Rainfall rate = 40.2 mm/Hr

UCWI = 111.1

Runoff rate (gross) = 41.0 l/s

Methods

Runoff factor (RF) = 68.0, 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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Project	30 Years Existing Runoff Station Works, Bury
Title	30 Years Existing Runoff Station Works, Bury

Area data:-

FSR data

M5-60 = 18.8

Soil index = 0.45

WRAP value = 4

r = 0.32

SAAR = 1100

Nat grid = SD 7807

Site data:-

Ret. period (yrs) = 30

Time of entry = 6.00

Impervious area drained = 4500 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 = 900 m²

Soil type = Clay

Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 68.0%

Rainfall rate = 100.2 mm/Hr

UCWI = 111.1

Runoff rate (gross) = 102.2 l/s

Methods

Runoff factor (RF) = 68.0, 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 12/09/22		
By	Checked	Reviewed

Project **100 Years Existing Runoff Station Works, Bury**

Title **100 Years Existing Runoff Station Works, Bury**

Area data:-

FSR data

M5-60 = 18.8

Soil index = 0.45

WRAP value = 4

r = 0.32

SAAR = 1100

Nat grid = SD 7807

Site data:-

Ret. period (yrs) = 100

Time of entry = 6.00

Impervious area drained = 4500 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 = 900 m²

Soil type = Clay

Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 68.0%

Rainfall rate = 126.7 mm/Hr

UCWI = 111.1

Runoff rate (gross) = 129.2 l/s

Methods

Runoff factor (RF) = 68.0, 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 12/09/22		
By	Checked	Reviewed

Project	30 Years Storage Event Station Works, Bury
Title	30 Years Storage Event Station Works, Bury

Data:-

FSR Hydrology:-

Location = STATION WORKS
M5-60 (mm) = 18.8
Soil index = 0.45
Return period = 30
UCWI = 113.8

Grid reference = SD 7807
r = 0.32
SAAR (mm/yr) = 1100
WRAP = 4
Climate change = 0

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

Runoff factor (RF) = 61.0, calculated from:-

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

where

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

UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 4000 m²
Total area (TA) = 5400 m²
Mean disch. rate = 5.000 l/s
Additional flow = 0.00 l/s

Pervious area = 1400 m²
Equiv area = 3294 m² (TA x RF).
Areal reduction factor = 1.000
Climate change factor = 0

Calculated data:-

Time to max = 126.0 mins
Rainfall at max = 17.60 mm/hr
Pipeline storage = 0.0 m³
Offline storage = 0.0 m³

Calculated storage volume = 83.9 m³
Allowed discharge rate = 5.000 l/s
Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours
Rainfall rate = 8.00 mm/hr

Calculated storage volume = 54.9 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	10690.1	1125	84.5	400 x 600	466.4	500 x 500	335.8
150	4751.1	1200	74.2	600 x 900	203.1	500 x 750	223.9
225	2111.6	1275	65.8	800 x 1200	114.2	500 x 1000	167.9
300	1187.8	1350	58.7			750 x 1000	111.9
375	760.2	1425	52.6			750 x 1200	93.3
450	527.9	1500	47.5			750 x 1500	74.6
525	387.8	1575	43.1			1000 x 1000	83.9
600	296.9	1650	39.3			1000 x 1200	70.0
675	234.6	1725	35.9			1000 x 1500	56.0
750	190.0	1800	33.0			1000 x 1800	46.6
825	157.1	1875	30.4			1000 x 2000	42.0
900	132.0	1950	28.1			1500 x 1500	37.3
975	112.5	2025	26.1			1500 x 1800	31.1
1050	97.0	2100	24.2			1500 x 2000	28.0



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Data:-

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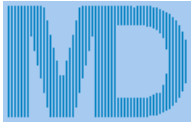
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Project **30 Years Storage Event Station Works, Bury**

Title **30 Years Storage Event Station Works, Bury**

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	81.0	44.287	3.000	41.287
20	56.0	61.996	6.000	55.996
30	45.0	73.484	9.000	64.484
40	37.0	82.186	12.000	70.186
50	33.0	89.264	15.000	74.264
60	29.0	95.267	18.000	77.267
70	26.0	100.499	21.000	79.499
80	24.0	105.147	24.000	81.147
90	22.0	109.336	27.000	82.336
100	21.0	113.152	30.000	83.152
110	19.0	116.659	33.000	83.659
120	18.0	119.906	36.000	83.906
130	17.0	122.928	39.000	83.928
140	16.0	125.756	42.000	83.756
150	16.0	128.413	45.000	83.413
160	15.0	130.918	48.000	82.918
170	14.0	133.288	51.000	82.288
180	14.0	135.536	54.000	81.536
190	13.0	137.674	57.000	80.674
200	13.0	139.711	60.000	79.711
210	12.0	141.657	63.000	78.657
220	12.0	143.518	66.000	77.518
230	12.0	145.302	69.000	76.302
240	11.0	147.013	72.000	75.013
250	11.0	148.658	75.000	73.658
260	11.0	150.310	78.000	72.310
270	10.0	151.924	81.000	70.924
280	10.0	153.492	84.000	69.492
290	10.0	155.017	87.000	68.017
300	10.0	156.503	90.000	66.503
310	9.0	157.950	93.000	64.950
320	9.0	159.362	96.000	63.362
330	9.0	160.740	99.000	61.740
340	9.0	162.086	102.000	60.086
350	9.0	163.402	105.000	58.402
360	8.0	164.689	108.000	56.689
370	8.0	165.949	111.000	54.949
380	8.0	167.183	114.000	53.183
390	8.0	168.392	117.000	51.392
400	8.0	169.578	120.000	49.578
410	8.0	170.740	123.000	47.740
420	7.0	171.882	126.000	45.882
430	7.0	173.002	129.000	44.002
440	7.0	174.102	132.000	42.102
450	7.0	175.183	135.000	40.183
460	7.0	176.246	138.000	38.246
470	7.0	177.291	141.000	36.291
480	7.0	178.320	144.000	34.320
490	7.0	179.331	147.000	32.331
500	7.0	180.327	150.000	30.327
510	6.0	181.308	153.000	28.308
520	6.0	182.274	156.000	26.274
530	6.0	183.226	159.000	24.226
540	6.0	184.164	162.000	22.164
550	6.0	185.088	165.000	20.088
560	6.0	186.000	168.000	18.000
570	6.0	186.900	171.000	15.900
580	6.0	187.787	174.000	13.787
590	6.0	188.662	177.000	11.662
600	6.0	189.527	180.000	9.527

Storage volume (m³) = 83.9 m³



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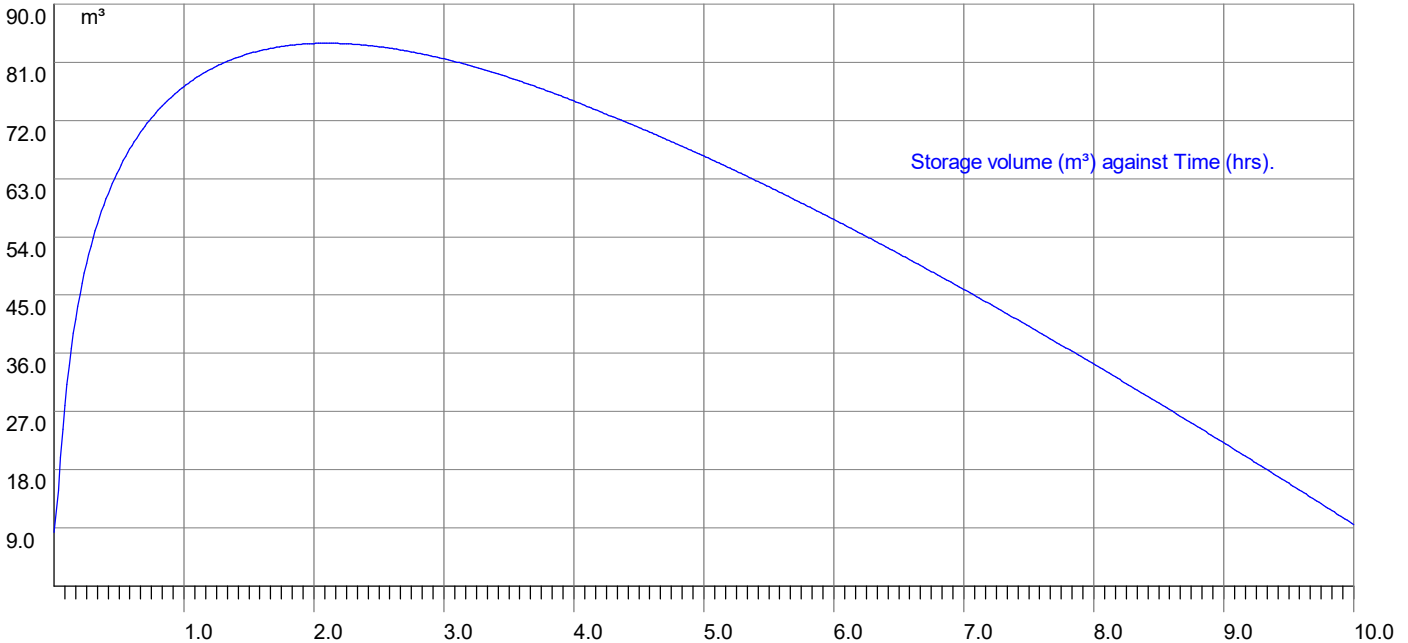
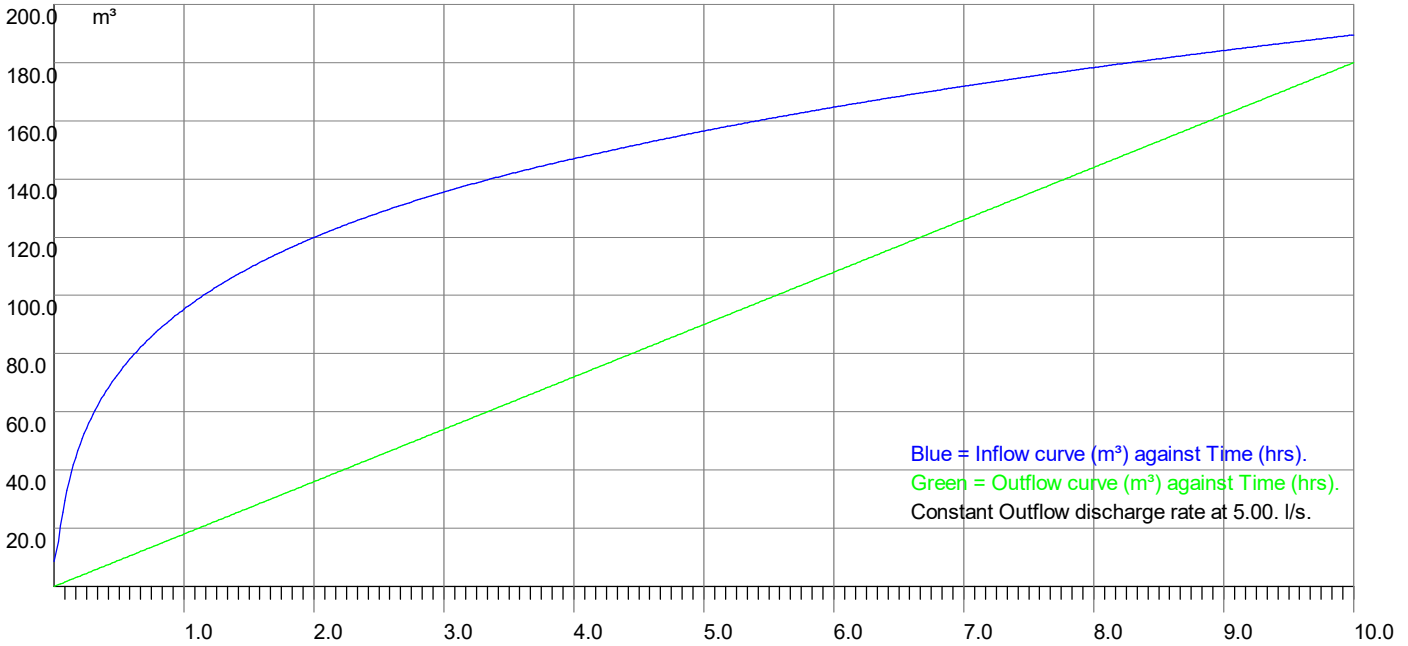
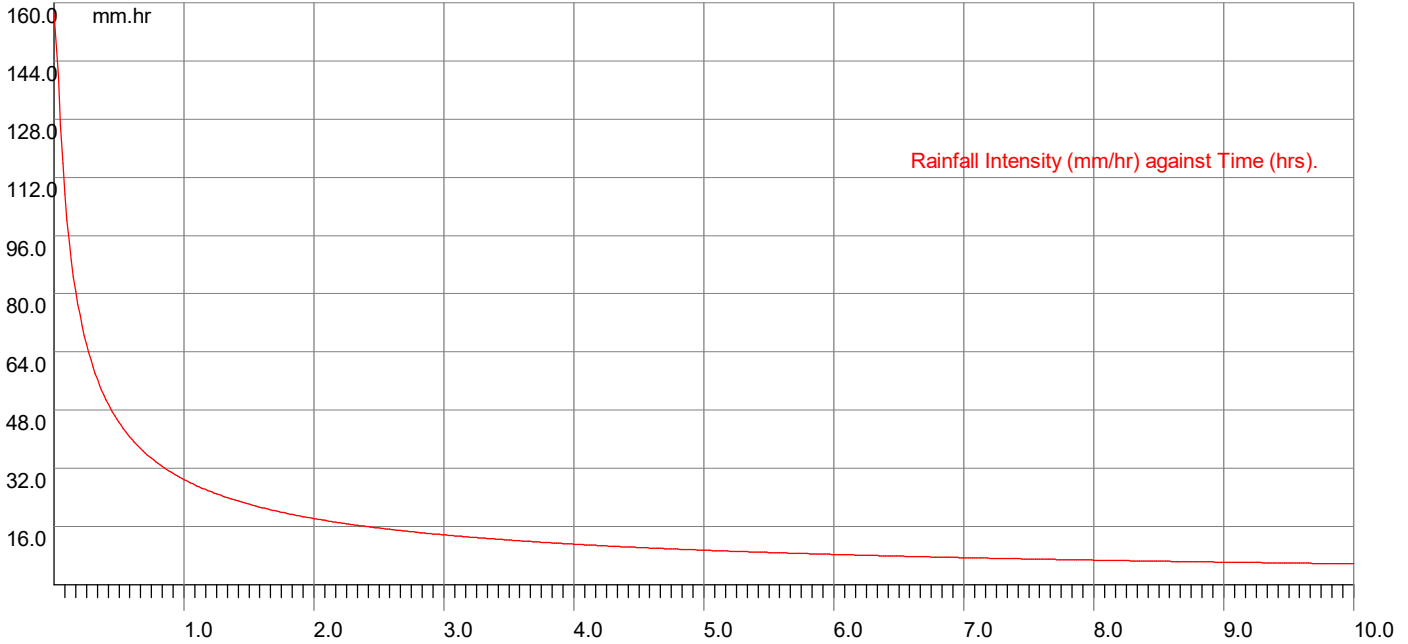
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Project **30 Years Storage Event Station Works, Bury**

Title **30 Years Storage Event Station Works, Bury**





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Date 12/09/22		
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Project **30 Years Storage Event Station Works, Bury**

Title **30 Years Storage Event Station Works, Bury**

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	100 Years + 20% CC Storage Event Station Works, Bury
Title	100 Years + 20% CC Storage Event Station Works, Bury

Data:-

FSR Hydrology:-

Location = STATION WORKS
M5-60 (mm) = 18.8
Soil index = 0.45
Return period = 100
UCWI = 113.8

Grid reference = SD 7807
r = 0.32
SAAR (mm/yr) = 1100
WRAP = 4
Climate change = 20

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

Runoff factor (RF) = 61.0, calculated from:-

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

where

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

UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 4000 m²
Total area (TA) = 5400 m²
Mean disch. rate = 5.000 l/s
Additional flow = 0.00 l/s

Pervious area = 1400 m²
Equiv area = 3294 m² (TA x RF).
Areal reduction factor = 1.000
Climate change factor = 20

Calculated data:-

Time to max = 196.0 mins
Rainfall at max = 20.26 mm/hr
Pipeline storage = 0.0 m³
Offline storage = 0.0 m³

Calculated storage volume = 159.2 m³
Allowed discharge rate = 5.000 l/s
Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours
Rainfall rate = 13.00 mm/hr

Calculated storage volume = 146.5 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	20278.5	1125	160.2	400 x 600	884.6	500 x 500	636.9
150	9012.7	1200	140.8	600 x 900	385.2	500 x 750	424.6
225	4005.6	1275	124.7	800 x 1200	216.6	500 x 1000	318.5
300	2253.2	1350	111.3			750 x 1000	212.3
375	1442.0	1425	99.9			750 x 1200	176.9
450	1001.4	1500	90.1			750 x 1500	141.5
525	735.7	1575	81.7			1000 x 1000	159.2
600	563.3	1650	74.5			1000 x 1200	132.7
675	445.1	1725	68.1			1000 x 1500	106.2
750	360.5	1800	62.6			1000 x 1800	88.5
825	297.9	1875	57.7			1000 x 2000	79.6
900	250.4	1950	53.3			1500 x 1500	70.8
975	213.3	2025	49.5			1500 x 1800	59.0
1050	183.9	2100	46.0			1500 x 2000	53.1



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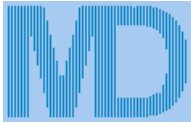
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Sheet no. 2		
Date 12/09/22		
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Project **100 Years + 20% CC Storage Event Station Works, Bury**

Title **100 Years + 20% CC Storage Event Station Works, Bury**

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	124.0	68.010	3.000	65.010
20	88.0	96.520	6.000	90.520
30	70.0	115.063	9.000	106.063
40	59.0	129.117	12.000	117.117
50	51.0	140.527	15.000	125.527
60	46.0	150.171	18.000	132.171
70	41.0	158.542	21.000	137.542
80	38.0	165.945	24.000	141.945
90	35.0	172.582	27.000	145.582
100	33.0	178.597	30.000	148.597
110	30.0	184.095	33.000	151.095
120	29.0	189.154	36.000	153.154
130	27.0	193.836	39.000	154.836
140	26.0	198.190	42.000	156.190
150	25.0	202.256	45.000	157.256
160	23.0	206.065	48.000	158.065
170	22.0	209.646	51.000	158.646
180	22.0	213.020	54.000	159.020
190	21.0	216.207	57.000	159.207
200	20.0	219.224	60.000	159.224
210	19.0	222.086	63.000	159.086
220	19.0	224.804	66.000	158.804
230	18.0	227.390	69.000	158.390
240	17.0	229.854	72.000	157.854
250	17.0	232.204	75.000	157.204
260	16.0	234.628	78.000	156.628
270	16.0	237.003	81.000	156.003
280	16.0	239.308	84.000	155.308
290	15.0	241.548	87.000	154.548
300	15.0	243.726	90.000	153.726
310	14.0	245.846	93.000	152.846
320	14.0	247.911	96.000	151.911
330	14.0	249.925	99.000	150.925
340	13.0	251.891	102.000	149.891
350	13.0	253.810	105.000	148.810
360	13.0	255.685	108.000	147.685
370	13.0	257.519	111.000	146.519
380	12.0	259.313	114.000	145.313
390	12.0	261.069	117.000	144.069
400	12.0	262.789	120.000	142.789
410	12.0	264.475	123.000	141.475
420	12.0	266.128	126.000	140.128
430	11.0	267.749	129.000	138.749
440	11.0	269.340	132.000	137.340
450	11.0	270.902	135.000	135.902
460	11.0	272.437	138.000	134.437
470	11.0	273.944	141.000	132.944
480	10.0	275.426	144.000	131.426
490	10.0	276.882	147.000	129.882
500	10.0	278.315	150.000	128.315
510	10.0	279.725	153.000	126.725
520	10.0	281.113	156.000	125.113
530	10.0	282.479	159.000	123.479
540	10.0	283.825	162.000	121.825
550	9.0	285.150	165.000	120.150
560	9.0	286.456	168.000	118.456
570	9.0	287.743	171.000	116.743
580	9.0	289.012	174.000	115.012
590	9.0	290.263	177.000	113.263
600	9.0	291.498	180.000	111.498

Storage volume (m³) = 159.2 m³



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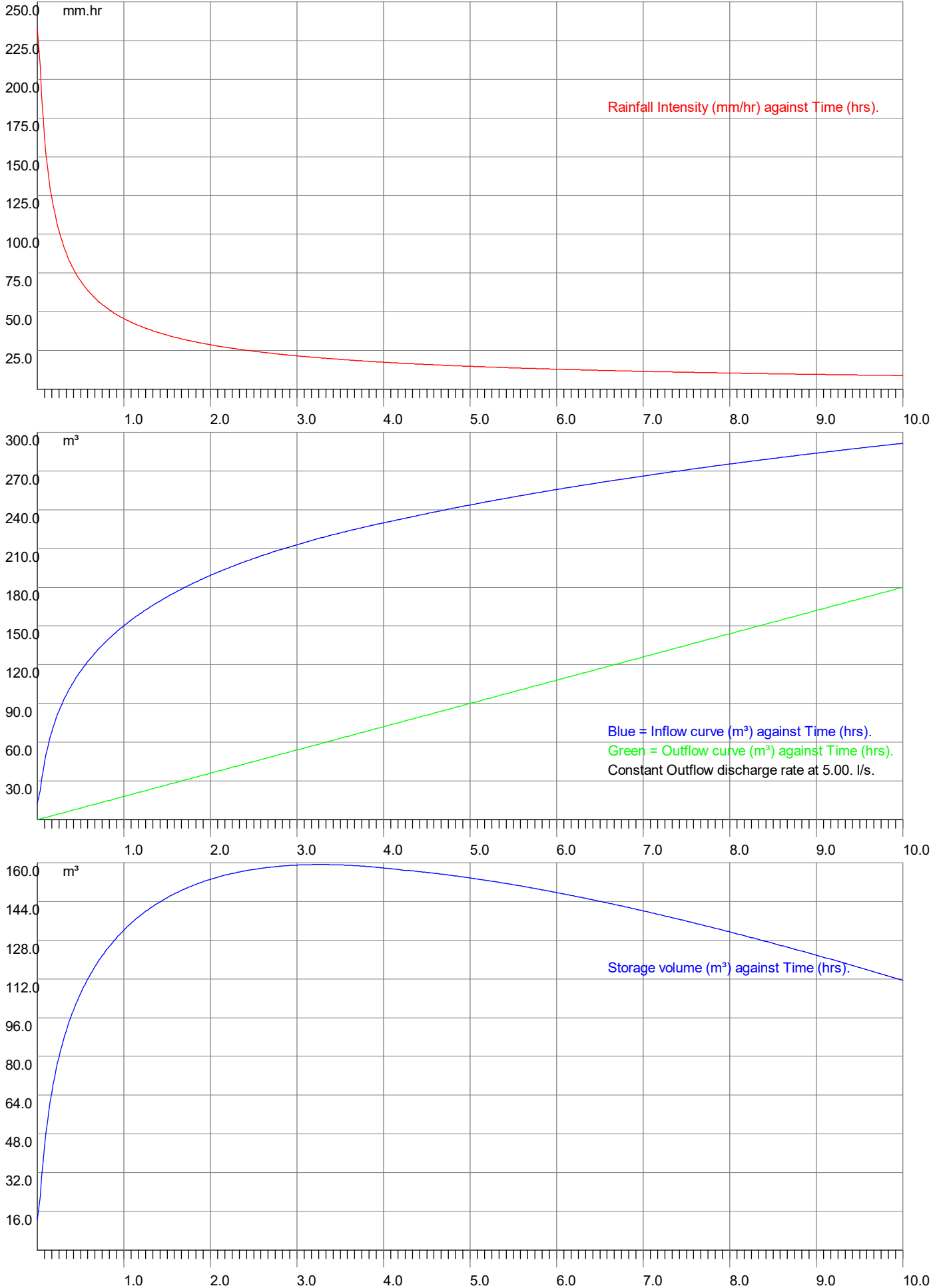
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Project **100 Years + 20% CC Storage Event Station Works, Bury**

Title **100 Years + 20% CC Storage Event Station Works, Bury**





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Project	100 Years + 20% CC Storage Event Station Works, Bury
Title	100 Years + 20% CC Storage Event Station Works, Bury

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.

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Project	100 Years + 40% CC Storage Event Station Works, Bury
Title	100 Years + 40% CC Storage Event Station Works, Bury

Data:-

FSR Hydrology:-

Location = STATION WORKS
M5-60 (mm) = 18.8
Soil index = 0.45
Return period = 100
UCWI = 113.8

Grid reference = SD 7807
r = 0.32
SAAR (mm/yr) = 1100
WRAP = 4
Climate change = 40

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

Runoff factor (RF) = 61.0, calculated from:-

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

where

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

UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 4000 m²
Total area (TA) = 5400 m²
Mean disch. rate = 5.000 l/s
Additional flow = 0.00 l/s

Pervious area = 1400 m²
Equiv area = 3294 m² (TA x RF).
Areal reduction factor = 1.000
Climate change factor = 40

Calculated data:-

Time to max = 226.0 mins
Rainfall at max = 21.29 mm/hr
Pipeline storage = 0.0 m³
Offline storage = 0.0 m³

Calculated storage volume = 196.3 m³
Allowed discharge rate = 5.000 l/s
Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours
Rainfall rate = 15.00 mm/hr

Calculated storage volume = 189.4 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	24998.3	1125	197.5	400 x 600	1090.6	500 x 500	785.2
150	11110.4	1200	173.6	600 x 900	474.8	500 x 750	523.5
225	4937.9	1275	153.8	800 x 1200	267.1	500 x 1000	392.6
300	2777.6	1350	137.2			750 x 1000	261.7
375	1777.7	1425	123.1			750 x 1200	218.1
450	1234.5	1500	111.1			750 x 1500	174.5
525	907.0	1575	100.8			1000 x 1000	196.3
600	694.4	1650	91.8			1000 x 1200	163.6
675	548.7	1725	84.0			1000 x 1500	130.9
750	444.4	1800	77.2			1000 x 1800	109.1
825	367.3	1875	71.1			1000 x 2000	98.1
900	308.6	1950	65.7			1500 x 1500	87.2
975	263.0	2025	61.0			1500 x 1800	72.7
1050	226.7	2100	56.7			1500 x 2000	65.4



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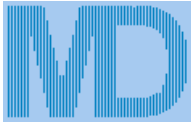
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Sheet no. 2		
Date 12/09/22		
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Project **100 Years + 40% CC Storage Event Station Works, Bury**

Title **100 Years + 40% CC Storage Event Station Works, Bury**

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	145.0	79.345	3.000	76.345
20	103.0	112.607	6.000	106.607
30	82.0	134.240	9.000	125.240
40	69.0	150.636	12.000	138.636
50	60.0	163.948	15.000	148.948
60	53.0	175.200	18.000	157.200
70	48.0	184.966	21.000	163.966
80	44.0	193.602	24.000	169.602
90	41.0	201.346	27.000	174.346
100	38.0	208.364	30.000	178.364
110	36.0	214.777	33.000	181.777
120	33.0	220.680	36.000	184.680
130	32.0	226.142	39.000	187.142
140	30.0	231.222	42.000	189.222
150	29.0	235.965	45.000	190.965
160	27.0	240.410	48.000	192.410
170	26.0	244.587	51.000	193.587
180	25.0	248.523	54.000	194.523
190	24.0	252.242	57.000	195.242
200	23.0	255.762	60.000	195.762
210	22.0	259.100	63.000	196.100
220	22.0	262.271	66.000	196.271
230	21.0	265.288	69.000	196.288
240	20.0	268.163	72.000	196.163
250	20.0	270.905	75.000	195.905
260	19.0	273.732	78.000	195.732
270	19.0	276.504	81.000	195.504
280	18.0	279.193	84.000	195.193
290	18.0	281.806	87.000	194.806
300	17.0	284.347	90.000	194.347
310	17.0	286.820	93.000	193.820
320	16.0	289.230	96.000	193.230
330	16.0	291.580	99.000	192.580
340	16.0	293.873	102.000	191.873
350	15.0	296.111	105.000	191.111
360	15.0	298.299	108.000	190.299
370	15.0	300.439	111.000	189.439
380	15.0	302.532	114.000	188.532
390	14.0	304.581	117.000	187.581
400	14.0	306.588	120.000	186.588
410	14.0	308.554	123.000	185.554
420	13.0	310.483	126.000	184.483
430	13.0	312.374	129.000	183.374
440	13.0	314.230	132.000	182.230
450	13.0	316.053	135.000	181.053
460	13.0	317.843	138.000	179.843
470	12.0	319.601	141.000	178.601
480	12.0	321.330	144.000	177.330
490	12.0	323.030	147.000	176.030
500	12.0	324.701	150.000	174.701
510	12.0	326.346	153.000	173.346
520	11.0	327.965	156.000	171.965
530	11.0	329.559	159.000	170.559
540	11.0	331.129	162.000	169.129
550	11.0	332.675	165.000	167.675
560	11.0	334.199	168.000	166.199
570	11.0	335.700	171.000	164.700
580	11.0	337.181	174.000	163.181
590	10.0	338.641	177.000	161.641
600	10.0	340.080	180.000	160.080

Storage volume (m³) = 196.3 m³



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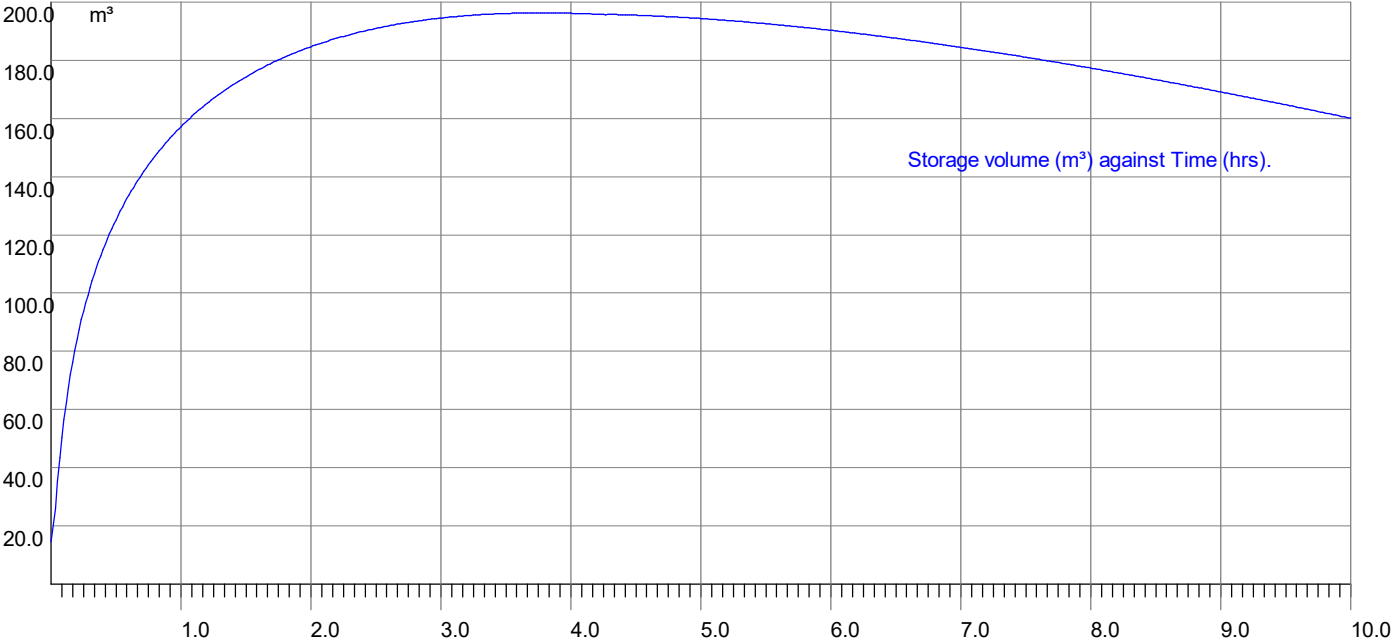
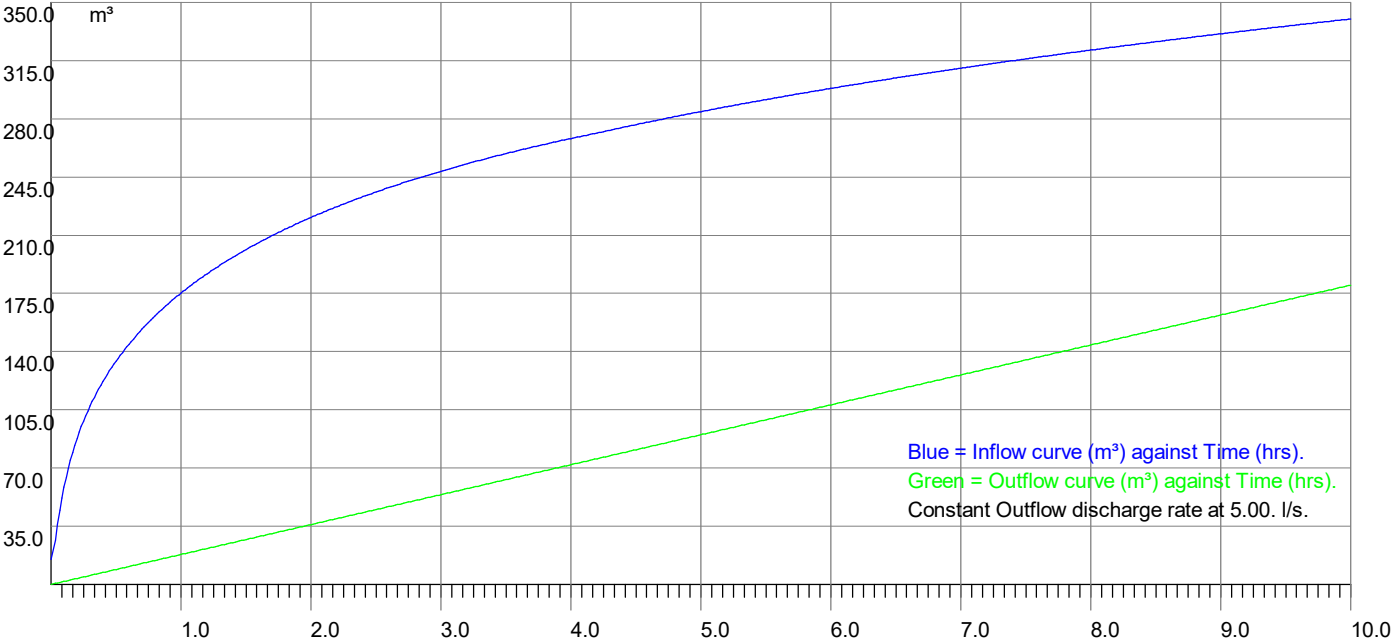
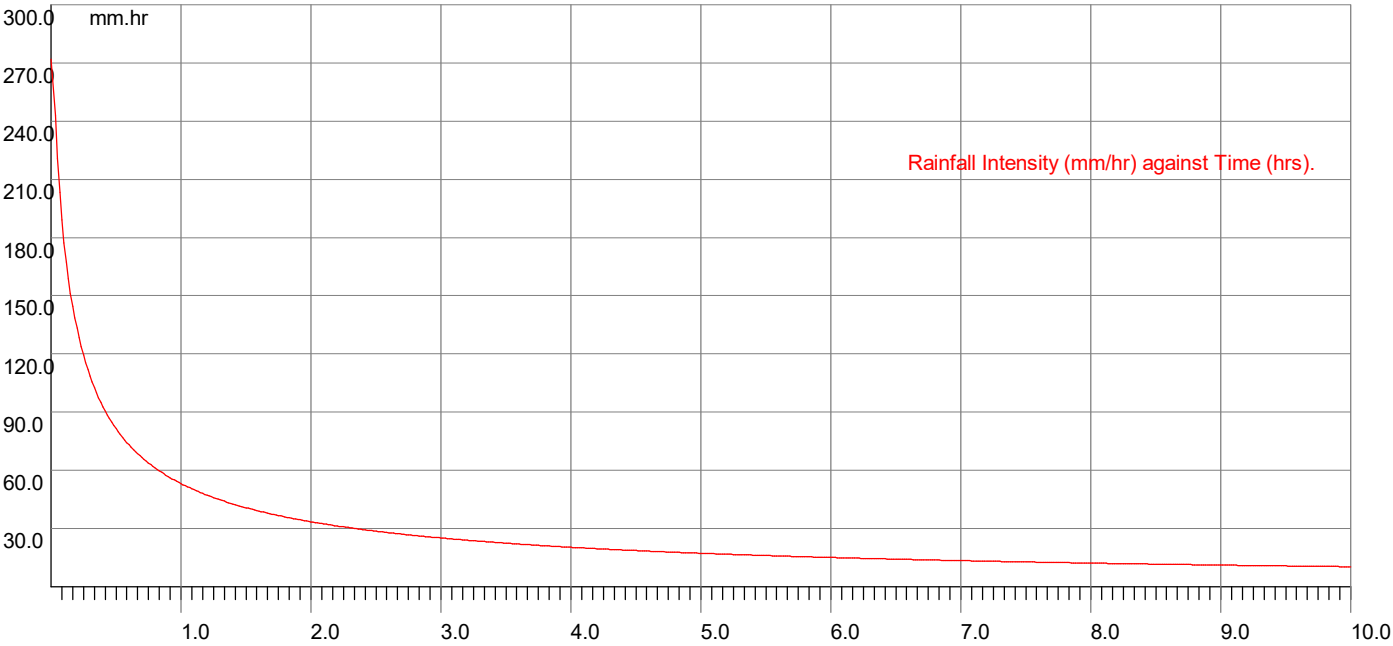
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Project	100 Years + 40% CC Storage Event Station Works, Bury
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Project **100 Years + 40% CC Storage Event Station Works, Bury**

Title **100 Years + 40% CC Storage Event Station Works, Bury**

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Explanatory notes for Hydrograph Storage

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The rainfall characteristics for each method are very different.

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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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