BROWN STREET, LITTLEBOROUGH
GREATER MANCHESTER

FLOOD RISK ASSESSMENT
& OUTLINE DRAINAGE STRATEGY

Job Number: FRA20 1133
Date: April 2020
Client: NJA Pension Scheme



INCREASING LAND VALUE

LK GROUP

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EXECUTIVE SUMMARY

Scope and Background

This Flood Risk Assessment and Outline Drainage Strategy (FRA) has been undertaken by LK Consult Ltd (LKC) to support a planning application for the development of land at Brown Street, Littleborough. The development comprises a residential development with provision for soft landscaping and car parking.

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

In considering the proposals the following key principles have therefore been applied:

- Identification of flood risks.
- Protection of users of the new development.
- No increased flood risk to third parties.

Consultations

The Environment Agency (EA) has been consulted to inform the preparation of this report. They have provided a more detailed flood map, but no modelled data was available.

Rochdale Borough Council and United Utilities were also consulted concerning flood risk.

All relevant consultees have confirmed that there is a Negligible to Very Low risk of flooding to this site from all sources.

Flood Risk

Environment Agency flood maps indicate that the site is not vulnerable to fluvial flooding from the adjacent watercourse, or the River Roch to the south of the site.

The site is shown on the Environment Agency's (EA) website Flood Zone Mapping as being in Flood Zone 1 (PPG Table 1).

The site is in Flood Zone 1 – Very Low Risk – annual probability of flooding less than 0.1% (1 in 1000).

The majority of the site is at Very Low Risk of surface water flooding. There is a small area of Medium to High Risk of surface water flooding in the western part of the site.

Mitigation

Design

Site falls will be arranged to allow reasonably level access for occupants and visitors and allowing the site to be free-draining in case of local ponding at times of heavy rainfall. Floor levels of dwellings will be set as high as possible above the flood level giving regard to necessary access for the less-able.

The development will not result in any reduction in flood plain storage compared to the existing situation.

In considering the potential drainage options for the site it is assumed that surface water runoff arising from the development will discharge into an infiltration basin.

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

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

The outline drainage strategy considers the use of infiltration-based SuDS. Therefore, the most effective strategy, in line with the SuDS management train, would be to have an infiltration facility within the western part of the site. The required storage volume has been estimated to be **199.2m^3**.

The outline drainage strategy also considers the use of attenuation-based SuDS to be feasible with a discharge to the adjacent sewer. For the 1 in 30 year storm event, the required detention tank or similar has been estimated to be **31.1m^3** for the 5l/s limited flow restriction.

Similarly, the estimated volume to be retained on site for the 1 in 100-year storm event including the allowance for climate change is between **63.7m^3** and **80.4m^3**.

The site is considered to be at low risk of flooding. It is recommended that the minimum finished floor levels for the development should be set at a nominal height above the proposed ground levels. This is to allow for overland flow during exceedance flows from an extreme event or a drainage failure.

Access

Access close to the site is elevated above potential flood levels and will always provide safe access to and from the site from Brown Street.

Contents

EXECUTIVE SUMMARY iii

1 Introduction **1**
1.1 Background 1
1.2 Site Details 2

2 Site Setting **3**
2.1 Vulnerability 3
2.2 The Sequential and Exception Tests 3
2.3 Environmental Setting 4
2.4 Site Reconnaissance 4
2.5 Site and Access Levels 4

3 Consultation **5**

4 Assessment of Flood Risk **7**
4.1 Flood Zones 7
4.2 Sources of Flooding 7
4.3 Summary of Flood Risk 8

5 Surface Water Management **9**
5.1 Infiltration 9
5.2 Surface Water Drainage Strategy 10
5.3 Surface Water Attenuation Requirements 15
5.4 Site Specific SuDS 16
5.5 Foul Drainage 16

6 Mitigation Measures **17**
6.1 Proposed Site levels and Developments Level 17
6.2 Safe Access 17
6.3 Flood Resistance and Resilience 17
6.4 Residual Risk 17

7 Conclusions **19**

Appendices

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

1 Introduction

1.1 Background

LK Consult Ltd (LKC) were commissioned by CJ Partnership Ltd to carry out a Flood Risk Assessment (FRA) and Outline Drainage Strategy for land at Brown Street, Littleborough. The report was undertaken in support of a planning application to redevelop the site for residential use.

The report will address the vulnerability to flooding from all possible sources and will also consider the impact of the development on surface water runoff accounting for climate change and the potential to increase flood risk elsewhere. The Outline Drainage Strategy in Section 5 will provide an overview of the SuDS techniques which could be considered on the site. The issues of actual flood risk are discussed in Section 4.

Government policy with respect to development in flood risk areas is contained within the Department of Communities and Local Government National Planning Policy Framework[1] and accompanying Technical Guidance of March 2012 (revised to the Planning Practice Guidance (PPG)[2], which supersedes Planning Policy Statement 25 (PPS25) 'Development and Flood Risk'. The guidance on Climate Change allowance issued by the Environment Agency in February 2016 has also been considered.

LKC has prepared this Flood Risk Assessment (FRA) in line with the NPPF and the PPG where appropriate. The level of detail entered into any flood risk assessment is dependent upon the scale and potential impact of the proposed development, and the vulnerability classification of the proposed land-use.

SuDS should be designed where practical to maximise the opportunities and benefits that can be secured from surface water management. The strategy will consider the four 'pillars' of SuDS. To maximise these benefits, surface water management should be considered from the beginning of the development planning process and throughout influencing site and wildlife layout and design, and the use and characteristics of open spaces.

The main drivers for SuDS are the controlling water quantity and water quality[3] (Plate 1), with an increasing emphasis on amenity and biodiversity benefits where practical.

[1] DCLG (2018). "National Planning Policy Framework." Department of Communities and Local Government. June 2018.
[2] DCLG (2014). "Planning Practice Guidance" http://planningguidance.communities.gov.uk, April 2014.
[3] The SuDS Manual (C753) – CIRIA November 2015.

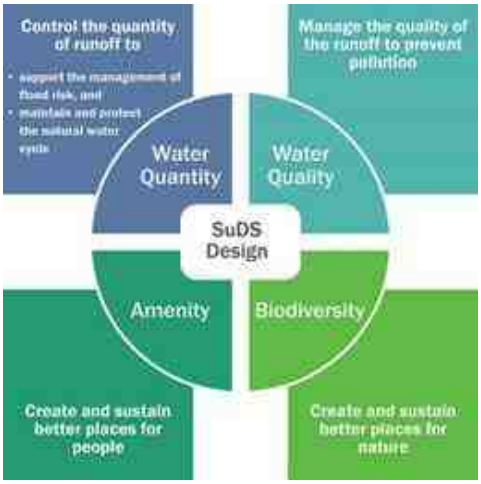

Plate 1: Four 'pillars' of SuDS design as defined by CIRIA in The SuDS Manual.

1.2 Site Details

A summary of the general site details is presented in Table 1-1. Plans, Drawings and Figures are provided in Appendix A. Figures 1 and 2 indicate the site location and boundary. Figure 3 indicates the proposed development.

Site Details	
Location	West of Brown Street, Littleborough, Greater Manchester, OL15 8BW. Centred at approximate National Grid Reference 393522E 416427N.
Area	Approximately 0.42ha.
Topography	Approximately 150m in the north, falling to approximately 148m in the southwest. Site is sloping down gently to the southwest.
Current Land Use	Site Hardstood concrete and gravel yard with industrial buildings. Surrounding Area/ Boundary Treatment North: Parkland. East: Residential area. South: Residential area. West: Industrial area.
Proposed Development	Residential development with provision for soft landscaping and car parking.

Table 1-1: Summary of site details.

2 Site Setting

2.1 Vulnerability

As an initial phase in identifying whether a site is potentially at risk of flooding, LKC has consulted the Environment Agency's (EA) website Flood Zone Mapping. This mapping is (often) based on coarse scale modelling and provides only an initial indication of the flood risk to a site. The Environment Agency Flood Zone maps were developed using a very coarse Digital Elevation Map (DEM) and are superseded by a more detailed analysis of modelled flood levels and topographic survey levels.

The Flood Zones divide the floodplain into three categories of flood risk, and do not take flood defences into account. The NPPF defines the Flood Zones as:

- Flood Zone 1 – little or no risk, with annual probability of flooding from rivers and the sea of less than 0.1% (1 in 1000).
- Flood Zone 2 – low risk, with annual probability of flooding of 0.1 to 1.0% from rivers and 0.1 to 0.5% from the sea.
- Flood Zone 3 – medium to high risk of flooding with an annual probability of flooding of 1.0% or greater from rivers, and 0.5% or greater from the sea.

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

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

2.2 The Sequential and Exception Tests

The NPPF does not require that the Sequential Test be applied to development proposals in Flood Zone 1. Since the site has been shown to be located in Zone 1 for flood risk (see section 4.1), a sequential approach should not be required for planning.

However, the principles should still be applied for developments within the site such that, for example, dwellings are situated on a high part of the site when there is a risk of local surface water flooding. The issues of actual flood risk are discussed below. The issues of safety and reduction in flood risk to others required by an Exception Test are also addressed in this document.

The Local Planning Authority (LPA) will make the final decision with regard to any planning application.

2.3 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	- Alluvial Fan Deposits – Sand and Gravel.
	Bedrock	- Pennine Lower Coal Measures Formation – Mudstone, Siltstone and Sandstone.
	BGS Boreholes	BH Ref: SD91 NW7, 100m west: Made ground to 3.81m. Varying sand, gravel and boulders to 37.03m. Varying Shale and Coal to 62.79. Gritstone to 99.52m.
Hydrogeology	Superficial	- Secondary (undifferentiated) aquifer to the west; Secondary A aquifer to the east.
	Bedrock	- Secondary A aquifer.
Hydrology	All adjacent and internal surface water	- There is culverted watercourse to the western boundary. The site is also positioned approximately 200m to the north of the River Roch.
Site History		- Industrial land use, pre-dating 1900.

Table 2-1: Summary of the Environmental Setting.

2.4 Site Reconnaissance

A site reconnaissance was undertaken in February 2020 and photographs are provided in Appendix B.

- Site comprising former works building in the centre of the site, a self-storage unit area in the south with an access off Brown Street, a car park and rough overgrown area in the north.
- Site comprising a mix of compacted gravel surfacing and soft ground areas. Limited areas of hardstood present adjacent to the existing building within the south of the site.
- Site levels varying across the site. Generally, site is sloping towards the north and the west. There is a sharp drop by few meters in the centre of the site adjacent to the western boundary.
- Site is higher than the area to the west and at the same level as Brown Street to the east.
- Positive drainage was observed to the existing work building in form of roof gutters and downpipes connecting to the underground drainage system. No drainage observed to the storage units.
- A public sewer was observed in Brown Street. Number of manholes observed.
- Culverted watercourse manhole was noted northwest of the site, adjacent to public footpath. This was at few meters lower that the site levels.
- Made ground was noted across the site, comprising of abundant ash and clinker to approx. 1mbgl.

2.5 Site and Access Levels

The site falls from approximately 150m in the north, to 148m in the southwest. The final site levels and ground floor levels of dwellings have not yet been determined. The proposed access would join Brown Street at around 149m AOD.

3 Consultation

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

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

Source	Details	
Environment Agency	Flood Zone 1: very low risk, with annual probability of flooding from rivers and the sea of less than 0.1% (1 in 1000).	
	Modelled Levels for River Roch	The nearest modelled watercourse is the River Roch, which is approximately 200m to the south of the site. The site is significantly above the modelled flood levels for all modelled scenarios. There is no modelled data associated with the adjacent watercourse.
	Records of Flooding	No records of flooding within the vicinity of the site.
	Records of Flood Warning Service	Not within a flood warning service area.
	Surface Water Flooding	Very Low risk of surface water flooding across the majority of the site.
	Flooding from reservoirs	No risk from reservoirs.
	Groundwater Source Protection Zone	Not within Source Protection Zone.
Rochdale Council	Possible or known incidents of highway flooding	There are no known historical flood incidents in the vicinity of the site.
United Utilities	Likely conditions for connecting into their sewerage system	United Utilities would request conditions for a separate system with only foul draining to foul / combined sewers and surface water draining to soakaway/SuDS or watercourse. - United Utilities Waste Developer department was contacted regarding sewer flooding history for the site. Water Company confirmed that they did have records of internal or external sewer flooding of properties in the vicinity of the site as a result of overloaded sewers.
	Sewer map	There is a 600mm diameter public surface water sewer to the northwest of the site, which becomes a 750mm diameter private sewer adjacent to the western site boundary. There is a 825mm diameter public combined sewer to the west of the site , which reduces in diameter to 750mm to the south of the site. This is also joined by a 225mm diameter combined sewer within Victoria Street to the south, which itself is connected to a network of combined sewers within Brown Street to the southwest.

Table 3-1: Summary consultee information.

Source	Details	
Strategic Flood Risk Assessment (SFRA)	Level 1 SFRA[4]	There is no indication of any history of flooding from any source within the vicinity of the site.
	Level 2 SFRA[5]	There is no indication of any history of flooding from any source within the vicinity of the site.
Preliminary Flood Risk Assessment (PFRA)[6]	The Preliminary Flood Risk Assessment (PFRA)[3] for the area indicates that there are no records of flooding for the area, which conforms with information supplied by the EA.	

Table 3-1 (continued): Summary consultee information.

[4] Strategic Flood Risk Assessment Level 1: Bury, Rochdale and Oldham Councils; 2009, JBA Consulting.
[5] Strategic Flood Risk Assessment Level 2: Bury, Rochdale and Oldham Councils; 2009, JBA Consulting.
[6] Preliminary Flood Risk Assessment: Rochdale Metropolitan Borough Council; 2011, JBA Consulting.

4 Assessment of Flood Risk

4.1 Flood Zones

The detailed flood map provided by the EA indicates that the site is in Flood Zone 1 (see Appendix C).

A direct comparison was made between the provided EA flood levels at this location and the topographical levels.

The EA design flood levels are significantly lower than the site. It can be reasonably concluded on the evidence above that the site is in Flood Zone 1 for the purposes of this assessment.

Comparison of the modelling data and topographical survey indicates that the 1% (100-year plus CC) flood level would not affect any part of the site. Therefore, the actual flood position is much better than that indicated by the published flood map.

The extents of the 0.1% (1000-year) flood level remain outside of the development area.

4.2 Sources of Flooding

The risk of flooding from the following flood sources has been considered:

Fluvial – The EA has confirmed the study area is within Flood Zone 1. Therefore, the flood risk associated with this source is considered Very Low.

Tidal – The study area is remote from the sea and tidally influenced water bodies. Therefore, the flood risk associated with this source is considered Negligible.

Pluvial (Rainfall) – The surface water flood risk maps shows a small area at the western site boundary that has the potential to flood during prolonged heavy rainfall. This area is associated with a depression that is likely to be removed/positively drained following the development process. These areas need consideration within the detailed design or there is the potential to have areas of standing water in gardens and landscaped areas not positively drained if overland flow routes are not considered. Therefore, the risk of flooding from surface water flooding is Very Low but should be considered further during the detailed design.

Surface Water (Overland flow) – This relates to surface water entering the site. Any surface water arising from the north of the study area is likely to be intercepted by the highway drains and therefore pose no threat to the development. The flood risk associated with this source is considered Very Low.

Groundwater – The EA/BGS has no groundwater records for the study area. No evidence of shallow groundwater was observed during the walkover. Therefore, the flood risk associated with this source is considered Very Low.

Sewers – United Utilities sewer records show a combined sewer to the southwest and within Victoria Road to the south. The sewers flow away to the south; however UU mentioned records of sewer flooding within the vicinity of the site. Therefore, the flood risk associated with this source is considered Low.

Artificial sources – According to the EA online maps, the study area is not at risk from reservoir flooding. Therefore, the flood risk associated with this source is considered Negligible.

4.3 Summary of Flood Risk

Source of Flooding	Risk Assessment Level
Fluvial	Very Low
Pluvial (Rainfall)	Very Low
Surface Water	Very Low
Tidal	Negligible
Groundwater	Very Low
Sewers	Low
Artificial Sources	Negligible

Table 4-1: Summary of Existing Risk Level.

The site is located within Flood Zone 1 and a Negligible to Low risk of flooding from all sources have been identified for the site. LKC therefore consider that a strategy for surface water management will be required at the site to mitigate the risk to others. The assessments of a range of measures that are feasible for the site are outlined in Section 5.

5 Surface Water Management

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 H3[7] 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 2010[8].

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.

5.1 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 5-1 below:

Classification	Description	Aquifer Classification	Recorded Water Table Depth	Soakaway Potential
Alluvial Fan Deposits	Sand and Gravel	Secondary A	N/A	Good
Pennine Lower Coal Measures Formation	Mudstone, Siltstone and Sandstone	Secondary A	N/A	Limited

Table 5-1: Geological and Hydrogeological Setting.

[7] Building Regulations part H3 2010: Approved Document, Drainage and Waste Disposal.
[8] Flood and Water Management Act 2010: UK Government.

Infiltration methods such as soakaways are likely to be feasible, but this may be investigated further at the detailed design stage.

5.2 Surface Water Drainage Strategy

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

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

There is a culverted watercourse adjacent to the western site boundary.

The drainage options relating to the final discharge of surface water for this section of the site are listed in Table 5-2 in order of priority within the NPPF:

Option No:	Drainage Solution	Most feasible solution	Comments
a	Soakaway/Infiltration	1	Reasoning: Likely to be feasible on account of potential permeable ground conditions.
b	Connection to Watercourse	3	There is a culverted watercourse to the west of the site which is feasible for discharge from the site is outside of the site boundary.
c	Discharge into a sewer	2	Would be practical on account of the proximity of the public combined sewers adjacent to the site.

Table 5-2: Drainage options.

Table 5-3 provides a summary of the SuDS options appraisal with consideration of CIRIA C753 (The SUDS Manual)[9] for the development:

SuDS Option	Appropriate to Development	Comments	Benefits	Comments
Infiltration				
Soakaways	✓	Due to the nature of the ground conditions, the use of infiltration systems may be feasible.	Water quantity Water quality	Soakaways provide stormwater attenuation, stormwater treatment and groundwater recharge. Runoff is treated by physical filtration to remove solids, by absorption into the soil and removal and by biochemical reactions involving micro-organisms growing on the soil.
Infiltration basin	✓	Depressions that store and dispose of water via infiltration. May be appropriate given the ground conditions.	Water quantity Water quality Biodiversity Amenity	Infiltration basin reduces the volume of runoff from a drainage area, can be very effective at pollutant removal via filtering through the soils, contributes to groundwater recharge and baseflow augmentation. Runoff is treated by physical filtration to remove solids, by absorption into the soil and removal and by biochemical reactions involving micro-organisms growing on the soil.
Infiltration trench	✓	Infiltration trenches are shallow excavations with rubble or stone.	Water quantity Water quality Amenity	An Infiltration trench can create temporary subsurface storage of stormwater runoff, thereby enhancing the natural capacity of the ground to store and drain water. Infiltration trenches allow water to dissipate into the surrounding soils from the bottom and sides of the trench where runoff is treated by physical filtration, adsorption and biochemical reactions involving micro-organisms growing in the soil. Infiltration trenches are easy to integrate into a site. They are ideal for use around playing fields, recreational areas or public open space.
Rain gardens	*	Rain gardens are relatively small depressions in the ground that are planted up with native vegetation. Most likely to be implemented on private property close to buildings on relatively flat areas.	Amenity Biodiversity Water quality Water quantity	Attractive features that can help to improve open space. Can be planned as landscaping features. Flexible layout to fit into landscape. Runoff can be treated by physical filtration to remove solids, by absorption and removal by biochemical reactions involving micro-organisms growing on the soil. They can reduce rate of run off and provide some volume reduction.
Filtration				
Filter drain / trench	X	Linear trenches filled with a permeable granular material, often with a perforated pipe in the base of the trench.	Water quantity Water quality	Filter trenches create temporary subsurface storage of stormwater runoff and provide stormwater treatment. These trenches can be used to filter and convey stormwater to downstream SuDS components.
Filter strip	X	Engineered filters that use vegetation to remove and treat runoff. The filter strip is sloped to allow sheet flow across the vegetated strip. May be appropriate given the site topography.	Water quality Amenity Biodiversity	A filter strip offers no storage and is used solely to remove pollutants from surface water. The vegetation traps organic and mineral particles that are then incorporated into the soil, while the vegetation takes up any nutrients. A filter strip features medium amenity potential. Local wild grass and flower species can be introduced for visual interest and to provide a wildlife habitat.

Table 5-3: Summary of the SuDS options appraisal.

[9] CIRIA C753 - The SUDS Manual. London 2015.

SuDS Option	Appropriate to Development	Comments	Benefits	Comments
Retention & Detention				
Detention basin	X	Dry depressions designed to hold water for a specific retention time. Basins tend to be found towards the end of the SuDS management train, so are used if extended treatment of the runoff is required or if they are required for wildlife or landscape reasons.	Water quantity Water quality Biodiversity Amenity	Detention basins provide flow control through attenuation of stormwater runoff for a wide range of rainfall events. Basins treat runoff in a variety of ways: settlement of solids in still or slow moving water, adsorption by the soil, biological activity. Basins offer many opportunities for the landscape designer. Basins should not be built on but can be used for sports and recreation. Basins can be part of public open space.
Attenuation Ponds	X	Attenuation ponds can be used to offset the increase in surface water flows attributable to increased area of hard standing, in order to minimise the risk of flooding to and from the proposed development.	Water quantity Water quality Biodiversity Amenity	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. Ponds treat runoff in a variety of ways: settlement of solids in still water (having plants in the water enhances calm conditions and promotes settlement), adsorption by aquatic vegetation, biological activity. Permanently wet ponds can be used to store water for reuse and offer excellent opportunities for the provision of wildlife habitats. Ponds can be part of public open space.
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.	Water quantity	Geo-cellular systems can be used to control and manage rainwater surface water runoff either as a soakaway or as a storage tank. Geo-cellular storage systems provide high storage volume capacity High void ratios (up to 96%). Capable of managing high flow events.
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.	Water quantity	Oversized pipes can reduce rate of run off and provide some volume reduction.
Tanks	✓	Prefabricated underground tanks could be considered at the detailed design stage in order to provide storage to attenuate surface water runoff.	Water quantity	Storage tanks can be used to control and manage rainwater surface water runoff providing high storage volume capacity. Tanks are capable of managing high flow events.

Table 5-3 (continued): Summary of the SuDS options appraisal.

SuDS Option	Appropriate to Development	Comments	Benefits	Comments
Swales & conveyance channels				
Swales	*	Swales are shallow grass-lined channels that provide capacity for conveying flows at a controlled rate into ponds and watercourses.	Water quality Biodiversity Amenity Water quantity	Swales are effective at removing polluting suspended solids through filtration and sedimentation. The vegetation traps organic and mineral particles that are then incorporated into the soil, while the vegetation takes up any nutrients. Swales are often integrated into the surrounding land use. Local wild grass and flower species can be introduced for visual interest and to provide a wildlife habitat. Swales are usually designed as conveyance systems but can also be designed with check dams to increase attenuation and, where applicable, infiltration.
Channels & rills	*	Channels and rills are open surface water channels with hard edges.	Water quality Amenity Water quantity Biodiversity	Effective in water & pollution treatment. Can act as pre-treatment to remove silt before water is conveyed into further SuDS features. Can be visually appealing in urban landscapes. Amenity value for the local community and biodiversity value (design dependant).
Control structures				
Flow control devices	✓	Flow control devices e.g. hydro-brake style flow control systems, and restricted orifices enable the discharge to be restricted to a constant rate from the development.	Water quantity	Control the peak flow. Complex controls can reduce upstream storage requirements.
Inlets, outlets and controls	X	There are many different designs and variations, including landscaped pipes, perforated pipes, weirs.	Water quality Amenity	Inlets, outlets and other control structures are key elements of well-designed SuDS. Inlet and outlet features allow water to flow into and out of features and also limit the rate at which water flows along and out of the system. There are many different approaches and products available and they can be easily designed to add interest to the urban landscape. Can provide accurate flow control from one SuDS feature to another.
Source control				
Green roofs	*	Green roofs comprise a multi-layered system that covers the roof of a building or podium structure with vegetation cover/landscaping.	Water quality Water quantity Amenity Biodiversity	Green roof installations can help to reduce surface water runoff from roof areas depending on the system specified. Good removal capability of atmospherically deposited urban pollutants. Ecological, aesthetic and amenity benefits.
Blue roofs	*	A blue roof is a roof design that is explicitly intended to store water, typically rainfall.	Water quantity Amenity Biodiversity	Blue roofs are designed to attenuate and manage stormwater on a flat roof in urban areas where options for ground-based attenuation systems are limited, and in particular, where construction is being carried out within flood sensitive areas. Amenity value for the local community.

Table 5-3 (continued): Summary of the SuDS options appraisal.

SuDS Option	Appropriate to Development	Comments	Benefits	Comments
Rainwater harvesting	*	Rainwater harvesting collects the rain which falls onto roofs, then stores it in a tank until required for a non-potable use.	Water quantity	In the process, a volume of water is kept out of the storm-water management system, thereby helping to reduce flooding risks. When required, the water is pumped to the point of use, thus displacing what would otherwise be a demand for mains-water. Reduces demand on mains water.
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.	Water quality Water quantity	Reduced peak flows to watercourses, reducing the risk of flooding downstream. Reduced effects of pollution in runoff on the environment.
Other SuDS				
Wetlands	X	These comprise of shallow ponds and marshy areas, covered almost entirely in aquatic vegetation.	Water quality Water quantity Amenity Biodiversity	Wetlands provide both stormwater attenuation and treatment. Wetlands detain flows for an extended period to allow sediments to settle, and to remove contaminates by facilitating adhesion to vegetation and aerobic decomposition. They also provide significant ecological benefits.

Table 5-3 (continued): 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

5.3 Surface Water Attenuation Requirements

From correspondence with the UU the flow should be limited to a 'brownfield scenario' for estimating the attenuation volumes required.

It is estimated from the supplied plan (see Appendix A) that the site will have the following designated areas (Table 5-4). Table 5-4 shows the assumed split in area included within the calculations.

Existing Areas	Plot Area
Total area (ha)	0.42
Impermeable Split (ha)	0.42
Permeable Split (ha)	0.00
Proposed Areas	**Plot Area**
Total area (ha)	0.42
Impermeable Split (ha)	0.42
Permeable Split (ha)	0.00

Table 5-4: Assumed plot areas.

5.3.1 Infiltration Storage Estimate

It is possible that this area maybe drained via infiltration-based SuDS following further testing.

Typical k Values from 'Environmental Geotechnics' (Sarsby)[10] suggests that a value of $1x10^{-5}$m/s is typical given that the area is underlain by Sand and Gravel.

As a result of these figures the volume of the required infiltration basin has been estimated using CIRIA Report 156[11] / BRE365[12] and is shown in Appendix E. This assumes a safety factor of 2. For an infiltration rate of $1x10^{-5}$m/s, for example a width of 10m, a length of 20m and a depth of 1m creates the required total storage volume of **199.2m³**. This volume can readily be achieved within the site boundary.

5.3.2 Attenuation Estimate

For the contributing catchment an estimate has been produced assuming a developable area of 0.42ha, of which 50% is permeable. This gives the following runoff rates and attenuation requirements for this section based on the Wallingford method:

- Q_{bar}: 49.8 l/s
- 1 in 1-year runoff rate: 35.6 l/s
- 1 in 30-year runoff rate: 87.2 l/s
- 1 in 100-year runoff rate: 110.0 l/s

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

The following attenuation has been estimated for the development assuming an estimated flow limited to 5l/s to the sewer and utilises the FSR methodology[13] as:

[10] Environmental Geotechnics 2nd Edition – Sarsby 2013.
[11] Infiltration drainage, Manual of good practice (R156). 1996. [12] Soakaway Design - BRE DIGEST 365, 1991.
[13] Flood Studies Report Wallingford NERC 1975.

- Attenuation storage volume: **31.1 m³** (1 in 30-year event)
- Retention on site volume: **63.7 m³** (1 in 100 year + 20% Climate Change)
- Retention on site volume: **80.4 m³** (1 in 100 year + 40% Climate Change)

Attenuation storage aims to limit the peak rate of runoff from the development to the corresponding runoff for a range of annual flow rate probabilities before discharge to watercourse. As the flow from the development would be restricted to the brownfield equivalent there should be little change in the flows that enter the unnamed watercourse and thus the risk of flooding and the level of erosion created 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 **31.1 m³** and for the 1 in 100-year event, a storage capacity of between **63.7 m³** and **80.4 m³** will be required from on-site storage as well as SuDS systems. All volumes can be stored within the site boundary and discharges will be limited by flow control devices to the adjacent sewer.

The use of permeable paving may be viable dependant on the detailed design of the proposed development. If this drainage technique is considered to be feasible then it will reduce the requirement for attenuation as it will reduce the contributing area.

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

5.4 Site Specific SuDS

Infiltration facilities may be feasible giving likely permeable ground conditions. An infiltration facility will provide a significant volume of storage and contribute to surface water treatment via filtering through the soils. Infiltration facility will also contribute to groundwater recharge and baseflow augmentation (subsurface storage).

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.

5.5 Foul Drainage

United Utilities have stated that foul discharge will be allowed to drain to the public combined sewer at an unrestricted rate and a convenient point.

6 Mitigation Measures

6.1 Proposed Site levels and Developments Level

Current Environment Agency guidance recommends that the minimum ground floor levels of residential developments are set at a nominal height above the 1% annual probability (1 in 100 year) flood level including an additional fluvial allowance for climate change. It is generally accepted that vehicle parking can be accommodated within the flood zone with suitable safeguards. The 'design' flood level for the site should therefore be the 1% annual probability event with allowance for climate change plus an allowance for freeboard.

This and the 0.1% annual probability (1 in 1000-year) are significantly below the lowest existing ground level measured on site by approximately. On this basis the finished floor levels (FFL) should be set at a nominal height above the finalised ground levels to allow for any overland flow from a drainage failure. No further mitigation measures are therefore recommended.

6.2 Safe Access

Safe and dry access is available via Brown Street to the west, significantly above the 1% annual probability event. Therefore, no mitigation is proposed.

6.3 Flood Resistance and Resilience

The development proposed may be subject to flooding at more extreme events than those considered. However, the risk appears to be sufficiently low that flood resilience measures need not be included into ground floor construction to aid recovery after any event. If utilised, typical measures would include solid floors, use of suitable materials and services fed from upper floors with outlets at high level. The need can be discussed and agreed with building control officers during detailed design.

6.4 Residual Risk

It is impossible to completely guard against flooding since extreme events greater than the design standard event are always possible. However, it is likely that with the 1% annual probability flood event with allowance for climate change significantly below the lowest site levels, the relatively elevated position of the development will safeguard it from localised fluvial flooding during extreme rainfall events and fluvial flooding events outside the scope of this assessment. However, ground floor levels should be set above proposed levels across the site and provide a nominal freeboard to allow overland flow under exceptional conditions. Overland flow routes should be considered in case of drainage failure and the extreme events.

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7 Conclusions

The site is shown on published mapping to be located within the Environment Agency's Flood Zone 1. Comparison of topographical data with the EA modelled flood level data indicates that the whole site is in Flood Zone 1 – Very Low Risk of fluvial flooding.

Negligible to Low risks of flooding from all sources have been identified from information provided by the EA, Rochdale Council and United Utilities.

An assessment of these risks in conjunction with the development proposals have resulted in the following recommendations for the safe development of the site:

- The finished floor level should be set at a nominal height above the finished ground levels to allow for overland flow routes in extreme events and drainage failures.
- Pedestrian and vehicular safe access to and from the site is achievable under all conditions via the access road off Brown Street.
- There is potential for soakaway use for rainwater disposal; however, this should be investigated further at the detailed design phase
- Surface water flow will probably need to be attenuated to 5l/s or as agreed with United Utilities and the LLFA.
- Surface water discharge into the culvert to the west of the site would be dependent on third party access.
- Proposed SuDS should be selected to provide a wide range of benefits including amenity, biodiversity and maintaining water quality where practical. During construction, adequate measures should be proposed to control pollution to existing watercourses and groundwater.
- A formal evacuation plan is not considered to be required.

Further details on the proposed mitigation measures are provided in Section 6. All proposed measures should be agreed with the Local Authority prior to commencement of the development.

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Appendix A

Figures, Plans and Drawings

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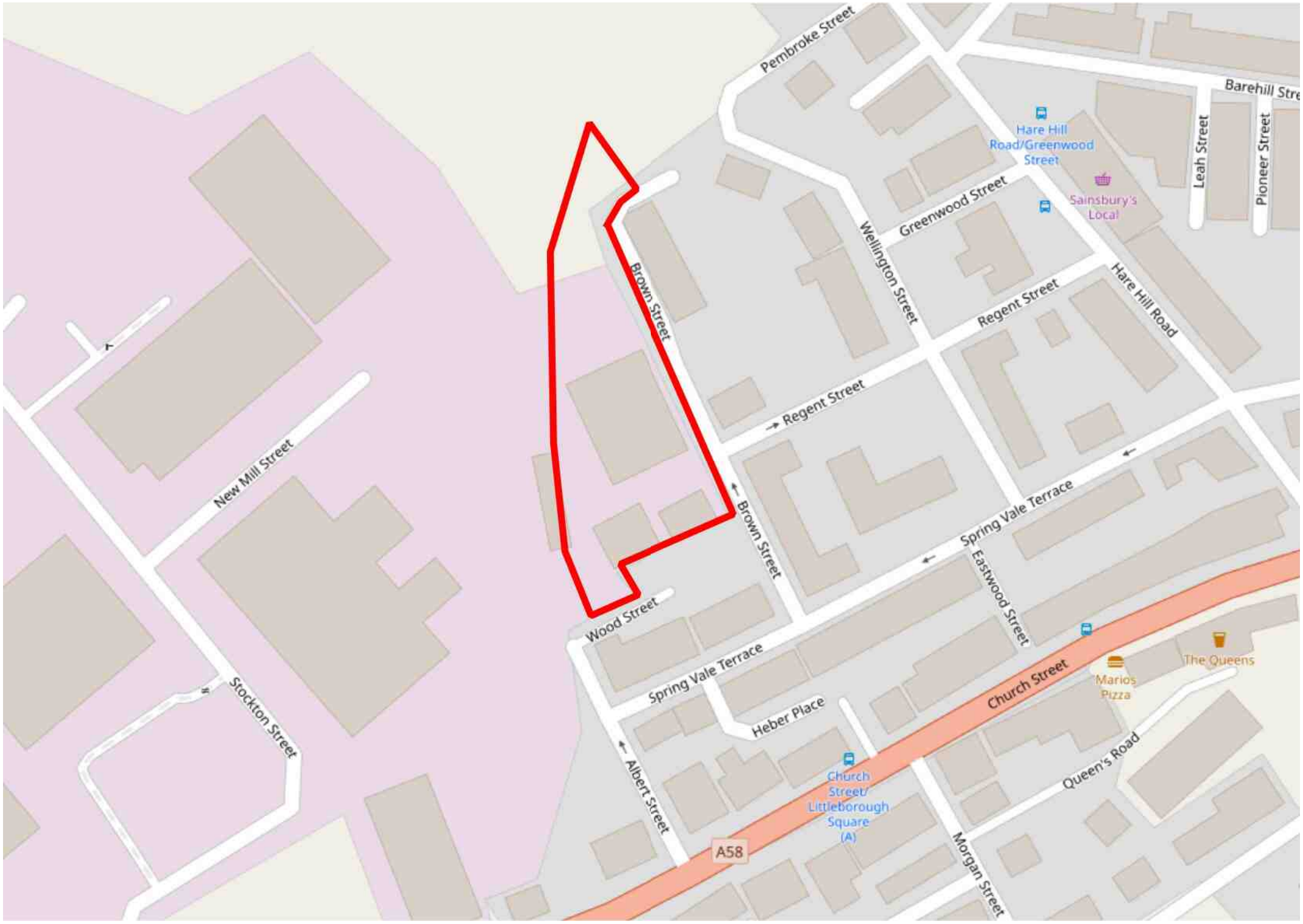
Site Location


Pembroke Street
Barehill Stre
Hare Hill Road/Greenwood Street
Leah Street
Pioneer Street
Sainsbury's Local
Greenwood Street
Wellington Street
Brown Street
Regent Street
Hare Hill Road
Regent Street
New Mill Street
Brown Street
Spring Vale Terrace
Eastwood Street
Wood Street
Spring Vale Terrace
Church Street
Marios Pizza
The Queens
Heber Place
Stockton Street
Albert Street
Church Street/ Littleborough Square (A)
Queen's Road
A58
Morgan Street

Appendix B

Site Information

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Flood map for planning

Your reference	Location (easting/northing)	Created
<Unspecified>	**393520/416411**	**2 Apr 2020 15:23**

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

This means:

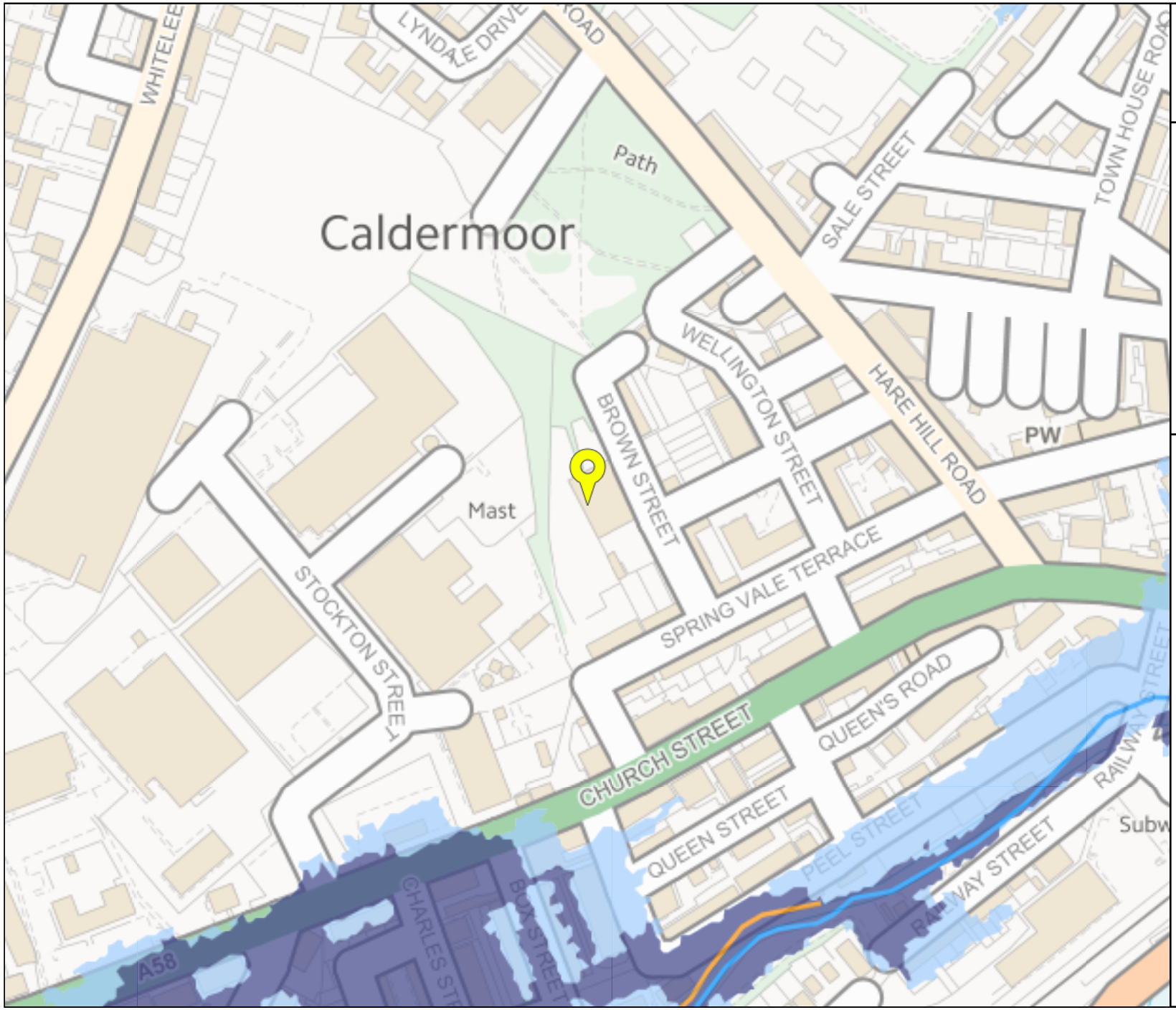
- you don't need to do a flood risk assessment if your development is smaller than 1 hectare and not affected by other sources of flooding
- you may need to do a flood risk assessment if your development is larger than 1 hectare or affected by other sources of flooding or in an area with critical drainage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

Notes

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

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

The Open Government Licence sets out the terms and conditions for using government data.
https://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/



Environment Agency

Flood map for planning

Your reference
<Unspecified>

Location (easting/northing)
393520/416411

Scale
1:2500

Created
2 Apr 2020 15:23

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

0 20 40 60m

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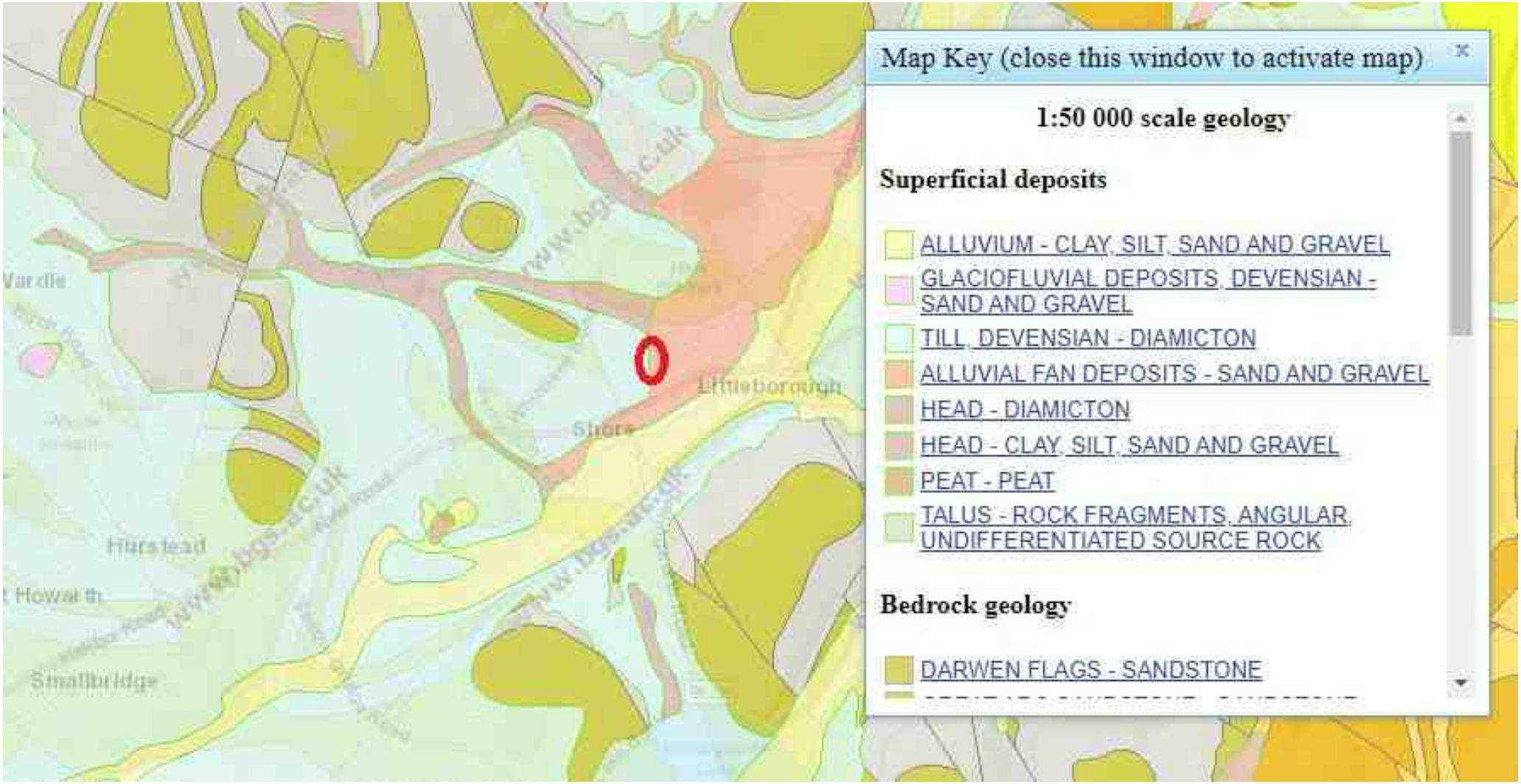
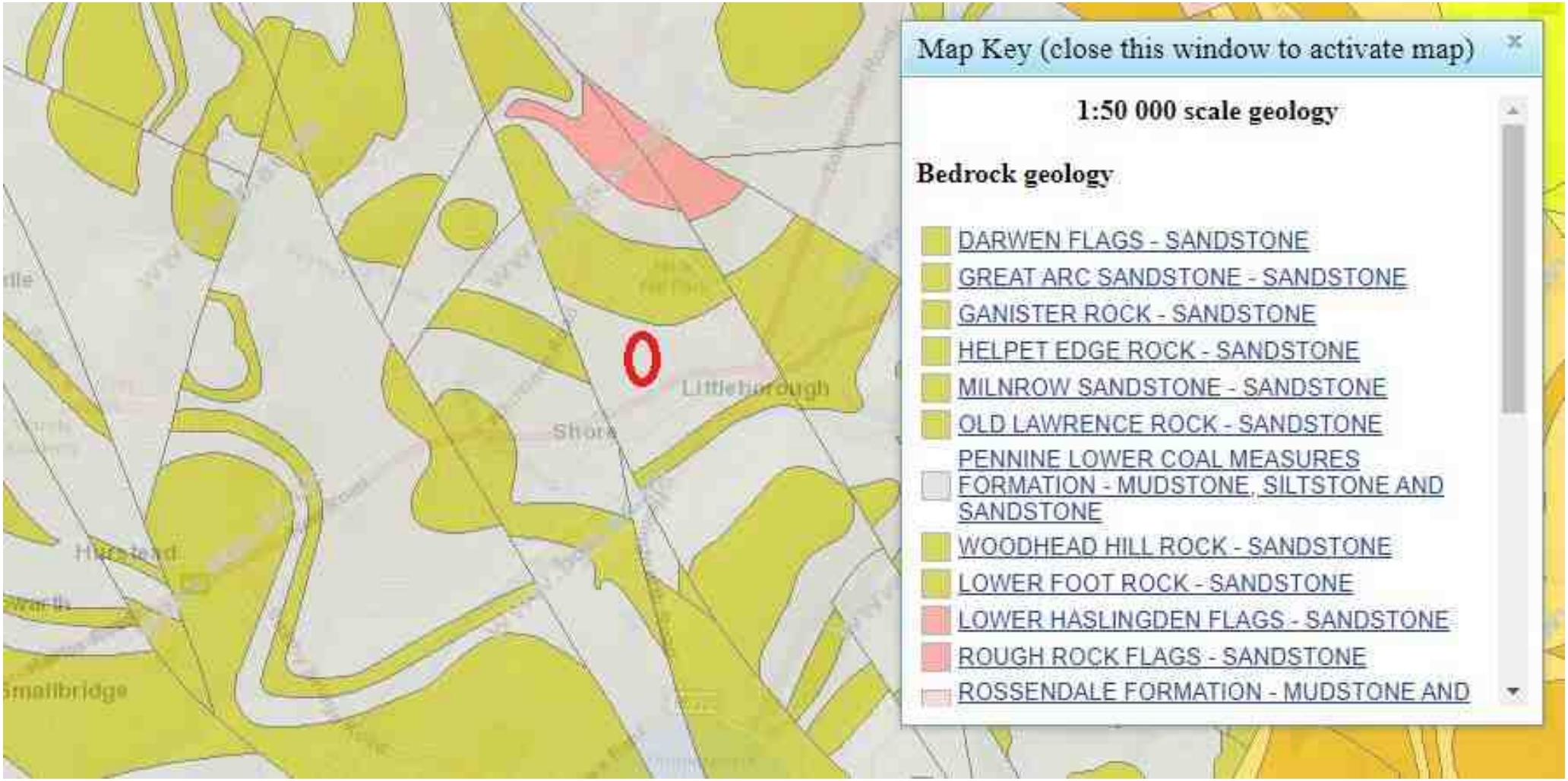
Extent of flooding from surface water

High Medium Low Very low


Map Key (close this window to activate map)
1:50 000 scale geology
Superficial deposits
ALLUVIUM - CLAY, SILT, SAND AND GRAVEL
GLACIOFLUVIAL DEPOSITS, DEVENSIAN - SAND AND GRAVEL
TILL, DEVENSIAN - DIAMICTON
ALLUVIAL FAN DEPOSITS - SAND AND GRAVEL
HEAD - DIAMICTON
HEAD - CLAY, SILT, SAND AND GRAVEL
PEAT - PEAT
TALUS - ROCK FRAGMENTS, ANGULAR, UNDIFFERENTIATED SOURCE ROCK
Bedrock geology
DARWEN FLAGS - SANDSTONE
Littleborough
Hurstead
Shaw Bridge


Map Key (close this window to activate map)
1:50 000 scale geology
Bedrock geology
DARWEN FLAGS - SANDSTONE
GREAT ARC SANDSTONE - SANDSTONE
GANISTER ROCK - SANDSTONE
HELPET EDGE ROCK - SANDSTONE
MILNROW SANDSTONE - SANDSTONE
OLD LAWRENCE ROCK - SANDSTONE
PENNINE LOWER COAL MEASURES FORMATION - MUDSTONE, SILTSTONE AND SANDSTONE
WOODHEAD HILL ROCK - SANDSTONE
LOWER FOOT ROCK - SANDSTONE
LOWER HASLINGDEN FLAGS - SANDSTONE
ROUGH ROCK FLAGS - SANDSTONE
ROSSENDALE FORMATION - MUDSTONE AND
Littleborough
Shore
Hurstead
Smallbridge

NGR. C.9341 1634

RECORD OF WELL (SHAFT OR BORE)

SD91 NW 7

1" N.S. 76
1" O.S.
Grid Ref. 13

At ~~British~~ Breda Visada Ltd., Python Mill,

Town or Village Littleborough County Lancs. Six-inch quarter sheet 81 SW

Exact site ..... in parish of ..... (A rough sketch-map or a tracing from a map is very desirable)

Level of ground surface above sea-level (O.D.) c470 ft. If well starts below ground surface, state how far ..... ft.

Shaft ..... ft., diameter ..... ft. Bore ..... ft. Diameter of bore: at top ..... ins.; at bottom 24. ins.

Details of permanent lining tubes (internal diameters preferred) Tubed to 123'6" with 24½" diameter tubes.

Water struck at depths of (feet) .....

Rest-level of water ~~below~~ ~~above~~ top of well O.F. ..... feet. Suction at ..... feet. Yield on ..... hours' days' test ..... gallons per ..... (with pump of capacity ..... g.p.h.); depressing water level to ..... feet below top. Time of recovery ..... hrs. Amount normally pumped daily ..... g.p.h. for ..... hours.

Quality (attach copy of analysis if available) .....

Sunk by Messrs. T. Matthews for Mr. British Visada Ltd., Date of well 1929

Information from Messrs. Thomas Matthews, Pendleton, Manchester.

Ec Eng 18/9/29

SD 91 NW/7
County .....
6" Quarter Sheet .....

(For Survey use only). GEOLOGICAL CLASSIFICATION.	NATURE OF STRATA (and any additional remarks).	THICKNESS Feet.	THICKNESS Inches.	DEPTH Feet.	DEPTH Inches.	THICKNESS Thickness metric		DEPTH metric	
	Made ground	12	6	12	6	3	81	3	81
	Grey sand and gravel	2	3	14	9	0	69	4	50
	Sand and gravel	14	9	29	6	4	49	8	99
	Clay and sand	2	6	32	-	0	76	9	75
	Gravel with boulders	7	6	39	6	2	29	12	04
	Sand and gravel	3	6	43	-	1	07	13	11
	Red sand and gravel	7	-	50	-	1	23	15	24
	Grey sand and gravel	23	3	73	3	7	09	22	33
	Red sand	6	9	80	-	2	05	24	38
	Sand gravel and boulders	32	3	112	3	9	83	34	21
	Clay gravel and boulders	9	3	121	6	2	82	37	03
	Grey shale	14	6	136	-	4	42	41	45
	Black shale	6	6	142	6	1	98	43	43
	Hard shale	1	-	143	6	0	31	43	74
	Shale	2	-	145	6	0	61	44	35
	Black shale	5	6	151	-	1	68	46	03
	Black shale and coal	5	-	156	-	1	52	47	55
	Black shale and nodules	16	-	172	-	4	88	52	43
	Hard black shale	28	-	200	-	8	53	60	96
	Coal	3	-	203	-	0	91	61	87
	Black shale	3	-	206	-	0	91	62	79
	Hard grey gritstone	5	6	211	6	1	68	64	47
	Grey grits	-	6	212	-	0	15	64	62
	Hard grey gritstone	6	-	218	-	1	83	66	45
	Grey grit	4	-	222	-	1	22	67	67
	Grey grit	70	-	292	-	21	33	89	00
	Hard grey grit	1	-	293	-	0	31	89	31
	Grey grit	33	6	326	6	10	21	99	52

W.6. Yielded up to 25,000 gph with submersible pump, pumping water level 80' below well top. Water normally overflows. Hardness said to be 13-15° Hardness iron free.

No longer in use owing to closure of factory. Water O.F.

Visited and sited [illegible] 4-56.

For Survey use only

Date received	G.S.M. Office File No.	Site marked on 1" map (use symbol)

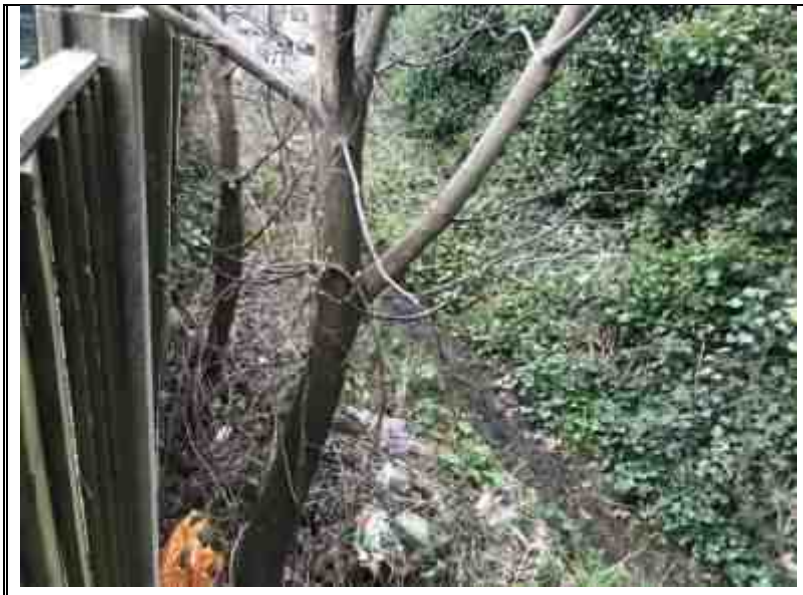
GEOLOGICAL SURVEY AND MUSEUM.
SOUTH KENSINGTON.
LONDON. S.W.7.

(7993) Wt.36064/0349 5,000 12/38
A.&E.W.Ltd. Gp.486

British Geological Survey

	**Photograph 1 (facing W):** Access off Brown Street.
	**Photograph 2 (facing W):** Self-storage unit area.
	**Photograph 3 (facing N):** Former works building. Limited areas of hardstanding adjacent to the building.

	**Photograph 4 (facing N):** Site is sloping to the north. View of the sharp drop adjacent to the western boundary.
	**Photograph 5 (facing S):** View of works building and adjacent area.
	**Photograph 6 (facing SE):** Honksford Brook adjacent to former silk mill buildings showing half round channel.

	**Photograph 7 (facing W):** Public footpath running adjacent to the western boundary at lower level than the site.
	**Photograph 8 (facing W):** Gravel car park present adjacent to the north of the building. Downpipes observed to drain into underground drainage system.
	**Photograph 9 (facing N):** Car park as above and Brown Street on the right-hand side.

	**Photograph 10 (facing SE):** View of manhole in Brown Street.
	**Photograph 11 (facing E):** View of manhole in Brown Street.
	**Photograph 12 (facing NW):** Soft ground area in the north adjacent to Brown Street.

	**Photograph 13 (facing NW):** Public footpath adjacent to north of the site.
	**Photograph 14 (facing S):** View of rough area in the north of the site. Steep slope towards the west present on the eastern boundary.
	**Photograph 15 (facing NW):** Presence of culverted watercourse manhole northwest of the site at few meters below site levels.

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Appendix C

Environment Agency Data

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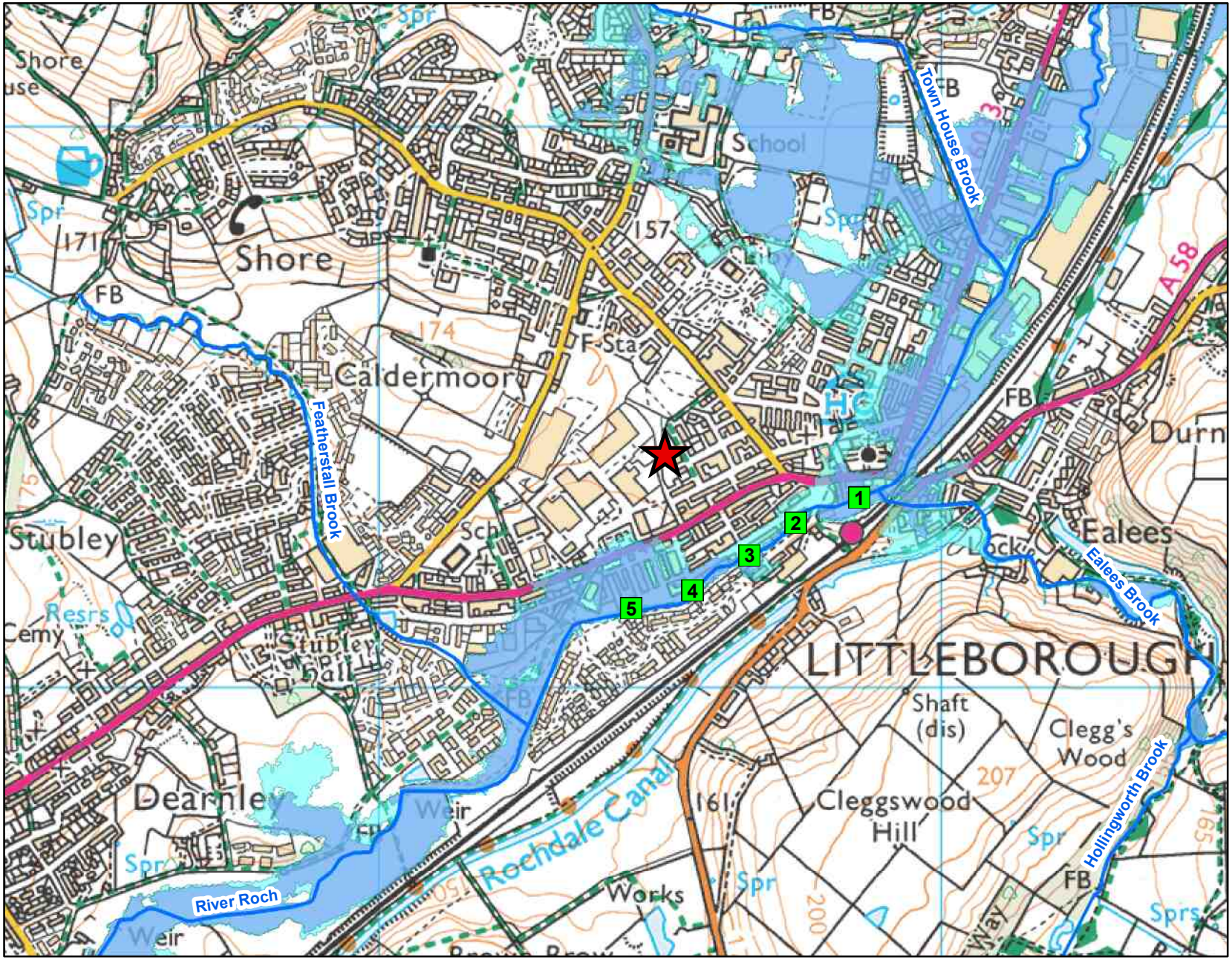
Detailed Flood Map centred on Brown Street, Littleborough, OL15 8BW. Created on 19/02/2020 [GMMC161228AB]



Environment Agency

1:10,001

N

Legend

- Site Location
- Model Measurements
- Main River
- Flood Zone 3 Fluvial
- Flood Zone 2 Fluvial

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Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 08708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

					Undefended								Defended							
Map Reference	Model Node Reference	Easting	Northing	Data	5 % AEP (1 in 20 year)	3.33 % AEP (1 in 30 year)	1.33 % AEP (1 in 75 year)	1 % AEP (1 in 100 year)	1 % AEP (1 in 100 year) + 35% increase in flow	1 % AEP (1 in 100 year) + 70% increase in flow	0.5 % AEP (1 in 200 year)	0.1 % AEP (1 in 1000 year)	5 % AEP (1 in 20 year)	3.33 % AEP (1 in 30 year)	1.33 % AEP (1 in 75 year)	1 % AEP (1 in 100 year)	1 % AEP (1 in 100 year) + 35% increase in flow	1 % AEP (1 in 100 year) + 70% increase in flow	0.5 % AEP (1 in 200 year)	0.1 % AEP (1 in 1000 year)
1	ea013_model_ROCH05_09450	393858	416338	Modelled Water Level (m aodN)	143.39	143.51	143.99	144.08	144.83	145.21	144.27	144.99	143.31	143.39	143.98	144.10	144.93	145.38	144.29	145.06
				Modelled Flow (cumecs)	23.38	24.48	32.21	33.69	41.36	43.69	37.76	41.71	23.15	24.17	30.75	32.40	41.56	42.43	36.60	41.70
2	ea013_model_ROCH05_9335	393744	416293	Modelled Water Level (m aodN)	142.48	142.52	142.83	142.89	143.47	143.71	143.20	143.57	142.45	142.48	142.82	142.89	143.55	143.78	143.19	143.61
				Modelled Flow (cumecs)	24.69	26.32	34.77	36.35	50.57	52.94	41.89	51.94	23.64	24.88	34.47	36.38	51.35	52.91	41.59	51.44
3	ea013_model_ROCH05_9235	393662	416236	Modelled Water Level (m aodN)	142.26	142.32	142.65	142.71	143.07	143.32	142.86	143.15	142.22	142.27	142.65	142.72	143.12	143.42	142.86	143.19
				Modelled Flow (cumecs)	24.69	26.33	33.76	34.66	43.62	52.32	38.34	46.26	23.64	24.87	33.45	34.60	45.31	55.74	37.88	47.60
4	ea013_model_ROCH05_9110	393560	416173	Modelled Water Level (m aodN)	141.40	141.40	141.49	141.51	141.73	141.92	141.58	141.78	141.44	141.48	141.76	141.78	141.89	142.02	141.83	141.92
				Modelled Flow (cumecs)	25.20	26.85	34.76	35.99	45.85	54.28	39.50	48.78	24.17	25.27	34.05	35.40	46.40	57.89	38.67	49.18
5	ea013_model_ROCH05_8985	393451	416141	Modelled Water Level (m aodN)	140.49	140.53	140.69	140.72	140.92	140.99	140.80	140.93	140.51	140.56	140.85	140.88	141.10	141.36	140.93	141.13
				Modelled Flow (cumecs)	23.54	24.33	27.25	27.69	31.23	34.44	28.95	31.66	24.16	25.26	32.17	32.61	34.39	36.32	33.70	34.89

Model data taken from Rochdale & Littleborough 2013

AEP - Annual Exceedence Probability

m aodN - metres above ordnance datum Newlyn

cumecs - cubic metres per second

Notes: *Climate Change Scenario - 35% and 70% increases in flow calculated for the 2080's (2070 - 2115). Please see https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances for more information regarding the new climate change guidance. The location of the site and the type (vulnerability) of development determine the climate change allowances to consider in any flood risk assessment.

Matthew Craig

From: GMMC Info Requests <InfoRequests.GMMC@environment-agency.gov.uk>
Sent: 25 February 2020 11:39
To: Matthew Craig
Subject: GMMC161228AB Response attached from the Environment Agency
Attachments: GMMC161228AB_DFM.PDF; GMMC161228AB_P4.pdf; GMMC161228AB_Res.pdf; Reservoir Flood Map Attachment.pdf; CCA - GMMC Area External Guidance v5.pdf

Dear Matthew,

Thank you for your enquiry which was received on 11/2/20.

We respond to requests under the Freedom of Information Act 2000 and Environmental Information Regulations 2004.

I enclose the data requested.

We have no record of flooding affecting this site. However, this does not mean flooding has not occurred in the past or that it will not flood in future. We recommend that you also contact United Utilities and Rochdale Metropolitan District Authority who may hold additional information (the former especially in relation to sewer flooding).

There are no flood defences within the vicinity of the site.

From April 2015 Lead Local Flood Authorities became the statutory consultee for surface water flood risk in relation to planning applications. They are now the appropriate body to assess applicants/developers surface water drainage proposals and the Local Planning Authority should consult the LLFA as necessary during determination of applications.

On 12th September 2014 Defra published a new consultation on delivering SuDS. The consultation document set out an alternative approach to the one envisaged in the Flood & Water Management Act 2010. The proposals dropped all the key provisions of Schedule 3 and the idea of establishing SuDS Approval Boards (SABs). The alternative approach was adopted and a written statement made on 18th December 2014 to Parliament:- https://www.gov.uk/government/speeches/sustainable-drainage-systems. The alternative approach sets out an expectation that “major developments” should incorporate SuDS designs. The supporting “Non Statutory Technical Standards for SuDS was also issued in March 2015”:- https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards. It is no longer the EAs role to comment on the suitability of a developer’s surface water drainage design as to whether it meets the National Planning Policy Framework, Non-Statutory Standards, the Council’s policies or any relevant SFRA requirements. If the LLFA wishes to consult us as part of their SuDS design assessment (i.e. if discharge is proposed direct to a “main river”) this can be done directly with the EA’s PSO Team here. Accordingly, if you have not already done so, we recommend you discuss your surface water drainage proposals directly with the LLFA. This development may require a permit under the Environmental Permitting (England and Wales) Regulations 2010 from the Environment Agency for any proposed works or structures, in, under, over or within eight metres of the top of the bank of a watercourse, designated a ‘main river’. This was formerly called a Flood Defence Consent. Some activities are also now excluded or exempt. A permit is separate to and in addition to any planning permission granted. Further details and guidance are available on the GOV.UK website: https://www.gov.uk/guidance/flood-risk-activities-environmental-permits.

Flood risk from surface water can be found at https://flood-warning-information.service.gov.uk/long-term-flood-risk/map

Please be aware you can check your risk of flooding on our external website https://flood-warning-information.service.gov.uk/long-term-flood-risk/

Please also note that all current EA flood risk strategy documents can be found on our external website https://www.gov.uk/guidance/flood-risk-assessment-local-planning-authorities and https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Please refer to the Open Government Licence which explains the permitted use of this information.

Please get in touch if you have any further queries or contact us within two months if you'd like us to review the information we have sent.

Kind regards,

Anne Ball
Customer and Engagement Officer
Greater Manchester, Merseyside and Cheshire
External: 020 302 51232
Mobile: 07769285094
Email: Inforequests.gmmc@environment-agency.gov.uk

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Appendix D

Consultee Correspondence

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Matthew Craig

From: Wastewater Developer Services <WastewaterDeveloperServices@uuplc.co.uk>
Sent: 24 February 2020 14:46
To: Matthew Craig
Cc: Wastewater Developer Services
Subject: 4200030340 - Pre-Development Enquiry - Brown Street, Littleborough
Attachments: 3142 01 A Location Plan.pdf; United Utilities - wastewater development.docx

Dear Matthew,

Our reference for this pre-development enquiry: 4200030340

We have carried out an assessment of your application which is based on the information provided; this pre development advice will be valid for 12 months

Records of historic flooding:

I can confirm that we do have current records of sewer flooding on our DG5 register within the vicinity of the proposed development. The DG5 register is a register of properties that have flooded as a result of hydraulic inadequacy of the public sewer network.

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

Our response does not include:

- any sewer flooding events caused by blockages or collapses which are the result of third party actions, natural events or other actions over which UUW has no control and not a facet of sewer capacity; or

- any historical sewer flooding events that have been removed from the register as a result of investment in our infrastructure.

Foul

Foul will be allowed to drain to the public combined sewer network at an unrestricted rate, and at any conveniant point.

Surface Water

In order to follow the drainage heirachy outlined in Building Regulations part H3 and National Planning Practice Guidance (NPPG), surface water should be drained via infiltration systems/soakaways wherever possible.

Please note, where ground conditions could potentially allow for an infiltration-based drainage strategy, we would expect to see percolation test results in line with BRE Digest 365.

If infiltration proves to be infeasible, surface water must connect to the culverted watercourse to the West of the site (running roughly North to South).

General Information:

Please be aware that on 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.

Connection Application

Although we may discuss and agree discharge points & 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

http://www.unitedutilities.com/connecting-public-sewer.aspx

Trade Effluent

If you intend to discharge trade effluent to the public sewer you will require a trade effluent permit. Please see United Utilities' website for details.

https://www.unitedutilities.com/wholesale-services/trade-effluent/

Many thanks and kind regards,

Tom

United Utilities
Water for the North West

Thomas Bethell
Assistant Engineer
Developer Services & Metering
Customer Services
T: 01925 679 308
unitedutilities.com

If you have received a great service today why not tell us?
Visit: unitedutilities.com/wow

From: Matthew Craig [mailto:m.craig@thelkgroup.com]
Sent: 11 February 2020 16:34
To: Wastewater Developer Services <WastewaterDeveloperServices@uuplc.co.uk>
Subject: FRA query - Brown Street, Littleborough

Dear Sir/Madam

LK Consult Ltd. has been commissioned to undertake a Flood Risk Assessment (FRA), for land at Brown Street, Littleborough, OL15 8BW

Centred at approximate National Grid Reference 393519E, 416433N.

The area of interest appears to be in Flood Zone 1.

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

- Records of any historic flood events and potential sources of flooding from foul and surface water sewers on site and in the area.
- Any restrictions to discharge into the sewers

If you have any queries please get in touch with me.

We are, of course, happy to pay your reasonable charge for this service. Please let me know by return what information is available and 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?

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

Regards

Matthew Craig

Matthew Craig
Environmental Scientist – Flood Risk
LK Consult | 0161 763 7200 |
Manchester | London | Liverpool | Glasgow |
www.thelkgroup.com

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

EMGateway3.uuplc.co.uk made the following annotations

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www.unitedutilities.com
www.unitedutilities.com/subsidiaries

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

LKGroup

Unit 29, Eton Business Park
Eton Hill Road,
Radcliffe, Greater Manchester
M26 2ZS

FAO:

Your Ref: FRA 20 1133
Our Ref: UUPS-ORD-154834
Date: 03/03/2020

Dear Sirs

Location: Brown Street Littleborough

I acknowledge with thanks your request dated 03/03/2020 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

United Utilities Water Limited
Registered In England & Wales No. 2366678
Registered Office Haweswater House, Lingley Mere Business Park,
Lingley Green Avenue, Great Sankey, Warrington, WA5 3LP

TERMS AND CONDITIONS - WASTEWATER AND WATER DISTRIBUTION PLANS

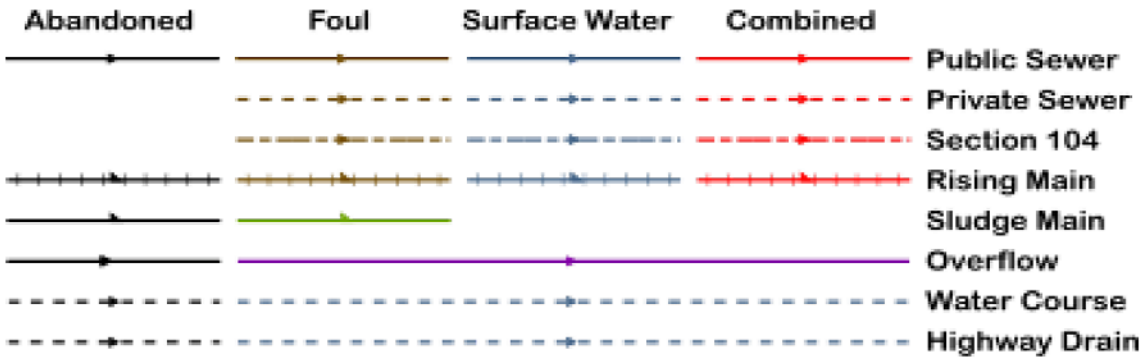
These provisions apply to the public sewerage, water distribution and telemetry systems (including sewers which are the subject of an agreement under Section 104 of the Water Industry Act 1991 and mains installed in accordance with the agreement for the self construction of water mains) (UUWL apparatus)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

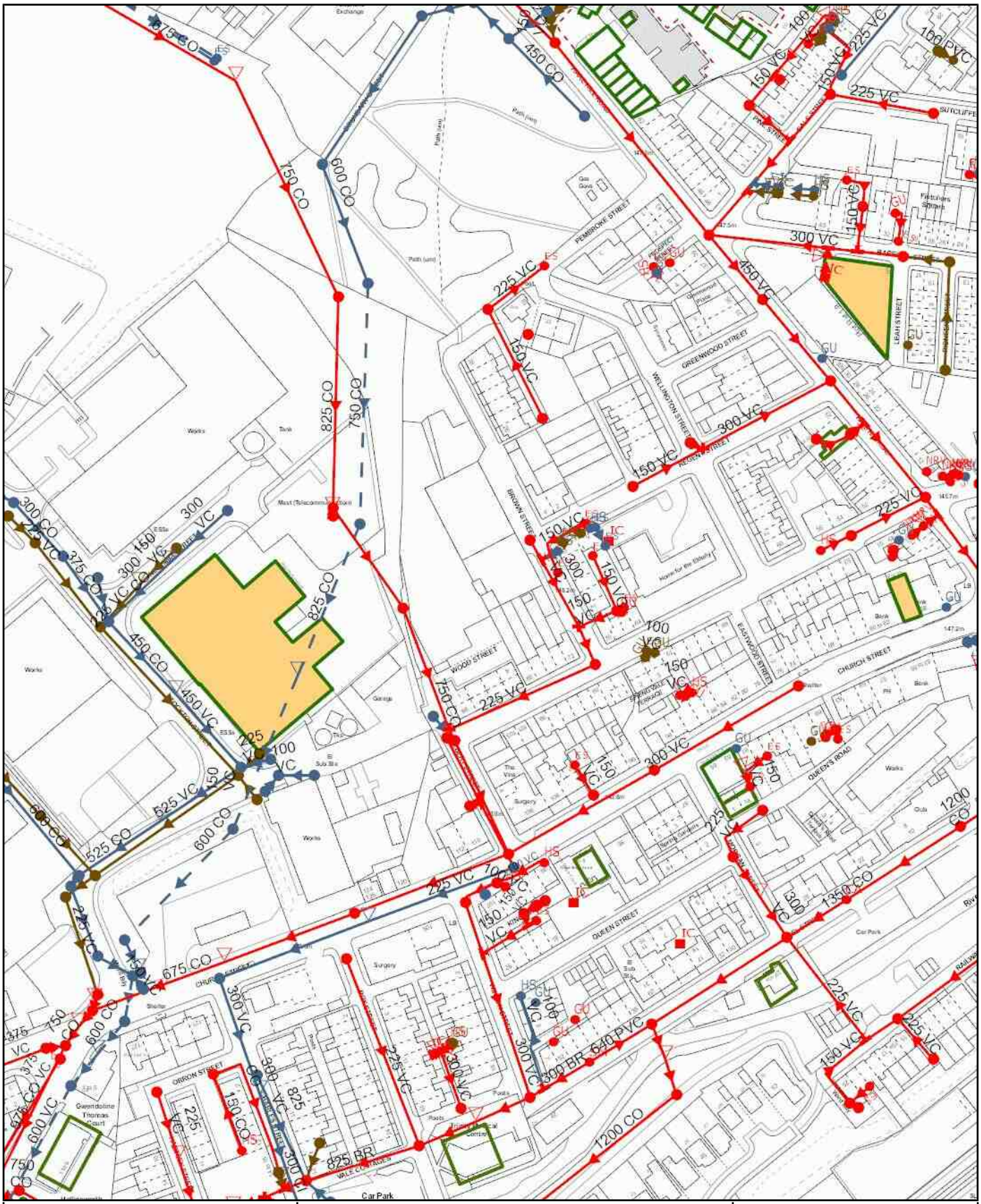
United Utilities Water Limited
Registered In England & Wales No. 2366678
Registered Office Haweswater House, Lingley Mere Business Park,
Lingley Green Avenue, Great Sankey, Warrington, WA5 3LP

Wastewater Symbology



All point assets follow the standard colour convention: red – combined, brown - foul, blue – surface water, purple - overflow

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



Scale:	1:1954	**SEWER RECORDS**	United Utilities helping life flow smoothly
Date:	03/03/2020		
Address or Site Reference:	Brown Street Littleborough		
Printed by:	Property Searches		

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

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Matthew Craig

From: Stephen McCann <Stephen.McCann@Rochdale.Gov.UK>
Sent: 12 March 2020 11:03
To: Matthew Craig; Andrew Eadie
Subject: FRA query - Brown Street, Littleborough
Attachments: Brown St site - Drainage Comments 12.3.20.pdf

Matthew,

Here are my comments.
Andrew:- I included your comment about the council having no records of flooding of the site.

Stephen McCann
Drainage & Flooding Engineer
Highways, Property & Strategic Housing

ROCHDALE BOROUGH COUNCIL

01706 924606
stephen.mccann@rochdale.gov.uk

From: Andrew Eadie <Andrew.Eadie@Rochdale.Gov.UK>
Sent: 11 March 2020 19:44
To: Stephen McCann <Stephen.McCann@Rochdale.Gov.UK>
Subject: FW: FRA query - Brown Street, Littleborough

Hi Stephen,

Do you have anything to add, and I'll do a reply? I can tell them that we don't have any records relating to historic flood incidents at this site.

Cheers

Andrew Eadie
Principal Planning Officer
Planning & Development

ROCHDALE BOROUGH COUNCIL

01706 924371
andrew.eadie@rochdale.gov.uk

Rochdale Borough Council
Floor 3, Number One Riverside
Smith Street, Rochdale, OL16 1XU

From: Matthew Craig <m.craig@thelkgroup.com>
Sent: 03 March 2020 14:00
To: Strategic Planning <Strategic.Planning@Rochdale.Gov.UK>
Subject: FRA query - Brown Street, Littleborough

Dear Sir/Madam

LK Consult Ltd. has been commissioned to undertake a Flood Risk Assessment (FRA), for land at Brown Street, Littleborough, OL15 8BW

Centred at approximate National Grid Reference 393519E, 416433N.

The area of interest appears to be in Flood Zone 1.

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

- Records of any historic flood events and potential sources of flooding from foul and surface water sewers on site and in the area.
- Any restrictions to discharge into the sewers

If you have any queries please get in touch with me.

We are, of course, happy to pay your reasonable charge for this service. Please let me know by return what information is available and 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?

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

Regards

Matthew Craig

Matthew Craig
Environmental Scientist – Flood Risk
LK Consult | 0161 763 7200 |
Manchester | London | Liverpool | Glasgow |
www.thelkgroup.com

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

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ROCHDALE BOROUGH COUNCIL

Date: 12/03/2020

Highways and Engineering Service - Economy and Environment

Author: **Stephen McCann,** Drainage & Flooding Engineer, Highways, Property & Strategic Housing
01706 924606 stephen.mccann@rochdale.gov.uk
Rochdale Borough Council, Floor 2, No. One Riverside, Smith Street, Rochdale, OL16 1XU

FLOODING RECORDS

The council has no records relating to historic flood incidents at this site. However, you should check with the Environment Agency in case they have flooding records.

SEWERS IN THE VICINITY

A 750mm dia. combined sewer runs through the site, which is a United Utilities Asset.

A 750mm dia concrete surface water SW drainage pipe (approx. 3m below ground) runs to the west of the site. According to United Utilities' plans (fig 1 below), the dashed line suggests that this pipe is a "culvert" i.e. a piped stream and consequently is maintained by Rochdale council.

The Drainage Officer believes that this 'culvert' is incorrected labelled and should be a United Utilities asset because:-

- a review of historical maps (back to 1898) do not indicate that a permanent stream existed;
- the upstream connections to this 'culvert' are solely United Utilities' surface water pipes.

However, the Drainage Officer suggests that the Applicant sends this document to United Utilities when discussing discharging of foul and controlled surface water discharges to UU's assets. Once UU become involved in the discussion, RBC will discuss the issue in full with UU and the Applicant.

The government hierarchy of drainage directs that SW should be preferentially discharged to a SW pipe rather than a combined sewer. Since the 'culvert' is located approx. 15m away across land that is probably owned by McCormick (this can be checked via Land Registry), it will be easier for UU to gain permission to discharge to the culvert IF the pipe is classed as a UU sewer rather than as a 'culvert'. The reason:- a culvert has to be maintained by the landowner not UU; and UU has legal means to cross other land to make connections to its own sewerage system.

SURFACE WATER DISCHARGE RATE

For brownfield sites, UU & RBC wish to target a reduction in accordance with national standards on sustainable drainage which seek to reduce run-off to greenfield rates. Our minimum expectation on a brownfield site is a 50% reduction in the rate of discharge for the 1 in 30 year storm. A flow control of 5 l/s is accepted as the minimum practical flow control value that can be applied using a vortex flow control such that the outlet diameter of the flow control does not block.

Date: 12/03/2020

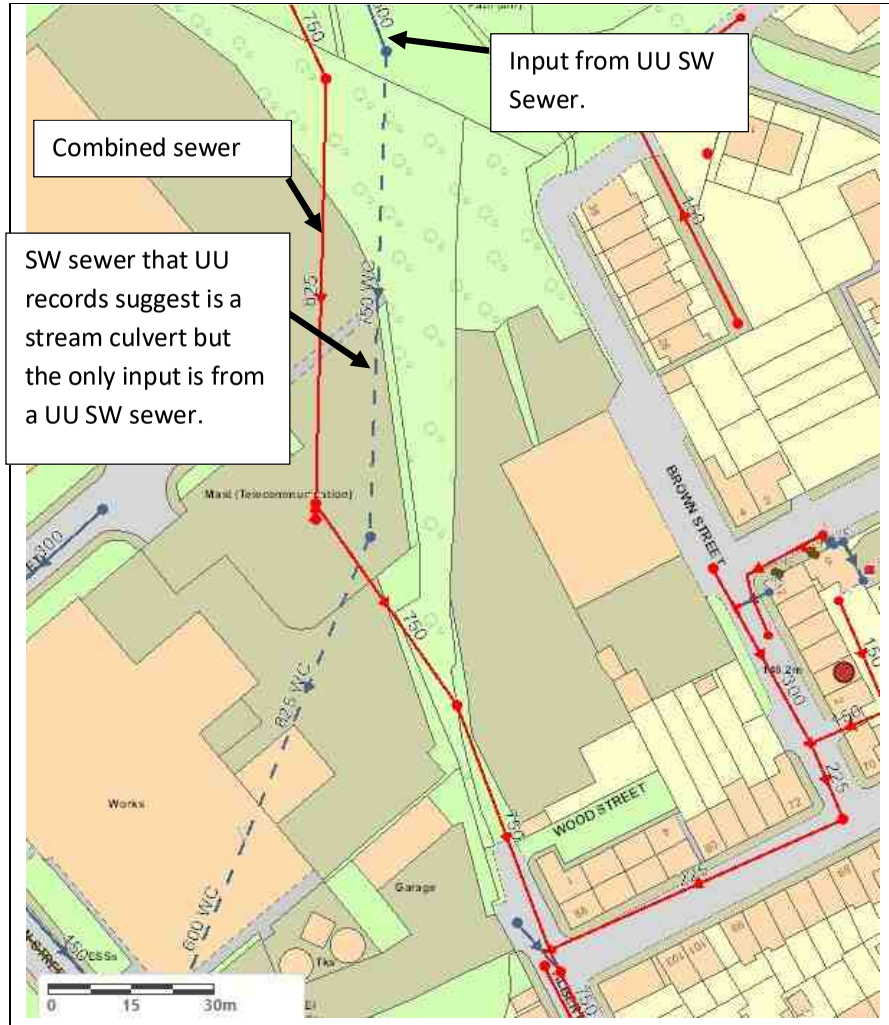

Fig1. UU sewer plans



Fig 2. Red line boundary to the site

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Appendix E

Calculations

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The LK Group
www.thelkgroup.com
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Eton Hill Road,
Radcliffe M26 2ZS
Tel: 0161 763 7200
email: m.jones@thelkgroup.com

MasterDrain
SW 16.08

Job No.			
Sheet no.	1		
Date	03/04/20		
Project	Brown Street	By	Checked / Reviewed
Title	1x10-5		

Data:-

Location hydrological data (FSR):-

Location	= Littleborough	Grid reference	= SD8913
M5-60 (mm)	= 19.0	r	= 0.28
Soil index	= 0.30	SAAR (mm/yr)	= 1150
WRAP	= 2	Area = England and Wales	

Soil classification for WRAP type 2
i) Very permeable soils with shallow ground water;
ii) Permeable soils over rock or fragipan, commonly on slopes in western Britain associated with smaller areas of less permeable wet soils;
iii) Moderately permeable soils, some with slowly permeable subsoils.

Design data:-

Safety factor = 2.0 - Minor inconvenience (SF=2)
Fill porosity = 1.00
Equivalent porosity (n1) = 1.00

Area drained = 2100 m²

Infiltration coefficient = 0.036 m/hr
Effective inf.coeff (q) = 0.018

Return period = 100 yrs

Climate change factor = 40%

Calculations :-

Perimeter of pit = (2 x Excavation Width)+(2 x Excavation Length)
Area of base = Excavation Width x Excavation Length
Infiltration area = (Area of base)+(Perimeter of pit x Hmax)
Temporary constant 'a'
= (Area of base / perimeter)-((AreaDrained x Rainfall depth /1000)/(Perimeter/Inf. coeff))
Temporary constant 'b' = (Perimeter/Inf. coeff) / (Area of base x porosity)
Hmax = a*((EXP(-1 x b x Duration of storm))-1)

Note: The Hmax calculation is iterated to a maximum value of Hmax.

Note: Duration of storm in hours, Rainfall depth in mm/hr x Climate Change factor.

Results :-

Emptying time to 50% volume = 22:38 (hr:min)
hMax (Depth) = 1.0 metres
Time to maximum = 17:00 hr:min
Rainfall at maximum = 7.42mm/hr
Width (m) = 10.0

Length (m) = 20.0

Total Infiltration area = 259.8m² (base area + sidewall area).

Total available volume = 199.20m³

N.B. The rainfall rates are calculated using the location specific values above in accordance with the Wallingford procedure.
Formulae and methods from CIRIA 156.

The LK Group
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email: m.jones@thelkgroup.com

MasterDrain
SW 16.08

Job No.			
Sheet no.	1		
Date	03/04/20		
Project	Brown Street	By	Checked / Reviewed
Title	1x10-5		

Data:-

Hydrology:-

Location = Littleborough
M5-60 (mm) = 19
WRAP = 2
SAAR (mm/yr) = 1150
Grid reference = SD8913
r = 0.28
Soil index = 0.30
Area = England and Wales

Soil classification for WRAP type 2
i) Very permeable soils with shallow ground water;
ii) Permeable soils over rock or fragipan, commonly on slopes in western Britain associated with smaller areas of less permeable wet soils;
iii) Moderately permeable soils, some with slowly permeable subsoils.

Design data:-

Pit length = 20.00 m
Pit depth = 1.00 m
Voids % = 100
Max inf area = 259.76 m²
Season = Winter
Return period = 100 yrs
Pit width = 10.00 m
Available volume = 199.20 m³
Pit volume = 199.20 m³
Inf coeff. = 0.0360 m/hr
Climate change = 40.0 %

Results:-

Duration hours	Peak rain mm/hr	Max volume m³	Max. Outflow l/s	Peak time hours	Max depth mm	% full
0.25	23.05	60.14	2.18	0.25	300.72	30.19
0.50	16.10	82.80	2.25	0.50	413.98	41.56
1.00	10.76	107.97	2.32	1.00	539.84	54.20
2.00	6.92	133.06	2.40	2.00	665.31	66.80
3.00	5.24	145.24	2.44	3.00	726.19	72.91
4.00	4.27	151.85	2.46	4.00	759.27	76.23
6.00	4.33	159.42	2.48	5.52	797.08	80.03
8.00	4.31	162.81	2.49	7.04	814.06	81.73
10.00	4.34	164.06	2.49	8.40	820.32	82.36
12.00	4.38	164.18	2.50	9.72	820.90	82.42
16.00	4.50	162.19	2.49	12.48	810.95	81.42
24.00	4.51	153.40	2.47	17.76	766.99	77.01
36.00	4.25	135.76	2.42	25.56	678.82	68.15
48.00	4.37	117.03	2.36	32.64	585.13	58.75
96.00	3.81	52.11	2.18	59.52	260.54	26.16
192.00	0.00	0.00	0.00	0.00	0.00	0.00

Results display
This display shows data associated with the maximum state:-
Duration - length of storm in hours
Peak rain mm/hr - rainfall intensity at peak of storage
Max volume m³ - water volume at peak of storage
Max. Outflow l/s - infiltration rate at peak of storage
Peak time hrs - time at peak of storage
% full - % of available volume used at peak of storage

MasterDrain
SW 16.08

The LK Group

www.thelkgroup.com

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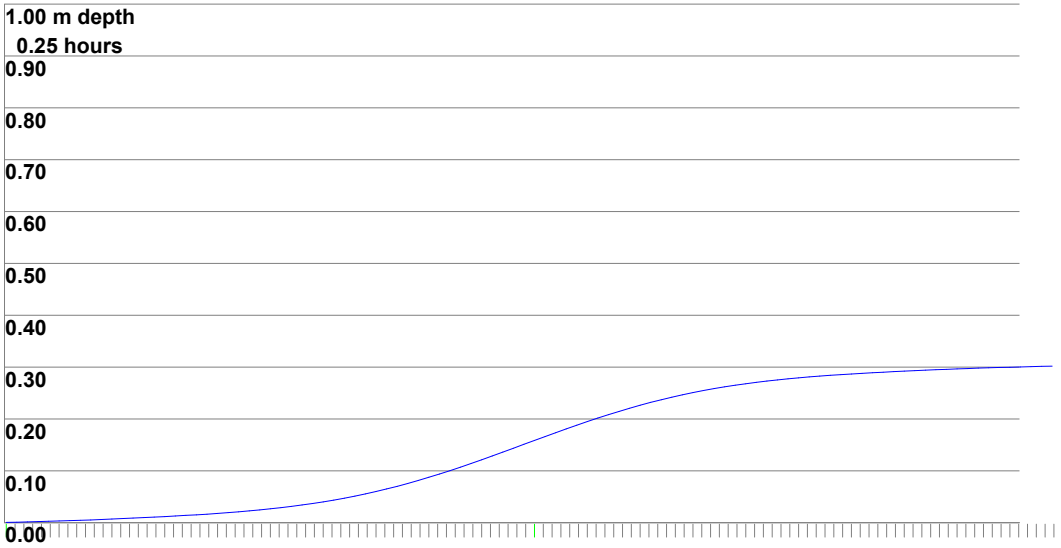
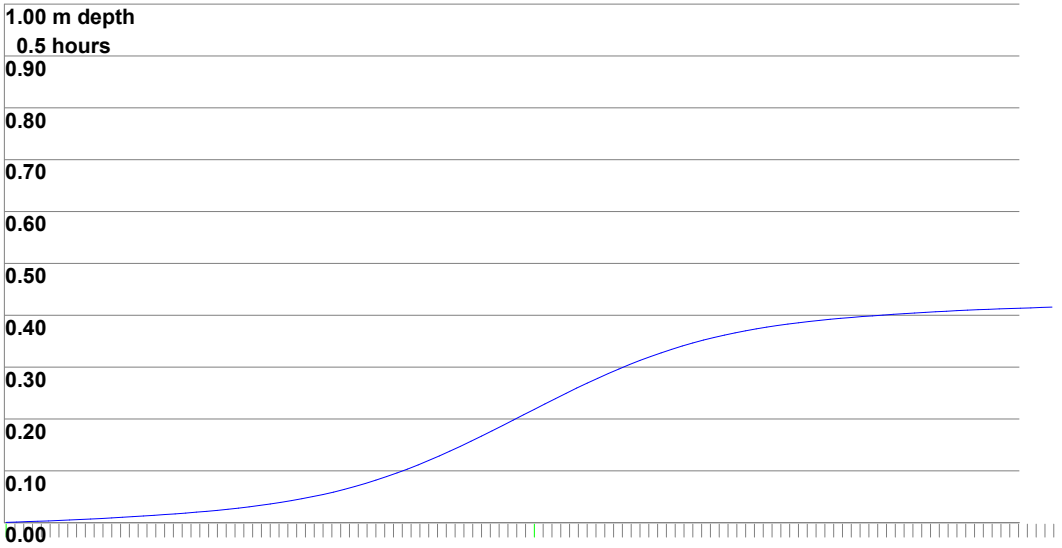
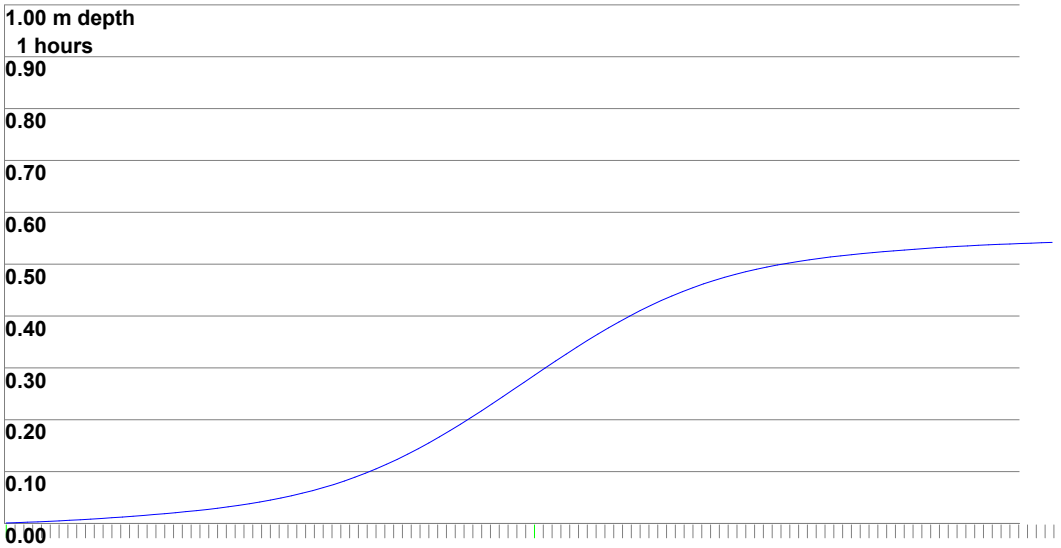
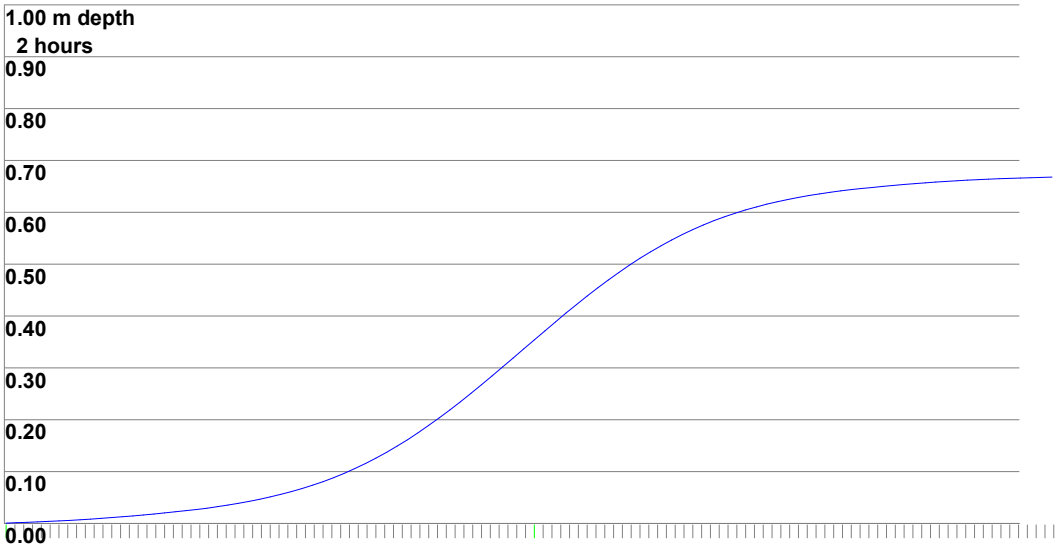
Job No.			
Sheet no.	2		
Date	03/04/20		
Project	Brown Street	By	Checked / Reviewed
Title	1x10-5		









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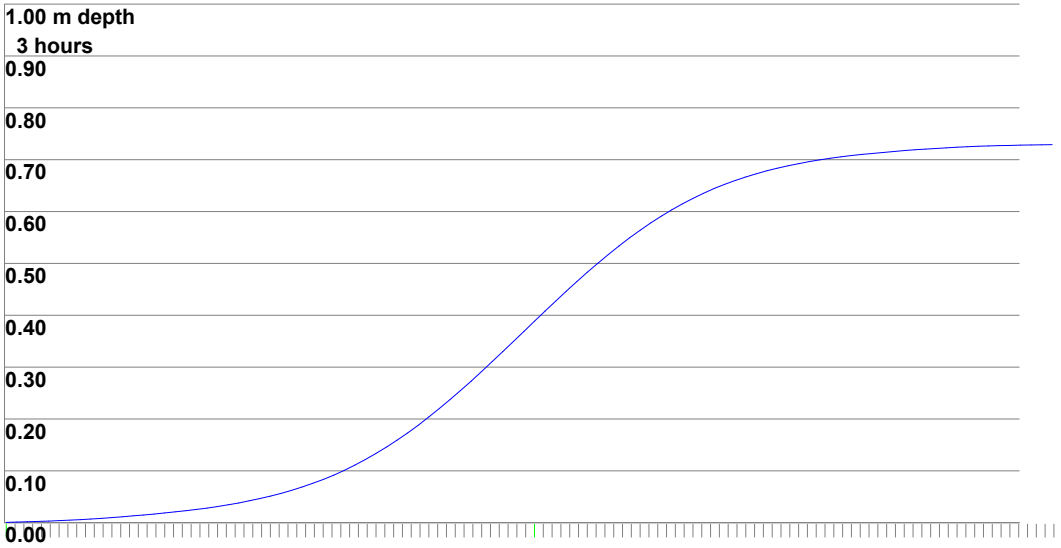
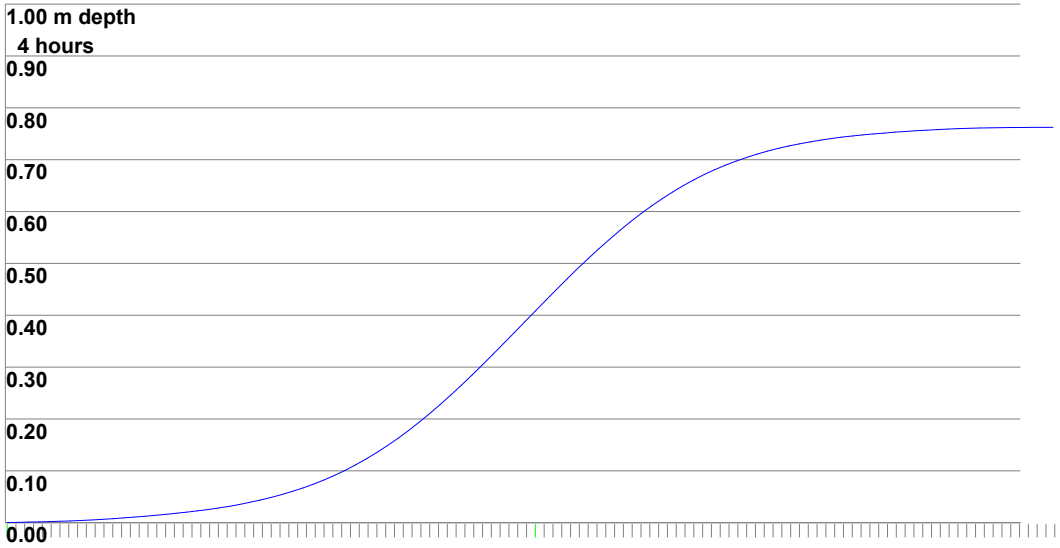
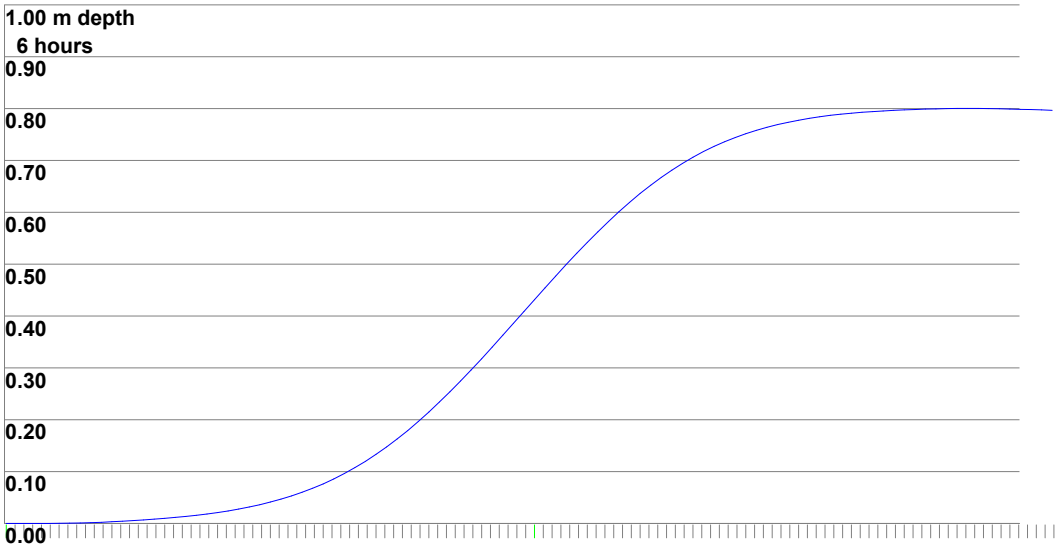
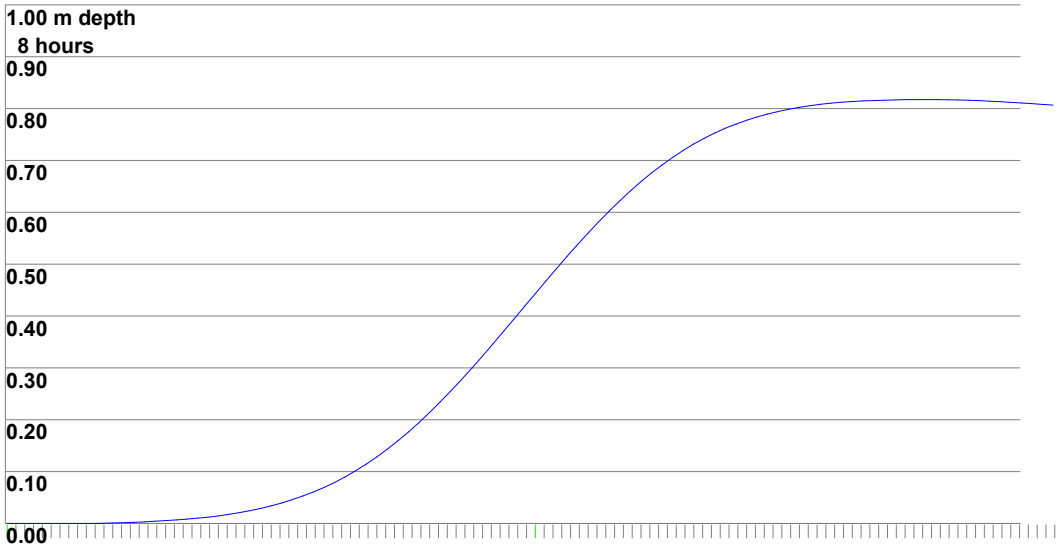
MasterDrain
SW 16.08

Job No.			
Sheet no.	3		
Date	03/04/20		
Project	Brown Street	By	Checked / Reviewed
Title	1x10-5		









MasterDrain
SW 16.08

The LK Group

www.thelkgroup.com

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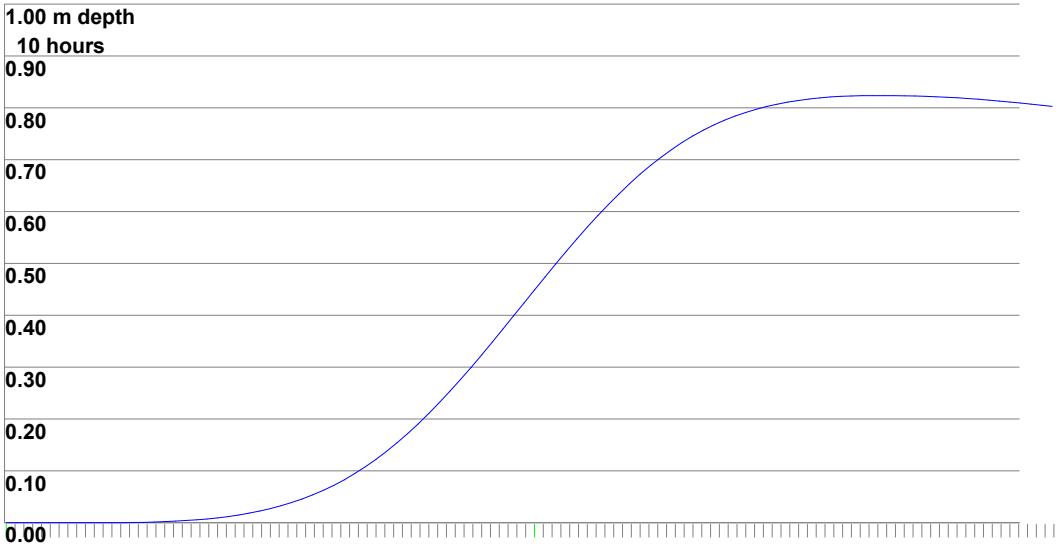
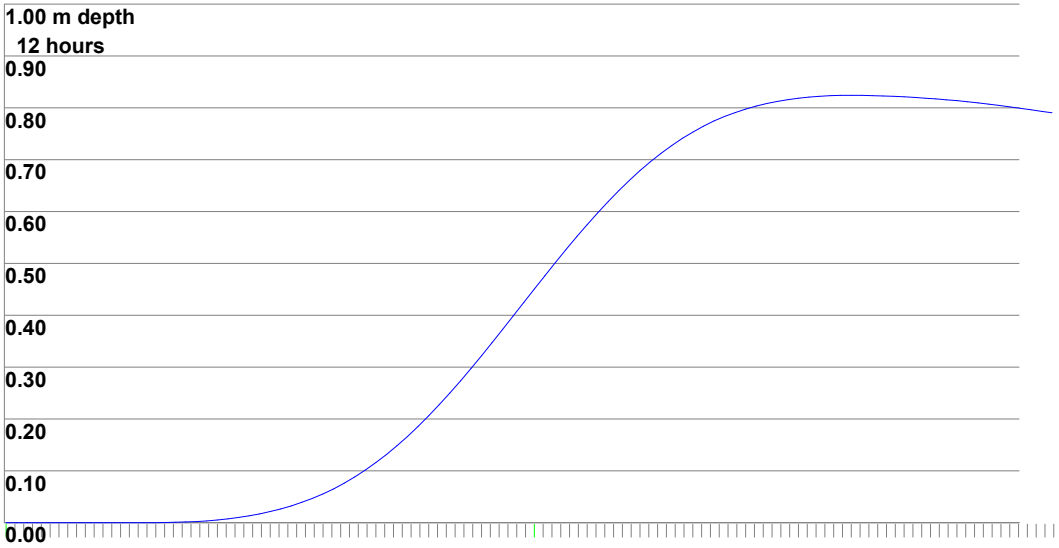
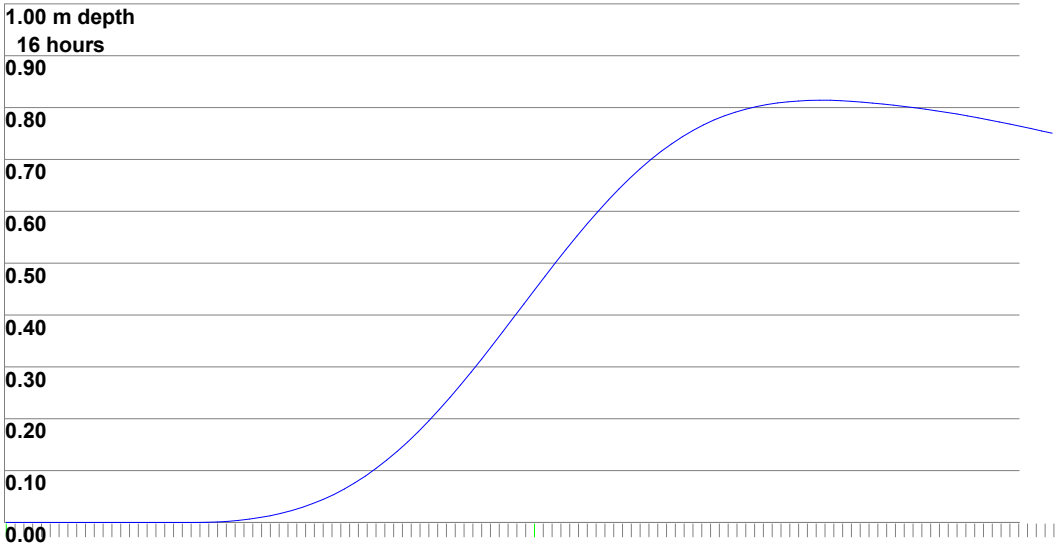
Tel: 0161 763 7200
email: m.jones@thelkgroup.com

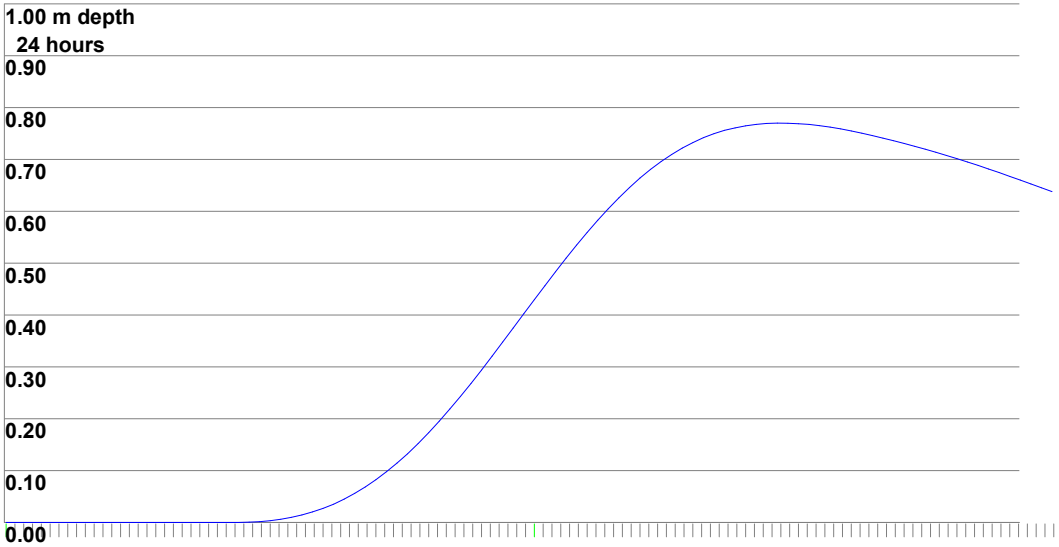
Job No.	
Sheet no.	4
Date	03/04/20
Project	Brown Street
Title	1x10-5

By	Checked	Reviewed









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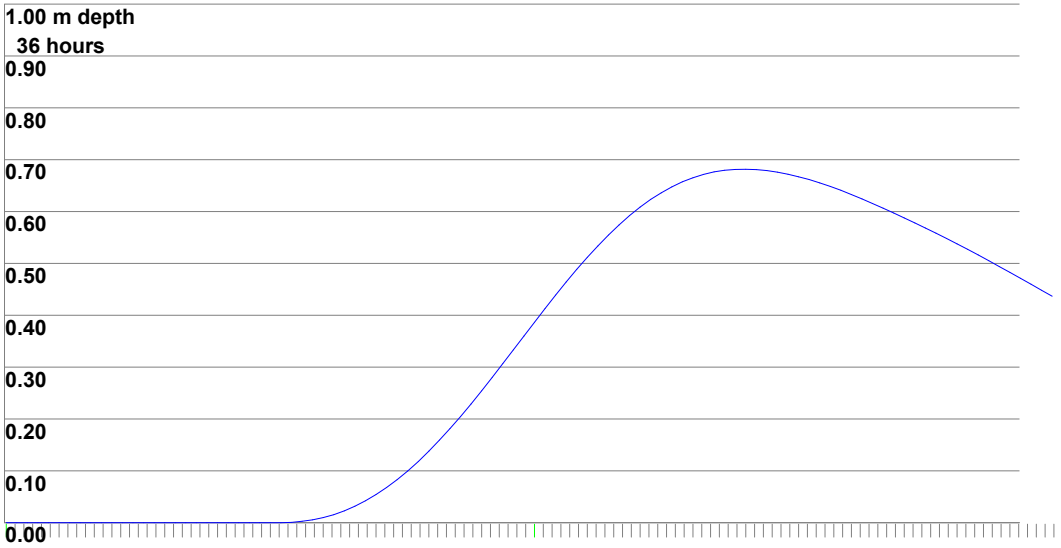
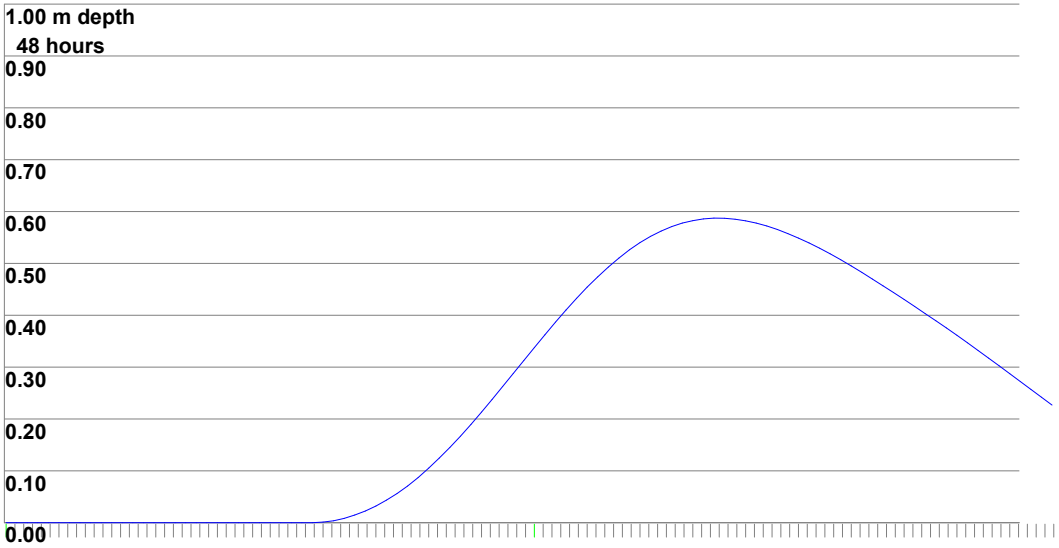
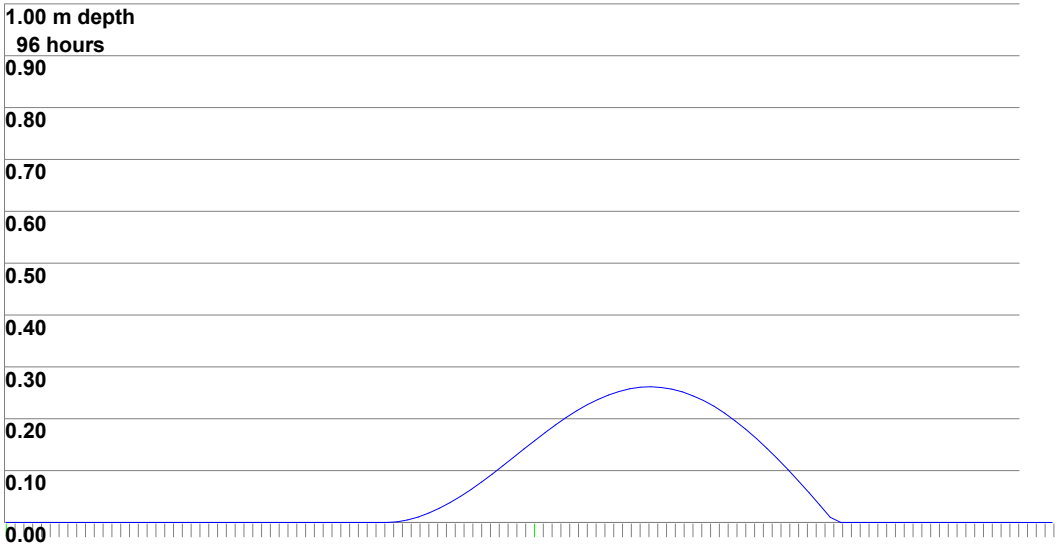
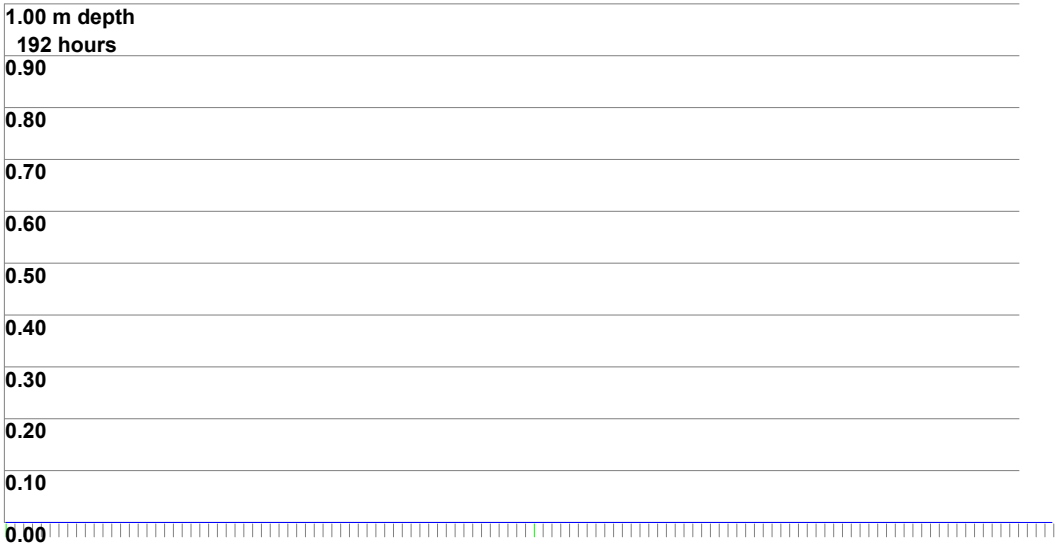
SW 16.08

Job No.			
Sheet no.	5		
Date	03/04/20		
Project	Brown Street	By	Checked / Reviewed
Title	1x10-5		









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Job No.			
Sheet no.	1		
Date	04/03/20		
Project	Brown Street, Littleborough	By	Checked / Reviewed
Title	Peak Runoff - 1 in 1 year		

Area data:-

FSR data

M5-60 = 19
Soil index = 0.30
WRAP value = 2

r = 0.28
SAAR = 1150
Nat grid = SD8913

Site data:-

Ret. period (yrs) = 1
Time of entry = 10.00
Impervious area drained = 4200 m²
Site slope = Mild <2% (1:50)
Length of overland flow = 0.00

ToC = 10.0 mins
Overland flow time = 0.0 mins
Pervious area drained = 0 m²
Soil type = Medium textured
Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 79.0%
Rainfall rate= 38.6 mm/Hr

UCWI = 115.0
Runoff rate (gross)= 35.6 l/s

Methods

Runoff factor (RF) = 79.0, calculated from:-

Runoff factor = (0.829*PIMP)+(25*SOIL)+(0.078*UCWI)-20.7

where

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

UCWI = Calculated value for Wetness Index

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Job No.			
Sheet no.	1		
Date	04/03/20		
Project	Brown Street, Littleborough	By	Checked / Reviewed
Title	Peak Runoff - 1 in 30 year		

Area data:-

FSR data
M5-60 = 19
Soil index = 0.30
WRAP value = 2
r = 0.28
SAAR = 1150
Nat grid = SD8913

Site data:-

Ret. period (yrs) = 30
Time of entry = 6.00
Impervious area drained = 4200 m²
Site slope = Mild <2% (1:50)
Length of overland flow = 0.00
ToC = 6.0 mins
Overland flow time = 0.0 mins
Pervious area drained = 0 m²
Soil type = Medium textured
Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 79.0%
Rainfall rate= 94.6 mm/Hr
UCWI = 115.0
Runoff rate (gross)= 87.2 l/s

Methods

Runoff factor (RF) = 79.0, calculated from:-

Runoff factor = (0.829*PIMP)+(25*SOIL)+(0.078*UCWI)-20.7
where
PIMP = Impervious Area*100/(Impervious Area+Pervious Area)
UCWI = Calculated value for Wetness Index

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Job No.			
Sheet no.	1		
Date	04/03/20		
Project	Brown Street, Littleborough	By	Checked / Reviewed
Title	Peak Runoff - 1 in 100 year		

Area data:-

FSR data
M5-60 = 19
Soil index = 0.30
WRAP value = 2
r = 0.28
SAAR = 1150
Nat grid = SD8913

Site data:-

Ret. period (yrs) = 100
Time of entry = 6.00
Impervious area drained = 4200 m²
Site slope = Mild <2% (1:50)
Length of overland flow = 0.00
ToC = 6.0 mins
Overland flow time = 0.0 mins
Pervious area drained = 0 m²
Soil type = Medium textured
Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 79.0%
Rainfall rate= 119.4 mm/Hr
UCWI = 115.0
Runoff rate (gross)= 110.0 l/s

Methods

Runoff factor (RF) = 79.0, calculated from:-

Runoff factor = (0.829*PIMP)+(25*SOIL)+(0.078*UCWI)-20.7
where
PIMP = Impervious Area*100/(Impervious Area+Pervious Area)
UCWI = Calculated value for Wetness Index

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Job No.			
Sheet no.	1		
Date	31/03/20		
Project	Brown Street, Littleborough	By	Checked / Reviewed
Title	Peak Flow Storage - 1 in 30 year		

Data:-

FSR Hydrology:-

Location = Littleborough
M5-60 (mm) = 19
Soil index = 0.30
Return period = 30
UCWI = 117.8

Grid reference = SD8913
r = 0.28
SAAR (mm/yr) = 1150
WRAP = 2
Climate change = 0

i) Very permeable soils with shallow ground water;
ii) Permeable soils over rock or fragipan, commonly on slopes in western Britain associated with smaller areas of less permeable wet soils; The layer is low in organic matter, mottled and (fragipan - a natural subsurface horizon having a higher bulk density than the solum above. Seemingly cemented when dry but showing moderate to weak brittleness when moist. Slowly or very slowly permeable to water. It is found in profiles of either cultivated or virgin soils but not in calcareous material).
iii) Moderately permeable soils, some with slowly permeable subsoils.

Runoff factor (RF) = 37.0, calculated from:-

Runoff factor = (0.829*PIMP)+(25*SOIL)+(0.078*UCWI)-20.7
where
PIMP = Impervious Area*100/(Impervious Area+Pervious Area)
UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 2100 m²
Total area (TA) = 4200 m²
Allowed discharge rate = 5.000 l/s
Additional flow = 0.00 l/s

Pervious area = 2100 m²
Equiv area = 1554 m² (TA x RF).
Areal reduction factor = 1.000
Climate change factor = 0

Calculated data:-

Time to max = 64.0 mins
Rainfall at max = 28.10 mm/hr
Pipeline storage = 0.0 m³
Offline storage = 0.0 m³

Calculated storage volume = 31.1 m³
Allowed discharge rate = 5.000 l/s
Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours
Rainfall rate = 9.00 mm/hr

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

Rainfall intensities calculated using the Wallingford Procedure

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

Diam	Len	Diam	Len
100	3966.5	1125	31.3
150	1762.9	1200	27.5
225	783.5	1275	24.4
300	440.7	1350	21.8
375	282.1	1425	19.5
450	195.9	1500	17.6
525	143.9	1575	16.0
600	110.2	1650	14.6
675	87.1	1725	13.3
750	70.5	1800	12.2
825	58.3	1875	11.3
900	49.0	1950	10.4
975	41.7	2025	9.7
1050	36.0	2100	9.0

Ovoid	Len
400 x 600	173.0
600 x 900	75.3
800 x 1200	42.4

Box culvert	Len
500 x 500	124.6
500 x 750	83.1
500 x 1000	62.3
750 x 1000	41.5
750 x 1200	34.6
750 x 1500	27.7
1000 x 1000	31.1
1000 x 1200	26.0
1000 x 1500	20.8
1000 x 1800	17.3
1000 x 2000	15.6
1500 x 1500	13.8
1500 x 1800	11.5
1500 x 2000	10.4

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Job No.	
Sheet no.	2
Date	31/03/20
Project	Brown Street, Littleborough
Title	Peak Flow Storage - 1 in 30 year
By	
Checked	
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Data:-

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	77.0	21.567	3.000	18.567
20	55.0	30.832	6.000	24.832
30	44.0	37.023	9.000	28.023
40	37.0	41.804	12.000	29.804
50	33.0	45.745	15.000	30.745
60	29.0	49.119	18.000	31.119
70	27.0	52.081	21.000	31.081
80	24.0	54.726	24.000	30.726
90	23.0	57.120	27.000	30.120
100	21.0	59.308	30.000	29.308
110	20.0	61.324	33.000	28.324
120	19.0	63.194	36.000	27.194
130	18.0	64.936	39.000	25.936
140	17.0	66.568	42.000	24.568
150	16.0	68.102	45.000	23.102
160	16.0	69.549	48.000	21.549
170	15.0	70.918	51.000	19.918
180	14.0	72.215	54.000	18.215
190	14.0	73.448	57.000	16.448
200	13.0	74.622	60.000	14.622
210	13.0	75.742	63.000	12.742
220	12.0	76.859	66.000	10.859
230	12.0	77.946	69.000	8.946
240	12.0	78.999	72.000	6.999
250	11.0	80.020	75.000	5.020
260	11.0	81.011	78.000	3.011
270	11.0	81.975	81.000	0.975
280	11.0	82.911	84.000	0.000
290	10.0	83.824	87.000	0.000
300	10.0	84.713	90.000	0.000
310	10.0	85.581	93.000	0.000
320	10.0	86.428	96.000	0.000
330	9.0	87.255	99.000	0.000
340	9.0	88.064	102.000	0.000
350	9.0	88.856	105.000	0.000
360	9.0	89.631	108.000	0.000
370	9.0	90.390	111.000	0.000
380	9.0	91.134	114.000	0.000
390	8.0	91.864	117.000	0.000
400	8.0	92.580	120.000	0.000
410	8.0	93.282	123.000	0.000
420	8.0	93.972	126.000	0.000
430	8.0	94.650	129.000	0.000
440	8.0	95.317	132.000	0.000
450	8.0	95.972	135.000	0.000
460	8.0	96.616	138.000	0.000
470	7.0	97.250	141.000	0.000
480	7.0	97.874	144.000	0.000
490	7.0	98.489	147.000	0.000
500	7.0	99.094	150.000	0.000
510	7.0	99.690	153.000	0.000
520	7.0	100.278	156.000	0.000
530	7.0	100.857	159.000	0.000
540	7.0	101.428	162.000	0.000
550	7.0	101.992	165.000	0.000
560	7.0	102.547	168.000	0.000
570	6.0	103.096	171.000	0.000
580	6.0	103.637	174.000	0.000
590	6.0	104.172	177.000	0.000
600	6.0	104.699	180.000	0.000

Storage volume (m^3) = 31.1 m^3

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Job No.	
Sheet no.	3
Date	31/03/20

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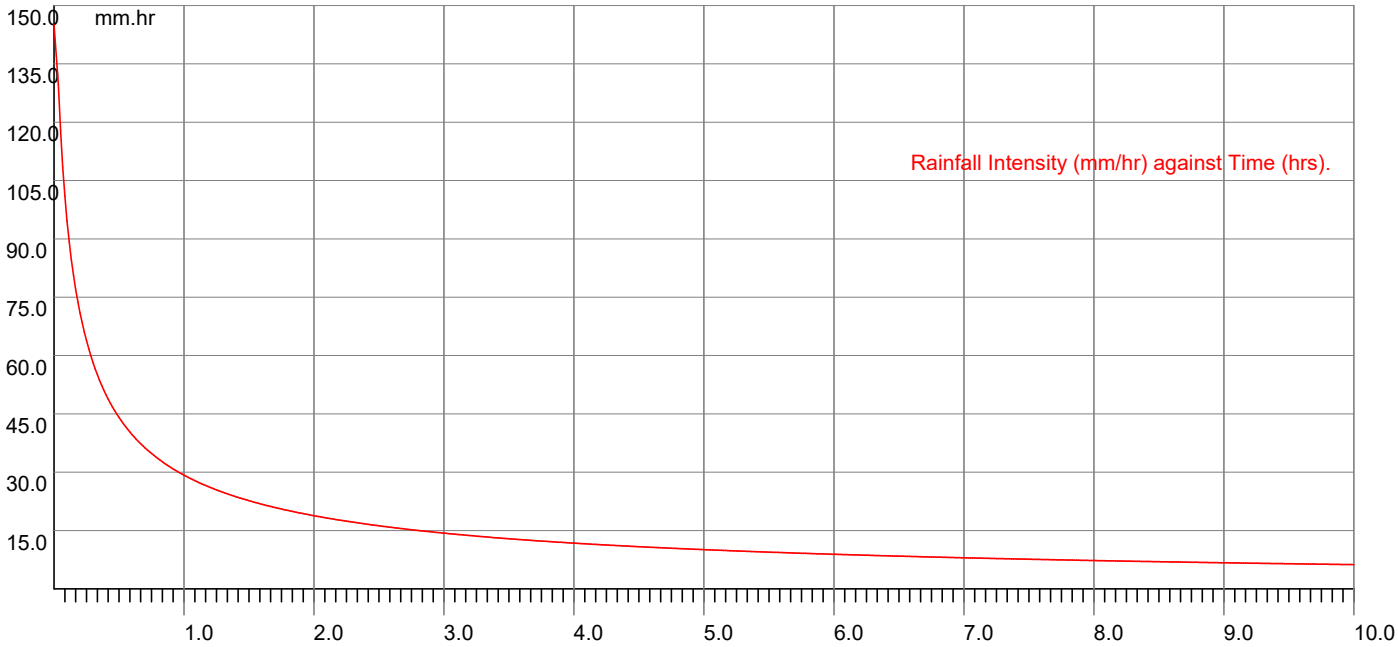
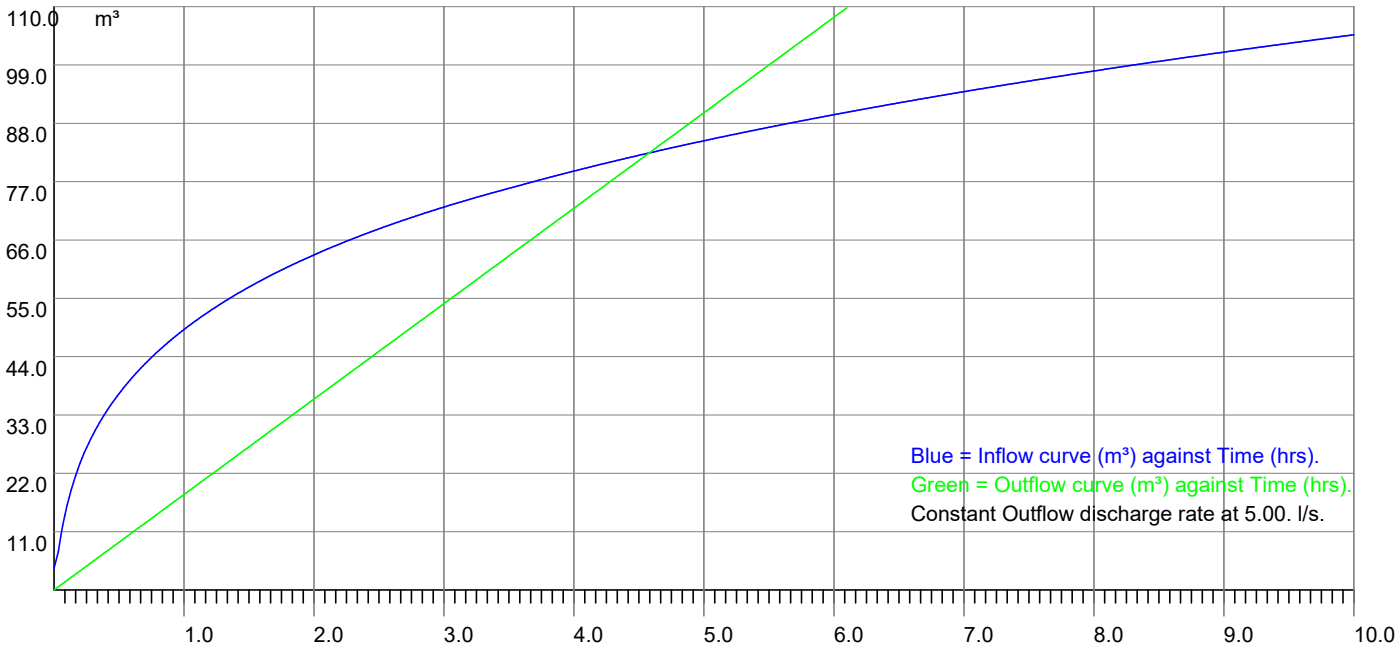
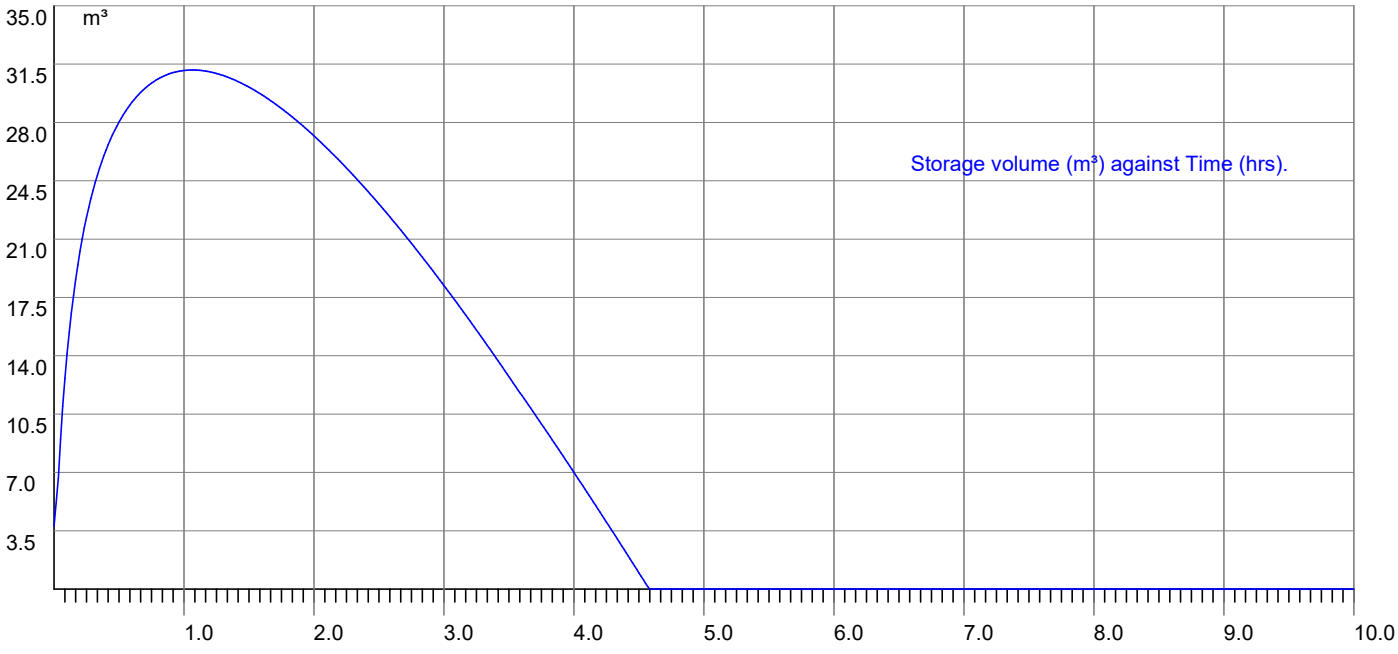
Project	Brown Street, Littleborough	By	Checked / Reviewed
Title	Peak Flow Storage - 1 in 30 year		







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 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.

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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www.thelkgroup.com		Sheet no.	1	
		Date	31/03/20	
Project: Brown Street, Littleborough		By	Checked	Reviewed
Title: Peak Flow Storage - 1 in100 year + 20% Climate Change				

Data:-

FSR Hydrology:-

Location = Littleborough
M5-60 (mm) = 19
Soil index = 0.30
Return period = 100
UCWI = 117.8

Grid reference = SD8913
r = 0.28
SAAR (mm/yr) = 1150
WRAP = 2
Climate change = 20

i) Very permeable soils with shallow ground water;
ii) Permeable soils over rock or fragipan, commonly on slopes in western Britain associated with smaller areas of less permeable wet soils; The layer is low in organic matter, mottled and (fragipan - a natural subsurface horizon having a higher bulk density than the solum above. Seemingly cemented when dry but showing moderate to weak brittleness when moist. Slowly or very slowly permeable to water. It is found in profiles of either cultivated or virgin soils but not in calcareous material).
iii) Moderately permeable soils, some with slowly permeable subsoils.

Runoff factor (RF) = 37.0, calculated from:-

Runoff factor = (0.829*PIMP)+(25*SOIL)+(0.078*UCWI)-20.7
where
PIMP = Impervious Area*100/(Impervious Area+Pervious Area)
UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 2100 m²
Total area (TA) = 4200 m²
Allowed discharge rate = 5.000 l/s
Additional flow = 0.00 l/s

Pervious area = 2100 m²
Equiv area = 1554 m² (TA x RF).
Areal reduction factor = 1.000
Climate change factor = 20

Calculated data:-

Time to max = 110.0 mins
Rainfall at max = 31.41 mm/hr
Pipeline storage = 0.0 m³
Offline storage = 0.0 m³

Calculated storage volume = 63.7 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 = 28.7 m³
Allowed discharge rate = 5.000 l/s

Rainfall intensities calculated using the Wallingford Procedure

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

Diam	Len	Diam	Len
100	8116.7	1125	64.1
150	3607.4	1200	56.4
225	1603.3	1275	49.9
300	901.9	1350	44.5
375	577.2	1425	40.0
450	400.8	1500	36.1
525	294.5	1575	32.7
600	225.5	1650	29.8
675	178.1	1725	27.3
750	144.3	1800	25.1
825	119.3	1875	23.1
900	100.2	1950	21.3
975	85.4	2025	19.8
1050	73.6	2100	18.4

Ovoid	Len
400 x 600	354.1
600 x 900	154.2
800 x 1200	86.7

Box culvert	Len
500 x 500	254.9
500 x 750	170.0
500 x 1000	127.5
750 x 1000	85.0
750 x 1200	70.8
750 x 1500	56.7
1000 x 1000	63.7
1000 x 1200	53.1
1000 x 1500	42.5
1000 x 1800	35.4
1000 x 2000	31.9
1500 x 1500	28.3
1500 x 1800	23.6
1500 x 2000	21.2

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Job No.	
Sheet no.	2
Date	31/03/20

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Project	Brown Street, Littleborough	By	Checked / Reviewed
Title	Peak Flow Storage - 1 in100 year + 20% Climate Change		

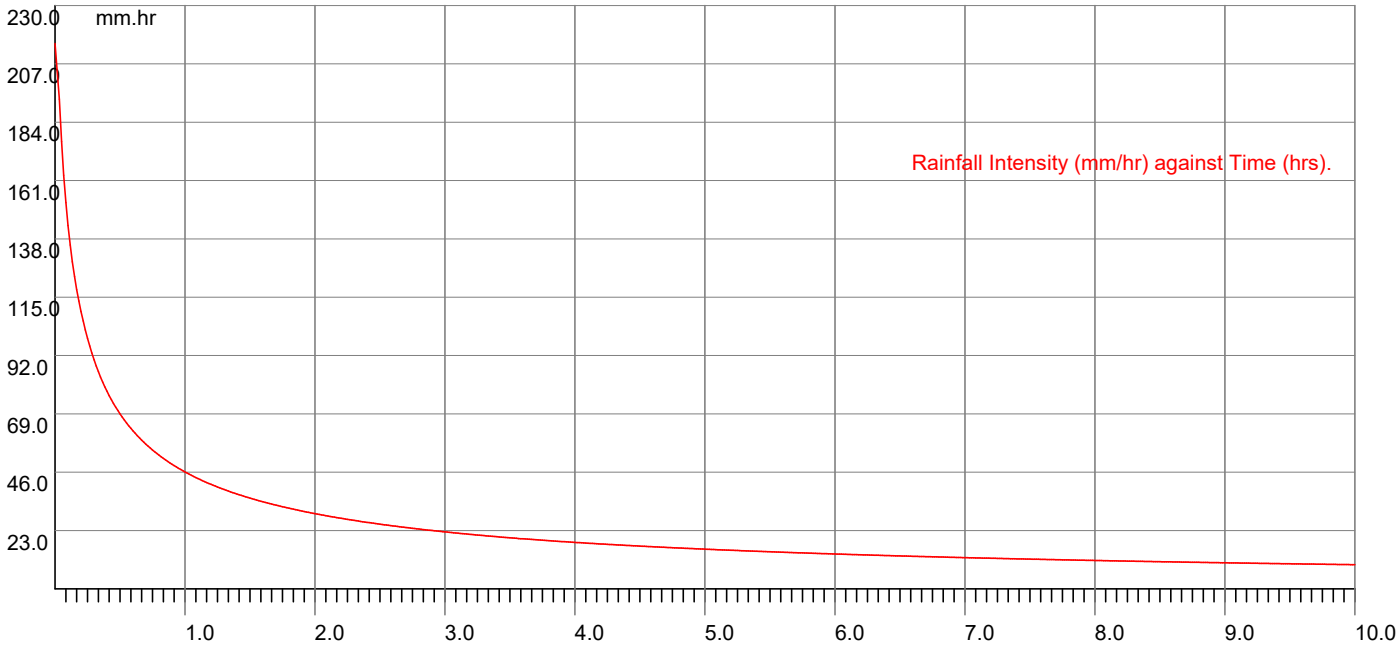
Data:-

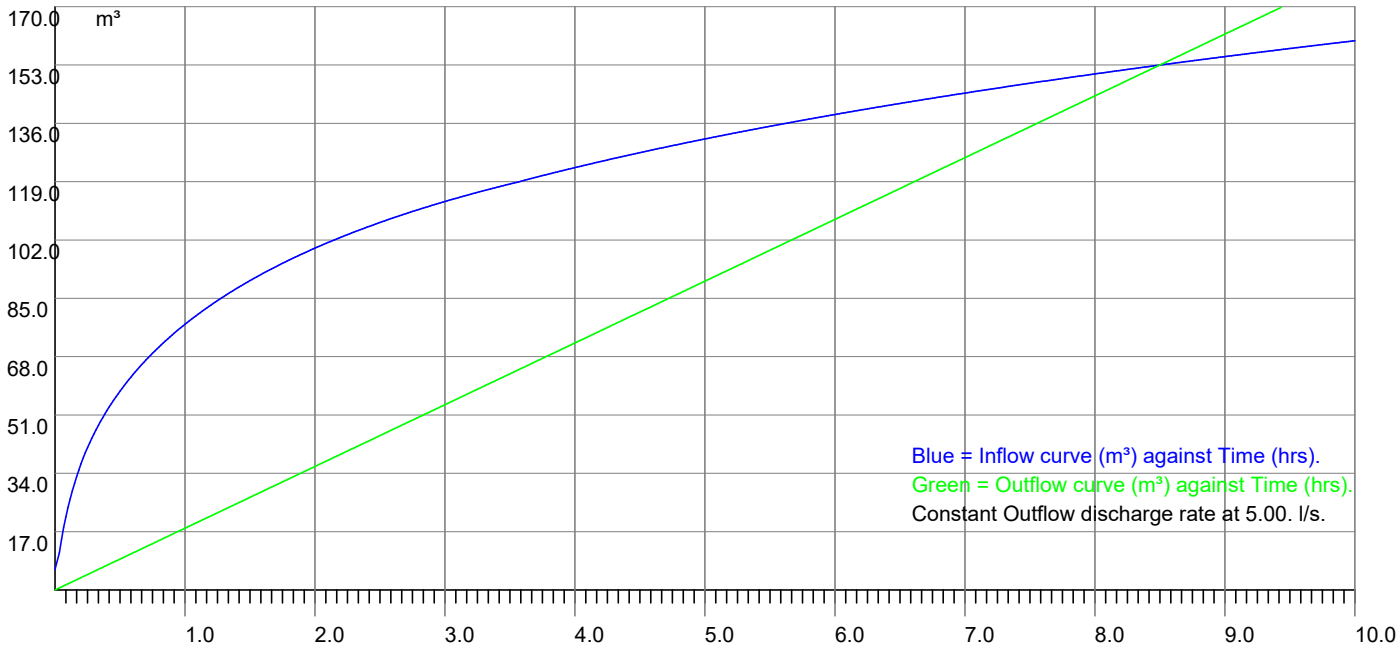
Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	118.0	33.047	3.000	30.047
20	86.0	47.958	6.000	41.958
30	69.0	57.949	9.000	48.949
40	59.0	65.671	12.000	53.671
50	51.0	72.023	15.000	57.023
60	46.0	77.441	18.000	59.441
70	42.0	82.174	21.000	61.174
80	39.0	86.379	24.000	62.379
90	36.0	90.160	27.000	63.160
100	33.0	93.594	30.000	63.594
110	31.0	96.736	33.000	63.736
120	30.0	99.629	36.000	63.629
130	28.0	102.304	39.000	63.304
140	27.0	104.791	42.000	62.791
150	26.0	107.109	45.000	62.109
160	24.0	109.276	48.000	61.276
170	23.0	111.309	51.000	60.309
180	22.0	113.220	54.000	59.220
190	22.0	115.019	57.000	58.019
200	21.0	116.717	60.000	56.717
210	20.0	118.320	63.000	55.320
220	19.0	119.956	66.000	53.956
230	19.0	121.556	69.000	52.556
240	18.0	123.103	72.000	51.103
250	18.0	124.599	75.000	49.599
260	17.0	126.050	78.000	48.050
270	17.0	127.458	81.000	46.458
280	16.0	128.826	84.000	44.826
290	16.0	130.156	87.000	43.156
300	16.0	131.450	90.000	41.450
310	15.0	132.711	93.000	39.711
320	15.0	133.940	96.000	37.940
330	15.0	135.140	99.000	36.140
340	14.0	136.311	102.000	34.311
350	14.0	137.456	105.000	32.456
360	14.0	138.576	108.000	30.576
370	13.0	139.671	111.000	28.671
380	13.0	140.743	114.000	26.743
390	13.0	141.793	117.000	24.793
400	13.0	142.822	120.000	22.822
410	13.0	143.831	123.000	20.831
420	12.0	144.821	126.000	18.821
430	12.0	145.792	129.000	16.792
440	12.0	146.746	132.000	14.746
450	12.0	147.683	135.000	12.683
460	12.0	148.604	138.000	10.604
470	11.0	149.508	141.000	8.508
480	11.0	150.398	144.000	6.398
490	11.0	151.273	147.000	4.273
500	11.0	152.135	150.000	2.135
510	11.0	152.982	153.000	0.000
520	11.0	153.817	156.000	0.000
530	10.0	154.639	159.000	0.000
540	10.0	155.449	162.000	0.000
550	10.0	156.247	165.000	0.000
560	10.0	157.034	168.000	0.000
570	10.0	157.809	171.000	0.000
580	10.0	158.574	174.000	0.000
590	10.0	159.328	177.000	0.000
600	10.0	160.073	180.000	0.000

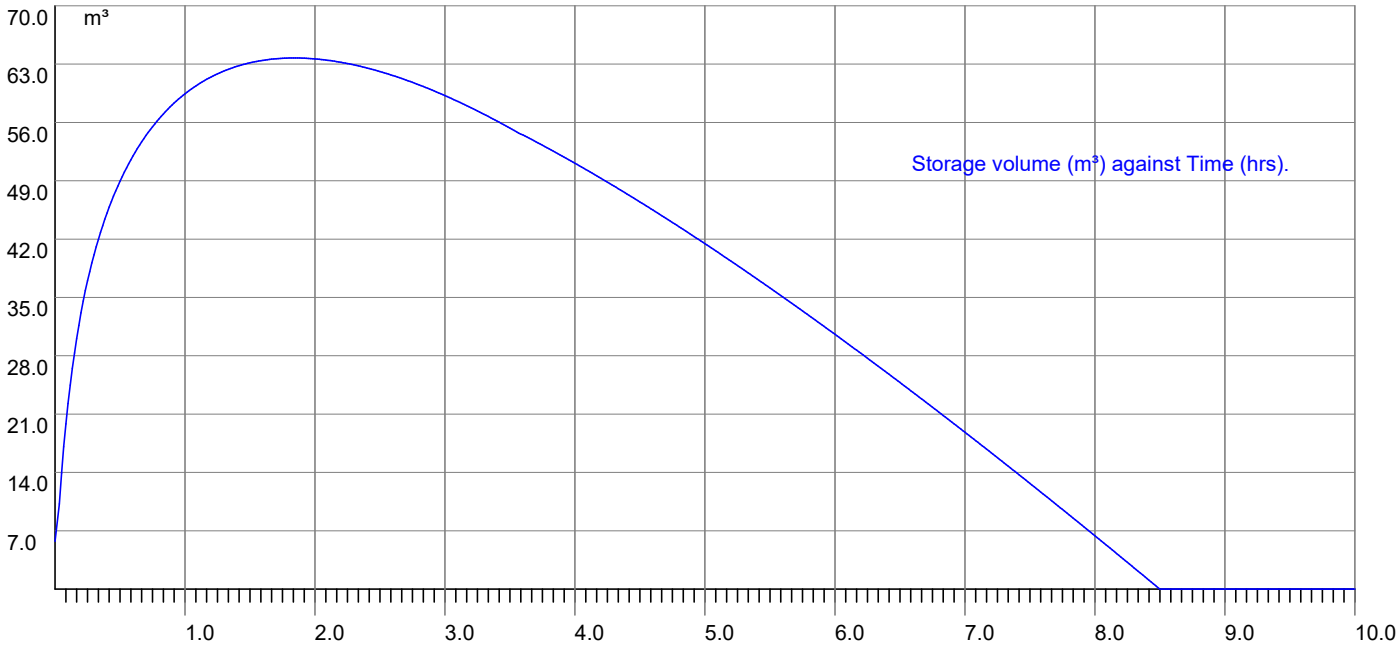
Storage volume (m^3) = 63.7 m^3

MasterDrain SW

The LK Group www.thelkgroup.com	Eton Business Park, Eton Hill Road, Radcliffe M26 2ZS Tel: 0161 763 7200 email: m.jones@thelkgroup.com	Job No.	
		Sheet no.	3
		Date	31/03/20
Project: **Brown Street, Littleborough**		By	Checked / Reviewed
Title: **Peak Flow Storage - 1 in100 year + 20% Climate Change**			







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 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.

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.

MasterDrain SW

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Job No.			
Sheet no.	1		
Date	31/03/20		
Project	Brown Street, Littleborough	By	Checked / Reviewed
Title	Peak Flow Storage - 1 in 100 year + 40% Climate Change		

Data:-

FSR Hydrology:-

Location = Littleborough
M5-60 (mm) = 19
Soil index = 0.30
Return period = 100
UCWI = 117.8

Grid reference = SD8913
r = 0.28
SAAR (mm/yr) = 1150
WRAP = 2
Climate change = 40

i) Very permeable soils with shallow ground water;
ii) Permeable soils over rock or fragipan, commonly on slopes in western Britain associated with smaller areas of less permeable wet soils; The layer is low in organic matter, mottled and (fragipan - a natural subsurface horizon having a higher bulk density than the solum above. Seemingly cemented when dry but showing moderate to weak brittleness when moist. Slowly or very slowly permeable to water. It is found in profiles of either cultivated or virgin soils but not in calcareous material).
iii) Moderately permeable soils, some with slowly permeable subsoils.

Runoff factor (RF) = 37.0, calculated from:-

Runoff factor = (0.829*PIMP)+(25*SOIL)+(0.078*UCWI)-20.7
where
PIMP = Impervious Area*100/(Impervious Area+Pervious Area)
UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 2100 m²
Total area (TA) = 4200 m²
Allowed discharge rate = 5.000 l/s
Additional flow = 0.00 l/s

Pervious area = 2100 m²
Equiv area = 1554 m² (TA x RF).
Areal reduction factor = 1.000
Climate change factor = 40

Calculated data:-

Time to max = 130.0 mins
Rainfall at max = 32.79 mm/hr
Pipeline storage = 0.0 m³
Offline storage = 0.0 m³

Calculated storage volume = 80.4 m³
Allowed discharge rate = 5.000 l/s
Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours
Rainfall rate = 16.00 mm/hr

Calculated storage volume = 51.9 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
100	10233.1	1125	80.9
150	4548.0	1200	71.1
225	2021.3	1275	62.9
300	1137.0	1350	56.1
375	727.7	1425	50.4
450	505.3	1500	45.5
525	371.3	1575	41.3
600	284.3	1650	37.6
675	224.6	1725	34.4
750	181.9	1800	31.6
825	150.3	1875	29.1
900	126.3	1950	26.9
975	107.6	2025	25.0
1050	92.8	2100	23.2

Ovoid	Len
400 x 600	446.4
600 x 900	194.4
800 x 1200	109.3

Box culvert	Len
500 x 500	321.4
500 x 750	214.3
500 x 1000	160.7
750 x 1000	107.1
750 x 1200	89.3
750 x 1500	71.4
1000 x 1000	80.4
1000 x 1200	67.0
1000 x 1500	53.6
1000 x 1800	44.6
1000 x 2000	40.2
1500 x 1500	35.7
1500 x 1800	29.8
1500 x 2000	26.8

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Job No.	
Sheet no.	2
Date	31/03/20
Project	Brown Street, Littleborough
Title	Peak Flow Storage - 1 in 100 year + 40% Climate Change

By	Checked	Reviewed

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Data:-

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	138.0	38.554	3.000	35.554
20	100.0	55.952	6.000	49.952
30	80.0	67.607	9.000	58.607
40	68.0	76.617	12.000	64.617
50	60.0	84.027	15.000	69.027
60	54.0	90.348	18.000	72.348
70	49.0	95.870	21.000	74.870
80	45.0	100.775	24.000	76.775
90	42.0	105.187	27.000	78.187
100	39.0	109.194	30.000	79.194
110	37.0	112.859	33.000	79.859
120	35.0	116.233	36.000	80.233
130	33.0	119.355	39.000	80.355
140	31.0	122.256	42.000	80.256
150	30.0	124.960	45.000	79.960
160	28.0	127.489	48.000	79.489
170	27.0	129.861	51.000	78.861
180	26.0	132.090	54.000	78.090
190	25.0	134.189	57.000	77.189
200	24.0	136.169	60.000	76.169
210	23.0	138.040	63.000	75.040
220	23.0	139.948	66.000	73.948
230	22.0	141.815	69.000	72.815
240	21.0	143.620	72.000	71.620
250	21.0	145.366	75.000	70.366
260	20.0	147.059	78.000	69.059
270	20.0	148.701	81.000	67.701
280	19.0	150.297	84.000	66.297
290	19.0	151.848	87.000	64.848
300	18.0	153.358	90.000	63.358
310	18.0	154.829	93.000	61.829
320	17.0	156.264	96.000	60.264
330	17.0	157.663	99.000	58.663
340	17.0	159.030	102.000	57.030
350	16.0	160.366	105.000	55.366
360	16.0	161.671	108.000	53.671
370	16.0	162.949	111.000	51.949
380	15.0	164.200	114.000	50.200
390	15.0	165.425	117.000	48.425
400	15.0	166.626	120.000	46.626
410	15.0	167.803	123.000	44.803
420	14.0	168.958	126.000	42.958
430	14.0	170.091	129.000	41.091
440	14.0	171.204	132.000	39.204
450	14.0	172.297	135.000	37.297
460	13.0	173.371	138.000	35.371
470	13.0	174.426	141.000	33.426
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490	13.0	176.486	147.000	29.486
500	13.0	177.490	150.000	27.490
510	12.0	178.479	153.000	25.479
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560	12.0	183.206	168.000	15.206
570	12.0	184.111	171.000	13.111
580	11.0	185.003	174.000	11.003
590	11.0	185.883	177.000	8.883
600	11.0	186.751	180.000	6.751

Storage volume (m^3) = 80.4 m^3

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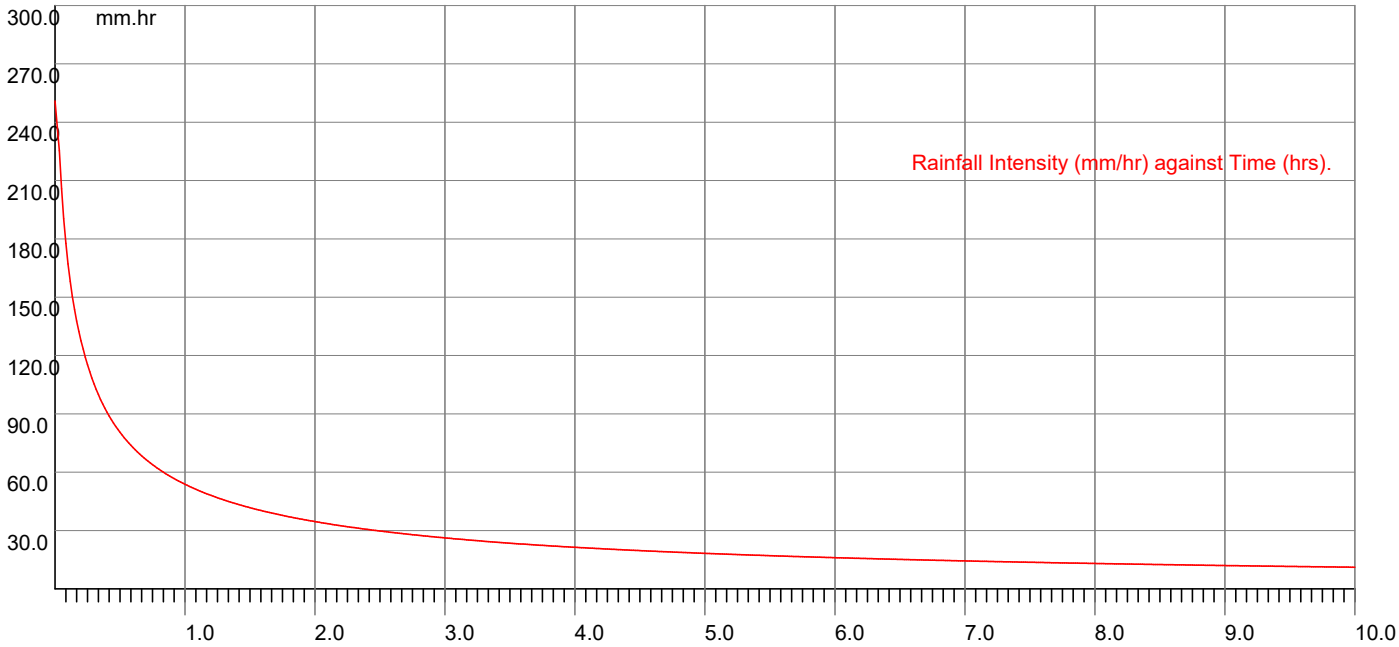
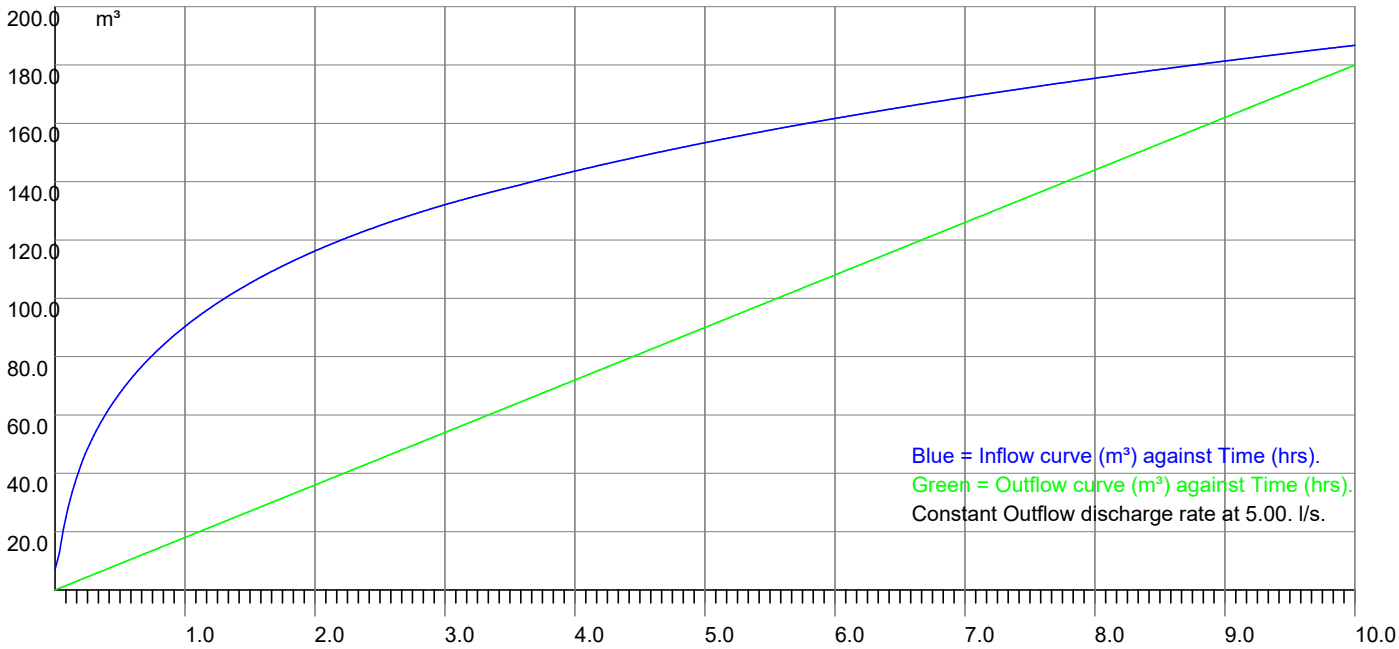
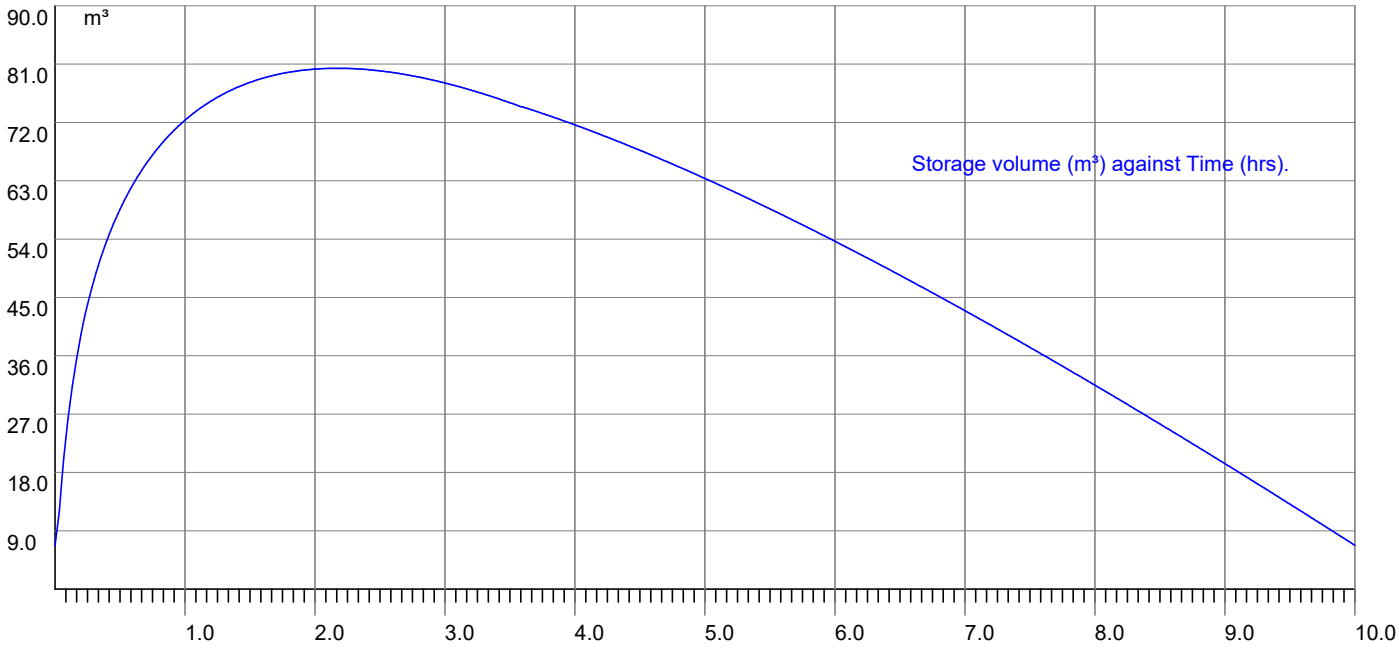
The LK Group www.thelkgroup.com	Eton Business Park, Eton Hill Road, Radcliffe M26 2ZS Tel: 0161 763 7200 email: m.jones@thelkgroup.com	Job No.	
		Sheet no.	3
		Date	31/03/20
Project: **Brown Street, Littleborough**		By	Checked / Reviewed
Title: **Peak Flow Storage - 1 in 100 year + 40% Climate Change**			







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