LAND AT EARL STREET, HEYWOOD
GREATER MANCHESTER

FLOOD RISK ASSESSMENT
& OUTLINE DRAINAGE STRATEGY

Job Number: FRA 20 1269
Date: April 2021
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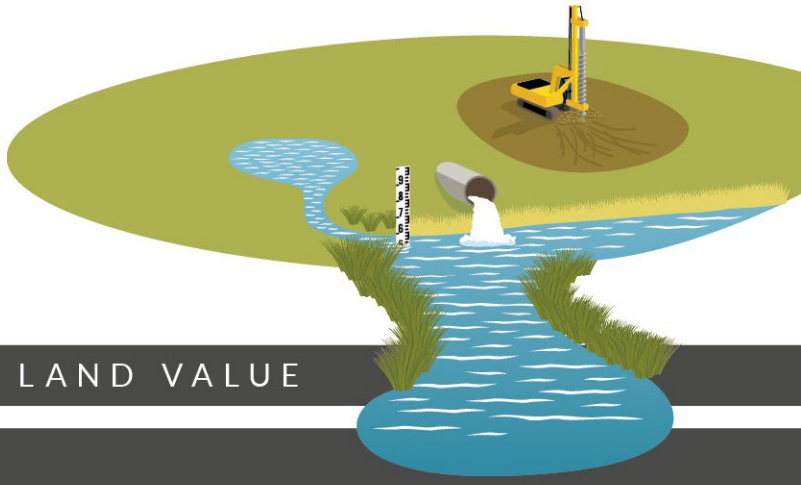

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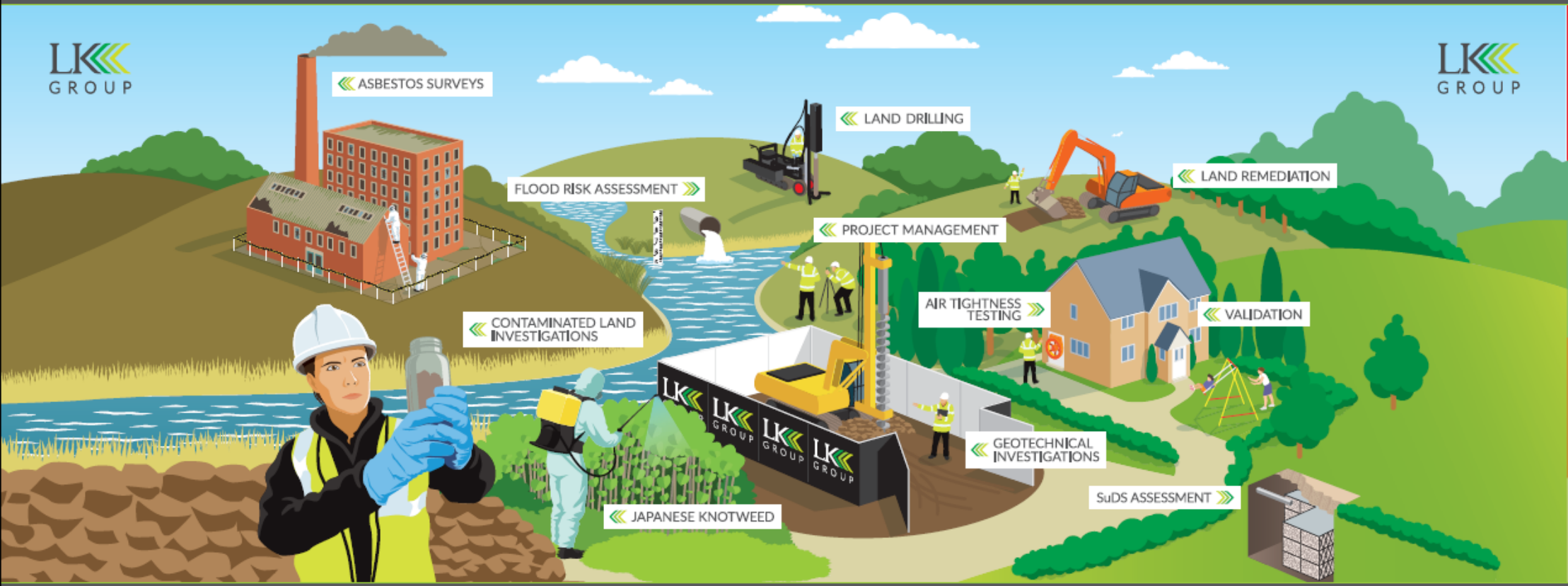

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EXECUTIVE SUMMARY

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 Earl Street, Heywood. The development comprises a residential development.

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, supplemented by modelled data.

Rochdale 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, with the exception of Medium which is deemed to be Medium risk.

Flood Risk

Environment Agency flood maps indicate that the site is not vulnerable to fluvial flooding,

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

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

The site is at Low to Medium risk of surface water flooding.

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 at present it is assumed that surface water runoff arising from the development will discharge into the existing sewer.

The proportion of the site covered by impermeable surfaces will remain similar to the existing and will therefore generate similar runoff. Any attenuation will therefore be required as an allowance for climate change.

Foul sewage arising from the development will be discharged into the public combined sewer in Earl Street to the south.

The outline drainage strategy considers the use of attenuation-based SuDS to be feasible with a discharge to the combined sewer in Earl Street to the south of the site. Therefore, the most effective strategy, in line with the SuDS management train, would be to have a detention tank beneath the site towards the southern site boundary. The required detention tank or similar has been estimated to be **1.7m^3** for the 1 in 30-year greenfield flow restriction.

Similarly, the estimated volume to be retained on site for the 1 in 100-year storm event including the allowance for climate change is between **4.4m^3** and **5.9m^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 Taylor Street to the east.

Contents

EXECUTIVE SUMMARY v

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

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 **7**

4 Assessment of Flood Risk **9**
4.1 Flood Zones 9
4.2 Sources of Flooding 9
4.3 Summary of Flood Risk 10

5 Surface Water Management **11**
5.1 Infiltration 11
5.2 Surface Water Drainage Strategy 12
5.3 Surface Water Attenuation Requirements 14
5.4 Site Specific SuDS 15
5.5 Foul Drainage 15

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 Tang & Associates Architects Ltd to carry out a Flood Risk Assessment (FRA) and Outline Drainage Strategy for land at Earl Street, Heywood. 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.

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	North of Earl Street, Heywood, OL10 1HT. Centred at approximate National Grid Reference 385485E 410769N.
Area	475m^2
Topography	Approximately 116.75 metres above ordnance datum (AOD) in the north of the site and 116.15m AOD in the south. The is sloping down gently towards the south.
Current Land Use	Site Hardstood ground across site. Surrounding Area/ Boundary Treatment North: Commercial (bicycle shop); Market Street beyond. East: Taylor Street; car park and commercial building South: Earl Street; car park. West: Bethel Street; commercial buildings.
Proposed Development	Residential, comprising a four-storey apartment block.

Table 1-1: Summary of site details.

[1] DCLG (2019). "National Planning Policy Framework." Department of Communities and Local Government. February 2019.
[2] DCLG (2014). "Planning Practice Guidance" http://planningguidance.communities.gov.uk, April 2014.

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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 have previously undertaken a Preliminary Risk Assessment for the site[3] (CL-602-LKC 20 2021-01, March 2021) and pertinent environmental information for the site is summarised in Table 2-1 below.

Summary of the Environmental Setting			
Geology	Superficial		Glaciofluvial Deposits, Devensian - Sand and Gravel.
	Bedrock		Pennine Lower Coal Measures Formation, Mudstone, Siltstone, Sandstone.
	BGS Boreholes		BH SD81SE285: 150m north; Made Ground to 2.9m depth, Grey Organic clayey Silt to 3.4m, clayey silt to 4.9m depth. BH SD81SE700: 150m northwest; Made Ground to 0.6m depth, very sandy clayey Silt to 0.8m, Silty sandy Clay containing gravel to 3.5m depth. BH SD81SE307: 200m east; Made Ground to 0.85m, silty fine Sand with some gravel at depth to 3.4m, silty fine to coarse Sand with some gravel to 6.0m.
	Defra Soilscape Mapping		Slowly permeable seasonally wet acid loamy and clayey soils have been identified within the site.
Hydrogeology	Aquifer Designation	Superficial	Secondary A
		Bedrock	Secondary A
Hydrology	All adjacent and internal surface water		There are no watercourses in the vicinity of the site.
	Flooding		No records of flooding.
Site History			A number of buildings occupied the site up to 1937 with a number of reservoirs to the west. Commercial area (adjacent to Market Street) pre-dating 1850. Site has most recently been used as a car park.

Table 2-1: Summary of the Environmental Setting.

2.4 Site Reconnaissance

A site reconnaissance was undertaken in March 2021 and photographs are provided in Appendix B.

Relevant features identified on site are summarised below:

- The site is currently hardstood ground comprising tarmacadam in poor condition.
- The site is sloping down gently to the south.
- No evidence was found of any standing surface water in the vicinity of the site.
- There are combined sewers within the adjacent roads.
- There are gullies within the adjacent roads.
- There are no watercourses in the vicinity of the site.

The surrounding area comprises commercial buildings and car parking areas.

2.5 Site and Access Levels

A topographic survey of the site has been undertaken to OS GPS datum, and information is included on the drawings in Appendix B. The site falls from approximately 116.75m AOD at the northern boundary, to approximately 116.15m

[3] Phase 1 Preliminary Risk Assessment: LK Consult Ltd, CL-602-LKC 20 2021-01, March 2021.

AOD at the southern boundary. The final site levels and ground floor levels of dwellings have not yet been determined. The proposed access would join Taylor Street to the east at around 116.6m AOD.

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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).

For modelled levels refer to extracted Level table and node location map in Appendix C.

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 the River Roch Nearest Node: 1	Level of 99.10m for 1% annual probability event. Level of 100.12m for 1% event with climate change allowance. Level of 99.90m for 0.1% annual probability event.
	Records of Flooding	No records of flooding at the site location.
	Records of Flood Warning Service	Not within a flood warning service area.
	Surface Water Flooding	Medium risk of surface water flooding across the northern and southwestern parts 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 records of flooding at the site location.
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, watercourse or surface water sewer. All surface water flow from the proposed development should drain in-line with the drainage hierarchy, as outlined in Paragraph 80 of the National Planning Practice Guidance. Surface water runoff generated from this development should discharge to the ground via infiltration system where feasible. If not feasible, UU will consider a connection to the 450mm diameter public combined sewer located in Earl Street at a pass forward flow to be agreed by the Lead Local Flood Authority. UU request that any agreed rate does not exceed 5l/s. Foul flow from this site will be allowed to drain into the public combined sewer system. UU's preferred point of discharge would be to the 450mm diameter public combined sewer within Earl Street at an unrestricted rate.

Table 3-1: Summary consultee information.

Source	Details	
United Utilities (continued)	Sewer map	No surface water sewers within the vicinity of the site. The site is surrounded to the west, east and south by 375mm and 400mm diameter combined sewers.
Strategic Flood Risk Assessment (SFRA)	Level 1 SFRA[4]	There is no indication of any history of flooding at the site location. However, it is mentioned that the wider area of Heywood is at risk of surface water flooding.
	Level 2 SFRA[5]	There is no indication of any history of flooding at the site location. However, it is mentioned that the wider area of Heywood is at risk of surface water flooding.
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; 2009, JBA Consulting.
[5] Strategic Flood Risk Assessment Level 2: Bury, Rochdale and Oldham; 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 show small areas that have the potential to flood during prolonged heavy rainfall. These areas are associated with natural depressions that are 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 adjacent to the northern boundary where not positively drained if overland flow routes are not considered. Therefore, the risk of flooding from surface water flooding is Low but should be considered further during the detailed design.

Surface Water (Overland flow) – This relates to surface water entering the site. The site is surrounded by impermeable surfaces. The site is shown on EA mapping as being at risk of surface water flooding. However, any surface water arising from the north of the study area is likely to be intercepted by the highway drainage. There is some potential for flooding to the south of the site boundary in Earl Street. Therefore, the flood risk associated with this source is considered Low.

Groundwater – The EA 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 combined sewers in the adjacent roads. The Drainage and Water Enquiry states that no property on land adjacent to the site is at risk of internal flooding due to overloaded public sewers. There are no records of sewer flooding at the site location. The adjacent road drainage would intercept any

overland flow before it enters the site. Therefore, the flood risk associated with this source is considered Very 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)	Low
Surface Water	Low
Tidal	Negligible
Groundwater	Very Low
Sewers	Very Low
Artificial Sources	Negligible

Table 4-1: Summary of Existing Risk Level.

The site is located within Flood Zone 1 and a Low to Negligible risk of flooding from all sources has 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 any new development is a material planning consideration in determining if the proposals for the development and use of land are acceptable.

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 is shown in Table 5-1 overleaf:

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

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

Table 5-1: Geological and Hydrogeological Setting.

The historical maps and nearest boreholes record made ground and a silty sandy Clay natural soils are likely to be encountered beneath the site. The presence of the former backfilled reservoirs adjacent to the site in the east could also indicate clay based superficial soils may be present near the site. The boreholes that do indicate the presence of sands are to the east of the site. The urban constraints of highways and foundations would also restrict the location of any soakaways.

Infiltration methods such as soakaways are unlikely 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 south.

There are no observable watercourses within or near the boundary of the site.

There are no surface water sewers within the vicinity of the site, although there are 375mm and 400mm diameter combined sewers in the adjacent roads.

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	2	Reasoning: constraints to construction, made ground and low permeability.
b	Connection to Watercourse	N/A	There are no watercourses in the vicinity of the site.
c	Discharge into a sewer	1	The depth of the sewer on adjacent to the site and levels at the south east corner indicate that a connection is possible – subject to approval from UU.

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

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

Notes

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

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

X Not suitable.

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

5.3 Surface Water Attenuation Requirements

From correspondence with the EA 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 (m^2)	475
Impermeable Split (m^2)	475
Permeable Split (m^2)	0
Designated Areas	**Plot Area**
Total area (m^2)	475
Impermeable Split (m^2)	475
Permeable Split (m^2)	0

Table 5-4: Assumed plot areas.

5.3.1 Infiltration Storage Estimate

The ground conditions identified on site indicate that infiltration is unlikely to be feasible, however, this may be investigated further at the detailed design stage.

5.3.2 Attenuation Estimate

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

For the contributing catchment, an estimate has been produced assuming a developable area of 475m^2 of which 100% impermeable. This gives the following runoff rates and attenuation requirements for this section based on the Wallingford method:

- Q_{bar}: 4.7 l/s
- 1 in 1-year runoff rate: 3.9 l/s
- 1 in 30-year runoff rate: 9.5 l/s
- 1 in 100-year runoff rate: 12.0 l/s

United Utilities has specified an allowable discharge rate of 5l/s to their adjacent combined drain.

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

The following attenuation has been estimated for the development using a 5l/s reduced runoff rate and utilises the FSR methodology[10] as:

- Attenuation storage volume: **1.7 m^3** (1 in 30-year event)
- Retention on site volume: **4.4 m^3** (1 in 100 year + 20% Climate Change)
- Retention on site volume: **5.9 m^3** (1 in 100 year + 40% Climate Change)

Attenuation storage aims to limit the peak rate of runoff from the development to the corresponding greenfield runoff for a range of annual flow rate probabilities before discharge to watercourse. As the flow from the development would be restricted to 5l/s there should be little change in the flows that enter the public sewer and thus the risk

[10] Flood Studies Report Wallingford NERC 1975.

of flooding as a result from the development should not increase the risk of flooding off-site.

The attenuation required for a 1 in 30-year storm event, requires a storage volume of **1.7 m^3** and for the 1 in 100-year event, a storage capacity of between **4.4 m^3** and **5.9 m^3** 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.

5.4 Site Specific SuDS

The use of a green/blue roof or similar is deemed to be the most feasible and practical option for the development. The attenuation will provide required storage volume to limit peak runoff arising from the development.

Utilising of the flow control devices at the end of the system will control the peak flow rates.

The use of a blue/green roof may be viable dependant on the detailed design of the proposed development. If this drainage technique is considered to be feasible then it 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

The foul could be discharged into the adjacent 450mm diameter combined sewer in Earl Street at an unrestricted rate.

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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 below the lowest existing ground level measured on site by approximately 16m. 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.

There is a potential surface water flooding risk in Earl Street and adjacent to the northern boundary Overland flow paths should be considered along the northern boundary. The FFL on the southern boundary should be raised by a minimum of 300mm to be above the existing pavement level to avoid the potential surface water flooding in Earl Street.

6.2 Safe Access

Safe and dry access is available via Taylor Street (116.6m AOD) to the south significantly above the 1% annual probability event (100.1m AOD). 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.

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

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 except in Earl Street where the FFL should be set at a minimum of 300mm above the pavement level for potential surface water flooding.
- Pedestrian and vehicular safe access to and from the site is achievable under all conditions via the access road off Taylor Street to the east.
- Potential for soakaway use for rainwater disposal is low; however, this could be investigated further, at the detailed design phase if required.
- Surface water flow will probably need to be attenuated to a maximum of 5l/s as requested by United Utilities.
- Surface water arising from the site could potentially discharge into a combined sewer.
- Foul sewage could be discharged into the existing public combined sewer in Earl Street as agreed by United Utilities.
- 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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Client: Tang & Associates Ltd	Title: Site Location & Boundary Plan		
Site: Earl Street, Heywood	Scale (see scale bar): 1:10,000 & 1:500 @ A4	Figure: 1	Revision:
Job No.: LKC 20 2021 / Drawn By: EK / Checked By: ID / Drawn: Mar 2021			

LK CONSULT LIMITED

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Appendix B

Site Information

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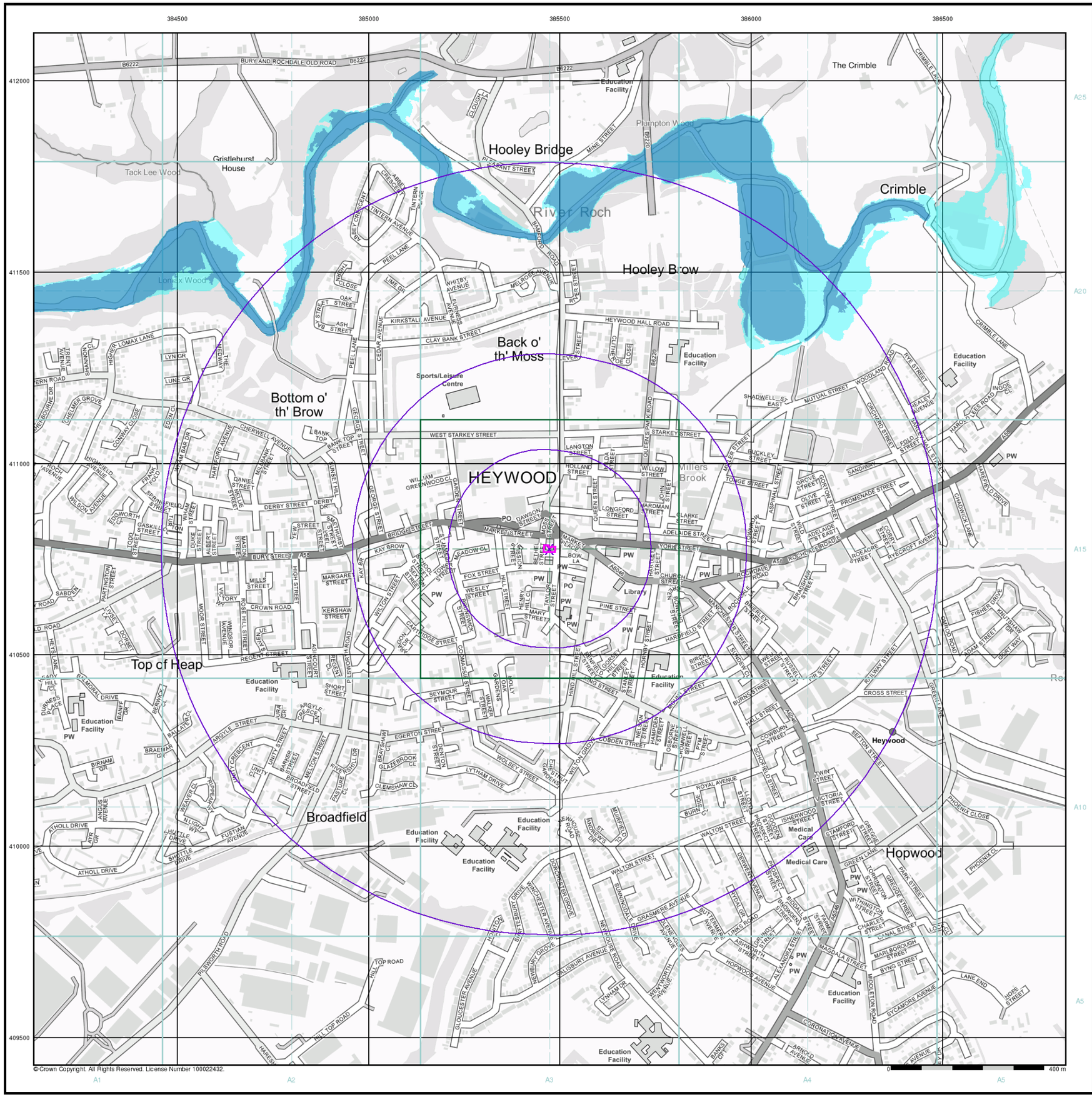
	Photograph 1 (facing E): Northeastern corner of site, adjacent to Taylor Street.
	Photograph 2 (facing SE): Southeastern corner of site.
	Photograph 3 (facing S): Western site boundary, adjacent to Bethel Street.

	Photograph 4 (facing W): View across site, facing towards west.
	Photograph 5 (facing S): Western site boundary, adjacent to Bethel Street.
	Photograph 6 (facing NE): Earl Street adjacent to southern site boundary



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LK GROUP

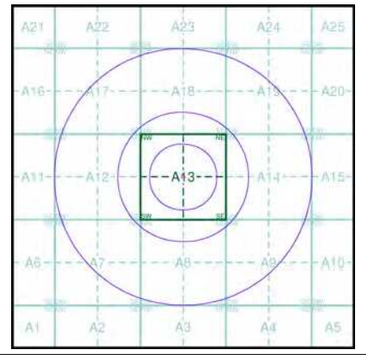
General

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

Agency and Hydrological (Flood)

- Extreme Flooding from Rivers or Sea without Defences (Zone 2)
- Flooding from Rivers or Sea without Defences (Zone 3)
- Area Benefiting from Flood Defence
- Flood Water Storage Areas
- Flood Defence

Flood Map - Slice A



N

Order Details

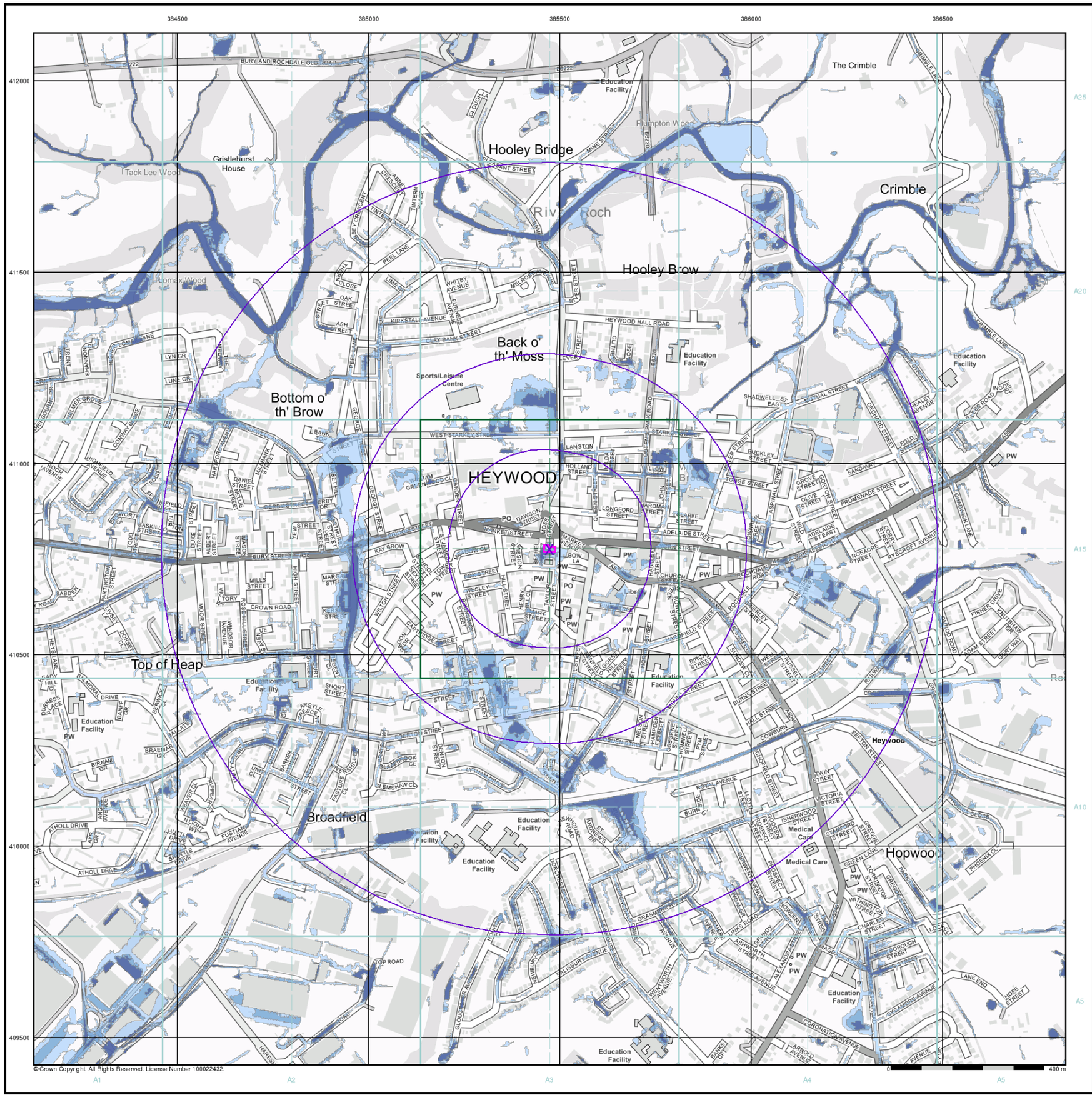
Order Number:	274310720_1_1
Customer Ref:	LKC 20 2021
National Grid Reference:	385470, 410780
Slice:	A
Site Area (Ha):	0.05
Search Buffer (m):	1000

Site Details

Earl Street, Heywood, OL10 1HU

Landmark INFORMATION GROUP

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



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LK GROUP

General

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

Risk of Flooding from Surface Water

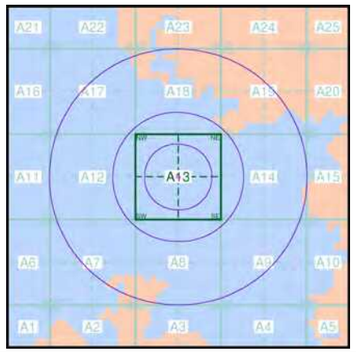
- High - 30 Year Return
- Medium - 100 Year Return
- Low - 1000 Year Return

Suitability

See the suitability map below

- National to county
- County to town
- Town to street
- Street to parcels of land
- Property

EA/NRW Suitability Map - Slice A



N

Order Details

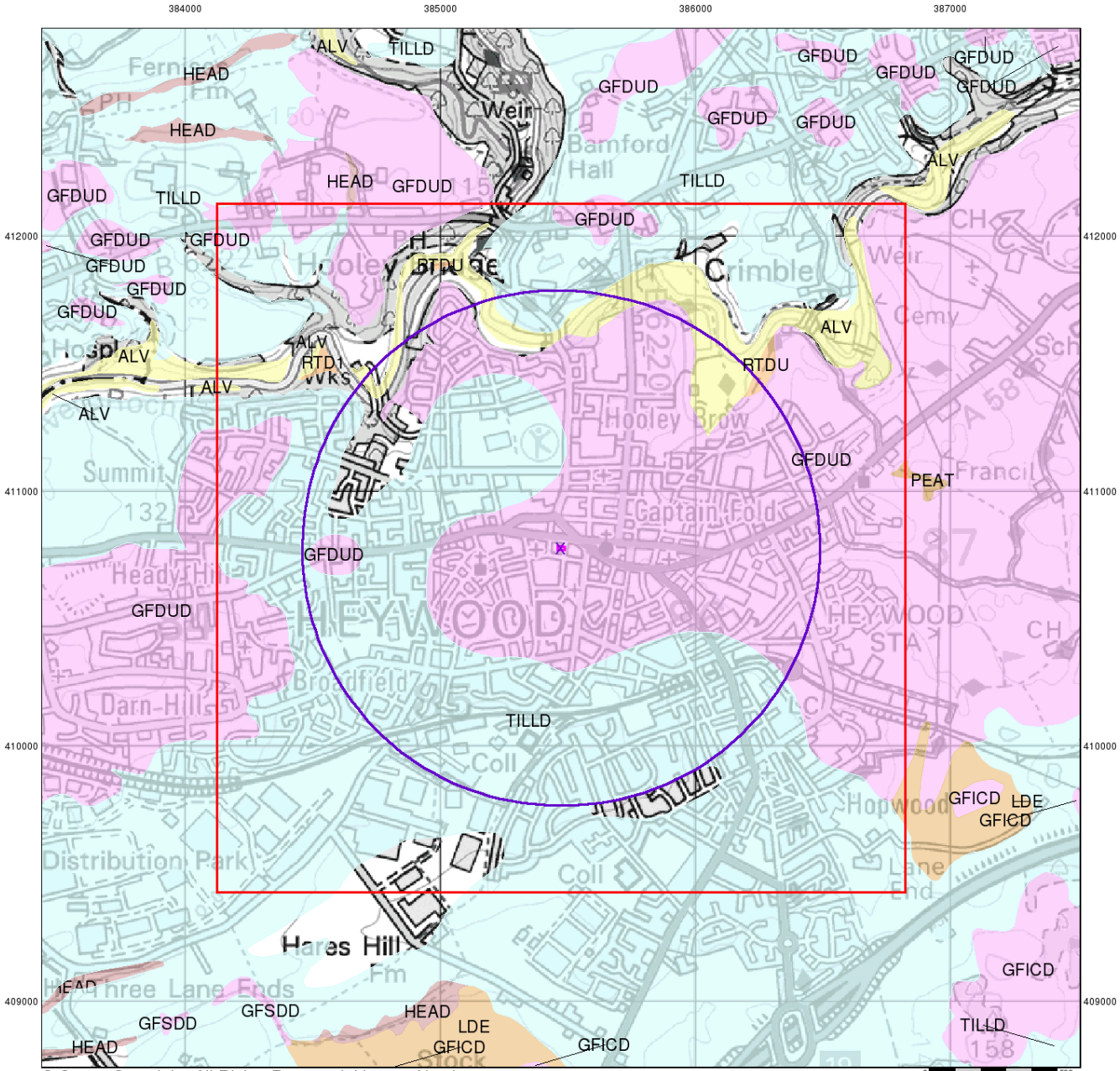
Order Number:	274310720_1_1
Customer Ref:	LKC 20 2021
National Grid Reference:	385470, 410780
Slice:	A
Site Area (Ha):	0.05
Search Buffer (m):	1000

Site Details

Earl Street, Heywood, OL10 1HU

Landmark INFORMATION GROUP

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



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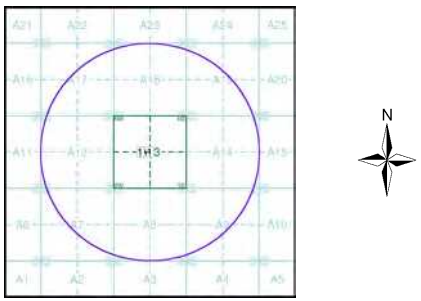
Superficial Geology

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

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

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

Superficial Geology Map - Slice A



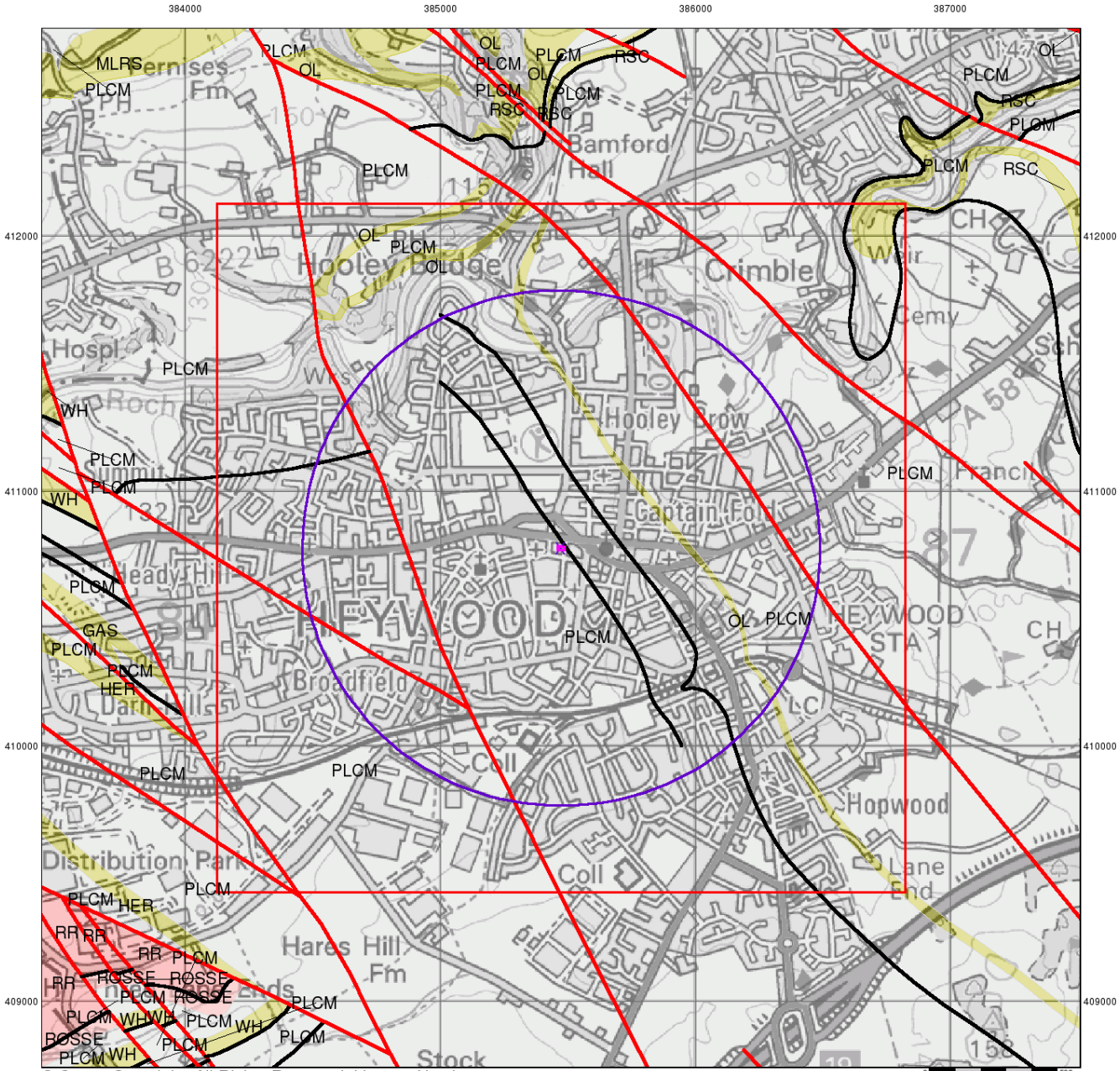
Order Details:

Order Number:	274310720_1_1
Customer Reference:	LKC 20 2021
National Grid Reference:	385470, 410780
Slice:	A
Site Area (Ha):	0.05
Search Buffer (m):	1000

Site Details:

Earl Street, Heywood, OL10 1HU

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



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Bedrock and Faults

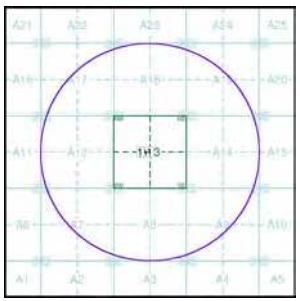
Bedrock geology is a term used for the main mass of rocks forming the Earth and are present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water.

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

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

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

Bedrock and Faults Map - Slice A



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Order Details:

Order Number:	274310720_1_1
Customer Reference:	LKC 20 2021
National Grid Reference:	385470, 410780
Slice:	A
Site Area (Ha):	0.05
Search Buffer (m):	1000

Site Details:

Earl Street, Heywood, OL10 1HU

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

Norwest Holst Soil Engineering Ltd.

Borehole No. 1

BOREHOLE LOG

Contract No. F5732
Location: Heywood East Sewer
Client: Rochdale Metropolitan Borough Council
Method of Boring: Percussion
Diameter of Borehole: 150mm

Sheet 1 of 1
Chainage:
Ground Level: 110.77 m.A.O.D.
Date: 10.11.83 - 11/11/83

50815E 285

Description of Strata	Legend	Depth Below G.L.(m)	O.D. Level (m)	Casing Depth at Sampling	Sampling and Coring	"N"/ R.Q.D.%	Daily Progress
CONCRETE		0.30	110.5				
MADE GROUND - Ash, topsoil, brick rubble, clinker, shell with some clay matrix		2.00	108.8		1.50	13	
MADE GROUND - Black fibrous organic clay with ash		2.90	107.9		2.50 (16)		
Grey organic clayey SILT		3.40	107.4				
		3.80	107.0		3.50 (27)		
Soft brown laminated silty CLAY							
Loose brown clayey SILT		4.90	105.9		4.50	9	
Firm to stiff grey sandy stony CLAY		6.10	104.7		5.50 No recovery (21)		
Medium dense grey/brown silty medium to coarse SAND		7.50	103.3		6.00 (18)		
Stiff brown sandy stony CLAY		8.00	102.8		7.50	15	

Type of Sample

- Is S.P.T.
- Undisturbed
- Ic. C.P.T.
- × Vane
- O Jar
- Δ Water
- ● Bulk
- Piezometer

Remarks (Observations of Ground Water etc.) (16) - U100 blows

Water seepage at 6.00m
Service pit dug to 1.50m

British Geological Survey

CLIENT	JOB NO	LOCATION	BOREHOLE NO
B.S.C.P	CB444	WM MORRISONS HEYWOOD LANCS	TP8

DATE	SCALE	BORING METHOD	Sheet:
APRIL 1996	1 to 50	MECHANICAL EXCAVATOR (JCB4X)	1

Drilling & Casing Progress	SAMPLE/TEST Type & No.	SAMPLE/TEST Depth(M)	SPT N – value or COHESION	DESCRIPTION	O D LEVEL	LEGEND	DEPTH
10TH							0.0
				MADE GROUND – 25mm of fine aggregate concrete screed, underlain by concrete slab (reinforced).			0.15
				MADE GROUND – Black ash, fragmented and whole bricks etc..			0.60
				Very soft to soft light grey, olive and brown very sandy clayey SILT.			0.80
				Initially firm, becoming very stiff and friable, light orangey brown and grey mottled silty sandy CLAY with much fine to coarse gravel and some rounded cobbles.			2.90
10TH				Very stiff and friable light grey very silty slightly sandy CLAY with some to much fine to medium gravel.			3.50

DUNELM DRILLING COMPANY
TEL 091-526-2534 FAX 091-517-0085

BOREHOLE LOGSHEET

Water Observations, Remarks, Etc

No water encountered.
No side wall collapse recorded.

Mexe cone test at 0.70m – 0.5% to 1.5% CBR range, typical 0.75%

British Geological Survey

Norwest Holst Soil Engineering Ltd.

Borehole No. **2**

BOREHOLE LOG

Contract No. F5822
Location: Heywood-Hopwood Sewer
Client: Metropolitan Borough of Rochdale
Method of Boring: Percussion
Diameter of Borehole: 150mm

Sheet 1 of 1
Chainage:
Ground Level: 118.27 m.A.O.D.
Date: 12/2/84

Description of Strata	Legend	Depth Below G.L.(m)	O.D. Level (m)	Casing Depth at Sampling	Sampling and Coring	"N"/ R.Q.D.%	Daily Progress
MADE GROUND: bituminous road surfacing		0.20	118.07				
MADE GROUND: concrete		0.45	117.82				
MADE GROUND: silty sandy gravel with brick and stone fragments		0.85	117.42		1.00 (24)		
Brown, silty fine SAND with occasional fine to medium angular gravel from 1.75m to 2.75m					2.00 (24)		
		3.40	114.87				
Medium dense, dark brown, silty fine to coarse SAND with occasional gravel and cobbles		4.20	114.07		3.50 s	27	
Medium dense, brown, silty, gravelly fine to coarse SAND		4.70	113.57		4.50	18	
Medium dense, brown silty fine to coarse SAND		5.00	113.27		s		
Medium dense, brown, silty, gravelly fine to coarse SAND		6.00	112.27	150mm to 6.00m	5.50 s	27	
End of Borehole							

Type of Sample

- Is S.P.T.
- Ic. C.P.T.
- O Jar
- ● Bulk
- ■ Undisturbed
- × Vane
- Δ Water
- Piezometer

Remarks (Observations of Ground Water etc.)

Water struck at 5.00m
Standing level (20 mins) at 4.50m
(-) U100 blows

British Geological Survey

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Appendix C

Environment Agency Data

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Matthew Craig

From: GMMC Info Requests <InfoRequests.GMMC@environment-agency.gov.uk>
Sent: 25 March 2021 16:58
To: Matthew Craig
Subject: GMMC209607SW Response from the Environment Agency
Attachments: GMMC209607SW_DFM.pdf; GMMC209607SW_Table.pdf; Flood Risk Assessments - Climate Change Allowances.pdf

Dear Matthew,

Re: Land at Earl Street, Heywood, OL10 1HT.

Thank you for your enquiry which was received on 09/03/21.

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

Please find the data requested attached and my colleagues supporting comments below;

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

We have no records of flooding affecting the 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 Council who may hold additional information (the former especially in relation to sewer flooding).

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/

Here are some useful links below:

https://www.gov.uk/guidance/flood-risk-assessment-local-planning-authorities

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,

Sarah

Sarah Walters | Customer and Engagement Officer
Greater Manchester, Merseyside and Cheshire

Direct email: **Inforequests.GMMC@environment-agency.gov.uk**
Office address: Richard Fairclough House, Knutsford Road, Latchford, Warrington, WA4 1HT

CORONAVIRUS
PROTECT YOURSELF & OTHERS
For the latest guidance:
- INTRANET.EA.GOV
- NHS.UK/coronavirus
- GOV.UK/coronavirus
Environment Agency

From: Matthew Craig [mailto:m.craig@thelkgroup.com]
Sent: 09 March 2021 10:27
To: Enquiries, Unit <enquiries@environment-agency.gov.uk>
Subject: 210315/SSR33 - FRA query - Earl Street, Heywood

Dear Sir/Madam

LK Consult Ltd. has been commissioned to undertake a Flood Risk Assessment (FRA), of land at Earl Street, Heywood. OL10 1HT.

Centred at approximate National Grid Reference 385474E, 410778N. The area of interest appears to be within Flood Zone 1

The site plans are attached to this email.

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

- The modelled 1% and 0.1% annual probability fluvial flood level, the 1% annual probability plus climate change flood level and any lower order flood levels, in particular the modelled 5% fluvial flood level if relevant for functional floodplain, (with confirmation of the reference datum used for the levels – i.e. Local OSBM or OSGPS) if available.
- Details of any flood defences in the immediate area, including their extent, crest levels (and datum), assumed level of standard, construction and maintenance regime, as well as any other structures which may influence the local hydraulics.
- Proposed defence levels and timescale for implementation.
- Results of any breach analyses for defences in the area which may be relevant.
- Records of any historic flood events and potential sources of flooding from rivers, land drainage, groundwater, foul and surface water sewers on site and in the area.
- Any restrictions to infiltration and discharge to the watercourse.
- A copy of your detailed flood zone map and the modelled flood extent plans for the area.

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.

We will also contact Lancashire County Council and United Utilities for their information and requirements.

Any advice or recommendations you may have regarding the potential discharges from the development of this site?

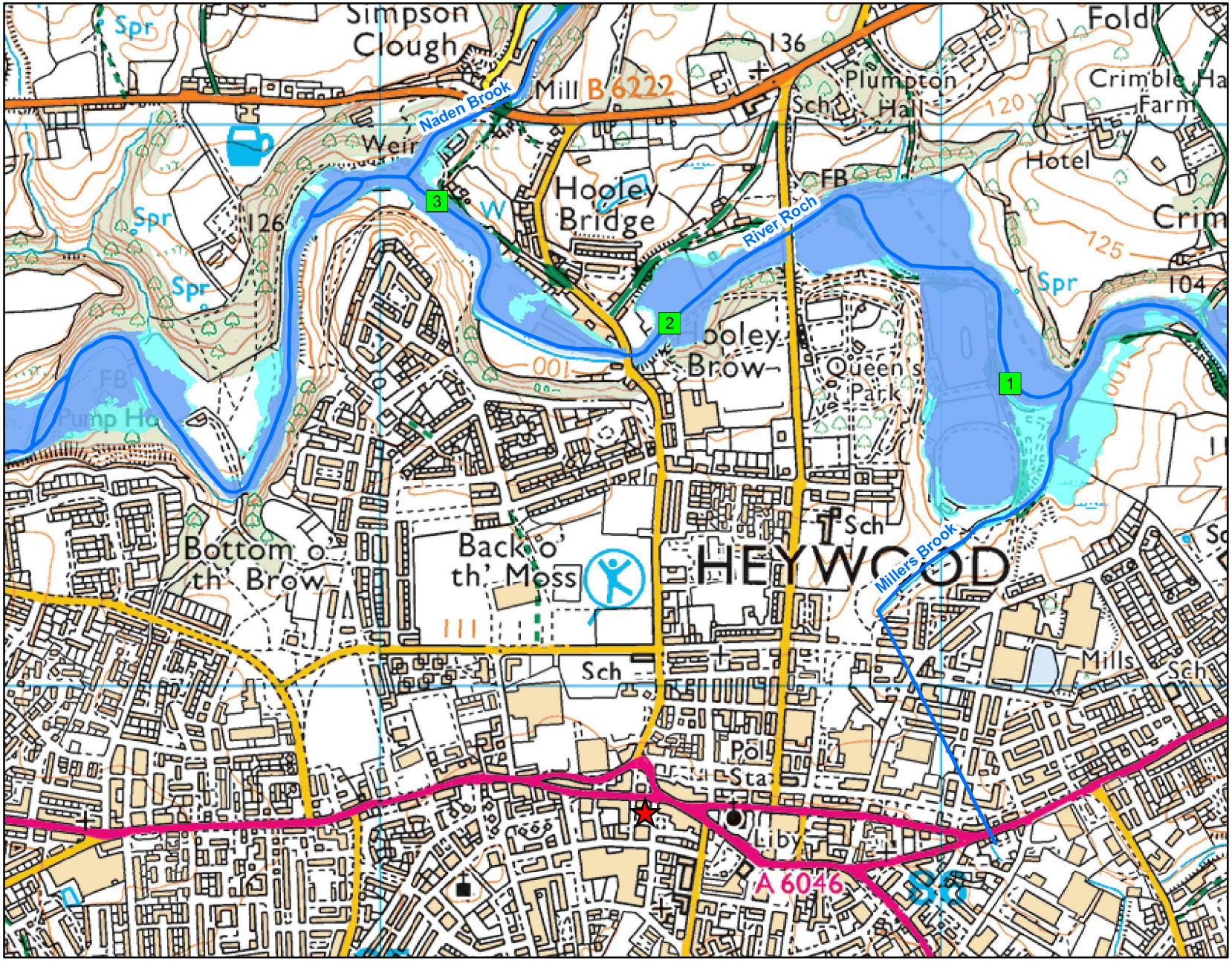
We will be in contact with all other relevant authorities to get a more complete understanding of the issues in the area.

Regards

Matthew Craig

Information in this message may be confidential and may be legally privileged. If you have received this message by mistake, please notify the sender immediately, delete it and do not copy it to anyone else. We have checked this email and its attachments for viruses. But you should still check any attachment before opening it. We may have to

Detailed Flood Map centred on Earl Street, Heywood, OL10 1HT. Created on 23/03/2021 [GMMC209607SW]



Environment Agency

1:10,001

N

Legend

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

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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

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					Undefended														Defended												
Map Reference	Model Node Reference	Easting	Northing	Data	50 % AEP (1 in 2 year)	20 % AEP (1 in 5 year)	10 % AEP (1 in 10 year)	5 % AEP (1 in 20 year)	4 % AEP (1 in 25 year)	2 % AEP (1 in 50 year)	1.33 % AEP (1 in 75 year)	1 % AEP (1 in 100 year)	1 % AEP (1 in 100 year) + 30% increase in flow	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)	0.1 % AEP (1 in 1000 year) + 30% increase in flow	50 % AEP (1 in 2 year)	20 % AEP (1 in 5 year)	10 % AEP (1 in 10 year)	5 % AEP (1 in 20 year)	4 % AEP (1 in 25 year)	2 % AEP (1 in 50 year)	1.33 % AEP (1 in 75 year)	1 % AEP (1 in 100 year)	1 % AEP (1 in 100 year) + 30% increase in flow	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)	0.1 % AEP (1 in 1000 year) + 30% increase in flow
1	RIOCH03_01657	386118	411543	Modelled Water Level (m aodN)	97.99	98.30	98.48	98.66	98.72	98.92	99.02	99.10	99.58	99.66	100.12	99.02	99.90	100.51	97.99	98.30	98.48	98.66	98.72	98.92	99.02	99.12	99.58	99.65	100.12	99.34	99.90	100.51
				Modelled Flow (cumecs)	47.60	60.12	69.22	78.91	82.23	93.54	100.72	106.23	137.18	142.91	179.49	121.01	160.99	208.71	47.60	60.12	69.22	78.91	82.23	93.54	100.72	106.04	137.18	142.57	179.49	121.01	160.99	208.71
2	RIOCH03_00745	385516	411645	Modelled Water Level (m aodN)	97.03	97.39	97.63	97.87	97.95	98.19	98.31	98.40	98.94	99.04	99.60	98.31	99.35	100.08	97.03	97.39	97.63	97.87	97.95	98.19	98.31	98.43	98.94	99.03	99.60	98.67	99.35	100.08
				Modelled Flow (cumecs)	48.29	60.99	70.39	80.31	83.71	95.40	102.26	107.23	140.14	146.64	183.80	123.11	166.32	215.40	48.29	60.99	70.39	80.31	83.71	95.40	102.26	108.68	140.14	145.78	183.80	123.11	166.32	215.40
3	RIOCH03_00134	385107	411873	Modelled Water Level (m aodN)	95.75	95.94	96.08	96.21	96.25	96.39	96.47	96.53	96.86	96.93	97.25	96.47	97.09	97.50	95.75	95.94	96.08	96.21	96.25	96.39	96.47	96.55	96.86	96.92	97.25	96.71	97.09	97.50
				Modelled Flow (cumecs)	48.25	60.95	70.33	80.23	83.62	95.29	102.13	107.10	140.07	146.52	183.68	123.06	166.21	215.29	48.25	60.95	70.33	80.23	83.62	95.29	102.13	108.58	140.07	145.70	183.68	123.06	166.21	215.29

Model data taken from Lower Roch 2017 Study

AEP - Annual Exceedence Probability

m aodN - metres above ordnance datum Newlyn

cumecs - cubic metres per second

Notes: *Climate Change Scenario - 30%, 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.

Appendix D

Consultee Correspondence

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Matthew Craig

From: Wastewater Developer Services <WastewaterDeveloperServices@uuplc.co.uk>
Sent: 18 March 2021 14:35
To: Matthew Craig
Cc: Wastewater Developer Services
Subject: FW: FRA query - Earl Street, Heywood - 4200038120
Attachments: Untitled.png; USE THIS ONEwastewater-pre-development-enquiry-12-03-20 AM.pdf

Good Afternoon Matthew,

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

If your investigations require access to our public sewer network, we ask that you contact our network engineers with a request for an access certificate via our main contact telephone number 0345 3723223 or refer to the link below:

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

Foul Water

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

Our preferred point of discharge would be to the 450 mm diameter public combined sewer within Earl Street located to the South of your proposed development at an unrestricted rate.

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

Surface Water

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

Generally, the aim should be to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable.
This is outlined as follows, in order of priority:

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

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

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

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

Infiltration

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

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

Particular attention must be paid to Ground Water Source Protection Zones to ensure that the risk of pollution to these valuable resources is not compromised. Details can be obtained from the government website:
https://www.gov.uk/guidance/groundwater-source-protection-zones-spzs#find-groundwater-spzs

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

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

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

Public Sewer

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

Once evidence is provided as outlined above, United Utilities will consider a connection to the 450 mm diameter public combined sewer located 3m to the South of the proposed site/ at a pass forward flow to be agreed by the Lead Local Flood Authority. United Utilities request that any agreed rate does not exceed 5 l/s.

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

Levels

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

Existing Water Assets Crossing the Site

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

Connection Application

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

https://www.unitedutilities.com/builders-developers/larger-developments/wastewater/sewer-connections/

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

Additional information.

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

Please note that United Utilities Water Limited (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.

As with all development sites, we recommend you liaise with our water and wastewater engineers by contacting our Developer Services team so the details of your development proposal can be considered further. Details can be found at the following link.

https://www.unitedutilities.com/services/builders-developers/

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

Kind regards,

United Utilities
Water for the North West

Marie Mura
Assistant Developer Engineer
Developer Services & Metering
Customer Services
T: 01925 537745
unitedutilities.com

If you have received a great service today why not tell us?
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Did you know we now have a live chat facility available to you Mon to Friday 8 -5pm. You just click on the orange live chat box on our webpage and one of our advisors will be ready to chat to you and help you with your enquiry https://www.unitedutilities.com/builders-developers/ or you can email us at developerserviceswater@uuplc.co.uk

From: Matthew Craig [mailto:m.craig@thelkgroup.com]
Sent: 09 March 2021 14:00

To: Wastewater Developer Services <WastewaterDeveloperServices@uuplc.co.uk>
Subject: FRA query - Earl Street, Heywood

Dear Sir/Madam

LK Consult Ltd. has been commissioned to undertake a Flood Risk Assessment (FRA), of land at Earl Street, Heywood. OL10 1HT.

Centred at approximate National Grid Reference 385474E, 410778N. The area of interest appears to be within Flood Zone 1

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

LK GROUP

Matthew Craig MSc, BSc (hons), MCIWEM
Environmental Scientist – Flood Risk
LK Consult | 0161 763 7200 |
Manchester | London | Liverpool | Glasgow |
www.thelkgroup.com

INCREASING LAND VALUE

EMGateway3.uuplc.co.uk made the following annotations

The information contained in this e-mail is intended only
for the individual to whom it is addressed. It may contain
legally privileged or confidential information or otherwise
be exempt from disclosure. If you have received this Message

Matthew Craig

From: Laura Precious <Laura.Precious@Rochdale.Gov.UK>
Sent: 10 March 2021 16:43
To: Matthew Craig
Subject: FW: FRA query - Earl Street, Heywood
Attachments: Rochdale Council - Drainage Planning Advice 2021.pdf

Matthew

Apologies – drainage advice now attached.

Kind regards

Laura

Laura Precious
Planning Officer
Planning & Development

ROCHDALE BOROUGH COUNCIL

01706 924381
laura.precious@rochdale.gov.uk

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

To access our services go to www.rochdale.gov.uk
For news and social media updates go to www.rochdale.gov.uk/news

Please consider the environment before printing this email.

From: Laura Precious
Sent: 10 March 2021 16:27
To: 'm.craig@thelkgroup.com' <m.craig@thelkgroup.com>
Subject: RE: FRA query - Earl Street, Heywood

Dear Matthew

Further to your below query I can confirm that we have not had any reported incidents of flooding nor drainage complaints in this area. Please note that whilst we may not have any incidents on record, this does not always mean incidents have not occurred; these may have gone unreported if, for example, the issue was not deemed to be affecting a building (the site is currently undeveloped and used as a car park).

Please take note of gov.uk mapping for fluvial and surface water flooding which places the site at a low – medium risk of flooding from surface water. The adjacent street (Earl Street) to the south and Bethel Street to west are both at high risk of flooding from surface water.

I have attached our latest drainage planning advice for your information. I would also recommend you review the planning history for the site here – planning permission was granted in 2016 for 14 apartments and you will note that at the time, United Utilities applied conditions requiring the disposal of foul and surface water on separate

systems. UU should be able to advise further as to whether this advice still stands. Please also refer to UU Safedig mapping for details of surrounding wastewater/cleanwater pipes.

I hope the above and attached is of assistance but please get in touch should you have any queries.

Kind regards

Laura

Laura Precious
Planning Officer
Planning & Development

ROCHDALE BOROUGH COUNCIL

01706 924381
laura.precious@rochdale.gov.uk

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

To access our services go to www.rochdale.gov.uk
For news and social media updates go to www.rochdale.gov.uk/news

Please consider the environment before printing this email.

From: Matthew Craig <m.craig@thelkgroup.com>
Sent: 09 March 2021 12:17
To: Strategic Planning <Strategic.Planning@Rochdale.Gov.UK>
Subject: FRA query - Earl Street, Heywood

Dear Sir/Madam

LK Consult Ltd. has been commissioned to undertake a Flood Risk Assessment (FRA), of land at Earl Street, Heywood. OL10 1HT.

Centred at approximate National Grid Reference 385474E, 410778N. The area of interest appears to be within Flood Zone 1

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

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As a public body, Rochdale Borough Council may be required to disclose this email (or any response to it) under the Freedom of Information Act 2000, unless the information in it is covered by one of the exemptions within the Act.

Appendix E

Calculations

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MasterDrain SW	**The LK Group** www.thelkgroup.com	Eton Business Park, Eton Hill Road, Radcliffe M26 2ZS Tel: 0161 763 7200 email: m.jones@thelkgroup.com	Job No.		
			Sheet no. 1		
			Date 01/04/21		
	Project **Earl Street Heywood**		By	Checked	Reviewed
	Title **Peak runoff - 1 in 1 year**				

Area data:-

FSR data

M5-60 = 18.9
Soil index = 0.15
WRAP value = 1

r = 0.29
SAAR = 1100
Nat grid = SD8510

Site data:-

Ret. period (yrs) = 1
Time of entry = 10.00
Impervious area drained = 475 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 = Coarse textured
Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 75.0%
Rainfall rate= 38.9 mm/Hr

UCWI = 111.1
Runoff rate (gross)= 3.9 l/s

Methods

Runoff factor (RF) = 75.0, 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

Calculations produced by MasterDrain Surface Water design program

MasterDrain SW	**The LK Group** www.thelkgroup.com	Eton Business Park, Eton Hill Road, Radcliffe M26 2ZS Tel: 0161 763 7200 email: m.jones@thelkgroup.com	Job No.		
			Sheet no. 1		
			Date 01/04/21		
	Project **Earl Street Heywood**		By	Checked	Reviewed
	Title **Peak runoff - 1 in 30 year**				

Area data:-

FSR data

M5-60 = 18.9
Soil index = 0.15
WRAP value = 1

r = 0.29
SAAR = 1100
Nat grid = SD8510

Site data:-

Ret. period (yrs) = 30
Time of entry = 6.00
Impervious area drained = 475 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 = Coarse textured
Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 75.0%
Rainfall rate= 95.8 mm/Hr

UCWI = 111.1
Runoff rate (gross)= 9.5 l/s

Methods

Runoff factor (RF) = 75.0, 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

Calculations produced by MasterDrain Surface Water design program

MasterDrain SW	**The LK Group** www.thelkgroup.com	Eton Business Park, Eton Hill Road, Radcliffe M26 2ZS Tel: 0161 763 7200 email: m.jones@thelkgroup.com	Job No.		
			Sheet no. 1		
			Date 01/04/21		
	Project **Earl Street, Heywood**		By	Checked	Reviewed
	Title **Peak runoff - 1 in 100 year**				

Area data:-

FSR data

M5-60 = 18.9
Soil index = 0.15
WRAP value = 1

r = 0.29
SAAR = 1100
Nat grid = SD8510

Site data:-

Ret. period (yrs) = 100
Time of entry = 6.00
Impervious area drained = 475 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 = Coarse textured
Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 75.0%
Rainfall rate= 120.9 mm/Hr

UCWI = 111.1
Runoff rate (gross)= 12.0 l/s

Methods

Runoff factor (RF) = 75.0, 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

Calculations produced by MasterDrain Surface Water design program

MasterDrain SW	**The LK Group** www.thelkgroup.com	Eton Business Park, Eton Hill Road, Radcliffe M26 2ZS Tel: 0161 763 7200 email: m.jones@thelkgroup.com	Job No. Sheet no. 1 Date 01/04/21
	Project: Earl Street Heywood		By / Checked / Reviewed
	Title: Peak Flow Storage - 5l/s - 1 in 30 year		

Data:-

FSR Hydrology:-

Location = Heywood
M5-60 (mm) = 18.9
Soil index = 0.15
Return period = 30
UCWI = 113.8

Grid reference = SD8510
r = 0.29
SAAR (mm/yr) = 1100
WRAP = 1
Climate change = 0

i) Well drained permeable sandy or loam soils and shallower analogues over highly permeable limestone, chalk, sandstone or related drifts;
ii) Earthy peat soils drained by dykes and pumps;
iii) Less permeable loamy over clayey soils on plateaux adjacent to very permeable soils in valleys.

Runoff factor (RF) = 75.0, 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 = 475 m²
Total area (TA) = 475 m²
Allowed discharge rate = 5.000 l/s
Additional flow = 0.00 l/s

Pervious area = 0 m²
Equiv area = 356 m² (TA x RF).
Areal reduction factor = 1.000
Climate change factor = 0

Calculated data:-

Time to max = 8.0 mins
Rainfall at max = 85.54 mm/hr
Pipeline storage = 0.0 m³
Offline storage = 0.0 m³

Calculated storage volume = 1.7 m³
Allowed discharge rate = 5.000 l/s
Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours
Rainfall rate = 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	211.8	1125	1.7
150	94.1	1200	1.5
225	41.8	1275	1.3
300	23.5	1350	1.2
375	15.1	1425	1.0
450	10.5	1500	0.9
525	7.7	1575	0.9
600	5.9	1650	0.8
675	4.6	1725	0.7
750	3.8	1800	0.7
825	3.1	1875	0.6
900	2.6	1950	0.6
975	2.2	2025	0.5
1050	1.9	2100	0.5

Ovoid	Len
400 x 600	9.2
600 x 900	4.0
800 x 1200	2.3

Box culvert	Len
500 x 500	6.7
500 x 750	4.4
500 x 1000	3.3
750 x 1000	2.2
750 x 1200	1.8
750 x 1500	1.5
1000 x 1000	1.7
1000 x 1200	1.4
1000 x 1500	1.1
1000 x 1800	0.9
1000 x 2000	0.8
1500 x 1500	0.7
1500 x 1800	0.6
1500 x 2000	0.6

The LK Group	Eton Business Park, Eton Hill Road, Radcliffe M26 2ZS Tel: 0161 763 7200 email: m.jones@thelkgroup.com	Job No.	
www.thelkgroup.com		Sheet no.	2
		Date	01/04/21
Project: Earl Street Heywood		By	Checked / Reviewed
Title: Peak Flow Storage - 5l/s - 1 in 30 year			

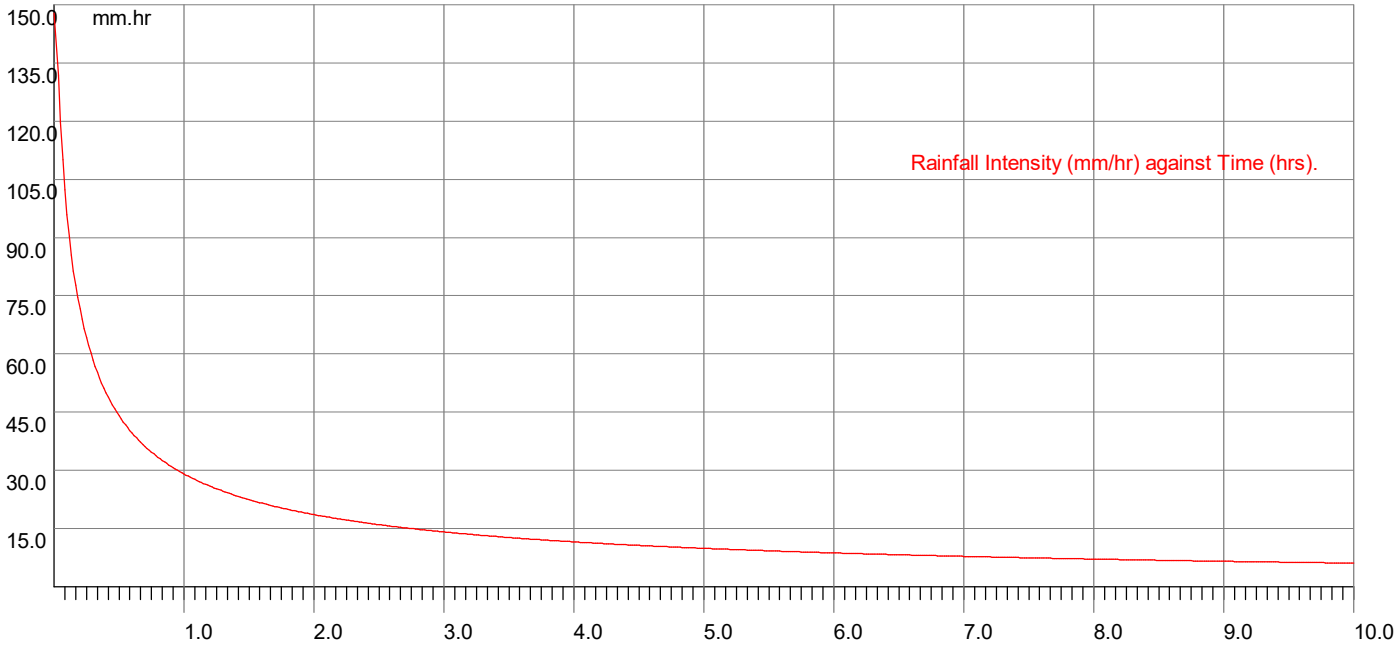
MasterDrain SW

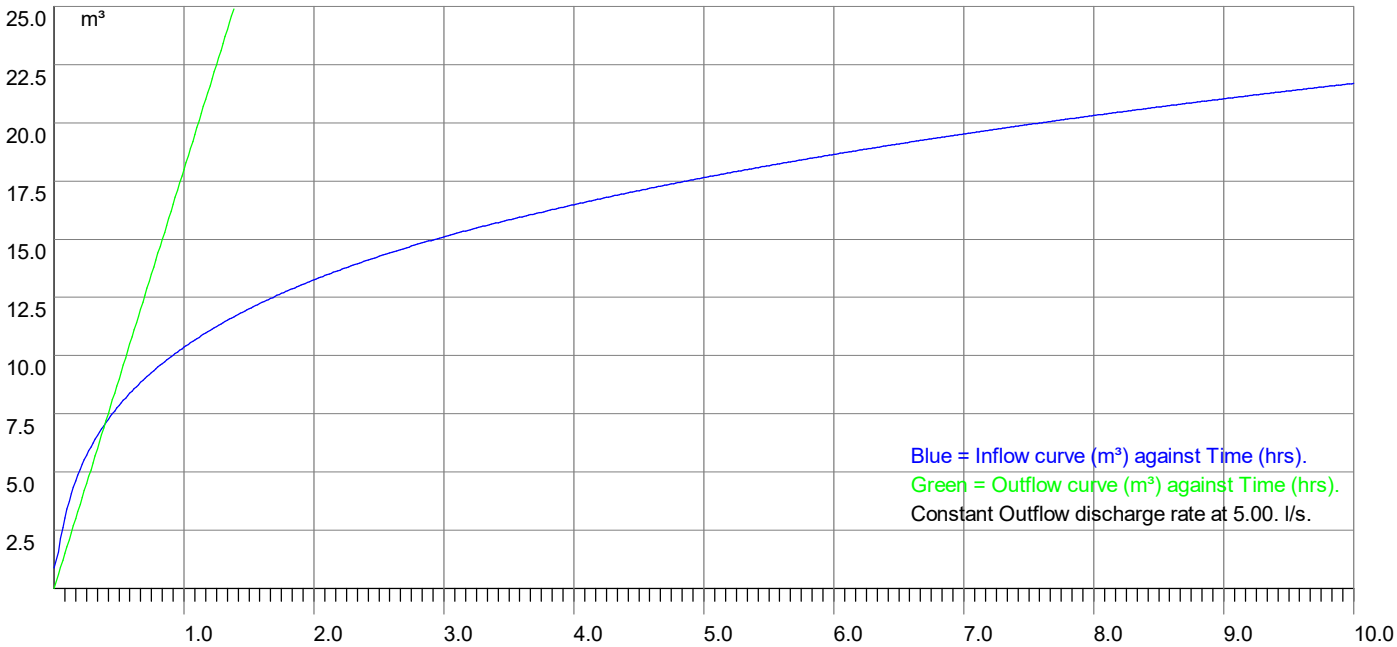
Data:-

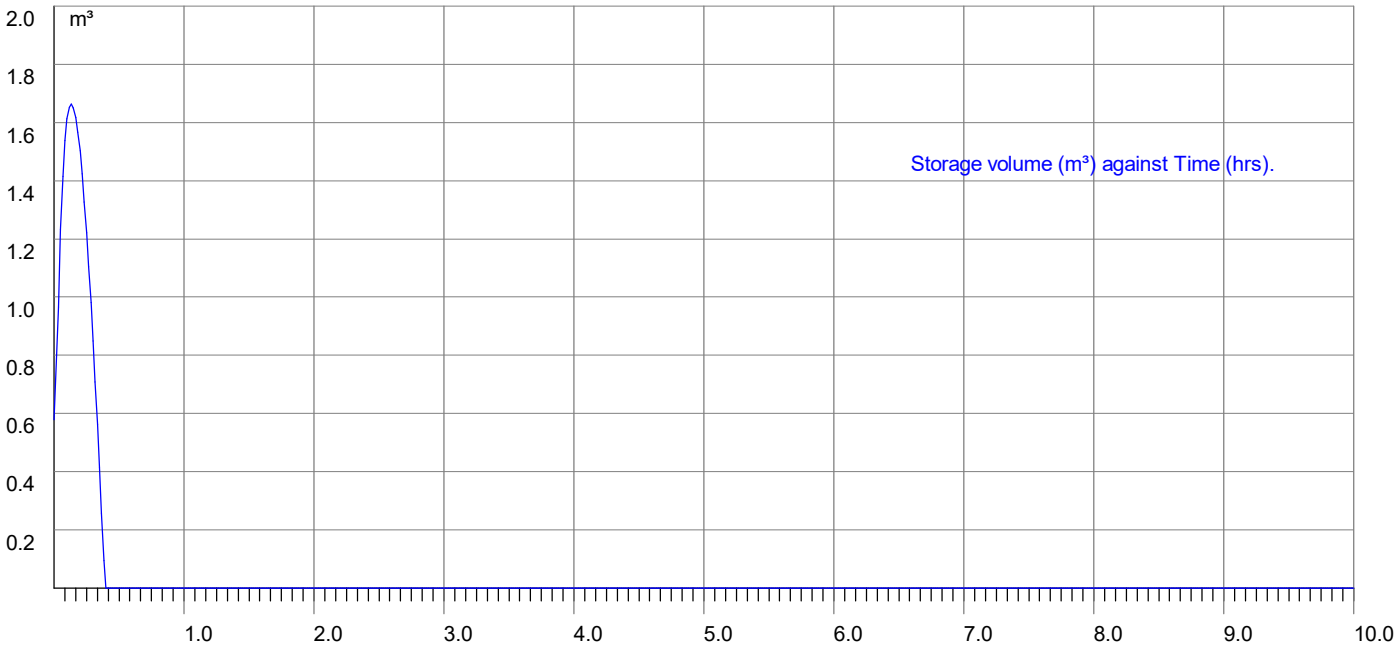
Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	78.0	4.617	3.000	1.617
20	55.0	6.564	6.000	0.564
30	44.0	7.855	9.000	0.000
40	37.0	8.848	12.000	0.000
50	33.0	9.663	15.000	0.000
60	29.0	10.360	18.000	0.000
70	26.0	10.970	21.000	0.000
80	24.0	11.514	24.000	0.000
90	22.0	12.006	27.000	0.000
100	21.0	12.456	30.000	0.000
110	20.0	12.870	33.000	0.000
120	19.0	13.254	36.000	0.000
130	18.0	13.611	39.000	0.000
140	17.0	13.946	42.000	0.000
150	16.0	14.261	45.000	0.000
160	15.0	14.558	48.000	0.000
170	15.0	14.839	51.000	0.000
180	14.0	15.106	54.000	0.000
190	14.0	15.359	57.000	0.000
200	13.0	15.600	60.000	0.000
210	13.0	15.831	63.000	0.000
220	12.0	16.051	66.000	0.000
230	12.0	16.270	69.000	0.000
240	12.0	16.484	72.000	0.000
250	11.0	16.692	75.000	0.000
260	11.0	16.893	78.000	0.000
270	11.0	17.089	81.000	0.000
280	10.0	17.279	84.000	0.000
290	10.0	17.465	87.000	0.000
300	10.0	17.645	90.000	0.000
310	10.0	17.822	93.000	0.000
320	9.0	17.993	96.000	0.000
330	9.0	18.161	99.000	0.000
340	9.0	18.326	102.000	0.000
350	9.0	18.486	105.000	0.000
360	9.0	18.643	108.000	0.000
370	9.0	18.797	111.000	0.000
380	8.0	18.948	114.000	0.000
390	8.0	19.096	117.000	0.000
400	8.0	19.241	120.000	0.000
410	8.0	19.384	123.000	0.000
420	8.0	19.523	126.000	0.000
430	8.0	19.661	129.000	0.000
440	8.0	19.796	132.000	0.000
450	7.0	19.928	135.000	0.000
460	7.0	20.059	138.000	0.000
470	7.0	20.187	141.000	0.000
480	7.0	20.313	144.000	0.000
490	7.0	20.438	147.000	0.000
500	7.0	20.560	150.000	0.000
510	7.0	20.681	153.000	0.000
520	7.0	20.800	156.000	0.000
530	7.0	20.917	159.000	0.000
540	7.0	21.032	162.000	0.000
550	6.0	21.146	165.000	0.000
560	6.0	21.259	168.000	0.000
570	6.0	21.370	171.000	0.000
580	6.0	21.479	174.000	0.000
590	6.0	21.587	177.000	0.000
600	6.0	21.694	180.000	0.000

Storage volume (m^3) = 1.7 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 01/04/21
	Project **Earl Street Heywood**		By / Checked / Reviewed
	Title **Peak Flow Storage - 5l/s - 1 in 30 year**		







MasterDrain SW	**The LK Group** www.thelkgroup.com	Eton Business Park, Eton Hill Road, Radcliffe M26 2ZS Tel: 0161 763 7200 email: m.jones@thelkgroup.com	Job No. Sheet no. 1 Date 01/04/21
	Project: Earl Street Heywood		By / Checked / Reviewed
	Title: Peak Flow Storage - 1 in 100 year + 20%CC		

Data:-

FSR Hydrology:-

Location = Heywood
M5-60 (mm) = 18.9
Soil index = 0.15
Return period = 100
UCWI = 113.8

Grid reference = SD8510
r = 0.29
SAAR (mm/yr) = 1100
WRAP = 1
Climate change = 20

i) Well drained permeable sandy or loam soils and shallower analogues over highly permeable limestone, chalk, sandstone or related drifts;
ii) Earthy peat soils drained by dykes and pumps;
iii) Less permeable loamy over clayey soils on plateaux adjacent to very permeable soils in valleys.

Runoff factor (RF) = 75.0, 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 = 475 m²
Total area (TA) = 475 m²
Allowed discharge rate = 5.000 l/s
Additional flow = 0.00 l/s

Pervious area = 0 m²
Equiv area = 356 m² (TA x RF).
Areal reduction factor = 1.000
Climate change factor = 20

Calculated data:-

Time to max = 15.0 mins
Rainfall at max = 99.44 mm/hr
Pipeline storage = 0.0 m³
Offline storage = 0.0 m³

Calculated storage volume = 4.4 m³
Allowed discharge rate = 5.000 l/s
Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours
Rainfall rate = 13.00 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	554.8	1125	4.4
150	246.6	1200	3.9
225	109.6	1275	3.4
300	61.6	1350	3.0
375	39.5	1425	2.7
450	27.4	1500	2.5
525	20.1	1575	2.2
600	15.4	1650	2.0
675	12.2	1725	1.9
750	9.9	1800	1.7
825	8.2	1875	1.6
900	6.8	1950	1.5
975	5.8	2025	1.4
1050	5.0	2100	1.3

Ovoid	Len
400 x 600	24.2
600 x 900	10.5
800 x 1200	5.9

Box culvert	Len
500 x 500	17.4
500 x 750	11.6
500 x 1000	8.7
750 x 1000	5.8
750 x 1200	4.8
750 x 1500	3.9
1000 x 1000	4.4
1000 x 1200	3.6
1000 x 1500	2.9
1000 x 1800	2.4
1000 x 2000	2.2
1500 x 1500	1.9
1500 x 1800	1.6
1500 x 2000	1.5

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		Date	01/04/21
Project: Earl Street Heywood		By	Checked / Reviewed
Title: Peak Flow Storage - 1 in 100 year + 20%CC			

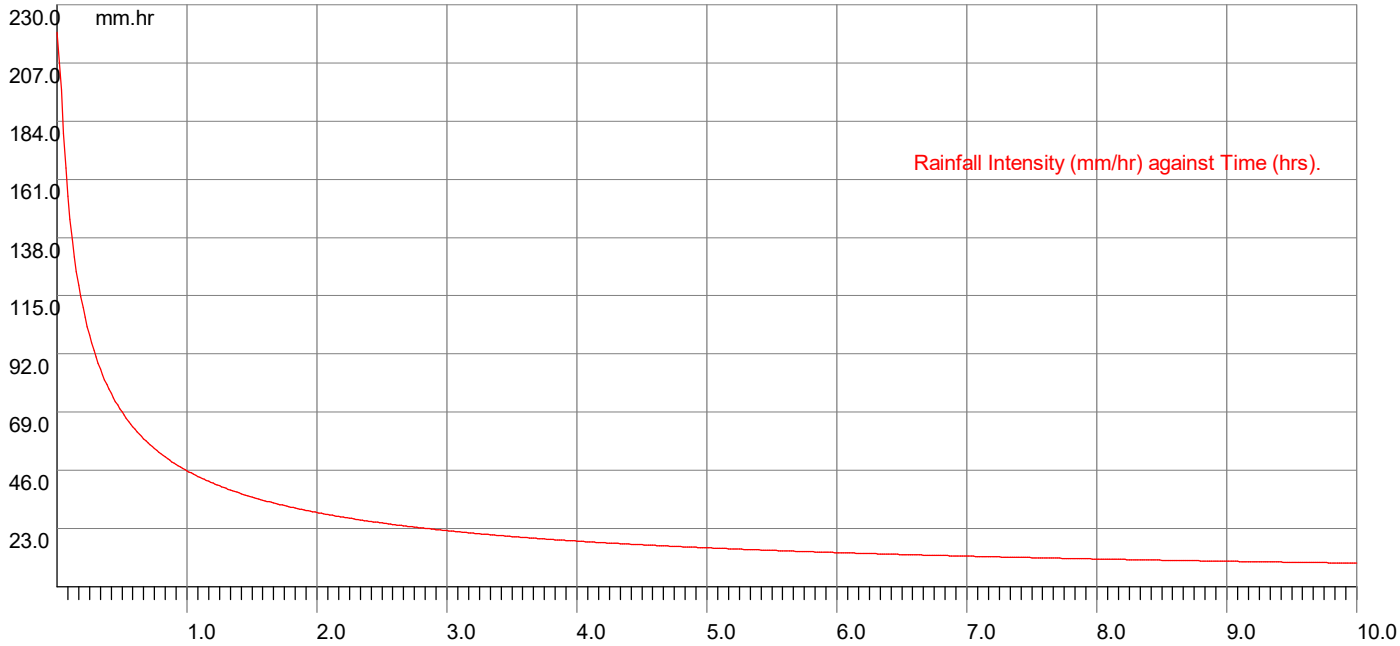
MasterDrain SW

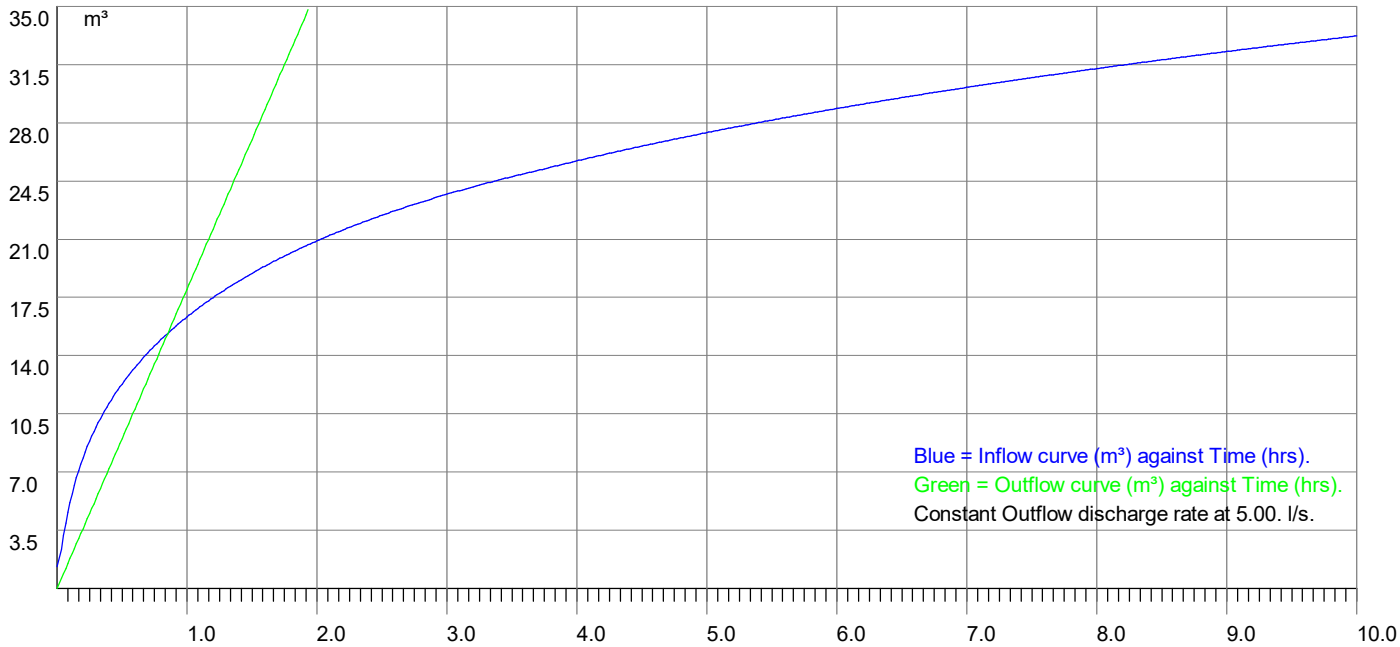
Data:-

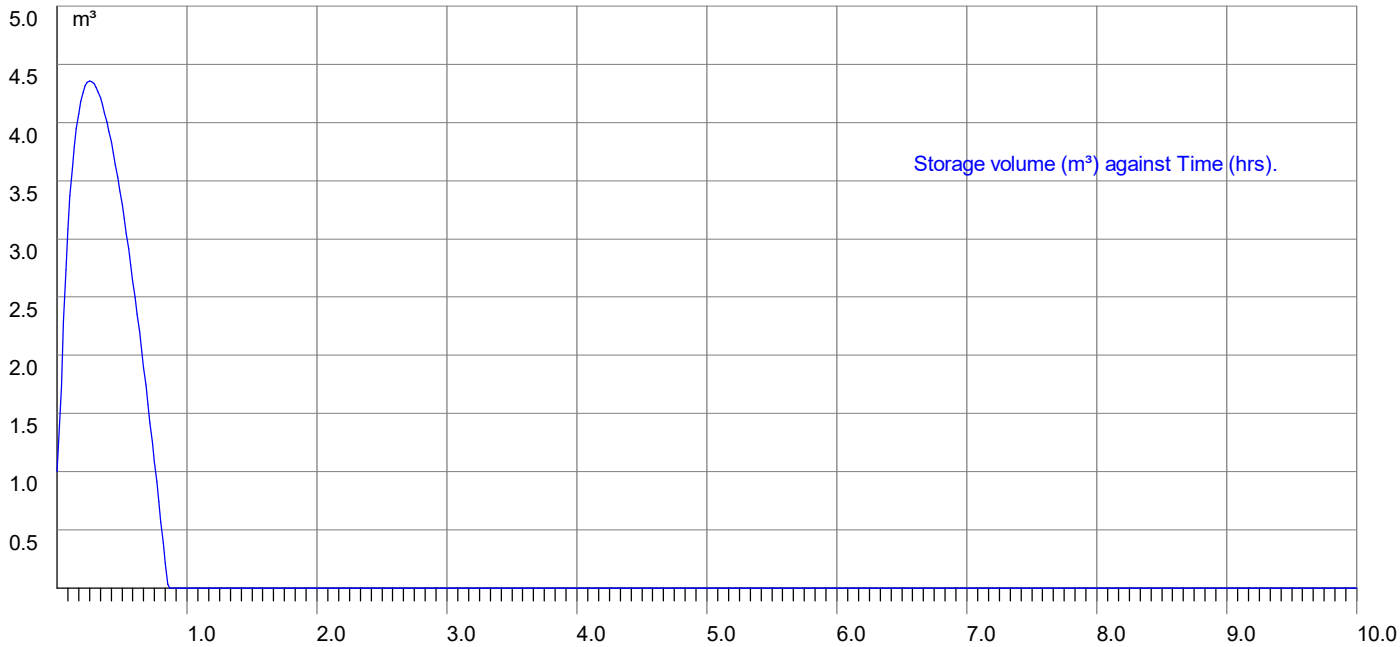
Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	119.0	7.077	3.000	4.077
20	86.0	10.212	6.000	4.212
30	69.0	12.296	9.000	3.296
40	59.0	13.899	12.000	1.899
50	51.0	15.213	15.000	0.213
60	46.0	16.331	18.000	0.000
70	42.0	17.307	21.000	0.000
80	38.0	18.173	24.000	0.000
90	35.0	18.952	27.000	0.000
100	33.0	19.658	30.000	0.000
110	31.0	20.305	33.000	0.000
120	29.0	20.900	36.000	0.000
130	28.0	21.451	39.000	0.000
140	26.0	21.963	42.000	0.000
150	25.0	22.441	45.000	0.000
160	24.0	22.888	48.000	0.000
170	23.0	23.308	51.000	0.000
180	22.0	23.703	54.000	0.000
190	21.0	24.075	57.000	0.000
200	21.0	24.427	60.000	0.000
210	20.0	24.760	63.000	0.000
220	19.0	25.075	66.000	0.000
230	19.0	25.395	69.000	0.000
240	18.0	25.710	72.000	0.000
250	18.0	26.016	75.000	0.000
260	17.0	26.311	78.000	0.000
270	17.0	26.598	81.000	0.000
280	16.0	26.877	84.000	0.000
290	16.0	27.147	87.000	0.000
300	15.0	27.411	90.000	0.000
310	15.0	27.667	93.000	0.000
320	15.0	27.918	96.000	0.000
330	14.0	28.162	99.000	0.000
340	14.0	28.400	102.000	0.000
350	14.0	28.633	105.000	0.000
360	14.0	28.861	108.000	0.000
370	13.0	29.083	111.000	0.000
380	13.0	29.301	114.000	0.000
390	13.0	29.515	117.000	0.000
400	13.0	29.724	120.000	0.000
410	12.0	29.929	123.000	0.000
420	12.0	30.130	126.000	0.000
430	12.0	30.327	129.000	0.000
440	12.0	30.521	132.000	0.000
450	11.0	30.711	135.000	0.000
460	11.0	30.898	138.000	0.000
470	11.0	31.082	141.000	0.000
480	11.0	31.263	144.000	0.000
490	11.0	31.441	147.000	0.000
500	11.0	31.615	150.000	0.000
510	10.0	31.787	153.000	0.000
520	10.0	31.957	156.000	0.000
530	10.0	32.124	159.000	0.000
540	10.0	32.288	162.000	0.000
550	10.0	32.450	165.000	0.000
560	10.0	32.610	168.000	0.000
570	10.0	32.767	171.000	0.000
580	10.0	32.922	174.000	0.000
590	9.0	33.075	177.000	0.000
600	9.0	33.226	180.000	0.000

Storage volume (m^3) = 4.4 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 01/04/21
	Project **Earl Street Heywood**		By / Checked / Reviewed
	Title **Peak Flow Storage - 1 in 100 year + 20%CC**		







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			Sheet no. 1
			Date 01/04/21
	Project: Earl Street Heywood		By / Checked / Reviewed
	Title: Peak Flow Storage - 1 in 100 year + 40%CC		

Data:-

FSR Hydrology:-

Location = Heywood
M5-60 (mm) = 18.9
Soil index = 0.15
Return period = 100
UCWI = 113.8

Grid reference = SD8510
r = 0.29
SAAR (mm/yr) = 1100
WRAP = 1
Climate change = 40

i) Well drained permeable sandy or loam soils and shallower analogues over highly permeable limestone, chalk, sandstone or related drifts;
ii) Earthy peat soils drained by dykes and pumps;
iii) Less permeable loamy over clayey soils on plateaux adjacent to very permeable soils in valleys.

Runoff factor (RF) = 75.0, 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 = 475 m²
Total area (TA) = 475 m²
Allowed discharge rate = 5.000 l/s
Additional flow = 0.00 l/s

Pervious area = 0 m²
Equiv area = 356 m² (TA x RF).
Areal reduction factor = 1.000
Climate change factor = 40

Calculated data:-

Time to max = 19.0 mins
Rainfall at max = 103.03 mm/hr
Pipeline storage = 0.0 m³
Offline storage = 0.0 m³

Calculated storage volume = 5.9 m³
Allowed discharge rate = 5.000 l/s
Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours
Rainfall rate = 15.00 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	754.3	1125	6.0
150	335.2	1200	5.2
225	149.0	1275	4.6
300	83.8	1350	4.1
375	53.6	1425	3.7
450	37.2	1500	3.4
525	27.4	1575	3.0
600	21.0	1650	2.8
675	16.6	1725	2.5
750	13.4	1800	2.3
825	11.1	1875	2.1
900	9.3	1950	2.0
975	7.9	2025	1.8
1050	6.8	2100	1.7

Ovoid	Len
400 x 600	32.9
600 x 900	14.3
800 x 1200	8.1

Box culvert	Len
500 x 500	23.7
500 x 750	15.8
500 x 1000	11.8
750 x 1000	7.9
750 x 1200	6.6
750 x 1500	5.3
1000 x 1000	5.9
1000 x 1200	4.9
1000 x 1500	3.9
1000 x 1800	3.3
1000 x 2000	3.0
1500 x 1500	2.6
1500 x 1800	2.2
1500 x 2000	2.0

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www.thelkgroup.com		Sheet no.	2
		Date	01/04/21
MasterDrain SW	Project: Earl Street Heywood	By	Checked / Reviewed
	Title: Peak Flow Storage - 1 in 100 year + 40%CC		

Data:-

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	139.0	8.257	3.000	5.257
20	100.0	11.914	6.000	5.914
30	81.0	14.345	9.000	5.345
40	68.0	16.215	12.000	4.215
50	60.0	17.748	15.000	2.748
60	53.0	19.053	18.000	1.053
70	49.0	20.192	21.000	0.000
80	45.0	21.202	24.000	0.000
90	41.0	22.110	27.000	0.000
100	39.0	22.935	30.000	0.000
110	36.0	23.689	33.000	0.000
120	34.0	24.384	36.000	0.000
130	32.0	25.026	39.000	0.000
140	31.0	25.624	42.000	0.000
150	29.0	26.181	45.000	0.000
160	28.0	26.703	48.000	0.000
170	27.0	27.193	51.000	0.000
180	26.0	27.653	54.000	0.000
190	25.0	28.088	57.000	0.000
200	24.0	28.498	60.000	0.000
210	23.0	28.886	63.000	0.000
220	22.0	29.254	66.000	0.000
230	22.0	29.628	69.000	0.000
240	21.0	29.996	72.000	0.000
250	20.0	30.352	75.000	0.000
260	20.0	30.696	78.000	0.000
270	19.0	31.031	81.000	0.000
280	19.0	31.356	84.000	0.000
290	18.0	31.672	87.000	0.000
300	18.0	31.979	90.000	0.000
310	18.0	32.279	93.000	0.000
320	17.0	32.571	96.000	0.000
330	17.0	32.855	99.000	0.000
340	16.0	33.133	102.000	0.000
350	16.0	33.405	105.000	0.000
360	16.0	33.671	108.000	0.000
370	15.0	33.930	111.000	0.000
380	15.0	34.185	114.000	0.000
390	15.0	34.434	117.000	0.000
400	15.0	34.678	120.000	0.000
410	14.0	34.917	123.000	0.000
420	14.0	35.152	126.000	0.000
430	14.0	35.382	129.000	0.000
440	14.0	35.608	132.000	0.000
450	13.0	35.830	135.000	0.000
460	13.0	36.048	138.000	0.000
470	13.0	36.262	141.000	0.000
480	13.0	36.473	144.000	0.000
490	13.0	36.681	147.000	0.000
500	12.0	36.885	150.000	0.000
510	12.0	37.085	153.000	0.000
520	12.0	37.283	156.000	0.000
530	12.0	37.478	159.000	0.000
540	12.0	37.669	162.000	0.000
550	12.0	37.858	165.000	0.000
560	11.0	38.045	168.000	0.000
570	11.0	38.228	171.000	0.000
580	11.0	38.409	174.000	0.000
590	11.0	38.588	177.000	0.000
600	11.0	38.764	180.000	0.000

Storage volume (m^3) = 5.9 m^3

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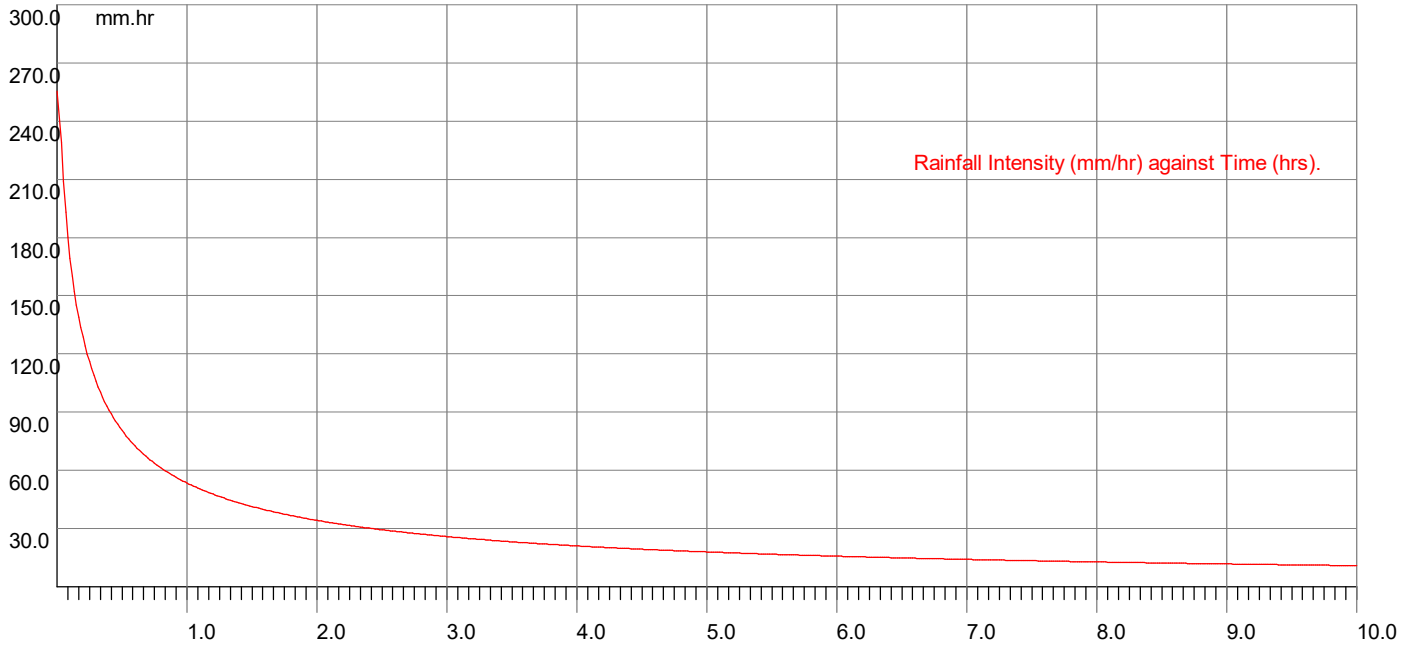

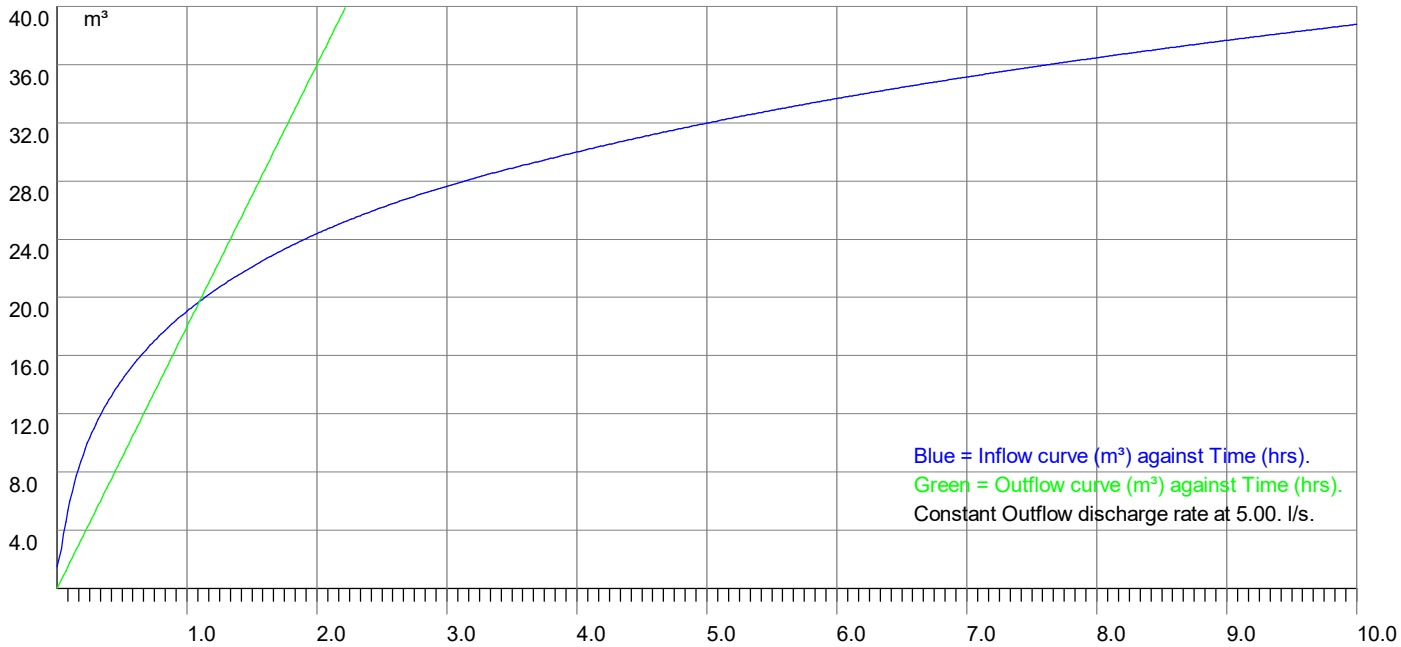

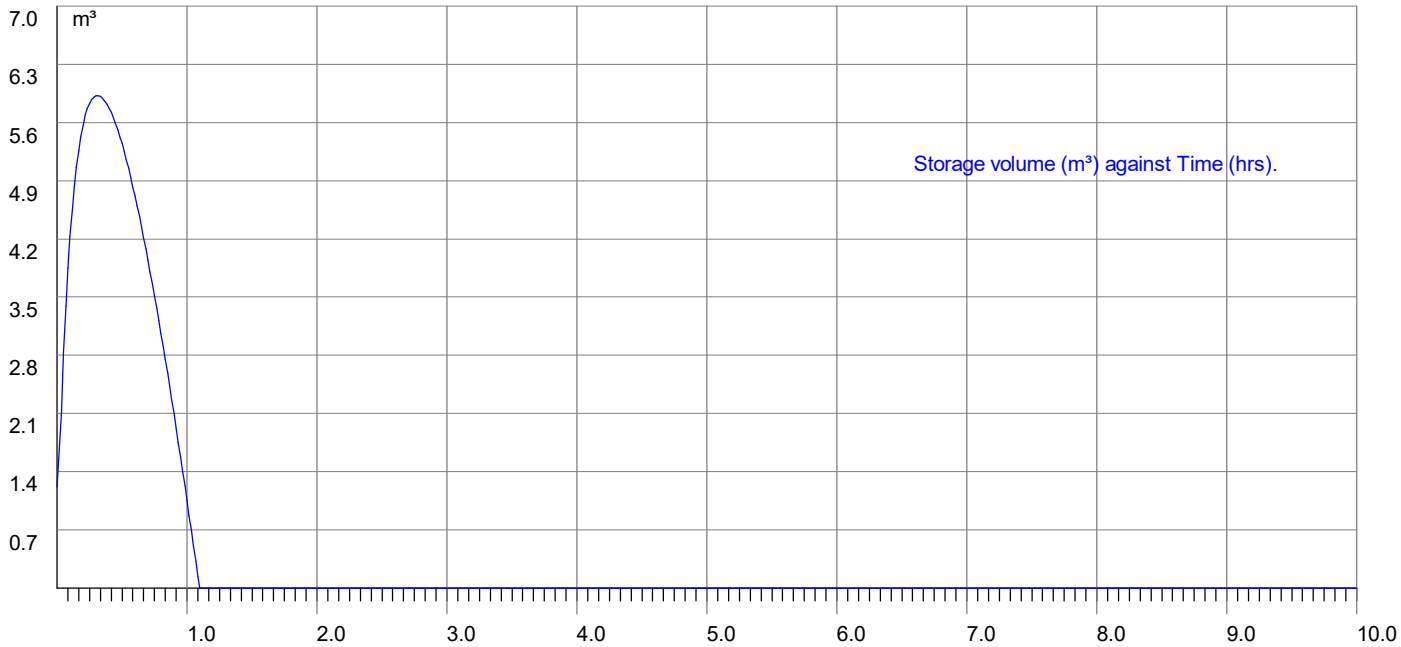

Explanatory notes for Peak Flow Storage

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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