

LAND AT HERBERT STREET CHEETHAM HILL, MANCHESTER

FLOOD RISK ASSESSMENT & OUTLINE DRAINAGE STRATEGY

Job Number: FRA 20 1115

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Client: Studio Tashkeel Architecture Ltd



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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 Herbert Street, Cheetham Hill, Manchester. The development comprises a residential development with provision for soft landscaping and car parking.

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

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

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

Consultations

The Environment Agency (EA) has been consulted to inform the preparation of this report. They have provided a more detailed flood map.

Modelled data was also provided, although this was not deemed to be relevant as the site is approximately 1km from the nearest main watercourse (the River Irk) and is well above the modelled flood levels.

Manchester City Council and United Utilities were also consulted concerning flood risk.

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

Flood Risk

Environment Agency flood maps indicate that the site is not vulnerable to fluvial flooding from the River Irk, which is approximately 1km to the east of the site.

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

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

However, comparison of modelled flood level data with the topographic survey shows that the site is wholly in Flood Zone 1 – Very Low Risk – annual probability of flooding less than 0.1% (1 in 1000).

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 combined sewer.

The proportion of the site covered by impermeable surfaces will be similar to the existing and will therefore generate similar runoff. Attenuation will therefore be required.

Foul sewage arising from the development will be discharged into the existing combined sewer.

The outline drainage strategy considers the use of attenuation-based SuDS to be feasible with a discharge to the combined sewer. Therefore, the most effective strategy, in line with the SuDS management train, would be to have a storage tank or similar within the southern part of the site. The required storage has been estimated to be **22.1m³** for the 1 in 30-year event 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 **43.7m³** and **54.8m³**.

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 Herbert Street.

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1 Introduction

1.1 Background

LK Consult Ltd (LKC) were commissioned by Studio Tashkeel Architecture Ltd to carry out a Flood Risk Assessment (FRA) and Outline Drainage Strategy for land at Herbert Street, Cheetham Hill. 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 Framework¹ and accompanying Technical Guidance of March 2012 (revised to the Planning Practice Guidance (PPG)², which supersedes Planning Policy Statement 25 (PPS25) 'Development and Flood Risk'. The guidance on Climate Change allowance issued by the Environment Agency in February 2016 has also been considered.

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

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

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.

The main drivers for SuDS are the controlling water quantity and water quality³ (Plate 1), with an increasing emphasis on amenity and biodiversity benefits where practical.



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

1.2 Site Details

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

Site Details	
Location	West of Herbert Street and north of Elizabeth Street, Cheetham Hill, Manchester, M8 8BN. Centred at approximate National Grid Reference 383969E 400494N.
Area	Approximately 2630m ² .
Topography	Falling from 57.00mAOD at the north, to 56.2mAOD at the south. There is a small raised area at 57.8mAOD in the south of the site. The site is approximately level.
Current Land Use	<u>Site</u> Existing industrial building surrounded by hardstood concrete and areas of overgrown vegetation at the north and south. <u>Surrounding Area/ Boundary Treatment</u> North: Alderglen Road; Residential Properties. East: Herbert Street; Residential. South: Elizabeth Street, and nursery. West: Cheetham Hill Test Centre.
Proposed Development	Residential development with provision for access road, car parking and soft landscaping.

Table 1-1: Summary of site details.

³ The SuDS Manual (C753) – CIRIA November 2015.

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 development site is in (Flood Zone 1), over 0.5 hectare in size and in a critical drainage area, so under current regulations a Flood Risk Assessment will be necessary to accompany the Planning Application.

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

The development involves the construction of more than 10 properties and is classed as a major application and as such Sustainable Drainage System should be provided.

2.2 The Sequential and Exception Tests

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

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

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

2.3 Environmental Setting

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

Summary of the Environmental Setting			
Geology	Superficial		Till, Devensian – Diamicton.
	Bedrock		Chester Formation – Sandstone.
	BGS Boreholes		BH Ref: SD80SW231, 20m west: Made ground: brick rubble to 2.2m. Soft black silty Clay to 2.9m. Firm to stiff red/brown boulder Clay to 6.25m.
	Defra Soilscape Mapping		The type of soil within the site has been identified as “Slowly permeable seasonally wet acid loamy and clayey soils”.
Hydrogeology	Aquifer Designation	Superficial	Secondary (undifferentiated).
		Bedrock	Principal
Hydrology	All adjacent and internal surface water		There are no watercourses in the vicinity of the site. The nearest main watercourses are the River Irk, approximately 1km to the east, and the River Irwell, approximately 1km to the south.
Site History			Open fields prior to 1850, watercourse shown running through area of Herbert Street. Housing to the southwest of the site and yard by 1890. Clay pit to the south of Elizabeth Street, Public baths and wash house erected by 1952. Housing within the site boundary demolished by 1970. Public laundry converted to commercial use and car parking added prior to 2000.

Table 2-1: Summary of the Environmental Setting.

2.4 Site Reconnaissance

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

Relevant features identified on site are summarised below:

- The site comprises a disused manufacturing/commercial building.
- The site has a slight fall from the north to the south.
- The ground is comprised mostly of concrete, with a car park at the north and access road at the south.
- There is an overgrown grass verge at the southern boundary with scrub and sporadic trees.
- There is a 150mm diameter combined sewer in the southern part of the site, which connects to a 675mm diameter combined sewer in Herbert Street.
- There is a watercourse marked on the sewer plan at the southwestern site boundary. However, no evidence was found of this during the site walkover. With reference to historical maps, the watercourse corresponded with the location of the 675mm diameter combined sewer that starts in Herbert Street, therefore it is speculated that the combined sewer is the former watercourse.

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 A. The site falls from approximately 57.0mAOD at the north, to approximately 56.2mAOD at the south. The final site levels and ground floor levels of dwellings have not yet been determined. The proposed access would join Herbert Street at around 56.28m AOD.

3 Consultation

Information from consultees (Environment Agency (EA), Manchester City 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 Flood Levels	Modelled data was provided for the River Irk. However, the site is approximately 1km from the closest flood extent. There are no main watercourses in the vicinity of the site.
	Records of Flooding	There are no records of flooding within the vicinity of the site.
	Records of Flood Warning Service	Not within a flood warning service area.
	Surface Water Flooding	Very low risk of surface water flooding.
	Flooding from reservoirs	No risk from reservoirs.
	Groundwater Source Protection Zone	Not within Source Protection Zone.
Manchester City Council	Possible or known incidents of highway flooding	No mention of any current or historic flooding incidents in the vicinity of the site.
United Utilities (UUPLC)	Likely conditions for connecting into their sewerage system	United Utilities would request conditions for a separate system with surface water draining to the adjacent watercourse. <i>[However, it should be noted that there is no evidence of the existence of the watercourse shown on the plan provided – historical maps indicate that the watercourse is located at Herbert Street, and therefore is speculated to have been reassigned as the existing 675mm diameter combined sewer. This appears to be necessarily the only available connection. United Utilities have been contacted for further information].</i> United Utilities Asset Protection department was contacted regarding sewer flooding history for the site. They confirmed that they did not have any record of internal or external sewer flooding of properties in the vicinity of the site as a result of overloaded sewers.
	Sewer map	United Utilities sewer records show a 225mm diameter combined sewer within the site, which joins a 675mm diameter combined sewer within Herbert Street to the east. There is also a 225mm diameter combined sewer flowing in Elizabeth Street to the south.

Table 3-1: Summary consultee information.

Source	Details	
Strategic Flood Risk Assessment (SFRA)	Level 1 SFRA ⁴	There is no indication of any history of flooding within the vicinity of the site.
	Level 2 SFRA ⁵	Cheetham Hill is identified as being a risk area for surface water flooding. However, there is no mention of any risk of flooding in Cheetham Hill from other sources, including fluvial. There is also no indication of any increased flood risk or history of flooding in the vicinity of Herbert Street.
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. The PFRA also indicates that the site is not in an area susceptible to groundwater flooding.	

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

⁴ Strategic Flood Risk Assessment Level 1: Manchester, Salford and Trafford Councils; 2010, JBA Consulting.

⁵ Strategic Flood Risk Assessment Level 2: Manchester, Salford and Trafford Councils; 2011, JBA Consulting.

⁶ Preliminary Flood Risk Assessment: Manchester City 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 in line with 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 in gardens and landscaped areas not positively drained if overland flow routes are not considered. Therefore, the risk of flooding from surface water flooding is Very Low but should be considered further during the detailed design.

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

Groundwater – The BGS has borehole records, but no groundwater recorded for the study area. The superficial 'head' deposits are comprised of Clay which would make it unlikely for groundwater flooding to occur. 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 shows combined sewers within the vicinity of the site. The Drainage and Water Enquiry states that no property within the vicinity is at risk of internal flooding due to overloaded public sewers. There are no records of

sewer flooding at the site location. 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)	Very Low
Surface Water	Very 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 Negligible to Very Low 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 development is a material planning consideration in determining proposals for the development and use of land.

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

The Building Regulations Requirement H3⁷ 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 2010⁸.

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

5.1 Infiltration

The Groundwater Source Protection Zone mapping from the EA website shows that the site is not within any identified protection zones.

A summary of the British Geological Survey superficial and bedrock aquifer descriptions and classifications supplemented by local records is shown in Table 5-1 below:

Classification	Description	Aquifer Classification	Recorded Water Table Depth	Soakaway Potential
Till, Devensian	Diamicton Silty Clay	Secondary (undifferentiated)	N/A	Poor
Chester Formation	Sandstone	Principal	N/A	Good

Table 5-1: Geological and Hydrogeological Setting.

⁷ Building Regulations part H3 2010: Approved Document, Drainage and Waste Disposal.

⁸ Flood and Water Management Act 2010: UK Government.

Infiltration methods such as soakaways are 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 is a culverted watercourse shown running within the site on the sewer plans. The historical mapping shows the original watercourse ran along what is now Herbert Street. Further historical evidence shows the route on the plan has been used as a large clay pit and has had a number of buildings old and new constructed along the line shown. There is a large diameter combined sewer shown starting within Herbert Street and then flowing to the east along Elizabeth Street, adjacent to the site that currently collects the surface water. It is located adjacent to the eastern site boundary.

There are no surface water sewers within the vicinity of the site, although there are combined sewers within Herbert Street to the east and Elizabeth Street to the south.

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

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

⁹ CIRIA C753 - The SUDS Manual. London 2015.

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

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

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

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

SuDS Option	Appropriate to Development	Comments	Benefits	Comments
Rainwater harvesting	*	Rainwater harvesting collects the rain which falls onto roofs, then stores it in a tank until required for a non-potable use.	Water quantity	In the process, a volume of water is kept out of the storm-water management system, thereby helping to reduce flooding risks. When required, the water is pumped to the point of use, thus displacing what would otherwise be a demand for mains-water. Reduces demand on mains water.
Permeable Pavements – with granular and geo-cellular storage systems	✓	Permeable pavements allow inflow of rainwater into underlying construction. Any geo-cellular storage systems would have to be lined with an impermeable membrane to provide storage rather than infiltration for runoff from highways.	Water quality Water quantity	Reduced peak flows to watercourses, reducing the risk of flooding downstream. Reduced effects of pollution in runoff on the environment.
Other SuDS				
Wetlands	✗	These comprise of shallow ponds and marshy areas, covered almost entirely in aquatic vegetation.	Water quality Water quantity Amenity Biodiversity	Wetlands provide both stormwater attenuation and treatment. Wetlands detain flows for an extended period to allow sediments to settle, and to remove contaminants by facilitating adhesion to vegetation and aerobic decomposition. They also provide significant ecological benefits.

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

Notes

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

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

✗ Not suitable.

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, with a 50% reduction in flow accordingly with the site's position in a critical drainage area.

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

Existing Areas	Plot Area
Total area (ha)	0.26
Impermeable Split (ha)	0.19
Permeable Split (ha)	0.07
Proposed Areas	Plot Area
Total area (ha)	0.26
Impermeable Split (ha)	0.18
Permeable Split (ha)	0.08

Table 5-4: Assumed plot areas.

5.3.1 Infiltration Storage Estimate

Infiltration is unlikely to be practical due to the impermeable ground conditions.

5.3.2 Attenuation Estimate

Surface water storage and runoff estimations based on the HR Wallingford procedure and IH 124¹⁰ 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 0.26ha, of which 0.18ha is impermeable. This gives the following brownfield runoff rates and attenuation requirements for this section based on the HR Wallingford procedure:

Q _{bar} :	23.8 l/s
1 in 1-year brown field runoff rate:	16.7 l/s
1 in 30-year brownfield runoff rate:	42.1 l/s
1 in 100-year brownfield runoff rate:	53.2 l/s

The 50% reduced rate, in accordance with the site's position in a critical drainage area, gives the following runoff rates:

50% Q _{bar} :	11.9 l/s
1 in 1-year reduced runoff rate:	8.4 l/s
1 in 30-year reduced runoff rate:	21.1 l/s
1 in 100-year reduced runoff rate:	26.6 l/s

The requirement for flows to be limited to as close as possible to the greenfield runoff rate where practical in accordance with the policy requirements of Manchester City Council, gives the following runoff rates:

¹⁰ IH124 Flood Estimation of Small Catchments.

➤➤ Q_{bar} :	1.53 l/s
➤➤ 1 in 1-year greenfield runoff rate:	1.30 l/s
➤➤ 1 in 30-year greenfield runoff rate:	2.58 l/s
➤➤ 1 in 100-year greenfield runoff rate:	3.22 l/s

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

As the greenfield runoff rates are smaller than the practical minimum of 5l/s, the storage calculations are based on an assumed runoff rate limited to 5l/s.

The following attenuation has been estimated for the development using runoff rates of 5l/s and utilises the FSR methodology¹¹ as:

- Attenuation storage volume: **22.1 m³** (1 in 30-year event)
- Retention on site volume: **43.7 m³** (1 in 100 year + 20% Climate Change)
- Retention on site volume: **54.8 m³** (1 in 100 year + 40% Climate Change)

Attenuation storage aims to limit the peak rate of runoff from the development to the corresponding greenfield runoff for a range of annual flow rate probabilities before discharge to watercourse. As the flow from the development would be restricted to the brownfield equivalent there should be little change in the flows that enter the unnamed watercourse and thus the risk of flooding 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 between **22.1 m³** and for the 1 in 100-year event, a storage capacity of between **43.7m³** and **54.8 m³** will be required from on-site storage as well as SuDS systems. All volumes can be stored within the site boundary and discharges will be limited by flow control devices to the adjacent combined sewer.

5.4 Site Specific SuDS

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

There are areas where conveyance systems such as rills may be utilised to intercept overland flow and to convey any water to the sewer in Herbert Street. This will provide an effective pre-treatment of suspended solids through filtration and sedimentation and will also provide ecological and amenity benefits.

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

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

¹¹ Flood Studies Report Wallingford NERC 1975.

5.5 Foul Drainage

United Utilities have confirmed that the foul can be discharged into the 225mm diameter combined sewer within the south of the site 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 minimum of 600mm above the 1% annual probability (1 in 100 year) flood level including an additional fluvial allowance for climate change. It is generally accepted that vehicle parking can be accommodated within the flood zone with suitable safeguards. The 'design' flood level for the site should therefore be the 1% annual probability event with allowance for climate change plus an allowance for freeboard.

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

6.2 Safe Access

Safe and dry access is available via Herbert Street (56.28m AOD) to the west significantly above the 1% annual probability event. Therefore, no mitigation is proposed.

6.3 Flood Resistance and Resilience

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

6.4 Residual Risk

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

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7 Conclusions

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

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

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

- » The finished floor level should be set at a nominal height above the finished ground levels to allow for overland flow routes in extreme events and drainage failures.
- » Pedestrian and vehicular safe access to and from the site is achievable under all conditions via the access road off Herbert Street.
- » Potential for soakaway use for rainwater disposal is low; however, this should be investigated further at the detailed design phase.
- » Surface water flow will probably need to be attenuated to a reduced runoff rate, subject to agreement with United Utilities.
- » Surface water arising from the site could potentially discharge into the adjacent combined sewer.
- » Proposed SuDS should be selected to provide a wide range of benefits including amenity, biodiversity and maintaining water quality where practical. During construction, adequate measures should be proposed to control pollution to existing watercourses and groundwater.
- » As agreed by United Utilities, foul sewage could be discharged into the existing combined sewer at the south of the site.
- » A formal evacuation plan is not considered to be required.

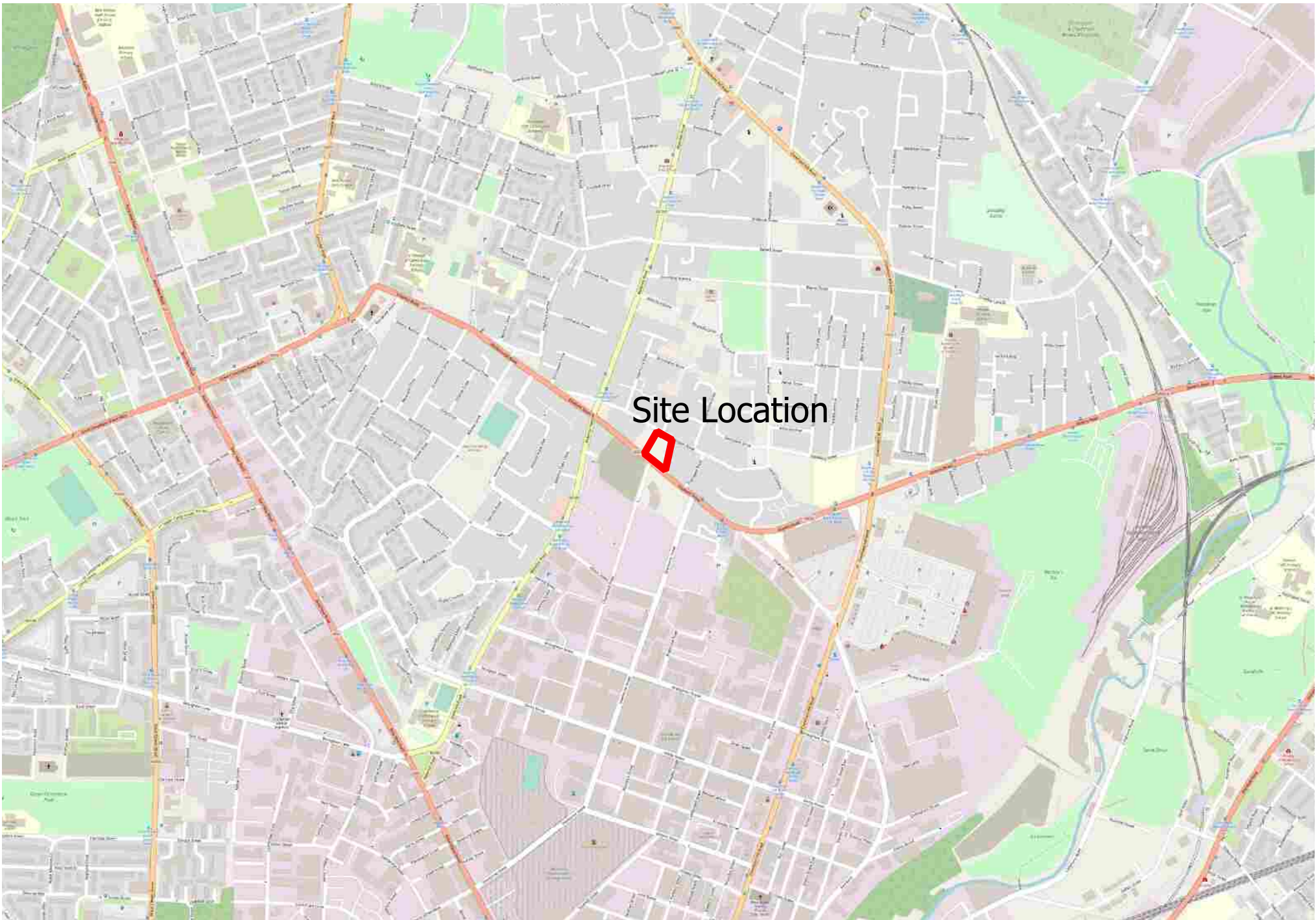
Further details on the proposed mitigation measures are provided in Section 6. All proposed measures should be agreed with the Local Authority prior to commencement of the development.

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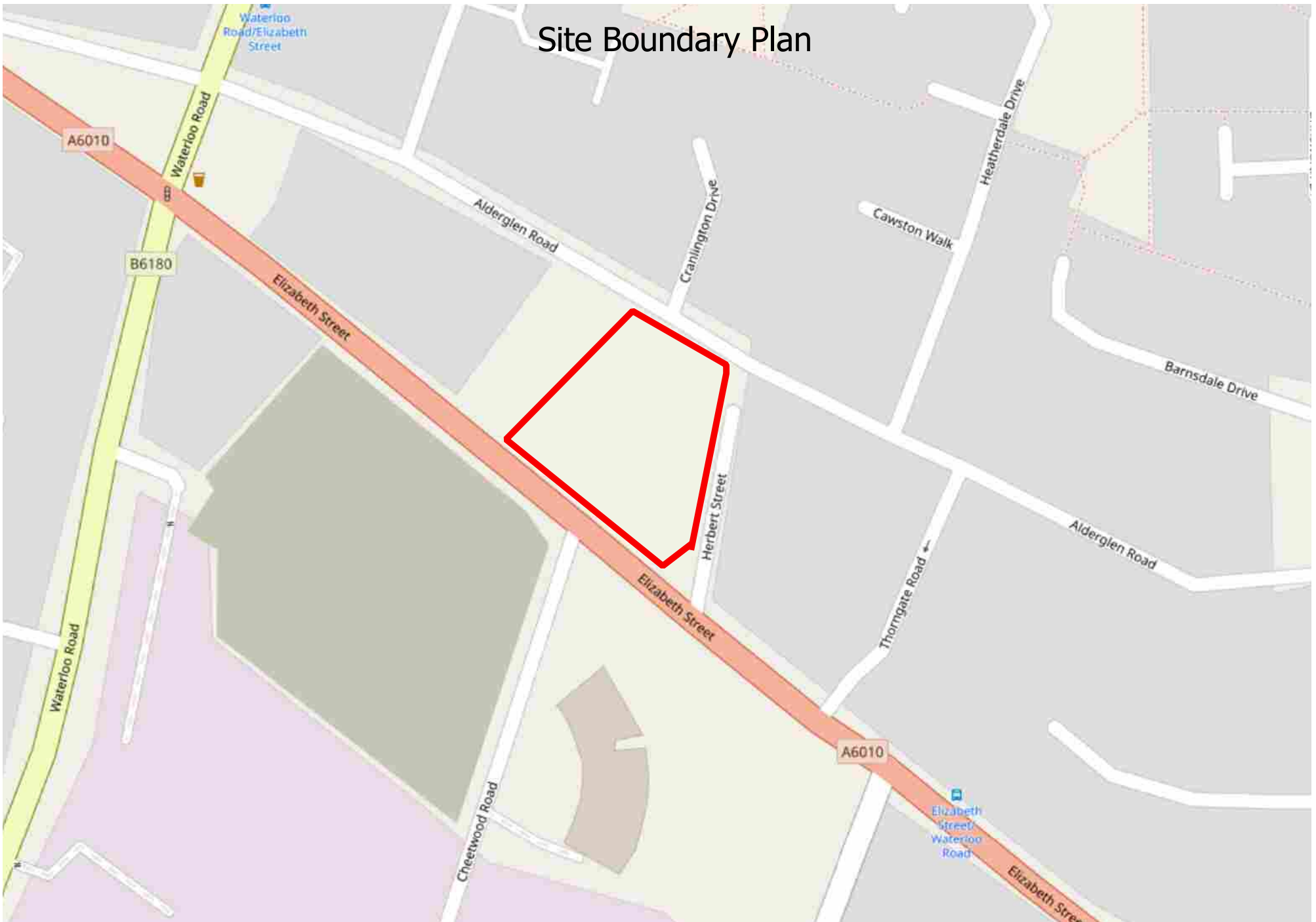
Appendix A

Figures, Plans and Drawings

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Site Boundary Plan



Appendix B

Site Information

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General Notes:

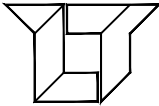
All site dimensions shall be verified by the Contractor on site prior to commencing any works.

Do not scale from this drawing.

Design intent drawing only. Construction to comply with latest building regulation requirements.

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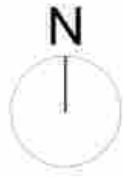
Rev	Description	Date	Dr by	App by



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E info@StudioTashkeel.com
www.studiotashkeel.com

client name Dude Ltd.		
project Herbert St		
drawing Existing Site		
project number 1907110	scale 1/300 @ A3	
drawing number 1907110_SK_001	rev -	issue status Draft
This drawing is to be read in conjunction with all related drawings. All dimensions must be checked and verified on site before commencing any work or producing shop drawings. The originator should be notified immediately of any discrepancy. This drawing is copyright and remains the property of Studio Tashkeel Architecture Ltd.		



General Notes:

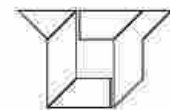
All site dimensions shall be verified by the Contractor on site prior to commencing any works.

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Rev	Description	Date	Dr by	App by



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E: info@studiotashkeel.com
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client name D.U.D.E Ltd.		
project Herbert St		
drawing Proposed Plan		
project number 1907110		scale 1/300 @ A3
drawing number 1907110_SK_002	rev -	issue status Draft
This drawing is to be read in conjunction with all related drawings. All dimensions must be checked and verified on site before commencing any work or producing shop drawings. The originator should be notified immediately of any discrepancy. This drawing is copyright and remains the property of Studio Tashkeel Architecture Ltd.		



Approximate
site location

Watercourse located
beneath current
Herbert Street

HOLST & CO. LTD.

SITE INVESTIGATION DEPT.

5-7, NEW YORK ROAD

LEEDS, 2

8400 0047

Contract No. M1946/F1261

Location Cheetham Hill

Client Manchester City Architect

Borehole No. 8

Ground Level

Date 7.7.69

BOREHOLE LOG

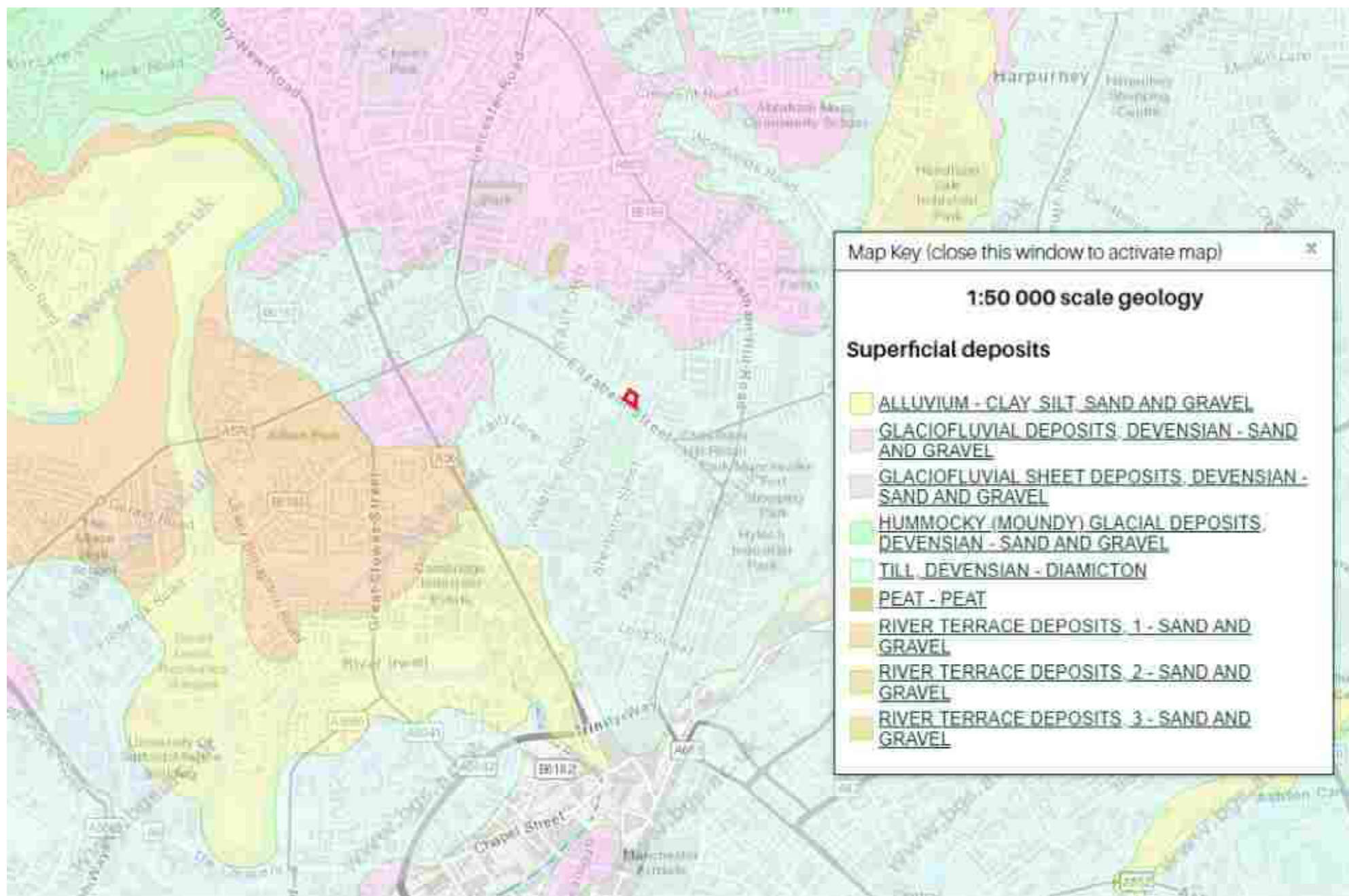
STRATA	Legend	Depth below Ground Level	Thickness of Strata	Type of Sample	c lb/sq. ft.	ϕ deg.	m.c %	y lb/cu. ft.	N
Made ground: Brick Rubble		7'3"	7'3"						
Soft Black silty clay		9'6"	2'3"	0'0"	1270	0	26.3	127	
Firm to stiff red/brown boulder clay			11'0"	14'3"	3660	0	19.2	132	
			18'6"		2650	0	21.2	129	
		20'6"							

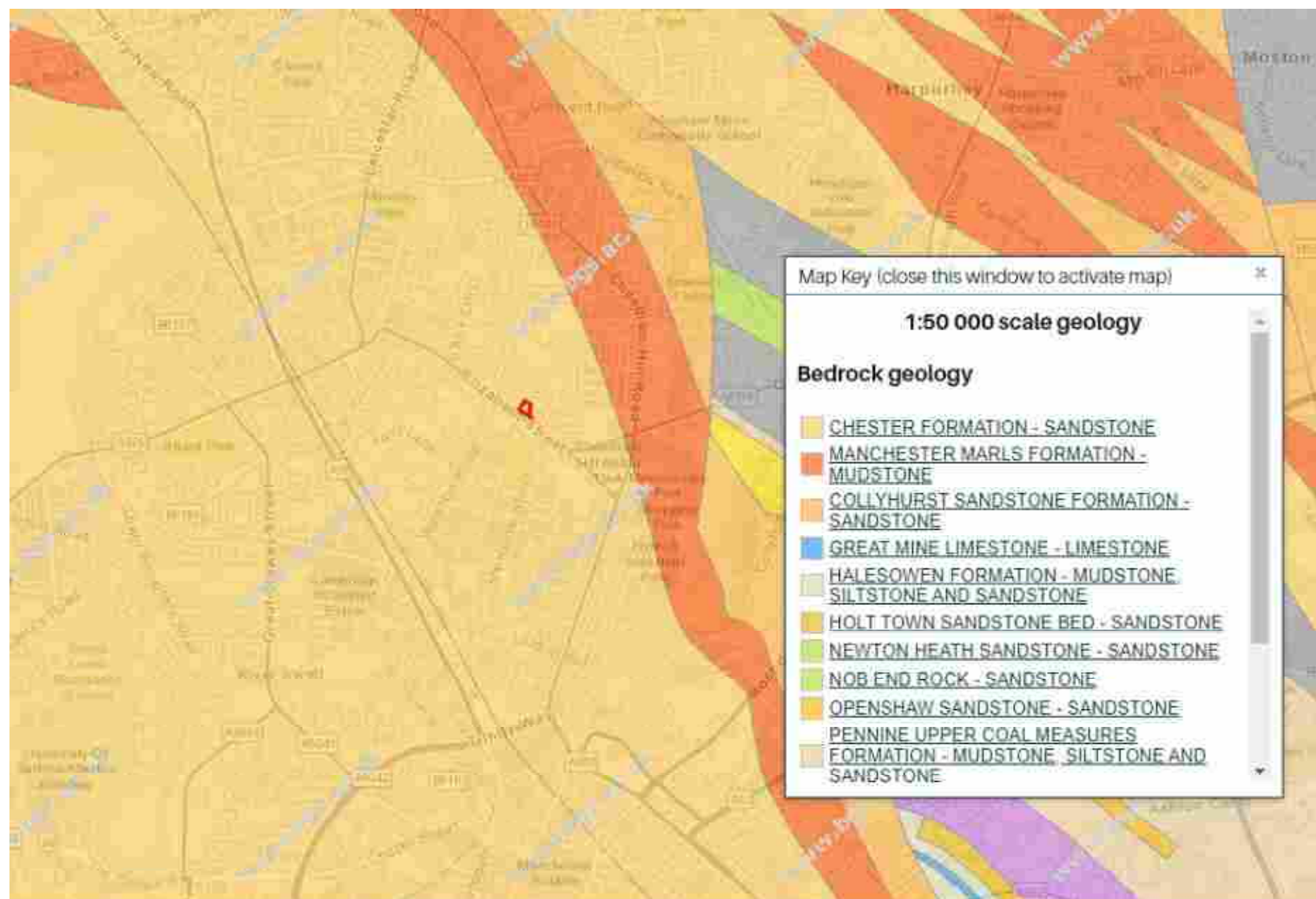
Water Struck at None encountered Maximum Observed Water Level

Undisturbed Sample ☐
 Disturbed Sample ☐
 Water Sample
 Penetration Test

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

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







Photograph 1
(facing NW):
 View across site from south-eastern corner, at junction of Herbert Street and Elizabeth Street.



Photograph 2
(facing NE):
 View from southern site boundary, adjacent to grass verge.



Photograph 3
(facing N):
 Grass verge at southern site boundary.



Photograph 4
(facing SE):
Southwestern
corner of site,
adjacent to
Elizabeth Street.



Photograph 5
(facing W):
Southern part of
site, taken from
Herbert Street.



Photograph 6
(facing SW):
Eastern site
boundary at
Herbert Street.



Photograph 7
(facing S):
Northern site
boundary, adjacent
to Alderglen Road.



Photograph 8
(facing W):
Facing across
northern part of
site, taken from
Herbert Street at
the northeast.

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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: 18 August 2020 12:13
To: Anna Mierzejewska
Subject: GMMC177911AB Response attached from the Environment Agency
Attachments: GMMC177911AB - DFM.PDF; GMMC177911AB - Table.pdf

Dear Anna,

Re: Herbert St, Manchester, M8 0DG

Thank you for your enquiry which was received on 14/7/20.

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

I enclose the data requested.

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

Historic - 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 Manchester 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,

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

Flood map for planning

Your reference
<Unspecified>

Location (easting/northing)
383972/400492

Created
3 Sep 2020 13:43

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

This means:

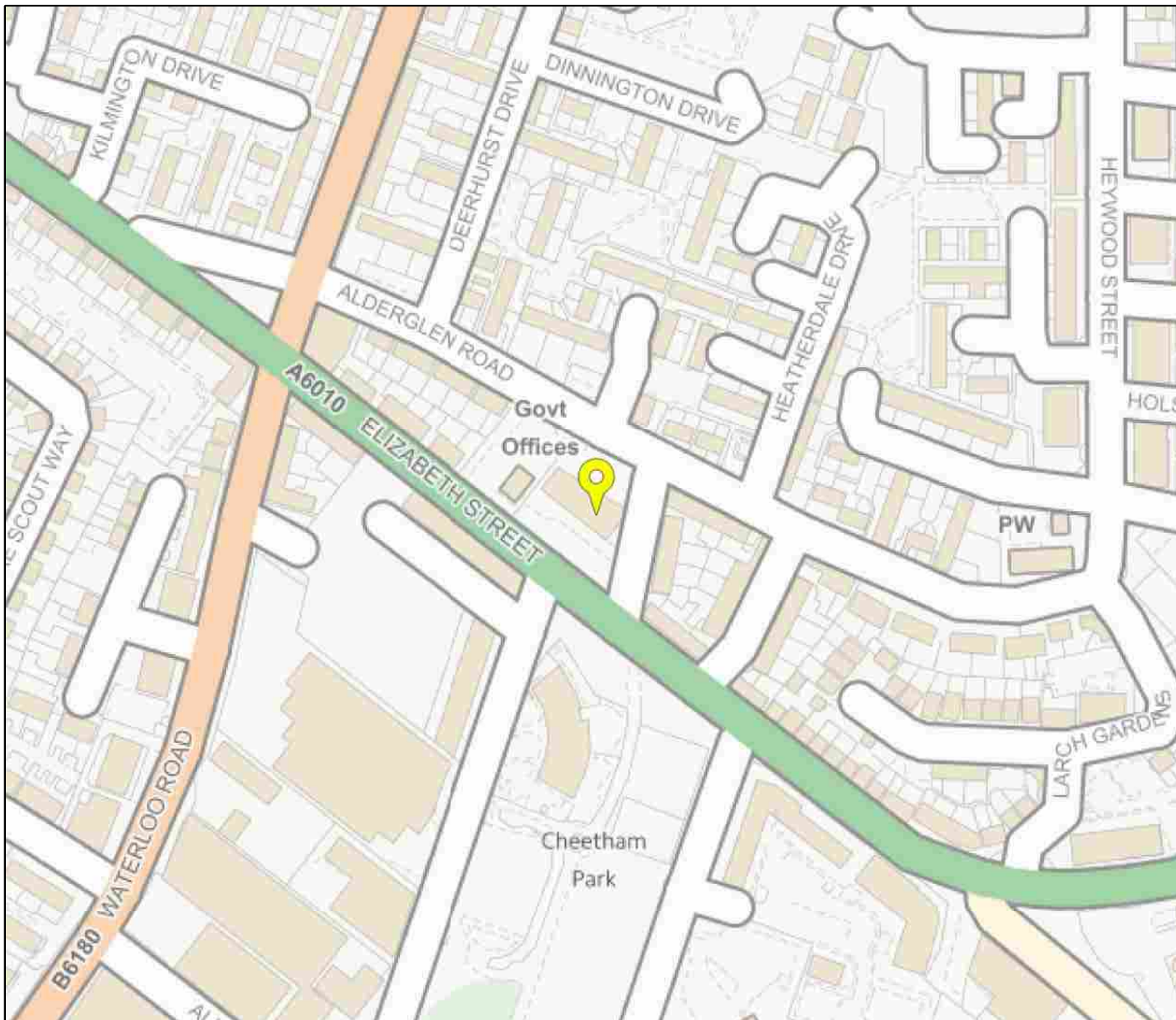
- you don't need to do a flood risk assessment if your development is smaller than 1 hectare and not affected by other sources of flooding
- you may need to do a flood risk assessment if your development is larger than 1 hectare or affected by other sources of flooding or in an area with critical drainage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

Notes

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

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

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



Flood map for planning

Your reference
<Unspecified>

Location (easting/northing)
383972/400492

Scale
1:2500

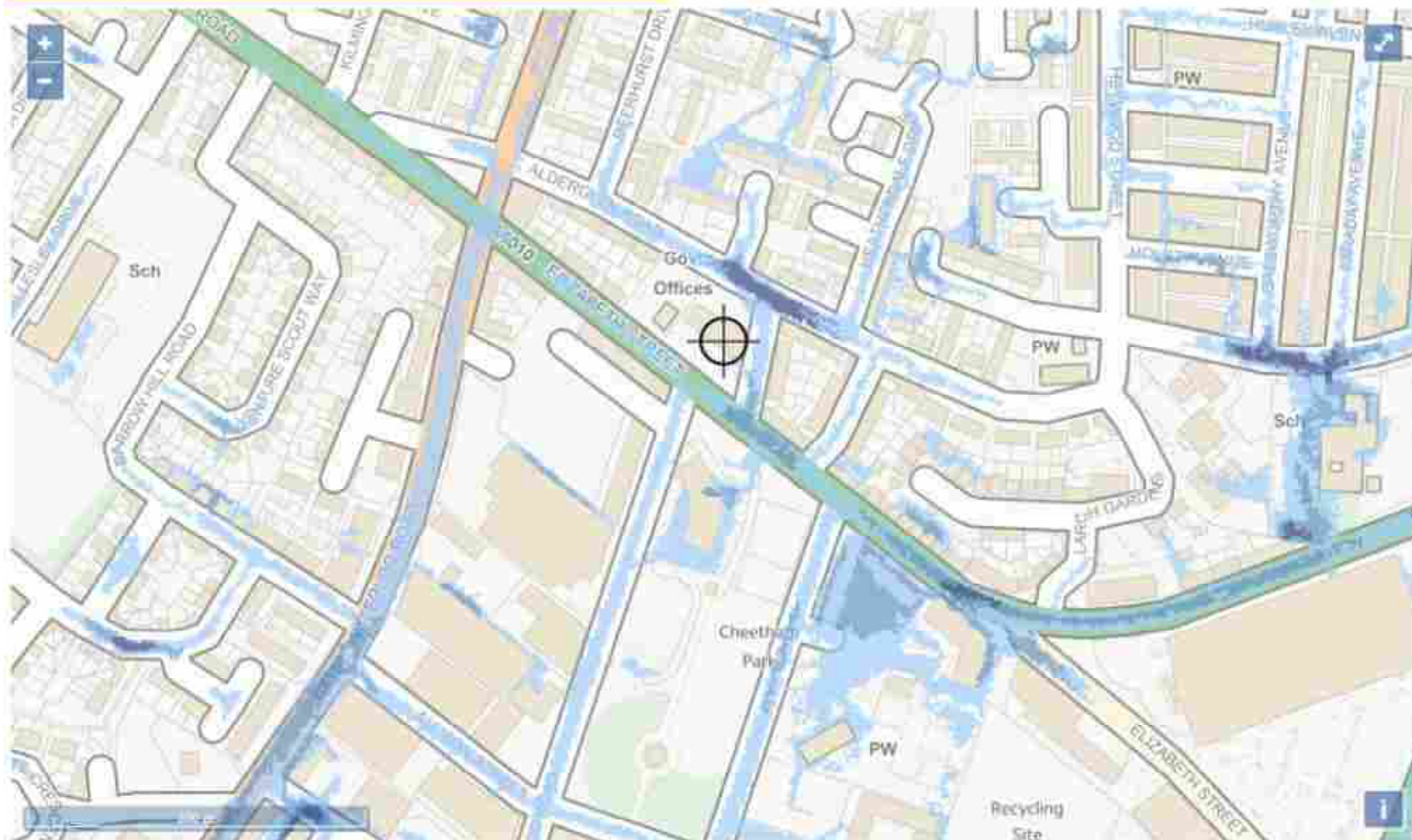
Created
3 Sep 2020 13:43

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

0 20 40 60m

Extent of flooding

Enter a place or postcode



Extent of flooding from surface water

High Medium Low Very low Location you selected

Appendix D

Consultee Correspondence

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Matthew Craig

From: Matthew Craig
Sent: 01 September 2020 17:20
To: Mura, Marie; Anna Mierzejewska
Cc: Wastewater Developer Services; Mark Jones
Subject: RE: FRA Enquiry - Herbert St, Manchester, M8 0DG - 4200032485

Hi Marie

I have been reviewing the information below, from July, and I have a query regarding the requested watercourse connection.

Old maps indicate that the watercourse historically corresponded with the location of Herbert Street at the east of the site.

Additionally, during a site walkover, no evidence was seen of the watercourse shown on the sewer plan at the west of the site.

Therefore, considering historical maps, it makes sense that the watercourse has always existed at the east of the site, and has since been reassigned as the 675mm diameter combined sewer.

Considering this information, it appears that the only possible course of action for the surface water drainage would be to connect to the combined sewer in Herbert Street to the east.

I wonder if you can confirm this to be the case?

Kind regards
Matthew

From: Mura, Marie <Marie.Mura@uuplc.co.uk>
Sent: 24 July 2020 11:30
To: Anna Mierzejewska <a.mierzejewska@thelkgroup.com>
Cc: Wastewater Developer Services <WastewaterDeveloperServices@uuplc.co.uk>
Subject: FW: FRA Enquiry - Herbert St, Manchester, M8 0DG - 4200032485
Importance: High

Good Morning Anna,

[For future reference we now have a new wastewater pre-development enquiry form designed to be easier and more user friendly which is available on our website via the following link:](#)

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

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:

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 225mm diameter public combined sewer within 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.

Waterbody

From the evidence provided we agree that infiltration is likely to be unfeasible, therefore we recommend that you contact the Lead Local Flood Authority and/or Environment Agency to discuss a point of discharge to the culverted watercourse located in the site boundary of the proposed site.

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

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 Wastewater Assets Crossing the Site

According to our public sewer records there are public sewers located within your site boundary. We will require unrestricted access to the sewer for maintenance purposes, we would ask that you maintain a minimum clearance of 6m which is measured 3m from the centre line of the pipe unless there happens to be a formal easement agreement in place, in which case the specified easement width would apply. If you cannot achieve this then you may wish to consider diverting and or abandoning the public sewer.

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

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

Existing Water Assets Crossing the Site

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

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

Connection Application

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

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

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

DG5 info

I can confirm that we have no current 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,



Marie Mura

Assistant Developer Engineer
Developer Services & Metering
Customer Services
T: 01925 537745
[unitedutilities.com](https://www.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

Coronavirus

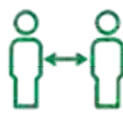
Prevent the spread



Wash your
hands



Disinfect
common surfaces



Practise social
distancing



FEVER +
COUGH

Stay home if you
have symptoms

[Click for our message to customers](#)

From: Anna Mierzejewska [<mailto:a.mierzejewska@thelkgroup.com>]

Sent: 14 July 2020 11:00

To: Wastewater Developer Services <WastewaterDeveloperServices@uuplc.co.uk>

Subject: FRA Enquiry - Herbert St, Manchester, M8 0DG

Importance: High

Dear Sir/Madam,

LK Consult Ltd. has been commissioned to undertake a Flood Risk Assessment (FRA) and Outline Drainage Strategy, for a site located at 1-1a Herbert St, Manchester, M8 0DG, centred at approximate National Grid Reference 383965E 400500N. The site is currently occupied by works building and associated car park and is proposed for residential.

The site has been previously developed since the earliest mapping having the existing buildings connected to the combined sewers. There seems to be a culverted watercourse crossing the site in the west in form of 600mm culvert pipe (see a sewer map attached). The site area is 0.25ha in total.

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

BGS data indicates that the site is within an area underlain by Till, Devensian superficial deposits and Chester Formation – Sandstone bedrock. The nearest borehole record shows deep made ground over firm to stiff clay to 6.2m bgl is present, so infiltration is likely to be unfeasible.

The site existing and proposed plan, the nearest borehole record and Pre-Development Enquiry Form are attached to this email.

To complete the FRA and Outline Drainage Strategy, 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 do not hesitate to get in touch.

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

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

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

Regards,
Anna



Anna Mierzejewska MSc
Environmental Scientist
LK Group | 0161 763 7200 | 07515 051 602
Manchester | London | Liverpool | Glasgow
www.thelkgroup.com

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

EMGateway3.uuplc.co.uk made the following annotations

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Anna Mierzejewska

From: Zorica Todorovic <z.todorovic@manchester.gov.uk>
Sent: 17 August 2020 15:27
To: Anna Mierzejewska
Subject: Fwd: Fw: FRA Enquiry - Herbert St, Manchester, M8 0DG
Attachments: Manchester City Council - SuDS Requirement for Developers 2019.pdf

----- Forwarded message -----

From: <floodriskmanagement@manchester.gov.uk>
Date: Mon, 17 Aug 2020 at 15:26
Subject: Fw: FRA Enquiry - Herbert St, Manchester, M8 0DG
To: <z.todorovic@manchester.gov.uk>

Flood Risk Management
Highways Service, Growth and Neighbourhoods Directorate
Manchester City Council
Tel: 0161 219 6295
Email: floodriskmanagement@manchester.gov.uk
Web: <http://www.manchester.gov.uk/>

POSTAL ADDRESS: Manchester City Council, Public Realm, The Neighbourhood
Service, PO Box 532, Town Hall, Manchester M60 2LA
----- Forwarded by Zorica Todorovic/Corporate.Services/MCC on 17/08/2020
15:25 -----

From: Flood Risk Management/MCC
To: Flood Risk Management/MCC@MCC,
Cc: Anna Mierzejewska <a.mierzejewska@thelkgroup.com>,
"floodriskmanagement@manchester.gov.uk"
<floodriskmanagement@manchester.gov.uk>
Date: 17/08/2020 13:48
Subject: Re: FRA Enquiry - Herbert St, Manchester, M8 0DG
Sent by: Zorica Todorovic

Flood Risk Management
Highways Service, Growth and Neighbourhoods Directorate
Manchester City Council
Tel: 0161 219 6295
Email: floodriskmanagement@manchester.gov.uk
Web: <http://www.manchester.gov.uk/>

POSTAL ADDRESS: Manchester City Council, Public Realm, The Neighbourhood
Service, PO Box 532, Town Hall, Manchester M60 2LA

From: Flood Risk Management/MCC
To: Anna Mierzejewska <a.mierzejewska@thelkgroup.com>,
Cc: "floodriskmanagement@manchester.gov.uk"
<floodriskmanagement@manchester.gov.uk>
Date: 24/07/2020 15:57
Subject: Re: FRA Enquiry - Herbert St, Manchester, M8 0DG
Sent by: Zorica Todorovic

Anna

With regards to this site we have the following information:

- There is an ordinary watercourse that runs west from the existing Depot across the Elizabeth Road and connection to that watercourse needs to be explored as part of the surface water strategy for this site.
- We do not have record of any flooding incident on this site or in immediate vicinity of the site.
- With regards to the SuDS requirements, I am attaching our guidance for developers. I trust you will find answers to your queries in this document.

If you need further clarifications please let us know.

Regards

Zorica

Flood Risk Management
Highways Service, Growth and Neighbourhoods Directorate(See attached file:
Manchester City Council - SuDS Requirement for Developers 2019.pdf)
Manchester City Council
Tel: 0161 219 6295
Email: floodriskmanagement@manchester.gov.uk
Web: <http://www.manchester.gov.uk/>

POSTAL ADDRESS: Manchester City Council, Public Realm, The Neighbourhood
Service, PO Box 532, Town Hall, Manchester M60 2LA

From: Anna Mierzejewska <a.mierzejewska@thelkgroup.com>
To: "floodriskmanagement@manchester.gov.uk"
<floodriskmanagement@manchester.gov.uk>,
Date: 14/07/2020 10:34
Subject: FRA Enquiry - Herbert St, Manchester, M8 0DG

Dear Zorica,

LK Consult Ltd. has been commissioned to undertake a Flood Risk Assessment (FRA) and Outline Drainage Strategy, for a site located at 1-1a Herbert St, Manchester, M8 0DG, centred at approximate National Grid Reference 383965E 400500N. The site is currently occupied by works building and associated

car park and is proposed for residential.

The site has been previously developed since the earliest mapping having the existing buildings connected to the combined sewers. There seems to be a culverted watercourse crossing the site in the west in form of 600mm culvert pipe (see a sewer map attached). The site area is 0.25ha in total.

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

BGS data indicates that the site is within an area underlain by Till, Devensian superficial deposits and Chester Formation – Sandstone bedrock. The nearest borehole record shows deep made ground over firm to stiff clay to 6.3m bgl is present, so infiltration is likely to be unfeasible.

The site location, the proposed development plan, the nearest borehole record and sewer plan are attached to this email.

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

- Details of any flood defences in the immediate area, including their extent, crest levels (and datum), assumed level of standard, construction and maintenance regime, as well as any other structures which may influence the local hydraulics.
- Records of any historic flood events and potential sources of flooding from rivers, land drainage, groundwater, foul and surface water sewers on site and in the area.
- Any restrictions applied to ordinary watercourses and sewers in the area.
- Any records of culverted watercourses in the area.
- Highway drainage restrictions and records.
- Policies that may relate to Sustainable Drainage Systems (SuDS).

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

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

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

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

Regards,
Anna

(Embedded image moved to file: pic20555.jpg)Grey LK Logo LineShrtTop

(Embedded image moved Anna Mierzejewska MSc

to file: Environmental Scientist
pic30835.jpg)New LK LK Group | 0161 763 7200 |07515 051 602
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INCREASING LAND VALUE

(Embedded image moved to file: pic17141.jpg)Grey LK Logo LineShrtTop

(Embedded image moved Anna Mierzejewska MSc
to file: Environmental Scientist
pic06643.jpg)New LK LK Group | 0161 763 7200 |07515 051 602
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INCREASING LAND VALUE

(Embedded image moved to file: pic23005.jpg)Grey LK Logo LineShrt

--
Zorica Todorovic
Flood Risk Management
Highways Service
Growth and Neighbourhoods Directorate

Office: 0161 219 6295

Email: z.todorovic@manchester.gov.uk
Web: <http://www.manchester.gov.uk>

POSTAL ADDRESS: Manchester City Council, The Highways Service, PO Box 532, Town Hall, Manchester, M60 2LA

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LKGroup

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

FAO:

How to contact us:

**United Utilities Water Limited
Property Searches
Haweswater House
Lingley Mere Business Park
Great Sankey
Warrington
WA5 3LP**

Telephone: 0370 7510101

E-mail: propertysearches@uuplc.co.uk

**Your Ref: Herbert St, FRA 20 1115
Our Ref: UUPS-ORD-169878
Date: 25/06/2020**

Dear Sirs

Location: D T M MOTORS 1-1A HERBERT STREET, MANCHESTER, M8 0DG

I acknowledge with thanks your request dated 23/06/2020 for information on the location of our services.

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

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

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

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

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

Yours Faithfully,



Karen McCormack
Property Searches Manager

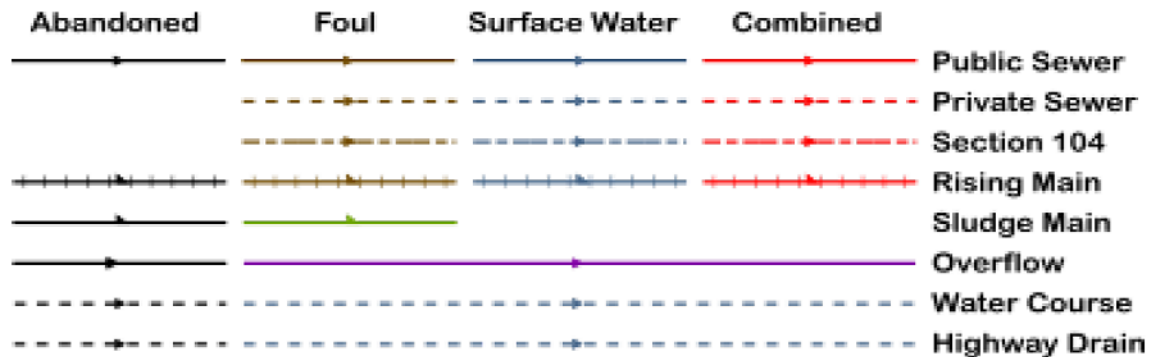
TERMS AND CONDITIONS - WASTEWATER AND WATER DISTRIBUTION PLANS

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

TERMS AND CONDITIONS:

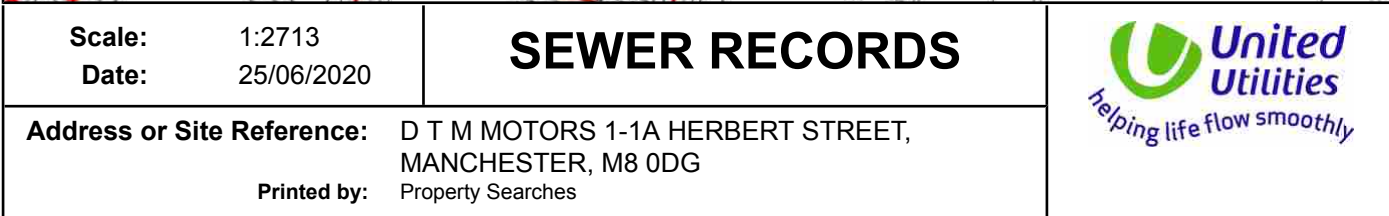
- This Map and any information supplied with it is issued subject to the provisions contained below, to the exclusion of all others and no party relies upon any representation, warranty, collateral contract or other assurance of any person (whether party to this agreement or not) that is not set out in this agreement or the documents referred to in it.
- This Map and any information supplied with it is provided for general guidance only and no representation, undertaking or warranty as to its accuracy, completeness or being up to date is given or implied.
- In particular, the position and depth of any UUWL apparatus shown on the Map are approximate only. UUWL strongly recommends that a comprehensive survey is undertaken in addition to reviewing this Map to determine and ensure the precise location of any UUWL apparatus. The exact location, positions and depths should be obtained by excavation trial holes.
- The location and position of private drains, private sewers and service pipes to properties are not normally shown on this Map but their presence must be anticipated and accounted for and you are strongly advised to carry out your own further enquiries and investigations in order to locate the same.
- The position and depth of UUWL apparatus is subject to change and therefore this Map is issued subject to any removal or change in location of the same. The onus is entirely upon you to confirm whether any changes to the Map have been made subsequent to issue and prior to any works being carried out.
- This Map and any information shown on it or provided with it must not be relied upon in the event of any development, construction or other works (including but not limited to any excavations) in the vicinity of UUWL apparatus or for the purpose of determining the suitability of a point of connection to the sewerage or other distribution systems.
- No person or legal entity, including any company shall be relieved from any liability howsoever and whensoever arising for any damage caused to UUWL apparatus by reason of the actual position and/or depths of UUWL apparatus being different from those shown on the Map and any information supplied with it.
- If any provision contained herein is or becomes legally invalid or unenforceable, it will be taken to be severed from the remaining provisions which shall be unaffected and continue in full force and affect.
- This agreement shall be governed by English law and all parties submit to the exclusive jurisdiction of the English courts, save that nothing will prevent UUWL from bringing proceedings in any other competent jurisdiction, whether concurrently or otherwise.

Wastewater Symbolology



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

Manhole	Side Entry Manhole
Head of System	Outfall
Extent of Survey	Screen Chamber
Rodding Eye	Inspection Chamber
Inlet	Bifurcation Chamber
Discharge Point	Lamp Hole
Vortex	T Junction / Saddle
Penstock	Catchpit
Washout Chamber	Valve Chamber
Valve	Vent Column
Air Valve	Vortex Chamber
Non Return Valve	Penstock Chamber
Soakaway	Network Storage Tank
Gully	Sewer Overflow
Cascade	Ww Treatment Works
Flow Meter	Ww Pumping Station
Hatch Box	Septic Tank
Oil Interceptor	Control Kiosk
Summit	
Drop Shaft	Change of Characteristic
Orifice Plate	



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Appendix E

Calculations

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The LK Group

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Radcliffe M26 2ZS
Tel: 0161 763 7200
email: m.jones@thelkgroup.com

Job No.		
Sheet no. 1		
Date 01/09/20		
By	Checked	Reviewed

Project **Herbert Street**

Title **Peak runoff - 1 in 1 year**

Area data:-

FSR data

M5-60 = 17.8

Soil index = 0.45

WRAP value = 4

r = 0.36

SAAR = 900

Nat grid = SJ8397

Site data:-

Ret. period (yrs) = 1

Time of entry = 10.00

Impervious area drained = 1900 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 = 700 m²

Soil type = Clay

Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 58.0%

Rainfall rate = 39.9 mm/Hr

UCWI = 93.9

Runoff rate (gross) = 16.7 l/s

Methods

Runoff factor (RF) = 58.0, calculated from:-

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

where

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

UCWI = Calculated value for Wetness Index

Calculations produced by MasterDrain Surface Water design program



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Job No.		
Sheet no. 1		
Date 01/09/20		
By	Checked	Reviewed

Project **Herbert Street**

Title **Peak runoff - 1 in 30 year**

Area data:-

FSR data

M5-60 = 17.8

Soil index = 0.45

WRAP value = 4

r = 0.36

SAAR = 900

Nat grid = SJ8397

Site data:-

Ret. period (yrs) = 30

Time of entry = 6.00

Impervious area drained = 1900 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 = 700 m²

Soil type = Clay

Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 58.0%

Rainfall rate = 100.5 mm/Hr

UCWI = 93.9

Runoff rate (gross) = 42.1 l/s

Methods

Runoff factor (RF) = 58.0, calculated from:-

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

where

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

UCWI = Calculated value for Wetness Index

Calculations produced by MasterDrain Surface Water design program



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Job No.		
Sheet no. 1		
Date 01/09/20		
By	Checked	Reviewed

Project **Herbert Street**

Title **Peak runoff - 1 in 100 year**

Area data:-

FSR data

M5-60 = 17.8

Soil index = 0.45

WRAP value = 4

r = 0.36

SAAR = 900

Nat grid = SJ8397

Site data:-

Ret. period (yrs) = 100

Time of entry = 6.00

Impervious area drained = 1900 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 = 700 m²

Soil type = Clay

Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 58.0%

Rainfall rate = 127.1 mm/Hr

UCWI = 93.9

Runoff rate (gross) = 53.2 l/s

Methods

Runoff factor (RF) = 58.0, calculated from:-

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

where

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

UCWI = Calculated value for Wetness Index

Calculations produced by MasterDrain Surface Water design program



MasterDrain
HY 10.07

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Job No.		
Sheet no. 1		
Date 03/09/20		
By	Checked	Reviewed

Project **Herbert Street**

Title **Greenfield Runoff - loH**

Hydrological Data:-

FSR Hydrology:-

Location = MANCHESTER (CENTRAL)	Grid reference = SJ8397
M5-60 (mm) = 17.8	r = 0.36
Soil runoff = 0.45	SAAR (mm/yr) = 900
WRAP = 4	Area = England & Wales
Hydrological area = 10	Hydrological zone = 5

Soil classification for WRAP type 4

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

Design data:-

Area = 0.0026 Km² - 0.26 Ha - 2600 m²

Calculation method:-

Runoff is calculated from:-

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

where

AREA = Site area in Km²

SAAR = Standard Average Annual Rainfall (mm/yr)

SOIL = Soil value derived from Winter Rainfall Acceptance Potential

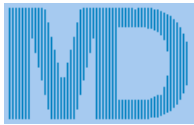
$Q_{\text{BAR(rural)}}$ = Runoff (cumecs)

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

Calculated data:-

For areas less than 50Ha, a modified calculation which multiplies the 50Ha runoff value by the ratio of the site area to 50Ha is used
Reducing factor used for these calculations is 0.005

Mean Annual Peak Flow $Q_{\text{BAR(rural)}} = 1.53 \text{ l/s}$



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Job No.		
Sheet no. 2		
Date 03/09/20		
By	Checked	Reviewed

Project	Herbert Street
Title	Greenfield Runoff - loH

Values for $Q_{BAR(rural)}$

Ret. per. 1yr	m ³ /hr 4.690	l/s 1.303	l/s/ha 5.011	Ret. per. 100yr	m ³ /hr 11.587	l/s 3.219	l/s/ha 12.379
2yr	5.131	1.425	5.482	100yr+20%	13.904	3.862	14.855
5yr	6.676	1.855	7.133	100yr+30%	15.063	4.184	16.093
10yr	7.614	2.115	8.135	200yr	13.242	3.678	14.148
30yr	9.270	2.575	9.903	200yr + 30%	17.215	4.782	18.392
50yr	10.207	2.835	10.905	500yr	15.063	4.184	16.093
				1000yr	16.773	4.659	17.920

Growth factors -

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

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



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email: m.jones@thelkgroup.com

Job No.

Sheet no. **1**

Date **03/09/20**

Project **Herbert Street**

Title **Peak Flow Storage - 5l/s - 1 in 30 year**

By

Checked

Reviewed

Data:-

FSR Hydrology:-

Location = MANCHESTER (CENTRAL)

M5-60 (mm) = 17.8

Soil index = 0.45

Return period = 30

UCWI = 96.2

Grid reference = SJ8397

r = 0.36

SAAR (mm/yr) = 900

WRAP = 4

Climate change = 0

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

Runoff factor (RF) = 55.0, calculated from:-

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

where

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

UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 1800 m²

Total area (TA) = 2600 m²

Allowed discharge rate = 5.000 l/s

Additional flow = 0.00 l/s

Pervious area = 800 m²

Equiv area = 1430 m² (TA x RF).

Areal reduction factor = 1.000

Climate change factor = 0

Calculated data:-

Time to max = 40.0 mins

Rainfall at max = 35.78 mm/hr

Pipeline storage = 0.0 m³

Offline storage = 0.0 m³

Calculated storage volume = 22.1 m³

Allowed discharge rate = 5.000 l/s

Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours

Rainfall rate = 7.00 mm/hr

Calculated storage volume = 0.0 m³

Allowed discharge rate = 5.000 l/s

Rainfall intensities calculated using the Wallingford Procedure

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

Diam	Len	Diam	Len	Ovoid	Len	Box culvert	Len
100	2815.1	1125	22.2	400 x 600	122.8	500 x 500	88.4
150	1251.2	1200	19.5	600 x 900	53.5	500 x 750	58.9
225	556.1	1275	17.3	800 x 1200	30.1	500 x 1000	44.2
300	312.8	1350	15.4			750 x 1000	29.5
375	200.2	1425	13.9			750 x 1200	24.6
450	139.0	1500	12.5			750 x 1500	19.6
525	102.1	1575	11.3			1000 x 1000	22.1
600	78.2	1650	10.3			1000 x 1200	18.4
675	61.8	1725	9.5			1000 x 1500	14.7
750	50.0	1800	8.7			1000 x 1800	12.3
825	41.4	1875	8.0			1000 x 2000	11.1
900	34.8	1950	7.4			1500 x 1500	9.8
975	29.6	2025	6.9			1500 x 1800	8.2
1050	25.5	2100	6.4			1500 x 2000	7.4



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Data:-

The LK Group

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Job No.

Sheet no.

2

Date

03/09/20

Project

Herbert Street

By

Checked

Reviewed

Title

Peak Flow Storage - 5l/s - 1 in 30 year

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	80.0	19.067	3.000	16.067
20	55.0	26.230	6.000	20.230
30	43.0	30.743	9.000	21.743
40	36.0	34.106	12.000	22.106
50	31.0	36.812	15.000	21.812
60	27.0	39.090	18.000	21.090
70	25.0	41.064	21.000	20.064
80	22.0	42.812	24.000	18.812
90	21.0	44.382	27.000	17.382
100	19.0	45.810	30.000	15.810
110	18.0	47.120	33.000	14.120
120	17.0	48.332	36.000	12.332
130	16.0	49.460	39.000	10.460
140	15.0	50.515	42.000	8.515
150	14.0	51.507	45.000	6.507
160	14.0	52.443	48.000	4.443
170	13.0	53.329	51.000	2.329
180	13.0	54.170	54.000	0.170
190	12.0	54.970	57.000	0.000
200	12.0	55.735	60.000	0.000
210	11.0	56.465	63.000	0.000
220	11.0	57.166	66.000	0.000
230	11.0	57.838	69.000	0.000
240	10.0	58.484	72.000	0.000
250	10.0	59.106	75.000	0.000
260	10.0	59.705	78.000	0.000
270	9.0	60.284	81.000	0.000
280	9.0	60.843	84.000	0.000
290	9.0	61.384	87.000	0.000
300	9.0	61.908	90.000	0.000
310	8.0	62.415	93.000	0.000
320	8.0	62.907	96.000	0.000
330	8.0	63.385	99.000	0.000
340	8.0	63.849	102.000	0.000
350	8.0	64.301	105.000	0.000
360	8.0	64.740	108.000	0.000
370	7.0	65.195	111.000	0.000
380	7.0	65.634	114.000	0.000
390	7.0	66.065	117.000	0.000
400	7.0	66.487	120.000	0.000
410	7.0	66.901	123.000	0.000
420	7.0	67.307	126.000	0.000
430	7.0	67.705	129.000	0.000
440	6.0	68.096	132.000	0.000
450	6.0	68.480	135.000	0.000
460	6.0	68.857	138.000	0.000
470	6.0	69.228	141.000	0.000
480	6.0	69.592	144.000	0.000
490	6.0	69.950	147.000	0.000
500	6.0	70.303	150.000	0.000
510	6.0	70.650	153.000	0.000
520	6.0	70.992	156.000	0.000
530	6.0	71.329	159.000	0.000
540	6.0	71.660	162.000	0.000
550	5.0	71.987	165.000	0.000
560	5.0	72.309	168.000	0.000
570	5.0	72.626	171.000	0.000
580	5.0	72.940	174.000	0.000
590	5.0	73.248	177.000	0.000
600	5.0	73.553	180.000	0.000

Storage volume (m³) = 22.1 m³



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Sheet no. **3**

Date **03/09/20**

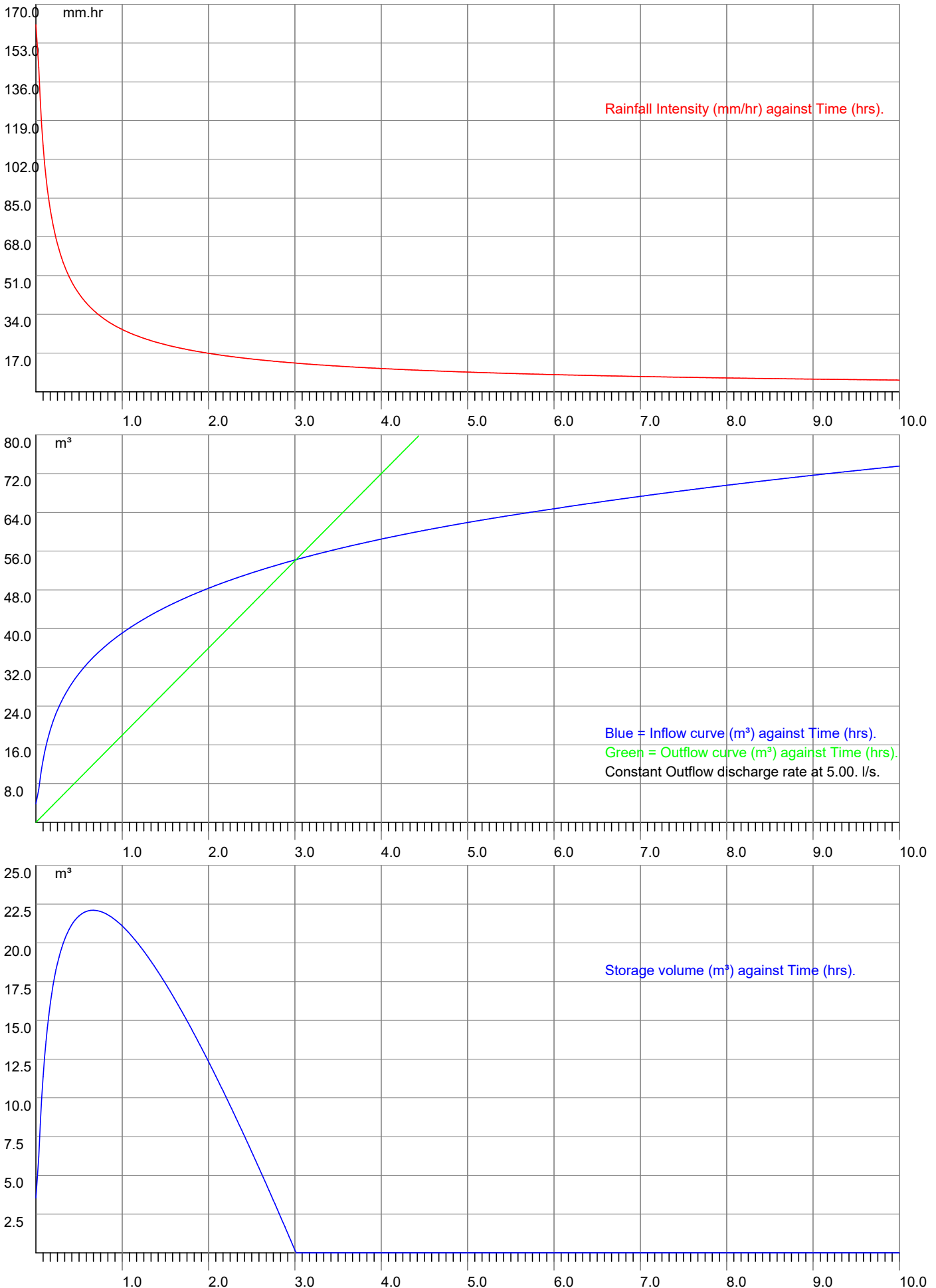
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Project **Herbert Street**

Title **Peak Flow Storage - 5l/s - 1 in 30 year**





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Job No.		
Sheet no. 1		
Date 03/09/20		
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Project	Herbert Street
Title	Peak Flow Storage - 5l/s - 1 in 100 year + 20% Climate Change

Data:-

FSR Hydrology:-

Location = MANCHESTER (CENTRAL)

M5-60 (mm) = 17.8

Soil index = 0.45

Return period = 100

UCWI = 96.2

Grid reference = SJ8397

r = 0.36

SAAR (mm/yr) = 900

WRAP = 4

Climate change = 20

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

Runoff factor (RF) = 55.0, calculated from:-

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

where

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

UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 1800 m²

Total area (TA) = 2600 m²

Allowed discharge rate = 5.000 l/s

Additional flow = 0.00 l/s

Pervious area = 800 m²

Equiv area = 1430 m² (TA x RF).

Areal reduction factor = 1.000

Climate change factor = 20

Calculated data:-

Time to max = 69.0 mins

Rainfall at max = 39.17 mm/hr

Pipeline storage = 0.0 m³

Offline storage = 0.0 m³

Calculated storage volume = 43.7 m³

Allowed discharge rate = 5.000 l/s

Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours

Rainfall rate = 12.00 mm/hr

Calculated storage volume = 0.0 m³

Allowed discharge rate = 5.000 l/s

Rainfall intensities calculated using the Wallingford Procedure

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

Diam	Len	Diam	Len	Ovoid	Len	Box culvert	Len
100	5568.1	1125	44.0	400 x 600	242.9	500 x 500	174.9
150	2474.7	1200	38.7	600 x 900	105.8	500 x 750	116.6
225	1099.9	1275	34.3	800 x 1200	59.5	500 x 1000	87.4
300	618.7	1350	30.6			750 x 1000	58.3
375	396.0	1425	27.4			750 x 1200	48.6
450	275.0	1500	24.7			750 x 1500	38.9
525	202.0	1575	22.4			1000 x 1000	43.7
600	154.7	1650	20.5			1000 x 1200	36.4
675	122.2	1725	18.7			1000 x 1500	29.1
750	99.0	1800	17.2			1000 x 1800	24.3
825	81.8	1875	15.8			1000 x 2000	21.9
900	68.7	1950	14.6			1500 x 1500	19.4
975	58.6	2025	13.6			1500 x 1800	16.2
1050	50.5	2100	12.6			1500 x 2000	14.6



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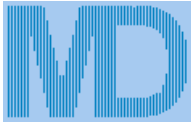
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Project	Herbert Street
Title	Peak Flow Storage - 5l/s - 1 in 100 year + 20% Climate Change

Data:-

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	123.0	29.269	3.000	26.269
20	86.0	40.799	6.000	34.799
30	67.0	48.080	9.000	39.080
40	56.0	53.513	12.000	41.513
50	49.0	57.881	15.000	42.881
60	43.0	61.550	18.000	43.550
70	39.0	64.722	21.000	43.722
80	35.0	67.521	24.000	43.521
90	33.0	70.028	27.000	43.028
100	30.0	72.299	30.000	42.299
110	28.0	74.376	33.000	41.376
120	27.0	76.290	36.000	40.290
130	25.0	78.064	39.000	39.064
140	24.0	79.718	42.000	37.718
150	23.0	81.266	45.000	36.266
160	22.0	82.720	48.000	34.720
170	21.0	84.091	51.000	33.091
180	20.0	85.388	54.000	31.388
190	19.0	86.617	57.000	29.617
200	18.0	87.785	60.000	27.785
210	18.0	88.898	63.000	25.898
220	17.0	89.959	66.000	23.959
230	17.0	90.973	69.000	21.973
240	16.0	91.944	72.000	19.944
250	16.0	92.875	75.000	17.875
260	15.0	93.768	78.000	15.768
270	15.0	94.626	81.000	13.626
280	14.0	95.452	84.000	11.452
290	14.0	96.247	87.000	9.247
300	14.0	97.014	90.000	7.014
310	13.0	97.753	93.000	4.753
320	13.0	98.467	96.000	2.467
330	13.0	99.157	99.000	0.157
340	12.0	99.825	102.000	0.000
350	12.0	100.470	105.000	0.000
360	12.0	101.096	108.000	0.000
370	12.0	101.771	111.000	0.000
380	11.0	102.419	114.000	0.000
390	11.0	103.053	117.000	0.000
400	11.0	103.673	120.000	0.000
410	11.0	104.281	123.000	0.000
420	10.0	104.876	126.000	0.000
430	10.0	105.460	129.000	0.000
440	10.0	106.033	132.000	0.000
450	10.0	106.596	135.000	0.000
460	10.0	107.148	138.000	0.000
470	10.0	107.690	141.000	0.000
480	9.0	108.222	144.000	0.000
490	9.0	108.746	147.000	0.000
500	9.0	109.261	150.000	0.000
510	9.0	109.767	153.000	0.000
520	9.0	110.265	156.000	0.000
530	9.0	110.756	159.000	0.000
540	9.0	111.239	162.000	0.000
550	9.0	111.714	165.000	0.000
560	8.0	112.182	168.000	0.000
570	8.0	112.644	171.000	0.000
580	8.0	113.099	174.000	0.000
590	8.0	113.547	177.000	0.000
600	8.0	113.989	180.000	0.000

Storage volume (m³) = 43.7 m³



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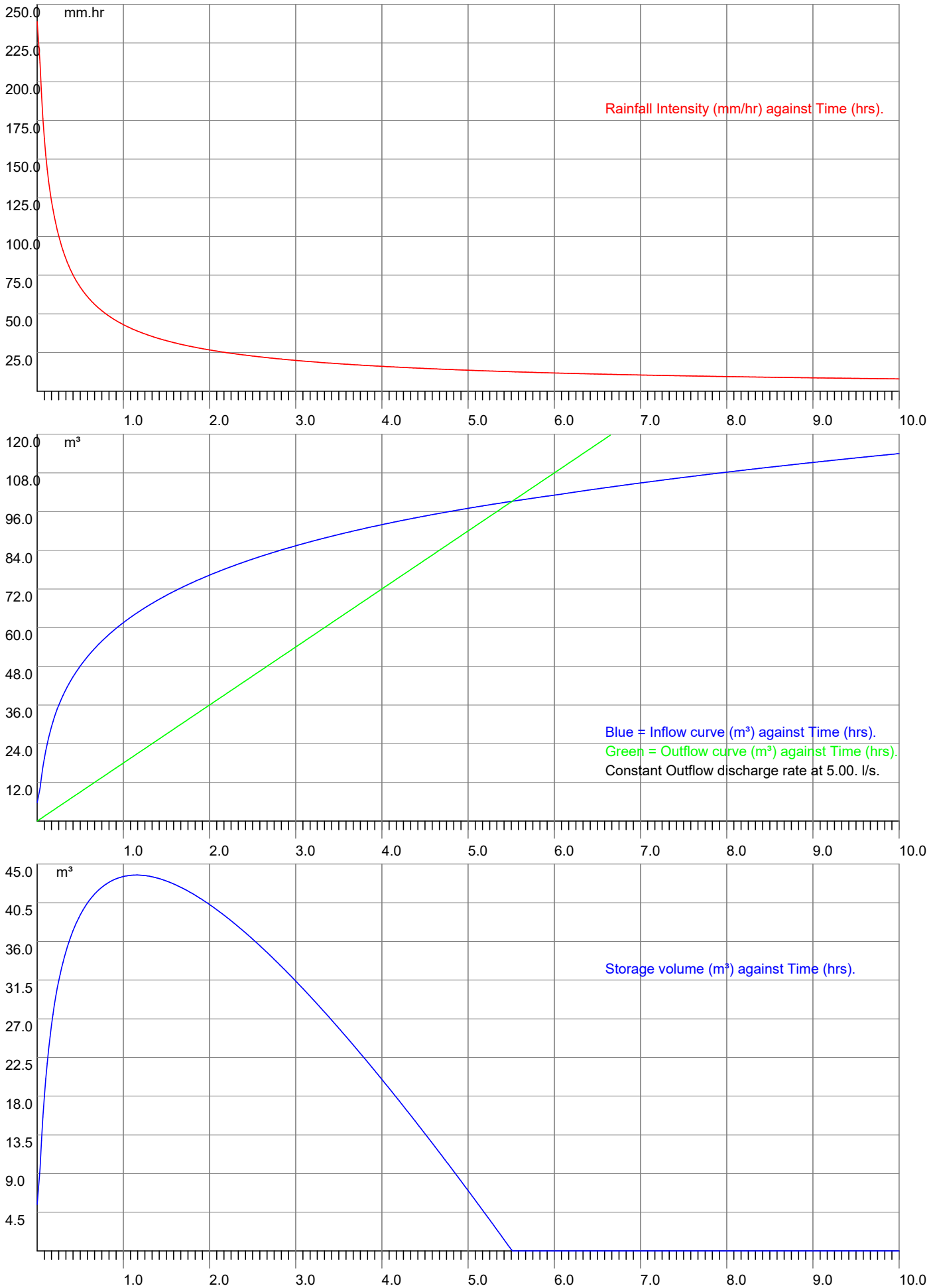
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Project

Herbert Street

Title

Peak Flow Storage - 5l/s - 1 in 100 year + 20% Climate Change





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Project	Herbert Street
Title	Peak Flow Storage - 5l/s - 1 in 100 year + 40% Climate Change

Data:-

FSR Hydrology:-

Location = MANCHESTER (CENTRAL)

M5-60 (mm) = 17.8

Soil index = 0.45

Return period = 100

UCWI = 96.2

Grid reference = SJ8397

r = 0.36

SAAR (mm/yr) = 900

WRAP = 4

Climate change = 40

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

Runoff factor (RF) = 55.0, calculated from:-

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

where

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

UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 1800 m²

Total area (TA) = 2600 m²

Allowed discharge rate = 5.000 l/s

Additional flow = 0.00 l/s

Pervious area = 800 m²

Equiv area = 1430 m² (TA x RF).

Areal reduction factor = 1.000

Climate change factor = 40

Calculated data:-

Time to max = 82.0 mins

Rainfall at max = 40.62 mm/hr

Pipeline storage = 0.0 m³

Offline storage = 0.0 m³

Calculated storage volume = 54.8 m³

Allowed discharge rate = 5.000 l/s

Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours

Rainfall rate = 13.00 mm/hr

Calculated storage volume = 7.7 m³

Allowed discharge rate = 5.000 l/s

Rainfall intensities calculated using the Wallingford Procedure

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

Diam	Len	Diam	Len	Ovoid	Len	Box culvert	Len
100	6976.6	1125	55.1	400 x 600	304.4	500 x 500	219.1
150	3100.7	1200	48.4	600 x 900	132.5	500 x 750	146.1
225	1378.1	1275	42.9	800 x 1200	74.5	500 x 1000	109.6
300	775.2	1350	38.3			750 x 1000	73.0
375	496.1	1425	34.4			750 x 1200	60.9
450	344.5	1500	31.0			750 x 1500	48.7
525	253.1	1575	28.1			1000 x 1000	54.8
600	193.8	1650	25.6			1000 x 1200	45.7
675	153.1	1725	23.4			1000 x 1500	36.5
750	124.0	1800	21.5			1000 x 1800	30.4
825	102.5	1875	19.8			1000 x 2000	27.4
900	86.1	1950	18.3			1500 x 1500	24.3
975	73.4	2025	17.0			1500 x 1800	20.3
1050	63.3	2100	15.8			1500 x 2000	18.3



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Data:-

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Project

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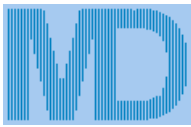
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Title

Peak Flow Storage - 5l/s - 1 in 100 year + 40% Climate Change

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	143.0	34.147	3.000	31.147
20	100.0	47.599	6.000	41.599
30	78.0	56.094	9.000	47.094
40	65.0	62.432	12.000	50.432
50	57.0	67.528	15.000	52.528
60	50.0	71.808	18.000	53.808
70	45.0	75.509	21.000	54.509
80	41.0	78.774	24.000	54.774
90	38.0	81.699	27.000	54.699
100	35.0	84.349	30.000	54.349
110	33.0	86.772	33.000	53.772
120	31.0	89.005	36.000	53.005
130	29.0	91.075	39.000	52.075
140	28.0	93.004	42.000	51.004
150	27.0	94.810	45.000	49.810
160	25.0	96.507	48.000	48.507
170	24.0	98.106	51.000	47.106
180	23.0	99.619	54.000	45.619
190	22.0	101.053	57.000	44.053
200	21.0	102.416	60.000	42.416
210	21.0	103.714	63.000	40.714
220	20.0	104.952	66.000	38.952
230	19.0	106.136	69.000	37.136
240	19.0	107.268	72.000	35.268
250	18.0	108.354	75.000	33.354
260	18.0	109.396	78.000	31.396
270	17.0	110.397	81.000	29.397
280	17.0	111.361	84.000	27.361
290	16.0	112.288	87.000	25.288
300	16.0	113.183	90.000	23.183
310	15.0	114.045	93.000	21.045
320	15.0	114.878	96.000	18.878
330	15.0	115.683	99.000	16.683
340	14.0	116.462	102.000	14.462
350	14.0	117.215	105.000	12.215
360	14.0	117.945	108.000	9.945
370	13.0	118.733	111.000	7.733
380	13.0	119.489	114.000	5.489
390	13.0	120.228	117.000	3.228
400	13.0	120.952	120.000	0.952
410	12.0	121.661	123.000	0.000
420	12.0	122.356	126.000	0.000
430	12.0	123.037	129.000	0.000
440	12.0	123.706	132.000	0.000
450	12.0	124.361	135.000	0.000
460	11.0	125.005	138.000	0.000
470	11.0	125.638	141.000	0.000
480	11.0	126.259	144.000	0.000
490	11.0	126.870	147.000	0.000
500	11.0	127.471	150.000	0.000
510	11.0	128.062	153.000	0.000
520	10.0	128.643	156.000	0.000
530	10.0	129.215	159.000	0.000
540	10.0	129.778	162.000	0.000
550	10.0	130.333	165.000	0.000
560	10.0	130.880	168.000	0.000
570	10.0	131.418	171.000	0.000
580	10.0	131.949	174.000	0.000
590	9.0	132.472	177.000	0.000
600	9.0	132.988	180.000	0.000

Storage volume (m³) = 54.8 m³



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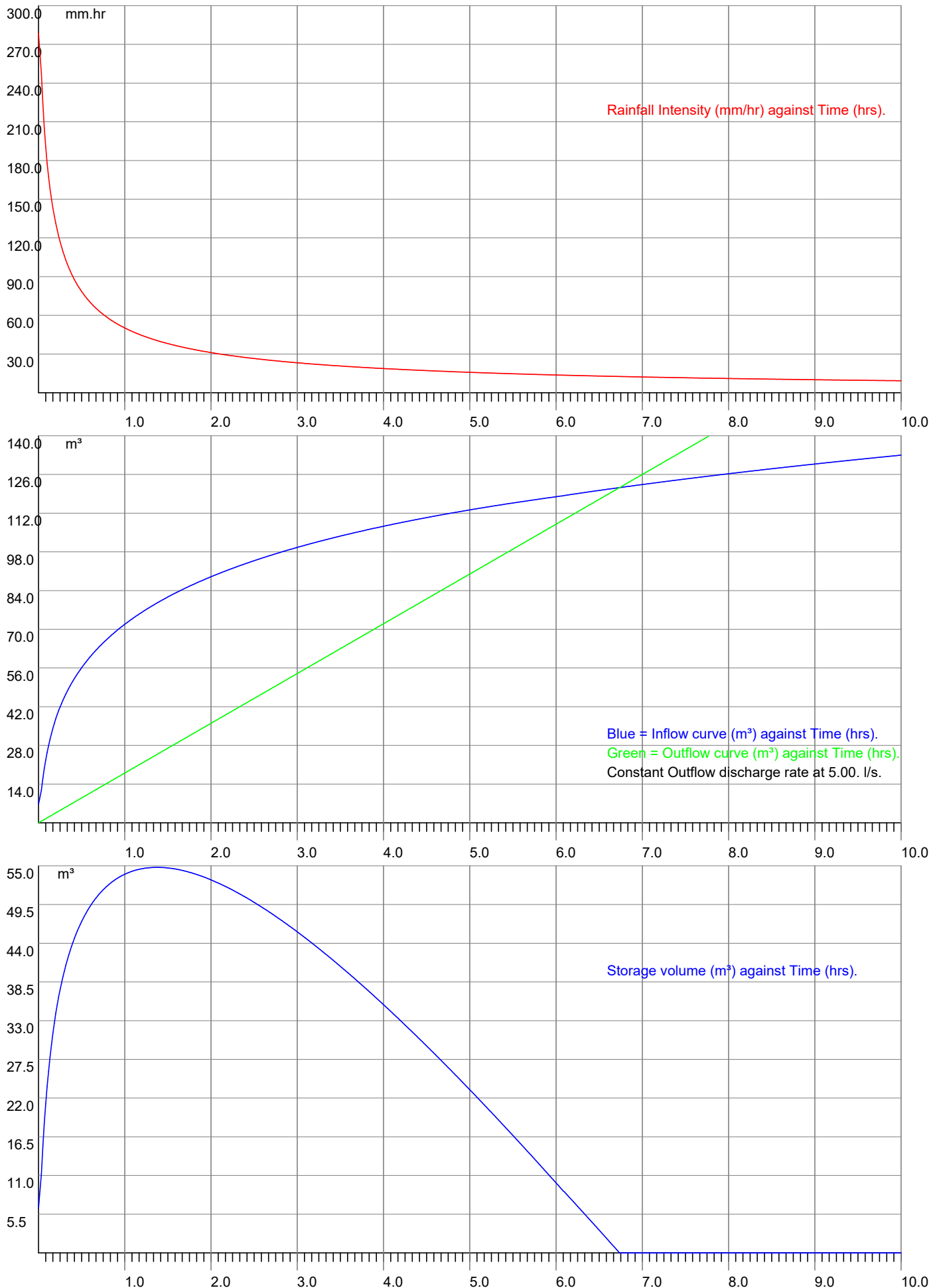
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Project

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Title

Peak Flow Storage - 5l/s - 1 in 100 year + 40% Climate Change





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Title	Peak Flow Storage - 5l/s - 1 in 100 year + 40% Climate Change

Explanatory notes for Peak Flow Storage

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

Explanatory notes for Hydrograph Storage

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

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

Why do the two methods give different results?

The rainfall characteristics for each method are very different.

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

The hydrograph method uses a standard curve for either Winter or Summer storms. Traditionally these are symmetrical about the central peak. UK rainfall does not fit into this convenient curve, so the calculations are dealing with a stylised set of data. The mean intensity for the storm is calculated from the IDF curve and applied to the curve data, calculating the storage for that step less the outflow volume. The final storage volume is the sum of the storage for all the steps.

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

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