

BLACKLEY FIRE STATION, MANCHESTER

FLOOD RISK ASSESSMENT & OUTLINE DRAINAGE STRATEGY

Job Number: FRA 22 1157

Date: January 2023

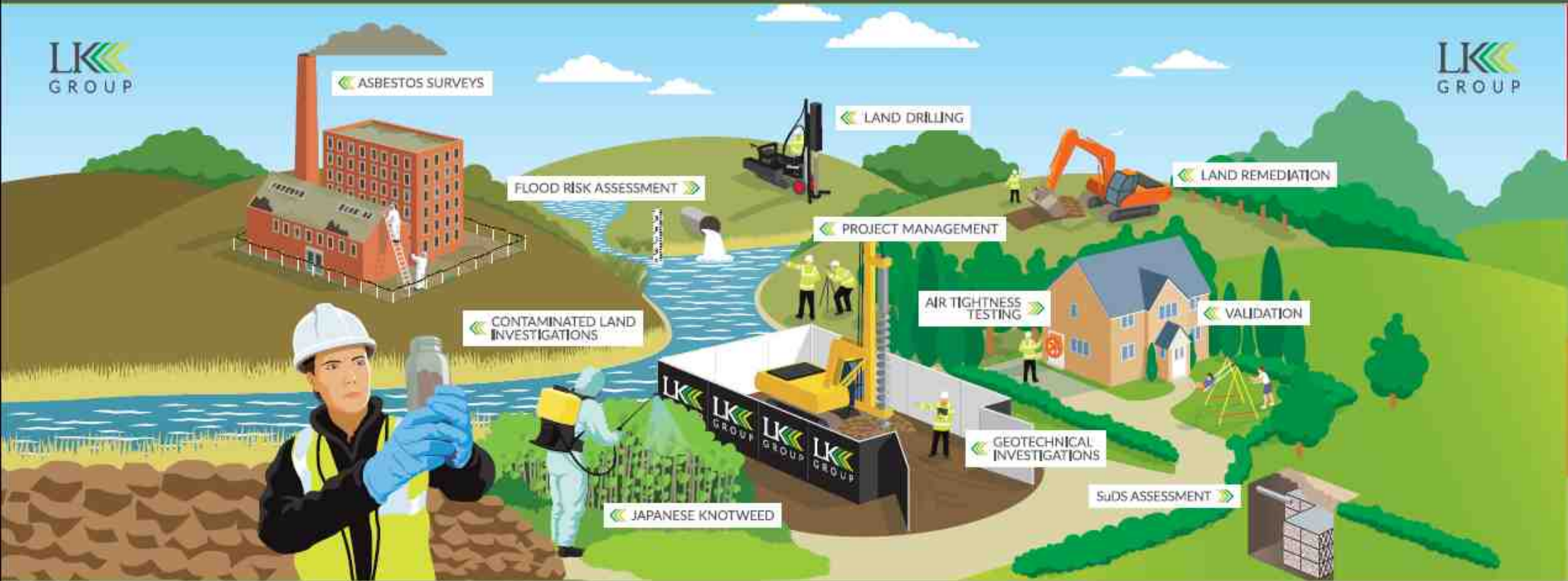
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Prepared By	Jenna Lowe – Flood Risk Engineer	Reviewed By	Mark Jones - Associate

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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 redevelopment of the Blackley Fire Station, Blackley. The development comprises a replacement Fire Station building with associated car parking, training yard and new training tower.

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

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

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

Consultations

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

Manchester City Council (LLFA) and United Utilities (UU) were also consulted concerning flood risk.

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

Flood Risk

Environment Agency flood maps indicate that the site is potentially vulnerable to fluvial flooding from the River Irk, southwest 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).

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 to allow the site to be free-draining in case of local ponding at times of heavy rainfall. Floor levels of the Fire Station buildings 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 a 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 in Rochdale Road to the west of the site via the existing connections.

The proposed development will not change the proportion of the site covered by impermeable surfaces and will therefore generate similar runoff. However, attenuation will be required to allow for climate change and other restrictions to limit the flow off site to the existing sewer system as the entire site consists of impermeable surface.

Foul sewage arising from the development will be discharged into the public combined sewer in Rochdale Road.

The outline drainage strategy considers the use of attenuation-based SuDS to be feasible with a discharge to the combined sewer on the western boundary of the site. Therefore, the most effective strategy, in line with the SuDS management train, would be to have a detention facility at the western boundary towards the southwest corner. The required detention facility or similar has been estimated to be **20.4m³** for the 1 in 30-year flow restriction.

Similarly, the estimated volume to be retained on site for the 1 in 100-year storm event including an allowance for climate change is between **41.0m³** and **51.7m³**.

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 surface 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 Rochdale Road.

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1 Introduction

1.1 Background

LK Consult Ltd (LKC) were commissioned by IKG Consulting to carry out a Flood Risk Assessment (FRA) and Outline Drainage Strategy for the extension of Blackley Fire Station, Manchester. The report was undertaken in support of a future planning application to redevelop the site for the extension of an existing Fire Station.

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.

¹ DCLG (2021). "National Planning Policy Framework." Department of Communities and Local Government. July 2021.

² DCLG (2014). "Planning Practice Guidance" <http://planningguidance.communities.gov.uk>, April 2014.

1.2 Site Details

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

Site Details	
Location	Blackley Fire Station, Rochdale Road, Manchester, M9 7EQ. Centred at approximate National Grid Reference 386050E, 403400N.
Area	Approximately 0.24 Ha.
Topography	81.35 metres above ordnance datum (AOD) in the northwest and 76.36m AOD in the southwest. The southern boundary is between 2-3m lower than the remainder of site. Towards the southeast the site is 79.91m AOD. The site is sloping down towards the southwest. There are localised depressions to the north and south facing lower ground walls. There are indications of a historical shallow valley running from north to south to the east of the fire station
Current Land Use	<u>Site</u> Fire Station with hardstanding and car parking area to the rear, currently includes a lower ground floor area. Establish trees and vegetation present to the north. <u>Surrounding Area/ Boundary Treatment</u> North: Residential Properties. East: Grassed area with vegetation and established trees. South: Vacant grassed area with hardstanding to the centre currently used for car parking. West: Rochdale Road and residential properties beyond.
Proposed Development	Erection of a new fire station building with training yard, training tower and car parking. Access will be from Rochdale Road.

Table 1-1: Summary of site details.

2 Site Setting

2.1 Vulnerability

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

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

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

The Flood Zone Mapping indicates the site as being within Flood Zone 1 in the PPG (paragraph 065, Table 1) 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 Fire Station, and this is classified within the 'Highly Vulnerable' category in the PPG (paragraph 066, Table 2).

2.2 The Sequential and Exception Tests

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

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

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

2.3 Environmental Setting

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

Summary of the Environmental Setting			
Geology	Superficial		Till, Devensian (Diamicton).
	Bedrock		Chester Formation (Sandstone).
	BGS Boreholes		BH Ref: SD80SE1003, 280m NE: Cinders, Sand, and brick fill to 0.27m, firm brown and grey mottled Clay to 0.60m, firm dark brown sandy Clay to 2.43m and firm brown boulder Clay to 7.31m.
	Defra Soilscape Mapping		Type 17 – Slowly permeable seasonally wet acid loamy and clayey soils.
Hydro-geology	Aquifer Designation	Superficial	Secondary Undifferentiated Aquifer.
		Bedrock	Principal Aquifer.
	Source Protection Zone (SPZ)		Site not within an SPZ.
Hydrology	All adjacent and internal surface water		The Lionfield Brook culverted ordinary watercourse is indicated to cross the centre of the site and connects to a ordinary watercourse conduit to the south from information provided by Manchester City Council. This serves open channels downstream of the site. Boggart Hole Brook is located approximately 400m southeast of site. Partially culverted tributaries of the brook are located 250m south of the site and 480m east of the site. The River Irk (Wince to Irwell) is located approximately 1.04km southwest of site.
	Flooding		Flood Zone 1.

Table 2-1: Summary of the Environmental Setting.

Summary of the Environmental Setting	
Site History	Maps prior to 1944 show a watercourse emerging to the south of White Moss Road flowing south towards the former bleach works feeding the upper Bleach Works Pond to the south of the road. This is indicated as Lions Brook. Historical mapping indicates that from 1844 until 1922 the site and surrounding area predominantly consisted of pastureland. To the south of the site was a Bleach Works, Print Works, Mill and accompanying industrial ponds and reservoirs. The industrial ponds and reservoirs were mainly fed from the River Irk and the Boggart Hole Brook (a tributary of the River Irk) to the east of the bleach works ponds. The majority of the unnamed ordinary watercourses and tributaries of the River Irk are culverted from the earliest mapping in 1844 within the surrounding area. The culverted Lionfield Brook is indicated to cross the site from the earliest mapping. From 1922 a majority of the surrounding industrial ponds and reservoirs have been infilled and the industrial works have been abandoned. From 1923 historical mapping indicates that a cemetery is present to the north of site and the surrounding area has become increasingly urbanised. From 1947 the surrounding area consists predominantly of residential developments. The site continues to be vacant until the latest available mapping in 1966. The earliest satellite imagery available indicates that the Fire Station has retained its current building footprint since at least 2000.

Table 2-1: Summary of the Environmental Setting (continued).

2.4 Site Reconnaissance

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

Relevant features identified on site are summarised below:

- Hardstanding (tarmacadam) across the majority of the site with a maintained grassland area to the southern boundary. There is a landscaped area with shrubbery and established trees towards the northern boundary which slopes down steeply in a south easterly direction towards the building and yard.
- Access is via Rochdale Road to the western boundary.
- The Fire Station building is present to towards the western section of the site and a car parking courtyard area is present in the east.
- Existing drainage downpipes and gutters are present on the Fire Station building.
- Two manholes are present towards the north eastern corner and two further manholes are present towards the rear of the Fire Station building in the south.
- Further manholes are present towards the front of the Fire Station building adjacent to the western boundary of the site.
- There are manhole covers adjacent to the lower ground floor area within the lower ground area to the north and south of the current buildings. These collect the drainage from the building towards Rochdale Road.

- Highway gullies are present within the adjacent highway in Rochdale Road to the west and in White Moss Road to the southern and eastern boundaries.
- Drainage gullies are present adjacent to the western boundary to the front of the building and in the car parking area to the rear of the building.
- There is a steep slope down to the south along the northern boundary of the site. This area is heavily vegetated with bushes and small trees.
- The surrounding area comprises residential properties to the north and west, an area of grassland and established trees to the east and residential properties beyond, and a car parking area to the south.

Relevant photographs are provided in Plate 2-1.



Photograph 1: View from the S of site. Road slopes down towards S.



Photograph 2: Road to rear of site. Steep slope down towards S.



Photograph 3: Grassed area adjacent S boundary. Steeply slopes down away from site.



Photograph 4: Existing Lower ground floor of building is below road level by approx. 2-3m. View of SW corner.



Photograph 5: Vegetated area adjacent N boundary. Steep slope down towards building's lower ground floor.



Photograph 6: Manhole covers towards NE corner.

Plate 2-1: Site photographs.

	
Photograph 7: Car parking area to rear of building. Gullies present adjacent building.	Photograph 8: Grassed area adjacent S boundary. Slopes down towards SW corner. Existing soil downpipe and manhole cover present next to existing lower ground floor level.
	
Photograph 9: Rear of building. Site slopes down towards W.	Photograph 10: Drainage gullies in car parking area in the E.
	
Photograph 11: Highway gullies in Rochdale Road to the W.	Photograph 12: Existing bridge from Rochdale Road to the Fire Station, showing weep pipe from structure.

Plate 2-1: Site photographs (continued).

2.5 Site and Access Levels

A topographic survey of the site has been undertaken to OS GPS datum, and information is included on the drawings in Appendix B. The site elevation ranges from 81.35m AOD in the northwest to 76.36m AOD in the southwest. The southwestern corner is the topographically lowest area on site and is between 2-3m lower than the remainder of site. The final site levels and ground floor levels of the proposed Fire Station have not yet been determined. The proposed access would join Rochdale Road at approximately 80.32m AOD.

3 Consultation

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

Relevant correspondence 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 (EA)	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 River Levels	As the site does not fall within 150m of an area at risk of flooding from rivers or the sea, the EA do not hold any detailed flood modelling data that would impact the site.
	Records of Flooding	No information available.
	Records of Flood Warning Service	Not within a flood warning service area.
	Surface Water Flooding	Low risk of surface water flooding up to a depth of 300mm less than 0.25m/s towards the northern boundary of the site. The remainder of the site has a very low risk of flooding.
	Flooding from reservoirs	No risk from reservoirs.
	Groundwater Source Protection Zone	Not within a Source Protection Zone.
Manchester City Council (LLFA)	Correspondence with Manchester City Council has confirmed that the site is located within a Critical Drainage Area. No flooding events have occurred on site. The nearest recorded flooding incident occurred 20m west of the site (21/12/2020) and was recorded as a blocked highway gully. The Lionfield Brook culverted ordinary watercourse is indicated to cross the site. The culvert is indicated to serve open channels downstream of the site. This is an indicative asset and has not been verified with a survey. Evidence of culverts in the vicinity is recorded in historic mapping. The 1984 drainage survey of major assets does not highlight the indicative culvert asset; however, reservoirs are highlighted corresponding to the present-day open channels.	
	Possible or known incidents of highway flooding	Unaware of any current flooding problems associated with Rochdale Road or White Moss Road.

Table 3-1: Summary consultee information.

Source	Details	
United Utilities (UU)	Likely conditions for connecting into their sewerage system	UU would request conditions for a separate system with only foul draining to foul / combined sewers and surface water draining to soakaway/SuDS, watercourse or surface water sewer. All surface water flow from the proposed development should drain in-line with the drainage hierarchy, as outlined in Paragraph 80 of the National Planning Practice Guidance. Surface water runoff generated from this development should discharge to the ground via infiltration system where feasible. If not feasible, UU will consider a connection to the 525mm diameter public combined sewer located in Rochdale Road to the west of site at a pass forward flow to be agreed by the Lead Local Flood Authority. UU request that any agreed rate does not exceed 5l/s. Foul flow from this site will be allowed to drain into the public combined sewer system. UU's preferred point of discharge would be to the 525mm diameter public combined sewer within Rochdale Road at an unrestricted rate. UU Wastewater Developer department was contacted regarding sewer flooding history for the site. UU confirmed that they did not have records of internal or external sewer flooding of properties in the vicinity of the site as a result of overloaded sewers.
	Sewer map	There is a 525mm diameter combined sewer adjacent to the western boundary in Rochdale Road running in a southerly direction. This continues south until a bifurcation splits into a 1500mm diameter and 450mm diameter pipe. The combined sewer is at a significant depth below Rochdale Road (see Appendix D). There is a 225mm diameter combined sewer towards the south of the site in White Moss Road running in an easterly direction.
Strategic Flood Risk Assessment (SFRA)	Level 1 SFRA ³	The site has no history of flooding from any source.
	Level 2 Hybrid SFRA ⁴	The site has no history of flooding from any source.
Preliminary Flood Risk Assessment (PFRA) ⁵	The Preliminary Flood Risk Assessment (PFRA) ³ for the area indicates that there are no records of flooding for the area which conforms with information supplied by the EA.	

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

³ Strategic Flood Risk Assessment Level 1: Greater Manchester Combined Authority; Level 1 SFRA for Greater Manchester (2019), JBA Consulting.

⁴ Strategic Flood Risk Assessment Level 2: Manchester City, Salford City and Trafford Councils Level 2 Hybrid SFRA (2011), JBA Consulting.

⁵ Preliminary Flood Risk Assessment: Manchester City Council; Preliminary Flood Risk Assessment (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).

The EA did not have any modelled levels for the stretch of the River Irk closest to the site.

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

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 towards the northern eastern boundary of the site that have the potential to flood during prolonged heavy rainfall. These areas are associated with natural depressions that are likely to be positively drained following the development process. During the walkover it was observed that this area was significantly lower than the lowest ground floor levels on site and are therefore highly unlikely to affect any part of the site during prolonged heavy rainfall. There is an area beneath the bridge area in the south west that has the potential to collect water. 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 Low but should be considered further during the detailed design.

Surface Water (Overland flow) – This relates to surface water entering the site. Surface water arising from the northwest of the study area is likely to be intercepted by the highway drains and therefore pose no threat to the development. There is potential for surface water to flow down the shallow valley to the north of the site towards the building. If there was a drainage failure of the potential culvert causing overland flow, it would flow towards the north boundary of the existing building. Therefore, the flood risk associated with this source is considered Low.

Groundwater – The BGS has no groundwater records for the study area. A previous ground investigation indicated waterlogged ground at a shallow depth. The superficial Till deposits are more than 7.0m thick which would make it unlikely for water from an aquifer to emerge. No evidence of shallow groundwater was observed during the walkover. Therefore, the flood risk associated with this source is considered Low.

Sewers – UU sewer records show combined water sewers within the vicinity of the study area and within the surrounding housing developments. The Drainage and Water Enquiry states that no property on land within the vicinity of the site is at risk of internal flooding due to overloaded public sewers. There are no records of sewer flooding at the site location. The highway to the west would intercept any overland flow before it

enters the site. Therefore, the flood risk associated with this source is considered Very Low.

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

4.3 Summary of Flood Risk

Source of Flooding	Risk Assessment Level
Fluvial	Very Low
Pluvial (Rainfall)	Low
Surface Water	Low
Tidal	Negligible
Groundwater	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 Low risk of flooding from all sources have been identified for the site. LKC consider that a strategy for surface water management will be required at the site to mitigate the risk to others. The assessments of a range of measures that are feasible for the site are outlined in Section 5.

5 Surface Water Management

The NPPF recognises that flood risk and other environmental damage can be managed by minimising changes in the volume and rate of surface run-off from development sites through the use of Sustainable Drainage Systems (SuDS), this being complementary to the control of development within the floodplain.

SuDS will not alleviate flooding in an area prone to flooding; however, properly designed SuDS have the potential to prevent the surface water runoff from new development worsening the flood risk. The effective disposal of surface water from any new development is a material planning consideration in determining if the proposals for the development and use of land are acceptable.

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

The Building Regulations Requirement H3⁶ 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 2010⁷.

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, Diamicton	Sand, firm mottled Clay and sandy Clay	Secondary Undifferentiated	N/A	Poor
Chester Formation	Sandstone	Principal	N/A	Good

Table 5-1: Geological and Hydrogeological Setting.

⁶ Building Regulations part H3 2010: Approved Document, Drainage and Waste Disposal.

⁷ Flood and Water Management Act 2010: UK Government.

Infiltration methods such as soakaways are unlikely to be practicable due to the waterlogged ground and clay content of the superficial soils, but this may be investigated further at the detailed design stage if required. The site is occupied by an existing Fire Station located within a densely built urban area with limited space for utilising any infiltration facilities. It is likely that infiltration methods such as soakaways are unlikely to be feasible.

5.2 Surface Water Drainage Strategy

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

There are no observable watercourses within or near the boundary of the site. However, information provided by Manchester City Council indicates that there is a potential culverted watercourse flowing across the site boundary towards the centre which could connect to an ordinary watercourse culvert to the south of the site.

There are no surface water sewers within the vicinity of the site.

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	N/A	Not likely to be feasible as the site is constrained by the proximity of the adjacent properties and roads. The impermeable ground conditions also make the use of infiltration unlikely.
b	Connection to Watercourse	2	A connection into the culverted section of the Lionfield Brook which historically crossed the site may be possible if it is located within the site boundary, and condition verified. This would require LLFA consent.
c	Discharge into a sewer	1	A connection into the 525mm diameter combined sewer in Rochdale Road would be possible – subject to approval from LLFA and connection consent from United Utilities.

Table 5-2: Drainage options.

Table 5-3 provides a summary of the SuDS options appraisal with consideration of CIRIA C753 (The SUDS Manual)⁸ for the development:

SuDS Option	Appropriate to Development	Comments
Soakaways	X	Due to the nature of the ground conditions, the use of infiltration systems may not be feasible.
Infiltration basin	X	Depressions that store and dispose of water via infiltration. May not be appropriate given the ground conditions.
Sand filter	✓	Treatment devices using sand beds as filter media.
Filter drains	✓	Linear trenches filled with a permeable granular material, often with a perforated pipe in the base of the trench.
Detention basin	X	Dry depressions designed to hold water for a specific retention time.
Swales	X	Swales are shallow grass-lined channels that provide capacity for conveying flows at a controlled rate into ponds and watercourses.
Rainwater harvesting	*	Rainwater harvesting collects the rain which falls onto roofs, then stores it in a tank until required for a non-potable use. When required, the water is pumped to the point of use, thus displacing what would otherwise be a demand for mains-water. In the process, a volume of water is kept out of the storm-water management system, thereby helping to reduce flooding risks. Rainwater harvesting systems are currently not included in the development proposals.
Green/blue roofs	*	Green roof installations can help to reduce surface water runoff from roof areas depending on the system specified. Green roofs are not currently included in the development proposals.
Geo-cellular storage systems	✓	Modular block systems can be used to provide an underground storage facility. Any geo-cellular storage systems should be lined with a geo-membrane to provide attenuation storage.
Permeable Pavements – with granular and geo-cellular storage systems	✓	Permeable pavements allow inflow of rainwater into underlying construction. Any geo-cellular storage systems would have to be lined with an impermeable membrane to provide storage rather than infiltration for runoff from highways.
Ponds	X	Attenuation ponds can be used to offset the increase in surface water flows attributable to increased area of hard standing, in order to minimise the risk of flooding to and from the proposed development. Ponds will attenuate the surface water flow prior to discharging to the public surface water sewers. The storage volume afforded by these features should not include any permanent water in the pond.
Oversized Pipes	✓	Oversizing the pipes that make up the on-site drainage network is a cost-effective method for providing attenuation storage within the network. Such systems could be considered on the parts of the development where gradients are relatively flat.
Tanks	✓	Prefabricated underground tanks could be considered at the detailed design stage in order to provide storage to attenuate surface water runoff.
Flow control devices	✓	The peak flow rates will be controlled by flow control devices e.g. hydrobrake style flow control systems, and restricted orifices. Flow control devices enable the discharge to be restricted to a constant rate from the development.

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

Notes

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

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

X Not suitable

⁸ CIRIA C753 - The SUDS Manual. London 2015.

5.3 Surface Water Attenuation Requirements

In line with the correspondence provided by Manchester City Council, the flow from this development should be reduced by the minimum of 50% from the existing runoff rates for estimating the attenuation volumes required.

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

Designated Areas	Plot Area
Total area (ha)	0.24
Development Area (ha)	0.17
Green Infrastructure (ha)	0.07
Contributing Catchment	
Developable Area (ha)	0.24
Impermeable split (ha)	0.17
Permeable split (ha)	0.07

Table 5-4: Assumed plot areas.

It can be seen that there is no change in impermeable area from the existing usage to the proposed. This is likely to require attenuation to reduce the existing flow off site to a level which is acceptable to the LLFA and to UU.

5.3.1 Attenuation Estimate

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

For the contributing catchment an estimate has been produced assuming a developable area of 0.17ha and a greenspace of 0.05ha. This gives the following runoff rates and attenuation requirements for this section based on the Wallingford method:

» Q_{bar} :	21.00 l/s
» 1 in 1-year existing runoff rate:	14.80 l/s
» 1 in 30-year existing runoff rate:	37.10 l/s
» 1 in 100-year existing runoff rate:	46.90 l/s

This reduced by 50% would give the following rates:

» Q_{bar} :	10.50 l/s
» 1 in 1-year existing runoff rate:	7.40 l/s
» 1 in 30-year existing runoff rate:	18.55 l/s
» 1 in 100-year existing runoff rate:	23.45 l/s

As the only observed working drainage in the area are the combined sewers United Utilities has specified an allowable discharge rate of 5l/s to their adjacent combined sewer in Rochdale Road.

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

The following attenuation has been estimated for the development using runoff rates and utilises the FSR methodology⁹ as:

- Attenuation storage volume: **20.4 m³** (1 in 30-year event)
- Retention on site volume: **41.0 m³** (1 in 100 year + 20% Climate Change)
- Retention on site volume: **51.7 m³** (1 in 100 year + 40% Climate Change)

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

The attenuation required for a 1 in 30-year storm event, requires a storage volume of **20.4 m³**. For the 1 in 100-year event, a storage capacity of between **41.0 m³** and **51.7 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 an attenuation tank or similar is 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.

Utilisation of a flow control device at the end of the system will control the peak flow rates.

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 peak flow and contributing impermeable area. The permeable paving will also provide some level of water treatment reducing effects of pollution in runoff on the environment.

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

5.5 Foul Drainage

The foul water could be discharged into the adjacent 525mm diameter combined sewer in Rochdale Road at unrestricted rate.

⁹ Flood Studies Report Wallingford NERC 1975.

6 Mitigation Measures

6.1 Proposed Site levels and Developments Level

Current Environment Agency guidance recommends that the minimum ground floor levels of 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.

This and the 0.1% annual probability (1 in 1000-year) are 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 Rochdale Road to the west of the site. 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. Flood resilience measures should be included into lower ground floor construction to aid recovery after any event if it is to be retained. 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 an 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.

7 Conclusions

The site is currently a Fire Station, and the proposal is to demolish the existing building and build a new Fire Station building with modern facilities, car parking and training space.

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

Negligible to Low Risks of flooding from all sources have been identified from information provided by the EA and BGS.

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 Rochdale Road.
- » Potential for soakaway use for rainwater disposal is low; however, this could be investigated further at the detailed design phase.
- » Surface water flow will likely need to be attenuated to the 5l/s runoff rate or a rate agreed with the LLFA and United Utilities.
- » Surface water arising from the site could potentially discharge into the combined sewer located to the west of the site in Rochdale Road.
- » Foul sewage could be discharged into the existing public combined sewer in Rochdale Road subject to the agreement of United Utilities.
- » A formal evacuation plan is not considered to be required.

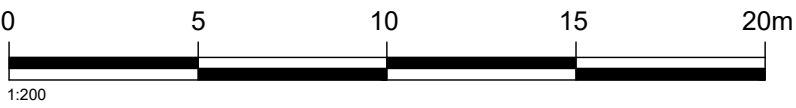
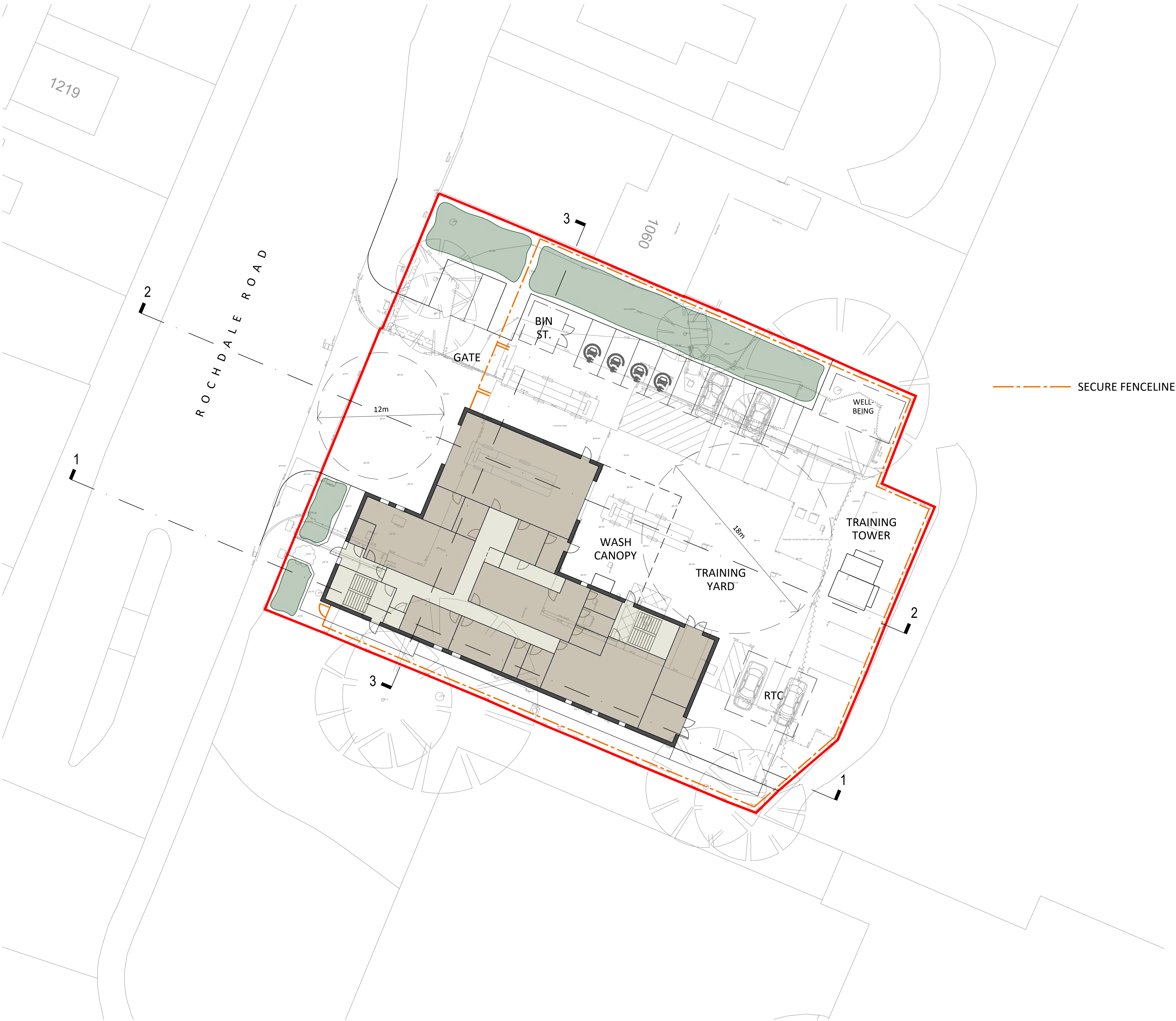
Further details on the proposed mitigation measures are provided in Section 6. All proposed measures should be agreed with the Local Authority prior to commencement of the development.

Appendix A

Figures, Plans and Drawings



Client: Bradshaw Gass & Hope LLP				Title: Site Location & Boundary Plan			
Site: Blackley Fire Station				Scale (see scale bar): 1:25,000 & 1:1,200 @ A4			
Job No.: FRA 22 1157	Drawn By: JL	Checked By: MJ	Drawn: Oct 2022	Figure: 1		Revision:	



status

FEASIBILITY

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All dimensions are to be checked on site by the contractor prior to proceeding with any work.

Hazard Identification

!

ref	hazard	date

N

P2	SECTION REFERENCES ADDED	ST	17.08.22
P1	FIRST ISSUE	ST	29.07.22
ref	revision	by	date

BGH

Architects
Consulting Engineers
Quantity Surveyors

21 Silverwell Street
Bolton
BL1 1PR
t: 01204 525321
email@bghbolton.co.uk
www.bghbolton.co.uk

client

GREATER MANCHESTER
COMBINED AUTHORITY

project

NEW FIRE STATIONS
FEASIBILITY STUDIES

drawing

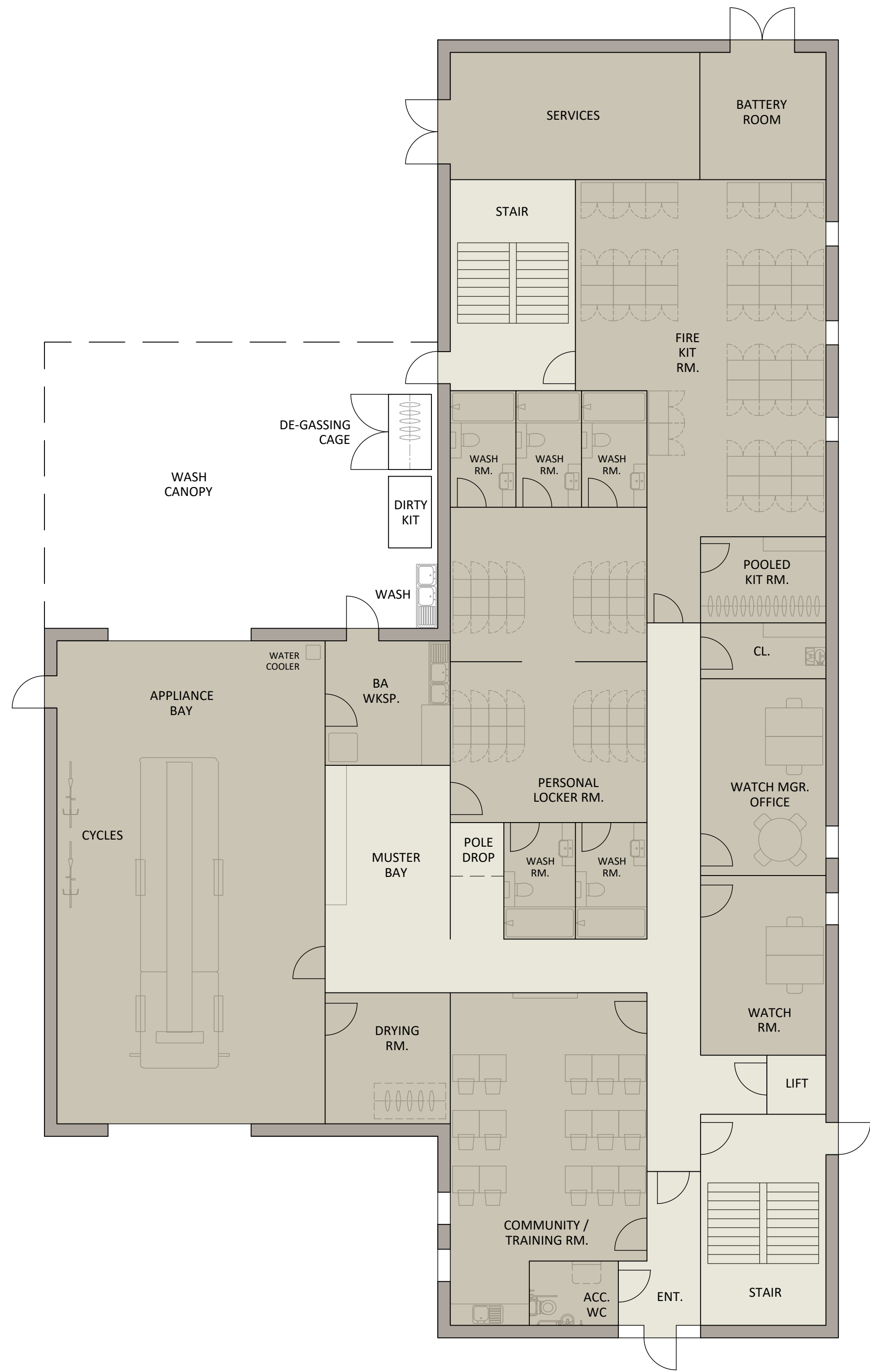
BLACKLEY FIRE STATION
PROPOSED SITE PLAN
OPTION 3

drawn by	ST	date	JUL 22
checked by		date	

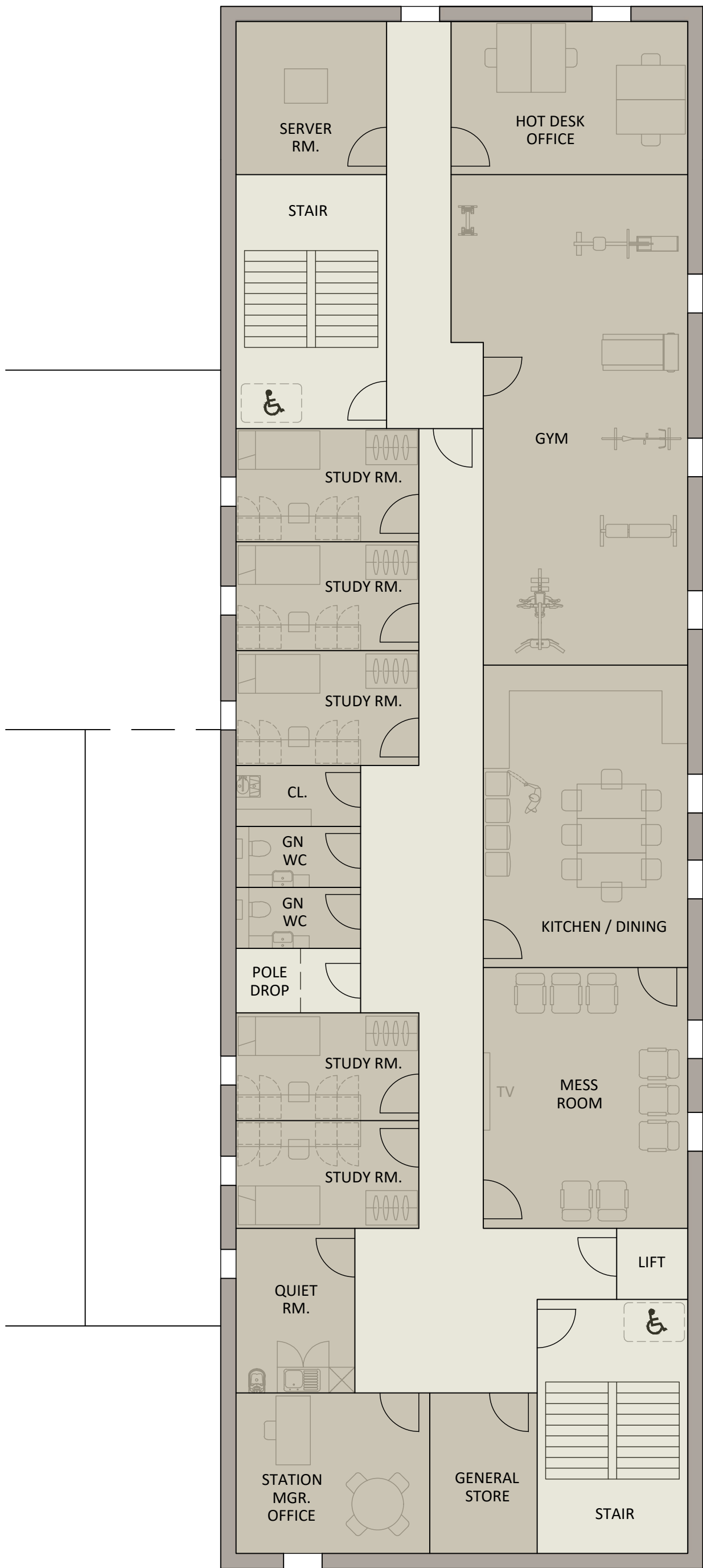
scale	1:200	A1
dwg no	1978.35.1206	rev P2

Appendix B

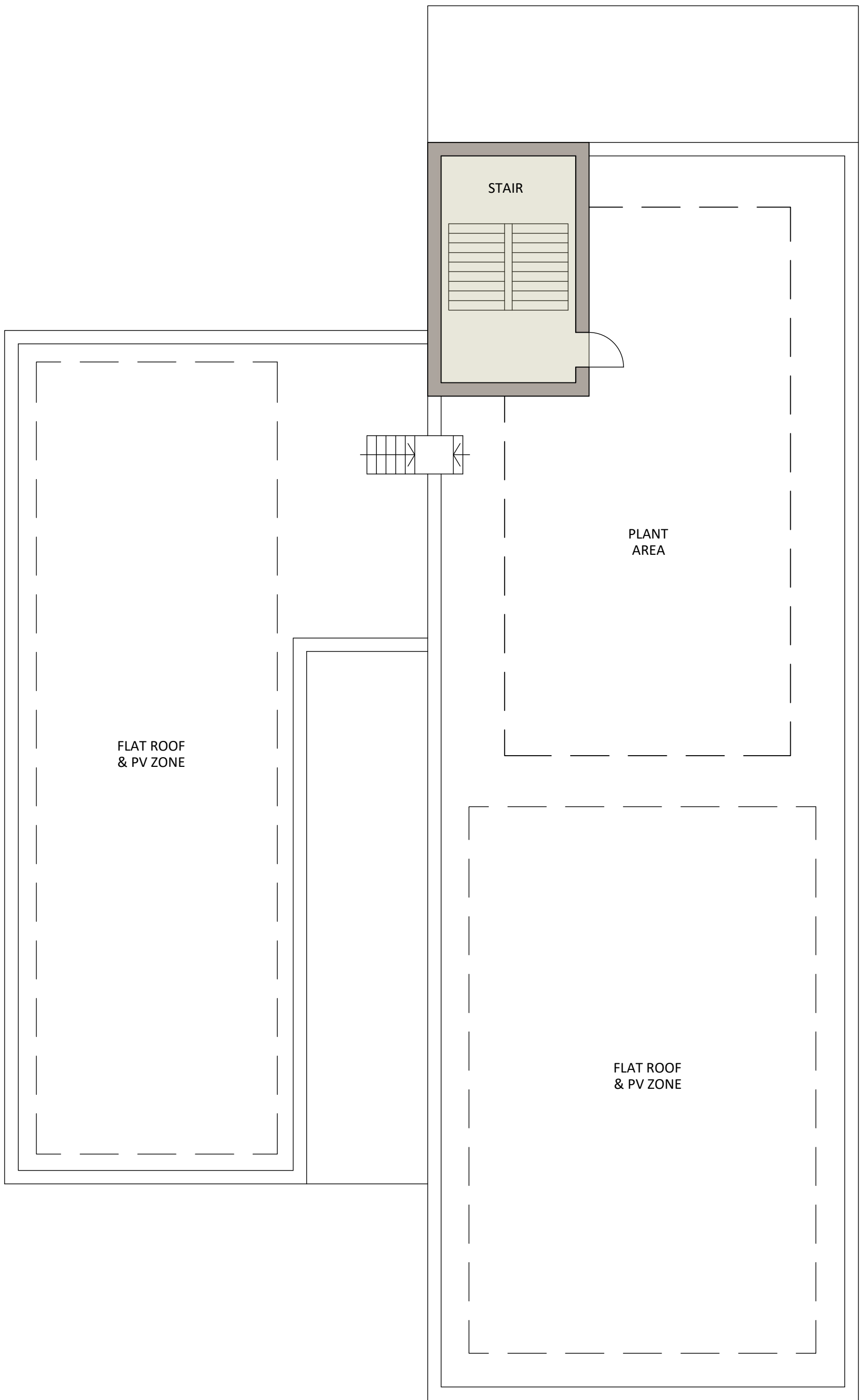
Site Information



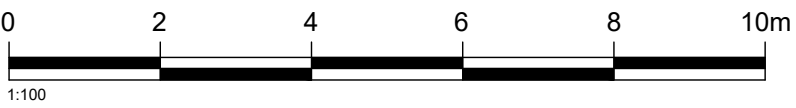
LEVEL 0



LEVEL 1



ROOF



status

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Hazard Identification 		
ref	hazard	date

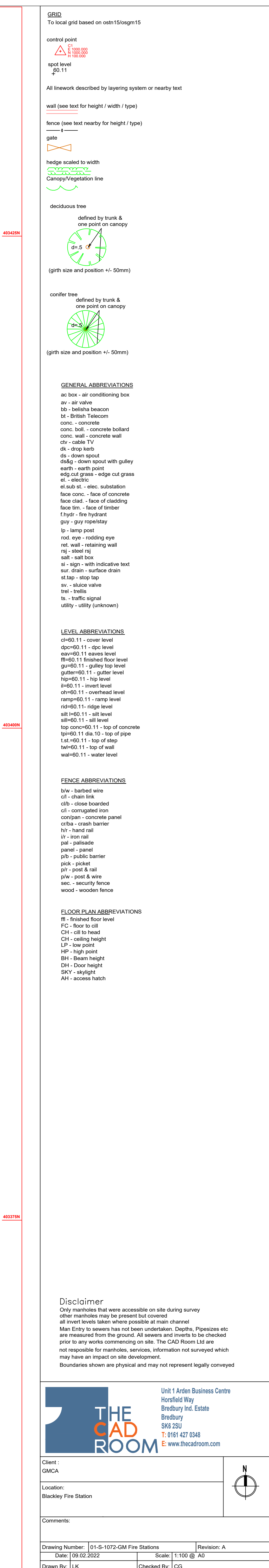
P5	2ND WASHROOMS ADDED. WALL & DOOR ADDED TO KITCHEN / DINING / MESS ROOM	ST	21.09.22
P4	REVISED FOLLOWING REVIEW AT MEETING 08.09.22	ST	09.09.22
P3	REVISED FOLLOWING COMMENTS RCD. AT MEETING 23.08.22	ST	27.08.22
P2	REVISED FOLLOWING COMMENTS RCD. AT MEETING 02.08.22	ST	16.08.22
P1	FIRST ISSUE	ST	29.07.22
ref	revision	by	date

Architects
Consulting Engineers
Quantity Surveyors

21 Silverwell Street
Bolton
BL1 1PR
t: 01204 525321
email@bghbolton.co.uk
www.bghbolton.co.uk

Bradshaw Gass & Hope LLP

client	GREATER MANCHESTER COMBINED AUTHORITY		
project	NEW FIRE STATIONS FEASIBILITY STUDIES		
drawing	BLACKLEY FIRE STATION PROPOSED FLOOR PLANS OPTION 3		
drawn by	ST	date	JUL 22
checked by		date	
scale	1:100		A1
dwg no	1978.35.1303		rev P5



GEO-RESEARCH LTD. CALE STREET, CALE GREEN STOCKPORT, CHESHIRE				Borehole No. 9 Sheet No. 1			
CONTRACT: Rochdale Road Relief Sewer.				Date Commenced 14th December 1963			
LOCATION: Manchester				Date Completed 16th December 1963.			
Scale 1 inch = 1 foot.				Sample No. 8020 0351			

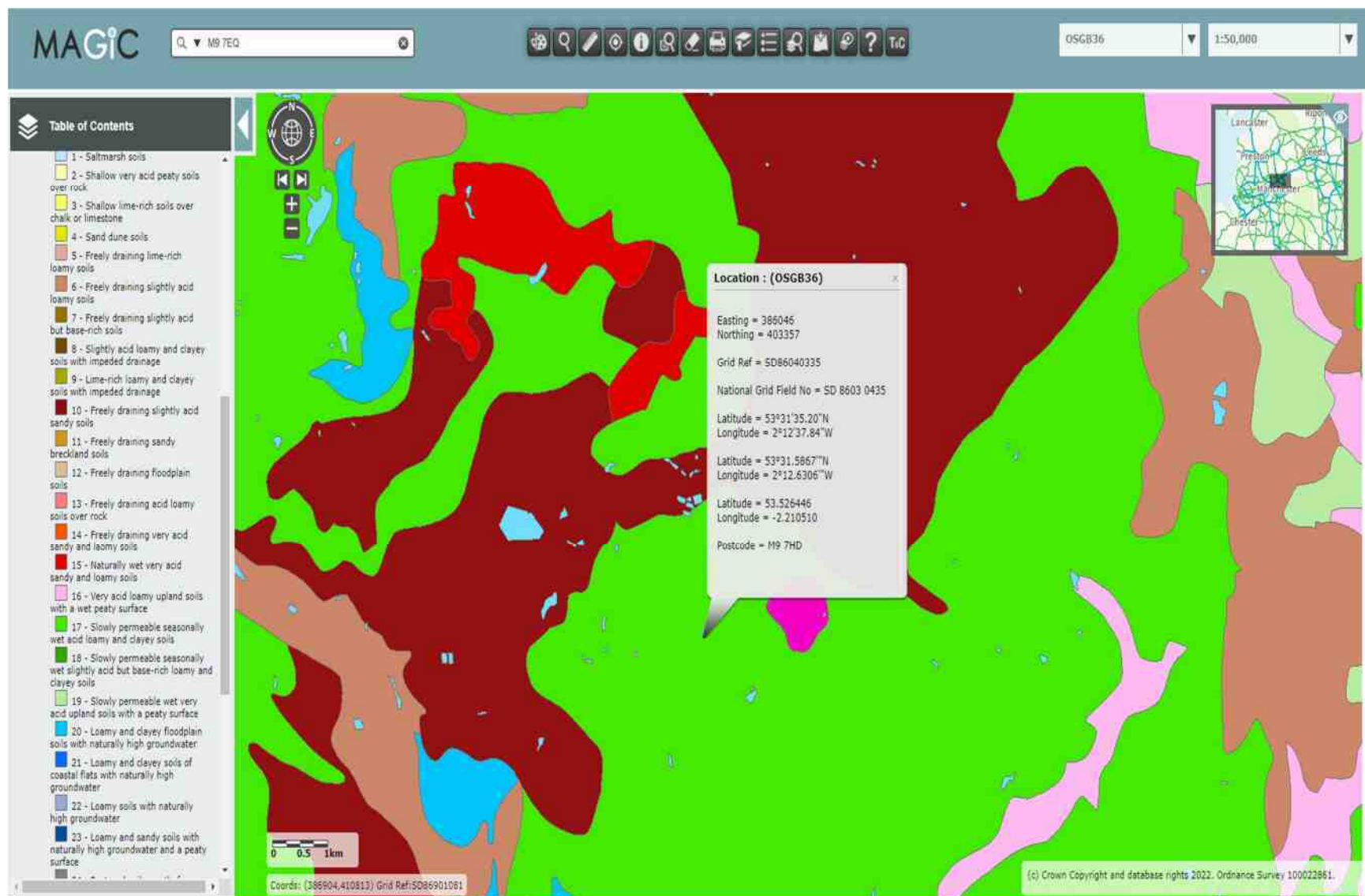
Stratum	Legend	Thick-ness	Depth	Sample No.	N Value	Level	Remarks
Cinder, sand & brick fill.		0' 9"	G.L.				
Firm brown and grey mottled clay.		2' 0"	0' 9"	D1			Very damp.
Firm dark brown sandy clay.		6' 0"	6' 9"				
		8' 0"		D2			Damp
Firm brown boulder clay with fine sandy bands.		13' 9"	20' 6"				
		21' 6"		D3			
Borehole complete		3' 6"	24' 0"				On completion of borehole - dry.
							On withdrawing casing borehole dry.



BGS Superficial Geology – Contains British Geological Survey Materials © UKRI 2020

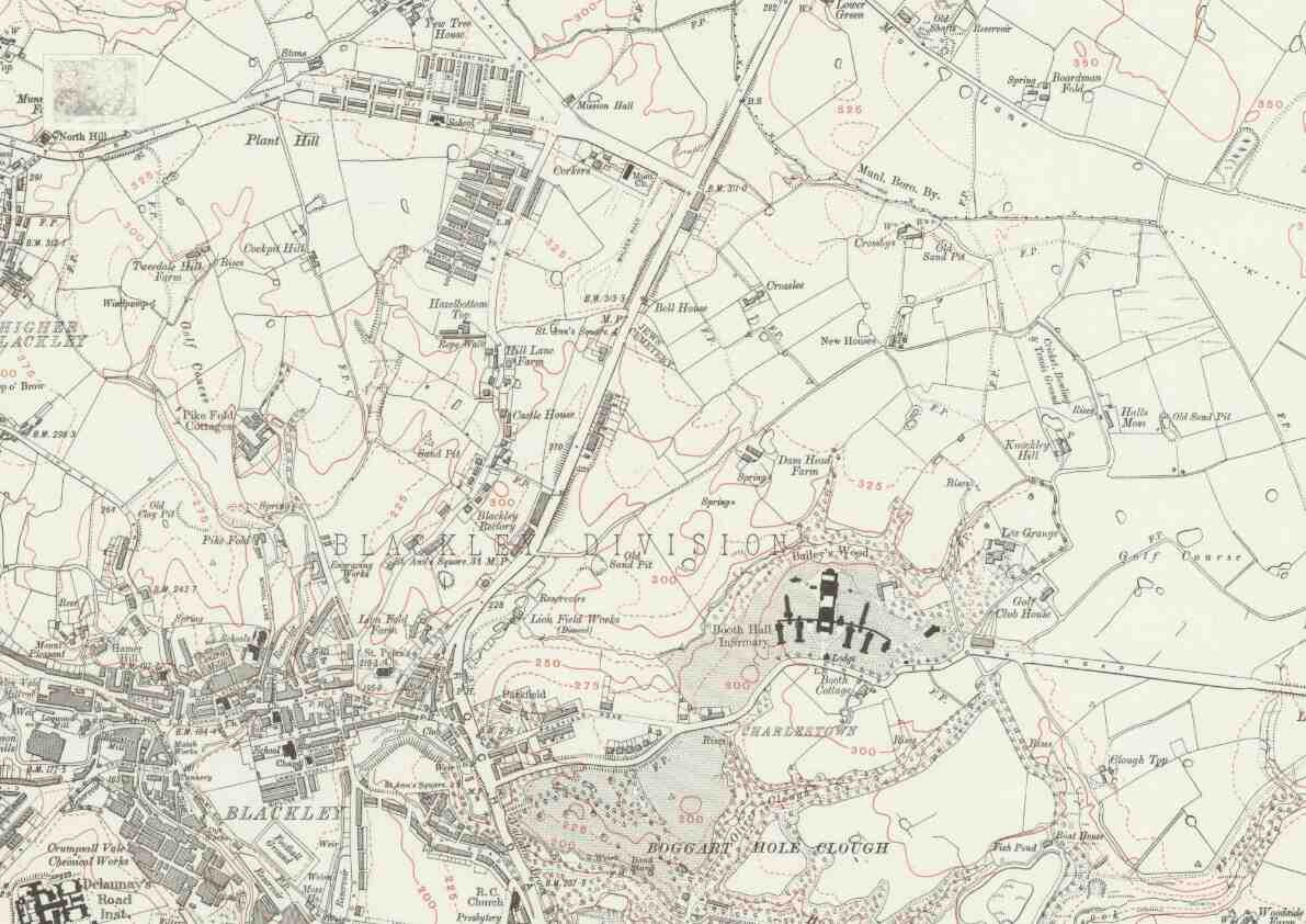


BGS Bedrock Geology – Contains British Geological Survey Materials © UKRI 2020



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







Appendix C

Environment Agency Data

Flood map for planning

Your reference
Blackley FS

Location (easting/northing)
386050/403400

Created
23 Nov 2022 11:08

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

You will need to do a flood risk assessment if your site is **any of the following:**

- bigger than 1 hectare (ha)
- In an area with critical drainage problems as notified by the Environment Agency
- identified as being at increased flood risk in future by the local authority's strategic flood risk assessment
- at risk from other sources of flooding (such as surface water or reservoirs) and its development would increase the vulnerability of its use (such as constructing an office on an undeveloped site or converting a shop to a dwelling)

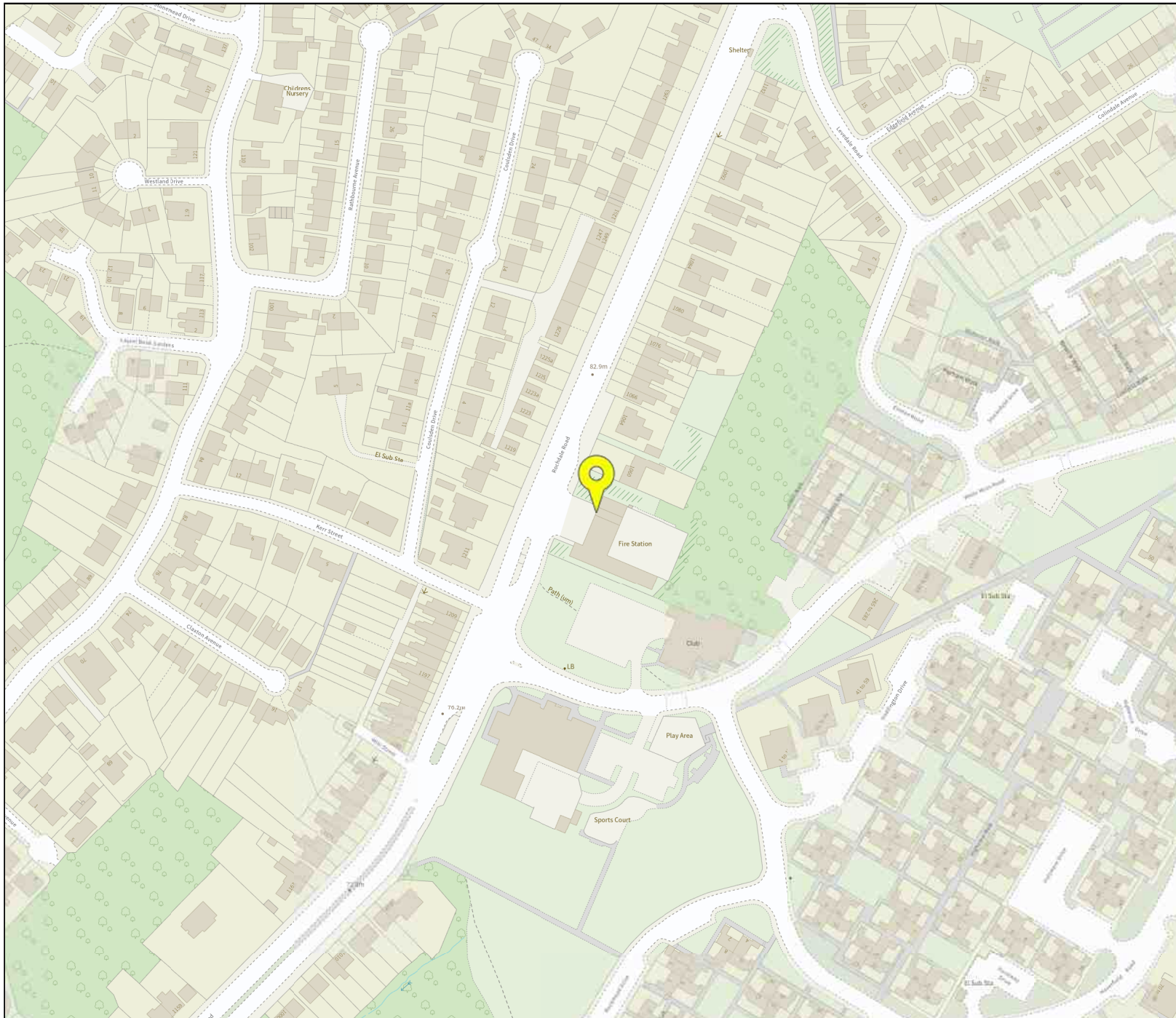
Notes

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

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

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

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



Flood map for planning

Your reference

Blackley FS

Location (easting/northing)

386050/403400

Scale

1:2500

Created

23 Nov 2022 11:08



Selected point



Flood zone 3



Flood zone 3: areas
benefitting from flood
defences



Flood zone 2



Flood zone 1



Flood defence

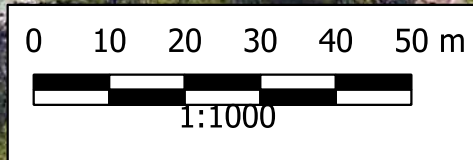


Main river



Water storage area





KEY



Site Location

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



Client: IKG Consulting

Site: Blackley Fire Station

Title: Low Surface Water Risk

Job No:	Scale (see scale bar):	Figure:	Rev:
FRA 22 1157	1:1000 @ A4		
Drawn By:	Checked By:	Drawn:	
JL	MJ	Oct 2022	

Appendix D

Consultee Correspondence

LKGroup**Unit 29 Eton Business Park
Unit 29, Eton Business Park,
Radcliffe, Greater Manchester
M26 2ZS****FAO:****How to contact us:****United Utilities Water Limited
Property Searches
Haweswater House
Lingley Mere Business Park
Great Sankey
Warrington
WA5 3LP****Telephone: 0370 7510101****E-mail: propertysearches@uuplc.co.uk****Your Ref: FRA 22 1157
Our Ref: UUPS-ORD-441966
Date: 25/10/2022****Dear Sirs****Location: 1060 ROCHDALE ROAD, MANCHESTER, M9 7EQ**

I acknowledge with thanks your request dated 24/10/2022 for information on the location of our services.

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

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

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

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

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

Yours Faithfully,



Karen McCormack
Property Searches Manager

TERMS AND CONDITIONS - WASTEWATER AND WATER DISTRIBUTION PLANS

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

TERMS AND CONDITIONS:

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



Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad	Refno	Cover	Func	Invert	Size x	Size y	Shape	Matl	Length	Grad
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3302	84.39	CO	80.56	450	150		VC	17.17663	1 in 51	1001	82.57	CO	80.77	225	150		VC	2.08719	1 in 3
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3302	84.39	CO	80.56	450	150		VC	17.17663	1 in 51	1001	82.57	CO	80.77	225	150		VC	9.34904	1 in 42
3302	84.39	CO	80.56	450	150		VC	17.17663	1 in 51	1001	82.57	CO	80.77	225	150		VC	26.71817	1 in 19
3302	84.39	CO	80.56	450	150		VC	17.17663	1 in 51	1001	82.57	CO	80.77	225	150		VC	23.99552	1 in 19
3302	84.39	CO	80.56	450	150		VC	17.17663	1 in 51	1001	82.57	CO	80.77	225	150		VC	23.99552	1 in 19
3302	84.39	CO	80.56	450	150		VC	17.17663	1 in 51	1001	82.57	CO	80.77	225	150		VC	23.99552	1 in 19
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3302	84.39	CO	80.56	450	150		VC	17.17663	1 in 51	1001	82.57	CO	80.77	225	150		VC	23.99552	1 in 19
3302	84.39	CO	80.56	450	150		VC	17.17663	1 in 51	1001	82.57	CO	80.77	225	150		VC	23.99552	1 in 19
3302	84.39	CO	80.56	450	150		VC	17.17663	1 in 51	1001	82.57	CO	80.77	225	150		VC	23.99552	1 in 19
3302	84.39	CO	80.56	450	150		VC	17.17663	1 in 51	1001	82.57	CO	80.77	225	150		VC	23.99552	1 in 19
3302	84.39	CO	80.56	450	150		VC	17.17663	1 in 51	1001	82.57	CO	80.77	225	150		VC	23.99552	1 in 19
3302	84.39	CO	80.56	450	150		VC	17.17663	1 in 51	1001	82.57	CO	80.77	225	150		VC	23.99552	1 in 19
3302	84.39	CO	80.56	450	150		VC	17.17663	1 in 51	1001	82.57	CO	80.77	225	150		VC	23.99552	1 in 19
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3302	84.39	CO	80.56	450	150		VC	17.17663	1 in 51	1001	82.57	CO	80.77	225	150		VC	23.99552	1 in 19
3302	84.39	CO	80.56	450	150		VC	17.17663	1 in 51	1001	82.57	CO	80.77	225	150		VC	23.99552	1 in 19
3302	84.39	CO	80.56	450	150		VC	17.17663	1 in 51	1001	82.57	CO	80.77	225	150		VC	23.99552	1 in 19
3302	84.39	CO	80.56	450	150		VC	17.17663	1 in 51	1001	82.57	CO	80.77	225	150		VC	23.99552	1 in 19
3302	84.39	CO	80.56	450	150		VC	17.17663	1 in 51	1001	82.57	CO	80.77	225	150		VC	23.99552	1 in 19
3302	84.39	CO	80.56	450	150		VC	17.17663	1 in 51	1001	82.57	CO	80.77	225	150		VC	23.99552	1 in 19
3302	84.39	CO	80.56	450	150		VC	17.17663	1 in 51	1001	82.57	CO	80.77	225	150		VC	23.99552	1 in 19
3302	84.39	CO	80.56	450	150		VC	17.17663	1 in 51	1001	82.57	CO	80.77	225	150		VC	23.99552	1 in 19
3302	84.39	CO	80.56	450	150														

Jenna Lowe

From: wastewaterdeveloperservices@uuplc.co.uk
Sent: 19 October 2022 12:25
To: Jenna Lowe
Subject: Pre Development Enquiry for: Blackley Fire Station, Rochdale Road, Manchester, M9 7EQ UU Reference Number : 02924778

Good Afternoon, Jenna

Pre Development Enquiry for: Blackley Fire Station, Rochdale Road, Manchester, M9 7EQ UU Reference Number : 02924778

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

If your investigations require access to our public sewer network, we ask that you contact our network engineers with a request for an access certificate via our main contact telephone number 0345 6723 723 or refer to the link below:

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

Foul Water

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

Our preferred point of discharge would be to the 525mm diameter public combined sewer within Rochdale Road located to the West of your proposed development at an unrestricted rate.

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

In accordance with our infrastructure plans we may ask you to change your point of connection. Therefore please contact us when you are ready to formalise your drainage proposals, we would suggest before you submit for Full Planning.

Surface Water

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

Generally, the aim should be to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable.

This is outlined as follows, in order of priority:

- 1. into the ground (infiltration);**

2. **to a surface waterbody;**
3. **to a surface water sewer or highway drain;**
4. **to a combined sewer.**

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

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

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

Infiltration

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

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

Particular attention must be paid to Ground Water Source Protection Zones to ensure that the risk of pollution to these valuable resources is not compromised. Details can be obtained from the government website:

<https://www.gov.uk/guidance/groundwater-source-protection-zones-spzs#find-groundwater-spzs>

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

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

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

Highway Drainage

If an evidence based assessment has been carried out and confirms that infiltration is not feasible, we recommend that you investigate the possibility of draining surface water to the highway drain where this ultimately discharges to a watercourse, by contacting the relevant Highway Authority.

Public Sewer

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

Once evidence is provided as outlined above, United Utilities will consider a connection to the 525mm diameter public combined sewer within Rochdale Road located West of the proposed site at a pass forward flow to be agreed by the Lead Local Flood Authority. United Utilities request that any agreed rate does not exceed 5l/s. This has been based on the HR Wallingford peak greenfield flow rate utilising soil type 5 (most impermeable).

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

Levels

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

Land drainage / Overland flows / track drainage

United Utilities have no obligation, and furthermore we do not accept land drainage, overland flows or track drainage into the public sewerage network under any circumstances

Existing Wastewater Assets Crossing the Site

We have reviewed our records and can confirm that there does not appear to be any charted public sewers located within the boundary of proposed development. However, due to the accuracy of the records and the public sewer transfer legislation in 2011, not all public sewers are shown on our records so we would ask that you proceed with caution and carry out your own site investigation works. If any uncharted sewers are identified while carrying out your works we would ask that you contact United Utilities at the earliest opportunity so that we can offer guidance and update our records.

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

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

Existing Water Assets Crossing the Site

It is the developer responsibility to identify utilities on-site. Where clean water assets are shown on our records, we recommend that you contact our Water Pre-Development Team, via the following email address:

DeveloperServicesWater@uuplc.co.uk. Further information for this service can be found on our website via the link below:

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

Connection Application

Although we may discuss and agree discharge points and rates in principle, please be aware that you will have to apply for a formal sewer connection. This is so that we can assess the method of construction, Health & Safety requirements

and to ultimately inspect the connection when it is made. Details of the application process and the form itself can be obtained from our website by following the link below:

<https://www.unitedutilities.com/builders-developers/wastewater-services/sewer-connections/sewer-connection/>

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

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

Sewer Adoptions

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

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

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

Please refer to links below to obtain further guidance:

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

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

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

SuDS

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

Section 104 Pre application form (1b)

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

Codes For Adoption

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

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

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

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

Many thanks and kind regards,



Gary Jaundrell
Assistant Developer Engineer
Developer Services & Metering
Customer Services
T: 07388 715 589
unitedutilities.com

If you have received a great service today why not tell us?

Visit: unitedutilities.com/wow

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

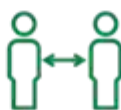
Coronavirus | Prevent the spread



Wash your
hands



Disinfect
common surfaces



Practise social
distancing



FEVER +
COUGH

Stay home if you
have symptoms

[Click for our message to customers](#)



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Lead Local Flood Authority

Highways Service
Growth and Neighbourhoods Directorate
Manchester City Council
PO Box 532
Town Hall
Manchester
M60 2LA

Email: floodriskmanagement@manchester.gov.uk

DATE 17/11/2022

Dear Sir or Madam,

RE: Our Ref: MCC017/11/2022

We acknowledge with thanks your payment received on 28/10/2022 for our LLFA data screen service.

Please find enclosed plan showing the results of the data screen. The position of features shown on this plan is approximate only and is given in accordance with the best information currently available.

The enclosed plan cannot be used to substitute a competent site investigation.

The enclosed plan is being provided to you subject to Manchester City Council's terms and conditions which are shown attached.

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

If you have any queries regarding this matter, please do not hesitate to contact us.

Yours Faithfully,

A handwritten signature in black ink, appearing to read "Neil Bayliss-Rowe".

Neil Bayliss-Rowe, Highways Development Control & Flood Risk Manager, Lead Local Flood Authority

TERMS AND CONDITIONS – LLFA DATA SCREEN

These provisions apply to LLFA data supplied by Manchester City Council (“MCC”).

TERMS AND CONDITIONS:

- This data 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.
- MCC has taken all reasonable care to compile this data Map. This data Map and any information supplied with it is provided for general guidance only and MCC makes no representation, undertaking or warranty of any kind as to its accuracy, completeness or being up to date is given or implied.
- In particular, the position of any culverted assets shown on the data Map are approximate only. MCC strongly recommends that a comprehensive site investigation is undertaken in addition to reviewing this data Map to determine and ensure the precise location of any assets. The exact location, positions and depths should be obtained by an appropriate survey which may include but shall not be limited to GPR and CCTV.
- The data screened may be modified over time without notice and therefore this data 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 data Map have been made subsequent to issue and prior to any works being carried out.
- This data 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) or for the purpose of determining the suitability of a point of connection to discharge.
- No person or legal entity, including any company shall be relieved from any liability howsoever and whensoever arising from damages of any kind caused to assets by reason of the actual position and/or existence of assets being different from those shown on the data 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 MCC from bringing proceedings in any other competent jurisdiction, whether concurrently or otherwise.

DATA SCREEN SYMBOLOGY

Bridge

-  Good
-  Fair
-  Poor
-  Very Poor
-  Unknown

Trash Screen

-  Good
-  Fair
-  Poor
-  Very Poor
-  Unknown

Culvert Orifice

-  Very Good
-  Good
-  Fair
-  Poor
-  Very Poor
-  Unknown

Culvert Conduit

-  CCTV surveyed
-  Not CCTV surveyed
-  Ordinary Watercourse Conduit
-  MCC SuDS
-  MCC Flood Incident Points
-  MCC Section 19 Report
-  MCC Flood Incident Polygons
-  MCC Local Authority Boundary

Supplementary Information where available:

Critical Drainage Area – This site is covered by the Conurbation Core CDA.

Flood Incidents – The nearest recorded incident is 20m west of the Site (21/12/2020), recorded as blocked highway gully/drain.

Culvert Conduits – The Lionfield Brook culverted ordinary watercourse is indicated to cross the Site. The culvert is indicated to serve open channels downstream of the Site. This is an indicative asset and has not been verified with survey. Evidence of culverts in the vicinity is recorded in historic mapping.

Survey and Design Archive – The 1984 drainage survey of major assets (enclosed) does not highlight the indicative culvert asset; however, reservoirs are highlighted corresponding to the present-day open channels.

Any other information identified by LLFA officer during screening – the Site would benefit from an investigation of the indicative culvert risk.



**MANCHESTER
CITY COUNCIL**

LLFA DATA SCREEN

Address/Site Ref:
Blackley Fire Station

Our Ref: **MCC017/11/2022**

Author: Manchester City Council LLFA
Date: 17/11/2022
Scale: 1:2,406

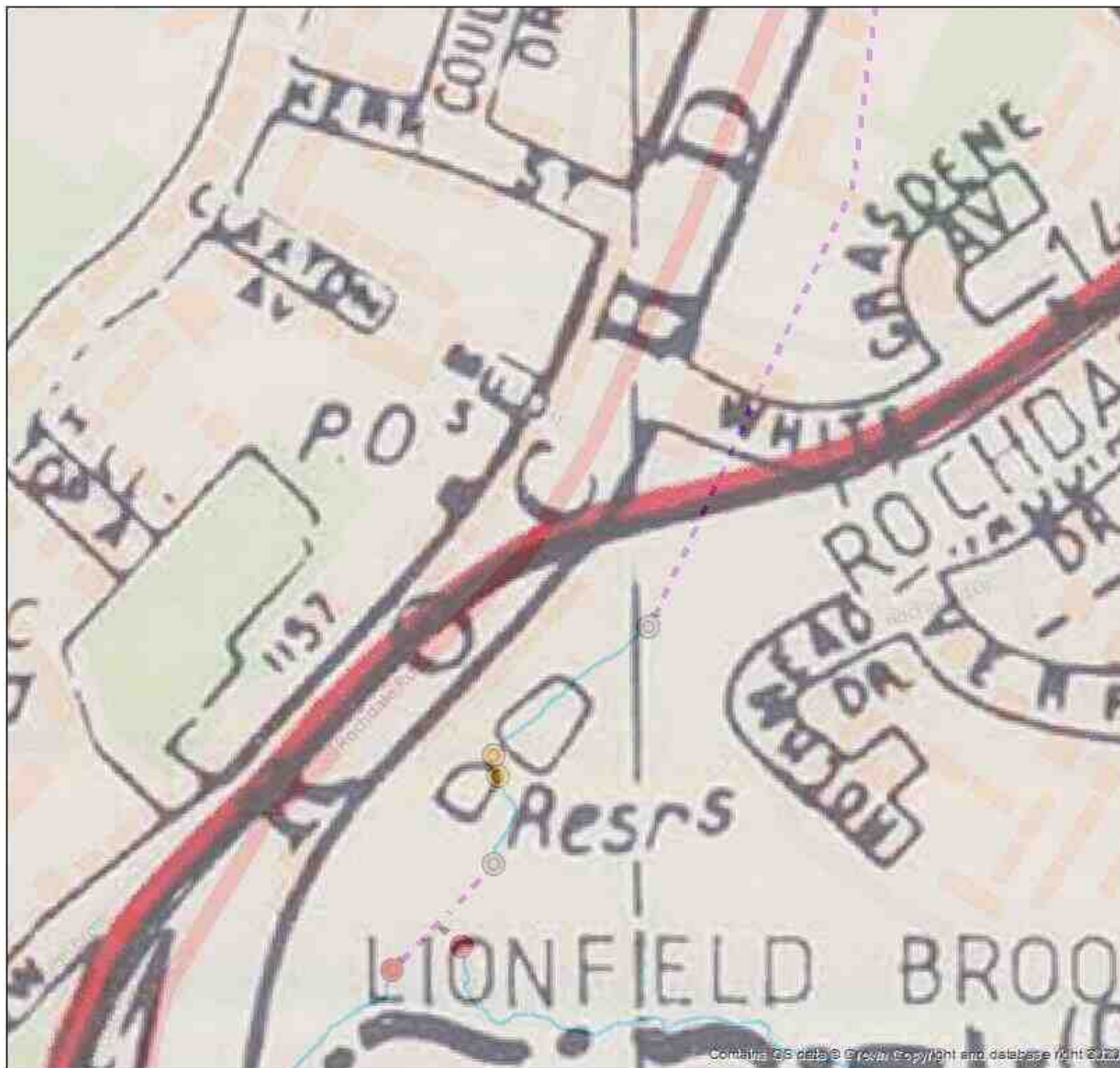
The position of features shown on this plan is approximate only and is given in accordance with the best information currently available. Manchester City Council will not accept liability for any loss or damage caused by the actual position being different from those shown.

0 15 30 60
Meters



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**MANCHESTER
CITY COUNCIL**

LLFA DATA SCREEN

Address/Site Ref:
Blackley Fire Station

Our Ref: **MCC017/11/2022**

Author: Manchester City Council LLFA
Date: 17/11/2022
Scale: 1:2,000

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

0 12.5 25 50
Meters



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Appendix E

Calculations



MasterDrain
SW

The LK Group

www.thelkgroup.com

Eton Business Park,
Eton Hill Road,
Radcliffe M26 2ZS
Tel: 0161 763 7200
email: m.jones@thelkgroup.com

Job No.		
Sheet no. 1		
Date 22/11/22		
By	Checked	Reviewed

Project **Qbar Existing Runoff Blackley Fire Station, Blackley**

Title **Qbar Existing Runoff Blackley Fire Station, Blackley**

Area data:-

FSR data

M5-60 = 18.1

Soil index = 0.40

WRAP value = 3

r = 0.34

SAAR = 980

Nat grid = SD 8603

Site data:-

Ret. period (yrs) = 2.3

Time of entry = 7.00

Impervious area drained = 1700 m²

Site slope = Mild <2% (1:50)

Length of overland flow = 0.00

ToC = 7.0 mins

Overland flow time = 0.0 mins

Pervious area drained = 700 m²

Soil type = Fine textured

Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 56.0%

Rainfall rate = 56.2 mm/Hr

UCWI = 101.1

Runoff rate (gross) = 21.0 l/s

Methods

Runoff factor (RF) = 56.0, 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



MasterDrain
SW

The LK Group

www.thelkgroup.com

Eton Business Park,
Eton Hill Road,
Radcliffe M26 2ZS
Tel: 0161 763 7200
email: m.jones@thelkgroup.com

Job No.		
Sheet no. 1		
Date 22/11/22		
By	Checked	Reviewed

Project	1 Year Existing Runoff Blackley Fire Station, Blackley
Title	1 Year Existing Runoff Blackley Fire Station, Blackley

Area data:-

FSR data

M5-60 = 18.1

Soil index = 0.40

WRAP value = 3

r = 0.34

SAAR = 980

Nat grid = SD 8603

Site data:-

Ret. period (yrs) = 1

Time of entry = 10.00

Impervious area drained = 1700 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 = Fine textured

Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 56.0%

Rainfall rate = 39.7 mm/Hr

UCWI = 101.1

Runoff rate (gross) = 14.8 l/s

Methods

Runoff factor (RF) = 56.0, 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



MasterDrain
SW

The LK Group

www.thelkgroup.com

Eton Business Park,
Eton Hill Road,
Radcliffe M26 2ZS
Tel: 0161 763 7200
email: m.jones@thelkgroup.com

Job No.		
Sheet no. 1		
Date 22/11/22		
By	Checked	Reviewed

Project	30 Years Existing Runoff Blackley Fire Station, Blackley
Title	30 Years Existing Runoff Blackley Fire Station, Blackley

Area data:-

FSR data

M5-60 = 18.1

Soil index = 0.40

WRAP value = 3

r = 0.34

SAAR = 980

Nat grid = SD 8603

Site data:-

Ret. period (yrs) = 30

Time of entry = 6.00

Impervious area drained = 1700 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 = Fine textured

Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 56.0%

Rainfall rate = 99.3 mm/Hr

UCWI = 101.1

Runoff rate (gross) = 37.1 l/s

Methods

Runoff factor (RF) = 56.0, 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



MasterDrain
SW

The LK Group

www.thelkgroup.com

Eton Business Park,
Eton Hill Road,
Radcliffe M26 2ZS
Tel: 0161 763 7200
email: m.jones@thelkgroup.com

Job No.		
Sheet no. 1		
Date 22/11/22		
By	Checked	Reviewed

Project	100 Years Existing Runoff Blackley Fire Station, Blackley
Title	100 Years Existing Runoff Blackley Fire Station, Blackley

Area data:-

FSR data

M5-60 = 18.1

Soil index = 0.40

WRAP value = 3

r = 0.34

SAAR = 980

Nat grid = SD 8603

Site data:-

Ret. period (yrs) = 100

Time of entry = 6.00

Impervious area drained = 1700 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 = Fine textured

Climate change factor = 0.0 %

Calculated data:-

Calculated runoff factor = 56.0%

Rainfall rate = 125.5 mm/Hr

UCWI = 101.1

Runoff rate (gross) = 46.9 l/s

Methods

Runoff factor (RF) = 56.0, 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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Eton Business Park,
Eton Hill Road,
Radcliffe M26 2ZS
Tel: 0161 763 7200
email: m.jones@thelkgroup.com

Job No.		
Sheet no. 1		
Date 22/11/22		
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Project	30 Years Storage Event Blackley Fire Station, Blackley
Title	30 Years Storage Event Blackley Fire Station, Blackley

Data:-

FSR Hydrology:-

Location = BLACKLEY FS
M5-60 (mm) = 18.1
Soil index = 0.40
Return period = 30
UCWI = 103.6

Grid reference = SD 8603
r = 0.34
SAAR (mm/yr) = 980
WRAP = 3
Climate change = 0

- i) Relatively impermeable soils in boulder and sedimentary clays, and in alluvium, especially in eastern England;
- ii) Permeable soils with shallow ground water in low-lying areas;
- iii) Mixed areas of permeable and impermeable soils, in approximately equal proportions.

Runoff factor (RF) = 56.0, calculated from:-

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

where

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

UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 1700 m²
Total area (TA) = 2400 m²
Mean disch. rate = 5.000 l/s
Additional flow = 0.00 l/s

Pervious area = 700 m²
Equiv area = 1344 m² (TA x RF).
Areal reduction factor = 1.000
Climate change factor = 0

Calculated data:-

Time to max = 39.0 mins
Rainfall at max = 36.78 mm/hr
Pipeline storage = 0.0 m³
Offline storage = 0.0 m³

Calculated storage volume = 20.4 m³
Allowed discharge rate = 5.000 l/s
Available MH storage = 0.0 m³

Fixed 6 hour data:-

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

Calculated storage volume = 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	2601.9	1125	20.6	400 x 600	113.5	500 x 500	81.7
150	1156.4	1200	18.1	600 x 900	49.4	500 x 750	54.5
225	514.0	1275	16.0	800 x 1200	27.8	500 x 1000	40.9
300	289.1	1350	14.3			750 x 1000	27.2
375	185.0	1425	12.8			750 x 1200	22.7
450	128.5	1500	11.6			750 x 1500	18.2
525	94.4	1575	10.5			1000 x 1000	20.4
600	72.3	1650	9.6			1000 x 1200	17.0
675	57.1	1725	8.7			1000 x 1500	13.6
750	46.3	1800	8.0			1000 x 1800	11.4
825	38.2	1875	7.4			1000 x 2000	10.2
900	32.1	1950	6.8			1500 x 1500	9.1
975	27.4	2025	6.3			1500 x 1800	7.6
1050	23.6	2100	5.9			1500 x 2000	6.8



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Data:-

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

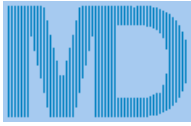
Job No.		
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Project **30 Years Storage Event Blackley Fire Station, Blackley**

Title **30 Years Storage Event Blackley Fire Station, Blackley**

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	79.0	17.803	3.000	14.803
20	55.0	24.704	6.000	18.704
30	43.0	29.115	9.000	20.115
40	36.0	32.430	12.000	20.430
50	31.0	35.112	15.000	20.112
60	28.0	37.380	18.000	19.380
70	25.0	39.351	21.000	18.351
80	23.0	41.100	24.000	17.100
90	21.0	42.674	27.000	15.674
100	20.0	44.108	30.000	14.108
110	18.0	45.425	33.000	12.425
120	17.0	46.645	36.000	10.645
130	16.0	47.780	39.000	8.780
140	16.0	48.843	42.000	6.843
150	15.0	49.842	45.000	4.842
160	14.0	50.785	48.000	2.785
170	14.0	51.677	51.000	0.677
180	13.0	52.524	54.000	0.000
190	13.0	53.331	57.000	0.000
200	12.0	54.101	60.000	0.000
210	12.0	54.837	63.000	0.000
220	11.0	55.541	66.000	0.000
230	11.0	56.218	69.000	0.000
240	11.0	56.867	72.000	0.000
250	10.0	57.492	75.000	0.000
260	10.0	58.095	78.000	0.000
270	10.0	58.676	81.000	0.000
280	9.0	59.237	84.000	0.000
290	9.0	59.779	87.000	0.000
300	9.0	60.304	90.000	0.000
310	9.0	60.812	93.000	0.000
320	9.0	61.334	96.000	0.000
330	8.0	61.840	99.000	0.000
340	8.0	62.333	102.000	0.000
350	8.0	62.816	105.000	0.000
360	8.0	63.288	108.000	0.000
370	8.0	63.749	111.000	0.000
380	8.0	64.201	114.000	0.000
390	7.0	64.644	117.000	0.000
400	7.0	65.078	120.000	0.000
410	7.0	65.503	123.000	0.000
420	7.0	65.921	126.000	0.000
430	7.0	66.330	129.000	0.000
440	7.0	66.733	132.000	0.000
450	7.0	67.128	135.000	0.000
460	7.0	67.516	138.000	0.000
470	6.0	67.898	141.000	0.000
480	6.0	68.274	144.000	0.000
490	6.0	68.643	147.000	0.000
500	6.0	69.007	150.000	0.000
510	6.0	69.365	153.000	0.000
520	6.0	69.717	156.000	0.000
530	6.0	70.064	159.000	0.000
540	6.0	70.406	162.000	0.000
550	6.0	70.744	165.000	0.000
560	6.0	71.076	168.000	0.000
570	6.0	71.404	171.000	0.000
580	6.0	71.727	174.000	0.000
590	5.0	72.046	177.000	0.000
600	5.0	72.361	180.000	0.000

Storage volume (m³) = 20.4 m³



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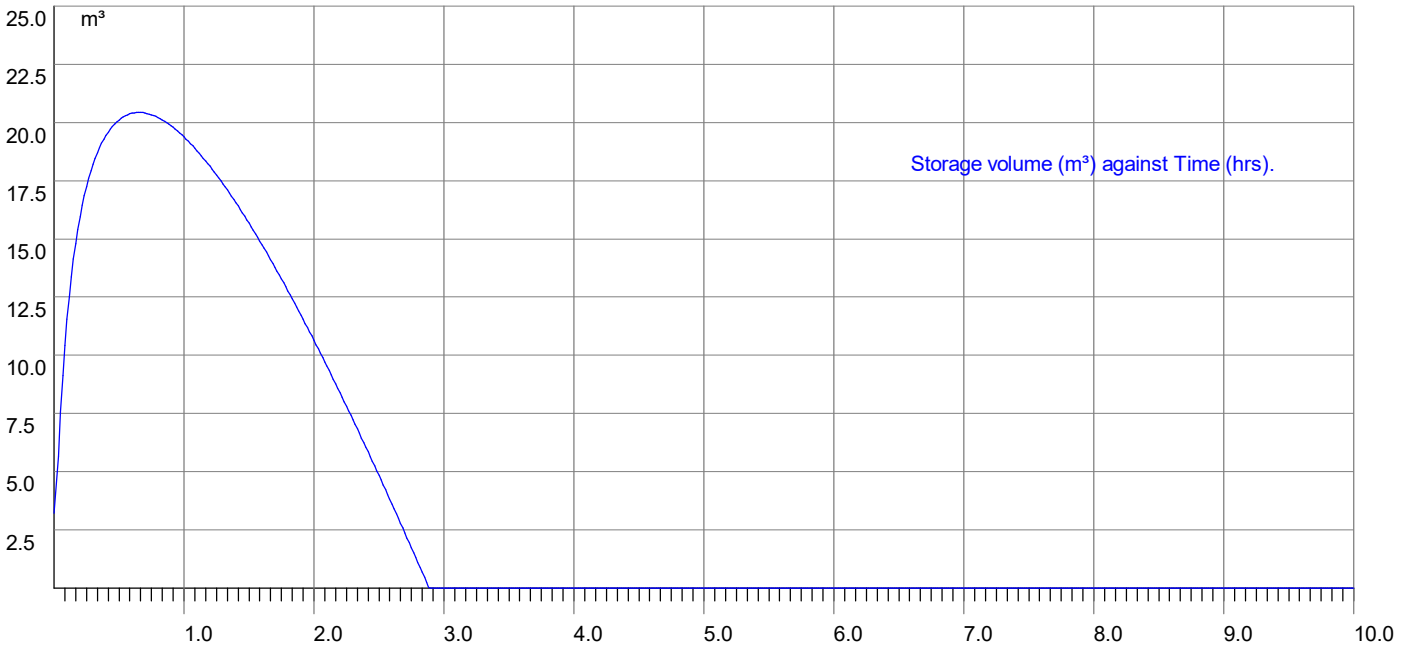
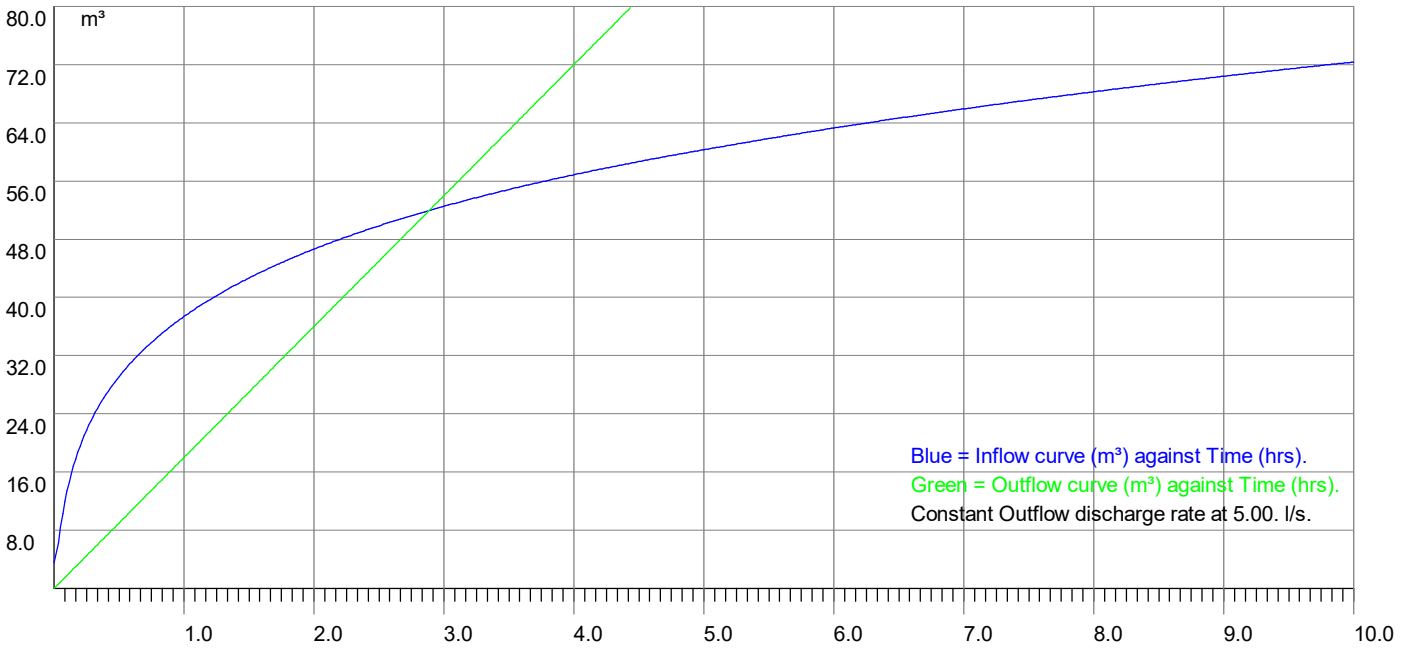
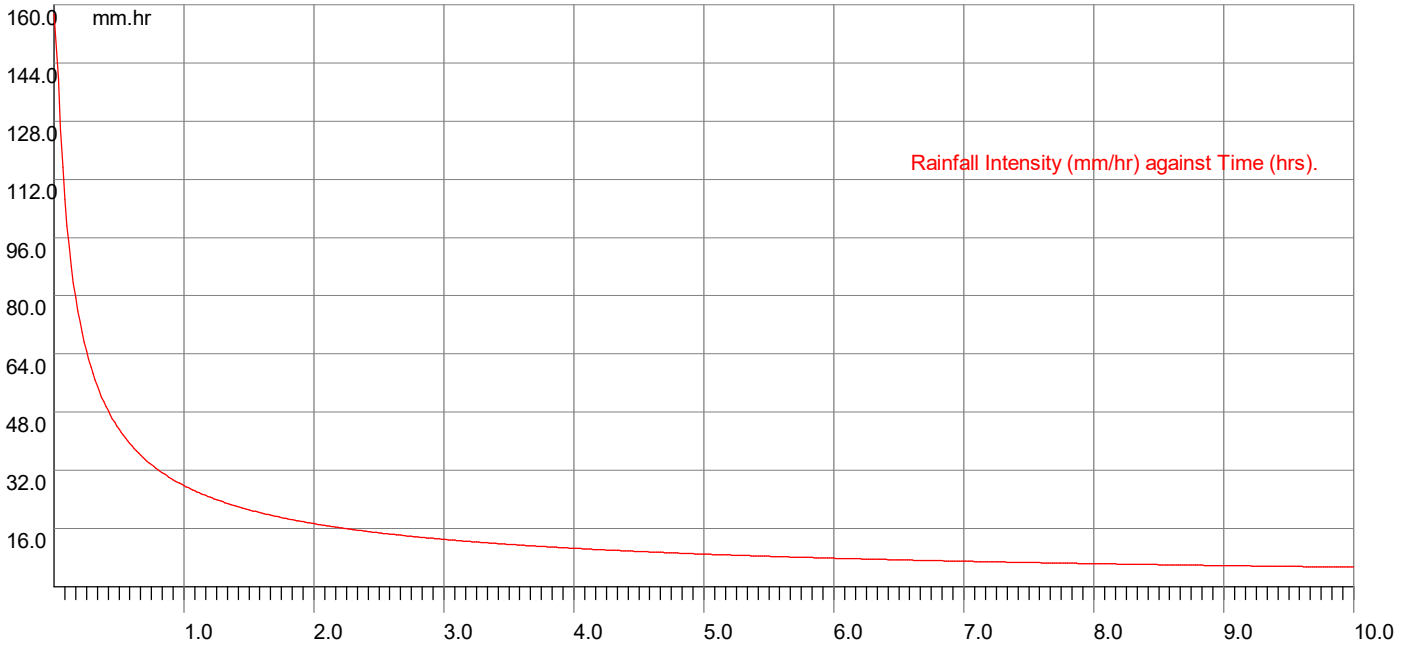
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Eton Hill Road,
Radcliffe M26 2ZS
Tel: 0161 763 7200
email: m.jones@thelkgroup.com

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Project **30 Years Storage Event Blackley Fire Station, Blackley**

Title **30 Years Storage Event Blackley Fire Station, Blackley**





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

Job No.		
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Date 22/11/22		
By	Checked	Reviewed

Project	100 Years + 20% CC Storage Event Blackley Fire Station, Blackley
Title	100 Years + 20% CC Storage Event Blackley Fire Station, Blackley

Data:-

FSR Hydrology:-

Location = BLACKLEY FS
M5-60 (mm) = 18.1
Soil index = 0.40
Return period = 100
UCWI = 103.6

Grid reference = SD 8603
r = 0.34
SAAR (mm/yr) = 980
WRAP = 3
Climate change = 20

- i) Relatively impermeable soils in boulder and sedimentary clays, and in alluvium, especially in eastern England;
- ii) Permeable soils with shallow ground water in low-lying areas;
- iii) Mixed areas of permeable and impermeable soils, in approximately equal proportions.

Runoff factor (RF) = 56.0, calculated from:-

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

where

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

UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 1700 m²
Total area (TA) = 2400 m²
Mean disch. rate = 5.000 l/s
Additional flow = 0.00 l/s

Pervious area = 700 m²
Equiv area = 1344 m² (TA x RF).
Areal reduction factor = 1.000
Climate change factor = 20

Calculated data:-

Time to max = 69.0 mins
Rainfall at max = 39.95 mm/hr
Pipeline storage = 0.0 m³
Offline storage = 0.0 m³

Calculated storage volume = 41.0 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	5226.9	1125	41.3	400 x 600	228.0	500 x 500	164.2
150	2323.1	1200	36.3	600 x 900	99.3	500 x 750	109.5
225	1032.5	1275	32.2	800 x 1200	55.8	500 x 1000	82.1
300	580.8	1350	28.7			750 x 1000	54.7
375	371.7	1425	25.7			750 x 1200	45.6
450	258.1	1500	23.2			750 x 1500	36.5
525	189.6	1575	21.1			1000 x 1000	41.0
600	145.2	1650	19.2			1000 x 1200	34.2
675	114.7	1725	17.6			1000 x 1500	27.4
750	92.9	1800	16.1			1000 x 1800	22.8
825	76.8	1875	14.9			1000 x 2000	20.5
900	64.5	1950	13.7			1500 x 1500	18.2
975	55.0	2025	12.7			1500 x 1800	15.2
1050	47.4	2100	11.9			1500 x 2000	13.7



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Data:-

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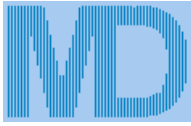
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Eton Hill Road,
Radcliffe M26 2ZS
Tel: 0161 763 7200
email: m.jones@thelkgroup.com

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Project	100 Years + 20% CC Storage Event Blackley Fire Station, Blackley
Title	100 Years + 20% CC Storage Event Blackley Fire Station, Blackley

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	122.0	27.319	3.000	24.319
20	86.0	38.429	6.000	32.429
30	68.0	45.546	9.000	36.546
40	57.0	50.900	12.000	38.900
50	49.0	55.229	15.000	40.229
60	44.0	58.878	18.000	40.878
70	40.0	62.042	21.000	41.042
80	36.0	64.839	24.000	40.839
90	33.0	67.347	27.000	40.347
100	31.0	69.621	30.000	39.621
110	29.0	71.702	33.000	38.702
120	27.0	73.619	36.000	37.619
130	26.0	75.397	39.000	36.397
140	25.0	77.053	42.000	35.053
150	23.0	78.602	45.000	33.602
160	22.0	80.057	48.000	32.057
170	21.0	81.427	51.000	30.427
180	21.0	82.722	54.000	28.722
190	20.0	83.948	57.000	26.948
200	19.0	85.113	60.000	25.113
210	18.0	86.220	63.000	23.220
220	18.0	87.275	66.000	21.275
230	17.0	88.282	69.000	19.282
240	17.0	89.244	72.000	17.244
250	16.0	90.165	75.000	15.165
260	16.0	91.048	78.000	13.048
270	15.0	91.895	81.000	10.895
280	15.0	92.709	84.000	8.709
290	14.0	93.491	87.000	6.491
300	14.0	94.243	90.000	4.243
310	14.0	94.967	93.000	1.967
320	13.0	95.739	96.000	0.000
330	13.0	96.484	99.000	0.000
340	13.0	97.210	102.000	0.000
350	12.0	97.919	105.000	0.000
360	12.0	98.611	108.000	0.000
370	12.0	99.288	111.000	0.000
380	12.0	99.950	114.000	0.000
390	12.0	100.598	117.000	0.000
400	11.0	101.233	120.000	0.000
410	11.0	101.855	123.000	0.000
420	11.0	102.464	126.000	0.000
430	11.0	103.062	129.000	0.000
440	11.0	103.649	132.000	0.000
450	10.0	104.225	135.000	0.000
460	10.0	104.790	138.000	0.000
470	10.0	105.345	141.000	0.000
480	10.0	105.891	144.000	0.000
490	10.0	106.428	147.000	0.000
500	10.0	106.956	150.000	0.000
510	9.0	107.475	153.000	0.000
520	9.0	107.986	156.000	0.000
530	9.0	108.489	159.000	0.000
540	9.0	108.984	162.000	0.000
550	9.0	109.472	165.000	0.000
560	9.0	109.952	168.000	0.000
570	9.0	110.426	171.000	0.000
580	9.0	110.893	174.000	0.000
590	8.0	111.353	177.000	0.000
600	8.0	111.807	180.000	0.000

Storage volume (m³) = 41.0 m³



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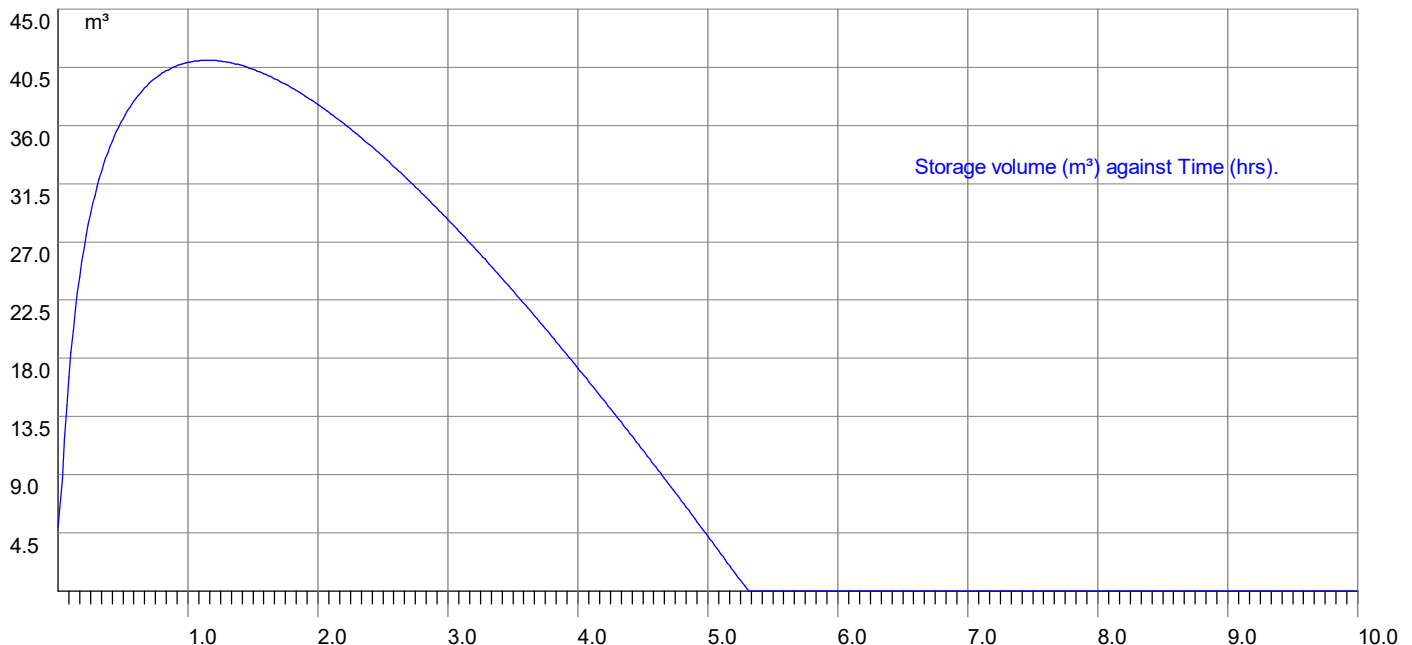
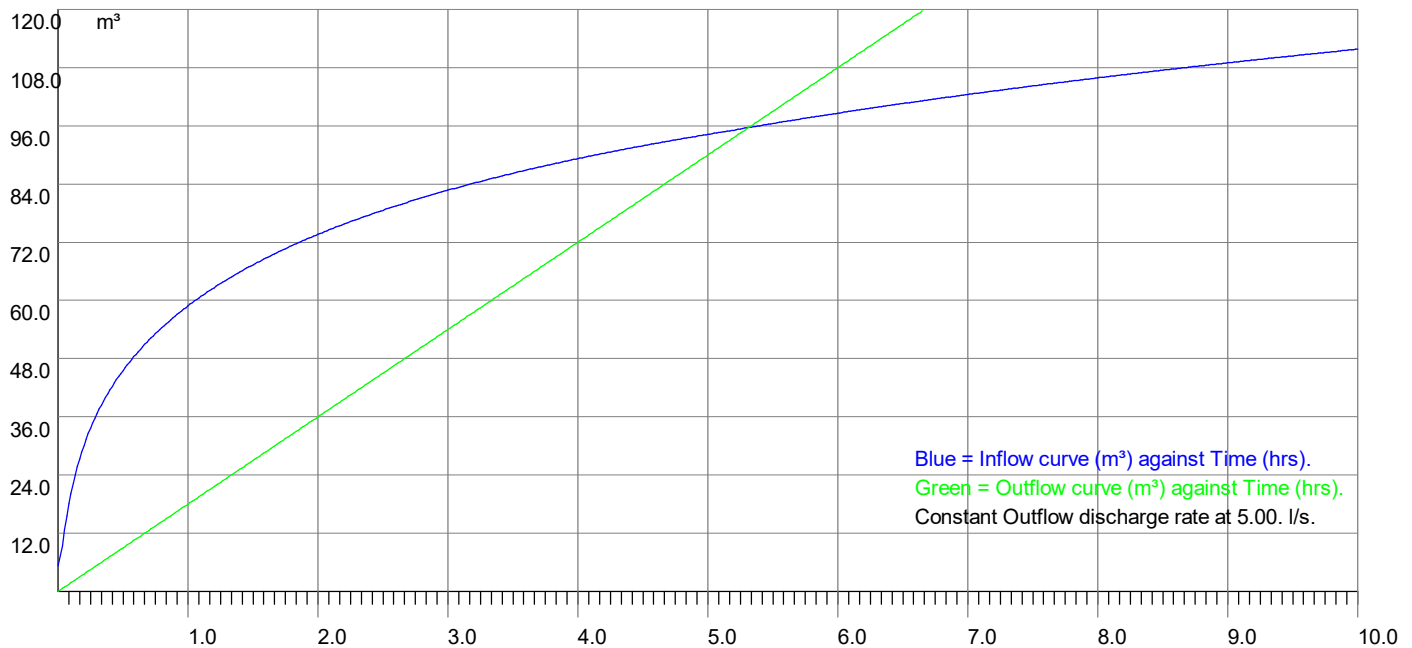
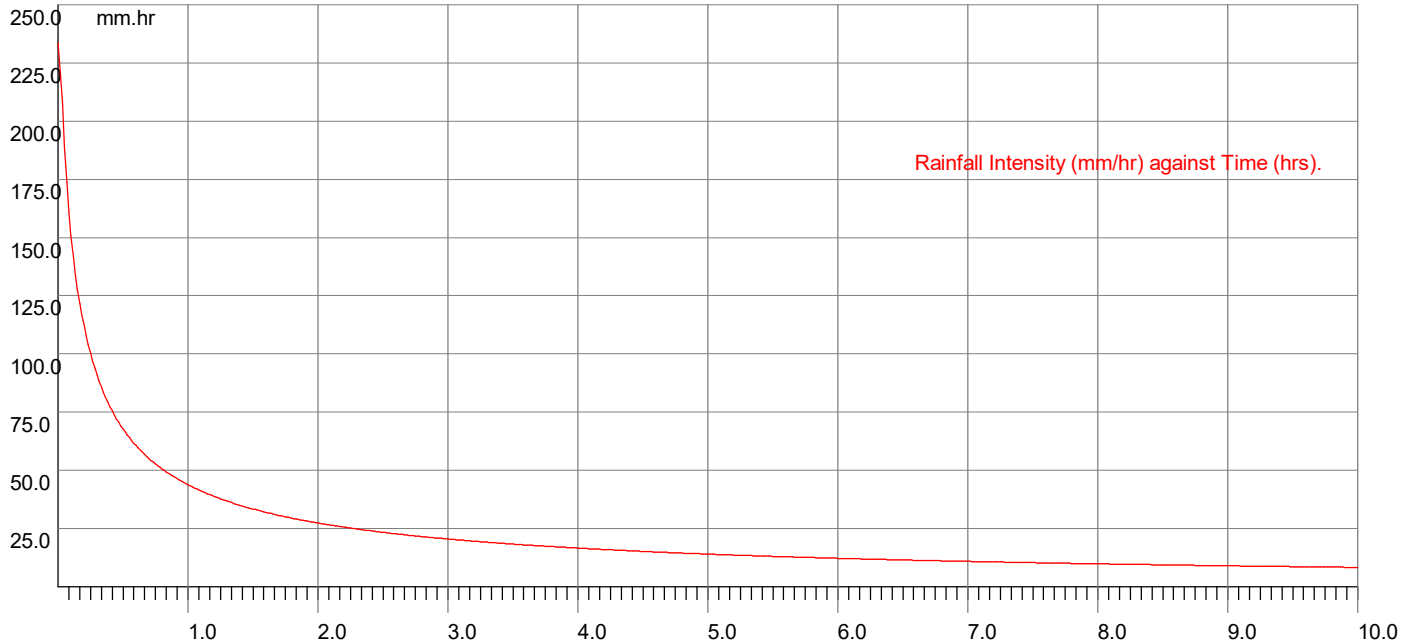
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Eton Hill Road,
Radcliffe M26 2ZS
Tel: 0161 763 7200
email: m.jones@thelkgroup.com

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Project **100 Years + 20% CC Storage Event Blackley Fire Station, Blackley**

Title **100 Years + 20% CC Storage Event Blackley Fire Station, Blackley**





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Job No.		
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Project	100 Years + 40% CC Storage Event Blackley Fire Station, Blackley
Title	100 Years + 40% CC Storage Event Blackley Fire Station, Blackley

Data:-

FSR Hydrology:-

Location = BLACKLEY FS
M5-60 (mm) = 18.1
Soil index = 0.40
Return period = 100
UCWI = 103.6

Grid reference = SD 8603
r = 0.34
SAAR (mm/yr) = 980
WRAP = 3
Climate change = 40

- Relatively impermeable soils in boulder and sedimentary clays, and in alluvium, especially in eastern England;
- Permeable soils with shallow ground water in low-lying areas;
- Mixed areas of permeable and impermeable soils, in approximately equal proportions.

Runoff factor (RF) = 56.0, calculated from:-

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

where

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

UCWI = Calculated value for Wetness Index

Design data:-

Imperv. area = 1700 m²
Total area (TA) = 2400 m²
Mean disch. rate = 5.000 l/s
Additional flow = 0.00 l/s

Pervious area = 700 m²
Equiv area = 1344 m² (TA x RF).
Areal reduction factor = 1.000
Climate change factor = 40

Calculated data:-

Time to max = 83.0 mins
Rainfall at max = 41.18 mm/hr
Pipeline storage = 0.0 m³
Offline storage = 0.0 m³

Calculated storage volume = 51.7 m³
Allowed discharge rate = 5.000 l/s
Available MH storage = 0.0 m³

Fixed 6 hour data:-

Rainfall event = 6 hours
Rainfall rate = 14.00 mm/hr

Calculated storage volume = 4.8 m³
Allowed discharge rate = 5.000 l/s

Rainfall intensities calculated using the Wallingford Procedure

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

Diam	Len	Diam	Len	Ovoid	Len	Box culvert	Len
100	6578.2	1125	52.0	400 x 600	287.0	500 x 500	206.6
150	2923.6	1200	45.7	600 x 900	125.0	500 x 750	137.7
225	1299.4	1275	40.5	800 x 1200	70.3	500 x 1000	103.3
300	730.9	1350	36.1			750 x 1000	68.9
375	467.8	1425	32.4			750 x 1200	57.4
450	324.8	1500	29.2			750 x 1500	45.9
525	238.7	1575	26.5			1000 x 1000	51.7
600	182.7	1650	24.2			1000 x 1200	43.0
675	144.4	1725	22.1			1000 x 1500	34.4
750	116.9	1800	20.3			1000 x 1800	28.7
825	96.6	1875	18.7			1000 x 2000	25.8
900	81.2	1950	17.3			1500 x 1500	23.0
975	69.2	2025	16.0			1500 x 1800	19.1
1050	59.7	2100	14.9			1500 x 2000	17.2



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Data:-

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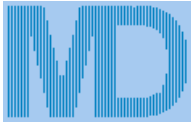
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email: m.jones@thelkgroup.com

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Project	100 Years + 40% CC Storage Event Blackley Fire Station, Blackley
Title	100 Years + 40% CC Storage Event Blackley Fire Station, Blackley

Time (mins)	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)
10	142.0	31.872	3.000	28.872
20	100.0	44.834	6.000	38.834
30	79.0	53.137	9.000	44.137
40	66.0	59.383	12.000	47.383
50	58.0	64.433	15.000	49.433
60	51.0	68.692	18.000	50.692
70	46.0	72.383	21.000	51.383
80	42.0	75.646	24.000	51.646
90	39.0	78.572	27.000	51.572
100	36.0	81.225	30.000	51.225
110	34.0	83.652	33.000	50.652
120	32.0	85.889	36.000	49.889
130	30.0	87.963	39.000	48.963
140	29.0	89.895	42.000	47.895
150	27.0	91.702	45.000	46.702
160	26.0	93.399	48.000	45.399
170	25.0	94.998	51.000	43.998
180	24.0	96.509	54.000	42.509
190	23.0	97.940	57.000	40.940
200	22.0	99.298	60.000	39.298
210	21.0	100.590	63.000	37.590
220	21.0	101.821	66.000	35.821
230	20.0	102.995	69.000	33.995
240	19.0	104.118	72.000	32.118
250	19.0	105.193	75.000	30.193
260	18.0	106.223	78.000	28.223
270	18.0	107.211	81.000	26.211
280	17.0	108.160	84.000	24.160
290	17.0	109.072	87.000	22.072
300	16.0	109.950	90.000	19.950
310	16.0	110.795	93.000	17.795
320	16.0	111.696	96.000	15.696
330	15.0	112.564	99.000	13.564
340	15.0	113.412	102.000	11.412
350	15.0	114.239	105.000	9.239
360	14.0	115.046	108.000	7.046
370	14.0	115.836	111.000	4.836
380	14.0	116.609	114.000	2.609
390	13.0	117.365	117.000	0.365
400	13.0	118.105	120.000	0.000
410	13.0	118.831	123.000	0.000
420	13.0	119.542	126.000	0.000
430	12.0	120.239	129.000	0.000
440	12.0	120.924	132.000	0.000
450	12.0	121.595	135.000	0.000
460	12.0	122.255	138.000	0.000
470	12.0	122.903	141.000	0.000
480	11.0	123.540	144.000	0.000
490	11.0	124.166	147.000	0.000
500	11.0	124.781	150.000	0.000
510	11.0	125.387	153.000	0.000
520	11.0	125.983	156.000	0.000
530	11.0	126.570	159.000	0.000
540	11.0	127.148	162.000	0.000
550	10.0	127.717	165.000	0.000
560	10.0	128.278	168.000	0.000
570	10.0	128.830	171.000	0.000
580	10.0	129.375	174.000	0.000
590	10.0	129.912	177.000	0.000
600	10.0	130.441	180.000	0.000

Storage volume (m³) = 51.7 m³



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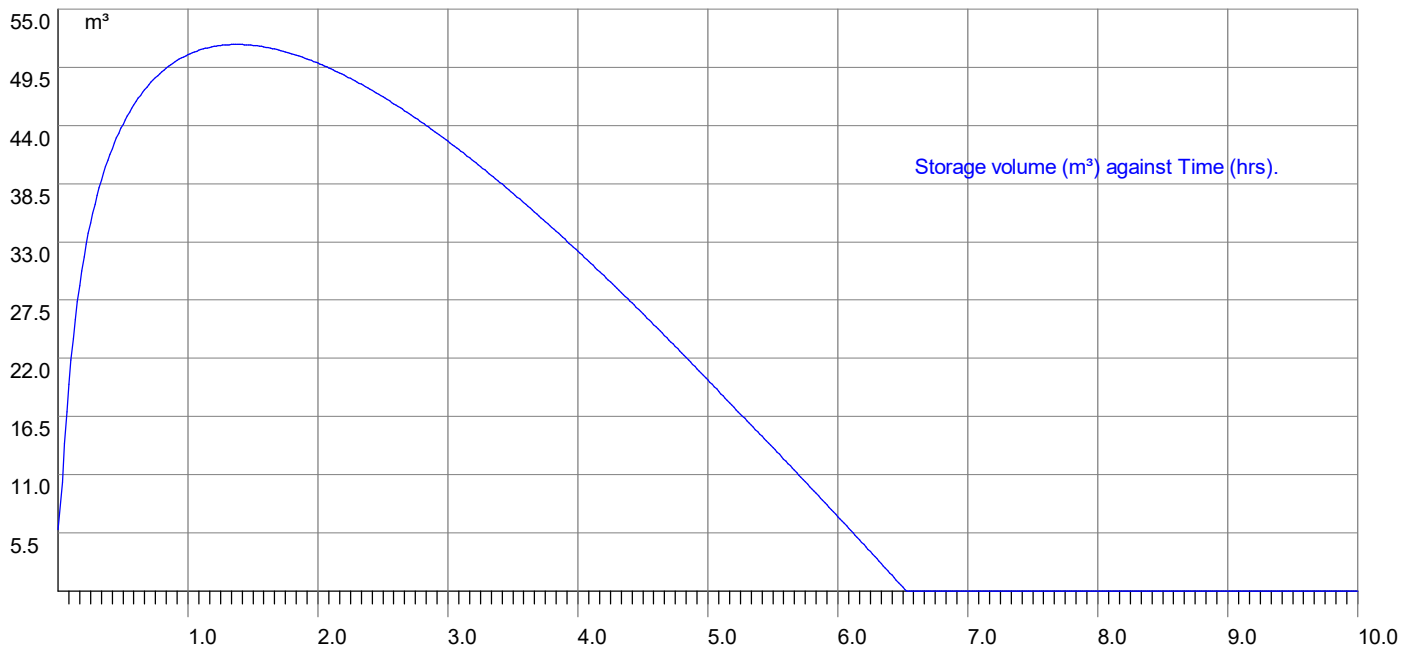
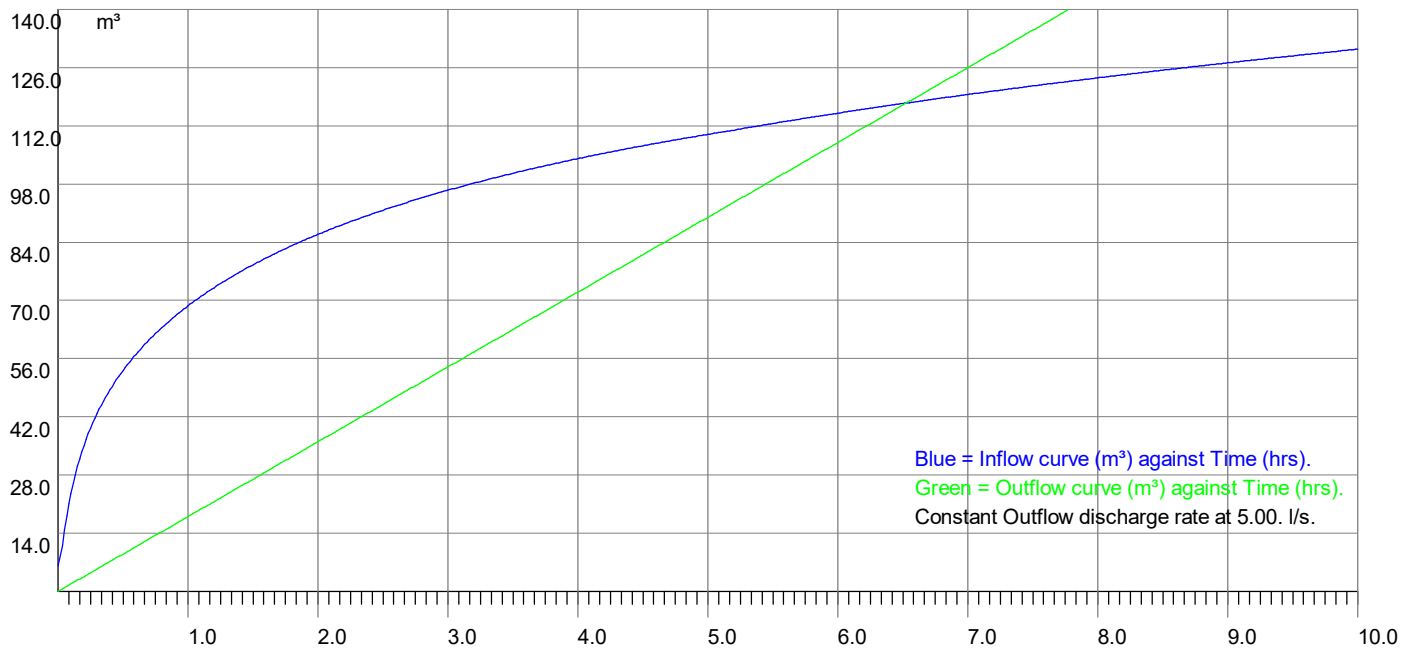
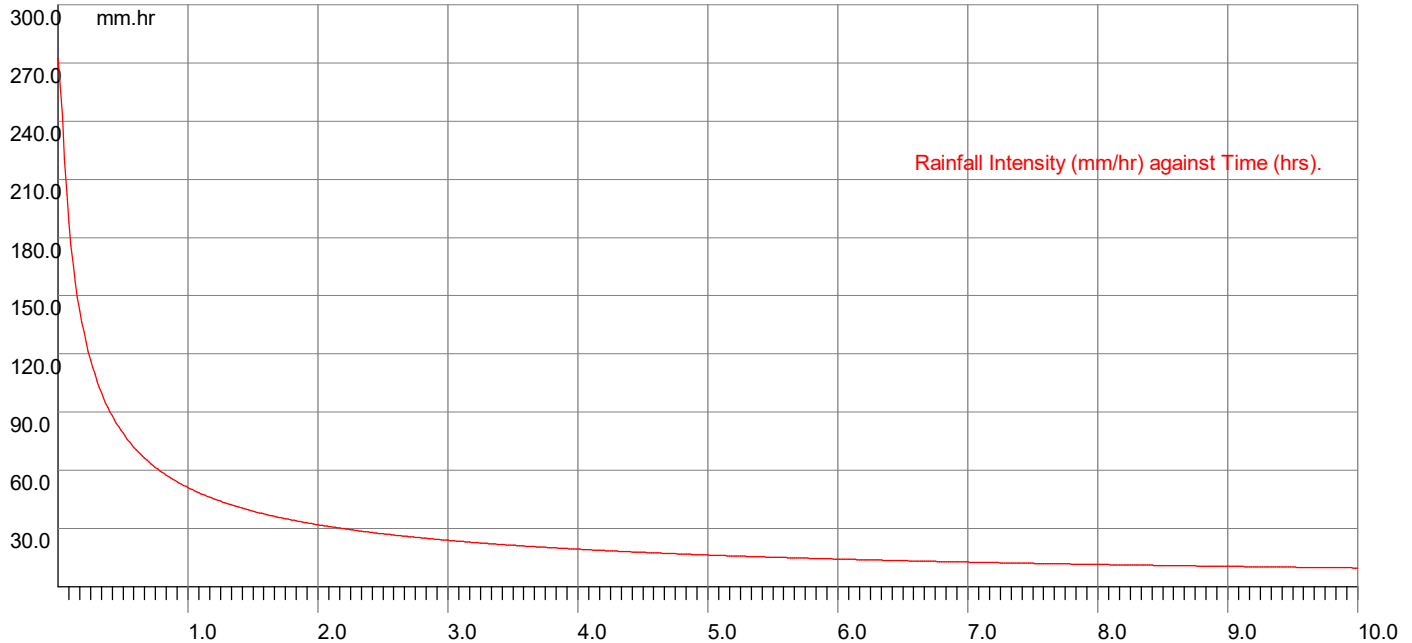
www.thelkgroup.com

Eton Business Park,
Eton Hill Road,
Radcliffe M26 2ZS
Tel: 0161 763 7200
email: m.jones@thelkgroup.com

Job No.		
Sheet no. 3		
Date 22/11/22		
By	Checked	Reviewed

Project **100 Years + 40% CC Storage Event Blackley Fire Station, Blackley**

Title **100 Years + 40% CC Storage Event Blackley Fire Station, Blackley**





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Eton Business Park,
Eton Hill Road,
Radcliffe M26 2ZS
Tel: 0161 763 7200
email: m.jones@thelkgroup.com

Job No.		
Sheet no. 4		
Date 22/11/22		
By	Checked	Reviewed

Project	100 Years + 40% CC Storage Event Blackley Fire Station, Blackley
Title	100 Years + 40% CC Storage Event Blackley Fire Station, Blackley

Explanatory notes for Peak Flow Storage

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

Explanatory notes for Hydrograph Storage

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

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

Why do the two methods give different results?

The rainfall characteristics for each method are very different.

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

The hydrograph method uses a standard curve for either Winter or Summer storms. Traditionally these are symmetrical about the central peak. UK rainfall does not fit into this convenient curve, so the calculations are dealing with a stylised set of data. The mean intensity for the storm is calculated from the IDF curve and applied to the curve data, calculating the storage for that step less the outflow volume. The final storage volume is the sum of the storage for all the steps. The outflow volume varies with the hydraulic head on the control device using flow equations provided by the control manufacturer. This is a far more accurate method than the peak flow method and often results in bigger storage volumes.

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

Based across the UK with
offices in Manchester,
London, Liverpool and Glasgow.

Manchester (Head Office)

Unit 29,
Eton Business Park
Eton Hill Rd, Radcliffe
M26 2ZS

t: 0161 763 7200
e: info@thelkgroup.com

London

Brooklands Business Park
Wellington Way
Weybridge
KT13 0TT

t: 01932 871872
e: info@thelkgroup.com

Glasgow

Wright Business Centre
1 Lonmay Road
Glasgow
G33 4EL

t: 0141 773 6269
e: info@thelkgroup.com

Liverpool

The Corn Exchange
Fenwick Street
Liverpool
L2 7QL

t: 0151 235 8716
e: info@thelkgroup.com

Swindon

39 Bowman House Business Centre
Bowman Court
Whitehill Lane
Royal Wootton Bassett
Swindon
SN4 7DB

t: 01793 987 390
e: info@thelkgroup.com



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