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Flood Risk Assessment Addendum Rev1

117 – 119 Slack Road,
Manchester,
M9 8AZ

23 November 2021

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Appendices

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Appendix C - Section Plan (prepared by KCS Ltd)

Prepared by	Checked by	Date
Carina Clarke BSc (Hons)	Peter Kinsella BSc (Hons)	23 November 2021

This document has been prepared solely as a Flood Risk Assessment Addendum for Kilo Construction Services Ltd. Base Energy accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

Background

Manchester City Council approved a planning application (123969/ FO/ 20) for the construction of 2 terraced dwellings with associated landscaping and boundary protection at 117-119 Slack Road, Manchester.

Condition 4 of the Decision Notice stated:

4) Prior to the commencement of the development, a flood risk assessment for the site detailing proposed flood mitigation measures shall be submitted for approval in writing by the City Council as the Local Planning Authority. The development shall be constructed and completed in accordance with the approved details.

Reason - The application site is located within a critical drainage area and in line with the requirements in relation to sustainable urban drainage systems, further consideration should be given to the control of surface water at the site in order to minimise localised flood risk pursuant to policies SP1, EN17 and DM1 of the Manchester Core Strategy (2012).

In order to discharge Condition 4, Base Energy prepared a Flood Risk and Surface Water Assessment (Rev1; dated 8 January 2021) (see **Appendix A of this Addendum**).

The report concluded:

Flood Risk and Mitigation

- The site is shown to be located within Flood Zone 3 and is therefore considered to be at high risk of fluvial flooding.
- At the time of writing, no topographic survey of the site has been carried out and therefore it is not possible to compare site levels with modelled flood levels to ascertain the potential depths of flooding at the site.
- The EA has confirmed that they do not hold any historic records of flooding at the site location.
- Based on the desktop study of underlying ground conditions, there may be a risk of groundwater flooding at the site and surrounding areas.

- The EA provide maps on their website which illustrate the risk of surface water flooding along with potential depths and velocities; these show that the site is at very low risk of surface water flooding. Slack Road is at high risk of surface water flooding, with potential depths ranging up to 900mm.
- In order to mitigate the risks of flooding, the following measures should be considered:
 - Finished floor levels to be set above existing ground levels.
 - Flood resilient construction techniques to be incorporated into the ground floor, in line with best practice guidance.
 - Occupants should register with the EA to receive flood alerts.

Surface Water and SuDS

Based on the strategic approach for the management of surface water runoff, the most feasible and safe strategy appears to be:

- Rainwater recycling
- Attenuation storage with a controlled outlet into the combined sewer
- Should the client wish to pursue infiltration SuDS further down the line, it is strongly recommended that percolation testing to BRE Digest 365 is carried out in order to a) confirm the suitability of the ground for infiltration, and b) confirm a rate of infiltration.
- *The SuDS strategy has been put together based on our understanding of the ground conditions and site layout. Building Control will need to be consulted on the siting of the SuDS, and the recommendations and advice of the SuDS manufacturer / installer should always be followed.*

Subsequently, Manchester City Council commented on the report stating that "The FRA should assess the risk of the development displacing flood water and how this will impact on surrounding properties."

Given that planning permission was granted and that Condition 6 does not refer to the displacement of flood waters, further clarification has been sought from Manchester City Council.

In an email dated 28 April 2021¹, Manchester City Council stated:

In order to discharge the drainage planning condition, further information is needed to confirm that the proposed drainage design is adequate to manage flood risk.

The outstanding evidence required:

- 1. The appendices referred to within the FRA have not been attached, these will need to be reviewed before the FRA can be approved.*
- 2. The finished floor levels of the property should be compared directly to the EA flood level data and be set a minimum of 300mm above the 1 in 100 year flood event (plus climate change), if this is not feasible then appropriate flood mitigation measures should be implemented (such as raising sockets above the 1 in 100 year flood event plus climate change) – all mitigation measures should refer to the predicted flood levels.*
- 3. The FRA should assess the risk of the development displacing flood water and how this will impact on surrounding properties.*
- 4. The FRA should include an evacuation plan identifying safe access and egress routes. We would also encourage that the properties are registered with the EA to receive early warnings of flood events*

As such, an Addendum (Rev0) to the Flood Risk Assessment was prepared to provide further clarification and more detail to enable the Condition to be discharged (see **Appendix B** of this Addendum). Whilst it was considered that the Addendum addressed the 'outstanding evidence' listed by the Council, further comments were raised by the Council:

- While the additional information does provide some clarification to my [below] points, I would need to see the FRA updated to include the updated information and reassess the level of flood risk posed to the new development.*
- In addition, I would also like to see an assessment of raising the finished floor levels 300mm above the 1 in 100 year flood event (including climate change if possible, and if this is not possible flood resistant building techniques and materials should be considered) as per the standing national advice.*

¹ Email from Eve Woolstencroft @ Manchester City Council to Kilo Construction dated 28 April 2021

-
- *I would also note that I would like to see an update of the excavation calculations (following confirmation of existing site levels) to avoid flood water displacement from the proposed property, this should again be discussed within the FRA.*

This revised Addendum has been prepared to take into account and address the Councils most recent comments. As detailed, for clarity and ease of reference, the initial FRA has been provided in **Appendix A**, and the initial Addendum is provided in **Appendix B**.

1. Level of flood risk posed to the new development.

- Currently, the site is a vacant piece of waste land adjacent to 121 Slack Lane.
- Proposals are for 2 terraced residential dwellings with associated landscaping.
- The EA detailed flooding information confirms that half of the site is located in Flood Zone 3 outline associated with Boggart Hole Brook, which is culverted at this location. The rear portion of the site is shown to be in Flood Zone 1.
- At the modelled node location nearest to the site (Node 3), flood levels are shown to be:
 - 1 in 100 year – 51.07m AOD
 - 1 in 100 year plus 35% CC - 51.19m AOD
 - 1 in 100 year plus 70% CC – 51.27m AOD
 - 1 in 1000 year – 51.25m AOD
- LiDAR data has been obtained from the EA (see **Figure 1** overleaf) and a desktop study of the site levels has been undertaken by KCS Ltd.
- The road level at the entrance to the site is 50.83m AOD
- On this basis, (and recognising that the road level is lower than existing site levels) potential depths of flooding would range from 240mm in the 1 in 100 year event, rising to 360mm in the 1 in 100 year plus 35% allowance for climate change and 440mm in the 1 in 1 in 100 year plus 75% allowance for climate change.
- It should be noted that since the initial FRA and Addendum were prepared, the EA have released revised climate change allowances. The site falls within the Irwell Management Catchment.
- However, given that the application was already prior to the release of the revised allowances, the original levels should still apply.
- In any case, the current 'upper end' allowance for the 2080s scenario (recognising the lifetime of the development) is 75%. So this has been used to inform the flood mitigation strategy (as detailed in Section 3).

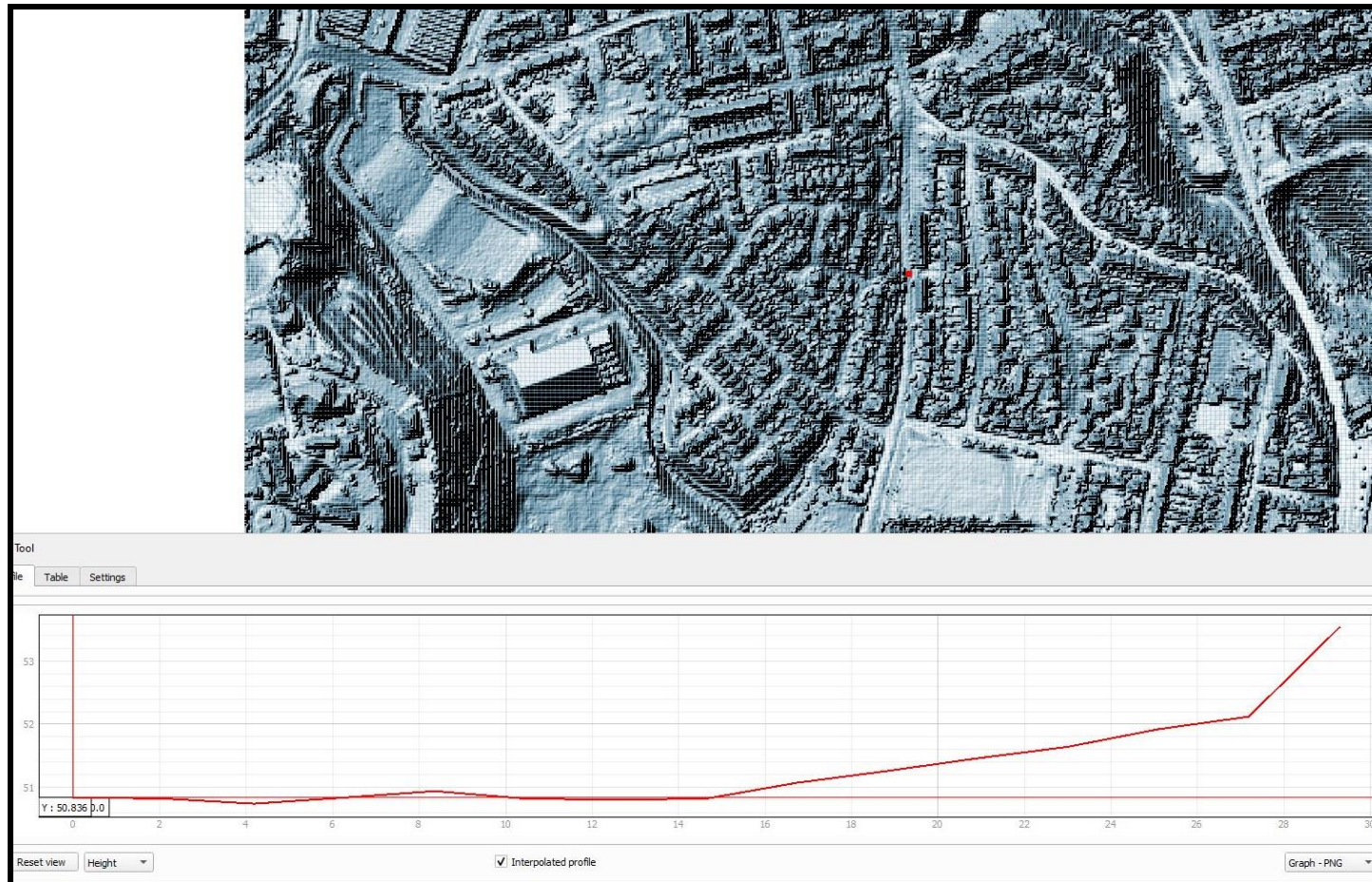


Figure 1 - EA LiDAR Data

2. Finished floor levels and flood resistant building techniques

- A Section Plan has been provided by KCS Ltd. A copy of this is provided in **Appendix C** of this Addendum.
- As shown on the plan, finished floor levels are to be set at 51.27m AOD, which is the 1 in 100 year plus 75% allowance for climate change level and provides a 200mm freeboard above the 1 in 100 year modelled flood level.
- Flood resilient construction techniques will be incorporated, in line with current best practice guidance - Communities and Local Government (CLG) Document, 'Improving the Flood Performance of New Buildings: Flood Resilient Construction'² based on a water exclusion strategy. These include:
 - Where possible, all service entries will be sealed (e.g. with expanding foam or similar closed cell material).
 - Pipework: Closed cell insulation will be used for pipes which are below 300mm
 - Drainage services: Non-return valves in the drainage system to prevent back-flow of diluted sewage in situations where there is an identified risk of the foul sewer surcharging. Maintenance of these valves is important to ensure their continued effectiveness.
 - Water, electricity and gas meters raised above 300mm.
 - Electrical services: electrical sockets will be installed above 300mm to minimise damage to electrical services and allow speedy re-occupation.

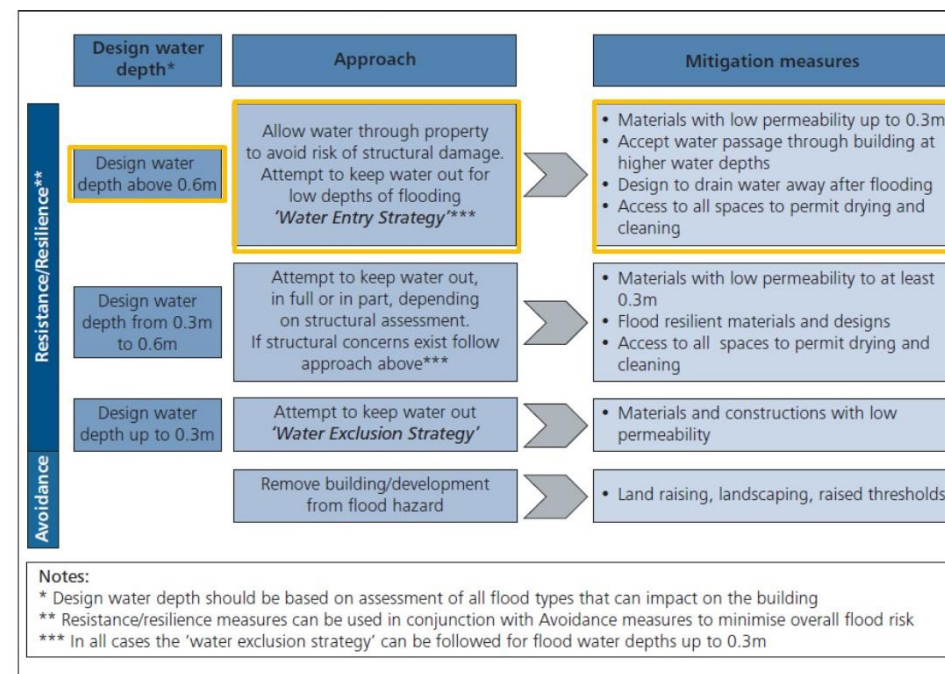


Figure 2 - Best Practice Approach to Flood Mitigation

² Improving the Flood Performance of New Buildings: Flood Resilient Construction. Department for Communities and Local Government. May 2007.

-
- Communications wiring: wiring for telephone, TV, Internet and other services will be protected by suitable insulation in the distribution ducts to prevent damage. Any proposed design solution for flood insulation on all potentially vulnerable wiring should be discussed with the relevant service providers.
 - Engineering bricks (Classes A and B) will be used which has 'good' resilience in terms of water penetration, drying ability and retention of pre-flood dimensions and integrity.
 - Building materials that are effective for a 'water exclusion strategy' include: engineering bricks, cement-based materials including water retaining concrete and dense stone.

3. Flood water displacement from the proposed property

- Compensatory storage will be provided at the rear of the property which is located outside of the flood extents; the land will be lowered to provide 9.3m³ of flood compensation. Channels will be provided to direct any flows to this lowered area of land.
- KCS Ltd calculated the volume of land from the elevation rise measured onsite which agrees with the lidar elevation data.
- The rear garden rises steeply towards the rear. Therefore, as part of the landscaping this portion of site will be levelled with the house.
- The Section Plan provided in **Appendix C** shows the location of the compensatory storage.

Appendices

Appendix A – Flood Risk and Surface Water Assessment Rev1 dated 8 January 2021

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Flood Risk and Surface Water Assessment Rev1

Site Address:

117 – 119 Slack Road,
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Date:

08 January 2021

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- Appendix G** - Micro Drainage Attenuation Storage Calculations

Prepared by	Checked by	Date
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1. Introduction

Manchester City Council has approved a planning application (123969/ FO/ 20) for the construction of 2 terraced dwellings with associated landscaping and boundary protection at 117-119 Slack Road, Manchester.

Condition 4 of the Decision Notice states:

4) Prior to the commencement of the development, a flood risk assessment for the site detailing proposed flood mitigation measures shall be submitted for approval in writing by the City Council as the Local Planning Authority. The development shall be constructed and completed in accordance with the approved details.

Reason - The application site is located within a critical drainage area and in line with the requirements in relation to sustainable urban drainage systems, further consideration should be given to the control of surface water at the site in order to minimise localised flood risk pursuant to policies SP1, EN17 and DM1 of the Manchester Core Strategy (2012).

This Flood Risk and Surface Water Assessment has been prepared to, so far as is practicable, discharge the above condition.

Development Proposals

A site location plan (showing the proposed site layout) is provided in **Appendix A**.

Currently, the site is a vacant piece of waste land adjacent to 121 Slack Lane. As detailed above, proposals are for 2 terraced residential dwellings with associated landscaping. A copy of the proposed site layout is provided in **Appendix B**.

2. Planning Policy- Flood Risk, and Surface Water Management

National Planning Policy Framework

The aim of the National Planning Policy Framework (NPPF) (and accompanying Planning Practice Guidance (PPG)) is to direct development away from areas at highest risk of flooding; where development is necessary, it should be made safe without increasing flood risk elsewhere.

The NPPF states that a Flood Risk Assessment (FRA) is required to support a planning application for developments that are:

- located in Flood Zone 2 and/or Flood Zone 3
- located in Flood Zone 1 and comprise 1ha or above

In some instances, for example where a site is located in Flood Zone 1 and comprises less than 1ha, an FRA may be required if the site is within an area which has critical drainage problems (i.e. a Critical Drainage Area - CDA) as notified to the Local Authority by the Environment Agency (EA).

In order to provide an indication of the flood zone classification of the site, and to ascertain whether an FRA is required, the starting point is the EA flood maps which are available on the EA website.

Environment Agency Flood Map

The EA flood maps show fluvial and tidal flood outlines based on the following:

- Flood Zone 1 - land assessed as having less than 1 in 1000 annual probability of river or sea flooding
- Flood Zone 2 - land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding, or between a 1 in 200 and 1 in 1000 annual probability of flooding from the sea
- Flood Zone 3 - land assessed as having a 1 in 100 or greater annual probability of river flooding, or a 1 in 200 or greater annual probability of flooding from the sea

The flood maps available on the EA website confirm that the site is located within the Flood Zone 3 outline associated with a culverted watercourse (**Figure 1**).

A detailed assessment of flood risk is provided in the following section.

Manchester City Council Core Strategy

Policy EN 14 Flood Risk states:

- In line with the risk-based sequential approach contained within PPS25, development should be directed away from sites at the greatest risk of flooding, and towards sites with little or no risk of flooding; this should take account of all sources of flooding identified in the Manchester-Salford-Trafford Strategic Flood Risk Assessment (SFRA).
- In addition to the requirements for site-specific Flood Risk Assessments (FRAs) set out in PPS25, an appropriate FRA will also be required for all development proposals, including changes of use, on sites greater than 0.5ha within Critical Drainage Areas (CDAs) and Canal Hazard Zones identified in the SFRA.

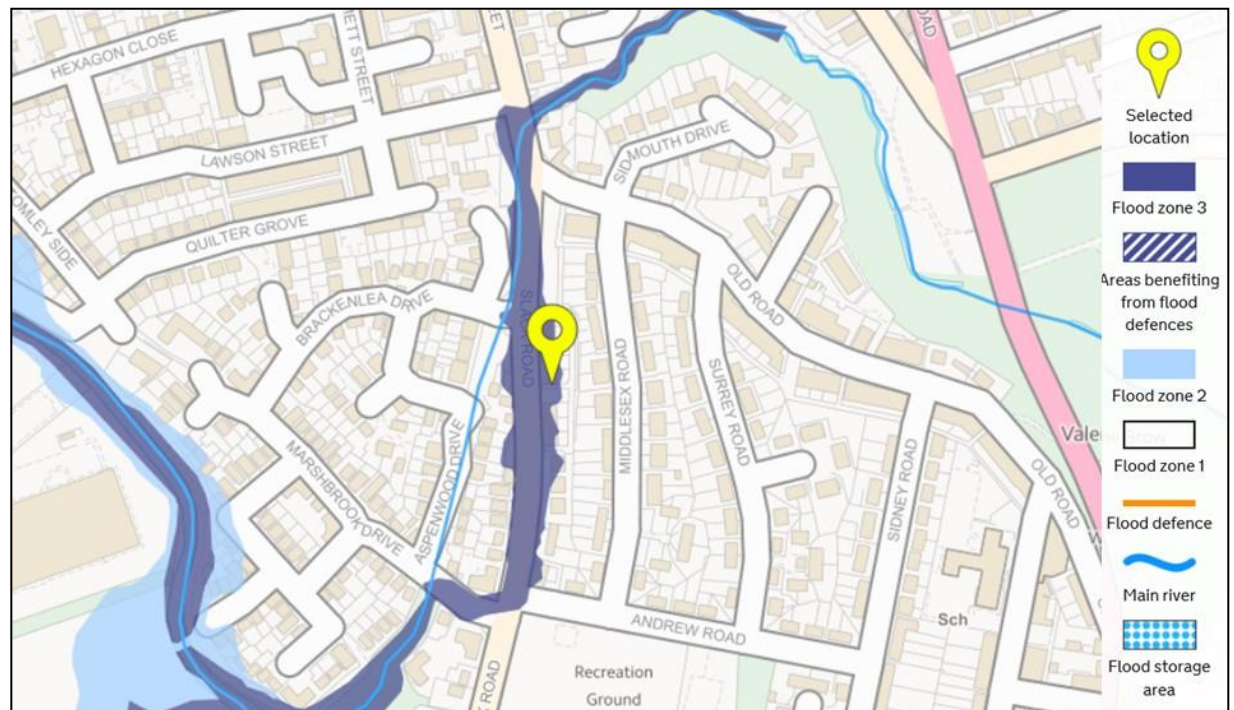


Figure 1 - Environment Agency Flood Map

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- All new development should minimise surface water run-off, including through Sustainable Drainage Systems (SuDS) and the appropriate use of Green Infrastructure. Developers should have regard to the surface water run-off rates in the SFRA User Guide. In CDAs, evidence to justify the surface water run-off approach / rates will be required.
 - The City of Manchester contains many sections of rivers which are culverted or 'hidden'; where these are indicated in the SFRA beneath the proposed development site, further investigation will be required and the development proposal should take this into account; where feasible and appropriate development should seek to open up culverted/hidden rivers to reduce the associated flood risk and danger of collapse, taking advantage of opportunities to enhance biodiversity and Green Infrastructure.

Non-Statutory Technical Standards for SuDS

The Non-Statutory Technical Standards for SuDS, (and accompanying Local Authority SuDS Officer Organisation (LASOO) Practice Guidance) sets out the details which should be addressed within a SuDS Report, including:

- Flood Risk Outside of the Development
- Peak Flow Control and Volume Control
- Flood Risk Within the Development
- Runoff Destinations
- Structural Integrity
- Designing for Maintenance Considerations
- Construction

3. Sources of Flood Risk

Fluvial Flood Risk – Boggart Hole Brook

The site is shown to be located within Flood Zone 3 and is therefore considered to be at high risk of fluvial flooding.

The EA has provided more detailed flooding information including a detailed flood and node location map, and modelled flood levels for a range of events. A copy of the information is provided in **Appendix C**. This confirms that half of the site is located in Flood Zone 3 outline associated with Boggart Hole Brook, which is culverted at this location. The rear portion of the site is shown to be in Flood Zone 1.

At the modelled node location nearest to the site (Node 3), flood levels are shown to be:

- 1 in 100 year – 51.07m AOD
- 1 in 100 year plus 35% CC - 51.19m AOD
- 1 in 100 year plus 70% CC – 51.27m AOD
- 1 in 1000 year – 51.25m AOD

At the time of writing, no topographic survey of the site has been carried out and therefore it is not possible to compare site levels with modelled flood levels to ascertain the potential depths of flooding at the site. However, the flood mitigation strategy (outlined in the following section) will be based on the above flood levels.

Historic Records of Flooding

The EA has confirmed that they do not hold any historic records of flooding at the site location.

Groundwater Flooding

Groundwater flooding generally occurs during intense, long-duration rainfall events, when infiltration of rainwater into the ground raises the level of the water table until it exceeds ground levels. It is most common in low-lying areas overlain by permeable soils and permeable geology, or in areas with a naturally high water table.

The Soils Maps provided by the National Soil Resources Institute at Cranfield University indicate that the soils at the site and surrounding areas are comprised of 'Slowly permeable seasonally wet acid loamy and clayey soils'.

Reference has been made to the British Geological Survey geology maps; these indicate that the site is underlain by Glaciofluvial Sheet Deposits, Devensian - Sand and Gravel. The underlying bedrock is comprised of Chester Formation - Sandstone.

Based on the above, there may be a risk of groundwater flooding at the site and surrounding areas.

Surface Water Flooding

Surface water flooding results from rainfall generated overland flows, before the runoff reaches a watercourse/ drainage system, or where the watercourse/ drainage system is overwhelmed and unable to accept further runoff. Surface water runoff is usually associated with high intensity rainfall events but may also occur with lower intensity rainfall where the ground is saturated, developed or otherwise has low permeability resulting in overland flows and ponding within depressions in the topography.

The EA provide maps on their website which illustrate the risk of surface water flooding along with potential depths and velocities; these show that the site is at very low risk of surface water flooding. Slack Road is at high risk of surface water flooding, with potential depths ranging up to 900mm.

Section 5 of this report details the surface water drainage strategy for the site, which will ensure that surface water is appropriately managed over the lifetime of the development and will ensure that the proposals will not exacerbate surface water flooding at the site or surrounding areas.

Sewer Flooding

Sewer flooding occurs when the capacity of underground sewerage systems is exceeded, resulting in flooding inside and outside of buildings. Normal discharge of sewers and drains through outfalls may be impeded by high water levels in receiving waters.

There are no known records of sewer flooding at the site location.

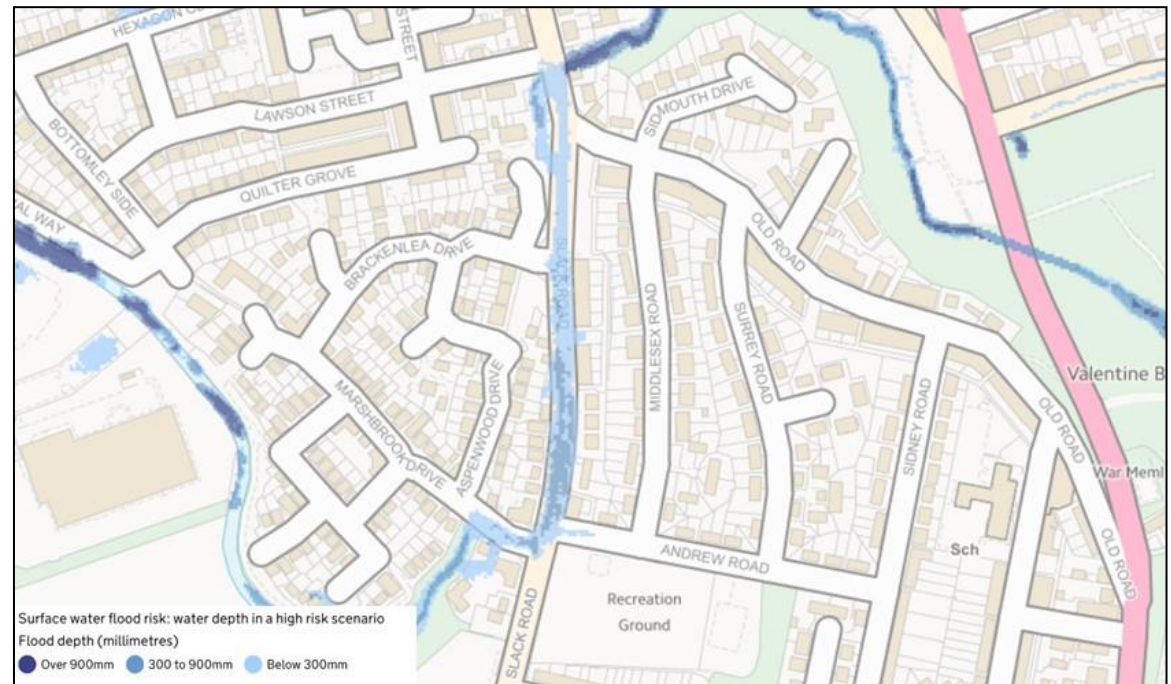


Figure 2 – Environment Agency Surface Water Flooding Map

4. Flood Mitigation Measures

Given that the site is located in Flood Zone 3, and proposals are for residential development, the following measures to mitigate the risk of flooding are recommended.

Floor Levels

Finished floor levels will be set above ground levels.

Flood Resilient Construction

Flood resilient construction techniques should also be incorporated into the ground floor, in line with guidance provided in the Communities and Local Government Document, *Improving the Flood Performance of New Buildings: Flood Resilient Construction*¹. These include:

- Flood resilient building materials and fittings
- Raised sockets

The Design Team should review the guidance and ensure that the most appropriate measures are incorporated into the proposals.

Flood Alerts

The site is located in an area where the EA provides Flood Alerts. Occupants should register with the EA at:

<https://www.fws.environment-agency.gov.uk/app/olr/doDetails>

¹ Improving the Flood Performance of New Buildings: Flood Resilient Construction. Department for Communities and Local Government. May 2007.

5. Surface Water and SuDS

The whole site comprises approximately 170m².

Surface Water Runoff from the Existing Site

The existing site is a vacant portion of waste land.

A copy of the Thames Water public sewer records is provided in **Appendix D**. These show that a 225mm public combined sewer is located to the north of the site, before connecting into the main combined sewer located in Slack Road.

In order to gain an indication of the rates of surface water runoff from the existing site, the ICP SuDS Method within Micro Drainage has been used, as detailed in **Appendix E**. The flow rates are shown in **Table 2**.

Table 2 –ICP SuDS - Existing Rates of Runoff (greenfield) (l/s)

Return Period	Flow Rate for 170m ² (l/s)
1 in 1 year	0.1
Qbar	0.2
1 in 30 year	0.2

Surface Water Runoff from the Redeveloped Site

As shown on the proposed site drawings, following redevelopment the site areas will be as follows:

- Roof areas - 100m²
- Hardstanding (paving etc) - ~20m²
- Landscaped areas – ~70m²

Through redevelopment of the site, there will be a decrease in hardstanding areas of ~1372m².

SuDS Approach

When choosing and designing SuDS for a development, it is important to recognise the constraints associated with the type of SuDS to be installed, including the size of the site and the underlying ground conditions. Most Councils set out a strategic approach for the disposal of surface water runoff, which mirrors the hierarchy set out in Building Regulations Approved Document Part H². In general, these are as follows:

1 Store rainwater for later use

There is the potential for simple rainwater reuse. See the following section of this report.

2 Use infiltration techniques, such as porous surfaces in non-clay areas

As previously detailed, the Soilscales Maps provided by the National Soil Resources Institute at Cranfield University indicate that the soils at the site and surrounding areas are comprised of 'Slowly permeable seasonally wet acid loamy and clayey soils'.

The British Geological Survey geology maps indicate that the site is underlain by Glaciofluvial Sheet Deposits, Devensian - Sand and Gravel. The underlying bedrock is comprised of Chester Formation - Sandstone.

In order to investigate the underlying ground conditions further, a review of nearby BGS borehole records has been carried out. A copy of the records is provided in **Appendix F**. These indicate that beneath the top layer of made ground is a band of peat / clayey sand.

Given the presence of clay, infiltration of surface water is not recommended. Should infiltration SuDS be pursued further down the line, it is strongly recommended that percolation testing to BRE Digest 365 is carried out in order to a) confirm the suitability of the ground for infiltration, and b) confirm a rate of infiltration.

² Building Regulations Approved Document H Section 3 page 45

3 Attenuate rainwater in ponds or open water features for gradual release

The site does not have the appropriate space required for a pond or open water feature to be safely provided.

4 Attenuate rainwater by storing in tanks or sealed water features for gradual release

Attenuation storage with a controlled outlet is an option.

5 Discharge rainwater direct to a watercourse

It is not feasible to discharge directly into the nearby watercourse.

6 Discharge rainwater to a surface water sewer/drain

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

7 Discharge rainwater to the combined sewer.

Attenuation storage with a controlled outlet into the public combined sewer is an option.

Based on the strategic approach for the management of surface water runoff, the most feasible and safe strategy appears to be:

- Rainwater recycling
- Attenuation storage with a controlled outlet into the combined sewer

Rainwater Recycling

In order to provide a level of rainwater recycling, water butts should be provided. Water butts afford the opportunity for future occupants to reuse water collected in the water butt, for example when watering the garden/or washing cars etc. If this supply is used frequently this may also ensure that some additional storage is available during an extreme rainfall event.

However, it is not recommended that water butts are used for storm water storage as there is a possibility that they may be full before the onset of a storm and as such there is no guarantee that these types of system will provide additional storage when required. Any additional storage provided by the water butt has therefore not been included within the SuDS calculations for the site.

Attenuation Storage with Hydrobrake

Micro Drainage has been used to calculate storage for surface water runoff from hardstanding areas (120m²) in up to the 1 in 100 year plus 40% allowance for climate change.

Flows have been restricted to 2l/s; this is the lowest flow rate recommended to avoid blockage of the system.

As shown in **Appendix G**, a total storage volume of 1.6m³ will be required. The storage has been designed at a depth of 1.5m, filling to 1.0m and with a 0.5m freeboard provided, should any excess flows be received.

The SuDS strategy has been put together based on our understanding of the ground conditions and site layout. Building Control will need to be consulted on the siting of the SuDS, and the recommendations and advice of the SuDS manufacturer / installer should always be followed.

SuDS Maintenance

Schedules are provided below (taken from Ciria C753 The SuDS Manual): the property owners / management company will be responsible for ensuring that these, or similar schedules are followed.

Water Butts

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	The water butt should be routinely checked for litter – leaves can become trapped in the water butt which could lead to blockage of the taps and overflow	Monthly
	Where appropriate, and if safe to do so, the water butt should be cleaned annually to prevent smells associated with stagnant water, and to remove any algae.	Annually

Attenuation Storage

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	Remove sediment from pre-treatment structures and/or internal forebays	Annually, or as required
Remedial Actions	Repair/ rehabilitate inlets, outlet, overflow, and vents	As required
Monitoring	Inspect/ check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build up and remove if necessary	Every five years, or as required

Pipe System

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required take remedial action.	Monthly for 3 months then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly

	Remove sediment from pre-treatment inlet structures and inspection chambers.	Annually or as required
	Maintain vegetation to designed limits within the vicinity of below ground drainage pipes and tanks to avoid damage to system	Monthly or as required
Remedial Actions	Repair physical damage if necessary	As required
Monitoring	Inspect all inlets, outlets and vents to ensure that they are in good condition and operating as designed.	Annually
	Survey inside of pipe runs for sediment build up and remove if necessary.	Every 5 years or as required

Hydrobrake

Hydro International Warranty, Maintenance Statement

The following has been provided by Hydro International:

Normally, little maintenance is required as there are no moving parts within the Flow Control. Experience has shown that if blockages occur they do so at the intake, and the cause on such occasions has been due to a lack of attention to engineering detail such as approach velocities being too low, inadequate benching, or the use of units below the minimum recommended size.

The Flow Control (where applicable) is fitted with a pivoting bypass door, which allows the manhole chamber to be drained down should blockage occur. The smaller conical units, below the minimum recommended size, are also supplied with rodding facilities or vortex suppressor pipes as standard.

Following installation of the Flow Control it is vitally important that any extraneous material i.e. building materials are removed from the unit and the chamber.

After the system is made live, and assuming that the chamber design is satisfactory, it is recommended that each unit be inspected monthly for three months and thereafter at six monthly intervals with hose down if required.

6. Conclusions

This Flood Risk and Surface Water Assessment has been prepared to, so far as is practicable, discharge Condition 4 of the Decision Notice for the proposed residential development on a portion of vacant land located off Slack Road.

Proposals are for 2 terraced dwellings.

Flood Risk and Mitigation

- The site is shown to be located within Flood Zone 3 and is therefore considered to be at high risk of fluvial flooding.
- At the time of writing, no topographic survey of the site has been carried out and therefore it is not possible to compare site levels with modelled flood levels to ascertain the potential depths of flooding at the site.
- The EA has confirmed that they do not hold any historic records of flooding at the site location.
- Based on the desktop study of underlying ground conditions, there may be a risk of groundwater flooding at the site and surrounding areas.
- The EA provide maps on their website which illustrate the risk of surface water flooding along with potential depths and velocities; these show that the site is at very low risk of surface water flooding. Slack Road is at high risk of surface water flooding, with potential depths ranging up to 900mm.
- In order to mitigate the risks of flooding, the following measures should be considered:
- Finished floor levels to be set above existing ground levels.
- Flood resilient construction techniques to be incorporated into the ground floor, in line with best practice guidance.
- Occupants should register with the EA to receive flood alerts.

Surface Water and SuDS

Based on the strategic approach for the management of surface water runoff, the most feasible and safe strategy appears to be:

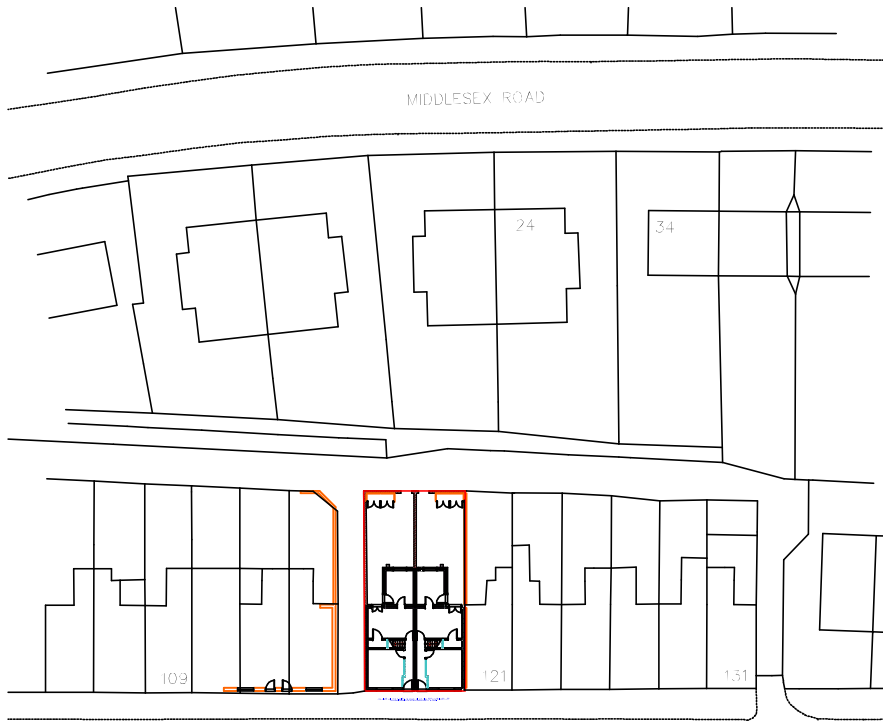
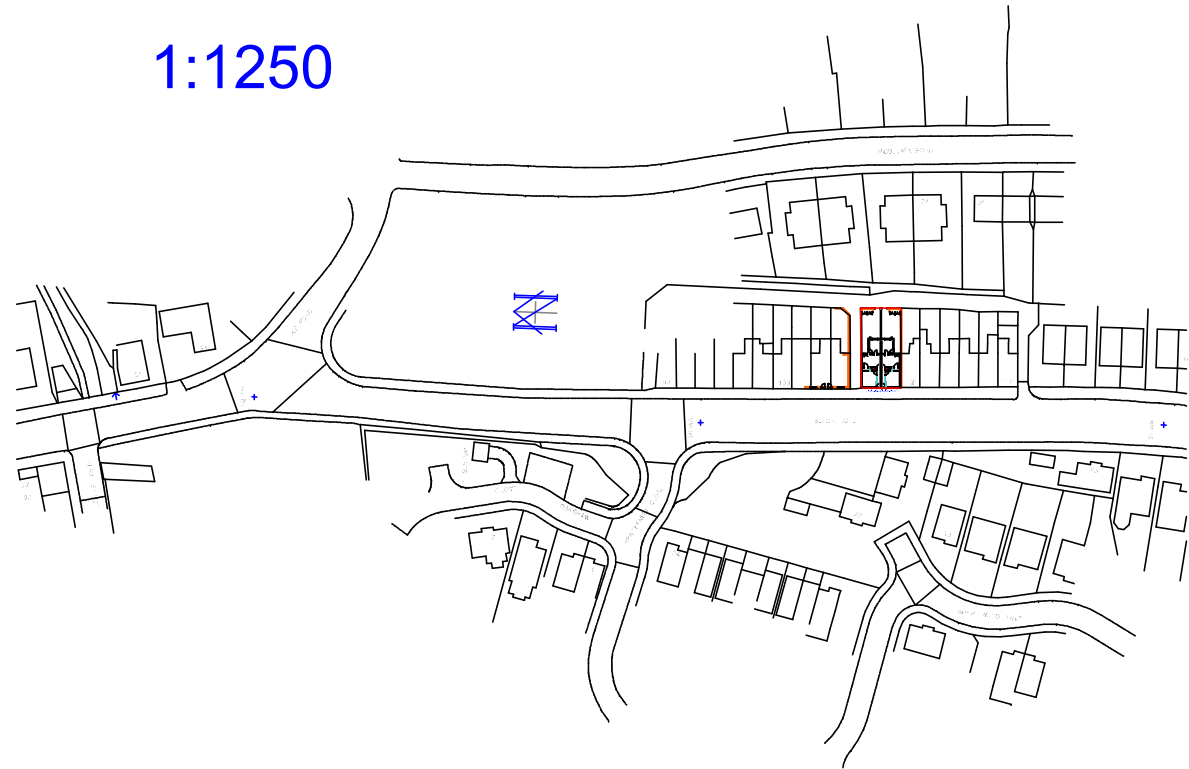
- Rainwater recycling
- Attenuation storage with a controlled outlet into the combined sewer

-
- Should the client wish to pursue infiltration SuDS further down the line, it is strongly recommended that percolation testing to BRE Digest 365 is carried out in order to a) confirm the suitability of the ground for infiltration, and b) confirm a rate of infiltration.
 - *The SuDS strategy has been put together based on our understanding of the ground conditions and site layout. Building Control will need to be consulted on the siting of the SuDS, and the recommendations and advice of the SuDS manufacturer / installer should always be followed.*

Appendices

Appendix A - Site Location

1:1250



SLACK ROAD



1:500

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Jeffrey C. Goodchild

Architectural Technologist

62 Belmont Ave, Springhead,
Oldham, OL4 4RS.
Tel : 078165 98985



Scale:

Client:

Mr I Shah

Date:

15/05/2019

Address:

117/119 Slack Rd.,
Manchester
M9 8AZ

Dwg. Rev. Page

5491

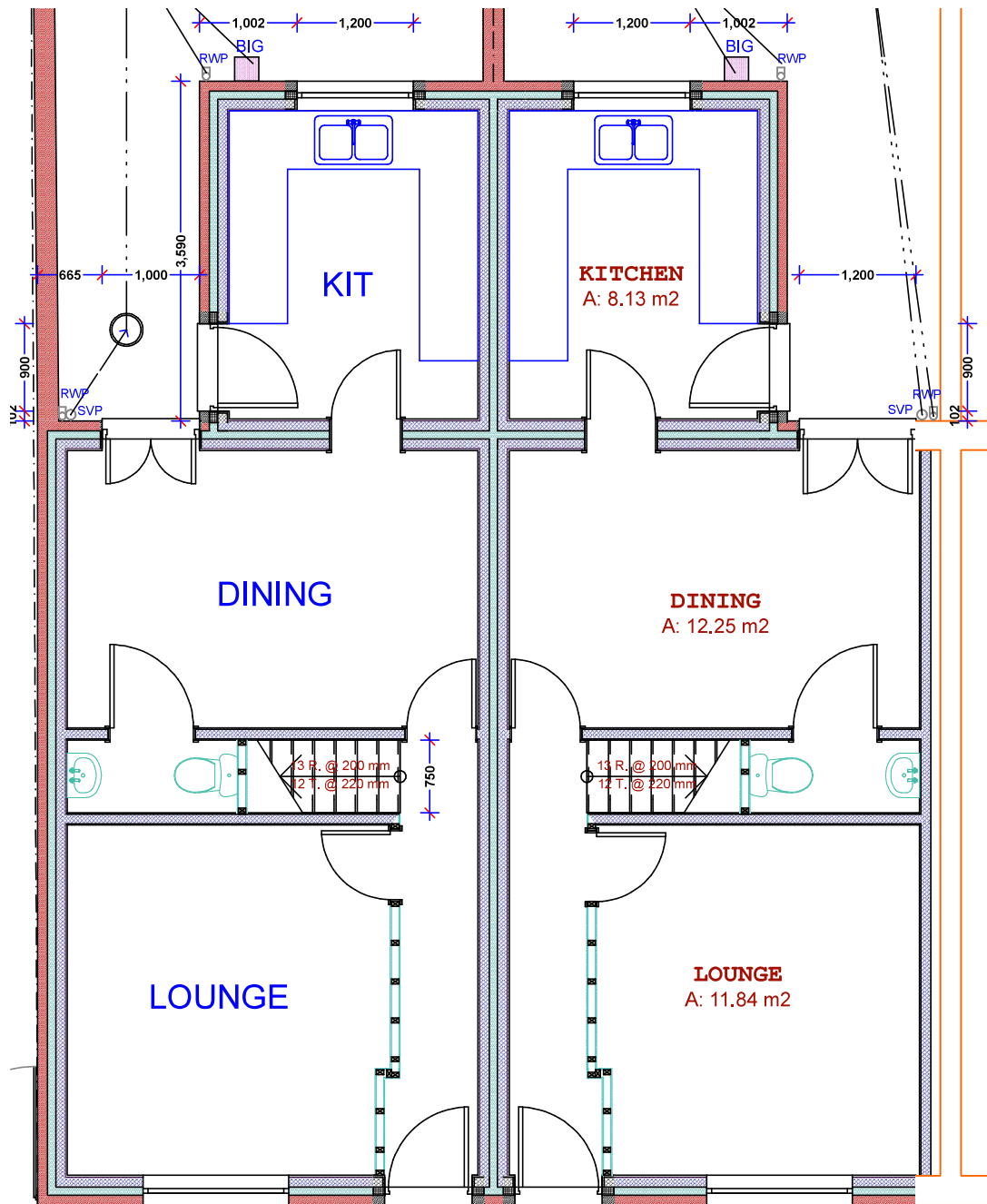
B

Title:

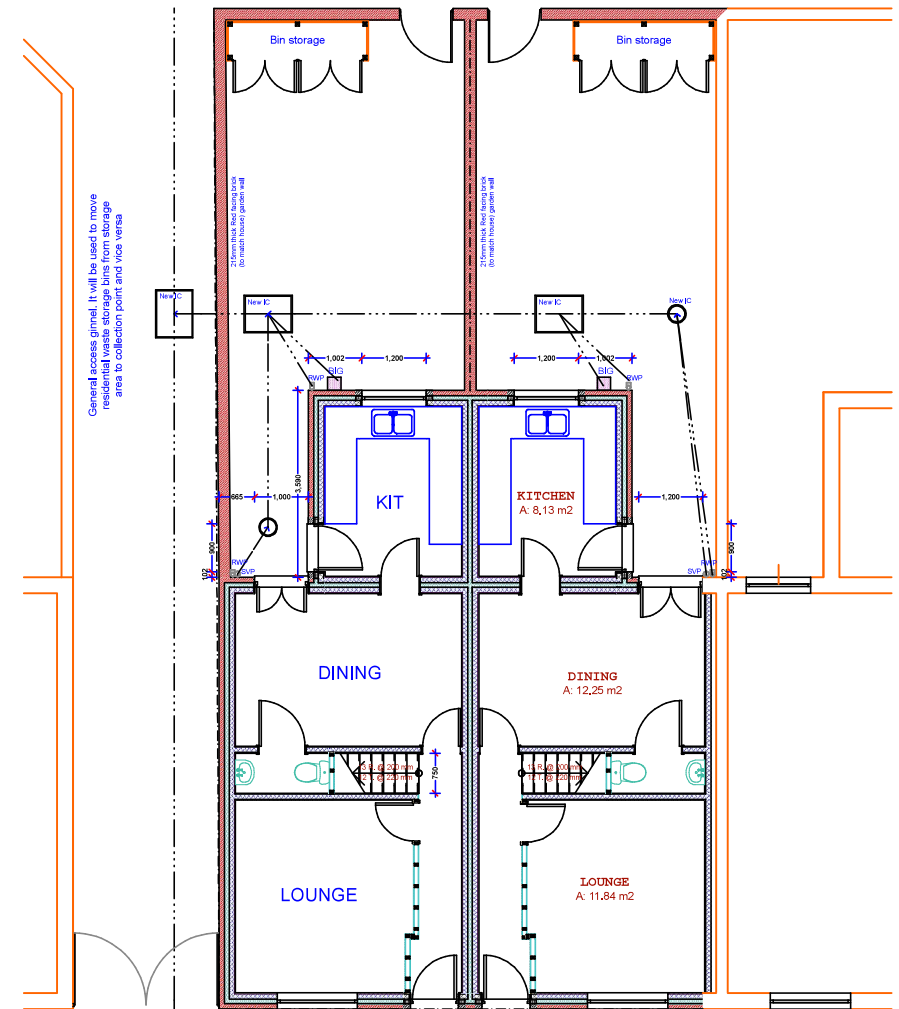
2No New Build
Terrace Houses

B=planners request
windows 06/08/19

Appendix B - Proposed Site Layout



Proposed Ground



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Scale:
1:100 & 1:50

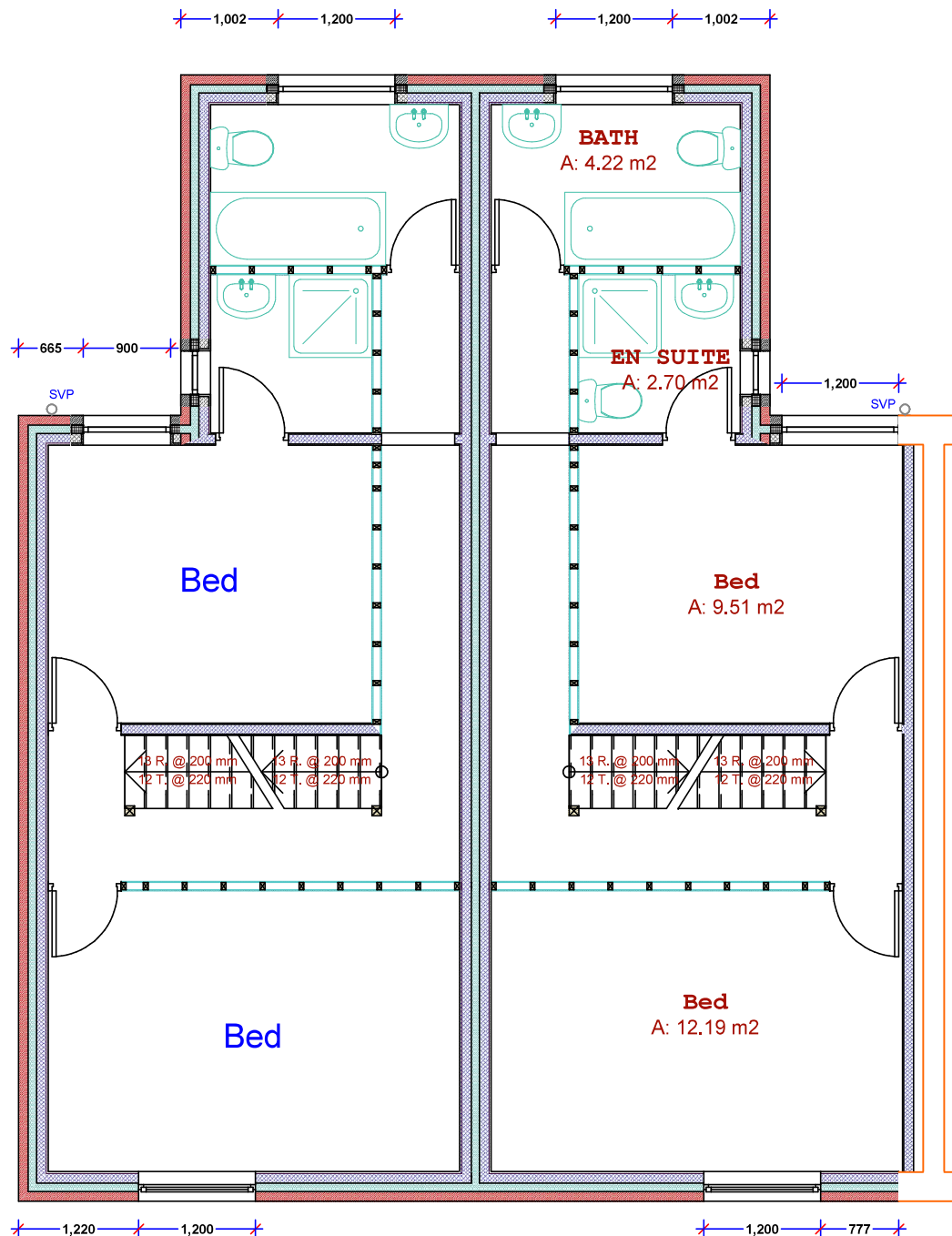
Client:
Mr I Shah

Date:
15/05/2019

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Manchester
M9 8AZ

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5491 B 1/5

Title: 2No New Build
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Proposed First

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Scale: 1:50

Client: Mr I Shah

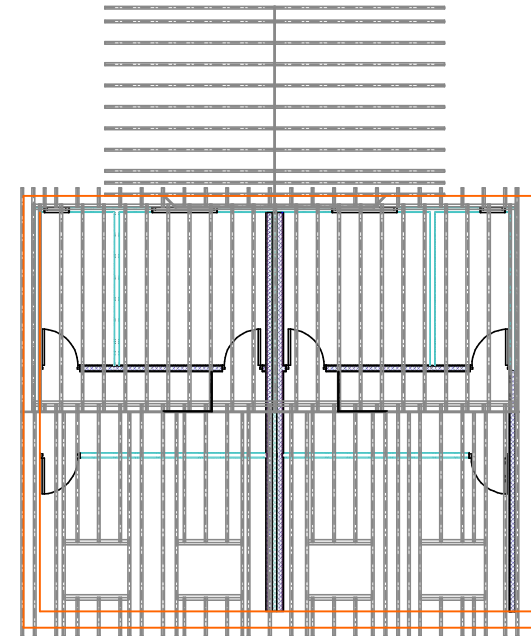
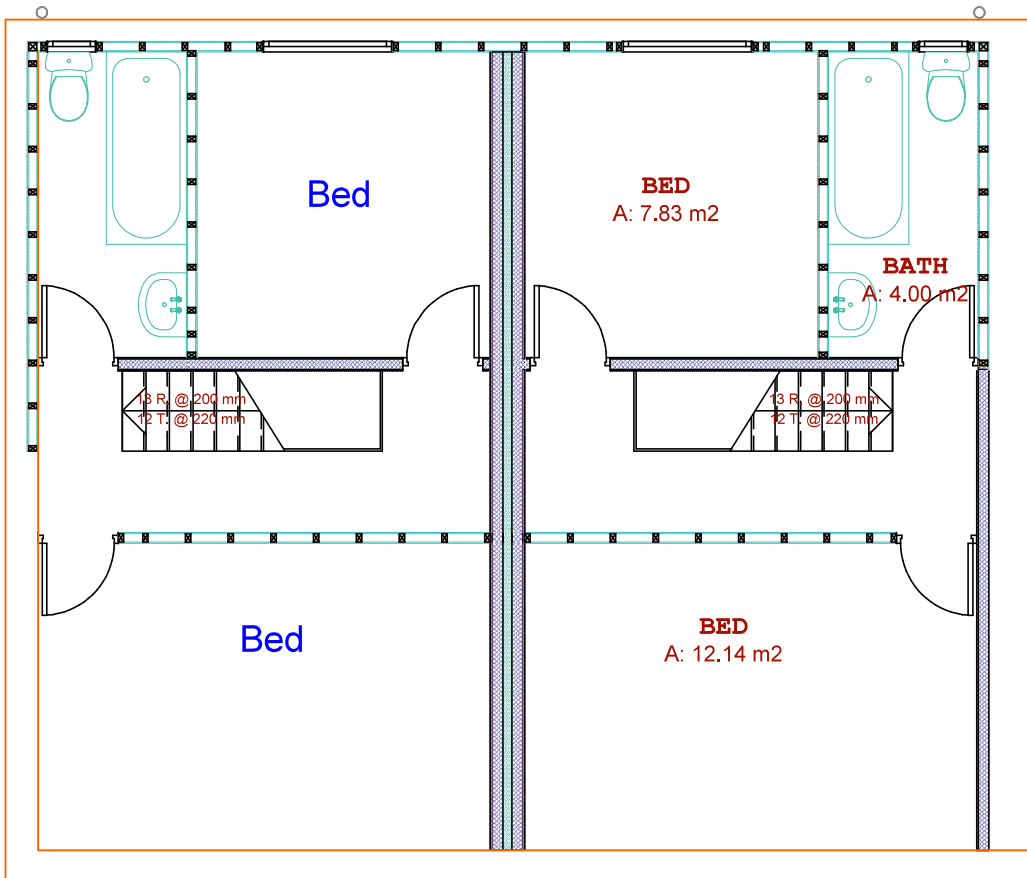
Date: 15/05/2019

Address: 117/119 Slack Rd.,
Manchester
M9 8AZ

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Title: 2No New Build
Terrace Houses

Proposed Second



Proposed roof structure

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Scale:

1:50

Client:

Mr I Shah

Date:

15/05/2019

Address: 117/119 Slack Rd.,
Manchester
M9 8AZ

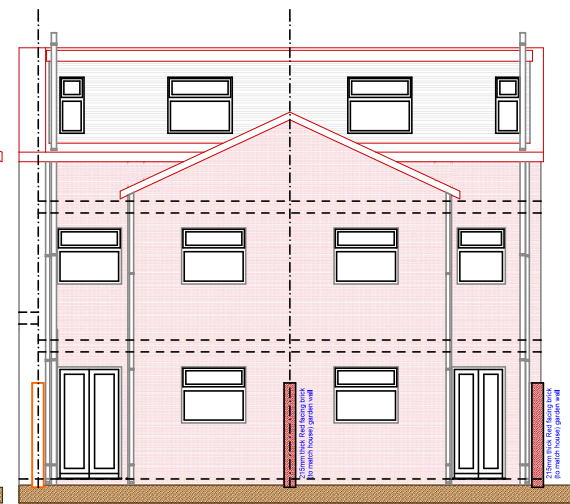
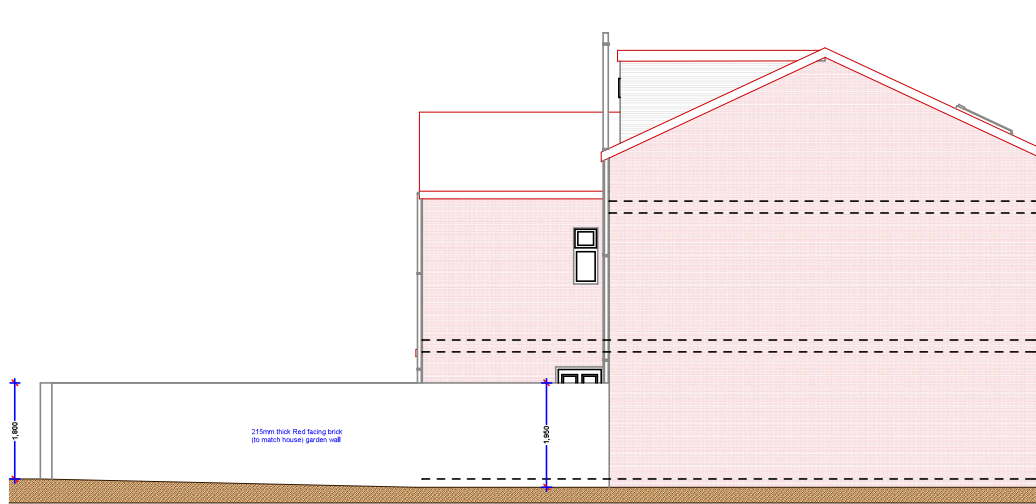
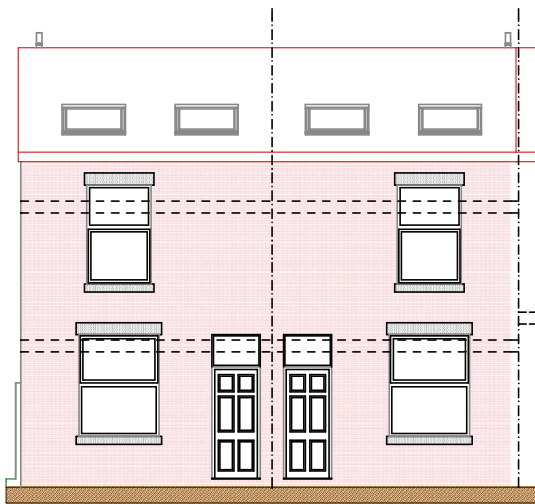
Dwg. Rev. Page

5491

B 3/5

Title:

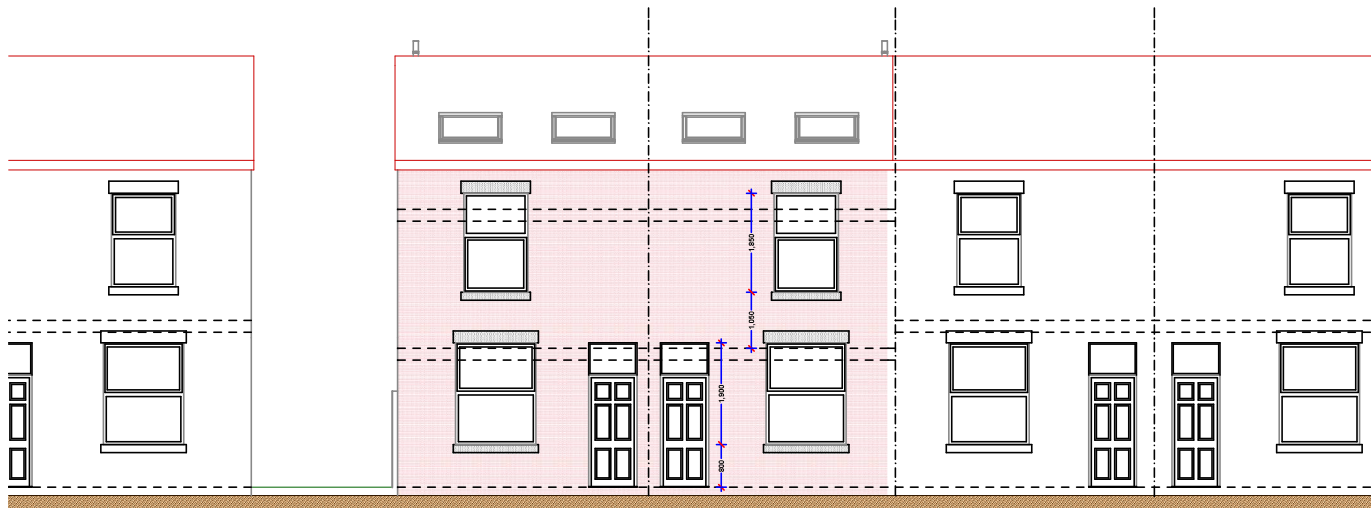
2No New Build
Terrace Houses



Front

Side

Rear



Street

Elevations

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Scale:

1:100

Client:

Mr I Shah

Date:

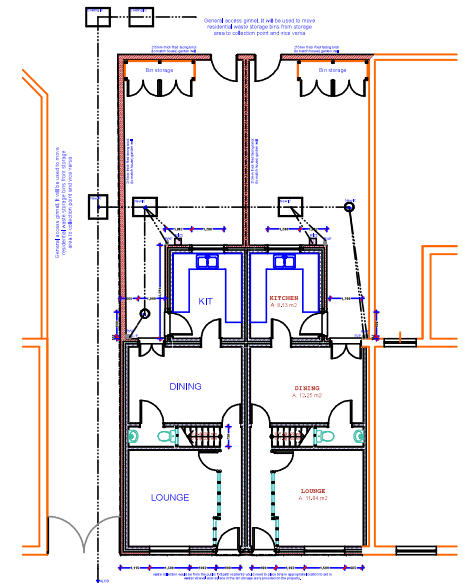
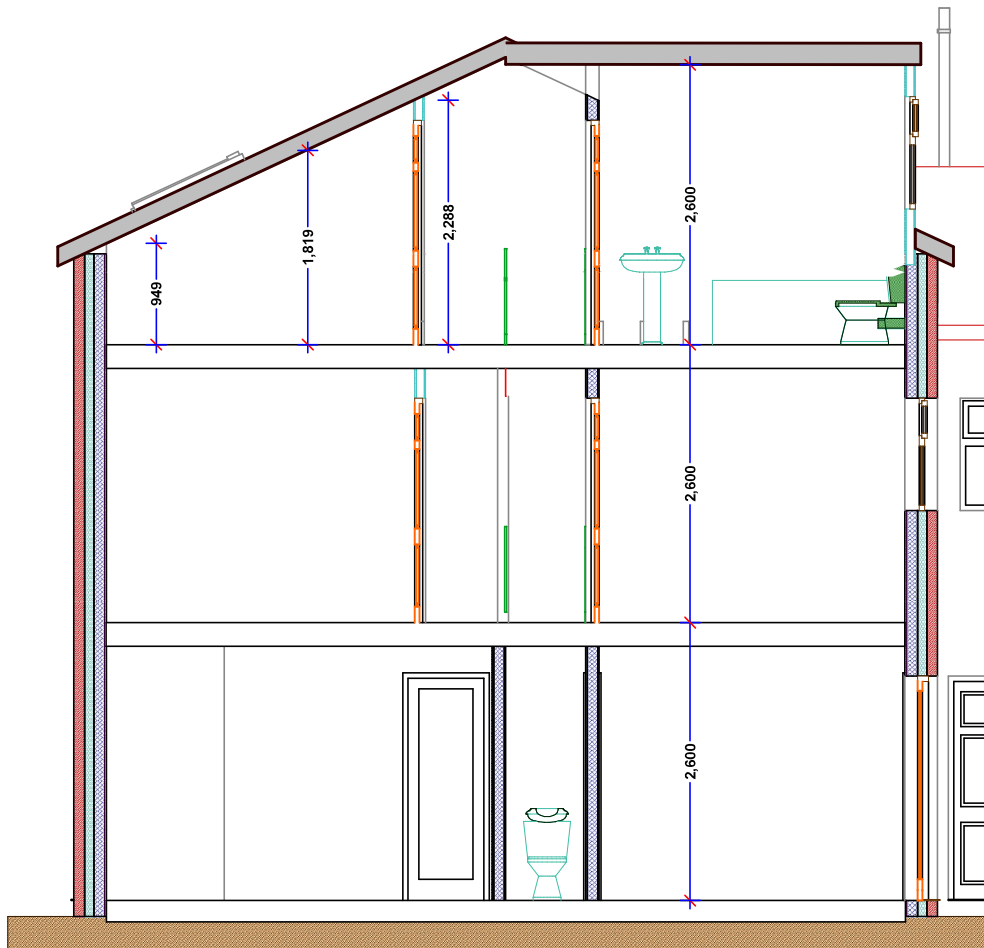
15/05/2019

Address: 117/119 Slack Rd.,
Manchester
M9 8AZ

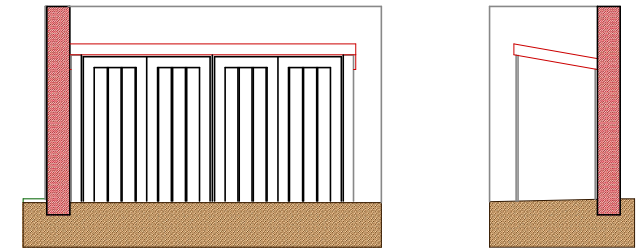
Dwg. Rev. Page
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Title: 2No New Build
Terrace Houses

Test Section



Waste storage



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Scale:

1:50

Client:

Mr I Shah

Date:

15/05/2019

Address: 117/119 Slack Rd.,
Manchester
M9 8AZ

Dwg. Rev. Page

5491

B 4/5

Title:

2No New Build
Terrace Houses

Appendix C - Environment Agency Detailed Flood Information

Map Reference	Model Node Reference	Easting	Northing	Data	Undefended			
					1 % AEP (1 in 100 year)	1 % AEP (1 in 100 year) + 35% increase in flow	1 % AEP (1 in 100 year) + 70% increase in flow	0.1 % AEP (1 in 1000 year)
1	ea013_0060_BOGG01_0787	385740	402853	Modelled Water Level (m aodN)	54.71	54.92	55.06	55.01
				Modelled Flow (cumecs)	8.23	11.71	14.75	13.56
2	ea013_0060_BOGG01_0587u	385579	402804	Modelled Water Level (m aodN)	53.28	53.38	53.45	53.43
				Modelled Flow (cumecs)	8.25	11.74	14.78	13.57
3	ea013_0060_BOGG01_0446	385574	402620	Modelled Water Level (m aodN)	51.07	51.19	51.27	51.25
				Modelled Flow (cumecs)	4.86	8.27	11.29	10.08
4	ea013_0060_BOGG01_0324G	385525	402509	Modelled Water Level (m aodN)	50.05	50.15	50.23	50.21
				Modelled Flow (cumecs)	4.87	8.28	11.29	10.08

Model data taken from Boggart Hole Brook 2007 Study

AEP - Annual Exceedence Probability

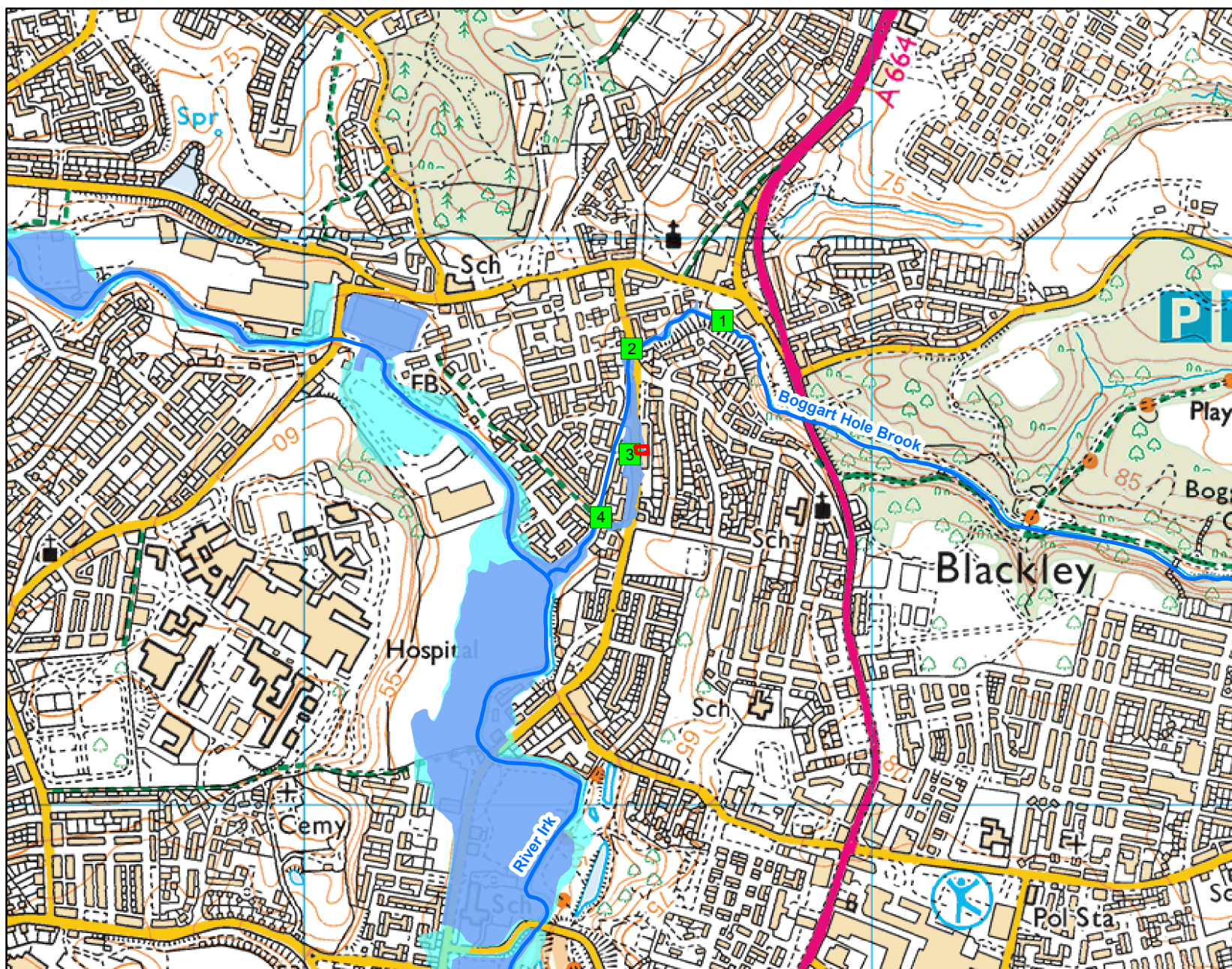
m aodN - metres above ordnance datum Newlyn

cumecs - cubic metres per second

Notes:

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

Detailed Flood Map centred on Slack Road, Manchester, M9 8AZ. Created on 01/12/2020 [GMMC192279CC]



1:10,001



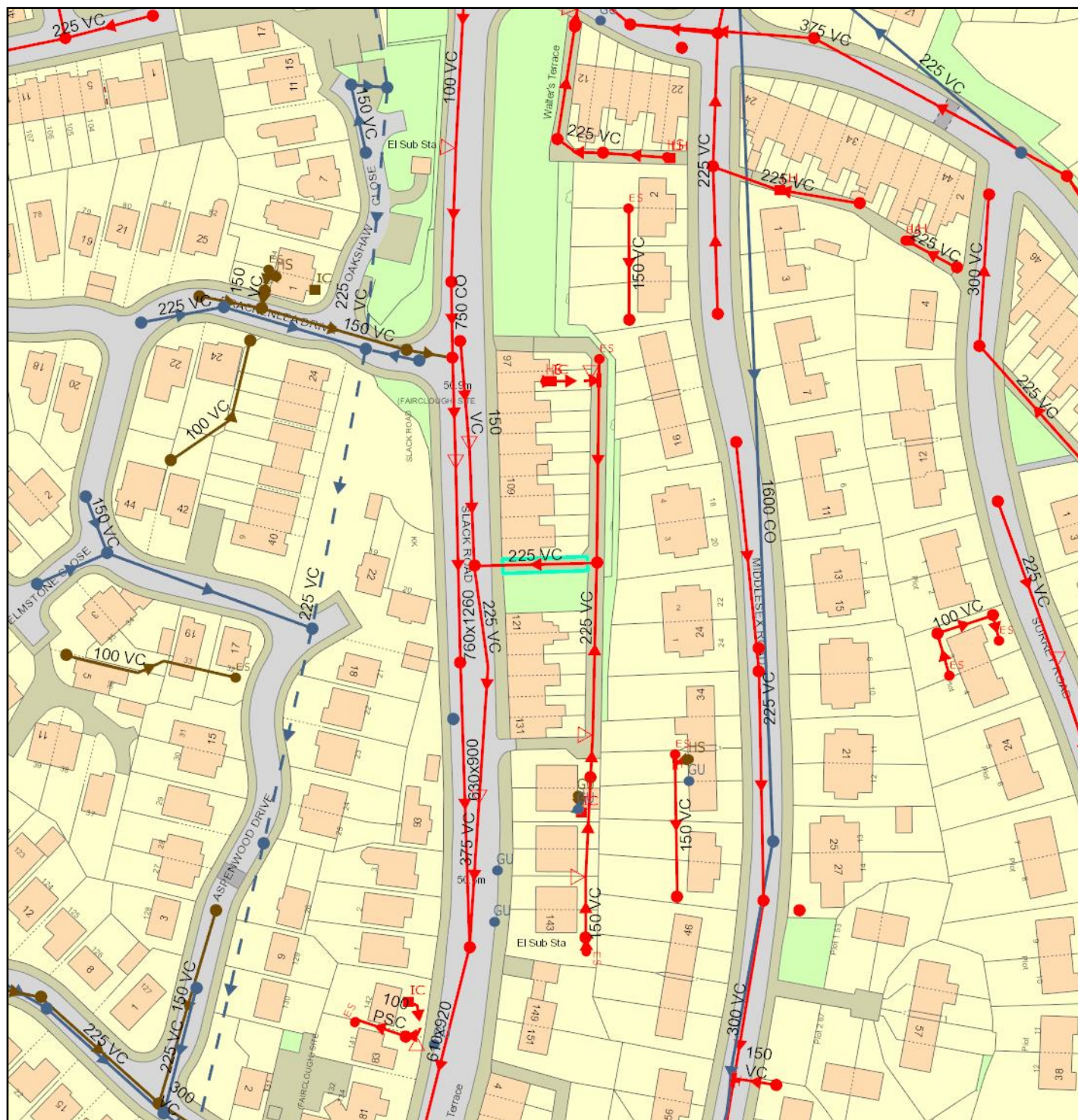
Legend

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

Appendix D - Thames Water Public Sewer Records

SEWER RECORD

117 Slack Road Manchester



The position of underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. The actual positions may be different from those shown on the plan and private pipes, sewers or drains may not be recorded. United Utilities Water PLC will not accept any liability for any damage caused by the actual positions being different from those shown.

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Wastewater Symbolology

Abandoned	Foul	Surface Water	Combined	
				Public Sewer
				Private Sewer
				Section 104
				Rising Main
				Sludge Main
				Overflow
				Water Course
				Highway Drain

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

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

Appendix E - ICP SuDS Greenfield Rate of Runoff

Base Energy Services Limited		Page 1												
44 Canal Street Bootle Liverpool L20 8QU	Slack Road Existing Greenfield													
Date 06/12/2020 File	Designed by CC Checked by PK													
Micro Drainage		Source Control 2019.1												
<u>ICP SUDS Mean Annual Flood</u> Input <table> <tr> <td>Return Period (years)</td> <td>100</td> <td>Soil</td> <td>0.450</td> </tr> <tr> <td>Area (ha)</td> <td>0.017</td> <td>Urban</td> <td>0.000</td> </tr> <tr> <td>SAAR (mm)</td> <td>884</td> <td>Region Number</td> <td>Region 10</td> </tr> </table> Results 1/s QBAR Rural 0.1 QBAR Urban 0.1 Q100 years 0.2 Q1 year 0.1 Q30 years 0.2 Q100 years 0.2			Return Period (years)	100	Soil	0.450	Area (ha)	0.017	Urban	0.000	SAAR (mm)	884	Region Number	Region 10
Return Period (years)	100	Soil	0.450											
Area (ha)	0.017	Urban	0.000											
SAAR (mm)	884	Region Number	Region 10											
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Appendix F - British Geological Survey Borehole Records

GEO-RESEARCH LTD.

CALE STREET, CALE GREEN,
STOCKPORT, CHESHIRE

SD80SE 1010

CONTRACT: Rochdale Road Relief Sewer

8563
0266

LOCATION: Manchester

Borehole No. 1

Street No. 1

Date Commenced 16th. December 1963

Date Completed 16th. December 1963

Scale 1 inch = 1 foot.

Stratum	Legend	Thick- ness	Depth	Sample No.	N Value	Level	Remarks
			G.L.				
Medium well graded sand and gravel.			1'0"	D1			Damp
Medium well graded clayey sand with bands of clay.		3'0"	3'0"	D2			Moist
			3'6"	D3			
			4'6"	D4			
Fine well graded reddish/ brown sand.		2'6"	5'6"	D4			Damp
			6'0"				Water table
Medium well graded sand and gravel.		4'6"	10'0"				
			11'0"	L5			Damp
Fine well graded sand and silt.		4'6"	14'0"				
			15'0"	D6			Damp
Medium well graded sand and gravel with organic inclusions.		12'0"	26'0"				
			27'0"	D7			Damp
		4'0"	30'0"				

Continued on page 2.

SD 80 SE 304

SECTION OF Borehole

at In. Reservoir, Moss House Works,
Blackley

British Geological Survey

British Geological Survey

Maps: One-inch 85

Six-inch 96 S.E.N

County Manchester

Height above O.D. —

Latitude —

Longitude —

Communicated by

Manchester Corporation

Date of Sinking —

Made by

Dip of Strata —

Thickness.

Depth from Surface.

metres

30 made ground

Peat clay & sand [Water at 7 ft.]

Peat

Quicksand & pebbles

6 - 0.83 6 -

1 6 2.28 7 6

6 - 4.11 13 6

5 - 5.63 18 6

Appendix G - Micro Drainage Attenuation Storage Calculations

Base Energy Services Limited					Page 1
44 Canal Street		Slack Road			
Bootle		Attenuation			
Liverpool L20 8QU		100yr40CC			
Date 06/12/2020		Designed by CC			
File Attenuation.SRCX		Checked by PK			
Micro Drainage		Source Control 2019.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.797	0.797	1.9	1.3	O K
30 min Summer	0.863	0.863	1.9	1.4	O K
60 min Summer	0.763	0.763	1.9	1.2	O K
120 min Summer	0.396	0.396	1.9	0.6	O K
180 min Summer	0.197	0.197	1.9	0.3	O K
240 min Summer	0.117	0.117	1.7	0.2	O K
360 min Summer	0.074	0.074	1.3	0.1	O K
480 min Summer	0.061	0.061	1.1	0.1	O K
600 min Summer	0.053	0.053	0.9	0.1	O K
720 min Summer	0.048	0.048	0.8	0.1	O K
960 min Summer	0.042	0.042	0.6	0.1	O K
1440 min Summer	0.035	0.035	0.5	0.1	O K
2160 min Summer	0.029	0.029	0.3	0.0	O K
2880 min Summer	0.026	0.026	0.3	0.0	O K
4320 min Summer	0.022	0.022	0.2	0.0	O K
5760 min Summer	0.020	0.020	0.2	0.0	O K
7200 min Summer	0.018	0.018	0.1	0.0	O K
8640 min Summer	0.016	0.016	0.1	0.0	O K
10080 min Summer	0.015	0.015	0.1	0.0	O K
15 min Winter	0.931	0.931	1.9	1.5	O K
30 min Winter	0.978	0.978	2.0	1.6	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	118.613	0.0	2.7	16	
30 min Summer	79.413	0.0	3.6	25	
60 min Summer	50.812	0.0	4.6	42	
120 min Summer	31.468	0.0	5.7	72	
180 min Summer	23.466	0.0	6.3	98	
240 min Summer	18.940	0.0	6.8	128	
360 min Summer	13.882	0.0	7.5	186	
480 min Summer	11.143	0.0	8.0	246	
600 min Summer	9.389	0.0	8.4	304	
720 min Summer	8.158	0.0	8.8	366	
960 min Summer	6.531	0.0	9.4	484	
1440 min Summer	4.764	0.0	10.3	730	
2160 min Summer	3.468	0.0	11.2	1068	
2880 min Summer	2.766	0.0	11.9	1472	
4320 min Summer	2.007	0.0	13.0	2152	
5760 min Summer	1.596	0.0	13.8	2864	
7200 min Summer	1.336	0.0	14.4	3568	
8640 min Summer	1.154	0.0	15.0	4400	
10080 min Summer	1.020	0.0	15.4	5136	
15 min Winter	118.613	0.0	3.0	17	
30 min Winter	79.413	0.0	4.0	26	
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Base Energy Services Limited				Page 2	
44 Canal Street		Slack Road			
Bootle		Attenuation			
Liverpool L20 8QU		100yr40CC			
Date 06/12/2020		Designed by CC			
File Attenuation.SRCX		Checked by PK			
Micro Drainage		Source Control 2019.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.782	0.782	1.9	1.3	O K
120 min Winter	0.237	0.237	1.9	0.4	O K
180 min Winter	0.098	0.098	1.6	0.2	O K
240 min Winter	0.074	0.074	1.3	0.1	O K
360 min Winter	0.056	0.056	1.0	0.1	O K
480 min Winter	0.048	0.048	0.8	0.1	O K
600 min Winter	0.043	0.043	0.7	0.1	O K
720 min Winter	0.040	0.040	0.6	0.1	O K
960 min Winter	0.035	0.035	0.5	0.1	O K
1440 min Winter	0.029	0.029	0.3	0.0	O K
2160 min Winter	0.024	0.024	0.2	0.0	O K
2880 min Winter	0.022	0.022	0.2	0.0	O K
4320 min Winter	0.018	0.018	0.1	0.0	O K
5760 min Winter	0.016	0.016	0.1	0.0	O K
7200 min Winter	0.015	0.015	0.1	0.0	O K
8640 min Winter	0.014	0.014	0.1	0.0	O K
10080 min Winter	0.013	0.013	0.1	0.0	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	50.812	0.0	5.1	44	
120 min Winter	31.468	0.0	6.3	72	
180 min Winter	23.466	0.0	7.1	98	
240 min Winter	18.940	0.0	7.6	126	
360 min Winter	13.882	0.0	8.4	186	
480 min Winter	11.143	0.0	9.0	246	
600 min Winter	9.389	0.0	9.5	306	
720 min Winter	8.158	0.0	9.9	362	
960 min Winter	6.531	0.0	10.5	494	
1440 min Winter	4.764	0.0	11.5	718	
2160 min Winter	3.468	0.0	12.6	1056	
2880 min Winter	2.766	0.0	13.4	1392	
4320 min Winter	2.007	0.0	14.6	2172	
5760 min Winter	1.596	0.0	15.4	2856	
7200 min Winter	1.336	0.0	16.2	3576	
8640 min Winter	1.154	0.0	16.8	4400	
10080 min Winter	1.020	0.0	17.3	5224	
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Base Energy Services Limited		Page 3																																				
44 Canal Street	Slack Road																																					
Bootle	Attenuation																																					
Liverpool L20 8QU	100yr40CC																																					
Date 06/12/2020	Designed by CC																																					
File Attenuation.SRCX	Checked by PK																																					
Micro Drainage		Source Control 2019.1																																				
<u>Rainfall Details</u> <table> <tr> <td>Rainfall Model</td> <td>FSR</td> <td>Winter Storms</td> <td>Yes</td> </tr> <tr> <td>Return Period (years)</td> <td>100</td> <td>Cv (Summer)</td> <td>0.750</td> </tr> <tr> <td>Region</td> <td>England and Wales</td> <td>Cv (Winter)</td> <td>0.840</td> </tr> <tr> <td>M5-60 (mm)</td> <td>18.000</td> <td>Shortest Storm (mins)</td> <td>15</td> </tr> <tr> <td>Ratio R</td> <td>0.360</td> <td>Longest Storm (mins)</td> <td>10080</td> </tr> <tr> <td>Summer Storms</td> <td>Yes</td> <td>Climate Change %</td> <td>+40</td> </tr> </table> <u>Time Area Diagram</u> Total Area (ha) 0.012 <table> <thead> <tr> <th>Time (mins)</th> <th>Area</th> <th>Time (mins)</th> <th>Area</th> </tr> <tr> <th>From:</th> <th>To: (ha)</th> <th>From:</th> <th>To: (ha)</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>4 0.006</td> <td>4</td> <td>8 0.006</td> </tr> </tbody> </table>			Rainfall Model	FSR	Winter Storms	Yes	Return Period (years)	100	Cv (Summer)	0.750	Region	England and Wales	Cv (Winter)	0.840	M5-60 (mm)	18.000	Shortest Storm (mins)	15	Ratio R	0.360	Longest Storm (mins)	10080	Summer Storms	Yes	Climate Change %	+40	Time (mins)	Area	Time (mins)	Area	From:	To: (ha)	From:	To: (ha)	0	4 0.006	4	8 0.006
Rainfall Model	FSR	Winter Storms	Yes																																			
Return Period (years)	100	Cv (Summer)	0.750																																			
Region	England and Wales	Cv (Winter)	0.840																																			
M5-60 (mm)	18.000	Shortest Storm (mins)	15																																			
Ratio R	0.360	Longest Storm (mins)	10080																																			
Summer Storms	Yes	Climate Change %	+40																																			
Time (mins)	Area	Time (mins)	Area																																			
From:	To: (ha)	From:	To: (ha)																																			
0	4 0.006	4	8 0.006																																			
©1982-2019 Innovyze																																						

Base Energy Services Limited		Page 4					
44 Canal Street	Slack Road						
Bootle	Attenuation						
Liverpool L20 8QU	100yr40CC						
Date 06/12/2020	Designed by CC						
File Attenuation.SRCX	Checked by PK						
Micro Drainage		Source Control 2019.1					
<u>Model Details</u>							
Storage is Online Cover Level (m) 1.500							
<u>Tank or Pond Structure</u>							
Invert Level (m) 0.000							
Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	1.6	0.700	1.6	1.400	1.6	2.100	1.6
0.100	1.6	0.800	1.6	1.500	1.6	2.200	1.6
0.200	1.6	0.900	1.6	1.600	1.6	2.300	1.6
0.300	1.6	1.000	1.6	1.700	1.6	2.400	1.6
0.400	1.6	1.100	1.6	1.800	1.6	2.500	1.6
0.500	1.6	1.200	1.6	1.900	1.6		
0.600	1.6	1.300	1.6	2.000	1.6		
<u>Hydro-Brake® Optimum Outflow Control</u>							
Unit Reference MD-SHE-0067-2000-1000-2000							
Design Head (m) 1.000							
Design Flow (l/s) 2.0							
Flush-Flo™ Calculated							
Objective Minimise upstream storage							
Application Surface							
Sump Available Yes							
Diameter (mm) 67							
Invert Level (m) 0.000							
Minimum Outlet Pipe Diameter (mm) 100							
Suggested Manhole Diameter (mm) 1200							
Control Points		Head (m)	Flow (l/s)	Control Points		Head (m)	Flow (l/s)
Design Point (Calculated)		1.000	2.0	Kick-Flo®		0.599	1.6
Flush-Flo™		0.296	1.9	Mean Flow over Head Range		-	1.7
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated							
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.6	1.200	2.2	3.000	3.3	7.000	4.9
0.200	1.9	1.400	2.3	3.500	3.5	7.500	5.1
0.300	1.9	1.600	2.5	4.000	3.8	8.000	5.2
0.400	1.9	1.800	2.6	4.500	4.0	8.500	5.4
0.500	1.8	2.000	2.7	5.000	4.2	9.000	5.5
0.600	1.6	2.200	2.9	5.500	4.4	9.500	5.7
0.800	1.8	2.400	3.0	6.000	4.6		
1.000	2.0	2.600	3.1	6.500	4.7		
©1982-2019 Innovyze							

Appendix B - Flood Risk Addendum Rev0 dated 2 June 2021

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Flood Risk Assessment Addendum Rev0 Final

117 – 119 Slack Road,
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2 June 2021

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Appendices

Appendix A – Flood Risk and Surface Water Assessment Rev1 dated 8 January 2021

Prepared by	Checked by	Date
Carina Clarke BSc (Hons)	Peter Kinsella BSc (Hons)	2 June 2021

This document has been prepared solely as a Flood Risk Assessment Addendum for Kilo Construction Services Ltd. Base Energy accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

Background

Manchester City Council approved a planning application (123969/ FO/ 20) for the construction of 2 terraced dwellings with associated landscaping and boundary protection at 117-119 Slack Road, Manchester.

Condition 4 of the Decision Notice stated:

4) Prior to the commencement of the development, a flood risk assessment for the site detailing proposed flood mitigation measures shall be submitted for approval in writing by the City Council as the Local Planning Authority. The development shall be constructed and completed in accordance with the approved details.

Reason - The application site is located within a critical drainage area and in line with the requirements in relation to sustainable urban drainage systems, further consideration should be given to the control of surface water at the site in order to minimise localised flood risk pursuant to policies SP1, EN17 and DM1 of the Manchester Core Strategy (2012).

In order to discharge Condition 4, Base Energy prepared a Flood Risk and Surface Water Assessment (Rev1; dated 8 January 2021). The report concluded:

Flood Risk and Mitigation

- The site is shown to be located within Flood Zone 3 and is therefore considered to be at high risk of fluvial flooding.
- At the time of writing, no topographic survey of the site has been carried out and therefore it is not possible to compare site levels with modelled flood levels to ascertain the potential depths of flooding at the site.
- The EA has confirmed that they do not hold any historic records of flooding at the site location.
- Based on the desktop study of underlying ground conditions, there may be a risk of groundwater flooding at the site and surrounding areas.

- The EA provide maps on their website which illustrate the risk of surface water flooding along with potential depths and velocities; these show that the site is at very low risk of surface water flooding. Slack Road is at high risk of surface water flooding, with potential depths ranging up to 900mm.
- In order to mitigate the risks of flooding, the following measures should be considered:
 - Finished floor levels to be set above existing ground levels.
 - Flood resilient construction techniques to be incorporated into the ground floor, in line with best practice guidance.
 - Occupants should register with the EA to receive flood alerts.

Surface Water and SuDS

Based on the strategic approach for the management of surface water runoff, the most feasible and safe strategy appears to be:

- Rainwater recycling
- Attenuation storage with a controlled outlet into the combined sewer
- Should the client wish to pursue infiltration SuDS further down the line, it is strongly recommended that percolation testing to BRE Digest 365 is carried out in order to a) confirm the suitability of the ground for infiltration, and b) confirm a rate of infiltration.
- *The SuDS strategy has been put together based on our understanding of the ground conditions and site layout. Building Control will need to be consulted on the siting of the SuDS, and the recommendations and advice of the SuDS manufacturer / installer should always be followed.*

Subsequently, Manchester City Council commented on the report stating that "The FRA should assess the risk of the development displacing flood water and how this will impact on surrounding properties."

Given that planning permission was granted and that Condition 6 does not refer to the displacement of flood waters, further clarification has been sought from Manchester City Council.

In an email dated 28 April 2021¹, Manchester City Council state:

In order to discharge the drainage planning condition, further information is needed to confirm that the proposed drainage design is adequate to manage flood risk.

The outstanding evidence required:

- 1. The appendices referred to within the FRA have not been attached, these will need to be reviewed before the FRA can be approved.*
- 2. The finished floor levels of the property should be compared directly to the EA flood level data and be set a minimum of 300mm above the 1 in 100 year flood event (plus climate change), if this is not feasible then appropriate flood mitigation measures should be implemented (such as raising sockets above the 1 in 100 year flood event plus climate change) – all mitigation measures should refer to the predicted flood levels.*
- 3. The FRA should assess the risk of the development displacing flood water and how this will impact on surrounding properties.*
- 4. The FRA should include an evacuation plan identifying safe access and egress routes. We would also encourage that the properties are registered with the EA to receive early warnings of flood events*

Whilst some of the above information was included in the Flood Risk and Surface Water Assessment, this Addendum has been prepared to provide further clarification and more detail to enable the Condition to be discharged.

¹ Email from Eve Woolstencroft @ Manchester City Council to Kilo Construction dated 28 April 2021

1. Appendices Details

The appendices referred to within the FRA have not been attached, these will need to be reviewed before the FRA can be approved.

Having reviewed the Flood Risk and SuDS Assessment (Rev1), the Appendices were combined in the report. For ease of reference, Rev 1 has been included as **Appendix A** of this Addendum.

2. Finished Floor Levels and Flood Mitigation

The finished floor levels of the property should be compared directly to the EA flood level data and be set a minimum of 300mm above the 1 in 100 year flood event (plus climate change), if this is not feasible then appropriate flood mitigation measures should be implemented (such as raising sockets above the 1 in 100 year flood event plus climate change) – all mitigation measures should refer to the predicted flood levels.

As noted in Section 3 of the Flood Risk and Surface Water Report, the EA provided detailed flooding information including a detailed flood and node location map, and modelled flood levels for a range of events. This confirms that half of the site is located in Flood Zone 3 outline associated with Boggart Hole Brook, which is culverted at this location. The rear portion of the site is shown to be in Flood Zone 1.

At the modelled node location nearest to the site (Node 3), flood levels are shown to be:

- 1 in 100 year – 51.07m AOD
- 1 in 100 year plus 35% CC - 51.19m AOD
- 1 in 100 year plus 70% CC – 51.27m AOD
- 1 in 1000 year – 51.25m AOD

At the time of writing, no topographic survey of the site had been carried out and therefore it has not been possible to compare site levels with modelled flood levels to ascertain the potential depths of flooding at the site.

Finished Flood Levels

Given that no topographic survey is available, the finished floor levels cannot be compared with the EA flood data. However, as detailed in the report, finished floor levels will be set above existing ground levels, and the same level as the adjoining properties.

Flood Resilient Construction

Flood resilient construction techniques will be incorporated into the ground floor, in line with guidance provided in the Communities and Local Government Document, *Improving the Flood Performance of New Buildings: Flood Resilient Construction*².

Figure 1 is taken from *Improving the Flood Performance of New Buildings: Flood Resilient Construction*² and shows the preferred approaches for flood mitigation, which is based on the potential depths of flooding.

Given that the predicted depths of flooding is unknown, a water entry strategy will be followed.

It is important to note that the advice of the structural engineer should always be followed.

The following is taken from 'Improving the Flood Performance of New Buildings: Flood Resilient Construction' and shows the guidance provided within the report. These will be included wherever feasible.

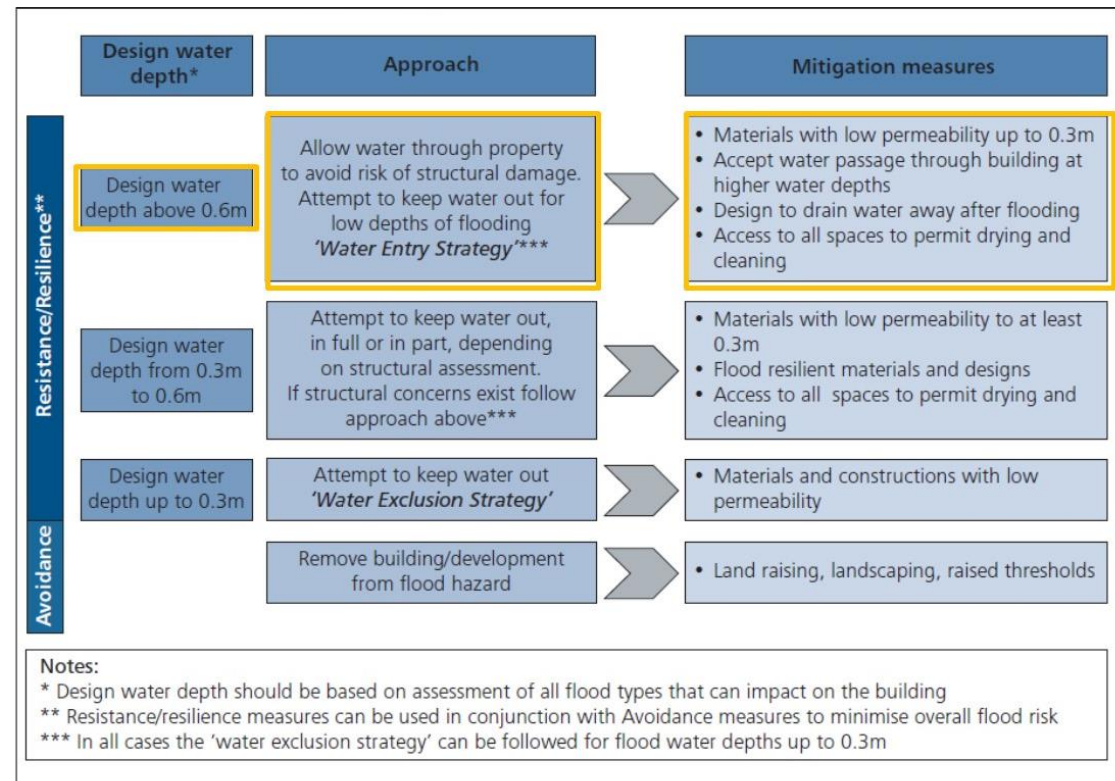


Figure 1 - Approaches for Flood Resistance and Resilience

² Improving the Flood Performance of New Buildings: Flood Resilient Construction. Department for Communities and Local Government. May 2007.

Floors

Materials that retain their integrity and properties when subjected to flood water (such as concrete) or those that can be easily replaced (sacrificial materials), should be specified. Construction should allow easy access for cleaning, (e.g. below suspended floors), and drainage.

Water Entry Strategy – Floors

Taken from 'Improving the Flood Performance of New Buildings: Flood Resilient Construction'

Concrete ground-supported floors are the preferred option and concrete slabs of at least 100mm thickness should be specified.

Suspended floors may be necessary where ground-supported floors are not suitable, namely in shrinkable/expanding soils (e.g. clay soils) or where the depth of fill is greater than 600mm. **Suspended timber floors**, particularly when including timber engineered joists, are **not generally recommended** in flood prone areas because most wooden materials tend to deform significantly when in contact with water and therefore may require replacement. Rapid drying can also cause deformation and cracking.

Damp Proof Membranes (d.p.m.) should be included in any design to minimise the passage of water through ground floors. Impermeable polythene membranes should be at least 1200 gauge to minimise ripping. Effective methods of joining membrane sections are: overlaps of 300mm or taping with mastic tape with an overlap of 50mm minimum.

Insulation materials: Water will lower the insulation properties of some insulation materials. Floor insulation should be of the closed-cell type to minimise the impact of flood water. The location of insulation materials, whether above or below the floor slab, is usually based on either achieving rapid heating of the building or aiming for more even temperature distribution with reduced risk of condensation. It is recommended that insulation be placed above the floor slab (and underneath the floor finish) rather than below would minimise the effect of flood water on the insulation properties and be more easily replaced, if needed.

Floor finishes: Sacrificial floor finishes can include timber flooring and soft furnishings such as carpets. Materials that are likely to withstand exposure to floodwater without significant deterioration are ceramic or concrete-based floor tiles, marble or stone. All tiles should be set on a bed of sand and cement render and water resistant grout should be used.

Concrete screeds above polystyrene or polyurethane insulation should be avoided as they hinder drying of the insulation material due to the relative impermeability.

Suitable materials for skirting boards include ceramic tiles and PVC. Ceramic tiles are likely to be more economically viable and environmentally acceptable. Replacement timber may be a suitable option, for cases where a strategy to use of sacrificial materials is adopted.

Floor sump: provision of a sump and small capacity pump in the floor at a low point of the ground floor is recommended in cases where the expected frequency of flooding is high; this system will help the draining process and speed up drying but it may only be effective for shallow depth flooding..

Services: under floor services using ferrous materials should be avoided.

Walls

Water Entry Strategy - Walls

Taken from 'Improving the Flood Performance of New Buildings: Flood Resilient Construction'

Masonry walls: Use good quality facing bricks for the external face of cavity walls. Do not use soft bricks, such as hand made clay bricks, which can easily crumble when subjected to water. Concrete blocks dry more quickly than Aircrete blocks. However, Aircrete blocks allow less leakage. Therefore, design of blockwork walls needs to take into account these two opposite types of behaviour and consider whether drying or resistance to water is most relevant in each situation. For a "water entry strategy" which is aimed at allowing water passage through the property, concrete blocks are recommended.

Framed walls: Avoid timber framed walls containing construction materials that have poor performance in floods, namely oriented strand board and mineral fibre insulation.

External renders should **not be used** as they provide a barrier to water penetration and may induce excessive differences in depth between outside and inside of the property resulting in possible structural problems.

Insulation:

External insulation is better than cavity insulation because it is easily replaced if necessary; however it is generally protected by rigid lining which may create a barrier to water.

Cavity insulation should incorporate rigid closed cell materials as these retain integrity and have low moisture take-up.

Other common types, such as mineral fibre batts, are not generally recommended as they can remain wet several months after exposure to flood water which slows down the wall drying process. Blown-in insulation can slump due to excessive moisture uptake, and some types can retain high levels of moisture for long periods of time (under natural drying conditions).

Internal linings: Avoid internal cement renders as these can prevent effective drying. Use standard gypsum plasterboard up to the predicted flood level (plus freeboard of 50mm) as a sacrificial material.

Above predicted flood level (plus freeboard) the use of plasterboard or internal cement renders is appropriate.

Doors and Windows

Water Entry Strategy – Doors and Windows

Taken from 'Improving the Flood Performance of New Buildings: Flood Resilient Construction'

Doors: Raising the threshold as high as possible, while complying with level access requirements, should be considered as the primary measure. In addition, sealed PVC external framed doors should be used and, where the use of wooden doors is a preferred option, all effort should be made to ensure a good fit and seal to their frames. Hollow core timber internal doors should not be used where the predicted frequency of flooding is high.

Windows/patio doors: Windows and patio doors are vulnerable to flood water and similar measures to those used for doors should be taken. Special care should be taken to ensure adequate sealing of any PVC window/door sills to the fabric of the house. Of particular concern would be excessive water pressure on the glazing of patio doors. Double glazing conforming to the relevant standards would in principle adequately resist the pressures

generated by flood waters; debris carrying flows may cause damage.

Fittings

The main principle is to use **durable fittings** that are not significantly affected by water and can be easily cleaned.

Water Entry Strategy – Fittings

Taken from 'Improving the Flood Performance of New Buildings: Flood Resilient Construction'

Place fittings as high as practicable above floor so that they are out of reach of flood water.

Ensure adequate sealing of joints between kitchen units and surfaces to prevent any penetration of water behind fittings

Services

Where possible, all service entries should be sealed (e.g. with expanding foam or similar closed cell material).

Water Entry Strategy – Services

Taken from 'Improving the Flood Performance of New Buildings: Flood Resilient Construction'

Pipework: Closed cell insulation should be used for pipes which are below the predicted flood level.

Drainage services: Non-return valves are recommended in the drainage system to prevent back-flow of diluted sewage in situations where there is an identified risk of the foul sewer surcharging. Maintenance of these valves is important to ensure their continued effectiveness.

Water, electricity and gas meters: should be located above predicted flood level.

Electrical services: electrical sockets should be installed above flood level for ground floors to minimise damage to electrical services and allow speedy re-occupation. Electric ring mains should be installed at first floor level with drops to ground floor sockets and switches.

Heating systems: boiler units and ancillary devices should be installed above predicted flood level and preferably on the first floor of two-storey properties. Underfloor heating should be avoided on ground floors and controls such as thermostats should be placed above flood level.

Conventional heating systems, e.g. hot water pipes are unlikely to be significantly affected by flood water unless it contains a large amount of salts. The less common, hot air duct heating would remain effective provided it is installed above the design flood level.

Communications wiring: wiring for telephone, TV, Internet and other services should be protected by suitable insulation in the distribution ducts to prevent damage. Any proposed design solution for flood insulation on all potentially vulnerable wiring should be discussed with the relevant service providers.

3. Flood Displacement

The FRA should assess the risk of the development displacing flood water and how this will impact on surrounding properties.

As previously detailed, no topographic survey is available to compare with modelled flood levels which would confirm the flood zone classification of the site. However the EA Flood Maps indicate that the front half of the site (off Slack Road) is located in Flood Zone 3 outline associated with Boggart Hole Brook, which is culverted at this location. The rear portion of the site is shown to be in Flood Zone 1.

As shown on the detailed EA flood maps, the flood outline extends for a small section of Slack Road, encompassing the front portions of existing dwellings in the immediate vicinity of the site.

It is important to note that, immediately to the north of the portion of land proposed for development, is a footpath. This, and the rear of the site (and the rear of the adjacent properties) are shown to be in Flood Zone 1 (see **Figure 3** overleaf)

Should any floodwaters be displaced by the development, the floodwaters could flow down the footpath towards the rear of the proposed site.

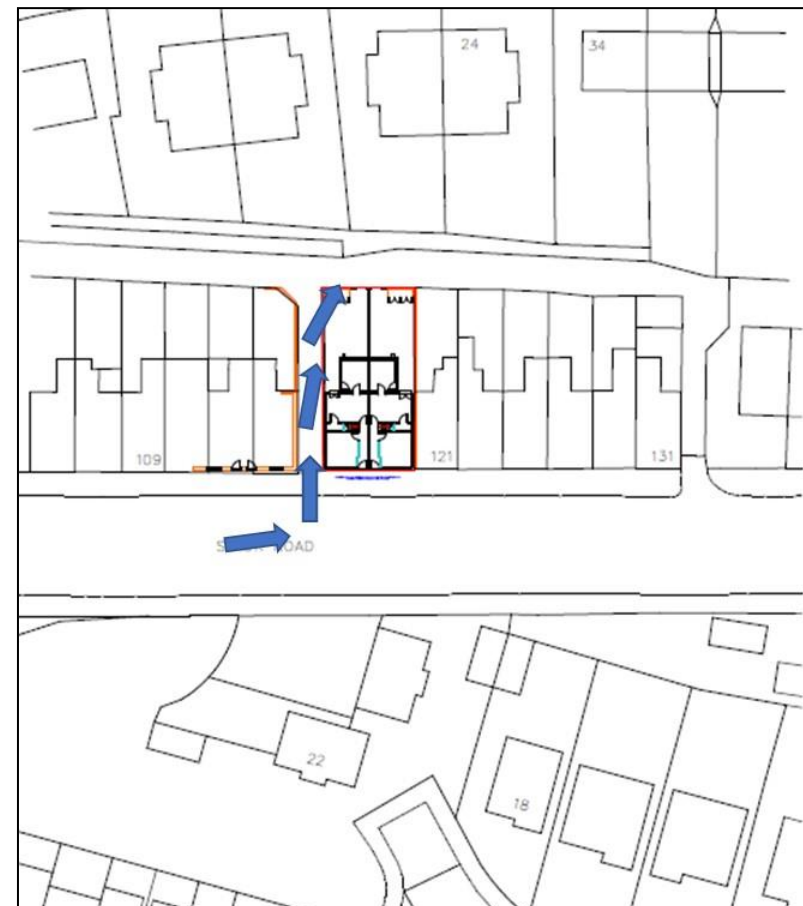


Figure 2 - Possible Flood Displacement Routes

4. Flood Evacuation

The FRA should include an evacuation plan identifying safe access and egress routes. We would also encourage that the properties are registered with the EA to receive early warnings of flood events

Access and Egress

It is important to note that the advice of the Emergency Services should always be followed.

However, it is good to be mindful of the predicted extent of flooding, and where the safest places are likely to be in the event of a flood.

This safe route is based on the fluvial flood outlines and surface water flooding risk. In this instance, it would appear that leaving the property and travelling down Slack Road in a southerly direction (away from where Boggart Hole Brook crosses Slack Road) would be the best option.

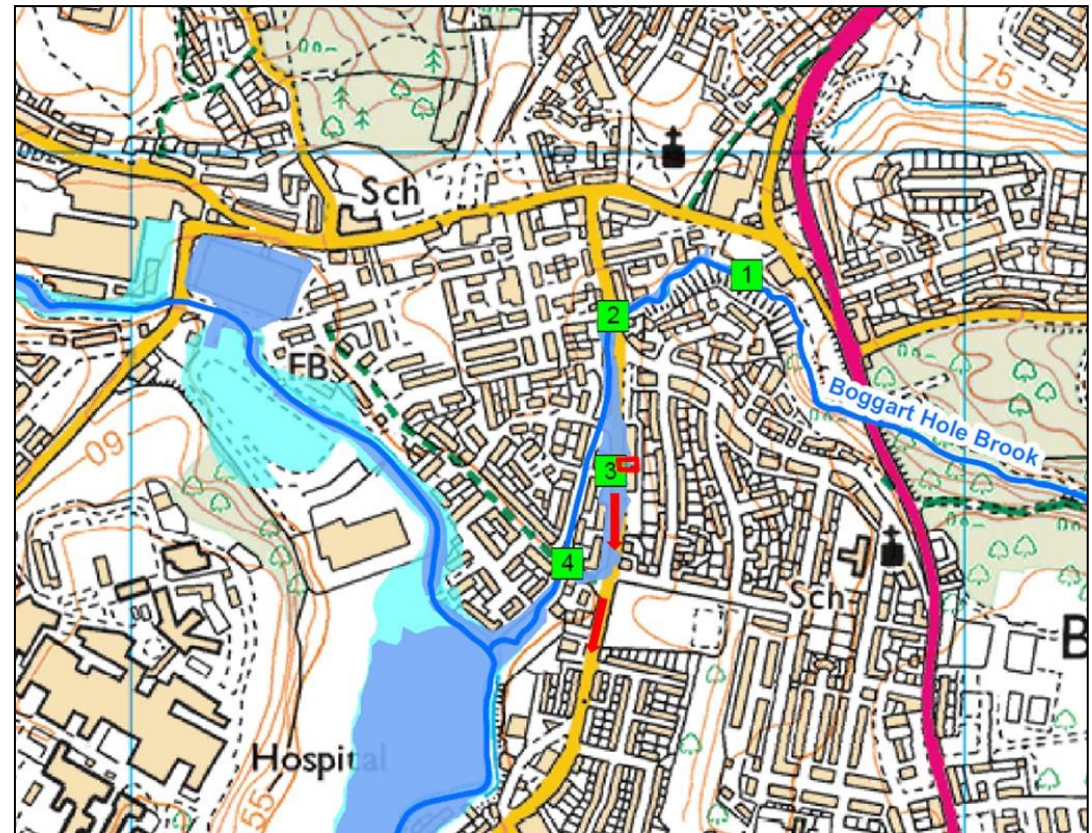


Figure 3 - Access and Egress Route

Flood Alerts

The EA provides a flood warning service in areas at risk of flooding from rivers or the sea. Using the latest available technology, Environment Agency staff monitor rainfall, river levels and sea conditions 24 hours a day and use this information to forecast the possibility of flooding. The site is located within an Environment Agency Flood Warning Area. It is strongly recommended that future occupants of the dwellings register to receive flood warnings by calling Floodline on 0345 988 1188 or by visiting www.gov.uk/sign-up-for-flood-warnings



Appendices

Appendix A – Flood Risk and Surface Water Assessment Rev1 dated 8 January 2021

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Flood Risk and Surface Water Assessment Rev1

Site Address:

117 – 119 Slack Road,
Manchester,
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Date:

08 January 2021

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- Appendix C** - Environment Agency Detailed Flood Information
- Appendix D** - Thames Water Public Sewer Records
- Appendix E** - ICP SuDS Greenfield Rate of Runoff
- Appendix F** - British Geological Survey Borehole Records
- Appendix G** - Micro Drainage Attenuation Storage Calculations

Prepared by	Checked by	Date
Carina Hassall BSc (Hons)	Liam Rushton	08 January 2021

This document has been prepared solely as a Flood Risk and Surface Water Assessment for Kilo Construction Services Ltd. Base Energy accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

1. Introduction

Manchester City Council has approved a planning application (123969/ FO/ 20) for the construction of 2 terraced dwellings with associated landscaping and boundary protection at 117-119 Slack Road, Manchester.

Condition 4 of the Decision Notice states:

4) Prior to the commencement of the development, a flood risk assessment for the site detailing proposed flood mitigation measures shall be submitted for approval in writing by the City Council as the Local Planning Authority. The development shall be constructed and completed in accordance with the approved details.

Reason - The application site is located within a critical drainage area and in line with the requirements in relation to sustainable urban drainage systems, further consideration should be given to the control of surface water at the site in order to minimise localised flood risk pursuant to policies SP1, EN17 and DM1 of the Manchester Core Strategy (2012).

This Flood Risk and Surface Water Assessment has been prepared to, so far as is practicable, discharge the above condition.

Development Proposals

A site location plan (showing the proposed site layout) is provided in **Appendix A**.

Currently, the site is a vacant piece of waste land adjacent to 121 Slack Lane. As detailed above, proposals are for 2 terraced residential dwellings with associated landscaping. A copy of the proposed site layout is provided in **Appendix B**.

2. Planning Policy- Flood Risk, and Surface Water Management

National Planning Policy Framework

The aim of the National Planning Policy Framework (NPPF) (and accompanying Planning Practice Guidance (PPG)) is to direct development away from areas at highest risk of flooding; where development is necessary, it should be made safe without increasing flood risk elsewhere.

The NPPF states that a Flood Risk Assessment (FRA) is required to support a planning application for developments that are:

- located in Flood Zone 2 and/or Flood Zone 3
- located in Flood Zone 1 and comprise 1ha or above

In some instances, for example where a site is located in Flood Zone 1 and comprises less than 1ha, an FRA may be required if the site is within an area which has critical drainage problems (i.e. a Critical Drainage Area - CDA) as notified to the Local Authority by the Environment Agency (EA).

In order to provide an indication of the flood zone classification of the site, and to ascertain whether an FRA is required, the starting point is the EA flood maps which are available on the EA website.

Environment Agency Flood Map

The EA flood maps show fluvial and tidal flood outlines based on the following:

- Flood Zone 1 - land assessed as having less than 1 in 1000 annual probability of river or sea flooding
- Flood Zone 2 - land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding, or between a 1 in 200 and 1 in 1000 annual probability of flooding from the sea
- Flood Zone 3 - land assessed as having a 1 in 100 or greater annual probability of river flooding, or a 1 in 200 or greater annual probability of flooding from the sea

The flood maps available on the EA website confirm that the site is located within the Flood Zone 3 outline associated with a culverted watercourse (**Figure 1**).

A detailed assessment of flood risk is provided in the following section.

Manchester City Council Core Strategy

Policy EN 14 Flood Risk states:

- In line with the risk-based sequential approach contained within PPS25, development should be directed away from sites at the greatest risk of flooding, and towards sites with little or no risk of flooding; this should take account of all sources of flooding identified in the Manchester-Salford-Trafford Strategic Flood Risk Assessment (SFRA).
- In addition to the requirements for site-specific Flood Risk Assessments (FRAs) set out in PPS25, an appropriate FRA will also be required for all development proposals, including changes of use, on sites greater than 0.5ha within Critical Drainage Areas (CDAs) and Canal Hazard Zones identified in the SFRA.

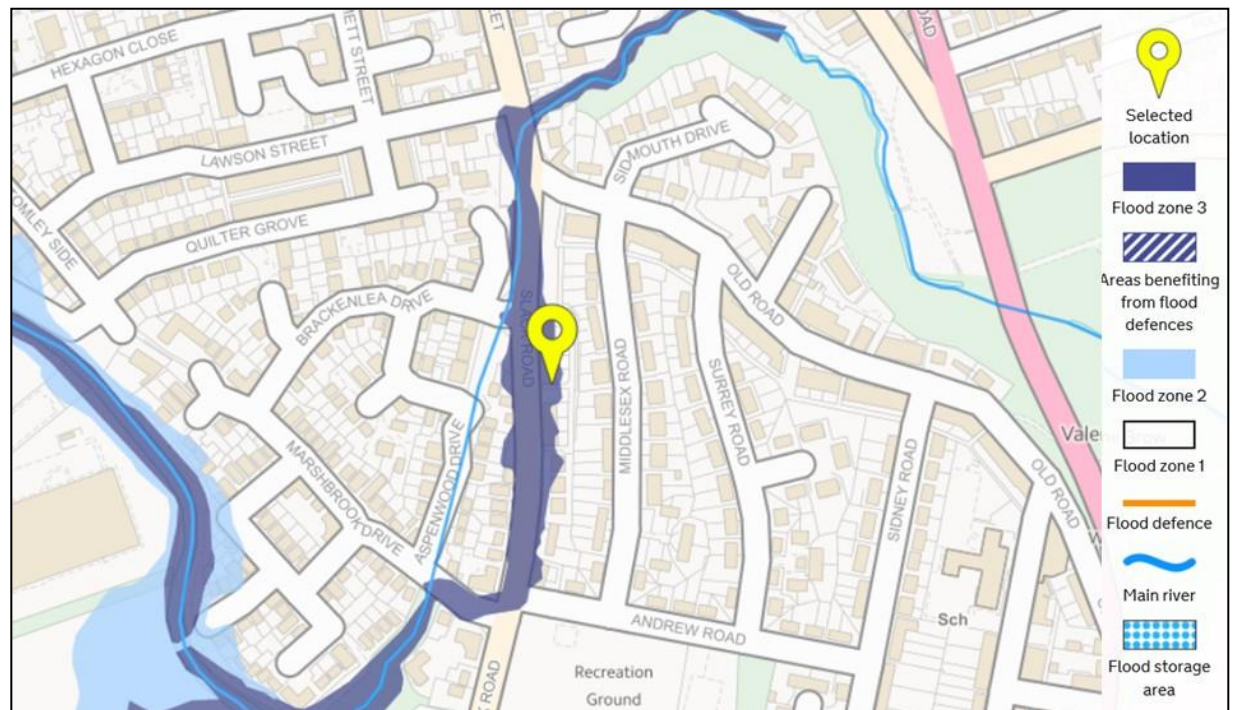


Figure 1 - Environment Agency Flood Map

-
- All new development should minimise surface water run-off, including through Sustainable Drainage Systems (SuDS) and the appropriate use of Green Infrastructure. Developers should have regard to the surface water run-off rates in the SFRA User Guide. In CDAs, evidence to justify the surface water run-off approach / rates will be required.
 - The City of Manchester contains many sections of rivers which are culverted or 'hidden'; where these are indicated in the SFRA beneath the proposed development site, further investigation will be required and the development proposal should take this into account; where feasible and appropriate development should seek to open up culverted/hidden rivers to reduce the associated flood risk and danger of collapse, taking advantage of opportunities to enhance biodiversity and Green Infrastructure.

Non-Statutory Technical Standards for SuDS

The Non-Statutory Technical Standards for SuDS, (and accompanying Local Authority SuDS Officer Organisation (LASOO) Practice Guidance) sets out the details which should be addressed within a SuDS Report, including:

- Flood Risk Outside of the Development
- Peak Flow Control and Volume Control
- Flood Risk Within the Development
- Runoff Destinations
- Structural Integrity
- Designing for Maintenance Considerations
- Construction

3. Sources of Flood Risk

Fluvial Flood Risk – Boggart Hole Brook

The site is shown to be located within Flood Zone 3 and is therefore considered to be at high risk of fluvial flooding.

The EA has provided more detailed flooding information including a detailed flood and node location map, and modelled flood levels for a range of events. A copy of the information is provided in **Appendix C**. This confirms that half of the site is located in Flood Zone 3 outline associated with Boggart Hole Brook, which is culverted at this location. The rear portion of the site is shown to be in Flood Zone 1.

At the modelled node location nearest to the site (Node 3), flood levels are shown to be:

- 1 in 100 year – 51.07m AOD
- 1 in 100 year plus 35% CC - 51.19m AOD
- 1 in 100 year plus 70% CC – 51.27m AOD
- 1 in 1000 year – 51.25m AOD

At the time of writing, no topographic survey of the site has been carried out and therefore it is not possible to compare site levels with modelled flood levels to ascertain the potential depths of flooding at the site. However, the flood mitigation strategy (outlined in the following section) will be based on the above flood levels.

Historic Records of Flooding

The EA has confirmed that they do not hold any historic records of flooding at the site location.

Groundwater Flooding

Groundwater flooding generally occurs during intense, long-duration rainfall events, when infiltration of rainwater into the ground raises the level of the water table until it exceeds ground levels. It is most common in low-lying areas overlain by permeable soils and permeable geology, or in areas with a naturally high water table.

The Soils Maps provided by the National Soil Resources Institute at Cranfield University indicate that the soils at the site and surrounding areas are comprised of 'Slowly permeable seasonally wet acid loamy and clayey soils'.

Reference has been made to the British Geological Survey geology maps; these indicate that the site is underlain by Glaciofluvial Sheet Deposits, Devensian - Sand and Gravel. The underlying bedrock is comprised of Chester Formation - Sandstone.

Based on the above, there may be a risk of groundwater flooding at the site and surrounding areas.

Surface Water Flooding

Surface water flooding results from rainfall generated overland flows, before the runoff reaches a watercourse/ drainage system, or where the watercourse/ drainage system is overwhelmed and unable to accept further runoff. Surface water runoff is usually associated with high intensity rainfall events but may also occur with lower intensity rainfall where the ground is saturated, developed or otherwise has low permeability resulting in overland flows and ponding within depressions in the topography.

The EA provide maps on their website which illustrate the risk of surface water flooding along with potential depths and velocities; these show that the site is at very low risk of surface water flooding. Slack Road is at high risk of surface water flooding, with potential depths ranging up to 900mm.

Section 5 of this report details the surface water drainage strategy for the site, which will ensure that surface water is appropriately managed over the lifetime of the development and will ensure that the proposals will not exacerbate surface water flooding at the site or surrounding areas.

Sewer Flooding

Sewer flooding occurs when the capacity of underground sewerage systems is exceeded, resulting in flooding inside and outside of buildings. Normal discharge of sewers and drains through outfalls may be impeded by high water levels in receiving waters.

There are no known records of sewer flooding at the site location.

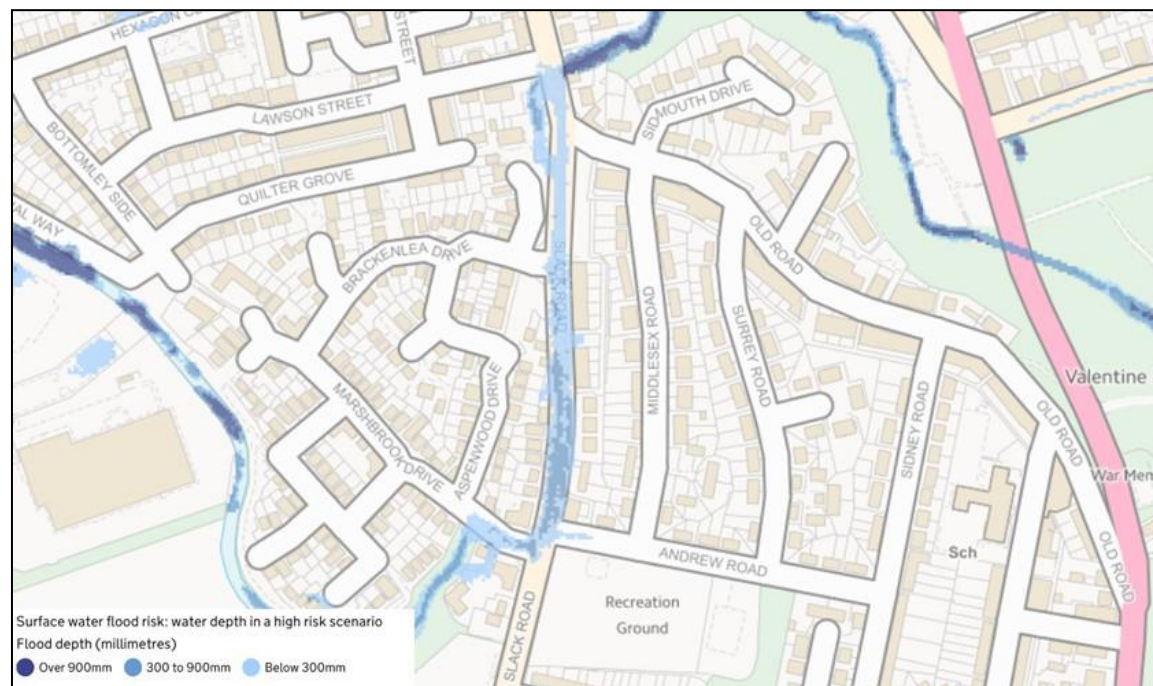


Figure 2 – Environment Agency Surface Water Flooding Map

4. Flood Mitigation Measures

Given that the site is located in Flood Zone 3, and proposals are for residential development, the following measures to mitigate the risk of flooding are recommended.

Floor Levels

Finished floor levels will be set above ground levels.

Flood Resilient Construction

Flood resilient construction techniques should also be incorporated into the ground floor, in line with guidance provided in the Communities and Local Government Document, *Improving the Flood Performance of New Buildings: Flood Resilient Construction*¹. These include:

- Flood resilient building materials and fittings
- Raised sockets

The Design Team should review the guidance and ensure that the most appropriate measures are incorporated into the proposals.

Flood Alerts

The site is located in an area where the EA provides Flood Alerts. Occupants should register with the EA at:

<https://www.fws.environment-agency.gov.uk/app/olr/doDetails>

¹ Improving the Flood Performance of New Buildings: Flood Resilient Construction. Department for Communities and Local Government. May 2007.

5. Surface Water and SuDS

The whole site comprises approximately 170m².

Surface Water Runoff from the Existing Site

The existing site is a vacant portion of waste land.

A copy of the Thames Water public sewer records is provided in **Appendix D**. These show that a 225mm public combined sewer is located to the north of the site, before connecting into the main combined sewer located in Slack Road.

In order to gain an indication of the rates of surface water runoff from the existing site, the ICP SuDS Method within Micro Drainage has been used, as detailed in **Appendix E**. The flow rates are shown in **Table 2**.

Table 2 –ICP SuDS - Existing Rates of Runoff (greenfield) (l/s)

Return Period	Flow Rate for 170m ² (l/s)
1 in 1 year	0.1
Qbar	0.2
1 in 30 year	0.2

Surface Water Runoff from the Redeveloped Site

As shown on the proposed site drawings, following redevelopment the site areas will be as follows:

- Roof areas - 100m²
- Hardstanding (paving etc) - ~20m²
- Landscaped areas – ~70m²

Through redevelopment of the site, there will be a decrease in hardstanding areas of ~1372m².

SuDS Approach

When choosing and designing SuDS for a development, it is important to recognise the constraints associated with the type of SuDS to be installed, including the size of the site and the underlying ground conditions. Most Councils set out a strategic approach for the disposal of surface water runoff, which mirrors the hierarchy set out in Building Regulations Approved Document Part H². In general, these are as follows:

1 Store rainwater for later use

There is the potential for simple rainwater reuse. See the following section of this report.

2 Use infiltration techniques, such as porous surfaces in non-clay areas

As previously detailed, the Soilscape Maps provided by the National Soil Resources Institute at Cranfield University indicate that the soils at the site and surrounding areas are comprised of 'Slowly permeable seasonally wet acid loamy and clayey soils'.

The British Geological Survey geology maps indicate that the site is underlain by Glaciofluvial Sheet Deposits, Devensian - Sand and Gravel. The underlying bedrock is comprised of Chester Formation - Sandstone.

In order to investigate the underlying ground conditions further, a review of nearby BGS borehole records has been carried out. A copy of the records is provided in **Appendix F**. These indicate that beneath the top layer of made ground is a band of peat / clayey sand.

Given the presence of clay, infiltration of surface water is not recommended. Should infiltration SuDS be pursued further down the line, it is strongly recommended that percolation testing to BRE Digest 365 is carried out in order to a) confirm the suitability of the ground for infiltration, and b) confirm a rate of infiltration.

² Building Regulations Approved Document H Section 3 page 45

3 Attenuate rainwater in ponds or open water features for gradual release

The site does not have the appropriate space required for a pond or open water feature to be safely provided.

4 Attenuate rainwater by storing in tanks or sealed water features for gradual release

Attenuation storage with a controlled outlet is an option.

5 Discharge rainwater direct to a watercourse

It is not feasible to discharge directly into the nearby watercourse.

6 Discharge rainwater to a surface water sewer/drain

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

7 Discharge rainwater to the combined sewer.

Attenuation storage with a controlled outlet into the public combined sewer is an option.

Based on the strategic approach for the management of surface water runoff, the most feasible and safe strategy appears to be:

- Rainwater recycling
- Attenuation storage with a controlled outlet into the combined sewer

Rainwater Recycling

In order to provide a level of rainwater recycling, water butts should be provided. Water butts afford the opportunity for future occupants to reuse water collected in the water butt, for example when watering the garden/or washing cars etc. If this supply is used frequently this may also ensure that some additional storage is available during an extreme rainfall event.

However, it is not recommended that water butts are used for storm water storage as there is a possibility that they may be full before the onset of a storm and as such there is no guarantee that these types of system will provide additional storage when required. Any additional storage provided by the water butt has therefore not been included within the SuDS calculations for the site.

Attenuation Storage with Hydrobrake

Micro Drainage has been used to calculate storage for surface water runoff from hardstanding areas (120m²) in up to the 1 in 100 year plus 40% allowance for climate change.

Flows have been restricted to 2l/s; this is the lowest flow rate recommended to avoid blockage of the system.

As shown in **Appendix G**, a total storage volume of 1.6m³ will be required. The storage has been designed at a depth of 1.5m, filling to 1.0m and with a 0.5m freeboard provided, should any excess flows be received.

The SuDS strategy has been put together based on our understanding of the ground conditions and site layout. Building Control will need to be consulted on the siting of the SuDS, and the recommendations and advice of the SuDS manufacturer / installer should always be followed.

SuDS Maintenance

Schedules are provided below (taken from Ciria C753 The SuDS Manual): the property owners / management company will be responsible for ensuring that these, or similar schedules are followed.

Water Butts

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	The water butt should be routinely checked for litter – leaves can become trapped in the water butt which could lead to blockage of the taps and overflow	Monthly
	Where appropriate, and if safe to do so, the water butt should be cleaned annually to prevent smells associated with stagnant water, and to remove any algae.	Annually

Attenuation Storage

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	Remove sediment from pre-treatment structures and/or internal forebays	Annually, or as required
Remedial Actions	Repair/ rehabilitate inlets, outlet, overflow, and vents	As required
Monitoring	Inspect/ check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build up and remove if necessary	Every five years, or as required

Pipe System

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required take remedial action.	Monthly for 3 months then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly

	Remove sediment from pre-treatment inlet structures and inspection chambers.	Annually or as required
	Maintain vegetation to designed limits within the vicinity of below ground drainage pipes and tanks to avoid damage to system	Monthly or as required
Remedial Actions	Repair physical damage if necessary	As required
Monitoring	Inspect all inlets, outlets and vents to ensure that they are in good condition and operating as designed.	Annually
	Survey inside of pipe runs for sediment build up and remove if necessary.	Every 5 years or as required

Hydrobrake

Hydro International Warranty, Maintenance Statement

The following has been provided by Hydro International:

Normally, little maintenance is required as there are no moving parts within the Flow Control. Experience has shown that if blockages occur they do so at the intake, and the cause on such occasions has been due to a lack of attention to engineering detail such as approach velocities being too low, inadequate benching, or the use of units below the minimum recommended size.

The Flow Control (where applicable) is fitted with a pivoting bypass door, which allows the manhole chamber to be drained down should blockage occur. The smaller conical units, below the minimum recommended size, are also supplied with rodding facilities or vortex suppressor pipes as standard.

Following installation of the Flow Control it is vitally important that any extraneous material i.e. building materials are removed from the unit and the chamber.

After the system is made live, and assuming that the chamber design is satisfactory, it is recommended that each unit be inspected monthly for three months and thereafter at six monthly intervals with hose down if required.

6. Conclusions

This Flood Risk and Surface Water Assessment has been prepared to, so far as is practicable, discharge Condition 4 of the Decision Notice for the proposed residential development on a portion of vacant land located off Slack Road.

Proposals are for 2 terraced dwellings.

Flood Risk and Mitigation

- The site is shown to be located within Flood Zone 3 and is therefore considered to be at high risk of fluvial flooding.
- At the time of writing, no topographic survey of the site has been carried out and therefore it is not possible to compare site levels with modelled flood levels to ascertain the potential depths of flooding at the site.
- The EA has confirmed that they do not hold any historic records of flooding at the site location.
- Based on the desktop study of underlying ground conditions, there may be a risk of groundwater flooding at the site and surrounding areas.
- The EA provide maps on their website which illustrate the risk of surface water flooding along with potential depths and velocities; these show that the site is at very low risk of surface water flooding. Slack Road is at high risk of surface water flooding, with potential depths ranging up to 900mm.
- In order to mitigate the risks of flooding, the following measures should be considered:
- Finished floor levels to be set above existing ground levels.
- Flood resilient construction techniques to be incorporated into the ground floor, in line with best practice guidance.
- Occupants should register with the EA to receive flood alerts.

Surface Water and SuDS

Based on the strategic approach for the management of surface water runoff, the most feasible and safe strategy appears to be:

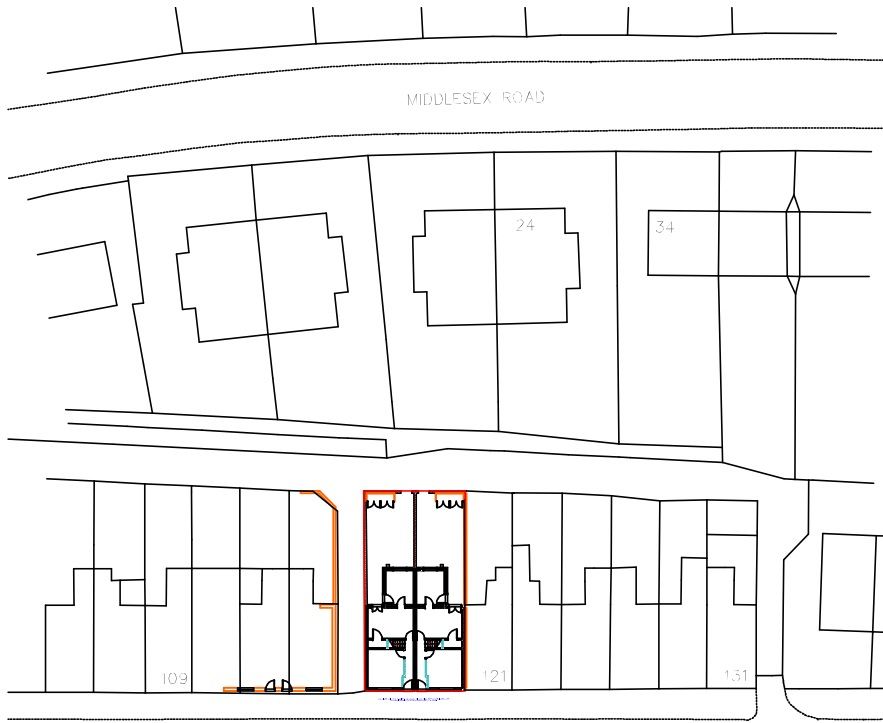
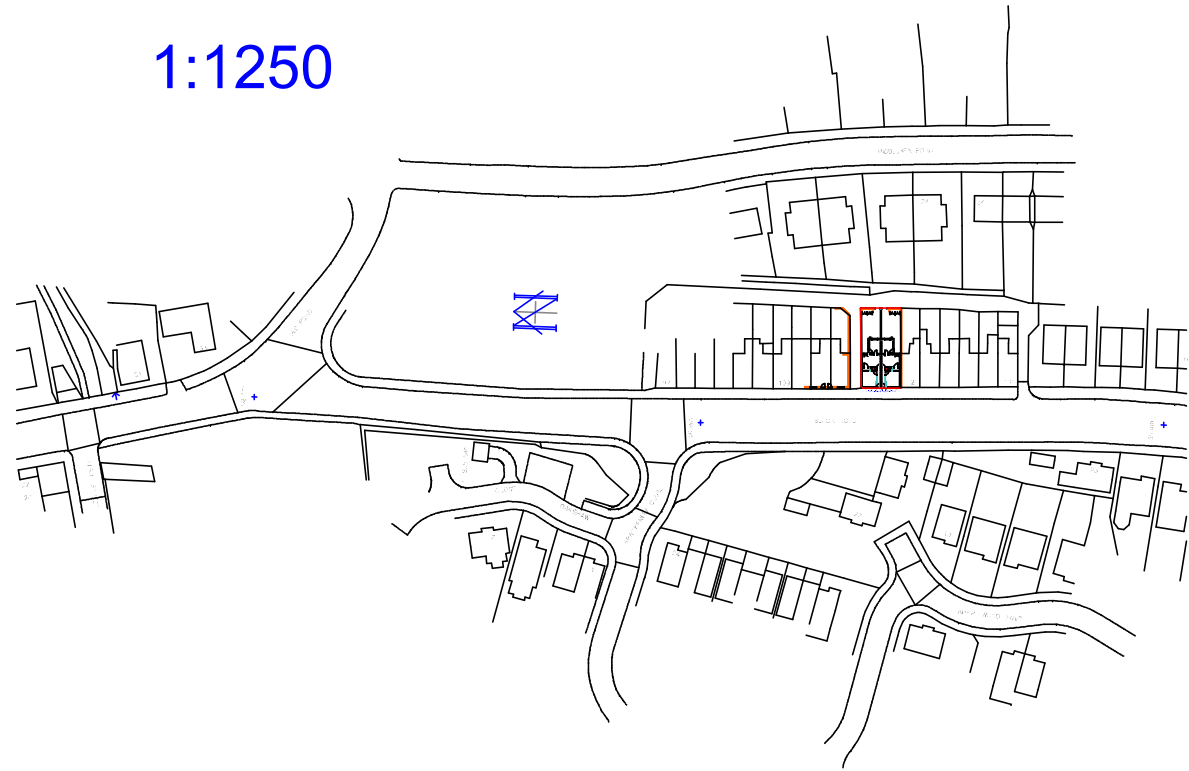
- Rainwater recycling
- Attenuation storage with a controlled outlet into the combined sewer

-
- Should the client wish to pursue infiltration SuDS further down the line, it is strongly recommended that percolation testing to BRE Digest 365 is carried out in order to a) confirm the suitability of the ground for infiltration, and b) confirm a rate of infiltration.
 - *The SuDS strategy has been put together based on our understanding of the ground conditions and site layout. Building Control will need to be consulted on the siting of the SuDS, and the recommendations and advice of the SuDS manufacturer / installer should always be followed.*

Appendices

Appendix A - Site Location

1:1250



SLACK ROAD



1:500

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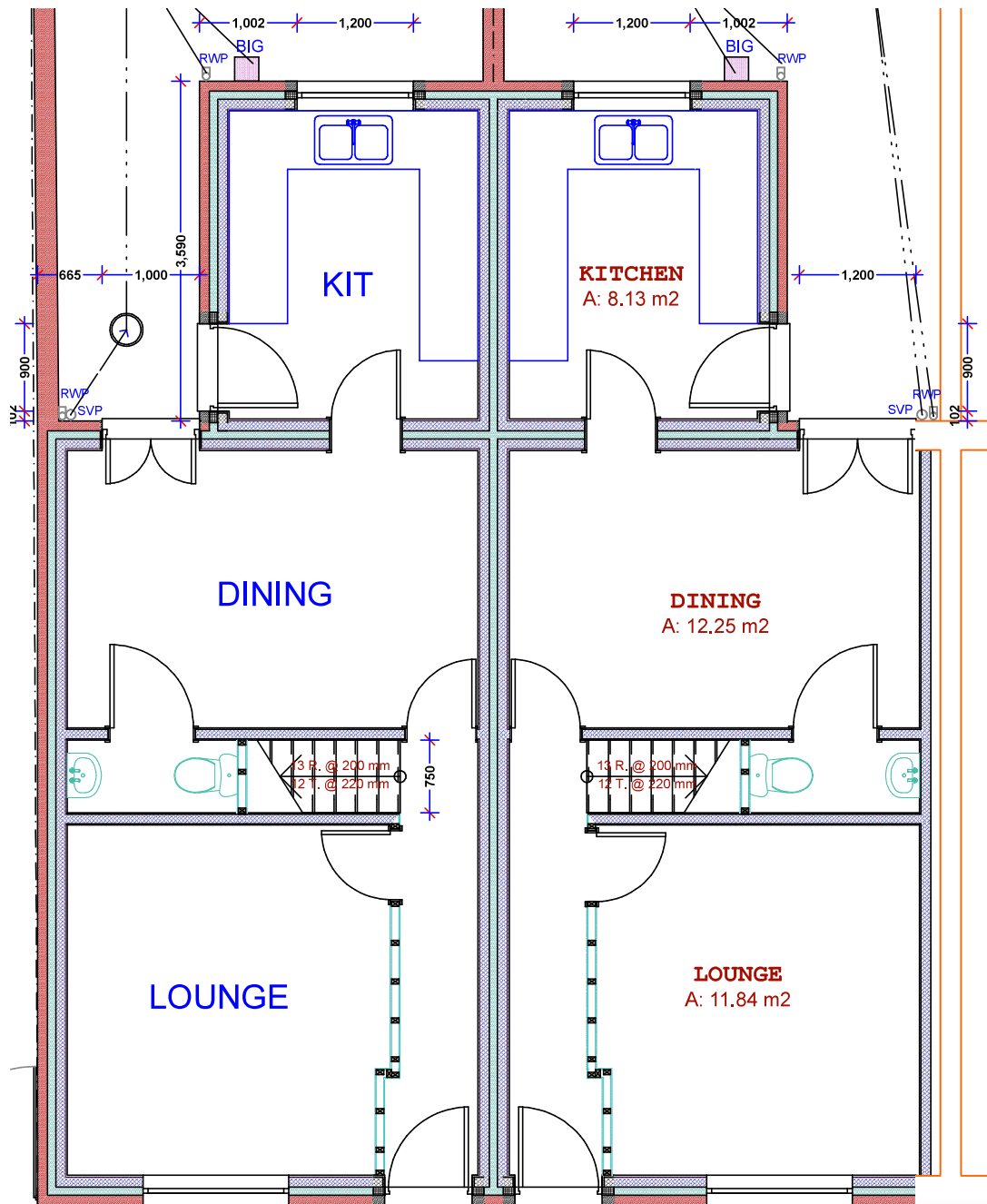
Architectural Technologist

62 Belmont Ave, Springhead,
Oldham, OL4 4RS.
Tel : 078165 98985

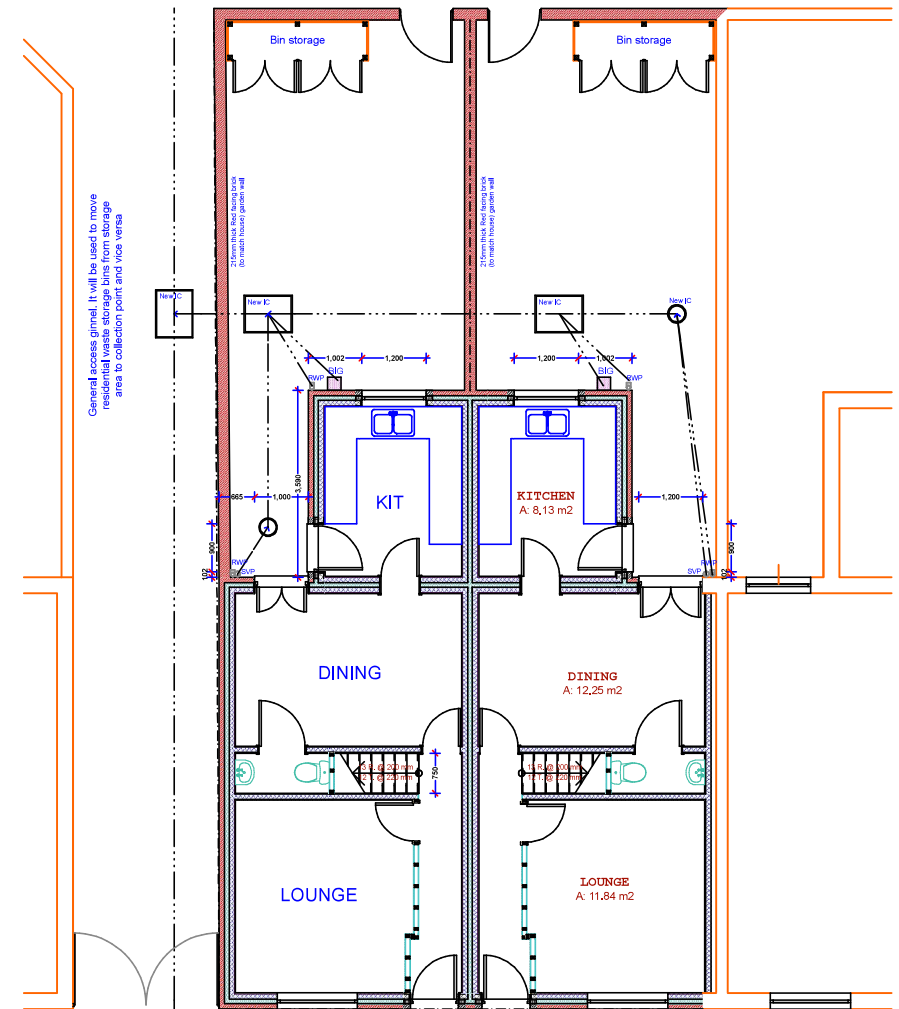


Scale:	Client:
	Mr I Shah
Date:	Address:
15/05/2019	117/119 Slack Rd., Manchester M9 8AZ
Dwg. Rev. Page	Title:
5491 B	2No New Build Terrace Houses

Appendix B - Proposed Site Layout



Proposed Ground



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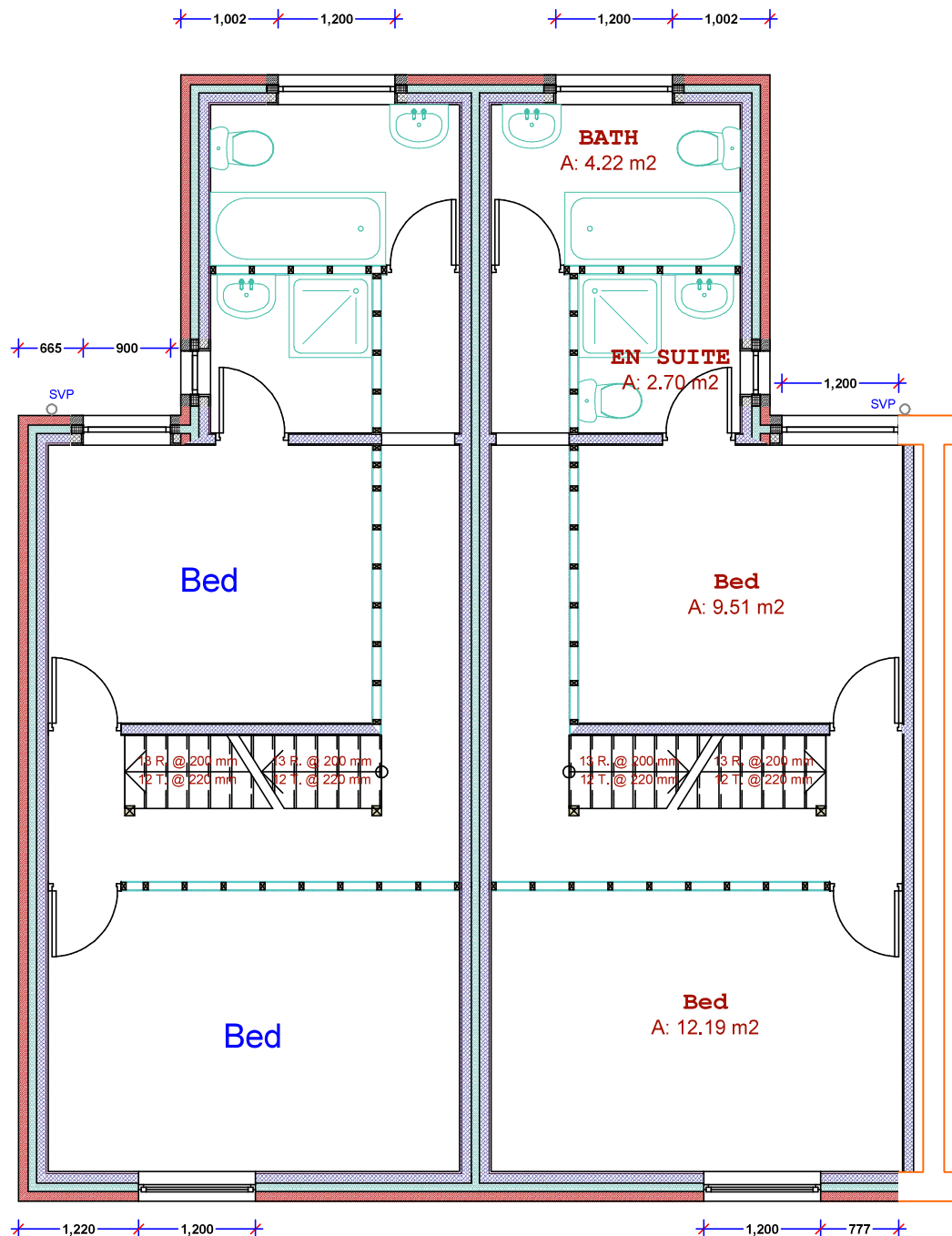
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Proposed First

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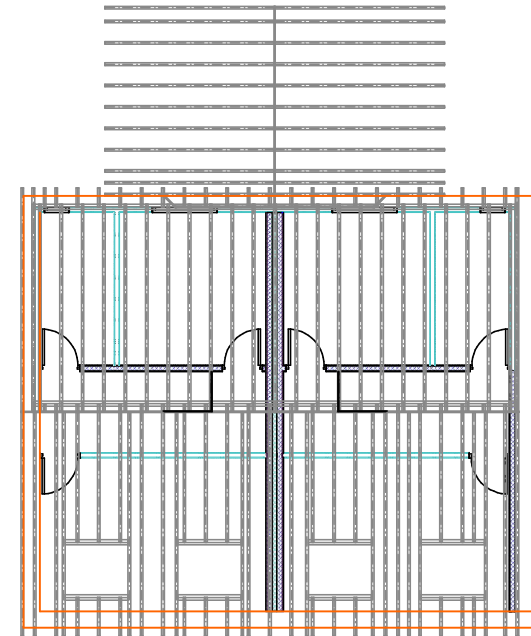
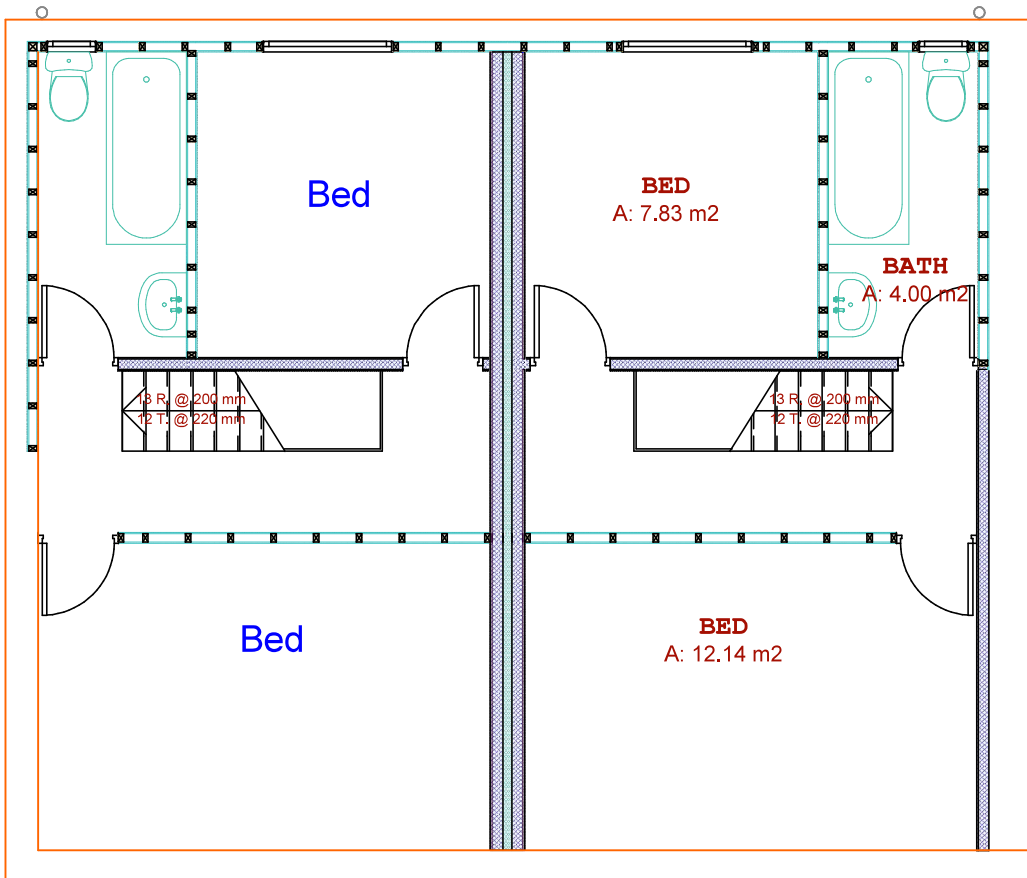
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Proposed Second



Proposed roof structure

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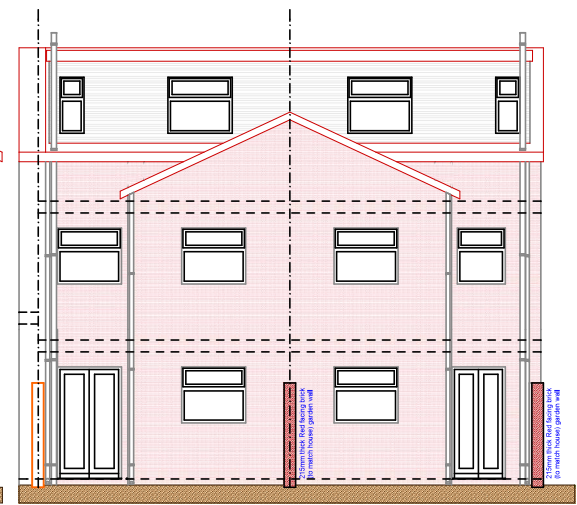
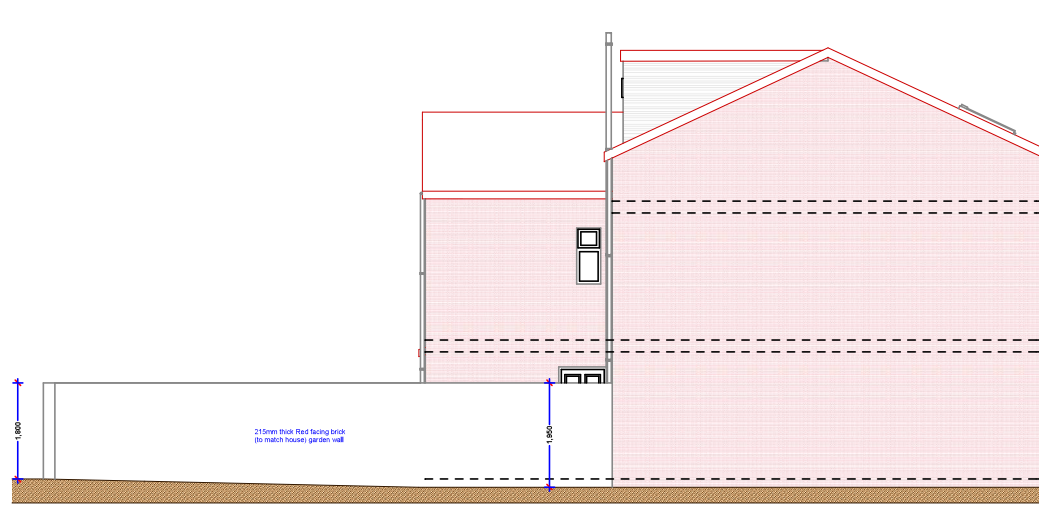
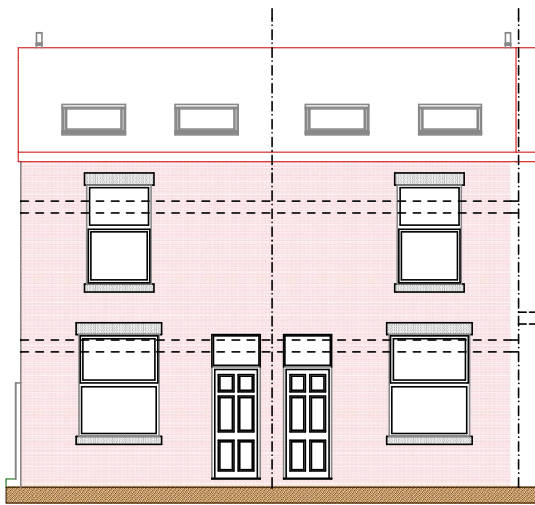
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B 3/5

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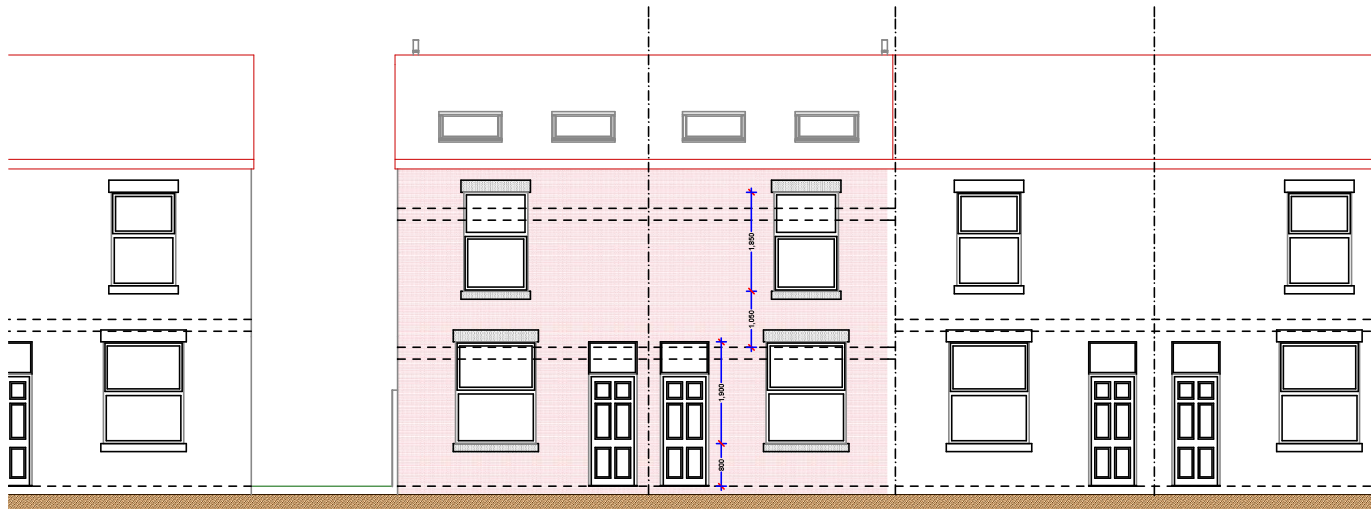
2No New Build
Terrace Houses



Front

Side

Rear



Street

Elevations

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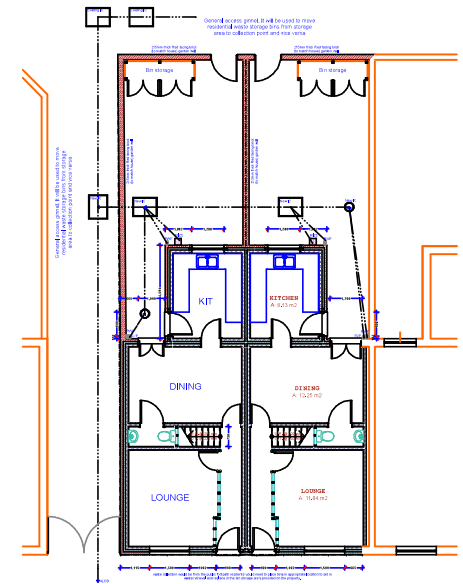
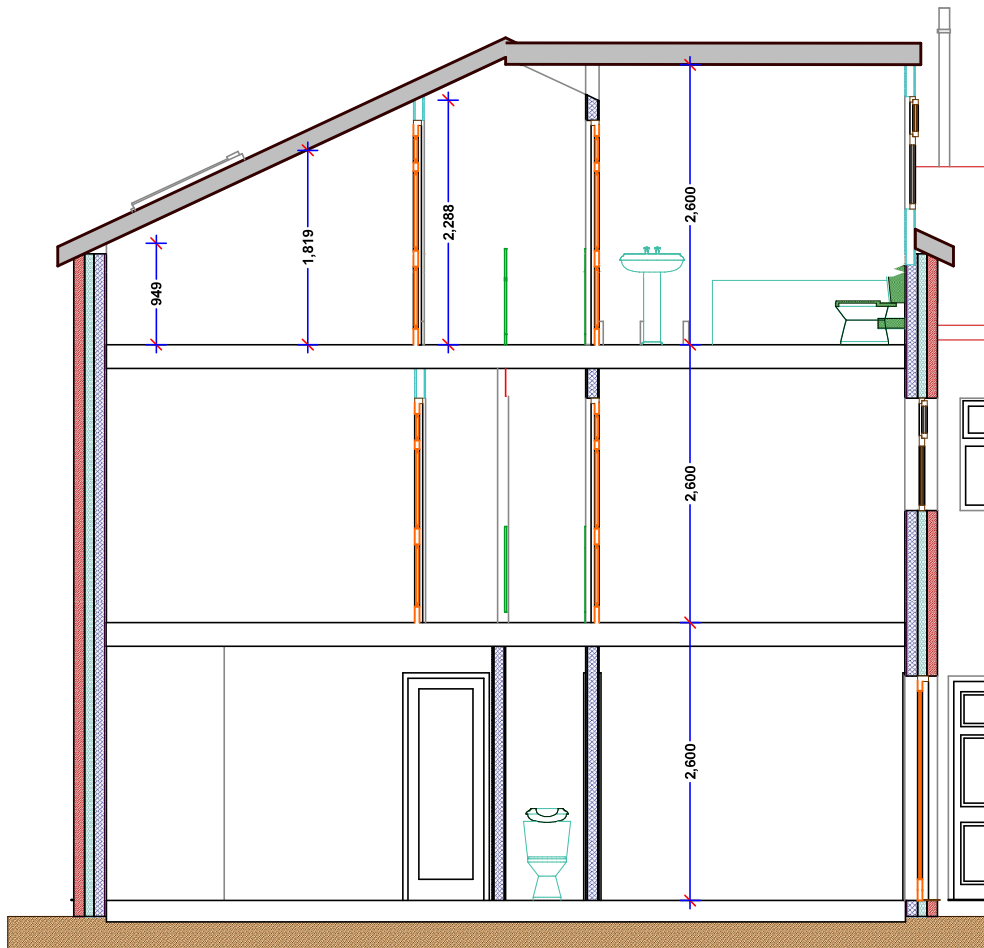
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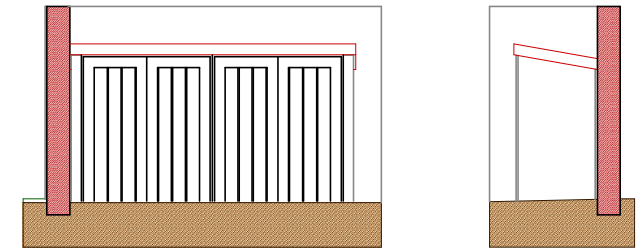
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Test Section



Waste storage



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M9 8AZ

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Title:

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Appendix C - Environment Agency Detailed Flood Information

Map Reference	Model Node Reference	Easting	Northing	Data	Undefended			
					1 % AEP (1 in 100 year)	1 % AEP (1 in 100 year) + 35% increase in flow	1 % AEP (1 in 100 year) + 70% increase in flow	0.1 % AEP (1 in 1000 year)
1	ea013_0060_BOGG01_0787	385740	402853	Modelled Water Level (m aodN)	54.71	54.92	55.06	55.01
				Modelled Flow (cumecs)	8.23	11.71	14.75	13.56
2	ea013_0060_BOGG01_0587u	385579	402804	Modelled Water Level (m aodN)	53.28	53.38	53.45	53.43
				Modelled Flow (cumecs)	8.25	11.74	14.78	13.57
3	ea013_0060_BOGG01_0446	385574	402620	Modelled Water Level (m aodN)	51.07	51.19	51.27	51.25
				Modelled Flow (cumecs)	4.86	8.27	11.29	10.08
4	ea013_0060_BOGG01_0324G	385525	402509	Modelled Water Level (m aodN)	50.05	50.15	50.23	50.21
				Modelled Flow (cumecs)	4.87	8.28	11.29	10.08

Model data taken from Boggart Hole Brook 2007 Study

AEP - Annual Exceedence Probability

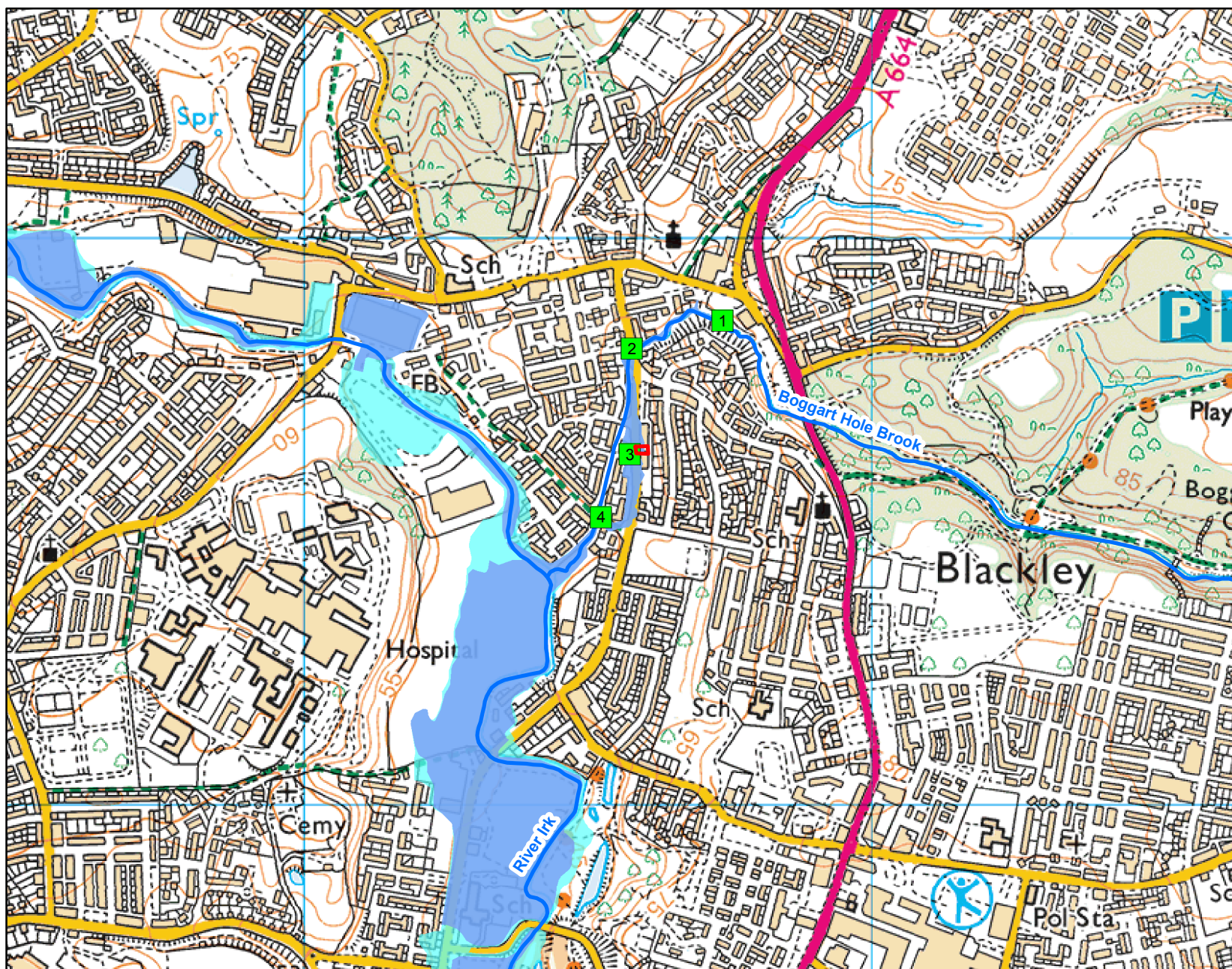
m aodN - metres above ordnance datum Newlyn

cumecs - cubic metres per second

Notes:

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

Detailed Flood Map centred on Slack Road, Manchester, M9 8AZ. Created on 01/12/2020 [GMMC192279CC]



1:10,001

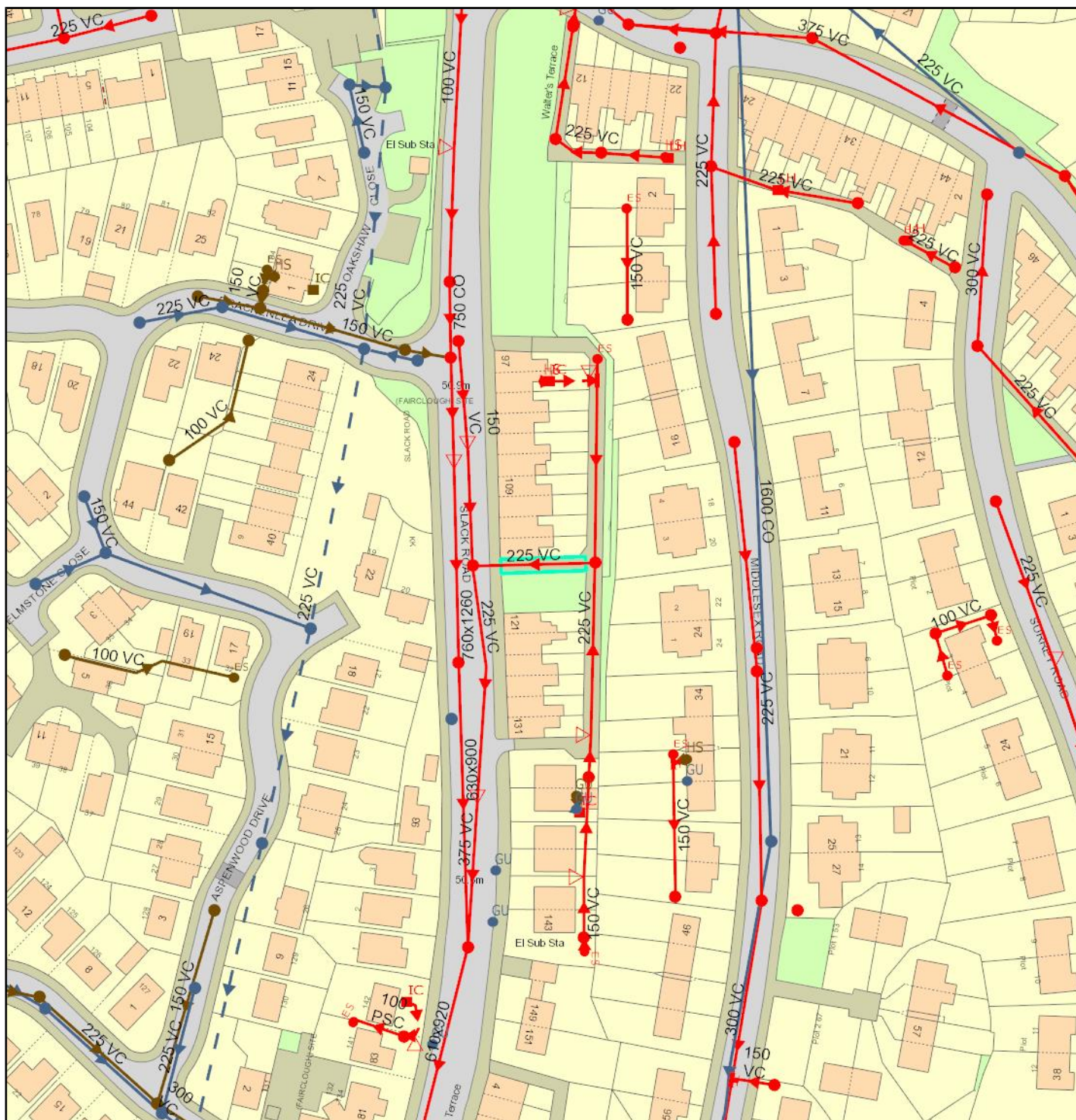


Legend

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

Appendix D - Thames Water Public Sewer Records

117 Slack Road Manchester



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Wastewater Symbolology

Abandoned	Foul	Surface Water	Combined	
				Public Sewer
				Private Sewer
				Section 104
				Rising Main
				Sludge Main
				Overflow
				Water Course
				Highway Drain

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

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

Appendix E - ICP SuDS Greenfield Rate of Runoff

Base Energy Services Limited		Page 1												
44 Canal Street Bootle Liverpool L20 8QU	Slack Road Existing Greenfield													
Date 06/12/2020 File	Designed by CC Checked by PK													
Micro Drainage		Source Control 2019.1												
<u>ICP SUDS Mean Annual Flood</u> Input <table> <tr> <td>Return Period (years)</td> <td>100</td> <td>Soil</td> <td>0.450</td> </tr> <tr> <td>Area (ha)</td> <td>0.017</td> <td>Urban</td> <td>0.000</td> </tr> <tr> <td>SAAR (mm)</td> <td>884</td> <td>Region Number</td> <td>Region 10</td> </tr> </table> Results 1/s QBAR Rural 0.1 QBAR Urban 0.1 Q100 years 0.2 Q1 year 0.1 Q30 years 0.2 Q100 years 0.2			Return Period (years)	100	Soil	0.450	Area (ha)	0.017	Urban	0.000	SAAR (mm)	884	Region Number	Region 10
Return Period (years)	100	Soil	0.450											
Area (ha)	0.017	Urban	0.000											
SAAR (mm)	884	Region Number	Region 10											
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Appendix F - British Geological Survey Borehole Records

GEO-RESEARCH LTD.

CALE STREET, CALE GREEN,
STOCKPORT, CHESHIRE

SD80SE 1010

CONTRACT: Rochdale Road Relief Sewer

8563
0266

LOCATION: Manchester

Borehole No. 1

Street No. 1

Date Commenced 16th. December 1963

Date Completed 16th. December 1963

Scale 1 inch = 1 foot.

Stratum	Legend	Thick- ness	Depth	Sample No.	N Value	Level	Remarks
			G.L.				
Medium well graded sand and gravel.			1'0"	D1			Damp
		3'0"	3'0"				
Medium well graded clayey sand with bands of clay.			3'6"	D2			Moist
			4'6"	D3			
		2'6"	5'6"				
Fine well graded reddish/ brown sand.			6'0"	D4			Damp
							Water table
			4'6"	10'0"			
Medium well graded sand and gravel.			11'0"	L5			Damp
			4'6"	14'0"			
Fine well graded sand and silt.			15'0"	D6			Damp
			12'0"	26'0"			
Medium well graded sand and gravel with organic inclusions.			27'0"	D7			Damp
			4'0"	30'0"			

Continued on page 2.

SD 80 SE 304

SECTION OF Borehole

at In. Reservoir, Moss House Works,
Blackley

British Geological Survey

British Geological Survey

Maps: One-inch 85

Six-inch 96 S.E.N

County Manchester

Height above O.D. —

Latitude —

Longitude —

Communicated by

Manchester Corporation

Date of Sinking —

Made by

Dip of Strata —

Thickness.

Depth from Surface.

metres

30 made ground

Peat clay & sand [Water at 7 ft.]

Peat

Quicksand & pebbles

6 - 0.83 6 -

1 6 2.28 7 6

6 - 4.11 13 6

5 - 5.63 18 6

Appendix G - Micro Drainage Attenuation Storage Calculations

Base Energy Services Limited					Page 1
44 Canal Street		Slack Road			
Bootle		Attenuation			
Liverpool L20 8QU		100yr40CC			
Date 06/12/2020		Designed by CC			
File Attenuation.SRCX		Checked by PK			
Micro Drainage		Source Control 2019.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.797	0.797	1.9	1.3	O K
30 min Summer	0.863	0.863	1.9	1.4	O K
60 min Summer	0.763	0.763	1.9	1.2	O K
120 min Summer	0.396	0.396	1.9	0.6	O K
180 min Summer	0.197	0.197	1.9	0.3	O K
240 min Summer	0.117	0.117	1.7	0.2	O K
360 min Summer	0.074	0.074	1.3	0.1	O K
480 min Summer	0.061	0.061	1.1	0.1	O K
600 min Summer	0.053	0.053	0.9	0.1	O K
720 min Summer	0.048	0.048	0.8	0.1	O K
960 min Summer	0.042	0.042	0.6	0.1	O K
1440 min Summer	0.035	0.035	0.5	0.1	O K
2160 min Summer	0.029	0.029	0.3	0.0	O K
2880 min Summer	0.026	0.026	0.3	0.0	O K
4320 min Summer	0.022	0.022	0.2	0.0	O K
5760 min Summer	0.020	0.020	0.2	0.0	O K
7200 min Summer	0.018	0.018	0.1	0.0	O K
8640 min Summer	0.016	0.016	0.1	0.0	O K
10080 min Summer	0.015	0.015	0.1	0.0	O K
15 min Winter	0.931	0.931	1.9	1.5	O K
30 min Winter	0.978	0.978	2.0	1.6	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	118.613	0.0	2.7	16	
30 min Summer	79.413	0.0	3.6	25	
60 min Summer	50.812	0.0	4.6	42	
120 min Summer	31.468	0.0	5.7	72	
180 min Summer	23.466	0.0	6.3	98	
240 min Summer	18.940	0.0	6.8	128	
360 min Summer	13.882	0.0	7.5	186	
480 min Summer	11.143	0.0	8.0	246	
600 min Summer	9.389	0.0	8.4	304	
720 min Summer	8.158	0.0	8.8	366	
960 min Summer	6.531	0.0	9.4	484	
1440 min Summer	4.764	0.0	10.3	730	
2160 min Summer	3.468	0.0	11.2	1068	
2880 min Summer	2.766	0.0	11.9	1472	
4320 min Summer	2.007	0.0	13.0	2152	
5760 min Summer	1.596	0.0	13.8	2864	
7200 min Summer	1.336	0.0	14.4	3568	
8640 min Summer	1.154	0.0	15.0	4400	
10080 min Summer	1.020	0.0	15.4	5136	
15 min Winter	118.613	0.0	3.0	17	
30 min Winter	79.413	0.0	4.0	26	
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Base Energy Services Limited					Page 2
44 Canal Street		Slack Road			
Bootle		Attenuation			
Liverpool L20 8QU		100yr40CC			
Date 06/12/2020		Designed by CC			
File Attenuation.SRCX		Checked by PK			
Micro Drainage		Source Control 2019.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.782	0.782	1.9	1.3	O K
120 min Winter	0.237	0.237	1.9	0.4	O K
180 min Winter	0.098	0.098	1.6	0.2	O K
240 min Winter	0.074	0.074	1.3	0.1	O K
360 min Winter	0.056	0.056	1.0	0.1	O K
480 min Winter	0.048	0.048	0.8	0.1	O K
600 min Winter	0.043	0.043	0.7	0.1	O K
720 min Winter	0.040	0.040	0.6	0.1	O K
960 min Winter	0.035	0.035	0.5	0.1	O K
1440 min Winter	0.029	0.029	0.3	0.0	O K
2160 min Winter	0.024	0.024	0.2	0.0	O K
2880 min Winter	0.022	0.022	0.2	0.0	O K
4320 min Winter	0.018	0.018	0.1	0.0	O K
5760 min Winter	0.016	0.016	0.1	0.0	O K
7200 min Winter	0.015	0.015	0.1	0.0	O K
8640 min Winter	0.014	0.014	0.1	0.0	O K
10080 min Winter	0.013	0.013	0.1	0.0	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	50.812	0.0	5.1	44	
120 min Winter	31.468	0.0	6.3	72	
180 min Winter	23.466	0.0	7.1	98	
240 min Winter	18.940	0.0	7.6	126	
360 min Winter	13.882	0.0	8.4	186	
480 min Winter	11.143	0.0	9.0	246	
600 min Winter	9.389	0.0	9.5	306	
720 min Winter	8.158	0.0	9.9	362	
960 min Winter	6.531	0.0	10.5	494	
1440 min Winter	4.764	0.0	11.5	718	
2160 min Winter	3.468	0.0	12.6	1056	
2880 min Winter	2.766	0.0	13.4	1392	
4320 min Winter	2.007	0.0	14.6	2172	
5760 min Winter	1.596	0.0	15.4	2856	
7200 min Winter	1.336	0.0	16.2	3576	
8640 min Winter	1.154	0.0	16.8	4400	
10080 min Winter	1.020	0.0	17.3	5224	
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Base Energy Services Limited		Page 3																																				
44 Canal Street	Slack Road																																					
Bootle	Attenuation																																					
Liverpool L20 8QU	100yr40CC																																					
Date 06/12/2020	Designed by CC																																					
File Attenuation.SRCX	Checked by PK																																					
Micro Drainage		Source Control 2019.1																																				
<u>Rainfall Details</u> <table> <tr> <td>Rainfall Model</td> <td>FSR</td> <td>Winter Storms</td> <td>Yes</td> </tr> <tr> <td>Return Period (years)</td> <td>100</td> <td>Cv (Summer)</td> <td>0.750</td> </tr> <tr> <td>Region</td> <td>England and Wales</td> <td>Cv (Winter)</td> <td>0.840</td> </tr> <tr> <td>M5-60 (mm)</td> <td>18.000</td> <td>Shortest Storm (mins)</td> <td>15</td> </tr> <tr> <td>Ratio R</td> <td>0.360</td> <td>Longest Storm (mins)</td> <td>10080</td> </tr> <tr> <td>Summer Storms</td> <td>Yes</td> <td>Climate Change %</td> <td>+40</td> </tr> </table> <u>Time Area Diagram</u> Total Area (ha) 0.012 <table> <thead> <tr> <th>Time (mins)</th> <th>Area</th> <th>Time (mins)</th> <th>Area</th> </tr> <tr> <th>From:</th> <th>To: (ha)</th> <th>From:</th> <th>To: (ha)</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>4 0.006</td> <td>4</td> <td>8 0.006</td> </tr> </tbody> </table>			Rainfall Model	FSR	Winter Storms	Yes	Return Period (years)	100	Cv (Summer)	0.750	Region	England and Wales	Cv (Winter)	0.840	M5-60 (mm)	18.000	Shortest Storm (mins)	15	Ratio R	0.360	Longest Storm (mins)	10080	Summer Storms	Yes	Climate Change %	+40	Time (mins)	Area	Time (mins)	Area	From:	To: (ha)	From:	To: (ha)	0	4 0.006	4	8 0.006
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44 Canal Street	Slack Road	
Bootle	Attenuation	
Liverpool L20 8QU	100yr40CC	
Date 06/12/2020	Designed by CC	
File Attenuation.SRCX	Checked by PK	
Micro Drainage		Source Control 2019.1
<u>Model Details</u>		
Storage is Online Cover Level (m) 1.500		
<u>Tank or Pond Structure</u>		
Invert Level (m) 0.000		
Depth (m)	Area (m ²)	Depth (m) Area (m ²) Depth (m) Area (m ²) Depth (m) Area (m ²)
0.000	1.6	0.700 1.6 1.400 1.6 2.100 1.6
0.100	1.6	0.800 1.6 1.500 1.6 2.200 1.6
0.200	1.6	0.900 1.6 1.600 1.6 2.300 1.6
0.300	1.6	1.000 1.6 1.700 1.6 2.400 1.6
0.400	1.6	1.100 1.6 1.800 1.6 2.500 1.6
0.500	1.6	1.200 1.6 1.900 1.6
0.600	1.6	1.300 1.6 2.000 1.6
<u>Hydro-Brake® Optimum Outflow Control</u>		
Unit Reference MD-SHE-0067-2000-1000-2000		
Design Head (m) 1.000		
Design Flow (l/s) 2.0		
Flush-Flo™ Calculated		
Objective Minimise upstream storage		
Application Surface		
Sump Available Yes		
Diameter (mm) 67		
Invert Level (m) 0.000		
Minimum Outlet Pipe Diameter (mm) 100		
Suggested Manhole Diameter (mm) 1200		
Control Points	Head (m) Flow (l/s)	Control Points Head (m) Flow (l/s)
Design Point (Calculated)	1.000 2.0	Kick-Flo® 0.599 1.6
Flush-Flo™	0.296 1.9	Mean Flow over Head Range - 1.7
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated		
Depth (m) Flow (l/s)	Depth (m) Flow (l/s)	Depth (m) Flow (l/s) Depth (m) Flow (l/s)
0.100 1.6	1.200 2.2	3.000 3.3 7.000 4.9
0.200 1.9	1.400 2.3	3.500 3.5 7.500 5.1
0.300 1.9	1.600 2.5	4.000 3.8 8.000 5.2
0.400 1.9	1.800 2.6	4.500 4.0 8.500 5.4
0.500 1.8	2.000 2.7	5.000 4.2 9.000 5.5
0.600 1.6	2.200 2.9	5.500 4.4 9.500 5.7
0.800 1.8	2.400 3.0	6.000 4.6
1.000 2.0	2.600 3.1	6.500 4.7
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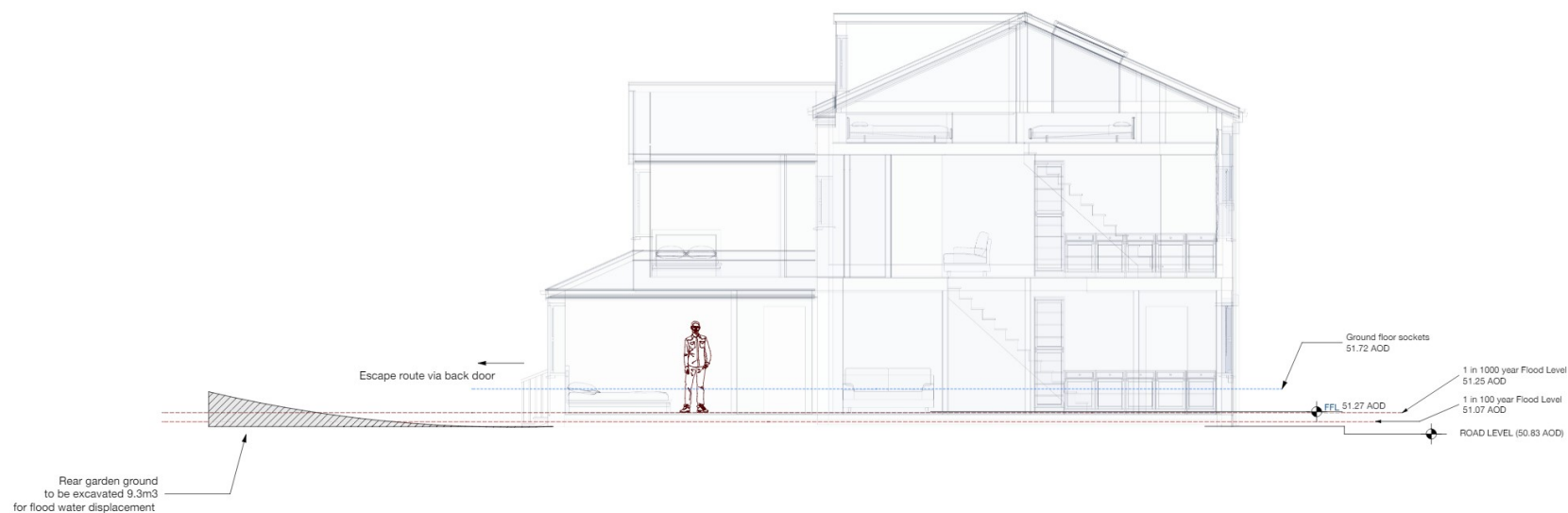
Appendix C - Section Plan (prepared by KCS Ltd)

GENERAL NOTES

- 1 Do not scale from this drawing.
- 2 Dimensions expressed in millimetres unless otherwise stated.
- 3 All dimensions are made to structural surfaces.

ABBREVIATIONS

DPC = DAMP PROOF COURSE, DPM = DAMP PROOF MEMBRANE w/W = WASTE WATER (SOIL PIPE), D/P = DRAIN PIPE, FFL = FINISH FLOOR LEVEL, GAS = GAS MAINS PIPE, MHRV = MECHANICAL HEAT RECOVERY UNIT, W/ = WITH



1 Side Elevation Indicating Flood Level
Scale 1:50 @ A1

Rev	Date	Description
Project Name		
117-119 Slack Road		
Drawing No.		Rev
A-200		
Sheet Title		
Flood Level Cross Section		
Scale	Date	Drawn
1 : 50 @ A1	20/10/2021	MA
KILO CONSTRUCTION SERVICES Kilo Construction Services Ltd 27 Old Gloucester Street London, WC1N 3AX		