



FLOOD RISK ASSESSMENT

Site Address

82 Mauldeth Road
West Withington
Manchester
M20 1AB

Client

Mr. Naser Khodadadi

Date

04/10/2021



CONSULTING GEO-ENVIRONMENTAL ENGINEERS AND SCIENTISTS

Phase 1 Contaminated Land Desk Studies, Geo-Environmental Site Investigations, Environmental Due Diligence, Flood Risk Assessments, Surface Water Management Strategies (SuDS), Ecology, Noise and Air Quality Assessments, Environmental Management Systems, GIS & Data Management Systems

1 Document Control



FLOOD RISK ASSESSMENT



Site Address:	82 Mauldeth Road West Withington Manchester M20 1AB
National Grid Reference:	384691, 393561
STM Reference:	STM – 2021 – 000155
Version No:	1.0
Prepared for:	Mr. Naser Khodadadi
Date:	04/10/2021
Report Author:	Nick Roebuck (MSc, BSc) Flood Risk Consultant
Authorised by:	Matthew Ashdown (BSc) Environmental Consultant

Contents

1	Document Control	2
2	Abbreviations.....	7
3	Disclaimer	8
4	Executive Summary.....	9
5	Introduction.....	11
6	Development Proposal.....	11
7	Report Aims and Objectives	11
8	Summary of Data Review Undertaken	11
9	Legislative and Policy Context.....	12
9.1	Legislative Context.....	12
9.2	Policy Context	12
9.2.1	National Planning Policy Framework (NPPF)	12
9.2.2	Local Planning Policy.....	15
9.3	EA Standing Advice on Flood Risk.....	16
10	Site Description and Environmental Characteristics	16
10.1	Site Location and Area.....	16
10.2	Site Access	16
10.3	Local Planning Authority	18
10.4	Lead Local Flood Authority	18
10.5	Flood Zone.....	18
10.6	Site and Surrounding Land Uses	18
10.6.1	Site Current Land Use.....	18
10.6.2	Surrounding Land Uses.....	18
10.7	Hydrology.....	18
10.8	Geology	19
10.9	Hydrogeology.....	19

10.10	Topography.....	19
11	The Sequential and Exception Tests	19
11.1	The Sequential Test.....	19
11.2	The Exception Test.....	20
12	Site Specific Flood Risk Analysis	22
12.1	Fluvial (River) and Tidal (Sea) Flood Risk	22
12.1.1	Mechanisms for Fluvial Flooding	22
12.1.2	Definition of EA Modelled Fluvial Flood Risk Zones	22
12.1.3	Main Potential Sources of Local Fluvial Flooding	23
12.1.4	Records of Historic Fluvial Flooding Incidents.....	23
12.1.5	Designated Fluvial Flood Risk Zone for the Site.....	23
12.1.6	Mechanisms for Tidal Flooding.....	23
12.1.7	Definition of EA Tidal Flood Risk Zones	23
12.1.8	Potential Sources of Tidal Flooding.....	24
12.1.9	Flood Defences	24
12.1.10	Climate Change - EA Modelled Predictions of Fluvial Flood Levels..	24
12.1.11	Long Term Fluvial Flood Risk Considering Flood Defences.....	25
12.2	Pluvial (Surface Water) Flood Risk	25
12.2.1	Mechanisms of Pluvial Flooding	26
12.2.2	Main Potential Sources of Local Pluvial Flooding.....	26
12.2.3	Records of Historic Pluvial Flooding Incidents.....	26
12.2.4	Surface Water Flood Risk from Artificial Sources (Reservoirs and Canals)	27
12.2.5	Sewer Flooding	27
12.2.6	Climate Change - Modelled Predictions of Surface Water Run-off Flooding	27
12.2.7	Long Term Surface Water Flood Risk	27

12.3	Risk of Flooding from Multiple Sources (ROFMS)	27
12.4	Groundwater Flood Risk	27
12.4.1	Historic Records of Groundwater Flooding.....	28
12.4.2	Susceptibility to Groundwater Flooding	28
12.5	Critical Drainage Area.....	28
13	Potential Impacts of the Development on Local Flood Risk	29
13.1	Impacts on Flood Storage	29
13.1.1	Changes to Impermeable Area and Building Footprint.....	29
13.2	Impacts on Flood Flow Routes.....	29
14	Flood Risk Mitigation Measures	29
14.1	SuDS	29
14.2	Flood Resilience	31
14.2.1	Finished Floor Levels	31
14.2.2	Compensatory Flood Storage.....	31
14.2.3	Flood Resilience Construction Measures	32
14.3	Emergency Plan.....	34
14.3.1	Assessment of Danger to People	34
14.3.2	EA Flood Warnings Direct Service Subscription.....	35
14.3.3	Access and Safe Egress	35
14.3.4	Safe Refuge	36
15	Conclusions and Recommendations.....	36
16	References	38
17	Appendices	39
17.1	Appendix 1 – Site Photographs.....	39
17.2	Appendix 2 – Development Plans	40
17.3	Appendix 3 – Environmental Characteristics	41
17.3.1	Superficial Hydrogeology Map.....	41
17.3.2	Bedrock Hydrogeology Map	42

17.3.3	Topology Map.....	43
17.4	Appendix 4 – Historical Flood Incident Maps	44
17.4.1	EA Historic Flood Outlines.....	44
17.4.2	Table of Recorded Historic Flooding (SFRA)	44
17.5	Appendix 5 - EA Flood Zone Map	45
17.6	Appendix 6 – Surface Water Flood Depth Map.....	46
17.6.1	Predicted surface water flood depth for the 1 in 1000-year return period (Source: EA, 2016).	46
17.7	Appendix 7 –Flood Defence and Reservoir Flood Risk Maps.....	47
17.7.1	EA Map showing flood defences within the vicinity of the site	47
17.7.2	Reservoir Flood Risk Map	47
17.8	Appendix 8 – Risk of Flooding from Multiple Sources Map	48
17.9	Appendix 9 – EA’s Long Term Flood Risk Maps.....	49
17.10	Appendix 10 – Groundwater Flood Maps.....	50
17.10.1	Groundwater Flooding (Susceptibility) Map (BGS) and Potential Depth to the Groundwater Water Map (BGS).....	50
17.11	Appendix 11 - EA Product 4 (Detailed Flood Risk) Data.....	51
17.12	Appendix 12 – Safe Egress to Flood Zone 1 Map.....	52
17.13	Appendix 13 – Calculation of Flood Hazard Rating.....	53

2 Abbreviations

Abbreviation	Description
STM	STM Environmental Consultants Limited
BGS	British Geological Survey
EA	Environment Agency
OS	Ordnance Survey of Great Britain
FRA	Flood Risk Assessment
NPPF	National Planning Policy Framework
FWD	Floodline Warning Direct
FRMS	Flood Risk Management Strategy
MCC	Manchester City Council
SWMP	Surface Water Management Plan
SFRA	Strategic Flood Risk Assessment
CDA	Critical Drainage Area
SuDS	Sustainable Drainage Systems
GWSPZ	Groundwater Source Protection Zone
LLFA	Lead Local Flood Authority
mbgl	metres below ground level
DCLG	Department for Communities and Local Government
PPGPS	Planning practice guidance and Planning system

3 Disclaimer

This report and any information or advice which it contains, is provided by STM Environmental Consultants Ltd (STM) and can only be used and relied upon by Mr Naser Khodadadi (Client).

STM has exercised such professional skill, care and diligence as may reasonably be expected of a properly qualified and competent consultant when undertaking works of this nature. However, STM gives no warranty, representation or assurance as to the accuracy or completeness of any information, assessments or evaluations presented within this report. Furthermore, STM accepts no liability whatsoever for any loss or damage arising from the interpretation or use of the information contained within this report. Any party other than the Client using or placing reliance upon any information contained in this report, do so at their own risk.

4 Executive Summary

SECTION	SUMMARY
Location	82 Mauldeth Road, West Withington, M20 1AB Grid Reference: 384691, 393561
Proposed Development	The demolition of existing structures in rear yard and erection of 3 no. residential apartments.
Flood Zone	Flood Zones 1, 2 and 3.
Topography	According to the LIDAR 1M DTM data, the site is relatively flat at 34.0mAOD.
Sequential and Exception Tests	Development is minor and more vulnerable so Sequential and Exception Tests should not be required. LLFA to decide.
Main Sources of Flooding	Cringle Black Brook (culverted adjacent to the northern boundary of the site). Chorlton Platt Gore/Platt Brook located approximately 470m north west of the site.
Flood Defences	Flood defences (high ground) identified approximately 470m north west of the site along Platt Brook, and multiple defences along Cringle Black Brook approximately 1km east of the site.
Records of Historic Flooding	Fluvial and Groundwater: None. Surface Water and Sewer: 3 events identified within vicinity of the site.
Fluvial (River) and Tidal (Sea) Flood Risk	Low – the site will remain dry during all modelled scenarios inclusive of climate change and flow increases.
Pluvial (Surface Water) Flood Risk	Low – the site will remain dry during all modelled scenarios.
Flood Risk from Artificial (Canals and Reservoirs) Sources	Low – no significant artificial sources identified.
Groundwater Flood Risk	Low – the BGS identify the site as lying within an area that has limited potential for groundwater flooding.
Development Impacts on Local Flood Risk	The development is external, however as the site comprises entirely of impermeable surfaces, it will not have an adverse impact upon local flood risk.
Proposed Flood Risk Mitigation Measures	- Finished floor levels will be raised 300mm above general ground levels (34.3mAOD) - Construction will utilise flood resistant materials and services will be placed as high as practicable to reduce impact of flooding; - Occupants will sign up for EA Emergency Flood Warning Direct Service; - Safe egress to Flood Zone 1 is a 3-minute walk away.
Surface Water Management (SuDS)	SuDS would reduce current surface water run off rates. Given the small size of the site (174m ²), there is limited potential for implementation. Consideration should be given to rainwater harvesting and permeable paving where possible.

SECTION	SUMMARY
Conclusions	Based on the information reviewed, it is considered that overall flood risk to the proposed development is low. With the proposed mitigation and appropriate flood resilience measures in place, the proposal will be safe for its residents. In addition, as the proposal will not increase the site's impermeable area, it will not have an adverse impact upon local flood risk. As such, we believe that the proposal is in compliance with local planning policy and the NPPF.

5 Introduction

STM Environmental Consultants Limited (STM) has been appointed by Mr Naser Khodadadi (Client) to provide a Flood Risk Assessment (FRA) at a site located at 82 Mauldeth Road, West Withington, M20 1AB.

6 Development Proposal

The FRA is required to support a planning application for the demolition of existing structures in rear yard and erection of 3 no. residential apartments to the rear.

Further details including drawings of the development plans are available in [Appendix 2](#).

7 Report Aims and Objectives

The purpose of this report is to establish the flood risk to the site from all potential sources and, where possible, to propose suitable mitigation methods to reduce any risks to an acceptable level. It aims to make an assessment of whether the development will be safe for its lifetime, taking into account climate change and the vulnerability of its users, without increasing flood risk elsewhere.

The FRA assesses flood risk to the site from tidal, fluvial, surface water, groundwater, sewers and artificial sources. The FRA has been produced in accordance with the National Planning Policy Framework (NPPF) and its supporting guidance.

8 Summary of Data Review Undertaken

The following research has been undertaken as part of the FRA:

-  Desktop assessment of topographical, hydrological and hydrogeological settings through review of the information sourced from the British Geological Survey (BGS), the Environment Agency (EA) and the Ordnance Survey (OS);
-  Review of publicly available flood risk mapping provided by the EA;

- Review of the Preliminary Flood Risk Assessment (PFRA) and Level 1 Strategic Flood Risk Assessment (SFRA) produced by the LLFA outlining flood risk from various sources within the borough.

9 Legislative and Policy Context

9.1 Legislative Context

The Flood and Water Management Act was introduced in 2010. The Act defines the role of lead local flood authority (LLFA) for an area. All LLFA are required to develop, maintain, apply and monitor a strategy for local flood risk management in its area, called “local flood risk management strategy”.

Alongside the Act, Flood Risk Regulations (2009) outline the roles and responsibilities of the various authorities, which include preparing Flood Risk Management Plans and identifying how significant flood risks are to be mitigated.

9.2 Policy Context

9.2.1 National Planning Policy Framework (NPPF)

The NPPF (updated July 2021) sets out the government’s planning policies for England and how these are expected to be applied. It also provides a set of guidelines and philosophy with which local planning authorities (LPAs) can build their own unique policies to appropriately regulate development within their jurisdictions.

Section 14 entitled “Meeting the challenge of climate change, flooding and coastal change” deals specifically with flood risk.

Paragraph 159 states that “Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere”.

In addition, Paragraph 161 outlines that “All plans should apply a sequential, risk-based approach to the location of development – taking into account all sources of flood risk and the current and future impacts of climate change – so as to avoid, where possible, flood risk to people and property. They should do this, and manage any residual risk, by:

-  applying the sequential test and then, if necessary, the exception test as set out below;
-  safeguarding land from development that is required, or likely to be required, for current or future flood management;
-  using opportunities provided by new development and improvements in green and other infrastructure to reduce the causes and impacts of flooding, (making as much use as possible of natural flood management techniques as part of an integrated approach to flood risk management);
-  where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to relocate development, including housing, to more sustainable locations”.

The NPPF then states in Paragraph 163 that “if it is not possible for development to be located in areas with a lower risk of flooding (taking into account wider sustainable development objectives), the exception test may have to be applied. The need for the exception test will depend on the potential vulnerability of the site and of the development proposed, in line with the Flood Risk Vulnerability Classification”.

It further states that when determining any planning application, LPAs should “ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment⁵⁵. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:

-  within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;
-  development is appropriately flood resilient and resistant;

- it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;
- any residual risk can be safely managed; and
- safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

Applications for minor development and changes of use should not be subject to the Sequential or Exception Tests but should still meet the requirements for site-specific flood risk assessments set out in footnote 55.

Footnote 55 states: “A site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.”

The NPPF also lays out requirements for how LPAs should deal with planning applications in coastal areas. They should ensure that should they “reduce risk from coastal change by avoiding inappropriate development in vulnerable areas or adding to the impacts of physical changes to the coast.”

Developments in Coastal Change Management Areas should only be considered appropriate where it is demonstrated that:

- it will be safe over its planned lifetime and will not have an unacceptable impact on coastal change;
- the character of the coast including designations is not compromised;
- the development provides wider sustainability benefits;
- the development does not hinder the creation and maintenance of a continuous signed and managed route around the coast.

9.2.2 Local Planning Policy

Within the Manchester City Council Core Strategy, it states that PPS25 requires local authorities to identify flood risk in their area through an appropriately-detailed Strategic Flood Risk Assessment (SFRA) which covers all sources of flood-risk; for Manchester this is flooding from rivers (fluvial), canals and reservoirs, groundwater, surface-water and sewers, and the implications of climate change. The Council (working with the neighbouring authorities of Salford and Trafford in recognition of the cross-boundary nature of flood risk) has produced an SFRA to inform future development which consists of a Level 1 and a Level 2 report and a mapping volume. The SFRA informs policies in the Core Strategy and provides a context for developers' site-specific Flood Risk Assessments (FRA).

Specifically, Policy EN14 of the Core Strategy addresses Flood Risk. It states the following:

-  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.
-  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.

9.3 EA Standing Advice on Flood Risk

The Environment Agency's [standing advice](#) lays out the process that must be followed when carrying out flood risk assessments for developments.

Flood Risk Assessments are required for developments within one of the Flood Zones. This includes developments:

-  in Flood Zone 2 or 3 including minor development and change of use more than 1 hectare (ha) in Flood Zone 1;
-  less than 1 ha in Flood Zone 1, including a change of use in development type to a more vulnerable class (for example from commercial to residential), where they could be affected by sources of flooding other than rivers and the sea (for example surface water drains, reservoirs);
-  in an area within Flood Zone 1 which has critical drainage problems as notified by the Environment Agency.

10 Site Description and Environmental Characteristics

10.1 Site Location and Area

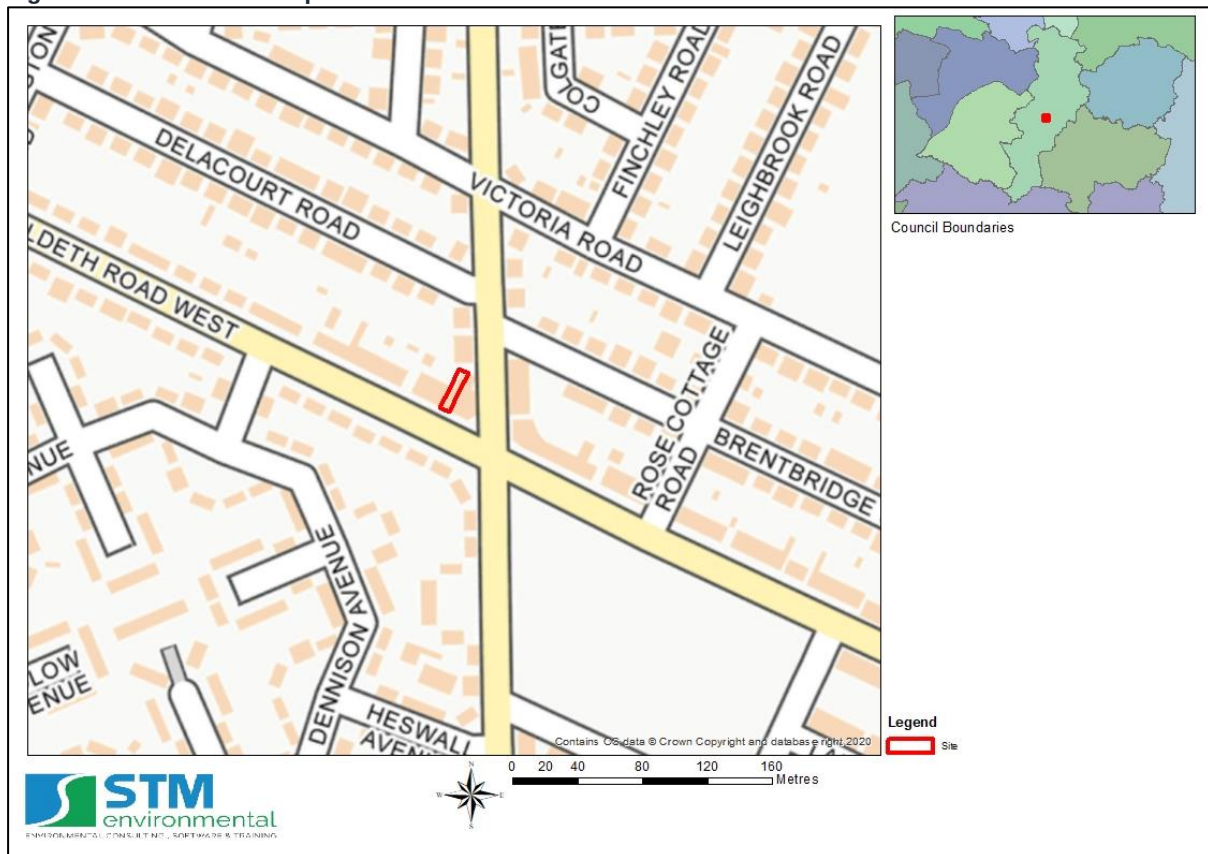
The site is located at 82 Mauldeth Road, West Withington, M20 1AB. It is centred at national grid reference 384691, 393561. The site has an area of 174m².

A site location map and aerial photo are shown below. Photographs of the site are available in [Appendix 1](#).

10.2 Site Access

The proposed development will be accessed via an access pathway off Yew Tree Road.

Figure 1: Site Location Maps



10.3 Local Planning Authority

The site falls within the jurisdiction of Manchester City Council (MCC) in terms of the planning process.

10.4 Lead Local Flood Authority

MCC is also the Lead Local Flood Authority (LLFA).

10.5 Flood Zone

For planning purposes, the site is located in Flood Zones 1, 2, and 3 as defined by the EA and LLFA.

10.6 Site and Surrounding Land Uses

10.6.1 Site Current Land Use

The site is currently used as commercial.

10.6.2 Surrounding Land Uses

A description of the current and surrounding land uses of the site is given in Table 1.

Table 1: Summary of surrounding land uses

Boundary	Land Use Description	
	Immediately Adjacent (within 0 – 25m)	General Local Area (i.e. within 25 - 250m)
Northern	Residential	Residential
Eastern	Commercial/Residential	Residential
Southern	Residential	Residential
Western	Commercial/Residential	Residential

10.7 Hydrology

The nearest main watercourse is Cringle Black Brook (culverted adjacent to the northern boundary of the site). Additionally, Chorlton Platt Gore/Platt Brook is located approximately 470m north west of the site.

10.8 Geology

Data from the British Geological Survey indicates that the underlying superficial geology is characterised as Till, Devensian. The underlying bedrock geology is characterized as Wilmslow Sandstone Formation.

10.9 Hydrogeology

The site lies upon an Unproductive superficial aquifer and a Principal bedrock aquifer.

[Appendix 3](#) provides BGS mapping showing the hydrogeology at the site location.

10.10 Topography

A LIDAR map showing the topology of the site and surrounding area is available in [Appendix 3](#). According to the LIDAR 1M DTM data, the site is relatively flat at 34.0mAOD.

A topographic survey has not been conducted.

11 The Sequential and Exception Tests

11.1 The Sequential Test

The Sequential Test aims to steer developments and redevelopments to areas of lower flood risk. The test compares the proposed development site with other available sites, in terms of flood risk, to aid the steering process. The Sequential Test is not required if the proposed development is a minor development or if it involves a change of use unless the development is a caravan, camping chalet, mobile home or park home site.

Based on Government Guidance, Minor Development means:

-  minor non-residential extensions: industrial/commercial/leisure etc extensions with a footprint less than 250 square metre.
-  alterations: development that does not increase the size of buildings eg alterations to external appearance.

- householder development: For example; sheds, garages, games rooms etc within the curtilage of the existing dwelling, in addition to physical extensions to the existing dwelling itself. This definition excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling eg subdivision of houses into flats.

With regard to residential and commercial developments, major development, as defined by the Town and Country Planning (Development Management Procedure) means one or more of the following:

- c(i) - the number of dwelling houses to be provided is 10 or more; or
- c(ii) - the development is to be carried out on a site having an area of 0.5 hectares or more and it is not known whether the development falls within subparagraph (c)(i);
- the provision of a building or buildings where the floor space to be created by the development is 1,000 square metres or more;
- or development carried out on a site having an area of 1 hectare or more.

The development is considered to be minor and as such the Sequential Test should not be required by the LLFA.

11.2 The Exception Test

If alternative sites of lower flood risk are not available then the proposed development may require an Exception Test to be granted planning permission. Where the exception test is required, it should be applied as soon as possible to all local development document allocations for developments and all planning applications other than for minor developments. All three elements of the exception test have to be passed before development is allocated or permitted. For the exception test to be passed:

- It must demonstrate that the development provides wider sustainability benefits to the community that outweigh the flood risk, informed by an SFRA, where one has been prepared;

-  The development should be on developed land or on previously developed land;
-  A flood risk assessment must demonstrate that the development will be safe without increasing flood risk elsewhere, and where possible will reduce the overall flood risk.

The requirements for an Exception Test are given in Table 2 and are defined in terms of Flood Zone and development vulnerability classification.

Table 2: NPPF Flood Zone vulnerability compatibility (source: NPPF).

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a	Exception Test required	X	Exception Test required	✓	✓
Zone 3b	Exception Test required	X	X	X	✓

Key:

- ✓ Development is appropriate
- X Development should not be permitted.

Based on its scale and nature, the development is considered to be “minor”. As such the Exception Test should not be required by the LLFA.

12 Site Specific Flood Risk Analysis

The PFRA and Level 1 SFRA produced by the LLFA and maps from the EA provide information regarding historic flooding events and incidents as well as predictions of flood extents and depths during extreme rainfall events.

12.1 Fluvial (River) and Tidal (Sea) Flood Risk

12.1.1 Mechanisms for Fluvial Flooding

Fluvial, or river flooding, occurs when excessive rainfall over an extended period of time or heavy snow melt causes a river to exceed its capacity. The damage from a fluvial flood can be widespread as the overflow may affect downstream tributaries, overtopping defences and flooding nearby inhabited areas. Fluvial flooding consists of two main types:

-  Overbank flooding – this occurs when water rises steadily and overflows over the edges of a river or stream;
-  Flash flooding – this is characterized by an intense, high velocity torrent of water that occurs in an existing river channel with little to no notice. Flash floods are very dangerous and destructive not only because of the force of the water, but also the hurtling debris that is often swept up in the flow.

12.1.2 Definition of EA Modelled Fluvial Flood Risk Zones

Fluvial flood risk is assessed using flooding maps produced by the Environment Agency. These maps use available historic data and hydraulic modelling to define zones of flood risk. The maps allow a site to be defined in terms of its flood zone (e.g. 1, 2, 3) and in terms of the overall flood risk (very low, low, medium or high). It is important to note that existing flood defences are not taken into account within the models or the maps. The EA fluvial flood zones are defined as follows:

-  Flood zone 1: Less than 1 in 1000 (0.1%) annual probability of flooding;
-  Flood zone 2: Between 1 in 100 (1%) and 1 in 1000 (0.1%) annual probability of flooding;
-  Flood zone 3: Greater than 1 in 100 (1%) annual probability of fluvial flooding.

Flood zone 3 is split into two sub-categories (3a and 3b) by LLFAs depending on whether the land is considered to be a functional flood plain (i.e. an important storage area for flood waters in extreme events).

-  Flood zone 3a: Greater than 1 in 100 (1%) annual probability of fluvial flooding and/or greater than 1 in 200 (0.5%) annual probability of tidal flooding;
-  Flood zone 3b: Functional flood plain (definition specific to the LLFA). Less than a 1 in 20 (5%) annual probability of fluvial and/or tidal flooding.

12.1.3 Main Potential Sources of Local Fluvial Flooding

The nearest potential sources of fluvial flooding to the site are considered to be Cringle Black Brook and Chorlton Platt Gore/Platt Brook.

12.1.4 Records of Historic Fluvial Flooding Incidents

The EA informed that they do not have any information on recorded flood incidents in the vicinity of the site.

12.1.5 Designated Fluvial Flood Risk Zone for the Site

The site is considered to be located within Flood Zones 1, 2, and 3 as defined by the Environment Agency and the LLFA indicating that it has between a less than 0.1% and greater than 1% annual probability of fluvial flooding.

12.1.6 Mechanisms for Tidal Flooding

Tidal flooding may be described simply as the inundation of low-lying coastal areas by the sea, or the overtopping or breaching of sea defences. Tidal flooding may be caused by seasonal high tides, storm surges and where increase in water level above the astronomical tide level is created by strong on shore winds or by storm driven wave action.

12.1.7 Definition of EA Tidal Flood Risk Zones

As with fluvial flood risk, tidal flood risk is assessed using flooding maps produced by the Environment Agency. The difference is in the probability return periods used to define tidal flood zones. The EA tidal Flood Zones are defined as:

-  Flood zone 1: Less than 1 in 1000 (0.1%) annual probability of flooding;
-  Flood zone 2: Between 1 in 200 (0.5%) and 1 in 1000 (0.1%) annual probability of tidal flooding;
-  Flood zone 3: Greater 1 in 200 (0.5%) annual probability of tidal flooding.

12.1.8 Potential Sources of Tidal Flooding

The area in which the site is located is considered unlikely to be affected by tidal flooding.

12.1.9 Flood Defences

The EA's Areas benefitting from flood defences and current flood defences map which is available in [Appendix 7](#) shows that there are flood defences within the vicinity of the site along Platts Brook and Cringle Black Brook. The defences consist of high ground along Platts Brook (approximately 470m north west of the site) and an embankment along Cringle Black Brook (approximately 1km east of the site).

12.1.10 Climate Change - EA Modelled Predictions of Fluvial Flood Levels

The EA Product 4 dataset which is presented in [Appendix 11](#) provides modelled flood levels and increased flow levels for model node points at (Node 5) and close to the site (Node 4). These are summarised in Table 3 below.

Different Modelled AEP Events (mAOD)						
	Defended			Undefended		
Node	0.1%	1%	0.1% + 30% CC	0.1%	1%	0.1% + 30% CC
4	31.89	31.85	31.91	31.89	31.85	31.91
5	-	-	-	-	-	-
	Increase Flow					
Node	1% + 30%	1% + 35%	1% + 70%	1% + 30%	1% + 35%	1% + 70%
5 (increase flow)	33.91	33.91	33.92	33.91	33.91	33.92

Table 3: EA modelled flood levels and expected flows for different return periods and scenarios.

In addition, the EA Product 4 Data did not supply climate change flood levels inclusive of the 1% AEP event. As such, the EA's local precautionary allowances for climate change impacts data can be added to provide an estimation of such levels. For all watercourses within the vicinity of the site, the 1% AEP inclusive of the central (0.15m), Higher Central (0.24m), and Upper (0.48m) allowances are detailed in Table 4 below.

Modelled Flood Level During the 1% AEP + CC allowances (mAOD)			
1% AEP (as above)	1% + Central	1% + Higher Central	1% + Upper
31.85	32.00	32.09	32.33

Table 4: Modelled Flood Level Inclusive of Climate Change Allowances

As the ground level at the site sits at an average topography of 34.0mAOD, the proposed development will remain dry during all modelled scenarios including the increase flow events and the climate change allowances.

12.1.11 Long Term Fluvial Flood Risk Considering Flood Defences

The EA's [long term flood risk maps](#) give an indication of the actual risk associated with flooding after taking into account the effect of any flood defences in the area. Copies of maps for the site which are available in [Appendix 9](#) indicate that the long-term risk from fluvial flooding to the site is medium.

12.2 Pluvial (Surface Water) Flood Risk

A pluvial, or surface water flood, is caused when heavy rainfall creates a flood event independent of an overflowing water body. Surface water flooding occurs when high intensity rainfall leads to run-off which flows over the ground surface, causing ponding in low-lying areas when the precipitation rate or overland flow rate is greater than the rate of infiltration, or return into watercourses. Surface water flooding can be exacerbated when the underlying soil and geology is saturated (as a result of prolonged precipitation or a high-water table) or when the drainage network has insufficient capacity.

12.2.1 Mechanisms of Pluvial Flooding

The chief mechanisms for surface water flooding can be divided into the following categories:

-  Runoff from higher topography;
-  Localised surface water runoff – as a result of localised ponding of surface water;
-  Sewer Flooding – areas where extensive and deep surface water flooding is likely to be influenced by sewer flooding. Where the sewer network has reached capacity, and surcharged, this will exacerbate the flood risk in these areas;
-  Low Lying Areas – areas such as underpasses, subways and lowered roads beneath railway lines are more susceptible to surface water flooding;
-  Railway Cuttings – railway infrastructure cut into the natural geological formations can cause extra surface run off and pooling disrupting service and potentially affecting adjacent structures;
-  Railway Embankments – discrete surface water flooding locations along the up-stream side of the raised network rail embankments where water flows are interrupted and ponding can occur;
-  Failure of artificial sources (i.e. man-made structures) such as such as canals and reservoirs.

12.2.2 Main Potential Sources of Local Pluvial Flooding

The main potential source of pluvial flooding to the site is considered to be surface water ponding and flooding associated with heavy rainfall in the area.

12.2.3 Records of Historic Pluvial Flooding Incidents

Examination of the LLFA's Level 1 SFRA revealed evidence of pluvial flooding in Fallowfield and Withington in 1911, 1947, and 1958. The exact locations are unknown. A table detailing historic flooding incidents is available in [Appendix 4](#) .

12.2.4 Surface Water Flood Risk from Artificial Sources (Reservoirs and Canals)

An examination of OS mapping and the EA's mapping revealed no indications of significant reservoirs or canals in the area of the site.

The EA's reservoir flood risk map indicates that the site does not lie within an area that is at risk of reservoir flooding.

12.2.5 Sewer Flooding

Examination of the LLFA's Level 1 SFRA revealed evidence of sewer flooding in Fallowfield and Withington in 1911, 1947, and 1958. The exact locations are unknown. A table detailing historic flooding is available in [Appendix 4](#).

12.2.6 Climate Change - Modelled Predictions of Surface Water Run-off Flooding

Mapping of the predicted extent and depth of surface water flooding for the 1 in 1000-year rainfall return periods provided by the EA are available in [Appendix 6](#).

The map shows that the entirety of the site remains dry during this event.

12.2.7 Long Term Surface Water Flood Risk

The EA's [long term flood risk maps](#) which are available in [Appendix 9](#) indicate that the long term risk of flooding from surface water is considered to be very low.

12.3 Risk of Flooding from Multiple Sources (ROFMS)

The Environment Agency provides a map which gives an indication the overall flood risk from fluvial, tidal and surface water sources considering the presence of river defences. This map indicates that there is a less than 0.1% chance of flooding at the site in any year. A copy of the map is presented in [Appendix 8](#).

12.4 Groundwater Flood Risk

Groundwater flooding occurs when water rises from the underlying aquifer at the location of a spring – where the underlying impermeable geology meets the ground surface. This tends to occur after much longer periods of intense precipitation, in

often low-lying areas where the water table is likely to be at a shallow depth. Groundwater flooding is known to occur in areas underlain by principal aquifers, although increasingly it is also being associated with more localised floodplain sands and gravels. A high groundwater table also has the potential to exacerbate the risk of surface water and fluvial flooding by reducing rainfall infiltration capacity, and to increase the risk of sewer flooding through sewer/groundwater interactions.

12.4.1 Historic Records of Groundwater Flooding

Examination of the LLFA's Level 1 SFRA revealed no records of groundwater flooding within 500m of the site.

12.4.2 Susceptibility to Groundwater Flooding

The Groundwater Flood Susceptibility Map provided by BGS, which is available in [Appendix 10](#) indicates that there is limited potential for groundwater flooding to occur at the site. The Groundwater Depth map also provided by BGS indicates that the groundwater level may be at approximately less than 3mbgl.

12.5 Critical Drainage Area

A Critical Drainage Area (CDA) may be defined as “a discrete geographic area (usually a hydrological catchment) where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, main river and/or tidal) cause flooding in one or more Local Flood Risk Zones during severe weather thereby affecting people, property or local infrastructure”. A CDA is defined in the Town and Country Planning (General Development Procedure) (Amendment) (No. 2) (England) Order 2006 as “an area within Flood Zone 1 which has critical drainage problems and which has been notified to the local planning authority by the Environment Agency”.

The site is located within Didsbury Critical Drainage Area as defined by the Manchester City Level 2 Hybrid SFRA.

13 Potential Impacts of the Development on Local Flood Risk

13.1 Impacts on Flood Storage

13.1.1 Changes to Impermeable Area and Building Footprint

Changes in ground cover arising from the development are presented in Table 5 below. As the current site comprises of all hardstanding from existing building and driveway, the proposed development will not increase the impermeable areas at the site.

Table 5: Existing and proposed site ground cover.

	Impermeable Area (m ²)	Permeable Area (m ²)	Total Area (m ²)
Existing	174	0	174
Proposed	174	0	174

As the development will not increase the site's impermeable area, it is considered unlikely that it will impact upon flood flow rates.

However, as the proposal will change the site's built up area, it may have an impact on local flood storage. Compensatory Flood Storage is discussed in Section 14.2.2 below.

13.2 Impacts on Flood Flow Routes

As the development involves the redesign of buildings at the site, it may alter flood flow paths.

14 Flood Risk Mitigation Measures

14.1 SuDS

Planning practice guidance (PPG) which is prepared by the Ministry of Housing, Communities and Local Government (DCLG) states that developers and Local Authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage techniques.

As such, the developer should implement a SuDS strategy in line with the drainage hierarchy as outlined in Table 6 below to reduce surface water discharges from the site.

Table 6: SuDS Options

	Store rainwater for later use;
	Use infiltration techniques, such as porous surfaces in non-clay areas;
	Attenuate rainwater in ponds or open water features for gradual release;
	Attenuate rainwater by storing in tanks or sealed water features for gradual release;
	Discharge directly to a water course;
	Discharge rainwater directly to a surface water sewer/drain;
	Discharge to a combined sewer.

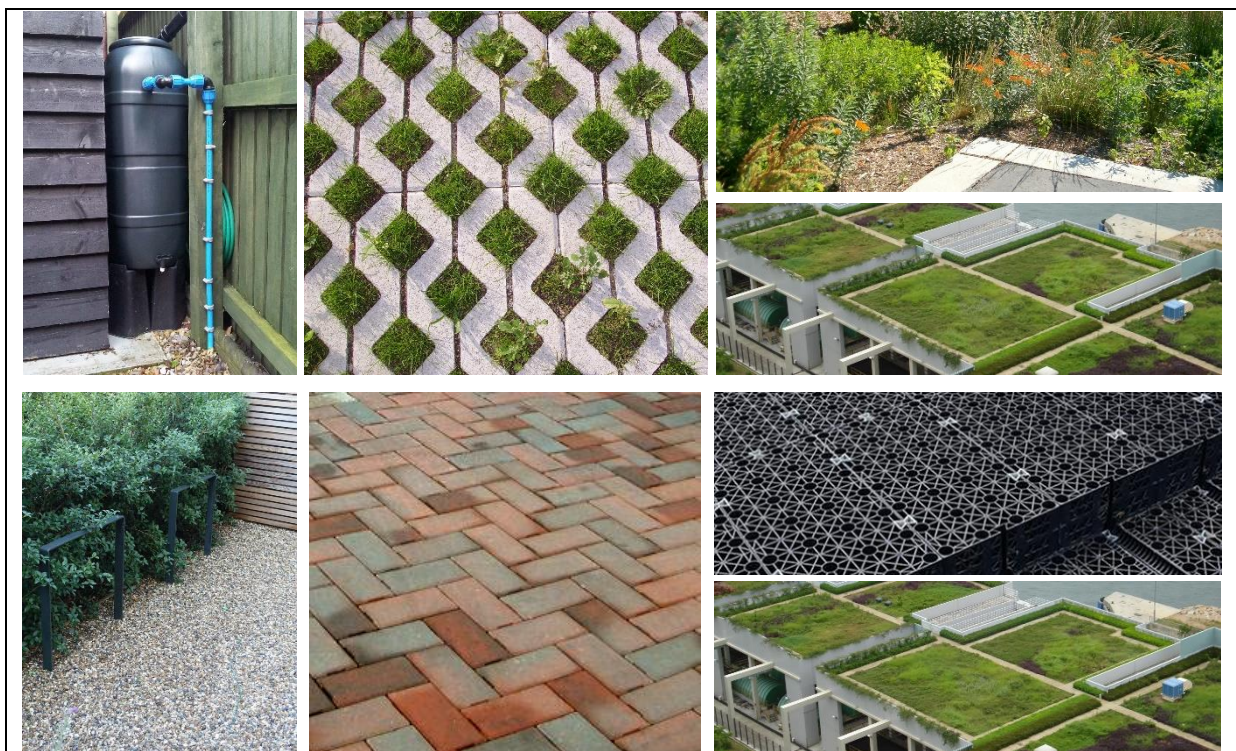


Figure 2: Surface water storage facilities and potential SuDS features - rainwater harvesting, on-site tank storage, rain garden soak-away and green roofs. (Source: UK SuDS Manual)

Given the nature of the development and the size of the site, it is considered that there are limited opportunities for implementing SuDS. Measures such as green roofs, rainwater harvesting, infiltration (permeable paving, rain gardens) or

attenuation storage tanks should be considered. A full SuDS strategy is outside the scope of works of this FRA.

14.2 Flood Resilience

Flood resilient construction uses methods and materials that reduce the impact from a flood, ensuring that structural integrity is maintained, and the drying out and cleaning required, following inundation and before reoccupation, is minimised.

14.2.1 Finished Floor Levels

The average ground level of site is 34.0mAOD.

For vulnerable developments, the EA's Standing Advice states that finished floor level of the lowest habitable room in any building Ground floor levels should be a minimum of 300millimetres (mm) above the general ground level of the site or 600mm above the estimated river or sea flood level whichever is higher.

As the development remains dry during all modelled scenarios, finished floor levels should be set to 300mm above general ground levels and therefore to 34.3mAOD.

14.2.2 Compensatory Flood Storage

All new development within Flood Zone 3 must not result in a net loss of flood storage capacity. Where possible, opportunities should be sought to achieve an increase in the provision of floodplain storage.

Where proposed development results in a change in building footprint, the developer must ensure that it does not impact upon the ability of the floodplain to store water, and should seek opportunities to provide a betterment with respect to floodplain storage.

As the development will remain dry during all modelled fluvial scenarios including the 0.1% AEP + 30% climate change (31.91mAOD) and the 1% AEP + Upper End (32.33mAOD), compensatory flood storage is not considered to be required.

14.2.3 Flood Resilience Construction Measures

In terms of achieving resilience, there are two main strategies, whose applicability is dependent on the water depth the property is subjected to. These are:

-  Water Exclusion (Flood Resistance) Strategy - should be employed where predicted flood depths are less than 0.3m and are likely to be for short duration. Emphasis is placed on minimising water entry and giving occupants time to relocate ground floor contents, maintaining structural integrity, and on using materials and construction techniques to facilitate drying and cleaning;
-  Water Entry (Flood Resilience) Strategy - Flood resilience measures are designed to allow water in but to limit damage and allow rapid re-occupancy. Resilience measures should be employed where flood depths are greater than 0.6m and where it is likely that structural damage will occur due to excessive water pressure.

Given that flood depths less than 0.3m are predicted in extreme scenarios, the water exclusion is considered most applicable for this site.

Water Exclusion Strategy:

There are a range of flood protection devices/methods that can be used in the Water Exclusion Strategy including:

-  Using materials and construction with low permeability;
-  Landscaping e.g. creation of low earth bunds (subject to this not increasing flood risk elsewhere);
-  Raising thresholds and finished floor levels (e.g. porches with higher thresholds than main entrance);
-  Flood gates with waterproof seals;
-  Sump and pump for floodwater to remove waste water faster than it enters;
-  Door guards and airbrick covers.

Flood resilience design and measures that will be implemented are outlined below. Water-resistant and resilient materials will be utilized throughout the construction to minimize the flood risk and potential impacts.

Floor construction:

-  Use of resilient flooring materials as ceramic tiles or stone floor finishes;
-  Use of a concrete slab 150mm thick;
-  Use of ceramic tiles or stone floor finishes is recommended;
-  Maintain existing under floor ventilation by UPVC telescopic vents above 400 mm to external face of extension;
-  Damp proof membrane of impermeable polythene at least 1200 gauge;
-  Avoid the use of MDF carpentry.

Wall construction:

-  Include in the external face of the extension a damp – proof course, 250 mm above ground level, to prevent damp rising through the wall;
-  Use rigid closed – cell material for insulation above the DPC;
-  Spread hardcore over the site within the external walls of the building to such thickness as required to raise the finished surface of the site concrete. The hardcore should be spread until it is roughly level and rammed until it forms a compact bed for the oversite concrete. This hardcore bed will be 100 mm thick and composed by well compacted inert material, blinded with fine inert material.

Doors:

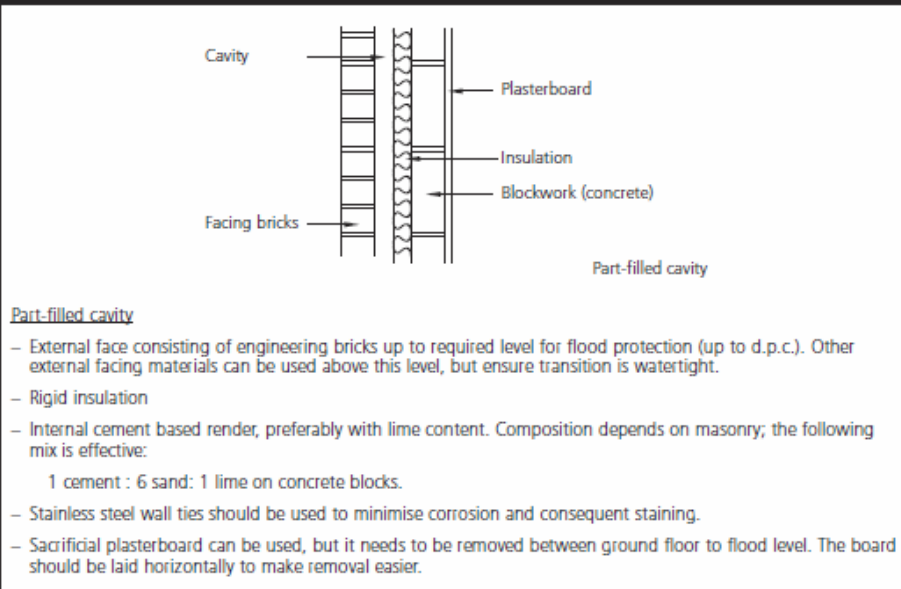
-  Seal doors around edges and openings. UPVC or composite material will be used with passive protection meaning that minimal intervention will be required in the event of flooding.

Underground drainage:

-  Avoid use of metal for any underground piping;
-  Use closed cell insulation for pipes that are below the predicted flood level;
-  Provide non – return valves for the drainage system to prevent back water flow;
-  Use UPVC or clay pipework for fells and surface water drainage.

Figure 3: Cavity External Walls

Figure 6.10 Cavity External Walls – Part-filled cavity with sacrificial plasterboard



As well as the above the following flood resilience features should be applied as part of the development:

- Electrical sockets should be installed above flood level for the ground floor;
- Utility services such as fuse boxes, meters, main cables, gas pipes, phone lines and sockets will be positioned as high as practicable;
- All external openings for pipes or vents below 400mm to be sealed around pipe or vent with expanding foam and mastic.

14.3 Emergency Plan

14.3.1 Assessment of Danger to People

The dangers associated with flood water to people are possible injury and/or death. This can occur as a result of drowning or being carried along by the waters into hard objects or vice versa. The risk to life is largely a function of the depth and velocity of the floodwater as it crosses the floodplain. Fast flowing deep water that contains debris would represent the greatest hazard.

The assessment of danger to people from walking in floodwater is described in the Flood Risks to People guidance documents (FD2321_TR1 and FD2321_TR2) by DEFRA/EA..

Danger can be estimated by the simple formula:

$$HR = d \times (v + 0.5) + DF$$

where, HR = (flood) hazard rating; d = depth of flooding (m); v = velocity of floodwaters (m/sec); and DF = debris factor. The scoring methodology and calculation matrix for this is summarised in [Appendix 13](#).

The EA Product 4 Data did not supply hazard mapping for the site. As such, it is not possible to determine the hazard score for the site.

14.3.2 EA Flood Warnings Direct Service Subscription

The occupants will subscribe to the EA Flood Warnings Direct Service which is a free service offered by the EA providing flood warnings direct to people by telephone, mobile, email, SMS text message and fax. The EA aims to provide 2 hours' notice of flood, day or night, allowing timely evacuation of the site.

The agency operates a 24-hour telephone service on 0345 988 1188 that provides frequently updated flood warnings and associated floodplain information. In addition, this information can also be found at <https://fwd.environment-agency.gov.uk/app/olr/home> along with recommendations on what steps should be taken to prepare for floods, what to do when warnings are issued, and how best to cope with the aftermath of floods.

14.3.3 Access and Safe Egress

Safe egress to Flood Zone 1 is available by a 3-minute walk away to the south along Yew Tree Road. Directions of this route are presented in [Appendix 12](#).

14.3.4 Safe Refuge

The ground floor apartment will not have internal access to the first floor and therefore safe refuge is not available for the residents of this property. The remaining apartments are located on the first and second floors of the development and therefore safe refuge is available.

15 Conclusions and Recommendations

This assessment has considered the potential risks to the application site associated with flooding from fluvial, tidal, surface water, artificial and groundwater sources and the potential impacts of climate change.

A review of LLFA's PFRA and SFRA as well as data provided by the EA was undertaken. The main findings of the review and assessment are provided below:

-  The site is classified as a more vulnerable minor development and is therefore unlikely to require sequential and exception tests to be undertaken;
-  The main sources of potential flooding to the site are Cringle Black Brook and Platt Brook;
-  The EA define the site as being within Flood Zones 1, 2, and 3;
-  EA mapping indicates that the site is in an area that benefits from flood defences;
-  Records of surface water flooding incidents were identified at or in the vicinity of the site;
-  The site is within a CDA. It is in an area that witnessed sewage flooding incidents;
-  No records of fluvial, artificial, or groundwater flooding incidents were identified at or in the vicinity of the site;
-  The development will not result in an increase in the impermeable area of the site and therefore is unlikely to increase local flood risk;
-  There are limited opportunities for implementing SuDS mitigation measures. Consideration should be given to use of permeable paving and rainwater harvesting;

-  Flood resilient materials and construction methods will be used so as to ensure that the impacts of any potential flooding are minimised as much as possible;
-  Occupants will subscribe to the EA Flood Warnings Direct Service;
-  Safe egress routes to Flood Zone 1 are easily accessible;
-  In the event that evacuation is not possible, safe refuge is not available in the upper floors of the building for the groundfloor apartment.

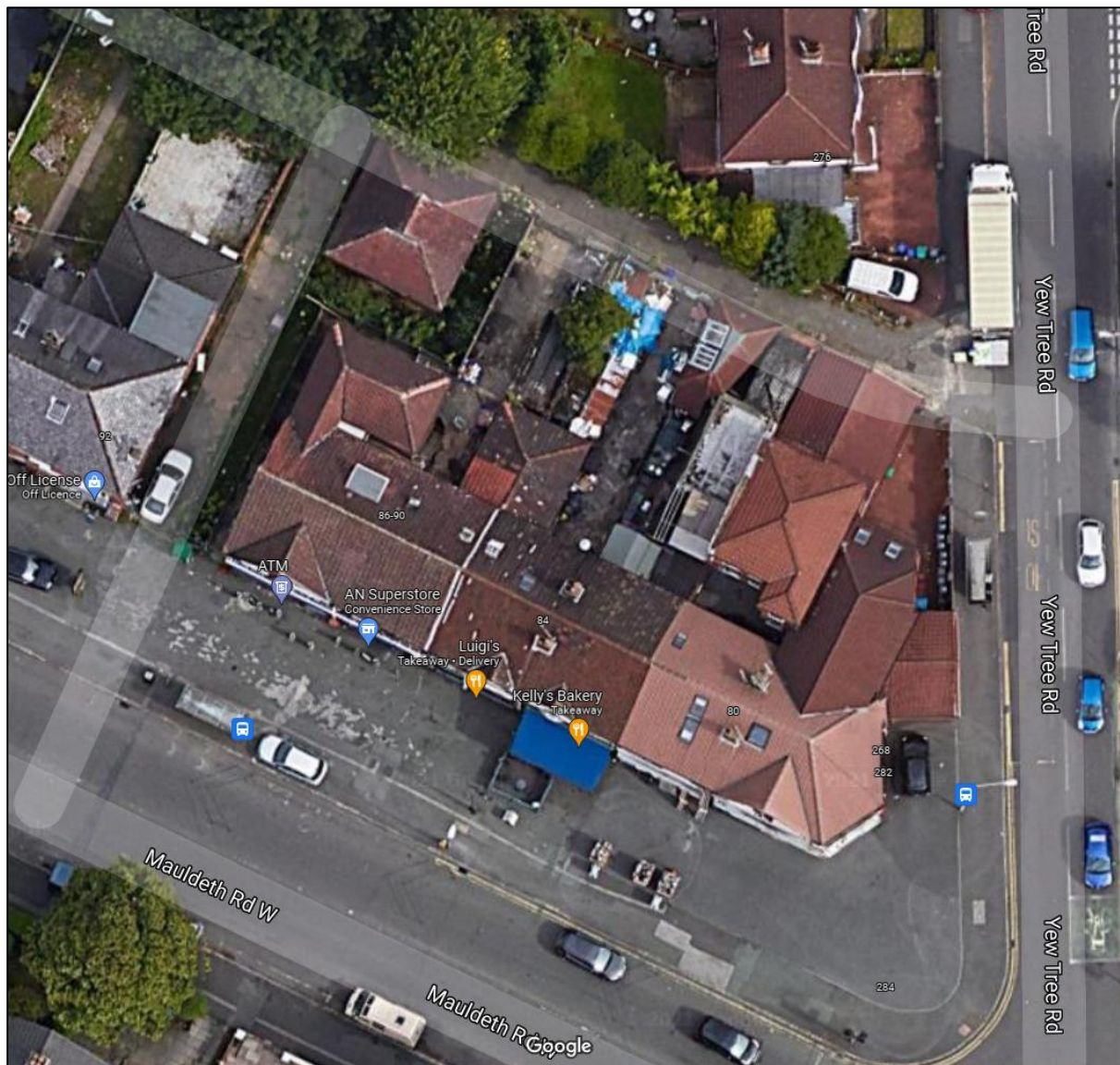
Based on the information reviewed, it is considered that overall flood risk to the proposed development is low. With the proposed mitigation and appropriate flood resilience measures in place, the proposal will be safe for its residents. In addition, as the proposal will not increase the site's impermeable area, it will not have an adverse impact upon local flood risk. As such, we believe that the proposal is in compliance with local planning policy and the NPPF.

16 References

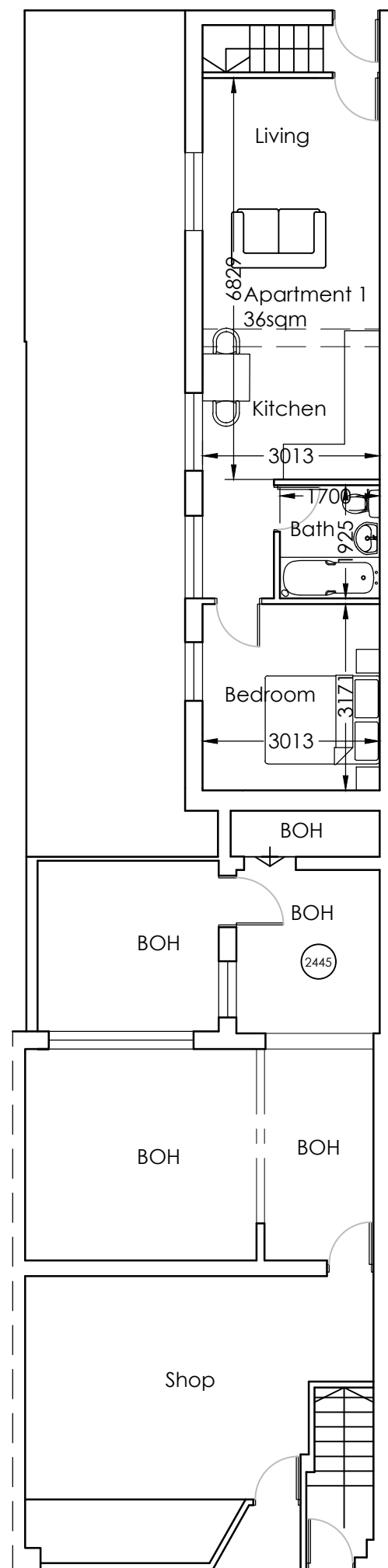
1. Communities and Local Government - National Planning Policy Framework NPPF, March 2019.
2. Communities and Local Government - Planning Practice Guidance: Flood Risk and Coastal Change, Updated 06 March 2014.
3. Preliminary Flood Risk Assessment – Manchester City Council, 2011
4. Strategic Flood Risk Assessment Level 1 – Manchester City Council, 2010
5. Strategic Flood Risk Assessment Level 2 – Manchester City Council, 2011
6. Manchester Core Strategy – Manchester City Council, 2012
7. CIRIA, Defra, Environment Agency – UK SuDS Manual, 2015.

17 Appendices

17.1 Appendix 1 – Site Photographs

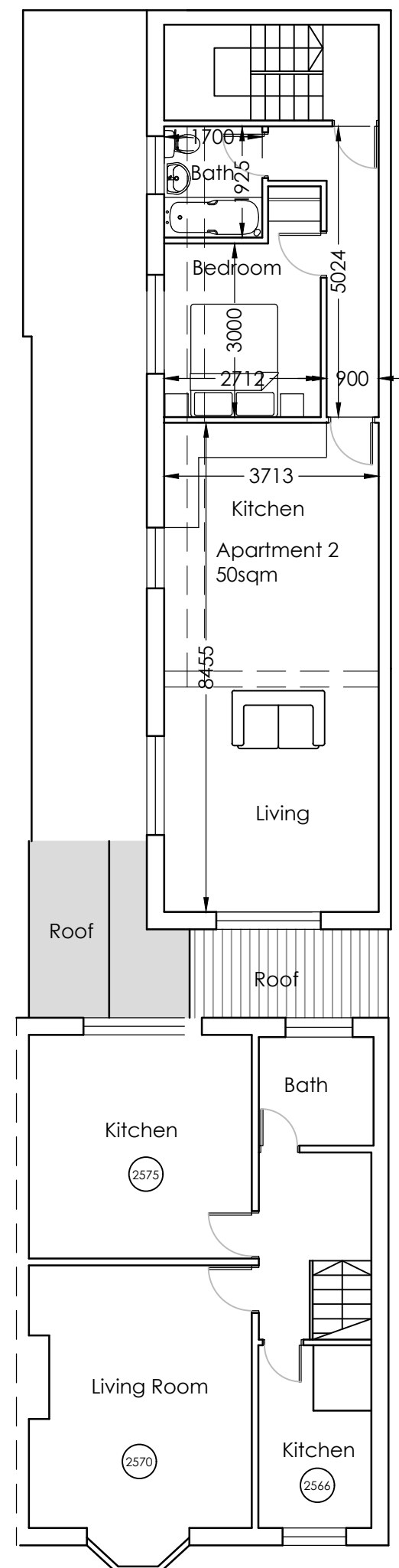


17.2 Appendix 2 – Development Plans

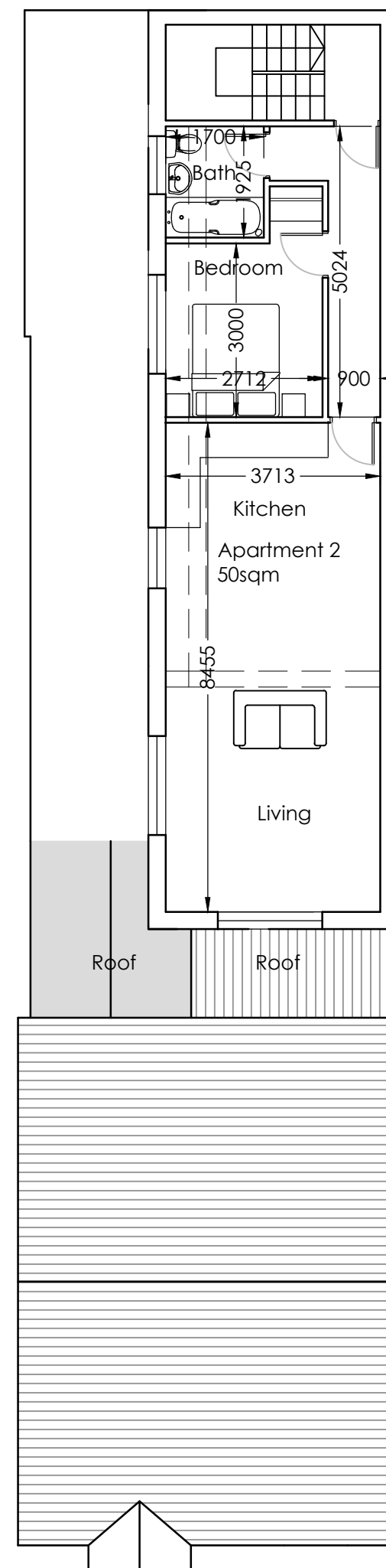


A

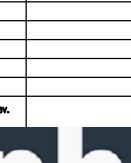
Proposed Ground Floor Plan



Proposed First Floor Plan

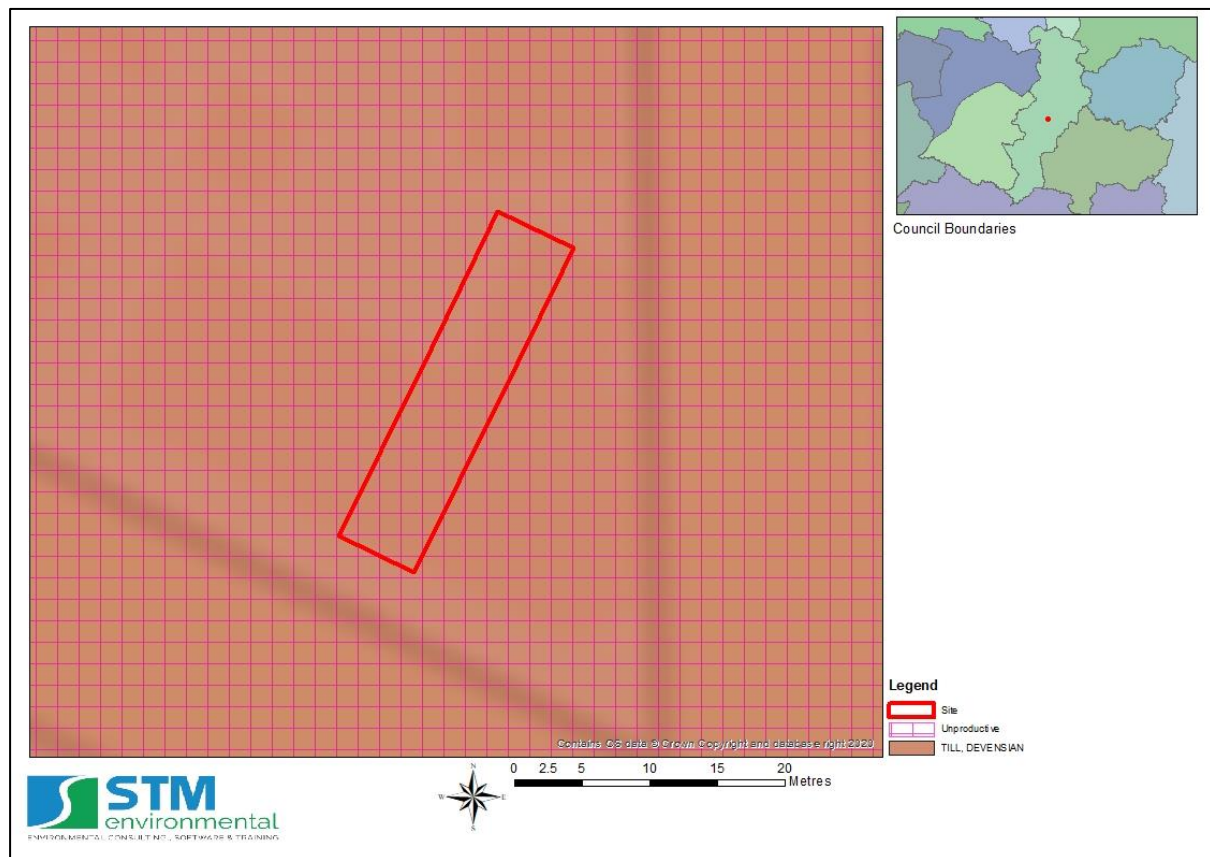


Proposed Second Floor Plan

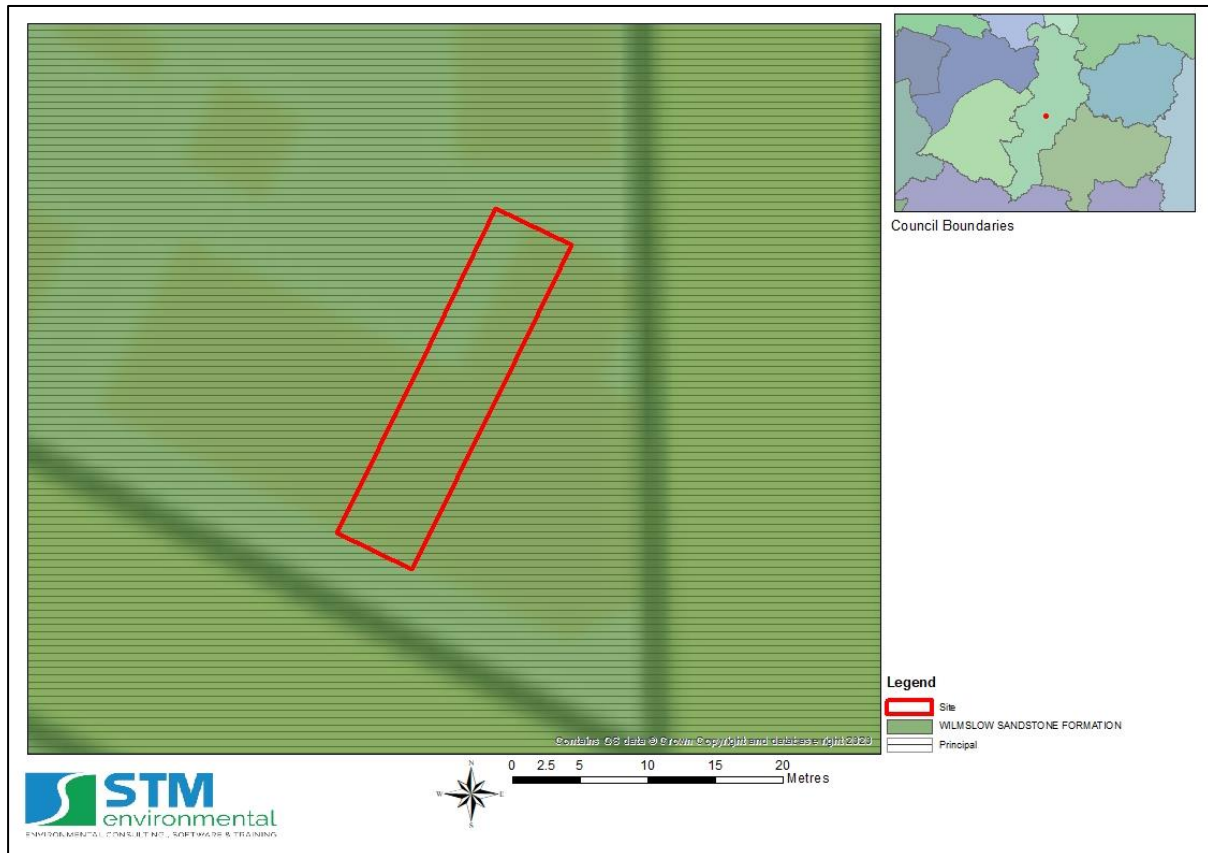
Rev.		By	Date
			
Chartered Architects & Interior Designers 1 Cranleigh Avenue Stockport SK4 3 PZ Tel : 07581 056 056			
Site Kelly's Bakery Mauldeth Road			
Title Proposed Plans			
Project Manager/ Checked	Drawn By	Scale 1:100 @ A3	Date Nov 20
Arch./Des.	Drawing Number	F01/T/04	Rev. C

17.3 Appendix 3 – Environmental Characteristics

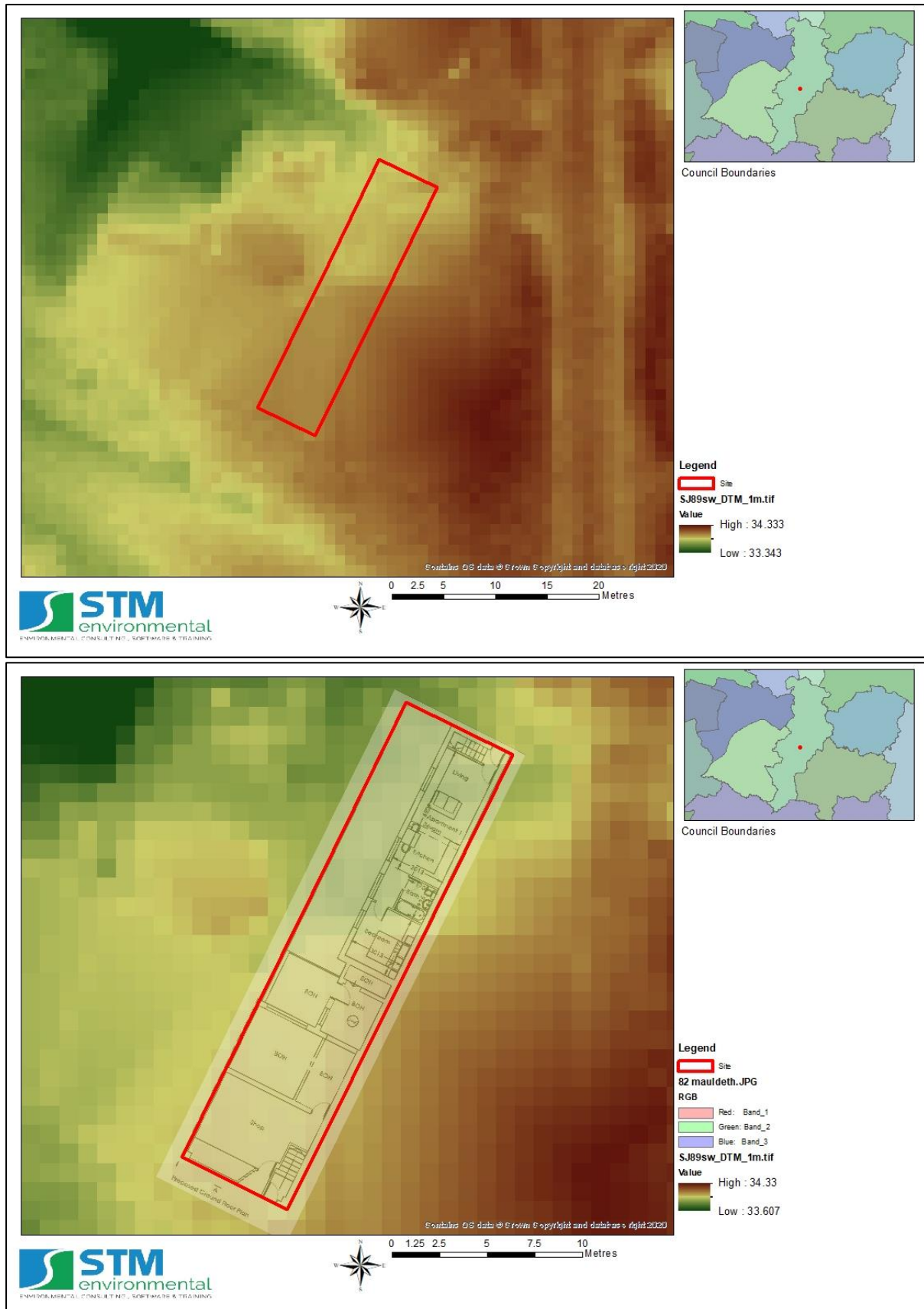
17.3.1 Superficial Hydrogeology Map



17.3.2 Bedrock Hydrogeology Map



17.3.3 Topology Map



17.4 Appendix 4 – Historical Flood Incident Maps

17.4.1 EA Historic Flood Outlines

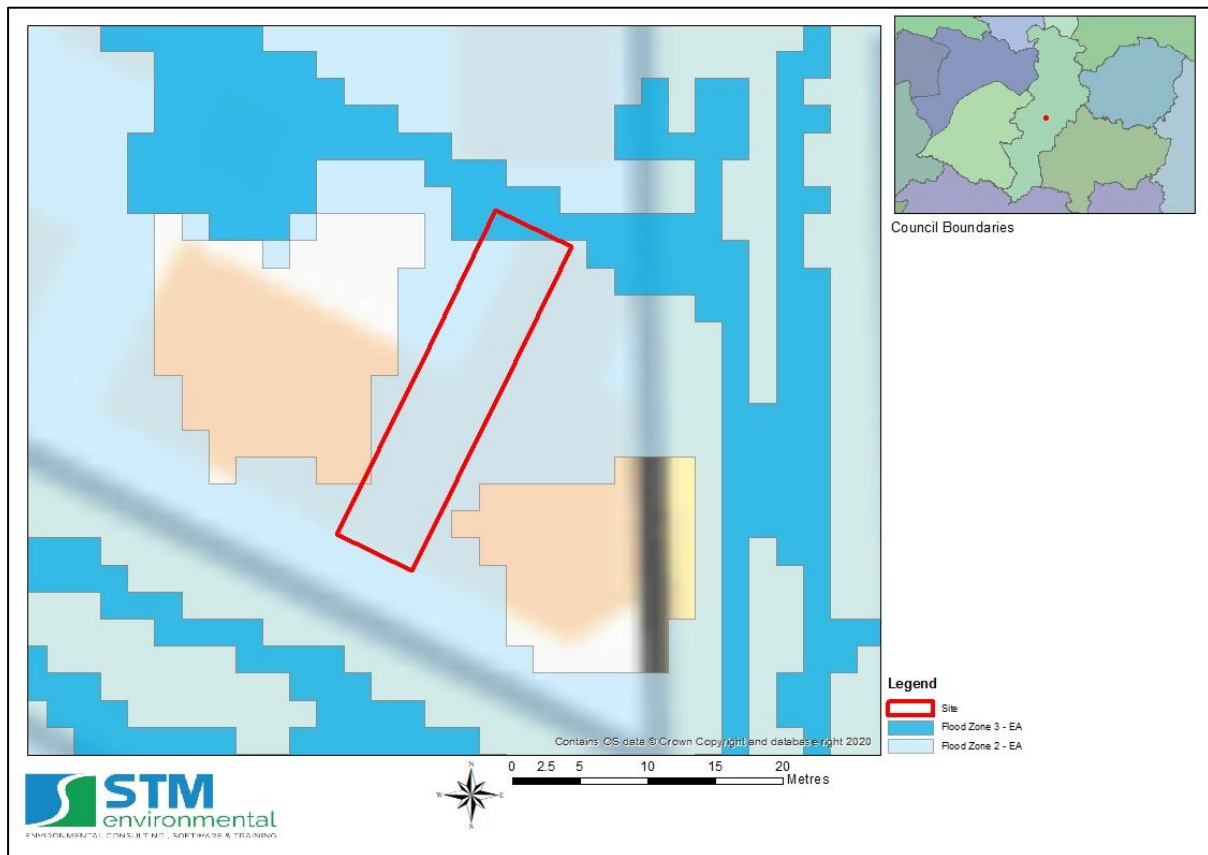
N.A

17.4.2 Table of Recorded Historic Flooding (SFRA)

Table 4-2: Historical Flood Events in Manchester

Date	Source	Description	Data source
2007	Ashton Canal	Flooding reported at Ancoats	EA Flood Event Outline
2004	Chorlton Brook	Flooded Halls of Residence, Manchester University, Fallowfield	AGMA Sub-regional SFRA
2001	Medlock / Bridgewater Canal	Overtopping of canal at Castlefield hotel area	Manchester Evening News
1991	Unknown	Flooding in Castlefield, Manchester City Centre, Great Lever, Ramsbottom, Radcliffe, Marple Bridge, Didsbury, Hollingworth, Stretford and Bury	Manchester Evening News
1981	Chorlton, Baguley, Sinderland and Timperley Brook	Over 280 properties flooded in Fallowfield, Withington, Gorton, Sale, and Altrincham	Upper Mersey CFMP
1965	Sewer	Sewer burst and surface water flooding to properties in Northenden and Didsbury	BHS Database
1958	Surface water and sewer	Flooded rail station. Wilbraham (Fallowfield), Ardwick and Fallowfield	BHS Database
1947	Surface water and sewer	Flooded rail station and line. Wilbraham (Fallowfield)	BHS Database
1911	Mersey, surface water, sewage	Flooded sewage works affecting Moss Side, Withington and Fallowfield	BHS Database
1872	Medlock, Mersey, Irk, Bridgewater Canal	Extensive flooding to properties in lower lying areas along: Mersey (Northenden, Didsbury) Medlock (North Manchester) Medlock overtopping into Bridgewater Canal. Barges in canal lifted out	BHS Database

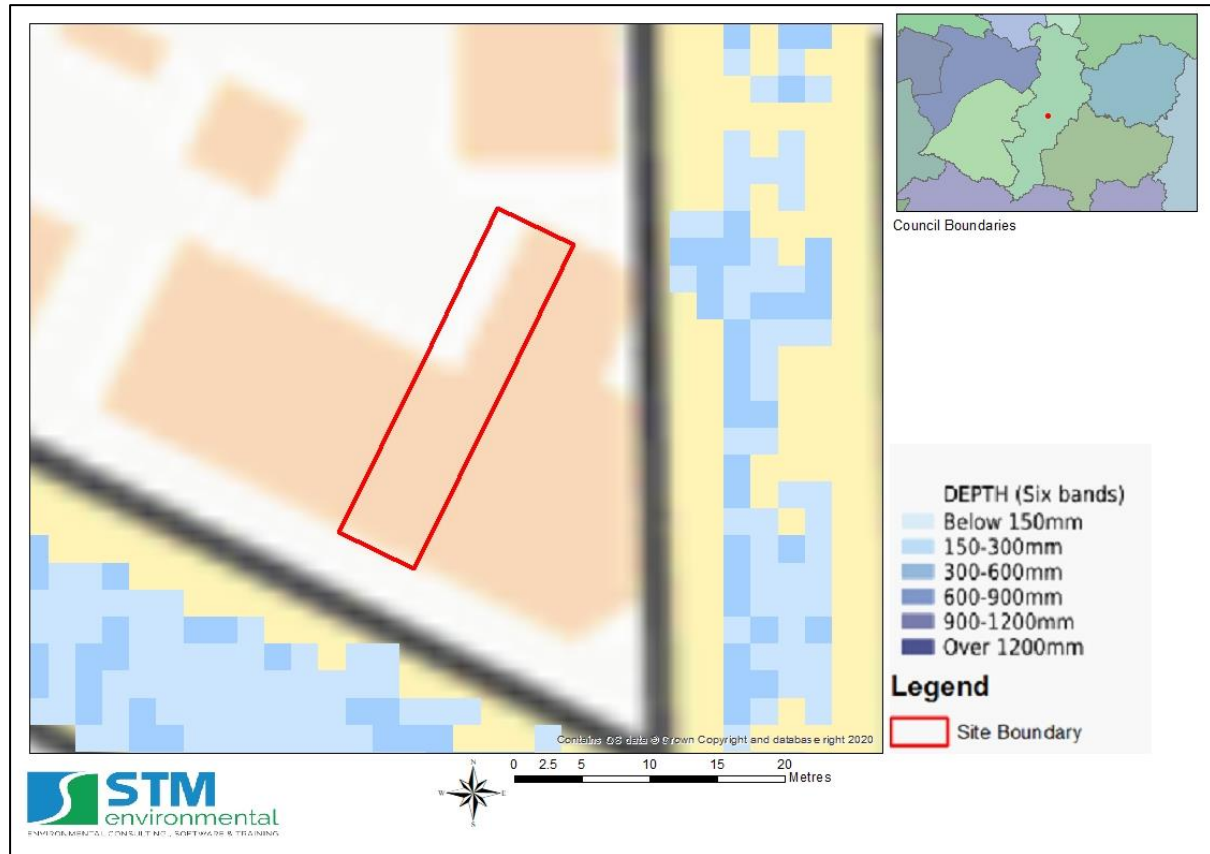
17.5 Appendix 5 - EA Flood Zone Map



17.6 Appendix 6 – Surface Water Flood Depth Map

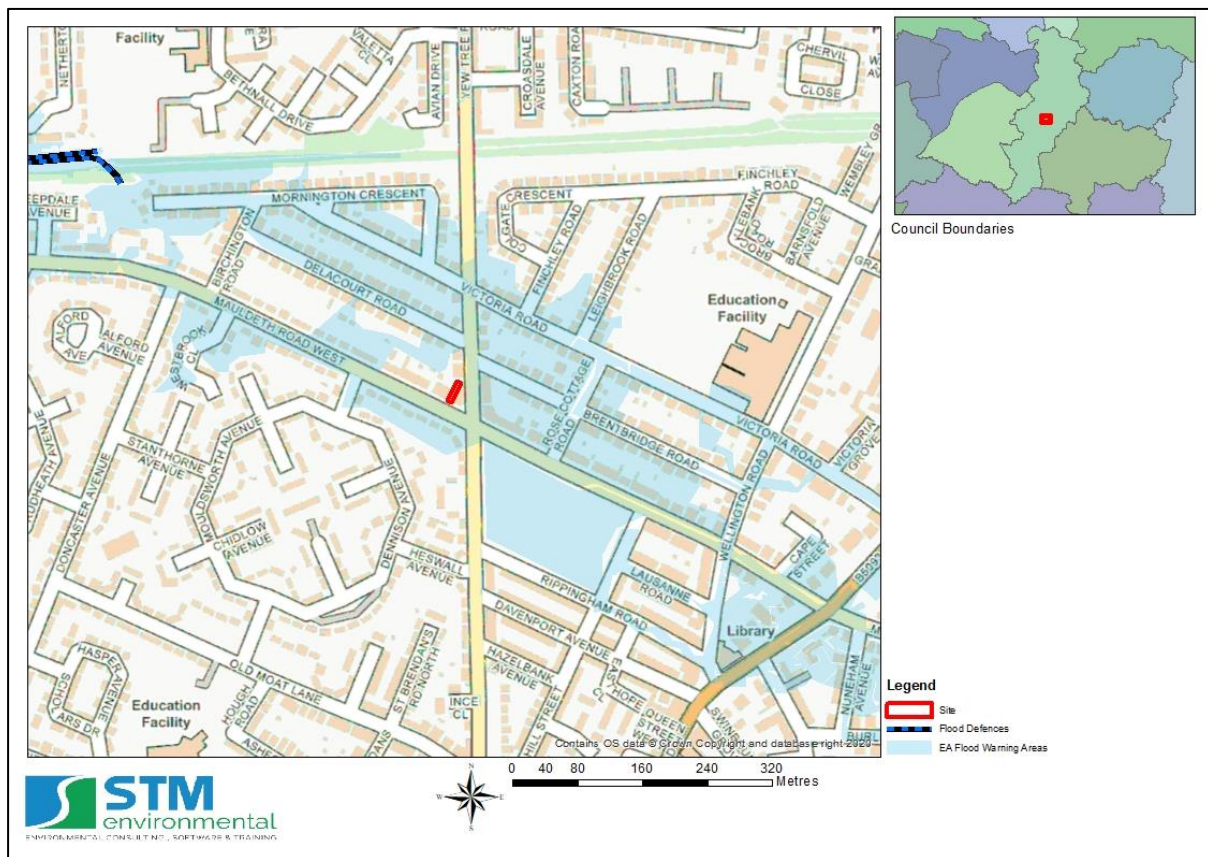
17.6.1 Predicted surface water flood depth for the 1 in 1000-year return period

(Source: EA, 2016).



17.7 Appendix 7 –Flood Defence and Reservoir Flood Risk Maps

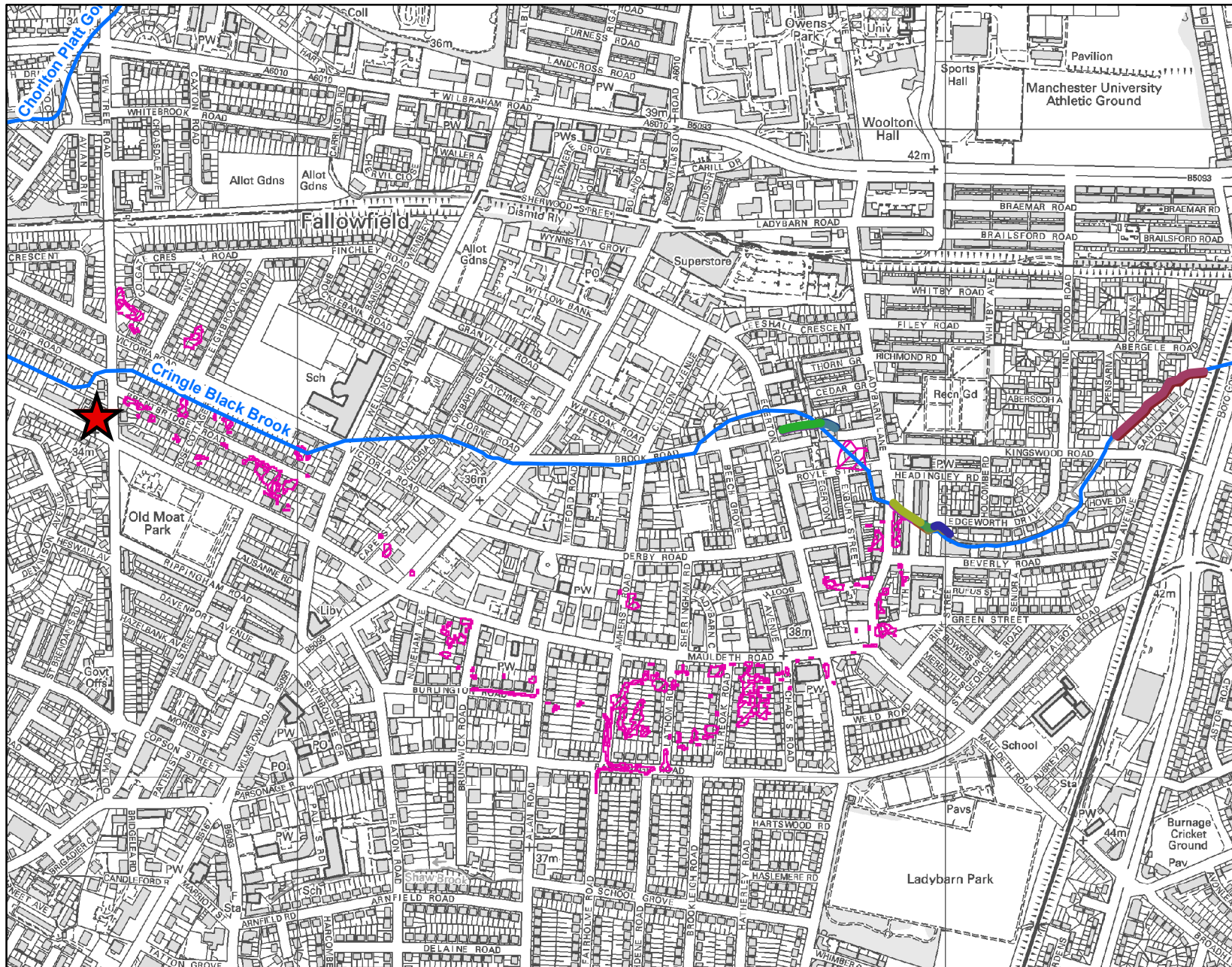
17.7.1 EA Map showing flood defences within the vicinity of the site



17.7.2 Reservoir Flood Risk Map

N.A

Flood Defence Map centred on Mauldeth Road West, Manchester, M20 1AB. Created on 07/09/2021 [GMMC232065CC]



1:8,775



Legend



Site Location

Flood Defences

Asset Id

7427

8870

8872

9557

9636

32270

32271

32357

32358

32836

59161

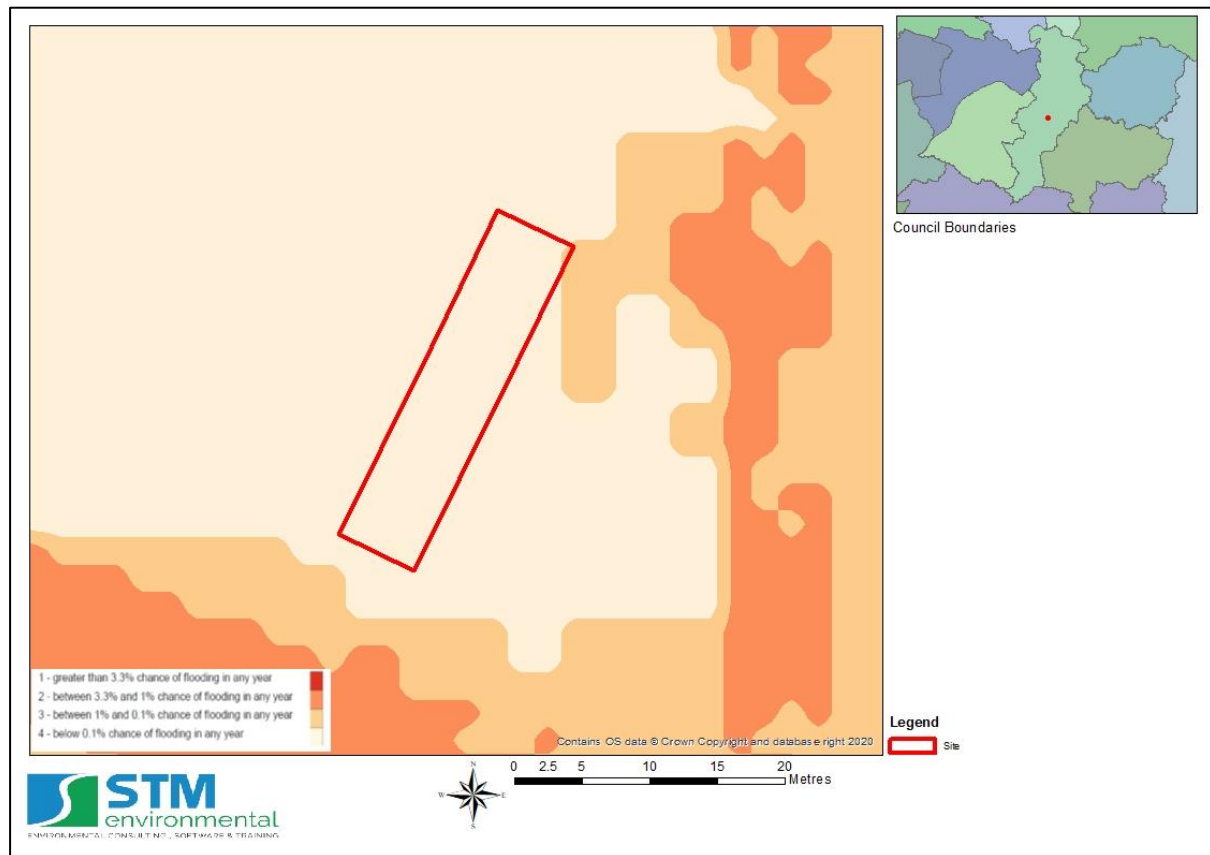
121698

121699

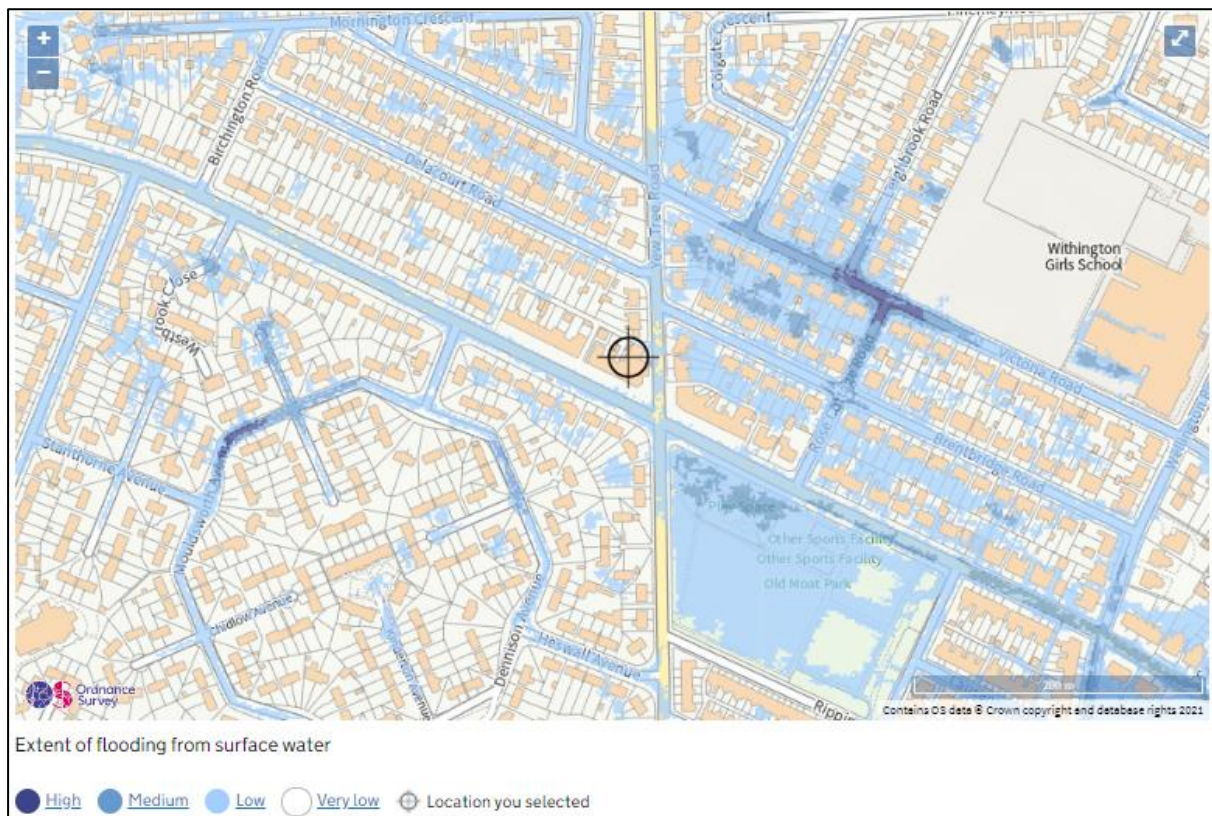
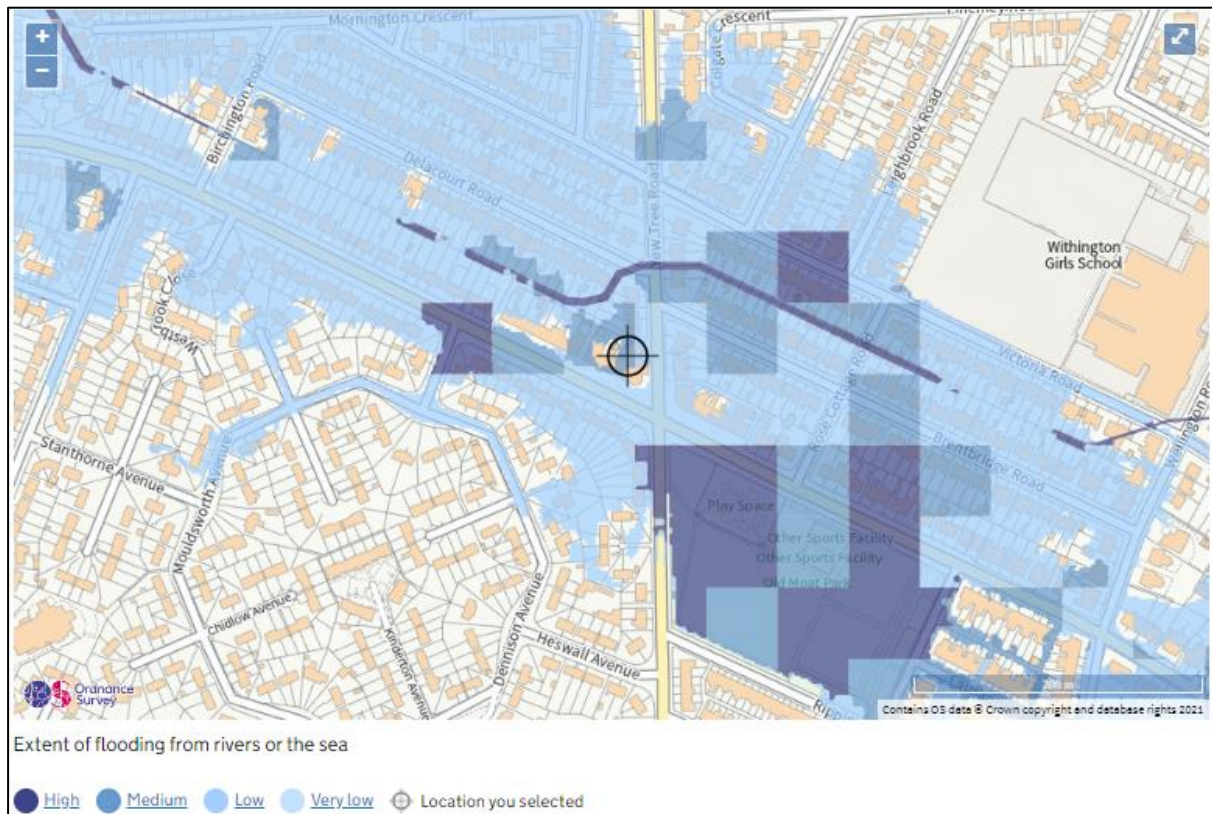
Areas Benefiting

Main River

17.8 Appendix 8 – Risk of Flooding from Multiple Sources Map

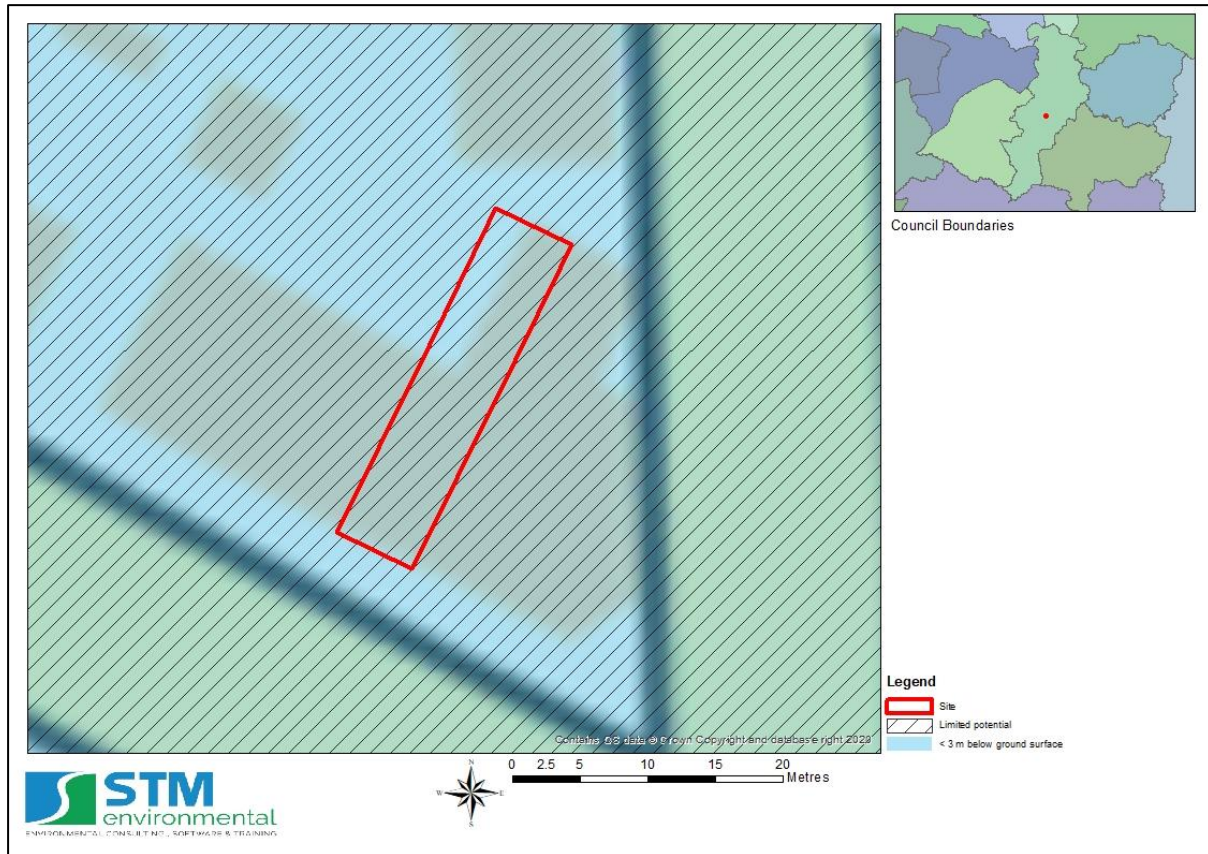


17.9 Appendix 9 – EA's Long Term Flood Risk Maps

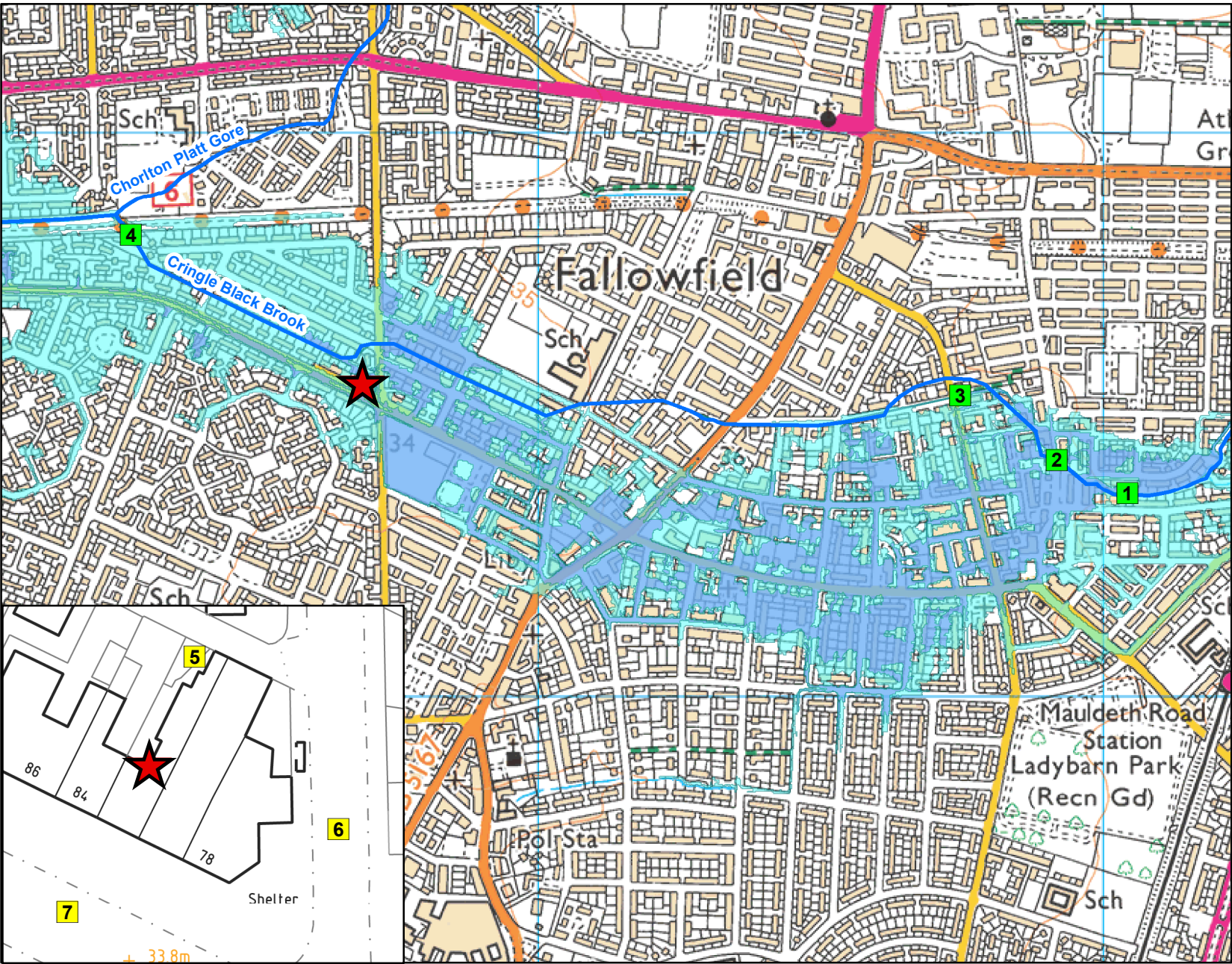


17.10 Appendix 10 – Groundwater Flood Maps

17.10.1 Groundwater Flooding (Susceptibility) Map (BGS) and Potential Depth to the Groundwater Water Map (BGS)



17.11 Appendix 11 - EA Product 4 (Detailed Flood Risk) Data



1:10,001



Legend

- ★ Site Location
- Model Measurements
- 2D Measures
- Main River
- Flood Zone 3
- Flood Zone 2

				Unflooded																	Deflooded																
Map Reference	Model Node Reference	Easting	Northing	Data	20 % AEP (1 in 5 year)	10 % AEP (1 in 10 year)	5 % AEP (1 in 20 year)	4 % AEP (1 in 25 year)	3.33 % AEP (1 in 30 year)	2 % AEP (1 in 50 year)	1.33 % AEP (1 in 75 year)	1 % AEP (1 in 100 year)	1 % AEP (1 in 100 year) + 30% increase flow	1 % AEP (1 in 100 year) + 35% increase flow	1 % AEP (1 in 100 year) + 70% increase flow	0.5 % AEP (1 in 200 year)	0.1 % AEP (1 in 1000 year)	0.1 % AEP (1 in 1000 year) + 30yr Climate Change	20 % AEP (1 in 5 year)	10 % AEP (1 in 10 year)	5 % AEP (1 in 20 year)	4 % AEP (1 in 25 year)	3.33 % AEP (1 in 30 year)	2 % AEP (1 in 50 year)	1.33 % AEP (1 in 75 year)	1 % AEP (1 in 100 year)	1 % AEP (1 in 100 year) + 30% increase flow	1 % AEP (1 in 100 year) + 35% increase flow	1 % AEP (1 in 100 year) + 70% increase flow	0.5 % AEP (1 in 200 year)	0.1 % AEP (1 in 1000 year)	0.1 % AEP (1 in 1000 year) + 30yr Climate Change					
1	es013_0238_CRIND1_1508	386043	393362	Modelled Water Level (m aodN)	39.57	39.73	39.78	39.79	39.80	39.83	39.85	39.86	39.91	39.91	39.95	39.89	40.08	40.16	39.57	39.73	39.78	39.79	39.80	39.83	39.85	39.86	39.91	39.91	39.95	39.89	40.08	40.16					
				Modelled Flow (cumecs)	3.70	4.57	5.07	5.17	5.27	5.53	5.72	5.82	6.42	6.52	7.26	6.19	8.56	9.24	3.70	4.57	5.07	5.17	5.27	5.53	5.72	5.82	6.42	6.52	7.26	6.19	8.56	9.24					
2	es013_0238_CRIND1_1791u	386820	393423	Modelled Water Level (m aodN)	38.77	39.31	39.33	39.34	39.34	39.35	39.36	39.36	39.37	39.38	39.39	39.37	39.43	39.46	38.77	39.31	39.33	39.34	39.34	39.35	39.36	39.36	39.37	39.38	39.39	39.37	39.43	39.46					
				Modelled Flow (cumecs)	3.69	4.28	4.39	4.38	4.39	4.40	4.41	4.42	4.44	4.44	4.49	4.44	4.48	4.51	3.69	4.28	4.39	4.38	4.39	4.40	4.41	4.42	4.44	4.44	4.49	4.44	4.48	4.51					
3	es013_0238_CRIND1_1551u	386748	393537	Modelled Water Level (m aodN)	38.02	38.43	38.45	38.45	38.46	38.47	38.47	38.47	38.49	38.50	38.53	38.48	38.56	38.61	38.02	38.43	38.45	38.45	38.46	38.47	38.47	38.47	38.49	38.50	38.53	38.48	38.56	38.61					
				Modelled Flow (cumecs)	3.69	4.27	4.37	4.38	4.39	4.40	4.41	4.42	4.44	4.44	4.44	4.43	4.47	4.49	3.69	4.27	4.37	4.38	4.39	4.40	4.41	4.42	4.44	4.44	4.44	4.43	4.47	4.49					
4	es013_0238_CRIND1_0050d	384279	393820	Modelled Water Level (m aodN)	31.85	31.85	31.85	31.85	31.85	31.85	31.85	31.85	31.85	31.85	31.85	31.85	31.89	31.91	31.85	31.85	31.85	31.85	31.85	31.85	31.85	31.85	31.85	31.85	31.85	31.85	31.89	31.91					
				Modelled Flow (cumecs)	3.68	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.97	3.97	3.97	3.97	3.98	3.99	3.68	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.97	3.97	3.97	3.98	3.99			
5	2D Measure	384697	393572	Modelled Water Level (m aodN)														33.91	33.91	33.92																	
6	2D Measure	384716	393548	Modelled Water Level (m aodN)														34.14	34.15	34.16																	
7	2D Measure	384679	393538	Modelled Water Level (m aodN)														33.94	33.95	33.96																	

Model data taken from Cringle Brook 2017

AEP - Annual Exceedence Probability

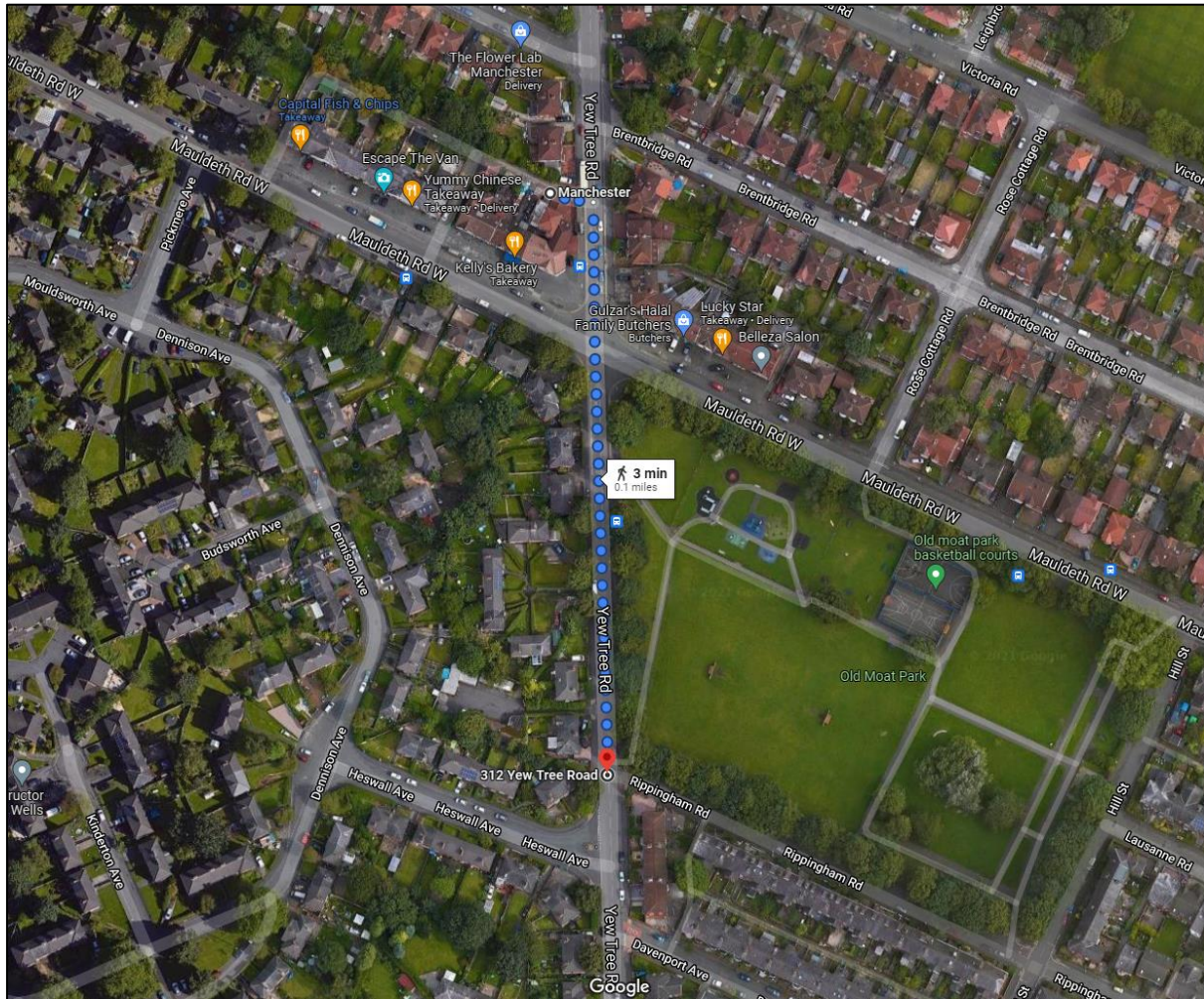
m aodN - metres above ordnance datum Newlyn

cumecs - cubic metres per second

Notes: *Climate Change Scenario - 30%, 35% and 70% increases in flow calculated for the 2080's (2070 - 2115). Please see <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances> for more information regarding the new climate change guidance. The location of the site and the type (vulnerability) of development determine the climate change allowances to consider in any flood risk assessment.

Flood Defences					
Start Date	Asset Type	Asset ID	Standard of Protection	Upstream Actual Crest Level (m aod)	Downstream Actual Crest Level (m aod)
01/01/2004	high_ground	9636	100	41.26	43.83
01/01/2004	wall	32836	100	39.36	39.40
01/01/2004	wall	32270	100	39.28	39.21
01/01/2004	wall	32271	100	39.73	39.40
01/01/2004	high_ground	7427	100	44.26	40.24
01/01/2004	wall	32387	100	40.97	40.67
01/01/2004	wall	32398	100	40.71	40.72
01/01/2004	wall	59161	100	40.13	40.13
01/01/2004	wall	8870	100	39.83	39.84
01/01/2004	embankment	8872	100	39.77	39.78
01/01/2004	wall	9557	100	39.89	39.88
01/01/2004	wall	121698	100	40.96	40.70

17.12 Appendix 12 – Safe Egress to Flood Zone 1 Map



17.13 Appendix 13 – Calculation of Flood Hazard Rating

Table 7: Flood Hazard Rating Scores – based on DF score of 0

Velocity	Depth									
	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.0	2.25	2.50
0.0	0.13	0.25	0.38	0.50	0.63	0.75	0.88	1.00	1.13	1.25
0.5	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
1.0	0.38	0.75	1.13	1.50	1.88	2.25	2.63	3.00	3.38	3.75
1.5	0.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00
2.0	0.63	1.25	1.88	2.50	3.13	3.75	4.38	5.00	5.63	6.25
2.5	0.75	1.50	2.25	3.00	3.75	4.50	5.25	6.00	6.75	7.50
3.0	0.88	1.75	2.63	3.50	4.38	5.25	6.13	7.00	7.88	8.75
3.5	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00
4.0	1.13	2.25	3.38	4.50	5.63	6.75	7.88	9.00	10.13	11.25
4.5	1.25	2.50	3.75	5.00	6.25	7.50	8.75	10.00	11.25	12.50
5.0	1.38	2.75	4.13	5.50	6.88	8.25	9.63	11.00	12.38	13.75

Table 8: Summary of Scores

	Score From	Score To	Flood Hazard	Description
	<0.75	0.75	Low	Exercise Caution
Class 1	0.75	1.5	Moderate	Danger for some
Class 2	1.5	2.5	Significant	Danger for most
Class 3	2.5	20.0	Extreme	Danger for all

Table 9: Values for Debris Factor for different flood depths

Depths	Pasture/Arable Land	Woodland	Urban
0 to 0.25	0	0	0
0.25 to 0.75	0.5	1	1
d>0.75 and/or v > 2	0.5	1	1

-  The “danger to some” category includes vulnerable groups such as children, the elderly and infirm. “Danger: Flood zone with deep or fast flowing water”
-  The “danger to most” category includes the general public.

 The danger to all category includes the emergency services.

A flood emergency plan is considered to be an acceptable way of managing flood risk where the flood hazard has been given a “very low hazard” rating. In some instances, flood emergency plans may also be acceptable where the rating is “danger for some”. However, it is unlikely to be an acceptable way of managing residual flood risk where the hazard to people classification is “danger for most” or “danger for all”.