
Job Title

Mirabel House / Great Ducie Street,
Manchester

Prepared for

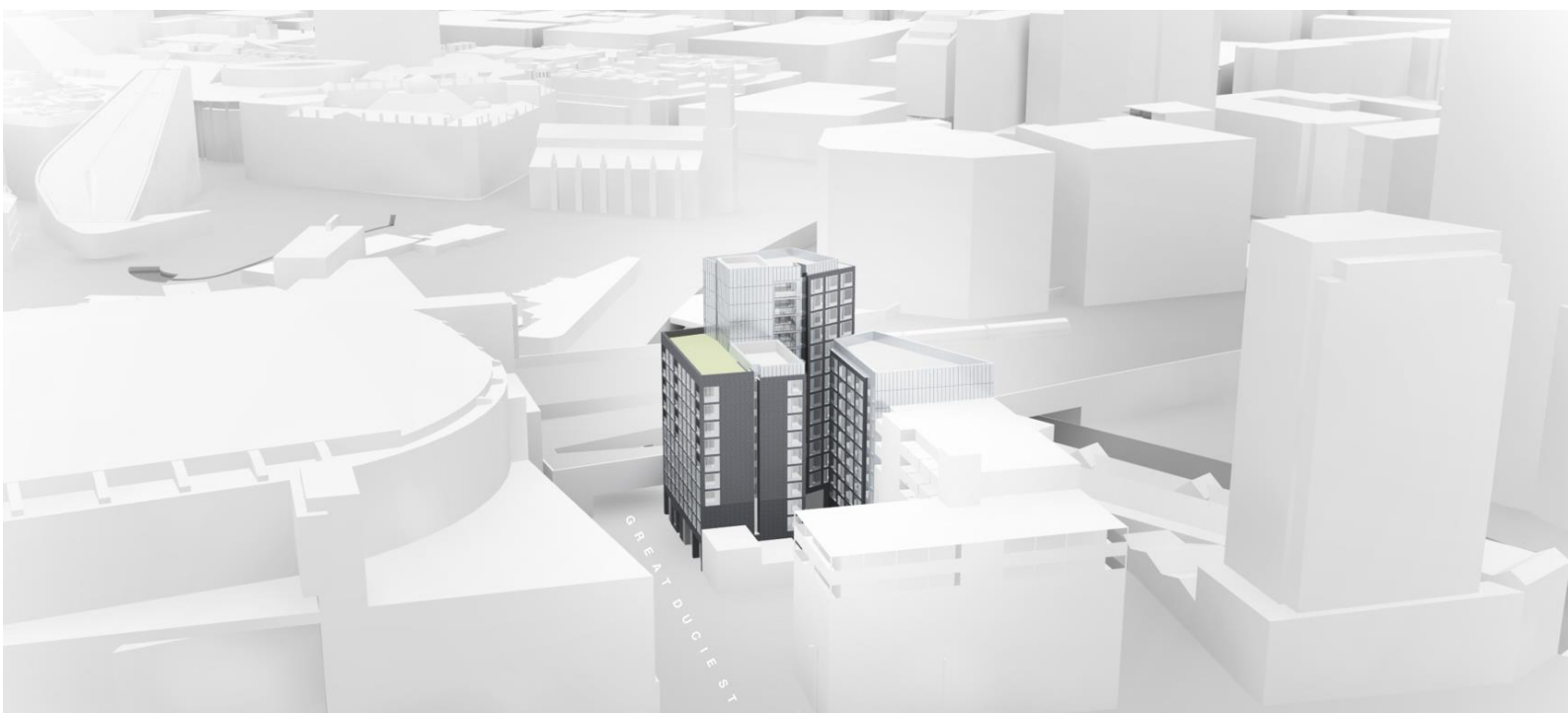
Maryland Securities

Report Type

Flood Risk Assessment

Date

3 August 2018



Contents

1. Introduction & Relevant Policy	1
2. Potential Sources of Flooding	5
3. Surface Water Management Strategy	12
4. Foul Drainage	15
5. Conclusion	16
Appendix A Existing Site Topographical Survey	i
Appendix B Development Proposals	ii
Appendix C Civic Engineers' Surface Water Management Strategy Drawing	iii
Appendix D Initial Surface Water Drainage Calculations	iv
Appendix E EA Product 4 Data	v

Flood Risk Assessment

Prepared by L J H

Reviewed by P M

Civic Job No. 756-01

Issued 3rd August 2018

This report is the copyright of Civic Engineers and is for the sole use of the person/organisation to whom it is addressed. It may not be used or referred to in whole or in part by anyone else without the express agreement of Civic Engineers. Civic Engineers do not accept liability for any loss or damage arising from any unauthorised use of this report. Civic Engineers is a trading name of Civic Engineers Ltd (registered number 06824088), which is a limited company registered in England, registered address Carver's Warehouse, 77 Dale Street, Manchester M1 2HG

1. Introduction & Relevant Policy

The objectives of an FRA aim to establish:

1. Whether a development will likely be affected by any current or future flooding from any possible source;
2. Whether the development will lead to flooding elsewhere;
3. Whether the measures proposed to deal with the risk and effects are appropriate;
4. Whether the development will be deemed safe and pass the Exception Test

The following report is a Flood Risk Assessment (FRA), prepared by Civic Engineers to support a planning application for the proposed development Mirabel House / Great Ducie Street in Manchester. This study has been prepared in accordance with the requirements of the National Planning Policy Framework (NPPF) and other relevant local policy and guidance.

This report is prepared for the exclusive use of Civic Engineers and our Client. All comments and conclusions in this report are based upon the assumption that the sourced data is reliable. Civic Engineers accepts no liability for any inaccurate conclusions or assumptions resulting from inaccurate information.

1.1 Relevant Policy

Regarding flood risk the NPPF requires that:

"Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere."

To establish the appropriateness of development at a specific site the NPPF refers to the Flood Zones which are shown on the Environment Agency Flood Map, and establishes the range of uses which are appropriate, or compatible, land uses for each Flood Zone.

The Flood Zones can be summarised as follows:

Zone 1: Low Probability. This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any one year. (<0.1%)

Zone 2: Medium Probability. This zone comprises land assessed as having between 1 in 100 and 1 in 1000 annual probability of river flooding (1%-0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% - 0.1%) in any year.

Zone 3a: High Probability. This zone comprises land assessed as having 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

Zone 3b: Functional Flood Plain. This zone comprises land where water flows or is stored in times of flood. Regional Strategic Flood Risk Assessments (SFRAs) should identify this zone.

The types of uses which are compatible with each flood zone are summarised in Table 1 below:

Table 1: Flood risk vulnerability and flood zone compatibility

Flood Risk Vulnerability Classification	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	√	√	Exception Test Required	√	√
Zone 2	Exception Test Required	√	Exception Test Required	√	√
Zone 3a	Exception Test Required	√	×	Exception Test Required	√
Zone 3b (functional floodplain)	Exception Test Required	√	×	×	×

√ Development is appropriate × Development should not be permitted.

1.2 Manchester Core Strategy (2012)

Policy EN 14 (Flood Risk) requires that:

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/expose culverted/hidden rivers to reduce the associated flood risk and danger of collapse, taking advantage of opportunities to enhance biodiversity and Green Infrastructure development Proposal

1.4 Site Location

The site is located off Great Ducie Street, Manchester at 29 Breslyn Street, Manchester M3 directly facing the Manchester Arena.

The site is centred on OS co-ordinates E:383796 N:399023. A location plan is given below, bounded by the redline. It should be noted that the site is bisected by Breslyn Street.

The site lies adjacent to The River Irwell which runs in a south east/north west direction to the south and west of the site. A historic masonry railway viaduct is located tight to the southern boundary of the site.

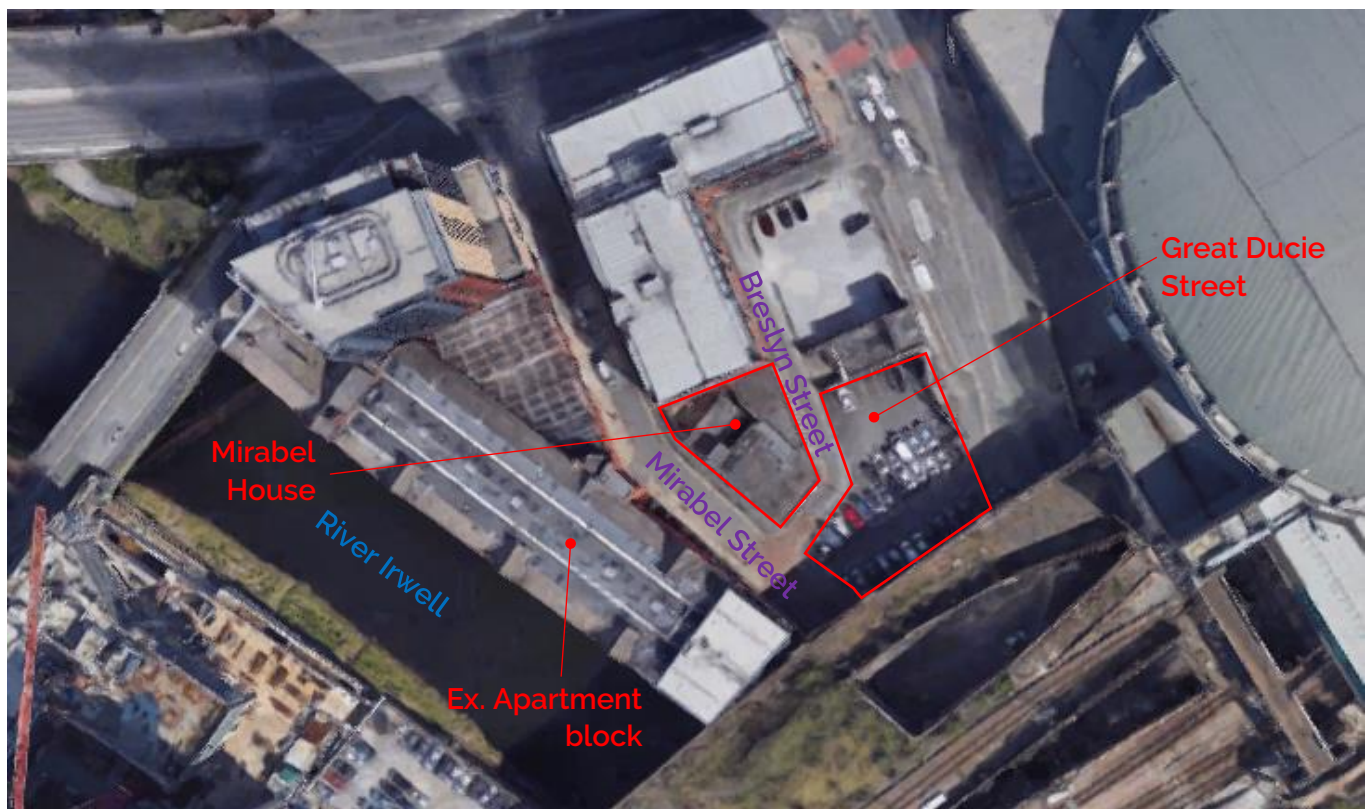


Figure 1: Location Plan

1.5 Site Description

The total site area is 0.122 ha; split into two distinct areas by Breslyn Street. The two sections of the site shall be referred to as Great Ducie Street and Mirabel House as depicted above.

The Mirabel House section of the site is currently occupied by an existing two storey building and the Great Ducie Street section is currently tarmacked and used as public and customer carparking for the local businesses. Existing site survey is contained within Appendix A of this document.

The River Irwell is located within 70 metres of the site to the south and west, the River Irwell is considered a Main River by the EA. There are no formal flood defence measures in place along the banks of the Irwell in this location, but it should be noted that large residential blocks directly adjacent the Irwell may act as an informal fluvial flood defence to the proposed development site.

1.6 Proposed Development

The proposed development intends to provide the following;

- 9 x studio apartments
- 31 x 1 bed apartments
- 80 x 2 bed apartments
- 9 x 3 bed apartments
- Commercial space and parking at ground floor level

In locating retail, parking and plant rooms at ground floor level and having lowest habitable demises at first floor level the development proposals acknowledges the potential residual flood risk.

2. Potential Sources of Flooding

In accordance with the NPPF, it is a requirement to assess the flood risk to the site from all potential sources. For the purposes of this assessment, this has been broken down into four potential sources:

- Fluvial and tidal;
- Groundwater;
- Surface water/Overland flow; and
- Artificial sources.

Further to the sources of flooding, an assessment of the impact of climate change has been carried out.

These sources are discussed in more detail in the sections below.

2.1 Fluvial and Tidal Flooding

The current Environment Agency flood risk maps for River and Coastal Flooding show that the proposed development is located within Flood Zone 2, (See Figure 2) which is classified as having a Medium Probability of flooding, between 1 in 100 and 1 in 1000 annual probability of river flooding (1%-0.1%).

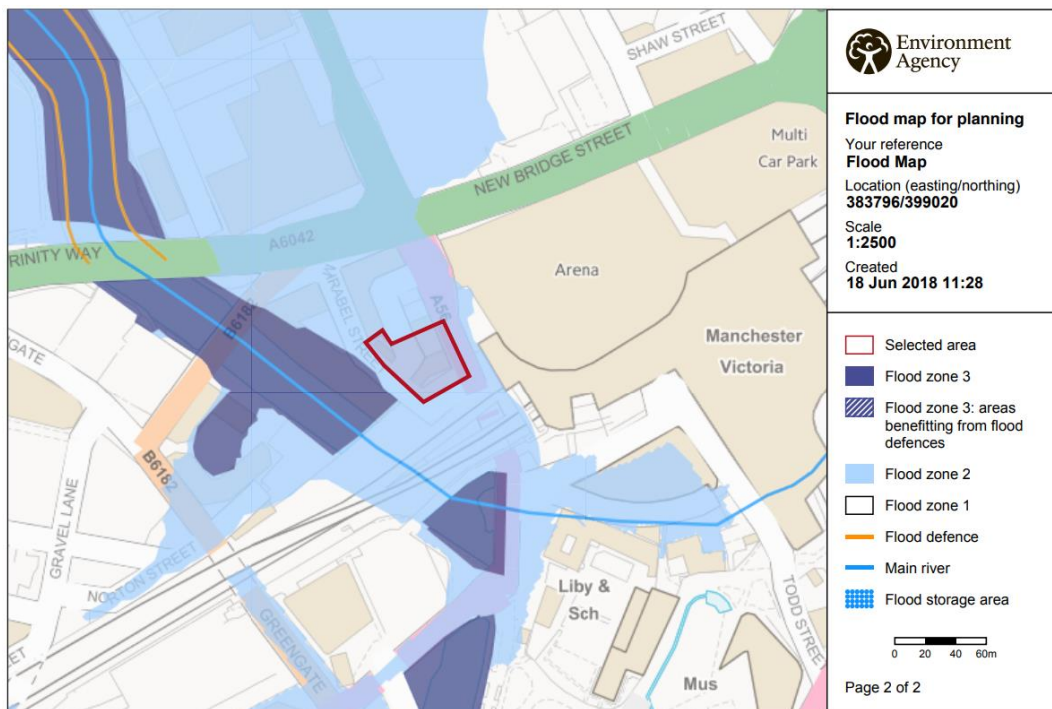


Figure 2: EA Flood Risk Map for River and Coastal Flooding

The proposed mixed-use is classed as a 'more vulnerable' development given the residential use. As the site is located in Flood Zone 2 it is considered appropriate for development by the NPPF (See Table 1).

Flood event level information has been obtained from EA and can be found in the summary below. EA Product 4 flood level data and maps can be found in Appendix E of this document.

Table 2: Summary of EA flood levels data

Location Ref.	1 in 100 year	1 in 100 year + Climate Change*	1 in 1000year
1 – IRW1_3476	26.32m	27.93m	29.87m
2 – IRW1_3363	26.19m	27.77m	29.73m
3 – IRW1_3226	26.00m	27.46m	28.98m
4 – IRW1_3167Bu	26.02m	27.47m	28.95m

* = 35/% allowance for climate change as per supplied EA documentation

Survey conducted in May 2011 by Cheshire Surveys show the existing site levels to site at between 28.31mAOD and 29.13mAOD. Since the survey was conducted the existing levels have been generally lowered across the site for the installation of tarmac hardstanding.

In the absence of an updated site topographical survey, site reconnaissance suggests that the site was levelled to about footpath level, therefore not below the minimum level of the site of 28.31m. An updated site topographical survey is to be arranged pre-commencement of works.



Figure 3: Google Maps Street View (May 2011)



Figure 4: Existing Site at Present

It is likely that the FFL for the ground floor will be at similar or higher level than existing.

With respect to nodes 3 and 4 (the nodes closest the site) existing site levels provide freeboard of at least 0.96m above the estimated 1in100 yr + climate change flood levels. However, the site is estimated to be inundated in the 1in1000 yr event.

The Impacts of Climate Change

Peak river flow allowances for various river basins, available from EA, are suitable for both Flood Risk Assessments and Strategic Flood Risk Assessments. They consider potential increase in peak river flow due to climate change. Table 3 below, based on data provided by the EA shows anticipated flow changes for the North West district.

The proposed development is considered "more vulnerable" within Flood Zone 2 and therefore a climate change allowance of 35% has been adopted in line with the Higher Central allowance category as per EA recommendations.

Table 3: Peak river flow allowances for the North West river basin district (use 1961 to 1990 baseline)

River Basin District	Allowance Category	Total potential change anticipated forecast		
		'2020s' (2015-2039)	'2050s' (2040-2069)	'2080s' (2070-2115)
North West	Upper End	20%	35%	70%
	Higher Central	20%	30%	35%
	Central	15%	25%	30%

2.3 Groundwater

Groundwater flooding generally occurs through water originating from sub-surface permeable strata, often in low lying areas which are underlain by permeable aquifers, allowing the water table to rise after a prolonged period of rainfall.

From current groundwater flood risk mapping from the Greater Manchester Strategic Flood Risk Assessment 2011 the development site appears to be located in an area designated as 'at risk of groundwater flooding'. This should, however, be considered a high-level assessment and further investigation of the site's ground water characteristics will be carried out during the Phase 2 site investigation. At the time of writing it is not possible to determine actual ground water levels without intrusive investigation.

The current EA groundwater source protection zones map (See Figure 3) shows that the site sits outside of a ground water protection zones; as such the site is considered to have a low risk of ground water flooding.

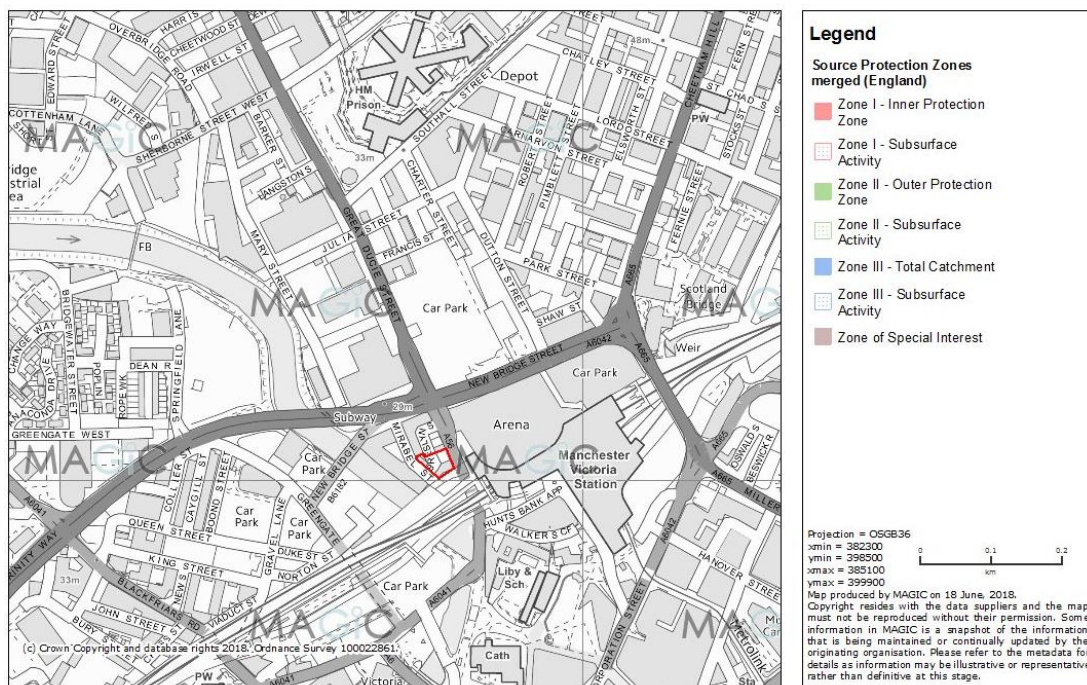


Figure 5: EA Map of Groundwater Source Protection Zones

In any case there is a residual risk of groundwater levels rising as a result of any flooding associated with the River Irwell.

Despite falling outside of any groundwater source protection zones, foundation solution will remain considerate to prevent the potential migration of contaminants into underlying strata and groundwater. Phase 1 Site Investigation has highlighted potential contamination sources such as heavy metals, PAHs, sulphate and asbestos. Phase 2 Site Investigation will establish contamination levels further via trial pit sampling.

2.4 Surface Water / Overland Flow

Surface water flooding is a result of surface run off and or ponding, normally due to heavy or prolonged rainfall or snow melt, where the large water volume is unable to soak into the ground or enter drainage systems. The run-off travels overland, following the contours of the land until reaching low lying areas in the topography causing 'ponding'. Such events normally have a short duration and depend on several factors such as geology, topography, rainfall, saturation, extent of urbanisation and vegetation.

The Environment Agency has undertaken national scale surface water flood modelling identifying areas at risk of surface water flooding, these risk categories can be classified as;

Very low flood probability – Zone has a less than a 1 in 1000 annual probability of a surface water flood event

Low flood probability – Zone has between a 1 in 100 and a 1 in 1000 annual probability of a surface water flood event

Medium flood probability – Zone has between a 1 in 30 and a 1 in 1000 annual probability of a surface water flood event

High flood probability – Zone has a greater than a 1 in 30 annual probability of a surface water flood event

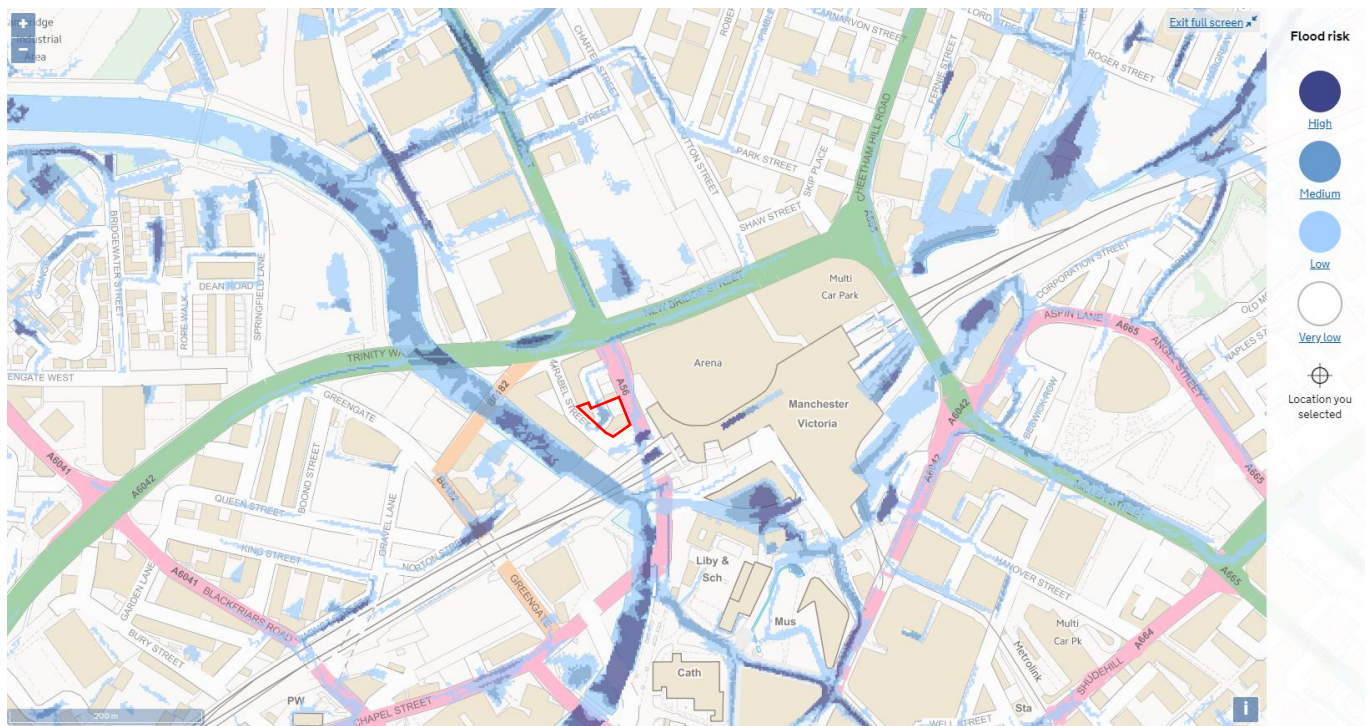


Figure 6: EA Flood Risk Map for Surface Water Flooding

The current EA Surface Water Flood Map (See Figure 4) indicates that the area of the development is classified with a 'very low' risk of surface water flooding. With 'low to medium' risk localised flooding shown along the surrounding highway and Breslyn Street which divides the site. Breslyn Street is to remain in its current arrangement and, as shown in Figure 1, sits outside of the site boundary.

2.5 Artificial Sources

2.5.1 Reservoirs

There are many reservoirs in and around the Greater Manchester Area. The failure of reservoirs leading to reservoir flooding is considered "extremely unlikely" by the Environment Agency. There has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs must be inspected and supervised by reservoir panel engineers. As the enforcement authority for the Reservoirs Act 1975 in England, we ensure that reservoirs are inspected regularly and essential safety work is carried out."

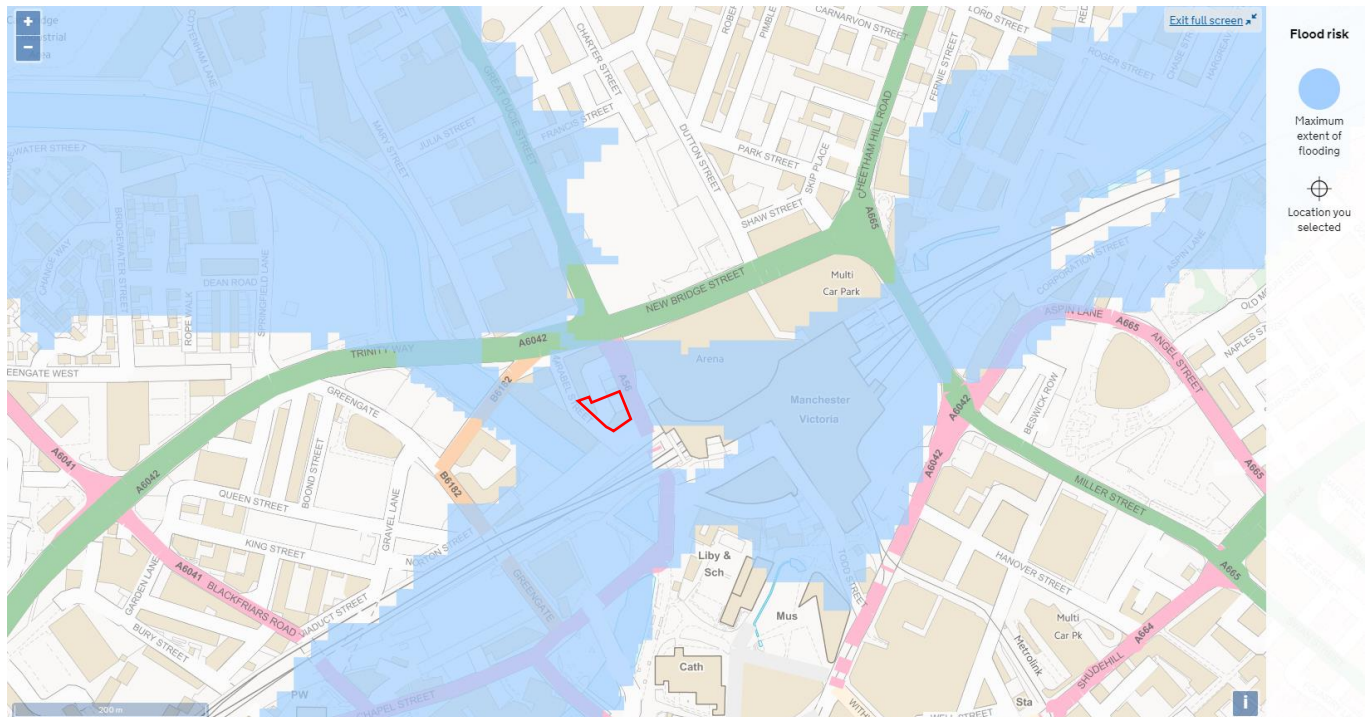


Figure 7: EA Flood Risk Map for Reservoir Flooding

The current EA Reservoir Flooding Map (See figure 5) indicates that the site lies within the flood area of a reservoir, however the reservoirs in the immediate vicinity have not been classified as being at risk therefore, reservoir flooding can be considered low risk.

2.5.2 Sewers

There are no known cases of the site or immediate area flooding as a result of surcharged public sewers.

2.7 Summary of Flood Risk

The site sits within Flood Zone 2 and therefore classified as being at moderate risk from fluvial flooding from the River Irwell - between 1 in 100 and 1 in 1000 annual probability of river flooding (1%-0.1%). It can be demonstrated that the existing site levels provide freeboard between 0.96m – 1.27m above the estimated flood levels obtained from the EA for the 1in100 yr event (with an allowance for increase due to climate change).

There is still a residual risk of the flooding in the 1in1000 yr event which is recognised by the development in providing less vulnerable uses such as retail, parking and plant rooms at ground floor level. Further simple mitigation measures such as the falling of levels away from door thresholds are also to be implemented. Large obstructions in the form of apartment blocks between the Irwell and the site is also considered to provide informal flood defence.

The site is considered as at medium risk of flooding due to groundwater but the actual groundwater regime on site is to be established during Phase 2 SI and flooding risk reviewed.

The site can be considered at low risk to flooding by reservoir failure or surcharge of public sewers. A localised area of Breslyn Street is at moderate risk of surface water flooding only with the development sites on either side at low risk.

3. Surface Water Management Strategy

The site is currently occupied by a building / car park and the entire site is considered as 100% impermeable.

The site consists of previously developed land and on-site drainage is yet to be located by survey. It is anticipated that the site drains into the combined sewer which runs below Breslyn Street (TBC) which can be seen from the United Utilities maps as shown on Civic Engineers' drainage strategy drawing found in Appendix C of this document, which combines United Utilities Asset maps with the proposed drainage strategy.

3.1 Proposed Point of Discharge

NPPF Planning Practice Guidance Paragraph 080 Reference ID:7-080-20150323 states that:

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

1. Into the ground (infiltration);
2. To a surface water body;
3. To a surface water sewer, highway drain, or another drainage system;
4. To a combined sewer."

Due to anticipated areas of made ground and impermeable nature of the underlying strata it is not feasible to dispose of surface water from the built development through infiltration.

The Site is approximately 70m from the River Irwell to the south and west of the site with built structures obstructing a clear path for discharge. Therefore, the creation of a discharge point into the watercourse is considered an unfeasible method for discharging surface water.

There are no existing surface water sewers present in the local vicinity according to United Utilities Asset maps.

Utilising the combined sewer beneath Breslyn Street is therefore the preferred method of surface water discharge.

3.2 Sustainable Drainage Systems (SuDS)

Section 1.1 of the SuDS Manual (Ciria C753) states the following:

"Sustainable drainage systems (SuDS) can deliver multiple benefits.

Surface water is a valuable resource and this should be reflected in the way it is managed and used in the built environment. It can add to and enhance biodiversity, beauty, tranquillity and the natural aesthetic of buildings, places and landscapes and it can help make them more resilient to the changing climate.

The philosophy of sustainable drainage systems is about maximising the benefits and minimising the negative impacts of surface water run-off from developed areas.

The SuDS approach involves slowing down and reducing the quantity of surface water runoff from a developed area to manage downstream flood risk and reducing the risk of that runoff causing pollution. This is achieved by harvesting, infiltrating, slowing, storing, conveying and treating runoff on site and, where possible, on the surface rather than underground. Water then becomes a much more visible and tangible part of the built environment, which can be enjoyed by everyone."

The SuDS Manual describes the four pillars of SuDS design as Water Quality, Water Quantity, Amenity and Biodiversity as illustrated in Figure 8 below.

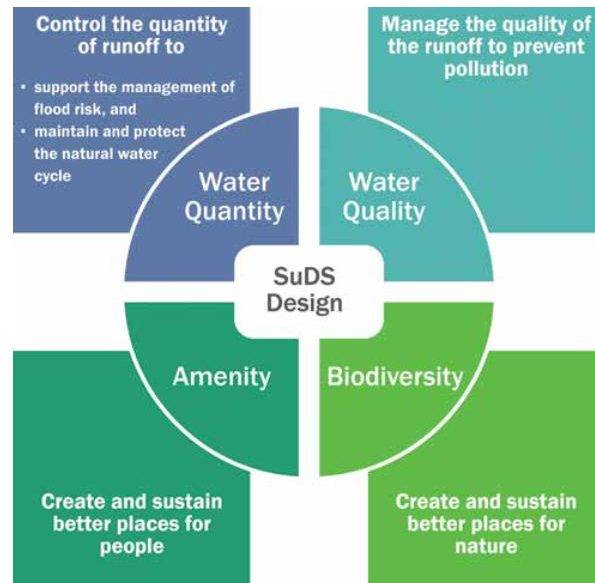


Figure 8: Sustainable Development Objectives (Representation of Figure 2.1 of The SuDS Manual)

Minimising the Impact of the Development on the QUANTITY of Surface Water Run-Off

The area of impermeable surfaces will remain constant between pre-development and post-development. In accordance with the recommendations in the SFRA, surface water drainage from the built development site will be restricted such that it does not exceed the pre-development run off rates, with the aim of achieving a 50% reduction in accordance with the recommendations as set out in the Manchester, Salford & Trafford SFRA.

The reduction in run-off rate will be achieved primarily through the provision of a flow control device. Restriction of flows will require the provision of a volume of attenuation to be provided within the development boundary.

Minimising the Impact of the Development on the QUALITY of Surface Water Run-Off

The surface water run-off from the site will predominantly be from roofs. Due to the proposed change of use the development will result in a significant improvement in the quality of the surface water run-off from the site, which currently likely has high concentrations of silts, debris and contamination washing from vehicles in the car park.

Maximise AMENITY & BIODIVERSITY Opportunities

The proposed development plans currently do not include significant open spaces for landscaping and the opportunity to maximise amenity and biodiversity. This said, a small portion of roof is to be

utilised as a terrace area – this presents the opportunity for some planting and potential for areas of green roof and green walls which also provides the benefit of attenuating surface water run off also.

Potential SuDS Features to be Considered

The proposed development plans currently do not include open spaces for landscaping and implementation of many of the typical source control SuDS devices. As noted above, there may be opportunity for the inclusion of a small green roof area to the terrace on Great Ducie Street, subject to agreement with the Architect.

Below ground attenuation tanks beneath both buildings are to be implemented in conjunction with flow control devices to restrict surface run off rates.

The table below describes the potential SuDS features that could be utilised on site and highlights where they contribute to the objectives as set out in The CIRIA SuDS Manual (C753).

Table 4: Potential SuDS Scheme Components

Components	Comments	Benefits		
		Quantity*	Quality	Amenity & Biodiversity
Green Roof	Opportunities will be explored to provide green roof to the proposed buildings.	√	√	√
Green Wall	Opportunities will be explored to provide green wall areas to the proposed buildings.	√	√	√
Underground Attenuation	It is anticipated that below ground storage will need to be provided to supplement the other SuDS.	√		
Trapped gullies, petrol interceptors and silt traps.	Provision of an appropriate level of treatment will need to be provided prior to discharge. Engineered components may be required to supplement the other SuDS.		√	

* reduction in quantity is based on flow rate rather than volume. Significant reductions in the volume of run-off can only realistically be achieved through rainwater harvesting and/or infiltration to the ground.

3.4 Development Surface Water Drainage Strategy

As the site is a Brownfield site having been previously developed, and is located within a Critical Drainage Area, surface water drainage from the main development site will be restricted such that it does not exceed the pre-development run off rates, with the aim of achieving a 50% reduction in accordance with the recommendations as set out in the Manchester, Salford & Trafford SFRA.

The proposed surface water drainage scheme is as shown on Civic Engineers' drawing DR-001 found in Appendix C of this document. The surface water drainage from the built development area will discharge via a flow control device to the combined sewer beneath Breslyn Street (subject to agreement with United Utilities).

In order to align with local policy the discharge rate will be restricted to 7.8l/s, which is equivalent to 50% of the pre-development discharge rate for the 1in100 yr + a 40% increase in rainfall intensity due to climate change; conforming to 'Environment agency – *Table 2. Peak Rainfall Intensity in Small and Urban Catchments*' guidance for 1in100 yr storm event.

The restricted discharge will result in the requirement for approximately 29m³ of storage, which will be accommodated primarily through provision of an attenuation tank within the development. Green roof provisions may also form part of the attenuation storage; to be agreed with Architect. (refer to calculations in Appendix D).

Maintenance of SuDS will be the responsibility of the developer/operator of the development.

4. Foul Drainage

The foul drainage is proposed to be discharged in to the combined system in Breslyn Street. Peak Discharge has currently been calculated at approximately 20l/s although this figure will be refined through the detailed design prior to submission of an s106 application for connection to the public sewer.

5. Conclusion

The proposed development is located within Flood Zone 2, which is characterised by medium probability of a flood occurring. Residential developments, such as this one, are classified as "*more vulnerable*" by the NPPF and **Table 1** states that this type of development is compatible with Flood Zone 2.

Whilst the risk of flooding to the Proposed Development generally is low, there may be a residual risk of flooding from groundwater - this will be confirmed by appropriate Phase 2 ground investigation and appropriate mitigation agreed and implemented if necessary.

Surface water will be managed by adequately designed drainage systems, so that the site will not flood due to surface water flow, nor result in an increased flood risk elsewhere and the proposed development drainage strategy will result in a reduction in run-off from the site in line with the recommendations as set out in the SFRA and will aim to utilise SuDS and include Green Infrastructure in line with Local Planning Policy requirements. This will be a betterment to the existing brownfield condition.

With incorporation of the proposed mitigation measures as described above the risk of flooding to the site will be low and the development will comply with National and Local Planning Policy.

Appendix A Existing Site Topographical Survey

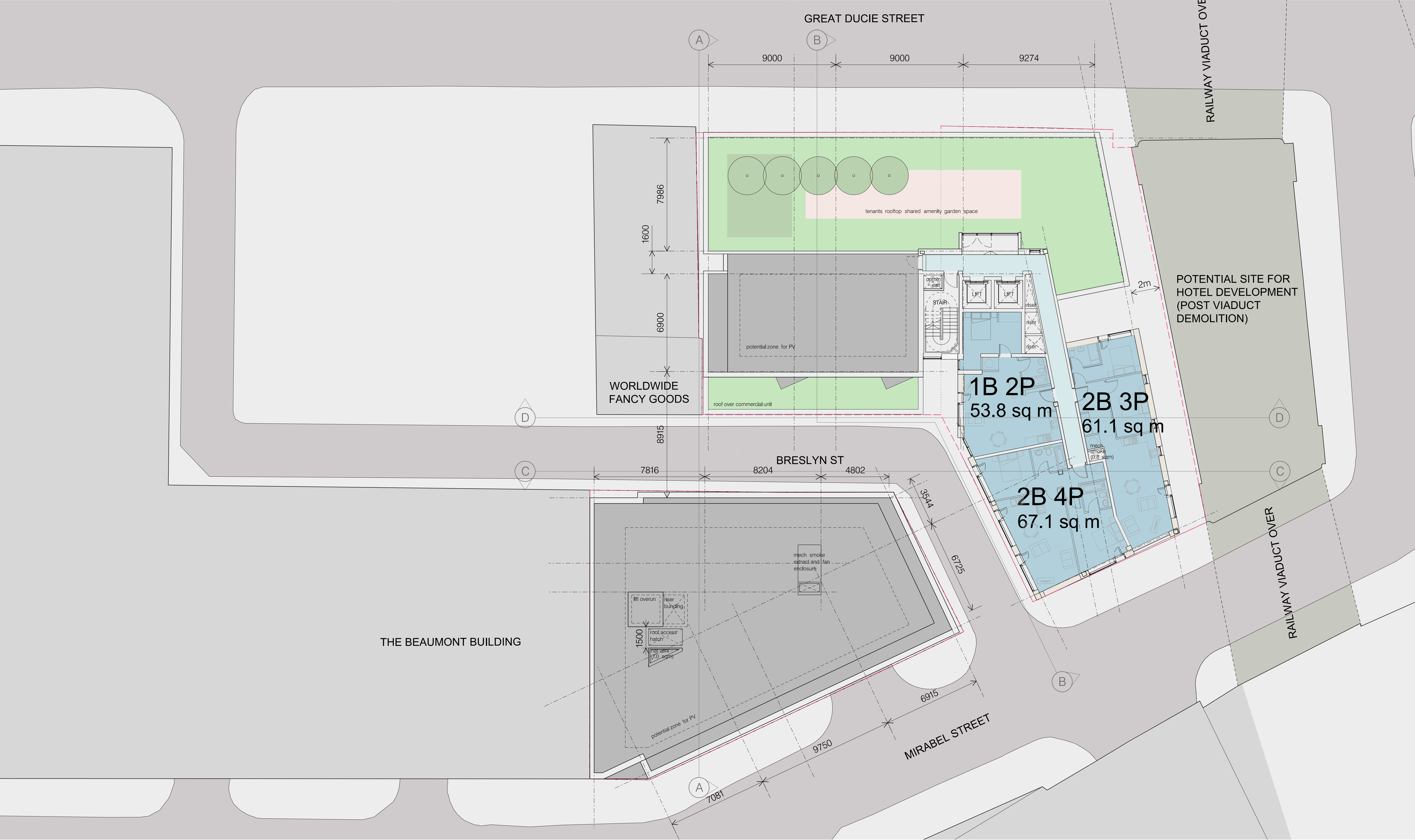
Appendix B Development Proposals

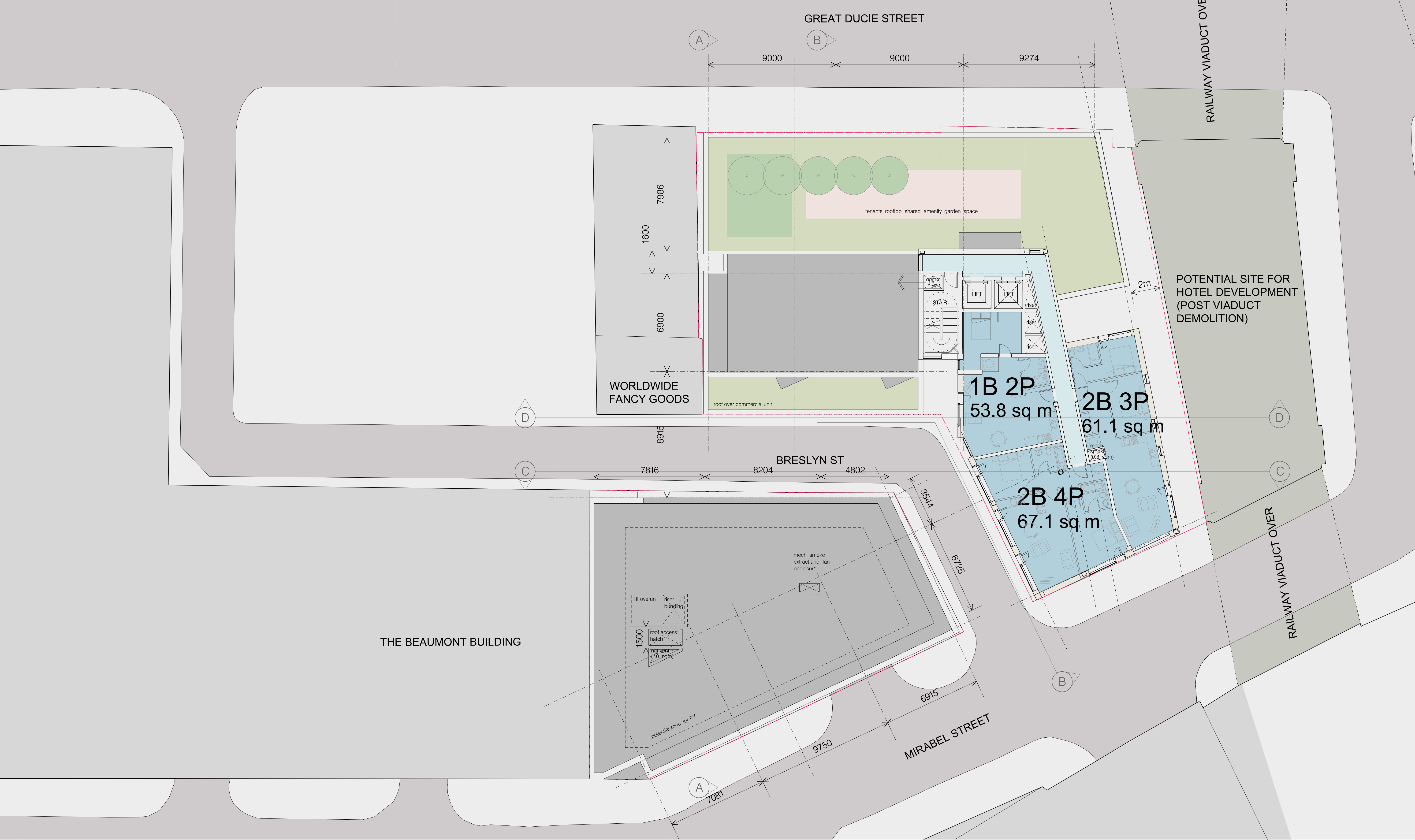


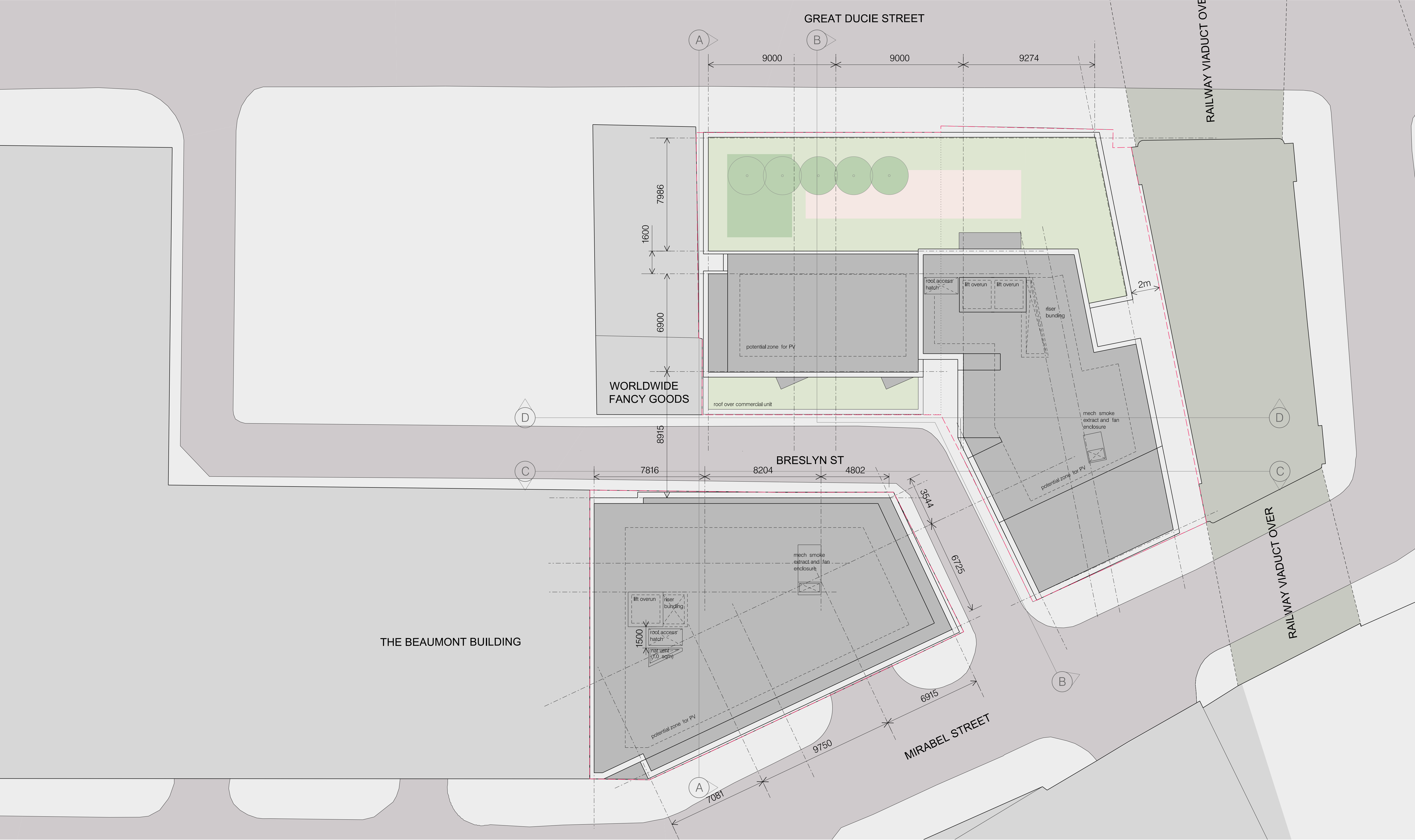












hodder+partners		
SGI Studios 1 Kelso Place Manchester M15 4LE		
t: +44(0)161 832 9842 e: mail@hodderandpartners.com w: www.hodderandpartners.com		
revisions + notes:		
REV. ~	28.06.16	team issue
REV. A	16.09.16	team issue
REV. B	03.10.16	team issue
REV. C	09.01.17	team issue
REV. D	09.07.18	PRE-PLANNING CONSULTN ISSUE

DO NOT SCALE
Work to annotated dimensions only.
Read drawing in conjunction with relevant specification,
Structural Engineers' and Services Engineers' drawings.
Confirm all dimensions before commencement of any
work on site or fabrication.



client:		date:	
MARYLAND SECURITIES		OCTOBER 2016	
project:		scale:	drawn by:
GREAT DUCIE STREET /MIRABEL STREET MANCHESTER		1:250@A3	RT
title:		drawing number:	
ROOF PLAN LAYOUT		(SK) 014	
status:		job number:	revision:
INFORMATION		0464	D

Appendix C Civic Engineers' Surface Water Management Strategy Drawing



Standard Notes

1. This drawing is to be read in conjunction with all relevant Architect's and Engineer's drawings and the specification.

2. This drawing should not be scaled.

3. All dimensions are to be verified by the contractor on site.

4. All discrepancies should be reported to the C.A. prior to the commencement of the works.

© CIVIC ENGINEERS

Location Plan

Notes and Keys

1. Drawing developed using existing sewer records provided by United Utilities 22.05.2018

Drainage Key

Proposed Surface Water Sewer

Proposed Foul Water Sewer

Proposed Combined Sewer

Existing Combined Sewer

Proposed Surface Water Flow Control Manhole

Proposed Foul Water Manhole

Proposed Combined Manhole

Proposed Surface Water Attenuation Tank

13.07.18	P02	Issued for Information	LJH	PM	
06.07.18	P01	Issued for Comment	LJH	PM	
Date	Rev	Description	Drawn	Chkd	

MANCHESTER

LONDON

LEEDS

Civic Engineers

Currier's Warehouse, 77 Dale Street, Manchester, M3 2HG. Tel: 0161 228 9757
Clyde Works, 14 Mill Street, London SE1 2BQ. Tel: 020 7253 2977
Tower Works, Unit 02-03, Globe Road, Leeds, LS13 5DB. Tel: 0113 2025 130

www.civicingineers.com

Project

Mirabel House
Great Ducie Street
Manchester

Title

Surface / Foul Water Drainage Strategy

Status

INFORMATION

Scale @ A1	Date Created	Drawn	Checked	
1:200	May 2018	LJH	PM	
Project Number	Originator	Discipline	Drawing Number	Revision
756-01	CIVIC	C	DR-100	P01

Appendix D Initial Surface Water Drainage Calculations

Mirabel House / Great Ducie Street, Manchester

Surface Water Analysis

Introduction

This report is to demonstrate the surface water run-off rates and attenuation volume calculation for the proposed development Mirabel House / Great Ducie Street, Manchester.

This report has been prepared to demonstrate that the surface water run-off rate for the new development site is managed so it adheres to current regulations and reduces the surface water run-off rate to 50% of the 1 in 1 – year pre-development rate.

The post development surface water attenuation volumes will include a 40% increase in rainfall intensity to conform to 'Environment Agency – Table 2 Peak Rainfall Intensity in Small and Urban Catchments' guidance for 1 in 100 year storm event.

Site Areas

The pre-and post-development impermeable / positively drained areas are to be established to calculate the pre-development surface water run-off rate, and subsequently a 50% betterment of that rate for the post development site.

The overall area and pre-and post-development impermeable / positively drained areas have been calculated to be:

Overall site area.....1220m² / 0.122 ha

Existing impermeable area..... 1220m² / 0.122 ha

Proposed impermeable area..... 1220m² / 0.122 ha

Surface Water Run-Off Calculations

To establish the post development surface water run-off, rate the pre-development peak 1 in 1-year rate is to be calculated. The post development surface water run-off rate is to be restricted to 50% of the peak pre-development 1 in 1-year rate to ensure that the required run-off isn't exceeded for any storm events.

The calculations are based on the pre-development positively drained area of 1220m², and the data given by the Flood Studies Report (FSR) and Wallingford Procedure, via a 'mock' network in the XP Solution WinDes software.

The variables used to calculate the surface water run-off rates from positively drained surface water run-off rates of the pre-development site are as follows:

Existing Impermeable Area.....	1220m ² / 0.122ha
M5 – 60 (mm).....	18.000
Ratio R.....	0.360
Cv (Summer).....	0.750
Cv (Winter)	0.840
Time of Entry.....	4 minutes

Based on the results from the computer software and using the variables above the peak 1 in 1-year surface water run-off rate from the pre-development site has been calculated to be 15.6/s.

Therefore, the post development surface water run-off rate required to adhere to the local authority requirements of providing 50% betterment on brownfield sites is to be 7.8/s.

Approximate Attenuation Volumes

The required attenuation volume for the restricted run-off rate of 7.8 l/s for the post development positively drained area of 2070m² has been calculated using the same variables as set out above. The approximate volume of attenuation required for each storm event are as follows:

Q ₁	=1.9m ³
Q ₃₀	=11.1m ³
Q _{100+cc}	=29.0m ³

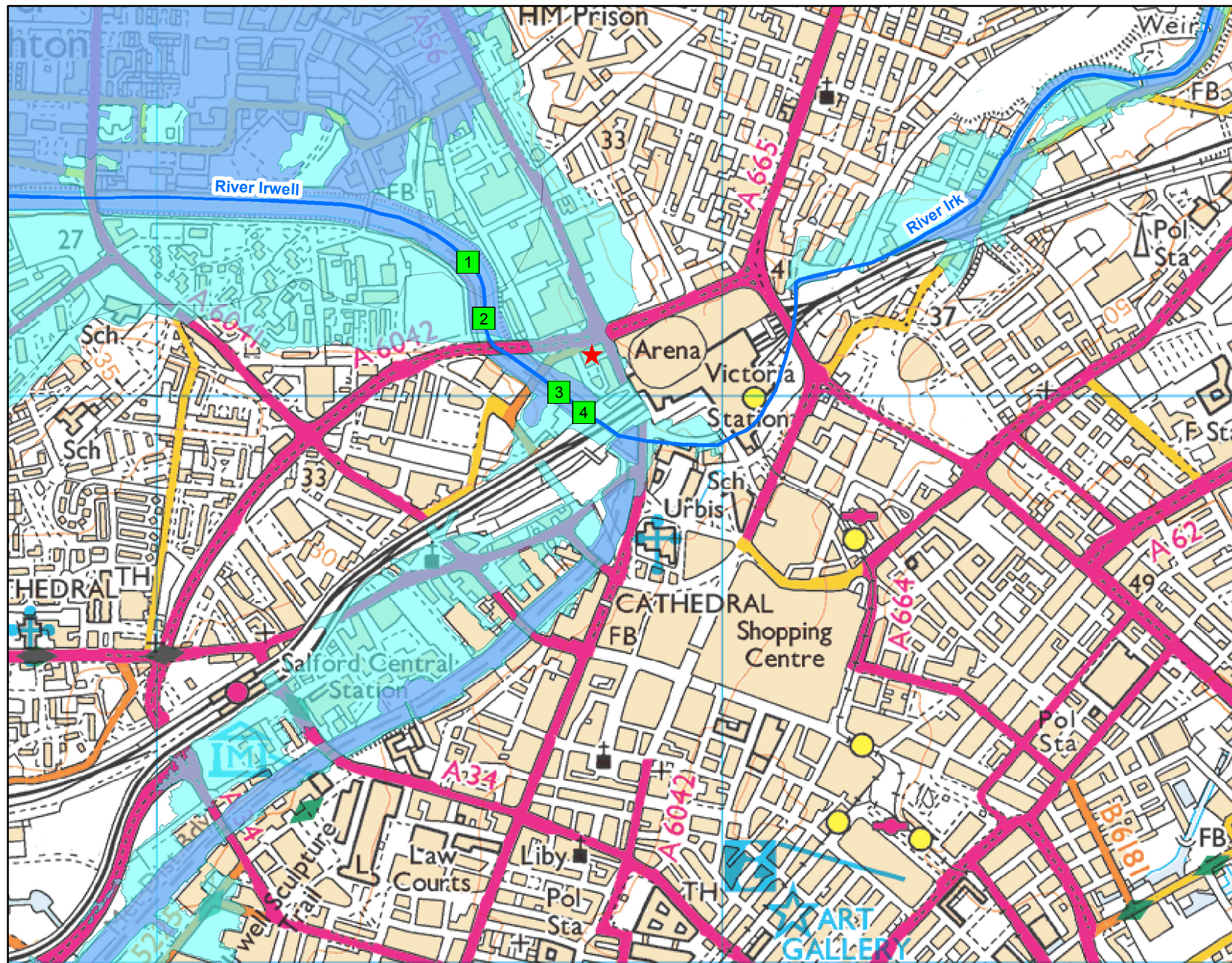
Estimated Attenuation Volume

Ciria SuDS Manual 2015, Paragraph 10.2.4 states that: 'Exceedance flows (i.e. flows more than those for which the system is designed for) should be managed safely in above-ground space such that risks to people and property are acceptable'.

Based on this guidance; the principle that attenuation will be within the drainage network itself; and the attenuation volumes for each of the storm events stated above, it is estimated that the required below ground attenuation volume will be 29.0m³.

Appendix E EA Product 4 Data

Detailed Flood Map centred on Breslyn St, Manchester. Created 05/01/2017 [GMMC33633AB]



1:10,001



Legend

-  Model_measurements
-  Site_location
-  Main River
-  Flood Zone 3
-  Flood Zone 2

Map Reference	Model Node Reference	Easting	Northing	Data	Undefended					Defended				
					1.33 % AEP (1 in 75 year)	1 % AEP (1 in 100 year)	0.1 % AEP (1 in 1000 year)	1 % AEP (1 in 100 year) + 35% increase in flow	1 % AEP (1 in 100 year) + 70% increase in flow	1.33 % AEP (1 in 75 year)	1 % AEP (1 in 100 year)	0.1 % AEP (1 in 1000 year)	1 % AEP (1 in 100 year) + 35% increase in flow	1 % AEP (1 in 100 year) + 70% increase in flow
1	ea013_0111 RW1_3476	383552	399237	Modelled Water Level (m aodN)	26.24	26.32	29.87	27.93	29.57	26.41	26.51	29.67	27.22	28.64
				Modelled Flow (cumecs)	425.85	433.38	572.30	592.46	565.13	444.52	457.77	591.41	544.87	612.72
2	ea013_0111 RW1_3363	383580	399137	Modelled Water Level (m aodN)	26.11	26.19	29.73	27.77	29.42	26.28	26.38	29.49	27.08	28.49
				Modelled Flow (cumecs)	425.97	433.51	624.76	608.99	636.09	444.64	457.89	654.00	546.32	646.01
3	ea013_0111 RW1_3226	383713	399007	Modelled Water Level (m aodN)	25.92	26.00	28.98	27.46	28.69	26.08	26.18	28.80	26.81	28.02
				Modelled Flow (cumecs)	426.09	433.64	697.26	610.53	703.97	444.77	458.02	695.98	546.25	658.12
4	ea013_0111 RW1_3167Bu	383757	398971	Modelled Water Level (m aodN)	25.94	26.02	28.95	27.47	28.68	26.10	26.20	28.78	26.83	28.02
				Modelled Flow (cumecs)	426.12	433.68	711.90	610.78	712.27	444.81	458.06	706.70	546.27	660.25

Model data taken from Salford 2012 Study

Notes:

AEP - Annual Exceedence Probability

m aodN - metres above ordnance datum Newlyn

cumecs - cubic metres per second

*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. Note that these levels have not yet been subject to detailed review and therefore should be treated as draft.

Historc Flooding

Flood Event Code	Start Date	End Date	Source of Flooding	Cause of Flooding
FEB01568D	20/09/1946	21/09/1946	main river	channel capacity exceeded
FEB01569C	01/11/1866	02/11/1866	main river	channel capacity exceeded
Boxing Day 2015	26/12/2016	26/12/2015	main river	overtopping of defences

Defences

Date built	Asset ID	Standard of Protection	Overall Condition Grade*	Upstream Actual Crest Level (m aodN)	Downstream Actual Crest Level (m aodN)
2003	88831	75	3	27.66	27.44

Manchester

Carver's Warehouse
77 Dale Street
Manchester M1 2HG
+44 (0)161 228 6757

London

Reeds Wharf
33 Mill Street
London SE1 2AX
+44 (0)20 7253 2977

Leeds

Unit 02/01 Tower Works
Globe Road
Leeds LS11 5QG
+44 (0)113 2025 130

Glasgow

Gresham Chambers
45 West Nile Street
Glasgow G1 2PT
+44 (0)141 370 1829