70020194-001

PLOTS 2, 3, 4 AND 5, ANGEL MEADOW

FLOOD RISK ASSESSMENT AND OUTLINE DRAINAGE STRATEGY REPORT

MAY 2017

WSP | PARSONS BRINCKERHOFF

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FLOOD RISK ASSESSMENT AND OUTLINE DRAINAGE STRATEGY

Final – For Planning

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1 PROJECT BACKGROUND

1.1 APPOINTMENT AND BRIEF

WSP have been appointed by Far East Consortium Limited (FEC Ltd) and the Co-op to provide a Flood Risk Assessment (FRA) and Outline Drainage Strategy in support of the full planning application for the proposed residential led development at Plots 2, 3, 4 and 5 adjoining Angel Meadow in Manchester.

1.1.1 A location plan for the site has been included in **Appendix A**.

1.2 AIM OF STUDY

1.2.1 The aim of this study is to carry out a Flood Risk Assessment and Outline Drainage Strategy of suitable scope and detail to support the submission of the full planning application for residential-led development of the Angel Meadows site. The Flood Risk Assessment herein will be undertaken in accordance with the National Planning Policy Framework (NPPF).

1.2.2 The scope of work for this FRA is listed below, namely:

- Consultation with statutory consultees regarding flooding of the site, including requesting information on historic flooding events and local flood defences;
- Collection and review of existing and publicly available data relevant to flood risk;
- Based on the data review, undertake an assessment of the risk of flooding to the proposed development from all sources, including consideration of the effects of climate change;
- Where required, identification of any mitigation measures required to manage the risk of flooding; and
- Reporting of all our findings in a Technical Report, providing sufficient supporting information as required.

1.3 PROPOSED DEVELOPMENT

1.3.1 This document is intended to support the submission of a full planning application for a residential led development of four plots with commercial and residential amenity uses at lower and ground floor levels. The development proposals are as follows:

- Plot 2: A 22-storey residential development plus one basement level with commercial uses and residential amenity uses at ground level;
- Plot 3: A 17-storey residential development plus one basement level with commercial uses and residential amenity uses at ground level;
- Plot 4: A 40-storey landmark residential development with commercial uses and residential amenity uses plus one lower ground level and one basement level; and
- Plot 5: A part 9-storey and part 12-storey residential development with residential amenity uses at ground level.

1.4 CONSULTATION

1.4.1 The following organisations have been consulted whilst preparing the Flood Risk Assessment and Drainage Strategy.

- The Environment Agency (EA)
- United Utilities (UU)
- Manchester City Council (MCC)

1.4.2 To date, formal responses have been received from all consultees. Copies of relevant consultation are included in **Appendix B.**

1.5 REFERENCE

1.5.1 The scope of this FRA, including a drainage strategy, has been developed based on a review of all relevant available policy information, along with requirements outlined in consultation responses.

1.5.2 It is anticipated that this report will fulfil the required criteria and is compliant with all relevant flood risk planning policies.

1.6 LIMITATIONS

1.6.1 This report is based on the interpretation and assessment of data provided by third parties.

1.6.2 Whilst every care has been taken to ensure this information is accurate and up-to-date, WSP cannot guarantee the accuracy of third party data, and the findings of this report may change if the data is amended or updated after consultation.

1.6.3 The recommendations made within this report may also be subject to change upon receipt of further consultation responses.

2 PLANNING POLICY AND CONSULTATION

2.1 RELEVANT LOCAL PLANNING POLICY AND STRATEGY DOCUMENTS

The following documents have been reviewed as part of the FRA:

- Defra Sustainable Drainage Systems Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015)
- Environment Agency Climate Change Guidance (February 2016)
- Flood and Water Management Act (April 2010)
- National Planning Policy Framework (March 2012) and Planning Practice Guidance (March 2014)
- Manchester City Council Core Strategy (adopted 11th July 2012)
- Manchester, Salford, Trafford Level 2 Hybrid Strategic Flood Risk Assessment (May 2010)
- Manchester, Salford, Trafford Strategic Flood Risk Assessment User Guide (May 2010)
- Angel Meadow Development Framework Document

2.2 NATIONAL PLANNING POLICY

NATIONAL PLANNING POLICY FRAMEWORK

2.2.1 The National Planning Policy Framework (NPPF) ensures that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding and to direct development away from areas of highest flood risk.

2.2.2 Where new development is exceptionally necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and, where possible, reducing flood risk overall.

2.2.3 On 6th March 2014 the Department for Communities and Local Government launched the Planning Practice Guidance web resource to supplement the framework. On this date, PPS 25 (Development and Flood Risk) was cancelled and replaced by the Flood Risk and Coastal Change Planning Practice Guidance.

DEFRA SUSTAINABLE DRAINAGE SYSTEMS NON-STATUTORY TECHNICAL STANDARDS FOR SUSTAINABLE DRAINAGE SYSTEMS (MARCH 2015)

2.2.4 This document sets out non-statutory technical standard for sustainable drainage systems. It should be used in conjunction with the National Planning Policy Framework and Planning Practice Guidance.

2.2.5 For sites which were previously developed, the peak run-off rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield run-off rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.

2.2.6 Where reasonably practicable, for sites which have been previously developed, the run-off volume from the development to any high way drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to

the greenfield run-off volume for the same event, but should never exceed the run-off volume from the development site prior to redevelopment for that event.

2.2.7 The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event,

2.2.8 The drainage system must be designed so that, unless an area is designate to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in part of: a building (including a basement); or in any utility plan susceptible to water (e.g pumping station or electricity substation) within the development.

2.2.9 The design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100 year rainfall event is managed in exceedance routes that minimise the risks to people and property.

SUSTAINABLE DRAINAGE SYSTEMS WRITTEN STATEMENT HCWS161 (DECEMBER 2014)

2.2.10 The Secretary of State for Communities and Local Government laid a Written Ministerial Statement in the House of Commons on 18th December 2014 setting out changes to planning that will apply for major development from 6th April 2015. This confirms that in considering planning applications, local planning authorities should consult the relevant Lead Local Flood Authority on the management of surface water; satisfy themselves that the proposed minimum standards of operation are appropriate and ensure through the use of planning conditions or obligations that there are clear arrangements in place for ongoing maintenance over the lifetime of the development.

2.2.11 Therefore from 6th April 2015, local planning policies and decisions on planning applications relating to major development are required to ensure that sustainable drainage systems (SuDS) are used for the management of surface water.

2.2.12 Major development is development involving any one or more of the following:

- The winning and working of minerals or the use of land for mineral-working deposits;
- Waste development;
- The provision of 10 dwellings or more;
- 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.

ENVIRONMENT AGENCY CLIMATE CHANGE ALLOWANCES (FEBRUARY 2016)

2.2.13 On the 19th February 2015, the EA updated the Climate Change Allowances for rainfall, rivers flows and sea level rises for FRAs. This revised guidance came into effect immediately and is applicable to proposed development sites in England and Wales. The changes apply to all new planning applications within the NPPF. Further information regarding the allowances applicable to the proposed development herein is provided within Section 9.

2.2.14 It should also be noted that on the 3rd February 2017 the guidance was further updated to clarify the climate change considerations for increased flood levels in relation to Flood Zone 1 site (low risk).

2.3 LOCAL PLANNING POLICY

MANCHESTER CITY COUNCIL CORE STRATEGY (JULY 2012)

2.3.1 The Manchester City Council Core Strategy was adopted on 11th July 2012 and contains the following policies relating to flood risk and drainage:

"***Policy EN 14 – Flood Risk***

- *In line with the risk-based approach contained within PPS25* (replaced by the NPPF/PPG)*, 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* (NPPF/PPG) *an appropriate FRA will also be required for all development proposals including changes of use, on sites greater than 0.5 ha 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 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."*

3 CONSULTATION

3.1 THE ENVIRONMENT AGENCY (EA)

3.1.1 A pre-development enquiry was submitted to the EA on 14th December 2016 regarding the nature of flood risk within the site.

3.1.2 The EA responded on 19th December 2016. The EA have provided detailed flood risk mapping which indicates that the north eastern corner of plot 3 and the north western corner of plot 4 are partially located within the extent of the Flood Zone 2 area.

3.1.3 Further mapping provided by the EA confirms that the Angel Meadow site is located within an area that is at risk of reservoir flooding.

3.1.4 The EA have confirmed that they do not hold any record of historical flooding within the site however this does not mean that the site will not flood in the future.

3.1.5 Based on the information above, modelled flood levels were requested from the EA in order to confirm the extent of Flood Zone 2 within the vicinity of the site. Modelled in-channel flood level data was provided by the EA on 10th January 2017. This data is discussed in detail in Section 6. The EA have since confirmed that no site specific flood level data is available.

3.1.6 Further consultation with the EA (Sandrine Thomas, 16/02/2017) has identified that the EA's flood risk standing advice should be considered as part of the development, due to its partial location within a Flood Zone 2 area. In addition, the EA advised that appropriate mitigation measures should be provided in order to prevent flood water from entering any below ground car parking areas.

3.2 UNITED UTILITIES (UU)

3.2.1 A pre-development enquiry was submitted to UU on the 4th January 2017 to request information relating to the capacity of the local sewer network and the acceptable foul and surface water discharge rates from the proposed development.

3.2.2 A formal response was received from UU via email dated 20th January 2017. The response has been summarised below:

- Foul flows arising from the proposed development will be allowed to drain directly into the adjacent public combined sewer network at an unrestricted rate. The new connection from the proposed development to the public sewer can be at a convenient point;
- Anticipated surface run-off arising from the proposed development will be allowed to drain to the public sewer network at an unrestricted rate. The connection to the public sewer can be at a convenient point;
- A formal application for sewer connection will be required;
- On site drainage must be designed in accordance with "Building Regulations National Planning Policy, Planning Conditions and local flood authority guidelines.

3.3 MANCHESTER CITY COUNCIL (MCC)

3.3.1 A pre-development enquiry was submitted to MCC on the 14th December 2016 requesting information relating to flood risk issues within the site.

3.3.2 A formal response was received via email dated 21st December 2016. A summary is given below:

- The nearest named watercourse to the proposed development site is the River Irk to the north of the plots. Responsibility in terms of flood risk rests with the EA, whilst maintenance is the responsibility of the riparian owners;
- Plot 3 is partially located within Flood Zone 2 and EA Standing Advice should be referred to when setting minimum floor levels and access and egress from the development;
- There are no flood defences either present; no flood alleviation schemes are planned for the area;
- The Council have no record of any previous flooding of the site;
- There is no record of historical groundwater flooding issues and the Council do not have any record of groundwater levels within the vicinity of the site;
- A 50% reduction of the existing Brownfield run-off rates for each site will be required as part of the development but these rates will also have to be agreed with UU based on the capacity of the existing sewerage infrastructure; and
- The site situated within the Core Conurbation Critical Drainage Area.

3.3.3 A Scoping Opinion response was received from Manchester City Council dated 24th February 2017. In terms of Drainage and Flood Risk, the following key requirements were noted:

- The design of the development should be in accordance with the EA Standing Advice for developments in Flood Zone 2.
- The proposed development lies within an area at low risk of surface water flooding;
- The proposed development lies within an area at low susceptibility to groundwater flooding;
- The City Council does not hold any recorded incidents of flooding within the site or close vicinity;
- The area is situated within the Conurbation Core Critical Drainage Area and in accordance with the Manchester City Council SFRA at least a 50% reduction in surface water runoff should be provided through SuDS as part of any Brownfield development with the aim of reducing to the Greenfield
- Surface water should be managed to ensure there is no increased surface water from the proposed development and runoff from extreme events should be retained within the site such that the adjacent third party land is not affected;
- All major planning applications being determined from 6th April 2015 must consider sustainable drainage systems;
- The suitabilty of SuDS should be assessed in accordance with paragraphs 051, 079 and 080 of the revised NPPF Planning Practise Guidance for Flood Risk and Coastal Change;
- Hydraulic calculations and drawings should be provided in accordance with paragraph 081 of NPPF Planning Practise Guidance;
- Climate change up to 40% increase in rainfall should be considered as part of the design;
- Overland flow paths for exceedance events or blockage of inlet structures should be considered.

4 SITE INFORMATION

4.1 SITE LOCATION

4.1.1 The site is located to the north of Manchester City centre adjacent to the Co-op headquarter at Noma. The site is divided into four parcels of land which surround Angel Meadow Park.

4.1.2 The general characteristics of the site are described in **Table 4-1** on page 10 below.

4.2 EXISTING WATERCOURSES

4.2.1 The River Irk, an EA defined Main River is located approximately 60m north of the development site at its nearest point. The River Irk flows in a south westerly direction prior to culverting beneath Manchester Victoria train station. Upon exiting this culvert the Irk discharges into the River Irwell which continues to flow in a south westerly direction, eventually forming the Manchester Ship Canal.

4.3 EXISTING FLOOD DEFENCE INFRASTRUCTURE

4.3.1 The EA have confirmed that there are no flood defences within the vicinity of the site.

4.4 EXISTING PUBLIC DRAINAGE

4.4.1 An extract from the public sewer records for the area was procured from UU by WSP for the purposes of this FRA. This has been overlain with proposed development plans in order to provide an understanding of where the public sewers are located in relation to the proposed development. A copy has been included in **Appendix C.**

4.4.2 The public sewer records indicate the following:

- A 1550mm diameter combined sewer flowing in a southerly direction beneath Dantzic Street, adjacent to the western boundaries of Plots 2 and 3;
- A 550mm x 750mm diameter combined sewer beneath Gould Street, adjacent to the northern boundary of Plot 4.
- A 1400mm x 1450mm diameter combined sewer also beneath Gould Street;
- A 400mm x 300mm diameter combined sewer beneath Irk Street, adjacent to the western boundary of Plot 4;
- A 300mm diameter public combined sewer beneath Naples Street, adjacent to the eastern boundary of Plot 5.
- A combined sewer, with an unconfirmed diameter, is identified to pass beneath the public realm areas.

4.4.3 UU records indicate the following sewers are located within the boundary of the site and would require build over/diversionary agreements with UU. The location of these sewers are as follows:

- The public realm area situated south east of Plot 2. The combined sewer is shown to extend in a north easterly direction from manhole 3101. The sewer is shown to extend beneath Angel Meadow Park. The sewer then turns in an easterly direction prior to joining with the combined sewer network emanating from Style Street;

- The south western corner of Plot 5. UU records identify the 300mm diameter combined sewer beneath Naples Street as crossing this part of the site; and
- The eastern area of Plot 4. The 550mm diameter combined sewer originating from manhole 5012. The sewer is shown to extend in a westerly direction beneath the park before turning northwards beneath the eastern area of Plot 4.

4.5 CCTV/ CONNECTIVITY SURVEY

4.5.1 A CCTV/Connectivity Survey is currently being undertaken to confirm the exact location and condition of the public sewer network within the vicinity of the site. The survey will also confirm the presence and condition of the existing private drainage networks. This information is required prior to the detailed design stage.

4.5.2 A site walkover survey was undertaken by WSP on 23rd March 2017 to confirm the presence of the manholes indicated on UU records in order to identify potential risk of sewers crossing the site.

4.5.3 The site walkover confirmed the presence of the existing public sewer networks in the immediate vicinity of the site. All of the public sewers shown on the UU records were noted on site, with the exception of one manhole identified on the existing 500mm x 750mm combined sewer beneath Gould Street.

4.6 GEOLOGY AND HYDROGEOLOGY

4.6.1 The British Geological Survey Geology of Britain Viewer[1] indicates that all plots are underlain by superficial deposits of Glacial Till. This is further underlain by bedrock deposits from the Chester Pebble Beds Formation which is described as comprising Sandstone.

4.6.2 The Land Information System Soilscapes Map[2] classifies the soil beneath the site as “slowly permeable seasonally wet acid loamy and clayey soils”. The soil is described as having “impeded drainage”.

4.6.3 BGS borehole log SJ89NW56 situated to the south of Angel Street, immediately to the south of Plot 2, did not record any information regarding ground water depths. Borehole log SJ89NW2903 records that groundwater was encountered during drilling at a depth of 2.7 m bgl however the borehole is located closer to the River Irk than the site.

4.6.4 The EA Groundwater Maps indicate that the superficial deposits are classified as a Secondary (undifferentiated) Aquifer. This has been assigned in cases where it has not been possible to attribute either category A or B to a rock type.

4.6.5 The underlying bedrock is classified as a Principal Aquifer. These are layers of rock or drift deposits that have high inter-granular and/or fracture permeability meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.

4.6.6 The site lies outside of a Groundwater Source Protection Zone.

[1] mapapps.bgs.ac.uk/geologyofbritain
[2] landis.org.uk/soilscapes

Table 4-1 Site Characteristics

Characteristic	Description
National Grid Reference Coordinates	Plot 2 – SJ 84352 99160 (approximate centre) Plot 3 – SJ 84389 99208 (approximate centre) Plot 4 – SJ 84525 99243 (approximate centre) Plot 5 – SJ84519 99156 (approximate centre)
Approximate area	Plot 2 – 0.28 ha Plot 3 – 0.25 ha Plot 4 – 0.56 ha Plot 5 – 0.33 ha
Site description	Plot 2 is roughly rectangular in shape and comprises a fenced asphalt surfaced ground level car park. The southern corner of Plot 2 is occupied by Angel Meadow Park Plot 3 is approximately square in shape and comprises a fenced asphalt surfaced ground level car park. Plot 4 comprises two garage buildings with access from Irk Street, off Gould Street to the north east. The eastern area of Plot 4 is currently occupied by part of Angel Meadow Park. Plot 5 is rectangular in shape and comprises a fenced asphalt surface ground level car park.
Site boundaries	Plot 2 is bounded by Mincing Street to the north, with Plot 3 beyond. Plot 2 is bounded to the east by Aspin Lane with Angel Meadow beyond and is bounded to the west by residential student accommodation. The plot is bounded to the south by Angel Street; Plot 3 is bounded by: Little Nelson Street to the north, with the King of Kings School beyond; Aspin Lane to the east with the park beyond; Mincing Street to the south with Plot 2 beyond; Dantzic Street to the west with a railway viaduct beyond. Plot 4 is bounded by: A railway viaduct to the northwest, with the River Irk and commercial units beyond; Gould Street to the northeast and car park beyond; the park to southeast and southwest. Plot 5 is bounded by: Old Mount Street to the northwest, with the park beyond; residential apartments immediately to the southwest, and to the northeast beyond Ludgate Hill; Naples Street to the southeast with the form CWS Tobacco factory, converted to apartments, beyond.
Topography	A topographical survey (dwg number 15846_OGL Rev 4) was produced by Greenhatch Group in June 2011. A copy is included as **Appendix D**. Levels are described as follows: Plot 2 – Levels across the plot range between 41.41m AOD, located in the south eastern corner, and 32.68m AOD in the north eastern corner. Plot 3 – Levels across the plot range between 32.99m AOD along the southern boundary of the site and 30.28m AOD along the north boundary. Plot 4 – Levels across Plot 4 are identified to range between 41.96m AOD, situated on the south eastern boundary, and 29.61m AOD located in the north western corner of the site. Plot 5 – Levels across Plot 5 are identified to range between 45.02m AOD, located in the southern corner of the site, and 42.31m AOD located in the northern corner.

5 PROPOSED DEVELOPMENT

5.1.1 The planning application relates to the development of 756 residential units across four plots, plots 2, 3, 4 and 5. It includes public realm and landscape proposals to the edge of Angel Meadow Park which sits within the application site boundary, as well as changes to the surrounding highways network including the alterations to parts of Aspin Lane, Mincing Street, Irk Street and Old Mount Street to create new public realm and shared surfaces. A summary of the development proposals for each plot is as follows:

- Plot 2: A 22-storey residential development plus one basement level with commercial uses and residential amenity uses at ground level.
- Plot 3: A 17-storey residential development plus one basement level with commercial uses and residential amenity uses at ground level.
- Plot 4: A 40-storey landmark residential development with commercial uses and residential amenity uses plus one lower ground level and one basement level.
- Plot 5: A part 9-storey and part 12-storey residential development with residential amenity uses at ground level.

5.1.2 The red line site area is noted to be 1.4015Ha.

5.1.3 The development also includes a substantial area of new public open space which is to be integrated with existing park and public spaces within the vicinity of each Plot. The development Masterplan has been included in **Appendix E**.

5.1.4 The finished ground floor levels within each plot have been set as follows:

- Plot 2
  - 33.50m AOD within the commercial unit;
  - 33.85m AOD within the generator room;
  - 34.05m AOD within the cycle store;
  - 34.40m AOD within the refuse store;
  - 35.35m AOD and 35.10m AOD within the DNO substation
  - 35.35m AOD within reception area and substation.
- Plot 3
  - 30.80m AOD within the commercial unit;
  - 30.95m AOD within the generator room;
  - 31.25m AOD within the main switch/meter room; and
  - 31.650m AOD within reception area and refuse storage.
- Plot 4 – Ground Floor
  - 34.50m AOD within the proposed commercial unit, reception, management office and cycle storage;
- Plot 4 - Lower Ground Floor

- 31.00m AOD entrance to lower ground and basement car parks, residential storage plus commercial unit;
- 30.70m AOD within Generator Room;
- 31.00m AOD – DNO substation.

→ Plot 5

- Lower ground floor levels to be set at 43.30m AOD (residential).
- Upper ground floor
  - 44.385m AOD entrance to car park off Naples Street.
  - 44.50m AOD refuse off Ludgate Hill.
  - 44.00m AOD cycle storage room off Ludgate Hill.
  - 44.92m AOD main switch/meter room.
  - 44.69m AOD general electric room.
  - 44.40m AOD refuse and cycle storage.

5.1.5 The residential dwellings within each block are noted to be set at and above the following levels:

→ Plot 2 = 38.850m AOD

→ Plot 3 = 35.150m AOD

→ Plot 4 = 44.000m AOD

→ Plot 5 = 43.300m AOD

6 DEFINITION OF FLOOD RISK

6.1.1 The risk of flooding to the site from all current and future potential sources of flooding has been assessed.

6.1.2 **Table 6-1** summarises the findings of the assessment. A more detailed explanation of the flood risk issues on the site and determination of flood risk ratings are presented in sections 6.2 to 6.7 below.

6.1.3 It should be noted that the designation of risk outlined below is prior to the inclusion of any mitigation measures, which may subsequently act to reduce the risk.

Table 6-1 Degree of risk from each source of flooding

SOURCE		RISK
Fluvial		Medium
Tidal		Not at risk
Groundwater		Low
Surface Water		Low
Sewer		Low
Artificial Sources	Reservoir	Low
	Canal	Not at risk

6.2 FLUVIAL FLOOD RISK

FLOOD MAPS

6.2.1 The National Planning Policy Framework (NPPF) categorises flood risk as follows:

- Zone 1 (low probability) is assessed as having less than a 1 in 1,000 annual probability of river or sea flooding (<0.1%);
- Zone 2 (medium probability) is assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year; and
- Zone 3 (high probability) is assessed as having a 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.

6.2.2 Reference to the EA's online Flood Map for Planning indicates that the site is predominantly located within Flood Zone 1. Notwithstanding this, the mapping also indicates that the north eastern corner of Plot 3 is located within Flood Zone 2. On this basis, modelled flood level data was requested from the EA in order to confirm the extent and depth of flooding across the site.

6.2.3 A formal response was received from the EA dated 10th January 2017. The response included modelled flood levels for the River Irk for a range of return period scenarios. These levels comprise in-channel flood levels and have been derived from the River Irk SFRA 2011 Study. It

should be noted that in-channel levels do not provide an accurate representation of flooding within the site and are therefore considered as a worst case scenario. Further consultation with the EA (27th February 2017) has confirmed that the EA do not hold any site specific flood levels.

6.2.4 The in-channel levels provided by the EA, for node point 2 (considered the most relevant to the proposed development site) are provided below. A copy of the data is provided in **Appendix F.**

Figure 6-2 - Degree of risk from each source of flooding

	UNDEFENDED MODELLED FLOOD LEVELS (M AOD)			
Node	**1 in 25 year**	**1 in 100 year**	**1 in 100 year plus 20% climate change**	**1 in 1000 year**
2	29.71	30.16	30.38	31.08

6.2.5 Based on a comparison between the topographical survey and the modelled flood level data, the site is noted to be predominantly located within Flood Zone 1. However, the north eastern corner of Plot 3 would be impacted by a maximum flood depth of 0.59m AOD in the event of a 1 in 1000 year event.

6.2.6 Furthermore, the north western corner of Plot 4 would be impacted by depths of up to 1.47m.

6.2.7 Development proposals identify the proposed finished floor levels at ground level within Plot 3. Levels are identified as:

- 30.80m AOD within the proposed commercial unit;
- 30.95m AOD within the generator room;
- 31.25m AOD within the main switch/meter room; and
- 31.65m AOD within the reception area.

6.2.8 Based on levels identified, the proposed commercial unit could potentially be impacted by a maximum depth of 280mm in the event of flooding during an extreme 1 in 1000 year event, post development. The remaining ground floor level is identified to be raised above the modelled 1 in 1000 year level. Residential dwellings within Plot 3 are located at a level of 35.15m AOD and above and are therefore not considered to be at risk of fluvial flooding.

6.2.9 In addition, development plans for Plot 4 indicate that the ground floor finished floor will be set at a minimum of 34.50m AOD and will therefore be raised 3.42m above the modelled 1 in 1000 year level. However the external areas in the northern area are currently set at 31.00m AOD and would therefore be impacted by depths of up to 80mm in the event of a 1 in 1000 year event. Based on the proposed finished floor levels, Plot 4 would not be impacted by fluvial flooding.

6.2.10 The northern part of Aspin Lane, which will form a pedestrian pathway between Plots' 3 and 4, is identified to be impacted by the 1 in 100 year plus 20% climate change event and can therefore be considered to be located within Flood Zone 3. There will be no built development within Aspin

Lane and works will comprise resurfacing of the existing road. It should be noted that dry access and egress is available to the south via the southern part of Aspin Lane.

6.2.11 The remaining area of Plots' 3 and 4 are located within Flood Zone 1. In addition, Plot 2 and 5 are wholly located within Flood Zone 1.

6.2.12 On the basis of the above, the proposed development site can therefore be assessed to have a medium risk of fluvial flooding.

6.3 TIDAL / COASTAL FLOOD RISK

6.3.1 The site is located 55km away from the coast therefore it is not considered to be at risk from tidal/coastal flooding.

6.4 GROUNDWATER FLOODING

6.4.1 The Manchester, Salford, Trafford Strategic Flood Risk Assessment indicates that the site is located in an area that is not at risk of groundwater flooding.

6.4.2 BGS borehole log SJ89NW2903 records groundwater was encountered at depth of 2.7 m bgl. However, this borehole is situated closer to the River Irk than the site.

6.4.3 It is understood that an intrusive site investigation is planned to be undertaken within each development plot, prior to detailed design stage. Groundwater levels within each plot will be confirmed by these works.

6.5 SURFACE WATER FLOODING

6.5.1 The EA's Surface Water Flood map indicates that Plots 2 and 3 are within an area of very low risk of surface water flooding. Aspin Lane, which forms the eastern boundary, is shown to have a medium to low risk of surface water flooding however this appears to be restricted to the road network.

6.5.2 Plot 4 appears to have a low risk of surface water flooding which corresponds to a depth of flooding of below 300 mm.

6.5.3 Plot 5 appears to have a very low risk of surface water flooding. Old Mount Street, adjacent to the western boundary of the site, and Ludgate Hill, adjacent to the northern boundary of the site, is shown to have a low risk of surface water flooding however this appears to be restricted to the road network.

6.5.4 Based on the available information it is considered that the current risk of surface water flooding across the site is low to very low.

6.6 SEWER FLOODING

6.6.1 Sewer Records procured from UU indicate the presence of several sections of public sewers in the vicinity of the site. The closest sewers to the site were listed previously in **Section 4.**

6.6.2 A pre-development enquiry regarding the capacity of the local sewer network was submitted to UU. A formal response was received on 20th January 2017. Within their response, UU have confirmed that foul and surface water run-off arising from the proposed development can discharge to the existing public combined sewer at an unrestricted rate, indicating that there is sufficient capacity within the public sewer network.

6.6.3 In the event of surcharging sewers within Dantzic Street, water is likely to follow the topography of the area and flow in a northerly direction. It is likely that water will remain restricted to the road network due to the presence of a raised kerb. Based on the proposed levels, there is potential for water to ingress into the proposed building in the event water exceeds the level of the kerb.

6.6.4 In the event of surcharging of the combined sewers within Gould Street, water is likely to follow local topographic levels and flow in a north westerly direction away from the site.

6.6.5 In the event of surcharging of the combined sewer within Naples Street, topographic levels indicate that water is likely to flow in a north easterly direction.

6.6.6 As noted in Section 4, sewers have been identified beneath Plots 4 and 5, and the public realm area. It is likely that diversion works or build over approval will be required.

6.6.7 Based on the topographic levels within the vicinity of each plot, the risk of sewer flooding is considered to be low.

6.7 RESERVOIR/ARTIFICIAL SOURCES FLOODING

6.7.1 Non-natural or artificial sources of flooding can include reservoirs, lakes, canals etc. The potential effects of flood risk management infrastructure and other structures needs to be considered.

RESERVOIRS

6.7.2 Following the June 2007 floods and the incident at Ulley Reservoir, Sir Michael Pitt was asked by the government to carry out a review of the emergency services' response. He called for reservoir flood maps to be made available to the public and to local emergency planners to allow them to respond quickly to a reservoir flood.

6.7.3 As a result, reservoir flood maps have been created for over 2000 reservoirs in England and Wales. These maps show the likelihood of flooding from large reservoirs that retain at least 25,000 cubic meters of water above natural ground level. The maps show the largest area that might be flooded if a reservoir were to fail in a credible worst case scenario.

6.7.4 Consultation with the EA has identified that Plots 2, 3 and 4 are located within the maximum flood extent in the event of a failure of the Heaton Park open reservoir. Block 5 appears to be located outside the extent of flooding.

6.7.5 The likelihood of reservoir flooding is considered much lower than other forms of flooding. Current reservoir regulation, which has been further enhanced by the Flood and Water Management Act, aims to ensure that all reservoirs are properly maintained and monitored in order to detect and repair any problem. Based on this, the risk of reservoir flooding is considered to be low.

CANALS

6.7.6 The Manchester Ship Canal is located approximately 570m south west of the site. In addition to its distance from the site, the Ship Canal is heavily controlled and is therefore unlikely to present any flood risk to the proposed development.

6.7.7 Based on the above, the risk of flooding from artificial sources is considered to be low.

7 NPPF SEQUENTIAL AND EXCEPTION TEST

7.1 THE SEQUENTIAL TEST

7.1.1 The Sequential Test, within the National Planning Policy Framework, aims to steer all new developments to areas at the lowest risk of flooding and to ensure that the development type proposed is appropriate by reference to the flood risk.

7.1.2 According to the records maintained by the EA, the proposed development is predominantly located within Flood Zone 1 area. However, the north eastern corner of Plot 3 is noted to be partially located within Flood Zone 2 and could be impacted by fluvial flooding in the event of a 1 in 1000 year rainfall event. In addition, the north western corner of Plot 4 is also shown to be impacted by a 1 in 1000 year rainfall event.

7.1.3 The proposed development is considered to have a low risk of flooding from all other sources.

7.1.4 Table 2 of the Flood Risk and Coastal Change Chapter of the Planning Practice Guidance (2014) classifies different types of development depending upon their vulnerability. The proposed residential element of the development is classified as “More Vulnerable”. The proposed lower ground car parking, reception and commercial units are classified as “Less Vulnerable”.

7.1.5 Development plans indicate that the “More Vulnerable” (residential dwellings) element of the development have been sequentially located above the identified level of flooding.

7.1.6 Whilst it has been identified that the commercial unit within Plot 3 and external areas of Block 4 would be impacted in the event of a 1 in 1000 year, the risk of fluvial flooding is considered to be low. Notwithstanding this, an appropriate level of mitigation has been recommended to ensure that the development remains free from flooding should this event take place.

7.1.7 Based on the assessment of flood risk within Section 6, and taking into account the recommended mitigation measures proposed in Section 9, the risk of flooding from all sources is considered to be low.

7.2 THE EXCEPTION TEST

7.2.1 Table 3 of the Flood Risk and Coastal Change Chapter of the Planning Practice Guidance (2014) shows that “‘More Vulnerable” land uses are considered to be appropriate development in areas of Flood Zone 1 and 2 and that no Exception Test is required.

7.2.2 No built development is proposed within the area of the site (northern section of Aspin Lane) that has been identified to be located in a Flood Zone 3 area.

8 DRAINAGE STRATEGY

8.1 SURFACE WATER DRAINAGE STRATEGY

DISPOSAL OF SURFACE WATER

8.1.1 The method for removal of surface water from the site must be selected in the order of preference outlined in Building Regulations Part H below:

- Infiltration to the ground;
- Discharge to a watercourse;
- Connection to a surface water sewer; and
- Connection to a combined sewer.

8.1.2 The LandIS Soilscapes Viewer[3] describes the soil under the site as “slowly permeable seasonally wet acid loamy and clayey soils”.

8.1.3 Perusal of the British Geological Survey Viewer[4] indicates that the site is underlain by superficial deposits of Devensian Glacial Till. This is underlain by bedrock deposits from the Chester Pebble Beds Formation which is described as comprising Sandstone.

8.1.4 Based on the presence of slowly permeable soils and Devensian Glacial Till, the potential for the use of infiltration methods for the disposal of surface water is likely to be limited. Notwithstanding this, infiltration testing may be required at the detailed design stage to confirm the permeability of the strata.

8.1.5 The River Irk is located approximately 60 m north of the development site at its nearest point. A possible connection to this watercourse has been investigated. It is likely that significant engineering works and third party consent would be required to provide a connection to the River Irk.

8.1.6 At this stage, it is anticipated that surface water run-off from the development will discharge to the public combined sewer network in the immediate vicinity of the development plots. UU have confirmed that anticipated surface runoffs will be allowed to discharge offsite via the public sewer network at an unrestricted rate. However a minimum 50% reduction in run-off rates has been applied due to the partial existing Brownfield areas, as stipulated by Manchester City Council. For areas that are currently Greenfield, anticipated surface run-off rates have been restricted to 5l/s (the minimum practicable rate for self-cleansing flows using a Hydrobrake Flow Control Device.

DISCHARGE RATES

8.1.7 The development comprises the construction of four individual blocks. At present Plots 3 and 5 are considered wholly Brownfield whist Plots 2 and 4 comprise a mixture of Brownfield and Greenfield land.

8.1.8 Consultation with UU has identified that surface water run-off arising from the proposed development can discharge offsite via the existing public sewer network in the immediate vicinity at an unrestricted rate.

[3] Landis.org.uk/soilscapes

[4] Mapapps.bgs.ac.uk/geologyofbritain

8.1.9 Notwithstanding the above, it is proposed to restrict the anticipated surface run-off from Brownfield areas to a minimum of 50% of the existing run-off rate, as stipulated by Manchester City Council. This will provide a significant betterment to the status-quo.

8.1.10 The Lloyd David Rational Method (140 l/s/ha – using a rainfall value of 50 mm/hr) is the approach commonly adopted by local planning authorities for calculating surface water run-off rates from the Brownfield areas.

8.1.11 For Greenfield areas, surface run-off will be restricted to a minimum rate of 5 l/s. This is considered the minimum practicable rate to allow self-cleansing of a Hydrobrake (or similar) Flow Control Device.

8.1.12 Based on the information above, the existing and proposed surface water run-off rates have been calculated on a plot-by-plot basis. These are listed in **Table 8.1 and Table 8.2** below.

Table 8-1 Surface Water Run-off Rates for Brownfield Plots

PLOT NUMBER	HARDSTANDING AREA (HA)	EXISTING SURFACE WATER RUN-OFF RATE (L/S)	50% REDUCTION IN EXISTING RATE (L/S)
3	0.250	34.75	17.38
5	0.329	46	23

Table 8-2 Surface Water Run-off Rates for a Mixture of Brownfield and Greenfield Plots

PLOT NUMBER	TYPE	HARDSTANDING AREA (HA)	EXISTING SURFACE WATER RUN-OFF RATE (L/S)	PROPOSED RUN-OFF RATE (L/S)
2A	Greenfield	0.039	0.20	5 (minimum practicable rate)
2B	Brownfield	0.251	34.88	17.44 (50% reduction)
4A	Greenfield	0.255	2.20	5 (minimum practicable rate)
4B	Brownfield	0.312	43.37	21.68 (50% reduction)

ATTENUATION STORAGE

8.1.13 The required storage capacity for the anticipated surface runoff from the proposed development has been assessed using the Source Control Module in WinDES Micro-Drainage software (2016). Attenuation calculations have been undertaken based on the areas proposed within each Plot as shown on the updated development Masterplan. Attenuation requirements for each development plot are included in **Table 8-3 and Table 8.4** below. Copies of the hydraulic assessment have been included as **Appendix G**.

Table 8-3 Plot by Plot Attenuation Requirements

PLOT NUMBER	PROPOSED HARDSTANDING AREA (HA)	PROPOSED SURFACE WATER RUN-OFF RATE	ATTENUATION REQUIRED FOR 1 IN 100 YEAR + 40% CLIMATE CHANGE ALLOWANCE
3	0.245	19.5	59.3
5	0.329	23	89.5

Table 8-4 Plot by Plot Attenuation Requirements

PLOT NUMBER	TYPE	PROPOSED HARDSTANDING AREA (HA)	PROPOSED SURFACE WATER RUN-OFF RATE	ATTENUATION REQUIREMENTS (M^3)
2A	Greenfield	0.231	5	96.6
2B	Brownfield	0.380	26.41	99.6
4A	Greenfield	0.142	5.00	51.0
4B	Brownfield	0.209	14.53	56.1

CONSIDERATION OF SUSTAINABLE DRAINAGE SYSTEMS (SuDS)

8.1.14 It is a requirement for planning that SuDS should be considered as part of Flood Risk Assessment for a proposed development. In order to determine the appropriate from of attenuation, the following SuDS techniques have been considered.

SOAKAWAYS

8.1.15 As noted above, the presence of low permeability strata and soils is likely to limit the potential for the use of infiltration based SuDS techniques. However, in-situ infiltration testing is likely to be required at the detailed design stage to confirm the permeability of the strata and to inform drainage design works.

SWALES, DETENTION BASINS AND PONDS

8.1.16 Due to the scale and nature of the development, the use of open SuDS features for the provision of storage is considered not feasible within the development.

PERMEABLE PAVING

8.1.17 The CIRIA SuDS Manual (C753) identifies that permeable paving provides a suitable surface for pedestrian and vehicle traffic whilst allowing run-off to infiltrate into the underlying structural layers. Run-off is temporarily stored beneath the overlying surface before controlled discharge downstream.

8.1.18 Permeable paving can be used as an alternative to impermeable surfaces across almost any development site. With regards to the proposed Angel Meadow development, permeable paving could be utilised within an external pedestrian/vehicular area. Permeable paving is typically constructed with a depth of 0.36 m and a void ratio of 0.3. Based on the above, the use of permeable paving has the potential to provide the full balance of attenuation for each Plot. The use of permeable paving is subject to confirmation of external finishes.

8.1.19 The use of permeable paving within the site is limited due to the proposed public realm and landscaping areas comprising existing stone sets. In addition the low permeability of the ground limits the incorporation of permeable paving systems which allow infiltration. The use of permeable paving is therefore not considered feasible within the proposed development.

GREEN ROOFS

8.1.20 Green Roofs are designed to typically intercept the first 5mm of rainfall however this interception value can be increased, dependent on the depth and type of substrate used in construction of the roof itself. The deeper the Green Roof substrate, the greater its retention percentage, however

the deeper a Green Roof is made, the more expensive the cost. In addition the weight of the Green Roof should also be considered as it could result in increased structural loadings.

8.1.21 The amount of rainfall retained within a Green Roof is also subject to antecedent weather conditions. In the summer, green roofs typically retain up to 80% of rainfall whereas in the winter, only 30% of rainfall is retained due to wetter conditions and therefore greater saturation of the roof.

8.1.22 The scope for the incorporation of Green Roofs at Angel Meadow is very limited. Hence the costs will likely outweigh the limited benefit that could be realised.

UNDERGROUND ATTENUATION TANKS

8.1.23 Due to the scale and nature of the development, the use of underground attenuation tanks is considered the most appropriate form of SuDS that could be incorporated on the proposed Angel Meadow development site. Providing attenuation on a plot-by-plot basis within underground tanks allows each plot to have a dedicated system and a single point of discharge.

8.1.24 The use of underground tanks is discussed in further detail below.

8.2 FOUL WATER DRAINAGE STRATEGY

8.2.1 The estimate foul flow from the proposed development has been assessed in accordance with Sewers for Adoption 7th Edition. It stipulates a figure of 4000 litres/unit dwelling/day. Therefore, for the proposed 756 no. residential dwellings the total anticipated foul flow equals 35 l/s.

8.2.2 Our strategy for dealing with the anticipated foul flows from the proposed development is to discharge the flows into the existing public combined sewer network within the immediate vicinity of each plot, subject to confirmation from UU.

8.2.3 The exact configuration of the foul drainage network and associated connection points will be determined at the detailed design stage, and will be subject to site and Plot layout, expected foul water loadings and agreement with United Utilities.

8.3 DRAINAGE PROPOSALS

8.3.1 The drainage proposals for each development plot are summarised below with plans included as **Appendix H**.

PLOT 2 - SURFACE WATER

It is proposed to discharge surface water run-off from the site into the 1,550mm diameter brick combined sewer located in Dantzic Street via a dedicated combined sewer connection.

Surface water will be stored on site for rainfall events up to the 1 in 100 year storm event plus a 40% allowance for climate change.

Attenuation storage will take the form of either a tank and pump arrangement or a tank and flow control (i.e. A Hydrobrake or Orifice Flow Control Device). This will be located externally within the site boundary at Mincing Street. The final arrangement for stormwater attenuation will require further design development.

Based on the invert levels indicated on the sewer records procured from UU, it appears that a gravity outfall connection to the sewer will be achievable.

PLOT 2 – FOUL WATER DRAINAGE STRATEGY

It is proposed to discharge anticipated foul flows from the development into the existing 1,550mm diameter public combined brick sewer located in Dantzic Street via a dedicated combined sewer connection.

Based on the invert levels indicated on the sewer records procured from UU, it appears that a gravity outfall connection to the sewer will be feasible. This will be subject to the completion of the CCTV Survey and receipt of associated report.

PLOT 3 – SURFACE WATER DRAINAGE STRATEGY

It is proposed to discharge surface water run-off from the site into the 1550mm diameter combined brick sewer via a dedicated combined sewer connection.

Surface water will be stored on site for rainfall events up to the 1 in 100 year storm event plus a 40% allowance for climate change.

Attenuation storage will take the form of either tank and pump arrangement or tank and flow control (i.e. Hydrobrake) device. Based on current proposals this will be located externally within the site boundary within Mincing Street. The final arrangement for storm water attenuation will require further design development.

Based on the invert levels indicated on the UU sewer records it appears feasible to achieve gravity outfall connections to the sewer.

PLOT 3 – FOUL WATER DRAINAGE STRATEGY

It is proposed to discharge foul water from the site into the 1,550mm diameter combined sewer located in Dantzic Street via a dedicated combined sewer connection.

Based on the invert levels indicated on the United Utilities records it appears that a gravity outfall connection to the sewer will be achievable. This will be subject to the completion of the CCTV survey and receipt of associated report.

PLOT 4 – SURFACE WATER DRAINAGE STRATEGY

It is proposed to discharge surface water run-off from the site into one of the following public sewers:

- 400mm x 300mm combined sewer in Irk Street;
- 550mm combined sewer in Gould Street; or
- 1,400 x 1,450 combined sewer in Gould Street.

Surface water will be stored on site for rainfall events up to the 1 in 100 year rainfall plus a 40% allowance for climate change.

Attenuation storage will take the form of either tank and pump arrangement or tank and flow control device such as a hydro-b rake unit. Based on current proposals this will be located externally within the site boundary within the new Public Realm at the lower ground floor in the western area of the Plot. The final arrangement for storm water attenuation will require further design development.

Surface water will be stored on site for rainfall events up to the 1 in 100 year rainfall plus a 40% allowance for climate change.

Attenuation storage will take the form of either tank and pump arrangement or tank and Flow Control Device such as a Hydrobrake. Based on current proposals this will be located externally within the site boundary within the new Public Realm at the lower ground floor in the western area of the Plot. The final arrangement for storm water attenuation will require further design development.

Based on the invert levels indicated on the public sewer records it appears a gravity outfall connection to the public sewer will be achievable. This will be confirmed at Detailed Design Stage upon the completion of the CCTV Survey.

PLOT 4 – FOUL WATER DRAINAGE STRATEGY

It is proposed to discharge foul water from the site into one of the following public sewers:

- 400 mm x 300 mm combined sewer in Irk Street;
- 550 mm combined sewer in Gould Street; or
- 1,400 mm x 1450 mm combined sewer in Gould Street.

Based on the invert levels indicated on the public sewer records it appears that a gravity outfall connection to the public sewer will be achievable. This will be subject to the completion of a CCTV survey and receipt of associated report.

PLOT 5 – SURFACE WATER DRAINAGE STRATEGY

It is proposed to discharge surface water run-off from the site into the 550mm combined sewer which crosses Mount Street via a dedicated combined sewer connection.

Surface water will be stored on site for rainfall events up to the 1 in 100 year storm event plus a 40% allowance for climate change.

Attenuation storage will take the form of either tank and pump arrangement or tank and Flow Control (i.e. Hydrobrake) Device. Based on current proposals this will be located externally within the site boundary within the new Public Realm at the lower ground floor level, adjacent to the north eastern corner of the Plot. The final arrangement for storm water attenuation will require further design development.

PLOT 5 – FOUL WATER DRAINAGE STRATEGY

It is proposed to discharge surface water run-off from the site into the 550 mm diameter combined brick sewer which crosses Mount Street via a dedicated combined sewer connection.

Based on the invert levels indicated on the UU sewer records it appears that a gravity outfall connection to the public sewer will be achievable. This will be subject to the completion of the CCTV survey and receipt of associated report.

8.4 ADOPTION AND MAINTENANCE REQUIREMENTS

8.4.1 The design of the foul and surface water system will be undertaken in accordance with the guidance outlined in Sewers for Adoption 7th Edition.

8.4.2 Suitable maintenance regimes will be defined at the detailed design stage, depending on the final drainage layout adopted.

9 MANAGEMENT OF FLOOD RISK

9.1.1 The findings of the flood risk assessment detailed in Section 6 identify that whilst the proposed development is predominantly located within Flood Zone 1, the north eastern corners of Plot 3, comprising the proposed commercial unit, and the north western corner of Plot 4, comprising external areas including vehicular access, are identified to be impacted in the event of a 1 in 1000 year event.

9.1.2 In addition, reference to the EA's Online Surface Water Mapping indicates that Plot 4 has a low risk of surface water flooding. The remaining plots are identified to have a very low risk of surface water flooding.

SITE LEVELS

9.1.3 As noted in Section 5 the finished floor level of the proposed commercial unit within Plot 3 has been set at 30.80m AOD and could therefore be impacted by depths of up to 0.28m in the event of a 1 in 1000 year event. Where development constraints allow, finished floor levels have been set above the modelled 1 in 1000 year level. Where development constraints restrict the raising of floor levels, flood resilience and resistance measures have been considered, as per the EA's Flood Risk Assessment Standing Advice.

9.1.4 Consultation with the EA has identified that appropriate mitigation should be considered to ensure flood water does not enter the underground car parking area. The EA have recommended that some form of traffic calming measures (i.e speed bump) could be incorporated at the entrance to the underground car park to prevent the ingress of water. This could be considered in further details at Detailed Design Stage.

9.1.5 It is proposed to grade external ground levels to incline away from the proposed buildings in order to allow water to drain away from the buildings. In addition, drains will be situated across entrances to the building and around the building edge where appropriate.

9.1.6 Finished external site levels will be engineered to provide positive drainage to a new drainage 8 system to prevent ponding. The accumulation of standing water will therefore not occur, and will not pose a risk to the development. The drainage strategy for the site will ensure that levels are adjusted so that ponding does not occur.

FLOOD RESISTANCE AND RESILIENCE

9.1.7 Where floor levels cannot be raised due to development constraints, the use of flood resilient and resistant techniques have been considered. The EA Flood Risk Assessment Standing Advice identifies that for water depths up to 0.3m *"the building or development must be designed to keep water out as much as possible. Materials that have low permeability (i.e materials that water can't pass through, eg. Impermeable concrete) should be used."*

ACCESS AND EGRESS

9.1.8 Dry access and egress is available from Plots 2 and 3 via the southern section of Aspin Lane in the direction of Angel Street. Access and egress from Plot 4 is available via Gould Street in an easterly direction.

COMPENSATORY FLOOD STORAGE

9.1.9 The site is predominantly located within Flood Zone 1 and partially located within Flood Zone 2. Notwithstanding this, the northern section of Aspin Lane, which provides access between Plots 3 and 4, is located within the 1 in 100 year plus 20% climate change event. However, no built development will occur within this section of the lane therefore compensatory floor storage will not be required.

SITE DRAINAGE

9.1.10 The drainage strategy discussed above includes the provision of adequate on-site storage facilities, sufficiently sized to accommodate the 1 in 100 year plus 40% allowance for climate change rainfall event. Therefore, only extreme rainfall in excess of this would run overland past the site boundary.

9.1.11 The proposed drainage strategy will ensure that site surface water runoff be restricted to 50% of the current surface runoff rate. This will represent an improvement to the existing situation on the site, and is likely to satisfy the stipulations of the Local Planning Authorities.

9.2 CONSIDERATION OF CLIMATE CHANGE

9.2.1 As explained in the Climate Change Adaptation Sub-Committee Progress Report 2014, increased flood risk is the greatest threat to the UK from climate change. Models of the climate system suggest floods of the type experienced in England and Wales in autumn 2000, and between December 2013 and February 2014, have become more likely as a consequence of increased concentrations of greenhouse gases in the atmosphere.

9.2.2 More frequent short-duration, high intensity rainfall and more frequent periods of long-duration rainfall could be expected. Sea levels are also expected to continue to rise.

9.2.3 New Environment Agency guidance “Flood risk assessments: climate change allowances” issued on the 19th February 2016 provides up to date information on expected changes in rainfall, river flows and sea level rise as a consequence of climate change.

9.2.4 A key change from the previous guidance is that the climate change allowances for peak river flows now are shown as variables on a regional basis; allowance are also now based on percentiles, whereby a percentile is a measure used in statistics to describe the proportion of possible scenarios that fall below an allowance level (e.g. a 50% percentile means that the allowance has 50% chances of not being exceeded).

9.2.5 On this basis key allowances for Peak River Flows based on percentiles are:

- central allowance, - based on the 50th percentile
- higher central - based on the 70th percentile
- upper end - based on the 90th percentile

9.2.6 These allowances are detailed in Table 1 (Peak River Flow allowances by river basin district) of the EA guidance.

9.2.7 As discussed in the EA Guidance the choice of the appropriate allowance for peak river flow (e.g. central or higher central) should reflect the risk for the proposed development and therefore is linked to the expected hazard, vulnerability and resilience of the scheme; recommendations on the appropriate allowances to be considered are provided in the EA Guidance.

9.2.8 For peak rainfall the EA Guidance provides an upper end and central allowance depending on epoch; the guidance recommends assessment of both the central and upper end allowances to understand the range of impact. These allowances are detailed in Table 2 (Peak Rainfall Intensity Allowance in Small and Urban Catchments) of the EA guidance

9.2.9 Sea levels allowances reflect the previous guidance and vary on a regional basis and for each epoch as shown in Table 3 of the EA Guidance.

DEVELOPMENT LIFESPAN AND APPLICABLE ALLOWANCES

9.2.10 A typical lifespan for this type of development is 100 years. Based on this assumption, the contingency allowances for climate change that are potentially applicable to this site are:

- Peak River Flows (Northwest);
  - Upper End – 70% for 2070 to 2115
  - Higher Central – 35% for 2070 to 2115
  - Central – 30% for 2070 to 2115
- Peak Rainfall;
  - Upper End – 40% for 2060 to 2115
  - Central – 20% for 2060 to 2115
- Sea Level Rise;
  - 1.02 m by 2115

IMPACT OF CLIMATE CHANGE ON THE DEVELOPMENT

9.2.11 The EA Guidance indicates that developers should assess both the central and upper end allowances to understand the range of impact, the drainage strategy will assess the impact of 20% and 40% climate change and will detail the risk associated with any flooding that may occur during this event, which will tie into any exceedance routes provided to cater for extreme events.

9.2.12 As a result of the above, any proposals for managing flood risk at the site will consider the potential increase in risk as a result of climate change.

9.2.13 Whilst the site predominantly lies within Flood Zone 1 it has been identified that the site partially lies within Flood Zone 2. The EA modelled flood level data identifies that the proposed commercial unit within Plot 3 would be impacted by a 1 in 1000 year event. The proposed residential dwellings are noted to be raised a minimum of 4.07 m above the modelled 1 in 1000 year level. Therefore, the “more vulnerable” element of the development is raised significantly above any future flood event.

9.2.14 For less vulnerable uses, at lower ground and ground floor level, within Flood Zone 2, EA Climate Change allowance guidance advises that the central allowance (30% for 2070 – 2115) for climate change should be considered. Based on the levels provided by the EA, which include a 20% allowance, it is unlikely that this additional climate change will have a significant impact and it is therefore considered the mitigation proposed above will provide sufficient protection.

9.2.15 In relation to surface water, we have adopted the upper limit of a 1 in 100 year plus 40% climate change allowance rainfall event within our outline drainage strategy. This is based on the lifetime of the development which is anticipated to be 100 years.

10 CONCLUSION

10.1.1 This FRA and Drainage Strategy Report will support the full planning application for 756 residential unit and ancillary spaces for residents across four proposed blocks within Angel Meadow.

10.1.2 The EA Flood Map for Planning indicates that the site is predominantly located within Flood Zone 1 whereby the annual probability of flooding is classified as less than 1 in 1000.

10.1.3 The north eastern corner of Plot 3 is identified to be located within Flood Zone 2 whereby the annual probability of flooding is classified as between 1 in 100 and 1 in 1000. A comparison between modelled flood level data, provided by the EA, and existing topographic levels indicate that the north eastern corner of Plot 3 could be impacted by maximum depths of up to 0.59m during a 1 in 1000 year event. In addition, the north western area of Plot 4 would be impacted by depths of up to 1.47m.

10.1.4 Finished floor levels within Plot 3 indicate that whilst the ground floor level is primarily raised above the 1 in 1000 year level, the proposed commercial unit could be impacted by depths of up to 0.28m. Floor levels cannot be raised further due to development constraints. As a result, the use of flood resilient and resistant measures has been incorporated and will be detailed at the next design stage.

10.1.5 Development plans indicate that external levels within the northern area of Plot 4, including vehicular access and pedestrian areas, is identified to be set at a level of 31.00m AOD and could therefore be impacted by depths of up to 80mm in the event of a 1 in 1000 year event. The EA have advised that traffic calming measures (i.e speed bump) should be incorporated at the entrance to the underground car park to prevent the ingress of water.

10.1.6 The development is considered to have a low risk of flooding from sewers, surface water, groundwater and artificial sources. External ground levels will be graded to ensure water drains away from the proposed buildings. Where appropriate, drains will be included at entrances and around the building edges in order to reduce the potential for the ingress of water.

10.1.7 Plans procured from UU indicate the existence of a public combined sewer network within the vicinity of the site. Sections of the public sewers have been identified to be located beneath Plot 4, 5 and external areas of Plot 2. There will be a requirement for either a Build-over or Sewer Diversion Agreement with UU prior to Detail Design Stage, subject to the completion of the CCTV survey. The CCTV survey is currently being undertaken and is anticipated to be completed by 12th April 2017.

10.1.8 UU have confirmed that anticipated that foul and surface water run-off arising from the proposed development can discharge into the public combined sewer network within the vicinity of each plot at an unrestricted rate.

10.1.9 The outline surface water drainage strategy considers the use of appropriate SuDS techniques to limit surface water run-off from the development to a minimum of 50% of the existing run-off rates for brownfield areas as stipulated by Manchester City Council. For Greenfield areas, surface water run-off will be restricted to 5 l/s (the minimum practicable rate for a Hydrobrake flow control device).

10.1.10 The amount of attenuation required to achieve this restriction on a plot-by-plot by basis has been calculated to ensure that excess anticipated surface water run-off is managed safely within the boundaries of the site.

10.1.11 A Scoping Opinion response received from Manchester City Council dated 24th February 2017, highlighting the following key requirements:

- The design of the development should be in accordance with the EA Standing Advice for developments in Flood Zone 2; **(Section 9)**
- The proposed development lies within an area at low risk of surface water flooding; **(Section 6)**
- The proposed development lies within an area at low susceptibility to groundwater flooding; **(Section 6)**
- The City Council does not hold any recorded incidents of flooding within the site or close vicinity; **(Section 3)**
- The area is situated within the Conurbation Core Critical Drainage Area and in accordance with the Manchester City Council SFRA at least a 50% reduction in surface water runoff should be provided through SuDS as part of any Brownfield development with the aim of reducing to the Greenfield rate; **(Section 8)**
- Surface water should be managed to ensure there is no increased surface water from the proposed development and runoff from extreme events should be retained within the site such that the adjacent third party land is not affected; **(Section 8)**
- All major planning applications being determined from 6th April 2015 must consider sustainable drainage systems; **(Section 8)**
- The suitability of SuDS should be assessed in accordance with paragraphs 051, 079 and 080 of the revised NPPF Planning Practise Guidance for Flood Risk and Coastal Change;
- Hydraulic calculations and drawings should be provided in accordance with paragraph 081 of NPPF Planning Practise Guidance; **(Section 8)**
- Climate change up to 40% increase in rainfall should be considered as part of the design; **(Section 9)**
- Overland flow paths for exceedance events or blockage of inlet structures should be considered. (**Appendix I)**

10.1.12 All of the above requirements have been addressed in this FRA and Drainage Strategy. The text in bold bracket shows the sections where these requirements have been addressed.

10.1.13 This FRA and Drainage Strategy proposed in this report will ensure that the proposed development does not result in an increase in flood risk to the site or to third party land, providing that the suggested mitigation measures are implemented.

Appendix A

SITE LOCATION PLAN



NOMA, Angel Meadow,
Manchester, M4 2AD

Appendix B

COPIES OF RELEVANT CORRESPONDENCE

Percival, Danny

From:	GMMC Info Requests <Inforequests.gmmc@environment-agency.gov.uk>
Sent:	03 January 2017 14:48
To:	Percival, Danny
Subject:	FW: Response from the Environment Agency - GMMC 32325 ANB
Attachments:	Detailed_flood_map_GMMC32325ANB.PDF; Reservoir_flood_map_GMMC32325ANB.PDF

Dear Daniel,

As discussed, please find your response attached.

Many thanks,

Anne

Anne Ball
Customer and Engagement
Greater Manchester, Merseyside and Cheshire
Direct: **Inforequests.GMMC@environment-agency.gov.uk**
Office address: Richard Fairclough House, Knutsford Road, Latchford, Warrington, WA4 1HT
External: 020 302 51232
Internal: 51232

From: GMMC Info Requests
Sent: 19 December 2016 15:06
To: 'Aadal.Khan@wspgroup.com' <Aadal.Khan@wspgroup.com>
Subject: Response from the Environment Agency - GMMC 32325 ANB

Dear Aadal

Thank you for your enquiry which was received on 14 December 2016.

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

I enclose the flood maps attached and the answers to questions.

Watercourses

- Details of any watercourses / culverted watercourses in the vicinity and who is responsible for their maintenance;
- The responsibility for the repair and condition of the watercourse, its channel, banks and adjacent structures, lies ultimately with the riparian owner.

- Minimum set back distances from any watercourse and governing statute / byelaw.
  For small area of site that is shown as in Flood Zone 1 (see attached map) - Not applicable, as site is remote from any “main river” watercourse.

  For rest of the site shown in Flood Zone 2 (see attached map) - Under the terms of the Environmental permitting regulations 2010, and the Land Drainage Byelaws, the prior written consent of the Environment Agency is required for any proposed works or structures, in, under, over or within 8 metres of the top of the bank of watercourses which are designated ‘main river’. We utilise the land drainage byelaws to control development within 8 metres of the bank top of the watercourse to ensure that our access arrangements to the watercourse are maintained.

Hydraulic Modelling

- Hydraulic modelling results of any watercourse that could potentially cause flooding at the site;
- Whether or not any hydraulic modelling of any surrounding watercourses would be required to accompany a FRA and if so, provide some guidance on the level of modelling required (e.g. 1D or 2D);
  Please refer to the guidance in the National Planning Policy Framework (NPPF) or the flooding risk standing advice on the GOV.UK website.

- Whether or not any hydraulic modelling of any blockage scenarios / breach analysis would be required to be undertaken as part of the FRA;
  Please refer to the guidance in the NPPF or the flooding risk standing advice on the GOV.UK website https://www.gov.uk/planning-applications-assessing-flood-risk

- Does modelling or any other evidence indicate that flood waters can come out of bank upstream / downstream from the site and flood the site by overland flow? Yes – see attached map
- Whether or not hydraulic modelling / Flood Zones will be updated in the near future.
  N/A

Flood Defences / Other Structures

- Details of any flood defences in the area including standard of protection, condition, type, who is responsible for maintenance;
  There are no flood defences in the vicinity of the site.

- If the EA are responsible for maintenance, will be they maintained to include climate change allowances;
  There are no flood defences in the vicinity of the site.

  Details of any proposals for any future flood alleviation scheme that could affect the site and if so, provide details and timescales;
  There currently no proposals in this area.

- Details of any other man-made structures / sources of flood risk that could affect the site.
  The Environment Agency holds information on flood risk from rivers and the sea and reservoirs. For information on Surface water flood risk please contact the Lead Local Flood Authority and for information on Sewer Flooding please contact United Utilities.

Previous flooding records

- Any previous flooding records and if so dates, source, depth, extent and any further detail.
  We have no records of flooding affecting the site. However, this does not mean flooding has not occurred in the past or that it will not flood in future. We recommend that you also contact United Utilities and Bolton Council who may hold additional information (the former especially in relation to sewer flooding).

Groundwater

- Details of any groundwater levels in the vicinity of the site;
- Whether or not the site lies within a Groundwater Source Protection Zone;
- Details of any groundwater flooding issues in the area.

Reservoir Flood Risk

- Whether or not the site is located within an area susceptible to reservoir flooding, and provide a copy of the Reservoir Flood Map to confirm this.
  The Environment Agency Flood map shows that the site is located in an area at risk of reservoir flooding. (see attached reservoir map).

Surface Water

- Whether or not the site is located within an area susceptible to flooding from surface water and provide a copy of the relevant surface water flooding map;
  The Local Authority is responsible for issues relating to surface water and hold information on surface water flooding.

- Details of any restrictions associated with the drainage of surface water from the site;
- The Local Authority is responsible for issues relating to surface water and hold information on surface water flooding. We recommend that you contact the local planning authority who will be able to discuss their requirements.

- Whether or not the site is located within a critical drainage area.
  This can be found by consulting the local authority Strategic Flood Risk Assessment.

Please refer to the Open Government Licence which explains the permitted use of this information.

Please get in touch if you have any further queries or contact us within two months if you'd like us to review the information we have sent.

We are committed to providing a professional customer service. Please help us understand more about what is important to you by completing our survey.
http://www.smartsurvey.co.uk/s/EnvironmentAgencyCustomerSurvey/?a=GMMC

Kind regards,

Andrew Barkhouse
Customer and Engagement Officer
Greater Manchester, Merseyside and Cheshire
Email: Inforequests.gmmc@environment-agency.gov.uk

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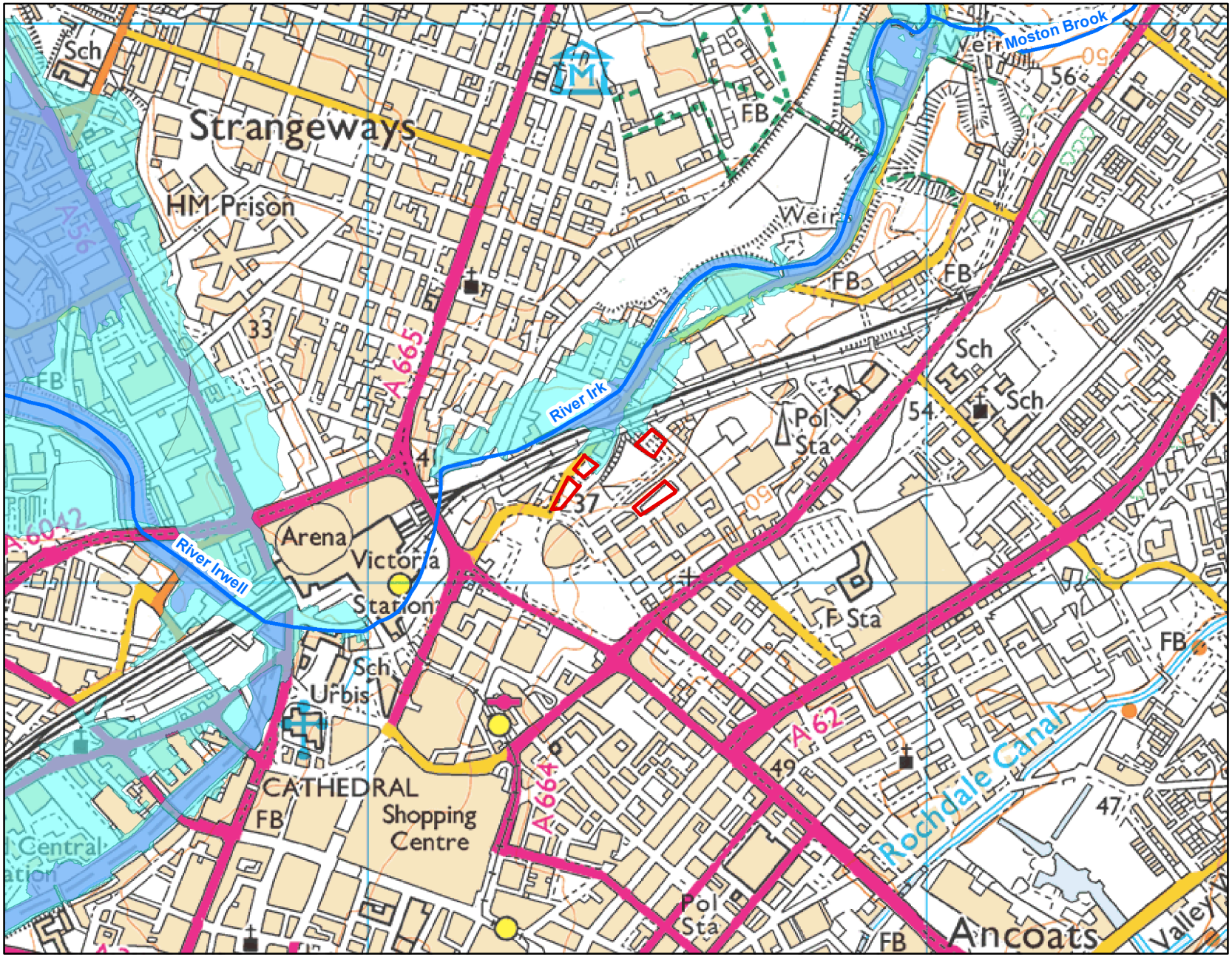
Detailed Flood Map centred on NOMA, Angel Meadow, Manchester M4 2AD. Created 19/12/2016 [GMMC32325ANB]



Environment Agency

1:10,001

N

Legend

- Site_Location
- Main River
- Flood Zone 3
- Flood Zone 2

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Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 08708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Lead Local Flood Authority - Manchester City Council

SuDS Requirements for New Developments

The Government has strengthened planning policy on the provision of sustainable drainage systems (SuDS) for 'major' planning applications which is being introduced from 6 April 2015 (Paragraph 103 of National Planning Policy Framework and Ministerial Statement on SuDS).

Changes were made to the Town and Country Planning Policy and Guidance to give Local Authority Planning Departments the responsibility for ensuring that new developments are drained in a sustainable way, through the planning process, in consultation with the Lead Local Flood Authorities. As per the guidance issued by the Department of Communities and Local Government (DCLG), all 'major' planning applications being determined from 6 April 2015, must consider sustainable drainage systems.

Decisions about the suitability of sustainable drainage provision are made by the Local Planning Authority. However, under the new consultation arrangements Manchester City Council, in its role as Lead Local Flood Authority, is a statutory consultee for all major applications with regards to sustainable drainage. All 'major' planning applications submitted from 15 April 2015 are required to include a Surface Water Drainage Statement.

Developers submitting the planning application to Manchester City Council are advised to:

- Assess the suitability of sustainable drainage systems in accordance with: paragraphs 051, 079 and 080 of the revised NPPF Planning Practice Guidance (PPG) for Flood Risk and Coastal Change.

  Design sustainable drainage systems in line with national Non-Statutory Technical Standards for SuDS: *https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards*

  and local policies DM1, EN08, EN14 and EN17 of the Core Strategy.

- Assess surface water attenuation requirements that offer a reduction in surface water runoff rate in line with the 'Manchester City, Salford City and Trafford Councils Level 2 Hybrid SFRA, User Guide, Final, dated May 2010'. (Section 3.4.1 Critical Drainage Areas, page 31). Please note that all new connections to the watercourses shall comply with reduction of flows to Greenfield runoff rates.

  http://www.manchester.gov.uk/downloads/download/3871/strategic_flood_risk_assessment-manchester_salford_trafford

- Submit hydraulic calculations and drawings to support the design along with proposed standards of operation and maintenance in accordance with paragraph 081 of NPF (PPG).

- It will be essential that the type of sustainable drainage system for a site, along with details of its extent/position, is identified at the design stage of the whole scheme. This information will be required for both outline and full applications so it is clearly demonstrated that the SuDS can be accommodated within the development that is proposed. It will no longer be acceptable to leave the design of SuDS to a later stage to be dealt with by planning conditions.

- Surface water run-off should be controlled as near to its source as possible through a sustainable drainage approach to surface water management. SuDS seek to mimic natural drainage systems and retain water on or near to the site, when rain falls, in contrast to traditional drainage approaches, which tend to pipe water off-site as quickly as possible. SuDS therefore offer significant advantages over conventional piped drainage systems.

Applicants are strongly advised to discuss their proposals with relevant planning officers at the pre-application stage to ensure that an acceptable SuDS scheme is submitted.

Minimum requirements for approval

In order to avoid objection, the following three elements of evidence are required:

- Surface Water Management Statement for the site is submitted that is in line with requirement of NPPF PPG Paragraph 079:

    - "New development should only be considered appropriate in areas at risk of flooding if priority has been given to the use of sustainable drainage systems. Additionally, and more widely, when considering major development, as defined in the Town and Country Planning (Development Management Procedure) (England) Order 2015, sustainable drainage systems should be provided unless demonstrated to be inappropriate".

    - The strategy should be accompanied by at least an outline layout of the proposed drainage systems with space allocation for the proposed attenuation in line with relevant flow reduction requirements.

- Evidence that drainage hierarchy has been applied in line with NPPF PPG Paragraph 080. The aim should be to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable:

    - into the ground (infiltration);
    - to a surface water body;
    - to a surface water sewer, highway drain, or another drainage system;
    - to a combined sewer.

- Evidence that one viable solution for draining the site is secured:

    - Results of ground investigation carried out under Building Research Establishment Digest 365. Site investigations should be undertaken in locations and at proposed depths of the proposed infiltration devices. Proposal of the attenuation that is achieving half emptying time within 24 hours. If no ground investigations are possible or infiltration is not feasible on site, evidence of alternative surface water disposal routes (as follows) is required.

    - Where surface water is connected to Main River, any works within or adjacent to the river that would affect it would require consent from Environment Agency. An email of acceptance of proposed flows and/or new connection will suffice.

    - Where surface water is connected to the public sewer, agreement in principle from United Utilities is required that there is adequate spare capacity in the existing system taking future development requirements into account. An email of acceptance of proposed flows and/or new connection will suffice.

Where surface water is connected to the ordinary watercourse, agreement in principle from Manchester City Council as Lead Local Flood Authority is required. Please note that all new connections to the watercourses shall comply with reduction of flows to Greenfield runoff rates. An email of acceptance of proposed flows and/or new connection will suffice.

- Where surface water is connected to ordinary watercourse, any works within or adjacent to the watercourse that would affect it would require consent from Manchester City Council as Lead Local Flood Authority. Consent forms can be obtained on the website at:

http://www.manchester.gov.uk/downloads/download/5567/land_drainage_consent_and_guidance.com

Avoiding or discharging drainage condition

- Evidence of consideration of green SuDS solution wherever practicable and viable in line with NPPF PPG Paragraph 051. SuDS should be designed to:
  - reduce the causes and impacts of flooding;
  - remove pollutants from urban run-off at source;
  - combine water management with green space with benefits for amenity, recreation and wildlife wherever practicable.

- For Greenfield site developments, details of surface water attenuation that offers a reduction in surface water runoff rate in line with the Manchester Trafford and Salford Strategic Flood Risk Assessment, i.e. to the Greenfield runoff rates;

- For Brownfield site developments, for all sites located within Conurbation Core Critical Drainage Areas, details of surface water attenuation that offers a reduction in surface water runoff rate in line with the Manchester Trafford and Salford Strategic Flood Risk Assessment, i.e. at least a 50% reduction in runoff rate compared to the existing rates with an aim to reduce to Greenfield runoff rates wherever practicable;

- Where surface water runoff is to be disposed through infiltration, details of surface water attenuation that is adequate for infiltration capacity of the underlying soil is required. This capacity has to be assessed through site investigation carried out in line with Building Research Establishment Digest 365. Site investigations should be undertaken in locations and at proposed depths of the proposed infiltration devices. Half emptying time of proposed attenuation within 24 hours should be achieved.

- Evidence that the drainage system has been designed (unless an area is designated to hold and/or convey water as part of the design) so that flooding does not occur during a 1 in 100 year rainfall event in any part of a building; The NPPF suggests that 'for events with a return-period in excess of 30 years, surface flooding of open spaces such as landscaped areas or car parks is acceptable for short periods, but the layout and landscaping of the site should aim to route water away from any vulnerable property, and avoid creating hazards to access and egress routes. No flooding of property should occur as a result of a one in 100 year storm event (including an appropriate allowance for climate change)'.

- Assessment of overland flow routes for extreme events that is diverted away from buildings providing long and cross sections for the proposed drainage system and

finished floor levels;

- Evidence that runoff volume in the 1 in 100 year, 6 hours rainfall shall be constrained to a value as close as is reasonably practical to the Greenfield runoff volume for the same event, but never to exceed the runoff volume from the development site prior to redevelopment;

- Hydraulic calculation of the proposed drainage system;

- Design construction drawings of proposed SuDS elements and flow controls;

- For sites where proposed development would cause unusual pollution risk to surface water (large car park areas (>50 parking spaces) or industrial estates), evidence of pollution control measures (preferably through SuDS) is required.

- Where an application is part of a larger site which already has planning permission it is essential that the new proposal does not compromise the drainage scheme already approved.

SuDS Maintenance

Maintenance of SuDS is essential for its proper operation and a clear management and maintenance plan for the lifetime of the development is required as part of the planning application.

In considering a development that includes a sustainable drainage system, Manchester City Council as local planning authority will want to be satisfied that the proposed minimum standards of operation are appropriate and that there are clear arrangements in place for ongoing maintenance. Information sought by Manchester City Council would be no more than necessary, having regard to the nature and scale of the development concerned in line with NPPF Paragraph 081.

In some instances where no clear adoption of the drainage system is proposed, a drainage maintenance condition could be attached to the planning applications. In order to discharge this condition, the following evidence should be provided following *construction:*

- Verification report providing photographic evidence of construction as per design drawings;

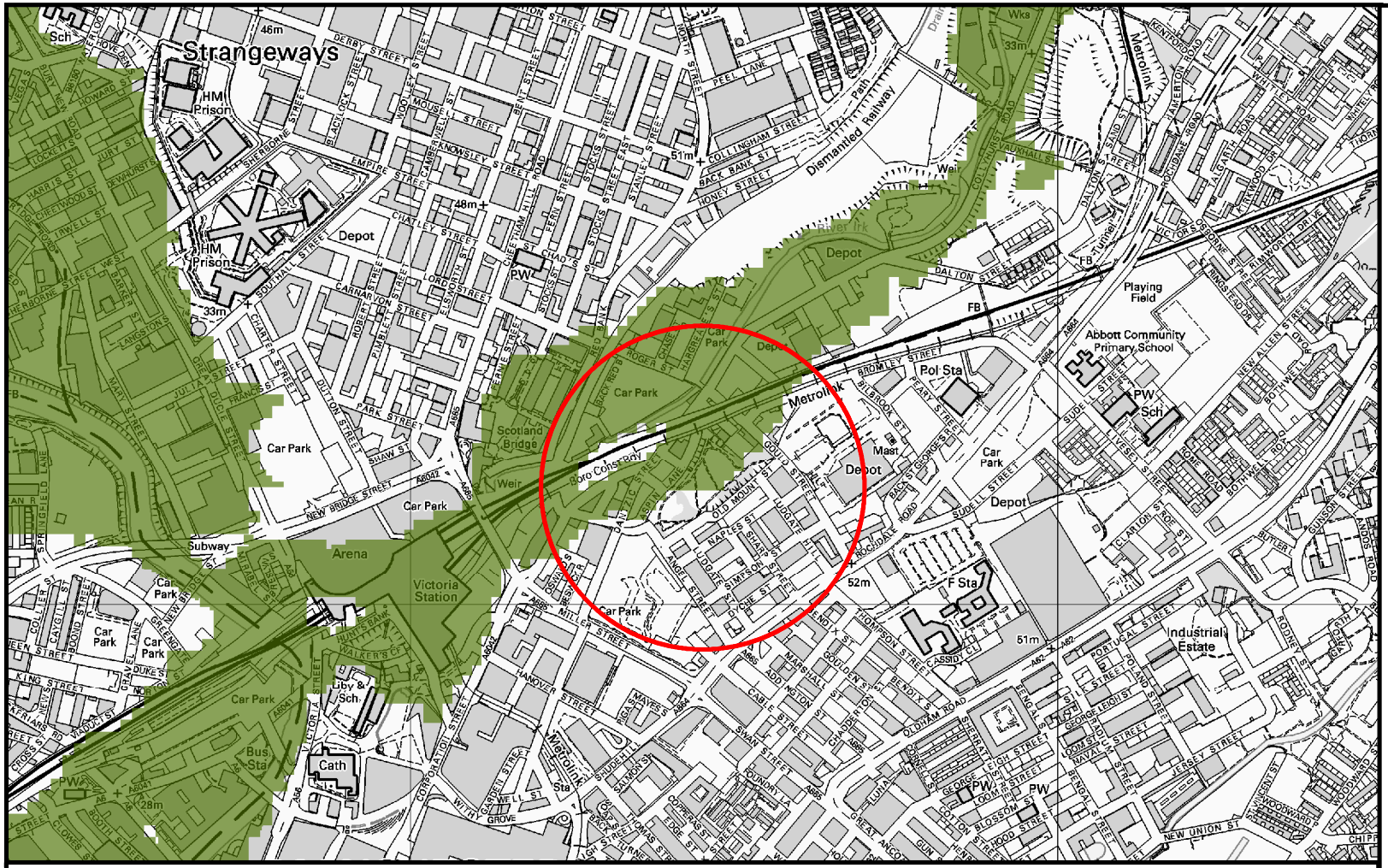
- As built construction drawings if different from design construction drawings;

- Management and maintenance plan for the lifetime of the development which shall include the arrangements for adoption by any public body or statutory undertaker, or any other arrangements to secure the operation of the sustainable drainage scheme throughout its lifetime.

Applicants are strongly advised to discuss their proposals with relevant planning officers at the pre-application stage to ensure that an acceptable SuDS scheme is submitted.

Reservoir Flood Map

Environment Agency
Asiantaeth yr Amgylchedd



The area within the red circle could be at risk of flooding from the following reservoirs:

Reservoir Name	Reservoir Owner	Location	Local Authority	Environment Agency Office
Heaton Park Open	United Utilities Water plc	383120, 40	Manchester	Environment Agency - Greater Ma

Note - this map provides a general indication of the largest area that might be flooded if a reservoir were to fail and release the water it holds. It is taken from a national assessment and displays a worst case scenario. The map is only intended as a guide and is not a prediction of what will happen.

Important

- This map has been produced for emergency planning purposes and displays a worst case scenario.
- It is not suitable for use at an individual property scale due to the method used.
- This map does not give any information on the likelihood of reservoir flooding or on the depth or speed of floodwaters. It also does not include any smaller reservoirs (which hold less than 25,000 cubic metres of water) or reservoirs commissioned or registered after Spring 2009.
- The information should not be interpreted as stating that the location you are interested in will or won't actually flood, but simply that it is in or not in an area that could be affected by reservoir flooding as shown on the maps.

Maximum extent of flood

1:10,000

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Percival, Danny

From: O'Brien, Neil <Neil.O'Brien@uuplc.co.uk>
Sent: 20 January 2017 10:18
To: Percival, Danny
Cc: Wastewater Developer Services
Subject: RE: Pre-development Enquiry - Angel Meadows, Manchester -DE3027

Dear Customer

We have carried out an assessment of your application which is based on the information provided; this pre development advice will be valid for 12 months

Foul will be allowed to drain to the public combined sewer network at an unrestricted rate. The connection(s) to the public sewer can be at a point(s) convenient to yourself

Surface water will be allowed to drain to the public sewer network at an unrestricted rate. The connection(s) to the public sewer can be at a point(s) convenient to yourself

Connection Application

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

http://www.unitedutilities.com/connecting-public-sewer.aspx

Please be aware that on site drainage must be designed in accordance with Building Regulations, National Planning Policy, Planning Conditions and local flood authority guidelines, we would recommend that you laise and make suitable agreements with the relevant statutory bodies.

Regards

Neil O'Brien

Developer Engineer
Developer Services and Planning

From: Percival, Danny [mailto:Daniel.Percival@wspgroup.com]
Sent: 04 January 2017 10:39
To: Wastewater Developer Services <WastewaterDeveloperServices@uuplc.co.uk>
Subject: Pre-development Enquiry - Angel Meadows, Manchester

Dear Sir / Madam,

We are currently working on behalf of our client who is proposing to development the above site at Angel

Meadows, Manchester, approximate postcode M4 2AD. We would be grateful if you could confirm that your apparatus have sufficient capacity to serve the proposed development. If not, it would be helpful if you could indicate the level of reinforcement that may be required.

Please find attached the following:

- A completed pre-development enquiry form; and
- A site location plan.

Please do not hesitate to contact me if you require further information.

Kind regards,

Daniel Percival
Assistant Engineer

WSP | PARSONS BRINCKERHOFF

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Appendix C

COPY OF PUBLIC SEWER RECORDS PROCURED FROM UU

					Undefended			
Map Reference	Model Node Reference	Easting	Northing	Data	4 % AEP (1 in 25 year)	1 % AEP (1 in 100 year)	1 % AEP (1 in 100 year) + Climate Change*	0.1 % AEP (1 in 1000 year)
1	ea013_Model_Irk_00029	384585	399539	Modelled Water Level (m aodN)	30.01	30.40	30.57	31.35
				Modelled Flow (cumecs)	55.70	65.63	74.43	112.48
2	ea013_Model_Irk_00031	384455	399346	Modelled Water Level (m aodN)	29.71	30.16	30.38	31.08
				Modelled Flow (cumecs)	55.63	60.61	61.06	63.05
3	ea013_Model_Irk_00034	384301	399252	Modelled Water Level (m aodN)	28.67	28.98	29.21	30.21
				Modelled Flow (cumecs)	55.63	65.43	72.38	95.01
4	ea013_Model_Irk_00037	384163	399210	Modelled Water Level (m aodN)	28.10	28.34	28.50	29.36
				Modelled Flow (cumecs)	55.92	65.83	72.66	94.66

Model data taken from River Irk SFRA 2011 Study

Notes:

AEP - Annual Exceedence Probability

m aodN - metres above ordnance datum Newlyn

cumecs - cubic metres per second

*Climate Change Scenario - 20% increase in flow. We only hold climate change measurements based on the previous climate change guidance. The new climate change guidance is available at https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances. The location of the site and the type (vulnerability) of development determine the climate change allowances to consider in any flood risk assessment.



N

Station Information:

Station	Easting (m)	Northing (m)	Level (m)
W1	384258.608	398957.678	39.670
W2	384213.212	398985.974	37.895
W3	384160.685	398996.333	36.974
W4	384125.365	398959.412	35.570
W5	384120.858	398916.335	35.237
W6	384092.411	398858.216	35.498
W7	384156.633	398841.111	38.507
W8	384200.333	398813.890	41.330
W9	384229.502	398865.166	41.574
W10	384237.547	398917.933	41.143

Note:

Some services may have been omitted due to parked vehicles. The Ordnance Survey tile is to be used as a guide only.

OS Buildings *Surveyed Buildings*

This survey has been orientated to the Ordnance Survey (O.S) National Grid (OSGB36) via a Global Position System (GPS) and the O.S. Active Network (OS Net).

A true OSGB36 coordinate has been established near to the site centre via a transformation using the OSTN02 & OSGM02 transformation models.
The survey has been correlated to this point and a further one or more OSGB36 points established to create a true O.S. bearing for angle orientation.

No scale factor has been applied to the survey therefore the coordinates shown are arbitrary & not true O.S. Coordinates which have a scale factor applied.

Please refer to Survey Station Table to enable establishment of the on-site grid.

Legend:

	Buildings	ELC	Electric
	Walls	BT	British Telecom
	Kerb line	Fh	Fire Hydrant
	Edge of surface	Di	Drip tray
	Canopy / Overhang	Sv	Stop-valve
	Line Marking	Wd	Wash-Out
	Centre Line	Wm	Water Meter
	Barrier	Mkr	Service Marker
	Hedge	Av	Air Valve
	Security Fence	Cmp	Cable Marker
	Panel Fence	Lp	Lamp Post
	Open Fence	Sp	Sign Post
	Overhead Powerline	Ep	Electricity Post
	Chamber	Tp	Telegraph Post
	Woodland	TL	Traffic light
100.000	Station and Name	Bs	Bus Stop
	Station Level	Fl	Floodlight
BH 1	Borehole	Fp	Flagpole
TP 1	Trial Hole	Pb	Post box
	Tree / Bush / Sapling	Lb	Litter Bin
	Area of Undergrowth	Bs	Bollard
	Gate	TCB	Telephone call box
IC	Inspection chamber	Fs	Flagstaff
CL	Cover level	WL	Water level
IL	Invert level	Ht	Height
P.Inv ø0.25	Pipe invert (diameter)	IFL	Internal floor level
Gy	Gully	THL	Threshold level
Bg	Back Gully	Ra	Roofing Eye
MH	Manhole	Dk	Drop kerb
		Gas	Gas
		Cr	Earth rod
		TT	Tactile Paving
		TWL	Top of Wall Level

Rev	Date	Description	Drawn	Q. Ref
4	16.05.15	Extended Survey	LP	A1110
3	03.04.14	Angel Meadow / Miller St	LM	A1110
2	11.11.13	Public Realm Survey	JK2	G860
1	14.10.13	Survey Extension	NSJ/K	

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CLIENT

E C Associates

PROJECT

Manchester Co-op Quarter

TITLE

Topographical Survey

SCALE	DATE	DRAWN	QUALITY REF
1: 1000	23.06.11	WA	G0697

Level datum	Previous Site Control
Grid orientation	Previous Site Control
Job number	15846
Drawing No.	15846_OGL
Rev.	4

Comments

This plan should only be used for its original purpose. GreenHatch Ltd accepts no responsibility for this plan if supplied to any party other than the original client.

All dimensions should be checked on site prior to design and construction.

Drainage information (where applicable) has been visually inspected from the surface and therefore should be treated as approximate only.

Notes:

DO NOT SCALE

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Appendix D

COPY OF TOPOGRAPHICAL SURVEY

Millgate
S Gantry
1 to 12 (below)
3201
3202
3102
3101
3001
4201
4202
4011
4012
5202
5203
5306
5303
5102
5104
5105
5107
6101
5109
DANTZIC STREET
LITTLE NELSON ST
MINCING STREET
ASPIN LANE
Car Park
Crown House
El Sub Sta
Hall
King of Kings School
St Michael's Place
Garage
IRK STREET
WILLIAMSON STREET
St Michael's Flags
(Recreation Ground)
OLD MOUNT STREET
NAPLES STREET
STYLE STREET
NEW MOUNT STREET
ANGEL ST
SIMEON STREET
GOULD STREET
LUDGATE HILL
ANT STREET
ESS
Ophthalmic Works
The Citadel
29.6m
30.2m
32.6m
36.9m
33.9m
37.2m
39.6m
350 x 300 VC
750 x 500 BR
600 CO
550 x 750 BR
1400 x 450 CSB
1050 x 650 BR
1550 BR
450 x 440 BR
525 x 400 VC
700 BR
700 VC HS
700 x 450 BR
1850 BR
300 VC
720 x 480 BR
550BR SEWER LOCATED BELOW BLOCK 4
300VC SEWER CLIPS THE EDGE OF BLOCK 5 SITE
UNKNOWN DIA COMBINED SEWER LOCATED BELOW PUBLIC REALM WORKS

Key

- Proposed Sewer Diversion
- Proposed Manhole
- Sewer to be Abandoned
- Option 2 Proposed Sewer Diversion
  5104 is at a higher level compared to 5105 therfore would be restrictive as cover levels would have to be raised
- Areas where erxisting public Sewers are likely to be affected

Proprietary and Drawing is copyright of 5plus Architects and is not to be copied or reproduced without written consent. Figured dimensions only are to be taken from this drawing. Do not scale from this drawing.
All dimensions must be checked by the contractor before taking and ordering all shop drawings relative to their work. Notify 5plus Architects any discrepancies or any variations.
Electronic data/ drawings issued are 'read only' and cannot be used/ adapted for measurement.
All dimensions and levels are to be 'read only' from those shown scaled to size, on the drawings.
CONSTRUCTION - this Consultant has the proposed works are within the scope of a competent Contractor and as such no unusual hazards have been identified, refer to relevant Key Scheduler Designers Risk Assessment.

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www.5plusarchitects.com

PROJECT: Angel Meadows Manchester
TITLE: Proposed Ground Floor Masterplan
SCALE: 1:500@A1
ORIGIN DATE: 18/01/17
DRAWN: AAB
CHECKED: JC
STATUS: Information
PROJECT: 05498
DRAWING NO: _MP_00_1200
REV: A

Architecture I Masterplanning I Interiors I Graphics I Branding

United Utilites Water Limited
Property Searches
Ground Floor Grasmere House
Lingley Mere Business Park
Great Sankey
Warrington
WA5 3LP
DX 715568 Warrington
Telephone 0370 751 0101

Property.searches@uuplc.co.uk

Your Ref: NOMA,Angel Meadow
Our Ref: 16/ 1236925
Date: 29/9/2016

WSP Parsons Brinckerhoff
The Victoria
150-182 The Quays
Salford
Greater Manchester
M50 3SP

FAO: Craig Taylor

Dear Sirs

Location: NOMA Angel Meadow Manchester M4 4HA

I acknowledge with thanks your request dated 28/09/16 for information on the location of our services.

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

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

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

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

If you have any queries regarding this matter please telephone us on 0370 7510101.

Yours Faithfully,

Amanda Simmonds
Property Searches Manager

UUWaterLimited 2014

United Utilities Water Limited
Registered in England & Wales No. 2366678
Registered Office: Haweswater House,
Lingley Mere Business Park, Lingley Green Avenue,
Great Sankey, Warrington, WA5 3LP

TERMS AND CONDITIONS - WASTERWATER & WATER DISTRIBUTION PLANS

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

TERMS AND CONDITIONS:

1. This Map and any information supplied with it is issued subject to the provisions contained below, to the exclusion of all others and no party relies upon any representation, warranty, collateral contract or other assurance of any person (whether party to this agreement or not) that is not set out in this agreement or the documents referred to in it.
2. This Map and any information supplied with it is provided for general guidance only and no representation, undertaking or warranty as to its accuracy, completeness or being up to date is given or implied.
3. In particular, the position and depth of any UUWL apparatus shown on the Map are approximate only and given in accordance with the best information available. The nature of the relevant system and/or its actual position may be different from that shown on the plan and UUWL is not liable for any damage caused by incorrect information provided save as stated in section 199 of the Water Industry Act 1991. UUWL strongly recommends that a comprehensive survey is undertaken in addition to reviewing this Map to determine and ensure the precise location of any UUWL apparatus. The exact location, positions and depths should be obtained by excavation trial holes.
4. The location and position of private drains, private sewers and service pipes to properties are not normally shown on this Map but their presence must be anticipated and accounted for and you are strongly advised to carry out your own further enquiries and investigations in order to locate the same.
5. The position and depth of UUWL apparatus is subject to change and therefore this Map is issued subject to any removal or change in location of the same. The onus is entirely upon you to confirm whether any changes to the Map have been made subsequent to issue and prior to any works being carried out.
6. This Map and any information shown on it or provided with it must not be relied upon in the event of any development, construction or other works (including but not limited to any excavations) in the vicinity of UUWL apparatus or for the purpose of determining the suitability of a point of connection to the sewerage or other distribution systems.
7. No person or legal entity, including any company shall be relieved from any liability howsoever and whensoever arising for any damage caused to UUWL apparatus by reason of the actual position and/or depths of UUWL apparatus being different from those shown on the Map and any information supplied with it.
8. If any provision contained herein is or becomes legally invalid or unenforceable, it will be taken to be severed from the remaining provisions which shall be unaffected and continue in full force and affect.
9. This agreement shall be governed by English law and all parties submit to the exclusive jurisdiction of the English courts, save that nothing will prevent UUWL from bringing proceedings in any other competent jurisdiction, whether concurrently or otherwise.

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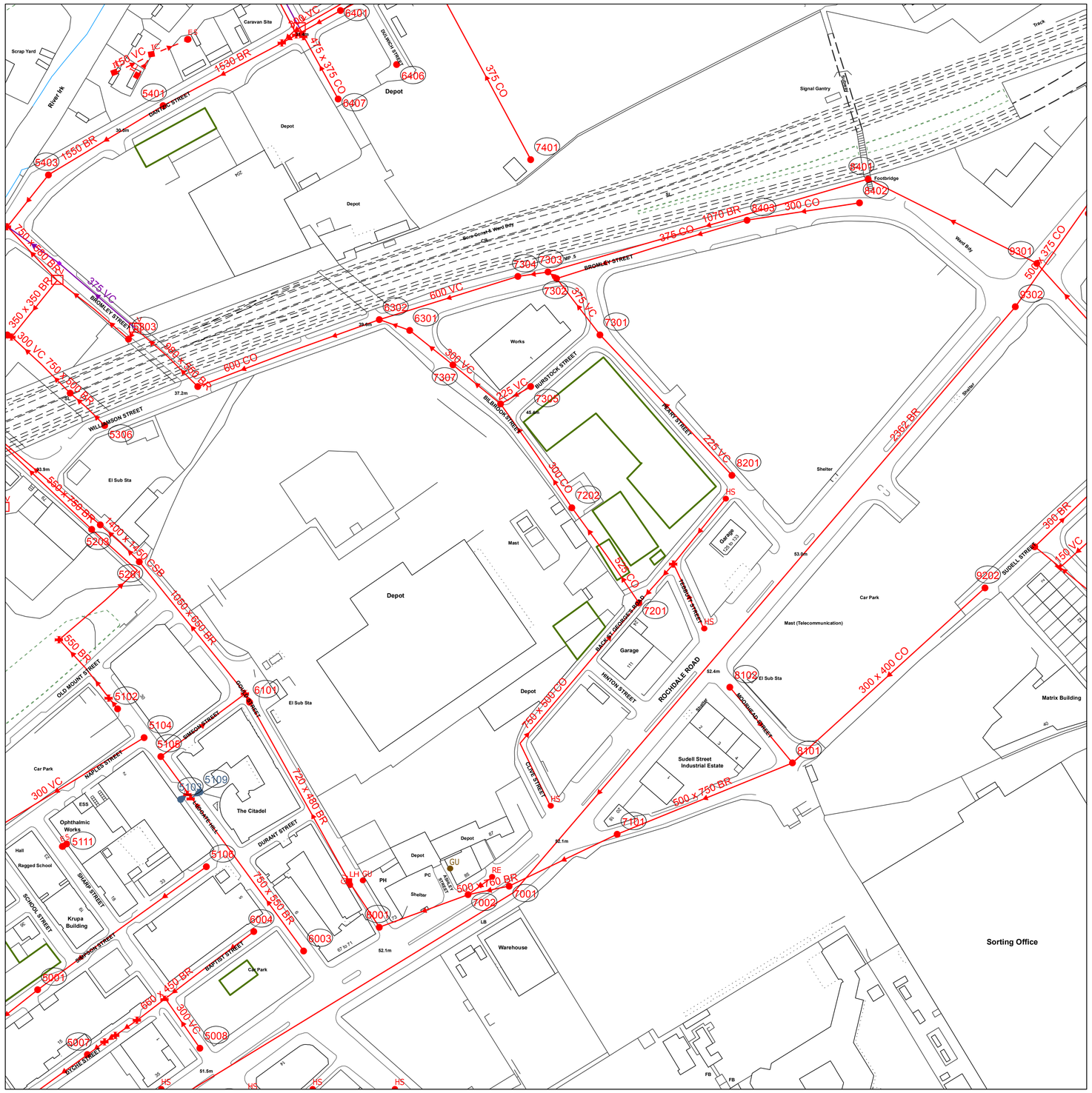
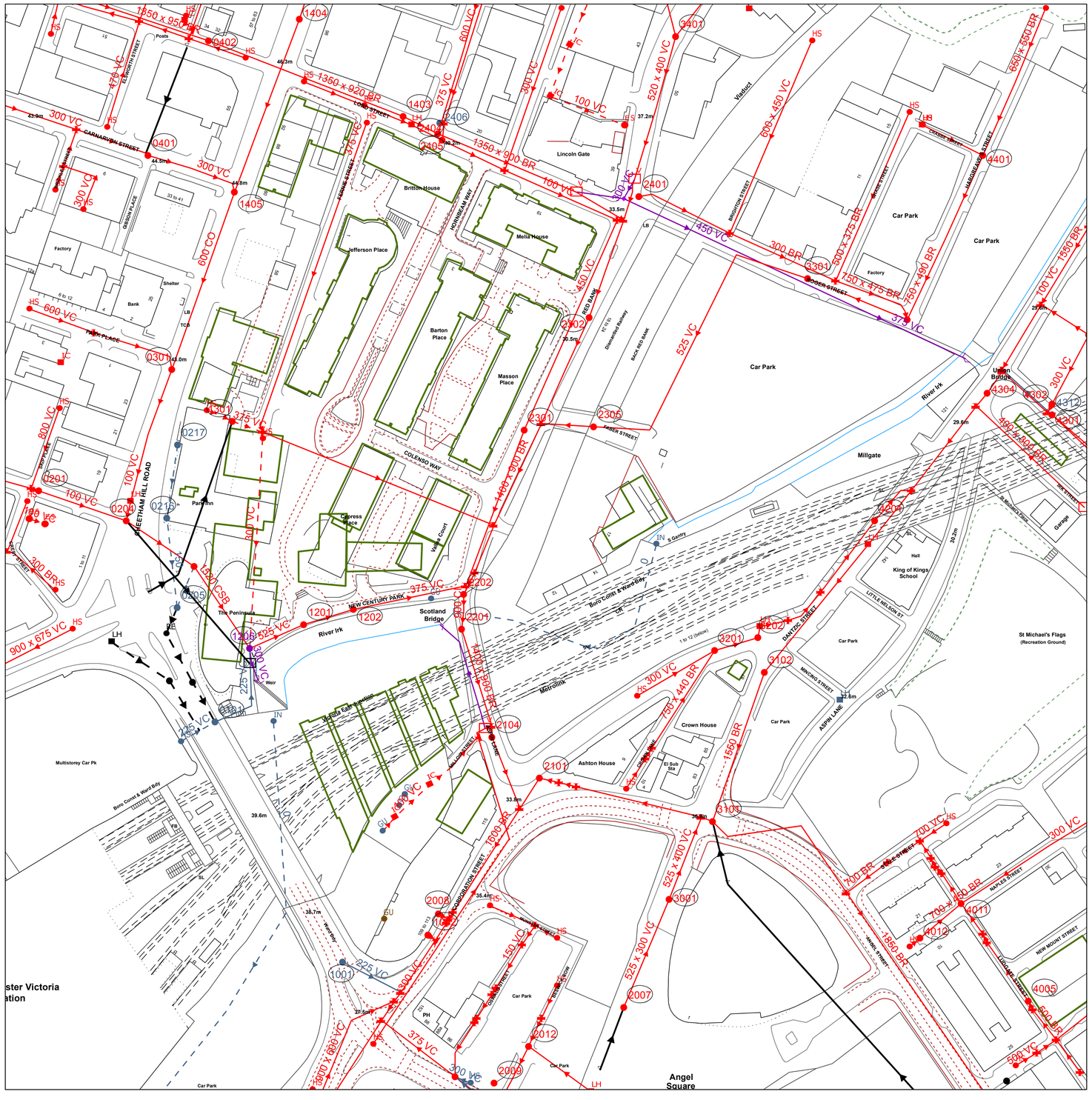

Scrap Yard
River Irk
Caravan Site
Depot
Signal Gantry
Track
Footbridge
Foundry
Works
Shelter
Garage
Mast
Mast (Telecommunication)
Car Park
El Sub Sta
Sudell Street Industrial Estate
Matrix Building
Sorting Office
Warehouse
The Citadel
Ophthalmic Works
Ragged School
Krupa Building
Hall
PH
PC
Ground
Water
Micro-Screen & Weir Bdy
CANDLE STREET
BROMLEY STREET
WILLIAMSON STREET
BURSTOCK STREET
BILSBROUGH STREET
PERRY STREET
SUDELL STREET
ROCHDALE ROAD
HINTON STREET
COLLYHURST STREET
OLD MOUNT STREET
SIMEON STREET
NAPLES STREET
DURANT STREET
SHARP STREET
SCHOOL STREET
JOHNSON STREET
BAPTIST STREET
ASHLEY STREET
ROCHDALE BRIDGE
OLIVE STREET
RIDGE STREET
ATTICUS STREET
7401 375 CO
6401 150 VC
6406 375 CO
6407 475 x 375 CO
5401 1530 BR
5403 1550 BR
7501 450 BR
375 VC
350 x 350 BR
6303 300 VC
750 x 750 BR
6306 600 CO
6302 600 VC
6301 300 VC
7307 225 VC
7304 7303 375 VC
7302 375 VC
7301 225 VC
7305 300 CO
7202 225 CO
8201 225 VC
6402 1070 BR
6403 300 CO
9301 500 x 375 CO
9302 2952 BR
9202 300 BR
150 VC
8101 300 x 400 CO
6101 750 x 300 CO
6102 720 x 450 BR
5102 550 BR
5201 1050 x 650 BR
5209 1400 x 1150 CSB
5001 450 BR
5007 600 x 450 BR
5008 300 VC
5106 750 x 300 BR
6004 6003 7001 7002 500 x 750 BR
8103 300 x 400 CO
8101 500 x 750 BR
7101 7201 750 x 300 CO
6001 300 VC
5104 5105 5108 5109 5110 5111 5103 5306
7304 7303 7307 7305 7202 8201 7301 7302 7201 7101 7001 7002 6001 6003 6004 6101 6102 6302 6301 6303 6306 5306 5209 5201 5001 5007 5008 5102 5103 5104 5105 5106 5108 5109 5110 5111 6401 6406 6407 6402 6403 6404 9301 9302 9202 8101 8103 8201 7401 7501 5401 5403
Depot
Car Park
Shelter
Mast
Works
Garage
Warehouse
Sorting Office
Matrix Building
Sudell Street Industrial Estate
Mast (Telecommunication)
Foundry
Track
Signal Gantry
Footbridge
Micro-Screen & Weir Bdy
Weir Bdy
Shelter
Ground
Water
Depot
Depot
Depot



Reno	Cover	Func	Invert	Size.x	Size.y	Shape	Matl	Length	Grad
0101	40.24	SW							
0201		CO							
0204	42.02	CO							
0205		SW		150		CI	VC	20.61	
0207	41	CO	27.61	1520		CI	CSB	45.86	85
0216		SW		150		CI		41.61	
0217		SW		150		CI		34.24	
0301	43.15	CO	36.3	600		CI	CO	31.95	
0401	44.58	CO	39.72	400	320	EG	VC	20.88	
0402	45.65	CO	34.82	1350	920	EG	BR	96.57	508
1001	37.66	SW	36.06	225		CI	VC	30.41	
1002		CO							
1201	28.65	CO							
1202	27.71	CO							
1206	31.02	OV	26.83	525		CI	VC	27.31	59
1301	35.76	CO	29.71	375		CI	VC	14.87	
1403	41.81	CO	34.61	1350	900	EG	BR	17.89	7
1404	46.61	CO	40.72	600		CI	CO	85.44	38
1405	44.79	CO							
2001	37.46	CO							
2007		CO	0	525	300	EG	VC	54.17	
2008		CO							
2009	37.76	CO							
2012	37.52	CO							
2101	33.56	CO							
2104	31.73	CO							
2201	29.83	CO	23.93	1400	900	EG	BR	52.13	
2202	29.44	CO	24.06	900		CI	CI	8	133
2301	29.5	CO	27.03	450		CI	VC	78.9	
2302	31.07	CO	27.68	300		CI	BR	26.4	
2305		CO							
2401	34.2	CO	30.24	300		CI	BR	46.33	
2404	40.29	CO	35.74	100		CI	VC	32.2	
2405	40.48	CO	32.12	1350	900	EG	BR	69.46	40
2406	40.78	SW	39.4	150		CI	VC	2	
3001	38.79	CO							
3101	37.07	CO	0	1850		CI	BR	187.39	62
3102	33.5	CO							
3201	32.52	CO							
3202	32.33	CO							
3301	30.59	CO							
3401	39.9	CO							
4005	47.34	CO							
4011	44.27	CO							
4012	44.24	CO							
4201	30	CO							
4301	31.02	CO	26.48	520	450	OV	BR	30.56	
4302	30.81	CO	28.25	300		CI	VC	4.47	
4304	29.73	CO	24.22	1550		CI	BR	57.01	
4305	29.97	CO	26.56	525		CI	VC	49.77	172
4312	31.02	SW							
4401	30.58	CO	27.66	680	520	FT	BR	41.63	77
0105		SW		225		CI	VC	18.32	
0210		CO	0	900	675	UN	VC	37.12	
0211		CO	0	300		CI	BR	28.66	
0212		CO	0	600	380	UN	BR	104.93	
0215		CO	32.75	600		CI	CO	5.1	11
0302		CO		225		CI	VC	6.71	
0306		CO	0	100		CI	VC	36.14	
0307		CO		320	400	EG	VC	6.32	
0310		CO	0	600		CI	VC	31.95	
0311		CO	0	800		CI	VC	39.22	
0406		CO	0	470		CI	VC	51.24	
0407		CO	0	300		CI	VC	31.97	
0409		CO	0	300		CI	VC	11.7	
0412		CO	0	470		CI	VC	17.46	
0414		CO	0	300		CI	VC	24.37	
0415		CO	0	400	320	EG	VC	1	
0416		CO							
0417		CO							
0503		CO							
1004		FO							
1006		CO	0	300		CI	VC	169.56	
1091		CO	0	900	600	EG	VC	21.93	
1101		SW							
1102		SW							
1103		SW							
1203		SW							
1302		CO		300		CI	VC	97.19	
1303		CO							
1407		CO	0	375		CI	VC	148.33	
1408		CO	0	400		CI	VC	30.08	
1409		CO	0	470		CI	VC	27.51	
2003		CO	0	150		CI	VC	22.85	
2004		CO	0	150		CI	VC	11.66	
2005		CO	0	700	450	UN	BR	17	
2006		CO	0	740	540	FT	BR	7.62	
2013		SW	0	300		CI	VC	7.62	
2014		CO	0	700	450	EG	BR	16.55	
2102		CO							
2110		CO	0	300		CI	VC	41.68	
2115		CO	0	750	440	EG	BR	16.64	
2212		CO	24	900		CI	CO	8.06	161
2213		CO	0	500	500	AR	BR	2.24	
2303		CO							
2304		CO	0	1380	950	EG	BR	24.35	
2412		CO	0	300		CI	VC	79.38	
2413		CO							
2417		CO	0	100		CI	VC	44.75	
3106		CO							
3304		OV	0	375		CI	VC	87.24	
3402		CO	0	600	450	UN	VC	96.77	
3403		CO	33.13	525	400	UN	VC	34.54	18
4010		CO	0	500		CI	VC	11.66	
4018		CO	0	700		CI	VC	6.4	
4020		CO	0	1750		CI	BR	85.23	35
4103		CO							
4107		CO	0	700		CI	VC	14.42	
4313		CO	27.12	750	490	FT	BR	42.05	79
4314		CO							
4315		CO	0	1550		CI	BR	30.7	
4316		CO	0	100		CI	VC	38.59	
4317		CO	0	750	500	UN	VC	13.04	
4403		CO	0	500	375	EG	BR	85.09	
4404		CO	0	650	550	RE	BR	36.77	
4405		CO	0	750	550	FT	BR	37.16	
0203		CO							
0209		CO	0	100		CI	VC	3.62	
0213		CO							
0309		CO	0	600		CI	CO	42.77	
0405		CO							
0408		CO							
0410		CO							
0411		CO							
0413		CO							
1003		CO							
1005		CO							
1090		CO							
1092		CO							
1304		CO	0	375		CI	VC	115.32	
1401		CO							
2010		CO							
2015		CO							
2016		CO	0	150		CI	VC	10.82	
2018		CO	0	375		CI	VC	3.61	
2019		CO	0	375		CI	VC	13.94	
2020		CO	0	375		CI	VC	2.24	
2021		CO	0	375		CI	VC	27.64	
2022		CO	0	150		CI	VC	23.32	
2023		CO	0	1600		CI	BR	5.83	
2024		CO	0	1600		CI	BR	84.59	
2103		CO							
2108		CO							
2109		CO							
2112		CO							
2113		CO							
2114		CO							
2150		CO							
2206		CO	0	1400	900	EG	BR	11.18	
2207		CO							

Reno	Cover	Func	Invert	Size.x	Size.y	Shape	Matl	Length	Grad
2290		CO							
2390		CO							
2410		CO							
2411		CO							
2414		CO							
2490		CO							
2491		CO							
3003		CO							
3103		SW							
3190		CO							
3203		CO							
3206		CO							
3207		CO		0	300		CI	VC	20.54
3208		CO							
3302		CO		0	300		CI	BR	53.71
3303		CO							
4013		CO							
4014		CO							
4015		CO							
4016		CO							
4017		CO							
4019		CO							
4021		CO		0	500		CI	CO	18.6
4104		CO							
4105		CO							
4106		CO		0	700		CI	BR	18.03
4108		CO		0	700		CI	BR	23.6
4204		CO		0	1550		CI	BR	108.07
4303		CO							
4308		CO							
4309		CO							
4310		CO							
4311		CO							
4402		CO							
0102	40.46	SW							
0103	40.59	SW							
0201		SW							
0202		SW							
0206		CO							
0208		SW							
0403		CO							
1101		SW							
2002		CO							
3002		CO							
4001		SW							
2105		CO		28.5	150		CI	VC	53.76
2402		CO		30.65	300		CI	VC	19.7
2403		CO		30.35	450		CI	VC	109.45
4202		CO		28.43	400	300	OV	BR	68.59
1104		SW			0				233.89
3204		SW			0				127.64

WASTE WATER SYMBOLOGY

Foul Surface Combined Overflow

Manhole
Manhole, Side Entry
MainSewer, Public
MainSewer, Private
MainSewer, S104
Rising Main, Public
Rising Main, Private
Rising Main, S104
Highway Drain, Private

Foul Surface Combined

WW Site Termination
Air Valve
Cascade
Non Return Valve
Extent of Survey
Flow Meter
Gulley
Hatch Box
Head of System
Hydrobrake / Vortex
Inlet
Inspection Chamber
Bifurcation
Catchpit
Contaminated Surface Water
WW Pumping Station
Sludge Pumping Station
Sewer Overflow
TJunction/Saddle
LampHole
OilInterceptor
PenStock
Pump
RoddingEye
Soakaway
Summit
Valve
Valve Chamber
Washout Chamber
DropShaft
WW Treatment Works
Septic Tank
Vent Column
Network Storage Tank
Orifice Plate
Vortex Chamber
Penstock Chamber
Blind Manhole

Foul Surface Combined Overflow

Screen Chamber
Discharge Point
Outfall
Control Kiosk
Unspecified

Sludge Main, Public
Sludge Main, Private
Sludge Main, S104

ABANDONED PIPE
MainSewer
Rising Main
Highway Drain
Sludge Main

LEGEND

MANHOLE FUNCTION

FO	Foul
SW	Surface Water
CO	Combined
OV	Overflow

SEWER SHAPE

CI	Circular	TR	Trapezoidal
EG	Egg	AR	Arch
OV	Oval	BA	Barrel
FT	Flat Top	HO	HorseShoe
RE	Rectangular	UN	Unspecified
SQ	Square		

SEWER MATERIAL

AC	Asbestos Cement	DI	Ductile Iron
BR	Brick	PVC	Polyvinyl Chloride
PE	Polyethylene	CI	Cast Iron
RP	Reinforced Plastic Matrix	SI	Spun Iron
CO	Concrete	ST	Steel
CSB	Concrete Segment Bolted	VC	Vitrified Clay
CSU	Concrete Segment Unbolted	PP	Polypropylene
CC	Concrete Box Culverted	PF	Pitch Fibre
PSC	Plastic/Steel Composite	MAC	Masonry, Coursed
GRC	Glass Reinforced Concrete	MAR	Masonry, Random
GRP	Glass Reinforced Plastic	U	Unspecified

The position of underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available.
The actual positions may be different from those shown on the plan and private pipes, sewers or drains may not be recorded.
United Utilities will not accept any liability for any damage caused by the actual positions being different from those shown.
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OS Sheet No: SJ8499SW
Scale: 1: 1250 Date: 29/09/2016
201 Nodes
Sheet 1 of 1

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SEWER RECORDS

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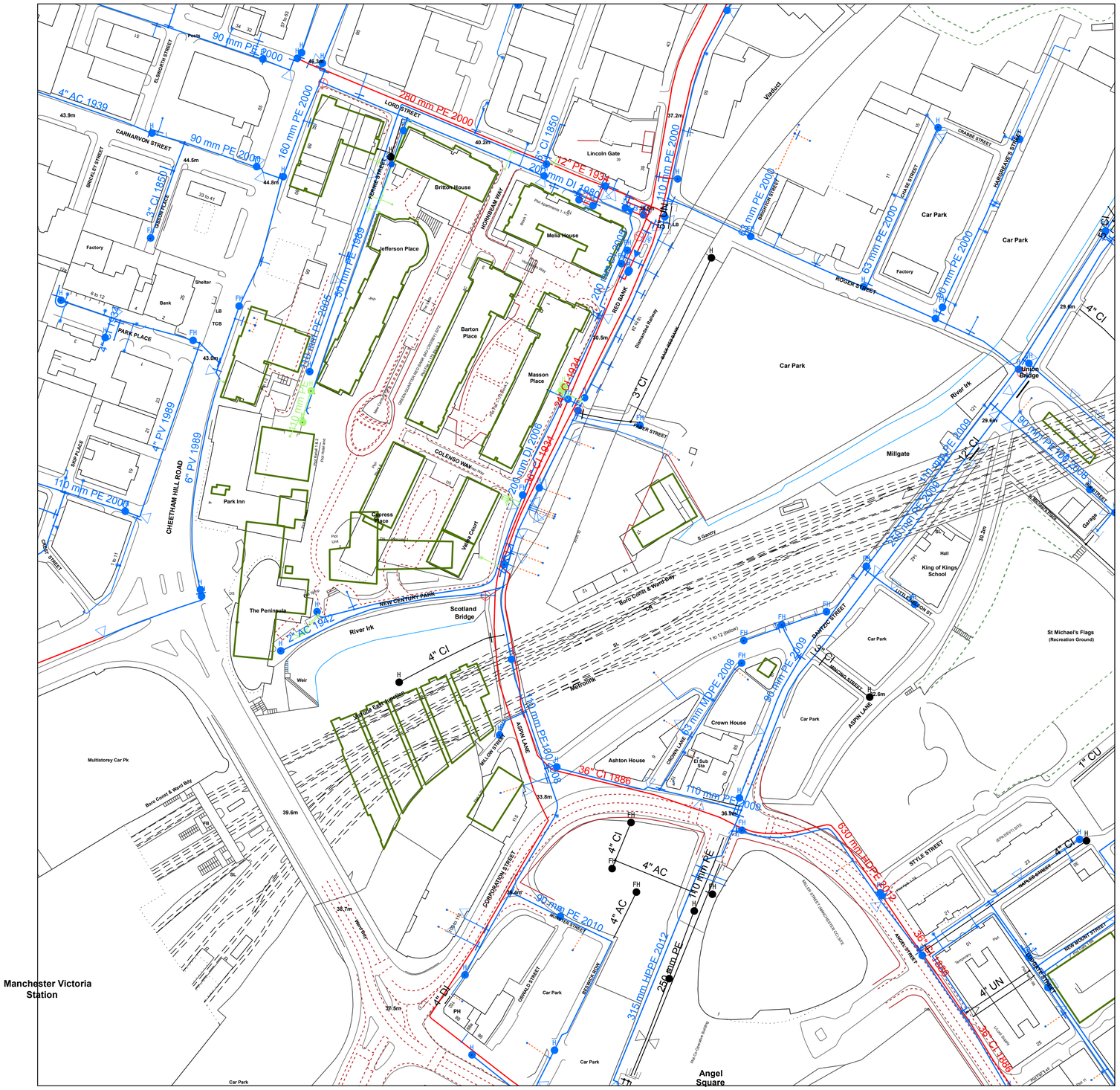
OS Sheet No: SJ8499SW

Scale: 1: 1250 Date: 29/09/2016



OS Sheet No: SJ8499SW

Scale: 1: 1250 Date: 29/09/2016

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Legend

PIPE WORK

Live	Proposed	
		Trunk Main - PressurisedMain
		Raw Water Aqueduct - PressurisedMain
		Raw Water Aqueduct - GravityMain
		LDTM Raw Water Distribution - PressurisedMain
		LDTM Raw Water Distribution - GravityMain
		LDTM Treated Water Distribution - PressurisedMain
		LDTM Treated Water Distribution - GravityMain
		Private Pipe - LateralLine
		Distribution Main - PressurisedMain
		Comms Pipe - LateralLine
		Concessionary Service - LateralLine

ABANDONED PIPE

- Trunk Main
- Raw Water Aqueduct
- LDTM Raw Water Distribution
- LDTM Treated Water Distribution
- Private Pipe
- Distribution Main
- Comms Pipe
- Concessionary Service

NODES/ FURNITURE

Live	Proposed	
		End Cap
		CC Valve
		AC Valve
		Air Valve
		Sluice Valve
		Non Return Valve
		Pressure Management Valve
		Change of Char
		Anode
		Chlorination Point
		De Chlorination Point
		Bore Hole
Inlet	Inlet	Inlet Point
		Bulk Supply Point
FH	FH	Fire Hydrant
H	H	Hydrant
PFH	PFH	Private Fire Hydrant
		Pump
		Site Termination
		Service Start
		Service End
PM	PM	Process Meter
		Stop Tap
		Monitor Location
SP	SP	Strainer Point
AP	AP	Access Point
HB	HB	Hatch Box
IP	IP	IP Point
RM		Route Marker
SPT	SPT	Sampling Station
LB	LB	Logger Box

Property Types

Live	Proposed	
		Condition Report
PB	PB	Pipe Bridges
PT	PT	Tunnels (non carrier)
		Pumping Station
		Water Treatment Works
		Private Treatment Works
VH	VH	Valve House
		Water Tower
SR	SR	Service Reservoir
SR (RCS)	SR (RCS)	Supply Reservoir
Inlet AP	Inlet AP	Abstraction Point
M	M	Domestic meter
CM	CM	Commercial meter
T	T	Telemetry Outstation

Material Types

AC ASBESTOS CEMENT	OT OTHERS
CI CAST IRON	PB LEAD
CU COPPER	PV uPVC
CO CONCRETE	SI SPUN IRON
DI DUCTILE IRON	ST STEEL
GI GALVANISED IRON	UN UNKNOWN
GR GREY IRON	PE POLYETHYLENE

Lining Types

CL CEMENT LINING	ERL EPOXY RESIN
TB TAR OR BITUMEN	

Insertion Types

DD DIE DRAWN	MO MOLING
DR DIRECTIONAL DRILLING	PI PIPELINE
	SL SLIP LINED

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OS Sheet No: SJ8499SW

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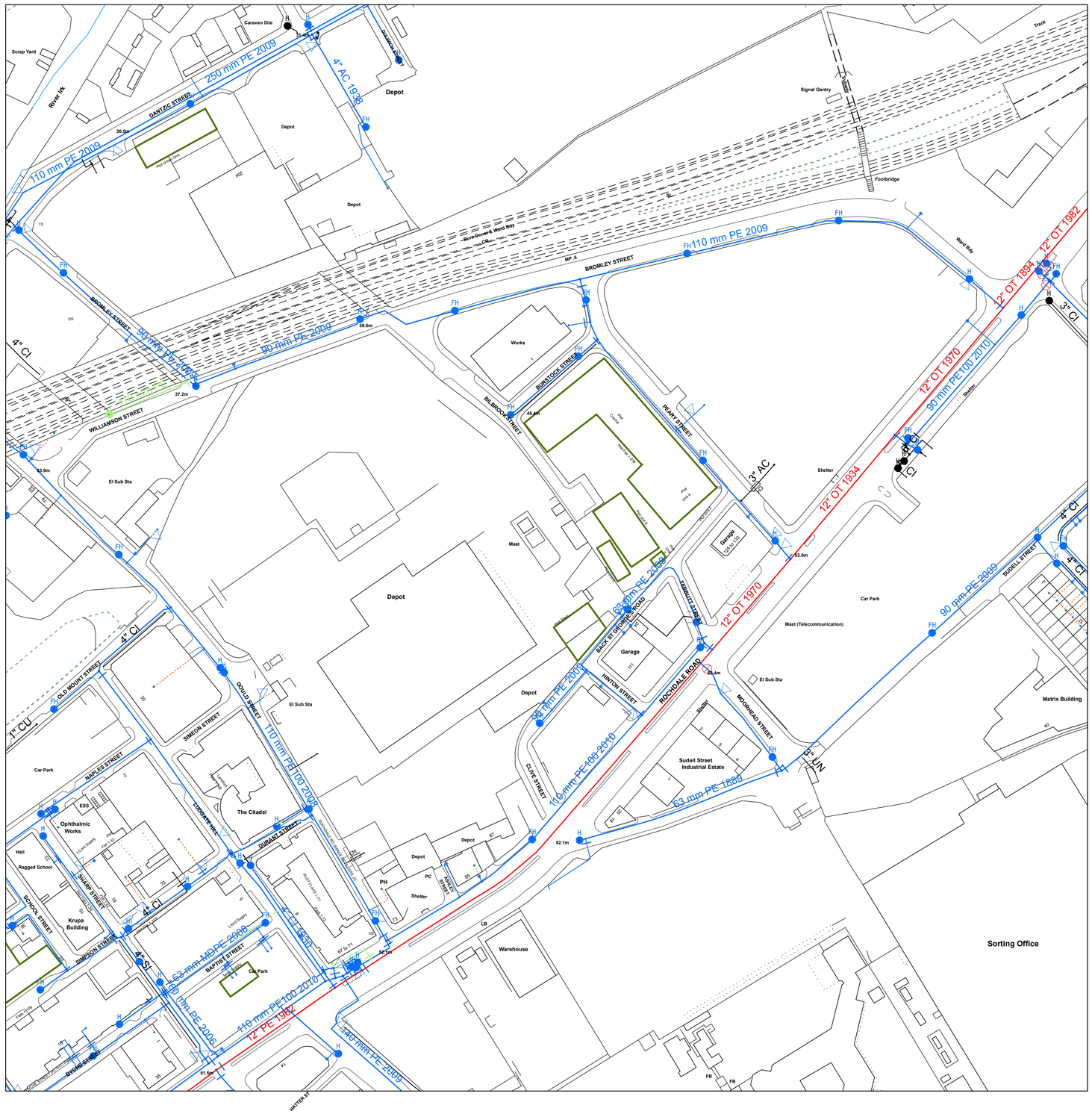
WATER MAIN RECORDS



OS Sheet No: SJ8499SE

Scale: 1: 1250 Date: 29/09/2016

Printed By: Property Searches

Legend

PIPE WORK

Live	Proposed	
		Trunk Main - PressurisedMain
		Raw Water Aqueduct - PressurisedMain
		Raw Water Aqueduct - GravityMain
		LDTM Raw Water Distribution - PressurisedMain
		LDTM Raw Water Distribution - GravityMain
		LDTM Treated Water Distribution - PressurisedMain
		LDTM Treated Water Distribution - GravityMain
		Private Pipe - LateralLine
		Distribution Main - PressurisedMain
		Comms Pipe - LateralLine
		Concessionary Service - LateralLine

ABANDONED PIPE

- Trunk Main
- Raw Water Aqueduct
- LDTM Raw Water Distribution
- LDTM Treated Water Distribution
- Private Pipe
- Distribution Main
- Comms Pipe
- Concessionary Service

NODES/ FURNITURE

Live	Proposed	
		End Cap
		CC Valve
		AC Valve
		Air Valve
		Sluice Valve
		Non Return Valve
		Pressure Management Valve
		Change of Char
		Anode
		Chlorination Point
		De Chlorination Point
		Bore Hole
Inlet	Inlet	Inlet Point
		Bulk Supply Point
FH	FH	Fire Hydrant
H	H	Hydrant
PFH	PFH	Private Fire Hydrant
		Pump
		Site Termination
		Service Start
		Service End
PM	PM	Process Meter
		Stop Tap
		Monitor Location
SP	SP	Strainer Point
AP	AP	Access Point
HB	HB	Hatch Box
IP	IP	IP Point
RM		Route Marker
SPT	SPT	Sampling Station
LB	LB	Logger Box

Property Types

Live	Proposed	
		Condition Report
PB	PB	Pipe Bridges
PT	PT	Tunnels (non carrier)
		Pumping Station
		Water Treatment Works
		Private Treatment Works
VH	VH	Valve House
		Water Tower
SR	SR	Service Reservoir
SR	SR	Supply Reservoir
Inlet AP	Inlet AP	Abstraction Point
M	M	Domestic meter
CM	CM	Commercial meter
T	T	Telemetry Outstation

Material Types

AC ASBESTOS CEMENT	OT OTHERS
CI CAST IRON	PB LEAD
CU COPPER	PV uPVC
CO CONCRETE	SI SPUN IRON
DI DUCTILE IRON	ST STEEL
GI GALVANISED IRON	UN UNKNOWN
GR GREY IRON	PE POLYETHYLENE

Lining Types

CL CEMENT LINING	ERL EPOXY RESIN
TB TAR OR BITUMEN	

Insertion Types

DD DIE DRAWN	MO MOLING
DR DIRECTIONAL DRILLING	PI PIPELINE
	SL SLIP LINED

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OS Sheet No: SJ8499SE

Scale: 1: 1250 Date: 29/09/2016

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WATER MAIN RECORDS

Appendix E

DEVELOPMENT PLANS

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Figured dimensions only are to be taken from this drawing. Do not scale from this drawing.

All Contractors must visit the site and are responsible for taking and checking all dimensions relative to their work. 5plus Architects are to be advised of any variation between drawings and site conditions.

Electronic data/ drawings issued as 'read only' and should not be interrogated for measurement.
All dimensions and levels should be 'read only' from those values stated in text, on the drawings

⚠ CONSTRUCTION - It is considered that the proposed works are within the scope of a competent Contractor and as such no unusual hazards have been identified, refer to relevant Key/ Scheduled Designers Risk Assessment

KEY PLAN:



Application Boundary

REV:	DATE:	DETAILS:
H	05/05/17	Planning Issue
G	24/04/17	Planning Issue
F	13/04/17	Draft Planning Issue
E	11/04/17	Draft Planning Issue
D	05/04/17	Draft Planning Issue
C	23/03/17	Design Freeze Issue.
B	17/02/17	Updated ground floor plans
A	02/02/17	Amended ground floor plans

5plus architects

4th Floor
The Hive
47 Lever Street
Manchester
M1 1FN

+44 (0)161 228 0211

www.5plusarchitects.com

PROJECT:
Angel Meadow
Manchester

TITLE:
Proposed Ground Floor Masterplan

SCALE:	ORIGIN DATE:	DRAWN:	CHECKED:
1:500@A1	18/01/17	AAB	JC

STATUS:
Planning

PROJECT	DRAWING NO:	REV:
05498	_MP_00_1200	H

Architecture | Masterplanning | Interiors | Graphics | Branding

Appendix F

ENVIRONMENT AGENCY MODELLED FLOOD LEVEL DATA

					Undefended			
Map Reference	Model Node Reference	Easting	Northing	Data	4 % AEP (1 in 25 year)	1 % AEP (1 in 100 year)	1 % AEP (1 in 100 year) + Climate Change*	0.1 % AEP (1 in 1000 year)
1	ea013_Model_Irk_00029	384585	399539	Modelled Water Level (m aodN)	30.01	30.40	30.57	31.35
				Modelled Flow (cumecs)	55.70	65.63	74.43	112.48
2	ea013_Model_Irk_00031	384455	399346	Modelled Water Level (m aodN)	29.71	30.16	30.38	31.08
				Modelled Flow (cumecs)	55.63	60.61	61.06	63.05
3	ea013_Model_Irk_00034	384301	399252	Modelled Water Level (m aodN)	28.67	28.98	29.21	30.21
				Modelled Flow (cumecs)	55.63	65.43	72.38	95.01
4	ea013_Model_Irk_00037	384163	399210	Modelled Water Level (m aodN)	28.10	28.34	28.50	29.36
				Modelled Flow (cumecs)	55.92	65.83	72.66	94.66

Model data taken from River Irk SFRA 2011 Study

Notes:

AEP - Annual Exceedence Probability

m aodN - metres above ordnance datum Newlyn

cumecs - cubic metres per second

*Climate Change Scenario - 20% increase in flow. We only hold climate change measurements based on the previous climate change guidance. The new climate change guidance is available at https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances. The location of the site and the type (vulnerability) of development determine the climate change allowances to consider in any flood risk assessment.

Appendix G

HYDRAULIC CALCULATIONS

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.196	0.696	17.4	34.8	O K
30 min Summer	99.325	0.825	17.4	41.3	O K
60 min Summer	99.355	0.855	17.4	42.8	O K
120 min Summer	99.251	0.751	17.4	37.6	O K
180 min Summer	99.114	0.614	17.4	30.7	O K
240 min Summer	98.989	0.489	17.4	24.5	O K
360 min Summer	98.809	0.309	17.3	15.5	O K
480 min Summer	98.718	0.218	16.6	10.9	O K
600 min Summer	98.682	0.182	15.2	9.1	O K
720 min Summer	98.663	0.163	13.4	8.1	O K
960 min Summer	98.639	0.139	10.9	7.0	O K
1440 min Summer	98.614	0.114	8.1	5.7	O K
2160 min Summer	98.595	0.095	5.9	4.7	O K
2880 min Summer	98.583	0.083	4.7	4.2	O K
4320 min Summer	98.570	0.070	3.4	3.5	O K
5760 min Summer	98.562	0.062	2.7	3.1	O K
7200 min Summer	98.556	0.056	2.3	2.8	O K
8640 min Summer	98.552	0.052	2.0	2.6	O K
10080 min Summer	98.549	0.049	1.7	2.4	O K
15 min Winter	99.302	0.802	17.4	40.1	O K
30 min Winter	99.448	0.948	17.4	47.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	118.382	0.0	45.9	16
30 min Summer	79.333	0.0	61.6	27
60 min Summer	50.812	0.0	78.9	44
120 min Summer	31.498	0.0	97.8	78
180 min Summer	23.499	0.0	109.4	110
240 min Summer	18.972	0.0	117.8	140
360 min Summer	13.913	0.0	129.6	196
480 min Summer	11.171	0.0	138.7	252
600 min Summer	9.415	0.0	146.1	308
720 min Summer	8.183	0.0	152.4	368
960 min Summer	6.552	0.0	162.7	490
1440 min Summer	4.782	0.0	178.1	734
2160 min Summer	3.483	0.0	194.6	1100
2880 min Summer	2.778	0.0	207.0	1468
4320 min Summer	2.016	0.0	225.3	2200
5760 min Summer	1.604	0.0	239.1	2936
7200 min Summer	1.343	0.0	250.1	3672
8640 min Summer	1.160	0.0	259.4	4384
10080 min Summer	1.025	0.0	267.4	5128
15 min Winter	118.382	0.0	51.4	16
30 min Winter	79.333	0.0	68.9	29

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.467	0.967	17.4	48.4	O K
120 min Winter	99.298	0.798	17.4	39.9	O K
180 min Winter	99.068	0.568	17.4	28.4	O K
240 min Winter	98.886	0.386	17.4	19.3	O K
360 min Winter	98.699	0.199	16.3	10.0	O K
480 min Winter	98.663	0.163	13.5	8.2	O K
600 min Winter	98.643	0.143	11.4	7.2	O K
720 min Winter	98.631	0.131	10.0	6.5	O K
960 min Winter	98.614	0.114	8.0	5.7	O K
1440 min Winter	98.594	0.094	5.8	4.7	O K
2160 min Winter	98.579	0.079	4.2	3.9	O K
2880 min Winter	98.570	0.070	3.4	3.5	O K
4320 min Winter	98.559	0.059	2.5	2.9	O K
5760 min Winter	98.552	0.052	2.0	2.6	O K
7200 min Winter	98.547	0.047	1.6	2.4	O K
8640 min Winter	98.544	0.044	1.4	2.2	O K
10080 min Winter	98.541	0.041	1.3	2.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	50.812	0.0	88.3	48
120 min Winter	31.498	0.0	109.5	86
180 min Winter	23.499	0.0	122.6	116
240 min Winter	18.972	0.0	132.0	144
360 min Winter	13.913	0.0	145.1	192
480 min Winter	11.171	0.0	155.4	248
600 min Winter	9.415	0.0	163.7	308
720 min Winter	8.183	0.0	170.7	368
960 min Winter	6.552	0.0	182.3	486
1440 min Winter	4.782	0.0	199.5	734
2160 min Winter	3.483	0.0	218.0	1100
2880 min Winter	2.778	0.0	231.8	1444
4320 min Winter	2.016	0.0	252.4	2144
5760 min Winter	1.604	0.0	267.8	2880
7200 min Winter	1.343	0.0	280.1	3568
8640 min Winter	1.160	0.0	290.5	4264
10080 min Winter	1.025	0.0	299.5	5072

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Shortest Storm (mins)	15
Ratio R	0.358	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.207

Time (mins) From:	To:	Area (ha)
0	4	0.207

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Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	50.0	0.700	50.0	1.400	0.0	2.100	0.0
0.100	50.0	0.800	50.0	1.500	0.0	2.200	0.0
0.200	50.0	0.900	50.0	1.600	0.0	2.300	0.0
0.300	50.0	1.000	50.0	1.700	0.0	2.400	0.0
0.400	50.0	1.001	0.0	1.800	0.0	2.500	0.0
0.500	50.0	1.200	0.0	1.900	0.0		
0.600	50.0	1.300	0.0	2.000	0.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0184-1740-1200-1740
Design Head (m)	1.200
Design Flow (l/s)	17.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	184
Invert Level (m)	98.500
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	17.4
Flush-Flo™	0.372	17.4
Kick-Flo®	0.818	14.5
Mean Flow over Head Range	-	14.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.5	1.200	17.4	3.000	26.9	7.000	40.5
0.200	16.3	1.400	18.7	3.500	29.0	7.500	41.9
0.300	17.3	1.600	19.9	4.000	30.9	8.000	43.2
0.400	17.4	1.800	21.1	4.500	32.7	8.500	44.5
0.500	17.2	2.000	22.2	5.000	34.5	9.000	45.8
0.600	16.8	2.200	23.2	5.500	36.1	9.500	47.0
0.800	14.9	2.400	24.2	6.000	37.6		
1.000	16.0	2.600	25.2	6.500	39.1		

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	98.919	0.419	5.0	1.7	O K
30 min Summer	98.903	0.403	5.0	1.6	O K
60 min Summer	98.776	0.276	4.9	1.1	O K
120 min Summer	98.636	0.136	4.3	0.5	O K
180 min Summer	98.602	0.102	3.5	0.4	O K
240 min Summer	98.586	0.086	2.9	0.3	O K
360 min Summer	98.570	0.070	2.2	0.3	O K
480 min Summer	98.561	0.061	1.7	0.2	O K
600 min Summer	98.555	0.055	1.5	0.2	O K
720 min Summer	98.551	0.051	1.3	0.2	O K
960 min Summer	98.545	0.045	1.0	0.2	O K
1440 min Summer	98.538	0.038	0.8	0.2	O K
2160 min Summer	98.532	0.032	0.6	0.1	O K
2880 min Summer	98.528	0.028	0.4	0.1	O K
4320 min Summer	98.524	0.024	0.3	0.1	O K
5760 min Summer	98.521	0.021	0.3	0.1	O K
7200 min Summer	98.520	0.020	0.2	0.1	O K
8640 min Summer	98.518	0.018	0.2	0.1	O K
10080 min Summer	98.517	0.017	0.2	0.1	O K
15 min Winter	98.973	0.473	5.0	1.9	O K
30 min Winter	98.903	0.403	5.0	1.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	118.382	0.0	4.2	12
30 min Summer	79.333	0.0	5.7	20
60 min Summer	50.812	0.0	7.2	36
120 min Summer	31.498	0.0	9.0	64
180 min Summer	23.499	0.0	10.0	94
240 min Summer	18.972	0.0	10.8	124
360 min Summer	13.913	0.0	11.9	182
480 min Summer	11.171	0.0	12.7	242
600 min Summer	9.415	0.0	13.4	306
720 min Summer	8.183	0.0	14.0	360
960 min Summer	6.552	0.0	14.9	478
1440 min Summer	4.782	0.0	16.4	726
2160 min Summer	3.483	0.0	17.9	1100
2880 min Summer	2.778	0.0	19.0	1468
4320 min Summer	2.016	0.0	20.7	2140
5760 min Summer	1.604	0.0	21.9	2912
7200 min Summer	1.343	0.0	23.0	3568
8640 min Summer	1.160	0.0	23.8	4264
10080 min Summer	1.025	0.0	24.5	4992
15 min Winter	118.382	0.0	4.7	13
30 min Winter	79.333	0.0	6.3	21

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	98.709	0.209	4.8	0.8	O K
120 min Winter	98.601	0.101	3.5	0.4	O K
180 min Winter	98.580	0.080	2.6	0.3	O K
240 min Winter	98.570	0.070	2.1	0.3	O K
360 min Winter	98.557	0.057	1.6	0.2	O K
480 min Winter	98.551	0.051	1.3	0.2	O K
600 min Winter	98.546	0.046	1.1	0.2	O K
720 min Winter	98.543	0.043	0.9	0.2	O K
960 min Winter	98.538	0.038	0.7	0.2	O K
1440 min Winter	98.532	0.032	0.5	0.1	O K
2160 min Winter	98.527	0.027	0.4	0.1	O K
2880 min Winter	98.524	0.024	0.3	0.1	O K
4320 min Winter	98.520	0.020	0.2	0.1	O K
5760 min Winter	98.518	0.018	0.2	0.1	O K
7200 min Winter	98.517	0.017	0.2	0.1	O K
8640 min Winter	98.515	0.015	0.1	0.1	O K
10080 min Winter	98.514	0.014	0.1	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	50.812	0.0	8.1	36
120 min Winter	31.498	0.0	10.1	64
180 min Winter	23.499	0.0	11.2	94
240 min Winter	18.972	0.0	12.1	122
360 min Winter	13.913	0.0	13.3	186
480 min Winter	11.171	0.0	14.3	246
600 min Winter	9.415	0.0	15.0	300
720 min Winter	8.183	0.0	15.7	364
960 min Winter	6.552	0.0	16.7	486
1440 min Winter	4.782	0.0	18.3	708
2160 min Winter	3.483	0.0	20.0	1104
2880 min Winter	2.778	0.0	21.3	1460
4320 min Winter	2.016	0.0	23.2	2160
5760 min Winter	1.604	0.0	24.6	2848
7200 min Winter	1.343	0.0	25.7	3496
8640 min Winter	1.160	0.0	26.7	4272
10080 min Winter	1.025	0.0	27.5	5056

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Shortest Storm (mins)	15
Ratio R	0.358	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.019

Time (mins) From:	To:	Area (ha)
0	4	0.019

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Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	4.0	0.700	4.0	1.400	0.0	2.100	0.0
0.100	4.0	0.800	4.0	1.500	0.0	2.200	0.0
0.200	4.0	0.900	4.0	1.600	0.0	2.300	0.0
0.300	4.0	1.000	4.0	1.700	0.0	2.400	0.0
0.400	4.0	1.001	0.0	1.800	0.0	2.500	0.0
0.500	4.0	1.200	0.0	1.900	0.0		
0.600	4.0	1.300	0.0	2.000	0.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0103-5000-1200-5000
Design Head (m)	1.200
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	103
Invert Level (m)	98.500
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.0
Flush-Flo™	0.354	5.0
Kick-Flo®	0.745	4.0
Mean Flow over Head Range	-	4.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.4	1.200	5.0	3.000	7.7	7.000	11.5
0.200	4.7	1.400	5.4	3.500	8.3	7.500	11.8
0.300	5.0	1.600	5.7	4.000	8.8	8.000	12.2
0.400	5.0	1.800	6.0	4.500	9.3	8.500	12.6
0.500	4.9	2.000	6.3	5.000	9.8	9.000	12.9
0.600	4.7	2.200	6.6	5.500	10.2	9.500	13.3
0.800	4.1	2.400	6.9	6.000	10.7		
1.000	4.6	2.600	7.2	6.500	11.1		

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.173	0.673	17.4	43.1	O K
30 min Summer	99.313	0.813	17.4	52.0	O K
60 min Summer	99.365	0.865	17.4	55.4	O K
120 min Summer	99.303	0.803	17.4	51.4	O K
180 min Summer	99.191	0.691	17.4	44.2	O K
240 min Summer	99.080	0.580	17.4	37.1	O K
360 min Summer	98.897	0.397	17.4	25.4	O K
480 min Summer	98.782	0.282	17.2	18.1	O K
600 min Summer	98.717	0.217	16.6	13.9	O K
720 min Summer	98.686	0.186	15.5	11.9	O K
960 min Summer	98.656	0.156	12.8	10.0	O K
1440 min Summer	98.627	0.127	9.5	8.1	O K
2160 min Summer	98.605	0.105	7.0	6.7	O K
2880 min Summer	98.592	0.092	5.6	5.9	O K
4320 min Summer	98.577	0.077	4.1	4.9	O K
5760 min Summer	98.568	0.068	3.2	4.3	O K
7200 min Summer	98.562	0.062	2.7	3.9	O K
8640 min Summer	98.557	0.057	2.3	3.6	O K
10080 min Summer	98.553	0.053	2.1	3.4	O K
15 min Winter	99.270	0.770	17.4	49.3	O K
30 min Winter	99.437	0.937	17.4	60.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	118.382	0.0	54.3	16
30 min Summer	79.333	0.0	72.8	30
60 min Summer	50.812	0.0	93.3	46
120 min Summer	31.498	0.0	115.7	80
180 min Summer	23.499	0.0	129.5	112
240 min Summer	18.972	0.0	139.4	144
360 min Summer	13.913	0.0	153.4	202
480 min Summer	11.171	0.0	164.2	258
600 min Summer	9.415	0.0	173.0	314
720 min Summer	8.183	0.0	180.4	370
960 min Summer	6.552	0.0	192.6	490
1440 min Summer	4.782	0.0	210.8	734
2160 min Summer	3.483	0.0	230.3	1100
2880 min Summer	2.778	0.0	245.0	1456
4320 min Summer	2.016	0.0	266.7	2168
5760 min Summer	1.604	0.0	283.0	2920
7200 min Summer	1.343	0.0	296.0	3632
8640 min Summer	1.160	0.0	307.0	4280
10080 min Summer	1.025	0.0	316.5	5008
15 min Winter	118.382	0.0	60.9	16
30 min Winter	79.333	0.0	81.6	30

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.484	0.984	17.4	63.0	O K
120 min Winter	99.385	0.885	17.4	56.7	O K
180 min Winter	99.196	0.696	17.4	44.6	O K
240 min Winter	99.022	0.522	17.4	33.4	O K
360 min Winter	98.780	0.280	17.2	17.9	O K
480 min Winter	98.689	0.189	15.8	12.1	O K
600 min Winter	98.663	0.163	13.4	10.4	O K
720 min Winter	98.646	0.146	11.7	9.4	O K
960 min Winter	98.626	0.126	9.4	8.1	O K
1440 min Winter	98.604	0.104	6.9	6.7	O K
2160 min Winter	98.587	0.087	5.0	5.5	O K
2880 min Winter	98.576	0.076	4.0	4.9	O K
4320 min Winter	98.564	0.064	2.9	4.1	O K
5760 min Winter	98.557	0.057	2.3	3.6	O K
7200 min Winter	98.552	0.052	2.0	3.3	O K
8640 min Winter	98.548	0.048	1.7	3.0	O K
10080 min Winter	98.545	0.045	1.5	2.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	50.812	0.0	104.5	48
120 min Winter	31.498	0.0	129.6	88
180 min Winter	23.499	0.0	145.1	122
240 min Winter	18.972	0.0	156.1	152
360 min Winter	13.913	0.0	171.8	206
480 min Winter	11.171	0.0	183.9	252
600 min Winter	9.415	0.0	193.7	312
720 min Winter	8.183	0.0	202.0	370
960 min Winter	6.552	0.0	215.7	490
1440 min Winter	4.782	0.0	236.1	734
2160 min Winter	3.483	0.0	258.0	1084
2880 min Winter	2.778	0.0	274.4	1468
4320 min Winter	2.016	0.0	298.7	2192
5760 min Winter	1.604	0.0	316.9	2872
7200 min Winter	1.343	0.0	331.6	3672
8640 min Winter	1.160	0.0	343.9	4400
10080 min Winter	1.025	0.0	354.5	5160

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Shortest Storm (mins)	15
Ratio R	0.358	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.245

Time (mins) From:	To:	Area (ha)
0	4	0.245

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Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	64.0	0.700	64.0	1.400	0.0	2.100	0.0
0.100	64.0	0.800	64.0	1.500	0.0	2.200	0.0
0.200	64.0	0.900	64.0	1.600	0.0	2.300	0.0
0.300	64.0	1.000	64.0	1.700	0.0	2.400	0.0
0.400	64.0	1.001	0.0	1.800	0.0	2.500	0.0
0.500	64.0	1.200	0.0	1.900	0.0		
0.600	64.0	1.300	0.0	2.000	0.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0184-1740-1200-1740
Design Head (m)	1.200
Design Flow (l/s)	17.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	184
Invert Level (m)	98.500
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	17.4
Flush-Flo™	0.372	17.4
Kick-Flo®	0.818	14.5
Mean Flow over Head Range	-	14.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.5	1.200	17.4	3.000	26.9	7.000	40.5
0.200	16.3	1.400	18.7	3.500	29.0	7.500	41.9
0.300	17.3	1.600	19.9	4.000	30.9	8.000	43.2
0.400	17.4	1.800	21.1	4.500	32.7	8.500	44.5
0.500	17.2	2.000	22.2	5.000	34.5	9.000	45.8
0.600	16.8	2.200	23.2	5.500	36.1	9.500	47.0
0.800	14.9	2.400	24.2	6.000	37.6		
1.000	16.0	2.600	25.2	6.500	39.1		

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	98.853	0.353	14.4	35.3	O K
30 min Summer	98.946	0.446	14.4	44.6	O K
60 min Summer	98.993	0.493	14.4	49.3	O K
120 min Summer	98.978	0.478	14.4	47.8	O K
180 min Summer	98.929	0.429	14.4	42.9	O K
240 min Summer	98.877	0.377	14.4	37.7	O K
360 min Summer	98.785	0.285	14.4	28.5	O K
480 min Summer	98.723	0.223	14.1	22.3	O K
600 min Summer	98.686	0.186	13.8	18.6	O K
720 min Summer	98.667	0.167	12.5	16.7	O K
960 min Summer	98.643	0.143	10.5	14.3	O K
1440 min Summer	98.618	0.118	8.0	11.8	O K
2160 min Summer	98.598	0.098	5.9	9.8	O K
2880 min Summer	98.586	0.086	4.7	8.6	O K
4320 min Summer	98.572	0.072	3.5	7.2	O K
5760 min Summer	98.564	0.064	2.8	6.4	O K
7200 min Summer	98.558	0.058	2.3	5.8	O K
8640 min Summer	98.554	0.054	2.0	5.4	O K
10080 min Summer	98.550	0.050	1.8	5.0	O K
15 min Winter	98.902	0.402	14.4	40.2	O K
30 min Winter	99.011	0.511	14.4	51.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	119.221	0.0	46.6	21
30 min Summer	79.853	0.0	62.4	32
60 min Summer	51.110	0.0	80.0	50
120 min Summer	31.656	0.0	99.2	84
180 min Summer	23.604	0.0	110.9	116
240 min Summer	19.048	0.0	119.4	148
360 min Summer	13.964	0.0	131.3	208
480 min Summer	11.210	0.0	140.5	264
600 min Summer	9.446	0.0	148.0	320
720 min Summer	8.209	0.0	154.3	378
960 min Summer	6.571	0.0	164.7	498
1440 min Summer	4.794	0.0	180.2	738
2160 min Summer	3.491	0.0	196.9	1104
2880 min Summer	2.784	0.0	209.4	1468
4320 min Summer	2.020	0.0	227.8	2200
5760 min Summer	1.607	0.0	241.8	2928
7200 min Summer	1.345	0.0	252.9	3600
8640 min Summer	1.162	0.0	262.3	4384
10080 min Summer	1.027	0.0	270.3	5136
15 min Winter	119.221	0.0	52.2	22
30 min Winter	79.853	0.0	69.9	33

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.061	0.561	14.4	56.1	O K
120 min Winter	99.021	0.521	14.4	52.1	O K
180 min Winter	98.939	0.439	14.4	43.9	O K
240 min Winter	98.856	0.356	14.4	35.6	O K
360 min Winter	98.729	0.229	14.2	22.9	O K
480 min Winter	98.673	0.173	13.1	17.3	O K
600 min Winter	98.651	0.151	11.3	15.1	O K
720 min Winter	98.637	0.137	9.9	13.7	O K
960 min Winter	98.618	0.118	8.0	11.8	O K
1440 min Winter	98.598	0.098	5.9	9.8	O K
2160 min Winter	98.581	0.081	4.3	8.2	O K
2880 min Winter	98.572	0.072	3.4	7.2	O K
4320 min Winter	98.560	0.060	2.5	6.0	O K
5760 min Winter	98.553	0.053	2.0	5.3	O K
7200 min Winter	98.549	0.049	1.7	4.9	O K
8640 min Winter	98.545	0.045	1.5	4.5	O K
10080 min Winter	98.542	0.042	1.3	4.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	51.110	0.0	89.7	54
120 min Winter	31.656	0.0	111.1	90
180 min Winter	23.604	0.0	124.2	126
240 min Winter	19.048	0.0	133.7	156
360 min Winter	13.964	0.0	147.0	212
480 min Winter	11.210	0.0	157.4	262
600 min Winter	9.446	0.0	165.7	320
720 min Winter	8.209	0.0	172.8	378
960 min Winter	6.571	0.0	184.5	500
1440 min Winter	4.794	0.0	201.9	738
2160 min Winter	3.491	0.0	220.6	1108
2880 min Winter	2.784	0.0	234.5	1472
4320 min Winter	2.020	0.0	255.2	2204
5760 min Winter	1.607	0.0	270.8	2936
7200 min Winter	1.345	0.0	283.3	3672
8640 min Winter	1.162	0.0	293.7	4336
10080 min Winter	1.027	0.0	302.7	5128

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.100	Shortest Storm (mins)	15
Ratio R	0.359	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.209

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.070	4	8	0.070	8	12	0.070

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Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	100.0	0.700	100.0	1.400	0.0	2.100	0.0
0.100	100.0	0.800	100.0	1.500	0.0	2.200	0.0
0.200	100.0	0.900	100.0	1.600	0.0	2.300	0.0
0.300	100.0	1.000	100.0	1.700	0.0	2.400	0.0
0.400	100.0	1.001	0.0	1.800	0.0	2.500	0.0
0.500	100.0	1.200	0.0	1.900	0.0		
0.600	100.0	1.300	0.0	2.000	0.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0172-1450-1000-1450
Design Head (m)	1.000
Design Flow (l/s)	14.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	172
Invert Level (m)	98.500
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	14.5
Flush-Flo™	0.320	14.4
Kick-Flo®	0.699	12.2
Mean Flow over Head Range	-	12.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.1	1.200	15.8	3.000	24.5	7.000	36.8
0.200	13.9	1.400	17.0	3.500	26.3	7.500	38.0
0.300	14.4	1.600	18.1	4.000	28.1	8.000	39.2
0.400	14.3	1.800	19.2	4.500	29.7	8.500	40.4
0.500	14.0	2.000	20.1	5.000	31.3	9.000	41.5
0.600	13.5	2.200	21.1	5.500	32.7	9.500	42.6
0.800	13.0	2.400	22.0	6.000	34.1		
1.000	14.5	2.600	22.8	6.500	35.5		

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	98.785	0.285	5.0	28.5	O K
30 min Summer	98.864	0.364	5.0	36.4	O K
60 min Summer	98.922	0.422	5.0	42.2	O K
120 min Summer	98.946	0.446	5.0	44.6	O K
180 min Summer	98.940	0.440	5.0	44.0	O K
240 min Summer	98.924	0.424	5.0	42.4	O K
360 min Summer	98.880	0.380	5.0	38.0	O K
480 min Summer	98.838	0.338	5.0	33.8	O K
600 min Summer	98.800	0.300	5.0	30.0	O K
720 min Summer	98.765	0.265	5.0	26.5	O K
960 min Summer	98.710	0.210	4.9	21.0	O K
1440 min Summer	98.642	0.142	4.6	14.2	O K
2160 min Summer	98.605	0.105	3.8	10.5	O K
2880 min Summer	98.589	0.089	3.1	8.9	O K
4320 min Summer	98.572	0.072	2.3	7.2	O K
5760 min Summer	98.563	0.063	1.9	6.3	O K
7200 min Summer	98.557	0.057	1.6	5.7	O K
8640 min Summer	98.552	0.052	1.4	5.2	O K
10080 min Summer	98.549	0.049	1.2	4.9	O K
15 min Winter	98.822	0.322	5.0	32.2	O K
30 min Winter	98.913	0.413	5.0	41.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	119.221	0.0	31.5	17
30 min Summer	79.853	0.0	42.3	32
60 min Summer	51.110	0.0	54.3	60
120 min Summer	31.656	0.0	67.3	94
180 min Summer	23.604	0.0	75.3	126
240 min Summer	19.048	0.0	81.0	160
360 min Summer	13.964	0.0	89.1	228
480 min Summer	11.210	0.0	95.4	294
600 min Summer	9.446	0.0	100.5	356
720 min Summer	8.209	0.0	104.8	418
960 min Summer	6.571	0.0	111.8	532
1440 min Summer	4.794	0.0	122.4	764
2160 min Summer	3.491	0.0	133.8	1104
2880 min Summer	2.784	0.0	142.2	1468
4320 min Summer	2.020	0.0	154.7	2204
5760 min Summer	1.607	0.0	164.2	2936
7200 min Summer	1.345	0.0	171.8	3648
8640 min Summer	1.162	0.0	178.1	4384
10080 min Summer	1.027	0.0	183.6	5104
15 min Winter	119.221	0.0	35.3	17
30 min Winter	79.853	0.0	47.4	31

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	98.985	0.485	5.0	48.5	O K
120 min Winter	99.010	0.510	5.0	51.0	O K
180 min Winter	98.999	0.499	5.0	49.9	O K
240 min Winter	98.973	0.473	5.0	47.3	O K
360 min Winter	98.904	0.404	5.0	40.4	O K
480 min Winter	98.838	0.338	5.0	33.8	O K
600 min Winter	98.780	0.280	5.0	28.0	O K
720 min Winter	98.731	0.231	4.9	23.1	O K
960 min Winter	98.662	0.162	4.7	16.2	O K
1440 min Winter	98.608	0.108	3.9	10.8	O K
2160 min Winter	98.584	0.084	2.9	8.4	O K
2880 min Winter	98.572	0.072	2.3	7.2	O K
4320 min Winter	98.559	0.059	1.7	5.9	O K
5760 min Winter	98.552	0.052	1.4	5.2	O K
7200 min Winter	98.547	0.047	1.1	4.7	O K
8640 min Winter	98.544	0.044	1.0	4.4	O K
10080 min Winter	98.541	0.041	0.9	4.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	51.110	0.0	60.9	60
120 min Winter	31.656	0.0	75.4	102
180 min Winter	23.604	0.0	84.4	138
240 min Winter	19.048	0.0	90.8	176
360 min Winter	13.964	0.0	99.8	248
480 min Winter	11.210	0.0	106.9	314
600 min Winter	9.446	0.0	112.6	376
720 min Winter	8.209	0.0	117.4	434
960 min Winter	6.571	0.0	125.3	546
1440 min Winter	4.794	0.0	137.1	764
2160 min Winter	3.491	0.0	149.8	1108
2880 min Winter	2.784	0.0	159.3	1468
4320 min Winter	2.020	0.0	173.3	2204
5760 min Winter	1.607	0.0	184.0	2928
7200 min Winter	1.345	0.0	192.4	3640
8640 min Winter	1.162	0.0	199.5	4368
10080 min Winter	1.027	0.0	205.6	5104

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.100	Shortest Storm (mins)	15
Ratio R	0.359	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.142

Time (mins) From:	To:	Area (ha)
0	4	0.142

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Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	100.0	0.700	100.0	1.400	0.0	2.100	0.0
0.100	100.0	0.800	100.0	1.500	0.0	2.200	0.0
0.200	100.0	0.900	100.0	1.600	0.0	2.300	0.0
0.300	100.0	1.000	100.0	1.700	0.0	2.400	0.0
0.400	100.0	1.001	0.0	1.800	0.0	2.500	0.0
0.500	100.0	1.200	0.0	1.900	0.0		
0.600	100.0	1.300	0.0	2.000	0.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0105-5000-1000-5000
Design Head (m)	1.000
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	105
Invert Level (m)	98.500
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	5.0
Flush-Flo™	0.296	5.0
Kick-Flo®	0.637	4.1
Mean Flow over Head Range	-	4.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.6	1.200	5.4	3.000	8.4	7.000	12.5
0.200	4.8	1.400	5.8	3.500	9.0	7.500	12.9
0.300	5.0	1.600	6.2	4.000	9.6	8.000	13.3
0.400	4.9	1.800	6.6	4.500	10.1	8.500	13.7
0.500	4.7	2.000	6.9	5.000	10.6	9.000	14.1
0.600	4.3	2.200	7.2	5.500	11.1	9.500	14.5
0.800	4.5	2.400	7.5	6.000	11.6		
1.000	5.0	2.600	7.8	6.500	12.1		

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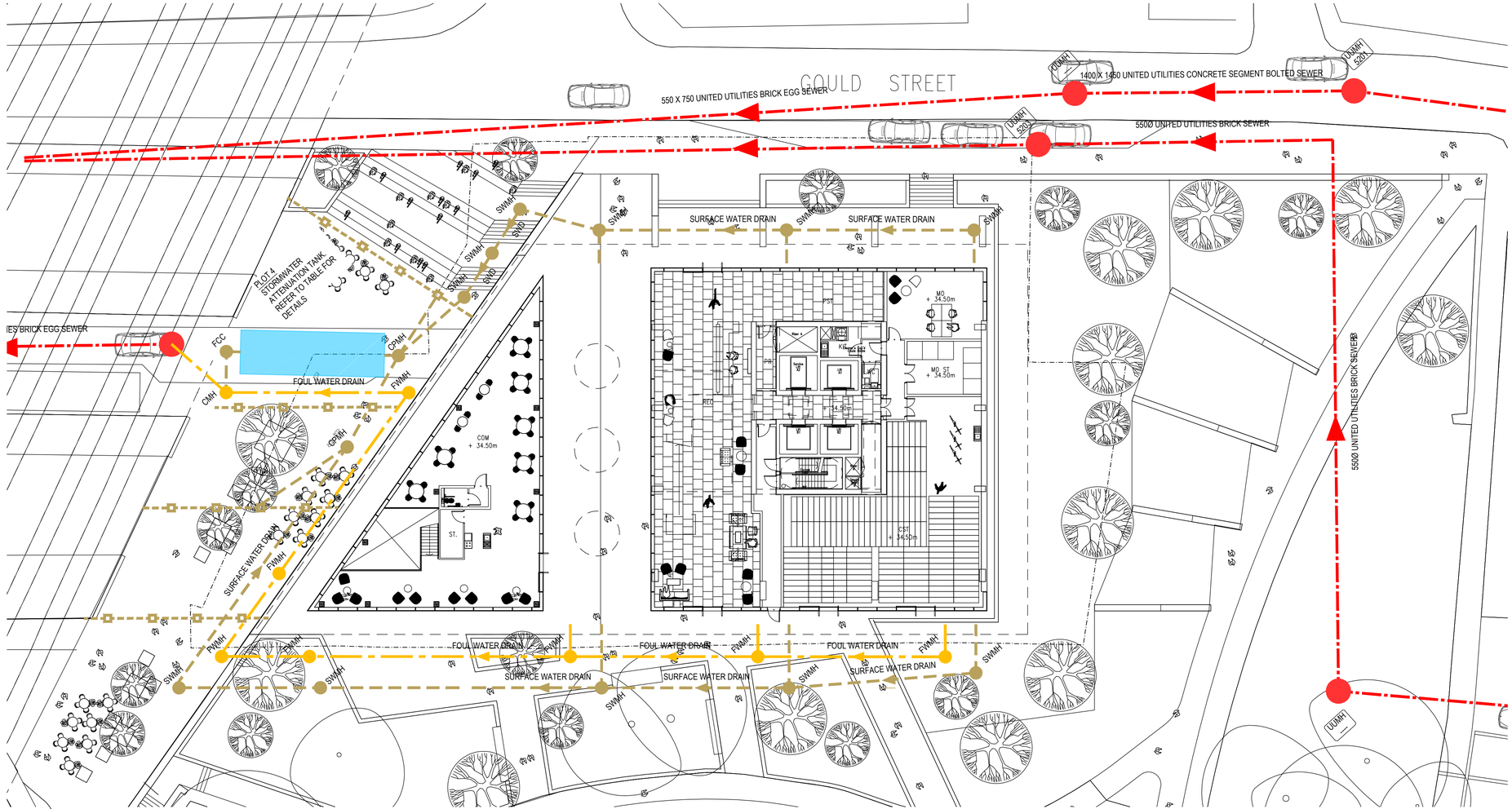
Appendix H

OUTLINE DRAINAGE STRATEGY



LEGEND

- UNITED UTILITIES COMBINED SEWER
- PROPOSED SURFACE WATER DRAIN
- PROPOSED FOUL DRAIN
- UNITED UTILITIES ACCESS CHAMBER
- PROPOSED SURFACE WATER MANHOLE
- PROPOSED FOUL WATER MANHOLE
- DIRECTION OF FLOW
- PROPOSED SURFACE WATER CHANNEL
- PROPOSED STORMWATER ATTENUATION

ABBREVIATIONS

SWMH – SURFACE WATER MANHOLE
FWMH – FOUL WATER MANHOLE
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RG – ROAD GULLY
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SW – SURFACE WATER
UU – UNITED UTILITIES

ATTENUATION TANK SIZING – BROWNFIELD RUN-OFF				
DESCRIPTION	DISCHARGE RATE	STORM EVENT	CLIMATE CHANGE	TANK VOLUME (m^3)
PLOT 2	26.41 L/S	100 YEAR	40%	99.6m^3
PLOT 3	19.5 L/S	100 YEAR	40%	59.3m^3
PLOT 4	14.53 L/S	100 YEAR	40%	62m^3
PLOT 5	23 L/S	100 YEAR	40%	81.6m^3

FOUL WATER DISCHARGE RATES			
DESCRIPTION	DISCHARGE UNITS	DISCHARGE RATE	DESIGN STANDARD
PLOT 2	1,300 DU'S	18.03 L/S	BS EN 12056
PLOT 3	654 DU'S	12.79 L/S	BS EN 12056
PLOT 4	2,089 DU'S	22.85 L/S	BS EN 12056
PLOT 5	893 DU'S	14.94 L/S	BS EN 12056

GENERAL NOTES:

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE STAGE 2 FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY REPORTS.
2. ALL DRAINAGE WORKS ARE TO BE IN ACCORDANCE WITH THE REQUIREMENTS OF SEWERS FOR ADOPTION 7TH EDITION, BS EN 752 AND APPROVED DOCUMENT H.
3. THE INFORMATION CONTAINED WITHIN THIS DRAWING HAS BEEN BASED ON THE WSP FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY AND IS INDICATIVE ONLY AND SUBJECT TO FURTHER DESIGN DEVELOPMENT.
4. THE DRAINAGE LAYOUT INDICATED ON THIS DRAWING IS INDICATIVE ONLY AND IS INTENDED TO PROVIDE PRELIMINARY INFORMATION IN RELATION TO THE BELOW GROUND DRAINAGE SYSTEMS SERVING EACH BUILDING, THE SW ATTENUATION REQUIREMENTS AND APPROXIMATE POINT OF CONNECTION WITH THE PUBLIC SEWER NETWORK.
5. FURTHER SURVEYS, INVESTIGATIONS AND COORDINATION WITH THE ARCHITECTURE, STRUCTURE AND MEP CONSULTANTS WILL BE NECESSARY.
6. THE FINAL LOCATIONS OF THE DISCHARGE CONNECTION POINTS IS SUBJECT TO THE NECESSARY APPLICATIONS AND VERIFICATION OF THE EXISTING INVERT LEVELS.
7. THIS DRAWING WAS PREPARED PRIOR TO THE COMPLETION OF THE CCTV SURVEY WORKS WHICH SHALL ASCERTAIN THE FULL EXTENT OF THE SEWER NETWORK IN THE VICINITY OF THE SITE.

SURFACE WATER NOTES:

1. THE PROPOSED SURFACE WATER DISCHARGE RATES AND STORMWATER ATTENUATION VOLUMES HAS BEEN TAKEN FROM THE WSP FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY REPORTS.
2. THE PROPOSED SURFACE WATER DISCHARGE RATES AND STORMWATER ATTENUATION TANK VOLUMES ARE SUBJECT TO AGREEMENT BY MANCHESTER CITY COUNCIL FLOOD RISK DEPARATMENT.
3. THE LOCATIONS OF ALL STORMWATER ATTENUATION TANKS ARE INDICATIVE AND SUBJECT TO FURTHER DESIGN DEVELOPMENT.
4. ALL ACCESS COVERS WILL BE FULLY SEALED TO ALLOW FOR THE SURCHARGE OF THE STORMWATER ATTENUATION TANK.

UNITED UTILITIES SEWER:

1. THE EXISTING SEWER INFORMATION INDICATED ON THIS DRAWING HAS BEEN TAKEN FROM UNITED UTILITIES SEWER RECORDS.
2. ALL INFORMATION RELATING TO THE SEWER INFRASTRUCTURE MUST BE VERIFIED PRIOR TO THE COMMENCEMENT OF THE NEXT DESIGN STAGE.
3. THE EXISTING PUBLIC SEWER NETWORK MUST BE FULLY CCTV SURVEYED PRIOR TO COMMENCEMENT OF THE DRAINAGE WORKS TO ASCERTAIN THE EXISTING CONDITION AND EXACT LINE AND LOCATION OF ALL CHAMBERS AND DRAINAGE RUNS.

DO NOT SCALE

Drawn In Accordance with

FILENAME	ORIGINATOR	TITLE	REV	DATE REC'D
05498_MP_00_1200	5 plus architects	Ground Floor GA	C	23.03.2017

General Notes:

1. The drawing shall be read in conjunction with the specification and all other relevant documents and drawings provided by WSP | Parsons Brinckerhoff.
2. The drawing indicates the design intent for the works.
3. The drawing does not indicate the precise position of services and shows the intended locations of building services items and service routes in such detail as to indicate the design. The drawing does not show all components that may be necessary to locate services in a fully coordinated manner.
4. The positions of all connection points, accessories, equipment and other building services items as shown on the drawing are approximate and for guidance in the preparation of the tender.
5. The contractor shall be responsible for the co-ordination of the installation and shall take account of all other works and trades either during or prior to their incorporation into the works.
6. Coordination working drawings, installation drawings and builders work drawings shall be prepared by the contractor.
7. WSP | Parsons Brinckerhoff is not responsible for the design and co-ordination of access platforms, access covers, gratings, ladders, stairs, rails and protecting elements required for future maintenance and operation of the works.
8. The drawing shall be used for the intended purpose only and WSP | Parsons Brinckerhoff will not be held responsible for any other use.

[Optional] 9. The drawing has been based on information provided by other parties and WSP | Parsons Brinckerhoff does not warrant the accuracy of this information.

Dimensions:

1. Dimensions shall not to be scaled from the drawing and the contractor shall be responsible for obtaining all dimensions and levels on site for the actual setting out of the works.
2. WSP | Parsons Brinckerhoff is not responsible for checking dimensions on site.
3. WSP | Parsons Brinckerhoff is not responsible for setting out grid lines, building lines etc.
4. WSP | Parsons Brinckerhoff is not responsible for dimensions used in the ordering and manufacturing of equipment and this shall be the responsibility of the contractor

Health and Safety:

1. The drawing shall be read in conjunction with the health and safety information provided in the tender documentation and/or within the pre- construction information.
2. Before commencement of works associated with the drawing refer to all relevant health and safety information for the works including residual risk information.

[Optional where existing services or existing building information is shown] 3. The drawing has been based on information provided by other parties and WSP | Parsons Brinckerhoff do not warrant the accuracy of this information Existing services.

[For projects involving existing services] 4. The position and location of all existing services are approximate only.

5. The nature and condition of the existing services shall not be relied upon and it is expected that the contractor shall verify all necessary information.
6. The drawing is to be read in conjunction with available record drawings and documentation of the site, structures and engineering services together with health and safety pre- construction information, which has been provided to WSP | Parsons Brinckerhoff.
7. WSP | Parsons Brinckerhoff is not responsible for undertaking investigations and surveys to determine the nature of the site, existing services, local conditions and restrictions likely to effect the execution of the works prior to commencement of the works.

REV	DATE	BY	DESCRIPTION	CHK	APP
P2	12.04.17	CT/LW	STAGE 2 UPDATE	CT	CH
P1	.2017	CT/LW	STAGE 2 ISSUE	CT	CH

DRAWING STATUS: STAGE 2

WSP
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www.wspgroup.com

CLIENT: FAR EAST CONSORTIUM

ARCHITECT: 5 PLUS ARCHITECTS

PROJECT: ANGEL MEADOWS
MANCHESTER

TITLE: PUBLIC HEALTH SERVICES
BELOW GROUND DRAINAGE
BUILDING 4 - GROUND FLOOR LEVEL

SCALE @ A1:	CHECKED:	APPROVED:
1:200	CT	CH

	DESIGNED:	DRAWN:	DATE:
70020194	CT/LW	CT	MARCH 2017

DRAWING No: WSP-0194-B4-510-GA-LG-101 REV: P2

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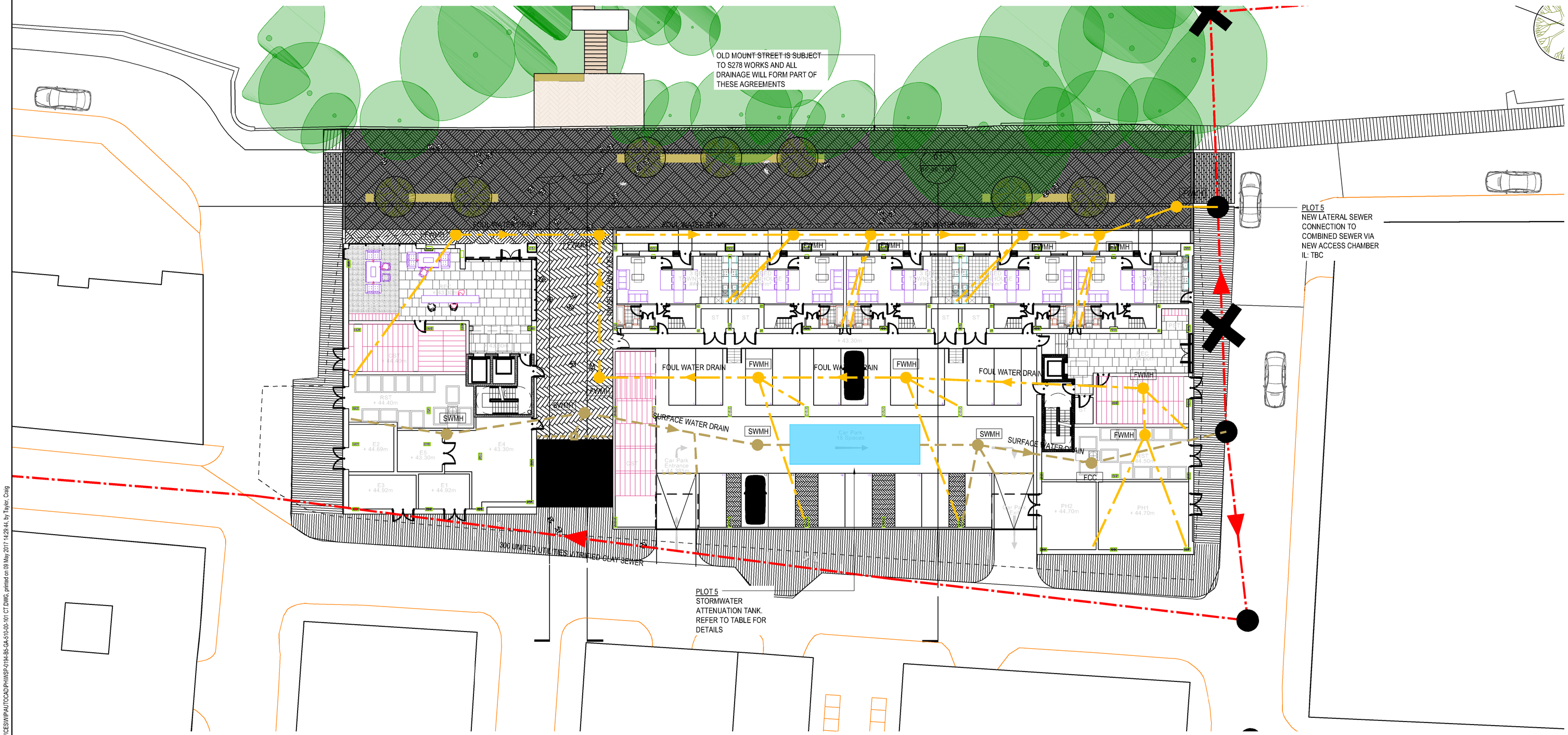
File name: \\UK.WSPGROUP.COM\CENTRAL DATA\PROJECTS\70020194 - ANGEL MEADOWS - MANCHESTER\E MODELS AND DRAWINGS\SERVICES\WIP\AUTOCAD\PH\WSP-0194-B4-GA-510-00-101.DWG, printed on 12 April 2017 17:10:40, by Curnpo4.tan

DO NOT SCALE



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REV	DATE	BY	DESCRIPTION	CHK	APP
P04	09.05.2017	CT	STAGE 2 UPDATE	CT	CH
P03	28.04.2017	CT	STAGE 2 UPDATE	CT	CH
P02	12.04.2017	CT	STAGE 2 UPDATE	CT	CH
P01	10.03.17	CT/LW	STAGE 2	CT	CH

LEGEND

- UNITED UTILITIES COMBINED SEWER
- PROPOSED SURFACE WATER DRAIN
- PROPOSED FOUL DRAIN
- UNITED UTILITIES ACCESS CHAMBER
- PROPOSED SURFACE WATER MANHOLE
- PROPOSED FOUL WATER MANHOLE
- DIRECTION OF FLOW
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ATTENUATION TANK SIZING – BROWNFIELD RUN-OFF

DESCRIPTION	DISCHARGE RATE	STORM EVENT	CLIMATE CHANGE	TANK VOLUME (m^3)
PLOT 2	26.41 L/S	100 YEAR	40%	99.6m^3
PLOT 3	19.5 L/S	100 YEAR	40%	59.3m^3
PLOT 4	14.53 L/S	100 YEAR	40%	62m^3
PLOT 5	23 L/S	100 YEAR	40%	81.6m^3

FOUL WATER DISCHARGE RATES

DESCRIPTION	DISCHARGE UNITS	DISCHARGE RATE	DESIGN STANDARD
PLOT 2	1,300 DU'S	18.03 L/S	BS EN 12056
PLOT 3	654 DU'S	12.79 L/S	BS EN 12056
PLOT 4	2,089 DU'S	22.85 L/S	BS EN 12056
PLOT 5	893 DU'S	14.94 L/S	BS EN 12056

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The Victoria, 150-182 The Quays, Salford, Manchester, M50 3SP
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DRAWING STATUS: STAGE 2

CLIENT: FAR EAST CONSORTIUM

ARCHITECT: 5 PLUS ARCHITECTS

PROJECT: ANGEL MEADOWS MANCHESTER

TITLE: PUBLIC HEALTH SERVICES BELOW GROUND DRAINAGE BUILDING 5

SCALE @ A1:	CHECKED:	APPROVED:
1:200	CT	CH
70020194	DESIGNED: CT / DRAWN: LW	DATE: MARCH 2017

DRAWING No: WSP-0194-B5-510-GA-00-101 REV: P04

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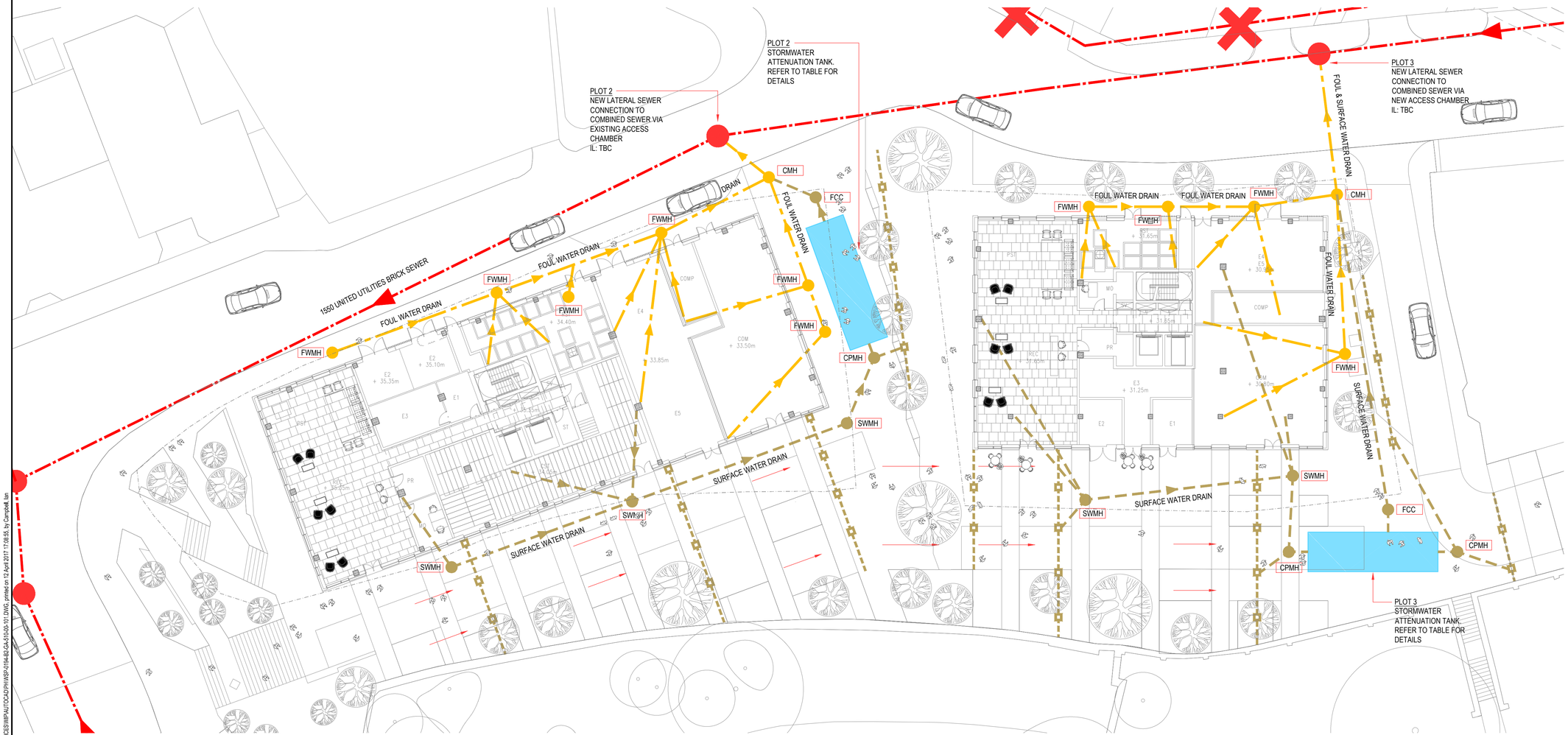
File name: \\UK.WSPGROUP.COM\CENTRAL DATA\PROJECTS\70020\XX\70020194 - ANGEL MEADOWS - MANCHESTER\E MODELS AND DRAWINGS\SERVICES\WSP\AUTOCAD\PUWSP-0194-B5-GA-510-00-101 CT.DWG, plotted on 09 May 2017 14:29:44, by Taylor, Craig



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7. THIS DRAWING WAS PREPARED PRIOR TO THE COMPLETION OF THE CCTV SURVEY WORKS WHICH SHALL ASCERTAIN THE FULL EXTENT OF THE SEWER NETWORK IN THE VICINITY OF THE SITE.

SURFACE WATER NOTES:

1. THE PROPOSED SURFACE WATER DISCHARGE RATES AND STORMWATER ATTENUATION VOLUMES HAS BEEN TAKEN FROM THE WSP FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY REPORTS.
2. THE PROPOSED SURFACE WATER DISCHARGE RATES AND STORMWATER ATTENUATION TANK VOLUMES ARE SUBJECT TO AGREEMENT BY MANCHESTER CITY COUNCIL FLOOD RISK DEPARATMENT.
3. THE LOCATIONS OF ALL STORMWATER ATTENUATION TANKS ARE INDICATIVE AND SUBJECT TO FURTHER DESIGN DEVELOPMENT.
4. ALL ACCESS COVERS WILL BE FULLY SEALED TO ALLOW FOR THE SURCHARGE OF THE STORMWATER ATTENUATION TANK.

UNITED UTILITIES SEWER:

1. THE EXISTING SEWER INFORMATION INDICATED ON THIS DRAWING HAS BEEN TAKEN FROM UNITED UTILITIES SEWER RECORDS.
2. ALL INFORMATION RELATING TO THE SEWER INFRASTRUCTURE MUST BE VERIFIED PRIOR TO THE COMMENCEMENT OF THE NEXT DESIGN STAGE.
3. THE EXISTING PUBLIC SEWER NETWORK MUST BE FULLY CCTV SURVEYED PRIOR TO COMMENCEMENT OF THE DRAINAGE WORKS TO ASCERTAIN THE EXISTING CONDITION AND EXACT LINE AND LOCATION OF ALL CHAMBERS AND DRAINAGE RUNS.

DO NOT SCALE

Drawn In Accordance with

FILENAME	ORIGINATOR	TITLE	REV	DATE REC'D
05498_MP_00_1200	5 plus architects	Ground Floor GA	C	23.03.2017

General Notes:

1. The drawing shall be read in conjunction with the specification and all other relevant documents and drawings provided by WSP | Parsons Brinckerhoff.
2. The drawing indicates the design intent for the works.
3. The drawing does not indicate the precise position of services and shows the intended locations of building services items and service routes in such detail as to indicate the design. The drawing does not show all components that may be necessary to locate services in a fully coordinated manner.
4. The positions of all connection points, accessories, equipment and other building services items as shown on the drawing are approximate and for guidance in the preparation of the tender.
5. The contractor shall be responsible for the co-ordination of the installation and shall take account of all other works and trades either during or prior to their incorporation into the works.
6. Coordination working drawings, installation drawings and builders work drawings shall be prepared by the contractor.
7. WSP | Parsons Brinckerhoff is not responsible for the design and co-ordination of access platforms, access covers, gratings, ladders, stairs, rails and protecting elements required for future maintenance and operation of the works.
8. The drawing shall be used for the intended purpose only and WSP | Parsons Brinckerhoff will not be held responsible for any other use.

[Optional] 9. The drawing has been based on information provided by other parties and WSP | Parsons Brinckerhoff does not warrant the accuracy of this information.

Dimensions:

1. Dimensions shall not to be scaled from the drawing and the contractor shall be responsible for obtaining all dimensions and levels on site for the actual setting out of the works.
2. WSP | Parsons Brinckerhoff is not responsible for checking dimensions on site.
3. WSP | Parsons Brinckerhoff is not responsible for setting out grid lines, building lines etc.
4. WSP | Parsons Brinckerhoff is not responsible for dimensions used in the ordering and manufacturing of equipment and this shall be the responsibility of the contractor

Health and Safety:

1. The drawing shall be read in conjunction with the health and safety information provided in the tender documentation and/or within the pre- construction information.
2. Before commencement of works associated with the drawing refer to all relevant health and safety information for the works including residual risk information.

[Optional where existing services or existing building information is shown] 3. The drawing has been based on information provided by other parties and WSP | Parsons Brinckerhoff do not warrant the accuracy of this information Existing services.

[For projects involving existing services] 4. The position and location of all existing services are approximate only.

5. The nature and condition of the existing services shall not be relied upon and it is expected that the contractor shall verify all necessary information.
6. The drawing is to be read in conjunction with available record drawings and documentation of the site, structures and engineering services together with health and safety pre- construction information, which has been provided to WSP | Parsons Brinckerhoff.
7. WSP | Parsons Brinckerhoff is not responsible for undertaking investigations and surveys to determine the nature of the site, existing services, local conditions and restrictions likely to effect the execution of the works prior to commencement of the works.

REV	DATE	BY	DESCRIPTION	CHK	APP
P02	12.04.2017	CT	STAGE 2 UPDATE	CT	CH
P01	10.03.17	CT/LW	STAGE 2	CT	CH

DRAWING STATUS: STAGE 2

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CLIENT: FAR EAST CONSORTIUM

ARCHITECT: 5 PLUS ARCHITECTS

PROJECT: ANGEL MEADOWS MANCHESTER

TITLE: PUBLIC HEALTH SERVICES BELOW GROUND DRAINAGE PLOTS 2 & 3

SCALE @ A1:	CHECKED:	APPROVED:
1:200	CT	CH

	DESIGNED:	DRAWN:	DATE:
70020194	CT	LW	MARCH 2017

DRAWING No: WSP-0194-B2-510-GA-00-101 REV: P02

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File name \\UK.WSPGROUP.COM\CENTRAL DATA\PROJECTS\70020\70020194 - ANGEL MEADOWS - MANCHESTER\E MODELS AND DRAWINGS\SERVICES\WIP\AUTOCAD\P#\WSP-0194-B2-GA-510-00-101.DWG, printed on 12 April 2017 17:08:55, by Campbell, Ian

Appendix I

OVERLAND FLOOD ROUTES

DO NOT SCALE

KEY
SITE BOUNDARY
DIRECTION OF OVERLAND FLOW

Notes:

1. No dimensions to be scaled from this drawing.

2. This drawing should be read in conjunction with the 100% Concept Flood Risk Assessment and Outline Drainage Strategy produced by WSP and dated 08.03.2017.

29.86 mAOD

Potential for overland flow to occur as a result of blockages within the private sewer network.

Potential for overland flow to occur as a result of blockages within the private sewer network.

31.48 mAOD

31.76 mAOD

29.92 mAOD

GOULD STREET

Potential for overland flow to occur as a result of blockages within the public sewer system or as a result of overland flow within the road.

34.64 mAOD

Potential for overland flow to occur as a result of blockages within the private sewer network.

41.22 mAOD

30.31 mAOD

36.698 mAOD

CORPORATION STREET

32.64 mAOD

32.99 mAOD

42.31 mAOD

32.59 mAOD

43.94 mAOD

44.29 mAOD

44.15 mAOD

Potential for overland flow to occur as a result of blockages within the private sewer network.

43.20 mAOD

37.15 mAOD

Potential for overland flow to occur as a result of blockages within the private sewer network.

45.02 mAOD

40.89 mAOD

REV	DATE	BY	DESCRIPTION	CHK	APD
A	07/03/2017	DP	FIRST ISSUE		

DRAWING STATUS:
FOR INFORMATION ONLY

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CLIENT: FEC International Ltd

ARCHITECT: 5Plusarchitects

PROJECT: NOMA Angel Meadows

TITLE: Overland Flow Routes

SCALE @ A0:	CHECKED:	APPROVED:
NTS	SS	SS
CAD FILE: 70020194-001	DESIGN DRAWN: DP	DATE: March 2017
PROJECT No: 70020194	DRAWING No: 70020194-001	REV: A

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