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PLOT 10A FIRST STREET, MANCHESTER

SURFACE AND FOUL WATER DRAINAGE STRATEGY

PLOT 10A FIRST STREET, MANCHESTER SURFACE AND FOUL WATER DRAINAGE STRATEGY

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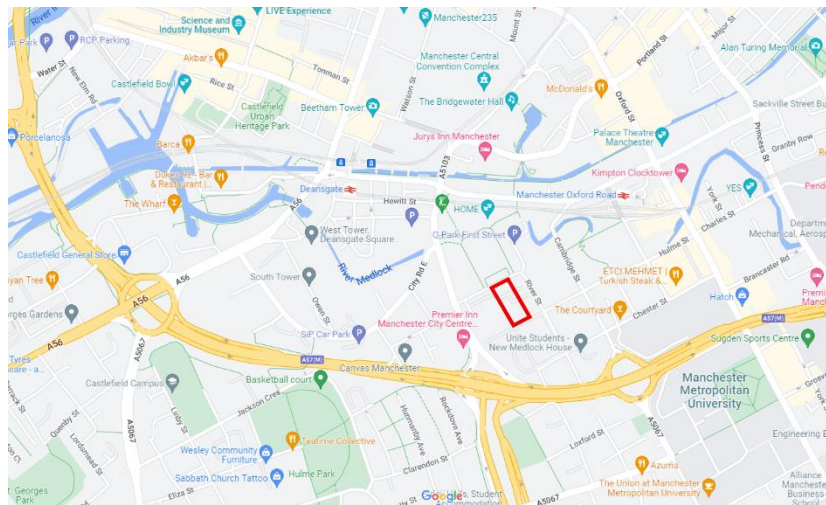
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1. INTRODUCTION

Ramboll UK Ltd has been appointed to undertake a Drainage Strategy in support of a planning application for the erection of a 13-storey building with basement comprising office accommodation (Use Class E(c)), 204 cycle spaces and associated facilities, landscaping, and associated works. The development consists of 20,155sqm of commercial office space at Plot 10a, First Street, Manchester.

The proposed development will hereafter be referred to as the "Site".

Location plans can be found below.



National Grid Ref

SJ837972

X Co-ordinates

383774

Y Co-ordinates

397280

WhatThreeWords

gravel.wallet.gains

Figure 1.1: Wider Context Site Location [Google Earth Extract ©2022 Google]



Figure 1.2: Plot Site Location [Google Earth Extract ©2022 Google]

2. SCOPE AND OBJECTIVES

2.1 Scope

This Drainage Strategy report has been prepared to support the planning application for the development of the Site. This should be read in conjunction with the Flood Risk Assessment reference 1620007819-RAM-XX-XX-RP-EV-00001 and all other planning documents.

2.2 Objectives

The specific objectives of this assessment are to establish the following:

- Existing drainage systems in and adjacent to the application site.
- Proposals for collection and discharge of surface water from the application site.
- Proposals for collection and discharge of foul water from the application site.

3. LIMITATIONS

This report has been prepared for the detailed planning application of the Site and shall not be relied upon by any third party unless that party has been granted a contractual right to rely on this report for the purpose for which it was prepared.

The findings and opinions in the report are based upon information derived from a variety of information sources. Ramboll believe these information sources to be reliable and where possible have tried to verify the information.

This report has been prepared based on the proposed end land use defined by the Client at the time of writing. If this proposed end land use is altered or changed then it will be necessary to review the findings of this report.

It should be noted that some of the aspects considered in this study are subject to change with time. Therefore, if the development is delayed or postponed for a significant period then it should be reviewed to confirm that no changes have taken place, either at the Site or within relevant legislation.

4. LEGISLATION

The following legislation has been reviewed and has been considered in preparation of the proposed drainage strategy.

4.1 Planning Policy

Government has strengthened planning policy on the provision of sustainable drainage systems (SuDS) for 'major' planning applications and this is covered in Section 14 of National Planning Policy Framework February 2019. As per the guidance issued by the Department of Communities and Local Government (DCLG), all 'major' planning applications being determined from 6 April 2015 and the NPPF 2021, must consider sustainable drainage systems.

Assessment of the suitability of sustainable drainage systems must be undertaken in accordance with Section 14 Meeting the challenge of climate change, flooding and coastal change.

The department for Environment, Food and Rural Affairs has produced a non-statutory technical standard for sustainable drainage systems.

In regard to peak discharge this states:

For greenfield developments the peak runoff rate from the development to any highways, sewer, or surface water body for the 1 in 1 year rainfall event should never exceed the peak greenfield runoff rate for the same event.

For developments which were previously developed, the peak runoff 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 close as reasonably practicable to the greenfield runoff 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.

In regard to volume control this states.

S4: Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer, or surface water body in the 1 in 100-year, 6-hour rainfall event should never exceed the greenfield runoff volume for the same event.

S5: Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway 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 runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.

S6: Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S4 or S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.

In regard to flood risk within the application site this states;

S7: 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.

S8: 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 during a 1 in 100 year rainfall event in any part of a building (including a basement); or in any utility plant susceptible to water (e.g., pumping station or electricity substation) within the development.

S9: 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 are managed in exceedance routes that minimise the risks to people and property.

4.2 Strategic Flood Risk Assessment

The Level 2 Manchester City Council, Salford City and Trafford Councils Strategic Flood Risk Assessment (SFRA) dated March 2011 has been reviewed. Criteria related to flood risk will be covered within the Flood Risk Assessment.

The SFRA states that for sites less than 1 ha in size but situated within a critical drainage area mitigation of potential surface water runoff from within the site will need to be included as part of the planning application assessments.

For critical drainage areas the SFRA states.

- Development should aim for a minimum reduction in surface water runoff rates of 50% for Brownfield sites, with an aim of reducing runoff to Greenfield rates up to a 1 in 100 year storm event, considering climate change; and
- Development should be designed so that there is no flooding to the development in a 1 in 30-year event and so that there is no property flooding in a 1 in 100 year plus climate change event.

5. CONSULTATIONS

5.1 United Utilities (UU)

Initial consultation for the scheme will soon be made with United Utilities for the Plot 10a development following the completion of the recent survey works on the surrounding sewers & services.

Based off previous experience with United Utilities, it is hoped that a strategy to be set out will be as follows:

- Foul drainage could drain to the public combined sewer network at an unrestricted rate.
- Surface water would need to drain to either soakaway or directly to watercourse unless evidence could be if this was not possible before connection to the public sewer.
- Formal sewer connection agreement would have to entered to confirm connections.
- Any adoptions would need to be in accordance with Sewers for Adoption 6th Edition and any pumping stations in accordance with United Utilities addendum to this.
- Site drainage must be designed in accordance with Building Regulations, National Planning Policy and local flood authority guidelines.

Infiltration and a connection to a watercourse is not possible for the site as has been discussed previously with United Utilities for the adjacent site, so a maximum pass forward flow rate of 5 l/s is hoped to be agreed upon.

Initial consultation has been made with United Utilities with regards to the S185 diversion proposal for the public sewers that cross the site and the response stated that they cannot fully review the proposal as a formal application is required.

Refer to Appendix 1 for a copy of the consultations to date.

5.2 Lead Local Flood Authority Manchester City Council (LLFA)

Initial communication will be made with the LLFA upon the completion of a coordinated strategy proposal with the landscape architect to confirm the viability of particular SuDS elements that depend on the landscaping to be made viable.

A surface water flow rate of 5 l/s will be proposed, which is greater than a 50% reduction in existing rates as set out within the SFRA guidance.

6. SITE DESCRIPTION

6.1 Existing Site Description

The site is located 1.3km southeast of Manchester City Centre and is located within the First Street Strategic Development Framework (SDF) 2018 area. It is part of a wider vision to create a mixed-use neighbourhood in the area, supported by a mixture of leisure, office, and residential blocks.

The application site is known as Plot 10a and is bound by River Street to the north, Plot 10b & Wilmott Street to the east, Hulme Street to the south, and two development sites known as Plot 9a & Plot 9b to the west. The site area is 0.370 ha.

The application site is currently mostly hardstanding, reflecting its recent use as a temporary car parking area ahead of the plot's permanent redevelopment, although limited positive drainage has been found on the site it is believed that this area was drained into the public sewer network. There is limited vegetation on site, limited to small shrubbery around the site.

Assessment of flood risk has determined a low baseline risk of flooding from fluvial, pluvial (surface water) and groundwater sources. Additionally, no flooding risk from artificial sources or reservoirs was identified. For the full flood risk assessment, refer to 1620007819-RAM-XX-XX-RP-EV-00001 by Ramboll.

6.2 Topography

A topographical survey was undertaken in April 2022 by Survey Operations for the Plot 9a, 9b and 10 sites.

The levels within Plot 10 indicate a level of 30.80 from the corner of River Street/Medlock Street to the Plot 10a boundary with Plot 9a. Levels then rise towards Hulme Street. A level of 33.20 is indicated where Hulme Street meets the proposed Plot 9a boundary to 33.10 where Hulme Street meets the application site boundary.

6.3 Existing Drainage

A review of the United Utilities public sewer records has been undertaken which indicates an existing 600x500 vitrified clay sewer within Hulme Street. CCTV surveys have found that public sewer manhole 7201 is 5.65m deep with an invert level of 27.57m.

The surveys found that this sewer appears to start within Hulme Street adjacent to the Plot 10 site and is therefore different from what is indicated on the sewer records. This sewer collects surface water from the gullies within Hulme Street and backdrop into the sewer.

A 590x680 brick combined public sewer is located within Plot 10 flowing from manhole 7201 to 7203. Sewer record information indicates the invert level of 7203 as 26.75.

The sewer then changes from a brick sewer to a 610mm diameter concrete sewer from manholes 7203 to 7301 with the invert level of 7301 at 26.68m.

An S104 application is due to be undertaken for the section of pipework between 7201 and 7301 as part of a separate package of works.

The sewer then heads Northeast along River Street within the Plot 10 boundary in a 610mm concrete sewer and connects into a large storage chamber outside of the site at the corner of River Street and Wilmott Street.

An S185 application is due to be undertaken to divert this pipework into River Street as part of a separate package of works.

There is a 300mm diameter outfall from the storage tank which heads South along Wilmott Street. The sewer records indicate a high level 300mm diameter overflow from the storage tank into the River Medlock although the physical surveys undertaken found that this was no longer in use. A copy of the sewer records and existing drainage drawing can be found in Appendix 2.

There is minimal private drainage within the application site currently, apart from a small system for collection of foul drainage from recent toilet facilities for the construction of No 8 First Street. Several connections from the site into the public sewer systems were found during the survey but due to the demolition of the existing buildings these have been severed within the boundary and are therefore unable to survey.

A private surface water drain is located within the existing First Street which collects surface water from No 8 First Street and associated public realm, River Street, and the existing section of First Street. This was installed as part of the First Street North development. The head of this system is at the boundary of Plot 9a.

The existing drainage can be found on drawing 7819-RAM-ZZ-XX-DR-C-000010 in Appendix 2.

6.4 Existing Surface Water Flows

The existing site, whilst it has been developed in the past currently does not have a full positive drainage system discharging from the site although connections into the sewer are visible along its length. It is not possible to model any of the existing private sections of drainage therefore both greenfield and brownfield rates have been calculated for the application site. The site is not deemed to be greenfield as it would have drained to the sewer previously.

To establish the existing peak storm run-off rates, two methods have been reviewed.

- Wallingford Procedure for brownfield developments; and
- Greenfield rates assuming a soil value of 0.50 for brownfield developments.

Table 1: Existing Run-off – Wallingford Procedure – Site Area = 0.370 ha

Return Period	Peak Run-off Rate (l/s)
M1-5	54.2 l/s
M2-5	69.0 l/s
M30-5	124.6 l/s
M100-5	156.3 l/s

Table 1: Existing Run-off - Greenfield - Site Area = 0.370 ha

Return Period	Peak Run-off Rate (l/s)
Q_{bar}	2.3 l/s
M1-5	2.0 l/s
M30-5	4.0 l/s
M100-5	4.9 l/s

7. SURFACE WATER DRAINAGE PROPOSALS

7.1 Surface Water Discharge Strategy

The following hierarchy has been reviewed regarding discharge of surface water from the Plot 10a site:

- To Ground/Infiltration
- To Watercourse
- To Sewer

Infiltration

Existing ground conditions comprise of hard standing/gravel surfacing overlying granular and cohesive made ground which overlays alluvium. It may be possible to infiltrate some of the water, however the development proposals for the application site indicate minimal external space between the 5m easement from proposed substructure, future buildings, and restrictions due to the easements of existing Cadent gas services and public sewer.

Watercourse

The River Medlock is located approximately 80m northeast of the application site and is culverted in this location. Surface water drainage was installed as part of the First Street North Development which starts at the north of Plot 9a within River Street.

The sewer records indicate there is also an overflow from the combined public sewer in the north-east corner of the site into the River Medlock, but survey work indicated this as being no longer utilised.

A review has been undertaken to determine whether a gravity connection could be installed to discharge to the watercourse. To enable a connection to be constructed a minimum of approximately 130m of 300mm pipework would be required which will need to cross existing infrastructure. Based on the information known on the existing services routing through would be complex and may require significant service diversions outside of the redline boundary in third party land or a pumped system to be installed from our site.

The private surface water drainage within First Street which discharges to the watercourse appears to drain River Street, First Street, and the existing Plot 5 and 6 buildings. A high-level capacity check of this has been undertaken to identify if there is any residual capacity for collection of Plot 9 and 10 surface water drainage. The review of the brownfield rates from the external works alone indicates that there would be limited capacity within the network for an additional connection and therefore this has been discounted.

Sewer

There are combined public sewers located within Plot 10. An S185 package is due to be undertaken to divert the public sewer into the nearby River Street to allow for the Application site's proposals. It is therefore proposed that discharge of foul and surface water from Plot 10a will be into this diverted combined public sewer.

Agreement with United Utilities on a connection into the diverted public sewer will be required via a formal S106 agreement, however the connection will be discussed during the S185 diversion works.

The proposed surface water drainage system for the application site shall be designed to adhere to the following criteria:

- No surcharging of pipework during storms up to a 1:2-year annual probability
- No flooding to occur on site during storms up to a 1:30-year annual probability

- No flooding of third-party land or buildings during storms up to a 1:100-year annual probability + 40% allowance for climate change.

7.2 Review of Sustainable Drainage Techniques

Planning policy promotes sustainable management of surface water run-off from a new development or redevelopment, and the use of SuDS is recommended. Due to the restrictions imposed on the surface water discharge attenuation will need to be incorporated within the design of the Plot 10a application site.

A review of potential sustainable drainage systems has been undertaken to identify the likely form of attenuation which could be included, and which methods are possible.

Possible Sustainable Drainage/Attenuation Systems

- **Tank/Cellular Storage:** A method involving storage tanks or geocellular crates installed below the lowest ground level that can be used to provide large volumes of storage prior to discharge. Cellular storage has the advantage of having a 95% void ratio allowing it to attenuate large volumes. The use of a tank solution is possible on this site within the section of public realm between Plot 10a and Plot 10b, possible crane base locations and the public sewer easement (subject to S185 works).
- **Increased pipe sizes:** The use of large diameter pipework could be used for attenuation and convey rainwater to the discharge point. The use of large pipes could be possible however due to the fall across the site, however space may be limited to external works spatial restrictions for other services.
- **Rainwater Harvesting:** The use of rainwater harvesting for greywater use within the buildings would decrease the volume and rate of surface water runoff. This will reduce the roof runoff in low return period events, however it cannot be considered to reduce peak flows since the drainage strategy has to assume that the rainwater tank is full and therefore overflowing. Rainwater Harvesting was considered for this scheme but as stated above must be discarded as a storage solution and therefore excluded from this drainage strategy.
- **Green/Brown Roofs:** Multi-layered system that covers the roof of a building with vegetation cover/landscaping over a drainage layer. Designed to intercept and retain precipitation, reducing the volume of run-off and attenuating peak flows. These structures are not a reliable attenuation system for extreme storm events due to the potential to become saturated. There are no proposals to install a green roof on the building due to the height or the building and future maintenance. As such the use of green roofs have been excluded from the drainage strategy.
- **Blue Roofs:** A blue roof is a system which is a method of storing water at roof level within geocellular shallow crates and restricted discharge at roof level. Cellular storage has the advantage of having a 95% voids ratio allowing it to attenuate roof drainage however this would need to be combined with additional attenuation for external works. A blue roof solution at levels 12 and 13 have been included for within the drainage strategy.
- **Permeable or porous surfaces:** Surfacing systems which allow water to infiltrate through the surface to an underlying gap-graded sub-base or into a sub-base tank and attenuated before discharge either through infiltration or restricted discharge. This use of permeable surfacing has been included for in some of the paved areas but due to space and

coordination of services it is proposed that this would need to be incorporated with other sustainable drainage options.

Sustainable Drainage Systems/Attenuation Not Possible on This Site

- Infiltration measures: Soakaways which infiltrate directly into the ground as opposed to discharging to a watercourse or sewer are only possible for small areas of the site due to the space restrictions on the site between substructure (5m away from any structure) and easements of public sewers. Due to the spatial limitations these have been discounted.
- Detention Basins: Surface storage basins are normally dry and can provide attenuation of surface water run-off in peak storm conditions. The spatial requirements for detention basins are not possible on this development.
- Swales: A grassland depression which is shallow and wider than a conventional ditch. Swales convey surface water run-off from the drained surface into a storage or infiltration system or let the surface water infiltrate directly and provide storage for peak surface water runoff flows. Swales require a large plan area for construction and therefore are not possible on this development.

The proposed strategy for the Plot 10a is to install surface water attenuation within a blue roof, small areas of permeable surfacing with collection pipework for drainage that will not infiltrate, SuDS enabled tree pit systems to capture low rainfall events and underground geocellular storage tanks.

Based on a Plot 10a site area of 0.370 ha and a discharge rate of 5.0 l/s a total storage volume will be required on site between 165m³ to 238m³.

The proposed drainage strategy is indicated on the drawing in Appendix 4.

Plot 10b surface water run-off will be constructed as a separate system and will connect into the proposed diversion works within River Street. And thus, is not being considered as part of the drainage strategy for Plot 10a.

7.3 Surface Water Discharge Calculations

There are several driving factors behind the selected discharge rate for the proposed development.

- Restrictions imposed by the LLFA to suit local and site development plans – 50% betterment on existing flows
- Restrictions imposed by the EA to suit local flood risk requirements – as per expected LLFA requirements
- Capacity of the existing downstream system
- Proposed site layout and adjacencies dictating viable space for attenuation or SuDS features.

As such, an assessment of these flows has been undertaken and can be found in the table below.

Table 7.1: Proposed Discharge Rates – Plot 9a

Return Period	Predevelopment run-off rate assuming brownfield (l/s)	Predevelopment run-off rate assuming greenfield (l/s)	50% Betterment on Brownfield (l/s)	Proposed Development Maximum Discharge Rates
M1-5	54.1	2.0	27.1	5.0 l/s
M30-5	124.7	4.0	62.3	5.0 l/s
M100-5	156.3	4.9	78.2	5.0 l/s
* M100-5 + 40% CC	218.8	6.9	109.5	5.0 l/s

** The M100 + Climate Change figure does not apply to the existing system but has been included for reference.*

Whilst the site is a brownfield site, we have tried to reduce the discharge to as close to greenfield rates as possible in line with the LLFA policies and guidance.

A review of the sustainable drainage options can be found in Section 7.4 of this report and include the option of a blue roof for this scheme.

To enable a blue roof to be included within the scheme, alongside attenuation in First Street, a minimum surface water discharge of 5.0 l/s has been calculated as practically achievable.

The split of this as this stage is 2.0 l/s peak discharge from the building and 3 l/s from the external works. The 2.0 l/s discharge from the blue roof system may be reduced following detailed design of this element. This flow rate would allow reasonable space for attenuation structures to be provided with coordination around existing services and existing easements on these services.

United Utilities will be contacted regarding the proposed maximum discharge rates, but the figure is believed to be acceptable by Ramboll.

A copy of these calculations can be found in Appendix 5.

7.4 Surface Water Design Criteria

The following British Standards and design guides shall be used for storm water design purposes. Please note that this list is not exhaustive but covers the overall general drainage requirements.

- BS EN 752 Drain and Sewer Systems Outside Buildings
- BS EN 12056-3 Gravity Drainage Systems Inside Buildings – Part 3 Roof Drainage
- BS EN 16933-2 Drain and Sewer Systems Outside Buildings – Part 2: Design
- CIRIA C753 The SuDS Manual
- HR Wallingford Wallingford Procedure for Design and Analysis of Urban Storm Drainage
- PPG3 Environment Agency Pollution Prevention Guidelines 3 (Withdrawn but remains best practice)

- SSG 2019 Sewer Sector Guidance (formerly Sewers for Adoption)
- Building Regulations 2010 Approved Document H – Drainage and Waste Disposal 2015

In accordance with Building Regulations 2010 Approved Document H, Section H5, separate foul and surface water systems shall be designed for the proposed development.

8. FOUL SEWAGE PROPOSALS

8.1 Foul Water Discharge Strategy

In accordance with Building Regulations 2010 Approved Document H, foul and surface water drainage systems will be kept separate on the application site prior to discharge.

It is hoped that United Utilities will confirm that unrestricted foul flows from Plot 10a would be acceptable into the public combined sewer system adjacent to the site at a point appropriate to the buildings construction.

The strategy for Plot 10a would be to construct a separate foul drainage system which would either connect directly into the diverted public sewer system within River street.

The below ground foul network shall be designed to achieve a minimum self-cleansing velocity of 0.70 m/s.

The foul drainage strategy is indicated on the drawing in Appendix 4.

Plot 10b foul water run-off will be constructed as a separate system and will connect into the proposed diversion works within River Street. And thus, is not being considered as part of the drainage strategy for Plot 10a.

8.2 Proposed Peak Foul Water Flows

Allowing for 6m² of office space per person the peak foul water flow rate using the Population Method as prescribed in BS EN 752, BS EN 16933-2 and British Water Flows and Loads Code of Practice has been calculated and a flow rate of 5.9 l/s has been determined.

The peak foul flow rate using the probability method has been calculated also and a flow rate of 16.3 l/s has been determined with a frequency factor of 0.5.

The proposed foul drainage pipes shall be sized using the Probability Method as prescribed by BS EN 752, BS EN 12056-2, and BS EN 16933-2.

Foul calculations can be found in Appendix 5.

8.3 Design Codes

The detailed foul drainage system will be designed in accordance with the following codes of practice:

- BS EN 752 - Drain and Sewer Systems Outside Buildings
- BS EN 12056-2 - Gravity Drainage Systems Inside Buildings – Part 2 Sanitary Drainage
- BS EN 16933-2 - Drain and Sewer Systems Outside Buildings – Part 2: Design
- SSG 2019 - Sewer Sector Guidance (formerly Sewers for Adoption)
- BW COP 4 - British Water Flows and Loads 4
- Building Regulations 2010 - Approved Document H – Drainage and Waste Disposal 2015

8.4 Summary of total discharge rate

The total discharge rate for foul and surface water has been calculated as 21 l/s for the application site.

The existing sewer outfall pipe is a 610mm diameter pipe at an approximate 1 in 300 gradient. This has a full-bore capacity of 413 l/s. CCTV survey indicates that this sewer currently serves only Plot 9 and 10.

This sewer formerly served a portion of Plot 11. However, the existing portion of sewer in Plot 11 has already been divested as part of the Plot 11 development proposals and is therefore not considered any further in this report.

The sewer discharges into a public sewer storage tank at the junction between River Street and Wilmott Street. The downstream pipe leaving the tank is a 300mm combined sewer which appears to be serving foul discharge from several existing buildings plus potentially surface water from the adjacent Macintosh Mills.

A review of the downstream levels indicates that the 300mm diameter sewer is at a gradient of 1 in 300 therefore would have a capacity of 65 l/s.

These results suggest that there is existing capacity in the system for a new connection from Plot 10a. The S185 diversion works will look to emulate that of the existing public sewer and that the existing capacity within the sewer will be maintained.

9. BREEAM Compliance Confirmation

The application site is to be designed to target BREEAM Outstanding at this stage. This drainage strategy relates to several credits within the 'Pollution' reference category under 'Pol 03 – Flood and Surface Water Management'. These credits are as follows:

9.1 Credit 2: Surface Water Runoff

As mentioned within the surface water drainage proposals, it has been determined that whilst this is a brownfield site. There are no obvious drain connections within the site into the public sewer that crosses the site.

The proposals for the surface water drainage network are for a flow rate that is as close to greenfield rates as is reasonably practical to enable all SuDS features to be utilised within the design.

9.2 Credit 3: Minimising Watercourse Pollution

To achieve this credit it requires for no discharge from the developed site for rainfall up to 5mm.

The site will be designed to achieve no flooding for a 1 in 100 year +40% climate change events. All the surface water on the site will be captured through the blue roof, drainage channels and SuDS features for this storm event, which would enable for a value greater than 5mm of rainfall to be captured and retained within the developed site.

10. MAINTENANCE OF DRAINAGE SYSTEMS

10.1 Performance Objectives

The operational maintenance need of the installed drainage system is to provide:

- a system that will continue to perform in accordance with the design;
- that the operation of the system is safe, environmentally acceptable, economically efficient and provide the client with a functional and easily operated asset.

The drainage design solution is integral with the landscaping design and any changes to this will impact on the drainage within the application site.

10.2 Maintenance Requirements

Effective maintenance includes a combination of planned and reactive tasks and looks to ensure that the system is kept in a condition where it can function as required.

The tasks may include:

- Localised repair or replacement of damaged pipework or other structures
- Removal of natural occurring sediments, abnormal obstructions etc. to restore hydraulic capacity
- Maintenance of mechanical plant
- Rodent and insect control

10.3 Maintenance Schedule

A strategy for the maintenance of the drainage elements will be developed incorporating normal regular maintenance requirements, any potential long term maintenance work and any monitoring required.

Any parties involved with the disposal of any waste materials from the underground drainage system should hold appropriate management licenses to undertake any such activities. Disposal of any site materials is required to be made in accordance with current legislation and guidance.

This initial maintenance schedule has been prepared using guidance provided in 'CIRIA C625 – Model agreements for sustainable water management systems', CIRIA 626 – Rainwater and Greywater systems, the SuDS Manual and manufacturers recommendation for specialist drainage elements.

The following table notes the likely maintenance requirements for this project and is to be developed further at the next stage of the design.

The tables below, taken from the CIRIA SuDS Manual, provides guidance on the type of operational and maintenance requirements that may be appropriate for the drainage features proposed in this Drainage Strategy report.

Table 4. Maintenance Requirements of Drainage Components (Pervious Pavements) [CIRIA SuDS manual, chapter 20]

TABLE 20.15 Operation and maintenance requirements for pervious pavements		
Maintenance schedule	Required action	Typical frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Table 5. Maintenance Requirements of Drainage Components (Attenuation Storage Tanks) [CIRIA SuDS manual, chapter 21]

TABLE 21.3 Operation and maintenance requirements for attenuation storage tanks		
Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/or internal forebays	Annually, or as required
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

In addition to the items listed above, the table below provides further guidance on type of operational and maintenance requirements that may be appropriate for the drainage features not included in the tables provided above.

Table 6: Drainage Maintenance Strategy

Drainage Feature	Regular Maintenance	Occasional/Remedial Maintenance	Monitoring
Drainage channels/Gullies	Inspections will include gratings; covers including their locking bolts; sumps and sump buckets; exposed concrete surround and adjacent surfacing. Check for accumulation of debris and silt and cleaned as necessary Gratings, frames and all associated locking parts to be checked for damage. Exposed concrete and adjacent surfacing to be checked for cracking and general damage. Check condition of inlet and outlet pipes, flow controls, baffles and isolation structures Check for accumulation of debris and silt and cleaned as necessary.	Channel cleaning will be by flushing with water or high pressure jetting (no boiling water or cleaning agent will be used). All silt buckets and sumps will be cleaned out replaced back into the units ensuring they are correctly fitted. All channel surfaces and joints will be checked and repaired as necessary. Repair/rehabilitation of inlets, outlet, overflows and vents, as required. Clean as necessary.	Inspect every 4 months or after large storm.
Catchpit Manholes/Inspection Chambers	Covers and frames to be checked for damage. Exposed concrete and adjacent surfacing to be checked for cracking and general damage. Check condition of inlet and outlet pipes, flow controls, baffles and isolation structures	All manhole and inspection chamber covers and frames to be replaced as necessary. Repair exposed concrete and surfacing as necessary Repair/rehabilitation of inlets, outlet, overflows and vents, as required.	Inspect every 6 months or after large storm.
Proprietary treatment system	Remove litter and debris and inspect for sediment, oil and grease accumulation; six monthly Change the filter media; as recommended by manufacturer Remove sediment, oil, grease and floatables; as necessary – indicated by system inspections or immediately following significant spill	Replace malfunctioning parts or structures; as required	Inspect for evidence of poor operation; six monthly Inspect filter media and establish appropriate replacement frequencies; six monthly Inspect sediment accumulation rates and establish appropriate removal frequencies; monthly during the first half year of operation, then every six months

APPENDIX 1 CONSULTATIONS

Conor O Loughlin

From: wastewaterdeveloperservices@uuplc.co.uk
Sent: 31 August 2022 17:06
To: Conor O Loughlin
Cc: Ivan Franco
Subject: RE: S185 Diversion Proposal - First Street, Manchester - UU REF: 02697206

Good afternoon Conor,

Thanks for your email. I could not approve or object to the proposed diversion without detailed information such as sewer size, material, and slope. Also, manhole locations, cover level, invert level and manholes name/reference.

Notes regarding your proposal:

- Our records show the 500 x 600 combined sewer extend past the junction of Hulme Street / Wilmot Street but your proposals only show the sewer up to Wilmot Street. If the sewer does extend past the Wilmot Street junction then the applicant must investigate that length of sewer and provide evidence that there are no live connections that will be abandoned.
- A full CCTV report needs to be provided.

Also, the S185 application will require to provide the following:

- PDF Plan at suitable scale to fit on an A3 sheet indicating grid reference, North point, road names and land marks. Site boundary edged in green and any required easements indicated as a yellow strip
- PDF of the proposed layout plan at 1:500 scale indicating all existing and proposed drainage. All new drainage to have cover and invert levels to Ordnance Datum, pipe sizes, pipe material, gradients etc. Proposed sewers should be coloured as follows: foul – brown, surface water – blue, combined – red, boundary of the site – green and easements - yellow. The value of the Ordnance Bench Mark should also be noted on this plan. If discharging to a watercourse then the top water level of the watercourse should be noted on the plan. If there is a rising main this should be indicated on the drainage plan. The title block should include scale and paper size.
- PDF (Scale 1:500 horizontal and 1:100 vertical) of the longitudinal sections indicating the existing and proposed ground levels, manhole positions with cover/invert levels, drainage, pipe diameters and materials, bedding types. If there is a pumping station, the rising main should be indicated.
- PDF 1:20 Manhole Schedules for each new manhole indicating internal layout, channel fittings up to 300mm (if over 300mm pipes then channels to be formed in Granolithic Concrete), benching widths, access type and position, rocker and cut pipes, depths to soffit and ladders, chains and safety railings where necessary.
- If not using United Utilities Standard Details, a copy of the applicable standard construction details for manholes, pipe bedding, ladders, headwalls etc.

- If surface water connections are made to the diverted sewer we require hydraulic calculations from a digital modelling software package, cross-referencing to pipe number on plan: Surface water simulations to be provided for the 1:2 year storm which should not indicate surcharging and 15, 30 and 60 minute simulations for the 1:30 year storm which should not indicate any flooding. 1 copy of the MDX file on disc 1 copy of the drainage area plan 1 copy of the foul water design
- 1 copy of the ground condition investigation report indicating ground conditions, any contamination, any conclusions and remediation
- 1 copy of the local council planning consent highlighting any drainage conditions
- 1 copy of the proposed sewer abandonment plan, identifying all live connections incorporating details of existing manholes.

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

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

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

<https://www.unitedutilities.com/builders-developers/wastewater-services/close-a-sewer/sewer-closures/>

Kind regards,



Mohammed Aljafarawi (He/Him)
 Developer Engineer
 Developer Services & Metering
 Customer Services
M: 07950474499
 unitedutilities.com

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----- Original Message -----

From: Conor O Loughlin [conor.oloughlin@ramboll.co.uk]

Sent: 23/08/2022 17:12

To: wastewaterdeveloperservices@uuplc.co.uk

Cc: ivan.franco-bastos@ramboll.co.uk

Subject: S185 Diversion Proposal - First Street, Manchester

Good afternoon,

I am writing to you to with regards to the sewers located within First street in Manchester, the sewer that connects Hulme street & River street. We have held discussions with yourselves previously under the application number 4200041958 about the potential divestment of the sewer and we may have discussed diversion works at this stage.

However, we are now looking to divert the sewer outside of the plot boundaries and would appreciate if you could provide your thoughts on the proposals? We will submit a formal application in due course, but we have just today finished off the undertaking of the various surveys that we would accompany this application upon issue to yourselves.

I have attached a sketch with an outline strategy of the diversion works, if you have any comments please do let me know. The key questions with regards to this are:

1. Are you happy with these diversions in principal subject to detailed design?
2. Would we require a S104 application for the abandonment of the sewer connecting Hulme Street to River street?

If you would like to discuss the proposals further prior to comments also, that is also fine we can arrange to discuss the proposals along with the results of the various surveys that have been undertaken. Please let me know if this is something you would like to do?

Thank you,

Kind regards
Conor O'Loughlin

BEng (Hons)
Apprentice Engineer
1621993 - Highways North

D +44 1244 606661
M +44 7870 806776
conor.oloughlin@ramboll.co.uk

Connect with us  

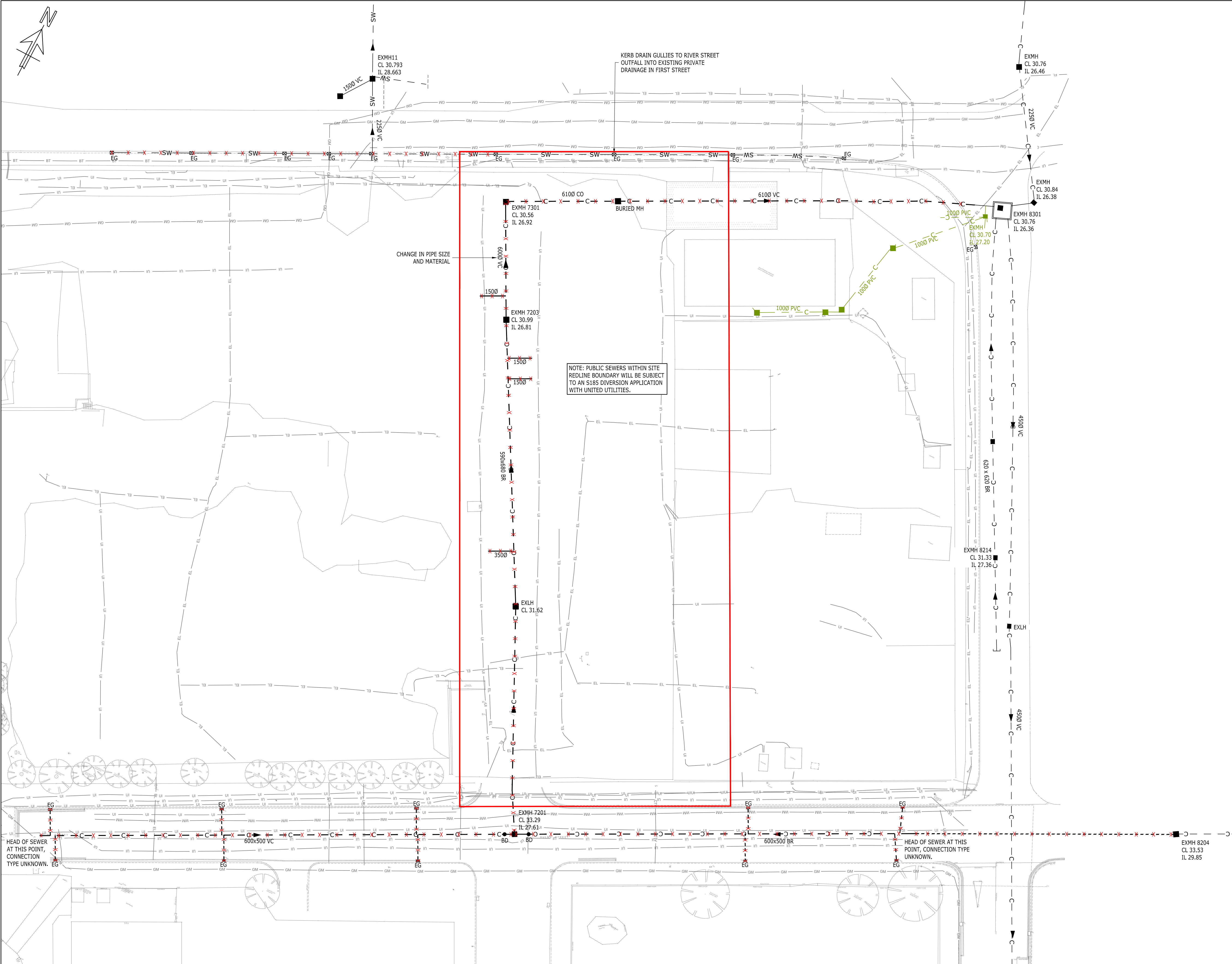
Ramboll

2nd Floor, The Exchange
St. John Street
Chester
CH1 1DA

<https://uk.ramboll.com>

APPENDIX 2

EXISTING DRAINAGE INFORMATION



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KEY

EXMH	CL	EXISTING MANHOLE
IL		
EG		EXISTING GULLY
C		EXISTING COMBINED UNITED UTILITIES SEWER
C		EXISTING COMBINED PRIVATE DRAIN
SW		EXISTING PRIVATE SURFACE WATER DRAIN
		ASSUMED EXISTING DRAIN
UTL		UNABLE TO LIFT
BD		BACKDROP INTO MANHOLE
EG		RED LINE - PLOT 9a BOUNDARY
EG		EXISTING GULLY TO BE REMOVED
SW		EXISTING PRIVATE SURFACE WATER DRAIN TO BE REMOVED

P02	PLANNING ISSUE - REDLINE BOUNDARY UPDATED	13/01 2023	CO SP	NM
P01	PLANNING ISSUE	16/09 2022	CO SP	NM
Rev	Description	Date	By Chk	App

PLANNING

PLOT 10A
FIRST STREET
MANCHESTER

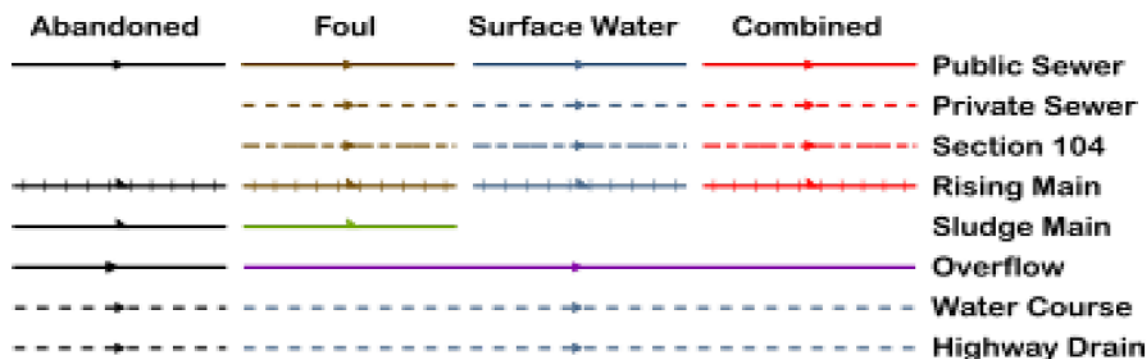
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tel 01244 311855 chester@ramboll.co.uk
www.ramboll.co.uk

EXISTING BELOW GROUND DRAINAGE

Project No:	Scale (@A1):	Drawn:	Date:
1620007819	1:250	CO	09/2022
Drawing No:			Rev
RAM-ZZ-XX-DR-C-000010			P02

Wastewater Symbolology



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

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



Scale: 1:1667
Date: 18/02/2020

SEWER RECORDS

Address or Site Reference: 20B030
Printed by: Property Searches

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

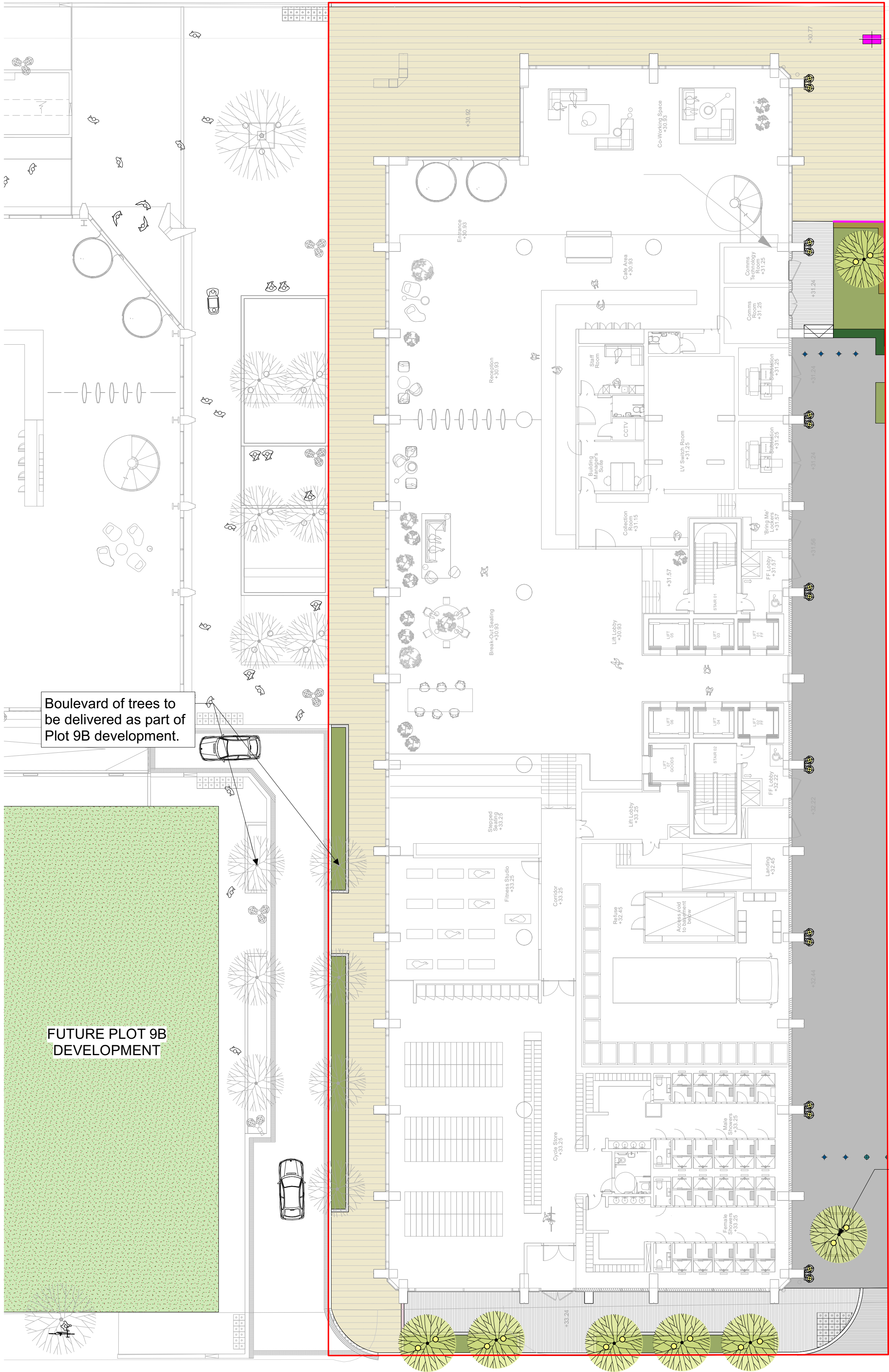
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APPENDIX 3 PROPOSED LANDSCAPE PLAN

RIVER STREET

WILMOTT STREET

HULME STREET

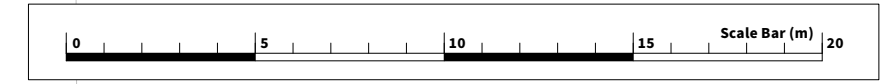


Boulevard of trees to be delivered as part of Plot 9B development.

FUTURE PLOT 9B DEVELOPMENT

MEANWHILE LAWN
Species rich wildflower lawn to be installed on plot 10B

Tree in planter to be delivered as part of plot 10B development. Access required for servicing to plot 10A.



KEY	HARDWORKS	SOFTWORKS
Application Boundary	YORKSTONE FLAG PAVING - Sandstone paving to match specification of existing First Street surfacing	SEMI-MATURE TREE - Proposed
	LINEAR CONCRETE BLOCK - Option to use permeable system	SHRUB/PERENNIAL PLANTING
	PERMEABLE CEDEK SURFACING - Option bound gravel finish	HEDGE - Instant, trough grown, 1.2m high, 1m troughs
	INSITU CONCRETE SURFACING	TEMPORARY MEANWHILE USE LAWN - Species rich wildflower lawn to be installed to future Plot 10B - To be removed before the construction of Plot 10B
	UPSTAND KERB - Granite upstand kerb; W: 300mm, H: 60mm	
	FLUSH KERB - PLANTER EDGING - Granite flush kerb; W: 200mm	
	FLUSH KERB - Granite flush kerb; W: 200mm	
	GRANITE STEPPS	
	GRANITE BLISTER HAZARD PAVING	
	TEMPORARY TIMBER RAILING To be removed before the construction of Plot 10B	

LIGHTING	FURNITURE
BUILDING MOUNTED LIGHTING	PROPOSED FIXED BOLLARD Bo1 Bo2 - Automatic telescopic bollards
SEAT STRIP LIGHTING	TREE PLANTER 3m x 2m - To Hulme Street site entrance
PLANTING UPLIGHTER - In soft	TIMBER BENCH
	WAY FINDING TOTEM

Revision	Date	Description	Drawn	Apprvd.
S1-P04	11-01-23	Minor amendments	YH	RM
S1-P03	04-01-23	Layout update	YH	RM
S1-P02	15-09-22	Layout update	VE	RM
S1-P01	02-09-22	First Issue	VE	RM

Client	Ask	
Project	First Street Plot 10a	
Drg Title	General Arrangement	
Created on	Created by	Approved by
02-09-22	YH	RM
Scale	Size	Workstage
1:200	A1	For comment
Drg No.	PL1471.2-PLA-ZZ-00-DR-L-001	
Suitability	Revision	
S1	P04	

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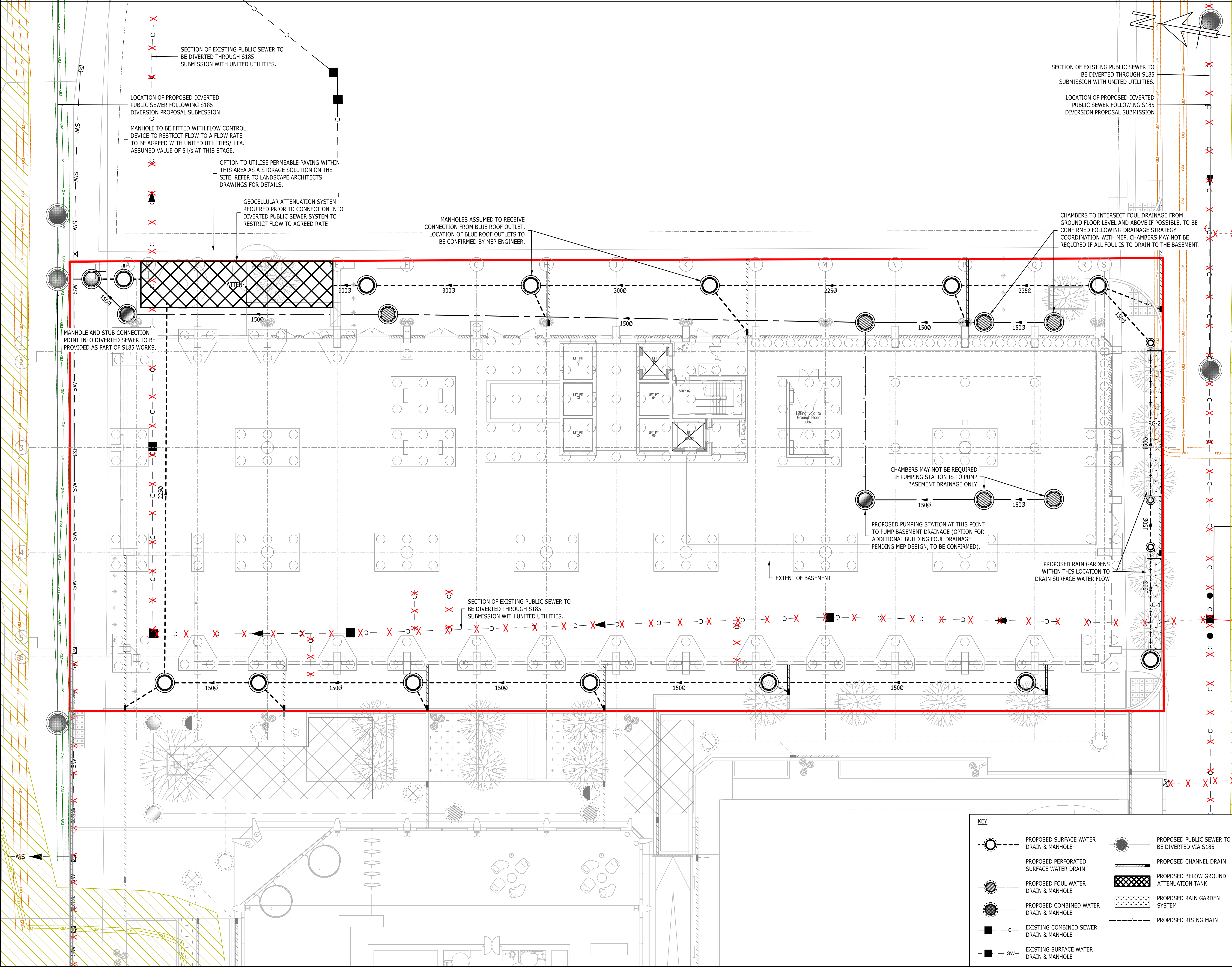
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NOTES:

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- All setting out, levels and dimensions to be agreed on site.
- The dimensions of all materials must be checked on site before being laid out.
- This drawing must be read with the relevant specification clauses and detail drawings.
- Order of construction and setting out to be agreed on site.

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APPENDIX 4 PROPOSED DRAINAGE STRATEGY



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 - THIS LAYOUT IS BASED ON:
 - FOUNDATION LAYOUT BY RAMBOLL
 - LANDSCAPE ARCHITECTS LAYOUT BY PLANIT
 - BASEMENT LAYOUT BY JMA
 - THIS DRAWING IS A CONCEPT DESIGN AT THIS STAGE THEREFORE IS SUBJECT TO CHANGE ONCE INFORMATION IS AVAILABLE ON FOUNDATIONS, STACK LOCATIONS, BLUE ROOF DESIGN, PROPOSED EXTERNAL LEVELS AND FLOW RATES.
 - 5 l/s SURFACE WATER DISCHARGE AND UNRESTRICTED FOUL FLOWS HAVE BEEN ASSUMED AND WILL BE DISCUSSED WITH UNITED UTILITIES FOR A CONNECTION INTO THE PUBLIC SEWER SYSTEM. AWAITING CONFIRMATION FROM THE LEAD LOCAL FLOOD AUTHORITY OF THIS STRATEGY THEREFORE CHANGES MAY BE REQUIRED ONCE CONSULTATIONS HAVE BEEN COMPLETED.
 - SURFACE WATER FROM THE ROOF IS ASSUMED TO COLLECT INTO A 100mm DEEP BLUE ROOF SYSTEM WITH FOUR DOWNPIPES BELOW GROUND WITH COMBINED DISCHARGE OF 2 l/s. CONFIRMATION OF THIS DESIGN BY SPECIALIST.
 - ALL PIPE SIZES AND LEVELS ARE TO BE INDICATIVE AT THIS STAGE.

P02	PLANNING ISSUE - REDLINE BOUNDARY UPDATED	13/01/2023	CO SP	NM
P01	DRAFT ISSUE FOR PLANNING	18/09/2022	CO SP	NM
Rev	Description	Date	By Chk	App

FOR PLANNING

PLOT 10a
FIRST STREET
MANCHESTER

RAMBOLL

tel 01244 311855 chester@ramboll.co.uk
www.ramboll.co.uk

PROPOSED DRAINAGE
STRATEGY

Project No:	Scale (@A1):	Drawn:	Date:
1620007819	1:150	CO	AUG 22
Drawing No:	Rev:		
RAM-XX-XX-DR-C-00100	P02		

APPENDIX 5 CALCULATIONS

[Print](#)[Close Report](#)

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:

Site name:

Site location:

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:

Longitude:

Reference:

Date:

Runoff estimation approach

Site characteristics

Total site area (ha):

Methodology

Q_{BAR} estimation method:

SPR estimation method:

Soil characteristics

	Default	Edited
--	---------	--------

SOIL type:	4	4
------------	--------------------------------	--------------------------------

HOST class:	N/A	N/A
-------------	----------------------------------	----------------------------------

SPR/SPRHOST:	0.47	0.47
--------------	-----------------------------------	-----------------------------------

Hydrological characteristics

	Default	Edited
--	---------	--------

SAAR (mm):	879	879
------------	----------------------------------	----------------------------------

Hydrological region:	10	10
----------------------	---------------------------------	---------------------------------

Growth curve factor 1 year:	0.87	0.87
-----------------------------	-----------------------------------	-----------------------------------

Growth curve factor 30 years:	1.7	1.7
-------------------------------	----------------------------------	----------------------------------

Growth curve factor 100 years:	2.08	2.08
--------------------------------	-----------------------------------	-----------------------------------

Growth curve factor 200 years:	2.37	2.37
--------------------------------	-----------------------------------	-----------------------------------

Notes

(1) Is $Q_{BAR} < 2.0$ l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is $SPR/SPRHOST \leq 0.3$?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	2.33	2.33
1 in 1 year (l/s):	2.03	2.03
1 in 30 years (l/s):	3.96	3.96
1 in 100 year (l/s):	4.85	4.85
1 in 200 years (l/s):	5.53	5.53

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

PLOT 10 MANCHESTER CALCULATION SHEET

1. Site Information

Nearest Postcode: M15 4RB XY Coordinates: 383774, 397280
M5-60: 18.000 mm r: 0.365 z₁: 0.360

2. Drained Area Calculations

For the following Greenfield calculations, the following hard standing areas will be utilised:

- Redline Boundary Area: 3,700 m² or 0.370 ha
- Plot 10 Building Area at Roof Level: 2,600 m² or 0.260 ha
- Plot 10 Building Area at Ground Level: 2,350 m² or 0.235 ha
- Plot 10 Externals Area: 1,350m² or 0.135 ha

3. Greenfield Calculations

These results were produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The outputs from this tool are estimates of greenfield runoff rates, see below:

Storm Event	Redline Boundary Area	Plot 10 Roof Area	Plot 10 Externals Area
Qbar	2.33 l/s	1.64 l/s	0.85 l/s
1 in 1 year	2.03 l/s	1.43 l/s	0.74 l/s
1 in 30 year	3.96 l/s	2.79 l/s	1.45 l/s
1 in 100 year	4.85 l/s	3.41 l/s	1.77 l/s
1 in 200 year	5.53 l/s	3.88 l/s	2.02 l/s

Plot 9a utilises an overall flow rate of 7.5 l/s for an overall area of 0.510 ha. Plot 10 is approximately 70% of the Plot 9a area.

4. Brownfield Calculations

During previous consultations with united utilities & the LLFA on other schemes a 50% betterment was required, so the following calculations are the areas with a betterment of 50% for the entire site & for the externals only.

Redline Boundary Area		
Storm Event	Existing Runoff	Proposed Discharge with a 50% Betterment
M1 - 5	54.152 l/s	27.076 l/s
M2 - 5	69.001 l/s	34.500 l/s
M5 - 5	89.089 l/s	44.545 l/s
M30 - 5	124.609 l/s	62.304 l/s
M100 - 5	156.343 l/s	78.172 l/s

Plot 10 Externals Area		
Storm Event	Existing Runoff	Proposed Discharge with a 50% Betterment
M1 - 5	19.758 l/s	9.879 l/s
M2 - 5	25.176 l/s	12.588 l/s
M5 - 5	32.506 l/s	16.253 l/s

M30 - 5	45.465 l/s	22.733 l/s
M100 - 5	57.044 l/s	28.522 l/s

5. Storage Estimates

5.1 Quick Storage Calculations

Using a combined runoff rate to calculate a quick storage estimate for various elements of the site (excluding façade areas) for a 1 in 100 year + 40% CC event.

- Redline Boundary Area: 3,700 m² or 0.370 ha
 - Greenfield Rate, 2.0 l/s: 219m³ to 307m³
 - Brownfield Betterment, 27.0 l/s: 75m³ to 138m³
 - Expected Rate, 5.0 l/s: 165m³ to 238m³
- Plot 10 Building Area at Roof Level: 2,600 m² or 0.260 ha
 - Greenfield Rate, 1.5 l/s: 151m³ to 212m³
 - Expected Rate, 2.0 l/s: 138m³ to 196m³
- Plot 10 Externals Area: 1,350m² or 0.135 ha
 - Greenfield Rate, 0.75 l/s: 78m³ to 109m³
 - Brownfield Betterment, 10 l/s: 27m³ to 50m³
 - Expected Rate, 3 l/s: 50m³ to 75m³

5.2 Blue Roof Initial Design

To gain a better understanding of the feasibility of a blue roof system being utilised for Plot 10 over the several roof levels an exercise has been carried out to assess blue roof capacity on each level. A 100mm depth crate has been assumed at this stage.

5.2.1 Available Areas

The area breakdown is as follows:

- Level 13:
 - Total Area: 480 m² or 0.048 ha
 - Available Area: 440 m² or 0.044 ha
- Level 12:
 - Total Area: 1900 m² or 0.190 ha
 - Available Area: 1680 m² or 0.168 ha
- Level 11:
 - Total Area: 100 m² or 0.010 ha
 - Available Area: N/A

5.2.2 Feasibility for 100mm Crate

To consider the feasibility the volume of storage required has been calculated based on areas.

- Level 13 (20% of roof area):
 - Greenfield Rate, 0.3 l/s: 30m³ to 42m³
 - Expected Rate, 0.4 l/s: 28m³ to 39m³
- Level 12 (80% of roof area):
 - Greenfield Rate, 1.2 l/s: 121m³ to 170m³
 - Expected Rate, 1.6 l/s: 110m³ to 157m³

Based on a 95% void ratio (standard for cellular crates), the evaluation is as follows based off the higher limit for the storage.

- Level 13 (20% of roof area):
 - Greenfield Rate, 42m³: 445m² required – **NOT** feasible

- Expected Rate, 39m³: 410m² required – feasible
- Level 12 (80% of roof area):
 - Greenfield Rate, 170m³: 1790m² required – **NOT** feasible
 - Expected Rate, 157m³: 1650m² required – feasible

6. Foul Flow Calculations

Due to the nature of the office space the peak foul flow rate will only occur for a typical office working day. Therefore, an eight-hour peak period will be utilised for the calculations. All below ground drainage will be designed to sustain a self-cleansing velocity during quitter periods.

At this stage, above ground flow calculations have not been undertaken so flow rates are subject to change.

To assess the foul flow calculations the population & expected probability rates as outlined within BS EN 752 & BS EN 12056 will be calculated and will be compared to gain an understanding of the flow rate.

6.1 Population Method

At this moment in time, occupancy figures have not been provided for the proposed Plot 10a building. However, utilising information within building regulations Approved Document B2, 'Fire safety: Buildings other than dwelling houses' Table C1 – Floor space factors. The floor space factor for an office is stated as 6.0 m² / person. The most area schedules (as of 14/06/2022) states the following office space per floor.

Grnd	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th	9 th	10 th	11 th	12 th	Total
0	1539	1878	1878	1878	1878	1878	1878	1878	1878	1878	1878	0	20319

Occupancy value: 1 person per 6m² therefore 20319 / 6 = 3386.5 people, round down.

A total area of 20,319m² would provide a maximum occupancy value of 3,386.

To establish the expected flow per person 'Flows & Loads 4' will be utilised to determine the most suitable scenario. The most applicable activity would be 'Office / Factory without canteen' which gives a base flow of 50 litres per person per day. Applying this value to the 3,386 expected capacity of the stand, a total foul flow volume can be calculated.

Therefore, $U = 3386 * 50 \text{ l/p/d} = 169,300 \text{ litres}$.

As mentioned previously, an eight-hour duration for an event is being utilised for a peak value for the foul flows. The peak foul flow, Q_{pop} can be calculated as follows:

$$Q_{pop} = \frac{U \text{ (in litres)}}{t \text{ (in seconds)}} \text{ l/s}$$

Therefore, $Q_{pop} = 169300 / (8 * 60 * 60) = 5.89 \text{ l/s}$

6.2 Probability Method

The number of appliances below are as per JMA layout dated 09/09/2021. Number of floor gullies have been assumed within plant spaces. For these calculations 'System II: Single discharge stack system with small bore discharge branch pipes' will be utilised, and a frequency factor of 0.5 will be utilised which is used for 'Intermittent use, e.g. in dwelling, guesthouse, office'.

The breakdown of the appliances are as follows:

- Ground floor (level 0): 7 WC's, 20 Showers, 1 Sink, 13 Wash hand basins, 6 FG's (assumed)
- Level 1 to 11 per floor: 18 WC's, 1 Sink, 18 Wash hand basins

- Total:
 - 207 WC's (2.0 DU): 414 DU
 - 213 Wash hand basins (0.3 DU): 63.9 DU
 - 20 Showers without plug (0.4 DU): 8 DU
 - 13 Sinks (0.6 DU): 7.8 DU
 - 8 Floor Gullies (1.2 DU): 9.6
 - Assume additional 40 DU for potential kitchen
 - Total DU: 543.3

Peak foul flow, Q_{ww} can be calculated as follows: $Q_{ww} = k\sqrt{\sum DU}$
Therefore, $Q_{ww} = 0.5 * \sqrt{543.3} = 16.3$ l/s

Note, this value may increase/decrease dependent on any design changes at detailed design.