



Project No

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Project

Withington Hospital CDC

Title

Surface Water Management Report

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1. Introduction

This surface water management report has been prepared by CCS Consulting in support of a full planning application for a new Endoscopy & Cardiorespiratory Development building at Withington Community Hospital, Manchester, M20 2LR (hereafter referred to as the 'Site').

The report describes and demonstrates how the surface water run-off rate and volume from the post development site will be managed to adhere to National and local planning policy, regulations, and relevant design guidance, which include:

- National Planning Policy Framework (NPPF), July 2021 Paragraphs 153-158 and 159-169;
- National Planning Practice Guidance (NPPG);
- Principles of Sustainable drainage systems (SuDS) set out by DEFRA (2011);
- CIRIA (2010) Planning for SuDS;
- Ciria SuDS Manual C753 (2015);
- Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015);
- Manchester City, Salford City and Trafford Councils Level 1 SFRA (May 2010);
- Manchester City, Salford City and Trafford Councils Level 2 SFRA (March 2011);
- Manchester City Council – Local Flood Risk Management Strategy (March 2014);
- Manchester Local Development Framework – Core Strategy Development Plan (July 2012).

Manchester City Council, acting as Lead Local Flood Authority (LLFA), need to be satisfied that the design and drainage principles of the proposed development will address the surface water management and risk of flooding within the site; will ensure that the drainage is managed and maintained for its lifetime to prevent flooding; and will ensure that the development will not increase the risk of flooding to neighbouring land and property.

The report is formatted such that it identifies and references appropriate design parameters, shows by calculation how the proposed drainage strategy can meet the various requirements and ultimately controls, mitigates and reduces future flood risk both on and off site.

2. Planning Policies and Guidance

2.1. National Planning Policy Framework (NPPF) and National Planning Practice Guidance (NPPG)

The NPPF (July 2021) sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally prepared plans for housing and other development can be produced. This document is used to form this surface water management report, with particular attention to Paragraphs 153 to 158 Planning for Climate Change, and Paragraphs 159 to 169 Planning for Flood Risk.

NPPG, Paragraph 051 states that sustainable drainage systems (SuDS) are designed to control surface water run off close to where it falls and mimic natural drainage as closely as possible, where they provide opportunities to reduce the causes and impacts of flooding; remove pollutants from urban run-off at source; and to combine water management with green space with benefits for amenity, recreation, and wildlife.

Further to this NPPG, Paragraph 080 states that the aim should be to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable which (in order) are into the ground (infiltration); to a surface water body; to a surface water sewer, highway drain, or another drainage system; to a combined sewer.

2.2. Flood and Water Management Act

The Flood and Water Management Act takes forward some of the proposals from three previous strategy documents published by the UK Government - Future Water (2008), Making Space for Water (2008) and the UK Government's response to the Sir Michael Pitt's Review of the summer 2007 floods. In doing so it gives the EA a strategic overview role for flood risk, and gives local authorities responsibility for preparing and putting in place strategies for managing flood risk from groundwater, surface water and ordinary watercourses in their areas.

2.3. Manchester Local Development Framework – Core Strategy Development Plan

Relevant Policy EN 08 states:

'All new development will be expected to be adaptable to climate change in terms of the design, layout, siting, and function of both buildings and associated external spaces. In achieving developments which are adaptable to climate change developers should minimise flood risk by appropriate siting, drainage, and treatment of surface areas to ensure rainwater permeability, and will be permitted to use green infrastructure elements such as green roofs'.

Relevant Policy EN 14 states:

'All new development should minimise surface water run-off, including through Sustainable Drainage Systems (SUDS) and the appropriate use of Green Infrastructure. Developers should have regard to the surface water run-off rates in the SFRA User Guide. In CDAs, evidence to justify the surface water run-off approach / rates will be required'.

Relevant Policy EN 17 states:

'Development should avoid any adverse impact on water quality, including during the construction phase, and wherever possible should seek to enhance water quality, both chemical and ecological; Development should minimise surface water run-off from development and associated roads, and maximise the use of appropriate sustainable drainage systems, to minimise groundwater contamination, and to avoid pollutants reaching watercourses; Development close to a watercourse should also ensure that waste or litter cannot enter the watercourse from the site; Development should, where feasible and appropriate, seek to open up any culverted or hidden watercourse beneath the site to improve the ecological status of that watercourse'.

3. Site Setting and Description

3.1. Site Location

The Site is part of Withington Community Hospital and is in residential area of West Didsbury, which is approximately 1.5km south-west of Mauldeth Road station, approximately 1km west of Brennage station, and is bound by existing hospital car parking and building leading to Nell Lane the north, Burton Road to the east, Fielden Road to the south, and hospital buildings leading onto Elizabeth Slinger Road to the west. The address of the site is Withington Community Hospital, Manchester, M20 2LR, with co-ordinates for the centre of the site being, Easting: 383735, Northing: 392005.

3.2. Existing Site and Topography

As detailed on the topographical survey in Appendix A, the Site is currently undeveloped and consists of trees, shrubs and grassed areas, and therefore is deemed to be greenfield. The site has a general fall from the centre towards the Site boundary, where the levels range from approximately 34.24m AOD to approximately 32.49m AOD.

3.3. Proposed Development

The proposed site is shown on the development plans in Appendix B, with a full description of the Site being stated by the Architect. In brief, and in relation to this surface water management report, the proposed development is to build a new hospital building to the centre of the site, with an access road to the south and west, car parking to the centre / west, and soft-landscaping areas around the site boundary and adjacent to the car park.

3.4. Ground Conditions

The ground conditions can be determined by the British Geological Survey (BGS) website, where it shows the Site to have superficial deposits of Glaciofluvial deposits (sands and gravels) over bedrock consisting of Wilmslow Sandstone Formation (sandstone). The BGS website also shows borehole log data adjacent to the Site in Burton Road (see Appendix C), which shows made ground to a depth of 2.20m, over coarse sand to a depth of 3.90m, over clay. The borehole also indicates ground water level rising in the coarse sand layers up to 3.00m bgl.

3.5. Waterbody / Rivers / Canals

There are no known waterbodies, rivers or canals near to the development site, with the nearest being the River Mersey approximately 250m to the south, and Platt Brook approximately 2.5 km to the north.

3.6. On-Site Drainage and Public Sewers

As detailed on the United Utilities asset plan in Appendix D, there is an 825 x 1200mm surface water sewer in Burton Road (west of site), a 525mm diameter combined water sewer in Burton Road (west of site), and a 300mm diameter combined water sewer in Fielden Road (south of site).

As the site is undeveloped it is believed that there are no drainage networks within the development / site boundary. The topographical survey however identifies existing foul and surface water networks serving the existing hospital building to the north. In particular, and relevant to this report, the topographical survey shows a 225mm diameter surface water network which is believed to discharge to the surface water sewer in Burton Road.

3.7. Surface Water Management Areas

The Site boundary area is approximately **5,510m² / 0.551 ha**.

The pre-development surface water run-off from within the site boundary will discharge off the site at a greenfield rate, with an urban factor of 0.

Surface water run-off from the building, access road and car park equate to **3,030m² / 0.303 ha** and will form the surface water management area, with the surface water run-off from the soft-landscaping areas continuing to discharge off the site at a natural / greenfield rate.

4. Surface Water Management Principles

The surface water for the development site is to be managed so that it adheres to the current national regulations and local authority requirements.

4.1. Run-Off Destination

Surface water run-off is to discharge to one or more of the following in the order of priority shown:

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

4.2. The Management Train

A concept fundamental to implementing a successful SuDS scheme is the management train. This is a sequence of SuDS components that serve to reduce run-off rates and volumes and reduce pollution. The hierarchy of techniques that are to be used for the surface water management of the development are:

- Prevention - Prevention of run-off by good site design and reduction of impermeable areas;
- Source Control - Dealing with water where and when it falls (e.g. infiltration techniques);
- Site Control - Management of water in the local area (e.g. swales, detention basins);
- Regional Control - Management of run-off from sites (e.g. balancing ponds, wetlands).

4.3. Design Principles

The design principles for the surface water management of the development will be to:

- Ensure that people, property, and critical infrastructure are protected from flooding;
- Ensure that the development does not increase flood risk off site;
- Ensure that SuDS can be economically maintained for the development.

4.4. Peak Surface Water Flow

Non-Statutory Technical Standards for Sustainable Drainage Systems states:

S2 *For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100-year rainfall event should never exceed the peak greenfield runoff rate for the same event.*

4.5. Volume Control

National Non-statutory technical standards for sustainable drainage systems 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.

4.6. Flood Risk within Development

National Non-statutory technical standards for sustainable drainage systems 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’.

4.7. Pollution / Water Quality

The SuDS design for the development site will ensure that the quality of any receiving water body is not adversely affected and preferably enhanced in accordance with Ciria SuDS Manual C753, Chapter 4.

4.8. Designing for Exceedance

The development site design will be such that when SuDS features fail or are exceeded, exceedance flows do not cause flooding of properties on or off site. This is achieved by completely containing the surface water within the drainage system (including areas designed to hold or convey water) for all events up to a 1 in 30-year event. The design of the site ensures that flows from rainfall more than a 1 in 100-year rainfall event are managed in exceedance routes that avoid risk to people and property both on and off site.

5. Surface Water Run-Off Destination

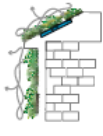
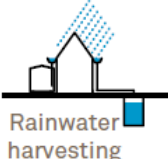
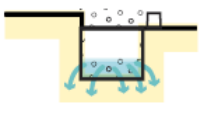
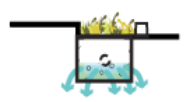
The destination of the surface water run-off from the post development site has been assessed against the prioritisation set by the Approved Document H (2010). The feasibility of the surface water run-off to the priority receptors are as follows:

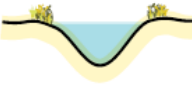
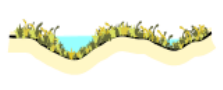
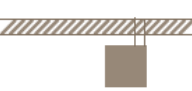
Run-Off Destination	Feasible / Required	Description
Discharge to Ground	No	Based on the BGS data, the ground at the development site is consists of made ground over coarse sand and clay layers. Coarse sand is suitable material for infiltration, however, the BGS data identifies ground water to be 3.00m bgl (above clay strata) which is 0.80m below made ground. In accordance with CIRIA 753 Infiltration structures/ soakaways are to be at least 1.0m above known known groundwater levels. This will make any infiltration structure / soakaway being within made ground which is not feasible due to ground stability and risk of contamination. Therefore, based on the relatively shallow ground water and the presence of made ground, discharge of surface water to ground is not feasible.
Discharge to Surface Water Body	No	There are no known waterbodies near to the development site, and therefore this is not a feasible discharge destination.
Discharge to Surface Water Sewer	Yes	As the ground is not suitable for infiltration, and there are no known waterbodies near the development site, the only alternative is to discharge the surface water from the post development site into the surface water sewer within Burton Road via the existing 225mm surface water drainage nwtowkr within the hospital site.
Discharge to Highway or Other Drain	No	There are no known highway drains near to the development site, and therefore this is not a feasible discharge destination.
Discharge to Combined Water Network	No	There are combined water sewers to the west and south of the site. However, as the surface water is to discharge to the surface water sewer, this discharge destination is not required.

6. SuDS Feasibility

To reduce the surface water run-off to the greenfield rate, SuDS methods are to be introduced to the post development design.

SuDS methods as per the Sustainable Drainage System (SuDS) hierarchy, and the Non-Statutory Technical Standards for Sustainable Drainage Systems – March 2015, that can be used are detailed below:

	Description	Setting	Required area
 Green roofs	A planted soil layer is constructed on the roof of a building to create a living surface. Water is stored in the soil layer and absorbed by vegetation.	 Building	Building integrated.
 Rainwater harvesting	Rainwater is collected from the roof of a building or from other paved surfaces and stored in an overground or underground tank for treatment and reuse locally. Water could be used for toilet flushing and irrigation.	 Building	Water storage (underground or above ground).
 Soakaway	A soakaway is designed to allow water to quickly soak into permeable layers of soil. Constructed like a dry well, an underground pit is dug filled with gravel or rubble. Water can be piped to a soakaway where it will be stored and allowed to gradually seep into the ground.	 Open space	Dependant on runoff volumes and soils.
 Filter Strip	Filter strips are grassed or planted areas that runoff is allowed to run across to promote infiltration and cleansing.	 Open space	Minimum length 5 metres.
 Permeable paving	Paving which allows water to soak through. Can be in the form of paving blocks with gaps between solid blocks or porous paving where water filters through the block itself. Water can be stored in the sub-base beneath or allowed to infiltrate into ground below.	 Street/open space	Can typically drain double its area.
 Bioretention area	A vegetated area with gravel and sand layers below designed to channel, filter and cleanse water vertically. Water can infiltrate into the ground below or drain to a perforated pipe and be conveyed elsewhere. Bioretention systems can be integrated with tree-pits or gardens.	 Street/open space	Typically surface area is 5-10% of drained area with storage below.

	Description	Setting	Required area
 Swale	Swales are vegetated shallow depressions designed to convey and filter water. These can be 'wet' where water gathers above the surface, or 'dry' where water gathers in a gravel layer beneath. Can be lined or unlined to allow infiltration.	 Street/open space	Account for width to allow safe maintenance typically 2-3 metres wide.
 Hardscape storage	Hardscape water features can be used to store run-off above ground within a constructed container. Storage features can be integrated into public realm areas with a more urban character.	 Open space	Could be above or below ground and sized to storage need.
 Pond / Basin	Ponds can be used to store and treat water. 'Wet' ponds have a constant body of water and run-off is additional, while 'dry' ponds are empty during periods without rainfall. Ponds can be designed to allow infiltration into the ground or to store water for a period of time before discharge.	 Open space	Dependant on runoff volumes and soils.
 Wetland	Wetlands are shallow vegetated water bodies with a varying water level. Specially selected plant species are used to filter water. Water flows horizontally and is gradually treated before being discharged. Wetlands can be integrated with a natural or hardscape environment.	 Open space	Typically 5-15% of drainage area to provide good treatment.
 Underground storage	Water can be stored in tanks, gravel or plastic crates beneath the ground to provide attenuation.	 Open space	Dependant on runoff volumes and soils.

The feasibility of the above SuDS methods for the post developed site are summarised in the table below:

SuDS Method	Feasibility	Description
Green Roofs	No	The new building roof has not been structurally designed for the weight of green / living roofs, and therefore it is not a feasible SuDS method.
Rainwater Harvesting	No	Rainwater harvesting for water re-use has not been considered for the development due to the cost of a dual pipe network, and that water supply is crucial to this type of development (hospital / healthcare).
Soakaway	No	Based on the BGS data, the ground at the development site is consists of made ground over coarse sand and clay layers. Coarse sand is suitable material for infiltration, however, the BGS data identifies ground water to be 3.00m bgl (above clay strata) which is 0.80m below made ground. In accordance with CIRIA 753 Infiltration structures/ soakaways are to be at least 1.0m above known known groundwater levels.

		This will make any infiltration structure / soakaway being within made ground which is not feasible due to ground stability and risk of contamination. Therefore, based on the relatively shallow ground water and the presence of made ground, the use of soakaways is not a feasible SuDS method.
Filter Strips	Yes	There is potential to have filter drains within the soft landscaping areas of the site, which will take the surface water run-off from the access road to the south of the site. The filter drain will not discharge the surface water to ground, but will convey the surface water to the main network via perforated pipes within the trench (formed of 20mm no fines aggregate).
Permeable Paving	Yes	There is potential to have permeable paving within the car park areas of the site, which will take the surface water run-off from the car park area. The permeable paving system will not discharge the surface water to ground, but will convey the surface water to the main network via perforated pipes within the granular sub-base (formed of 20mm no fines aggregate).
Swale / Shallow Pond	Yes	There is potential to have a swale / shallow pond within the soft-landscaping area to the south of the site. The SuDS method will provide attenuation, act as a pollutant control and add biodiversity to the Site.
Underground Storage	Yes	The surface water run-off from the development site will be restricted. The restricted rate will be lower than the surface water run-off rate, therefore there will be a requirement to have further underground storage in the form of cellular units

7. Development Greenfield Run-Off Rates and Volume

To minimise the surface water run-off from the new development areas of the site, it is preferred that the post development surface water run-off be restricted to the equivalent greenfield run-off rate and volumes.

7.1. Greenfield Run-Off Rate

The Flood Estimation Handbook (FEH) is often used for the calculation of the greenfield run-off rate, however, relevant documents state that to calculate the greenfield run-off rates on small catchments less than 25km², the IH 124 QBAR equation (and the equation for the instantaneous time to peak for the unit hydrograph approach) is to be used. The IH method is based on the Flood Studies Report (FSR) approach and is developed for use on catchments less than 25km². It yields the Mean Annual Maximum Flood (QBAR). This reference also recommends the use Ciria C753 Table 24.2 to generate Growth Factors. These are used to convert QBAR to different return periods for different regions in the UK. The input variables to establish QBAR are:

Return Period (years)	Results based on a range of return periods and the specified RP;
Area	Catchment Area (ha) which is adjusted to km ² for use in the equation;
SAAR	Average annual rainfall in mm (1941-1970) from FSR figure II.3.1;
Soil	Procedure Volume 3. Soil classes 1 to 5 have Soil Index values of 0.15, 0.3, 0.4, 0.45 and 0.5 respectively;
Urban	Proportion of area urbanised expressed as a decimal;
Region Number	Region number of the catchment based on FSR Figure I.2.4.

QBAR(l/s)

The output variables to establish QBAR are calculated using the following formula (equation yields m³/s):

$$\text{QBAR} = 0.00108 \times \text{AREA}^{0.89} \times \text{SAAR}^{1.17} \times \text{SOIL}^{2.17}$$

The IH 124 Variables (taken from FSR) that are specific to this site are as follows:

Area	=	50.00 ha (required area for calculation)
SAAR	=	864
Soil	=	0.450
Urban Factor	=	0.00
Region Number	=	10

The calculations in Appendix E, show the rate for 50.00ha is 281.0 l/s, but is to be reduced to reflect the surface water management area (0.303 ha) of the development site. Therefore, the QBAR (greenfield run-off) for development area has been calculated to be:

$$\text{QBAR} = 1.70 \text{ l/s (5.62 l/s/ha)}$$

Ciria C753 Table 24.2 identifies the growth factors for each of the storm events, based on the known QBAR figure. The growth factors from the table vary depending on the site location. In this case hydrometric area (Region Number) is 10.

Based on the figures shown in the table, the growth factors, and the existing greenfield run-off rates for each of the storm events for the development areas of the site are as follows:

Storm Event	QBAR	Growth Factor (C753 Table 24.2)	Greenfield Run-off Rate
Q ₁	1.70 l/s	0.87	1.5 l/s
Q ₃₀	1.70 l/s	1.70	2.9 l/s
Q ₁₀₀	1.70 l/s	2.08	3.5 l/s

7.2. Greenfield Run-Off Volume

The greenfield run-off volume for the 100-year, 6-hour storm event has also been calculated in the MicroDrainage software using the data from the Flood Estimation Handbook (FEH), with the results shown in Appendix E. The FEH data and variables used to calculate the greenfield run-off volume at the development site locations are as follows:

Site Location	=	GB 383750 391950 SJ 83750 91950
C (1km)	=	-0.026
D1 (1km)	=	0.310
D2(1km)	=	0.367
D3 (1km)	=	0.334
E (1km)	=	0.304
F (1km)	=	2.444
Areal Reduction Factor	=	1.000
Area	=	323.750 ha
SAAR	=	852
CWI	=	119.861
SPR Host	=	38.23
URBTEXT	=	0.00

Based on these variables, and the calculation results provided by the MicroDrainage computer software (Appendix E), the greenfield run-off volume for the overall catchment area at the site location is:

$$Q_{100 \text{ (6-Hour)}} = 87,714.739\text{m}^3$$

This figure is for the catchment area of 323.750 ha, and is to be reduced to reflect the surface water management area of the development site which is 0.303 ha.

$$Q_{100 \text{ (6-Hour)}} = 82.09\text{m}^3 \text{ (270.93m}^3\text{/ha)}$$

8. Below Ground Drainage Networks and SW Management Calculations

8.1. Climate Change

The NPPF makes it a planning requirement to account for climate change in the proposed design. The recommended allowances are taken from the Environment Agency guidance (Table 2) summarised in Table 4 below.

Applies across all of England	Total change anticipated for the 2020's	Total change anticipated for the 2050's	Total change anticipated for the 2080's
Upper End	10%	20%	40%
Central	5%	10%	20%

The baseline year is 1961 to 1990. It is anticipated the life span of the hospital building will be approximately 80 years, and therefore will fall at least into the 2080's and will have rainfall intensity increase of **40%**.

8.2. Surface Water Network Calculations

The FEH data and variables used to calculate the required below ground attenuation network and attenuation volumes at the development site are as follows:

SW Management Area	=	0.269 ha
Site Location	=	GB 383750 391950 SJ 83750 91950
C (1km)	=	-0.026
D1 (1km)	=	0.310
D2(1km)	=	0.367
D3 (1km)	=	0.334
E (1km)	=	0.304
F (1km)	=	2.444

8.3. Surface Water Drainage Network and Management

As shown on the below ground drainage layout drawing in Appendix F, the proposed surface water main network will consist of 300mm to 450mm diameter pipes; 1200mm to 1500mm diameter manholes; permeable paving; filter drains; a swale / shallow pond; a 1500mm diameter flow control chamber containing a hydro-brake; and an attenuation tank in the form of cellular units.

The surface water run-off from the new roof areas will discharge to the main network via rainwater pipes with trap gullies; the surface water run-off from the access road and pedestrian area will discharge to the main drainage via filter drains, and the surface water run-off from the car park will discharge to the main drainage via the permeable paving system.

The surface water network will flow towards the western boundary of the site, and will discharge through the cellular units, shallow pond / swale and the flow control chamber prior to connection / discharge to the existing 225mm diameter surface water pipe and subsequently United Utilities surface water sewer in Burton Road

The surface water will surcharge the drainage network when being restricted, and will discharge into cellular units, and shallow pond / swale where the water will be stored to prevent flooding.

Post storm event, the water levels in the SuDS features will drop and flow back to the network and through the control chamber to the combined water system.

8.4. Surface Water Run-Off Rate

For the surface water run-off from the development site to be at the greenfield run-off rate, they are to be restricted to 1.5 l/s for the 1 in 1-year storm event; 2.9 l/s for the 1 in 30-year storm event, and 3.5 l/s for the 1 in 100-year storm event including 5% rainfall intensity increase (climate change).

This is to adhere to Ciria document C753 – The SuDS Manual which states that: *‘the flow controls / orifice design should be designed so that it has simplicity on operation, and has resistance to clogging, blocking or mechanical failure’*.

For this development, and based on the guidance, greenfield rates and greenfield run-off volume, the suitable / minimum size of the flow control opening (hydro-brake opening) is deemed to be 80mm, with a design flow of 3.5 l/s (100-year greenfield rate).

As shown in the output calculation from the MicroDrainage computer software in Appendix G, if the hydro-brake opening is set at 80mm, the design flow at 3.50 l/s, with a design head of 1.650m, the maximum surface water run-off rates for each storm event will be as follows:

Strom	-	Rate	-	Critical Storm Event
Q ₁	-	2.8 l/s	-	240-minute winter storm duration
Q ₃₀	-	2.9 l/s	-	240-minute winter storm duration
Q _{100 + CC}	-	3.3 l/s	-	480-minute winter storm duration

A summary of the post development surface water run-off rates compared to the greenfield rates are as follows:

Greenfield Rate to Post Development Rate

Strom	-	Greenfield	-	Post Dev	-	Difference
Q ₁	-	1.5 l/s	-	2.8 l/s	-	85% Increase
Q ₃₀	-	2.9 l/s	-	2.9 l/s	-	Equivalent
Q ₁₀₀	-	3.5 l/s	-	3.3 l/s	-	6% Reduction

The results show that the post development run-off rates are an increase of the 1-year greenfield rate, but are the equivalent to the 30-+year greenfield rate and a 6% reduction of the 1000-year greenfield rate.

Therefore, as the greenfield rates for extreme storms have not been exceeded, the discharge rates are deemed to be acceptable, as they meet the requirements set out in the Non-Statutory Technical Standards for Sustainable Drainage Systems.

8.5. Surface Water Run-Off Volume

The surface water run-off volumes for the post development site have also been calculated for 1 in 100-Year the 6-hour duration (Inc. 40% RII), using the peak surface water discharge rate, whereas detailed in the MicroDrainage calculation in Appendix G, where the volume equates to:

$$Q_{100 \text{ (6-Hour)}} = 3.3 \text{ l/s} \times (60 \times 60 \times 6) = 71,280 \text{ litres} = 71.28 \text{m}^3$$

A summary of the post development run-off volumes compared to the greenfield volume is as follows:

Greenfield Volume to Post Development Volume

Strom	-	Greenfield	-	Post Dev	-	Difference
Q ₁₀₀	-	82.09m	-	71.28m ³	-	13% Reduction

The post development surface water run-off volume is a 13% reduction of the greenfield volume for the same storm event and duration.

Therefore, the discharge volume deemed to be acceptable, as it meets the requirements set out in the Non-Statutory Technical Standards for Sustainable Drainage Systems.

8.6. Surface Water Attenuation Calculations

As stated above, the post development run-off rates are restricted, there will be a requirement for surface water attenuation.

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

Attenuation structure formed of below ground attenuation tank in the form of cellular units below a swale / shallow pond.

Cellular units to be built at pipe invert levels to a depth of 1.20m and covered by 100mm of 20mm no fines granular material and 130mm topsoil / sand mix to form the base of the swale. Base of swale to be 300mm below ground level with 1 in 3 gradients sloped to surface. Design details as follow

As detailed in the MicroDrainage calculations (Appendix G) and below ground drainage strategy layout (Appendix F) the attenuation volumes and details for the SuDS method are as follows:

Cellular Units

Attenuation Tank Length	-	21.00m
Attenuation Tank Width	-	9.00m
Attenuation Tank Area	-	189.00m ²
Attenuation Tank Depth	-	1.20m
Attenuation Tank Volume	-	226.80m³

Swale / Shallow Pond

Base Area	-	175.00m ²
Outer Area	-	230.00m ²
Depth	-	0.30m
Volume	-	60.75m³
Side Grade	-	1 in 3

The MicroDrainage calculations (Appendix G) show that with these SuDS methods and volumes, no flooding will occur for all storms up to and including the 100-year + 40% storm event.

9. Maintenance Requirements

The management and maintenance of the surface water drainage networks and SuDS features will be by estate management of the clinical site, where the maintenance of the drainage and SuDS will form part of the overall site management / landscaping / gardening. The details of the management and maintenance to be carried out is as follows:

9.1. Surface Water Drainage Network, Flow Control and Cellular Units

Operation	Frequency
Inspect and identify any areas that are not operating correctly, if required, take remedial actions	Monthly for 3 months, then six monthlies
Debris removal from manholes (where may cause risk performance)	Monthly
Where rainfall into network from above, check surface or filter for blockage or silt, algae, or other matter by jetting	As required, but at least twice a year
Remove sediment from pipework by jetting.	Annually or as required
Repair/check all inlets, outlets, and overflow pipes	As required
Inspect/check all inlets, outlets, and overflow pipes to ensure that they are in good condition and operating as designed	Annually and after large storms

9.2. Permeable Paving and Filter Drains

Operation	Frequency
Inspect and identify any areas that are not operating correctly, if required, take remedial actions	Monthly for 3 months, then six monthlies
Debris removal from on surface of filter drain and permeable paving or near system (where may cause risk performance)	Monthly
Rainfall infiltration into permeable paving and / or filter drain is ensured working effectively.	As required, but at least twice a year

9.3. Swale / Shallow Pond

Operation	Frequency
Inspections to identify any areas not operating correctly, eroded areas, hydrocarbon pollution, blocked outlets, and silt accumulation. Record any areas that are ponding and where water is lying more than 48 hours.	Monthly
Collect and remove from the site all extraneous rubbish that is detrimental to the operation of the SUDS feature and appearance of the site, including paper, packaging materials, bottles, cans, and similar debris.	Monthly

Maintain grass within the specified range. Ensure that the soil and grass does not become compacted. Do not cut during periods of drought or when ground conditions or grass are wet.	As required, but at least twice a year
Scarifying and spiking	As required
Reinstate design levels, repair eroded areas or damaged areas by returfing and reseeded.	As required
Seed or sod bare eroded areas.	As required

9.4. Linked and Further Maintenance Activities

The maintenance of the drainage network and SuDS features are to be linked with the wider site maintenance for the new residential landscaped / garden areas.

A log of all maintenance activities is to be kept and made available to the local planning authority (LPA) and / or the Lead Local Flood Authority (LLFA) on request.

10. Surface Water Design Exceedance

In the unlikely event of an extreme storm greater than 100-year + 40% climate change, or poor maintenance of the SuDS features and / or pipework, potential flooding of the drainage network could occur.

Surface water flow paths to follow existing and proposed ground topography, where water will flow towards the development boundaries, and into Burton and Fielden Road.

Flood water will flow away from the proposed building, and will not flow directly towards existing dwellings / properties outside the development boundary. The flood water within the roads will be contained due to the road having a gradient (water to flow along road) and upstand kerbs.

11. Water Quality

The level of water treatment is to be assessed against the details set out in Ciria SuDS Manual C753. Chapter 26 sets out the Pollution Hazard Indices for different land classifications, and how to calculate that against the SuDS mitigation indices to show suitable levels of treatment.

11.1. Access Road Car Park Areas Pollutant Hazard

C753 Table 26.2 Pollution Hazard Level = Low

C753 Table 26.2 Pollution Hazard Index:

Total Suspended Solid (TSS)	=	0.5
Metals	=	0.4
Hydrocarbons	=	0.4
Pollution Hazard Index	=	1.30

11.2. Access Road and Car Park Areas Pollutant Mitigation

Mitigation Measures:

Filter Drain and Permeable Paving

Permeable Paving Pollutant Mitigation Indices:

Total Suspended Solid (TSS)	=	0.7
Metals	=	0.6
Hydrocarbons	=	0.7
SuDS Mitigation Indices	=	2.00

The mitigation indices is greater than the pollution hazard index, and therefore suitable water quality is achieved.

12. Development Management and Construction Phase

All existing drainage networks within the development area are to be maintained during construction. The pipe network, cellular units, and flow control chamber are to be the first part of the drainage network to be built. This will ensure that the surface water discharge is suitably restricted without pollutants or flooding.

12.1. Construction Environment Management Plan

Full details of the construction environment management plan (CEMP) has to be confirmed by the chosen contractor who have been appointed for the development. Therefore, it is recommended that this is a planning condition, with the assurance that a CEMP will confirm to the requirements of CIRIA 753 – The SuDS Manual – Chapter 31. The construction programming for SuDS, however, for the development site will include:

12.2. Construction Access

The main construction traffic will access the site from the existing roads to be west and south of the site, and will ensure that traffic over the proposed cellular units will be avoided.

12.3. Sediments and Traps

Sediment basins and traps are to be installed before any major site earthworks take place, with further sediment traps and silt fences being installed as the earthworks progresses. This will keep sediment contained on site at appropriate locations.

12.4. Run-Off Control Measures

Run-off control measures are to be used in conjunction with sediment traps to divert water around planned earthworks areas to remove silts. Any surface water upstream of the site is to be diverted around the development areas, and to discharge to the existing drainage system. The surface water run-off destination for the diverted surface water will continue as existing.

12.5. Main Surface Water Run-Off Systems

The main drainage network, cellular units, flow control chamber, and outfall to existing drainage network are to be built prior to any phase of construction of site. Surface water from each of the phased area is to discharge to the new drainage network, where the water is adequately restricted, and water quality maintained before discharging to the river. Temporary inlet and outlet protection measures and appropriate silt traps are to be installed to prevent silt ingress into the main drainage network.

12.6. Clearing and Earthworks

Clearing and earthworks will only start when adequate erosion and sediment control measures are in place. Once the development areas are cleared, earthworks will follow immediately to ensure that the ground cover can be re-established quickly. Adjacent land to that being developed will be left undisturbed for as long as possible.

12.7. Surface Stabilisation Measures

Surface stabilisation measures will be applied to completed areas, channels ditches and other disturbed areas after the land is cleared and profiled. Permanent stabilisation measures will be installed as soon as possible after final profiling.

12.8. Construction of Permeable Surfacing

Construction of permeable paving is to be left to the later stages of construction. Unsuitable sediment is to be removed from surfacing prior to installation of sand binder layer and paving.

13. Conclusion / Summary

13.1. SuDS Principles and Discharge Destination

All feasible SuDS methods, and surface water discharge destination have been assessed, with the feasible SuDS methods being permeable paving, filter drains, swale / shallow ponds, cellular units and a flow control chamber, and the surface water destination being to a surface water sewer via an existing drainage network.

13.2. Peak Flow Control

The post development run-off rates are an increase of the 1-year greenfield rate, but are the equivalent to the 30+-year greenfield rate and a 6% reduction of the 1000-year greenfield rate. Therefore, as the greenfield rates for extreme storms have not been exceeded, the discharge rates are deemed to be acceptable, as they meet the requirements set out in the Non-Statutory Technical Standards for Sustainable Drainage Systems.

13.3. Volume Control

The post development surface water run-off volume is a 13% reduction of the greenfield volume for the same storm event and duration. Therefore, the discharge volume deemed to be acceptable, as it meets the requirements set out in the Non-Statutory Technical Standards for Sustainable Drainage Systems.

13.4. Flood Risk within the Development

The MicroDrainage calculations show that with these SuDS methods and volumes, no flooding will occur for all storms up to and including the 100-year + 40% storm event.

Maintenance

The management and maintenance of the surface water drainage networks and SuDS features will be by estate management of the clinical site, where the maintenance of the drainage and SuDS will form part of the overall site management / landscaping / gardening.

13.5. Surface Water Design Exceedance

In the unlikely event of an extreme storm greater than 100-year + 40% climate change, or poor maintenance of the SuDS features and / or pipework, potential flooding of the drainage network could occur. Surface water flow paths to follow existing and proposed ground topography, where water will flow towards the development boundaries, and into Burton and Fielden Road.

Flood water will flow away from the proposed building, and will not flow directly towards existing dwellings / properties outside the development boundary. The flood water within the roads will be contained due to the road having a gradient (water to flow along road) and upstand kerbs.

13.6. Water Quality

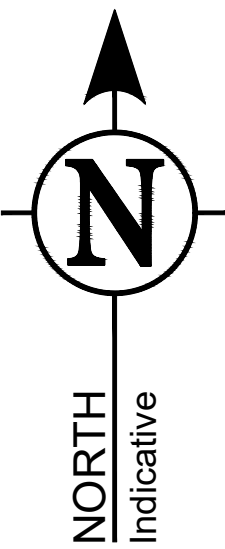
The level of water treatment is to be assessed against the details set out in Ciria SuDS Manual C753. Chapter 26 sets out the Pollution Hazard Indices for different land classifications, and how to calculate that against the SuDS mitigation indices to show suitable levels of treatment. The mitigation indices is greater than the pollution hazard index, and therefore suitable water quality is achieved.

13.7. Construction Environment Management Plan

All existing drainage networks within the development area are to be maintained during construction. The pipe network, cellular units, and flow control chamber are to be the first part of the drainage network to be built. This will ensure that the surface water discharge is suitably restricted without pollutants or flooding.

Appendix A

Topographical Survey

[illegible]

Topographical Survey

Trees are drawn to scale
heights should be used

All building names, descriptions, number of storeys, construction type incl. roof line details are indicative only and taken externally from ground level.

All below ground details including drainage, voids and services have been identified from above ground and therefore all details relating to these features including; sizes, depth, description etc will be approximate only. All critical dimensions and connections should be checked and verified prior to start of work.

Detail, services and features may not have been surveyed if obstructed or reasonably visible at the time of the survey.

Surveyed physical features may not necessarily represent the legal boundary.

Measured Building Surveys

Measurements to internal walls are taken to the wall finishes at approx. 1m above the floor level and the wall assumed to be vertical.

Cill heights are measured as floor to the cill and head heights are measured from cill to the top of window.

General

The contractor must check and verify all site and building dimensions, levels, utilities and drainage details and connections prior to commencing work. Any errors or discrepancies must be notified to Survey Solutions immediately.

The accuracy of the digital data is the same as the plotting scale implies. All dimensions are in metres unless otherwise stated.

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Do not scale from this drawing

SURVEY CONTROL CO-ORDINATES			
STATIONS	EASTINGS	NORTHINGS	LEVEL
0001	363716.801	392062.132	32.511
0002	363737.267	392040.497	32.089
0003	363760.250	392056.846	32.755
0004	363814.261	392015.657	33.092
0005	363770.903	392190.252	33.143
0006	363678.219	392009.554	32.015
000A	363771.236	392011.886	32.827
000A	363950.254	392013.966	32.794
00A1	363762.190	392002.477	33.986

SURVEY GRID AND LEVEL DATUM

The coordinate system established for this survey is related to Ordnance Survey (OS) national grid at a single point using Smartnet, then orientated to grid north with a scale factor of 1.000.

The level datum established for this survey is related to Ordnance Survey (4) using GPS Smartnet.

To avoid discrepancies any coordinated data used in conjunction with this system must be derived directly from this control data.

REV	DESCRIPTION	DRAWN	APPR	CHECKED
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LAND SURVEYING
BUILDING SURVEYING
UNDERGROUND SURVEYING
SITE ENGINEERING
MONITORING

0845 040 5969
survey-solutions.co.uk

IPSWICH BEDFORD COVENTRY GLASGOW LONDON MANCHESTER NORWICH
NOTTINGHAM YORK

PROJECT TITLE
Withington Community Hospital

DRAWING DETAIL
UTILITY CURVES

UTILITY SURVEY
Sheet 1 of 1

CLIENT

NHS Foundation T

SURVEYOR	SURVE
IDC	D-3-01

JD8	DBS 20
DRAWING NUMBER	

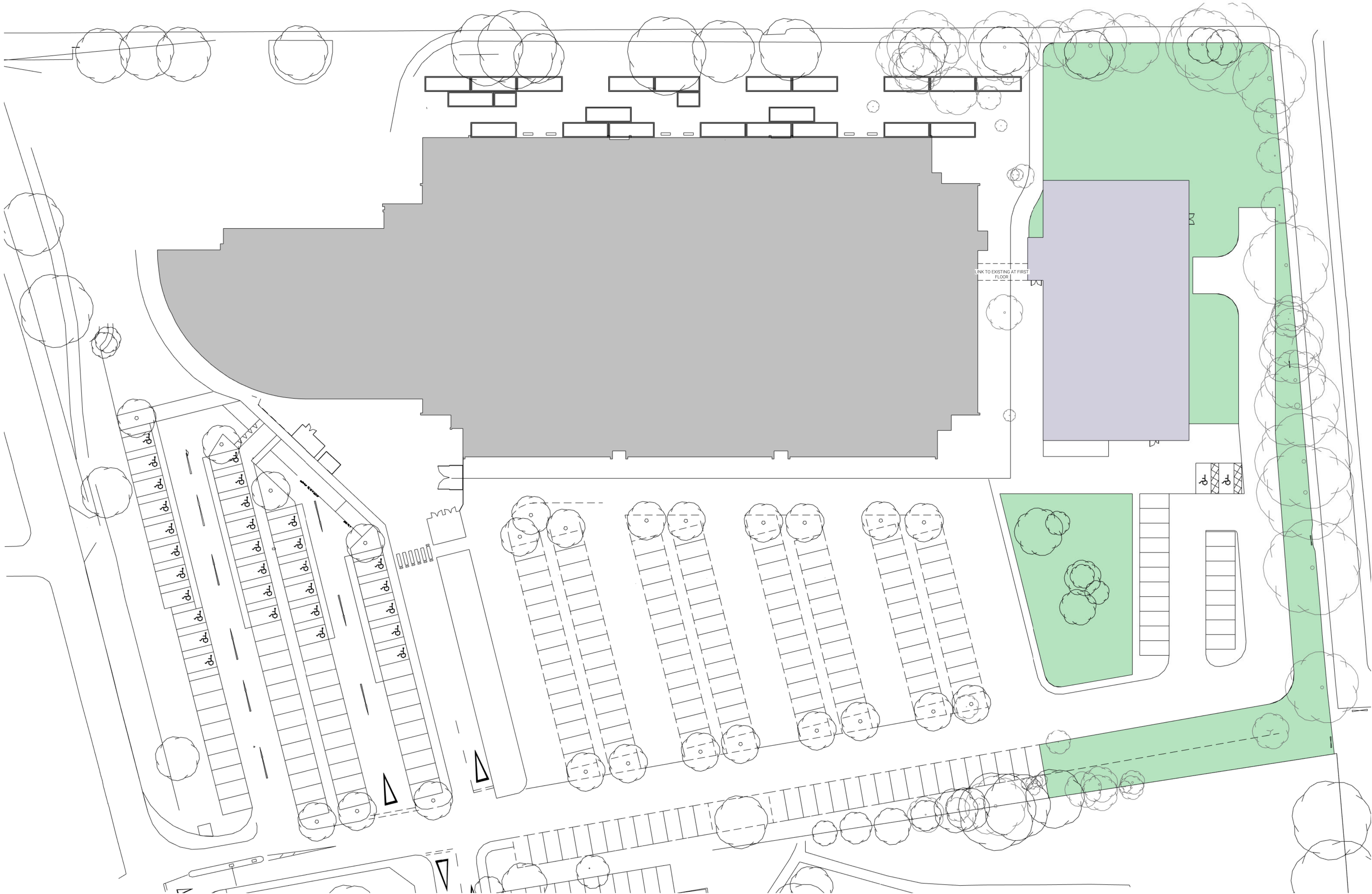
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Appendix B
Proposed Site Plan



Ground Floor GA Plan
1 : 200

GENERAL NOTES:

DAY Architectural Ltd accepts no responsibility for any costs, losses or claims whatsoever arising from these drawings, specifications and related documents unless there is full compliance with the Client or any unauthorised user of the following:

1. All boundaries, dimensions and levels are to be checked on site before construction and any discrepancies reported to the Architect / Designer.

2. Partial Service: Any discrepancies with site or other information is to be advised to the Architect / Designer and direction and / or approval is to be sought before the implementation of the detail.

3. Blocks and site plans are reproduced under license from the Ordnance Survey.

4. Do not scale the drawing.

5. For the purposes of coordination, all relevant parties must check this information prior to implementation and report any discrepancies to the Architect / Designer.

CLIENT

Manchester University Hospital NHS Foundation Trust

DRAWING

Overall Hospital Site Plan

SCALE

1 : 200 @ A0

FIRST ISSUED

01/12/23

PROJECT

Endoscopy & Cardiorespiratory, Withington Community Hospital

PROJECT

1342-22

CLIENT REF

MFT

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MA

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ORIGIN

DAY

VOLUME

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LEVEL

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REVISION

P1

SUITABILITY

INFORMATION

P1

Issue for Information

12.01.23

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DESCRIPTION

DATE

REV BY

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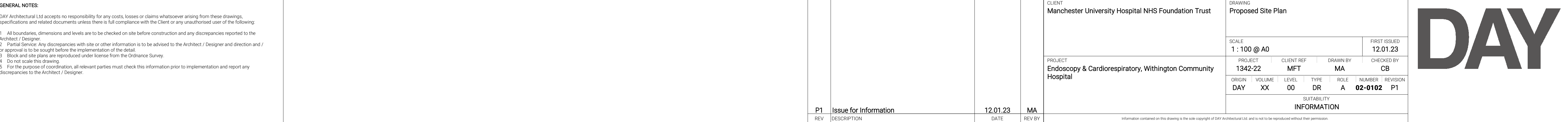
Studio 1, Lancaster Buildings

17 Deansgate, Manchester, M3

26W

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W: www.day-architectural.com



Appendix C

Ground Investigation Data

55895-2654
8383 9203

DATE	CASING DEPTH (m)	WATER LEVEL MORNING & EVENING	DEPTH OF STRATA BELOW GL	Reduced Level	DESCRIPTION	No. and Type of Sample	SAMPLE DEPTH PENETRATION		No. of Blows	Legend
							From	To		
			0.40		Bituminous surfacing onto concrete					
			0.70		Brown-black silt, sand, ash, cinders, gravel, brick, clay etc. MADEGROUND	D1	0.50			
21-2-87	0.00	DRY	1.40		Very loose grey-brown very gravelly fine to coarse SAND with clay lenses	D2 P1 B1	1.00 1.55 1.80	1.85 2.20	3	
22-2-87			2.20		MADEGROUND					
			2.70		Very loose grey-brown gravelly fine to coarse SAND	P2 B2	2.35 2.70	2.65 3.20	1	
			3.90		Medium-dense brown slightly silty and very gravelly fine to coarse SAND	P3 W1	3.35 3.65	3.65	11	
					Stiff/very stiff brown silty and sandy CLAY with silt and sand laminae and lenses and fine to medium gravel becoming firm/stiff silty and slightly sandy laminated CLAY with occasional fine gravel below 5.20 m and stiff below 6.0 m	D3 U1 D4 U2 D5 U3 D6	4.00 4.30 4.85 5.20 5.75 6.00 6.55	4.75 5.65 6.45		
22-2-87	4.50	DRY	6.55		END OF BOREHOLE					

SAMPLE TEST KEY	D - DISTURBED SAMPLE	B - BULK SAMPLE	U - UNDISTURBED SAMPLE
	P - SPT SAMPLE	W - WATER SAMPLE	

ALL DEPTHS AND REDUCED LEVELS IN (m) UNLESS OTHERWISE STATED

COMMERCIAL
IN CONFIDENCE

Appendix D
United Utilities Asset Plan



Refo	Cover	Func	Invert	Size x	Size y	Shape	Mat	Length	Grad
7205	CO	0	225	150	150	VC	15.4872	1 in 524	
8879	CO	0	300	150	150	VC	5.26934	1 in 285	
8002	CO	0	300	150	150	VC	21.0502	1 in 30	
7904	31.61	SW	26.43	300	150	BR	10.47265	1 in 106	
8701	33.18	SW	24.89	825	150	BR	76.84399	1 in 280	
8701	33.08	CO	25.34	375	150	VC	10.03115	1 in 326	
8710	CO	0	150	150	150	VC	2.834257	1 in 7	
8729	CO	0	150	150	150	VC	5.549199	1 in 280	
8700	33.41	CO	30.56	225	150	VC	5.587059	1 in 280	
7302	33.41	FO	30.56	300	150	VC	87.7525	1 in 280	
9800	33.21	CO	26.62	375	150	VC	24.28131	1 in 326	
9139	CO	0	150	150	150	VC	10.03115	1 in 326	
5100	32.09	CO	28.07	375	150	VC	61.84058	1 in 1170	
8841	CO	0	300	150	150	VC	11.54543	1 in 326	
9817	CO	0	225	150	150	VC	13.43007	1 in 326	
9912	CO	0	225	150	150	VC	12.15411	1 in 326	
4700	32.16	CO	27.12	300	150	VC	90.37699	1 in 2086	
6200	31.83	CO	25.97	1500	150	BR	146.0208	1 in 640	
9101	32.42	CO	25.11	300	150	VC	64.03745	1 in 53	
6704	33.25	CO	29.71	225	150	VC	12.64911	1 in 1170	
9102	32.78	SW	25.62	825	150	BR	128.7051	1 in 1170	
9151	CO	0	100	150	150	PVC	3.873959	1 in 49	
9912	CO	0	150	150	150	VC	17.47439	1 in 225	
7801	33.1	CO	225	150	150	VC	9.928783	1 in 225	
9101	32.78	CO	26.04	1800	150	BR	31.05445	1 in 225	
8001	32.69	CO	26.98	300	150	VC	6.219544	1 in 225	
8948	CO	0	100	150	150	BR	6.959341	1 in 225	
9700	33.78	CO	30.8	450	150	BR	93.00338	1 in 225	
9137	CO	0	150	150	150	VC	2.40768	1 in 225	
8727	CO	0	375	150	150	VC	4.69148	1 in 225	
7702	33.48	SW	24.32	1200	150	CO	85.60374	1 in 225	
8718	CO	0	150	150	150	VC	3.123973	1 in 225	
7203	CO	0	150	150	150	VC	4.791372	1 in 225	
8714	CO	0	150	150	150	VC	21.04261	1 in 225	
9309	CO	0	150	150	150	VC	7.713778	1 in 225	
8745	CO	0	150	150	150	VC	3.638474	1 in 225	
8005	32.82	SW	25.26	825	150	BR	14.26587	1 in 225	
8707	CO	0	150	150	150	VC	150.0333	1 in 225	
8802	CO	0	150	150	150	VC	19.05572	1 in 225	
8800	32.76	CO	25.28	225	150	VC	17.11178	1 in 225	
8800	32.78	CO	31.16	225	150	VC	59.06038	1 in 225	
0901	32.83	CO	27.29	225	150	VC	64.14047	1 in 225	
9902	32.41	CO	30.78	225	150	VC	22.80351	1 in 225	
6702	33.4	CO	27.59	875	150	BR	65.60488	1 in 225	
5102	31.82	CO	28.78	300	150	VC	27.24909	1 in 225	
4900	32.54	CO	25.81	225	150	VC	17.20465	1 in 225	
7102	CO	0	150	150	150	VC	6.65864	1 in 225	
9103	32.4	CO	29.42	225	150	VC	35.22033	1 in 225	
7701	CO	0	150	150	150	VC	92.13034	1 in 225	
8810	CO	0	225	150	150	VC	7.130762	1 in 225	
8906	CO	0	225	150	150	VC	6.387374	1 in 225	
8818	CO	0	225	150	150	VC	21.9079	1 in 225	
9103	32.68	CO	28.7	225	150	VC	12.04159	1 in 225	
8103	32.68	CO	28.22	1500	150	BR	130.1761	1 in 225	
9714	CO	0	150	150	150	VC	8.506868	1 in 225	
7204	CO	0	300	150	150	VC	30.64482	1 in 225	
9141	CO	0	150	150	150	VC	1.720775	1 in 225	
8911	CO	0	150	150	150	VC	12.54253	1 in 225	
0301	32.61	CO	26.35	1500	150	BR	56.60389	1 in 225	
0905	CO	0	100	150	150	VC	6.94021	1 in 225	
8800	33.04	CO	28.41	375	150	VC	92.35857	1 in 225	
9903	CO	0	150	150	150	VC	5.079626	1 in 225	
9904	CO	0	225	150	150	VC	1.04784	1 in 225	
8733	CO	0	375	150	150	VC	7.611504	1 in 225	
6203	CO	0	450	150	150	VC	3.479422	1 in 225	
9901	32.76	CO	28.99	300	150	VC	75.54448	1 in 225	
5304	31.56	CO	26.41	450	150	BR	5.102233	1 in 225	
6706	33.42	CO	25.46	450	150	VC	18.38478	1 in 225	
9205	CO	0	150	150	150	VC	26.41669	1 in 225	
3206	32.41	CO	29.47	225	150	VC	6.138181	1 in 225	
7804	CO	0	150	150	150	VC	10.63828	1 in 225	
8804	CO	0	150	150	150	VC	11.50908	1 in 225	
9712	CO	0	150	150	150	VC	10.46095	1 in 225	
8909	CO	0	150	150	150	VC	6.258584	1 in 225	
5708	CO	0	150	150	150	VC	12.96276	1 in 225	
9906	CO	0	150	150	150	VC	1.387729	1 in 225	
8711	CO	0	150	150	150	VC	5.784056	1 in 225	
9803	32.89	CO	23.12	2600	150	BR	223.7074	1 in 2237	
9725	CO	0	150	150	150	VC	11.50096	1 in 2237	
9900	32.98	CO	26.71	375	150	VC	104.561	1 in 2237	
8205	32.41	CO	30.92	150	150	VC	20.59129	1 in 2237	
0704	CO	0	225	150	150	VC	24.26984	1 in 2237	
5207	32.71	SW	26.11	825	150	BR	128.999	1 in 2237	
5001	CO	0	300	150	150	VC	70.80254	1 in 2237	
6700	33.57	CO	23.39	2600	150	BR	112.1068	1 in 2237	
9802	CO	0	150	150	150	VC	43.78187	1 in 2237	
8800	33.68	CO	25.64	450	150	VC	34.0147	1 in 2237	
9722	CO	0	150	150	150	VC	8.897824	1 in 2237	
8201	32.24	CO	29.92	225	150	VC	49.93014	1 in 2237	
9802	33.85	CO	31.33	450	150	BR	101.8442	1 in 2237	
9921	CO	0	225	150	150	VC	7.798248	1 in 2237	
7903	33.16	CO	29.96	100	150	VC	11.6919	1 in 2237	
9005	CO	0	100	150	150	VC	5.837942	1 in 2237	
9205	32.51	CO	29.71	225	150	VC	8.602325	1 in 2237	
9801	32.58	CO	26.13	300	150	VC	53.83729	1 in 2237	
8704	CO	0	100	150	150	VC	17.18688	1 in 2237	
8804	CO	0	100	150	150	VC	1.700394	1 in 2237	
8912	CO	0	225	150	150	VC	29.98889	1 in 2237	
4301	31.38	CO	25.86	1500	150	BR	70.10715	1 in 2237	
9045	CO	0	150	150	150	VC	10.99521	1 in 2237	
6701	33.57	CO	25.58	525	150	VC	14.5022	1 in 2237	
6204	CO	0	675	150	150	VC	49.88557	1 in 2237	
9900	CO	0	225	150	150	VC	34.05365	1 in 2237	
7811	CO	0	150	150	150	VC	6.207654	1 in 2237	
9925	CO	0	150	150	150	VC	16.17339	1 in 2237	
8739	CO	0	150	150	150	VC	29.07333	1 in 2237	
7900	33.12	CO	25.77	625	150	VC	76.27988	1 in 2237	
5802	32.99	CO	26.39	675	150	BR	40.05517	1 in 2237	
9007	CO	0	100	150	150	VC	6.605479	1 in 2237	
9047	CO	0	150	150	150	VC	20.20811	1 in 2237	
8908	CO	0	150	150	150	VC	11.81484	1 in 2237	
9726	CO	0	150	150	150	VC	21.23095	1 in 2237	
8806	CO	0	100	150	150	VC	6.035951	1 in 2237	
6202	CO	0	375	150	150	VC	24.73813	1 in 2237	
8809	CO	0	150	150	150	VC	16.56894	1 in 2237	
9939	CO	0	150	150	150	VC	11.26034	1 in 2237	
9000	32.59	CO	29.68	300	150	VC	34.73535	1 in 2237	
0201	32.45	CO	31.55	150	150	VC	13.0384	1 in 2237	
8204	32.51	CO	30.59	150	150	VC	8.944272	1 in 2237	
7202	CO	0	150	150	150	VC	33.61886	1 in 2237	
7609	CO	0	150	150	150	VC	11.34898	1 in 2237	
9006	CO	0	100	150	150	VC	5.924034	1 in 2237	
9202	32.56	CO	28.65	300	150	VC	21.40903	1 in 2237	
9001	32.69	CO	30.07	225	150	VC	32.43091	1 in 2237	
9801	33.44	CO	30.44	450	150	BR	87.80492	1 in 2237	
9913	CO	0	150	150	150	VC	6.886971	1 in 2237	
8700	33.64	CO	30.01	450	150	VC	5.830952	1 in 2237	
6808	CO	0	150	150	150	VC	12.9111	1 in 2237	
8708	CO	0	150	150	150	VC	19.35541	1 in 2237	
5830	CO	0	150	150	150	VC	5.892976	1 in 2237	
8804	CO	0	37.11025	150	150	VC	37.11025	1 in 2237	
5829	CO	0	29.73	100	150	VC	8.867601	1 in 2237	
9951	CO	0	100	150	150	VC	11.7948	1 in 2237	
7901	32.76	CO	27.77	300	150	VC	43.999	1 in 2237	
4800	32.54	CO	25.07	675	150	BR	93.00993	1 in 2237	
9043	CO	0	150	150	150	VC	15.80206	1 in 2237	
8000	32.89	CO	25.88	525	150	VC	105.125	1 in 2237	
9232	CO	0	150	150	150	VC	14.457897	1 in 2237	
7812	CO	0	150	150	150	VC	23.39453	1 in 2237	
8246	CO	0	150	150	150	VC	0.70077	1 in 2237	
8203	32.49	CO	225	150	150	VC	30.23423	1 in 2237	
7									

Appendix E

Greenfield Run-Off Rates and Volume Calculations

Flo Consult UK Ltd		Page 1
4 Market Square	Withington CH	
Old Amersham	Greenfield Run-Off	
Buckinghamshire, HP7 0DQ	Rate Calculations	
Date 19/01/2023	Designed by MDS	
File	Checked by MDS	
Innovyze	Source Control 2020.1	

IH 124 Mean Annual Flood

Input

Return Period (years)	1	Soil	0.450
Area (ha)	50.000	Urban	0.000
SAAR (mm)	864	Region Number	Region 10

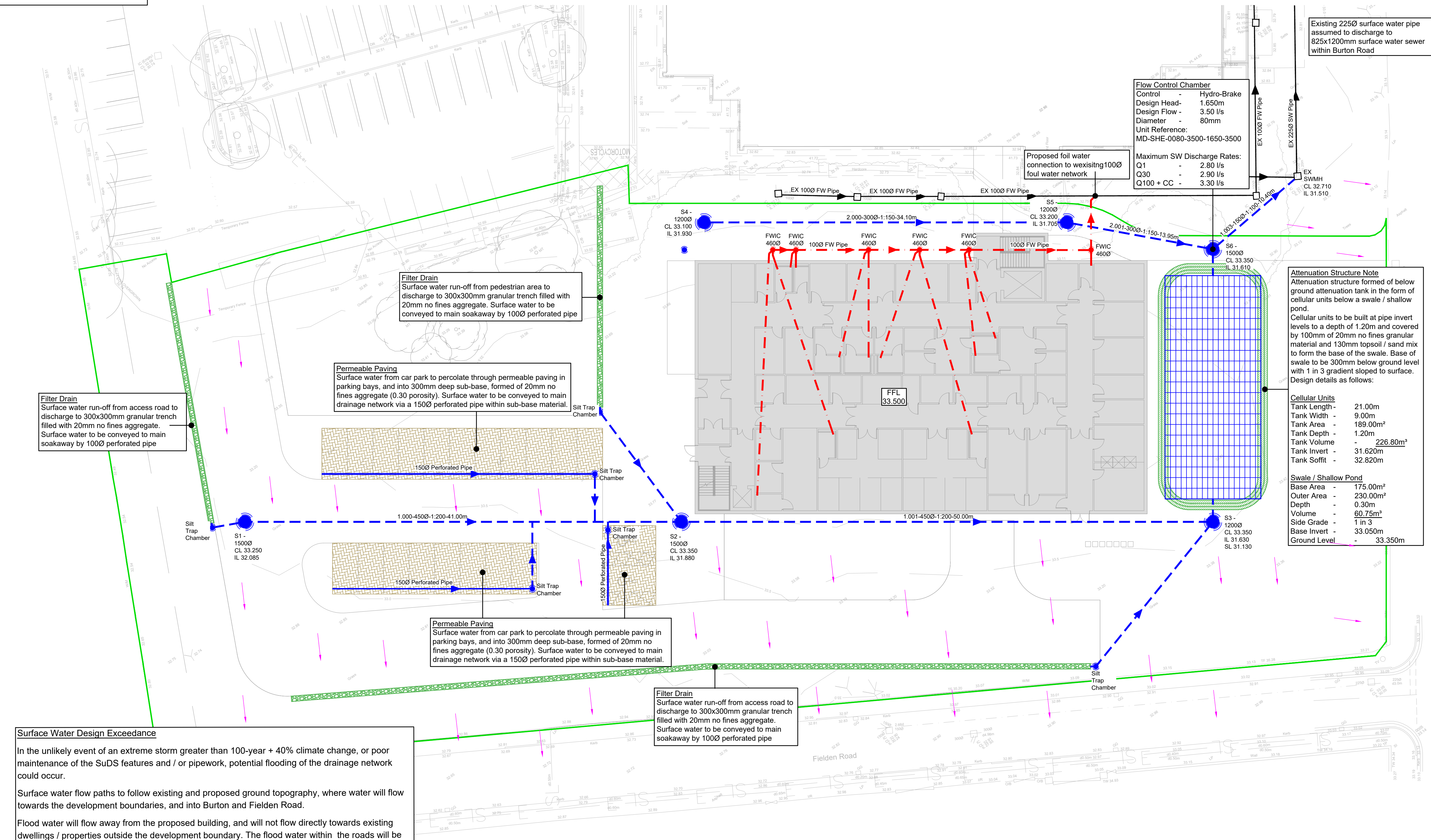
Results 1/s

QBAR Rural	281.0
QBAR Urban	281.0
Q1 year	244.5
Q1 year	244.5
Q2 years	261.7
Q5 years	334.4
Q10 years	387.8
Q20 years	441.8
Q25 years	460.8
Q30 years	476.4
Q50 years	519.8
Q100 years	584.5
Q200 years	663.1
Q250 years	688.4
Q1000 years	854.2

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4 Market Square	Withington CH																																					
Old Amersham	Greenfiled Run-Off																																					
Buckinghamshire, HP7 0DQ	Volume Calculations																																					
Date 19/01/2023	Designed by MDS																																					
File	Checked by MDS																																					
Innovyze		Source Control 2020.1																																				
<u>Greenfield Runoff Volume</u> FEH Data <table> <tr> <td>Return Period (years)</td> <td>100</td> </tr> <tr> <td>Storm Duration (mins)</td> <td>360</td> </tr> <tr> <td>FEH Rainfall Version</td> <td>1999</td> </tr> <tr> <td>Site Location</td> <td>GB 383750 391950 SJ 83750 91950</td> </tr> <tr> <td>C (1km)</td> <td>-0.026</td> </tr> <tr> <td>D1 (1km)</td> <td>0.310</td> </tr> <tr> <td>D2 (1km)</td> <td>0.367</td> </tr> <tr> <td>D3 (1km)</td> <td>0.334</td> </tr> <tr> <td>E (1km)</td> <td>0.304</td> </tr> <tr> <td>F (1km)</td> <td>2.444</td> </tr> <tr> <td>Areal Reduction Factor</td> <td>1.00</td> </tr> <tr> <td>Area (ha)</td> <td>323.750</td> </tr> <tr> <td>SAAR (mm)</td> <td>852</td> </tr> <tr> <td>CWI</td> <td>119.861</td> </tr> <tr> <td>SPR Host</td> <td>38.230</td> </tr> <tr> <td>URBEXT (USER)</td> <td>0.0000</td> </tr> </table> Results <table> <tr> <td>Percentage Runoff (%)</td> <td>41.30</td> </tr> <tr> <td>Greenfield Runoff Volume (m³)</td> <td>87714.739</td> </tr> </table>			Return Period (years)	100	Storm Duration (mins)	360	FEH Rainfall Version	1999	Site Location	GB 383750 391950 SJ 83750 91950	C (1km)	-0.026	D1 (1km)	0.310	D2 (1km)	0.367	D3 (1km)	0.334	E (1km)	0.304	F (1km)	2.444	Areal Reduction Factor	1.00	Area (ha)	323.750	SAAR (mm)	852	CWI	119.861	SPR Host	38.230	URBEXT (USER)	0.0000	Percentage Runoff (%)	41.30	Greenfield Runoff Volume (m³)	87714.739
Return Period (years)	100																																					
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Percentage Runoff (%)	41.30																																					
Greenfield Runoff Volume (m³)	87714.739																																					
©1982-2020 Innovyze																																						

Appendix F
Below Ground Drainage Strategy Layout and Details



notes :

- IF THIS DRAWING HAS BEEN RECEIVED ELECTRONICALLY IT IS THE RECIPIENT'S RESPONSIBILITY TO PRINT THE DOCUMENT TO THE CORRECT SCALE
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE. IT IS RECOMMENDED THAT INFORMATION IS NOT SCALED OFF THIS DRAWING
- THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS AND SPECIFICATIONS
- ANY DISCREPANCIES NOTED ON SITE ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY.

Drainage

Key

- Proposed Surface Water Drainage
- Proposed Foul Water Drainage
- Existing Surface Water Sewer
- Existing Foul Water Sewer
- Filter Drain
- Permeable Paving
- Swale / Shallow Pond
- Exceedance Flow Routes
- Development Boundary

P1	Preliminary Issue	20.01.23	MS	YA
REV.	DESCRIPTION	DATE	DRW.	CHK.

NHS
Manchester University
NHS Foundation Trust

APPOINTED PARTY LOGO/INFORMATION
ccs consulting
MANCHESTER • LONDON • LEEDS

PROJECT
Withington Community Hospital -
Community Diagnostic Centre

TITLE
Proposed Below Ground
Drainage Layout

STATUS S1	PURPOSE OF ISSUE For Comments
--------------	----------------------------------

DRAWN BY MS	CHECKED BY YA	DATE Jan. '23
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SCALE (@A1) As Shown	PROJECT NUMBER 22-2357
-------------------------	---------------------------

FILE DRAWING NUMBER 222357 - CCS - S1 - XX - DR - S - 0100	REV. P1
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Preliminary Issue - For Discussion Purposes Only

Appendix G

Surface Water Network / Management Calculations

Flo Consult UK Ltd			Page 1																																																																																																																																												
4 Market Square Old Amersham Buckinghamshire, HP7 0DQ		Withington CH Surface Water Network / Management Calculations																																																																																																																																													
Date 19/01/2023		Designed by MDS																																																																																																																																													
File Withington - SW Network ...		Checked by MDS																																																																																																																																													
Innovyze		Network 2020.1																																																																																																																																													
<u>STORM SEWER DESIGN by the Modified Rational Method</u> <u>Design Criteria for Storm</u> Pipe Sizes STANDARD Manhole Sizes STANDARD <table><tr><td colspan="6">FEH Rainfall Model</td></tr><tr><td>Return Period (years)</td><td colspan="4"></td><td>100</td></tr><tr><td>FEH Rainfall Version</td><td colspan="4"></td><td>1999</td></tr><tr><td>Site Location</td><td>GB</td><td>383750</td><td>391950</td><td>SJ</td><td>83750 91950</td></tr><tr><td>C (1km)</td><td colspan="4"></td><td>-0.026</td></tr><tr><td>D1 (1km)</td><td colspan="4"></td><td>0.310</td></tr><tr><td>D2 (1km)</td><td colspan="4"></td><td>0.367</td></tr><tr><td>D3 (1km)</td><td colspan="4"></td><td>0.334</td></tr><tr><td>E (1km)</td><td colspan="4"></td><td>0.304</td></tr><tr><td>F (1km)</td><td colspan="4"></td><td>2.444</td></tr><tr><td>Maximum Rainfall (mm/hr)</td><td colspan="4"></td><td>50</td></tr><tr><td>Maximum Time of Concentration (mins)</td><td colspan="4"></td><td>30</td></tr><tr><td>Foul Sewage (l/s/ha)</td><td colspan="4"></td><td>0.000</td></tr><tr><td>Volumetric Runoff Coeff.</td><td colspan="4"></td><td>0.750</td></tr><tr><td>PIMP (%)</td><td colspan="4"></td><td>100</td></tr><tr><td>Add Flow / Climate Change (%)</td><td colspan="4"></td><td>40</td></tr><tr><td>Minimum Backdrop Height (m)</td><td colspan="4"></td><td>0.000</td></tr><tr><td>Maximum Backdrop Height (m)</td><td colspan="4"></td><td>0.000</td></tr><tr><td>Min Design Depth for Optimisation (m)</td><td colspan="4"></td><td>1.200</td></tr><tr><td>Min Vel for Auto Design only (m/s)</td><td colspan="4"></td><td>1.00</td></tr><tr><td>Min Slope for Optimisation (1:X)</td><td colspan="4"></td><td>500</td></tr></table> Designed with Level Inverts <u>Time Area Diagram for Storm</u> <table><tr><td>Time</td><td>Area</td><td>Time</td><td>Area</td></tr><tr><td>(mins)</td><td>(ha)</td><td>(mins)</td><td>(ha)</td></tr><tr><td>0-4</td><td>0.232</td><td>4-8</td><td>0.071</td></tr></table> Total Area Contributing (ha) = 0.303 Total Pipe Volume (m³) = 20.160						FEH Rainfall Model						Return Period (years)					100	FEH Rainfall Version					1999	Site Location	GB	383750	391950	SJ	83750 91950	C (1km)					-0.026	D1 (1km)					0.310	D2 (1km)					0.367	D3 (1km)					0.334	E (1km)					0.304	F (1km)					2.444	Maximum Rainfall (mm/hr)					50	Maximum Time of Concentration (mins)					30	Foul Sewage (l/s/ha)					0.000	Volumetric Runoff Coeff.					0.750	PIMP (%)					100	Add Flow / Climate Change (%)					40	Minimum Backdrop Height (m)					0.000	Maximum Backdrop Height (m)					0.000	Min Design Depth for Optimisation (m)					1.200	Min Vel for Auto Design only (m/s)					1.00	Min Slope for Optimisation (1:X)					500	Time	Area	Time	Area	(mins)	(ha)	(mins)	(ha)	0-4	0.232	4-8	0.071
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0-4	0.232	4-8	0.071																																																																																																																																												
<u>Network Design Table for Storm</u> <table><tr><td>PN</td><td>Length</td><td>Fall</td><td>Slope</td><td>I.Area</td><td>T.E.</td><td>Base</td><td>k</td><td>HYD</td><td>DIA</td><td>Section</td><td>Type</td><td>Auto</td></tr><tr><td></td><td>(m)</td><td>(m)</td><td>(1:X)</td><td>(ha)</td><td>(mins)</td><td>Flow (l/s)</td><td>(mm)</td><td>SECT</td><td>(mm)</td><td></td><td></td><td>Design</td></tr></table> <u>Network Results Table</u> ©1982-2020 Innovyze						PN	Length	Fall	Slope	I.Area	T.E.	Base	k	HYD	DIA	Section	Type	Auto		(m)	(m)	(1:X)	(ha)	(mins)	Flow (l/s)	(mm)	SECT	(mm)			Design																																																																																																																
PN	Length	Fall	Slope	I.Area	T.E.	Base	k	HYD	DIA	Section	Type	Auto																																																																																																																																			
	(m)	(m)	(1:X)	(ha)	(mins)	Flow (l/s)	(mm)	SECT	(mm)			Design																																																																																																																																			

Flo Consult UK Ltd										Page 2	
4 Market Square Old Amersham Buckinghamshire, HP7 0DQ					Withington CH Surface Water Network / Management Calculations						
Date 19/01/2023					Designed by MDS						
File Withington - SW Network ...					Checked by MDS						
Innovyze					Network 2020.1						
<u>Network Design Table for Storm</u>											
PN	Rain	T.C.	US/IL	Σ I	Area	Σ Base	Foul	Add Flow	Vel	Cap	Flow
	(mm/hr)	(mins)	(m)		(ha)	Flow (l/s)	(l/s)	(l/s)	(m/s)	(l/s)	(l/s)

Flo Consult UK Ltd		Page 3
4 Market Square Old Amersham Buckinghamshire, HP7 0DQ	Withington CH Surface Water Network / Management Calculations	
Date 19/01/2023	Designed by MDS	
File Withington - SW Network ...	Checked by MDS	
Innovyze	Network 2020.1	

Network Design Table for Storm

Network Results Table

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Date 19/01/2023 File Withington - SW Network ...		Designed by MDS Checked by MDS	
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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	450	S1	33.250	32.085	0.715	Open Manhole	1500
1.001	o	450	S2	33.350	31.880	1.020	Open Manhole	1500
1.002	o	450	S3	33.350	31.630	1.270	Open Manhole	1500
2.000	o	300	S4	33.100	31.930	0.870	Open Manhole	1200
2.001	o	300	S5	33.200	31.705	1.195	Open Manhole	1200
1.003	o	450	S6	33.350	31.610	1.290	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	41.000	200.0	S2	33.350	31.880	1.020	Open Manhole	1500
1.001	50.000	200.0	S3	33.350	31.630	1.270	Open Manhole	1500
1.002	4.000	200.0	S6	33.350	31.610	1.290	Open Manhole	1500
2.000	34.100	151.6	S5	33.200	31.705	1.195	Open Manhole	1200
2.001	13.950	146.8	S6	33.350	31.610	1.440	Open Manhole	1500
1.003	10.400	104.0	EX SWMH	32.710	31.510	0.750	Open Manhole	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	40.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999

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Synthetic Rainfall Details Site Location GB 383750 391950 SJ 83750 91950 C (1km) -0.026 D1 (1km) 0.310 D2 (1km) 0.367 D3 (1km) 0.334 E (1km) 0.304 F (1km) 2.444 Summer Storms Yes Winter Storms Yes Cv (Summer) 0.750 Cv (Winter) 0.840 Storm Duration (mins) 30		
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Hydro-Brake® Optimum Manhole: S6, DS/PN: 1.003, Volume (m³): 4.4																																																																										
Unit Reference MD-SHE-0080-3500-1650-3500 Design Head (m) 1.650 Design Flow (l/s) 3.5 Flush-Flo™ Calculated Objective Minimise upstream storage Application Surface Sump Available Yes Diameter (mm) 80 Invert Level (m) 31.610 Minimum Outlet Pipe Diameter (mm) 100 Suggested Manhole Diameter (mm) 1200																																																																										
<table><tr><td>Control Points</td><td>Head (m)</td><td>Flow (l/s)</td><td>Control Points</td><td>Head (m)</td><td>Flow (l/s)</td></tr><tr><td>Design Point (Calculated)</td><td>1.650</td><td>3.5</td><td>Kick-Flo®</td><td>0.711</td><td>2.4</td></tr><tr><td>Flush-Flo™</td><td>0.349</td><td>3.0</td><td>Mean Flow over Head Range</td><td>-</td><td>2.8</td></tr></table>			Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	1.650	3.5	Kick-Flo®	0.711	2.4	Flush-Flo™	0.349	3.0	Mean Flow over Head Range	-	2.8																																																						
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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																																																																										
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Storage Structures for Storm Complex Manhole: S6, DS/PN: 1.003 Cellular Storage Invert Level (m) 31.620 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><thead><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr></thead><tbody><tr><td>0.000</td><td>189.0</td><td>0.0</td><td>2.600</td><td>0.0</td><td>0.0</td></tr><tr><td>0.200</td><td>189.0</td><td>0.0</td><td>2.800</td><td>0.0</td><td>0.0</td></tr><tr><td>0.400</td><td>189.0</td><td>0.0</td><td>3.000</td><td>0.0</td><td>0.0</td></tr><tr><td>0.600</td><td>189.0</td><td>0.0</td><td>3.200</td><td>0.0</td><td>0.0</td></tr><tr><td>0.800</td><td>189.0</td><td>0.0</td><td>3.400</td><td>0.0</td><td>0.0</td></tr><tr><td>1.000</td><td>189.0</td><td>0.0</td><td>3.600</td><td>0.0</td><td>0.0</td></tr><tr><td>1.200</td><td>189.0</td><td>0.0</td><td>3.800</td><td>0.0</td><td>0.0</td></tr><tr><td>1.400</td><td>0.0</td><td>0.0</td><td>4.000</td><td>0.0</td><td>0.0</td></tr><tr><td>1.600</td><td>0.0</td><td>0.0</td><td>4.200</td><td>0.0</td><td>0.0</td></tr><tr><td>1.800</td><td>0.0</td><td>0.0</td><td>4.400</td><td>0.0</td><td>0.0</td></tr><tr><td>2.000</td><td>0.0</td><td>0.0</td><td>4.600</td><td>0.0</td><td>0.0</td></tr><tr><td>2.200</td><td>0.0</td><td>0.0</td><td>4.800</td><td>0.0</td><td>0.0</td></tr><tr><td>2.400</td><td>0.0</td><td>0.0</td><td>5.000</td><td>0.0</td><td>0.0</td></tr></tbody></table> Tank or Pond Invert Level (m) 33.050 <table><thead><tr><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th></tr></thead><tbody><tr><td>0.000</td><td>175.0</td><td>0.700</td><td>0.0</td><td>1.400</td><td>0.0</td><td>2.100</td><td>0.0</td></tr><tr><td>0.100</td><td>195.0</td><td>0.800</td><td>0.0</td><td>1.500</td><td>0.0</td><td>2.200</td><td>0.0</td></tr><tr><td>0.200</td><td>210.0</td><td>0.900</td><td>0.0</td><td>1.600</td><td>0.0</td><td>2.300</td><td>0.0</td></tr><tr><td>0.300</td><td>230.0</td><td>1.000</td><td>0.0</td><td>1.700</td><td>0.0</td><td>2.400</td><td>0.0</td></tr><tr><td>0.400</td><td>0.0</td><td>1.100</td><td>0.0</td><td>1.800</td><td>0.0</td><td>2.500</td><td>0.0</td></tr><tr><td>0.500</td><td>0.0</td><td>1.200</td><td>0.0</td><td>1.900</td><td>0.0</td><td></td><td></td></tr><tr><td>0.600</td><td>0.0</td><td>1.300</td><td>0.0</td><td>2.000</td><td>0.0</td><td></td><td></td></tr></tbody></table>			Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	189.0	0.0	2.600	0.0	0.0	0.200	189.0	0.0	2.800	0.0	0.0	0.400	189.0	0.0	3.000	0.0	0.0	0.600	189.0	0.0	3.200	0.0	0.0	0.800	189.0	0.0	3.400	0.0	0.0	1.000	189.0	0.0	3.600	0.0	0.0	1.200	189.0	0.0	3.800	0.0	0.0	1.400	0.0	0.0	4.000	0.0	0.0	1.600	0.0	0.0	4.200	0.0	0.0	1.800	0.0	0.0	4.400	0.0	0.0	2.000	0.0	0.0	4.600	0.0	0.0	2.200	0.0	0.0	4.800	0.0	0.0	2.400	0.0	0.0	5.000	0.0	0.0	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	175.0	0.700	0.0	1.400	0.0	2.100	0.0	0.100	195.0	0.800	0.0	1.500	0.0	2.200	0.0	0.200	210.0	0.900	0.0	1.600	0.0	2.300	0.0	0.300	230.0	1.000	0.0	1.700	0.0	2.400	0.0	0.400	0.0	1.100	0.0	1.800	0.0	2.500	0.0	0.500	0.0	1.200	0.0	1.900	0.0			0.600	0.0	1.300	0.0	2.000	0.0		
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Innovyze				Network 2020.1			
1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm							
Simulation Criteria							
Areal Reduction Factor 1.000				Additional Flow - % of Total Flow 40.000			
Hot Start (mins) 0				MADD Factor * 10m³/ha Storage 2.000			
Hot Start Level (mm) 0				Inlet Coefficient 0.800			
Manhole Headloss Coeff (Global) 0.500				Flow per Person per Day (l/per/day) 0.000			
Foul Sewage per hectare (l/s) 0.000							
Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0 Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0							
Synthetic Rainfall Details							
Rainfall Model				FEH			
FEH Rainfall Version				1999			
Site Location GB 383750 391950 SJ 83750 91950							
C (1km)				-0.026			
D1 (1km)				0.310			
D2 (1km)				0.367			
D3 (1km)				0.334			
E (1km)				0.304			
F (1km)				2.444			
Cv (Summer)				0.750			
Cv (Winter)				0.840			
Margin for Flood Risk Warning (mm) 300.0							
Analysis Timestep 2.5 Second Increment (Extended)							
DTS Status ON							
DVD Status ON							
Inertia Status OFF							
Profile(s) Summer and Winter							
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440							
Return Period(s) (years) 1, 30, 100							
Climate Change (%) 0, 0, 40							
Water							
US/MH	Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level
PN Name Storm Period Change Surchage Flood Overflow Act. (m)							
1.000 S1 15 Winter 1 +0% 100/15 Summer							32.169
1.001 S2 15 Winter 1 +0% 100/15 Summer							31.988
1.002 S3 240 Winter 1 +0% 30/60 Winter							31.825
2.000 S4 15 Winter 1 +0% 100/15 Summer							31.997
2.001 S5 240 Winter 1 +0% 30/15 Winter							31.825
1.003 S6 240 Winter 1 +0% 30/30 Winter							31.825
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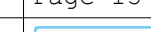
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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Flooded		Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)						
1.000	S1	-0.366	0.000	0.08			15.6	OK	
1.001	S2	-0.342	0.000	0.13			26.8	OK	
1.002	S3	-0.255	0.000	0.07			7.9	OK	
2.000	S4	-0.233	0.000	0.11			9.2	OK	
2.001	S5	-0.180	0.000	0.03			2.6	OK	
1.003	S6	-0.235	0.000	0.02		167	2.8	OK	

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<u>30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)</u> <u>for Storm</u>									
		Surcharged		Flooded		Half Drain	Pipe		
	US/MH	Depth	Volume	Flow /	Overflow	Time	Flow		Level
PN	Name	(m)	(m³)	Cap.	(l/s)	(mins)	(l/s)	Status	Exceeded
1.000	S1	-0.298	0.000	0.24			49.0	OK	
1.001	S2	-0.124	0.000	0.07			14.1	OK	
1.002	S3	0.126	0.000	0.15			18.0	SURCHARGED	
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Number of Input Hydrographs		0	Number of Offline Controls		0	Number of Time/Area Diagrams		0																																									
Number of Online Controls		1	Number of Storage Structures		1	Number of Real Time Controls		0																																									
<u>Synthetic Rainfall Details</u>																																																	
Rainfall Model				FEH																																													
FEH Rainfall Version				1999																																													
Site Location				GB 383750 391950 SJ 83750 91950																																													
C (1km)				-0.026																																													
D1 (1km)				0.310																																													
D2 (1km)				0.367																																													
D3 (1km)				0.334																																													
E (1km)				0.304																																													
F (1km)				2.444																																													
Cv (Summer)				0.750																																													
Cv (Winter)				0.840																																													
Margin for Flood Risk Warning (mm)				300.0																																													
Analysis Timestep				2.5 Second Increment (Extended)																																													
DTS Status				ON																																													
DVD Status				ON																																													
Inertia Status				OFF																																													
Profile(s)				Summer and Winter																																													
Duration(s) (mins)				15, 30, 60, 120, 240, 360, 480, 960, 1440																																													
Return Period(s) (years)				1, 30, 100																																													
Climate Change (%)				0, 0, 40																																													
WARNING: Half Drain Time has not been calculated as the structure is too full.																																																	
<table border="1"> <thead> <tr> <th>PN</th> <th>US/MH Name</th> <th>Storm</th> <th>Return Period</th> <th>Climate Change</th> <th>First (X) Surge</th> <th>First (Y) Flood</th> <th>First (Z) Overflow</th> <th>Overflow Act.</th> <th>Water Level (m)</th> </tr> </thead> <tbody> <tr> <td>1.000</td> <td>S1 480</td> <td>Winter</td> <td>100</td> <td>+40%</td> <td>100/15</td> <td>Summer</td> <td></td> <td></td> <td>33.099</td> </tr> <tr> <td>1.001</td> <td>S2 480</td> <td>Winter</td> <td>100</td> <td>+40%</td> <td>100/15</td> <td>Summer</td> <td></td> <td></td> <td>33.100</td> </tr> <tr> <td>1.002</td> <td>S3 480</td> <td>Winter</td> <td>100</td> <td>+40%</td> <td>30/60</td> <td>Winter</td> <td></td> <td></td> <td>33.099</td> </tr> </tbody> </table>										PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	1.000	S1 480	Winter	100	+40%	100/15	Summer			33.099	1.001	S2 480	Winter	100	+40%	100/15	Summer			33.100	1.002	S3 480	Winter	100	+40%	30/60	Winter			33.099
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Flo Consult UK Ltd		Page 15
4 Market Square Old Amersham Buckinghamshire, HP7 0DQ	Withington CH Surface Water Network / Management Calculations	
Date 19/01/2023	Designed by MDS	
File Withington - SW Network ...	Checked by MDS	
Innovyze	Network 2020.1	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Surcharged	Flooded			Half Drain	Pipe	Status	Level Exceeded
		Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)		
1.000	S1	0.564	0.000	0.04			8.4	FLOOD RISK	
1.001	S2	0.770	0.000	0.08			15.8	FLOOD RISK	
1.002	S3	1.019	0.000	0.19			22.1	FLOOD RISK	

