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Project

TLHC Wythenshawe Hospital

Title

Flood Risk Assessment
Surface Water Management Report

Date

December 2024

Revision

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1. Introduction

CCS Consulting has prepared this flood risk assessment and surface water management for a new Targeted Lung Health Check building, at Wythenshawe Hospital, Manchester (hereafter referred to as the 'Site').

This report provides a detailed overview of the proposed development and an assessment of it in relation to the flood risk, and how the proposals have been developed in relation to current flood map data and current planning policy and requirements, including:

- National Planning Policy Framework (NPPF), December 2023, Paragraphs 158 and 165 - 175;
- National Planning Practice Guidance (NPPG), released in March 2014 and updated in August 2022;
- National Standards for Sustainable Drainage Systems (SuDS) set out by the Department for Environment, Food & Rural Affairs (DEFRA) (2011);
- DEFRA Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015);
- CIRIA (2010) Planning for SuDS – Making it Happen C687;
- CIRIA SuDS Manual C753 (2015).

And local policies including:

- 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 need to be satisfied that the design and drainage principles of the proposed development will address the risk of flooding to the development site; will ensure that the drainage is maintained to prevent flooding; and in turn not to increase the risk of flooding to neighbouring land and property.

This flood risk statement and surface water management report has therefore been prepared to: identify and evaluate the various possible sources of flood risk to which the proposed site might be subjected to; identify any mitigation, protection or compensation measures deemed necessary or feasible; manage the surface water so it is sustainable, and does not increase the probability of flooding within, or near the site.

2. Planning Policies and Guidance

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

NPPF (December 2023) sets out the Government's national policy on development and flood risk, and seeks to provide clarity on what is required at regional and local levels, to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk.

NPPF Paragraph 158 provides guidance for developments to take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk.

NPPF Paragraphs 165 to 175 provide guidance for planning and flood risk, where are plans should apply a sequential, risk-based approach to the location of development taking into account current and future impacts of climate change; to ensure that flood risk is not increased elsewhere due to the development; and to incorporate sustainable drainage systems.

NPPG, Paragraph 055 (Reference ID:7-055-20220825) 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 056 (Reference ID:7-056-20220825) 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 (FWMA) received royal assent in April 2010, aiming to create a simpler and more effective means of managing flood risk and coastal erosion. The FWMA incorporates and implements some of the recommendations from the Pitt Review (2008), following the severe flooding that affected a large area of the UK in 2007. The FWMA also places several new duties and responsibilities on LLFAs regarding the management of local flood risk, to: Develop, maintain, apply, and monitor a Local Flood Risk Management Strategy; Approve, adopt, and maintain Sustainable Drainage Systems (SuDS) (yet to be implemented); Establish and maintain a flood risk Asset Register; Investigate incidents of flooding (where appropriate) and publish the findings in a report; Ensure delivery of effective and joined up management of flood risk.

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:

- *'In line with the risk-based sequential approach contained within PPS25, development should be directed away from sites at the greatest risk of flooding, and towards sites with little or no risk of flooding; this should take account of all sources of flooding identified in the Manchester-Salford-Trafford Strategic Flood Risk Assessment (SFRA).*

- *In addition to the requirements for site-specific Flood Risk Assessments (FRAs) set out in PPS25, an appropriate FRA will also be required for all development proposals, including changes of use, on sites greater than 0.5ha within Critical Drainage Areas (CDAs) and Canal Hazard Zones identified in the SFRA.*

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

- *The City of Manchester contains many sections of rivers which are culverted or 'hidden'; where these are indicated in the SFRA beneath the proposed development site, further investigation will be required and the development proposal should take this into account; where feasible and appropriate development should seek to open up culverted/hidden rivers to reduce the associated flood risk and danger of collapse, taking advantage of opportunities to enhance biodiversity and Green Infrastructure'.*

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 Wythenshaw Hospital, and is bound by the North-West Heart Centre building to the north and east, an internal access road to the south, and Floats Road to the west.

The co-ordinates to the centre of the Site are - E: 380405, N: 388055.

3.2. Existing Site and Topography

The Site, in a pre-development state, consist of existing hard-standing parking areas to the north and south of an existing internal access road.

As detailed on the topographical survey plan in Appendix A, the area of the Site to the north of the access road falls in a northerly direction, with the levels ranging from approximately 42.00m AOD to 41.02m AOD. The areas of the Site to the south of the access road also fall in a northerly direction with the levels ranging from approximately 43.06m AOD to 42.27m AOD.

3.3. Proposed Development

The proposed site plan is shown in Appendix B, with a full description of the Site being stated by the Architect. In brief, and in relation to this report, the Site, in a post development state, will consist of a new Targeted Lung Health Check (TLHC) building, hard-standing areas for a mobile modular unit, and new parking areas to the south of the existing access road.

3.4. Ground Conditions

The ground conditions can be determined by the British Geological Survey (BGS) data website, which shows the Site to have superficial deposits of Till Devensian (Diamicton), over bedrock consisting of Bollin Mudstone Member (mudstone). Public borehole logs taken near the Site (see Appendix C) shows the ground to predominantly consists of clay.

3.5. Waterbody / Rivers / Artificial Sources

There are no waterbodies near the Site, with the nearest being Fairywell Brook approximately 350m to the west.

3.6. Existing Drainage Networks

As detailed on the utilities survey plan in Appendix D, there is an existing 150mm to 300mm diameter surface water drainage network that flows in a northerly direction from the existing access road and across the Site area to the north.

The existing network is believed to discharge to a surface water sewer in Southmoor Road. The survey shows connections from gullies to which the areas within the Site fall towards. Therefore, based on the topography and utilities survey, surface water from all the Site, in a pre-development state, discharges to the surface water drainage network.

3.7. Surface Water Management Areas

The Site has an overall area of approximately 1,160m² / **0.116 ha**.

The Site, in a pre-development state, is all developed with the surface water run-off discharging to an existing surface water drainage network. Therefore, the Site is classed as a Brownfield, with an urban factor of **1.00**, and a pre-development surface water run-off area of 1,160m² / **0.116 ha**.

The Site, in post development state, will be formed of the new building and external hard-standing areas only. Therefore, the post development surface water management area will also equate to 1,160m² / **0.116 ha**.

4. Flood Risk Assessment - Potential Sources of Existing Flooding

In accordance with the NPPF, flood risk must be assessed for all sources of flooding. All possible sources of flooding, and a brief description of each, are as follows:

4.1. Fluvial Flooding

Fluvial flooding has resulted from watercourses / rivers surcharging and flooding the surrounding areas.

4.2. Pluvial Flooding

'Pluvial' flooding is that which results from rainfall generated overland flow before the run-off enters any watercourse, drain or sewer. It is more often linked to high intensity rainfall events (typically more than 30mm per hour).

However, it can also result from lower intensity rainfall or melting snow where the ground is saturated, frozen, developed or has low permeability. This results in overland flow and ponding in depressions in the topography. In urban areas 'pluvial' flows are likely to follow the routes of highways and other surface connectivity to low spots where flooding can occur. In some cases, it can deviate from this route into adjacent developments via dropped kerbs (either for access to driveways or disability access).

4.3. Groundwater Flooding

Groundwater flooding is caused by the emergence of water from sub-surface permeable strata. Fluctuations in the groundwater table can cause flooding should the table rise above the existing ground level. Groundwater flooding events tend to have long durations, lasting days, or weeks.

4.4. Flooding from Drains and Sewers

Flooding from drains and sewers is caused when the capacity of the drains and sewers is exceeded and will result in flooding from the manholes.

4.5. Canals, Reservoirs and Other Artificial Sources

Flooding from canals, reservoirs and artificial sources is caused when the capacity of the sources is exceeded, or if there is an infrastructure failure.

5. Flood Risk Assessment - Probability of Flooding

5.1. Fluvial Flooding

The fluvial flood map (Risk of Flooding from Rivers and Sea) on the EA website (see Figure 1 below) identifies all the Site to be in Flood Zone 1 (low probability of flooding).

Figure 1 – EA Fluvial Flood Zone Map

The fluvial flood probability map on the EA website (see Figure 2 below) identifies that all the Site to have a better than very low probability of fluvial flooding.

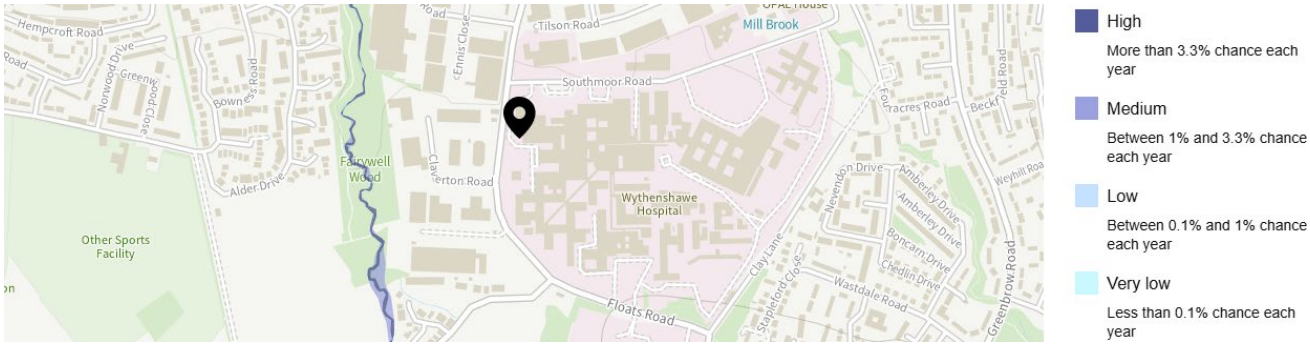


Figure 2 – EA Fluvial Flood Probability Map

Therefore, based on the flood map data, the probability of fluvial flooding is deemed to be low.

5.2. Pluvial Flooding

The pluvial flood map on the EA website (see Figure 3 below) identifies all the Site to have a very low probability of pluvial / surface water flooding.

Therefore, based on the flood map data, the probability of pluvial flooding is deemed to be low.

Figure 3 – EA Pluvial / Surface Water Flood Probaility Map

5.3. Ground Water Flooding

BGS shows the Site to have superficial deposits of Till Devensian (Diamicton), over bedrock consisting of Bollin Mudstone Member (mudstone). Public borehole logs taken near the Site also show the ground to predominantly consists of clay.

Clay is known to have exceptionally low / no infiltration value, and therefore it is likely to hold no groundwater that will rise and flood the Site.

Therefore, based on this data, the probability of groundwater flooding is deemed to be low.

5.4. Drains and Sewers

There is an existing 150mm to 300mm diameter surface water drainage network that flows in a northerly direction from the existing access road and across the Site area to the north. The existing network is believed to discharge to a surface water sewer in Southmoor Road.

There has been no history of flooding from the drainage networks within the Site, and if flooding were to occur from the public sewer (within Southmoor Road), the water would not flow towards the development areas, but will continue to flow in a northerly direction to follows the roads topography.

Therefore, based on this, the probability of drains and sewer flooding is deemed to be low.

5.5. Canal, Reservoirs and Artificial Sources

The reservoir flood map on the EA website (see Figure 4 below) shows that there is no flooding from reservoirs when the river levels are normal or when there is flooding from rivers.

Figure 4 – EA Mximum Extent of Flooding from Reservois

There are no known canals or other artificial waterbodies near the Site, and therefore the risk of flooding from artificial sources is deemed to be low.

6. Flood Risk Assessment – Flood Risk and Vulnerability

The NPPG Paragraphs 077 to 078 set out the flood risk for the Site by assessing the flood zones, flood risk vulnerability classification, and flood risk vulnerability and flood zone 'compatibility'.

6.1. Flood Zones

NPPG Paragraph 077, Table 1 indicates that the flood zones are:

Flood Zones	
Flood Zone	**Definition**
Zone 1 Low Probability	Land having a less than 0.1% annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map for Planning – all land outside Zones 2, 3a and 3b)
Zone 2 Medium Probability	Land having between a 1% and 0.1% annual probability of river flooding; or land having between a 0.5% and 0.1% annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)
Flood Zone 3b The Functional Flood Plain	This zone comprises land where water from rivers or the sea has to flow or be stored in times of flood. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. Functional floodplain will normally comprise: • land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively; or • land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding). Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)

The EA flood map data has identified the Site to be in Flood Zone 1 (land having a less than 0.1% annual probability of river flooding).

6.2. Flood Risk Vulnerability Classification

NPPG Paragraph 077, refers to NPPF Annex 3 where is states the flood risk vulnerability classifications as:

Flood Risk Vulnerability Classification
Essential Infrastructure Essential transport infrastructure (including mass evacuation routes) which should cross the area at risk; Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood; Wind turbines.
Highly Vulnerable Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operational during flooding; Emergency dispersal points; Basement dwellings; Caravans, mobile homes and park homes intended for permanent residential use; Installations requiring hazardous substances consent.
More Vulnerable **Hospitals**; Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels; Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels; Non–residential uses for health services, nurseries and educational establishments; Landfill* and sites used for waste management facilities for hazardous waste; Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less Vulnerable Police, ambulance and fire stations which are not required to be operational during flooding; Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the 'More Vulnerable' class; and assembly and leisure; Land and buildings used for agriculture and forestry; Waste treatment (except landfill* and hazardous waste facilities); Minerals working and processing (except for sand and gravel working); Water treatment works which do not need to remain operational during times of flood.
Water Compatible development Flood control infrastructure; Water transmission infrastructure and pumping stations; Sewage transmission infrastructure and pumping stations; Sand and gravel working; Docks, marinas and wharves; Navigation facilities; Ministry of Defence installations; Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location; Water-based recreation (excluding sleeping accommodation); Lifeguard and coastguard stations; Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms; Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

This Site will be used as a hospital and therefore is classed as 'More Vulnerable'.

6.3. Flood Risk Vulnerability and Flood Zone 'Compatibility'

NPPG Paragraph 078 Table 2, gives guidance on flood risk vulnerability compared with flood zones, to determine the compatibility.

Flood Risk Vulnerability and Flood Zone 'Compatibility'					
Flood Zones	Flood Risk Vulnerability Classification				
	Essential Infrastructure	Highly Vulnerable	**More Vulnerable**	Less Vulnerable	Water Compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a †	† Exception Test required	X	Exception Test required	✓	✓
Zone 3b*	* Exception Test required	X	X	X	✓*

"†" In Flood Zone 3a essential infrastructure should be designed and constructed to remain operational and safe in times of flood.

"*" In Flood Zone 3b (functional floodplain) essential infrastructure that has passed the Exception Test, and water-compatible uses, should be designed and constructed to:

- remain operational and safe for users in times of flood;
- result in no net loss of floodplain storage;
- not impede water flows and not increase flood risk elsewhere.

The Site is classed as 'More Vulnerable', but as it is in Flood Zone 1, Table 2 of the NPPG states that the Site is **Appropriate for Development**, with the requirements of an **Exception Test.**

7. Flood Risk Assessment - The Sequential Test

7.1. Sequential Test Guidance

Paragraph 168 of the NPPF states that: '*The aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding. The Strategic Flood Risk Assessment will provide the basis for applying this test. A sequential approach should be used in areas known to be at risk from any form of flooding.*

7.2. The Test

The Site has passed the sequential test as the TLHC building is built in Flood Zone 1, and in an area low risk of flooding from all other sources. The Site is also associated with existing hospital buildings, and therefore is not appropriate in any other location.

8. Surface Water Management - Principles

The surface water for the Site is to be managed so that it adheres to the current regulations, and local authority requirements, as detailed in previous sections of this report.

8.1. 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.

8.2. 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).

8.3. 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.

8.4. Peak Surface Water Flow

DEFRA Non-Statutory Technical Standards for Sustainable Drainage Systems states:

***'S3** 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 as 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'.*

Manchester City Council for previous development have stated:

'Where flows less than 5 l/s are proposed, a blockage risk assessment must be undertaken. If the risk cannot be adequately managed, a higher minimum discharge rate should be considered / agreed with relevant authority. Details of surface water attenuation that offers a reduction in surface water runoff rate in line with the Manchester Trafford and Salford Strategic Flood Risk Assessment. Provide at least a 50% reduction in brownfield runoff rate or greenfield runoff rate'.

Therefore, based on the guidance, the surface water run-off from the Site areas (north and south of access road) will aim to reduce the flow rates to as close as possible to the greenfield rates (feasibility dependent on flow control size), but at least 5 l/s or 50% reduction of the pre-development rates (whichever is lower).

8.5. Volume Control

DEFRA National Non-Statutory Technical Standards for Sustainable Drainage Systems states:

*‘**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 S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk’.*

8.6. Flood Risk

DEFRA 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’.*

8.7. Pollution

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.

8.8. 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 will be achieved by designing suitable ground exceedance or flood pathways, and run-off will be completely contained within the drainage system (including areas designed to hold or convey water) for all events up to a 1 in 100-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.

9. Surface Water Management - Run-Off Destination

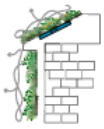
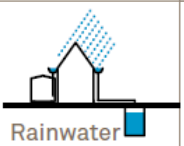
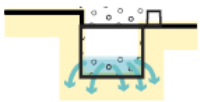
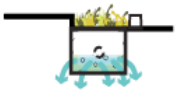
The destination of the surface water run-off from the post development site has been assessed against the prioritisation set by the Approved Document H – Drainage and Waste Disposal (2010). The feasibility of the surface water run-off to the priority receptors are as follows:

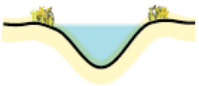
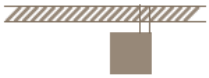
Run-Off Destination	Feasible / Required?	Description
Discharge to Ground	No	BGS data shows the Site to have superficial deposits of Till Devensian (Diamicton), over bedrock consisting of Bollin Mudstone Formation (mudstone). Public borehole logs taken near the Site show the ground to predominantly consists of clay. Clay is known to have exceptionally low / no infiltration value, therefore discharge to ground is not feasible.
Discharge to Surface Water Body	No	There are no known surface waterbodies near the development site, and therefore discharge to a surface waterbody is not a feasible destination.
Discharge to Surface Water Sewer	**Yes**	As the ground is not suitable for infiltration and there are no known surface waterbodies near the Site, the only alternative is to discharge to the existing surface water drainage network within the Site. **This will replicate the pre-development surface water run-off destination.**
Discharge to Highway Drain or Other	No	There are no known highway drains near the development site, and therefore discharge to a highway drain is not a feasible destination.
Discharge to Combined Water Sewer	No	There are no known combined water sewers near the development site, and therefore discharge to a surface water sewer is not a feasible destination.

10. Surface Water Management - 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 maintenancce 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	Use	Description
Living Roofs	No	The TLHC building roof has not been structurally designed for living roofs. Therefore, this is not a feasible SuDS method.
Rainwater Harvesting	No	Rainwater harvesting for water re-use has not been considered for the Site due to the cost and difficulty to install a dual pipe network to the new TLHC building, the adjacent hospital building and hospital site already having water main connections, and that water supply is crucial to this type of development (hospital / healthcare).
Soakaway	No	BGS data shows the Site to have superficial deposits of Till Devensian (Diamicton), over bedrock consisting of Bollin Mudstone Formation (mudstone). Public borehole logs taken near the Site show the ground to predominantly consists of clay. Clay is known to have exceptionally low / no infiltration value, therefore the use of soakaways is not feasible.
Permeable Paving	**Yes**	The parking bay areas to the south of the Site can be formed of permeable paving, and will take the surface water run-off from the access and parking areas. The permeable paving will be built over a 300mm deep sub-

		base formed of 20mm no fines aggregate and wrapped in a permeable membrane. Surface water will not discharge to ground (for reasons stated above) but will also be conveyed to the main drainage network via a perforated pipe within the sub-base material. Permeable surfacing will reduce the surface water run-off rates and act as a pollutant control at source.
Filter Drains	No	The Site will consist of the new TLHC building and external hard-standing areas only, where permeable paving is utilised. There are no proposed areas of soft-landscaping, and therefore, there is no requirement for filter drains to be used.
Hardscape Storage	No	There is no requirement for hardscape storage as all surface water run-off from the external areas will discharge to the permeable paving systems.
Swales / Ponds / Bioretention Areas	No	There are no soft-landscaping areas within the Site. Therefore, due to no suitable areas, the use of bioretention areas, swales or ponds are not feasible.
Underground Storage	**Yes**	The surface water run-off from the development area will be restricted. Therefore, there will be a requirement to have underground storage for storm events up to 1 in 30-year; and to suitably sized so that the volume of water during the 1 in 100-year storm event is kept a minimum at surface level, where it can be contained on the Site.

11. Surface Water Management - Greenfield Run-Off Rate and Volumes

To minimise the surface water run-off from the development site, it is preferred that the post development surface water run-off is restricted to the equivalent greenfield run-off rates and volume.

11.1. 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 Studied 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 km2 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):

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

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

Area	=	50.00 ha (IH 124 Method – Pro-rata to actual area)
SAAR	=	864
Soil	=	0.450
Urban Factor	=	0.75 (actual 1.00, but 075 highest for calculation)
Region Number	=	10

Based on these variables, and the calculation results provided by the MicroDrainage computer software (Appendix E), the QBAR for a 50.00ha catchment area is:

QBAR = 702.8 l/s

This figure is for the catchment area of 50.00 ha, and is to be reduced to reflect the Site surface water management area (0.116 ha) of the Site. Therefore, the QBAR for the Site has been calculated to be:

QBAR = 1.63 l/s (14.05 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_2	1.63 l/s	0.93	**1.5 l/s**
Q_{30}	1.63 l/s	1.70	**2.8 l/s**
Q_{100}	1.63 l/s	2.08	**3.4 l/s**

11.2. 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) 2013, where:

Site Location = GB 380405 388055 SJ 80405 88055

SW Catchment Area = 0.116 ha

SAAR = 828

CWI = 118.697

SPR Host = 47.000

URBTEXT = 0.50 (actual 1.00, but 0.50 highest for calculation)

Based on these calculation results (as shown in Appendix E), the greenfield run-off volume for the surface water management area of the development site (0.116 ha) is:

$Q_{100\ (6\text{-}Hour)}$ ` = 42.96m³ (370.34m³/ha)

12. Surface Water Management - Pre-Development Run-Off Calculations

The pre-development surface water run-off rates and volume from the existing hard-standing parking areas are to be calculated, to ensure there is at least a 50% reduction of the pre-development surface water run-off rates.

The calculations to determine the pre-development surface water run-off rates and volume are based on the pre-development surface water run-off area of 0.116 ha, the rainfall data given by the FEH 2013, and simulation / calculations in the MicroDrainage computer software (see Appendix F).

Based on the computer software results, the pre-development surface water run-off rates are as follows:

Q_2 = 21.4 l/s (15-minute storm duration)

Q_{30} = 55.2 l/s (15-minute storm duration)

Q_{100} = 76.6 l/s (15-minute storm duration)

The surface water run-off volumes for the pre-development site have also been calculated for 1 in 100-Year the 6-hour duration within the MicroDrainage computer software (Appendix F), where:

$Q_{100\ (6\text{-}hour)}$ = 76.68m³

13. Surface Water Management - 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 summarised in Figure 5 below.

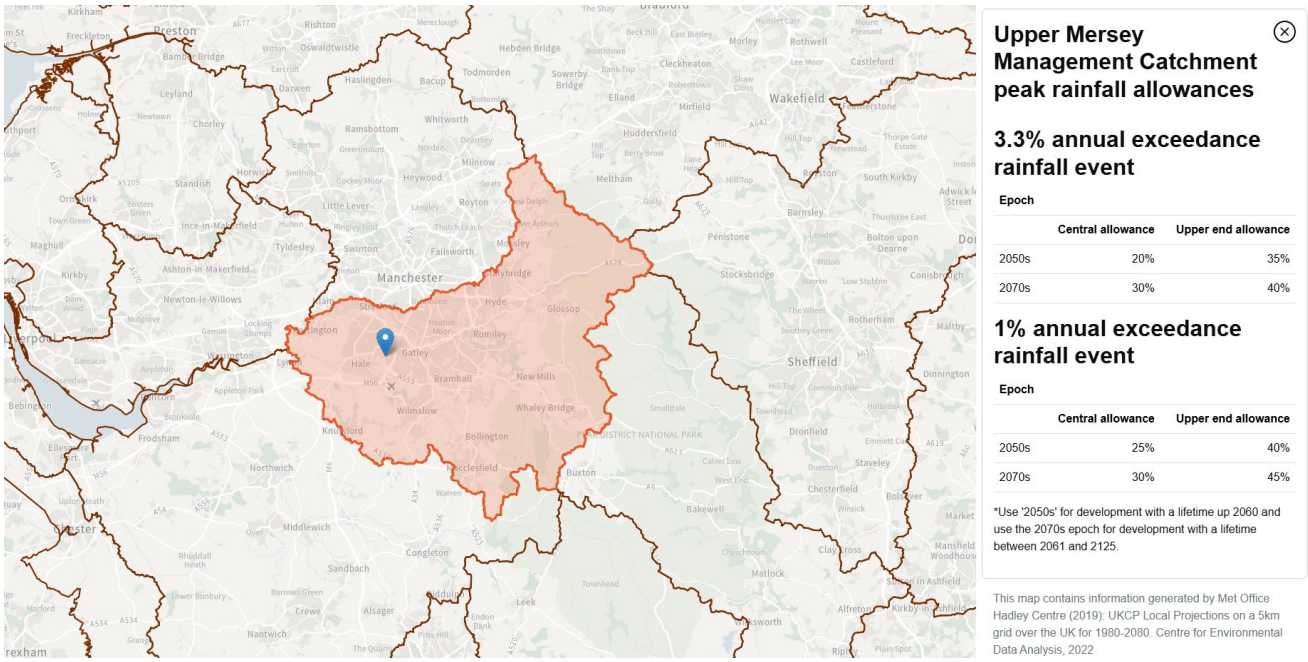


Figure 5 - DEFRA – Climate Change Allowances

The lifetime of the Site is likely to be beyond 2061, and therefore the Epoch 2070's is to be used with Upper End Allowance. Therefore, the climate change allowance for the surface water run-off will be 40% for the 30-Year Storm, and 45% for the 100-Year Storm.

14. Surface Water Management - Networks and Calculation

14.1. Surface Water Network Calculations

The calculations to determine the post development surface water run-off rates and required attenuation volume are based on the post development surface water run-off area of 0.116 ha, and the rainfall data given by the FEH13.

14.2. Surface Water Management Details

As shown on the surface water management layout drawing in Appendix G, the surface water drainage network will consist of 460mm silt trap chambers; 1200mm diameter manholes; 150mm diameters pipes; 150mm diameter perforated pipes; permeable paving systems; a flow control chamber containing a hydro-brake; and a below ground attenuation tank in the form of cellular units.

The surface water run-off from the building roof areas will discharge to the main network via trapped rainwater pipes / gullies (containing first 5mm of water), and the surface water run-off from the mobile modular unit, access and parking areas will discharge to the main network via the permeable paving system and channel drains.

The surface water network will flow towards the north of the Site and will discharge through a flow control chamber prior to connection / discharge to the existing 300mm diameter surface water network.

The surface water will surcharge the drainage network when being restricted by the flow control chamber and will discharge back into the network and cellular units, where the water will be stored to prevent flooding.

Post storm event, the water levels in the tank will drop and flow back to the network and through the control chamber to the watercourse.

14.3. Surface Water Run-Off Rate

For the surface water run-off from the Site, in a post-development state, to be at the greenfield run-off rate, they are to be restricted to 1.5 l/s for the 1 in 2-year storm event, 2.8 l/s for the 1 in 30-year storm event including 40% allowance, and 3.4 l/s for the 1 in 100-year storm event including 45% allowance.

For the surface water run-off from the Site, in a post-development state, to be a 50% reduction of the post development rates are to be restricted to 10.7 l/s for the 1 in 2-year storm event (pre-development 21.4 l/s), 27.6 l/s for the 1 in 30-year storm event including 40% allowance (pre-development 55.2 l/s); and 38.3 l/s for the 1 in 100-year storm event including 45% allowance (pre-development 76.6 l/s).

An assessment of the suitable flow control opening, and subsequent surface water discharge also needs to assessed, where CIRIA document C753 – The SuDS Manual 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'.*

Manchester City Council have previously stated: *'Where flows less than 5 l/s are proposed, a blockage risk assessment must be undertaken. If the risk cannot be adequately managed, a higher minimum discharge rate should be considered / agreed with relevant authority'.*

For this development, the greenfield run-off rates are deemed to be too low (maximum 1.5 l/s – 3.4 l/s), where the flow control opening to achieve the greenfield rate will have to be at a size where it is likely to cause a blockage and subsequent flooding. The suitable / minimum size of the flow control opening (hydro-brake opening) to reduce the risk of blockage is deemed to be 97mm.

As shown in the surface water network calculations (via MicroDrainage) in Appendix H, if the hydro-brake opening is set at 97mm the maximum surface water run-off rates for each storm event will be as follows:

Storm	-	**Rate**	-	**Critical Storm Event**
Q_2	-	**4.7 l/s**	-	30-minute winter storm duration
$Q_{30 + 40\%}$	-	**4.7 l/s**	-	60-minute winter storm duration
$Q_{100 + 45\%}$	-	**5.0 l/s**	-	60-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

Storm	-	**Greenfield**	-	**Post Dev**	-	**Difference**
Q_2	-	1.5 l/s	-	4.7 l/s	-	Increase
$Q_{30 + 40\%}$	-	2.8 l/s	-	5.7 l/s	-	Increase
$Q_{100 + 45\%}$	-	3.4 l/s	-	5.0 l/s	-	Increase

Pre-Development Rate to Post Development Rate

Storm	-	**Pre-Dev**	-	**Post Dev**	-	**Difference**
Q_2	-	21.4 l/s	-	4.7 l/s	-	78% Reduction
$Q_{30 + CC}$	-	55.2 l/s	-	4.7 l/s	-	91% Reduction
$Q_{100 + CC}$	-	76.6 l/s	-	5.0 l/s	-	93% Reduction

The results show that the post development run-off rates are an increase of the greenfield run-off rates, but between a 78% and 93% reduction of the pre-development rates.

Therefore, the rates will still adhere to DEFRA National Non-Statutory Technical Standards for Sustainable Drainage Systems (S3), as they have been reduced to as low as possible with existing the pre-development rates. The rates will also meet Manchester City Council requirements, as the rates are more than a 50% reduction of the pre-development rates.

14.4. 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. 45% CC), as detailed in the MicroDrainage calculation in Appendix H, where:

$Q_{100\ (6\text{-}Hour)}$ = 95.59m³

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

Greenfield Volume to Post Development Volume

Storm	-	**Greenfield**	-	**Post Dev**	-	**Difference**
Q_{100}	-	42.96m³	-	95.5m³	-	Increase

Pre-Development Volume to Post Development Volume

Storm	-	**Pre-Dev**	-	**Post Dev**	-	**Difference**
Q_{100}	-	76.88m³	-	95.59m³	-	Increase

The surface water run-off volume for the 100-year, 6-hour storm event exceeds the greenfield and pre-development run-off volumes.

However, the post development discharge volume still adheres to DEFRA Non-Statutory Technical Standards for Sustainable Drainage Systems (S6), which states: *'where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S5, the runoff volume must be discharged at a rate that does not adversely affect flood risk'.*

The volume of water is discharged at an 93% reduction of the pre-development rate, and therefore the volume will not adversely affect flood risk.

14.5. 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.

As detailed in the MicroDrainage calculations (Appendix H) and surface water management layout (Appendix G), the attenuation volume and details for this SuDS method is as follows:

Cellular Units

Attenuation Tank Length	-	6.00m
Attenuation Tank Width	-	7.00m
Attenuation Tank Area	-	42.00m²
Attenuation Tank Depth	-	1.20m
Attenuation Tank Volume	-	50.40m³
Porosity	-	0.95
Attenuation Volume	-	47.86m³

The MicroDrainage calculations (Appendix H) show that with the drainage network and cellular unit volume, no flooding will occur for all storms up to and including the 100-year + 45% storm event.

Therefore, the attenuation volume is deemed to be acceptable, as they meet the requirements set out in the Non-Statutory Technical Standards for Sustainable Drainage Systems (S7-S9).

15. Surface Water Management - Maintenance Requirements

Details of the maintenance required, and the parties to carry out the maintenance of all drainage aspects, to ensure that the network and SuDS methods are working affectively, and subsequently reducing the risk of flooding on the Site, are set out below.

15.1. Drainage Responsibilities

The management and maintenance of the surface water drainage networks and SuDS features within the Site will be by contractors appointed by the managers of the Wythenshawe Hospital.

A copy of the drainage design layout / details and a drainage maintenance / management document will be handed to the managers on completion of the TLHC building and occupancy, where they will be made aware of the features within the Site, and responsibility to maintain the drainage features shown on said drawings and details.

15.2. Maintenance and Management Document on Completion

The document produced, and handed to the owners of the managers, will state the following:

'The owners and parties with responsibilities for the surface water drainage system on this development will comprise of the following stakeholders:

Wythenshawe Hospital Managers

All of which is clearly defined on the surface water management layout.

As you are the managers if the Site, you have responsibilities for the maintenance of the surface water drainage system which fall within the 'development boundary'. Failure to maintain or removal of surface water drainage features may result in civil litigation with neighbouring bookings and sites if flooding occurs as a result.

Surface water drainage pipes, inspection chambers, permeable paving, flow control chambers and the attenuation tanks within the development boundary are to be managed by you, as such the managers area responsibility for maintenance / repairs & replacement drainage and SuDS items. The operation and frequency of the maintenance and management set out in this report and as shown on the drainage layout are to be carried out as follows:

Drainage Networks, Cellular Units, Flow Control Chamber

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 network (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*

Permeable Paving

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 permeable paving (where may cause risk performance)	*Monthly*
Where rainfall infiltration into permeable paving ensure working effectively.	*As required, but at least twice a year*

15.3. Linked and Further Maintenance and 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.

16. Surface Waer Management - Design Exceedance

In the event of an extreme storm event (greater than 100-year + 45% climate change), potential flooding of the drainage network could occur.

Surface water flow paths will follow existing and proposed ground topography, where water will flow in a northerly direction and into the existing access road.

Flood water will flow away from the new TLHC building and will not flow directly towards existing buildings prior to discharge onto the road.

There are no below ground attenuation volumes in the existing external areas, and therefore, the volume of water at surface will always be 44.46m³ (total proposed attenuation) less in a post development scenario. Therefore, there will always be a reduced risk of flooding to the existing buildings / land near the Site.

17. Surface Water Management - Water Quality

The level of water treatment (for external areas subject to pollutants) 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.

17.1. External Car Park Area 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**

17.2. External Car Park Area Pollutant Mitigation

Mitigation Measures:

- **Permeable Paving**

Permeable Surfacing / Paving Pollutant Mitigation Indices

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

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

Note: Surface water run-off from the TLHC building roof and mobile modular unit area to have very low pollutants, and will flow through trapped gullies (rainwater pipe and channel drains) prior to discharge to main drainage network. Therefore, the surface water run-off from these areas will not affect the water quality.

18. Surface Water Management - Construction Phase

All existing drainage networks (if found) within the Site are to be maintained during construction. The flow control and cellular units are to be the first part of the drainage network to be built. This will ensure that the surface water discharge at a reduced rate during all phases of the build.

18.1. Construction Environment Management Plan

Full details of the construction environment management plan (CEMP) are to be confirmed by the chosen contractor who has been appointed for the development. However, it will conform to the requirements of CIRIA 753 – The SuDS Manual – Chapter 31, and will include:

18.2. Construction Access

The main construction traffic will access the site from the existing access road. The set-up areas will be limited to avoid the attenuation tank, with protection measures (i.e. concrete slab) put over the installed attenuation tank to prevent damage during vehicle movements.

18.3. Sediments and Traps

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

18.4. 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 300mm surface water network. The surface water run-off destination for the diverted surface water will continue as existing.

18.5. Main Surface Water Run-Off Systems

The flow control chamber and cellular units are to be built prior to any phase of construction of site. This will ensure that the surface water discharge at a reduced rate during all phases of the build. Temporary inlet and outlet protection measures and appropriate silt traps are to be installed to prevent silt ingress into the main drainage network.

18.6. 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.

18.7. 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.

18.8. Construction of Permeable Paving

Construction of permeable paving are 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.

19. Conclusion / Summary

19.1. Existing Flood Probability

All potential sources of flooding to the development site have assessed, and it is deemed that the probability of flooding to the Site from all existing sources is low.

19.2. Exception and Sequential Test

The Site is classed as 'More Vulnerable', but as it is in Flood Zone 1, Table 2 of the NPPG states that the Site is Appropriate for Development, with the requirements of an Exception Test.

The Site has passed the sequential test as the TLHC building is built in Flood Zone 1, and in an area low risk of flooding from all other sources. The Site is also associated with existing hospital buildings, and therefore is not appropriate in any other location.

19.3. SuDS Principles

All feasible SuDS methods, and surface water discharge destination have been assessed, with the feasible SuDS methods being permeable paving, cellular units and a flow control, with the surface water destination being to a surface water sewer.

19.4. Peak Flow Control

The post development run-off rates are an increase of the greenfield run-off rates, but between a 78% and 93% reduction of the pre-development rates.

Therefore, the rates will still adhere to DEFRA National Non-Statutory Technical Standards for Sustainable Drainage Systems (S3), as they have been reduced to as low as possible with existing the pre-development rates. The rates will also meet Manchester City Council requirements, as the rates are more than a 50% reduction of the pre-development rates.

19.5. Volume Control

The surface water run-off volume for the 100-year, 6-hour storm event exceeds the greenfield and pre-development run-off volumes.

However, the post development discharge volume still adheres to DEFRA Non-Statutory Technical Standards for Sustainable Drainage Systems (S6), which states: '*where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S5, the runoff volume must be discharged at a rate that does not adversely affect flood risk'.*

The volume of water is discharged at an 93% reduction of the pre-development rate, and therefore the volume will not adversely affect flood risk.

19.6. Flood Risk within the Development

With the drainage network and cellular unit volume, no flooding will occur for all storms up to and including the 100-year + 45% storm event.

Therefore, the attenuation volume is deemed to be acceptable, as they meet the requirements set out in the Non-Statutory Technical Standards for Sustainable Drainage Systems (S7-S9).

19.7. Management and Maintenance

The management and maintenance of the surface water drainage networks and SuDS features within the Site will be by contractors appointed by the managers of the Wythenshawe Hospital.

A copy of the drainage design layout / details and a drainage maintenance / management document will be handed to the managers on completion of the TLHC building and occupancy, where they will be made aware of the features within the Site, and responsibility to maintain the drainage features shown on said drawings and details.

19.8. Surface Water Design Exceedance

Surface water flow paths will follow existing and proposed ground topography, where water will flow in a northerly direction and into the existing access road.

Flood water will flow away from the new TLHC building and will not flow directly towards existing buildings prior to discharge onto the road.

There are no below ground attenuation volumes in the existing external areas, and therefore, the volume of water at surface will always be 44.46m³ (total proposed attenuation) less in a post development scenario. Therefore, there will always be a reduced risk of flooding to the existing buildings / land near the Site.

19.9. Water Quality

The level of water treatment has been 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 are greater than the pollution hazard index, and therefore suitable water quality is achieved.

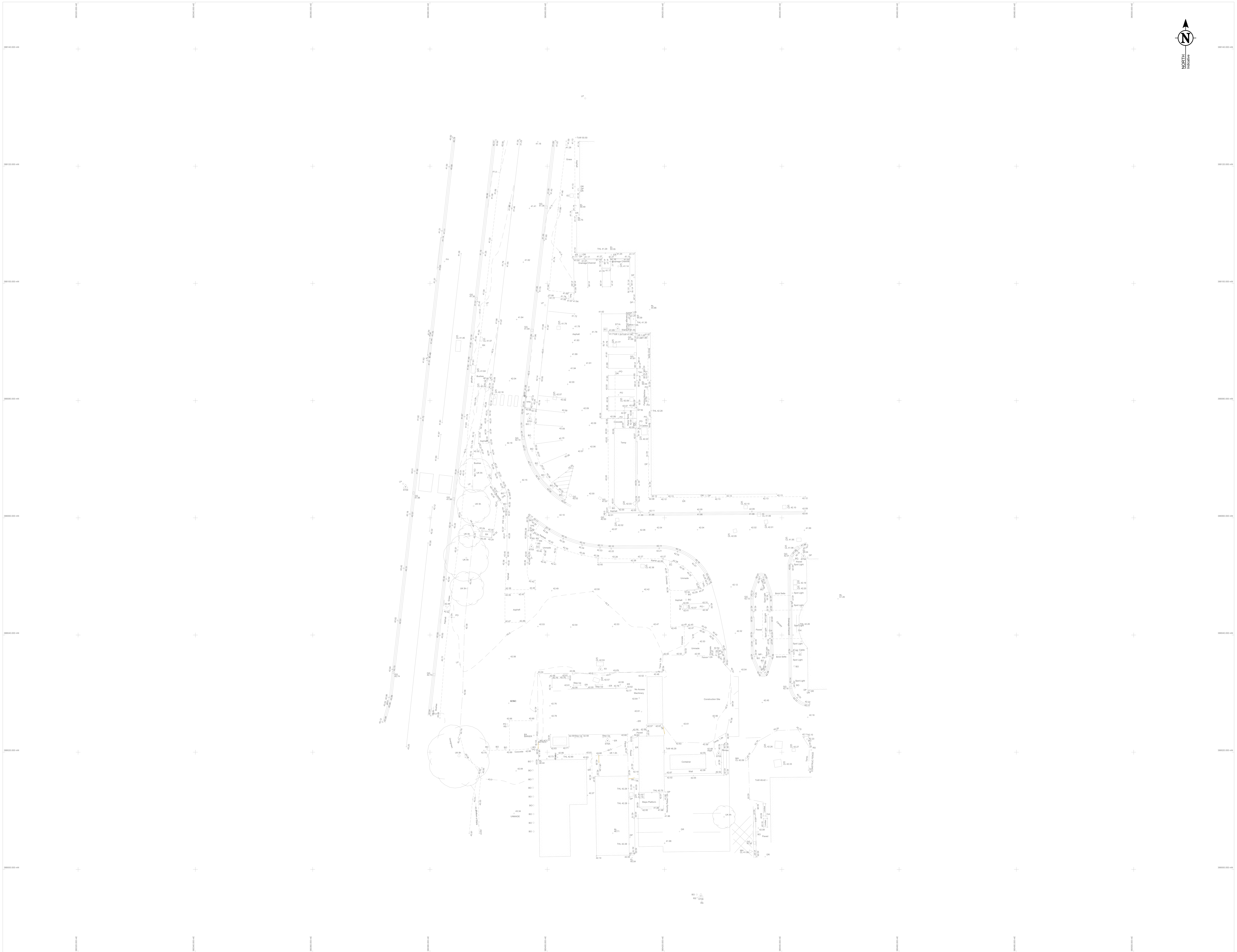
19.10. Construction Phase and Management

All existing drainage networks (if found) within the development area are to be maintained during construction. The drainage 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.

Full details of the construction environment management plan (CEMP) are to be confirmed by the chosen contractor who has been appointed for the development. However, it will conform to the requirements of CIRIA 753 – The SuDS Manual – Chapter 31.

Appendix A

Topographical Survey Plan



TOPOGRAPHICAL & MEASURED BUILDING SURVEYS

ABBREVIATIONS & SYMBOLS

AH	Arch Head Level	ET	EP+Transformer	RSD	Roller Shutter Door
A/B	Air Brick	FB	Flower Bed	RSJ	Rolled Steel Joist
AR	Assumed Route	F/C-Lev	False Ceiling Level	SI	Sign Post
AV	Air Valve	FBD	Floor Board Direction	SL	Window Sill Level
BB	Belisha Beacon	FH	Fire Hydrant	SP	Arch Spring Point Level
BH	Bore Hole	FL	Floor Level	SV	Stop Valve
BL	Bed Level	FP	Flag Pole	SW	Surface Water
BO	Bollard	FW	Foul Water	SY	Cable Stay
BS	Bus Stop	GG	Gully Grate	Tac.	Tactile Paving
BU	Bush	GV	Gas Valve	TC	Telecom Cover
B/W	Barbed Wire Fence	HL	Window Head Level	TH	Trial Pit
BX	Box (Utilities)	IC	Inspection Cover	THL	Threshold Level
C/B	Close Board Fence	IL	Invert Level	TL	Traffic Light
CL	Cover Level	I/R	Iron Railings	ToF	Top of Fence
C/L	Chain Link Fence	KO	Kerb Outlet	ToW	Top of Wall
C-Lev	Ceiling Level	LP	Lamp Post	TP	Telegraph Pole
Col.	Column	MH	Manhole	TS	Traffic Signal Cover
C/P	Chestnut Paling Fence	MP	Marker Post	TV	Cable TV Cover
CR	Cable Riser	NB	Name Board	UC	Unknown Cover
C/W	Chicken Wire	OHL	Overhead Line (approx)	Uk	Unknown Tree
DC	Drainage Channel	Pan	Panel Fence	UMG	Unmade Ground
Dil.	Dilapidated	PB	Post Box	USB	Under Side Beam
DL	Door Level	PM	Parking Meter	UTL	Unable To Lift
DP	Down Pipe	PO	Post	UTS	Unable To Survey
DR	Drain	P/R	Post & Rail Fence	VP	Vent Pipe
EBx	Electric Box	P/W	Post & Wire Fence	WB	Waste Bin
EC	Electric Supply Cover	RE	Rodding Eye	WH	Weep Hole
EL	Eaves Level	RL	Ridge Level	WL	Water Level
EP	Electric Pole	RP	Reflector Post	WM	Water Meter
ER	Earth Rod	RS	Road Sign	WO	Wash Out
				△	Survey Control Station

DRAWING NOTES

Topographical Surveys

Trees are drawn to scale showing the average canopy spread. Descriptions and heights should be used as a guide only.

All building names, descriptions, number of storeys, construction type including 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 starting work.

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

Surveyed physical features may not necessarily represent the legal boundary line.

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.

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.

The survey control listed is only to be used for topographical surveys at the stated scale. All control must be checked and verified prior to use.

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This drawing should only be scaled using digital methods.

SURVEY STATIONS

Name	Easting	Northing	Height
ST01	380397.016	388076.985	42.129
ST02	380398.786	388158.161	40.554
ST03	380397.283	388055.132	42.457
ST04	380443.694	388053.494	42.142
ST05	380429.232	388019.838	42.465
ST06	380426.205	387995.471	42.051
ST09	380375.843	388065.293	42.106
XX	380409.045	388034.187	42.563
ST1A	380412.034	388092.279	41.507
ST1B	380415.149	388078.833	42.107
ST6A	380410.279	388021.977	42.566

SURVEY GRID AND LEVEL DATUM

The coordinate system established for this survey is related to Ordnance Survey (OS) National Grid at multiple points using GNSS with a scale factor of 1.000.

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

To avoid discrepancies within the survey, adding to the survey or setting out points from the survey, any coordinated data must be directly derived from the original survey control. Survey Solutions are not responsible for any third-party adding survey data to the existing information.

REV	DESCRIPTION	DRAWN	APPR	DATE

SURVEY SOLUTIONS

LAND SURVEYING
BUILDING SURVEYING
UNDERGROUND SURVEYING
SITE ENGINEERING
MONITORING

0845 040 5969
www.survey-solutions.co.uk

IPSWICH / BEDFORD / BIRMINGHAM / COVENTRY / CRAWLEY / GLASGOW / LEEDS / LONDON-CENTRAL / LONDON-EAST / MANCHESTER / NEWCASTLE / NORWICH / NOTTINGHAM / THAMES VALLEY

PROJECT TITLE Wythenshaw Hospital, Entrance 7 Southmoor Rd,Wythenshawe, M23 9LT				
DRAWING DETAIL TOPOGRAPHICAL SURVEY Sheet 1 of 1				
CLIENT Day Architectural Ltd				SCALE 1:200
SURVEYOR GS	SURVEY DATE 27/08/2024	CHECKED BY	APPROVED BY SR	DWG STATUS FINAL
DRAWING NUMBER 60819MCLS-01			REVISION	ISSUE DATE 05/09/2024

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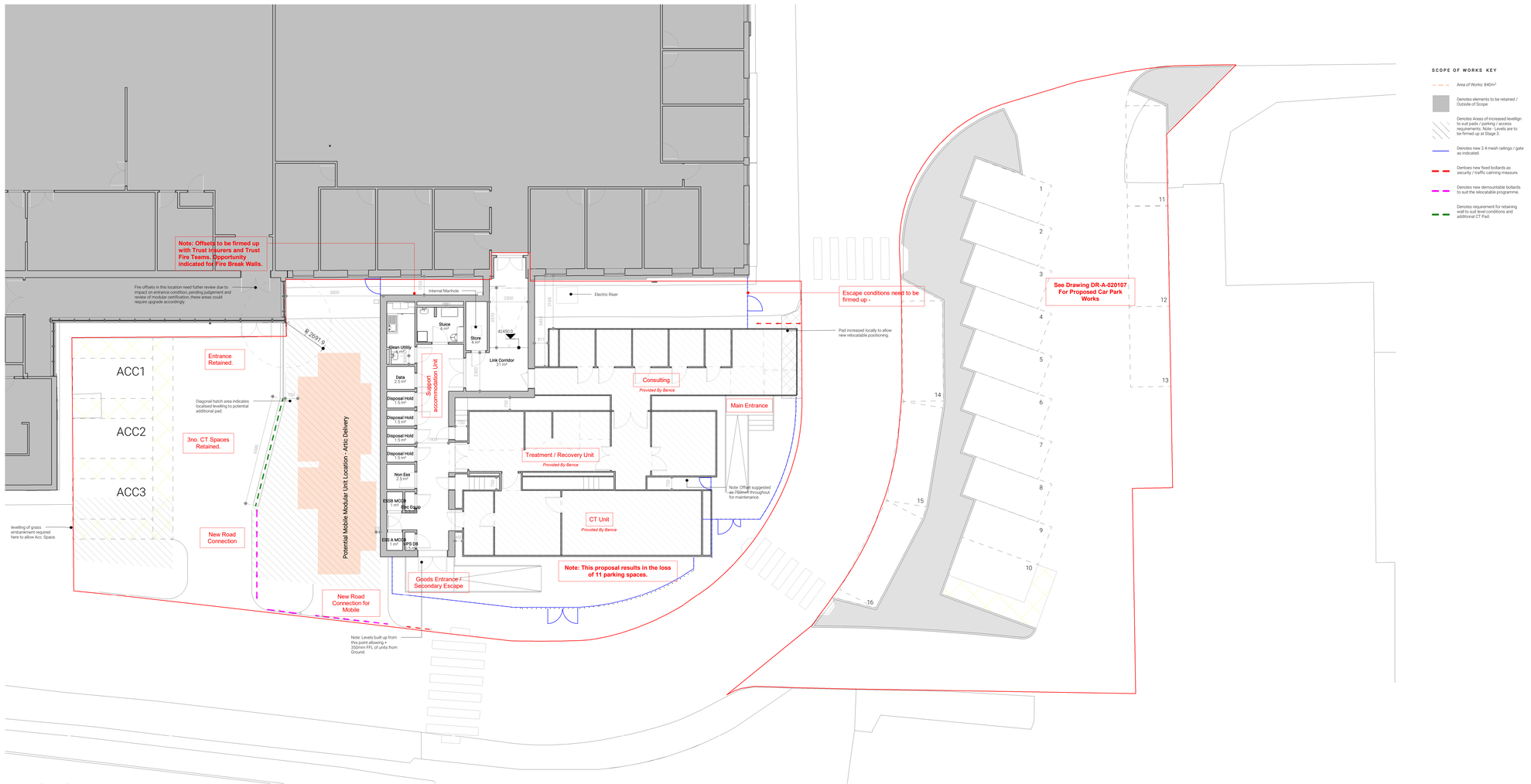
Original Sheet Size A0H

Appendix B

Proposed Site Plan



Proposed Site Plan
1 : 100

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2. Any details or dimensions 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.
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4. For the purpose of coordination, all relevant parties must check this information prior to implementation and report any discepancies to the Architect / Designer The information must solely and only be used for the coordination and/or execution of the intended purpose.
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EXTERNAL MODEL REFERENCES

MEP MODEL | REV | DATE

??????-??-??-M3-ME-?????? | ?? | DD.MM.YY

S.ENG MODEL | REV | DATE

??????-??-??-M3-S-?????? | ?? | DD.MM.YY

NOTES

REV	DESCRIPTION	DATE	BY	CHK
P10	Updated support unit to traditional build	14.10.24	AM	GAB
P09	Clean and dirty utility updated	02.10.24	AM	GAB
P08	Issued for coordination	18.09.24	AM	GAB
P07	Issued for coodination	13.09.24	AM	GAB
P06	Unit offsets updated following Coordination meeting_11.09.24	12.09.24	GAB	GAB
P05	Stage 2 Issue following 05.09.24 Stakeholder Review Meeting	06.09.24	GAB	GAB
P04	Revised following 03.09.24 Stakeholder Review Meeting	04.09.24	GAB	GAB
P03	Revised Arrangement following 22.08 Stakeholder Meeting	27.08.24	GAB	GAB
P02	Revised - Alliance pad retention	13.08.24	GAB	GAB
P01	First Issue - Stage 1 Feasibily	31.07.24	GAB	GAB

KEY PLAN

CLIENT
Manchester University Hospitals NHS FT

CONTRACTOR
TBD

Lancaster Buildings | 77 Deansgate | Manchester | M3 2BW
T: 0161 834 8193 | W: www.day-architectural.com
DAY Architectural Ltd

PROJECT
TLHC - Wythenshawe

DRAWING
Proposed Site Plan - Entrance 7

SCALE
As indicated @ A0

PROJECT REF	DAY REF	DRAWN BY	FIRST ISSUED
1643-24	1643-24	GAB	13/08/24

ORIG	VOL	LEV	TYPE	ROLE	NUM	REV
DAY	XX	00	DR	A	020108	P10

SUITABILITY	DRAWING STATUS
S1- FOR COORDINATION	FOR COMMENT / COORDINATION

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Appendix C

British Geological Survey Data

SJ88NW 111A

STRATA SURVEYS LTD.,
HOLMES CHAPEL ROAD,
MIDDLEWICH, CHESHIRE. CW10 0JB
Telephone: 0606 84 4637 Fax: 0606 84 6657

Trial Pit No. : TP 3
Sheet No. 1 Of 1.
Depth 0 to 4 metres.
Dates : 30/6/88

Job Number : 4403 Location: Claverton Road.
Client : Lydon Reece Partnership.

Equipment and Methods
J.C.B. 3cx Excavator
8035
8806

Description of Strata	Red. Level	Legend	Thick -ness	Depth m	Sample Depths	Sample Types	NMC	Cu	Remarks
grass over Topsoil			(0.20)	0.00 0.20					
Tarmac over brick hardcore and concrete; MADE GROUND			(0.60)	0.80					
soft/ firm clayey topsoil with some rootlets with occasional ash brick pottery and glass; MADE GROUND			(1.00)	1.80				V 40	
stiff brown sandy CLAY with slight gravel with occasional cobbles			(0.60)	2.40					
stiff brown silty brown silty CLAY (highly weathered Mudstone)			(0.40)	2.80					
End Of Trial Pit									

Key

Sample Types
U Undisturbed
D Disturbed
B Bulk Disturbed
W Water

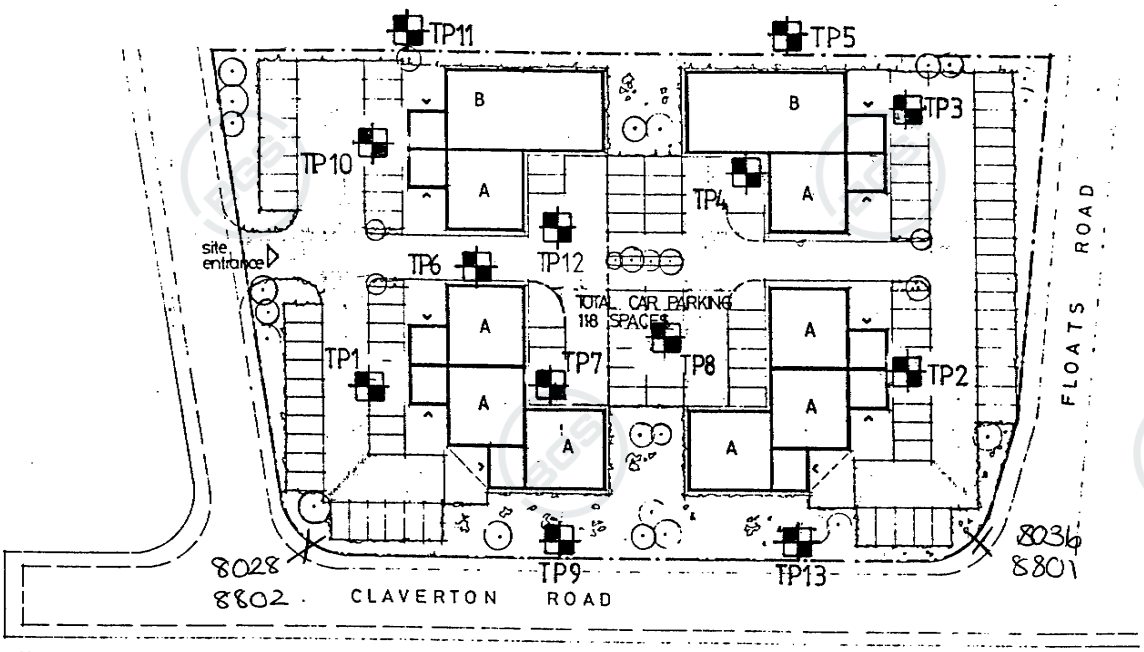
In-Situ Tests
V Vane Test
Pb Plate Bearing Test
CBR In-Situ CBR Test

Pp Pocket Penetrometer

Progress / Water Levels
Borehole Depth
Water Level
Water Strike

General Remarks
No water encountered during excavation.
Sides of Trial Pit Stable.

Sketch/Plan



site plan 1:500

SCHEDULE OF ACCOMMODATION.

		Site Totals.
8 Nº Type A Units — Each 248m² [Gross External] Ground & 1st fl.	=	1984 m²
2 Nº Type B Units — Each 448m² [Gross External] Ground & 1st fl.	=	896 m²
		2880 m² [31000 sq ft²]

Gross Internal Per Unit 226·5m²
Nett Lettable Per Unit 187·5m²

Downs+Variava
Chartered Architects Planning Consultants
8 Grange Lane Didsbury Manchester
M20 0RW tel: 061-434 4414/5/6

WYTHENSHAWE BUSINESS CENTRE
CLAVERTON ROAD. for QUORUM ESTATES.

SITE LAYOUT & ELEVATIONS 21 88004

date : June 88 drawn : S.C.M.
scale : 1: 500

Drawing Nº 2203/1

SJ88NW 1112 - 1124

SJ88NW 1122

STRATA SURVEYS LTD.,
HOLMES CHAPEL ROAD,
MIDDLEWICH, CHESHIRE. CW10 0JB
Telephone: 0606 84 4637 Fax: 0606 84 6657

Trial Pit No. : TP 11

Sheet No. 1 Of 1.
Depth 0 to 4 metres.

Dates : 30/6/88

Job Number : 4403 Location: Claverton Road
Client : Lydon Reece Partnership.

Equipment and Methods
J.C.B. 3cx Excavator 8030 8808

Description of Strata	Red. Level	Legend	Thick -ness	Depth m	Sample Depths	Sample Types	NMC	Cu	Remarks
grass over Topsoil			(0.20)	0.00 0.20					
firm/ stiff brown yellow silty CLAY with occasional thin bands of fine/ medium sand with occasional gravel and cobbles			(2.40)					V 65	
very stiff moderately weak highly weathered MUDSTONE			(0.20)	2.60 2.80					
End Of Trial Pit									

Key

Sample Types
U Undisturbed
D Disturbed
B Bulk Disturbed
W Water

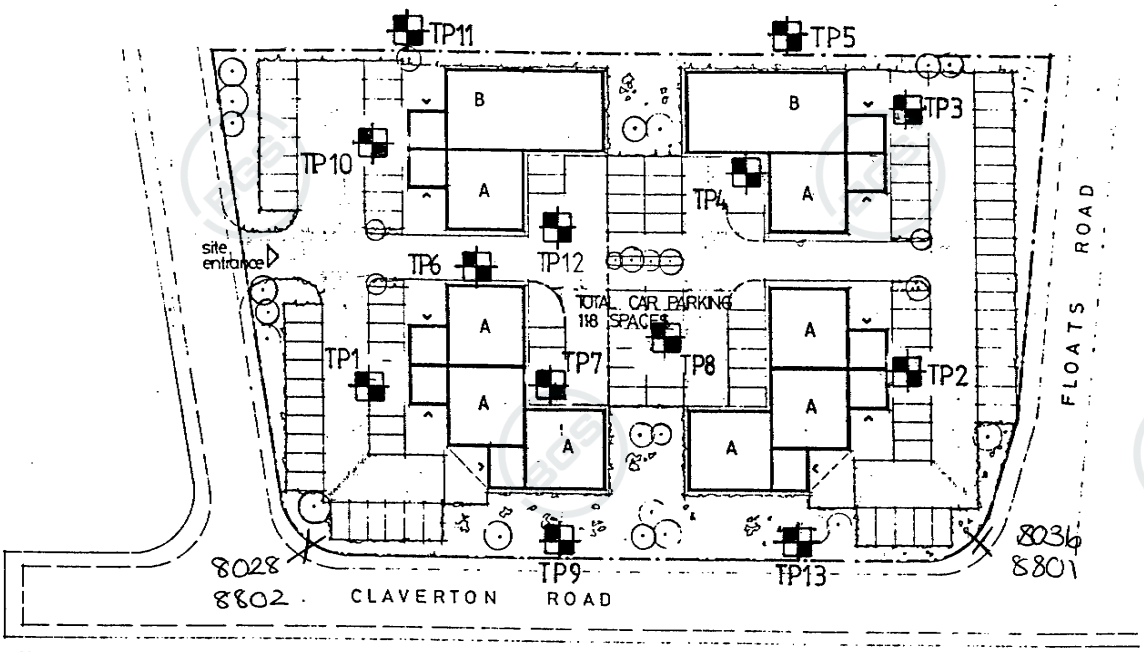
In-Situ Tests
V Vane Test
Pb Plate Bearing Test
CBR In-Situ CBR Test

Pp Pocket Penetrometer

Progress / Water Levels
Borehole Depth
Water Level
Water Strike

General Remarks
No water encountered during excavation.
Sides of Trial Pit.

Sketch/Plan



site plan 1:500

SCHEDULE OF ACCOMMODATION.

		Site Totals.
8 Nº Type A Units — Each 248m² [Gross External] Ground & 1st fl.	=	1984 m²
2 Nº Type B Units — Each 448m² [Gross External] Ground & 1st fl.	=	896 m²
		2880 m² [31000 sq ft²]

Gross Internal Per Unit 226·5m²
Nett Lettable Per Unit 187·5m²

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SITE LAYOUT & ELEVATIONS 21 88004

date : June 88 drawn : S.C.M.
scale : 1: 500

Drawing Nº 2203/1

SJ88NW 1122 - 1124

SJ88NW 1112

STRATA SURVEYS LTD.,
HOLMES CHAPEL ROAD,
MIDDLEWICH, CHESHIRE. CW10 0JB
Telephone: 0606 84 4637 Fax: 0606 84 6657

Trial Pit No. : TP 1

Sheet No. 1 Of 1.
Depth 0 to 4 metres.

Dates : 30/6/88

Job Number : 4403 Location: Claverton Road.
Client : Lydon Reece Partnership.

Equipment and Methods
J.C.B. 3cx Excavator

8029
8803

Description of Strata	Red. Level	Legend	Thick -ness	Depth m	Sample Depths	Sample Types	NMC	Cu	Remarks
grass over Topsoil			(0.25)	0.00					
stiff brown yellow silty CLAY			(1.35)	0.25				V120 V 90 V120	
stiff grey brown silty CLAY (highly weathered Mudstone)			(0.10)	1.60 1.70					
brown moderately weathered silty MUDSTONE			(0.80)						
End Of Trial Pit				2.50					

Key

Pp Pocket Penetrometer

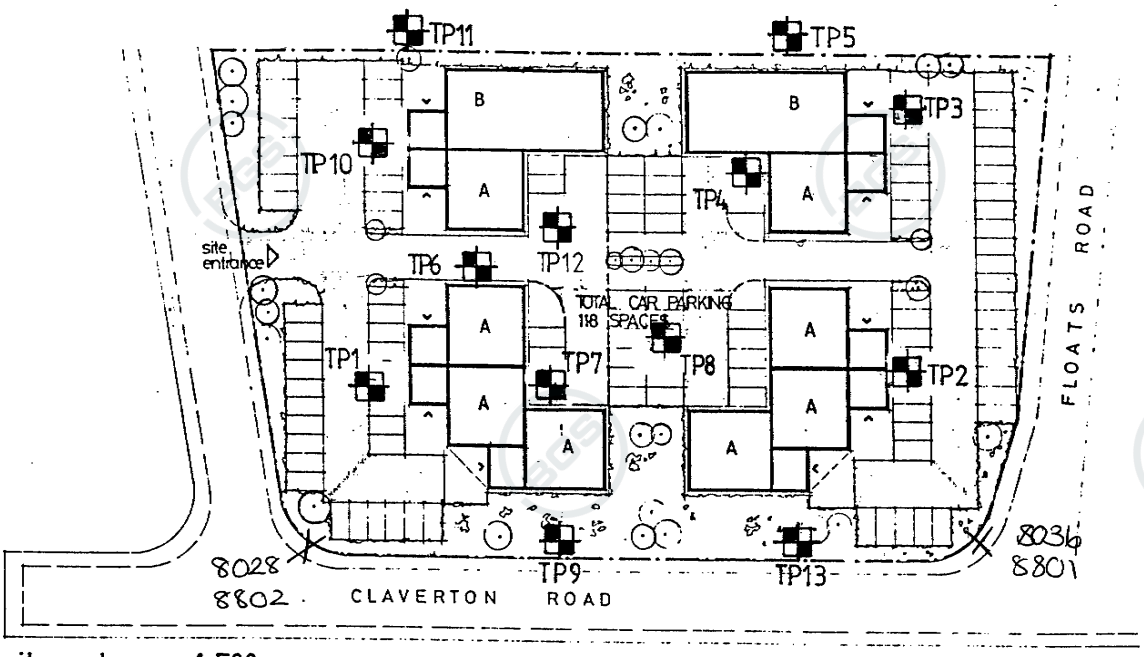
Sample Types
U Undisturbed
D Disturbed
B Bulk Disturbed
W Water

In-Situ Tests
V Vane Test
Pb Plate Bearing Test
CBR In-Situ CBR Test

Progress / Water Levels
Borehole Depth
Water Level
Water Strike

General Remarks
No water encountered during excavation.
Sides of Trial Pit Stable.

Sketch/Plan



site plan 1:500

SJ88NW 1112 - 1124

SCHEDULE OF ACCOMMODATION.

		Site Totals.
8 Nº Type A Units — Each 248m² [Gross External] Ground & 1st fl.	=	1984 m²
2 Nº Type B Units — Each 448m² [Gross External] Ground & 1st fl.	=	896 m²
		2880 m² [31000 sq ft²]

Gross Internal Per Unit 226·5m²
Nett Lettable Per Unit 187·5m²

Downs+Variava
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8 Grange Lane Didsbury Manchester
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WYTHENSHAWE BUSINESS CENTRE
CLAVERTON ROAD. for QUORUM ESTATES.

SITE LAYOUT & ELEVATIONS 21 88004

date : June 88 drawn : S.C.M.
scale : 1: 500

Drawing Nº 2203/1

Appendix D

Existing Drainage Plan

PAS 128: 2022 QUALITY LEVEL GUIDE

Q-LEVEL	DESCRIPTION	ACC.	Q-LEVEL	DESCRIPTION
QL-D	Service positions taken from records.	Undefined	QL-B2	Horizontal & vertical location using only one geophysical technique.
QL-C	Visual evidence of service existence but undetectable by geophysical technology.	Undefined	QL-B1	Horizontal & vertical location using multiple geophysical techniques.
QL-B4	Undetectable service present shown as an assumed route. (AR).	H: +/- 500mm V: N/A	QL-A	Horizontal & vertical position verification by open excavation, manholes and/or inspection chambers.
QL-B3	Horizontal location by one geophysical technique but with none or poor depth information.			

DETECTION METHOD

IN ACCORDANCE WITH PAS 128: 2022 SURVEY TYPE B

DRAINAGE SURVEY

All accessible Manholes and Inspection chambers have had their respective covers lifted with pipe sizes, inverts, chamber sizes/types and service data recorded from ground level. All connections from DPs, Gullies, Drains, VP's, RE's and lampholes have been proven wherever possible using audible connections (AC) and/or sonde instrumentation where applicable. Where these methods have proved unsuccessful then assumed (AR) straight line connections will be shown.

CCTV DRAINAGE SURVEY

All accessible Manholes and Inspection chambers have had their respective covers lifted with pipe sizes, inverts, chamber sizes/type and service data recorded from ground level. Pipework has been traced, accessed and collected for post processing. Drainage layout, including manhole covers not located by topographical survey, may be taken from CCTV chainage and will be shown as indicative only.

Electricity

Elec cables will have been predominantly located using EML methodology with electronically derived depths shown. GPR techniques will be employed to achieve greater quality levels as required.

British Telecoms

BT cables will have been predominantly located using EML methodology with electronically derived depths shown. GPR techniques will be employed to achieve greater quality levels as required. Due to current laws and legislation protecting all BT apparatus, cabling can only be located remotely. We therefore compare all our telecom findings against record information to produce the final service layout. In some instances, where high amount of cable ducts are present, we may only be able to identify a linear centre peak signal rather than identifying all the individual duct positions. For further information regarding Telecoms apparatus, please contact Openreach directly.

Cable TV & Communications

CTV and/or Com cables will have been predominantly located using EML methodology with electronically derived depths shown. GPR techniques will be employed to achieve greater quality levels as required.

Fibre Optic

FO cables will have been predominantly located using GPR methodology. This is due to the materials used within fibre optic cabling. In some rare instances, tracer cabling or conductible non fibre optic cabling will be present within some or all ducting. When this is the case, both EML and GPR methodology will be combined to identify service network and achieve greater quality levels.

Lighting, Traffic Signal & Security Cables

LC, TS and/or Sec cables will have been predominantly located using EML methodology with electronically derived depths shown. GPR techniques will be employed to achieve greater quality levels as required.

Gas & Water Inc. Fuel Pipes and Hot Water Pipes

GM/GS and/or WM/WS pipe work will have been attempted and located using both EML & GPR methodology with electronically derived depths shown for the former and depths to crown levels shown for the latter.
When the Gas/Water pipe work is constructed using conductible materials, then we are able to to employ multiple geophysical techniques to identify service network and achieve greater quality levels. When a non conductible material is used, GPR methodology will be employed to locate and plot the final service layout.

Ground Penetrating Radar

GPR methodology is used to identify and locate all non metallic, non conductible piping and cabling. We also employ GPR to obtain a greater accuracy levels on EML located services. The GPR has a greater success rate on pipe or service diameter upward of Ø63mm,C63mm, as size increments increase, so does the chance of detection. The GPR can produces varying results and as such, wouldn't be used as an independent utility surveying instrument.

Unidentified Traces

All UITs will have been predominantly located using EML methodology with electronically derived depths shown. GPR techniques will be employed to achieve greater quality levels as required. Every effort has been made to identify the service but in this instance, is not achievable. We recommend excavation work to determine identity and depth where applicable.

Scarring (QL-C)

Scarring has been identified on site with a potential of an undetectable service present.

Assumed Routes & Taken from Records (QL-B4/D)

Assumed routes (AR) are shown if there is evidence that a service exists but we are unable to trace it whilst on site. The surveyor will attempt to locate various risers/ics/valves/meters (service evidence) etc. around site area to successfully determine an assumed route between these points. If there is little evidence on site but they believe a service is still present, then a common sense approach to an assumed route shall be employed.

Taken from records (TFR) are service routes that are taken from STAT record plans or previous survey information and overlaid onto our drawings.

SURVEY RECOMMENDATIONS

LIST RECOMMENDATIONS TO IMPROVE SURVEY DATA

The areas of dense vegetation to be cleared to allow access if any of these areas are deemed critical or of high importance.

The sewers with high levels of silt or blockages to be jetted to extend the CCTV drainage survey, if any of these areas are deemed critical or of high importance.

We recommend full statutory record information be obtained to confirm site findings and to position undetectable which may be present.

Due to the geophysical nature of subsurface technology, we always recommend excavation works to be carried out within critical areas for verification and to eliminate the possibility of undetectable services present.

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Original Sheet Size A0H

UTILITIES & UNDERGROUND INVESTIGATIONS

ABBREVIATIONS & SYMBOLS

1D 5C	1 Duct 5 Cables	DCr	Depth To Crown	RBC	Rectangular Brick Chamber
Ø	Diameter	DI	Depth To Invert	RCC	Rectangular Conc Chamber
AC	Audible Connection	DS	Depth To Silt	RE	Rodding Eye
AG	Above Ground	DTB	Depth To Base	SA	Survey Abandoned
AR	Assumed Route	DTW	Depth To Water	SL	Silt Level
BL	Base Level	DTS	Depth To Surcharge	SuL	Surcharge Level
CB	Concrete Benching	EBD	External Backdrop	TFR	Taken From Records
CBC	Circular Brick Chamber	EOT	End Of Trace	UTC	Unable To CCTV
CCC	Circular Conc Chamber	IBD	Internal Backdrop	UTDO	Unable To Determine Outfall
CL	Cover Level	IL	Invert Level	UTL	Unable To Lift
CPC	Circ Plastic Chamber	OH	Overhead	UTS	Unable To Survey
CrL	Crown Level	PDR	Poor Depth Response	UTT	Unable To Trace
CU	Camera Under Water	RB ●	Rest Bend	WL	Water Level

- BT — BT CABLE(S)
- O/BT — OVERHEAD BT CABLE(S)
- COM — COMMUNICATIONS CABLE(S)
- CTV — CABLE TV CABLE(S)
- DUCT — EMPTY DUCT
- E — ELECTRIC CABLE(S)
- O/E — OVERHEAD ELECTRIC CABLE(S)
- FO — FIBREOPTIC CABLE(S)
- FUEL — FUEL PIPE(S)
- GM — GAS MAIN
- GS — GAS SERVICE
- GPR — GROUND PENETRATING RADAR (GPR) TRACE
- HW — HOT WATER PIPE
- LC — LIGHTING CIRCUIT
- OIL — OIL PIPE(S)
- SCAR — VISIBLE SCARRING
- SEC — SECURITY CABLING
- TC — TELECOM CABLE(S)
- TS — TRAFFIC SIGNAL
- UIS — UNIDENTIFIED SERVICE
- UIT — UNIDENTIFIED TRACE
- WM — WATER MAIN
- WS — WATER SERVICE
- CW — COMBINED SEWER
- CW RM — COMBINED WATER RISING MAIN
- EW — EFFLUENT WATER
- FOUL SEWER
- FW RM — FOUL WATER RISING MAIN
- RM — RISING MAIN
- SURFACE WATER SEWER
- SW RM — SURFACE WATER RISING MAIN
- INVESTIGATION EXTENTS

- NORTH Indicative
- Note: ...... — UTILITIES COMMENT BOX (GENERAL NOTES)
- d0.37m — DEPTH TO SERVICE
- ??-AC — AUDIBLE CONNECTION
- ??-AG — SERVICE ABOVE GROUND
- ??-CU — CAMERA UNDER WATER
- ??-OH — SERVICE OVERHEAD

DRAWING NOTES

All below ground details shown have been identified from above ground without excavation. Survey Solution use electro-magnetic and/or ground penetrating radar (GPR) methods to investigate for underground utilities, services and features. Results using these methods are not infallible and we recommend trial excavations are carried out for verification of positions, depths and identification.

Any areas on the drawing where services or features have not been shown are not necessarily clear of services or features but are an indication that no items have been identified during our investigations. All reasonable care and normal good practice should still be employed during design and construction processes.

Certain types of services such as plastic or concrete pipes, some conduit and ducting where direct access can not be achieved for tracing may not be shown and alternative locating methods should be used.

Survey Solutions has used all reasonable care to research available service records but the completeness or use of the service records supplied to or by Survey Solutions cannot be guaranteed. Therefore Survey Solutions cannot be held responsible for any features annotated as 'taken from records' (TFR).

Depths obtained using electro-magnetic or GPR are effected by ground conditions and should be treated as indicative only. Electro-magnetic depths to utilities and services are generally taken to the centre of a feature, GPR depths to the top of a feature and drainage depth shown to inverts, unless otherwise indicated.

Drainage pipe sizes will be obtained without entering the chamber and therefore should be treated as approximate. Pipe dimensions which have not been obtained visually will be taken from records when available.

All services, drainage and utilities routes are assumed straight between access points, unless otherwise stated. The numbers of cables in runs will not be shown unless specifically requested. All services are below ground unless indicated.

Services, utilities and features may not have been surveyed if obstructed or not reasonably visible or accessible at the time of survey.

Survey Solutions accept no responsibility for the completeness or accuracy of either the topographical survey or base mapping on this project.

All critical dimensions and measurements should be checked and verified with any errors or discrepancies 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.

The contractor must check and verify all site and building dimensions, levels, utilities and drainage details and connections prior to commencing work.

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This drawing should only be scaled using digital methods.

GENERAL SYNOPSIS

This survey has been carried out in accordance with PAS 128: 2014 & our version of the Royal Institution of Chartered Surveyors (RICS) specification for Measured Surveys of Land, Buildings and Utilities. Our survey extents have been agreed and confirmed with formal acceptance of 60819 from DAY ARCHITECTURAL LTD. If you have any queries regarding the final services layout, please may we ask you to carefully read all the information within this title block in its entirety before continuing to do so.

TOPOGRAPHICAL/.DWG DRAWING INFORMATION

TOPOGRAPHICAL SURVEY DATE 05/09/2024

SURVEY TYPE	DESCRIPTION	EFFECT ON SURVEY RESULTS
TOPO	SURVEY SOLUTIONS	
OUTDATED		
OS		
NTS		

GENERAL SITE CONDITIONS

AVERAGE

ADDITIONAL INFORMATION	EFFECT ON SURVEY RESULTS

DESKTOP UTILITY RECORDS (PAS 128: 2014 SURVEY TYPE D)
PREREQUISITE FOR PAS 128: 2014 SURVEY TYPE B
COMMISSIONED: NO

UTILITY	AVAILABILITY	UTILITY COMPANY PROVIDER
SEWER	NO	N/A
WATER MAIN	NO	N/A
GAS MAIN	PUBLIC	CADENT GAS
TELECOM	PUBLIC	BRITISH TELECOMS
CABLE TV	NO	N/A
ELECTRICITY	NO	N/A
OIL PIPES	NO	N/A
OTHER	NO	N/A

REV	DESCRIPTION	DRAWN	CHECKED	APPR	SURVEY DATE
A	REVISED CCTV DRAINAGE, GAS RECORDS	TH	DWR	DWR	25/09/2024

SURVEY SOLUTIONS

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PROJECT TITLE
WYTHENSHAWE HOSPITAL, ENTRANCE 7,
SOUTHMOOR ROAD, WYTHENSHAWE, M23 9LT

DRAWING DETAIL
UTILITIES AND CCTV DRAINAGE SURVEY.
SHEET 1 OF 1

CLIENT				SCALE
DAY ARCHITECTURAL LTD				1:200
SURVEYOR	SURVEY DATE	CHECKED BY	APPROVED BY	DWG STATUS
TH CG AC	04/09/2024	DWR	DWR	FINAL
DRAWING NUMBER			REVISION	ISSUE DATE
60819MCUG-01a			A	11/09/2024

Appendix E

Greenfield Run-Off Rates and Volume Calculations

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.450
Area (ha)	50.000	Urban	0.750
SAAR (mm)	864	Region Number	Region 10

Results	**l/s**
QBAR Rural	281.0
QBAR Urban	702.8
Q100 years	1106.0
Q1 year	611.4
Q2 years	718.0
Q5 years	861.6
Q10 years	928.6
Q20 years	989.6
Q25 years	1005.3
Q30 years	1017.8
Q50 years	1050.1
Q100 years	1106.0
Q200 years	1183.5
Q250 years	1206.8
Q1000 years	1351.6

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Greenfield Runoff Volume

FEH Data

Return Period (years)	100
Storm Duration (mins)	360
FEH Rainfall Version	2013
Site Location	GB 380405 388055 SJ 80405 88055
Data Type	Point
Areal Reduction Factor	1.00
Area (ha)	0.116
SAAR (mm)	828
CWI	118.697
SPR Host	47.000
URBEXT (USER)	0.5000

Results

Percentage Runoff (%)	56.04
Greenfield Runoff Volume (m^3)	42.956

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Appendix F

Pre-Development Run-Off Rates and Volume Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 380405 388055 SJ 80405 88055
Data Type	Point
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 (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
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

Designed with Level Soffits

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	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 0	Number of Storage Structures 0	Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 380405 388055 SJ 80405 88055
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840

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Synthetic Rainfall Details

Storm Duration (mins) 30

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2 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 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 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 0 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH
FEH Rainfall Version 2013
Site Location GB 380405 388055 SJ 80405 88055
Data Type Point
Cv (Summer) 1.000
Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 2, 30, 100
Climate Change (%) 0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Summer	2	+0%					41.077
1.001	2	15 Summer	2	+0%					41.007

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.223	0.000	0.15			11.7	OK	
1.001	2	-0.193	0.000	0.27			21.4	OK	

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30 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	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	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	0	Number of Storage Structures	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 380405 388055 SJ 80405 88055
Data Type	Point
Cv (Summer)	1.000
Cv (Winter)	1.000

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Summer	30	+0%					41.120
1.001	2	15 Summer	30	+0%					41.087

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.180	0.000	0.33			26.2	OK	
1.001	2	-0.113	0.000	0.70			55.2	OK	

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100 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 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 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 0 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH
FEH Rainfall Version 2013
Site Location GB 380405 388055 SJ 80405 88055
Data Type Point
Cv (Summer) 1.000
Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 2, 30, 100
Climate Change (%) 0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Summer	100	+0%					41.161
1.001	2	15 Summer	100	+0%					41.137

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.139	0.000	0.46			36.3	OK	
1.001	2	-0.063	0.000	0.97			76.6	OK	

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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	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	0	Number of Storage Structures	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 380405 388055 SJ 80405 88055
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Storm Duration (mins)	30

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Summary Wizard of 360 minute 100 year Winter I+0% for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	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	0	Number of Storage Structures	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 380405 388055 SJ 80405 88055
Data Type	Point
Cv (Summer)	1.000
Cv (Winter)	1.000

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 0

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	1	360 minute 100 year Winter I+0%	42.000	41.046	-0.254	0.000	0.06
1.001	2	360 minute 100 year Winter I+0%	42.000	40.967	-0.233	0.000	0.11

PN	US/MH Name	Overflow (l/s)	Discharge Vol (m³)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	1		38.326		4.5	OK
1.001	2		76.684		8.9	OK

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Appendix G

Surface Water Management Layout and SuDS Details

Appendix H

Surface Water Network / Management Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 380405 388055 SJ 80405 88055
Data Type	Point
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 (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
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

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.099	4-8	0.017

Total Area Contributing (ha) = 0.116

Total Pipe Volume (m³) = 1.806

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	1.500	0.020	75.0	0.023	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	14.800	0.195	75.9	0.030	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	26.350	0.330	79.8	0.051	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	6.250	0.075	83.3	0.012	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.02	40.800	0.023	0.0	0.0	0.0	1.51	60.1	3.1
1.001	50.00	5.18	40.780	0.053	0.0	0.0	0.0	1.50	59.7	7.2
1.002	50.00	5.48	40.585	0.104	0.0	0.0	0.0	1.46	58.2	14.1
1.003	50.00	5.58	40.255	0.116	0.0	0.0	0.0	1.10	19.5	15.7

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S1	42.540	1.740	Open Manhole	1200	1.000	40.800	225				
Tank	42.500	1.720	Open Manhole	1	1.001	40.780	225	1.000	40.780	225	
S2	42.020	1.435	Open Manhole	1200	1.002	40.585	225	1.001	40.585	225	
S3	41.850	1.595	Open Manhole	1200	1.003	40.255	150	1.002	40.255	225	
EX SWMH	41.770	1.590	Open Manhole	0		OUTFALL		1.003	40.180	150	

No coordinates have been specified, layout information cannot be produced.

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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	225	S1	42.540	40.800	1.515	Open Manhole	1200
1.001	o	225	Tank	42.500	40.780	1.495	Open Manhole	1
1.002	o	225	S2	42.020	40.585	1.210	Open Manhole	1200
1.003	o	150	S3	41.850	40.255	1.445	Open Manhole	1200

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	1.500	75.0	Tank	42.500	40.780	1.495	Open Manhole	1
1.001	14.800	75.9	S2	42.020	40.585	1.210	Open Manhole	1200
1.002	26.350	79.8	S3	41.850	40.255	1.370	Open Manhole	1200
1.003	6.250	83.3	EX SWMH	41.770	40.180	1.440	Open Manhole	0

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Network Classifications for Storm

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
1.000	S1	225	1.495	1.515	Unclassified	1200	0	1.515	Unclassified
1.001	Tank	225	1.210	1.495	Unclassified	1	0	1.495	Unclassified
1.002	S2	225	1.210	1.370	Unclassified	1200	0	1.210	Unclassified
1.003	S3	150	1.440	1.445	Unclassified	1200	0	1.445	Unclassified

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.003	EX SWMH	41.770	40.180	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	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	2013
Site Location	GB 380405 388055 SJ 80405 88055
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Storm Duration (mins)	30

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S3, DS/PN: 1.003, Volume (m³): 2.8

Unit Reference	MD-SHE-0097-5000-1600-5000
Design Head (m)	1.600
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	97
Invert Level (m)	40.255
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	5.0	Kick-Flo®	0.865	3.8
Flush-Flo™	0.425	4.7	Mean Flow over Head Range	-	4.2

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.1	1.200	4.4	3.000	6.7	7.000	10.0
0.200	4.3	1.400	4.7	3.500	7.2	7.500	10.3
0.300	4.6	1.600	5.0	4.000	7.7	8.000	10.7
0.400	4.7	1.800	5.3	4.500	8.1	8.500	11.0
0.500	4.7	2.000	5.5	5.000	8.5	9.000	11.3
0.600	4.6	2.200	5.8	5.500	8.9	9.500	11.6
0.800	4.1	2.400	6.0	6.000	9.3		
1.000	4.0	2.600	6.3	6.500	9.7		

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Storage Structures for Storm

Cellular Storage Manhole: Tank, DS/PN: 1.001

Invert Level (m) 40.780 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	42.0	0.0	2.600	0.0	0.0
0.200	42.0	0.0	2.800	0.0	0.0
0.400	42.0	0.0	3.000	0.0	0.0
0.600	42.0	0.0	3.200	0.0	0.0
0.800	42.0	0.0	3.400	0.0	0.0
1.000	42.0	0.0	3.600	0.0	0.0
1.200	42.0	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

Manhole Headloss for Storm

PN	US/MH Name	US/MH Headloss
1.000	S1	0.500
1.001	Tank	0.500
1.002	S2	0.500
1.003	S3	0.500

Volume Summary (Static)

Length Calculations based on Centre-Centre

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
1.000	S1	1.968	0.060	0.000	2.028
1.001	Tank	0.000	0.588	50.540	51.128
1.002	S2	1.623	1.048	0.000	2.671
1.003	S3	1.804	0.110	0.000	1.914
Total		5.395	1.806	50.540	57.741

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Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
1.000	S1	1.968	0.036	0.000	2.004
1.001	Tank	0.000	0.565	50.540	51.105
1.002	S2	1.623	1.000	0.000	2.623
1.003	S3	1.804	0.100	0.000	1.904
Total		5.395	1.700	50.540	57.635

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2 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 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 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 2013
Site Location GB 380405 388055 SJ 80405 88055
Data Type Point
Cv (Summer) 0.750
Cv (Winter) 0.860

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
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) 2, 30, 100
Climate Change (%) 0, 40, 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	15 Winter	2	+0%	30/15 Summer				40.853
1.001	Tank	30 Winter	2	+0%	30/15 Summer				40.851
1.002	S2	15 Winter	2	+0%	2/15 Summer				40.853
1.003	S3	15 Winter	2	+0%	2/15 Summer				40.845

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	-0.172	0.000	0.13			3.7	OK	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.001	Tank	-0.154	0.000	0.09		13	4.5	OK	
1.002	S2	0.043	0.000	0.17			9.2	SURCHARGED	
1.003	S3	0.440	0.000	0.29			4.7	SURCHARGED	

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30 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 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 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 2013
Site Location GB 380405 388055 SJ 80405 88055
Data Type Point
Cv (Summer) 0.750
Cv (Winter) 0.860

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
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) 2, 30, 100
Climate Change (%) 0, 40, 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	60 Winter	30	+40%	30/15 Summer				41.415
1.001	Tank	60 Winter	30	+40%	30/15 Summer				41.415
1.002	S2	60 Winter	30	+40%	2/15 Summer				41.412
1.003	S3	60 Winter	30	+40%	2/15 Summer				41.403

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	0.390	0.000	0.17			5.2	SURCHARGED	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.001	Tank	0.410	0.000	0.08		64	4.2	SURCHARGED	
1.002	S2	0.602	0.000	0.14			7.8	SURCHARGED	
1.003	S3	0.998	0.000	0.29			4.7	SURCHARGED	

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100 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 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 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 2013
Site Location GB 380405 388055 SJ 80405 88055
Data Type Point
Cv (Summer) 0.750
Cv (Winter) 0.860

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
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) 2, 30, 100
Climate Change (%) 0, 40, 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S1	60 Winter	100	+45%	30/15 Summer				41.845
1.001	Tank	60 Winter	100	+45%	30/15 Summer				41.845
1.002	S2	60 Winter	100	+45%	2/15 Summer				41.842
1.003	S3	60 Winter	100	+45%	2/15 Summer				41.831

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	0.820	0.000	0.25			7.6	SURCHARGED	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.001	Tank	0.840	0.000	0.09		92	4.6	SURCHARGED	
1.002	S2	1.032	0.000	0.13			6.9	FLOOD RISK	
1.003	S3	1.426	0.000	0.30			5.0	FLOOD RISK	

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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	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	2013
Site Location	GB 380405 388055 SJ 80405 88055
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Storm Duration (mins)	30

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Summary Wizard of 360 minute 100 year Winter I+45% for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	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	2013
Site Location	GB 380405 388055 SJ 80405 88055
Data Type	Point
Cv (Summer)	0.750
Cv (Winter)	0.860

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
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)	2, 30, 100
Climate Change (%)	0, 40, 45

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	S1	360 minute 100 year Winter I+45%	42.540	41.459	0.434	0.000	0.07
1.001	Tank	360 minute 100 year Winter I+45%	42.500	41.458	0.453	0.000	0.08
1.002	S2	360 minute 100 year Winter I+45%	42.020	41.455	0.645	0.000	0.10
1.003	S3	360 minute 100 year Winter I+45%	41.850	41.446	1.041	0.000	0.29

PN	US/MH Name	Overflow (l/s)	Discharge Vol (m³)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	S1		18.953		2.0	SURCHARGED
1.001	Tank		43.675	122	4.1	SURCHARGED

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Summary Wizard of 360 minute 100 year Winter I+45% for Storm

PN	US/MH Name	Overflow (l/s)	Discharge Vol (m³)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.002	S2		85.705		5.3	SURCHARGED
1.003	S3		95.592		4.7	SURCHARGED

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