

PROJECT RED, MANCHESTER ROYAL INFIRMARY



29/10/2020

FLOOD RISK ASSESSMENT & DRAINAGE STRATEGY REPORT

The Alan Johnston Partnership LLP

Ref: RED-AJP-XX-00-RP-C-0900



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Project Closure Report Version Control

Version	Date	Author	Change Description
P01	29/10/2020	J.Speers	First Issue

Record of Approval

Originator	Approved	Date
J.Speers	P.Bryan	29/10/2020

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1.0 INTRODUCTION

This Flood Risk Assessment (FRA) and Drainage Strategy Report has been prepared on behalf of Manchester University NHS Foundation Trust in connection with a planning application for the construction of an extension to the existing A&E department building. The proposed site is located to the west of North Road, within the existing Manchester Royal Infirmary site.

The site is located within Flood Zone 1, with a total area of 0.486ha and therefore a Flood Risk Assessment (FRA) is not required. Despite this, all forms of flooding have been considered and a site-specific FRA for the proposed development site has been completed.

This FRA has been prepared in accordance with the general requirements of the National Planning Policy Framework and the Technical Guidance to the National Planning Policy Framework, both published by the Department for Communities and Local Government. This involves the identification of flood risk to new development(s) on the site, the possible effect of this development on flood risk elsewhere and the investigation of the impact on the development as a result of increased sea levels, fluvial flows and larger pluvial events due to increased impermeable areas and climate change.

The purpose of this report is to present a site-specific assessment of flood risk based on available information, to identify relevant flood levels affecting the site with respect to a particular probability of flooding. The flood levels identified are dependent on the correctness of the current conditions, as stated in this report and the prediction of future climatic conditions implicit in the National Planning Policy Framework.

For any size of storm event, the procedure will always yield a probability that the event will occur in any year, albeit the probability is smaller for larger events. The predicted storm event has a probability of occurrence in any year and the derived flood level has an associated probability of exceedance. This means that there is always a risk that property flooding could occur one or more times in any year.

Therefore, this report should not be interpreted or relied upon as providing a guarantee against flooding. There is always a residual risk that flooding will occur and it is not possible to predict a zero risk of flooding.

In accordance with National Planning Policy Framework (NPPF) and the associated Technical Guidance document, flood risk must be assessed for all sources including tidal (from the sea), fluvial (from rivers), pluvial (from land), groundwater, sewer and artificial water bodies (e.g. reservoirs, canals, major water supply infrastructure etc.).

More specifically, the development of any site must be carried out in such a way as to mitigate any potential flood risk, both on and off site from all sources of flooding.

The other purpose of this report is to present the surface water and foul water outline drainage strategies for the site which have been developed by the Alan Johnston Partnership. To demonstrate how the specific drainage requirements are to be met, the report should be read in conjunction with the relevant drawings and supporting information, included within the appendices.

The drainage strategies outlined within this report, have been prepared in accordance with BS EN 752:2008 (Drain and sewer systems outside buildings), Sewers for Adoption, Building Regulations Approved Document H (Drainage and waste disposal) and the Technical Guidance to the National Planning Policy Framework document (Department for Communities and Local Government, March 2012).

2.0 SITE DESCRIPTION

The existing site is situated to the west of North Road, within the existing Manchester Royal Infirmary site and is located at National Grid reference SJ 85111 96319. The location of the existing site is illustrated in Appendix A and the extent of the area to which the application relates is shown on the enclosed aerial photo, attached in Appendix B.

The existing site covers a total area of 0.486ha and is a brownfield site. The site currently consists of existing buildings, car park and hardstanding areas.

The site is bounded to the north, south and west by existing Manchester Royal Infirmary buildings and to the east, is bounded by the existing highway Upper Brook Street. The site slopes generally from north to south with levels sloping from approximately 40.50mAOD in the north to approximately 39.90mAOD in the south. A topographic survey of the existing site is attached in Appendix C and an aerial photo is included in Appendix B to illustrate the site at the present day.

2.1 Geology

An intrusive site investigation was completed in October 2018 by WSP and is contained within the WSP Ground Investigation Report, Project RED: Manchester Royal Infirmary, 70048625-11173(1). The site investigation report indicates that the underlying strata consists of made ground to a maximum recorded depth of 2.10mbgl, which is underlain by Glacial Till deposits comprising mainly of silty clays to a maximum recorded depth of 12.00mbgl. This is then underlain by bedrock, comprising of mudstone, to a maximum recorded depth of 15.80mbgl.

This is supported by the information taken from the British Geological Survey (BGS) 1:50,000 Bedrock geology maps. These show that the site has superficial deposits comprising of Glacial Till deposits, with the bedrock reported to be of the Manchester Marls Formation comprising of mudstone.

2.2 Hydrogeology

The Environment Agency groundwater maps show that the superficial deposits are classified as Secondary undifferentiated strata. These are defined as areas where it has not been possible to attribute either category A or B to a rock type, respectively. In most cases this is due to the variable characteristics of the rock type. The bedrock is classified as a Secondary B Aquifer, defined as an area with predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering.

The Environment Agency groundwater maps also indicate that the development site is not situated within a groundwater Source Protection Zone (SPZ) but is very close to being located with a SPZ III Zone. Groundwater monitoring was undertaken as part of the WSP Ground Investigation Report and this indicates that groundwater was recorded between 1.50mbgl and 2.50mbgl but the report then states that the groundwater encountered is likely to be perched water rather than the groundwater table.

2.3 Hydrology

The development site is situated in the direct catchment of the River Medlock, which is located approximately 1.3km north-west of the site. The site is located within Flood Zone 1 which is categorized by the Environment Agency as land assessed as having less than a 1 in 1,000 annual probability of river flooding (1% – 0.1%). Therefore, the site is an area identified by the Environment Agency as at low risk of flooding from rivers and streams.

3.0 PROPOSED DEVELOPMENT

The proposed development is split across 3 no. separate sites, which include with the area to the east of the existing building, the area to the north-east of the existing building and the area to the north-west of the existing building. The area to the east of the existing building covers a total area of 0.320ha and will include the extension to the existing A&E department building and also amendments to the existing car parking areas to the east of North Road.

The other two site areas to the north-east and north-west of the existing building currently consist of existing car parking areas. These two sites will remain as car parking areas with only minor amendments such as resurfacing/making good to be completed within these two areas. Therefore, it is envisaged that these two areas will continue to drain as per the existing scenario and as such will not be included within the remainder of this report.

Therefore, only the building extension site area to the east of the existing building will be considered throughout the remainder of this report. To enable a viable scheme, the proposed site levels are constrained by the existing developments and highways surrounding the site, therefore the site levels are likely to remain similar to the existing. The proposed site plan is attached in Appendix D.

4.0 PLANNING POLICY

The National Planning Policy Framework (NPPF) sets out the Government's policy on meeting the challenges of climate change, flooding and coastal change. The NPPF states that:

"Planning plays a key role in helping shape places to secure radical reductions in greenhouse gas emissions, minimising vulnerability and providing resilience to the impact of climate change, and supporting the delivery of renewable and low carbon energy and associated infrastructure. This is central to the economic, social and environmental dimensions of sustainable development. Local planning authorities should adopt proactive strategies to mitigate and adapt to climate change taking full account of flood risk, coastal change and water supply and demand consideration."

This Flood Risk Assessment proposes recommendations to facilitate the proposed development so that it takes into account flood risk at all stages of the development.

4.1 Sequential Test

Based on the sites location, within Flood Zone 1, the Sequential Test is not required. Therefore, the development is deemed appropriate, in Flood Zone 1 and a sequential test is not required.

4.2 Exception Test

NPPF classifies the development (Hospital) as a 'More vulnerable' development but as the site is located within Flood Zone 1, the development is deemed appropriate according to NPPF and therefore the Exception Test is not required.

5.0 FORMS OF FLOODING

The Technical Guidance to the National Planning Policy Framework requires all forms of flooding to be considered.

5.1 Flooding from Rivers

The Flood Risk map is included as Appendix E.

As can be seen from the Flood Risk map, the entire site is located within Flood Zone 1 and therefore, the site is located in Flood Zone 1 with a chance of flooding of less than 0.1% (or 1 in 1000).

The nearest surface water feature is understood to be an unnamed culverted river (potentially Corn Brook) located approximately 440m north-west of the site, with the nearest designated main river being the River Medlock which is located approximately 1.30km north-west of the site.

Despite this, the risk of flooding to the new development from rivers is considered to be low.

5.2 Flooding from the Sea

The site is not at risk of flooding from the sea. The lowest level of the site is approximately 39.90mAOD, i.e. well above tidal flood levels.

5.3 Flooding from Land

Intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems can run quickly off land and result in local flooding.

The Surface Water Flooding map is included in Appendix E. It can be seen from the map that the entire site is classified as having a low and very low risk of surface water flooding. As such, the risk of flooding from overland flows due to surface water flooding is considered to be low.

Therefore, the risk of flooding from overland flows due to surface water flooding is considered to be low and as such the overall site is considered to be at low risk of flooding from surface water/surrounding land.

5.4 Flooding from Groundwater

The Groundwater Flooding Map contained within the Manchester City, Salford City and Trafford Councils Level 2 Hybrid Strategic Flood Risk Assessment (SFRA) Report indicates that the site is in an area which is not at risk of groundwater flooding.

This is supported by the WSP Ground Investigation Report which has indicated that groundwater monitoring only encountered perched water between depths of 1.50mbgl and 2.50mbgl, with no groundwater table encountered to depths of up to 15.80mbgl.

As such, due to the lack of the groundwater table encountered by the site investigation and the Groundwater Flooding Map indicating that the site is not at risk of groundwater flooding, it is envisaged that the site has a negligible risk of groundwater flooding. Therefore, the site is considered to be at low risk of flooding from groundwater.

5.5 Flooding from Sewers

A record of historic public sewers surrounding and serving the development site has been obtained and this is included in Appendix F. As can be seen from the public sewer map, there are no existing public sewers located within the site boundary with the only nearby public sewers located within the surrounding highways. However, as can be seen from the existing utilities survey, attached in Appendix G, the site is currently served by existing private sewers.

Therefore, due to the lack of public sewers within the proposed site and the fact that the proposed drainage networks for the site will be suitably designed, leads to the conclusion that the site itself is considered to have a low risk of flooding from sewers.

5.6 Flooding from Reservoirs, Canals and Other Artificial Sources

The Reservoir Flood Risk map is included in Appendix E and the closest artificial waterbody or reservoir is Audenshaw Reservoir which is located approximately 5.8km east of the site. As such, it can be seen from the map that the site is not at risk of flooding from reservoirs, canals or other artificial sources.

Therefore, the proposed development has a low risk of flooding from reservoirs, canals and other artificial sources.

6.0 DEVELOPMENT AND DRAINAGE STRATEGY

6.1 Effect of Development on Flood Risk

The existing site covers a total area of 0.320ha and currently consists of part of the existing hospital building, the existing access road, North Road and adjacent car parking area to the east of North Road. The pre and post development impermeable areas have been assessed and are indicated on the attached drawing in Appendix H. The comparison between the pre and post development impermeable areas is also summarised below;

Total Development Site Area (ha)	Existing Impermeable Area (ha)	Proposed Impermeable Area (ha)
0.320	0.205	0.209

As can be seen from the pre and post development impermeable areas drawing, attached in Appendix H, only minor amendments such as repainting and/or resurfacing is to be completed on the North Road area and the existing car parking area to the east of North Road. As such, it is envisaged that these areas will continue to drain as per the existing scenario and therefore this 0.091ha area is to be excluded from the pre and post development impermeable areas calculations.

As can be seen from the summary table above, the introduction of the proposed buildings and associated hard-standing areas will slightly increase the impermeable area across the site. This increase in the impervious area within the proposed site will lead to a slight increase in the;

- Volume of surface water ponding on the site.
- Volume of surface water runoff leaving the site or discharging into surrounding areas.
- Peak discharge rate from the site.

Accordingly, drainage systems are needed to drain the foul and surface water flows arising from the proposed development. Where possible, any existing drainage networks should be utilised. Appropriate design and construction of these systems as set out in Section 6.3 should ensure that there is no increase in offsite flood risk that would otherwise impact downstream areas.

6.2 Existing Drainage Systems

As can be seen from the public sewer map, attached in Appendix F, there are no existing public sewers located within the proposed development site area. The only nearby public sewers are the 790mm x 620mm brick public combined water sewer located to the east of the site on Upper Brook Street and the 825mm x 600mm brick public combined water sewer located to the north of the site on Grafton Street.

Despite this, the existing utilities survey drawing, attached in Appendix G, shows that the existing site is currently served by private drainage networks. A CCTV survey was also undertaken by Lanes Group in December 2018 and it proves that the existing site is currently drained via private drainage networks. Extracts from the CCTV survey report is attached in Appendix I.

To enable the construction of the proposed development it is envisaged that the existing private drainage networks will need to be diverted or abandoned, where possible. As the existing private drainage serves the remainder of the existing hospital building and surrounding areas outside of the site boundary it is envisaged that the existing drainage will need to be diverted to ensure the areas surrounding the development site will continue to be served by the private drainage.

6.3 Proposed Drainage Strategy

As outlined above in section 6.1, where required drainage systems are needed to drain the foul and surface water flows arising from the proposed development. The proposed drainage systems must ensure that there is no increase in offsite flood risk that would otherwise impact downstream areas.

6.3.1 Surface Water Drainage

The Building Regulations - Approved Document H (2002) details a hierarchy of potential methods for disposing of surface water as shown below in order of preference:

- Discharge via infiltration
- Discharge to watercourse
- Discharge to sewer

Considering the hierarchy above, the surface water network for the proposed development should infiltrate where possible. Even though the WSP Ground Investigation did not undertake any BRE365 complaint infiltration tests it has indicated that the site is underlain by made ground which is in turn impermeable clay superficial deposits. This is highlighted by the fact that the site investigation report identifies the groundwater as perched water above and within the impermeable clay strata.

This coupled with the lack of space across the site and the fact that Building Regulations Part-H states that no infiltration should take place within 5m of a building or highway, leads to the conclusion that infiltration is not suitable for the proposed development.

As the underlying impermeable clay strata and Building Regulations restrictions have ruled out the use of infiltration, the intention for the development would be to discharge to watercourse. The nearest watercourse is understood to be an unnamed culverted river (potentially Corn Brook) located approximately 440m north-west of the site, with the nearest designated main river being the River Medlock which is located approximately 1.30km north-west of the site. Therefore, due to the distance through developed third-party land, discharging to watercourse has been deemed impractical.

As such, the only practical solution for the discharge of the surface water is discharge to public sewer. As indicated within Section 6.2, the only nearby public sewers are located within the highways surrounding the existing hospital site. As such, it is envisaged that the surface water runoff from the proposed development will discharge to the existing private surface water drainage which currently serves the proposed development.

While every effort to utilise any suitable existing systems should be made, the drainage systems should be designed to suit the proposed site layout and topography which aims to provide an efficient design.

In line with Sewers for Adoption (7th Edition), the requirements for the design of a new surface water drainage systems are as follows:

- Below ground piped drainage to be sized to accommodate the 1 in 2 year (50% AEP) design storm without surcharge.
- System to be designed not to flood any part of the site in a 1 in 30 year (3% AEP) design storm.
- For events in exceedance of the 1 in 30 year design storm and up to and including the 1 in 100 year event, site drainage and topography should be designed where practicable to route surface water run-off away from buildings to safe above-ground storage areas on site, thereby preventing this run-off from leaving the site and increasing flood risk elsewhere.

For each design case described above, the design storm is the critical storm duration for the site conditions. In the case of the 1 in 100 year design storm, a 40% increase in the peak rainfall intensity is applied to allow for the estimated worst case impacts of climate change. This is in accordance with new advice, issued by the Environment Agency, which updates previous climate change allowances outlined in the National Planning Policy Framework.

Therefore, suitable systems of below ground drainage will be required to contain as a minimum requirement, the 1 in 30 year event. Additionally, any surface water run-off from events that exceed the design capacity of the new drainage system, up to and including the 1 in 100 year (+40%) event, will be retained on-site in safe storage areas.

As the site area consists mainly of pedestrianised areas and roof areas, the risk of pollution has been deemed to be minimal and therefore in line with the requirements of Pollution Prevention Guidelines 3 (PPG3), no measures to prevent oil and other contaminants being passed forward to the existing private surface water sewer are required.

In line with common practice, it is proposed the surface water discharge from the proposed development should mimic that from the existing site.

It is envisaged that a minimum 50% betterment on the existing surface water brownfield runoff rate is to be applied, in line with Section 3.4.1 of the Manchester City, Salford City and Trafford Councils Level 2 Hybrid SFRA User Guide.

Therefore, an assessment of the existing surface water run-off from the brownfield site has been completed using a simple three pipe network modelled in Micro Drainage. For the existing 0.320ha site, using the existing impermeable area of 0.205ha, an existing 2-year return period brownfield discharge rate of 32.0 L/s was generated. The brownfield runoff assessment is attached in Appendix J.

As such, applying a 50% reduction to comply with the Manchester City, Salford City and Trafford Councils Level 2 Hybrid SFRA User Guide, the maximum surface water discharge rate for the site is **16.0 L/s**. This maximum discharge rate should be applied to all rainfall events up to and including the 1 in 100 year return period plus 40% climate change design storm.

Using a total post development area of 0.209ha at the restricted discharge rate of 16.0 L/s, for the 1 in 100 year + 40% return period design storm, a storage volume of **49.3m³** is required. The preliminary storage estimate is attached in Appendix K.

Manchester City Council (Lead Local Flood Authority) have been contacted regarding the maximum surface water discharge rate from the proposed development and they have indicated that a 50% betterment on the existing brownfield discharge rate would be acceptable. The LLFA correspondence is attached in Appendix L. As the drainage proposals do not discharge to or affect any United Utilities assets, it is envisaged that no discussions with United Utilities is required.

As outlined below, all SuDS techniques have been considered and comments made on their suitability for this proposed development;

SuDS Technique	Suitable?	Reasoning
Green Roof	✗	Unsuitable due to minimal available roof space.
Rainwater Harvesting	✗	Impractical due to minimal roof area available.
Basins, Ponds or Swales	✗	Unsuitable due to lack of available space.
Filter Strips	✗	Unsuitable due to impermeable strata.
Infiltration Techniques	✗	Unsuitable due to impermeable strata.
Permeable Surfaces	✗	Unsuitable due to impermeable strata and lack of available areas.
Tank / Oversized Pipe Systems	✓	Suitable and incorporated.

Given the lack of available space on the proposed site and the fact that the existing private drainage networks will need to be diverted, it is envisaged that the only available space to locate the attenuation storage is below the hardstanding area and North Road, to the east of the proposed building extension.

As such, it is proposed that the surface water drainage will mimic the existing private drainage by collecting and conveying the runoff from the proposed development from south to north, where it will be restricted via a

vortex flow control chamber, prior to discharging into the existing private surface water drainage network to the north of the proposed building extension.

As outlined previously, the surcharged runoff is to be stored within a below ground cellular attenuation tank, which is to be located below the hardstanding area and North Road, to the east of the proposed building extension.

Due to the lack of available above ground storage areas and the critical nature of the required access to the extension building, the proposed drainage network and below ground cellular attenuation tank should be suitably sized to prevent any flooding for all rainfall events up to and including the 1 in 100 year return period plus 40% climate change design storm.

The surface water drainage strategy and SuDS solutions outlined above are all subject to detailed drainage design and LLFA approvals. It is also subject to change, dependent upon the final site layout and levels. The surface water drainage proposals and discharge rates should be confirmed via detailed discussions with the Lead Local Flood Authority prior to the commencement of any works.

6.3.2 Foul Water Drainage

Foul water drainage disposal is set out in Part H of the Building Regulations in order of priority the preferred methods are;

1. Public sewer
2. Septic tank
3. Cesspool.

The foul water system shall be designed in accordance with;

- BS EN 752:2017 (Drain and sewer systems outside buildings)
- Sewers for Adoption (7th Edition)
- Technical Guidance to the National Planning Policy Framework document (Department for Communities and Local Government, March 2012).
- BS EN 12056-2:2000 (Drainage systems inside buildings)
- Building Regulations Approved Document H, Drainage and waste disposal. (Office of the Deputy Prime Minister, December 2010).

It is anticipated that the foul water from all areas will discharge at an unrestricted rate into the surrounding private foul water sewers. As such, it is anticipated that the foul water from the proposed building extension will discharge at unrestricted rates into the existing private foul water sewers or any proposed diversions, at the nearest possible connection point.

Therefore, the proposed foul water drainage will mimic the existing, with the proposed foul water from the building extension being collected and conveyed to the existing private foul water sewers or any proposed diversions, where it will discharge at unrestricted rates into the nearest possible connection point. As such, it is envisaged that there will be multiple connections into the existing private foul water sewers from the proposed building extension.

As with the surface water drainage strategy, the foul water drainage strategy outlined above is subject to change and is dependent upon detailed drainage design and LLFA approvals, in addition to the finalised site layout and levels. The foul water drainage strategy and unrestricted discharge rates should also be confirmed via detailed discussions with the Lead Local Flood Authority prior to the commencement of any works.

7.0 FUTURE MANAGEMENT & MAINTENANCE

The proposed drainage solution uses SUDS techniques in accordance with the CIRIA SUDS Manual C753. The surface water run-off from the proposed development is to be restricted using a vortex flow control device and the attenuated run-off is stored using a cellular attenuation tank.

It is envisaged that the following components have been or will be included within the drainage strategy for the proposed development:

- Inspection chambers, manholes and catchpits.
- Pipes.
- Drainage channels and gullies.
- Vortex flow control device.
- Cellular attenuation tank.

A suitable maintenance strategy should be adopted to ensure the drainage network is cleaned regularly and the routine maintenance and cleansing regime should be documented. It is assumed that the proposed drainage will remain private and therefore maintenance of the surface and foul water drainage systems will be the responsibility of an on-site facilities management team or the end user.

As such, the maintenance of the specified SuDS should be included within the developments Operation and Maintenance Manual and should be detailed in accordance with the CIRIA SuDS Manual C753, as per the operation and maintenance guidance outlined below.

7.1 General Maintenance & Inspection Requirements

- No work shall be carried out on the drainage system without permission from a nominated person, who has access to information/a working knowledge of the system.
- Maintenance/inspection work shall be carried out in a safe/planned manner.
- All work is to be carried out by competent persons suitably trained and equipped in accordance with current statutory safe working policies.
- Entry into confined spaces shall be kept to a minimum and be restricted to suitably qualified/equipped persons working in accordance with current statutory safe working policies.
- Drainage systems shall be inspected on a regular basis or should any problems be suspected. Any debris/defects discovered shall be recorded and a programme of cleaning/ repair initiated. Urgent repairs/cleaning shall be actioned as soon as practicable.
- It is recommended that the drainage system is inspected as a minimum twice a year, with the system also being inspected after any major storm event.
- Clearing of the drainage system can be achieved by a number of methods depending on the nature of the work;
 - Rodding – Manual/Mechanical with flexible rods.
 - Jetting – High pressure water jetting.
 - Plunging.

7.2 Inspection Chambers, Manholes and Catchpits

The appropriate health and safety equipment must be used when accessing manholes/catchpits. Confined space certificates must be held by any personnel entering a manhole and the appropriate permits should be obtained from the Maintenance Manager prior to any access. The following operations should be carried out annually.

- Covers of inspection chambers and manholes shall be removed and the sides, benchings and channels cleared.
- Accumulated deposits of silt in inspection chambers, catchpits and manholes shall be removed. Any traps shall then be plunged and thoroughly flushed out with clean water. This should be completed in Autumn, after leaf fall.
- Main and branch drains shall be cleared as required and afterwards be flushed with clean water. Any obstructions found shall be removed and not flushed down the system.
- Covers of inspection chambers, manholes and catchpits shall be replaced, bedded in suitable grease or other sealing material as required and bolted/locked down as appropriate. Missing bolts and broken items shall be replaced in accordance with the manufacturer's details.

7.3 Pipes

Regular inspection and maintenance is important to identify areas which may have become obstructed/clogged and may not be draining correctly, as failure to do so would expose the development to a greater level of flood risk.

Pipes are proprietary products and therefore the materials used can vary across the site. As such, where used the manufacturer's recommendations should be followed. Access for maintenance of the pipes is provided through inspection chambers and manholes. The below table sets out the maintenance schedule for the pipe components of the proposed drainage systems.

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Inspect for evidence of poor operation via water levels. If required take remedial action.	Monthly for 3 months, then six-monthly intervals. Also, 48 hours after large storms.
	Check and remove large debris and/or vegetation growth near pipe runs.	Monthly or as required.
Remedial Actions	Rod through poorly performing runs as initial remediation.	As required.
	If continued poor performance jet and CCTV survey poorly performing runs.	As required.
	Seek advice as to remediation techniques suitable for the type of performance issue.	As required, if above actions do not improve performance.
Monitoring	Initial Inspection should be provided as post construction CCTV survey.	N/A
	Inspect/check all inlets, outlets and overflows to ensure they are in good condition and operating as designed.	Monthly for 3 months, then six-monthly intervals. Also, 48 hours after large storms.

7.4 Drainage Channels and Gullies

Channels and gullies should be inspected and cleaned in accordance with the manufacturer's details. Channel units can be cleaned through the use of a high-pressure hose; this can be fed into the channel system through access units strategically placed along the channel run. The throat section of channel units should be kept clear at all times to ensure uninterrupted flow of surface water into the drainage channel and any debris within the throat should be removed.

Locking bolts should be replaced and sufficiently tightened, taking care that the bolt heads do not stand above the top surface of the cover or grate. If covers are allowed to move within their frame, this may cause damage to the frame or seating. The below table sets out the maintenance schedule for the drainage channel and gullies components of the proposed drainage systems.

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Litter and debris removal.	Monthly or as required.
	Check and remove large debris and/or vegetation growth near pipe runs.	Monthly or as required.
	Inspect for evidence of poor operation and/or weed growth. If required take remedial action. Inspect silt accumulation rates and establish appropriate brushing frequencies.	Monthly for 3 months, then six-monthly intervals. Also, 48 hours after large storms.
Remedial Actions	Inspect access/outlet boxes and rod through poorly performing channels and outlets as initial remediation.	As required.
	Seek advice as to remediation techniques suitable for the type of performance issue.	As required, if above actions do not improve performance.
Monitoring	Initial Inspection including channel outlet boxes and gully sumps.	Monthly for 3 months, then six-monthly intervals. Also, 48 hours after large storms.

7.5 Vortex Flow Control Device

Regular inspection and maintenance is important to identify if the vortex flow control device has become obstructed/clogged and may not be functioning correctly, as failure to do so would expose the development to a greater level of flood risk.

Vortex flow control devices are proprietary products and therefore can vary from manufacturer to manufacturer. As such, where used the manufacturer's recommendations should be followed.

- Normally, little maintenance is required as there are generally a vortex flow control device has no moving parts.
- If blockages occur they tend to do so at the intake of the vortex flow control device.
- Vortex flow control devices are generally fitted with a pivoting by-pass door, which allows the manhole chamber to be drained down should blockages occur.
- The smaller type conical units, below the minimum recommended size, are also supplied with roding facilities or vortex suppressor pipes as standard.
- Following installation of the vortex flow control device it is vitally important that any extraneous material i.e. Building materials are removed from the unit and the chamber.
- After the system is made live, it is recommended that each unit be inspected monthly for three months and thereafter at six monthly intervals with hose down if required. Units should also be inspected within 48 hours after large storms.

7.6 Cellular Attenuation Tank

Regular inspection and maintenance is important to identify if the inlets/outlets have become obstructed/clogged and may not be functioning correctly, as failure to do so would expose the development to a greater level of flood risk. The maintenance requirements for cellular attenuation tanks are outlined within Table 21.3 of the CIRIA SUDS Manual C753. An extract of that table is given below to set out the maintenance schedule for the cellular attenuation tank component of the proposed drainage systems.

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

It should be noted that the Main Contractor should provide a Verification Report, including photographic evidence, to demonstrate that the drainage has been constructed as per the design drawings. As-built drawings should as be supplied by the Main Contractor, where the construction of the drainage varies from the design construction status drawings.

8.0 CONCLUSIONS

- The site is located within Flood Zone 1 and therefore is classified as having a low probability of flooding from rivers or sea. The site is also at a low risk of flooding from surface water flows and all other sources.
- An intrusive site investigation has been completed but this does not include BRE365 compliant infiltration tests. However, the site investigation has indicated that the site is underlain by made ground which is in turn impermeable clay superficial deposits. This is highlighted by the fact that the site investigation report identifies the groundwater as perched water above and within the impermeable clay strata.
- Therefore, due to the impermeable clay stratum and Building Regulations restrictions indicating that no infiltration should take place within 5m of a building or highway, infiltration is not considered to be viable across the site and therefore BRE365 infiltration tests are not required. This should be confirmed via detailed discussions with the LLFA.
- The nearest watercourse is understood to be an unnamed culverted river (potentially Corn Brook) located approximately 440m north-west of the site, with the nearest designated main river being the River Medlock which is located approximately 1.30km north-west of the site. Therefore, due to the distance through developed third-party land, discharging to watercourse has been deemed impractical. As such, the only practical solution for the discharge of the surface water is discharge to public sewer.
- The only nearby public sewers are located within the highways surrounding the existing hospital site. As such, it is envisaged that the surface water runoff from the proposed development will discharge to the existing private surface water drainage which currently serves the proposed development.
- It is envisaged that a minimum 50% betterment on the existing surface water brownfield runoff rate is to be applied, in line with Section 3.4.1 of the Manchester City, Salford City and Trafford Councils Level 2 Hybrid SFRA User Guide.
- Therefore, an assessment of the existing surface water run-off from the brownfield site has been completed using a simple three pipe network modelled in Micro Drainage. For the existing 0.320ha site, using an existing impermeable area of 0.205ha, an existing 2-year brownfield discharge rate of 32.0 L/s was generated.
- As such, applying a 50% reduction to offer improvement and comply with the Manchester City, Salford City and Trafford Councils Level 2 Hybrid SFRA User Guide, the maximum surface water discharge rate for the site as a whole is 16.0 L/s.
- The existing utilities survey drawing and the CCTV survey, undertaken by Lanes Group in December 2018, prove that the existing site is currently drained via private drainage networks.
- To enable the construction of the proposed development it is envisaged that the existing private drainage networks will need to be diverted or abandoned, where possible. As the existing private drainage serves the remainder of the existing hospital building and surrounding areas outside of the site boundary it is envisaged that the existing drainage will need to be diverted to ensure the areas surrounding the development site will continue to be served by the private drainage.
- It is anticipated that the proposed surface water drainage will mimic the existing private drainage by collecting and conveying the surface water runoff from the proposed development from south to north, where it will be restricted via a vortex flow control chamber, prior to discharging into the existing private surface water drainage network to the north of the proposed building extension.
- As the surface water discharge is to be restricted, the surface water runoff will surcharge the proposed drainage network. Due to a lack of available open space it is envisaged that the required attenuation storage will be provided in the form of a below ground cellular attenuation tank, which is to be located below the hardstanding area and North Road, to the east of the proposed building extension.

- Due to the lack of available above ground storage areas and the critical nature of the required access to the extension building, the proposed drainage network and below ground cellular attenuation tank should be suitably sized to prevent any flooding for all rainfall events up to and including the 1 in 100 year return period plus 40% climate change design storm.
- To achieve this a preliminary storage estimate has been completed. Using a total post development area of 0.209ha at the restricted discharge rate of 16.0 L/s, for the 1 in 100 year + 40% return period design storm, a storage volume of 49.3m³ is required to prevent any flooding for all rainfall events up to and including the 1 in 100 year return period plus 40% climate change design storm.
- The surface water drainage strategy and SuDS solutions are all subject to detailed drainage design and LLFA approvals. It is also subject to change, dependent upon the final site layout and levels. The surface water drainage proposals and discharge rates should be confirmed via detailed discussions with the Lead Local Flood Authority prior to the commencement of any works.
- It is anticipated that the foul water from all areas will discharge at an unrestricted rate into the surrounding private foul water sewers. As such, it is anticipated that the foul water from the proposed building extension will discharge at unrestricted rates into the existing private foul water sewers or any proposed diversions, at the nearest possible connection point.
- The foul water drainage strategy is also subject to change and is dependent upon detailed drainage design and LLFA approvals, in addition to the finalised site layout and levels. The foul water drainage strategy and unrestricted discharge rates should also be confirmed via detailed discussions with the Lead Local Flood Authority prior to the commencement of any works.
- Manchester City Council (Lead Local Flood Authority) have been contacted regarding the maximum surface water discharge rate from the proposed development and they have indicated that a 50% betterment on the existing brownfield discharge rate would be acceptable. As the drainage proposals do not discharge to or affect any United Utilities assets, it is envisaged that no discussions with United Utilities is required. Detailed discussions must be undertaken with the LLFA to confirm their acceptance of the proposed drainage strategy.

Appendix A Site Location Plan

