



Christie TIF Wards, Manchester

DRAINAGE STRATEGY REPORT



27th January 2023

Christie TIF Wards, Manchester

Drainage Strategy Report

CHRCW-AJP-VV-XX-RP-C-3010

AJP Ref: 222-164

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Christie TIF Wards, Manchester

Drainage Strategy Report

The Christie NHS Foundation Trust - Christie TIF Wards, Manchester



	Originator:	Approved:	Date:
Record of Approval	J.Rogers Graduate Civil Engineer	J.Speers Associate	14/12/2022
Version	Author:	Change Description:	
P01	J.Rogers	Original Issue	14/12/2022
P02	J.Rogers	Updated To Suit Site Changes	27/01/2023

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Alan Johnston Partnership Ltd.

Company No. 13204766

Christie TIF Wards, Manchester

Drainage Strategy Report

1.0 INTRODUCTION

This drainage strategy report has been prepared on behalf of The Christie NHS Foundation Trust in connection with a planning application for the construction of a small building extension and internal refurbishment of the existing Oak Road Treatment Centre at The Christies, Manchester.

The 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 752:2017 (Drain and sewer systems outside buildings), Sewers for Adoption, Building Regulations Approved Document H (Drainage and waste disposal), the Planning Practice Guidance and the National Planning Policy Framework document (Department for Communities and Local Government, March 2014).

The site is located within Flood Zone 1, with a total site area under 1.0ha. Therefore, in accordance with DEFRA guidance, a Flood Risk Assessment (FRA) is not required.



2.0 SITE DESCRIPTION

The site is situated on the existing Oak Road Treatment Centre and is located at National Grid reference SJ 84877 94431. The site location 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 0.126ha with the proposed development area covering the entire site. The site currently comprises of the existing active Oak Road Treatment Centre buildings and the site cabins associated with the ongoing adjacent development, to the east of site.

The site generally falls from north east to south west, with levels falling from approximately 34.60mAOD in the north-east of the site to approximately 34.20mAOD in the south of the site. An aerial photo is included in Appendix B to illustrate the site at the present day and the existing topography is indicated on the drainage record information attached in Appendix C.

3.0 PROPOSED DEVELOPMENT

The entire site covers a total area of 0.126ha, with the proposed internal refurbishment area covering a total area of 0.077ha and the remaining 0.049ha of area covering the proposed small extension to the existing building and the associated external works.

It is envisaged that as the 0.077ha area is an internal refurbishment area, it will continue to drain as per the existing scenario and therefore only the remaining 0.049ha area will require a new drainage networks.

To enable a viable scheme, the proposed site levels are constrained by the existing hospital buildings and access roads surrounding the site. Therefore, site levels are likely to remain similar to the existing. The proposed site plan indicating the proposed building extension is attached in Appendix D.



4.0 ASSESSMENT OF FLOOD RISK

Even though a Flood Risk Assessment is not required under the Planning Practice Guidance and National Planning Policy Framework, a small site-specific flood risk assessment has been completed below.

4.1 Flooding from Rivers

The Flood Risk map is included as Appendix E. As can be seen from the Flood Risk map, all three sites are located within Flood Zone 1 and therefore, the sites are all located in Flood Zone 1 with a chance of flooding of less than 0.1% (or 1 in 1000).

The nearest watercourse is the River Mersey, which is located approximately 1.60km south-west of the site. As such, the risk of flooding to the new development from rivers is considered to be low.

4.2 Flooding from the Sea

The sites are not at risk of flooding from the sea. The lowest level across all three sites is approximately 34.20mAOD, i.e. well above tidal flood levels.

4.3 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 site is classified as having a very low risk of surface water flooding, with Oak Road to the south of the site having a low risk of surface water flooding. Therefore, the risk of flooding from overland flows due to surface water flooding is considered to be low.

4.4 Flooding from Groundwater

An intrusive site Investigation is yet to be undertaken but an intrusive site investigation report by CCG, report ref: CCG-C-18-10614, dated April 2019 has been completed for the adjacent development to the east. Numerous boreholes were completed as part of this site investigation and it indicates that there were no groundwater strikes during any of the boreholes. Therefore, indicating that the groundwater is located at depth.

Due to the close proximity of the adjacent site to the east, it is assumed that the proposed development will be similar. Therefore, it is envisaged that the groundwater level for the proposed development site will be similar.

As such, it is envisaged that the proposed site has a low risk of flooding from groundwater but this should be confirmed via an intrusive site investigation.

4.5 Flooding from Sewers

A record of public sewers surrounding and serving the development site is included in Appendix F. As can be seen from the public sewer map the only nearby public combined water sewers, which are located in Oak Road to the south of the site and Wilmslow Road to the east of the site. These include a 300mm diameter public combined water sewer running east to west along Oak Road and a 450mm diameter public combined water sewer running north to south along Wilmslow Road.

The site also contains a series of private surface, foul and combined water sewers which are assumed to discharge into the aforementioned public combined water sewers, located within the highways to the south and east of the site.

Therefore, as the proposed drainage networks for the proposed site will be suitably designed and the fact that the surrounding public sewers are all located within the surrounding highways and are maintained by United Utilities, leads to the conclusion that the site itself is considered to have a low risk of flooding from sewers.

4.6 Flooding from Reservoirs, Canals and Other Artificial Sources

The Reservoir Flood Risk map is included in Appendix E. It can be seen from the map that the site is not at risk of flooding from reservoirs. The closest open waterbody is Chorlton Water Park which is located approximately 4.50km west of the site and the nearest reservoir is Gorton Lower Reservoir which is located approximately 5.70km north-east of the site.

Therefore, the site is considered to be at low risk of flooding from reservoirs, canals and other artificial sources.

5.0 PROPOSED DEVELOPMENT

5.1 Effect of Proposed Development

As previously outlined in section 2.0, the existing site covers a total area of 0.126ha but the 0.077ha internal refurbishment areas are to remain as per the existing scenario and have therefore not been included within the pre and post development impermeable area calculations.

As such, only the remaining 0.049ha area has been incorporated within the pre and post development impermeable area calculations.

The pre and post development impermeable areas for the 0.049ha development area have been assessed and are indicated on the attached drawing in Appendix G. The comparison between the pre and post development impermeable areas is also summarised below;

Total Development Area (ha)	Pre-Development Impermeable Area (ha)	Post Development Impermeable Area (ha)
0.049	0.049	0.049

Given that there is no change to the total impermeable area, the proposed development will have no change to 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 5.3 should ensure that there is no increase in offsite flood risk that would otherwise impact downstream areas.

5.2 Existing Drainage Systems

As can be seen from the Public Sewer Map, attached in Appendix F, there are no public sewers located within the proposed site. As can be seen from the public sewer map the only nearby public combined water sewers, which are located in Oak Road to the south of the site and Wilmslow Road to the east of the site. These include a 300mm diameter public combined water sewer running east to west along Oak Road and a 450mm diameter public combined water sewer running north to south along Wilmslow Road.

As well as public sewers there are also a number of existing private sewers located within and surrounding the proposed site area. The drainage record information attached in Appendix C, indicates the extent of the existing private drainage within and surrounding the proposed site.

As can be seen from the drainage record information attached in Appendix C, there is an existing private surface water network located to the west of the proposed site and this discharges into an existing private combined water network, within the site boundary. The existing private combined water network then travels west to east through the site, where it is assumed to continue east prior to discharging into the 450mm diameter public combined water sewer running north to south along Wilmslow Road.

Current layout plans indicate that the existing private combined water sewer which runs west to east through the site can be maintained and as such no diversion of the existing private drain is required. However, this should be confirmed via a detailed proposed site plan and also CCTV surveys to identify the exact location and details of the existing private drainage within and surrounding the proposed site.

As all of the public sewers are located outside of the site and are not being affected by the proposed works, it is envisaged that no public sewer diversions or reduced easement agreements will be required with United Utilities.

As outlined above, a CCTV survey should be undertaken to determine the exact location and details of the existing private drainage, both within and surrounding the proposed site. Once received, the possibility of utilising the existing private combined water drainage as an outfall for the proposed development drainage should be confirmed. CCTV surveys should also confirm the extents, condition and levels of the existing private drainage.

5.3 Proposed Drainage Strategy

As outlined above in Section 5.1, site-wide drainage systems are required 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.

5.3.1 Surface Water Drainage

The Planning Policy Guidance and the CIRIA SuDS Manual detail that surface water runoff from a development should be disposed of as high up the following hierarchy as reasonably practicable:

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

Considering the hierarchy above, the surface water network for the 0.049ha developed area of the site should infiltrate where possible. As indicated in Section 4.4, an intrusive site investigation is yet to be undertaken but an intrusive site investigation report by CCG, report ref: CCG-C-18-10614, dated April 2019 has been completed for the adjacent development to the east.

This report includes falling head tests which indicate that the infiltration rate was around 7.45×10^{-8} m/s and therefore is not a viable infiltration rate. This coupled with the Building

Regulations Part-H restrictions indicating that soakaways should not be located within 5m of a building or highway, results in the conclusion that infiltration will not be suitable for the proposed development.

As the possibility of infiltration has been ruled out, the intention for the development would be to discharge to watercourse/surface water body. As indicated in Section 4.1, the nearest watercourse is the River Mersey which is located 1.60km south-west of the site. Given the distance across various plots of developed third party land, it has been deemed impractical to discharge to watercourse.

As such, the only practical solution for discharge of the surface water is to discharge to a public sewer. As indicated within Section 5.2, there is an existing private combined water sewer which runs west to east through the site, prior to discharging into the 450mm diameter public combined water sewer running north to south along Wilmslow Road. Therefore, due to the lack of nearby public surface water sewers, it is envisaged that this will be used as the proposed outfall for the development.

While every effort to use the 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 advice, issued by the Environment Agency, which updates previous climate change allowances outlined in the National Planning Policy Framework.

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.

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

As the existing site is a brownfield site, Manchester City Council will require the proposed water runoff to be restricted to at least a 50% betterment over the existing rates.

Using a pre development area of 511m² as shown in Appendix G, an assessment of the existing surface water run-off from the brownfield site has been completed using the ICP SuDS method within Micro Drainage. For the existing 0.051ha site, the existing brownfield run-off rates were calculated. The brownfield runoff assessment is attached in Appendix H and the results are summarised within the table below.

Rainfall Return Period (years)	Existing Brownfield Runoff Rate (L/s)	Proposed Maximum Discharge Rate (L/s)
1 Year	5.3	2.7
2 Year (Qbar)	6.9	3.5
30 Year	11.9	6.0
100 Year	18.2	9.1

The proposed maximum runoff rates after applying 50% betterment, as per the Lead Local Flood Authority's requirements, are also outlined within the table above. However, as can be seen the 2 year (Qbar) proposed maximum discharge rate is 3.5 L/s and therefore it is envisaged that the minimum discharge restriction of 5.0 L/s will be applied.

The 5.0 L/s discharge restriction is generally accepted as the minimum discharge rate to avoid the need for very small orifices, which due to their minimal size are prone to blockage. The 5.0 L/s discharge rate is in compliance with the Environment Agency document; 'Rainfall runoff management for developers', Report SC030219.

This is further supported by United Utilities, as the guidance notes within the United Utilities Section 104 adoption agreement states that for any flow control device, "*The minimum acceptable orifice size is 100mm.*" and to achieve this minimum orifice diameter a maximum discharge rate of 5.0 L/s is required.

Using a total post development impermeable area of 0.049ha at the restricted discharge rate of 5.0 L/s, for the 1 in 100 year + 40% return period design storm, a storage volume of 10m³ is required. The preliminary attenuation storage estimate is attached in Appendix I.

As seen in from the Outline Drainage Strategy Drawing attached in Appendix J, it is anticipated that the attenuation storage will be provided in the form of a cellular attenuation tank and the surface water drainage network itself with a vortex flow control device used to restrict the discharge rate to the required brownfield runoff rates indicated above.

The surface water drainage strategy and discharge rate should be confirmed via more detailed discussions with Manchester City Council prior to the commencement of any works.

5.3.2 SuDS Summary

As outlined below, all other SuDS techniques have been considered for this development;

SuDS Technique	Suitable for This Development?	Reasoning
Green Roof	✗	Not suitable due to minimal roof area available due to plant and equipment on roof.
Rainwater Harvesting	✗	Impractical due to lack of demand for greywater.
Basins & Ponds	✗	Unsuitable due to lack of available space.
Filter Strips & Swales	✗	Unsuitable due to lack of available space.
Bio-retention Areas	✗	Unsuitable due to lack of available space.
Infiltration Techniques	✗	Unsuitable due existing impermeable strata.
Permeable Surfaces	✗	Unsuitable due to minimal available areas available and existing impermeable strata.
Tanked/Piped Systems	✓	Suitable and incorporated.

Green roof areas have been considered but due to the minimal roof area available due to the size of the building and need for plant and equipment on the roof, the use of a green roof has been discounted. Rainwater harvesting was also considered but due to a lack of greywater demand it has been deemed as impractical to include a rainwater harvesting system.

Due to the lack of available space across the site and the fact that the site is located within an existing hospital building, the use of detention basins and/or ponds has also been discounted. Filter drains/strips, swales and bio-retention areas have also been deemed as impractical due to the lack of available space within the site.

As previously discussed in Section 5.3.1 infiltration is deemed as not feasible across the site and therefore the use of infiltration SuDS techniques is not possible. Non-infiltration (tanked) permeable surfaces such as permeable paving have also been considered but due to the lack of available areas this has also been discounted.

Finally, the use of oversized pipe networks may be required but it is envisaged that the use of the below ground attenuation tank will be required to store the surcharged surface water runoff from the site.

The use of specific SuDS techniques across the site will be confirmed during the later stages of the design process but where possible, the above SuDS summary should be adhered to as close as reasonably possible.

5.3.4 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)
- ◆ National Planning Policy Framework document (Department for Communities and Local Government, March 2012).
- ◆ Planning Practice Guidance
- ◆ 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 2015).

As can be seen from the Outline Drainage Strategy Drawing attached in Appendix J, the proposed foul water drainage will collect the runoff from the new proposed building extension and convey the foul water to the east of the proposed site.

Here the foul water runoff will discharge via gravity into the existing private combined water sewer manhole. It is anticipated that the foul water can discharge into the existing private sewer at unrestricted rates.

Further CCTV surveys should be undertaken to determine the exact location and details of the existing private drainage, both within and surrounding the proposed site. Once received, the possibility of utilising the existing private combined water drainage as an outfall for the proposed development drainage should be confirmed.

The foul water drainage strategy and unrestricted discharge rate should be confirmed via more detailed discussions with Manchester City Council prior to the commencement of any works.

6.0 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 restricted using a vortex flow control device and the attenuated run-off is stored using a below ground cellular attenuation tank.

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

- ◆ 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 The Christie NHS Foundation Trust or an on-site facilities management team and therefore a copy of the final construction drainage layout should be provided in the final Operations and Maintenance Manual.

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.

6.1 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.

6.2 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 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.

6.3 Pipes

Regular inspection and maintenance are 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.

6.4 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.

6.5 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 rodding 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.

6.6 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.

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.

7.0 CONCLUSIONS

- ◆ The site is located within Flood Zone 1 with a low probability of flooding from all sources.
- ◆ An intrusive site investigation is yet to be undertaken but an intrusive site investigation report by CCG, report ref: CCG-C-18-10614, dated April 2019 has been completed for the adjacent development to the east. This report includes falling head tests which indicate that infiltration is not feasible. This coupled with the Building Regulations Part-H restrictions indicating that soakaways should not be located within 5m of a building or highway, results in the conclusion that infiltration will not be suitable for the proposed development.
- ◆ Due to the distance across developed third-party land, discharging the surface water from the site to the nearest watercourse has been deemed as impractical. This and the lack of public surface water sewers within and surrounding the proposed site results in the only practical option for the disposal of the surface water runoff from the proposed development is to discharge into the private combined water sewers within the site boundary.
- ◆ The surface water discharge is to be restricted a 50% betterment on the existing brownfield runoff rates, for all rainfall events up to and including the 100 year plus 40% climate change design storm, to comply with LLFA requirements. The proposed surface water drainage design meets this criteria and also ensures there is no flooding for all rainfall events up to and including the 100 year plus 40% climate change design storm.
- ◆ The runoff is to be restricted using a vortex flow control device and the surcharged runoff attenuated using the proposed surface water drainage network itself and a below ground cellular attenuation tank located within the proposed hard landscaping area.
- ◆ The foul water drainage is to discharge into the existing private combined water manhole to the east of site, via gravity. It is anticipated that the foul water can discharge into the private sewer at unrestricted rates.
- ◆ The external ground levels around proposed buildings shall fall away from the proposed building with any new levels being designed to ensure any overland flood routes, for events in excess of the 100 Year + 40% CC, exit towards the surrounding highways, for use in exceptional circumstances.



8.0 RECOMMENDATIONS

- ◆ A detailed proposed site plan and also CCTV surveys should be obtained to identify the exact location and details of the existing private drainage within and surrounding the proposed site. This will confirm if the existing private combined water sewer which runs west to east through the site can be maintained or if a diversion of the existing private drain is required.
- ◆ A CCTV survey should be undertaken to determine the exact location and details of the existing private drainage, both within and surrounding the proposed site. Once received, the possibility of utilising the existing private combined water drainage as an outfall for the proposed development drainage should be confirmed. CCTV surveys should also confirm the extents, condition and levels of the existing private drainage.
- ◆ An intrusive site investigation should be undertaken to confirm the underlying strata and its permeability. The site investigation should also identify the existing groundwater table and any other anomalies below the proposed site.
- ◆ The surface water drainage strategy and discharge rates should be confirmed via more detailed discussions with Manchester City Council and United Utilities prior to the commencement of any works.
- ◆ The foul water drainage strategy and unrestricted discharge rate should be confirmed via more detailed discussions with Manchester City Council and United Utilities prior to the commencement of any works.
- ◆ The use of specific SuDS techniques across the site should be determined during the detailed design process but where possible, the SuDS summary should be adhered to as close as reasonably possible with SuDS techniques incorporated, where possible, across the site.

Appendix A – Site Location Plan



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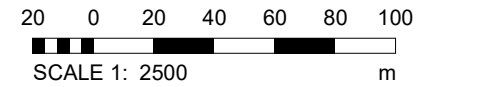
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NOTES:

- Application Boundary (Approx. 1266m²)
- Site Boundary / Client Ownership

P02	CLS	Red line boundary updated to include upper floors	07/12/22
P01	MJC	First Issue	04/11/22
Rev	By	Description	Date



The Cruck Barn, Duxbury Park, Chorley, Lancashire, PR7 4AT
t: 01257 260070 f: 01257 260071

Client Name:
The Christie NHS Foundation Trust

Site Name:
The Christie, Wilmslow Road, Manchester

Project Name:
TIF Wards

Drawing Title:
Site Location Plan

Project No: 8283-002	Sheet Size: A3	Scale: 1 : 2500	
Drawn by: SK	Checked by: CLS	Approved by: NW	Revision: P02
Suitability: Issued for Planning			Status: S4

Drawing Number:
Project Code / Orig / Vol / Level / Type / Disc / System-Number
CHRCW-GDA-V4-S1-DR-A-9901

Appendix B – Aerial Photo



Appendix C – Existing Drainage Information with Topo

Appendix D – Proposed Site Plan



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P02	AS	GA's Updated to Option 2 Lift and Stair arrangement	02/12/22
P01	CLS	First Issue - For Information Only	24.10.22
Rev	By	Description	Date


The Cruck Barn, Duxbury Park, Chorley, Lancashire. PR7 4AT
t: 01257 260070 f: 01257 260071

Client Name:
The Christie NHS Foundation Trust

Site Name:
The Christie, Wilmslow Road, Manchester

Project Name:
TIF Wards

Drawing Title:
Proposed Ground Floor GA Plan

Project No: 8283-002
Sheet Size: A2
Scale: 1 : 100

Drawn by: MJC
Checked by: CLS
Approved by: NW
Revision: P02

Suitability: Initial Stage WIP
Status: S0

Drawing Number:
Project Code / Orig / Vol / Level / Type / Disc / System-Number
CHRCW-GDA-V4-00-DR-A-1001

Appendix E – Flood Risk Maps

Flood map for planning

Your reference
222-164

Location (easting/northing)
384872/392409

Created
14 Dec 2022 14:19

Your selected location is in flood zone 1, an area with a low probability of flooding.

You will need to do a flood risk assessment if your site is **any of the following:**

- bigger than 1 hectare (ha)
- In an area with critical drainage problems as notified by the Environment Agency
- identified as being at increased flood risk in future by the local authority's strategic flood risk assessment
- at risk from other sources of flooding (such as surface water or reservoirs) and its development would increase the vulnerability of its use (such as constructing an office on an undeveloped site or converting a shop to a dwelling)

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

Flood risk data is covered by the Open Government Licence **which** sets out the terms and conditions for using government data. <https://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/>

Use of the address and mapping data is subject to Ordnance Survey public viewing terms under Crown copyright and database rights 2022 OS 100024198. <https://flood-map-for-planning.service.gov.uk/os-terms>



Flood map for planning

Your reference

222-164

Location (easting/northing)

384872/392409

Scale

1:2500

Created

14 Dec 2022 14:19

-  Selected area
-  Flood zone 3
-  Flood zone 2
-  Flood zone 1
-  Flood defence
-  Main river
-  Water storage area



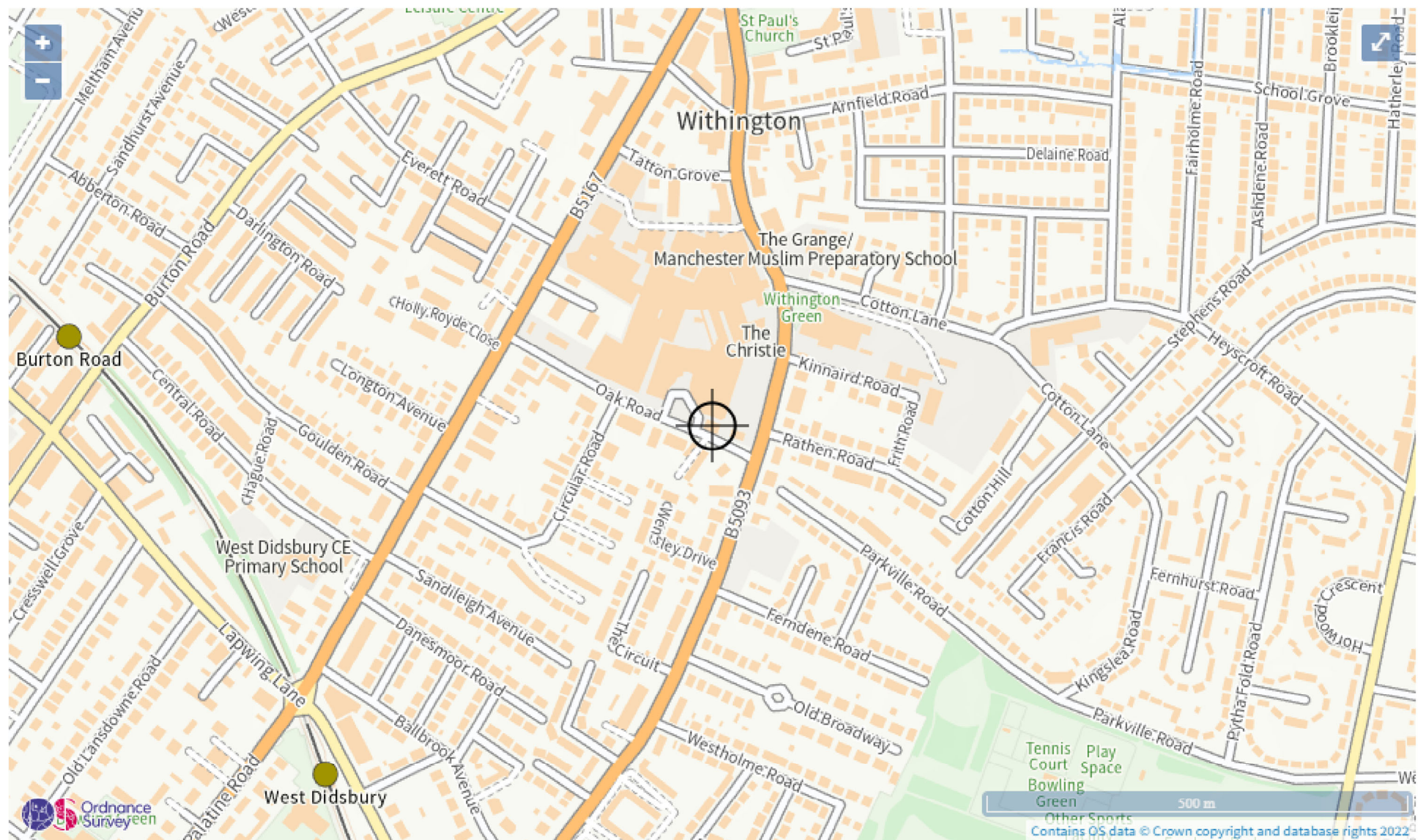
Flood risk

Extent of flooding



Location

Enter a place or postcode



Extent of flooding from rivers or the sea

High Medium Low Very low Location you selected

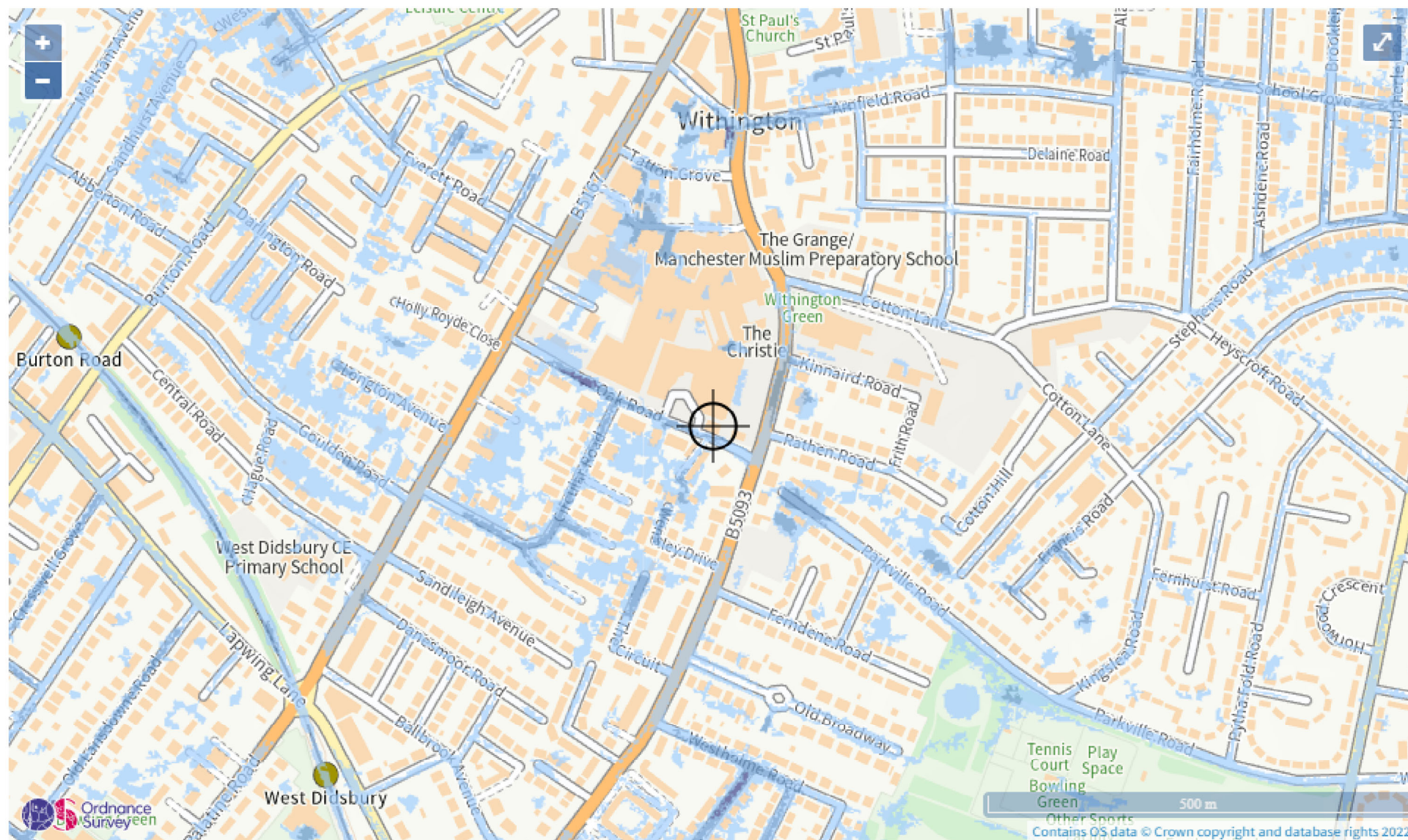
Flood risk

Extent of flooding



Location

Enter a place or postcode



Extent of flooding from surface water

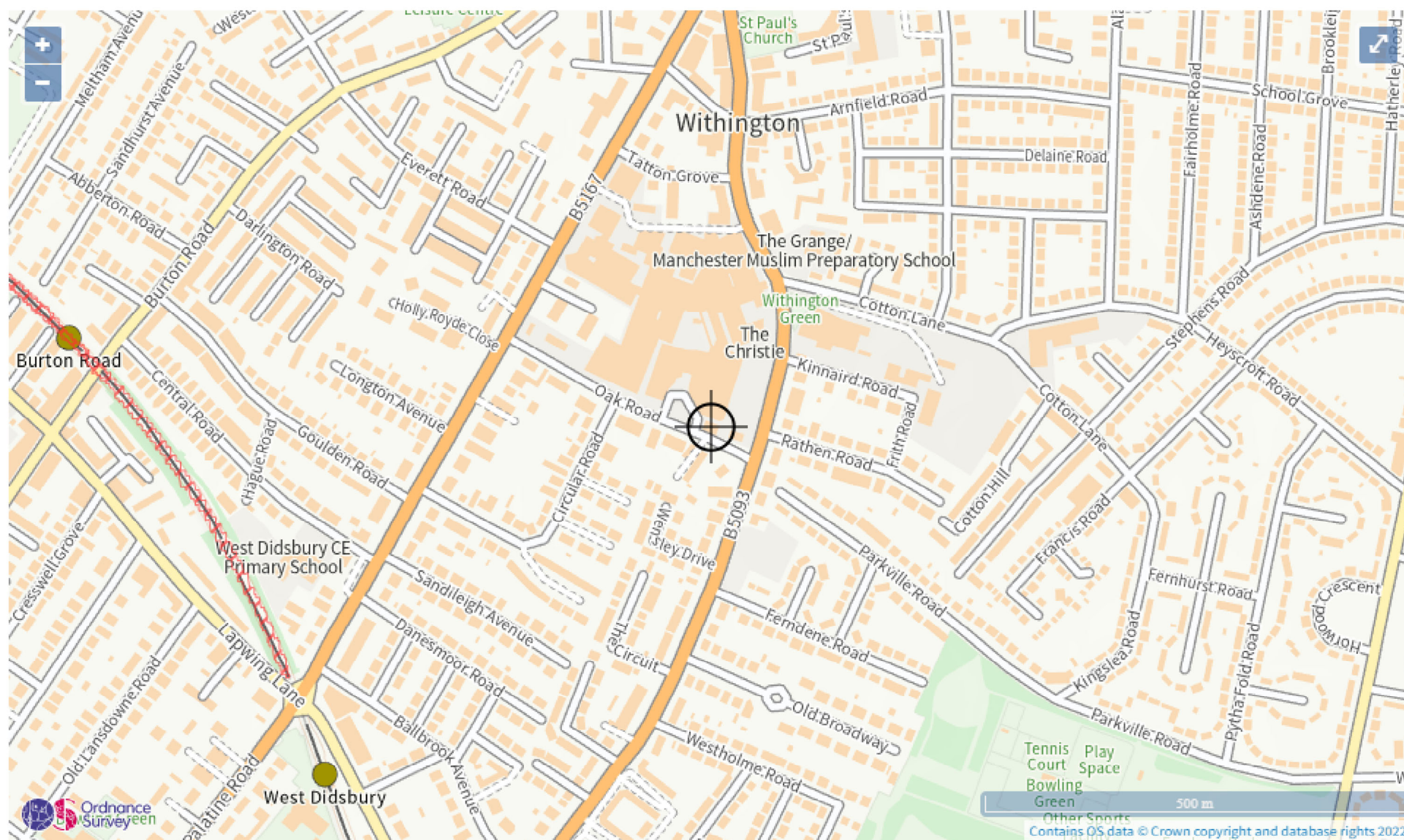
● High ● Medium ● Low ○ Very low ⊕ Location you selected

Flood risk

Extent of flooding

Location

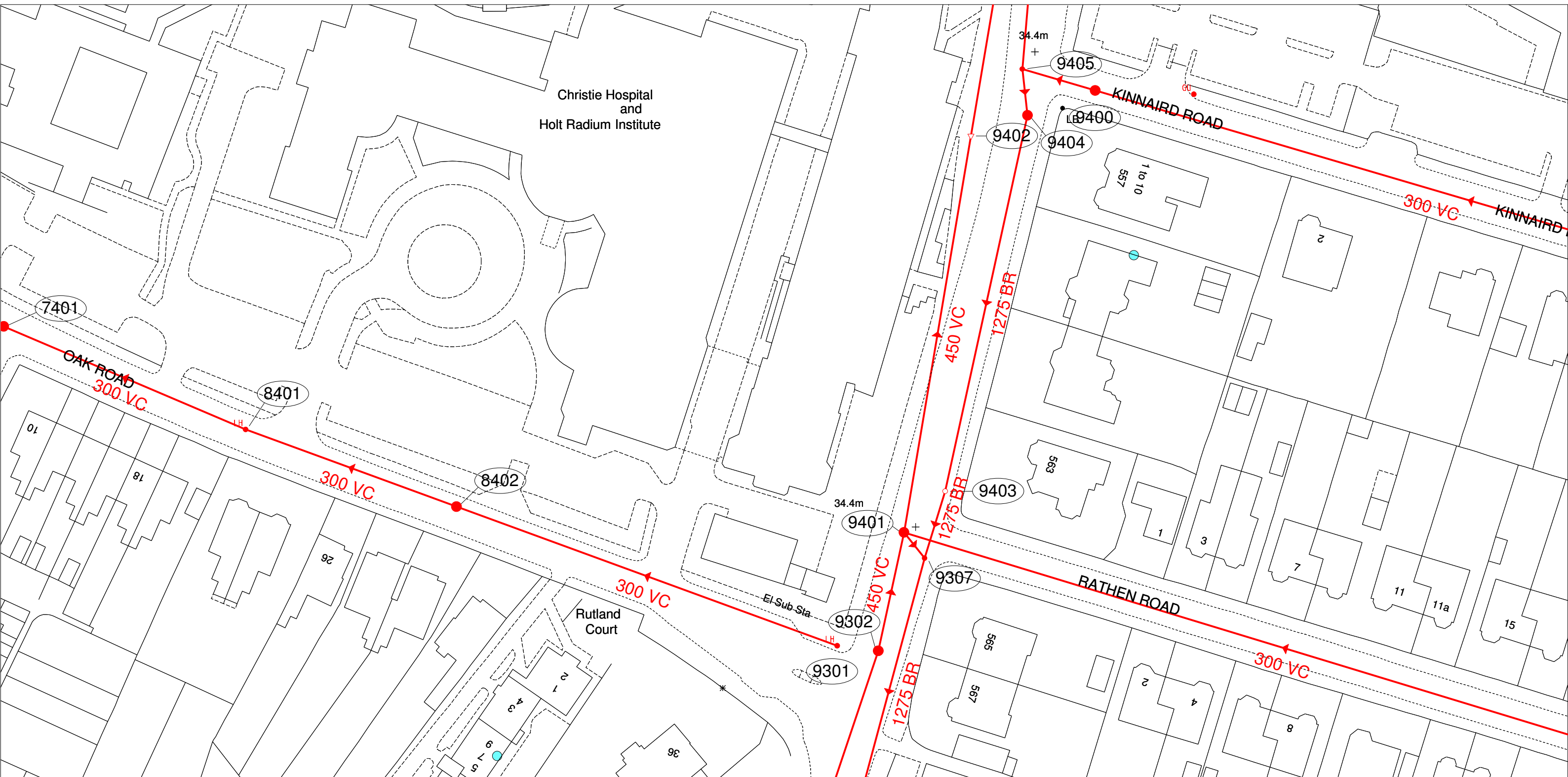
Enter a place or postcode



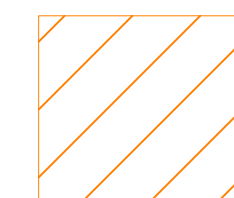
Maximum extent of flooding from reservoirs:

● when river levels are normal ● when there is also flooding from rivers ⊕ Location you selected

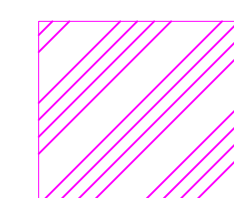
Appendix F –Public Sewer Map



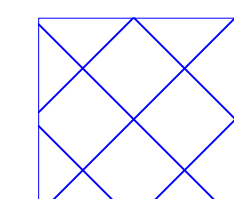
Appendix G – Pre & Post Development Impermeable Areas Drawing



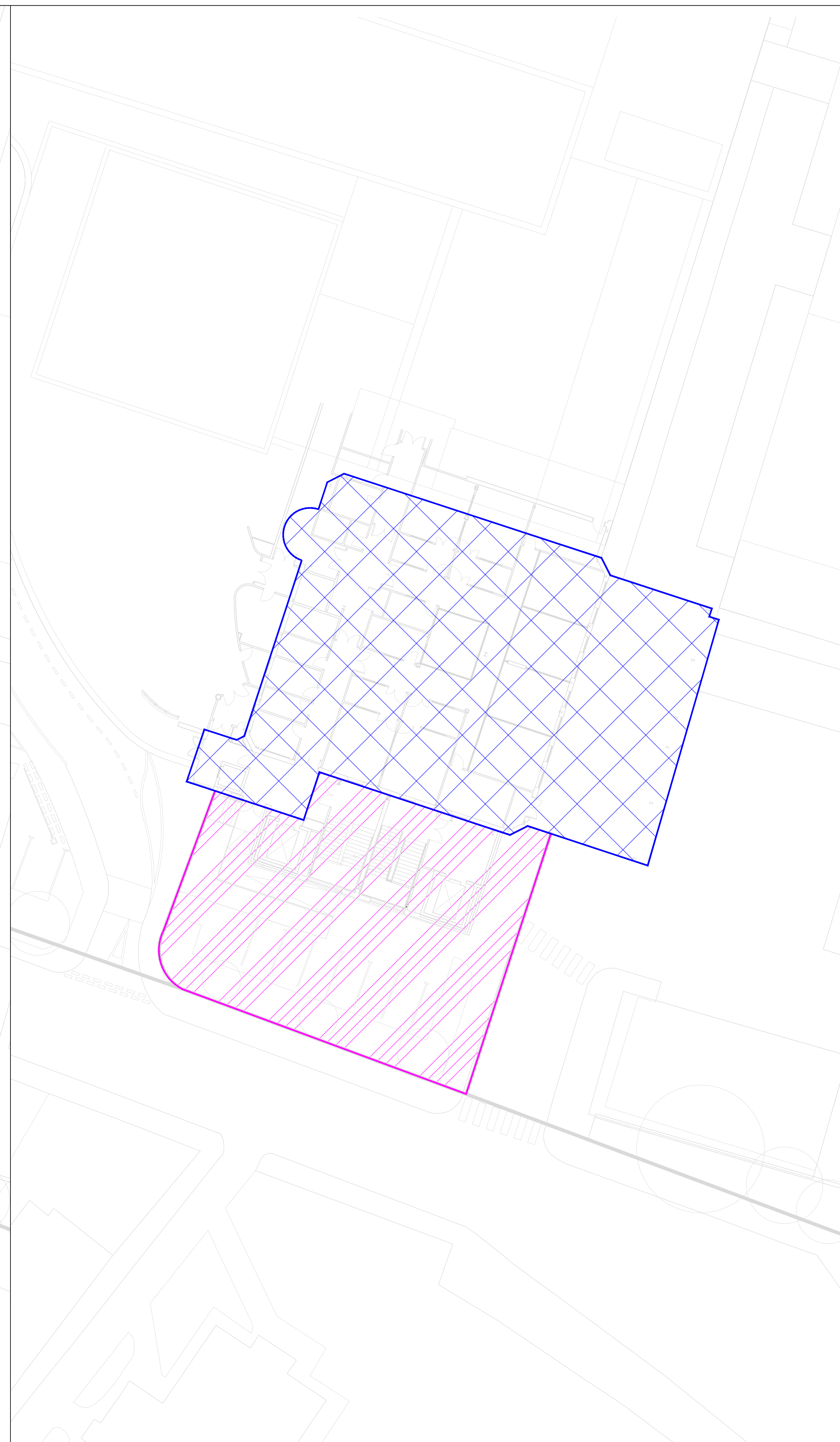
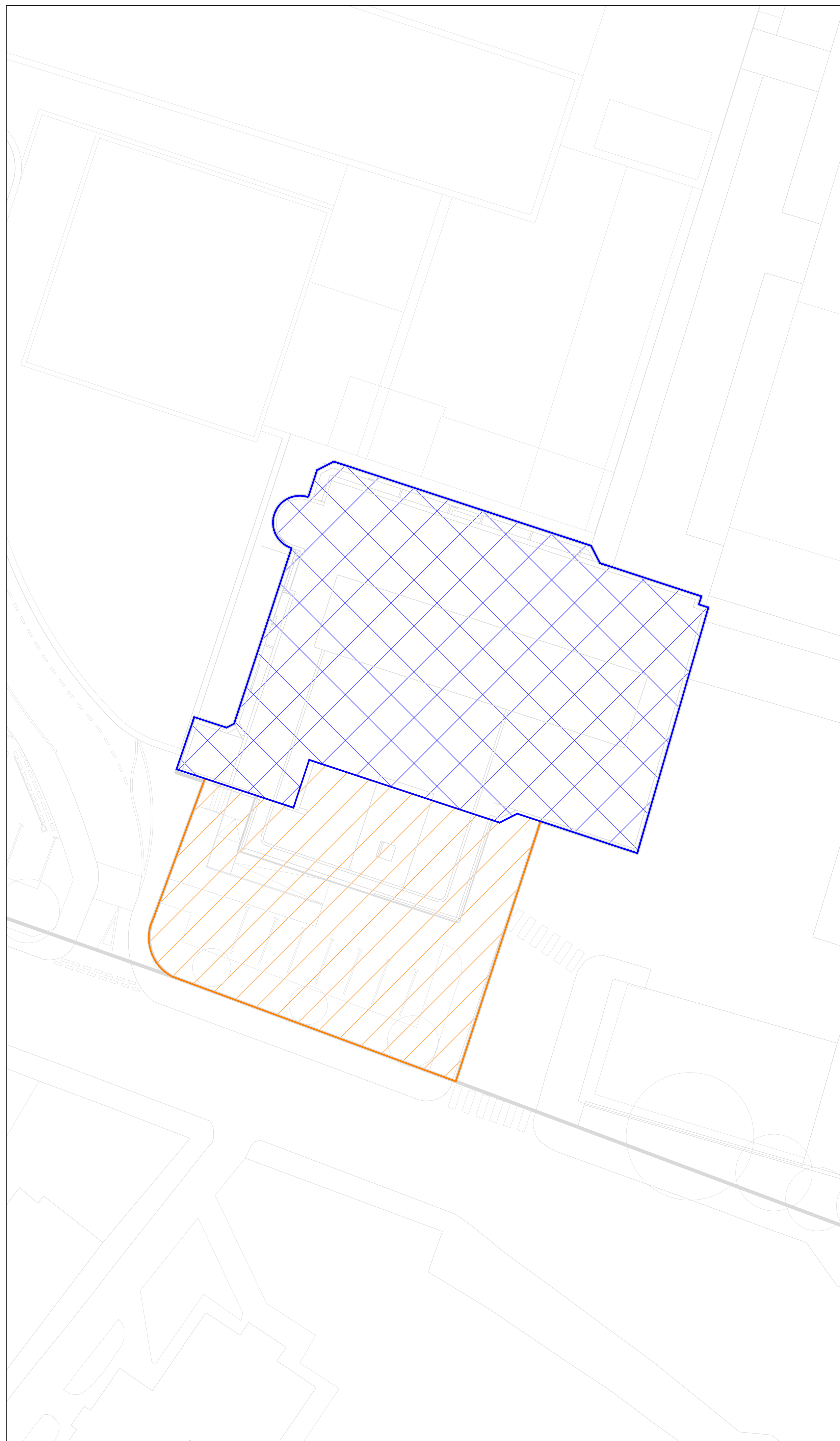
PRE DEVELOPMENT IMPERMEABLE AREAS = 493m²



POST DEVELOPMENT IMPERMEABLE
AREAS = 493m²



PROPOSED AREAS TO DRAIN AS PER
EXISTING SCENARIO = 773m²

[illegible]

DRAWING STATUS:

PRELIMINARY

CLIENT:

NHS INTEGRATED HEALTH PROJECTS

ARCHITECT:

GILLING DOD

PROJECT:

THE CHRISTIE HOSPITAL
TIF WARDS

TITLE:

BELOW GROUND DRAINAGE
PRE & POST DEVELOPMENT IMPERMEABLE AREAS

STATUS:	PROJECT No.	PROJECT	ORIGINATOR	VOL/SYS	LEVEL	TYPE	ROLE	DRAWING No.	REV:
S2	222-164	CHRCW-AJP-V4 - 00 - SK - C - 0001							P02

SCALE @ A1:	DESIGNED:	DRAWN:	CHECKED:	APPROVED:	DATE:
1:200	JJR	JJR	JRS	PB	DEC 2022

Appendix H – Existing Brownfield Runoff Calculations

The Alan Johnston Partnership		Page 1
1 Dale Street Liverpool L2 2ET	222-164 Christe TIF Brownfield Run Off Rates	
Date 27/01/2023 11:25 File BROWNFIELD RUN OFF RATES.MDX	Designed by JJR Checked by JRS	
XP Solutions	Network 2019.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.361	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	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	0.044	4-8	0.005

Total Area Contributing (ha) = 0.049

Total Pipe Volume (m³) = 0.118

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	5.000	0.100	50.0	0.017	5.00	0.0	0.600	o	100	Pipe/Conduit	
1.001	5.000	0.100	50.0	0.016	0.00	0.0	0.600	o	100	Pipe/Conduit	
1.002	5.000	0.100	50.0	0.016	0.00	0.0	0.600	o	100	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	5.08	33.000	0.017	0.0	0.0	0.0	1.09	8.6	2.3
1.001	50.00	5.15	32.900	0.033	0.0	0.0	0.0	1.09	8.6	4.5
1.002	50.00	5.23	32.800	0.049	0.0	0.0	0.0	1.09	8.6	6.6

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)
1.002		34.000	32.700	32.000	1200	0

The Alan Johnston Partnership		Page 2
1 Dale Street Liverpool L2 2ET	222-164 Christe TIF Brownfield Run Off Rates	
Date 27/01/2023 11:25 File BROWNFIELD RUN OFF RATES.MDX	Designed by JJR Checked by JRS	
XP Solutions	Network 2019.1	

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1
Number of Input Hydrographs	0	Number of Offline Controls	0
Number of Online Controls	0	Number of Storage Structures	0
		Number of Time/Area Diagrams	0
		Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Storm Duration (mins)	30
Ratio R	0.361		

The Alan Johnston Partnership		Page 3
1 Dale Street Liverpool L2 2ET	222-164 Christe TIF Brownfield Run Off Rates	
Date 27/01/2023 11:25 File BROWNFIELD RUN OFF RATES.MDX	Designed by JJR Checked by JRS	
XP Solutions	Network 2019.1	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.361 Cv (Winter) 0.840

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) 1, 2, 30, 100
 Climate Change (%) 0, 0, 0, 40

									Water	Surcharged	Flooded	
	US/MH			Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level	Depth	Volume
PN	Name	Storm		Period	Change	Surcharge	Flood	Overflow	Act.	(m)	(m)	(m³)
1.000	SW01	15	Winter		1	+0%	30/15	Summer		33.036	-0.064	0.000
1.001	SW02	15	Winter		1	+0%	30/15	Summer		32.950	-0.050	0.000
1.002	SW03	15	Winter		1	+0%	30/15	Summer		32.863	-0.037	0.000

The Alan Johnston Partnership		Page 4
1 Dale Street Liverpool L2 2ET	222-164 Christe TIF Brownfield Run Off Rates	
Date 27/01/2023 11:25 File BROWNFIELD RUN OFF RATES.MDX	Designed by JJR Checked by JRS	
XP Solutions	Network 2019.1	

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 Coefficient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
 Foul Sewage per hectare (l/s) 0.000

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.361 Cv (Winter) 0.840

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) 1, 2, 30, 100
 Climate Change (%) 0, 0, 0, 40

									Water	Surcharged	Flooded
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)	Depth (m)	Volume (m³)
1.000	SW01	15 Winter	2	+0%	30/15	Summer			33.041	-0.059	0.000
1.001	SW02	15 Winter	2	+0%	30/15	Summer			32.959	-0.041	0.000
1.002	SW03	15 Winter	2	+0%	30/15	Summer			32.875	-0.025	0.000

			Pipe				
PN	US/MH Name	Cap.	Flow / Overflow (l/s)	Flow (l/s)	Status	Level Exceeded	
1.000	SW01	0.35		2.6	OK		
1.001	SW02	0.63		4.8	OK		
1.002	SW03	0.92		6.9	OK		

The Alan Johnston Partnership		Page 5
1 Dale Street Liverpool L2 2ET	222-164 Christe TIF Brownfield Run Off Rates	
Date 27/01/2023 11:25 File BROWNFIELD RUN OFF RATES.MDX	Designed by JJR Checked by JRS	
XP Solutions	Network 2019.1	

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 Coefficient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
 Foul Sewage per hectare (l/s) 0.000

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.361 Cv (Winter) 0.840

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) 1, 2, 30, 100
 Climate Change (%) 0, 0, 0, 40

									Water	Surcharged	Flooded
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)	Depth (m)	Volume (m³)
1.000	SW01	15 Winter	30	+0%	30/15	Summer			33.201	0.101	0.000
1.001	SW02	15 Winter	30	+0%	30/15	Summer			33.169	0.169	0.000
1.002	SW03	15 Winter	30	+0%	30/15	Summer			33.053	0.153	0.000

			Pipe				
PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Flow (l/s)	Status	Level Exceeded	
1.000	SW01	0.59		4.4	SURCHARGED		
1.001	SW02	1.08		8.1	SURCHARGED		
1.002	SW03	1.58		11.9	SURCHARGED		

The Alan Johnston Partnership		Page 6
1 Dale Street Liverpool L2 2ET	222-164 Christe TIF Brownfield Run Off Rates	
Date 27/01/2023 11:25 File BROWNFIELD RUN OFF RATES.MDX	Designed by JJR Checked by JRS	
XP Solutions	Network 2019.1	

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 Coefficient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
 Foul Sewage per hectare (l/s) 0.000

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.361 Cv (Winter) 0.840

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) 1, 2, 30, 100
 Climate Change (%) 0, 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	SW01	15 Winter	100	+40%	30/15	Summer			33.741	0.641	0.000
1.001	SW02	15 Winter	100	+40%	30/15	Summer			33.655	0.655	0.000
1.002	SW03	15 Winter	100	+40%	30/15	Summer			33.395	0.495	0.000

				Pipe		
	US/MH	Flow /	Overflow	Flow		Level
PN	Name	Cap.	(1/s)	(1/s)	Status	Exceeded
1.000	SW01	0.93		7.0	FLOOD RISK	
1.001	SW02	1.66		12.4	SURCHARGED	
1.002	SW03	2.43		18.2	SURCHARGED	

Appendix I – Preliminary Storage Estimate Calculations

The Alan Johnston Partnership		Page 1
1 Dale Street Liverpool L2 2ET	222.164 Christie TIF Prelim Storage 5.0 L/s	
Date 27/01/2023 11:27	Designed by JJR	
File PRELIM STORAGE CALCS 5.0LS.SRCX	Checked by JRS	
XP Solutions	Source Control 2019.1	

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

Half Drain Time : 16 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	32.714	0.714	0.0	5.0	5.0	6.5	O K
30 min Summer	32.885	0.885	0.0	5.0	5.0	8.1	O K
60 min Summer	32.881	0.881	0.0	5.0	5.0	8.0	O K
120 min Summer	32.715	0.715	0.0	5.0	5.0	6.5	O K
180 min Summer	32.511	0.511	0.0	5.0	5.0	4.7	O K
240 min Summer	32.359	0.359	0.0	5.0	5.0	3.3	O K
360 min Summer	32.192	0.192	0.0	4.7	4.7	1.7	O K
480 min Summer	32.126	0.126	0.0	4.2	4.2	1.1	O K
600 min Summer	32.106	0.106	0.0	3.6	3.6	1.0	O K
720 min Summer	32.094	0.094	0.0	3.2	3.2	0.9	O K
960 min Summer	32.079	0.079	0.0	2.6	2.6	0.7	O K
1440 min Summer	32.065	0.065	0.0	1.9	1.9	0.6	O K
2160 min Summer	32.054	0.054	0.0	1.4	1.4	0.5	O K
2880 min Summer	32.047	0.047	0.0	1.1	1.1	0.4	O K
4320 min Summer	32.040	0.040	0.0	0.8	0.8	0.4	O K
5760 min Summer	32.035	0.035	0.0	0.6	0.6	0.3	O K
7200 min Summer	32.032	0.032	0.0	0.5	0.5	0.3	O K
8640 min Summer	32.029	0.029	0.0	0.5	0.5	0.3	O K
10080 min Summer	32.028	0.028	0.0	0.4	0.4	0.3	O K
15 min Winter	32.844	0.844	0.0	5.0	5.0	7.7	O K
30 min Winter	33.227	1.227	0.0	5.0	5.0	9.3	O K
60 min Winter	32.999	0.999	0.0	5.0	5.0	9.1	O K
120 min Winter	32.715	0.715	0.0	5.0	5.0	6.5	O K
180 min Winter	32.399	0.399	0.0	5.0	5.0	3.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	118.958	0.0	10.9	21
30 min Summer	79.532	0.0	14.6	30
60 min Summer	50.812	0.0	18.7	48
120 min Summer	31.423	0.0	23.1	80
180 min Summer	23.415	0.0	25.8	110
240 min Summer	18.891	0.0	27.8	138
360 min Summer	13.837	0.0	30.5	194
480 min Summer	11.101	0.0	32.6	250
600 min Summer	9.350	0.0	34.4	310
720 min Summer	8.122	0.0	35.8	368
960 min Summer	6.498	0.0	38.2	490
1440 min Summer	4.738	0.0	41.8	728
2160 min Summer	3.447	0.0	45.6	1084
2880 min Summer	2.748	0.0	48.5	1444
4320 min Summer	1.992	0.0	52.7	2172
5760 min Summer	1.584	0.0	55.9	2848
7200 min Summer	1.325	0.0	58.4	3576
8640 min Summer	1.145	0.0	60.6	4352
10080 min Summer	1.012	0.0	62.5	4984
15 min Winter	118.958	0.0	12.2	21
30 min Winter	79.532	0.0	16.4	31
60 min Winter	50.812	0.0	20.9	50
120 min Winter	31.423	0.0	25.9	86
180 min Winter	23.415	0.0	28.9	114

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1 Dale Street Liverpool L2 2ET	222.164 Christie TIF Prelim Storage 5.0 L/s	
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XP Solutions	Source Control 2019.1	

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	32.227	0.227	0.0	4.8	4.8	2.1	O K
360 min Winter	32.116	0.116	0.0	3.9	3.9	1.1	O K
480 min Winter	32.094	0.094	0.0	3.2	3.2	0.9	O K
600 min Winter	32.082	0.082	0.0	2.7	2.7	0.7	O K
720 min Winter	32.074	0.074	0.0	2.4	2.4	0.7	O K
960 min Winter	32.064	0.064	0.0	1.9	1.9	0.6	O K
1440 min Winter	32.053	0.053	0.0	1.4	1.4	0.5	O K
2160 min Winter	32.045	0.045	0.0	1.0	1.0	0.4	O K
2880 min Winter	32.039	0.039	0.0	0.8	0.8	0.4	O K
4320 min Winter	32.033	0.033	0.0	0.6	0.6	0.3	O K
5760 min Winter	32.029	0.029	0.0	0.5	0.5	0.3	O K
7200 min Winter	32.027	0.027	0.0	0.4	0.4	0.2	O K
8640 min Winter	32.025	0.025	0.0	0.3	0.3	0.2	O K
10080 min Winter	32.023	0.023	0.0	0.3	0.3	0.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	18.891	0.0	31.1	140
360 min Winter	13.837	0.0	34.2	190
480 min Winter	11.101	0.0	36.5	248
600 min Winter	9.350	0.0	38.5	310
720 min Winter	8.122	0.0	40.1	368
960 min Winter	6.498	0.0	42.8	490
1440 min Winter	4.738	0.0	46.8	716
2160 min Winter	3.447	0.0	51.1	1088
2880 min Winter	2.748	0.0	54.3	1476
4320 min Winter	1.992	0.0	59.0	2164
5760 min Winter	1.584	0.0	62.6	2888
7200 min Winter	1.325	0.0	65.5	3568
8640 min Winter	1.145	0.0	67.9	4296
10080 min Winter	1.012	0.0	70.0	5232

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XP Solutions	Source Control 2019.1	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Shortest Storm (mins)	15
Ratio R	0.363	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.049

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To:	(ha)	From: To:	(ha)	From: To:	(ha)
0 4	0.017	4 8	0.016	8 12	0.016

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Model Details

Storage is Online Cover Level (m) 34.000

Cellular Storage Structure

Invert Level (m) 32.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	9.6	0.0	1.000	9.6	0.0	1.001	0.0	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0103-5000-1200-5000
Design Head (m) 1.200
Design Flow (l/s) 5.0
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 103
Invert Level (m) 32.000
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)	1.200	5.0	Kick-Flo®	0.745	4.0
Flush-Flo™	0.354	5.0	Mean Flow over Head Range	-	4.4

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

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

Appendix J – Outline Drainage Strategy Drawing

ALL PROPOSED DRAINAGE IS CURRENTLY
PRELIMINARY SUBJECT TO EXISTING
DRAINAGE SURVEYS AND DETAILED
DRAINAGE DESIGN BEING COMPLETED

