UNIVERSITY OF LIVERPOOL, CYPRESS BUILDING EXTENSION

07/12/2017

DRAINAGE STRATEGY REPORT

The Alan Johnston Partnership LLP

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Originator	Approved	Date
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1.0 INTRODUCTION

This drainage strategy report has been prepared on behalf of the University of Liverpool in connection with a planning application for the construction of a new extension to the existing University of Liverpool, Cypress Building. The old Cypress Building and its new extension will form the new University of Liverpool School of Law and Social Justice building. The proposed site is located to the west of Chatham Street, Liverpool.

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 752:2008 (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).

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 is not required.

2.0 SITE DESCRIPTION

The proposed development site is located to the west of Chatham Street, Liverpool at National Grid reference SJ 35961 89880. The location of the existing site is illustrated in Appendix A and the extent of the area to which the application relates is also shown on the aerial photo enclosed in Appendix B.

The proposed development site covers a total area of approximately 0.128ha and is currently a brownfield site. The existing site currently consists of the existing Cypress building with a greenfield area and impermeable walkways to the west. The site is bounded to the north, south and west by existing University of Liverpool buildings and to the west, is bounded by the existing highway, Chatham Street.

The existing ground levels around the existing building are fairly flat, with the levels varying from around 46.60mAOD to 46.80mAOD. The greenfield area to the west of the building has a small mound with levels rising to approximately 47.50mAOD.

An aerial photo is included in Appendix B to illustrate the site at the present day and the topographic survey is included in Appendix C.

3.0 PROPOSED DEVELOPMENT

The proposed development consists of the refurbished existing Cypress building and the new extension located to the west of the site. The refurbished Cypress building will have an extra storey added with the new extension being constructed to the same number of storeys as the refurbished Cypress building.

To enable a viable scheme, the proposed site levels are constrained by the existing Cypress building levels and the levels of the surrounding University of Liverpool buildings and highway. Therefore, site levels are likely to remain similar to the existing. A proposed site plan is attached in Appendix D.

4.0 ASSESSMENT OF FLOOD RISK

Even though a Flood Risk Assessment is not required under the Technical Guidance to the 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 in Appendix E.
It can be seen from the map that the site is located in Flood Zone 1 with a chance of flooding of less than 0.1% (or 1 in 1000).

The nearest designated main river is the River Mersey which is located approximately 2.0km west of the site. Therefore, the risk of flooding to the new development from rivers is considered to be low.

4.2 Flooding from the Sea

The site is not at risk of flooding from the sea. The lowest level of the site is approximately 46.60mAOD, i.e. well above tidal flood levels. This level is taken from an ordnance survey map and is therefore approximate.

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 only the greenfield area to the west of the existing building having a low to medium risk of surface water flooding. However, as indicated within the topographic survey, attached in Appendix C, this is likely to a result of runoff from the mound within the greenfield area creating a low point to the west of the building resulting in ponding in the lower level areas.

However, the existing mound and greenfield area are to be removed and replaced with the proposed building extension. Therefore, the area with a low to medium risk of surface water flooding will be mitigated by the proposed development, as any rainfall landing on the proposed new extension roof area will be positively drained.

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.

4.4 Flooding from Groundwater

A intrusive site investigation was completed by TerraConsult in November 2017 and the borehole logs indicated that no groundwater was encountered in any of the boreholes, up to a maximum recorded depth of 5.0mbgl. It is therefore envisaged that there is no shallow groundwater level in this area and as such there is a negligible risk of groundwater flooding.

Therefore, the site is considered to be at low risk of flooding from groundwater.

4.5 Flooding from Sewers

A record of Public Sewers surrounding and serving the development site has been obtained from United Utilities and this is included in Appendix F. As can be seen the only nearby existing public sewer is the 900mm x 550mm combined brick culvert located within the highway Chatham Street, to the east of the site.

As the proposed site is located at a higher level than the surrounding highways, the topography of the site means that should any flooding from sewers occur this should be contained within the existing highways and not encroach upon the proposed site.

The existing utility survey drawing attached in Appendix F indicates that there are a number of existing private sewers located within the site boundary. However, discussions with the client have indicated that there have been no historical flooding from the existing private sewers.

This coupled with the lack of existing public sewers within the site boundary and the fact that Figure 9 within the Liverpool City Council Strategic Flood Risk Assessment (SFRA) indicates that there is no recorded historical flooding from sewers within the site area, leads to the conclusion that the site is at a low risk of flooding from sewers.

Therefore, the site is considered to be at 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 the lake/pond located within Newsham Park, which is located approximately 2.7km north-west of the site, therefore the site is considered to be at low risk of flooding from reservoirs.

5.0 DEVELOPMENT AND DRAINAGE STRATEGY

5.1 Effect of Proposed Development

As previously outlined in Section 2.0, the existing site covers a total area of 0.128ha and is a brownfield site. However, as the externals of the existing Cypress building is to remain there would be no change in impermeable areas across the existing building. As such, the only area where the impermeable areas would increase would be the proposed extension area to the west of the existing building.

As the site on which the extension is to be constructed is currently greenfield, the construction of the new building extension will increase the impermeable area. Therefore, the changes to the existing greenfield site will increase the volume of impermeable areas and as such, the proposed development will lead to an 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, site-wide drainage systems are required 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 United Utilities map, attached in Appendix F, there are no existing public sewers crossing the proposed site. The only nearby existing public sewer is the 900mm x 550mm combined brick culvert located within the highway Chatham Street, to the east of the site. However, the existing utility survey drawing attached in Appendix F indicates that there are a number of existing private sewers located within the site boundary.

The existing private sewers consist of foul water, surface water and combined water drainage, all of which serves the surrounding buildings. As can be seen from the existing utility survey drawing attached in Appendix F, the main outfall sewer is an existing private 300mm diameter combined water sewer which collects the foul and surface water runoff from the surrounding buildings and the existing Cypress building. The sewer then conveys the flow from west to east, running under the existing Cypress building prior to discharging into the existing public 900mm x 550mm combined brick culvert, which is the located within the highway Chatham Street, to the east of the site.

A CCTV survey of the existing drainage systems has been completed and it confirms the arrangement of the existing drainage systems serving the current site is as per the United Utilities map and utilities survey drawing attached in Appendix F. The survey also confirms the levels of the existing drainage systems and also if the existing private 300mm diameter combined water sewer is suitable for re-use as an outfall pipeline.

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 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 site should infiltrate where possible. The TerraConsult Phase 1 & 2 Site Investigation Report, November 2017 indicates that the general strata consists of made ground to a maximum depth of 0.90mbgl, underlain by clayey, gravelly sand deposits to a maximum depth of 3.10mbgl.

The clayey, gravelly sand deposits are underlain by superficial deposits of cohesive glacial till to a maximum recorded depth of 5.00mbgl. The glacial till deposits are underlain by bedrock consisting of sandstone to a maximum recorded depth of 13.50mbgl. Therefore, due to the cohesive nature of the underlying glacial till strata, soakaways are unlikely to be successful.

Also, in compliance with Building Regulations Part-H no soakaways are to be located within 5m of any buildings and roads. Assessing the proposed site layout, the surrounding buildings and proposed development mean that it is unlikely that a soakaway of suitable size could be located between the buildings and still comply with this restriction.

Therefore, as a result of the underlying strata and Building Regulations restrictions, infiltration drainage is not considered to be a viable option for the discharge of surface water.

As the possibility of infiltration has been ruled out by the site investigation, the intention for the development would be to discharge to watercourse. The nearest watercourse is the River Mersey which is located approximately 2.0km west of the site.

Due to the distance across various plots of third party land and properties, discharging to watercourse has been deemed impractical. Therefore, the only practical solution for discharge of the surface water is discharge to public sewer.

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 (6th 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 30% increase in the peak rainfall intensity is applied to allow for the estimated worst case impacts of climate change. This is in accordance with Table 5 of the Technical Guidance to 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 (+30%) event, will be retained on-site in safe storage areas.

As there are no areas at risk of pollution, 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 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. As the external footprint of the existing Cypress building is to remain in-situ, it is proposed that the newly refurbished building will utilise the existing foul and surface water drainage outlets and as the external footprint is not changing, be subject to no discharge restrictions, as per the existing building.

It is therefore envisaged that the drainage from the proposed extension is to be treated separately to the drainage from the newly refurbished Cypress building and will therefore have its own separate drainage systems.

it is envisaged that United Utilities will accept a 5.0 L/s surface water discharge restriction from the proposed extension, as this is the maximum discharge restriction which can be imposed due to the small size of required orifice diameters for any discharge rate smaller than 5.0 L/s being prone to blockage. However, a pre-development enquiry should be completed with United Utilities to ensure they will accept the proposed drainage strategy and discharge rates.

It is also envisaged that as with United Utilities, Liverpool City Council (Lead Local Flood Authority) will accept a 5.0 L/s surface water discharge restriction from the proposed extension, as this is the maximum discharge restriction which can be imposed due to the small size of required orifice diameters for any discharge rate smaller than 5.0 L/s being prone to blockage. However, a pre-development enquiry should also be completed with Liverpool City Council to ensure they will accept the proposed drainage strategy and discharge rates.

As the proposed Cypress building refurbishment does not increase the impermeable areas or change the footprint of the existing building, it is envisaged that both United Utilities and Liverpool City Council will accept the refurbished Cypress building utilising the existing drainage outlets and therefore there will be no discharge restrictions imposed on the drainage from the refurbished Cypress building drainage.

Therefore, only the drainage from the proposed extension will be subject to a surface water discharge restriction. As outlined above, due to the relatively small footprint of the proposed extension and the fact that it is being built upon a greenfield area, it is likely that this will be the maximum discharge restriction of 5.0 L/s.

However, to ensure the existing greenfield discharge rate is not greater than the 5.0 L/s proposed rate, an assessment of the existing Greenfield runoff rate has been completed, with the calculations are attached in Appendix G. As can be seen the greenfield discharge rates are a lot lower than the maximum discharge restriction of 5.0 L/s.

Therefore, the surface water drainage system is to be designed to restrict the discharge to the 5.0 L/s required rate, for all rainfall events up to and including the 1 in 100 year return period plus 30% climate change design storm. This should be confirmed via more detailed discussions with United Utilities and the Lead Local Flood Authority prior to the commencement of any works.

Using a total post development impermeable area of 0.119ha (proposed extension and proposed positively drained hardstanding) at the restricted discharge rate of 5.0 L/s, for the 1 in 100 year + 30% return period design storm, a storage volume of **35.1m^3** is required. The preliminary storage assessment is attached in Appendix H.

As seen in the Drainage Strategy Drawing, attached in Appendix I, it is anticipated that the attenuation storage will be provided in the form of a below ground cellular attenuation tank and the discharge restriction achieved using a vortex flow control device. The 35.1m^3 attenuation tank provides all of the storage required to contain the surcharged runoff for all rainfall events up to and including the 1 in 100 year return period plus 30% climate change design storm.

It is anticipated that due to the lack of available space and number of buildings across the site, there are no areas of sufficient size to safely store above ground flooding and therefore the proposed surface water drainage network is suitably sized to contain the surcharged runoff for all rainfall events up to and including the 1 in 100 year + 30% climate change rainfall event.

As can be seen from the Drainage Strategy Drawing, attached in Appendix I, it is proposed to discharge the surface water runoff from the proposed extension into the existing 300mm diameter private combined water sewer, which runs from west to east under the existing Cypress building. Therefore, this sewer must remain intact throughout the construction of the proposed extension and refurbishment of the existing Cypress building.

It is proposed that the newly refurbished building will utilise the existing surface water drainage outlets, where possible, as the external footprint of the existing building is not changing. Where, this is not deemed possible small diversions should be constructed to ensure the existing building is suitably drained to the existing 300mm diameter private combined water sewer which ultimately discharges into the existing public 900mm x 550mm combined brick sewer, located within the highway Chatham Street, to the east of the site, as this is where the existing foul and surface water from the Cypress building drains.

The surface water drainage strategy and discharge rate should be confirmed via more detailed discussions with United Utilities and the Lead Local Flood Authority prior to the commencement of any works.

5.3.2 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 752:2008 (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).

All of the proposed foul water appliances are located within the existing Cypress building and therefore it is envisaged that no foul water drainage is required from the proposed extension area.

As previously discussed, it is proposed that the newly refurbished building will utilise the existing foul water drainage outlets, where possible, as the external footprint of the existing building is not changing. Where, this is not deemed possible small diversions should be constructed to ensure the existing building is suitably drained to the existing public 900mm x 550mm combined brick sewer, located within the highway Chatham Street, to the east of the site. However, as per the existing Cypress building this will be via the existing 300mm diameter private combined water sewer, which ultimately discharges into the combined public sewer.

A number of proposed foul water diversions have been indicated on the Drainage Strategy Drawing, attached in Appendix I, but should it be feasible to utilise the existing foul water drainage outlets within the Cypress building, the proposed foul water drainage should be re-designed to suit, where possible.

The foul water drainage strategy and unrestricted discharge rate should also be confirmed via more detailed discussions with United Utilities and the Lead Local Flood Authority prior to the commencement of any works.

5.3.3 Existing Sewer Capacity

As previously discussed, it is proposed to discharge the surface water runoff from the proposed extension into the existing 300mm diameter private combined water sewer, which runs from west to east under the existing Cypress building. It is also proposed, as per the existing scenario, to discharge the surface and foul water runoff from the existing Cypress building into the existing 300mm diameter private combined water sewer.

However, the existing 300mm diameter private combined water sewer also collects the runoff from a number of other buildings surrounding the existing Cypress building. As such, the capacity of the existing sewer needs to be assessed to ensure it is sufficient to collect the additional 5.0 L/s surface water runoff from the proposed extension and hard landscaping and also the foul water discharge from the refurbished Cypress building.

After assessing the utility survey, it was identified that the Abercrombe Building to the north, the Roxby Building to the south-west and the Rendall Building to the west all discharge their foul water into the existing 300mm diameter private combined water sewer.

Floor plans for each of the buildings above where obtained from the University of Liverpool and the existing appliances on each floor where totalled. An identical exercise was completed for the proposed refurbished Cypress building floor plans and the total foul flow rate of 13.4 L/s was calculated. The calculations are attached in Appendix J.

The roof and hardstanding areas draining into the existing 300mm diameter private combined water sewer have also been assessed and are indicated on the Existing Impermeable Areas Drawing, attached in Appendix J. As can be seen, the total impermeable area draining into the existing sewer is 0.464ha. Therefore, the total surface water flow rate into the existing sewer is; Q = 2.78 x 50 x 0.464 = 64.5 L/s. (Equation E.6, BS EN 752:2008).

Adding the surface water and foul water discharges results in a total flow rate of 77.9 L/s (64.5 + 13.4). Then adding the 5.0 L/s restricted surface water discharge from the proposed extension would result in a total peak flow rate of 82.9 L/s.

The CCTV and utility survey shave indicated invert levels of the existing 300mm diameter private combined water sewer and therefore the minimum gradient of this sewer has been calculated as 1:130. This results in a full bore capacity of approximately 86.0 L/s and therefore it is deemed that the existing 300mm diameter private combined water sewer has sufficient capacity to cope with the additional runoff from the proposed extension and the foul water discharge from the refurbished Cypress building.

6.0 CONCLUSIONS

- The site is located within Flood Zone 1 and is less than 1.0ha in area, therefore no Flood Risk Assessment is required to support the planning application. Despite this, all forms of flooding have been considered and the site has been deemed to have a low risk of flooding from all sources.

- The underlying cohesive, glacial till strata encountered during the TerraConsult Phase 1 & 2 Site Investigation Report, November 2017 and Building Regulations Part H restrictions indicate that infiltration SUDS techniques are not be a viable option for the discharge of surface water.

- As the possibility of infiltration has been ruled out by the site investigation and Building Regulations restrictions, the intention for the development would be to discharge to watercourse. The nearest watercourse is River Mersey which is located approximately 2.0km west of the site and due to the distance across various plots of third party land and properties, discharging to watercourse has been deemed impractical.

- Therefore, the only practical solution for discharge of the surface water is discharge to public sewer. As the existing Cypress building discharges to the existing 900mm x 550mm combined brick public sewer, located within the highway Chatham Street, to the east of the site, it is proposed to discharge the surface water runoff from the proposed extension into this public sewer. However, as per the existing Cypress building this will be via the existing 300mm diameter private combined water sewer, which ultimately discharges into the combined public sewer.

- It is proposed that the newly refurbished building will utilise the existing surface water drainage outlets, where possible, as the external footprint of the existing building is not changing. Where, this is not deemed possible small diversions should be constructed to ensure the existing building is suitably drained to the existing 300mm diameter private combined water sewer which ultimately discharges into the existing public 900mm x 550mm combined brick sewer, located within the highway Chatham Street, to the east of the site, as this is where the existing foul and surface water from the Cypress building drains.

- As the proposed Cypress building refurbishment does not increase the impermeable areas or change the footprint of the existing building, it is envisaged that both United Utilities and Liverpool City Council will accept the refurbished Cypress building utilising the existing drainage outlets and therefore there will be no discharge restrictions imposed on the drainage from the refurbished Cypress building drainage.

- Therefore, it is envisaged that only the drainage from the proposed extension will be subject to a surface water discharge restriction. As the existing greenfield discharge rates from the proposed extension area are lower than the maximum discharge restriction of 5.0 L/s it is anticipated that the surface water discharge is to be restricted to the discharge rate of 5.0 L/s, during the 100 year plus 30% climate change design storm.

- The surcharged runoff is to be stored using a below ground cellular attenuation tank and the proposed surface water drainage network itself. The network is to prevent any flooding for all rainfall events up to and including the 1 in 100 year + 30% climate change rainfall event.

- Further detailed discussions with the Lead Local Flood Authority and United Utilities should be completed to ensure agreement of the surface water discharge rate and the overall approach.

- All of the proposed foul water appliances are located within the existing Cypress building and therefore it is envisaged that no foul water drainage is required from the proposed extension area.

- As previously discussed, it is proposed that the newly refurbished building will utilise the existing foul water drainage outlets, where possible, as the external footprint of the existing building is not changing. Where, this is not deemed possible small diversions should be constructed to ensure the existing building is suitably drained to the existing public 900mm x 550mm combined brick sewer, located within the highway Chatham Street, to the east of the site. However, as per the existing Cypress building this will be via the existing 300mm diameter private combined water sewer, which ultimately discharges into the combined public sewer.

- Further discussions with the Lead Local Flood Authority and United Utilities should be completed to ensure agreement of the foul water discharge rate and the overall approach.

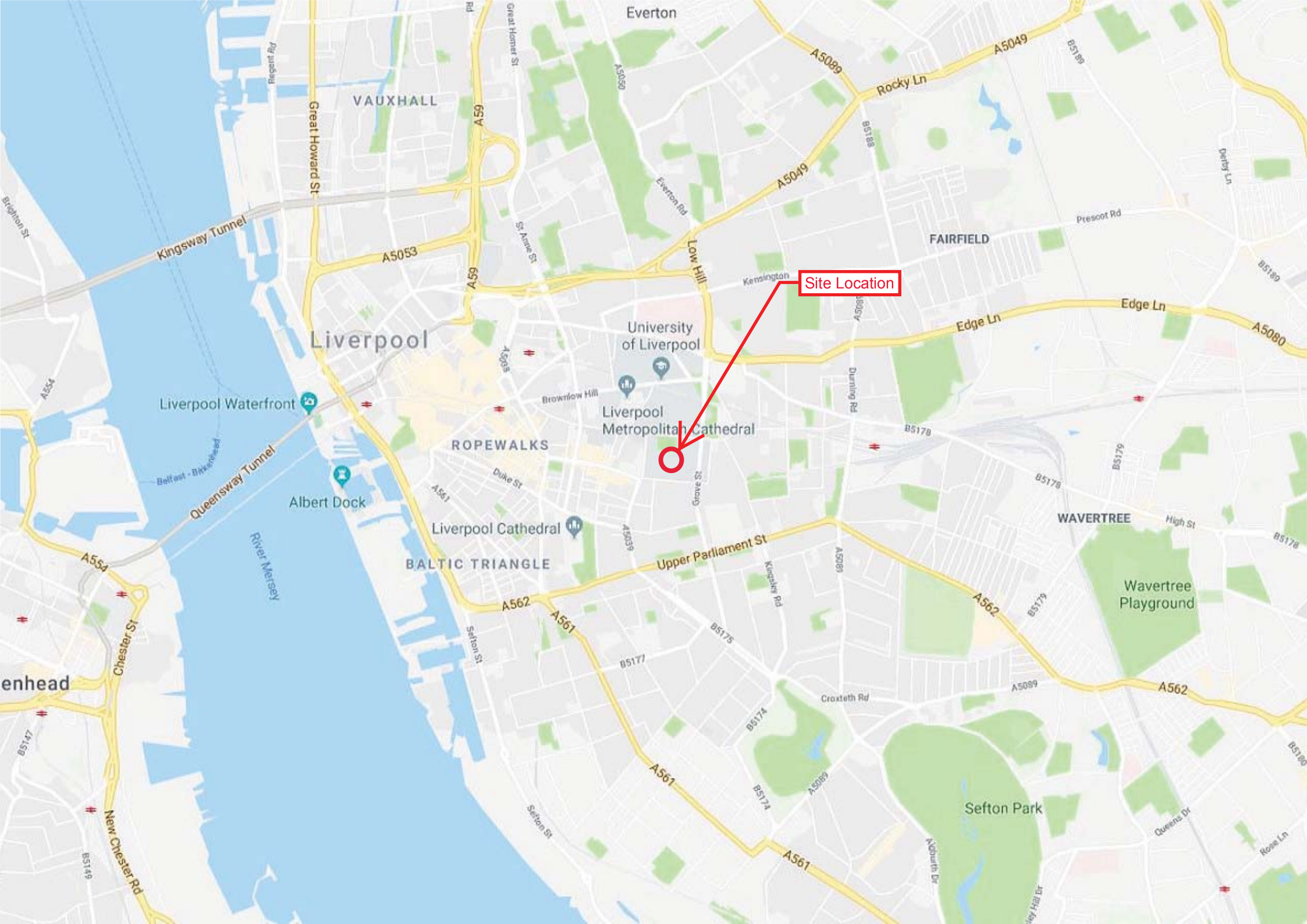
7.0 RECOMMENDATIONS

- A below ground cellular attenuation tank and a vortex flow control device should be utilised to restrict the surface water runoff to the required 5.0 L/s discharge rate and prevent any flooding for rainfall events up to and including the 1 in 100 year plus 30% climate change event.

- The external ground levels around the proposed building 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 + 30% climate change event, exit towards the highway, for use in exceptional circumstances.

- Further investigations on the existing foul and surface water outlets form the existing Cypress building should be completed to assess if any of the existing outlets are suitable for re-use.

Appendix A Site Location Plan


Site Location
Everton
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A59
A5089
A5049
Rocky Ln
Kingsway Tunnel
A5053
Regent Rd
Great Homer St
Everton Rd
St Anne St
Low Hill
Kensington
FAIRFIELD
Prescot Rd
Edge Ln
A5080
Liverpool
University of Liverpool
Liverpool Waterfront
Brownlow Hill
Liverpool Metropolitan Cathedral
Dunlop Rd
ROPEWALKS
Duke St
Grove St
Queensway Tunnel
Albert Dock
Liverpool Cathedral
BALTIC TRIANGLE
Upper Parliament St
River Mersey
A554
A562
A561
Kingsley Rd
Sefton St
Chester St
New Chester Rd
WAVERTREE
High St
Wavertree Playground
Croxteth Rd
Sefton Park
Queens Dr
Rose Ln
Aldourth Dr
Derby Ln
Brighton St
Belfast - Birkenhead
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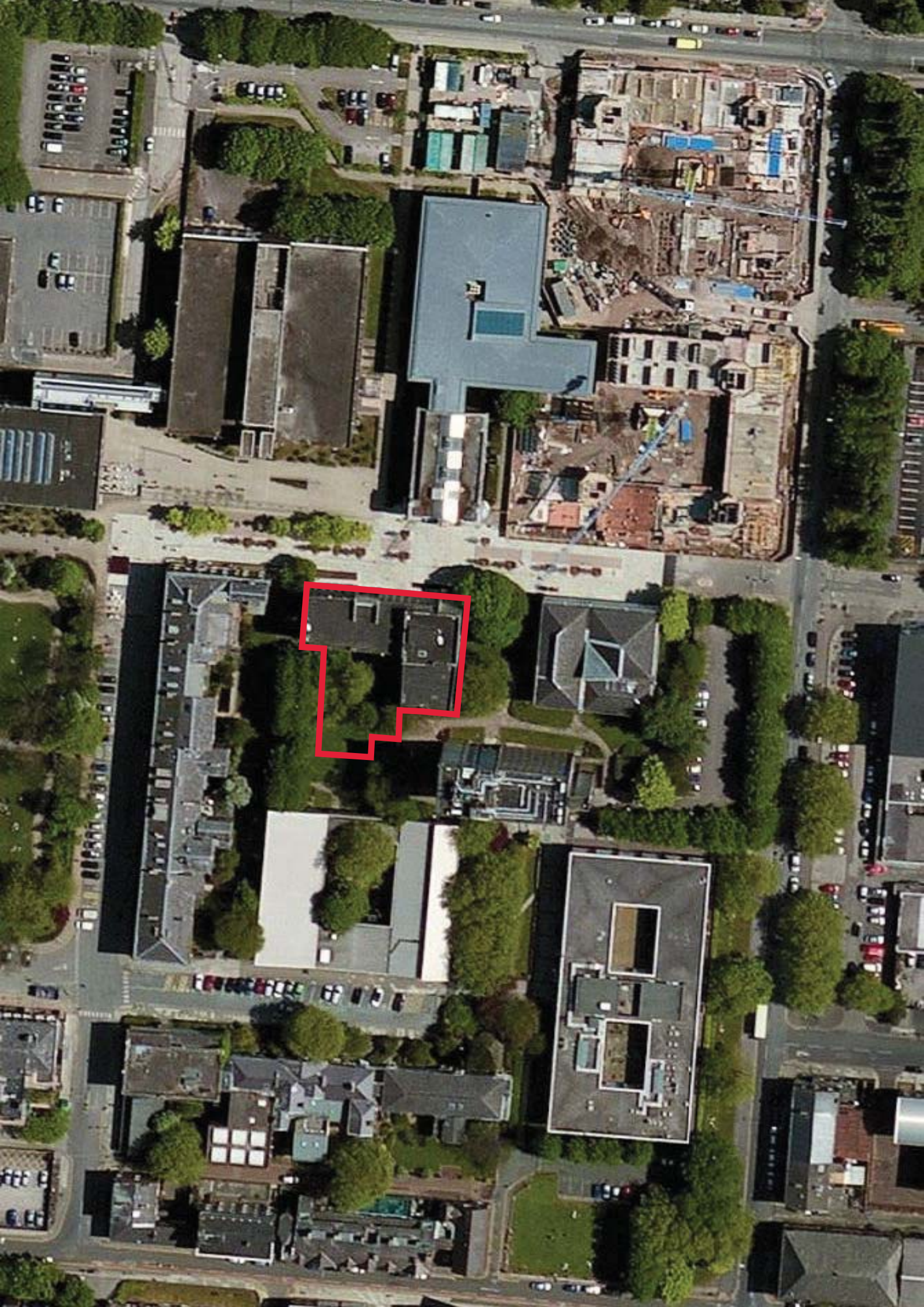
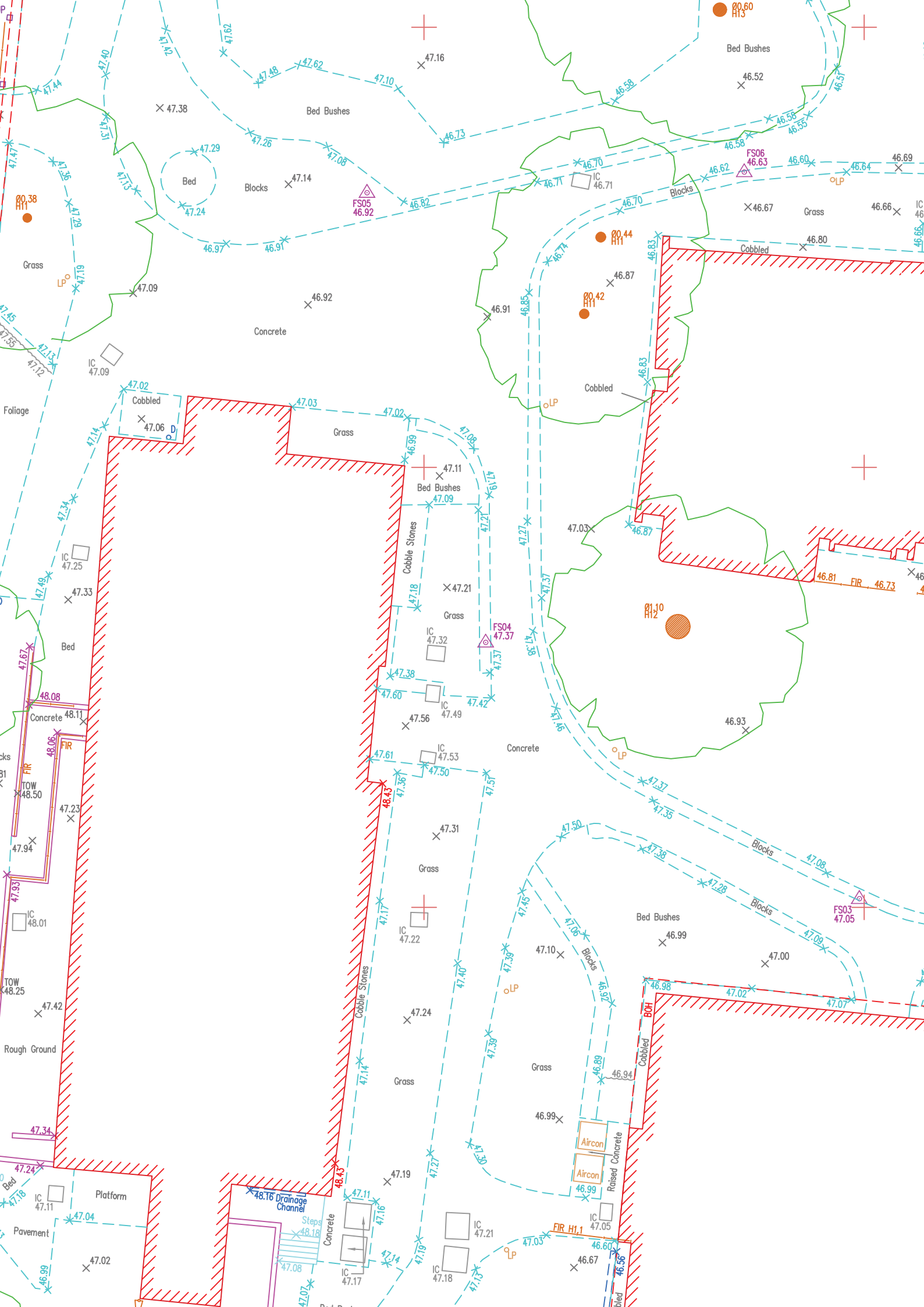
Appendix B Aerial Photograph



Appendix C Topographic Survey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Bed
Blocks
Grass
Concrete
Cobbled
Foliage
Cobble Stones
Rough Ground
Platform
Pavement
Drainage Channel
Steps
Aircon
Raised Concrete
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BOH
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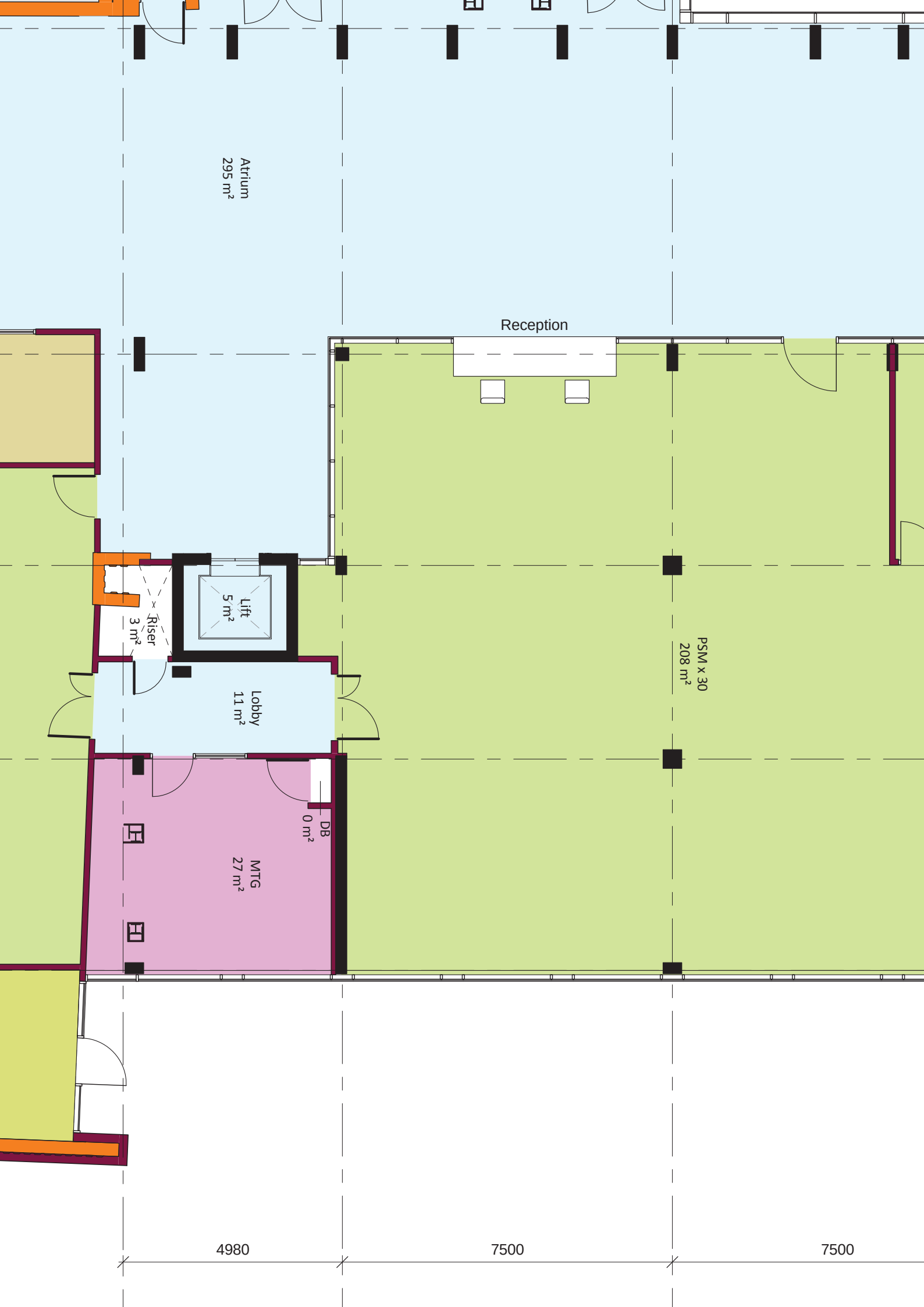
FS06 46.63
FS04 47.37
FS03 47.05
FIR H1.1

Appendix D Proposed Site Plan


Atrium
295 m²
Reception
Lift
5 m²
Riser
3 m²
Lobby
11 m²
PSM x 30
208 m²
DB
0 m²
MTG
27 m²
4980
7500
7500

Appendix E Flood Risk Maps

Basic view Detailed view

Location Enter a place or postcode in England

Flood risk from rivers or the sea

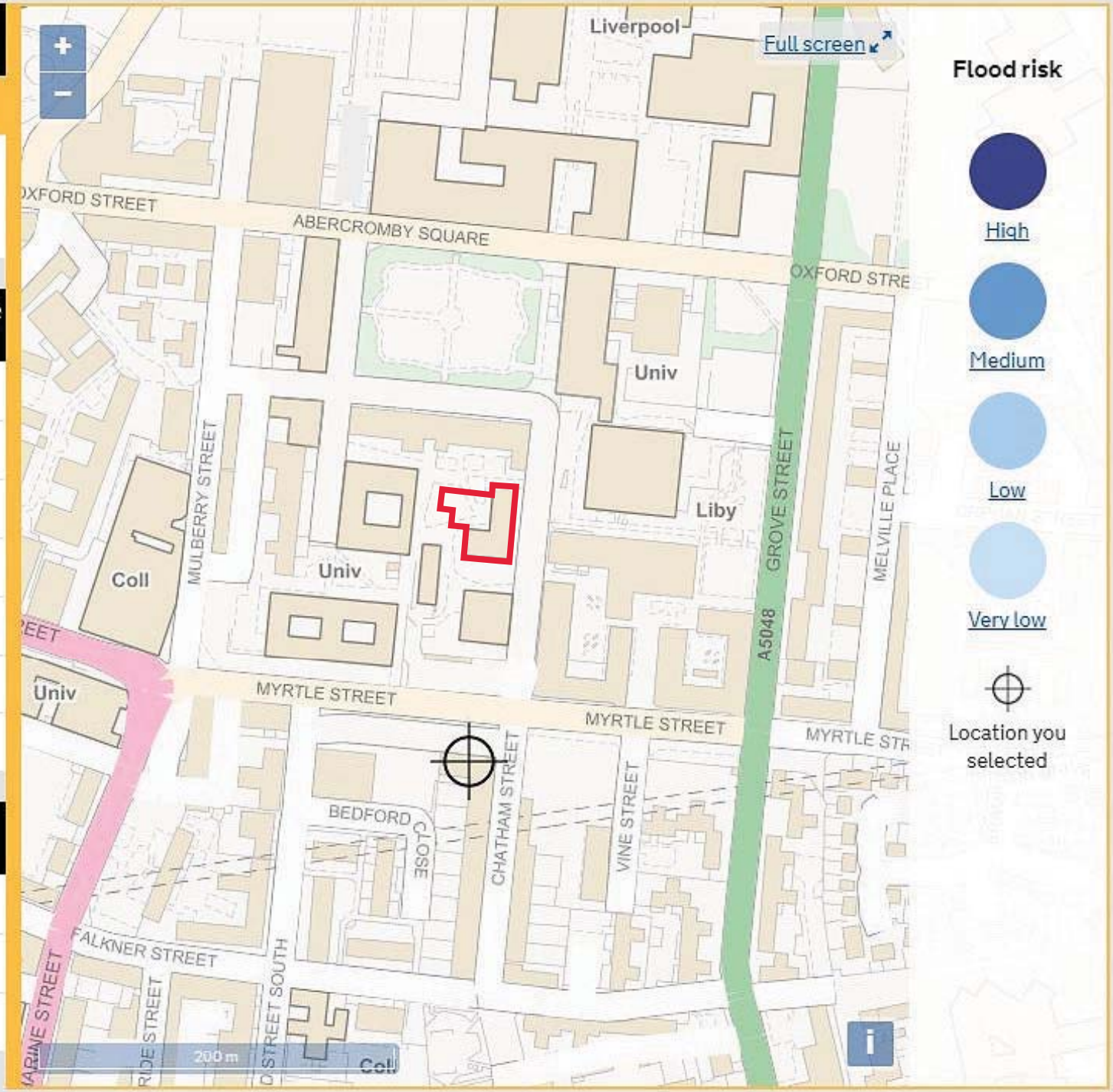
- Extent of flooding
- Depth and flow estimates at monitoring stations

Flood risk from surface water

- Extent of flooding
- High risk: depth
- High risk: velocity
- Medium risk: depth
- Medium risk: velocity
- Low risk: depth
- Low risk: velocity

Flood risk from reservoirs

- Extent of flooding
- Flood depth
- Flood speed



Basic view Detailed view

Location Enter a place or postcode in England

Flood risk from rivers or the sea

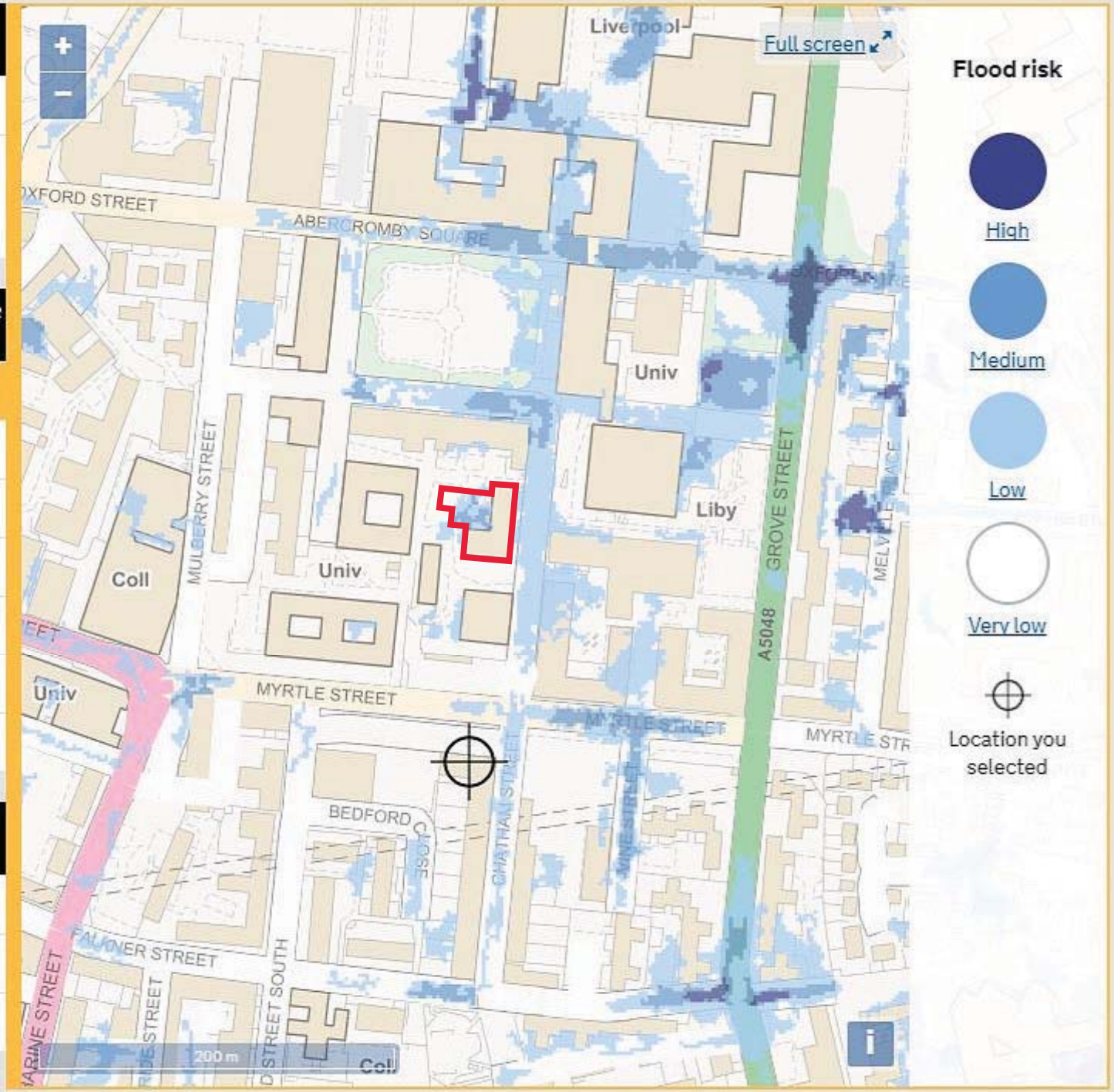
- Extent of flooding
- Depth and flow estimates at monitoring stations

Flood risk from surface water

- Extent of flooding
- High risk: depth
- High risk: velocity
- Medium risk: depth
- Medium risk: velocity
- Low risk: depth
- Low risk: velocity

Flood risk from reservoirs

- Extent of flooding
- Flood depth
- Flood speed



Basic view Detailed view

Location Enter a place or postcode in England

Flood risk from rivers or the sea

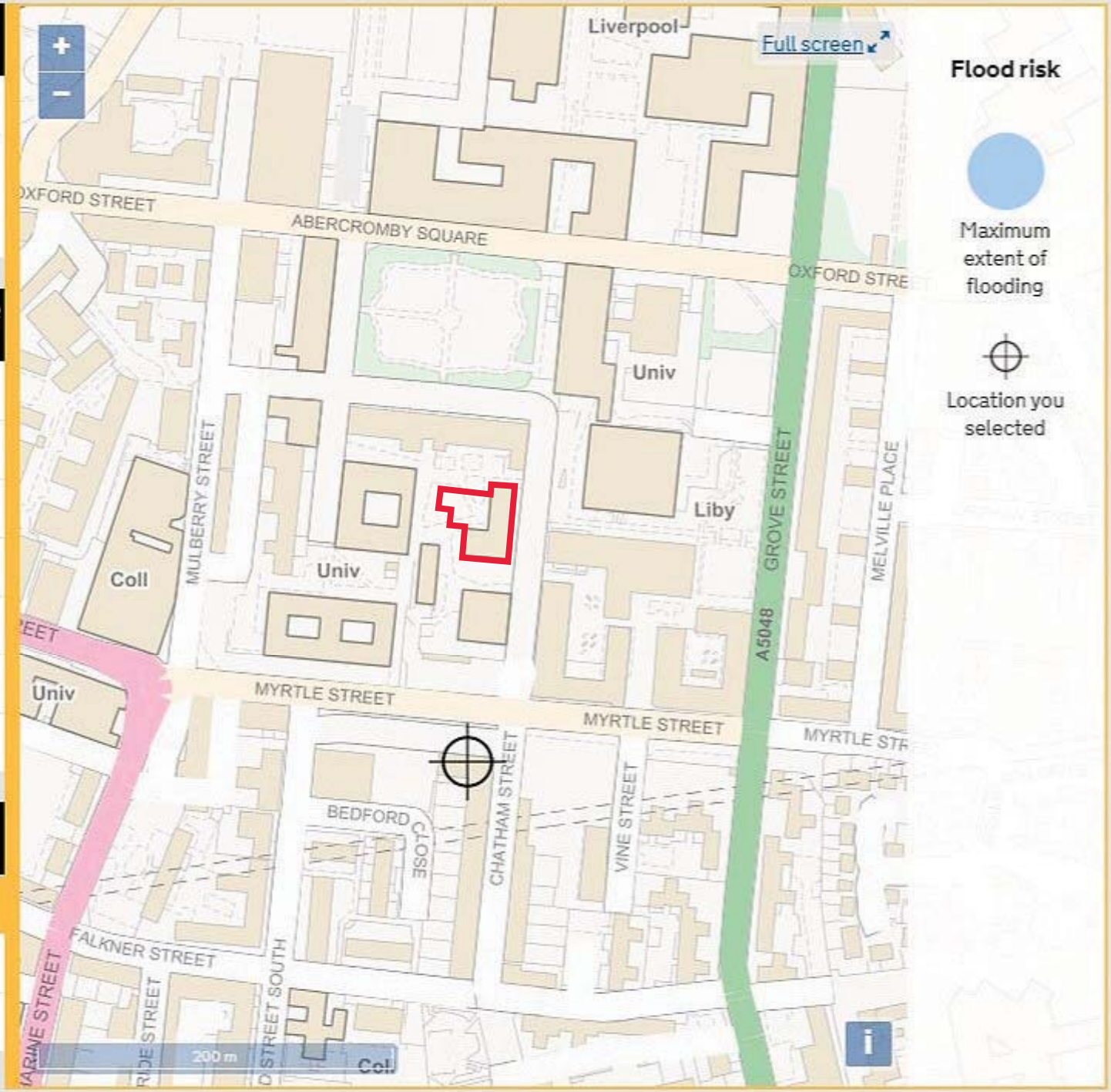
- Extent of flooding
- Depth and flow estimates at monitoring stations

Flood risk from surface water

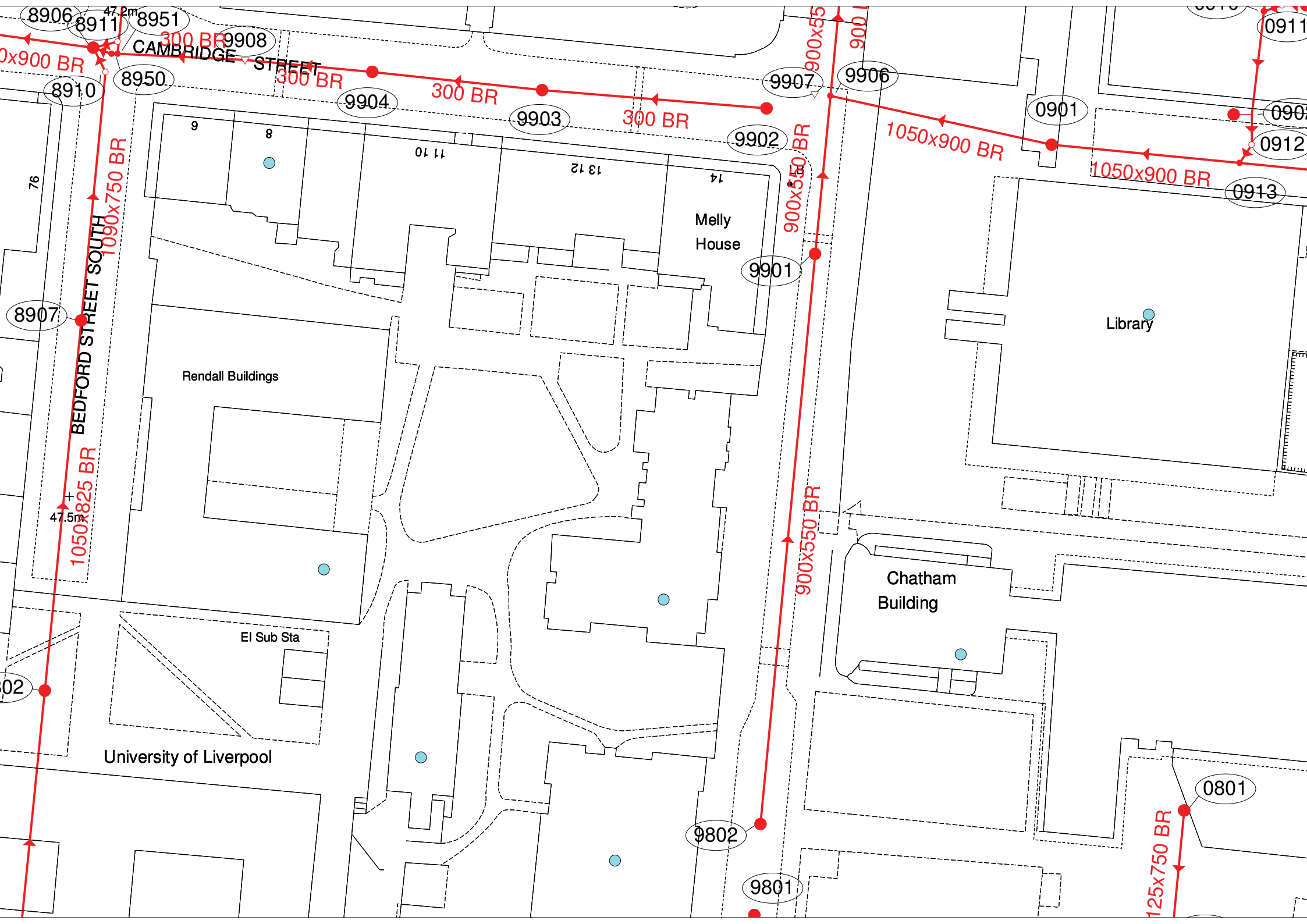
- Extent of flooding
- High risk: depth
- High risk: velocity
- Medium risk: depth
- Medium risk: velocity
- Low risk: depth
- Low risk: velocity

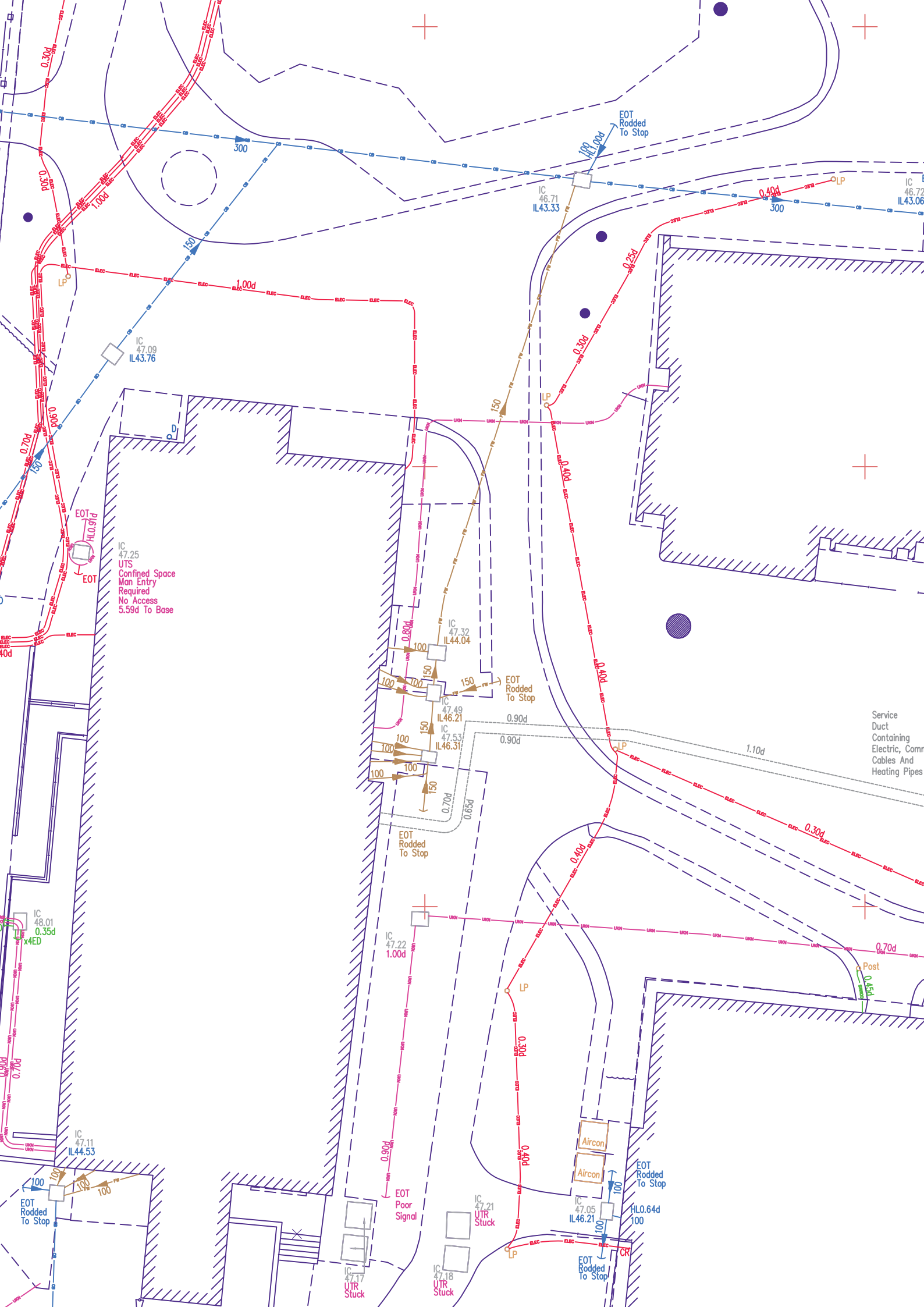
Flood risk from reservoirs

- Extent of flooding
- Flood depth
- Flood speed



Appendix F Existing Drainage Information


8906
47.2m
8911
8951
300 BR
9908
CAMBRIDGE STREET
0x900 BR
8910
8950
300 BR
9904
300 BR
9903
300 BR
9902
9907
9906
900x55
900
0911
0901
0912
1050x900 BR
1050x900 BR
0913
900x550 BR
Melly House
9901
Library
8907
BEDFORD STREET SOUTH
1050x750 BR
Rendall Buildings
1050x825 BR
47.5m
900x550 BR
Chatham Building
El Sub Sta
University of Liverpool
0801
9802
9801
125x750 BR


EOT
Rodded
To Stop
IC
46.71
IL43.33
IC
47.09
IL43.76
IC
47.25
UTS
Confined Space
Man Entry
Required
No Access
5.59d To Base
IC
47.32
IL44.04
IC
47.49
IL46.21
IC
47.53
IL46.31
EOT
Rodded
To Stop
Service
Duct
Containing
Electric, Comm
Cables And
Heating Pipes
IC
48.01
0.35d
x4ED
IC
47.22
1.00d
Post
IC
47.11
IL44.53
EOT
Rodded
To Stop
EOT
Poor
Signal
IC
47.21
UTR
Stuck
IC
47.17
UTR
Stuck
IC
47.18
UTR
Stuck
Aircon
Aircon
IC
47.05
IL46.21
HL0.64d
100
EOT
Rodded
To Stop
EOT
Rodded
To Stop
LP
CR

Appendix G Existing Greenfield Runoff Rate Calculations

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	SAAR (mm)	800	Urban	0.000
Area (ha)	0.119	Soil	0.450	Region Number	Region 10

Results	**l/s**
QBAR Rural	0.6
QBAR Urban	0.6
Q100 years	1.3
Q1 year	0.5
Q30 years	1.0
Q100 years	1.3

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Appendix H Preliminary Stroage Assessment

Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 66 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	46.046	0.746	0.0	5.0	5.0	22.0	O K
30 min Summer	46.239	0.939	0.0	5.0	5.0	27.7	O K
60 min Summer	46.331	1.031	0.0	5.0	5.0	30.4	O K
120 min Summer	46.305	1.005	0.0	5.0	5.0	29.6	O K
180 min Summer	46.240	0.940	0.0	5.0	5.0	27.7	O K
240 min Summer	46.165	0.865	0.0	5.0	5.0	25.5	O K
360 min Summer	45.984	0.684	0.0	5.0	5.0	20.2	O K
480 min Summer	45.826	0.526	0.0	5.0	5.0	15.5	O K
600 min Summer	45.706	0.406	0.0	5.0	5.0	11.9	O K
720 min Summer	45.615	0.315	0.0	5.0	5.0	9.3	O K
960 min Summer	45.503	0.203	0.0	4.7	4.7	6.0	O K
1440 min Summer	45.419	0.119	0.0	4.0	4.0	3.5	O K
2160 min Summer	45.388	0.088	0.0	3.0	3.0	2.6	O K
2880 min Summer	45.375	0.075	0.0	2.4	2.4	2.2	O K
4320 min Summer	45.361	0.061	0.0	1.7	1.7	1.8	O K
5760 min Summer	45.353	0.053	0.0	1.4	1.4	1.6	O K
7200 min Summer	45.348	0.048	0.0	1.1	1.1	1.4	O K
8640 min Summer	45.344	0.044	0.0	1.0	1.0	1.3	O K
10080 min Summer	45.341	0.041	0.0	0.9	0.9	1.2	O K
15 min Winter	46.151	0.851	0.0	5.0	5.0	25.1	O K
30 min Winter	46.372	1.072	0.0	5.0	5.0	31.6	O K
60 min Winter	46.491	1.191	0.0	5.0	5.0	35.1	O K
120 min Winter	46.453	1.153	0.0	5.0	5.0	33.9	O K
180 min Winter	46.357	1.057	0.0	5.0	5.0	31.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	119.869	0.0	26.7	23
30 min Summer	78.788	0.0	35.1	35
60 min Summer	49.388	0.0	44.1	60
120 min Summer	29.955	0.0	53.5	92
180 min Summer	22.080	0.0	59.1	126
240 min Summer	17.687	0.0	63.1	162
360 min Summer	12.839	0.0	68.7	228
480 min Summer	10.237	0.0	73.1	286
600 min Summer	8.581	0.0	76.6	344
720 min Summer	7.426	0.0	79.5	400
960 min Summer	5.907	0.0	84.3	512
1440 min Summer	4.271	0.0	91.5	738
2160 min Summer	3.084	0.0	99.1	1100
2880 min Summer	2.445	0.0	104.7	1468
4320 min Summer	1.760	0.0	113.1	2156
5760 min Summer	1.393	0.0	119.3	2928
7200 min Summer	1.161	0.0	124.4	3632
8640 min Summer	1.000	0.0	128.5	4368
10080 min Summer	0.882	0.0	132.2	5096
15 min Winter	119.869	0.0	29.9	23
30 min Winter	78.788	0.0	39.4	35
60 min Winter	49.388	0.0	49.4	60
120 min Winter	29.955	0.0	59.9	98
180 min Winter	22.080	0.0	66.2	136

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Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	46.244	0.944	0.0	5.0	5.0	27.8	O K
360 min Winter	45.966	0.666	0.0	5.0	5.0	19.6	O K
480 min Winter	45.734	0.434	0.0	5.0	5.0	12.8	O K
600 min Winter	45.585	0.285	0.0	5.0	5.0	8.4	O K
720 min Winter	45.497	0.197	0.0	4.7	4.7	5.8	O K
960 min Winter	45.421	0.121	0.0	4.1	4.1	3.6	O K
1440 min Winter	45.389	0.089	0.0	3.0	3.0	2.6	O K
2160 min Winter	45.370	0.070	0.0	2.2	2.2	2.1	O K
2880 min Winter	45.361	0.061	0.0	1.7	1.7	1.8	O K
4320 min Winter	45.350	0.050	0.0	1.2	1.2	1.5	O K
5760 min Winter	45.344	0.044	0.0	1.0	1.0	1.3	O K
7200 min Winter	45.340	0.040	0.0	0.8	0.8	1.2	O K
8640 min Winter	45.337	0.037	0.0	0.7	0.7	1.1	O K
10080 min Winter	45.334	0.034	0.0	0.6	0.6	1.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	17.687	0.0	70.7	174
360 min Winter	12.839	0.0	77.0	244
480 min Winter	10.237	0.0	81.9	298
600 min Winter	8.581	0.0	85.8	350
720 min Winter	7.426	0.0	89.1	402
960 min Winter	5.907	0.0	94.5	500
1440 min Winter	4.271	0.0	102.5	736
2160 min Winter	3.084	0.0	111.0	1104
2880 min Winter	2.445	0.0	117.3	1472
4320 min Winter	1.760	0.0	126.7	2176
5760 min Winter	1.393	0.0	133.7	2952
7200 min Winter	1.161	0.0	139.3	3648
8640 min Winter	1.000	0.0	144.0	4256
10080 min Winter	0.882	0.0	148.0	5136

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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)	18.800	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.119

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.040	4	8	0.040	8	12	0.039

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Model Details

Storage is Online Cover Level (m) 47.300

Cellular Storage Structure

Invert Level (m) 45.300 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	31.0	0.0	1.200	31.0	0.0	1.201	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)	45.300
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

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Appendix I Outline Drainage Strategy Drawing

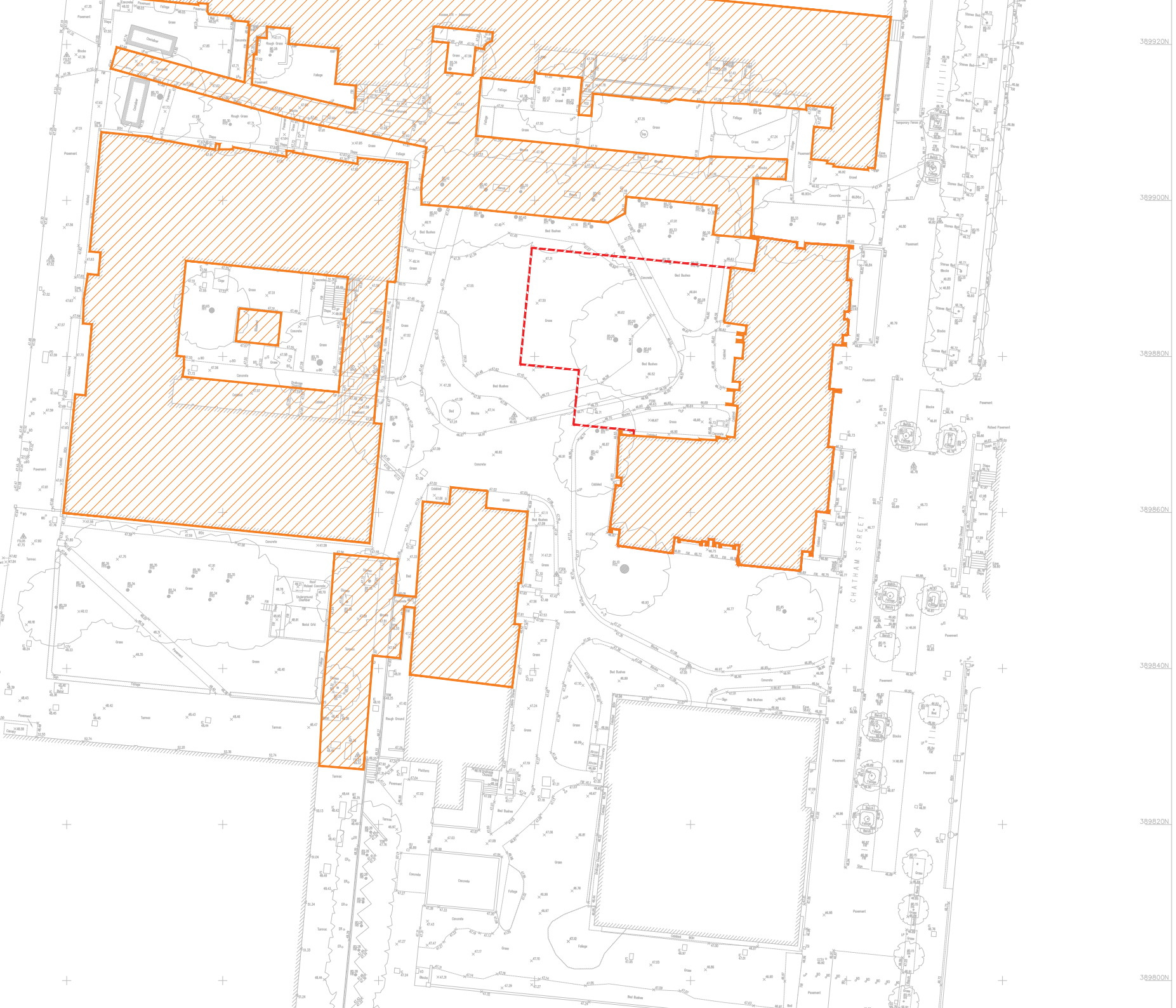
PROPOSED EXTENSION
EXISTING BUILDING
PSM HOD 14 m²
PSM 1 12 m²
PSM 2 12 m²
PSM Wait / MTG 37 m²
PSM x 30 208 m²
Lobby 4 m²
Riser 1 m²
Stair C 23 m²
1:1 MTG 11 m²
Reception
ENTRANCE
DB 0 m²
MTG 22 m²
Lobby 11 m²
Riser 3 m²
Common Room / Kitchen 54 m²
PGR 110 m²
BM 14 m²
GN WC 4 m²
Stair B 23 m²
Riser 1 m²
Atrium 195 m²
Lobby 13 m²
Plant 6 m²
CL 1 m²
Riser 16 m²
Stair A Redundant Room
Riser Redundant Room
Event Space (100) Seats 152 m²
Lobby 26 m²
Lobby 3 m²
Meeting Seminar (30 Seats)
Teaponit
Bench
Bed Bushes
Concrete
Foliage
Pavement
Stones Bed
Blocks
Cobbled
EOT Rodded To Stop
IC 47.00 IL46.39
IC 46.84 IL46.08
IC 46.72 IL43.06
IC 46.87 IL44.66
IC 46.88 IL44.92
IC 46.73 IR Stuck
GU 46.74 No Exit Visible
GU 46.72 No Exit Visible
GU 46.69 No Exit
SW
SW (A)
FW
CB
BD
GU
IC
FS10 46.82
FS0 46.78

Appendix J Existing Sewer Capacity Calculations

e Building - Ground Floor	9no. Wasbasins	4.5	4.000
	4no. Sinks	3.2	4.000
	2no. Urinals	1.6	4.000
be Building - First Floor	5no. WCs	10.0	4.000
	4no. Wasbasins	2.0	4.000
	6no. Sinks	4.8	4.000
e Building - Second Floor	1no. WC	2.0	4.000
	1no. Wasbasin	0.5	4.000
	3no. Sinks	2.4	4.000
be Building - Attic Floor	N/A	0.0	4.000
ilding - Basement Floor	5no. Floor Gullies	10.0	4.000
ing - Lower Ground Floor	6no. WCs	12.0	4.000
	5no. Wasbasins	2.5	4.000
	2no. Urinals	1.6	4.000
	2no. Floor Gullies	4.0	4.000
	1no. Shower	0.8	4.000
uilding - Ground Floor	1no. Sink	0.8	3.000
Building - First Floor	1no. WC	2.0	3.000
	1no. Wasbasin	0.5	3.000
	1no. Sink	0.8	3.000
uilding - Second Floor	2no. WCs	4.0	3.000
	2no. Wasbasins	1.0	3.000
	1no. Sink	0.8	3.000
Building - Third Floor	1no. WC	2.0	3.000
	2no. Wasbasins	1.0	3.000
	2no. Urinals	1.6	3.000
	1no. Sink	0.8	3.000
Building - Fourth Floor	2no. WCs	4.0	3.000
	2no. Wasbasins	1.0	3.000
	4no. Sinks	3.2	3.000
Building - Fifth Floor	1no. WC	2.0	3.000
	2no. Wasbasins	1.0	3.000
	2no. Urinals	1.6	3.000
	1no. Sink	0.8	3.000
Building - Sixth Floor	2no. WCs	4.0	3.000
	2no. Wasbasins	1.0	3.000
	1no. Sink	0.8	3.000
uilding - Seventh Floor	1no. WC	2.0	3.000
	2no. Wasbasins	1.0	3.000
	2no. Urinals	1.6	3.000
	4no. Sinks	3.2	3.000
Building - Eighth Floor	1no. WC	2.0	3.000
	1no. Wasbasin	0.5	3.000
	3no. Sinks	2.4	3.000
Building - Ninth Floor	1no. WC	2.0	3.000
	3no. Wasbasins	1.5	3.000
	2no. Urinals	1.6	3.000
	6no. Sinks	4.8	3.000
Building - Tenth Floor	N/A	0.0	3.000
uilding - Basement Floor	7no. WCs	14.0	2.000
	12no. Wasbasins	6.0	2.000
	3no. Floor Gullies	6.0	2.000
	12no. Urinals	9.6	2.000
Building - Ground Floor	7no. WCs	14.0	2.000
	6no. Wasbasins	3.0	2.000
	2no. Sinks	1.6	2.000
l Building - First Floor	11no. WCs	22.0	2.000
	13no. Wasbasins	6.5	2.000
	2no. Sinks	1.6	2.000
	5no. Urinals	4.0	2.000
Building - Second Floor	N/A	0.0	2.000
g Refurb & Extension - Level 0	7no. WCs	14.0	5.000
	7no. Wasbasins	3.5	5.000
	1no. Sink	0.8	5.000
	1no. Floor Gully	2.0	5.000
g Refurb & Extension - Level 1	6no. WCs	12.0	5.000
	6no. Wasbasins	3.0	5.000
	2no. Sinks	1.6	5.000
	1no. Floor Gully	2.0	5.000
	1no. Shower	0.8	5.000
g Refurb & Extension - Level 2	5no. WCs	10.0	5.000
	5no. Wasbasins	2.5	5.000
	2no. Sinks	1.6	5.000
	1no. Shower	0.8	5.000
g Refurb & Extension - Level 3	5no. WCs	10.0	5.000
	5no. Wasbasins	2.5	5.000
	2no. Sinks	1.6	5.000
	1no. Shower	0.8	5.000

University of Liverpool - Existing & Proposed Foul Drainage Output Sheet

Pipe Number	Total DU	Cumulative DU	Usage Factor	Flowrate (l/s)
1.000	0.0	0.0	0.7	**0.00**
2.000	88.3	88.3	0.7	**6.58**
1.001	0.0	88.3	0.7	**6.58**
3.000	57.3	57.3	0.7	**5.30**
1.002	0.0	145.6	0.7	**8.45**
4.000	120.6	120.6	0.7	**7.69**
1.003	0.0	266.2	0.7	**11.42**
5.000	99.3	99.3	0.7	**6.98**
1.004	0.0	365.5	0.7	**13.38**
	365.5			**13.38**



REV	DATE

DRAWING STATUS:

CLIENT:

ARCHITECT:

PROJECT:

TITLE: