



Halsnead Garden Village, Lickers Lane, Whiston

FLOOD RISK ASSESSMENT & DRAINAGE STRATEGY REPORT



30 August 2022

Halsnead Garden Village, Lickers Lane, Whiston

Flood Risk Assessment & Drainage Strategy Report

AJP Ref: 221-130

PREPARED BY JOHN SPEERS



Halsnead Garden Village, Lickers Lane, Whiston

Flood Risk Assessment & Drainage Strategy Report

Vistry Partnerships



	Originator:	Approved:	Date:
Record of Approval	J.Speers Associate	K.O'Brien Director	30/08/2022
Version	Author:	Change Description:	
P01	J.Speers	Original Issue	22/07/2022
P02	J.Speers	Original Issue	30/08/2022

Contents

1.0 INTRODUCTION	4
2.0 SITE DESCRIPTION	5
2.1 Geology.....	5
2.2 Hydrogeology	6
2.3 Hydrology	6
3.0 PROPOSED DEVELOPMENT	6
4.0 PLANNING POLICY.....	6
4.1 Sequential and Exception Test	7
4.2 Exception Test	7
5.0 FORMS OF FLOODING.....	7
5.1 Flooding from Rivers	7
5.2 Flooding from Sea	7
5.3 Flooding from Land.....	7
5.4 Flooding from Groundwater	8
5.5 Flooding from Sewers.....	8
5.6 Flooding from Reservoirs, Canals and Other Artificial Sources	8
6.0 PROPOSED DEVELOPMENT	9
6.1 Effect of Proposed Development	9
6.2 Existing Drainage Systems.....	9
6.3 Proposed Drainage Strategy.....	10
6.3.1 Surface Water Drainage	10
6.3.2 SuDS Summary.....	13
6.3.3 Water Quality Assessment	14
6.3.4 Foul Water Drainage.....	15

7.0 FUTURE MANAGEMENT & MAINTENANCE	15
7.1 General Maintenance & Inspection Requirements.....	16
7.2 Inspection Chambers, Manholes and Catchpits	17
7.3 Pipes	17
7.4 Drainage Channels and Gullies.....	18
7.5 Vortex Flow Control Device.....	18
7.6 Rainwater Harvesting (Water Butts)	19
7.7 Bioretention Systems	20
7.8 Permeable Paving	21
7.9 Cellular Attenuation Tank.....	22
8.0 CONCLUSIONS	23
9.0 RECOMMENDATIONS.....	24
Appendix A - Site Location Plan	25
Appendix B - Aerial Photograph	26
Appendix C - Topographic Survey	27
Appendix D - Proposed Site Plan.....	28
Appendix E - Flood Risk Maps.....	29
Appendix F - United Utilities Sewer Maps & Correspondence	30
Appendix G - Greenfield Runoff Calculations	31
Appendix H - Drainage Strategy Drawing & SW Drainage Calculations	32
Appendix I - Knowsley Council Pro Forma 1.....	33



Constructionline



Alan Johnston Partnership Ltd.

Company No. 13204766

Halsnead Garden Village, Lickers Lane, Whiston

Flood Risk Assessment & Drainage Strategy Report

1.0 INTRODUCTION

This Flood Risk Assessment (FRA) and Drainage Strategy Report has been prepared on behalf of Vistry Partnerships in connection with a new residential development which is part of the overall Halsnead Garden Village development. The site is located to the south of Lickers Lane, Whiston. Even though the site is located entirely within Flood Zone 1, the total area of the proposed residential development is over 1.0ha and therefore an FRA is required.

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

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

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

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

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

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

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

The drainage strategies outlined within this report, have been prepared in accordance with BS EN 752:2017 (Drain and sewer systems outside buildings), Sewers for Adoption, Building Regulations Approved Document H (Drainage and waste disposal), the National Planning Policy Framework document (Department for Communities and Local Government, July 2021) and associated Planning Practice Guidance.



2.0 SITE DESCRIPTION

The site is situated to the south of Lickers Lane, Whiston and is part of the overall Halsnead garden Village development. The site is located at National Grid reference SJ 47441 90386. 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 3.41ha and is a greenfield site. The site comprises entirely of greenfield areas. The site is bounded to the north by existing woodland and pond areas, with Lickers Lane located further north. To the east, south and west the site is bounded by existing greenfield and agricultural land.

The site falls from north to south, with levels falling from approximately 51.50mAOD in the north to approximately 45.80mAOD in the south. An aerial photo is included in Appendix B to illustrate the site at the present day and a topographic survey is attached in Appendix C.

2.1 Geology

An intrusive site investigation was completed in November 2021 by e3p; report ref: 15-065-R2-1. The site investigation report indicates that the underlying strata consists of topsoil to a maximum recorded depth of 0.60mbgl, which is underlain directly by Kinnerton Sandstone Formation bedrock which comprises mainly of very dense sands/sandstone, to a maximum recorded depth of 40.00mbgl.

The bedrock information is supported by the information taken from the British Geological Survey (BGS) 1:50,000 Bedrock geology maps, as this shows that the site is underlain by Kinnerton Sandstone Formation bedrock, comprising of sandstone. However, the BGS maps information indicates that the site has Till superficial deposits comprising of clays and sands but these superficial deposits were not encountered during the intrusive site investigation works.

2.2 Hydrogeology

The Environment Agency groundwater maps show that the superficial deposits are classified as a Secondary (undifferentiated) Aquifer. These are defined as areas where it is not possible to apply either a Secondary A or B definition because of the variable characteristics of the rock type.

The bedrock is classified as a Principal Aquifer, defined as areas with layers of rock or drift deposits that have high intergranular and/or fracture permeability, meaning they usually provide a high level of water storage and transmission. They may support water supply and/or river base flow on a strategic scale.

The Environment Agency groundwater maps also indicate that the development site is located within a Source Protection Zone III area. Therefore, any soakaways would require discussions with the Environment Agency to determine the required level of treatment prior to infiltration into the SPZ III area.

2.3 Hydrology

The development site is situated in the direct catchment of Fox's Bank Brook, which is located to the east of the site. The site is located within Flood Zone 1 which is categorized by the Environment Agency as land assessed as having less than a 1 in 1,000 annual probability of river flooding (1% - 0.1%). Therefore, the site is an area identified by the Environment Agency as at low risk of flooding from rivers and streams.

3.0 PROPOSED DEVELOPMENT

The proposed residential development covers a total area of 3.41ha and is part of the overall Halsnead Garden Village development. The residential development consists of 120no. residential units with associated car parking, access roads and landscaped areas.

To enable a viable scheme, the proposed site levels are constrained by the existing highways surrounding the site, therefore the site levels may be amended but are likely to remain similar to the existing in order to tie into the surrounding highways. A proposed site plan is attached in Appendix D.

4.0 PLANNING POLICY

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

"Planning plays a key role in helping shape places to secure radical reductions in greenhouse gas emissions, minimising vulnerability and providing resilience to the impact of climate change, and supporting the delivery of renewable and low carbon energy and associated infrastructure. This is central to the economic, social and environmental dimensions of

sustainable development. Local planning authorities should adopt proactive strategies to mitigate and adapt to climate change taking full account of flood risk, coastal change and water supply and demand consideration.”

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

4.1 Sequential and Exception Test

Based on the sites location in Flood Zone 1, the development is deemed appropriate according to NPPF therefore the development is appropriately situated and the Sequential Test is not required.

4.2 Exception Test

NPPF classifies the development (Residential) as ‘More Vulnerable’ but as the site is located within Flood Zone 1 the Exception Test is not required.



5.0 FORMS OF FLOODING

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

5.1 Flooding from Rivers

The Flood Risk map is included as Appendix E.

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

The nearest designated main river is Fox’s Bank Brook, which is located approximately 670m east of the site. Despite this, the risk of flooding to the new development from rivers is considered to be low.

5.2 Flooding from Sea

The site is not at risk of flooding from the sea. The lowest level of the site is approximately 45.80mAOD, i.e., well above tidal flood levels.

5.3 Flooding from Land

Intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems can run quickly off land and result in local flooding. The Surface Water Flooding map is included in Appendix E. It can be seen from the map that the majority of the site is classified as having a low or very low risk of surface water flooding but there are some small areas to the south of the site that are classified as medium or high risk of surface water flooding.

However, when assessing the topographic survey it can be seen that these areas are small dips in the existing levels. As part of the proposed development it is assumed that these dips will be levelled out and also the proposed development will have suitably designed surface water drainage. Therefore, it is envisaged that these actions will mitigate the areas which are currently at a medium to high risk of surface water flooding.

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

5.4 Flooding from Groundwater

As outline in Section 2.1, the e3p site investigation report ref: 15-065-R2-1, concludes that no groundwater was encountered during the entire site investigation works. Therefore, due to the lack of groundwater encountered by the site investigation, the site is considered to be at low risk of flooding from groundwater.

5.5 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 from the United Utilities sewer map, there are no public sewers located within the proposed site boundary.

The only nearby public sewers are located within the surrounding highways and therefore should any flooding from sewers occur it would likely be contained within the highways and not encroach upon the proposed site.

Therefore, due to the lack of public sewers within the proposed site, the proposed drainage networks for the site being suitably designed and the fact that the surrounding public sewers are located within the 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.

5.6 Flooding from Reservoirs, Canals and Other Artificial Sources

The Reservoir Flood Risk map is included in Appendix E and the closest artificial waterbody or reservoir is the Number 3 Reservoir which is located approximately 3.10km north of the site. As such, it can be seen from the map that the site is not at risk of flooding from reservoirs, canals or other artificial sources.

6.0 PROPOSED DEVELOPMENT

6.1 Effect of Proposed Development

As previously outlined in Section 2.0, the existing site covers a total area of 1.11ha that is entirely greenfield areas. The pre and post development impermeable areas for the 1.11ha development area have been assessed and are summarised below;

Total Development Site Area (ha)	Existing Impermeable Area (ha)	Proposed Impermeable Area (ha)
3.41	0.00	1.46

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

6.2 Existing Drainage Systems

As can be seen from the United Utilities sewer maps attached in Appendix F, there are no existing public sewers located within the site boundary. The only nearby public sewers are the existing 675mm diameter public surface water sewer and the 225/300mm diameter public foul water sewer, both of which are located on the highway Lickers Lane, to the north of the site.

As can be seen from the United Utilities correspondence attached in Appendix F, additional United Utilities public sewers are to be constructed along the spine road to the south of the proposed site, to serve an adjacent development to the west of the proposed development.

As all of these public sewers are located outside of the site it is not envisaged that any public sewer diversions or abandonments will need to be agreed with United Utilities. However, it is envisaged that the proposed drainage from the residential development will connect to these public sewers and therefore Section 106 connection agreements will be required with United Utilities.

As the area of proposed development is currently greenfield with no indication of any previous works, it is anticipated that there is no existing private drainage located within the development site area.

Despite this, utility and CCTV surveys should be undertaken to determine the exact details of any nearby private and public drainage, including those indicated on the proposed spine road to the south of the site, when they are constructed. The proposed surveys should identify the existing location, condition and levels of any existing public and private drainage.

6.3 Proposed Drainage Strategy

As outlined above in section 6.1, 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.

6.3.1 Surface Water Drainage

The Building Regulations - Approved Document H (2015) 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 residential development should infiltrate where possible. As indicated in Section 2.1, an intrusive site investigation was completed in November 2021 by e3p; report ref: 15-065-R2-1.

The e3p report undertook falling head permeability tests and encountered mixed results, with 2no. tests failing to produce an infiltration rate and 2no. producing very slow rates. As such, the e3p report states that *“Within SA102 and SA103 infiltration testing identified that in these locations the tests soaked away within 24 hours, however, to be compliant with BRE 365 it is recommended that further testing is completed in these areas to allow 3No tests to be completed over an allotted number of days in order to inform infiltration design.”*

As such, infiltration is not considered to be feasible across the entire site and that coupled with the steep topography leads to the conclusion that infiltration may not be suitable for the proposed development. However, this should be confirmed via full BRE365 infiltration tests, to confirm if/where across the site infiltration is suitable.

Assuming the possibility of infiltration is not feasible, the intention for the development would be to discharge to watercourse. The nearest watercourse is Fox's Bank Brook, which is located 670m west of the site. However, due to the distance through developed third-party land, discharging directly to this watercourse has been deemed impractical.

As such, the only practical solution for discharge of the surface water is discharge to public sewer. As indicated within Section 6.2, the only nearby public surface water sewer is located within the highway Lickers Lane, to the north of the site and the public sewers along the spine road to the south of the site, which are yet to be constructed.

Therefore, due to the topography of the site sloping steeply from north to south and the existing woodland and pond areas located between the proposed development and Lickers Lane to the north, it is envisaged that the surface water runoff from the proposed development will discharge to the public sewers along the spine road to the south of the site, which are yet to be constructed.

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

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

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

For each design case described above, the design storm is the critical storm duration for the site conditions. In the case of the 1 in 100 year design storm, a 40% increase in the peak rainfall intensity is applied to allow for the estimated worst case impacts of climate change. This is in accordance with advice, issued by the Environment Agency, which updates previous climate change allowances outlined in the National Planning Policy Framework and Table 1 of the Knowsley Council Sustainable Drainage Systems Completing your Pro-Forma: Advice Note.

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 greenfield, to comply with Knowsley Council requirements it is anticipated that the proposed surface water runoff rates will be restricted to match the existing greenfield run off rates.

Therefore, an assessment of the existing surface water run-off from the greenfield site has been completed using the ICP SuDS method within Micro Drainage. For the existing 3.41ha site, the existing greenfield run-off rates were calculated. The greenfield runoff assessment is attached in Appendix G and the results are summarised within the table below.

Rainfall Return Period (years)	Existing Greenfield Runoff Rate (L/s)
1 Year	16.7
Qbar	19.2
30 year	32.5
100 year	39.9

Therefore, to comply with Knowsley Council requirements, the maximum surface water discharge rate for the site should be restricted to the existing greenfield runoff rates for the same rainfall event. This should be applied for all rainfall events up to and including a 1 in 100 year return period plus 40% climate change design storm.

It is anticipated that due to the lack of available public open spaces across the site and also the steep topography of the site, the majority of the attenuation storage will be provided by oversized pipes and below ground cellular tanks. However, various forms of SuDS should still be considered across the site.

Where possible, these are likely to include; tree pits, rain gardens, permeable paving and rainwater harvesting in the form of water butts. The surface water drainage network will be restricted to the existing greenfield runoff rates via vortex flow control devices. Due to the steep topography of the site multiple vortex flow control devices may be required but this is to be confirmed via detailed drainage design.

It is envisaged that the surface water drainage will collect the runoff from the site and convey the runoff to the south of the proposed site. Here it will be restricted to the required greenfield runoff rates via vortex flow control devices, prior to discharging into the public sewers, which are to be constructed along the spine road to the south of the proposed site.

Due to the topography of the site, it is assumed that discharging the surface water runoff via gravity is achievable but if not the surface water runoff will need to be pumped. This is to be confirmed via CCTV surveys of the existing private and surrounding public drainage, when constructed.

The Drainage Strategy drawing and surface water drainage calculations for the proposed site are included within Appendix H. As can be seen from the strategy drawing and surface water calculations, the surface water drainage utilises oversized pipes and a series of vortex flow controls to ensure the existing greenfield runoff rates are met for each rainfall event and that the required attenuation storage volume is achieved to prevent any flooding for all rainfall events up to and including the 1 in 100 year +40% climate change event.

While the use of permeable paving, water butts, tree pits and/or rain gardens are not incorporated within the surface water drainage design, attached in Appendix H, it is envisaged that when the proposed site layout has been finalised these SuDS solutions will be incorporated, where possible, across the site during the detailed drainage design.

The surface water drainage strategy and discharge rate is subject to detailed drainage design and should be confirmed via detailed discussions with Knowsley Council and United Utilities prior to the commencement of any works.

6.3.2 SuDS Summary

As outlined within the summary table below, all SuDS techniques have been considered for this development;

SuDS Technique	Suitable for This Development?	Reasoning
Green Roof	✗	Not suitable due to residential nature of development
Rainwater Harvesting	✓	Where possible, water butts to be installed to all residential units.
Basins & Ponds	✗	Unsuitable due to lack of available space and steep topography of site.
Filter Strips & Swales	✗	Unsuitable due to lack of available space and steep topography of site.
Bio-retention Areas	✓	Where possible, tree pits and/or rain gardens should be utilised across the site.
Infiltration Techniques	✗	Assumed to be unsuitable due to falling head test results and steep topography of site.
Permeable Surfaces	✓	Where possible non-infiltration permeable paving should be incorporated across site.
Tanked/Piped Systems	✓	Suitable and should be incorporated where possible.

Green roof areas have been considered but due to the residential nature of the proposed development, the use of green roofs has been discounted. Rainwater harvesting was also considered and where possible, water butts should be installed to all residential units to include a form of rainwater harvesting across the site.

Due to the lack of available space across the site and the steep topography of the site, the use of detention basins and/or ponds have been deemed as unsuitable. Again, due to the lack of available space across the site and the steep topography of the site, the use of filter drains/strips and swales have also been deemed as unsuitable.

Bio-retention areas should be incorporated, where possible, across the site. It is envisaged that tree pits and/or rain gardens could be used to drain some hardstanding areas and these would also provide water quality and biodiversity benefits across the site.

As previously discussed in Section 6.3.1 infiltration is assumed as not feasible across the site and therefore the use of infiltration SuDS techniques is not possible. However, non-infiltration permeable surfaces such as permeable paving could be utilised to drain the proposed driveways and other car parking areas. This would also incorporate water quality benefits across the site.

Finally, the use of oversized pipe networks and below ground cellular attenuation tanks will likely be required due to the lack of any other available SuDS solutions to attenuate the majority of the surcharged runoff across the site.

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

6.3.3 Water Quality Assessment

Managing the water quality of the surface water runoff from the proposed development is important to ensure that the receiving surface waters or groundwater are well protected. Generally, this can be achieved through the use of well-designed SuDS systems which provide treatment and pollution removal to the surface water runoff.

Standard S3 of the Statutory National Standards for Sustainable Drainage Systems (2018) details the water quality management and addresses the drainage design requirements to minimise the potential pollution risk.

As the proposed development consists of residential roof areas, individual property driveways and low traffic roads, in accordance within Table G3.2 of the Statutory National Standards for Sustainable Drainage Systems (2018) the pollution hazard level is low and as such the simple index approach can be used to assess the treatment requirements for the low risk of pollution.

The simple index approach is outlined within Chapter 26 of CIRIA Report C753 - The SuDS Manual. Therefore, using Table 26.2 and applying the proposed site description above, results in the pollution hazard indices being; TSS - 0.5, Metals - 0.4 and Hydrocarbons - 0.4.

Assessing this against Table 26.3 of CIRIA Report C753 - The SuDS Manual using the SuDS treatment train of permeable paving and bio-retention areas, results in the mitigation indices outweighing the pollution hazard indices identified above. The use of permeable paving itself would result in mitigation indices of; TSS - 0.7, Metals - 0.6 and Hydrocarbons - 0.7, which would be sufficient on its own.

Therefore, as the mitigation indices are equal to or greater than each of the pollution hazard indices the use of a permeable paving with oversized pipes and/or cellular attenuation tanks is deemed acceptable from a pollution mitigation perspective and as such complies with the water quality requirements of Standard S3 of the Statutory National Standards for Sustainable Drainage Systems (2018).

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

6.3.4 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)
- ◆ Planning Practice Guidance and the National Planning Policy Framework document (Department for Communities and Local Government, July 2021).
- ◆ 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).

It is proposed that the foul water discharge from the proposed residential development will be collected and conveyed to the south of the proposed site, where it will discharge into the public sewers along the spine road to the south of the site, which are yet to be constructed.

Due to the topography of the site, it is assumed that discharging the foul water via gravity is achievable but if not the foul water discharge will need to be pumped. This is to be confirmed via CCTV surveys of the existing private and surrounding public drainage, when constructed.

The foul water drainage strategy and unrestricted discharge rate is subject to detailed drainage design and should be confirmed via detailed discussions with Knowsley Council and United Utilities prior to the commencement of any works.



7.0 FUTURE MANAGEMENT & MAINTENANCE

The proposed drainage solution uses SUDS techniques in accordance with the CIRIA SUDS Manual C753. The surface water run-off from the proposed development is to be restricted using vortex flow control devices and the attenuated run-off is to be stored using a series of SuDS techniques including where possible; rainwater harvesting (water butts), tree pits, rain gardens, permeable paving and cellular attenuation tanks.

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

- ◆ Inspection chambers, manholes and catchpits.
- ◆ Pipes.
- ◆ Drainage channels and gullies.

- ◆ Vortex flow control devices.
- ◆ Rainwater harvesting.
- ◆ Bio-retention systems (tree pits/rain gardens).
- ◆ Permeable paving.
- ◆ 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 majority of the proposed drainage will be adopted by United Utilities and therefore the maintenance of the surface and foul water drainage systems will be the responsibility of United Utilities.

It is however anticipated that the maintenance of the water butts will be the responsibility of each individual property owner. 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.

7.1 General Maintenance & Inspection Requirements

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

7.2 Inspection Chambers, Manholes and Catchpits

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

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

7.3 Pipes

Regular inspection and maintenance 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.

7.4 Drainage Channels and Gullies

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

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

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

7.5 Vortex Flow Control Device

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

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

- ◆ Normally, little maintenance is required as there are generally a vortex flow control device has no moving parts.
- ◆ If blockages occur, they tend to do so at the intake of the vortex flow control device.
- ◆ Vortex flow control devices are generally fitted with a pivoting by-pass door, which allows the manhole chamber to be drained down should blockages occur.
- ◆ The smaller type conical units, below the minimum recommended size, are also supplied with 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.

7.6 Rainwater Harvesting (Water Butts)

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 rainwater harvesting are outlined within Table 11.6 of the CIRIA SUDS Manual C753. An extract of that table is given below to set out the maintenance schedule for the potential swale component of the proposed drainage system.

TABLE 11.6 Operation and maintenance requirements for RWH systems		
Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspection of the tank for debris and sediment build-up, inlets/outlets/withdrawal devices, overflow areas, pumps, filters	Annually (and following poor performance)
	Cleaning of tank, inlets, outlets, gutters, withdrawal devices and roof drain filters of silts and other debris	Annually (and following poor performance)
Occasional maintenance	Cleaning and/or replacement of any filters	Three monthly (or as required)
Remedial actions	Repair of overflow erosion damage or damage to tank	As required
	Pump repairs	As required

7.7 Bioretention Systems

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 bioretention systems are outlined within Table 18.3 of the CIRIA SUDS Manual C753. An extract of that table is given below to set out the maintenance schedule for the potential bioretention systems component of the proposed drainage system.

Maintenance schedule	Required action	Typical frequency
Regular inspections	Inspect infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels in underdrain (if appropriate) to determine if maintenance is necessary	Quarterly
	Check operation of underdrains by inspection of flows after rain	Annually
	Assess plants for disease infection, poor growth, invasive species etc and replace as necessary	Quarterly
	Inspect inlets and outlets for blockage	Quarterly
Regular maintenance	Remove litter and surface debris and weeds	Quarterly (or more frequently for tidiness or aesthetic reasons)
	Replace any plants, to maintain planting density	As required
	Remove sediment, litter and debris build-up from around inlets or from forebays	Quarterly to biannually
Occasional maintenance	Infill any holes or scour in the filter medium, improve erosion protection if required	As required
	Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch	As required
Remedial actions	Remove and replace filter medium and vegetation above	As required but likely to be > 20 years

7.8 Permeable Paving

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 permeable paving are outlined within Table 20.15 of the CIRIA SUDS Manual C753. An extract of that table is given below to set out the maintenance schedule for the potential permeable paving component of the proposed drainage system.

TABLE 20.15 Operation and maintenance requirements for pervious pavements		
Maintenance schedule	Required action	Typical frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

7.9 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.

8.0 CONCLUSIONS

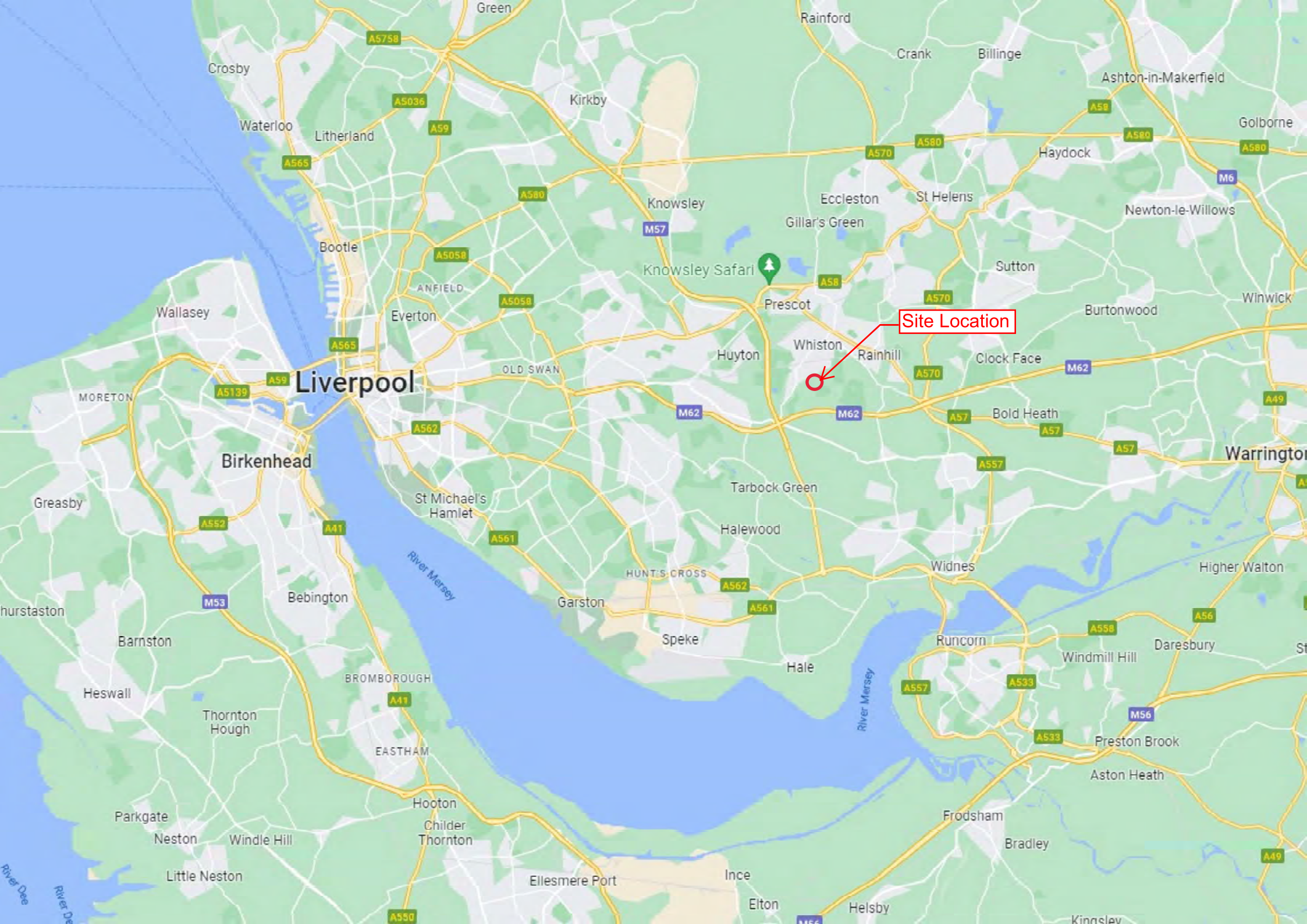
- ◆ The site is located within Flood Zone 1 with a low probability of flooding from all sources.
- ◆ The e3p site investigation report, 15-065-R2-1 undertook falling head permeability tests and encountered mixed results, with 2no. tests failing to produce an infiltration rate and 2no. producing very slow rates.
- ◆ As such, infiltration is not considered to be feasible across the entire site and that coupled with the steep topography leads to the conclusion that infiltration may not be suitable for the proposed development.
- ◆ Assuming the possibility of infiltration is not feasible, the intention for the development would be to discharge to watercourse. The nearest watercourse is Fox's Bank Brook, which is located 670m west of the site. However, due to the distance through developed third-party land, discharging directly to this watercourse has been deemed impractical.
- ◆ As such, the only practical solution for discharge of the surface water is discharge to public sewer. Due to the topography of the site sloping steeply from north to south and the existing woodland and pond areas located between the proposed development and Lickers Lane to the north, it is envisaged that the surface water runoff from the proposed development will discharge to the public sewers along the spine road to the south of the site, which are yet to be constructed.
- ◆ The surface water discharge is to be restricted to the existing greenfield 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 surcharged runoff is to be restricted using vortex flow control devices and the surcharged runoff attenuated using the proposed oversized surface water drainage network itself.
- ◆ Where possible, other SuDS solutions such as, rainwater harvesting (water butts), permeable paving, tree pits and rain gardens should be used across the site and these should be incorporated at detailed drainage design stage.
- ◆ The foul water drainage is to discharge at unrestricted rates into the public sewers along the spine road to the south of the site, which are yet to be constructed. This is as per the previous discussions with United Utilities that outlined the construction of the spine road and public sewers to serve the adjacent residential development.

- ◆ As the site topography slopes steeply from north to south, it is envisaged that the levels of the public sewers in the spine road will be low enough to accommodate gravity connections from the proposed residential developments foul and surface water drainage networks, therefore it is anticipated that no pumping will be required.
- ◆ Discussions with Knowsley Council and United Utilities should be completed to ensure agreement ensure agreement of the surface and foul water discharge rates and the overall approach.
- ◆ 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.

9.0 RECOMMENDATIONS

- ◆ Utility and CCTV surveys should be undertaken to determine the exact details of any nearby private and public drainage. The proposed surveys should identify the existing location, condition and levels of the existing public and private drainage, including the public sewers along the spine road, once they are constructed.
- ◆ BRE365 infiltration tests, should be undertaken to confirm if/where across the site infiltration is suitable. Should infiltration be suitable the proposed surface water drainage design should be revised to suit.
- ◆ The surface water drainage strategy and discharge rate is subject to detailed drainage design and should be confirmed via detailed discussions with Knowsley Council and United Utilities prior to the commencement of any works.
- ◆ The foul water drainage strategy and unrestricted discharge rate is subject to detailed drainage design and should be confirmed via detailed discussions with Knowsley 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.

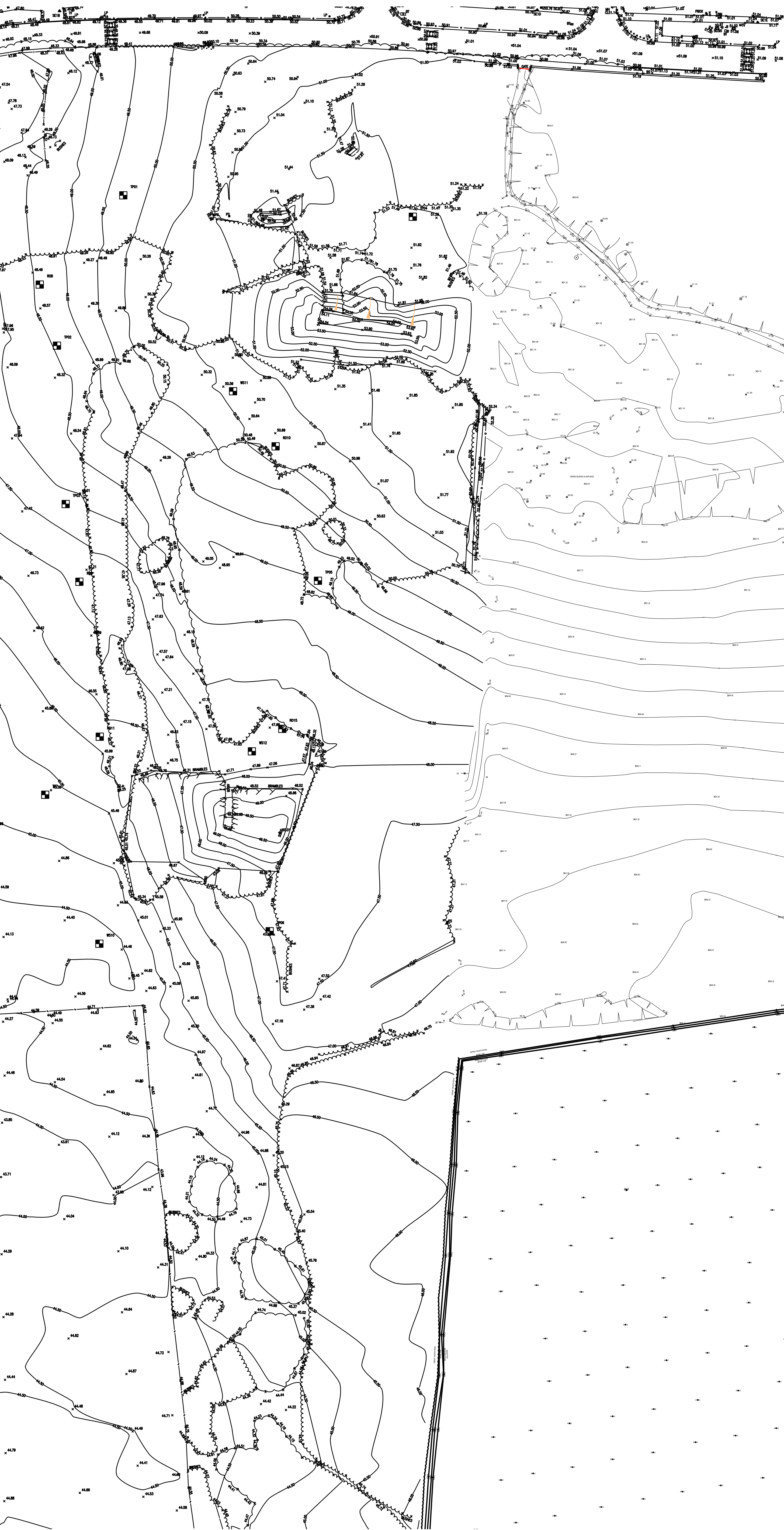
Appendix A – Site Location Plan



Appendix B – Aerial Photograph



Appendix C – Topographic Survey



Appendix D – Proposed Site Plan



Appendix E – Flood Risk Maps

Flood map for planning

Your reference
221-130

Location (easting/northing)
347545/390366

Created
18 Jul 2022 14:25

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)

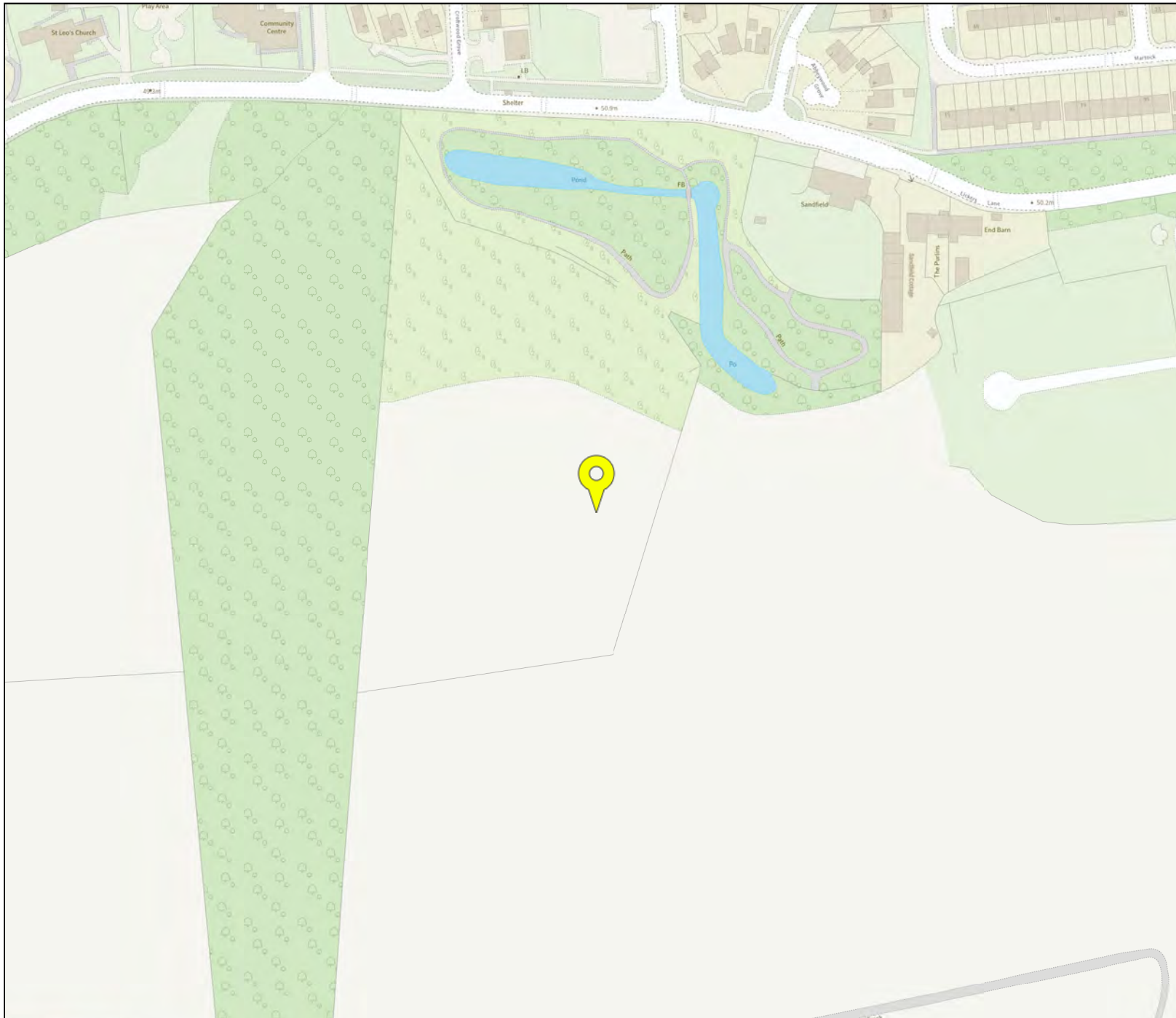
Notes

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 2021 OS 100024198. <https://flood-map-for-planning.service.gov.uk/os-terms>



Flood map for planning

Your reference

221-130

Location (easting/northing)

347545/390366

Scale

1:2500

Created

18 Jul 2022 14:25

-  Selected point
-  Flood zone 3
-  Flood zone 3: areas benefiting from flood defences
-  Flood zone 2
-  Flood zone 1
-  Flood defence
-  Main river
-  Water storage area

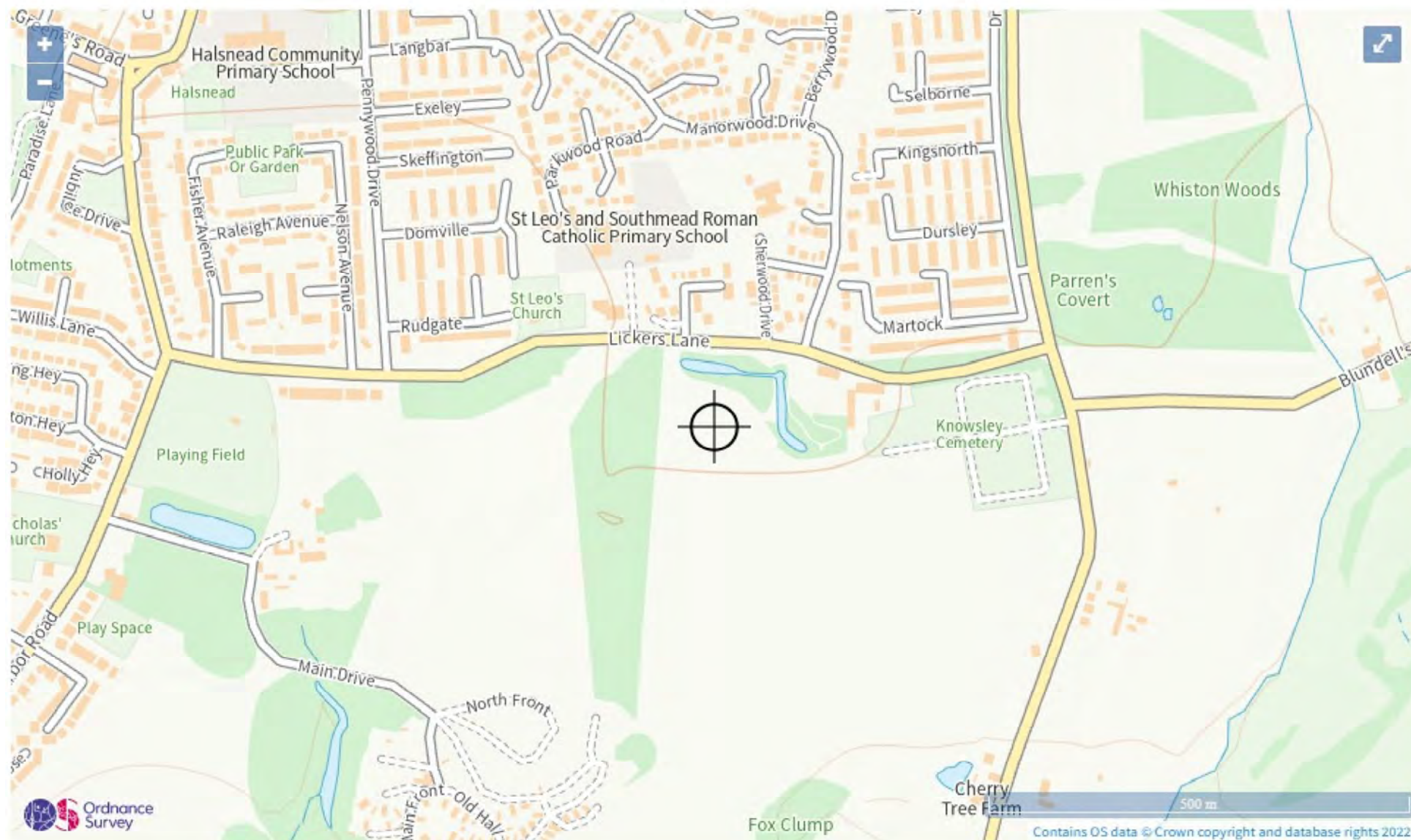
0 20 40 60m

Flood risk

Location

Extent of flooding

Enter a place or postcode



Extent of flooding from rivers or the sea

High Medium Low Very low Location you selected

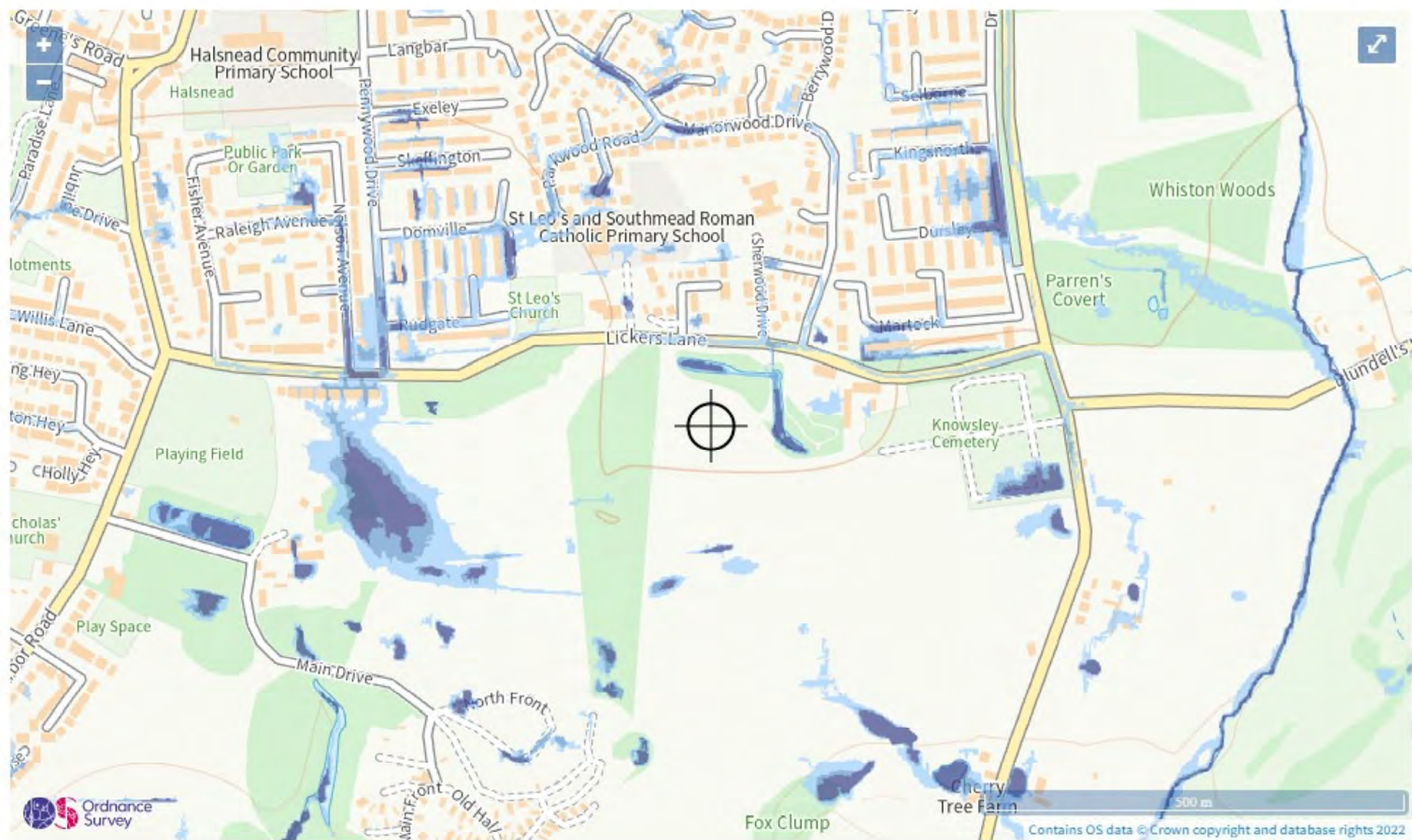
Flood risk

Location

Extent of flooding



Enter a place or postcode



Extent of flooding from surface water

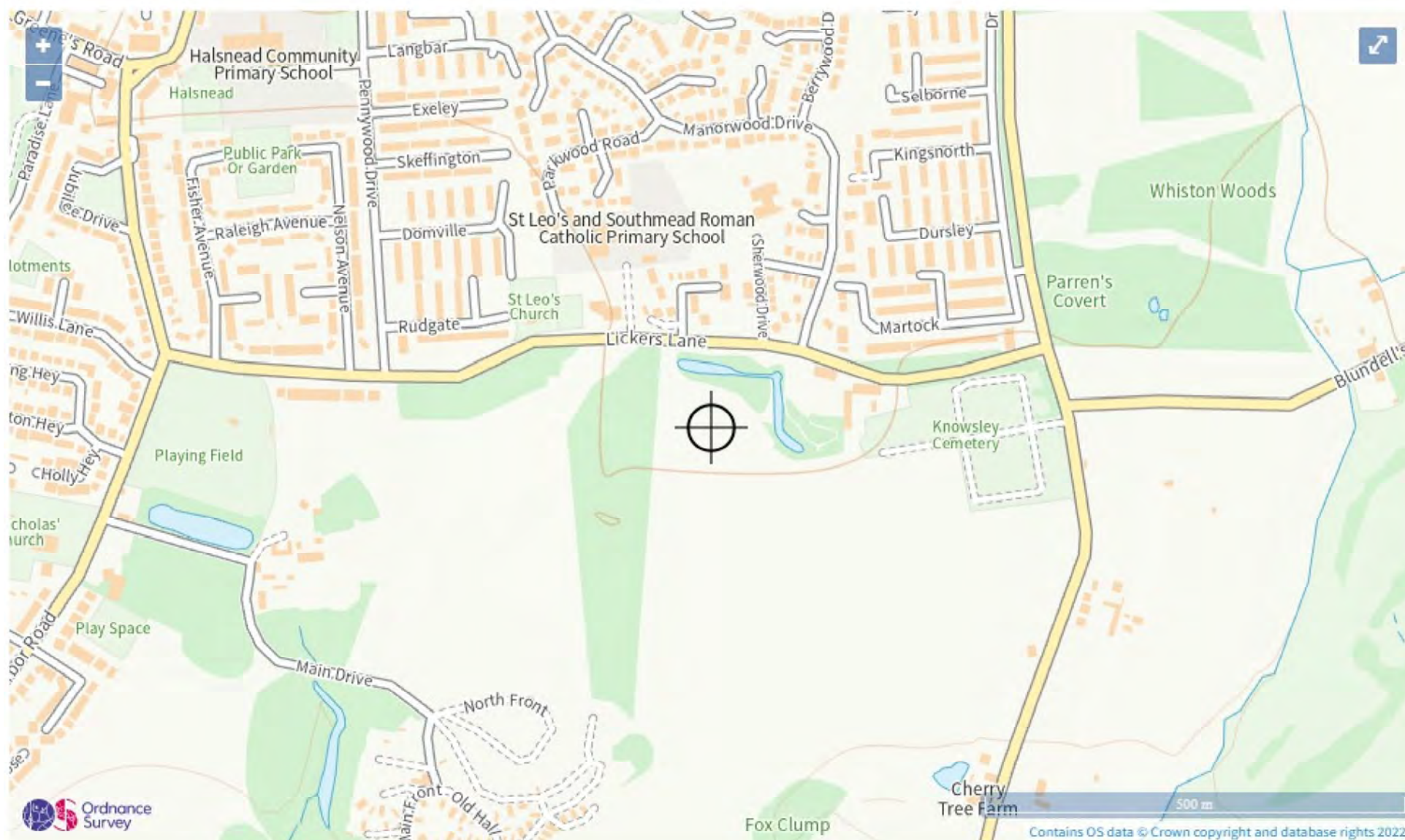
High Medium Low Very low Location you selected

Flood risk

Extent of flooding

Location

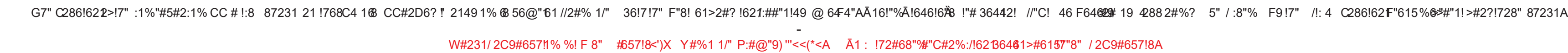
Enter a place or postcode



Maximum extent of flooding from reservoirs:

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

Appendix F – United Utilities Sewer Maps & Correspondence

[illegible]

MANHOLE FUNCTION	
FO	Foul
SW	Surface Water
CO	Combined
DV	Overflow

		SEWER MATERIAL
		AC Asbestos Cement
		BR Brick
		PE Polyethylene
		RP Reinforced Plastic Matrix
		CO Concrete
		CSB Concrete Segment Bolted
		CSU Concrete Segment Unbolted
		CC Concrete Box Culverted
		PSC Plastic / Steel Composite
		GRC Glass Reinforced Plastic
		DI Ductile Iron
		PVC Polyvinyl Chloride
		CI Cast Iron
		GI Spun Iron
		ST Steel
		VC Vitrified Clay
		PP Polypropylene
		PF Pitch Fibre
		MAC Masonry, Coursed
		MAR Masonry, Random
		U Unspecified

OS sheet - P_(XR'PV
Number:
Scale:)K)<,' - Date: <,&'(&
- Nodes: - <
- Sheet: - * 2>
- - -
- Printed by: - B#2C"#!9" #/7"8

SEWER RECORDS

 **United Utilities**
helping life flow smoothly

John Speers

Subject: FW: PDE 4200042907 Parcel 2C Halsnead drainage Lickers Lane Whiston L35 3PW

From: Kenny O'Brien <kennyobrien@ajpltd.co.uk>

Sent: 21 July 2022 16:02

To: John Speers <johnspeers@ajpltd.co.uk>

Subject: FW: PDE 4200042907 Parcel 2C Halsnead drainage Lickers Lane Whiston L35 3PW



Kenny O'Brien

Director

☎ 0151 227 1462

☎ 07809516842

✉ kennyobrien@ajpltd.co.uk

📍 1 Dale St, Liverpool, L2 2ET

Note Upcoming Annual Leave – 1st Aug – 19th Aug

From: Perry, Graham <Graham.Perry@uuplc.co.uk>

Sent: 17 September 2021 17:31

To: peter.bowen@vistrypartnerships.co.uk; Pete.Hayes@vistrypartnerships.co.uk; Jack.Walvin@vistrypartnerships.co.uk; Kenny O'Brien <kennyobrien@ajpltd.co.uk>; Lee Stanley <leestanley@ajpltd.co.uk>

Cc: Wastewater Developer Services <WastewaterDeveloperServices@uuplc.co.uk>

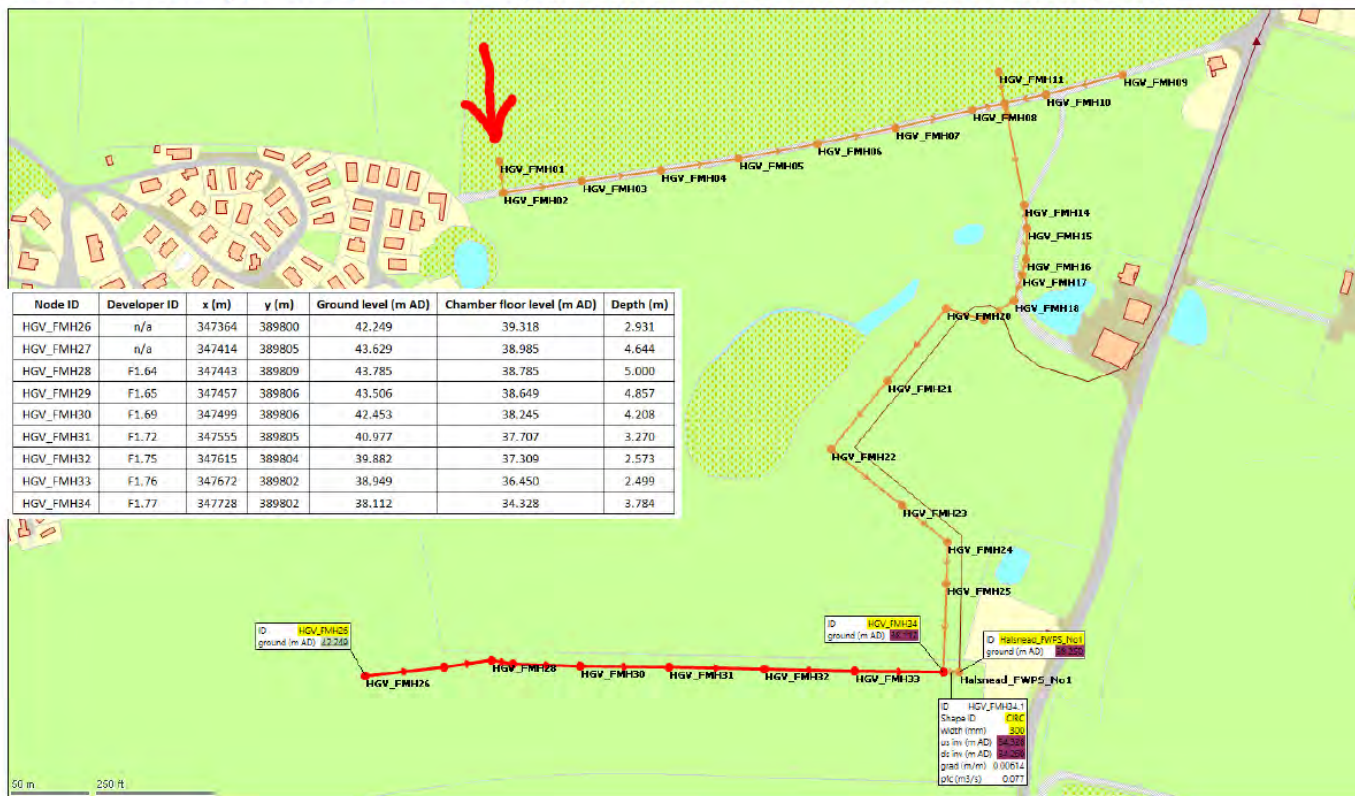
Subject: RE: PDE 4200042907 Parcel 2C Halsnead drainage Lickers Lane Whiston L35 3PW

Hello Peter

Thanks for letting me know about timescales. I have let the project team know.

For information purposes only I attach a copy of an indicative layout of the proposed sewers to service the site and have drawn a red arrow showing where we expect your site to drain either directly or indirectly.

Halsnead Garden Village, Knowsley – Indicative Layout of UU Connecting Sewers – Individual Sections (4 of 4)





Graham Perry
Development Engineer
Developer Services
M: 07557 577548
T: 01925 679405
unitedutilities.com

If you have received a great service today why not tell us?

Visit: unitedutilities.com/wow

From: Wastewater Developer Services

Sent: 07 September 2021 14:55

To: Perry, Graham <Graham.Perry@uuplc.co.uk>

Subject: FW: PDE 4200042907 Parcel 2C Halsnead drainage Lickers Lane Whiston L35 3PW

Kind regards



Lucie Gaskell
Customer Advisor Advanced
Developer Services & Metering
Customer Services
Direct Tel: 01925 233050
Tel: 0345 072 6067
unitedutilities.com

If you have received a great service today why not tell us?

Visit: unitedutilities.com/wow

Did you know we now have a live chat facility available to you Mon to Friday 8 -5pm. You just click on the orange live chat box on our webpage and one of our advisors will be ready to chat to you and help you with your enquiry <https://www.unitedutilities.com/builders-developers/> or you can email us at WastewaterDeveloperServices@uuplc.co.uk

From: Peter Bowen [<mailto:Peter.Bowen@vistrypartnerships.co.uk>]

Sent: 07 September 2021 11:46

To: Perry, Graham <Graham.Perry@uuplc.co.uk>

Cc: Brennan, Adam <Adam.Brennan@uuplc.co.uk>; Wastewater Developer Services <WastewaterDeveloperServices@uuplc.co.uk>; Edwards, Stuart <Stuart.Edwards@uuplc.co.uk>; Pete Hayes <Pete.Hayes@vistrypartnerships.co.uk>; Jack Walvin <Jack.Walvin@vistrypartnerships.co.uk>; kennyobrien@ajpltd.co.uk; Lee Stanley <leestanley@ajpltd.co.uk>

Subject: RE: PDE 4200042907 Parcel 2C Halsnead drainage Lickers Lane Whiston L35 3PW

EXTERNAL EMAIL This email originated outside of the organisation. Do not click links or open attachments unless you recognise the sender and know the content is safe.

Hi Graham

Many thanks for the reply and update in respect of your assessment of the drainage capacity and strategy of the HGVD and will look to liaise with our consulting engineers who we have requested to review the site and overall drainage strategy to liaise with you with this to agree the strategy and points of discharge for our site once we have a layout agreed, which following our recent pre app enquiry with KMBC is subject to a full review which I'll forward a copy over in due course.

Timescale wise we are targeting a detailed planning submission early in the new year and site start mid 2022 and anticipate discharge requirements late 2022 subject of course to planning.

If you can confirm your likely programme and provide any further details I can forward to AJP to assess.

Kind Regards

Peter Bowen

Pre Commencement Development Manager (Consultant)

Mobile: 07895 415100

Land Line: 01925 885700

Email: peter.bowen@vistrypartnerships.co.uk

Vistry Partnerships North West

Innovation House, Kelburn Court,
Birchwood, Warrington, WA3 6UT



Part of the **Vistry Group**

Vistry Groups charity partner of the year is Mind Mental Health Charity. If you would like to support us and this wonderful charity, please click [Vistry Partnerships North West is fundraising for Mind \(justgiving.com\)](https://justgiving.com/VistryPartnershipsNorthWest) for our fundraising page

This email is confidential and may be legally privileged. If you are not the intended recipient of this email and its attachments you must not copy, distribute, disclose or use them for any purpose. If you have received this email in error, please notify postmaster@vistrygroup.co.uk and delete all copies from your system. Email communications cannot be guaranteed to be secure or free from error or viruses. Vistry Group accepts no liability for any loss or damage which may be caused by viruses. Opinions, conclusions and other information within this email unrelated to the business of Vistry Group are the responsibility of the individual sender. Vistry Group PLC is registered in England and Wales with registered number 306718. The registered office is 11 Tower View, Kings Hill, West Malling, Kent, ME19 4UY. You can view a copy of our privacy policy: <https://www.vistrygroup.co.uk/site-services/privacy/> .

From: Perry, Graham <Graham.Perry@uuplc.co.uk>
Sent: 02 September 2021 17:10
To: Peter Bowen <Peter.Bowen@vistrypartnerships.co.uk>
Cc: Brennan, Adam <Adam.Brennan@uuplc.co.uk>; Wastewater Developer Services <WastewaterDeveloperServices@uuplc.co.uk>; Edwards, Stuart <Stuart.Edwards@uuplc.co.uk>
Subject: FW: PDE 4200042907 Parcel 2C Halsnead drainage Lickers Lane Whiston L35 3PW

NOTE: Email originated outside of Vistry Group.

Hello Peter

Thank you for getting in touch.

We have modelled the existing sewer network surrounding the Halsnead Garden Village Development site and confirmed that, due to the significant increase in discharges into the public sewerage system we need to carry out network reinforcements.

We have excluded surface water from our proposals because we believe that there are a number of surface water bodies across the site that developments can access so you may want to investigate the method of surface water disposal for the site at this time.

We have carried out high level modelling works across the development site and prepared a strategy where all foul sewers will drain south towards the Cherry Tree Farm development where a centralised pumping station will be sited to receive flows. These flows will then be controlled as they are pumped into the public sewer on Lickers Lane.

We are currently working with a developer to provide the outfall for your scheme but nothing has been built to date so we would ask that you delay your planning application until we are able to offer a suitable discharge point.

Could you provide timescales when you are looking to submit your application to the planners and when you realistically need a discharge point for foul discharges.

Thanks

Graham Perry



Graham Perry
Development Engineer
Developer Services
M: 07557 577548
T: 01925 679405
unitedutilities.com

If you have received a great service today why not tell us?
Visit: unitedutilities.com/wow

From: Brennan, Adam
Sent: 23 August 2021 14:57
To: Wastewater Developer Services <WastewaterDeveloperServices@uuplc.co.uk>
Cc: Peter.Bowen@vistrypartnerships.co.uk
Subject: FW: External Mail: RE: Parcel 2C Halsnead drainage

Are you able to log the below please as a pre-dev for Graham Perry to review?

Peter – thanks for your email. I've forwarded on to our wastewater developer services team to log as a pre-development enquiry. The submissions seems like something they'd want to take a look at and provide initial feedback regarding the drainage proposals.

On receipt of the response I'm happy to be part of discussions as you look to submit for planning approval.

Thanks,



Adam Brennan
Planner
Planning, Landscape and Ecology
United Utilities
M: 07584 204 923
unitedutilities.com

If you have received a great service today why not tell us?
Visit: unitedutilities.com/wow

Coronavirus | Prevent the spread



Wash your hands



Disinfect common surfaces



Practise social distancing



Stay home if you have symptoms
FEVER + COUGH

[Click for our message to customers](#)

From: Peter Bowen [mailto:]
Sent: 23 August 2021 14:50
To: Brennan, Adam <Adam.Brennan@uuplc.co.uk>
Subject: FW: External Mail: RE: Parcel 2C Halsnead drainage

EXTERNAL EMAIL This email originated outside of the organisation. Do not click links or open attachments unless you recognise the sender and know the content is safe.

Hi Adam,

I've recently joined Vistry and have been passed your details via Pete Hayes / Clare Appleyard re the above parcel to seek your assistance and guidance in respect of the drainage proposals for the site and to look to understand what UU's improvement proposals are with the existing infrastructure and upgrading.

Also have you been consulted with the adjacent Your Housing Group's Outline application which we are looking to connect.

I attach our draft proposals which following the recent pre app enquiry are currently being re assessed in respect of the access and impact due to the existing trees along the northern boundary and woodland.

I trust this is sufficient and look forward to hearing from you to enable progression with our drainage strategy.

Kind Regards

Peter Bowen

Pre Commencement Development Manager (Consultant)

Mobile: 07895 415100

Land Line: 01925 885700

Email: peter.bowen@vistrypartnerships.co.uk

Vistry Partnerships North West

Innovation House, Kelburn Court,
Birchwood, Warrington, WA3 6UT



Part of the **Vistry Group**

Vistry Groups charity partner of the year is Mind Mental Health Charity. If you would like to support us and this wonderful charity, please click [Vistry Partnerships North West is fundraising for Mind \(justgiving.com\)](https://www.vistrygroup.co.uk/site-services/privacy/) for our fundraising page

This email is confidential and may be legally privileged. If you are not the intended recipient of this email and its attachments you must not copy, distribute, disclose or use them for any purpose. If you have received this email in error, please notify postmaster@vistrygroup.co.uk and delete all copies from your system. Email communications cannot be guaranteed to be secure or free from error or viruses. Vistry Group accepts no liability for any loss or damage which may be caused by viruses. Opinions, conclusions and other information within this email unrelated to the business of Vistry Group are the responsibility of the individual sender. Vistry Group PLC is registered in England and Wales with registered number 306718. The registered office is 11 Tower View, Kings Hill, West Malling, Kent, ME19 4UY. You can view a copy of our privacy policy: <https://www.vistrygroup.co.uk/site-services/privacy/>.

I attach are draft proposals which are currently being reassessed for access and implications with the existing trees and woodland to the northern boundary.

I look forward to hearing from you.

Kind regards

From: Brennan, Adam <Adam.Brennan@uuplc.co.uk>

Sent: 18 August 2021 14:20

To: appleyard, clare <Clare.Appleyard@knowsley.gov.uk>; Pete Hayes <Pete.Hayes@vistrypartnerships.co.uk>

Subject: RE: External Mail: RE: Halsnead drainage

NOTE: Email originated outside of Vistry Group.

Thanks Clare.

Pete – happy to discuss and/or review any plans you may have to date.

 Water for the North West	Adam Brennan Planner Planning, Landscape and Ecology United Utilities M: 07584 204 923 unitedutilities.com
---	---

If you have received a great service today why not tell us?

Visit: unitedutilities.com/wow

Coronavirus | Prevent the spread



Wash your hands



Disinfect common surfaces



Practise social distancing



Stay home if you have symptoms

FEVER + COUGH

[Click for our message to customers](#)

From: appleyard, clare [<mailto:Clare.Appleyard@knowsley.gov.uk>]

Sent: 18 August 2021 10:20

To: Pete.Hayes@vistrypartnerships.co.uk
Cc: Brennan, Adam <Adam.Brennan@uuplc.co.uk>
Subject: FW: External Mail: RE: Halsnead drainage

EXTERNAL EMAIL This email originated outside of the organisation. Do not click links or open attachments unless you recognise the sender and know the content is safe.

Hi Pete
Please see the contact details below at UU.

Adam – this is relation to the pre-app we have for a parcel of land within Halsnead North.
Regards
Clare

 United Utilities Water for the North West	Adam Brennan Planner Planning, Landscape and Ecology United Utilities M: 07584 204 923 unitedutilities.com
--	---

If you have received a great service today why not tell us?
Visit: unitedutilities.com/wow

Coronavirus | Prevent the spread



Wash your hands



Disinfect common surfaces

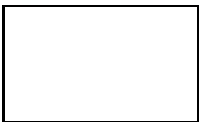


Practise social distancing



Stay home if you have symptoms
FEVER + COUGH

[Click for our message to customers](#)



This e-mail and any attachments are confidential. It may contain privileged information and is intended for the named recipient(s) only. It must not be distributed without consent. If you are not one of the intended recipients, please notify the sender immediately and do not disclose, distribute, or retain this email or any part of it and do not take any action based on it.

Unless expressly stated, opinions in this email are those of the individual sender, and not of Knowsley MBC. Legally binding obligations can only be created for, or be entered into on behalf of, Knowsley MBC by duly authorised officers or representatives.

Knowsley MBC excludes any liability whatsoever for any offence caused, any direct or consequential loss arising from the use, or reliance on, this e-mail or its contents. We believe but do not warrant that this e-mail and any attachments are virus free. You must therefore take full responsibility for virus checking and no responsibility is accepted for loss or damage arising from viruses or changes made to this message after it was sent. Knowsley MBC reserves the right to monitor and/or record all e-mail communications through its network in accordance with relevant legislation.

The information contained in this e-mail is intended only for the individual to whom it is addressed. It may contain legally privileged or confidential information or otherwise be exempt from disclosure. If you have received this Message in error or there are any problems, please notify the sender

immediately and delete the message from your computer. You must not use, disclose, copy or alter this message for any unauthorised purpose. Neither United Utilities Group PLC nor any of its subsidiaries will be liable for any direct, special, indirect or consequential damages as a result of any virus being passed on, or arising from the alteration of the contents of this message by a third party.

United Utilities Group PLC, Haweswater House, Lingley Mere
Business Park, Lingley Green Avenue, Great Sankey,
Warrington, WA5 3LP
Registered in England and Wales. Registered No 6559020

www.unitedutilities.com

www.unitedutilities.com/subsidiaries

This email is confidential and may be legally privileged. If you are not the intended recipient of this email and its attachments you must not copy, distribute, disclose or use them for any purpose. If you have received this email in error, please notify postmaster@vistrygroup.co.uk and delete all copies from your system.

Email communications cannot be guaranteed to be secure or free from error or viruses. Vistry Group accepts no liability for any loss or damage which may be caused by viruses. Opinions, conclusions and other information within this email unrelated to the business of Vistry Group are the responsibility of the individual sender. Vistry Group PLC is registered in England and Wales with registered number 306718.

The registered office is 11 Tower View, Kings Hill, West Malling, Kent, ME19 4UY. You can view a copy of our privacy policy: <https://www.vistrygroup.co.uk/site-services/privacy/>.

This email is confidential and may be legally privileged. If you are not the intended recipient of this email and its attachments you must not copy, distribute, disclose or use them for any purpose. If you have received this email in error, please notify postmaster@vistrygroup.co.uk and delete all copies from your system.

Email communications cannot be guaranteed to be secure or free from error or viruses. Vistry Group accepts no liability for any loss or damage which may be caused by viruses. Opinions, conclusions and other information within this email unrelated to the business of Vistry Group are the responsibility of the individual sender. Vistry Group PLC is registered in England and Wales with registered number 306718.

The registered office is 11 Tower View, Kings Hill, West Malling, Kent, ME19 4UY. You can view a copy of our privacy policy: <https://www.vistrygroup.co.uk/site-services/privacy/>.

Appendix G – Greenfield Runoff Calculations

The Alan Johnston Partnership		Page 1
1 Dale Street Liverpool L2 2ET	221-130 Lickers Lane Greenfield Runoff Rates	
Date 22/07/2022 13:39 File	Designed by JRS Checked by KOB	
Micro Drainage	Source Control 2019.1	

ICP SUDS Mean Annual Flood

Input

Return Period (years) 1 SAAR (mm) 865 Urban 0.000
Area (ha) 3.410 Soil 0.450 Region Number Region 10

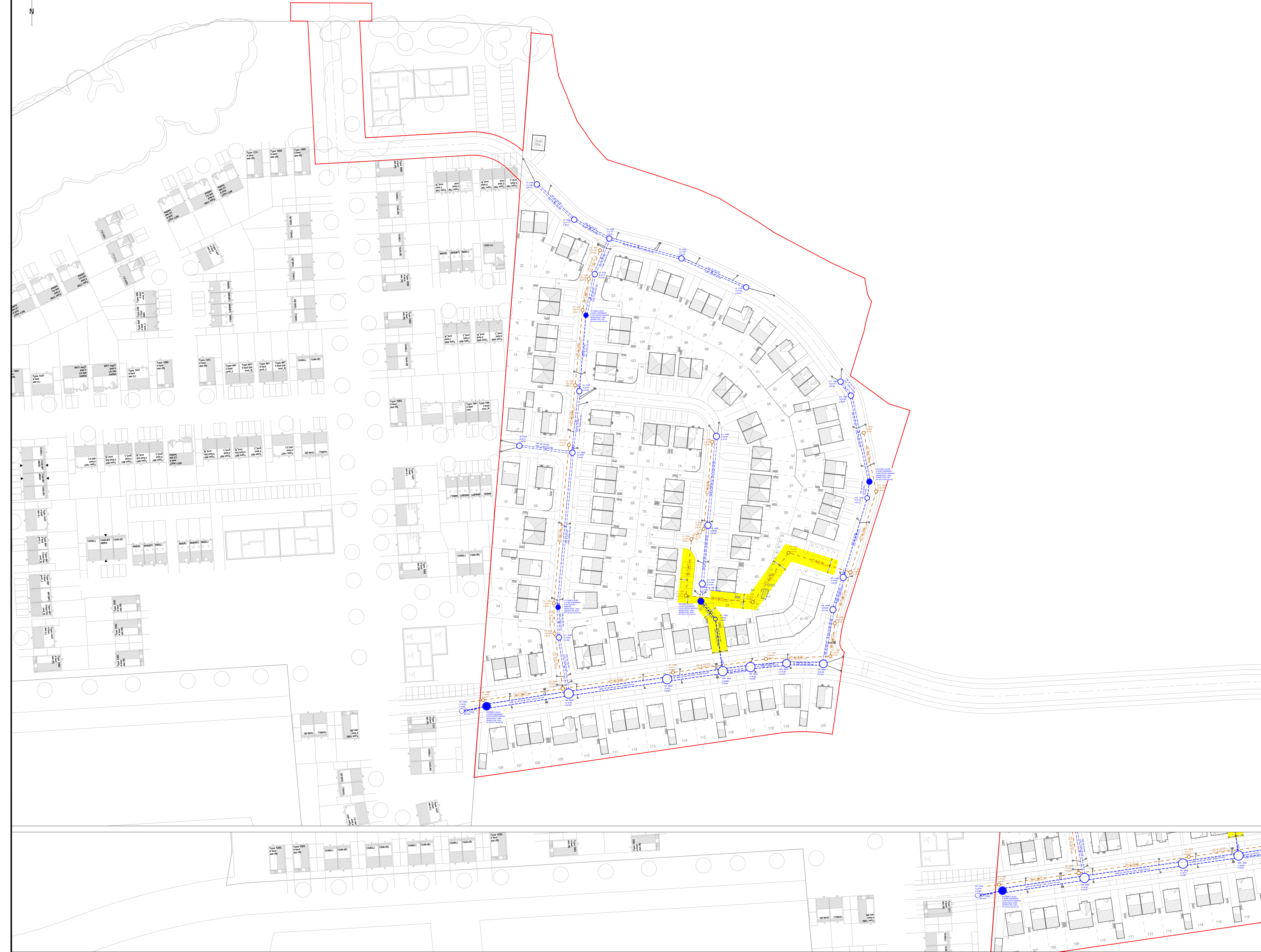
Results l/s

QBAR Rural 19.2
QBAR Urban 19.2

Q1 year 16.7

Q1 year 16.7
Q30 years 32.5
Q100 years 39.9

Appendix H – Drainage Strategy Drawing & SW Drainage Calculations



SURFACE WATER

TOTAL SITE AREA: 2.59 ha

EXISTING RUN-OFF RATES:

- $\bar{Q} = 14.7 \text{ l/s}$

PROPOSED SITE IMPERMEABLE AREA: 1.20 ha (approx.)

SURFACE WATER IS INTENDED TO DISCHARGE SOUTH-WEST OF THE SITE DIRECTLY INTO THE EXISTING UU STORM NETWORK.

STORM EVENTS UP TO AND INCLUDING THE 1:30 YEAR EVENT IS PROVIDED IN THE OVERSIZED PIPE NETWORK.

ADDITIONAL ATTENUATION IS PROVIDED IN PRIVATE STORM ATTENUATION CRATES FOR STORMS IN EXCESS OF THE 1:30 YEAR EVENT, UP TO AND INCLUDING THE 1:100 YEAR + 40% CLIMATE CHANGE EVENT.

THE PROPOSED GRADIENTS WILL ALLOW A GRAVITY NETWORK TO DISCHARGE INTO THE EXISTING UU STORM NETWORK LOCATED TO THE SOUTH-WEST OF THE SITE.

FOUL WATER

THE PROPOSED FOUL WATER NETWORK WILL FOLLOW THE PROPOSED SITE GRADIENTS TO ENSURE DEPTHS ARE KEPT TO A MINIMUM AND THE CLOSEST POINT OF CONNECTION TO THE EXISTING SEWER NETWORK CAN BE MADE.

FOUL WATER WILL DISCHARGE UNRESTRICTED BY GRAVITY TO THE PROPOSED FOUL WATER NETWORK DUE TO BE CONSTRUCTED IN THE SOUTHERN SPINE ROAD.

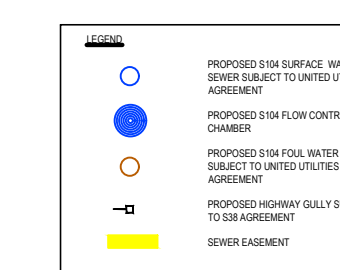
GENERAL NOTES

1. SETTING OUT SHALL BE UNDERTAKEN USING ONLY THE INFORMATION GIVEN. DISTANCES SHOULD NOT BE SCALED FROM THIS DRAWING.
2. THE MINIMUM SHALL BE CONSTRUCTED ACCORDING TO SPECIFICATIONS FOR ADOPTION OF 14TH EDITION AND UNITED UTILITIES DESIGN GUIDELINES.
3. THE MINIMUM (SHAW) P.V. DRAINER UNDER ADOPTABLE HIGHWAYS SHALL BE 150mm
4. IT IS THE RESPONSIBILITY OF ALL SEWERERS TO VERIFY ALL INFORMATION GIVEN WITH REGARDS TO EXISTING SERVICES AND DRAINAGE CONNECTIONS. EIGHTY PER CENT OF THE WORKS. THE RATES SHALL INCLUDE THE COST OF ALL SERVICES WHERE NECESSARY. THE CONTRACTOR SHALL ADHERE TO THE CITY OF DUBLIN REGULATIONS AT ALL TIMES.
5. THE OUTSIDES OF ALL SEWERS SHALL BE A MINIMUM OF 1.2m FROM FINDER LINES AND THE OUTSIDE OF MANHOLES SHALL BE A MINIMUM OF 3.0m FROM LINES
6. EXISTING FLOWS IN WATERCOURSES, SEWERS AND LAND DRAINS SHALL BE MAINTAINED AT ALL TIMES
7. ONLY TRAINED PERSONNEL SHALL BE PERMITTED TO ENTER CONFINED SPACES
8. ALL METHODS TO BE USED TO RELAY THE S. ATTEMPT AND COMPLY WITH THE SPECIFICATIONS FOR ALL CONNECTIONS TO BE MADE. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING THE SITE INVESTIGATION REPORT PROVES THAT SULPHATE ACID FROM SOILS AND GROUNDWATER WILL NOT OCCUR TO WITHSTAND A CLASS
9. ALL OPENING NOTICES ARE AS REQUIRED UNDER LOCAL ACTS ARE TO BE OBTAINED PRIOR TO COMMENCEMENT OF WORKS. ALL WORKS ARE TO BE INSPECTED BY A N.C.I. OR THE NETWORK OPERATOR OF THE DRAINAGE
10. WHERE "ULTRA R.P." UVPC PIPES (OR SIMILAR APPROVED) ARE TO BE ADOPTED IN CONNECTION DRAINING, THEY SHALL BE LAPPED AND LAD IN ACCORDANCE WITH THE SPECIFICATION AND QUANTITY SHOULD BE THE HIGH PERFORMANCE PIPE
11. A CLASS B AND SUBORDINATE NOT BE USED FOR SUCH PURPOSES. TRENCH BACKFILL, HIGHWAYS TO WITHIN OF HIGHWAY SHALL, AS DIRECTED BY THE HIGHWAY AUTHORITY BY A SATISFACTORY GRANULAR MATERIAL ALL IN ACCORDANCE WITH THE SPECIFICATIONS FOR ADOPTION OF 14TH EDITION AND UNITED UTILITIES DESIGN GUIDELINES
12. S.S. LEVELS SHALL NOT BE VARYED WITHOUT REFERENCE TO THE ENGINEER FOR GRADUAL
13. DOMESTIC CHARGE SHALL BE BUILDING REGULATIONS APPROVED DOCUMENT H. 150mm U.P.V.C. PIPES LAD TO THE FOLLOWING MINIMUM FALLS (UNLESS OTHERWISE SHOWN).
- | | FOAL | S.W |
|-----------|----------|----------|
| HEAD IN | 1 IN 100 | 1 IN 100 |
| ELSEWHERE | 1 IN 100 | 1 IN 100 |

- CLASS 'S' BEDDING AND SURROUND TO BE USED WHERE MINIMUM COVER IS ACHIEVED.
- WHERE MINIMUM COVER IS NOT ACHIEVED CLASS 'Z' BEDDING AND SURROUND (CONCRETE ENCASEMENT) IS TO BE USED

REFER TO UNITED UTILITIES STANDARD DRAWINGS FOR
CONSTRUCTION DETAILS

- STDND/19/001 - TYPE 1 MANHOLE
- STDND/19/002 - TYPE 2 MANHOLE & INVERT ACCESS DETAIL
- STDND/19/003 - SHALLOW MANHOLE DETAIL FOR SMALL DIAMETER PIPES
- STDND/19/004 - SHALLOW SW MANHOLE DETAIL
- STDND/19/007 - EXTERNAL AND INTERNAL BACKDROPS
- STDND/19/008 - PIPE EMBEDMENT DETAILS
- STDND/19/010 - VARIABLE MANHOLE GUIDANCE NOTES



P4	02.09.2022	UPDATED TO SUIT LATEST SITE LAYOUT	JP	KOB	KC
P3	24.08.2022	UPDATED TO SUIT LATEST SITE LAYOUT	JP	KOB	KC
P2	22.07.2022	UPDATED TO SUIT LATEST SITE LAYOUT	JP	KOB	KC
P1	02.12.2021	PRELIMINARY ISSUE	LS	KOB	KC
REV	DATE	DESCRIPTION	BY	CHK	APP

PRELIMINARY

CLIENT:

VISTRY PARTNERSHIPS

ARCHITECT

MPSI

PROJECT

HALSNEAD GARDEN VILLAGE
LICKERS LANE
WHISTON

TITLE: DRAINAGE STRATEGY
MASTERPLAN

STATUS:	PROJECT No.	PROJECT	ORIGINATOR	VOL	SY	LEVEL	TYPE	ROLE	DRAWING No.	REV.
S2	221-130	HLL - AJP	- XX	- 00	- DR	- C	- 0900		P04	
SCALE @ AD:	DESIGNED:	DRAWN:	CHECKED:	APPROVED:	DATE:					
1:500	IS	IS	AMC	KOR	NOV 2021					

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)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.391	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	3.000
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

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	28.778	0.072	399.7	0.078	5.00	0.0	0.600	o	750	Pipe/Conduit	
1.001	30.470	0.076	400.9	0.078	0.00	0.0	0.600	o	750	Pipe/Conduit	
2.000	20.701	0.052	398.1	0.030	5.00	0.0	0.600	o	750	Pipe/Conduit	
2.001	16.177	0.040	404.4	0.029	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.002	15.601	0.038	410.6	0.021	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.003	17.000	0.043	395.3	0.000	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.004	30.884	1.206	25.6	0.025	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.005	25.108	0.126	199.3	0.125	0.00	0.0	0.600	o	750	Pipe/Conduit	
3.000	21.687	0.055	394.3	0.064	5.00	0.0	0.600	o	750	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.34	49.220	0.078	0.0	0.0	0.0	1.39	615.7	10.6
1.001	50.00	5.71	49.148	0.156	0.0	0.0	0.0	1.39	614.7	21.1
2.000	50.00	5.25	49.164	0.030	0.0	0.0	0.0	1.40	616.9	4.1
2.001	50.00	5.44	49.112	0.059	0.0	0.0	0.0	1.39	612.0	8.0
1.002	50.00	5.90	49.072	0.236	0.0	0.0	0.0	1.37	607.4	32.0
1.003	50.00	6.10	49.034	0.236	0.0	0.0	0.0	1.40	619.1	32.0
1.004	50.00	5.26	48.991	0.000	5.0	0.0	0.0	2.00	35.3	5.0
1.005	50.00	5.47	45.000	0.125	5.0	0.0	0.0	1.98	874.2	21.9
3.000	50.00	5.26	44.929	0.064	0.0	0.0	0.0	1.40	619.9	8.7

The Alan Johnston Partnership		Page 2
1 Dale Street Liverpool L2 2ET		
Date 02/09/2022 09:17	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.09.01.MDX	Checked by	
XP Solutions	Network 2018.1.1	

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
1.006	62.905	0.157	400.7	0.075	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.007	12.204	0.031	393.7	0.120	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.008	23.323	0.062	376.2	0.049	0.00	0.0	0.600	o	750	Pipe/Conduit	
4.000	7.038	0.018	391.0	0.044	5.00	0.0	0.600	o	750	Pipe/Conduit	
4.001	35.690	0.089	401.0	0.035	0.00	0.0	0.600	o	750	Pipe/Conduit	
4.002	6.676	0.150	44.5	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.003	33.651	1.500	22.4	0.059	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.004	13.696	0.034	402.8	0.044	0.00	0.0	0.600	o	900	Pipe/Conduit	
4.005	22.286	0.056	398.0	0.027	0.00	0.0	0.600	o	900	Pipe/Conduit	
4.006	14.917	0.037	403.2	0.015	0.00	0.0	0.600	o	1200	Pipe/Conduit	
4.007	14.669	0.037	396.5	0.021	0.00	0.0	0.600	o	1500	Pipe/Conduit	
4.008	11.573	0.029	400.0	0.168	0.00	0.0	0.600	o	1800	Pipe/Conduit	
5.000	36.241	0.091	398.3	0.145	5.00	0.0	0.600	o	900	Pipe/Conduit	
5.001	23.839	0.060	397.3	0.074	0.00	0.0	0.600	o	900	Pipe/Conduit	
5.002	7.101	0.018	394.5	0.080	0.00	0.0	0.600	o	900	Pipe/Conduit	
5.003	9.274	0.057	162.7	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.004	21.280	0.130	163.7	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.009	22.489	0.056	401.6	0.000	0.00	0.0	0.600	o	1800	Pipe/Conduit	
4.010	40.714	0.102	399.2	0.148	0.00	0.0	0.600	o	1800	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.006	50.00	6.22	44.874	0.264	5.0	0.0	0.0	1.39	614.9	40.7
1.007	50.00	6.37	41.892	0.384	5.0	0.0	0.0	1.40	620.4	57.0
1.008	50.00	6.64	41.861	0.433	5.0	0.0	0.0	1.44	634.8	63.6
4.000	50.00	5.08	47.000	0.044	0.0	0.0	0.0	1.41	622.5	6.0
4.001	50.00	5.51	46.982	0.079	0.0	0.0	0.0	1.39	614.6	10.7
4.002	50.00	5.58	46.893	0.079	0.0	0.0	0.0	1.51	26.7	10.7
4.003	50.00	5.85	46.793	0.138	0.0	0.0	0.0	2.14	37.7	18.7
4.004	50.00	5.99	42.000	0.182	0.0	0.0	0.0	1.55	989.2	24.6
4.005	50.00	6.23	41.966	0.209	0.0	0.0	0.0	1.56	995.3	28.3
4.006	50.00	6.37	41.610	0.224	0.0	0.0	0.0	1.86	2100.2	30.3
4.007	50.00	6.48	41.273	0.245	0.0	0.0	0.0	2.15	3796.0	33.2
4.008	50.00	6.56	40.936	0.413	0.0	0.0	0.0	2.39	6084.1	55.9
5.000	50.00	5.39	44.750	0.145	0.0	0.0	0.0	1.56	994.9	19.6
5.001	50.00	5.64	44.659	0.219	0.0	0.0	0.0	1.57	996.1	29.7
5.002	50.00	5.72	44.599	0.299	0.0	0.0	0.0	1.57	999.7	40.5
5.003	50.00	5.15	44.581	0.000	15.0	0.0	0.0	1.02	40.6	15.0
5.004	50.00	5.50	44.524	0.000	15.0	0.0	0.0	1.02	40.5	15.0
4.009	50.00	6.72	40.907	0.413	15.0	0.0	0.0	2.39	6072.0	70.9
4.010	50.00	7.00	40.851	0.561	15.0	0.0	0.0	2.39	6090.6	91.0

The Alan Johnston Partnership		Page 3
1 Dale Street Liverpool L2 2ET		
Date 02/09/2022 09:17	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.09.01.MDX	Checked by	
XP Solutions	Network 2018.1.1	

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
1.009	33.634	0.084	400.4	0.172	0.00	0.0	0.600	o	1800	Pipe/Conduit	
1.010	10.232	0.300	34.1	0.000	0.00	0.0	0.600	o	300	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)
1.009	50.00	7.23	40.749	1.166	20.0	0.0	0.0	2.39	6081.1	177.9
1.010	50.00	5.06	40.665	0.000	19.2	0.0	0.0	2.70	190.9	19.2

The Alan Johnston Partnership		Page 4
1 Dale Street Liverpool L2 2ET		
Date 02/09/2022 09:17	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.09.01.MDX	Checked by	
XP Solutions	Network 2018.1.1	

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	51.810	2.590	Open Manhole	2100	1.000	49.220	750				
2	51.451	2.303	Open Manhole	2100	1.001	49.148	750	1.000	49.148	750	
3	51.524	2.360	Open Manhole	2100	2.000	49.164	750				
4	51.717	2.605	Open Manhole	2100	2.001	49.112	750	2.000	49.112	750	
5	51.577	2.505	Open Manhole	2100	1.002	49.072	750	1.001	49.072	750	
								2.001	49.072	750	
6	52.151	3.117	Open Manhole	2100	1.003	49.034	750	1.002	49.034	750	
7	52.381	3.390	Open Manhole	2100	1.004	48.991	150	1.003	48.991	750	
8	50.910	5.910	Open Manhole	2100	1.005	45.000	750	1.004	47.785	150	2185
9	49.157	4.228	Open Manhole	2100	3.000	44.929	750				
10	49.655	4.781	Open Manhole	2100	1.006	44.874	750	1.005	44.874	750	
								3.000	44.874	750	
11	46.847	4.955	Open Manhole	2100	1.007	41.892	750	1.006	44.717	750	2825
12	46.598	4.737	Open Manhole	2100	1.008	41.861	750	1.007	41.861	750	
13	51.081	4.081	Open Manhole	2100	4.000	47.000	750				
14	50.082	3.100	Open Manhole	2100	4.001	46.982	750	4.000	46.982	750	
16	48.200	1.307	Open Manhole	2100	4.002	46.893	150	4.001	46.893	750	
16a	47.750	1.007	Open Manhole	1500	4.003	46.793	150	4.002	46.743	150	
23	46.906	4.906	Open Manhole	2400	4.004	42.000	900	4.003	45.293	150	2543
24	46.681	4.715	Open Manhole	2400	4.005	41.966	900	4.004	41.966	900	
25	46.386	4.776	Open Manhole	3000	4.006	41.610	1200	4.005	41.910	900	
25a	46.386	5.113	Open Manhole	3000	4.007	41.273	1500	4.006	41.573	1200	
26	46.082	5.146	Open Manhole	3600	4.008	40.936	1800	4.007	41.236	1500	
17	50.302	5.552	Open Manhole	2400	5.000	44.750	900				
18	48.488	3.829	Open Manhole	2400	5.001	44.659	900	5.000	44.659	900	
19	47.296	2.697	Open Manhole	2400	5.002	44.599	900	5.001	44.599	900	
20	47.310	2.729	Open Manhole	2400	5.003	44.581	225	5.002	44.581	900	
21	46.500	1.976	Open Manhole	1500	5.004	44.524	225	5.003	44.524	225	
26A	46.000	5.093	Open Manhole	3600	4.009	40.907	1800	4.008	40.907	1800	
								5.004	44.394	225	1912
27	46.171	5.320	Open Manhole	3600	4.010	40.851	1800	4.009	40.851	1800	
28	46.282	5.533	Open Manhole	3600	1.009	40.749	1800	1.008	41.799	750	
								4.010	40.749	1800	
29	46.240	5.575	Open Manhole	3600	1.010	40.665	300	1.009	40.665	1800	
37	46.240	5.875	Open Manhole	0		OUTFALL		1.010	40.365	300	

The Alan Johnston Partnership		Page 5
1 Dale Street Liverpool L2 2ET		
Date 02/09/2022 09:17	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.09.01.MDX	Checked by	
XP Solutions	Network 2018.1.1	

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 7, DS/PN: 1.004, Volume (m³): 18.3

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)	48.991
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

Hydro-Brake® Optimum Manhole: 11, DS/PN: 1.007, Volume (m³): 44.0

Unit Reference	MD-SHE-0232-3000-1400-3000
Design Head (m)	1.400
Design Flow (l/s)	30.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	232
Invert Level (m)	41.892
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.400	30.0	Kick-Flo®	0.967	25.1
Flush-Flo™	0.444	30.0	Mean Flow over Head Range	-	25.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as

The Alan Johnston Partnership		Page 6
1 Dale Street Liverpool L2 2ET		
Date 02/09/2022 09:17	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.09.01.MDX	Checked by	
XP Solutions	Network 2018.1.1	

Hydro-Brake® Optimum Manhole: 11, DS/PN: 1.007, Volume (m³): 44.0

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	7.7	0.800	28.3	2.000	35.6	4.000	49.7	7.000	65.2
0.200	23.3	1.000	25.5	2.200	37.3	4.500	52.6	7.500	67.4
0.300	29.2	1.200	27.9	2.400	38.9	5.000	55.4	8.000	69.6
0.400	29.9	1.400	30.0	2.600	40.4	5.500	58.0	8.500	71.7
0.500	29.9	1.600	32.0	3.000	43.3	6.000	60.5	9.000	73.7
0.600	29.5	1.800	33.8	3.500	46.6	6.500	62.9	9.500	75.7

Hydro-Brake® Optimum Manhole: 16, DS/PN: 4.002, Volume (m³): 19.4

Unit Reference	MD-SHE-0102-5000-1250-5000
Design Head (m)	1.250
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	102
Invert Level (m)	46.893
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)	1.250	5.0	Kick-Flo®	0.772	4.0
Flush-Flo™	0.370	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	6.2	4.000	8.6	7.000	11.2
0.200	4.7	1.000	4.5	2.200	6.5	4.500	9.1	7.500	11.6
0.300	5.0	1.200	4.9	2.400	6.8	5.000	9.6	8.000	12.0
0.400	5.0	1.400	5.3	2.600	7.0	5.500	10.0	8.500	12.3
0.500	4.9	1.600	5.6	3.000	7.5	6.000	10.4	9.000	12.7
0.600	4.7	1.800	5.9	3.500	8.1	6.500	10.9	9.500	13.0

Hydro-Brake® Optimum Manhole: 20, DS/PN: 5.003, Volume (m³): 15.3

Unit Reference	MD-SHE-0172-1500-1200-1500
Design Head (m)	1.200
Design Flow (l/s)	15.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface

The Alan Johnston Partnership		Page 7
1 Dale Street Liverpool L2 2ET		
Date 02/09/2022 09:17	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.09.01.MDX	Checked by	
XP Solutions	Network 2018.1.1	

Hydro-Brake® Optimum Manhole: 20, DS/PN: 5.003, Volume (m³): 15.3

Sump Available Yes
Diameter (mm) 172
Invert Level (m) 44.581
Minimum Outlet Pipe Diameter (mm) 225
Suggested Manhole Diameter (mm) 1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	15.0	Kick-Flo®	0.805	12.4
Flush-Flo™	0.364	15.0	Mean Flow over Head Range	-	12.9

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	6.1	0.800	12.5	2.000	19.1	4.000	26.6	7.000	34.9
0.200	14.1	1.000	13.8	2.200	20.0	4.500	28.2	7.500	36.1
0.300	14.9	1.200	15.0	2.400	20.9	5.000	29.7	8.000	37.2
0.400	15.0	1.400	16.1	2.600	21.7	5.500	31.1	8.500	38.3
0.500	14.8	1.600	17.2	3.000	23.2	6.000	32.4	9.000	39.4
0.600	14.4	1.800	18.2	3.500	25.0	6.500	33.7	9.500	40.4

Hydro-Brake® Optimum Manhole: 29, DS/PN: 1.010, Volume (m³): 133.2

Unit Reference MD-SHE-0162-1920-3250-1920
Design Head (m) 3.250
Design Flow (l/s) 19.2
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 162
Invert Level (m) 40.665
Minimum Outlet Pipe Diameter (mm) 225
Suggested Manhole Diameter (mm) 1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	3.250	19.2	Kick-Flo®	1.455	13.1
Flush-Flo™	0.712	16.6	Mean Flow over Head Range	-	15.5

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	5.8	0.500	16.2	1.200	15.4	2.000	15.2	3.000	18.5
0.200	13.0	0.600	16.5	1.400	13.8	2.200	15.9	3.500	19.9
0.300	14.7	0.800	16.6	1.600	13.7	2.400	16.6	4.000	21.2
0.400	15.7	1.000	16.2	1.800	14.5	2.600	17.2	4.500	22.4

Hydro-Brake® Optimum Manhole: 29, DS/PN: 1.010, Volume (m³): 133.2

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)
5.000	23.6	6.000	25.7	7.000	27.7	8.000	29.6	9.000	31.3
5.500	24.7	6.500	26.7	7.500	28.7	8.500	30.4	9.500	32.1

The Alan Johnston Partnership		Page 9
1 Dale Street Liverpool L2 2ET		
Date 02/09/2022 09:17	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.09.01.MDX	Checked by	
XP Solutions	Network 2018.1.1	

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 5 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.389 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status ON
 DVD Status OFF
 Inertia Status OFF

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 2, 100
 Climate Change (%) 0, 0, 40

PN	US/MH		Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	Surcharged Depth	Flooded Volume
	Name	Storm							(m)	(m)	(m³)
1.000	1	120 Winter	100	+40%	100/30 Summer				51.434	1.464	0.000
1.001	2	120 Winter	100	+40%	100/30 Summer				51.434	1.536	0.000
2.000	3	120 Winter	100	+40%	100/30 Summer				51.434	1.520	0.000
2.001	4	120 Winter	100	+40%	100/15 Winter				51.434	1.572	0.000
1.002	5	120 Winter	100	+40%	100/15 Winter				51.434	1.612	0.000
1.003	6	120 Winter	100	+40%	100/15 Winter				51.433	1.649	0.000
1.004	7	120 Winter	100	+40%	1/15 Summer				51.433	2.292	0.000
1.005	8	30 Winter	100	+40%	100/15 Winter				46.670	0.920	0.000
3.000	9	30 Winter	100	+40%	100/15 Winter				46.669	0.990	0.000
1.006	10	30 Winter	100	+40%	100/15 Summer				46.668	1.044	0.000
1.007	11	30 Winter	100	+40%	1/15 Summer				46.661	4.019	0.000
1.008	12	240 Winter	100	+40%	100/30 Winter				45.749	3.138	0.000
4.000	13	60 Winter	100	+40%					47.667	-0.083	0.000
4.001	14	60 Winter	100	+40%					47.667	-0.065	0.000
4.002	16	60 Winter	100	+40%	1/15 Summer				47.667	0.624	0.000
4.003	16a	15 Winter	100	+40%	100/15 Summer				47.144	0.201	0.000
4.004	23	240 Winter	100	+40%	100/60 Summer				45.748	2.848	0.000
4.005	24	240 Winter	100	+40%	100/60 Summer				45.748	2.882	0.000
4.006	25	240 Winter	100	+40%	100/60 Summer				45.748	2.938	0.000
4.007	25a	240 Winter	100	+40%	100/60 Summer				45.748	2.975	0.000
4.008	26	240 Winter	100	+40%	100/30 Winter				45.748	3.012	0.000
5.000	17	60 Winter	100	+40%	100/15 Summer				47.246	1.596	0.000

The Alan Johnston Partnership		Page 10
1 Dale Street Liverpool L2 2ET		
Date 02/09/2022 09:17	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.09.01.MDX	Checked by	
XP Solutions	Network 2018.1.1	

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

PN	US/MH Name	Flow / Overflow		Pipe Flow	Status	Level
		Cap.	(l/s)	(l/s)		Exceeded
1.000	1	0.03		13.6	SURCHARGED	
1.001	2	0.04		18.4	FLOOD RISK	
2.000	3	0.01		4.2	FLOOD RISK	
2.001	4	0.01		2.6	FLOOD RISK	
1.002	5	0.04		11.8	FLOOD RISK	
1.003	6	0.02		6.6	SURCHARGED	
1.004	7	0.21		7.0	SURCHARGED	
1.005	8	0.10		60.7	SURCHARGED	
3.000	9	0.05		23.9	SURCHARGED	
1.006	10	0.15		82.5	SURCHARGED	
1.007	11	0.16		52.2	FLOOD RISK	
1.008	12	0.09		40.8	SURCHARGED	
4.000	13	0.04		12.3	OK	
4.001	14	0.04		19.9	OK	
4.002	16	0.22		5.0	SURCHARGED	
4.003	16a	1.06		38.7	SURCHARGED	
4.004	23	0.03		15.1	SURCHARGED	
4.005	24	0.03		17.1	SURCHARGED	
4.006	25	0.02		15.1	SURCHARGED	
4.007	25a	0.01		11.5	SURCHARGED	
4.008	26	0.01		15.9	SURCHARGED	
5.000	17	0.05		40.0	SURCHARGED	

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

			US/MH		Return Climate		First (X)		First (Y)		First (Z)		Overflow		Water Level	Surcharged Depth	Flooded Volume
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)	(m)	(m³)						
5.001	18	60 Winter	100	+40%	100/15 Summer				47.245	1.686	0.000						
5.002	19	60 Winter	100	+40%	100/15 Summer				47.244	1.745	0.000						
5.003	20	60 Winter	100	+40%	1/15 Summer				47.243	2.437	0.000						
5.004	21	240 Winter	100	+40%	100/120 Summer				45.754	1.005	0.000						
4.009	26A	240 Winter	100	+40%	100/30 Winter				45.748	3.041	0.000						
4.010	27	240 Winter	100	+40%	100/30 Winter				45.748	3.097	0.000						
1.009	28	240 Winter	100	+40%	100/30 Summer				45.748	3.199	0.000						
1.010	29	240 Winter	100	+40%	1/15 Summer				45.748	4.783	0.000						

			US/MH		Pipe		Flow / Overflow		Flow		Level	
PN	Name	Cap.	(l/s)	(l/s)	Status	Exceeded						
5.001	18	0.04		29.4	SURCHARGED							
5.002	19	0.07		32.7	FLOOD RISK							
5.003	20	0.64		21.6	FLOOD RISK							
5.004	21	0.44		16.2	SURCHARGED							
4.009	26A	0.01		21.8	FLOOD RISK							
4.010	27	0.01		20.7	SURCHARGED							
1.009	28	0.01		38.3	SURCHARGED							
1.010	29	0.17		23.8	SURCHARGED							

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)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.391	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	3.000
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

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	28.778	0.072	399.7	0.078	5.00	0.0	0.600	o	750	Pipe/Conduit	
1.001	30.470	0.076	400.9	0.078	0.00	0.0	0.600	o	750	Pipe/Conduit	
2.000	20.701	0.052	398.1	0.030	5.00	0.0	0.600	o	750	Pipe/Conduit	
2.001	16.177	0.040	404.4	0.029	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.002	15.601	0.038	410.6	0.021	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.003	17.000	0.043	395.3	0.000	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.004	30.884	1.206	25.6	0.025	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.005	25.108	0.126	199.3	0.125	0.00	0.0	0.600	o	750	Pipe/Conduit	
3.000	21.687	0.055	394.3	0.064	5.00	0.0	0.600	o	750	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.34	49.220	0.078	0.0	0.0	0.0	1.39	615.7	10.6
1.001	50.00	5.71	49.148	0.156	0.0	0.0	0.0	1.39	614.7	21.1
2.000	50.00	5.25	49.164	0.030	0.0	0.0	0.0	1.40	616.9	4.1
2.001	50.00	5.44	49.112	0.059	0.0	0.0	0.0	1.39	612.0	8.0
1.002	50.00	5.90	49.072	0.236	0.0	0.0	0.0	1.37	607.4	32.0
1.003	50.00	6.10	49.034	0.236	0.0	0.0	0.0	1.40	619.1	32.0
1.004	50.00	5.26	48.991	0.000	5.0	0.0	0.0	2.00	35.3	5.0
1.005	50.00	5.47	45.000	0.125	5.0	0.0	0.0	1.98	874.2	21.9
3.000	50.00	5.26	44.929	0.064	0.0	0.0	0.0	1.40	619.9	8.7

The Alan Johnston Partnership		Page 2
1 Dale Street Liverpool L2 2ET		
Date 16/08/2022 12:58	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.08.10.MDX	Checked by	
XP Solutions	Network 2018.1.1	

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
1.006	62.905	0.157	400.7	0.075	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.007	12.204	0.031	393.7	0.120	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.008	23.323	0.062	376.2	0.049	0.00	0.0	0.600	o	750	Pipe/Conduit	
4.000	7.038	0.018	391.0	0.044	5.00	0.0	0.600	o	750	Pipe/Conduit	
4.001	35.690	0.089	401.0	0.035	0.00	0.0	0.600	o	750	Pipe/Conduit	
4.002	6.676	0.150	44.5	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.003	33.651	1.500	22.4	0.059	0.00	0.0	0.600	o	150	Pipe/Conduit	
5.000	36.273	0.091	398.6	0.145	5.00	0.0	0.600	o	900	Pipe/Conduit	
5.001	23.838	0.060	397.3	0.074	0.00	0.0	0.600	o	900	Pipe/Conduit	
5.002	7.100	0.018	394.4	0.080	0.00	0.0	0.600	o	900	Pipe/Conduit	
5.003	22.171	0.135	164.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.004	23.078	0.154	149.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.005	23.154	0.500	46.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.004	13.696	0.034	402.8	0.044	0.00	0.0	0.600	o	900	Pipe/Conduit	
4.005	22.286	0.056	398.0	0.027	0.00	0.0	0.600	o	900	Pipe/Conduit	
4.006	14.917	0.037	403.2	0.015	0.00	0.0	0.600	o	1200	Pipe/Conduit	
4.007	14.669	0.037	396.5	0.021	0.00	0.0	0.600	o	1500	Pipe/Conduit	
4.008	34.057	0.085	400.7	0.168	0.00	0.0	0.600	o	1800	Pipe/Conduit	
4.009	40.714	0.102	399.2	0.148	0.00	0.0	0.600	o	1800	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)
1.006	50.00	6.22	44.874	0.264	5.0	0.0	0.0	1.39	614.9	40.7
1.007	50.00	6.37	41.892	0.384	5.0	0.0	0.0	1.40	620.4	57.0
1.008	50.00	6.64	41.861	0.433	5.0	0.0	0.0	1.44	634.8	63.6
4.000	50.00	5.08	47.000	0.044	0.0	0.0	0.0	1.41	622.5	6.0
4.001	50.00	5.51	46.982	0.079	0.0	0.0	0.0	1.39	614.6	10.7
4.002	50.00	5.58	46.893	0.079	0.0	0.0	0.0	1.51	26.7	10.7
4.003	50.00	5.85	46.793	0.138	0.0	0.0	0.0	2.14	37.7	18.7
5.000	50.00	5.39	44.750	0.145	0.0	0.0	0.0	1.56	994.5	19.6
5.001	50.00	5.64	44.659	0.219	0.0	0.0	0.0	1.57	996.1	29.7
5.002	50.00	5.72	44.599	0.299	0.0	0.0	0.0	1.57	999.7	40.5
5.003	50.00	5.36	44.581	0.000	15.0	0.0	0.0	1.02	40.5	15.0
5.004	50.00	5.72	44.446	0.000	15.0	0.0	0.0	1.07	42.4	15.0
5.005	50.00	5.92	44.292	0.000	15.0	0.0	0.0	1.93	76.6	15.0
4.004	50.00	6.07	42.000	0.182	15.0	0.0	0.0	1.55	989.2	39.6
4.005	50.00	6.31	41.966	0.209	15.0	0.0	0.0	1.56	995.3	43.3
4.006	50.00	6.44	41.610	0.224	15.0	0.0	0.0	1.86	2100.2	45.3
4.007	50.00	6.56	41.273	0.245	15.0	0.0	0.0	2.15	3796.0	48.2
4.008	50.00	6.79	40.936	0.413	15.0	0.0	0.0	2.39	6079.0	70.9
4.009	50.00	7.08	40.851	0.561	15.0	0.0	0.0	2.39	6090.6	91.0

The Alan Johnston Partnership		Page 3
1 Dale Street Liverpool L2 2ET		
Date 16/08/2022 12:58	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.08.10.MDX	Checked by	
XP Solutions	Network 2018.1.1	

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
1.009	33.634	0.084	400.4	0.172	0.00	0.0	0.600	o	1800	Pipe/Conduit	
1.010	10.232	0.300	34.1	0.000	0.00	0.0	0.600	o	300	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)
1.009	50.00	7.31	40.749	1.166	20.0	0.0	0.0	2.39	6081.1	177.9
1.010	50.00	5.06	40.665	0.000	19.2	0.0	0.0	2.70	190.9	19.2

The Alan Johnston Partnership		Page 4
1 Dale Street Liverpool L2 2ET		
Date 16/08/2022 12:58	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.08.10.MDX	Checked by	
XP Solutions	Network 2018.1.1	

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	Pipe Out PN Invert Level (m)	Diameter (mm)	Pipes In PN Invert Level (m)	Diameter (mm)	Backdrop (mm)
1	51.810	2.590	Open Manhole	2100	1.000	49.220	750		
2	51.451	2.303	Open Manhole	2100	1.001	49.148	750	1.000	49.148
3	51.524	2.360	Open Manhole	2100	2.000	49.164	750		
4	51.717	2.605	Open Manhole	2100	2.001	49.112	750	2.000	49.112
5	51.577	2.505	Open Manhole	2100	1.002	49.072	750	1.001	49.072
							2.001	49.072	750
6	52.151	3.117	Open Manhole	2100	1.003	49.034	750	1.002	49.034
7	52.381	3.390	Open Manhole	2100	1.004	48.991	150	1.003	48.991
8	50.910	5.910	Open Manhole	2100	1.005	45.000	750	1.004	47.785
9	49.157	4.228	Open Manhole	2100	3.000	44.929	750		2185
10	49.655	4.781	Open Manhole	2100	1.006	44.874	750	1.005	44.874
							3.000	44.874	750
11	46.847	4.955	Open Manhole	2100	1.007	41.892	750	1.006	44.717
12	46.598	4.737	Open Manhole	2100	1.008	41.861	750	1.007	41.861
13	51.081	4.081	Open Manhole	2100	4.000	47.000	750		2825
14	50.082	3.100	Open Manhole	2100	4.001	46.982	750	4.000	46.982
16	48.200	1.307	Open Manhole	2100	4.002	46.893	150	4.001	46.893
16a	47.750	1.007	Open Manhole	1500	4.003	46.793	150	4.002	46.743
17	50.302	5.552	Open Manhole	2400	5.000	44.750	900		
18	48.488	3.829	Open Manhole	2400	5.001	44.659	900	5.000	44.659
19	47.296	2.697	Open Manhole	2400	5.002	44.599	900	5.001	44.599
20	47.310	2.729	Open Manhole	2400	5.003	44.581	225	5.002	44.581
21	46.850	2.404	Open Manhole	1500	5.004	44.446	225	5.003	44.446
22	47.000	2.708	Open Manhole	1500	5.005	44.292	225	5.004	44.292
23	46.906	4.906	Open Manhole	2400	4.004	42.000	900	4.003	45.293
							5.005	43.792	225
24	46.681	4.715	Open Manhole	2400	4.005	41.966	900	4.004	41.966
25	46.386	4.776	Open Manhole	3000	4.006	41.610	1200	4.005	41.910
25a	46.386	5.113	Open Manhole	3000	4.007	41.273	1500	4.006	41.573
26	46.082	5.146	Open Manhole	3600	4.008	40.936	1800	4.007	41.236
27	46.171	5.320	Open Manhole	3600	4.009	40.851	1800	4.008	40.851
28	46.282	5.533	Open Manhole	3600	1.009	40.749	1800	1.008	41.799
							4.009	40.749	1800
29	46.240	5.575	Open Manhole	3600	1.010	40.665	300	1.009	40.665
37	46.240	5.875	Open Manhole	0		OUTFALL		1.010	40.365

The Alan Johnston Partnership		Page 5
1 Dale Street Liverpool L2 2ET		
Date 16/08/2022 12:58	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.08.10.MDX	Checked by	
XP Solutions	Network 2018.1.1	

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 7, DS/PN: 1.004, Volume (m³): 18.3

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)	48.991
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

Hydro-Brake® Optimum Manhole: 11, DS/PN: 1.007, Volume (m³): 44.0

Unit Reference	MD-SHE-0232-3000-1400-3000
Design Head (m)	1.400
Design Flow (l/s)	30.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	232
Invert Level (m)	41.892
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.400	30.0	Kick-Flo®	0.967	25.1
Flush-Flo™	0.444	30.0	Mean Flow over Head Range	-	25.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as

The Alan Johnston Partnership		Page 6
1 Dale Street Liverpool L2 2ET		
Date 16/08/2022 12:58	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.08.10.MDX	Checked by	
XP Solutions	Network 2018.1.1	

Hydro-Brake® Optimum Manhole: 11, DS/PN: 1.007, Volume (m³): 44.0

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	7.7	0.800	28.3	2.000	35.6	4.000	49.7	7.000	65.2
0.200	23.3	1.000	25.5	2.200	37.3	4.500	52.6	7.500	67.4
0.300	29.2	1.200	27.9	2.400	38.9	5.000	55.4	8.000	69.6
0.400	29.9	1.400	30.0	2.600	40.4	5.500	58.0	8.500	71.7
0.500	29.9	1.600	32.0	3.000	43.3	6.000	60.5	9.000	73.7
0.600	29.5	1.800	33.8	3.500	46.6	6.500	62.9	9.500	75.7

Hydro-Brake® Optimum Manhole: 16, DS/PN: 4.002, Volume (m³): 19.4

Unit Reference	MD-SHE-0102-5000-1250-5000
Design Head (m)	1.250
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	102
Invert Level (m)	46.893
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)	1.250	5.0	Kick-Flo®	0.772	4.0
Flush-Flo™	0.370	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	6.2	4.000	8.6	7.000	11.2
0.200	4.7	1.000	4.5	2.200	6.5	4.500	9.1	7.500	11.6
0.300	5.0	1.200	4.9	2.400	6.8	5.000	9.6	8.000	12.0
0.400	5.0	1.400	5.3	2.600	7.0	5.500	10.0	8.500	12.3
0.500	4.9	1.600	5.6	3.000	7.5	6.000	10.4	9.000	12.7
0.600	4.7	1.800	5.9	3.500	8.1	6.500	10.9	9.500	13.0

Hydro-Brake® Optimum Manhole: 20, DS/PN: 5.003, Volume (m³): 15.3

Unit Reference	MD-SHE-0172-1500-1200-1500
Design Head (m)	1.200
Design Flow (l/s)	15.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface

The Alan Johnston Partnership		Page 7
1 Dale Street Liverpool L2 2ET		
Date 16/08/2022 12:58	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.08.10.MDX	Checked by	
XP Solutions	Network 2018.1.1	

Hydro-Brake® Optimum Manhole: 20, DS/PN: 5.003, Volume (m³): 15.3

Sump Available Yes
Diameter (mm) 172
Invert Level (m) 44.581
Minimum Outlet Pipe Diameter (mm) 225
Suggested Manhole Diameter (mm) 1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	15.0	Kick-Flo®	0.805	12.4
Flush-Flo™	0.364	15.0	Mean Flow over Head Range	-	12.9

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	6.1	0.800	12.5	2.000	19.1	4.000	26.6	7.000	34.9
0.200	14.1	1.000	13.8	2.200	20.0	4.500	28.2	7.500	36.1
0.300	14.9	1.200	15.0	2.400	20.9	5.000	29.7	8.000	37.2
0.400	15.0	1.400	16.1	2.600	21.7	5.500	31.1	8.500	38.3
0.500	14.8	1.600	17.2	3.000	23.2	6.000	32.4	9.000	39.4
0.600	14.4	1.800	18.2	3.500	25.0	6.500	33.7	9.500	40.4

Hydro-Brake® Optimum Manhole: 29, DS/PN: 1.010, Volume (m³): 133.2

Unit Reference MD-SHE-0162-1920-3250-1920
Design Head (m) 3.250
Design Flow (l/s) 19.2
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 162
Invert Level (m) 40.665
Minimum Outlet Pipe Diameter (mm) 225
Suggested Manhole Diameter (mm) 1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	3.250	19.2	Kick-Flo®	1.455	13.1
Flush-Flo™	0.712	16.6	Mean Flow over Head Range	-	15.5

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	5.8	0.500	16.2	1.200	15.4	2.000	15.2	3.000	18.5
0.200	13.0	0.600	16.5	1.400	13.8	2.200	15.9	3.500	19.9
0.300	14.7	0.800	16.6	1.600	13.7	2.400	16.6	4.000	21.2
0.400	15.7	1.000	16.2	1.800	14.5	2.600	17.2	4.500	22.4

Hydro-Brake® Optimum Manhole: 29, DS/PN: 1.010, Volume (m³): 133.2

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)
5.000	23.6	6.000	25.7	7.000	27.7	8.000	29.6	9.000	31.3
5.500	24.7	6.500	26.7	7.500	28.7	8.500	30.4	9.500	32.1

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 5

Number of Storage Structures 0

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model

FSR M5-60 (mm) 20.000

Cv (Summer) 0.750

Region England and Wales

Ratio R 0.389

Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)

300.0

Analysis Timestep 2.5 Second Increment (Extended)

DTS Status

ON

DVD Status

OFF

Inertia Status

OFF

Profile(s)

Summer and Winter

Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440

Return Period(s) (years)

1, 2

Climate Change (%)

0, 0

US/MH			Return Climate		First (X)	First (Y)	First (Z)	Overflow	Water	Surcharged	Flooded	Flow /
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	Level (m)	Depth (m)	Volume (m³)	
1.000	1 60	Winter	2	+0%					49.395	-0.575	0.000	0.01
1.001	2 60	Winter	2	+0%					49.395	-0.503	0.000	0.02
2.000	3 60	Winter	2	+0%					49.395	-0.519	0.000	0.00
2.001	4 60	Winter	2	+0%					49.395	-0.467	0.000	0.01
1.002	5 60	Winter	2	+0%					49.395	-0.427	0.000	0.03
1.003	6 60	Winter	2	+0%					49.394	-0.390	0.000	0.02
1.004	7 60	Winter	2	+0%	1/15	Summer			49.394	0.253	0.000	0.15
1.005	8 15	Winter	2	+0%					45.097	-0.653	0.000	0.04
3.000	9 15	Winter	2	+0%					45.037	-0.642	0.000	0.02
1.006	10 15	Winter	2	+0%					45.020	-0.604	0.000	0.08
1.007	11 15	Winter	2	+0%	1/15	Summer			44.467	1.825	0.000	0.12
1.008	12 15	Winter	2	+0%					42.014	-0.597	0.000	0.09
4.000	13 15	Winter	2	+0%					47.114	-0.636	0.000	0.02
4.001	14 15	Winter	2	+0%					47.113	-0.619	0.000	0.02
4.002	16 15	Winter	2	+0%	1/15	Summer			47.111	0.068	0.000	0.21
4.003	16a 15	Winter	2	+0%					46.856	-0.087	0.000	0.36
5.000	17 30	Winter	2	+0%					44.973	-0.677	0.000	0.02
5.001	18 30	Winter	2	+0%					44.972	-0.587	0.000	0.03
5.002	19 30	Winter	2	+0%					44.971	-0.528	0.000	0.04
5.003	20 30	Winter	2	+0%	1/15	Summer			44.971	0.165	0.000	0.45
5.004	21 30	Winter	2	+0%					44.543	-0.128	0.000	0.38
5.005	22 30	Winter	2	+0%					44.364	-0.153	0.000	0.23

The Alan Johnston Partnership		Page 10
1 Dale Street Liverpool L2 2ET		
Date 16/08/2022 12:58	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.08.10.MDX	Checked by	
XP Solutions	Network 2018.1.1	

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

PN	US/MH Name	Overflow (l/s)	Pipe	Status	Level
			Flow (l/s)		Exceeded
1.000	1		6.8		OK
1.001	2		10.9		OK
2.000	3		1.9		OK
2.001	4		2.3		OK
1.002	5		8.9		OK
1.003	6		6.3		OK
1.004	7		5.0	SURCHARGED	
1.005	8		23.5		OK
3.000	9		11.0		OK
1.006	10		45.2		OK
1.007	11		39.2	SURCHARGED	
1.008	12		42.6		OK
4.000	13		7.5		OK
4.001	14		11.9		OK
4.002	16		4.8	SURCHARGED	
4.003	16a		13.2		OK
5.000	17		18.7		OK
5.001	18		18.9		OK
5.002	19		18.7		OK
5.003	20		14.9	SURCHARGED	
5.004	21		14.9		OK
5.005	22		14.9		OK

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

US/MH			Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water	Surcharged	Flooded	Flow / Cap.
PN	Name	Storm							Level (m)	Depth (m)	Volume (m³)	
4.004	23	15 Winter	2	+0%					42.152	-0.748	0.000	0.07
4.005	24	15 Winter	2	+0%					42.102	-0.764	0.000	0.06
4.006	25	120 Winter	2	+0%					41.813	-0.997	0.000	0.03
4.007	25a	120 Winter	2	+0%					41.813	-0.960	0.000	0.02
4.008	26	120 Winter	2	+0%					41.813	-0.923	0.000	0.01
4.009	27	120 Winter	2	+0%					41.814	-0.837	0.000	0.01
1.009	28	120 Winter	2	+0%					41.814	-0.735	0.000	0.01
1.010	29	120 Winter	2	+0%	1/15 Summer				41.813	0.848	0.000	0.12

		Pipe			
		US/MH	Overflow	Flow	Level
PN	Name	(l/s)	(l/s)	Status	Exceeded
4.004	23		33.8	OK	
4.005	24		37.8	OK	
4.006	25		26.3	OK	
4.007	25a		25.9	OK	
4.008	26		31.2	OK	
4.009	27		21.6	OK	
1.009	28		37.1	OK	
1.010	29		16.6	SURCHARGED	

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)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.391	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	3.000
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

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	28.778	0.072	399.7	0.078	5.00	0.0	0.600	o	750	Pipe/Conduit	
1.001	30.470	0.076	400.9	0.078	0.00	0.0	0.600	o	750	Pipe/Conduit	
2.000	20.701	0.052	398.1	0.030	5.00	0.0	0.600	o	750	Pipe/Conduit	
2.001	16.177	0.040	404.4	0.029	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.002	15.601	0.038	410.6	0.021	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.003	17.000	0.043	395.3	0.000	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.004	30.884	1.206	25.6	0.025	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.005	25.108	0.126	199.3	0.125	0.00	0.0	0.600	o	750	Pipe/Conduit	
3.000	21.687	0.055	394.3	0.064	5.00	0.0	0.600	o	750	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.34	49.220	0.078	0.0	0.0	0.0	1.39	615.7	10.6
1.001	50.00	5.71	49.148	0.156	0.0	0.0	0.0	1.39	614.7	21.1
2.000	50.00	5.25	49.164	0.030	0.0	0.0	0.0	1.40	616.9	4.1
2.001	50.00	5.44	49.112	0.059	0.0	0.0	0.0	1.39	612.0	8.0
1.002	50.00	5.90	49.072	0.236	0.0	0.0	0.0	1.37	607.4	32.0
1.003	50.00	6.10	49.034	0.236	0.0	0.0	0.0	1.40	619.1	32.0
1.004	50.00	5.26	48.991	0.000	5.0	0.0	0.0	2.00	35.3	5.0
1.005	50.00	5.47	45.000	0.125	5.0	0.0	0.0	1.98	874.2	21.9
3.000	50.00	5.26	44.929	0.064	0.0	0.0	0.0	1.40	619.9	8.7

The Alan Johnston Partnership		Page 2
1 Dale Street Liverpool L2 2ET		
Date 16/08/2022 12:56	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.08.10.MDX	Checked by	
XP Solutions	Network 2018.1.1	

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
1.006	62.905	0.157	400.7	0.075	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.007	12.204	0.031	393.7	0.120	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.008	23.323	0.062	376.2	0.049	0.00	0.0	0.600	o	750	Pipe/Conduit	
4.000	7.038	0.018	391.0	0.044	5.00	0.0	0.600	o	750	Pipe/Conduit	
4.001	35.690	0.089	401.0	0.035	0.00	0.0	0.600	o	750	Pipe/Conduit	
4.002	6.676	0.150	44.5	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.003	33.651	1.500	22.4	0.059	0.00	0.0	0.600	o	150	Pipe/Conduit	
5.000	36.273	0.091	398.6	0.145	5.00	0.0	0.600	o	900	Pipe/Conduit	
5.001	23.838	0.060	397.3	0.074	0.00	0.0	0.600	o	900	Pipe/Conduit	
5.002	7.100	0.018	394.4	0.080	0.00	0.0	0.600	o	900	Pipe/Conduit	
5.003	22.171	0.135	164.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.004	23.078	0.154	149.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.005	23.154	0.500	46.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.004	13.696	0.034	402.8	0.044	0.00	0.0	0.600	o	900	Pipe/Conduit	
4.005	22.286	0.056	398.0	0.027	0.00	0.0	0.600	o	900	Pipe/Conduit	
4.006	14.917	0.037	403.2	0.015	0.00	0.0	0.600	o	1200	Pipe/Conduit	
4.007	14.669	0.037	396.5	0.021	0.00	0.0	0.600	o	1500	Pipe/Conduit	
4.008	34.057	0.085	400.7	0.168	0.00	0.0	0.600	o	1800	Pipe/Conduit	
4.009	40.714	0.102	399.2	0.148	0.00	0.0	0.600	o	1800	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)
1.006	50.00	6.22	44.874	0.264	5.0	0.0	0.0	1.39	614.9	40.7
1.007	50.00	6.37	41.892	0.384	5.0	0.0	0.0	1.40	620.4	57.0
1.008	50.00	6.64	41.861	0.433	5.0	0.0	0.0	1.44	634.8	63.6
4.000	50.00	5.08	47.000	0.044	0.0	0.0	0.0	1.41	622.5	6.0
4.001	50.00	5.51	46.982	0.079	0.0	0.0	0.0	1.39	614.6	10.7
4.002	50.00	5.58	46.893	0.079	0.0	0.0	0.0	1.51	26.7	10.7
4.003	50.00	5.85	46.793	0.138	0.0	0.0	0.0	2.14	37.7	18.7
5.000	50.00	5.39	44.750	0.145	0.0	0.0	0.0	1.56	994.5	19.6
5.001	50.00	5.64	44.659	0.219	0.0	0.0	0.0	1.57	996.1	29.7
5.002	50.00	5.72	44.599	0.299	0.0	0.0	0.0	1.57	999.7	40.5
5.003	50.00	5.36	44.581	0.000	15.0	0.0	0.0	1.02	40.5	15.0
5.004	50.00	5.72	44.446	0.000	15.0	0.0	0.0	1.07	42.4	15.0
5.005	50.00	5.92	44.292	0.000	15.0	0.0	0.0	1.93	76.6	15.0
4.004	50.00	6.07	42.000	0.182	15.0	0.0	0.0	1.55	989.2	39.6
4.005	50.00	6.31	41.966	0.209	15.0	0.0	0.0	1.56	995.3	43.3
4.006	50.00	6.44	41.610	0.224	15.0	0.0	0.0	1.86	2100.2	45.3
4.007	50.00	6.56	41.273	0.245	15.0	0.0	0.0	2.15	3796.0	48.2
4.008	50.00	6.79	40.936	0.413	15.0	0.0	0.0	2.39	6079.0	70.9
4.009	50.00	7.08	40.851	0.561	15.0	0.0	0.0	2.39	6090.6	91.0

The Alan Johnston Partnership		Page 3
1 Dale Street Liverpool L2 2ET		
Date 16/08/2022 12:56	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.08.10.MDX	Checked by	
XP Solutions	Network 2018.1.1	

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
1.009	33.634	0.084	400.4	0.172	0.00	0.0	0.600	o	1800	Pipe/Conduit	
1.010	10.232	0.300	34.1	0.000	0.00	0.0	0.600	o	300	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)
1.009	50.00	7.31	40.749	1.166	20.0	0.0	0.0	2.39	6081.1	177.9
1.010	50.00	5.06	40.665	0.000	19.2	0.0	0.0	2.70	190.9	19.2

The Alan Johnston Partnership		Page 4
1 Dale Street Liverpool L2 2ET		
Date 16/08/2022 12:56	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.08.10.MDX	Checked by	
XP Solutions	Network 2018.1.1	

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	51.810	2.590	Open Manhole	2100	1.000	49.220	750				
2	51.451	2.303	Open Manhole	2100	1.001	49.148	750	1.000	49.148	750	
3	51.524	2.360	Open Manhole	2100	2.000	49.164	750				
4	51.717	2.605	Open Manhole	2100	2.001	49.112	750	2.000	49.112	750	
5	51.577	2.505	Open Manhole	2100	1.002	49.072	750	1.001	49.072	750	
								2.001	49.072	750	
6	52.151	3.117	Open Manhole	2100	1.003	49.034	750	1.002	49.034	750	
7	52.381	3.390	Open Manhole	2100	1.004	48.991	150	1.003	48.991	750	
8	50.910	5.910	Open Manhole	2100	1.005	45.000	750	1.004	47.785	150	2185
9	49.157	4.228	Open Manhole	2100	3.000	44.929	750				
10	49.655	4.781	Open Manhole	2100	1.006	44.874	750	1.005	44.874	750	
								3.000	44.874	750	
11	46.847	4.955	Open Manhole	2100	1.007	41.892	750	1.006	44.717	750	2825
12	46.598	4.737	Open Manhole	2100	1.008	41.861	750	1.007	41.861	750	
13	51.081	4.081	Open Manhole	2100	4.000	47.000	750				
14	50.082	3.100	Open Manhole	2100	4.001	46.982	750	4.000	46.982	750	
16	48.200	1.307	Open Manhole	2100	4.002	46.893	150	4.001	46.893	750	
16a	47.750	1.007	Open Manhole	1500	4.003	46.793	150	4.002	46.743	150	
17	50.302	5.552	Open Manhole	2400	5.000	44.750	900				
18	48.488	3.829	Open Manhole	2400	5.001	44.659	900	5.000	44.659	900	
19	47.296	2.697	Open Manhole	2400	5.002	44.599	900	5.001	44.599	900	
20	47.310	2.729	Open Manhole	2400	5.003	44.581	225	5.002	44.581	900	
21	46.850	2.404	Open Manhole	1500	5.004	44.446	225	5.003	44.446	225	
22	47.000	2.708	Open Manhole	1500	5.005	44.292	225	5.004	44.292	225	
23	46.906	4.906	Open Manhole	2400	4.004	42.000	900	4.003	45.293	150	2543
								5.005	43.792	225	1117
24	46.681	4.715	Open Manhole	2400	4.005	41.966	900	4.004	41.966	900	
25	46.386	4.776	Open Manhole	3000	4.006	41.610	1200	4.005	41.910	900	
25a	46.386	5.113	Open Manhole	3000	4.007	41.273	1500	4.006	41.573	1200	
26	46.082	5.146	Open Manhole	3600	4.008	40.936	1800	4.007	41.236	1500	
27	46.171	5.320	Open Manhole	3600	4.009	40.851	1800	4.008	40.851	1800	
28	46.282	5.533	Open Manhole	3600	1.009	40.749	1800	1.008	41.799	750	
								4.009	40.749	1800	
29	46.240	5.575	Open Manhole	3600	1.010	40.665	300	1.009	40.665	1800	
37	46.240	5.875	Open Manhole	0		OUTFALL		1.010	40.365	300	

The Alan Johnston Partnership		Page 5
1 Dale Street Liverpool L2 2ET		
Date 16/08/2022 12:56	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.08.10.MDX	Checked by	
XP Solutions	Network 2018.1.1	

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 7, DS/PN: 1.004, Volume (m³): 18.3

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)	48.991
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

Hydro-Brake® Optimum Manhole: 11, DS/PN: 1.007, Volume (m³): 44.0

Unit Reference	MD-SHE-0232-3000-1400-3000
Design Head (m)	1.400
Design Flow (l/s)	30.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	232
Invert Level (m)	41.892
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.400	30.0	Kick-Flo®	0.967	25.1
Flush-Flo™	0.444	30.0	Mean Flow over Head Range	-	25.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as

The Alan Johnston Partnership		Page 6
1 Dale Street Liverpool L2 2ET		
Date 16/08/2022 12:56	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.08.10.MDX	Checked by	
XP Solutions	Network 2018.1.1	

Hydro-Brake® Optimum Manhole: 11, DS/PN: 1.007, Volume (m³): 44.0

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	7.7	0.800	28.3	2.000	35.6	4.000	49.7	7.000	65.2
0.200	23.3	1.000	25.5	2.200	37.3	4.500	52.6	7.500	67.4
0.300	29.2	1.200	27.9	2.400	38.9	5.000	55.4	8.000	69.6
0.400	29.9	1.400	30.0	2.600	40.4	5.500	58.0	8.500	71.7
0.500	29.9	1.600	32.0	3.000	43.3	6.000	60.5	9.000	73.7
0.600	29.5	1.800	33.8	3.500	46.6	6.500	62.9	9.500	75.7

Hydro-Brake® Optimum Manhole: 16, DS/PN: 4.002, Volume (m³): 19.4

Unit Reference	MD-SHE-0102-5000-1250-5000
Design Head (m)	1.250
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	102
Invert Level (m)	46.893
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)	1.250	5.0	Kick-Flo®	0.772	4.0
Flush-Flo™	0.370	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	6.2	4.000	8.6	7.000	11.2
0.200	4.7	1.000	4.5	2.200	6.5	4.500	9.1	7.500	11.6
0.300	5.0	1.200	4.9	2.400	6.8	5.000	9.6	8.000	12.0
0.400	5.0	1.400	5.3	2.600	7.0	5.500	10.0	8.500	12.3
0.500	4.9	1.600	5.6	3.000	7.5	6.000	10.4	9.000	12.7
0.600	4.7	1.800	5.9	3.500	8.1	6.500	10.9	9.500	13.0

Hydro-Brake® Optimum Manhole: 20, DS/PN: 5.003, Volume (m³): 15.3

Unit Reference	MD-SHE-0172-1500-1200-1500
Design Head (m)	1.200
Design Flow (l/s)	15.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface

The Alan Johnston Partnership		Page 7
1 Dale Street Liverpool L2 2ET		
Date 16/08/2022 12:56	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.08.10.MDX	Checked by	
XP Solutions	Network 2018.1.1	

Hydro-Brake® Optimum Manhole: 20, DS/PN: 5.003, Volume (m³): 15.3

Sump Available Yes
Diameter (mm) 172
Invert Level (m) 44.581
Minimum Outlet Pipe Diameter (mm) 225
Suggested Manhole Diameter (mm) 1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	15.0	Kick-Flo®	0.805	12.4
Flush-Flo™	0.364	15.0	Mean Flow over Head Range	-	12.9

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	6.1	0.800	12.5	2.000	19.1	4.000	26.6	7.000	34.9
0.200	14.1	1.000	13.8	2.200	20.0	4.500	28.2	7.500	36.1
0.300	14.9	1.200	15.0	2.400	20.9	5.000	29.7	8.000	37.2
0.400	15.0	1.400	16.1	2.600	21.7	5.500	31.1	8.500	38.3
0.500	14.8	1.600	17.2	3.000	23.2	6.000	32.4	9.000	39.4
0.600	14.4	1.800	18.2	3.500	25.0	6.500	33.7	9.500	40.4

Hydro-Brake® Optimum Manhole: 29, DS/PN: 1.010, Volume (m³): 133.2

Unit Reference MD-SHE-0162-1920-3250-1920
Design Head (m) 3.250
Design Flow (l/s) 19.2
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 162
Invert Level (m) 40.665
Minimum Outlet Pipe Diameter (mm) 225
Suggested Manhole Diameter (mm) 1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	3.250	19.2	Kick-Flo®	1.455	13.1
Flush-Flo™	0.712	16.6	Mean Flow over Head Range	-	15.5

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	5.8	0.500	16.2	1.200	15.4	2.000	15.2	3.000	18.5
0.200	13.0	0.600	16.5	1.400	13.8	2.200	15.9	3.500	19.9
0.300	14.7	0.800	16.6	1.600	13.7	2.400	16.6	4.000	21.2
0.400	15.7	1.000	16.2	1.800	14.5	2.600	17.2	4.500	22.4

Hydro-Brake® Optimum Manhole: 29, DS/PN: 1.010, Volume (m³): 133.2

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)
5.000	23.6	6.000	25.7	7.000	27.7	8.000	29.6	9.000	31.3
5.500	24.7	6.500	26.7	7.500	28.7	8.500	30.4	9.500	32.1

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 * 10m ³ /ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	5	Number of Storage Structures	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR M5-60 (mm)	20.000	Cv (Summer)	0.750
Region	England and Wales	Ratio R	0.389	Cv (Winter)

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 2, 30
Climate Change (%)	0, 0, 0

									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	1	60	Winter	30	+0%					49.676	-0.294	0.000
1.001	2	60	Winter	30	+0%					49.676	-0.222	0.000
2.000	3	60	Winter	30	+0%					49.676	-0.238	0.000
2.001	4	60	Winter	30	+0%					49.676	-0.186	0.000
1.002	5	60	Winter	30	+0%					49.676	-0.146	0.000
1.003	6	60	Winter	30	+0%					49.675	-0.109	0.000
1.004	7	60	Winter	30	+0%	1/15	Summer			49.675	0.534	0.000
1.005	8	30	Winter	30	+0%					45.191	-0.559	0.000
3.000	9	30	Winter	30	+0%					45.188	-0.491	0.000
1.006	10	30	Winter	30	+0%					45.187	-0.437	0.000
1.007	11	30	Winter	30	+0%	1/15	Summer			45.182	2.540	0.000
1.008	12	240	Winter	30	+0%	30/240	Winter			42.639	0.028	0.000
4.000	13	30	Winter	30	+0%					47.280	-0.470	0.000
4.001	14	30	Winter	30	+0%					47.280	-0.452	0.000
4.002	16	30	Winter	30	+0%	1/15	Summer			47.280	0.237	0.000
4.003	16a	15	Winter	30	+0%					46.888	-0.055	0.000
5.000	17	30	Winter	30	+0%					45.330	-0.320	0.000
5.001	18	30	Winter	30	+0%					45.330	-0.229	0.000
5.002	19	30	Winter	30	+0%					45.329	-0.170	0.000
5.003	20	30	Winter	30	+0%	1/15	Summer			45.328	0.522	0.000
5.004	21	240	Summer	30	+0%					44.543	-0.128	0.000
5.005	22	240	Summer	30	+0%					44.364	-0.153	0.000

The Alan Johnston Partnership		Page 10
1 Dale Street Liverpool L2 2ET		
Date 16/08/2022 12:56	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.08.10.MDX	Checked by	
XP Solutions	Network 2018.1.1	

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

PN	US/MH Name	Flow / Overflow		Pipe Flow	Status	Level
		Cap.	(l/s)	(l/s)		Exceeded
1.000	1	0.03		12.2	OK	
1.001	2	0.04		17.8	OK	
2.000	3	0.01		3.9	OK	
2.001	4	0.01		2.9	OK	
1.002	5	0.04		11.2	OK	
1.003	6	0.02		6.4	OK	
1.004	7	0.15		5.0	SURCHARGED	
1.005	8	0.06		38.6	OK	
3.000	9	0.04		16.1	OK	
1.006	10	0.13		70.0	OK	
1.007	11	0.13		44.3	SURCHARGED	
1.008	12	0.07		32.7	SURCHARGED	
4.000	13	0.03		10.2	OK	
4.001	14	0.03		17.2	OK	
4.002	16	0.22		5.0	SURCHARGED	
4.003	16a	0.72		26.1	OK	
5.000	17	0.04		33.7	OK	
5.001	18	0.03		22.9	OK	
5.002	19	0.05		22.8	OK	
5.003	20	0.45		14.9	SURCHARGED	
5.004	21	0.38		15.0	OK	
5.005	22	0.23		15.0	OK	

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

US/MH		Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water	Surcharged	Flooded
PN	Name								Level (m)	Depth (m)	Volume (m³)
4.004	23	240 Winter	30	+0%					42.640	-0.260	0.000
4.005	24	240 Winter	30	+0%					42.640	-0.226	0.000
4.006	25	240 Winter	30	+0%					42.640	-0.170	0.000
4.007	25a	240 Winter	30	+0%					42.640	-0.133	0.000
4.008	26	240 Winter	30	+0%					42.640	-0.096	0.000
4.009	27	240 Winter	30	+0%					42.640	-0.011	0.000
1.009	28	240 Winter	30	+0%	30/240 Winter				42.638	0.089	0.000
1.010	29	240 Winter	30	+0%	1/15 Summer				42.638	1.673	0.000

US/MH		Pipe		Status	Level Exceeded
PN	Name	Flow / Cap.	Overflow (l/s)		
4.004	23	0.05	25.9	OK	
4.005	24	0.04	27.6	OK	
4.006	25	0.03	27.3	OK	
4.007	25a	0.02	25.5	OK	
4.008	26	0.01	28.3	OK	
4.009	27	0.00	18.6	OK	
1.009	28	0.01	35.4	SURCHARGED	
1.010	29	0.12	16.6	SURCHARGED	

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)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.391	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	3.000
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

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	28.778	0.072	399.7	0.078	5.00	0.0	0.600	o	750	Pipe/Conduit	
1.001	30.470	0.076	400.9	0.078	0.00	0.0	0.600	o	750	Pipe/Conduit	
2.000	20.701	0.052	398.1	0.030	5.00	0.0	0.600	o	750	Pipe/Conduit	
2.001	16.177	0.040	404.4	0.029	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.002	15.601	0.038	410.6	0.021	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.003	17.000	0.043	395.3	0.000	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.004	30.884	1.206	25.6	0.025	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.005	25.108	0.126	199.3	0.125	0.00	0.0	0.600	o	750	Pipe/Conduit	
3.000	21.687	0.055	394.3	0.064	5.00	0.0	0.600	o	750	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.34	49.220	0.078	0.0	0.0	0.0	1.39	615.7	10.6
1.001	50.00	5.71	49.148	0.156	0.0	0.0	0.0	1.39	614.7	21.1
2.000	50.00	5.25	49.164	0.030	0.0	0.0	0.0	1.40	616.9	4.1
2.001	50.00	5.44	49.112	0.059	0.0	0.0	0.0	1.39	612.0	8.0
1.002	50.00	5.90	49.072	0.236	0.0	0.0	0.0	1.37	607.4	32.0
1.003	50.00	6.10	49.034	0.236	0.0	0.0	0.0	1.40	619.1	32.0
1.004	50.00	5.26	48.991	0.000	5.0	0.0	0.0	2.00	35.3	5.0
1.005	50.00	5.47	45.000	0.125	5.0	0.0	0.0	1.98	874.2	21.9
3.000	50.00	5.26	44.929	0.064	0.0	0.0	0.0	1.40	619.9	8.7

The Alan Johnston Partnership		Page 2
1 Dale Street Liverpool L2 2ET		
Date 16/08/2022 12:54	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.08.10.MDX	Checked by	
XP Solutions	Network 2018.1.1	

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
1.006	62.905	0.157	400.7	0.075	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.007	12.204	0.031	393.7	0.120	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.008	23.323	0.062	376.2	0.049	0.00	0.0	0.600	o	750	Pipe/Conduit	
4.000	7.038	0.018	391.0	0.044	5.00	0.0	0.600	o	750	Pipe/Conduit	
4.001	35.690	0.089	401.0	0.035	0.00	0.0	0.600	o	750	Pipe/Conduit	
4.002	6.676	0.150	44.5	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.003	33.651	1.500	22.4	0.059	0.00	0.0	0.600	o	150	Pipe/Conduit	
5.000	36.273	0.091	398.6	0.145	5.00	0.0	0.600	o	900	Pipe/Conduit	
5.001	23.838	0.060	397.3	0.074	0.00	0.0	0.600	o	900	Pipe/Conduit	
5.002	7.100	0.018	394.4	0.080	0.00	0.0	0.600	o	900	Pipe/Conduit	
5.003	22.171	0.135	164.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.004	23.078	0.154	149.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.005	23.154	0.500	46.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.004	13.696	0.034	402.8	0.044	0.00	0.0	0.600	o	900	Pipe/Conduit	
4.005	22.286	0.056	398.0	0.027	0.00	0.0	0.600	o	900	Pipe/Conduit	
4.006	14.917	0.037	403.2	0.015	0.00	0.0	0.600	o	1200	Pipe/Conduit	
4.007	14.669	0.037	396.5	0.021	0.00	0.0	0.600	o	1500	Pipe/Conduit	
4.008	34.057	0.085	400.7	0.168	0.00	0.0	0.600	o	1800	Pipe/Conduit	
4.009	40.714	0.102	399.2	0.148	0.00	0.0	0.600	o	1800	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)
1.006	50.00	6.22	44.874	0.264	5.0	0.0	0.0	1.39	614.9	40.7
1.007	50.00	6.37	41.892	0.384	5.0	0.0	0.0	1.40	620.4	57.0
1.008	50.00	6.64	41.861	0.433	5.0	0.0	0.0	1.44	634.8	63.6
4.000	50.00	5.08	47.000	0.044	0.0	0.0	0.0	1.41	622.5	6.0
4.001	50.00	5.51	46.982	0.079	0.0	0.0	0.0	1.39	614.6	10.7
4.002	50.00	5.58	46.893	0.079	0.0	0.0	0.0	1.51	26.7	10.7
4.003	50.00	5.85	46.793	0.138	0.0	0.0	0.0	2.14	37.7	18.7
5.000	50.00	5.39	44.750	0.145	0.0	0.0	0.0	1.56	994.5	19.6
5.001	50.00	5.64	44.659	0.219	0.0	0.0	0.0	1.57	996.1	29.7
5.002	50.00	5.72	44.599	0.299	0.0	0.0	0.0	1.57	999.7	40.5
5.003	50.00	5.36	44.581	0.000	15.0	0.0	0.0	1.02	40.5	15.0
5.004	50.00	5.72	44.446	0.000	15.0	0.0	0.0	1.07	42.4	15.0
5.005	50.00	5.92	44.292	0.000	15.0	0.0	0.0	1.93	76.6	15.0
4.004	50.00	6.07	42.000	0.182	15.0	0.0	0.0	1.55	989.2	39.6
4.005	50.00	6.31	41.966	0.209	15.0	0.0	0.0	1.56	995.3	43.3
4.006	50.00	6.44	41.610	0.224	15.0	0.0	0.0	1.86	2100.2	45.3
4.007	50.00	6.56	41.273	0.245	15.0	0.0	0.0	2.15	3796.0	48.2
4.008	50.00	6.79	40.936	0.413	15.0	0.0	0.0	2.39	6079.0	70.9
4.009	50.00	7.08	40.851	0.561	15.0	0.0	0.0	2.39	6090.6	91.0

The Alan Johnston Partnership		Page 3
1 Dale Street Liverpool L2 2ET		
Date 16/08/2022 12:54	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.08.10.MDX	Checked by	
XP Solutions	Network 2018.1.1	

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
1.009	33.634	0.084	400.4	0.172	0.00	0.0	0.600	o	1800	Pipe/Conduit	
1.010	10.232	0.300	34.1	0.000	0.00	0.0	0.600	o	300	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)
1.009	50.00	7.31	40.749	1.166	20.0	0.0	0.0	2.39	6081.1	177.9
1.010	50.00	5.06	40.665	0.000	19.2	0.0	0.0	2.70	190.9	19.2

The Alan Johnston Partnership		Page 4
1 Dale Street Liverpool L2 2ET		
Date 16/08/2022 12:54	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.08.10.MDX	Checked by	
XP Solutions	Network 2018.1.1	

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	51.810	2.590	Open Manhole	2100	1.000	49.220	750				
2	51.451	2.303	Open Manhole	2100	1.001	49.148	750	1.000	49.148	750	
3	51.524	2.360	Open Manhole	2100	2.000	49.164	750				
4	51.717	2.605	Open Manhole	2100	2.001	49.112	750	2.000	49.112	750	
5	51.577	2.505	Open Manhole	2100	1.002	49.072	750	1.001	49.072	750	
								2.001	49.072	750	
6	52.151	3.117	Open Manhole	2100	1.003	49.034	750	1.002	49.034	750	
7	52.381	3.390	Open Manhole	2100	1.004	48.991	150	1.003	48.991	750	
8	50.910	5.910	Open Manhole	2100	1.005	45.000	750	1.004	47.785	150	2185
9	49.157	4.228	Open Manhole	2100	3.000	44.929	750				
10	49.655	4.781	Open Manhole	2100	1.006	44.874	750	1.005	44.874	750	
								3.000	44.874	750	
11	46.847	4.955	Open Manhole	2100	1.007	41.892	750	1.006	44.717	750	2825
12	46.598	4.737	Open Manhole	2100	1.008	41.861	750	1.007	41.861	750	
13	51.081	4.081	Open Manhole	2100	4.000	47.000	750				
14	50.082	3.100	Open Manhole	2100	4.001	46.982	750	4.000	46.982	750	
16	48.200	1.307	Open Manhole	2100	4.002	46.893	150	4.001	46.893	750	
16a	47.750	1.007	Open Manhole	1500	4.003	46.793	150	4.002	46.743	150	
17	50.302	5.552	Open Manhole	2400	5.000	44.750	900				
18	48.488	3.829	Open Manhole	2400	5.001	44.659	900	5.000	44.659	900	
19	47.296	2.697	Open Manhole	2400	5.002	44.599	900	5.001	44.599	900	
20	47.310	2.729	Open Manhole	2400	5.003	44.581	225	5.002	44.581	900	
21	46.850	2.404	Open Manhole	1500	5.004	44.446	225	5.003	44.446	225	
22	47.000	2.708	Open Manhole	1500	5.005	44.292	225	5.004	44.292	225	
23	46.906	4.906	Open Manhole	2400	4.004	42.000	900	4.003	45.293	150	2543
								5.005	43.792	225	1117
24	46.681	4.715	Open Manhole	2400	4.005	41.966	900	4.004	41.966	900	
25	46.386	4.776	Open Manhole	3000	4.006	41.610	1200	4.005	41.910	900	
25a	46.386	5.113	Open Manhole	3000	4.007	41.273	1500	4.006	41.573	1200	
26	46.082	5.146	Open Manhole	3600	4.008	40.936	1800	4.007	41.236	1500	
27	46.171	5.320	Open Manhole	3600	4.009	40.851	1800	4.008	40.851	1800	
28	46.282	5.533	Open Manhole	3600	1.009	40.749	1800	1.008	41.799	750	
								4.009	40.749	1800	
29	46.240	5.575	Open Manhole	3600	1.010	40.665	300	1.009	40.665	1800	
37	46.240	5.875	Open Manhole	0		OUTFALL		1.010	40.365	300	

The Alan Johnston Partnership		Page 5
1 Dale Street Liverpool L2 2ET		
Date 16/08/2022 12:54	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.08.10.MDX	Checked by	
XP Solutions	Network 2018.1.1	

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 7, DS/PN: 1.004, Volume (m³): 18.3

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)	48.991
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

Hydro-Brake® Optimum Manhole: 11, DS/PN: 1.007, Volume (m³): 44.0

Unit Reference	MD-SHE-0232-3000-1400-3000
Design Head (m)	1.400
Design Flow (l/s)	30.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	232
Invert Level (m)	41.892
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.400	30.0	Kick-Flo®	0.967	25.1
Flush-Flo™	0.444	30.0	Mean Flow over Head Range	-	25.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as

The Alan Johnston Partnership		Page 6
1 Dale Street Liverpool L2 2ET		
Date 16/08/2022 12:54	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.08.10.MDX	Checked by	
XP Solutions	Network 2018.1.1	

Hydro-Brake® Optimum Manhole: 11, DS/PN: 1.007, Volume (m³): 44.0

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	7.7	0.800	28.3	2.000	35.6	4.000	49.7	7.000	65.2
0.200	23.3	1.000	25.5	2.200	37.3	4.500	52.6	7.500	67.4
0.300	29.2	1.200	27.9	2.400	38.9	5.000	55.4	8.000	69.6
0.400	29.9	1.400	30.0	2.600	40.4	5.500	58.0	8.500	71.7
0.500	29.9	1.600	32.0	3.000	43.3	6.000	60.5	9.000	73.7
0.600	29.5	1.800	33.8	3.500	46.6	6.500	62.9	9.500	75.7

Hydro-Brake® Optimum Manhole: 16, DS/PN: 4.002, Volume (m³): 19.4

Unit Reference	MD-SHE-0102-5000-1250-5000
Design Head (m)	1.250
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	102
Invert Level (m)	46.893
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)	1.250	5.0	Kick-Flo®	0.772	4.0
Flush-Flo™	0.370	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	6.2	4.000	8.6	7.000	11.2
0.200	4.7	1.000	4.5	2.200	6.5	4.500	9.1	7.500	11.6
0.300	5.0	1.200	4.9	2.400	6.8	5.000	9.6	8.000	12.0
0.400	5.0	1.400	5.3	2.600	7.0	5.500	10.0	8.500	12.3
0.500	4.9	1.600	5.6	3.000	7.5	6.000	10.4	9.000	12.7
0.600	4.7	1.800	5.9	3.500	8.1	6.500	10.9	9.500	13.0

Hydro-Brake® Optimum Manhole: 20, DS/PN: 5.003, Volume (m³): 15.3

Unit Reference	MD-SHE-0172-1500-1200-1500
Design Head (m)	1.200
Design Flow (l/s)	15.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface

The Alan Johnston Partnership		Page 7
1 Dale Street Liverpool L2 2ET		
Date 16/08/2022 12:54	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.08.10.MDX	Checked by	
XP Solutions	Network 2018.1.1	

Hydro-Brake® Optimum Manhole: 20, DS/PN: 5.003, Volume (m³): 15.3

Sump Available Yes
Diameter (mm) 172
Invert Level (m) 44.581
Minimum Outlet Pipe Diameter (mm) 225
Suggested Manhole Diameter (mm) 1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	15.0	Kick-Flo®	0.805	12.4
Flush-Flo™	0.364	15.0	Mean Flow over Head Range	-	12.9

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	6.1	0.800	12.5	2.000	19.1	4.000	26.6	7.000	34.9
0.200	14.1	1.000	13.8	2.200	20.0	4.500	28.2	7.500	36.1
0.300	14.9	1.200	15.0	2.400	20.9	5.000	29.7	8.000	37.2
0.400	15.0	1.400	16.1	2.600	21.7	5.500	31.1	8.500	38.3
0.500	14.8	1.600	17.2	3.000	23.2	6.000	32.4	9.000	39.4
0.600	14.4	1.800	18.2	3.500	25.0	6.500	33.7	9.500	40.4

Hydro-Brake® Optimum Manhole: 29, DS/PN: 1.010, Volume (m³): 133.2

Unit Reference MD-SHE-0162-1920-3250-1920
Design Head (m) 3.250
Design Flow (l/s) 19.2
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 162
Invert Level (m) 40.665
Minimum Outlet Pipe Diameter (mm) 225
Suggested Manhole Diameter (mm) 1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	3.250	19.2	Kick-Flo®	1.455	13.1
Flush-Flo™	0.712	16.6	Mean Flow over Head Range	-	15.5

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	5.8	0.500	16.2	1.200	15.4	2.000	15.2	3.000	18.5
0.200	13.0	0.600	16.5	1.400	13.8	2.200	15.9	3.500	19.9
0.300	14.7	0.800	16.6	1.600	13.7	2.400	16.6	4.000	21.2
0.400	15.7	1.000	16.2	1.800	14.5	2.600	17.2	4.500	22.4

Hydro-Brake® Optimum Manhole: 29, DS/PN: 1.010, Volume (m³): 133.2

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)
5.000	23.6	6.000	25.7	7.000	27.7	8.000	29.6	9.000	31.3
5.500	24.7	6.500	26.7	7.500	28.7	8.500	30.4	9.500	32.1

The Alan Johnston Partnership		Page 9
1 Dale Street Liverpool L2 2ET		
Date 16/08/2022 12:54	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.08.10.MDX	Checked by	
XP Solutions	Network 2018.1.1	

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 5 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.389 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status ON
 DVD Status OFF
 Inertia Status OFF

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 2, 100
 Climate Change (%) 0, 0, 40

PN	US/MH		Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water	Surcharged	Flooded
	Name	Storm							Level (m)	Depth (m)	Volume (m³)
1.000	1	120 Winter	100	+40%	100/30 Summer				51.434	1.464	0.000
1.001	2	120 Winter	100	+40%	100/30 Summer				51.434	1.536	0.000
2.000	3	120 Winter	100	+40%	100/30 Summer				51.434	1.520	0.000
2.001	4	120 Winter	100	+40%	100/15 Winter				51.434	1.572	0.000
1.002	5	120 Winter	100	+40%	100/15 Winter				51.434	1.612	0.000
1.003	6	120 Winter	100	+40%	100/15 Winter				51.433	1.649	0.000
1.004	7	120 Winter	100	+40%	1/15 Summer				51.433	2.292	0.000
1.005	8	30 Winter	100	+40%	100/15 Winter				46.671	0.921	0.000
3.000	9	30 Winter	100	+40%	100/15 Winter				46.670	0.991	0.000
1.006	10	30 Winter	100	+40%	100/15 Summer				46.669	1.045	0.000
1.007	11	30 Winter	100	+40%	1/15 Summer				46.663	4.021	0.000
1.008	12	240 Winter	100	+40%	100/30 Winter				46.036	3.425	0.000
4.000	13	60 Winter	100	+40%					47.667	-0.083	0.000
4.001	14	60 Winter	100	+40%					47.667	-0.065	0.000
4.002	16	60 Winter	100	+40%	1/15 Summer				47.667	0.624	0.000
4.003	16a	15 Winter	100	+40%	100/15 Summer				47.144	0.201	0.000
5.000	17	60 Winter	100	+40%	100/15 Summer				47.207	1.557	0.000
5.001	18	60 Winter	100	+40%	100/15 Summer				47.206	1.647	0.000
5.002	19	60 Winter	100	+40%	100/15 Summer				47.204	1.705	0.000
5.003	20	60 Winter	100	+40%	1/15 Summer				47.204	2.398	0.000
5.004	21	240 Winter	100	+40%	100/120 Summer				46.051	1.380	0.000
5.005	22	240 Winter	100	+40%	100/60 Winter				46.044	1.527	0.000

The Alan Johnston Partnership		Page 10
1 Dale Street Liverpool L2 2ET		
Date 16/08/2022 12:54	Designed by JosephPoole	
File 221-130 MDX NETWORK 2022.08.10.MDX	Checked by	
XP Solutions	Network 2018.1.1	

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

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe	Status	Level
				Flow (l/s)		Exceeded
1.000	1	0.03		13.6	SURCHARGED	
1.001	2	0.04		18.4	FLOOD RISK	
2.000	3	0.01		4.2	FLOOD RISK	
2.001	4	0.01		2.6	FLOOD RISK	
1.002	5	0.04		11.8	FLOOD RISK	
1.003	6	0.02		6.6	SURCHARGED	
1.004	7	0.21		7.0	SURCHARGED	
1.005	8	0.10		60.7	SURCHARGED	
3.000	9	0.05		23.9	SURCHARGED	
1.006	10	0.15		82.5	SURCHARGED	
1.007	11	0.16		52.2	FLOOD RISK	
1.008	12	0.09		40.6	SURCHARGED	
4.000	13	0.04		12.3	OK	
4.001	14	0.04		19.9	OK	
4.002	16	0.22		5.0	SURCHARGED	
4.003	16a	1.06		38.7	SURCHARGED	
5.000	17	0.05		40.0	SURCHARGED	
5.001	18	0.04		29.6	SURCHARGED	
5.002	19	0.07		32.6	FLOOD RISK	
5.003	20	0.65		21.6	FLOOD RISK	
5.004	21	0.40		15.7	SURCHARGED	
5.005	22	0.23		15.3	SURCHARGED	

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

US/MH		Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water	Surcharged	Flooded
PN	Name								Level (m)	Depth (m)	Volume (m³)
4.004	23	240	Winter	100	+40%	100/60	Summer		46.037	3.137	0.000
4.005	24	240	Winter	100	+40%	100/60	Summer		46.036	3.170	0.000
4.006	25	240	Winter	100	+40%	100/30	Winter		46.035	3.225	0.000
4.007	25a	240	Winter	100	+40%	100/30	Winter		46.035	3.262	0.000
4.008	26	240	Winter	100	+40%	100/30	Winter		46.035	3.299	0.000
4.009	27	240	Winter	100	+40%	100/30	Winter		46.035	3.384	0.000
1.009	28	240	Winter	100	+40%	100/30	Summer		46.035	3.486	0.000
1.010	29	240	Winter	100	+40%	1/15	Summer		46.035	5.070	0.000

US/MH		Pipe		Status	Level Exceeded
PN	Name	Flow / Cap.	Overflow (l/s)		
4.004	23	0.06	29.8	SURCHARGED	
4.005	24	0.05	32.0	SURCHARGED	
4.006	25	0.04	29.8	SURCHARGED	
4.007	25a	0.02	26.0	SURCHARGED	
4.008	26	0.01	30.3	FLOOD RISK	
4.009	27	0.01	22.2	FLOOD RISK	
1.009	28	0.01	38.3	FLOOD RISK	
1.010	29	0.18	24.4	FLOOD RISK	

Appendix I – Knowsley Council Pro Forma 1

PRO-FORMA 1: Sustainable Drainage System: Planning Permission

This pro-forma is a requirement of the Planning Validation Checklist. You **must complete all white boxes in full** and submit this pro-forma along with your supporting evidence to the Local Planning Authority for any application which seeks planning permission for major development (as defined in section 2 of [Statutory Instrument 2015 No. 595](#)).

This pro-forma supports developers and regulators in **summarising and confirming** how surface water from a development will be managed sustainably under current and future conditions. It should be completed in conjunction with the Council's 'Completing your Pro Forma' document and your sustainable drainage system should be designed in accordance with [CIRIA The SuDS Manual C753](#).

The pro-forma follows Policy CS24 of [Knowsley MBC's Local Plan](#), [National Planning Policy Framework](#), [House of Commons Written Statement \(HWSW 161\) on SuDS](#), [Planning Practice Guidance](#) and [Defra's Non-Statutory Technical Standards for Sustainable Drainage Systems](#). It is supported by the [Defra/EA Guidance on Rainfall Runoff Management](#) and can be completed using freely available tools such as [Tools for Sustainable Drainage Systems](#) or approved Industry Standard surface water management design software. The Council's [Sustainable Drainage & Surface Water Management Technical Guidance document](#) also provides further information.

Section 1: Development Details

Development Name		Halsnead Garden Village, Lickers Lane, Whiston		
Development Address (including postcode)		Lickers Lane, Whiston, Knowsley, Merseyside L35 3SR	Planning Application Reference (if available)	N/A
Development Grid Reference	Northings	390388	Expected lifetime of development (years)	100
	Eastings	347488	Have you submitted a Flood Risk Assessment?	Yes ☒ No ☐
Total Development Site Area (Ha)		3.41	Type of Planning Application (✓)	Outline ☐
Site area served by proposed drainage system (excluding open space) (Ha)*		1.46		Full ☒
Is your surface water drainage system designed to a (tick all that apply):				Hybrid ☐
Greenfield Standard - Site is undeveloped and a new drainage system will be installed; OR - Site is already developed and a new surface water drainage system will be installed to serve the new development.		☒		Reserved Matters ☐
Previously Developed Standard Site is already developed and the <u>entirety</u> of the existing surface water drainage system will be used to serve the new development.		☐		

PRO-FORMA 1: Sustainable Drainage System: Planning Permission

Section 2: Impermeable Area and Existing Drainage For outline or reserved matters applications, go to Section 3

	Existing (E)	Proposed (P)	Difference (P – E)	Evidence Checklist	
Impermeable Area (Ha)	0	1.46	1.46	☒	Plans showing development layout of site with existing and proposed impermeable areas.
State Drainage Method	N/A	Refer to Section 6.3 of FRA Report	N/A	☒	Plans showing current and proposed locations of sustainable drainage system.
Are there existing sewers, watercourses, water bodies, highway drains, soakaways or filter drains on the site?			Yes ☐ No ☒	☒	Plans showing existing layout to include: • Watercourses, open or culverted • Water bodies – ponds, swales etc. • Sewers, including manholes • Highway drains, include manholes • Soakaways, filter drains

Section 3: Surface Water Discharge Hierarchy – Planning Practice Guidance

Surface Water Discharge Method	Proposed?	If YES - Evidence Checklist		If NO - Evidence Checklist	
1. Infiltration to ground	Yes ☐ No ☒	☐	Completed Infiltration Checklist from CIRIA The SuDS Manual C753 Appendix B <i>An editable version of this form is available on SusDrain website.</i>	☒	Geotechnical Survey, including Soil Permeability Testing stating Percolation Coefficient, in accordance with BRE 365 AND Statement providing justification in your Sustainable Drainage Strategy
2. Discharge to watercourse or surface water body (Main River or Ordinary)	Yes ☐ No ☒	☐	Watercourse and/or Water Body Survey Report	☒	Plan showing nearby watercourses and water bodies AND Statement providing justification in your Sustainable Drainage Strategy
3. Discharge to surface water sewer	Yes ☒ No ☐	☒	Water and Sewerage Company written agreement for the Right to Connect.	☐	Plan showing nearby sewers AND Statement providing justification in your Sustainable Drainage Strategy
4. Discharge to combined sewer	Yes ☐ No ☒				

PRO-FORMA 1: Sustainable Drainage System: Planning Permission

Section 4: Calculate Peak Discharge Rates – Technical Standards S2 and S3 (unless S1 applies)

Rainfall Event	Existing Rate (l/s)	Greenfield Rate (l/s)	Proposed Rate (l/s) <i>Brownfield sites must reduce discharge rates by 50%</i>	Evidence Checklist	
Qbar	N/A	19.2	16.6	☒	MicroDrainage (or equivalent) calculations
1:1 Year Event	N/A	16.7	16.6		
1:30 Year Event	N/A	32.5	16.6		
1:100 Year Event	N/A	39.9	24.4		

Section 5: Calculate Discharge Volume – Technical Standards S4 and S6 (unless S1 applies)

Rainfall Event	Existing Volume (m ³)	Greenfield Volume (m ³)	Proposed Volume (m ³)	Evidence Checklist	
1:100 Year 6 Hour Event	N/A	861.8	2382.0	☒	MicroDrainage (or equivalent) calculations

Section 6: Infiltration

Site Information	✓	Evidence Checklist	
Do your sustainable drainage proposals include any infiltration?	Yes ☐ No ☒ <i>If NO, please move on to Section 7</i>	☒	Proposed sustainable drainage plans
You should submit an alternative 'Plan B' sustainable drainage design utilising an alternative discharge method if site specific ground conditions are unknown at this stage. This will become the default design in the event infiltration proposals are not feasible upon site specific ground investigation. Have you submitted an alternative 'Plan B' sustainable drainage design?	Yes ☒ No ☐	☒	'Plan B' conceptual sustainable drainage plans and statement of approach

PRO-FORMA 1: Sustainable Drainage System: Planning Permission

Section 7: Storage – Technical Standards S7, S8 and S9

Storage Details	Details	Evidence Checklist	
State climate change allowance used (%)	40	☒	State / use in MicroDrainage
State storage volume provided (m ³) (excluding non-void spaces) <i>Must include an allowance for climate change and urban creep.</i>	629	☒	Drainage plans showing location of attenuation and all flow control devices and any supporting calculations
Summarise how storage will be provided for 1:30 year event on site. <i>Storage must be designed to ensure that at no flooding occurs onsite in a 1 in 30 year event except in designed areas and no flooding occurs offsite in a 1 in 100 year (+ climate change allowance) event.</i>	oversized pipes	☒	Plans showing size and location of storage and supporting calculations
Summarise how storage will be provided for 1:100 year (+ climate change) 6 hour event on site. <i>Where storage above the 1:30 year rainfall event is provided in designated areas designed to accommodate excess surface water volumes, plans showing storage locations and surface water depths and supported by MicroDrainage (or equivalent) calculations.</i>	oversized pipes	☒	Plans showing size and location of storage and supporting calculations

Section 8: Operation and Maintenance – Technical Standard S12 and HCWS161

Consideration	Select <u>ALL</u> that apply (✓)		Evidence Checklist
State how <u>ALL</u> components of the sustainable drainage system will be maintained for the design life of the development.	Sustainable drainage features are at property level	☒	☒ Statement provided within your Sustainable Drainage Strategy
	Sustainable drainage system to be adopted by Water and Sewerage Company through a Section 104 agreement (Water Industry Act 1991)	☒	
	Applicant to secure maintenance of sustainable drainage features by entering into a Section 106 agreement (Town and Country Planning Act 1990)	☐	

PRO-FORMA 1: Sustainable Drainage System: Planning Permission

Declaration and Submission

This pro-forma has been completed using evidence from information which has been submitted with my planning application.

The information submitted in the Sustainable Drainage Strategy and site-specific Flood Risk Assessment (FRA), where submitted, is proportionate to the site conditions, flood risks and magnitude of development and I agree that this information can be used as evidence to this sustainable drainage approach.

Submitter Details

Form <u>completed</u> by	John Speers	Email Address	johnspeers@ajpltd.co.uk
		Daytime Telephone	0151 227 1462
Form <u>signed off</u> by	John Speers	Accreditation(s) and/or Qualification(s) of Signatory	CEng MICE, MSc, BEng (Hons)
Date (dd/mm/yyyy)	22/07/2022	Company	AJP

Client Details

Name	Peter Bowen	Company	Vistry Partnerships North West
------	-------------	---------	--------------------------------