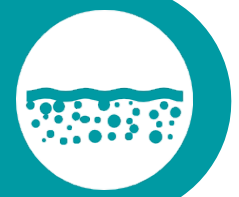


SuDSmart Plus



Sustainable Drainage Assessment

Site Address

Land off Whitecarr Lane / Newall Road
Wythenshawe
M23 2TX

Date

2022-04-19

Report Status

FINAL

Grid Reference

380719, 387281

Site Area

0.30 ha

Report Prepared for

Abbeyway Commercial

Report Reference

76712.01R1



Discharge to Ground

The proposed Sustainable Drainage Scheme (SuDS) strategy is comprised of a rainwater harvesting butt, permeable paving and a soakaway for surface water runoff.

Surface water will infiltrate to ground, subject to confirmation of the infiltration potential and depth to groundwater.

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1 Executive summary



This report assesses the feasibility of a range of Sustainable Drainage Scheme (SuDS) options in support of the Site development process. A SuDS strategy is proposed to ensure surface water runoff can be managed effectively over the lifetime of the development.

SuDS suitability

Risk	Issue	Result
Discharge Location	What is the infiltration potential at the Site?	Moderate
	What is the potential to discharge to surface water features?	Low
	What is the potential to discharge to sewers?	Medium
	What is the potential to discharge to highway drains?	Low
Flooding	What is the river (fluvial) flood risk at the Site?	Very Low
	What is the surface water (pluvial) flood risk at the Site?	Very Low
	What is the groundwater flood risk at the Site?	Negligible
Pollution	Is the groundwater a protected resource?	No
	Is the surface water feature a protected resource?	N/A

Summary of existing and proposed development

The Site is currently used within an agricultural capacity as part of Newall Green Farm (adjacent to the eastern boundary). At present there is an access road and car parking connecting to the farm buildings to the east, as well as undeveloped land to the north and south of the road.

Development proposals comprise the construction of a two-storey apartment building containing eight apartments. The existing access road and car parking will be retained with modification to suit the new use. An amenity area and landscaping are also included.

Summary of discharge routes

GeoSmart's SuDS Infiltration Potential (SD50) map indicates the Site has a Moderate potential for infiltration, primarily due to the variable permeability of the underlying geology (Devensian Till). Infiltration to ground is therefore potentially feasible, subject to confirmation of the local geology and infiltration rates at the Site.

A drainage ditch is located c. 120 m south of the Site (leading to the Fairywell Brook). However, discharging to this watercourse would require pipework to cross a significant distance of third party land, including a highway, and therefore discharge to surface watercourse is unlikely to be feasible.

The utilities search included in Appendix D confirms the Site is located within 40 m of the public sewer network. Due to the moderate distance to nearby sewers discharging surface water runoff to the sewer is potentially feasible.

According to Google Streetview, highway gullies are located within Newall Road but were not identified along Whitecarr Lane, indicating the presence of the highway drainage network along Newall Road.

Runoff rate and attenuation requirements

Discharging via infiltration requires 63.39 m³ of attenuation to be provided to ensure there is no flooding as a result of the development in all storm events up to and including the 1 in 100 year (critical storm duration) including a 40% allowance for climate change. This volume is subject to the results of infiltration testing and would ensure runoff is not increased above the greenfield scenario.

Discharging off-Site requires 48.00 m³ of attenuation to be provided to ensure there is no flooding within the development in all storm events up to and including the 1 in 100 year including a 40% allowance for climate change. This volume is subject to the discharge rate being restricted to 2 l/s (as close to the Greenfield 1 in 1 year rate as possible, without increasing the potential for blockages, and beneath the Greenfield 1 in 100 year rate).

Proposed SuDS strategy

SuDS features comprised of rainwater harvesting, lined permeable surfacing and a soakaway are proposed to attenuate a minimum of 63.39 m³ of surface water runoff. The SuDS features would provide some water quality benefits (interception and filtration) prior to infiltrating to ground. Focused infiltration features should be sited at least 5m from building foundations and 2-3m from adjacent highways. A secondary strategy has also been proposed in the event that infiltration SuDS are deemed unsuitable.

The proposed SuDS strategy would ensure surface water runoff is stored on-Site in SuDS features for the 1 in 100 year event including a 40% allowance for climate change and will not cause flooding to the proposed development in accordance with DEFRA's non-statutory technical standards (DEFRA, 2015).

SuDS & drainage network maintenance

The management and maintenance of the SuDS features, in line with the details and schedules outlined in Section 10 of this report, will be undertaken by contractors appointed by the owners and occupiers of the new apartment building, where payments for the works will form part of the property deeds and / or rental agreements.

Recommendations / Next steps

A site investigation is required to confirm the infiltration capacity of the ground in line with BRE 365 guidelines to confirm the infiltration rate and the groundwater level.

Where site investigation confirms the underlying ground conditions are not conducive to infiltration, the capacity of the public sewer network should be confirmed with the utility provider and permission to connect should be obtained where required.

2 Proposed SuDS strategy



The most suitable SuDS options are outlined below and a SuDS strategy schematic is shown overleaf. Supporting information is provided in subsequent sections.

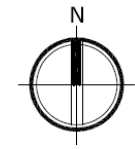
Table 1. Proposed SuDS type, features, discharge location and rate restriction

SuDS type	Source control (interception) and infiltration SuDS.
SuDS features	Rainwater harvesting, lined permeable paving, soakaway
Discharge location	Infiltration
Discharge rate	1×10^{-5} m/s (example infiltration rate for silty clayey sand, taken from the CIRIA SuDS Manual C753, to be confirmed via infiltration testing)

Table 2. Proposed SuDS sizing (dimensions) and attenuation volumes

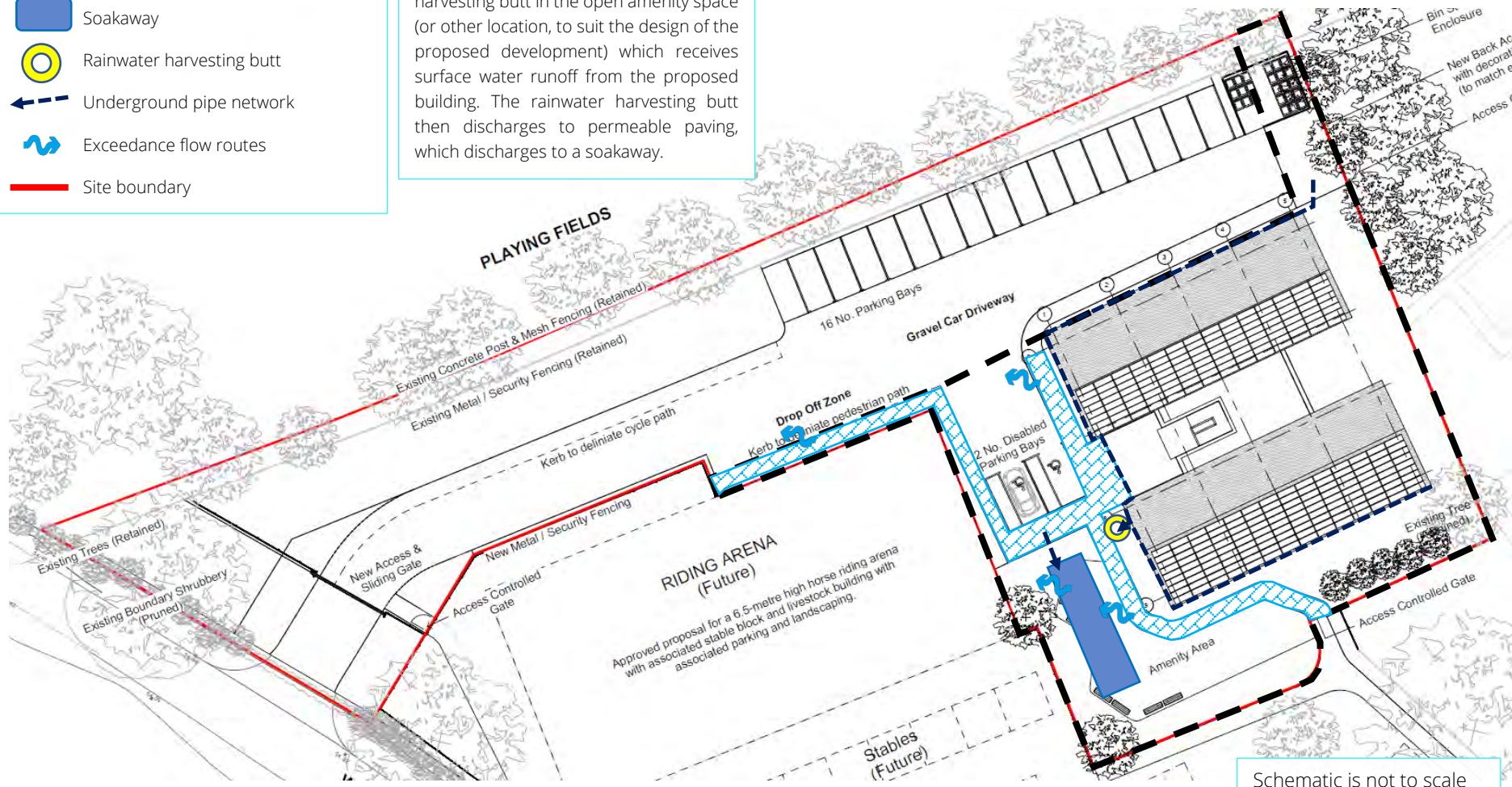
Rainwater Harvesting	To provide additional amenity and water re-use benefits, rainwater harvesting butts should be established for the proposed development. In terms of attenuation storage within this SuDS scheme, the volume of run-off which could be attenuated by Rainwater Harvesting has not been considered within the Preliminary SuDS schematic.
Lined permeable paving	A 130 m^2 area of permeable paving (underlain with a Type 3 aggregate material) within the proposed paved areas to a depth of 0.5 m, with a 30% porosity would result in c. 19.5 m^3 attenuation. Note that the permeable paving should be lined to ensure no focused infiltration occurs within 5 m of any on-Site or off-Site buildings.
Soakaway	A soakaway within the open amenity space with an area of c. 46.2 m^2 (e.g. $14 \text{ m} \times 3.3 \text{ m}$) and a depth of 1 m, filled with geo-cellular crates with a 95% void ratio, would provide 43.89 m^3 attenuation.
Total Attenuation Provided	63.39 m^3

2. Proposed SuDS scheme layout



-  Lined permeable paving
-  Soakaway
-  Rainwater harvesting butt
-  Underground pipe network
-  Exceedance flow routes
-  Site boundary

The SuDS scheme comprises a rainwater harvesting butt in the open amenity space (or other location, to suit the design of the proposed development) which receives surface water runoff from the proposed building. The rainwater harvesting butt then discharges to permeable paving, which discharges to a soakaway.



Schematic is not to scale

3 Site analysis

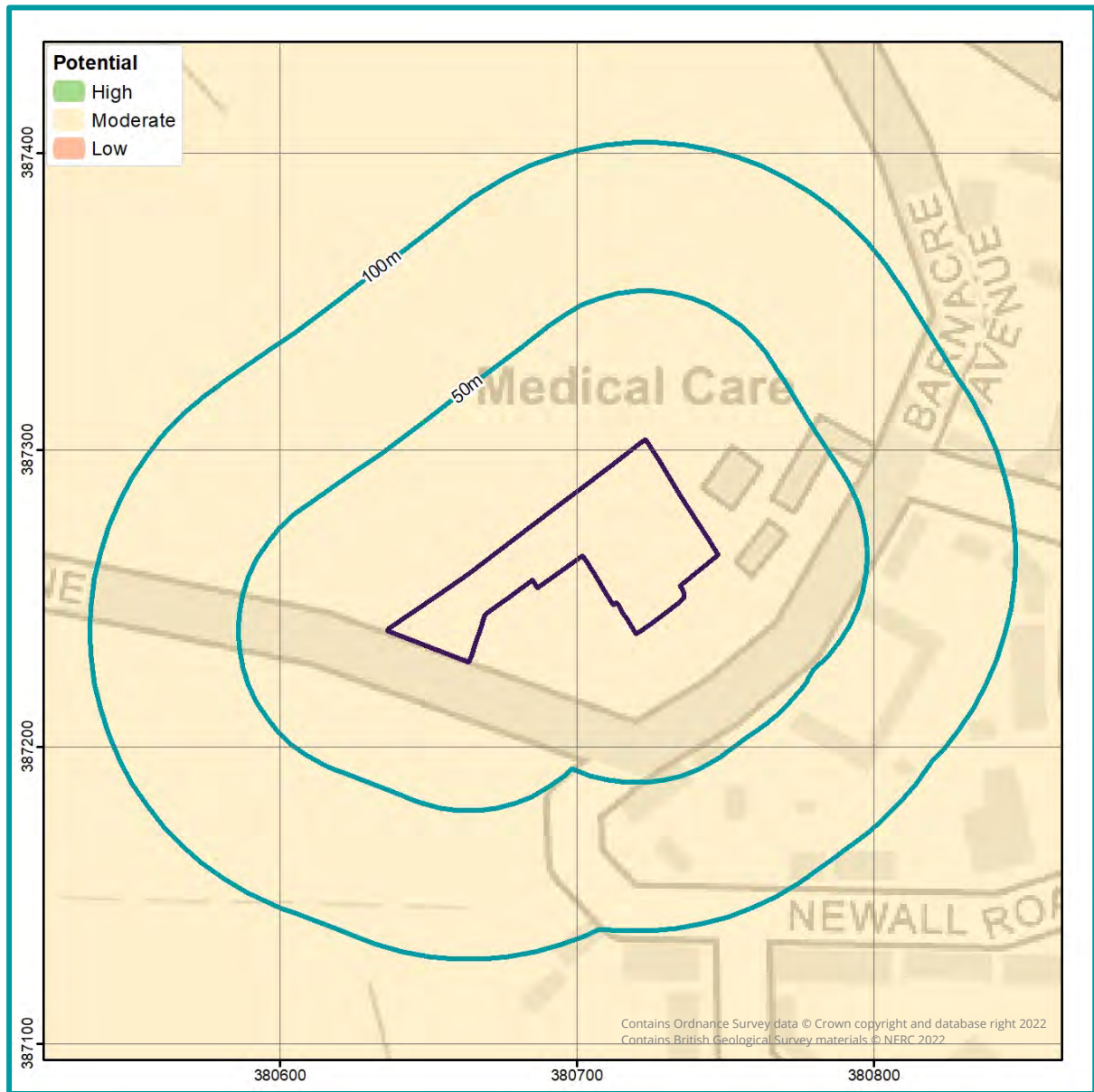


Site location

Figure 2. Aerial Imagery (Bluesky, 2022)



Figure 3. SuDS infiltration suitability (SD50) map (GeoSmart, 2022)



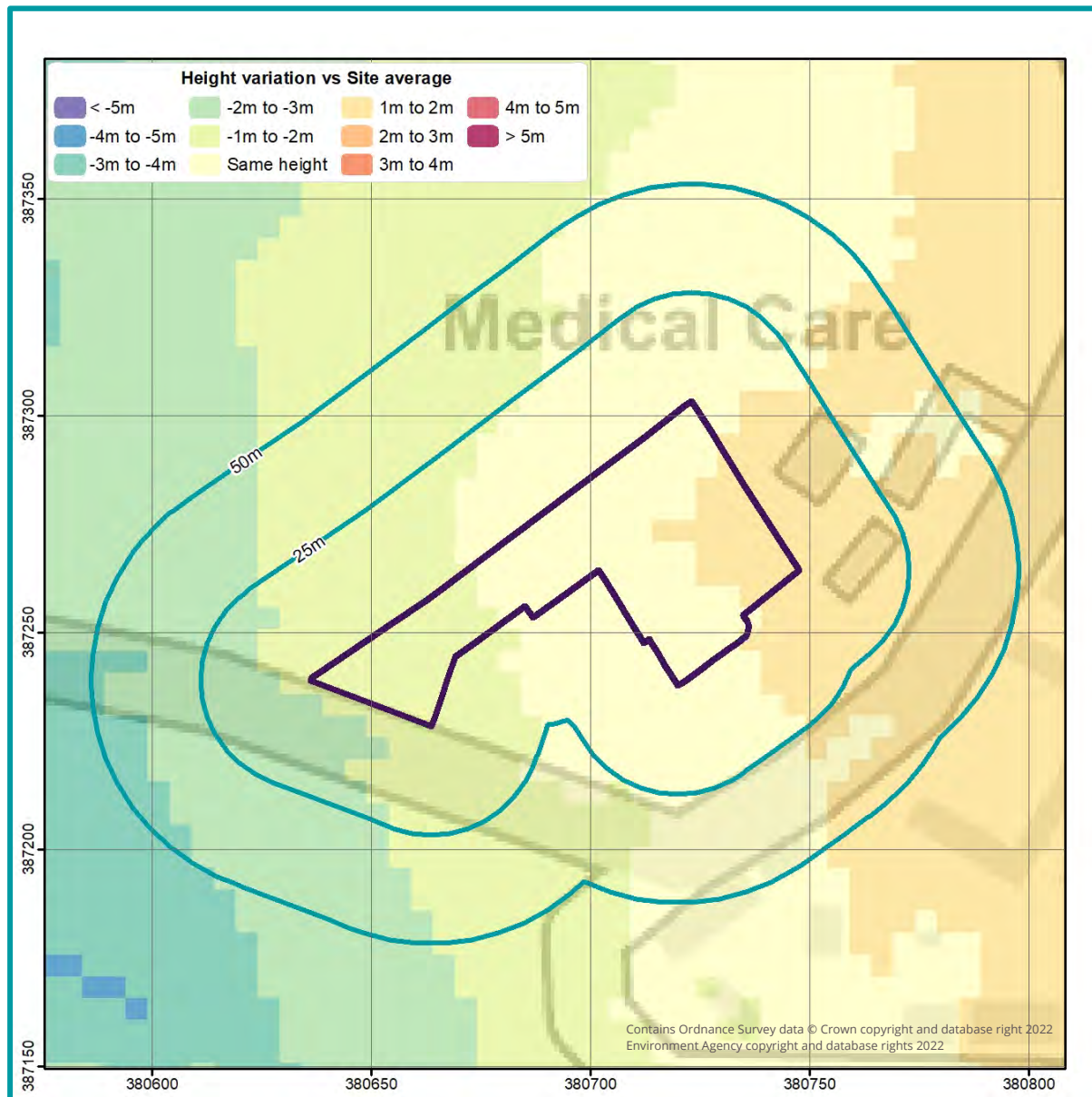
The GeoSmart SuDS Infiltration Suitability Map (SD50) screens the potential for infiltration drainage at the Site and indicates where further assessment is recommended. The map combines information on the thickness and permeability of the underlying material and the depth to the high groundwater table. It supports conceptual Site drainage design and the planning of further Site investigation.

There is a Moderate potential for infiltration SuDS across the Site. It is likely that the underlying geology at the Site has a variable permeability and an infiltration SuDS scheme could potentially be possible at the Site.

Groundwater levels could potentially be sufficiently deep at the Site. However, a Site Investigation is recommended to confirm the infiltration capacity and the depth to

groundwater. Various options can be considered for infiltration SuDS and these include infiltration trenches, soakaways, swales and permeable pavements.

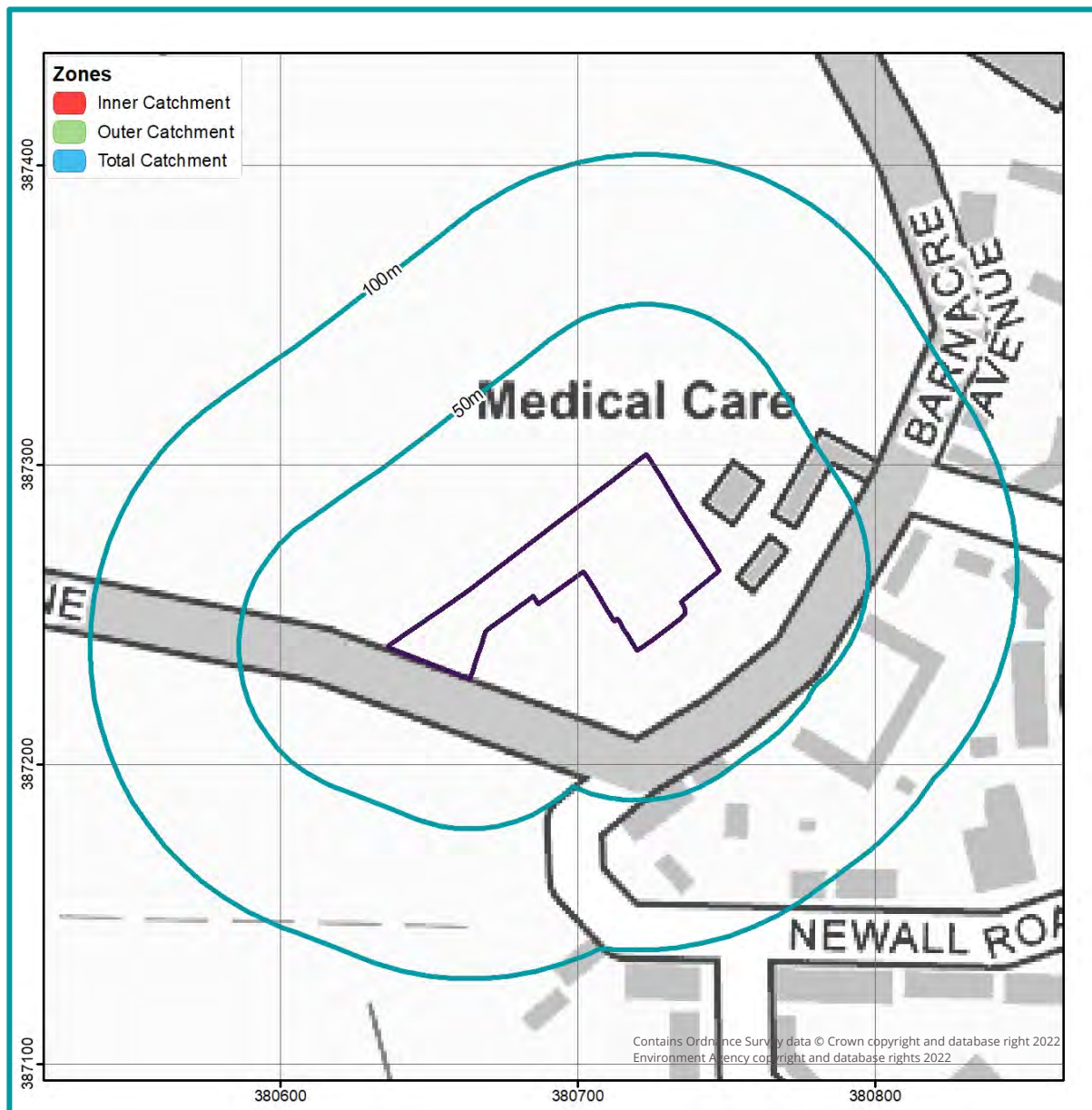
Figure 4. Site topography (GeoSmart, 2022)



An assessment of the topography at the Site has been undertaken using a topographical survey provided for the Site (Corstorphine and Wright, 2022) in conjunction with LiDAR DTM5 elevation data to identify the general slope and any localised depressions. The mapping shows a comparison between average ground levels on the Site with ground levels in the surrounding area. The mapping confirms the overall Site is generally on a gradual slope, with ground levels falling toward the west.

General ground levels are between 54.96 mAOD in the western corner and 57.06 mAOD along the eastern boundary.

Figure 5. Source protection zone map (EA, 2022)

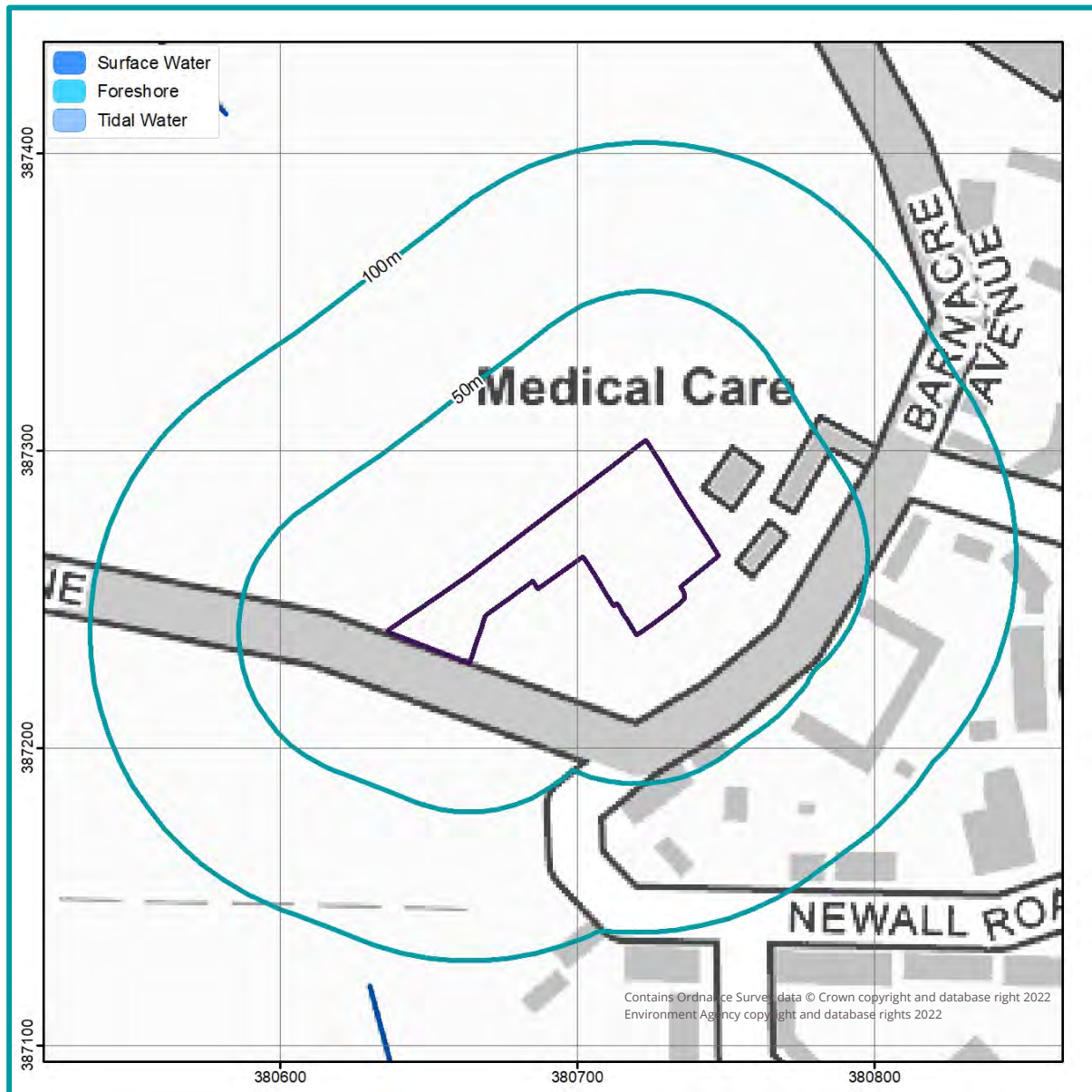


An assessment of the EA's groundwater Source Protection Zones (SPZs) has been undertaken within the vicinity of the Site and confirms the Site is not located within an SPZ.

Infiltration, if possible, is likely to be acceptable providing risk screening identifies suitable mitigation measures, if required, to prevent an impact on water quality from the proposed or historical land use and contaminated land.

If further analysis is required, this would involve a review of Site specific contaminated land data. If hazards are identified, it is recommended that the Local Authority and the Environment Agency are contacted to confirm the susceptibility of any SPZs within the wider area.

Figure 6. Surface water features map (EA, 2022)



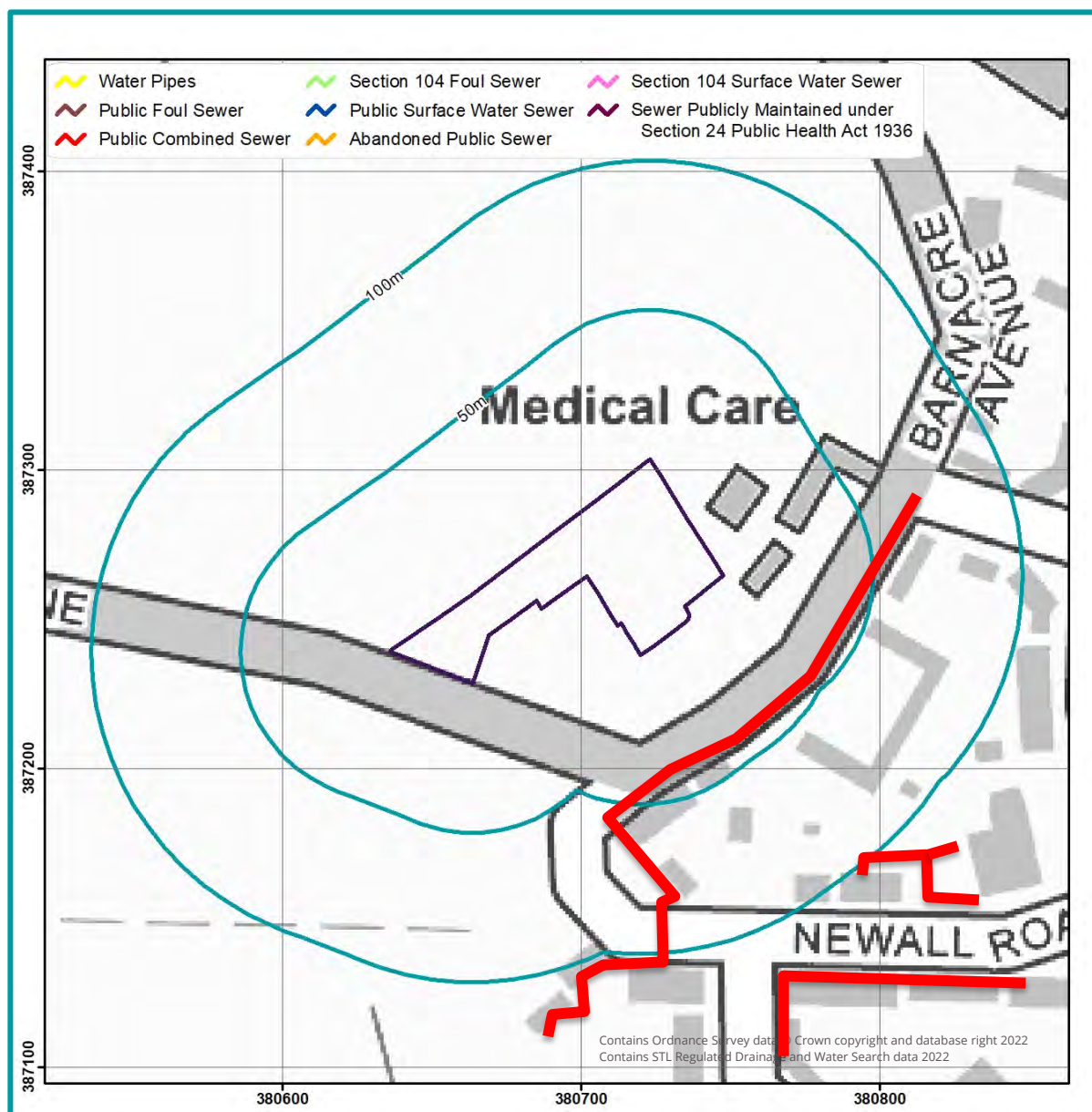
OS mapping indicates the nearest surface water feature is a drainage ditch c. 120 m south of the Site (leading to the Fairywell Brook).

However, discharging to this watercourse would require pipework to cross a significant distance of third party land, including a highway, and therefore discharge to surface watercourse should not be considered.

According to the EA's Magic Map, the Site is not within 250m of a SSSI or SPA.

Further analysis could be undertaken by visiting the Site or by contacting the Local Council and the Environment Agency (EA) to confirm the presence, location and condition of any mapped or additional unmapped surface water features.

Figure 7. Sewer features map (OS & STL, 2022)



GeoSmart has undertaken an assessment of the location of sewer features within the vicinity of the Site. According to a utilities search undertaken at the Site (Appendix D), there is a public combined sewer located c. 40 m south-east of the Site.

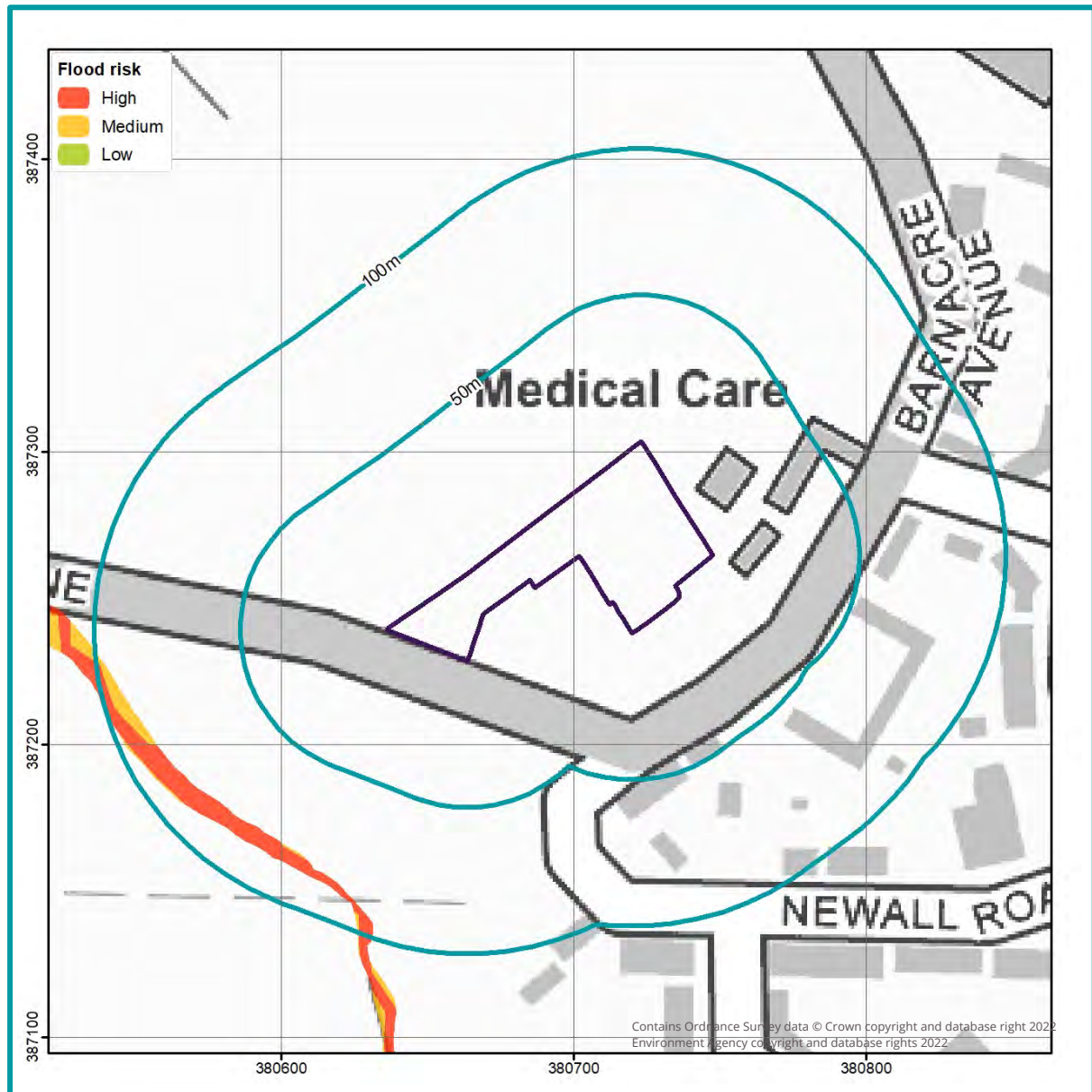
In order for discharge to the combined sewer to occur, pipework would have to cross third-party land not contained within the Site boundary. It is noted that Site plans indicate the land between the Site and Newall Road is owned by the client.

Due to the moderate distance to the nearest combined sewer, discharge to sewer is potentially feasible at the Site and could be considered in the event that infiltration SuDS are proven unfeasible.

Further analysis of the connections and condition of the public surface water drainage system should be undertaken by carrying out a CCTV survey or by contacting the drainage provider

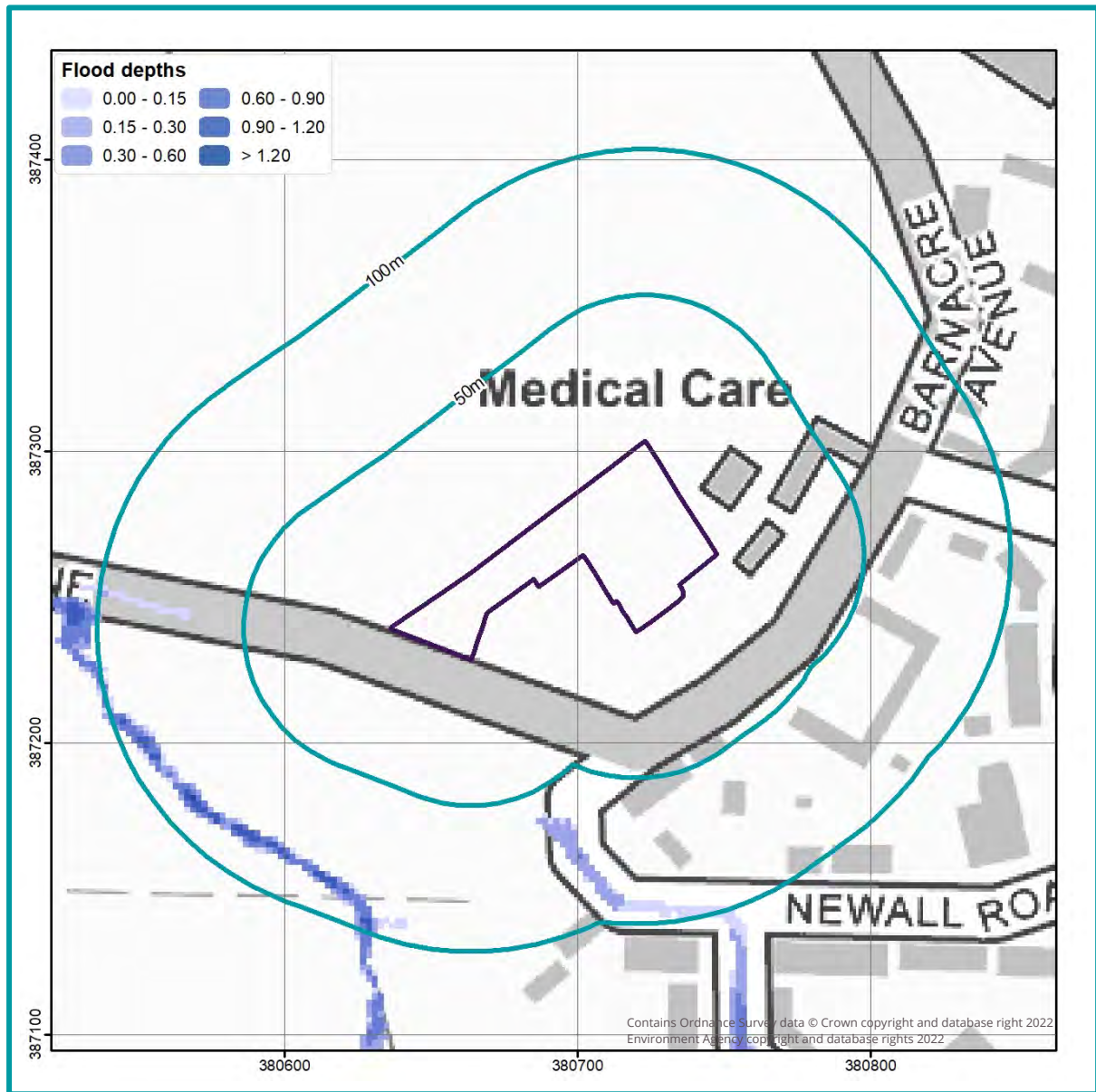
or the Local Council to confirm the presence, location and condition of the sewer. Consultation with the drainage provider would also be required to determine that sufficient capacity is available to accept the proposed discharge, and to gain permission to connect if required.

Figure 8. Risk of flooding from rivers & sea map (EA, 2022)



According to the EA's Risk of Flooding from Rivers and the Sea (RoFRS) map, the Site has a Very Low risk of flooding from fluvial or coastal flooding, with less than 0.1% annual probability of flooding, therefore the SuDs design is unlikely to be affected.

Figure 9. Risk of surface water flooding map (EA,2022)



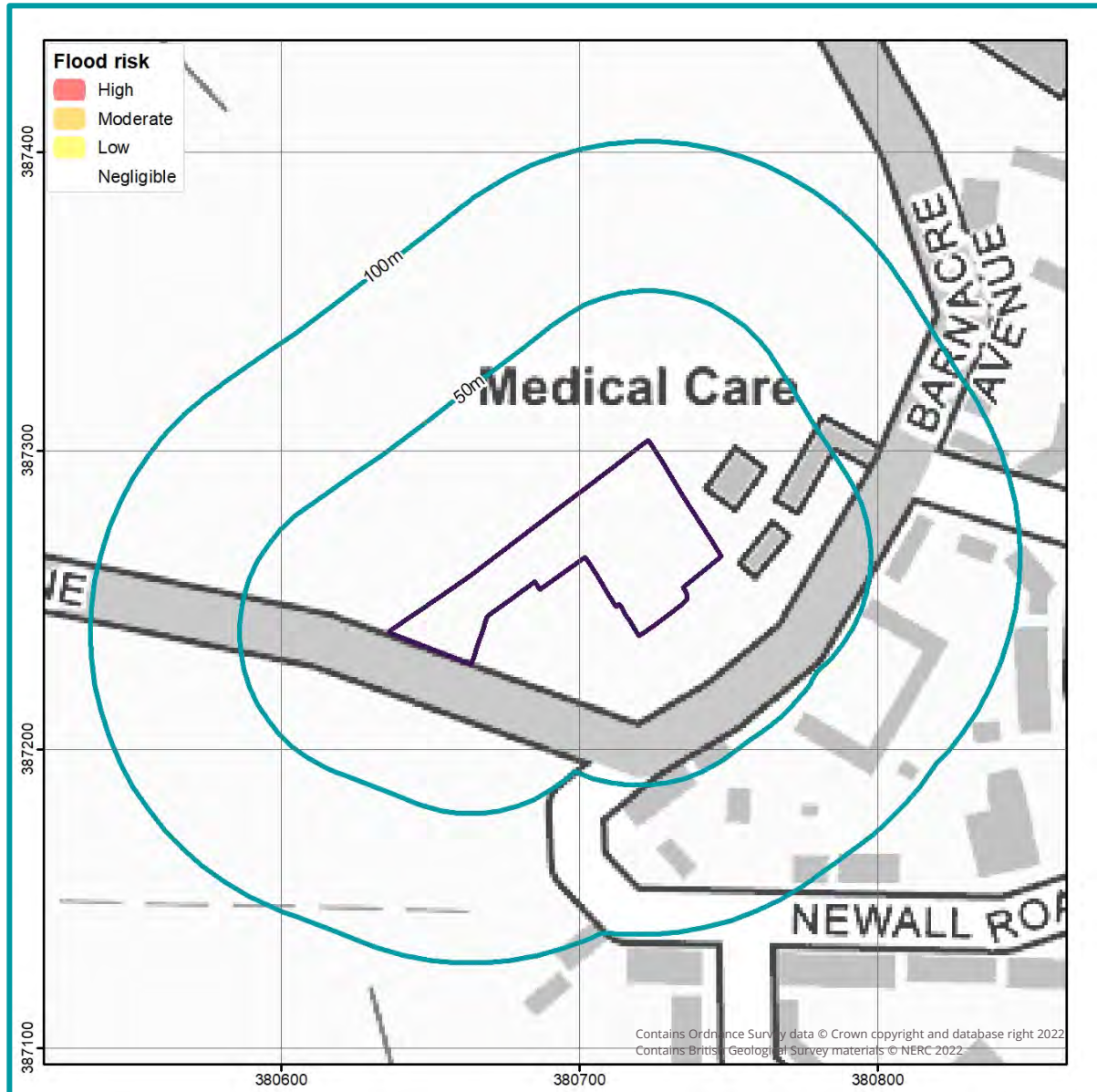
GeoSmart have undertaken an assessment of the risk of flooding from surface water (pluvial) sources within the vicinity of the Site using the EA's Risk of Flooding from Surface Water (RoFSW) mapping. The EA's mapping confirms the Site is considered to be at Very Low risk of surface water flooding.

The above map shows the extent and depth of flooding during a 1% annual probability (1 in 100 year) event. This confirms there are no areas on the Site which would be affected by flooding in the 100 year event.

According to the Manchester City, Salford City and Trafford Councils Level 2 Hybrid SFRA, the Site is located in the Manchester and Trafford South Critical Drainage Area (JBA Consulting, 2011).

Further analysis could be undertaken by visiting the Site or by contacting the Local Council and the Environment Agency to confirm the pluvial flood risk, flood depths and velocities where applicable.

Figure 10. Groundwater flood risk (GW5) map (GeoSmart, 2022)



GeoSmart have undertaken an assessment of the risk of flooding from groundwater within the vicinity of the Site. GeoSmart's Groundwater Flood Risk Screening (GW5) map confirms the Site has a Negligible risk of groundwater flooding during a 1% annual probability (1 in 100 year) event.

4 Site context



Site information

The purpose of this report is to assess the potential for disposing of surface water through a Sustainable Drainage System (SuDS) for the site of the Land off Whitecarr Lane / Newall Road, Wythenshawe, M23 2TX (the Site). The Site is located on the outskirts of Wythenshawe in a setting of primarily agricultural and residential land use. Site plans and drawings are provided in Appendix A.

Development

The Site is currently used within an agricultural capacity as part of Newall Green Farm (adjacent to the eastern boundary). At present there is an access road and car parking connecting to the farm buildings to the east, as well as undeveloped land to the north and south of the road.

Development proposals comprise the construction of a two-storey apartment building containing eight apartments. The existing access road and car parking will be retained with modification to suit the new use. An amenity area and landscaping are also included.

Geology, permeability and thickness

British Geological Survey (BGS) national superficial and bedrock geology mapping confirms the geological formations underlying the Site and each formation may have a range of permeability.

Table 3. Site Geology

Geology present on-Site		Potentially permeable?
Superficial geology (Figure 11)	Devensian Till (TILLD) – diamicton	✓
Bedrock geology (Figure 12)	Bollin Mudstone Member (BOM) – mudstone	✗

The permeability of the underlying material at the Site shown within the BGS mapping is moderate, confirmation of the infiltration capacity is required.

The BGS website was used to extract ground information from the nearest borehole records to the Site (ref: SJ88NW13 and SJ88NW1124). These boreholes are located approximately 680 m to the southeast at an elevation of c. 60 mAOD and 830 m to the northwest of the Site at an elevation of c. 43 mAOD, respectively.

The SJ88NW13 borehole comprises soil to 0.20 m below ground level (bgl), variegated clay to 0.61 m bgl, very sandy clay to 0.76 m bgl, variegated marl to 3.81 m bgl, soft variegated marl to 6.40 m bgl, marl to 8.53 m bgl and variegated marl to 9.45 m bgl, at which the borehole ended.

The SJ88NW1124 borehole comprises made ground to 0.2 m bgl, sandy clay to 1.0 m bgl, firm silty clay to 2.0 m bgl and mudstone to 2.3 m bgl, at which the borehole ended.

The borehole records are consistent with the predicted geology of Devensian Till superficial deposits with underlying Bollin Mudstone. It is unclear to what depth the superficial deposits extend.

Infiltration SuDs are proposed directly into permeable superficial deposits. It is noted that both boreholes contain shallow sandy clay horizons, which suggests that superficial deposits at the Site may be of low permeability; however, due to the long distance between the Site and any publicly available borehole records, the local geology of the Site is unclear.

The soil infiltration coefficient must be sufficient to accommodate the constraints on the dimensions of the soakaway and its emptying time.

Depth to groundwater

The SuDS system should be designed to operate in periods of extreme groundwater levels.

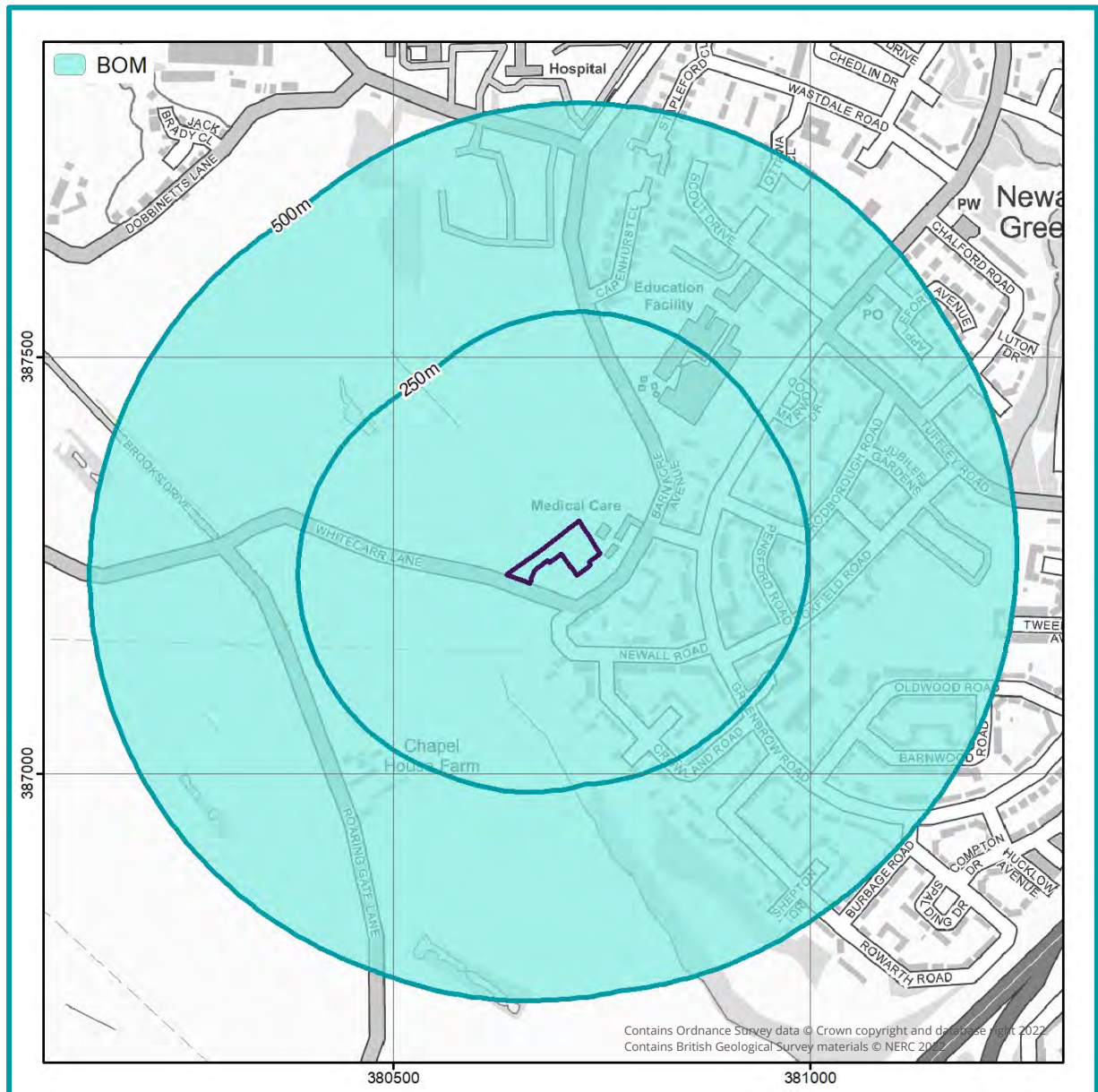
According to borehole data and GeoSmart's Groundwater Flood Risk (GW5) map, shallow groundwater is unlikely to be an issue at the Site.

The SJ88NW13 borehole did not record the depth to groundwater. The SJ88NW1124 borehole did not encounter groundwater during its 2.3 m depth.

It is possible that perched groundwater may occur within permeable horizons at the contact with lower permeability bedrock material, depending on the local geology at the Site.

The base of the infiltration system needs to be 1 m above the expected seasonal high-water table. Passage through unsaturated soil is important for improving the quality of infiltrating water before it reaches the water table.

Figure 12. Bedrock Geology (BGS, 2022)



Ground conditions

Infiltration SuDS are proposed within potentially permeable superficial deposits above clay bedrock. A detailed review of underlying ground conditions is recommended to ensure focused infiltration does not result in the creation of shrink-swell clays.

Soakaways should be a minimum of 5m away from the foundations of a building and local guidance may recommend a greater distance, such as 10m on some areas of the Chalk.

Water quality

The Site does not lie within an SPZ. The infiltrated water quality should be of sufficient quality that it does not give rise to pollution of the underlying groundwater. Further consultation with the water company is unlikely to be required.

A Phase I contaminated land report has also been prepared for the Site (ref: 76712), which will aid in the identification of any potential contamination.

Infiltration systems should not be used where there is a risk of contaminating groundwater by infiltrating polluted runoff or where receiving groundwater is particularly sensitive.

The influence of surface runoff on water quality will depend on whether there is a source of contamination on-Site and the sensitivity of the receiving environment, either groundwater or surface water. The intervening pathway from source to receptor including mitigation and natural attenuation will determine the final impact.

The impact of contaminants on the groundwater will be reduced by travel and natural attenuation through the unsaturated soil zone. A greater depth of unsaturated zone and the presence of significant clay and organic material will provide greater protection for the underlying groundwater. Rapid flow through fractures will provide less protection than intergranular flow around soil and rock particles.

5 National & local policy context



National Guidance

CIRIA SuDS Manual (C753) (2015)

A development should utilise sustainable drainage systems (SUDS) unless there are practical reasons for not doing so, and should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible in line with the following drainage hierarchy:

1. Use infiltration techniques, such as porous surfaces in non-clay areas,
2. attenuate rainwater in ponds or open water features for gradual release,
3. attenuate rainwater by storing in tanks or sealed water features for gradual release,
4. discharge rainwater direct to a watercourse,
5. discharge rainwater to a surface water sewer / drain,
6. discharge rainwater to the combined sewer.

Defra - Sustainable Drainage Systems: Non-statutory technical standards for sustainable drainage systems (2015)

Peak Flow control

For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.

For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.

Volume control

Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event. The runoff volume must be discharged at a rate that does not adversely affect flood risk.

The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the Site for a 1 in 30 year rainfall event.

Ministry of Housing, Communities & Local Government – National Planning Practice Guidance: Flood risk assessments: climate change allowances (2014)

The Peak rainfall intensity allowances section provides advice on the increased rainfall effects on river levels and land and urban drainage systems. The anticipated changes in peak rainfall intensity in small catchments (less than 5 km²) and urban catchments are shown in Table 4.

For large rural catchments use the alternative allowances defined for rivers.

In order to understand the range of impact, both the central and upper end allowances should be assessed.

Table 4. Peak rainfall intensity allowance in small and urban catchments (use 1961 to 1990 baseline)

Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115
Upper end	10%	20%	40%
Central	5%	10%	20%

The drainage system should be designed to make sure there is no increase in the rate of runoff discharged from the Site for the upper end allowance.

Where on-Site flooding for the upper end allowance presents a significant flood hazard (for example, depths and velocities of surface water runoff cause a significant danger to people), you will need to take further mitigation measures to protect people and property (for example, raising finished floor levels). As a minimum, there should be no significant flood hazard to people from on-Site flooding for the central allowance.

Local Policy

Manchester City Council – Core Strategy Development Plan Document, Policy EN 14: Flood Riskk (July 2012)

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

Manchester City Council – Local Flood Risk Management Strategy (March 2014)

Within Critical Drainage Areas (the Site is in the Manchester and Trafford South CDA), and consistent with Core Strategy policy EN14 Flood Risk, developers should aim to minimise surface water runoff from developments, and achieve at least the following runoff rates:

- Greenfield runoff on Greenfield sites up to a 1 in 100 year storm event, including consideration of climate change.
- A 50% runoff rate reduction for Brownfield sites, with an aim of reducing runoff to Greenfield rates up to a 1 in 100 year storm event, including consideration of climate change 57.

6 Storage, volume and peak flow rate



Suggested minimum and aspirational storage requirements for an infiltration or attenuation SuDS scheme for the development footprint are set out below, with more detail provided in subsequent sections. Storage volumes may be reduced (but not below the minimum level) if the design incorporates off-Site discharge.

Table 5. Storage requirements at the proposed development Site (Discharge runoff via infiltration)

Attenuation scenario	Attenuation required (m ³)	Explanation
Discharge runoff via infiltration - 1 in 100 year including 40% CC	63.39	Attenuation required to ensure surface water runoff is attenuated in all storm events up to and including the 1 in 100 year event including a 40% allowance for climate change*. This attenuation volume is based on 130 m² of permeable paving to 0.5 m depth and filled with a Type 3 aggregate with a 30% porosity and a soakaway with an area of 46.2 m² and depth of 1 m, filled with geo-cellular crates with a 95% void ratio. The volume is calculated using Causeway Flow v. 10.2. An infiltration rate of 1×10^{-5} m/s is used (example infiltration rate for silty clayey sand, taken from the CIRIA SuDS Manual C753 in the absence of confirmation of the local geology).

*Subject to confirmation through infiltration testing. See Appendix B for associated calculations.

Table 6. Storage requirements at the proposed development Site (Discharge runoff to combined sewer)

Attenuation scenario		Attenuation required (m³)	Explanation	
Discharge runoff to combined sewer	1 in 30 year	19.77	Attenuation required to ensure surface water runoff is attenuated in all storm events up to and including the 1 in 30 year (1 hour, Critical Storm Duration) event*. Flooding of the Site of 11.14 m³ should be contained within permeable landscaped areas within the Site to ensure no flooding of internal areas during the 1 in 100 year storm event.	A further 17.09 m³ should be managed within overland flow routes to ensure there is no increase in flood risk in all events up to the 1 in 100 year including 40% allowance for climate change.
	1 in 100 year	30.91	Attenuation required to ensure surface water runoff is attenuated in all storm events up to and including the 1 in 100 year (1 hour, Critical Storm Duration) event*.	
	1 in 100 year including 40% CC	48.00	Attenuation required to ensure surface water runoff is attenuated in all storm events up to and including the 1 in 100 year (2 hour, Critical Storm Duration) event including a 40% allowance for climate change*.	

*See Appendix C for associated runoff and discharge calculations. Discharge rates all restricted as close as possible to greenfield rates in their respective events.

Surface water runoff

An increase in impermeable area on-Site will result in greater rainfall runoff. Reduction in runoff will help mitigate flood risk both on and off-Site. Further information on the surface water runoff calculations is provided in Section 12 'Background Information'.

Please note only the proposed building footprint and extension to the existing car parking and access road has been included. The existing access road is assumed to be retained and therefore will drain as existing.

Guidance

The Non-Statutory Technical Guidance for SuDS (Defra, March 2015) states:

"Where reasonably practicable, for Greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the Greenfield runoff volume for the same event. Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the Greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event."

Table 7. Change in impermeable area associated with the development

Total Site area	2973 m ²
Impermeable area (and as a percentage of the total area of the proposed development footprint of 1359 m²)	
Pre-development	Post-development
57 m ² (4%)	835 m ² (61%)
Impermeable Land use: Paving Permeable Land use: Undeveloped land	New impermeable land use: Building footprint, paving*, car parking New permeable land use: Landscaped areas

*Please note, while these areas will be utilized for SuDS, for the calculations these areas will be classed as impermeable in order to assess the potential run-off volumes and rates for the Site post- development and the potential holding capability of the proposed SuDS features.

Guidance

"The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event' and 'flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development"

(Defra, March 2015, non-statutory guidance).

Peak discharge rates

The table below presents peak discharge rates for a range of storm events used to assess the impact of the proposed development and select the maximum permitted discharge rate. Further information on the calculation and control of peak discharge rates is provided in Section 12 'Background Information'.

Table 8. Peak discharge rates associated with the development

Rainfall event	Greenfield runoff rates (l/s)	Existing runoff rates ¹ (l/s)	Potential runoff rates without attenuation (l/s)	Potential minus existing (l/s)
QBAR	0.80	N/A	N/A	N/A
6 hour 1 in 1 year	0.68	0.71	1.14	0.43
6 hour 1 in 10 year	1.10	1.13	1.78	0.66
6 hour 1 in 30 year	1.34	1.49	2.42	0.92
6 hour 1 in 100 year	1.66	2.05	3.31	1.26
6 hour 1 in 100 year + 20% CC	N/A	N/A	3.97	1.92
6 hour 1 in 100 year + 40% CC	N/A	N/A	4.64	2.59

¹ Assumes 100% runoff from impermeable surfaces. Assumes Greenfield runoff from permeable surfaces calculated using the IoH124 method.

Relevant national, regional and local planning policy has been consulted in Section 5 to determine restrictions on runoff from previously developed and greenfield sites. In some cases, greenfield rates may be requested, but in practice it is difficult to restrict discharge rates at any one control point to less than 2 l/s, without increasing the risk of any potential blockages occurring in the drainage network.

Total discharge volumes

The table below presents discharge volumes for a range of storm events used to assess the impact of the proposed development and calculate the required storage volumes. Further information on the calculation of total discharge volumes is provided in Section 11 'Methodology and Limitations'. Total discharge volumes associated with the development.

Table 9. Total discharge volumes associated with the development

Rainfall event	Greenfield runoff volume (m ³)	Existing runoff volume ² (m ³)	Potential runoff volume without attenuation (m ³)	Potential minus existing (m ³)
QBAR	15.34	N/A	N/A	N/A
6 hour 1 in 1 year	14.55	15.24	24.63	9.39
6 hour 1 in 10 year	23.28	24.31	38.47	14.15
6 hour 1 in 30 year	30.83	32.29	52.19	19.90
6 hour 1 in 100 year	42.25	44.24	71.52	27.27
6 hour 1 in 100 year + 20% CC	N/A	N/A	85.82	41.58
6 hour 1 in 100 year + 40% CC	N/A	N/A	100.12	55.88

² Assumes 100% runoff from impermeable surfaces. Assumes Greenfield runoff from permeable surfaces calculated using the loH124 method.

Critical storm duration and volume requirements

Storage volumes for a range of return periods including the 1 in 30 year, 1 in 100 year and 1 in 100 year plus climate change (40%) events have been calculated to assess the impact of the proposed development. The required storage volumes for attenuation features have been calculated for the critical storm durations, limited to a maximum discharge rate of 2 l/s.

Table 10. Critical Storm Duration and Attenuation volume requirements

Return Period	Runoff rate restriction (l/s)	Critical Storm Duration (hr)	Attenuation volume required (m ³)
1 in 30 year	2	1	19.77
1 in 100 year	2	1	30.91
1 in 100 year including a 40% climate change	2	2	48.00

7 Runoff destination



Options for the destination for the runoff generated on-Site have been assessed in line with the prioritisation set out in the Building Regulations Part H document (HM Government, published in 2010 and updated in 2015) and Defra's Non-statutory Technical Standards for SuDS (2015).

Flow attenuation using infiltration SuDS (discharge to ground) is generally the preferred option. If discharge to ground is not available, runoff discharge to surface water is the other preferred method. Only if these two options are impractical should discharge to the sewer network be considered.

Discharge to ground

The Site has Moderate potential for infiltration, with potentially permeable underlying Devensian Till.

Based on the available borehole information (subject to confirmation by site investigation) and groundwater flood risk mapping, shallow groundwater is unlikely to be an issue at the Site. However, the permeability of the local geology is unclear and therefore a perched water table within the permeable superficial deposits is possible.

There are no known issues identified relating to the presence of a SPZ. A Phase I contaminated land report has also been prepared for the Site (ref: 76712); depending on the degree of contamination identified, the potential for infiltration may be constrained.

A site investigation comprising trial pits is recommended to confirm the depth to groundwater and allow infiltration tests to be undertaken to confirm the feasibility of an infiltration SuDS scheme.

Discharge to surface watercourse

A drainage ditch is located c. 120 m south of the Site (leading to the Fairywell Brook). However, discharging to this watercourse would require pipework to cross a significant distance of third party land, including a highway, and therefore discharge to surface watercourse and is not considered feasible.

Discharge to sewer

Discharge to sewer is not likely to be the optimum sustainable drainage option for the new development area.

However, according to a utilities search undertaken at the Site (Appendix D), there is a public combined sewer located c. 40 m south-east of the Site. Therefore, subject to permission for pipework to cross the land to the south of the Site, discharge to sewer would be feasible at the Site.

If discharge to sewer is required, consultation with the local sewer undertaker should be undertaken. Discharge to sewer would only be accepted if it can be demonstrated that infiltration SuDS would not be practical. Discharge would have to be controlled and on-Site attenuation would be required.

The Site is at a similar elevation to the main road along which the drainage network is located, with no significant change in topography between them. As a result, it is considered feasible to drain the majority of the Site under gravity to the existing sewer network.

8 Water quality



A key requirement of any SuDS system is that it protects the receiving water body from the risk of pollution. This can be effectively managed by an appropriate “train” or sequence of SuDS components that are connected in series. The frequent and short duration rainfall events are those that are most loaded with potential contaminants (silts, fines, heavy metals and various organic and inorganic contaminants). Therefore, the first 5-10 mm of rainfall (first flush) should be adequately treated with SuDS.

The minimum number of treatment stages will depend on the sensitivity of the receiving water body and the potential hazard associated with the proposed development SuDS Manual (CIRIA, 2015). The proposed development is a combination of very low (roof water) to low hazard (runoff from car parking and road). The Site does not lie within an SPZ and therefore additional treatment stages are not required.

Table 11. Level of hazard

Hazard	Source of hazard
Very Low	Residential roof drainage
Low	Residential, amenity uses including low usage car parking spaces and roads, other roof drainage.
Medium	Commercial, industrial uses including car parking spaces and roads (excluding low usage roads, trunk roads and motorways).
High	Areas used for handling and storage of chemicals and fuels, handling of storage and waste (incl. scrap-yards).

The recommended minimum number treatment stages suggested for the different runoff waters identified for the proposed development is highlighted in the table below.

Table 12. Minimum number of treatment stages for runoff

		Sensitivity of the receiving water body		
		Low	Medium	High
Hazard	Low	1	1	1
	Med	2	2	2
	High	3	3	3

A soakaway and permeable paving would offer sufficient treatment stages (storage/attenuation, filtration through sub-base and filtration through the unsaturated soil zone).

9 Proposed SuDS strategy



Sustainable drainage systems

DEFRA's non-statutory requirements for SuDS require the below ground drainage systems to have the capacity to accommodate at least the 1 in 30 year event and to manage the 1 in 100 year event without flooding of on-site buildings and substations. All runoff should be managed on-Site though for the 1 in 100 year event, accounting for the maximum impacts of climate change to ensure flood risk is not increased to third-parties.

It is assumed that drainage from areas outside the development footprint will continue to use existing drainage arrangements.

A surface water drainage strategy (summarised in Section 2 of this report) includes the following SuDS features to intercept, attenuate and treat surface water runoff.

Primary SuDS Strategy:

Ground conditions at the Site are potentially conducive to infiltration; surface water runoff will be managed within SuDS features and infiltrated to ground. A secondary SuDS strategy is included should infiltration SuDS be deemed unviable at the Site.

Table 13. Proposed SuDS type, features, discharge location and rate restriction

SuDS type	Source control (interception) and infiltration SuDS.
SuDS features	Rainwater harvesting, lined permeable paving, soakaway
Discharge location	Infiltration
Discharge rate	1×10^{-5} m/s (example infiltration rate for silty clayey sand, taken from the CIRIA SuDS Manual C753, to be confirmed via infiltration testing)

Table 14. Proposed SuDS sizing (dimensions) and attenuation volumes

Rainwater Harvesting	To provide additional amenity and water re-use benefits, rainwater harvesting butts should be established for the proposed development. In terms of attenuation storage within this SuDS scheme, the volume of run-off which could be attenuated by Rainwater Harvesting has not been considered within the Preliminary SuDS schematic.
Lined permeable paving	A 130 m^2 area of permeable paving (underlain with a Type 3 aggregate material) within the proposed paved areas to a depth of 0.5 m, with a 30% porosity would result in c. 19.5 m^3 attenuation. Note that the

	permeable paving should be lined to ensure no focused infiltration occurs within 5 m of any on-Site or off-Site buildings.
Soakaway	A soakaway within the open amenity space with an area of c. 46.2 m ² (e.g. 14 m x 3.3 m) and a depth of 1 m, filled with geo-cellular crates with a 95% void ratio, would provide 43.89 m ³ attenuation.
Total Attenuation Provided	63.39 m ³

Rainwater harvesting

Rainwater harvesting should be considered at the Site. This could take the form of rainwater harvesting butts within the amenity space to provide recycled water for garden maintenance, or a tank within the roof space of the building to provide a grey water supply for toilets.

The run-off from the proposed development roof would be led into the rainwater harvesting system via rainwater downpipes and guttering to catch run-off from the development roof. Overflow from the system should be discharged into the storage system provided by the permeable paving and soakaway.

Due to the relatively insignificant amounts of attenuation provided by rainwater harvesting tanks in this instance and the requirement to retain water for non-potable uses such garden maintenance and toilets, the volume of run-off which could be attenuated by rainwater harvesting has not been considered within the report.

Roof run-off is generally less polluted than run-off from road surfaces but can still generate pollutants such as sediments. Pollutants would be captured by the collection and filtration system and, by reducing the volume of run-off generated from the Site. Primary screening devices are used to prevent leaves and other debris from entering the butt and first flush devices can be designed to divert the first part of the rainfall away from the main storage tank and can pick up most of the dirt, debris and contaminants that collect on a residential roof.

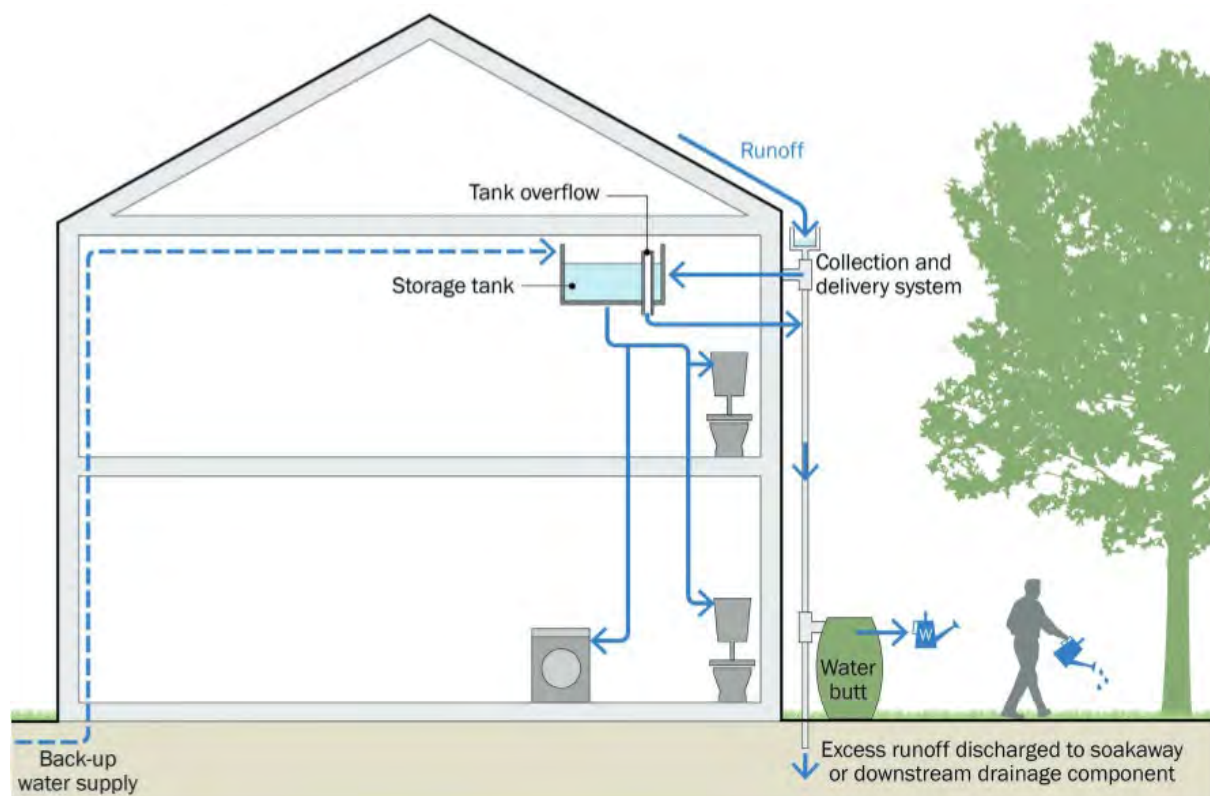


Figure 11.3 of the CIRIA SuDS Manual (C753) (2015)

Permeable paving

Permeable Paving is proposed for the new paved areas to intercept runoff. Suitable aggregate materials (angular gravels with suitable grading as per CIRIA, 2015) will improve water quality due to their filtration capacity and usually work to a 30% porosity. A geotextile layer will be required for paving underlain by aggregate material to intercept silt/particles. Permeable pavements are multi-layered surfacing systems. The surface layer is constructed out of permeable material allowing infiltration of water through gaps along its surface. A geomembrane isolates stored water from the surrounding soil, especially in contaminated areas and a geotextile layer prevents clogging and damage to the geo-cellular modules.

The geotextile layer works to intercept silt/particles flowing through the system via direct rainfall, or through vehicle use deposited onto the car park area and into the permeable paving. The majority of silt would be trapped within the top 30mm of the joining material between the paving blocks. Rainfall flowing into the permeable paving directly from the development roof/rainwater butts would not contain enough volumes of silt and or particles to cause blockage so will be fed directly into underlying porous substrate via rainwater pipes. Downpipes from the development roofs/rainwater butts should extend through the paving for c.5 meters to divert roof run-off away from building foundations. Paving could also implement an impermeable liner close to the building or creating a separate compartment within the permeable sub-base close to the building to further divert attenuated water away from building foundations.

The permeable paving should be lined to ensure no focused infiltration occurs within 5 m of any on-Site or off-Site buildings.

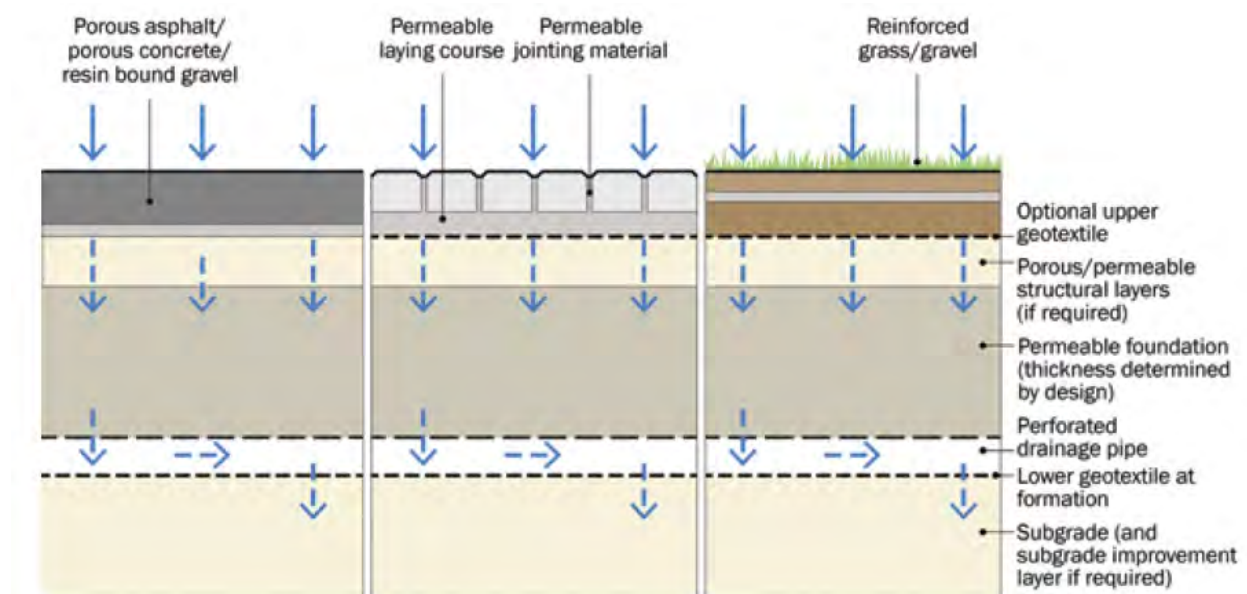


Figure 20.13 of the CIRIA SuDS Manual (C753) (2015)

Soakaways

A soakaway is proposed at the Site in the open amenity space.

Soakaways are used to store run-off and infiltrate collected water gradually into the ground. The base of the infiltration features should lie at an elevation at least 1 m above the highest winter groundwater levels, to ensure there is sufficient space for surface water to discharge. Soakaway excavation should be outside of the root zone of any protected trees, and soakaways should not be within 5 m of the building footprint and ideally 2.5 m away from the Site boundary to account for any further development.

Exceedance Flows

Exceedance flow routes are included within the proposed SuDS drainage layout. Where possible, exceedance flows should be directed away from buildings and into non-essential areas of the Site such as the car park. The SuDS system recommended for the Site should provide enough storage that this method would only be utilized during a worst case scenario.

During an exceedance event, flows should also be directed into the nearest surface water channel/sewer network. The SuDS system recommended for the Site provides enough storage that this method would only be utilized during a worst case scenario.

Secondary SuDS strategy:

Where infiltration to ground is not achievable at the Site, an attenuation volume of 48 m³ should be stored within lined SuDS features to accommodate the calculated 2 hour Critical Storm Duration for surface water discharge runoff, restricted to 2 l/s.

SuDS features listed in the primary recommendations are still applicable to the secondary recommendation the Site.

Permeable paving can still be incorporated if discharge to ground is not achievable. However, paving will need to be lined to ensure groundwater does not interact with the system.

Table 15. Proposed SuDS type, features, discharge location and rate restriction

SuDS type	Source control (interception) and attenuation SuDS.
SuDS features	Rainwater harvesting, rain garden, lined permeable paving
Discharge location	Public combined sewer network
Discharge rate	2 l/s (as close to the Greenfield 1 in 1 year rate as possible without increasing the potential for blockages)

Table 16. Proposed SuDS sizing (dimensions) and attenuation volumes

Rainwater Harvesting	To provide additional amenity and water re-use benefits, rainwater harvesting butts should be established for the proposed development. In terms of attenuation storage within this SuDS scheme, the volume of run-off which could be attenuated by Rainwater Harvesting has not been considered within the Preliminary SuDS schematic.
Rain garden	Rain gardens are proposed for water quality purposes. It is proposed that a rain garden, with an area of c. 10 m ² , is established for the development. The rain garden would comprise a 0.4 m depth of soil and 0.2 m depth of porous (30% porosity) aggregate, including 0.1 m of storage above the topsoil, which would result in 1.6 m ³ attenuation.
Lined Permeable paving	A 130 m ² area of lined permeable paving (underlain with geo-cellular crates with 95% void ratio) within the proposed paved areas to a depth of 0.38 m would result in c. 46.93 m ³ attenuation.
Total Attenuation Provided	48.53 m ³
Total Attenuation Required	48.00 m ³

Freeboard Storage Provided	0.53 m³
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Rain Gardens

A rain garden (bio-retention area) will be used to collect surface water. The bio-retention area should provide an area to store and treat rainwater where water is collected and returned to the permeable paving. This feature will reduce surface run-off by intercepting the first 5 mm of rain to reduce the volume of water running off-Site.

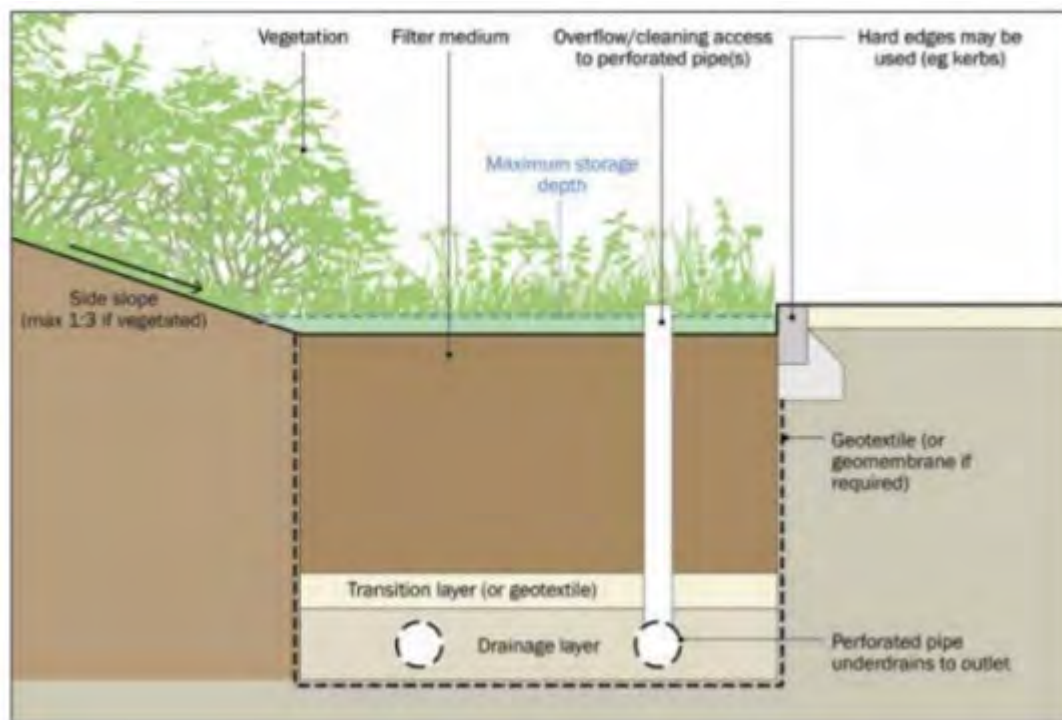


Figure 18.1 of the CIRIA SuDS Manual (C753) (2015)

The main elements of the system comprise the inlet, which allows water to evenly distribute into the filter system. The vegetation will influence the performance of the system through direct uptake of any pollutants and by facilitating physical and chemical processes in the soil that remove nutrients. The filter medium is normally sand based which controls the rate at which water filters through the system. This medium is usually 750-1000mm thick through can be reduced for smaller catchments (minimum depth – 400mm). The transition layer is required to prevent washing of fines from the filter medium into the drainage layer and must be at least 100mm thick. The drainage layer is used to collect water from the filter medium to allow for access into the perforated pipes.

Flow control devices and systems

Hydrobrake Flow control systems can be used to reduce the runoff rate from the Site. These are usually a device used for controlling water flow into a connecting feature, such as a sewer, to a specific attenuation performance. The design consists of an intake, a volute and an outlet and the configuration is critical to ensure discharge control. For drainage areas which are less than 3 ha, outlet throttle diameters would have to be small (<150mm diameter) to achieve outflow rates which could result in blockage. For most SuDS features, a flow control device will comprise a fixed orifice or a throttle such as a short pipe.

A Vortex Control is usually a self-activating vortex flow device which directs water into a volute to form a vortex. For the Site, rainwater down pipes from the development roof should drain directly into the attenuation feature to reduce infill from potential flood water.

Drainage protection devices

A non-return flap valve is recommended for outflow pipes to reduce the risk of backflow from the channel/sewer during a large scale rainfall event.

Additional recommendations

Additional SuDS options that may be considered for the Site are as follows:

- Having part/all of the roof as a green roof covered in vegetation intercepts up to 30mm of rain before any runoff is generated from the structure.

Policy compliance

An attenuation volume of 63.39 m³ for infiltration will comply with the following policies required by Manchester City Council:

- Comply with the Drainage hierarchy preference of infiltration to ground;
- Reduce run-off volumes to below 1 in 100 year Greenfield rate, and as close to the 1 in 1 year Greenfield rate as possible without increasing the potential for blockages (in accordance with Manchester City Council's Local Flood Risk Management Strategy (March 2014)).

10 SuDS maintenance



Regular maintenance is essential to ensure effective operation of the SuDS features over the intended lifespan of the proposed development. The SuDS Manual (C753) (CIRIA, 2015) provides a maintenance schedule for SuDS with details of the necessary required actions as shown in the Table below.

Table 17. SuDS operation and recommended maintenance requirements

Asset type	Maintenance schedule (and frequency)
Soakaways	Regular maintenance: - Remove sediment and debris from pretreatment and inspection chamber. Clean gutters, filters, downpipes. Trim roots prevent blockages (annually). - Reconstruct/ clean if performance deteriorates, replace clogged geotextile (as required) Monitoring: - Inspect inlets/outlets, silt traps – note rate of accumulation (monthly). - Check water levels and emptying time (annually).
Permeable pavements	Regular maintenance: - Brushing and vacuuming (three times per year). - Trimming any roots and surrounding grass and weeds that may be causing blockages (annually or as required). Monitoring: - Initial inspection (monthly). - Inspect for poor performance and inspection chambers (annually).
Hydro-Brake Flow Control	Low amounts of maintenance required as there are no moving parts within the Hydro-Brake® Flow Control. Initial monthly inspection at the manhole once the construction phase is over. If blockages occur they normally do so at the intake. Hydro-Brake® Flow Controls are fitted with a pivoting by-pass door, which allows the manhole chamber to be drained down should blockages occur. Inspection should be undertaken annually or when a storm event occurs.
Underground drainage pipe network	Regular maintenance: - Remove sediment and debris from pre-treatment devices and floor of inspection tube or chamber (annually). - Cleaning of gutters and any filters on downpipes (annually).

Asset type	Maintenance schedule (and frequency)
	- Trimming any roots that may be causing blockages (annually or as required). Monitoring: - Inspect silt traps and note rate of sediment accumulation (monthly in the first year and then annually).
Rainwater Harvesting	Regular maintenance: - Inspection of tank for debris and sediment build up (annually and following poor performance). - Inspection of inlets, outlets, overflow areas, pumps and filters (annually and following poor performance). - Cleaning of tank, inlets, outlets, gutters, roof drain filters and withdrawal devices (annually or as required). Remedial actions: - Repair or overflow erosion damage or damage to tank and associated components (as required)
Rain Gardens	Regular maintenance: - Remove litter and debris from basin (monthly). - Trimming any roots and surrounding grass blockages (as required). Monitoring: - Inspect inlets, outlets and overflows for blockages,(monthly or after a heavy storm). - Inspect inlets and outlets for silt accumulation (half yearly). - Inspect infiltration surfaces for compaction and ponding (monthly).

Client checklist

A drainage strategy has been recommended as suitable on the basis of the information provided. Prior to installation of the Site drainage system it is recommended that the client carries out the following checks to confirm the development proposals. Geosmart would be able to support with any updates required to the drainage scheme, please contact us and we would be happy to provide you with a proposal to undertake the work.

Table 18. Potential SuDS limitations

Conditions in Non-Statutory Technical Standards (Defra, 2015), limitations to infiltration SuDS	Do these conditions arise at the Site?
Is the surface runoff greater than the rate at which water can infiltrate into the ground?	
Is there an unacceptable risk of ground instability?	
Is there an unacceptable risk of mobilising contaminants?	
Is there an unacceptable risk of pollution to groundwater?	
Is there an unacceptable risk of groundwater flooding?	
Is the infiltration system going to create a high risk of groundwater leakage to the combined sewer?	

Table 19. SuDS design considerations

Confirm that potential flooding on-Site in excess of the design storm event and exceedance flow routes have been considered.	
Review options for the control of discharge rates (e.g. hydrobrake).	
Confirm the owners/adopters of the drainage system. Consider management options for multiple owners.	
Is there an unacceptable risk of pollution to groundwater?	
Review access and way leave requirements.	
Review maintenance requirements.	

Health and safety considerations for SuDS

GeoSmart reports may include outline strategies or designs to support with development plans. Any drawings or advice provided do not comprise any form of detailed design. Implementation of any conceptual scheme options may constitute 'Construction Work' as defined by CDM Regulations (2015).

The CDM Regulations place specific Health and Safety duties on those commissioning, planning and undertaking construction works. If you are uncertain what this means you should seek the advice of your architect, builder or other competent professional.

GeoSmart does not provide health and safety advisory services but we are required to advise you of your general responsibilities under CDM (visit <http://geosmartinfo.co.uk/knowledge-hub/cdm-2015/> for more information).

Please remember that detailed design work should be undertaken by a competent professional who might be your engineer, architect, builder or another competent party.

11 Methodology and limitations of study



This report assesses the feasibility of infiltration SuDS and alternative drainage strategies in support of the Site development process. From April 6th 2015 SuDS are regulated by Local Planning Authorities and will be required under law for major developments in all cases unless demonstrated to be inappropriate. What is considered appropriate in terms of costs and benefits by the Planning Authority will vary depending on local planning policy, and Site setting. The Lead Local Flood Authority will require information as a statutory consultee on major planning applications with surface water drainage implications. The National Planning Policy Framework requires that new developments in areas at risk of flooding should give priority to the use of SuDS and demonstrate that the proposed development does not increase flood risk downstream to third parties.

How was the suitability of SuDS estimated for the Site?

There are a range of SuDS options available to provide effective surface water management that intercept and store excess runoff. When considering these options, the destination of the runoff should be assessed using the order of preference outlined in the Building Regulations Part H document (HM Government, 2010) and Defra's National Standards for SuDS (2015):

1. Discharge to the ground;
2. Discharge to a surface water body;
3. Discharge to a surface water sewer;
4. Discharge to a local highway drain; and
5. Discharge to a combined sewer.

Data sets relating to each of the potential discharge options have been analysed to assess the feasibility of each option according to the hierarchy set out above. Hydrogeological characteristics for the Site are assessed in conjunction with the occurrence of SPZ's to assess infiltration suitability. The Site has been screened to determine whether flood risk from groundwater, surface water, fluvial or coastal sources may constrain SuDS. The distance to surface water bodies and sewers has been reviewed gauge whether these provide alternative options.

GeoSmart SuDS Infiltration Suitability Map (SD50)

The GeoSmart SuDS Infiltration Suitability Map (SD50) screens the suitability for infiltration drainage in different parts of the Site and indicates where further assessment is recommended. In producing the SuDS Infiltration Suitability Map (SD50), GeoSmart used data from the British Geological Survey on groundwater levels, geology and permeability to screen

for areas where infiltration SuDS may be suitable. The map classifies areas into 3 categories of High, Medium and Low suitability for infiltration SuDS. This can then be used in conjunction with additional data on Site constraints to give recommendations for SuDS design and further investigation.

The primary constraint on infiltration potential is the minimum permeability of the underlying material and in some cases the range in permeability may be considerable, ranging down to low. The map classifies these areas as moderate infiltration suitability requiring further investigation. In cases where the thickness of the receiving permeable horizon is less than 1.5 meters then additional Site investigation is recommended. If the Site is at risk of groundwater flooding for up to the 1% annual occurrence the map classifies these areas as moderate infiltration suitability requiring further investigation.

The GeoSmart SuDS Infiltration Suitability Map (SD50) is a national screening tool for infiltration SuDS techniques but a Site specific assessment should be used before final detailed design is undertaken. Further information on the GeoSmart SuDS Infiltration Suitability Map (SD50) is available at geosmartinfo.co.uk

How is the suitability to discharge to sewers and watercourses calculated?

The suitability to discharge to discharge to sewers and watercourses has been calculated using the distance from the Site to both. For example, where the Site is within 50m of a surface water body. Discharge to surface water is potentially appropriate subject to land access arrangements and a feasibility assessment. Where the Site is within 50m of a sewer, discharge to sewer is potentially appropriate subject to land access arrangements and a feasibility assessment. The utility company should be contacted to agree connection feasibility and sewer capacity.

Further information relating to sewers available in the area can be found in Appendix C.

What is a Source Protection Zone?

The Environment Agency have defined Source Protection Zones (SPZs) for 2000 groundwater sources such as wells, boreholes and springs used for public drinking water supply. These zones show the risk of contamination from any activities that might cause pollution in the area. The closer the activity, the greater the risk. The maps show three main zones (inner, outer and total catchment) and a fourth zone of special interest, which is occasionally applied. The zones are used to set up pollution prevention measures in areas which are at a higher risk. The shape and size of a zone depends on the condition of the ground, how the groundwater is removed, and other environmental factors. Inner zone (Zone 1) is defined as the 50 day travel time from any point below the water table to the source (minimum radius of 50 metres). Outer zone (Zone 2) is defined by a 400 day travel time. Total catchment (Zone 3) is defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source.

How was surface water runoff estimated from the Site?

In accordance with The SuDS Manual (C753) (CIRIA, 2015), the Greenfield runoff from the Site has been calculated using the Ioh124 method and is assumed representative of the runoff generated on the undeveloped surfaces that are affected by the proposed development. The method used for calculating the runoff complies with the NPPF (MHCLG, 2019). For the impermeable surfaces, it has been assumed that 100% runoff will occur (calculations provided in Appendix C). Rainfall data is derived from the Flood Estimation Handbook (FEH), developed by NERC (2009). Only areas affected by the proposed development are considered in the flow and volume calculations. Permeable areas that remain unchanged are not included in the calculations as it is assumed these will not be actively drained and attenuated.

What is the peak discharge rate?

An estimation of peak runoff flow rate and volume is required to calculate infiltration, storage and discharge requirements. The peak discharge rate is the maximum flow rate at which surface water runoff leaves the Site during a particular storm event, without considering the impact of any mitigation such as storage, infiltration or flow control. Proposed discharge rates (with mitigation) should be no greater than existing rates for all corresponding storm events. If all drainage is to infiltration there will be no discharge off-Site. Discharging all flow from Site at the existing 1 in 100 event would increase flood risk during smaller events. Flow restriction is generally required to limit the final discharge from Site during all events as a basic minimum to the green field QBAR rate. A more complex flow restriction which varies the final discharge rate from the Site depending on the storm event will reduce the volume of storage required on-Site. Drainage to infiltration SuDS is subtracted from the total discharge off-Site to achieve a beneficial net affect.

What is the total discharge volume?

The total discharge volume is calculated on the basis of the surface water runoff that has the potential to leave the Site as a result of the assumed 6 hour duration design storm event. The runoff is related to the underlying soil conditions, impermeable cover, rainfall intensity and duration of the storm event. The total volume generated by the current Site is compared to the potential total volume from the developed Site (not taking into consideration any mitigation). The difference provides the minimum total volume that will need to be stored and infiltrated on-Site or released at a controlled rate. Guidance indicates that the total discharge volume should never exceed the runoff volume from the development Site prior to redevelopment for that event and should be as close as is reasonably practicable to the Greenfield runoff volume.

12 Background SuDS information



SuDS control surface water runoff close to where it falls. SuDS are designed to replicate, as closely as possible, the natural drainage from the Site before development to ensure that the flood risk downstream does not increase as a result of the Site being developed, and that the Site will have satisfactory drainage under current and likely future climatic conditions. SuDS provide opportunities to reduce the causes and impacts of flooding; remove pollutants from urban runoff at source; and combine water management with green space with benefits for amenity, recreation and wildlife. Government planning policy and planning decisions now include a presumption in favour of SuDS being used for all development Sites, unless they can be shown to be inappropriate.

For general information on SuDS see our website: <http://geosmartinfo.co.uk/>

Infiltration SuDS

Government policy for England is to introduce sustainable drainage systems (SuDS) via conditions in planning approvals. Guidance indicates that capturing rainfall runoff on-Site and infiltrating it into the ground (infiltration SuDS) is the preferred method for managing surface water without increasing flood risk downstream.

The greatest benefit to general flood risk is if all runoff is infiltrated on-Site, however, this may not be feasible due to physical and economic constraints in which case infiltration may be considered as a part of an integrated drainage solution. The final design capacity for an infiltration SuDS system depends on the Site constraints and the requirements of the individual Planning Authority and the Lead Local Flood Authority.

The capacity of the ground to receive infiltration depends on the nature, thickness and permeability of the underlying material and the depth to the high groundwater table. The final proportion of the Site drained by infiltration will depend on topography, outfall levels and a suitable drainage gradient. It is important to note that, even if the whole Site cannot be drained by infiltration, the use of partial infiltration is encouraged, with the remainder of runoff discharged via other SuDS systems.

Types of infiltration SuDS

Infiltration components include infiltration trenches, soakaways, swales and infiltration basins without outlets, rain gardens and permeable pavements. These are used to capture surface water runoff and allow it to infiltrate (soak) and filter through to the subsoil layer, before returning it to the water table below.

An infiltration trench is usually filled with permeable granular material and is designed to promote infiltration of surface water to the ground. An infiltration basin is a dry basin or depression designed to promote infiltration of surface water runoff into the ground. Soakaways are the most common type of infiltration device in the UK where drainage is often connected to over-sized square or rectangular, rubble-filled voids sited beneath lawns.

According to the guidance in Building Research Establishment (BRE) Digest 365 (2016) a soakaway must be able to discharge 50% of the runoff generated during a 1 in 10 year storm event within 24 hours in readiness for subsequent storm flow. This is the basic threshold criteria for a soakaway design and the internal surface area of the proposed soakaway design options should be calculated on this basis by taking into account the soil infiltration rate for the Site.

Developers need to ensure their design takes account of the construction, operation and maintenance requirements of both surface and subsurface components, allowing for any machinery access required.

SuDS maintenance and adoption

Regular maintenance is essential to ensure effective operation of the soakaway(s) over the intended lifespan of the proposed development. A maintenance schedule for SuDs is required. Sewerage undertakers or Local Authorities may adopt SuDS and will require maintenance issues to be dealt with in accordance with their Management Plan. If the SuDS will not be adopted other provision is required with associated financial implications. Maintenance is a long-term obligation requiring the upkeep of all elements of the SuDS, including mechanical components (e.g. pumps), as well as inspections, regular maintenance and repair.

Additional background SuDS information can be found on our website: <http://geosmartinfo.co.uk/>

13 Further information



The following table includes a list of additional products by GeoSmart:

Additional GeoSmart Products			
	Additional assessment:		The FloodSmart Report range provides clear and pragmatic advice regarding the nature and potential significance of flood hazards which may be present at a Site. Our consultants assess available data to determine the level of risk based on professional judgement and years of experience.
	FloodSmart Report		Please contact info@geosmartinfo.co.uk for further information.

14 References and glossary



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Glossary

General terms

Attenuation	Reduction of peak flow and increased duration of a flow event.
Combined sewer	A sewer designed to carry foul sewage and surface water in the same pipe.
Detention basin	A vegetated depression, normally is dry except after storm events, constructed to store water temporarily to attenuate flows. May allow infiltration of water to the ground.
Evapotranspiration	The process by which the Earth's surface or soil loses moisture by evaporation of water and by uptake and then transpiration from plants.
FEH	Flood Estimation Handbook, produced by Centre for Ecology and Hydrology, Wallingford (formerly the Institute of Hydrology).
Filter drain or trench	A linear drain consisting of a trench filled with a permeable material, often with a perforated pipe in the base of the trench to assist drainage, to store and conduct water, but may also be designed to permit infiltration.
First flush	The initial runoff from a site or catchment following the start of a rainfall event. As runoff travels over a catchment it will collect or dissolve pollutants, and the "first flush" portion of the flow may be the most contaminated as a result. This is especially the case for intense storms and in small or more uniform catchments. In larger or more complex catchments pollution.
Flood plain	Land adjacent to a watercourse that would be subject to repeated flooding under natural conditions (see Environment Agency's Policy and practice for the protection of flood plains for a fuller definition).
Greenfield runoff	This is the surface water runoff regime from a site before development, or the existing site conditions for brownfield redevelopment sites.
Impermeable surface	An artificial non-porous surface that generates a surface water runoff after rainfall.
Permeability	A measure of the ease with which a fluid can flow through a porous medium. It depends on the physical properties of the medium, for example grain size, porosity and pore shape.

Runoff	Water flow over the ground surface to the drainage system. This occurs if the ground is impermeable, is saturated or if rainfall is particularly intense.
Sewerage undertaker	This is a collective term relating to the statutory undertaking of water companies that are responsible for sewerage and sewage disposal including surface water from roofs and yards of premises.
Soakaway	A subsurface structure into which surface water is conveyed to allow infiltration into the ground.
Treatment	Improving the quality of water by physical, chemical and/or biological means.

The terms included in this glossary have been taken from CIRIA (2015) guidance.

Data Sources

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Flood Risk (Groundwater) and SuDS infiltration suitability (SD50)	GeoSmart, BGS & OS GW5 (v2.4) Map (GeoSmart, 2022) Contains British Geological Survey materials © NERC 2022 Ordnance Survey data © Crown copyright and database right 2022
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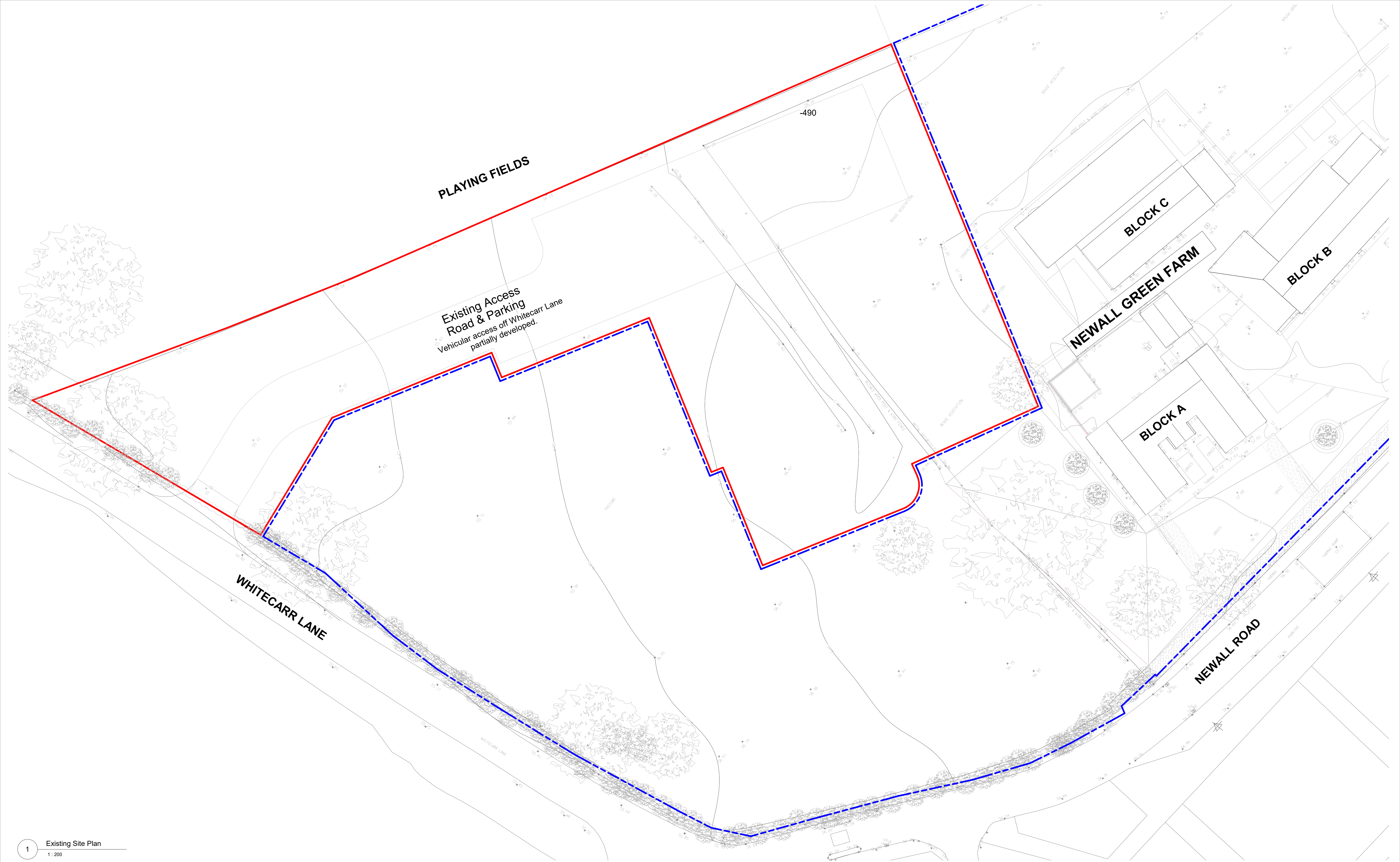
15 Appendices



Appendix A



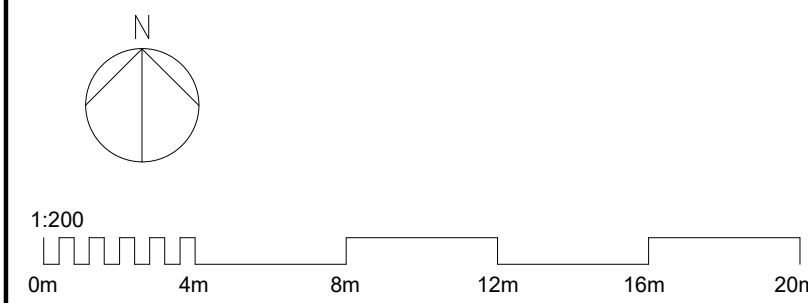
Site plans (layout and topography)



1

Existing Site Plan

1 : 200



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P01 Issued For Information

01.04.22 SU LM

Date Draw Chk

Client:
ZENO LTD.

Project:
NEWALL GREEN FARM

Drawing Title:
Existing Site Plan

Drawing Status:
INFORMATION

Corstorphine & Wright

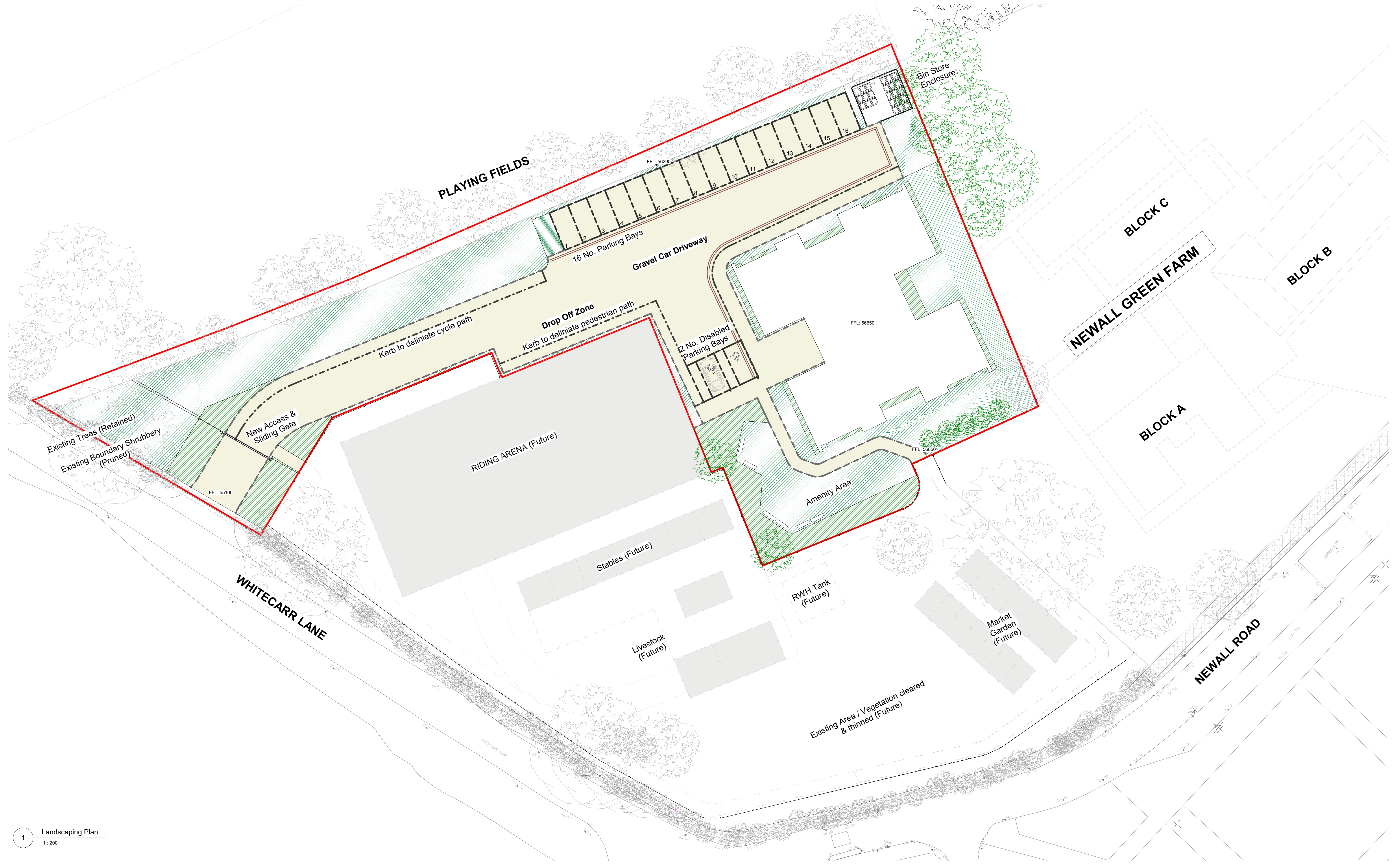
Manchester Studio
The Stables, Paradise Wharf, Ducie Street, Manchester, M1 2JN

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Drawing No.
18421-CWA-XX-A-0302

Revision
P01

Drawn SU	Checked LM	Paper Size A1	Scale 1 : 200	Date 02/28/22
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1 Landscaping Plan
1 : 200

N

1:200

0m

4m

8m

12m

16m

20m

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SOFT LANDSCAPING
Existing Vegetation

SOFT LANDSCAPING
New Turf

SOFT LANDSCAPING
New Shrubby borders

HARD LANDSCAPING
Self-binding gravel (existing gravel retained and reused)

PARKING AREA

EDGINGS TO GRAVEL PATHS/ DRIVEWAYS

EDGINGS TO DELINIATE PEDESTRIAN PATHS

CONCRETE CHANNEL DRAIN

Client:
ZENO LTD.

Project:
NEWALL GREEN FARM

Drawing Title:
Proposed Landscaping Plan

Drawing Status:
INFORMATION

Manchester Studio
The Stables, Paradise Wharf, Ducie Street, Manchester, M1 2JN
0161 272 8100
corstorphine-wright.com

Drawing No.
18421-CWA-XX-A-0341

Scale
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Date
03/08/22

Revision
P01

Drawn
SU

Checked
LM

Paper Size
A1

Scale
1 : 200

Date
03/08/22

01.04.22
Date

SU
Draw

LM
Chk

P01
Rev

Issued For Information
Description



Area Schedule (GIA) - GF	
Apartment	Area
Apartment 01	85 m ²
Apartment 02	85 m ²
Apartment 03	85 m ²
Apartment 04	85 m ²
Circulation	20 m ²
Circulation	20 m ²
Plant / Store	5 m ²
Stair Core	13 m ²
Utility / Store	7 m ²
Total: 9	407 m ²

1 00 - Ground Floor
1 : 50

Appendix B



Infiltration calculations

Design Settings

Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Depth (m)
1	0.084	5.00	10.000	1.600

Simulation Settings

Rainfall Methodology	FEH-13	Analysis Speed	Normal	Additional Storage (m ³ /ha)	20.0
Summer CV	0.750	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	0.840	Drain Down Time (mins)	240	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440
----	----	----	-----	-----	-----	-----	-----	-----	-----	-----	------

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	0	0
100	0	0	0
100	40	0	0

Node 1 Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.03600	Invert Level (m)	8.400	Depth (m)	1.000
Side Inf Coefficient (m/hr)	0.03600	Time to half empty (mins)	1152	Inf Depth (m)	
Safety Factor	2.0	Pit Width (m)	3.300	Number Required	1
Porosity	0.95	Pit Length (m)	14.000		

Node 1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	9.350	Slope (1:X)	100.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)		Depth (m)	0.500
Safety Factor	2.0	Width (m)	13.000	Inf Depth (m)	
Porosity	0.30	Length (m)	10.000		

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	1	440	8.668	0.268	1.5	12.0424	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
480 minute winter	1	Infiltration	0.3

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	1	472	9.045	0.645	3.2	28.9904	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
480 minute winter	1	Infiltration	0.3

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	1	472	9.313	0.913	4.3	41.0447	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)					
480 minute winter	1	Infiltration	0.4					

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
720 minute winter	1	705	9.797	1.397	4.3	60.8835	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
720 minute winter	1	Infiltration	0.4

Appendix C



Rainfall runoff calculations

Greenfield Site Run-Off Calculations using the loH124 method

Greenfield peak run-off rate (QBAR):

Parameters	Input	Units	Comments
Area	50	ha	minimum 50ha
SAAR	827	mm	FEH CD ROM (NERC, 2009)
SPR	0.47	N/A	Soil run-off coefficient
Region	10	N/A	Region on Hydrological area map

QBAR

$$Q_{\text{BAR(rural)}} = 1.08 \text{AREA}^{0.89} \text{SAAR}^{1.17} \text{SPR}^{2.17}$$

Where:

$Q_{\text{BAR(rural)}}$	is the mean annual flood (a return period of 2.3 years) in l/s
AREA	is the area of the catchment in km ² (minimum of 0.5km ²)
SAAR	is the standard average rainfall for the period 1941 to 1970 in mm
SPR	is the soil run-off coefficient

$Q_{\text{BAR(rural)}}$ can be factored by the UK Flood Studies Report regional growth curves to produce peak flood flows for any return period.

$Q_{\text{BAR(rural)}}$	=	293.39	l/s for 50ha site
Divided by 50 to scale down	=	5.87	l/s/ha
Actual Area of the entire Site	=	0.14	ha

Return Periods (Growth curves obtained from DEFRA report)

Return Period		Growth Factor	Peak site run-off rate	
			l/s/ha	(l/s)
1	$Q_{\text{BAR(rural)}} \times$	0.85	4.99	0.678
2	$Q_{\text{BAR(rural)}} \times$	0.93	5.46	0.74
5	$Q_{\text{BAR(rural)}} \times$	1.19	6.98	0.95
10	$Q_{\text{BAR(rural)}} \times$	1.38	8.10	1.10
25	$Q_{\text{BAR(rural)}} \times$	1.64	9.62	1.31
30	$Q_{\text{BAR(rural)}} \times$	1.68	9.86	1.340
50	$Q_{\text{BAR(rural)}} \times$	1.85	10.86	1.48
100	$Q_{\text{BAR(rural)}} \times$	2.08	12.20	1.66
200	$Q_{\text{BAR(rural)}} \times$	2.32	13.61	1.85

Greenfield total run-off volume:

= actual area of the entire site x SPR x 6 hour rainfall depth

Return Period	6 hour rainfall (mm) from FEH CD-ROM	Area (ha)	SPR	Total run-off (m ³)
2.3 (QBAR)	24.01	0.14	0.47	15.3
1	22.78	0.14	0.47	14.6
10	36.44	0.14	0.47	23.3
30	48.27	0.14	0.47	30.8
100	66.14	0.14	0.47	42.2

Developed site run-off calculation sheet																						
1 in 1 year					1 in 30 year										1 in 100 year							
Proposed impermeable area		0.084 ha			Proposed impermeable area		0.084 ha					Proposed impermeable area		0.084 ha								
CC Factor		40%			CC Factor		40%					CC Factor		40%								
Total volume for surfaces during 6 hour event		19.02 m³			Total volume for surfaces during 6 hour event		40.31 m³					Total volume for surfaces during 6 hour event		55.23 m³								
Total volume for 6 hour event inc CC		26.63 m³			Total volume for 6 hour event inc CC		56.43 m³					Total volume for 6 hour event inc CC		77.32 m³								
Total volume for 6 hour event exc CC		19.02 m³			Total volume for 6 hour event exc CC		40.31 m³					Total volume for 6 hour event exc CC		55.23 m³								
Duration	Rainfall	Run-off rate	Run-off rate	Duration	Rainfall	Run-off volume	Run-off volume	Duration	Rainfall	Run-off volume	Run-off volume	Outflow at 2 l/s	inflow from rain	Diff (storage required)	Duration	Rainfall	Run-off volume	Run-off volume	Outflow at 2 l/s	inflow from rain	100yr Scenario	CC Scenario
	1 yr event	1 yr event	1 yr +cc event		30 yr event	30 yr event	30 yr +cc event		100 yr event	100 yr event	100 yr +cc event					Diff (storage required)	Diff (storage required)					
hours	mm	m³	m³	hours	mm	m³	m³	hours	mm	m³	m³	hours	mm	m³	hours	mm	m³	m³	hours	mm	m³	m³
0.25	7.84	6.55	9.16	0.25	19.80	16.53	23.15	0.25	27.51	22.97	32.16	1.80	16.53	14.73	0.25	27.51	22.97	32.16	1.80	32.16	21.17	30.36
0.5	10.04	8.38	11.74	0.5	25.82	21.56	30.18	0.5	36.29	30.30	42.42	3.60	21.56	17.96	0.5	36.29	30.30	42.42	3.60	42.42	26.70	38.82
0.75	11.44	9.55	13.37	0.75	29.57	24.69	34.57	0.75	41.65	34.78	48.69	5.40	24.69	19.29	0.75	41.65	34.78	48.69	5.40	48.69	29.38	43.29
1	12.44	10.39	14.54	1	32.30	26.97	37.76	1	45.64	38.11	53.35	7.20	26.97	19.77	1	45.64	38.11	53.35	7.20	53.35	30.91	46.15
2	16.10	13.44	18.82	2	38.01	31.74	44.43	2	53.38	44.57	62.40	14.40	31.74	17.34	2	53.38	44.57	62.40	14.40	62.40	30.17	48.00
3	18.40	15.36	21.51	3	41.58	34.72	48.61	3	57.96	48.40	67.76	21.60	34.72	13.12	3	57.96	48.40	67.76	21.60	67.76	26.80	46.16
4	20.14	16.82	23.54	4	44.25	36.95	51.73	4	61.28	51.17	71.64	28.80	36.95	8.15	4	61.28	51.17	71.64	28.80	71.64	22.37	42.84
5	21.56	18.00	25.20	5	46.42	38.76	54.26	5	63.92	53.37	74.72	36.00	38.76	2.76	5	63.92	53.37	74.72	36.00	74.72	17.37	38.72
6	22.78	19.02	26.63	6	48.27	40.31	56.43	6	66.14	55.23	77.32	43.20	40.31	-2.89	6	66.14	55.23	77.32	43.20	77.32	12.03	34.12
8	24.83	20.73	29.03	8	51.34	42.87	60.02	8	69.77	58.26	81.56	57.60	42.87	-14.73	8	69.77	58.26	81.56	57.60	81.56	0.66	23.96
10	26.55	22.17	31.04	10	53.88	44.99	62.99	10	72.71	60.71	85.00	72.00	44.99	-27.01	10	72.71	60.71	85.00	72.00	85.00	-11.29	13.00
12	28.04	23.41	32.78	12	56.07	46.82	65.55	12	75.23	62.82	87.94	86.40	46.82	-39.58	12	75.23	62.82	87.94	86.40	87.94	-23.58	1.54
16	30.60	25.55	35.77	16	59.77	49.91	69.87	16	79.44	66.33	92.87	115.20	49.91	-65.29	16	79.44	66.33	92.87	115.20	92.87	-48.87	-22.33
20	32.76	27.35	38.30	20	62.89	52.51	73.52	20	82.92	69.24	96.93	144.00	52.51	-91.49	20	82.92	69.24	96.93	144.00	96.93	-74.76	-47.07
24	34.64	28.92	40.49	24	65.62	54.79	76.71	24	85.93	71.75	100.45	172.80	54.79	-118.01	24	85.93	71.75	100.45	172.80	100.45	-101.05	-72.35
28	36.37	30.37	42.52	28	68.07	56.84	79.57	28	88.60	73.98	103.57	201.60	56.84	-144.76	28	88.60	73.98	103.57	201.60	103.57	-127.62	-98.03
32	37.97	31.70	44.39	32	70.28	58.68	82.16	32	91.01	75.99	106.39	230.40	58.68	-171.72	32	91.01	75.99	106.39	230.40	106.39	-154.41	-124.01
36	39.45	32.94	46.12	36	72.32	60.39	84.54	36	93.22	77.84	108.97	259.20	60.39	-198.81	36	93.22	77.84	108.97	259.20	108.97	-181.36	-150.23
40	40.85	34.11	47.75	40	74.21	61.97	86.75	40	95.26	79.54	111.36	288.00	61.97	-226.03	40	95.26	79.54	111.36	288.00	111.36	-208.46	-176.64
44	42.17	35.21	49.30	44	75.99	63.45	88.83	44	97.16	81.13	113.58	316.80	63.45	-253.35	44	97.16	81.13	113.58	316.80	113.58	-235.67	-203.22
48	43.43	36.26	50.77	48	77.65	64.84	90.77	48	98.95	82.62	115.67	345.60	64.84	-280.76	48	98.95	82.62	115.67	345.60	115.67	-262.98	-229.93

Rainfall event	Greenfield run-off rates (l/s)	Existing run-off rates(l/s)	Potential run-off rates without attenuation (l/s)	Potential minus existing (l/s)
QBAR	0.80			
6 hour 1 in 1 year	0.68	0.71	1.14	0.43
6 hour 1 in 10 year	1.10	1.13	1.78	0.66
6 hour 1 in 30 year	1.34	1.49	2.42	0.92
6 hour 1 in 100 year	1.66	2.05	3.31	1.26
6 hour 1 in 100 year + 20% CC			3.97	1.92
6 hour 1 in 100 year + 40% CC			4.64	2.59

Rainfall event	Greenfield run-off volume (m³)	Existing run-off volume (m³)*	Potential run-off volume without attenuation (m³)	Potential minus existing (m³)
QBAR	15.34			
6 hour 1 in 1 year	14.55	15.24	24.63	9.39
6 hour 1 in 10 year	23.28	24.31	38.47	14.15
6 hour 1 in 30 year	30.83	32.29	52.19	19.90
6 hour 1 in 100 year	42.25	44.24	71.52	27.27
6 hour 1 in 100 year + 20% CC			85.82	41.58
6 hour 1 in 100 year + 40% CC			100.12	55.88

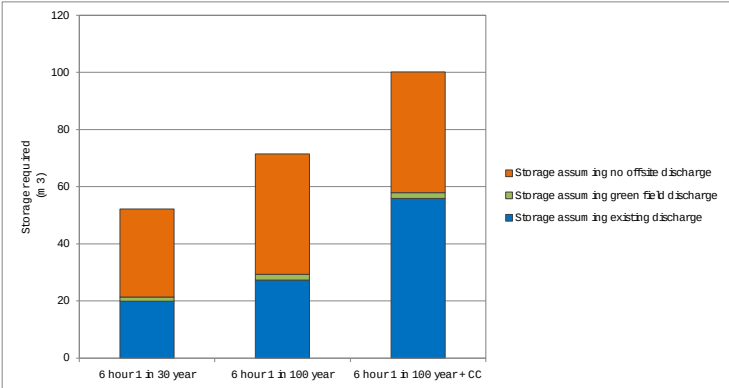
*Assumes 100% run-off from impermeable surfaces. Assumes greenfield run-off from permeable surfaces calculated using the IOH124 method.

Vol at 5 l/s for 6hrs** 108 m3
 **As recommended on the Susdrain website, may vary between sites and depending on discharge route/method

6 hour 1 in 30 year
 6 hour 1 in 100 year
 6 hour 1 in 100 year + CC
 Note CC may change depending on requirement - if so, K16 cell ref will need to change

Existing run-off volume (m3)	Potential run-off volume without attenuation (m³)	Greenfield run-off volume (m³)	Potential minus existing (m³)	Extra storage for greenfield run-off	Extra storage for no offsite discharge	Data check
32.3	52.2	30.8	19.9	1.5	30.8	Y
44.2	71.5	42.2	27.3	2.0	42.2	Y
44.2	100.1	42.2	55.9	2.0	42.2	Y

Storage assuming no offsite discharge
 Storage assuming green field discharge
 Storage assuming existing discharge



Summary				
Entire site area:	0.136 ha			
Climate Change Factor	40%			
	Current	Proposed		
Permeable Surface (ha)	0.130	0.052		
Impermeable Surface (ha)	0.006	0.084		
1 in 1 year				
Greenfield run-off volume total:	14.55 m ³			
RUN-OFF During a 1 in 1 year 6 hour event:	Greenfield Site	Current Development	Proposed Development	Proposed Development +CC
From permeable surfaces (using GF total run-off) (m ³)	14.55	13.94	5.61	7.85
From impermeable surfaces (m ³)		1.30	19.02	26.63
TOTAL run-off produced from Site (m ³)	14.55	15.24	24.63	34.48
Difference between greenfield site and proposed +cc development (m ³):				19.93
				137%
Difference between current and proposed +cc development (m ³):				19.25
				126%
Peak Greenfield run-off rate that must not be exceeded in the run-off from the proposed development (l/s):				0.68
1 in 10 year				
Greenfield run-off volume total:	23.28 m ³			
RUN-OFF During a 1 in 1 year 6 hour event:	Greenfield Site	Current Development	Proposed Development	Proposed Development +CC
From permeable surfaces (using GF total run-off) (m ³)	23.28	22.30	8.97	12.56
From impermeable surfaces (m ³)		2.01	29.49	41.29
TOTAL run-off produced from Site (m ³)	23.28	24.31	38.47	53.85
Difference between greenfield site and proposed +cc development (m ³):				30.58
				131%
Difference between current and proposed +cc development (m ³):				29.54
				122%
Peak Greenfield run-off rate that must not be exceeded in the run-off from the proposed development (l/s):				1.10
1 in 30 year				
Greenfield run-off volume total:	30.83 m ³			
RUN-OFF During a 1 in 30 year 6 hour event:	Greenfield Site	Current Development	Proposed Development	Proposed Development +CC
From permeable surfaces (using GF total run-off) (m ³)	30.83	29.54	11.89	16.64
From impermeable surfaces (m ³)		2.75	40.31	56.43
TOTAL run-off produced from Site (m ³)	30.83	32.29	52.19	73.07
Difference between greenfield site and proposed +cc development (m ³):				42.24
				137%
Difference between current and proposed +cc development (m ³):				40.78
				126%
Peak Greenfield run-off rate that must not be exceeded in the run-off from the proposed development (l/s):				1.34
1 in 100 year				
Greenfield run-off volume total:	42.25 m ³			
RUN-OFF During a 1 in 100 year 6 hour event:	Greenfield Site	Current Development	Proposed Development	Proposed Development +CC
From permeable surfaces (using GF total run-off) (m ³)	42.25	40.47	16.29	22.80
From impermeable surfaces (m ³)		3.77	55.23	77.32
TOTAL run-off produced from Site (m ³)	42.25	44.24	71.52	100.12
Difference between greenfield site and proposed +cc development (m ³):				57.88
				137%
Difference between current and proposed +cc development (m ³):				55.88
				126%
Peak Greenfield run-off rate that must not be exceeded in the run-off from the proposed development (l/s):				1.66

Appendix D



Regulated Drainage and Water Search

GeoSmart Information

Suite 9-11, Old Bank Buildings
Bellstone,
Shropshire,
SY1 1HU

FAO:

How to contact us:

United Utilities Water Limited
Property Searches
Haweswater House
Lingley Mere Business Park
Great Sankey
Warrington
WA5 3LP

Telephone: 0370 7510101

E-mail: propertysearches@uuplc.co.uk

Your Ref: 76712
Our Ref: UUPS-ORD-384629
Date: 11/04/2022

Dear Sirs

Location: Land off Whitecarr Lane, Wythenshawe, M23 2TX

I acknowledge with thanks your request dated 07/04/2022 for information on the location of our services.

Please find enclosed plans showing the approximate position of United Utilities' apparatus known to be in the vicinity of this site.

The enclosed plans are being provided to you subject to the United Utilities terms and conditions for both the wastewater and water distribution plans which are shown attached.

If you are planning works anywhere in the North West, please read United Utilities' access statement before you start work to check how it will affect our network. <http://www.unitedutilities.com/work-near-asset.aspx>.

I trust the above meets with your requirements and look forward to hearing from you should you need anything further.

If you have any queries regarding this matter please [contact us](#).

Yours Faithfully,



Karen McCormack
Property Searches Manager

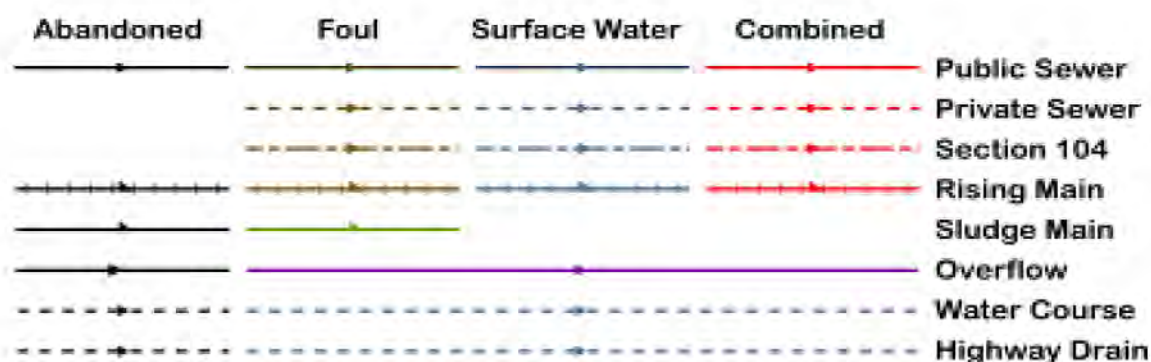
TERMS AND CONDITIONS - WASTEWATER AND WATER DISTRIBUTION PLANS

These provisions apply to the public sewerage, water distribution and telemetry systems (including sewers which are the subject of an agreement under Section 104 of the Water Industry Act 1991 and mains installed in accordance with the agreement for the self construction of water mains) (UUWL apparatus) of United Utilities Water Limited "(UUWL)".

TERMS AND CONDITIONS:

- This Map and any information supplied with it is issued subject to the provisions contained below, to the exclusion of all others and no party relies upon any representation, warranty, collateral contract or other assurance of any person (whether party to this agreement or not) that is not set out in this agreement or the documents referred to in it.
- This Map and any information supplied with it is provided for general guidance only and no representation, undertaking or warranty as to its accuracy, completeness or being up to date is given or implied.
- In particular, the position and depth of any UUWL apparatus shown on the Map are approximate only. UUWL strongly recommends that a comprehensive survey is undertaken in addition to reviewing this Map to determine and ensure the precise location of any UUWL apparatus. The exact location, positions and depths should be obtained by excavation trial holes.
- The location and position of private drains, private sewers and service pipes to properties are not normally shown on this Map but their presence must be anticipated and accounted for and you are strongly advised to carry out your own further enquiries and investigations in order to locate the same.
- The position and depth of UUWL apparatus is subject to change and therefore this Map is issued subject to any removal or change in location of the same. The onus is entirely upon you to confirm whether any changes to the Map have been made subsequent to issue and prior to any works being carried out.
- This Map and any information shown on it or provided with it must not be relied upon in the event of any development, construction or other works (including but not limited to any excavations) in the vicinity of UUWL apparatus or for the purpose of determining the suitability of a point of connection to the sewerage or other distribution systems.
- No person or legal entity, including any company shall be relieved from any liability howsoever and whensoever arising for any damage caused to UUWL apparatus by reason of the actual position and/or depths of UUWL apparatus being different from those shown on the Map and any information supplied with it.
- If any provision contained herein is or becomes legally invalid or unenforceable, it will be taken to be severed from the remaining provisions which shall be unaffected and continue in full force and affect.
- This agreement shall be governed by English law and all parties submit to the exclusive jurisdiction of the English courts, save that nothing will prevent UUWL from bringing proceedings in any other competent jurisdiction, whether concurrently or otherwise.

Wastewater Symbolology



All point assets follow the standard colour convention: **red** – combined **brown** - foul
blue – surface water **purple** - overflow

Manhole	Side Entry Manhole
Head of System	Outfall
Extent of Survey	Screen Chamber
Rodding Eye	Inspection Chamber
Inlet	Bifurcation Chamber
Discharge Point	Lamp Hole
Vortex	T Junction / Saddle
Penstock	Catchpit
Washout Chamber	Valve Chamber
Valve	Vent Column
Air Valve	Vortex Chamber
Non Return Valve	Penstock Chamber
Soakaway	Network Storage Tank
Gully	Sewer Overflow
Cascade	Ww Treatment Works
Flow Meter	Ww Pumping Station
Hatch Box	Septic Tank
Oil Interceptor	Control Kiosk
Summit	
Drop Shaft	Change of Characteristic
Orifice Plate	



Scale: 1:1250 Date: 11/04/2022	SEWER RECORDS	 Water for the North West
Address or Site Reference: Land off Whitecarr Lane, Wythenshawe, M23 2TX Printed by: Property Searches		

The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. United Utilities Water will not accept liability for any loss or damage caused by the actual position being different from those shown.

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Disclaimer

This report has been prepared by GeoSmart in its professional capacity as soil, groundwater, flood risk and drainage specialists, with reasonable skill, care and diligence within the agreed scope and terms of contract and taking account of the manpower and resources devoted to it by agreement with its client and is provided by GeoSmart solely for the internal use of its client.

The advice and opinions in this report should be read and relied on only in the context of the report as a whole, taking account of the terms of reference agreed with the client. The findings are based on the information made available to GeoSmart at the date of the report (and will have been assumed to be correct) and on current UK standards, codes, technology and practices as at that time. They do not purport to include any manner of legal advice or opinion. New information or changes in conditions and regulatory requirements may occur in future, which will change the conclusions presented here.

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Further information

Information on confidence levels and ways to improve this report can be provided for any location on written request to info@geosmart.co.uk or via our website. Updates to our model are ongoing and additional information is being collated from several sources to improve the database and allow increased confidence in the findings. Further information on groundwater levels and flooding are being incorporated in the model to enable improved accuracy to be achieved in future versions of the map. Please contact us if you would like to join our User Group and help with feedback on infiltration SuDS and mapping suggestion.

Important consumer protection information

This search has been produced by GeoSmart Information Limited, Suite 9-11, 1st Floor, Old Bank Buildings, Bellstone, Shrewsbury, SY1 1HU.

Tel: 01743 298 100

Email: info@geosmartinfo.co.uk

GeoSmart Information Limited is registered with the Property Codes Compliance Board (PCCB) as a subscriber to the Search Code. The PCCB independently monitors how registered search firms maintain compliance with the Code.

The Search Code:

- provides protection for homebuyers, sellers, estate agents, conveyancers and mortgage lenders who rely on the information included in property search reports undertaken by subscribers on residential and commercial property within the United Kingdom.
- sets out minimum standards which firms compiling and selling search reports have to meet.
- promotes the best practice and quality standards within the industry for the benefit of consumers and property professionals.
- enables consumers and property professionals to have confidence in firms which subscribe to the code, their products and services.
- By giving you this information, the search firm is confirming that they keep to the principles of the Code. This provides important protection for you.

The Code's core principles

Firms which subscribe to the Search Code will:

- display the Search Code logo prominently on their search reports.
- act with integrity and carry out work with due skill, care and diligence.
- at all times maintain adequate and appropriate insurance to protect consumers.
- conduct business in an honest, fair and professional manner.
- handle complaints speedily and fairly.
- ensure that products and services comply with industry registration rules and standards and relevant laws.
- monitor their compliance with the Code.

Complaints

If you have a query or complaint about your search, you should raise it directly with the search firm, and if appropriate ask for any complaint to be considered under their formal internal complaints procedure. If you remain dissatisfied with the firm's final response, after your complaint has been formally considered, or if the firm has exceeded the response timescales, you may refer your complaint for consideration under The Property Ombudsman scheme (TPOs). The Ombudsman can award up to £5,000 to you if the Ombudsman finds that you have suffered actual financial loss and/or aggravation, distress or inconvenience as a result of your search provider failing to keep to the Code.

Please note that all queries or complaints regarding your search should be directed to your search provider in the first instance, not to TPOs or to the PCCB.

TPOs contact details:

The Property Ombudsman scheme
Milford House
43-55 Milford Street
Salisbury
Wiltshire SP1 2BP
Tel: 01722 333306
Fax: 01722 332296
Email: admin@tpos.co.uk

You can get more information about the PCCB from www.propertycodes.org.uk.

Please ask your search provider if you would like a copy of the search code

Complaints procedure

GeoSmart Information Limited is registered with the Property Codes Compliance Board as a subscriber to the Search Code. A key commitment under the Code is that firms will handle any complaints both speedily and fairly. If you want to make a complaint, we will:

- Acknowledge it within 5 working days of receipt.
- Normally deal with it fully and provide a final response, in writing, within 20 working days of receipt.
- Keep you informed by letter, telephone or e-mail, as you prefer, if we need more time.
- Provide a final response, in writing, at the latest within 40 working days of receipt.
- Liaise, at your request, with anyone acting formally on your behalf.

If you are not satisfied with our final response, or if we exceed the response timescales, you may refer the complaint to The Property Ombudsman scheme (TPOs): Tel: 01722 333306, E-mail: admin@tpos.co.uk.

We will co-operate fully with the Ombudsman during an investigation and comply with his final decision. Complaints should be sent to:

Martin Lucass

Commercial Director

GeoSmart Information Limited

Suite 9-11, 1st Floor,

Old Bank Buildings,

Bellstone, Shrewsbury, SY1 1HU

Tel: 01743 298 100

martinlucass@geosmartinfo.co.uk

16 Terms and conditions, CDM regulations and data limitations



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Data use and limitations can be found on our website:

<http://geosmartinfo.co.uk/data-limitations/>