GeoSmart Information

SuDSmart Plus

Sustainable Drainage Assessment

Site Address

Corner of Fore Street and High Road
Eastcote
Pinner
HA5 2ET

Grid Reference

510330, 188448

Report Prepared for

Watervale Property Ltd
41 The Broadway
Joel Street
Northwood Hills
Northwood
HA6 1NZ

Date

2023-01-18

Report Status

FINAL

Site Area

0.39 ha

Report Reference

77698.01R3

Infiltrate to Ground

The primary proposed Sustainable Drainage Scheme (SuDS) strategy is comprised of permeable surfacing and a rainwater harvesting butt to attenuate surface water runoff.

Surface water will be discharged to ground, subject to infiltration testing to confirm the capacity of underlying deposits.

Should infiltration testing deem infiltration to ground unfeasible, the secondary strategy is comprised of a green roof, permeable surfacing and a rainwater harvesting butt for surface water runoff.

Surface water will be discharged into the adjacent surface water feature (River Pinn) at a total restricted rate of 2 l/s.

Report Author

Daniel Howlett

Consultant

Report Checker

Mike Piotrowski

Principal Hydrologist

Report Reviewer

Bob Sargent

Associate

GeoSmart Information Ltd
Suite 9-11, 1st Floor, Old Bank Buildings,
Bellstone, Shrewsbury, SY1 1HU
+44(0)1743 298 100
info@geosmartinfo.co.uk
www.geosmartinfo.co.uk

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?	High
	What is the potential to discharge to sewers?	High
	What is the potential to discharge to highway drains?	Medium
Flooding	What is the river (fluvial) flood risk at the Site?	Medium
	What is the surface water (pluvial) flood risk at the Site?	High
	What is the groundwater flood risk at the Site?	Negligible
Pollution	Is the groundwater a protected resource?	Yes
	Is the surface water feature a protected resource?	No

Summary of existing and proposed development

The site is a vacant site situated on the corner of Fore Street and High Road, Eastcote. It lies behind a small area of public open space and is bound by the river Pinn to the Northwest and the petrol station at Eastcote to the North East. The site perimeter contains multiple TPO trees and vegetation which screen the site from public view. The site is private land and has never been in public use, Ordnance survey maps show there was once a timber structure on the site which sold fruit and vegetables. The site area is predominantly residential in character, with the exception of a small local shopping parade located approximately 150m North East along the high road, a petrol station and the Black Horse Public House (Grade II listed).

Development proposals comprise the construction of an early year's nursery with a capacity of 80 children plus staff, including the formation of new associated access and landscaping within the Site. Within the development plans, the nursery building is due to be constructed on top of a mound 300 mm in height and have finished floor levels an additional 300 mm above this.

Summary of discharge routes

GeoSmart's SuDS Infiltration Potential (SD50) map indicates the Site has a Moderate potential for infiltration, primarily due to the high permeability of the underlying geology. However, a high water table (1.6 mbgl) has been identified from nearby boreholes. Infiltration testing should be carried out to confirm the capacity of underlying geology and subsequent feasibility of infiltration.

Ordnance Survey (OS) mapping indicates a surface water feature is located adjacent to the northern Site boundary and therefore discharging into this feature should be considered.

Further discussions should be held with the regulators to agree a suitable discharge route and any easements required.

The regulated drainage and water search included in Appendix C confirms the Site is located within 5 m of the public sewer network. Due to the short distance to nearby sewers discharging surface water runoff to the sewer is feasible.

According to Google Streetview, highway gullies are located within High Road and Fore Street, indicating the presence of the highway drainage network.

Runoff rate and attenuation requirements

Discharging via infiltration requires 63.3 m^3 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 including a 40% allowance for climate change. This volume has been calculated using Causeway Flow v.10.4 based on an assumed infiltration rate of 1 x 10^{-5} m/s taken from the table 25.1 of the CIRIA SuDS (C753) (2015) as the worst case scenario for sand and gravel soil types. 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 98.7 m^3 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 total discharge rate for the Site being restricted to 2 l/s (as close to the Greenfield 1 in 1 year rate as possible, without increasing the potential for blockages).

Proposed Primary SuDS strategy

Where infiltration confirms that infiltration to ground is feasible, the following SuDS feature (permeable surfacing) is proposed to attenuate a minimum of 63.3 m^3 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 5 m from building foundations and from adjacent highways.

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 DEFRAs non-statutory technical standards (DEFRA, 2015).

Proposed Secondary SuDS strategy

In the event of infiltration testing confirming that infiltration to ground is not feasible, the following SuDS features are proposed (permeable surfacing, green roofing and rainwater harvesting butts) to attenuate a minimum of 98.7 m^3 of surface water runoff. The SuDS features would provide some water quality benefits (interception and filtration) prior to discharging to the River Pinn. Discharge to the River Pinn will occur through multiple separate outfalls located at the northwest and southwest of the development respectively due to the topographic gradient of the Site making the direction of run-off to a single discharge point unfeasible. The number of outfalls required will be confirmed at the design stage, but the total discharge rate from the Site will be limited to 2 l/s.

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 DEFRAs 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 residential building, where payments for the works will form part of the property deeds and / or rental agreements.

Recommendations

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.

An investigation is required to confirm the capacity of surface water bodies to accept surface water runoff and whether sewers within the immediate vicinity of the Site could be used within the SuDS design. The condition and capacity of the surface watercourse should be confirmed and permission should be obtained from the Environment Agency for proposed outfalls and any other permits required to discharge to the River Pinn (Main River).

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.

Primary Strategy

Table 1. Proposed SuDS type, features, discharge location and rate restriction (Primary Strategy)

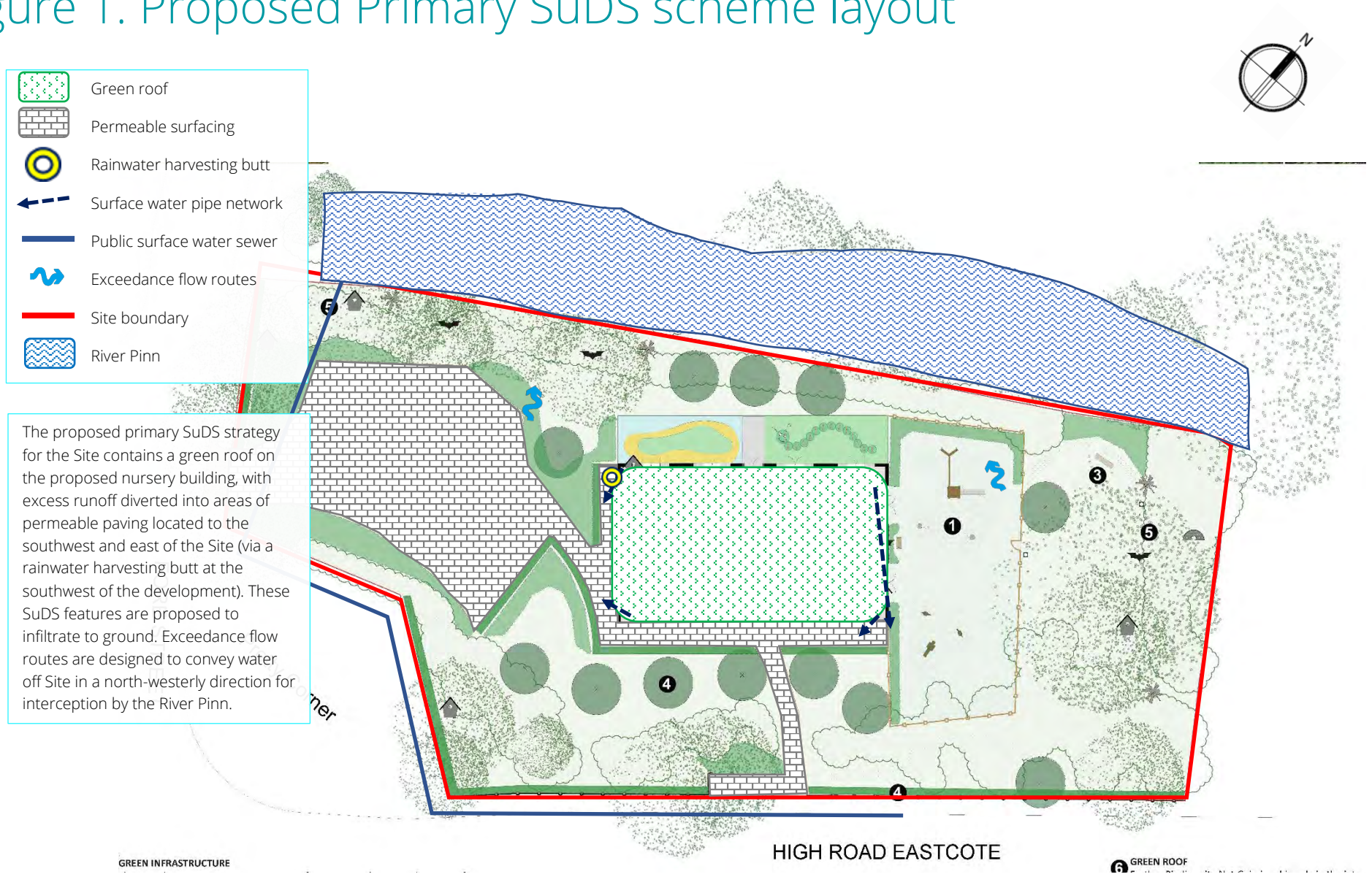
SuDS type	Source control (interception) and attenuation SuDS.
SuDS features	Permeable surfacing, green roof and rainwater harvesting.
Discharge location	Infiltrate to ground.
Discharge rate	1 x 10^{-5} m/s*.

*The worst case infiltration rate for sand and gravel soils as set out in the CIRIA SuDS Manual (C753), 2015

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

Rainwater Harvesting	To comply with London Plan policy, a rainwater harvesting butt 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.
Permeable surfacing	A 640 m^2 area of permeable surfacing (underlain with a Type 3 aggregate material) within the proposed driveway and access areas to a depth of 0.25 m, with a 30% porosity would result in c. 48.0 m^3 attenuation.
Green Roof	A green roof covering a total area of 408 m^2 (cover area of all roof spaces) with a green roof mix example volume of 81.6 m^3 (0.2m depth) and Geo-composite layer example volume of 6.1 m^3 (0.015m depth) would result in 15.3 m^3 of attenuation.
Total Attenuation Provided	63.3 m^3

Figure 1. Proposed Primary SuDS scheme layout



Schematic is not to scale

Secondary Strategy

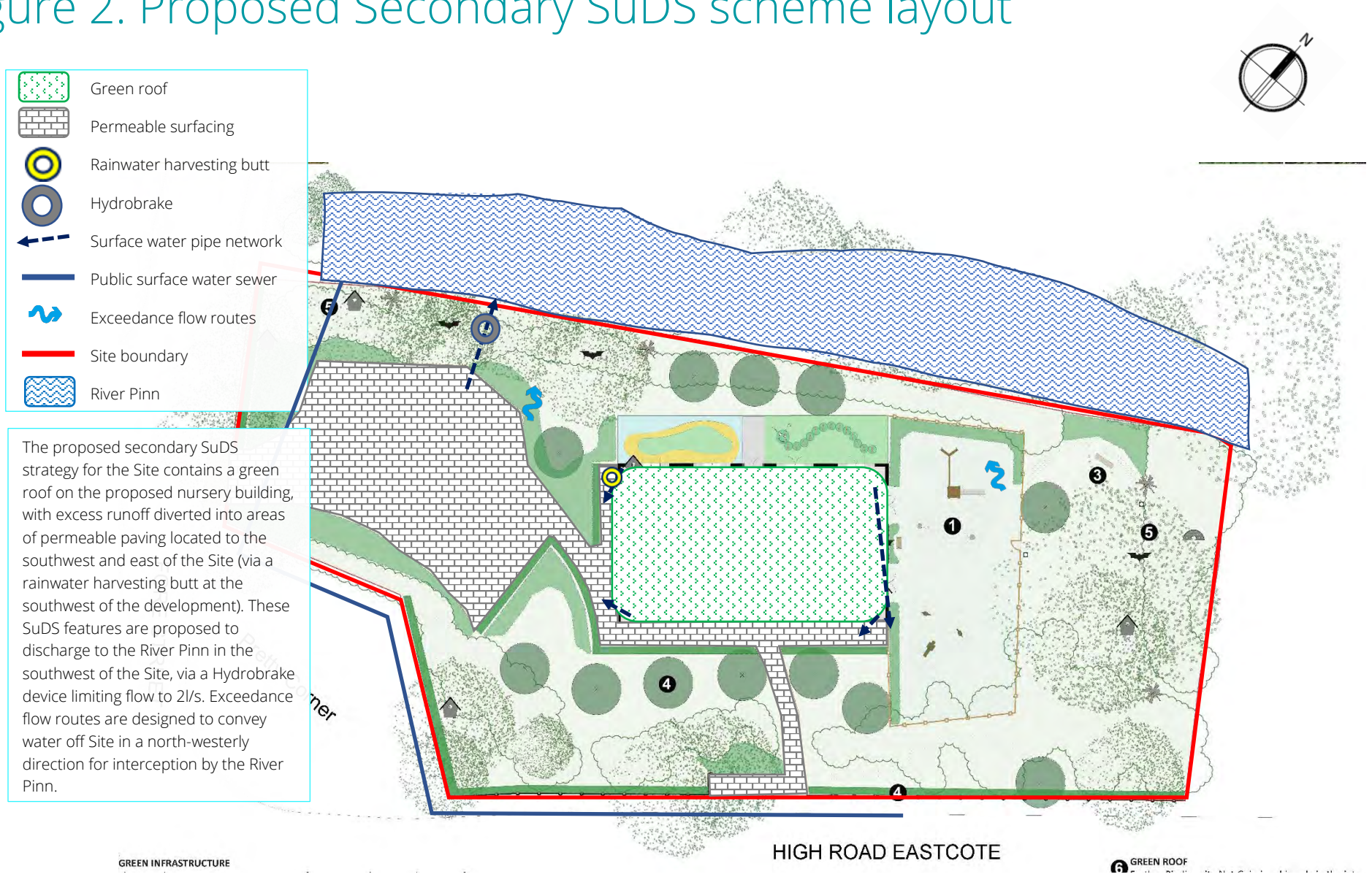
Table 3. Proposed SuDS type, features, discharge location and rate restriction (Secondary strategy)

SuDS type	Source control (interception) and attenuation SuDS.
SuDS features	Permeable surfacing, green roof and rainwater harvesting.
Discharge location	Surface water feature.
Discharge rate	2 l/s

Table 4. Proposed SuDS sizing (dimensions) and attenuation volumes

Rainwater Harvesting	To comply with London Plan policy, a rainwater harvesting butt 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.
Green Roof	A 640 m2 area of permeable surfacing (underlain with a Type 3 aggregate material) within the proposed driveway and access areas to a depth of 0.45 m, with a 30% porosity would result in c. 86.4 m3 attenuation.
Permeable surfacing	A green roof covering a total area of 408 m2 (cover area of all roof spaces) with a green roof mix example volume of 81.6 m3 (0.2m depth) and Geo-composite layer example volume of 6.1 m3 (0.015m depth) would result in 15.3 m3 of attenuation.
Total Attenuation Provided	101.7 m^3
Total Attenuation Required	98.7 m^3
Freeboard Storage Provided	3.0 m^3

Figure 2. Proposed Secondary SuDS scheme layout



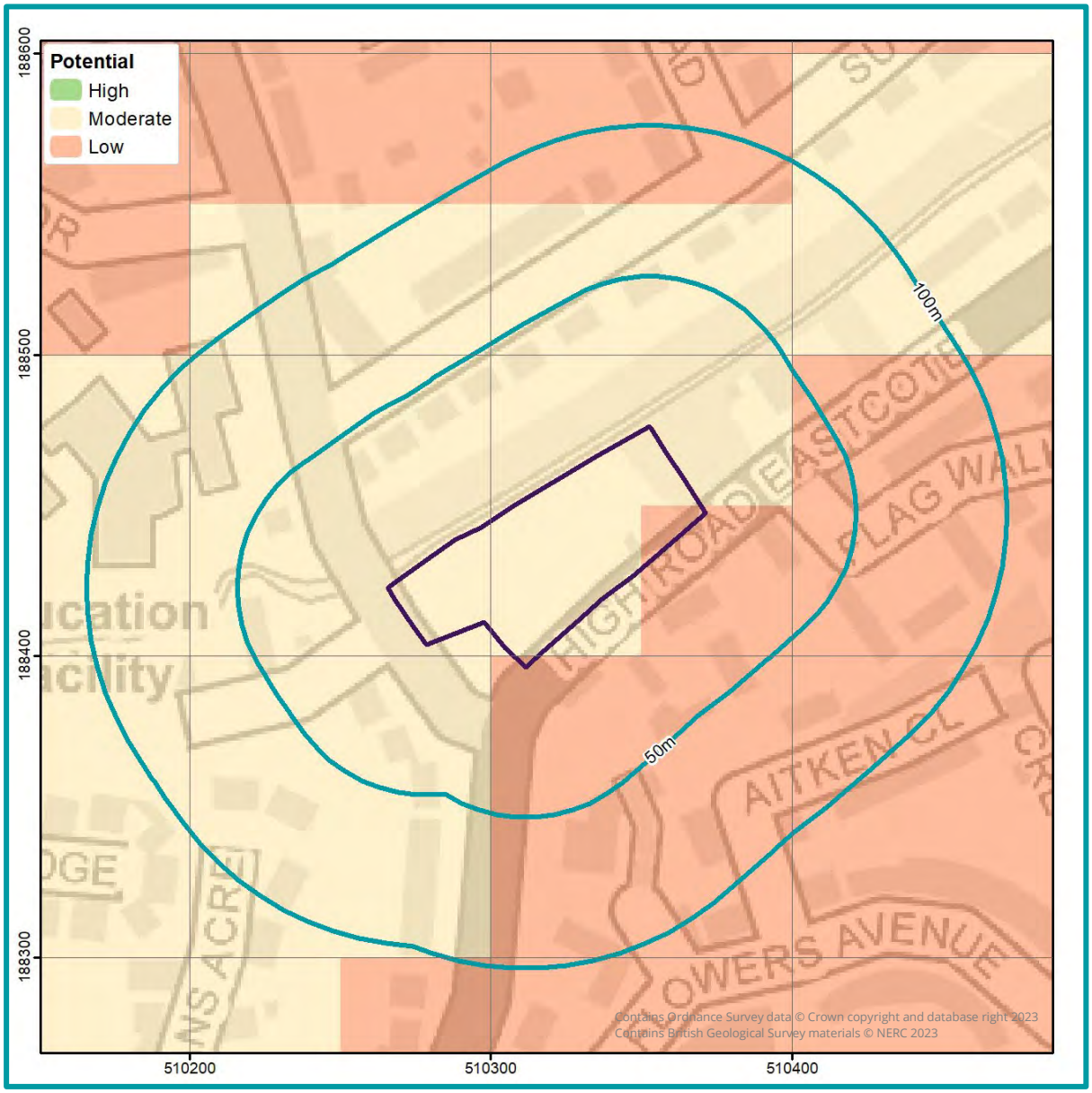
Schematic is not to scale

3 Site analysis

Site location

Figure 3. Aerial Imagery (Bluesky, 2023)

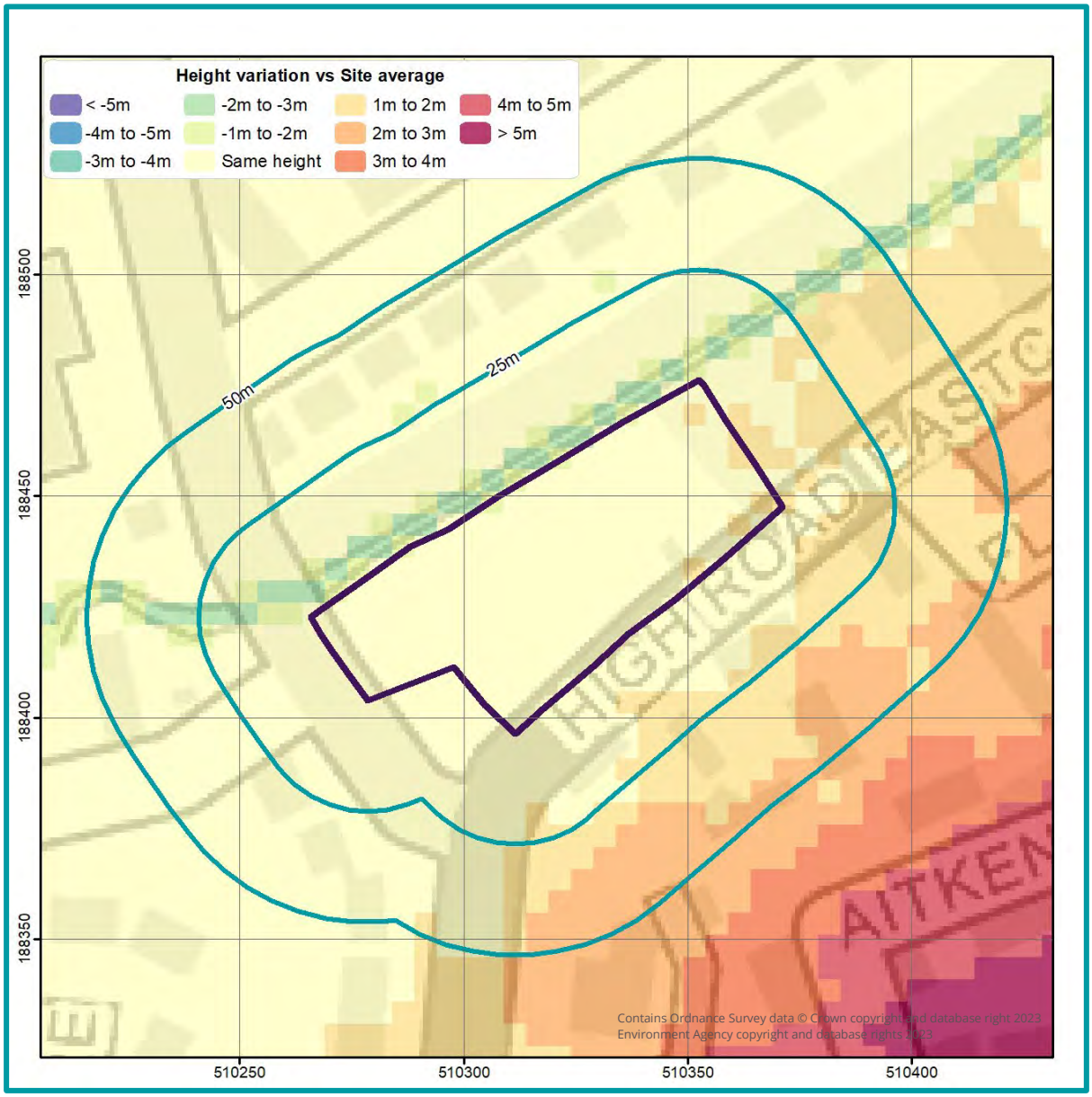
Figure 4. SuDS infiltration suitability (SD50) map (GeoSmart, 2023)



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 moderate permeability. An infiltration SuDS scheme should be considered at the Site, although there may be constraints associated with the depth to groundwater or with the infiltration rate of the underlying substrate.

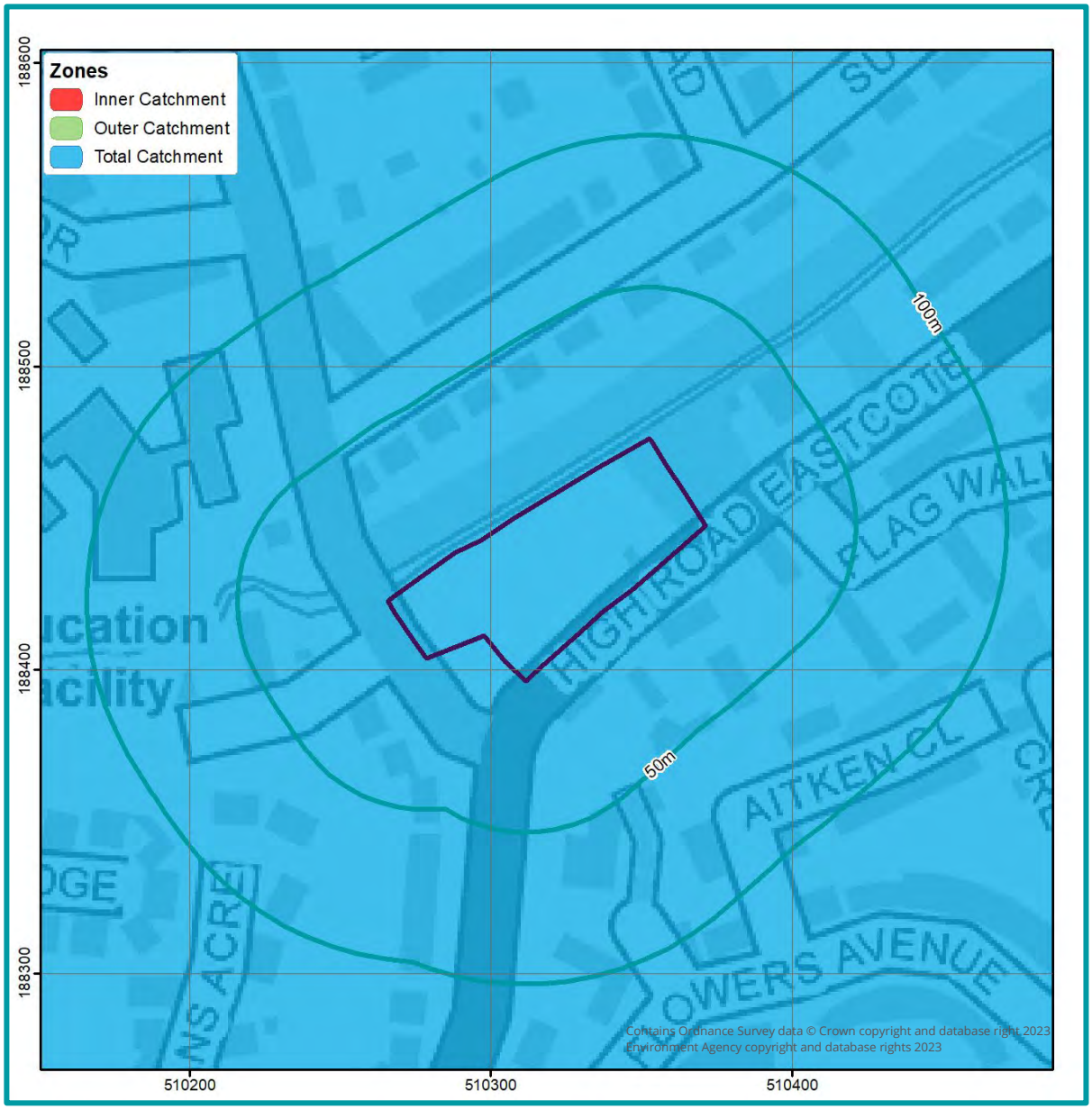
Figure 5. Site topography (GeoSmart, 2023)



An assessment of the topography at the Site has been undertaken using 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 level.

Further analysis could be undertaken by visiting the Site or by collecting additional topographic survey to provide further confirmation of ground levels.

Figure 6. Source protection zone map (EA, 2023)

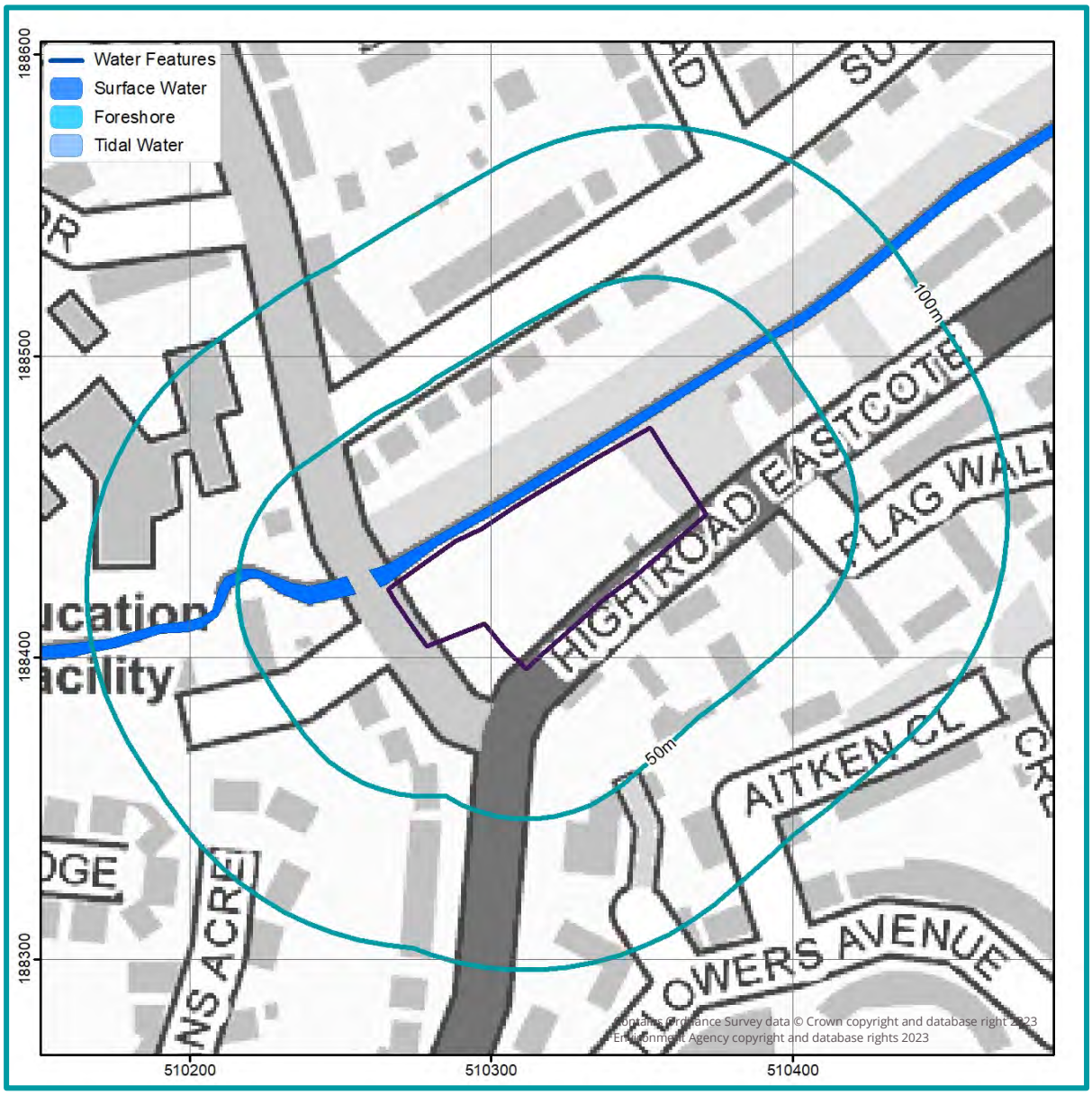


An assessment of the EA's groundwater Source Protection Zones (SPZs) has been undertaken within the vicinity of the Site and confirms the Site lies within a total groundwater Source Protection Zone (SPZ III).

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 7. Surface water features map (EA, 2023)



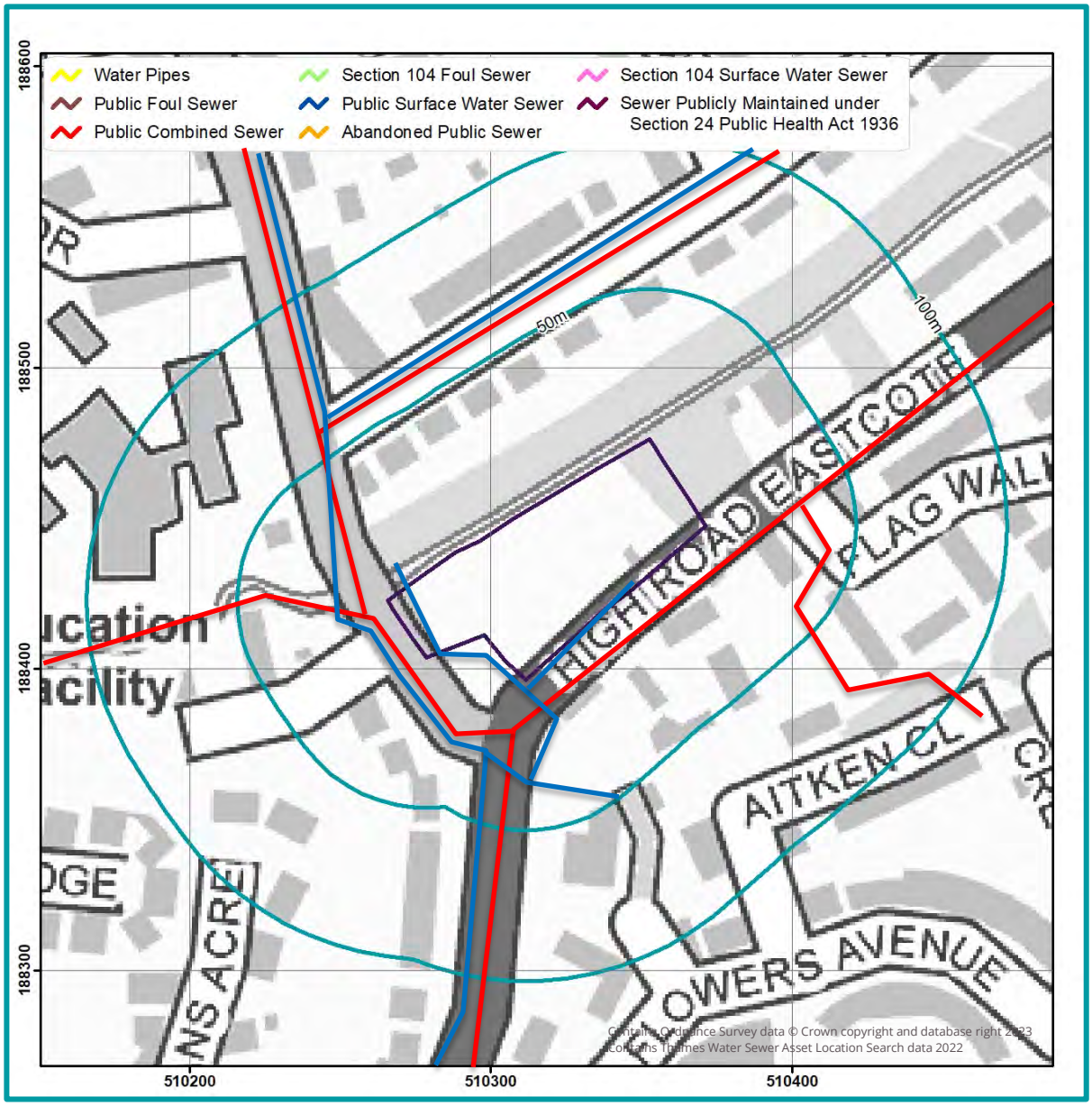
OS mapping indicates a surface water feature is located adjacent to the northern boundary of the Site. According to the EA's Magic Map, the Site is not within 250m of a SSSI or SPA.

The feature is located adjacent to the Site and therefore, discharge into this feature should be considered.

Further discussions should be held with the regulators to agree a suitable discharge route and any easements required.

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 8. Sewer features map (OS & Thames Water, 2023)



GeoSmart has undertaken an assessment of the location of sewer features within the vicinity of the Site. There is a public surface water sewer, located adjacent to the southern and western boundaries of the Site, therefore discharge to sewer is likely to be appropriate.

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.

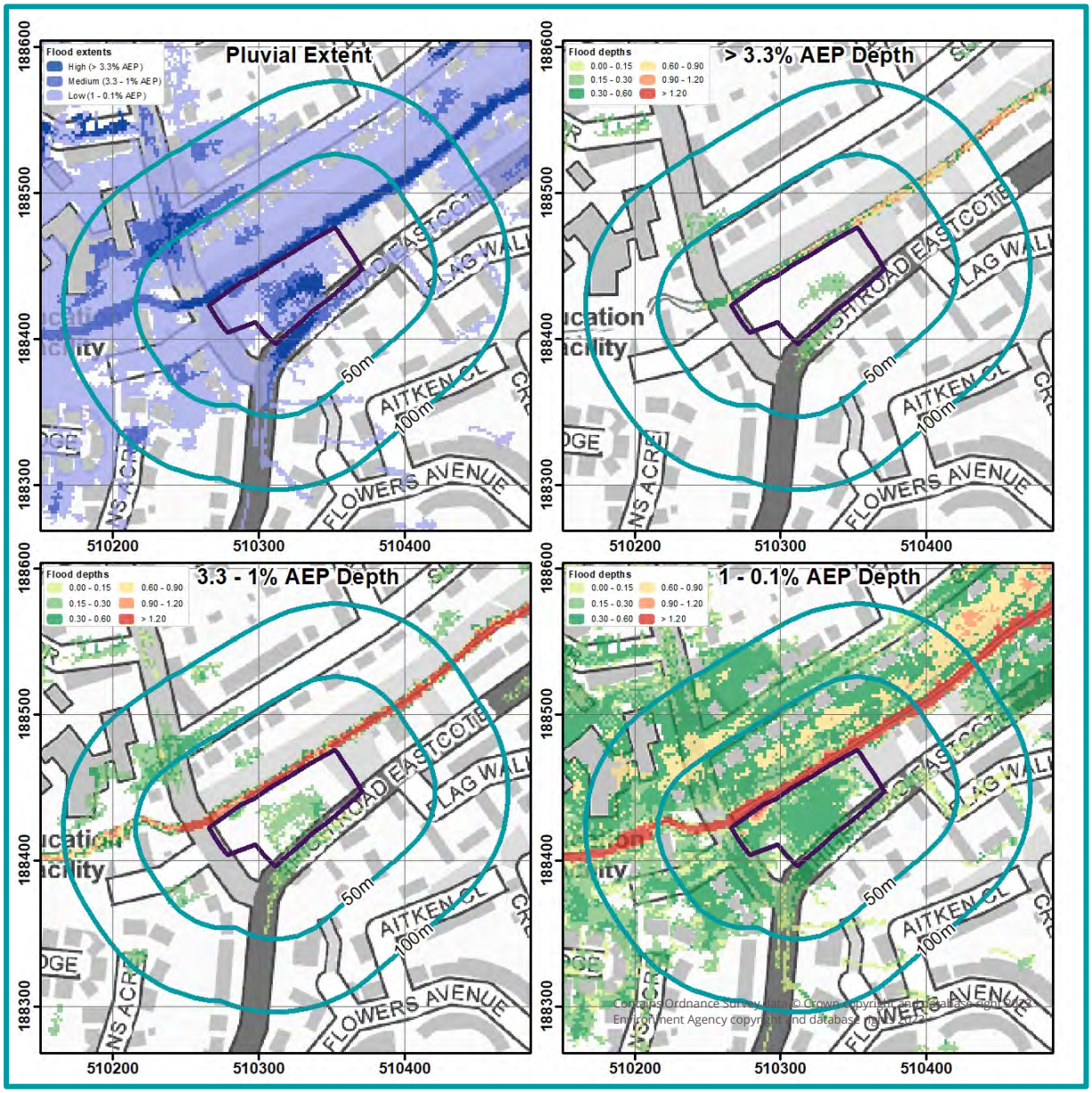
Figure 9. Risk of flooding from rivers & sea map (EA, 2023)

According to the EA's Risk of Flooding from Rivers and the Sea (RoFRS) map, the Site has a Medium risk of flooding from Rivers and/or the Sea with more than a 1% annual probability of occurring. Therefore the SuDS design could potentially be affected by flooding in this event.

The use of certain types of SuDS features such as attenuation / infiltration basins may be affected in Medium or High risk areas and should be avoided. Further analysis could be undertaken by visiting the Site or by contacting the Local Council and the EA to confirm the risk and the associated flood depths.

A separate Flood Risk Assessment has been undertaken (ref: 77698), where the potential risks to the development are discussed further.

Figure 10. Risk of surface water flooding map (EA,2023)



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 High risk of surface water flooding.

The above map shows the extent and depth of flooding during 3.3% (1 in 30 year), 1% annual probability (1 in 100 year) and 0.1% (1 in 1000 year) events, this confirms there are areas where flooding could occur in the 1 in 30, 1 in 100 and 1 in 1000 year events. Flooding in these areas may constrain certain types of SuDS features being used.

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 11. Groundwater flood risk (GW5) map (GeoSmart, 2023)

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 Corner of Fore Street, Pinner, Hillingdon, HA5 2ET (the Site). The Site is located in a setting of residential land use. The land slopes to the southeast from 43.8 mAOD to 42.7 mAOD along the northern boundary (EA, 2023). Site plans and drawings are provided in Appendix A.

Development

The site is a vacant site situated on the corner of Fore Street and High Road, Eastcote. It lies behind a small area of public open space and is bound by the river Pinn to the Northwest and the petrol station at Eastcote to the North East. The site perimeter contains multiple TPO trees and vegetation which screen the site from public view. The site is private land and has never been in public use, Ordnance survey maps show there was once a timber structure on the site which sold fruit and vegetables. The site area is predominantly residential in character, with the exception of a small local shopping parade located approximately 150m North East along the high road, a petrol station and the Black Horse Public House (Grade II listed).

Development proposals comprise the construction of an early year's nursery with a capacity of 80 children plus staff, including the formation of new associated access and landscaping within the Site. Within the development plans, the nursery building is due to be constructed on top of a mound 300 mm in height and have finished floor levels an additional 300 mm above this.

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 5. Site Geology

Geology present on-Site		Potentially permeable?
Superficial geology (Figure 11)	Alluvium (ALV)	✓
Bedrock geology (Figure 12)	Lambeth Group (LMBE)	✓

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: TQ18NW94 and TQ18NW93). These boreholes are located approximately 140 m and 180 m to the northwest of the Site at 43.0 mAOD elevation respectively.

The borehole records confirm the underlying geology is comprised of Alluvium to a depth of between 1.6 m below ground level (bgl) underlain by Lambeth Member Clay to a depth of between 1.6 m and 4.9 m bgl.

Infiltration SuDs are proposed directly into the thin permeable superficial deposits overlying low permeability bedrock.

The soil infiltration coefficient must be sufficient to accommodate the constraints on the dimensions of the permeable paving and its emptying time. Infiltration features should be situated at least 1 m above the groundwater table.

Depth to groundwater

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

According to Site-specific borehole data and GeoSmart's Groundwater Flood Risk (GW5) map, shallow groundwater is potentially a problem at the Site.

Relevant Borehole records indicate groundwater levels may fluctuate around 1.6 mbgl within the permeable superficial deposits (Alluvium) which are situated above impermeable bedrock deposits (Lambeth Member Clay). This indicates the presence of a perched groundwater table within the Alluvium deposits which underly 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. Superficial Geology (BGS, 2023)

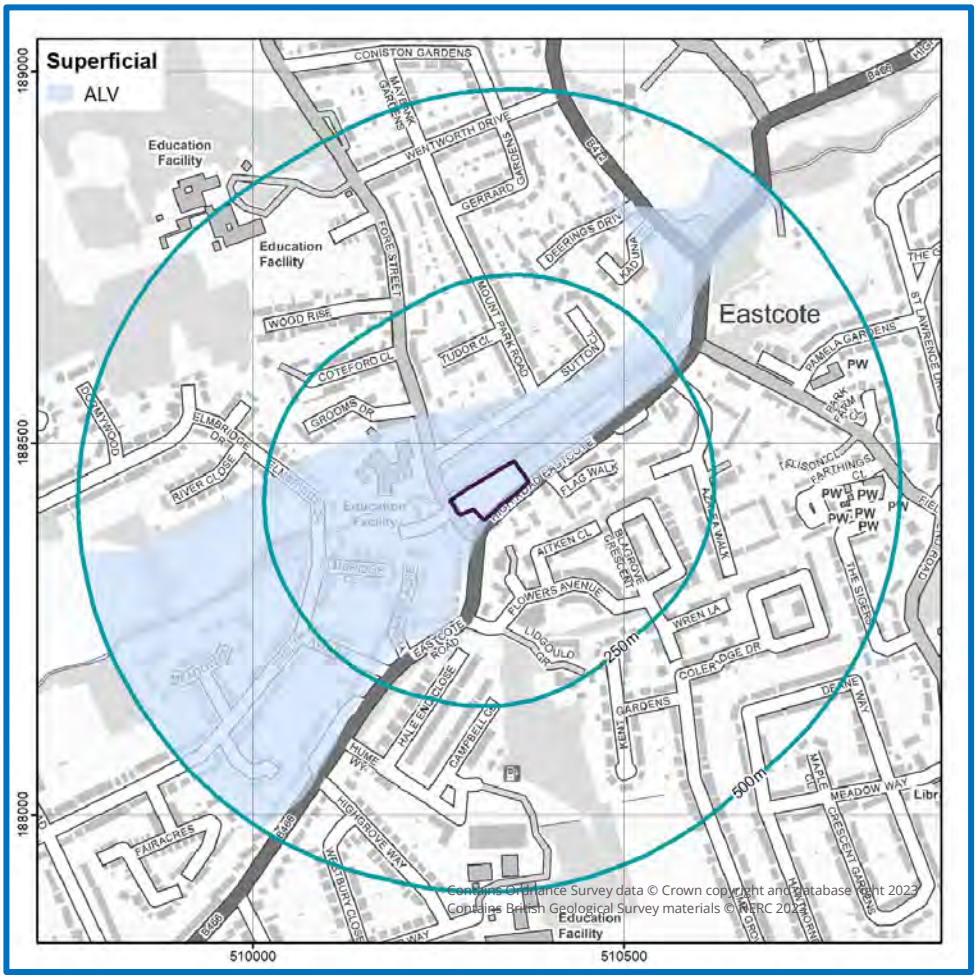


Figure 13. Bedrock Geology (BGS, 2023)

Ground conditions

Infiltration SuDS are proposed within 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. Focused infiltration features should be a minimum of 5m away from the foundations of a building and local guidance may recommend a greater distance, such as 10 m on some areas of the Chalk.

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 km^2) 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 6. Colne management Catchment Peak Rainfall Allowances

Colne Management Catchment Peak Rainfall Allowances	3.3% AEP Event		1% AEP Event	
	2050's	2070's	2050's	2070's
Central	20%	25%	20%	25%
Upper end	35%	35%	40%	40%

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.

Sub-national Drainage Policy (i.e. county/London plan level)

London Plan - Policy SI13 Sustainable drainage (2021)

Lead Local Flood Authorities should identify – through their Local Flood Risk Management Strategies and Surface Water Management Plans – areas where there are particular surface water management issues and aim to reduce these risks. Increases in surface water run-off outside these areas also need to be identified and addressed. Development proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible. There should also be a preference for green over grey features, in line with the following drainage hierarchy:

1. Rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation);
2. Rainwater infiltration to ground at or close to source;
3. Rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens);
4. Rainwater discharge direct to a watercourse (unless not appropriate);
5. Controlled rainwater discharge to a surface water sewer or drain;
6. Controlled rainwater discharge to a combined sewer.

Development proposals for impermeable surfacing should normally be resisted unless they can be shown to be unavoidable, including on small surfaces such as front gardens and driveways.

Drainage should be designed and implemented in ways that promote multiple benefits including increased water use efficiency, improved water quality, and enhanced biodiversity, urban greening, amenity and recreation.

Development proposals should aim to get as close to greenfield run-off rates as possible depending on Site conditions. The well-established drainage hierarchy set out in this policy helps to reduce the rate and volume of surface water run-off. Rainwater should be managed as close to the top of the hierarchy as possible. There should be a preference for green over grey features, and drainage by gravity over pumped systems. A blue roof is an attenuation tank at roof or podium level; the combination of a blue and green roof is particularly beneficial, as the attenuated water is used to irrigate the green roof.

For many sites, it may be appropriate to use more than one form of drainage, for example a proportion of rainwater can be managed by more sustainable methods, with residual rainwater managed lower down the hierarchy. In some cases, direct discharge into the watercourse is an appropriate approach, for example rainwater discharge into the tidal Thames or a dock. This should include suitable pollution prevention filtering measures, ideally by using soft engineering or green infrastructure. In addition, if direct discharge is to a watercourse where the outfall is likely to be affected by tide-locking, suitable storage should be designed into the system. However, in other cases direct discharge will not be appropriate, for example discharge into a small stream at the headwaters of a catchment, which may cause flooding. This will need to be assessed on a case-bycase basis, taking into account the location, scale and quality of the discharge and the receiving watercourse. The maintenance of identified drainage measures should also be considered in development proposals.

London Plan - Sustainable design and Construction SPG: Section 3.4.9 (2014)

Most developments have been able to achieve at least 50% attenuation of the site's (prior to re-development) surface water runoff at peak times. This is the minimum expectation from development proposals.

On previously developed sites, runoff rates should not be more than three times the calculated greenfield rate. The only exceptions to this, where greater discharge rates may be

acceptable, are where a pumped discharge would be required to meet the standards or where surface water drainage is to tidal waters and therefore would be able to discharge at unrestricted rates provided unacceptable scour would not result.

Discharge to surface water course/sewer

There may be situations where it is not appropriate to discharge at greenfield runoff rates. These include, for example, sites where the calculated greenfield runoff rate is extremely low and the final outfall of a piped system required to achieve this would be prone to blockage.

Local Policy

London Borough of Hillingdon SuDS D&E Guide (McCoy Consulting & Bray Associates, 2018)

Rainfall should not discharge into the foul sewer.

The way that rainfall leaves a development should follow the following hierarchy:

1. Re-use on Site
2. Infiltration into the ground
3. A natural watercourse
4. Surface water sewer
5. Combined sewer

Each development should contribute to reducing the pressure on water resources through the provision of water reuse and rainwater harvesting.

The additional volume generated by a development (is) allowed to discharge at a maximum of 2/ls/ha.

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 7. Storage requirements at the proposed development Site (Discharge runoff to ground via infiltration)

Attenuation scenario		Attenuation Provided (m^3)	Explanation
Discharge runoff via infiltration	1 in 100 year including 40% CC	63.3	Permeable surfacing, located along the access paths to the proposed building, with a total area of 640 m^2, permeability of 30% and a depth of 0.25m would provide c. 48.0 m^3 attenuation. A green roof covering a total area of 408 m2 (cover area of all roof spaces) with a green roof mix example volume of 81.6 m3 (0.2m depth) and Geo-composite layer example volume of 6.1 m3 (0.015m depth) would result in 15.3 m3 of attenuation. Assuming a potential infiltration rate of 1 x 10^{-5} m/s* (the worst case infiltration rate for sand and gravel soils as set out in the CIRIA SuDS Manual (C753), 2015, which provides a reasonable assumption for the geology prior to infiltration testing), the soakaway would provide sufficient attenuation storage up to the 1 in 100 year + 40% CC Critical Storm event.

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

Table 8. Storage requirements at the proposed development Site (Discharge runoff to surface water feature)

Attenuation scenario		Attenuation required (m^3)	Explanation	
Discharge runoff to surface water feature	1 in 30 year	42.5	Attenuation required to ensure surface water runoff is attenuated in all storm events up to and including the 1 in 30 year (2 hour, Critical Storm Duration) event*. Flooding of the Site of 20.2 m^3 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 36.0 m^3 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	62.7	Attenuation required to ensure surface water runoff is attenuated in all storm events up to and including the 1 in 100 year (3 hour, Critical Storm Duration) event*.	
	1 in 100 year including 40% CC	98.7	Attenuation required to ensure surface water runoff is attenuated in all storm events up to and including the 1 in 100 year (4 hour, Critical Storm Duration) event including a 40% allowance for climate change*.	

*See Appendix B 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'.

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 9. Change in impermeable area associated with the development

Total Site area	3900 m^2
Impermeable area (and as a percentage of the total area of the proposed development footprint of 1,894 m^2)	
Pre-development	Post-development
0 m^2 (0%)	1,277 m^2 (33%)
Impermeable Land use: None Permeable Land use: Landscaped areas	New impermeable land use: 408 m^2 nursery building, 229 m^2 outdoor rubber surface play areas New permeable land use: 640 m^2 of permeable surfacing*

*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 10. 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	1.74	N/A	N/A	N/A
6 hour 1 in 1 year	1.48	2.21	3.03	0.82
6 hour 1 in 10 year	2.82	3.88	5.24	1.36
6 hour 1 in 30 year	3.90	4.94	6.76	1.82
6 hour 1 in 100 year	5.56	6.63	9.08	2.45
6 hour 1 in 100 year + 20% CC	N/A	N/A	10.89	4.26
6 hour 1 in 100 year + 40% CC	N/A	N/A	12.71	6.08

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

Relevant national, local and regional 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 11. 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	51.21	N/A	N/A	N/A
6 hour 1 in 1 year	47.77	47.77	65.41	17.64
6 hour 1 in 10 year	83.84	83.84	113.15	29.31
6 hour 1 in 30 year	106.64	106.64	146.02	39.38
6 hour 1 in 100 year	143.19	143.19	196.07	52.87
6 hour 1 in 100 year + 20% CC	N/A	N/A	235.28	92.09
6 hour 1 in 100 year + 40% CC	N/A	N/A	274.49	131.30

[2] Assumes 100% runoff from impermeable surfaces. Assumes Greenfield runoff from permeable surfaces calculated using the IoH124 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 12. 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	2	42.5
1 in 100 year	2	3	62.7
1 in 100 year including a 40% climate change	2	4	98.7

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 a thin layer of permeable underlying Alluvium superficial deposits. The superficial deposits are underlain by low permeability Lambeth Clay bedrock deposits, resulting in a perched water table underneath the Site at a depth of ~1.6 mbgl based on the available borehole information (subject to confirmation by site investigation) and groundwater flood risk mapping. There is the potential for high groundwater levels at the Site in response to rises in water level in the adjacent River Pinn which would prevent infiltration during these periods (See SuDS Infiltration Suitability Map (SD50)).

There are no known issues identified relating to Site contamination, but the Site is located within a SPZ.

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

The River Pinn is located adjacent to the northern boundary of the Site. It sits at a lower elevation then any potential SuDS scheme would be and is also in the direction of the natural flow path of runoff from the Site. Thus, off-Site discharge with flow attenuation and storage is a suitable alternative option should the results of infiltration testing prove infiltration to ground unfeasible

Discharge to sewer

Discharge to sewer is not likely to be the optimum sustainable drainage option for the new development area. A Thames Water Sewer Asset Location Search has confirmed that a surface water sewer line runs adjacent to the southern and western Site boundaries. If required consultation with the local sewer undertaker should be undertaken. Discharge to sewer would only be accepted if it can be demonstrated that none of the above options are

reasonably practical. Discharge would have to be controlled and on-Site attenuation would be required.

The topographic gradient on the Site falls gradually to the north away from the existing drainage network along the main road. It would be difficult to drain the majority of the Site under gravity to the existing sewer network, unless the sewer depth is located at a sufficient depth.

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 lie within an SPZ and therefore additional treatment stages may be required.

Table 13. 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. Permeable surfacing, and green roofing would offer sufficient treatment stages (storage/attenuation, filtration through sub-base and filtration through the unsaturated soil zone).

Table 14. 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

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 (subject to infiltration testing and groundwater monitoring).

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

SuDS type	Source control (interception) and infiltration SuDS.
SuDS features	Permeable surfacing, Green roof, Rainwater harvesting.
Discharge location	Infiltration to ground.
Discharge rate	1×10^{-5} m/s*.

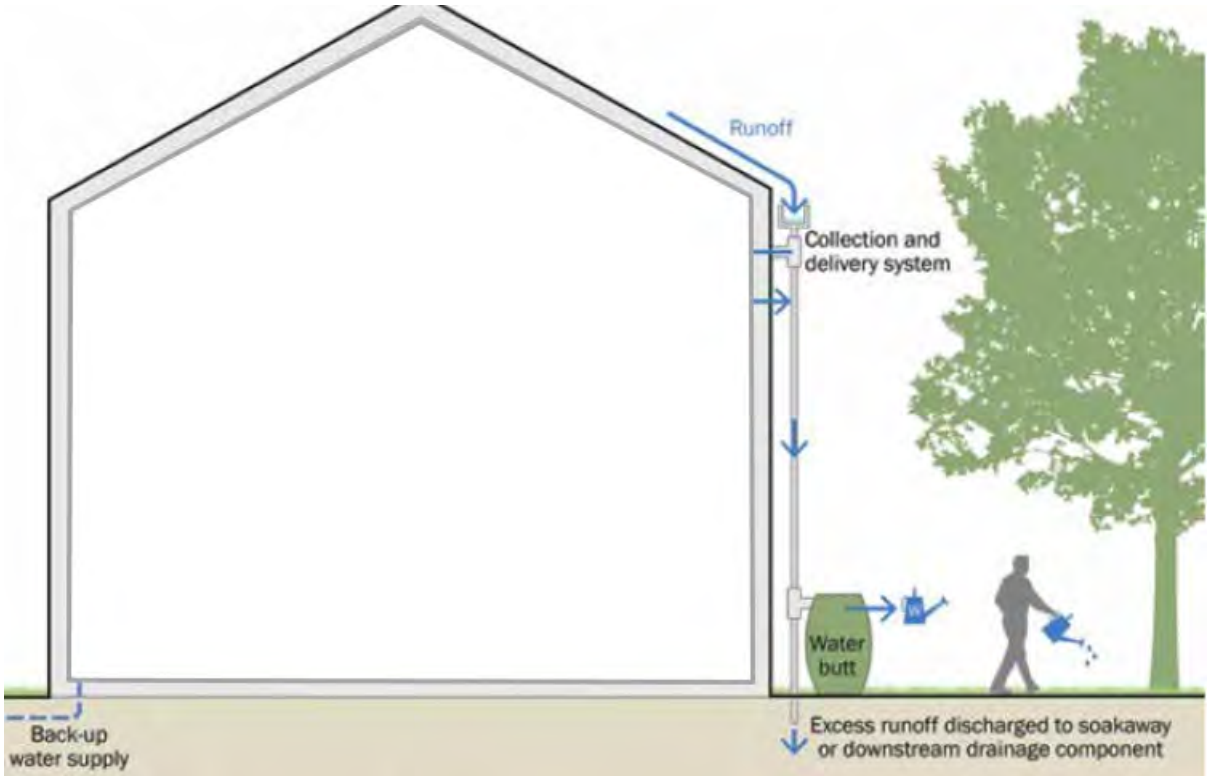
*The worst case infiltration rate for sand and gravel soils as set out in the CIRIA SuDS Manual (C753), 2015

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

Rainwater Harvesting	To comply with London Plan policy, a rainwater harvesting butt 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.
Permeable surfacing	A 640m^2 area of permeable surfacing (underlain with a Type 3 aggregate material) within the proposed driveway and access areas to a depth of 0.25 m, with a 30% porosity would result in c. 48.0 m^3 attenuation.
Green Roof	A green roof covering a total area of 408 m^2 (cover area of all roof spaces) with a green roof mix example volume of 81.6 m^3 (0.2m depth) and Geo-composite layer example volume of 6.1 m^3 (0.015m depth) would result in 15.3 m^3 of attenuation.
Total Attenuation Provided	63.3 m^3

Rainwater harvesting

To comply with London Plan policy, a rainwater harvesting butt is proposed. The run-off from the proposed development roof should be led into rainwater harvesting butts via rainwater downpipes and guttering to catch run-off from the extension roof. Overflow from the butts should be discharged into the storage system provided by the permeable surfacing.



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

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, the volume of run-off which could be attenuated by rainwater harvesting has not been considered within the report.

As there is an issue with the storage capability of Rainwater Harvesting tanks, this method should have a fixed attenuation volume and a controlled outlet to discharge into the proposed SuDS feature. An overflow system will be required for implementation on the Site due to exceedance events (where the pumps fail or there is a blockage within the system / or the number of residents and subsequent water usage is reduced).

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 devises 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 contaminates that collect on a residential roof.

Permeable surfacing

Permeable Surfacing is proposed for walkways, carparking and playground 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 surfacing 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.

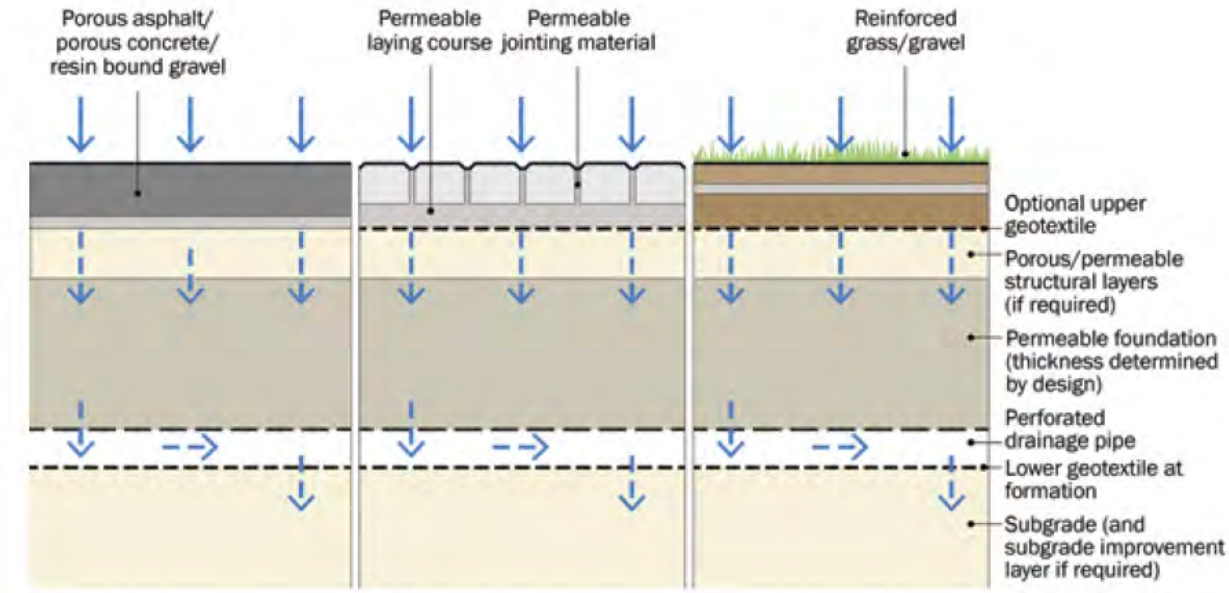


Figure 20.13 of the CIRIA SuDS Manual (C753) (2015)

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 surfacing. The majority of silt would be trapped within the top 30mm of the joining material between the surfacing blocks. Rainfall flowing into the permeable surfacing 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 surfacing for c.5 meters to divert roof run-off away from building foundations. Surfacing 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.

Plastic geo-cellular systems could also be used, which can increase the void space and therefore storage but do not allow filtration unless they are combined with aggregate material and/or permeable geotextiles which could increase their storage potential by up to 20%. Geo-cellular modules also have the added advantage of reducing the amount of aggregate sub base required, thus keeping costs lower. Void systems, such as permavoids, have a void ratio of 95% (i.e. for every 1 m^3 there is 0.95 m^3 of space available for water storage), which has been factored into the storage capacity calculations.

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. 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:

Should infiltration to ground be deemed not achievable at the Site by infiltration testing, an attenuation volume of 190.7 m³ should be stored within lined SuDS features to accommodate the calculated 10 hour Critical Storm Duration for surface water discharge runoff, and discharged to the River Pinn (total discharge rate restricted to 2 l/s).

SuDS features listed in the primary recommendations are still applicable to the secondary recommendation the Site, with the extent of permeable surfacing being increased to additionally cover the car parking and playground areas and the installing of a green roof upon the proposed building (see Tables 17 & 18).

Permeable paving can still be incorporated if discharge to ground is not achievable, however, paving will need to be lined within 5 m of the foundations of the proposed building.

When infiltration to ground is not achievable at the Site due to high groundwater levels, surface water runoff will be managed within SuDS features and discharged to the water feature identified.

Table 17. Proposed SuDS type, features, discharge location and rate restriction

SuDS type	Source control (interception) and attenuation SuDS.
SuDS features	Permeable surfacing, Green roof, Rainwater harvesting.
Discharge location	Surface water feature.
Discharge rate	2 l/s (combined discharge from all outflows).

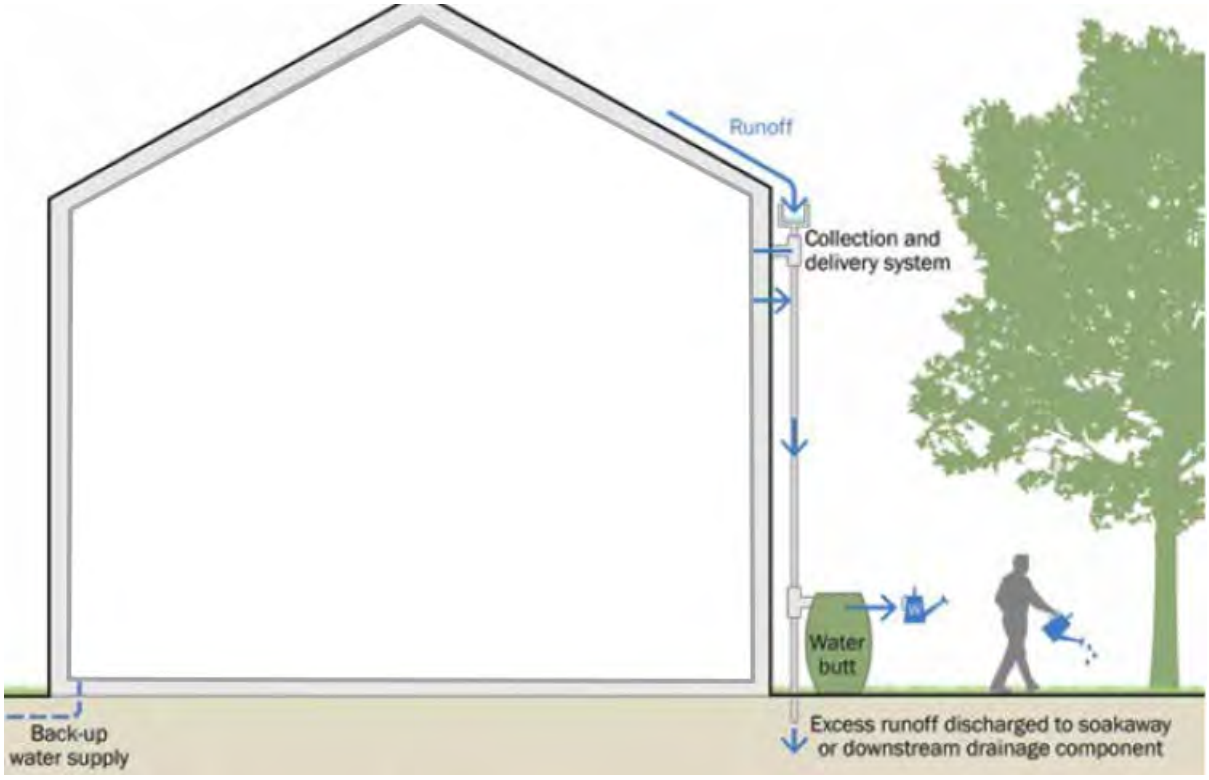
Table 18. Proposed SuDS sizing (dimensions) and attenuation volumes

Rainwater Harvesting	To comply with London Plan policy, a rainwater harvesting butt 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.
Green Roof	A 640 m2 area of permeable surfacing (underlain with a Type 3 aggregate material) within the proposed driveway and access areas to a depth of 0.45 m, with a 30% porosity would result in c. 86.4 m3 attenuation.
Permeable surfacing	A green roof covering a total area of 408 m2 (cover area of all roof spaces) with a green roof mix example volume of 81.6 m3 (0.2m

	depth) and Geo-composite layer example volume of 6.1 m3 (0.015m depth) would result in 15.3 m3 of attenuation.
Total Attenuation Provided	101.7 m^3
Total Attenuation Required	98.7 m^3
Freeboard Storage Provided	3.0 m^3

Rainwater harvesting

To comply with London Plan policy, a rainwater harvesting butt is proposed. The run-off from the proposed development roof should be led into rainwater harvesting butts via rainwater downpipes and guttering to catch run-off from the extension roof. Overflow from the butts should be discharged into the storage system provided by the permeable surfacing.



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

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, the volume of run-off which could be attenuated by rainwater harvesting has not been considered within the report.

As there is an issue with the storage capability of Rainwater Harvesting tanks, this method should have a fixed attenuation volume and a controlled outlet to discharge into the proposed SuDS feature. An overflow system will be required for implementation on the Site due to exceedance events (where the pumps fail or there is a blockage within the system / or the number of residents and subsequent water usage is reduced).

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 devises 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 contaminates that collect on a residential roof.

Green Roof

Green Roofs are proposed on the roofs of the proposed nursery which will aim to intercept and store runoff within a porous substrate (depth of 0.2 m) over a total area of 398 m^2 would attenuate up to 14.9 m^3 of surface water runoff (green roof calculations based upon calculations within best practice guidance document - London Borough of Tower Hamlets SuDS Guidance, Section 3.5).

Interception via green/brown roofs will enable the storage of run-off and infiltrate collected water gradually into the underlying substrate; this provides various levels of storage depending on the surface area of the feature and the thickness / type of the substrate being use. The different types of green roof include the following:

- Extensive roofs, have low substrate depths (and therefore low loadings on the building structure), simple planting and low maintenance requirements; these tend not to be accessible.
- Intensive roofs (or roof gardens) have deeper substrates (and therefore higher loadings on the building structure) that can support a wide variety of accessible planting but which tend to require more intensive maintenance.

Green roofs can also provide improvements to water quality as they intercept water at the source, and the layering of the substrate can incorporate filtration measures to remove pollutants from the system. Green Roofs are roofs which incorporate planting, often sedum or wildflower and meadow planting, grasses and mosses. In fact, some can even be planted with trees and shrubs. Brown roofs are similar to green roofs, the main difference is that whilst green roofs are often installed partly for the aesthetic value, brown roofs tend to be installed for environmental reasons, mainly, to encourage plants and wildlife.

In addition, although green roofs absorb most of the rainfall that they receive during frequent events, there will always be a need to discharge excess water to the building's drainage system and these areas should be positively drained. The hydraulic performance of green roofs once saturated tends to be fairly similar to standard roofs. Therefore, the hydraulic design of green roof drainage should follow the advice in BS EN 12056-3:2000. Useful information is also provided in BS 6229:2003. Detailed guidelines for the planning, execution and upkeep of green roof sites are contained within GRO (2014).

It is recommended that attenuation should be provided in the form of a high porosity substrate underlying the growing medium (approximately 50% depending on the supplier), which would provide sufficient storage (depending on loading requirements of a fully saturated substrate). It is likely that the high porosity medium would only have to be relatively thin in order to achieve the attenuation requirements. Surface water would then be throttled to a suitable rate at a downpipe entrance before discharging to the combined sewer system, via an existing connection.

Permeable surfacing

Permeable Surfacing is proposed for walkways, carparking and playground 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 surfacing 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.

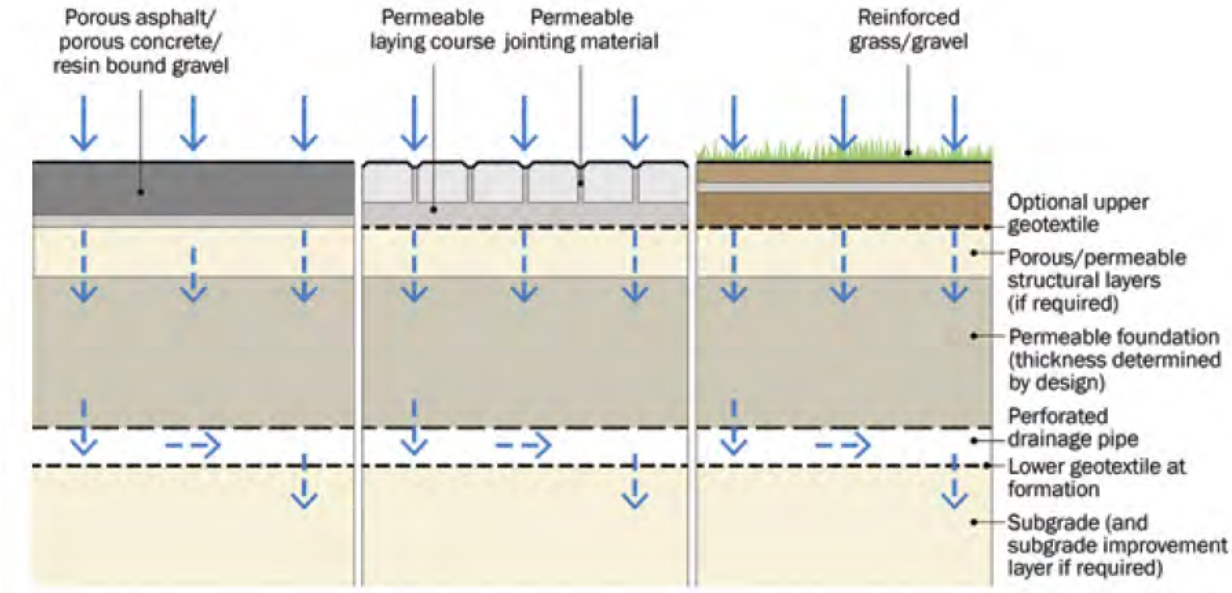


Figure 20.13 of the CIRIA SuDS Manual (C753) (2015)

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 surfacing. The majority of silt would be trapped within the top 30mm of the joining material between the surfacing blocks. Rainfall flowing into the permeable surfacing 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 surfacing for c.5 meters to divert roof run-off away from building foundations. Surfacing 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.

Plastic geo-cellular systems could also be used, which can increase the void space and therefore storage but do not allow filtration unless they are combined with aggregate material and/or permeable geotextiles which could increase their storage potential by up to 20%. Geo-cellular modules also have the added advantage of reducing the amount of aggregate sub base required, thus keeping costs lower. Void systems, such as permavoids, have a void ratio of 95% (i.e. for every 1 m^3 there is 0.95 m^3 of space available for water storage), which has been factored into the storage capacity calculations.

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 value is recommended for outflow pipes to reduce the risk of backflow from the channel/sewer during a large-scale rainfall event.

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. The SuDS system recommended for the Site provides enough storage that this method would only be utilized during a worst-case scenario.

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 19. SuDS operation and recommended maintenance requirements

Asset type	Maintenance schedule (and frequency)
Permeable surfacing	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). • 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).
Green Roof	Regular inspection:

Asset type	Maintenance schedule (and frequency)
	• Inspect all components (soil substrate, vegetation, drainage, irrigation systems, membranes and roof structure, waterproofing, structural stability (annually and after severe storms) • Inspect soil substrate for evidence of erosion channels (annually and after severe storms). • Inspect drain inlets for unrestricted run-off (annually and after severe storms). • Inspect underside of roof for leakage (annually and after severe storms). Regular maintenance: • Remove litter and debris from inlet drains (six monthly, annually or as required). • Cleaning of clippings (six monthly or as required). • Trimming of grasses and removal of nuisance weeds and invasive vegetation (six monthly or as required). • Replace dead plants (annually or as required). Monitoring: • Stabilise any erosion channels with extra soil substrate (as required). • Identify sources of erosion and control (as required). • Investigate and repair drain inlet if inlet has settled, cracked or moved (as required).
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)

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 20. 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 21. 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 B). 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: EnviroSmart Report		Provides a robust desk-based assessment of potential contaminated land issues, taking into account the regulatory perspective. Our EnviroSmart reports are designed to be the most cost effective solution for planning conditions. Each report is individually prepared by a highly experienced consultant conversant with Local Authority requirements. Ideal for pre-planning or for addressing planning conditions for small developments. Can also be used for land transactions. Please contact info@geosmartinfo.co.uk for further information.

14 References and glossary

British Geological Survey (BGS). (2023). Geology of Britain Viewer. Based on British Geological Survey materials © NERC 2023. Accessed from: http://mapapps.bgs.ac.uk/geologyofbritain/home.html on 12/01/2023.

Building Research Establishment (BRE) (2016). Digest 365, Soakaway design.

CEH (2023) Online FEH web service Depth/duration/frequency modelling using the FEH 1999 and new 2013 models. Accessed from: https://fehweb.ceh.ac.uk/ on 12/01/2023.

CIRIA (2015) The SuDS manual (C753).

Department for Environment, Food and Rural Affairs (2015). Non-statutory technical standards for SuDS (March 2015).

Environment Agency [EA] (2023). MagicMap. Accessed from: http://magic.defra.gov.uk/MagicMap.aspx on 12/01/2023.

GeoSmart (2023) GeoSmart GW5 Version 2.4.

HM Government (2010). The building regulations 2010 Part H drainage and waste disposal (2015 edition).

LASOO (2015) Practice Guidance, Local Authority SuDS Officer Organisation.

McCoy Consulting & Bray Associates (2018). London Borough of Hillingdon SuDS D&E Guide. Accessed from: http://online.flipbuilder.com/mccloy.consulting/ztpy/mobile/index.html#p=28 on 12/01/2023.

Ministry of Housing, Communities & Local Government. (2021). National Planning Policy Framework (NPPF).

Ministry of Housing, Communities & Local Government. (2022). National Planning Policy Guidance (NPPG).

NERC (2009) WINFAP-FEH CD-ROM version 3.0.

GeoSmart Information

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.

GeoSmart Information

Data Sources

Aerial Photography	Contains Ordnance Survey data © Crown copyright and database right 2023 BlueSky copyright and database rights 2023
Bedrock & Superficial Geology	Contains British Geological Survey materials © NERC 2023 Ordnance Survey data © Crown copyright and database right 2023
Flood Risk (RoFRS/Pluvial/Surface Water Features/SPZ)	Environment Agency copyright and database rights 2023 Ordnance Survey data © Crown copyright and database right 2023
Flood Risk (Groundwater) and SuDS infiltration suitability (SD50)	GeoSmart, BGS & OS GW5 (v2.4) Map (GeoSmart, 2023) Contains British Geological Survey materials © NERC 2023 Ordnance Survey data © Crown copyright and database right 2023
Sewer Location	Contains Ordnance Survey data © Crown copyright and database right 2023 Contains STL Regulated Drainage and Water Search data 2023
Topographic Data	OS LiDAR/EA Contains Ordnance Survey data © Crown copyright and database right 2023 Environment Agency copyright and database rights 2023

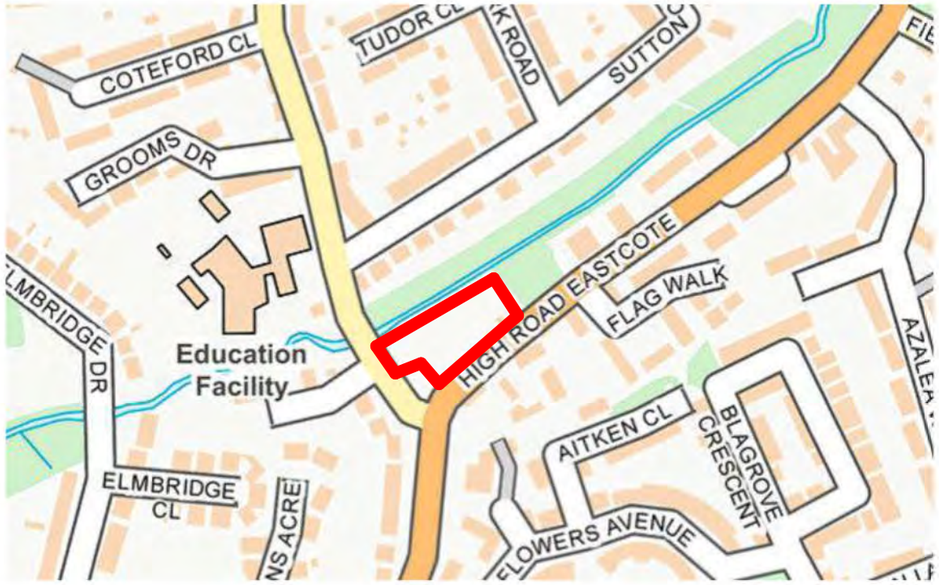
15 Appendices

GeoSmart Information

Appendix A

Site plans (layout and topography)

These drawings are for use in the planning process only. All measurements should be checked on site. These plans should not be used for structural calculations or any other engineering purpose.



not to scale

site area 3892sqm

1 **Site**
1 : 1250

0 m 50 m 100 m

North

Peter Pendleton & Associates
97 Lower Marsh
London SE1 7AB

www.pendleton-assoc.com

REVISION:

Land at Corner
of Fore Street and High
Road, HA5 2ET

Site location plan

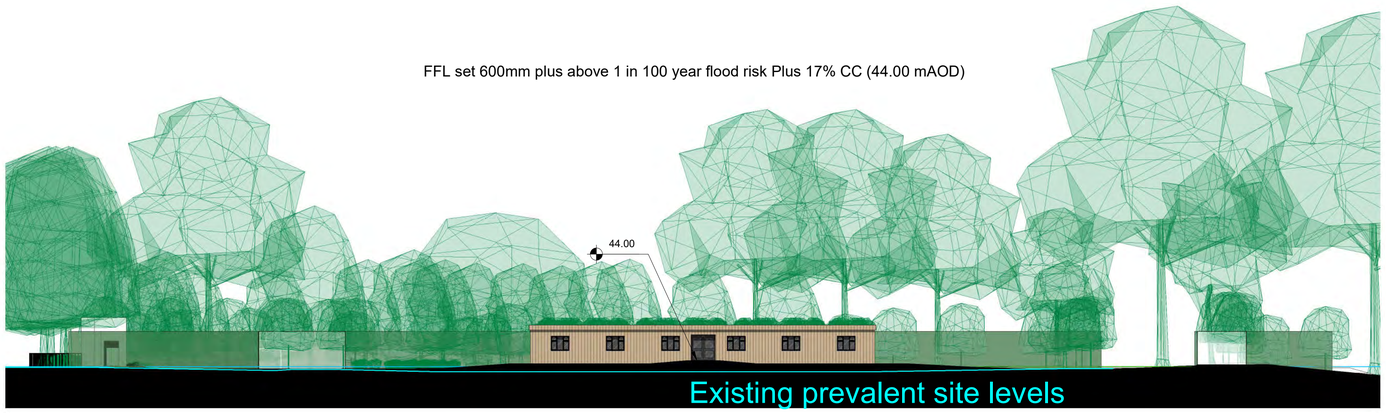
Project number	EAS
Date	10/01/2023
Drawn by	JH
Checked by	NKW

EX-EAS-01

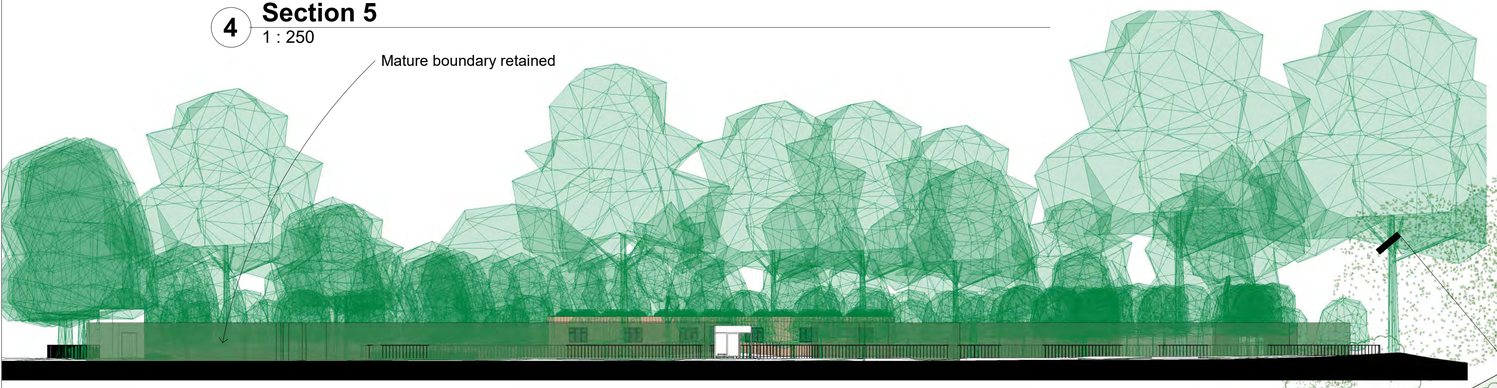
Scale@A3 1 : 1250

10/01/2023 15:26:36

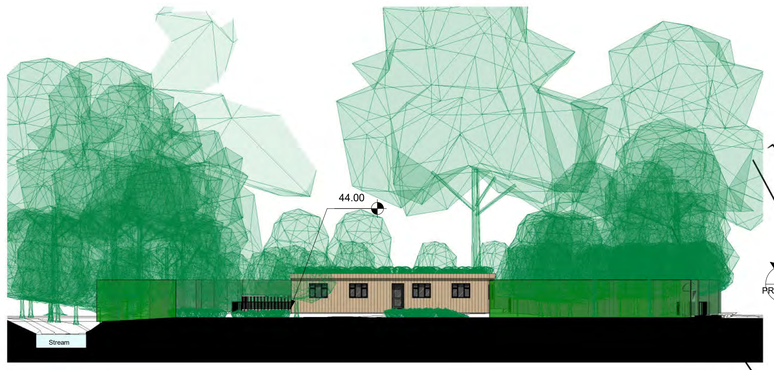
FFL set 600mm plus above 1 in 100 year flood risk Plus 17% CC (44.00 mAOD)



4 Section 5
1 : 250

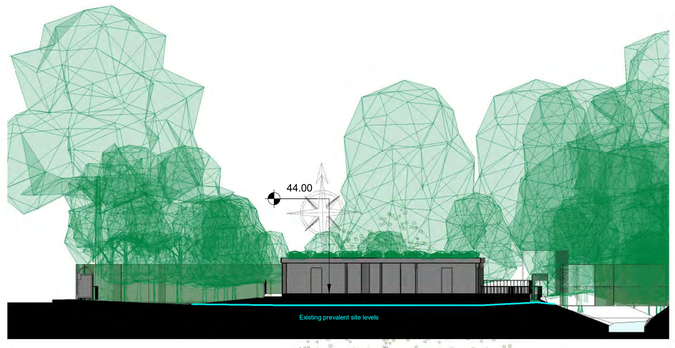


3 High Road street elevation
1 : 250

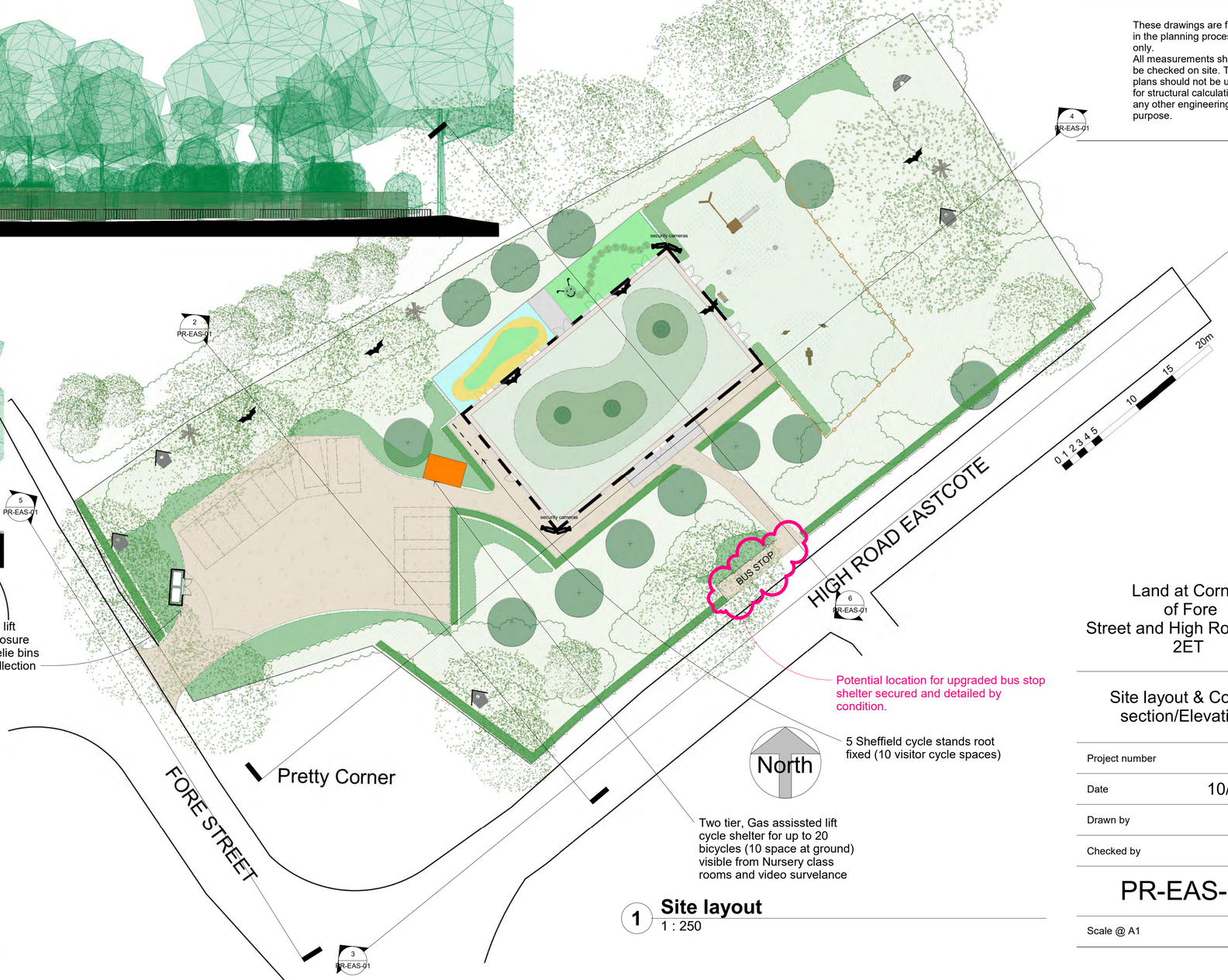


2 Section 6
1 : 250

5 Section 7
1 : 250



6 Section 8
1 : 250



1 Site layout
1 : 250

PETER PENDLETON & ASSOCIATES LTD

www.pendleton-assoc.com

Peter Pendleton &
Associates
0207 202 9001
0207 202 9002
info@pendleton-assoc.com

Land at Corner
of Fore
Street and High Road, HA5
2ET

Site layout & Context section/Elevations

Project number	EAS
Date	10/01/2023
Drawn by	JH
Checked by	NKW

PR-EAS-01

Scale @ A1	1 : 250

11/01/2023 10:49:03

1 CHILDREN'S PLAY AREA

350m2+ of play space with quality timber equipment including a combination tower with slide and swing together with a pair of wobble dishes and some snail creatures. There's also a musical arbour and magnifying post to encouage examination of woodland finds. Play surfacing will be a rubber matting through which the grass can grow. There is also a toddler's play area with colourful, stimulating designs in Wetpour






2 SURFACING

All works within the Tree Root Protection Areas receive Cellweb TRP, which is a cellular confinement system allowing a no-dig solution to prevent compaction around tree roots. The carpark and paths are surfaced with a permeable buff tarmac


3 WOODLAND WALK

Due to the verdant nature of the locale, adjacent to the river, trees have been retained wherever possible, thus creating a Woodland Walk accessed via the Children's Play Area with a meandering woodchip path that leads to a Storytelling Circle with mushroom stools. The flora is enhanced with shade tolerant perennials, wildflower seed and drifts of springtime bulbs, such as aconite, snowdrops and wood anemone.






KEY

- Existing trees retained & protected in accordance with BS5037:2012 & EnviroArb-Solutions Arboricultural Impact Assessment ref. EAS-062v2 dated 2/12/22
- Existing vegetation retained where practicable in accordance with LUC Ecological Assessment ref. 14216 dated 11/22
- Porous asphalt - colour buff
- Cellweb TRP (Tree Root Protection) system
- Wetpour rubber surfacing - island design & colour TBC
- Wetpour rubber surfacing - caterpillar alphabet design & colour TBC
- Tarmac
- Bark mulch path
- Galvanised metal, anti-trap bow-top railings in green, RAL 6005, 1200mm he
- Timber palisade fencing in natural, 1000mm height
- Lawn - newly laid turf to BS3969:1998
- Rubber matting for Critical Fall Height
- Wildflower meadow - Emorsgate EW1 Woodland Seed Mix
- Bulbs scattered, left to naturalise
- Intensive green roof
- Hedgerows
- Shrubs & herbaceous planting
- Mushroom stools - ex.www.caledoniaplay.com
- Rustic bench - ex.www.caledoniaplay.com
- Magpost - ex.www.caledoniaplay.com
- Bird boxes - various types as directed by ecologist
- Bat boxes - various types as directed by ecologist
- Log pile from site won timber
- Hedgehog house
- Musical arbour with instruments ex.www.caledoniaplay.com
- Wobble dish ex. www.timberplay.com
- Snail ex. www.timberplay.com
- Queen snail ex. www.timberplay.com
- Timber hut, swing & slide - Hut Combination 371 ex. www.timberplay.com

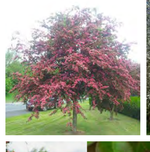
PLANTING SCHEDULE

CLASS	LATIN NAME	COMMON NAME	LOCATION
Trees	Crataegus laevigata 'Paul's Scarlet'	Crimson hawthorn	Building frontage
	Malus tschonoski	Crab apple	Building frontage
	Prunus avium	Wild cherry	Carpark & Children's Play Area perimeter
	Quercus robur	Oak	Rear of building & High Road Eastcote
	Sorbus aucuparia	Rowan	Building frontage
Mixed Native Hedgerow	Acer campestre	Field maple	To perimeter
	Cornus sanguinea	Dogwood	
	Corylus avellana	Hazel	
	Crataegus monogyna	Hawthorn	
	Ilex aquafolium	Holly	
	Ligustrum vulgare	Privet	
	Rosa canina	Dog rose	
	Viburnum opulus	Guelder rose	
Hedging	Carpinus betulus	Hornbeam	To building
Woodland infill	Ajuga reptans 'Caitlins Giant'	Bugle	In drifts throughout the woodland
	Corylus avellana	Hazel	
	Deschampsia cespitosa	Tufted hair grass	
	Dryopteris filix-mas	Male fern	
	Helleborus foetidus	Stinking hellebore	
	Luzula nivea	Snowy woodrush	
	Stachys officinalis	Betony	
Bulbs	Anemone blanda	Wood anemone	Rear of building and woodland
	Eranthis hyemalis	Winter aconite	
	Erythronium 'Pagoda'	Dog's tooth violet	
	Fritillaria meleagris	Snake's head fritillary	
	Galanthus nivalis	Snowdrop	
	Narcissus poeticus	Poet's daffodil	Front of building
	Narcissus pseudonarcissus	Wild daffodil	
Shrubs	Buddleia davidii	Butterfly bush	To the car park
	Cistus purpurea	Rock rose	
	Hypericum spp.	St. Johns Wort	
	Lavandula angustifolia 'Munstead'	Lavender	
	Pachysandra terminalis	Japanese spurge	
	Philadelphus 'Belle etoile'	Mock orange	
	Salvia spp.	Sage	
	Sarcococca confusa	Sweet box	
	Viburnum tinus	Laurustinus	
Intensive Green Roof	Amelanchier lamarckii	Snowy mespilus	Zone 1 - central, 300mm depth substrate
	Anemone 'Honorine Jobert'	Japanese anemone	
	Cornus kousa	Chinese dogwood	
	Euonymus 'Red Cascade'	Spindle	
	Mahonia 'Winter Sun'	Oregon grape	
	Miscanthus 'Undine'	Elephant grass	
	Allium 'Globemaster'	Ornamental onion	Zone 2 - mid, 200mm depth substrate
	Brunnera macrophylla	Siberian bugloss	
	Euphorbia spp.	Wood spurge	
	Gaura 'Whirling Butterflies'	Whirling Butterflies	
	Helictotrichon sempervirens	Blue oat grass	
	Kniphofia 'Fawny King'	Red Hot Poker	
	Melica ciliata	Hairy Melic	
	Nepeta 'Walkers Low'	Catmint	
	Sesleleria nitida	Autumn moor grass	
	Verbena bonariensis	Purple top	
	Armeria maritima	Sea thrift	Zone 3 - outer, 100mm depth substrate
	Eschscholzia californica	Californian poppy	
	Lychnis coronaria 'Alba'	White rosa campion	
	Pulsatilla vulgaris	Pasqueflower	
	Primula veris	Primrose	
	Scabiosa columbaria	Small scabious	
	Thymus serphyllum	Creeping thyme	
	Tulipa turkestanica	Turkestan tulip	

NOTE:
Do not scale from this drawing. Drawings represent design intent only. Green roof details to be confirmed by structural engineer and specialist subcontractor. Structural stability of all items to be confirmed by contractor. All materials, components and workmanship shall comply with the relevant British Standards Code of Practice & manufacturers written instructions.

4 GREEN INFRASTRUCTURE

The Biodiversity Net Gain is significant via the introduction of various nectar rich trees, shrubs and perennials; including oak, rowan, wild cherry, hornbeam, crab apple and crimson hawthorn. Mixed native hedging borders the frontage of High Road Eastcote, whilst hornbeam frames the building.





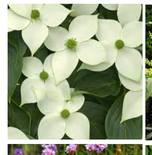
5 ECOLOGICAL ENHANCEMENTS

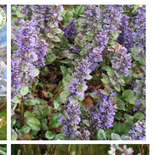
Working in conjunction with Land Use Consultants Ltd. (LUC) , ecological enhancements have been included wherever practicable, including; bat boxes, bird boxes for various species, a hedgehog house and site won log piles. Furthermore the majority of planting is nectar rich , thus creating foraging and nesting opportunities for local wildlife.




6 GREEN ROOF

Further Biodiversity Net Gain is achieved via the introduction of an intensive green roof. This is zoned to different depth substrates to maximise planting opportunities. Larger shrubs such as Amelanchier, Cornus kousa and Mahonia sit centrally, within islands of perennials including; spurges, bugle, alliums, grasses and whirling butterflies. Whilst the outer perimeter is home to the creeping low varieties including, thyme, thrift, scabious and primrose.





Christina Odell
Chartered Landscape Arcitect
7, St. Margaret's Terrace, St. Leonard's-on-Sea, East Sussex TN37 6EN
07818 566522 - christinajodell@gmail.com

site
Land at the corner of Fore Street & High Road Eastcote, Pinner HA5 2ET

scale
1:200@ A1

date
21.12.2022

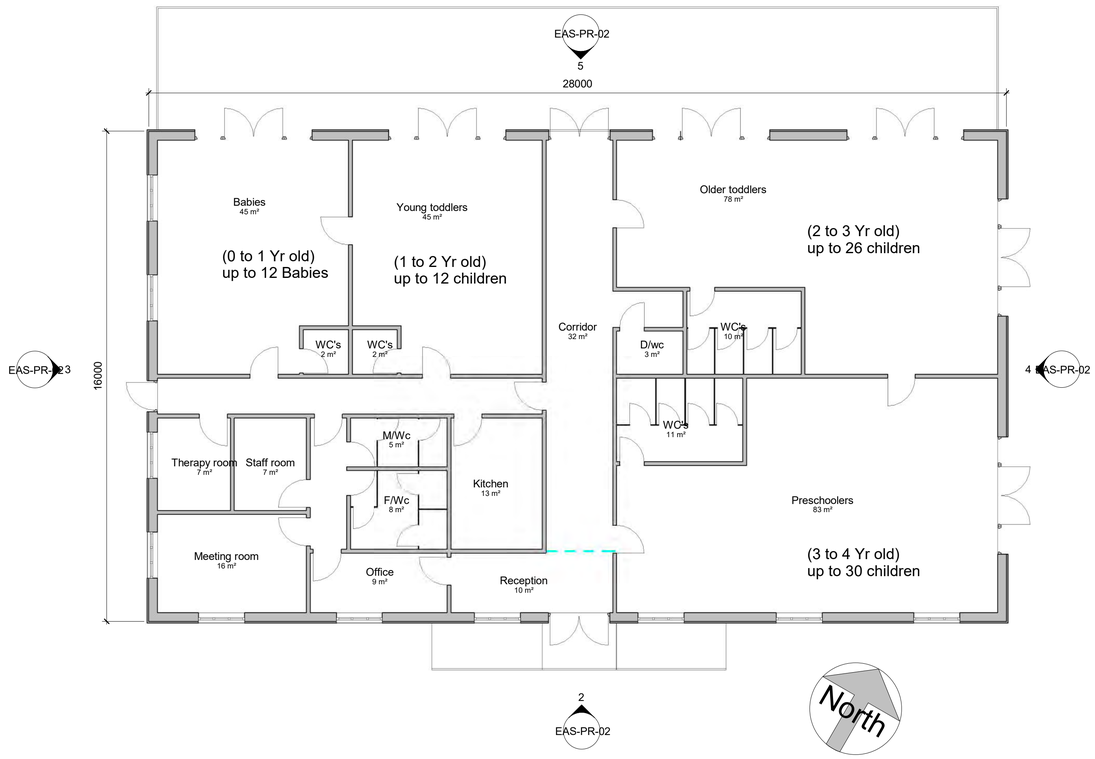
title
Landscape Masterplan

drawn by
CJO

checked
CJO

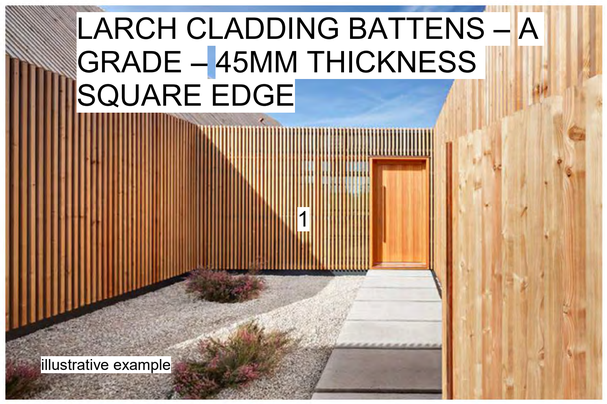
drawing number
22-1201

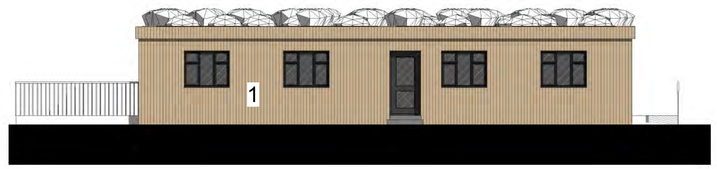
revision



1 ENTRANCE
1 : 100

2 South
1 : 100



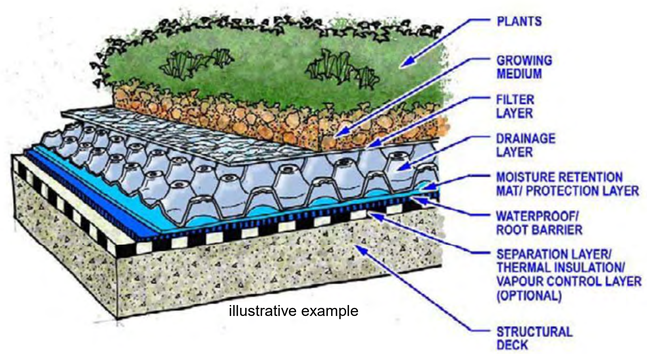


3 West
1 : 100

4 East
1 : 100

5 North
1 : 100

INTENSIVE GREEN ROOF



PETER PENDLETON & ASSOCIATES LTD

www.pendleton-assoc.com

Peter Pendleton &
Associates
0207 202 9001
0207 202 9002
info@pendleton-assoc.com

Land at the corner of
Fore
Street & High Road
Eastcote,
Pinner HA5 2ET

Proposed elevation and plan

Project number	EAS
Date	10/01/2023
Drawn by	JH
Checked by	NKW

EAS-PR-02

Scale @ A1	1 : 100

10/01/2023 15:33:45

GeoSmart Information

Appendix B

Rainfall runoff calculations

Greenfield Site Run-Off Calculations usng the IoH124 method

Greenfield peak run-off rate (QBAR):

Parameters	Input	Units	Comments
Area	50	ha	mimimum 50ha
SAAR	655	mm	FEH CD ROM (NERC, 2009)
SPR	0.47	N/A	Soil run-off coefficient
Region	6	N/A	Region on Hydrological area map

QBAR

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

Where:

$Q_{BAR(rural)}$	is the mean annual flood (a return period of 2.3 years) in l/s
AREA	is the area of the catchment in km² (minimum of 0.5km²)
SAAR	is the standard average rainfall for the period 1941 to 1970 in mm
SPR	is the soil run-off coefficient

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

$Q_{BAR(rural)}$	=	223.34	l/s for 50ha site
Divided by 50 to scale down	=	4.47	l/s/ha
Actual Area of the entire Site	=	0.39	ha

Return Periods (Growth curves obtained from DEFRA report)

Return Period		Growth Factor	l/s/ha	Peak site run-off rate (l/s)
1	**$Q_{BAR(rural)}$ x**	**0.85**	**3.80**	**1.481**
2	$Q_{BAR(rural)}$ x	0.88	3.93	1.53
5	$Q_{BAR(rural)}$ x	1.28	5.72	2.23
10	$Q_{BAR(rural)}$ x	1.62	7.24	2.82
25	$Q_{BAR(rural)}$ x	2.14	9.56	3.73
30	**$Q_{BAR(rural)}$ x**	**2.24**	**10.01**	**3.902**
50	$Q_{BAR(rural)}$ x	2.62	11.70	4.56
100	**$Q_{BAR(rural)}$ x**	**3.19**	**14.25**	**5.56**
200	$Q_{BAR(rural)}$ x	3.86	17.24	6.72

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)	27.94	0.39	0.47	51.2
1	26.06	0.39	0.47	47.8
10	45.74	0.39	0.47	83.8
30	58.18	0.39	0.47	106.6
100	78.12	0.39	0.47	143.2

Developed site run-off calculation sheet

1 in 1 year

Proposed impermeable area	0.128	ha
CC Factor	40%	
Total volume for surfaces during 6 hour event	33.28	m³
Total volume for 6 hour event inc CC	46.59	m³
Total volume for 6 hour event exc CC	33.28	m³

Duration	Rainfall 1 yr event	Run-off rate 1 yr event	Run-off rate 1 yr +cc event
hours	mm	m³	m³
0.25	7.73	9.87	13.82
0.5	9.83	12.55	17.57
0.75	11.13	14.21	19.90
1	12.13	15.49	21.69
2	17.66	22.55	31.57
3	20.92	26.71	37.40
4	23.16	29.58	41.41
5	24.79	31.66	44.32
6	26.06	33.28	46.59
8	27.92	35.65	49.92
10	29.29	37.40	52.36
12	30.39	38.81	54.33
16	32.08	40.97	57.35
20	33.45	42.72	59.80
24	34.66	44.26	61.97
28	35.76	45.67	63.93
32	36.78	46.97	65.76
36	37.74	48.19	67.47
40	38.66	49.37	69.12
44	39.55	50.51	70.71
48	40.41	51.60	72.24

1 in 30 year

Proposed impermeable area	0.128	ha
CC Factor	40%	
Total volume for surfaces during 6 hour event	74.30	m³
Total volume for 6 hour event inc CC	104.01	m³
Total volume for 6 hour event exc CC	74.30	m³

Duration	Rainfall 30 yr event	Run-off volume 30 yr event	Run-off volume 30 yr +cc event	Outflow at 2 l/s	inflow from rain	Diff (storage required)
hours	mm	m³	m³			
0.25	22.21	28.36	39.71	1.80	28.36	26.56
0.5	28.63	36.56	51.18	3.60	36.56	32.96
0.75	32.50	41.50	58.10	5.40	41.50	36.10
1	35.28	45.05	63.07	7.20	45.05	37.85
2	44.54	56.88	79.63	14.40	56.88	42.48
3	49.95	63.79	89.30	21.60	63.79	42.19
4	53.59	68.43	95.81	28.80	68.43	39.63
5	56.19	71.75	100.46	36.00	71.75	35.75
6	58.18	74.30	104.01	43.20	74.30	31.10
8	61.02	77.92	109.09	57.60	77.92	20.32
10	63.06	80.53	112.74	72.00	80.53	8.53
12	64.64	82.55	115.56	86.40	82.55	-3.85
16	66.99	85.55	119.76	115.20	85.55	-29.65
20	68.85	87.92	123.09	144.00	87.92	-56.08
24	70.47	89.99	125.99	172.80	89.99	-82.81
28	71.89	91.80	128.52	201.60	91.80	-109.80
32	73.19	93.46	130.85	230.40	93.46	-136.94
36	74.41	95.02	133.03	259.20	95.02	-164.18
40	75.56	96.49	135.09	288.00	96.49	-191.51
44	76.66	97.89	137.05	316.80	97.89	-218.91
48	77.71	99.24	138.93	345.60	99.24	-246.36

1 in 100 year

Proposed impermeable area	0.128	ha
CC Factor	40%	
Total volume for surfaces during 6 hour event	99.76	m³
Total volume for 6 hour event inc CC	139.66	m³
Total volume for 6 hour event exc CC	99.76	m³

Duration	Rainfall 100 yr event	Run-off volume 100 yr event	Run-off volume 100 yr +cc event	Outflow at 2 l/s	inflow from rain	100yr Scenario Diff (storage required)	CC Scenario Diff (storage required)
hours	mm	m³	m³				
0.25	28.26	36.09	50.52	1.80	50.52	34.29	48.72
0.5	36.60	46.74	65.43	3.60	65.43	43.14	61.83
0.75	41.70	53.25	74.55	5.40	74.55	47.85	69.15
1	45.30	57.85	80.99	7.20	80.99	50.65	73.79
2	58.25	74.39	104.14	14.40	104.14	59.99	89.74
3	65.99	84.27	117.98	21.60	117.98	62.67	96.38
4	71.30	91.05	127.47	28.80	127.47	62.25	98.67
5	75.16	95.98	134.37	36.00	134.37	59.98	98.37
6	78.12	99.76	139.66	43.20	139.66	56.56	96.46
8	82.38	105.20	147.28	57.60	147.28	47.60	89.68
10	85.31	108.94	152.52	72.00	152.52	36.94	80.52
12	87.47	111.70	156.38	86.40	156.38	25.30	69.98
16	90.42	115.47	161.65	115.20	161.65	0.27	46.45
20	92.47	118.08	165.32	144.00	165.32	-25.92	21.32
24	94.06	120.11	168.16	172.80	168.16	-52.69	-4.64
28	95.33	121.74	170.43	201.60	170.43	-79.86	-31.17
32	96.45	123.17	172.43	230.40	172.43	-107.23	-57.97
36	97.48	124.48	174.27	259.20	174.27	-134.72	-84.93
40	98.42	125.68	175.96	288.00	175.96	-162.32	-112.04
44	99.32	126.83	177.56	316.80	177.56	-189.97	-139.24
48	100.17	127.92	179.08	345.60	179.08	-217.68	-166.52

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)	Cover Level (m)	Depth (m)
1	0.064	10.000	0.550

Simulation Settings

Rainfall Methodology	FEH-13	Analysis Speed	Normal	Additional Storage (m³/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 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	9.450	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.03600	Time to half empty (mins)	9173	Depth (m)	0.250
Safety Factor	2.0	Width (m)	25.000	Inf Depth (m)	
Porosity	0.30	Length (m)	25.000		

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
1440 minute winter	1	1440	9.577	0.127	0.5	16.3593	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
1440 minute winter	1	Infiltration	0.0

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
1440 minute winter	1	1410	9.654	0.204	1.0	30.9483	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
1440 minute winter	1	Infiltration	0.1

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
1440 minute winter	1	1410	9.991	0.541	1.3	40.3574	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
1440 minute winter	1	Infiltration	0.1

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 (m³)	Flood (m³)	Status
1440 minute winter	1	870	10.000	0.550	1.8	40.3779	15.5258	FLOOD

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
1440 minute winter	1	Infiltration	0.1

GeoSmart Information

Appendix C

Regulated Drainage and Water Search

Asset location search

Property Searches

GeoSmart Information Ltd
1st Floor,Old Bank Buildings,S Old Bank Buildings

SHREWSBURY
SY1 1HU

Search address supplied Corner of Fore Street and High Road
Eastcote
Pinner
HA5 2ET

Your reference 77698

Our reference ALS/ALS Standard/2022_4720831

Search date 20 September 2022

Knowledge of features below the surface is essential for every development

The benefits of this knowledge not only include ensuring due diligence and avoiding risk, but also being able to ascertain the feasibility of any development.

Did you know that Thames Water Property Searches can also provide a variety of utility searches including a more comprehensive view of utility providers' assets (across up to 35-45 different providers), as well as more focused searches relating to specific major utility companies such as National Grid (gas and electric).

Contact us to find out more.

Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13

searches@thameswater.co.uk
www.thameswater-propertysearches.co.uk

0800 009 4540

Asset location search

Property Searches

Search address supplied: Corner of Fore Street and High Road, Eastcote, Pinner, HA5 2ET

Dear Sir / Madam

An Asset Location Search is recommended when undertaking a site development. It is essential to obtain information on the size and location of clean water and sewerage assets to safeguard against expensive damage and allow cost-effective service design.

The following records were searched in compiling this report: - the map of public sewers & the map of waterworks. Thames Water Utilities Ltd (TWUL) holds all of these.

This searchprovides maps showing the position, size of Thames Water assets close to the proposed development and also manhole cover and invert levels, where available.

Please note that none of the charges made for this report relate to the provision of Ordnance Survey mapping information. The replies contained in this letter are given following inspection of the public service records available to this company. No responsibility can be accepted for any error or omission in the replies.

You should be aware that the information contained on these plans is current only on the day that the plans are issued. The plans should only be used for the duration of the work that is being carried out at the present time. Under no circumstances should this data be copied or transmitted to parties other than those for whom the current work is being carried out.

Thames Water do update these service plans on a regular basis and failure to observe the above conditions could lead to damage arising to new or diverted services at a later date.

Contact Us

If you have any further queries regarding this enquiry please feel free to contact a member of the team on 0800 009 4540, or use the address below:

Thames Water Utilities Ltd
Property Searches
PO Box 3189
Slough
SL1 4WW

Email: searches@thameswater.co.uk
Web: www.thameswater-propertysearches.co.uk

Asset location search

Property Searches

Waste Water Services

Please provide a copy extract from the public sewer map.

Enclosed is a map showing the approximate lines of our sewers. Our plans do not show sewer connections from individual properties or any sewers not owned by Thames Water unless specifically annotated otherwise. Records such as "private" pipework are in some cases available from the Building Control Department of the relevant Local Authority.

Where the Local Authority does not hold such plans it might be advisable to consult the property deeds for the site or contact neighbouring landowners.

This report relates only to sewerage apparatus of Thames Water Utilities Ltd, it does not disclose details of cables and or communications equipment that may be running through or around such apparatus.

The sewer level information contained in this response represents all of the level data available in our existing records. Should you require any further Information, please refer to the relevant section within the 'Further Contacts' page found later in this document.

For your guidance:

- The Company is not generally responsible for rivers, watercourses, ponds, culverts or highway drains. If any of these are shown on the copy extract they are shown for information only.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an ‘as constructed’ record. It is recommended these details be checked with the developer.

Clean Water Services

Please provide a copy extract from the public water main map.

With regard to the fresh water supply, this site falls within the boundary of another water company. For more information, please redirect your enquiry to the following address:

Affinity Water Ltd
Tamblin Way
Hatfield

Asset location search

Thames Water Property Searches

AL10 9EZ
Tel: 0345 3572401

For your guidance:

- Assets other than vested water mains may be shown on the plan, for information only.
- If an extract of the public water main record is enclosed, this will show known public water mains in the vicinity of the property. It should be possible to estimate the likely length and route of any private water supply pipe connecting the property to the public water network.

Payment for this Search

A charge will be added to your suppliers account.

Further contacts:

Waste Water queries

Should you require verification of the invert levels of public sewers, by site measurement, you will need to approach the relevant Thames Water Area Network Office for permission to lift the appropriate covers. This permission will usually involve you completing a TWOSA form. For further information please contact our Customer Centre on Tel: 0845 920 0800. Alternatively, a survey can be arranged, for a fee, through our Customer Centre on the above number.

If you have any questions regarding sewer connections, budget estimates, diversions, building over issues or any other questions regarding operational issues please direct them to our service desk. Which can be contacted by writing to:

Developer Services (Waste Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

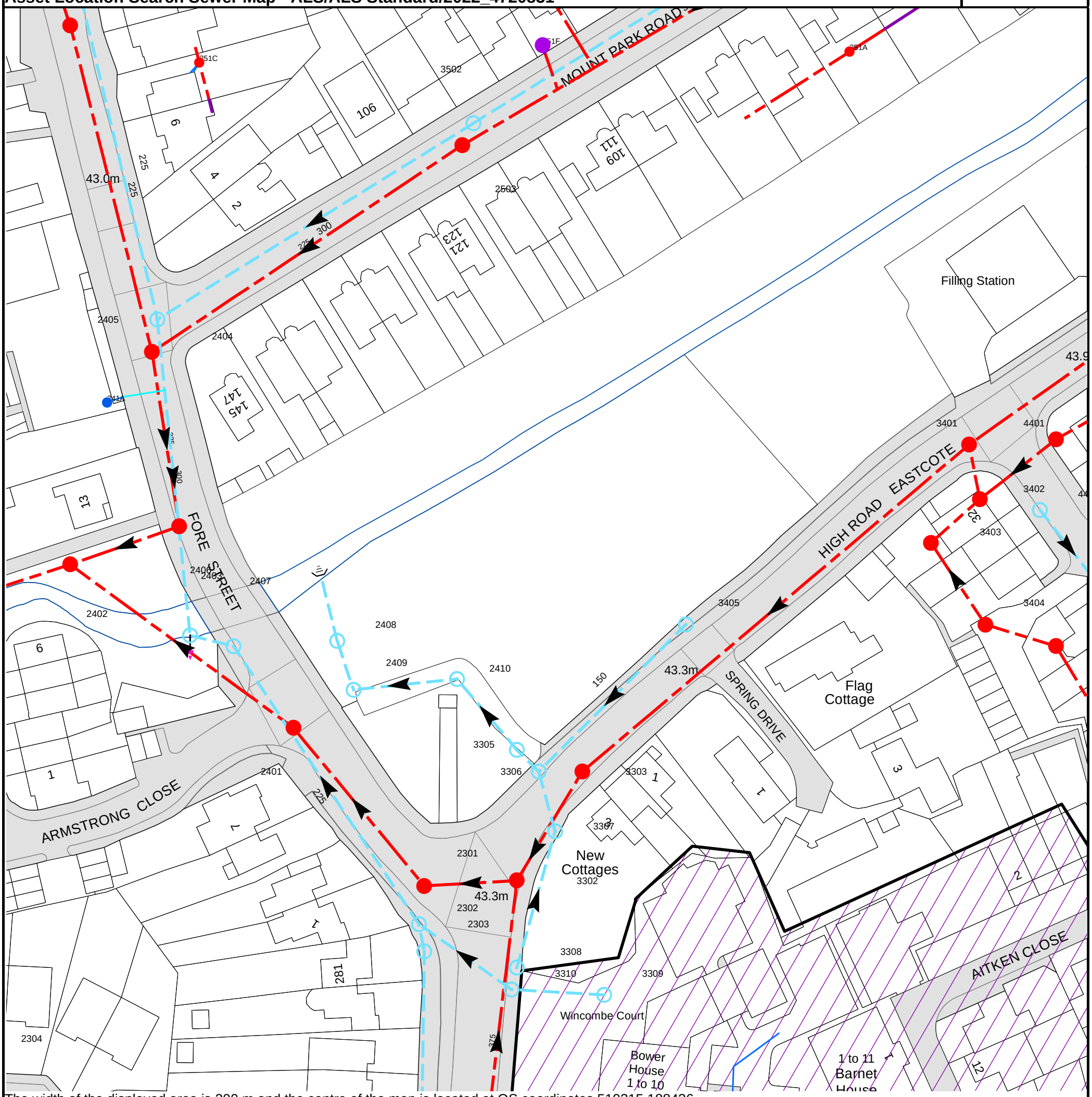
Clean Water queries

Should you require any advice concerning clean water operational issues or clean water connections, please contact:

Developer Services (Clean Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

Asset Location Search Sewer Map - ALS/ALS Standard/2022_4720831



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 510315,188436

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
251C	n/a	n/a
351F	n/a	n/a
3403	44.04	42.8
3401	43.73	39.08
3402	n/a	n/a
3404	44.38	43.53
4405	44.14	43.53
4402	n/a	n/a
4401	n/a	n/a
351A	n/a	n/a
3309	44.76	43.04
3310	43.49	42.88
3308	n/a	n/a
2303	43.53	42.5
2302	43.5	42.56
2301	41.26	38.69
3302	43.29	38.74
3307	43.27	42.58
3306	43.54	42.46
3303	43.12	38.74
3305	43.27	41.84
2401	43.2	38.62
2409	43.62	41.92
2410	43.55	42
2407	43.48	41.95
2408	n/a	n/a
2406	43.55	42.06
3405	43.54	42.34
2402	43.25	38.45
2403	43.29	40
241A	n/a	n/a
2404	42.92	40.08
2405	42.95	41.63
2503	43.09	40.64
3502	42.25	41.06
2501	43.19	40.45

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Asset Location Search - Sewer Key

Public Sewer Types (Operated and maintained by Thames Water)

Foul Sewer: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water Sewer: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined Sewer: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

- Storm Sewer
- Sludge Sewer
- Foul Trunk Sewer
- Surface Trunk Sewer
- Combined Trunk Sewer
- Foul Rising Main
- Surface Water Rising Main
- Combined Rising Main
- Vacuum
- Thames Water Proposed
- Vent Pipe
- Gallery

Other Sewer Types (Not operated and maintained by Thames Water)

- Sewer
- Culverted Watercourse
- Proposed
- Decommissioned Sewer
- Content of this drainage network is currently unknown
- Ownership of this drainage network is currently unknown

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

- Air Valve
- Meter
- Dam Chase
- Vent
- Fitting

Operational Controls

A feature in a sewer that changes or divects the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

- Ancillary
- Drop Pipe
- Control Valve
- Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol. Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

- Inlet
- Outfall
- Undefined End

Other Symbols

Symbols used on maps which do not fall under other general categories.

- Change of Characteristic Indicator
- Public / Private Pumping Station
- Invert Level
- Summit

Areas

Lines denoting areas of underground surveys, etc.

- Agreement
- Chamber
- Operational Site

Ducts or Crossings

- Casement — Ducts may contain high voltage cables. Please check with Thames Water.
- Conduit Bridge
- Subway
- Tunnel

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plan are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate the direction of flow.
4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
5) 'na' or '0' on a manhole indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in millimeters.
Text next to a manhole indicates the manhole reference number and should not be taken as a measurement.
If you are unsure about any text or symbology, please contact Property Searches on 0800 009 4540.

Terms and Conditions

All sales are made in accordance with Thames Water Utilities Limited (TWUL) standard terms and conditions unless previously agreed in writing.

1. All goods remain in the property of Thames Water Utilities Ltd until full payment is received.
2. Provision of service will be in accordance with all legal requirements and published TWUL policies.
3. All invoices are strictly due for payment 14 days from due date of the invoice. Any other terms must be accepted/agreed in writing prior to provision of goods or service, or will be held to be invalid.
4. Thames Water does not accept post-dated cheques-any cheques received will be processed for payment on date of receipt.
5. In case of dispute TWUL`s terms and conditions shall apply.
6. Penalty interest may be invoked by TWUL in the event of unjustifiable payment delay. Interest charges will be in line with UK Statute Law 'The Late Payment of Commercial Debts (Interest) Act 1998'.
7. Interest will be charged in line with current Court Interest Charges, if legal action is taken.
8. A charge may be made at the discretion of the company for increased administration costs.

A copy of Thames Water's standard terms and conditions are available from the Commercial Billing Team (cashoperations@thameswater.co.uk).

We publish several Codes of Practice including a guaranteed standards scheme. You can obtain copies of these leaflets by calling us on 0800 316 9800

If you are unhappy with our service you can speak to your original goods or customer service provider. If you are not satisfied with the response, your complaint will be reviewed by the Customer Services Director. You can write to her at: Thames Water Utilities Ltd. PO Box 492, Swindon, SN38 8TU.

If the Goods or Services covered by this invoice falls under the regulation of the 1991 Water Industry Act, and you remain dissatisfied you can refer your complaint to Consumer Council for Water on 0121 345 1000 or write to them at Consumer Council for Water, 1st Floor, Victoria Square House, Victoria Square, Birmingham, B2 4AJ.

Ways to pay your bill

Credit Card	**BACS Payment**	**Telephone Banking**	**Cheque**
Call **0800 009 4540** quoting your invoice number starting CBA or ADS / OSS	Account number **90478703** Sort code **60-00-01** A remittance advice must be sent to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW.** or email **ps.billing@thameswater.co.uk**	By calling your bank and quoting: Account number **90478703** Sort code **60-00-01** and your invoice number	Made payable to '**Thames Water Utilities Ltd**' Write your Thames Water account number on the back. Send to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW** or by DX to **151280 Slough 13**

Thames Water Utilities Ltd Registered in England & Wales No. 2366661 Registered Office Clearwater Court, Vastern Rd, Reading, Berks, RG1 8DB.

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.

This report is confidential to the client. The client may submit the report to regulatory bodies, where appropriate. Should the client wish to release this report to any other third party for that party's reliance, GeoSmart may, by prior written agreement, agree to such release, provided that it is acknowledged that GeoSmart accepts no responsibility of any nature to any third party to whom this report or any part thereof is made known. GeoSmart accepts no responsibility for any loss or damage incurred as a result, and the third party does not acquire any rights whatsoever, contractual or otherwise, against GeoSmart except as expressly agreed with GeoSmart in writing.

For full T&Cs see http://geosmartinfo.co.uk/terms-conditions

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

Terms and conditions can be found on our website:

http://geosmartinfo.co.uk/terms-conditions/

CDM regulations can be found on our website:

http://geosmartinfo.co.uk/knowledge-hub/cdm-2015/

Data use and limitations can be found on our website:

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