GeoSmart Information

SuDSmart

Sustainable Drainage Assessment

Site Address

31 Beech Hill Avenue
Hadley Wood
Herts
EN4 0LU

Grid Reference

526577, 197631

Report Prepared for

Novello (Palmers Green) Ltd
3 Sandridge Close
Barnet
EN4 0HB

Date

2023-11-15

Report Status

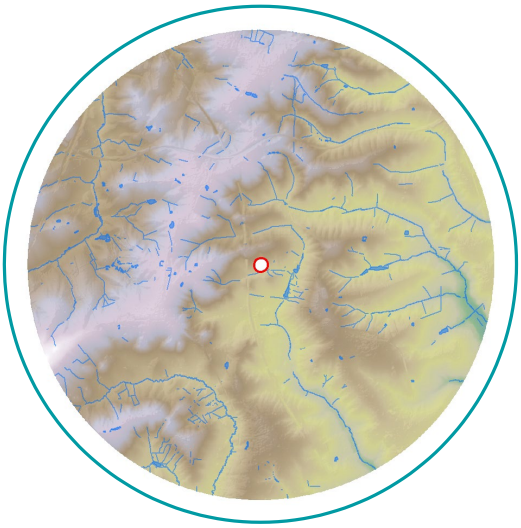
FINAL

Site Area

0.189ha

Report Reference

74006R3



Discharge to Sewer

Surface water runoff should be attenuated on site prior to discharge to the nearby public surface water sewer.

Report Author

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Report Reviewer

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1 Executive summary

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

SuDS suitability

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

Summary of existing and proposed development

The Site is currently used within a residential capacity as a two storey, five-bedroom dwelling including associated access, garage, car parking, swimming pool and landscaping.

Development proposals comprise the demolition of the existing buildings and swimming pool, and the construction of two dwellings, including the formation of new associated access and landscaping. Plot 1 in the north of the Site is a six-bedroom dwelling with rear facing balcony. Plot 2 in the south of the Site is a four-bedroom dwelling with rear facing balcony.

Summary of discharge routes

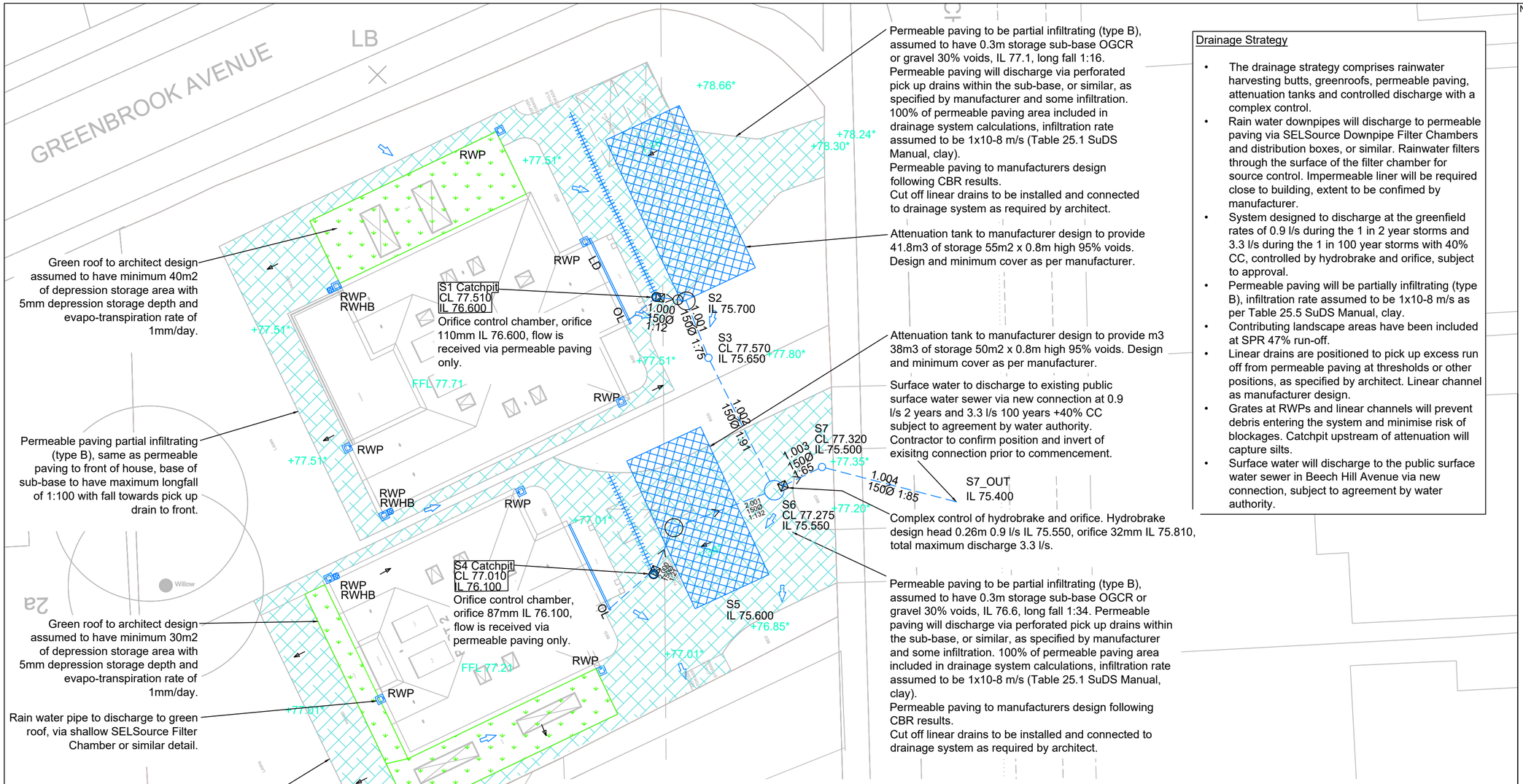
GeoSmart's SuDS Infiltration Potential (SD50) map indicates the Site has a Low potential for infiltration, primarily due to the anticipated low permeability of the underlying geology (London Clay). Infiltration to ground is therefore unlikely to be feasible.

Ordnance Survey (OS) mapping indicates that there are no nearby surface watercourses for the Site to discharge into.

There is a public surface water sewer, located adjacent to the north and east of the Site within the adjacent roads, therefore discharge to sewer is likely to be appropriate.

Runoff rate and attenuation requirements

Surface water will be attenuated onsite via a green roof, partially infiltrating permeable paving and attenuation tanks 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. The proposed run rate will be restricted to the equivalent greenfield runoff rates, 0.9 l/s during the 2 year storm event and 3.3 l/s during the 100 year plus climate change event.



Drainage Strategy

- The drainage strategy comprises rainwater harvesting butts, greenroofs, permeable paving, attenuation tanks and controlled discharge with a complex control.
- Rain water downpipes will discharge to permeable paving via SELSource Downpipe Filter Chambers and distribution boxes, or similar. Rainwater filters through the surface of the filter chamber for source control. Impermeable liner will be required close to building, extent to be confimed by manufacturer.
- System designed to discharge at the greenfield rates of 0.9 l/s during the 1 in 2 year storms and 3.3 l/s during the 1 in 100 year storms with 40% CC, controlled by hydrobrake and orifice, subject to approval.
- Permeable paving will be partially infiltrating (type B), infiltration rate assumed to be 1x10-8 m/s as per Table 25.5 SuDS Manual, clay.
- Contributing landscape areas have been included at SPR 47% run-off.
- Linear drains are positioned to pick up excess run off from permeable paving at thresholds or other positions, as specified by architect. Linear channel as manufacturer design.
- Grates at RWPs and linear channels will prevent debris entering the system and minimise risk of blockages. Catchpit upstream of attenuation will capture silts.
- Surface water will discharge to the public surface water sewer in Beech Hill Avenue via new connection, subject to agreement by water authority.

Contributing Areas (with 47% of landscape) total 1,410m2

- Building Roof (100%) 433m2
- Green Roof (100%) 114m2
- Permeable Paving (100%) 500m2
- Soft Landscaping (47%) 773m2 (363m2)

London Plan Drainage Hierarchy	
1. Store rainwater for later use	Rainwater harvesting butts are proposed
2. use infiltration techniques, such as porous surfaces in non clay areas	The site lies on clay however partial infiltrating permeable paving is proposed. All RWP discharge to surface of permeable paving or green roof.
3. attenuate rainwater in ponds or open water features for gradual release	Green roofs are proposed to the flat roof areas
4. attenuate rainwater by storing in tanks or sealed water features for gradual release	Attenuation is proposed using the storage layer of the permeable paving and underground geocellular crates
5. discharge direct to a watercourse	N/A
6. discharge rainwater to a surface water sewer / drain	Discharge is to an existing public surface water sewer
7. discharge rainwater to a combined sewer	N/A

Notes.

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14. Minimum cover to thermoplastic pipes in garden or patio areas 0.6m, in driveway 0.9m, in road 1.2m, otherwise concrete protection will be required.
15. Access chamber cover class A15 for garden and patio, B125 for driveway, C250 for lightly trafficked roads or small private carparks.
16. * assumed levels and gradients, to be confirmed.

KEY:

- Permeable paving partial infiltrating (Type B)
- Attenuation tank
- Green Roof
- RWP — Rain water pipe
- Surface water drain
- S3 CL 67.000 IL 66.300 — Surface water manhole with reference number, Cover level, Invert level
- LD / OL — Linear drain with outlet; Assumed falls
- Perforated pick up drain within permeable paving sub-base
- SEL Source Downpipe Filter Chamber and distribution box, or similar
- +78.24* — Spot level
- Overland flow routes for exceedance events
- RWHB — Rainwater harvesting butt

Rev	Date	Detail	Drawn	Chkd
P05	09.11.23	Updated to new layout	MG	DS
P04	21.12.21	Updated to LLFA comments	MG	MG
P03	12.11.21	Updated to LLFA comments	MG	AW
P02	24.08.21	Additional SuDS features, complex control	MG	AW
P01	25.05.21	Initial issue	MG	AW

Client:
Novello (Palmers Green) Ltd

Project:
31 Beech Hill Avenue

Drawing Title:
Proposed Surface Drainage Layout

GeoSmart Information
Environmental Thinking
Suite 9-11, 1st Floor, Old Bank Buildings, Bellstone, Shrewsbury, SY1 1HU

Drawn by:	Checked by:	Date:
MG	DS	May 2021
Scale: 1:200 @ A2		Status: Preliminary
Drawing No: 74006.01 100		Issue: P05

	Asset Type	Maintenance Schedule (and Frequency)	Party Responsible
	Permeable pavements	Regular maintenance: • Brushing and vacuuming (three time per year) • Trimming any roots and surrounding grass and weeds that may be causing blockages (anually or as required) Monitoring: • Initial inspection (monthly) • Inspect surface for poor performance or ponding (anually or after large storm events)	Privately owned. Maintained by house owners or asset management company as agreed between house owners
	Underground drainage pipe network and manholes / catchpits	Regular maintenance: • Remove sediment and debris from pre-treatment devices and floor of inspectiion 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)	
	Attenuation tank	Regular maintenance: • Remove litter and debris from inlets and outlets (monthly) • Trimming any roots and surrounding grass blockages (as required) Monitoring: • Inspect inlets, outlets and overflows for blockages (monthly or after a heavy storm) • Inspect inlets and outlets for silt accumulation (half yearly) • Inspect infiltration surfaces for compaction and ponding (monthly) • Survey inside of tank for sediment build-up and remove (annually or as required)	
	Linear drainage channel Rain water pipe	Regular maintenance: • Remove sediment and debris from grating, channel and sump (monthly or as required) • Trimming any roots and surrounding grass blockages (as required) Monitoring: • Inspect inlets and outlets for blockages or silt accumulation (monthly or after a heavy storm)	
	Control	Regular maintenance: • Remove silts from the control chamber sump (annually) • Remove any debris obstructing the inlet, outlet or control ensuring the emergency drain down mechanism if replaced correctly (annually) Monitoring: • Inspect the control chamber sump for build up of silt and the inlet and outlet for debris (annually) • Check the emergency drain down mechanism is in good working order (annually)	
	Rainwater harvesting water butt	Regular maintenance: • Clean tank, inlets, outlets, gutters, roof drain filters and withdrawal devices (annually or as required) • Empty water butt and clean interior, removing any sludge, algea or sediments (annually or as required) Monitoring: • Inspect tank for debris and sediment build up (annually and following poor performance) • Inspect inlets, outlets and overflow (annually and following poor performance)	
	Downpipe filter chamber	Regular maintenance: • Remove silts from the chamber (annually or after poor performance) • Remove any debris from the surface (as required) Monitoring: • Inspect chamber for sediment build up (annually and following poor performance) • Inspect outlets (annually and following poor performance)	
	Green Roof	Regular maintenance: • Remove debris and litter at inlet (6 monthly or as required) Replace dead plants as necessary during establishment (monthly, usually responsibility of manufacturer) Replace dead plants as required post establishment (annually in autumn) Remove fallen leaves and debris from deciduous plant foilage (6 monthly or as required) Mow grasses, prune shrubs and manage planting as required, clippings to be removed (6 monthly or as required) Monitoring: • Inspect all components including soil substrate, vegetation, drains, irrigation system if applicable, membranes and roof structure for proper operation, integrity of waterproofing and structural stability (annually and after heavy storms) • Inspect soil substrate for evidence of erosion channels and identify sediment sources (annually and after heavy storms) • Inspect drain inlets to ensure unrestricted runoff from the drainage layer (annually and after heavy storms) • Inspect underside of roof for evidence of leakage (annually and after heavy storms)	

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Rev	Date	Detail	Drawn	Chkd
P03	09.11.23	Updated to new layout	MG	DS
P02	12.11.21	Updated to LLFA comments	MG	AW
P01	24.08.21	Initial issue	MG	AW

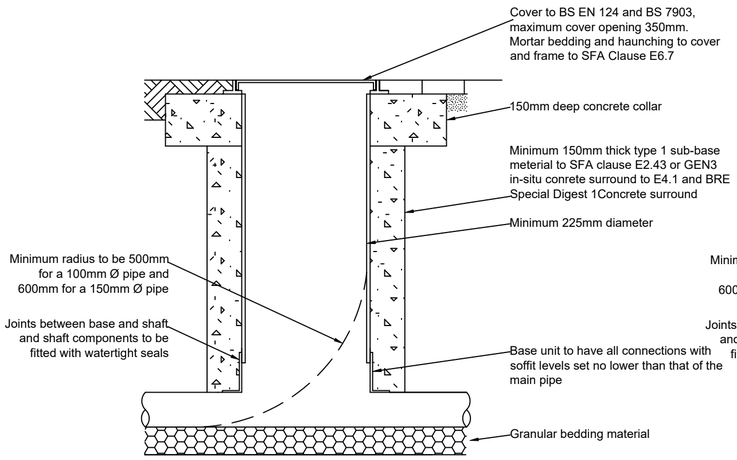
Client:
Novello (Palmers Green) Ltd

Project:
31 Beech Hill Avenue

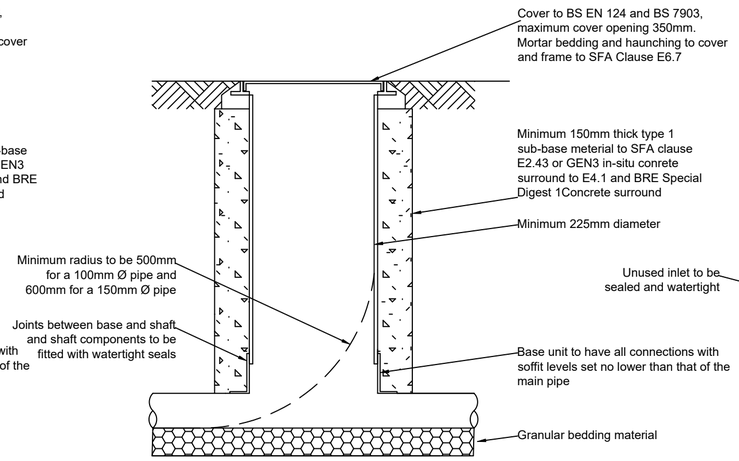
Drawing Title:
Management and Maintenance Plan

GeoSmart Information
Environmental Thinking
Suite 9-11, 1st Floor, Old Bank Buildings, Bellstone, Shrewsbury, SY1 1HU

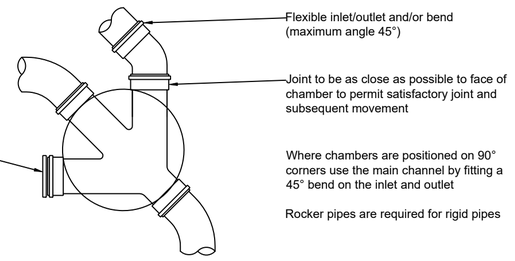
Drawn by:	Checked by:	Date:
MG	DS	May 2021
Scale: 1:200 @ A2		Status: Preliminary
Drawing No: 74006.01 101		Issue: P03



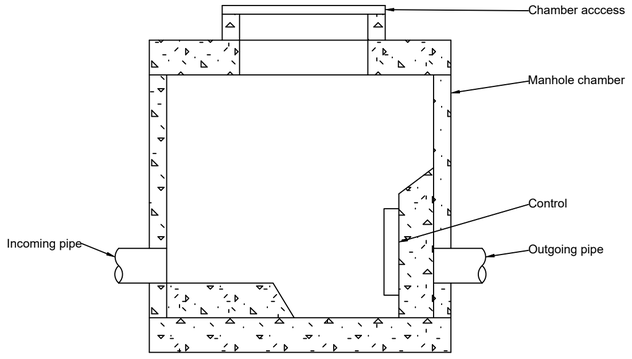
SFA Type 4 Inspection Chamber
(Driveways, paved areas)



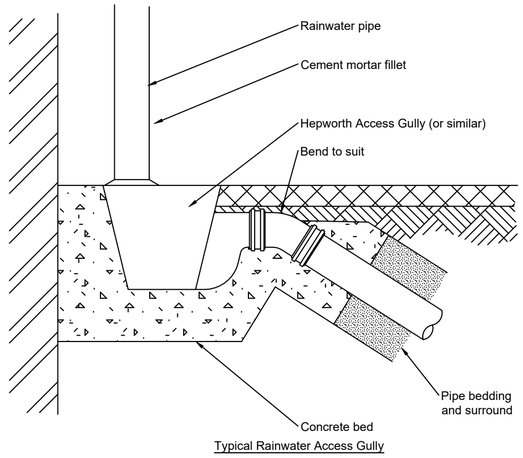
SFA Type 4 Inspection Chamber
(Domestic gardens)



Typical base layout of Type 4 chambers

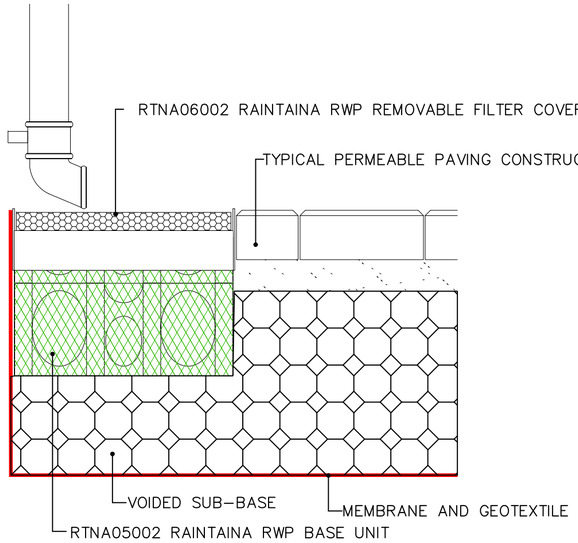


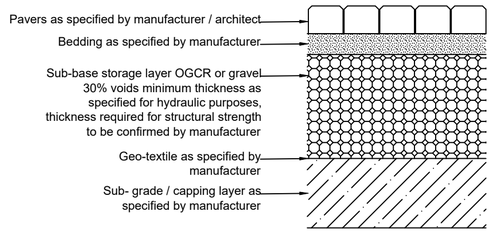
Typical control chamber
(Design to be specified by manufacturer)



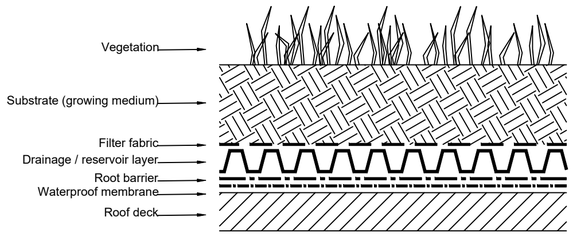
Typical Rainwater Access Gully

RTNA05002 – RAINTAINA FILTER CHAMBER

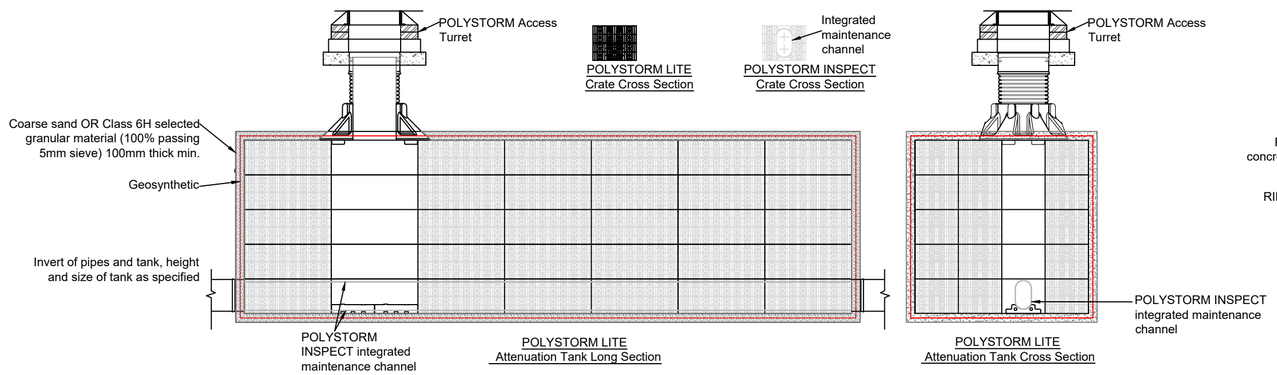


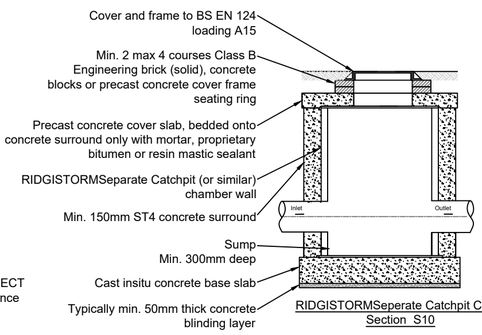


Typical Permeable Paving

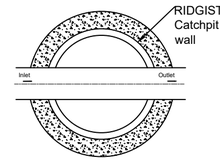


Typical Green Roof





RIDGISTORMSeperate Catchpit Cross Section S10



RIDGISTORMSeperate Catchpit Plan S10

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Rev	Date	Detail	Drawn	Chkd
P01	24.08.21	Initial issue	MG	AW

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Drawn by:	Checked by:	Date:
MG	DS	May 2021

Scale:	Status:
N.T.S.	Preliminary

Drawing No:	Issue:
74006.01 102	P01

2 Site analysis

Site location

Figure 1. Aerial Imagery (Bluesky, 2023)

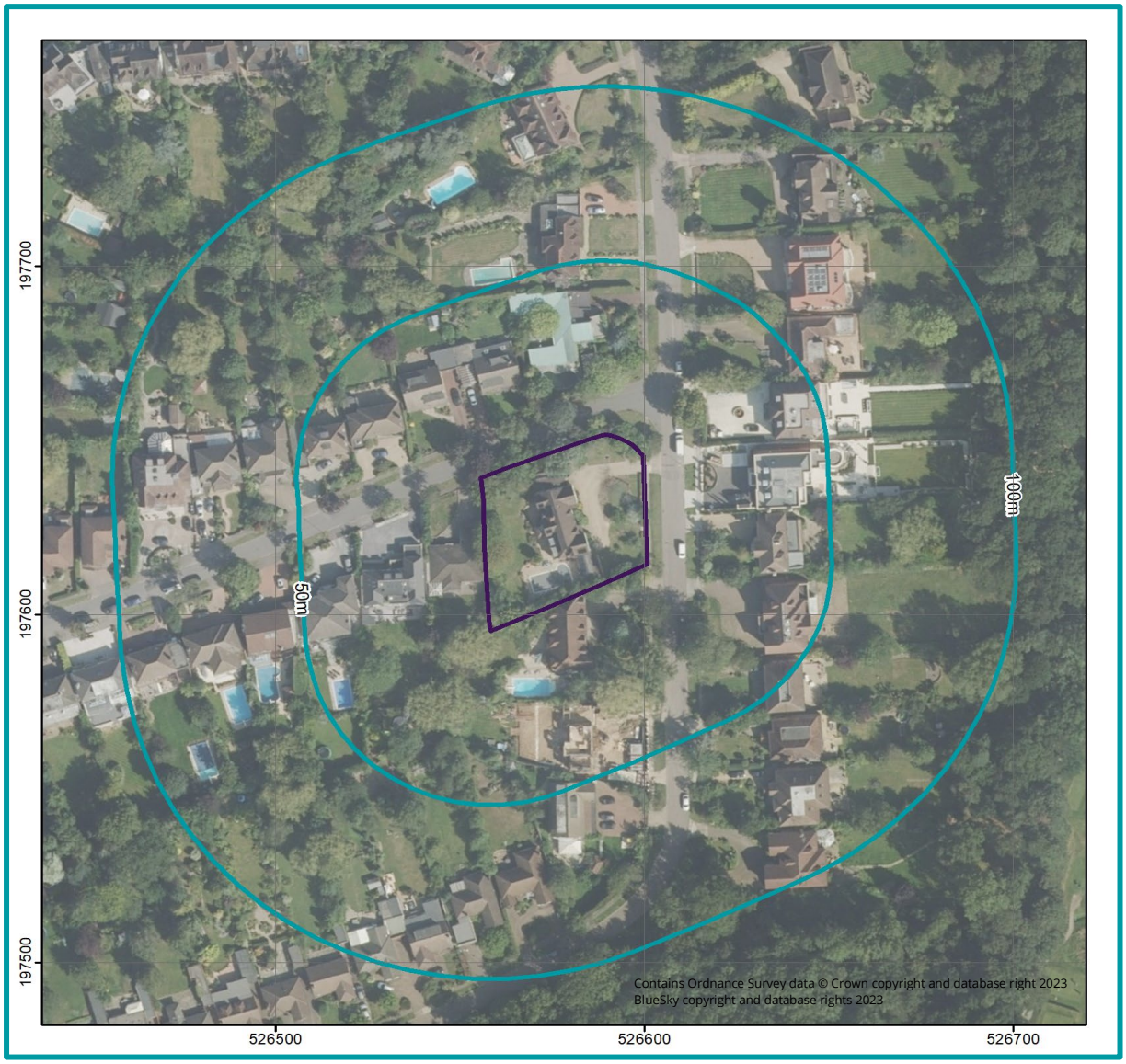
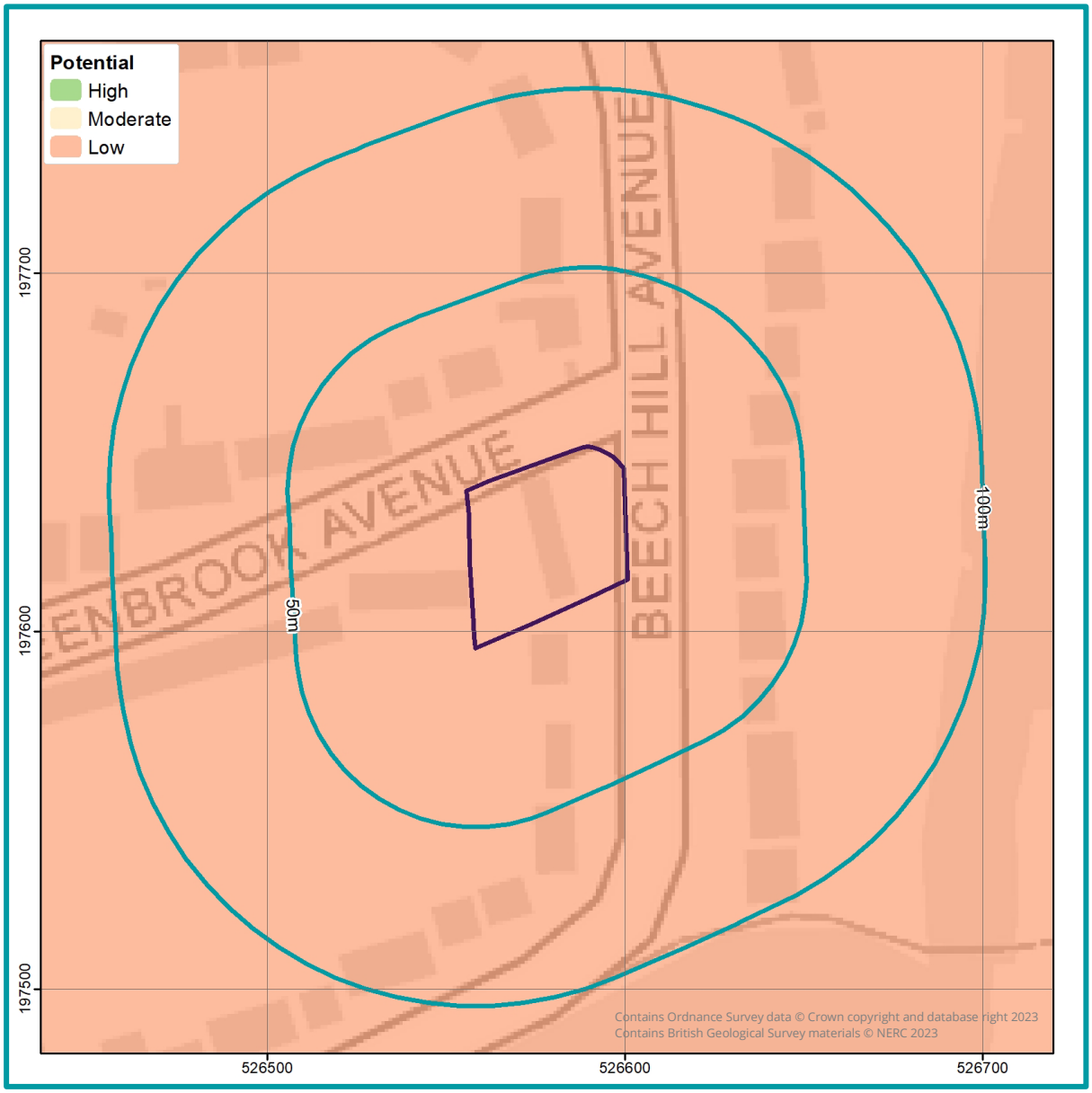


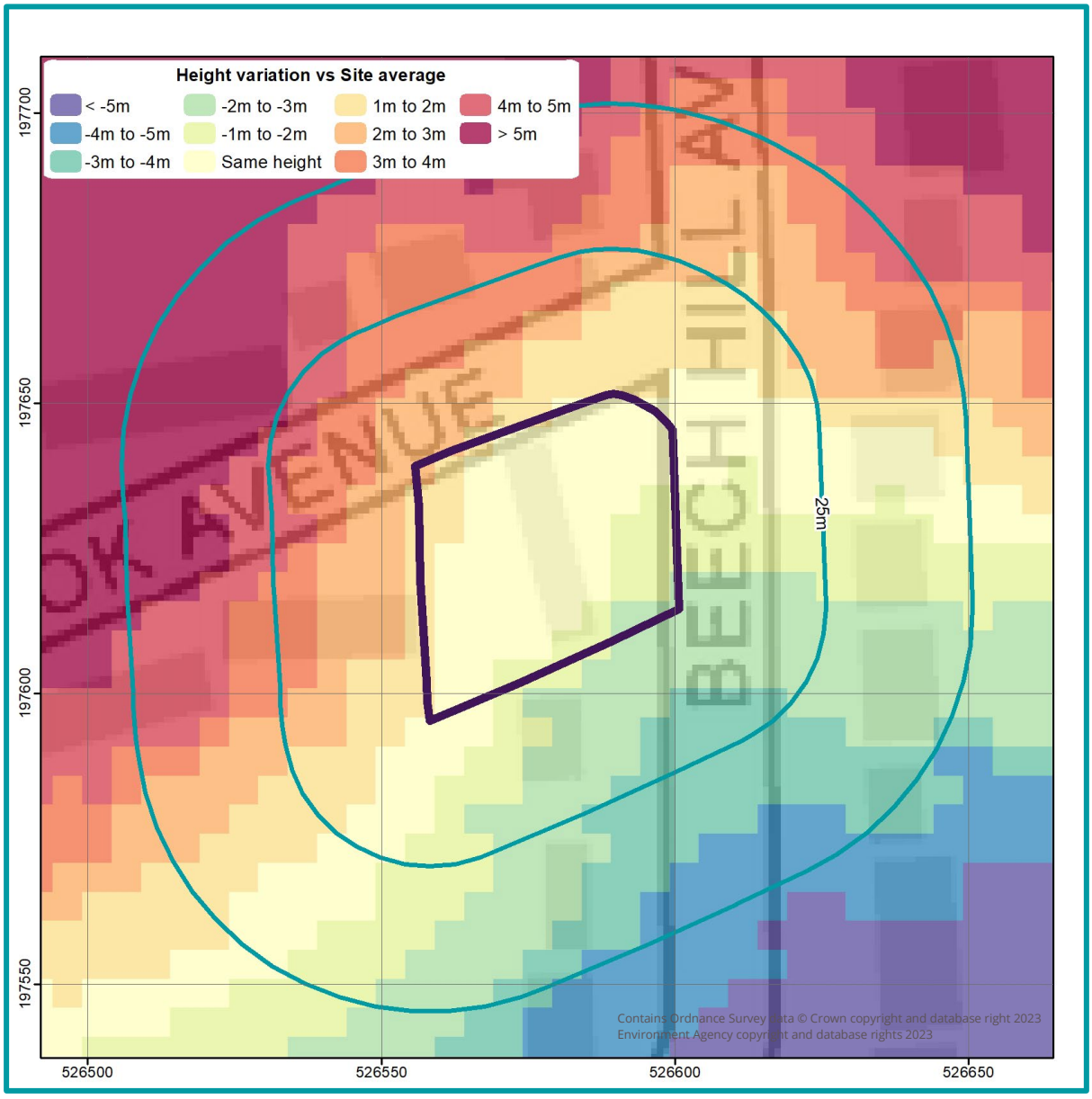
Figure 2. SuDS infiltration suitability (SD50) map (GeoSmart, 2023)



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 Low potential for infiltration SuDS across the Site. It is likely that the underlying geology at the Site has low permeability which would limit the effectiveness of a proposed infiltration SuDS scheme.

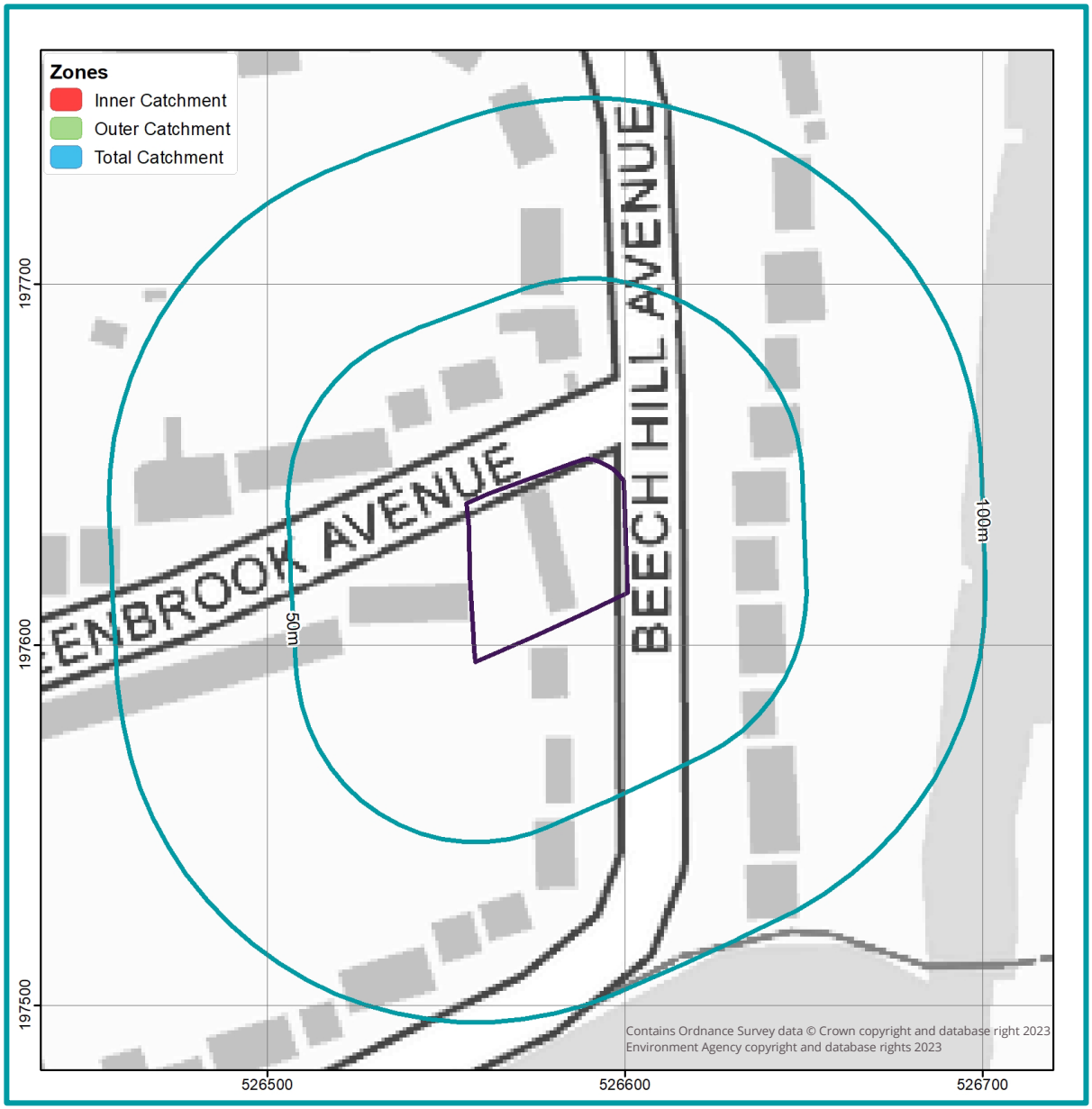
Figure 3. Site topography (GeoSmart, 2023)



An assessment of the topography at the Site has been undertaken using LiDAR DTM5 elevation data to identify the general slope and any localized 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 falls in a south easterly direction.

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

Figure 4. Source protection zone map (EA, 2023)

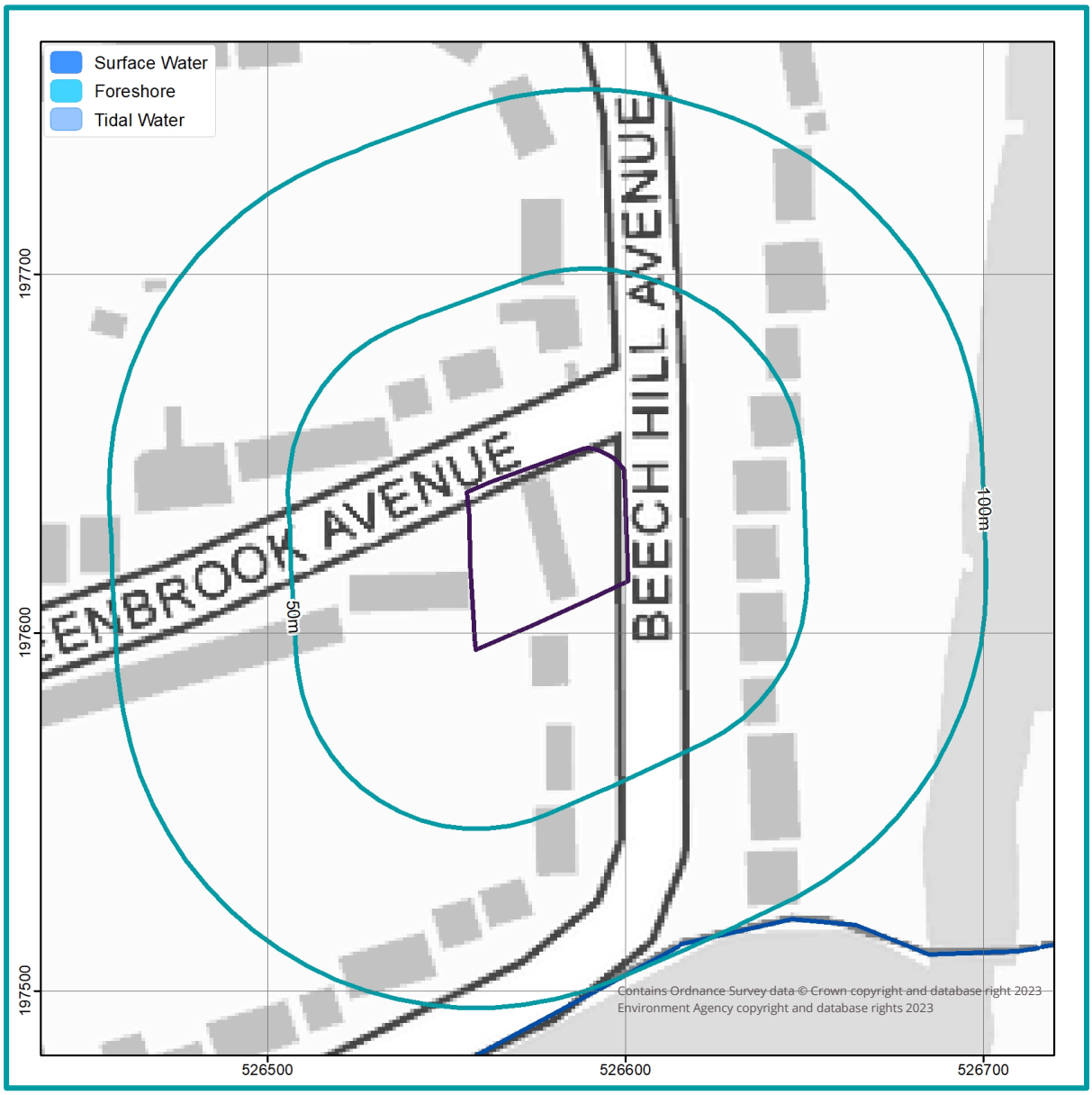


An assessment of the EA's groundwater Source Protection Zones (SPZs) has been undertaken within the vicinity of the Site and confirms the Site is not located within an SPZ.

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

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

Figure 5. Surface water features map (EA, 2023)

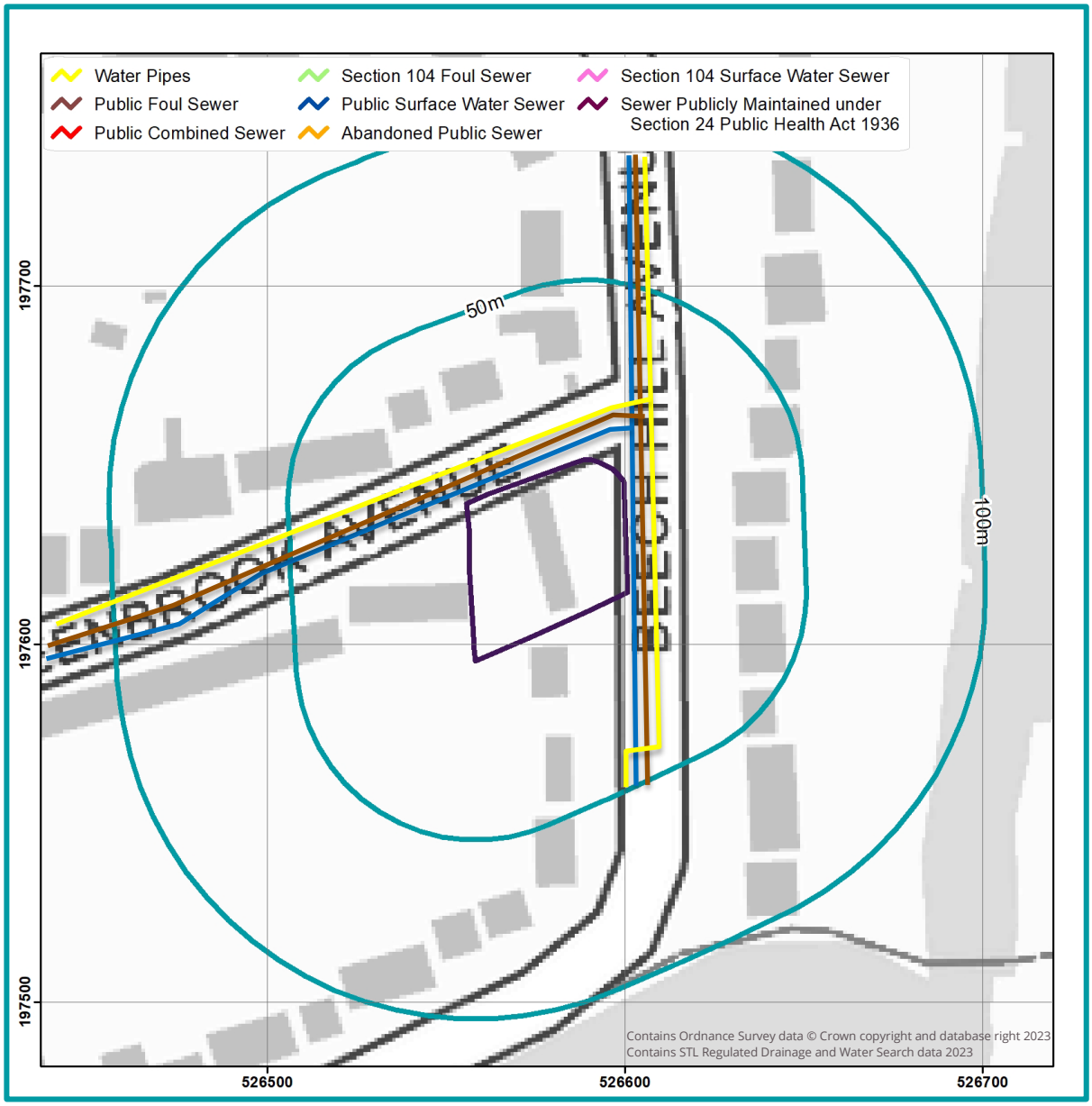


The mapping above confirms that there is a surface water feature located 115m south of the Site. However due to the large distance and multiple private properties between the site and the watercourse, discharge of surface water runoff to this feature is unlikely to be appropriate.

According to DEFRA's MagicMap, the Site is not within 250m of a SSSI or SPA.

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

Figure 6. Sewer features map (OS & STL, 2023)

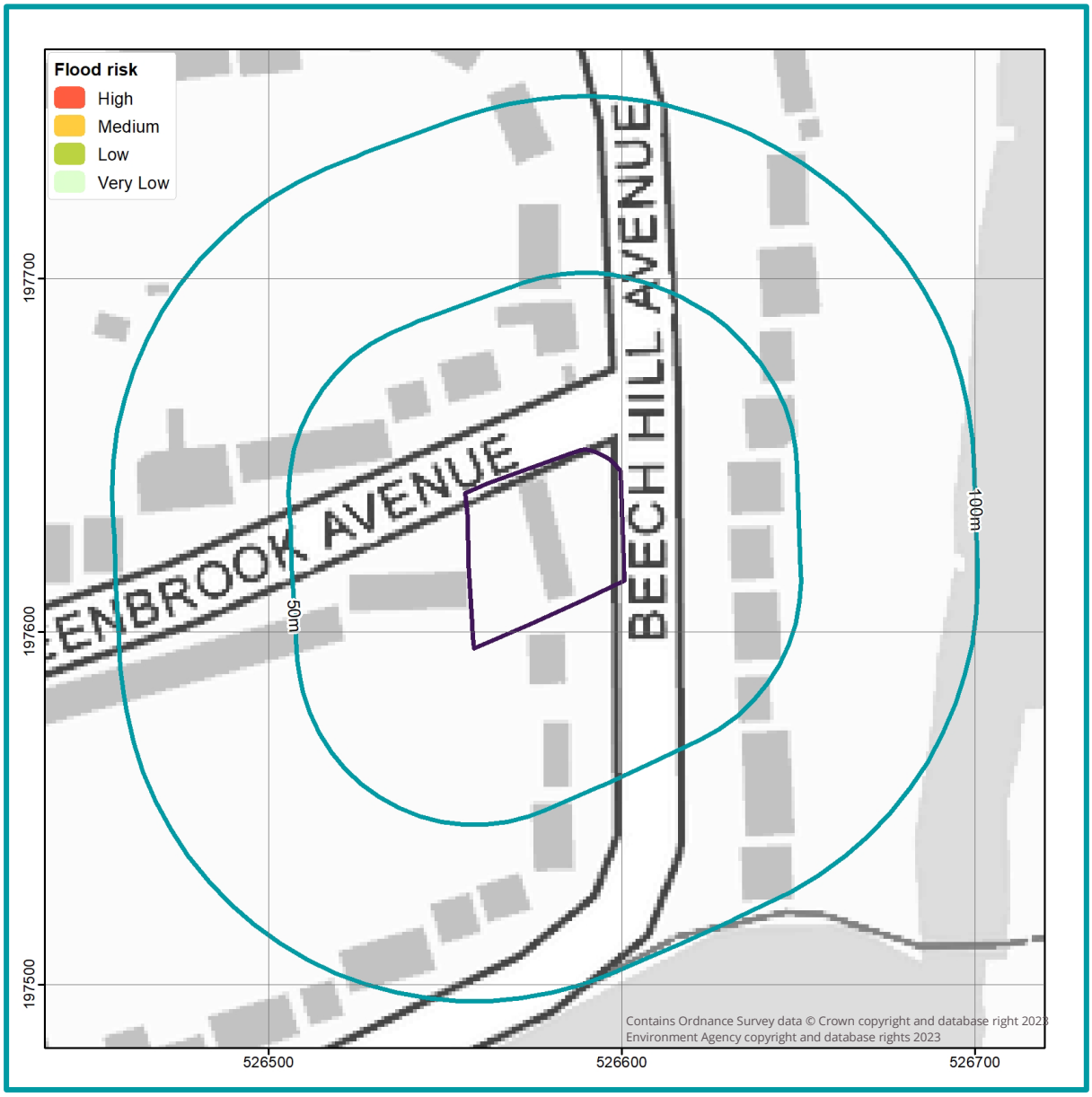


GeoSmart has undertaken an assessment of the location of sewer features within the vicinity of the Site. There is a public surface water sewer, located adjacent to the north and east of the Site within the adjacent roads, therefore discharge to sewer is likely to be appropriate. The regulated drainage and water search (Appendix C) also confirms that the current properties are connected to the public sewer.

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.

Where development is proposed above or within close proximity to the public sewer network, a build-over agreement or easement may be required with the relevant utility provider.

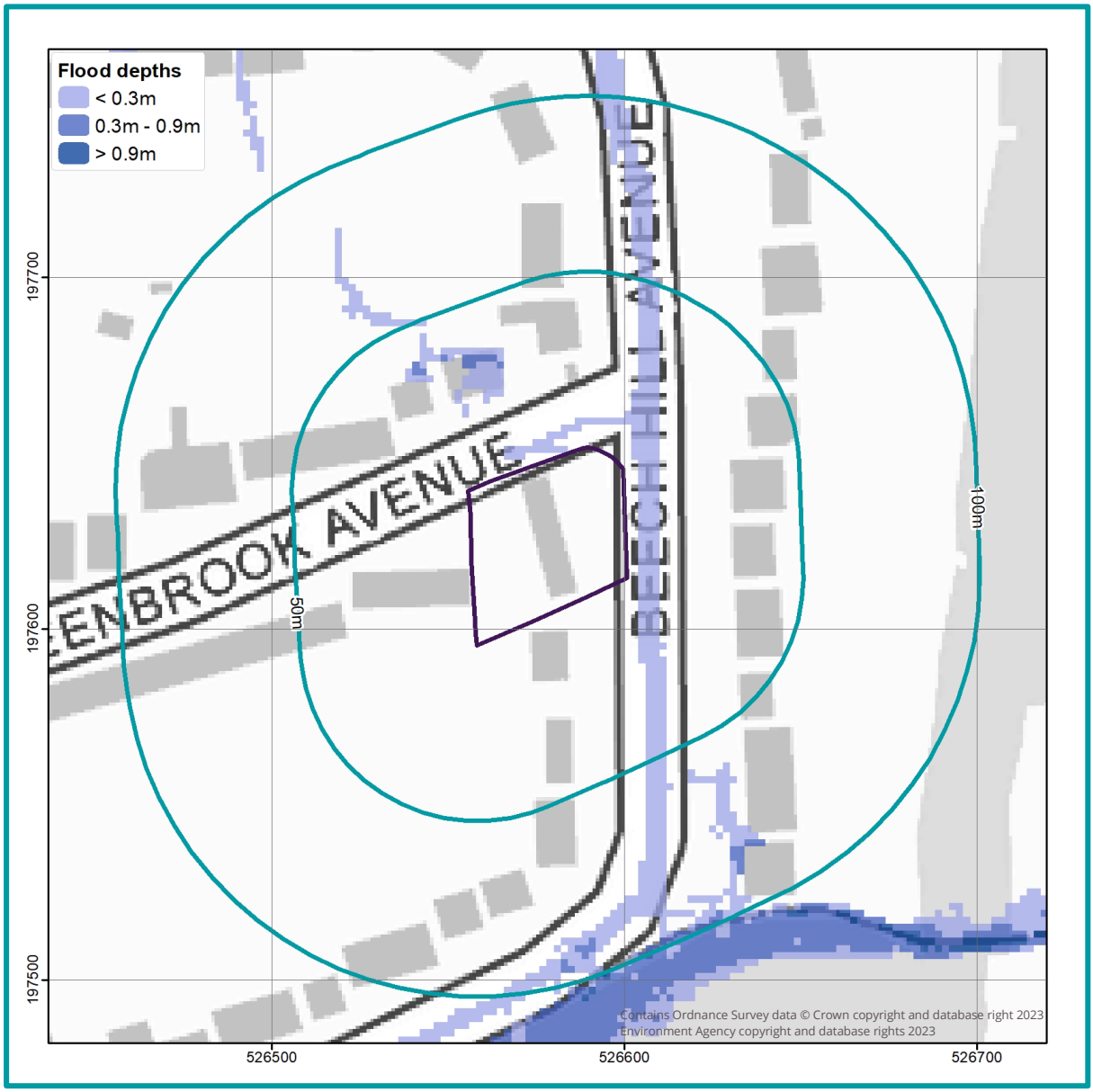
Figure 7. Risk of flooding from rivers & sea map (EA, 2023)



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

A flood risk assessment (FRA) has been undertaken separately by GeoSmart to further assess the fluvial flood risk to the Site.

Figure 8. Risk of surface water flooding map (EA, 2023)

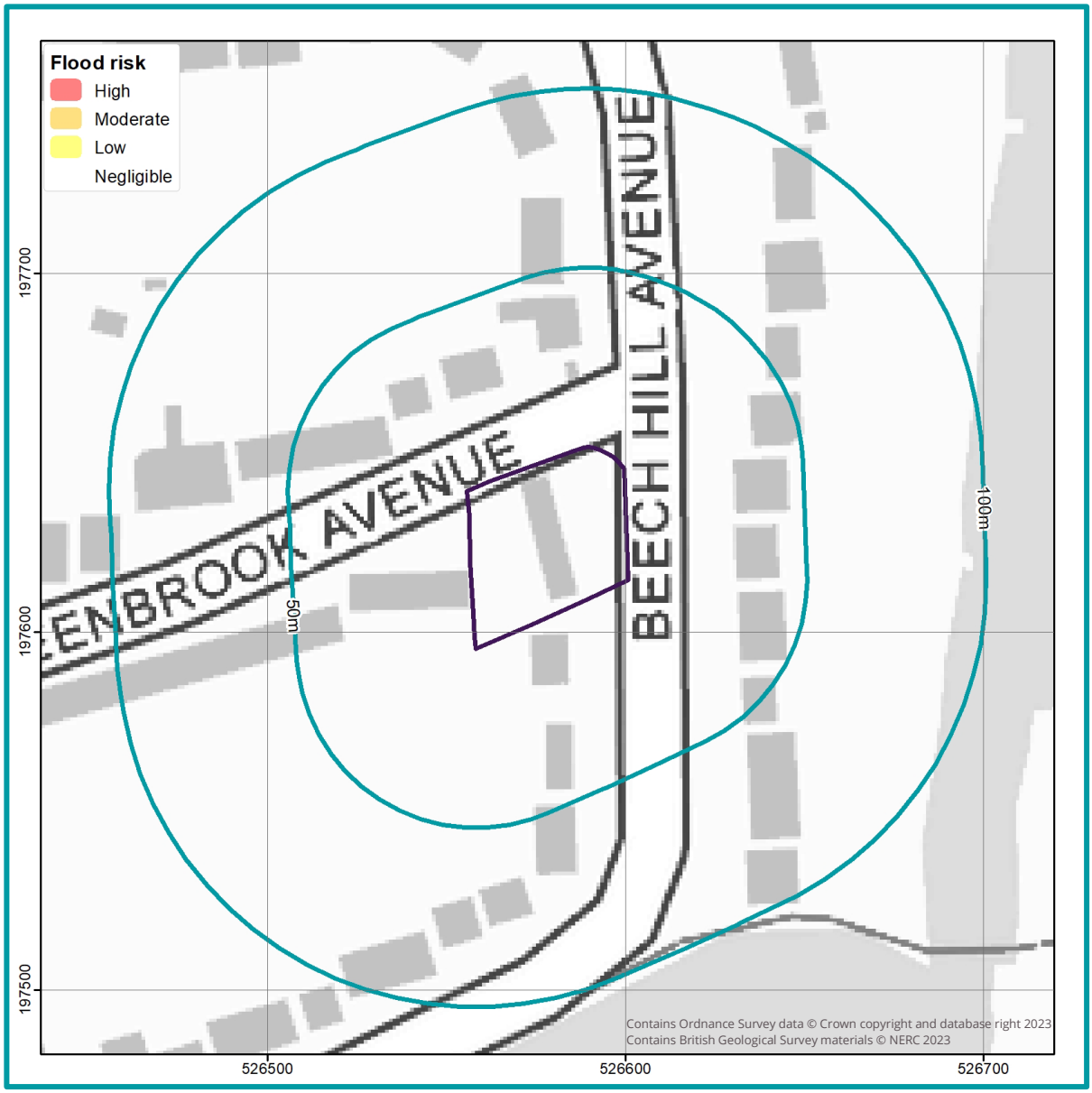


GeoSmart have undertaken an assessment of the risk of flooding from surface water (pluvial) sources within the vicinity of the Site using the EA's Risk of Flooding from Surface Water (RoFSW) mapping.

According to the EA's RoFSW (pluvial) flood mapping, the Site is at a variable risk of pluvial flooding ranging from Very Low to Low.

A flood risk assessment (FRA) has been undertaken separately by GeoSmart to further assess the surface water flood risk to the Site.

Figure 9. 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.

A flood risk assessment (FRA) has been undertaken separately by GeoSmart to further assess the groundwater flood risk to the Site.

3 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 31 Beech Hill Avenue, Hadley Wood, Herts, EN4 0LU (the Site). The Site is located in a setting of residential land use. Site plans and drawings are provided in Appendix A.

Development

The Site is currently used within a residential capacity as a two storey, five-bedroom dwelling including associated access, garage, car parking, swimming pool and landscaping.

Development proposals comprise the demolition of the existing buildings and swimming pool, and the construction of two dwellings, including the formation of new associated access and landscaping. Plot 1 in the north of the Site is a six-bedroom dwelling with rear facing balcony. Plot 2 in the south of the Site is a four-bedroom dwelling with rear facing balcony.

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 1. Site Geology

Geology present on-Site		Potentially permeable?
Superficial geology (Figure 10)	No superficial deposits	N/A
Bedrock geology (Figure 11)	London Clay	X

A review of the BGS borehole database (BGS, 2023) indicates the nearest and most relevant borehole (ref: TQ29NE121) is 405 m to the west of the Site boundary at an elevation of 82.8 mAOD and indicates 0.6 m thickness of made ground overlying 4.3 m of London Clay.

The permeability of the underlying material at the Site shown within the BGS mapping is low, confirmation of the infiltration capacity is not considered to be required.

Figure 10. Superficial Geology (BGS, 2023)

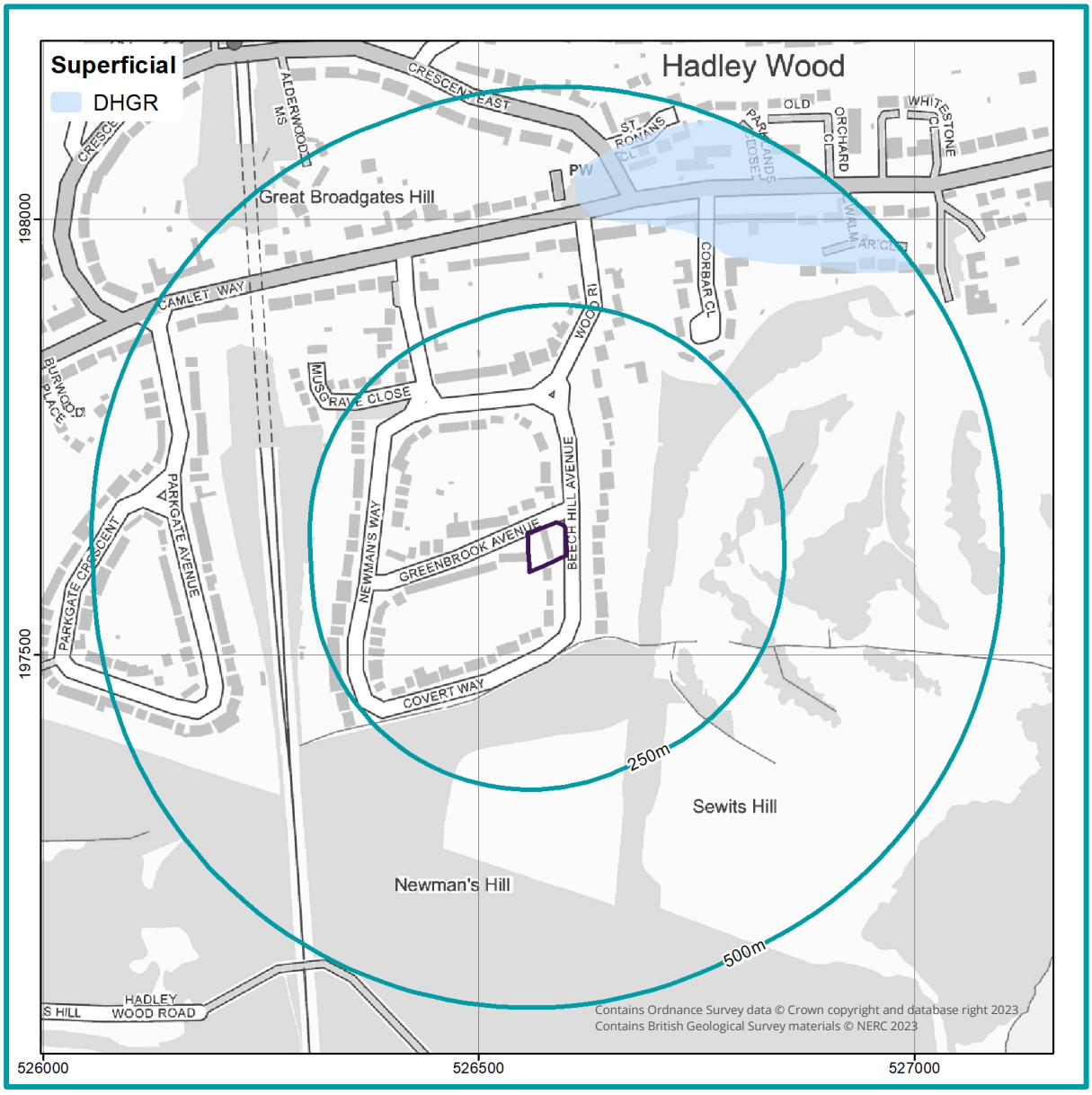
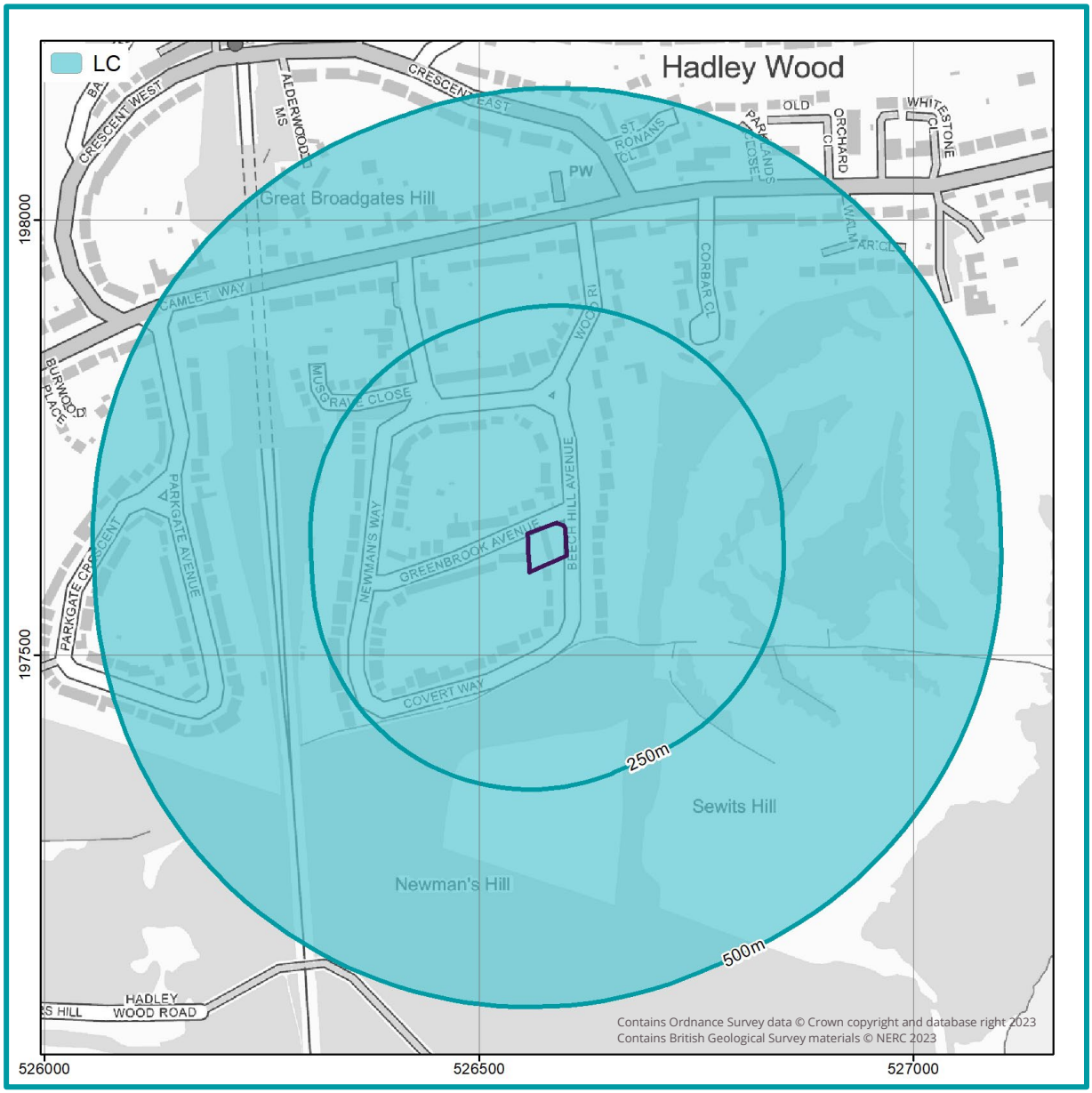


Figure 11. Bedrock Geology (BGS, 2023)



Depth to groundwater

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

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

Infiltration features are not proposed at the Site, given the impermeability of the underlying geology.

Ground conditions

Infiltration SuDS features are not proposed at the Site, therefore a detailed investigation into the ground conditions is not required.

Water quality

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

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

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

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

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

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

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

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

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

London Plan - Policy 5.13 Sustainable drainage (2016)

A development should utilise sustainable urban 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. Store rainwater for later use,
2. use infiltration techniques, such as porous surfaces in non-clay areas,
3. attenuate rainwater in ponds or open water features for gradual release,

4. attenuate rainwater by storing in tanks or sealed water features for gradual release,
5. discharge rainwater direct to a watercourse,
6. discharge rainwater to a surface water sewer / drain,
7. discharge rainwater to the combined sewer.

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

Enfield Council – Sustainable Drainage Design and Evaluation Guide (McCloy Consulting and Robert Bray Associates, 2018)

DMD 61 Managing Surface Water A Drainage Strategy will be required for all developments to demonstrate how proposed measures manage surface water as close to its source as possible and follow the drainage hierarchy in the London Plan. All developments must maximise the use of and, where possible, retrofit Sustainable Drainage Systems (SuDS) which meet the following requirements:

1. Suitability a. SuDS measure(s) should be appropriate having regard to the proposed use of site, site conditions/context (including proximity to Source Protection Zones and potential for contamination) and geology.

5 Storage, volume and peak flow rate

Surface water will be attenuated onsite via a green roof, partially infiltrating permeable paving and attenuation tanks 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. The proposed run rate will be restricted to the equivalent greenfield runoff rates, 0.9 l/s during the 2 year storm event and 3.3 l/s during the 100 year plus climate change event. See Appendix B for full calculations.

Surface water 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 3. Change in impermeable area associated with the development

Total Site area	1,820 m^2
Impermeable area (and as a percentage of the total area of the proposed development footprint of 1,820 m^2)	
Pre-development	Post-development
568 m^2 (31%)	1,047 m^2 (58%)
Impermeable Land use: building footprint, paving and swimming pool Permeable Land use: landscaped areas and gravel driveway	New impermeable land use: building footprint and paving New permeable land use: landscaped areas

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).

6 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

GeoSmart's SuDS Infiltration Potential (SD50) map indicates the Site has a Low potential for infiltration, primarily due to the anticipated low permeability of the underlying geology (London Clay). Infiltration to ground is therefore unlikely to be feasible.

Discharge to surface watercourse

Ordnance Survey (OS) mapping indicates that there are no nearby surface watercourses for the Site to discharge into.

Discharge to sewer

There is a public surface water sewer, located adjacent to the north and east of the Site within the adjacent roads, therefore discharge to sewer is likely to be appropriate.

7 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 of low hazard. The Site does not lie within an SPZ and therefore additional treatment stages are not required.

Table 4. Level of hazard

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

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

Table 5. 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

8 Client checklist

A drainage strategy should now be compiled 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 6. 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 7. 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.

9 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.

10 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/

11 Further information

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

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

12 References and glossary

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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.

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13 Appendices

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Appendix A

Site plans (layout and topography)

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Appendix B

Rainfall runoff calculations

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Appendix C

Regulated Drainage and Water Search

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.

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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.

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- 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.
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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.
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- 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:

Alan White

Operations Manager

GeoSmart Information Limited

Suite 9-11, 1st Floor,

Old Bank Buildings,

Bellstone, Shrewsbury, SY1 1HU

Tel: 01743 298 100

alanwhite@geosmartinfo.co.uk

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