GeoSmart Information

SuDSmart Plus

Sustainable Drainage Assessment

Site Address

Owler Lane
Birstall
Leeds
WF17 9BW

Grid Reference

422786, 427623

Report Prepared for

Fox Hall

Date

06/03/2025

Report Status

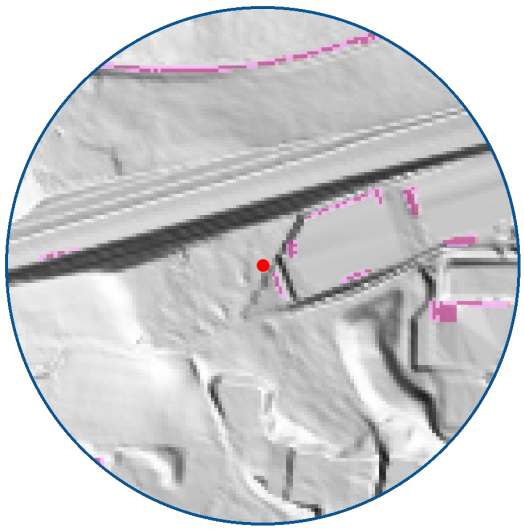
FINAL

Site Area

0.61 ha

Report Reference

83705R2



Infiltrate into ground / discharge to sewer

The proposed Sustainable Drainage Scheme (SuDS) strategy includes infiltration SuDS features (including rainwater harvesting tanks, permeable paving and soakaways) across the majority of the Site, with attenuation SuDS features for discharge to sewer proposed in the north-west of the Site due to water quality concerns in this area.

A site investigation should be conducted to confirm the infiltration capacity of the ground in line with BRE 365 guidelines. The capacity of the public sewer network should also be confirmed with the utility provider and permission to connect gained where required.

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1 Executive summary

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

SuDS suitability

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

Summary of existing and proposed development

The Site is currently used within a commercial capacity. At present there are three large industrial buildings present, with a large area of hardstanding containing multiple shipping containers and vehicles. Development proposals comprise the demolition of two of the existing buildings and the construction of two new units, an office building and a material recovery facility along with associated parking. A weighbridge, storage area and secure storage are also proposed.

Summary of discharge routes

GeoSmart's SuDS Infiltration Potential (SD50) map indicates the Site has a Moderate to High potential for infiltration, primarily due to the high permeability of the underlying bedrock (Emley Rock). Due to the use of the Site as a commercial and domestic waste services facility, infiltration is not considered within the north-western section of the Site due to water quality concerns. The client has confirmed that this area will be self-contained, and no contaminated runoff will reach the rest of the Site where it may infiltrate into ground.

Ordnance Survey (OS) mapping indicates that there are no surface water features within 100 m of the Site. Therefore, discharge to surface water feature is not feasible.

The asset location plan search included in Appendix C confirms the Site is located adjacent to the public sewer network and currently discharges to this. Therefore, discharging runoff to the public sewer network is feasible.

Runoff rate and attenuation requirements

Primary strategy

A partial infiltration strategy is considered most appropriate for the development and has been proposed. As part of this, the self-contained area in the north-west of the Site will discharge runoff to the public combined sewer (due to water quality concerns restricting the use of infiltration in this area). Runoff from the remainder of the Site will be discharged to ground.

A split scheme between discharge and infiltration requires 256.95 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 45% allowance for climate change. As part of this, 140.13 m^3 of storage is required within attenuation SuDS in the north-west corner of the Site and 116.82 m^3 is required within infiltration SuDS for the remainder of the Site.

These volumes are subject to the results of infiltration testing and discharge rates being restricted to 1.30 l/s (a 30% reduction in surface water run-off from the existing 1 in 1 year runoff rate, as stated in Policy LP28 of the Kirklees Local Plan Strategy and Policies). They would ensure runoff is not increased above the greenfield scenario.

Secondary strategy

Should infiltration be proven feasible at the Site, runoff from all areas of the Site is proposed to be discharged off-Site, to the public combined sewer.

Discharging off-Site requires 445.51 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 45% allowance for climate change. This volume is subject to the discharge rate being restricted to 4.80 l/s (a 30% reduction in surface water run-off from the existing 1 in 1 year runoff rate, as stated in Policy LP28 of the Kirklees Local Plan Strategy and Policies).

Proposed SuDS strategy

Primary strategy

SuDS features comprised of rainwater harvesting tanks, permeable paving, two soakaways and an attenuation tank are proposed to attenuate a minimum of 265.62 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 5m from building foundations and 2-3m 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 45% allowance for climate change and will not

cause flooding to the proposed development in accordance with DEFRAs non-statutory technical standards (DEFRA, 2015).

Secondary strategy

SuDS features comprised of an attenuation tank are proposed to attenuate a minimum of 450 m^3 of surface water runoff.

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 45% 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 of the Site, where payments for the works will form part of the property deeds and / or rental agreements.

Recommendations / Next steps

A site investigation is required to confirm the infiltration capacity of the ground in line with BRE 365 guidelines to confirm the infiltration rate and the groundwater level. The capacity of the public sewer network should also be confirmed with the utility provider and permission to connect gained where required.

2 Proposed SuDS strategy

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

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

SuDS type	Source control (interception), attenuation and infiltration SuDS.
SuDS features	Rainwater harvesting tanks, permeable paving, two soakaways and an attenuation tank.
Discharge location	Infiltration (majority of Site area) / public combined sewer network (self-contained area in north-western corner of Site).
Discharge rate	1 x 10^{-5} m/s (where infiltration is proposed) / 1.30 l/s (where discharge to sewer is proposed).

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

Rainwater Harvesting	Rainwater harvesting tanks can be established for each proposed building. 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 strategy. Water from these tanks can be used to supply toilets with grey water. Alternatively, the water can be utilised for other approved uses across the Site deemed appropriate.
Unlined permeable paving	Within the area for infiltration into ground, a 2,303 m^2 area of permeable paving (underlain with a Type 3 aggregate material) is proposed. This area will be designed to drain itself and is therefore not proposed to provide attenuation.
Soakaway	Two soakaways filled with geo-cellular crates with a 95% void ratio are proposed. A soakaway with a width of 4.00 m, length of 4.50 m and a depth of 1.20 m is proposed to infiltrate runoff from Unit 1 and the office (Figure 1). This soakaway will provide c. 20.52 m^3 of attenuation. A soakaway with a width of 10.00 m, length of 12.25 m and a depth of 1.00 m is proposed to infiltrate runoff from Unit 2, Unit 3 and all areas of hardstanding (Figure 1). This soakaway will provide c. 116.38 m^3 of attenuation. Both soakaways will provide c. 136.90 m^3 attenuation.
Attenuation tank	Within the self-contained area in the north-west of the Site, an attenuation tank with a length of 10.5 m, width of 12 m and depth of

	1.0 m, filled with geo-cellular crates with a 95% void ratio, would provide c. 119.7 m^3 attenuation.
Total Attenuation Provided	256.60 m^3
Total Attenuation Required	253.93 m^3
Freeboard Storage Provided	2.67 m^3

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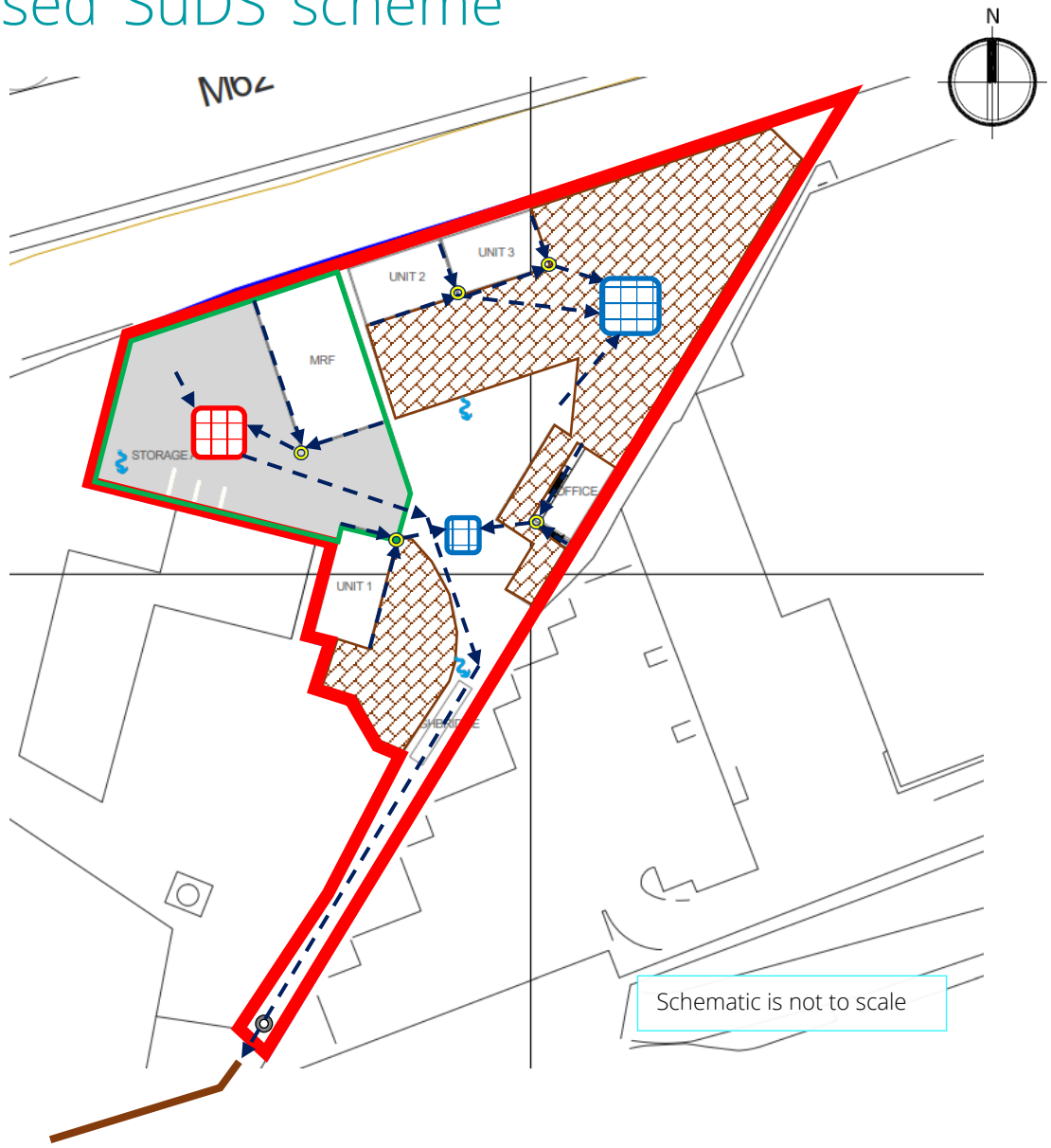
Figure 1. Proposed SuDS scheme

- Rainwater harvesting tank
- Permeable paving
- Soakaway
- Attenuation tank
- Hydro-brake flow control
- Surface water drainage network
- Exceedance flow routes
- Site boundary
- Self-contained area (for discharge to sewer)
- Public combined sewer



Surface water runoff in the self-contained area will be captured by the guttering and a rainwater harvesting tank which will be stored in the attenuation tank before discharging at a restricted rate to the public combined sewer.

For the rest of the Site, surface water runoff from the roofs will be discharged into rainwater harvesting tanks. Overflows from the tanks will be discharged to two soakaways for infiltration to ground. Areas of permeable paving are proposed to drain themselves.

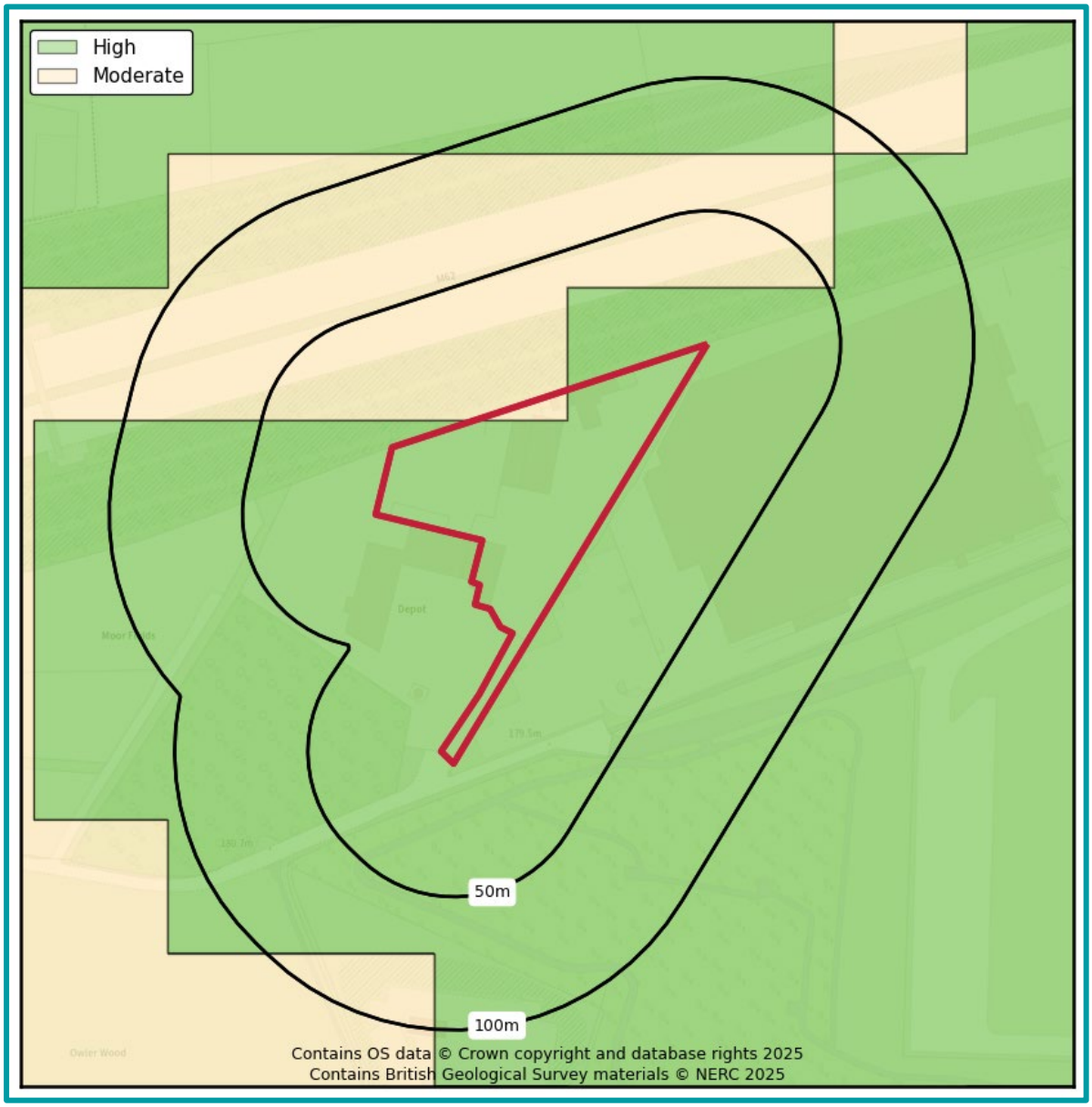
Exceedance flows are directed towards non-essential areas on-Site.

3 Site analysis

Site location

Figure 2. Aerial Imagery (Bluesky, 2025)

Figure 3. SuDS infiltration suitability (SD50) map (GeoSmart, 2025)



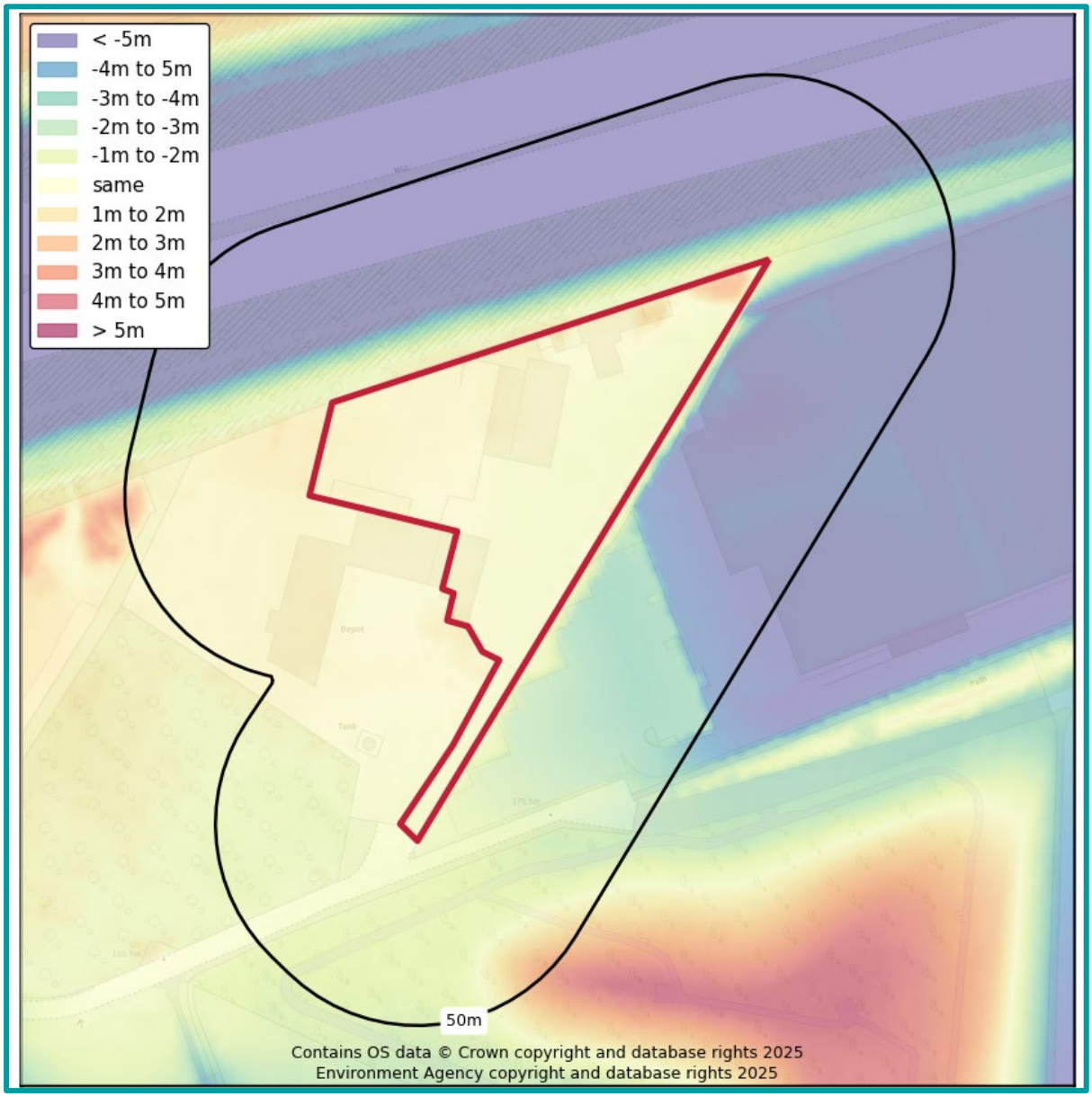
The GeoSmart SuDS Infiltration Suitability Map (SD50) screens the potential for infiltration drainage at the Site and indicates where further assessment is recommended. The map combines information on the thickness and permeability of the underlying material and the depth to the high groundwater table.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

There is a Moderate to High potential for infiltration SuDS across the Site. It is likely that the underlying geology at the Site has high permeability and an infiltration SuDS scheme should be possible at the Site.

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

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

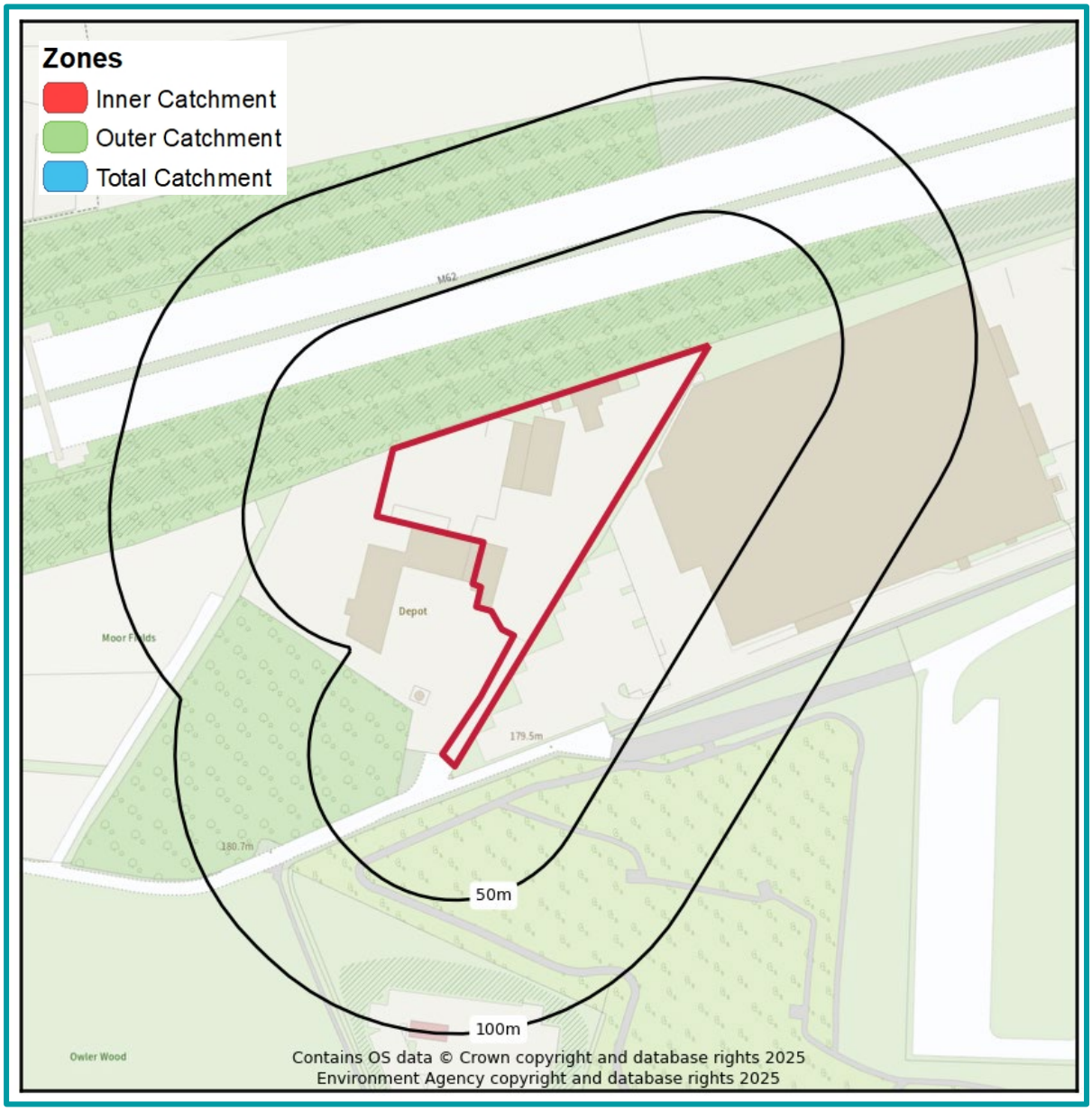
Figure 4. Site topography (GeoSmart, 2025)



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, with a very gradual slope to the south.

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

Figure 5. Source protection zone map (EA, 2025)

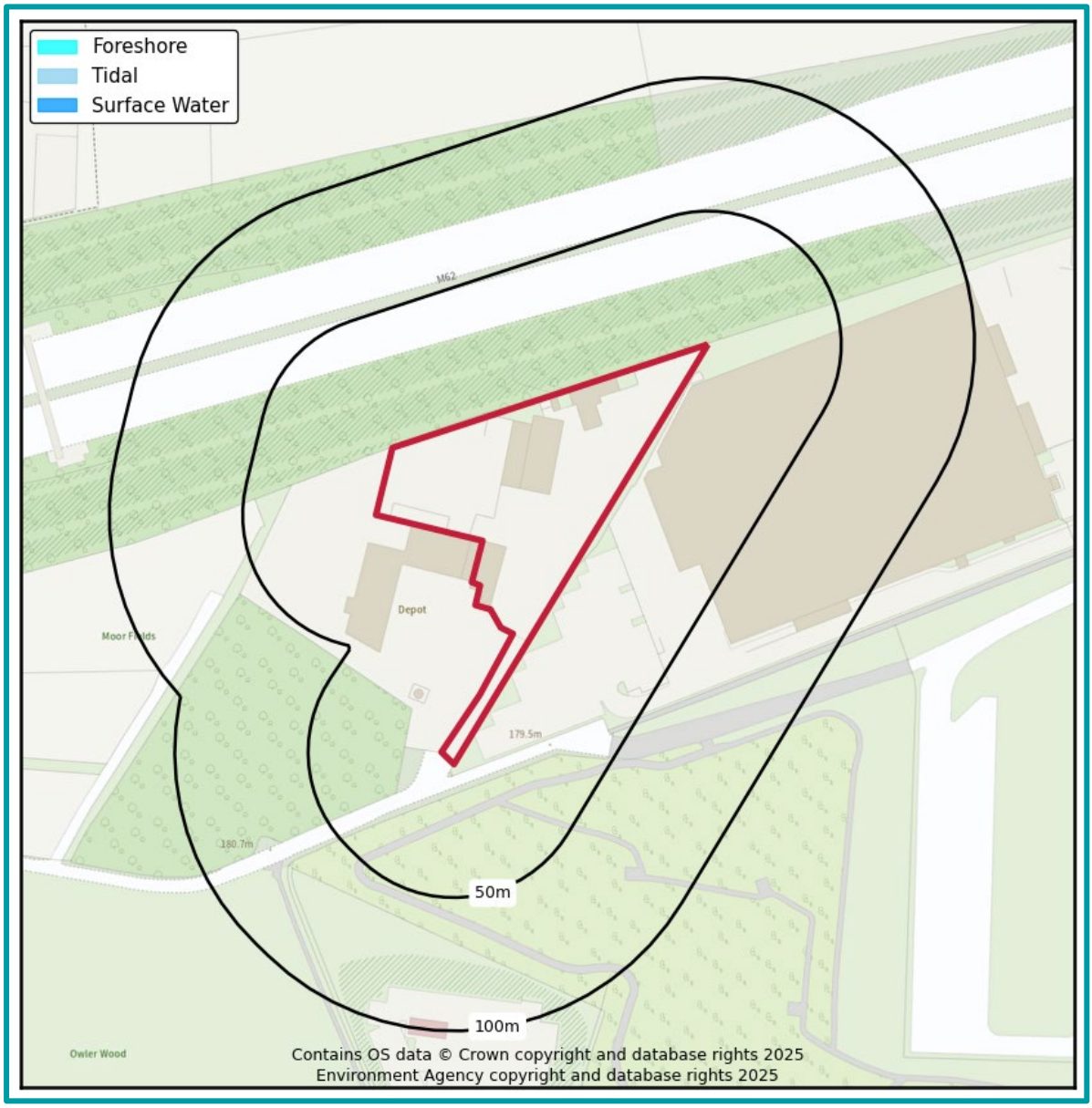


An assessment of the EA's groundwater Source Protection Zones (SPZs) has been undertaken within the vicinity of the Site and confirms the Site is not located within an SPZ.

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

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

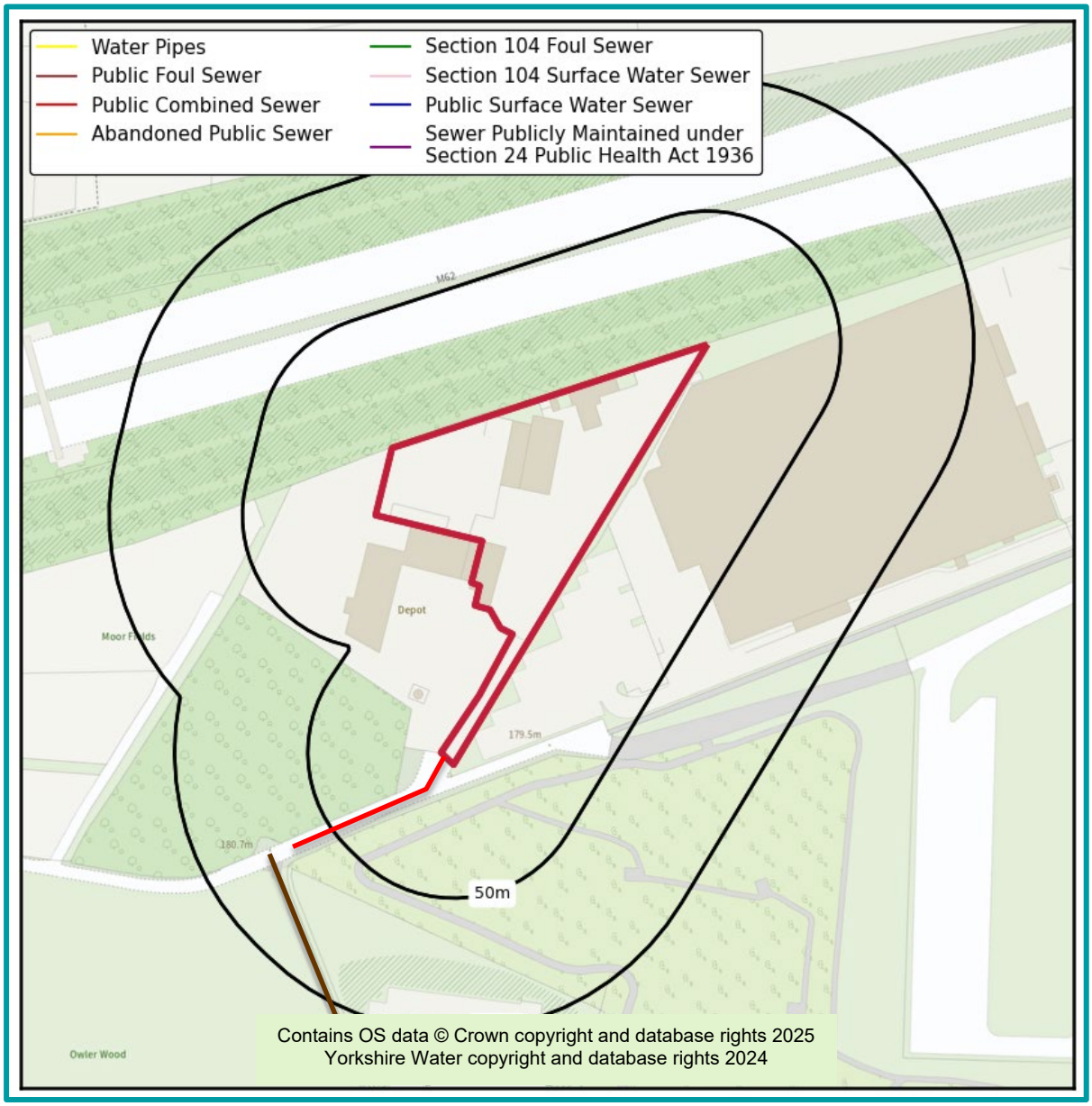
Figure 6. Surface water features map (EA, 2025)



Ordnance Survey (OS) mapping indicates that there are no surface water features within 100 m of the Site. Therefore, discharge to surface water feature is not feasible.

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

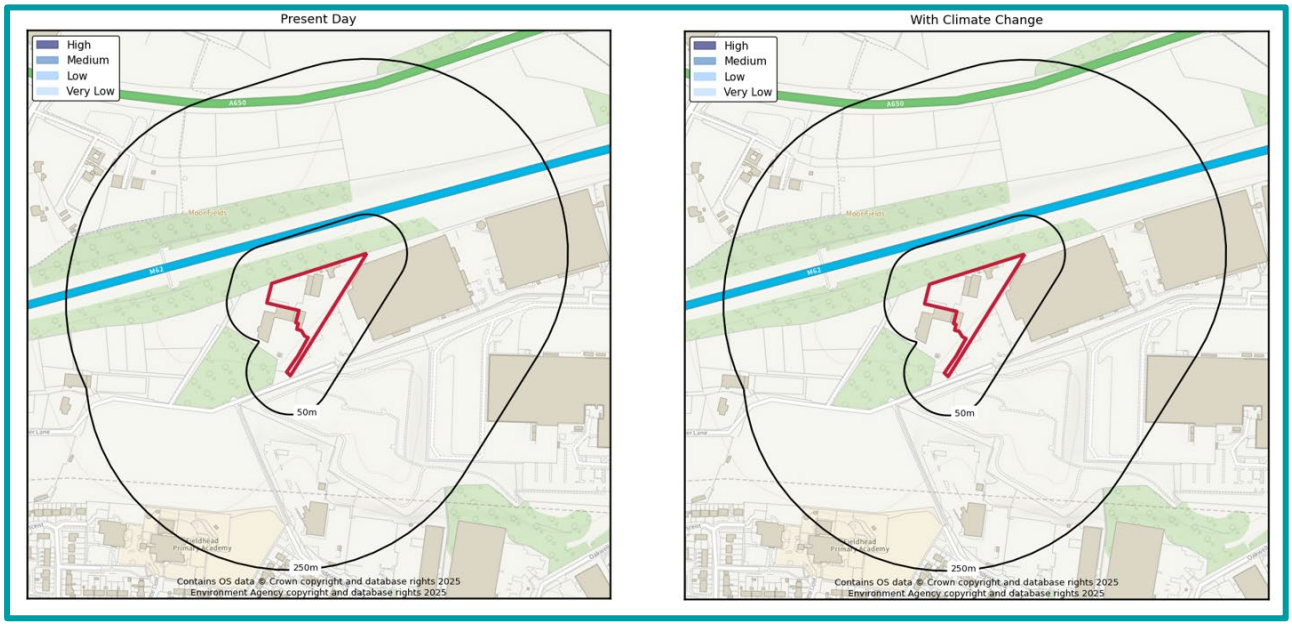
Figure 7. Sewer features map (OS, 2025)



GeoSmart has undertaken an assessment of the location of sewer features within the vicinity of the Site. There is a public combined sewer, located adjacent to the south of the Site; therefore, discharge to sewer is likely to be appropriate. The asset location plan (Appendix C) also confirms that the current properties are connected to the public sewer.

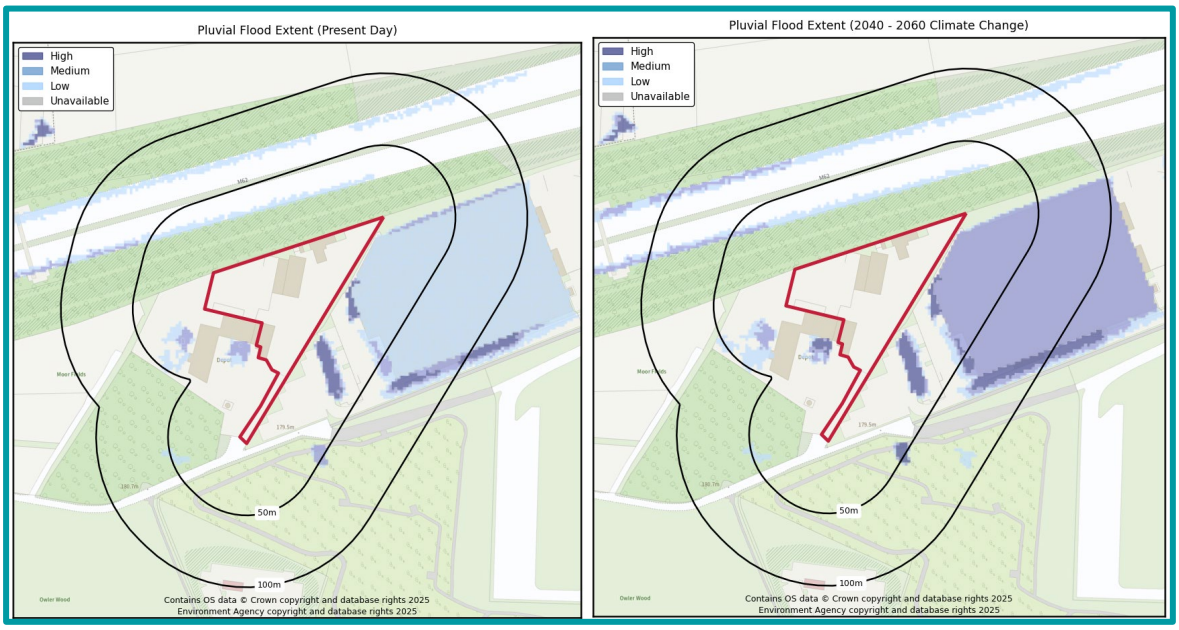
Further analysis of the connections and condition of the public surface water drainage system should be undertaken by carrying out a CCTV survey or by contacting the drainage provider or the Local Council to confirm the presence, location and condition of the sewer. Consultation with the drainage provider would also be required to determine that sufficient capacity is available to accept the proposed discharge, and to gain permission to connect if required.

Figure 8. Risk of flooding from rivers & sea map (EA, 2025)



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 in both the present day and climate change (2035 to 2069) scenarios, with less than 0.1% annual probability of flooding. Therefore, the SuDS design is unlikely to be affected.

Figure 9. Risk of surface water flooding map (EA,2025)

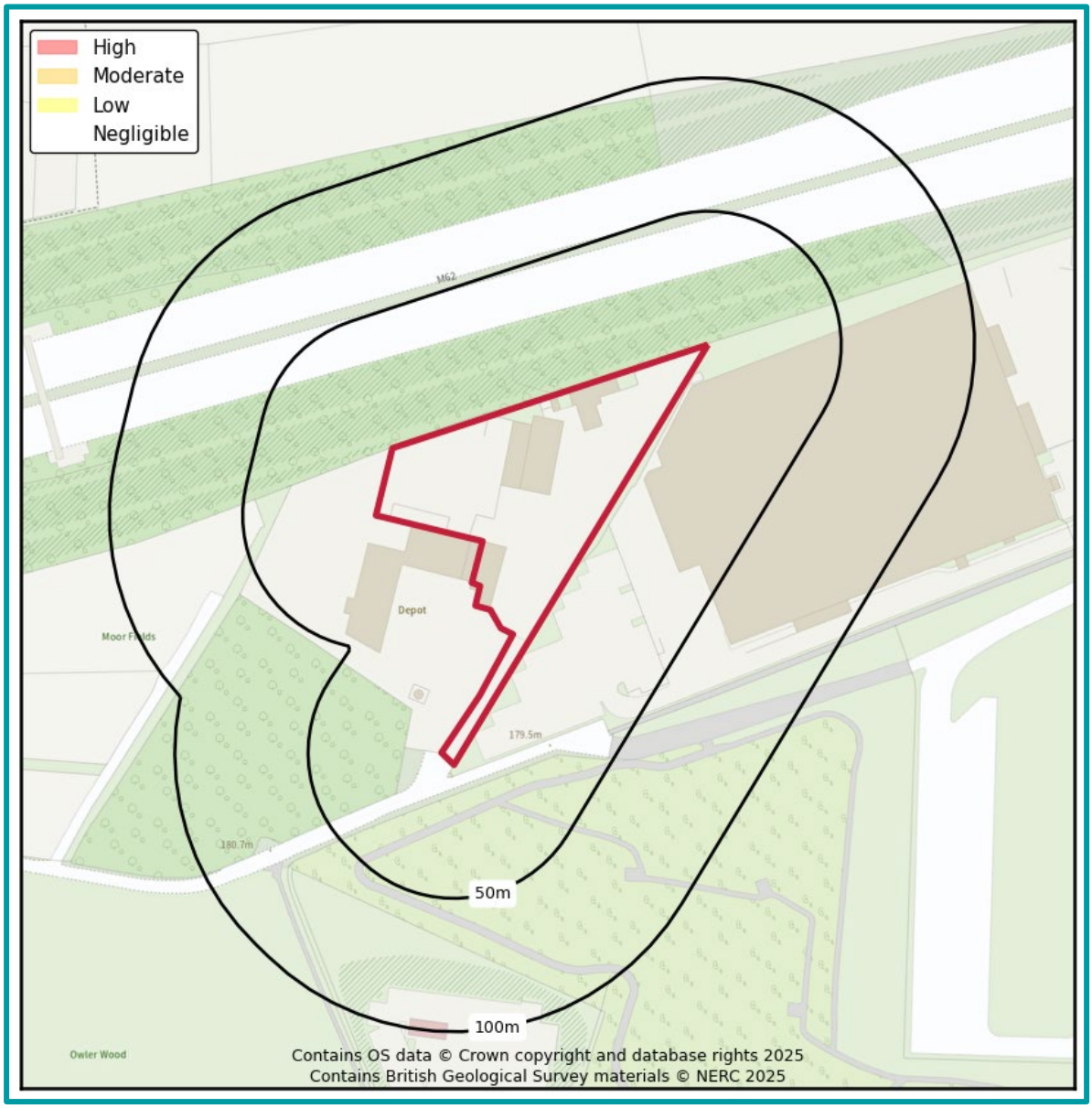


GeoSmart have undertaken an assessment of the risk of flooding from surface water (pluvial) sources within the vicinity of the Site using the EA's Risk of Flooding from Surface Water (RoFSW) mapping. The EA's mapping confirms the Site is considered to be at Very Low risk of surface water flooding.

The above map shows the extent and depth of flooding during the >3.3% annual probability (AEP) (1 in 30 year – High risk), 3.3 – 1% AEP (1 in 100 year – Medium risk) and 1 – 0.1% AEP (1 in 1000 year – Low risk) events. This confirms that there are no areas of the Site which would be affected by surface water flooding during both the present day and climate change (2050s) scenarios.

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

Figure 10. Groundwater flood risk (GW5) map (GeoSmart, 2025)



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 at Owler Lane, Birstall, Leeds, WF17 9BW (the Site). The Site is located on the outskirts of Birstall in a setting of commercial and industrial land use. The land slopes slightly to the south from 183 mAOD to 180 mAOD. This is based on EA elevation data obtained for the Site to a 1 m resolution with a vertical accuracy of ±150 mm. Site plans and drawings are provided in Appendix A.

Development

The Site is currently used within a commercial capacity. At present there are three large industrial buildings present, with a large area of hardstanding containing multiple shipping containers and vehicles. Development proposals comprise the demolition of two of the existing buildings and the construction of two new units, an office building and a material recovery facility along with associated parking. A weighbridge, storage area and secure storage are also proposed.

Due to the use of the Site as a commercial and domestic waste services facility, infiltration is not considered within the north-western section of the Site due to water quality concerns. The client has confirmed that this area will be self-contained and no contaminated runoff will reach the rest of the Site where it may infiltrate into ground.

Geology, permeability and thickness

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

Table 3. Site Geology

Geology present on-Site		Potentially permeable?
Superficial geology (Figure 12)	No underlying superficial deposits	N/A
Bedrock geology (Figure 13)	Emley Rock (ER) – sandstone with mudstone partings	✓

The BGS website was used to extract ground information from the nearest borehole record to the Site (ref: SE22NW125). This borehole is located approximately 30m to the north of the Site at an elevation of 181.6 mAOD.

The borehole record confirms the underlying geology is comprised of topsoil to a depth of 0.3 m below ground level (bgl), underlain by clay and sandstone to a depth of 2.0m bgl, underlain by sandstone to a depth of 4.3m bgl, underlain by siltstone to a depth of 5.6m bgl, underlain by a coal seam to a depth of 6.2m bgl, underlain by mudstone to a depth of 7.5m bgl, underlain by siltstone to a depth of 15.2m bgl where this borehole was terminated.

Depth to groundwater

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

No groundwater was observed in the above borehole (ref: SE22NW125) or in any other nearby boreholes.

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

Figure 11. Superficial Geology (BGS, 2025)

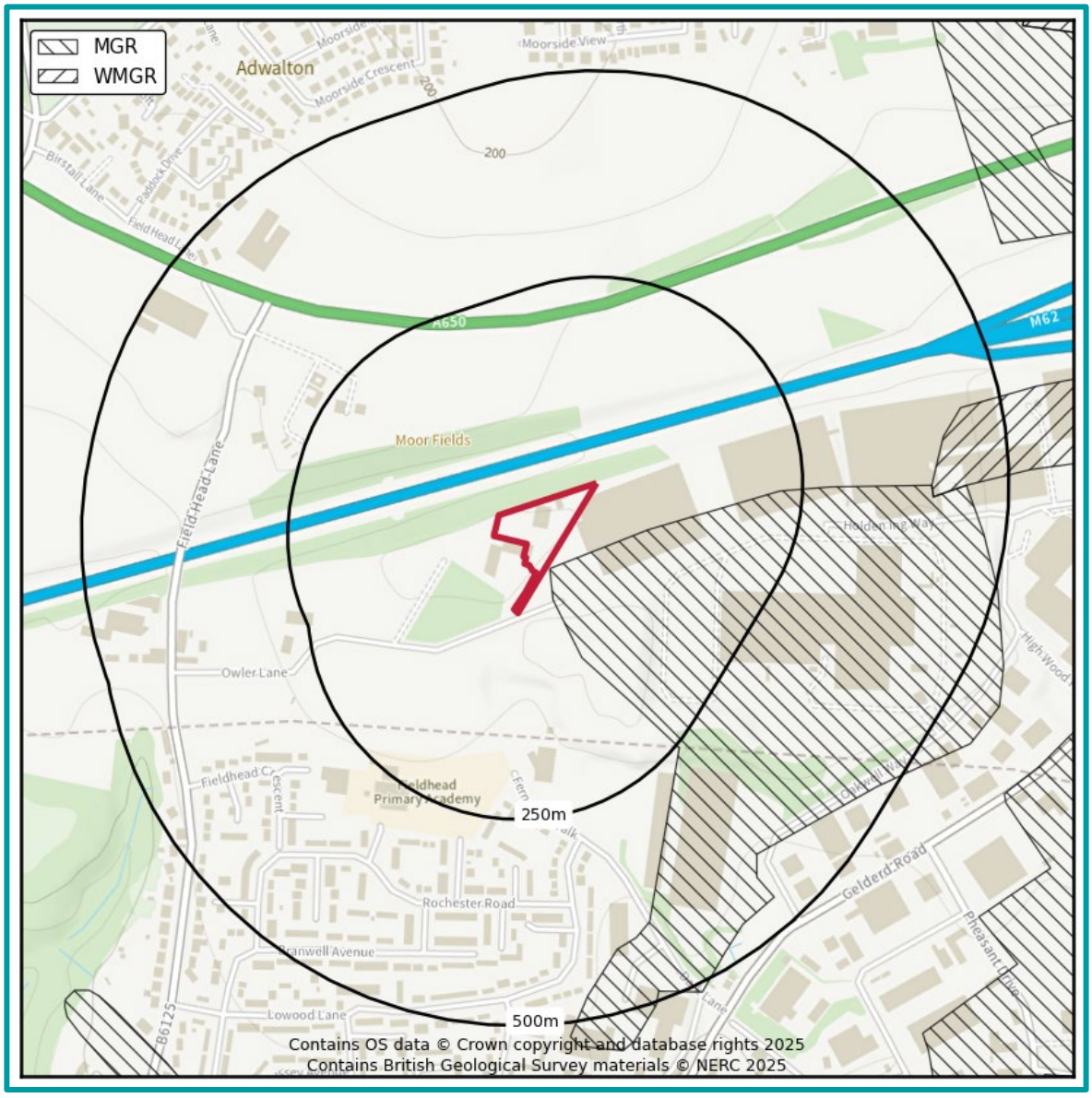
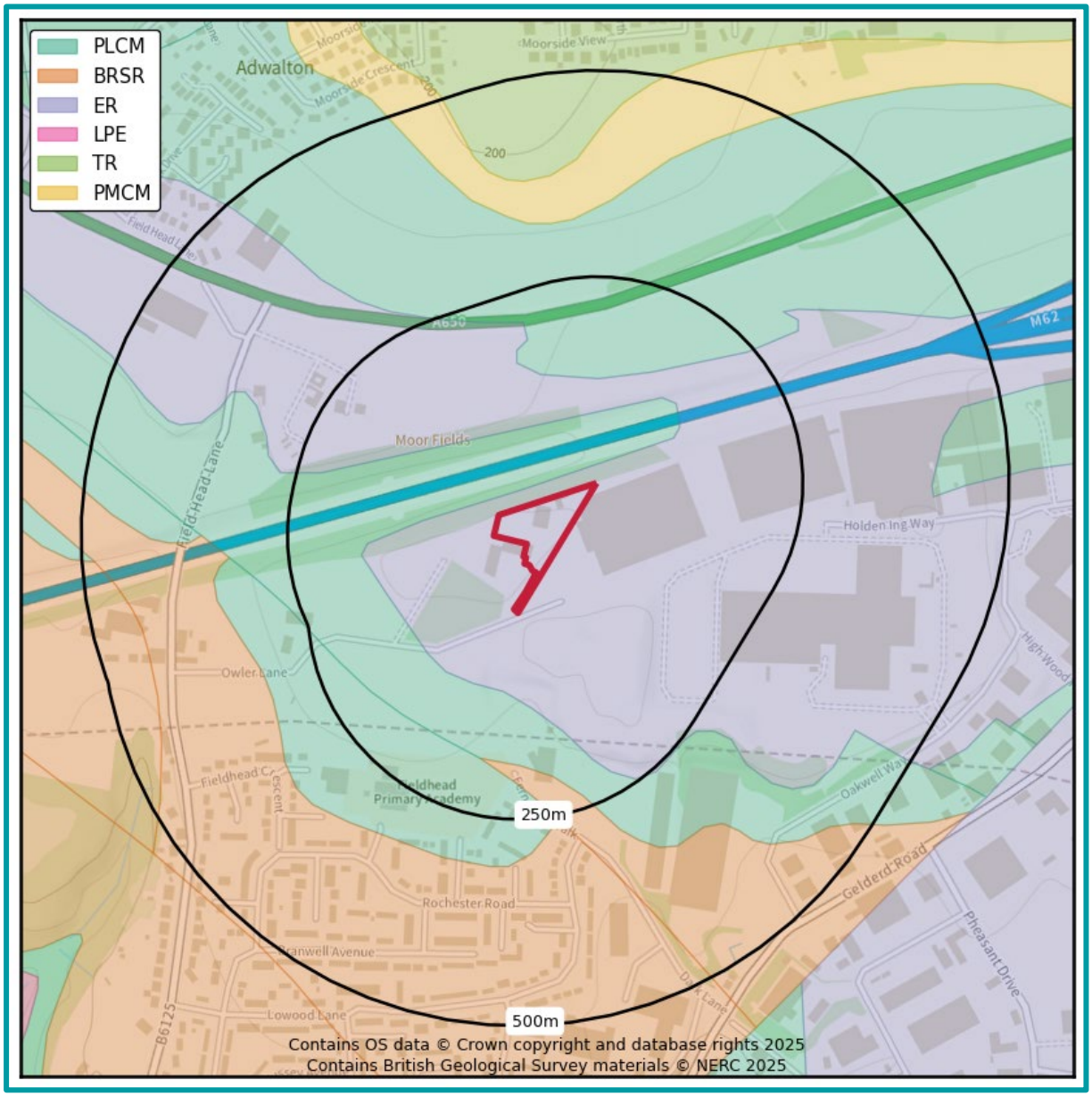


Figure 12. Bedrock Geology (BGS, 2025)



Ground conditions

Infiltration SuDS are proposed within permeable bedrock deposits. A detailed review of underlying ground conditions is therefore recommended to ensure focused infiltration does not cause ground instability as a result of landslide or collapse associated with running sand.

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

Water quality

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

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.

Due to the use of the Site as a commercial and domestic waste services facility, infiltration is not considered within the north-western section of the Site due to water quality concerns. The client has confirmed that this area will be self-contained and no contaminated runoff will reach the rest of the Site where it may infiltrate into ground.

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 (2022)

The Peak rainfall intensity allowances section provides advice on the increased rainfall effects on river levels and land and urban drainage systems. As of May 2022, the applicable climate change allowance is defined by specific Management Catchment for the 1 in 30 (≥ 3.3% AEP) and 1 in 100 (< 3.3 to 1% AEP) year event.

As the Site is located within the Aire and Calder Management Catchment the following climate change allowances are applicable.

Table 4. Aire and Calder Management Catchment peak rainfall allowances

Aire and Calder Management Catchment	3.3% Annual exceedance rainfall event		1% Annual exceedance rainfall event	
	2050s	2070s	2050s	2070s
Central	20%	25%	25%	30%
Upper end	35%	40%	40%	45%

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

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

Local Policy

Kirklees Local Plan Strategy and Policies (February, 2019).

Policy LP28

Drainage

The presumption is that Sustainable Drainage Systems (SuDS) will be used to assist in achieving the following on each site:

a. for proposals on greenfield sites, typical greenfield run-off rates should not be exceeded;

b. for proposals on brownfield sites there should be a minimum 30% reduction in surface water run-off where previous positive surface water connections from the site can be proven. New connections will be subject to at least greenfield restrictions;

c. No negative impact on local water quality and improvements in water quality where practicable;

d. Consider whether proposed open spaces and green infrastructure within sites can contribute to the sustainable drainage of the site.

Local conditions including the existence of critical drainage areas may require a lower run-off rate to be agreed to reflect volume control, local surface water risks, water course capacity and flood risk further downstream.

There will be a general presumption against pumping surface water. It must also be demonstrated that the surface water management solution is designed to meet requirements over the lifetime of the development including evidence that management and maintenance arrangements have been secured to cover that period. This includes ensuring proposals to store water meet national standards and latest best practice.

Flow paths accommodating water from outside the site or due to an exceedance event should be designed to avoid buildings and curtilages.

Development will only be permitted if it can be demonstrated that the water supply and waste water infrastructure required is available or can be co-ordinated to meet the demand generated by the new development.

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.

The primary strategy involves the majority of the Site infiltrating into ground, with a small area to the north-west (indicated in Figure 1) discharging to the nearby combined sewer system due to contamination concerns.

Should infiltration not be possible at the Site, the secondary strategy proposes all runoff to discharge to the nearby combined sewer system via an attenuation tank.

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

Attenuation scenario	Attenuation required (m^3)	Explanation
1 in 100 year including 45% CC	140.13	Attenuation required to ensure surface water runoff is attenuated in all storm events up to and including the 1 in 100 year event including a 45% allowance for climate change. Calculations are based on an assumed infiltration rate of $1x\ 10^{-5}$ m/s (the worst-case infiltration rate for 'slightly silty, slightly clayey sand' soil types, taken from Table 25.1 of the CIRIA SuDS manual (C753) (2015) – to be confirmed via infiltration testing).

Table 6. Storage requirements within the proposed self-contained area (Discharge runoff to combined sewer) (primary strategy)

Attenuation scenario		Attenuation required (m^3)	Explanation	
Primary strategy (partial discharge)				
Discharge runoff to combined sewer	1 in 30 year	52.42	Attenuation required to ensure surface water runoff is attenuated in all storm events up to and including the 1 in 30 year (4 hour, Critical Storm Duration) event*. Flooding of the Site of 18.45 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 45.95 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 45% allowance for climate change.
	1 in 100 year	70.88	Attenuation required to ensure surface water runoff is attenuated in all storm events up to and including the 1 in 100 year (5 hour, Critical Storm Duration) event*.	
	1 in 100 year including 45% CC	116.82	Attenuation required to ensure surface water runoff is attenuated in all storm events up to and including the 1 in 100 year (8 hour, Critical Storm Duration) event including a 45% 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.

Table 7. Storage requirements at the proposed development Site (Discharge runoff to combined sewer) (secondary strategy)

Attenuation scenario		Attenuation required (m^3)	Explanation	
Secondary strategy				
Discharge runoff to combined sewer	1 in 30 year	199.92	Attenuation required to ensure surface water runoff is attenuated in all storm events up to and including the 1 in 30 year (4 hour, Critical Storm Duration) event*. Flooding of the Site of 70.20 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 175.40 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 45% allowance for climate change.
	1 in 100 year	270.11	Attenuation required to ensure surface water runoff is attenuated in all storm events up to and including the 1 in 100 year (5 hour, Critical Storm Duration) event*.	
	1 in 100 year including 45% CC	445.51	Attenuation required to ensure surface water runoff is attenuated in all storm events up to and including the 1 in 100 year (10 hour, Critical Storm Duration) event including a 45% 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 8. Change in impermeable area associated with the development

Total Site area	6,058 m^2
Impermeable area (and as a percentage of the total area of the proposed development footprint of 6,058 m^2)	
Pre-development	Post-development
6,058 m^2 (100%)	3,755 m^2 (62%)
Impermeable land use: Commercial purposes, storage and car park Permeable land use: N/A	New impermeable land use: Material recovery facility, three commercial units, a commercial office and hardstanding New permeable land use: Permeable paving* (2,303 m^2)

*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 9. Peak discharge rates associated with the development (primary strategy – partial discharge)

Rainfall event	Greenfield runoff rates (l/s)	Existing runoff rates[1] (l/s)	Potential runoff rates without attenuation (l/s)	Potential minus existing (l/s)
QBAR	0.85	N/A	N/A	N/A
6 hour 1 in 1 year	0.72	1.83	1.83	0.00
6 hour 1 in 10 year	1.24	2.82	2.82	0.00
6 hour 1 in 30 year	1.49	3.66	3.66	0.00
6 hour 1 in 100 year	1.77	4.57	4.57	0.00
6 hour 1 in 100 year + 20% CC	N/A	N/A	5.49	0.91
6 hour 1 in 100 year + 45% CC	N/A	N/A	6.63	2.06

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

Table 10. Peak discharge rates associated with the development (secondary strategy)

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	3.23	N/A	N/A	N/A
6 hour 1 in 1 year	2.74	6.92	6.92	0.00
6 hour 1 in 10 year	4.68	10.68	10.68	0.00
6 hour 1 in 30 year	5.64	13.84	13.84	0.00
6 hour 1 in 100 year	6.71	17.29	17.29	0.00
6 hour 1 in 100 year + 20% CC	N/A	N/A	20.75	3.46
6 hour 1 in 100 year + 45% CC	N/A	N/A	25.07	7.78

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

Relevant national, regional and local planning policy has been consulted in Section 5 to determine restrictions on runoff from previously developed and greenfield sites. In some cases, greenfield rates may be requested, but in practice it is difficult to restrict discharge rates at any one control point to this 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'.

Table 11. Total discharge volumes associated with the development (primary strategy – partial discharge)

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	19.67	N/A	N/A	N/A
6 hour 1 in 1 year	18.57	39.51	39.51	0.00
6 hour 1 in 10 year	29.76	60.99	60.99	0.00
6 hour 1 in 30 year	37.17	79.07	79.07	0.00
6 hour 1 in 100 year	46.42	98.76	98.76	0.00
6 hour 1 in 100 year + 20% CC	N/A	N/A	118.52	19.75
6 hour 1 in 100 year + 45% CC	N/A	N/A	143.21	44.44

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

Table 12. Total discharge volumes associated with the development (secondary strategy)

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	74.40	N/A	N/A	N/A
6 hour 1 in 1 year	70.21	149.39	149.39	0.00
6 hour 1 in 10 year	112.55	230.63	230.63	0.00
6 hour 1 in 30 year	140.54	299.02	299.02	0.00
6 hour 1 in 100 year	175.53	373.48	373.48	0.00
6 hour 1 in 100 year + 20% CC	N/A	N/A	448.17	74.70
6 hour 1 in 100 year + 45% CC	N/A	N/A	541.54	168.06

[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 (45%) 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 1.30 l/s in the primary strategy and 4.80 l/s in the secondary strategy (both a 30% reduction in surface water run-off compared to the existing 1 in 1 year runoff rate, as stated in Policy LP28 of the Kirklees Local Plan Strategy and Policies).

Table 13. Critical Storm Duration and Attenuation volume requirements (primary strategy)*

Return Period	Runoff rate restriction (l/s)	Critical Storm Duration (hr)	Attenuation volume required (m^3)
1 in 30 year	1.30	4.00	52.42
1 in 100 year	1.30	5.00	70.88
1 in 100 year including a 45% climate change	1.30	8.00	116.82

*It should be noted that these calculations only apply to the north-western corner of the Site, which will drain to sewer due to water quality concerns. The remainder of the Site will require additional attenuation prior to discharge to ground (as shown within Table 5).

Table 14. Critical Storm Duration and Attenuation volume requirements (secondary strategy)

Return Period	Runoff rate restriction (l/s)	Critical Storm Duration (hr)	Attenuation volume required (m^3)
1 in 30 year	4.80	4.00	199.92
1 in 100 year	4.80	5.00	270.11
1 in 100 year including a 45% climate change	4.80	10.00	445.51

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 a Moderate to High potential for infiltration within the permeable underlying bedrock (Emley Rock).

There are known issues identified relating to Site contamination, but the Site is not located within a SPZ. Due to the use of the Site as a commercial and domestic waste services facility, infiltration is not considered within the north-western section of the Site due to water quality concerns. The client has confirmed that this area will be self-contained and no contaminated runoff will reach the rest of the Site where it may infiltrate into ground.

As such, infiltration is considered to be feasible across the majority of the Site. The primary strategy for the disposal of runoff therefore proposes the use of infiltration across the majority of the Site, with runoff from the north-western area discharged to sewer.

Discharge to surface watercourse

Ordnance Survey (OS) mapping indicates that there are no surface water features within 100 m of the Site. Therefore, discharge to surface water feature is not feasible.

Discharge to sewer

An assessment of the location of sewer features within the vicinity of the Site (Yorkshire Water, 2024) has been provided by the client. There is a public combined sewer, located adjacent to the south of the Site; therefore, discharge to sewer is likely to be appropriate. Runoff from the north-western corner of the Site is proposed to be discharged to sewer due to water quality concerns as part of the primary strategy, with the remainder of the Site utilizing infiltration SuDS.

It is understood that the existing Site drainage is to the sewer; the existing connection to the sewer could potentially be utilised. If required consultation with the local sewer undertaker should be undertaken. Discharge must be controlled and on-Site attenuation is required.

The topographic gradient on the Site slopes slightly to the south from 183 mAOD to 180 mAOD towards the public sewer network, and therefore runoff from the majority of the Site could be drained via gravity.

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 Low (roof water) to High hazard (runoff from areas used for the handling and storage of chemicals). The Site does not lie within an SPZ and therefore additional treatment stages are not required.

Table 15. 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).

*It should be noted that the client has confirmed that the area containing the High hazard will be self-contained and no contaminated runoff will reach the rest of the Site where it may infiltrate into ground.

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

Table 16. 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.

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 conducive to infiltration. Therefore, surface water runoff from the majority of the Site will be managed within SuDS features and infiltrated to ground.

However, due to the use of the Site as a commercial and domestic waste services facility, infiltration is not considered within the north-western section of the Site due to water quality concerns. The client has confirmed that this area will be self-contained and no contaminated runoff will reach the rest of the Site where it may infiltrate into ground. Runoff from this area is proposed to be attenuated within SuDS features prior to being discharged to sewer.

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

SuDS type	Source control (interception), attenuation and infiltration SuDS.
SuDS features	Rainwater harvesting tanks, permeable paving, two soakaways and an attenuation tank.
Discharge location	Infiltration (majority of Site area) / public combined sewer network (self-contained area in north-western corner of Site).
Discharge rate	1 x 10^{-5} m/s (where infiltration is proposed) / 1.30 l/s (where discharge to sewer is proposed).

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

Rainwater Harvesting	Rainwater harvesting tanks can be established for each proposed building. 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 strategy. Water from these tanks can be used to supply toilets with grey water. Alternatively, the water can be utilised for other approved uses across the Site deemed appropriate.

Unlined permeable paving	Within the area for infiltration into ground, a 2,303 m^2 area of permeable paving (underlain with a Type 3 aggregate material) is proposed. This area will be designed to drain itself and is therefore not proposed to provide attenuation.
Soakaway	Two soakaways filled with geo-cellular crates with a 95% void ratio are proposed. A soakaway with a width of 4.00 m, length of 4.50 m and a depth of 1.20 m is proposed to infiltrate runoff from Unit 1 and the office (Figure 1). This soakaway will provide c. 20.52 m^3 of attenuation. A soakaway with a width of 10.00 m, length of 12.25 m and a depth of 1.00 m is proposed to infiltrate runoff from Unit 2, Unit 3 and all areas of hardstanding (Figure 1). This soakaway will provide c. 116.38 m^3 of attenuation. Both soakaways will provide c. 136.90 m^3 attenuation.
Attenuation tank	Within the self-contained area in the north-west of the Site, an attenuation tank with a length of 10.5 m, width of 12 m and depth of 1.0 m, filled with geo-cellular crates with a 95% void ratio, would provide c. 119.7 m^3 attenuation.
Total Attenuation Provided	256.60 m^3
Total Attenuation Required	253.93 m^3
Freeboard Storage Provided	2.67 m^3

Rainwater harvesting

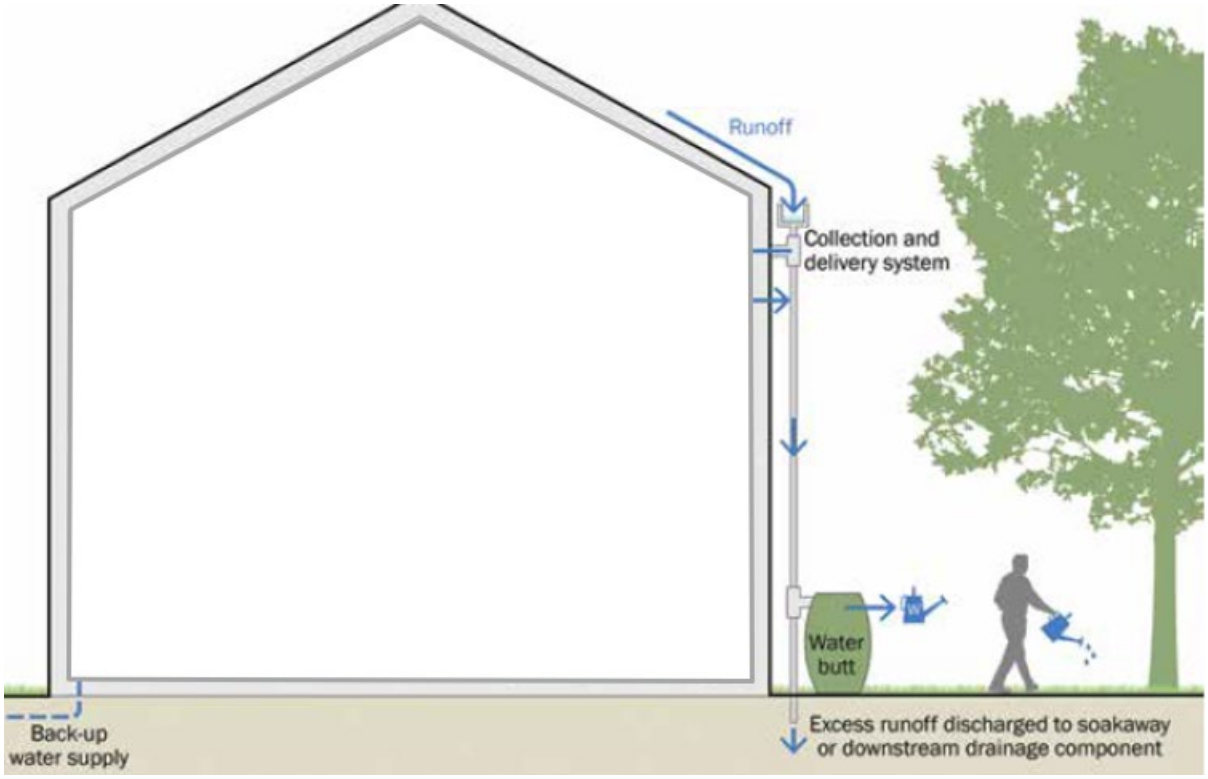
Rainwater harvesting tanks are proposed. The run-off from roofs should be led into rainwater harvesting tanks via rainwater downpipes and guttering to catch run-off from the roof. Overflow from the tanks should be discharged into the storage system provided by the soakaway or attenuation tank.

Due to the relatively insignificant amounts of attenuation provided by rainwater harvesting tanks in this instance and the potential requirement to retain water for non-potable uses, 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 customers 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 tank and first flush devices can be designed to divert the first part of the rainfall away from the main storage tank and can pick up most of the dirt, debris and contaminates that collect on a roof.



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

Permeable paving

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

The geotextile layer works to intercept silt/particles flowing through the system via direct rainfall, or through vehicle use deposited onto the car park area and into the permeable paving. The majority of silt would be trapped within the top 30mm of the joining material

between the paving blocks. Rainfall flowing into the permeable paving directly from the development roof/rainwater tanks 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 tanks should extend through the paving for c.5 meters to divert roof run-off away from building foundations. Paving could also implement an impermeable liner close to the building or creating a separate compartment within the permeable sub-base close to the building to further divert attenuated water away from building foundations.

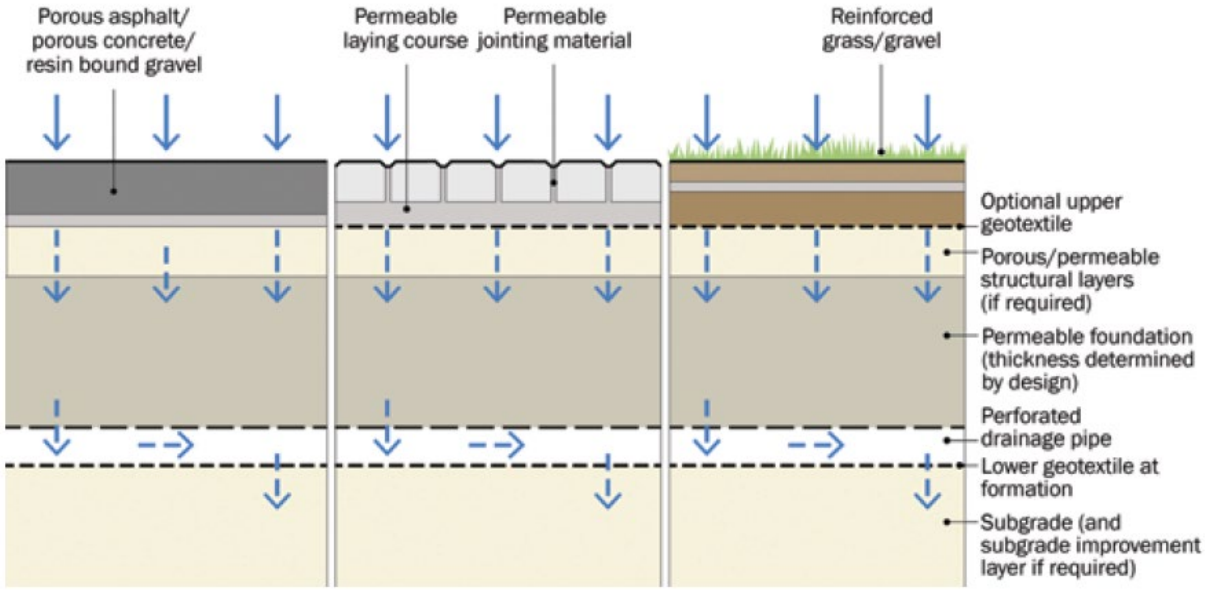


Figure 20.13 of the CIRIA SuDS Manual (C753) (2015)

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.

Soakaways

Two soakaways should be used to store run-off and infiltrate collected water gradually into the ground in the south-east of the Site. Roof water should be collected and conveyed by underground pipes to the proposed soakaways. The base of the infiltration features should lie at an elevation at least 1 m above the highest winter groundwater levels, to ensure there is sufficient space for surface water to discharge. Soakaway excavation should be outside of the root zone of any protected trees and dimensions will depend on the depth to the sand layer where the soakaway is eventually situated.

Draining via a soakaway means that property owners are less likely to pay for the utility company to drain surface water. In terms of future ownership and maintenance, where a soakaway drains a single property, the ownership and maintenance would be the property owner's responsibility. When a soakaway drains several properties, an agreement would have to be made between the property owners with regards to the maintenance. However, in the

new sewers for adoption guidance, utility providers may adopt private soakaways and provide the necessary maintenance:

Soakaways: Adoption would normally include the whole structure up to the external face, including any external rubble fill or membrane.

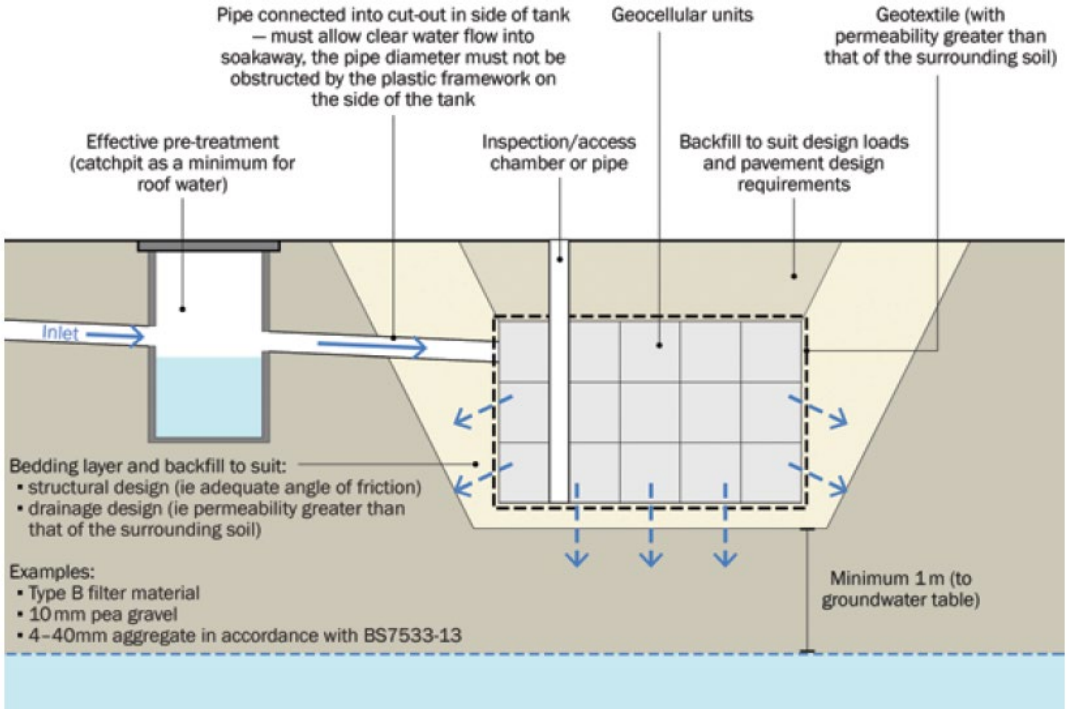


Figure 13.1 of the CIRIA SuDS Manual (C753) (2015)

Attenuation tanks

Glass reinforced plastic (GRP) tanks or geo-cellular storage tanks/crates are proposed to provide the storage required. Attenuation tanks provide a below-ground void space for use of temporary storage via controlled release. They can also be modified to suit specific characteristics of a site. DEFRA, 2015 states that the run-off volume from the development to drain to any sewer or surface water body in the 1 in 100 year rainfall event must be constrained to a value as close as is reasonably practical to the greenfield runoff volume for the same event but should never exceed the runoff volume from the development prior to redevelopment from the Site.

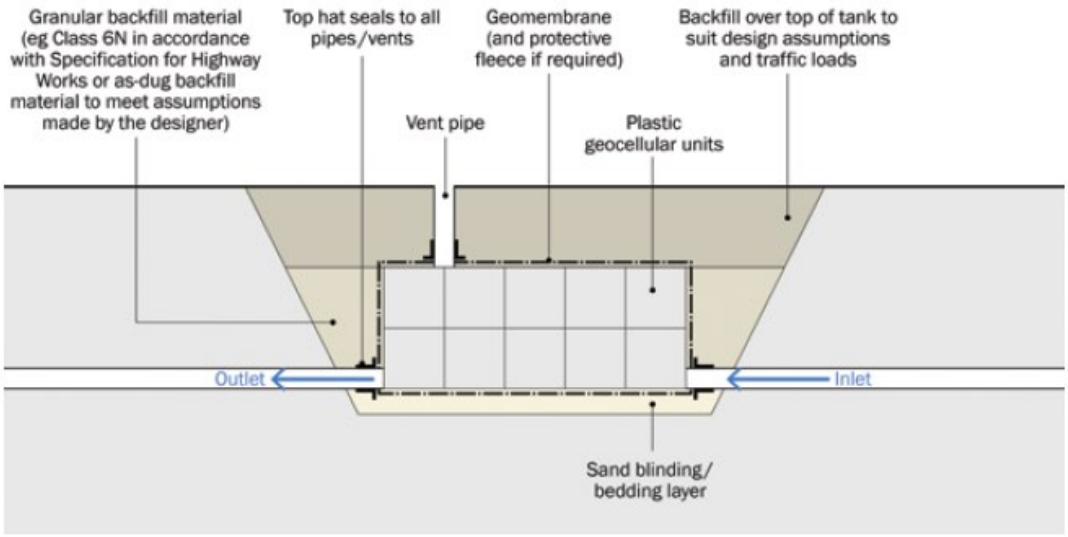


Figure 21.4 of the CIRIA SuDS Manual (C753) (2015)

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 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 car parking areas. The SuDS system recommended for the Site should provide enough storage that this method would only be utilised during a worst case scenario.

Secondary SuDS Strategy:

Where infiltration to ground is not achievable at the Site, the entirety of the Site should drain to the public combined sewer. An attenuation volume of 445.51 m³ should be stored within

lined SuDS features to accommodate the calculated 10 hour Critical Storm Duration for surface water discharge runoff, restricted to 4.8 l/s (a 30% reduction in surface water run-off from existing, as stated in Policy LP28 of the Kirklees Local Plan Strategy and Policies).

Table 19. Proposed SuDS type, features, discharge location and rate restriction

SuDS type	Source control (interception) and attenuation SuDS.
SuDS features	Rainwater harvesting tanks, lined permeable paving and an attenuation tank.
Discharge location	Public combined sewer network.
Discharge rate	4.8 l/s (a 30% reduction in surface water run-off from existing, as stated in Policy LP28 of the Kirklees Local Plan Strategy and Policies).

Table 20. Proposed SuDS sizing (dimensions) and attenuation volumes

Rainwater Harvesting	Rainwater harvesting tanks can be established for each proposed building. 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 strategy. Water from these tanks can be used to supply toilets with grey water. Alternatively, the water can be utilised for other approved uses across the Site deemed appropriate.
Lined permeable paving	A 425 m^2 area of lined permeable paving (underlain with a Type 3 aggregate material with a 30% porosity) within the proposed car park areas to a depth of 0.60 m would result in c. 76.5 m^3 attenuation.
Attenuation tank	An attenuation tank with an area of 390 m^2 and to a depth of 1 m in the centre of the Site, filled with geo-cellular crates with a 95% void ratio, would provide 370.5 m^3 of attenuation. Runoff will be discharged to the combined sewer within Owler Lane to the south via a flow control device.
Total Attenuation Provided	447.00 m^3
Total Attenuation Required	445.51 m^3
Freeboard Storage Provided	1.49 m^3

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 21. SuDS operation and recommended maintenance requirements

Asset type	Maintenance schedule (and frequency)
Soakaways	Regular maintenance: • Remove sediment and debris from pretreatment and inspection chamber. Clean gutters, filters, downpipes. Trim roots prevent blockages (annually). • Reconstruct/ clean if performance deteriorates, replace clogged geotextile (as required) Monitoring: • Inspect inlets/outlets, silt traps – note rate of accumulation (monthly). Check water levels and emptying time (annually).
Permeable pavements	Regular maintenance: • Brushing and vacuuming (three times per year). • Trimming any roots and surrounding grass and weeds that may be causing blockages (annually or as required). Monitoring: • Initial inspection (monthly). Inspect for poor performance and inspection chambers (annually).
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).
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.

Asset type	Maintenance schedule (and frequency)
	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).

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 22. 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 23. 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 50 m 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 50 m 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, 2024). 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: 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.

14 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.

Data Sources

Aerial Photography	Contains Ordnance Survey data © Crown copyright and database right 2025 BlueSky copyright and database rights 2025
Bedrock & Superficial Geology	Contains British Geological Survey materials © NERC 2025 Ordnance Survey data © Crown copyright and database right 2025
Flood Risk (RoFRS/Pluvial/Surface Water Features/SPZ)	Environment Agency copyright and database rights 2025 Ordnance Survey data © Crown copyright and database right 2025
Flood Risk (Groundwater) and SuDS infiltration suitability (SD50)	GeoSmart, BGS & OS GW5 (v2.4) Map (GeoSmart, 2025) Contains British Geological Survey materials © NERC 2025 Ordnance Survey data © Crown copyright and database right 2025
Sewer Location	Contains Ordnance Survey data © Crown copyright and database right 2025 Contains Yorkshire Water data 2024
Topographic Data	OS LiDAR/EA Contains Ordnance Survey data © Crown copyright and database right 2025 Environment Agency copyright and database rights 2025

15 Appendices

GeoSmart Information

Appendix A

Site plans

Key

Ownership Boundary

Limit of Proposed Development

Existing Concrete hardstanding

Revision	Date	Change
Rev 1	xx/xx/xx	XXXX

Client

Foxhall Environmental

Plan Title

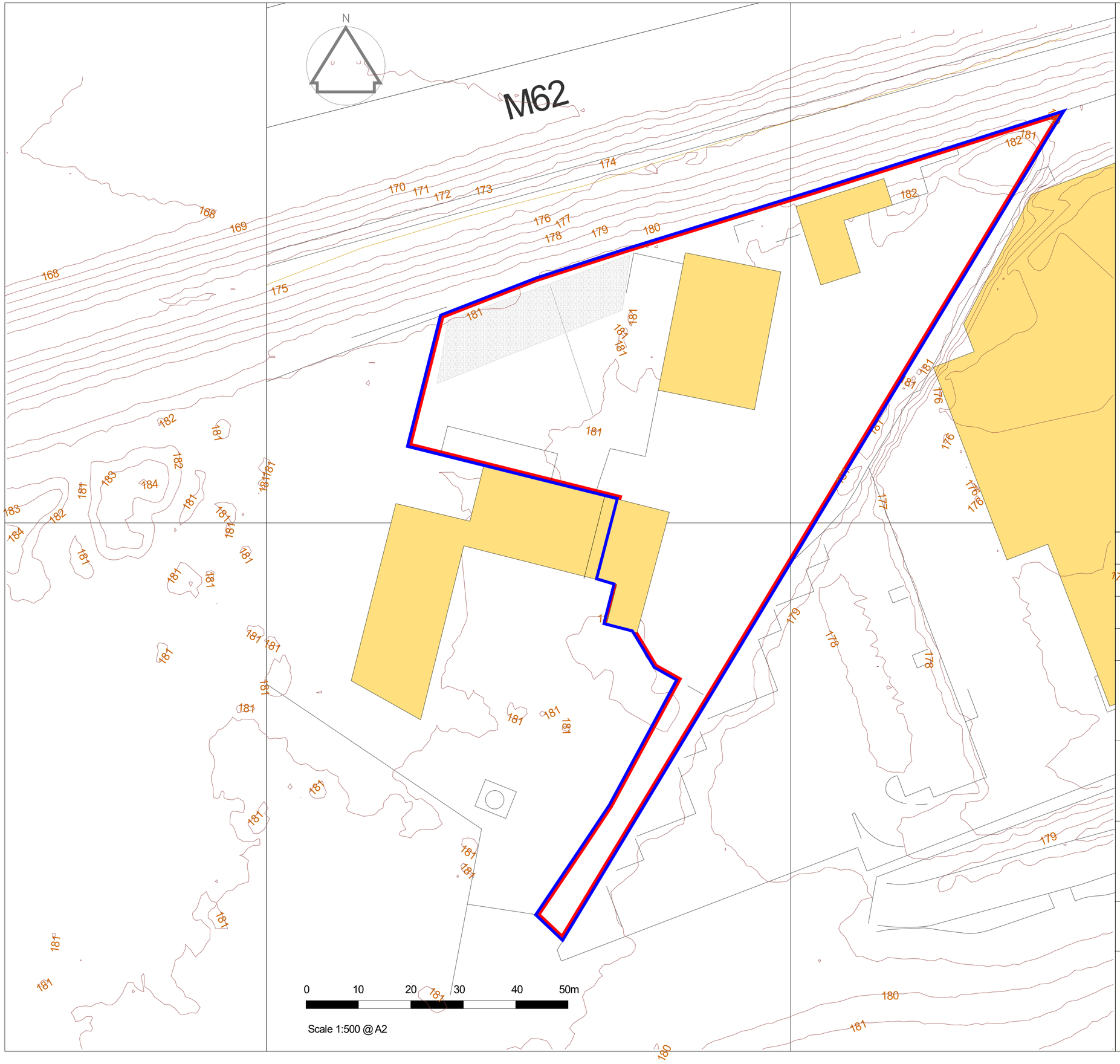
Existing Site Layout

Plan No.

FOX/BIR/IND/PL/02

Drawn	Date	
M Leivers	Sep 2024	

leivers consultancy



Key

Ownership Boundary

Limit of Proposed Development

Existing Concrete hardstanding

Revision	Date	Change
Rev 1	xx/xx/xx	XXXX

Client

Foxhall Environmental

Plan Title

Existing Site Layout

Plan No.

FOX/BIR/IND/PL/02

Drawn	Date	
M Leivers	Sep 2024	

leivers consultancy

Key

Ownership Boundary

Limit of Proposed Development

Existing concrete hardstanding

Block pavement permeable areas

Hardcore surfacing

Revision	Date	Change
Rev 1	xx/xx/xx	XXXX

Client

Foxhall Environmental

Plan Title

Proposed Development Layout

Plan No.

FOX/BIR/IND/PL/03

Drawn	Date	
M Leivers	Sep 2024	

leivers consultancy

GeoSmart Information

Appendix B

Rainfall runoff calculations

Design Settings

Rainfall Methodology	FEH-22	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)
Soakaway 1	0.028	10.000	1.800
Soakaway 2	0.160	10.000	1.600

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Starting Level (m)	
Rainfall Events	Singular	Skip Steady State	x	Check Discharge Rate(s)	x
Summer CV	0.750	Drain Down Time (mins)	240	Check Discharge Volume	x
Winter CV	0.840	Additional Storage (m³/ha)	20.0		

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	45	0	0

Node Soakaway 1 Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.03600	Invert Level (m)	8.200	Depth (m)	1.200
Side Inf Coefficient (m/hr)	0.03600	Time to half empty (mins)	1213	Inf Depth (m)	
Safety Factor	2.0	Pit Width (m)	4.000	Number Required	1
Porosity	0.95	Pit Length (m)	4.500		

Node Soakaway 2 Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.03600	Invert Level (m)	8.400	Depth (m)	1.000
Side Inf Coefficient (m/hr)	0.03600	Time to half empty (mins)	1340	Inf Depth (m)	
Safety Factor	2.0	Pit Width (m)	10.000	Number Required	1
Porosity	0.95	Pit Length (m)	12.250		

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
600 minute winter	Soakaway 1	450	8.450	0.250	0.5	4.3528	0.0000	OK
480 minute winter	Soakaway 2	376	8.598	0.198	3.2	23.4337	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
600 minute winter	Soakaway 1	Infiltration	0.1
480 minute winter	Soakaway 2	Infiltration	0.7

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
600 minute winter	Soakaway 1	570	8.760	0.560	0.9	9.7493	0.0000	OK
600 minute winter	Soakaway 2	570	8.866	0.466	5.2	55.1200	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
600 minute winter	Soakaway 1	Infiltration	0.1
600 minute winter	Soakaway 2	Infiltration	0.7

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
720 minute winter	Soakaway 1	675	8.933	0.733	1.0	12.7580	0.0000	OK
720 minute winter	Soakaway 2	690	9.017	0.617	5.8	72.9800	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
720 minute winter	Soakaway 1	Infiltration	0.2
720 minute winter	Soakaway 2	Infiltration	0.7

Results for 100 year +45% 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	Soakaway 1	1320	9.332	1.132	0.9	19.7094	0.0000	OK
960 minute winter	Soakaway 2	930	9.392	0.992	6.8	117.3983	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
1440 minute winter	Soakaway 1	Infiltration	0.2
960 minute winter	Soakaway 2	Infiltration	0.8

Input parameters for run-off calculations		
Country	England	
Total site area	6058	m^2
Area proposed for development	1602	m^2
Current permeable ground cover	0	m^2
Current impermeable ground cover	1602	m^2
Proposed permeable ground cover	0	m^2
Proposed impermeable ground cover	1602	m^2
Urban Creep Allowance	0%	
Final impermeable ground cover	1602	m^2
SPR	0.47	
SAAR	761	mm
Region	3	
Climate change factor	45%	
Discharge Rate (l/s)	1.3	
Run-off coefficient	100%	

Current impermeable area as % of total	100%
Proposed impermeable area as % of total	100%
Change in permeable area (m2)	0
Change in impermeable area (m2)	0
Change in impermeable area as % of total	0%

Rainfall event	Greenfield run-off rates (l/s)	Existing run-off rates(l/s)	Potential run-off rates without attenuation (l/s)	Potential minus exisiting (l/s)
QBAR	0.85	N/A	N/A	N/A
6 hour 1 in 1 year	0.72	1.83	1.83	0.00
6 hour 1 in 10 year	1.24	2.82	2.82	0.00
6 hour 1 in 30 year	1.49	3.66	3.66	0.00
6 hour 1 in 100 year	1.77	4.57	4.57	0.00
6 hour 1 in 100 year + 20% CC	N/A	N/A	5.49	0.91
6 hour 1 in 100 year + 45% CC	N/A	N/A	6.63	2.06

Rainfall event	Greenfield run-off volume (m^3)	Existing run-off volume (m^3)	Potential run-off volume without attenuation (m^3)	Potential minus existing (m^3)
QBAR	19.67	N/A	N/A	N/A
6 hour 1 in 1 year	18.57	39.51	39.51	0.00
6 hour 1 in 10 year	29.76	60.99	60.99	0.00
6 hour 1 in 30 year	37.17	79.07	79.07	0.00
6 hour 1 in 100 year	46.42	98.76	98.76	0.00
6 hour 1 in 100 year + 20% CC	N/A	N/A	118.52	19.75
6 hour 1 in 100 year + 45% CC	N/A	N/A	143.21	44.44

Return Period	Runoff rate restriction (l/s)	Critical Storm Duration (hr)	Attenuation Volume Required (m^3)	Volume required above previous return period
1 in 30 year	1.30	4	52.42	N/A
6 hour 1 in 100 year	1.30	5	70.88	18.45
6 hour 1 in 100 year + 45% CC	1.30	8	116.82	45.95

Input parameters for run-off calculations		
Country	England	
Total site area	6058	m^2
Area proposed for development	6058	m^2
Current permeable ground cover	0	m^2
Current impermeable ground cover	6058	m^2
Proposed permeable ground cover	0	m^2
Proposed impermeable ground cover	6058	m^2
Urban Creep Allowance	0%	
Final impermeable ground cover	6058	m^2
SPR	0.47	
SAAR	761	mm
Region	3	
Climate change factor	45%	
Discharge Rate (l/s)	4.8	
Run-off coefficient	100%	

Current impermeable area as % of total	100%
Proposed impermeable area as % of total	100%
Change in permeable area (m2)	0
Change in impermeable area (m2)	0
Change in impermeable area as % of total	0%

Rainfall event	Greenfield run-off rates (l/s)	Existing run-off rates(l/s)	Potential run-off rates without attenuation (l/s)	Potential minus exisiting (l/s)
QBAR	3.23	N/A	N/A	N/A
6 hour 1 in 1 year	2.74	6.92	6.92	0.00
6 hour 1 in 10 year	4.68	10.68	10.68	0.00
6 hour 1 in 30 year	5.64	13.84	13.84	0.00
6 hour 1 in 100 year	6.71	17.29	17.29	0.00
6 hour 1 in 100 year + 20% CC	N/A	N/A	20.75	3.46
6 hour 1 in 100 year + 45% CC	N/A	N/A	25.07	7.78

Rainfall event	Greenfield run-off volume (m^3)	Existing run-off volume (m^3)	Potential run-off volume without attenuation (m^3)	Potential minus existing (m^3)
QBAR	74.40	N/A	N/A	N/A
6 hour 1 in 1 year	70.21	149.39	149.39	0.00
6 hour 1 in 10 year	112.55	230.63	230.63	0.00
6 hour 1 in 30 year	140.54	299.02	299.02	0.00
6 hour 1 in 100 year	175.53	373.48	373.48	0.00
6 hour 1 in 100 year + 20% CC	N/A	N/A	448.17	74.70
6 hour 1 in 100 year + 45% CC	N/A	N/A	541.54	168.06

Return Period	Runoff rate restriction (l/s)	Critical Storm Duration (hr)	Attenuation Volume Required (m^3)	Volume required above previous return period
1 in 30 year	4.80	4	199.92	N/A
6 hour 1 in 100 year	4.80	5	270.11	70.20
6 hour 1 in 100 year + 45% CC	4.80	10	445.51	175.40

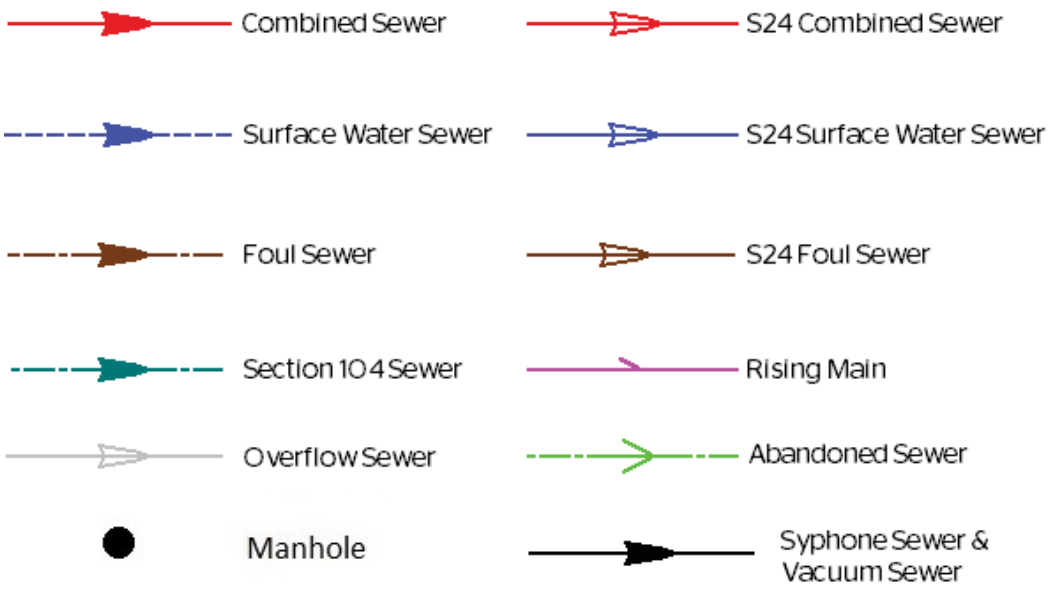
GeoSmart Information

Appendix C

Yorkshire Water Asset Location Plan

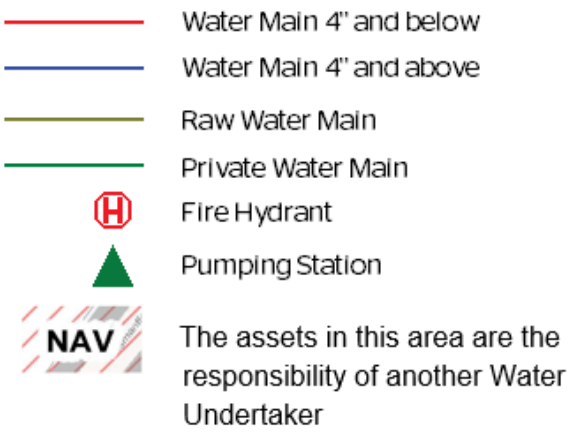
Property Identfier

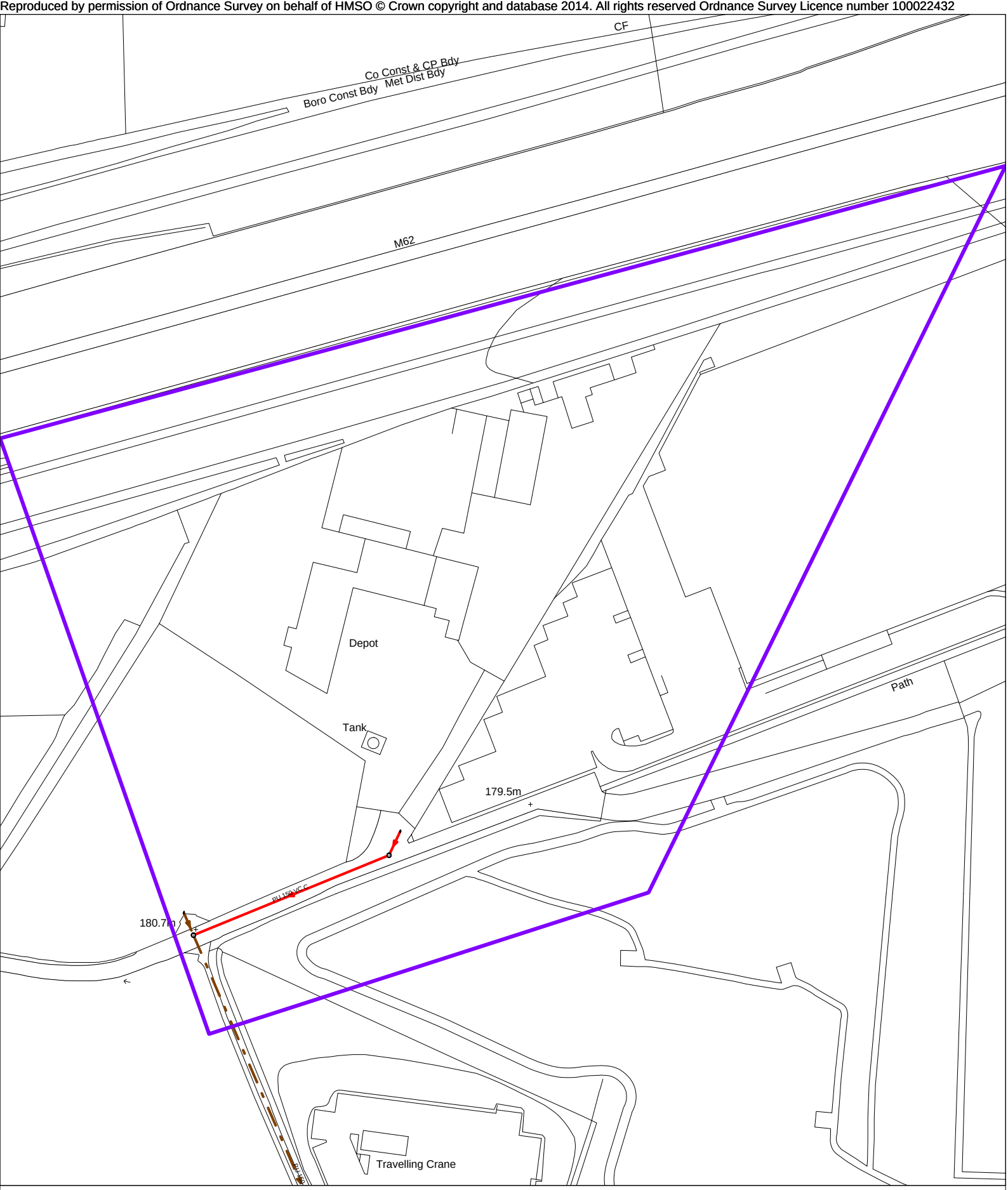
Sewer Legend



Please note that the direction of flow arrows may not always appear depending on the scale of the map.

Water Legend





Public Waste Water Network 12/09/2024 11:09:43 OS Grid Coordinates: 422627 : 427408 Map Name : SE2227SE svcGISSafeMovePD

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

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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/