[redacted]

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Date	Prepared For	Reference
June 2023	Lowdham Cars	73101

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Contract

GeoSon Limited were instructed by Melanie Hibbitt of Lowdham Cars, by an email dated 16th May 2023, to undertake a Site Specific Flood Risk Assessment and Outline Surface Water Drainage Strategy to support a proposed planning application for development at Lowdham Cars, Lowdham Road, Gunthorpe.

Project	Flood Risk Assessment and Outline Surface Water Drainage Strategy for Planning
Prepared For	Lowdham Cars
Location	Lowdham Cars, Lowdham Road, Gunthorpe, Nottingham NG14 7ES
Application	Demolition of the current buildings at the site followed by construction of 8 x residential dwellings with associated access road, amenity space and car parking.
Our Reference	73101
Version	1.0
Issue Date	02/06/2023
Issued To	Melanie Hibbitt (Lowdham Cars) [redacted]
Prepared By	Thomas Smith BSc (Hons) PIEMA C.WEM MCIWEM

Purpose

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Introduction

Context

GeoSon Limited have been instructed by Melanie Hibbitt of Lowdham Cars to undertake a Site Specific Flood Risk Assessment (FRA) and Outline Surface Water Drainage Strategy to support a proposed planning application for development at Lowdham Cars, Lowdham Road, Gunthorpe.

This assessment has been undertaken in accordance with the revised National Planning Policy Framework (NPPF) July 2021, the associated Planning Practice Guidance (PPG) and the CIRIA SuDS Manual c753.

Study Objectives

In accordance with the National Planning Policy Framework (NPPF), a Flood Risk Assessment is required to accompany a planning application when a development site is:

- located within flood zones 2 or 3 (including minor development and change of use)
- more than 1 hectare (ha) in size
- less than 1 ha in flood zone 1 however includes a change of use in development type to a more vulnerable class (for example from commercial to residential) which could be affected by sources of flooding other than rivers and the sea
- located within an area which has been identified to have critical drainage problems by the Environment Agency

The site is located within Flood Zone 3 on the Environment Agency's Flood Map for Planning. As such, in accordance with NPPF guidance the applicant is required to submit a Flood Risk Assessment.

The Flood Risk Assessment is required to consider the proposed use of the site and assess the potential flood risk posed to the intended development from multiple sources of flooding including rivers, seas, surface water, groundwater, reservoir failure, sewer surcharge and any other artificial sources. This FRA will assess the risk posed from all potential sources of flooding so that site users and third party land will be safe now and for the expected lifetime of the development, taking climate change into account.

Additionally, given that the proposed development will alter the impermeable coverage at the site, thus will impact the existing runoff regime, details of the post development surface water drainage arrangements will be required to accompany the proposed planning application in line with current industry standards.

In accordance with the NPPF guidance and the CIRIA SuDS manual all surface water drainage strategies should follow the Drainage Hierarchy whereby discharge options are considered in the following order:

1. Stormwater reuse,
2. Discharge to ground,
3. Discharge to watercourse,
4. Discharge to surface water sewer,
5. Discharge to combined sewer.

This report details the preferred method for managing post development surface water runoff generated by newly introduced impermeable surfacing at the site. This includes how runoff can be managed now and for the lifetime of the development, so that future site users and third party land will not be at an increased risk of flooding as a result of the proposals.

Site Details

Site Description

The proposed application site is located at Lowdham Cars, Lowdham Road, Gunthorpe, Nottingham NG14 7ES. According to plans provided by the client the site is approximately 2287m^2 in size and currently forms part of a wider car dealership. The site itself is occupied by a garage, showroom and a car lot.

The site is accessed via Lowdham Road which runs along the western boundary of the application area.

Having reviewed aerial imagery, land associated with the car dealership extends offsite in an easterly and southerly direction. A pair of semi-detached residential dwellings are located adjacent north with Lowdham Road adjacent west. Google images indicates that a caravan dealership is situated on the other side of Lowdham Road from the site.

Site Address	Lowdham Cars, Lowdham Road, Gunthorpe, Nottingham NG14 7ES
Client Ownership Boundary	7500m^2
Red Outline/Application Boundary	2287m^2
Current Use	Commercial Use
Proposed Use	Residential Use
OS NGR	SK 67713 44606
County	Nottinghamshire
Local Planning Authority	Newark and Sherwood District Council
Lead Local Flood Authority	Nottinghamshire County Council

Table 1: Site Details

Figure 1: View of the Site from Lowdham Road (Source: Google)

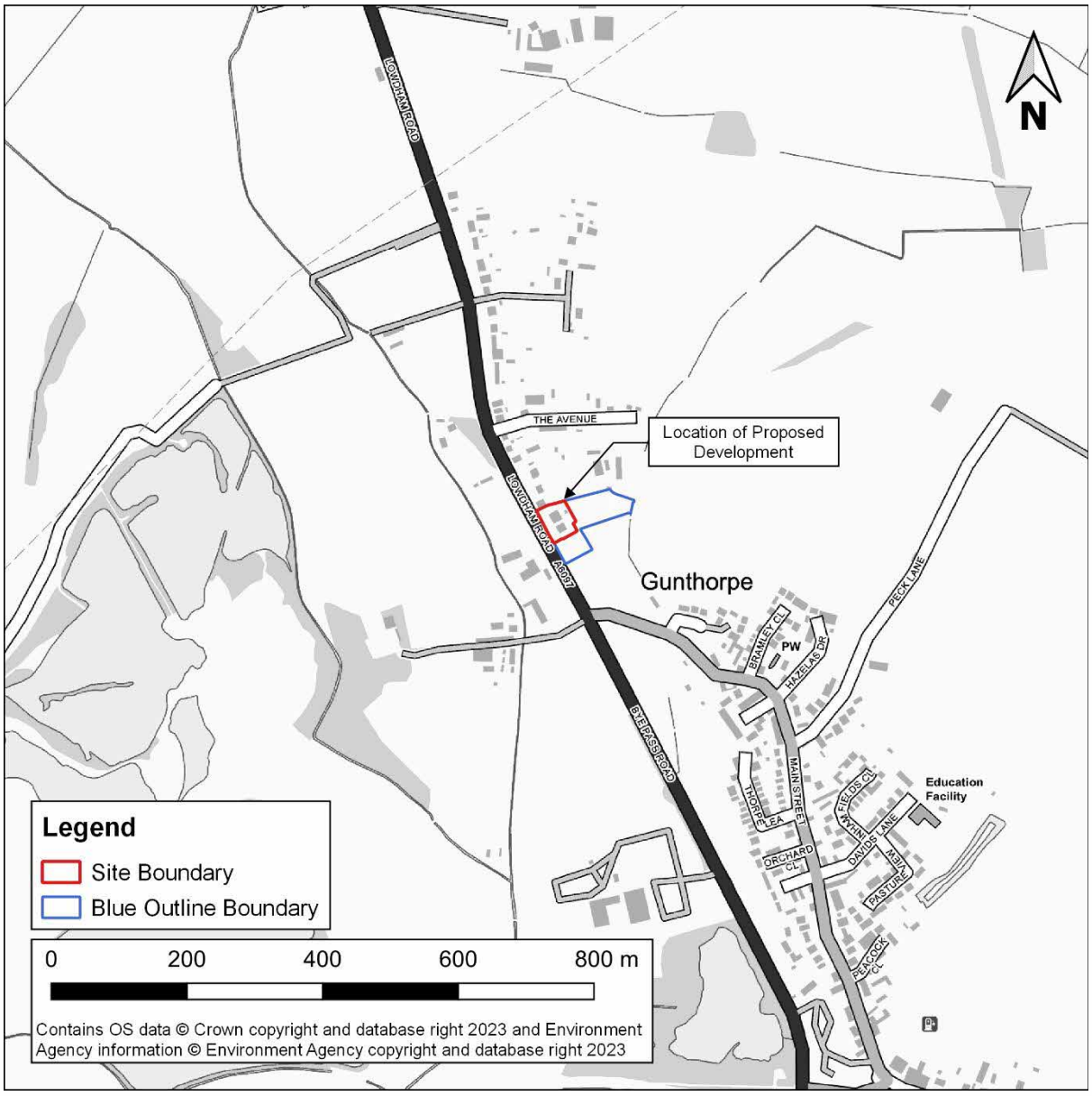


Figure 2: Site Location

Topography

Topographic LiDAR data has been obtained from the Environment Agency to assess the ground elevation profile across the site and within the wider area.

Light Detection and Ranging (LiDAR) is an airborne remote sensing technique, which accurately measures the height of the terrain and surface objects on the ground through the use of a laser, scanner and GPS receiver. The mapping technique measures the distance between the aircraft and the ground to generate precise, three-dimensional information of the terrain and surface objects. Hundreds of thousands of measurements per second are made of the ground, allowing highly detailed surface and terrain models to be generated at different spatial resolutions ranging between 25cm and 2.0 metres.

The LiDAR dataset can be supplied in two forms by the EA:

1. As a Digital Surface Model (DSM), which includes surface objects, such as vehicles, buildings and vegetation, as well as the terrain surface. Or;
2. As a Digital Terrain Model (DTM) produced by removing surface objects such as buildings from the Digital Surface Model through application of bespoke algorithms and manual filtering techniques.

For the purposes of this study the 1.0m resolution Digital Terrain Model has been used.

Environment Agency 1.0m LiDAR data indicates that the site, and section of Lowdham Road adjacent west, are located on a plateau with land to the west and east sloping away towards Cocker Beck and the drainage ditch (located along the boundary of the client's ownership), respectively. Refer to Figure 3.

The ground topography within the development boundary is reported to be relatively flat and ranges from approximately 17.70mAOD to 17.90mAOD.

According to EA data, the proposed dwellings will be constructed upon land with an approximate elevation of 17.80mAOD to 17.90mAOD.

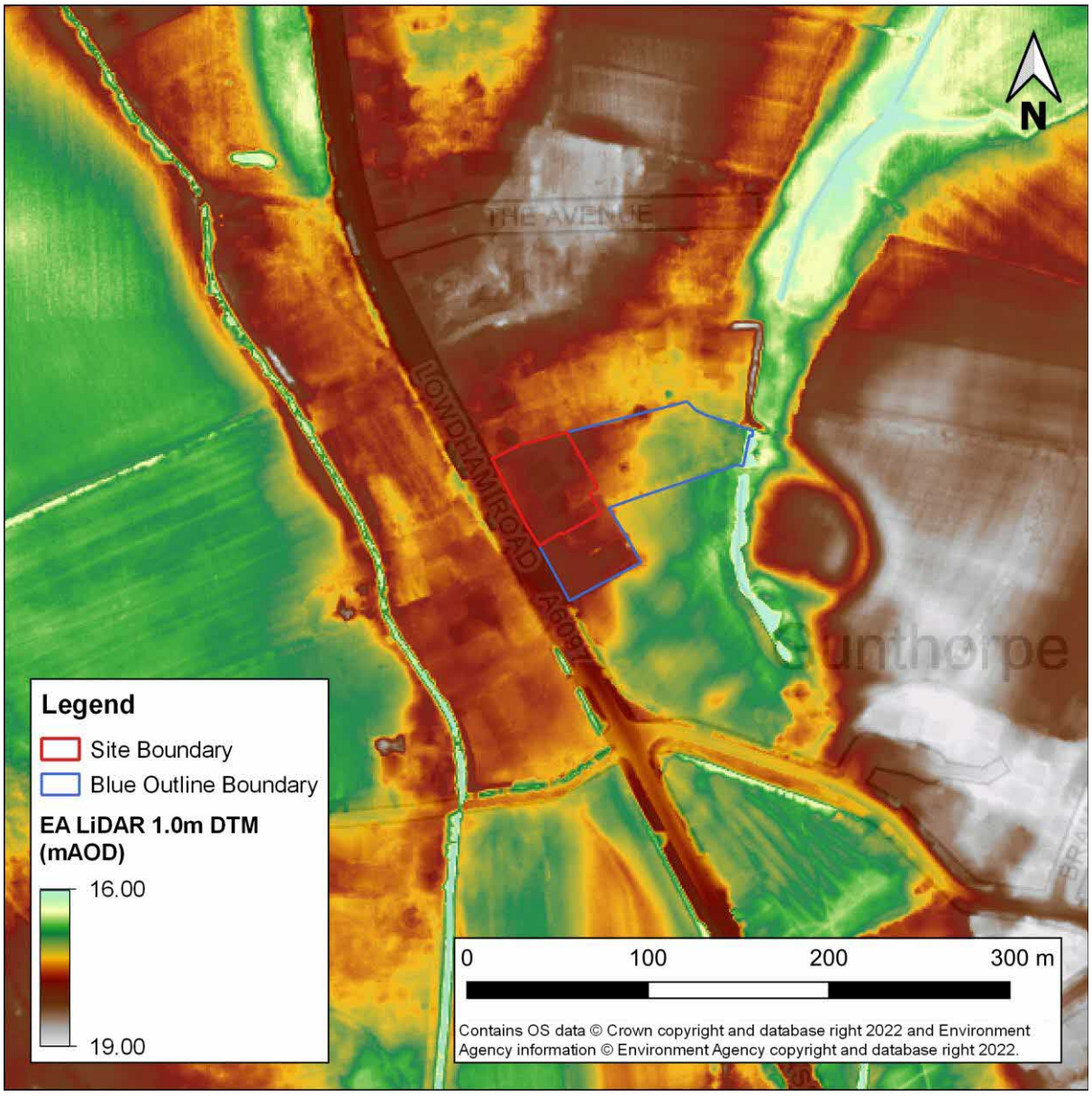


Figure 3: Topography of the Site and Surrounding Area

Geology and Hydrogeology

Review of online British Geological Survey (BGS) records indicates that the site is located upon Gunthorpe Member (Mudstone) bedrock. This geological strata was formed between the Anisian Age and Ladinian Age some 237.0 to 247.1 million years ago.

Records state that Gunthorpe Member bedrock is typically characterised by mudstone, red-brown, with subordinate dolomitic siltstone and fine-grained sandstone, greenish grey, common gypsum veins and nodules.

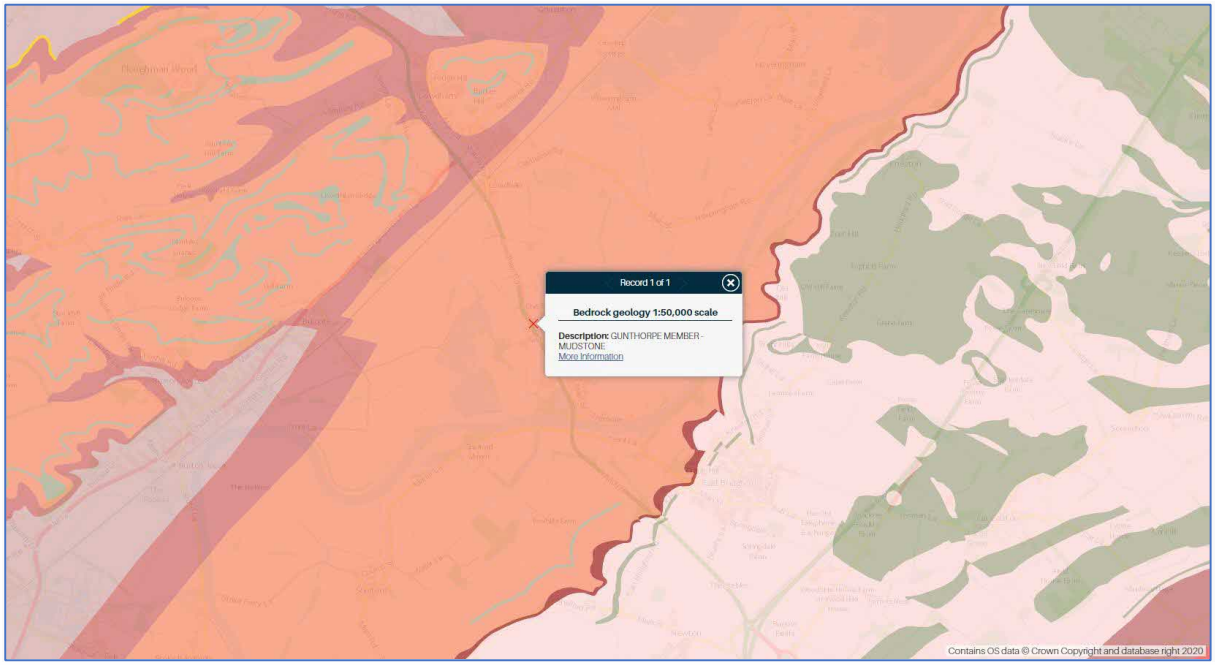


Figure 4: Bedrock Geology Map (Source: British Geological Survey)

According to BGS data the site is also underlain by superficial deposits comprising Holme Pierrepont Sand and Gravel Member.

Figure 5: Superficial Deposit Geology Map (Source: British Geological Survey)

Review of Landis Soilscapes online viewer suggests that the site is located on the boundary of two separate areas where the soils are classified as 'Freely draining slightly acid loamy soils' and 'Loamy and clayey floodplain soils with naturally high groundwater'.

DEFRA 'Magic Maps' indicate that there are no groundwater Source Protection Zones beneath the site. According to DEFRA 'Magic Maps' the closest Source Protection Zone to the development is located approximately 2.4km west (near Bulcote) and is classified as Zone II - Subsurface Activity.

Nearby Watercourses

Review of aerial imagery indicates that there are no open watercourses at the site. However, several watercourses have been identified within a 1.0km radius of the development, including:

A tributary of Dover Beck 90m east of the development, which runs along the eastern boundary of land under the client's ownership;
Cocker Beck 90m west;
The River Trent 840m south, and;
Car Dyke 1.25km north east of the site.

Ordinary watercourses in the area, including the drainage ditch 90m east of the development, are managed by Trent Valley Internal Drainage Board (IDB). Any proposed connection to an ordinary watercourse will require consent from the Water Management Consortium prior to installation. Cocker Beck and the River Trent are classified as main rivers and are therefore managed by the Environment Agency.

The watercourses within a 1.0km radius of the site are shown in Figure 6 (below).

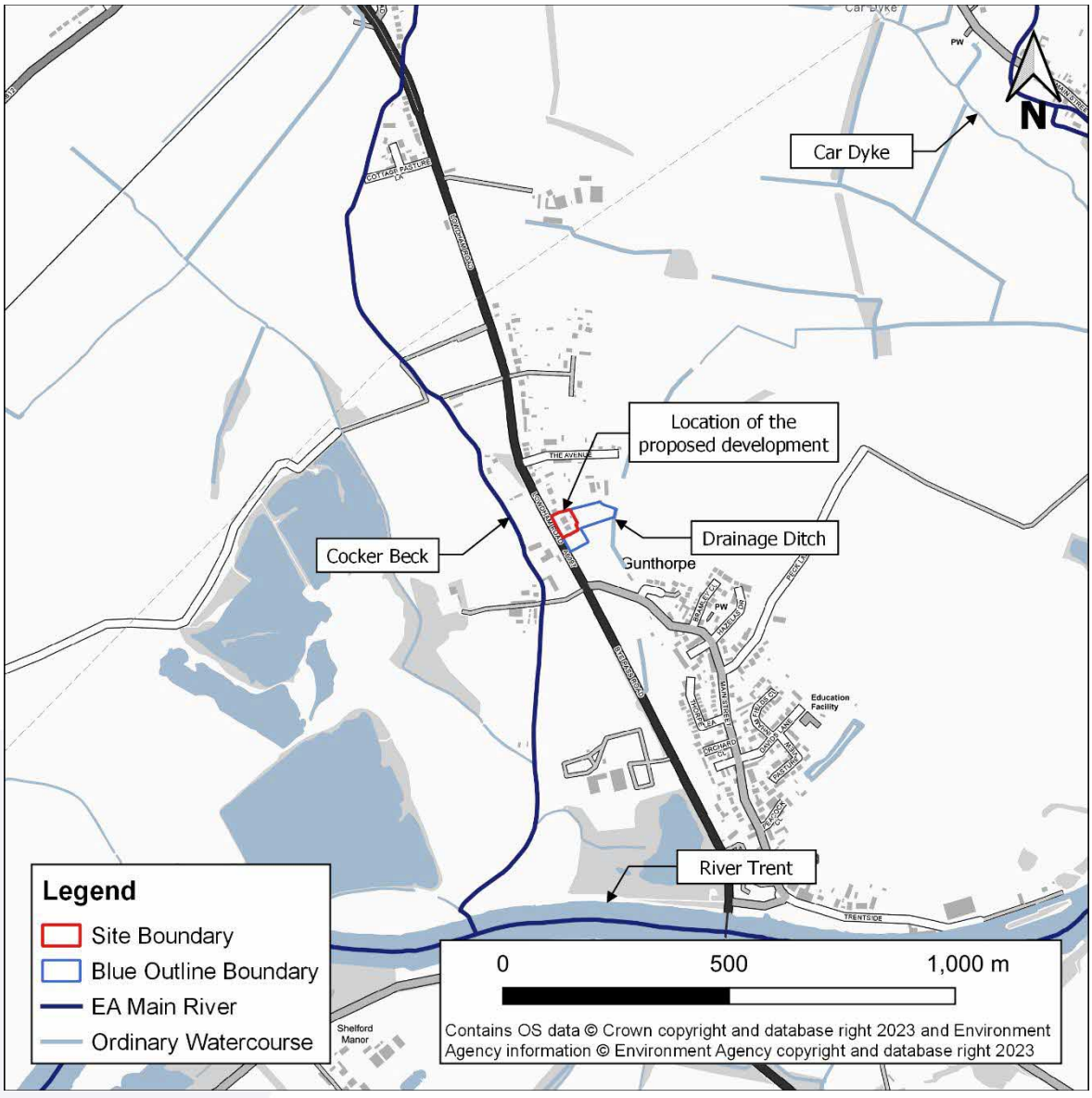


Figure 6: Watercourses Near the Site

A drainage ditch has been identified approximately 90m east of the development. Whilst the watercourse is situated some 90m away from the red outline boundary the client has provided an ownership title which shows that the developer owns the land between the development and the watercourse. As such discharge across the land which separates the development and the watercourse can be achieved without the need to obtain third party land owner permission, if required.

Review of 1.0m LiDAR DTM data indicates that the top of bank of the section of watercourse 90m east has an elevation of approximately 16.90mAODmAOD. The client has confirmed that the channel in this location has an approximate depth of 4ft, which equates to 1.22m. Therefore, the section of watercourse 90m east of the site is considered to have an approximate bed level of 15.68mAOD.

Given the topographic profile of the site and surrounding area, it is considered that any surface water runoff which is not captured by the existing drainage infrastructure at the site, is likely to be directed towards the watercourse 90m east. Any water within this watercourse is conveyed in a north easterly direction and discharges into Dover Beck some 675m east of the development before converging with the River Trent.

Nearby Public Sewerage Infrastructure

An Asset Location Search has been obtained from Severn Trent Water and indicates that there are no main surface water sewers located beneath Lowdham Road or within close proximity to the development.

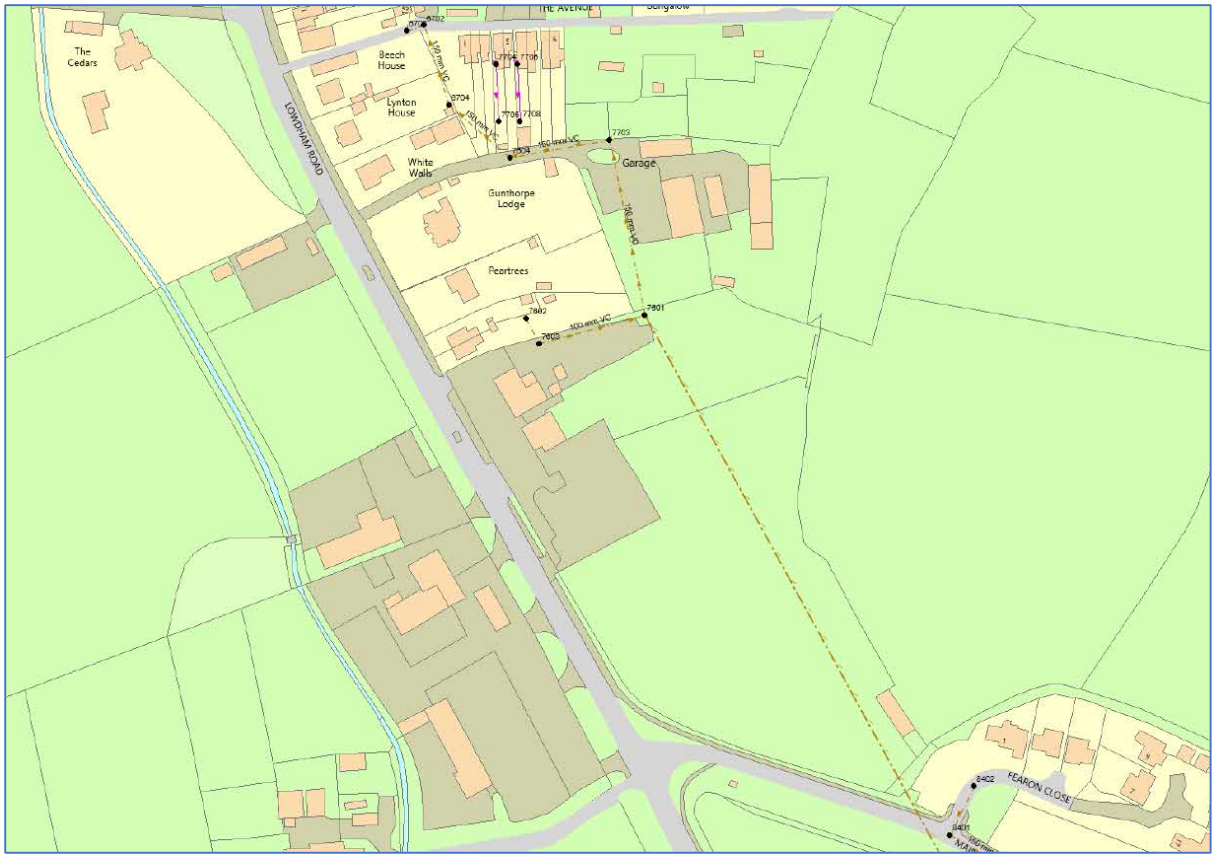


Figure 7: Thames Water Asset Location Search Plan

The Asset Location Search shows that a 100mm diameter vitrified clay foul sewer flows beneath the north eastern corner of the site.

Information provided by Severn Trent Water indicates that manhole reference 7603 is located approximately 13m east of the proposed built footprint. According to Severn Trent Water records manhole reference 7603 has a cover and invert level of 17.65mAOD and 16.85mAOD, respectively.

From manhole reference 7603 foul effluent appears to be conveyed in an easterly direction off site before discharging into a pressure main foul sewer which runs in a northerly direction some 35m east of the development boundary. Manhole reference 7601 is located at the confluence of both sewer runs. Severn Trent Water confirm that manhole reference 7603 has a cover and invert level of 17.39mAOD and 16.31mAOD, respectively.

It is recommended that the applicant undertakes a GPS drainage survey to determine the exact location, depth and condition of the foul sewer infrastructure beneath the site and within the blue outline boundary prior to detailed design and construction. The findings of this survey will determine the final levels to be used within the surface water drainage strategy for the development.

A copy of the Asset Location Search, provided by Severn Trent Water, is included in Appendix C.

Existing Surface Water Drainage Arrangements

It is currently unknown where surface water generated by existing impermeable areas at Lowdham Cars discharges. However, given the lack of nearby Severn Trent Water surface water sewer assets it can be confidently assumed that a connection to a main surface water sewer is not present.

Review of Google Streetview indicates that the existing buildings at the site feature downpipe drainage and there are several linear drains within the forecourt.

In light of this, it is assumed that any surface water runoff generated by the application area currently drains into the ground or is conveyed via overland and subsurface flow into the drainage ditch 90m east, the existing foul sewer network or the highway drainage system.

Proposed Development

Development Proposals

The proposed planning application is for demolition of the existing buildings at the site followed by construction of eight residential dwellings with associated access road, parking and amenity space.

According to plans provided by the client, post development the total impermeable area at the site will amount to approximately 1400m^2 comprising 455m^2 of roof area and 945m^2 of hardstanding (paving and roads).

However, it is worth noting that the site is classified as brownfield land and is already underlain by 1184m^2 of hardstanding, associated with the car lot and existing buildings. Therefore, the true increase in impermeable area as a result of the development will amount to only 216m^2.

Despite this, attenuation sizing within the strategy will be based on a total impermeable area of 1400m^2. As such, significant betterment will be provided post development when compared to the current situation.

A copy of the proposed site layout plan is provided below and is included within Appendix B.

Figure 8: Proposed Layout Plan

Development Vulnerability Classification

The National Planning Policy Framework classifies land use type in terms of vulnerability to flooding. Annex 3 of the NPPF details the flood risk vulnerability classification for each land use type (refer below).

Essential infrastructure
Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including infrastructure for electricity supply including generation, storage and distribution systems; including electricity generating power stations, grid and primary substations storage; and water treatment works that need to remain operational in times of flood. Wind turbines. Solar farms.
Highly vulnerable
Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operational during flooding. Emergency dispersal points. Basement dwellings. Caravans, mobile homes and park homes intended for permanent residential use. Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure'.)
More vulnerable
Hospitals Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. **Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels.** Non–residential uses for health services, nurseries and educational establishments. Landfill* and sites used for waste management facilities for hazardous waste. Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less vulnerable
Police, ambulance and fire stations which are not required to be operational during flooding. Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the 'more vulnerable' class; and assembly and leisure. Land and buildings used for agriculture and forestry. Waste treatment (except landfill* and hazardous waste facilities).

Minerals working and processing (except for sand and gravel working). Water treatment works which do not need to remain operational during times of flood. Sewage treatment works, if adequate measures to control pollution and manage sewage during flooding events are in place. Car parks.
Water-compatible development
Flood control infrastructure. Water transmission infrastructure and pumping stations. Sewage transmission infrastructure and pumping stations. Sand and gravel working. Docks, marinas and wharves. Navigation facilities. Ministry of Defence installations. Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. Water-based recreation (excluding sleeping accommodation). Lifeguard and coastguard stations. Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

Table 2: Flood Risk Vulnerability Classification (Source: NPPF)

The site is currently occupied by a car dealership. Therefore, in terms of flood risk vulnerability it is considered "Less Vulnerable".

The proposals comprise construction of eight residential dwellings. As such, according to NPPF guidance the site as whole will become "More Vulnerable" post development.

In light of this, it is considered that the vulnerability of the site as a whole will increase as a result of the development.

Sequential and Exception Test

In accordance with the National Planning Policy Framework, and associated Planning Practice Guidance, the Sequential and Exception Tests should be undertaken to determine the most appropriate location for a development and used to inform the proposed design layout.

The Sequential Test is designed to steer new development to areas with the lowest risk of flooding, taking all sources of flood risk and climate change into account.

The Exception Test is undertaken when development in a flood risk area cannot be avoided. The Exception Test comprises of two elements which need to be satisfied before a development can be permitted. It needs to be demonstrated that:

1. A development will provide wider sustainability benefits to the community that outweigh flood risk; and
2. A development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test Required	✓	✓	✓
Zone 3a	Exception Test Required	X	Exception Test Required	✓	✓
Zone 3b	Exception Test Required	X	X	X	✓

Table 3: Flood risk vulnerability and flood zone 'incompatibility' (Source: PPG)

Given the nature of the proposals the development is considered 'More Vulnerable'.

According to Table 3 (above) 'More Vulnerable' development is considered compatible within Flood Zone 1, 2 and 3a (subject to application of the Exception Test).

Assessment of Flood Risk

Flood risk is a combination of:

- the probability (likelihood or chance) of a flood event happening; and
- the potential consequences (impact) if an event were to occur.

In accordance with guidance set out in the Flood Risk and Coastal Change section of the PPG, areas at risk of flooding should be considered as those at risk of flooding from any source, now or in the future.

This study uses publicly available data (including EA flood maps and Local Authority documentation) to assess the potential flood risk posed to the intended development from multiple sources of flooding and the risk of flooding elsewhere, as a result of the proposals.

Where flood risks are identified this study outlines appropriate mitigation measures, compliant with NPPF and PPG, which would be suitable to incorporate within the proposed development to manage said flood risk(s).

Document Review

The following Local Authority documents have been reviewed as part of the Flood Risk Assessment element of this study:

- Newark and Sherwood District Council Level 1 Strategic Flood Risk Assessment (2009)
- Newark and Sherwood District Council Strategic Flood Risk Assessment Level 2 Stage 1 (2010)
- Newark and Sherwood District Council Strategic Flood Risk Assessment Level 2 Stage 2 (2012)
- Newark and Sherwood District Council SFRA Review (2016)
- Nottinghamshire Level 1 Minerals Strategic Flood Risk Assessment (2019)

Historical Flooding

Newark and Sherwood District Council Strategic Flood Risk Assessment Level 2 Stage 2 (2012) includes a map which shows areas known to have flooded within the borough from the following sources:

- Fluvial / Tidal
- Sewer surcharge
- Surface water

According to the Level 2 Stage 2 SFRA surface water and sewer surcharge flooding have not been recorded at the site or within the immediate surrounding area. However, historic fluvial extents have been recorded within the development boundary.

Nottinghamshire Level 1 Minerals Strategic Flood Risk Assessment (2019) includes historical flood mapping which also shows the site to be located within an area which has flooded as result of the River Trent exceeding capacity. In addition to the historic fluvial extents, Nottinghamshire Level 1 Minerals SFRA shows several flood incidents to have been reported to the north of the site along Lowdham Road. These records have been obtained from the Severn Trent Hydraulic Flood Risk Register.

Review of the Environment Agency's Recorded Flood Outline and Historic Flood Map datasets shows that several historic flood events have been recorded at the site and within the surrounding area (refer to Table 4 and Figure 9).

According to information held by the EA the following flood events have been recorded at the site.

Event Name	Source of Flood	Cause
Trent 1932 Gunthorpe - Newark	Main River	Channel capacity exceeded (no raised defences)
Fluvial Trent March 1947	Main River	Channel capacity exceeded (no raised defences)
Fluvial Trent February 1977	Main River	Channel capacity exceeded (no raised defences)
Trent 8th November 2000	Main River	Channel capacity exceeded (no raised defences)

Table 4: Recorded Flood Extents at the Site (Source: EA)

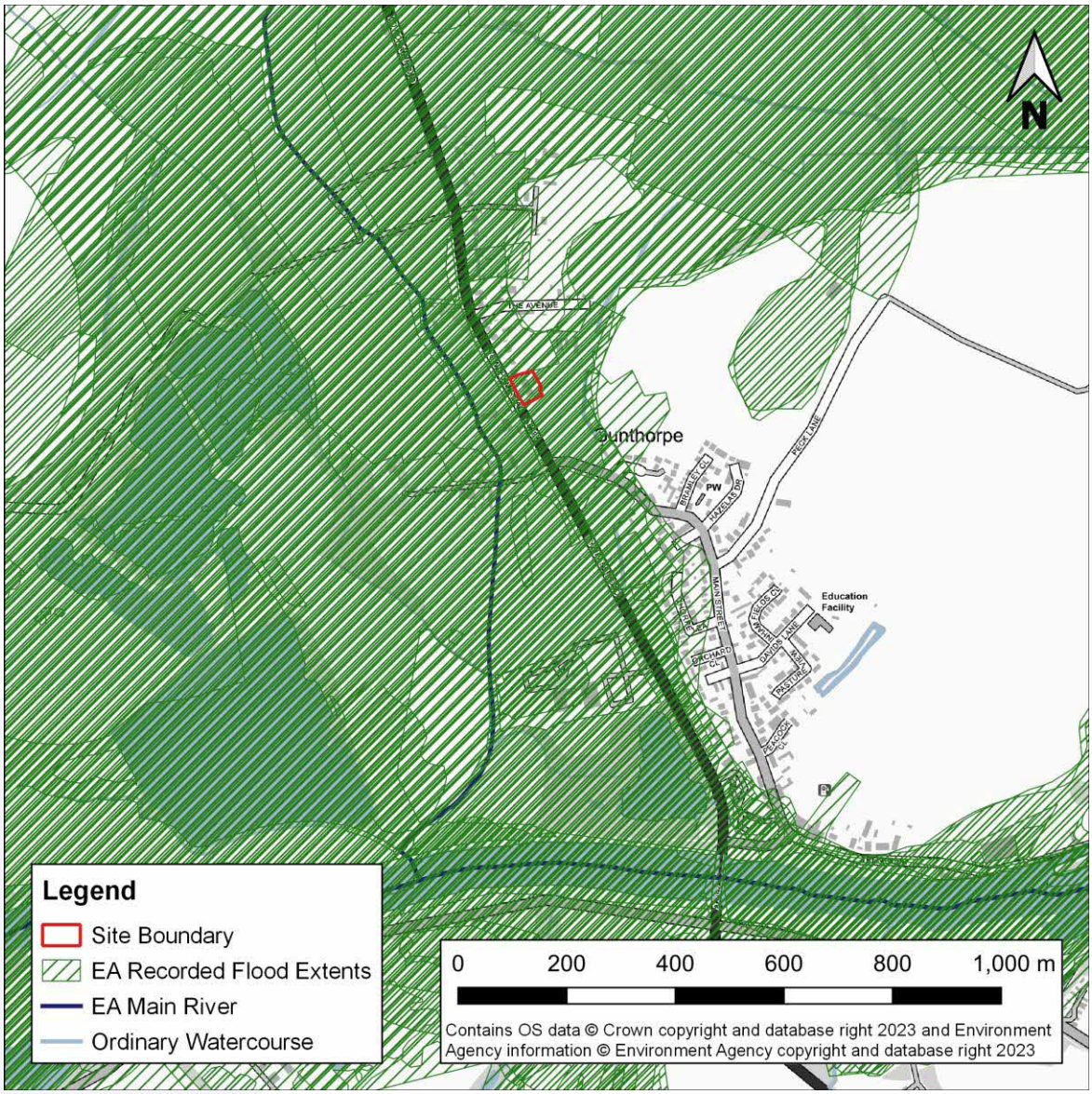


Figure 9: Environment Agency Recorded Flood Outlines

Flood Zones

The Environment Agency has created a set of Flood Zones which shows the risk of flooding from rivers and sea in England, for several return period events, ignoring the presence of defences. The Flood Zones are shown on the EA's Flood Map for Planning which forms the basis for assessing flood risk and development suitability under the National Planning Policy Framework.

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than a 1 in 1000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map for Planning – all land outside Zones 2, 3a and 3b)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1000 annual probability of tidal flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of riv flooding; or Land having a 1 in 200 or greater annual probability of tidal flooding. (Land shown in dark blue on the Flood Map)
Zone 3b Functional Floodplain	This zone comprises land where water from rivers or the sea has to flow or be stored in times of flood. The identificat functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. Tl functional floodplain will normally comprise: • land having a 1 in 30 or greater annual probability of flooding with any existing flood risk management infrastructure operating effectively; or • land that is designed to flood (such as a flood attenua scheme), even if it would only flood in more extreme events (such as 1 in 1000 annual probability of flooding). Areas of functional floodplain should be identified by local planning authorities within Strategic Flood Risk Assessments, in agreement with the Environment Agency. (Note, Zone 3b is not separately distinguished from Zone 3a on the Flood Map).

Table 5: Flood Zone Definitions (Source: Planning Practice Guidance)

Note: The Flood Zones shown on the Environment Agency's Flood Map for Planning (Rivers and Sea) do not take into account the possible impacts of climate change and consequent changes in the future probability of flooding.

To the Site

According to the Environment Agency's Flood Map for Planning (refer to Figure 10) the site and surrounding area are located within Flood Zone 3 (High Probability), defined as land having greater than a 1 in 100 annual probability of fluvial flooding.

The primary sources of flood risk to the site appear to be sourced from The River Trent and Cocker Beck.

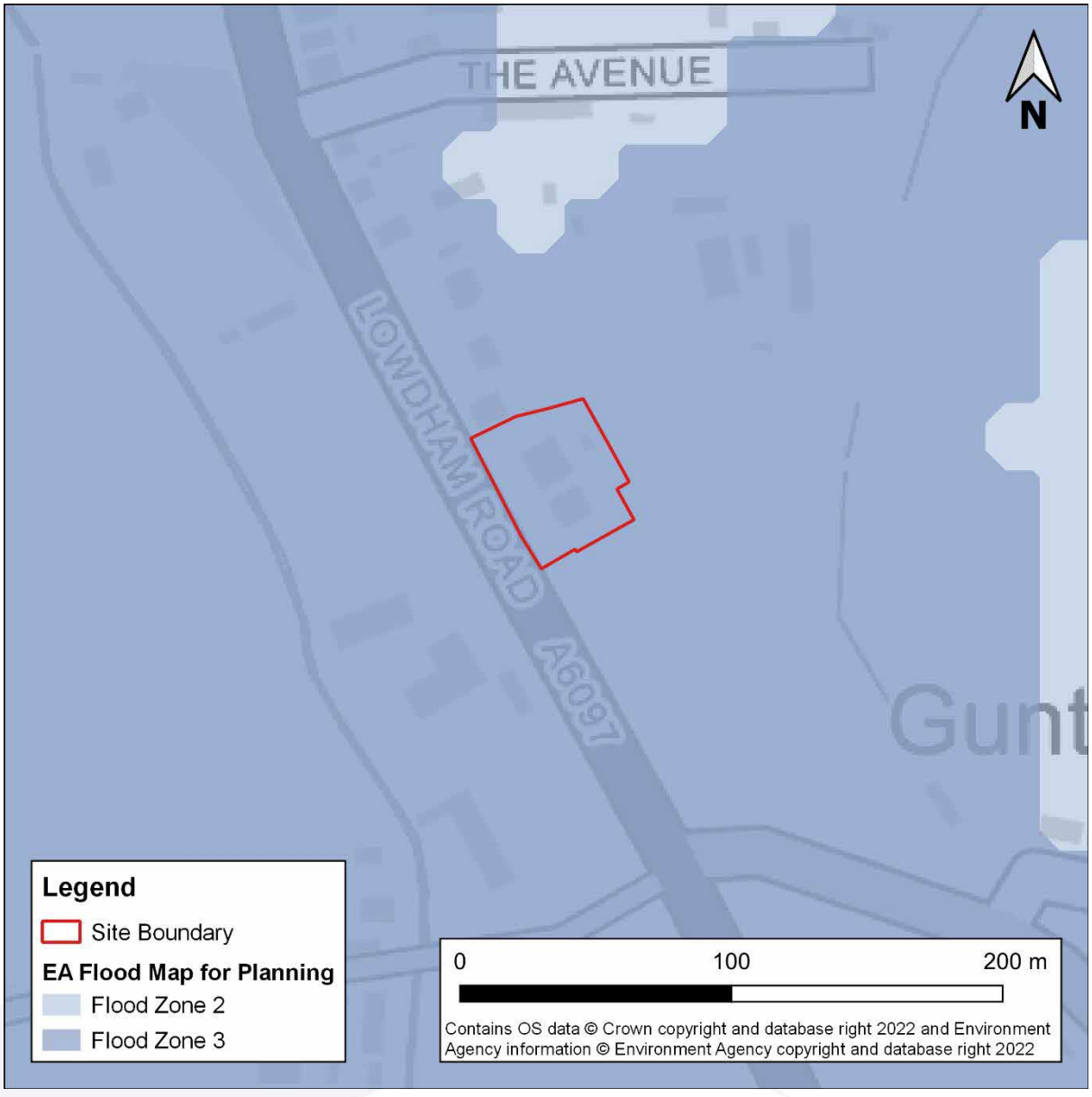


Figure 10: Environment Agency Flood Map for Planning

From the Site

Given that the site is located entirely within Flood Zone 3, it is considered that the proposed development may have an impact on the existing floodplain functionality and could increase the risk of fluvial flooding elsewhere. Any fluvial displacement caused as a result of the development proposals will need to be managed appropriately.

Refer to the 'Offsite Impacts' section of this report for more information on how potential floodplain displacement will be managed at the development.

Newark and Sherwood District Council SFRA Review (2016)

In 2016 Newark and Sherwood District Council published its SFRA Review which built upon the Level 1 Strategic Flood Risk Assessment published in 2009.

As part of 2016 SFRA Review, revised modelling was undertaken for the section of River Trent upstream of Cromwell Weir and Lock. The published SFRA Review includes flood maps which show the updated model outputs for the 1 in 100 year event and the 1 in 100 year climate change scenarios. Extracts of the published maps for the 1 in 100 year and the 1 in 100 year plus 30% increase in flows are shown in Figure 11 and Figure 12.

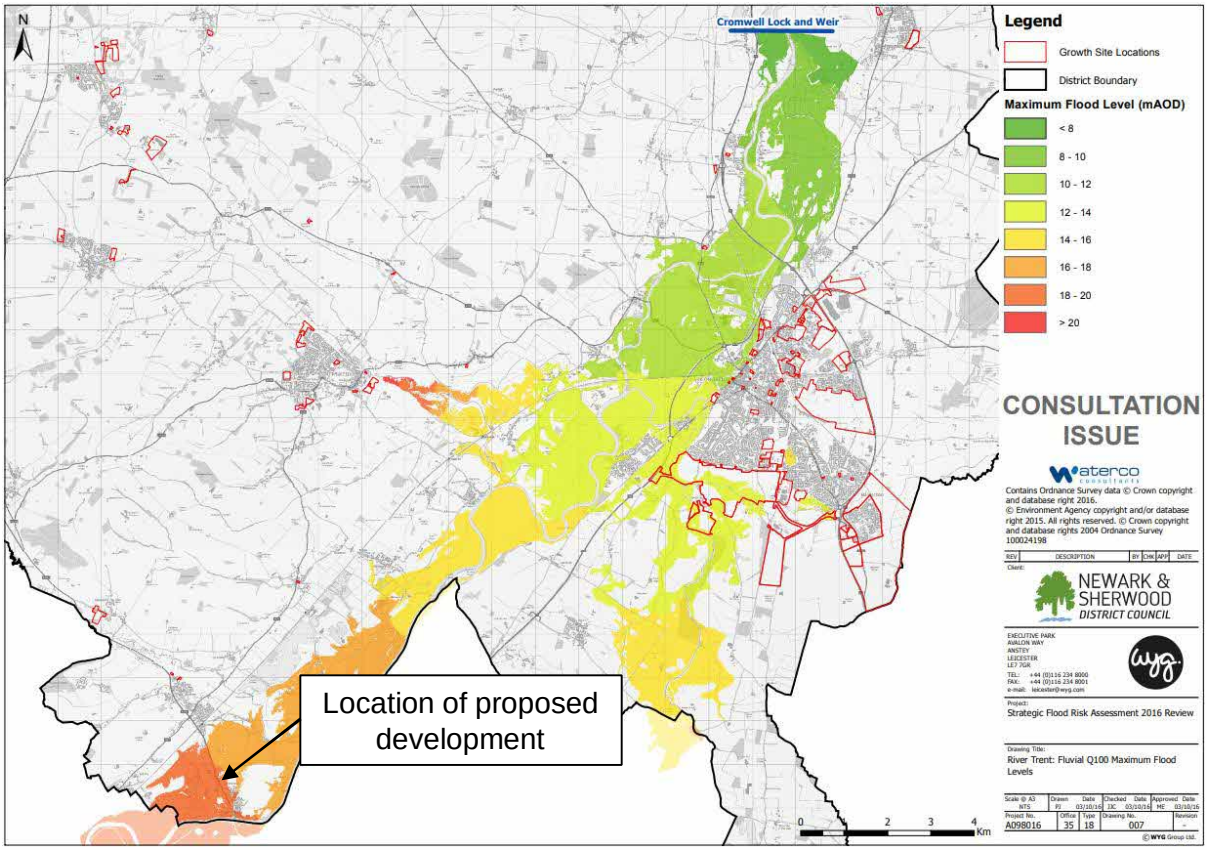


Figure 11: 1 in 100 year Maximum Flood Levels (Source: NSDC SFRA 2016)

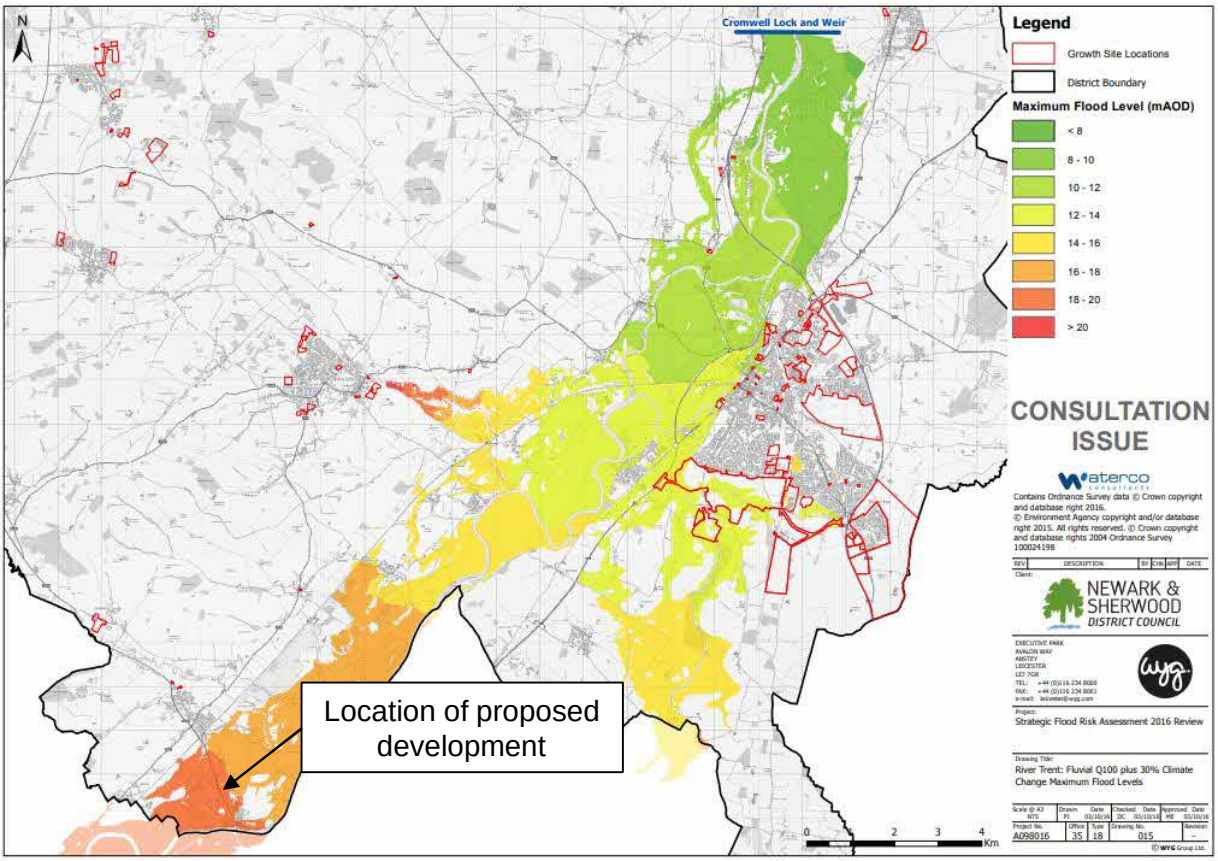


Figure 12: 1 in 100 year plus 30% increase in flows maximum flood levels (Source: NSDC SFRA 2016)

Review of the flood maps provided within the 2016 SFRA update shows that the site is located within the present day Flood Zone 3 extent and appears to be located within the 1 in 100 year plus 30% climate change extent.

Fluvial (Rivers)

Detailed Modelling

Considering that the site has been modelled within Flood Zone 3 on the EA's Flood Map for Planning and within the 2016 SFRA Review, a Product 4 enquiry has been raised with the Environment Agency to obtain detailed flood model information in the relation to the site.

At the time of producing this report the Environment Agency Product 4 request is pending.

Newark and Sherwood District Council have requested that the applicant submits the required information, including this Flood Risk Assessment, within 21 calendar days of the date of the validation letter. Considering that the letter was issued on the 12th May, there is a requirement to submit the additional information as soon as possible.

In light of this, in order to meet the validation deadline and allow the applicant to progress with the application, nearby flood levels have been utilised to base this assessment on.

Floodplain levels for a range of return period events are available for the area surrounding the site (refer to Table 6). These floodplain levels have been taken from a nearby FRA Product 4 and have been extracted from the Trent and Tributaries SFRM2 Model produced by Halcrow in July 2011 and the Nottingham Tributaries SFRM Model produced by JBA in January 2014.

Return Period Event	Floodplain Levels near the Site (mAOD)	
	Trent and Tributaries SFRM2 Model (2011)	Nottingham Tributaries SFRM Model (2014)
1 in 100 year	18.43	17.74
1 in 100 year +20% CC	18.62	17.74
1 in 1000 year	18.89	17.74

Table 6: Nearby Floodplain Levels

According to a nearby FRA undertaken in December 2021, the Environment Agency recommend that developments use the Halcrow 2011 model to base Flood Risk Assessments in the area.

Comparison of the approximate ground levels at the development (17.80mAOD to 17.90mAOD, taken from EA LiDAR data) with the modelled available floodplain levels indicates that the proposed built footprints will be elevated above the modelled scenarios taken from the Nottingham Tributaries SFRM Model (2014).

However, EA LiDAR data indicates that the development area is elevated below the modelled floodplain levels for the 1 in 100 year, 1 in 100 year (+20% CC) and 1 in 1000 year events.

Revised Climate Change Uplifts

Since the Trent and Tributaries SFRM2 Model was produced in 2011 the Environment Agency have issued revised climate change allowances for the study area.

In July 2021 the Environment Agency issued revised peak river flow allowances for management catchments in England. As part of the update the EA published the Peak River Flow Map which shows anticipated changes to peak river flows over time based on management catchment. Management catchments are sub-catchments of river basin districts.

According to the EA's Peak River Flow Map the site and the River Trent are located within the Lower Trent and Erewash Management Catchment. Updated peak river flow allowances for this catchment are as follows:

Epoch	Central	Higher	Upper
2020s	13%	18%	29%
2050s	17%	23%	38%
2080s	29%	39%	62%

Table 7: Lower Trent and Erewash Management Catchment Peak River Flow Allowances

The specific Climate Change allowance required to the be assessed within the Flood Risk Assessment, to account for future change in peak river flows, is dependent on the development's design lifetime and vulnerability classification.

In accordance with the development lifetime guidance, residential developments should be considered to have a minimum lifetime of 100 years.

Additionally, residential developments are considered 'More Vulnerable' (refer to Table 2). In line with government guidance More Vulnerable developments located in flood zones 2 and 3a should use the Central Allowance to account for future climate change.

As such, considering the nature of the proposals, the development should be assessed against the 1 in 100 year plus 29% Climate Change fluvial event.

Whilst the modelled floodplain levels available do not include outputs for the 1 in 100 year plus 29% Climate Change fluvial event, floodplain levels are reported for the 1 in 1000 year event.

In the absence of a site specific Product 4 response from the Environment Agency, a conservative approach has been adopted and the 1 in 1000 year floodplain level at the site (18.89mAOD), taken from the 2011 Halcrow model, has been used to base this Flood Risk Assessment on.

Comparison of the 1 in 1000 year floodplain level (18.89mAOD) with EA LiDAR data corresponding to the proposed built footprints(17.80mAOD to 17.90mAOD) indicates that the developable area may experience flood depths of up to 1.09m during the 1 in 1000 year scenario.

Defences

According to Environment Agency data, formal flood defences are located along Cocker Beck and the River Trent including:

- Natural High Ground 85m west of the application boundary along the eastern bank of Cocker Beck;
- Engineered High Ground 170m south west of the application boundary along the eastern bank of Cocker Beck; and,
- Engineered and Natural High Ground some 900m south of the site along the northern bank of the River Trent.

Figure 13 shows the closest formal flood defences to the development based on the EA's AIMS Spatial Flood Defences dataset.

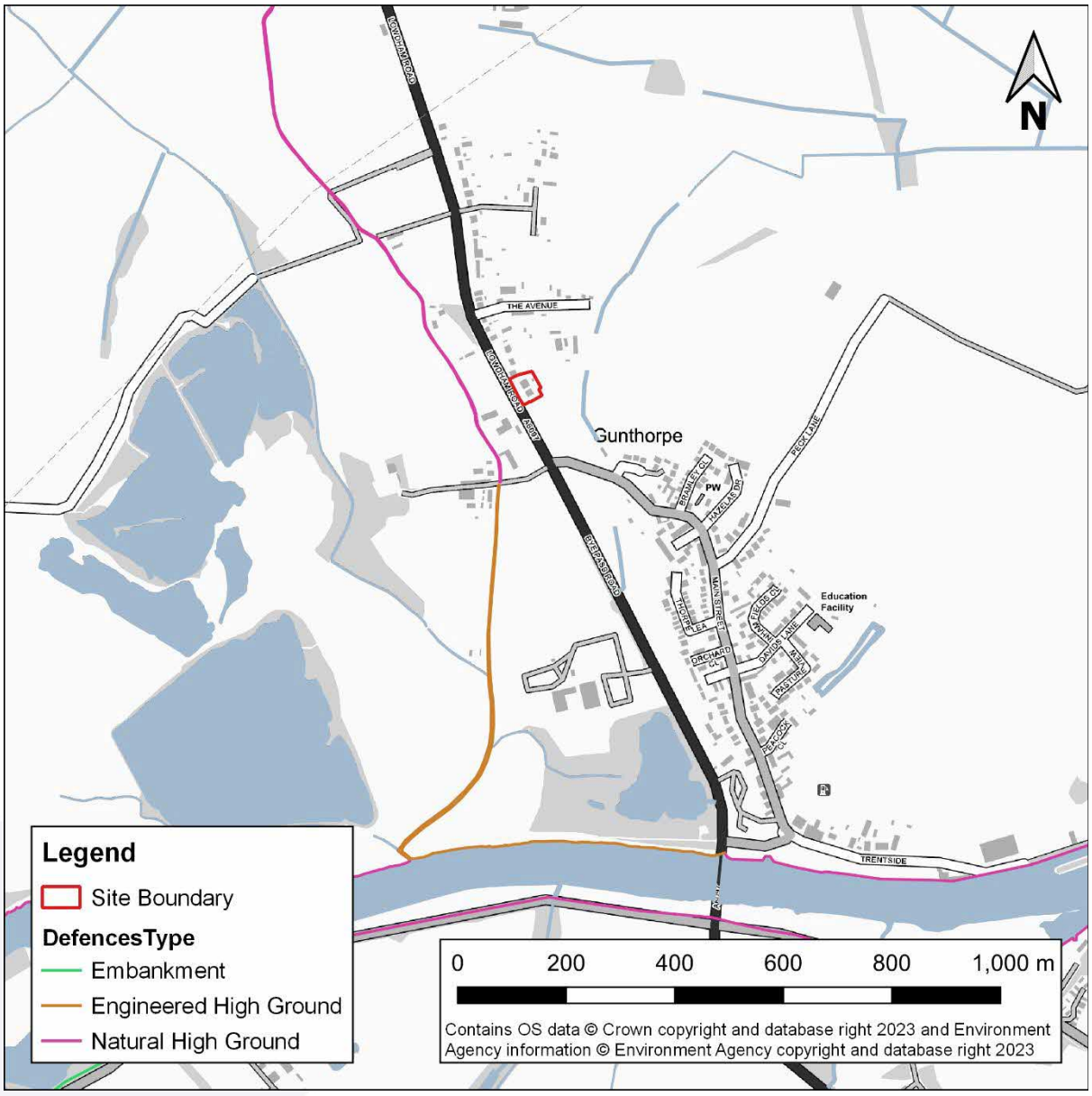


Figure 13: Formal Flood Defences Near the Site

Pluvial (Surface Water)

Pluvial (surface water) flooding occurs as a result of excess overland flow and stormwater ponding. Surface water flooding can happen when water does not have time to soak into the underlying ground or cannot infiltrate at all, for instance because the ground is already fully saturated.

This mechanism of flooding can also arise when the volume of precipitation exceeds the capacity of the drainage system meaning that water is unable to drain away through the sewer network and instead flows overland.

Overland flow will follow the local topography and can therefore pose a risk to both the development and surrounding third party land.

To the Site

The risk posed to the site from surface water flooding has been assessed using the Environment Agency's Risk of Flooding from Surface Water (RoFSW) dataset, refer to Figure 14.

The Risk of Flooding from Surface Water maps were produced in 2013 by the Environment Agency, working with Lead Local Flood Authorities. They are considered to represent a significant improvement on the previous surface water flood maps, both in terms of method and representation of the risk of flooding. Considerable improvements were made to the modelling techniques and data used, including the incorporation of locally produced mapping, where available, to represent features best modelled at a local scale.

The RoFSW information assesses flooding scenarios as a result of rainfall with the following chance of occurring in any given year:

1 in 30 (3.3%)
1 in 100 (1%)
1 in 1000 (0.1%)

The modelled return period outputs are then classified into four categories based on the level of surface water flood risk posed to an area. These categories are detailed below:

High	An area which has a 1 in 30 (3.3%) or greater annual probability of flooding
Medium	An area which has between a 1 in 100 (1%) and 1 in 30 (3.3%) annual probability of flooding
Low	An area which has between a 1 in 1000 (0.1%) and 1 in 100 (1%) annual probability of flooding
Very Low	An area which has less than a 1 in 1000 (0.1%) annual probability of flooding

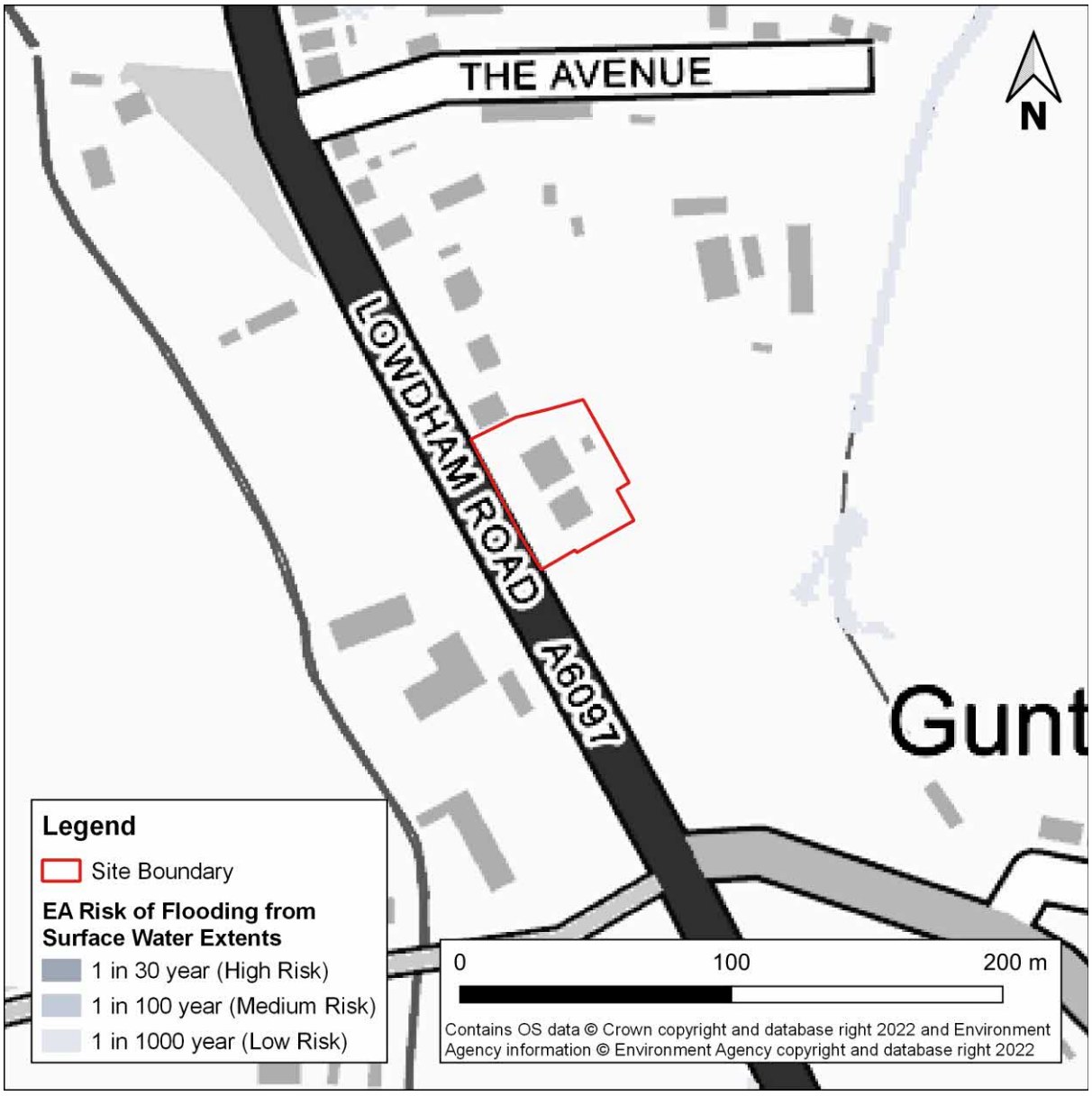


Figure 14: Environment Agency's Risk of Flooding from Surface Water Map

The EA's Risk of Flooding from Surface Water data (Figure 14) shows that the site is located within an area at "Very Low" risk of flooding from surface water.

The closest area of land identified at risk of surface water flooding is located 90m east of the development. Having reviewed aerial imagery it appears that the linear area of modelled "Low" risk correlates with the location of the drainage ditch. As such, the area of "Low" risk identified on the RoFSW map is considered to be associated with an existing watercourse and should therefore be regarded as in-channel flows.

No information has been provide to suggest that the site has historically flooded as a result of surface water flows.

From the Site

Increases in impermeable surfacing can alter the runoff regime at a site and can lead to increased surface water runoff rates and volumes when compared to the pre-developed situation.

Any additional surface water runoff can increase flood risk to third party land, create new flow paths and can lead to pollution of downstream waterways. Considering this, post development surface water runoff will need to be managed appropriately.

Refer to the Outline Surface Water Drainage Strategy section for more information on the potential options available to manage post development surface water runoff at the site.

Groundwater

Groundwater flooding occurs when the water table rises up from the underlying rocks and emerges at the ground surface or within subsurface infrastructure (such as basements). Low lying areas that are underlain by permeable bedrock, superficial geology and aquifers are particularly susceptible to this form of flooding, especially during the winter months and after periods of heavy, sustained precipitation.

Unlike other mechanisms of flooding, groundwater flooding takes longer to dissipate as the water table needs to lower before any emerged flood water can soak back into the ground. As a result of this, whilst groundwater flooding does not pose a significant risk to life, flood waters can last for many months and can cause considerable damage to property.

Newark and Sherwood District Council Level 2 Stage 2 SFRA (2012) includes an extract from the Environment Agency's Areas Susceptible to Groundwater Flooding (AStGWf) map which shows the site to be located within an area classified as '>=50% <75% susceptible to groundwater flooding'.

Despite this, no information has been provided to suggest that the site or surrounding area has historically been subject to groundwater flooding.

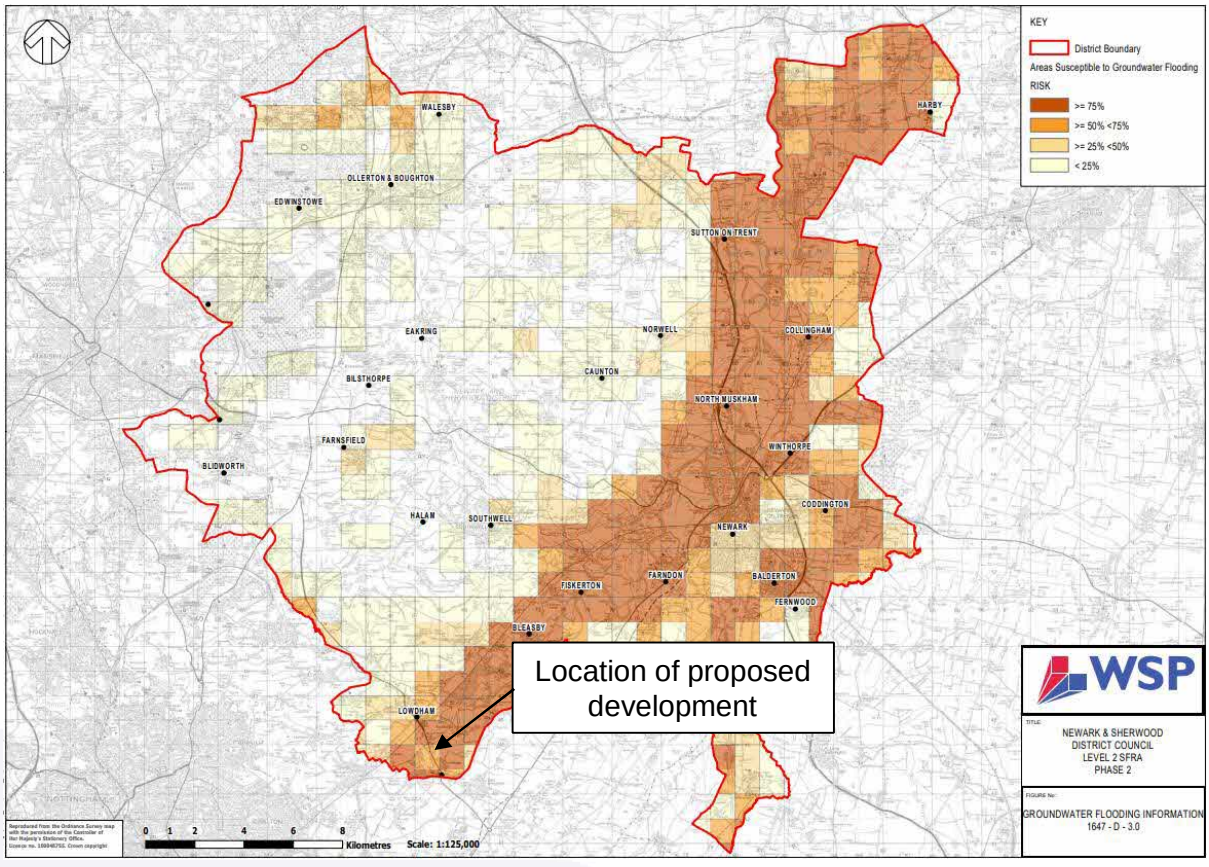


Figure 15: Areas Susceptible to Groundwater Flooding (Source: NSDC L2S2 SFRA)

Sewer Surcharge

Sewer flooding occurs when the volume of water entering a drainage system is greater than the capacity of the sewer network. It is often experienced during periods of heavy rainfall, when a large amount of precipitation falls within a short period of time, and overloads the sewer system capacity causing a surcharge and localised short-term flooding.

Sewer flooding can also occur when the sewerage system is unable to discharge as intended. This is frequently caused by problems such as high water levels within the receiving watercourse, blockages, siltation and structural defects.

Having reviewed Newark and Sherwood District Council's flood risk documents there is no information to suggest that the site itself is susceptible to sewer surcharge flooding.

Reservoir

Reservoirs are artificially created lakes, typically formed by building a dam across an existing watercourse to hold water back. Whilst unlikely, flooding from reservoirs can occur as a result of water exceeding the reservoir capacity or structural failure of the dam or bank.

All large reservoirs are regulated under the Reservoirs Act 1975 and undergo regular maintenance to minimise the possibility of reservoir failure. This legislation is enforced by the Environment Agency and requires reservoirs to be routinely inspected and maintained to an appropriate standard. As an enforcement authority the Environment Agency is responsible for some 2,000 reservoirs in England and Wales.

The Environment Agency have produced a flood map which shows where water may go in the unlikely event of a dam or reservoir failure. Two flooding scenarios are shown on the reservoir flood maps:

A 'dry-day' scenario which shows the predicted flood extents if a dam or reservoir failed when rivers are at normal levels

A 'wet-day' scenario which shows how much greater the flood extent might be if a downstream river is already experiencing an extreme flood event

Review of the Environment Agency's Risk of Flooding from Reservoirs map indicates that the site is located within the 'maximum extent of flooding from reservoirs when there is also flooding from rivers'. As such, whilst unlikely to occur, the development is considered to be susceptible to reservoir failure.

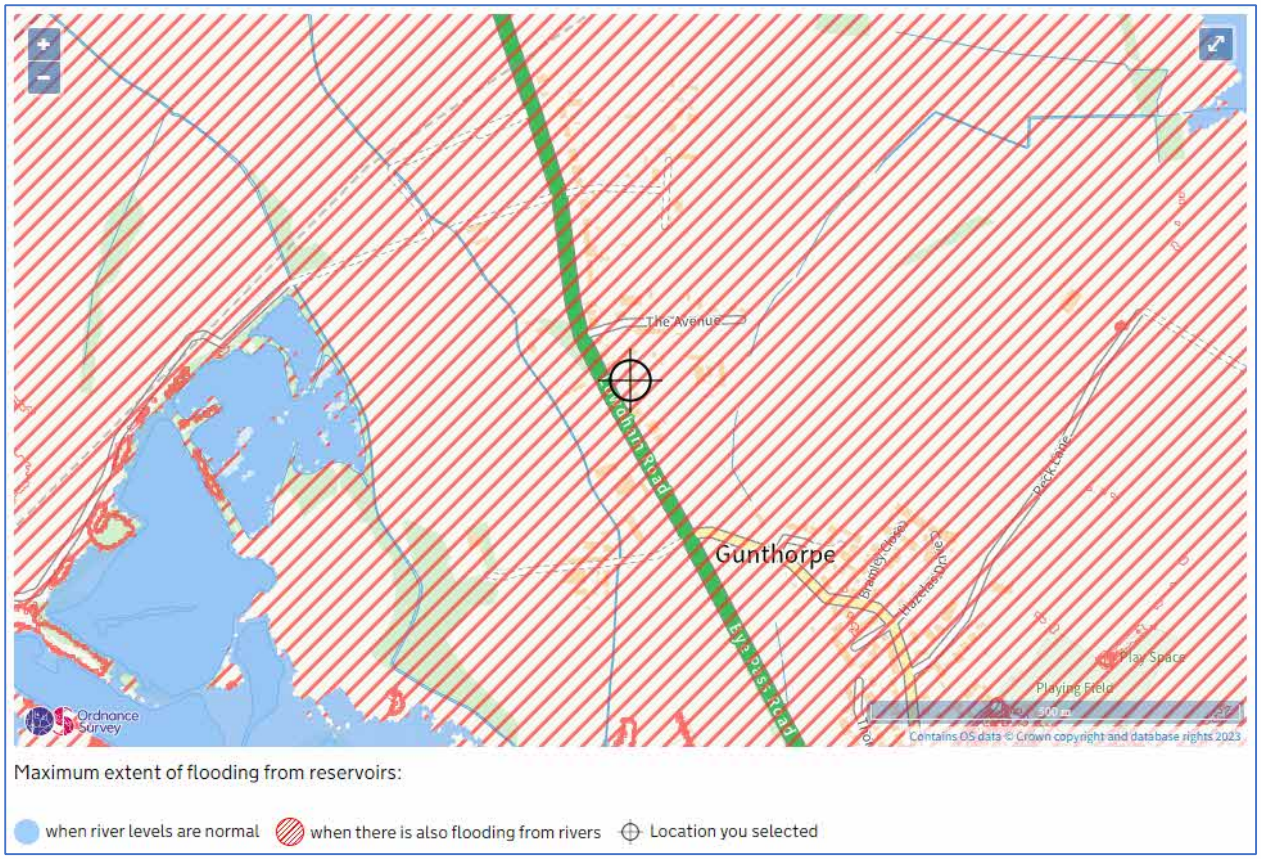


Figure 16: Flood Risk from Reservoirs Map (Source: EA)

Other Sources

No other artificial infrastructure have been identified within the surrounding area which could pose a risk of flooding to the development.

Flood Risk Management

Finished Floor Levels

The NPPF requires new residential Finished Floor Levels (FFL) to be set at least 300mm above the modelled 1 in 100 year plus allowance for climate change flood level. In instances where bedroom accommodation is proposed to be located on the ground floor, such as in bungalows and self-contained flats, Finished Floor Levels should be set at least 600mm above the modelled 1 in 100 year plus allowance for climate change flood level.

Floodplain levels for a range of return period events are available for the area surrounding the site (refer to Table 6) extracted from the Trent and Tributaries SFRM2 Model produced by Halcrow in July 2011 and the Nottingham Tributaries SFRM Model produced by JBA in January 2014. These floodplain levels have been taken from a nearby FRA Product 4 response whilst the site specific Product 4 request for this development is pending with the EA.

In accordance with the latest guidance, considering the nature of the proposals, the development should be assessed against the 1 in 100 year plus 29% Climate Change fluvial event.

The available modelled floodplain levels do not include outputs for the 1 in 100 year plus 29% Climate Change fluvial event. However, floodplain levels are reported for the 1 in 1000 year event.

In the absence of a site specific Product 4 response, a conservative approach has been adopted and the 1 in 1000 year floodplain level at the site (18.89mAOD), taken from the 2011 Halcrow model, has been used to base this Flood Risk Assessment on.

Given this, it is recommended that the Finished Floor Level of all eight proposed dwellings are designed in line with Building Regulations and set at a minimum elevation of 19.19mAOD, raised at least 300mm above the 1 in 1000 year floodplain level (18.89mAOD).

A Finished Floor Level of 19.19mAOD would raise the development approximately 1.29-1.39m above the external ground levels surrounding the proposed built footprints.

Mitigation Measures

Whilst the FFL of the proposed dwellings will be elevated at least 300mm above the 1 in 1000 year floodplain level, in order to offer further protection during an extreme flood event it is recommended that the following mitigation measures are considered in consultation with the Local Authority:

- Non-return valves fitted on drains and pipes
- Manhole covers are secured
- Ground floor electrical main ring run from first floor level and located on a separate switch circuit to the upper floor
- Boilers, gas meters and electrical incomer/meter installed at least 600mm above the design flood level (19.49mAOD and above)
- Solid concrete ground floor slab, with waterproof membrane
- Waterproof screed used on ground floors with waterproof ground floor internal render
- External walls rendered resistant to flooding to first floor level
- Covers for airbricks, pet flaps and appliance vents
- Demountable flood defence barriers to protect ground floor entry thresholds against flood water ingress up to a maximum depth of 0.6m.
- Water resistant materials such as stainless steel, plastic or solid wood used for the ground floor level fitout.

Surface Water Flood Risk

The site is located outside of the Environment Agency's modelled 1 in 30 year, 1 in 100 year and 1 in 1000 year surface water flood extents.

Despite this, it is recommended that any external landscaping should be designed to slope away from the proposed dwellings, where possible. These measures will help mitigate against overland flows being directed towards dwellings during storm events and will reduce the risk of stormwater ponding at threshold entry points and stormwater ingress.

Groundwater Flood Risk

The inclusion of basement rooms within the dwellings is not recommended.

Flood Warnings and Alerts

The site is located within an EA Flood Warning and Alert area. Therefore it is recommended that the developer and future residents sign up to the Environment Agency's free Targeted Flood Warning Service at https://www.gov.uk/sign-up-for-flood-warnings.

Future residents should also be advised to monitor weather forecasts by signing up to the Met Office weather warnings.

Given the nature of flood risk in this area it is also recommended that the applicant considers developing a Flood Warning and Evacuation Plan for future residents. The Flood Warning and Evacuation Plan should outline the site-specific actions which will be followed by future site users in the event of a flood warning being issued.

Safe Access and Egress

The NPPF requires all new residential developments in areas at risk of flooding to demonstrate a route of safe escape for residents and site users which can be maintained for the lifetime of the development.

Given that the Finished Floor Level of all eight residential dwellings will be constructed at least 300mm above the 1 in 1000 year floodplain level (set at least 19.19mAOD), it is considered that safe refuge can be provided within the dwellings themselves.

Safe access and egress to and from the site can be provided via Lowdham Road, adjacent west. It is recommended that future residents travel north along Lowdham Road. This route is located outside of the modelled 1 in 1000 year extent from 1.15km north of the site.

It is recommended that future residents are made aware of the safe access and egress routes.

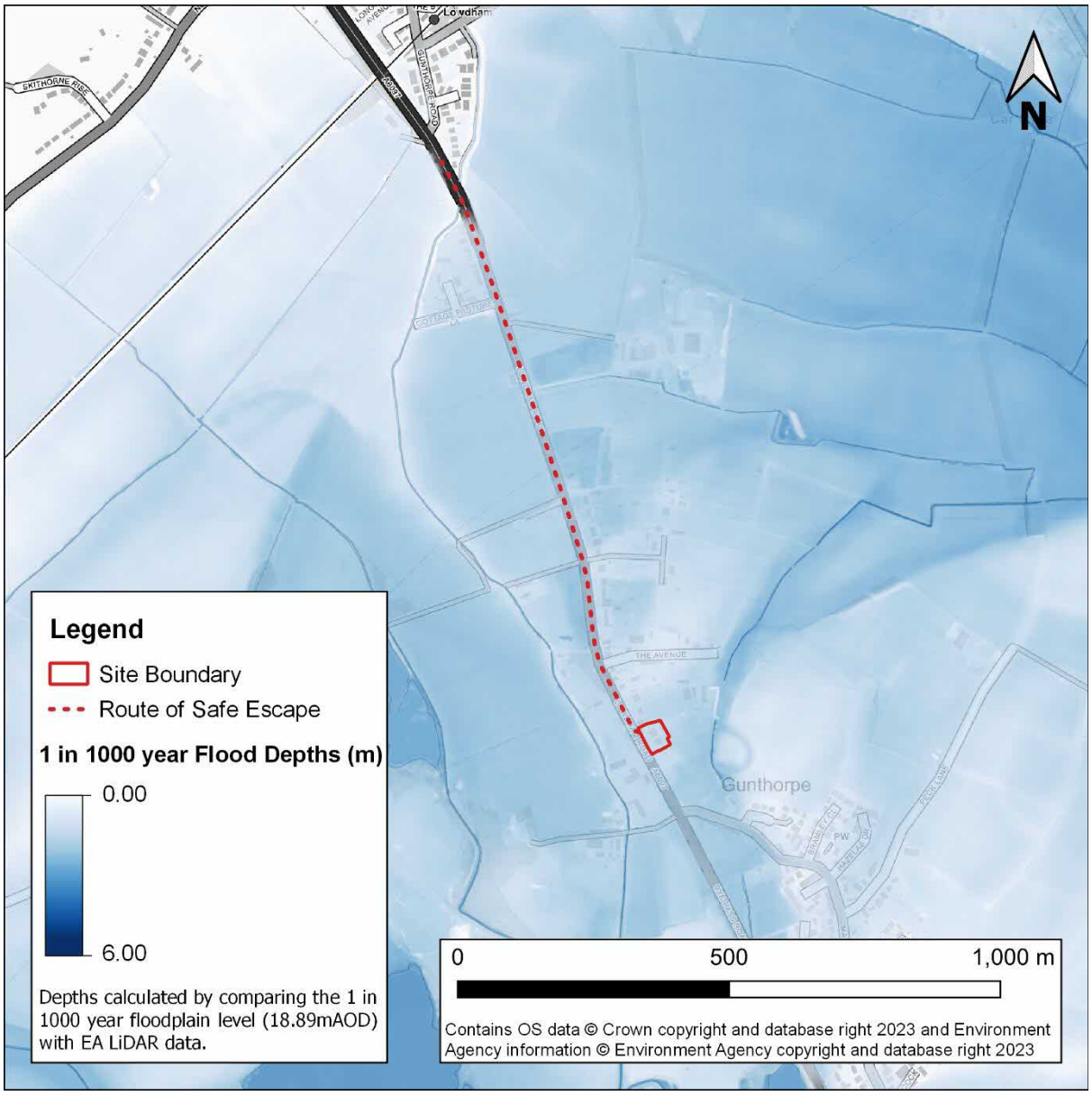


Figure 17: Route of Safe Access and Egress

Offsite Impacts

Increase in Surface Water Runoff

Given that the proposed development will introduce impermeable surfacing at the site, the client has agreed to incorporate Sustainable Urban Drainage System (SuDS) techniques within the proposals to mitigate against increased flood risk to third party land and deterioration of the receiving water environment.

Refer to the Outline Surface Water Drainage Strategy section for more information on how post development surface water runoff can be managed.

Floodplain Displacement and Compensatory Storage

The entire site is situated within Flood Zone 3 when using the Environment Agency Flood Map for Planning (Rivers and Sea) and is located below the 1 in 1000 year floodplain level of 18.89mAOD.

According to plans provided by the client the proposed development will introduce approximately 455m² of built footprint to the site. However, it should be noted that existing buildings at the site, amounting to a total area of 270m^2, will be demolished as part of the proposals. Therefore the true increase in total built footprint as a result of the development will amount to approximately 185m^2.

Despite this, given that the site is located entirely within Flood Zone 3 and there will be an overall increase in built footprint post development, it is considered that the application may have an impact on the existing floodplain functionality and could increase the risk of fluvial flooding elsewhere.

To make sure that there is no loss of fluvial floodplain storage as a result of the development, and that the new buildings will not affect flood conveyance routes across the site, it is recommended that the applicant constructs all eight dwellings on voids.

Provision of the development on voids will mean that there will be no increase in fluvial floodplain displacement at the site, post development. Construction of all eight dwellings on voids will actually increase the floodplain volume when compared to the existing situation by an area of 270m^2.

It is recommended that the voids are constructed as follows:

- The voids should be at least 1.0 m wide at every opening.
- Void openings should be situated no more than 5m apart, on all sides of the building(s).
- The minimum height of the void opening beneath each dwelling will be from the existing ground level to 19.19mAOD (300mm above the modelled 1 in 1000 year floodplain level).
- Vertical bars should be installed with a 100mm spacing to minimise accumulation of material which could block the voids.

On previous schemes the Environment Agency have questioned the suitability of voids as a method to provide flood storage and conveyance. It has been raised that void space beneath a building can become blocked over time and that maintenance agreements can be difficult to enforce.

In order to make sure that the voids are incorporated within the development and do not become ineffective over time it is recommended that:

- The voids are constructed in the line with the guidance detailed above
- The inclusion of voids within the scheme forms part of a formal planning condition applied to the development
- That the ongoing future maintenance of the voids is guaranteed through inclusion of the features within each property's deeds. It is recommended that within the deeds it is clearly stated that all voids are to remain clear of debris and accessible for the lifetime of the development.

Outline Surface Water Drainage Strategy

Planning and Relevant Guidance

Given that the proposed development will alter the impermeable surfacing at the site and will impact the existing runoff regime, details of post development surface water management will be required to accompany the planning proposals.

The aim of this outline Surface Water Drainage Strategy is to assess how surface water runoff generated by the proposed development can be managed now and for the lifetime of the development so that future site users and third party land will not be at an increased risk of flooding as a result of the proposals.

This outline Surface Water Drainage Strategy has been designed in accordance with national and local guidance including:

Nottinghamshire County Council's Guidance Note on the Validation Requirements for Planning Applications
National Planning Policy Framework
Planning Practice Guidance on Flood Risk and Coastal Change (Updated August 2022)
Sustainable Drainage Systems: Non-Statutory Technical Standards
CIRIA SuDS Manual (c753)
Sewerage Sector Guidance – Design and Construction Standards
ICE SuDS Route Maps

Peak Rainfall Intensity Allowance

In May 2022 the Environment Agency issued revised peak rainfall intensity allowances for Management Catchments in England. The update introduced a regional variation in rainfall uplifts to account for Climate Change based on Management Catchment and development lifetime.

The Environment Agency published the Peak Rainfall Allowance Map which shows anticipated changes in peak rainfall intensity over time based on drainage catchment. According to the EA's Peak Rainfall Allowance Map the site is located within the Lower Trent and Erewash Management Catchment. Peak rainfall allowances for this catchment are as follows:

3.3% Annual Exceedance Rainfall Event		
Epoch	Central Allowance	Upper End Allowance
2050s	20%	35%
2070s	25%	35%
1% Annual Exceedance Rainfall Event		
Epoch	Central Allowance	Upper End Allowance
2050s	20%	40%
2070s	25%	40%

Table 8: Lower Trent and Erewash Management Catchment Peak Rainfall Allowances

The specific Climate Change allowance required to the be applied within the attenuation storage calculations to account for future change in peak rainfall intensity is dependent on the design lifetime of the proposed development.

In accordance with the development lifetime guidance, residential developments should be considered to have a minimum lifetime of 100 years. Developments with a lifetime beyond 2100 should use the Upper End Allowance for the 2070s epoch for both the 1% and 3.3% annual exceedance probability events.

As such, this drainage strategy has been designed to accommodate all surface water runoff during the 1% annual exceedance probability Upper End Allowance (40%) Climate Change event.

Urban Creep

Urban creep is the conversion of permeable surfaces to impermeable over time. Typical examples include paving of front gardens to provide parking or extensions to existing buildings.

An allowance for urban creep is required to be considered within the drainage design for residential developments only to account for the incremental change of use from permeable to impermeable surfacing over the lifetime of a development.

Where applicable, the following allowances must be applied to the impermeable area within the site curtilage to account for urban creep:

Residential Development Density (Dwellings per Hectare)	Urban Creep Allowance (%)
≤ 25	10
30	8
35	6
45	4
≥ 50	2
Flats and Apartments	0

Table 9: Urban Creep Allowances

Note: Where the inclusion of the urban creep allowance would increase the total impermeable area to greater than 100% of the site area, the drainage system should be sized to accommodate runoff generated by 100% of the site area.

Given the nature of the proposed development and the site's intended use, a 10% allowance for urban creep has been accounted for within the design calculations.

Outline Surface Water Drainage Strategy

Drainage Hierarchy

In accordance with NPPF guidance and the CIRIA SuDS manual all surface water drainage strategies should follow the Drainage Hierarchy whereby discharge options are considered in the following order:

1. Stormwater reuse,
2. Discharge to ground,
3. Discharge to watercourse,
4. Discharge to surface water sewer,
5. Discharge to combined sewer.

The following sections detail how the drainage hierarchy has been followed and each of the discharge locations considered as part of this drainage strategy.

Water Re-Use (Optional)

Review of the design layout indicates that each plot will have an associated area of soft landscaping. Therefore, it is considered likely that there will be a demand for non-potable water supply post development.

Rainwater butts offer a simple mechanism for water re-use. They typically take the form of an above ground storage tank which collects roof runoff from building downpipes. Any stored water within the rainwater butt can subsequently be drawn off at a later time for non-potable uses such as wash-down purposes or irrigation use. In accordance with CIRIA SuDS Manual water re-use SuDS provide an *'indirect amenity value by supporting the resilience of developments and their landscape to changes in climate and water resource availability'*.

Rainwater butts are simple to incorporate within residential developments and can easily be added onto building downpipes at any stage of a development, with the tank overflow connected to the site's wider drainage system.

In practise, water re-use SuDS provide little in the way of attenuation storage therefore are not accounted for within the formal attenuation storage calculations. However, they do increase the lag time for storm water to enter a drainage system.

In light of the above, it is considered that there would a benefit from incorporating rainwater butts into the scheme as a form of water re-use SuDS to reduce post development water demand.

Infiltration to Ground

Review of British Geological Survey (BGS) records indicates that the site is located upon Gunthorpe Member (Mudstone) bedrock.

Additionally, given the current use of the site as a garage it is unknown whether there are any residual contaminants present within the underlying soils.

In light of the this, it is considered that a scheme based on infiltration to ground is not feasible at the site. As such infiltration to ground has not been considered further.

Discharge to Watercourse

The client has confirmed that a drainage ditch runs in a northerly direction approximately 90m east of the development.

Comparison of EA LiDAR levels at the site with levels correlating to the area surrounding the watercourse indicates that the top of bank is elevated approximately 0.8m lower than ground

levels within the development boundary. Therefore, it is considered that a gravity connection could be achieved to this watercourse.

Whilst the stream is located some 90m east of the red outline boundary the client has confirmed that the land between the development and the watercourse is within their ownership. As such, discharge across this land can be achieved without the need to obtain third party land owner permission and the conveyance infrastructure proposed to be run across this land can be maintained by the owner-developer for the lifetime of the development.

Given the above, it is proposed to discharge all post development runoff at a controlled rate to the section of watercourse some 90m east of the development.

Discharge to Sewer

It is proposed to discharge post development runoff to watercourse therefore a connection to the main sewer network has not been explored further within this drainage strategy.

Existing Runoff Rates

The Institute of Hydrology Report 124 Flood Estimation for Small Catchments (IH124) is appropriate for use where the site area is between 0 – 200 ha. Where the site is less than 50ha the analysis for determining the peak run-off-rate should use 50ha in the formula and scale it down using linear interpolation.

Considering that the site area is below 50ha the ICP SuDS method has been used to estimate the greenfield runoff rate for several return period events including QBAR.

Storm Event	Greenfield Runoff Rate (l/s)
QBAR	0.5
1 in 1 year	0.5
1 in 30 year	1.0
1 in 100 year	1.4

Table 10: Greenfield Runoff Rates

However, the site is currently occupied by brownfield land and underlain by approximately 1184m^2 of impermeable surfacing associated with the vehicle forecourt and the existing buildings. Therefore, the greenfield rates detailed above are not considered to represent the current situation at the site.

Brownfield runoff rates for the 1-year, 30-year and 100-year 15-minute storm duration events have been calculated using the Modified Rational Method. Refer to Table 11 (below). The rates shown in Table 11 are based on the existing hardstanding area only (1184m^2).

Storm Event	Existing Runoff Rate (l/s)	Proposed Runoff Rate (l/s)	Pre/Post Development Change (%)
1 in 1 year	12.10	1.0	- 91
1 in 30 year	30.19	1.0	- 96
1 in 100 year	38.30	1.0	- 97
1 in 100 year + 40% CC	-	1.0	-

Table 11: Existing Runoff Rates

Despite the calculated existing runoff rates, it is proposed that post development runoff from the site is limited to a maximum discharge rate of 1.0 l/s. Restricting post development runoff to a maximum rate of 1.0 l/s will provide significant betterment for all return period scenarios when compared to the existing situation (as detailed in the final column of Table 11).

Limiting runoff to a maximum rate of 1.0l/s via hydro-brake equates to a 55mm diameter orifice with a 400mm head. In accordance with guidance a 50mm orifice diameter is considered the lowest practicable size to minimise the risk of blockage to the outflow control.

Lined Permeable Paving

It is proposed that all surface water runoff generated by newly introduced impermeable areas at the development will be conveyed and stored within 660m^2 of lined permeable paving located beneath the majority of the access road and all sixteen car parking spaces.

It is proposed that all sixteen car parking spaces and the site access road (apart from the dropped kerbs located outside of the red outline boundary) will be underlain by lined permeable paving. Precipitation which lands on these areas will percolate through the paving surface and will be stored within the gravel/geocellular storage sub-base.

Surface water runoff generated by the remaining impermeable surfacing comprising 455m^2 of roof area, 245m^2 of private paving and 40m^2 of road associated with the dropped kerb will be directed towards the permeable paving sub-base via linear drains and subterranean pipework.

From the permeable paving sub-base any stored water will be gradually discharged to a section of existing watercourse located 90m east of the red outline boundary at a restricted rate of 1.0l/s via hydro-brake control device or similar.

Given the nature of the development a 10% allowance for urban creep needs to be taken into account within the design calculations. As such, the proposed SuDS system has been designed based on a total impermeable contribution area of 1540m^2.

All preliminary surface water drainage calculations have been undertaken using Innovyze InfoDrainage software. A summary of the design parameters and results are shown in Table 12, below. The InfoDrainage calculation sheets are included in Appendix E, F and G.

Area of Impermeable Surfacing (m^2)	1400
Impermeable Surfacing with Urban Creep (m^2)	1540
Dimension of Proposed Permeable Paving (m)	660m^2 x 0.4m
Void Ratio (%)	54.375
Proposed Discharge Rate (l/s)	1.0
Volume of Attenuation Required to Accommodate runoff for the 1 in 100yr + (40%) CC Event (m^3)	102.75
Total Volume Provided by Permeable Paving (m^3)	143.55

Table 12: Summary of Proposed Permeable Paving SuDS System

A void ratio of 54.375% has been used within the permeable paving calculations.

It is proposed that the 400mm permeable paving sub-base depth is made up of a combination of 150mm permavoid geocellular storage underlain by 250mm gravel. Graded gravel is considered to have a void ratio of 30% and geocelluar storage has a void ratio of 95%. Therefore, a void ratio 54.375% has been derived from the following calculation:

=(((0.15 x 0.95) + (0.25 x 0.3)) / 0.4) x 100

The 250mm of graded gravel will be located beneath the permavoid geocelluar storage with the proposed flow control outfall located at the invert of the gravel layer. This will ensure that any stored water percolates through the graded gravel component of the sub-base before discharging to the ordinary watercourse, enabling the proposed SuDS system to meet the water quality requirements as set out within CIRIA SuDS Manual.

The SuDS system has been sized to provide sufficient storage to accommodate all runoff generated by post development impermeable surfacing at the site during the 1 in 100yr plus (40%) Climate Change event.

Design Exceedance

The SuDS system has been designed to accommodate all surface water runoff generated by post development impermeable surfacing during the 1 in 100yr plus (40%) Climate Change event. As such, the SuDS system also has capacity to accommodate all runoff generated by the 1 in 30yr plus (35%) Climate Change rainfall event with no exceedance.

Despite this it is recommended that the profile of the site is designed to direct any exceedance surface water flows towards the formal drainage system.

In addition, it is advised that raised thresholds are put in place in line with building regulations, linear drains are installed at building entrance points and all landscaping is designed to slope away from doorways. These measures will mitigate against water ingress.

Potential exceedance flow routes can be seen on the proposed SuDS layout plan in Appendix H.

Water Quality

In accordance with The Simple Index Approach, detailed in the CIRIA SuDS Manual, residential roof runoff is considered to have a 'very low' pollution hazard level (refer to Table 13). Nevertheless, it is recommended that debris / sediment traps are included on any new drainage.

Runoff from private driveways and low trafficked roads (eg. cul de sacs, homezones and general access roads) are considered to have a 'low' pollution hazard level.

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential Roofs	Very Low	0.2	0.2	0.05
Private Driveways and Low Trafficked Roads	Low	0.5	0.4	0.4

Table 13: Pollution Hazard Indices for Different Land Use Classifications

It is proposed to manage all surface water runoff from the development via lined permeable paving. Indicative SuDS mitigation indices for permeable pavement features are as follows:

Type of SuDS Component	Mitigation Indices		
	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Permeable Pavement	0.7	0.6	0.7

Table 14: Indicative SuDS Mitigation Indices for Discharges to Surface Waters

As demonstrated in Table 14, the proposed permeable paving will provide adequate treatment for surface water runoff generated by the proposals as permeable paving is shown to have a higher mitigation index than the pollution hazard index for the development.

Scheme Dependencies

Post development connection to the ordinary watercourse will be subject to receipt of:

Severn Trent build over agreement to cross the existing pressure foul sewer which runs in a northerly direction 35m east of the development boundary;

Third party permission to construct an outfall adjacent to the channel. Consent will be required from the Water Management Consortium (which Trent Valley Internal Drainage Board forms a part of);

Discharge Consent to discharge surface water flows into the ordinary watercourse. Again this will need to be obtained from the Water Management Consortium who manage the ordinary watercourses in the area.

More information on the Water Management Consortium consents can be found here: https://tvidb.wmc-idbs.org.uk/services/byelaws-and-planning/

Adoption and Maintenance

It is foreseen that all SuDS components will be maintained privately by the future site owner(s) / operators or an appropriate management company.

All SuDS components should be maintained in line with the guidance provided in The SuDS Manual (C753). The following operation and maintenance requirements are recommended for the SuDS elements proposed in this strategy.

Drainage Infrastructure	Required Action	Typical Frequency
Conveyance Pipes	Inspect and remove silt/debris. Jet where appropriate.	To be inspected annually and as required.
Chambers and Catchpits	Inspect and remove silt/debris. Jet where appropriate. Replace damaged covers.	To be inspected annually and following a large storm event.
Flow Control and Associated Chamber	Inspect for blockages and clear where required. Remediate any faults.	To be inspected annually and following a large storm event.

Table 15: Suggested Maintenance Requirements for Drainage Infrastructure

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

Table 16: Maintenance Requirements for Pervious Pavements (Source: CIRIA SuDS Manual)

Conclusions and Recommendations

GeoSon Limited have been instructed by Melanie Hibbitt of Lowdham Cars to undertake a Site Specific Flood Risk Assessment (FRA) and Outline Surface Water Drainage Strategy to support a proposed planning application for development at Lowdham Cars, Lowdham Road, Gunthorpe.

The proposed application site is located at Lowdham Cars, Lowdham Road, Gunthorpe, Nottingham NG14 7ES. According to plans provided by the client the site is approximately 2287m^2 in size and currently forms part of a wider car dealership. The site itself is occupied by a garage, showroom and a car lot.

The proposed planning application is for demolition of the existing buildings at the site followed by construction of eight residential dwellings with associated access road, parking and amenity space.

According to plans provided by the client, post development the total impermeable area at the site will amount to approximately 1400m^2 comprising 455m^2 of roof area and 945m^2 of hardstanding (paving and roads).

Flood Risk Assessment Summary

Review of the Environment Agency's Recorded Flood Outline and Historic Flood Map datasets shows that four historical flood events have been recorded at the site since 1932.

According to the Environment Agency's Flood Map for Planning the site and surrounding area are located within Flood Zone 3 (High Probability), defined as land having greater than a 1 in 100 annual probability of fluvial flooding.

Considering that the site has been modelled within Flood Zone 3 on the EA's Flood Map for Planning, a Product 4 enquiry has been raised with the Environment Agency to obtain detailed flood model information in the relation to the site.

At the time of producing this report the site-specific Environment Agency Product 4 request is pending. Therefore, in order to meet the validation deadline set by Newark and Sherwood District Council, floodplain levels from a nearby FRA have been utilised to base this assessment on.

Floodplain levels for a range of return period events are available for the area surrounding the site. These floodplain levels have been extracted from the Trent and Tributaries SFRM2 Model produced by Halcrow in July 2011 and the Nottingham Tributaries SFRM Model produced by JBA in January 2014.

According to a nearby FRA undertaken in December 2021, the Environment Agency recommend that developments use the Halcrow 2011 model to base Flood Risk Assessments in the area.

Since the Trent and Tributaries SFRM2 Model was produced in 2011 the Environment Agency have issued revised climate change allowances for the study area. Based on the latest guidance, the development should be assessed against the 1 in 100 year plus 29% Climate Change fluvial event.

The available modelled floodplain levels do not include outputs for the 1 in 100 year plus 29% Climate Change fluvial event. However, floodplain levels are reported for the 1 in 1000 year event.

In the absence of a site specific Product 4 response, a conservative approach has been adopted and the 1 in 1000 year floodplain level at the site (18.89mAOD), taken from the 2011 Halcrow model, has been used to base this Flood Risk Assessment on.

Comparison of the 1 in 1000 year floodplain level (18.89mAOD) with EA LiDAR data corresponding to the proposed built footprints(17.80mAOD to 17.90mAOD) indicates that the developable area may experience flood depths of up to 1.09m during the 1 in 1000 year scenario.

The EA's Risk of Flooding from Surface Water data shows that the site is located within an area at "Very Low" risk of flooding from surface water.

According to Newark and Sherwood District Council Level 2 Stage 2 SFRA (2012) the development is located within an area classified as '>=50% <75% susceptible to groundwater flooding'. No further information has been provided to suggest that the site or surrounding area has historically been subject to groundwater flooding.

Review of the Environment Agency's Risk of Flooding from Reservoirs map indicates that the site is located within the 'maximum extent of flooding from reservoirs when there is also flooding from rivers'.

No information has been provided to suggest that the site has historically been subject to sewer surcharge flooding. In addition, no other artificial infrastructure have been identified within the surrounding area which could pose a risk of flooding to the development.

The following flood risk mitigation measures are recommended:

- The Finished Floor Level of all eight proposed dwellings is designed in line with Building Regulations and set at a minimum elevation of 19.19mAOD, raised at least 300mm above the 1 in 1000 year floodplain level (18.89mAOD).
- Considering that the site is at risk of flooding from rivers flood resistance and resilience measures are recommended to further protect the dwellings (refer to page 35).
- Any external landscaping should be designed to slope away from the proposed dwellings, where possible.
- The inclusion of basement rooms within the dwellings is not recommended.
- The development is located within an EA Flood Warning and Alert area. Therefore it is recommended that the developer and future residents sign up to the Environment Agency's free Targeted Flood Warning Service at https://www.gov.uk/sign-up-for-flood-warnings.
- Given the nature of flood risk at the site it is recommended that the applicant considers developing a Flood Warning and Evacuation Plan for future residents.
- Safe refuge can be provided within the residential dwellings.
- Safe access and egress to and from the development can be provided via Lowdham Road.
- To make sure that there is no loss of fluvial floodplain storage as a result of the development, and that the new buildings will not affect flood conveyance routes across the site, it is recommended that the applicant constructs all eight dwellings on voids.

Outline Surface Water Drainage Strategy Summary

It is proposed that post development discharge from the site will be restricted to a maximum rate of 1.0 l/s. Restricting post development runoff to a maximum rate of 1.0 l/s will provide significant betterment for all return period scenarios when compared to the existing situation (as detailed in the final column of Table 11).

It is proposed that all surface water runoff generated by newly introduced impermeable areas at the development will be conveyed and stored within 660m^2 of lined permeable paving located beneath the majority of the access road and all sixteen car parking spaces.

From the permeable paving sub-base any stored water will be gradually discharged to a section of existing watercourse located 90m east of the red outline boundary at a restricted rate of 1.0l/s via hydro-brake control device or similar.

Given the nature of the development a 10% allowance for urban creep needs to be taken into account within the design calculations. As such, the proposed SuDS system has been designed based on a total impermeable contribution area of 1540m^2.

Preliminary calculations indicate that approximately 103m^3 of storage will be required to accommodate all runoff generated by 1540m^2 of impermeable surfacing for all storms up to and including the 1 in 100 year plus (40%) climate change event, whilst limiting discharge to 1.0l/s.

Calculations show that permeable paving with a surface area of 660m^2, sub-base depth of 0.4m and void ratio of 54.375 will provide sufficient storage to accommodate all runoff generated by 1540m^2 of impermeable surfacing during the 1 in 100 year plus (40%) climate change event.

Post development connection to the ordinary watercourse will be subject to receipt of:

- Severn Trent build over agreement to cross the existing pressure foul sewer which runs in a northerly direction 35m east of the development boundary;
- Third party permission to construct an outfall adjacent to the channel. Consent will be required from the Water Management Consortium (which Trent Valley Internal Drainage Board forms a part of);
- Discharge Consent to discharge surface water flows into the ordinary watercourse. Again this will need to be obtained from the Water Management Consortium who manage the ordinary watercourses in the area.

The SuDS system has been designed to accommodate all surface water runoff generated by post development impermeable surfacing during the 1 in 100yr plus (40%) Climate Change event. As such, the SuDS system has capacity to accommodate all runoff generated by the 1 in 30yr plus (35%) Climate Change rainfall event with no exceedance.

Appendix

A. Location Plan

B. Development Proposals

C. Severn Trent Water Asset Location Search

D. Environment Agency Product 4 Response – Taken From Nearby FRA

E. ICP SUDS Greenfield Runoff Calculations

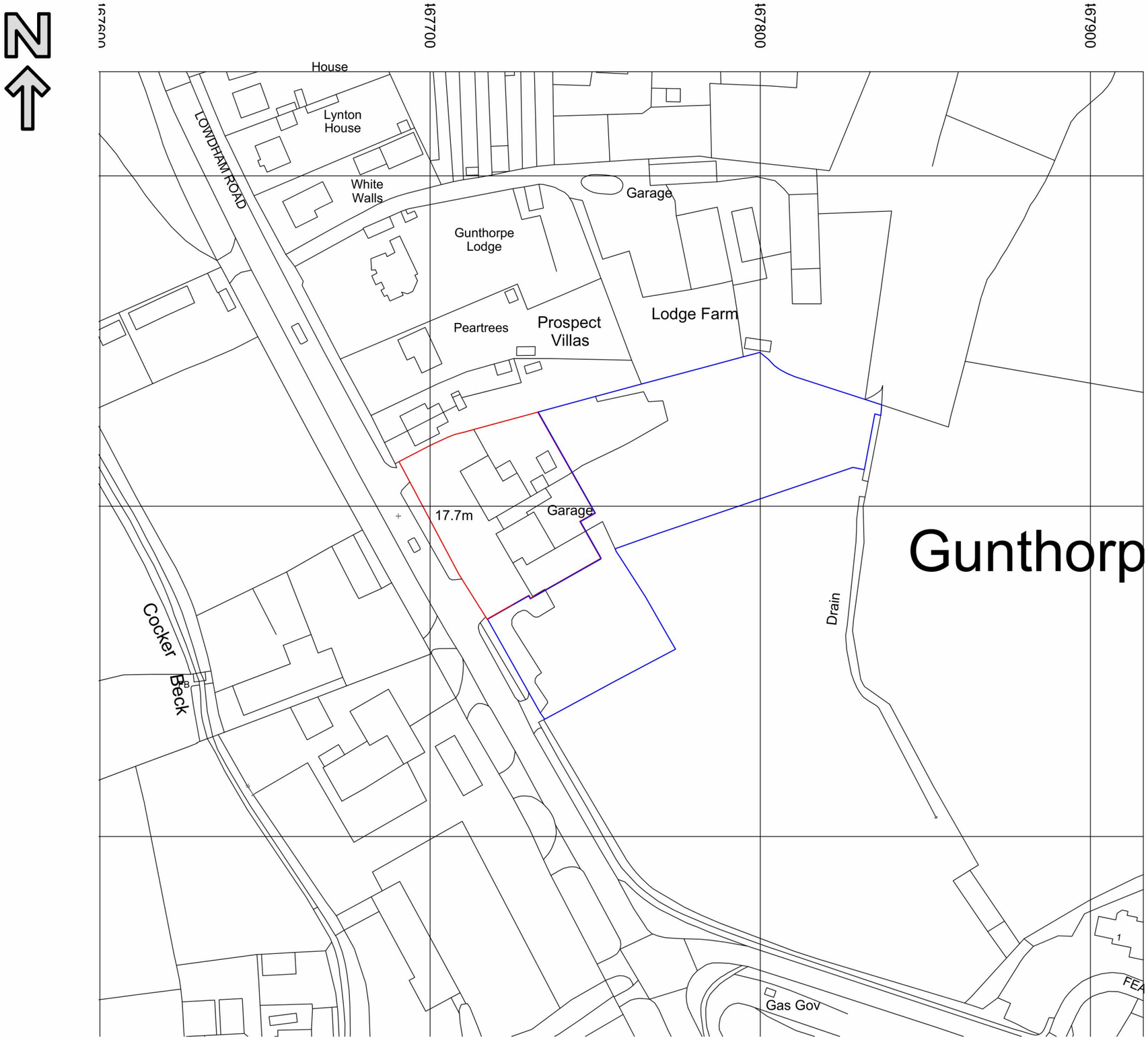
F. Modified Rational Method Brownfield Runoff Calculations

G. Innovyze InfoDrainage Permeable Paving Calculations

H. Proposed SuDS Layout Plan

I. Permavoid Technical Specification Product Sheet

Appendix A



Site Location Plan Scale 1/1250

SJC
ARCHITECTURE
[redacted]

Prior to the commencement of work, the contractor and client are to check on-site all exterior dimensions, setting out positions, boundary positions and details to verify and agree upon. Any errors, omissions or design changes should be reported immediately to enable amended plans to be prepared and submitted for approval.

The contractor will be responsible for locating all hidden services that may be affected by the proposal and stopping off or diverting as necessary. Drainage runs shown are assumed and must be checked on site before work commences. Any proposed building works within 3 meters of a public sewer will require a "building over/close to" application to be submitted and approved by the water authority prior to work commencing.

All work to comply with CDM 2015. The principle contractor, for projects with more than one contractor, must take on the legal duties of the client in addition to their own as principle contractor. If the domestic client has not appointed a principle contractor, the clients duties must be carried out by the contractor in control of the construction work.

This drawing is to be read in conjunction with the structural engineers drawings and details.

Client
Lowdham Cars,
Lowdham Road,
Gunthorpe,
Nottinghamshire,
NG14 7ES

Project
Creation of 8 new build dwellings on site of existing car sales and former dwelling

Drawing Title
Site location plan

Scale 1/1250 | Date April 2023
By SJC | Status Planning

Drawing number
SC/OB/05/04/23/01

Revision

original sheet size A3

Appendix B

Site Block Plan Scale 1/500

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[redacted]

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This drawing is to be read in conjunction with the structural engineers drawings and details.

Client
Lowdham Cars,
Lowdham Road,
Gunthorpe,
Nottinghamshire,
NG14 7ES

Project
Creation of 5 new build dwellings on site of existing car sales and former dwelling

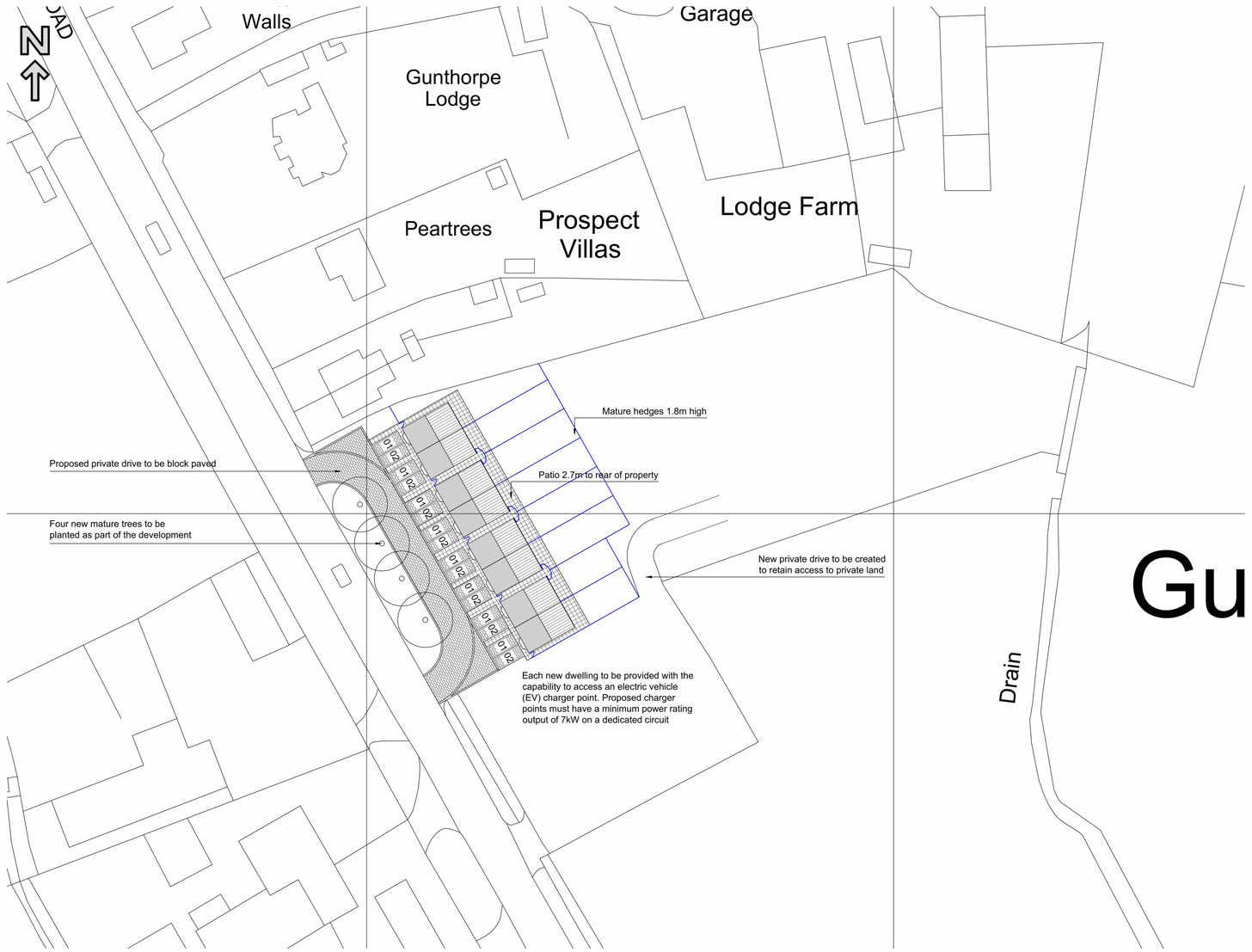
Drawing Title
Site block plan

Scale 1/500 | Date April 2023
By SJC | Status Planning

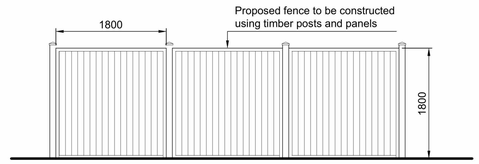
Drawing number | Revision
SC/OB/05/04/23/02

 original sheet size A2

Proposed Street Scene Scale 1/100



Site Block Plan Scale 1/500



1800mm Close Boarded Fence
Scale 1/50

1800mm Close Boarded Door
Scale 1/50

SJC
ARCHITECTURE
[redacted]

Prior to the commencement of work, the contractor and client are to check on-site all exterior dimensions, setting out positions, boundary positions and details to verify and agree upon. Any errors, omissions or design changes should be reported immediately to enable amended plans to be prepared and submitted for approval.

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This drawing is to be read in conjunction with the structural engineers drawings and details.

Client
Lowdham Cars,
Lowdham Road,
Gunthorpe,
Nottinghamshire,
NG14 7ES

Project
Creation of 8 new build dwellings on site of existing car sales and former dwelling

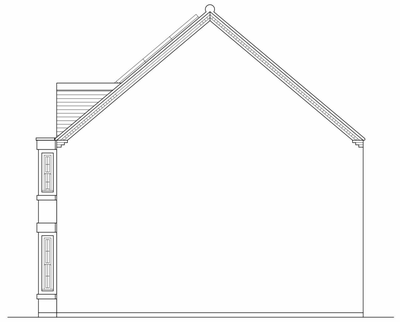
Drawing Title
Boundary plan and street scene

Scale 1/50, 1/100, 1/500 Date April 2023
By SJC Status Planning

Drawing number SC/OB/05/04/23/05 Revision

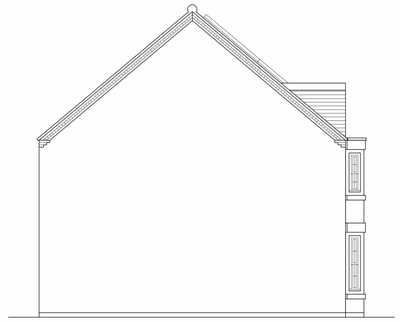
 original sheet size A1

Proposed Front Elevation
Scale 1/100

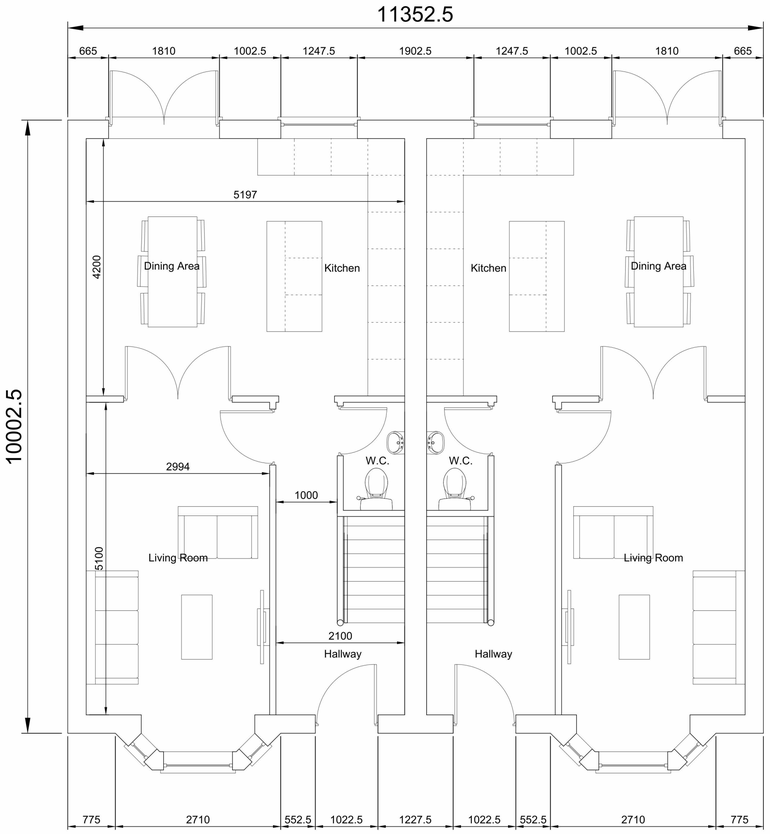


Proposed Side Elevation
Scale 1/100

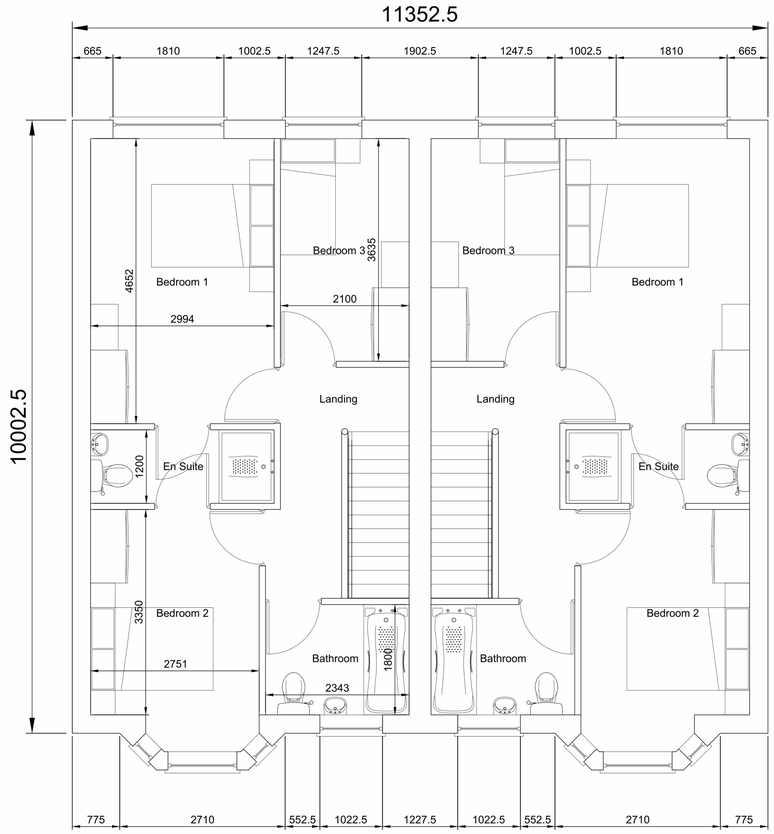
Proposed Rear Elevation
Scale 1/100



Proposed Side Elevation
Scale 1/100



Proposed Ground Floor Plan Scale 1/50



Proposed First Floor Plan Scale 1/50

SJC
ARCHITECTURE
[redacted]

Prior to the commencement of work, the contractor and client are to check on-site all exterior dimensions, setting out positions, boundary positions and details to verify and agree upon. Any errors, omissions or design changes should be reported immediately to enable amended plans to be prepared and submitted for approval.

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All work to comply with CDM 2015. The principle contractor, for projects with more than one contractor, must take on the legal duties of the client in addition to their own as principle contractor. If the domestic client has not appointed a principle contractor, the clients duties must be carried out by the contractor in control of the construction work.

This drawing is to be read in conjunction with the structural engineers drawings and details.

Client
Lowdham Cars,
Lowdham Road,
Gunthorpe,
Nottinghamshire,
NG14 7ES

Project
Creation of 8 new build dwellings on site of existing car sales and former dwelling

Drawing Title
Proposed elevations and floor plans for plots 1-2, 3-4, 5-6, 7-8

Scale 1/50, 1/100 Date April 2023
By SJC Status Planning

Drawing number SC/OB/05/04/23/03 Revision

 original sheet size A1

Proposed Front Elevation
Scale 1/100

Proposed Front Elevation
Scale 1/100

Proposed Front Elevation
Scale 1/100

SJC
ARCHITECTURE

Prior to the commencement of work, the contractor and client are to check on-site all exterior dimensions, setting out positions, boundary positions and details to verify and agree upon. Any errors, omissions or design changes should be reported immediately to enable amended plans to be prepared and submitted for approval.

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Client
Lowdham Cars,
Lowdham Road,
Gunthorpe,
Nottinghamshire,
NG14 7ES

Project
Creation of 8 new build dwellings on site of existing car sales and former dwelling

Drawing Title
Front elevation ideas

Scale 1/100	Date April 2023
By SJC	Status Planning
Drawing number SC/OB/05/04/23/IDEAS	Revision

original sheet size A3

545W JA Solar Mono PERC Half-Cell MBB MC4 Solar Panel x6 per dwelling

Dentil brickwork detail to all eaves on proposed dwelling

Cast stone window heads to proposed bay window

All windows to front elevation to be white timber double glazed sliding sash windows

Cast stone window sills to proposed bay window

Proposed front door to be traditionally made 68mm thick solid timber front door

Proposed Front Elevation Scale 1/50

Proposed guttering to be fixed using galvanised steel rise and fall brackets

Proposed roof to be covered in Marley Concrete Plain Tile Smooth Grey

Cast stone window sills to proposed rear windows

Proposed facade to be constructed using red brick

Cast stone window heads to proposed bay window

Proposed French doors to be white and constructed from solid timber

Proposed Rear Elevation Scale 1/50

SJC ARCHITECTURE [redacted]

Prior to the commencement of work, the contractor and client are to check on-site all exterior dimensions, setting out positions, boundary positions and details to verify and agree upon. Any errors, omissions or design changes should be reported immediately to enable amended plans to be prepared and submitted for approval.

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This drawing is to be read in conjunction with the structural engineers drawings and details.

Client
Lowdham Cars,
Lowdham Road,
Gunthorpe,
Nottinghamshire,
NG14 7ES

Project
Creation of 8 new build dwellings on site of existing car sales and former dwelling

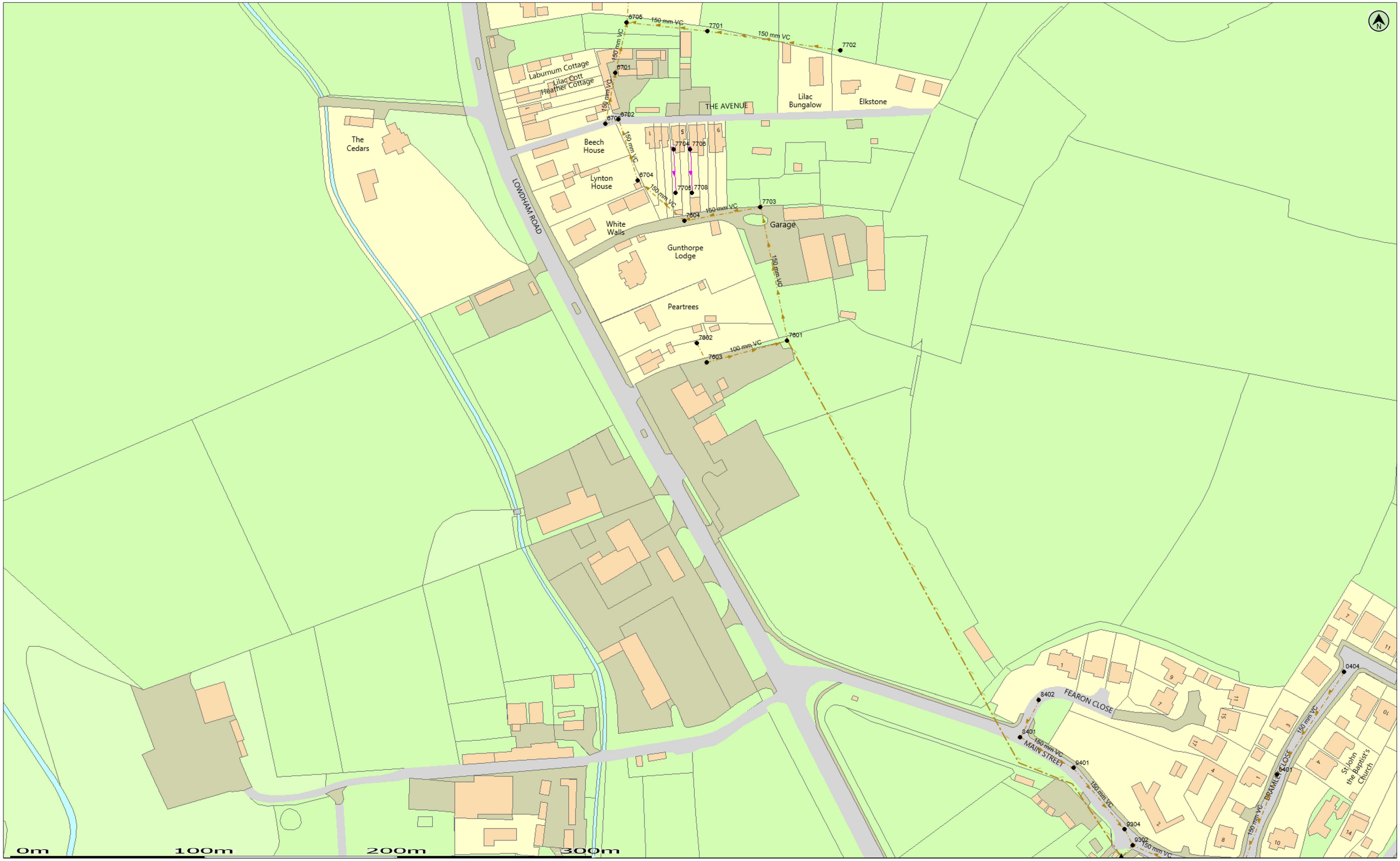
Drawing Title
Proposed materials plan

Scale 1/50 | Date April 2023
By SJC | Status Planning

Drawing number SC/OB/05/04/23/04 | Revision

 original sheet size A2

Appendix C



(c) Crown copyright and database rights 2023 Ordnance Survey 100031673 | Date: 18/05/23 | Scale: 1:1250 | Map Centre: 467724,344590 | Data updated: 14/05/23 | Our Ref: 1179733 - 1 | Wastewater Plan A2

- Public Foul Gravity/Lateral Drain
- Public Combined Gravity/Lateral Drain
- Public Surface Water Gravity/Lateral Drain
- Pressure Foul
- Pressure Combined
- Pressure Surface Water
- Highway Drain
- Overflow Pipe
- Disposal Pipe
- Culverted Water Course
- Pumping Station
- Fitting
- Manhole Foul
- Manhole Surface
- Abandoned Pipe
- Chamber

Section 104 sewers are shown in green

Private sewers are shown in magenta

[redacted]

73101

SEVERN TRENT

GENERAL CONDITIONS AND PRECAUTIONS TO BE TAKEN WHEN CARRYING OUT WORK ADJACENT TO SEVERN TRENT WATER'S APPARATUS

Please ensure that a copy of these conditions is passed to your representative and/or your contractor on site. If any damage is caused to Severn Trent Water Limited (STW) apparatus (defined below), the person, contractor or subcontractor responsible must inform STW immediately on:
0800 783 4444 (24 hours)

a) These general conditions and precautions apply to the public sewerage, water distribution and cables in ducts including (but not limited to) sewers which are the subject of an Agreement under Section 104 of the Water Industry Act 1991(a legal agreement between a developer and STW, where a developer agrees to build sewers to an agreed standard, which STW will then adopt); mains installed in accordance with an agreement for the self-construction of water mains entered into with STW and the assets described at condition b) of these general conditions and precautions. Such apparatus is referred to as ³STW Apparatus´ in these general conditions and precautions.

b) Please be aware that due to The Private Sewers Transfer Regulations June 2011, the number of public sewers has increased, but many of these are not shown on the public sewer record. However, some idea of their positions may be obtained from the position of inspection covers and their existence must be anticipated.

c) On request, STW will issue a copy of the plan showing the approximate locations of STW Apparatus although in certain instances a charge will be made. The position of private drains, private sewers and water service pipes to properties are not normally shown but their presence must be anticipated. This plan and the information supplied with it is furnished as a general guide only and STW does not guarantee its accuracy.

d) STW does not update these plans on a regular basis. Therefore the position and depth of STW Apparatus may change and this plan is issued subject to any such change. Before any works are carried out, you should confirm whether any changes to the plan have been made since it was issued.

e) The plan must not be relied upon in the event of excavations or other works in the vicinity of STW Apparatus. It is your responsibility to ascertain the precise location of any STW Apparatus prior to undertaking any development or other works (including but not limited to excavations).

f) No person or company shall be relieved from liability for loss and/or damage caused to STW Apparatus by reason of the actual position and/or depths of STW Apparatus being different from those shown on the plan.

In order to achieve safe working conditions adjacent to any STW Apparatus the following should be observed:

1. All STW Apparatus should be located by hand digging prior to the use of mechanical excavators.

2. All information set out in any plans received from us, or given by our staff at the site of the works, about the position and depth of the mains, is approximate. Every possible precaution should be taken to avoid damage to STW Apparatus. You or your contractor must ensure the safety of STW Apparatus and will be responsible for the cost of repairing any loss and/or damage caused (including without limitation replacement parts).

3. Water mains are normally laid at a depth of 900mm. No records are kept of customer service pipes which are normally laid at a depth of 750mm; but some idea of their positions may be obtained from the position of stop tap covers and their existence must be anticipated.

4. During construction work, where heavy plant will cross the line of STW Apparatus, specific crossing points must be agreed with STW and suitably reinforced where required. These crossing points should be clearly marked and crossing of the line of STW Apparatus at other locations must be prevented.

5. Where it is proposed to carry out piling or boring within 20 metres of any STW Apparatus, STW should be consulted to enable any affected STW Apparatus to be surveyed prior to the works commencing.

6. Where excavation of trenches adjacent to any STW Apparatus affects its support, the STW Apparatus must be supported to the satisfaction of STW. Water mains and some sewers are pressurised and can fail if excavation removes support to thrust blocks to bends and other fittings.

7. Where a trench is excavated crossing or parallel to the line of any STW Apparatus, the backfill should be adequately compacted to prevent any settlement which could subsequently cause damage to the STW Apparatus. In special cases, it may be necessary to provide permanent support to STW Apparatus which has been exposed over a length of the excavation before backfilling and reinstatement is carried out. There should be no concrete backfill in contact with the STW Apparatus.

8. No other apparatus should be laid along the line of STW Apparatus irrespective of clearance. Above ground apparatus must not be located within a minimum of 3 metres either side of the centre line of STW Apparatus for smaller sized pipes and 6 metres either side for larger sized pipes without prior approval. No manhole or chamber shall be built over or around any STW Apparatus.

9. A minimum radial clearance of 300 millimetres should be allowed between any plant or equipment being installed and existing STW Apparatus. We reserve the right to increase this distance where strategic assets are affected.

10. Where any STW Apparatus coated with a special wrapping is damaged, even to a minor extent, STW must be notified and the trench left open until the damage has been inspected and the necessary repairs have been carried out. In the case of any material damage to any STW Apparatus causing leakage, weakening of the mechanical strength of the pipe or corrosion-protection damage, the necessary remedial work will be recharged to you.

11. It may be necessary to adjust the finished level of any surface boxes which may fall within your proposed construction. Please ensure that these are not damaged, buried or otherwise rendered inaccessible as a result of the works and that all stop taps, valves, hydrants, etc. remain accessible and operable. Minor reduction in existing levels may result in conflict with STW Apparatus such as valve spindles or tops of hydrants housed under the surface boxes. Checks should be made during site investigations to ascertain the level of such STW Apparatus in order to determine any necessary alterations in advance of the works.

12. With regard to any proposed resurfacing works, you are required to contact STW on the number given above to arrange a site inspection to establish the condition of any STW Apparatus in the nature of surface boxes or manhole covers and frames affected by the works. STW will then advise on any measures to be taken, in the event of this a proportionate charge will be made.

13. You are advised that STW will not agree to either the erection of posts, directly over or within 1.0 metre of valves and hydrants,

14. No explosives are to be used in the vicinity of any STW Apparatus without prior consultation with STW.

TREE PLANTING RESTRICTIONS

There are many problems with the location of trees adjacent to sewers, water mains and other STW Apparatus and these can lead to the loss of trees and hence amenity to the area which many people may have become used to. It is best if the problem is not created in the first place. Set out below are the recommendations for tree planting in close proximity to public sewers, water mains and other STW Apparatus.

15. Please ensure that, in relation to STW Apparatus, the mature root systems and canopies of any tree planted do not and will not encroach within the recommended distances specified in the notes below.

16. Both Poplar and Willow trees have extensive root systems and should not be planted within 12 metres of a sewer, water main or other STW Apparatus.

17. The following trees and those of similar size, be they deciduous or evergreen, should not be planted within 6 metres of a sewer, water main or other STW Apparatus. E.g. Ash, Beech, Birch, most Conifers, Elm, Horse Chestnut, Lime, Oak, Sycamore, Apple and Pear. Asset Protection Statements Updated May 2014

18. STW personnel require a clear path to conduct surveys etc. No shrubs or bushes should be planted within 2 metre of the centre line of a sewer, water main or other STW Apparatus.

19. In certain circumstances, both STW and landowners may wish to plant shrubs/bushes in close proximity to a sewer, water main of other STW Apparatus for screening purposes. The following are shallow rooting and are suitable for this purpose: Blackthorn, Broom, Cotoneaster, Elder, Hazel, Laurel, Privet, Quickthorn, Snowberry, and most ornamental flowering shrubs.

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
7704	C	-	0	0
7705	C	-	0	0
7706	C	-	0	0
7708	C	-	0	0
0401	F	19	15.48	3.52
0404	F	18.51	16	2.51
6701	F	17.42	14.94	2.48
6702	F	18.16	15.4	2.76
6703	F	18.05	15.32	2.73
6704	F	18.4	15.62	2.78
6705	F	17.63	15.19	2.44
7601	F	17.39	16.31	1.08
7602	F	17.55	16.76	0.79
7603	F	17.65	16.85	0.8
7604	F	18.37	15.75	2.63
7701	F	18.23	15.77	2.46
7702	F	18.17	16.69	1.48
7703	F	17.25	15.95	1.3
8401	F	17.46	16.03	1.43
8402	F	17.94	16.45	1.48
9302	F	17.37	14.7	2.67
9304	F	17.43	15.19	2.24
9401	F	17.38	15.68	1.7

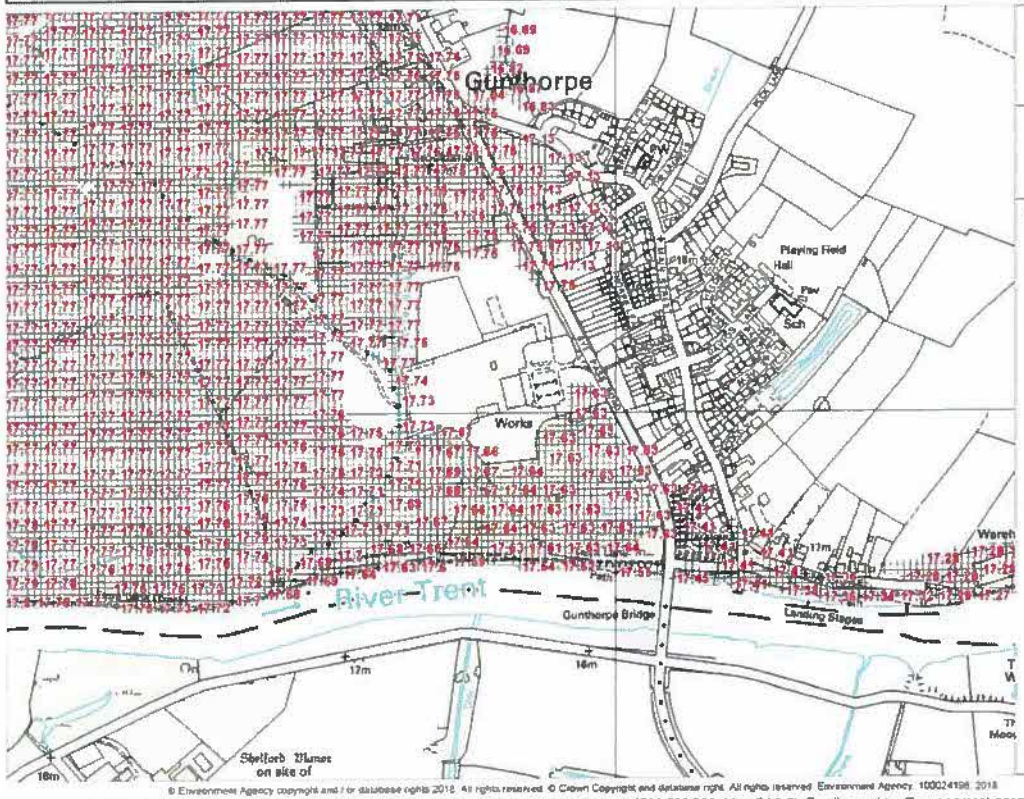
Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Appendix D

Floodplain Heights Map centred on Gunthorpe, Nottinghamshire - created 12 September 2018



Environment Agency

Scale 1:5,000

N W E S

Legend

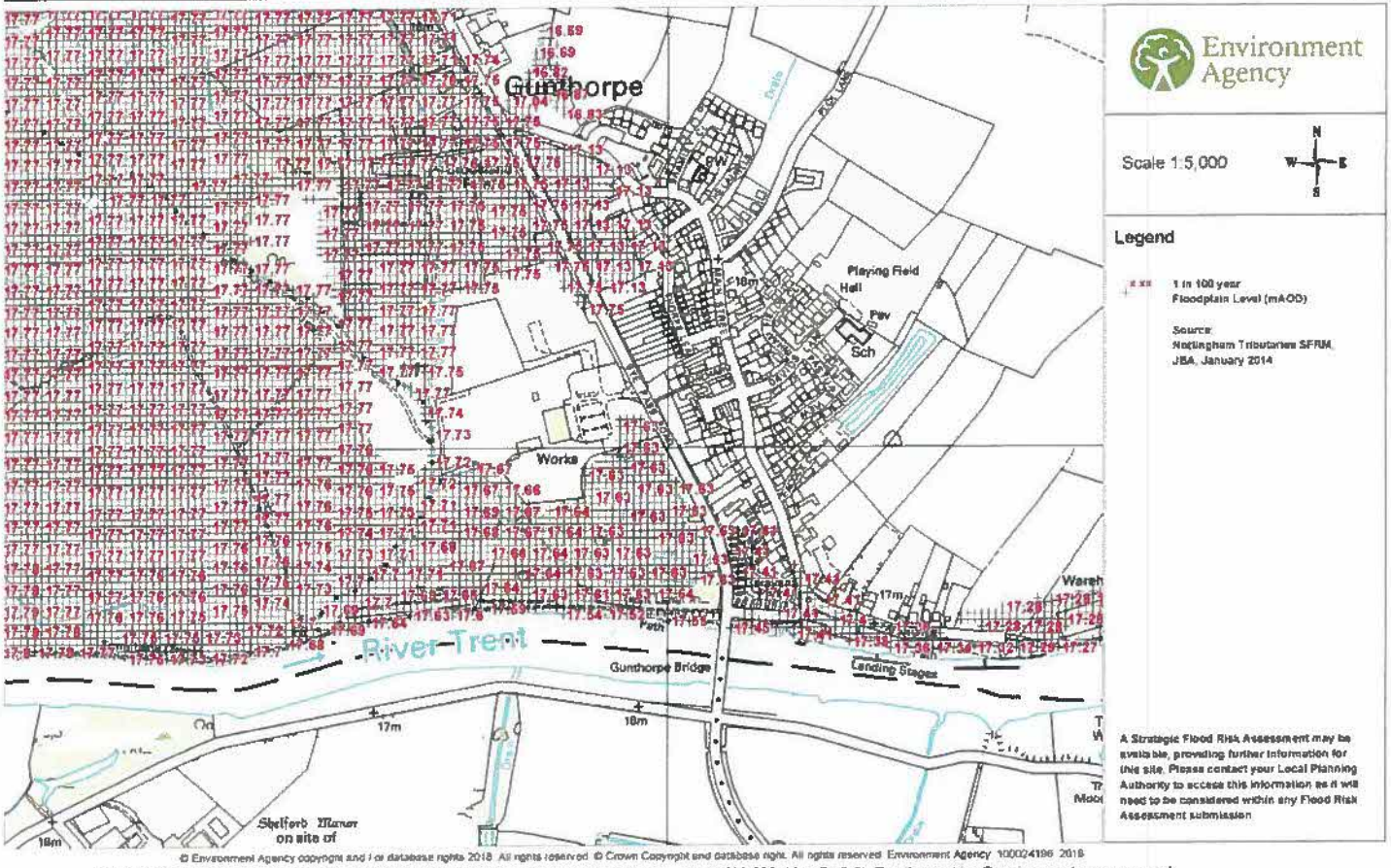
1 in 100 year (including climate change forecast) Floodplain Level (mAOD)

Source: Nottingham Tributaries SFRM, JBA, January 2014

A Strategic Flood Risk Assessment may be available, providing further information for this site. Please contact your Local Planning Authority to access this information as it will need to be considered within any Flood Risk Assessment submission

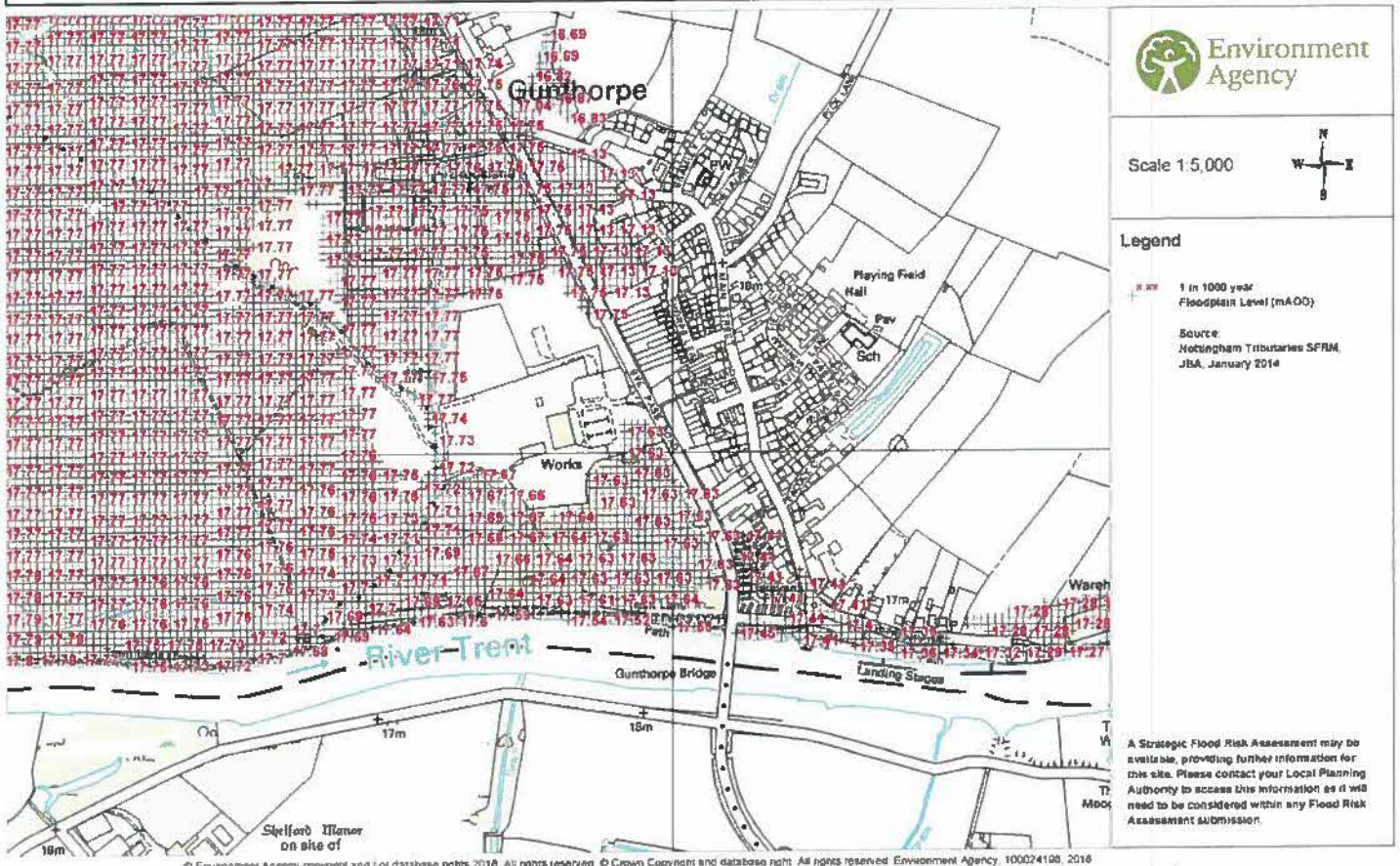
Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY Tel: 03708 506 506 (Mon-Fri 8-6) Email: enquiries@environment-agency.gov.uk

Floodplain Heights Map centred on Gunthorpe, Nottinghamshire - created 12 September 2018



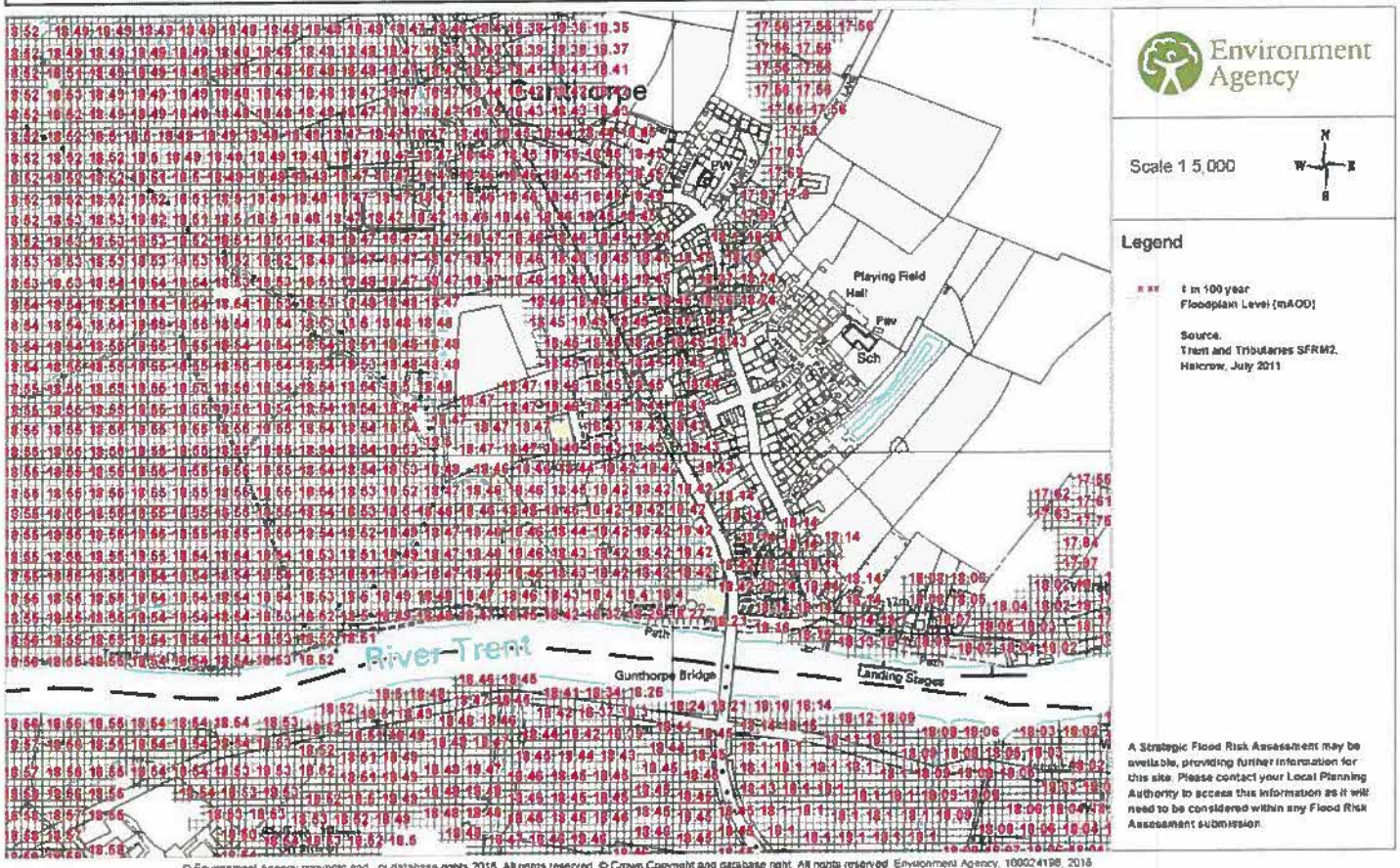
Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Floodplain Heights Map centred on Gunthorpe, Nottinghamshire - created 12 September 2018



Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Floodplain Heights Map centred on Gunthorpe, Nottinghamshire - created 12 September 2018



Environment Agency

Scale 1:5,000

N
W
E
S

Legend

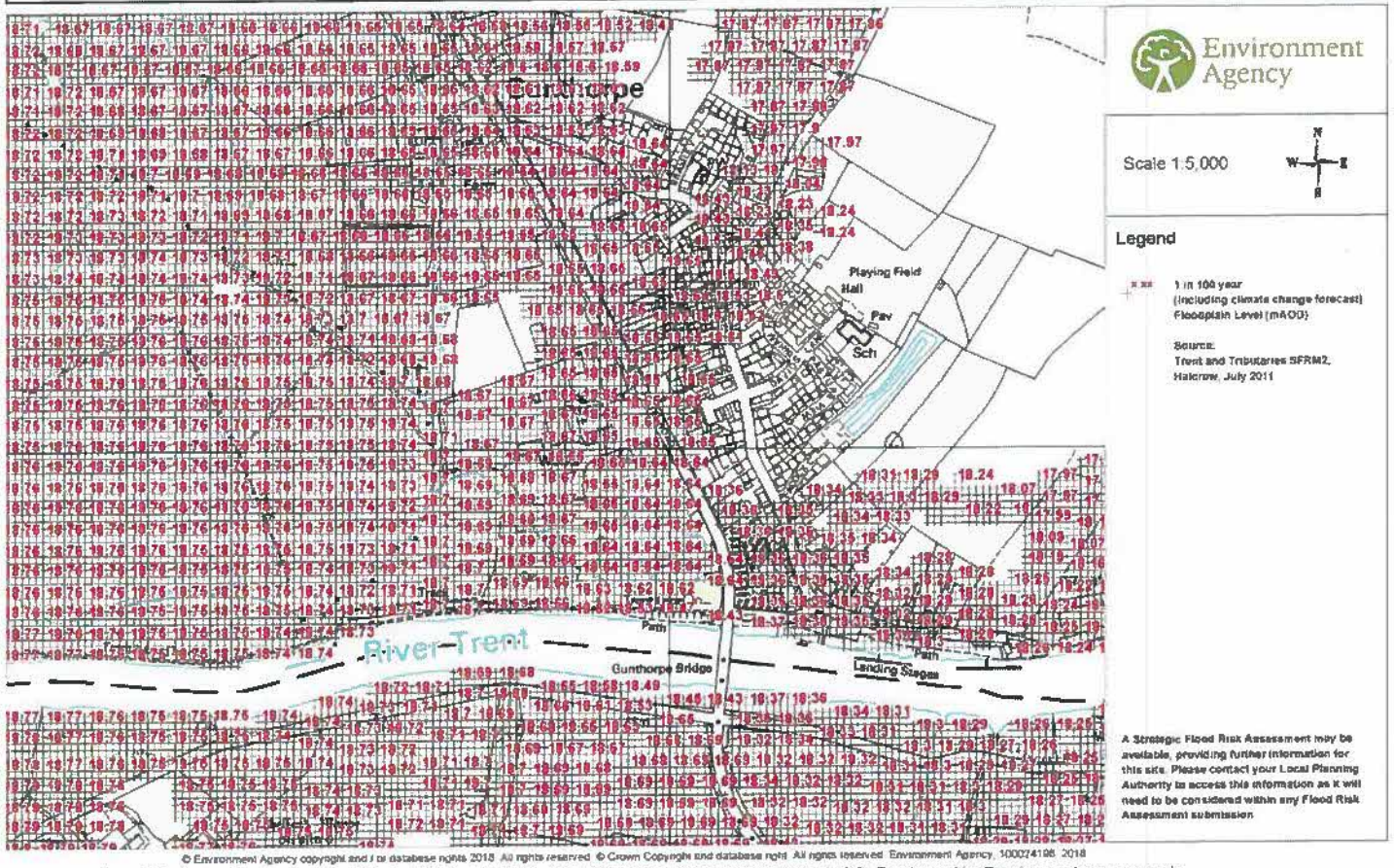
x.xx ft in 100 year Floodplain Level (mAOD)

Source:
Trent and Tributaries SFRM2, Halcrow, July 2011

A Strategic Flood Risk Assessment may be available, providing further information for this site. Please contact your Local Planning Authority to access this information as it will need to be considered within any Flood Risk Assessment submission.

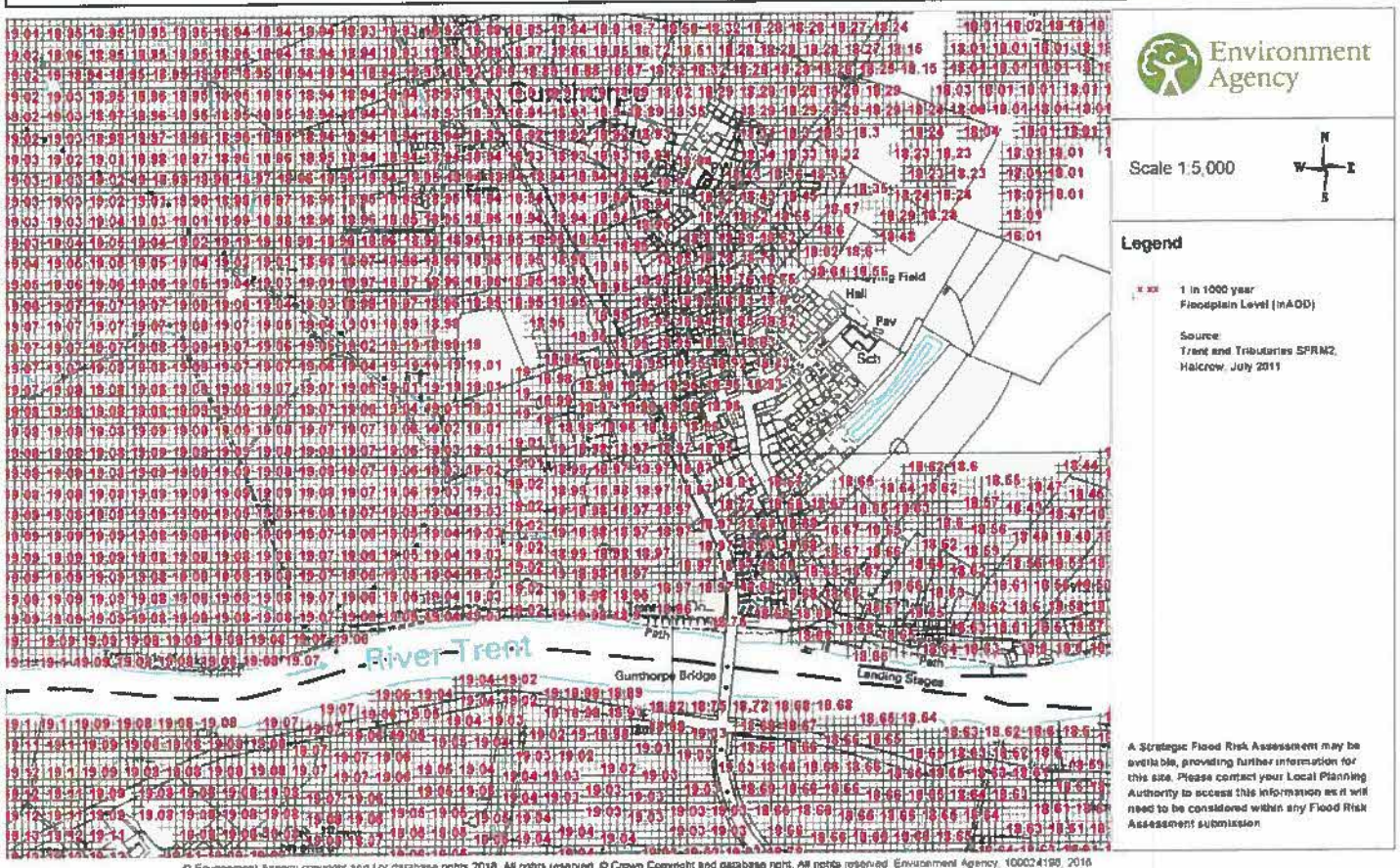
Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Floodplain Heights Map centred on Gunthorpe, Nottinghamshire - created 12 September 2018



Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Floodplain Heights Map centred on Gunthorpe, Nottinghamshire - created 12 September 2018



Contact Us: National Customer Contact Centre PO Box 544, Rotherham S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Appendix E

Project:	Date:		
73101 - Lowdham Cars Greenfield Runoff Rates	30/05/2023		
	Designed by: TS	Checked by:	Approved By:
Report Title: UK and Ireland Rural Runoff Calculator	Company Address: GeoSon Limited		

ICP SUDS / IH 124

Details

Method	ICP SUDS
Area (ha)	0.229
SAAR (mm)	600.0
Soil	0.37
Region	Region 1
Urban	0
Return Period (years)	0

Results

Region	QBAR Rural (L/s)	QBAR Urban (L/s)	Q 1 (years) (L/s)	Q 30 (years) (L/s)	Q 100 (years) (L/s)
Region 1	0.5	0.5	0.5	1.0	1.4

Appendix F

Modified Rational Method Calculation Sheet

Qp = CiA/0.36

	T (Return Period)		
	1 in 1 year	1 in 30 year	1 in 100 year
Qp (l/s)	12.10	30.19	38.30
C	1.30	1.30	1.30
ARF x i (mm/hr)	28.41	70.86	89.89
A (ha)	0.118	0.118	0.118

Modified Rational Method Workings for the 15-Minute Storm Duration:

	1 in 1 year	1 in 30 year	1 in 100 year
Determination of C			
Cv	1.00	1.00	1.00
Cr	1.30	1.30	1.30
C	1.30	1.30	1.30
Determination of i			
M5-60min (mm)	19.5	19.5	19.5
r	0.402	0.402	0.402
D (mins)	15	15	15
T (yrs)	1	30	100
	Determination of M5-D		
Z1	0.63	0.63	0.63
M5-D (mm)	12.285	12.285	12.285
	Determination of MT-D		
Z2	0.615	1.534	1.946
MT-D (mm)	7.555	18.845	23.907

	Determination of point rainfall intensities		
i (mm/hr)	30.221	75.381	95.626
	Application of areal reduction factor		
ARF	0.94	0.94	0.94
i (mm/hr)	28.41	70.86	89.89

Appendix G

Project:	Date:		
73101 - Lowdham Cars Lined Permeable Paving 1 in 30yr +35% CC Event	30/05/2023		
	Designed by: TS	Checked by:	Approved By:
Report Details: Type: Inflows Storm Phase: Phase	Company Address: GeoSon Limited		

Catchment Area

Type : Catchment Area

Area (ha)	0.154

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.750
Winter Volumetric Runoff	0.840
Time of Concentration (mins)	5
Percentage Impervious (%)	100

Project:	Date:		
73101 - Lowdham Cars Lined Permeable Paving 1 in 30yr +35% CC Event	30/05/2023		
	Designed by:	Checked by:	Approved By:
	TS		
Report Details: Type: Stormwater Controls Storm Phase: Phase	Company Address: GeoSon Limited		

Porous Paving

Type : Porous Paving

Dimensions

Exceedance Level (m)	17.700
Depth (m)	0.530
Base Level (m)	17.170
Paving Layer Depth (mm)	130
Membrane Percolation (m/hr)	1.0
Porosity (%)	54.375
Length (m)	12.000
Long. Slope (1:X)	1000.00
Width (m)	55.000
Total Volume (m³)	143.550

Inlets

Inlet

Inlet Type	Lateral Inflow
Incoming Item(s)	Catchment Area
Bypass Destination	(None)
Capacity Type	No Restriction

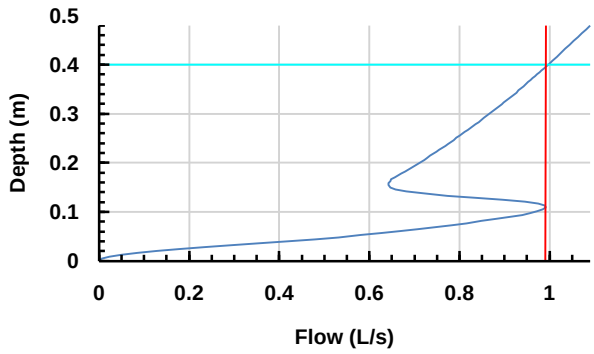
Outlets

Outlet

Outgoing Connection	(None)
Outlet Type	Hydro-Brake®

Invert Level (m)	17.170
Design Depth (m)	0.400
Design Flow (L/s)	1.0
Objective	Minimise Upstream Storage Requirements
Application	Surface Water Only
Sump Available	☐

Unit Reference	CHE-0055-1000-0400-1000



Advanced

Conductivity (m/hr)	250.0

Project:	Date:		
73101 - Lowdham Cars Lined Permeable Paving 1 in 30yr +35% CC Event	30/05/2023		
	Designed by:	Checked by:	Approved By:
	TS		
Report Title:	Company Address:		
Rainfall Analysis Criteria	GeoSon Limited		

Runoff Type	Dynamic
Output Interval (mins)	5
Time Step	Default
Urban Creep	Apply Global Value
Urban Creep Global Value (%)	0
Junction Flood Risk Margin (mm)	300
Perform No Discharge Analysis	☐

Rainfall

FSR

Type: FSR

Region	England And Wales
M5-60 (mm)	19.5
Ratio R	0.402
Summer	☑
Winter	☑

Return Period

Return Period (years)	Increase Rainfall (%)
30.0	35.000

Storm Durations

Duration (mins)	Run Time (mins)
15	30
30	60
60	120
120	240
180	360
240	480
360	720
480	960
600	1200
720	1440
960	1920
1440	2880
2160	4320
2880	5760
4320	8640
5760	11520
7200	14400
8640	17280
10080	20160

Project:	Date:		
73101 - Lowdham Cars Lined Permeable Paving 1 in 30yr +35% CC Event	30/05/2023 Designed by: TS	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	Company Address: GeoSon Limited		

Summary Results for Porous Paving: Rank By: Max. Avg. Depth

Storm Event	Max. US Level (m)	Max. DS Level (m)	Max. US Depth (m)	Max. DS Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Total Lost Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Half Drain Down Time (mins)	Percentage Available (%)	Status
FSR: 30 years: +35 %: 15 mins: Summer	17.262	17.248	0.080	0.078	64.1	28.437	0.000	0.000	0.8	0.964	417	80.190	OK
FSR: 30 years: +35 %: 15 mins: Winter	17.271	17.257	0.089	0.087	67.6	31.850	0.000	0.000	0.9	1.058	416	77.812	OK
FSR: 30 years: +35 %: 30 mins: Summer	17.285	17.269	0.103	0.099	43.4	36.593	0.000	0.000	1.0	2.466	663	74.509	OK
FSR: 30 years: +35 %: 30 mins: Winter	17.297	17.281	0.115	0.111	45.6	41.031	0.000	0.000	1.0	2.591	672	71.417	OK
FSR: 30 years: +35 %: 60 mins: Summer	17.308	17.290	0.126	0.120	37.5	44.723	0.000	0.000	1.0	5.348	612	68.845	OK
FSR: 30 years: +35 %: 60 mins: Winter	17.324	17.308	0.142	0.138	33.7	50.442	0.000	0.000	1.0	4.499	626	64.861	OK
FSR: 30 years: +35 %: 120 mins: Summer	17.331	17.315	0.149	0.145	26.8	52.943	0.000	0.000	1.0	8.551	587	63.119	OK
FSR: 30 years: +35 %: 120 mins: Winter	17.349	17.335	0.167	0.165	21.6	59.797	0.000	0.000	1.0	8.050	613	58.344	OK
FSR: 30 years: +35 %: 180 mins: Summer	17.342	17.329	0.160	0.159	21.0	57.442	0.000	0.000	1.0	12.010	583	59.985	OK
FSR: 30 years: +35 %: 180 mins: Winter	17.362	17.350	0.180	0.180	16.2	64.780	0.000	0.000	1.0	12.300	609	54.873	OK
FSR: 30 years: +35 %: 240 mins: Summer	17.349	17.337	0.167	0.167	17.3	60.149	0.000	0.000	1.0	15.945	572	58.099	OK
FSR: 30 years: +35 %: 240 mins: Winter	17.370	17.359	0.188	0.189	13.1	67.864	0.000	0.000	1.0	16.653	606	52.725	OK
FSR: 30 years: +35 %: 360 mins: Summer	17.357	17.346	0.175	0.176	13.0	63.179	0.000	0.000	1.0	24.208	641	55.988	OK
FSR: 30 years: +35 %: 360 mins: Winter	17.379	17.369	0.197	0.199	9.6	71.326	0.000	0.000	1.0	25.329	658	50.313	OK

FSR: 30 years: +35 %: 480 mins: Summer	17.361	17.350	0.179	0.180	10.6	64.638	0.000	0.000	1.0	33.405	605	54.972	OK
FSR: 30 years: +35 %: 480 mins: Winter	17.384	17.374	0.202	0.204	7.7	73.110	0.000	0.000	1.0	33.918	634	49.070	OK
FSR: 30 years: +35 %: 600 mins: Summer	17.362	17.352	0.180	0.182	8.9	65.153	0.000	0.000	1.0	43.715	626	54.613	OK
FSR: 30 years: +35 %: 600 mins: Winter	17.386	17.376	0.204	0.206	6.5	73.917	0.000	0.000	1.0	42.664	649	48.508	OK
FSR: 30 years: +35 %: 720 mins: Summer	17.362	17.351	0.180	0.181	7.8	65.067	0.000	0.000	1.0	53.755	589	54.673	OK
FSR: 30 years: +35 %: 720 mins: Winter	17.387	17.377	0.205	0.207	5.6	74.041	0.000	0.000	1.0	52.803	653	48.422	OK
FSR: 30 years: +35 %: 960 mins: Summer	17.361	17.350	0.179	0.180	6.2	64.673	0.000	0.000	1.0	70.381	604	54.947	OK
FSR: 30 years: +35 %: 960 mins: Winter	17.384	17.374	0.202	0.204	4.5	73.174	0.000	0.000	1.0	73.605	644	49.026	OK
FSR: 30 years: +35 %: 1440 mins: Summer	17.357	17.346	0.175	0.176	4.5	63.069	0.000	0.000	1.0	89.499	584	56.065	OK
FSR: 30 years: +35 %: 1440 mins: Winter	17.377	17.367	0.195	0.197	3.2	70.477	0.000	0.000	1.0	99.142	631	50.904	OK
FSR: 30 years: +35 %: 2160 mins: Summer	17.347	17.335	0.165	0.165	3.3	59.430	0.000	0.000	1.0	103.688	567	58.600	OK
FSR: 30 years: +35 %: 2160 mins: Winter	17.362	17.351	0.180	0.181	2.4	65.027	0.000	0.000	1.0	115.993	596	54.701	OK
FSR: 30 years: +35 %: 2880 mins: Summer	17.333	17.321	0.151	0.151	2.6	54.433	0.000	0.000	1.0	112.571	533	62.081	OK
FSR: 30 years: +35 %: 2880 mins: Winter	17.342	17.330	0.160	0.160	1.9	57.668	0.000	0.000	1.0	125.895	549	59.827	OK
FSR: 30 years: +35 %: 4320 mins: Summer	17.306	17.282	0.124	0.112	1.9	42.938	0.000	0.000	1.0	124.209	466	70.089	OK
FSR: 30 years: +35 %: 4320 mins: Winter	17.300	17.275	0.118	0.105	1.4	40.645	0.000	0.000	1.0	139.270	450	71.686	OK
FSR: 30 years: +35 %: 5760 mins: Summer	17.292	17.265	0.110	0.095	1.5	37.378	0.000	0.000	1.0	132.277	439	73.962	OK

Project:	Date:		
73101 - Lowdham Cars Lined Permeable Paving 1 in 30yr +35% CC Event	30/05/2023		
	Designed by:	Checked by:	Approved By:
	TS		
Report Details:	Company Address:		
Type: Stormwater Controls Summary Storm Phase: Phase	GeoSon Limited		

FSR: 30 years: +35 %: 5760 mins: Winter	17.283	17.256	0.101	0.086	1.1	34.201	0.000	0.000	0.9	148.387	437	76.175	OK
FSR: 30 years: +35 %: 7200 mins: Summer	17.282	17.254	0.100	0.084	1.3	33.605	0.000	0.000	0.9	138.818	436	76.590	OK
FSR: 30 years: +35 %: 7200 mins: Winter	17.271	17.244	0.089	0.074	0.9	29.897	0.000	0.000	0.8	155.246	442	79.173	OK
FSR: 30 years: +35 %: 8640 mins: Summer	17.274	17.246	0.092	0.076	1.1	30.668	0.000	0.000	0.8	143.905	439	78.636	OK
FSR: 30 years: +35 %: 8640 mins: Winter	17.263	17.235	0.081	0.065	0.8	26.716	0.000	0.000	0.7	161.035	450	81.389	OK
FSR: 30 years: +35 %: 10080 mins: Summer	17.267	17.239	0.085	0.069	1.0	28.351	0.000	0.000	0.8	148.538	443	80.250	OK
FSR: 30 years: +35 %: 10080 mins: Winter	17.256	17.228	0.074	0.058	0.7	24.373	0.000	0.000	0.6	166.304	458	83.021	OK

Project:	Date:		
73101 - Lowdham Cars Lined Permeable Paving 1 in 100yr +40% CC Event	30/05/2023		
	Designed by: TS	Checked by:	Approved By:
Report Details: Type: Inflows Storm Phase: Phase	Company Address: GeoSon Limited		

Catchment Area

Type : Catchment Area

Area (ha)	0.154

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.750
Winter Volumetric Runoff	0.840
Time of Concentration (mins)	5
Percentage Impervious (%)	100

Project:	Date:		
73101 - Lowdham Cars Lined Permeable Paving 1 in 100yr +40% CC Event	30/05/2023 Designed by: TS	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Storm Phase: Phase	Company Address: GeoSon Limited		

Porous Paving

Type : Porous Paving

Dimensions

Exceedance Level (m)	17.700
Depth (m)	0.530
Base Level (m)	17.170
Paving Layer Depth (mm)	130
Membrane Percolation (m/hr)	1.0
Porosity (%)	54.375
Length (m)	12.000
Long. Slope (1:X)	1000.00
Width (m)	55.000
Total Volume (m³)	143.550

Inlets

Inlet

Inlet Type	Lateral Inflow
Incoming Item(s)	Catchment Area
Bypass Destination	(None)
Capacity Type	No Restriction

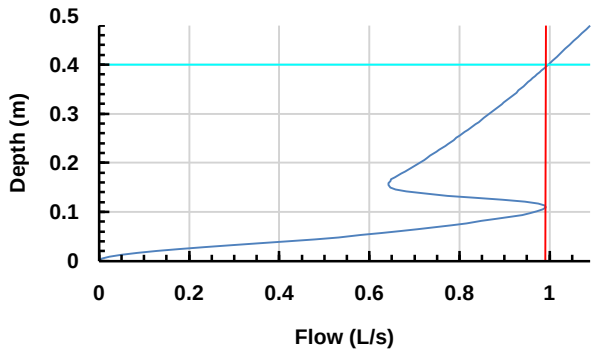
Outlets

Outlet

Outgoing Connection	(None)
Outlet Type	Hydro-Brake®

Invert Level (m)	17.170
Design Depth (m)	0.400
Design Flow (L/s)	1.0
Objective	Minimise Upstream Storage Requirements
Application	Surface Water Only
Sump Available	☐

Unit Reference	CHE-0055-1000-0400-1000



Advanced

Conductivity (m/hr)	250.0

Project:	Date:		
73101 - Lowdham Cars Lined Permeable Paving 1 in 100yr +40% CC Event	30/05/2023 Designed by: TS	Checked by:	Approved By:
Report Title: Rainfall Analysis Criteria	Company Address: GeoSon Limited		

Runoff Type	Dynamic
Output Interval (mins)	5
Time Step	Default
Urban Creep	Apply Global Value
Urban Creep Global Value (%)	0
Junction Flood Risk Margin (mm)	300
Perform No Discharge Analysis	☐

Rainfall

FSR

Type: FSR

Region	England And Wales
M5-60 (mm)	19.5
Ratio R	0.402
Summer	☑
Winter	☑

Return Period

Return Period (years)	Increase Rainfall (%)
100.0	40.000

Storm Durations

Duration (mins)	Run Time (mins)
15	30
30	60
60	120
120	240
180	360
240	480
360	720
480	960
600	1200
720	1440
960	1920
1440	2880
2160	4320
2880	5760
4320	8640
5760	11520
7200	14400
8640	17280
10080	20160

Project:	Date:		
73101 - Lowdham Cars Lined Permeable Paving 1 in 100yr +40% CC Event	30/05/2023 Designed by: TS	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	Company Address: GeoSon Limited		

Summary Results for Porous Paving: Rank By: Max. Avg. Depth

Storm Event	Max. US Level (m)	Max. DS Level (m)	Max. US Depth (m)	Max. DS Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Total Lost Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Half Drain Down Time (mins)	Percentage Available (%)	Status
FSR: 100 years: +40 %: 15 mins: Summer	17.289	17.275	0.107	0.105	86.2	38.269	0.000	0.000	1.0	1.190	441	73.341	OK
FSR: 100 years: +40 %: 15 mins: Winter	17.302	17.288	0.120	0.118	90.9	42.894	0.000	0.000	1.0	1.228	470	70.119	OK
FSR: 100 years: +40 %: 30 mins: Summer	17.322	17.307	0.140	0.137	58.9	49.967	0.000	0.000	0.9	2.168	819	65.192	OK
FSR: 100 years: +40 %: 30 mins: Winter	17.339	17.325	0.157	0.155	61.9	56.146	0.000	0.000	1.0	1.966	830	60.888	OK
FSR: 100 years: +40 %: 60 mins: Summer	17.355	17.342	0.173	0.172	51.1	62.047	0.000	0.000	1.0	3.954	772	56.777	OK
FSR: 100 years: +40 %: 60 mins: Winter	17.376	17.363	0.194	0.193	46.0	69.591	0.000	0.000	1.0	4.184	774	51.521	OK
FSR: 100 years: +40 %: 120 mins: Summer	17.386	17.375	0.204	0.205	36.6	73.559	0.000	0.000	1.0	8.480	744	48.757	OK
FSR: 100 years: +40 %: 120 mins: Winter	17.411	17.400	0.229	0.230	29.5	82.512	0.000	0.000	1.0	9.102	776	42.521	OK
FSR: 100 years: +40 %: 180 mins: Summer	17.402	17.392	0.220	0.222	28.5	79.555	0.000	0.000	1.0	13.216	746	44.580	OK
FSR: 100 years: +40 %: 180 mins: Winter	17.429	17.420	0.247	0.250	22.0	89.341	0.000	0.000	1.0	14.150	798	37.763	OK
FSR: 100 years: +40 %: 240 mins: Summer	17.412	17.402	0.230	0.232	23.5	83.167	0.000	0.000	1.0	17.992	748	42.064	OK
FSR: 100 years: +40 %: 240 mins: Winter	17.441	17.432	0.259	0.262	17.7	93.549	0.000	0.000	1.0	19.240	838	34.832	OK
FSR: 100 years: +40 %: 360 mins: Summer	17.423	17.414	0.241	0.244	17.5	87.164	0.000	0.000	1.0	27.451	745	39.280	OK
FSR: 100 years: +40 %: 360 mins: Winter	17.454	17.445	0.272	0.275	12.9	98.299	0.000	0.000	1.0	29.381	915	31.523	OK

FSR: 100 years: +40 %: 480 mins: Summer	17.429	17.420	0.247	0.250	14.2	89.268	0.000	0.000	1.0	36.804	801	37.814	OK
FSR: 100 years: +40 %: 480 mins: Winter	17.461	17.452	0.279	0.282	10.3	100.948	0.000	0.000	1.0	39.441	956	29.677	OK
FSR: 100 years: +40 %: 600 mins: Summer	17.431	17.422	0.249	0.252	12.0	90.229	0.000	0.000	1.0	45.918	784	37.145	OK
FSR: 100 years: +40 %: 600 mins: Winter	17.465	17.456	0.283	0.286	8.6	102.271	0.000	0.000	1.0	49.274	991	28.756	OK
FSR: 100 years: +40 %: 720 mins: Summer	17.432	17.423	0.250	0.253	10.3	90.343	0.000	0.000	1.0	54.727	799	37.065	OK
FSR: 100 years: +40 %: 720 mins: Winter	17.466	17.458	0.284	0.288	7.5	102.754	0.000	0.000	1.0	58.816	997	28.419	OK
FSR: 100 years: +40 %: 960 mins: Summer	17.430	17.420	0.248	0.250	8.2	89.551	0.000	0.000	1.0	72.129	778	37.617	OK
FSR: 100 years: +40 %: 960 mins: Winter	17.465	17.456	0.283	0.286	5.9	102.184	0.000	0.000	1.0	76.944	988	28.816	OK
FSR: 100 years: +40 %: 1440 mins: Summer	17.424	17.415	0.242	0.245	5.9	87.478	0.000	0.000	1.0	110.866	746	39.061	OK
FSR: 100 years: +40 %: 1440 mins: Winter	17.455	17.446	0.273	0.276	4.3	98.805	0.000	0.000	1.0	116.995	910	31.170	OK
FSR: 100 years: +40 %: 2160 mins: Summer	17.413	17.403	0.231	0.233	4.3	83.496	0.000	0.000	1.0	134.605	704	41.835	OK
FSR: 100 years: +40 %: 2160 mins: Winter	17.440	17.431	0.258	0.261	3.1	93.180	0.000	0.000	1.0	150.039	811	35.089	OK
FSR: 100 years: +40 %: 2880 mins: Summer	17.401	17.391	0.219	0.221	3.4	79.080	0.000	0.000	1.0	146.115	676	44.911	OK
FSR: 100 years: +40 %: 2880 mins: Winter	17.421	17.412	0.239	0.242	2.5	86.557	0.000	0.000	1.0	163.437	732	39.702	OK
FSR: 100 years: +40 %: 4320 mins: Summer	17.375	17.365	0.193	0.195	2.4	69.794	0.000	0.000	1.0	160.486	622	51.380	OK
FSR: 100 years: +40 %: 4320 mins: Winter	17.382	17.372	0.200	0.202	1.8	72.396	0.000	0.000	1.0	179.592	629	49.567	OK
FSR: 100 years: +40 %: 5760 mins: Summer	17.348	17.336	0.166	0.166	1.9	59.841	0.000	0.000	1.0	170.215	564	58.313	OK

FSR: 100 years: +40 %: 5760 mins: Winter	17.331	17.318	0.149	0.148	1.4	53.513	0.000	0.000	1.0	190.687	526	62.722	OK
FSR: 100 years: +40 %: 7200 mins: Summer	17.311	17.289	0.129	0.119	1.6	44.972	0.000	0.000	1.0	177.415	478	68.672	OK
FSR: 100 years: +40 %: 7200 mins: Winter	17.296	17.270	0.114	0.100	1.2	38.873	0.000	0.000	1.0	198.601	444	72.920	OK
FSR: 100 years: +40 %: 8640 mins: Summer	17.297	17.272	0.115	0.102	1.4	39.514	0.000	0.000	1.0	183.312	447	72.474	OK
FSR: 100 years: +40 %: 8640 mins: Winter	17.283	17.256	0.101	0.086	1.0	34.009	0.000	0.000	0.9	205.596	438	76.308	OK
FSR: 100 years: +40 %: 10080 mins: Summer	17.288	17.261	0.106	0.091	1.2	35.818	0.000	0.000	0.9	188.102	437	75.048	OK
FSR: 100 years: +40 %: 10080 mins: Winter	17.273	17.245	0.091	0.075	0.9	30.385	0.000	0.000	0.8	210.944	440	78.833	OK

Appendix H

Peartrees

Prospect Villas

Lodge Farm

7602
GL: 17.55
IL: 16.76

7603
GL: 17.65
IL: 16.85

7601
GL: 17.39
IL: 16.31

Proposed lined permeable paving will provide required storage for design runoff from all impermeable areas including an allowance for urban creep (1540m^2)
Area: 660m^2
GL: 17.70
IL: 17.17
Void Ratio: 54.375

Linear Drain

Hydro-brake
GL: 17.70
IL: 17.17

Linear Drain

New hardstanding located outside the red outline boundary (areas shaded purple) should be designed to slope towards the linear drains on-site. This will ensure that surface water runoff from the dropped kerbs is not directed into the highway.

Lined permeable paving outflow restricted to a maximum discharge rate of 1.0l/s via hydro-brake device or similar. Restricting discharge to 1.0l/s via hydro-brake with 0.4m head results in a 0.55mm orifice.

Gravity connection to watercourse. Subject to consents for discharge and construction of an outfall from Trent Valley IDB / the Water Management Consortium. Outfall IL: 16.00mAOD

Approx. watercourse levels
Top of bank: 16.90
IL: 15.68
Depth:1.22m

Severn Trent Water Build Over Agreement will be required to cross the surface water outflow pipe over the foul pressure main

Piped discharge to watercourse 90m east of development

Drain

GeoSon Limited, Runway East, 1 Victoria St, Bristol BS1 6AA
info@geoson.co.uk | 01174 414993 | www.geoson.co.uk

Key

- Site Boundary
- Client's Ownership Boundary
- Proposed Roof Areas
- Proposed Hardstanding
- Proposed Off-Site Hardstanding
- Proposed Permeable Paving
- Proposed Linear Drain
- Proposed Surface Water Pipework
- Proposed Surface Water Manhole
- Proposed Flow Control
- Proposed Outfall
- Drainage Ditch / Watercourse
- Severn Trent Water Foul Sewer
- Severn Trent Water Foul Manhole
- Potential Overland Flow Route

Notes

1. All dimensions in this drawing are in millimetres unless stated otherwise.
2. All levels are in metres Above Ordnance Datum (mAOD).
3. The proposed drainage layout is based on drawing reference Lowdham_Cars_Site_Layout_Plan.dwg provided by DfV Planning Services.
4. Environment Agency LiDAR data has been used to approximate ground levels at the site. Final levels should be confirmed by a topographic survey undertaken to mAOD prior to construction.
5. Sufficient storage to accommodate all runoff generated by impermeable areas during the 1 in 100 year plus (40%) Climate Change event will be provided within lined permeable paving.
6. Discharge from the entire site to watercourse will be restricted to a maximum rate of 1.0 l/s (subject to consents from Trent Valley IDB).
7. No deep rooted vegetation should be planted within proximity of the proposed below ground drainage components.
8. STW asset location plans show that a foul sewer network crosses the site and blue outline boundary. It is recommended that the applicant undertakes a GPS survey of the existing foul sewer prior to detailed design and construction to determine the exact location, depth and condition of STW assets in proximity to the development.
9. It is currently unknown whether there are any utilities beneath the site. A survey of the existing service infrastructure should be undertaken to determine the location of any utilities prior to detailed design.
10. At this stage, detailed modelling of the drainage system has not been undertaken therefore the proposed SuDS scheme should be taken as indicative.
11. This drawing is for planning purposes only. Not for construction.
12. Do not scale from this drawing.

Client

Lowdham Cars

Title

Drainage Layout Plan

Location

Lowdham Cars, Lowdham Road, Gunthorpe

Drawing Number: 73101-01		Revision: v.1.0
Date: 02/06/2023		Scale: 1:250
Designed By:	Checked By:	Approved By:
TS	JN	TS

Disclaimer

The drawing(s) provided are for planning purposes only. Not for construction.

Appendix I

Permavoid Modular Cell 150

Data Sheet

PRODUCT INFORMATION P1 ISSUE 6 - JUNE 2021

Product code: PVPP150

Permavoid is a geocellular interlocking system designed for shallow ground water storage or infltration, to be used in place of traditional aggregate sub-base, or to provide source control above ground at both roof and podium level, removing the need for heavier and less ef cient systems. The system has an exceptionally high compressive and tensile strength and bending resistance with a proprietary jointing system to create a horizontal structural 'raft' within the pavement that is ideal for the shallow attenuation of surface water. The system can also be combined in layers using interlocking shear connectors to increase depth in 85mm and 150mm increments. This is particularly useful in designing infltration systems, allowing fexibility in balancing the soil permeability/ infltration area of the Permavoid storage units and residual temporary attenuation.

Applications

The Permavoid units are suitable for use as a stormwater attenuation and/or infltration. The system comprises of single, interconnected cells which can be installed in the ground as part of sub-base formation, or above ground as part of roof or podium attenuation systems for source control. Permavoid is suitable for use in a range of applications including residential, industrial estates, car parks, sports pitches, roofs, basements, pedestrian areas and rainwater harvesting.

Key Benefts

- High strength, high capacity, shallow, sub-base replacement system
- Stormwater attenuation and/or infltration system
- Used as part of a sustainable drainage system (SuDS) scheme to ofer stormwater storage at shallow construction depths
- 100% recyclable
- Units are manufactured from 100% recycled polypropylene (PP)

Performance

The structural load bearing capacity of the Permavoid units have been tested in accordance with the following European Standard: BS 7533-13:2009. The system's structural design life expectancy, based upon creep test data (tested in accordance with CIRIA guidelines) is as follows; for lightly loaded areas such as car parks a design life of 50 years is achievable. For areas with prolonged HGV loading a typical design life may only be 25 years, depending on the design of the pavement surfacing and structural layers over the tank.

Installation

All calculations for Permavoid units are based upon site-specifc load cases, pavement construction types and thicknesses, soil cover and ground conditions and the suitability must therefore be approved for each project.

Technical Support

Detailed guidance and assistance is available.
For further information, please contact our Technical Team on +44 (0) 1509 615 100 or email civils@polypipe.com or visit www.polypipe.com/civils-technical-hub

ELEMENT	VALUE
PHYSICAL PROPERTIES	
Weight per unit	3kg
Weight per square metre	12kg
Length	708mm
Width	354mm
Depth	150mm
SHORT TERM COMPRESSIVE STRENGTH	
Vertical	715kN/m²
Lateral	156kN/m²
SHORT TERM DEFLECTION	
Vertical	1mm per 126kN/m²
Lateral	1mm per 15kN/m²
TENSILE STRENGTH	
Of a single joint	42.4kN/m²
Of a single joint at (1% secant modulus)	18.8kN/m²
Bending resistance of unit	0.71kN/m
Bending resistance of single joint	0.16kN/m
OTHER PROPERTIES	
Volumetric void ratio	95%
Average efective perforated surface area	52%
Intrinsic permeability (k)	Minimum 1.0 x 10^{-5}
Ancillary	Permavoid Permatie Permavoid Shear Connector
Material	Polypropylene (PP)

HYDRAULIC PERFORMANCE						
3 units wide, 1 unit deep (1.06m x 0.15m)						
FREE DISCHARGE						
Gradient (%)	0	1	2	3	4	5
Flow Rate (l/m/s)	8	13	15	17	19	21

Polypipe Civils & Green Urbanisation,
Charnwood Business Park, Loughborough, Leicestershire LE11 1LE
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www.polypipe.com/wms

Polypipe

Permavoid Modular Cell 150

Data Sheet

PRODUCT INFORMATION P2 ISSUE 6 - JUNE 2021

Permavoid Modular Cell 150 can be utilised in these SuDS techniques

TECHNIQUES													
Blue-Green roofs	Podium Decks	Trees	Sports Pitches	Cycle Paths	Permeable Paving (sub base & podium)	Bioretention & Rain Gardens	Attenuation Storage Tanks	Inf ltration	Swales	Filter Drains	Detention Basins	Ponds & Wetlands	Filter Strips
	ü		ü	ü	ü	ü	ü	ü	ü	ü			

Visit www.polypipe.com/greeninfrastructure

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