BRIGHT YOUNG

Flood Risk Assessment & Drainage Strategy Report

Cudworth Parkway
For Fenwood Estates Date
19/05/2025
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Introduction

Bright Young Consulting Ltd has been commissioned by Fenwood Estates to undertake a Flood Risk Assessment and Drainage Strategy for a proposed residential development at Land off the A628 Cudworth Parkway, Barnsley, South Yorkshire. S72 8BA.

The site is primarily located in Flood Zone 1 with the exception of a small area of land to the east which is indicated to be in Flood Zone 2.

The site comprises land that is safeguarded for residential development in the Barnsley MBC Local Plan (HS36, Site at Weetshaw Lane & HS39, Land West of Three Nooks Lane).

A location plan for the site is provided in Appendix A.

Proposed Development

The planning application will seek consent for a proposed residential development on land to the south of Cudworth Parkway, Barnsley. The proposals include 52 2-bed and 184 3-bed residential dwellings (272 total) across a gross site area of 5.59ha.

A copy of the development masterplan is provided in Appendix B.

Aim of the Report

The aim of this report is to undertake a Flood Risk Assessment and Drainage Strategy in accordance with the National Planning Policy Framework (NPPF) and current guidance for the purposes of providing a baseline assessment of flood risk.

This report assesses flood risk to the site and any impact on flood risk to adjacent land and property as a result of the development proposals.

This report is intended to provide information and present proposals relating to the following:

- The existing topography, geology and hydrogeology across the development
- The existing surface and foul water drainage systems within the vicinity of the site
- Identify existing overland flow paths
- Assess the risk of flooding due to fluvial, tidal, groundwater, surface water, flows from surcharged sewers and risks for other possible sources
- Identify potential constraints imposed by the regulatory bodies including the Environment Agency, Local Water Authority and Lead Local Flood Authority

As part of the development of this report, information has been obtained from Yorkshire Water (YW), and the Environment Agency (EA).

Limitations

The discussion, conclusions and recommendations contained in this Report represent the professional opinions of Bright Young Consulting Limited (BYC), based upon the information listed in the Report, exercising the duty of care required of an experienced Engineering Consultant. BYC does not warrant the accuracy of the information or data forming the basis of the report and will not be responsible for any opinions which BYC has expressed, or conclusions which it has reached in reliance upon information which is subsequently proven to be inaccurate.

This Report was prepared by BYC for the sole and exclusive use of the Client and for the specific purpose for which BYC was instructed. Nothing contained in this Report shall be construed to give any rights or benefits to anyone other than the Client and BYC, and all duties and responsibilities undertaken are for the sole and exclusive benefit of the Client and not for the benefit of any other party. In particular, BYC does not intend, without its written consent, for this Report to be disseminated to anyone other than the Client or to be used or relied upon by anyone other than the Client. Use of the Report by any other person is unauthorised and such use is at the sole risk of the user. Anyone using or relying upon this Report, other than the Client, agrees by virtue of its use to indemnify and hold harmless BYC from and against all claims, losses and damages (of whatsoever nature and howsoever or whensoever arising), arising out of or resulting from the performance of the work by BYC.

Policy & Guidance

National Planning Policy Framework

The NPPF was published in England in March 2012 and most recently revised in December 2024 before being further amended in February 2025.

This revised framework replaces the previous NPPF, revised in July 2018, updated in February 2012, revised in July 2021, updated in September 2023 and revised in December 2023.

The key aim of the NPPF is to ensure sustainable development through the planning process, taking into account the risks from climate change, flood risk and coastal change to avoid inappropriate development in areas at risk and directing development away from areas of high risk.

It advises that where development is necessary in areas of high risk, it should be safe, and that flood resilience should also be incorporated into the design. It also advises of the fact that new developments should not increase flood risk elsewhere and new developments should aid in mitigating flood risk to the wider area.

The NPPF's advice on climate change, flooding and coastal change is set out in section 14 paragraphs 161-186, with the approach to planning for flood risk between paragraphs 170-182.

In March 2014 the Planning Practice Guidance web resource was launched to support the NPPF. A specific Flood Risk and Coastal Change PPG was published which provides guidance on how flood risk should be assessed during the planning and development process. This document was last updated in August 2022.

Planning Practice Guidance – Flood Risk & Coastal Change

The Planning Practice Guidance, Flood Risk & Coastal Change, advises how to take account of and address the risks associated with flooding and coastal change in the planning process.

The document gives further context and detail to local authorities and developers about how national policy with respect to Flood Risk is to be understood and implemented.

A significantly revised PPG on Flood Risk & Coastal Change was released in August 2022 to reflect changes to the NPPF (made in 2018, 2019 and 2021) whilst also incorporating learning from practice that has been gathered since the PPG was first published in 2014.

In particular, more clarity was provided around when and how the sequential and exception tests should be applied, making roles and responsibilities for carrying out the tests clearer along with advice on how planning authorities can apply the tests more consistently and efficiently.

The Sequential Test

The NPPF and accompanying PPG describe the principles of the Sequential Test, which aims to steer new development to areas with the lowest probability of flooding, taking all sources of flood risk and climate change into account (fluvial, pluvial, tidal, ground water and sewers).

Where it is not possible to locate development in low-risk areas, the Sequential Test should compare reasonably available sites:

- Within medium risk areas; and
- Then, only where there are no reasonably available sites in low and medium risk areas, within high-risk areas.

The presence of any existing flood risk management infrastructure should be ignored, as the long-term funding, maintenance and renewal of this is uncertain. Furthermore, climate change will also impact on the level of protection this infrastructure will offer through the lifetime of the development.

The PPG is explicit in its assertion that other forms of flooding need to be treated consistently with fluvial flooding and that all sources of flood risk are to be taken into account. Should a site be at risk from any source of flooding, then the Sequential Test needs to be satisfied, regardless of whether the proposed development is able to mitigate these issues through design. The only exceptions to this are:

- The site is allocated in the local development plan and was subject to the Sequential Test at plan making stage for a use consistent with the development that is being proposed.
- The site is at low risk from all sources of flooding.
- Where a site-specific flood risk assessment demonstrates that no built development within the site boundary, including access or escape routes, land raising or other potentially vulnerable elements, would be located on an area that would be at risk of flooding from any source, now and in the future (having regard to potential changes in flood risk).

With respect to the development site, and as detailed in the following sections of this report, the area is located primarily in Flood Zone 1. This zone comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%).

Notwithstanding, there is a small section of Flood Zone 2 indicated to the east in the area of public open space. A Product 4 data request from the Environment Agency has determined that this is associated with an incident of historic flooding dating back to 1947 and no flood levels are available as flood modelling has not been undertaken in the vicinity.

On the basis that the topography of the site is steeply sloping in this area, fluvial flooding is unlikely to manifest itself as suggested and therefore the entire development is considered to be at low risk.

There is a small section of surface water flooding indicated along the northern boundary. However, this is in an area of the site where no development is proposed and therefore the risk is considered to be low.

As highlighted above, the site is identified in the local plan and is safeguarded for residential development.

Taking all this into consideration, the sequential test is considered to be passed.

The Exception Test

The Exception Test process is defined in the NPPF. It provides a method of managing flood risk whilst still allowing necessary development to occur.

Where required, suitable information would need to be provided to ensure that the development can pass both parts of the exception test by:

- Demonstrating that the development would provide wider sustainability benefits to the community that outweigh the flood risk (part a).
- Referring to wider sustainability objectives in the Sustainability Appraisal. These generally consider matters such as biodiversity, green infrastructure, historic environment, climate change adaptation, flood risk, green energy, pollution, health, transport etc.
- Detailing the suitability issues the development will address and how doing it will outweigh the flood risk concerns for the site e.g., by facilitating wider regeneration of an area,

contributing to the local economy, providing community facilities, infrastructure that benefits the wider area, etc.

- Demonstrating that the 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 (part b).
- Demonstrating that the site will be safe, and the people will not be exposed to hazardous flooding from any source. The site-specific FRA should consider actual and residual risk and how this will be managed over the lifetime of the development, including:
    - The design of any flood defence infrastructure, including operation and maintenance.
    - Availability of dry access and egress routes during a flood.
    - Design of the development to manage and reduce flood risk wherever possible i.e., through SuDS, including for designated ownership and maintenance procedures.
    - Resident awareness through appropriate emergency plans and signposting / signage.
    - Emergency planning and flood warning and evacuation procedures, including whether the development would increase the pressure on emergency services to rescue people during a flood event; and
    - Any funding arrangements required for implementing mitigation measures, maintenance procedures.

The first part of the test reflects on the wider sustainability benefits of the development, which should be tested against the aims and objectives of Local Plan policy. spatial planning issues such as transport, housing economic growth, natural resources, regeneration, biodiversity and the historic environment can influence the overall suitability and sustainability of development at a particular site.

The second part of the Exception Test relates to the safety of the development and the need to not increase flood risk elsewhere. Appropriate application of the flood risk management hierarchy of 'Avoid – Substitute – Control – Mitigate' can increase the safety of a development, however it is the responsibility of the developer to demonstrate that any measures proposed are sufficient.

Notwithstanding the above, the requirement for the Exception Test is dependent upon the vulnerability of the proposed development in line with Table 2 of the NPPF and Annex 3 (Flood risk Vulnerability Classification).

As the application site comprises residential development, this is classed as 'More Vulnerable'. On the basis that no development is proposed in Flood Zone 3, the Exception Test would not be to be required.

Barnsley Level 1 Strategic Flood Risk Assessment

The Barnsley Level 1 Strategic Flood Risk Assessment (SFRA) was prepared by JBA Consulting in October 2008 and published as a Final Report in September 2010.

The purpose of the Level 1 SFRA is to identify and analyse current and future broad scale flooding issues for proposed development allocation sites/areas in Barnsley Metropolitan Borough Council (MBC) and provide support for further assessment and sequential testing of proposed development allocations.

Flood risk is a material consideration in planning and Barnsley MBC has a policy in its draft Local Development Framework Core Strategy that reflects the increasing nature of flood risk (from all sources of flooding) within the borough and the importance of a balanced and sustainable approach to ensuring necessary safe re-generation, growth and economic investment across the area.

The SFRA flood mapping indicates the same flood zone 2 risk as that shown on the EA flood map i.e. the site is largely located in Flood Zone 1 with an area of Flood Zone 2 located to the east.

C753 The SuDS Manual

This document provides best practice guidance on the planning, design, construction, operation, and maintenance of sustainable drainage systems (SuDS). This document provides detail on all the typical sustainable drainage systems and details on how they can be interconnected to not only provide the required drainage performance but also act as pollution control whilst enhancing the site wide Masterplan proposals.

SuDS should not be thought of as an individual component, but as an interconnected system designed to manage, treat, and make best use of surface water, from where it falls as rain to the point at which it is discharged into the receiving environment beyond the boundaries of the site.

A central design concept for SuDS is the SuDS Management Train. This describes the use of a sequence of components that collectively provides the necessary processes to control the frequency of runoff, the flow rates and the volumes of runoff, and to reduce concentrations of contaminants to acceptable levels. There are six specific functions provided by SuDS components. They are not independent, and one component may provide two or more functions.

National Standards for SuDS, 2025

The national standards document provides information for designers, property developers, local authorities and other interested parties, such as sewerage undertakers and the Environment Agency.

These standards are intended for application in the design of surface water drainage systems for new infrastructure and development, whether on greenfield or brownfield sites. They are not designed to apply to retrofit SuDS designs, which often have different objectives and face broader constraints, although they do serve as s starting point for retrofit design.

The principles for surface water drainage design explain the objectives and approach for applying the standards.

There are 2 types of standards:

- the hierarchy standard (standard 1) gives criteria for prioritising the choice of final runoff destination
- fixed standards (standards 2 to 7) state the minimum design criteria that all surface water drainage systems should satisfy and how they should be built, maintained and operated

The 7 standards are complementary, and the delivery of each standard should support delivery of the other standards. A surface water drainage system design that delivers multiple benefits will include a range of features and each of these should contribute to the delivery of several, if not all, of the standards.

The 7 standards are:

- Standard 1: runoff destinations
- Standard 2: management of everyday rainfall (interception)
- Standard 3: management of extreme rainfall and flooding
- Standard 4: water quality
- Standard 5: amenity
- Standard 6: biodiversity

- Standard 7: design of drainage for construction, operation, maintenance, decommissioning and structural integrity.

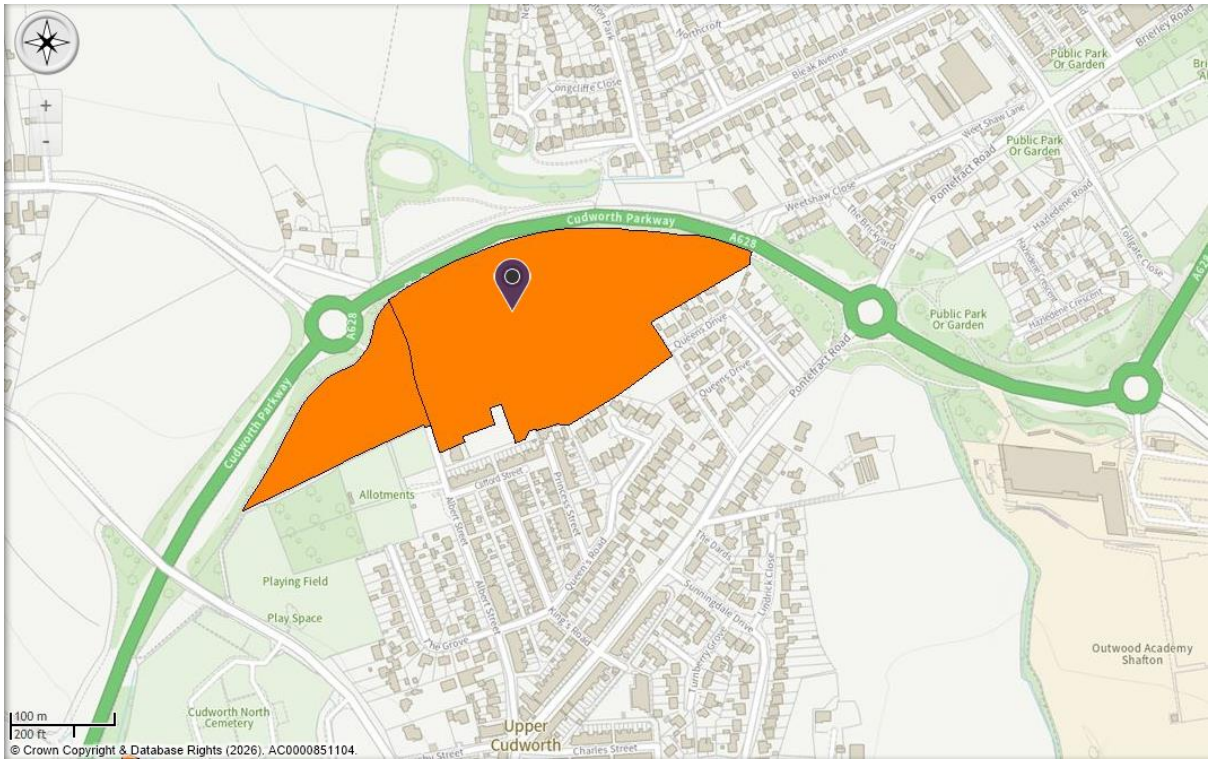
Site Context

The site extends to 5.59ha and is located approximately 1km north from the village of Cudworth on an area of agricultural grassland to the south of the A628 Cudworth Parkway.

The National Grid Reference for the site is SE 390 103 and nearest postcode is S72 8FG.

A site location plan is included below and in Appendix A.

Figure 1 – Site Location Plan



Site Characterisation / Land USe

Development Area		The gross site area is approximately 5.59ha
Existing Surfaces and Current Use		The development site is irregular in shape and comprises existing agricultural grassland defined by hedgerows, trees and fencing. Three Nooks Lane, which is surfaced with asphalt, runs through the site and links the existing residential area to the south with Cudworth Parkway.
Boundaries	North	Cudworth Parkway and Three Nooks Lane form the northern boundary of the site, beyond which lies agricultural land and the Plumpton Park residential estate
	South	Existing residential estate
	East	Cudworth Parkway beyond which lies the existing residential area of Weetshaw Close.
	West	Allotments, Cudworth Parkway and further agricultural land.

Access	Vehicles	Vehicular access is available via locked gated entrances off Cudworth Parkway to the north and Three Nooks Lane to the south
	Pedestrians / Cycles	Pedestrian access is available via the same gated vehicular entrances noted above and two further pedestrian access points to the north and east respectively from Cudworth Parkway.

Topography

A topographical survey was undertaken by Haycock & Todd in January 2023 and is provided in Appendix C for review.

The site is shown to slope relatively gently from south to north at a gradient of around 1:15 with levels along the southern boundary, near the allotment gardens, at around 85mAOD down to 75mAOD in the northeast corner. There is a steep slope, circa 1 in 3, immediately beyond the northwest boundary where the site interfaces with Cudworth Parkway

Geology

Reference to the British Geological Survey (BGS) online mapping (1:50,000 scale) and the British Geological Survey (BGS) 1:50,000 geological map indicates that the site is underlain by the Mexborough Rock-Sandstone formation with Pennine Lower Coal measures (mudstone, siltstone & sandstone) in the far east.

A former sandstone quarry is recorded in the east of the site which is shown to be disuses in 1962 and then used as a landfill, accepting waste until 1984. The base of the quarry has been found to be between 1.6m and 5.2m deep with an average of 3.1m.

Hydrogeology

Reference to the DEFRA 'Magic Map' online Aquifer Designation Map indicates the following:

- The site is underlain by a Secondary A aquifer relating to the Mexborough Rock Sandstone formation.

Secondary A aquifers comprise permeable layers that can support local water supplies and may form an important source of base flow to rivers.

Groundwater Protection Zones

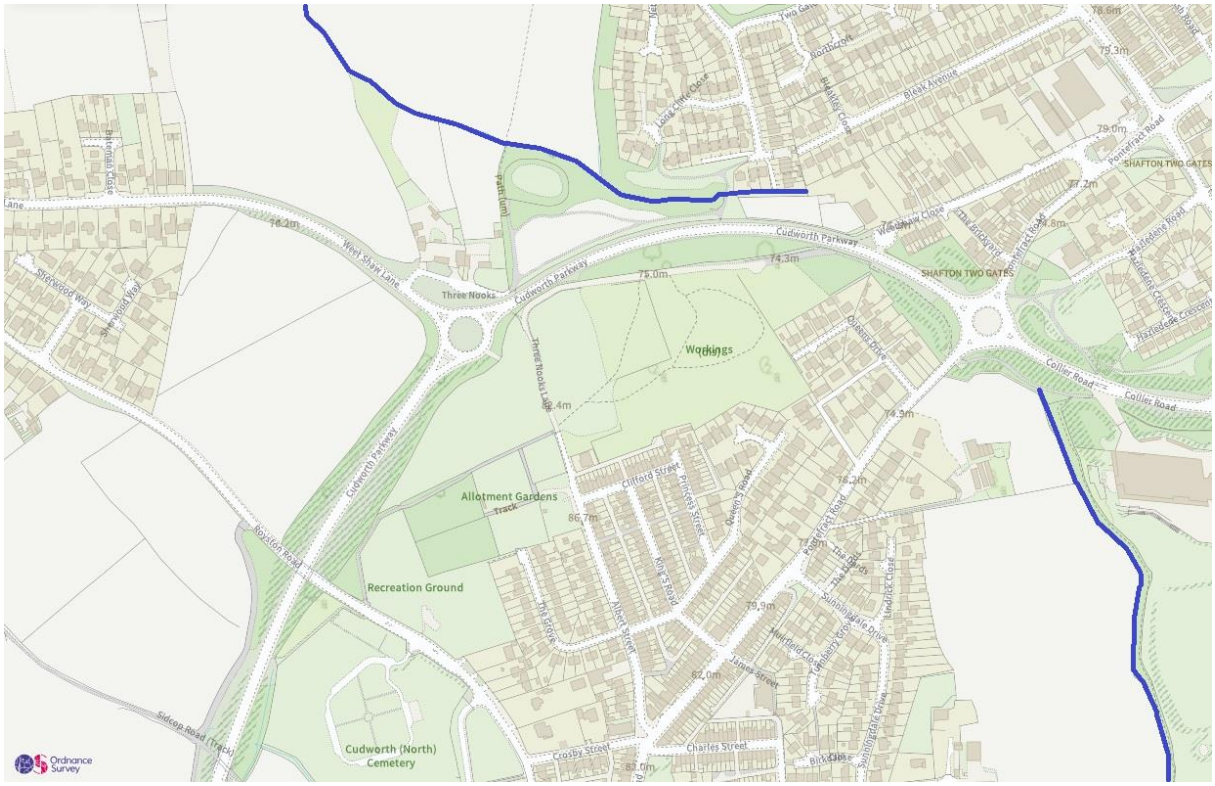
The Environment Agency have defined Source Protection Zones (SPZs) for 2,000 groundwater sources such as wells, boreholes and springs used for public drinking water supply. These zones show the risk of contamination from any activities that might cause pollution in the area. The closer the activity, the greater the risk. The maps show three main zones (inner, outer, and total catchment) and a fourth zone of special interest, which the Environment Agency occasionally applies, to a groundwater source.

The site is not located in a Groundwater Protection Zone.

Watercourses, Land Drainage and other Waterbodies

The nearest watercourse is an unnamed feature circa 40m outside the northern boundary which flows in a north-westerly direction. A further watercourse is believed to be present to the east, beyond Shafton Roundabout. It is not known whether these two watercourses are linked but it seems likely they are the same feature which has been partially culverted to facilitate the creation of the Cudworth Parkway Bypass.

Figure 2 – Watercourse Network



No other watercourses or land drainage features are located within, or in close proximity to, the site.

Public Sewer Records

Yorkshire Water public sewer records indicate that there is no sewerage infrastructure present within the site boundary. The residential estate to the south contains a network of combined sewers along with a relatively small number of foul and surface water sewers. These are all in the 150-225mm diameter range and flow southward towards Pontefract Road.

Appendix D contains the sewer records

Drainage CCTV Survey

To support the proposed development, a drainage CCTV survey was undertaken to confirm the alignment, level and condition of specific drainage features in the vicinity of the site. This survey indicates that there is a network of surface water pipes in Cudworth Parkway to the north and east which is expected to be highway drainage associated with the bypass. The survey also investigated a number of the existing combined sewers in the residential area to the south.

Appendix E contains the drainage CCTV survey report

Highway Drainage Records

A copy of the proposed highway drainage scheme for Cudworth Parkway to the north of the site has been obtained from the planning portal. The highway has limited drainage pipework and is generally served by a combined kerb and drainage system which collects and conveys runoff. This connects into a carrier drain on the northern side of the carriageway where it flows northward and discharges into a detention basin before eventually outfalling into the existing ordinary watercourse described earlier in this report.

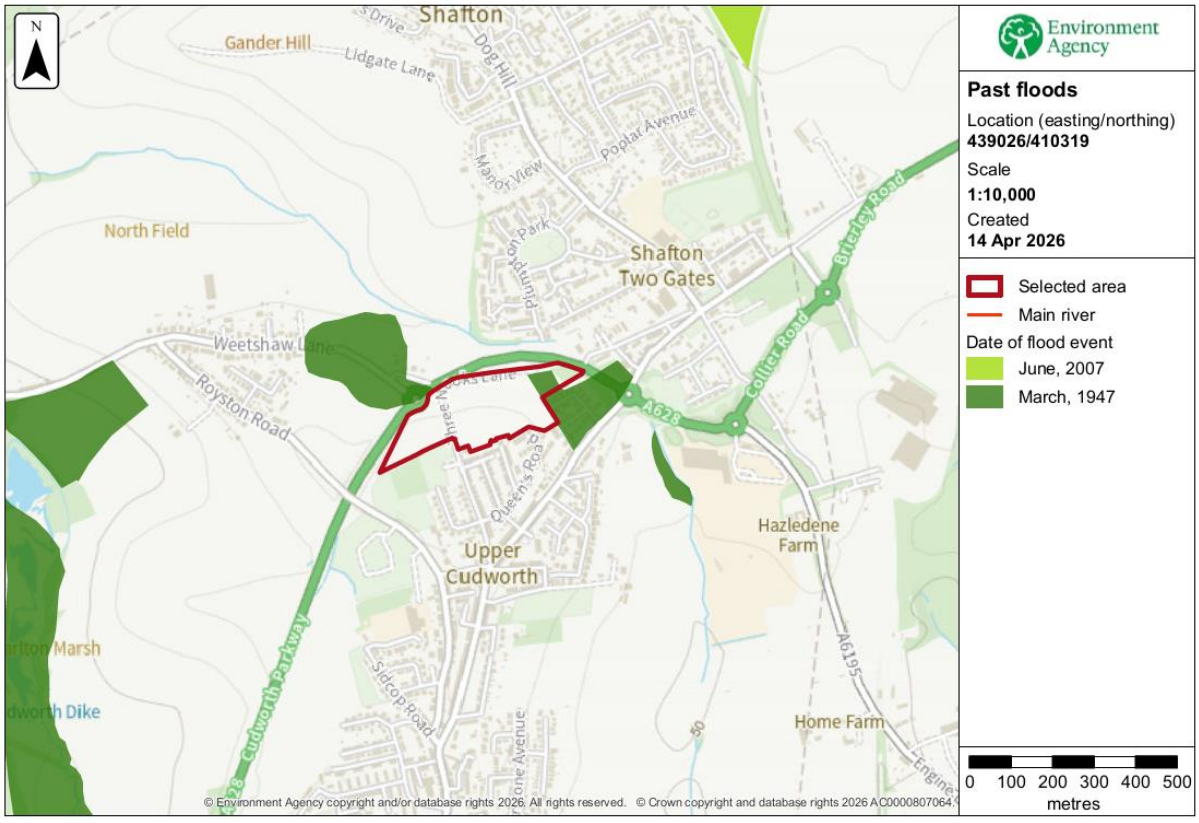
Appendix F contains the highway drainage records.

Historic Flood Records

No records of historic sewer flooding were identified in the either the Barnsley Preliminary Flood Risk Assessment or Strategic Flood Risk Assessment reports.

A Product 4 data request to the Environment Agency provided mapping which contained details of a historic flood event from 1947. This is suggested to have occurred from the local watercourse network where the channel capacity was exceeded. It seems unlikely that this has the potential to occur in a similar manner in the future given the Cudworth Parkway Bypass, completed in 2010, has likely culverted this section of watercourse and effectively provides a barrier to any potential floodwater reaching the site.

Figure 3 – EA Historic Flood Events



Flood Risk Appraisal

Summary of Potential Sources

The table below summarises the flood risk across the site from various potential sources, these are then discussed in more detail in the proceeding sections.

Source of Flooding	Risk	Notes
Fluvial	**Low**	EA flood mapping indicates that the site is largely located in Flood Zone 1 with the exception of a small section to the east which is shown to be in Flood Zone 2. A Product 4 data requested received from the Environment Agency advises that no fluvial modelling data is available for this location and ultimately the flood zone extent shown correlates with a record of historic watercourse flooding dating back to March 1947. It is therefore clear that this historic record information has been used to inform the fluvial flood mapping. In 2010 the Cudworth Parkway bypass was constructed which partially culverted this watercourse and effectively provides a barrier to any potential future exceedance flow from reaching the site. Taking the above into consideration, the site is considered to be wholly within Flood Zone 1 and the risk of fluvial flooding is **Low**.
Pluvial	**Low**	The site generally has a very low risk of pluvial flooding, however an area if medium/ high risk exists at the northern boundary along the line of Weetshaw Lane. Based on the topography of the site, this areas represents a low spot and will ultimately be retained as existing, with the exception of some re-landscaping. As the site is to be re-developed extensively, future surface water flooding will be managed/ mitigated as part of the development drainage design. The impact on the proposed development from surface water flooding is therefore considered to be **Low.**
Tidal	**N/A**	There is no risk of tidal flooding to the site.
Groundwater	**Low**	The intrusive site investigations works undertaken by Lithos Consulting (Report Ref: 4674/1 June 2024) indicate that no significant groundwater was encountered In natural ground beyond the depth of the historic quarry. Some inflows and seepages of perched groundwater were noted in a number of excavations but these were limited to the base of the made ground. Soilscape (England) describes the site as having slowly permeable, seasonally wet, slightly acid but base-rich loamy and clayey soils with impeded drainage. The risk of groundwater flooding to the development is considered to be **Low**.
Canal	**N/A**	The site is not located in the vicinity of any canals.
Sewer	**Low**	Yorkshire Water sewer records indicate that there is no sewerage infrastructure within the site itself and any in the immediate surrounding area is generally limited. There are no known capacity issues or history of sewer flooding to the site from any of this apparatus. Furthermore, the risk from failure/ exceedance

		of the sewer network surrounding the site would be limited and would likely be contained within the local area. The impact on the proposed development from sewer water flooding is therefore considered to be **Low.**

Tidal Flood Risk

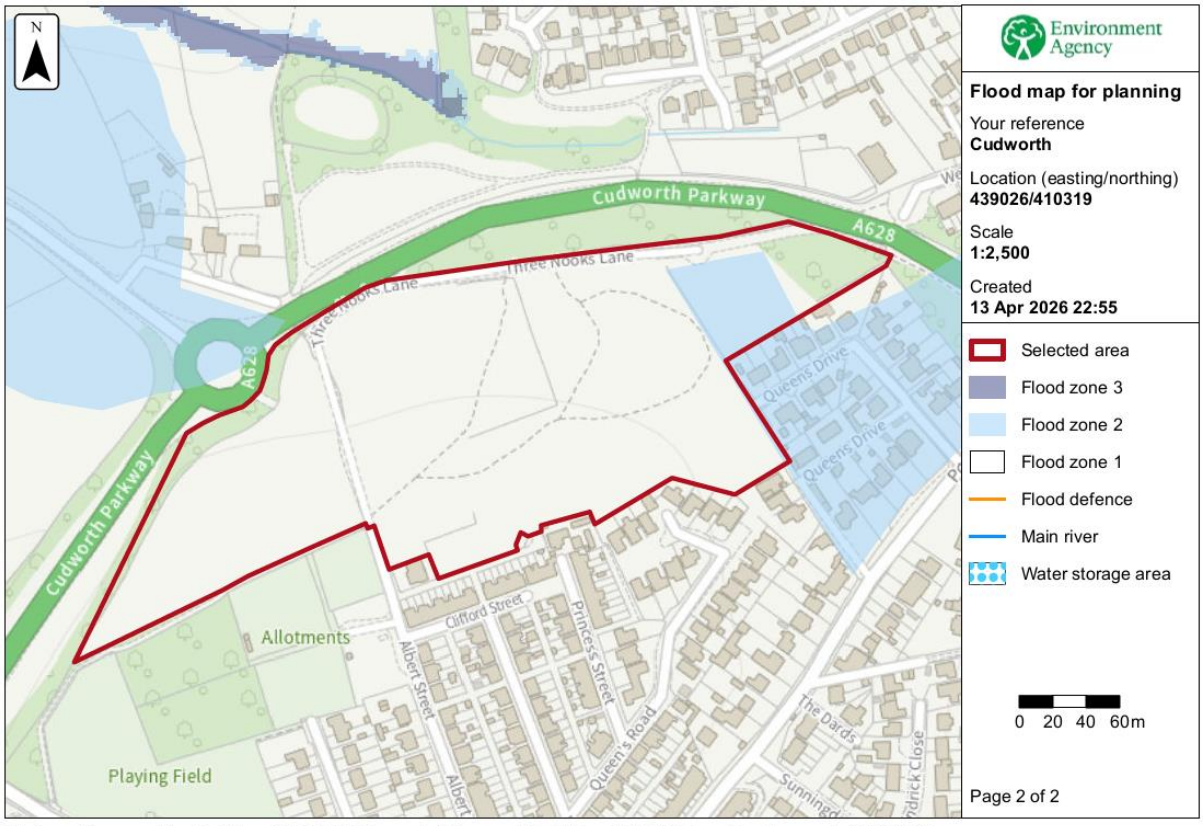
The Site is situated circa 50km from the coast and is significantly above sea level. Therefore, there is no risk from tidal flooding.

Fluvial Flood Risk

As described earlier in this report, the nearest watercourse is an unnamed feature circa 40m outside the northern boundary which flows in a north-westerly direction. A further watercourse is believed to be present to the east, beyond Shafton Roundabout. It is not known whether these two watercourses are linked but it seems likely they are the same feature which has been partially culverted to facilitate the creation of the Cudworth Parkway Bypass.

Figure 3 below, which is also provided in Appendix G, reproduces the EA 'Flood Map for Planning' and identifies the local EA Flood Zones.

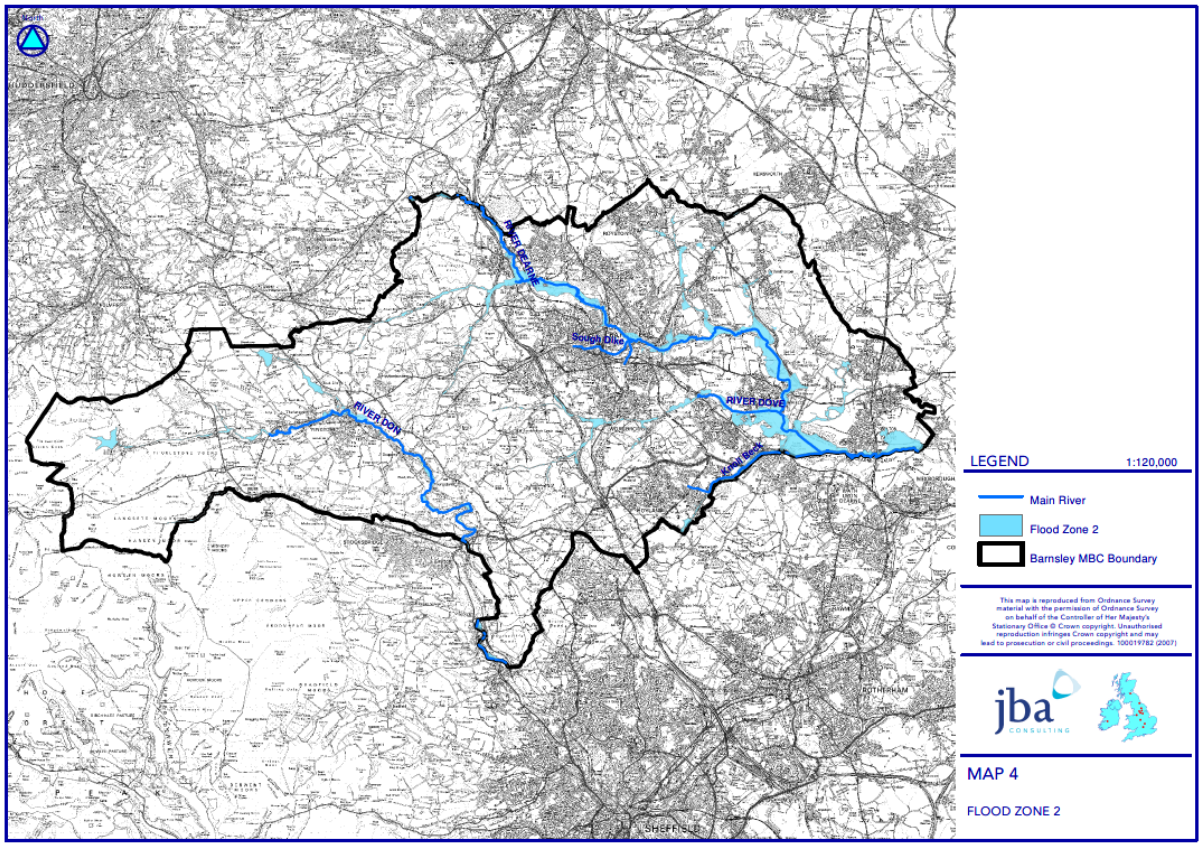
Figure 4 – EA 'Flood Map for Planning'



The Site is shown to be situated largely within Flood Zone 1. This zone comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%).

Notwithstanding, there is a small section of Flood Zone 2 indicated to the east in the area of public open space. The SFRA flood mapping indicates the same flood zone 2 risk as that shown on the EA flood map.

Figure 5 – Barnsley SFRA Flood Zone 2

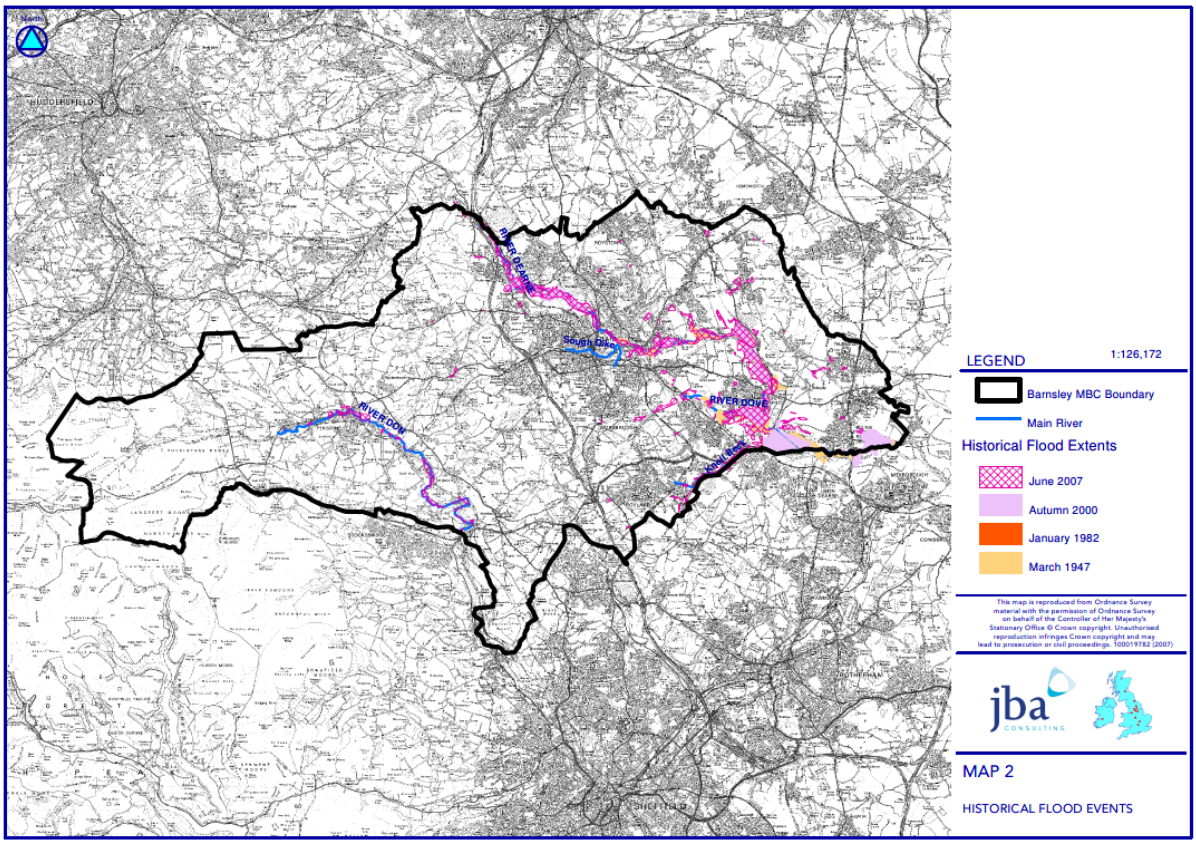


As highlighted earlier in this report, a Product 4 data request from the Environment Agency (appendix H) has determined that this extent is associated with an incident of historic flooding dating back to 1947. No flood levels are available for the area as flood modelling has not been undertaken in the vicinity therefore the extent of Flood Zone 2 is based on historic anecdotal information.

It seems unlikely that this has the potential to occur in a similar manner in the future given the Cudworth Parkway Bypass, completed in 2010, appears to have culverted the section of watercourse responsible for the flooding and has also effectively provided a barrier to any potential floodwater reaching the site.

It should also be noted that the SFRA also contains details of historical flood events and the mapping contained therein does not show any historic flooding in the area despite including details dating back to March 1947.

Figure 6 – Barnsley SFRA Historic Flood Events



Taking the above all into consideration, the risk to the site from Fluvial Flooding is considered to be LOW.

Pluvial Flood Risk

Pluvial, or surface water, flooding is defined as flooding resulting from rainfall generated overland flow before run-off enters any watercourse or sewer.

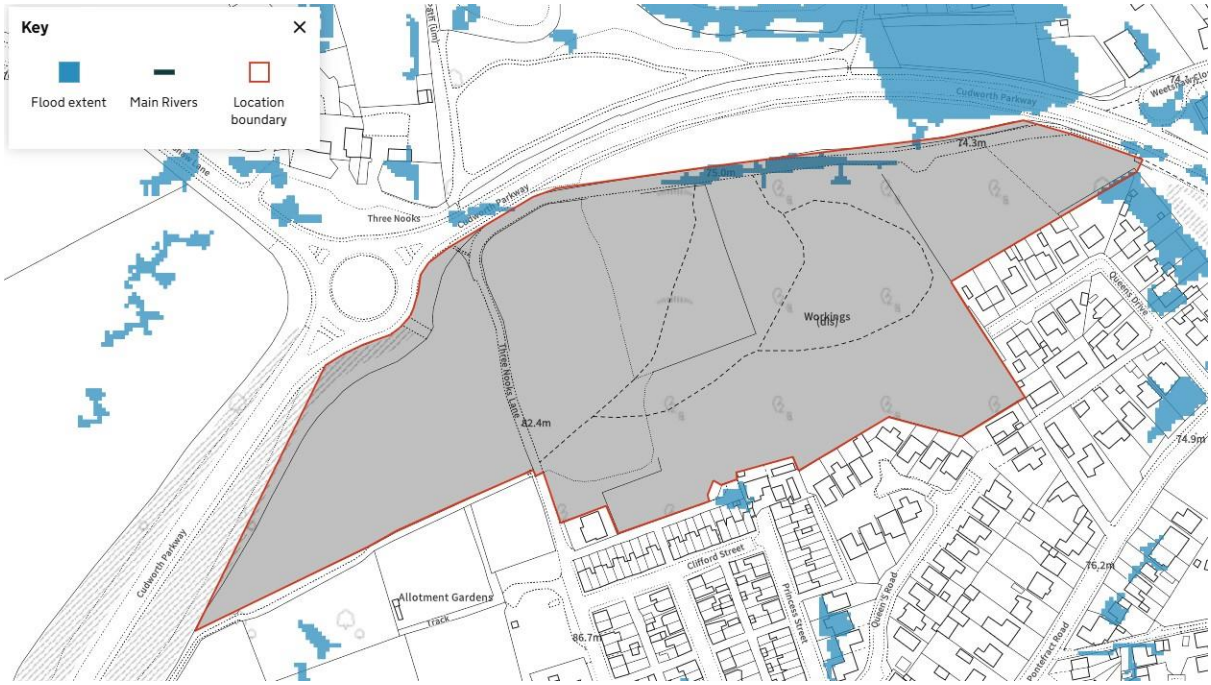
It is usually associated with high intensity rainfall events but can also occur with low intensity rainfall or melting snow where ground is saturated, frozen, developed or otherwise has low permeability resulting in overland flow and ponding in depressions in the topography. Large catchment areas are particularly prone to this type of flooding.

The Environment Agency flood mapping indicates that the risk of surface water flooding across the site ranges from Very Low to High. However, the only area at risk is restricted to a small section along the northern boundary where the site interfaces with Weetshaw Lane.

Based on the topography of the site, this areas represents a low spot and will ultimately be retained as existing, with the exception of some re-landscaping.

The Barnsley SFRA does not identify any surface flood risk at, or within the vicinity of, the site.

Figure 7 – EA 1000 year Surface Water Flood Risk



As the site is to be re-developed extensively, future surface water flooding will be managed/ mitigated as part of the development drainage design.

The impact on the proposed development from surface water flooding is therefore considered to be Low.

Tidal Flood Risk

The site is not considered to be at risk of tidal flooding due to its inland location.

Groundwater

In general terms, groundwater flooding can occur from three main sources, raised water tables, seepage and percolation, and groundwater recovery or rebound. If groundwater levels are naturally close to the surface, then this can present a flood risk during intense rainfall.

The SFRA does not indicate the site and surrounding area as being somewhere that is potentially susceptibility to groundwater flooding.

Soilscape (England) describes the site as having slowly permeable, seasonally wet, slightly acid but base-rich loamy and clayey soils with impeded drainage.

The British Geological Survey (BGS) 1:50,000 geological map indicates that the site is underlain by the Mexborough Rock-Sandstone formation with Pennine Lower Coal measures (mudstone, siltstone & sandstone) in the far east.

Intrusive site investigations works undertaken by Lithos Consulting (Report Ref: 4674/1 June 2024) indicate that no significant groundwater was encountered in natural ground beyond the depth of the historic quarry. Some inflows and seepages of perched groundwater were noted in a number of excavations, but these were limited to the base of the made ground.

It is therefore considered that the risk to the proposed development from groundwater is LOW.

Canal Flood Risk

Generally, canals are owned and operated by the Canals & Rivers Trust (CRT). Water levels are regulated between normal and statutory levels by means of weirs and sluice gates and whilst a breach or overtopping of the structure is unlikely, the possible flood risk needs to be assessed.

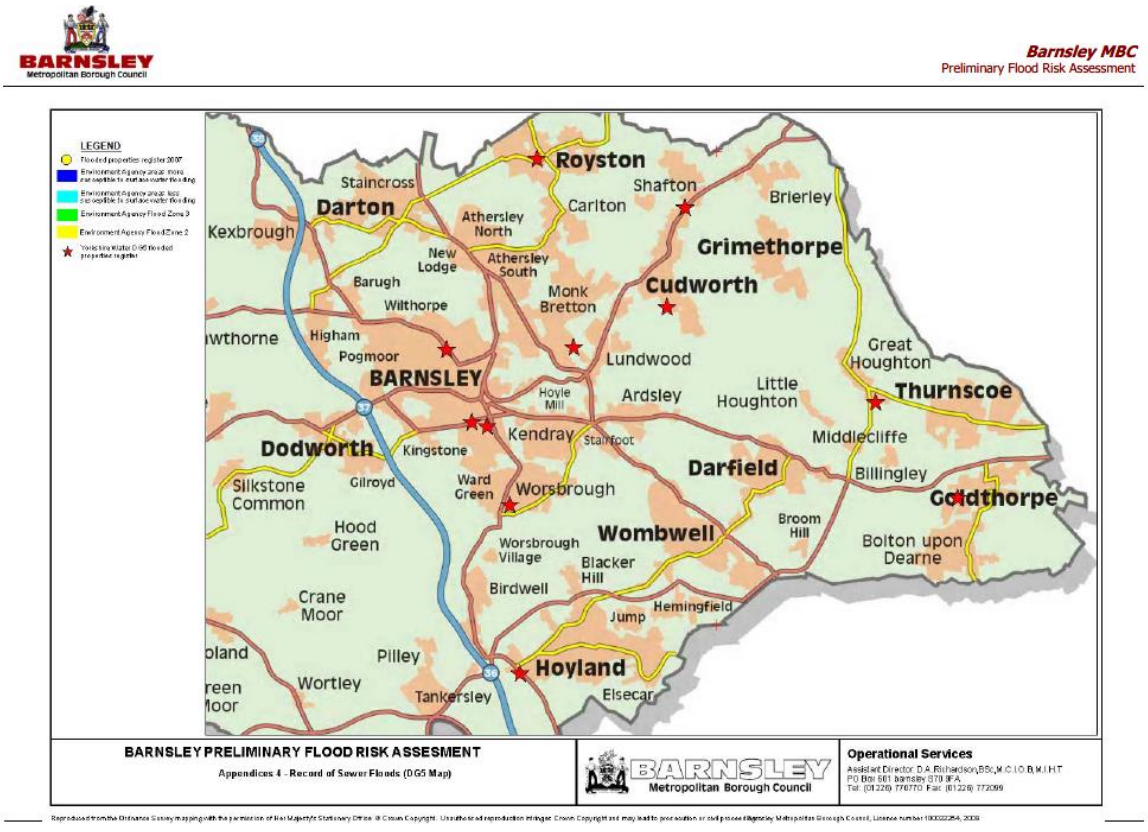
There are no canals in close proximity to the site. There is therefore not considered to be any risk of flooding to the site from canals.

Sewer Flood Risk

Flooding from the sewer network can occur when flow entering the system, such as an urban storm water drainage system, exceeds its available discharge capacity, the system becomes blocked, or it cannot discharge due to a high-water level in the receiving watercourse. Pinch points and failures within the drainage network may also restrict flows. Water then begins to back up through the sewers and surcharge through manholes, potentially flooding highways, and properties.

The Barnsley Preliminary Flood Risk Assessment contains details of areas which are on the Yorkshire Water DG5 register, this indicates that there are potentially some properties in the vicinity of the site. However, there is no record of any flooding having ever occurred at the site itself.

Figure 8 – DG5 Flooding Record



Notwithstanding the above, there is no sewerage infrastructure present within the site itself and whilst the surrounding residential areas do contain a network of public sewers, any flooding of these areas is unlikely to impact on the proposed development.

New foul and surface water drainage systems would be installed to serve any redevelopment at the site which would be designed to maintain flows below ground.

With the exception of any open SuDS features, there would likely be no surface flooding except for the most extreme rainfall events which exceed the design capacity of the drainage system.

Taking all the above into consideration, the risk of flooding to the future development of the site from surcharged drains or sewers can be considered as LOW.

Flood Risk Vulnerability Classification

The proposed development is residential and can be considered as 'More Vulnerable' within Table 3: Flood Risk Vulnerability Classification in the NPPF

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	✓

✓ development is permitted

X development is not permitted

This type of development would be wholly appropriate for Flood Zone 1.

Flood Risk Mitigation Measures

Development Levels

The site is considered to be wholly within Flood Zone 1 despite the flood map for planning suggesting an area of Flood Zone 2 is present to the east. Nevertheless, there are no built development works proposed in this area as the land is either to be retained as existing or re-landscaped as part of the POS.

Preliminary finished floor levels for the site have been proposed and are detailed on the preliminary levels drawing in Appendix I which is discussed in the subsequent sections of this report. As the existing site has a gradient of approximately 1:15 across it, raising and lowering of levels, alongside retaining features, will be required to facilitate development plateaus and ensure compliant gradients are achieved for vehicular and pedestrian areas.

Finished floor levels have been set generally at a minimum of 150mm above the surrounding ground, with the exception of entrance points which will be provided with a level threshold. Externally, levels will fall away from buildings to ensure that surface water run-off does not pose a risk.

The general fall of the site, from south to north, will be retained to ensure that exceedance flow paths continue in the same manner post-development.

Safe Access & Egress

The NPPF requires that, where required, safe access and egress is available to/from new developments in flood risk areas. Access routes should be such that occupants can safely access and exit the area in design flood conditions. These routes must also provide the emergency services with access to the development during a flood event and enable flood defence authorities to carry out any necessary duties during the period of flood.

As evidenced above, the site is considered to be wholly located in Flood Zone 1 and therefore safe access and egress for residents and visitors will be available at all times.

Proposed Drainage

The new foul and surface water drainage systems that will serve the development, as described in the subsequent sections of this report, will be designed to maintain flows below ground / within surface attenuation features where applicable.

Generally, surface flooding of areas will be minimised and there is expected there will be none except for the most extreme events. However, this would quickly drain back into the on-site drainage system and therefore not pose a risk.

The proposed foul water pumping station will be designed to adoptable standards and with sufficient emergency storage to avoid any potential flooding in the event of a power cut or pump failure.

As with any drainage system, blockages within the foul and surface water sewer systems constructed to serve the development have the potential to cause flooding or disruption. Any drainage systems which are not to be offered for adoption to either Yorkshire Water or the Local Authority will have a suitable maintenance regime scheduled and an appropriate management company appointed to carry out the works.

Drainage Strategy

Surface Water Management

The National Standards for Sustainable Drainage Systems (SuDS) dictate a priority list of surface water run-off destinations, stating the following:

A 'SuDS approach' shall be adopted to address the management of surface water by the development and where it should be discharged. Runoff shall be treated as a resource and managed in a way that avoids negative impacts of the development on flood risk, the morphology and water quality of receiving waters and the associated ecology. Runoff from the development shall be discharged to the following final destinations, to the maximum extent practicable, in accordance with the below hierarchy:

- Priority 1 – Collected for non-potable use;
- Priority 2 – Infiltration to ground;
- Priority 3 - Discharged to an above ground surface water body;
- Priority 4 – Discharged to a surface water sewer, or another surface water drainage system
- Priority 5 – Discharged to a combined sewer.

Priority 1 – Collected for non-potable use

The proposed development is residential and as such there will be a demand for non-potable water for toilet flushing and landscape irrigation. The feasibility of introducing this across the site at an individual property level and to support the apartment block and care home facility would need to be explored at detailed design stage. It is therefore not currently possible to commit to this as a solution.

Notwithstanding, it should be recognised that rainwater harvesting is unlikely to offer a final destination for the discharge of surface water run-off when considering the likely demand compared to the volume generated during larger storm return periods. Whilst it may be feasible to combine a rainwater harvesting system with the attenuation requirement for the apartment block and care home facility, this is unlikely to be practicable on an individual residential property level. Furthermore, the adoptable site wide access roads would not be able to feed into a private rainwater harvesting system and therefore separate attenuation and runoff destination would be required as a minimum for this element.

Taking this into consideration, this option has been discounted but will be explored further during detailed design.

Priority 2 – Infiltration to ground

Soakaway testing has been undertaken across the site to confirm whether infiltration-based methods are likely to be the most appropriate way of dealing with surface water run-off generated by the proposed development.

In total, seven separate locations were identified (Figure 9) and the testing repeated 3 times at each one where conditions allowed.

Figure 9 – Soakaway Test Locations

Infiltration rates for each soakaway test were calculated in accordance with BRE Digest 365. This takes account the time of emptying the soakaway between 25% and 7% of its effective depth. The calculated rates for each test are summarised in Figure 10 below.

Figure 10 – Summary of Soakaway Infiltration Rates

Soakaway	Stratum	Test no.	Infiltration rate (m/s)	Remarks
SA101	Granular Residual Soils (0.5 – 1.0m), Weathered Sandstone (1.0m – 2.4m)	1	4.34×10^{-4}	-
		2	4.40×10^{-4}	-
		3	4.06×10^{-4}	-
SA102	Granular Residual Soils (0.5 – 1.1m), Weathered Sandstone (1.1m – 2.2m)	1	5.27×10^{-5}	-
		2	4.87×10^{-5}	-
		3	3.79×10^{-5}	-
SA103	Granular Residual Soils (0.6 – 1.4m), Weathered Sandstone (1.4m – 2.2m)	1	3.78×10^{-5}	-
		2	3.19×10^{-5}	-
		3	2.91×10^{-5}	-
SA104	Granular Residual Soils (0.3 – 1.1m), Weathered Sandstone (1.1m – 2.2m)	1	Unable to calculate	Still c. 75% full after 4 hrs.
SA105	Granular Residual Soils (0.3 – 1.8m), Weathered Sandstone (1.8m – 2.2m)	1	Unable to calculate	Still c. 75% full after 4 hrs.
SA107	Granular Residual Soils (0.3 – 1.7m), Weathered Sandstone (1.7m – 2.3m)	1	Unable to calculate	Still c. 75% full after 3 hrs.
SA108	Granular Residual Soils (0.3 – 1.2m), Weathered Sandstone (1.2m – 2.1m)	1	2.52×10^{-4}	-
		2	2.01×10^{-4}	-
		3	1.78×10^{-4}	-

The results from the testing varied, ranging from $2.01x10^{-5}$ m/s to $4.06x10^{-4}$ m/s. Generally speaking, any rate greater than $1x10^{-6}$ m/s is considered suitable for soakaway-based drainage.

Notwithstanding, there were three locations to the east of the site where an infiltration rate could not be calculated. It is recommended that further testing is undertaken to support future detailed design should any potential soakaway feature be positioned in this area.

As noted earlier, perched groundwater was encountered in a small number of the excavations during intrusive investigations and monitoring wells generally remained dry. However, it is recommended that further seasonal monitoring is undertaken which specifically targets proposed attenuation areas and depths to ensure that groundwater does not present a potential issue.

Taking the above into consideration, discharge via infiltration is considered to be a potentially suitable method for disposal subject to further targeted testing and groundwater monitoring.

Priority 3 - Discharge to an above ground surface water body

The nearest watercourse to the site is located approximately 40m to the north beyond the A628 Cudworth Parkway. A connection to this feature is not considered to be feasible as it would require a connection through third party land outside of the client's control.

There is the potential that a connection could be made to the east, where the watercourse is believed to be culverted beneath the bypass however, based on the topography of the site, it is likely that a pumped connection would be required and works would still be required in land outside of the clients ownership and control.

On the basis that infiltration testing indicates that this is a feasible method of disposal, a connection to either of these watercourse features has not been considered further.

Priority 4 – Discharge to a surface water sewer or drain

The proposed application area is undeveloped and therefore has no existing drainage. However, the surrounding residential areas are served by a network of public sewers. The sewers to the south are all primarily combined with a very small number of surface water shown. Whilst a connection to these would be technically feasible, pumping would be required.

The residential area to the north is served by a more significant number of surface water sewers however, these lie to the north of the existing watercourse and so a connection to these in lieu of other options is not a logical approach.

The Cudworth Parkway Bypass is drained by a surface water system, but this has a limited number of carrier drains which could be utilised as a point of connection. The system also drains through a detention basin and discharges at a restricted rate. Therefore, it would be unlikely to have any spare capacity to receive run-off from the proposed development.

On the basis that infiltration is considered a viable method of disposal and there is the potential to pump flows to the nearby culverted watercourse, this option has not been considered further.

the wider campus is served by a network of private drainage some of which is surface water. This drainage discharges both independently to the various ponds and culverts across the campus, ultimately feeding Watercourse A and Whitehall Brook, and also to the foul system which discharges to the public combined sewer in Alderley Road.

Priority 5 – Discharged to a combined sewer

As highlighted previously, the surrounding residential areas contain a number of combined sewers which could potentially be utilised for the discharge of surface water. However, based on the topography of the site and location of these assets, pumping would be required. There is also no guarantee that these sewers have any capacity to receive surface water flows, particularly given there are known DG5 flooding issues in the vicinity.

There is no requirement to utilise this method for the disposal of surface water runoff due to the availability of higher priority options. This has therefore not been considered further.

Surface Water Drainage Strategy

The most appropriate method of surface water management for the site is considered to be infiltration. Given the topography of the site and development proposals, it is intended that the site will be drained primarily by below ground gravity pipework which will convey run-off generated by roofs and areas of hardstanding to the north of the site where it is able to infiltrate at the lowest point.

It is not considered practicable to utilise other SuDS techniques such as permeable pavements for driveway and parking areas due to the steep topography. As noted above, it is intended that rainwater harvesting at an individual property level will be explored as a method of rainwater re-use/ disposal. Notwithstanding, as a minimum each residential dwelling will be provided with a rainwater butt with at least 200l capacity.

To achieve the volume of storage required, it is proposed that geocelluar tanks will be used as the primary method of attenuation which will infiltrate into the underlying subgrade. These will be constructed below a series of detention basins which will provide additional exceedance storage at surface level for larger storm events.

A copy of the preliminary drainage scheme for the site based on the above principles is included in Appendix K.

Design Criteria

The following criteria have been used for the design of the surface water drainage network.

$M_{5\text{-}60}$ (mm)	18.80
Rainfall Ratio (R)	0.322
Global Time of Entry (min)	5.0
Max. Rainfall (mm/hr)	50
Max. Time of Concentration (mm)	30
PIMP (%)	100
Volumetric Run-off Coeff. (Cv)	1.00
Min. Velocity (m/s)	1.0
Pipe Roughness (mm)	0.6
Min. Gradient	1:DN
Climate Change Allowance	30yr 35%, 100yr 40%

Surface Water Catchment Areas

A list of catchment areas considered within the surface water drainage design are detailed below. These include a 10% allowance for urban creep in accordance with the South Yorkshire Interim Local Guidance for SuDS.

- Adoptable Roads: 1.015ha
- Private Roofs & Hardstanding: 1.965ha

Total Drained Area: 2.98ha

Hydraulic Design

Micro drainage software by Innovyze has been used to design the proposed piped network, details of which can be found on the drainage strategy drawing in Appendix L.

The Summer and Winter Volumetric Runoff Coefficient (CV) value has been taken as 1.0 to represent the sites impermeable drained catchment areas.

The system has been designed to ensure that the design criteria identified above are satisfied and that all surface water is retained below ground for storm events up to and including the 30-year return period plus climate change, with some nominal flooding allowed for events beyond this.

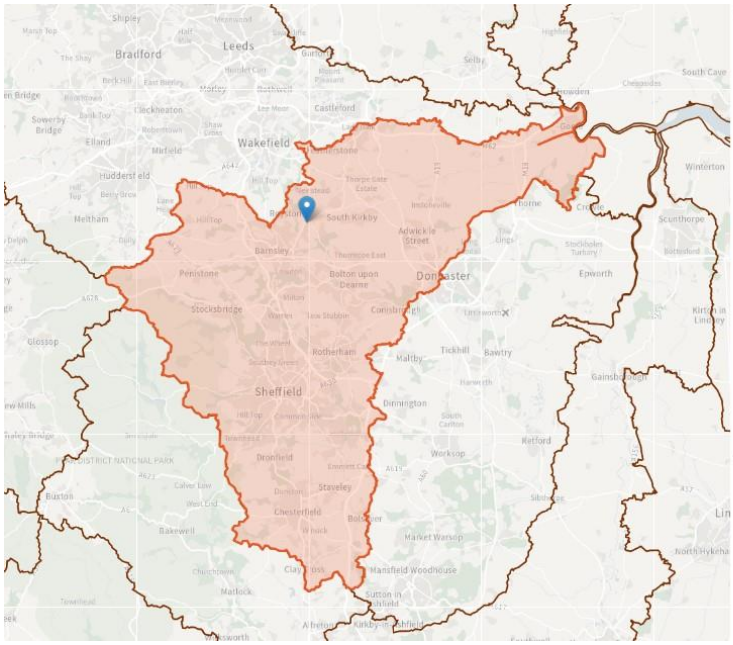
The total volume of attenuation provided is approximately **2,680m^3** which is split as follows

- Below Ground Tanks: 1,360m^3
- Above Ground Detention Basins: 1,320m^3

The extracts below show the results from micro drainage for the critical 2-year, 30 year+35% CC and 100 year +40% CC storm event ranked by Maximum Level.

Climate change allowances for the 3.3% and 1% AEP events are based on the Upper End Allowances defined by the Environment Agency for the Don and Rother Management Catchment.

Figure 11 – Peak Rainfall Allowances



Don and Rother Management Catchment peak rainfall allowances

3.3% annual exceedance rainfall event

Epoch	Central allowance	Upper end allowance
2050s	20%	35%
2070s	25%	35%

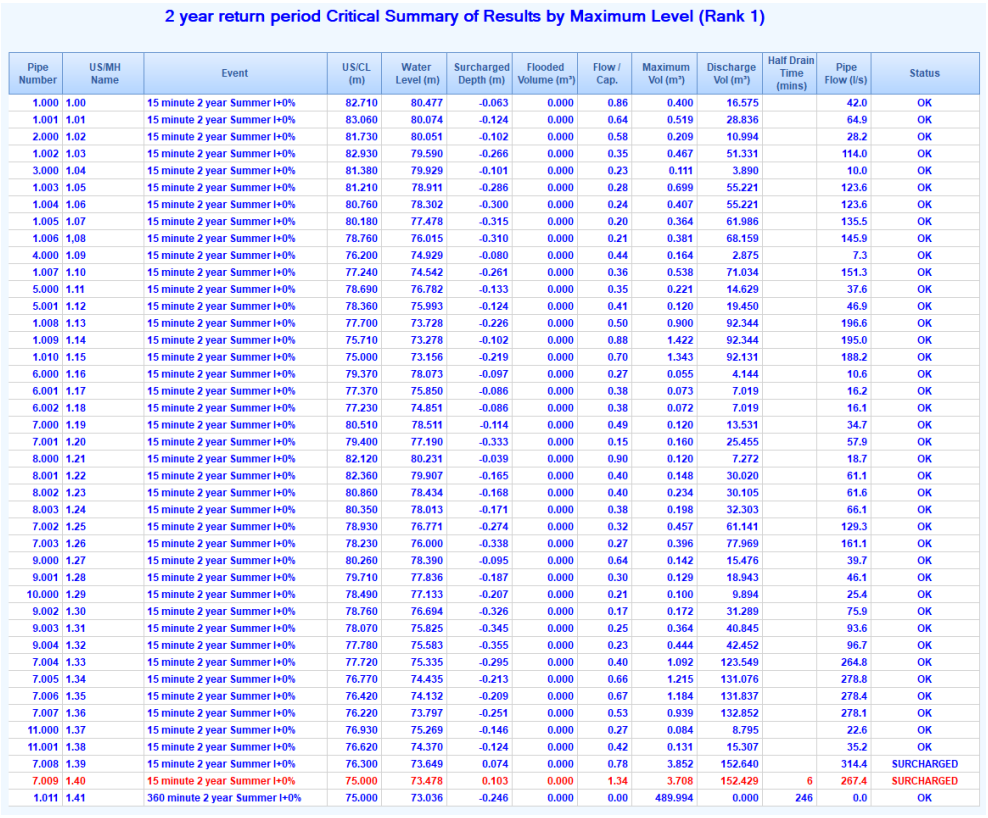
1% annual exceedance rainfall event

Epoch	Central allowance	Upper end allowance
2050s	20%	40%
2070s	25%	40%

*Use '2050s' for development with a lifetime up 2060 and use the 2070s epoch for development with a lifetime between 2061 and 2125.

This map contains information generated by Met Office Hadley Centre (2019): UKCP Local Projections on a 5km grid over the UK for 1980-2080. Centre for Environmental Data Analysis, 2022

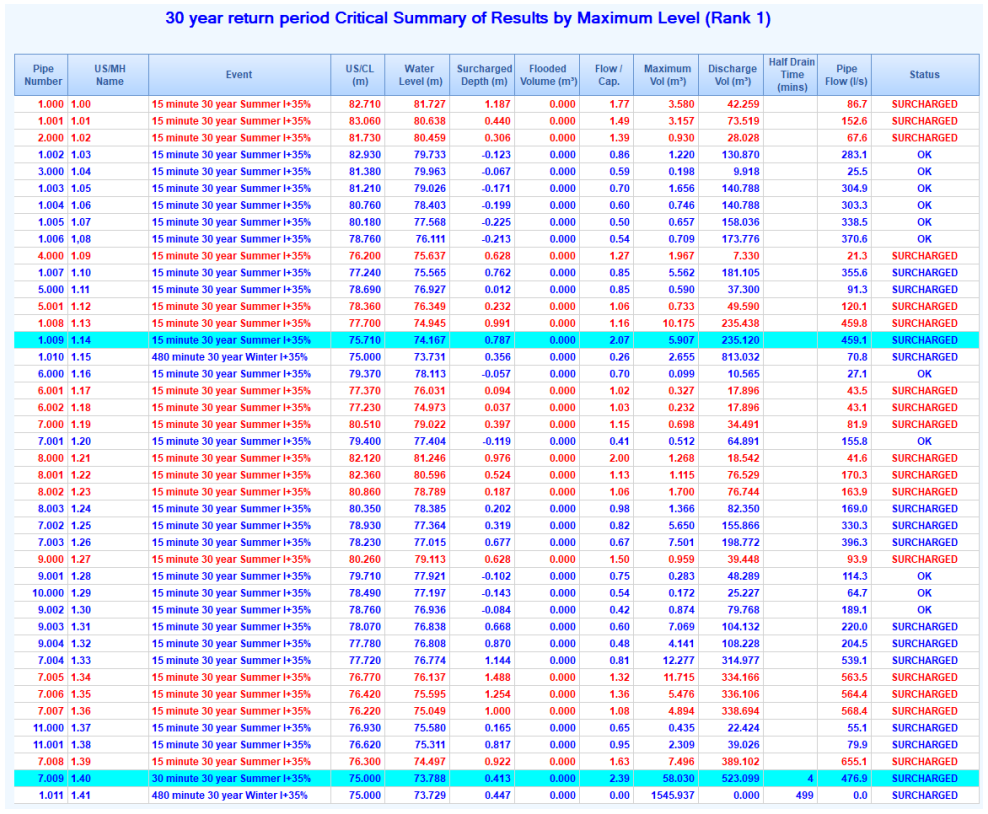
Figure 12 – 2 Year Return Period Critical Results Summary



2 year return period Critical Summary of Results by Maximum Level (Rank 1)

Pipe Number	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Discharge Vol (m³)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	1.00	15 minute 2 year Summer I+0%	82.710	80.477	-0.063	0.000	0.86	0.400	16.575		42.0	OK
1.001	1.01	15 minute 2 year Summer I+0%	83.060	80.074	-0.124	0.000	0.64	0.519	28.836		64.9	OK
2.000	1.02	15 minute 2 year Summer I+0%	81.730	80.051	-0.102	0.000	0.58	0.209	10.994		28.2	OK
1.002	1.03	15 minute 2 year Summer I+0%	82.930	79.590	-0.266	0.000	0.35	0.467	51.331		114.0	OK
3.000	1.04	15 minute 2 year Summer I+0%	81.380	79.929	-0.101	0.000	0.23	0.111	3.890		10.0	OK
1.003	1.05	15 minute 2 year Summer I+0%	81.210	78.911	-0.286	0.000	0.28	0.699	55.221		123.6	OK
1.004	1.06	15 minute 2 year Summer I+0%	80.760	78.302	-0.300	0.000	0.24	0.407	55.221		123.6	OK
1.005	1.07	15 minute 2 year Summer I+0%	80.180	77.478	-0.315	0.000	0.20	0.364	61.986		135.5	OK
1.006	1.08	15 minute 2 year Summer I+0%	78.760	76.015	-0.310	0.000	0.21	0.381	68.159		145.9	OK
4.000	1.09	15 minute 2 year Summer I+0%	76.200	74.929	-0.080	0.000	0.44	0.164	2.875		7.3	OK
1.007	1.10	15 minute 2 year Summer I+0%	77.240	74.542	-0.261	0.000	0.36	0.538	71.034		151.3	OK
5.000	1.11	15 minute 2 year Summer I+0%	78.690	76.782	-0.133	0.000	0.35	0.221	14.629		37.6	OK
5.001	1.12	15 minute 2 year Summer I+0%	78.360	75.993	-0.124	0.000	0.41	0.120	19.450		46.9	OK
1.008	1.13	15 minute 2 year Summer I+0%	77.700	73.728	-0.226	0.000	0.50	0.900	92.344		196.6	OK
1.009	1.14	15 minute 2 year Summer I+0%	75.710	73.278	-0.102	0.000	0.88	1.422	92.344		195.0	OK
1.010	1.15	15 minute 2 year Summer I+0%	75.000	73.156	-0.219	0.000	0.70	1.343	92.131		188.2	OK
6.000	1.16	15 minute 2 year Summer I+0%	79.370	78.073	-0.097	0.000	0.27	0.055	4.144		10.6	OK
6.001	1.17	15 minute 2 year Summer I+0%	77.370	75.850	-0.086	0.000	0.38	0.073	7.019		16.2	OK
6.002	1.18	15 minute 2 year Summer I+0%	77.230	74.851	-0.086	0.000	0.38	0.072	7.019		16.1	OK
7.000	1.19	15 minute 2 year Summer I+0%	80.510	78.511	-0.114	0.000	0.49	0.120	13.531		34.7	OK
7.001	1.20	15 minute 2 year Summer I+0%	79.400	77.190	-0.333	0.000	0.15	0.160	25.455		57.9	OK
8.000	1.21	15 minute 2 year Summer I+0%	82.120	80.231	-0.039	0.000	0.90	0.120	7.272		18.7	OK
8.001	1.22	15 minute 2 year Summer I+0%	82.360	79.907	-0.165	0.000	0.40	0.148	30.020		61.1	OK
8.002	1.23	15 minute 2 year Summer I+0%	80.860	78.434	-0.168	0.000	0.40	0.234	30.105		61.6	OK
8.003	1.24	15 minute 2 year Summer I+0%	80.350	78.013	-0.171	0.000	0.38	0.198	32.303		66.1	OK
7.002	1.25	15 minute 2 year Summer I+0%	78.930	76.771	-0.274	0.000	0.32	0.457	61.141		129.3	OK
7.003	1.26	15 minute 2 year Summer I+0%	78.230	76.000	-0.338	0.000	0.27	0.396	77.969		161.1	OK
9.000	1.27	15 minute 2 year Summer I+0%	80.260	78.390	-0.095	0.000	0.64	0.142	15.476		39.7	OK
9.001	1.28	15 minute 2 year Summer I+0%	79.710	77.836	-0.187	0.000	0.30	0.129	18.943		46.1	OK
10.000	1.29	15 minute 2 year Summer I+0%	78.490	77.133	-0.207	0.000	0.21	0.100	9.894		25.4	OK
9.002	1.30	15 minute 2 year Summer I+0%	78.760	76.694	-0.326	0.000	0.17	0.172	31.289		75.9	OK
9.003	1.31	15 minute 2 year Summer I+0%	78.070	75.825	-0.345	0.000	0.25	0.364	40.845		93.6	OK
9.004	1.32	15 minute 2 year Summer I+0%	77.780	75.583	-0.355	0.000	0.23	0.444	42.452		96.7	OK
7.004	1.33	15 minute 2 year Summer I+0%	77.720	75.335	-0.295	0.000	0.40	1.092	123.549		264.8	OK
7.005	1.34	15 minute 2 year Summer I+0%	76.770	74.435	-0.213	0.000	0.66	1.215	131.076		278.8	OK
7.006	1.35	15 minute 2 year Summer I+0%	76.420	74.132	-0.209	0.000	0.67	1.184	131.837		278.4	OK
7.007	1.36	15 minute 2 year Summer I+0%	76.220	73.797	-0.251	0.000	0.53	0.939	132.852		278.1	OK
11.000	1.37	15 minute 2 year Summer I+0%	76.930	75.269	-0.146	0.000	0.27	0.084	8.795		22.6	OK
11.001	1.38	15 minute 2 year Summer I+0%	76.620	74.370	-0.124	0.000	0.42	0.131	15.307		35.2	OK
7.008	1.39	15 minute 2 year Summer I+0%	76.300	73.649	0.074	0.000	0.78	3.852	152.640		314.4	SURCHARGED
7.009	1.40	15 minute 2 year Summer I+0%	75.000	73.478	0.103	0.000	1.34	3.708	152.429	6	267.4	SURCHARGED
1.011	1.41	360 minute 2 year Summer I+0%	75.000	73.036	-0.246	0.000	0.00	489.994	0.000	246	0.0	OK

Figure 13 – 30 Year+35% Return Period Critical Results Summary



30 year return period Critical Summary of Results by Maximum Level (Rank 1)

Pipe Number	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Discharge Vol (m³)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	1.00	15 minute 30 year Summer I+35%	82.710	81.727	1.187	0.000	1.77	3.580	42.259		86.7	SURCHARGED
1.001	1.01	15 minute 30 year Summer I+35%	83.060	80.638	0.440	0.000	1.49	3.157	73.519		152.6	SURCHARGED
2.000	1.02	15 minute 30 year Summer I+35%	81.730	80.459	0.306	0.000	1.39	0.930	28.028		67.6	SURCHARGED
1.002	1.03	15 minute 30 year Summer I+35%	82.930	79.733	-0.123	0.000	0.86	1.220	130.870		283.1	OK
3.000	1.04	15 minute 30 year Summer I+35%	81.380	79.963	-0.067	0.000	0.59	0.198	9.918		25.5	OK
1.003	1.05	15 minute 30 year Summer I+35%	81.210	79.026	-0.171	0.000	0.70	1.656	140.788		304.9	OK
1.004	1.06	15 minute 30 year Summer I+35%	80.760	78.403	-0.199	0.000	0.60	0.746	140.788		303.3	OK
1.005	1.07	15 minute 30 year Summer I+35%	80.180	77.568	-0.225	0.000	0.50	0.657	158.036		338.5	OK
1.006	1.08	15 minute 30 year Summer I+35%	78.760	76.111	-0.213	0.000	0.54	0.709	173.776		370.6	OK
4.000	1.09	15 minute 30 year Summer I+35%	76.200	75.637	0.628	0.000	1.27	1.967	7.330		21.3	SURCHARGED
1.007	1.10	15 minute 30 year Summer I+35%	77.240	75.565	0.762	0.000	0.85	5.562	181.105		355.6	SURCHARGED
5.000	1.11	15 minute 30 year Summer I+35%	78.690	76.927	0.012	0.000	0.85	0.590	37.300		91.3	SURCHARGED
5.001	1.12	15 minute 30 year Summer I+35%	78.360	76.349	0.232	0.000	1.06	0.733	49.590		120.1	SURCHARGED
1.008	1.13	15 minute 30 year Summer I+35%	77.700	74.945	0.991	0.000	1.16	10.175	235.438		459.8	SURCHARGED
1.009	1.14	15 minute 30 year Summer I+35%	75.710	74.167	0.787	0.000	2.07	5.907	235.120		459.1	SURCHARGED
1.010	1.15	480 minute 30 year Winter I+35%	75.000	73.731	0.356	0.000	0.26	2.655	813.032		70.8	SURCHARGED
6.000	1.16	15 minute 30 year Summer I+35%	79.370	78.113	-0.057	0.000	0.70	0.099	10.565		27.1	OK
6.001	1.17	15 minute 30 year Summer I+35%	77.370	76.031	0.094	0.000	1.02	0.327	17.896		43.5	SURCHARGED
6.002	1.18	15 minute 30 year Summer I+35%	77.230	74.973	0.037	0.000	1.03	0.232	17.896		43.1	SURCHARGED
7.000	1.19	15 minute 30 year Summer I+35%	80.510	79.022	0.397	0.000	1.15	0.698	34.491		81.9	SURCHARGED
7.001	1.20	15 minute 30 year Summer I+35%	79.400	77.404	-0.119	0.000	0.41	0.512	64.891		155.8	OK
8.000	1.21	15 minute 30 year Summer I+35%	82.120	81.246	0.976	0.000	2.00	1.268	18.542		41.6	SURCHARGED
8.001	1.22	15 minute 30 year Summer I+35%	82.360	80.596	0.524	0.000	1.13	1.115	76.529		170.3	SURCHARGED
8.002	1.23	15 minute 30 year Summer I+35%	80.860	78.789	0.187	0.000	1.06	1.700	76.744		163.9	SURCHARGED
8.003	1.24	15 minute 30 year Summer I+35%	80.350	78.385	0.202	0.000	0.98	1.366	82.350		169.0	SURCHARGED
7.002	1.25	15 minute 30 year Summer I+35%	78.930	77.364	0.319	0.000	0.82	5.650	155.866		330.3	SURCHARGED
7.003	1.26	15 minute 30 year Summer I+35%	78.230	77.015	0.677	0.000	0.67	7.501	198.772		396.3	SURCHARGED
9.000	1.27	15 minute 30 year Summer I+35%	80.260	79.113	0.628	0.000	1.50	0.959	39.448		93.9	SURCHARGED
9.001	1.28	15 minute 30 year Summer I+35%	79.710	77.921	-0.102	0.000	0.75	0.283	48.289		114.3	OK
10.000	1.29	15 minute 30 year Summer I+35%	78.490	77.197	-0.143	0.000	0.54	0.172	25.227		64.7	OK
9.002	1.30	15 minute 30 year Summer I+35%	78.760	76.936	-0.084	0.000	0.42	0.874	79.768		189.1	OK
9.003	1.31	15 minute 30 year Summer I+35%	78.070	76.838	0.668	0.000	0.60	7.069	104.132		220.0	SURCHARGED
9.004	1.32	15 minute 30 year Summer I+35%	77.780	76.808	0.870	0.000	0.48	4.141	108.228		204.5	SURCHARGED
7.004	1.33	15 minute 30 year Summer I+35%	77.720	76.774	1.144	0.000	0.81	12.277	314.977		539.1	SURCHARGED
7.005	1.34	15 minute 30 year Summer I+35%	76.770	76.137	1.488	0.000	1.32	11.715	334.166		563.5	SURCHARGED
7.006	1.35	15 minute 30 year Summer I+35%	76.420	75.595	1.254	0.000	1.36	5.476	336.106		564.4	SURCHARGED
7.007	1.36	15 minute 30 year Summer I+35%	76.220	75.049	1.000	0.000	1.08	4.894	338.694		568.4	SURCHARGED
11.000	1.37	15 minute 30 year Summer I+35%	76.930	75.580	0.165	0.000	0.65	0.435	22.424		55.1	SURCHARGED
11.001	1.38	15 minute 30 year Summer I+35%	76.620	75.311	0.817	0.000	0.95	2.309	39.026		79.9	SURCHARGED
7.008	1.39	15 minute 30 year Summer I+35%	76.300	74.497	0.922	0.000	1.63	7.496	389.102		655.1	SURCHARGED
7.009	1.40	30 minute 30 year Summer I+35%	75.000	73.788	0.413	0.000	2.39	58.030	523.099	4	476.9	SURCHARGED
1.011	1.41	480 minute 30 year Winter I+35%	75.000	73.729	0.447	0.000	0.00	1545.937	0.000	499	0.0	SURCHARGED

Figure 14 – 100 Year+40% Return Period Critical Results Summary

100 year return period Critical Summary of Results by Maximum Level (Rank 1)

Pipe Number	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Discharge Vol (m³)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	1.00	15 minute 100 year Summer I+40%	82.710	82.711	2.171	0.851	2.19	6.933	56.520		107.0	FLOOD
1.001	1.01	15 minute 100 year Summer I+40%	83.060	81.140	0.942	0.000	1.86	4.436	98.333		189.7	SURCHARGED
2.000	1.02	15 minute 100 year Summer I+40%	81.730	80.891	0.738	0.000	1.78	1.694	37.490		86.6	SURCHARGED
1.002	1.03	15 minute 100 year Summer I+40%	82.930	79.939	0.083	0.000	1.05	3.546	175.042		347.8	SURCHARGED
3.000	1.04	15 minute 100 year Summer I+40%	81.380	79.981	-0.049	0.000	0.79	0.243	13.266		34.1	OK
1.003	1.05	15 minute 100 year Summer I+40%	81.210	79.073	-0.124	0.000	0.86	2.173	188.308		373.7	OK
1.004	1.06	15 minute 100 year Summer I+40%	80.760	78.442	-0.159	0.000	0.74	0.890	188.308		376.0	OK
1.005	1.07	15 minute 100 year Summer I+40%	80.180	77.600	-0.192	0.000	0.61	0.777	211.379		417.2	OK
1.006	1.08	15 minute 100 year Summer I+40%	78.760	77.000	0.675	0.000	0.62	4.812	232.431		428.8	SURCHARGED
4.000	1.09	30 minute 100 year Summer I+40%	76.200	76.204	1.195	3.786	2.38	7.162	13.537		39.8	FLOOD
1.007	1.10	15 minute 100 year Summer I+40%	77.240	76.413	1.609	0.000	0.99	8.903	242.241		411.8	SURCHARGED
5.000	1.11	15 minute 100 year Summer I+40%	78.690	77.887	0.972	0.000	0.93	3.034	49.891		99.2	SURCHARGED
5.001	1.12	15 minute 100 year Summer I+40%	78.360	77.278	1.161	0.000	1.12	2.086	66.330		127.2	SURCHARGED
1.008	1.13	15 minute 100 year Summer I+40%	77.700	75.573	1.619	0.000	1.34	12.209	314.915		532.6	SURCHARGED
1.009	1.14	15 minute 100 year Summer I+40%	75.710	74.526	1.146	0.000	2.41	6.422	314.152		534.2	SURCHARGED
1.010	1.15	600 minute 100 year Winter I+40%	75.000	73.941	0.565	0.000	0.30	3.024	1150.895		80.0	SURCHARGED
6.000	1.16	15 minute 100 year Summer I+40%	79.370	78.231	0.061	0.000	0.88	0.233	14.127		34.0	SURCHARGED
6.001	1.17	15 minute 100 year Summer I+40%	77.370	76.721	0.784	0.000	1.20	1.345	23.933		51.2	SURCHARGED
6.002	1.18	15 minute 100 year Summer I+40%	77.230	75.287	0.350	0.000	1.19	0.663	23.933		50.2	SURCHARGED
7.000	1.19	15 minute 100 year Summer I+40%	80.510	80.113	1.488	0.000	1.36	1.932	46.138		96.2	SURCHARGED
7.001	1.20	30 minute 100 year Summer I+40%	79.400	78.514	0.991	0.000	0.43	4.123	119.834		163.0	SURCHARGED
8.000	1.21	15 minute 100 year Summer I+40%	82.120	82.123	1.853	2.614	2.53	4.780	24.801		52.8	FLOOD
8.001	1.22	15 minute 100 year Summer I+40%	82.360	81.837	1.765	0.000	1.29	2.518	102.360		195.2	SURCHARGED
8.002	1.23	15 minute 100 year Summer I+40%	80.860	80.024	1.422	0.000	1.04	7.001	102.648		162.0	SURCHARGED
8.003	1.24	15 minute 100 year Summer I+40%	80.350	79.581	1.397	0.000	1.01	2.904	110.146		172.9	SURCHARGED
7.002	1.25	30 minute 100 year Summer I+40%	78.930	78.446	1.401	0.000	0.83	9.079	287.833		334.1	SURCHARGED
7.003	1.26	30 minute 100 year Summer I+40%	78.230	78.015	1.677	0.000	0.67	9.282	367.065		395.0	FLOOD RISK
9.000	1.27	15 minute 100 year Summer I+40%	80.260	79.846	1.361	0.000	1.87	1.788	52.770		116.6	SURCHARGED
9.001	1.28	15 minute 100 year Summer I+40%	79.710	78.522	0.499	0.000	0.89	1.953	64.586		136.5	SURCHARGED
10.000	1.29	30 minute 100 year Summer I+40%	78.490	77.956	0.616	0.000	0.65	1.031	46.584		78.3	SURCHARGED
9.002	1.30	30 minute 100 year Summer I+40%	78.760	77.908	0.888	0.000	0.43	5.955	147.320		191.0	SURCHARGED
9.003	1.31	30 minute 100 year Summer I+40%	78.070	77.779	1.609	0.000	0.59	8.944	192.310		219.2	FLOOD RISK
9.004	1.32	30 minute 100 year Summer I+40%	77.780	77.732	1.794	0.000	0.53	5.774	199.875		227.0	FLOOD RISK
7.004	1.33	30 minute 100 year Summer I+40%	77.720	77.680	2.050	0.000	0.95	13.878	581.672		636.5	FLOOD RISK
7.005	1.34	30 minute 100 year Summer I+40%	76.770	76.775	2.126	4.798	1.50	17.576	617.107		636.9	FLOOD
7.006	1.35	15 minute 100 year Summer I+40%	76.420	76.125	1.784	0.000	1.54	6.412	449.591		640.4	FLOOD RISK
7.007	1.36	15 minute 100 year Summer I+40%	76.220	75.454	1.405	0.000	1.22	5.610	453.188		642.5	SURCHARGED
11.000	1.37	15 minute 100 year Summer I+40%	76.930	76.551	1.136	0.000	0.69	1.534	29.994		58.0	SURCHARGED
11.001	1.38	15 minute 100 year Summer I+40%	76.620	76.109	1.615	0.000	1.20	3.258	52.200		101.2	SURCHARGED
7.008	1.39	15 minute 100 year Summer I+40%	76.300	74.765	1.190	0.000	1.88	7.974	520.333		754.5	SURCHARGED
7.009	1.40	600 minute 100 year Winter I+40%	75.000	73.939	0.564	0.000	0.66	279.205	1472.909	183	132.5	SURCHARGED
1.011	1.41	600 minute 100 year Winter I+40%	75.000	73.936	0.654	0.000	0.00	1769.373	0.000	696	0.0	SURCHARGED

The results demonstrate that the surface water drainage system is able to operate satisfactorily with only 12m^3 of flooding in the 15 & 30 minute 100 year plus climate change return period. The flooding only occurs in the extreme short duration event and represents a very small amount which would be safely retained within the highway corridor.

A full copy of the microdrainage calculations are provided in Appendix L.

Water Quality

Land use is the primary influencing factor in the quality of urban surface water runoff and is used to assess the pollution hazard posed by the development.

In accordance with CIRIA SuDS Manual 2015 guidance, and the requirements of the Lead Local Flood Authority, it is proposed that the Simple Index Approach is used to assess pollution risk based upon land use.

Figure 15 – CIRIA SuDS Manual Water Quality Risk Management

TABLE 26.1 Approaches to water quality risk management

Design method	Hazard characterisation	Risk reduction	
		For surface water	For groundwater
Simple index approach	Simple pollution hazard indices based on land use (eg Table 26.2 or equivalent)	Simple SuDS hazard mitigation indices (eg Table 26.3 or equivalent)	Simple SuDS hazard mitigation indices (eg Table 26.4 or equivalent)
Risk screening[1]	Factors characterising traffic density and extent of infiltration likely to occur (eg Table 26.5 or equivalent)	N/A	Factors characterising unsaturated soil depth and type, and predominant flow type through the soils (eg Table 26.5 or equivalent)
Detailed risk assessment	Site specific information used to define likely pollutants and their significance	More detailed, component specific performance information used to demonstrate that the proposed SuDS components reduce the hazard to acceptable levels	
Process-based treatment modelling	Time series rainfall used with generic pollution characteristics to determine statistical distributions of likely concentrations and loadings in the runoff	Models that represent the treatment processes in the proposed SuDS components give estimates of reductions in event mean discharge concentrations and total annual load reductions delivered by the system	

As evident in Table 26.2 below (Figure 16), the risk of contamination from the residentialroof areas, individual property driveway and low traffic roads, is considered to be Low.

Figure 16 – CIRIA SuDS Manual Pollution Hazard Indices

TABLE 26.2 Pollution hazard indices for different land use classifications

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways[1]	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1]	High	0.8[2]	0.8[2]	0.9[2]

The table below details the Total Pollution Hazard Indices for the site.

Land Use	Pollution/ Hazard Level	TSS	Metals	Hydrocarbons
Residential Roofs	Low	0.2	0.2	0.05
Individual property driveways, residential car parks, low traffic roads (e.g. cul de sacs, homezones and general access roads)	Low	0.5	0.4	0.4
TOTAL POLLUTION HAZARD INDICES		**0.7**	**0.6**	**0.45**

As detailed in the preliminary drainage strategy, it is intended that the site will be drained primarily by below ground gravity pipework which will convey run-off generated by roofs and areas of hardstanding to the north of the site where it is able to infiltrate via a combination of below ground tanks and above ground detention basins. Proprietary treatment systems are anticipated to be required in conjunction with these SuDS measures to ensure the necessary level of treatment is provided. This is detailed in the table below.

Treatment Component	TSS	Metals	Hydro.	Comment
Infiltration Tank	0.4	0.3	0.3	Underlain by a soil with a good contaminant attenuation potential of at least 300mm in depth
Infiltration Basin	0.4	0.3	0.3	Underlain by a soil with a good contaminant attenuation potential of at least 300mm in depth
StormShark	0.8	0.6	0.96	To be installed in advance of any infiltration system
TOTAL	**1.6**	**1.2**	**1.56**	
Indices Balance	**+0.9**	**+0.6**	**+1.11**	

Based on the above, it can be demonstrated that the proposed treatment components will ensure there are no adverse impacts on the receiving groundwater.

Foul Water Management

It is intended that a new foul drainage system will be installed to serve the proposed development.

The foul water system will be designed in accordance with the current Building Regulations, BS EN:752 'Drainage and Sewer Systems Outside Buildings', the Local Authority Building Control specifications and requirements, Sewerage Sector Guidance (Appendix C) and the Civil Engineering Specification for the Water Industry

Foul flow rates have been calculated based on the Sewerage Sector Guidance Appendix C which advises that the peak foul flow rate for residential dwellings should de either:

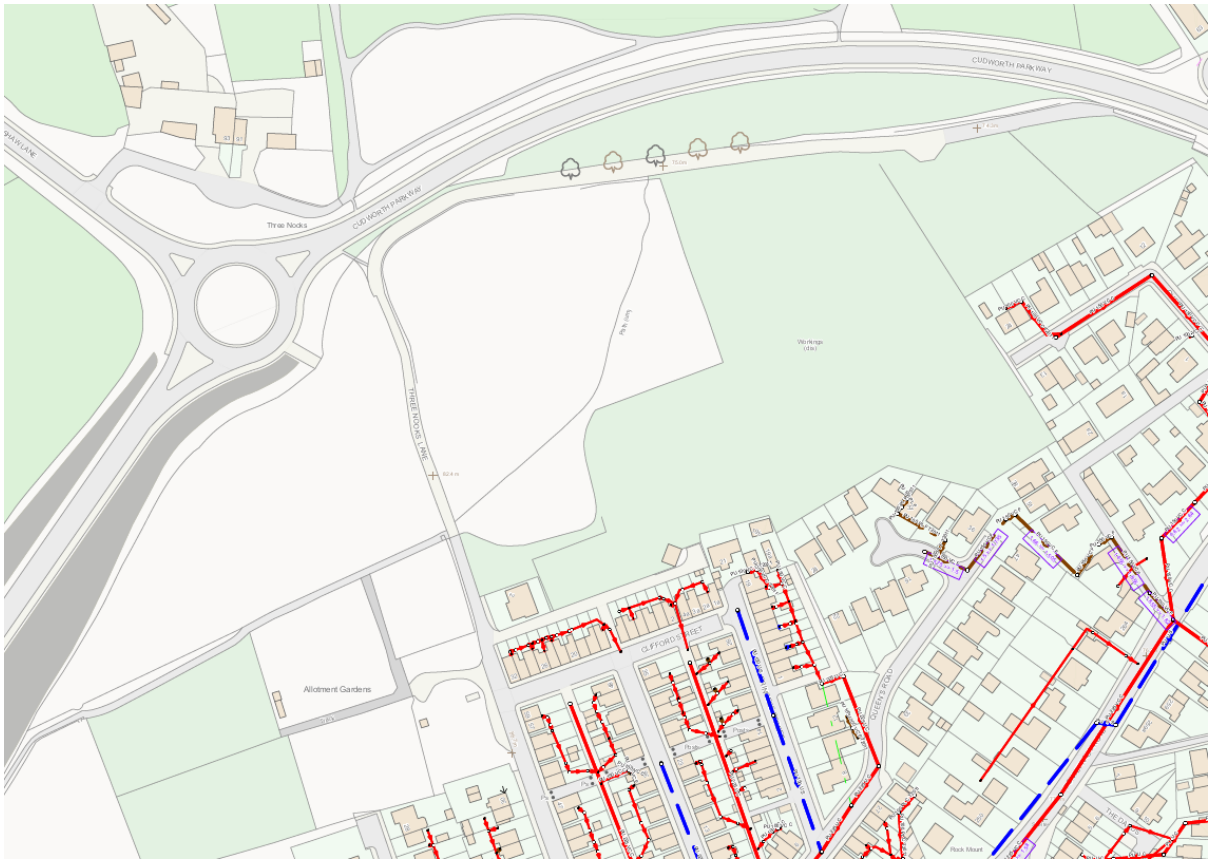
a. calculated in accordance with BS EN 12056-2 System II or
b. 4000 litres per dwelling per day (0.05 litres per second per dwelling).

The approximate peak foul flow generated, based on method (b), for a total of 144 dwellings is **6.66 l/s**

Foul Water Point of Connection

The nearest available public sewer to the site as a 150mm diameter combined drain in Queens Drive to the southeast.

Figure 17 – Yorkshire Water Sewer Records



The topography of the site falls in a south to north direction with a level difference of approximately 11m between the highest and lowest points. As a result, it will not be possible to drain the entire development by gravity, and a foul water pumping station will be required.

A survey of the combined sewer in Queens Drive was undertaken as part of the wider drainage investigations works, a copy of this survey is included in Appendix E. This indicates that the sewer has an invert of 75.91m at the proposed point of connection.

It is intended that around 46 of the units to the south of the site will be able to drain by gravity to the outfall, with the remaining 98 being pumped from the north. The rising main will discharge to this same system on site so that a single gravity outfall to the public sewer is provided.

A copy of the drainage strategy for the site is included in Appendix K.

Foul Water Capacity

Yorkshire Water are to be consulted with via the pre-development enquiry process with respect to the proposed foul water connection. Details of that response will be included in a future revision of this report when received.

However, it should be recognised that a developer has a right to connect to the public sewerage network at a point of its choosing and the Sewerage Undertaker has a duty to carry out any works necessary to accommodate the resulting foul flows (s106 and s94 of the Water Industry Act (WIA)1991).

Section 94 WIA 1991

Under section 94(1) of the WIA1991, sewerage undertakers have a duty to provide, improve, extend and make provision for the emptying of their sewerage systems by effectually dealing, by means of sewage disposal works or otherwise, with the contents of those sewers that comprise the public sewerage system. The provisions of this section of the WIA1991 relate not only to long term capital works to improve the sewerage system generally but also place a duty on the sewerage undertaker to react to changes in the level of discharges into its networks.

Section 94(1) places a duty on sewerage undertakers to plan and implement any works they feel are necessary to ensure their network of sewers (and sewage treatment facilities) continue to operate satisfactorily once they have received notification that a developer intends to exercise the right to connect under section 106.

A sewerage undertaker therefore has sufficient certainty and time as a result of the advance notice they receive that a development will be proceeding on the grant of planning permission (outline or full) and should consider any necessary actions to comply with its section 94 duty at that stage.

Taking the above into consideration, whilst Yorkshire Water could potentially advise that they do not have sufficient capacity to serve the proposed development at this time, they have adequate notice of the proposals, both through the pre-development enquiry and planning process, to programme any works deemed necessary to improve their network accordingly.

Section 112 WIA 1991

Notwithstanding the above, whilst all developers and landowners have an absolute right to connect to the public sewer nearest to their development, in some circumstances it may be the case that the sewerage undertaker requires drainage systems to be constructed in a manner which better protects the existing public sewer network.

For example, it may be beneficial for a sewerage undertaker to request that a developer connects at an alternative location which better serves their network or perhaps provide onsite attenuation to ensure that new flows are only discharged at certain times until any deficiencies in its systems have been resolved.

Given the rights and duties under section 106 and 94 of the WIA1991, it would not however be appropriate to expect a developer to pay for any additional works. Therefore, Section 112 of the WIA 1991 provides a mechanism for sewerage undertakers to compel a developer to carry out alternative works, but with the difference of cost being met by the sewerage undertaker.

Clearly if alternative works would be more cost effective for a sewerage undertaker than implementing sewer or sewage treatment improvements, such as local on-site treatment and disposal, this option is both viable and useful to ensure that a development can be successfully drained.

Management Plan

The proposed drainage system for the development adopts SuDS measures alongside traditional drainage techniques. It is important that these are maintained to ensure that all elements operate effectively for their lifetime.

Like any drainage system, maintenance is a necessary and important consideration of Sustainable Drainage System (SUDS) design. If systems are properly monitored and maintained, any deterioration in performance can often be managed out.

Effective maintenance will help to ensure that the SuDS features continue to function as they were intended and keep hydraulic capacity and pollutant removal efficiency of the systems at design levels.

Based on the nature of the development, it is anticipated that the foul and surface water drainage piped systems and pumping station would be offered for adoption to Yorkshire Water. It is anticipated that the attenuation features would remain private and maintained by a management company who would provide regular and reactive maintenance as necessary.

Requirements for the ongoing maintenance of the drainage network will form part of the Operation and Maintenance manual for the site. Any specialist or proprietary products specified at detailed design stage (e.g. hydrodynamic seperators) should have a specific maintenance regime which will be included in the document.

The table provides preliminary details on the recommended maintenance requirements for the drainage scheme. This will be updated as necessary post-planning following detailed design and included within the Operation and Maintenance Plan.

Drainage Feature		Action Required	Typical Frequency
Gully's & Channels	Occasional Maintenance	Inspect cover and frame for any defects, repair and replace as necessary.	Quarterly
		Inspect channels for the build-up of silt and debris. Removal of silt and debris by means of vacuum suction and or jetting/ rodding.	
		Inspect sumps and outgoing pipework for the build-up of silt and debris. Removal of silt and debris by means of vacuum suction and or jetting/ rodding.	
Manholes/ Catchpits	Occasional Maintenance	Inspect chamber cover and frame for any defects, repair and replace as necessary. Inspect chamber interior and incoming/ outgoing pipes for the build-up of silt and debris. Removal of silt and debris by means of vacuum suction and or jetting/ rodding.	Quarterly

		Ensure manhole access steps/ ladders are secured and inspect for corrosion.	
Ponds/ Basins	Regular Maintenance	Inspect and identify any areas that are not operating correctly e.g. clogging or other blockages. If required, take remedial actions	Monthly for 3 months then annually.
		Remove debris from the invert area e.g. leaf litter	Monthly
		Vegetation management e.g. grass cutting, pruning etc	Monthly
	Occasional Maintenance	Monitor health of vegetation/ planting & replace as necessary	Quarterly/ As needed
		Inspect/ check all inlets/ outlets to ensure they are in good condition and operating as designed.	Quarterly
		Remove sediment from low flow channels where applicable	As required
Hydrodynamic Separator	Regular Maintenance	Normally, little maintenance is required as there are no moving parts within the device. However, it is recommended that each unit should be inspected for debris or blockages	6 monthly to determine rate of sediment accumulation then as required.
Gecellular Attenuation	Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial actions	Monthly for 3 months then annually.
		Remove debris from the catchment surface i.e., driveways and associated hardstanding areas	Monthly
		Remove sediment from inlet manhole	Annually or as required
	Occasional Maintenance	Repair/ rehabilitate inlets and vents	As required
		Inspect/ check all inlets and vents to ensure they are in good conditions and operating as designed.	Annually
		Survey drainage system up to tank for sediment build-up and remove if necessary	As required

Summary

Flood Risk

The flood map for planning indicates that the site is location largely in Flood Zone 1. This zone comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%).

There is a small section of Flood Zone 2 indicated to the east in the area of public open space. A data request from the Environment Agency indicates that this is associated with a record of historic flooding dating back to March 1947. No flood levels are available for the area as flood modelling has not been undertaken in the vicinity, therefore the extent of this Flood Zone 2 is based on anecdotal information.

It is considered unlikely that this flooding has the potential to occur in a similar manner in the future given the Cudworth Parkway Bypass, completed in 2010, appears to have culverted the section of watercourse responsible for the flooding and has also effectively provided a barrier to any potential floodwater reaching the site. Furthermore, the topography of the site slopes at a gradient of circa 1:15, making it impossible for any exceedance flow to flood the site as suggested.

On this basis, it is concluded that the whole development site is located in Flood Zone 1, contrary to what is shown on the EA flood mapping.

The flood risk assessment has reviewed all other sources of flood risk to both the proposed development and surrounding area including tidal, pluvial, groundwater, sewers and flooding from artificial sources. This report demonstrates that the development site is not at significant risk of flooding, nor does it increase flood risk off-site.

The development is always accessible for emergency access and egress as the flood plain does not extend into the area proposed for development.

As with any drainage system, blockages within the surface water sewer systems constructed to serve the development have the potential to cause flooding or disruption. Any drainage systems which are not to be offered for adoption to either the Yorkshire Water or the Local Authority will have a suitable maintenance regime scheduled and an appropriate management company appointed to carry out the works.

This Flood Risk Assessment is therefore considered to be commensurate with the development proposals and in summary, the development can be considered appropriate in accordance with the NPPF.

Surface Water Management

Surface water runoff from the site is to be drained primarily by below ground gravity pipework which will convey run-off generated by roofs and areas of hardstanding to the north of the site where it is able to infiltrate at the lowest topographical point.

Soakaway testing has been undertaken to confirm the sites infiltration potential. The results from the testing varied, ranging from 2.01x10-5 m/s to 4.06x10-4 m/s which is considered suitable for soakaway-based drainage solutions.

To achieve the volume of storage required, it is proposed that geocelluar tanks will be used as the primary method of attenuation which will infiltrate into the underlying subgrade. These will be

constructed below a series of detention basins which will provide additional exceedance storage at surface level for larger storm events.

A 10% allowance for urban creep has been included in the site catchment areas in accordance with the South Yorkshire Interim Local Guidance for SuDS.

Climate change has been considered within the preliminary surface water drainage design for the 3.33% and 1% AEP storm events. This is based on the Upper End Allowances defined by the Environment Agency for the Don and Rother Management Catchment.

It is not considered practicable to utilise other SuDS techniques such as permeable pavements for driveway and parking areas due to the steep topography. Rainwater harvesting at an individual property level will be explored as a method of potential rainwater re-use/ disposal during detailed design stage. Notwithstanding, as a minimum each residential dwelling will be provided with a rainwater butt with at least 200l capacity.

Foul Water Management

A new foul water drainage system is proposed which will convey flows from the development site to an existing public combined sewer in Queens Drive to the southeast of the site.

Foul flow rates have been calculated as 6.66 l/s based on Appendix C of the Sewerage Sector Guidance.

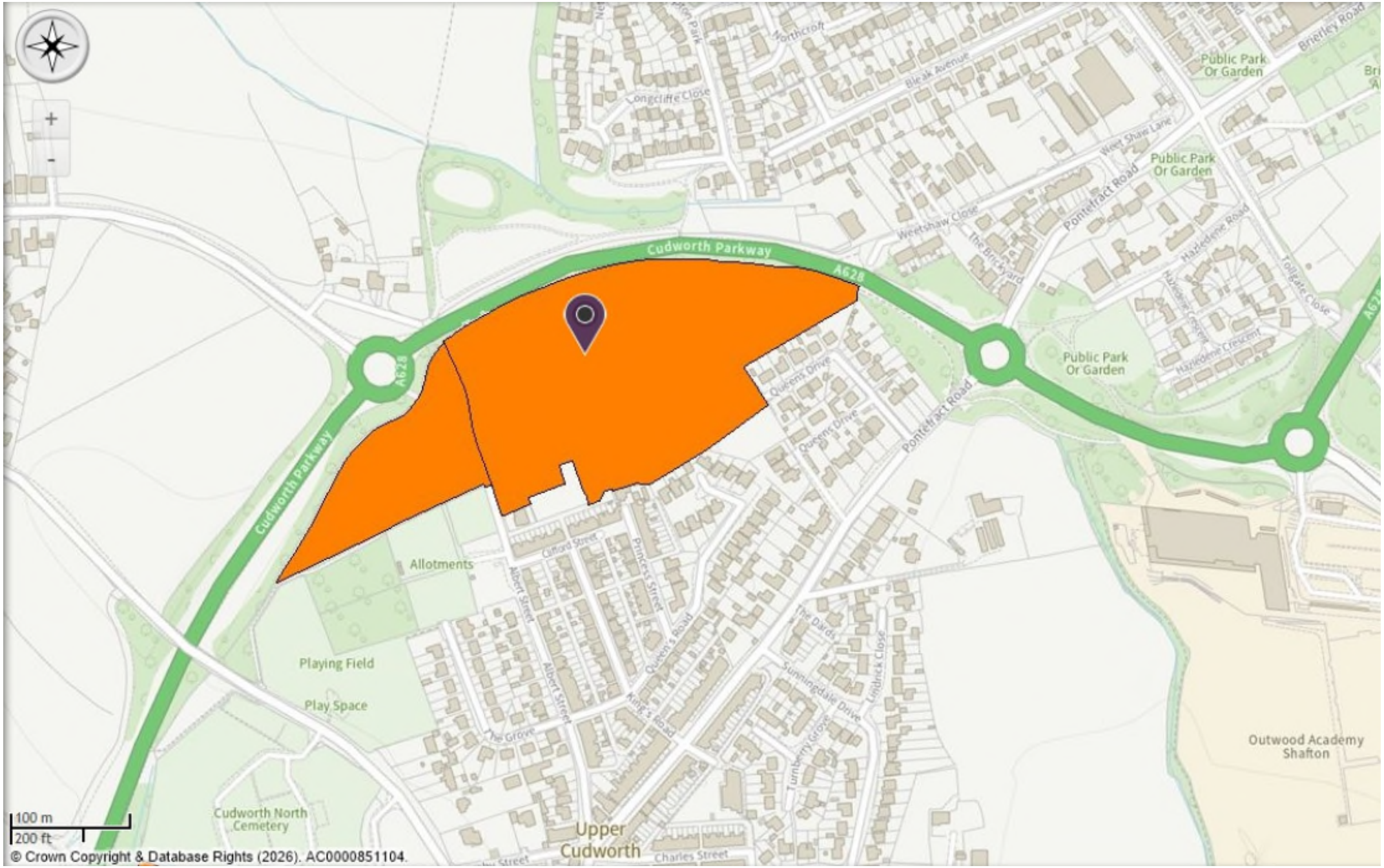
As a result of the sites topography, it will not be possible to drain the entire development by gravity, and a foul water pumping station will be required. It is intended that around 46 of the units to the south of the site will be able to drain by gravity to the outfall, with the remaining 98 being pumped from the north.

The rising main will discharge to this same system on site so that a single gravity outfall to the public sewer is provided

Yorkshire Water are to be consulted with via the pre-development enquiry process with respect to the proposed foul water connection. Details of that response will be included in a future revision of this report when received.

Under the Water Industry Act, developers have an absolute right of connection to the public sewer network which cannot be refused on grounds of capacity. Yorkshire Water can request alternative connection points to suit local network requirements under Section112 of the WIA 1991, however any additional cost in doing so must be met by them.

APPENDIX A – Location Plan



APPENDIX B – Development Masterplan

BEDS	HOUSE TYPES		BARNSLEY % TARGET	UNITS PROVIDED
2 BEDS	**BROOK** **4no**	**2B3P Bungalow** **73m²** (Single Floor) SYRDG, NDSS, M4(3)(2)(b) Wheelchair accessible	(37%)	52 NO. (36.1%)
	WILLOW **4no**	**2B3P Bungalow** **71m²** (Single Floor) SYRDG, NDSS, M4(3)(2)(b) Wheelchair accessible		
	EMBER **44no**	**2B4P** **70m²** SYRDG, M4(2)		
3 BEDS	**CARLTON** **40no**	**3B4P** **86m²** SYRDG, M4(1) Ensuite	(47.5%)	67 NO. (46.5%)
	MIDLAND **8no**	**3B4P** **84m²** SYRDG, NDSS, M4(2)		
	MONCKTON **17no**	**3B5P** **96m²** SYRDG, NDSS, M4(2). Ensuite, + Detached Garage		
	FERRYMOOR **2no**	**3B5P** **90m²** SYRDG, M4(1).		
4 BEDS	**STONELEIGH** **17no**	**4B5P** **101m²** SYRDG, M4(2) + Garage (Detached)	(15.5%)	25 NO. (17.4%)
	GRANGE **4no**	**4B6P** **113m²** SYRDG, NDSS, M4(2) & M4(3) adaptable + Garage (integrated)		
	HAWTHORN **4no**	**4B5P** **110m²** SYRDG, NDSS, M4(1)		
TOTAL HOUSES = 144				

Housing mix targets are derived from the Barnsley Strategic Housing Market Assessment 2021.

Accessibility provision as per Design of Housing Development SPD (Adopted July 2023) 26% M4(2) adaptable standard and 6% M4(3) wheelchair accessible.

SITE AREA CALCULATION		
GROSS SITE AREA	54,941m²	5.49Ha
NET DEVELOPABLE AREA	50,523m²	5.05Ha

P.O.S		
REQUIREMENT = 15%	TARGET = 7,578m²	ACTUAL = 5,806m²

15% minimum open space provision sourced from SPD Open Space Provision on New Housing Developments (Adopted May 2019).

PARKING SPACES		
REQUIREMENT	2 BED = 1 SPACE (52) 3 BEDS+ = 2 SPACES (184) 1 VISITOR SPACE PER 4 DWELLINGS (36) TOTAL = 272	
CURRENT PROVISION	PRIVATE = 244 VISITOR = 28 TOTAL = 272	NOTE: Calculation does not include the 52 Garage spaces provided. M4(3)(2)(b) plots have additional private spaces for care provision access.

Parking requirements as per Parking SPD (adopted 2019), South Yorkshire Residential Design Guide and Design of Housing Development SPD (Adopted 2023)

AFFORDABLE HOUSING		
REQUIREMENT = 10%	TARGET = 14	ACTUAL= 14

Policy H7 of the local plan advises developments of 15 or more dwellings will be expected to provide affordable housing. We understand Cudworth to be part of the Rural East area defined in the **Affordable Housing SPD**, which has a requirement of 10% affordable homes as per Table 1: Affordable homes - Tenure Split. This is to be confirmed by the local authority.

KEY
SITE BOUNDARY
AFFORDABLE HOUSING
POS
QUARRY
PROPOSED ATTENUATION LOCATION
Private / Visitor Parking
Residential Street (5.5m wide with 2m Footpath to both sides)
Level Surface Street (5.5m wide with 0.6m verge)
Pedestrian pathways. (not including general footpaths)

Existing Tree information imported from Encon Associates Tree Survey Plan Drawings A5956-01 and A5956-02 (29/04/2025). Please refer to those drawings for more information on existing tree classification and root protection areas.

King Post Retaining Wall
Reinforced Earthworks Retaining Wall
Reinforced Masonry Retaining Wall

Retaining walls as indicated on Bright Young Preliminary Levels Assessment Sheet 1 - 3. Please refer to drawings 26016/SK101, 26016/SK102, 26016/SK103 by Bright Young Consulting Limited for more information on proposed heights and build ups.

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

Refer to the relevant Construction (Design and Management) documentation where applicable.

All works on this drawing will be carried out by a competent contractor, working to an approved method statement.

NOTES:

All soft landscaping is indicative. For more information on proposed landscaping, planting schedules and tree retention please refer Landscape Architects drawings A5956-07 & A5956-08 by Encon Associates

For more detailed information on proposed site levels and topography please refer to civil engineers site plans and sections by Bright Young Consulting.

Existing ground levels based on the topographical survey by Haycock+Todd, job no. S10563.

Any change in external levels greater than 0.6m to have edge protection.

For more information on surface water attenuation and site drainage, please refer to the Civil Engineering drawings by Bright Young Consulting Limited.

For more information on proposed boundary treatments to plots, please refer to drawing **A23104-SASA-Z0-Z0-DR-A-91163**

For clarification of the area allocated for Public Open Space, please refer to drawing **A23104-SASA-Z0-Z0-DR-A-91165**

For clarification of Private Amenity Space provision and separating distances to neighbouring properties, please refer to drawings **A23104-SASA-Z0-Z0-DR-A-91161** and **A23104-SASA-Z0-Z0-DR-A-91162.**

All drawings to be read in conjunction with the Design and Access Statement document **A23104-SASA-XX-XX-RP-A-00201**

rev:	date:	comment(s):	issued by:
J	2026-05-13	Planning Issue	CC
I	2026-05-08	Red Line Update	CC
H	2026-05-06	Planning Issue	CC
G	2026-04-17	Updated to include engineers retaining walls and attenuation proposals.	CC
F	2026-03-26	Coordination Updates	CC
E	2026-02-26	Plots 20-31 updated to add turning head, rear driveways and visitor parking.	CC
D	2026-02-13	House type 3D added, minor updates to verges and parking.	CC
C	2026-02-03	Updates in response to Pre app design feedback	CC
B	2025-08-19	Minor Annotation updates	CC

Status: S0 RIBA Stage: 2

Southgate & Sarabia ARCHITECTS
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Client:

Fenwood ESTATES

Job: Cudworth Parkway Housing

Title: Proposed Site Plan

Date: 2025-07-31 Scale @ A0: 1 : 500

Drawn: EF Checked By: CC Authorised By: NSJ

0m 10m 20m 30m 40m 50m

VISUAL SCALE 1:500

Job Number	Originator	Volume	Level	Type	Role	Number	Revision
A23104	SASA	Z0	Z0	DR	A	91150	J

APPENDIX C – Topographic Survey

Haycock+Todd
Land Survey Consultants Architectural Surveyors
The Hollies, 43 Church Street, Royston, Barnsley, S71 4QU. T:01226 709630
E:info@land-surveying.co.uk W:land-surveying.co.uk

Site Survey

Cudworth Parkway
Cudworth, Barnsley.

Sheet 1 of 1	Surveyed by RF TI
Datum	Drawn by RF TI
GRID– Related to Ordnance Survey using One Point Localisation on Station T5. Orientation at OS Grid North.	Date of Survey January 2023
	Scale 1/200
LEVEL– Related to Ordnance Survey by connection to the OS Active Network by G.P.S	Survey Job No. S10472

LEGEND

Manhole shown thus	MH	Floor Level	FL 10.907
Inspection Cover	IC	Height floor to ceiling	C 2.22
Lamp post	LP	Height floor to struct soffit	SS 2.87
Gully	G	Height floor to false ceiling	FC 2.22
Lampost	LP	Height floor to sill	S0.67
Telegraph Pole	TP	Height sill to window head	W1.23
Electricity Pole	EP	Height of Door	D1.98
Road Traffic Signs	RS	Height floor to underside	US 3.61
Traffic Lights	TL	Ceiling Slopes Up	csu →
British Telecom	BT	Height floor to Arch	Ar2.99
Cable Television	CATV	Height floor to Arch Spring	Sp2.67
Fire Hydrant	FH	Vent	VP
Safety Valve	SV	Fall Pipe	FP
Stop tap Water	W	Sky Light	SL
Stopcock Gas	Gas	Water Closet	WC
Unknown Stoptap	ST	Sink	S
		Boxed Column	B

439920E

439960E

440000E

440040E

A 628 Cudworth Parkway

A 628 Cudwo

Tarmac

Kerb

Drainage kerb

Bottom of bank

Top of bank

Brambles

Edge of foliage

Area of small trees

Wood post & rail. Ht.1.20

3.50 Hedge. Ht.3.00

Wooden posts

Densely overgrown

Overgrown

Long grass

Grass

Unmade footpath

Mature Hedgerow. Ht.5.00

Ger

Sap

MHCL75.821

MHCL75.953

MHCL75.233

MHCL74.422

T25

T26

T27

T32

END

439080E
439120E
439160E
439200E
A 628 Cudworth Parkway
Cudworth Parkway
Tarmac
Kerb
Drainage kerb
Bottom of bank
Top of bank
Area of small trees
Unmade footpath
Wood post & rail. Ht.1.20
Bushes
Grass
Stumps
Edge of tree canopy
Edge of foliage
Long grass
Densely overgrown
Mature hedgerow Ht.5.00
Concrete post & wood panel. Ht.1.70
75.0
76.0
77.0
78.0

439240E
439280E
439320E
410460N
410440N
410400N
410360N
A 628 Cudworth Parkway
th Parkway
Queen's Drive
en's Drive
Tarmac
Kerb
Grass
Drainage kerb
Wood post & rail Ht.1.20
Unmade footpath
Edge of tree canopy
Area of small trees
Wood closeboard Ht.2.00
Concrete post & wood panel Ht.1.70
Brick wall
MHCL74.099
MHCL74.044
74.0
75.0
12
R29
R30
R19
R16

10320N
10280N
10240N
A 628 Cudworth Parkway
80.0
81.0
82.0
Grass
Tarmac
Drainage kerb
Kerb
Bushes
Long grass
Top of bank
Bottom of bank
Edge of foliage
Area of small trees
Brick paved
Rockery
Brambles