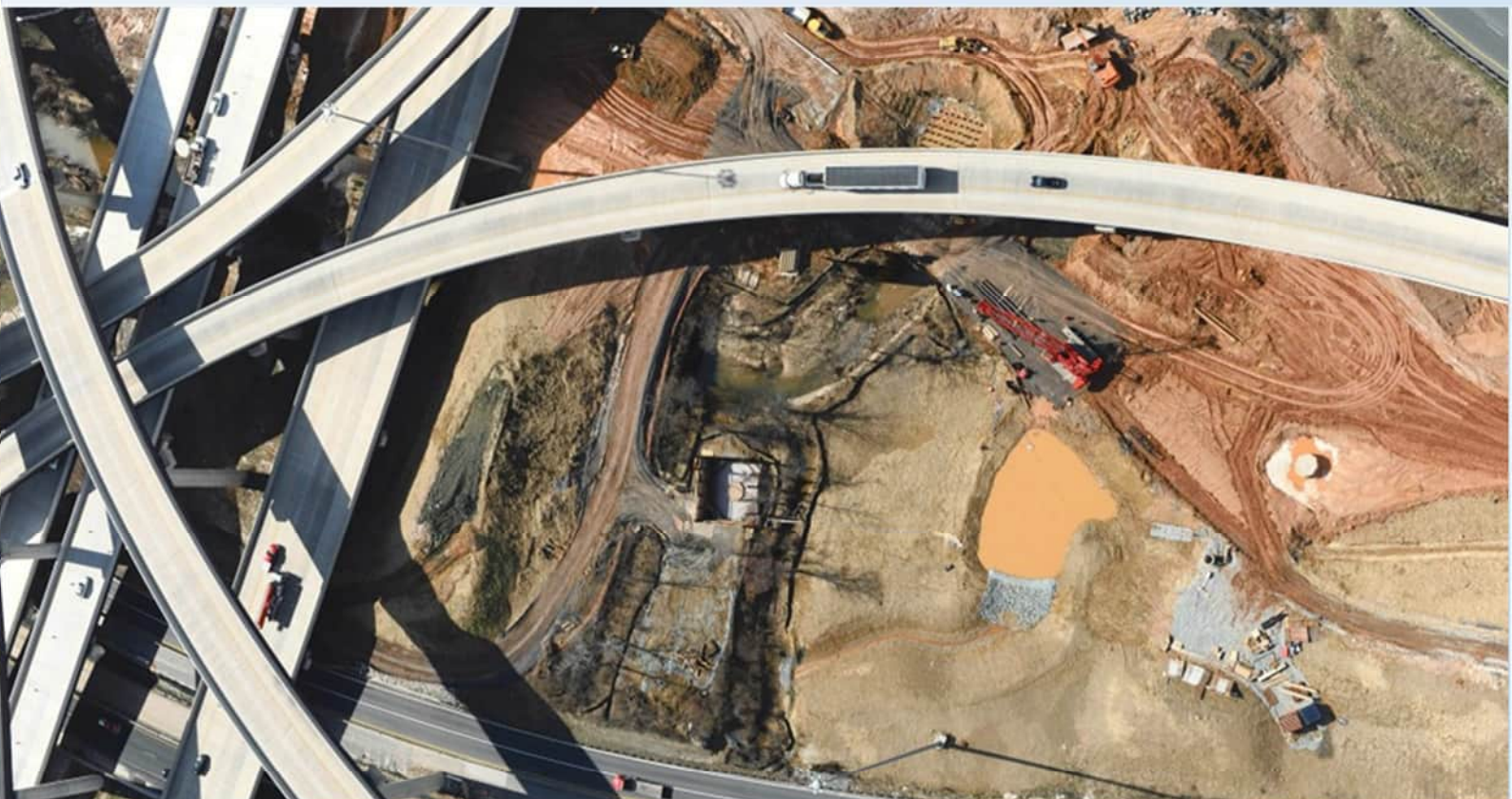




Barnsley Metropolitan Borough Council

A635 BUS RAPID TRANSIT ROUTE

Flood Risk Assessment





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1 INTRODUCTION

1.1 APPOINTMENT AND BRIEF

- 1.1.1. WSP has been instructed by Barnsley Metropolitan Borough Council (BMBC) to prepare a Flood Risk Assessment (FRA) for a highways improvement scheme looking to improve the capacity at Stairfoot roundabout by providing three lanes consistently around the roundabout. The number of lanes on all approaches to the roundabout will either be retained or increased. The existing bus lanes are to be removed as part of the scheme and it is intended that the increase in capacity will reduce congestion and improve bus journey times and reliability.
- 1.1.2. A drainage strategy document (70111595-WSP-HDG-AZ-RP-CD-000001) is available for the Proposed Scheme and can be found in **Appendix A**.
- 1.1.3. The General Arrangement plans showing the Proposed Scheme at design fix 2 can be found in **Appendix A**.
- 1.1.4. This FRA has been completed in accordance with National Planning Policy Framework (NPPF)¹ and the Planning Practice Guidance (PPG)² which sets out the Government's overarching planning policies for England.
- 1.1.5. The NPPF states that a FRA will be required to support a planning application for any development that is;
- In Flood Zone 2 or 3 including minor development and change of use;
 - More than 1 hectare (ha) in Flood Zone 1;
 - Less than 1 ha in Flood Zone 1, including a change of use in development type to a more vulnerable class (for example from commercial to residential), where they could be affected by sources of flooding other than rivers and the sea (for example surface water drains, reservoirs); or
 - In an area within Flood Zone 1 which has critical drainage problems as notified by the Environment Agency (EA).
- 1.1.6. The Proposed Scheme is located in Flood Zone 1 and is more than 1ha in size, therefore a FRA is required in accordance with the NPPF.

1.2 SOURCES OF INFORMATION

- 1.2.1. The following documents have been reviewed to gather information for this FRA. The FRA has also taken into consideration applicable local planning policy contained in the list.
- Local Flood Risk Management Strategy (2017) BMBC;
 - Preliminary Flood Risk Assessment (2011) BMBC;
 - Strategic Flood Risk Assessment (2010) BMBC;

¹ <https://www.gov.uk/government/publications/national-planning-policy-framework--2>

² <https://www.gov.uk/government/collections/planning-practice-guidance>

- Local Plan (2019) BMBC;
- NPPF (2023) Ministry of Housing, Communities & Local Government;
- Flood Risk and Coast Change PPG (2023) Ministry of Housing, Communities & Local Government;
- Flood and Water Management Act (2010);
- EA web-based flood maps for planning (2024)³;
- EA web-based long-term flood risk mapping (2024)⁴;
- British Geological Survey (BGS) Geology of Britain viewer (2024)⁵; and
- Google Earth Pro.

1.3 POLICY CONTENT

1.3.1. The coordination of policies for the water environment is overseen by the UK Government and is split into the following jurisdictions:

- The EA has a strategic overview regarding the management of all of sources of flooding and an operational responsibility for managing the risk of flooding from main rivers, reservoirs, estuaries, and tidal sources.
- Lead Local Flood Authorities (LLFAs) are responsible for managing the risk of flooding from local sources, including surface water, groundwater, and ordinary watercourses. The LLFA relevant to the proposed scheme is BMBC.

1.3.2. The applicable legislative framework is summarised below.

NATIONAL POLICY

National Planning Policy Framework

- 1.3.3. The NPPF sets out the Government's planning policies for England, providing a framework within which local councils can produce their own plans that better reflect the specific needs of their communities. The Flood Risk and Coastal Change PPG has been published alongside the NPPF to set out how certain policies, including those relating to flood risk, should be implemented. The PPG for Flood Risk and Coastal Change is updated regularly to respond to changes in guidance and best practice.
- 1.3.4. Section 14, paragraphs 157-179 of the NPPF 'Meeting the challenge of climate change, flooding and coastal change' is applicable for this assessment.
- 1.3.5. The NPPF and the Flood Risk and Coastal Change PPG identify how new developments must take flood risk into account, including making an allowance for climate change impacts, and steers development to those areas at lowest risk. Under Annex 3 of the NPPF, the Proposed Development is classified as 'Essential Infrastructure' with respect to flood risk vulnerability. As the Site lies in

³ <https://flood-map-for-planning.service.gov.uk/>

⁴ <https://www.gov.uk/check-long-term-flood-risk>

⁵ https://geologyviewer.bgs.ac.uk/?_ga=2.82481557.2091956514.1679313616-1057900287.1679313616

Flood Zone 1, the Proposed Scheme will not require the Exception Test, as shown later in **Table 4-1**.

1.4 LIMITATIONS

- 1.4.1. This report is based on the interpretation and assessment of data provided by third parties at the time of writing. WSP cannot be held responsible for the accuracy of the third-party data and the conclusions and findings of this report may change if the data is amended or updated after the date of consultations.
- 1.4.2. The conclusions of this report are based on the data gathered for the purposes of the report and are therefore limited in their accuracy in proportion to the validity of the dataset. The data gathered has been based on an agreed scope of works. WSP cannot guarantee that the data used is the best available at the time of the report, but it is the best available data that could be gathered based on the agreed scope of works.
- 1.4.3. WSP has prepared this report in accordance with the instructions of our client, BMBC, for their sole and specific use relating solely to the above Scheme. Any person who uses any information contained herein does so at their own risk and shall hold WSP harmless in any event.
- 1.4.4. WSP UK Ltd makes no warranties or guarantees, actual or implied, in relation to this report, or the ultimate commercial, technical, economic, or financial effect on the project to which it relates and bears no responsibility or liability related to its use other than as set out in the contract under which it was supplied.

2 SITE DESCRIPTION

2.1 PROPOSED SCHEME LOCATION

- 2.1.1. The Proposed Scheme is located on the south eastern extent of Barnsley, approximately 2.8km from the town centre at approximate Grid Reference SE 37295 05516 (E: 437295, N: 405516). The nearest post code is S71 5AH. The existing site is currently accessed by the A635, A633, and B6100 and for ease of reference have been labelled in **Figure 2-1**.
- 2.1.2. The Proposed Scheme is located within Stairfoot Roundabout and its aforementioned access points. The site is immediately bounded on all directions predominantly by retail and residential land; these include terraced housing, retail units / retail park Highgrove Care Home and some greenfield agricultural land.
- 2.1.3. The Proposed Scheme covers a linear distance of approximately 1km (north – south) along the A633 and approximately 400m along the A635. A site location plan is shown in **Figure 2-1**.

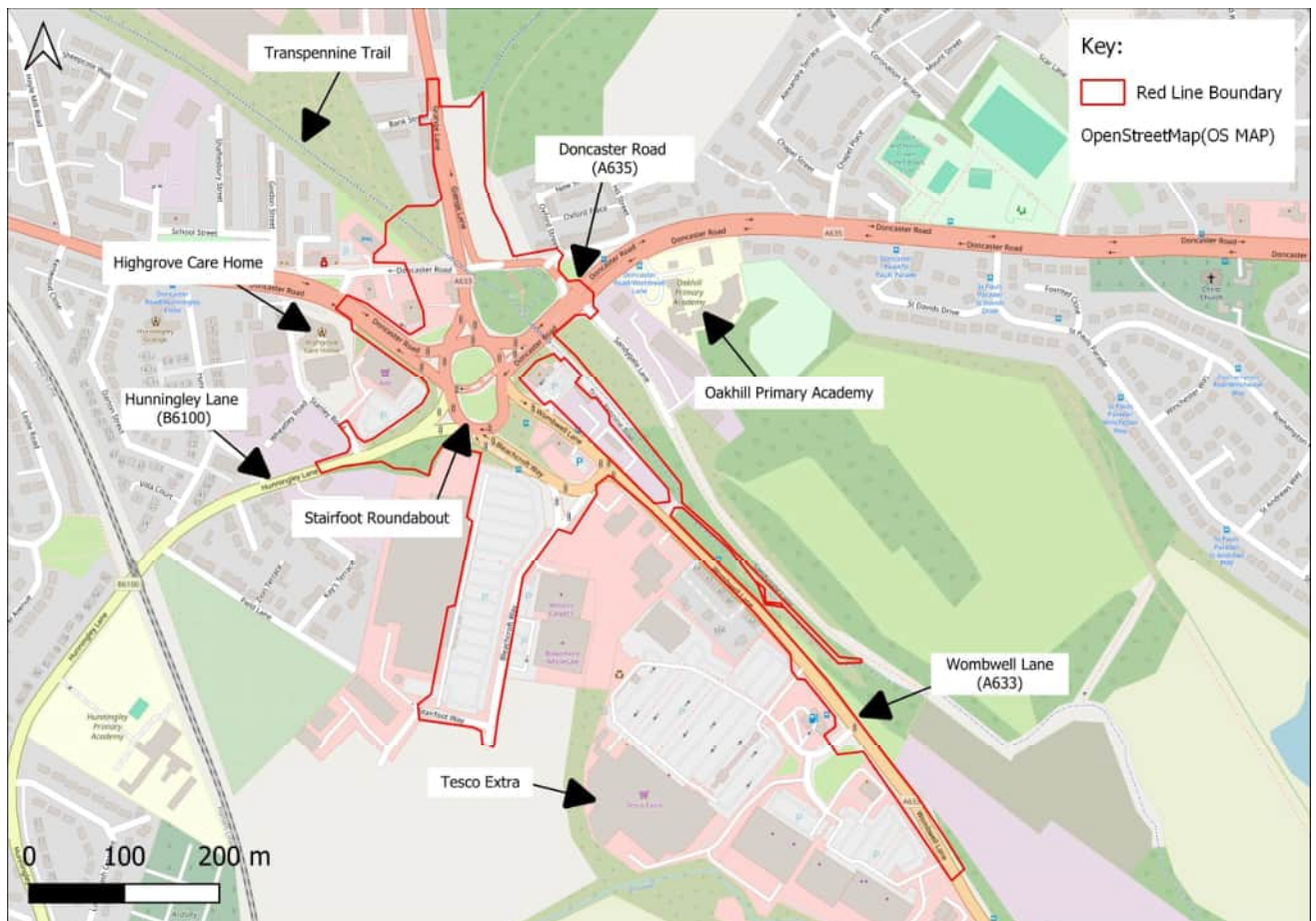


Figure 2-1 - Site Location Plan (Source – Ordnance Survey Mapping, 2024).

- 2.1.4. The existing site is comprised of the following:
- An existing roundabout (Stairfoot Roundabout);
 - The approach (180m) of the A633 (Grange Lane) from the north;

- The approach of the A635 (Doncaster Road) from the east and west;
- The approach (650m) of the A633 (Wombwell Lane) from the south east;
- The approach (140m) of the B6100 (Hunningley Lane) from the south west; and
- Ancillary areas of land comprising existing retail / commercial establishments.

2.2 TOPOGRAPHY

- 2.2.1. To provide an initial assessment of the local ground levels, the Environment Agency's LIDAR data was utilised. The general levels of the Proposed Scheme are summarised below:
- Doncaster Road (A635) falls from 66.5m (200m east of the site boundary) to 49.8m (centre of the existing roundabout) over a distance of approximately 500m.
 - Levels in the centre of the existing roundabout are shown at 49.8m AOD (labelled '1' on **Figure 2-2.**)
 - The A633 road falls towards the northern and southern extents of the site to approximately 45.3 mAOD and 47.7mAOD respectively (labelled '2' and '3' on **Figure 2-2.**)
 - The overall topographical change within the site is 4.5mAOD.
 - Due to the change in topography the site is at risk to overland run-on, particularly to the north.
- 2.2.2. A further review of the Environment Agency's 1m LiDAR DTM (2022) indicates the site lies in a linear 'valley' along the A633 corridor with the surrounding land rising to both the east and the west.
- 2.2.3. The average fall in the area and across the site (SW to NE) is approximately 1:20, though shallower and steeper gradients are evidenced within the area.
- 2.2.4. The Environment Agency LiDAR data is shown below in **Figure 2-2.**

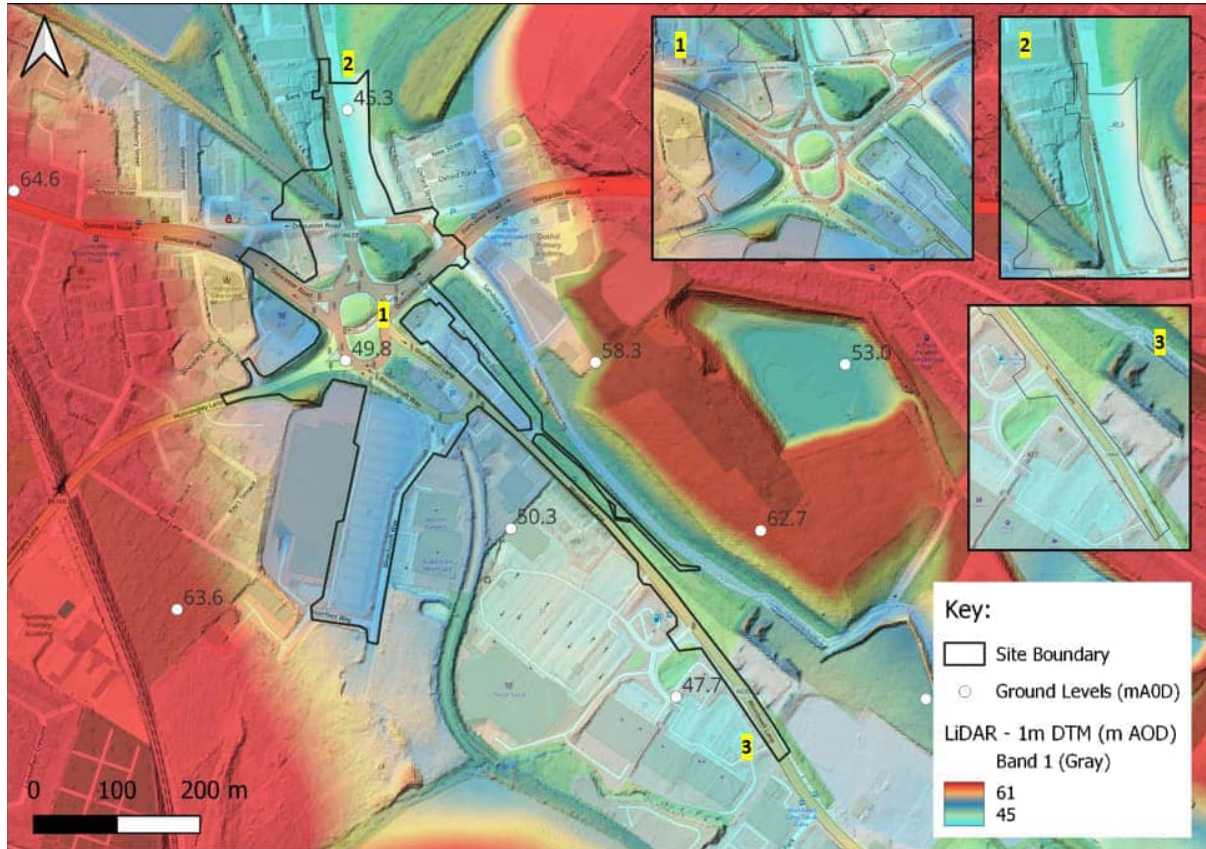


Figure 2-2 – Environment Agency 1m LiDAR DTM Topography

- 2.2.5. A topographical survey was undertaken in March 2021 and is included in **Appendix C**.
- 2.2.6. The topographic survey verified that the proposed scheme lies in a linear valley along the A633 corridor and therefore the land (and road surfaces) rise to both the east and west. This is highlighted from the information below:
- The highest point is the westernmost point of the Proposed Scheme (A635), resting at approximately 58m AOD (labelled 'A' on **Figure 2-3**).
 - The second highest point comes from the easternmost point of the Proposed Scheme (A635) resting at approximately 56.5m AOD.
 - Both the eastern and western extents of the Proposed Scheme fall towards the centre of Stairfoot roundabout, resting at approximately 49.5m AOD.
 - The lowest point is the northernmost point of the Proposed Scheme (A633), resting at approximately 40.5m AOD. (labelled 'B' on **Figure 2-3**).
 - A total of 17.5m AOD variation within the Proposed Scheme.

- 2.2.7. The topographic survey confirmed that the A633 falls away from the roundabout to the northern and southern extents of the site to approximately 45.3 mAOD and 47.7mAOD respectively. Hunningley Lane (B6100) falls towards the roundabout from a high of 55.4m to a low of 49.5m over 120m (1:20 fall).
- 2.2.8. There is a low spot to the east of the roundabout (A635), below the railway bridge (Labelled 'C' on **Figure 2-3**), reaching a low point of 45.76m AOD before raising back up to 47.17m AOD at the entrance/exit to the roundabout. This is likely a contributing factor for this section of the A635 being the most at-risk area of flooding on the Proposed Scheme.

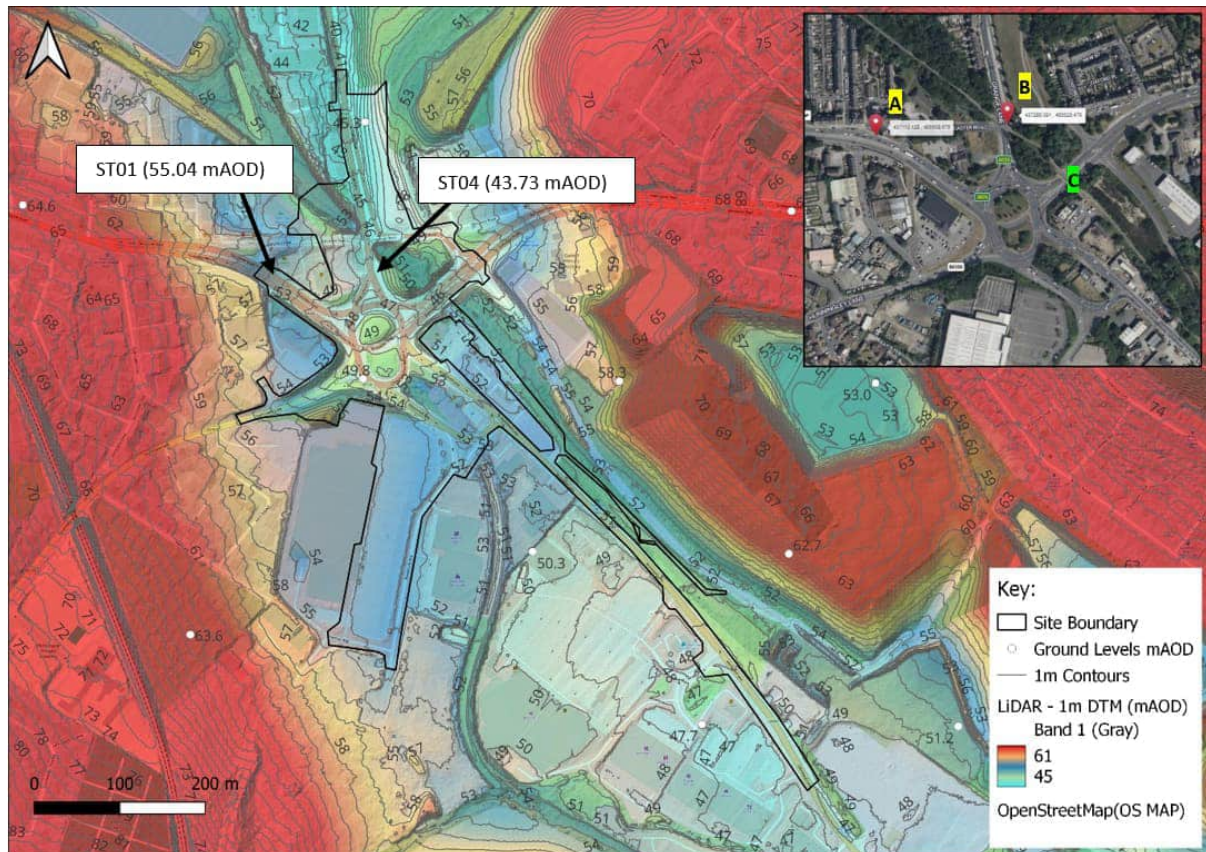


Figure 2-3 – A Topographic Map highlighting the Key Findings from the Topographic Survey

2.3 HYDROLOGY

- 2.3.1. There are three ponds located within the wider vicinity of the Proposed Scheme. The first is approximately 380m northeast of the Proposed Scheme (labelled '1' in **Figure 2-4**).
- 2.3.2. The second is approximately 360m east/southeast of the Proposed Scheme (labelled '2' in **Figure 2-4**).
- 2.3.3. The third 280m east / southeast of the Proposed Scheme (labelled '3' in **Figure 2-4**).

- 2.3.4. Historical aerial imagery suggests water levels in ponds 2 and 3 fluctuate significantly. Ponds 2 and 3 are located within former / now disused clay pits.
- 2.3.5. At the time of writing there was no information available to suggest any existing culverted watercourses on site or within its vicinity.
- 2.3.6. The former alignment of the Dearne and Dove canal runs through the area. The now disused canal is truncated in sections.
- 2.3.7. The River Dearne is the nearest 'Main River' to the Proposed Scheme and flows in an easterly direction from Barnsley. It is located 460m north from the Site at its nearest point. The River Dearne is under the jurisdiction of the Environment Agency.
- 2.3.8. Dob Sike is an ordinary named watercourse situated approximately 150m southwest of the site.
- 2.3.9. The location and proximity of the site to the water bodies can be seen in **Figure 2-4**.

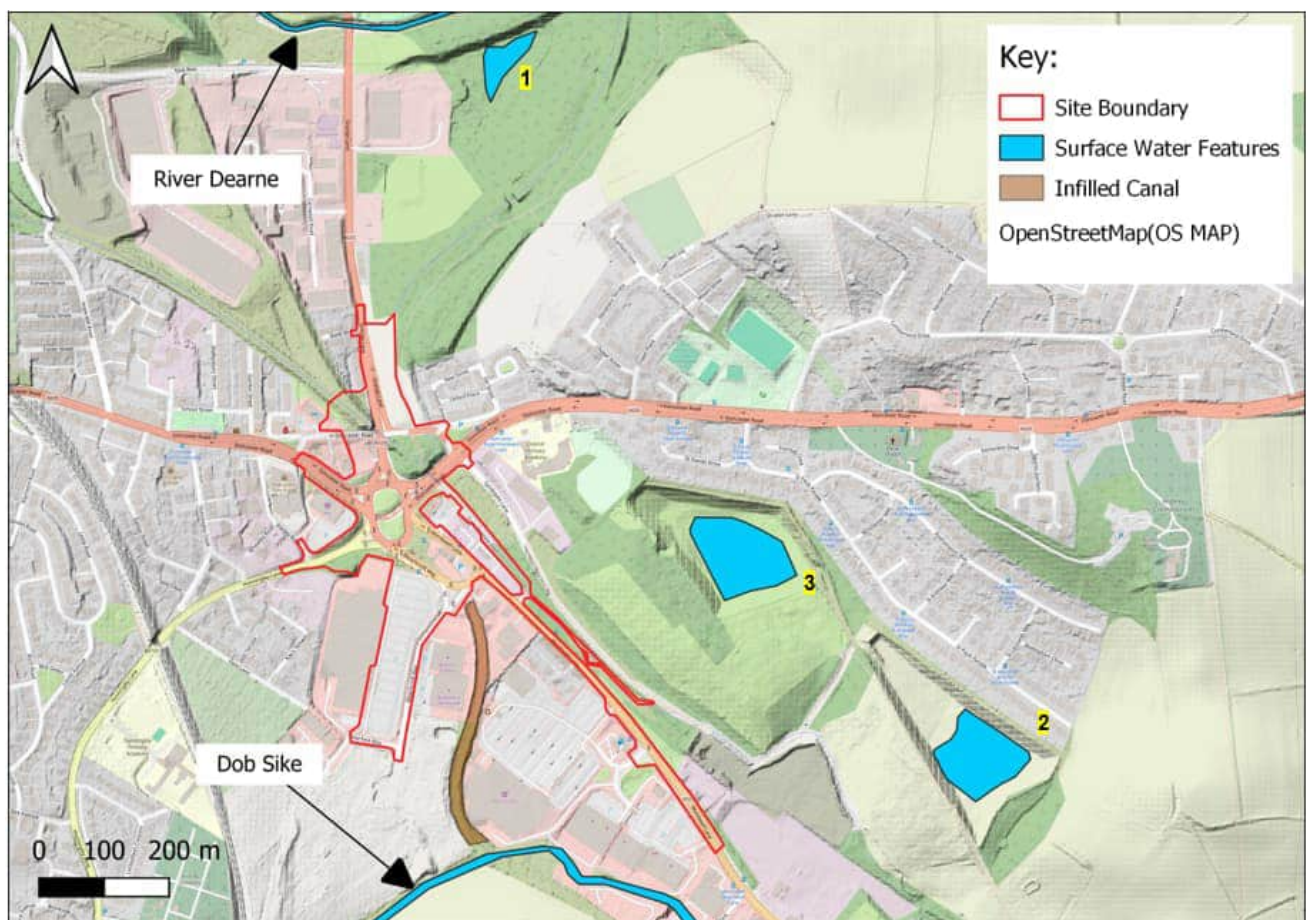


Figure 2-4 – Location of Existing Waterbodies (OS Mapping 2024)

2.4 GEOLOGY AND HYDROGEOLOGY

2.4.1. A review of the available geological and hydrogeological data from the British Geological Survey (BGS, 2024) is summarised in **Table 2-1** below.

Table 2-1 – Geological Summary

Geology	Geological Description	Source
Bedrock Geology	Pennine Middle Coal Measures Formation – Mudstone, Siltstone and Sandstone.	BGS (2024)
Superficial Geology	No Superficial Deposits / minor area of alluvium adjacent to the A633 (vicinity of retail park)	BGS (2024)
Borehole Records	A borehole record is present on site (SE3ONE63A) however its length as well as its results are unknown. A further 7 boreholes are present immediately to the east of the site with the deepest (SE3ONE63) being 411m. A review of this borehole record further indicates that the area generally comprises Mudstone, Siltstone and Sandstone.	BGS (2024)
Soil Type	Slowly permeable seasonally wet acid loamy and clayey soils.	Cranfield University Soilscales (2024)

- 2.4.2. Table 2-1 indicates that the Proposed Scheme is mainly underlain by loamy and clayey soils with generally poor permeability characteristics.
- 2.4.3. A review of DEFRA's Magic Map (2024) indicates that the site is within an area of high groundwater vulnerability. Furthermore, the site is located above a secondary (undifferentiated) bedrock Aquifer.
- 2.4.4. The Site is not located within a Source Protection Zone (SPZ).
- 2.4.5. There is no groundwater level monitoring information available for this site at the time of writing.

2.5 EXISTING DRAINAGE INFRASTRUCTURE

- 2.5.1. The current highways drainage system connects into the Yorkshire Water sewer system.
- 2.5.2. Yorkshire Water sewer records have therefore been sourced as part of the information requests for the overall scheme. The existing sewer records are summarised in Section 5.6 and included in **Appendix D**.

3 CLIMATE CHANGE

3.1 INTRODUCTION

- 3.1.1. As explained in the Climate Change Adaptation Sub-Committee Progress Report 2014, increased flood risk is the greatest threat to the UK resulting from climate change. Models of the climate system suggest floods of the type experienced in England and Wales, in Autumn 2000 and between December 2013 and February 2014, have become more likely as a consequence of increased concentrations of greenhouse gases in the atmosphere.
- 3.1.2. More frequent short-duration, high intensity rainfall and more frequent periods of long-duration rainfall could be expected. Sea levels are also expected to continue to rise.
- 3.1.3. To increase resilience to flooding and coastal change, allowances for climate change should be included within flood risk assessments and factored into development design, such as drainage systems.

3.2 DEVELOPMENT LIFESPAN

The Proposed Scheme is expected to have a lifespan of 75 years⁶ in line with the PPG.

3.3 REVIEW OF CLIMATE CHANGE GUIDANCE

- 3.3.1. At the time of writing, the EA's 'Flood risk assessments: climate change allowances' guidance, issued in February 2016 and updated in May 2022, provides up to date and catchment-specific information on expected changes in rainfall, river flows and sea level rise as a consequence of climate change.

According to the EA, the contingency allowances for climate change that are potentially applicable at this time to the Proposed Development are given below. Screenshots from the Climate Change mapping are found in **Figure 3-1** and **Figure 3-2** below.

Table 3-1 - Don and Rother Management Catchment Peak Rainfall Allowance for 1% Annual Exceedance (Environment Agency, 2023)

Don and Rother Management Catchment peak rainfall allowances	Total potential change anticipated for the '2050s'	Total potential change anticipated for the '2070s'
Central	20%	25%
Upper End	40%	40%

⁶ Planning Practice Guidance (PPG), Paragraph 6, 25th August 2022 - <https://www.gov.uk/guidance/flood-risk-and-coastal-change>

Table 3-2 – Don and Rother Management Catchment Peak River Flow Allowance for the 2050's and 2080's (Environment Agency, 2023).

Don and Rother Management Catchment Peak rainfall allowances	Total potential change anticipated for the '2050s'	Total potential change anticipated for the '2080s'
Central	15%	28%
Higher	21%	38%

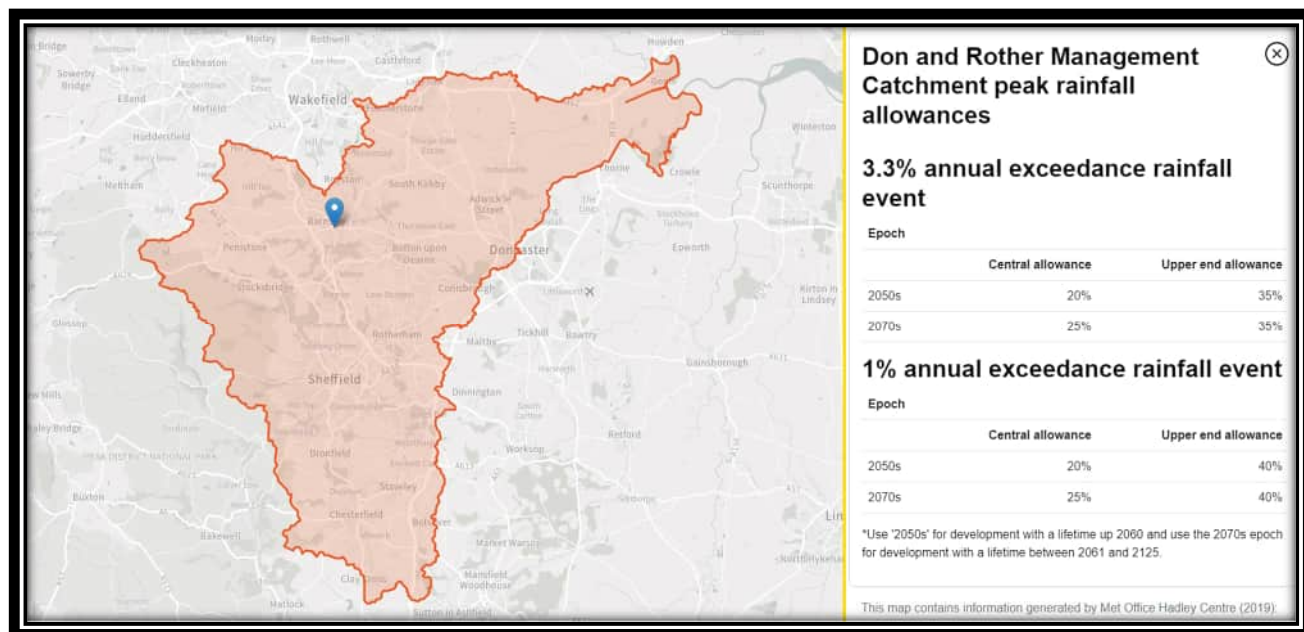


Figure 3-1 – An EA map displaying the catchment and its peak rainfall allowances for future epochs.

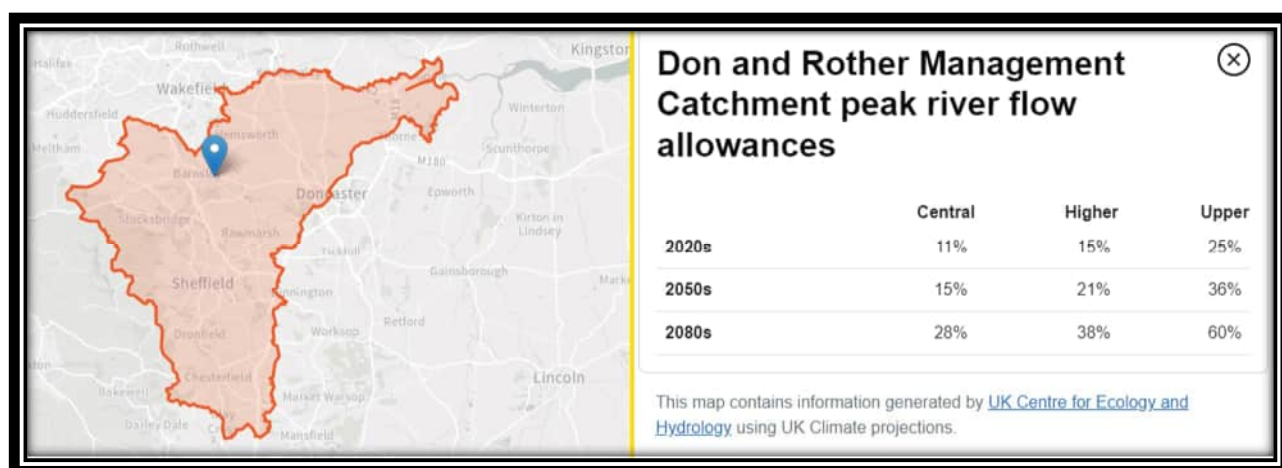


Figure 3-2 – An EA map displaying the catchment and its peak river flow allowances for future epochs.

3.4 IMPACT OF CLIMATE CHANGE ON THE DEVELOPMENT

- 3.4.1. Surface water flood risk is generally expected to increase in the future as a consequence of climate change and the expected increase in extreme rainfall events. Consequently, a surface water drainage strategy, which takes into account the latest climate change guidance and the requirements set out by BMBC in its role as LLFA, will be required to manage the increase in runoff generated by the Proposed Scheme. The Drainage Strategy document capturing the climate change allowance being applied to the Proposed Scheme can be found in **Appendix A**.
- 3.4.2. Overall, as shown by the location in Flood Zone 1, the Proposed Scheme is unlikely to be impacted by increased fluvial levels due to climate change.
- 3.4.3. The Flood Risk and Coastal Change PPG sets out the requirement to consider Sustainable Drainage Systems (SuDS) within all new development where appropriate. Paragraph 56 states that developments should aim to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable:
- Discharge into ground (via infiltration); or, where not reasonably practicable,
 - Discharge to a surface water body (watercourse / body); or, where not reasonably practicable,
 - Discharge to a surface water sewer, highway drain, or another drainage system; or, where not reasonably practicable, and
 - Discharge to a combined sewer.

Flood and Water Management Act 2010

- 3.4.4. The Flood and Water Management Act 2010 (the 'Act') created the role of the LLFA to take responsibility for leading the co-ordination of local flood risk management in their areas. In accordance with the Act the Environment Agency is responsible for the management of risks associated with main rivers, the sea, and reservoirs; and LLFAs are responsible for the management of risks associated with local sources of flooding such as ordinary watercourses, surface water, and groundwater.
- 3.4.5. The Act also guides the role of the LLFA in the review and approval of surface water management systems. This has led to a recent change that requires the LLFA to review and comment on a significant development regarding SuDS.
- 3.4.6. From 2024, SuDS will have to be incorporated into new developments in England following the implementation of Schedule 3 of the Act. Applications for the approval of SuDS on new developments that meet the criteria will have to be made to a SuDS Approving Body (SAB) which will sit within the council. SAB approval will be separate from the Local Planning Authority (LPA) approval. At the time of writing, the implementation date for Schedule 3 of the Act is not confirmed.

4 PROPOSED SCHEME

4.1 PROPOSED SCHEME

4.1.1. The Proposed Scheme permanent works include the following:

- Roundabout re-profile to provide 3 lanes consistently around the roundabout;
- Therefore, the number of lanes entering and exiting the roundabout shall be either retained or increased, including re-profiling to into new roundabout levels; and
- The demolition and construction of Grange Lane Footbridge
- Retaining walls to accommodate the new roundabout profile

4.1.2. The Proposed Scheme covers the total area of approximately 6.5ha and will involve works along approximately 1km long section of highways. The General Arrangement drawings can be found in **Appendix B**.

4.2 VULNERABILITY CLASSIFICATION

4.2.1. The Proposed Scheme is classified as 'Essential Infrastructure' within the NPPF PPG. Essential Infrastructure developments are considered acceptable within Flood Zone 1, and does not require the Exception Test, as shown in **Table 4-1**.

4.2.2. The NPPF and relevant PPG identify how new developments must take flood risk into account, including making an allowance for climate change impacts and steer development to those areas at lowest risk.

Table 4-1 – Flood Risk Vulnerability and Flood Zone incompatibility (PPG Table 2)

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Fluvial Flood Zone	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test Required	✓	✓
	Zone 3a	Exception Test Required	✓	✗	Exception Test Required	✓
	Zone 3b	Exception Test Required	✓	✗	✗	✗

4.3 SEQUENTIAL AND EXCEPTION TEST

4.3.1. The PPG and NPPF state that Planning Authorities should complete a risk based "Sequential Test" which is to "steer new developments to areas with the lowest risk of flooding" (Paragraph 168 of the NPPF, December 2023).

4.4 SEQUENTIAL TEST

- 4.4.1. The purpose of the NPPF Sequential Test is to ensure that land-use planning takes due regard of flood risks, to ensure that areas at low or no risk of flooding are developed in preference to areas at higher risk. As such, the Sequential Test aims to steer new development to areas with the lowest risk of flooding, taking all sources of flood risk and climate change into account.
- 4.4.2. The Site lies entirely within Flood Zone 1; consequently, the Proposed Scheme fulfils the flood risk requirements on the Sequential Test as it is not required for this Essential Infrastructure Development.
- 4.4.3. The Exception Test is only used on selected sites where a Sequential Test has demonstrated it is not possible to locate the Essential Infrastructure development in an area at lower flood risk, as per **Table 4-1**.

5 CONSULTATIONS

- 5.1.1. Environment Agency (EA), and BMBC, as its role as LLFA and Yorkshire Water (YW) were consulted as part of this study to obtain historic flood records along with any flood risk and drainage information pertinent to the proposed redevelopment of the site.
- 5.1.1. A summary of these findings can be found in **Table 5-1**, whereas the full consultation responses are contained within **Appendix E**. Details from their responses have been therefore uses, where relevant, within this report.

Table 5-1 –Summary of Consultation Correspondence

Stakeholder	Response
Environment Agency (EA)	The EA responded to a Product 4 data request with the following pertinent information: ■ The site is located within Flood Zone 1. ■ There are two cases of historic flooding on the EA's record including the 25th June 2007 and the 19th March 1947. Their records are incomplete, it is therefore possible that other flood events occurred. In addition, the EA only has flood risk data relating to flooding from rivers or the sea. ■ An embankment (Asset 25890) is present north of the site on the banks of the River Dearne with a standard of protection of 30 years. Its current condition is unknown. ■ The EA also provided modelled data in the form of outline maps. Point node maps, and water level maps. All these are presented in the Appendix. ■ The Defended Climate Change modelled fluvial extent map is presented in Figure 6-3 below:
Barnsley Metropolitan Borough Council (LLFA)	A request for information was made via the BMBC website and followed up with an email to 'Highwaydrainage@barnsley.co.uk. The Edward Allen at the LLFA responded and have referred us to YW for further information.
Yorkshire Water (YW)	YW have been contacted, however at the time of writing, consultations responses from YW were not available.

6 FLOOD RISK ASSESSMENT

- 6.1.1. The following section examines the level of flood risk to the Proposed Scheme, and risk arising to and from the proposed development. An assessment has been undertaken for each source that could affect the Proposed Development in accordance with the NPPF Flood Risk and Coastal Change Planning Practice Guidance (PPG) and BS 8533:2011.

6.2 HISTORIC FLOODING

- 6.2.1. Environment Agency web-based information has been used and incorporated into a Flood Map Pack (FMP) as a basis for this FRA, which is presented in **Appendix F**. An extract can be seen in **Figure 6-1** below showing there are records of flooding approximately 180m north of the Proposed Scheme's location.

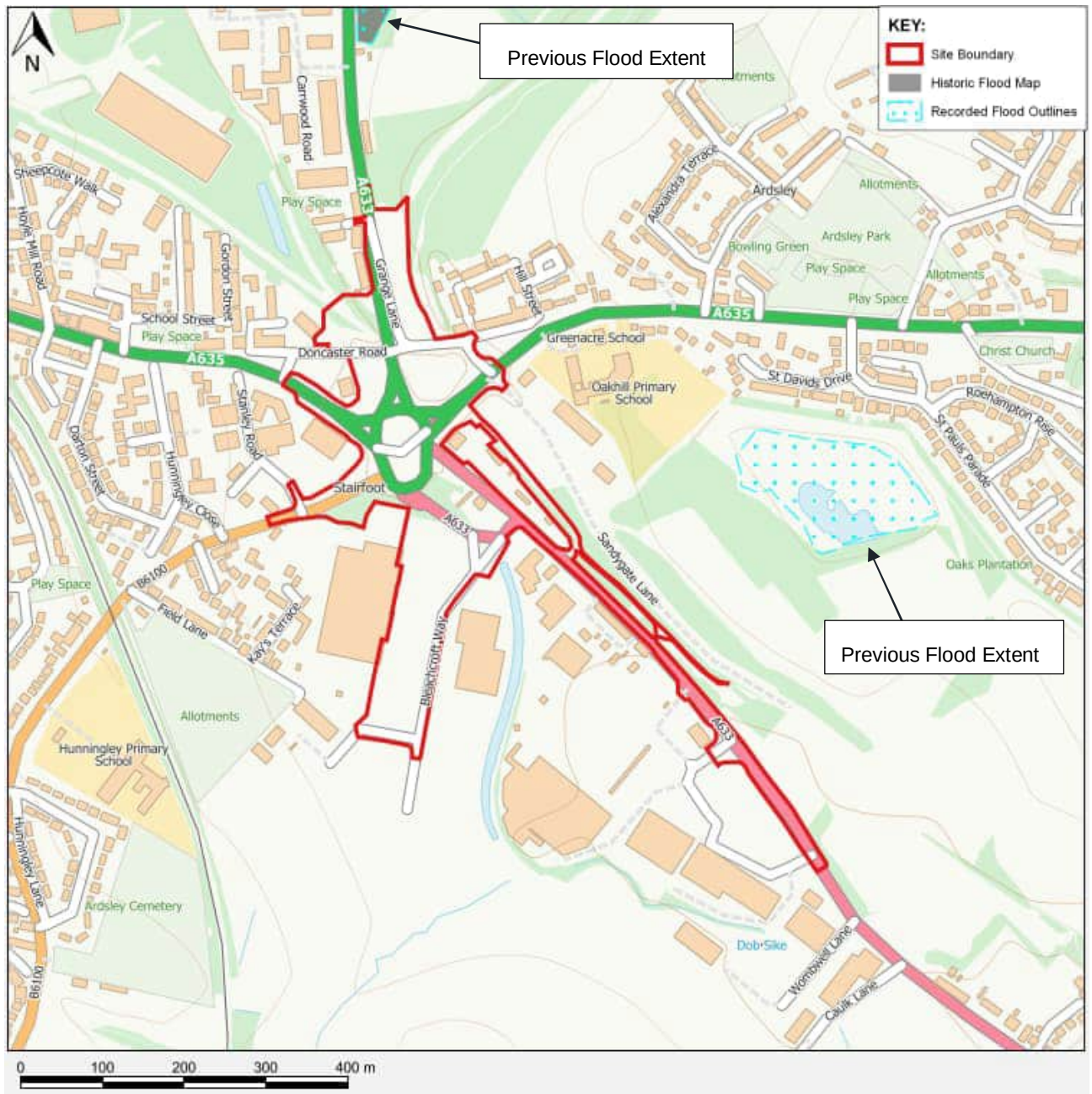


Figure 6-1 – Historical Flooding (WSP Flood Map Pack, contains OS (C) Crown Copyright and database right 2024)

- Spatial Flood Defences are present on the banks of the River Dearne in the form of water storage areas; and
- The Flood Zones 2 and 3 mapping from the EA extend further than the water storage areas which directly correlates with the historical flood extents.
- According to the EA notes, the area north of the Proposed Scheme last significantly flooded in 2007; The source was the River Dearne and got within 375m of the Proposed Scheme's boundary.
- There are no historic flood records impacting the Proposed Scheme.

- 6.2.2. The LLFA as part of their consultation response noted that localise highway flooding on Grange Lane has occurred on a number of occasions, though was a result of operational issues with the highway drainage network. The LLFA also confirmed that flooding had occurred to Grange Lane and surrounding properties in the vicinity of the River Dearne which accords with the EA's response.

6.3 FLOOD RISK FROM TIDAL / COASTAL SOURCES

- 6.3.1. The Proposed Scheme is neither located within the vicinity of the coast, nor is it situated within the vicinity of an estuary or tidally influenced watercourse. The risk of coastal and tidal flooding to the Proposed Scheme is negligible and therefore no mitigation measures are required.

6.4 FLUVIAL FLOODING

- 6.4.1. Fluvial flooding occurs when flows exceed the capacity of the watercourses, such as rivers, causing out of bank flows.
- 6.4.2. The Environment Agency Flood Map for Planning (**Figure 6-2**) indicates that the proposed development and surrounding area is within Flood Zone 1 (very low risk), an area assessed as having less than 1 in 1,000 annual exceedance probability (AEP) of river or sea flooding (<0.1%), and consequentially, the Proposed Scheme is considered to be at very low risk of fluvial flooding.
- 6.4.3. The closest areas of mapped Flood Zone 2 and 3 areas shown to lie approximately 50m to the north of the northernmost point on the Proposed Scheme's boundary.
- 6.4.4. The Environment Agency holds the most up-to-date information on fluvial flood risk for the Barnsley area. Therefore, the Environment Agency web-based information has been used and incorporated into the FMP as a basis for this FRA, which is presented in **Appendix F**.
- 6.4.5. **Figure 6-2** below presents the undefended spatial distribution of the fluvial flood zones present both within the Proposed Scheme and within its immediate vicinity (without climate change). The figure also acknowledges the spatial flood defences and consequently, the reduction in risk of flooding from rivers and sea.
- 6.4.6. **Figure 6-3** below is an EA map which presents the defended modelled fluvial extent scenarios at different Annual Exceedance Probability (AEP) events whilst taking climate change into account.

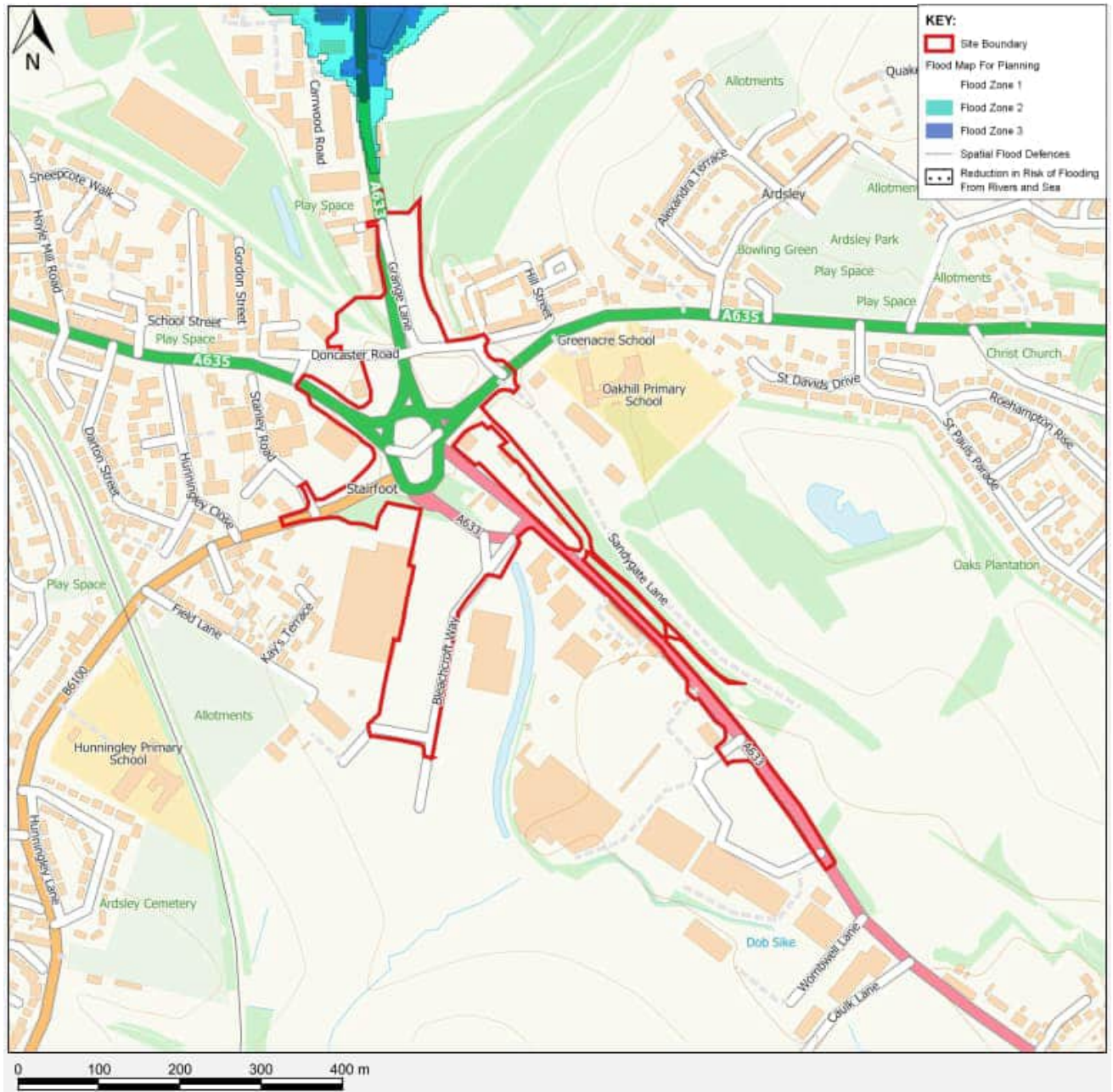


Figure 6-2 – Undefended Fluvial Flooding without climate change (WSP Flood Map Pack, contains OS (C) Crown Copyright and database right 2024)

Climate change

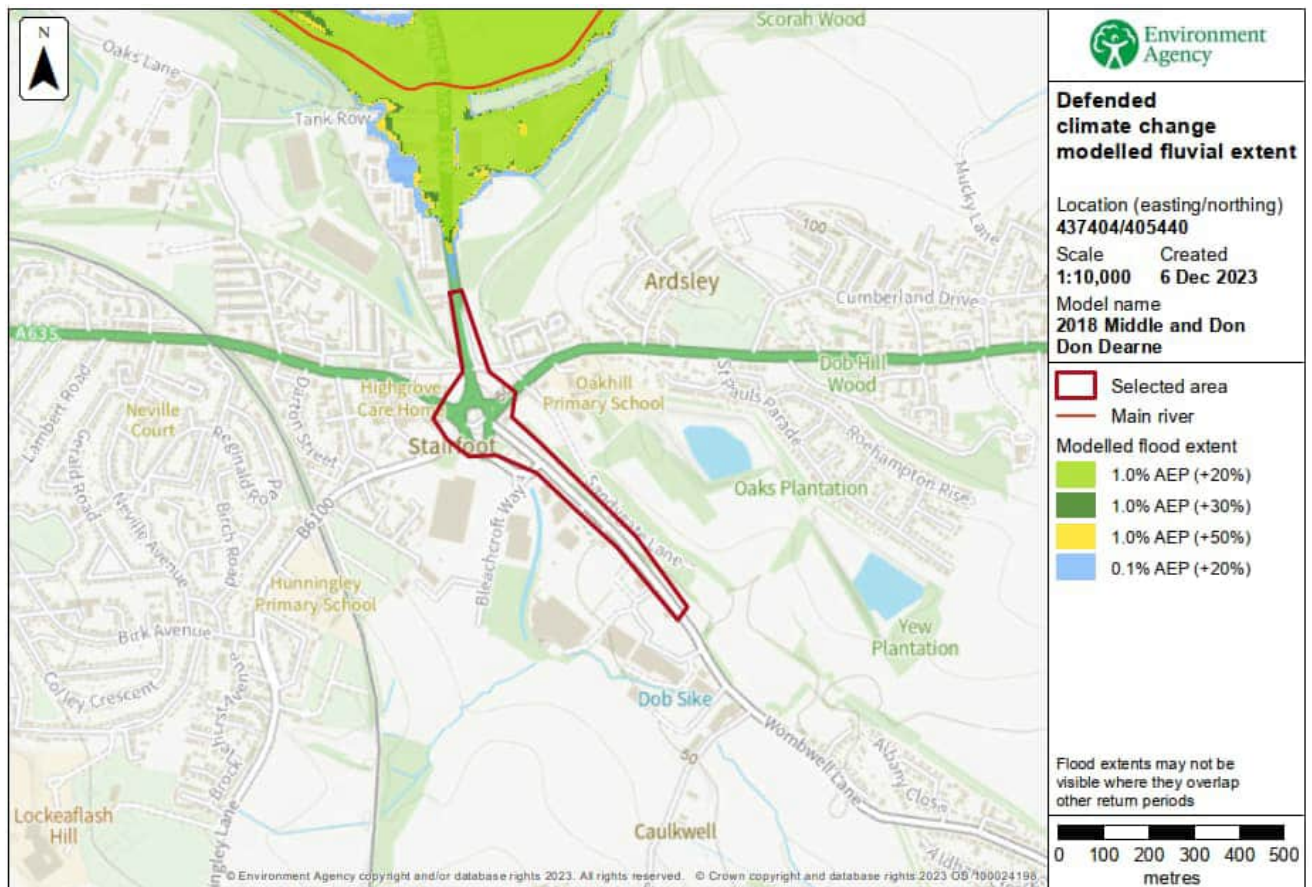


Figure 6-3 – EA map presenting the Defended Climate Change Modelled Fluvial Extent scenario.

- 6.4.7. As part of the EA's Product 4 data response, defended climate change modelled extents have been provided as shown in **Figure 6-3**. The modelled outputs show that the site is not impacted by a 1%AEP (+20%, 30% or 50%) or a 0.1% AEP (+20%) event. As such it is considered that fluvial flow increases attributable to climate change over the lifetime of the development are unlikely to adversely impact upon the Proposed Scheme.

6.5 FLOOD RISK FROM SURFACE WATER

- 6.5.1. Based on the Environment Agency's mapping (**Figure 6-4**), large areas of the site are at risk from surface water flooding. Barnsley Council were not able to provide any further information as the present highway drainage system connects into the Yorkshire Water sewer network. A response from Yorkshire Water is currently pending.

- 6.5.2. The following areas of surface water risk were noted within the scheme boundary:

- Doncaster Road (A635) the approach to Stairfoot Roundabout from the east is shown to lie in a mapped area of high surface water flood risk (Labelled '1' on **Figure 6-4**) The location of this mapped high surface water flood risk corresponds with a 'dip' in the road as it passes beneath the disused railway bridge.

- Grange Lane (A633) is also partially at high risk on the approach to Stairfoot Roundabout from the north, with further areas of medium risk extending north beyond the disused railway bridge (labelled '2' on **Figure 6-4**).
- The northern section of Stairfoot Roundabout itself is at medium to high risk. The location of this mapped high surface water flood risk corresponds with the camber on the roundabout creating an artificial low point on the inner lanes against the central island. This artificial low point in addition to the natural topography could result in the surface water accumulating at this point from the access roads (**Figure 6-5**), thus increasing the risk to surface water flooding.
- Hunningley Lane (B6100) is predominantly shown to be at a medium risk of pluvial flooding extending from the south west (labelled '3' on **Figure 6-4**).
- Wombwell Lane (A633) is predominantly at very low risk of surface water flooding; the very southern extent of the red line boundary of the scheme is an area shown to be at medium surface water flood risk (labelled '4' on **Figure 6-4**).

Due to the nature and location of the works, the surface water flood risk noted above is likely to be attributable to the existing highways infrastructure in the area. The overall risk of the surface water flooding for the Proposed Scheme is considered very low - high and further mitigation should be considered with respect to elevations and surface water drainage where practicable. Due to the nature of the scheme (increase in impermeable area) and the existing setting, attempts to alleviate the existing surface water flood risk should be made where practicable. Further information with respect to the design proposals / drainage strategy are presented in Section 6 of this FRA and the accompanying Drainage Strategy Report located in **Appendix A**.

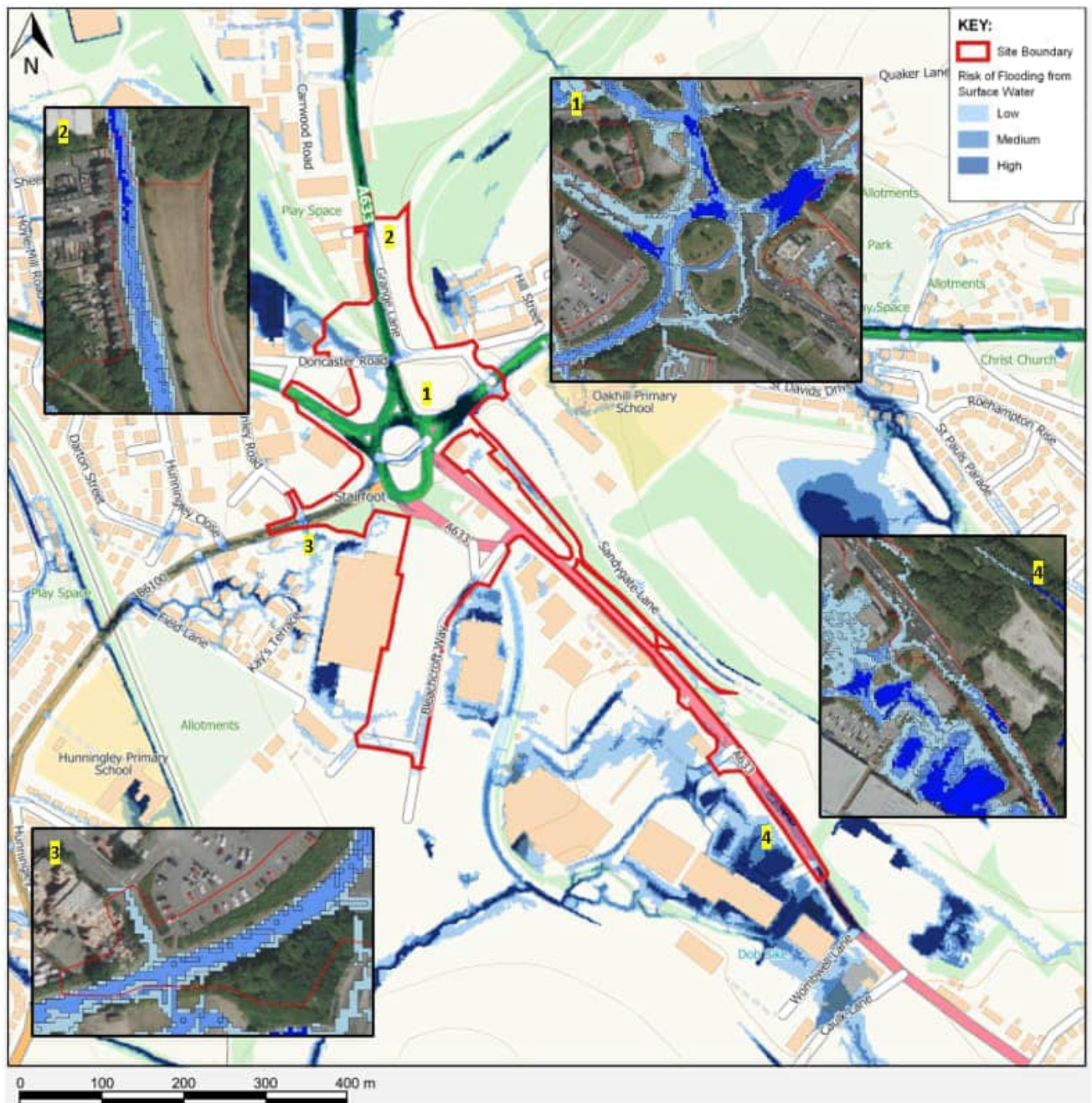


Figure 6-4 – Surface Water Flooding (WSP Flood Map Pack, contains OS (C) Crown Copyright and database right 2024)

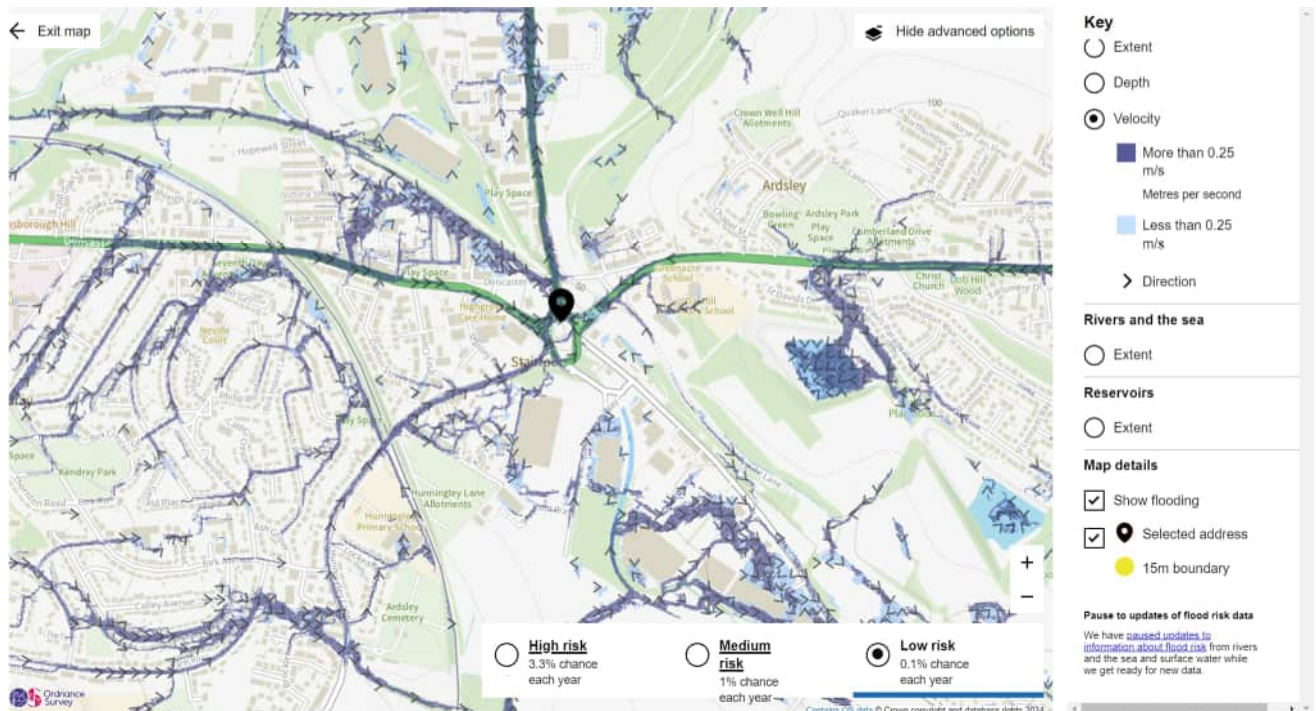


Figure 6-5 - Surface Water Flow Velocity Mapping (low risk) (contains OS (C) Crown Copyright and Database Right 2024)

6.6 FLOODING FROM GROUNDWATER SOURCES

- 6.6.1. Groundwater flooding occurs when water stored below ground reaches the surface. It is commonly associated with porous or fractured underlying geology, such as chalk, sands and gravels.
- 6.6.2. The Proposed Scheme lies above a secondary (A) bedrock Aquifer and does not lie above any superficial deposits and is underlined by 'slowly permeable seasonally wet acid loamy and clayey soils' (Cranfield's university Soilscales).
- 6.6.3. There is limited information to fully assess the risk of groundwater flooding upon the development proposals (subject to confirmation on proposed road levels). The Groundsure Report (appended to the Phase 1 Desk Study⁷) suggests the groundwater flood risk to the site is negligible.

With respect to the above, pockets of perched groundwater at the site cannot be ruled out. At the detailed design stages further ground investigation works could help inform on the local groundwater levels, and therefore inform future detailed design. For this assessment, the risk associated with the groundwater sources is deemed to be at low. Further mitigation may be required (such as dewatering) should groundwater be encountered during any highways excavations at the site.

⁷ Abbeydale (2023) Phase 1 Desk Study – Stairfoot Roundabout, Barnsley, South Yorkshire, Report 151134-DS, July 2023

6.7 FLOODING FROM HIGHWAYS, SEWER AND DRAINAGE INFRASTRUCTURE

- 6.7.1. As noted earlier, BMBC do not have any records of flooding at the site and noted that the majority of surface water drains into the Yorkshire Water network rather than the highways drainage system. A response from Yorkshire Water is currently pending.
- 6.7.2. To provide further context to the risk of flooding from sewer and drainage infrastructure, a drainage survey has been conducted across the Proposed Scheme with the findings summarised below:
- Doncaster Road, A635 (east of Stairfoot roundabout) has approximately 165m of both public surface water sewer pipes and combined sewer pipes flowing in a westerly direction where they join at Grange Lane, A633 and flow north.
 - Wombwell Lane, A633 (southeast of Stairfoot roundabout) has approximately 415m of public surface water sewer pipes and combined sewer pipes, flowing in a northerly/north-westerly direction until joining at Grange Lane, A633 and flow north.
 - Hunningley Lane, B6100 (southwest of Stairfoot roundabout) has approximately 210m of combined sewer pipes, flowing in a north-easterly direction until joining at Grange Lane, A633 and flow north.
 - Doncaster Road, A635 (west of Stairfoot roundabout) has approximately 165m of both public surface water sewer and combined sewer pipes, flowing in an easterly direction until joining at Grange Lane, A633 and flow north.
 - There is a recorded collapsed pipe (MH37-MH36) down Wombwell Lane as well as a 'significant amount of missing information regarding the highway drainage along Wombwell Lane'⁸
- 6.7.3. Given the presence of an extensive drainage system local to the Site, the risk of flooding from highways, sewers and drainage infrastructure is conservatively assessed to be medium – high.
- 6.7.4. For further information, the drainage survey drawings can be found in **Appendix D**.

6.8 FLOOD RISK FROM OTHER SOURCES

Canals

- 6.8.1. There are no operational canals within the vicinity of the Proposed Scheme or the immediate surrounding areas; however, based on the provided data, infilled / truncated sections of the disused Dearne and Dove Canal are located within the vicinity of the site, this can be seen in **Appendix D**. Despite this, due to the truncated nature of any sections in the local area, the risk from these sections is considered negligible.

Reservoirs

- 6.8.2. Reservoir flood maps have been created for over 2,000 reservoirs in England and Wales. These maps show the likelihood of flooding from large reservoirs that retain at least 25,000 cubic metres of water above natural ground level. The maps show the largest area that might be flooded if a reservoir were

⁸ A635 Bus Rapid Transport Scheme (2024) Drainage Strategy – Stairfoot Roundabout, Barnsley, South Yorkshire.

to fail in a credible worst-case scenario. The Environment Agency's Reservoir Flooding Map (**Figure 6-6**) indicates that the site does not lie within either the 'wet' and 'dry' day reservoir flood extents.

- 6.8.3. On the basis of the information available from the EA, the Proposed Scheme is considered to be at a low risk of reservoir flooding.

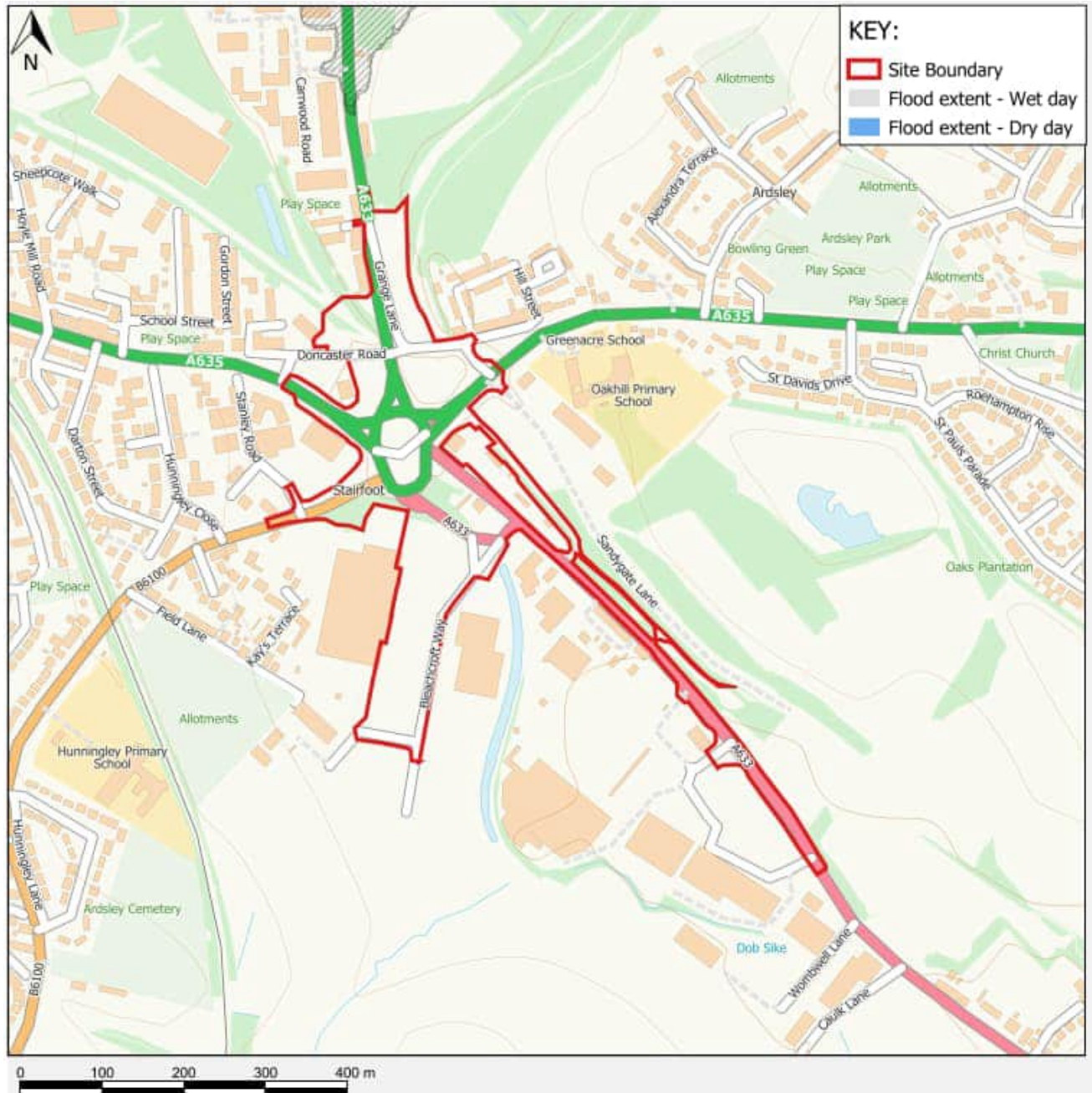


Figure 6-6 – Reservoir Flooding (WSP Flood Map Pack, contains OS (C) Crown Copyright and database right 2024)

Ponds

- 6.8.4. It is assumed all nearby ponds are free draining into the wider local water network and therefore pose limited risk to the Proposed Scheme.

There are three ponds located in the vicinity of the Proposed Scheme and for ease of reference have been labelled in

Figure 2-4

- '1' is located approximately 370m northeast of the Proposed Scheme and rests at approximately 35mAOD.
- '2' is located approximately 775m southwest of the Proposed Scheme and rests at approximately 52m AOD.
- '3' is located approximately 288m west of the Proposed Scheme and rests at approximately 53m AOD.
- As confirmed by the topographical survey, the road levels range from approximately 40.5mAOD to 58mAOD.

6.8.5. A combination of distance, the lack of mapped flow paths (Figure 6-5), and the road levels of the Proposed Scheme in relation to the ponds result in the overall risk of flooding from this source to be assessed as very low.

SUMMARY

6.8.6. **Table 6-1** provides a summary of the identified risk of flooding to the area of the Proposed Scheme from all sources of flooding.

6.8.7. It should be noted that the designations of risk outlined below is provided on a site wide basis and prior to the inclusion of any potential mitigation measures, which may subsequently act to reduce the risk. These have been discussed in Section 6.

Table 6-1 – Flood Risk Summary

Source of flood risk	Assessed risk to the Proposed Scheme
Fluvial flooding	Very Low
Tidal flooding	Negligible
Surface water flooding	Very low – high
Groundwater	Low
Highways, Sewers and Drainage Infrastructure	Medium – High
Canal (Artificial) flooding	Negligible
Reservoir (Artificial) flooding	Low
Ponds	Very low

7 FLOOD MITIGATIONS

7.1 INTRODUCTION

- 7.1.1. As discussed in Section 5 the proposed scheme is considered to be at negligible to low risk and therefore not require mitigation from the following sources:
- Fluvial flooding;
 - Tidal flooding;
 - Flooding from Reservoirs; and
 - Flooding from Canals.
- 7.1.2. Areas of surface water flooding have been identified in Section 6. They include Doncaster Road (particularly to the North East), Grange Lane and Hunningley lane.
- 7.1.3. Based on the existing flood risk described in Section 5, the Proposed Development considered the mitigation measures for the below sources of flooding.

7.2 SURFACE WATER FLOOD RISK

- 7.2.1. A drainage strategy (70111595-WSP-HDG-AZ-RP-CD-000001) shown in **Appendix A** has been produced to support the application but aside from a summary, the scope for the drainage strategy lies outside of this report and should therefore be read in conjunction with this report. Road geometry levels have yet to be provided for the upgrades to the existing highways.
- It is anticipated that the surface water drainage strategy for the highway improvements will seek to accommodate extreme rainfall events where practicable. It should be ensured that the development does not exacerbate surface water flood risk elsewhere.
 - An upgraded highway drainage system is recommended where possible via the new scheme, providing additional drainage measures.
 - Where possible, minimise low spots to prevent surface water ponding on highways whilst also raising road levels where there is a possible SW risk.
- 7.2.2. In accordance with the drainage strategy (70111595-WSP-HDG-AZ-RP-CD-000001) the new highway layout for Stairfoot Roundabout will result in an increase of impermeable area. It is therefore important that the proposed scheme does not increase flood risk in the surrounding area. This will be achieved by ensuring that the proposed discharge flow rates do not exceed existing flow rates, as well as accommodating for future allowance to offset the effect of climate change.

7.3 GROUNDWATER FLOOD RISK

- 7.3.1. A site-specific ground investigation has been recommended within the Phase 1 Desk Study. Any further GI should include an assessment of potential groundwater influences in the area.
- 7.3.2. Where possible, the proposed roads levels should be raised to prevent areas where the road could be impacted by groundwater emergence.

8 CONCLUSIONS

- 8.1.1. WSP has been commissioned by BMBC to prepare a Flood Risk Assessment (FRA) for works proposed at Stairfoot Roundabout to develop a highway scheme consisting of a new bus lane and enlarging the existing roundabout.
- 8.1.2. Consultations have been held with the EA, BMBC and YW, details of which has been included in the report.
- 8.1.3. Flood risk related to the proposed development has been assessed in accordance with the National Planning Policy Framework (NPPF) and the Planning Policy Guidance (PPG). EA and British Geological Survey (BGS) data have also been used to gather information for this study.
- 8.1.4. EA records indicate that the Proposed Scheme has not been impacted by historic flood events.
- 8.1.5. A review of the EA flood risk zones for rivers has shown that the Proposed Scheme lies within Flood Zone 1 and is considered to be at low risk of fluvial flooding. As the Proposed Scheme is classed as 'Essential Infrastructure' under the NPPF, it is appropriate in this location and does not require the Exception Test to be undertaken.
- 8.1.6. The potential increase in flood risk due to climate change has been considered for the lifetime of the Proposed Scheme. The Proposed Scheme is within Flood Zone 1, i.e. outside the fluvial floodplain and therefore it is not expected that climate change would significantly increase the fluvial flood risk to the Scheme in accordance with the provided EA mapping.
- 8.1.7. A summary of flood risk is provided in Section 6 of this document. The site is considered to be at negligible risk of flooding from tidal and coastal flooding, at very low risk of flooding from fluvial flooding and at low risk from artificial sources and groundwater flooding.
- 8.1.8. The Proposed Scheme is located within an area of very low – high surface water flood. A Drainage Strategy has been undertaken to help inform improvements to the drainage in the area whilst also mitigating the increase in flood risk due to the increased impermeable area.
- 8.1.9. Based on the findings of this FRA, the development proposals are considered to be appropriate and in accordance with both National and Local Planning Policy. The proposed development is unlikely to increase flood risk either on site or elsewhere.

Appendix A

DRAINAGE STRATEGY





Barnsley Metropolitan Borough Council

A635 BUS RAPID TRANSPORT SCHEME

Drainage Strategy





Barnsley Metropolitan Borough Council

A635 BUS RAPID TRANSPORT SCHEME

Drainage Strategy

TYPE OF DOCUMENT (VERSION) OFFICIAL

PROJECT NO. 70111595

OUR REF. NO. 70111595-WSP-HDG-AZ-RP-CD-000001

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Signature	<i>C. Kirk</i>	<i>C. Kirk</i>		
Checked by	Luke Basterfield	Luke Basterfield		
Signature	<i>L.Basterfield</i>	<i>L.Basterfield</i>		
Authorised by	Vicky Belton	Vicky Belton		
Signature	<i>V.Belton</i>	<i>V.Belton</i>		
Project number	70111595	70111595		
Report number	70111595-WSP-HDG-AZ-RP-000001	70111595-WSP-HDG-AZ-RP-000001		
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1 SCHEME BACKGROUND

- 1.1.1. The Barnsley-Doncaster Quality Bus Corridor (BRT) starts at the Stairfoot Roundabout junction, extends North up Grange Lane to include the Cundy Cross junction, south-east along Wombwell Lane to Netherwood Roundabout and west along Doncaster Road to the Alhambra Roundabout. A corridor length of approximately 7.2km.
- 1.1.2. The proposed BRT scheme aims to support economic growth through investments at key junctions which focus on reducing current and forecast congestion, improving bus journey time reliability, and widening sustainable travel opportunities. The site location plan can be seen below in Figure 1.



Figure 1 – Scheme Location Plan (OS Grid Ref 437286, 405524)

- 1.1.3. WSP is commissioned by Barnsley Metropolitan Borough Council (BMBC) to undertake the preliminary design of the highway improvement scheme which will incorporate amendment to the drainage network.

2 PURPOSE OF THIS REPORT

- 2.1.1. This report summarises the existing and proposed surface water drainage strategy for the A635 Bus Rapid Transfer Route scheme at the Stairfoot Roundabout in Barnsley. This will set out the principles and methodology for undertaking the drainage design.

3 KEY CONTACTS & STAKEHOLDERS

3.1.1. Table 3.1 details the key scheme contacts and stakeholders for drainage on the scheme.

Table 3-1 – Key Contacts and Stakeholders

Company	Role	Name	Telephone	E-mail
BMBC	Project Manager	Jake Rowlands	07561516162	Jakerowlands@barnsley.gov.uk
BMBC	BMBC Drainage	Wayne Atkins	-	Wayneatkins@barnsley.gov.uk
Yorkshire Water	-	TBC	TBC	TBC

4 EXISTING DRAINAGE REVIEW

- 4.1.1. Plans of existing Yorkshire Water (YW) apparatus were obtained which show surface water, combined and foul drainage networks. BMBC also provided plans of a surface water network.
- 4.1.2. An All Assets Condition and Connectivity Survey was undertaken by Enviroflow in November 2023 on behalf of BMBC to confirm the location and condition of the existing network.
- 4.1.3. Information from the reports received, together with information from YW and BMBC, is shown on the following drawings, see Appendix C:
 - 70111595-WSP-HDG-AZ-DR-CD-000001 to 000009 – Drainage Defects
 - 70111595-WSP-HDG-AZ-DR-CD-000019 to 000027 – Drainage Network
- 4.1.4. Additional surveys will be required to give a complete record of the existing drainage network.
- 4.1.5. The existing carriageway is drained by a system of road gullies and combined drainage kerbs which discharge into surface water and combined networks running within the carriages, highway verges and central reserves.
- 4.1.6. The existing BMBC surface water network generally follows the roundabout approach roads, falling towards the northern end of the central island. This then discharges into a YW surface water sewer which falls northwards along the A633 Grange Lane.
- 4.1.7. The existing YW networks fall from the south and from the east and west along the old Doncaster Road. They meet at the junction of the old Doncaster Road and Grange Lane and continue northwards along Grange Lane.
- 4.1.8. There appears to be a significant amount of missing information regarding the highway drainage along Wombwell Land. This issue is described in more detail in Section 6 of this report.

5 INFORMATION RECEIVED

- 5.1.1. See Table 5.1 below for a list of the information received relating to the drainage for the A635 BRT scheme.

Table 5-1 – Information Received

Document Name	Format
DR-SK-002 - Stairfoot Roundabout - Known Existing Drainage Apparatus	PDF
DR-SK-003- Stairfoot Roundabout - drainage surveys	CAD
ENV10013 - Barnsley - Stairfoot Roundabout - TRACKER	Excel
ENV10013 - DR-SK-003 - Stairfoot Roundabout - Existing Manhole Locations - P2	PDF
Enviroflow - Barnsley - Stairfoot Roundabout Nodes	PDF
Enviroflow - Barnsley - Stairfoot Roundabout Sections	PDF
EX_Survey - Stairfoot	CAD
Original As Built	CAD
SE3505-5 - Trimmed to Survey	CAD
Stairfoot Drainage Layout	CAD

6 ASSUMPTIONS MADE

- 6.1.1. Following a review of the existing information available and the Enviroflow drainage survey, the following assumptions will be made to feed into the existing network model and proposed design.

EXISTING DRAINAGE

- 6.1.2. There appears to be a significant amount of missing information regarding the existing drainage along Wombwell Lane. Neither YW utility plans or EnviroFlow Drainage survey show any relevant drainage apparatus, specifically between the Bleachcroft Way junction and the entrance to Tesco car park. As there are numerous gullies that can be observed located along this section of road which must drain somewhere.
- 6.1.3. This issue was raised with BMBC during a meeting held on the 1st of March and they agreed some drainage network must be present to pick up all the gullies. Subsequently, other colleagues in the Highway Drainage department, BMBC have confirmed that there is highway drainage located in the footway up to the Tesco car park entrance. This is corroborated by that fact that circular covers can be seen in the footway. The drainage survey also shows an additional drainage run heading off to the south east (away from the roundabout) therefore it will be assumed that the entrance to the Tesco car park will be the limit of the Wombwell Lane catchment area that is draining towards the roundabout.
- 6.1.4. Ideally this existing drainage would be surveyed to confirm various details such as location, chamber size/shape, pipe diameter and depth, however arranging for additional drainage survey work, particularly for a busy road such as this, is probably not quick/easy operation. It is therefore suggested that a dummy run is added to the existing drainage model so that this catchment can be incorporated into the model. This dummy run will include numerous assumptions (such as location and standard 1.2m depth) until such time where the actual detail can be confirmed via drainage survey. It is also assumed that Tesco car park does not drain into this highway drainage run, along with the car park / hardstanding areas of other premises adjacent to Wombwell Lane, i.e McDonalds, MD Car Sales etc.
- 6.1.5. Another area with a significant amount of missing drainage information is the north-eastern approach (Doncaster Road) to the roundabout. There is limited drainage information north-east of the Sandy Gate Lane junction however this road appears to fall towards the roundabout for a significant distance (potentially all the way up to Chapel Street Junction). There are Yorkshire Water sewers that run perpendicular to the road, just east of Sandy Gate Lane junction. It is assumed that these sewers collect the highway drainage here and so the existing drainage model will only include the carriageway up to this location. This assumption will need to be confirmed through additional drainage survey works as it represents a large area, which will have a significant impact on the overall flow rates generated by the existing network model.
- 6.1.6. It is assumed that B&Q car park does not connect into the highway drainage network.
- 6.1.7. There are some gullies within the existing footprint of the roundabout that appear to connect into YW sewers rather than the highway drainage network. When the existing drainage model is produced, these gullies will be assumed to connect into the highway drainage network so that these areas are accommodated when calculating the existing flow rates.

GENERAL ASSUMPTIONS

- 6.1.8. There appears to be a significant number of utility apparatus within the footprint of the existing roundabout, such as large gas mains, etc. It is assumed that these utilities will be diverted in order to provide sufficient clear area to provide the large volume of attenuation storage that will likely be required so that proposed flow rates can be throttled down to the agreed maximum discharge rates.

GENERAL METHODOLOGY AND HYDRAULIC DESIGN

6.1.9. The following design parameters will be used on the scheme:

- Coefficient of runoff 'C': Unmade embankments, cuttings and verges = 20%, Fields = 15%, Highways, footways, roof and other Impermeable Areas = 100%
- Minimum self-cleansing velocity = 0.75m/s
- Minimum pipe diameter = 150mm
- Causeway FLOW software acceptable for the modelling.
- M5-60 Value = 20mm
- 'r' ratio = 0.3
- SAAR value = 633
- Summer CV = 0.75, Winter CV = 0.840
- Maximum spacing between manhole chambers = 100m
- MCHW Type 7 catchpits chambers can be used for surface water drains up to 450mm dia. BMBC to advise on the limitations of their use.

ATTENUATION STORAGE DESIGN

6.1.10. The following design parameters will be used for the drainage attenuation:

- Attenuation basin / pond side slopes = 1V:3H
- Minimum freeboard depth for attenuation basin / pond = 300mm
- BMBC to confirm maintenance access requirements around attenuation basin / pond.
- BMBC to confirm maximum allowable water depth for attenuation basin / pond.
- Preferred flow control = Hydro-Brake devices.
- Minimum size of orifice = 75mm
- Underground storage tanks to be used if attenuation basin / pond not feasible. Storage tanks to be deep enough to allow for manned entry.

GULLY DESIGN

6.1.11. The following design parameters will be used for the gullies:

- Return Period (yrs) = 5
- Flow width = 0.75m
- minM5 (mm) = 3
- T (mins) = 5
- Gully type = R (D400)
- Maintenance factor = 0.9
- Mannings n = 0.017 (asphalt channels)
- Desirable maximum length of one gully connection = 20m.
- Max area draining to each gully, as per CD526
- Max gully spacing, none, as per CD526
- CKD's acceptable where gully spacings less than 6m centres.

7 PROPOSED ROAD IMPROVEMENT SCHEME

The A635 BRT scheme work will enlarge Stairfoot Roundabout within council owned land and 3rd party land that will be acquired as part of the scheme. This will increase the capacity of the roundabout to reduce congestion, a key client requirement. The scheme will look to provide new traffic signals, lighting and drainage. All crossings and footpaths on the scheme will be increased to 3.5m to accommodate for cyclists and improve links to the Trans Pennine Trail. Key elements of the scheme that will have implications on the drainage are detailed below:

- Increase the existing lane provision on Grange Lane for inbound and outbound traffic at the roundabout.
- Carriageway widening to the northern kerb extents on Wombwell Lane.
- Introduction of soft landscaping throughout the scheme to improve the appearance and to achieve a suggested 20% Biodiversity Net gain.

The Design Fix 0 layout, presented in Appendix B, shows the proposed highways alignment.

8 CLIENT SCHEME REQUIREMENTS

During the initial stages of the scheme, various questions were raised by WSP regarding their client scheme requirements pertaining to drainage. Refer to Appendix C for details the email conversation. A meeting was subsequently held to provide further clarification. Within this email a number of requirements were discussed and agreed. These are summarised below:

- The scheme shall be design to the Design Manual for Roads and Bridges (DMRB). However, the 'no flooding' criteria from the highways drainage system shall be 1 in 10 years as opposed to 1 in 5 years.
- Following discussions with the Lead Local Flood Authority (LLFA) it is suggested that the climate change uplift will be 30%, i.e. 100 year Storm +30%. This has been confirmed with the LLFA.
- Initial discussions with the LLFA suggest that the 30% uplift shall be applied to the whole site. This has been confirmed with the LLFA.
- Attenuation storage preferably to be oversized pipes, box culverts or ponds dependent upon storage volume requirements and land availability. Stormcell or similar is not acceptable.
- Gullies are preferred over combined kerb units but will depend on gully spacing requirements.

9 PROPOSED STRATEGY

GENERAL

- 9.1.1. A new surface water drainage network will be provided to drain the new highway layout for Stairfoot Roundabout. This new drainage network will be designed in accordance with CG 501 as well as the additional design parameters stated in Section 6 and 8 of this report. This will replace the existing surface water drainage network which will be abandoned via standard practices (i.e grouting up pipes, concreting gully pots and backfilling chambers up to formation level).
- 9.1.2. The proposed network will outfall via the same method as the existing surface water network, which is by discharging into the YW combined sewer network via a connection to existing manhole reference HEL1012.
- 9.1.3. The new highway layout for Stairfoot Roundabout will result in an increase of impermeable area. It is therefore important that the proposed scheme does not increase flood risk in the surrounding area. This will be achieved by ensuring that the proposed discharge flow rates do not exceed existing flow rates, as well as accommodating for future allowance to offset the effect of climate change.
- 9.1.4. To facilitate this approach, a drainage model will be produced of the existing surface water network upstream of manhole HEL1012. This model will be simulated via specialist drainage software (Causeway FLOW) to determine existing flow rates. The existing drainage model (including associated contributing areas), simulation results and final discharge rates will all be provided to BMBC for approval. Once agreed, these maximum discharge rates will form the foundation for the proposed attenuation solutions that will be developed during the design process.
- 9.1.5. The Designers will seek advice from BMBC on maintenance requirements for drainage infrastructure while developing the initial general arrangement layout, particularly in terms of proposed drainage apparatus located in and around the new roundabout.

UTILITY INTERFACE

- 9.1.6. The existing highway drainage network upstream of HEL1012 will be replaced by the new drainage network. During the design, an opportunity will be investigated to determine if it is possible to connect the new drainage network into existing drain MH17X, just prior to manhole HEL1012. This may avoid having to do any work on manhole HEL1012, which is owned by YW. If this is not possible (likely due to the issues with levels) then a new connection into manhole HEL1012 will be required, along with all the associated constraints and permits that come with such a connection.
- 9.1.7. There are also additional YW sewers within the current footprint of the roundabout. This existing apparatus will remain insitu, albeit some work will be required to raise/lower manhole covers to match the new proposed ground level. Some covers may also need to be replaced by stronger graded covers if they going to be located in areas with higher traffic loading.
- 9.1.8. Any new drainage works along Doncaster Road and Grange Lane will connect into the existing BMBC highway drains. Where BMBC highway drains are not present, existing gully connections will be utilised to avoid the need to provide new junctions/connection into existing YW sewer network.

SURFACE WATER COLLECTION SYSTEM

- 9.1.9. The preferred method of surface water collection will be via kerbs and gullies. These will be designed in accordance with CD 526 and the additional associated design parameters stated in Section 6 of this report. All proposed gullies will have cycle safe gratings.
- 9.1.10. Combined Kerb Drainage (CKD) units will only be used in locations where the proposed gully spacing has been calculated as less than 6m.

FLOW CONTROL MEASURES

- 9.1.11. The outfall of the proposed drainage network will need to be throttled to ensure that the discharge flow rates do not exceed the maximum allowed flow rates. It is assumed that this be via vortex control device such as a HydroBrake or similar. Attenuation storage will need to be provided to accommodate the large volume of surcharging water that will be generated during this throttling process.
- 9.1.12. The general format of this attenuation storage is still to be decided at this stage, but the initial preference is to use attenuation basin / ponds. These will be located in the centre of the proposed roundabout, but their inclusion will be wholly dependent on there being sufficient area to provide such a feature. Attenuation basins/ponds generally take up a larger footprint than alternative storage structures due to their associated earthworks (side slopes bunding).
- 9.1.13. If there is insufficient area to provide an attenuation basin/pond then the alternative option is to provide underground storage tanks. BMBC have stated that they would need these storage tanks to be deep enough to facilitate manned entry.
- 9.1.14. Locating the attenuation storage in the centre of the roundabout will mean that the final stretch of the proposed network (between the northern end of the roundabout and manhole HEL1012 at the Doncaster Rd / Grange Ln junction) will not be able to be throttled prior to discharge. It is therefore proposed that flow control device in the roundabout will 'over-throttle' the flow to counteract this issue.

HYDRAULIC PERFORMANCE

- 9.1.15. The proposed drainage network will be designed not to surcharge (unless required for attenuation purposes) for up to a 1 in 1 year storm return period and to flood for up to a 1 in 10 year storm return period.
- 9.1.16. The attenuation storage will be designed not to flood (encroach into the designated freeboard) for up to a 1 in 100 year storm return period including 30% additional allowance for climate change.

WATER QUALITY

- 9.1.17. All new gullies will include sumps to encourage sediment collection. It is also proposed to use catchpit chambers where applicable (for pipes up to 450mm dia). These catchpits will have a minimum 300mm sump to collect sediment.
- 9.1.18. If attenuation basin/ponds can be provided, then these will also provide vegetative treatment.

- 9.1.19. Any additional measures to improve water quality in the area are not proposed at this time however will be reviewed if required.

DEPARTURES FROM STANDARDS

To be confirmed.