

# **FLOODING & DRAINAGE ASSESSMENT FOR A PROPOSED RESIDENTIAL DEVELOPMENT SITE ADJACENT BUTT LANE, SNAITH**

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## **1.0 INTRODUCTION**

- 1.01 Following instructions from Midland Construction Services Ltd during August 2018, CoDA Structures have undertaken an initial assessment of flooding and drainage issues in relation to a potential residential development site adjacent Butt Lane, Snaith.
- 1.02 The site is undeveloped.
- 1.03 This report has been prepared to accompany a planning application on the site. The report examines any potential flooding and drainage issues in relation to the proposed development and outlines solutions where necessary, to deal with the identified issues.
- 1.04 The Local Authority and the Local Lead Flood Authority is East Riding of Yorkshire Council (ERYC).

## **2.0 POLICY CONSIDERATIONS AND OBJECTIVES**

### **2.01 National Planning Policy Framework:**

Section 10 of the National Planning Policy Framework (NPPF) published in July 2018 sets out Government policy on development and flood risk for England. It aims to ensure that flood risk is taken into account at all stages of the planning process, to avoid inappropriate developments in areas at risk of flooding, and to direct development away from areas of highest risk. Where new development is thought necessary in areas of flood risk, the NPPF aims to make it safe, without increasing flood risk elsewhere, and, where possible, reduce the overall flood risk.

The NPPF promotes a sequential risk-based approach to determine the suitability of land for development in flood risk areas. The broad aim of the NPPF is to reduce the number of people and properties within the natural and built environment at risk of flooding. To achieve this aim, planning authorities are required to ensure that flood risk is properly assessed during the initial planning stages of any development.

### **2.02 Consideration and Objectives:**

This Flooding and Drainage Assessment Report will consider the following:-

- whether the proposed development is likely to be affected by flooding.
- whether the proposed development will increase flood risk to adjacent properties.

The report will also demonstrate that any existing flood risk or flood risk associated with the proposed development can satisfactorily managed. This will include:-

- whether the proposed development is likely to be affected by flooding and whether it will increase flood risk elsewhere.
- specifying the measures proposed to deal with the identified risks, including, where appropriate, proposals to reduce existing and/or future flood risk levels.
- satisfy the Local Authority that any flood risk to the development or additional risk arising from the proposal will be successfully managed so the site can be developed and occupied safely with out risk to adjacent properties.

### 3.0 FLOODING ISSUES

#### 3.01 The Site:

The site is located to the west of Butt Lane and lies approximately 275m to the south of the centre of Snaith. A site location plan (Fig. 1) is attached in Appendix B.

The Ordnance Survey co-ordinates for the centre of the site are 464370mE, 421730mN.

The site is approximately 2.00 hectares in area.

The site can be accessed from Butt Lane.

The general fall of the site is to the southeast. Site levels range from:-

Location	Level m (AOD)
Northern boundary	7.81 – 10.45
Southern boundary	6.61 – 7.85
Eastern boundary	6.61 – 7.81
Western boundary	7.61 – 1.10

A site topographical survey (Fig. 2) is attached in Appendix C.

A site aerial photograph is attached in Appendix D.

No watercourses are believed to lie on or in the immediate vicinity of the site.

From the inspection of OS maps and the OS Water Network Map, there are watercourses in the vicinity of the site as follows:-

- drainage ditch approximately 100m to the southeast.
- drainage ditch approximately 375m to the southeast.
- drainage ditch approximately 400m to the south.
- 2 no. drainage ditches approximately 450m to the north.
- 2 no. drainage ditches approximately 500m to the south.

The River Aire lies approximately 900m to the north of the site.

There is a small pond approximately 375m to the southeast of the site.

The location of the river, drainage ditches and pond are indicated on the Site Location Plan (Fig. 1) attached in Appendix B and OS Water Network Map attached in Appendix E.

### 3.02 Flood Zone Classification:

The site is located within Flood Zone 1 on the EA flood map. This zone comprises land assessed as having less than 1 in 1000 (<0.1%) annual probability of tidal or river flooding in any year.

A copy of the EA flood map is attached in Appendix F.

### 3.03 Sources of Flood Risk:

The following table shows a summary of the forms of flood and the potential issues in relation to the site that require further assessment.

<b>Flood Source</b>	<b>Applicable</b>	<b>Comment</b>
Fluvial	✓	There are drainage ditches in the vicinity of the site.
Tidal	X	Site inland.
Run Off	✓	Potential for run off from higher land to the northwest.
Groundwater	X	BGS Groundwater flooding susceptibility for the site is indicated as 'limited potential for groundwater flooding to occur'.
Sewers	✓	A 225mm diameter surface water sewer crosses the eastern sector of the site. A 150mm diameter foul sewer lies in Sycamore Close to the north of the site. A 100mm diameter combined sewer lies in Walnut Crescent to the west of the site. There is a 150mm diameter rising main in Butt Lane adjacent the site. There is a 150mm foul sewer in Butt Lane to the southeast of the site.
Reservoirs, Canals, etc.	X	No such features in the vicinity of the site.

### 3.04 Flood Risk Assessment:

The site is within Flood Zone 1. This zone comprises land assessed as having less than a 1 in 1000 (<0.1%) annual probability of tidal or river flooding in any one year.

The drainage ditches to the south of the site may be a source of localised fluvial flooding that has not been captured on the EA flood map.

The development may be at risk from potential overland flood waters from higher ground to the northwest. However, any such flood waters would flow through the site to the southeast.

The effect of groundwater as a flood source is not known to be an issue at this location. BGS Groundwater flooding susceptibility for the site is indicated as 'limited potential for groundwater flooding to occur'.

From inspection of the EA Risk of Flooding from Surface Water Maps, it would appear there is a very low risk (less than 1 in 1000 [0.1%]) of surface water flooding affecting the site. However, it should be noted that surface water flooding can be difficult to predict and occurs when rainwater does not drain away through the 'normal' drainage systems or soaks into the ground but lies on or flows over the ground instead.

The EA Risk of Flooding from Surface Water Map is attached in Appendix G.

The development may be at risk from overland flood waters from the potential overloading of the public surface water sewers that crosses the eastern sector of the site. However, any such flood waters would flow through the site to the southeast.

### **3.05 Sequential Test:**

The Sequential Test should be applied at all stages of planning. Its aim is to steer new development to areas at the lowest probability of flooding.

Table 2 of the Technical Guidance to the NPPF (which categorises the flood risk vulnerability of land uses) indicates the proposed development is categorised as a 'more vulnerable' land use.

From the EA flood map site is identified as being Flood Zone 1.

Table 3 of the Technical Guidance to the NPPF indicates where the proposed land use is 'more vulnerable' development is appropriate in Flood Zone 1. Therefore, the Sequential Test has been passed.

### **3.06 Exception Test:**

Table 3 of the Technical Guidance to the NPPF indicates where the proposed land use is 'more vulnerable' development is considered appropriate in Flood Zone 1 and the Exception Test is not required.

Notwithstanding the above the following sections of this report will demonstrate that the proposed development will be safe from flooding and will not increase flood risk elsewhere.

### **3.07 Effect of Development on the Wider Catchment:**

The proposed development on the site will result in an impermeable area on the site and unattenuated surface water flows from the development would potentially increase the flooding risk to the receiving watercourses or sewers in the wider

catchment. This is assessed in detail in the drainage section of this report.

### **3.08 Flood Risk Mitigation:**

The proposed development is in Flood Zone 1.

The proposed finished floor level on the new build development should be set at least 0.15 and ideally 0.30m above the existing ground level.

The external levels around the development should be set to route any potential overland flood waters around the proposed building to the southeast as the existing situation.

## **4.0 DRAINAGE**

### **4.01 Public Sewers:**

A 225mm surface water sewer crosses the eastern sector of the site. A 150mm diameter foul sewer lies in Sycamore Close to the north of the site. A 100mm diameter combined sewer lies in Walnut Crescent to the west of the site. There is a 150mm diameter rising main in Butt Lane adjacent the site and a 150mm foul sewer in Butt Lane to the southeast of the site.

An extract from the public sewer record is attached in Appendix G.

### **4.02 Existing Drainage:**

Land drains may be present on the site.

#### **Foul Water Drainage**

### **4.03 Foul Drainage:**

A separate foul water system will be provided on the development.

It is proposed to discharge foul water from the development to the 150mm foul sewer in Butt Lane to the southeast of the site. The foul sewer in Butt Lane to the southeast of the site is 1.35m deep and it appears a gravity system can be adopted on the development.

#### **Surface Water Drainage**

### **4.04 Geology:**

BGS Geological Sheet 79 Goole indicates the following:-

- The site is underlain by the Sherwood Sandstone Group of the Guadalupian Age.
- The Brighton Sand Formation is likely to be present at the surface.
- No faults or abnormal features are recorded on or in the vicinity of the site.
- No coal seams are recording as outcropping on or in the near vicinity of the site.
- There are no areas of made or filled ground within 1000m of the site.

A borehole log (Ref: SE62SW197) viewed on the BGS website, undertaken approximately 250m to the southeast of the site, indicates the following sequence of strata:-

<b>Borehole (SE62SW197)</b>	
<b>Strata</b>	<b>Thickness (m)</b>
Made Ground	0.70
Clay	1.00
Sand	1.10
Clay	1.70
Sandstone	34.50

#### 4.05 Ground Conditions:

A trial pit ground investigation was undertaken on the site on 20 September 2018. It should be noted TP11 wasn't excavated.

The following ground conditions were encountered on the site:-

Strata	Location					
	TP01	TP02	TP03	TP04	TP05	TP06
Approx. Ground Level (m AOD)	9.81	8.50	9.40	9.45	8.40	7.45
Topsoil	0.00 – 0.35m	0.00 – 0.30m	0.00 – 0.30m	0.00 – 0.30m	0.00 – 0.35m	0.00 – 0.38m
Sands / Gravels	0.35 – 1.10m (sand & gravel)	0.30 – 0.90m (sand & gravel)	0.30 – 0.80m (sand & gravel)	-	0.35 – 1.40m (sand)	-
	1.10 – 1.60m (clayey sand)					
Clay	1.60 – 1.80m (soft, low strength)	0.90 – 1.40m (very stiff)	0.80 – 1.30m (very stiff)	0.30 – 1.10m (very desiccated)	1.40 – 2.00m (firm)	1.38 – 1.50m (stiff, desiccated)
	1.80 – 2.30m (with sand bands)			1.10 – 1.60m (soft, low strength)		1.50 – 1.80m (very soft, low strength)
						1.80 – 2.10m (very stiff, high strength)
Silt	-	-	1.30 – 1.80m (very soft, low	-	-	-



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			strength)			
Sands / Gravels	2.30 – 3.40m (sand)	1.40 – 2.60m (sand) 2.60 – 3.80m (sand & gravel)	1.80 – 2.70m (sand)	1.60 – 3.00m (sand)	2.00 – 3.50m (sand)	2.10 – 3.60m (sand & gravel)
Clay	3.40 – 3.70m (firm)	-	2.70 – 3.50m (soft, low strength)	3.00 – 3.70m (soft, low strength)	-	-
Sand	-	-	3.50 – 4.00m (sand & gravel)	3.70 – 4.00m (sand)	-	-
Stability	Major collapse of pit walls below 2.30m	Continued collapse of pit walls below 3.40m	Slight collapse of pit walls from 1.80 – 2.70m and below 3.50m	Slight collapse of pit walls below 3.70m	Slight collapse of pit walls below 2.90m	Slight collapse of pit walls below 2.10m

Strata	Location					
	TP07	TP08	TP09	TP10	TP12	TP13
Approx. Ground Level (m AOD)	8.75	7.60	7.75	8.20	7.60	7.30
Topsoil	0.00 – 0.35m	0.00 – 0.30m	0.00 – 0.30m	0.00 – 0.30m	0.00 – 0.35m	0.00 – 0.50m
Sands & Gravels	-	0.30 – 1.10m (sand)	-	-	-	-
Clay	0.35 – 1.40m (very stiff, desiccated)	1.10 – 1.50m (stiff, desiccated)	0.30 – 1.30m (very stiff, desiccated)	0.30 – 1.40m (very stiff, desiccated)	0.30 – 1.20m (desiccated)	0.50 – 1.35m (very stiff, high strength, desiccated)
	1.40 – 2.80m (very soft, low strength)		1.30 – 1.70m (firm, medium strength)	1.70 – 2.00m (soft, becoming firm, low strength)		
Silt	-	-	-	-	-	-
Sands & Gravels	2.80 – 3.80m (sand & gravel)	1.50 – 3.00m (sand & gravel)	1.70 – 3.50m (sand & gravel)	2.00 – 2.95m (sand & gravel)	1.20 – 2.00m (sand)	1.35 – 3.50m (sand & gravel)
		3.00 – 3.70m (sand)		2.95 – 3.50m (sand)	2.00 – 3.55m (sand & gravel)	3.50 – 3.95m (gravel)
Clay	-	-	-	-	-	-
Sand	-	-	-	-	-	-
Stability	Slight collapse of pit walls below 3.10m	Slight collapse of pit walls below 1.80m	Slight collapse of pit walls below 3.20m	Slight collapse of pit walls	Slight collapse of pit walls	Slight collapse of pit walls

For the detailed description of the strata encountered see the trial pit logs attached in Appendix I.



**4.06 Groundwater:**

Groundwater was encountered during the trial pit investigation as follows:-

Strata	Location					
	TP01	TP02	TP03	TP04	TP05	TP06
Approx. Ground Level (m AOD)	9.81	8.50	9.40	9.45	8.40	7.45
Groundwater	Soils damp at 2.80m Seepage at 3.20m	Soils wet at 3.40m	Soils damp at 1.80m Soils damp at 3.50m	Soils damp at 1.60m	Soils damp at 3.00m	Soils damp at 3.40m

Strata	Location					
	TP07	TP08	TP09	TP10	TP12	TP13
Approx. Ground Level (m AOD)	8.75	7.60	7.75	8.20	7.60	7.30
Groundwater	Soils damp at 3.20m	Not encountered	Soils damp at 2.60m	Soils damp at 3.40m	Soils damp at 2.80m	Soils damp at 3.50m

**4.07 Environmental Setting:**

The site is underlain by a bedrock aquifer designated as a Principle Aquifer which is strata that has a high intergranular and/or fracture permeability and usually provides a high level of water storage that may support water supplies and/or river base flow on a strategic scale.

The superficial aquifer is designated as a Secondary Aquifer – A which is strata which contains permeable layers capable of supporting water supplies at a local rather than strategic scale and in some cases forming an important source of base flows to rivers.

The overlying soils are classified as having a high leaching potential.

There is 1 no. water abstraction license held within 1000m of the site and details are summarised as follows:-

- surface water abstraction for spray irrigation 766m to the west.

The site is within Zone III of a Source Protection Zone.

The use of infiltration drainage on the site has not yet been discussed with the EA Groundwater Protection Team but it is envisaged it will be acceptable in principle. However, the scheme will need to include adequate treatment prior to infiltration and this should follow in the guidance given in the CIRIA 697 The SUDS Manual. Given the nature of the bedrock (Sandstone) underlying the site all infiltration devices should not be in direct contact with the underlying bedrock because of the likely rapid migration of the discharge to groundwater.

#### 4.08 Surface Water Drainage:

A separate surface water drainage system should be provided on the development.

Ground conditions on the site indicate the use of soakaways for the disposal of water from the development may be possible in the underlying sands and gravels. However, this will need to be confirmed by falling head permeability testing undertaken in accordance with BRE365:Soakaways.

The following infiltration drainage system would be utilised on the development:-

- The use of porous paving on the development will be subject to near surface ground conditions.
- Roof water and water from roads and hardstandings will be discharged into either chamber or trench soakaways.
- Silt pits will be provided before the inlet to all soakaways.
- A sand filter layer will be provided at the base of each of the soakaways.

If testing indicates that the use of soakaways on the site isn't feasible then it would be proposed, subject to agreement from Yorkshire Water, to discharge surface water from the development to the 225mm diameter surface water that crosses the site. The discharge would be limited to greenfield run-off which is generally accepted as 1.4 l/sec/ha for this area. The storm water storage would be provided for storms up to a 1:100 year storm return period with a 40% increase in rainfall intensity for climate change. Hardcover areas would also be increased by 10% to cater for urban creep.

#### **Soakaway Design**

Soakaways will be designed to BRE 365: Soakaways.

It is proposed to design the soakaways on the development for storms up to a 1:100 year return period plus a 40% increase on rainfall intensity for climate change.

Hardcover areas will be increased by 10% to cater for urban creep.

In order to cater for 'exceedance' events and to prevent water leaving the site areas local to soakaways will be either dished or bunded to provide surface detention areas.

As the proposed design criteria is significantly in excess of the 1:10 year storm return period recommended in BRE 365 Soakaway Design and The Building Regulations, and 'exceedance' events are also catered for, a design factor of safety of 1.5 is proposed on the soakaway design.

**4.09 Maintenance Requirements of the Surface Water System**

## Private Areas – Roofs and Hardstandings

The following requirements are based on the recommendations in The SUDS Manual (CIRIA C697), Section 13.8 (1). Regular inspection and maintenance is required to ensure the effective long-term operation of below ground infiltration and attenuation systems. The maintenance of the surface water drainage system will initially be the developer and then the responsibility of the individual householders.

<b>Maintenance Schedule</b>	<b>Required Action</b>	<b>Recommended Frequency</b>
Regular maintenance	Remove debris from any catchment surfaces (may cause risks to performance).	Monthly for first 3 months, then six monthly thereafter (and after large storm events).
	Visual inspection of silt trap manholes to ensure no obvious build-up of silt or other blockages. De-silt as required. Check to ensure there is no standing water in the manholes.	Monthly for first 3 months, then six monthly thereafter (and after large storm events).
	Remove sediment from silt traps and upstream inspection chambers, rainwater gullies and jet associated pipework.	Annually, or as required.
	Visual inspection of permeable block paving and joints. Mechanically brush to ensure no vegetation of any sort is allowed to grow and develop in the joints.	Twice yearly, spring and autumn.
Ongoing monitoring	Inspect/check all upstream drainage inlets, outlets and vents to ensure that they are in good condition and operating as designed.	Annually and after large storm events.
Remedial actions	Repair/rehabilitation of inlets, outlets, overflows and vents. De-silt as required.	As required.

**5.0 SUMMARY**


<b>The Site</b>	<p>The site is located to the west of Butt Lane and lies approximately 275m to the south of the centre of Snaith.</p> <p>The Ordnance Survey co-ordinates for the centre of the site are 464370mE, 421730mN.</p> <p>The site is approximately 2.00 hectares in area.</p> <p>The site can be accessed from Butt Lane.</p> <p>The general fall of the site is to the southeast. Site levels vary as follows:-</p> <table border="1" data-bbox="443 510 1066 645"> <thead> <tr> <th>Location</th><th>Level m (AOD)</th></tr> </thead> <tbody> <tr> <td>Northern boundary</td><td>7.81 – 10.45</td></tr> <tr> <td>Southern boundary</td><td>6.61 – 7.85</td></tr> <tr> <td>Eastern boundary</td><td>6.61 – 7.81</td></tr> <tr> <td>Western boundary</td><td>7.61 – 1.10</td></tr> </tbody> </table> <p>No watercourses are believed to lie on or in the immediate vicinity of the site.</p> <p>From the inspection of OS maps and the OS Water Network Map, there are watercourses in the vicinity of the site as follows:-</p> <ul style="list-style-type: none"> <li>- drainage ditch approximately 100m to the southeast.</li> <li>- drainage ditch approximately 375m to the southeast.</li> <li>- drainage ditch approximately 400m to the south.</li> <li>- 2 no. drainage ditches approximately 450m to the north.</li> <li>- 2 no. drainage ditches approximately 500m to the south.</li> </ul> <p>The River Aire lies approximately 900m to the north of the site.</p> <p>There is a small pond approximately 375m to the southeast of the site.</p>	Location	Level m (AOD)	Northern boundary	7.81 – 10.45	Southern boundary	6.61 – 7.85	Eastern boundary	6.61 – 7.81	Western boundary	7.61 – 1.10
Location	Level m (AOD)										
Northern boundary	7.81 – 10.45										
Southern boundary	6.61 – 7.85										
Eastern boundary	6.61 – 7.81										
Western boundary	7.61 – 1.10										
<b>Flood Risk Assessment</b>	<p>The site is within Flood Zone 1. This zone comprises land assessed as having less than a 1 in 1000 (&lt;0.1%) annual probability of tidal or river flooding in any one year.</p> <p>The drainage ditches to the south of the site may be a source of localised fluvial flooding that has not been captured on the EA flood map.</p> <p>The development may be at risk from potential overland flood waters from higher ground to the north. However, any such flood waters would flow through the site to the southeast.</p> <p>The effect of groundwater as a flood source is not known to be an issue at this location. BGS Groundwater flooding susceptibility for the site is indicated as 'limited potential for groundwater flooding to occur'.</p> <p>From inspection of the EA Risk of Flooding from Surface Water Maps, it would appear there is a very low risk (less than 1 in 1000 [0.1%]) of surface water flooding affecting the site.</p> <p>However, it should be noted that surface water flooding can be difficult to predict and occurs when rainwater does not drain away through the 'normal' drainage systems or soaks into the ground but lies on or flows over the ground instead.</p> <p>The development may be at risk from overland flood waters from the potential overloading of the public surface water sewers that crosses the eastern sector of the site. However, any such flood waters would flow through the site to the southeast.</p>										
<b>Sequential Test</b>	<p>The Sequential Test should be applied at all stages of planning. Its aim is to steer new development to areas at the lowest probability of flooding.</p> <p>Table 2 of the Technical Guidance to the NPPF (which categorises the flood risk vulnerability of land uses) indicates the proposed development is categorised as a 'more vulnerable' land use.</p> <p>From the EA flood zone map site is identified as being Flood Zone 1.</p> <p>Table 3 of the Technical Guidance to the NPPF indicates where the proposed land use is 'more vulnerable' development is appropriate in Flood Zone 1. Therefore, the Sequential Test has been passed.</p>										
<b>Exception Test</b>	<p>Table 3 of the Technical Guidance to the NPPF indicates where the proposed land use is 'more vulnerable' development is considered appropriate in Flood Zone 1 and the Exception Test is not required.</p> <p>Notwithstanding the above the following sections of this report will demonstrate that the proposed development will be safe from flooding and will not increase flood risk elsewhere.</p>										
<b>Flood Risk Mitigation</b>	<p>The proposed finished floor level on the new build development should be set at least 0.15 and ideally 0.30m above the existing ground level.</p> <p>The external levels around the development should be set to route any potential overland</p>										

	flood waters around the proposed buildings to the south as the existing situation.
<b>Foul Drainage</b>	<p>A separate foul water system will be provided on the development.</p> <p>It is proposed to discharge foul water from the development to the 150mm foul sewer in Butt Lane to the southeast of the site. The foul sewer in Butt Lane to the southeast of the site is 1.35m deep and it appears a gravity system can be adopted on the development.</p>
<b>Environmental Setting</b>	<p>The site is underlain by a bedrock aquifer designated as a Principle Aquifer which is strata that has a high intergranular and/or fracture permeability and usually provides a high level of water storage that may support water supplies and/or river base flow on a strategic scale.</p> <p>The superficial aquifer is designated as a Secondary Aquifer – A which is strata which contains permeable layers capable of supporting water supplies at a local rather than strategic scale and in some cases forming an important source of base flows to rivers.</p> <p>The overlying soils are classified as having a high leaching potential.</p> <p>There is 1 no. water abstraction license held within 1000m of the site and details are summarised as follows:-</p> <ul style="list-style-type: none"> <li>- surface water abstraction for spray irrigation 766m to the west.</li> </ul> <p>The site is within Zone 111 of a Source Protection Zone.</p> <p>The use of infiltration drainage on the site has not yet been discussed with the EA Groundwater Protection Team but it is envisaged it will be acceptable in principle. However, the scheme will need to include adequate treatment prior to infiltration and this should follow in the guidance given in the CIRIA 697 The SUDS Manual. Given the nature of the bedrock (Sandstone) underlying the site all infiltration devices should not be in direct contact with the underlying bedrock because of the likely rapid migration of the discharge to groundwater.</p>
<b>Surface Water Drainage</b>	<p>A separate surface water drainage system should be provided on the development.</p> <p>Ground conditions on the site indicate the use of soakaways for the disposal of water from the development may be possible in the underlying sands and gravels. However, this will need to be confirmed by falling head permeability testing undertaken in accordance with BRE365:Soakaways.</p> <p>The following infiltration drainage system would be utilised on the development:-</p> <ul style="list-style-type: none"> <li>- The use of porous paving on the development will be subject to near surface ground conditions.</li> <li>- Roof water and water from roads and hardstandings will be discharged into either chamber or trench soakaways.</li> <li>- Silt pits will be provided before the inlet to all soakaways.</li> <li>- A sand filter layer will be provided at the base of each of the soakaways.</li> </ul> <p>Soakaways will be designed to BRE 365: Soakaway Design.</p> <p>It is proposed to design the soakaways on the development for storms up to a 1:100 year return period plus a 40% increase on rainfall intensity for climate change.</p> <p>Hardcover areas will be increased by 10% to cater for urban creep.</p> <p>In order to cater for 'exceedance' events and to prevent water leaving the site areas local to soakaways will be either dished or bunded to provide surface detention areas.</p> <p>As the proposed design criteria is significantly in excess of the 1:10 year storm return period recommended in BRE 365 Soakaway Design and The Building Regulations, and 'exceedance' events are also catered for, a design factor of safety of 1.5 is proposed on the soakaway design.</p> <p>If testing indicates that the use of soakaways on the site isn't feasible then it would be proposed, subject to agreement from Yorkshire Water, to discharge surface water from the development to the 225mm diameter surface water that crosses the site.</p> <p>The discharge would be limited to greenfield run-off which is generally accepted as 1.4 l/sec/ha for this area. The storm water storage would be provided for storms up to a 1:100 year storm return period with a 40% increase in rainfall intensity for climate change.</p> <p>Hardcover areas would also be increased by 10% to cater for urban creep.</p>

**6.0 CAVEATS**

- 6.01 The comments given in this report and recommendations made are based on the information that could be obtained from reasonably accessible sources. Detailed discussions have not yet been held with statutory bodies and the local authority.
- 6.02 This report has been prepared for the sole use of Midlands Construction Services Ltd and their development funders, unless agreed otherwise in writing by CoDA Structures.

Signed:

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J Lawrence B Eng C Eng M I Struct E

## **APPENDIX A**

### **PROPOSED DEVELOPMENT PLAN - FIG. 1**