

**FLOODING & DRAINAGE ASSESSMENT  
FOR A MIXED USE DEVELOPMENT SITE  
ADJACENT CLITHEROE ROAD, WHALLEY**

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## 1.0 INTRODUCTION

- 1.01 Following instructions from Applethwaite Ltd during May 2018, CoDA Structures have undertaken an assessment of flooding and drainage issues in relation to a mixed use development site adjacent Clitheroe Road, Whalley.
- 1.02 The site is undeveloped.
- 1.03 It is proposed to develop the site for a mixed use scheme. The proposed development plan is attached in Appendix A.
- 1.04 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.
- 1.05 The local authority is Ribble Valley Borough Council (RVBC).

## 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 east of Clitheroe Road and lies approximately 4.0 miles to the south of Clitheroe Town Centre. A site location plan is attached in Volume 2, Appendix B.

The Ordnance Survey co-ordinates for the centre of the site are 373660mE, 437380mN.

The site is approximately 6.35 hectares in area.

The site can be accessed from Clitheroe Road.

The general fall of the site is to the southwest.

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

A site aerial photograph is attached in Appendix D.

A piped watercourse runs through the site. The location is indicated on Fig. 2 attached in Appendix C.

From the inspection of OS Maps and the Environmental Agency River Network Map there are open watercourses in the surrounding area (within 500m) of the site as follows:-

- unnamed watercourse approximately 125m to the southeast
- unnamed watercourse approximately 150m to the northwest
- unnamed watercourse approximately 150m to the south
- unnamed watercourse approximately 450m to the northwest
- unnamed watercourse approximately 400m to the southeast

There is a spring approximately 250m to the northeast, 300m to the southeast and 400m to the east of the site.

The position of the water courses are indicated on the Site Location Plan (Fig. 1) attached in Appendix A and the EA River Network Map attached in Appendix F.

### 3.02 Flood Zone Classification:

The site is located within Flood Zone 1 on the Environmental Agency (EA) flood map. This zone comprises land assessed as having less than a 1:1000 (<0.1%) annual probability of river flooding or flooding from the sea in any year. The EA flood map is attached in Appendix E.

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

### 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.

Flood Source	Applicable	Comment
Fluvial	✓	A piped watercourse crosses the site.
Tidal	X	
Run Off	✓	Potential for run off from higher land to the north and east.
Groundwater	X	Relatively high groundwater levels are not believed to be an issue this location.
Sewers	✓	A 225mm diameter combined sewer lies approximately 40m to the west of the site.
Reservoirs, Canals, etc.	X	No 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 piped watercourse on the site may be a source of localised fluvial flooding that has not been captured on the Environment Agency flood zone map.

The development may be at risk from potential overland flood waters from higher ground to the north and east of the site. However, any such flood water from the east would tend to be 'integrated' by the adjacent A59.

From inspection of the EA Website 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 majority of the site.

However, it would appear there is a:-

- low (between 1 in 1000 [0.1%] and 1:100 [0.1%]) risk of surface water flooding affecting parts of the central and eastern sectors.
- a medium (between 1 in 100 [0.1%] and 1 in 30 [3.3%]) to high [greater than 1

in 30 [3.3%] risk of surface water flooding affecting parts of the western sector of the site.

It is indicated that there is:-

- a low to high risk of below 300mm depth of flooding affecting central and eastern parts of the site
- a low to high risk of between 300 and 900mm depth of flooding affecting isolated areas of the central sector of 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 Website Risk of Flooding from Surface Water Maps are attached at Appendix G.

The effect of groundwater as a flood source is not considered to be an issue at this location.

The site does not appear to be at risk from overland flood waters from potential overloading of the public combined sewer to the west of the site as any such flood waters would tend to flow away from the site to the southwest.

### 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 zone 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 will result in impermeable area on the site. Therefore, unattenuated flows from the development may increase the flooding risk to the receiving sewers and the wider catchment. This is assessed in detail in the drainage section of this report.

**3.08 Piped Watercourse:**

A survey of the piped watercourse was undertaken during June 2018. The survey has indicated that the pipe is 225mm in diameter and is generally in a poor condition and broken in several places.

There is a manhole in Meads Croft, adjacent the site, that is on a stone culvert. However, it was not possible to survey the culvert as it was blocked by cobbles.

The location of the piped water course and highways drain are indicated on Fig2 attached in Appendix C

**3.09 Flood Risk Mitigation:**

As part of the development of the site it is proposed to open up, wherever possible, the piped watercourse. This would provide a far greater capacity as well as providing some residual capacity for stormwater storage and capacity for potential overland flood waters through the site.

The off-site culvert should be cleared out and camera surveyed. Any defects should be rectified by the riparian owner.

The proposed external levels around the development should be set to route any potential overland flood waters away and around the proposed buildings to the proposed open watercourse.

It is proposed to provide a cut-off ditch along the northern boundary of the site to intercept any surface water that enters the site from the adjacent housing development on former Pendle Garage site.

Floor levels on the development, where possible, should be set between 0.15 – 0.30m above the adjacent proposed road level.

The proposals for the water course diversion and opening up to an open channel are shown on the schematic surface water drainage layout for the development attached in Appendix K.

## **4.0 DRAINAGE**

### **4.01 Public Sewers:**

A 225mm diameter public combined sewer lies approximately 40m to the west of the site.

It is envisaged that foul water from the development can be discharged to the 225mm diameter combined sewer to the west of the site.

UU will require surface water from the development to be disposed off by either infiltration or discharged directly to the watercourse on the site.

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

### **4.02 Existing Drainage:**

Survey work has indicated there is a 900mm diameter surface water sewer that runs adjacent the site boundary to the A59. The sewer is believed to drain the A59.

The location of this sewer is indicated in Fig. 2 attached in Appendix B.

### **4.03 Foul Water:**

Foul water from the development will be discharged to the 225m diameter combined sewer approximately 40m to the west of the site.

In invert level of the sewer is approximately 62.46 so it appears the development can be drained by gravity.

A section of the off-site sewer required will be across third party and the applicant has an agreement in place with the third party land owner to construct such a sewer under a S104 agreement.

A schematic foul drainage layout applicant for the development is attached in Appendix K.

### **4.04 Geology:**

1:50,000 British Geological Survey (BGS) geological sheet 68 Clitheroe indicates the following:-

- The site is underlain by Limestone of the Dinantian Age.
- No faults lie within approximately 900m of the site.

- Glacial deposits of boulder clay are likely to be present at the surface.

**4.05 Ground Conditions:**

The following typical ground conditions were encountered in the trial pit investigation:-

Strata	Location					
	TP01	TP02	TP04	TP05	TP06	TP07
Approx. Ground Level (m AOD)	67.25	65.50	65.00	69.00	66.25	67.75
Topsoil	-	0.00 – 0.30m	0.00 – 0.20m	-	0.00 – 0.40m	0.00 – 0.20m
Made Ground	0.00 – 0.90m	-	-	0.00 – 0.65m	-	-
Clay	0.90 – 2.50m (soft becoming firm, high strength)	0.30 – 2.70m (firm, medium to high strength)	0.20 – 1.20m (firm, high strength)	0.65 – 1.40m (stiff, high strength)	0.40 – 2.50m (firm, becoming soft, medium strength)	0.20 – 0.80m (firm, high strength)
			1.20 – 2.70m (firm, medium strength)	1.40 – 2.50m (firm, becoming soft, medium strength)		0.80 – 2.50m (soft, medium strength)
Stability	Pit walls stable whilst open	Pit walls stable whilst open	Pit walls stable whilst open	Pit walls stable whilst open	Pit walls stable whilst open	Pit walls stable whilst open

Strata	Location							
	TP08	TP09	TP11	TP12	TP14	TP15		
Approx. Ground Level (m AOD)	70.50	68.50	stockpile	71.00	70.50	70.50		
Topsoil	0.00 – 0.30m	0.00 – 0.45m	-	0.00 – 0.30m	0.00 – 0.20m	0.00 – 0.30m		
Made Ground	-	-	0.00 – 1.40m (mound)	-	-	-		
Clay	0.30 – 0.50m (stiff)	0.45 – 1.50m (firm, medium strength)	-	0.30 – 1.00m (firm, medium strength)	0.20 – 0.40m (firm)	0.30 – 1.20m (firm, medium strength)		
	0.50 – 1.30m (firm, high strength)			1.00 – 2.00m (soft to firm, medium strength)			0.40 – 1.60m (firm, high strength)	1.20 – 2.50m (soft to firm)
	1.30 – 2.60m (firm, medium strength)			2.00 – 2.50m (soft)			1.60 – 2.50m (firm, medium strength)	
Stability	Pit walls stable whilst open	Pit walls stable whilst open	Pit walls stable whilst open	Pit walls stable whilst open	Pit walls stable whilst open	Pit walls stable whilst open		

Strata	Location			
	TP17	TP18	TP19	TP20
Approx. Ground Level (m AOD)	73.50	72.00	74.25	74.00
Topsoil	0.00 – 0.20m	0.00 – 0.40m	0.00 – 0.30m	0.00 – 0.20m
Made Ground	-	-	-	-
Clay	0.20 – 2.50m (firm, high becoming medium strength)	0.40 – 1.10m (firm, medium strength)	0.30 – 1.80m (firm)	0.20 – 2.50m (firm, locally stiff, medium strength)
		1.10 – 2.50m (firm)		
Stability	Pit walls stable whilst open	Pit walls stable whilst open	Pit walls stable whilst open	Pit walls stable whilst open

For the detailed description of the strata encountered see the trial pit logs attached in Appendix I. The location of the trial pits are indicated on Fig 2 attached in Appendix C.

#### 8.04 Groundwater:

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

Strata	Location					
	TP01	TP02	TP04	TP05	TP06	TP07
Approx. Ground Level (m AOD)	67.25	65.50	65.00	69.00	66.25	67.75
Groundwater	Not encountered	Seepage at 1.20m	Seepage at 1.20m	Not encountered	Not encountered	Seepage at 1.40m

Strata	Location					
	TP08	TP09	TP11	TP12	TP14	TP15
Approx. Ground Level (m AOD)	70.50	68.50	stockpile	71.00	70.50	70.50
Groundwater	Seepage at 1.30m	Not encountered	Not encountered	Not encountered	Not encountered	Not encountered

Strata	Location			
	TP17	TP18	TP19	TP20
Approx. Ground Level (m AOD)	73.50	72.00	74.25	74.00
Groundwater	Seepage at 1.30m	Not encountered	Not encountered	Not encountered

#### 4.07 Surface Water Drainage:

Ground conditions on the site are relatively impermeable clays. Therefore, use of soakaways and/or permeable paving on the development is not considered feasible or appropriate.

It is proposed to limit the discharge of surface water from the development to the watercourse that flows through the site to greenfield run-off. The greenfield run-off from the site has been calculated using the IH124 method as 6.4 l/sec/ha by prorating down the discharge for a 50 hectare catchment. This would result in a discharge of 40.6 l/sec for the development. The calculation is attached in Appendix J.

The following estimation of stormwater storage requirements for the development has been based on the following parameters:-

##### Area 1 – Employment and Drive Thru

Proposed discharge rate: 5.0 l/sec.

Proposed Hardcover area: 7200m<sup>2</sup>

Stormwater storage requirements: 466.2m<sup>3</sup>

(Based on a 1:100 year storm return period and a 30% increase in rainfall intensity for climate change).

Area 2 - PFS

Proposed discharge rate: 4.0 l/sec.

Proposed Hardcover area: 3530m<sup>2</sup>Stormwater storage requirements: 179.2m<sup>3</sup>

(Based on a 1:100 year storm return period and a 30% increase in rainfall intensity for climate change).

Area 3 –Employment

Proposed discharge rate: 5.0 l/sec.

Proposed Hardcover area: 7420m<sup>2</sup>Stormwater storage requirements: 487.9m<sup>3</sup>

(Based on a 1:100 year storm return period and a 30% increase in rainfall intensity for climate change).

Area 4 – Carehome

Proposed discharge rate: 5.0 l/sec.

Proposed Hardcover area: 3300m<sup>2</sup>Stormwater storage requirements: 161.8m<sup>3</sup>

(Based on a 1:100 year storm return period and a 30% increase in rainfall intensity for climate change).

Area 5 – Road off A59

Proposed discharge rate: 4.0 l/sec.

Proposed Hardcover area: 2050m<sup>2</sup>Stormwater storage requirements: 82.1m<sup>3</sup>

(Based on a 1:100 year storm return period and a 30% increase in rainfall intensity for climate change).

Area 6 - Residential

Proposed discharge rate: 14.5 l/sec. [reduced from 17.6 l/sec]

Proposed Hardcover area: 12430m<sup>2</sup>

(Including 10% increase for urban creep)

Stormwater storage requirements: 614m<sup>3</sup>

(Based on a 1:100 year storm return period and a 30% increase in rainfall intensity for climate change).

The stormwater storage estimate calculations are attached in Appendix J.

The greenfield run-off volume for the 1:100 year 6 hour rainfall event has been calculated as 1175m<sup>3</sup>.

The run-off volume for the 1:100 year 6 hour rainfall event for the developed site has been calculated as 1138m<sup>3</sup>.

As there is no increase in run-off volume from the site for the 1:100 year 6 hour rainfall event, there is no potential increase of risk of off-site downstream flooding

from the development of the site.

The volumetric calculations are attached in Appendix J

A schematic surface water drainage layout for the development is attached in Appendix K.

#### 4.08 Maintenance Requirements of the Surface Water Drainage System

##### a) Private Areas – Roofs and Hardstandings

Regular inspection and maintenance is required to ensure the effective long-term operation of below ground drainage systems. Initially, the maintenance will be the responsibility of the developer. However, it will ultimately become the responsibility of the residents or uses of the commercial building on the site.

Maintenance Schedule	Required Action	Recommended Frequency
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 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 inspection chambers, rainwater gullies, channels and jet associated pipework.	Annually, or as required.
Ongoing monitoring	Inspect/check all drainage inlets to ensure that they are in good condition and operating as designed.	Annually and after large storm events.
Remedial actions	Repair/rehabilitation of drainage inlets. De-silt as required.	As required.

##### b) Adopted Highway:

Regular inspection and maintenance is required to ensure the effective long-term operation of below ground drainage and attenuation systems. Initially, the maintenance of the adopted drainage will be the responsibility of the developer. However, when the roads and sewers are formally adopted they will become the responsibility of the adopting Highway Authority (LCC) and UU respectively.

Maintenance Schedule	Required Action	Recommended Frequency
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

	Visual inspection of manholes and flow control unit 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.	events). Monthly for first 3 months, then six monthly thereafter (and after large storm events).
	Remove sediment from manholes, road gullies and jet associated pipework.	Annually, or as required.
Ongoing monitoring	Inspect/check all drainage inlets and flow control unit to ensure that they are in good condition and operating as designed.	Annually and after large storm events.
Remedial actions	Repair/rehabilitation of drainage inlets, attenuation and flow control. De-silt as required.	As required.

**5.0 SUMMARY**

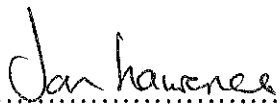
<b>The Site</b>	<p>The site is located to the east of Clitheroe Road and lies approximately 4.0 miles to the south of Clitheroe Town Centre.</p> <p>The Ordnance Survey co-ordinates for the centre of the site are 373660mE, 437380mN. The site is approximately 6.35 hectares in area.</p> <p>The site can be accessed from Clitheroe Road.</p> <p>The general fall of the site is to the southwest.</p> <p>A piped watercourse runs through the site.</p> <p>From the inspection of OS Maps and the Environmental Agency River Network Map there are open watercourses in the surrounding area (within 500m) of the site as follows:-</p> <ul style="list-style-type: none"> <li>- unnamed watercourse approximately 125m to the southeast</li> <li>- unnamed watercourse approximately 150m to the northwest</li> <li>- unnamed watercourse approximately 150m to the south</li> <li>- unnamed watercourse approximately 450m to the northwest</li> <li>- unnamed watercourse approximately 400m to the southeast</li> </ul> <p>There is a spring approximately 250m to the northeast, 300m to the southeast and 400m to the east of the site.</p>
<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 piped watercourse on the site may be a source of localised fluvial flooding that has not been captured on the Environment Agency flood zone map.</p> <p>The development may be at risk from potential overland flood waters from higher ground to the north and east of the site. However, any such flood water from the east would tend to be 'integrated' by the adjacent A59.</p> <p>From inspection of the EA Website 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 majority of the site. However, it would appear there is a low (between 1 in 1000 [0.1%] and 1:100 [0.1%]) risk of surface water flooding affecting parts of the central and eastern sectors. In addition, there is a medium (between 1 in 100 [0.1%] and 1 in 30 [3.3%]) to high [greater than 1 in 30 [3.3%]) risk of surface water flooding affecting parts of the western sector of 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.</p> <p>The effect of groundwater as a flood source is not considered to be an issue at this location.</p> <p>The site does not appear to be at risk from overland flood waters from potential overloading of the public combined sewer to the west of the site as any such flood waters would tend to flow away from the site to the southwest.</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 'less 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 'less 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 'less vulnerable' development is considered appropriate in Flood Zone 1 and the Exception Test is not required.</p>
<b>Flood Risk Mitigation</b>	<p>As part of the development of the site it is proposed to open up, wherever possible, the piped watercourse. This would provide a far greater capacity as well as providing some residual capacity for stormwater storage and capacity for potential overland flood waters through the site.</p>

	<p>The off-site culvert should be cleared out and camera surveyed. Any defects should be rectified by the riparian owner.</p> <p>The proposed external levels around the development should be set to route any potential overland flood waters away and around the proposed buildings to the proposed open watercourse.</p> <p>It is proposed to provide a cut-off ditch along the northern boundary of the site to intercept any surface water that enters the site from the adjacent housing development on former Pendle Garage site.</p> <p>Floor levels on the development, where possible, should be set between 0.15 – 0.30m above the adjacent road level.</p>
<p><b>Foul Drainage</b></p>	<p>Foul water from the development will be discharged to the 225m diameter combined sewer approximately 40m to the west of the site. Invert level of the sewer is approximately 62.46 so it appears the development can be drained by gravity.</p> <p>A section of the off-site sewer required will be across third party and the applicant has an agreement in place with the third party land owner to construct such a sewer under a S104 agreement.</p>
<p><b>Surface Water</b></p>	<p>Ground conditions on the site are likely to be relatively impermeable clays. Therefore, use of soakaways and/or permeable paving on the development is not considered feasible or appropriate.</p> <p>It is proposed to limit the discharge of surface water from the development to the watercourse that flows through the site to greenfield run-off. The greenfield run-off from the site has been calculated using the IH124 method as 6.4 l/sec by prorating down the discharge for a 50 hectare catchment. This would result in a discharge of 40.6l/sec for the development.</p> <p>The following estimation of stormwater storage requirements for the development has been based on the following parameters:-</p> <p><u>Area 1 – Employment and Drive Thru</u></p> <p>Proposed discharge rate: 5.0 l/sec. Proposed Hardcover area: 7200m<sup>2</sup> Stormwater storage requirements: 466.2m<sup>3</sup> (Based on a 1:100 year storm return period and a 30% increase in rainfall intensity for climate change).</p> <p><u>Area 2 – PFS</u></p> <p>Proposed discharge rate: 4.0 l/sec. Proposed Hardcover area: 3530m<sup>2</sup> Stormwater storage requirements: 179.2m<sup>3</sup> (Based on a 1:100 year storm return period and a 30% increase in rainfall intensity for climate change).</p> <p><u>Area 3 – Employment</u></p> <p>Proposed discharge rate: 5.0 l/sec. Proposed Hardcover area: 7420m<sup>2</sup> Stormwater storage requirements: 487.9m<sup>3</sup> (Based on a 1:100 year storm return period and a 30% increase in rainfall intensity for climate change).</p> <p><u>Area 4 – Carehome</u></p> <p>Proposed discharge rate: 5.0 l/sec. Proposed Hardcover area: 3300m<sup>2</sup> Stormwater storage requirements: 161.8m<sup>3</sup> (Based on a 1:100 year storm return period and a 30% increase in rainfall intensity for climate change).</p> <p><u>Area 5 – Road off A59</u></p> <p>Proposed discharge rate: 4.0 l/sec. Proposed Hardcover area: 2050m<sup>2</sup> Stormwater storage requirements: 82.1m<sup>3</sup> (Based on a 1:100 year storm return period and a 30% increase in rainfall intensity for climate change).</p> <p><u>Area 6 – Residential</u></p>

	<p>Proposed discharge rate: 14.5 l/sec. [reduced from 17.6 l/sec] Proposed Hardcover area: 12430m<sup>2</sup> (Including 10% increase for urban creep) Stormwater storage requirements: 614m<sup>3</sup> (Based on a 1:100 year storm return period and a 30% increase in rainfall intensity for climate change). The greenfield run-off volume for the 1:100 year 6 hour rainfall event has been calculated as 1175m<sup>3</sup>. The run-off volume for the 1:100 year 6 hour rainfall event for the developed site has been calculated as 1138m<sup>3</sup>. As there is no increase in run-off volume from the site for the 1:100 year 6 hour rainfall event, there is no potential increase of risk of off-site downstream flooding from the development of the site.</p>
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**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 Applethwaite Ltd and their development funders, unless agreed otherwise in writing by CoDA Structures.

Signed: .....  .....

J Lawrence B Eng C Eng M I Struct E