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RESIDENTIAL AND COMMERCIAL DESIGN CONSULTANTS

Strata Sterling Barnsley West Ltd

Barnsley West

DRAINAGE IMPACT ASSESSMENT

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APPENDICES

1. Introduction

1.1 Queensberry Design Ltd has been commissioned by Strata Sterling Barnsley West Ltd to undertake a Drainage Impact Assessment for a proposed mixed-use development at Barnsley West. The purpose of this document is to consider drainage and surface water flooding implications from the proposed development.

1.2 This assessment covers the residential area of the Barnsley West scheme information considering the adjacent (but within the application redline) employment site can be viewed within the JPG Drainage Impact Assessment ref: 4848-JPG-XX-XX-RP-D-0622-S2-P01.

1.3 This report should be read in conjunction with the site wide Flood Risk Assessment (FRA) produced by JPG ref: 4848-JPG-XX-XX-RP-D-0620-S2-P01.

1.4 Consultation has been undertaken with Yorkshire Water (YW), Environment Agency (EA) and Barnsley Lead Local Flood Authority (LLFA) including inspection of their Strategic Flood Risk Assessment (SFRA). Data has also been gathered from several other sources including aerial photographs, Ordnance Survey (OS), the British Geological Society (BGS), National Soil Resources Institute (NSRI), Sewerage Sector Guidance (SSG), SuDS Manual (C753) and anecdotal evidence from the internet.

1.5 Information available from previous assessments will be used as part of this assessment.

2. Site Description

2.1 The residential part of the development is circa 68.23 hectares in size and is located 3km west of Barnsley Town Centre, at a national grid reference of SW 31632 07538.

2.2 For the purposes of development description on locality refer to phasing plan in appendix 2.

2.3 The site is located north of the M1 motorway and south of the A635 Barugh Green Road, between Higham and Gawber.

2.4 The site is irregular shaped arable farmland split into different fields by smalls ditches, fence lines and hedgerows. Site topography is steep and undulating.

2.5 Redbrook farm is located adjacent the north-eastern boundary of phase R4, it is unknown whether the farm is used as a habitable building, however for the purpose of this assessment it should be considered when assessing exceedance from the development.

2.6 Beyond Barugh Green Road on the sites northern boundary is Claycliffe Business Park, Redbrook plantation and residential areas of Gawber and Pogmoor are located beyond the eastern boundary, residential area of Higham is located west of the site.

2.7 Hermit Lane, an unclassified road crosses the site in an east-west direction through phase R6 Hermit Lane is operational on open to the public. Hermit House is located south of Hermit Lane.

2.8 A valley intersects the middle of the site between R4 and R6 the valley is steep with gradient up to 1:2. The valley is occupied by mature woodland with a small watercourse at the base flowing in a north-east direction.

2.9 The northeastern boundary of R2 is bound by open land, which forms part of the Barnsley West allocation, but not this application, this report will consider this land to be developed.

2.10 The location of the development is shown in Figure 1a, and Figure 1b.

Site Levels

2.11 A topographical survey has been carried out and can be viewed in Appendix 1.

2.12 Levels fall in a north, north-eastern direction, site level are generally steep and undulating. The high point of the residential development is the southern tip in the R7 area at a level of 141.50m AOD. The R7 area falls in northern direction to a level of 129.00m AOD levels then drop significantly to the watercourse north of R7.

2.13 Site levels continue to fall in a north, northeastern direction in cell R6 from a level of 124.00 – 101.00m AOD. Levels within the northern tip of R6 fall sometimes nearly vertically to the watercourse.

2.14 The watercourse dissecting R6 and R4 is in within a valley at its highest point the drop within the valley is circa 7.0m

2.15 Site levels north of Hermit Lane are of a more constant gradient, however site walls are significant with 31m level difference from Hermit Lane falling towards Barugh Green Road.

Geology

2.16 The site is underlain with Solid (bedrock) Pennine Middle Coal Measure – Mudstone, siltstone and Sandstone.

Hydrogeology

2.17 The site is not within a ground water source protection zone and is underlaid by a Secondary A Aquifer (solid). No significant pollution incidents have been recorded and no ground water abstractions are noted within 1km of the site.

2.18 The existing farmhouse is noted to have a discharge consent for treated effluent to land/soakaway, the details are unknown, however given the location in comparison to the site, no impact on the development is expected.

Watercourses and Existing Flood Risk

2.19 The site has several watercourses and ditches within its boundary which form part of the Cawthorne Dyke, River Dearn and then the River Don River basin catchment.

2.20 The nearest main river is Silkstone Beck circa 1.5km west of the site, this development is outside the Silkstone Beck catchment. Cawthorne Dyke and river Dearn are located north of the site, over 2km away.

2.21 Surface water flood mapping shows watercourses within the site boundary which are also recorded on the topographical survey.

2.22 A ditch is recorded on the northern most boundary adjacent Barugh Green Road this ditch collects greenfield run-off from the development before culverting under Barugh Green Road via a 300 dia pipe which is understood to flow towards Claycliffe Business Park. Then connecting to the wider surface water network in Claycliffe Road.

2.23 A further ditch is noted on the northeastern boundary of R2 and the adjacent application site. This ditch collects run-off from some of the Claycliffe Road catchment shown in appendix 2. The ditch turns north-east at the northern most tip of R2 and passes across the front of the adjacent land within hedgerows along the line of Barugh Green Road.

2.24 The ditch is then culverted by a 600dia pipe passing flows north towards the supermarket and Claycliffe Road. It is understood the culvert is the preferred outfall location for the adjacent land.

2.25 Minor surface water flooding is recorded on the head of the culvert within the adjacent land, which would tend to indicate the culvert is passing flow and has capacity. Flooding does increase adjacent the

supermarket and at the junction of Claycliffe Road and Medina Way where run-off from the Claycliffe Business Park run-off mixes with the Claycliffe Road catchment.

2.26 A large portion of the site pre-development circa 21.7 hectares discharge to this culvert.

2.27 A watercourse is located at the base of the valley north of Hermit Lane, this watercourse collects run-off from the site via drainage ditches and sheet run-off. The watercourse is culverted in part within Craven Wood it then opens within Redbrook Plantation it is culverted again beneath Redbrook Road.

2.28 Based on available discussion records with Barnsley LLFA it is understood that the culverted watercourse runs under highway and through Zenith Park Industrial Estate, the route being unknown. Before out falling to a ditch northeast of Zenith Park.

2.29 The LLFA have highlighted known issues with the culvert and have suggested the developer should carry out a survey of the culvert, survey work is pending at the time of this report.

2.30 Information from the Environment Agency surface water flood maps shows high risk flooding within Redbrook Road which may be a mixture of culvert capacity issues and the amount of greenfield run-off being directed by the pre-development site. Flooding is noted to reduce to mainly low with Zenith Park.

2.31 Further south of the main watercourse a ditch is recorded between cells R6 and R7 this ditch flows north to the development boundary where it turns northwest where it joins the main watercourse within the Redbrook Plantation valley. This ditch also receives run-off from the northern boundary ditch of cell R7.

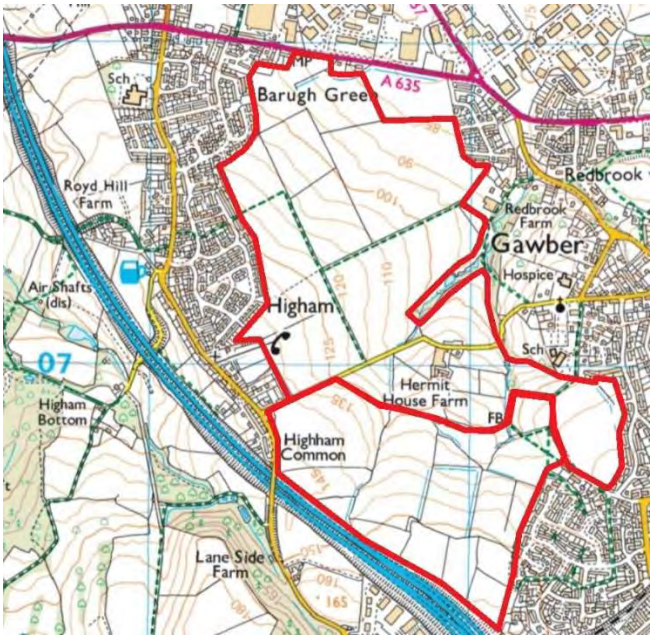
Existing Drainage Infrastructure

2.32 Existing public sewerage infrastructure which is present within the site's vicinity is described below. The existing sewer records provided by Yorkshire Water can be found in Appendix 4.

2.33 Previous consultation with Barnsley Highways Authority it is believed highway drains are located within Barugh Green Road.

2.34 Records show no public sewers within the development boundary. Sewer networks are located outside the boundary which can be viewed in appendix 4.

2.35 *Figure 1a – Site Location, Ordnance Survey*



2.36 *Figure 1a – Site Location, Ordnance Survey*

2.37 *Figure 1b - Detailed Site Location*

3. Existing Drainage Regime

3.1 The site is completely greenfield and discharge greenfield run-off via either sheet flow overland or by flow being collected and directed by drainage ditches.

3.2 The site dischargers to three catchments, Claycliffe Business Park, Claycliffe Road and Redbrook.

3.3 The HR Wallingford Greenfield run-off rate estimate tool to ascertain the existing 'pre-development' discharge rates. The direction of catchment and rates can be viewed in appendix 3 with table 1 detailing the rates.

Table 1 – Existing Greenfield Run-off

Catchment	Return Period	Discharge Rate
Claycliffe Business Park	QBAR 1 in 30 1 in 100 1 in 200	27.05 l/sec 47.33 l/sec 56.26 l/sec 64.10 l/sec
Claycliffe Road	QBAR 1 in 30 1 in 100 1 in 200	104.21 l/sec 182.36 l/sec 216.75 l/sec 246.97 l/sec
Claycliffe Ditch (part of Claycliffe Road)	QBAR 1 in 30 1 in 100 1 in 200	37.31 l/sec 65.29 l/sec 77.60 l/sec 88.42 l/sec
Redbrook	QBAR 1 in 30 1 in 100 1 in 200	197.68 l/sec 345.95 l/sec 411.18 l/sec 468.81 l/sec

4. Proposed Development

4.1 The Hybrid planning application for residential development up to 1560 dwelling, including:

Full application for

- Earthworks to create development
- Strategic drainage ponds/dry detention basins and associated drainage infrastructure
- Construction of new link road
- Location of strategic landscape and ecological areas
- Demolition of existing buildings
- Works to Hermit Lane, and
- Erection of Phase 1(a) residential development comprising of 216 dwellings.

Outline planning permission for

- Residential development comprising upto, 1344 dwellings
- New primary school
- Small shops and community facilities, and
- Associated infrastructure works

4.2 The following sections will provide discharge rates, storage volumes and catchments. As well as detailed design considerations which are to be applied to each development cell.

4.3 As the scheme proposals are to a masterplan level of detail, further detailed design will be required in the future by the developer of each plot.

4.4 Allocation of discharge rate and storage volumes will need to be assessed on a development cell by cell basis once a proposed developer as a planning layout, following the principles of this assessment.

4.5 Further modelling will need to be undertaken by Queensberry Design Ltd as and when development cell information is available to ensure the overall development strategy is being met.

4.6 A copy of the proposed masterplan and development cell phasing can be viewed in Appendix 2.

5. Surface Water Disposal Hierarchy

Possible Drainage Solutions

5.1 An assessment of possible drainage options has been undertaken in accordance with Building Regulations H3 Section 3 and NPPF. The disposal of surface water has been considered in the following order of priority.

-An adequate soakaway or some other infiltration system; or, where not reasonably practicable,

-A watercourse, or where not reasonably practicable,

-A sewer

Infiltration

5.2 Made ground is present across large swaths of the development area, this made ground consists of cohesive material over cohesive and granular opencast backfill.

5.3 Due to the underlying soil types and historic opencast working infiltration will not be possible for the disposal of surface water from the development site.

Discharge to a Watercourse

5.4 Discharge to a watercourse will be the preferred method of surface water disposal.

5.5 As discussed in section 3 and appendix 3 of this report, the existing site discharge greenfield run-off into three catchments.

5.6 The existing greenfield discharge rates are proposed to be applied to all storm events including climate change exceedance.

Discharge to Public Sewers

5.7 There are no existing sewers suitable to accept run-off from the new development.

6. Proposed Run-off Rates and Destination

6.1 As detailed in section 3 of the report, the scheme has three distinct drainage catchments Claycliffe Business Park, Claycliffe Road and Redbrook.

6.2 The development proposal is to mimic the existing catchment and reduced percentage run-off where practical.

6.3 The proposed site areas have been allocated to different discharge locations, based on development phasing, existing catchments and the placement of the strategic drainage ponds/dry detention basins.

6.4 A detailed drawing is provided in appendix 6. This assessment, allocation of discharge points and rates has determined the northern sections of R1, R2 and spine road shall drain to the existing ditch at the northern point of the site matching the existing QBAR rate currently being received by this ditch.

6.5 Then the southern portion of cells R1 and R2 the local centre and school and residential cells R3, R4, R5 and part of R6 will drain to the Redbrook Catchment. Additional Cells R6 and R7 will have their own storage and points of discharge into the Redbrook catchment.

6.6 Due to the way attenuation and discharge has been allocated the levels design for the scheme can now follow the existing site falls. Negating the need for significant depths of cut and fill to the development boundary.

6.7 Additionally, the development will be removing run-off from the Claycliffe Business Park and Claycliffe Road catchment on all return periods, contributing to the possible reduction of the recorded surface water flooding north of the development.

6.8 The scheme will match the existing QBAR rate for the Redbrook catchment but then provide a reduction during greater rainfall events.

6.9 Table 2 provides the run-off rates to each catchment.

Table 2 – Proposed Development Run-off Rates

Catchment	Return Period	Existing Rate	Proposed Rate	Percentage Reduction
Claycliffe Business Park	QBAR 1 in 30 1 in 100 1 in 200	27.05 l/sec 47.33 l/sec 56.26 l/sec 64.10 l/sec	0.00 l/sec 0.00 l/sec 0.00 l/sec 0.00 l/sec	100% on all events
Claycliffe Road (discharge via ditch see drawing QD2088-00-101)	QBAR 1 in 30 1 in 100 1 in 200	104.21 l/sec 182.36 l/sec 216.75 l/sec 246.97 l/sec	31.3 l/sec 31.3 l/sec 31.3 l/sec 31.3 l/sec	69.9% reduction 82.8% reduction 85.5% reduction 87.3% reduction
Redbrook	QBAR 1 in 30 1 in 100 1 in 200	197.68 l/sec 345.95 l/sec 411.18 l/sec 468.81 l/sec	197.6 l/sec 198.6 l/sec 198.6 l/sec 198.6 l/sec	No reduction 69.9% reduction 51.7% reduction 57.6% reduction

7. Sustainable Urban Drainage Systems

Storm Drainage

7.1 SuDS features will be incorporated into the design to provide attenuation and improve water quality.

7.2 SuDS measures are to be implemented in accordance with Ciria SuDS Manual (C753).

Table 3 - Possible SuDS Solutions for the Site

SuDS Feature	Suitability	Comments
Silt Traps	Yes	Efficient sediment collection.
Trapped Gullies	Yes	Maintains efficiency within sewerage system.
Green Roofs	No	Not appropriate for this form of development which has traditional steep pitched roofs. Householders are not appropriate to maintain this specialist form of roof covering.
Rainwater Harvesting	No	High capital cost and high maintenance and running cots make this form of SuDS inappropriate for this development. Development will be served by new watermains.
Swales	No	Not appropriate for the housing or roads within the development as swales take substantial area due to the batter slopes and the need to be reasonably deep to receive flows from any road gullies. Steep road gradient required due to development levels which may cause flood issues from swale
Filter Strips	Limited	These systems deal with sheet runoff and require large areas to accommodate. Mainly used for car parking and large hardstanding areas but could be incorporated adjacent shared private drives – to be reviewed by preferred developer for each cell.
Permeable Paving	No	It is understood that LLFA/highways do not adopt permeable paving. Permeable paving in private areas presents viability and ongoing maintenance issues. Due to the presence of largely low permeability clay soils infiltration would not be viable.
Pond	Yes	Ponds could be incorporated into the layout.
Detention Basin	Yes	Detention basis can be located across the site to attenuate surface water flows.
Soakaways	No	Due to the presence of largely low permeability clay soils.
Attenuation Storage Tanks	No	A tank or oversized storage pipes would be utilised as the storage for the development; however, these do not offer any surface water treatment or public amenity value so detention basins would be preferred.

7.3 SuDS features will be incorporated into the design to provide attenuation and improve water quality, given the strategic nature of the scheme the drainage pond/dry detention basins shall be designed to provide adequate treatment of run-off and attenuation, rather than plot level treatment and attention falling outside the scope of the hybrid application.

8. Pollution Control

8.1 Affective pollutant removal performance is required for all small rainfall events up to and including a more intense event which, on average may occur once a year (1 in 1 year event). The developer should consider water quality during and after construction to ensure the receiving waterbodies are not adversely affected by run-off from the development.

8.2 Assessment has been done using the simple index approach within the SuDS Manual Chapter 26. The land use pollution loads have been derived from table 26.2 as below.

Land use	Catchment (Y/N)	Pollution Hazard Level	Total Suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Y	Very Low	0.2	0.2	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non residential car parking with infrequent change (eg schools, offices) ie <300 traffic movements/day	Y	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways.	N	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways.	N	High	0.8	0.8	0.9

8.3 The SuDS components have then been assessed per scenario using the mitigation indices shown in table 26.3 of the SuDS Manual, extract of the site's components below.

Scenario	Type of suds component provided	Mitigation Indices		
		Total Suspended solids (TSS)	Metals	Hydro-carbons
1	Detention basin	0.5	0.5	0.6
2	Pond[4]	0.7[3]	0.7	0.5

8.4 CIRIA SuDS Manual Notes applicable to scheme:

- *SuDS components only deliver these indices of they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters.*
- *Filter drains can remove coarse sediments, but their use for this purpose will have significant implications with respect to maintenance requirements, and this should be taken into account tin the design and maintenance plan.*
- *Ponds and wetlands can remove coarse sediments, but their use for this purpose will have significant implications with respect to the maintenance requirements and amenity value of the system. Sediment should normally be removed upstream, unless they are specifically designed to retain sediment in a separate part of the component, where it cannot easily migrate to the main body of water.*

8.5 As it can be viewed the development run-off can be adequately treat by the SuDS components proposed.

8.6 The CIRIA SUDS manual provides three water quality parameters required to achieve water treatment within detention basins.

1) The 1 in 1 year water depth should be below 150mm, where possible the best practice goal is less than 100mm (although the water depth against vegetation height is also a consideration).
2) Flow velocity should be 0.3m/s or less to ensure adequate run-off filtration
3) The flow residence time within the basin should be at least 9 minutes

8.7 The proposals for the dry detention basins aim to meet these requirements securing adequate treatment.

9. Outline Surface Water Strategy

9.1 The proposed surface water infrastructure will be designed and put forward for adoption under Section 104 of the Water Industry Act following the requirements of 'Code for Adoption'. The system will either be adopted and maintained by Yorkshire Water or an Independent Distribution Network Operator 'IDNO'.

9.2 The prospective on-site cell drainage will connect into the infrastructure shown in this report, future cell details are outside the scope of this report and will be subject to separate reserved matters applications.

9.3 Adoption considerations of the SuDS is to be confirmed post planning determinate given the design parameters used to set of this drainage strategy, the proposed features are suitable for adoption.

9.4 Further maintenance assessment is required outside the scope of this document.

9.5 In accordance with the requirements of H3 of the Building Regulations surface water discharge hierarchy has been assessed and infiltration will not be possible for the development, as such following the hierarchy discharge to watercourse is the next preferred option.

9.6 As section 3 of this report the topographical survey have been used to model the site levels and then to determine the direction of run-off from the pre-development site.

9.7 These areas have then been used to generate pre-development greenfield run-off rates using the HR Wallingford calculator.

9.8 Suitable points of discharge mimicking the existing greenfield run-off (or reducing the existing greenfield run-off) have been allocated. The overarching principle of the distribution of run-off and allocation of storage is to follow existing site levels where possible to design out the requirements of large earthworks, retaining structures and deep drainage through future development cells.

9.9 The scheme proposes to discharge to the Claycliffe catchment and Redbrook catchment at Q_{BAR} rates as table 2.

9.10 Previous meetings with the LLFA have determined that a restricted rate to Redbrook is acceptable in principle following greenfield run-off rates.

9.11 Off-site flooding issues on the existing drainage network are known in the Redbrook catchment, some of this flooding will be cause by unrestricted greenfield run-off from the development.

9.12 The LLFA have stated that as the development is discharging to the Redbrook culvert (downstream of the open watercourse within the development), the culvert should be surveyed by the developer. This is so the condition can be assessed, and any necessary repairs carried out. The survey is pending at the time of this report revision.

9.13 Further off-site flooding has been raised by the LLFA west of the supermarket, the development proposes to discharge to this catchment, however significant reduction is run-off is proposed as detailed in table 2. This reduction will help to reduce the off-site flood risk.

9.14 Modelling has then been carried out to establish feeding pipe diameters and attenuation storage requirements.

9.15 It should be noted if boundaries change through future planning applications assessment of this drainage strategy is required to ensure the scheme still complies.

9.16 The proposed on-site drainage system shall be designed to 'code for adoption' and national non-technical standards and the scheme must meet the following design criteria:

- No surcharging of the system (other than flow controls) during the 1 in 1 year event.
- No flooding from the system during the 1 in 30 year event.
- No flooding to properties (both on and off site) or flooding risking people during the 1 in 100 year event plus climate change (40%).

9.17 No pumping is proposed for the development as the system propose to mimic the existing run-off characteristics.

9.18 Preliminary run-off volumes have been assessed using a 55% impermeability factor the total attenuation volumes can be seen in table 4 can be viewed on the drainage strategy drawing and calculations in appendix 7.

Table 4 – Attenuation Requirements

Catchment	Proposed Rate	Storage Volume
Basin 1	31.3 l/sec	4394m³
Basin 2	72.5 l/sec	8138m³
Basin 3	5.0 l/sec	1350m³
Basin 4	5.0 l/sec	1200m³
Basin 5	5.0 l/sec	830m³
Basin 6	52.8 l/sec	6190m³
Basin 7	41.6 l/sec	4000m³
Basin 8 (wetland)	30.8 l/sec	2240m³

9.19 It is proposed to restrict the run-off from the local and local centre separately, each phase has an allowance of 5 l/sec.

9.20 Flood routing from the proposed attenuation for storms above the design event of 100 year plus 40% climate change, shall be directed to the existing watercourse network, avoiding people and property.

9.21 Refer to appendix 7 for outline drainage strategy and calculations.

10. Foul Drainage

10.1 A pre-planning enquiry has been previously submitted to Yorkshire Water the response can be viewed in appendix 4.

10.2 The response confirms the closet point of discharge is the 600dia combined sewer in Barugh Green Road.

10.3 The response confirms the sewer has limited capacity and the nearest treatment works is Lundwood which is understood also to have limited capacity.

10.4 Given the capacity issues further feasibility studies will be required post planning approval to understand what is to be done to provide capacity, development phasing and timings of connections will be required from the developers to commence these studies. The cost associated with study work is Yorkshire Waters which is ultimately funded by new development infrastructure charges.

10.5 Draft calculation which are subject to further assessment on receipt of more detailed proposals for the Local Centre and School confirm a total discharge rate of 88 l/sec from the overall development to the existing public sewer network.

10.6 An overview of flow rate are as follows:

- School = 0.6 x 2.65 = 1.59 l/sec
- Local centre = 0.6 x 1.54 = 0.924 l/sec
- Employment site = 13.9 l/sec
- 1560 dwellings = 74.1 l/sec

10.7 Most of the site can discharge via gravity; however, two pumping stations are required serving parts of R6 and R7. These pumping stations are subject to detailed design however the design and approval will be under ‘code for adoption’ and Yorkshire Waters design standards.

11. Conclusion

Storm Drainage

11.1 Surface water run-off will discharge to the Redbrook and Claycliffe catchments. The development will restrict surface water flow to existing greenfield run-off rates (or less) across all storm events which is the equivalent greenfield run off rate for the proposed developable boundary.

11.2 Applying a restricted discharge rate in this way results in a reduction from pre-development rates during extreme rainfall events which may result in flooding / flood risk reduction.

11.3 Storage will be provided by eight drainage ponds/dry detention basins which have been sized to accommodate the masterplan.

11.4 All new adoptable standard surface water drainage is to be designed in accordance with 'SSG' and to ensure that no flooding occurs during the critical 1 in 30-year storm event.

11.5 A 40% increase in rainfall due to climate change has been considered for the 1 in 100 year event.

11.6 Exceedance from the development shall be assessed and the proposed level design must ensure exceedance flow is directed away from people or property.

Foul Drainage

11.7 It is proposed to discharge foul flows into the 600 dia sewer in Barugh Green Road.

11.8 Further feasibility studies are required of the public sewer network and Lundwood treatment works.

11.9 All new adoptable foul sewerage is to be designed in accordance with 'SSG'.

11.10 Two pumping stations will be required to serve parts of R6 and R7.

Appendix 1 - Topographical Survey