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Drainage Philosophy

219112-MSJ-ZZ-XX-RP-D-0001-S3-P2

Introduction

This philosophy is for the foul and surface water drainage systems at a proposed housing development at High Street, Shafton.

Existing Site

The existing site is a relatively rectangular area of green field land located adjacent to High Street. It is approximately 1.3ha. The site is mostly undeveloped and currently comprises of grassland along with hardstanding from demolished building footprints. The site generally falls from the South West to the North East from approximately 79.9m to 73.5m.

Site location plan is shown in Appendix A and the existing topographical survey is shown in Appendix B.

Existing Drainage

The existing site is greenfield and has no surface or foul water discharges. The nearest public surface water sewer is north west to the junction of Acacia Grove approximately 40m North East of the site. The nearest public foul sewer is approximately 1.5m away running North of the site in private gardens. Public combined sewers exist to the South of the site.

Drainage Philosophy

In accordance with Approved Doc H, surface water should, in order of priority, discharge to

- The site itself via infiltration
- A local watercourse
- Surface water sewer
- Combined sewer

In addition to this, planning policy dictates that new development should utilise sustainable drainage systems (SuDS) wherever possible.

Various investigations have been undertaken to establish the viability of the above.

Soakaway testing was carried out by WYG in 2017. The testing determined site-specific infiltration rates and that ground water was not encountered during the investigation although perched water was encountered in all the bore holes at shallow depth. See Appendix C.

There was no surface water bodies located on site or in the surrounding area with the nearest watercourse, Hemp Dyke, being 850m North of the site.

Yorkshire Water was contacted about the viability of discharging foul and surface water into the public drains. Yorkshire Water will allow a foul water connection to any of the local foul and combined sewers in the locality at an unrestricted rate. Surface water can connect into the public surface water sewer in Acacia Grove at a restricted rate of 3.5l/sec. The foul water will discharge via a manhole at the north of the site. The surface water will discharge via a manhole on Park View. The existing mean maximum run off rate for the greenfield condition (QBar) for this site has been calculated to be 5.7l/sec Appendix E. This rate should be reduced by 30% for any post development surface water discharges. This would give a rate of 4 litres per second. As the Yorkshire water specified discharge rate is lower than this, the 3.5 l/sec rate will be used in design. See Appendix D.

Surface Water Drainage

As mentioned above, SuDS systems should be used wherever possible. Of these systems, infiltration methods of disposal such as soakaways or infiltration basins have been discounted on this site, due to the poor testing results.

SuDS systems are however not limited to systems that simply dispose of water and other components can be used to convey and treat surface water on site. Examples of such systems are:-

- Swales
- Filter Strips of drains
- Permeable paving
- Green roofs
- Detention ponds
- Attenuation tanks

Linear features such as swales and filter strips are generally located adjacent to highways and are intended to accept sheet flow from roads and areas of hardstanding. They require an area of green space adjacent to roads. The approved planning layout is designed in such a way that in many cases the private parking bays are immediately adjacent to the highway. There is very little green space adjacent to most of the highways and private drives. Linear Suds features such swales, filter strips and drains are therefore not considered viable on this site.

Green roofs generally require relatively flat roof to be able to work effectively. As this is a housing development which uses pitched roofs, green roofs are not considered viable.

Permeable paving is most effective when the ground is suitable for infiltration. Additionally, permeable paving is unsuitable for adopted highways. For these reasons, permeable paving has been discounted.

Detention basins and attenuation tanks are both viable and as there is a surface flow restriction on this site, some form of attenuation is necessary. Both systems temporarily store water during heavy rainfall. The site investigation reported standing water at shallow depth in all of the boreholes and as such, a detention basin has been discounted as there must be no standing water within 1m of the base of the basin. An underground tank is the preferred option on this site

Based on the above, it is proposed to drain this site with an underground system of pipes to an underground attenuation tank. Discharge from the tank will flow via a flow control to an offsite existing surface water sewer situated on park view adjacent to the site. Despite having possible connection locations on Acacia Grove available we have deemed them not a viable option due to the invert levels being much higher than the connection locations further downstream on Park View. If the SW sewers in Acacia Grove were to be used, either pumping would be required or site levels would need to be substantially increased.

Based on a restricted discharge rate of 3.5l/s, a Quick Storage Estimate has been produced and the tank size will be approximately 450m^3. See Appendix F. The tank will be located at the north of the site labelled as public open space. A draft drainage layout is attached in Appendix G.

Additionally the surface water system will be designed to the following standards:

- System will not surcharge for 2 year RP events
- System will surcharge but not flood for 30 year RP events
- System will flood for 100 year +30%CC + 10% Urban Creep but that any floodwater will be managed in such a way that it will not pose a risk to property
- Flood flow paths will be identified to assess the risks to properties in the event of exceedance or sewer failure.

Maintenance

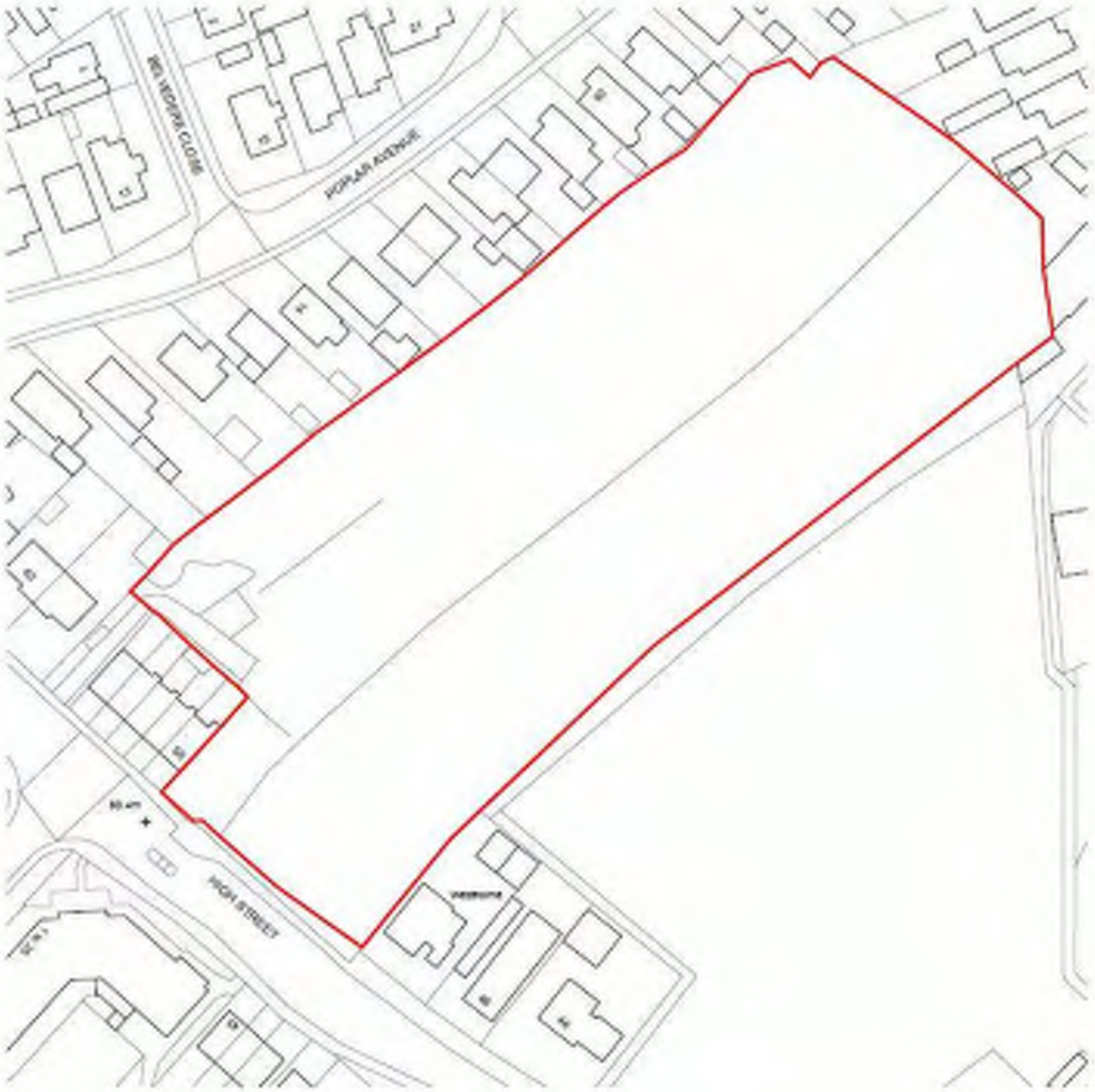
It is essential that surface water systems are adequately maintained to ensure their long term performance. Attenuation tanks require maintenance and also silt removal facilities to ensure that the volume in the tank is maintained and also to help reduce the likelihood blockages. The private drainage systems will drain via trapped gullies and linear drainage channels that will have silt traps. These must be periodically cleaned out and it will be the responsibility of individual home owners to do this. Road gullies for the adoptable highway will also have silt traps and it will be the responsibility of the local highways authority to ensure that they are adequately maintained.

The attenuation tank and flow controls will be adopted by Yorkshire Water under a Section 104 agreement. The long term maintenance of these elements together with the adopted sewers in the roads will be the responsibility of Yorkshire Water.

Foul Water

Foul water will drain from properties via gravity to a system of underground sewers. These sewers will drain to an offsite existing sewer located to the north of the site. There are a number of potential connection points available in private gardens to North of the site. Any foul water connection in 3rd party land will be done with the consent of the landowner or via a Section 98 sewer requisition. The exact location of the connection is yet to be determined.

Appendix A





Notes | Sketch schemes may be based on plan information of unknown origin and is subject to verification and survey. Contractors must verify all dimensions on site before commencing any work or shop drawings. This drawing is not to be scaled. Use figured dimensions only. Ensure digital versions are plotted at 'Actual Size'. Building areas are liable to adjustment over the course of the design process due to ongoing construction detailing developments. Subject to statutory approvals and survey. The bar above is to check that the drawing has been printed to scale.

Rev	Date	Description	Drawn	Checked

Project	High Street, Shafton
Drawing	Location Plan
Client	Vistry Partnerships Limited

BIM Suitability Description: SUITABLE FOR INFORMATION — BIM Suitability Code: 02

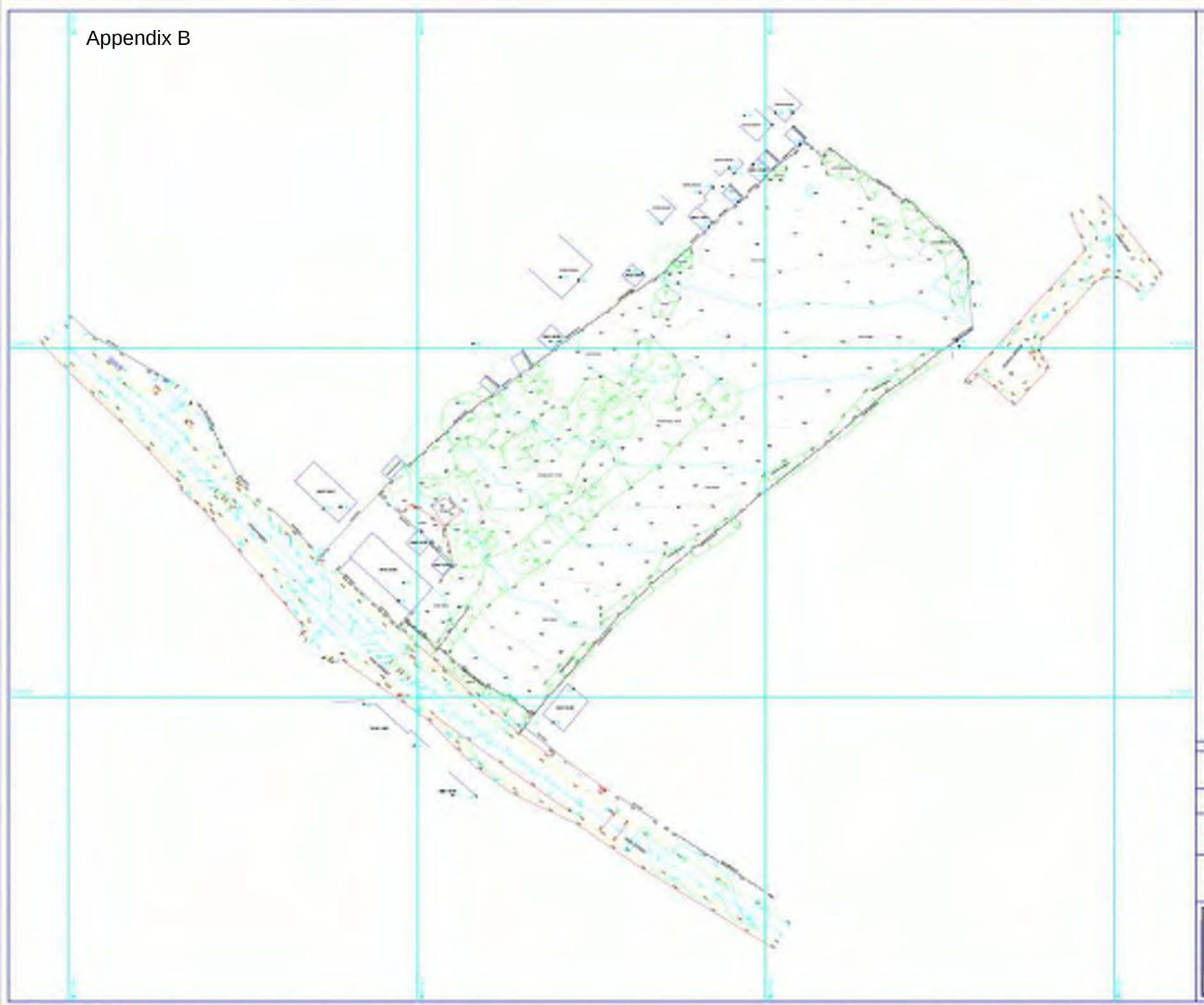
Status	Preliminary
Date	21.02.20
Drawn	CR
Checked	GE
Scale (A4)	1:1250

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0812 · EA · A · S001 ·

Appendix B



PROPOSED DEVELOPMENT AT
HIGH STREET, SHAFTON

WESTRY PARTNERSHIP

TOPOGRAPHICAL SURVEY

VP002/T00

RJP

*receptors were considered to be **Very Low**, with the potential for higher risk if asbestos is identified in soils.*

- *Residual below-ground structures from the early allotment structures may remain. It is unlikely that these would be substantial, although they should be removed before redevelopment.*
- *Intrusive site investigations including geotechnical and limited contamination testing and gas monitoring are recommended within the development area to investigate ground conditions, determine the extent and properties of Made Ground, to determine gas risk and to inform foundation / structure design.*

A soakaway investigation was undertaken and reported by WYG in 2017 [3]. The purpose of the investigation was to determine site-specific soil infiltration rates. Key findings from the investigation are detailed below:

- *Three trial pits (SO01-SO03) for the purposes of soakaway testing were excavated to a maximum depth of 2.5m bgl. All three trial pits were situated in the eastern half of the site. In general, the ground conditions comprised topsoil to 0.3m bgl, overlying sandy clay to depth between 1.55m and 1.70m bgl, overlying mudstone and sandstone of the Pennine Lower Coal Measures.*
- *Groundwater was not encountered during investigation works.*
- *Infiltration rates were calculated from SO01, SO02 and SO03 as 1.408^{-07} m/s, 9.758^{-07} m/s and 1.772^{-06} m/s, respectively, with an average infiltration rate of 9.612^{-07} m/s.*

1.0 Executive Summary

Proposed Development	Residential development is proposed.
Site Conditions	Most of the site comprises gently undulating open grassland with scrub vegetation. Areas of hardstanding from demolished building footprints and several piles of demolition arisings / household waste were encountered in the north-western portion of the site.
Ground Investigation	The ground investigation was undertaken by WYG between 24 and 25 January 2019. The investigation comprised the excavating of 8No. trial pits and drilling of 5No. window sample boreholes. Groundwater and gas monitoring standpipes were installed in the 5No. boreholes.
Ground Conditions	The ground conditions typically comprised topsoil overlying cohesive superficial deposits overlying MUDSTONE or SANDSTONE bedrock of the Pennine Middle Coal Measures Formation. Groundwater monitoring recorded water at depths between 0.32m and 1.14m bgl; water levels are likely affected by surface water infiltration.
Geotechnical Assessment	In general, the CLAY underlying the site was of medium to high strength. The average moisture content of TOPSOIL was 36%, superficial CLAY was 26% and MUDSTONE was 12%. The Atterberg Limits test indicate that superficial CLAY generally has a high to very high plasticity and a medium to high volume change potential. The superficial CLAY deposits fell within the grading envelopes of 2B/2C. 2.5kg compaction testing returned optimum moisture content values of 26-34% and a maximum dry density of 1.37-1.57Mg/m^3. The Design Sulphate Class was assessed as DS-1, ACEC Class AC-1s.
Contamination Assessment	Contaminant concentrations were predominantly below relevant screening criteria. Sporadic elevated concentrations of metals were assessed as not requiring remedial action following supplementary investigation. Ground gas monitoring was constrained by shallow groundwater levels. However, gas protection will be required due to radon risk and no further protection is required to mitigate other gases.
Conclusions and Recommendations	Building foundations and waste materials remain on site and will require removal to facilitate development. Numerous trees are present within the site and around the site boundary; CLAY beneath the site is of medium to high volume change potential. It would be prudent to undertake a tree survey to confirm species and heights to assess their potential effects on the underlying CLAY. If high-water demand species are present in close proximity to proposed building footprints and a significant proportion of the development would require deep trench fill footings, it may be more economical to consider a piled foundation solution. Where applicable, a proprietary compressible material should be incorporated into the foundation design to protect against heave/ shrinkage.

Appendix C

Land off High Street, Shafton: Geo-Environmental Report

	Suspended ground floors should be used in all situations where heave can occur within the area bounded by the foundations. Water levels were recorded at shallow depths immediately after the site investigation and the boreholes were subsequently purged during the monitoring period. After purging the groundwater levels returned to the initial levels and therefore management of groundwater during site redevelopment will be required and the presence of a shallow groundwater should be considered during the foundation design. Suitable foundations should be designed in accordance with NHBC Guidelines. No requirements for contamination remediation were identified. Buildings will require gas protection due to radon, which will also provide precautionary protection from other gases.
This sheet is intended as a summary of the assessment of the site in relation to ground contamination and geotechnical conditions. It does not provide a definitive engineering analysis.	

Appendix C



Exploratory Hole Location Plan

Land off High Street, Shafton

Homes England

N

Legend

- Trial Pit (2017 WYG)
- Site Boundary

Exploratory Hole (2019 WYG)

- Window Sample
- Trial Pit

Notes:

Drawn by: LM

Drawing No. A090070-S00_Fig2

Checked by: AW

Revision No. 1

0 30 60 90 Metres

Scale: 1:1750 @A3

4/2/2019

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anna.cuanalo

From: Chris.Roberts@yorkshirewater.co.uk on behalf of technical.sewerage@yorkshirewater.co.uk
Sent: 10 December 2017 11:09
To: colin.davidson
Subject: High Street, Shafton - Pre Planning Sewerage Enquiry R661557
Attachments: image001.png; image002.png; image003.png; image004.png; image005.png; roberts4_rad7974C.PNG; HIGH.pdf; A090070-332 - High Street, Shafton - Soakaway Letter Report.pdf

Dear Mr Davidson.

Thank you for your email.

Foul Water

We have very limited depth information on the sewers in this area. All known inverts are shown on the plan I sent in pink. In regards to alternate connection locations I would not have any objections to you connecting to any of the foul / combined sewers in the area.

Surface Water

It is accepted that soakaways will not be feasible for this development and there are no recorded watercourses close to the site.

I can agree to surface water discharging to the 225 mm surface water sewer in Acacia Grove at a maximum rate of 3.5 l/s.

Please note further restrictions on surface water disposal from the site may be imposed by other parties. You are strongly advised to seek advice/comments from the Environment Agency/Land Drainage Authority/Internal Drainage Board, with regard to surface water disposal from the site.

Kind Regards

Chris Roberts
Sewerage Technician
Yorkshire Water

*** Please note, all correspondence must be sent to technical.sewerage@yorkshirewater.co.uk and will be responded to within 10 working days ***

Appendix E

Wells Smith and Jones		Page 1
Vinery Court 58 Cardigan Lane Leeds LS6 2LD	High St Shafton	Micro Drainage
Date 07/08/2020 09:08 File	Designed by MH Checked by	
Innovyze	Source Control 2020.1	

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.450
Area (ha)	50.000	Urban	0.000
SAAR (mm)	697	Region Number	Region 3

Results l/s

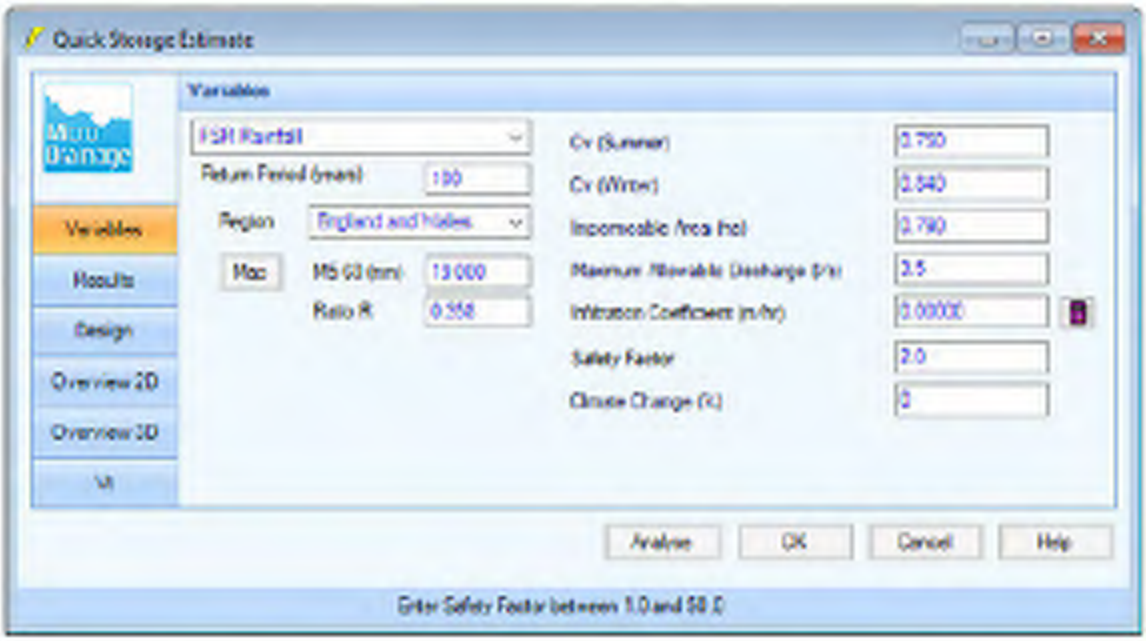
QBAR Rural	218.6
QBAR Urban	218.6
Q100 years	454.6
Q1 year	188.0
Q2 years	206.2
Q5 years	273.2
Q10 years	316.9
Q20 years	358.9
Q25 years	372.9
Q30 years	384.2
Q50 years	413.9
Q100 years	454.6
Q200 years	515.8
Q250 years	535.5
Q1000 years	668.4

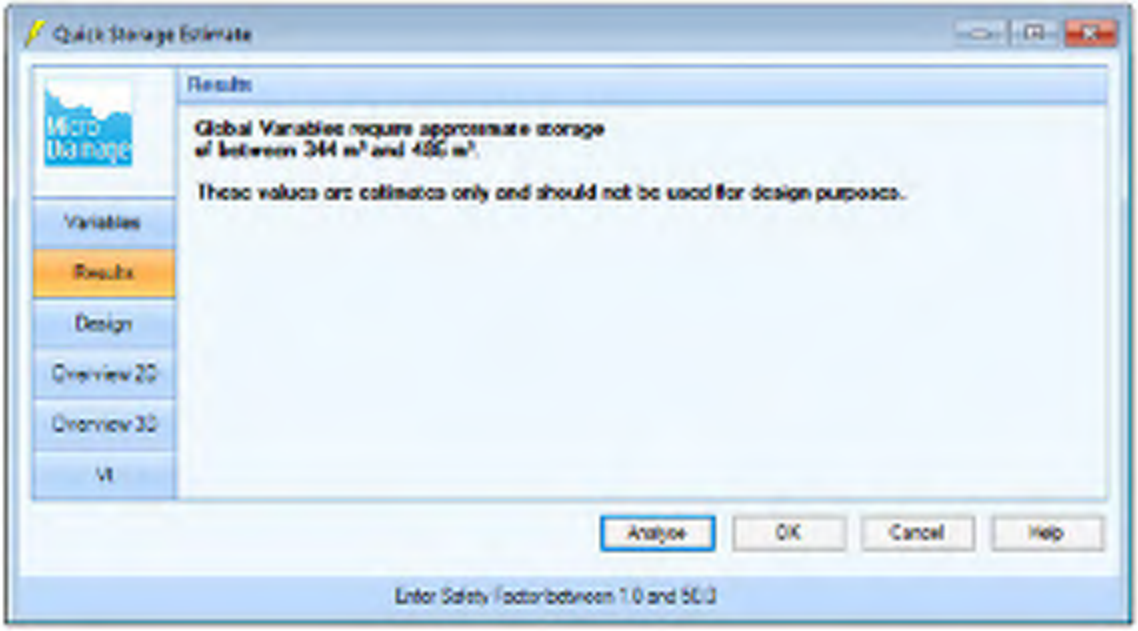
Qbar for a 50ha site = 218.6. Value for a 1.3ha site pro rata = 5.68 l/sec

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Appendix F

2189112 High Street Shafton.
Approximate surface water storage volume based on a site area of 0.72 + 10% urban creep, 3.5 litres per second discharge and 100 year return period storms.

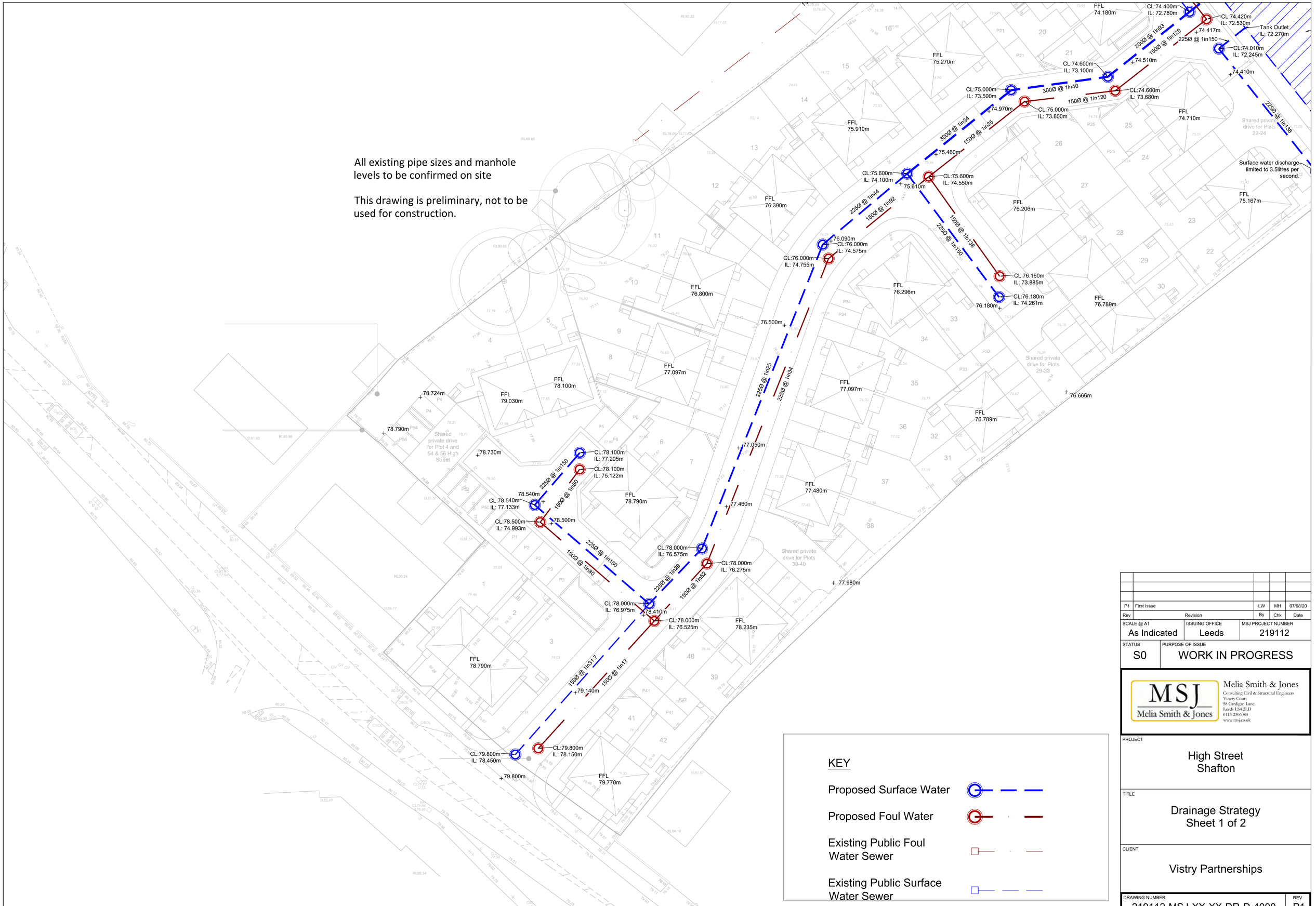




Appendix G

All existing pipe sizes and manhole levels to be confirmed on site

This drawing is preliminary, not to be used for construction.



KEY

- Proposed Surface Water
- Proposed Foul Water
- Existing Public Foul Water Sewer
- Existing Public Surface Water Sewer

Rev	Revision	By	Chk	Date
P1	First Issue	LW	MH	07/08/20

SCALE @ A1	ISSUING OFFICE	MSJ PROJECT NUMBER
As Indicated	Leeds	219112

STATUS	PURPOSE OF ISSUE
S0	WORK IN PROGRESS

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PROJECT

High Street
Shafton

TITLE

Drainage Strategy
Sheet 1 of 2

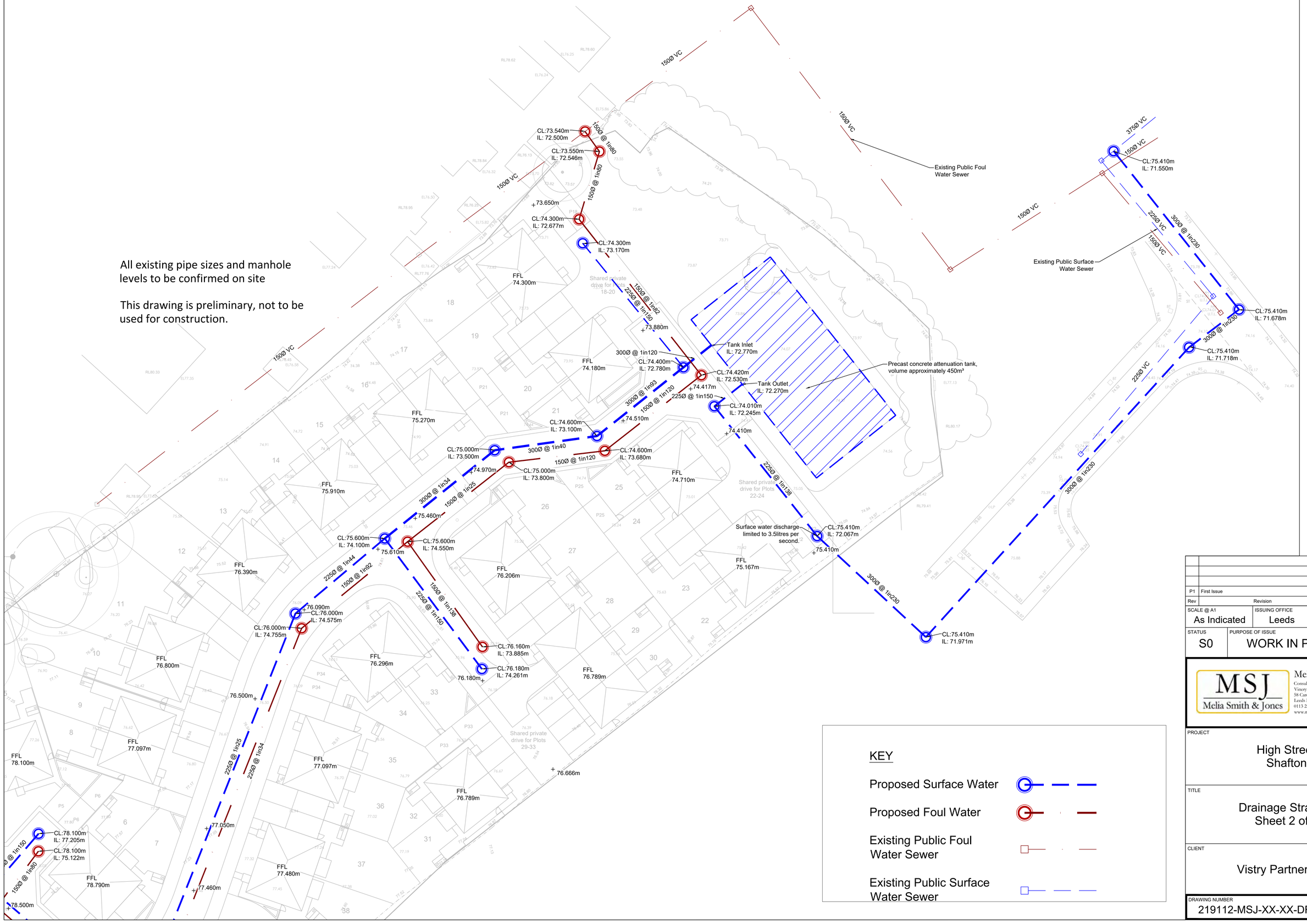
CLIENT

Vistry Partnerships

DRAWING NUMBER	REV
219112-MSJ-XX-XX-DR-D-4000	P1

All existing pipe sizes and manhole levels to be confirmed on site

This drawing is preliminary, not to be used for construction.



KEY

- Proposed Surface Water
- Proposed Foul Water
- Existing Public Foul Water Sewer
- Existing Public Surface Water Sewer

Rev	Revision	By	Chk	Date
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PROJECT

High Street
Shafton

TITLE

Drainage Strategy
Sheet 2 of 2

CLIENT

Vistry Partnerships

DRAWING NUMBER	REV
219112-MSJ-XX-XX-DR-D-4001	P1

Appendix H
Flood Risk Assessment

Homes England

Proposed Residential Development, Shafton, Barnsley,

Flood Risk and Foul Drainage Assessment

March 2018

Geneva Building, Lake View Drive, Sherwood Business Park
Annesley, Nottingham NG15 0ED

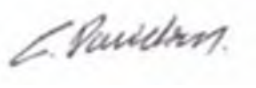
www.wyg.com

Document Control

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Project:	Shafton, Barnsley
Client:	Homes England
Job Number:	A090070-332
File Origin:	O:\Engineer\Projects A000000 to A999999\A090070-332 Shafton FRA\Project Admin\Reports\Shafton FRA
Revision: -	**Version 1**
Date:	**March 2018**

Prepared by	Checked by	Approved By
Anna Cuanalo	**Tom Spawton**	**Colin Davidson**





This report has been prepared for Homes England, and any duty of care to any other party is excluded. Any other party using or intending to use this information for any other purpose should seek the prior written consent of WYG.

The conclusions reached are those which can reasonably be determined from the sources of information referred to in the report and from our knowledge of current professional practice and standards. Any limitations resulting from the data are identified where possible but both these and our conclusions may require amendment should additional information become available. The report is only intended for use in the stated context and should not be used otherwise.

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Appendix A - Proposed Site Layouts

Appendix B - LLFA Correspondance

Appendix C - YW Plans and Correspondace

Appendix D - SFRA and PFRA Maps

Appendix E – MicroDrainage Calculations

Appendix F – Topographic Survey

Appendix G – Soakaway Testing

Appendix H – CCTV Survey

1 Executive Summary

Existing Site	The Greenfield Site covers an area of approximately 1.3ha and is located to the north east of High Street, Shafton, Barnsley, S72 8NF (grid reference 439371mE, 410885mN). The proposed development is to construct 43 residential dwellings.
Flood Risk Assessment	The Environment Agency (EA) flood risk zone map shows the site to lie entirely within Flood Risk Zone 1 (low risk – likelihood of flooding less than 0.1% - 1 in 1000 year return period). The closest Main River to the site is Hemp Dike which is located approximately 850m to the North of the site. Following review of flood risk at the site, it is considered that the proposed development is at low risk of flooding from sources including rivers and watercourses, surface water, sewers and groundwater. According to Table 2 of the NPPF, the proposed development would be considered as the 'More Vulnerable' land use classification in respect to flood risk vulnerability.
Site Drainage	In accordance with the recommendations in the NPPF, the design of the new development will adopt measures to reduce the surface water discharge through the use of sustainable drainage techniques. Surface water runoff will be attenuated within the Site drainage system to mitigate off-site flooding and to protect vulnerable areas within the Site. Soakaway testing has identified poor infiltration rates for the site. In the absence of a local watercourse a sewer connection is considered the only feasible option. Yorkshire Water has been consulted and has confirmed that in this instance a limited discharge of 3.5 l/s of surface water could be connected to the surface water sewer within Acacia Grove. An above ground detention basin has been sized that provides a volume of 431 m^3 of attenuation storage which is sufficient to balance flows during the 1 in

	100 year + CC event whilst limiting the discharge to 3.5 l/s. Other potential SuDS options such as permeable paving with subgrade storage within private parking areas and filter drains may be considered at detailed design stage. Yorkshire Water has confirmed that the foul sewerage from the site can discharge at an unrestricted rate to the combined sewer in High Street to the south west of the site. A pumped connection will be required.
Conclusions	Provided that steps are taken within the detailed design to mitigate and manage the residual flood risks it is concluded that the site is appropriate for the proposed development. A practical means of surface water management for the site has been provided.

2 Introduction

2.1 Background

This report was commissioned by Homes England and has been produced to support the planning application for 43 residential dwellings located to the north of High Street, Shafton, Barnsley, S72 8NF. The land to be developed currently consists of Greenfield land.

This Flood Risk Assessment report is undertaken in accordance with the National Planning Policy Framework (NPPF, March 2012) and the accompanying technical guidance issued by the Department for Communities and Local Government (March 2012). Recommendations and guidance set out within the Code of Practice 'BS 8533: 2011 Assessing and Managing Flood Risk in Development' has also been considered in the production of this report.

2.2 Site Location

The Site is located north east of High Street, Shafton, Barnsley, S72 8NF (grid reference 439371mE, 410885mN). The land under consideration has an approximate area of 1.3ha and is a Greenfield Site. The Site is approximately rectangular in shape and is bound to the East by Residential Dwellings and Greenfield land, to the south by High Street, and to the north and west by Residential Dwellings as shown in Figure 1.

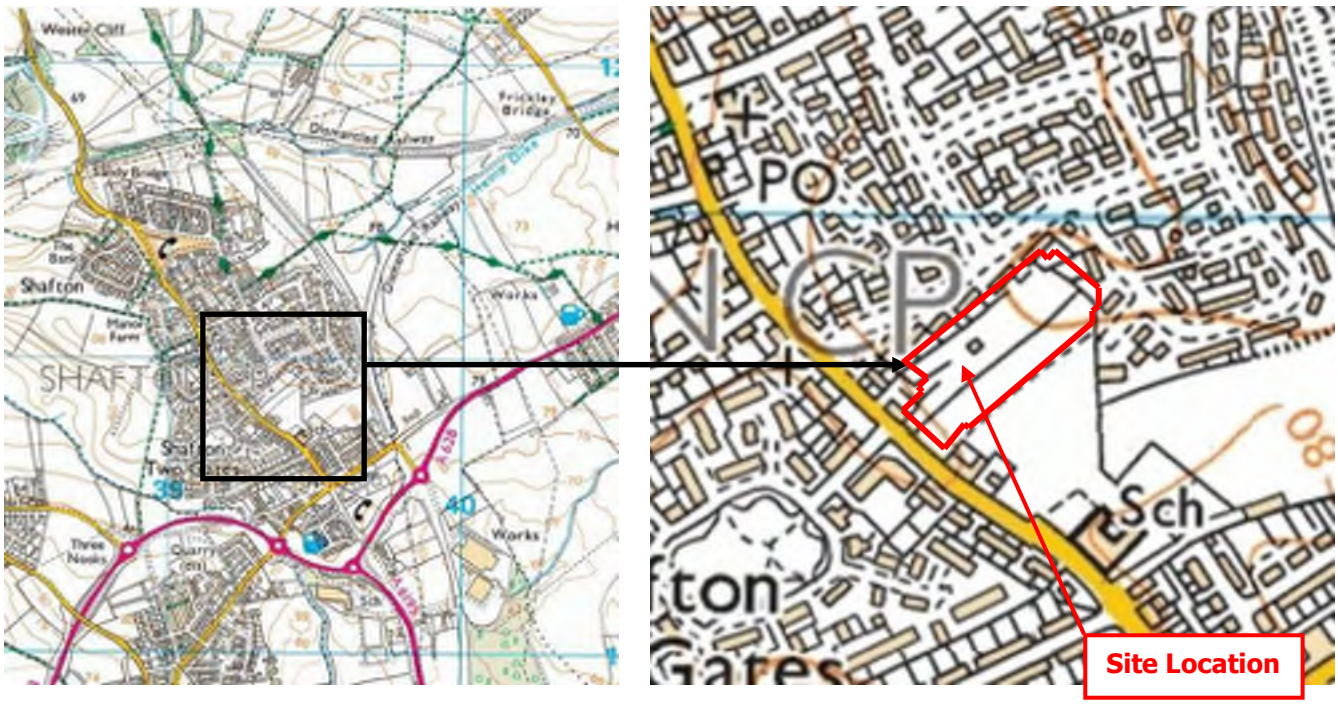


Figure 1 – Site location plan

2.3 Data Collection

The flood risk assessment utilises the following data sources:

- Proposed Site Layout;
- Topographical Survey;
- Barnsley Metropolitan Borough Council Strategic Flood Risk Assessment (SFRA) dated September 2010;
- Barnsley Metropolitan Borough Council Preliminary Flood Risk Assessment (PFRA) dated July 2011;
- British Geological Survey (BGS) Mapping (BGS website);
- Environment Agency flood mapping (EA website);
- LLFA Correspondence;
- WYG Soakaway testing, November 2017;
- CCTV Drainage Survey of downstream network.

2.4 Proposed Development

The proposals indicate that the Greenfield land is to be redeveloped for residential use with the client stating that up to 43 residential dwellings are proposed for the site. A proposed residential development layout is included within Appendix A of this report.

According to NPPF Flood Vulnerability Classification (Table 2), residential development is classed as 'more vulnerable' in respect to flood risk. The proposed land use is considered appropriate within Flood Risk Zone 1.

3 Data

3.1 Environment Agency

The Environment Agency's (EA) Flood Risk Map has been consulted and the entirety of the site is shown to lie within Flood Risk Zone 1. This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding (<0.1% annual exceedance probability (AEP)). The EA flood risk map is shown in Figure 2 below.

The EA website flood risk map shows that the closest Main River to the site is Hemp Dike which is located approximately 850m to the north of the site.

The EA flood risk map is shown in Figure 2 below.

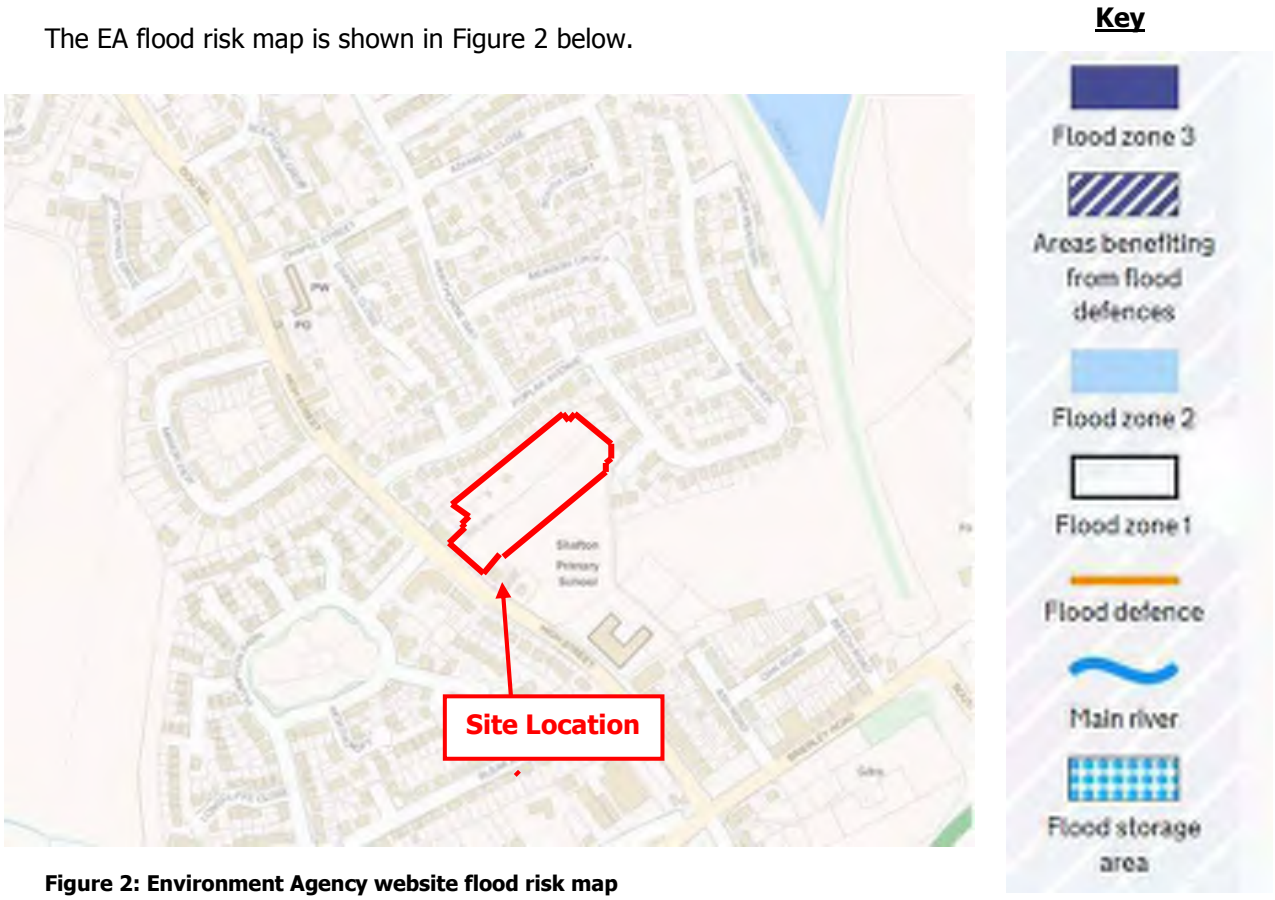


Figure 2: Environment Agency website flood risk map

Since the application site is located within Flood Risk Zone 1, no recent correspondence has been undertaken with the EA as the responsibility for flood risk is now covered by the Lead Local Flood Authority (LLFA) for the area, this being the Barnsley Metropolitan Borough Council.

3.2 Topographical Survey

A topographical survey has been made available for the site and is shown within Appendix F. The topography of the Site varies from 73.4m AOD and 79.3m AOD, with a general downwards slope from southwest to northeast.

3.3 Strategic Flood Risk Assessment

Barnsley Metropolitan Borough Council Strategic Flood Risk Assessment (SFRA) was completed by JBA Consulting and was published in September 2010.

The SFRA provides historic information with regard to flooding and assesses the risk of flooding from rivers, the sea; surface water/overland flow, groundwater, sewers and artificial sources. Each of these flood risks are discussed in detail in Section 4 of this report.

3.4 Preliminary Flood Risk Assessment

The Preliminary Flood Risk Assessment (PFRA) prepared by East Barnsley Metropolitan Borough Council dated July 2011 has been reviewed. The report discusses the past and present flood risks and historical flooding within the area. The report also discusses other sources of flooding such as groundwater and surface water.

3.5 British Geological Survey Mapping

From the British Geological Survey (BGS) Mapping, the Site is shown to be underlain by coal measures and mudstone, siltstone and sandstone with no superficial deposits.

3.6 Soakaway Testing

To determine whether the site is suitable for infiltration type drainage, soakaway testing was undertaken. The soakage testing report is shown within Appendix G. A series of three trial pits were excavated to a maximum depth of 2.5 m BGL. Infiltration rates were calculated as $1.40E^{-7}$, $9.75E^{-7}$ and $1.77E^{-6}$ respectively with an average site infiltration rate of $9.61E^{-7}$. Based on these poor infiltration rates, the site is considered not to be suitable for infiltration type SuDS and discharge of surface water from site will be required.

3.7 CCTV Survey

A CCTV survey was conducted to identify invert levels of the sewers to the northeast of the site. The report from the survey is shown in Appendix H. The survey identified that a gravity connection to surface water sewer may be feasible but would require laying through third party land or a narrow public footpath.

4 Flood Risk Assessment

4.1 Historical Flooding

Map 2 of the SFRA shows historical flood events from local sources of flooding. According to the Map, no instances of flooding have been recorded within the vicinity of the Site or the immediate surrounding area. The map is available in Appendix D of this report.

The LLFA correspondence has mentioned past flooding within the gardens and outbuildings to properties within Acacia Grove which is believed to be caused by run-off from the site.

4.2 Fluvial Flooding

The EA flood risk map shows that the closest Main River to the site is Hemp Dike which is located approximately 850m to the north of the site.

As stated in Section 3.1 of this report, the entirety of the site and the surrounding area is shown to lie within Flood Risk Zone 1 which comprises of land assessed as having a less than 1 in 1000 annual probability of river flooding (<0.1% AEP).

Map D-1 of the SFRA shows 1 in 100 year fluvial flood extent and depth maps within the region. There are no instances of fluvial flooding shown within the vicinity of the proposed development or within the Shafton area.

The LLFA have confirmed via correspondence that the proposed development is not affected by any flood plains from major watercourses in the area.

Based on the available data, there is no record of fluvial flooding of the site, and therefore the site is considered to be at low risk of fluvial flooding.

4.3 Tidal Flooding

The site is remote from the coast and at levels in excess of 70m AOD. As such the site is not considered to be at risk of tidal flooding.

4.4 Groundwater

Groundwater flooding can occur when heavy rainfall causes the groundwater table to reach the surface of the ground. In this case, the Site is not located on a Principal Aquifer or a Source Protection Zone. As previously stated, the Site is underlain by coal measures and mudstone, siltstone and sandstone which is relatively impermeable by nature.

The PFRA states that the Environment Agency's national dataset has been used to assess flood risk from groundwater and shows that there is no local information available which provides evidence on future groundwater flood risk across Barnsley and groundwater is not believed to be an issue within the borough. Ground water was not encountered during the excavation of trial pits as part of the in site soakaway testing (November 2017). Due to the relatively low risk of groundwater flooding indicated by the PFRA, and the absence of any recorded instances of flooding from this source, the site is not considered to be at risk of groundwater flooding.

4.5 Surface Water/Overland Flow

Surface water flooding occurs following heavy or prolonged rainfall, where water can no longer be absorbed into the ground resulting in surface run-off. Unless it is channelled elsewhere, the run-off travels overland, following the natural gradient of the land. Ponding occurs as the overland flow reaches natural depressions or blockages in the local topography.

The SFRA Map C-1, included within Appendix D, has identified areas within the Barnsley Metropolitan Borough catchment that are considered to be most at risk of surface water flooding. The nearest area to the Site is within farmland 2km south of the site.

The EA Risk of Flooding from Surface Water map has been consulted and a copy of the map is shown in Figure 3.



Figure 3 - Environment Agency website surface water flood risk map

The map shows that the majority existing site is at very low risk of flooding from surface water (annual probability of flooding less than 1 in 1000 years). A small area within the site, as well as areas north of the site is at low risk of flooding from surface water (annual probability of flooding of between 1 in 100 and 1 in 1000 years) and an area north of the site on Poplar Avenue is at high risk of flooding from surface water (annual probability of flooding of greater than 1 in 30 years).

The surface water depth map for the low chance of occurring event has been reviewed and is shown within Figure 4.



Figure 4 – Environment Agency website surface water depth map

The map shows that the depth of flood water near the north border of the site for the low chance of occurring event is mostly below 300mm and partly between 300 to 900mm.

The LLFA are aware of flooding issues to gardens and outbuildings to properties on Acacia Grove which are believed to be caused by runoff from the site.

As part of the development a new piped drainage network, designed to current standards, will be provided to intercept surface water run-off from the development areas that increase the impermeable area. Suitable provision would also be made for the storage of excess surface water run-off within an attenuation basin on site.

The site is considered to be at low risk of surface water flooding, and it is believed that with increased surface water management as part of the proposed development, the risk of surface water flooding to land north of the site is likely to reduce.

4.6 Sewer Flooding

Sewer flooding can occur when the capacity of a piped network is exceeded or when the system becomes blocked or collapses.

The PFRA Appendix 4 contains a record of sewer floods. The nearest recorded sewer flood was approximately 430m south of the site. The PFRA concludes that sewer flooding across Barnsley generally appears to be sporadic and infrequent.

Following implementation of a suitable drainage scheme for the proposed development the risk of flooding from sewers is considered to be low.

4.7 Artificial Sources

The EA online Map showing the 'Risk of Flooding from Reservoirs' shows that the site is not located within an area at risk of flooding from reservoirs.

4.8 Climate Change

In accordance with the NPPF and EA updated guidance dated 19th February 2016, and to minimise the risk of surface water flooding, the site drainage will be designed taking climate change into account thereby minimising the risk both to the site and the wider catchment. Additional storage will be provided within the new drainage system to allow for the anticipated increase in rainfall intensities over the life of the development due to climate change.

In respect of other sources of flooding it is acknowledged that the effects of climate change are likely to increase flood risk; however, since the site is considered to be at relatively low risk at present, after taking climate change into account, it is considered that the risk will remain low.

5 Site Drainage

5.1 Existing Site Drainage

The existing site is currently undeveloped Greenfield land that slopes from southwest to northeast. The YW asset plans, included within Appendix C of this report, show 225mm and 375mm diameter surface water sewers located within the Poplar Avenue to the north west of the site and a 225mm diameter surface water sewer within Acacia Grove to the north east. A 150mm diameter foul water sewer flows within gardens to the rear of residential properties located north of the site. A 225mm combined sewer is located within High Street to the west of the site.

A short length of combined sewer, serving existing terrace properties which front onto High Street, flows within the site boundary. This sewer, which is of unspecified diameter, will be protected by easement (assumed 6m centred on the pipe). YW have stated that a build over may be permitted subject to approval, however based on the masterplan it is likely to be more practical to divert this sewer as part of the new on site drainage works.

It is assumed that the surface water runoff from the site currently drains via overland flow with a small element of infiltration into the soil. The LLFA are aware of flooding issues to gardens and outbuildings of properties on Acacia Grove which the LLFA believe to be caused by runoff from the site.

Soakage testing undertaken identified very low permeability rates for the site, therefore infiltration type drainage into the ground would not be viable.

The Qbar (mean annual flood flow rate) for the site has been estimated to be 5.4 l/s using Micro Drainage software. The Micro Drainage calculations of the existing Qbar (greenfield runoff) rate for the site are included within Appendix E.

It is proposed that surface water discharge from the developed site will be managed on site with a restricted discharge to the public surface water sewer preventing uncontrolled discharge of runoff to adjacent developed areas which is believed to occur in the current regime. Yorkshire Water has advised that the maximum discharge to surface water sewer is 3.5 l/s; a rate which is lower than the existing Qbar runoff rate. The proposed drainage strategy is discussed in more detail in the following section.

There are understood to be no foul flows currently discharging from the site.

5.2 Proposed New Development Drainage

Surface Water

In accordance with the recommendations set out in the NPPF, the design of the new development will adopt measures to reduce the impact of surface water run-off through the use of sustainable drainage techniques.

The Planning Practice Guidance provides the following statement in relation to the method of discharging surface water.

"Generally, the aim should be to discharge surface water as high up the following hierarchy of drainage options as reasonably practicable:

1. *Into the ground (infiltration)*
2. *To a surface water body;*
3. *To a surface water sewer, highway drain or another drainage system;*
4. *To a combined sewer."*

In line with the NPPG hierarchy, the preferred method of surface water removal would be to drain the site via infiltration. Infiltration testing was undertaken and identified very poor infiltration rates for the site, therefore infiltration type drainage is not considered suitable for this site.

Discharge to watercourse was also considered, however no watercourses were identified in proximity to the site. Therefore, discharge to a surface water body is not considered suitable for this site.

Discharge to surface water sewer is therefore the preferred option for this site. An appropriate drainage strategy could involve a combination of above ground detention basins, permeable paving with sub-structure attenuation storage, swales and the use of oversized pipes.

The outlet from the attenuation storage would be connected to the existing public surface water sewer located within Acacia Grove. The rate of flow from the developed site would be restricted using a suitable flow control device such as an orifice plate or Hydro-brake. Yorkshire Water have identified capacity for connection within Acacia Grove at a rate of 3.5 l/s. The proposed connection point will require sewer laying through third party land and therefore this will require either a suitable agreement with the third party land owner or a sewer requisition. Additionally in order to achieve a gravity surface water connection it is considered likely that additional off site sewer laying will be required in order to reach a point within the downstream public sewer network where sewers are of sufficient depth. A potential point of connection

within Park View, just downstream of Acacia Grove, has been identified and is shown on the Indicative Drainage Strategy Plan in Appendix A.

The topographical survey plan shows a small pond in the north of the site with an outfall pipe. It is not clear whether the pipe outfalls into the pond from adjacent properties or whether the pipe conveys flows away from the pond. Based on the invert level of the pipe it is not considered likely that this feature could provide a suitable gravity connection for the site, however further investigation of this feature is advised to determine whether there are any flows into the site which need to be maintained.

Attenuation requirements

The site masterplan, available within Appendix A, is shown to create approximately 0.61ha of impermeable area over the 1.3ha site (48%).

Appendix B of the Non-Statutory Technical Standards for Sustainable Drainage Practice Guidance (Lasoo; 2016) defines a good practice approach to the application of urban creep factors to new developments. The urban creep factor allows for consideration of the potential impact of the conversion of permeable surfaces to impermeable over time e.g. impermeable surfacing of front gardens to provide additional parking spaces, extensions to existing buildings, creation of large patio areas etc. The allowance relevant to a development with density 30 – 34 dwellings per hectare is an allowance of 8% which should be applied to the impermeable area within the curtilage of proposed properties. The impermeable area of the site, excluding proposed access roads, is approximately 0.33 ha. Therefore, allowing an 8% increase to the 0.33 ha area and considering an impermeable area of 0.28 ha for access roads, the total impermeable area of the site would be 0.636 ha.

A Micro Drainage Source Control analysis has been undertaken using an impermeable area of 0.636 ha; FEH rainfall data and a discharge restriction of 3.5 l/s to estimate the amount of surface water attenuation storage required for the site. As advised by the LLFA an allowance of 30% for climate change has been included within the calculation. It has been calculated that a volume of approximately 432 m^3 of storage is required to attenuate the 1 in 100 year plus 30% climate change event when limiting the discharge to the surface water sewer to the Yorkshire Water required rate of 3.5 l/s. The Micro Drainage calculation sheets are included within Appendix E of this report.

Changes to the estimated impermeable areas, indicated above, or to the size of any land use shown in the site layout will affect the storage required.

Drainage strategy

The indicative drainage strategy is shown within Appendix A. The 432 m^3 of storage can be provided within an above ground attenuation feature. Permeable paving could also be utilised in areas proposed for private parking / shared access. The above ground attenuation feature has been modelled as 1.3 m deep with 1 in 4 side slopes.

Water Quality

The SuDS design should seek to provide an appropriate management train of SuDS components to effectively mitigate the pollution risks associated with the different site uses.

Within this development, there are two key drivers in respect of pollutant risks to the receiving downstream sewer systems, these being pollution from vehicle parking areas and pollution from highways.

In accordance with Table 4.3 of The SuDS Manual CIRIA C753, the pollution hazard level is considered to be 'Low' for the proposed land use. Therefore, the requirements for discharge to surface waters state that the 'Simple index approach' should be used.

Step 1 of the simple index approach is to identify the pollution hazard indices for the proposed land use. Table 26.2 of The SuDS Manual states the following:

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Individual property driveways, residential car parks, low traffic roads and non-residential car parking with infrequent change.	Low	0.5	0.4	0.4

Step 2 of the simple index approach is to select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index.

Up to four levels of treatment may be possible with these potentially being provided by the following systems:

- Permeable Paving;
- Filter Strips;
- Swales; and
- Detention Basins.

Table 26.3 of The SuDS Manual states the various mitigation indices for discharges to surface waters. The mitigation indices for the potential SuDS systems are shown below.

	Mitigation indices		
Type of SuDS component	**TSS**	**Metals**	**Hydro-carbons**
Permeable pavement	0.7	0.6	0.7
Filter strip	0.4	0.4	0.5
Swale	0.5	0.6	0.6
Detention basin	0.5	0.5	0.6

It can be demonstrated that if during the detailed surface water drainage design, filter strips, swales or permeable paving are not utilised, then the detention basin would provide adequate treatment for the proposed development.

Although possible options have been stated, alternative SuDS options may also be considered during the detailed design stage which achieves or exceeds the water quality objective.

Provided that the mitigation indices of the treatment techniques are greater than or equal to the hazard indices for the proposed development then there should be no reduction in the overall water quality within the receiving system.

Maintenance of SuDS

It is proposed that the new sewers would be offered for adoption are by the Water and Sewerage Company, via a S104 agreement. The proposed detention basin would be maintained privately by a suitable

management company, paid for by the residents. A regular inspection & maintenance regime will be provided as part of the detailed design, together with details of who will be responsible for the inspection and maintenance of the proposed SuDS components.

Highways drainage associated with adopted roads would be the responsibility of the highways authority.

5.3 Foul Discharge

The proposed development includes construction of 43 dwellings. The estimated foul sewerage discharge from the site, based on 4000 l/dwelling/day as recommended in Sewer for Adoption 7th edition, is 2.0 l/s. YW have confirmed that the public combined sewer in High Street to the south west of the site has capacity for the proposed development, however a pumped connection will be required to connect at this point (see YW asset plan in Appendix C).

There is a further foul sewer to the north west of the site shown running through the gardens of properties adjacent to the site. This sewer is shown very close to the site boundary at the northern corner of the site and may offer an alternative connection point for foul sewerage for the site. Invert levels of this sewer are not known however it is possible that a gravity sewer connection may be possible at this location. Since this alternative connection point lies within third party garden land, agreement with the land owner or sewer requisition would be required. It is advised this option is investigated further as part of the detailed design.

6 Flood Risk Management and Mitigation Measures

6.1 Sequential Test

The proposed development site is shown to be located within Flood Zone 1 and is classified as a more vulnerable development. Therefore, in accordance with the NPPF, the site is considered suitable for the proposed development.

6.2 Mitigation of Surface Water Flood Risk

Ground floor levels within the proposed development should be set a minimum of 150mm above surrounding ground levels in accordance with Building Regulations so the future risk of flooding from surface water runoff will be minimal. External paved areas should be designed to fall away from the new buildings and in particular to channel flows away from entrances into buildings.

6.3 Proposed Site Drainage

In accordance with the recommendations in the NPPF, the design of the new development will adopt measures to reduce the surface water discharge through the use of sustainable drainage techniques. Surface water runoff will be attenuated within the Site drainage system to mitigate off-site flooding and to protect vulnerable areas within the Site. The proposed drainage strategy includes a storage system providing sufficient volume such that no off Site flooding occurs for up to the 1 in 100 year event including a 30% increase in runoff for climate change.

An above ground detention basin has been modelled in order to estimate the amount of storage that is required. The size of the basin required to limit discharge to the sites Greenfield runoff rate has been provided in Section 5.2. The detention basin will provide sufficient volume such that no off-site flooding occurs for up to the 1 in 100 year storm event including a 30% increase for climate change and a 8% allowance for urban creep.

7 Conclusions

This FRA has been commissioned by Homes England to support the planning application for a residential development of 43 dwelling units. The land to be developed currently consists of Greenfield land located to the north of High Street, Shafton, Barnsley, S72 8NF (grid reference 439371mE, 410885mN).

According to Table 2 contained within the NPPF, the proposed development would be considered as 'More Vulnerable' land use classification in respect to flood risk vulnerability.

The Environment Agency's (EA) Flood Risk Map has been consulted and the entirety of the site is shown to lie within Flood Risk Zone 1. This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding (<0.1% annual exceedance probability (AEP)). An assessment of flood risk within the site has been carried out and the site is not considered to be at risk of flooding from surface water, groundwater, sewers or artificial sources. It is therefore concluded that the site is at low risk of flooding and in accordance with the requirements of the Sequential Test in the NPPF; the site is suitable for the proposed development.

The principle source of flood risk to the development is considered to be an increase in surface water runoff as a consequence of increasing the impermeable area of the site following development.

To mitigate this risk, the site drainage will be designed taking climate change into account thereby minimising the risk both to the site and the wider catchment. Additional storage will be provided within the new drainage system to allow for the anticipated increase in rainfall intensities over the life of the development due to climate change.

There is a practical strategy identified for discharge of foul and surface water from the site, however, a sewer requisition may be required for the surface water connection.

This report concludes that the site is at low risk of flooding. Through incorporation of appropriate SuDS techniques, the development will not increase flood risk elsewhere in the catchment. Furthermore, it is concluded that a practical means of surface water and foul water management can be provided for the site.

Appendix A

Proposed Site Layout
Indicative Drainage Strategy

Belvedere Close

Poplar Avenue

Acacia Grove

High Street

Legend

- Parking space
- Attenuation pond
- Pumping station
- Pumping station buffer
- Existing tree to be retained
- Existing tree to be removed
- Proposed tree

Proposed Development Mix

2 bed	11	26%
3 bed	30	70%
4 bed	2	5%
	43	

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North

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