

**Ref: 6238/R1
Rev B**

**Halsnead Garden Village
Prescot
Merseyside**

Flood Risk Assessment

April 2018



REPORT DETAILS

Site Name: Halsnead Garden Village, Prescot, Merseyside

Report Title: Flood Risk Assessment

Report Number: 6238/R1

Revision	Date	Status
-	4 th April 2018	For Planning Submission
A	23 rd April 2018	For Planning Submission
B	22 nd November 2019	Updated following LLFA consultations and to incorporate revised Phase 1 layout

Client: Bloor Homes

Client Contact: Norman Kelly

Prepared By: John E Lees B.Sc., C.Eng., M.I.C.E., M.C.I.W.E.M.

CONTENTS

1.0	INTRODUCTION	1
2.0	SITE LOCATION AND DESCRIPTION	2
2.1	Location	2
2.2	Surrounding Land Use and Access	2
2.3	Site Description	2
2.4	Topography	3
2.5	Existing Drainage	3
3.0	FLOOD RISK.....	4
3.1	Flood Mapping	4
3.2	Sequential and Exception Tests	5
3.3	Sources of Flood Risk	5
4.0	SURFACE WATER RUNOFF.....	7
4.1	Requirements for Surface Water Drainage of the Site	7
4.2	Site Area	7
4.3	Existing Site Run Off	7
4.4	Surface Water Run Off from the Developed Site	7
4.5	Potential for Ground Infiltration Drainage	7
4.6	Surface Water Outfalls	8
5.0	FLOOD MITIGATION MEASURES	10
6.0	CONCLUSIONS	12

APPENDICES

Appendix 1 SITE DETAILS

1A Location Plan

1B Watercourse Systems

Appendix 2 TOPOGRAPHICAL SURVEY

Appendix 3 UNITED UTILITIES PUBLIC SEWER RECORDS

Appendix 4 PRELIMINARY DRAINAGE STRATEGY

Lees Roxburgh Drg. No. 6268/01-06D

1.0 **INTRODUCTION**

1.1 Lees Roxburgh have been instructed by Bloor Homes to carry out a Flood Risk Assessment (FRA) for proposed residential development of land off Windy Arbor Road, Whiston, Prescot, Merseyside.

1.2 This report has been prepared to accompany the detailed planning application.

The land falls within a much larger development area described as Halsnead Garden Village and for which Waterman have been undertaking flood risk and drainage appraisal work for Knowsley Council.

The Waterman work whilst still in draft form has been reviewed in preparing this FRA.

Waterman have split the overall area into several catchment areas with this site designated as comprising Area I and the western part of Area H. Area E to the north east drains into this site and therefore allowance for drainage is to be made within this scheme. The remaining areas drain independently to the watercourse network.

1.3 The site lies within an area designated on EA Flood mapping as Flood Risk Zone 1 and therefore comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (< 0.1%).

1.4 *The National Planning Policy Framework (NPPF)* and the accompanying *National Planning Policy Guidance* sets out the requirements for addressing flood risk with respect to potential development sites.

In accordance with the NPPF at over 1 hectare in area the site is required to be the subject of an FRA.

1.5 The purpose of an FRA is to address the following;

- The potential for the proposed development to be affected by flooding either from the development proposal or external sources.
- The potential for the proposed development to increase the flood risk elsewhere.
- That mitigation measures introduced to deal with any risks identified can be successfully managed.
- That the site can be developed and occupied safely.

The NPPF indicates that an assessment of flood risk should be proportionate to the risk and appropriate to the scale, nature and location of the development. This report reflects the requirements of the NPPF in this regard.

1.6 This report has been prepared specifically for Bloor Homes for the sole purposes of the planning application and any reliance on its contents must be read in conjunction with the requirements of any subsequent planning conditions.

2.0 SITE LOCATION AND DESCRIPTION

2.1 Location

- 2.1.1 The site is centred on approximate National Grid references E346650, N389820 and is 14.7 ha in area (**Appendix 1**).
- 2.1.2 The site lies adjacent to the existing Whiston residential development off Windy Arbor Road to the north west and is located some 2.8km to the south of Prescott town centre.

2.2 Surrounding Land Use and Access

- 2.2.1 Windy Arbor Road abuts a short length of the site boundary at its south west corner from where there is a track access into the site that also serves a nearby telecommunications mast located adjacent to the western site boundary.

There is a field gate access at the extreme north east corner of the site onto Main Drive, which connects the small housing development known as Halsnead Park, some 200m east of the site, to Windy Arbor Road to the north of the site.

- 2.2.2 To the west of the site, beyond Windy Arbor Road, there is Whiston Enterprise Park and the Village Hotel, with the M57 motorway travelling south east to north west some 200m from the site boundary.

The large Huyton Business Park is located to the west of the M57 motorway.

- 2.2.3 The long north west site boundary abuts the rear gardens of the Windy Arbor Road residential area, with a small playground field at the northern corner.

The short north east boundary wraps around a derelict and overgrown area with a security fenced perimeter.

- 2.2.4 The dog-legged eastern boundary borders a small woodland area and the Big Water fishing lake and recreation area, which is part of the Halsnead Park Estate.

- 2.2.5 The southern site boundary runs along the top of a motorway embankment beside the junction link road from the M57 southbound onto the M62 travelling eastbound towards Warrington.

Beyond the M62 to the south there is some open farmland and old mining and quarried ground.

2.3 Site Description

- 2.3.1 The site is irregular in shape. It comprises two parcels of land that are separated by the largely overgrown route of a now dismantled mineral railway line that runs from deep cutting at the north west site boundary to rise on embankment as it approaches the southern boundary and a motorway bridge. Currently the bridge is fenced across to prevent access from either side of the motorway.

- 2.3.2 The smaller field in the south west corner appears to be unmanaged grassland, whilst the much larger field to the north east is currently set to agricultural use.
- 2.3.3 The majority of site boundaries are formed by hedgerows and trees. There is a variety of rear garden fencing along the boundary with the residential areas, and the motorway fencing is post and rail.

2.4 Topography

- 2.4.1 Reference should be made to the topographical survey (**Appendix 2**).
- 2.4.2 Within the smaller western field the land has a fairly regular fall towards the motorway boundary to the south of approximately 1 in 18.

Within the western part of the larger field the fall is generally south westerly at approximately 1 in 20, but becoming steeper at the southern extent. The northern part of the larger field generally falls south.

General falls have been identified on the survey.

2.5 Existing Drainage

- 2.5.1 Watercourse systems in the area are identified in **Appendix 1B** with Chapel Brook to the west and south west, an unnamed system running through Big Water to the east and Strettlles Bog with Ochre Brook beyond to the south.
- 2.5.2 There are no watercourses identified within the site area. However, overland surface water flow results in some ponding immediately east of the dismantled railway line embankment and close to the motorway bridge.

This small pond area overflows down towards the motorway where it is collected by a large grid-covered catchpit, from where it is connected via 225mm diameter pipe into the motorway land drainage system at the top of the motorway embankment. There is a manhole on this system located on the railway line embankment just before it reaches the motorway bridge.

- 2.5.3 Some 70m to the east of the site an overflow from the Big Water lake runs down to the M62 motorway embankment where it passes in 1200mm diameter culvert beneath the motorway to join a watercourse on the opposite side which feeds into Strettlles Bog. The invert level at the culvert entrance is approximately 23.5m AOD.
- 2.5.4 Raised manhole covers within the site confirm the presence of a 1m diameter United Utilities surface water drain that cuts across the site from the north east corner at Main Drive to eventually cross under the M62 motorway close to the mid-point of the smaller field's southern boundary and outfalls into Chapel Brook which again feeds into Strettlles Bog.
- 2.5.5 Manhole covers within the Windy Arbor Road housing development reflect the United Utilities sewer records for the area (**Appendix 3**).

3.0 FLOOD RISK

3.1 Flood Mapping

3.1.1 Gov.UK Flood Map for Planning

- 3.1.1.1 Reference to the Gov.UK Flood Map for Planning (**Figure. 1**) indicates that the existing site is situated within a Flood Zone 1 Area of flood risk. This is land defined within the NPPF as having a less than 1 in 1000 annual probability of flooding (<0.1% in any year). All uses of land are appropriate in this zone.



Figure 1: Gov.UK Flood Map for Planning

- 3.3.1.2 There is a watercourse system which runs within the woodland to the east through Big Water passing under the M62 and continuing south through Strettles Bog and becoming Ochre Brook to the south. As noted, Chapel Brook is located to the south west. Again, levels are such that these systems do not present a source of risk to the development.

As noted under Section 2.5, water collects at the line of the former railway and is picked up by the land drainage measures associated with the M62 and directed down to Strettles Bog. Whilst it is considered a minor source of risk this nonetheless needs to be considered within the development proposals.

The site is located within the catchment of the Ochre Brook system which therefore represents the ultimate natural outfall for drainage from the development site.

- 3.3.1.3 On this basis, the risk of flooding associated with water bodies and watercourses can be discounted but the minor risk associated with the area of the former railway within the site needs to be considered.

3.3.2 Existing Sewers and Drainage

- 3.3.2.1 Copies of United Utilities public sewer records have been obtained and identify the presence of adopted drainage infrastructure in the area of the site. These records have been incorporated in **Appendix 3**.

- 3.3.2.2 Reference to the public sewer records indicates the following;

- Combined sewer system with localised sections of surface water and foul within the residential development to the north west.
- 675mm diameter surface water sewer system entering the site at Main Drive and becoming 1m in diameter and continuing south west across the site before passing under the M62 and outfalling in to Chapel Brook.

3.3.3 General Land Drainage and Groundwater

- 3.3.3.1 No land drainage issues which cannot be dealt with as part of the normal design and construction process are anticipated.

3.3.4 Comment

- 3.3.4.1 On the basis of the assessment of the potential sources of flood risk described above, it is considered that the risks associated with the following need to be addressed by this FRA;

- Land drainage in the area of the former railway
- Development drainage proposals

4.0 SURFACE WATER RUNOFF

4.1 Requirements for Surface Water Drainage of the Site

- 4.1.1 The NPPF recommends that surface water generated by the development site should, as far as is practicable, be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development.
- 4.1.2 Proposals should ensure that peak flow rates of surface water leaving the developed site are no greater than those prior to development.

4.2 Site Area

- 4.2.1 The total area of the site comprises 14.7 hectares.

4.3 Existing Site Run Off

- 4.3.1 The existing site is greenfield.
- 4.3.2 As noted the area to the west of the railway is to drain to the UU sewer at a rate of 6 litres/sec.
- 4.3.3 Waterman have identified a permissible Qbar based discharge rate for the land allocated for development of 5.2 litres/sec/hectare.

On this basis for this development;

Total permissible rate – $14.7 \times 5.2 = 76.44$ litres/sec of which 6 litres/sec proposed to the UU sewer leaving;

Leaving;

Permissible rate direct into the watercourse network = 70.44, say 70 litres/sec.

4.4 Surface Water Run Off from the Developed Site

- 4.4.1 The development plan is incorporated in **Appendix 4**.
- 4.4.2 Development will introduce a significant impermeable area into the catchment and uncontrolled flows from the development will therefore exceed greenfield run off rates. For the purposes of this FRA, it is considered that development run off rates limited at maximum to the greenfield run off rates identified in 4.3.2 would be appropriate.

4.5 Potential for Ground Infiltration Drainage

- 4.5.1 A Phase II Geonvironmental Assessment report has been prepared by Wardell Armstrong (November 2018 – ST16036 – Report No. 0001) and has identified that ground conditions will not be suitable for surface water infiltration based drainage.
- 4.5.2 Positive surface water outfall arrangements from the development are therefore required.

4.6 Surface Water Outfalls

- 4.6.1 As noted the natural point of outfall for the development area is to Chapel Brook to the south but such a connection has to negotiate the presence of the motorway slip road.

Following protracted consultations, Highways England have refused to permit connection even on a greenfield basis from the land to the north east of the dismantled railway into the motorway drainage system. In this regard it is noted that even if such a connection were to be permitted the topography is such that a separate outfall from the land to the west of the mineral railway would still be required.

- 4.6.2 Following consultations, United Utilities have agreed to permit a connection into their sewer restricted to 6 litres/sec from the development area to the west of the mineral railway.

A second surface water outfall is proposed to serve the balance of the development comprising connection into the Big Water system downstream of the lake.

- 4.6.3 The constraints identified above will result in an adjustment to the surface water run off regime locally to the site but not in the wider catchment.

As noted, it is intended to make provision within this development for drainage of the parcel of land designated Area E to the north east. This will include allowance for an easement for a surface water sewer to be constructed through the north east area of this development prior to connection on a greenfield run off rate basis direct into the lake. Attenuation of flows to the appropriate standard will be delivered within the Area E parcel itself.

It is considered that any removal of greenfield run off direct into the lake arising from the completion of this development would, in the context of the overall catchment, have a negligible effect on the hydraulic behaviour of the lake. Any residual concerns in this regard could be addressed by designating a limited area within the north part of the development to drain uncontrolled into the lake utilising the Area E outfall.

- 4.6.4 Given the proposal is to ultimately convey surface water to its natural outfall point to the south, albeit via a different route, it is considered that the surface water outfall proposals set out above will overall not have any material adverse impact.

4.7 Comment

- 4.7.1 Geoenvironmental Assessment work has established that ground conditions will not be suitable for a surface water infiltration based drainage solution.

- 4.7.2 Ground levels from the proposed development area generally fall towards Chapel Brook which runs beyond the M57/M62 slip road to the south. As noted this system and that which flows through Big Water to the east form tributaries to the Ochre Brook system to the south.

Surface water connection from the development ultimately to this watercourse system therefore needs to be delivered. On this basis it is proposed to outfall development to the west of the railway to the UU surface water sewer and the remaining area to the watercourse system to the east.

5.0 FLOOD MITIGATION MEASURES

5.1 Area of Former Railway

- 5.1.1 Development levels will be set to ensure that flows in this area continue to be picked up by the motorway land drainage system.

A piped culvert will be provided where the main development access road crosses the line of the former railway.

- 5.1.2 In this regard it is noted that development of itself will significantly reduce uncontrolled run off from the development area.

5.2 Development Drainage Proposals

- 5.2.1 The following surface water drainage options have been considered;

- Infiltration Techniques
- Piped Systems into Attenuation Basins

5.2.2 Infiltration Techniques

- 5.2.2.1 Geoenvironmental assessment work has established that ground conditions are not suitable for a ground infiltration based solution and a positive surface water outfall solution is therefore required.

5.2.3 Piped Systems into Attenuation Basins

- 5.2.3.1 It is proposed to overall limit and attenuate flows as follows:

- Land west of mineral railway

Limiting Flow to UU Sewer 6 litres/sec

Attenuation basin
- Land east of mineral railway

Limiting flow to watercourse... 70 litres/sec

Attenuation basin

- 5.2.3.2 Highways, houses and associated hard surfaces will be served by a piped surface water system designed to adoptable standards to ensure, at minimum, no flooding up to the 1 in 30 year event and will discharge into the basins.

The basin bed levels will be set slightly lower than the outfall levels to provide for a permanent water depth.

Overall flows up to the 1 in 100 year event plus allowance for 30% climate change will be contained on site within the basins and pipe system supplemented by appropriate setting of levels.

The basins have been sized accordingly but remain subject to detailed design.

The detailed design will be sensitivity tested to see that property will not be placed at risk up to the 40% climate change standard, and if necessary the design amended accordingly.

5.2.4 **Future Maintenance**

- 5.2.4.1 It is proposed that the main piped systems will be adopted under a S104 agreement by United Utilities with the management company for the development taking on responsibility for those elements of the basins, control structures and outfalls which will not be adoptable.

5.2.5 **Water Quality**

- 5.2.5.1 Whilst ground conditions will be unsuitable for the incorporation of infiltration based drainage techniques, the risk to water quality from housing developments is categorised as low to very low.
- 5.2.5.2 The incorporation of trapped gullies to roads and the basins will nonetheless provide two levels of treatment.

5.3 **Drainage Strategy**

- 5.3.1 The drainage strategy for the development has been prepared accordingly and is incorporated in **Appendix 4**.

5.4 **Exceedance Flows**

- 5.4.1 More generally, floor levels will be set a minimum of 0.15m above external ground level and will encourage any flows generated by an exceedance event (i.e. greater than the 1 in 100 year plus climate change design event) to pass safely through the development.

5.5 **Consent to Outfall**

- 5.5.1 Formal LLFA consent will be required for the construction of the outfall from the east basin at the watercourse.

6.0 **CONCLUSIONS**

- 6.1 The FRA has identified that the site lies in an area of Zone 1 Flood Risk.

The Sequential and Exception Tests do not therefore apply.

- 6.2 There are no water bodies or watercourse systems which present a source of risk to the development.

Development levels will be set to ensure that flows in the area of the former mineral railway continue to be picked up by the motorway drainage system and a piped culvert will be provided at the main development access road crossing.

In this regard it is noted that development of itself will significantly reduce uncontrolled runoff.

- 6.3 Geoenvironmental Assessment work has established that ground conditions will not be suitable for a surface water infiltration based drainage solution.

The proposed development area lies within the catchment of Chapel Brook which runs beyond the M57/M62 slip road to the south. This system and that which flows through Big Water to the east form tributaries to the Ochre Brook system to the south.

Surface water connection from the development to this watercourse system therefore needs to be delivered but is precluded from doing so direct by the motorway.

On this basis it is proposed to connect surface water from the area to the west of the mineral railway into the UU public surface sewer with flows restricted to 6 litres/sec.

The remaining area will be discharged into the watercourse to the east with flows limited to 70 litres/sec.

- 6.4 The proposed piped drainage systems will be designed to contain flows from, at minimum, a 1 in 30 year event and will discharge through the attenuation basins prior to outfall via flow control structures. Overall flows will be contained on site up to the 1 in 100 year plus 30% climate change event with the design being sensitivity tested up to the 40% standard.

The basin bed levels will be set slightly lower than the outfall levels to provide for a permanent water depth.

Provision will be made within the east area of the site for a future outfall from a development of Area E to the north east.

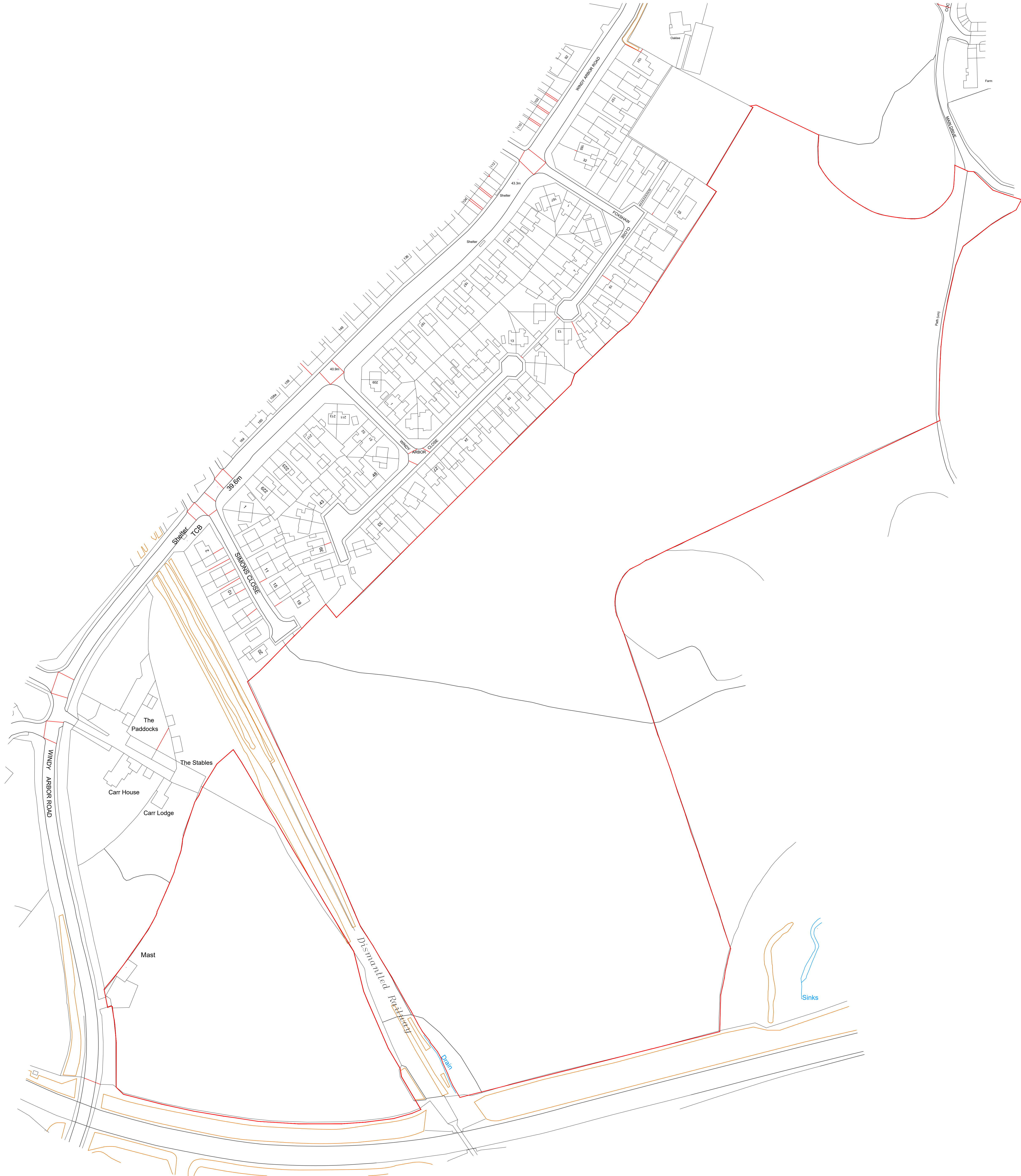
- 6.5 The piped systems, flow control structures and outfalls will be put forward for adoption by United Utilities under a Section 104 agreement and United Utilities will therefore become responsible for long term maintenance of the system.

The management company for the development will become responsible for the attenuation basins unless these can be incorporated into the Section 104 agreement by negotiation with United Utilities.

- 6.6 Although the risk to water quality from housing developments is categorised as low to very low, the basins and incorporation of trapped gullies to roads will nonetheless provide two levels of treatment.
- 6.7 Floor levels will be set a minimum of 0.15m above external ground level and will encourage any flows generated by an exceedance event to pass safely through the development.
- 6.8 Formal LLFA consent will be required for the outfall to the watercourse.
- 6.9 It is therefore concluded that this FRA has demonstrated in accordance with the NPPF that the development is not at risk of flooding from external sources, will not increase flood risk associated with the development and its environment and is therefore appropriate.

Appendix 1: Site Details

Appendix 1A: Location Plan



Windy Arbour Rd, Whiston

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH SEPARATE GROUP / SITE SPECIFIC CONSTRUCTION NOTES AND MATERIALS SPECIFICATION.

Notes

Revision:

Job:

WINDY ARBOUR ROAD
WHISTON

Title:

Location Plan

Scale:

1:1000 @ A0

Date:

Feb18

Drawn:

JPW

Checked:

THIS DRAWING AND THE BUILDING WORKS DEPICTED ARE THE COPYRIGHT OF J S BLOOR (SERVICES) LIMITED AND MAY NOT BE REPRODUCED OR AMENDED EXCEPT BY WRITTEN PERMISSION AND LIABILITY WILL BE ACCEPTED FOR AMENDMENTS MADE BY OTHER PERSONS. DO NOT SCALE THIS DRAWING. USE FOURED DIMENSIONS ONLY. IF IN DOUBT ASK.

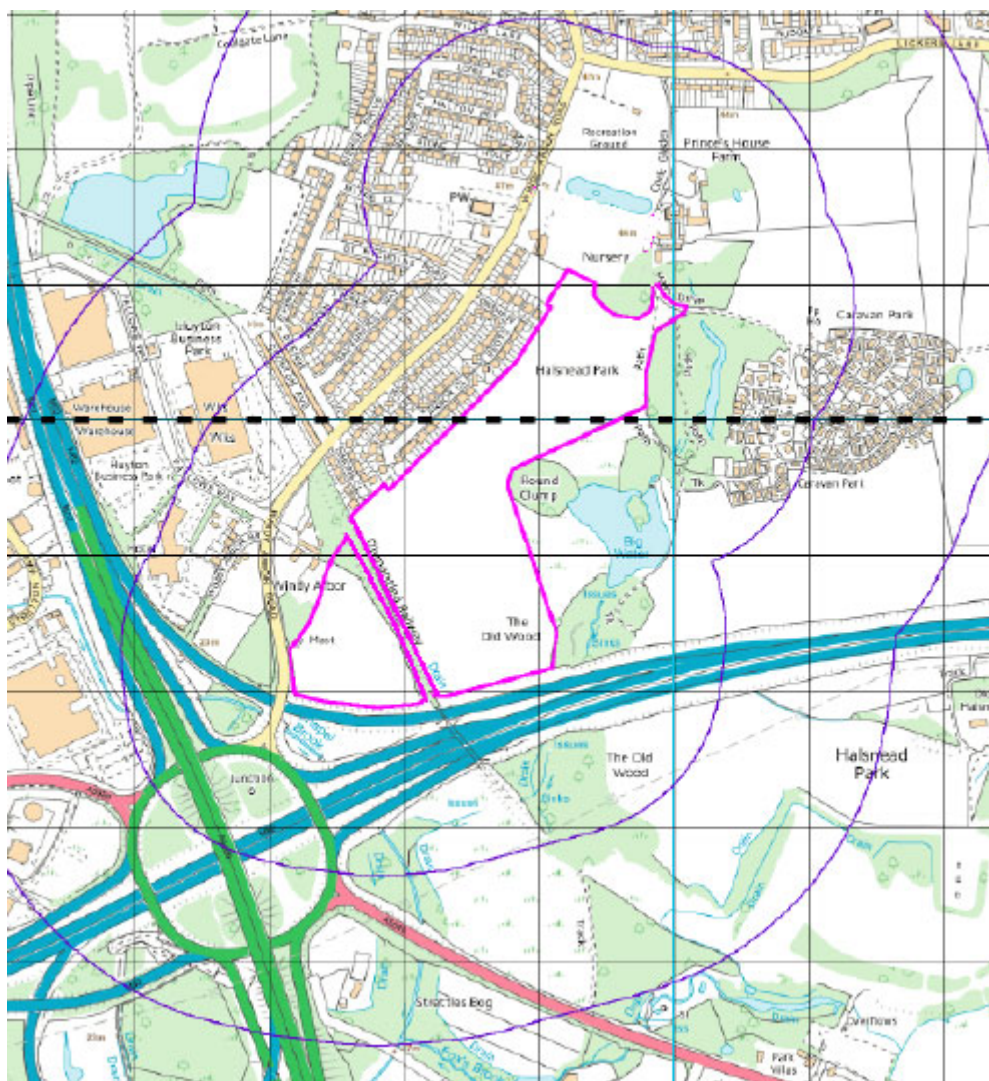
BLOOR HOMES

J S BLOOR (SERVICES) LIMITED
ASHBY ROAD, MEASHAM, SWADLINCOTE,
DERBYSHIRE DE12 7JP
TELEPHONE 01530 270100 FACSIMILE 01530 272006

Drawing No.

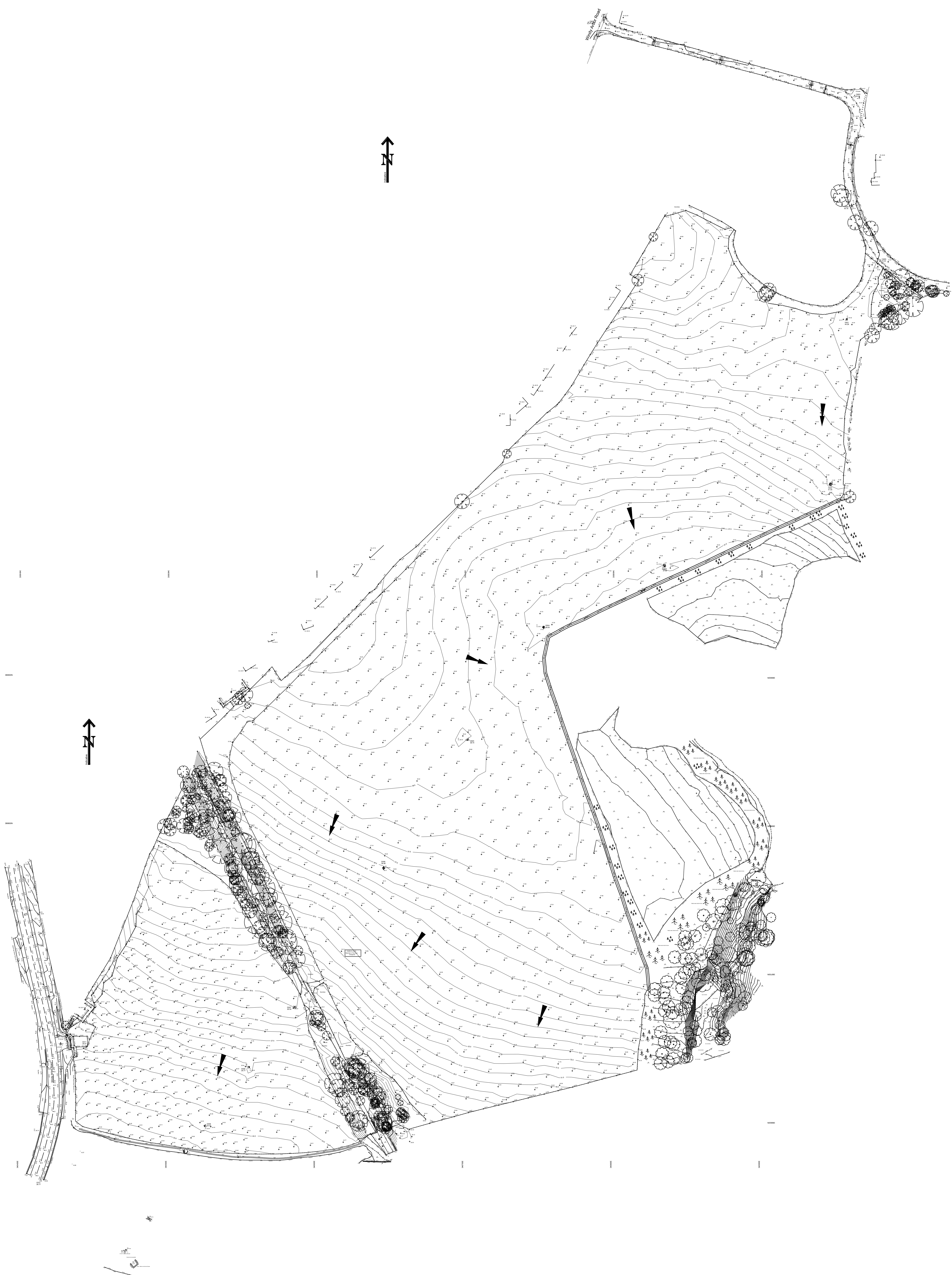
NW034-SL-0002

Appendix 1B: Watercourse Systems

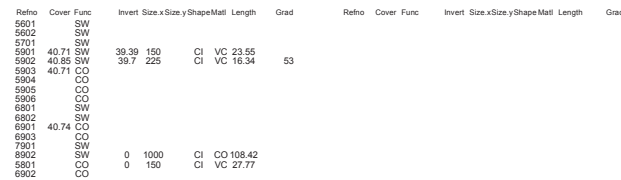


HALSNEAD GARDEN VILLAGE, PRESECOT, MERSEYSIDE

Appendix 2: Topographical Survey



Appendix 3: United Utilities Public Sewer Records



MANHOLE FUNCTION	
FO	Foul
SW	Surface Water
CO	Combined
OV	Overflow
SEWER SHAPE	
CI	Circular
EG	Egg
OV	Oval
FT	Flat Top
RE	Rectangular
SQ	Square
TR	Trapezoidal
AR	Arch
BA	Barrel
HO	HorseShoe
UN	Unspecified
SEWER MATERIAL	
AC	Asbestos Cement
BR	Brick
PE	Polyethylene
RP	Reinforced Plastic Matrix
CO	Concrete
CSB	Concrete Segment Bolted
CSU	Concrete Segment Unbolted
CC	Concrete Box Culverted
PSC	Plastic/Steel Composite
GRC	Glass Reinforced Concrete
GRP	Glass Reinforced Plastic
DI	Ductile Iron
PVC	Polyvinyl Chloride
CI	Cast Iron
SI	Spun Iron
ST	Steel
VC	Vitrified Clay
PP	Polypropylene
PF	Pitch Fibre
MAC	Masonry, Coursed
MAR	Masonry, Random
U	Unspecified

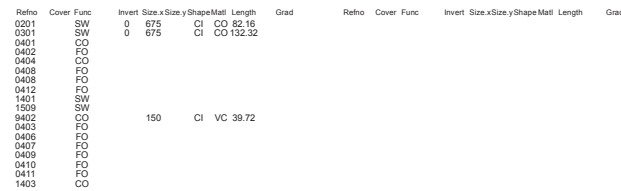
The position of underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. The actual positions may be different from those shown on the plan and private pipes, sewers or drains may not be recorded.

United Utilities will not accept any liability for any damage caused by the actual positions being different from those shown.

© Crown Copyright, United Utilities Water Limited 2014. The plan is based upon the Ordnance Survey Map with the sanction of the Controller of H.M. Stationery Office. Crown and United Utilities copyrights are reserved. Unauthorised reproduction will infringe these copyrights.

OS Sheet No: SJ4689NE
Scale: 1: 1250 Date: 03/12/2015
17 Nodes
Sheet 1 of 1


SEWER RECORDS



MANHOLE FUNCTION	
FO	Foul
SW	Surface Water
CO	Combined
OV	Overflow
SEWER SHAPE	
CI	Circular
EG	Egg
OV	Oval
FT	Flat Top
RE	Rectangular
SQ	Square
TR	Trapezoidal
AR	Arch
BA	Barrel
HO	HorseShoe
UN	Unspecified
SEWER MATERIAL	
AC	Asbestos Cement
BR	Brick
PE	Polyethylene
RP	Reinforced Plastic Matrix
CO	Concrete
CSB	Concrete Segment Bolted
CSU	Concrete Segment Unbolted
CC	Concrete Box Culverted
PSC	Plastic/Steel Composite
GRC	Glass Reinforced Concrete
GRP	Glass Reinforced Plastic
DI	Ductile Iron
PVC	Polyvinyl Chloride
CI	Cast Iron
SI	Spun Iron
ST	Steel
VC	Vitrified Clay
PP	Polypropylene
PF	Pitch Fibre
MAC	Masonry, Coursed
MAR	Masonry, Random
U	Unspecified

The position of underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. The actual positions may be different from those shown on the plan and private pipes, sewers or drains may not be recorded.

United Utilities will not accept any liability for any damage caused by the actual positions being different from those shown.

© Crown Copyright, United Utilities Water Limited 2014. The plan is based upon the Ordnance Survey Map with the sanction of the Controller of H.M. Stationery Office. Crown and United Utilities copyrights are reserved. Unauthorised reproduction will infringe these copyrights.

OS Sheet No: SJ4790SW
Scale: 1: 1250 Date: 03/12/2015
18 Nodes
Sheet 1 of 1





Refno	Cover	Func	Invert	Size	xSize	yShape	Mat	Length	Grad	Refno	Cover	Func	Invert	Size	xSize	yShape	Mat	Length	Grad
5001	40.75	CO	38.48	225		CI	VC	88.46	201	5101	37.41	CO	35.56	225		CI	VC	58.41	70
5102	37.76	CO								5103	39.38	CO	36.48	225		CI	VC	20.81	52
5104	38.01	CO								5105	38.05	CO							
5106	39.4	CO	36.72	225		CI	VC	29.41	48	5107	40.57	SW							
5108	36.66	CO								5201	35.29	FO							
5202	37.54	CO								5301	36.12	SW	37.51	150		CI	VC	58.05	19
5302	36.1	FO	33.86	225		CI	VC	60.22	29	5303	32.92	CO	30.65	1050		CI	VC	60.46	43
5304	32.86	CO	31.57	225		CI	VC	2	307	5305	33.04	CO	31.35	375		CI	VC	68.23	68
5306	33.92	CO	32.27	225		CI	VC	34.93	15	5307	36.12	CO	33.66	150		CI	VC	43.05	13
5308	38.65	CO	37	150		CI	VC	57.78	289	5309	33.26	FO	31.56	375		CI	VC	57.78	289
5312		FO								5313		FO							
5314		FO								5401	33.34	CO	30.93	1050		CI	VC	38.08	152
5402	34.28	CO								5403	34.24	SW							
5404	35.97	CO	33.91	225		CI	VC	56.04	38	5405	35.88	SW	33.28	375		CI	VC	52.48	39
5406		FO								6001	40.44	CO	39.49	225		CI	VC	66.23	170
6002	40.7	CO	40.21	225		CI	VC	23.65	60	6101	41.38	CO	40.21	225		CI	VC	69.12	22
6102	40.1	CO	43.21	225		CI	VC	97.19	22	6201	41.65	CO							
6202	44.81	CO								6302		FO							
6303		FO								6304		FO							
6401	37.25	FO	35.03	225		CI	VC	35.85	31	6402	37.02	SW	34.47	225		CI	VC	40.82	136
6403	38.17	FO	36.43	225		CI	VC	64.47	47	6404	39.15	SW	39.25	225		CI	VC	53.85	26
6405	41.46	SW	39.84	225		CI	VC	56.75	18	6406	41.44	FO	38.95	225		CI	VC	61.39	19
6407	41.1	SW	38.48	225		CI	VC	81.58	24	6408	41.05	FO							
6409		FO								7001	41.69	CO	40.69	225		CI	VC	48.86	130
7101	42.36	CO	41.33	225		CI	VC	38.95	61	7102	42.81	CO	41.69	225		CI	VC	19.21	64
7103	43.31	CO	41.99	225		CI	VC	30.81	114	7104	43.33	CO	42.07	225		CI	VC	4.47	64
7105	43.75	CO	43.71	225		CI	VC	11.4	18	7106	46.61	CO	42.5	225		CI	VC	38.83	79
7107	43.37	CO	41.09	225		CI	VC	43.59	34	7201	43.02	FO	41.61	225		CI	VC	82.87	32
7301	43.02	FO								7302	43.3	SW							
7303	42.02	FO								7401	44.22	SW	42.47	225		CI	VC	44.78	55
7402	43.16	SW	41.71	225		CI	VC	73.98	31	7403	43.17	FO	41.51	225		CI	VC	72.18	44
8401	47.06	CO								8402	46.93	SW	44.01	150		CI	VC	7	10
9001		SW	0	1000		CI	VC	128.84		9101		SW	0	1000		CI	VC	128.88	
9103		SW	0	1000		CI	VC	29.83		9401		FO							
9402		FO								9403		FO							
9404		FO								9405		FO							
9406		FO								9407		FO							
9408		FO								9409		FO							
9410		FO								9411		FO							
9412		FO								9413		FO							
9414		FO								9415		FO							
9416		FO								9417		FO							
9418		FO								9419		FO							
9420		FO								9421		FO							
9422		FO								9423		FO							
9424		FO								9425		FO							
9426		FO								9427		FO							
9428		FO								9429		FO							
9430		FO								9431		FO							
9432		FO								9433		FO							
9434		FO								9435		FO							
9436		FO								9437		FO							
9438		FO								9439		FO							
9440		FO								9441		FO							
9442		FO								9443		FO							
9444		FO								9445		FO							
9446		FO								9447		FO							
9448		FO								9449		FO							
9450		FO								9451		FO							
9452		FO								9453		FO							
9454		FO								9455		FO							
9456		FO								9457		FO							
9458		FO								9459		FO							
9460		FO								9461		FO							
9462		FO								9463		FO							
9464		FO								9465		FO							
9466		FO								9467		FO							
9468		FO								9469		FO							
9470		FO								9471		FO							
9472		FO								9473		FO							
9474		FO								9475		FO							
9476		FO								9477		FO							
9478		FO								9479		FO							
9480		FO								9481		FO							
9482		FO								9483		FO							
9484		FO								9485		FO							
9486		FO								9487		FO							
9488		FO								9489		FO							
9490		FO								9491		FO							
9492		FO								9493		FO							
9494		FO								9495		FO							
9496		FO								9497		FO							
9498		FO								9499		FO							
9500		FO								9501		FO							
9502		FO								9503		FO							
9504		FO								9505		FO							
9506		FO								9507		FO							
9508		FO								9509		FO							
9510		FO								9511		FO							
9512		FO								9513		FO							
9514		FO								9515		FO							
9516		FO								9517		FO							
9518		FO								9519		FO							
9520		FO								9521		FO							
9522		FO								9523		FO							
9524		FO								9525		FO							
9526		FO								9527		FO							
9528		FO								9529		FO							
9530		FO								9531		FO							
9532		FO								9533		FO							
9534		FO								9535		FO							
9536		FO								9537		FO							
9538		FO								9539		FO							
9540		FO								9541		FO							
9542		FO								9543		FO							
9544		FO								9545		FO							
9546		FO								9547		FO							
9548		FO								9549		FO							
9550		FO								9551		FO							
9552		FO								9553		FO							

Appendix 5: Preliminary Drainage Strategy
Lees Roxburgh Drg. No. 6268/01-06D