RODGERS LEASK
Consulting Civil & Structural Engineers

Athersley, Barnsley

Flood Risk Assessment & Drainage Strategy

Athersley, Barnsley

Flood Risk Assessment & Drainage Strategy

For

Harworth Estates

April 2021

P17-172

Revision B

Document History

Prepared by	:	Matt Leask
Position	:	**Senior Engineer**
Date	:	**April 2018**
Authorised by	:	Kriston Harvey
Position	:	**Director**
Date	:	**April 2018**
Document Status	:	**Final**
Revision	:	**B**

Revision	Date	Comment	Editor
#	Sep 17	Issued for comment.	
A	Apr 18	Drainage strategy amended.	ML
B	Apr 21	Appendices updated where appropriate.	BRM

Summary

Conclusion	All forms of flood risk have been reviewed for the proposed development site which is located entirely within Flood Zone 1; it is considered that the site and surrounding land would be at a low flood risk following redevelopment. A robust drainage strategy has been proposed to deal with both foul and surface water which would be generated by the redeveloped site, with no surface water flooding occurring for storms up to and including the 1 in 100 year plus climate change event. Flow routing has been considered to ensure that in the event of a blockage, existing adjacent landowners are not subject to an increased flood risk. It is therefore considered that from a flood risk and drainage point of view, the proposed development is appropriate.
Introduction	Rodgers Leask Ltd has been commissioned by Harworth Estates to undertake a Flood Risk Assessment and Drainage Strategy for the proposed development of the parcel of land off Wakefield Road, Athersley, Barnsley. This report has been commissioned in support of an outline planning application to Barnsley Metropolitan Borough Council. This Flood Risk Assessment and Drainage Strategy has been prepared in accordance with the Department for Communities and Local Government (DCLG) National Planning Policy Guidance, and the publication 'National Planning Policy Framework' published 27th March 2012 which supersedes 'Planning Policy Statement 25 (PPS25) Development and Flood Risk' (2010). However this report also conforms to PPS25 and is in line with current guidance and best practice.
Site Location Description and Details	The site has an overall area of approximately 7.73 hectares and is located off Wakefield Road, Athersley, Barnsley; centred at approximate OS GR: E434724 N408742. The site lies west of Wakefield Road, approximately 2.5km north of Barnsley Town Centre; and is currently Greenfield. A topographical survey of the site area has been undertaken. The site slopes generally from north to south with a natural valley formed along the route of a watercourse which flows through the centre of the site. The highest part of the site is located in the north eastern corner and reaches a level of 78.25mAOD. The lowest part of the site is the southernmost point at a level of 56.14mAOD.

<table>
<tr><td>Definition of the Flood Hazard and Probability</td><td>All means of flood risk at the site have been assessed and it has been demonstrated that the site is not at risk of flooding, nor would it pose a risk to adjacent land following development subject to the recommendations contained within this report being adhered to.</td></tr>
<tr><td>Predevelopment Surface Water Runoff</td><td>The Greenfield runoff rates for the site are as follows:
<table>
<tr><td>Storm Event (yr)</td><td>QBar</td><td>1</td><td>30</td><td>100</td></tr>
<tr><td>Discharge (l/s)</td><td>28.8</td><td>24.8</td><td>50.7</td><td>60.0</td></tr>
</table></td></tr>
<tr><td>Development Proposals and Site Surface Water Strategy</td><td>The development is approximately 7.73ha and is proposed for up to 220 residential dwellings and associated infrastructure.

Rodgers Leask Environmental has carried out permeability testing at various points on the site to assess the viability of soakaways as a drainage solution. None of the locations tested recorded sufficient percolation rates to support infiltration; furthermore, made ground is present across large areas of the site. The ground conditions preclude the use of soakaways at the site.

It is therefore considered that infiltration would not be suitable as the primary means of disposal of surface water runoff from the proposed development.

The site currently drains predominantly via overland flow to the unnamed watercourse which runs through the centre of the site, with a portion of the site draining to an existing culvert further west, that runs beneath the railway embankment. Hydrogeological and historic mapping suggests a connection between the watercourse and the land drains to the south of the site; this was believed to be in the form of a culvert underneath the historical railway embankment similar to the culvert observed in the western section of the site.

Following site walkovers by Rodgers Leask, Rodgers Leask Environmental and Discovery Surveys on a number of separate occasions, no culvert has been found in this area. Barnsley Metropolitan Borough Council has since confirmed that they have explored this further and that a connection to the watercourse would not be acceptable due to the lack of positive connection beyond the site.

For the purposes of proposing a robust drainage strategy, it has thus been assumed that no culvert exists within this area.

It is therefore proposed that the development site would discharge surface water runoff to the existing culvert to the west and the combined public sewer which runs through the site via on-site sustainable drainage networks. Discussions have been held with Catherine Wellham of Yorkshire Water and it has been agreed that a connection into the public sewer is</td></tr>
</table>

	acceptable, due to site topography, at a reduced discharge rate. Following correspondence with Barnsley Metropolitan Borough Council it has been agreed that a restricted discharge rate of 5 l/s/ha is acceptable for surface water flows from the site. For the total developable area of 6.65 ha, the overall discharge rate has been calculated as 33.25 l/s. Impermeable areas have been conservatively assumed as 65% of the development areas. The green corridor shown on the proposed site layout has been discounted from the developable area. It is proposed to discharge surface water from the site at maximum discharge rate of 29.7 l/s to the western culvert and 3.5 l/s to the public combined water sewer. The Drainage Strategy drawing (P17-172-200) shows the required attenuation volumes for each catchment along with the respective discharge rates for each feature. It is proposed to attenuate flows using attenuation basins for the two catchments, that could be offered up for adoption by Yorkshire Water. Flows up to the 1 in 2-year rainfall event will be attenuated in below ground oversized pipes without entering the basin in accordance with Yorkshire Water requirements. It is considered that by adhering to the strategy outlined above, the additional volumes of surface water runoff generated by the redeveloped site will be managed such that the residual risk to adjacent buildings and land is negligible.
Climate Change	The proposed surface water drainage system should be designed to accommodate the 1:30 year rainfall event without any surface water flooding and should be capable of retaining the 1:100 year plus 40% climate change storm event on site without flooding any buildings.
Pre Development Foul Water Regime	As the site was previously Greenfield, there are currently no provisions for foul water drainage on site.
Proposed Developed Site Foul Water Strategy	A new connection into the existing combined sewer which runs centrally through the site is proposed. A pre-planning enquiry response has been received from Yorkshire Water as well as further correspondence which confirms that a foul connection for the development could be accommodated in the public sewer.

Contents

1	**Introduction**	**1**
1.1	Terms of Reference	1
1.2	Guidance	1
2	**Background Information**	**2**
2.1	Site Location, Description and Details	2
2.2	Main Drainage Catchment Context	2
2.3	Approach to the Assessment	3
3	**Flood Risk Assessment**	**4**
3.1	Definition of the Flood Hazard and Probability	4
3.2	Development Description and Planning Context	7
3.3	Pre Development Surface Water Runoff	7
3.4	Design Considerations for Exceedance and Climate Change	7
3.5	Development Proposals and Surface Water Strategy	7
3.6	SuDS	9
3.7	SuDS Maintenance	9
3.8	Pre Development Foul Water Regime	10
3.9	Proposed Developed Site Foul Water Strategy	10
4	**Recommendations**	**11**
4.1	Recommendations	11
4.2	Disclaimer	11

Appendices

A Topographical Survey

B Yorkshire Water Sewer Records

C Groundsure Enviro Insight Hydrology Map

D Illustrative Masterplan

E ICP SUDS Calculation

F LLFA Correspondence

G Drainage Strategy Drawing

H Yorkshire Water Correspondence

I MicroDrainage Calculations

1 Introduction

1.1 Terms of Reference

1.1.1 Rodgers Leask Ltd has been commissioned by Harworth Estates to undertake a Flood Risk Assessment and Drainage Strategy for the proposed development of the parcel of land off Wakefield Road, Athersley, Barnsley.

1.1.2 This report has been commissioned in support of an outline planning application to Barnsley Metropolitan Borough Council.

1.1.3 Discussions have been held with Barnsley Metropolitan Borough Council (LLFA), the Environment Agency and Yorkshire Water with regard to flood risk and drainage.

1.1.4 This Flood Risk Assessment and Drainage Strategy has been prepared in accordance with the Department for Communities and Local Government (DCLG) National Planning Policy Guidance, and the publication 'National Planning Policy Framework' published 27th March 2012 which supersedes 'Planning Policy Statement 25 (PPS25) Development and Flood Risk' (2010). However this report also conforms to PPS25 and is in line with current guidance and best practice.

1.1.5 This report has been produced on behalf of the client, Harworth Estates, and no responsibility is accepted to any third party for all or any part. This report should not be relied upon or transferred to any other parties without the express written authorisation of Rodgers Leask Ltd.

1.2 Guidance

1.2.1 The Planning Practice Guidance was published on the 6th March 2014 and contains guidance on Flood Risk and Coastal Change (updated on 15th April 2015).

1.2.2 The National Planning Policy Framework (NPPF) document was published 27th March 2012.

1.2.3 The latest version of PPS 25 was released on the 29th March 2010 and is now superseded by the NPPF.

1.2.4 NPPF can be downloaded free of charge from the internet at the following link:

http://www.communities.gov.uk/documents/planningandbuilding/pdf/2116950.pdf

1.2.5 Flood risk assessments: climate change allowances was published on the 19th February 2016 and can be downloaded free of charge from the internet at the following link:

https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

2 Background Information

2.1 Site Location, Description and Details

2.1.1 Figure 2.1 below indicates the location of the site.

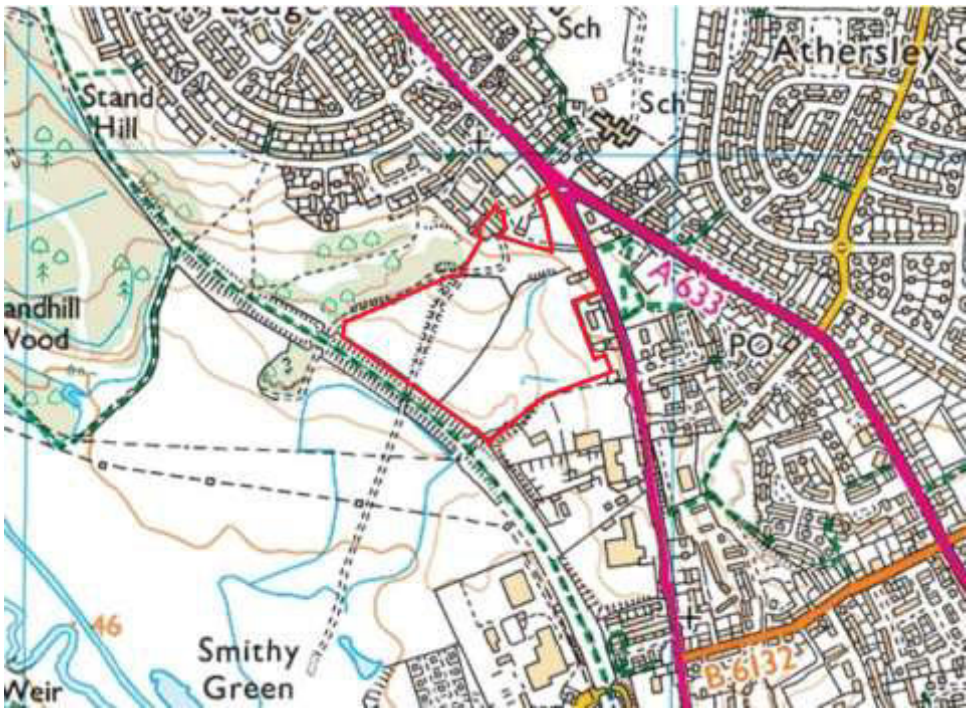


Figure 2.1 Athersley, Barnsley – Site Location Plan

2.1.2 The site, as outlined above in Figure 2.1, has an overall area of approximately 7.73 hectares and is located off Wakefield Road, Athersley, Barnsley; centred at approximate OS GR: E434724 N408742.

2.1.3 The site lies west of Wakefield Road and approximately 2.5km north of Barnsley Town Centre; it is currently Greenfield.

2.1.4 A topographical survey of the site area has been undertaken and is included in Appendix A. The site slopes generally from north to south with a natural valley formed along the route of a watercourse which flows through the centre of the site. The highest part of the site is located in the north eastern corner and reaches a level of 78.25mAOD. The lowest part of the site is the southernmost point at a level of 56.14mAOD.

2.2 Main Drainage Catchment Context

2.2.1 The site is currently Greenfield and has an overall area of approximately 7.73 hectares. Surface water runoff generated by the site currently drains predominantly via overland flow to a watercourse in the centre of the site that flows from north to south before sinking under the adjacent historical railway embankment and springing on the other side.

2.2.2 The Yorkshire Water sewer records are included in Appendix B. The records indicate that public combined sewers enter the site via the northern, eastern and western boundaries before meeting at a combined sewer overflow chamber. The sewer then runs from north to south before leaving the site via the southern boundary. A surface water sewer is also shown to enter the site via the eastern boundary from the commercial/industrial premises located to the southeast, before terminating at an existing pond which forms part of the watercourse within the site.

2.3 Approach to the Assessment

2.3.1 This assessment seeks to consider the risks of flooding both to the site and to the wider area as a consequence of the development proposal. This also requires assessment of the development constraints of the site and the opportunities offered by the existing infrastructure and natural environment in order to propose a strategy by which the site can be developed both economically and sustainably. This assessment draws upon our investigations regarding the local area.

3 Flood Risk Assessment

3.1 Definition of the Flood Hazard and Probability

3.1.1 Fluvial Flood Risk:

The site is located within the River Dearne catchment; in the Don and Rother sub-catchment, and is located approximately 635m northeast of the River Dearne itself.

Barnsley Metropolitan Borough Council (Lead Local Flood Authority – LLFA) was contacted regarding the site. There have been no historic flood incidents provided for the site or in the vicinity.

Based upon the Environment Agency Flood Map for Planning (see Figure 3.1 below), the entirety of the site lies within Flood Zone 1, where there is less than a 1 in 1000 (0.01%) chance of flooding each year.

Fig 3.1 Athersley, Barnsley – Environment Agency Flood Map for Planning

As such, the site is considered to be at a low risk of flooding from fluvial sources.

3.1.2 Tidal Flood Risk:

The site is approximately 56 kilometres from the nearest coastal location and at an average altitude of approximately 65m above mean sea level. The site is therefore not considered to be at risk of flooding from tidal sources.

3.1.3 Surface Water Flood Risk:

A watercourse, shown on the hydrological mapping contained within Appendix C as a partially culverted tertiary river, runs through the centre of the site from north to south. The culvert size and location is unconfirmed and was not visible during the site walkover. Through subsequent site visits and liaison with Barnsley Metropolitan Borough Council, it is assumed that no culvert exists along the watercourse. It is likely that the area surrounding the existing watercourse will be retained as a landscaped corridor and that overland flow that currently drains into the watercourse will be controlled through the proposed development.

Reviewing the Environment Agency's online flood mapping, the risk of surface water flooding to the watercourse ranges from low risk in the northern section of the site, with a chance of flooding between 1 in 100 (1% AEP) and 1 in 1000 (0.1% AEP), to high risk in the southern section from the surface water sewer outfall to the reed beds, with a chance of flooding greater than 1 in 30 (3.3% AEP). It is considered that following development surface water flows into this watercourse will be restricted to 5 l/s/ha, providing a betterment for the higher category storms such as the 1 in 30 and 1 in 100-year events.

The small portion of the site to the north of the existing access road is at high risk of surface water flooding due to its topography. A low spot exists in the south western corner partly surrounded by steep banks with no positive outfall, allowing overland flows to accumulate during rainfall events. This area will be filled in to allow development, and therefore surface water flows will no longer accumulate, greatly reducing the surface water flood risk.

The entire lengths of the southern and western boundaries of the site are shown as being at low risk of surface water flooding, though a portion of the western boundary is shown as being at high risk in the approximate region of the brick culvert identified during the site walkover. The cutting through the historical railway embankment is also shown as an area of low risk. It is considered that overland flows draining into the ditches along these boundaries would be controlled through the development for the higher category storms such that flood risk in these areas would be effectively reduced.

Additionally, the land drains to the south of the site would also benefit from a reduced flood risk due to the discharge rate originating from the site being reduced for the higher category storms following development.

As such, it is considered that the site will be at a low risk of flooding from either flows generated on-site, or from overland flows from off-site. Furthermore, it is considered

that the flood risk to surrounding areas as a result of flows originating from the site will also be reduced.

3.1.4 Flood Risk from Ground Water:

Geological information for the site has been obtained via GroundSure GeoInsight reports, the British Geological Survey's Geology of Britain viewer and intrusive investigations undertaken by Rodgers Leask Environmental. Areas of the site lie on the Pennine Middle Coal Measures and Woolley Edge rock formations with bedrock comprising mudstone, siltstone and sandstone. Localised superficial deposits consisting of Glaciofluvial Deposits are shown just within the northern boundary of the site.

Areas of made ground are shown on geological records across the site, but mainly in the area of a historic railway embankment in the north of the site and an old track that runs through the west of the site.

A Non-Residential Mining Report has been obtained from The Coal Authority. The site is shown to be located within an area that could be affected by historic underground mining with disused mineshafts and adits recorded in the northern section of the site.

Boreholes recorded by the British Geological Survey to the southeast of the site indicate the area to be underlain by mudstone, siltstone and coal measures.

Rodgers Leask Environmental excavated a number of trial pits and window samples across the site. 6no window samples encountered groundwater between 2 – 4m below ground level; 2no trial pits encountered groundwater at approximately 2m below ground level.

The Barnsley Metropolitan Borough Council Preliminary Flood Risk Assessment Report (PFRA) gives little information on areas at risk of groundwater flooding but does mention that groundwater rebound is not believed to be an issue across the borough.

Following development of the site, only small areas of permeable surface will be left over. As such, it is not expected that any significant groundwater emergence will occur.

Flood routing should be provided to deal with any localized groundwater flooding for remaining soft landscaped areas and ground floor levels should be set a nominal 150mm above the general ground level of the site in accordance with best practice.

The site is therefore not considered to be at risk of flooding from ground water, allowing for a typical seasonal fluctuation.

3.1.5 Flood Risk from Infrastructure:

Reviewing the Environment Agency's online flood mapping the site can be seen to be out of the area at risk of flooding from reservoirs.

Yorkshire Water is the statutory sewerage undertaker and is responsible for the maintenance and repair of the public sewer systems within the Barnsley area.

The Barnsley Metropolitan Borough Council Strategic Flood Risk Assessment (SFRA) identifies a number of areas around Barnsley where it is believed that flooding from sewers is more prevalent. Athersley is not included in this list, however.

As such, the site is not considered to be at risk of flooding from infrastructure.

3.2 Development Description and Planning Context

3.2.1 The current development proposals are for up to 220 residential units and associated infrastructure. An Illustrative Masterplan showing the developable area and proposed access location is included in Appendix D.

3.2.2 In accordance with the NPPF, buildings used for dwellings fall under the More Vulnerable category in terms of flood risk.

3.2.3 All forms of development are considered suitable in Flood Zone 1.

3.2.4 References have been taken from the Barnsley Metropolitan Borough Council SFRA, however, there is very little information regarding the site specifically within the report.

3.3 Pre Development Surface Water Runoff

3.3.1 The site is currently Greenfield and discharges surface water runoff via overland flow to the unnamed watercourse which flows from north to south through the centre of the site.

3.3.2 The Greenfield runoff rates are as follows:

Storm Event (yr)	QBar	1	30	100
Discharge (l/s)	28.8	24.8	50.7	60.0

The calculations are contained within Appendix E.

3.4 Design Considerations for Exceedance and Climate Change

3.4.1 The proposed surface water drainage system should be designed to accommodate the 1:30 year rainfall event without any surface water flooding and should be capable of retaining the 1:100 year plus 40% climate change storm event on site without flooding any buildings.

3.5 Development Proposals and Surface Water Strategy

3.5.1 The development is approximately 7.73ha and is proposed for up to 220 residential dwellings and associated infrastructure.

3.5.2 Rodgers Leask Environmental has carried out permeability testing at various points on the site to assess the viability of soakaways as a drainage solution.

None of the locations tested recorded sufficient percolation rates to support infiltration; furthermore, made ground is present across large areas of the site. It is considered the ground conditions precludes the use of soakaways at the site.

3.5.3 It is therefore anticipated that infiltration would not be suitable as the primary means of disposal of surface water runoff from the proposed development.

3.5.4 The site currently drains predominantly via overland flow to the unnamed watercourse which runs through the centre of the site, with a portion of the site draining to an existing culvert further west, that runs beneath the railway embankment. The hydrology map contained within Appendix C suggests a connection between the watercourse and the land drains to the south of the site; this was believed to be in the form of a culvert underneath the historical railway embankment similar to the culvert observed in the western section of the site.

3.5.5 Following site walkovers by Rodgers Leask, Rodgers Leask Environmental and Discovery Surveys on a number of separate occasions, no culvert has been found in this area. Barnsley Metropolitan Borough Council has since confirmed that they have explored this further and that a connection to the watercourse would not be acceptable due to the lack of positive connection beyond the site.

3.5.6 For the purposes of proposing a robust drainage strategy, it has thus been assumed that no culvert exists within this area and that surface water sinks within the site and springs on the southern side of the railway embankment.

3.5.7 It is therefore proposed that the development site would discharge surface water runoff predominantly to the existing culvert further west, where practicable, with a small section of the site discharging to the existing combined public sewer which runs through the site, via on-site sustainable drainage networks. Discussions have been held with Catherine Wellham of Yorkshire Water and it has been agreed that a small section of the site could discharge to the public combined water sewer at a maximum rate of 3.5 l/s, due to site topography. Correspondence with Yorkshire Water can be found in Appendix H.

3.5.8 Following correspondence with Barnsley Metropolitan Borough Council, it has been agreed that a restricted discharge rate of 5 l/s/ha is acceptable for surface water flows from the site. For the total developable area of 6.65 ha, the overall discharge rate has been calculated as 33.25 l/s. Impermeable areas have been conservatively assumed as 65% of the development areas. The green corridor shown on the proposed site layout within Appendix D has been discounted from the developable area. Correspondence with the LLFA can be found in Appendix F.

3.5.9 It is proposed to discharge surface water from the site at maximum discharge rate of 29.7 l/s to the western culvert and 3.5 l/s to the public combined water sewer.

3.5.10 The Drainage Strategy drawing (P17-172-200) in Appendix G shows the required attenuation volumes for each catchment along with the respective discharge rates for each feature.

3.5.11 It is proposed to attenuate flows using attenuation basins for the two catchments, that could be offered up for adoption by Yorkshire Water. Flows up to the 1 in 2-

year rainfall event will be attenuated in below ground oversized pipes without entering the basin in accordance with Yorkshire Water requirements.

3.5.12 Past experience has found that at detailed design stage, the actual attenuation volume required tends toward the lower end of the preliminary modelling range.

3.5.13 Overland flow routes will be carefully considered for blockage and exceedance events to ensure that routing is away from both existing and proposed buildings.

3.5.14 It is considered that by adhering to the strategy outlined above, the additional volumes of surface water runoff generated by the redeveloped site will be managed such that the residual risk to adjacent buildings and land is negligible.

3.6 SuDS

3.6.1 SuDS have been considered as part of the drainage solution. Typically, SuDS techniques are used to mimic the natural drainage of the land, infiltrating surface water into the ground or discharging it into a local water course. Where this occurs it is important to ensure that the quality of water is as clean as possible to prevent the spread of any pollutants. This is also the case when discharging surface water to a surface water sewer as in most cases these types of sewers discharge into water courses.

3.6.2 Water treatment will generally be provided within development parcels via a combination of methods, which may include swales, permeable paving, filter strips and filter trenches where practicable.

3.6.3 It is considered that by adhering to the SuDS strategy above, the necessary treatment could be provided to allow compliance with CIRIA C753 guidance.

3.7 SuDS Maintenance

3.7.1 Any swales serving the site will only serve the private drainage network and would be adopted by a private management company and will require regular maintenance including:

- Regular litter removal
- Inlet and outlet inspection quarterly and clearing when necessary
- Vegetation management including regular mowing as required
- Sediment removal as required

3.7.2 Filter Strips

- Regular litter removal
- Vegetation management including regular mowing as required
- Sediment removal as required

3.7.3 Filter Trenches

- Regular litter removal
- Inlet and outlet inspection quarterly and clearing when necessary
- Sediment removal as required

3.7.4 Any detention basins serving the site will be adopted by Yorkshire Water and will be maintained in accordance with Yorkshire Water policy.

3.8 Pre Development Foul Water Regime

3.8.1 As the site was previously Greenfield, there are currently no provisions for foul water drainage on site.

3.9 Proposed Developed Site Foul Water Strategy

3.9.1 A new connection into the existing combined sewer which runs centrally through the site is proposed. Please refer to the sewer records in Appendix B.

3.9.2 It is likely that the existing combined water sewers that currently cross the site will need to be diverted to suit the proposed layout, including the combined sewer overflow pipe. It is proposed to retain the combined sewer overflow apparatus in its existing location within an area of open space in the layout accessible to vehicles, whilst also maintaining a 15m cordon sanitaire.

3.9.3 A pre-planning enquiry response has been received from Yorkshire Water as well as further correspondence (see Appendix H) which confirms that a foul connection for the development could be accommodated in the public sewer.

4 Recommendations

4.1 Recommendations

4.1.1 All means of flood risk at the site have been assessed and it has been demonstrated that the site is not at risk of flooding, nor would it pose a risk to adjacent land following development subject to the recommendations below being adhered to.

4.1.2 An outfall to the unnamed watercourse via on-site sustainable drainage networks incorporating water treatment should be considered as the primary means of surface water discharge.

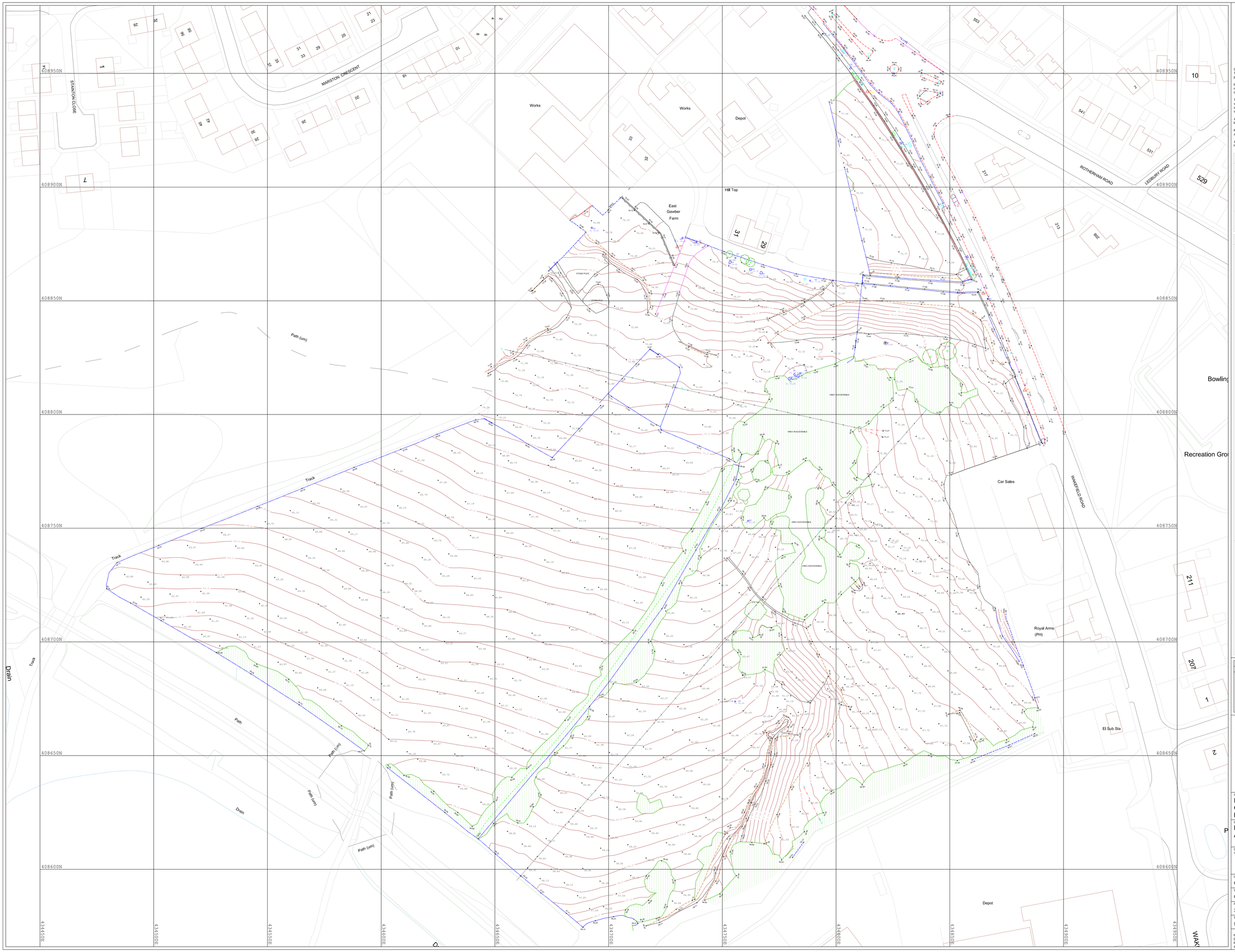
4.1.3 The proposed surface water drainage system should be designed to accommodate the 1:30 year rainfall event without any surface water flooding and should be capable of retaining the 1:100 year plus 40% climate change storm event on site without flooding any buildings.

4.2 Disclaimer

We would note that all comments made in this report are based on the sources stated in Section 1.1. This report and its recommendations are intended for the use of Harworth Estates for the above site only.

Appendices

Appendix A – Topographical Survey



ISO 9001 REGISTERED FIRM

Comments;
The plan and digital data should only be used for its original intended purpose at the defined survey scale.

It is for the use only of the party to whom it has been addressed and no responsibility is accepted to any third party for the whole or part of its contents.

This survey has been prepared on the basis that all information and facts, which may affect the survey, have been disclosed to us by the parties concerned and no liability nor responsibility can be accepted, unless full disclosure has been made.

All ground features that were visible at the time of the survey have been located, however there may have been items obscured.

Pipe sizes and flow direction have been visually assessed from the surface and should be considered as approximate only.

All data remains the ownership of Oakes Survey Services until full payment has been received.

STATION SCHEDULE

Station	Easting	Northing	Level
O1	434813.752	408942.036	79.991
O2	434864.691	408853.276	78.271
O3	434882.863	408810.662	77.680
REF	434730.180	408873.723	76.268

LEGEND

Air Valve	Av
Belisha Beacon	BB
Borehole	BH
Rubbish Bin	Bin
Bollard	Boll
Bus Stop	Bs
Telecom Point	BT
Camera	Cam
Control Box	Cbox
Closed Circuit TV	Cctv
Cable TV Covers	Ctv
Down Pipe	Dp
Eaves Height	Eave
Electric Box	Ebox
Electric Post	Ep
Earth Rod	Er
Fire Hydrant	Fh
Flood light	Fl
Flag Staff	Fs
Gas Marker	Gmkr
Gate Post	Gp
Gas Valve	Gv
Gully	Gy
Illuminated Bollard	IB
Inspection Cover	IC
Inspection Cover Undefined	Icu
Floor Level	IFL
Invert Level	Inv
Letter Box	LBox
Lamp post	Lp
Manholes	MH
Marker Post	Mkr
Pipe Invert	PInv
Trial Pit	Pit
Parking Meter	PM
Posts	Post
Ridge Height	Rdge
Road Name Board	Rnb
Rodding Eye	Re
Sign Post	Sp
Stile	Stil
Tree Stump	Stmp
Stop Tap	St
Stop Valve	Sv
Cable Stay	Sy
Threshold Level	THL
Traffic Light	TL
Telegraph Post	Tp
Traffic Signal	TS
Top of Wall	TW
Unable to Lift	UTL
Valve	Va
Vent Pipe	Vp
Water Level	WL
Water Meter	Wm
Wash Out	Wo

STA1	Survey Station
	Channel Line
	Centre Line
	Edge of Vegetation
	Fence Open
	Fence Panel
	Fence Secure
	Gate
	Hedge
	O/H Utilities
	Top of Face

Revisions:

Ref.	Description:	Date:

OAKES SURVEYS LTD
8 The Heritage Business Centre, Derby Road, Belper, Derbyshire. DE56 1SW
Tel : 01773 820124 Fax : 01773 825407
E : info@oakessurveys.com W : www.oakessurveys.com

Client:
HARWORTH ESTATES PROPERTY GROUP LTD, ADVANTAGE HOUSE POPLAR WAY, ROTHERHAM S60 2JG

Location/Site:
LAND AT WAKEFIELD ROAD ATHERSLEY, BARNSLEY S71 1NX

Drawing Title:
TOPOGRAPHICAL SURVEY

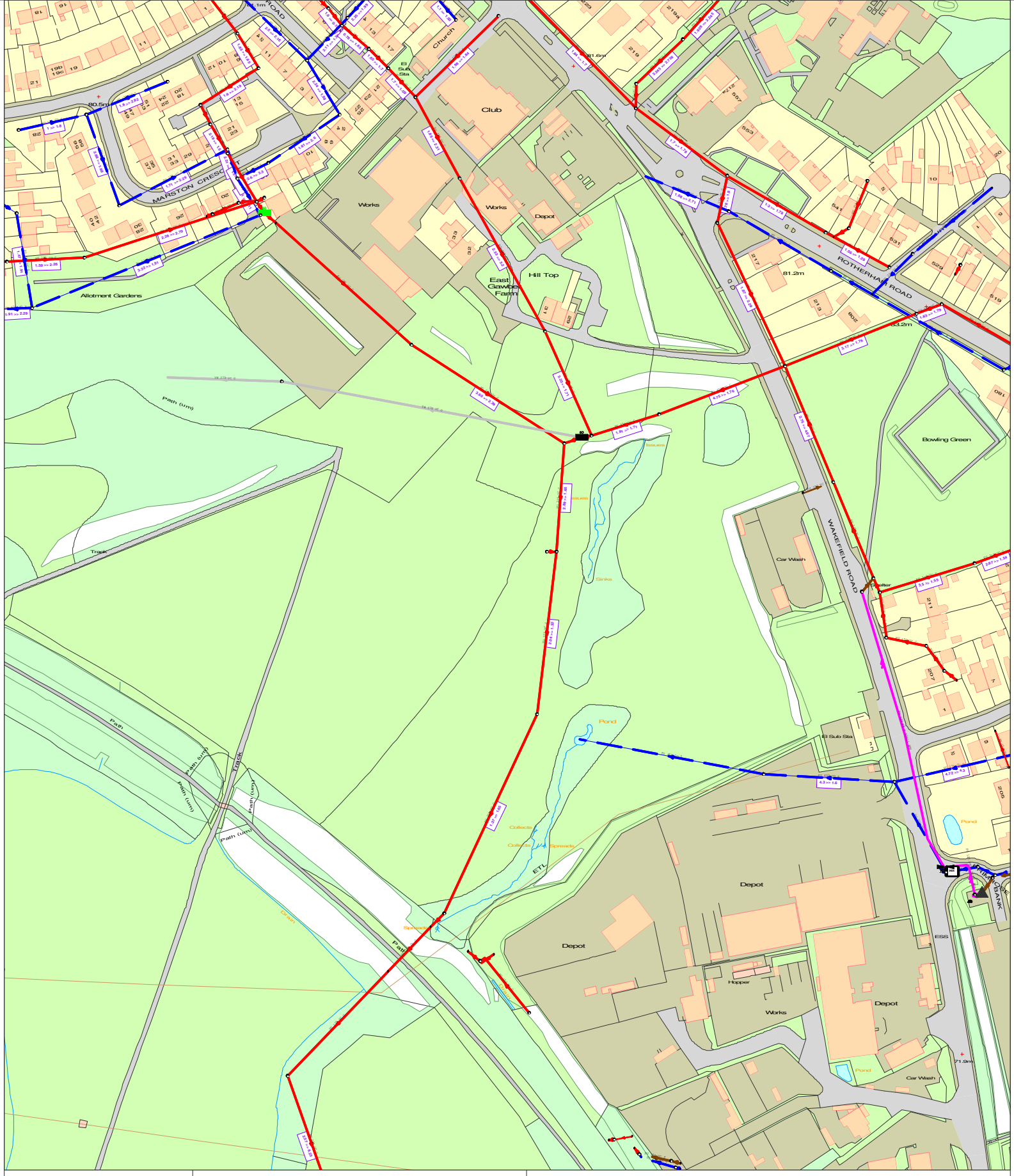
Level Datum:
ORDNANCE SURVEY

Grid Datum:
ORDNANCE SURVEY

Project Number:		Drawing Reference:	
3898		3898_ATHERSLEY-GAWBER_OGL	
Surveyor:	Checked:	Date:	Scale:
SRO	SRO/KDA	15/05/2017	1:500@A0

Notes:
Do not scale, use figured dimensions only.
Please report any discrepancies immediately to Oakes Surveys Limited.
©Oakes Surveys Limited, reproduction forbidden without permission.

Appendix B – Yorkshire Water Sewer Records



434429 : 408381	Map Name : SE3408SW	Title

Yorkshire Water,
PO Box 500,
Halifax Road,
Bradford BD6 2LZ
Contact Name :
G Delaney
Contact Tel :

Notes

Partial Key

Foul Sewer = F

Combined Sewer = C

Surface Water Sewer = SW

Trade Sewer = TD

Partially Separate = PS

This plan is furnished as a general guide only and no warranty as to its correctness is given or implied. This plan must not be relied upon in the event of excavations or other works made in the vicinity of public sewers. No house or property connections are shown.

(Ody) COPYRIGHT STATEMENTS: Reproduced by permission of Ordnance Survey on behalf of HMSO
© Crown copyright and database 2014. All rights reserved Ordnance Survey Licence number 100022432

Registered Office, Yorkshire Water Services Limited
Western House, Halifax Road, Bradford BD6 2SZ. Registered in England and Wales No. 2366682

Date Req : 26/05/2017, 15:16:25

Date Gen : 26/05/2017, 15:16:29

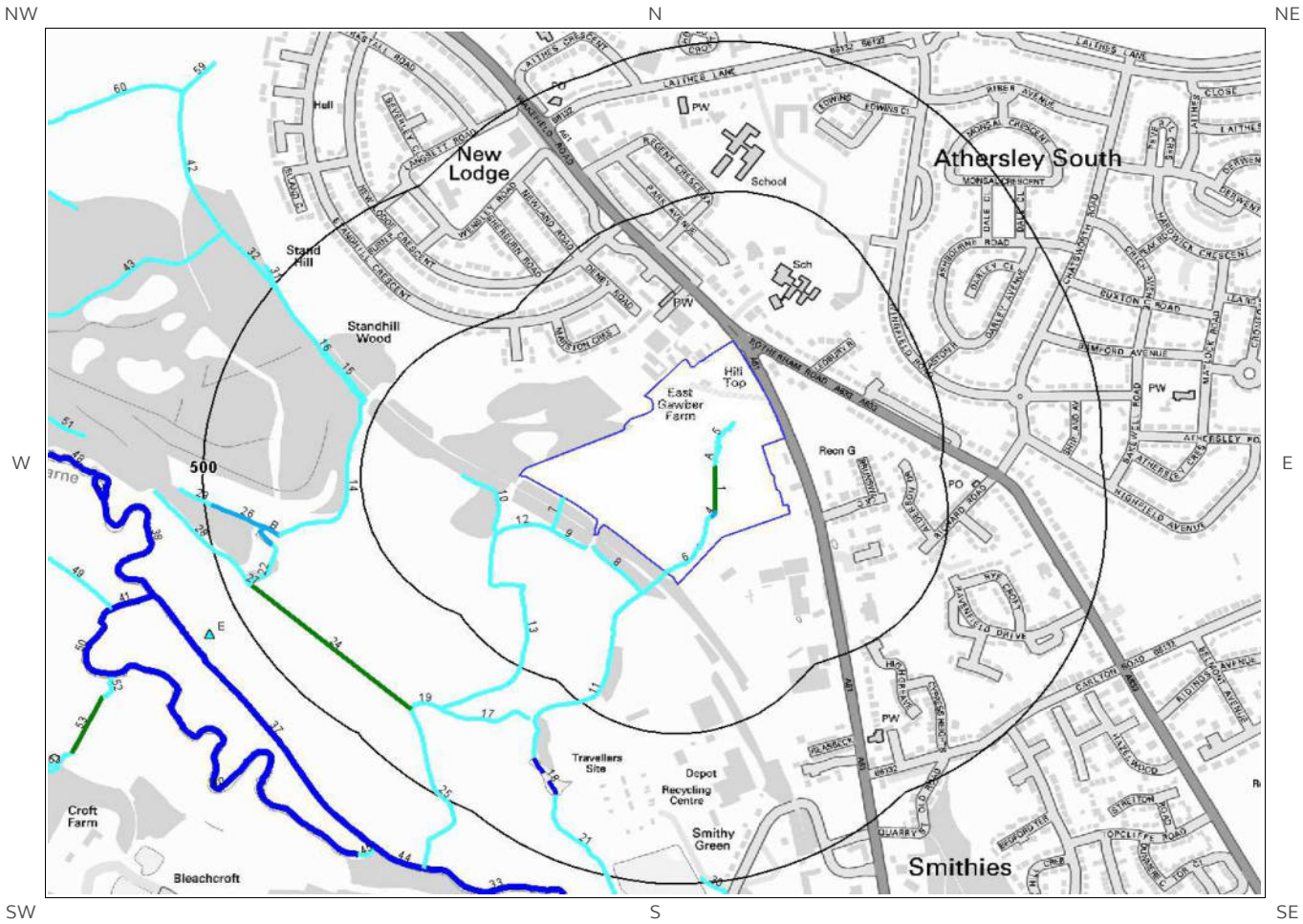
Source : Sewer Network Enquiry

UPN: Undefined

Originator: G Delaney, ,

Appendix C – Groundsure Enviro Insight Hydrology Map

6e. Hydrology – Detailed River Network and River Quality



© Crown copyright and database rights 2017.
Ordnance Survey license 100035207.

Site Outline

250 500 Search Buffers (m)

Primary River
Secondary River
Tertiary River
Lake/Reservoir
Underground River (inferred)
General Quality Assessment: Biology
General Quality Assessment: Chemistry
Canal
Canal Tunnel
Culvert
Multiple Channel Culvert
Underground River (Potential Sewer)
Underground River (local knowledge)

Appendix D – Illustrative Masterplan

PLAN SHOWS EXISTING CONTOURS AT 1m INTERVALS FOR REFERENCE. PROPOSED LEVELS TO BE CONFIRMED.

REV	DATE	DESCRIPTION	BY	CHECK
A	20.03.18	MASTERPLAN AMENDED TO INCORPORATE NEW DRAINAGE DESIGN. CENTRAL GREENSPACE INTRODUCED ACCOMMOD-ATING CORDON SANITAIRE. DEVELOPMENT SET BACK ON FRONTAGE TO ALLOW FOR A61 BUS LANE IMPROVEMENTS.	LB	VS

jrp ARCHITECTURE | PLANNING | LANDSCAPE

NORTH

1:1250 SCALE

10m 100m

CLIENT:
HARWORTH ESTATES

PROJECT:
ATHERSLEY

DRAWING:
ILLUSTRATIVE MASTERPLAN

DRAWING NUMBER:
P17 5091 03

SCALE @ A1:
1:1250

DRAWN: LB **DATE:** 05.09.17

CHECKED: **DATE:**

14 MARINER COURT / CALDER PARK / WAKEFIELD / WF4 3FL
01924 383322 / www.jrpassoc.co.uk / info@jrpassoc.co.uk
jrpassociates is a trading style of John R Paley Associates Limited

Do not scale off this drawing - Only figured dimensions to be taken from this drawing. Drawings based on Ordnance Survey and/or existing record drawings - Design and Drawing content subject to Site Survey, Structural Survey, Site Investigations, Planning and Statutory Requirements and Approvals.
Authorised reproduction from Ordnance Survey Map with permission of the Controller of Her Majesty's Stationery Office. Crown Copyright reserved.

03 / ILLUSTRATIVE MASTERPLAN

Appendix E – ICP Suds Calculation

ICP SUDS Mean Annual Flood

Input

Return Period (years)	2	Soil	0.450
Area (ha)	6.650	Urban	0.000
SAAR (mm)	692	Region Number	Region 3

Results	**l/s**
QBAR Rural	28.8
QBAR Urban	28.8
Q2 years	27.2
Q1 year	24.8
Q30 years	50.7
Q100 years	60.0

©1982-2016 XP Solutions

Appendix F – LLFA Correspondence

Alex Parkes

From: Grayson , Ian [iangrayson@barnsley.gov.uk]
Sent: 06 June 2017 15:33
To: Alex Parkes
Subject: FW: Historic flooding information - Athersley

Follow Up Flag: Follow up
Flag Status: Completed

Hello Alex

I can you confirm that a discharge rate of 5l/s/ha is acceptable for this site

Thanks

From: HighwayDrainage
Sent: 06 June 2017 15:31
To: Grayson , Ian
Subject: FW: Historic flooding information - Athersley

From: Alex Parkes [mailto:alex.parkes@rodgersleask.co.uk]
Sent: 06 June 2017 15:27
To: HighwayDrainage
Subject: RE: Historic flooding information - Athersley

Good afternoon,

Are you able to comment on the below please?

Thanks,
Alex

RODGERS LEASK
Consulting Civil & Structural Engineers

ALEX PARKES BEng (Hons) GMICE
Graduate Engineer

alex.parkes@rodgersleask.co.uk

Rodgers Leask Limited
St James House • St Mary's Wharf • Mansfield Road • Derby DE1 3TQ

Tel: 01332 285000 • Fax: 01332 291728
www.rodgersleask.co.uk

This e-mail is confidential and is intended solely for the use of the individual or entity to whom it is addressed. If you are not the intended recipient and you have received this e-mail in error then any use, dissemination, forwarding, printing or copying of this e-mail is strictly prohibited and you should contact the sender by e-mail return and then delete all the material from your system. Any views or opinions presented are solely those of the author and do not necessarily represent those of Rodgers Leask Limited. Company Registration No. 2352923 Registered office: St James House, St Mary's Wharf, Mansfield Road, Derby DE1 3TQ

From: Alex Parkes
Sent: 26 May 2017 15:21
To: HighwayDrainage
Subject: RE: Historic flooding information - Athersley

Hello,

Please can you confirm that a discharge rate of 5l/s/ha in accordance with CIRIA C753 guidance will be acceptable when calculating the allowable discharge rate for surface water flows outfalling into the watercourse within the bounds of the below site?

Best regards,
Alex

RODGERS LEASK
Consulting Civil & Structural Engineers

ALEX PARKES BEng (Hons) GMICE
Graduate Engineer

alex.parkes@rodgersleask.co.uk

Rodgers Leask Limited
St James House • St Mary's Wharf • Mansfield Road • Derby DE1 3TQ

Tel: 01332 285000 • Fax: 01332 291728
www.rodgersleask.co.uk

This e-mail is confidential and is intended solely for the use of the individual or entity to whom it is addressed. If you are not the intended recipient and you have received this e-mail in error then any use, dissemination, forwarding, printing or copying of this e-mail is strictly prohibited and you should contact the sender by e-mail return and then delete all the material from your system. Any views or opinions presented are solely those of the author and do not necessarily represent those of Rodgers Leask Limited. Company Registration No. 2352923 Registered office: St James House, St Mary's Wharf, Mansfield Road, Derby DE1 3TQ

From: HighwayDrainage [mailto:HighwayDrainage@barnsley.gov.uk]
Sent: 22 May 2017 12:36
To: Alex Parkes
Subject: RE: Historic flooding information - Athersley

Hello Alex

I have attached a plan of the site that shows

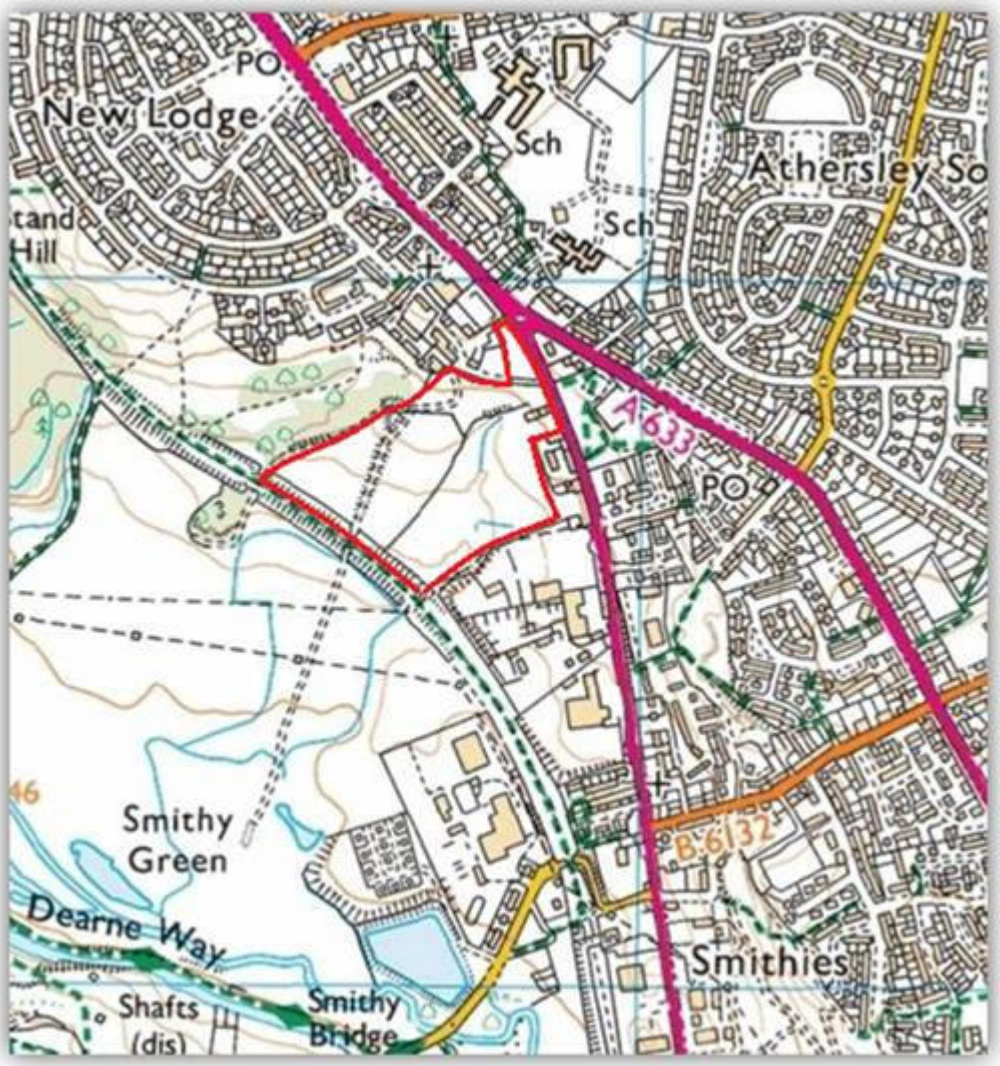
1.A Open/Culverted watercourse runs through the site
2.Yorkshire Water have a large number of sewers within the site
3.I am not aware of flooding on the site but it appears on the EA 30/200 year surface water flooding plans.

Thanks

From: Alex Parkes [mailto:alex.parkes@rodgersleask.co.uk]
Sent: 22 May 2017 11:35
To: HighwayDrainage
Subject: Historic flooding information - Athersley

Good morning,

I'm currently working on a flood risk assessment for a site off Wakefield Road, Athersley (Grid Ref: X: 434751 Y: 408763), below is a site location plan for your information.



I would be grateful if you could send any relevant information relating to flooding for the site and vicinity, in particular, any groundwater or surface water flooding which may have occurred in the past.

Best regards,
Alex

RODGERS LEASK
Consulting Civil & Structural Engineers

ALEX PARKES BEng (Hons) GMICE
Graduate Engineer

alex.parkes@rodgersleask.co.uk

Rodgers Leask Limited
St James House • St Mary's Wharf • Mansfield Road • Derby DE1 3TQ

Tel: 01332 285000 • Fax: 01332 291728
www.rodgersleask.co.uk

This e-mail is confidential and is intended solely for the use of the individual or entity to whom it is addressed. If you are not the intended recipient and you have received this e-mail in error then any use, dissemination, forwarding, printing or copying of this e-mail is strictly prohibited and you should contact the sender by e-mail return and then delete all the material from your system. Any views or opinions presented are solely those of the author and do not necessarily represent those of Rodgers Leask Limited. Company Registration No. 2352923 Registered office: St James House, St Mary's Wharf, Mansfield Road, Derby DE1 3TQ

Disclaimer

The information contained in this communication from the sender is confidential. It is intended solely for use by the recipient and others authorized to receive it. If you are not the recipient, you are hereby notified that any disclosure, copying, distribution or taking action in relation of the contents of this information is strictly prohibited and may be unlawful.

This email has been scanned for viruses and malware, and may have been automatically archived by **Mimecast Ltd**, an innovator in Software as a Service (SaaS) for business. Providing a **safer** and **more useful** place for your human generated data. Specializing in; Security, archiving and compliance. To find out more Click Here.

*** Barnsley MBC Disclaimer:
This e-mail and any files attached are confidential for the use of the intended recipient. If you have received this e-mail in error please notify the sender as soon as possible and delete the communication from your system without copying, disseminating or distributing the same in any way by any means. Any views or opinions expressed belong solely to the author and do not necessarily represent those of the Council. In particular, the Council will not accept liability for any defamatory statements made by email communications. Recipients are responsible for ensuring that all e-mails and files sent are checked for viruses. The Council will not accept liability for damage caused by any virus transmitted by this e-mail. No guarantees are offered on the security, content and accuracy of any e-mails and files received. Be aware that this e-mail communication may be intercepted for regulatory, quality control, or crime detection purposes unless otherwise prohibited. The content of this email and any attachment may be stored for future reference.

Disclaimer

The information contained in this communication from the sender is confidential. It is intended solely for use by the recipient and others authorized to receive it. If you are not the recipient, you are hereby notified that any disclosure, copying, distribution or taking action in relation of the contents of this information is strictly prohibited and may be unlawful.

This email has been scanned for viruses and malware, and may have been automatically archived by **Mimecast Ltd**, an innovator in Software as a Service (SaaS) for business. Providing a **safer** and **more useful** place for your human generated data. Specializing in; Security, archiving and compliance. To find out more Click Here.

Matt,

I can confirm that I have no objections in principal to the discharge of surface water from the development site into the watercourse in question at a rate of 5 l/s/ha. However, I would require a survey of the culvert under the railway line and the downstream watercourses to prove capacity and connection to the main river network prior to giving formal consent and discharging any relevant planning conditions.

Regards

Wayne Atkins
Principal Engineer – Drainage
Environment & Transport
Place Directorate
Barnsley Metropolitan Borough Council

Telephone: 01226 772182
E-mail: wayneatkins@barnsley.gov.uk

From: Matt Leask [mailto:matt.leask@rodgersleask.co.uk]
Sent: 09 February 2018 11:58
To: Atkins , Wayne
Cc: Grayson , Ian; Stefan Morgan
Subject: RE: Site at Wakefield Road, Athersley

Wayne,

Thank you for your response. As an alternative, can you confirm that surface water flows from the entire proposed development site can in principle discharge to the culvert further north, that drains part of the site at present into the ditch network south of the railway embankment? Please see highlighted in pink cloud in the screenshot below:

We would look to restrict flows in accordance with the rate agreed previously with Ian of 5 l/s/ha.

Best regards,

Matt

RODGERS LEASK
Consulting Civil & Structural Engineers

Matt Leask
Senior Engineer

Rodgers Leask Limited
St James House • St Mary's Wharf • Mansfield Road • Derby DE1 3TQ

Tel: 01332 285000 • Mobile: 07515159060
matt.leask@rodgersleask.co.uk
www.rodgersleask.com

This e-mail is confidential and is intended solely for the use of the individual or entity to whom it is addressed. If you are not the intended recipient and you have received this e-mail in error then any use, dissemination, forwarding, printing or copying of this e-mail is strictly prohibited and you should contact the sender by e-mail return and then delete all the material from your system. Any views or opinions presented are solely those of the author and do not necessarily represent those of Rodgers Leask Limited. Company Registration No. 2352923 Registered office: St James House, St Mary's Wharf, Mansfield Road, Derby DE1 3TQ

From: Atkins , Wayne [mailto:WayneAtkins@barnsley.gov.uk]
Sent: 09 February 2018 11:22
To: Matt Leask
Cc: Grayson , Ian; Stefan Morgan
Subject: RE: Site at Wakefield Road, Athersley

Matt,

We have investigated the watercourse in question and can find no positive connection to the River Dearne or ordinary watercourse network downstream of the old railway line. Therefore, regretfully I have to say this is not a suitable outfall for flows from the development site and I must refuse your application to discharge surface water flows from the development site to this watercourse.

If you have any queries please let me know.

Regards

Wayne Atkins
Principal Engineer – Drainage
Environment & Transport
Place Directorate
Barnsley Metropolitan Borough Council

Telephone: 01226 772182
E-mail: wayneatkins@barnsley.gov.uk

From: Matt Leask [mailto:matt.leask@rodgersleask.co.uk]
Sent: 08 February 2018 15:27
To: Atkins , Wayne
Cc: Grayson , Ian; Stefan Morgan
Subject: Site at Wakefield Road, Athersley

Wayne,

Thank you for the meeting on Tuesday with regards to the site at Athersley, it was very useful.

Can you confirm that the marshy low point at the end of the watercourse that runs through the site as shown within the pink cloud in the screenshot below is a suitable surface water outfall connection point?

Best regards,

Matt

RODGERS LEASK
Consulting Civil & Structural Engineers

Matt Leask
Senior Engineer

Rodgers Leask Limited
St James House • St Mary's Wharf • Mansfield Road • Derby DE1 3TQ

Tel: 01332 285000 • Mobile: 07515159060
matt.leask@rodgersleask.co.uk
www.rodgersleask.com

This e-mail is confidential and is intended solely for the use of the individual or entity to whom it is addressed. If you are not the intended recipient and you have received this e-mail in error then any use, dissemination, forwarding, printing or copying of this e-mail is strictly prohibited and you should contact the sender by e-mail return and then delete all the material from your system. Any views or opinions presented are solely those of the author and do not necessarily represent those of Rodgers Leask Limited. Company Registration No. 2352923 Registered office: St James House, St Mary's Wharf, Mansfield Road, Derby DE1 3TQ

From: Grayson , Ian [mailto:iangrayson@barnsley.gov.uk]
Sent: 31 January 2018 11:21
To: Matt Leask
Cc: Atkins , Wayne
Subject: RE: Site at Wakefield Road, Athersley

Matt

Wayne and I are free all day next Wednesday(07/02/18). If this is ok for you give us a time to suit yourselves and I will book a room

Thanks

From: Matt Leask [mailto:matt.leask@rodgersleask.co.uk]
Sent: 31 January 2018 11:15
To: Grayson , Ian
Cc: Atkins , Wayne
Subject: Site at Wakefield Road, Athersley

Ian,

As discussed we would like to arrange a meeting with yourself to discuss surface water discharge from the site, if you could confirm your availability over the next week or so this would be appreciated.

Best regards,

Matt

RODGERS LEASK
Consulting Civil & Structural Engineers

Matt Leask
Senior Engineer

Rodgers Leask Limited
St James House • St Mary's Wharf • Mansfield Road • Derby DE1 3TQ

Tel: 01332 285000 • Mobile: 07515159060
matt.leask@rodgersleask.co.uk
www.rodgersleask.com

This e-mail is confidential and is intended solely for the use of the individual or entity to whom it is addressed. If you are not the intended recipient and you have received this e-mail in error then any use, dissemination, forwarding, printing or copying of this e-mail is strictly prohibited and you should contact the sender by e-mail return and then delete all the material from your system. Any views or opinions presented are solely those of the author and do not necessarily represent those of Rodgers Leask Limited. Company Registration No. 2352923 Registered office: St James House, St Mary's Wharf, Mansfield Road, Derby DE1 3TQ

Disclaimer

The information contained in this communication from the sender is confidential. It is intended solely for use by the recipient and others authorized to receive it. If you are not the recipient, you are hereby notified that any disclosure, copying, distribution or taking action in relation of the contents of this information is strictly prohibited and may be unlawful.

This email has been scanned for viruses and malware, and may have been automatically archived by **Mimecast Ltd**, an innovator in Software as a Service (SaaS) for business. Providing a **safer** and **more useful** place for your human generated data. Specializing in; Security, archiving and compliance. To find out more Click Here.

*** Barnsley MBC Disclaimer:
This e-mail and any files attached are confidential for the use of the intended recipient. If you have received this e-mail in error please notify the sender as soon as possible and delete the communication from your system without copying, disseminating or distributing the same in any way by any means. Any views or opinions expressed belong solely to the author and do not necessarily represent those of the Council. In particular, the Council will not accept liability for any defamatory statements made by email communications. Recipients are responsible for ensuring that all e-mails and files sent are checked for viruses. The Council will not accept liability for damage caused by any virus transmitted by this e-mail. No guarantees are offered on the security, content and accuracy of any e-mails and files received. Be aware that this e-mail communication may be intercepted for regulatory, quality control, or crime detection purposes unless otherwise prohibited. The content of this email and any attachment may be stored for future reference.

Disclaimer

The information contained in this communication from the sender is confidential. It is intended solely for use by the recipient and others authorized to receive it. If you are not the recipient, you are hereby notified that any disclosure, copying, distribution or taking action in relation of the contents of this information is strictly prohibited and may be unlawful.

This email has been scanned for viruses and malware, and may have been automatically archived by **Mimecast Ltd**, an innovator in Software as a Service (SaaS) for business. Providing a **safer** and **more useful** place for your human generated data. Specializing in; Security, archiving and compliance. To find out more Click Here.

Disclaimer

The information contained in this communication from the sender is confidential. It is intended solely for use by the recipient and others authorized to receive it. If you are not the recipient, you are hereby notified that any disclosure, copying, distribution or taking action in relation of the contents of this information is strictly prohibited and may be unlawful.

This email has been scanned for viruses and malware, and may have been automatically archived by **Mimecast Ltd**, an innovator in Software as a Service (SaaS) for business. Providing a **safer** and **more useful** place for your human generated data. Specializing in; Security, archiving and compliance. To find out more Click Here.

Appendix G – Drainage Strategy Drawing

General Notes

1. Do not scale this drawing. If in doubt, ask.

2. This drawing is to be read in conjunction with all other relevant Engineers, Architects and specialist design drawings and details.

3. All dimensions are in metres unless noted otherwise. All levels are in metres unless noted otherwise.

4. Any discrepancies noted on site are to be reported to the Engineer immediately.

5. All adopted sewers and underground storage tanks will require an easement as per Sewers for Adoption 6th Edition.

6. This drawing is for preliminary design purposes only.

Key:

- Site boundary
- Existing YW surface water sewer
- Existing YW combined sewer
- Existing YW foul water sewer
- Existing YW foul water rising main
- Proposed surface water sewer
- Proposed foul sewer
- Proposed combined sewer diversion
- Existing YW combined sewer to be grubbed up
- Indicative sewer easement
- Culverted watercourse
- Open watercourse approximate extents
- Existing land drainage

NOTE:
Pipe diameters for combined sewer diversion are shown indicatively only are subject to detailed design and catchment modelling by Yorkshire Water.

NOTE:
The location of existing Yorkshire Water sewers shown on this drawing are indicative only. The exact line and length of any sewers within the boundaries of the site should be surveyed prior to the commencement of any on-site works. Rodgers Leask cannot accept any liability for the accuracy of the provided information.

Rev	Date	Amendments	By	Chk
H	09.04.21	Strategy updated to show amended detention basins and updated FFLs.	BRM	KH
G	30.06.20	Pipe attenuation removed. Attenuation feature sizes increased accordingly.	ML	KAH
F	20.04.18	Updated to suit latest layout.	ML	ML
E	14.03.18	Drainage strategy amended.	ML	ML
D	21.02.18	Drainage strategy amended to discharge to western culvert.	ML	ML
C	18.01.18	SW network 2 and 3 attenuation amended.	ML	ML
B	17.01.18	SW network 2 attenuation amended.	ML	ML
A	01.11.17	SW attenuation amended and SW & FW pipe networks added.	ML	KAH

RLRE

Client
HARWORTH ESTATES

Project
ATHERSLEY, BARNSLEY

Drawing Title
DRAINAGE STRATEGY

Status
PRELIMINARY

Scale	Drawn	Checked	Date
A0@1:500	AP	ML	11.09.17

Drawing No. P17-172-200
Rev. H

Scale Bar: 1:500 10 20 30

St James House • Mansfield Road • Derby • DE1 3TQ • Tel: 01332 295000 • Fax: 01332 291708 • www.rodgersleask.co.uk

Copyright © Rodgers Leask Limited

Appendix H – Yorkshire Water Correspondence

YorkshireWater

Yorkshire Water Services
Developer Services
Sewerage Technical Team
PO BOX 52
Bradford
BD3 7AY

Tel: 0345 120 8482
Fax: (01274) 372 834

For telephone enquiries ring:

Jane Phillips on 0345 120 8482

Rodgers Leask Limited
St James House; St Marys Wharf
Mansfield Road
DE1 3TQ

alex.parkes@rodgersleask.co.uk

Your Ref:
Our Ref: T008435

1st June 2017

Dear Sir,

Wakefield Road, Athersley, Barnsley, S71 1NX - Pre-planning sewerage enquiry on R580243 - Residential

Thank you for your recent enquiry and remittance. Our official VAT receipt has been sent to you under separate cover. Please find enclosed a complimentary extract from the Statutory Sewer Map which indicates the recorded position of the public sewers. Please note that as of October 2011 and the private to public sewer transfer, there are many uncharted Yorkshire Water assets currently not shown on our records.

The following comments reflect our view, with regard to the public sewer network only, based on a 'desk top' study of the site and are valid for a maximum period of twelve months:

Existing Infrastructure

Please note that as a result of the Water Industry (Scheme for Adoption of Private Sewers) Regulations 2011, there are public sewers not shown on our mapping records. It may be the case that there are unmapped sewers capable of accommodating the proposed foul water discharge in the vicinity of the site. It is recommended that the developer investigates this by visiting the site to establish the location of any transferred public sewers.

There are two 225mm diameter public combined sewers and a 375mm diameter overflow recorded crossing the site. No buildings, or other obstructions, are to be erected within 3 (three) metres, nor trees planted within 5 (five) metres of this public sewer.

There is a 450mm diameter public combined sewers recorded crossing the site. No buildings, or other obstructions, are to be erected within 5 (five) metres, nor trees planted within 5 (five) metres of this public sewer.

There is a 450mm diameter surface water sewer which outfalls to a pond within the site. No buildings, or other obstructions, are to be erected within 4 (four) metres, nor trees planted within 5 (five) metres of this public sewer.

It may not be acceptable to raise or lower ground levels over the sewer, nor to restrict access to the manholes on the sewer. If you wish to have this sewer diverted under Section 185 of the Water Industry Act 1991 an application should be made in writing. To discuss this matter, please telephone 0345 120 84 82.

There is a 225 mm diameter public sewer recorded crossing the site. In this instance, building-over

may take place under the control of Part H4 Building Regulations 2000.

There is also a combined sewage overflow and surfacwe water outfall to watercourse, under the control of Yorkshire Water, located within the site. Vehicular access, including with large tankers, could be required at any time.

The proximity of the existing combined sewer overflow (CSO) outfall to the site may mean a loss of amenity for future residents / workers. In order to minimise the risk of odour, noise and nuisance, industry standards recommend that habitable buildings should not be located within 15 (fifteen) metres of the existing CSO. To reduce the visible impact of the installation, the erection (by the developer) of suitable screening is advised.

The local Waste Water Treatment Works (WWTW) is Lundwood. It is understood that this WWTW may only have limited spare capacity, if any, available. We have contacted the respective treatment team for more information regarding the impact of proposed development and will contact you when an assessment has been made. Please note I could be waiting for up to 14 days for a response.

Foul Water

Development of the site should take place with separate systems for foul and surface water drainage. The separate systems should extend to the points of discharge to be agreed.

Foul water domestic waste should discharge to the 225 mm diameter public combined sewer recorded within the site.

Surface Water

The developer's attention is drawn to Requirement H3 of the Building Regulations 2000. This establishes a preferred hierarchy for surface water disposal. Consideration should firstly be given to discharge to soakaway, infiltration system and watercourse in that priority order.

Sustainable Drainage Systems (SuDS), for example the use of soakaways and/or permeable hardstanding etc, may be a suitable solution for surface water disposal appropriate in this situation. You are advised to seek comments on the suitability of SuDS in this instance from the appropriate authorities.

As the proposal site is currently undeveloped no surface water is known to have previously discharged to the public sewer network

As such, the local public sewer network does not have capacity to accept any surface water from the proposed site. If SuDS are not viable, the developer is advised to contact the Environment Agency/local Land Drainage Authority with a view to establishing a suitable watercourse (if any nearby) for discharge.

It is understood that various watercourses are located within the site. These appear to be the obvious places for surface water disposal (if SuDS are not viable).

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, with regard to surface water disposal from the site.

Other Observations

Any new connection to an existing public sewer will require the prior approval of Yorkshire Water. You may obtain an application form from our website (www.yorkshirewater.com) or by telephoning 0345 120 84 82.

Prospectively adoptable sewers and pumping stations must be designed and constructed in accordance with the WRc publication "Sewers for Adoption - a design and construction guide for developers" 6th Edition as supplemented by Yorkshire Water's requirements, pursuant to an

YorkshireWater

agreement under Section 104 of the Water Industry Act 1991. An application to enter into a Section 104 agreement must be made in writing prior to any works commencing on site. Please contact our Developer Services Team (telephone 0345 120 84 82) for further information.

The public sewer network is for domestic sewage purposes. This generally means foul water for domestic purposes and, where a suitable surface water or combined sewer is available, surface water from the roofs of buildings together with surface water from paved areas of land appurtenant to those buildings. Land and highway drainage have no right of connection to the public sewer network. No land drainage to be connected/discharged to public sewer.

All the above comments are based upon the information and records available at the present time. The information contained in this letter together with that shown on any extract from the Statutory Sewer Map that may be enclosed is believed to be correct and is supplied in good faith.

Please note that capacity in the public sewer network is not reserved for specific future development. It is used up on a 'first come, first served' basis. You should visit the site and establish the line and level of any public sewers affecting your proposals before the commencement of any design work.

Yours faithfully

Developer Services Team

Alex Parkes

From: jane.phillips@yorkshirewater.co.uk
Sent: 13 June 2017 15:44
To: Alex Parkes
Subject: Fw: Wakefield Road, Athersley, Barnsley, S71 1NX - Pre-planning sewerage enquiry on R580243 - Residential

Follow Up Flag: Follow up
Flag Status: Completed

Yorkshire Water Services
Developer Services
Sewerage Technical Team
PO BOX 52
Bradford
BD3 7AY

Tel: 0345 120 8482
Fax: (01274) 372 834
For telephone enquiries ring:

Jane Phillips on 0345 120 8482

Date: 13/06/2017

Rodgers Leask Limited
St James House, St Marys Wharf
Mansfield Road
DE1 3TQ

alex.parkes@rodgersleask.co.uk

Your Ref:
Our Ref: T008435

Dear Alex,

Wakefield Road, Athersley, Barnsley, S71 1NX - Pre-planning sewerage enquiry on R580243 - Residential

I have been advised that The local Waste Water Treatment Works (WWTW) is Lundwood

The anticipated domestic foul flows can be accommodated at the WWTW, however it is imperative that a separate outfall is provided for surface water.

Yours faithfully

Developer Services Team

Spotted a leak?
If you spot a leak please report it immediately. Call us on 0800 57 3553 or go to https://www.yorkshirewater.com/leaks

Get a free water saving pack.
Don't forget to request your free water and energy saving pack, it could save you money on your utility bills and help you conserve water. https://www.yorkshirewater.com/savewater

The information in this e-mail, and any files transmitted with it, is confidential and may also be legally privileged. The contents are intended solely for the addressee only and are subject to the legal notice available at http://www.keldagroup.com/email.htm. This email does not constitute a binding offer, acceptance, amendment, waiver or other agreement, or create any obligation whatsoever, unless such intention is clearly stated in the body of the email. If you are not the intended recipient, please return the message by replying to it and then delete the message from your computer. Any disclosure, copying, distribution or action taken in reliance on its contents is prohibited and may be unlawful.

Yorkshire Water Services Limited
Registered Office Western House, Halifax Road, Bradford, BD6 2SZ Registered in England and Wales No 2366682

Hi Matt

As blockages can happen through third parties putting unsuitable items down the sewer, I cannot categorically say that a blockage won't occur, however, the 3.5 litres a second is acceptable after consulting with my senior engineer.

Kind regards

Catherine Wellham
Developer Services Waste Technician
0345 120 84 82

Please note I do not work Wednesdays

Do not reply to this email. Please send any correspondence to
technical.sewerage@yorkshirewater.co.uk

|---------->
| From: |
|---------->
>----------|
|Matt Leask <matt.leask@rodgersleask.co.uk>
|
>----------|
|---------->
| To: |
|---------->
>----------|
|"technical.sewerage@yorkshirewater.co.uk" <technical.sewerage@yorkshirewater.co.uk>,
|
>----------|
|---------->
| Date: |
|---------->
>----------|
|06/03/2018 14:01 |
>----------|
|---------->
| Subject: |
|---------->
>----------|

|RE: Wakefield Road, Athersley, Barnsley, S71 1NX
|
>----------|

Catherine,

It would be a relatively small catchment to be honest, in the region of 3,000-4,000m2 impermeable area. a max rate of 3.5l/s would be helpful and appreciated, as long as you are satisfied that there will be no issues with blockage. The min. vortex control orifice size you will permit is 75mm in your policy, so this might just work.

Best regards,

Matt

Matt Leask
Senior Engineer
Rodgers Leask Limited
St James House • St Mary's Wharf • Mansfield Road • Derby DE1 3TQ

Tel: 01332 285000 • Mobile: 07515159060
matt.leask@rodgersleask.co.uk
www.rodgersleask.com

This e-mail is confidential and is intended solely for the use of the individual or entity to whom it is addressed. If you are not the intended recipient and you have received this e-mail in error then any use, dissemination, forwarding, printing or copying of this e-mail is strictly prohibited and you should contact the sender by e-mail return and then delete all the material from your system. Any views or opinions presented are solely those of the author and do not necessarily represent those of Rodgers Leask Limited. Company Registration No. 2352923 Registered office:
St James House, St Mary's Wharf, Mansfield Road, Derby DE1 3TQ

-----Original Message-----
From: Catherine.Wellham@yorkshirewater.co.uk [mailto:Catherine.Wellham@yorkshirewater.co.uk] On Behalf Of technical.sewerage@yorkshirewater.co.uk
Sent: 06 March 2018 13:32
To: Matt Leask
Subject: RE: Wakefield Road, Athersley, Barnsley, S71 1NX

Hi Matt

Sorry for the delay in responding, we had to shut the office last week due to the weather.

We wouldn't allow more than 3.5 litres a second to the combined. What area are you proposing?

Kind regards

Catherine Wellham
Developer Services Waste Technician
0345 120 84 82

Please note I do not work Wednesdays

Do not reply to this email. Please send any correspondence to
technical.sewerage@yorkshirewater.co.uk

|---------->
| From: |
|---------->

>----------
----------|
|Matt Leask
<matt.leask@rodgersleask.co.uk> |

>----------
----------|
|---------->
| To: |
|---------->

>----------
----------|
|"technical.sewerage@yorkshirewater.co.uk"
<technical.sewerage@yorkshirewater.co.uk>,
|

>----------
----------|
|---------->
| Date: |
|---------->

>----------
----------|
|21/02/2018
08:59 |

>----------
----------|

|---------->
| Subject: |
|---------->

>----------
----------|
|RE: Wakefield Road, Athersley, Barnsley, S71 1NX |

>----------
----------|

Catherine,

The watercourse terminates within the site as per the screenshot below.
Wayne has confirmed that there is no positive outfall to this watercourse and so we cannot discharge into it. Wayne has confirmed in the emails forwarded to you that as much of the site as possible can drain to the culvert shown further west that has a positive connection through the railway embankment, however there is a section of the site that will not drain via gravity due to the site levels.

If the site was to be fully developed then we would need to consider an adopted surface water pumping station if you will not entertain small section of the site draining to the combined sewer where it leaves the site.

(Embedded image moved to file: pic06334.jpg)

Best regards,

Matt

Matt Leask

Senior Engineer

Rodgers Leask Limited

St James House • St Mary's Wharf • Mansfield Road • Derby DE1 3TQ

Tel: 01332 285000 • Mobile: 07515159060

matt.leask@rodgersleask.co.uk

www.rodgersleask.com

This e-mail is confidential and is intended solely for the use of the individual or entity to whom it is addressed. If you are not the intended recipient and you have received this e-mail in error then any use, dissemination, forwarding, printing or copying of this e-mail is strictly prohibited and you should contact the sender by e-mail return and then delete all the material from your system. Any views or opinions presented are solely those of the author and do not necessarily represent those of Rodgers Leask Limited. Company Registration No. 2352923 Registered office:
St James House, St Mary's Wharf, Mansfield Road, Derby DE1 3TQ

Appendix I – MicroDrainage Calculations

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 2012 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	60.094	1.594	0.0	2.8	2.8	233.8	O K
30 min Summer	60.233	1.733	0.0	3.0	3.0	311.9	O K
60 min Summer	60.372	1.872	0.0	3.1	3.1	395.6	O K
120 min Summer	60.507	2.007	0.0	3.2	3.2	481.4	O K
180 min Summer	60.579	2.079	0.0	3.2	3.2	529.5	O K
240 min Summer	60.624	2.124	0.0	3.2	3.2	560.6	O K
360 min Summer	60.682	2.182	0.0	3.3	3.3	601.2	O K
480 min Summer	60.719	2.219	0.0	3.3	3.3	627.6	O K
600 min Summer	60.744	2.244	0.0	3.3	3.3	645.2	O K
720 min Summer	60.760	2.260	0.0	3.3	3.3	657.0	O K
960 min Summer	60.776	2.276	0.0	3.3	3.3	669.2	O K
1440 min Summer	60.775	2.275	0.0	3.3	3.3	667.8	O K
2160 min Summer	60.745	2.245	0.0	3.3	3.3	646.6	O K
2880 min Summer	60.713	2.213	0.0	3.3	3.3	622.9	O K
4320 min Summer	60.651	2.151	0.0	3.3	3.3	578.9	O K
5760 min Summer	60.594	2.094	0.0	3.2	3.2	539.5	O K
7200 min Summer	60.539	2.039	0.0	3.2	3.2	502.9	O K
8640 min Summer	60.487	1.987	0.0	3.1	3.1	468.4	O K
10080 min Summer	60.437	1.937	0.0	3.1	3.1	436.5	O K
15 min Winter	60.145	1.645	0.0	2.9	2.9	262.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	125.500	0.0	207.0	19
30 min Summer	84.088	0.0	227.0	34
60 min Summer	53.779	0.0	403.4	64
120 min Summer	33.226	0.0	465.9	124
180 min Summer	24.710	0.0	481.9	184
240 min Summer	19.890	0.0	496.5	244
360 min Summer	14.593	0.0	511.4	362
480 min Summer	11.713	0.0	517.5	482
600 min Summer	9.868	0.0	520.0	602
720 min Summer	8.575	0.0	521.2	722
960 min Summer	6.863	0.0	520.8	962
1440 min Summer	5.006	0.0	513.5	1440
2160 min Summer	3.643	0.0	960.7	1772
2880 min Summer	2.904	0.0	961.3	2136
4320 min Summer	2.106	0.0	924.9	2940
5760 min Summer	1.675	0.0	1210.8	3752
7200 min Summer	1.401	0.0	1266.1	4608
8640 min Summer	1.211	0.0	1313.1	5368
10080 min Summer	1.072	0.0	1355.1	6160
15 min Winter	125.500	0.0	212.4	19

©1982-2017 XP Solutions

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	60.297	1.797	0.0	3.0	3.0	349.9	O K
60 min Winter	60.449	1.949	0.0	3.1	3.1	444.1	O K
120 min Winter	60.597	2.097	0.0	3.2	3.2	541.5	O K
180 min Winter	60.676	2.176	0.0	3.3	3.3	596.5	O K
240 min Winter	60.726	2.226	0.0	3.3	3.3	632.6	O K
360 min Winter	60.791	2.291	0.0	3.4	3.4	680.3	O K
480 min Winter	60.834	2.334	0.0	3.4	3.4	712.3	O K
600 min Winter	60.863	2.363	0.0	3.4	3.4	734.5	O K
720 min Winter	60.884	2.384	0.0	3.4	3.4	750.2	O K
960 min Winter	60.908	2.408	0.0	3.4	3.4	768.9	O K
1440 min Winter	60.920	2.420	0.0	3.4	3.4	778.1	O K
2160 min Winter	60.894	2.394	0.0	3.4	3.4	758.3	O K
2880 min Winter	60.856	2.356	0.0	3.4	3.4	728.9	O K
4320 min Winter	60.777	2.277	0.0	3.3	3.3	669.5	O K
5760 min Winter	60.697	2.197	0.0	3.3	3.3	611.7	O K
7200 min Winter	60.619	2.119	0.0	3.2	3.2	557.1	O K
8640 min Winter	60.543	2.043	0.0	3.2	3.2	505.3	O K
10080 min Winter	60.470	1.970	0.0	3.1	3.1	457.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	84.088	0.0	238.0	34
60 min Winter	53.779	0.0	448.3	64
120 min Winter	33.226	0.0	484.0	122
180 min Winter	24.710	0.0	506.5	182
240 min Winter	19.890	0.0	517.5	240
360 min Winter	14.593	0.0	526.8	358
480 min Winter	11.713	0.0	531.5	474
600 min Winter	9.868	0.0	533.9	592
720 min Winter	8.575	0.0	534.9	708
960 min Winter	6.863	0.0	534.2	936
1440 min Winter	5.006	0.0	525.9	1384
2160 min Winter	3.643	0.0	1007.8	2012
2880 min Winter	2.904	0.0	1007.7	2276
4320 min Winter	2.106	0.0	963.7	3196
5760 min Winter	1.675	0.0	1356.0	4096
7200 min Winter	1.401	0.0	1418.0	4976
8640 min Winter	1.211	0.0	1470.6	5800
10080 min Winter	1.072	0.0	1517.3	6656

©1982-2017 XP Solutions

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.357	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.004

Time (mins) From:	To:	Area (ha)
0	4	1.004

©1982-2017 XP Solutions

Model Details

Storage is Online Cover Level (m) 61.300

Complex Structure

Tank or Pond

Invert Level (m) 58.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	122.6	1.500	122.6

Tank or Pond

Invert Level (m) 60.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	398.0	1.000	686.0	1.300	783.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0072-3500-2500-3500
Design Head (m)	2.500
Design Flow (l/s)	3.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	72
Invert Level (m)	58.500
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.500	3.5
Flush-Flo™	0.317	2.3
Kick-Flo®	0.646	1.9
Mean Flow over Head Range	-	2.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.9	0.300	2.3	0.500	2.2	0.800	2.1
0.200	2.3	0.400	2.3	0.600	2.0	1.000	2.3

©1982-2017 XP Solutions

Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	2.5	2.400	3.4	5.000	4.8	8.000	6.0
1.400	2.7	2.600	3.6	5.500	5.1	8.500	6.2
1.600	2.8	3.000	3.8	6.000	5.3	9.000	6.4
1.800	3.0	3.500	4.1	6.500	5.5	9.500	6.5
2.000	3.2	4.000	4.4	7.000	5.7		
2.200	3.3	4.500	4.6	7.500	5.9		

©1982-2017 XP Solutions

Summary of Results for 30 year Return Period

Half Drain Time : 1097 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	59.548	1.048	0.0	2.3	2.3	128.5	O K
30 min Summer	59.879	1.379	0.0	2.7	2.7	169.1	O K
60 min Summer	60.053	1.553	0.0	2.8	2.8	211.8	O K
120 min Summer	60.132	1.632	0.0	2.9	2.9	254.8	O K
180 min Summer	60.174	1.674	0.0	2.9	2.9	278.4	O K
240 min Summer	60.200	1.700	0.0	2.9	2.9	293.3	O K
360 min Summer	60.231	1.731	0.0	3.0	3.0	311.0	O K
480 min Summer	60.247	1.747	0.0	3.0	3.0	320.5	O K
600 min Summer	60.255	1.755	0.0	3.0	3.0	325.0	O K
720 min Summer	60.257	1.757	0.0	3.0	3.0	326.4	O K
960 min Summer	60.253	1.753	0.0	3.0	3.0	324.0	O K
1440 min Summer	60.239	1.739	0.0	3.0	3.0	315.6	O K
2160 min Summer	60.213	1.713	0.0	2.9	2.9	300.7	O K
2880 min Summer	60.187	1.687	0.0	2.9	2.9	285.9	O K
4320 min Summer	60.137	1.637	0.0	2.9	2.9	257.5	O K
5760 min Summer	60.087	1.587	0.0	2.8	2.8	230.4	O K
7200 min Summer	60.041	1.541	0.0	2.8	2.8	205.5	O K
8640 min Summer	59.996	1.496	0.0	2.8	2.8	183.5	O K
10080 min Summer	59.848	1.348	0.0	2.6	2.6	165.3	O K
15 min Winter	59.675	1.175	0.0	2.5	2.5	144.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	69.299	0.0	129.4	19
30 min Summer	45.987	0.0	170.9	34
60 min Summer	29.238	0.0	219.8	64
120 min Summer	18.051	0.0	271.4	124
180 min Summer	13.465	0.0	303.6	182
240 min Summer	10.884	0.0	327.1	242
360 min Summer	8.039	0.0	362.2	362
480 min Summer	6.482	0.0	388.9	482
600 min Summer	5.481	0.0	410.1	600
720 min Summer	4.777	0.0	425.7	720
960 min Summer	3.844	0.0	432.0	874
1440 min Summer	2.826	0.0	430.9	1110
2160 min Summer	2.074	0.0	562.0	1512
2880 min Summer	1.664	0.0	601.2	1928
4320 min Summer	1.219	0.0	660.0	2724
5760 min Summer	0.977	0.0	705.9	3520
7200 min Summer	0.822	0.0	742.6	4320
8640 min Summer	0.714	0.0	773.9	5096
10080 min Summer	0.634	0.0	801.7	5848
15 min Winter	69.299	0.0	144.8	19

©1982-2017 XP Solutions

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	60.011	1.511	0.0	2.8	2.8	189.8	O K
60 min Winter	60.102	1.602	0.0	2.8	2.8	238.2	O K
120 min Winter	60.190	1.690	0.0	2.9	2.9	287.6	O K
180 min Winter	60.238	1.738	0.0	3.0	3.0	315.1	O K
240 min Winter	60.268	1.768	0.0	3.0	3.0	332.8	O K
360 min Winter	60.305	1.805	0.0	3.0	3.0	354.9	O K
480 min Winter	60.327	1.827	0.0	3.0	3.0	367.9	O K
600 min Winter	60.339	1.839	0.0	3.0	3.0	375.3	O K
720 min Winter	60.346	1.846	0.0	3.0	3.0	379.2	O K
960 min Winter	60.347	1.847	0.0	3.0	3.0	380.2	O K
1440 min Winter	60.329	1.829	0.0	3.0	3.0	369.0	O K
2160 min Winter	60.297	1.797	0.0	3.0	3.0	349.6	O K
2880 min Winter	60.259	1.759	0.0	3.0	3.0	327.6	O K
4320 min Winter	60.184	1.684	0.0	2.9	2.9	283.8	O K
5760 min Winter	60.109	1.609	0.0	2.9	2.9	242.4	O K
7200 min Winter	60.041	1.541	0.0	2.8	2.8	205.4	O K
8640 min Winter	59.930	1.430	0.0	2.7	2.7	175.3	O K
10080 min Winter	59.728	1.228	0.0	2.5	2.5	150.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	45.987	0.0	189.6	33
60 min Winter	29.238	0.0	246.2	62
120 min Winter	18.051	0.0	303.9	122
180 min Winter	13.465	0.0	339.9	180
240 min Winter	10.884	0.0	366.1	238
360 min Winter	8.039	0.0	404.9	356
480 min Winter	6.482	0.0	432.1	470
600 min Winter	5.481	0.0	441.6	584
720 min Winter	4.777	0.0	443.9	696
960 min Winter	3.844	0.0	447.1	914
1440 min Winter	2.826	0.0	452.4	1182
2160 min Winter	2.074	0.0	629.4	1624
2880 min Winter	1.664	0.0	673.3	2080
4320 min Winter	1.219	0.0	738.3	2980
5760 min Winter	0.977	0.0	790.6	3808
7200 min Winter	0.822	0.0	831.7	4608
8640 min Winter	0.714	0.0	866.8	5360
10080 min Winter	0.634	0.0	898.0	6160

©1982-2017 XP Solutions

Summary of Results for 1 year Return Period

Half Drain Time : 540 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	58.920	0.420	0.0	2.3	2.3	51.5	O K
30 min Summer	59.048	0.548	0.0	2.3	2.3	67.2	O K
60 min Summer	59.192	0.692	0.0	2.3	2.3	84.8	O K
120 min Summer	59.338	0.838	0.0	2.3	2.3	102.7	O K
180 min Summer	59.417	0.917	0.0	2.3	2.3	112.5	O K
240 min Summer	59.467	0.967	0.0	2.3	2.3	118.6	O K
360 min Summer	59.513	1.013	0.0	2.3	2.3	124.3	O K
480 min Summer	59.526	1.026	0.0	2.3	2.3	125.8	O K
600 min Summer	59.532	1.032	0.0	2.3	2.3	126.5	O K
720 min Summer	59.533	1.033	0.0	2.3	2.3	126.7	O K
960 min Summer	59.527	1.027	0.0	2.3	2.3	126.0	O K
1440 min Summer	59.501	1.001	0.0	2.3	2.3	122.7	O K
2160 min Summer	59.445	0.945	0.0	2.3	2.3	115.8	O K
2880 min Summer	59.380	0.880	0.0	2.3	2.3	107.9	O K
4320 min Summer	59.244	0.744	0.0	2.3	2.3	91.2	O K
5760 min Summer	59.070	0.570	0.0	2.3	2.3	69.9	O K
7200 min Summer	58.932	0.432	0.0	2.3	2.3	53.0	O K
8640 min Summer	58.832	0.332	0.0	2.3	2.3	40.7	O K
10080 min Summer	58.759	0.259	0.0	2.3	2.3	31.7	O K
15 min Winter	58.972	0.472	0.0	2.3	2.3	57.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	28.295	0.0	52.8	19
30 min Summer	18.712	0.0	69.9	33
60 min Summer	12.084	0.0	90.8	64
120 min Summer	7.660	0.0	115.1	122
180 min Summer	5.843	0.0	131.8	182
240 min Summer	4.818	0.0	144.9	242
360 min Summer	3.649	0.0	164.5	360
480 min Summer	2.986	0.0	179.5	430
600 min Summer	2.556	0.0	192.1	494
720 min Summer	2.251	0.0	203.0	558
960 min Summer	1.842	0.0	221.5	692
1440 min Summer	1.390	0.0	250.6	968
2160 min Summer	1.049	0.0	284.2	1388
2880 min Summer	0.858	0.0	310.1	1812
4320 min Summer	0.648	0.0	350.7	2636
5760 min Summer	0.531	0.0	383.5	3352
7200 min Summer	0.455	0.0	411.0	4032
8640 min Summer	0.401	0.0	434.5	4672
10080 min Summer	0.359	0.0	454.3	5352
15 min Winter	28.295	0.0	59.2	18

©1982-2017 XP Solutions

Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	59.117	0.617	0.0	2.3	2.3	75.7	O K
60 min Winter	59.280	0.780	0.0	2.3	2.3	95.6	O K
120 min Winter	59.448	0.948	0.0	2.3	2.3	116.2	O K
180 min Winter	59.543	1.043	0.0	2.3	2.3	127.8	O K
240 min Winter	59.604	1.104	0.0	2.4	2.4	135.4	O K
360 min Winter	59.668	1.168	0.0	2.5	2.5	143.2	O K
480 min Winter	59.691	1.191	0.0	2.5	2.5	146.0	O K
600 min Winter	59.695	1.195	0.0	2.5	2.5	146.5	O K
720 min Winter	59.693	1.193	0.0	2.5	2.5	146.2	O K
960 min Winter	59.684	1.184	0.0	2.5	2.5	145.1	O K
1440 min Winter	59.635	1.135	0.0	2.4	2.4	139.2	O K
2160 min Winter	59.536	1.036	0.0	2.3	2.3	127.0	O K
2880 min Winter	59.427	0.927	0.0	2.3	2.3	113.7	O K
4320 min Winter	59.194	0.694	0.0	2.3	2.3	85.0	O K
5760 min Winter	58.914	0.414	0.0	2.3	2.3	50.8	O K
7200 min Winter	58.762	0.262	0.0	2.3	2.3	32.1	O K
8640 min Winter	58.677	0.177	0.0	2.2	2.2	21.7	O K
10080 min Winter	58.629	0.129	0.0	2.1	2.1	15.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	18.712	0.0	78.3	33
60 min Winter	12.084	0.0	101.7	62
120 min Winter	7.660	0.0	129.0	120
180 min Winter	5.843	0.0	147.6	178
240 min Winter	4.818	0.0	162.2	236
360 min Winter	3.649	0.0	184.3	348
480 min Winter	2.986	0.0	201.1	456
600 min Winter	2.556	0.0	215.1	556
720 min Winter	2.251	0.0	227.4	582
960 min Winter	1.842	0.0	248.1	734
1440 min Winter	1.390	0.0	280.6	1052
2160 min Winter	1.049	0.0	318.4	1512
2880 min Winter	0.858	0.0	347.3	1956
4320 min Winter	0.648	0.0	392.9	2852
5760 min Winter	0.531	0.0	429.6	3456
7200 min Winter	0.455	0.0	460.3	4040
8640 min Winter	0.401	0.0	486.7	4672
10080 min Winter	0.359	0.0	508.9	5344

©1982-2017 XP Solutions

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 510 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	62.301	1.801	0.0	29.6	29.6	698.0	O K
30 min Summer	62.480	1.980	0.0	29.6	29.6	921.2	O K
60 min Summer	62.643	2.143	0.0	29.6	29.6	1144.3	O K
120 min Summer	62.775	2.275	0.0	29.6	29.6	1342.8	O K
180 min Summer	62.828	2.328	0.0	29.6	29.6	1425.3	O K
240 min Summer	62.847	2.347	0.0	29.6	29.6	1456.3	O K
360 min Summer	62.847	2.347	0.0	29.6	29.6	1455.9	O K
480 min Summer	62.829	2.329	0.0	29.6	29.6	1426.3	O K
600 min Summer	62.809	2.309	0.0	29.6	29.6	1395.0	O K
720 min Summer	62.789	2.289	0.0	29.6	29.6	1364.0	O K
960 min Summer	62.752	2.252	0.0	29.6	29.6	1306.1	O K
1440 min Summer	62.677	2.177	0.0	29.6	29.6	1194.3	O K
2160 min Summer	62.562	2.062	0.0	29.6	29.6	1030.9	O K
2880 min Summer	62.445	1.945	0.0	29.6	29.6	876.1	O K
4320 min Summer	62.216	1.716	0.0	29.6	29.6	601.1	O K
5760 min Summer	61.738	1.238	0.0	29.6	29.6	309.6	O K
7200 min Summer	61.158	0.658	0.0	29.6	29.6	164.4	O K
8640 min Summer	60.916	0.416	0.0	28.1	28.1	104.1	O K
10080 min Summer	60.798	0.298	0.0	26.1	26.1	74.5	O K
15 min Winter	62.372	1.872	0.0	29.6	29.6	784.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	125.500	0.0	720.3	19
30 min Summer	84.088	0.0	965.4	33
60 min Summer	53.779	0.0	1236.1	64
120 min Summer	33.226	0.0	1527.5	122
180 min Summer	24.710	0.0	1704.0	182
240 min Summer	19.890	0.0	1828.8	242
360 min Summer	14.593	0.0	2012.6	360
480 min Summer	11.713	0.0	2154.0	420
600 min Summer	9.868	0.0	2268.4	482
720 min Summer	8.575	0.0	2365.3	546
960 min Summer	6.863	0.0	2524.1	676
1440 min Summer	5.006	0.0	2761.2	952
2160 min Summer	3.643	0.0	3015.6	1364
2880 min Summer	2.904	0.0	3205.3	1760
4320 min Summer	2.106	0.0	3486.6	2548
5760 min Summer	1.675	0.0	3697.6	3176
7200 min Summer	1.401	0.0	3866.7	3752
8640 min Summer	1.211	0.0	4010.5	4416
10080 min Summer	1.072	0.0	4139.1	5144
15 min Winter	125.500	0.0	806.8	19

©1982-2017 XP Solutions

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	62.567	2.067	0.0	29.6	29.6	1037.5	O K
60 min Winter	62.744	2.244	0.0	29.6	29.6	1294.2	O K
120 min Winter	62.892	2.392	0.0	29.6	29.6	1528.8	O K
180 min Winter	62.954	2.454	0.0	29.6	29.6	1633.9	O K
240 min Winter	62.982	2.482	0.0	29.6	29.6	1681.3	O K
360 min Winter	62.996	2.496	0.0	29.7	29.7	1705.0	O K
480 min Winter	62.985	2.485	0.0	29.6	29.6	1686.0	O K
600 min Winter	62.961	2.461	0.0	29.6	29.6	1644.4	O K
720 min Winter	62.935	2.435	0.0	29.6	29.6	1601.0	O K
960 min Winter	62.888	2.388	0.0	29.6	29.6	1522.5	O K
1440 min Winter	62.785	2.285	0.0	29.6	29.6	1357.9	O K
2160 min Winter	62.617	2.117	0.0	29.6	29.6	1107.7	O K
2880 min Winter	62.442	1.942	0.0	29.6	29.6	871.4	O K
4320 min Winter	62.032	1.532	0.0	29.6	29.6	406.9	O K
5760 min Winter	60.976	0.476	0.0	28.8	28.8	118.9	O K
7200 min Winter	60.758	0.258	0.0	25.1	25.1	64.5	O K
8640 min Winter	60.709	0.209	0.0	21.9	21.9	52.4	O K
10080 min Winter	60.687	0.187	0.0	19.4	19.4	46.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	84.088	0.0	1081.3	33
60 min Winter	53.779	0.0	1384.5	62
120 min Winter	33.226	0.0	1710.8	120
180 min Winter	24.710	0.0	1908.5	178
240 min Winter	19.890	0.0	2048.3	236
360 min Winter	14.593	0.0	2254.2	348
480 min Winter	11.713	0.0	2412.5	456
600 min Winter	9.868	0.0	2540.7	556
720 min Winter	8.575	0.0	2649.1	578
960 min Winter	6.863	0.0	2827.0	732
1440 min Winter	5.006	0.0	3092.4	1038
2160 min Winter	3.643	0.0	3377.5	1472
2880 min Winter	2.904	0.0	3589.9	1900
4320 min Winter	2.106	0.0	3905.1	2720
5760 min Winter	1.675	0.0	4141.3	3064
7200 min Winter	1.401	0.0	4330.7	3680
8640 min Winter	1.211	0.0	4491.8	4400
10080 min Winter	1.072	0.0	4635.9	5136

©1982-2017 XP Solutions

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.357	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 3.066

Time (mins) From:	To:	Area (ha)
0	4	3.066

©1982-2017 XP Solutions

Model Details

Storage is Online Cover Level (m) 63.300

Complex Structure

Tank or Pond

Invert Level (m) 60.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	250.0	1.500	250.0

Tank or Pond

Invert Level (m) 62.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	725.0	1.000	1496.0	1.300	1738.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0214-2970-2500-2970
Design Head (m)	2.500
Design Flow (l/s)	29.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	214
Invert Level (m)	60.500
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.500	29.7
Flush-Flo™	0.721	29.6
Kick-Flo®	1.520	23.4
Mean Flow over Head Range	-	25.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.3	0.300	26.2	0.500	29.0	0.800	29.6
0.200	20.9	0.400	27.9	0.600	29.5	1.000	29.0

©1982-2017 XP Solutions

Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	27.9	2.400	29.1	5.000	41.4	8.000	52.0
1.400	25.7	2.600	30.3	5.500	43.4	8.500	53.6
1.600	24.0	3.000	32.4	6.000	45.3	9.000	55.1
1.800	25.4	3.500	34.9	6.500	47.0	9.500	56.5
2.000	26.7	4.000	37.2	7.000	48.8		
2.200	27.9	4.500	39.4	7.500	50.4		

©1982-2017 XP Solutions

Summary of Results for 30 year Return Period

Half Drain Time : 255 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	62.002	1.502	0.0	29.6	29.6	376.8	O K
30 min Summer	62.113	1.613	0.0	29.6	29.6	488.8	O K
60 min Summer	62.208	1.708	0.0	29.6	29.6	592.3	O K
120 min Summer	62.275	1.775	0.0	29.6	29.6	668.5	O K
180 min Summer	62.291	1.791	0.0	29.6	29.6	686.5	O K
240 min Summer	62.287	1.787	0.0	29.6	29.6	681.4	O K
360 min Summer	62.269	1.769	0.0	29.6	29.6	661.5	O K
480 min Summer	62.250	1.750	0.0	29.6	29.6	639.3	O K
600 min Summer	62.230	1.730	0.0	29.6	29.6	616.2	O K
720 min Summer	62.208	1.708	0.0	29.6	29.6	592.3	O K
960 min Summer	62.164	1.664	0.0	29.6	29.6	543.2	O K
1440 min Summer	62.067	1.567	0.0	29.6	29.6	442.1	O K
2160 min Summer	61.609	1.109	0.0	29.6	29.6	277.4	O K
2880 min Summer	61.217	0.717	0.0	29.6	29.6	179.3	O K
4320 min Summer	60.857	0.357	0.0	27.3	27.3	89.3	O K
5760 min Summer	60.732	0.232	0.0	24.3	24.3	57.9	O K
7200 min Summer	60.697	0.197	0.0	20.6	20.6	49.3	O K
8640 min Summer	60.675	0.175	0.0	17.9	17.9	43.8	O K
10080 min Summer	60.661	0.161	0.0	15.9	15.9	40.3	O K
15 min Winter	62.050	1.550	0.0	29.6	29.6	424.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	69.299	0.0	397.4	18
30 min Summer	45.987	0.0	527.7	33
60 min Summer	29.238	0.0	671.9	62
120 min Summer	18.051	0.0	829.7	122
180 min Summer	13.465	0.0	928.4	180
240 min Summer	10.884	0.0	1000.6	220
360 min Summer	8.039	0.0	1108.6	282
480 min Summer	6.482	0.0	1191.8	346
600 min Summer	5.481	0.0	1259.8	414
720 min Summer	4.777	0.0	1317.7	484
960 min Summer	3.844	0.0	1413.6	620
1440 min Summer	2.826	0.0	1558.6	894
2160 min Summer	2.074	0.0	1716.8	1236
2880 min Summer	1.664	0.0	1836.7	1560
4320 min Summer	1.219	0.0	2017.3	2248
5760 min Summer	0.977	0.0	2155.6	2936
7200 min Summer	0.822	0.0	2267.7	3672
8640 min Summer	0.714	0.0	2363.5	4400
10080 min Summer	0.634	0.0	2448.5	5128
15 min Winter	69.299	0.0	445.2	18

©1982-2017 XP Solutions

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	62.171	1.671	0.0	29.6	29.6	551.7	O K
60 min Winter	62.279	1.779	0.0	29.6	29.6	672.3	O K
120 min Winter	62.359	1.859	0.0	29.6	29.6	767.6	O K
180 min Winter	62.383	1.883	0.0	29.6	29.6	797.3	O K
240 min Winter	62.384	1.884	0.0	29.6	29.6	799.0	O K
360 min Winter	62.361	1.861	0.0	29.6	29.6	770.5	O K
480 min Winter	62.337	1.837	0.0	29.6	29.6	740.9	O K
600 min Winter	62.308	1.808	0.0	29.6	29.6	706.6	O K
720 min Winter	62.276	1.776	0.0	29.6	29.6	669.7	O K
960 min Winter	62.208	1.708	0.0	29.6	29.6	592.1	O K
1440 min Winter	62.051	1.551	0.0	29.6	29.6	426.0	O K
2160 min Winter	61.265	0.765	0.0	29.6	29.6	191.2	O K
2880 min Winter	60.898	0.398	0.0	27.9	27.9	99.4	O K
4320 min Winter	60.710	0.210	0.0	22.0	22.0	52.5	O K
5760 min Winter	60.674	0.174	0.0	17.7	17.7	43.4	O K
7200 min Winter	60.654	0.154	0.0	14.9	14.9	38.5	O K
8640 min Winter	60.641	0.141	0.0	12.9	12.9	35.1	O K
10080 min Winter	60.631	0.131	0.0	11.5	11.5	32.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	45.987	0.0	591.1	33
60 min Winter	29.238	0.0	752.6	62
120 min Winter	18.051	0.0	929.3	118
180 min Winter	13.465	0.0	1039.8	176
240 min Winter	10.884	0.0	1120.7	230
360 min Winter	8.039	0.0	1241.7	302
480 min Winter	6.482	0.0	1334.9	372
600 min Winter	5.481	0.0	1411.0	448
720 min Winter	4.777	0.0	1475.9	526
960 min Winter	3.844	0.0	1583.2	674
1440 min Winter	2.826	0.0	1745.7	966
2160 min Winter	2.074	0.0	1922.9	1256
2880 min Winter	1.664	0.0	2057.1	1560
4320 min Winter	1.219	0.0	2259.6	2204
5760 min Winter	0.977	0.0	2414.2	2936
7200 min Winter	0.822	0.0	2539.8	3608
8640 min Winter	0.714	0.0	2647.2	4392
10080 min Winter	0.634	0.0	2742.4	5056

©1982-2017 XP Solutions

Summary of Results for 1 year Return Period

Half Drain Time : 74 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	61.077	0.577	0.0	29.4	29.4	144.2	O K
30 min Summer	61.217	0.717	0.0	29.6	29.6	179.3	O K
60 min Summer	61.325	0.825	0.0	29.6	29.6	206.3	O K
120 min Summer	61.387	0.887	0.0	29.6	29.6	221.8	O K
180 min Summer	61.392	0.892	0.0	29.6	29.6	223.1	O K
240 min Summer	61.376	0.876	0.0	29.6	29.6	219.1	O K
360 min Summer	61.313	0.813	0.0	29.6	29.6	203.2	O K
480 min Summer	61.239	0.739	0.0	29.6	29.6	184.8	O K
600 min Summer	61.168	0.668	0.0	29.6	29.6	167.0	O K
720 min Summer	61.103	0.603	0.0	29.5	29.5	150.7	O K
960 min Summer	60.993	0.493	0.0	28.9	28.9	123.3	O K
1440 min Summer	60.846	0.346	0.0	27.1	27.1	86.4	O K
2160 min Summer	60.737	0.237	0.0	24.4	24.4	59.1	O K
2880 min Summer	60.700	0.200	0.0	20.9	20.9	50.0	O K
4320 min Summer	60.663	0.163	0.0	16.1	16.1	40.7	O K
5760 min Summer	60.643	0.143	0.0	13.3	13.3	35.8	O K
7200 min Summer	60.630	0.130	0.0	11.4	11.4	32.5	O K
8640 min Summer	60.621	0.121	0.0	10.1	10.1	30.1	O K
10080 min Summer	60.613	0.113	0.0	9.0	9.0	28.3	O K
15 min Winter	61.152	0.652	0.0	29.6	29.6	163.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	28.295	0.0	161.8	17
30 min Summer	18.712	0.0	214.3	31
60 min Summer	12.084	0.0	277.5	54
120 min Summer	7.660	0.0	351.9	88
180 min Summer	5.843	0.0	402.7	124
240 min Summer	4.818	0.0	442.8	158
360 min Summer	3.649	0.0	503.0	226
480 min Summer	2.986	0.0	548.8	292
600 min Summer	2.556	0.0	587.2	356
720 min Summer	2.251	0.0	620.6	418
960 min Summer	1.842	0.0	677.3	538
1440 min Summer	1.390	0.0	766.5	766
2160 min Summer	1.049	0.0	868.1	1104
2880 min Summer	0.858	0.0	947.0	1468
4320 min Summer	0.648	0.0	1071.3	2200
5760 min Summer	0.531	0.0	1171.2	2928
7200 min Summer	0.455	0.0	1255.0	3664
8640 min Summer	0.401	0.0	1327.0	4360
10080 min Summer	0.359	0.0	1387.6	5080
15 min Winter	28.295	0.0	181.3	17

©1982-2017 XP Solutions

Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	61.316	0.816	0.0	29.6	29.6	204.1	O K
60 min Winter	61.450	0.950	0.0	29.6	29.6	237.5	O K
120 min Winter	61.510	1.010	0.0	29.6	29.6	252.5	O K
180 min Winter	61.504	1.004	0.0	29.6	29.6	250.9	O K
240 min Winter	61.468	0.968	0.0	29.6	29.6	241.9	O K
360 min Winter	61.354	0.854	0.0	29.6	29.6	213.6	O K
480 min Winter	61.232	0.732	0.0	29.6	29.6	182.9	O K
600 min Winter	61.121	0.621	0.0	29.5	29.5	155.1	O K
720 min Winter	61.025	0.525	0.0	29.1	29.1	131.3	O K
960 min Winter	60.882	0.382	0.0	27.7	27.7	95.4	O K
1440 min Winter	60.734	0.234	0.0	24.3	24.3	58.5	O K
2160 min Winter	60.682	0.182	0.0	18.8	18.8	45.6	O K
2880 min Winter	60.658	0.158	0.0	15.5	15.5	39.6	O K
4320 min Winter	60.632	0.132	0.0	11.7	11.7	33.0	O K
5760 min Winter	60.618	0.118	0.0	9.6	9.6	29.4	O K
7200 min Winter	60.607	0.107	0.0	8.2	8.2	26.9	O K
8640 min Winter	60.600	0.100	0.0	7.3	7.3	25.0	O K
10080 min Winter	60.594	0.094	0.0	6.5	6.5	23.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	18.712	0.0	240.1	31
60 min Winter	12.084	0.0	310.9	58
120 min Winter	7.660	0.0	394.2	96
180 min Winter	5.843	0.0	451.1	134
240 min Winter	4.818	0.0	495.9	172
360 min Winter	3.649	0.0	563.4	244
480 min Winter	2.986	0.0	614.7	312
600 min Winter	2.556	0.0	657.7	374
720 min Winter	2.251	0.0	695.1	434
960 min Winter	1.842	0.0	758.6	550
1440 min Winter	1.390	0.0	858.6	754
2160 min Winter	1.049	0.0	972.3	1108
2880 min Winter	0.858	0.0	1060.7	1468
4320 min Winter	0.648	0.0	1200.0	2204
5760 min Winter	0.531	0.0	1311.7	2928
7200 min Winter	0.455	0.0	1405.7	3672
8640 min Winter	0.401	0.0	1486.3	4344
10080 min Winter	0.359	0.0	1554.2	5040

©1982-2017 XP Solutions

Rodgers Leask Limited

St James House St Mary's Wharf Mansfield Road Derby DE1 3TQ

Tel: 01332 285000 Fax: 01332 291728

rllderby@rodgersleask.co.uk

www.rodgersleask.co.uk