

Mr Yakub Valli

**Petrol Filling Station
Mitchell Way/Barnsley Road
Wombwell
South Yorkshire**

Flood Risk Assessment

**Prepared by EWE Associates Ltd
Final RevA March 2018**



**EWE Associates Ltd
7 Waveney Close
Burton Upon Stather
Scunthorpe
North Lincolnshire
DN15 9DT
t: 01724 721099
M: 07875 972270
e: lea.favill@eweassociates.com**

This document has been prepared solely as a Flood Risk Assessment for Mr Yakub Valli. EWE Associates Ltd accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.


CLIENT DETAILS

Mr Yakub Valli
1 Warren Street
Savile Town
Dewsbury
WF12 9LU

CONTRACT

This report describes work commissioned by Mr Yakub Valli under written instruction dated 13th December 2017. The representative for the contract was Mr Nick Willock of Robert Halstead Chartered Surveyors & Town Planners. Lea Favill of EWE Associates Ltd carried out the work.

Date: 15th March 2018

Prepared by:  Lea Favill
Director

REVISION HISTORY

Draft Report Rev0 issued 7th March 2018
- Nick Willock - 1No. copy

Final Report RevA issued 15th March 2018
- Nick Willock - 1No. copy

EXECUTIVE SUMMARY

The existing site is located to the east of Barnsley Road and to the west of Mitchell Way within Wombwell. The development site is currently vacant land. There is extensive residential and commercial development to all sides of the site.

The development site is shown in the aerial photograph below. The ground levels vary between 44.44mOD up to 46.70mOD within the area proposed for the petrol filling station. The developable area of the site is approximately 1409m² and is considered to be 100% permeable as the site is undrained vegetated land.

The proposal is to construct a petrol filling station within the site. It is estimated that the impermeable area following completion of the development will be at 93%, hence 1304m² which is considered to be small.

The risk of tidal, fluvial and surface water flooding is considered to be low. As such, it is considered that the site will not be inundated from these sources. Therefore, building ground floor level should be elevated at least 150mm above the adjacent external ground level to reduce the risk of localised flooding.

There is no evidence of localised flooding due to incapacity. The size of the development is unlikely to have any significant impact on the localised drainage system.

The proposed drainage system incorporates an interceptor prior to discharge to the combined sewer in order to reduce the risk of contaminating the surface water sewer and local watercourses. Therefore, it is recommended that the relevant water authority is approached at the earliest opportunity to discuss and agree the discharge limit from the site.

Following the proposed development, the impermeable area will be increased to 1304m² (0.131 hectares). It is considered that the site currently discharges runoff via a combination of infiltration, evaporation and overland flow to the sewer to the west of the site.

Using software developed by Microdrainage the required attenuation has been calculated for the 1 in 100 year plus climate change (30%) event. The site will discharge into the combined sewer to the west of the site at a peak discharge rate of 3l/s. The primary attenuation will be provided within a single tank. It is estimated that approximately 60.9m³ of storage will be required during the 1 in 100 year plus climate change (30%) event.

The tank will be used to accommodate the storage during 1 in 1 year, 30 year, 100 year and 100 year +CC storms (worst case scenario).

The proposal is to provide a hydro-brake to restrict flows from the site. During an event which exceeds the system's capacity the hydro brake manhole will be flooded and flows will head north along Barnsley Road.

It is concluded that there is a low risk of flooding from the fluvial sources at the site. It is unlikely that the proposed development will have any adverse impact on the surface water drainage in the area.

CONTENTS

1.	INTRODUCTION	6
	Terms of Reference	6
	Approach to the Assessment	6
	Application of the Sequential & Exceptions Test	8
2.	DETAILS OF THE SITE	9
	Site Location	9
	Site Details	9
	Site Description	10
	Site Photographs	10
3.	INITIAL ASSESSMENT	11
	Environment Agency Flood Map	11
	Environment Agency Reservoir Flood Map	11
	Environment Agency Surface Water Flood Map	12
	Past Flooding History	12
	SFRA Flooding History	12
	Environment Agency Flooding History	12
	Reservoir Flood Risk	12
	Surface Water Flood Risk	13
	Possible Flooding Mechanisms	13
4.	FLOOD RISK ASSESSMENT	14
	Requirements of the Environment Agency	14
	Existing Drainage	14
	Existing Runoff from Site	14
	Proposed Drainage Strategy	15
5.	MITIGATION MEASURES	17
	Raising Floor Levels/Land Raising	17
	Emergency Access & Egress	17
	Control of Runoff	17
6.	CONCLUSION	19

APPENDICES:

APPENDIX A: -	EXISTING GROUND LEVELS
APPENDIX B: -	PROPOSED SITE PLAN
APPENDIX C: -	YORKSHIRE WATER SEWER MAP
APPENDIX D: -	ICPSUDS RUNOFF CALCULATION SHEET
APPENDIX E: -	WINDES CALCULATION SHEET
APPENDIX F: -	DRAINAGE STRATEGY DRAWING

LIST OF TABLES

Table 1-1: Flood Risk Vulnerability and Flood Zone ‘Compatibility’	8
Table 2-1: Location Plan.....	9
Table 2-2: Site Details	9
Table 4-1: ICPSUDS flows from existing site 1409m ²	14
Table 4-2: WinDes 1 in 100 year+CC Storage Volume.....	15

1. INTRODUCTION

Terms of Reference

This report was commissioned by Mr Yakub Valli to support a planning application for the construction of a petrol filling station within a currently vacant area of land at the junction of Mitchell Way and Barnsley Road in Wombwell, South Yorkshire. The site is located to the north west of the centre of Wombwell and can be currently accessed via Barnsley Road to the west of the site. The location of the site is shown on Table 2-1.

The development site lies within Zone 1 of the Environment Agency Flood Map (version 2.8.2), being the zone with risk of 1 in 1,000 year (0.1% AEP) or less for fluvial flooding. The overall size of the development is less than 1 hectare.

It is usual for the Agency to raise an objection to development applications within the floodplain or Zone 2 or 3 of the flood map until the question of flood risk has been properly evaluated. The Agency will also object to developments where the total site area is in excess of 1 hectare until suitable consideration has been given to surface water runoff.

Approach to the Assessment

As there is a single source of flood risk which requires initial consideration – surface water runoff – it is necessary to determine flood water levels at the site for the desired return periods emanating from this source. Consideration has also been given to the site flooding from either overland flow or ponding of localised rainfall within the site.

Barnsley Metropolitan Borough Council commissioned JBA Consulting to undertake a level 1 SFRA. The final report was completed during September 2010. References have been taken from the assessment; however, there is very little site-specific information within the report relevant to the area close to the site.

The proposed development will increase the paved and roofed area within the site. As such, the existing method of draining the site will be appraised. EWE Associates Ltd has undertaken a drainage feasibility study for the site and will provide indicative storage volumes estimated using Micro Drainage Software.

The storage volumes needed to attenuate surface water flow from the development to accommodate the required 1 in 100 year plus 30% climate change event, have therefore been calculated, using the proposed drainage strategy, as outlined above. However, the volume balance requirements should be recalculated during the detailed design stage to reflect the actual development proposal, the extent of impermeable areas and runoff to be generated.

A walk over survey of the site was conducted by Mr Lea Favill, a senior river engineer during February 2018; during the visit a photograph survey of the site was undertaken. A topographical survey was provided by the client's representative. The survey was carried out to establish the existing ground levels within the site boundary. The survey was calibrated to ordnance datum.

The requirements for flood risk assessments are generally as set out in National Planning Policy Framework (NPPF). The detail and complexity of the study required

should be appropriate to the scale and potential impact of the development. For the purposes of this study, the following have been considered: -

- Available information on historical flooding in the area.
- Site level information.
- Details of structures, which may influence hydraulics of the watercourse and consideration of the effect of blockage of structures.
- Estimates of design levels, equivalent to a 200-year (coastal/tidal) and a 100-year (fluvial) return period flood event.
- Allowances for increased flows resulting from the effects of climate change.
- Allowances for sea level rise resulting from the effects of climate change.

Assess the existing runoff characteristics and the potential impact the proposed development will have on the runoff.

Further guidance is also provided in the CIRIA Research Project 624 “Development and Flood Risk: Guidance for the Construction Industry”.

Application of the Sequential & Exceptions Test

The development site lies within Zone 1 of the Environment Agency Flood Map (version 2.8.2), being the zone with risk of 1 in 1,000 year (0.1% AEP) or less for fluvial flooding. The proposed development includes an petrol filling station and as such is less vulnerable.

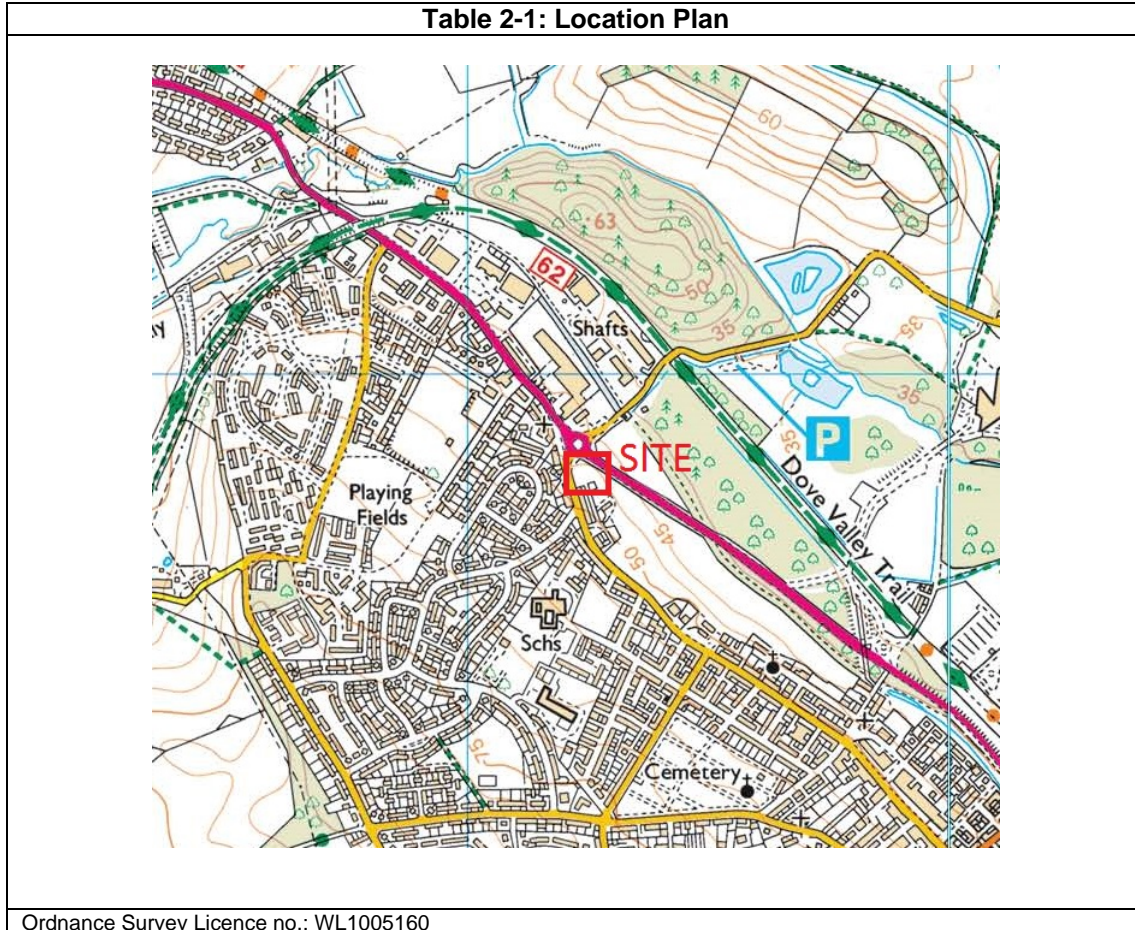
Table 1-1: Flood Risk Vulnerability and Flood Zone ‘Compatibility’

Flood Risk Vulnerability classification		Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	✗	Exception Test required	✓
	Zone 3b	Exception Test required	✓	✗	✗	✗

- ✓ Development is appropriate
- ✗ Development should not be permitted

2. DETAILS OF THE SITE

Site Location



Site Details

Table 2-2: Site Details	
Site Name	Mitchell Way/Barnsley Road, Wombwell
Existing Land Use	Vacant Land
Proposed Development	Petrol Filling Station
Grid Reference	SE 39247 03795
County	South Yorkshire
Local Planning Authority	Barnsley Metropolitan Borough Council
Internal Drainage Board	Not Applicable
Others	Not Applicable
Post Code	S73 8DR

Site Description

The existing site is located to the east of Barnsley Road and to the west of Mitchell Way within Wombwell. The development site is currently vacant land.

There is extensive residential and commercial development to all sides of the site.

The development site is shown in the aerial photograph below. The ground levels vary between 44.44mOD up to 46.70mOD within the area proposed for the petrol filling station.

The ground levels within the site are illustrated at Appendix A of this report. The developable area of the site is approximately 1409m² and is considered to be 100% permeable as the site is undrained vegetated land.

The proposal is to construct a petrol filling station within the site. The detailed layout plan for the proposed development is shown at Appendix B of this report.

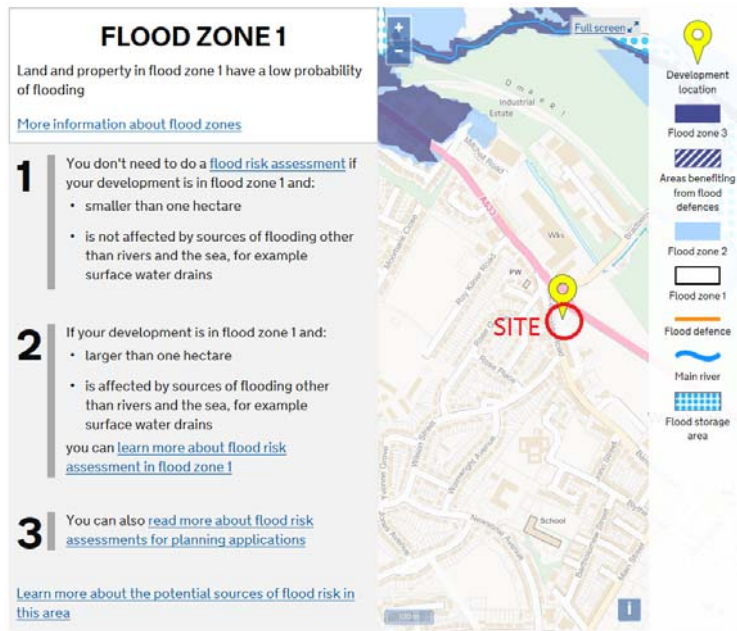
It is estimated that the impermeable area following completion of the development will be at 93%, hence 1304m² which is considered to be small.

Site Photographs

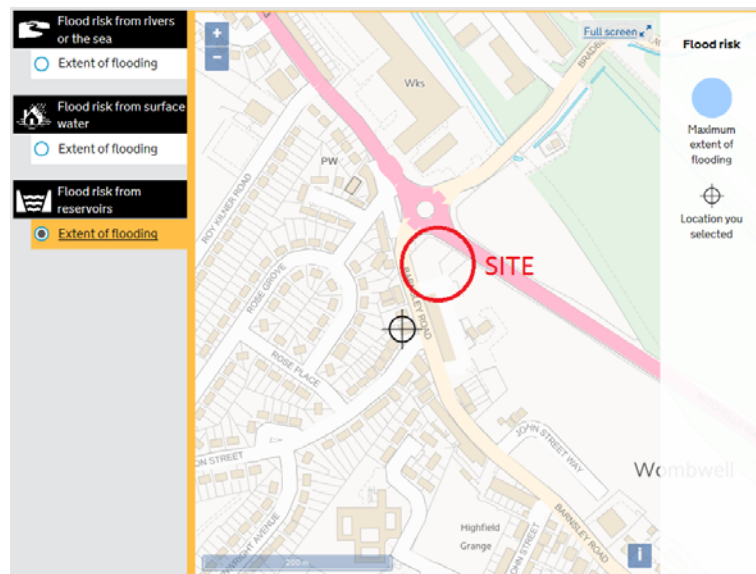


3. INITIAL ASSESSMENT

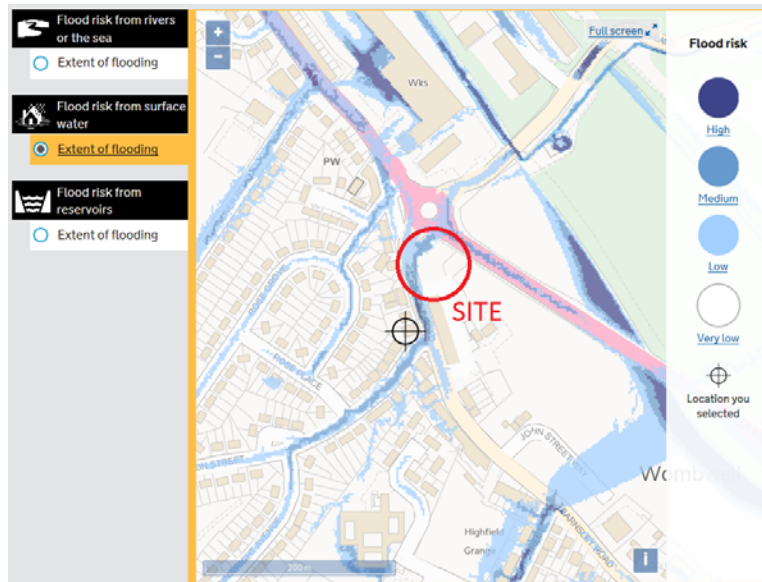
Environment Agency Flood Map



Environment Agency Reservoir Flood Map



Environment Agency Surface Water Flood Map



Past Flooding History

A search on the British Hydrological Society Chronology of British Hydrological Events website¹ found no records of past flooding close to the site.

Undertaking an internet based search for flooding found no further reference to flooding close to the site.

SFRA Flooding History

The SFRA contained no references to the site being flooded.

Environment Agency Flooding History

The Environment Agency did not provide any historical flood information within close proximity of the site.

Reservoir Flood Risk

The reservoir flood map shows that the site is not at risk if a reservoir breached.

¹ <http://www.dundee.ac.uk/geography/cbhe/>

Surface Water Flood Risk

The site is shown to be within a very low risk area. However, the adjacent Mitchell Way is shown to be within a low risk area where surface water flooding from the surface water sewers within the highway could flood to depths of less than 300mm with a velocity of less than 0.25m/s.

Possible Flooding Mechanisms

As there is a single remaining source of flood risk which require further consideration – surface water runoff – it is necessary to determine flood water levels at the site for the desired return periods emanating from this source.

The proposed development will increase the impermeable area and subsequently the runoff from the site will also be increased. An initial drainage strategy has been completed as part of this assessment based on available data.

There is no higher ground adjacent to the site which could promote overland flow of water across the site. There are no depressed areas within the site which could encourage ponding, therefore these flood mechanisms have not been considered further.

Information on groundwater flooding is limited within the Barnsley Metropolitan Borough Council. The SFRA provided no further information.

Yorkshire Water is the statutory water undertaker and is responsible for the public sewer systems within Wombwell area. Yorkshire Water maintains a register of historical sewer flooding events (DG5 Register) within the area. There are no report incidents close to the site. The SFRA provided no further information.

4. FLOOD RISK ASSESSMENT

Requirements of the Environment Agency

The Environment Agency, as part of its development control procedures, generally require finished floor levels to be set above the 1% AEP plus climate change flood water level at the site.

The development is commercial in nature, as such it is considered that access and egress from the development site will be desirable during times of extreme floods.

Rainfall Runoff from the Proposed Development

Existing Drainage

The existing site is vacant land. There is a small area of tarmac within the south west corner of the site. This area isn't supported by any formalised drainage. The Yorkshire Water sewer plan, which is provided at Appendix C of this report shows both surface water and combined sewers within Barnsley Road. The surface water sewer cuts across the northern boundary of the site. The combined sewer is 225m diameter and the surface water sewer is 600mm diameter.

Existing Runoff from Site

The total site area has been estimated at 1409m² (0.141 hectares.) There is no formalised drainage supporting this area.

Table 4-1: ICPSUDS flows from existing site 1409m²

Return Period	Flow in litres per second (l/s)
Qbar	0.5
1 in 1 year	0.4
1 in 30 year	1.0
1 in 100 year	1.4

The ICPSUDs Method has been used to calculate the existing runoff from the site. The calculation sheet is provided at Appendix D of this report. Any discharge from the site into the combined sewer will require the consent of the appropriate water authority/riparian owner, as such, they will also need to be approached to agree the discharge restriction from the site.

The existing 1 in 1 year flow from the site has been estimated at 0.4l/s. As this is less than the practical minimum of 3l/s currently adopted by Yorkshire Water it is

recommended that the discharge from the site into the combined sewer is limited to 3l/s.

Proposed Drainage Strategy

Drainage from the forecourt area (subject to potential contamination) will be discharged into the existing combined water drains via a 10,000Ltr class 1 full retention separator. The interceptor is also alarmed and monitored by a remote monitoring system, which would automatically shut off the interceptor in the unlikely event of fuel spillage.

The post development impermeable area has been estimated at 1304m² (0.131 hectares) which includes both roofed and paved areas. A peak discharge rate from the site of 3 l/s has been adopted.

An assessment of the required balance volume has been made using the estimated post development impermeable area of 0.131 hectares. Using WinDes Source Control software developed by Microdrainage the required attenuation has been calculated for the 1 in 100 year plus climate change (30%) event.

Reference should be made to Appendix E where the calculation sheets are provided. The attenuation size has been tabulated below in Table 4-2. It is estimated that during the 1 in 100 year plus climate change (30%) event that 60.9m³ of storage will be required. This will be provided within a single tank located within the parking area. The drainage strategy drawing provided at Appendix F shows the initial drainage strategy for the site which includes a single tank discharging to the combined water sewer controlled by a 3l/s hydrobrake.

Table 4-2: WinDes 1 in 100 year+CC Storage Volume

Return Period	Required Attenuation	Approx Volume (m ³)
1 in 100 year + CC	tank 48m ² x 1.2m deep	60.9

It is normal practice to ensure that the 1 in 30 year event is maintained below the ground in the form of storage and the difference between the 1 in 100 year and the 1 in 30 year is permitted to flood the surface as long as there is no flooding to buildings and the flood volume is contained within the site boundary. Alternatively, if the development is considered to be sensitive, the client can choose to store the full 1 in 100 year plus climate change balance volume below ground.

The volume balance requirements should be recalculated during the detailed design stage to reflect the actual development proposal, agreed discharge rate and the extent of impermeable areas and runoff to be generated.

Environmental Statement

The Petrol Station shall be for domestic fuel supply to the general public for transportation and its operation will involve two primary activities including unloading of Unleaded and Diesel fuel from delivery tanker vehicles to underground storage tanks (UST) and fuel dispensing on the forecourt by customer self service. The storage and management of Hazardous Materials on site will be subject to a series of Control Measures including compliance with:

- The “Design, construction, modification, maintenance and decommissioning of filling stations” produced by the APEA and Energy Institute.
- DSEAR (Dangerous Substances & Explosive Atmospheres Regulations) 2002.

- Environment Agency PPG7: Refuelling Facilities.
- Environment Agency PPG: Oil separators in surface water drainage systems.
- ASDA Store management training procedures and operational guidelines.

Fuel Storage & distribution

There shall be provision for 3 number double compartment underground tanks. The tanks will be double skinned with the interstitial space between the inner and outer lining continuously monitored by a state of art Vedeer-Rout TLS 350 leak detection system. The tanks will be finished in polyurethane finish which is the highest specification standard carrying a 30 year warranty.

Tanks will be installed with a pea shingle surround that facilitates easy access in case of remedial works and removal at the end of its life expectancy. Monitoring wells are provided for routine inspection as an additional measure to the leak detection system. Tanks are fitted with “Atlas” tank chambers comprising the highest standard of robust construction and access arrangements for H&S access.

Fuel distribution shall be by 63mm Polyurethane pipework with fusion welded joints, pipework shall be set to falls 1:100 back to the tanks for gravity draining in case of pump failure or removal.

Surface water discharge/containment of the dispensing forecourt will be by drainage channels to the forecourt perimeter. The channel specification around the tanker delivery area shall a 300mm² section with special grating to collect a discharge rating of 44Ltrs/sec over 2LM and has the capacity to transport 15Ltrs/sec, all in accordance with the APEA guidance. These drains are then run to a 10,000Ltr Class I interceptor which is fitted with a shut of valve activated by an Environmental sensor that is alarmed and constantly monitored by a forecourt Management System (FMS). The size of the interceptor is determined by the compartment size of a fuel tanker to ensure that in the event of a hose uncoupling or leakage it can achieve full containment.

Water outfalls from the interceptor shall discharge into the existing combined drainage system in accordance with PPG 3.

5. MITIGATION MEASURES

Raising Floor Levels/Land Raising

The risk of tidal, fluvial and surface water flooding is considered to be low. As such, it is considered that the site will not be inundated from these sources. Therefore, building ground floor level should be elevated at least 150mm above the adjacent external ground level to reduce the risk of localised flooding.

Emergency Access & Egress

As the development is commercial, it is considered that dry access and egress from the development site will be essential during extreme flood events.

It is considered that the proposed development is located within flood zone 1, low risk and will be a safe area during extreme flood events.

Control of Runoff

There is no evidence of localised flooding due to incapacity. The size of the development is unlikely to have any significant impact on the localised drainage system.

The proposed drainage system incorporates an interceptor prior to discharge to the combined sewer in order to reduce the risk of contaminating the surface water sewer and local watercourses. Therefore it is recommended that the relevant water authority is approached at the earliest opportunity to discuss and agree the discharge limit from the site.

Following the proposed development, the impermeable area will be increased to 1304m² (0.131 hectares). It is considered that the site currently discharges runoff via a combination of infiltration, evaporation and overland flow to the sewer to the west of the site.

Using software developed by Microdrainage the required attenuation has been calculated for the 1 in 100 year plus climate change (30%) event. The site will discharge into the combined sewer to the west of the site at a peak discharge rate of 3l/s. The primary attenuation will be provided within a single tank. It is estimated that approximately 60.9m³ of storage will be required during the 1 in 100 year plus climate change (30%) event.

The tank will be used to accommodate the storage during 1 in 1 year, 30 year, 100 year and 100 year +CC storms (worst case scenario).

The proposal is to provide a hydro-brake to restrict flows from the site. During an event which exceeds the system's capacity the hydro brake manhole will be flooded and flows will head north along Barnsley Road.

It is recommended that during the detailed phase of the development the following items are considered.

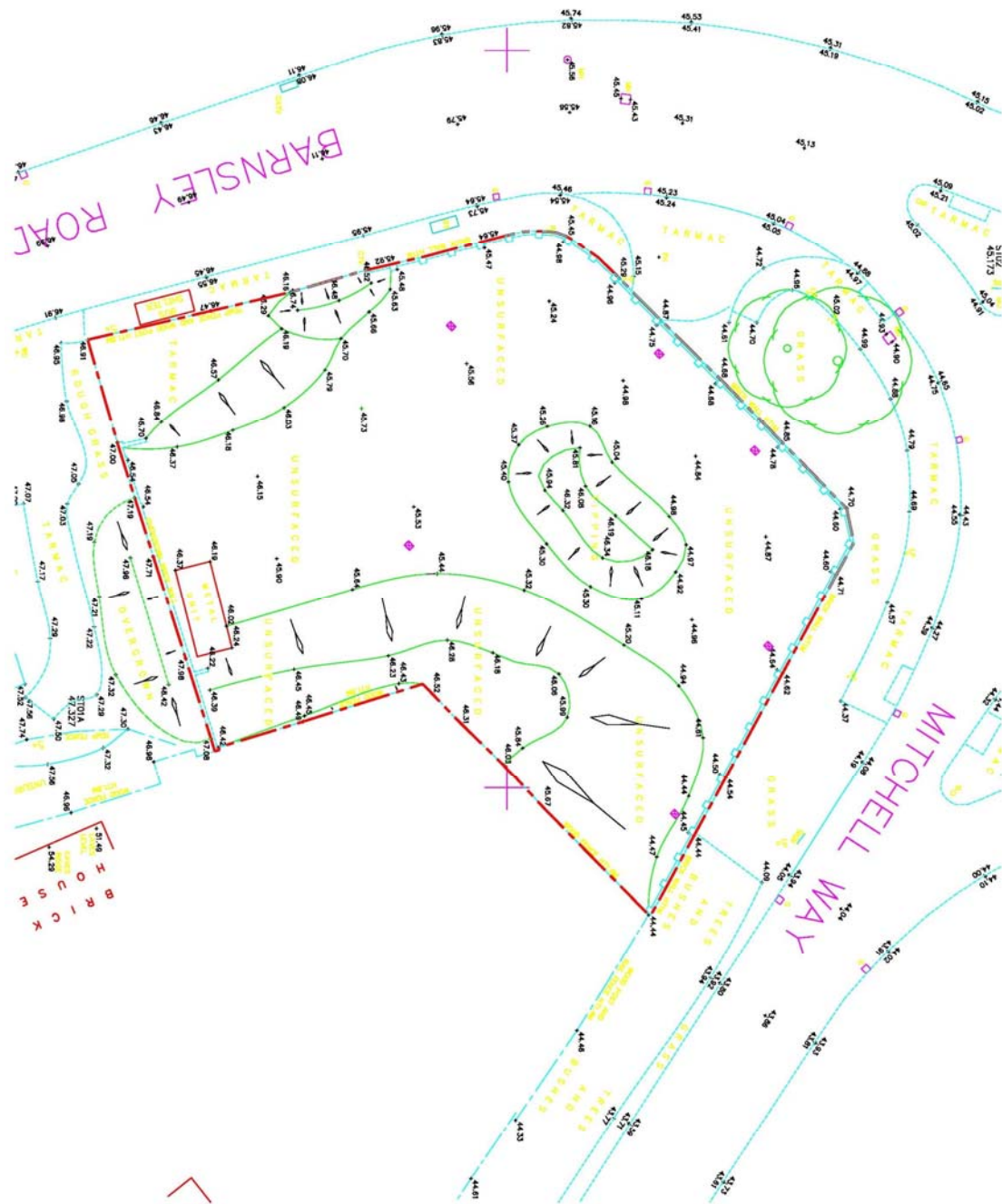
- The maintenance and adoption regimes for all elements of the development should be considered for the lifetime of the development.

- Consenting will be required from the Water Authority for any connections into the public sewer.

6. CONCLUSION

It is concluded that there is a low risk of flooding from the fluvial sources at the site. It is unlikely that the proposed development will have any adverse impact on the surface water drainage in the area.

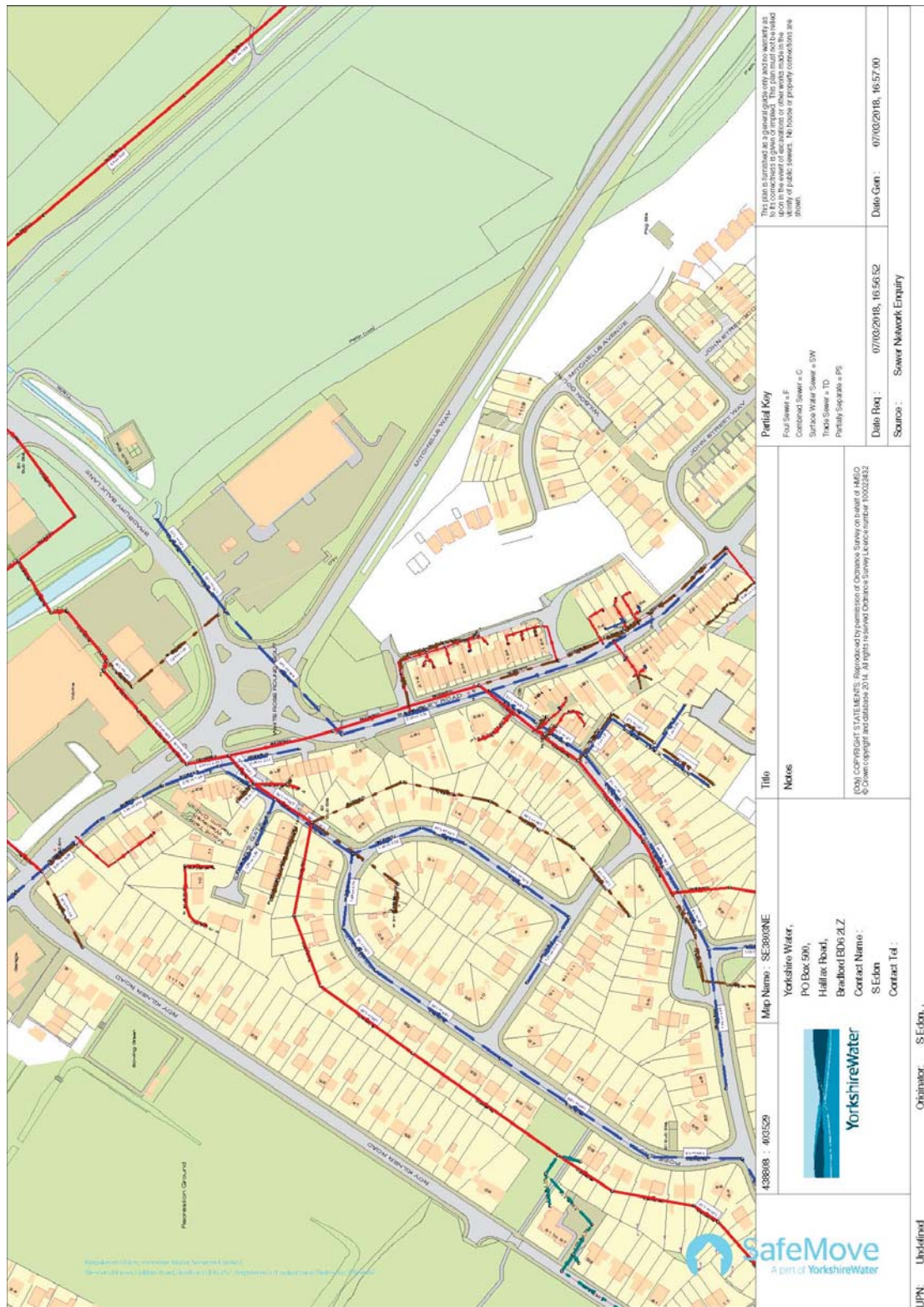
Appendix A: - Existing Ground Levels




Appendix B: - Proposed Site Plan




Appendix C: - Yorkshire
 Water Sewer Map





Appendix D: - ICPSUDS Runoff
 Calculation Sheet


EWE Associates Ltd		Page 1
Windy Ridge Barn Thealby Lane Winterton DN15 9TG		
Date 07/03/2018 17:38 File	Designed By Lea Checked By	
Micro Drainage	Source Control W.12.4	
<u>ICP SUDS Mean Annual Flood</u>		
Input		
Return Period (years)	1	Soil 0.450
Area (ha)	0.141	Urban 0.000
SAAR (mm)	618	Region Number Region 4
Results 1/s		
QBAR Rural	0.5	
QBAR Urban	0.5	
Q1 year	0.4	
Q1 year	0.4	
Q30 years	1.0	
Q100 years	1.4	
©1982-2010 Micro Drainage Ltd		

Appendix E: - WINDES Calculation Sheet

EWE Associates Ltd		Page 1			
Windy Ridge Barn Thealby Lane Winterton DN15 9TG					
Date 07/03/2018 17:45 File 100yr+CC30% tank ...	Designed By Lea Checked By				
Micro Drainage		Source Control W.12.4			
<u>Summary of Results for 100 year Return Period (+30%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	44.005	0.765	2.0	36.7	O K
30 min Summer	44.126	0.896	2.1	42.5	O K
60 min Summer	44.242	1.002	2.3	48.1	O K
120 min Summer	44.327	1.087	2.4	52.2	O K
180 min Summer	44.343	1.103	2.4	53.0	O K
240 min Summer	44.344	1.104	2.4	53.0	O K
360 min Summer	44.330	1.090	2.4	52.3	O K
480 min Summer	44.305	1.065	2.3	51.1	O K
600 min Summer	44.275	1.035	2.3	49.7	O K
720 min Summer	44.246	1.006	2.3	48.3	O K
960 min Summer	44.206	0.966	2.2	46.4	O K
1440 min Summer	44.125	0.885	2.1	42.5	O K
2160 min Summer	44.010	0.770	2.0	37.0	O K
2880 min Summer	43.912	0.672	1.9	32.3	O K
4320 min Summer	43.697	0.457	1.5	21.9	O K
5760 min Summer	43.550	0.310	1.4	14.9	O K
7200 min Summer	43.378	0.138	1.4	6.6	O K
8640 min Summer	43.334	0.094	1.3	4.5	O K
10080 min Summer	43.321	0.081	1.1	3.9	O K
Storm Event	Rain (mm/hr)	Time-Peak (mins)			
15 min Summer	157.250	25			
30 min Summer	93.049	39			
60 min Summer	55.059	66			
120 min Summer	32.580	122			
180 min Summer	23.969	170			
240 min Summer	19.278	198			
360 min Summer	14.183	264			
480 min Summer	11.407	332			
600 min Summer	9.634	402			
720 min Summer	8.392	470			
960 min Summer	6.848	608			
1440 min Summer	5.141	876			
2160 min Summer	3.860	1264			
2880 min Summer	3.149	1648			
4320 min Summer	2.213	2384			
5760 min Summer	1.723	3168			
7200 min Summer	1.419	3760			
8640 min Summer	1.211	4408			
10080 min Summer	1.059	5136			
©1982-2010 Micro Drainage Ltd					

EWE Associates Ltd		Page 2			
Windy Ridge Barn Thealby Lane Winterton DN15 9TG					
Date 07/03/2018 17:45 File 100yr+CC30% tank ...	Designed By Lea Checked By				
Micro Drainage		Source Control W.12.4			
<u>Summary of Results for 100 year Return Period (+30%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	44.099	0.859	2.1	41.2	O K
30 min Winter	44.237	0.997	2.3	47.9	O K
60 min Winter	44.373	1.133	2.4	54.4	O K
120 min Winter	44.485	1.245	2.5	59.5	O K
180 min Winter	44.527	1.287	2.6	60.9	O K
240 min Winter	44.520	1.280	2.6	60.7	O K
360 min Winter	44.493	1.253	2.5	59.8	O K
480 min Winter	44.451	1.211	2.5	58.1	O K
600 min Winter	44.407	1.167	2.5	56.0	O K
720 min Winter	44.362	1.122	2.4	53.8	O K
960 min Winter	44.293	1.053	2.3	50.5	O K
1440 min Winter	44.160	0.920	2.2	44.1	O K
2160 min Winter	43.989	0.749	2.0	36.0	O K
2880 min Winter	43.855	0.615	1.8	29.5	O K
4320 min Winter	43.598	0.358	1.4	17.2	O K
5760 min Winter	43.339	0.099	1.3	4.8	O K
7200 min Winter	43.318	0.078	1.1	3.8	O K
8640 min Winter	43.309	0.069	0.9	3.3	O K
10080 min Winter	43.303	0.063	0.8	3.0	O K
Storm Event	Rain (mm/hr)	Time-Peak (mins)			
15 min Winter	157.250	25			
30 min Winter	93.049	39			
60 min Winter	55.059	66			
120 min Winter	32.580	122			
180 min Winter	23.969	176			
240 min Winter	19.278	222			
360 min Winter	14.183	280			
480 min Winter	11.407	358			
600 min Winter	9.634	434			
720 min Winter	8.392	508			
960 min Winter	6.848	654			
1440 min Winter	5.141	934			
2160 min Winter	3.860	1340			
2880 min Winter	3.149	1732			
4320 min Winter	2.213	2512			
5760 min Winter	1.723	2992			
7200 min Winter	1.419	3672			
8640 min Winter	1.211	4400			
10080 min Winter	1.059	5144			
©1982-2010 Micro Drainage Ltd					

EWE Associates Ltd		Page 3			
Windy Ridge Barn Thealby Lane Winterton DN15 9TG					
Date 07/03/2018 17:45 File 100yr+CC30% tank ...	Designed By Lea Checked By				
Micro Drainage		Source Control W.12.4			
<u>Rainfall Details</u>					
Rainfall Model	FEH				
Return Period (years)	100				
Site Location	440700 403250 SE 40700 03250				
C (1km)	-0.025				
D1 (1km)	0.358				
D2 (1km)	0.408				
D3 (1km)	0.245				
E (1km)	0.300				
F (1km)	2.366				
Summer Storms	Yes				
Winter Storms	Yes				
Cv (Summer)	0.750				
Cv (Winter)	0.840				
Shortest Storm (mins)	15				
Longest Storm (mins)	10080				
Climate Change %	+30				
<u>Time / Area Diagram</u>					
Total Area (ha) 0.131					
Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.044	4-8	0.044	8-12	0.044
©1982-2010 Micro Drainage Ltd					

EWE Associates Ltd		Page 4					
Windy Ridge Barn Thealby Lane Winterton DN15 9TG							
Date 07/03/2018 17:45 File 100yr+CC30% tank ...	Designed By Lea Checked By						
Micro Drainage		Source Control W.12.4					
<u>Model Details</u>							
Storage is Online Cover Level (m) 45.240							
<u>Tank or Pond Structure</u>							
Invert Level (m) 43.240							
Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	48.0	1.400	0.0	2.800	0.0	4.200	0.0
0.200	48.0	1.600	0.0	3.000	0.0	4.400	0.0
0.400	48.0	1.800	0.0	3.200	0.0	4.600	0.0
0.600	48.0	2.000	0.0	3.400	0.0	4.800	0.0
0.800	48.0	2.200	0.0	3.600	0.0	5.000	0.0
1.000	48.0	2.400	0.0	3.800	0.0		
1.200	48.0	2.600	0.0	4.000	0.0		
<u>Hydro-Brake® Outflow Control</u>							
Design Head (m)	1.800	Hydro-Brake® Type	Md4	Invert Level (m)	43.240		
Design Flow (l/s)	3.0	Diameter (mm)	54				
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.3	1.200	2.5	3.000	3.9	7.000	6.0
0.200	1.1	1.400	2.7	3.500	4.3	7.500	6.2
0.300	1.3	1.600	2.9	4.000	4.6	8.000	6.4
0.400	1.4	1.800	3.1	4.500	4.8	8.500	6.6
0.500	1.6	2.000	3.2	5.000	5.1	9.000	6.8
0.600	1.8	2.200	3.4	5.500	5.3	9.500	7.0
0.800	2.0	2.400	3.5	6.000	5.6		
1.000	2.3	2.600	3.7	6.500	5.8		
©1982-2010 Micro Drainage Ltd							

