

Harworth Estates

Flood Risk Assessment

North Gawber

880442 R1 (03)

MARCH 2014

RSK

RSK GENERAL NOTES

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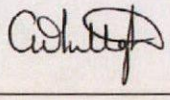
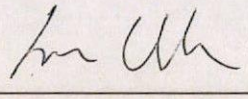
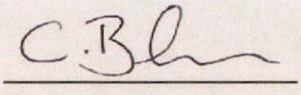
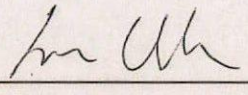
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1 INTRODUCTION

RSK Land and Development Engineering Ltd were commissioned by Harworth Estates to carry out a flood risk assessment (FRA) to accompany a planning application for a residential development on land located at Mappelwell, Yorkshire.

The assessment has been prepared in accordance with National Planning Policy Framework (NPPF) (Ref. 1) and its accompanying guidance document (Ref. 2), the Interim Code of Practice for Sustainable Drainage (Ref. 3) and BS 8533-2011 Assessing and managing flood risk in development Code of practice (Ref. 4), with site-specific advice from the Environment Agency and the client.

The NPPF sets out the criteria for development and flood risk by stating that inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere. The key definitions are:

- "areas at risk of flooding" means land within Flood Zones 2 and 3; or land within Flood Zone 1 which has critical drainage problems and which has been notified to the local planning authority by the Environment Agency
- "flood risk" means risk from all sources of flooding - including from rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

For the proposed development, an FRA is required because the works to be undertaken extend to over 1ha, and in accordance with NPPF a flood risk and drainage assessment is required.

2 CONTEXT AND SCOPE OF WORK

A key element of project development is to prepare a Flood Risk Assessment to establish the risk associated with the proposed development and to propose suitable mitigation, if required to reduce the risk to a more acceptable level.

The scope of work relating to a flood risk assessment is based on the guidance provided in Section 10 of NPPF (Ref. 1) and its accompanying guidance (Ref. 2).

A site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall. The scope of this assessment therefore comprises of the following elements:

- to obtain information on the hydrology and hydrological regime in and around the site
- to obtain the views of the Environment Agency including scope, location and impacts
- to determine the extent of new flooding provision and the influence on the site;
- to review site surface water drainage based on the proposed layout. To determine the extent of infrastructure required
- to review architect plans and planning information and other studies to determine the existing site conditions
- to assess the impact on the site from climate change effects and anticipated increases in rainfall over a 100 year period for residential uses
- preparation of a report including calculations and summaries of the source information and elements reviewed.

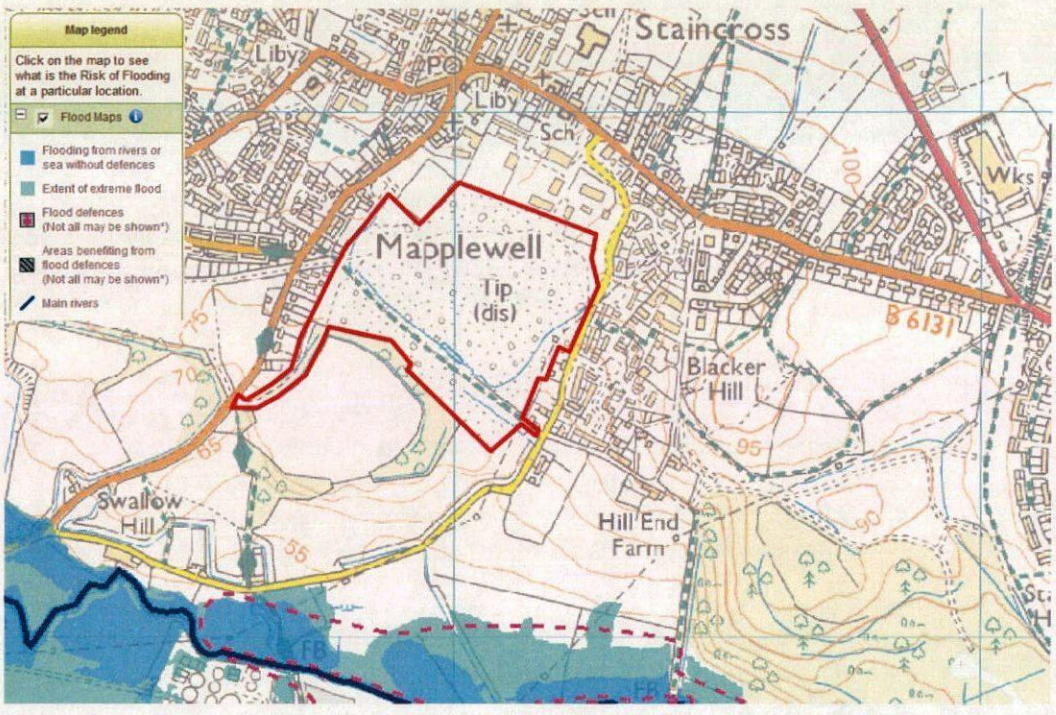


Figure 1: Environment Agency flood zone map (March 2014)

3 SITE DESCRIPTION

3.1 Site location

The site is located in Mapplewell, approximately 4km north-west of Barnsley. The approximate centre of the site is located at Ordnance Survey National Grid reference 433,050E 409,650N. The site occupies an area of approximately 16 hectares and comprises three main terraces, starting at an elevation of approximately 95m above Ordnance Datum (AOD) in the north of the site, falling to 70m AOD in the southern parts of the site.

3.2 Site description

The site, comprising mainly colliery spoil, is used as informal recreation ground by the public. Some areas of the site are covered by trees, and grass-cover is sparse. There is a drainage ditch running north-west to south-east in the southern part of the site. Ordnance Survey mapping indicates that a public right of way runs alongside this drainage ditch.

To the north of the site there are modern warehouse and factory buildings. A car body repair garage is using a small hardstanding area of approximately 200m^2 in the north-east corner of the site to store cars. The site boundary passes along the edge of North Gawber Football Club's pitch in the north-west corner.

Carr Green Lane runs along the eastern boundary of the site, off which there are residential properties and some industrial buildings. Spark Lane borders the site to the west, on which there are also residential properties.

A birch woodland defines the southern boundary, beyond which the reclaimed colliery tip is used as grazing land.

The site is bounded to the:

- north by the existing Mapplewell Business Park, with a school beyond
- east by Carr Green Lane, a residential area
- south by open fields and a recreational area, further south (approximately 650m) is the River Dearne, a Main River
- west by residential properties off Spark Lane.

3.3 Proposed site use

It is understood that the site is being considered for redevelopment for residential properties, largely on the terraced parts of the site. It is understood that outline planning permission was granted for this in January 2013.

3.4 Geology and hydrogeology

Published records indicate that there are no superficial deposits across the site, although thin glacial deposits have been encountered on site during previous investigations. The bedrock is recorded as the Pennine Middle Coal Measures Formation, comprising mudstone, siltstone and sandstone with coal seams. The Kent's Thin coal seam outcrops across the northern part of the site, striking from north-west to south-east. This is underlain by the Kent's Thick seam (also known as the Mapplewell seam), which outcrops across the centre of the site. This is underlain by the Barnsley Rider coal seam, which outcrops south of the site boundary. The coal seams dip to the northeast. A seam, denoted as 'M' on the six inch geological map, which presumably refers to the Mapplewell Coal (the Kent's Thick) is shown to dip at a ratio of 1 in 21, or approximately 3 degrees.

The bedrock units are classified as a secondary A aquifer. There are no groundwater source protection zones on or around the site.

3.5 Site hydrology

A minor watercourse flows in a southerly direction along the western boundary of the site and crosses the site in a west to east direction towards the southern boundary of the site, as shown on the existing site survey, **Appendix B.** This watercourse is culverted for a short section to the south east of the site before issuing into an open ditch flowing in a southerly direction away from the site. It is likely that this watercourse has been modified and diverted as the works on the site progressed. According to the site survey this ditch varies in geometry along its length.

A small ponded area is located to the south east of the site, as shown on the existing site survey, **Appendix B.** It is believed that this feature lies on the course of the watercourse prior to its current route.

The closest Main River to the site is the River Dearne, 500m to the south of the site.

3.5.1 Surface water quality

A watercourse runs in a south-easterly direction in the southern part of the site. Work has been carried out in the past year to extend the culverted part of the watercourse to prevent southern parts of the site from being waterlogged. This appears to have been effective.

The River Dearne runs eastwards, approximately 500m south of the site. The part of the river closest to the site is currently classified by the Environment Agency as having an ecological quality of 'moderate potential', and 'good' chemical quality.

3.5.2 Discharge consents

Until 16 October 2013 there were 37 discharge consents issued within 1000m of the site. Of those 37, 4 were located within 100m of the site. These were for sewage discharges; final/treated sewage effluent; site drainage of trade effluent; or surface water effluent, mostly during storm events. None of the recorded discharges is considered likely to have had any significant adverse effect on the site.

3.5.3 Water abstractions

There is an active groundwater abstraction point for commercial use approximately 1300m west of the site. In view of its distance from the site, and the likelihood that groundwater flow beneath the site is towards the River Dearne, to the south, it is unlikely that the site will have any adverse effect on this abstraction.

4 POLICY AND LEGISLATION

4.1 National

Table 4.1: National legislation and policy context

Policy/Legislation name	Key Provisions
National Planning Policy Framework	The aims of planning policy on development and flood risk are to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall.
Water Resources Act 1991	*Section 24* - The Environment Agency (EA) is empowered under this Act to maintain and improve the quality of 'controlled' waters *Section 85* - It is an offence to cause or knowingly permit pollution of controlled waters *Section 88* - Discharge consents are required for discharges to controlled waters
Flood and Water Management Act 2010	This is new legislation formally ratified in July 2010. The aim is to implement the findings of the 2007 Pitt Review and co-ordinate control of drainage and flood issues. There are a number of increased responsibilities within the act that affect adoption of Sustainable Drainage Systems (SuDS) features and the role of the EA to expand on the mapping data they provide. The implementation of SuDS features has many beneficial impacts on the treatment of surface water during remediation works.
Water Framework Directive (2000)	The Water Framework Directive (WFD) came in to force in 2000 and requires all inland and coastal waters to reach 'good' chemical and biological status by 2015. Flood risk management is unlikely to have a significant impact on chemical water quality except where maintenance works disturb sediment (such as de-silting) or where pollutants are mobilised from contaminated land by floodwaters. The main impact of the WFD on flood risk management, both now and in the future, relates to the ecological quality of water bodies. Channel works, such as straightening and deepening, or flood risk management schemes that modify geomorphological processes can change river morphology. The WFD aims to protect conservation sites identified by the EC Habitats Directive and Birds Directive that have water-related features, by designating them as 'protected sites'.

4.2 Local policy

Local policy ensures that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding and making development safe without increasing flood risk elsewhere and where possible, reducing flood risk.

Table 4.2: Local legislation and policy context

Policy/Legislation name	Key Provisions
Core Strategy CSP 1 Climate Change	Development will be expected to: • Reduce and mitigate the impact of growth on the environment and carbon emissions • Ensure existing and new communities are resilient to climate change • Harness the opportunities that growth, and its associated energy demands, brings to increase the efficient use of resources through sustainable construction techniques and the use of renewable energy We will take action to adapt to climate change by: • Giving preference to development of previously developed land in sustainable locations • Locating and designing development to reduce the risk of flooding • Promoting the use of sustainable drainage systems • Encouraging environments that promote biodiversity and improve the Borough's green infrastructure
Core Strategy CSP 4 Flood Risk	The extent and impact of flooding will be reduced by: not permitting new development where it would be at an unacceptable risk of flooding or would give rise to flooding elsewhere requiring developers with proposals in Flood Zones 2 and 3 to provide evidence of the sequential test requiring site-specific Flood Risk Assessments (FRAs) for proposals over 1 hectare in Flood Zone 1 and all development proposals in Flood Zones 2 and 3 requiring proposals over 1000 m2 floor space or 0.4 hectares in Flood Zone 1 to demonstrate how the proposal will make a positive contribution to reducing or managing flood risk requiring all development proposals on Brownfield sites to reduce surface water run-off by at least 30% and development on Greenfield sites to maintain or reduce existing run-off rates requiring development proposals to use Sustainable Urban Drainage Systems (SuDS) in accordance with policy CSP 3 not culverting or building over watercourses and encouraging the removal of existing culverts wherever practicable using flood resilient design in areas of high flood risk.
Barnsley Council Core Strategy (September 2011)	The Core Strategy for Barnsley is set out by the local Council. The Core Strategy is a fundamental element of Barnsley's Local Development Framework. It considers the key elements of the planning and transportation framework for Barnsley, and the approach to its long term

Policy/Legislation name	Key Provisions
	physical development to achieve the Councils vision of what sort of place Barnsley wants to become. Its purpose is to forms part of the statutory development plan. This sets out the council's vision for the future development of Barnsley over the next 15 - 20 years and is the principal, overarching document in the LDF.

5 SOURCES OF FLOOD RISK

In accordance with NPPF (Ref. 1) and advice from the Environment Agency, a prediction of the flood sources and levels is required along with the effects of climate change from the present for the design life of the development (in this case assumed to be 100 years). To consider these effects of climate change, NPPF Technical Guidance Table 5 recommends consideration of a 30% increase in rainfall intensity and 20% increase in peak river flows over this timeframe.

The flood risk elements that need to be considered for any site are defined in BS 8533 as the "Forms of Flooding" and are listed as:

- flooding from rivers (fluvial flood risk)
- flooding from the sea (tidal flood risk)
- flooding from the land
- flooding from groundwater
- flooding from sewers (sewer and drain exceedance, pumping station failure etc)
- flooding from reservoirs, canals and other artificial structures.

5.1 Flooding from rivers (fluvial flood risk)

The Environment Agency has produced Flood Zone maps for much of England and Wales. The current displayed map is reproduced as **Figure 1.** The latest Flood Zone map shows the site to be located in Flood Zone 1.

Therefore the risk of flooding to the site from fluvial sources is low.

The minor watercourse flowing near the southern boundary is to be diverted. As part of the diversion process the watercourse will be designed to convey design flows and ensure that the site is not at risk of flooding from this source.

5.2 Flooding from the sea (tidal flood risk)

On the coast storm surges and high tides can threaten low lying coastal areas, and can sometimes be large and rapid enough to overtop defence works, causing significantly more damage than river flooding.

Tidal flooding is not considered a risk to the site, due to its inland location.

5.3 Flooding from the land (pluvial flood risk)

If intense rain is unable to soak into the ground or be carried through man made drainage systems, for a variety of reasons, it can run off over the surface causing localised floods before reaching a river or other watercourse.

Generally, where there is impermeable surfacing or where the ground infiltration capacity is exceeded, surface water runoff will occur. Excess surface water flows from

the site are believed to drain naturally to the local water features, either by overland flow or through infiltration.

The proposed development will have a surface water drainage system designed for the development and will include the design flood events within the system. This means the previous pluvial flooding water (the 1 in 100 year rainstorm event) will be included within the drainage systems capacity and therefore the proposed drainage system will reduce the impact of pluvial flooding for the site.

Rainfall falling on the site issues to the water course crossing the site. The proposed development of the site has the potential to increase the surface runoff generated from the site. Attempts should be made to mitigate against the increased velocity and volume of runoff from the site.

The risk to the site from off-site surface runoff stems mainly from any surrounding hardstanding, which is predominantly located to the north of the site in the form of roads and other impermeable surfaces. It is considered, however, that the volumes of runoff that these areas would generate would be relatively insignificant and would be controlled by existing drainage systems.

The Environment Agency has produced a national assessment of surface water flood risk in the form of two national mapping datasets. The first generation national mapping, Areas Susceptible to Surface Water Flooding (AStSWF), contains three susceptibility bandings for a rainfall event with a 1 in 200 chance of occurring. The national methodology has since been updated to produce the Flood Map for Surface Water (FMfSW), a revised model containing two flood events (1 in 30 annual chance and 1 in 200 annual chance) and two depth bandings (greater than 0.1m and greater than 0.3m).

The latest maps for the site does not highlight any areas at significant risk of flooding from this source, this is due to the steep topography of the site.

Flood risk from this source is therefore considered to be **low**.

5.4 Flooding from groundwater

Groundwater flooding tends to occur after much longer periods of sustained high rainfall. Higher rainfall means more water will infiltrate into the ground and cause the water table to rise above normal levels. Groundwater tends to flow from areas where the ground level is high, to areas where the ground level is low. In low-lying areas the water table is usually at shallower depths anyway, but during very wet periods, with all the additional groundwater flowing towards these areas, the water table can rise up to the surface causing groundwater flooding.

Groundwater flooding is most likely to occur in low-lying areas underlain by permeable rocks (aquifers). These may be extensive, regional aquifers, such as chalk or sandstone, or may be localised sands or river gravels in valley bottoms underlain by less permeable rocks. Groundwater flooding takes longer to dissipate because groundwater moves much more slowly than surface water and will take time to flow away underground.

Given the steep topography of the site, it is reasonable to suggest that the risk to the site, of flooding from groundwater is considered to be **low**.

5.5 Flooding from sewers

Flooding from artificial drainage systems occurs when flow entering a system, such as an urban storm water drainage system, exceeds its conveyance capacity, the system becomes blocked or it cannot discharge due to a high water level in the receiving watercourse. A sewer flood is often caused by surface water drains discharging into the combined sewer systems; sewer capacity is exceeded in large rainfall events causing the backing up of floodwaters within properties or discharging through manholes. Most adopted surface water drainage networks are designed to the criteria set out in Sewers for Adoption 6th edition (Ref. 5). One of the design parameters is that sewer systems be designed such that no flooding of any part of the site occurs in a 1 in 30 year rainfall event. By definition a 1 in 100 year event would exceed the capacity of the surrounding sewer network as well as any proposed drainage.

Sewer Crossing

There are 375mm, 450mm, 525mm and 825mm diameter public combined sewers recorded crossing the site. No buildings are to be erected within 3 metres of the 375/400mm diameter public sewers, 5 metres of the 825mm diameter public sewer and no buildings within 6 metres of the 525mm diameter public sewer.

A copy of the sewer records is located within **Appendix C**.

Any new infrastructure will be designed to the latest standards and exceedance considered within development.

Therefore as long as any new sewer system is designed in line with best practice the risk of sewer flooding is considered to be **low** for the site.

5.6 Flooding from reservoirs, canals and other artificial structures

The Environment Agency has recently published flood risk mapping as a result of potential failure of reservoirs and artificial structures.

The Environment Agency reservoir flood map indicates that the site is not at a risk of flooding from this source.

5.7 Historic flooding

Historically there had been a few small scale flooding events within the Barnsley Metropolitan Borough Council area, usually these affected the Darton village which is known to be the first community to be affected by high water levels in the River Dearne and acts as an informal 'barometer' for flooding across the borough. This area is known to have flooded during the 1950's, 1960's 1970's and also in the autumn of 2000. The impact of these events was relatively small scale. A handful of properties in

the upper Don catchment were flooded during flooding events in the 1950's and 1960's.

Apart from fluvial and pluvial flooding events during 2007-8, other flooding events were documented over the past few decades, however very few records were kept and much of the information about these were anecdotal reports from those affected at the time.

Barnsley was affected by heavy and sustained rainfall which continued for a 10-day period leading up to the first flood which started early in the morning of Friday 15th June 2007. In total there were 352 properties flooded and many of these neighbourhoods which had not experienced flooding before and were poorly prepared for responding to flooding.

During all the document flood events recorded, the site was not reported as being affected by flooding from any source.

5.8 Climate change

Climate change can affect local flood risk in several ways. Impacts will depend on local conditions and vulnerability.

In the Humber River Basin District, wetter winters and more rain falling in wet spells may increase river flooding for rivers and tributaries. More intense rainfall causes more surface runoff, increasing localised flooding and erosion. In turn, this may increase pressure on drains, sewers and water quality. Storm intensity in summer could increase even in drier summers. Rising sea or river levels may increase local flood risk inland or away from major rivers because of interactions with drains, sewers and smaller watercourses.

In accordance with the requirements of the NPPF the latest climate change predictions will be considered within this assessment.

Latest figures for the Humber River Basin District (Ref. 9) show that if emissions follow a medium future scenario, UKCP09 projected changes by the 2050s relative to the recent past are:

- winter precipitation increases of around 14% (very likely to be between 4% and 28%)
- precipitation on the wettest day in winter up by around 11% (very unlikely to be more than 25%)
- relative sea levels are very likely to be up between 6cm and 36cm from 1990 levels (not including extra potential rises from polar ice sheet loss)
- peak river flows in a typical catchment likely to increase between 11% and 18%.

Climate change on the site may become significant in the coming years; however these will be taken into account when considering the surface water drainage of the site.

5.9 Watercourse diversion

The existing watercourse crossing the site has been subject to a number of historic diversions during site operation. As a result the geometry of the ditch varies along its length and offers very little in terms of ecological benefit.

It is proposed to divert the ditch along the western boundary towards the existing ponded feature to the south west (thought to be on the historic route of the watercourse) where it will flow in a easterly direction towards the existing outfall from the site. Further works are required to determine the existing flows and to ensure the proposed channel can convey existing flows with no on-site flood risk.

5.10 Flood risk summary

According to the Environment Agency Flood Zone Map the site lies within Flood Zone 1. The site has not experienced any recorded flooding events from fluvial, pluvial, groundwater, sewers or artificial sources.

6 PLANNING CONTEXT

6.1 Application of planning policy

NPPF includes (Section 10) measures specifically dealing with development planning and flood risk using a sequential characterisation of risk based on planning zones and the Environment Agency Flood Map. The main study requirement is to identify the flood zones and vulnerability classification relevant to the proposed development, based on an assessment of current and future conditions.

6.2 Land use vulnerability

From the NPPF Technical Guidance, a "Less Vulnerable" land use could be appropriate to Flood Zone 3a (High Probability of flooding at higher than 1 in 100 annual probability) with the "More Vulnerable" use only permitted if the exception test is passed. For a "More Vulnerable" class, development on this site could be appropriate within Flood Zone 2 (Medium Probability of flooding at less than 1 in 100 but higher than 1 in 1,000 annual probability).

In applying the sequential test, reference is made to the following table (reproduced from Table 3 contained within NPPF);

Table 7.1 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	Appropriate	Appropriate	Appropriate	Appropriate	Appropriate
	Zone 2	Appropriate	Appropriate	Exception Test Required	Appropriate	Appropriate
	Zone 3a	Exception Test Required	Appropriate	Should not be permitted	Exception Test Required	Appropriate
	Zone 3b functional floodplain	Exception Test Required	Appropriate	Should not be permitted	Should not be permitted	Should not be permitted

6.3 Sequential test

The Sequential Test is required to assess flood risk and NPPF Technical Guidance recommends that the test be applied at all stages of the planning process to direct new development to areas with the lowest probability of flooding (Flood Zone 1).

According to NPPF, if there is no reasonably available site in Flood Zone 1, the flood vulnerability of the proposed development (see NPPF Technical Guidance Table 2)

can be taken into account in locating development in Flood Zone 2 and then Flood Zone 3. Within each Flood Zone new development should be directed to sites at the lowest probability of flooding from all sources.

The proposed development is classified as 'More Vulnerable' and therefore is permitted within Flood Zone 1.

6.4 Exception test

Due to the location of the development within Flood Zone 1, the exception test is not required.

7 SURFACE WATER DRAINAGE ASSESSMENT

7.1 Pre-development situation

The majority of the site comprises of land which can be classified as brownfield due to the previous use, however for the purposed of this report, it is assume that the run-off generated from the site does not originate from significant areas of hardstanding, and as such the developed rate of run-off should be no greater than the existing rate of run-off for the same event.

A range of annual flow rate probabilities up to and including the one per cent annual exceedance probability (1 in 100 years) event, including an appropriate allowance for climate change has been used for the site.

It is believed that the current site does not have a formal surface water management scheme, however precipitation that falls on the site will issue to the onsite watercourse.

Therefore, it is essential that the volume of runoff generated as a result of any future development should either remain the same as the existing discharge rate or be reduced. Preferably the discharge rate should be restricted to near the pre-development rate if possible.

7.1.1 Existing site

In terms of estimating the potential runoff from the permeable area of the site, the pro-rata IOH method (Ref. 9) has been used based on a greenfield site. The results are highlighted in Table 7.1 (**Appendix D**) details the WinDes Calculations sheet).

Table 7.1: IoH surface water runoff calculations

Return Period	Peak flow l/s/ha
QBAR	5.5
1 in 30 year peak flow	9.7
1 in 100 year peak flow	11.5

It should be noted that the proposed National SuDS Standards makes it clear that off-site impacts should not increase flood risk elsewhere but considers previously developed land.

7.2 Off site discharge options

An order of preference exists for drainage receptors. Infiltration drainage should be used where possible. Where this is not possible, or does not provide sufficient capacity, attenuated discharge to watercourses should be sought. Only where neither of these two options are available should discharge to sewers be considered.

7.3 Infiltration

The effectiveness of infiltration is completely dependent on the physical conditions at the site. Potential obstacles include:

Local variations in permeability preventing infiltration – Given the geology of the site and the surrounding area, it is unlikely that infiltration will be a feasible option for the site. Further infiltration testing is required to establish if infiltration is a possible option for the site.

Shallow groundwater table - For infiltration drainage devices Building Regulation approved document H2 states that these, "should not be built in ground where the water table reaches the bottom of the device at any time of the year".

Source Protection Zones - As discussed in Section 3.5 the site is not located in a source protection zone.

A ground investigation has been carried out on the site; this confirms that the geology (once remediated) surrounding the site is not suitable for discharging surface water to ground or infiltration.

7.4 Discharge to watercourse

The most suitable option to discharge surface water from the developed site is to the minor watercourse to the south. This watercourse received the runoff from the site at present, therefore by discharging the post development surface water runoff to this ditch the generally hydrology of the catchment is not adversely impacted and flood risk downstream will not be increased. As mentioned in Section 6.2, this watercourse will require diverting and regarding. Surface water discharge will be limited to the predevelopment greenfield rates as stipulated in Table 7.1 with on site attenuation being provided where required.

7.5 Discharge to sewers

Under the terms of Section H of the Building regulations 2000, the disposal of surface water by means of soakaways should be considered as the primary method. If this is not suitable, discharge to the public surface water sewers shall be based on a greenfield run off rate of 5 l/sec/ha and include an extra 30% storage to allow for climate change.

7.6 Post-development situation

Infiltration techniques are thought not to be suitable, due to the current ground conditions.

The proposed development will increase the impermeable area. As a result the post development run-off rates will be more than that of the pre-development.

Surface water runoff from the developed site will need to be restricted to the pre-development rates as outlined in Table 7.1.

Any additional runoff created will need to be attenuated onsite in a suitably sized and designed attenuation features.

Further details on surface water drainage for the site will be provided at the detailed design stage.

8 CONCLUSIONS AND RECOMMENDATIONS

This Flood Risk Assessment has been prepared in support of the proposed residential development at North Gawber.

The entire site is located within Flood Zone 1 according to the latest Environment Agency flood zone maps, indicating that the site is at low risk from fluvial sources of flooding.

Data obtained from the SFRA and PFRA places the site at low risk of flooding from other sources. In accordance with the NPPF and local policy, this Flood Risk Assessment has considered the impact on the surface water regime in the area should development occur.

Data obtained from other data sources also places the site at low risk of flooding from other sources. In accordance with the NPPF and local policy, this FRA has considered the impact on the surface water regime in the area should development occur.

Suitable mitigation can be incorporated to ensure that flood risk to the proposed properties remains low and meets the requirements of the NPPF.

Surface water runoff from the site is believed to currently issue to the watercourse crossing the site. It is proposed to discharge surface water from the proposed development into the diverted watercourse to the south of the site.

The proposed diversion of the watercourse crossing the site will require further investigation including an assessment of existing flows from the upstream catchment and details on the proposed watercourse to ensure flows can be conveyed with no increase in flood risk.

Based on the information available the **flood risk to the proposed development is low** and development should not be precluded on flood risk grounds.

9 REFERENCES

1. Communities and Local Government "National Planning Policy Framework" NPPF, March 2012.
2. Communities and Local Government "Technical Guidance to the National Planning Policy Framework", March 2012.
3. DEFRA "Interim Code of Practice for Sustainable Drainage Systems" National SUDS Working Group, July 2004.
4. BS 8533-2011 "Assessing and managing flood risk in development Code of practice", November 2011.
5. WRC "Sewers for Adoption 6th Edition", 2012.
6. River Basin Management Plan, Humber River Basin District, December 2009.

APPENDIX A
RSK SERVICE CONSTRAINTS

1. This report is carried out in connection with the report (together the "Services") were compiled and carried out by RSK LDE Ltd (RSK) for Harworth Estates (the "client") in accordance with the terms of a contract between RSK and the "client". The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable Civil Engineer at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.

2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.

3. Unless otherwise agreed the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.

4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date hereof, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.

5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.

6. The observations and conclusions described in this report are based solely upon the Services, which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.

7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walk-over survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.

8. The phase II or intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and RSK] [based on an understanding of the available operational and historical information,] and it should not be inferred that other chemical species are not present.

9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site.

APPENDIX B
TOPOGRAPHICAL SURVEY

NOTES

ALL LEVELS ARE RELATED TO ORDNANCE DATUM (NEWLYN)

COORDINATE GRID IS BASED ON OSGB36 CO-ORDINATE SYSTEM (GPS)

Station	Easting	Northing	Level
MP01	433277.587	409845.675	83.449
MP02	433284.468	409817.186	84.011
MP03	433286.465	409811.585	85.078
MP04	433302.575	409803.388	85.870
MP05	433320.081	409800.398	84.181
MP06	433295.442	409833.859	83.319
MP07	433277.832	409854.470	83.112
MP08	433317.832	409814.470	83.112
MP10	433281.939	409810.040	84.131
MP11	433317.594	409777.938	85.880
MP12	433151.795	409782.486	86.825
MP13	433151.795	409782.486	86.825
MP14	433142.211	409820.240	84.313
MP16	433111.889	409779.294	82.257
MP21	433082.511	409814.446	72.203
MP22	433082.511	409814.446	72.203
MP23	433082.125	409813.814	72.328
MP24	433047.913	409849.882	72.203
MP25	433014.587	409811.891	73.110
MP26	433017.844	409814.836	73.110
MP28	433117.588	409814.836	84.580
MP30	433111.194	409827.392	69.561
MP40	433160.515	409847.488	74.563
MP41	433162.810	409810.332	73.109
MP42	433162.810	409810.332	73.109
MP51	432960.157	409868.925	88.954
MP52	432966.387	409858.317	88.858
MP53	432918.925	409871.306	84.810
MP54	432830.556	409799.901	85.568
MP55	432779.331	409770.801	85.568
MP56	432776.331	409770.558	85.358

KEY

LEVELS
- OSM Ordnance Bench Mark
- CL Cover Level
- FFL Finished Floor Level
- FRL Flat Roof Level
- RL Roof Level
- SIL Structural Sill Level
- WL Water Level

BUILDINGS - HEIGHTS ABOUT FLOOR
- C Ceiling
- FF Floor Tread
- GU Gutter Fixing
- MID Window C/S
- WH Window Head

INSPECTION CHAMBERS
- BC British Gas
- CA Cable Access
- CATV Cable Television
- CIC Clarke Inspection Chamber
- HYD Fire Hydrant
- IC Inspection Inspection Chamber
- IL Inspection Cover
- GIC Gas Inspection Chamber
- GV Gate Valve
- C Gully
- IC Inspection Chamber
- JB London Box
- KI Kerb Inlet
- NG Notting Grid
- SH Stop Valve
- SWCP Surface Water Catch Pit
- SWIC Surface Water Inspection Chamber
- ST Telephone Inspection Chamber
- U Unidentified
- VCS Chutes to Pl
- WIC Water Inspection Chamber
- WM Water Meter
- WSV Water Stop Valve

PIPES
- GP Gas Pipe
- WMP Main Water Pipe
- SWP Surface Water Pipe
- VP Vent Pipe
- PVP Petrol Vent Pipes

POSTS
- CPO Concrete Post
- HYD Fire Hydrant Marker
- FPO Fence Post
- GM Gas Marker Post
- LP Lamp Post
- LTG Lampolier Post
- MK Marker Post
- MPO Metal Post
- RP Reflector Post
- TPO Timber Post

STREET FURNITURE
- BBS Bobbie Beacon
- BO Bollard
- BS Bus Stop
- CB Cattle Grid
- EC Electric Cupboard
- EP Electric Pole
- FB Flower Border
- FL Flood Light
- LB Light Bollard
- LBO Letter Box
- LP Lamp Post
- MP Meter Point
- PO Parking Meter
- RS Road Sign
- SK Tilar
- STN Survey Station
- TL Traffic Light
- TCB Traffic Light Control Box
- TP Telephone Pole

FENCES
- BW Barbed Wire
- CVE Chain Link
- CH Chestnut
- CPA Chestnut Paling
- CPF Conc. Post & Wire
- SAT Knott (Lattice)
- IRN Iron Railings
- WE Yew and Rail
- WW Wattle-ing Wall

LEGEND

- SPOT LEVEL
- SURVEY STATION
- WATER FEATURE, DITCH ETC
- SAPLING
- BUSHES/SHRUBS
- HEDGEBANK OR UNDERGROWTH
- TREES (SPREAD TO SCALE)
- BUILDING
- CONTOUR
- BOREHOLE/TEST HOLE
- TRIAL PIT
- RETAINING WALL
- BUILDING/WALLS
- GATE
- STILE
- KISSING GATE
- BANKING
- ROCKFACE
- OSBM VALUE ORDNANCE SURVEY BENCH MARK
- TBM VALUE TEMPORARY BENCH MARK/BRITISH DATUM

REVISIONS

CLIENT

Harworth Estates
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SITE

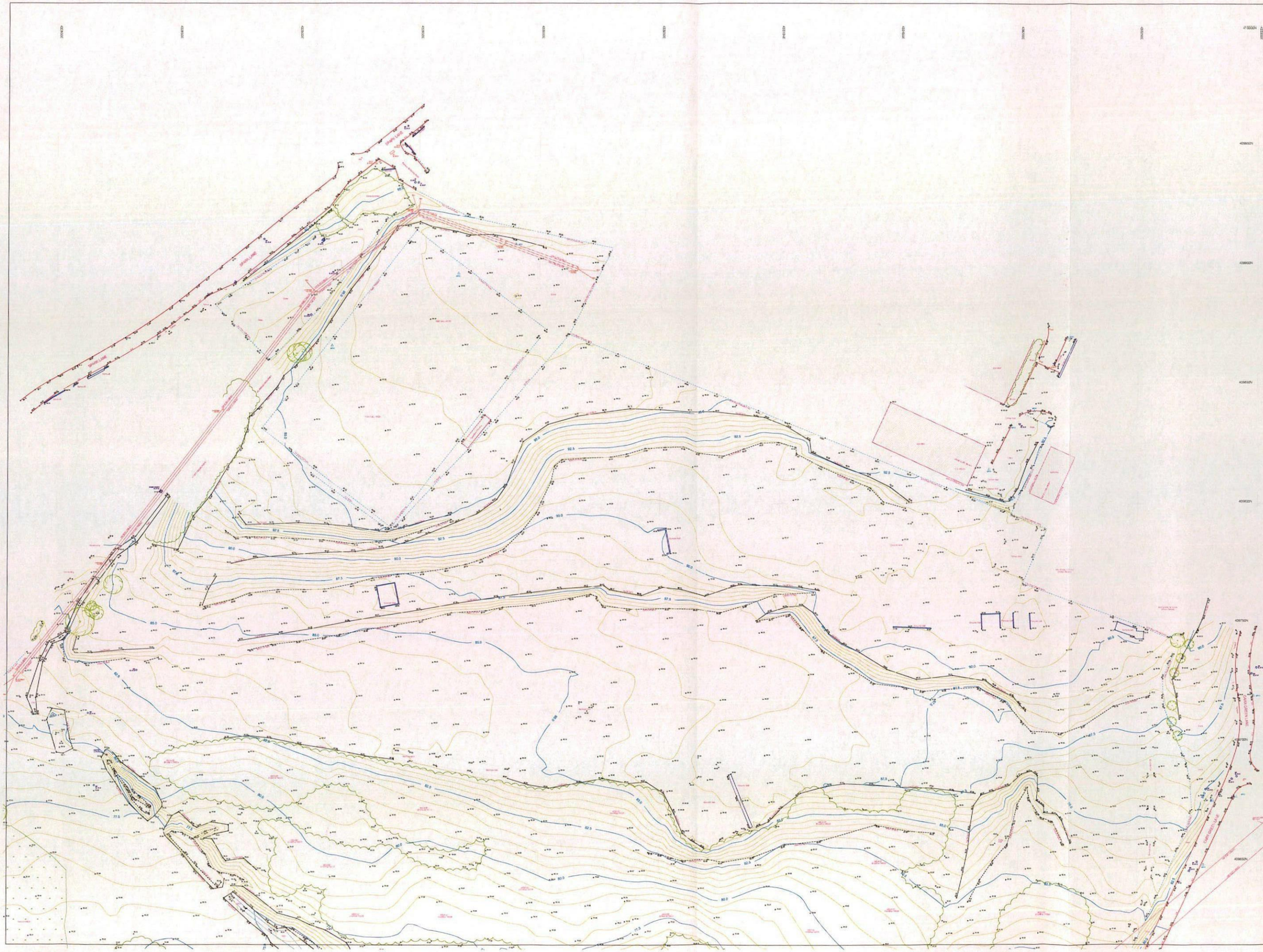
FORMER Nd GARIBER COLLIERY
MAPPLEWELL
BARNSLEY.

DRAWING: TOPOGRAPHICAL SURVEY

DRAWING NUMBER	SURVEYED BY	DATE
DW03-TSY	CP	APR 2007
SHEET 1 OF 3	DRAWN BY	SCALE
REVISION No.	CP	1:500

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NOTES

ALL LEVELS ARE RELATED TO OSBM VALUE OF +206.748(M) (OPS)

COORDINATE GRID IS BASED ON OSGB36 OS-ATOM(N) 'S' SYSTEM (OPS)

Station	Eastings	Northings	Level
MP01	433317.527	409848.472	87.466
MP02	433361.576	409677.190	84.418
MP03	433368.488	409718.530	87.015
MP04	433653.376	409618.393	85.879
MP05	433744.441	409588.557	85.319
MP06	433709.441	409508.557	85.319
MP07	433195.880	409502.952	85.460
MP08	433187.859	409502.952	85.115
MP09	433291.556	409670.045	84.151
MP10	433311.556	409670.045	84.151
MP11	433111.768	409362.488	69.825
MP12	433157.668	409320.115	69.771
MP13	433140.211	409301.042	84.513
MP14	433111.556	409279.304	82.291
MP15	433111.556	409279.304	82.291
MP22	432979.176	409403.874	72.373
MP23	433082.136	409495.954	72.928
MP24	433121.556	409511.304	73.015
MP25	433261.000	409471.527	72.915
MP26	433304.539	409470.580	73.000
MP28	433117.998	409410.309	68.980
MP30	433111.194	409407.360	68.561
MP31	433111.194	409407.360	68.561
MP32	433153.515	409514.332	73.109
MP33	433214.561	409668.333	69.543
MP34	433480.117	409668.523	68.564
MP35	433406.087	409668.523	68.564
MP36	433406.087	409781.804	84.438
MP37	433324.038	409708.901	84.560
MP38	433791.094	409717.835	81.109
MP39	433705.576	409719.548	80.954

KEY

LEVELS

OBM	Ordnance Bench Mark
CL	Cover Level
FFL	Finished Floor Level
FRL	Flat Roof Level
IL	Invert Level
MSL	Mean Sea Level
WL	Water Level

BUILDINGS - HEIGHTS ABOVE FLOOR

CEILING	
DH	Door Head
FC	False Ceiling
WC	Window Cill
WH	Window Head

UNDERGROUND SERVICES

AC	Access Cover
CA	Cable Ducting
CATV	Cable Television
CHC	Communications Chamber
FHC	Fire Hydrant
FWH	Foul Water Inspection Chamber
IC	Inspection Cover
GIC	Gas Inspection Chamber
GV	Gas Valve
H	Hydrant
IC	Inspection Chamber
JB	Junction Box
KH	Kerb Inlet
LP	Lamp Post Light
PV	Pump Valve
SWCP	Surface Water Catch Pit
SWMH	Surface Water Inspection Chamber
ST	Telephone Inspection Chamber
TP	Telegraph Pole
UI	Unidentified
WIC	Water Inspection Chamber
WM	Water Meter
WSV	Water Stop Valve

PIPES

GAS	Gas Pipe
RWP	Rain Water Pipe
SVP	Sewer Vent Pipe
VP	Vent Pipe
PVP	Petrol Vent Pipe

POSTS

CPO	Concrete Post
HYD	Fire Hydrant Marker
GP	Gate Marker Post
GM	Gate Marker Post
GPO	Gate Post
LTO	Lamp Post
MK	Marker Post
MP	Mile Post
RP	Reflector Post
TPO	Timber Post

STREET FURNITURE

BB	Bollard Bollard
BS	Bus Stop
BC	Bus Stop
CC	Cattle Crossing
EC	Electric Pole
FH	Fire Hydrant
FL	Flood Light
H	Hay Rack
L	Light Bollard
LBO	Letter Box
LP	Lamp Post
M	Name Plate
PM	Parking Meter
RS	Road Sign
S	Sign
SB	Signal Station
TL	Traffic Light
TCB	Traffic Light Control Box
TP	Telephone Pole

FENCES

BW	Barbed Wire
CB	Close Board
CL	Chain Link
CH	Chestnut Paling
CSO	Conc. Post & Wire
HH	Hedge & Hedge
WI	Iron Railings
WK	Post and Rail
WW	Retaining Wall

LEGEND

- SPOT LEVEL
- SURVEY STATION
- WATER FEATURE, DITCH ETC
- BATTLING
- BURIED SERVICES
- HEDGE/AREA OF UNDERGROWTH
- TREES (SPREAD TO SCALE)
- BUILDING
- CONTOUR
- BOREHOLE/TEST HOLE
- TRIAL PIT
- RETAINING WALL
- BUILDING/WALLS
- GATE
- STILE
- FENCELINE
- TANKING
- ROCKFACE
- OBM VALUE — ORDNANCE SURVEY BENCH MARK
- TBM VALUE — TEMPORARY BENCH MARK(ASSUMED DATUM)

REVISIONS

CLIENT

Harworth Estates
A division of UK COAL PLC

SITE

FORMER MR GANSER COLLIERY
WAPPLEWELL,
BARNSLEY.

DRAWING: TOPOGRAPHICAL SURVEY

DRAWING NUMBER	SURVEYED BY	DATE
09/03/152	CP	APR 2007
SHEET 2 OF 3	DRAWN BY	SCALE
REVISION No.	CP	1:500

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NOTES

ALL LEVELS ARE RELATED TO OSBM VALUE OF +.(OSTN02)(OPS)

COORDINATE GRID IS BASED ON OSGB36 CO-ORDINATE SYSTEM (OPS)

Station	Easting	Northing	Level
MP01	433077.697	409468.918	82.449
MP02	433261.578	409677.199	84.419
MP03	433402.875	409815.182	87.473
MP04	433602.575	409913.585	91.870
MP05	433200.941	409889.399	84.187
MP06	433056.447	409851.403	81.233
MP07	433195.885	409832.902	83.443
MP08	433371.868	409813.117	87.113
MP09	433391.988	409811.048	84.331
MP10	433171.354	409375.638	86.829
MP11	433157.852	409358.178	86.777
MP12	433137.852	409338.178	86.771
MP13	433143.213	409320.240	84.313
MP14	433111.888	409372.334	87.237
MP31	433382.911	409413.445	72.855
MP32	433367.136	409433.445	72.855
MP33	433367.136	409453.864	72.855
MP34	433347.333	409465.858	72.825
MP35	433347.333	409477.858	72.213
MP36	433347.333	409477.858	72.355
MP37	433111.888	409477.858	72.355
MP38	433111.888	409477.337	69.081
MP40	433180.518	409543.488	74.060
MP41	433180.518	409543.488	74.060
MP42	433414.000	409566.233	84.462
MP51	433960.157	409666.533	85.004
MP52	433960.387	409666.387	84.458
MP53	433918.923	409678.308	84.813
MP54	433918.923	409678.308	84.813
MP55	433769.589	409677.205	81.135
MP56	433719.374	409715.958	80.389

KEY

LEVELS

OSBM	Ordnance Bench Mark
CL	Cover Level
FFL	Finished Floor Level
RE	Rail Head Level
IL	Invert Level
SWL	Standing Water Level
WL	Water Level

BUILDINGS - HEIGHTS ABOVE FLOOR

C	Ceiling
CH	Canopy Head
FC	False Ceiling
WC	Window Cill
WH	Window Head

INSPECTION CHAMBERS

AC	Access Cover
CA	Ashlar Chamber
CCTV	Cable Valuation
EIC	Electric Inspection Chamber
FHY	Fire Hydrant
FWI	Foul Water Inspection Chamber
GC	Gas Chamber
GIC	Gas Inspection Chamber
GV	Gas Valve
G	Gully
IC	Inspection Chamber
MH	Manhole
R	Rodding Eye
RE	Retaining Eye
SV	Stop Valve
SWOF	Surface Water Outlet Pit
TIC	Telephone Inspection Chamber
TP	Telephone Inspection Chamber
U	Unidentified
UTL	Unable to lift
WI	Water Inspection Chamber
WV	Water Valve
WSV	Water Stop Valve

PIPES

GP	Gas Pipe
WP	Water Main Pipe
SP	Storm Main Pipe
FP	Foul Pipe
HP	Petrol Flow Pipe

POSTS

CPO	Concrete Post
FHO	Fire Hydrant Marker
FPO	Fence Post
GM	Gas Marker Post
GPO	Gate Post
LPO	Lamp Column Pole
MP	Marker Post
MPO	Metal Post
SP	Reflector Post
TPO	Timber Post

STREET FURNITURE

BB	Bollard Beacon
BO	Bollard
BS	Bus Stop
CB	Catch Basin
CC	Grating Cobbond
EP	Electric Pole
FE	Flower Border
FL	Flood Light
G	Grating
LB	Litter Bollard
LSD	Letter Box
LP	Lamp Post
NP	Name Plate
RW	Retaining Wall
SI	Sign Post
SI	Sign
STN	Survey Station
TL	Traffic Light
TCB	Traffic Light Control Box
TP	Telephone Pole

FENCES

BW	Barbed Wire
CS	Close Board
CP	Chain Link
CF	Chestnut Paling
CW	Cons. Post & Wire
HH	Hiree palisade
IR	Iron Railings
PR	Post and Rail
WW	Retaining Wall

LEGEND

- SPOT LEVEL
- SURVEY STATION
- WATER FEATURE: DITCH ETC
- RAILING
- RUINS/BARNS/ED
- HEDGE/BANK OF UNDERGROWTH
- TREE (SPREAD TO SCALE)
- BUILDING
- CONTOUR
- BOREHOLE/TEST HOLE
- TRIAL PIT
- RETAINING WALL
- SUB/CONCRETE WALLS
- GATE
- STILE
- BANKING
- ROOF RIDGE
- OSGRM VALUE: ORDNANCE SURVEY BENCH MARK
- TSM VALUE: TEMPORARY BENCH MARK(S) DATUM

REVISIONS

CLIENT

Harworth Estates

A division of UK COAL PLC

SITE

FORMER Nth BARNBER COLLIERY
WATH UPON DEARNE,
BARNSLEY.

DRAWING: TOPOGRAPHICAL SURVEY

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09/033-TS3	CP	APR 2007
SHEET 3 OF 3	DRAWN BY	SCALE
REVISION No.	CP	1:500

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APPENDIX C
SEWER RECORDS



safe-move
A part of NorthGateMaps

432572 : 400370

Map Name : SE31085E

Yorkshire Water,
PO Box 500,
Halifax Road,
Bradford BD6 2LZ
Contact Name :
Ms H Webster
Contact Tel :

YorkshireWater

Title

Notes

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Partial Key
Foul Sewer = F
Combined Sewer = C
Surface Water Sewer = SW
Trade Sewer = TS
Partially Separate = PS

Date Req : 04/07/2013, 14:26:08

Source : Sewer Network Enquiry

Date Gen : 04/07/2013, 14:26:21

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 connection

UPN: Undefined

Originator: H Webster, Safe Move.

APPENDIX D
WINDES CALCULATIONS

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.500
Area (ha)	50.000	Urban	0.000
SAAR (mm)	700	Region Number	Region 3

Results	**l/s**
QBAR Rural	276.1
QBAR Urban	276.1
Q100 years	574.2
Q1 year	237.4
Q2 years	260.5
Q5 years	345.1
Q10 years	400.3
Q20 years	453.4
Q25 years	471.0
Q30 years	485.3
Q50 years	522.9
Q100 years	574.2
Q200 years	651.6
Q250 years	676.4
Q1000 years	839.3

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