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NPPF: Flood Risk Assessment

Houghton Main, Barnsley

Peel Environmental

CRM.066.004.HY.R.01.B

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Project:	NPPF: Flood Risk Assessment
For:	Peel Environmental
Status:	Final
Date:	February 2015
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1.0 Introduction

1.1 Background

1.1.1 At the request of Peel Environmental, a Flood Risk Assessment (FRA) has been undertaken, in accordance with the National Planning Policy Framework (NPPF)[1] and Planning Practice Guidance[2], to support a planning application for a Timber Resource Recovery Centre on land off Houghton Main Colliery Roundabout, Park Spring Road, Barnsley, South Yorkshire, S71 5EX (see Drawing 1). This has included an assessment of the surface water drainage requirements of the site.

1.1.2 This report details the flood risk at the site and how this could be managed and mitigated to allow the site to be developed. The proposed development may present risks of flooding on-site and/or off-site if flooding is not effectively managed.

1.1.3 It is recognised that developments that are designed without regard to flood risk may endanger lives, damage property, cause disruption to the wider community, damage the environment, be difficult to insure and require additional expense on remedial works. Current guidance on development and flood risk[3] identifies several key aims for a development to ensure that it is sustainable in flood risk terms. These aims are as follows:

- the development should not be at a significant risk of flooding and should not be susceptible to damage due to flooding;
- the development should not be exposed to flood risk such that the health, safety and welfare of the users of the development, or the population elsewhere, is threatened;
- normal operation of the development should not be susceptible to disruption as a result of flooding;
- safe access to and from the development should be possible during flood events;
- the development should not increase flood risk elsewhere;
- the development should not prevent safe maintenance of watercourses or maintenance and operation of flood defences;
- the development should not be associated with an onerous or difficult operation and maintenance regime to manage flood risk. The responsibility for any operation and maintenance required should be clearly defined;
- future users of the development should be made aware of any flood risk issues relating to the development;
- the development design should be such that future users will not have difficulty obtaining insurance or mortgage finance, or in selling all or part of the development, as a result of flood risk issues;
- the development should not lead to degradation of the environment; and
- the development should meet all of the above criteria for its entire lifetime, including consideration of the potential effects of climate change.

[1] Department for Communities and Local Government (2012) National Planning Policy Framework.
[2] Department for Communities and Local Government (2014) Planning Practice Guidance, ID: 7, Flood Risk and Coastal Change
[3] CIRIA (2004) Funders report CP/102 Development and Flood Risk – Guidance for the Construction Industry.

1.1.4 The FRA is undertaken with due consideration of these sustainability aims.

1.1.5 The key objectives of the FRA are:

- To assess the flood risk to the proposed development and to demonstrate the feasibility of appropriately designing the development such that any residual flood risk to the development and its users would be acceptable;
- To assess the potential impact of the proposed development on flood risk elsewhere and to demonstrate the feasibility of appropriately designing the development such that the development would not increase flood risk elsewhere; and
- To satisfy the requirements of national planning policy guidance which require FRAs to be submitted in support of planning applications.

1.2 Project Scope

1.2.1 In order to achieve the aims outlined above, a staged approach has been adopted in undertaking this FRA, in accordance with current best practice. A screening study has initially been undertaken to identify whether there are any potential sources of flooding at the site, which may warrant further consideration. Any potential flooding issues identified in the screening study have subsequently been considered in a scoping study. The aim of the scoping study is to review all available information and provide a qualitative assessment of the flood risk to the site and the impact of the site on flood risk elsewhere.

1.3 Report Structure

1.3.1 This FRA has the following report structure:

- Section 2 identifies the sources of information that have been consulted during the FRA;
- Section 3 describes the application area including the existing and proposed development;
- Section 4 outlines the flood risk to the existing and proposed development;
- Section 5 assesses the potential impacts of the proposed development on surface water drainage; and
- Section 6 presents a summary and conclusions.

2.0 Sources of Information

2.1 Sources of Information

2.1.1 General information regarding the site setting and hydrology of the application site has been obtained from the OS Explorer 278: Sheffield & Barnsley.

2.1.2 Information regarding the current flood risk at the application site, local flood defences and flood water levels has been checked against Environment Agency flood mapping available online.

2.1.3 A location plan of the buildings/structures that form the development is shown on Drawing 1.

2.2 Discussion with Regulators

2.2.1 A wide range of regulators should be consulted when carrying out an FRA. These include the Environment Agency, the Local Planning Authority (LPA), and Water Regulators. Consultation and discussions with the relevant regulators have been undertaken during this FRA.

2.3 Environment Agency

2.3.1 The Flood and Water Management Act 2010 gives the Environment Agency a strategic overview role for all forms of flooding and coastal erosion. They also have direct responsibility for the prevention, mitigation and remediation of flood damage for main rivers and coastal areas. The Environment Agency is the statutory consultee with regards to flood risk and planning.

2.3.2 Environment Agency Standing Advice and the NPPF has been consulted and reviewed during this FRA.

2.3.3 A meeting was held with Gary Cliff and Lesley Slaney, Environment Agency Representatives in the Yorkshire and North East Regional Office on 19th February 2014 to discuss the proposals and nature and scale of the flood risk assessment to be carried out.

2.3.4 A data request was submitted to the Environment Agency in relation to flood risk at this site. All correspondences with the Environment Agency have been included within Appendix 3.

2.4 Local Authorities

2.4.1 Planning guidance written by BMBC regarding flood risk was consulted to assess the mitigation policies in place. These documents include the evidence base for the Local Development Framework and the Local Plan.

2.4.2 As part of this consultation the Barnsley Strategic Flood Risk Assessment (SFRA)[4] was also reviewed.

2.4.3 A data request was issued to BMBC. At the time this report was written, a response from BMBC has not been received in relation to flood risk aspects of the site.

2.4.4 Flood mapping produced as part of the SFRA has been included within Appendix 5.

[4] Barnsley Strategic Flood Risk Assessment, Level 1, Barnsley Metropolitan Borough Council, September 2010.

2.5 Yorkshire Water

2.5.1 Yorkshire Water is responsible for the disposal of waste water and supply of clean water within the Barnsley area.

2.5.2 Information with regards to sewer and water main flooding contained within the SFRA has been consulted as part of this FRA. All Water Companies have a statutory obligation to maintain a register of properties/areas which are at risk of flooding from the public sewerage system, and this is shown on the DG5 Flood Register.

2.5.3 All correspondences with Yorkshire Water, including asset plans, have been included within Appendix 4.

3.0 Description of Application Area

3.1 Site Location

3.1.1 The development site is located on land off Park Spring Road, Grimethorpe, Barnsley, S72 0HW (see Drawing 1).

3.1.2 The National Grid Reference of the site is 441799, 406582.

3.2 Existing Development

3.2.1 The development site is approximately 3.00 hectares (ha) in area.

3.2.2 The site is currently a brownfield site which is largely grassland with limited areas of a mixture of young and mature tree cover located towards the westernmost boundary of the site, with a number of hedgerows around the site perimeter. Its brownfield classification is related to the sites former use as mine pithead location with disused railway lines bounding the southern and western extents of the site with a former rail junction at the southern and western boundary intersection. The rails have been removed; however, much of the ballast remains.

3.2.3 The site is bounded by agricultural land on the southern, western and northern boundaries. The east is bounded by a large distribution warehouse with agricultural land beyond.

3.2.4 The existing site is largely permeable and is currently accessed via an exit off the Houghton Main Colliery roundabout on Park Spring Road. A *de facto* access track leads from the roundabout in westerly direction linking up to the southern disused railway heading west.

3.3 Proposed Development

3.3.1 It is understood the proposal is for the construction of a Timber Resource Recovery Centre.

3.3.2 The proposed development (see Appendix 1) may present risks of flooding on-site and/or off-site if flooding is not effectively managed.

3.3.3 Further details with regard to the proposed development can be found in the information submitted with the planning application.

3.4 Topographic Information

3.4.1 A topographic survey of the site has been undertaken by SLR Consulting in May 2011, and a further survey was undertaken by QuicSurv in March 2014.

3.4.2 The site generally slopes in a south-westerly direction towards the River Dearne, falling from approximately 33.77mAOD in the northern corner of the site to approximately 30.17mAOD in the westernmost corner of the site closest to the River Dearne. This equates to a fall of approximately 3.6m over a distance of approximately 320m.

3.4.3 There are some constructed mounds on the southernmost boundary close to the access track from Houghton Main roundabout with a peak of 34.83mAOD. These are not representative of the overall slope of the site.

3.4.4 A copy of the topographic survey has been included within Appendix 2.

3.5 Catchment Hydrology

3.5.1 Based on a review of the Environment Agency online flood maps, the River Dearne dominates the hydrology of the site. The River Dearne flows close to the western and southern boundaries of the site. At the westernmost point of the site, the river passes beneath a former railway bridge 85m away from the site. The River Dearne is a 'Main River' and is maintained by the Environment Agency.

3.5.2 A short distance upstream of the railway bridge, a confluence with the River Dearne and an unnamed river occurs, 100m north-west of the westernmost corner of the site. This unnamed river is an 'Ordinary Watercourse' and maintained by the local drainage authority, Barnsley Metropolitan Borough Council (BMBC).

3.5.3 A land drain exists 100m east of the northernmost corner of the site which flows in a south-easterly direction, remaining on the northern side of the A6195. This is an 'Ordinary Watercourse' and maintained by the local drainage authority, BMBC.

3.5.4 Two flood storage reservoirs (FSRs), which are also classed as wetlands, are located to the north and west of the site. OS Mapping and site walkover has shown the northern FSR is located 220m to the north-west of the northernmost corner of the site. The western FSR is located beyond spillway within constructed flood defences on the right bank of the River Dearne, located 125m to the west of the western corner of the site.

4.0 Flood Risk

4.1 Potential Sources of Flooding – Level 1 Screening Study

4.1.1 All potential sources of flooding must be considered for any proposed development. A summary of the potential sources of flooding and a review of the potential risk posed by each source at the application site is presented in Table 4.1.

Table 4.1: Potential Risk Posed by Flooding Sources

Flooding Source	Potential Flood Risk at Application Site?	Potential Source	Data Sources
Fluvial flooding	Yes	River Dearne, Unnamed Tributary	Environment Agency, SFRA, OS Map
Tidal flooding	No	None Identified	Environment Agency
Flooding from rising / high groundwater	Yes	Aquifer	BGS Map, SFRA
Overland flow flooding	Yes	Poor permeability	RMS Map, SFRA
Flooding from artificial drainage systems	No	Sewers	Yorkshire Water, SFRA
Flooding due to infrastructure failure	No	Houghton Washland Reservoir	Environment Agency. OS Map

Fluvial Flooding Sources

4.1.2 As noted above, there is a Main River located within the vicinity of the site; namely the River Dearne.

4.1.3 Furthermore, there are two unnamed Ordinary Watercourses located within the vicinity of the site. The first is a tributary to the River Dearne flowing in at a confluence located 100m north-west of the westernmost corner of the site. The catchment for this watercourse is land surrounding the northern FSR.

4.1.4 The second Ordinary Watercourse is an unnamed drainage ditch located on the northern side of the A6195 Park Spring Road and is not considered further within this FRA as it will not affect the site.

4.1.5 The Environment Agency flood map shows that the site is located largely within Flood Zone 1; outside the 1 in 1000 year return period (<0.1% AEP) (see Drawing 3), which is considered to be at low risk of fluvial flooding.

4.1.6 A small section in the westernmost part of the site is located within the current mapped Flood Zone 2; located between the 1 in 100 to 1 in 1000 annual probability of fluvial flooding (<1% AEP->0.1% AEP), which is considered to be at medium risk of fluvial flooding .

4.1.7 Based on the above, the site has a low to medium risk of fluvial flooding. The extent of Flood Zone 2 as depicted by the Environment Agency mapping is however disputed, which is discussed in more detail below in Section 4.2.

Tidal Flooding Sources

4.1.8 The site is not located within the vicinity of tidal flooding sources. Therefore, flooding from this source is considered negligible and has not been considered further within this FRA.

Flooding from rising / high groundwater

4.1.9 The BGS Groundwater Flooding Susceptibility Map indicates the site lies within an area with at least a limited potential for groundwater flooding to occur. Furthermore, the central region of the site lies within an area with the potential for groundwater flooding to occur at the surface while northern and southern areas have areas with a potential for groundwater flooding to occur in property situated below ground level (see Drawing 3).

4.1.10 The BGS data set is a hazard data set, not a risk data set, meaning that it does not provide any information about the likelihood of a groundwater flooding event occurring. It is noted that the BGS flood map is to be used as a screening tool, and should not be used to inform planning decisions.

4.1.11 Groundwater flooding tends to occur sporadically in both location and time. When groundwater flooding does occur, it tends to mostly affect low-lying areas, below surface infrastructure and buildings (for example, tunnels, basements and car parks) underlain by permeable rocks (aquifers).

4.1.12 The BGS Hydrogeology online viewer[5] shows the sites is underlain by superficial deposits of Pennine Middle Coal Measures with a regional, cyclic multi-layered aquifer with moderate yields from sandstones and many springs.

4.1.13 The plans in Appendix 1 indicate there is no proposed constructed development below ground level.

4.1.14 As such the site is not considered at risk of flooding from rising / high groundwater. This will be mitigated by the adoption of a surface water management strategy for the site (see Chapter 5).

Overland flow flooding

4.1.15 Overland land flow flooding tends to occur sporadically in both location and time.

4.1.16 Soils mapping produced by the National Soils Resources Institute (Cranfield University) shows that the south-west section of the site is underlain by loamy and clayey floodplain soils with naturally high groundwater. The north-eastern section of the site is underlain by slowly permeable, seasonally wet, acid, loamy and clayey soils.

4.1.17 The British Geological Survey (BGS) online mapping (Geology of Britain Viewer) shows that the superficial deposits beneath the site area comprise of Pennine Middle Coal Measures Formation with Sandstone, Mudstone and Siltstone.

4.1.18 From the information sources above, it is likely that the site will experience low rates of infiltration resulting in a potentially higher incidence of overland flow flooding.

4.1.19 The Risk Management Solutions (RMS) overland flow flood map shows central sections of the site located on the southern and northern boundaries of the site reside within the 1 in 1000 annual probability of flooding from this source. Limited sections of the site along the eastern boundary reside within a 1 in 75 annual probability of overland flow flooding (see Drawing 4).

[5] http://mapapps.bgs.ac.uk/hydrogeologymap/hydromap.html

4.1.20 Based on the above, the site is considered to be at a low risk of overland flow flooding. . This will be mitigated by the adoption of a surface water management strategy for the site (see Chapter 5).

Flooding from Artificial Drainage Systems/Infrastructure Failure

Artificial Drainage Systems

4.1.21 Sewer flooding occurs when urban drainage networks become overwhelmed and maximum capacity is reached. This can occur if there is a blockage in the network causing water to back up behind it or if the sheer volume of water draining into the system is too great to be handled. This type of flooding tends to occur sporadically in both location and time.

4.1.22 The majority of sewers are built to the guidelines within Sewers for Adoption[6]. These sewers have a design standard to the 1 in 30 year flood event and therefore it is likely that the majority of sewer systems will surcharge during rainstorm events with a return period greater than 30 years (e.g. 100 years). This was clearly the case during the 2007 national flooding event when drains and sewers were rapidly overwhelmed by the intense and prolonged rainfall, and as such played a considerable role in the flood event.

4.1.23 Yorkshire Water is responsible for the disposal of waste water and supply of clean water within the area. Information with regards to sewer and water main flooding contained within the SFRA has been consulted as part of this FRA. Like all Water Companies, Yorkshire Water has a statutory obligation to maintain a register of properties/areas which are at risk of flooding from the public sewerage system, and this is shown on the DG5 Flood Register. This includes records of flooding incidents from public foul sewers, combined sewers and surface water sewers which are maintained by the Water Company. When an incident is reported, a decision chart is used to assess whether the properties/areas are 'at risk' and then the record is added to the appropriate register.

4.1.24 Yorkshire Water sewer asset plans show that there are no public sewer assets crossing the proposed site. The nearest asset is foul only located approximately 380m south-east of the southernmost site boundary located at the northern end of Ings Lane.

4.1.25 Yorkshire Water confirm there is sufficient capacity to receive the additional flows into this asset via a requisitioned foul sewer following the western side of the A6195.

4.1.26 Based on the above, there is a low risk of flooding from sewers.

Flooding from Reservoirs

4.1.27 Based on the Environment Agency Flood Map, the site's western boundary is located within the extent of flooding sourced from Houghton Washland Reservoir. Although the outline of modelled flooding from this source is shown to potentially affect the site, flooding from reservoirs is seen as being very unlikely to occur. It is also worthy of note that the mapping error within the current EA flood zones, is likely to also be present within the reservoir mapping.

4.1.28 With reference to Environment Agency information on reservoir flooding, owners of reservoirs are obliged to maintain them according to the Reservoir Act (1975) where reservoir assets are to be inspected and supervised by panel engineers.

4.1.29 The Environment Agency state that no loss of life has occurred as a result of reservoir flooding since 1925. Therefore, with the mitigation measures that are in place to maintain all reservoirs, the likelihood of an event occurring is extremely low.

[6] WRC (2012) Sewers for Adoption 7th Edition.

4.1.30 Therefore, the risk posed by this source of flooding is considered low.

Summary

4.1.31 Given the information that is available, it is considered that a 'low' level of flood risk is posed by this source of flooding.

4.2 Environment Agency Flood Map

4.2.1 A review of the Environment Agency's flood map indicates that the site is largely located in Flood Zone 1; outside the 1 in 1000 annual probability of river flooding in any year (<0.1% AEP).

4.2.2 A small section in the westernmost area of the site is, according to Environment Agency mapping, located in Flood Zone 2; within the 1 in 100 to 1 in 1000 annual probability of fluvial flooding (1-0.1% AEP).

4.2.3 Based on the Environment Agency online mapping, the site is considered to be at 'low' to 'moderate' risk of fluvial flooding, sourced from the River Dearne.

4.2.4 A meeting was held with Gary Cliff and Lesley Slaney, Environment Agency Representatives in the Yorkshire and North East Regional Office on 19th February 2014 regarding the location of the site in relation to the current Flood Zone 2 outline. After discussions were held, it was agreed that topographic information for the site illustrates that the Flood Zone 2 outline may not be truly representative and that further modelling work was not required to discount the Flood Zone 2 location in relation to the site.

4.2.5 A site walkover confirmed there are informal flood defence assets running along the right bank (southern bank) of the River Dearne. A spillway in this defence asset is designed to allow flood water into adjacent agricultural washland (Houghton FSR). The flood alleviation area is large and it is proposed that this will aid in reducing the flood water levels for the reach of the Dearne near the site such that inundation will reach no higher than the former railway embankment.

4.2.6 Enzygo has mapped the modelled flood levels obtained after consultation with the Environment Agency (see Appendix 3). This modelling work was conducted by JBA Consulting Ltd in May 2004. Using detailed topographical information for the site area and the modelled flood levels from the Environment Agency, it can be seen in Drawing 1 (modelled flood zones) that the flood zone associated with a 1 in 200 year flooding event (0.5% AEP) does not extend to the site area.

4.2.7 The difference between the 1 in 200 year flood height (28.34mAOD) from the model node 14806 provided by the Environment Agency and the lowest known point on the western boundary of the site (30.17mAOD) is 1.83m. This gives a margin of clearance. It is not known if this model included the spillway and flood alleviation area in its calculations.

4.2.8 The Environment Agency were unable to provide a 1 in 1000 year modelled flood level for these node points as they had not been established in the modelling work carried out on the River Dearne in 2004.

4.2.9 Upon reviewing the standard Flood Zone mapping from the Environment Agency, the extent of Flood Zone 2 in relation to the topographical heights of the land, which this zone inundates, has some discrepancies.

4.2.10 The level of flooding for a 1 in 1000 year event, when viewing the periphery of the zone outline directly west of the site, shows inundation to occur at one location to elevations >40mAOD according to OS contour lines. If one then follows the outline of the Flood Zone a short distance south (downstream) by approximately 500m, the outline of the inundation for this flooding is

at topographical levels of <30mAOD. There are no topographical obstructions that would explain the 10m fall in inundation across this reach of the River Dearne where channel gradients are extremely low; a 5m fall over 3.5km according to Ordnance Survey contours equivalent to a slope of 0.001m/m. On the opposite bank of the River Dearne, levels for the same reach are currently shown to exceed 30mAOD on the western edge of the site. It could be argued that flood levels on site should be similar to the opposite bank and not exceed 30mAOD. Therefore, this would rule out the site area being located within Flood Zone 2, and would place the site entirely within Flood Zone 1 (low risk).

4.2.11 It can be seen in Drawing 9 that similar anomalies with flood inundation areas in EA flood maps misaligning to topographic information exist on the site. As the 1 in 1000 year flood/Flood Zone 2 outline enters the site, it does so near the height marker of 30.53mAOD. The edge of the Flood Zone 2 as it crosses the site then rises in height to nearer 32mAOD as it leaves the site on the western boundary. This rise in flood level of approximately 1.5m over a distance of approximately 80m. This is an unlikely occurrence and it is proposed that flood levels would not rise above 30m as per the explanation in section 4.2.9.

4.2.12 The Environment Agency Flood Zones and acceptable development types are explained in Table 4.2. All development types are generally deemed acceptable in terms of flood risk in Flood Zone 1.

4.2.13 In PPG ID: 7 (Table 1), the appropriate uses have been identified for the Flood Zones. Applying the Flood Risk Vulnerability Classification in Table 2 and 3 of PPG ID: 7, the proposed development is classified as 'less vulnerable'.

4.2.14 Based on the above, the Sequential Test should be passed and the Exception Test should not be required.

Table 4.2: Environment Agency Flood Zones and Appropriate Land Use

Flood Zone	Probability	Explanation	Appropriate Land use
Zone 1	Low	Less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%)	All development types generally acceptable
Zone 2	Medium	Between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% 0.1%) in any year	Most development type are generally acceptable
Zone 3a	High	A 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year	Some development types not acceptable

Flood Zone	Probability	Explanation	Appropriate Land use
Zone 3b	'Functional Floodplain'	Land where water has to be flow or be stored in times of flood. SFRAs should identify this zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1% flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes)	Some development types not acceptable

Note: *The Flood Zones are the current best information on the extent of the extreme flood from rivers or the sea that would occur without the presence of flood defences, because these can be breached, overtopped and may not be in existence for the lifetime of the development.*

Table 4.3: Flood Risk Vulnerability and Flood Zone 'Compatibility' as identified in Table 3 of PPG ID: 7

Flood Risk Vulnerability classification (see Table 1 of PPG ID: 7)	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	Yes	Yes	Yes	Yes	Yes
Zone 2	Yes	Yes	Exception test required	Yes	Yes
Zone 3a	Exception test required	Yes	No	Exception test required	Yes
Zone 3b 'Functional Floodplain'	Exception test required	Yes	No	No	No

Key: *Yes: Development is appropriate, No: Development should not be permitted.*

4.3 Historic Flooding

4.3.1 Environment Agency mapping shows that flooding has occurred on the River Dearne near to the site in 1947, 1982, 2000 and 2007. The historic flood outline for June 2007 is the only one to indicate flooding affected the site (Drawing 7). The outline of this appears to assimilate the outline of the current Environment Agency Flood Zone 2 outline and affected the westernmost corner of the development site.

4.3.2 Based on the above, the extent of flooding during June 2007 is derived from limited on-the-ground evidence, collated by the authorities, during a flood event. During a flooding event a considerable amount of man hours are inherently taken up dealing with the initial effects of flood, in particular where communities are impacted (i.e. 'more vulnerable' residential development) rather than 'less vulnerable' industrial units, less so for undeveloped land which is considered to be a floodplain (i.e. the site) and expected to flood. As such, the inherent inaccuracy of the historical flood event mapping is less reliable than the modelled flood levels, from which the Environment Agency flood maps are derived. As such, the Environment

Agency flood maps (based on modelled flood levels) are considered the best available baseline conditions to base the FRA report on.

The British Hydrological Society "Chronology of British Hydrological Event[7]" has no further records of flooding in the immediate area. No other historical records of flooding for the site have been recorded.

4.4 Existing and Planned Flood Defence Measures

4.4.1 The Environment Agency confirmed in writing that the site is not protected by formal flood defence measures (Appendix 3).

4.4.2 A site walkover confirms that the site is naturally protected by the former railway embankment on the western and northern boundaries. There are additional informal flood defence assets and washlands as part of a flood alleviation scheme to protect downstream villages. The washlands are located to the north (Cudworth FSR) and west (Houghton FSR) of the site. The plans of these defences can be seen in Appendix 3.

4.4.3 These defence assets are maintained by BMBC.

4.5 Current Flood Risk

4.5.1 The site is largely located within Flood Zone 1 and is at 'low risk' of fluvial flooding.

4.5.2 Two secondary flooding sources have been identified for the site:

- Groundwater flooding
- Overland Flow flooding

4.5.3 The secondary flooding sources identified above will be dealt with by an adequately designed drainage system, and these sources would only inundate the site to a relatively low water depth and water velocity, will only last a short period of time, in very extreme cases and will not have an impact on the whole of the proposed development site.

4.5.4 As noted in Section 4.2, the site has a 'low probability' of fluvial flooding as the majority of the site is located within Flood Zone 1; outside the extent of the 1 in 1000 year annual probability of the fluvial flooding (<0.1 % AEP).

4.5.5 The proposed development is classified as 'less vulnerable'. Less vulnerable uses are appropriate within Flood Zones 1, 2 and 3 after the completion of a satisfactory FRA. All development is, however, appropriate within Flood Zone 1.

[7] http://www.dundee.ac.uk/geography/cbhe/

5.0 Site Drainage

5.1 Surface Water Drainage

5.1.1 It is recognised that consideration of flood issues should not be confined to the floodplain. The alteration of natural surface water flow patterns through developments can lead to problems elsewhere in the catchment, particularly flooding downstream. For example, replacing vegetated areas with roofs, roads and other paved areas can increase both the total and the peak flow of surface water runoff from the development site. Changes of land use on previously developed land can also have significant downstream impacts where the existing drainage system may not have sufficient capacity for the additional drainage. This section considers the existing drainage system at the application site and potential impacts resulting from the development.

5.1.2 A surface water management strategy for the development will be required to manage and reduce the flood risk posed by the surface water runoff from the site. The developer will be required to ensure that any scheme for surface water should build in sufficient capacity for the entire site.

5.1.3 There are three possible options to discharge the surface water runoff in accordance with requirement H3 of the Building Regulations 2010[8]. Rainwater shall discharge to one of the following, listed in order of priority:

5.1.4 An adequate soakaway or some other adequate infiltration system; or, where that is not reasonably practicable,

- a watercourse; or where that is not reasonably practicable,
- a sewer.

5.1.5 An assessment of the surface water runoff rates has been undertaken, in order to determine the surface water options and attenuation requirements for the site. The assessment considers the impact of the site compared to current conditions. Therefore, the surface water attenuation requirement for the developed site can be determined and reviewed against existing arrangements.

5.1.6 The surface water drainage arrangements for any development site should be such that the volumes and peak flow rates of surface water leaving a developed site are no greater than the rates prior to the proposed development, unless specific off-site arrangements are made and result in the same net effect.

5.2 Existing Drainage System

5.2.1 The development site is approximately 3.00 hectares (ha) in area and is currently a brownfield site which is largely grassland with limited areas of a mixture of young and mature tree cover located towards the westernmost boundary of the site, with a number of hedgerows around the site perimeter. The site is almost entirely permeable.

5.2.2 Following a site walkover, it was observed that rainfall which falls on to the site partially infiltrates at source, and the remainder as overland flow to the river Dearne.

5.2.3 There is currently no foul water discharging from the site.

[8] Office of the Deputy Prime Minister, The Building Regulations 2010.

5.3 Current Runoff Rate

5.3.1 It is assumed that the majority of rainfall currently infiltrates into the ground or occurs as overland flow at source. This is considered feasible given the soils and geology beneath the site.

5.3.2 Soils mapping produced by the National Soils Resources Institute (Cranfield University) shows that the south-west section of the site is underlain by loamy and clayey floodplain soils with naturally high groundwater. The north-eastern section of the site is underlain by slowly permeable, seasonally wet, acid, loamy and clayey soils.

5.4 Proposed Development

5.4.1 It is understood the proposals are for a Timber Resource Recovery Centre with associated buildings, storage tanks, parking areas and access roads within the 3.00ha site, which is currently entirely permeable.

5.4.2 Based on the proposed site layouts, the site will be approximately 51% impermeable (1.54ha). Current site layouts show that the proposed development will increase the impermeable area by approximately 51% (1.54ha) when compared to the existing brownfield site.

Table 5.1: Impermeable Area

	Existing Buildings and Hardstanding	Proposed Buildings and Hardstanding	Difference
Area (Ha)	0	1.54	+1.54
Percentage of Total Site Area (%)	0	51	+51

Note - *The above permeable/impermeable areas are defined in Drawing 9.*

5.4.3 Based on the above it has been shown that the proposed development will increase the overall areas of permeable surfaces. Attenuation of surface runoff for the proposed development will still need to be introduced.

5.5 Post-Development Runoff Rate

5.5.1 It is understood the proposals are for a Timber Resource Recovery Centre with associated buildings, storage tanks, parking areas and access roads within the 3.00ha site, which is currently entirely permeable. Landscaped areas will be incorporated into the layout of the site.

5.5.2 The incorporation of landscaping areas will result in a proportion of the rainfall infiltrating into the soil substrate therefore, reducing the surface water runoff compared to current conditions and ensuring that the development will not increase flood risk elsewhere.

5.5.3 Conditions will result in the rainfall discharging as surface water runoff from the site being controlled, treated, managed and mitigated.

5.6 Developed Site Drainage

5.6.1 An assessment of the surface water runoff rates has been undertaken, in order to determine the surface water options and attenuation requirements for the site. The assessment considers the impact of the site compared to current conditions. Therefore, the surface water attenuation requirement for the developed site can be determined and reviewed against existing arrangements.

5.6.2 In order to quantify any potential increase in surface water runoff, the existing brownfield runoff rate from the site must initially be determined. The rates of runoff have been determined using the current 'industry best practice' guidelines as outlined in the Interim Code of Practice for SuDS[9].

5.6.3 The Building Regulations [10] permissible runoff rate is 0.014 l/s/m^2 (140 l/s/ha) with a recommended reduction of 30% betterment, as per correspondence received in a pre-application advice letter from BMBC received 7th March 2014.

5.6.4 The measures detailed in Section 5.7 and 5.8 will control the surface water runoff from the site to this level and therefore surface water flood risk from the developed site.

5.7 Sustainable Drainage Options (SuDS)

5.7.1 Sustainable water management measures should be used to control the surface water runoff from the proposed development site therefore, managing the flood risk to the site and surrounding areas from surface water runoff.

5.7.2 Current guidance promotes sustainable water management through the use of SuDS. SuDS options include:

- Green roofs
- Water butts
- Permeable paving
- Rainwater harvesting
- Filter strips
- Wetland Areas
- Infiltration basins
- Detention basins
- Oversized pipes
- Brown roofs
- Swales
- Cellular Storage

5.7.3 A hierarchy of techniques is identified[11]:

1. **Prevention** – the use of good site design and housekeeping measures on individual sites to prevent runoff and pollution (e.g. minimise areas of hard standing).
2. **Source Control** – control of runoff at or very near its source (such as the use of rainwater harvesting).
3. **Site Control** – management of water from several sub-catchments (including routing water from roofs and car parks to one/several large soakaways for the whole site).
4. **Regional Control** – management of runoff from several sites, typically in a detention pond or wetland.

[9] Office of the Deputy Prime Minister, National SuDS Working Group, July 2004, Interim Code of Practice for sustainable drainage systems.
[10] Building Regulations, Part H – Drainage and Waste Disposal, Section 3, 2000; amended 2010.
[11] CIRIA (2004) Report C609, Sustainable Drainage Systems – Hydraulic, Structural and Water Quality advice.

5.7.4 It is generally accepted that the implementation of SuDS as opposed to conventional drainage systems, provides several benefits by:

- reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream;
- reducing the volumes and frequency of water flowing directly to watercourses or sewers from developed sites;
- improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources;
- reducing potable water demand through rainwater harvesting;
- improving amenity through the provision of public open spaces and wildlife habitat; and
- replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.

5.8 Feasibility of SuDS Options

5.8.1 Soils mapping produced by the National Soils Resources Institute (Cranfield University) shows that the south-west section of the site is underlain by loamy and clayey floodplain soils with naturally high groundwater. The north-eastern section of the site is underlain by slowly permeable, seasonally wet, acid, loamy and clayey soils.

5.8.2 Based on the above, the permeability of the soil appears to be reduced and the bedrock may encourage high groundwater. As such the use of infiltration SuDS may be limited.

5.8.3 If an infiltration system is proposed, it is recommended that a series of infiltration/soakaway tests are carried out on site to BRE Digest 365 Guidelines to confirm the assumptions made in the calculations.

5.9 Surface Water Management Strategy

5.9.1 A surface water management strategy for the proposed development has been developed as part of a FRA to manage and reduce the flood risk posed by the surface water runoff from the site.

5.9.2 A surface water management strategy for the proposed development will manage and reduce the flood risk posed by the surface water runoff from the site.

5.9.3 At this stage the use of SuDS features may be limited by the infiltration. Landscaped areas within the site appear to be limited, however, those areas surrounding site installations and vehicle manoeuvring areas in the northern section of the site will allow a proportion of the rainfall to infiltrate into the soil substrate.

5.9.4 It is recommended that interceptors should be fitted on the upstream side of attenuation storage devices in order to improve the quality of surface water discharging from the site.

5.9.5 Due to the nature of the site being the location of former mine works, it is proposed that the ground bears the conditions of a brownfield site as it was backfilled with poor quality earth and has shallow soil horizons. It is therefore proposed that the Building Regulations permissible runoff rate is more applicable to the site of 140 l/s/ha; subject to a 30% reduction for betterment.

5.9.6 From the detailed drainage design in Appendix 6, surface runoff will be attenuated in underground cellular storage units before discharging to the River Dearne via an existing

outfall. This outfall currently serves the neighbouring Alkane facility and a highway drain from Park Spring Road, and is located 180m south of the southern boundary.

5.9.7 All events up to and including the 1 in 100 year (+30%) rainfall event will be attenuated. During detailed design the system could be designed to attenuate to the 1 in 1, 1 in 30 and 1 in 100 year events, in accordance with the Interim Code of Practice for SuDS.

5.9.8 Surface water runoff would be directed to the drainage system through drainage gullies located around the perimeter of the buildings and through contouring of the hardstanding areas.

5.9.9 At this stage of the planning process it is proposed that a planning condition can be adopted to cover the detailed design of the surface water runoff from the site. It is proposed that the detailed drainage design of the final scheme would be secured by a planning condition attached to any planning permission granted and agreed with the Environment Agency and the LPA prior to works commencing.

5.9.10 From the detailed surface water drainage design in Appendix 6, the total attenuation required for the site to attenuate to the brownfield rate, allowing for a 30% betterment, has been calculated at 207.5m^3; delivered via four separate geocellular storage units within the site boundary.

5.9.11 The adoption of a surface water management strategy for the site represents an enhancement from the current conditions as the current surface water runoff from the site is uncontrolled, untreated, unmanaged and unmitigated.

5.10 Foul Drainage

5.10.1 The proposed development will create foul flows from the site.

5.10.2 There are no Yorkshire Water sewer assets located within the immediate vicinity of the site. As such, a foul sewer is planned to be requisitioned to connect with a known connection point located approximately 380m south-east of the southernmost boundary of the site. Yorkshire Water confirms there is sufficient capacity to connect foul flows from this site into the identified asset (Appendix 4).

5.10.3 According to British Water Flows and Loads guidance[12], peak foul water discharge from an industrial development (with a canteen) can be considered to be 100 litres per person per day. A figure of 50 litres of foul flow per person per day is considered for industrial units without a canteen. Using this method, approximate foul flows can be calculated for the proposed industrial development for both scenarios outlined above.

5.10.4 A figure of 25 full-time equivalent (FTE) members of staff is expected to be on site during the operation phase.

5.10.5 Peak foul flows from the proposed development is summarised below in Table 5.6. The foul flow rates below are indicative only and should be established at detailed design.

[12] British Water Code of Practice , Flows and Loads – 3, 2009

Table 5.6: Anticipated Foul Flows

Industrial Unit Type	Discharge Rate Per Person Per Day (litres)	No. of FTE Staff	Peak Foul Flows (l/s)
With Canteen	100	25	0.03
Without Canteen	50	25	0.015

5.10.6 Based on tables 5.6 above, a maximum flow of 0.03 l/s of foul flow can be anticipated to be discharged from the proposed development, assuming the maximum figure of 25 FTE staff in an industrial unit with a canteen.

5.11 Site Drainage Summary

5.11.1 It has been demonstrated that both surface water and foul flows from the site can be managed such that flood risk to and from the site following development is not increased.

6.0 Summary and Conclusions

6.1 Introduction

6.1.1. This report presents an FRA, in accordance with the NPPF, an application for a Timber Resource Recovery Centre to be located on land located off the Houghton Main Colliery Roundabout, Park Spring Road, Houghton Main, Barnsley. This has included an assessment of the surface water drainage requirements of the site.

6.1.2. This report details the flood risk at the site and how this could be managed and mitigated to allow the site to be developed in support of the enclosed planning application. The proposed scale of development may present risks of flooding on-site and/or off-site if flooding is not effectively managed.

6.2 Assessment of Flood Risk

6.2.1 The FRA has demonstrated the following:

- There is a main River (River Dearne) at its closest point, located 85m to the north of the north-western corner of the site. Furthermore, an ordinary watercourse is 100m to the north of the northern perimeter of the site at its closest point at a confluence with the River Dearne. .
- The detailed flood map provided by the Environment Agency show that the site is largely located within Flood Zone 1; outside the extent of the 1 in 1000 annual probability of flooding / <0.1% AEP. A small section in the western section of the site is shown to be located within Flood Zone 2; between the 1 in 100 to 1 in 1000 annual probability of fluvial flooding (1 - 0.1% AEP). However, it has been discussed within this FRA that the extent of the current Flood Zone mapping is erroneous and that the site should be considered to lie entirely within Flood Zone 1.
- In PPG ID: 7, the appropriate uses have been identified for the Flood Zones. The proposed development is classified as 'less vulnerable'. All development types are generally deemed acceptable in terms of flood risk in Flood Zone 1. Based on the above, the Sequential Test should be passed and the Exception Test should not be required.
- Two secondary flooding sources were identified within the site:
    - Overland flow flooding; and
    - Groundwater flooding.
- It is further recommended that any electrical equipment or such equipment sensitive to water ingress be installed with sufficient ground clearance to avoid the potential for groundwater and overland flooding to affect such infrastructure.

6.2.2 Table 6.1 summarises the probability and consequence of flooding for the site with and without mitigation measures.

Table 6.1: Probability and consequences of all sources of flooding

Flooding Source	Potential Source	Probability	Consequence & Impact Without Mitigation	Consequence & Impact With Mitigation	Comment
Fluvial flooding	River Dearne (Main River), Unnamed Tributary (Ordinary Watercourse)	Low	Low	Negligible	Will not affect the site area.
Tidal flooding	None	Negligible	Negligible	Negligible	None
Flooding from rising / high groundwater	Aquifer	Low	Low	Negligible	No occupation of buildings below ground level. Negligible impact with correct management (i.e. appropriated sized drainage system).
Overland flow flooding	Poor Permeability	Low	Low	Negligible	Negligible impact with correct management (i.e. appropriated sized drainage system).
Flooding from artificial drainage systems	Sewers	Negligible	Negligible	Negligible	Will not affect the site area.
Flooding due to infrastructure failure	Houghton Washland Reservoir	Low	Negligible	Negligible	Flood Zone will not affect site area

Key: *Green - Negligible, Yellow - Low, Orange - Medium and Red - High; based on consequence and impact with mitigation from each flooding source.*

6.3 Site Drainage

6.3.1 In addition, the FRA has considered the potential impact of the development on surface water and foul runoff rates.

Surface Water

6.3.2 The surface water management strategy for the proposed development will manage and reduce the flood risk posed by the surface water runoff from the site.

6.3.3 The site is approximately 3.00ha in area and is currently a brownfield site which is largely grassland with limited areas of a mixture of young and mature tree cover located towards the westernmost boundary of the site, with a number of hedgerows around the site perimeter.

6.3.4 The attenuation volume required to reduce the post-application surface water runoff to the permissible Brownfield runoff rate of 140 l/s/ha (minus 30%) has been calculated in the detailed drainage design in Appendix 6.

6.3.5 The total storage requirement for this site has been designed to provide 207.5m^3 of attenuation.

Foul Water

6.3.6 Assuming a peak foul water discharge of 100 litres per person per day, for 25 FTE staff at an industrial unit with a canteen, the peak foul flow from the site will be approximately 0.03 l/s. An industrial unit without a canteen with similar staff levels will have a peak foul flow of 0.015 l/s.

6.3.7 There are no Yorkshire Water sewers located within the immediate vicinity of the site. As such, the use of an appropriately specified package treatment plant, located within the site, should be investigated further at detailed design.

6.3.8 The location and treatment requirement for these works would need to be developed with the Environment Agency and LPA as part of the Environmental permitting process set out by the Environmental Permitting (England and Wales) Regulations 2010.

6.3.9 It has been demonstrated that both surface water and foul flows from the site can be managed such that flood risk to and from the site following the proposed development is not increased.

6.4 Conclusion

6.4.1 This FRA demonstrates that the proposed development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of the NPPF.

6.4.2 The development should not therefore be precluded on the grounds of flood risk.

Key

Site Location
(SE 41676 06429)

enzygo
environmental consultants
STEP Business Centre, Wortley Rd, Sheffield, S36 2UH

CLIENT: Peel Environmental Ltd

SCALE: 1:20,000@A3

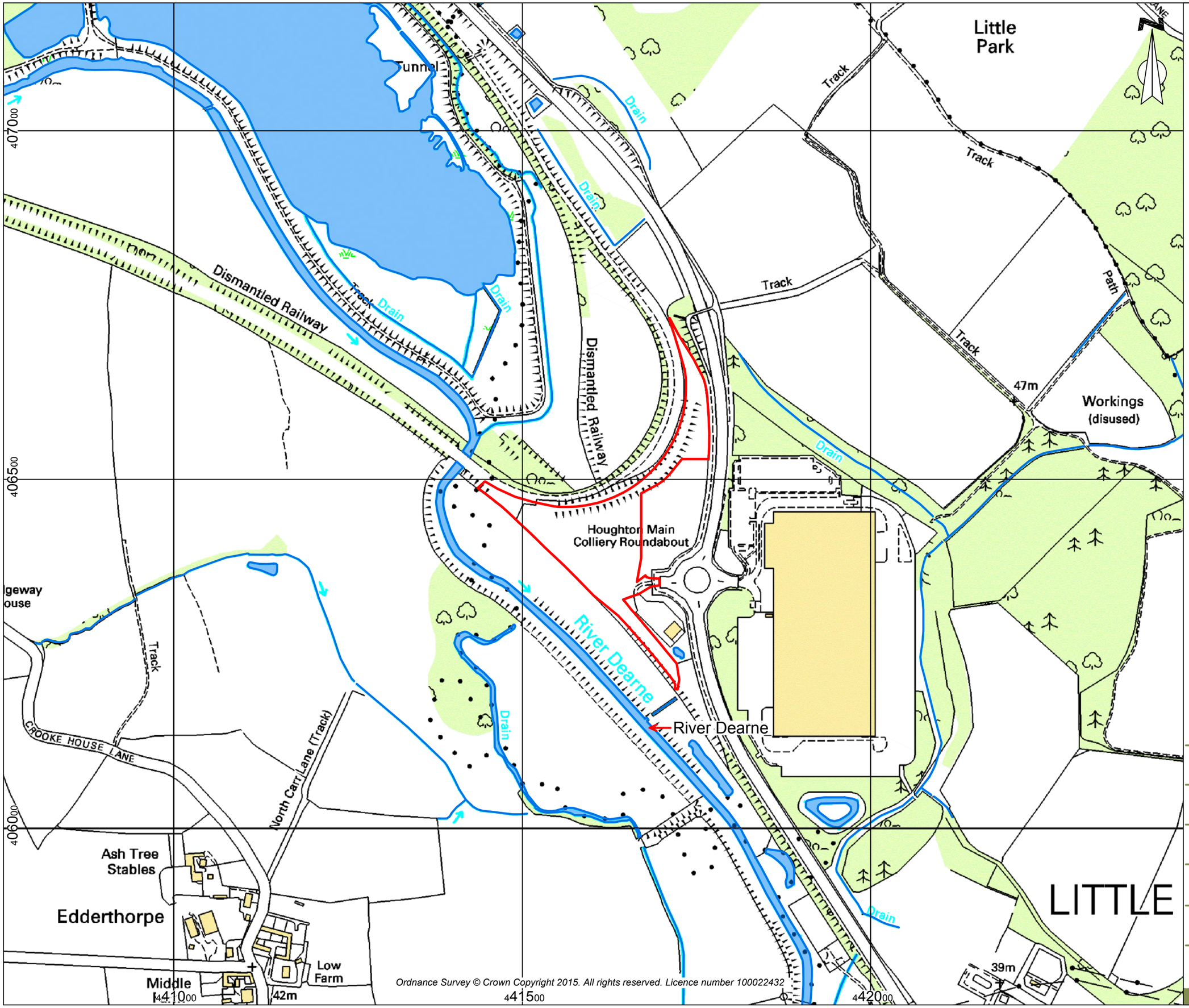
PROJECT REF: CRM.066.004.D.001

DRAWN:	CHECKED:	DATE:
MG	SD	Jan 2015

PROJECT: Houghton Main

TITLE: Site Location Plan

FIGURE NO: 1



Key

- Site Boundary
- Surface Water Features

enzygo environmental consultants
STEP Business Centre, Wortley Rd, Sheffield, S36 2UH

CLIENT: Peel Environmental Ltd

SCALE: 1:5,000@A3

PROJECT REF: CRM.066.004.D.002

DRAWN: MG

CHECKED: SD

DATE: Jan 2015

PROJECT: Houghton Main

TITLE: Surface Water Features

FIGURE NO: 2

Key

- Site Boundary
- Potential for Groundwater Flooding to Occur at Surface
- Potential for Groundwater Flooding of Property Situated Below Ground Level
- Limited Potential for Groundwater Flooding to Occur

enzygo environmental consultants
STEP Business Centre, Wortley Rd, Sheffield, S36 2UH

CLIENT: Peel Environmental Ltd

SCALE: 1:5,000@A3

PROJECT REF: CRM.066.004.D.003

DRAWN: MG

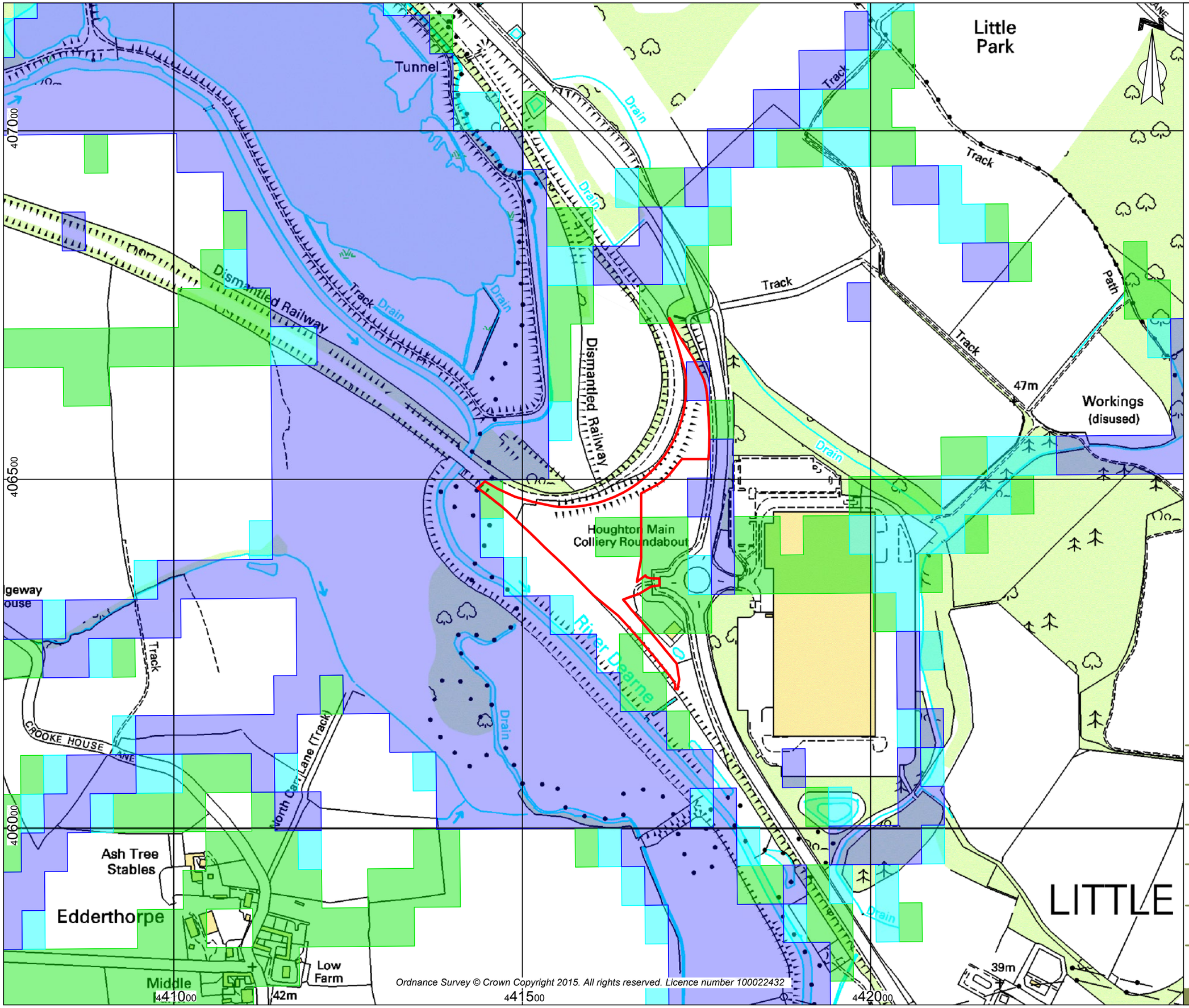
CHECKED: SD

DATE: Jan 2015

PROJECT: Houghton Main

TITLE: BGS Groundwater Flooding Susceptibility

FIGURE NO: 3



Key

- Site Boundary
- 1 in 75 Year Flood Event
- 1 in 100 Year Flood Event
- 1 in 1000 Year Flood Event

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STEP Business Centre, Wortley Rd, Sheffield, S36 2UH

CLIENT: Peel Environmental Ltd

SCALE: 1:5,000@A3

PROJECT REF: CRM.066.004.D.004

DRAWN: MG

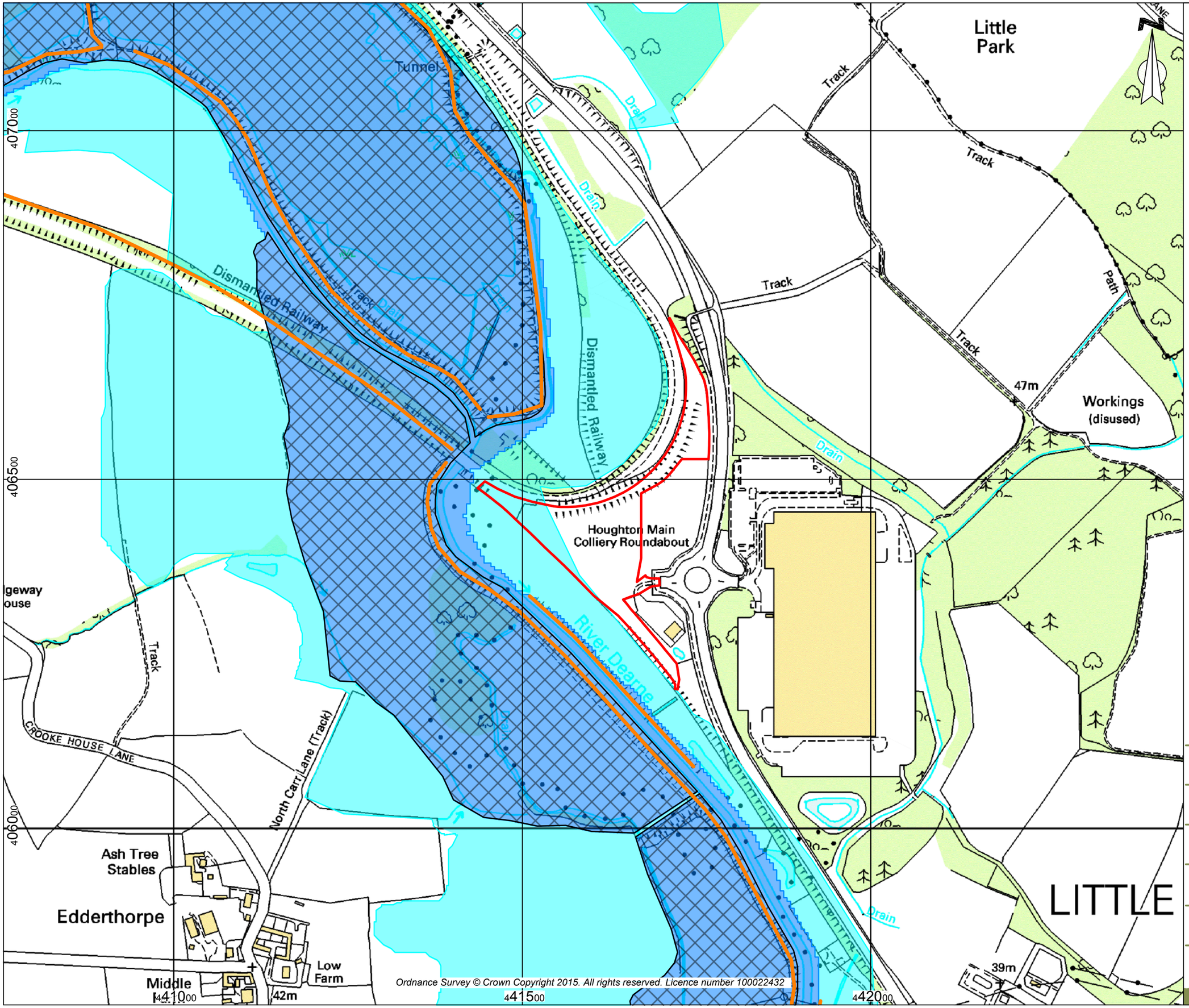
CHECKED: SD

DATE: Jan 2015

PROJECT: Houghton Main

TITLE: RMS Overland Flow Flooding

FIGURE NO: 4



enzygo
environmental consultants
STEP Business Centre, Wortley Rd, Sheffield, S36 2UH

CLIENT: Peel Environmental Ltd

SCALE: 1:5,000@A3

PROJECT REF: CRM.066.004.D.005

DRAWN: MG

CHECKED: SD

DATE: Jan 2015

PROJECT: Houghton Main

TITLE: Environment Agency Flood Zones

FIGURE NO: 5

Little Park

Tunnel

Drain

Track

Dismantled Railway

Path

47m

Workings (disused)

Houghton Main Colliery Roundabout

River Dearne

39m

LITTLE

Ash Tree Stables

Edderthorpe

Middle Farm

Low Farm

42m

CROOKE HOUSE LANE

North Carr Lane (Track)

4070^{00}

4065^{00}

4060^{00}

4410^{00}

4415^{00}

4420^{00}

Key

- Site Boundary
- Geological Indicators of Flooding

enzygo
environmental consultants
STEP Business Centre, Wortley Rd, Sheffield, S36 2UH

CLIENT: Peel Environmental Ltd

SCALE: 1:5,000@A3

PROJECT REF: CRM.066.004.D.006

DRAWN: MG

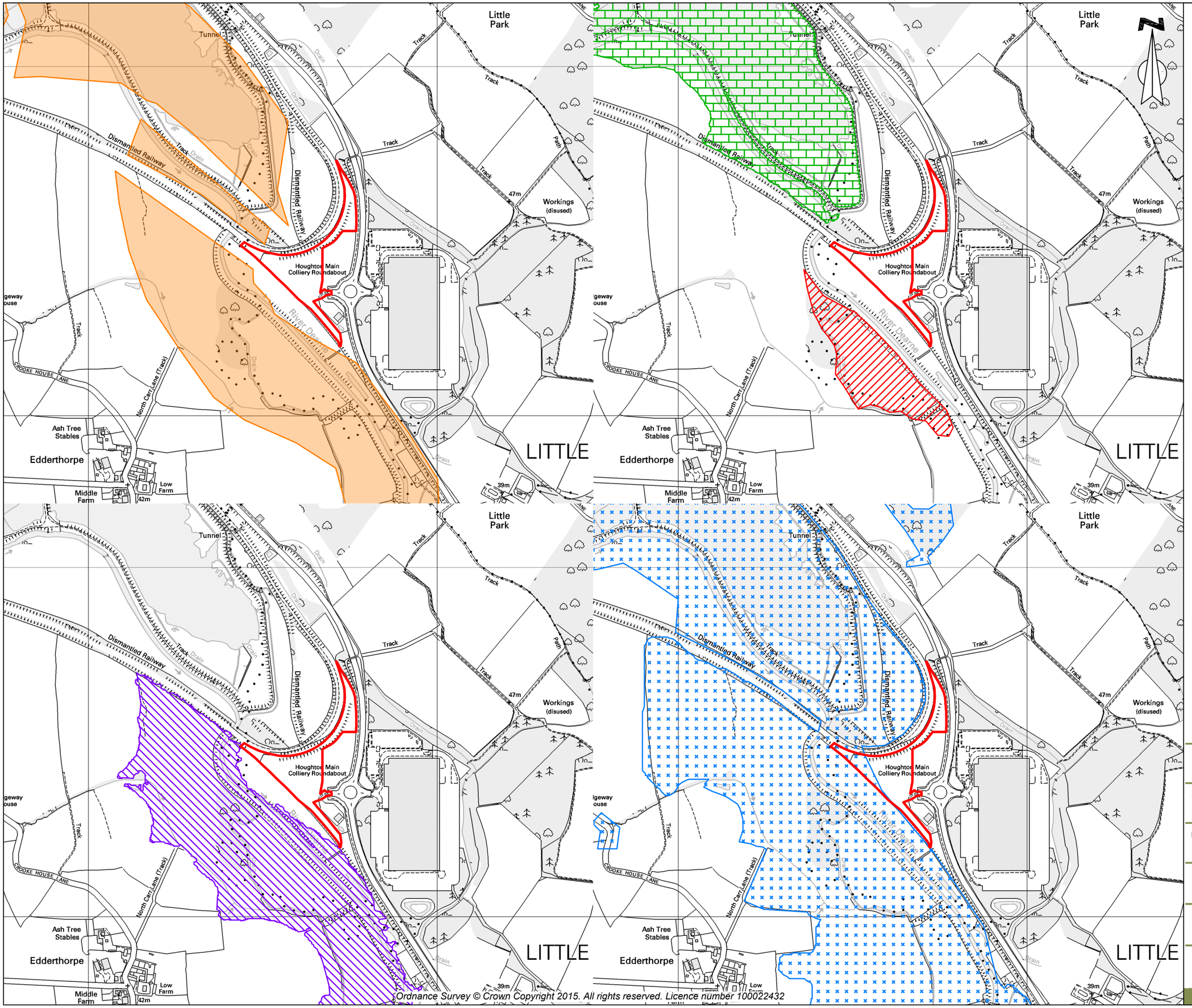
CHECKED: SD

DATE: Jan 2015

PROJECT: Houghton Main

TITLE: Geological Indicators of Flooding (based on geological deposits)

FIGURE NO: 6



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STEP Business Centre, Wortley Rd, Sheffield, S36 2UH

CLIENT: Peel Environmental Ltd

SCALE: 1:5,000@A3

PROJECT REF: CRM.066.004.D.007

DRAWN: MG

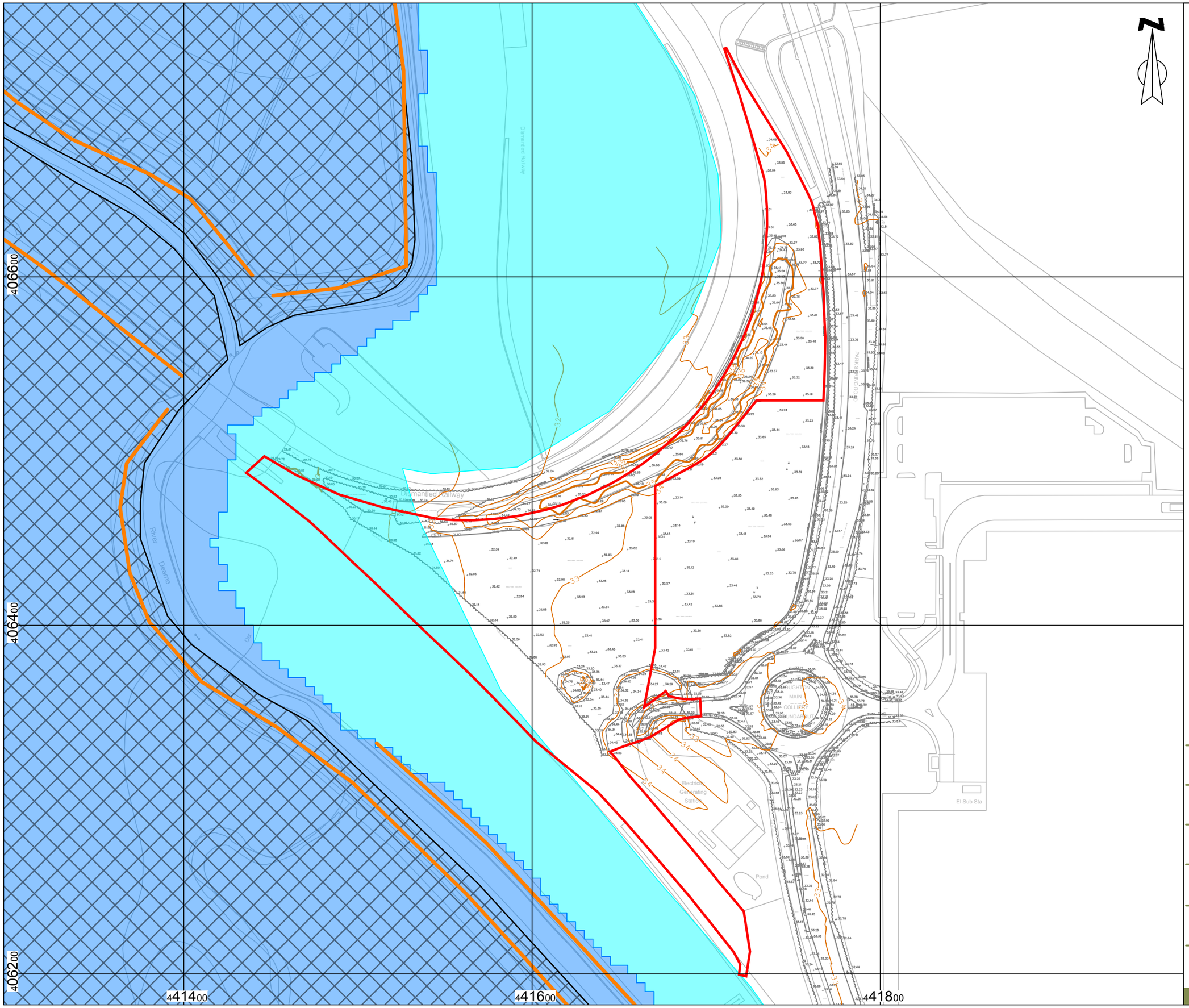
CHECKED: SD

DATE: Jan 2015

PROJECT: Houghton Main

TITLE: Historic Flood Events

FIGURE NO: 7



Key

- Site Boundary
- Flood Defences
- Flood Water Storage Areas
- Flood Zone 3
- Flood Zone 2
- Flood Zone 1

enzygo
environmental consultants
STEP Business Centre, Wortley Rd, Sheffield, S36 2UH

CLIENT: Peel Environmental Ltd

SCALE: 1:5,000@A3

PROJECT REF: CRM.066.004.D.008

DRAWN: MG

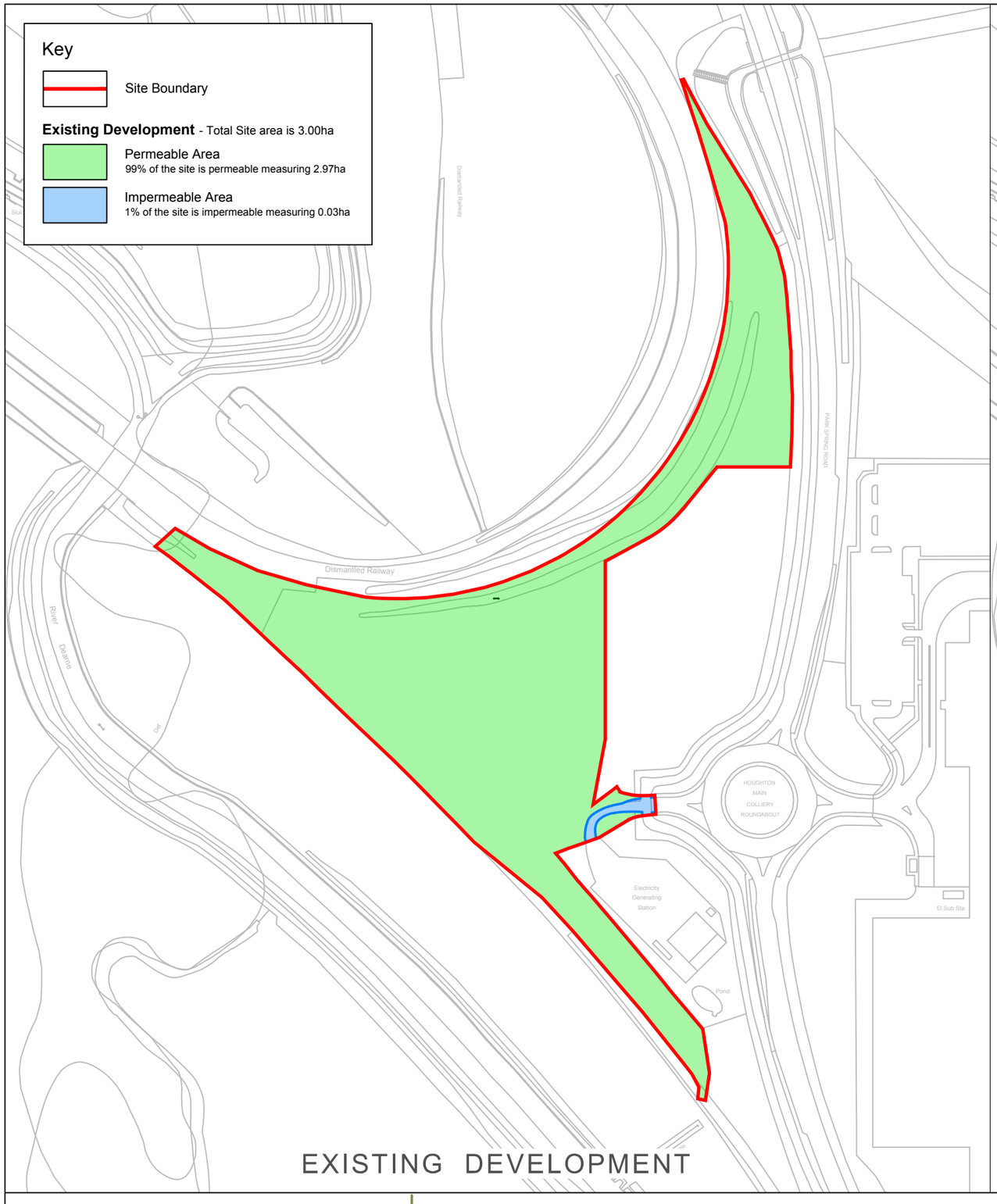
CHECKED: SD

DATE: Jan 2015

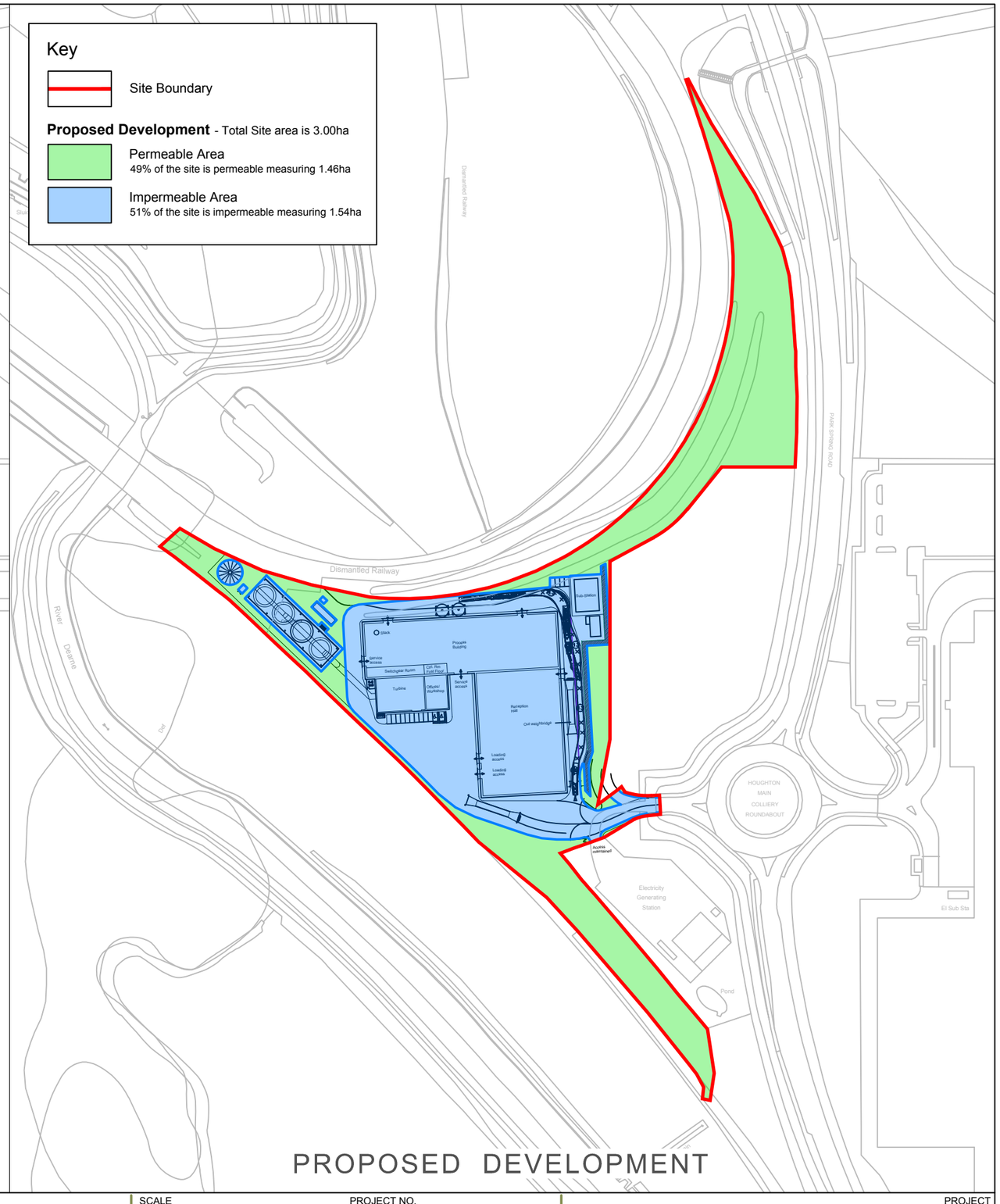
PROJECT: Houghton Main

TITLE: Environment Agency Flood Zones

FIGURE NO: 8



EXISTING DEVELOPMENT



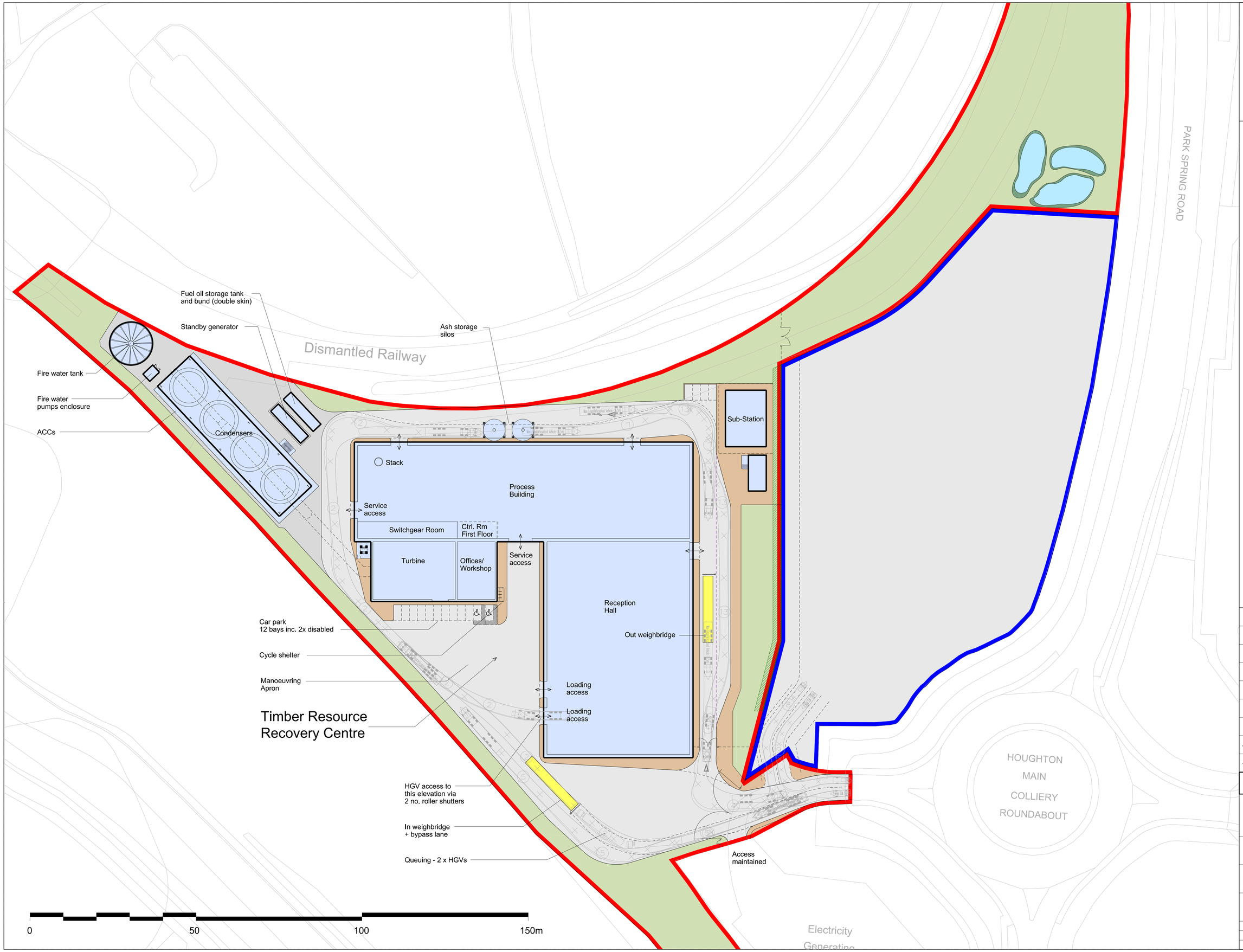
PROPOSED DEVELOPMENT

enzygo
environmental consultants
STEP Business Centre, Wortley Rd, Sheffield, S36 2UH

SCALE	PROJECT NO.	PROJECT
1:2,500@A3	CRM.066.004.D.009	Houghton Main
DATE	DRAWING NO.	DRAWING TITLE
Jan 2015	9	Permeable and Impermeable Areas
DRAWN	CHECKED	CLIENT
MG	SD	Peel Environmental Ltd

APPENDICES

Appendix 1 – Proposed Site Layout



NOTE

1. THIS DRAWING IS COPYRIGHT GSDA LTD.
2. THE CONTRACTOR MUST NOT SCALE FROM THE DRAWING ALL DIMENSIONS TO BE TAKEN FROM DIMENSION STRINGS.
3. WHERE ANY DISCREPANCIES ARE FOUND BETWEEN DIMENSIONS THESE MUST BE BROUGHT TO THE ATTENTION OF THE ARCHITECTS FOR RESOLUTION.
4. WHERE DISCREPANCIES EXIST BETWEEN REFERENCE OR ASSEMBLY DRAWINGS & DETAIL DRAWINGS, THE LATTER TAKE PREFERENCE.

NORTH

KEY

- Site boundary
- Adjacent site
- 2.5m wide hedge/ tree line perimeter
- For details of proposed landscaping and planting please refer to PL036-37

A	150128	Issued for information
-	150127	Issued for information

FOR INFORMATION

GSDA
GARRY STEWART DESIGN ASSOCIATES
Highlands House, Office 101A, 165 The Broadway, Wimbledon, London, SW19 1NE
T: 020 8544 9085

HOUGHTON MAIN TRRC
PROJECT

Proposed Revised Site Boundary
DRAWING

1:500@A1
1:1000@A3
SCALE

150128
DATE

1313_SK173	A	GS
DWG. NO.	REVISION	CHECKED

Appendix 2 – Topographic Survey

N
W E
S

LEGEND

1. TOPOGRAPHICAL SURVEY INFORMATION SHOWN ON THIS DRAWING IS BASED UPON THE ORDNANCE SURVEY NATIONAL GRID HEIGHT AND PLAN DATUM DERIVED BY G.P.S.(OSTN02,OSGB36).

2. WHILST EVERY EFFORT HAS BEEN MADE TO INCLUDE ALL ACCESSIBLE DETAIL, SOME FEATURES MAY NOT BE SHOWN IF OBSCURRED AT THE TIME OF SURVEY.

LEGEND

BH	Borehole
BOL	Bollard
BS	Bus stop
BT	Telecom. cover
CATV	Cable television cover
DR	Drain
DP	Down pipe
Elec	Electrical cover
EP	Elec. pole
ER	Earth rod
FH	Hydrant
FP	Flagpole
G	Gully
GV	Gas valve
IC	Inspection cover
KO	Kerb outlet
LB	Litter bin
LP	Lamp post
MH	Manhole
MK	Utility marker
NP	Name plate
PB	Post box
PM	Parking meter
PO	Post
PSY	Stay
MKR	Marker post
RE	Rodding eye
RS	Road sign
ST	Stop tap
SV	Sluice valve
TCB	Telephone call box
TL	Traffic light
TP	Telegraph pole
T.P.S.	Tactile paving slabs
VP	Vent pipe
WM	Water meter
WO	Water outlet

Level prefix descriptions

GL	Ground level
CL	Cover level
E.L.	Eaves level
IL	Invert level
P.L.	Parapet level
R.L.	Roof ridge level
TFL	Threshold level
WL	Water level
F.R.L.	Flat Roof level

50.00 + Spot level

STA 101
25.75 Survey control station with ID and Level

Fence annotation(Where annotated)

P/W Post & wire

P/W HT 1.2m Fence

Gate

Edge of Vegetation

0 10 20 30 40m 60 80 100

Metres
1:1000

Revision	By	Chk'd By	Date	Comments
0	JC	NPS	05/11	TOPOGRAPHICAL SURVEY

PEEL ENVIRONMENTAL

SLR
ASPECT HOUSE
ASPECT BUSINESS PARK
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www.slrconsulting.com

Site
PEEL ENVIRONMENTAL

Project
HOUGHTON MAIN

Drawing Title
TOPOGRAPHICAL SURVEY
MAY 2011

Scale
1:1000@A1

Date

Drawing Number
001

Revision
0

00304-00043.19.001.0.HOUGHTON_MAIN_TOPO_SURVEY.dwg

Appendix 3 – Environment Agency Correspondence

From:	Daniel Alstead
To:	Scott Dawson
Subject:	FW: Your Enquiry: RFI/2013/27509
Date:	18 November 2013 08:55:49
Attachments:	Standard_Notice sept 2012.pdf Flood History Map.pdf Flood Map.pdf Model Summary Sheets.pdf NPPF TG Climate Change extract.pdf VAT Receipt.pdf

---

From: Beech, Cheryl [mailto:Cheryl.Beech@environment-agency.gov.uk]
Sent: 12 November 2013 15:12
To: Daniel Alstead
Subject: Your Enquiry: RFI/2013/27509

Our Ref: RFI/2013/27509

Your Ref:

Dear Daniel

Provision of Product 4 for Park Spring Road, Houghton Main, Barnsley S71 5EX

Thank you for your request of 22 October 2013 to use Environment Agency data, Product 4, in the development of the above site. The information is attached.

If you have requested this information to help inform a development proposal, then you should note the detail in the attached advisory text on the use of Environment Agency Information for Flood Risk Assessments.

Supporting Information

The Flood Map

Please see the enclosed extract from the Flood Map.

The Flood Map provides information on flooding from rivers and the sea for England and Wales. The Flood Map also has information on flood defences and the areas benefiting from those flood defences.

The Flood Map shows the following:

1. Flood Zone 3 (dark blue area on the enclosed map): natural flood plain area that could be affected by flooding from rivers and/or the sea – not taking into account the presence of any flood defences
   - For flooding from rivers the map indicates the extent of a flood with a 1% (1 in 100) chance of happening each year;
   - For flooding from the sea the map shows the extent of a flood with a 0.5% (1 in 200) chance of happening each year.

2. Flood Zone 2 (light blue area): natural flood plain area that could be affected by flooding from rivers and/or the sea – not taking into account the presence of any flood defences. Flood Zone 2:

- indicates the extent of a flood with a 0.1% (1 in 1000) chance of happening each year.
- and/or indicates the greatest recorded historic flood, whichever is greater.

3. Flood defences built in the last five years to protect against river floods with a 1% (1 in 100) chance of happening each year, together with some natural or constructed entities which retain, store or channel water and which may protect against smaller floods.

4. Areas benefiting from flood defences - areas that benefit from the flood defences shown, in the event of a river flood with a 1% (1 in 100) chance of happening each year, or a flood from the sea with a 0.5% (1 in 200) chance of happening each year. If the defences were not there, these areas would flood.

Flood History

To the best of our knowledge there is no known flood history for this site. However, in close proximity to this location we do have some flood history available (see enclosed map).

Water causing flooding can come from different places, for example from rivers or the sea; surface water (i.e. rainwater flowing over or accumulating on the ground before it is able to enter rivers or the drainage system); overflowing or backing up of sewers or drainage systems which have been overwhelmed or from groundwater rising up from underground aquifers.

Currently the Environment Agency can only supply flood risk data relating to the risk of flooding from rivers or the sea. However you should be aware that in recent years, there has been an increase in flood damage caused by surface water flooding or drainage systems that have been overwhelmed. Local Authorities and/or Water Companies may be able to provide some knowledge on the risk of flooding from sources other than rivers and the sea and we are working with these organisations to improve knowledge and understanding of surface water flooding.

Assets

There are no formal flood defences helping to reduce flood risk in your area of interest.

Modelling - Flood Modelling - River Don

The River Don Catchment Flood Model was completed by Jeremy Benn Associates in May 2004. See enclosed the ISIS Hydraulic Model Summary Sheets showing modelled water levels and flows for 5 different annual probabilities

Please note that the model was developed taking into account the presence of

flood defences along the River Don and its tributaries as existed at the time of modelling.

Climate Change

See attached extract from the National Planning Policy Framework Technical Guidance by Communities and Local Government.

LIDAR Data

Light Detection and Ranging (LIDAR) is an airborne mapping technique, which uses a laser to measure the distance between the aircraft and the ground. This technique results in the production of an accurate, cost-effective terrain model suitable for assessing flood risk and other environmental applications.

The Environment Agency owns two LIDAR systems, which are installed in a survey aircraft along with its other operational remote sensing instruments.

The aircraft is positioned and navigated using Global Positioning System (GPS) corrected to known ground reference points. The aircraft typically flies at a height of about 800 metres above ground level and a scanning mirror allows a swath width of about 600 metres to be surveyed during a flight.

To get a license for the data you will need to contact our Science Group, stating the area you are interested in (preferably an OS Grid Reference, or a map with the area outlined). There may be a charge for this data.

Low resolution Data is returned as an ASCII grid, which can easily be converted to a surface model for use in most GIS applications, and is provided in 2km x 2km tiles, at a resolution of 2m.

High resolution Data is also returned as an ASCII grid, in 0.5km x 0.5km tiles, at a resolution between 0.125 and 0.5m.

For current catalogue of coverage see: http://www.geomatics-group.co.uk/GeoCMS/order.aspx

To obtain the data and license agreement, please contact:

Environment Agency Geomatics
Phoenix House
Lower Bristol Road
Bath BA2 9ES

Tel: 01225 487658
Fax: 01225 487643

E-mail: archived-lidardata@environment-agency.gov.uk
Or visit the website at www.geomatics-group.co.uk

The Rights & Responsibilities of a Riverside Owner

The owner of property adjacent to a watercourse is usually deemed to be the riparian owner and, as such, has both riparian rights and responsibilities with regard to the watercourse within their ownership.
The responsibility for general maintenance and repair of the watercourse and its banks rests with the riparian owner. For more information on Rights and Responsibilities of a riverside owner, you can visit our website at: www.environment-agency.gov.uk and click on 'Flood', 'How can I be prepared?, 'Guidance for riverside property owners' and download the 'Living on the Edge' booklet.

Alternatively type the following address into your web browser: http://www.environment-agency.gov.uk/homeandleisure/floods/31626.aspx

Flood Zones

Under the National Planning Policy Framework (NPPF) land is divided into three zones with regard to flood risk.

Zone 1, little or no risk, this is land outside the 1 in 1000 year flood plain, land deemed to be safe from flooding in the event of a flood with a 0.1% probability of occurring in any one year.

Zone 2, medium risk; land between the 1 in 1000 and 1 in 100 year fluvial (1 in 200 year tidal) flood plain. Between 0.1% and 1.0% (0.5%) probability of occurring in any one year.

Zone 3, high risk, land within the 1 in 100 year fluvial (1 in 200 year tidal) flood plain, at risk in the event of a flood with a 1.0% (0.5%) probability of occurring in any in year.

These zones do not take account of any flood defences that may exist as these could be overtopped or breached by a more severe flood event than designed for or maintained against.

Site Assessment;

From the supplied location plan I can confirm the site falls in flood zone 1 according to the Environment Agency Flood Map. We have no record of any watercourses on or abutting this property. The site may be subject to flooding from a number of different sources (small or culverted watercourses, public sewers, highway drains, overland surface water flow) and I would suggest that you contact the local authority main drainage department who may hold more detailed information for the site, and may be able to advise further.

Information to be included in a Flood Risk Assessment

A flood risk assessment (FRA) must be submitted with a planning application on any proposed development site over 1ha within Flood Zone 1. The FRA assessment would need to demonstrate that the development would not increase the risk of flooding to others and would not be at risk of flooding itself.

All potential sources of flooding will need consideration including; river flooding,

groundwater flooding, surface water runoff and flooding from sewers etc. It should also assess the existing and proposed surface water drainage from the site.

Further information on producing a FRA and where a FRA is required can be found on the Environment Agency's website on the Flood Risk Standing Advice pages which can be found at: http://www.environment-agency.gov.uk/research/planning/82587.aspx

A more comprehensive guide on FRA's can be found in CIRIA Report C624 'Development and flood risk - guidance for the construction industry' available through their website: http://www.ciria.org.

Your Local Planning Authority should have undertaken a Strategic Flood Risk Assessment, where information on flood risk locally has been collated which may inform your FRA. Please contact your Local Planning Authority to determine what information may be available.

Floor Levels

Setting the ground floor level above site ground level will provide a measure of protection against any flooding, prior to the introduction of NPPF the Agency's standard response was to require floor levels to be 600mm above site ground level. You should propose a suitable minimum floor level related to Ordnance Datum.

Surface Water Runoff

Surface water discharge from new development should ideally 'mimic' the pre-development situation using a sustainable drainage system so that flow in watercourses is not increased. In normal circumstances surface water discharge from new development should be attenuated to the 'greenfield' 1 in 1 year flow from site, or lower than the existing rate of runoff for a pre-developed site.

Greenfield sites

The acceptable greenfield runoff rate is normally 5 litre/second/hectare, **but you should consult with the Lead Local Flood Authority for variances in their district.**

Brownfield sites

Surface water runoff should be attenuated to provide a minimum 30% reduction of surface water discharge when compared with the existing site outflow prior to redevelopment, unless otherwise agreed with the relevant drainage authority. If a new discharge is required to a watercourse should be limited to the acceptable greenfield runoff rate, also it must be ensured that any additional volume of surface water to the receiving watercourse will not cause flooding problems.

The attenuation system needs to be designed so there is no flooding to properties on or off site for rainfall events up to 1 in 100 year return period.

Any conventional adopted balancing facility should be designed to accommodate volume storage for at least the 1 in 30 year flow from the site below ground, with the 1 in 100 year flow retained within the site (including an allowance for climate change), without causing any flooding to buildings.

There are alternatives to conventional storage for the control of surface water run-off that are favoured by the Environment Agency where ground conditions are suitable.

Sustainable Urban Drainage techniques (SUDs) tackle surface water run-off problems at source using features such as soakaways, permeable pavements, grassed swales, infiltration trenches, ponds and wetlands to attenuate flood peak flows, produce water quality improvements and environmental enhancements.

The Environment Agency seeks to promote the use of SUDs techniques to this site and expects the developer of the site to submit detailed investigations such that the use of SUDs has been fully explored.

More information on SUDs can be found at: http://www.ciria.org.uk/suds/

For information on Green Roofs in particular, please visit: www.thegreenroofcentre.co.uk

Please note that the view expressed in this letter by the Environment Agency is a response to a pre-application enquiry only and does not represent our final view in relation to any future planning application made in relation to this site. We reserve the right to change our position in relation to any such application.

You should seek your own expert advice in relation to technical matters relevant to any planning application before submission.

If you wish to discuss your plans further with the engineer dealing with the area Lesley Slaney can contacted on (0113) 8196044.

There are no environmentally sensitive receptors within the site area.

This information is provided subject to the attached notice which we advise that you should read.

We would be really grateful if you could spare five minutes to help us improve our service. Please click on the link below and fill in our survey – we use every piece of feedback we receive:

http://www.surveyshack.com/link/a3d10

If you require any further help, please do not hesitate to contact me.

Yours sincerely

Cheryl Beech
Customers and Engagement Team
Direct Dial 0113 8196360
Email neyorkshire@environment-agency.gov.uk

Please note: I only work part time - my usual working days are Tuesday, Wednesday & Thursday

Taking climate change into account

11. Global sea level will continue to rise, depending on greenhouse gas emissions and the sensitivity of the climate system. The relative sea level rise in England also depends on the local vertical movement of the land, which is generally falling in the south-east and rising in the north and west. In preparing a Strategic Flood Risk Assessment or a site-specific flood risk assessment, the allowances for the rates of relative sea level rise shown in table 4 should be used as a starting point for considering flooding from the sea, along with the sensitivity ranges for wave height and wind speed in table 5.

Table 4: Recommended contingency allowances for net sea level rises

	Net sea level rise (mm per year) relative to 1990			
	1990 to 2025	**2025 to 2055**	**2055 to 2085**	**2085 to 2115**
East of England, east midlands, London, south-east England (south of Flamborough Head)	4.0	8.5	12.0	15.0
South-west England	3.5	8.0	11.5	14.5
North-west England, north-east England (north of Flamborough Head)	2.5	7.0	10.0	13.0

Notes to table 4:

a. For deriving sea levels up to 2025, the 4mm per year, 3mm per year and 2.5mm per year rates (covering the three geographical groups respectively), should be applied back to the 1990 base sea level year. From 2026 to 2055, the increase in sea level in this period is derived by adding the number of years on from 2025 (to 2055), multiplied by the respective rate shown in the table. Subsequent time periods 2056 to 2085 and 2086 to 2115 are treated similarly.

b. Refer to Department for Environment, Food and Rural Affairs *FCDPAG3 Economic Appraisal Supplementary Note to Operating Authorities – Climate Change Impacts,* October 2006, for details of the derivation of this table. In particular, Annex A1 of this Note shows examples of how to calculate sea level rise.

c. Vertical movement of the land is incorporated in the table and does not need to be calculated separately.

12. The rise in sea level will change the frequency of occurrence of high water levels relative to today's sea levels, assuming no change in storminess. There may also be secondary impacts such as changes in wave heights due to increased water depths, as well as possible changes in the frequency, duration and severity of storm events. A 10 per cent sensitivity allowance should be added to offshore wind speeds and wave heights by the 2080s.

13. In making an assessment of the impacts of climate change on flooding from the land, rivers and sea as part of a flood risk assessment, the sensitivity ranges in table 5 may provide an appropriate precautionary response to the uncertainty about climate change impacts on rainfall intensities, river flow, wave height and wind speed.

Table 5: Recommended national precautionary sensitivity ranges for peak rainfall intensities, peak river flows, offshore wind speeds and wave heights

Parameter	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	*+5%*	*+10%*	*+20%*	*+30%*
Peak river flow	*+10%*	*+20%*		
Offshore wind speed	*+5%*		*+10%*	
Extreme wave height	*+5%*		*+10%*	

Notes to table 5:

a. Refer to Department for Environment, Food and Rural Affairs *FCDPAG3 Economic Appraisal Supplementary Note to Operating Authorities – Climate Change Impacts,* October 2006, for details of the derivation of this table.

b. For deriving peak rainfall, for example, between 2025 and 2055 multiply the rainfall measurement (in mm per hour) by 10 per cent and between 2055 and 2085 multiply the rainfall measurement by 20 per cent. So, if there is a 10mm per hour event, for the 2025 to 2055 period this would equate to 11mm per hour; and for the 2055 to 2085 period, this would equate to 12mm per hour. Other parameters in table 5 are treated similarly.

14. Sensitivity testing of the flood map produced by the Environment Agency, using the 20 per cent from 2025 to 2115 allowance for peak flows, suggests that changes in the extent of inundation are negligible in well-defined floodplains, but can be dramatic in very flat areas. However, changes in the depth of flooding under the same allowance will reduce the return period of a given flood. This

means that a site currently located within a lower risk zone (e.g. Zone 2 in table 1) could in future be re-classified as lying within a higher risk zone (e.g. Zone 3a in table 1). This in turn could have implications for the type of development that is appropriate according to its vulnerability to flooding (see table 2). It will therefore be important that developers, their advisors and local authorities refer to the current flood map and the Strategic Flood Risk Assessment when preparing and considering proposals.

15. Flooding in estuaries may result from the combined effects of high river flows and high sea surges. When taking account of impacts of climate change in flood risk assessments covering tidal estuaries, it will be necessary for the allowances for sea level rise in table 4 and the allowances for peak flow, wave height and wind speed in table 5 to be combined.[11]

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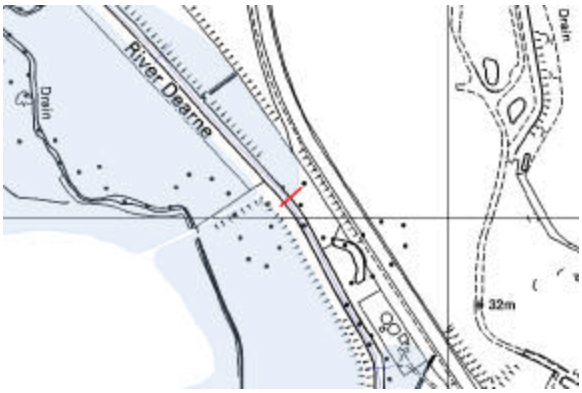
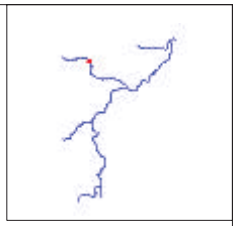
[11] Refer to Defra *FCDPAG3 Economic Appraisal Supplementary Note to Operating Authorities – Climate Change Impacts*, October 2006. Annex A2 gives details of joint probability analysis. www.defra.gov.uk/environ/fcd/pubs/pagn/climatechangeupdate.pdf

Environment Agency - North East Region
Re-working of the River Don Model
ISIS Hydraulic Model Summary Sheet

Location Plan



Cross Section References



River: DRN

Reach: 01

Chainage: 14304

Section Type: SECTION

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Survey Dwg Ref: N/A

Photograph Ref: DEAR_14304.JPG

Next
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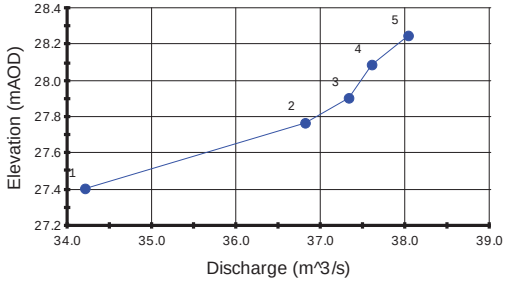
Section U/s: 14554

Rating Curve



Number represents model profile number

Summary of Results

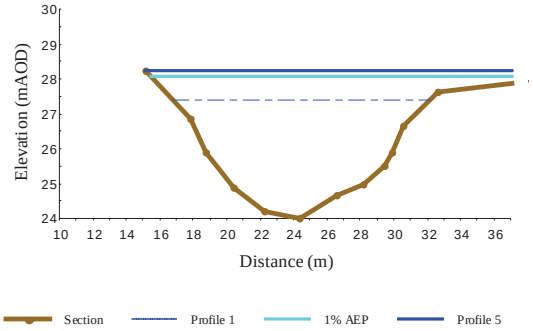
Profile No	AEP (%)	Flow (m^3/s)	Water Level (mAOD)	Velocity (m/s)
1	4.00	34.2	27.408	1.06
2	2.00	36.8	27.769	1.09
3	1.33	37.3	27.905	1.09
4	1.00	37.6	28.087	1.10
5	0.67	38.0	28.248	1.11

Level of Left Bank 28.240 mAOD

Level of Right Bank 27.630 mAOD

AEP: Annual Exceedance Probability = 1/T, where T = Return Period (Years)

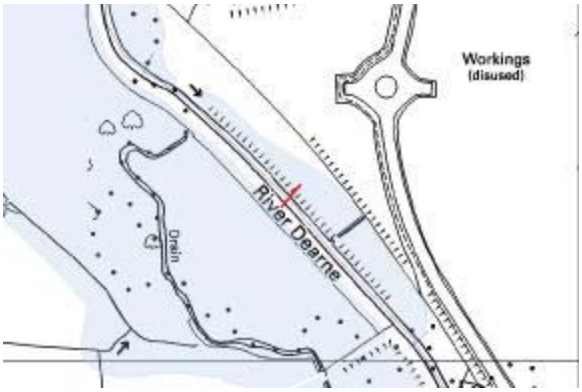
Cross Section Profile



DRN: 01: CROSS SECTION NUMBER 14304

Print Date: 21/05/2004

Location Plan



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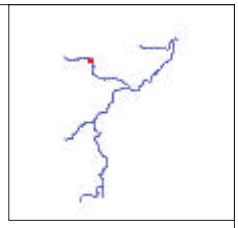

River: DRN

Reach: 01

Chainage: 14554

Section Type: SECTION

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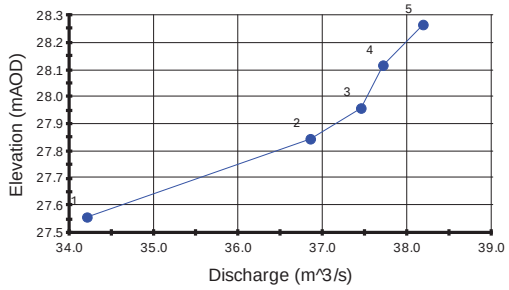
Photograph Ref: DEAR_14554.JPG

Next
Section D/s: 14304
Section U/s: 14806

Rating Curve



Number represents model profile number

Summary of Results

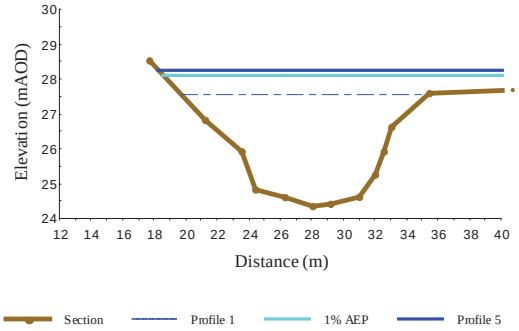
Profile No	AEP (%)	Flow (m^3/s)	Water Level (mAOD)	Velocity (m/s)
1	4.00	34.2	27.560	1.13
2	2.00	36.9	27.846	1.15
3	1.33	37.5	27.959	1.16
4	1.00	37.7	28.115	1.16
5	0.67	38.2	28.264	1.17

Level of Left Bank 28.530 mAOD

Level of Right Bank 27.600 mAOD

AEP: Annual Exceedance Probability = 1/T, where T = Return Period (Years)

Cross Section Profile



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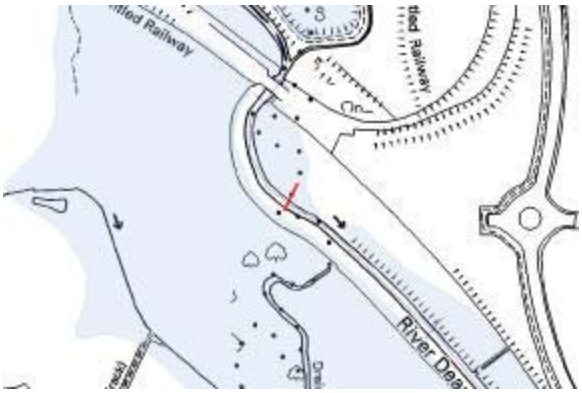
Re-working of the River Don Model
ISIS Hydraulic Model Summary Sheet

Location Plan



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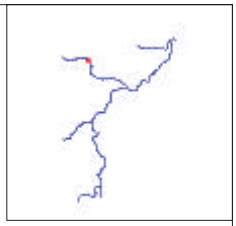

River: DRN

Reach: 01

Chainage: 14806

Section Type: SECTION

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Survey Dwg Ref: N/A

Photograph Ref: DEAR_14806.JPG

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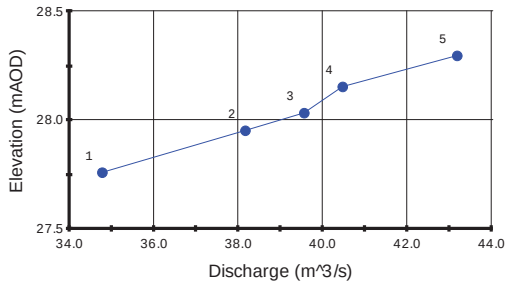
Section U/s: 14998D

Rating Curve



Number represents model profile number

Summary of Results

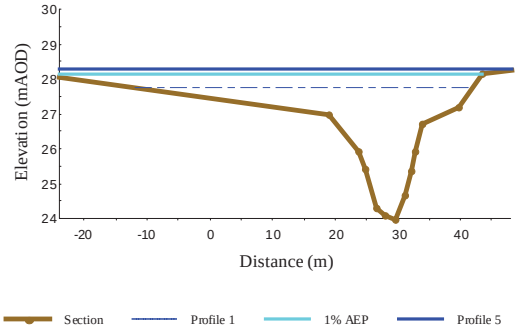
Profile No	AEP (%)	Flow (m^3/s)	Water Level (mAOD)	Velocity (m/s)
1	4.00	34.8	27.762	0.79
2	2.00	38.2	27.953	0.80
3	1.33	39.6	28.034	0.80
4	1.00	40.5	28.154	0.80
5	0.67	43.2	28.296	0.80

Level of Left Bank 28.060 mAOD

Level of Right Bank 27.850 mAOD

AEP: Annual Exceedance Probability = 1/T, where T = Return Period (Years)

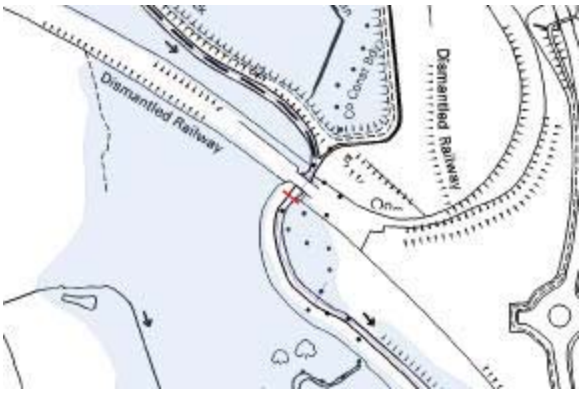
Cross Section Profile



DRN: 01: CROSS SECTION NUMBER 14806

Print Date: 21/05/2004

Location Plan



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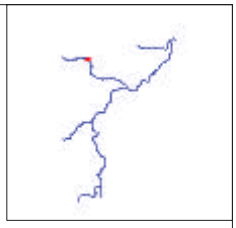

River: DRN

Reach: 01

Chainage: 14998D

Section Type: SECTION

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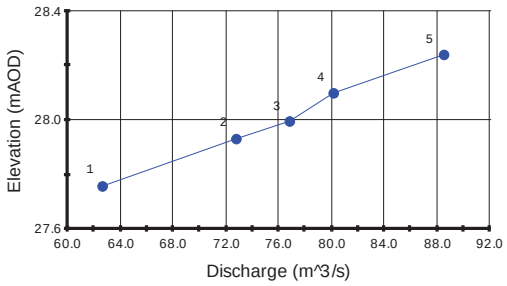
Photograph Ref: DEAR_14998b.JPG

Next
Section D/s: 14806
Section U/s: 14998U

Rating Curve



Number represents model profile number

Summary of Results

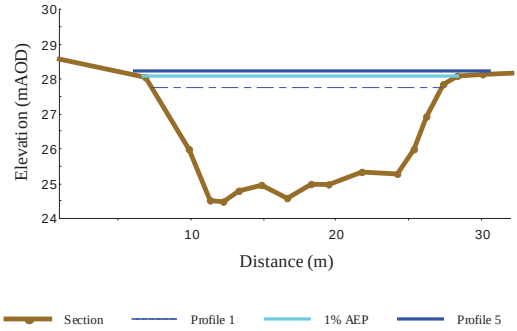
Profile No	AEP (%)	Flow (m^3/s)	Water Level (mAOD)	Velocity (m/s)
1	4.00	62.7	27.759	1.37
2	2.00	72.8	27.932	1.53
3	1.33	76.8	27.997	1.61
4	1.00	80.1	28.099	1.65
5	0.67	88.5	28.240	1.74

Level of Left Bank 28.060 mAOD

Level of Right Bank 27.850 mAOD

AEP: Annual Exceedance Probability = 1/T, where T = Return Period (Years)

Cross Section Profile



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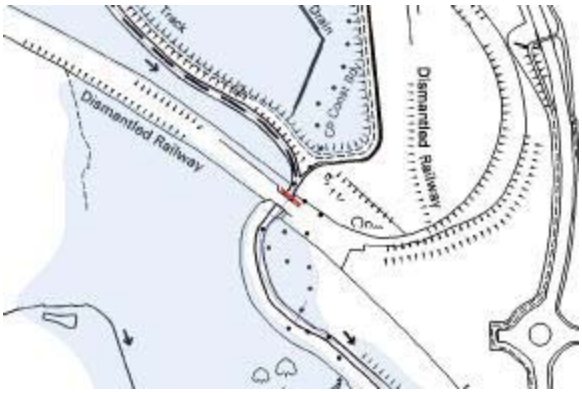
Location Plan



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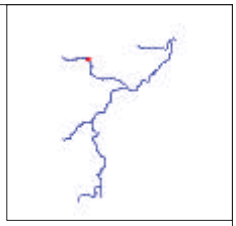

River: DRN

Reach: 01

Chainage: 14998U

Section Type: BRIDGE, SECTION

OS NGR: SE 41426 06534

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Photograph Ref: DEAR_14998b.JPG

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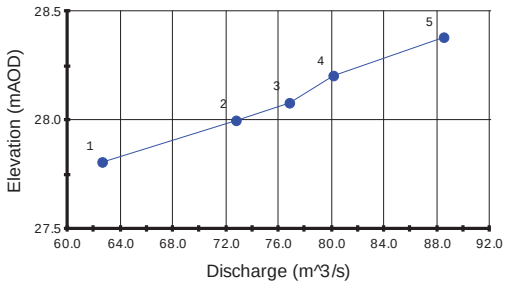
Rating Curve



Number represents model profile number

Summary of Results

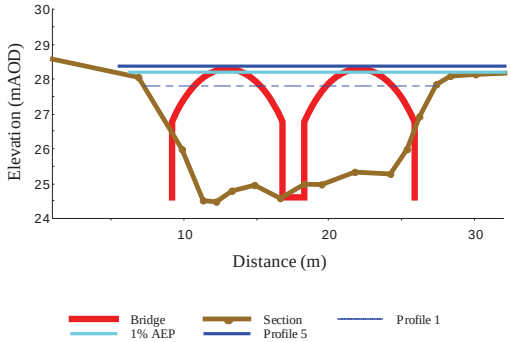
Profile No	AEP (%)	Flow (m^3/s)	Water Level (mAOD)	Velocity (m/s)
1	4.00	62.7	27.809	1.34
2	2.00	72.8	27.998	1.49
3	1.33	76.8	28.079	1.56
4	1.00	80.1	28.203	1.60
5	0.67	88.5	28.379	1.68

Level of Left Bank 28.060 mAOD

Level of Right Bank 27.850 mAOD

AEP: Annual Exceedance Probability = 1/T, where T = Return Period (Years)

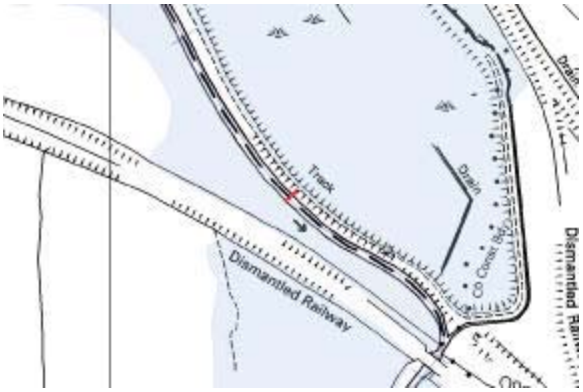
Cross Section Profile



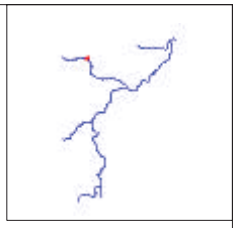
DRN: 01: CROSS SECTION NUMBER 14998U

Environment Agency - North East Region
Re-working of the River Don Model
ISIS Hydraulic Model Summary Sheet

Location Plan



Cross Section References



River: DRN

Reach: 01

Chainage: 15304U

Section Type: SECTION

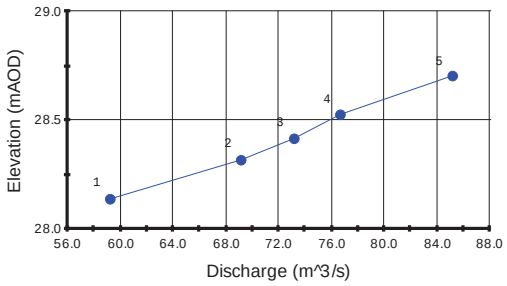
OS NGR: SE 41235 06743

Survey Dwg Ref: N/A

Photograph Ref: DEAR_15304.JPG

Next
Section D/s: 14998U
Section U/s: 15555

Rating Curve



Number represents model profile number

Summary of Results

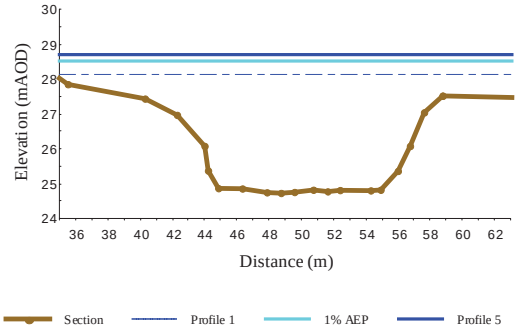
Profile No	AEP (%)	Flow (m^3/s)	Water Level (mAOD)	Velocity (m/s)
1	4.00	59.2	28.141	0.83
2	2.00	69.2	28.319	0.86
3	1.33	73.2	28.417	0.87
4	1.00	76.7	28.526	0.87
5	0.67	85.1	28.703	0.88

Level of Left Bank 27.440 mAOD

Level of Right Bank 27.520 mAOD

AEP: Annual Exceedance Probability = 1/T, where T = Return Period (Years)

Cross Section Profile

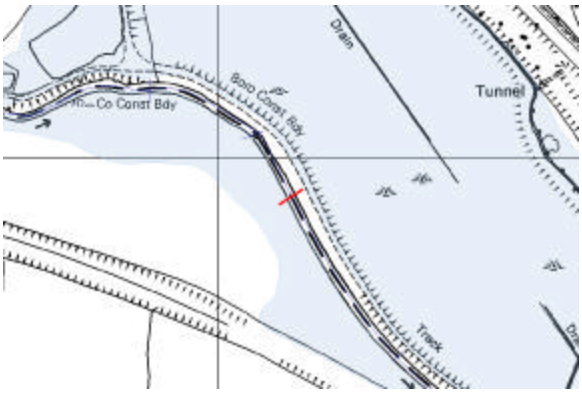


DRN: 01: CROSS SECTION NUMBER 15304U

Print Date: 21/05/2004

Environment Agency - North East Region
Re-working of the River Don Model
ISIS Hydraulic Model Summary Sheet

Location Plan



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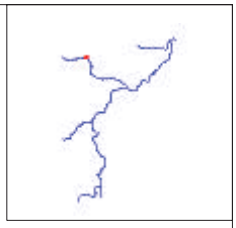


River: DRN

Reach: 01

Chainage: 15555

Section Type: SECTION

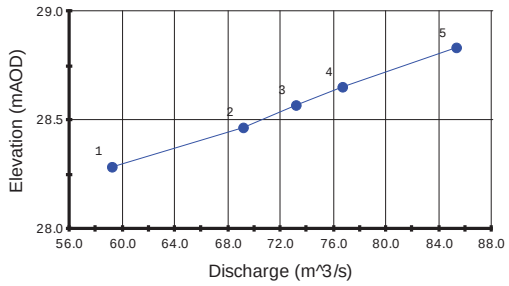
OS NGR: SE 41094 06949

Survey Dwg Ref: N/A

Photograph Ref: DEAR_15650.JPG

Next
Section D/s: 15304U
Section U/s: 15650U

Rating Curve



Number represents model profile number

Summary of Results

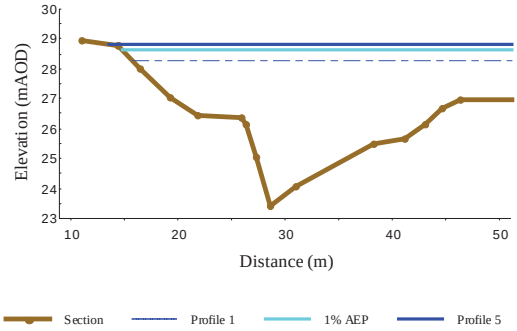
Profile No	AEP (%)	Flow (m^3/s)	Water Level (mAOD)	Velocity (m/s)
1	4.00	59.2	28.287	0.51
2	2.00	69.2	28.466	0.54
3	1.33	73.2	28.568	0.55
4	1.00	76.7	28.652	0.56
5	0.67	85.3	28.832	0.57

Level of Left Bank 28.790 mAOD

Level of Right Bank 26.980 mAOD

AEP: Annual Exceedance Probability = 1/T, where T = Return Period (Years)

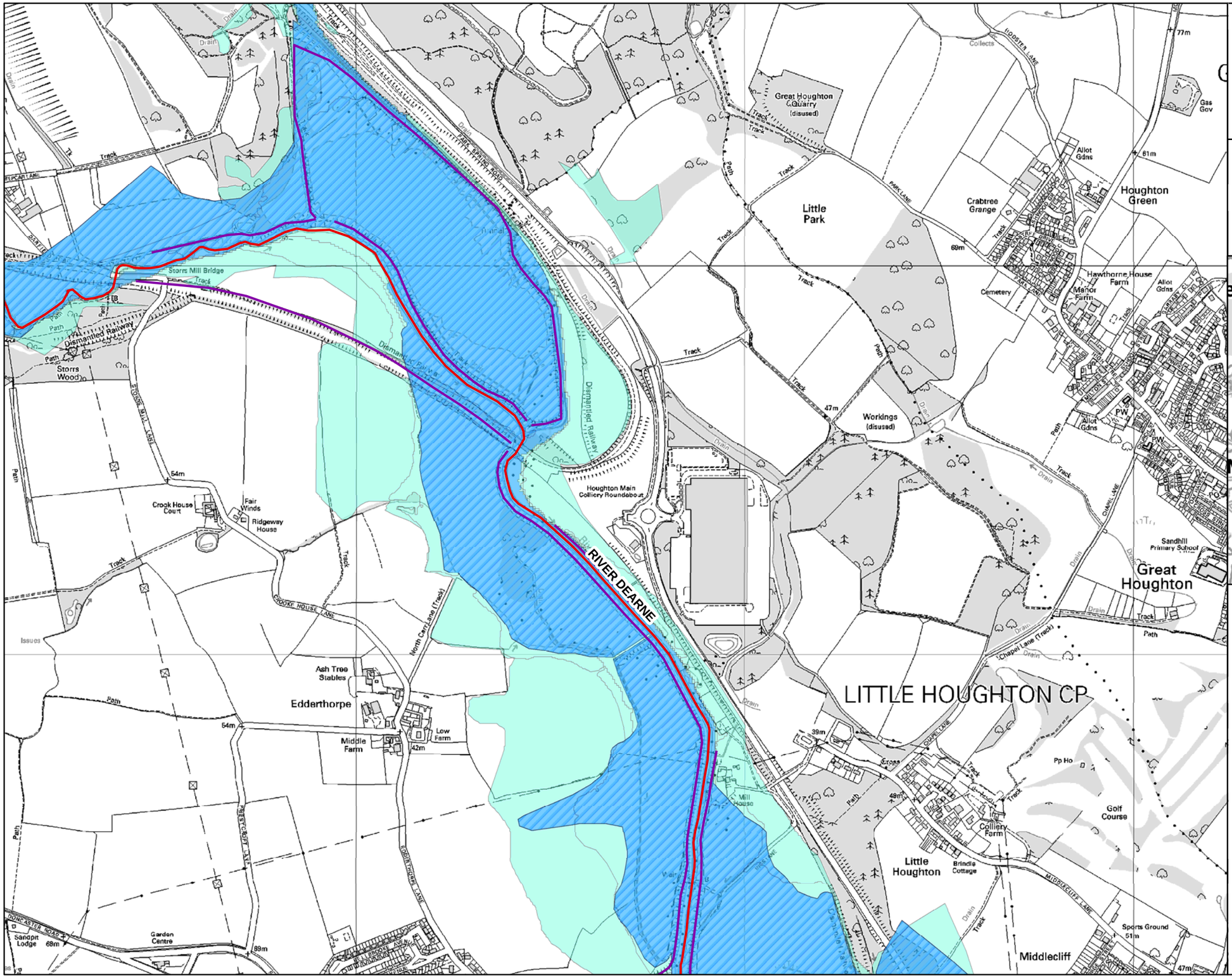
Cross Section Profile



DRN: 01: CROSS SECTION NUMBER 15555

Print Date: 21/05/2004

Flood Map for Park Spring Road, Houghton Main, Barnsley - Date Created: 07/11/2013 Ref: 27509



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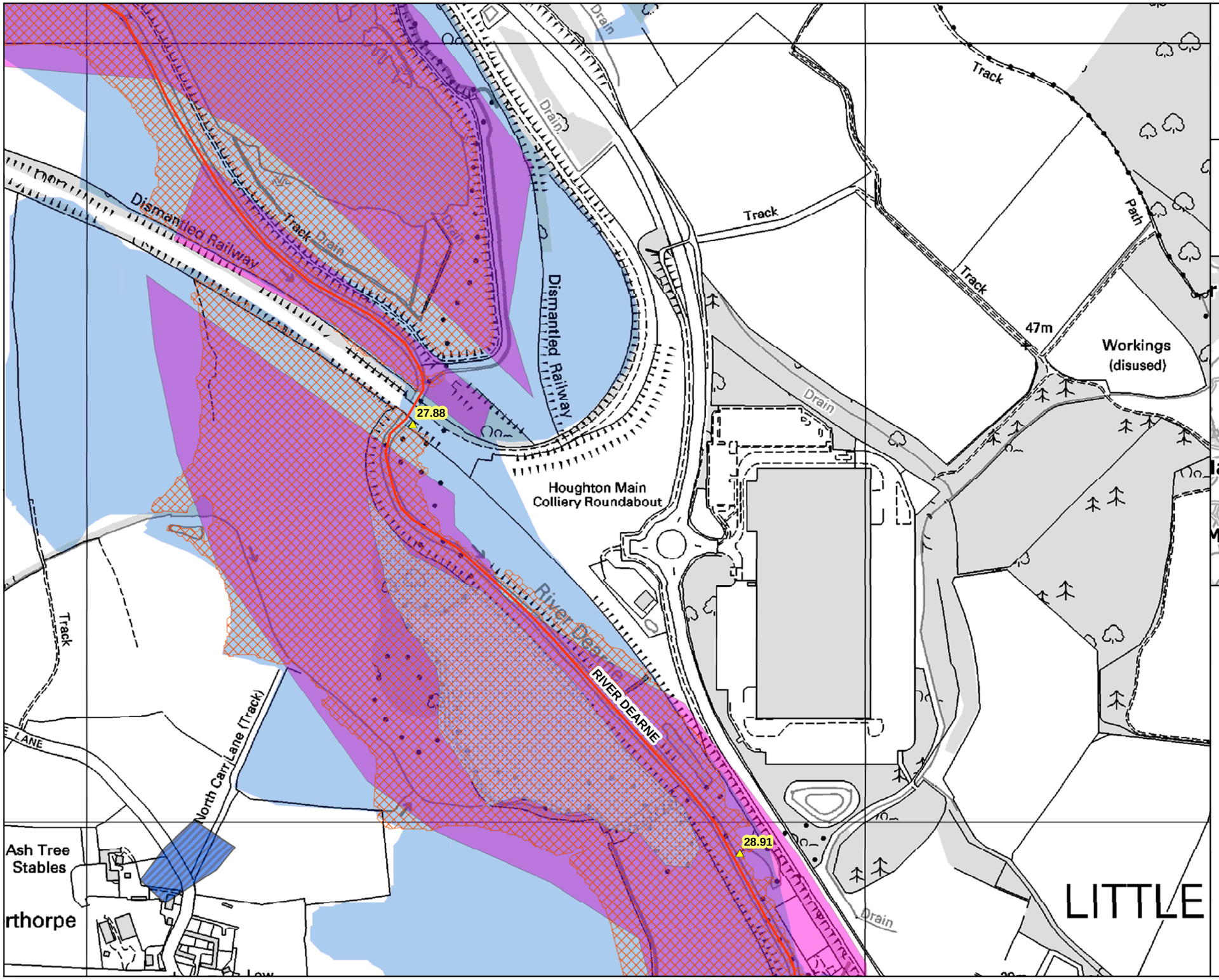
N
W E
S

LEGEND

- Main River
- Flood Map Flood Defences
- Flood Zone 3 (FZ3)
- Flood Zone 2 (FZ2)
- Flood Storage Areas

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 08708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Flood History Map for Park Spring Road, Houghton Main, Barnsley- dated: 07/11/2013 [Ref: 27509]



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Scale: 1:5,000

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N
W E
S

Flood Extents

Legend

- Main River
- Autumn 2000 Flood Event Flood Level (m)
- Autumn 2000 Flood Event Flood Extent
- 2007 Flood Events Flood Extent
- 2007 Flood Event Surface Water Flood Extent
- 1982 Flood Event Flood Extent
- River Don 1947 Flood Event Flood Extent

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 08708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

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Appendix 4 – Yorkshire Water Correspondence

YORKSHIRE WATER

PROTECTION OF MAINS AND SERVICES

1. The position of Yorkshire Water Services Ltd (YWS) apparatus shown on the existing mains record drawing(s) indicates the ***general*** position and nature of our apparatus and the accuracy of this information cannot be guaranteed. Any damage to YWS apparatus as a result of your works may have serious consequences and you will be held responsible for all costs incurred. Prior to commencing major works, the exact location of apparatus must be determined on site, if necessary by excavating trial holes. The actual position of such apparatus and that of service pipes which have not been indicated must be established on site by contacting the Customer Helpline (0845 124 24 24) for water and (0845 124 24 29) for sewerage.

2. The public sewer network is lawfully retained in its existing position and the sewerage undertaker is entitled to have it remain so without any disturbance. The provisions of section 159 of the Water Industry Act 1991 provides that the sewerage undertaker may "inspect, maintain, adjust, repair or alter" the network. Those rights are given to enable the sewerage undertaker to perform its statutory duties. Any development of the land or any other action that unacceptably hindered the exercise of those rights would be unlawful.

3. Ground levels over existing YWS apparatus are to be maintained. Sewers in highways will ***generally*** be laid to give 1200mm of cover from finished ground level working to kerb races, other permanent identification of the limits of the road or to an agreed line and level. Substantial increases or decreases to this 1200mm depth of cover will result in the sewer being re-laid at your expense.

4. If surface levels are to be decreased / increased significantly the effects on existing water supply apparatus will be carefully considered and if any alterations are necessary, the costs of the alterations will be recharged to you in full. Outlets on fire hydrants must be no more than 300mm below the new levels and all surface boxes must be adjusted as part of the scheme.

5. To enable future repair works to be carried out without hindrance; any pipe, cable, duct, etc. installed parallel to a water main or service pipe should not be installed directly over or within 300mm of a water main or service pipe or 1000mm of a waste water asset. Where a pipe, cable, duct, etc. crosses a main or service it should preferably cross perpendicular or at an angle of no less than 45° and with a minimum clearance of 150mm. These requirements apply to activities within an existing highway and are relevant to the installation of pipes, cables, ducts, etc. up to and including 250mm in diameter. Necessary protection measures for installations greater than 250mm in diameter and/or in private land will need to be agreed on an individual basis. Installations within a new development site must comply with the National Joint Utilities Group publication Volume 2: NJUG Guidelines On The Positioning Of Underground Utilities Apparatus For New Development Sites.

6. All excavation works near to YW apparatus should be by hand digging only.

7. Backfilling with a suitable material to a minimum 300mm above YW apparatus is required.

8. Adequate support must be provided where any works pass under YW apparatus.

9. Jointing chambers, lighting columns and other structures must be installed in such a way that future repair or maintenance works to YW apparatus will not be hindered.

10. Apparatus such as; railings, sign posts, etc. must not be placed in such a way that they prevent access to or full operation of controlling valves, hydrants or similar apparatus. YWS surface boxes must not be covered or buried. Any adjustment, alteration or replacement of manhole covers must be agreed on site prior to the commencement of the works with a YWS Inspector who may be contacted via our Call Centre on 0845 124 24 29.

11. Explosives shall not be used within 100 metres of any Yorkshire Water Services apparatus or installations.

12. Vibrating plant should not be used directly over any apparatus. Movement or operation by vehicles or heavy plant is not to be permitted in the immediate vicinity of YWS plant or apparatus unless there has been prior consultation and, if necessary, adequate protection provided without cost to YWS.

13. ***Under no circumstances*** should thrust boring or similar trenchless techniques commence until the actual position of the Company's mains/services along the proposed route have been confirmed by trial holes.

14. Any alterations to the highway should be notified following the procedures outlined in the New Road and Street Works Act 1991 Code of Practice; Measures Necessary Where Apparatus Is Affected By Major Works (Diversionary Works).

15. You will be held responsible for any damage or loss to YWS apparatus during and after completion of work, caused by yourselves, your servant or agent. Any damage caused or observed to YWS plant or apparatus should be immediately reported to YWS. Should YW incur any costs as a result of non-compliance with the above, all costs will be rechargeable in full.

16. You should ensure that nothing is done on the site to prejudice the safety or operation of YWS employees, plant or apparatus.

17. In accordance with the New Roads and Street Works Act 1991, Chapter 22, Part 3, Section 80. The location of any identified YW asset "*which is not marked, or is wrongly marked, on the records made available* " should be communicated back to Yorkshire Water. The location of the apparatus should be identified on copies of the supplied plans which should be returned to Yorkshire Water (Asset Records Team) with photographic supporting evidence where possible.

18. The Government has decided that responsibility for private sewers serving two or more properties and lateral drains (the section of

pipe beyond the boundary of a single property, connecting it to the public sewer) will be transferred to the water companies on Oct 1 2011. Private pumping stations will also transfer during the period 1 October 2011 – 1 Oct 2016. Records of these assets may not yet be shown on the existing mains record drawing(s). If you encounter any of these assets you must inform Yorkshire Water Services Ltd (YWS).

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Sewer Legend


Combined Sewer


S24 Combined Sewer


Surface Water Sewer


S24 Surface Water Sewer


Foul Sewer


S24 Foul Sewer


Section 104 Sewer

Public Rising Main


Pumping Station


Abandoned Sewer

Public Sewage
Treatment Works


Syphon Sewer &
Vacuum Sewer

\+ Property Identifier

Water Legend

Water Main 4" and below

Water Main 4" and above

Raw Water Main

Private Water Main


Fire Hydrant


Pumping Station

safe-move
A part of YorkshireWater

Track
Ward Bdy
CR
Drain
Ward Bdy
Drain
MP 173
Sluice
Dismantled Railway
Dismantled Railway
River Dearne
Def
(Track)
Drain
PARK SPRLNG ROAD
48.9m
Track
Post
Drain
Foot Bridge
HOUGHTON MAIN COLLIERY ROUNDABOUT
Electricity Generating Station
El Sub Sta
Pond

441256 : 406191	Map Name : SE4106SW	Title	Partial Key Water mains up to 4" in diameter Water mains over 4" in diameter Raw water mains Private water mains
	Yorkshire Water, PO Box 500, Halifax Road, Bradford BD6 2LZ Contact Name : Ms H Webster Contact Tel :	Notes	The position and depths of apparatus shown on this plan are approximate only. The exact positions and depths should be obtained by excavation trial holes.
		(Ody) COPYRIGHT STATEMENTS: Reproduced by permission of Ordnance Survey on behalf of HMSO © Crown copyright and database 2004. All rights reserved Ordnance Survey Licence number 100019559	Scale : 1:2500 Drg No : Maris No : Date Req : 20/03/2014, 09:04:53 Date Gen : 20/03/2014, 09:04:53 Source : Water Network Enquiry

UPN: Undefined Originator: H Webster, Safe Move,

safe-move
A part of YorkshireWater

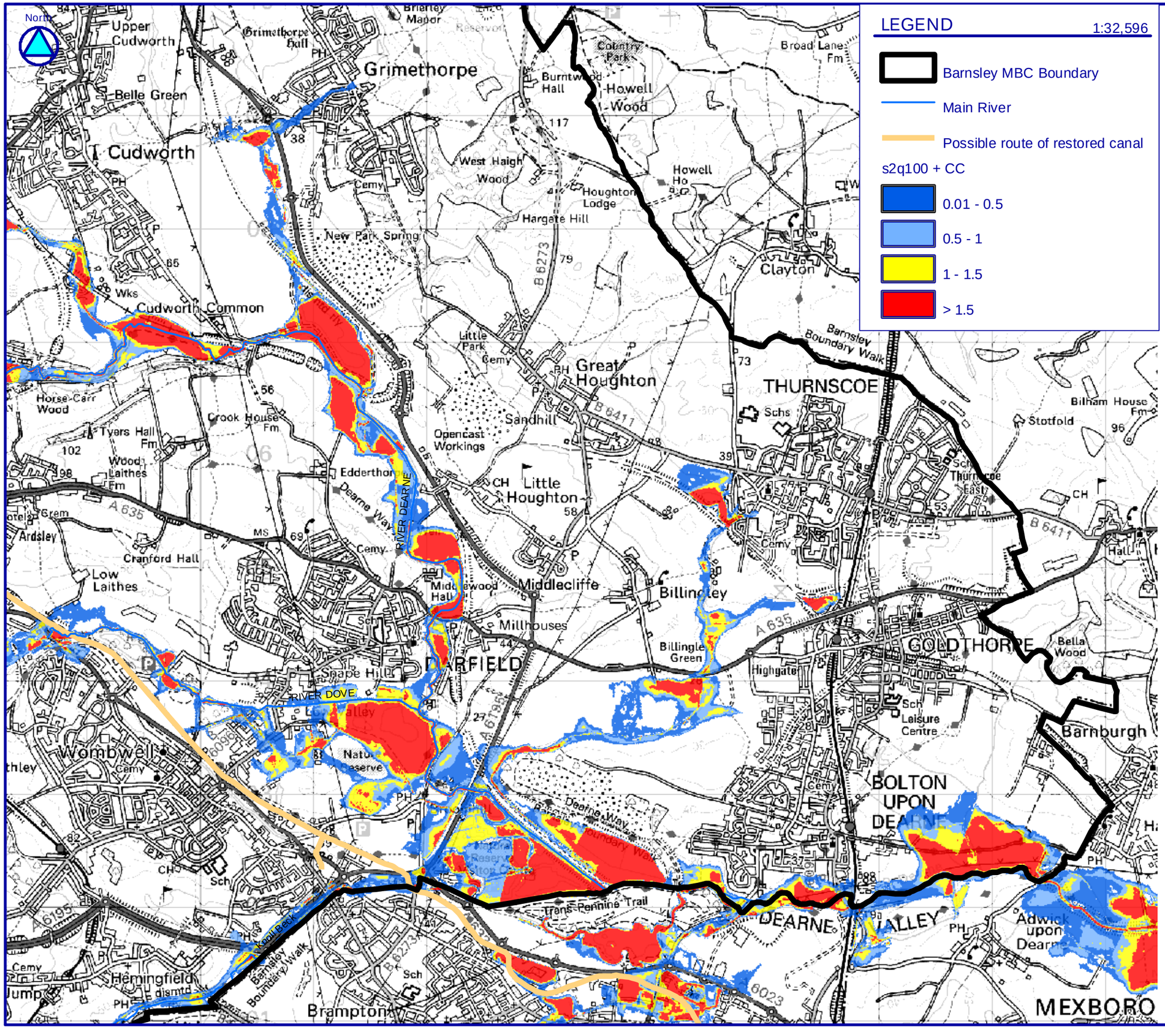
Track
Ward Bdy
CR
Drain
Ward Bdy
Drain
MP 173
Sluice
Dismantled Railway
Dismantled Railway
River Dearne
Def
PARK SPRLNG ROAD
48.9m
Track
Post
Drain
Foot Bridge
HOUGHTON MAIN COLLIERY ROUNDABOUT
Electricity Generating Station
El Sub Sta
Pond
Drain
(Track)

441256 : 406191	Map Name : SE4106SW	Title	Partial Key
	Yorkshire Water, PO Box 500, Halifax Road, Bradford BD6 2LZ Contact Name : Ms H Webster Contact Tel :	Notes	Foul Sewer = F Combined Sewer = C Surface Water Sewer = SW Trade Sewer = TD Partially Separate = PS

Date Req : 20/03/2014, 09:05:10
Date Gen : 20/03/2014, 09:05:12
Source : Sewer Network Enquiry

UPN: Undefined
Originator: H Webster, Safe Move,

Appendix 5 – SFRA Extracts



LEGEND

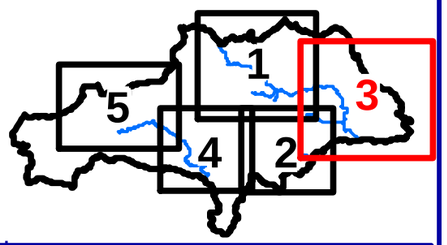
1:32,596

- Barnsley MBC Boundary
- Main River
- Possible route of restored canal

s2q100 + CC

- 0.01 - 0.5
- 0.5 - 1
- 1 - 1.5
- > 1.5

KEYPLAN



Note:

This map shows the potential scale of flood inundation for a range of severe overtopping flood events and different standards of flood defence. They do not include the impact of a breach or failure of these defences.

Typical range of defence standards for the River Don and Dearne is to protect up to a 1 in 30year (3%) return period.

s2 = 1 in 2year Standard of Defence
q100 = 1 in 100year or 1% probability flood event.
Climate Change scenario represents 20% increase of flood flow.

This map should be considered in support of the Environment Agency Flood Zone Maps to aid the Sequential and Exception Tests.
It should not be considered in isolation without reference to the other SFRA Flood Risk Maps.

Please see the Section 6 of the SFRA for further details.

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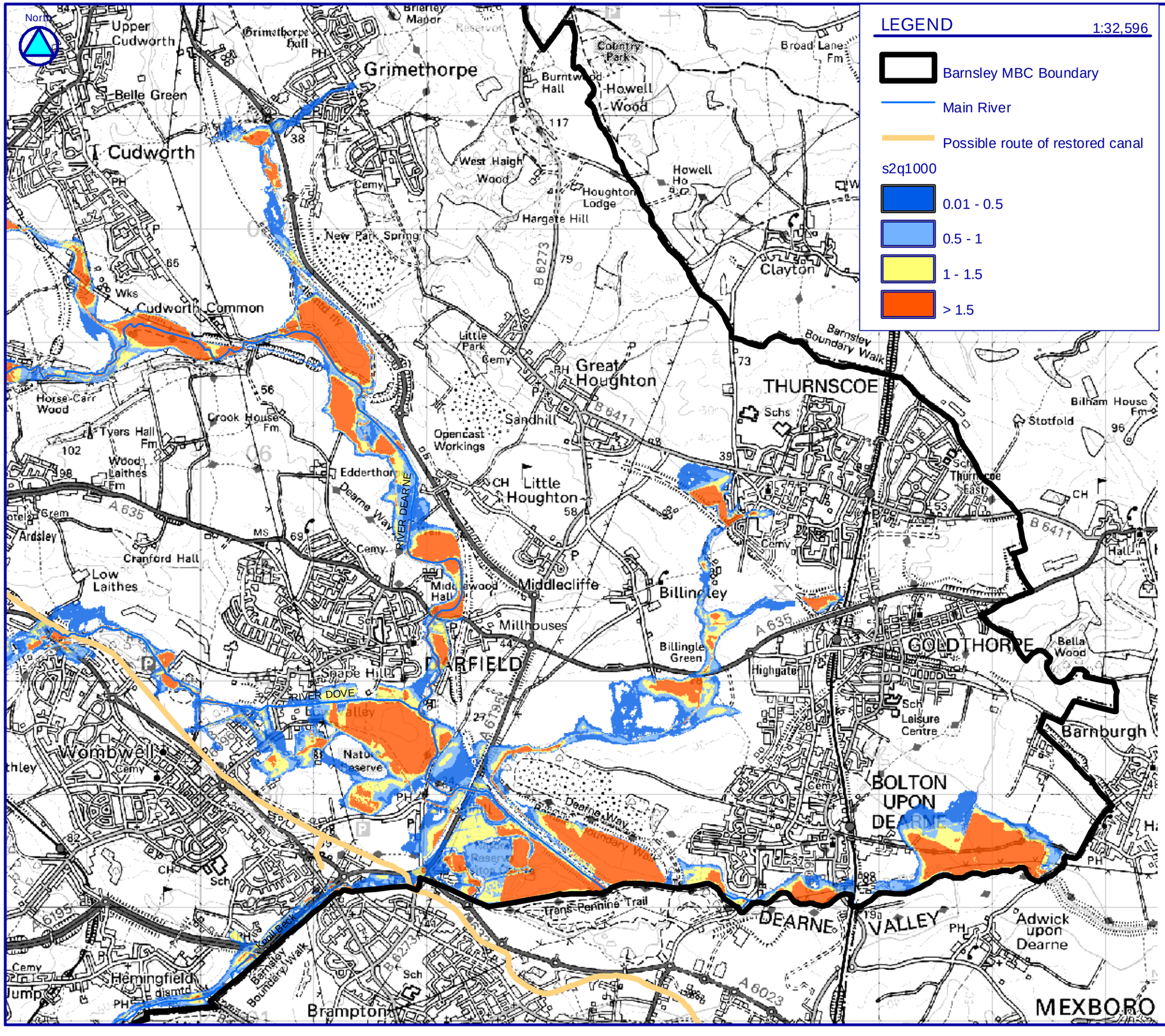
MAP H - 3

s2q100 + Climate Change



LEGEND

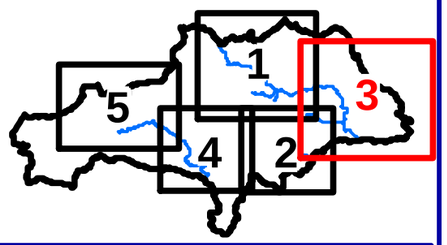
1:32,596

- Barnsley MBC Boundary
- Main River
- Possible route of restored canal

s2q1000

- 0.01 - 0.5
- 0.5 - 1
- 1 - 1.5
- > 1.5

KEYPLAN



Note:
This map shows the potential scale of flood inundation for a range of severe overtopping flood events and different standards of flood defence. They do not include the impact of a breach or failure of these defences.

Typical range of defence standards for the River Don and Dearne is to protect up to a 1 in 30year (3%) return period.

s2 = 1 in 2year Standard of Defence
q1000 = 1 in 1000year or 0.1% probability flood event.

This map should be considered in support of the Environment Agency Flood Zone Maps to aid the Sequential and Exception Tests.
It should not be considered in isolation without reference to the other SFRA Flood Risk Maps.

Please see the Section 6 of the SFRA for further details.

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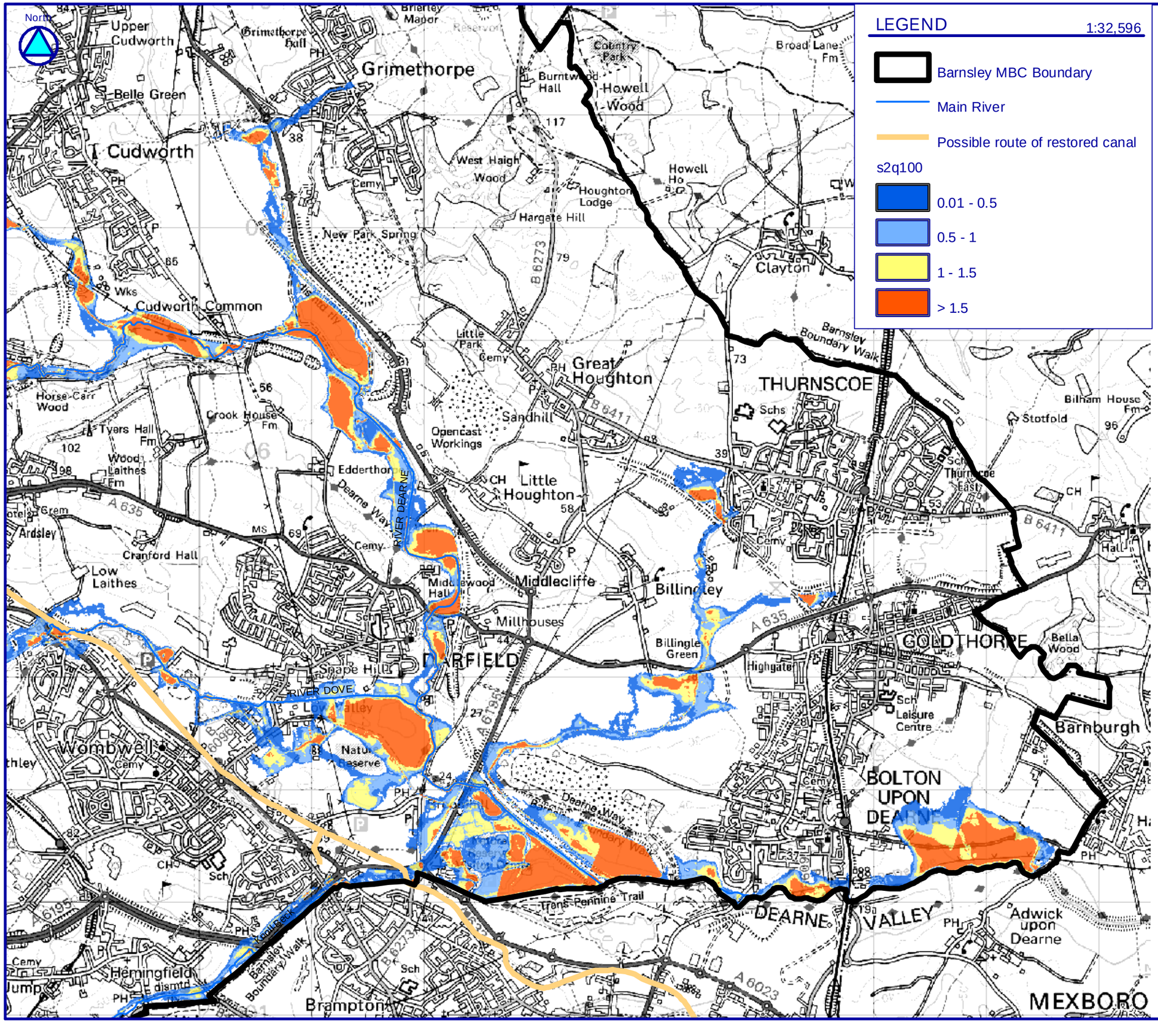
MAP E - 3

s2q1000



LEGEND

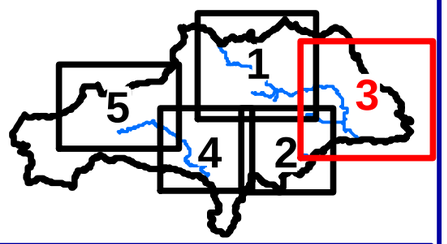
1:32,596

- Barnsley MBC Boundary
- Main River
- Possible route of restored canal

s2q100

- 0.01 - 0.5
- 0.5 - 1
- 1 - 1.5
- > 1.5

KEYPLAN



Note:
This map shows the potential scale of flood inundation for a range of severe overtopping flood events and different standards of flood defence. They do not include the impact of a breach or failure of these defences.

Typical range of defence standards for the River Don and Dearne is to protect up to a 1 in 30year (3%) return period.

s2 = 1 in 2year Standard of Defence
q100 = 1 in 100year or 1% probability flood event.

This map should be considered in support of the Environment Agency Flood Zone Maps to aid the Sequential and Exception Tests.
It should not be considered in isolation without reference to the other SFRA Flood Risk Maps.

Please see the Section 6 of the SFRA for further details.

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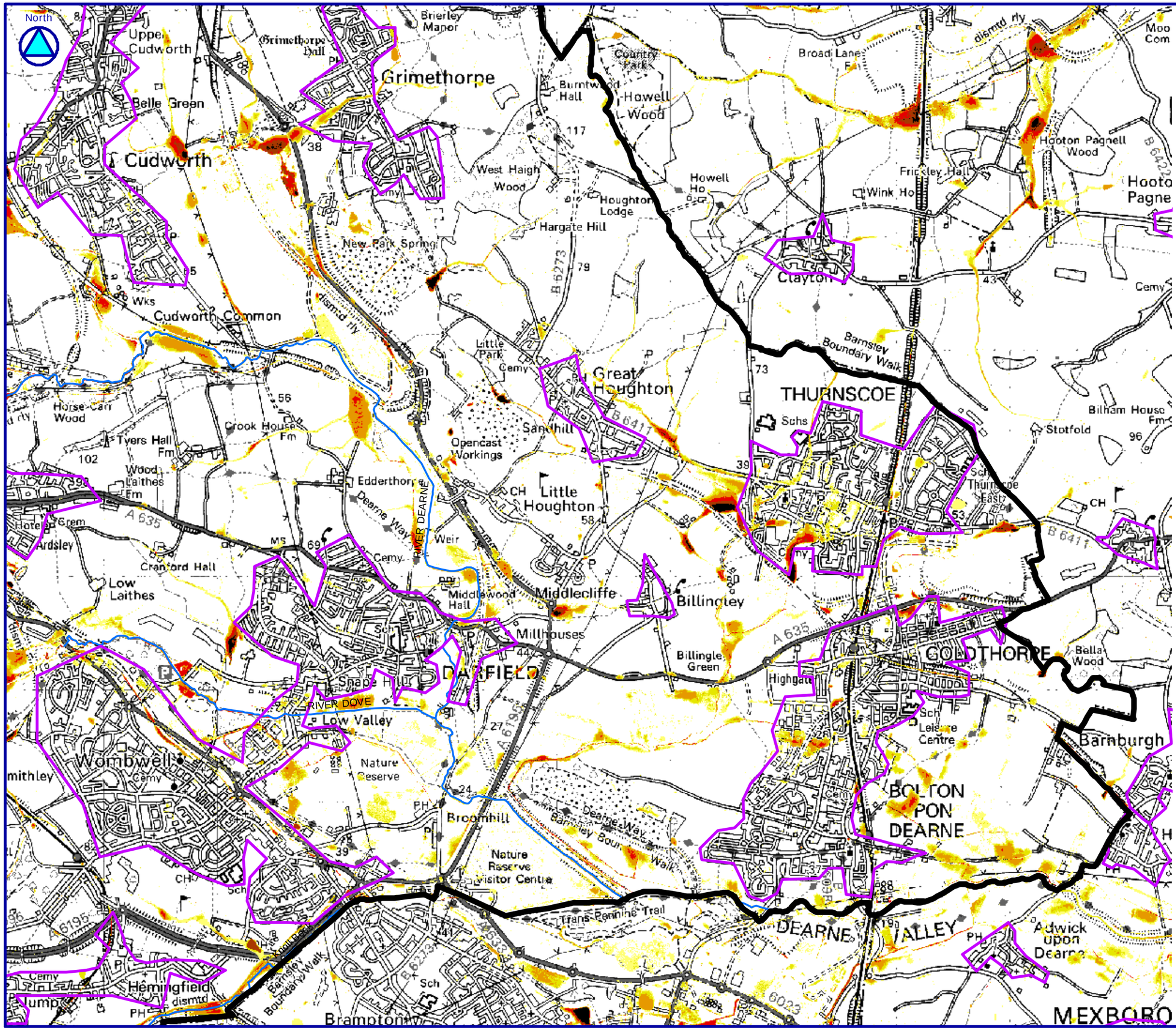
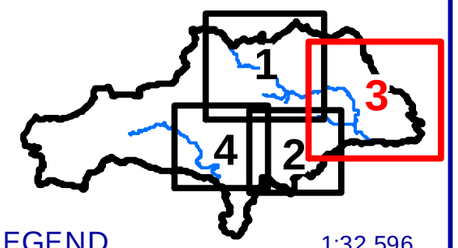
MAP D - 3

s2q100



KEYPLAN



LEGEND 1:32,596

- Barnsley MBC Boundary
- Urban Areas
- Main River

Surface Water Flooding

Flood Depth (m)

- 0.15 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 1.5
- 1 - 2
- > 2

Note:
Please see Section 5.8 of the SFRA for further details.

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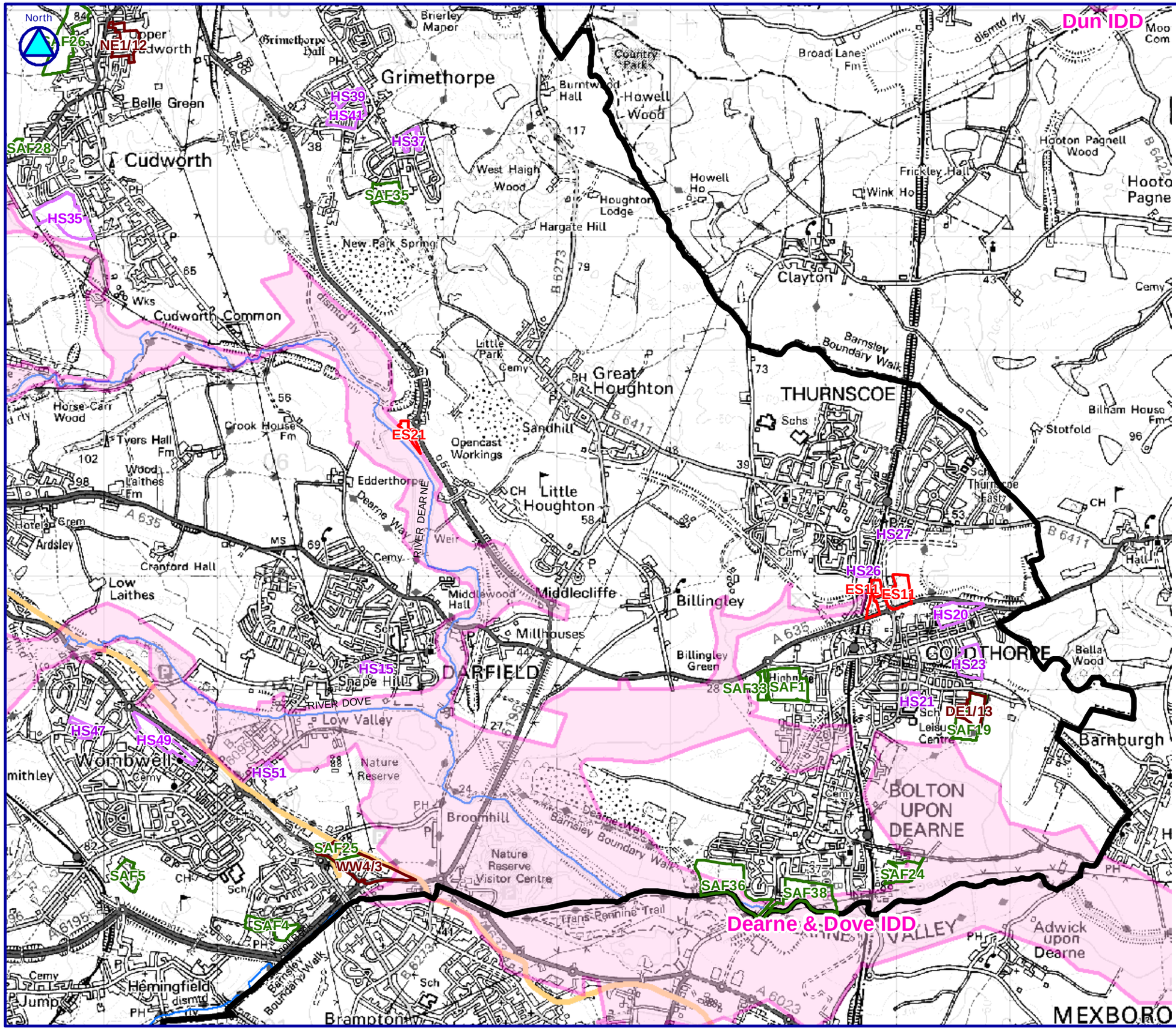
MAP C - 3

PLUVIAL FLOODING CAUSED BY 100YEAR RAINSTORM



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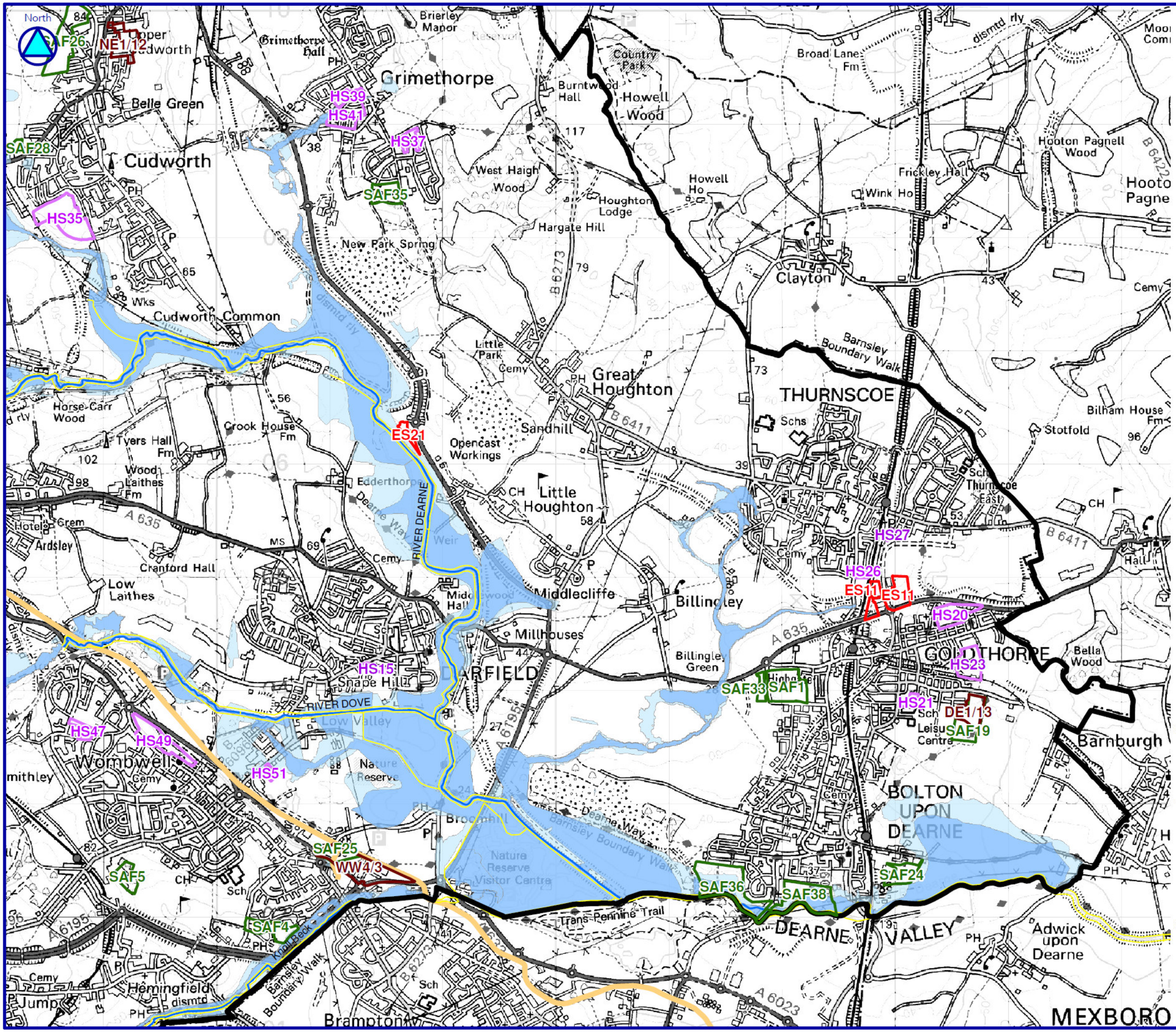
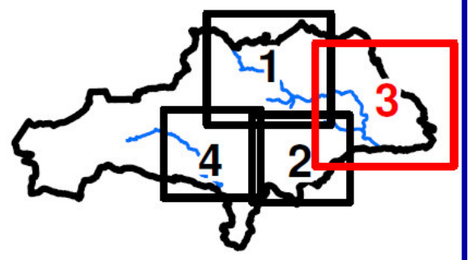
MAP B - 3

PROPOSED DEVELOPMENT SITES AND IDB BOUNDARIES



KEYPLAN



LEGEND

1:32,596

- Barnsley MBC Boundary
- Defence
- Main River
- Possible route of restored canal
- Flood Zone 3
- Flood Zone 2

Proposed Development Sites

- Employment Sites
- Housing Sites
- UDP Sites
- Safeguarded Land

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MAP A - 3

PROPOSED DEVELOPMENT SITES AND FLOOD ZONES

North

RIVER DEARNE

Sough Dike

RIVER DOVE

RIVER DON

Knoll Beck

1:126,172

LEGEND

Main River

Barnsley MBC Boundary

Topoghraphy (NextMap)

Elevation (m)

High : 1080.1

Low : -92

jba CONSULTING

MAP 1

STUDY AREA

North

HUDDERSFIELD

RIVER DEARNE

Sough Dike

RIVER DOVE

RIVER DON

Knoll Beck

PENISTONE

THURLSTONE MOORS

LANGSETT MOORS

HARDEN MOOR

MIDHOPE MOORS

HOWDEN MOORS

UPPER COMMONS

BRODDEAD MOOR

BRADFIELD MOORS

BIRCHINLEE PASTURE

BOWDEN PASTURE

DERWENT MOORS

EDALE MOOR

HOLMFIRTH

STOCKSBRIDGE

ROYSTON

HEMSWORTH

WORSBROUGH

HOYLAND

RAWMARSH

ROTHERHAM

SHEFFIELD

MEXBOROUGH

CONISBRO

THURNSCOE

1:126,172

LEGEND

Barnsley MBC Boundary

Main River

Historical Flood Extents

June 2007

Autumn 2000

January 1982

March 1947

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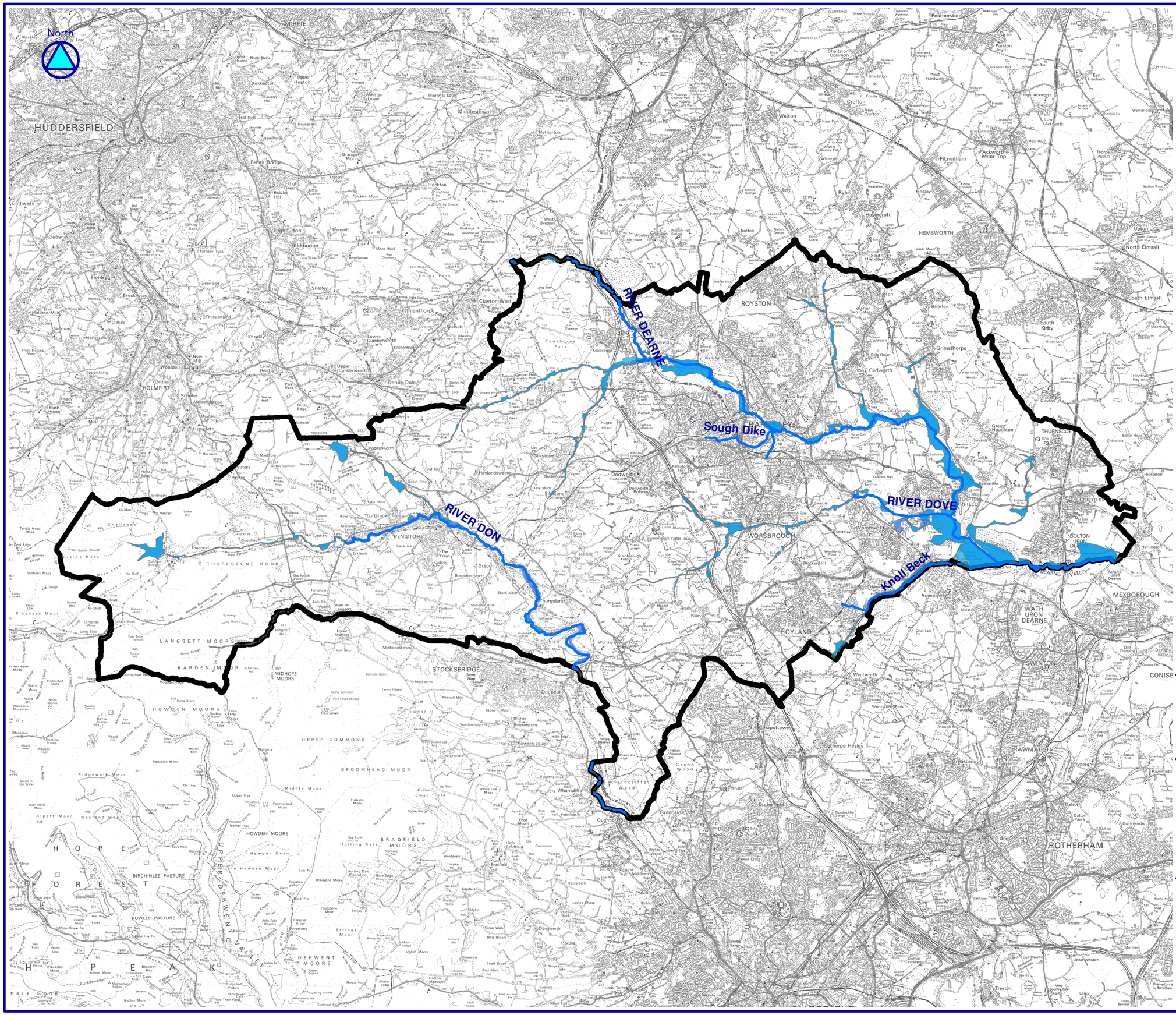
MAP 2

HISTORICAL FLOOD EVENTS



LEGEND

1:120,000

- Main River
- Flood Zone 3
- Barnsley MBC Boundary

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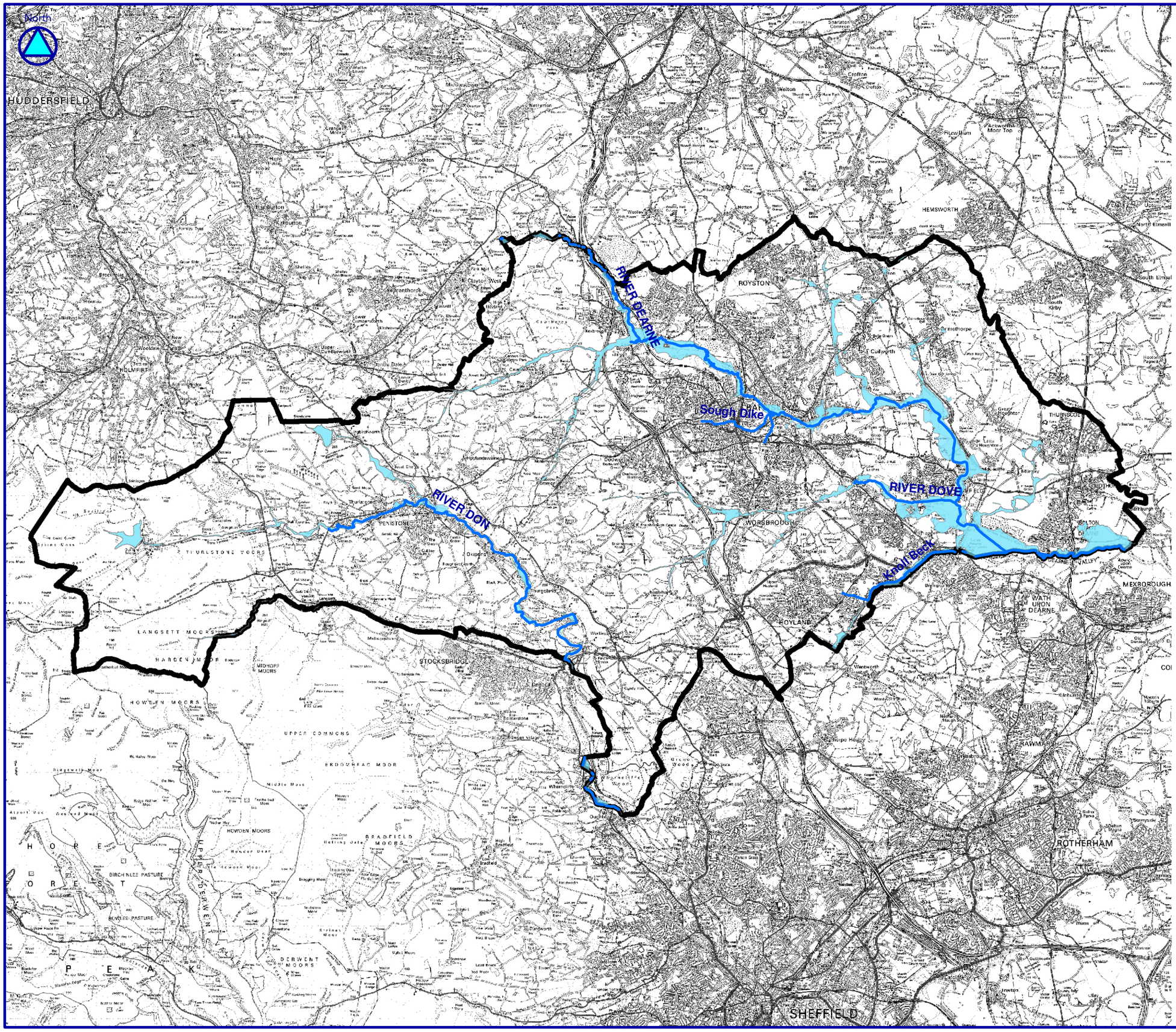
MAP 3

FLOOD ZONE 3



LEGEND

1:120,000

- Main River
- Flood Zone 2
- Barnsley MBC Boundary

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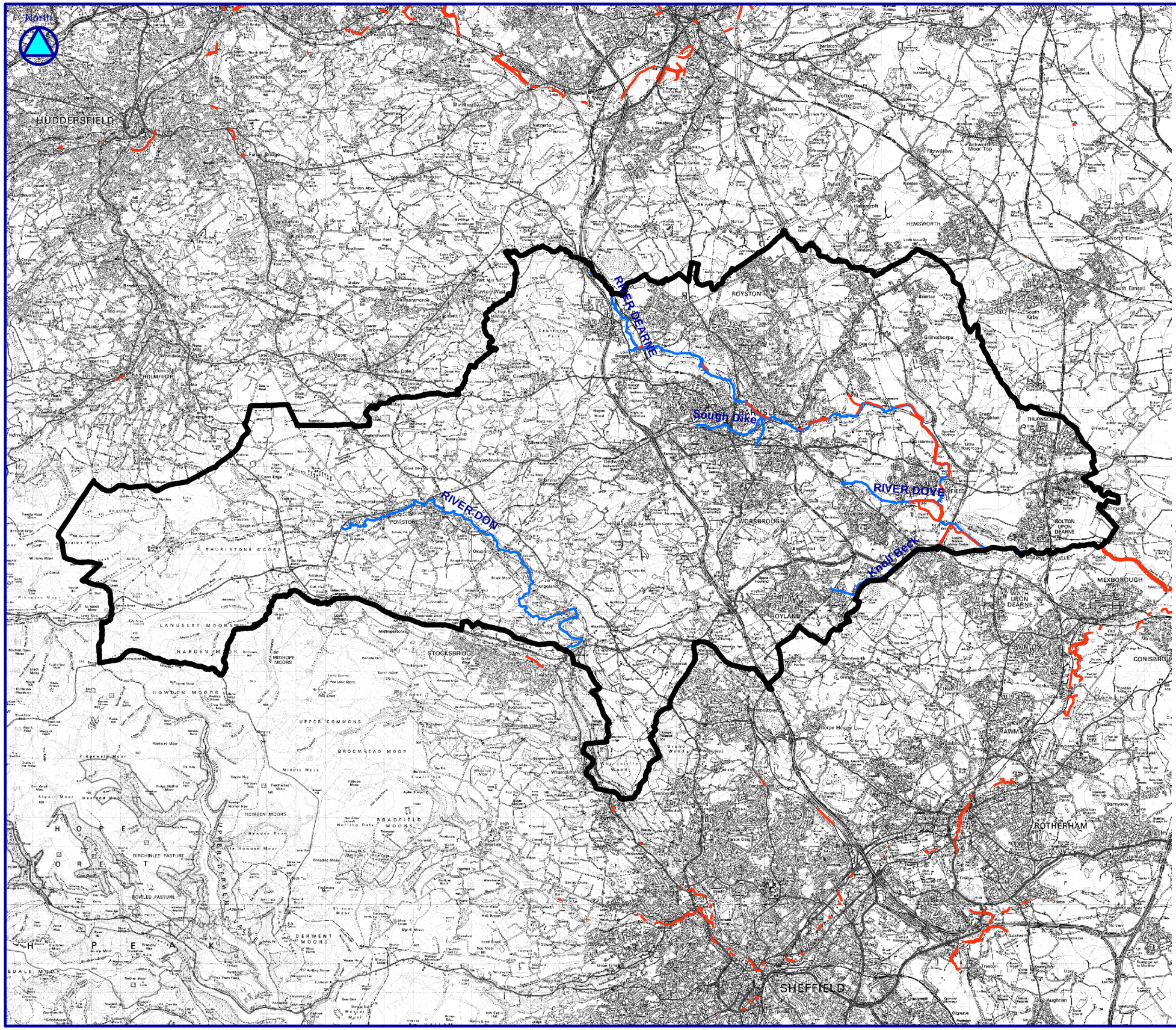
MAP 4

FLOOD ZONE 2



LEGEND

1:126,172

Barnsley MBC Boundary

Main River

Existing Flood Defences

Flood Defence

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MAP 5

EXISTING DEFENCES

North

HUDDERSFIELD

RIVER DEARNE

Sough Dike

RIVER DOVE

RIVER DON

Knoll Beck

HEMSWORTH

ROYSTON

PENISTONE

WORSBROUGH

HOYLAND

STOCKSBRIDGE

ROTHERHAM

SHEFFIELD

MEXBOROUGH

LEGEND

1:126,172

- Main River
- Barnsley MBC Boundary
- Functional Floodplain (FZ3b)

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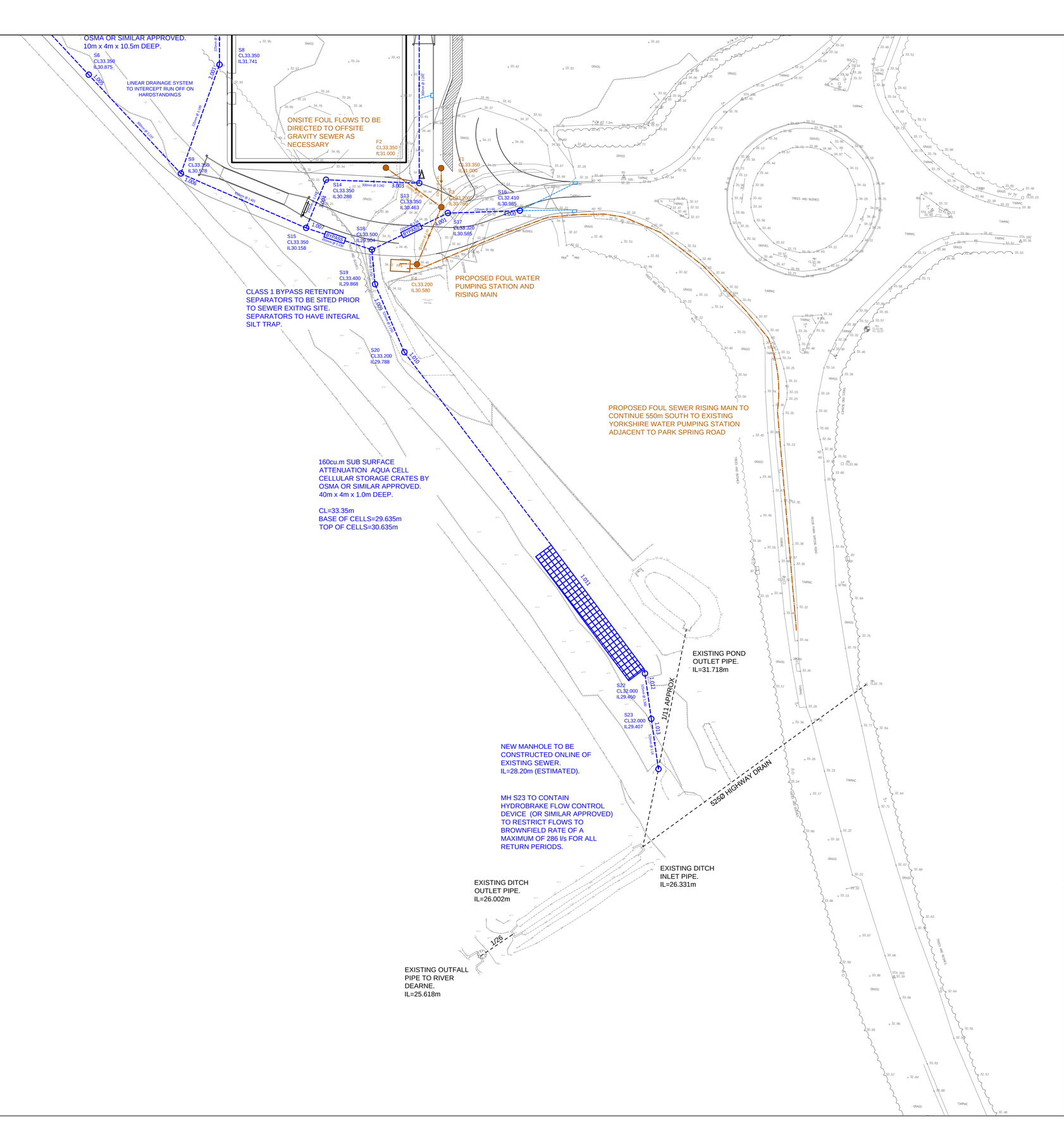
MAP 6

FUNCTIONAL FLOODPLAIN (FZ3b)

Appendix 6 – Detailed Drainage Design



CELLULAR STORAGE SYSTEM

Attenuation crates indicated are based upon AquaCell Core and Plus units by Osma Wavin. Installation of crates to be in strict accordance with manufacturers requirements/details.

Attenuation system to have three additional Inspection Chambers and single layer spines of AquaCell Plus (centrally and along each outer edge) in order to assist with future inspection and maintenance needs. Details in accordance with manufacturers guidance.

Attenuation system to be wrapped in suitable impermeable geomembrane and be surrounded in 100mm min of coarse sand or non-angular granular material. Additional wrap of geo-textile fabric to be introduced followed by a further 100mm min of coarse sand or non-angular granular material.

All in accordance with manufacturers specification and guidance.

Rev	Date	Description	Drawn	Checked
P3	01.15	Drainage revised to suit revised masterplan.	LPA	SL
P2	09.14	Foul drainage revised to suit offsite solution.	LPA	SL
P1	05.14	Minor amendments following initial Draft.	LPA	SL

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Client
ENZYGO LIMITED

Project
LAND OFF HOUGHTON
MAIN COLLIERY R'BOUT
PARK SPRINGS, BARNSLEY

Title
DRAINAGE
GENERAL ARRANGEMENT
SHEET 2 OF 2

Status
FOR PLANNING

Scale	Date	Drawn	Checked
1:500 @ A1	APRIL 14	LPA	SL

Drawing No
A012-02

Revision
P3

CELLULAR STORAGE SYSTEM

Attenuation crates indicated are based upon AquaCell Core and Plus units by Osma Wavin. Installation of crates to be in strict accordance with manufacturers requirements/details.

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All in accordance with manufacturers specification and guidance.

9.5cu.m SUB SURFACE ATTENUATION AQUA CELL CELLULAR STORAGE CRATES BY OSMA OR SIMILAR APPROVED. 5m x 4m x 10.5m DEEP.

19cu.m SUB SURFACE ATTENUATION AQUA CELL CELLULAR STORAGE CRATES BY OSMA OR SIMILAR APPROVED. 10m x 4m x 10.5m DEEP.

19cu.m SUB SURFACE ATTENUATION AQUA CELL CELLULAR STORAGE CRATES BY OSMA OR SIMILAR APPROVED. 10m x 4m x 10.5m DEEP.

160cu.m SUB SURFACE ATTENUATION AQUA CELL CELLULAR STORAGE CRATES BY OSMA OR SIMILAR APPROVED. 40m x 4m x 1.0m DEEP.

CL=33.35m
BASE OF CELLS=29.635m
TOP OF CELLS=30.635m

BUILDING FFL = 33.50m

BUILDING FFL = 33.50m

LINEAR DRAINAGE SYSTEM TO INTERCEPT RUN OFF ON HARDSTANDINGS

ONSITE FOUL FLOWS TO BE DIRECTED TO OFFSITE GRAVITY SEWER AS NECESSARY

PROPOSED FOUL WATER PUMPING STATION AND RISING MAIN

CLASS 1 BYPASS RETENTION SEPARATORS TO BE SITED PRIOR TO SEWER EXITING SITE. SEPARATORS TO HAVE INTEGRAL SILT TRAP.

PROPOSED FOUL SEWER RISING MAIN TO CONTINUE 550m SOUTH TO EXISTING YORKSHIRE WATER PUMPING STATION ADJACENT TO PARK SPRING ROAD

Rev	Date	Description	Drawn	Checked
P3	01.15	Drainage revised to suit revised masterplan.	LPA	SL
P2	09.14	Foul drainage revised to suit offsite solution.	LPA	SL
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Client
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Project
LAND OFF HOUGHTON MAIN COLLIERY R'BOUT PARK SPRINGS, BARNSLEY

Title
DRAINAGE GENERAL ARRANGEMENT SHEET 1 OF 2

Status
FOR PLANNING

Scale	Date	Drawn	Checked
1:500 @ A1	APRIL 14	LPA	SL

Drawing No
A012-01

Revision
P3

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	5	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.000	Minimum Backdrop Height (m)	0.000
Ratio R	0.355	Maximum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
S1.000	10.864	0.250	43.5	0.028	5.00	0.0	0.600	o	225	
S1.001	31.537	0.254	124.2	0.043	0.00	0.0	0.600	o	225	
S1.002	20.713	0.123	167.9	0.084	0.00	0.0	0.600	o	225	
S1.003	49.205	0.203	241.9	0.129	0.00	0.0	0.600	o	300	
S1.004	34.862	0.144	241.9	0.114	0.00	0.0	0.600	o	300	
S1.005	34.862	0.147	237.1	0.071	0.00	0.0	0.600	o	300	
S2.000	30.893	0.184	168.2	0.177	5.00	0.0	0.600	o	225	
S2.001	29.814	0.200	149.0	0.135	0.00	0.0	0.600	o	225	
S1.006	35.230	0.088	401.4	0.086	0.00	0.0	0.600	o	450	
S3.000	71.576	0.682	105.0	0.141	5.00	0.0	0.600	o	300	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.09	31.925	0.028	0.0	0.0	0.0	1.99	79.1	3.8
S1.001	50.00	5.54	31.675	0.071	0.0	0.0	0.0	1.17	46.6	9.6
S1.002	50.00	5.88	31.421	0.155	0.0	0.0	0.0	1.01	40.0	21.0
S1.003	50.00	6.70	31.223	0.284	0.0	0.0	0.0	1.01	71.1	38.5
S1.004	50.00	7.27	31.019	0.398	0.0	0.0	0.0	1.01	71.1	53.9
S1.005	50.00	7.85	30.875	0.469	0.0	0.0	0.0	1.02	71.9	63.5
S2.000	50.00	5.51	31.925	0.177	0.0	0.0	0.0	1.01	40.0	24.0
S2.001	50.00	5.98	31.741	0.312	0.0	0.0	0.0	1.07	42.5	42.2
S1.006	50.00	8.43	30.578	0.867	0.0	0.0	0.0	1.01	160.4	117.4
S3.000	50.00	5.78	31.850	0.141	0.0	0.0	0.0	1.53	108.5	19.1

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
S3.001	58.658	0.500	117.3	0.181	0.00	0.0	0.600	o	300	
S3.002	49.548	0.205	241.6	0.137	0.00	0.0	0.600	o	300	
S3.003	24.058	0.100	241.6	0.035	0.00	0.0	0.600	o	300	
S3.004	13.442	0.056	241.6	0.053	0.00	0.0	0.600	o	375	
S1.007	17.878	0.179	100.0	0.031	0.00	0.0	0.600	o	450	
S4.000	26.547	0.400	66.4	0.085	5.00	0.0	0.600	o	225	
S4.001	14.639	0.381	38.4	0.000	0.00	0.0	0.600	o	225	
S1.008	9.065	0.036	250.0	0.000	0.00	0.0	0.600	o	525	
S1.009	19.827	0.079	250.0	0.000	0.00	0.0	0.600	o	525	
S1.010	56.497	0.188	300.0	0.000	0.00	0.0	0.600	o	525	
S1.011	44.910	0.150	300.0	0.000	0.00	0.0	0.600	o	525	
S1.012	13.030	0.043	300.0	0.000	0.00	0.0	0.600	o	525	
S1.013	13.030	0.931	14.0	0.000	0.00	0.0	0.600	o	525	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S3.001	50.00	6.45	31.168	0.322	0.0	0.0	0.0	1.45	102.5	43.6
S3.002	50.00	7.27	30.668	0.459	0.0	0.0	0.0	1.01	71.2	62.1
S3.003	50.00	7.67	30.463	0.493	0.0	0.0	0.0	1.01	71.2	66.8
S3.004	50.00	7.86	30.288	0.546	0.0	0.0	0.0	1.16	128.3	74.0
S1.007	50.00	8.57	30.158	1.444	0.0	0.0	0.0	2.03	323.4	195.6
S4.000	50.00	5.28	30.985	0.085	0.0	0.0	0.0	1.61	63.9	11.5
S4.001	50.00	5.39	30.585	0.085	0.0	0.0	0.0	2.12	84.2	11.5
S1.008	50.00	8.68	29.904	1.529	0.0	0.0	0.0	1.41	305.7	207.1
S1.009	50.00	8.92	29.868	1.529	0.0	0.0	0.0	1.41	305.7	207.1
S1.010	50.00	9.65	29.788	1.529	0.0	0.0	0.0	1.29	278.8	207.1
S1.011	50.00	10.23	29.600	1.529	0.0	0.0	0.0	1.29	278.8	207.1
S1.012	50.00	10.40	29.450	1.529	0.0	0.0	0.0	1.29	278.8	207.1
S1.013	50.00	10.43	29.407	1.529	0.0	0.0	0.0	6.01	1300.9	207.1

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S1	33.350	1.425	Open Manhole	1200	S1.000	31.925	225				
S2	33.350	1.675	Open Manhole	1200	S1.001	31.675	225	S1.000	31.675	225	
S3	33.350	1.929	Open Manhole	1200	S1.002	31.421	225	S1.001	31.421	225	
S4	33.350	2.127	Open Manhole	1200	S1.003	31.223	300	S1.002	31.298	225	
S5	33.350	2.331	Open Manhole	1200	S1.004	31.019	300	S1.003	31.019	300	
S6	33.350	2.475	Open Manhole	1200	S1.005	30.875	300	S1.004	30.875	300	
S7	33.350	1.425	Open Manhole	1200	S2.000	31.925	225				
S8	33.350	1.609	Open Manhole	1200	S2.001	31.741	225	S2.000	31.741	225	
S9	33.350	2.772	Open Manhole	1350	S1.006	30.578	450	S1.005	30.728	300	
								S2.001	31.541	225	738
S10	33.350	1.500	Open Manhole	1200	S3.000	31.850	300				
S11	33.350	2.182	Open Manhole	1200	S3.001	31.168	300	S3.000	31.168	300	
S12	33.350	2.682	Open Manhole	1200	S3.002	30.668	300	S3.001	30.668	300	
S13	33.350	2.887	Open Manhole	1200	S3.003	30.463	300	S3.002	30.463	300	
S14	33.350	3.062	Open Manhole	1350	S3.004	30.288	375	S3.003	30.363	300	
S15	33.350	3.192	Open Manhole	1350	S1.007	30.158	450	S1.006	30.490	450	333
								S3.004	30.233	375	
S16	32.410	1.425	Open Manhole	1200	S4.000	30.985	225				
S17	33.320	2.735	Open Manhole	1200	S4.001	30.585	225	S4.000	30.585	225	
S18	33.500	3.596	Open Manhole	1500	S1.008	29.904	525	S1.007	29.979	450	
								S4.001	30.204	225	
S19	33.400	3.532	Open Manhole	1500	S1.009	29.868	525	S1.008	29.868	525	
S20	33.200	3.412	Open Manhole	1500	S1.010	29.788	525	S1.009	29.788	525	
S21	32.500	2.900	Open Manhole	1500	S1.011	29.600	525	S1.010	29.600	525	
S22	32.000	2.550	Open Manhole	1500	S1.012	29.450	525	S1.011	29.450	525	
S23	32.000	2.593	Open Manhole	1500	S1.013	29.407	525	S1.012	29.407	525	
S	31.000	2.524	Open Manhole	1500		OUTFALL		S1.013	28.476	525	

Online Controls for Storm

Hydro-Brake Optimum® Manhole: S23, DS/PN: S1.013, Volume (m³): 7.1

Unit Reference	MD-SHE-0520-2000-1500-2000
Design Head (m)	1.500
Design Flow (l/s)	200.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	520
Invert Level (m)	29.407
Minimum Outlet Pipe Diameter (mm)	Error (Contact Hydro International)
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	199.7
Flush-Flo™	0.750	199.8
Kick-Flo®	1.223	180.8
Mean Flow over Head Range	-	156.4

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	12.9	1.200	183.0	3.000	280.3	7.000	425.0
0.200	47.6	1.400	193.1	3.500	302.3	7.500	439.7
0.300	97.1	1.600	206.1	4.000	322.8	8.000	453.9
0.400	152.4	1.800	218.3	4.500	342.0	8.500	467.7
0.500	192.5	2.000	229.8	5.000	360.2	9.000	481.0
0.600	197.4	2.200	240.8	5.500	377.5	9.500	494.0
0.800	199.5	2.400	251.3	6.000	394.0		
1.000	194.8	2.600	261.3	6.500	409.8		

Storage Structures for Storm

Cellular Storage Manhole: S1, DS/PN: S1.000

Invert Level (m) 31.925 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	20.0	20.0	0.600	0.0	29.0
0.500	20.0	29.0			

Cellular Storage Manhole: S7, DS/PN: S2.000

Invert Level (m) 31.925 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	40.0	40.0	0.600	0.0	54.0
0.500	40.0	54.0			

Cellular Storage Manhole: S10, DS/PN: S3.000

Invert Level (m) 31.850 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	40.0	40.0	0.600	0.0	54.0
0.500	40.0	54.0			

Cellular Storage Manhole: S21, DS/PN: S1.011

Invert Level (m) 29.725 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	60.0	60.0	1.100	0.0	98.0
1.000	60.0	98.0			

Cellular Storage Manhole: S22, DS/PN: S1.012

Invert Level (m) 29.635 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Cellular Storage Manhole: S22, DS/PN: S1.012

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	100.0	100.0	1.100	0.0	158.0
1.000	100.0	158.0			

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	5
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.355
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2
Climate Change (%)	0

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
S1.000	15 Winter	2	0%					
S1.001	15 Winter	2	0%					
S1.002	15 Winter	2	0%					
S1.003	15 Winter	2	0%					
S1.004	15 Winter	2	0%					
S1.005	15 Winter	2	0%					
S2.000	15 Winter	2	0%					
S2.001	15 Winter	2	0%					
S1.006	15 Winter	2	0%					
S3.000	15 Winter	2	0%					
S3.001	15 Winter	2	0%					
S3.002	15 Winter	2	0%					
S3.003	15 Winter	2	0%					
S3.004	15 Winter	2	0%					
S1.007	15 Winter	2	0%					
S4.000	15 Winter	2	0%					
S4.001	15 Winter	2	0%					
S1.008	15 Winter	2	0%					
S1.009	15 Winter	2	0%					
S1.010	15 Winter	2	0%					
S1.011	15 Winter	2	0%					
S1.012	30 Winter	2	0%					

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
S1.013	30 Winter	2	0%					

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
S1.000	S1	31.961	-0.189	0.000	0.06	0.0	4.0	OK
S1.001	S2	31.747	-0.153	0.000	0.22	0.0	9.5	OK
S1.002	S3	31.543	-0.103	0.000	0.56	0.0	20.5	OK
S1.003	S4	31.385	-0.138	0.000	0.55	0.0	37.0	OK
S1.004	S5	31.219	-0.100	0.000	0.77	0.0	50.3	OK
S1.005	S6	31.094	-0.081	0.000	0.87	0.0	57.6	OK
S2.000	S7	32.052	-0.098	0.000	0.59	0.0	22.2	OK
S2.001	S8	31.918	-0.048	0.000	0.97	0.0	38.3	OK
S1.006	S9	30.869	-0.159	0.000	0.75	0.0	104.9	OK
S3.000	S10	31.938	-0.212	0.000	0.18	0.0	18.9	OK
S3.001	S11	31.306	-0.162	0.000	0.42	0.0	40.8	OK
S3.002	S12	30.883	-0.085	0.000	0.84	0.0	56.5	OK
S3.003	S13	30.693	-0.070	0.000	0.94	0.0	59.4	OK
S3.004	S14	30.507	-0.156	0.000	0.64	0.0	64.4	OK
S1.007	S15	30.442	-0.165	0.000	0.72	0.0	172.4	OK
S4.000	S16	31.059	-0.151	0.000	0.23	0.0	13.8	OK
S4.001	S17	30.651	-0.159	0.000	0.19	0.0	13.8	OK
S1.008	S18	30.297	-0.132	0.000	0.92	0.0	179.7	OK
S1.009	S19	30.210	-0.183	0.000	0.75	0.0	178.8	OK
S1.010	S20	30.117	-0.197	0.000	0.70	0.0	176.4	OK
S1.011	S21	29.917	-0.208	0.000	0.67	0.0	164.6	OK
S1.012	S22	29.807	-0.168	0.000	0.68	0.0	135.1	OK
S1.013	S23	29.775	-0.156	0.000	0.18	0.0	135.0	OK

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	5
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.355
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	30
Climate Change (%)	0

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
S1.000	15 Winter	30	0%					
S1.001	15 Winter	30	0%	30/15 Summer				
S1.002	15 Winter	30	0%	30/15 Summer				
S1.003	15 Winter	30	0%	30/15 Summer				
S1.004	15 Winter	30	0%	30/15 Summer				
S1.005	15 Winter	30	0%	30/15 Summer				
S2.000	15 Winter	30	0%	30/15 Summer				
S2.001	15 Winter	30	0%	30/15 Summer				
S1.006	15 Winter	30	0%	30/15 Summer				
S3.000	15 Winter	30	0%					
S3.001	15 Winter	30	0%	30/15 Summer				
S3.002	15 Winter	30	0%	30/15 Summer				
S3.003	15 Winter	30	0%	30/15 Summer				
S3.004	15 Winter	30	0%	30/15 Summer				
S1.007	15 Winter	30	0%	30/15 Summer				
S4.000	15 Winter	30	0%					
S4.001	15 Winter	30	0%					
S1.008	15 Winter	30	0%	30/15 Summer				
S1.009	15 Winter	30	0%	30/15 Summer				
S1.010	15 Winter	30	0%	30/15 Winter				
S1.011	30 Winter	30	0%	30/30 Winter				
S1.012	30 Winter	30	0%	30/15 Winter				

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
S1.013	30 Winter	30	0%	30/15 Winter				

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
S1.000	S1	32.012	-0.138	0.000	0.20	0.0	13.6	OK
S1.001	S2	32.052	0.152	0.000	0.52	0.0	22.6	SURCHARGED
S1.002	S3	32.032	0.386	0.000	1.07	0.0	38.9	SURCHARGED
S1.003	S4	31.945	0.423	0.000	0.94	0.0	63.1	SURCHARGED
S1.004	S5	31.757	0.438	0.000	1.38	0.0	90.6	SURCHARGED
S1.005	S6	31.468	0.292	0.000	1.61	0.0	106.1	SURCHARGED
S2.000	S7	32.246	0.096	0.000	0.95	0.0	35.6	SURCHARGED
S2.001	S8	32.158	0.192	0.000	1.39	0.0	55.2	SURCHARGED
S1.006	S9	31.064	0.036	0.000	1.25	0.0	175.8	SURCHARGED
S3.000	S10	31.980	-0.170	0.000	0.37	0.0	39.0	OK
S3.001	S11	31.708	0.240	0.000	0.71	0.0	69.3	SURCHARGED
S3.002	S12	31.487	0.519	0.000	1.40	0.0	93.7	SURCHARGED
S3.003	S13	31.123	0.360	0.000	1.53	0.0	96.9	SURCHARGED
S3.004	S14	30.907	0.244	0.000	1.03	0.0	103.6	SURCHARGED
S1.007	S15	30.850	0.243	0.000	1.14	0.0	271.6	SURCHARGED
S4.000	S16	31.091	-0.119	0.000	0.44	0.0	26.2	OK
S4.001	S17	30.679	-0.131	0.000	0.35	0.0	26.1	OK
S1.008	S18	30.615	0.186	0.000	1.46	0.0	285.7	SURCHARGED
S1.009	S19	30.478	0.085	0.000	1.20	0.0	285.6	SURCHARGED
S1.010	S20	30.341	0.028	0.000	1.12	0.0	282.1	SURCHARGED
S1.011	S21	30.131	0.006	0.000	0.97	0.0	238.9	SURCHARGED
S1.012	S22	30.032	0.057	0.000	1.00	0.0	197.1	SURCHARGED
S1.013	S23	29.989	0.057	0.000	0.27	0.0	196.7	SURCHARGED

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	5
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR	Ratio R 0.355
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	100
Climate Change (%)	30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
S1.000	15 Winter	100	+30%	100/15 Summer				
S1.001	15 Winter	100	+30%	100/15 Summer				
S1.002	15 Winter	100	+30%	100/15 Summer				
S1.003	15 Winter	100	+30%	100/15 Summer				
S1.004	15 Winter	100	+30%	100/15 Summer				
S1.005	15 Winter	100	+30%	100/15 Summer				
S2.000	15 Winter	100	+30%	100/15 Summer				
S2.001	15 Winter	100	+30%	100/15 Summer				
S1.006	15 Winter	100	+30%	100/15 Summer				
S3.000	15 Winter	100	+30%	100/15 Summer				
S3.001	15 Winter	100	+30%	100/15 Summer				
S3.002	15 Winter	100	+30%	100/15 Summer				
S3.003	15 Winter	100	+30%	100/15 Summer				
S3.004	15 Winter	100	+30%	100/15 Summer				
S1.007	15 Winter	100	+30%	100/15 Summer				
S4.000	15 Winter	100	+30%	100/15 Summer				
S4.001	15 Winter	100	+30%	100/15 Summer				
S1.008	15 Winter	100	+30%	100/15 Summer				
S1.009	30 Winter	100	+30%	100/15 Summer				
S1.010	30 Winter	100	+30%	100/15 Summer				
S1.011	30 Winter	100	+30%	100/15 Summer				
S1.012	30 Winter	100	+30%	100/15 Summer				

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
S1.013	30 Winter	100	+30%	100/15 Summer				

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
S1.000	S1	33.165	1.015	0.000	0.62	0.0	41.1	FLOOD RISK
S1.001	S2	33.156	1.256	0.000	1.01	0.0	44.1	FLOOD RISK
S1.002	S3	33.115	1.469	0.000	1.39	0.0	50.3	FLOOD RISK
S1.003	S4	32.991	1.468	0.000	1.09	0.0	73.2	SURCHARGED
S1.004	S5	32.848	1.529	0.000	1.79	0.0	117.4	SURCHARGED
S1.005	S6	32.466	1.291	0.000	2.15	0.0	142.3	SURCHARGED
S2.000	S7	33.310	1.160	0.000	1.48	0.0	55.3	FLOOD RISK
S2.001	S8	32.905	0.939	0.000	2.22	0.0	88.1	SURCHARGED
S1.006	S9	31.913	0.885	0.000	1.71	0.0	240.0	SURCHARGED
S3.000	S10	32.892	0.742	0.000	0.63	0.0	65.6	SURCHARGED
S3.001	S11	32.786	1.318	0.000	0.81	0.0	79.3	SURCHARGED
S3.002	S12	32.564	1.596	0.000	1.77	0.0	118.4	SURCHARGED
S3.003	S13	32.092	1.329	0.000	1.97	0.0	124.9	SURCHARGED
S3.004	S14	31.766	1.103	0.000	1.40	0.0	140.5	SURCHARGED
S1.007	S15	31.649	1.042	0.000	1.62	0.0	385.2	SURCHARGED
S4.000	S16	31.362	0.152	0.000	0.74	0.0	44.0	SURCHARGED
S4.001	S17	31.245	0.435	0.000	0.52	0.0	38.7	SURCHARGED
S1.008	S18	31.194	0.765	0.000	2.09	0.0	409.6	SURCHARGED
S1.009	S19	30.959	0.566	0.000	1.63	0.0	387.5	SURCHARGED
S1.010	S20	30.782	0.469	0.000	1.52	0.0	382.2	SURCHARGED
S1.011	S21	30.647	0.522	0.000	1.31	0.0	321.2	SURCHARGED
S1.012	S22	30.564	0.588	0.000	1.03	0.0	204.1	SURCHARGED
S1.013	S23	30.716	0.785	0.000	0.27	0.0	199.6	SURCHARGED

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