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HORIZON RESIDENTIAL DEVELOPMENTS LTD.

FLOOD RISK ASSESSMENT
LOWFIELD ROAD, BOLTON UPON DEARNE

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EXECUTIVE SUMMARY

In November 2005 Enviros Consulting Ltd were commissioned by Spawforth Planning and Urban Regeneration on behalf of Horizon Residential Developments Ltd to undertake a Flood Risk Assessment for the former Addspace site located within Bolton upon Dearne, South Yorkshire. This was undertaken to meet the requirements of Planning Policy Guidance note 25.

In August 2008 Enviros were commissioned to update this assessment to reflect changes in the development design as well as any new guidance, policy and practice. In particular this revised assessment is required to comply with Planning Policy Statement 25.

Flood Risk

The development site is elevated significantly above the River Dearne to the south. As such the proposed development levels are all at between 5 and 10 m above modelled and historic flood levels along the River Dearne adjacent to the site. Further to this photographic evidence from the June 2007 flooding clearly demonstrates that flooding was not close to impacting the site. In the light of this the risk of flooding from this source is considered to be low.

The potential for flooding from other sources including the failure of drainage infrastructure and surface runoff from adjacent areas has also been considered within this assessment. The risks for all such sources were assessed to be low or less.

Site Drainage

Although yet to be confirmed, it is assumed infiltration drainage will not prove viable for this site. Therefore, it is considered likely that storm water runoff from the completed development will discharge in a southerly direction towards the sewage treatment works (STW). Discussions are currently being undertaken with Yorkshire Water to determine whether these flows will bypass the STW and discharge into the River Dearne or whether flows will be discharged under the terms of the existing discharge consent held by Yorkshire Water.

An outline sustainable drainage strategy for the site has been developed by Halcrow. This scheme will ensure that peak rates of storm water runoff do not exceed the rate that would be expected from an equivalent greenfield site. This will be achieved by throttling discharge from the site down to the agreed low level and storing any flows in excess of this on site.

Preliminary calculations by Halcrow indicate that to achieve this objective, such that the annual probability of the system capacity being exceeded is less than 1%, would require between 250m^3 and 400m^3 of storage to be provided. These calculations assume that rainfall depth will increase by 30% over the development lifetime as a result of climate change.

1. INTRODUCTION

In November 2005 Enviros Consulting Ltd were commissioned by Spawforth Planning and Urban Regeneration on behalf of Horizon Residential Developments Ltd to undertake a Flood Risk Assessment for the former Addspace site located within Bolton upon Dearne, South Yorkshire (Figure 1). This was undertaken to meet the requirements of Planning Policy Guidance note 25[1].

In August 2008 Enviros were commissioned to update this assessment to reflect changes in the development design as well as any new guidance, policy and practice. In particular this revised assessment is required to comply with Planning Policy Statement 25[2].

1.1 Background

Planning permission is sought for the re-development of an area of the former Addspace site for residential use. This land is situated wholly in flood zone 1 (Figure 2). In the light of this, this site is considered to pass the sequential test and potentially be appropriate for all types of development.

The site covers an area of greater than one hectare and therefore a flood risk assessment is required to consider the impact of the development on flooding locally. In addition to this the site is in proximity to areas classified as flood zone 2/3 and the assessment must also confirm that this zoning is correct and that the site is not likely to be subject to flooding.

During the preparation of this document the following organisations have been contacted in order to obtain information; the Environment Agency (Appendix 1), Yorkshire Water (Appendix 2) and The Dearne and Dove Internal Drainage Board (Appendix 3). The report has been based on the information provided by these organisations, the client and observations from site visits conducted in December 2005.

1.2 Objectives

The principal aims of the Flood Risk Assessment are:

- to assess the risk posed to the site from external flood sources;
- to assess the impact of any site development on local flooding; and
- to discuss management of storm water runoff related to any potential development.

1.3 Report Synopsis

Chapter 2 describes the site, the surrounding area and the proposals for the redevelopment. Chapter 3 assesses the risk of flooding from external sources to the site with Chapter 4 covering issues relating to the management of storm water runoff within the site area. The report is then concluded in Chapter 5.

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1 Planning Policy Guidance 25 (PPG25): Development and Flood Risk, DETR, 2001

2 Planning policy Statement 25, Development and Flood Risk, DCLG, 2006

2. SITE DESCRIPTION

2.1 Location

The site is located on the south-east boundary of Bolton Upon Dearne, to the north of the River Dearne (Figure 1), which is defined as a Main River. This is approximately 10 miles southeast of Barnsley and is centrally located between the M1 and M18. The site lies to the south of Lowfield Road, east of a railway line and north of a sewage treatment works (STW). The approximate national grid reference of the site is SE 456 023.

2.2 Site Appearance

Site visits were undertaken by Daniel Watson and Nick Bosanko of Enviros in December 2005, individually.

The Addspace site covers an area of 5.3 hectares (ha) of which the proposed development would cover an area of 1.9 ha to the north (Figure 1).

The Addspace site was formerly occupied by two large warehouse units to the north of the site, one of which is a relatively new construction. These were surrounded by a number of smaller buildings and associated car parking and hard standing. The buildings were formerly used for furniture production and have now been demolished. The southern third of the site is undeveloped.

The development site was previously dominated by the larger of the two main buildings and was almost completely developed with buildings and hardstanding.

2.2.1 Topography

Site levels were surveyed by Ellam Land Surveys in October 2005 (Appendix 4). This data shows that at the southern boundary adjacent to the STW elevations are approximately 18.1m aOD. This is the lowest point on the site.

Within the Addspace site, adjacent to the STW, the ground levels are significantly higher than the land at the boundary and further to the south. This area is raised, artificially, by up to five metres at a steep embankment. This is clearly imported material which forms a plateau level with much of the rest of the site. It is assumed that much of the site is underlain by Made Ground.

The development site is all between 24m aOD and 28.5m aOD with levels sloping generally from the north to the south. To the west levels rise up from the site to a railway embankment and to the north levels rise up to a road embankment. This road embankment is where Lowfield Road passes over the railway line.

2.2.2 Site Drainage

A small dry ditch is located within an overgrown area just inside the southern boundary of the wider Addspace site. The Ordnance Survey 1:25000 map indicates that this is a spring. Given that no flow was observed it is assumed that this is an ephemeral feature.

All of the existing hard standing areas are served by a drainage network. The drainage network has clearly received little maintenance of late; many manholes have started to become blocked with sediment. The drainage network flows in a

southerly direction, however the point of discharge could not be located from the site survey drawing received from the client.

Following continued discussions with Yorkshire Water it became evident that an existing surface (450mm) and foul water (225mm) sewer discharge into a combined sewer that runs alongside the southern boundary of the Addspace site. This is not however shown on the plans provided (Appendix 2). An overflow pipe from the combined sewer discharges southward into the River Dearne.

2.2.3 Geology

As previously stated much of the site is underlain by Made Ground, the nature of which has not been confirmed. The Geological map[3] indicates that this is underlain by undifferentiated Middle Coal Measures, comprising mudstones, sandstones and siltstones.

The Coal Measures are regarded as a Minor Aquifer by the Environment Agency and are relatively permeable.

2.3 Surrounding Area

Land use to the west of the site is dominated by relatively densely spaced residential properties. Whilst to the east, flat and drained arable land dominates the landscape, with the exception of a relatively small residential area that extends along Lowfield Road. A STW is located down slope of the site between the southern site boundary and the River Dearne. To the east of the sewage treatment works, a recreational pond has been created which is stocked with fish; water levels in the pond are maintained through pumping to and from the River Dearne.

An active quarry and a disused waste disposal site occupy a significant proportion of the landscape to the south of the river.

The areas surrounding the site have no specific conservation classification. The River Dearne is the main hydrological feature in the area and is discussed in depth in Section 3 of this report.

2.3.1 Local drainage network (Appendix 2)

The drainage network located within the residential area, northeast of the site, along Lowfield Road, serves only a small area. There is therefore insufficient capacity for additional flow and also this is not suitably located for connection.

As mentioned above a combined sewer is located down slope of the site. It runs adjacent to the southern site boundary. Flows within this sewer discharge at the STW where they are treated and eventually discharged to the main river. Any excess flows above the capacity of the works would discharge via a surface water overflow, connected to the main combined sewer at the northeast corner of the STW. The precise nature of the system in this area is complicated and not precisely understood. However, it is assumed that excess storm flows are subject to overflow and enter the River Dearne directly.

3 British Geological Survey, 1:50,000 soil and drift map, Sheet 87 Runcorn

2.4 Description of Development

The outline planning application is for a number of residential units to be constructed on the development site. The properties would be a mix of detached houses with their own gardens and apartments. The site would be accessed from Lowfield Road to the north with a new site access road constructed down the eastern development boundary.

The development Masterplan is included as Appendix 5 to this report.

3. EXTERNAL FLOOD SOURCES

Current guidance[4] recommends that a Flood Risk Assessment should consider all possible sources of flooding for a given site. A large number of specific mechanisms exist; however, many of these can be easily discounted. Table 1 summarises a range of potential risks and the possibility that these may be relevant to this site.

Table 1 Summary of potential flood source

Flood Type	*Source*	*Pathway*	*Consider further*
Fluvial	River Dearne	Extreme event	Yes
Tidal	None	None	No
Overland flow	Runoff from higher land	Surface water runoff from small section of Lowfield Road	Yes
Drainage	Combined sewer	Surcharge	Yes
Groundwater	Undifferentiated Middle Coal Measures	None, minor aquifer potential, with soils of high leaching potential	No
Other / Artificial	None	None	No

3.1 Risk Assessment

The risk assessment methodology used within this project is set out in Appendix 6 and is written based on guidance provided in PPS25. The guidance recommends that flood risk is assessed through consideration of both the magnitude of potential impacts and the probability of occurrence. The magnitude of impact is then dependant on two factors; these are the sensitivity of potential receptors and the severity of the flooding. There are therefore three criteria on which flood risk is assessed. These are;

- Sensitivity of the receptor,
- Severity of flooding, and
- Probability of occurrence.

3.1.1 Sensitivity of receptor

Within PPS25 residential development is classified as a '*more vulnerable developments*'. Given this the sensitivity will be defined as high.

4 Planning Policy Statement 25: Development and Flood Risk, Department for Communities and Local Government, 2006

Development in general has the potential to impact the flood risk posed to off site receptors. All off site development is considered to be very highly vulnerable to any increase in flood risk and therefore it is important that any adverse off site impact to flood severity or frequency are avoided.

3.1.2 Severity and Probability of flooding

The severity and probability of flooding are both fully defined within Appendix 6 and the classification of these criteria is discussed over the following sections.

3.2 Fluvial

At the location where the River Dearne passes the site, the watercourse drains a catchment of approximately 300km^2. The river rises in the hills of the Pennines to the west of Barnsley and incorporates the whole of that town. As such the river has a fairly flashy response to rainfall for a watercourse of this size and has a history of flooding.

3.2.1 Flood History

A level gauge is located at Bolton Viaduct on the River Dearne, just upstream of the site. Peak flood elevations at this gauge for a number of high flow events on the River Dearne have been provided by the Environment Agency (Appendix 1). These records stretch back to 1958.

The most significant event for which a flood level has been obtained occurred in May 1967, where flood levels upstream of the viaduct peaked at 17.71m aOD. On the downstream side of the viaduct, adjacent to the site, the largest recorded events occurred in July 1958 and November 1968. Peak level for these events was recorded at 16.98m aOD.

It must be noted that level data is not available for what are believed to be the largest local flood events. These occurred in 1947, 2000 and 2007. Figure 3 illustrates the predicted extent of the 1947 and 2000 floods while the extent of the 2007 flooding is shown on Figure 4.

Figure 4 has been produced by Enviros based on Aerial photographs taken during the flooding on both the 16th and the 26th of June 2007. These photos are included as Appendix 7 to the report.

None of the data obtained suggests that flooding locally from the River Dearne has ever approached anywhere near the level of the site.

3.2.2 Modelling

The Environment Agency has provided estimates of the modelled peak flood levels for a range of different extreme events (Appendix 1) derived in 2004 by Jeremy Benn Associates (JBA). Levels at several cross sections within the vicinity of the site (Table 2) were provided.

Table 2 Flood elevation data

Cross section	*Annual Event Probability (%)*		
	2.00	*1.00*	*0.67*
	Elevation (m aOD)		
Upstream side of the Bolton Viaduct	17.39m	17.74m	18.17m
Adjacent to centre of site	15.57m	16.03m	16.49m
Adjacent to east boundary	15.55m	15.95m	16.39m

The cross sections are equally spaced, however the flood elevation observed immediately upstream of the viaduct is significantly higher than observed at the other two sections. This suggests that the viaduct has limiting conveyance capacity causing flood water to back up, upstream of the viaduct (upstream of the site).

The area that is flooded as a result of the backing up of water is remote from the site. It is therefore more appropriate to use the flood level from the cross section adjacent to the centre of the site. This would suggest that there is a 0.67% chance annually of the flood level adjacent to the site exceeding 16.49m aOD.

In the light of this the probability and the potential hazard of flooding from the River Dearne directly impacting the development site (at 24m aOD or above) is considered to be very low and low respectively.

3.2.3 Climate change

It is widely accepted that climate change has the potential to cause more prolonged and more intense rainfall. Current guidance (Reference 1) recommends that an allowance of 20% is made when studying peak river flows to account for this. The necessary allowances were made for climate change during the construction of the model by JBA and in the related flood values quoted in Table 2.

3.3 Overland flow

The only areas of land upslope of the site are the railway line and Lowfield Road. Neither of these are likely to generate significant volumes of surface runoff as drainage arrangements are in place. For the railway line this is of the form of high permeable coarse gravel surfacing that is unlikely to allow any surface runoff and for Lowfield Road this takes the form of formal road drainage.

Given the above the probability of flooding from these sources is considered to be very low.

The areas from which runoff could be generated with regards to these sources are also very small and as such the potential magnitude of hazard associated with any flooding is assessed to be low.

3.4 Drainage

All major local drainage networks are either located down slope of the site or on the far side of either the railway of Lowfield Road embankments. If the sewers become blocked or are overwhelmed during a significant rainfall event, the local topography will ensure that flood water is routed away from the site.

The drainage network does therefore not act as a flood risk upon the site because no pathway exists. In the light of this the risk posed by this source is assessed to be negligible.

3.5 Summary of risk assessment

The probability and severity of each type of flooding has been assessed in line with the methodology and guidance set out in Appendix 6. This is then combined (Table 3) with the assessment of receptor sensitivity to define the level of flood risk on a scale ranging from negligible to high.

Typically risks assessed to be low or less are acceptable whereas risks assessed to be moderate or high require additional mitigation or management to enable development to proceed.

All identified potential flood sources at this site were assessed to pose a risk or low or less.

Table 3 Flood Risk summary table

Flood Source		*Pathway*	*Receptor*	*Sensitivity*	*Severity of impact*	*Probability of impact**	*Flood Consequence*
Fluvial	River Dee	Regional fluvial flooding	Residential	High	Low	Very Low	Low
Overland flow	Embankments to north and west of site	Loss of flood storage	Residential	High	Low	Very Low	Low
Drainage	Sewer systems	Surcharge during storm event	Residential	High	Negligible	Low	Negligible

* During life time of development

4. STORM WATER MANAGEMENT

Flood risk in any area is controlled by a number of contributing factors. At the local scale, when developing or re-developing a site, it is usual to acknowledge the part that the site itself will play in contributing, or potentially alleviating, flood risk.

For the Lowfield Road site an outline drainage strategy has been prepared by Halcrow. Reference should therefore be made to the plans and calculations undertaken as part of that work. The following is a summary of the plans they have developed and the considered impact on flood risk.

4.1 Design Standards

In line with PPS25, the Environment Agency's standing policy for site redevelopments is that runoff from a site should not be increased and that a decrease of site runoff towards greenfield levels is desirable. Where possible, this should be done using **S**ustainable **D**rainage **S**ystems (SuDS).

It is understood that for this site the Environment Agency have requested that peak storm water runoff from the site be controlled at or below greenfield rates as calculated using methodology set out in Institute of Hydrology technical report 124[5]. Calculations undertaken by Halcrow have determined this to be 5.7l/s/ha.

The site drainage system will be designed such that the annual probability of this objective not being met is less than 1%. The design will also assume that the associated design rainfall depth will increase over the development lifetime by 30% as a result of climate change.

4.2 Storm water management strategy

The proposed site drainage systems has been developed based on sustainable drainage principles as laid out in a number of guidance documents and PPS25.

4.2.1 Site discharge

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

As discussed in Section 2.2.3, the site is underlain by Made Ground. It is currently assumed that infiltration into this material should be avoided in order to avoid mobilisation of historic contamination. Work is currently in progress to confirm this assumption.

Given the above it is currently assumed that discharge from the site to a surface water receptor will be required. Gravity drainage necessitates that the outfall be to the south of the site where the sewage treatment works is situated. Discussions with Yorkshire Water have confirmed that provide that the net flow from the developed site is significantly less than the former factory site water can be discharged directly to the STW. As such both storm water and foul flows will be discharged to the STW and then treated and discharged by Yorkshire Water under the terms of their existing discharge consent.

5 Institute of Hydrology (1994), Report No. 124 Flood Estimation for Small Catchments

4.2.2 Proposed Drainage Strategy

In order to ensure that site runoff does not exceed greenfield rates, discharge from the site will be throttled using a hydraulic structure of some kind. During storm events flows arriving at the outfall will exceed the allowable discharge rate and water will start to back up. Sufficient storage will be provided, such that flows will not overflow from the site during design conditions (as discussed above).

Calculations undertaken by Halcrow indicate that between 400m^3 and 600m^3 of attenuation storage would be required to accommodate this storm water without surface flooding occurring during the design event. Given the development design it is proposed that this storage volume be provided for in a below ground system situated at the south boundary of the development area.

Water will discharge from the attenuation area at a peak rate of 5.7l/s/ha. This will then discharge to the STW along with foul flows at a peak combined flow rate of 8l/s/ha. The outline system proposed is shown on Appendix 5.

Further details are contained in the work undertaken by Halcrow and appropriate details will be prepared and submitted to the Environment Agency for review at the detailed design stage.

4.3 Off site flood risk

Given the storm water strategy described above, the rates of site runoff during most large storm events would be considerably reduced from the existing situation where water discharges away from the site without any attenuation. As such any contribution to flood risks downstream of the development site will be reduced.

4.3.1 Exceedance

As with any drainage design the system will fail, given an event significantly larger than the design flood event. The probability of such an occurrence is however correspondingly low.

If this occurred water would surcharge from the system and away from the site to the south in line with local topography. Given this it is assessed that there is unlikely to be any unacceptably severe consequence resulting from very rare events in excess of the design event.

5. CONCLUSIONS

The following conclusions can be made;

1. The site is situated wholly within flood zone 1 and as such is considered to pass the sequential test and potentially be appropriate for any type of development.

2. To our knowledge the site has never been impacted by flooding, including the June 2007 flood events.

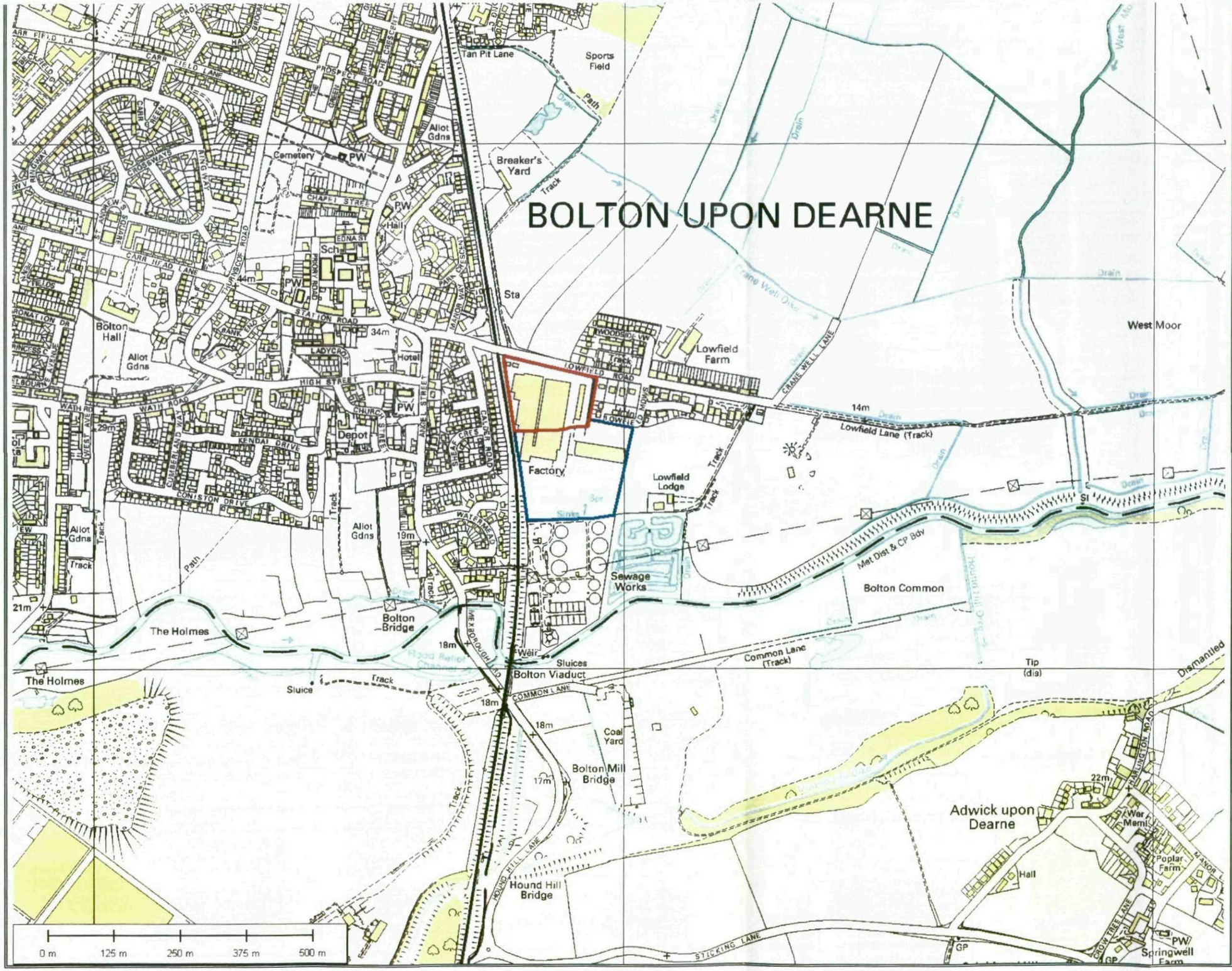
3. The existing levels within the development area are between 24m aOD and 28.5m aOD. The site is therefore somewhere between 5 and 10m above the highest reasonable local estimate of the design flood level along the River Dearne. In light of this the risk posed by this flood source to the site is considered to be low.

4. Other flood sources including overland flows and drainage infrastructure have been considered and all potential risks identified have been assessed to be low or less.

5. The site drainage strategy will ensure that flows from the site do not exceed greenfield runoff rates for all events up to the design event (1% annual probability) and including a 30% allowance for climate change over the development lifetime.

FIGURES

Figure 1 Site Location map



KEY

Ownership boundary

Development boundary

CLIENT	**Horizon Residential Development Ltd.**
PROJECT	Lowfield Road – flood risk assessment
DRAWING	Site Location map
SCALE: **As shown**	REF: Figure 1
CHECKED: APU	DATE: 01.09.2008

ENVIROS

Figure 2 Environment Agency flood map

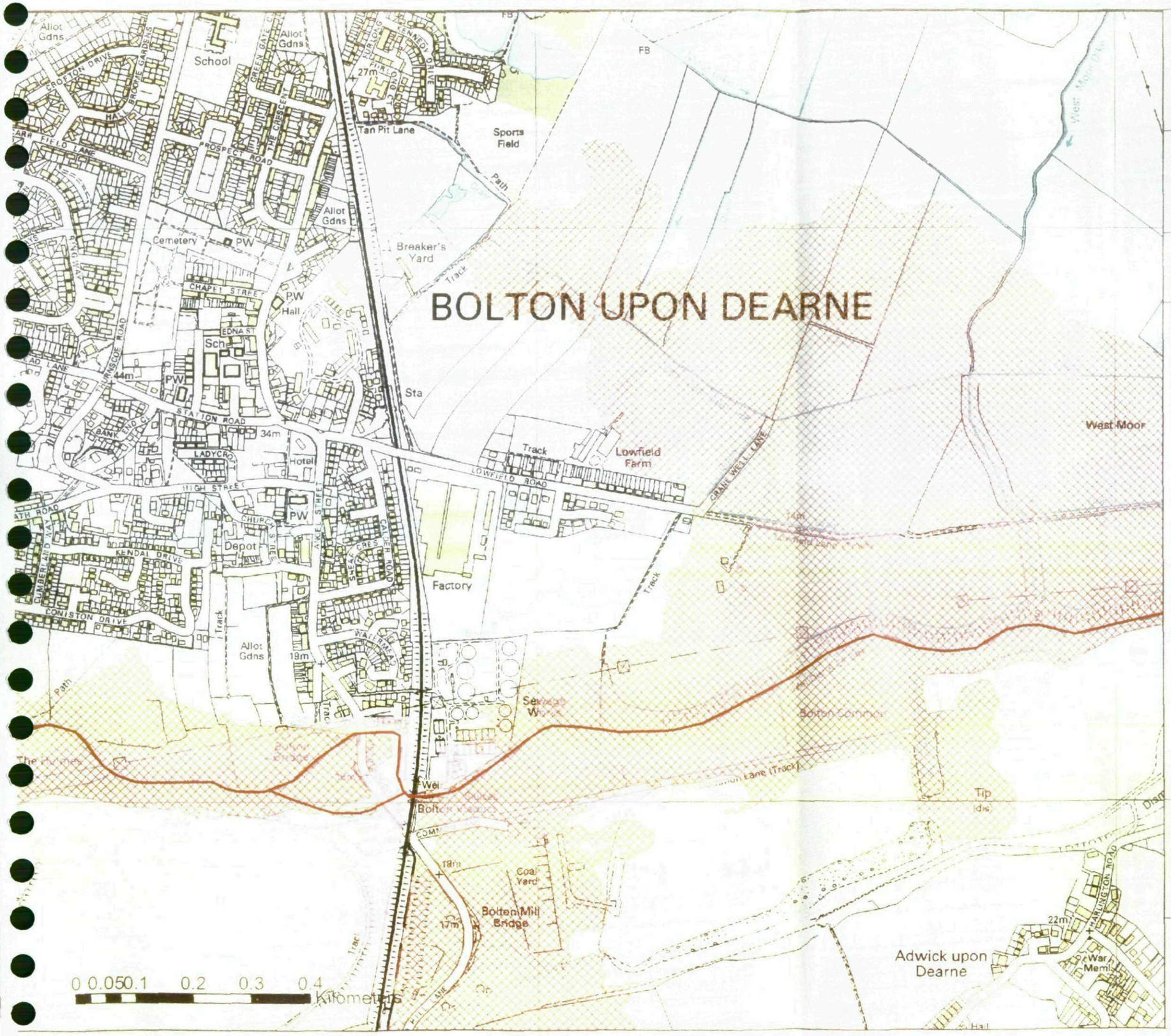
KEY

- Flood Zone 2
- Flood Zone 2
- Ownership boundary
- Development boundary

CLIENT	**Horizon Residential Development Ltd.**
PROJECT	Lowfield Road – flood risk assessment
DRAWING	Environment Agency flood map
SCALE: **As shown**	REF: Figure 2
CHECKED: APU	DATE: 01.09.2008

ENVIROS

Figure 3 Historic flood map (1947 and 2000)



Environment Agency

North East Region
Ridings Area
Phoenix House
Global Avenue
Leeds
LS11 8PG

Flood Extents and Level Information

Legend

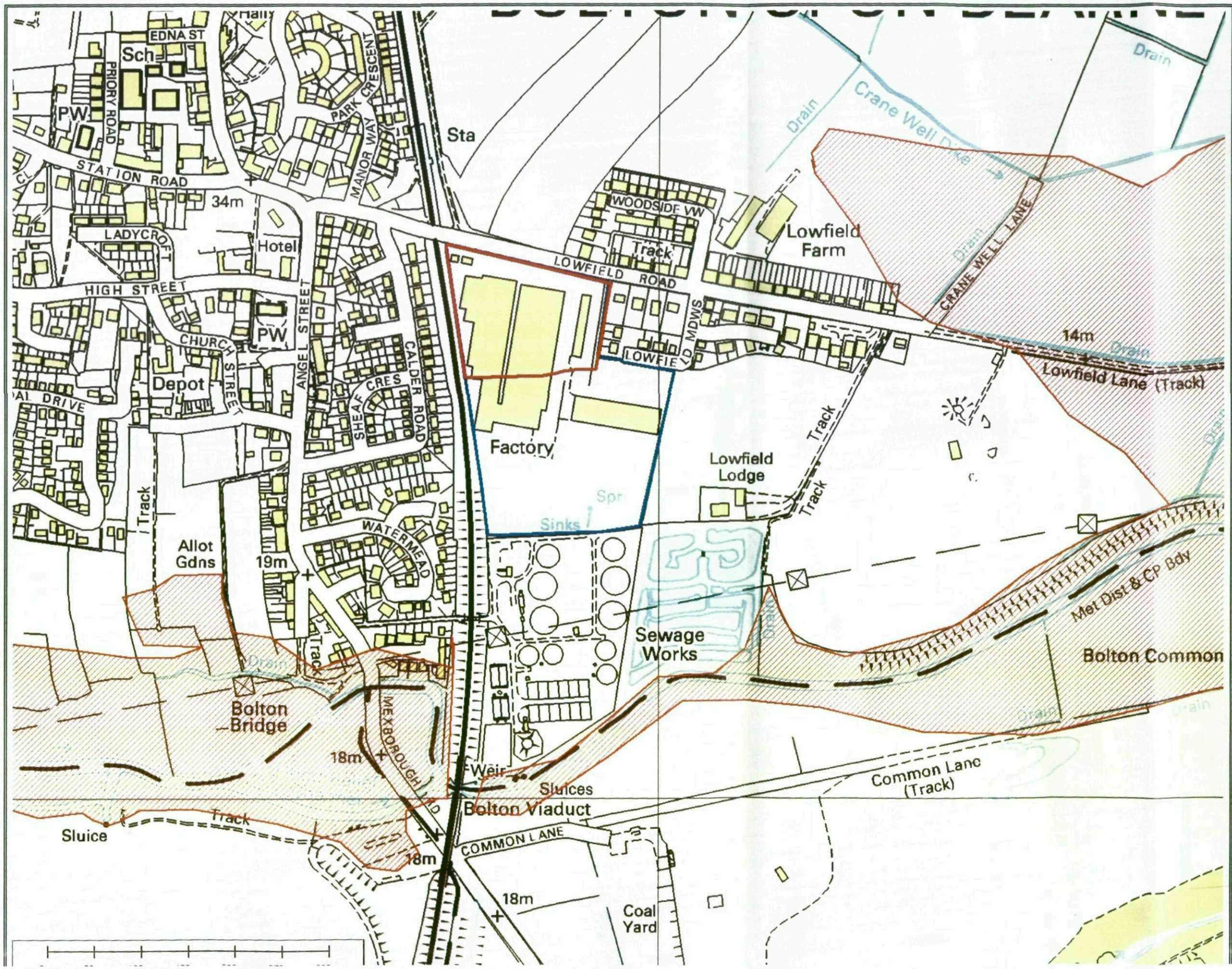
- Autumn 2000 Flood Event Flood Level (m)
- Main River
- Autumn 2000 Flood Event Flood Extent
- River Don 1947 Flood Event Flood Extent

Flood Extent and Flood Levels - Information Notes

The extent of flooding is only shown for those watercourses surveyed after the flood event. Other flooding may have occured which is not shown. This is the best information currently available.

The Map

Figure 4 Historic flood map (2007)



KEY

- Estimated flood extent
- Ownership boundary
- Development boundary

CLIENT	**Horizon Residential Development Ltd.**
PROJECT	Lowfield Road – flood risk assessment
DRAWING	June 2007 estimated flood extent
SCALE: **As shown**	REF: Figure 4
CHECKED: APU	DATE: 01.09.2008

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APPENDICES

1. ENVIRONMENT AGENCY CONSULTATION RESPONSE

creating a better place

RECEIVED
04 JAN 2006

Environment Agency

Daniel Watson
Enviros Consulting
3rd Floor Suite
Lister House
Lister Hill
Horsforth
Leeds
LS18 5AZ

Our Ref : RA/2005/027095-1/2
Your Ref : SP020017

Date : 23 December 2005

Dear Sirs

PROPOSED RESIDENTIAL REDEVELOPMENT - LOWFIELD ROAD, BOLTON UPON DEARNE, FLOOD RISK ASSESSMENT

Thank you for your enquiry, which was received on 9 December 2005.

Flood Risk Management

Flood Zone Map.
The Environment Agency has recently published the Flood Zone Map (see enclosed extract). This map shows natural floodplain 'zoned' into three areas based on risk for the purpose of PPG25. The three zones are shown as coloured areas on the map and are referred to as Zones 1,2,3 in PPG 25. They show the flooding that would occur if there were no flood defences and have been created from a combination of detailed models where available, generalised models based on the national Digital Terrain Model and relevant historic flood data. It should be noted that watercourses that have catchment size of less than 2 square kilometres have not been included.

Key for Map extract:

Zone 1 is not shaded showing areas with the lowest probability of flooding from rivers and the sea, where the annual probability is less than 1000 to 1 (0.1%).
Zone 2 is shaded turquoise and shows areas with an annual probability of flooding of between 1000 to 1 (0.1%) and 100 to 1 (1 %) in the case of river flooding or 200 to 1 (0.5%) in relation to coastal flooding. The outer edge of this zone is referred to as the 'Extreme Flood Outline' (EFO).
Zone 3 is shaded blue and shows areas with the highest probability of flooding, where the annual probability is greater than or equal to 100 to 1 (1%) for river flooding and greater than or equal to 200 to 1 (0.5%) for coastal flooding.

River Modelling

This reach of the River Dearne was modelled as part of the River Don Catchment Flood Model. This model was completed by Jeremy Benn Associates in May 2004.

Enclosed is an extract from the report describing the modelling approach taken and the are the Model Summary Sheets showing modelled water levels and flows for 5 different return periods adjacent to your site.

Flood History
See the enclosed map showing the flood history for this site. The extent of flooding is only shown for those watercourses surveyed after a flood event. Other flooding may have occurred which is not shown. This is the best information currently available.

Development Control

The Agency no longer makes recommendations as to minimum floor levels, however, prior to the introduction of PPG25 the Agency recommended that floor levels should be a minimum of 600mm above the 1 in 100 year flood level. An allowance should also be added for the possible effects of climate change.

An extract from historic flood records are enclosed.

The Agency is keen to promote the use of sustainable drainage systems and draw attention to Section 40 and Appendix E of Planning Policy Guidance Note 25 (PPG25).
If surface water will be discharged to public sewer the Water Authority, or their Agents, must confirm that there is adequate spare capacity in the existing system, this would be the limiting factor.
If the present surface water drainage system discharges to a watercourse and it is proposed that the redeveloped site will also discharge to the watercourse The Agency would require balancing to provide a 20% reduction in flows in line with the recommendations of PPG25 para 56 for the opportunity of redevelopment to be used to reduce run-off rates.

The Agency are not aware of any localised flooding problems relating to this site. The site is adjacent to an area covered by The Dearne and Dove Internal Drainage Board and enquiries should be made of the IDB and the Local Authority. Dearne and Dove IDB, Shire Group of Drainage Boards, Denison House, Hexthorpe Road, Doncaster, DN4 0BF, tel. 01302 342055.

The FRA should take account of the site levels in the vicinity of the spring and sinks, the flow, any seasonal variations, where the water would flow if the was a blockage of the watercourse. Any proposal to divert or culvert a watercourse requires the prior written approval of the Agency under the terms of the Land Drainage Act 1991. The Agency resists culverting on conservation and other grounds, and consent for such works will not normally be granted except for access crossings.

This information does not constitute a Flood Risk Assessment (FRA) in itself. It may be necessary to engage a consultant to utilise this data in the production of the FRA.

The Environment Agency does not undertake FRA's for any organisation other than itself.

We encourage you to have pre-application discussions with us if your enquiry will lead to you making a planning application with your local authority.

If your proposals for managing flood risk are acceptable, we can agree this with you before you make your planning application. We can give you a Letter of Compliance to send with your flood risk proposals to the local authority. The local authority will not need to contact us to ask for our advice about flood risk for your planning application.

The Letter of Compliance only covers flood risk grounds. We may have other (non-flood risk) concerns about your proposal and pre-application discussions may also help to cover these issues.

If you want to discuss this with us, please call Roger Dixon on 0113 2134679.

The information provided is based on that currently available to the Agency. The Agency and its officers accept no liability whatsoever for any loss or damage arising from the interpretation or use of the information.

I can advise that the interpretation of the information is your own responsibility however, should you have any queries regarding this letter, please contact this office at the address given below.

This information is provided subject to the enclosed notice, which you should read.

Yours faithfully

LESLEY SLANEY
EXTERNAL RELATIONS OFFICER

Encs:-

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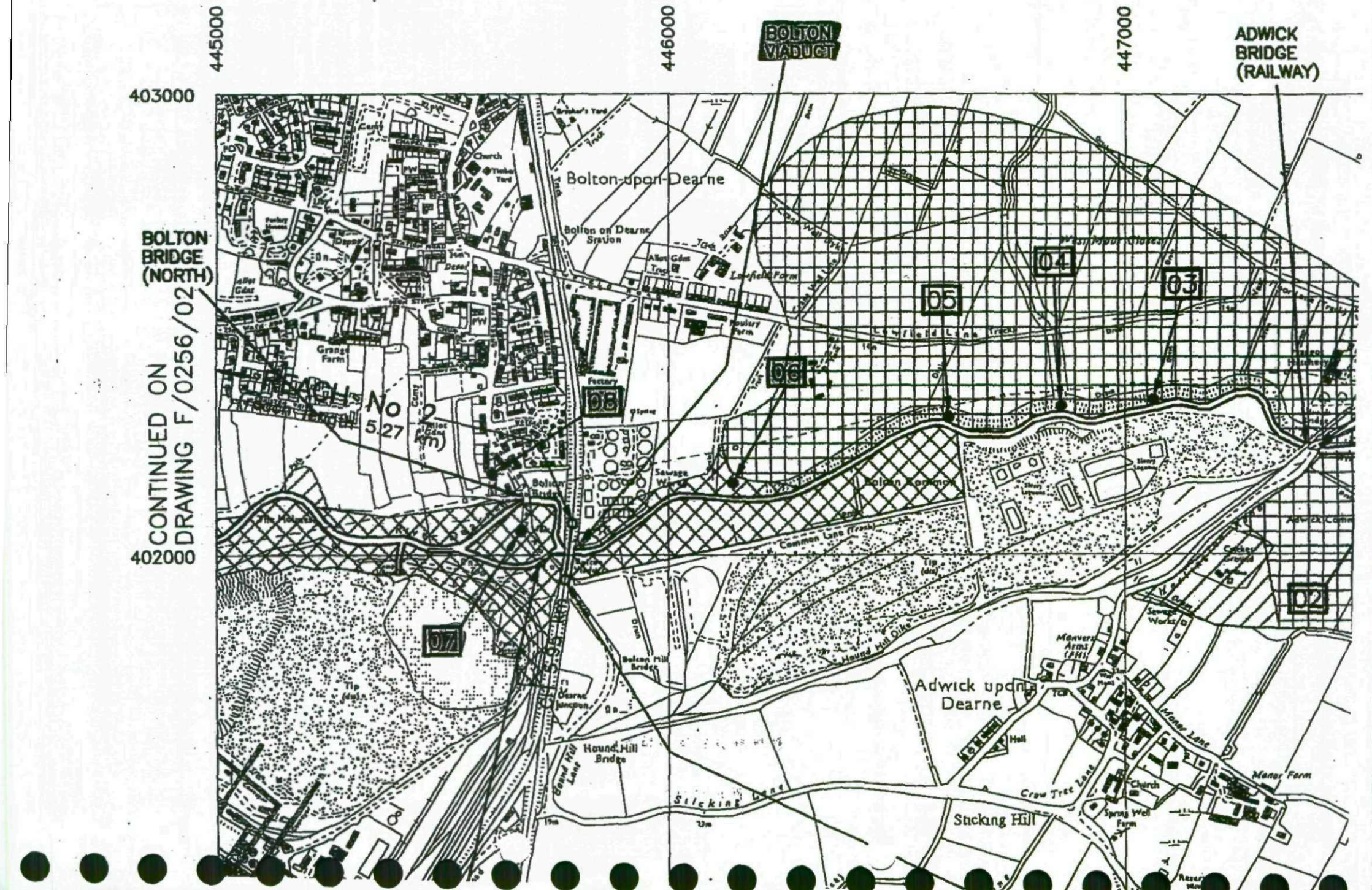
EXTRACT FROM HISTORIC FLOOD RECORDS



BOLTON VIADUCT

UPSTREAM				DOWNSTREAM			
DATE	LEVEL m.A.O.D.	DISTANCE (metres)	EVENT No.	EVENT No.	DATE	LEVEL m.A.O.D.	DISTANCE (metres)
4–16/5/67	17.71	0	04	02	7/58	16.98	0
2–3/11/68	17.15	0	06	05	3–6/11/67	16.92	0
2–13/4/70	16.95	0	07	06	2–3/11/68	16.98	0
				07	12–13/4/70	16.72	0

BOLTON BRIDGE (NORTH)

UPSTREAM				DOWNSTREAM			
DATE	LEVEL m.A.O.D.	DISTANCE (metres)	EVENT No.	EVENT No.	DATE	LEVEL m.A.O.D.	DISTANCE (metres)
2–3/11/68	17.70	0	06	06	2–3/11/68	17.29	0
12–13/4/70	17.24	0	07	07	12–13/4/70	16.96	0

ADWICK BRIDGE (RAILWAY)

UPSTREAM				DOWN	
DATE	LEVEL m.A.O.D.	DISTANCE (metres)	EVENT No.	EVENT No.	DATE
7/58	15.97	0	02	04	14–16/5/67
3–6/11/67	14.53	0	05	06	2–3/11/68
2–3/11/68	14.80	0	06		
12–13/4/70	14.89	0	07		

PASTURES ROAD BRIDGE

UPSTREAM				DOWN	
DATE	LEVEL m.A.O.D.	DISTANCE (metres)	EVENT No.	EVENT No.	DATE
7/58	14.11	0	02	04	14–16/5/67
7/58	14.35	30	02	05	3–6/11/67
3–6/11/67	12.80	0	05	06	2–3/11/68
2–3/11/68	13.42	0	06	07	12–13/4/70
12–13/4/70	13.66	0	07		

FOOTBRIDGE (MILL LANE)

WNSTREAM

LEVEL m.A.O.D.	DISTANCE (metres)
13.23	0
12.74	0
13.33	0
13.64	0

WNSTREAM

LEVEL m.A.O.D.	DISTANCE (metres)
13.69	40
13.87	40
13.91	40

WEIR

UPSTREAM

DATE	LEVEL m.A.O.D.	DISTANCE (metres)	EVENT No.
12–13/4/70	14.42	0	07

DOWNSTREAM

EVENT No.	DATE	LEVEL m.A.O.D.	DISTANCE (metres)

399000

OTHER LOCATIONS

DATE	LEVEL m.A.O.D.	LOCATION	EVENT No.
7/58	18.03	08	02
14–16/5/67	17.75	07	04
2–3/11/68	15.39	05	06
2–3/11/68	15.14	03	06
2–3/11/68	15.99	02	06
2–3/11/68	15.71	01	06
12–13/4/70	16.84	01	07
12–13/4/70	15.51	04	07
12–13/4/70	15.86	05	07
7/4/87	15.25	06	18

EVENT No.	DATE	LEVEL m.A.O.D.	LOCATION

ADWICK BRID(

UPSTREAM

DATE	LEVEL m.A.O.D.	DISTANCE (metres)	EVENT No.
2–3/11/68	14.95	0	06

1 INTRODUCTION

1.1 Note to Local Planning Authorities

1.1.1 This report describes a catchment flood study carried out on the River Don. This river and its tributaries flow through several local planning jurisdictions, and flood risks maps have been produced which are relevant to six local planning authorities (LPAs). These are:

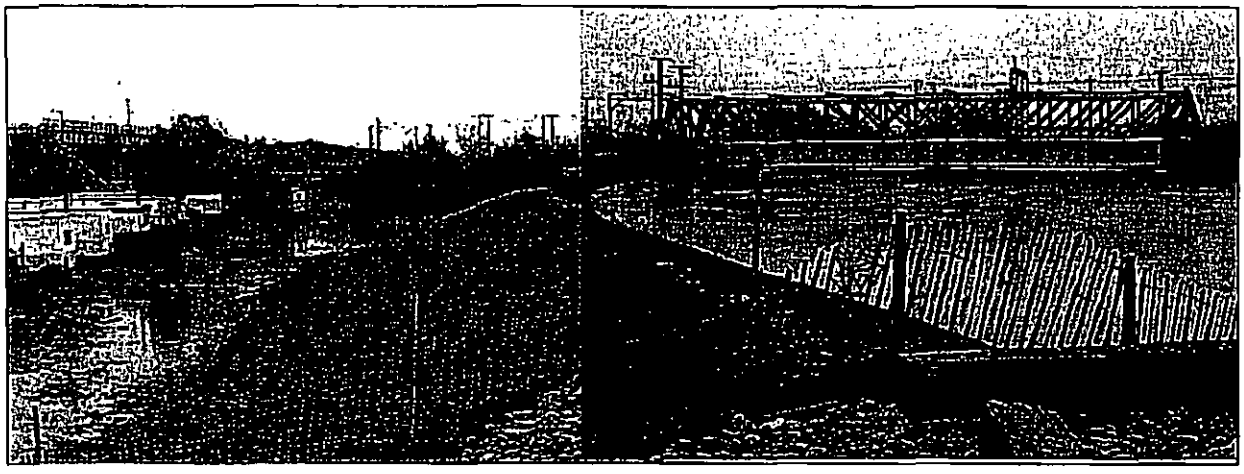
- Chesterfield
- North East Derbyshire
- Sheffield
- Rotherham
- Barnsley
- Doncaster

1.1.2 This report is a brief summary of the work carried out. For details about the project, or to reference the other volumes of the report, local planning authorities are asked to contact the Environment Agency in the first instance.

1.2 Background

1.2.1 In November 2000 the River Don registered the largest flow measured at Doncaster since 1973, and easily the largest flow since the completion of the last river regulator on the Rother in 1988 at Meadowgate. This event was a timely reminder of the potential for flooding in Doncaster, as water levels came within 0.1m of overtopping flood defences in the town (Figure 1.1, below).

Figure 1.1 : Flood levels adjacent to the caravan park in Doncaster in November 2000

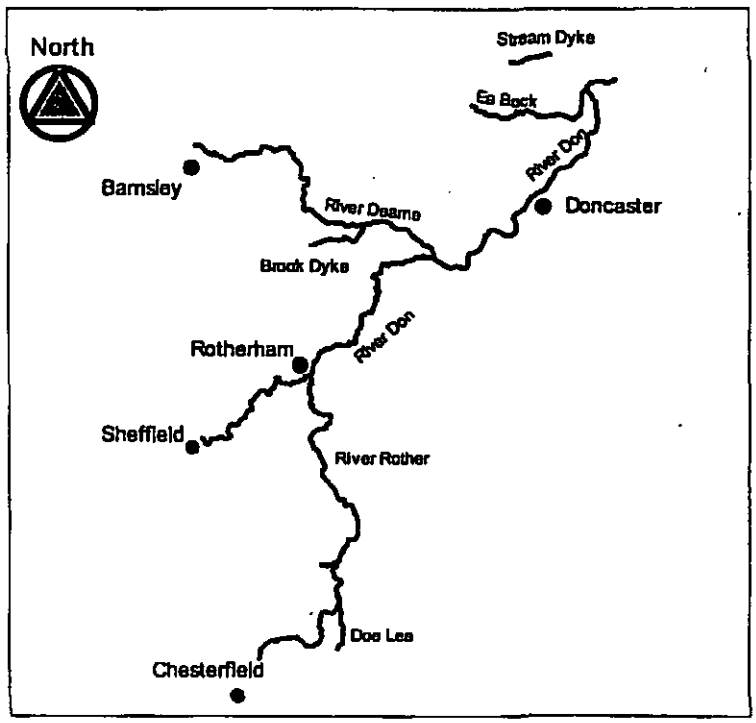


1.2.2 The River Don is an unusual catchment in that it relies on a combination of formal washland, flow control structures and river embankments to protect its lower reaches from flooding. The catchment is heavily urbanised for much of its lower reaches, and even the headwaters have been impacted upon by the needs of past industrial development, being extensively reservoired.

1.2.3 The combination of densely populated flood risk areas around Doncaster and Rotherham with the possibility of flooding over wide areas led the Environment Agency to commission this detailed hydrological and hydraulic modelling study of the River Don. The system of river regulation and formal washlands meant that the flood risk at Doncaster could only be evaluated with any certainty by considering the catchment and its main tributaries as a whole.

1.2.4 Several smaller watercourses, some of which were not direct tributaries of the River Don, were also included in the Don study. Bentley Moor Drain, Stream Dyke and Brook Dyke (a tributary of the River Deame) were all identified as being at risk from flooding and requiring further study. The River Don, River Deame and River Rother were the main components of the hydrological and river modelling study however, each forming a key part of the Don system. Figure 1.2 shows the locations of these watercourses relative to one another.

Figure 1.2 : Location of watercourses under study



1.3 Objectives

1.3.1 The study was carried out under the auspices of Section 105 of the Water Resources Act. The original brief was written in March 2000, and the Brightside reach of the River Don was included in November 2001. As a Section 105 commission, the primary objective was to determine the extent of the floodplain and flood risk areas. In order to achieve this, a hydraulic river model with hydrological inputs was needed. In addition to determining flood risk areas, the hydrological and hydraulic models were to be used to:

- Establish the present level of service for defences
- Obtain an understanding of the hydrology and hydraulic behaviour of the Don and its tributaries under flood conditions
- Examine the impact of proposed development
- Make recommendations on the effectiveness of flood control structures, flood forecasting and warning, the maintenance regime and capital works.

1.4 The Don Catchment

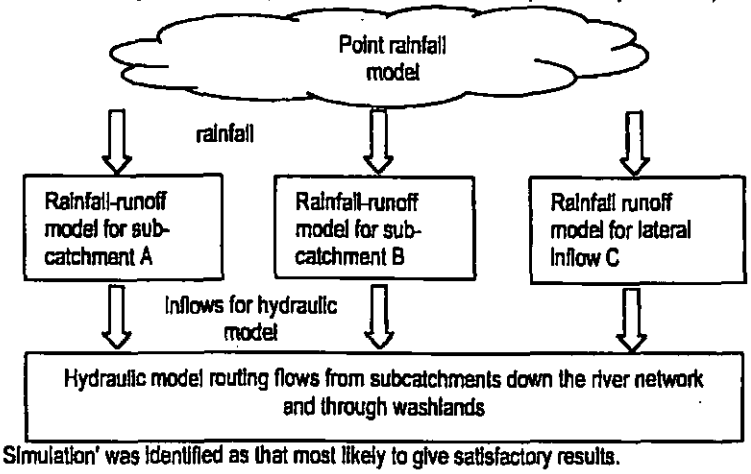
1.4.1 The River Don rises on the Southern Pennines, an area of high ground formed of Millstone Grit and Coal Measures. The Don's two main tributaries are the River Rother to the South and the Dearne to the North, a further watercourse joins the Don downstream of Doncaster, called Ea Beck. The steep upper parts of the Don, Rother and Dearne contrast sharply with the very flat Ea Beck and Lower Don. The Don, Rother and Dearne respond quickly to rainfall in their headwaters, but in the lower reaches of the Don and Ea Beck significant flood events tend to be much longer in duration.

1.4.2 There is significant urbanisation throughout the catchment, although this has most hydrological impact in Sheffield, Barnsley, Chesterfield and Rotherham. The Rother has a fairly natural flood response in its upper reaches, although downstream of the Doe Lea confluence there is significant flood storage. This storage is uncontrolled as far as Rother Valley Country Park, but three regulators between there and the Don confluence control the filling and emptying of large washlands. The flood response of the Upper Don is partly influenced by several water supply reservoirs in its headwaters. Almost half of the catchment upstream of Hadfields Gauging Station in Sheffield drains through such impoundments. The Dearne also flows off the Yorkshire Coal Measures and mining of this resource has been the cause of much subsidence and a changing topography. The middle and lower Dearne is utilised for flood storage, some of which can be controlled by Bolton Regulator. Ea Beck drains a very flat catchment which contributes flow to the Don downstream of Doncaster. An important feature of this river is that it is 'tide locked' by the Don during flood events so that water ponds behind flood banks until it is free to drain once more.

1.5 Approach to the study

1.5.1 The main reach of interest to this study, at Doncaster, lies downstream of the three main tributaries (Don, Rother and Dearne). Each river has differing hydrological characteristics and flood response times, and each tributary has formal and informal washland storage which serves to attenuate peak flows. Two tributaries also have flow control structures which directly regulate flows downstream.

1.5.2 The study approach needed to take account of these features in representing the hydrological response and hydraulic behaviour of the rivers being studied. After considering the various options identified in Section 3 (Volume 2) of this report, a relatively new technique known as 'Continuous Simulation' was identified as that most likely to give satisfactory results.



1.5.3 Continuous Simulation, in the context of a study of this scale, is a relatively simple concept that was very complicated to implement. The basic principle (illustrated by Figure 1.3) is that a very long flow series is derived, representing the extreme highs and lows, and shapes and sizes, of flood events that might occur over a period of say 1000 years. This 'realistic' flow series is then applied to a deterministic model of a complicated system (like a hydraulic river model). The results of the simulation at any point (or model node) can then be analysed as if they were an observed level or flow series, allowing the design flood to be calculated directly using the Gringorten plotting position (Equation 1.1).

1.5.4 The principles of continuous simulation are well known to the river modelling community, however the complexities described, together with computer processing requirements, mean that the technique has not been tried before on such a large scale in the UK. The work described in these volumes therefore has a 'pioneering' element to it, one that will hopefully lead to the furthering of flood modelling as a science, as well as developing an understanding of the Don Catchment.

Figure 1.3 : Schematic of the modelling framework

Gringorton formula : $$T = \frac{N + 0.12}{r - 0.44}$$ Equation 1.1

Where T is the return period in Years, N is the number of AMAX values and r is the rank.

1.5.5 With the River Don, a hydraulic model was used to simulate the reaches of the river that contained washlands and river regulators. This model (constructed using ISIS) extended up each tributary of the Don as far as a river flow gauging station, with the exception of Ea Beck which does not have one. The hydrological inputs are therefore relatively 'natural' and all the effects of storage and regulation are described by the hydraulic model.

1.5.6 Volume 2 of this report describes how the task of continuous simulation was approached for the River Don. The process was simplified into the following steps:

1. Hydraulic river model constructed and calibrated for the Don, Rother, Dearne and Ea Beck (Volume 3).
2. PDM (Probability Distributed Model) rainfall runoff models calibrated for each tributary against observed flow data (Section 4, Volume 2).
3. PDM Parameters derived for ungauged areas by transfer from hydrologically similar gauged catchments.
4. Stochastic rainfall series (1000 years in length at 1 hour intervals) generated, giving the same depth, duration and frequency (DDF) of rainfall as that predicted for the catchment from the FEH CD-ROM.
5. Stochastic rainfall series applied to each rainfall runoff model, generating 1000-years of hourly flow values for 21 sub-catchments.
6. Generated flow series adjusted for the gauged sub-catchments, forcing agreement with FEH statistical design peak flows (ungauged catchments were not adjusted).
7. Largest 97 flood events in the series at Hadfields identified, and these events run through the hydraulic model.

1.5.7 In practice, a truly continuous simulation using a large complex hydraulic river model is not practical because of the overwhelming demands on computer processing power, this is why only the largest 97 events at Hadfields were processed, a task still taking 3.5 days on a dual processor personal computer.

1.5.8 'Continuous simulation' unifies the normally separate hydraulic modelling and hydrological tasks, so that the design flow estimates are only generated when the hydraulic model has been run for the simulations, a process which also produces the design level estimates. The technique makes no assumption about the magnitude, duration or volume of flood events that go to make up the 100-year storm at a particular point in the river network. A great advantage is that it therefore allows each node to have a different design flood event, as might be expected in reality.

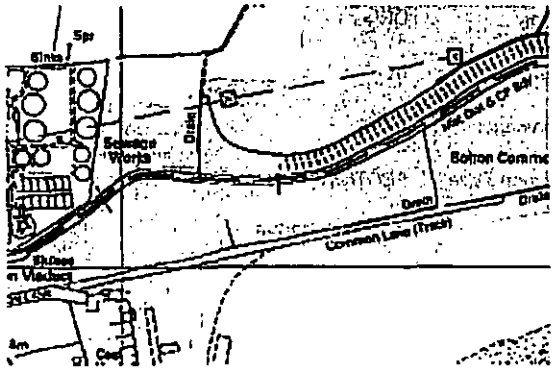
1.6 Report volumes

1.6.1 The main report is divided into 5 volumes, although local planning authorities have only been issued with the first of these. The first (this volume) attempts to summarise the methods used and the main findings of the study. It should be treated as an executive summary for the whole report. For greater detail, the reader should refer to the other volumes which describe the work undertaken in detail. Volume 2 covers the approach taken to the hydrology in this project. This report is quite lengthy because of the relative novelty of the methods employed and the need to document this work. Volume 3 covers the hydraulic modelling of the Rivers Don, Dearne, Rother and Ea Beck and contains details of the results. Volume 4 describes the hydraulic modelling of the minor watercourses not part of the ISIS model (Broook Dyke, Bentley Moor Drain and stream Dyke). Volume 5 contains the flood risk maps and supporting information, such as hydraulic model check files.

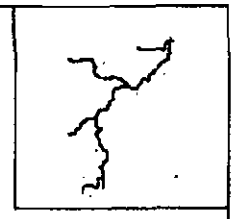
Environment Agency - North East Region
Re-working of the River Don Model
ISIS Hydraulic Model Summary Sheet

jba

Location Plan



Cross Section References



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Reach: 01

Chainage: 5544

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Survey Dwg Ref: N/A

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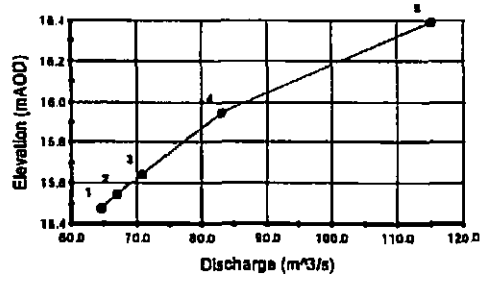
Section U/s: 5795

Rating Curve



Number represents model profile number

Summary of Results

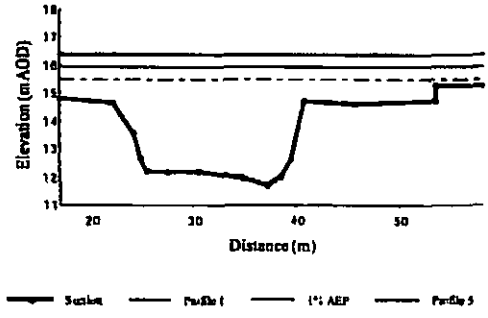
Profile No	AEP (%)	Flow (m^3/s)	Water Level (mAOD)	Velocity (m/s)
1	4.00	64.5	15.481	0.97
2	2.00	86.9	15.550	0.98
3	1.33	70.8	15.647	0.99
4	1.00	82.9	15.948	1.00
5	0.67	114.9	16.391	1.01

Level of Left Bank 14.650 mAOD

Level of Right Bank 15.275 mAOD

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

Cross Section Profile



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Print Date: 21/05/2004

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

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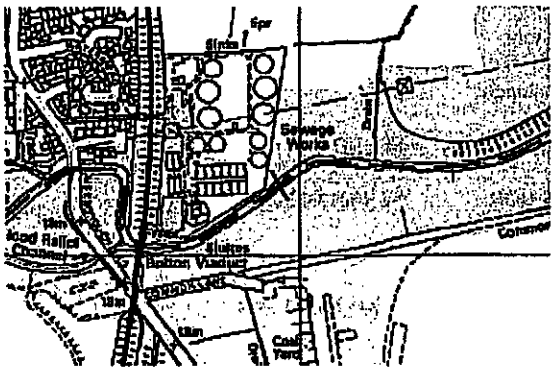
Location Plan



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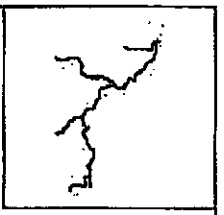

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Chainage: 5795

Section Type: SECTION

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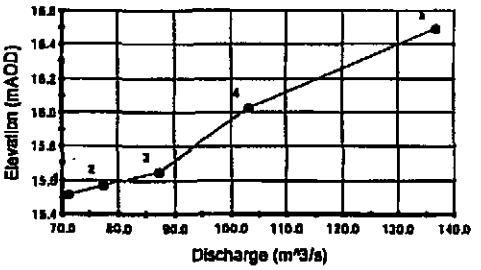
Section U/s: 6014U

Rating Curve



Number represents model profile number

Summary of Results

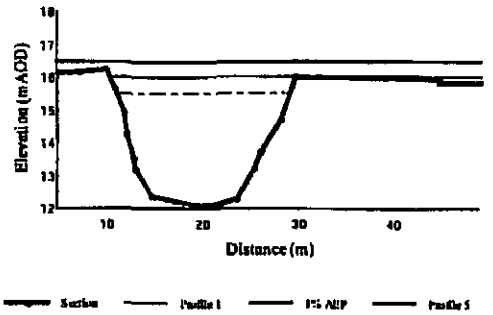
Profile No	AEP (%)	Flow (m^3/s)	Water Level (mAOD)	Velocity (m/s)
1	4.00	71.1	15.521	1.57
2	2.00	77.3	15.576	1.65
3	1.33	87.2	15.654	1.78
4	1.00	103.1	16.031	1.89
5	0.67	136.5	16.493	1.90

Level of Left Bank 16.260 mAOD

Level of Right Bank 15.850 mAOD

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

Cross Section Profile



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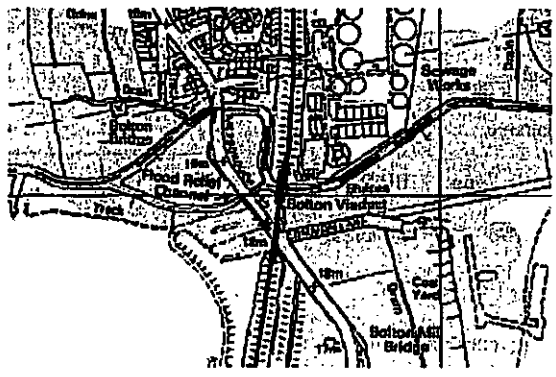
Print Date: 21/05/2004

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

jba

Location Plan



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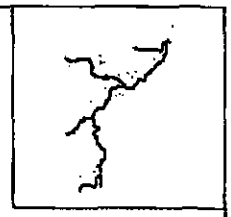

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Reach: 01

Chainage: 6014U

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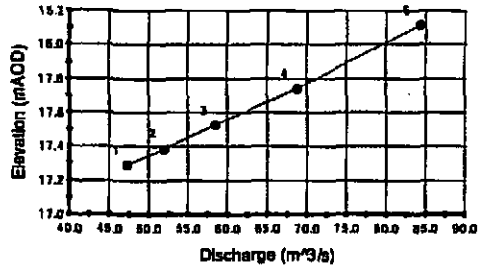


Number represents model profile number

Summary of Results

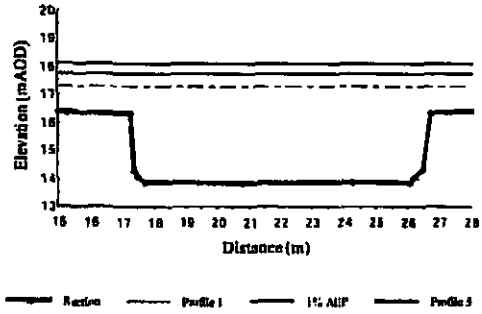
Profile No	AEP (%)	Flow (m^3/s)	Water Level (mAOD)	Velocity (m/s)
1	4.00	47.2	17.295	0.96
2	2.00	51.9	17.390	0.96
3	1.33	58.4	17.532	0.96
4	1.00	68.7	17.744	0.96
5	0.67	84.1	18.117	0.96

Level of Left Bank 16.332 mAOD

Level of Right Bank 16.342 mAOD

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

Cross Section Profile



DRN: 01: CROSS SECTION NUMBER 6014U

Print Date: 21/05/2004

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

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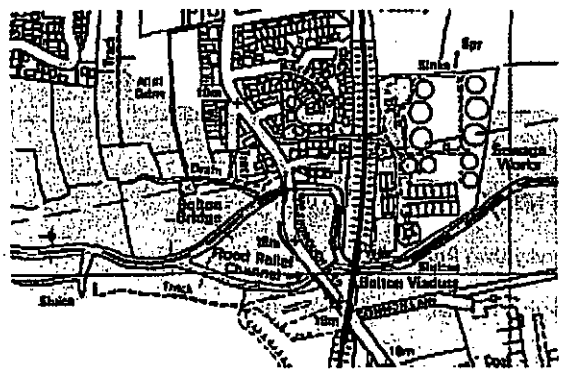
Location Plan



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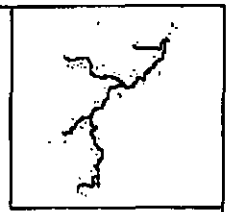

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Reach: 01

Chainage: 6197U

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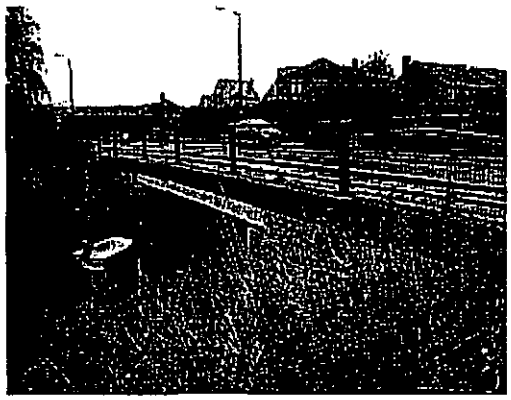
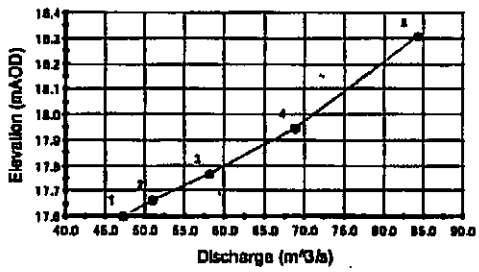


Rating Curve



Number represents model profile number

Summary of Results

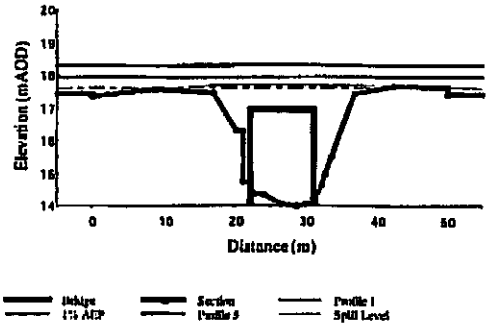
Profile No	AEP (%)	Flow (m^3/s)	Water Level (mAOD)	Velocity (m/s)
1	4.00	47.2	17.604	0.91
2	2.00	51.0	17.667	0.91
3	1.33	58.1	17.770	0.91
4	1.00	68.7	17.949	0.91
5	0.67	84.1	18.307	0.92

Level of Left Bank 17.350 mAOD

Level of Right Bank 17.412 mAOD

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

Cross Section Profile



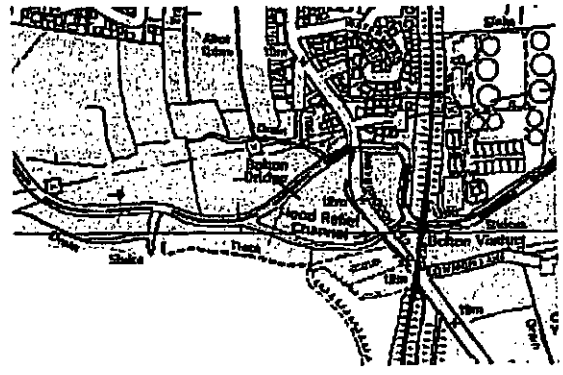
DRN: 01: CROSS SECTION NUMBER 6197U

Print Date: 21/05/2004

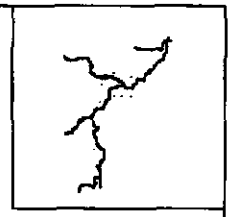
Environment Agency - North East Region
Re-working of the River Don Model
ISIS Hydraulic Model Summary Sheet

jba

Location Plan



Cross Section References



River: DRN

Reach: 01

Chainage: 6301

Section Type: SECTION

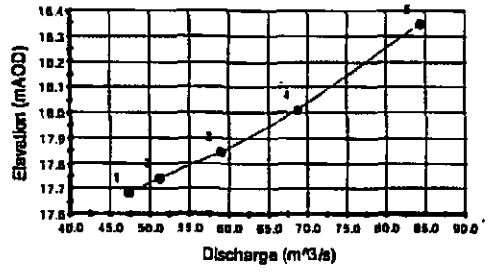
OS NGR: SE 45598 02066

Survey Dwg Ref: N/A

Photograph Ref: DEAR_06301.JPG

Next
Section D/s: 6197U
Section U/s: 6381U

Rating Curve



Number represents model profile number

Summary of Results

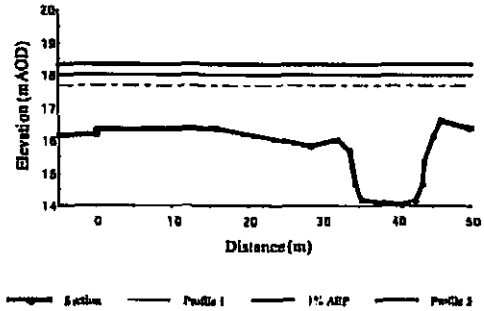
Profile No	AEP (%)	Flow (m^3/s)	Water Level (mAOD)	Velocity (m/s)
1	4.00	47.3	17.686	0.81
2	2.00	51.2	17.745	0.81
3	1.33	58.9	17.847	0.81
4	1.00	68.8	18.013	0.81
5	0.67	84.2	18.347	0.81

Level of Left Bank 16.340 mAOD

Level of Right Bank 16.620 mAOD

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

Cross Section Profile



DRN: 01: CROSS SECTION NUMBER 6301

Print Date: 21/05/2004

2. YORKSHIRE CONSULTATION RESPONSE

Nick

With reference to your correspondence of the 22 December 2005 concerning the easement requirements of Yorkshire Water and the above site.

A check of the statutory sewer record has indicated that a 400mm diameter combined rising main is recorded traversing the site. To allow the sewerage undertaker to perform its statutory duties in this instance no building or other obstruction should be located over or within 4 (four) metres of a public sewer. The proposal and/or proposed layout for the site may therefore be affected by the position of a/the public sewer(s).

A developer may, where it is reasonable to do so, require a sewerage undertaker to alter or remove a pipe where it is necessary to enable that person to carry out a proposed improvement of land. This provision is contained in section 185 of the Water Industry Act 1991 that also requires the developer to pay the full cost of carrying out the necessary works.

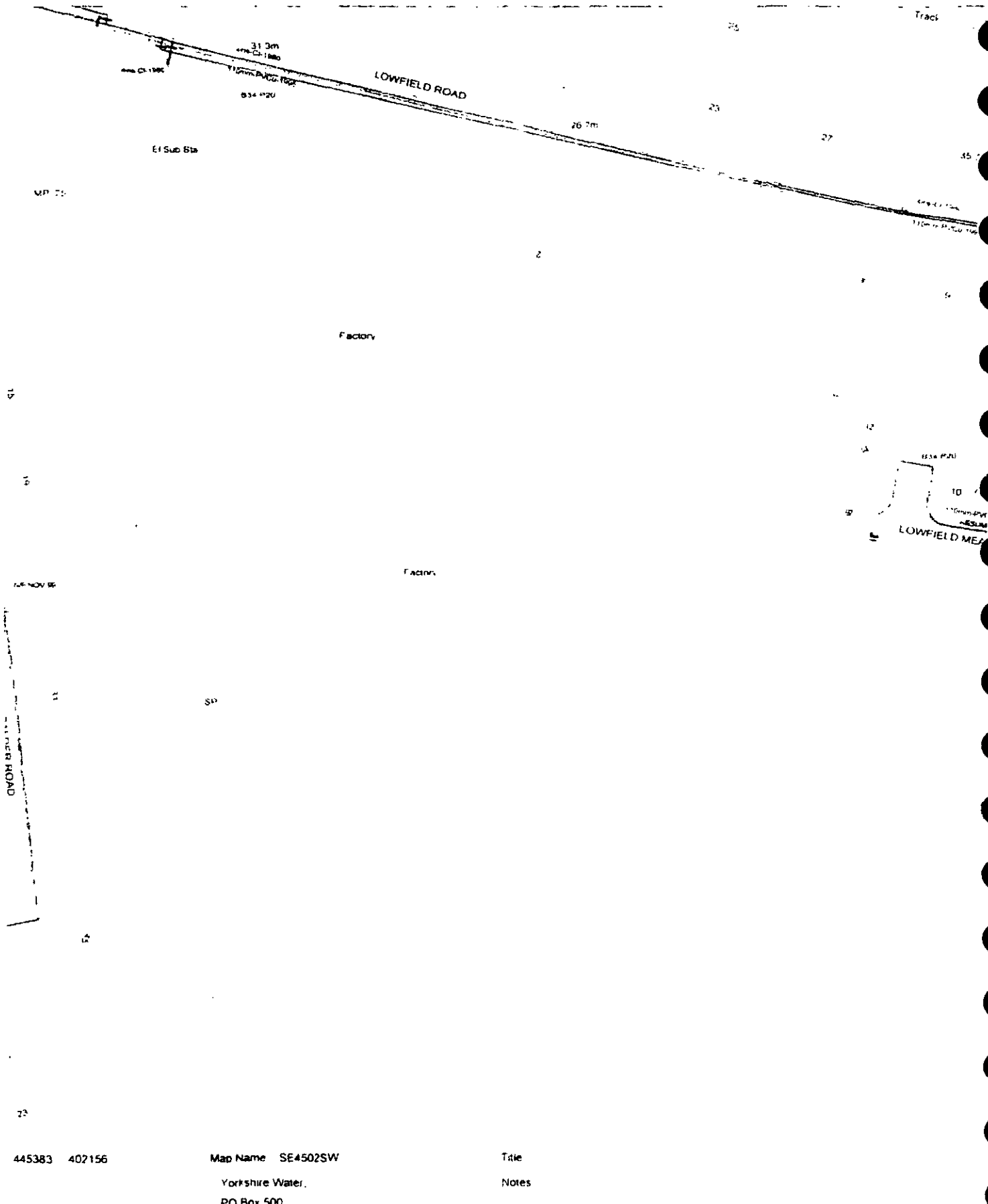
In this instance Yorkshire Water would object to any connections onto the 400mm diameter rising main

Please note the pipe(s) is/are lawfully retained in its/their existing
position(s) and the sewerage undertaker is entitled to have it/them 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 pipe(s). 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.

Terry Hill

Find out how to protect your home from frost this winter at www.yorkshirewater.com

YORKSHIRE WATER - WINNER OF THE UTILITY OF THE YEAR AWARD 2004 AND 2005



445383 402156

Map Name SE4502SW

Yorkshire Water,
PO Box 500,
Halifax Road,
Bradford BD6 2LZ
Contact Name
Ms A Galloway
Contact Tel : 0127437

Title

Notes

Partial Key

Water mains up to 4" in diameter

Water mains over 4" in diameter

Raw water mains

Private water mains

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.

Scale 1:1250

Drg No :

Mans No

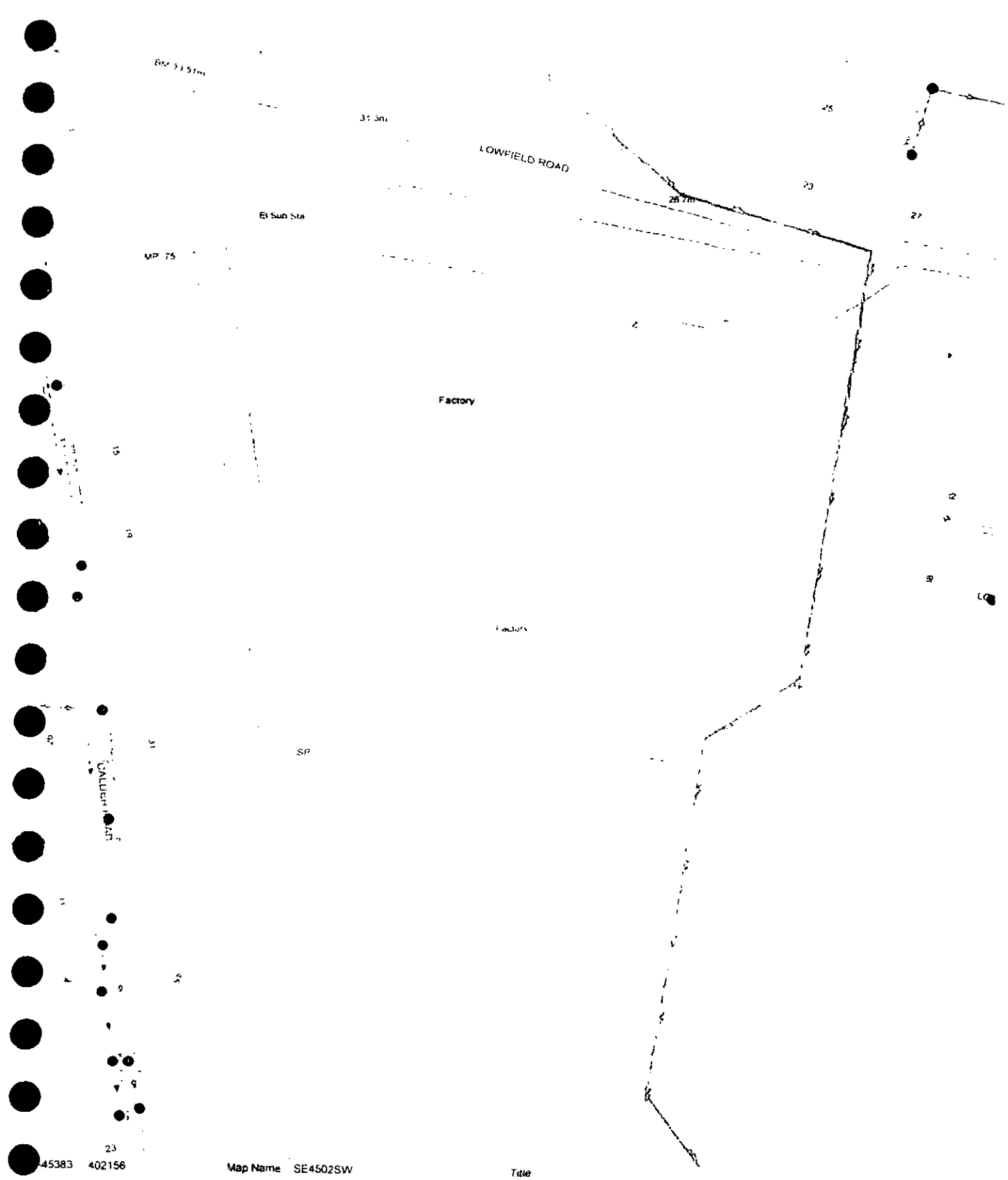
Date Req 02/12/2005, 08:56:30

Date Gen 02/12/2005, 08:56:36

Source : Water Network Enquiry

UPN Undefined

Originator A Galloway Mapping Data Unit 0127437



45383 402156

Map Name SE4502SW

Yorkshire Water,
PO Box 500,
Halifax Road,
Bradford BD6 2LZ
Contact Name
Ms A Galloway
Contact Tel 0127437

Title

Notes

Partial Key

Foul Sewer = F

Combined Sewer = C

Surface Water Sewer = SW

Trade Sewer = TD

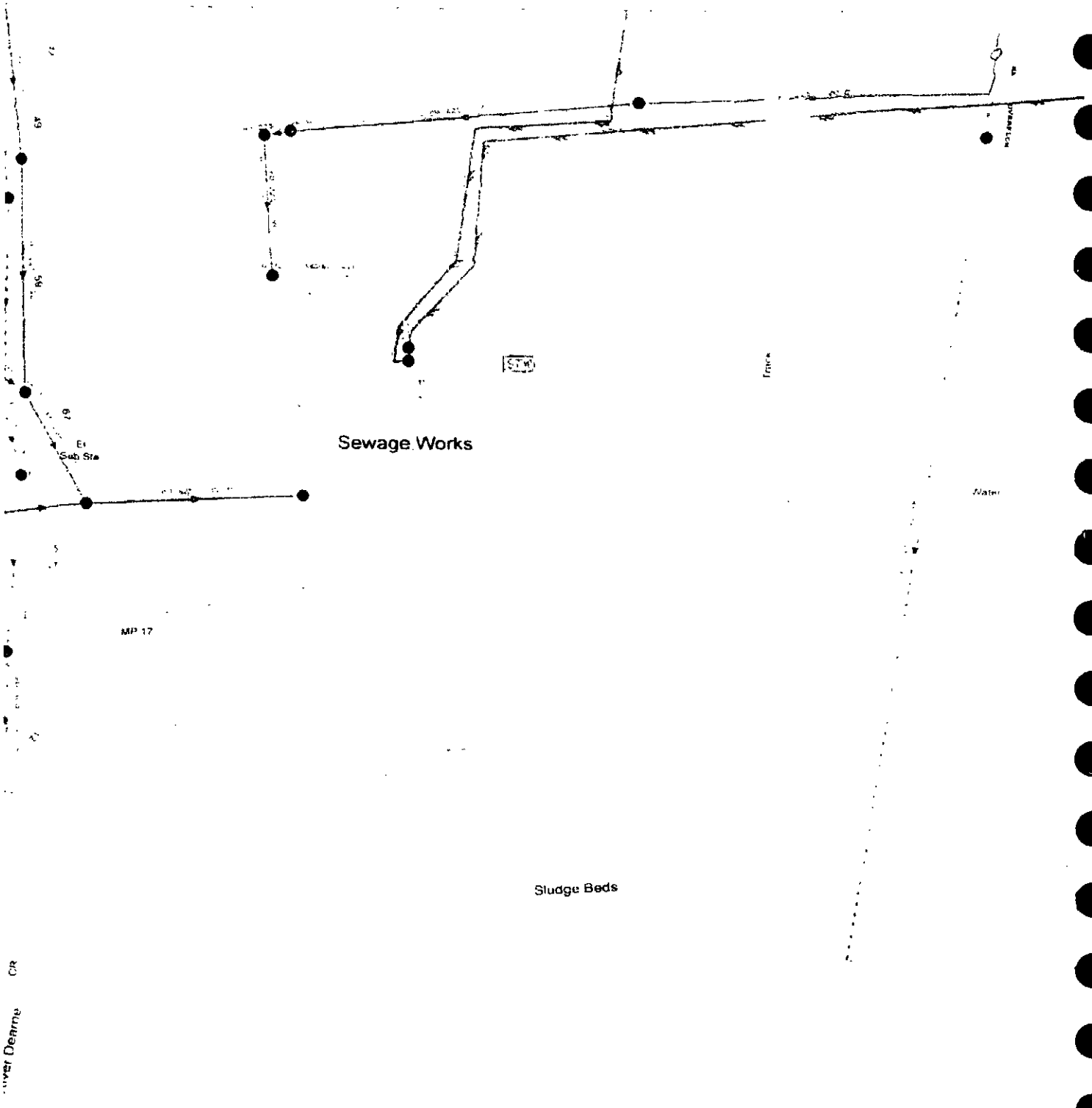
Partially Separate = PS

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

Date Req 02/12/2005, 08:57:05 Date Gen 02/12/2005, 08:57:13

Source Sewer Network Enquiry

PN Undefined Originator A Galloway Mapping Data Unit, 0127437



445490 401985 Map Name SE4501NW

Yorkshire Water,
PO Box 500,
Halifax Road,
Bradford BD6 2LZ
Contact Name
Ms K Lister
Contact Tel 01274 692974

Title

Notes

Partial Key

Foul Sewer = F

Combined Sewer = C

Surface Water Sewer = SW

Trade Sewer = TD

Partially Seperate = PS

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

Date Req 20/12/2005, 10 54 46 Date Gen 20/12/2005, 10:54:59

Source Sewer Network Enquiry

URN Undefined Originator K Lister Mapping Data Unit 01274 692974

3. IDB CONSULTATION RESPONSE

FAX TRANSMISSION

To	Nick Bosanko - Enviros Leeds
Fax Number	0113 239 5619
From	Chris Wright
Our Reference	IDB-4110/20
Date & Time	06/01/2006

No of pages including cover sheet 2

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e info@jbaconsulting.co.uk

Nick
Site off Lowfield Rd Bolton-On-Dearne

Further to our telephone conversation today, I was mistaken in that I have not had a planning consultation for this site.
However, I can confirm that if surface water from the site is to discharge into Lowfield Rd east of the site, the Dearne & Dove Internal Drainage Board will require flow restriction to prevent reduction of drainage standard downstream within the Board's area. If surface water is to be discharged into the River Dearne direct or into sewers which discharge into the river, then the Board would not object to the proposals.
The site lies just outside the Board's area so would be concerned if SW discharge were to enter the Board's area.
The attached plan extract shows the Board's area to the east of the boundary line.

We do not know of any flooding of the site from the drainage system in the Board's area.

I hope this is of some help.

Regards

Chris Wright
on behalf of the Dearne & Dove IDB

4. SITE TOPOGRAPHIC SURVEY

5. PROPOSED DEVELOPMENT MASTERPLAN

6. FLOOD RISK METHODOLOGY

It is recommended by both the Environment Agency and DEFRA that the primary assessment tool within a flood risk assessment should be the sequential test as set out in Tables D1 and D2 of the draft version of PPS25: Development and Flood Risk. Such an assessment however, deals almost exclusively with the risks associated with tidal and fluvial sources and not the full range of flooding sources identified in Annex C of PPS25. In addition to this, the sequential test does not provide guidance for assessing the impact of mitigation and residual risk subsequent to development, as required by Annex G of PPS25.

Therefore in order to allow for the wider assessment of flood risk this more generalised assessment methodology has been developed. It should be noted that where applied to fluvial and tidal sources the results of the assessment should be cross checked against the results of the sequential test.

Assessment Methodology

In line with guidance set out in the draft version of PPS25: Development and Flood Risk, the key to the classification is that the designation of significance (or risk) is based upon the consideration of:

- The sensitivity of the receptor – takes into account the nature of the development or receptor and its likely response to increased risk.
- The magnitude of the potential hazard (i.e. severity) – takes into account the potential severity and nature of the flooding.
- The probability of occurrence (i.e. likelihood) – takes into account both the presence of the hazard and receptor, and the integrity of the pathway.

Classification of Sensitivity of the Receptor

When considering new developments, the classification of sensitivity is based (where possible) directly on the sequential test as set out within Table D2 of the draft version of PPS25. When considering off site impacts there is a general assumption that all developments are highly sensitive. This assumption can however typically be relaxed when considering 'Water Compatible' development or undeveloped land. Given this the Sensitivity of the receptor is ranked as shown in Table 1.

Table 4 Classification of sensitivity of receptor

Sensitivity of receptor	New Development	Off site
Very High	*Highly Vulnerable** developments	All built developments unless mitigating circumstances exist. Key access routes
High	*More Vulnerable** developments	Other access routes
Medium	*Less Vulnerable** developments	Undeveloped Land
Low	*Water Compatible** developments	-
Very Low	Flood attenuation features	-

* For definition of italicised terms please see Table D2 of PPS25

Classification of Magnitude of Potential Effect

To classify the magnitude of the potential effects it is necessary to look at the nature and scale of the individual impacts. These include, but are not confined to, the extent of flooding, the depth of flooding, the duration of flooding and the velocity of flood waters. For new developments the assessment is based on the likely post development situation, for off site receptors it is based solely on the likely deterioration.

Given this the magnitude of the potential effect is then ranked as shown below in Table 2.

Table 5 Classification of Magnitude of Potential Hazard

Magnitude of Hazard	New Development	Off site
High	Any one of the following criteria *achieved:* • flood depths greater than 1m, • flood flow velocities greater than 0.45m/s • likely flood duration in excess of 24 hours	*Any marked (>10%) increase in flood* depth, flood flow velocity or flood duration. Any change in flood extent that impacts additional properties including access
Medium	Any one of the following criteria achieved: • flood depths between 0.3m and 1m, • flood flow velocity greater than 0.15m/s • likely flood duration in excess of one hour • Any restrictions to access and egress	Any other *measurable increase of flood* depths, durations, flow velocities or extent.
Low	All of the following criteria achieved: • flood depths below 0.3m, • likely flood duration below one hour • flood proofing measures planned	Likely, but unquantifiable small increases of flood depths, durations, flow velocities or extent
Very Low	Planned or permitted flooding that does not adversely impact the built development	-
Negligible	No potential for flooding, or no identifiable impact of flooding	No likely increase in flood severity at any off site location

Magnitude of potential effect

The magnitude of the hazard and the sensitivity of the receptor are combined using a matrix (shown below – Table 3) to determine the magnitude of the potential effect.

Table 6 Matrix for determining the Magnitude of the potential effect

		Sensitivity of Receptor				
		Very Low	Low	Medium	High	Very High
Magnitude of Potential Hazard	High	Low	Moderate	Moderate	High	High
	Medium	Very Low	Low	Moderate	Moderate	High
	Low	Very Low	Very Low	Low	Moderate	Moderate
	Very Low	Negligible	Very Low	Very Low	Low	Low
	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible

Classification of Probability of Occurrence

To classify the probability of occurrence for a potential effect it is necessary to understand how regularly a given event or outcome will come to pass. This can be assessed in a number of ways including assessments based on historical data, quantitative analysis, or experience from other similar sites. Often this assessment will be based on standard guidance. The magnitude of the potential effect is then ranked as shown below in Table 6.

Table 7 Classification of Probability of Occurrence

Probability of Occurrence	Potential effect
High	Any consequence would appear likely in the medium term and inevitable in the long term (Life time of the development).
	Equivalent to an annual probability of flooding of greater than 1% (0.5% for tidal) or *Flood Zone 3**.
Medium	Circumstances are such that an event is possible in the medium term and likely over the long term, although not necessarily inevitable.
	Equivalent to an annual probability between 0.1 and 1% (0.1 and 0.5% for tidal) or *Flood Zone 2**.
Low	It is unlikely that any consequence would arise within the lifetime of the development.
	Equivalent to an annual probability of less than 0.1% or *Flood Zone 1**.
Very Low	It is unlikely that any consequence will ever arise.

* For definition of italicised terms please see Table D1 of PPS25

It should be noted that in circumstances where sites are defended determining an accurate assessment of probability of flood occurrence is complex and assumptions that defences will not fail are unlikely to be acceptable. In such cases assessments can not be prescriptive and site specific assessments should be undertaken. Factors that should be considered include construction, age, condition, maintenance, exposure and other external pressures.

Risk Assessment

Once the magnitude of the potential effect and likelihood of occurrence have been assessed these are then combined using a risk matrix (Table 5) to assess the flood risk of each potential effect.

Table 8 Risk Matrix

		Likelihood of Occurrence			
		Very Low	Low	Medium	High
Magnitude of Potential Effect	High	Low	Moderate	High	High
	Moderate	Low	Low	Moderate	High
	Low	Very Low	Low	Low	Moderate
	Very Low	Negligible	Very Low	Low	Low

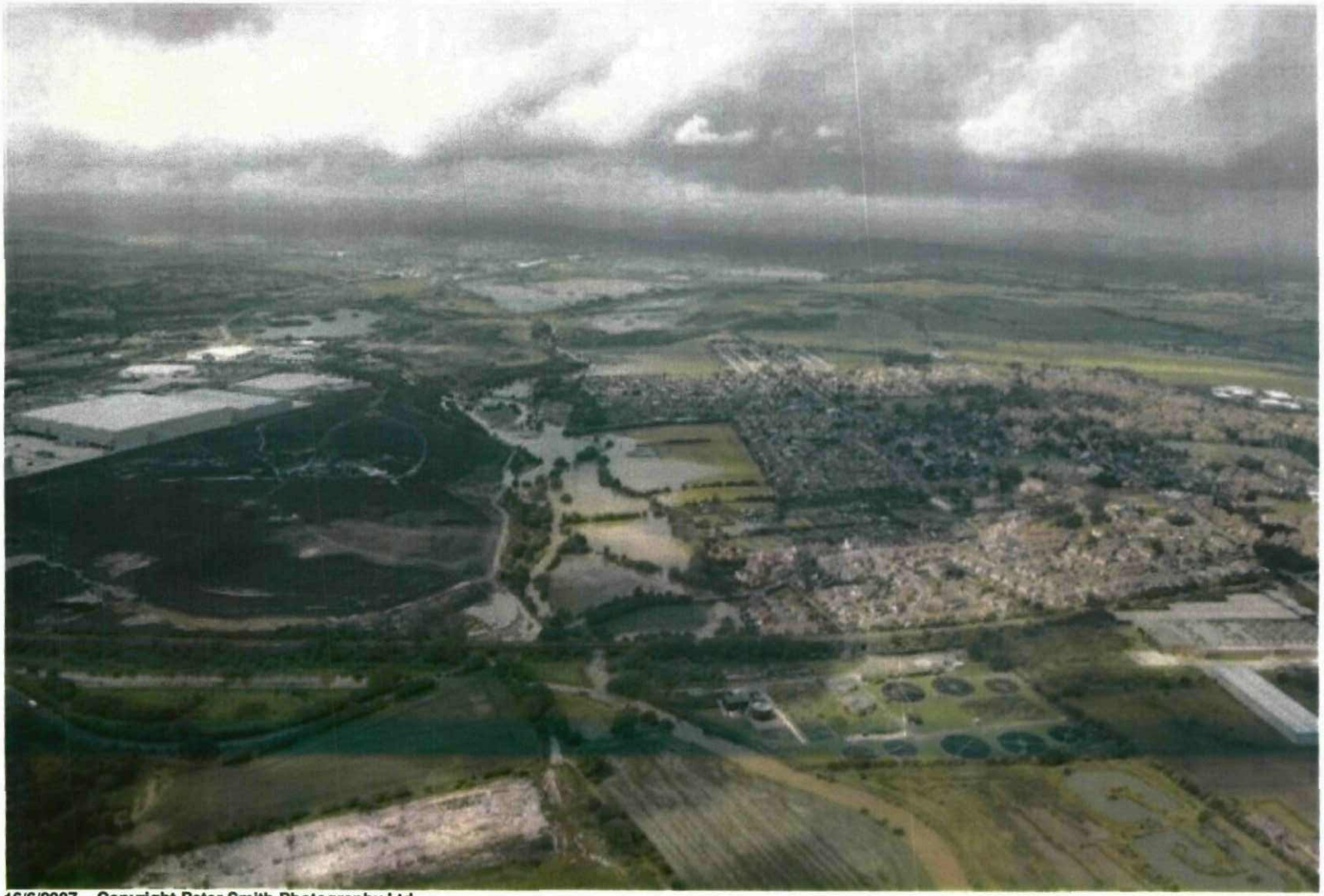
	Negligible	Negligible	Negligible	Negligible	Negligible

Typically flood risks assessed as low, or less are considered acceptable. If the assessment results in moderate or high risk, additional mitigation measure will be required to facilitate development.

In some situations the risk assessment procedure will result in an artificially low assessment of risk. This is particularly the case in situations where consequences of very rare flooding (i.e. breech scenarios) are so extreme that any residual risk however low should not be allowed. In such instances the assessed risk should be elevated. Such decisions must always be accompanied by detailed justification

.

7. AERIAL PHOTOS FROM JUNE 2007 FLOODING



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