FINAL

Barrowford Road, Colne, Lancashire, BB8 9TA

Environmental Review

For

Pendle Borough Council

PRIVATE AND CONFIDENTIAL

RPS Health, Safety & Environment
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FLL12761/005R
June 2005

This report has been prepared within the RPS Group Quality Management System to British Standard EN ISO 9001 : 2000.			
Report Status:		**FINAL**	
Project Number:		**FLL12761/005R**	
	Consultant	***Signature***	***Date***
Report by:	**M McLoughlin**		**30 June 2005**
Reviewed by:	**J Carlisle**		**30 June 2005**

CONTENTS

APPENDICES

1.0 EXECUTIVE SUMMARY

Site Details	Area:19.86 NGR: SD 865 402 Main use: Pasture Land for sheep
Site History	Historically the site has comprised eight open fields and the site has remained largely unchanged until the present day. Past industrial land uses in the area have included a Nursery (adjacent to south-east of site), Railway (10m east), Hospital (70m south), Quarry (200m south) and a Garage (29m south-east).
Current Condition & Activities	The site is currently divided into eight fields, which are used as pasture land for sheep. RPS understands that the site is proposed for development for light industrial land uses (B1, B2 and B8).
Geology	The generalised stratigraphic sequence underlying the site comprises Boulder Clay overlying Millstone Grit (mixed sandstone, mudstone and shales).
Hydrology/ Hydrogeology	The site is located on a Minor Aquifer relating to the underlying Millstone Grit. It is likely that shallow groundwater flow will be in hydraulic continuity with Wanless Water and flow towards the south-west. There are three watercourses within 800m of the site which are classified under the General Quality Assessment (GQA) scheme. These are Wanless Water, Colne Water and the Leeds and Liverpool Canal which lie on-site, approximately 561m south-west and approximately 155m north-west of the site respectively. Wanless Water is classified as a Grade B (good) watercourse, subsequently flows into Colne Water, which is classified as a Grade A (very good) watercourse. The Leeds and Liverpool Canal is classified as a Grade C (fairly good) quality watercourse. Environment Agency data indicates that the site is located within the indicative flood plain of Wanless Water. This area has a significant chance of flooding which is greater than 1.3% per year (1 in 75). This takes into account the effect of any flood defences that may be in this area.

Risk Assessment	Three landfills are recorded in this area. The closest being for domestic infill material 200m from the site. None are considered to represent a significant risk to the subject site. Pendle Borough Council has confirmed that there are no legally determined contaminated land sites within 500m of the subject site and that they have no specific concerns regarding the site. RPS has not identified a significant risk of liability associated with ground conditions at the site. With regard to the sites proposed use, the recommendations (see below) should be undertaken.
Recommendations & Costings	Part of the site has been identified as being in a floodplain. Consequently should the site be redeveloped there may be a planning requirement for a Flood Risk Assessment (to be confirmed by the Environment Agency during planning consultation) in accordance with PPG25 'Development and Flood Risk. *Cost Estimate: £2,500 - £10,000+VAT* Given the sites proposed use an ecological scoping survey of the site should be undertaken to inspect the site and its surroundings. This would identify any features, habitats or species which may represent a constraint to the proposed development of the site. *Cost Estimate: £1,250 - £3,000+VAT*

2.0 INTRODUCTION

RPS Health, Safety & Environment (RPS) was commissioned by **Indigo Planning Limited** on behalf of **Pendle Borough Council** to undertake an environmental review of *Barrowford Road, Colne, BB8 9TA.*

The principal aim of the review was to determine whether there was potential for contamination to be present which would significantly constrain the use of the site, or give rise to the risk of significant environmental liability.

The environmental review comprised:

i) a site walkover assessment;

ii) a review of the historical land uses associated with the site to assess the potential for ground contamination;

iii) a review of the environmental setting to assess the sensitivity of the surrounding environment to contamination/pollution;

iv) consultation with the regulatory authorities to establish whether there are any significant environmental issues that may impact upon the site, including records of any landfills in the vicinity;

Details of the limitations of this type of study are attached at Appendix B.

3.0 SITE SETTING AND DESCRIPTION

This section of the report is based upon observations made during a site visit on 1st June 2005. The site location and site boundary plans are shown in Appendix A.

3.1 *The Site*

The site is located to the north-east of Barrowford Town at National Grid Reference SD 875 405. It is of irregular shape, and occupies a total area of approximately 19.86 ha. Hiers House Lane delineates the eastern side of the site and Colne Road (B6247) lies approximately 50m from the southern boundary of the site. A number of ditches cross the site, separating the site into approximately eight fields. Wanless Water traverses the central to western side of the site, flowing to the south. The site is currently occupied by pasture land associated with a farm located at the north-east corner of the site and is currently grazed by sheep.

RPS understands that the site is potentially proposed for development for light industrial land uses (B1, B2 and B8).

The topography of the eastern side of the site is generally flat, gently sloping downwards from the south-eastern corner. Towards the west of the site, the ground banks steeply down to Wanless Water on and the western bank undulates steeply. The western side of the site, beyond the Wanless Water watercourse, slopes moderately and then levels out towards the western boundary of the site.

The eastern side of the site comprises mainly grassland with some deciduous trees including oak and hawthorn located along the boundaries and randomly distributed throughout the central area of the site. The site is traversed by approximately four streams draining towards Wanless Water in the south-western corner of the site. Reedbanks and some mature trees fringe the edges of these streams. The western side of the site, beyond Wanless Water, is largely dominated by deciduous trees (including ash and hawthorn), brambles, long grasses and nettles.

A small stream traverses the northern half of the site, running into Pendle Water to the west. Drainage across the western side of the site flows towards Pendle Water, and across the eastern side towards the Leeds and Liverpool Canal.

No sign of vegetation stress or are as of potential ground contamination were observed during the walkover.

3.2 *The Surrounding Area*

The site is located in an area of mainly rural land use. Open pasture fields are located to the west and north. Mixed woodland is located beyond the north-eastern boundary and residential properties are located to the south-east corner of the site. Nelson and Colne College is located approximately 80m south of the site. A disused railway line, which was entirely covered in hardstanding, lies approximately 10m from the eastern boundary of the site.

4.0 SITE HISTORY

The following account of the history of the site is based upon available past editions of Ordnance Survey (OS) maps dated 1848 to 2001. Extracts from the historical maps are given at Appendix A.

Maps Reviewed (publication dates)	***Map Scale***
1848; 1853; 1891 – 1895; 1896; 1911	25" to 1 mile scale
1893; 1912; 1932; 1962	1:2,500 scale
1961; 1993	1:1250 scale
1993; 2001	1:10,000 scale

4.1 *The Site*

Site Features	***Dates***
Eight Open Fields. Wanless Water traverses the West of the site from North to South	1848-2001

4.2 *The Surrounding Area*

Surrounding Features (300m radius)	***Orientation***	***Distance***	***Dates***
Nursery *Then* cleared	South-East	Adjacent	1961-2000 2001
Railway *Then* dismantled	East	10m	1848-1972 1973-2001
Farm	North	50m	1848-2001
Hospital *Then* Unlabelled Building	South	70m	1915-1955 1956-2001
Farm *Then* cleared	South	90m	1932-1992 1993-2001
Barrowford Reservoir	South-West	200m	1893-2001
Pumping Station with associated Tank *Then* cleared	North	200m	1915-1972 1973-2001
Sand Quarry *Then* infilled to from Bunkers Hill	South	200m	1933-1972 1973-2001
Leeds & Liverpool Canal	West	250m	1848-2001
Garage *Then* cleared	South-East	290m	1993-2000 2001
Coal Depot *Then* cleared *Then* redeveloped as residential	South-East	300m	1912-1972 1973-1992 1993-2001
Electrical Sub-Station	South-East	300m	1988-2001

5.0 ENVIRONMENTAL SETTING

Based on British Geological Survey 1:50,000 scale survey sheet No. 68, the stratigraphic sequence across the majority of the site is as follows:

- Boulder Clay *(Quaternary)*
- Millstone Grit *(Upper Carboniferous)*

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Boulder Clay

Information obtained from the BGS indicates that the Boulder Clay comprises very compact clayey fine-coarsed grained sand with fine-coarse subangular-subrounded gravel and subangular cobbles and small rounded boulders. This stratum is a few metres thick in the vicinity of the site.

Millstone Grit

Comprising beds of sandstone, conglomerates and grit with sequences of mudstones and shales, over 900 metres in thickness beneath the site.

5.2 *Hydrogeology*

According to the Environment Agency's Groundwater Vulnerability Map (Sheet 11) the site is located on a Minor Aquifer relating to the underlying Millstone Grit. These formations will seldom produce large quantities of water for abstraction though they are important both for local supplies and in supplying base flow to rivers. However the presence of overlying generally low permeability Boulder Clay will afford a degree of protection from downward migration of contaminants (if present) towards the underlying aquifer.

Considering the presence of Wanless Water in the central to western area of the site and flowing southwards, it is likely that shallow groundwater flow will be in hydraulic continuity with this surface water feature and flow towards the south-west.

According to data obtained from the Environment Agency the site is not located within a Groundwater Source Protection Zone (SPZ).

6.0 CONSULTATIONS & ADDITIONAL INFORMATION

6.1 *Surface Water*

Environment Agency data indicates that there are three watercourses within 800m of the site which are classified under the General Quality Assessment (GQA) scheme. These are Wanless Water, Colne Water and the Leeds and Liverpool Canal which lie on-site, approximately 560m south-west and approximately 155m north-west of the site respectively. Wanless Water is classified as a Grade B (good) watercourse, subsequently flows into Colne Water, which is classified as a Grade A (very good) watercourse. The Leeds and Liverpool Canal is classified as a Grade C (fairly good) quality watercourse.

Environment Agency data indicates that the site is located within the indicative flood plain of Wanless Water. This area has a significant chance of flooding which is greater than 1.3% per year (1 in 75). This takes into account the effect of any flood defences that may be in this area.

6.2 *Water Abstractions*

Information provided by the Environment Agency indicates that there are records of two licenced water abstractions within 800m of the site. The details of these are as follows:

Licence Holder	Source	Use	Approx. Distance and Direction from Site
John William Carradice	Surface Water	General Agriculture Use	510m North
Shubitz	Surface Water	Industrial Cooling	540m South

6.3 *Discharge Consents*

Environment Agency data shows that there is one licensed discharge consent within 250m of the site. The details of this is outlined in the table below:

Licence Holder	Receiving Medium	Type of Discharge	Approx. Distance and Direction from Site
United Utilities Water Plc	Watercourse	Storm/Emergency Overflow	40m East

6.4 *Waste Disposal Sites*

Information provided by the Environment Agency and British Geological Survey shows that there are two recorded landfill sites within 500m of the property. The details of these are listed in the table below.

Location	Waste Deposited	Approx. Distance and Direction from Site
Bunkers Hill, Off Cross Street West, Colne	Domestic	200m South
Barrowford Road Refuse Tip	Not Supplied	470m East

Pendle Borough Council has advised that it holds records of one pre-licensing landfill site within 500m of the site. The details of these are outlined in the table below:

Licence Holder	Waste Deposited	Approx. Distance and Direction from Site
Coal Wharf, North Valley Road, Colne	Household	320m East

6.5 *Pollution Incidents/Contaminated Land*

Environment Agency data indicates that there is one record of a significant pollution incident within 500m of the site. These are outlined in the following table:

Location/Address	Receiving Medium	Type of Pollution Incident	Approx. Distance and Direction from Site
Not Supplied	Wanless Water	Silage Liquor	230m North-West

Pendle Borough Council has confirmed that there are no legally determined contaminated land sites within 500m of the subject site and that they have no specific concerns regarding the site.

6.6 *Prescribed Processes*

Data supplied by the Environment Agency shows that there are no records of Part A (IPC) or IPPC processes authorised under the Environmental Protection Act 1990 or Pollution Prevention and Control Act 1999 within 500m of the site.

Pendle Borough Council has advised that there are no records of Part B (APC) processes authorised under the Environmental Protection Act 1990 within 500m of the site.

6.7 *Sites of Environmentally Sensitive Land Use*

Data supplied by English Nature indicates that there are two protected/sensitive environmental areas within 800m of the site. Both apply to the site itself. The details of these are outlined in the table below:

Sensitive Land Use Type	Description	Approx. Distance and Direction from Site
Area of Unadopted Green Belt	N/A	Onsite
Nitrate Vulnerable Zone	Surface Water	Onsite

6.8 *Coal Authority*

The Coal Authority Coal Mining report for the site indicates that the property is not within the zone of likely physical influence on the surface from past or present underground coal workings. Nor is the property within a geographical area for which a license to extract coal by underground or opencast methods is awaiting determination or has been granted by the Coal Authority.

The site is not located within a zone of influence of past or present open cast mining. However reserves of coal exist in the locality, which could be worked at some time in the future subject to feasibility, licenses, and planning consents. Furthermore, the Coal Authority have no record of any notice of the risk of the land being affected by subsidence being given under S.46 of the Coal Mining Subsidence Act 1991.

6.9 *Radon*

According to the National Radiological Protection Board's Radon Atlases of England, Wales and Scotland, this site is located in an area where less than 1% of homes are likely to be at risk from radon gas ingress. As a result, radon issues are not considered to be significant at this site.

6.10 *Existing Reports / Correspondence*

RPS has not been provided with any existing reports or correspondence regarding the site.

7.0 ENVIRONMENTAL RISK ASSESSMENT

7.1 Introduction

This section assesses the significance of the environmental issues which have been identified on the site or in the surrounding area. The issues have been classified under three broad categories.

The classes of significance referred to are as follows:

- **low risk -** it is considered unlikely that issues within the category will give rise to a liability/cost for the owner of the site.

- **moderate risk -** it is possible but not certain that issues within the category will give rise to a liability/cost for the owner of the site.

- **high risk -** there is a high potential that issues within the category will give rise to a liability/cost for the owner of the site.

7.2 Land Contamination/Pollution

Risk:	**Low**
Comments:	The site has historically been used as farm land since 1848. No other past land uses have been identified on-site. In the surrounding area, past industrial land uses have included a Nursery (adjacent to south-east of site), Railway (10m east), Hospital (70m south), Quarry (200m south) and a Garage (29m south-east). Consequently there is the potential for a degree of contamination to exist in the surrounding area. However, contaminant migration onsite is unlikely given the relatively low permeability of the underlying Boulder Clay. Three landfills are recorded in this area. The closest being for domestic infill material 200m from the site. None are considered to represent a significant risk to the subject site. Pendle Borough Council has confirmed that there are no legally determined contaminated land sites within 500m of the subject site

	and that they have no specific concerns regarding the site.

7.3 Groundwater Contamination/Pollution

Risk:	**Low**
Comments:	No significant sources of contamination have been identified at the site. The shallow drift deposits (Boulder Clay) are underlain by Millstone Grit, which is classified as a Minor Aquifer. Although dependent on the variable thickness of the Boulder Clay, a degree of protection is offered to the underlying groundwater resources. Given these factors and the low risk of contamination onsite, the likelihood of there being a significant risk to groundwater is considered to be low.

7.4 Surface Water Contamination/Pollution

Risk:	**Low/Moderate**
Comments:	The site is traversed by Wanless Water flowing to the south, and surface water drainage flows directly to the watercourse, hence surface water vulnerability is high. However given the absence of any identified significant sources of contamination at the site, the likelihood of there being a significant risk to this surface water receptor is considered to be low.

7.5 Air Pollution

Risk:	**Low**
Comments:	There is a low risk of air pollution on and adjacent to the subject site.

7.6 Other Environmental Issues

Risk:	**Moderate**
Comments:	In order to identify any features, habitats or species which may represent a constraint to the proposed development of the site, it is recommended that an ecological scoping survey of the site should be undertaken to inspect the site and its surroundings prior to redevelopment. Environment Agency data indicates that the site is located within the

	indicative flood plain of Wanless Water. This area has a significant chance of flooding which is greater than 1.3% per year (1 in 75). This takes into account the effect of any flood defences that may be in this area. As a result RPS recommend that a full flood risk assessment be carried out as part of any standard environmental planning conditions.

7.7 Overall Risk

Risk:	**Low**
Comments:	Given that no significantly contaminative land uses have been identified onsite; the likely flow of groundwater is southwards and any contaminant migration associated with the past land uses in the surrounding area (if present) is also likely to be in a southerly direction and therefore away from the site; and that the immediate underlying geology is of a relatively low permeability, the likelihood of significant ground contamination and any associated liability being incurred is low.

8.0 CONCLUSIONS & RECOMMENDATIONS

8.1 Conclusions

On the basis of existing information, ground conditions at the site represent a low risk with respect to its current and past uses.

RPS has not identified any significant risks of third party liability or regulatory action which could affect the site whilst it remains in its current use. However it has been identified that this site is within an area of significant flood risk and it is advised that a full flood risk assessment be carried out. In addition, an ecological scoping survey of the site should be undertaken to inspect the site and its surroundings. This would identify any features, habitats or species which may represent a constraint to the proposed development of the site.

Overall, RPS has identified a low risk of an environmental liability. With regard to the sites proposed use, the recommendations (see next section) should be undertaken.

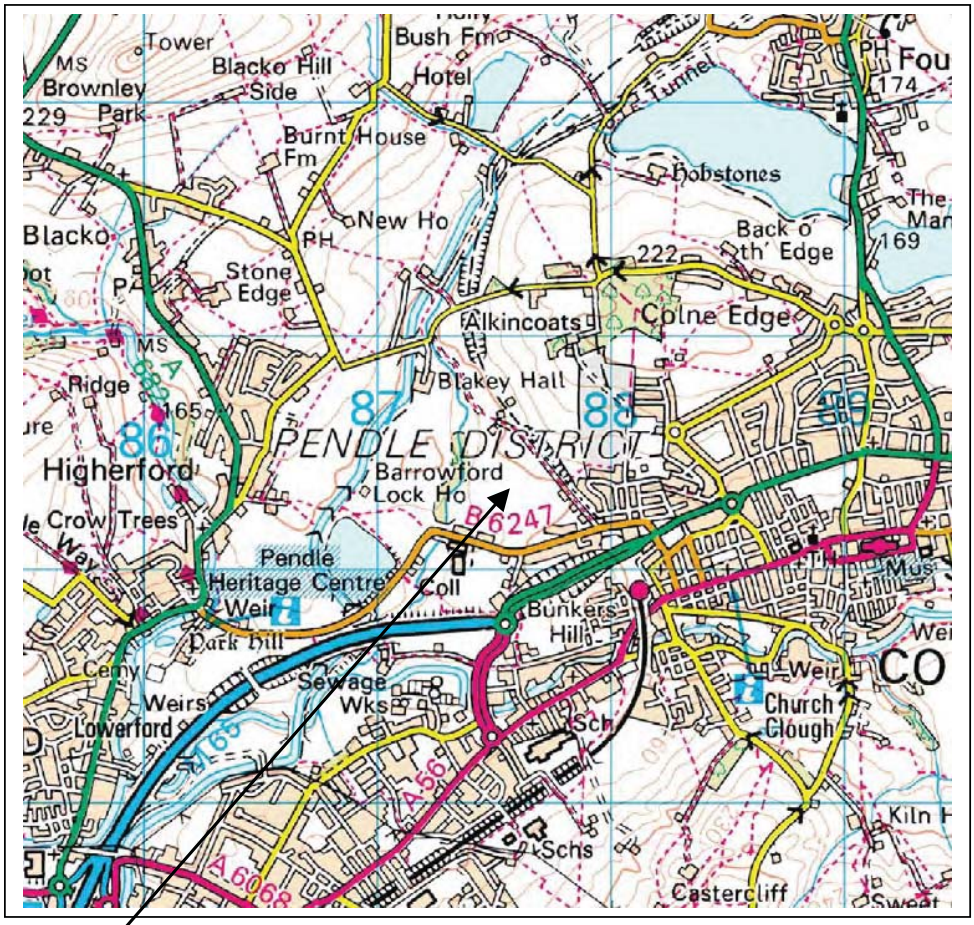
8.2 Recommendations

We recommend the following actions to reduce the environmental risks at the site:

Action	Cost Estimate
Part of the site has been identified as being in a floodplain. Consequently should the site be redeveloped there may be a planning requirement for a Flood Risk Assessment (to be confirmed by the Environment Agency during planning consultation) in accordance with PPG25 'Development and Flood Risk.	£2,500 - £10,000+VAT
Given the sites proposed use an ecological scoping survey of the site should be undertaken to inspect the site and its surroundings. This would identify any features, habitats or species which may represent a constraint to the proposed development of the site.	£1,250 - £3,000+VAT

APPENDIX A: FIGURES

Appendix A - 9 Pages



Site Location

Project:	Barrowford Road, Colne
Project No:	FLL2761
Date:	June 2005
Scale:	NTS
Figure 1:	Site Location Map

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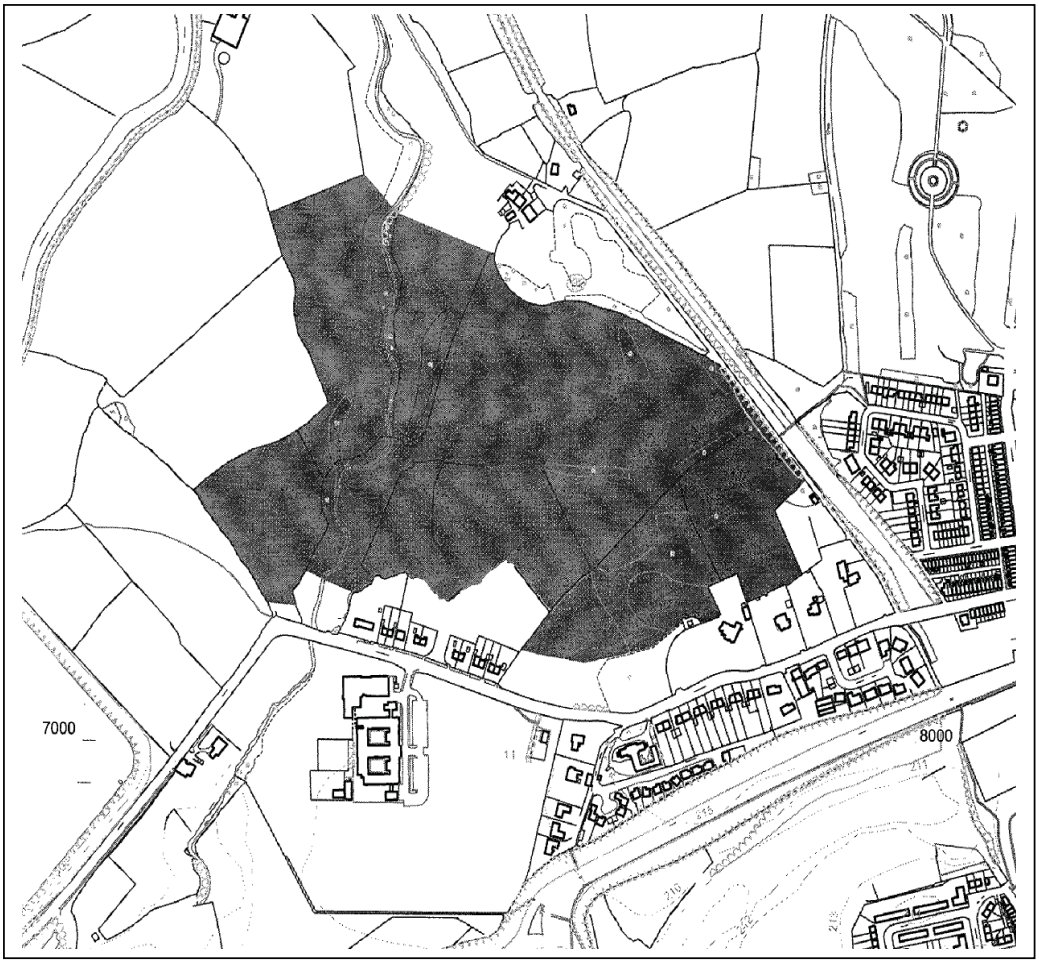

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Scale:	NTS
Figure 2:	Site Boundary Map

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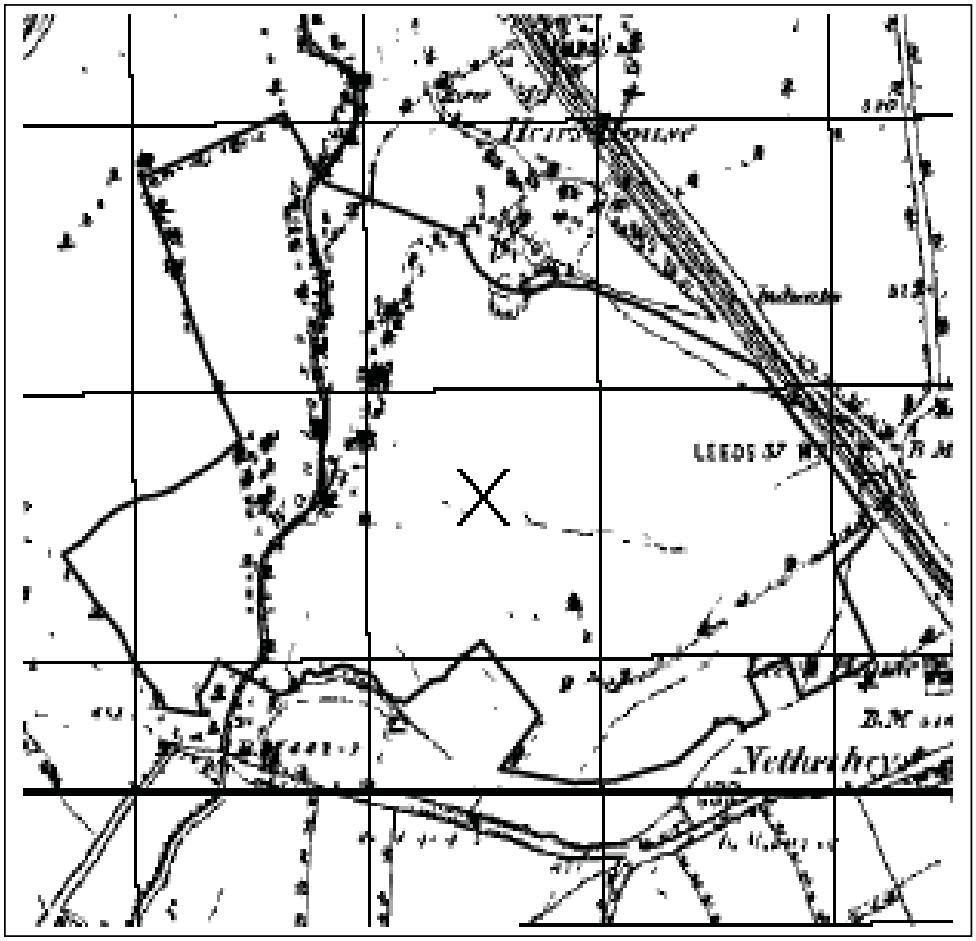

Project:	Barrowford Road, Colne
Project No:	FLL2761
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Scale:	NTS
Figure 3:	1848 Historical Map

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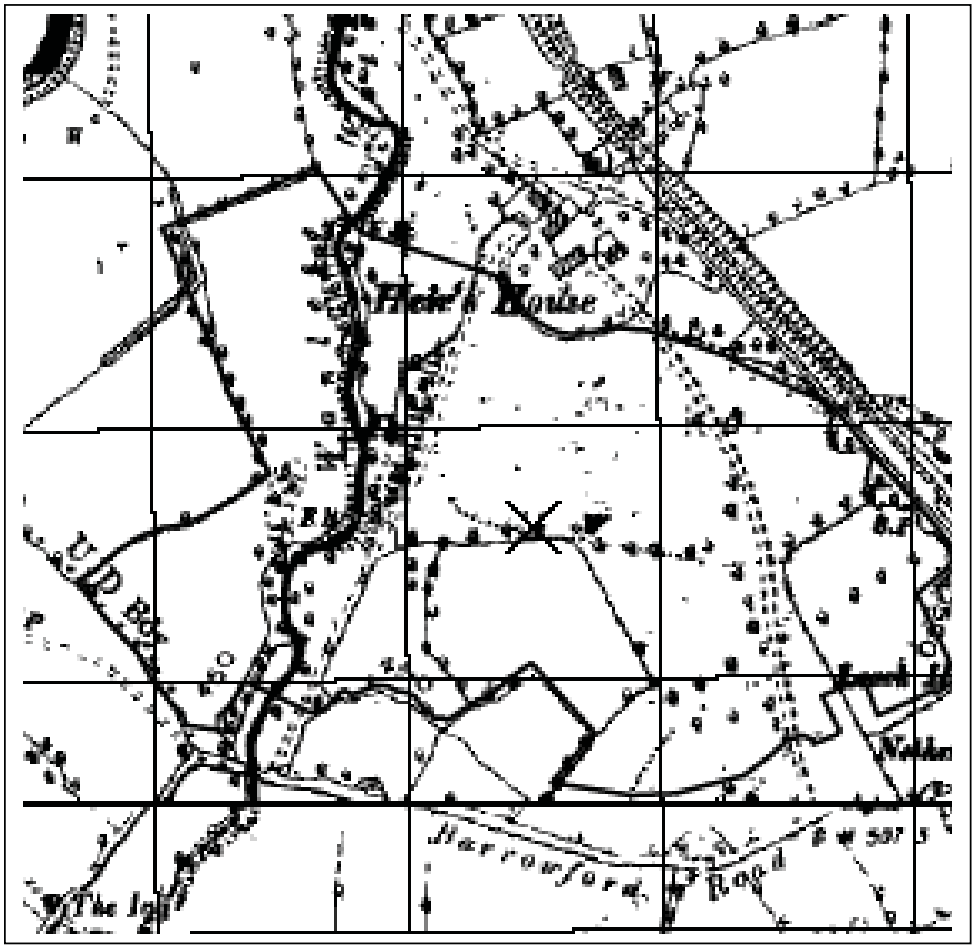

Project:	Barrowford Road, Colne
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Scale:	NTS
Figure 4:	1895 Historical Map

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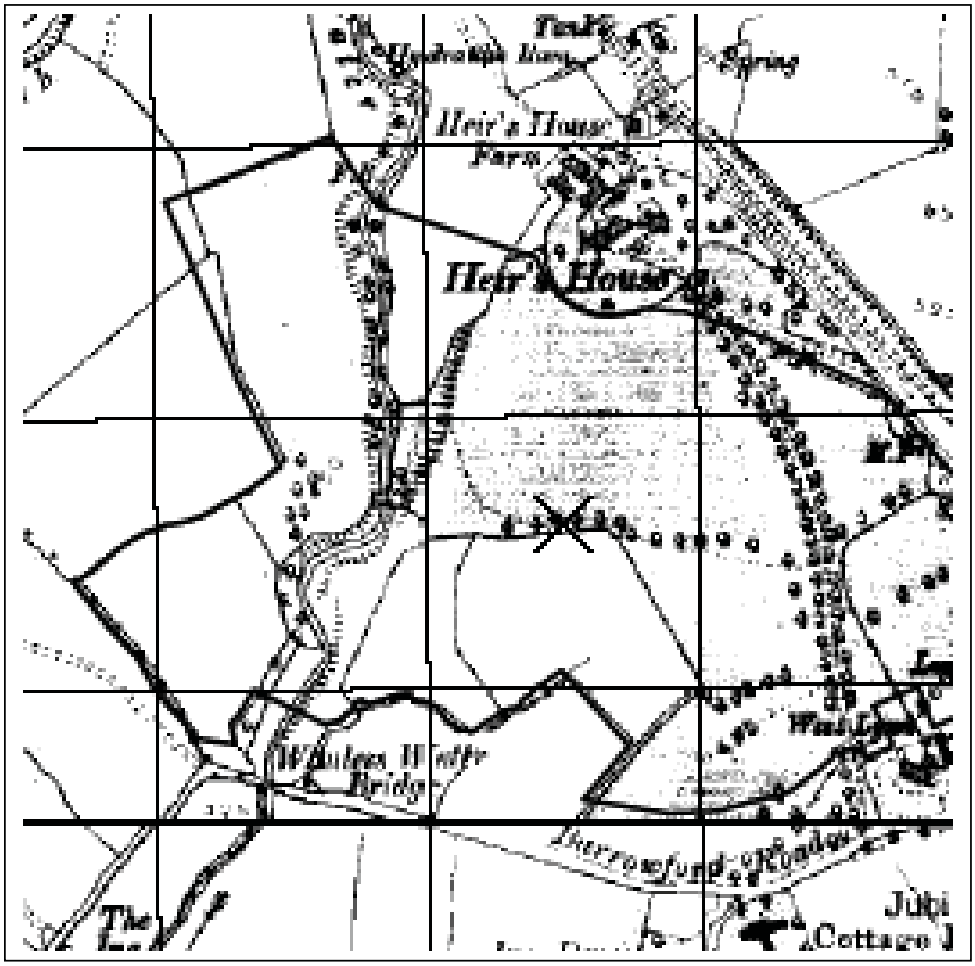

Project:	Barrowford Road, Colne
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Scale:	NTS
Figure 5:	1915 Historical Map

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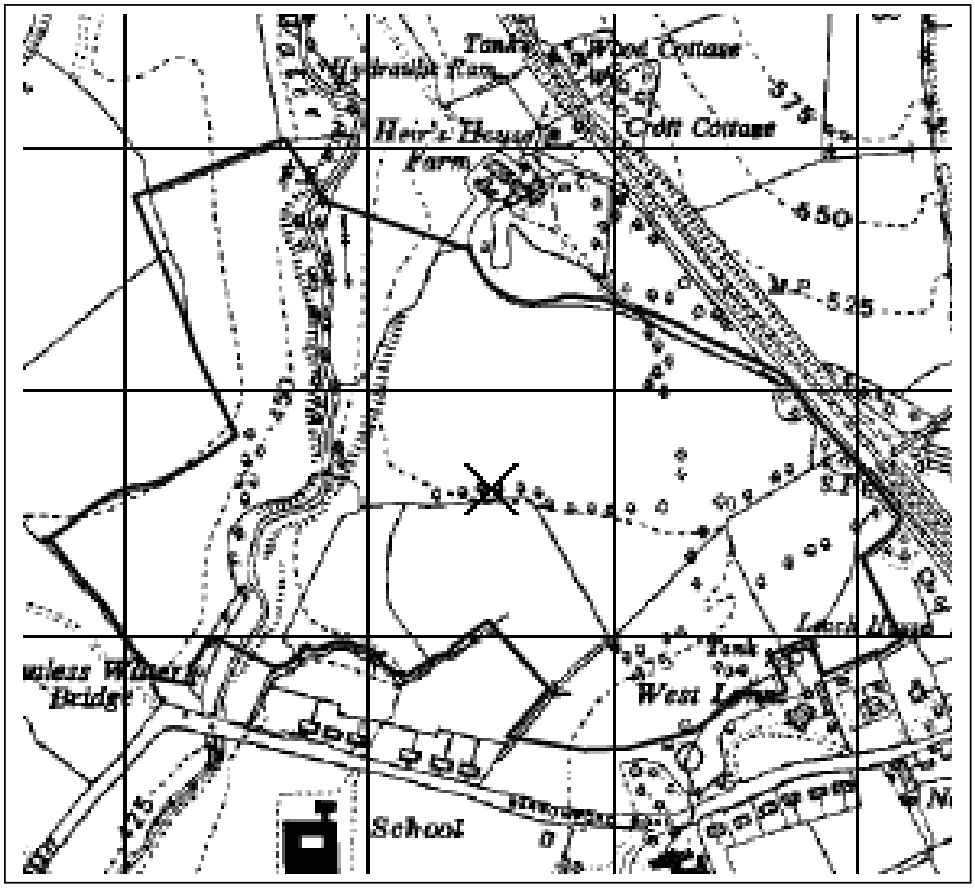

Project:	Barrowford Road, Colne
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Scale:	NTS
Figure 6:	1955 Historical Map

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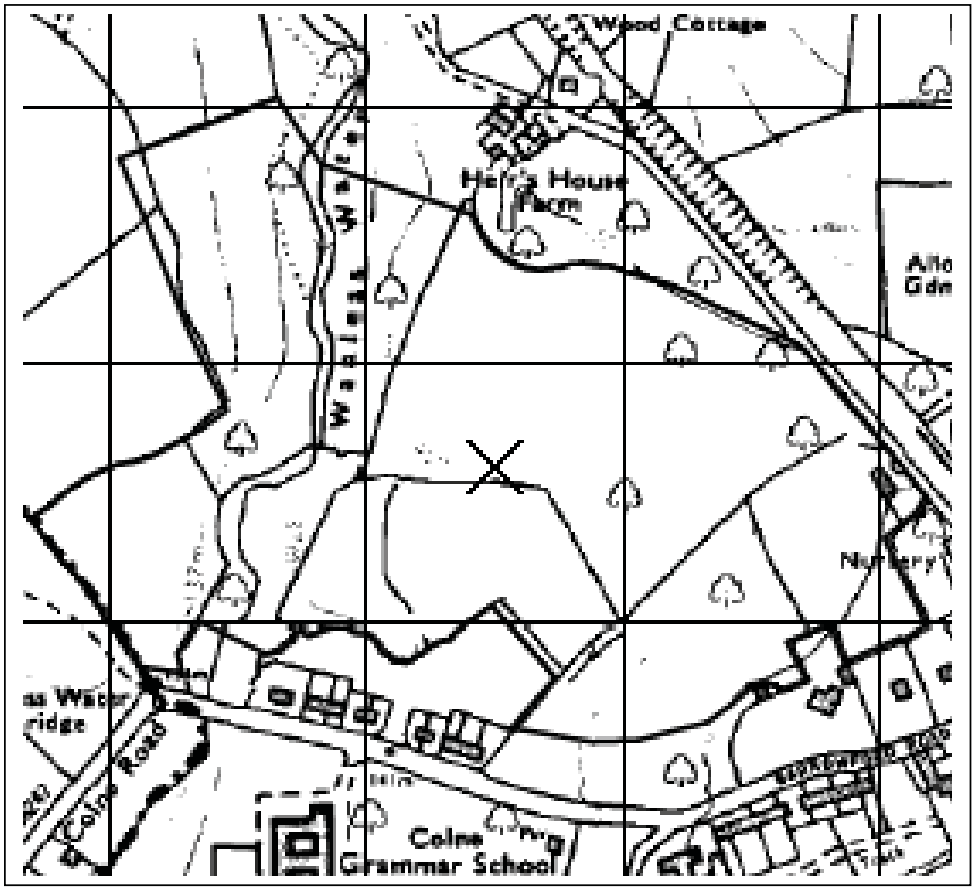

Project:	Barrowford Road, Colne
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Scale:	NTS
Figure 7:	1973 Historical Map

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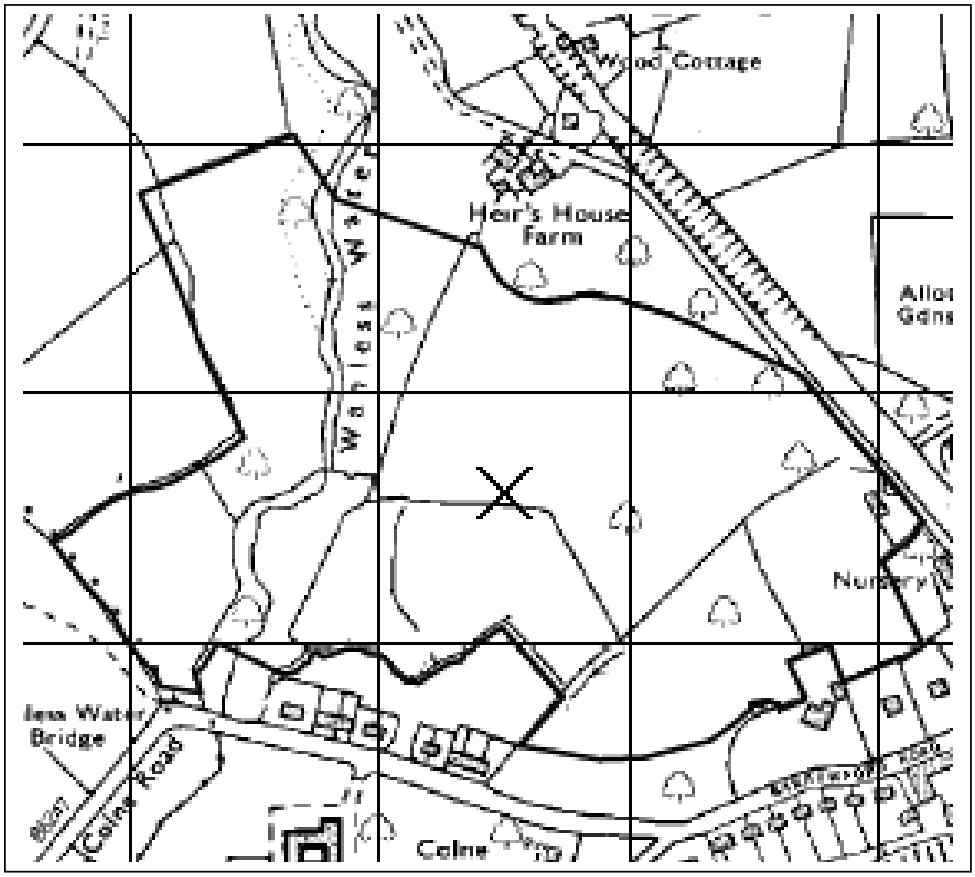

Project:	Barrowford Road, Colne
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Date:	June 2005
Scale:	NTS
Figure 8:	1993 Historical Map

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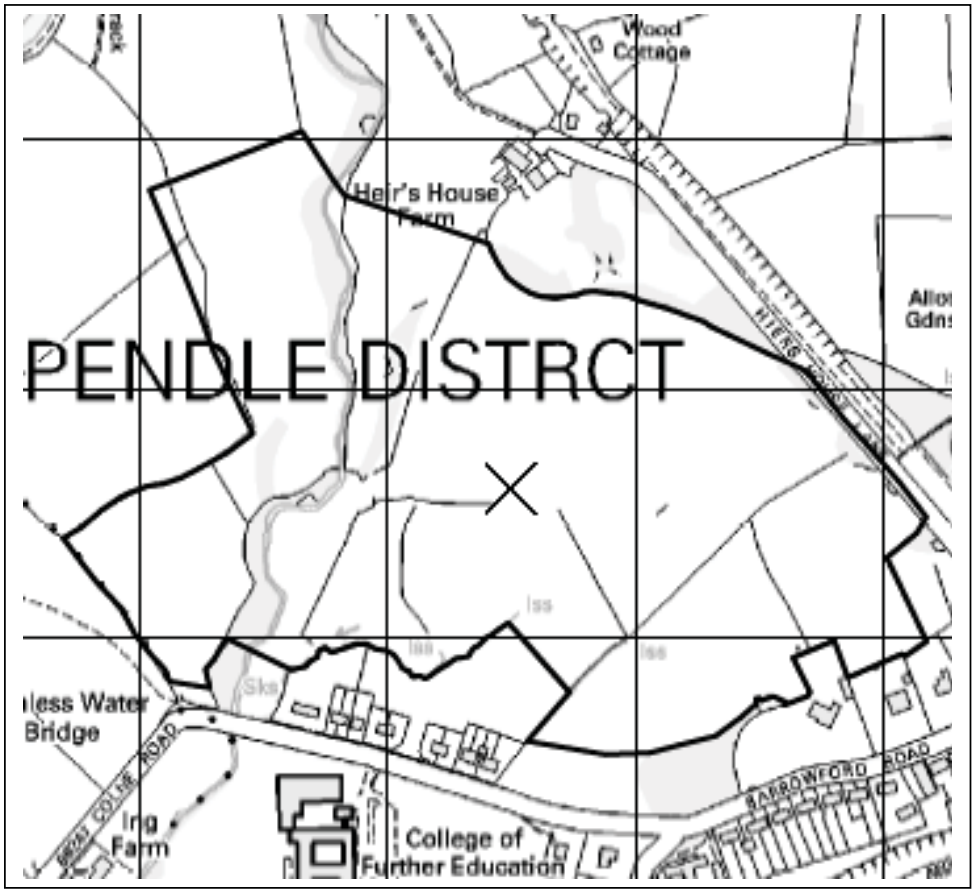

Project:	Barrowford Road, Colne
Project No:	FLL2761
Date:	June 2005
Scale:	NTS
Figure 9:	2001 Historical Map

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APPENDIX B:
DESK STUDY GENERAL NOTES

Appendix B - 1 Page

RPS HEALTH, SAFETY & ENVIRONMENT
DESK STUDY ENVIRONMENTAL REVIEW

General Notes

1. A "desk study" means that no site visits have been carried out as any part thereof, unless otherwise specified.

2. This report provides available factual data for the site obtained only from the sources described in the text and related to the site on the basis of the location information provided by the Client.

3. The desk study information is not necessarily exhaustive and further information relevant to the site may be available from other sources.

4. The accuracy of maps cannot be guaranteed and it should be recognised that different conditions on site may have existed between and subsequent to the various map surveys.

5. No sampling or analysis has been undertaken in relation to this desk study.

6. Any borehole data from British Geological Survey sources is included on the basis that: "The British Geological Survey accept no responsibility for omissions or misinterpretation of the data from their Data Bank as this may be old or obtained from non-BGS sources and may not represent current interpretation".

7. Where any data supplied by the client or from other sources, including that from previous site investigations, have been used it has been assumed that the information is correct. No responsibility can be accepted by RPS for inaccuracies in the data supplied by any other party.

8. This report is prepared and written in the context of an agreed scope of work and should not be used in a different context. Furthermore, new information, improved practices and changes in legislation may necessitate a re-interpretation of the report in whole or in part after its original submission.

9. The copyright in the written materials shall remain the property of the RPS Company but with a royalty-free perpetual licence to the client deemed to be granted on payment in full to the RPS Company by the client of the outstanding amounts.

10. The report is provided for sole use by the Client and is confidential to them, their professional advisors, no responsibility whatsoever for the contents of the report will be accepted to any person other than the client. [Unless otherwise agreed]

11. These terms apply in addition to the RPS Group "Standard Terms of Business" (or in addition to another written contract which may be in place instead thereof) unless specifically agreed in writing. (In the event of a conflict between these terms and the said Standard Terms of Business the said Standard Terms of Business shall prevail.) In the absence of such a written contract the Standard Terms of Business will apply.

Appendix E

Colne Road

FINAL

Colne Road, Barrowford
Lancashire, BB9 6AL

Environmental Review

For

Pendle Borough Council

PRIVATE AND CONFIDENTIAL

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Report by:	**M McLoughlin**		**30 June 2005**
Reviewed by:	**J Carlisle**		**30 June 2005**

CONTENTS

APPENDICES

1.0 EXECUTIVE SUMMARY

Site Details	Area:.21.69 ha NGR: SD 865 402 Main use: Pasture Land for sheep and cattle
Site History	Historically the site has comprised 11 fields. By 1912, a Coal Wharf was located in the south-east corner of the site. By 1965, this had been cleared and the site has remained largely unchanged until the present day. Past industrial land uses in the area have included Works (50m south-east), Mills (70m north-west and 250m south-east), and a Quarry (100m north-west).
Current Condition & Activities	The site is currently divided into 11 fields, which are used as pasture land for sheep and cattle.
Geology	The generalised stratigraphic sequence underlying the site comprises Boulder Clay overlying Millstone Grit (mixed sandstone, mudstone and shales).
Hydrology/ Hydrogeology	The site is located on a Minor Aquifer relating to the underlying Millstone Grit. It is likely that shallow groundwater flow to the west of the site will be in hydraulic continuity with Pendle Water and flow towards the south-west. Groundwater flow from the east of the site is likely to be in hydraulic continuity with the Leeds and Liverpool Canal and as such, flow towards the south-east. Environment Agency data indicates that the western boundary of the site is located within the indicative flood plain of Pendle Water. This area has a significant chance of flooding which is greater than 1.3% per year (1 in 75). This takes into account the effect of any flood defences that may be in this area.
Risk Assessment	Whilst there is potential for a degree of localised ground contamination to exist associated with the former Coal Wharf, this is likely to be relatively localised. Upon redevelopment, a degree of localised ground investigation and possibly remediation should be anticipated ion the south-eastern corner of the site. However, this is unlikely to result in a significant cost, relative to the overall size and value of the site.

Recommendations & Costings	Upon redevelopment, limited site investigation may be required as part of a standard environmental planning conditions on the former Coal Wharf. Cost Estimate: £5,000 - £10,000+VAT Part of the site has been identified as being in a floodplain. Consequently should the site be redeveloped there may be a planning requirement for a Flood Risk Assessment (to be confirmed by the Environment Agency during planning consultation) in accordance with PPG25 'Development and Flood Risk. *Cost Estimate: £2,500 - £10,000+VAT* Given the sites proposed use an ecological scoping survey of the site should be undertaken to inspect the site and its surroundings. This would identify any features, habitats or species which may represent a constraint to the proposed development of the site. *Cost Estimate: £1,250 - £3,000+VAT*

2.0 INTRODUCTION

RPS Health, Safety & Environment (RPS) was commissioned by **Indigo Planning Limited** on behalf of **Pendle Borough Council** to undertake an environmental review of *Colne Road, Barrowford, BB9 6AL.*

The principal aim of the review was to determine whether there was potential for contamination to be present which would significantly constrain the use of the site, or give rise to the risk of significant environmental liability.

The environmental review comprised:

i) a site walkover assessment;

ii) a review of the historical land uses associated with the site to assess the potential for ground contamination;

iii) a review of the environmental setting to assess the sensitivity of the surrounding environment to contamination/pollution;

iv) consultation with the regulatory authorities to establish whether there are any significant environmental issues that may impact upon the site, including records of any landfills in the vicinity;

Details of the limitations of this type of study are attached at Appendix B.

3.0 SITE SETTING AND DESCRIPTION

This section of the report is based upon observations made during a site visit on 31st May 2005. The site location and site boundary plans are shown in Appendix A.

3.1 *The Site*

The site is located to the north-east of Barrowford Town at National Grid Reference SD 865 402. It is approximately rectangular in shape with irregular sides, and occupies a total area of approximately 21.70 ha. The site is bounded to the west and east by Pendle Water and the Leeds and Liverpool Canal respectively. Colne Road (B6247) runs adjacent to the south of the site. A number of stone walls traverse the site, separating the site into approximately eleven fields.

The site appears to be pasture land associated with a farm located at the north-west corner of the site and is currently grazed by sheep and cattle. RPS understands that the site is proposed for development for light industrial land uses (B1, B2 and B8).

The topography of the southern area of the site is generally flat, with some gentle undulating slopes towards the northern area. The site comprises mainly grassland meadows with some broadleaved deciduous trees including oak and ash located down the centre, across the middle and on the outer boundaries of the site. The eastern boundary of the site slopes gently down to the Leeds and Liverpool Canal with some wetland habitat present.

A small stream traverses the northern half of the site, running into Pendle Water that forms the western boundary. Drainage across the western side of the site flows towards Pendle Water, and across the eastern side towards the Leeds and Liverpool Canal.

3.2 *The Surrounding Area*

The site is located in an area of mainly rural use, with some residential properties lying to the west and north of the site. The site is bounded by Pendle Water to the west and the Leeds and Liverpool Canal to the east. Beyond Pendle Water, approximately 20m from the western boundary, lies a suburb of Barrowford Town. A farm is located at the north-west corner of the site, and beyond lies a suburb of Higherford Town. Open pasture grassland is located to the north-east. Approximately 20m east of the eastern boundary, beyond the Canal, lies Barrowford

Reservoir. Colne Road delineates the site to the south, and beyond this lies open fields.

4.0 SITE HISTORY

The following account of the history of the site is based upon available past editions of Ordnance Survey (OS) maps dated 1848 to 2001. Extracts from the historical maps are given at Appendix A.

Maps Reviewed (publication dates)	***Map Scale***
1848; 1853; 1895; 1896; 1911; 1914 - 1915; 1930 - 1933; 1955 - 1956; 1967	25" to 1 mile scale
1893; 1912; 1931 - 1932; 1962 - 1967	1:2,500 scale
1961 to 1965; 1975; 1990; 1993	1:1250 scale
1973 to 1981; 1992 - 1993; 2001	1:10,000 scale

4.1 *The Site*

Site Features	***Dates***
On approximately 11 fields	1848-1911
Then Coal Wharf located on the south-eastern boundary	1912-1964
Then Coal Wharf cleared	1965-2001

4.2 *The Surrounding Area*

Surrounding Features (300m radius)	***Orientation***	***Distance***	***Dates***
Leeds & Liverpool Canal	East	Adjacent	1848-2001
Pendle Water	West	Adjacent	1948-2001
Barrowford Reservoir	East	20m	1893-2001
Unspecified Works *Then* Unlabelled Building	South-East	50m	1967-1992 1993-2001
Corn Mill	North-West	70m	1912-2001
Disused Quarry	North-West	100m	1893-2001
Wanless Water	South-East	200m	1848-2001
Mill *Then* Dye Works *Then* Unlabelled Building *Then* cleared	South-East	250m	1895-1914 1915-1932 1933-1966 1967-2001
Reservoir *Then* Unlabelled Lake	North-West	250m	1915-1972 1973-2001
Mill	South-West	300m	1895-2001
Sewage Farm *Then* relabelled as Sewage & Disposal Works	South-East	300m	1895-1932 1933-2001

5.0 ENVIRONMENTAL SETTING

5.1 *Geology*

Based on British Geological Survey 1:50,000 scale survey sheet No. 68 and BGS borehole logs the stratigraphic sequence across the majority of the site is as follows:

- Boulder Clay *(Quaternary)*
- Millstone Grit *(Upper Carboniferous)*

Made Ground

Made Ground is unlikely to be present across the site with the exception of the former Coal Wharf located at the south-eastern boundary. BGS borehole data was not available for this.

Boulder Clay

Information obtained from the BGS indicates that the Boulder Clay comprises very compact clayey fine-coarsed grained sand with fine-coarse subangular-subrounded gravel and subangular cobbles and small rounded boulders. This stratum is approximately 2.6m in thickness in the vicinity of the site.

Millstone Grit

Comprising beds of sandstone, conglomerates and grit with sequences of mudstones and shales, over 900 metres in thickness beneath the site.

5.2 *Hydrogeology*

According to the Environment Agency's Groundwater Vulnerability Map (Sheet 11) the site is located on a Minor Aquifer relating to the underlying Millstone Grit. These formations will seldom produce large quantities of water for abstraction though they are important both for local supplies and in supplying base flow to rivers. However the presence of the overlying Boulder Clay (Non-Aquifer) may prohibit/reduce any downward migration of contaminants (if present) towards the underlying aquifer.

Considering the presence of Pendle Water to the west and flowing southwards, and the Leeds and Liverpool Canal to the east flowing southwards, it is likely that shallow groundwater flow to the west of the site will be in hydraulic continuity with Pendle Water and flow towards the south-west.

6.0 CONSULTATIONS & ADDITIONAL INFORMATION

6.1 *Surface Water*

Environment Agency data indicates that there are four watercourses within 800m of the site which are classified under the General Quality Assessment (GQA) scheme. These are Pendle Water which lies adjacent to the west of the site; the Leeds and Liverpool Canal which lies adjacent to the east of the site; Wanless Water which lies approximately 180m south-east of the site links into Colne Water, which in turn links into Pendle Water to the south-west.

Wanless Water is classified as a Grade B (good) watercourse, although Colne Water into which it flows is classified as a Grade C (fairly good), and in turn these flow into Pendle Water which is classified as a Grade A (very good) watercourse. The Leeds and Liverpool Canal is classified as a Grade C (fairly good) watercourse.

Environment Agency data indicates that the western boundary of the site is located within the indicative flood plain of Pendle Water. This area has a significant chance of flooding which is greater than 1.3% per year (1 in 75). The central and eastern part of the site is located within an area that has a low chance of flooding (less than 0.5% per year (1 in 200)). This takes into account the effect of any flood defences that may be in this area.

6.2 *Water Abstractions*

Information provided by the Environment Agency indicates that there are no records of licenced water abstractions on site or within 200m of the site. There are 18 no. licenced water abstractions within 800m of the site and these are for general agriculture and aquaculture farming use, industrial/commercial/public service use and domestic use.

6.3 *Discharge Consents*

Environment Agency data shows that there are two licensed discharge consents within 250m of the site. The details of these are outlined in the table below:

Licence Holder	Receiving Medium	Type of Discharge	Approx. Distance and Direction from Site
J P Croasdale	Freshwater Stream/River	Discharge of Other Matter	160m North-West
United Utilities Water Plc	Freshwater River	Storm/Emergency Overflow	230m South-East

6.4 *Waste Disposal Sites*

Information provided by the Environment Agency shows that there is one recorded landfill site within 500m of the property. The details of this are listed in the table below.

Location	Waste Deposited	Approx. Distance and Direction from Site
Colne Sewage Works, Greenfield, Colne	Domestic, Industrial Waste	240m South-East

Pendle Borough Council has advised that it holds records of three pre-licensing landfill sites within 500m of the site. The details of these are outlined in the table below:

Location	Waste Deposited	Approx. Distance and Direction from Site
West Colne Water, Off Romney Avenue, Nelson	Not Supplied	400m South
Whitewalls No:1, Off Regent Street, Colne	Household	340m South
West Colne Water, Off Romney Avenue, Nelson	Not Supplied	370m South
Swindon Playing Fields, By Swinden Bridge, Cravendale Avenues, Barrowford	Not Supplied	380m South

6.5 *Pollution Incidents/Contaminated Land*

Environment Agency data indicates that there are eight records of major or significant pollution incidents within 500m of the site. These are outlined in the following table:

Location/Address	Receiving Medium	Type of Pollution Incident	Approx. Distance and Direction from Site
Not Supplied	Tributary Swinden Cloug	Industrial Effluent	320m South
Not Supplied	Swinden Clough	Oils – Diesel (Including Agricultural)	330m South
Not Supplied	Swinden Clough	Industrial Effluent	420m South
Not Supplied	Swinden Clough	Industrial Effluent: Abattoir Waste	430m South

Location/Address	Receiving Medium	Type of Pollution Incident	Approx. Distance and Direction from Site
Not Supplied	Colne Water	Sewage Gas Oil	410m South
Not Supplied	Swinden Clough	Industrial Waste: Abattoir Waste	430m South
Sewage Treatment Works	Colne Water/Pendle	Treated Sewage Effluent	440m South-East
Not Supplied	North Valley Stream	Transformer	470m South-East

Pendle Borough Council has confirmed that there are no legally determined contaminated land sites within 500m of the subject site and that they have no specific concerns regarding the site.

6.6 *Prescribed Processes*

Data supplied by the Environment Agency shows that there are no records of Part A (IPC) or IPPC processes authorised under the Environmental Protection Act 1990 or Pollution Prevention and Control Act 1999 within 500m of the site.

Pendle Borough Council has advised that there are no records of Part B (APC) processes authorised under the Environmental Protection Act 1990 within 500m of the site.

6.7 *Sites of Environmentally Sensitive Land Use*

Data supplied by English Nature indicates that there are two protected/sensitive environmental areas within 800m of the site. The details of these are outlined in the table below:

Sensitive Land Use Type	Description	Approx. Distance and Direction from Site
Area of Unadopted Green Belt	N/A	Onsite
Nitrate Vulnerable Zone	Surface Water	Onsite

6.8 *Coal Authority*

The Coal Authority Coal Mining report for the site indicates that the property is not within the zone of likely physical influence on the surface from past or present underground coal workings. Nor is the property within a geographical area for which a license to extract coal by underground or opencast methods is awaiting determination or has been granted by the Coal Authority.

The site is not located within a zone of influence of past or present open cast mining. However reserves of coal exist in the locality, which could be worked at some time in the future subject to feasibility, licenses, and planning consents. Furthermore, the Coal Authority have no record of any notice of the risk of the land being affected by subsidence being given under S.46 of the Coal Mining Subsidence Act 1991.

6.9 *Radon*

According to the National Radiological Protection Board's Radon Atlases of England, Wales and Scotland, this site is located in an area where less than 1% of homes are likely to be at risk from radon gas ingress. As a result, radon issues are not considered to be significant at this site.

6.10 *Existing Reports / Correspondence*

RPS has not been provided with any existing reports or correspondence regarding the site.

7.0 ENVIRONMENTAL RISK ASSESSMENT

7.1 Introduction

This section assesses the significance of the environmental issues which have been identified on the site or in the surrounding area. The issues have been classified under three broad categories.

The classes of significance referred to are as follows:

- **low risk -** it is considered unlikely that issues within the category will give rise to a liability/cost for the owner of the site.

- **moderate risk -** it is possible but not certain that issues within the category will give rise to a liability/cost for the owner of the site.

- **high risk -** there is a high potential that issues within the category will give rise to a liability/cost for the owner of the site.

7.2 Land Contamination/Pollution

Risk:	**Low/Moderate**
Comments:	The site has historically been used as farm land since 1848. A Coal Wharf was located at the south-east corner of the site in 1912, but was subsequently cleared by 1964. No other past industrial land uses have been identified on-site. Currently there is the potential for a degree of localised contamination in this corner. Pendle Borough Council has confirmed that they have no specific concerns regarding the site. In the surrounding area, past industrial land uses have included Works (50m south-east), Mills (70m north-west and 250m south-east), and a Quarry (100m north-west). Consequently there is the potential for a degree of contamination to exist in the surrounding area. However, significant contaminant migration onsite is unlikely given the relatively low permeability of the underlying geology.

7.3 Groundwater Contamination/Pollution

Risk:	**Low**
Comments:	No significant sources of contamination have been identified at the site. The shallow drift deposits (Boulder Clay) are underlain by Millstone Grit, which is classified as a Minor Aquifer, but it is not considered to be a significant water resource. Although dependent on the thickness of the Boulder Clay, some degree of protection is offered to the underlying groundwater resources. Given these factors, the likelihood of there being a significant risk to groundwater is considered to be low.

7.4 Surface Water Contamination/Pollution

Risk:	**Low**
Comments:	The site is bounded to the west and east by Pendle Water and the Leeds and Liverpool Canal respectively, however given the absence of any identified significant sources of contamination at the site, the likelihood of there being a significant risk to surface water receptors is considered to be low.

7.5 Air Pollution

Risk:	**Low**
Comments:	There is a low risk of air pollution on and adjacent to the subject site.

7.6 Other Environmental Issues

Risk:	**Moderate**
Comments:	In order to identify any features, habitats or species which may represent a constraint to the proposed development of the site, it is recommended that an ecological scoping survey of the site should be undertaken to inspect the site and its surroundings before any development. Environment Agency data indicates that the western boundary of the site is located within the indicative flood plain of Pendle Water. This area has a significant chance of flooding which is greater than 1.3% per year (1 in 75). As a result RPS recommend that a full flood risk

	assessment be carried out as part of any standard environmental planning conditions.

7.7 Overall Risk

Risk:	**Low**
Comments:	In view of the fact that no significantly contaminative land uses have been identified on a widespread basis within the site; the likely flow of groundwater is southwards and any contaminant migration associated with the past land uses in the surrounding area (if present) is also likely to be in a southerly direction and therefore away from the site; and that the underlying geology is of a relatively low permeability, the likelihood of a significant liability being incurred is low. Overall, RPS has identified a low risk of an environmental liability, whilst the site remains in its existing use and form. However, recommendations are given in the following section regarding the sites proposed use.

8.0 CONCLUSIONS & RECOMMENDATIONS

8.1 Conclusions

Overall, ground conditions at the site represent a low risk with respect to its current and past uses. RPS has not identified any significant risks of third party liability or regulatory action which could affect the site whilst it remains in its current use.

Upon redevelopment a limited degree of ground investigation and possibly localised remediation may be required in the vicinity of the former Coal Wharf. In addition, it has been identified that this site is within an area of significant flood risk and it is advised that a full flood risk assessment be carried out. Also, an ecological scoping survey of the site should be undertaken to inspect the site and its surroundings. This would identify any features, habitats or species which may represent a constraint to the proposed development of the site.

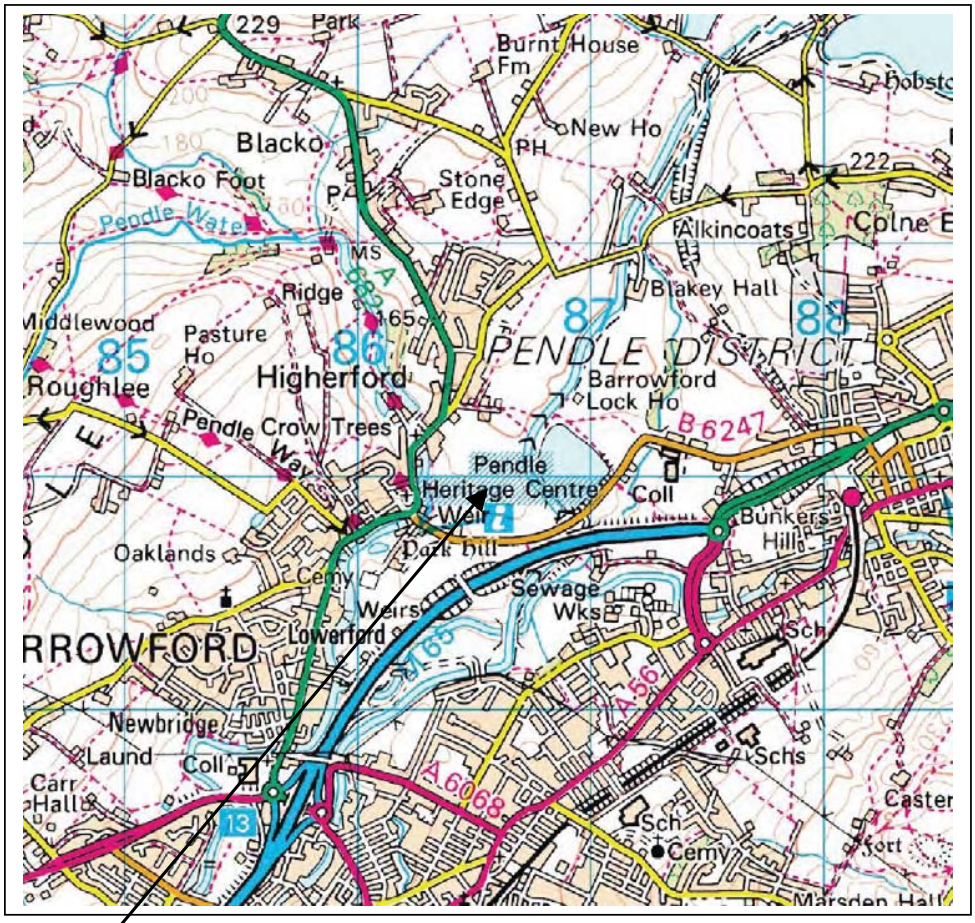
8.2 Recommendations

We recommend the following actions to reduce the environmental risks at the site:

Action	Cost Estimate
Upon redevelopment, limited site investigation may be required as part of a standard environmental planning conditions on the former Coal Wharf.	£5,000 - £10,000+VAT
Part of the site has been identified as being in a floodplain. Consequently should the site be redeveloped there may be a planning requirement for a Flood Risk Assessment (to be confirmed by the Environment Agency during planning consultation) in accordance with PPG25 'Development and Flood Risk.	£2,500 - £10,000+VAT
Given the sites proposed use an ecological scoping survey of the site should be undertaken to inspect the site and its surroundings. This would identify any features, habitats or species which may represent a constraint to the proposed development of the site.	£1,250 - £3,000+VAT

APPENDIX A: FIGURES

Appendix A - 8 Pages

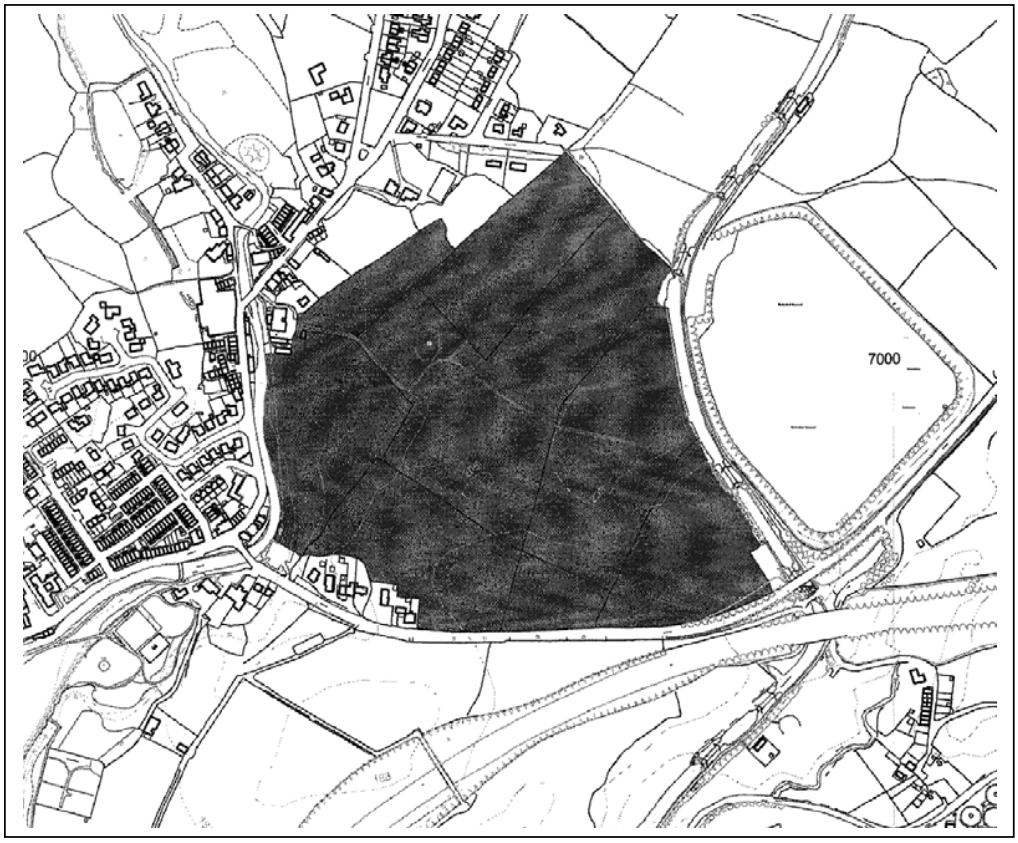


Site Location

Project:	Colne Road, Barrowford
Project No:	FLL2761
Date:	June 2005
Scale:	NTS
Figure 1:	Site Location Map

RPS Health, Safety and Environment

1 Stamford Street
London
SE1 9NT
☎ 020-7928-0999
020-7928-0708
www.rpsplc.co.uk



Project:	Colne Road, Barrowford
Project No:	FLL2761
Date:	June 2005
Scale:	NTS
Figure 2:	Site Boundary Map

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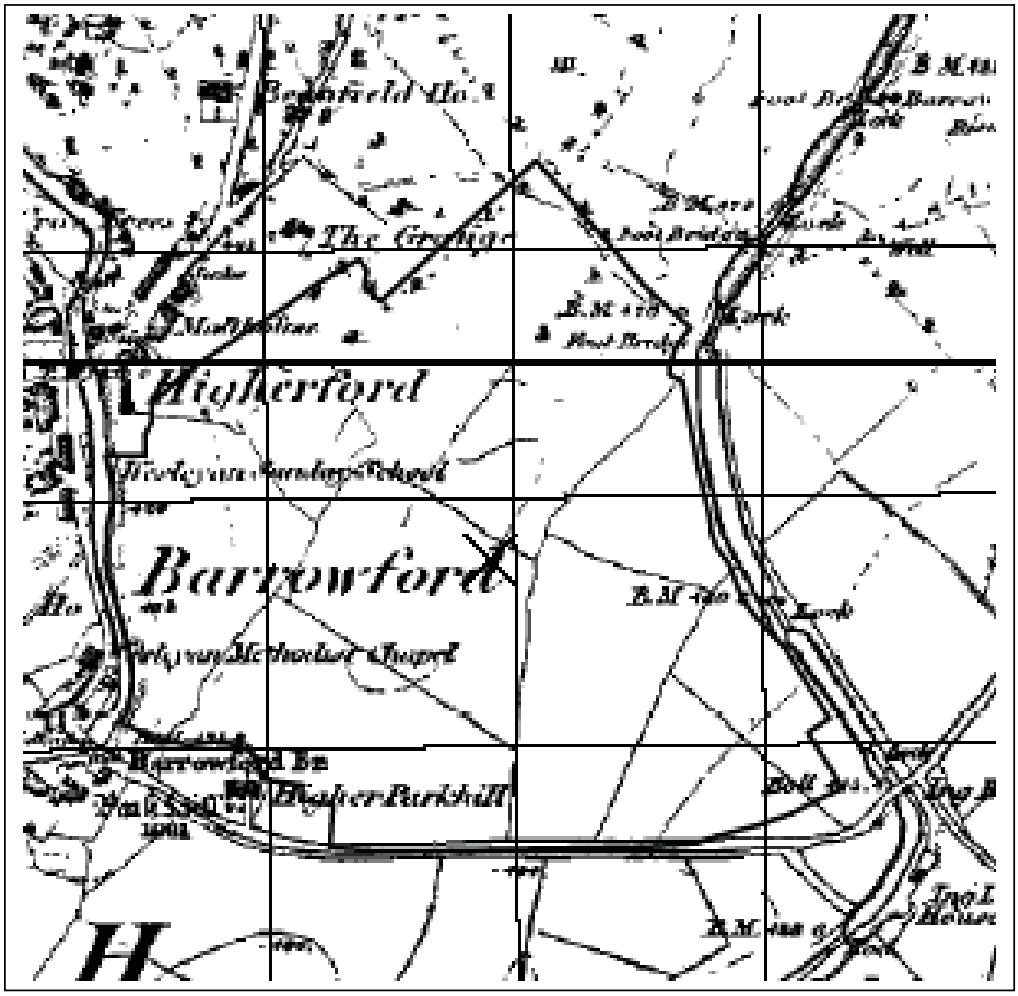

Project:	Colne Road, Barrowford
Project No:	FLL2761
Date:	June 2005
Scale:	NTS
Figure 3:	1848 Historical Map

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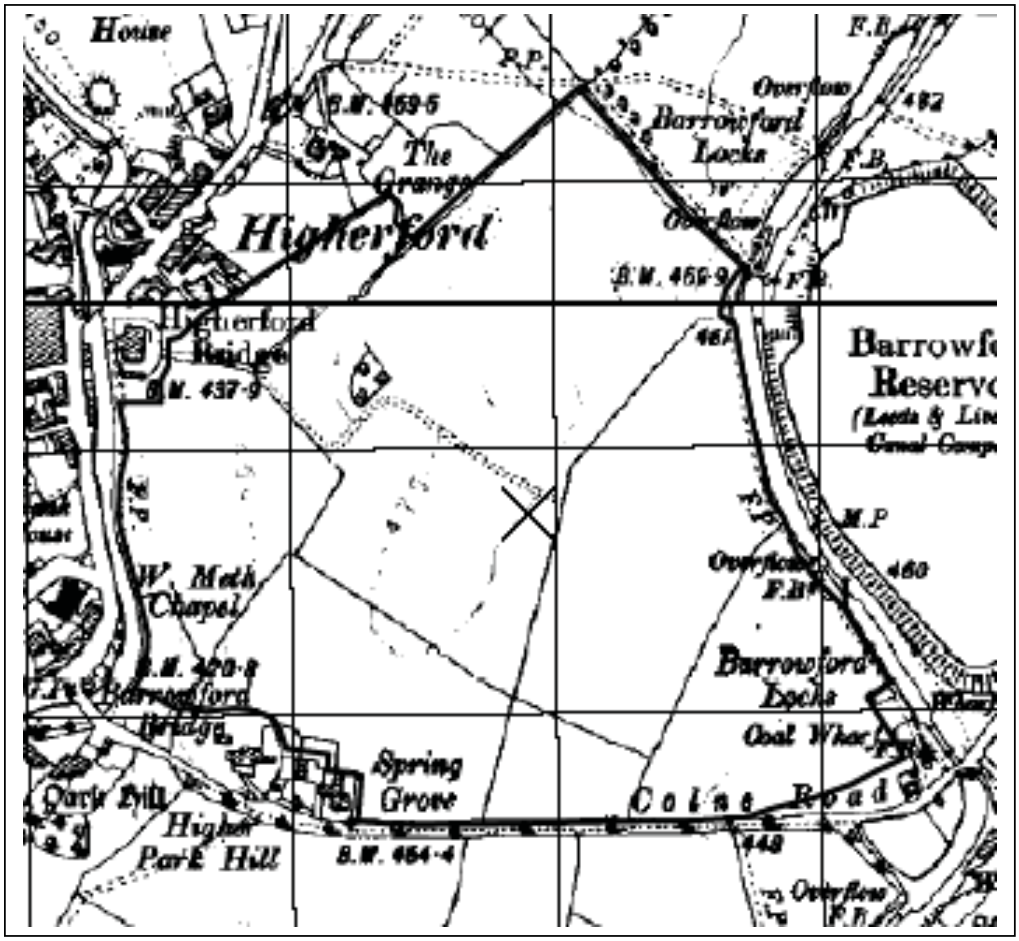

Project:	Colne Road, Barrowford
Project No:	FLL2761
Date:	June 2005
Scale:	NTS
Figure 4:	1915 HistoricalMap

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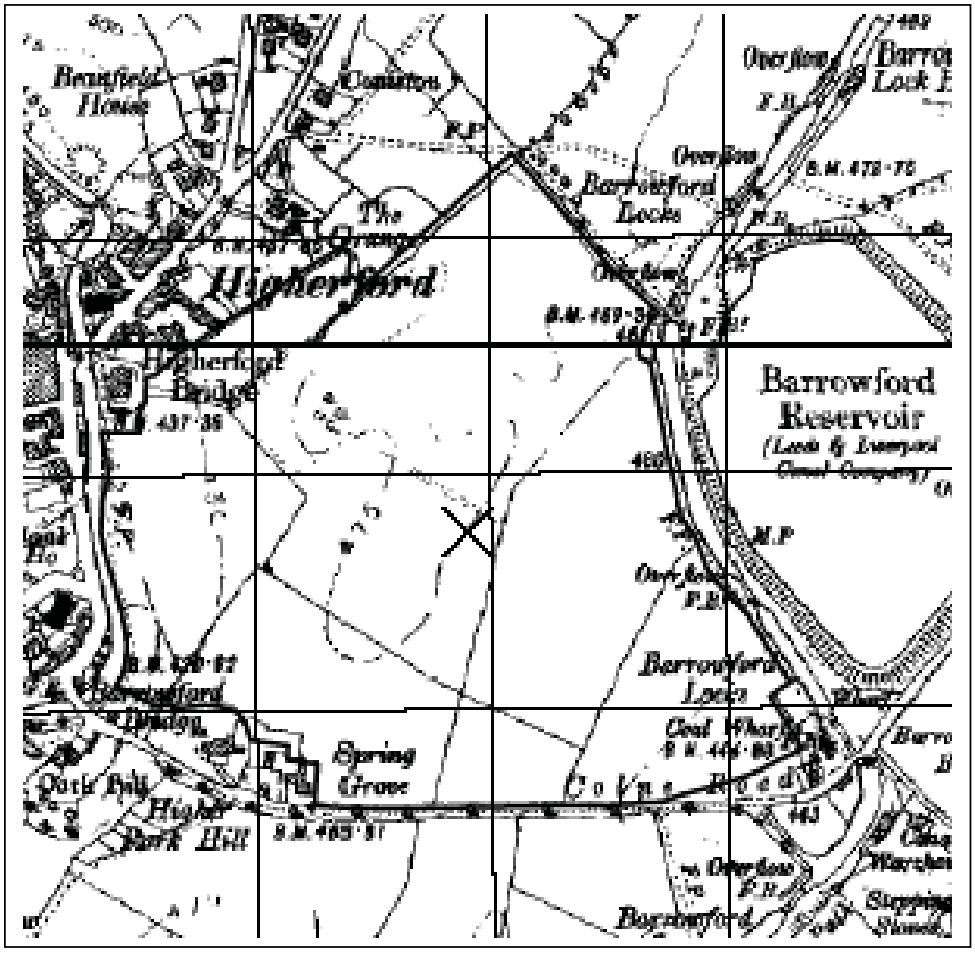

Project:	Colne Road, Barrowford
Project No:	FLL2761
Date:	June 2005
Scale:	NTS
Figure 5:	1933 Historical Map

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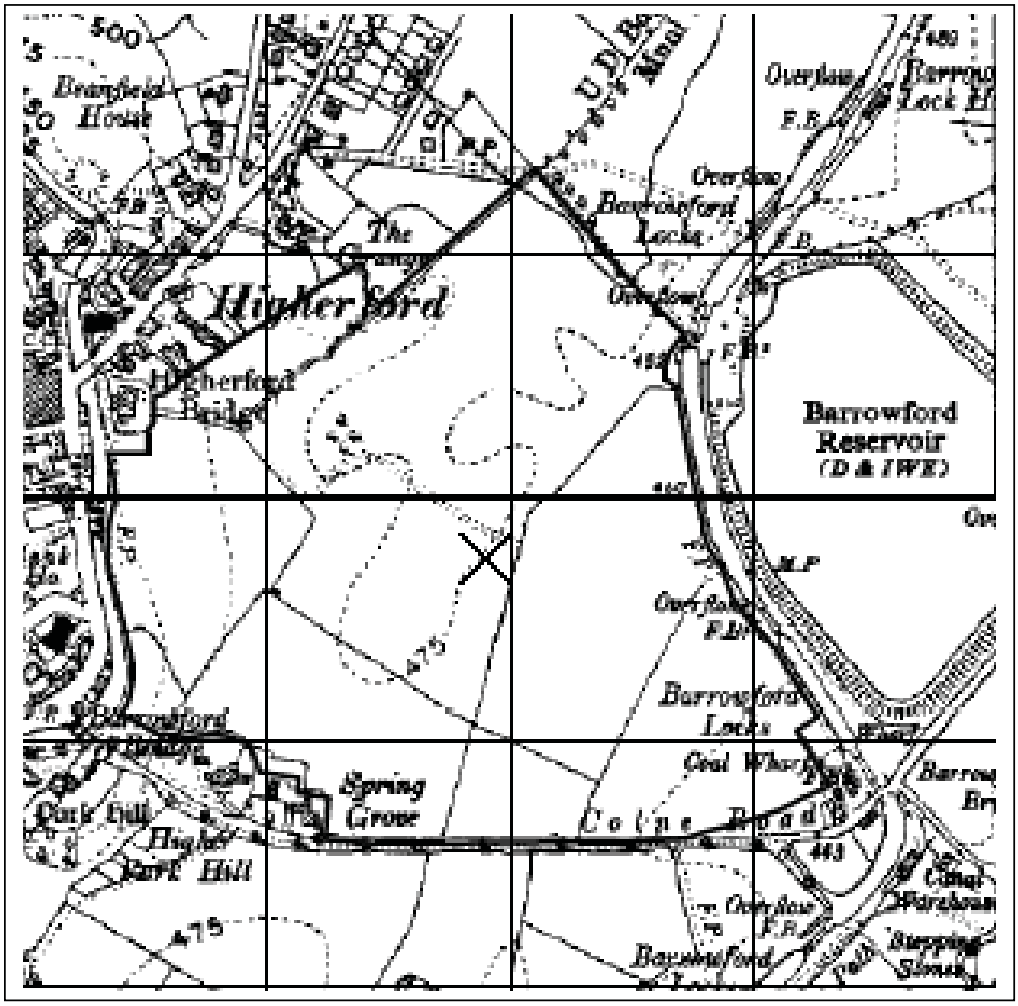

Project:	Colne Road, Barrowford
Project No:	FLL2761
Date:	June 2005
Scale:	NTS
Figure 6:	1956 Historical Map

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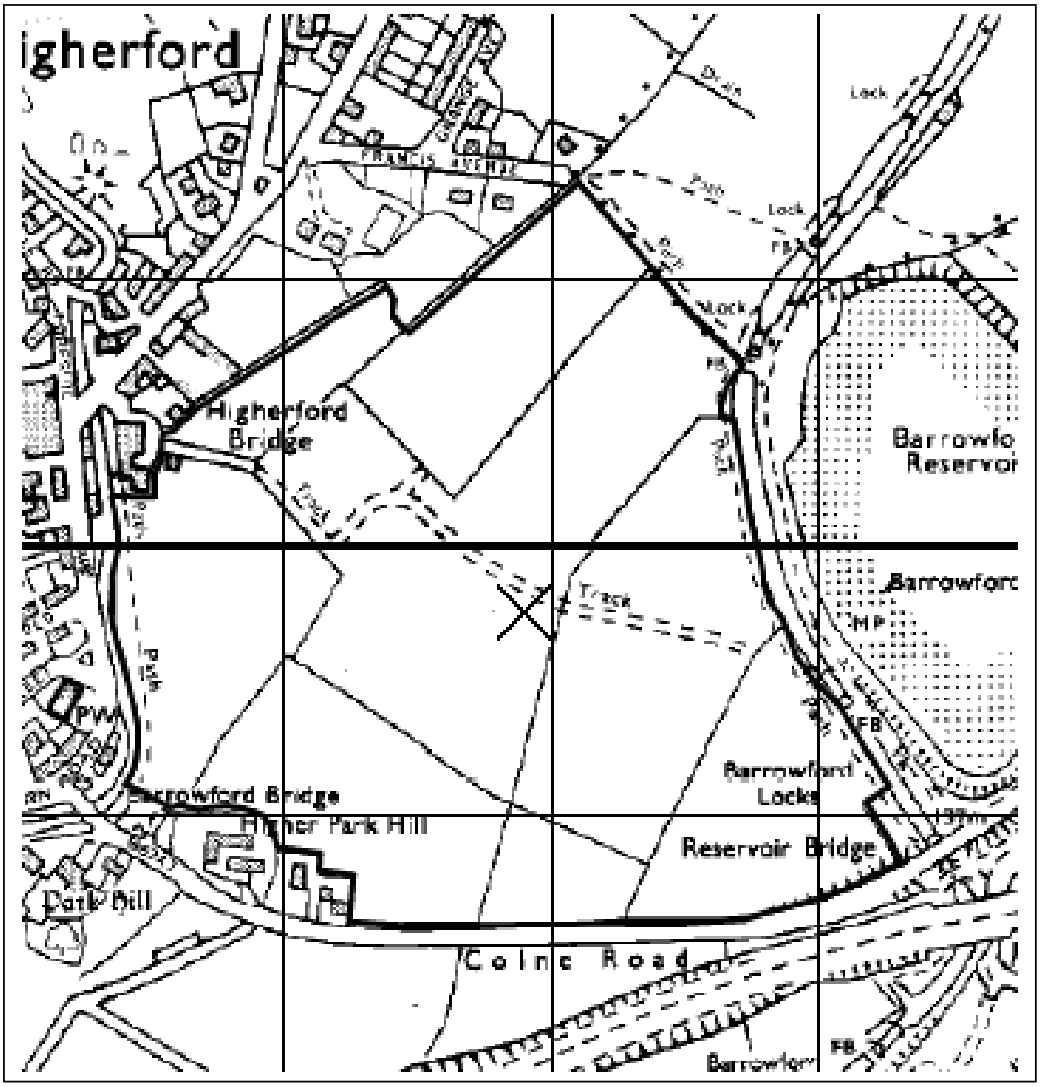

Project:	Colne Road, Barrowford
Project No:	FLL2761
Date:	June 2005
Scale:	NTS
Figure 7:	1992 Historical Map

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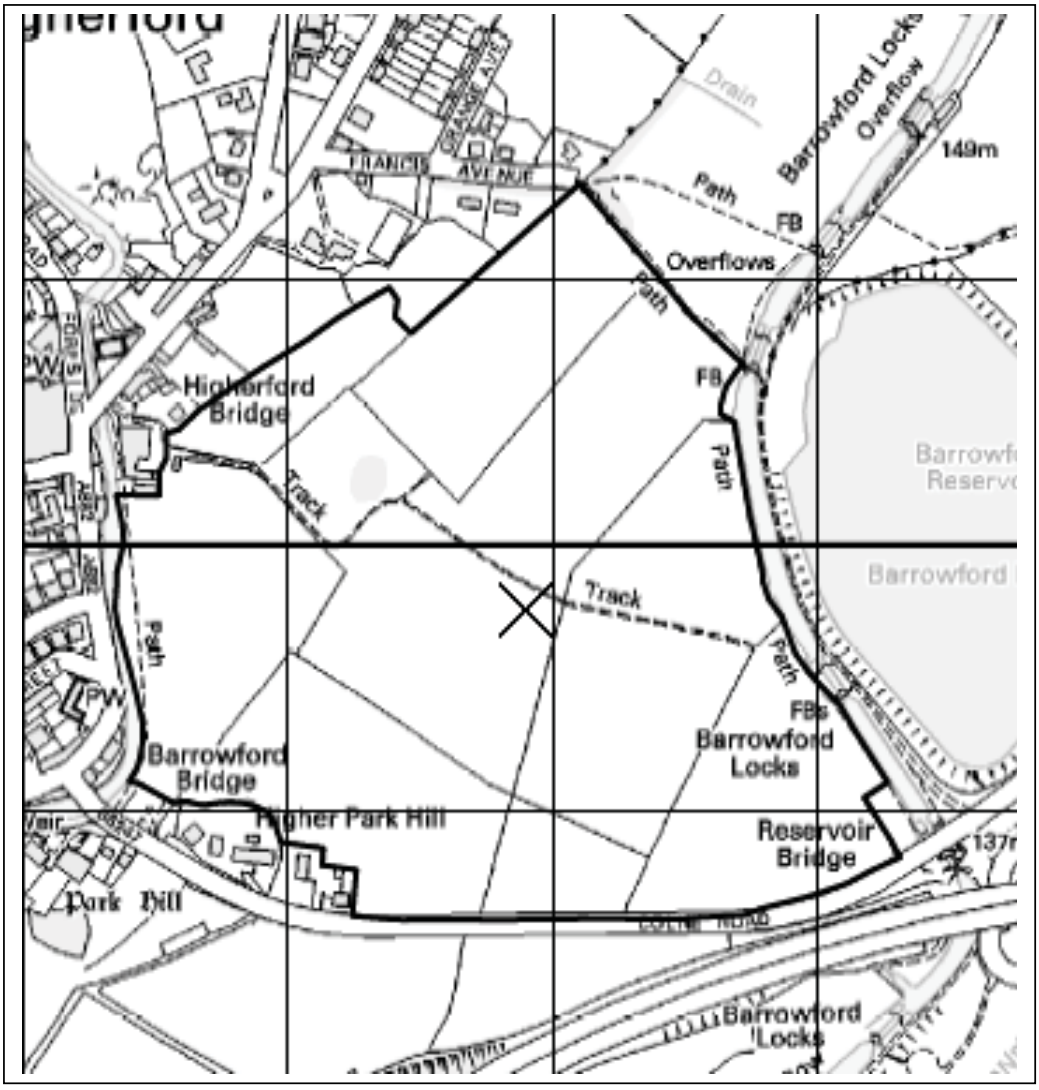

Project:	Colne Road, Barrowford
Project No:	FLL2761
Date:	June 2005
Scale:	NTS
Figure 8:	2001 Historical Map

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APPENDIX B:
DESK STUDY GENERAL NOTES

Appendix B - 1 Page

RPS HEALTH, SAFETY & ENVIRONMENT
DESK STUDY ENVIRONMENTAL REVIEW

General Notes

1. A "desk study" means that no site visits have been carried out as any part thereof, unless otherwise specified.

2. This report provides available factual data for the site obtained only from the sources described in the text and related to the site on the basis of the location information provided by the Client.

3. The desk study information is not necessarily exhaustive and further information relevant to the site may be available from other sources.

4. The accuracy of maps cannot be guaranteed and it should be recognised that different conditions on site may have existed between and subsequent to the various map surveys.

5. No sampling or analysis has been undertaken in relation to this desk study.

6. Any borehole data from British Geological Survey sources is included on the basis that: "The British Geological Survey accept no responsibility for omissions or misinterpretation of the data from their Data Bank as this may be old or obtained from non-BGS sources and may not represent current interpretation".

7. Where any data supplied by the client or from other sources, including that from previous site investigations, have been used it has been assumed that the information is correct. No responsibility can be accepted by RPS for inaccuracies in the data supplied by any other party.

8. This report is prepared and written in the context of an agreed scope of work and should not be used in a different context. Furthermore, new information, improved practices and changes in legislation may necessitate a re-interpretation of the report in whole or in part after its original submission.

9. The copyright in the written materials shall remain the property of the RPS Company but with a royalty-free perpetual licence to the client deemed to be granted on payment in full to the RPS Company by the client of the outstanding amounts.

10. The report is provided for sole use by the Client and is confidential to them, their professional advisors, no responsibility whatsoever for the contents of the report will be accepted to any person other than the client. [Unless otherwise agreed]

11. These terms apply in addition to the RPS Group "Standard Terms of Business" (or in addition to another written contract which may be in place instead thereof) unless specifically agreed in writing. (In the event of a conflict between these terms and the said Standard Terms of Business the said Standard Terms of Business shall prevail.) In the absence of such a written contract the Standard Terms of Business will apply.

Appendix F

Foulridge

FINAL

Land North of Foulridge Wharf
Lancashire, BB18 6XY

Environmental Review

For

Pendle Borough Council

PRIVATE AND CONFIDENTIAL

RPS Health, Safety & Environment
1 Stamford Street
London
SE1 9NT

Tel: 020 7928 0999
Fax: 020 7928 0708

FLL12761/007R
June 2005

This report has been prepared within the RPS Group Quality Management System to British Standard EN ISO 9001 : 2000.			
Report Status:		**FINAL**	
Project Number:		**FLL1276/007R**	
	Consultant	***Signature***	***Date***
Report by:	**E. Auger**		**30 June 2005**
Reviewed by:	**J Carlisle**		**30 June 2005**

CONTENTS

APPENDICES

1.0 EXECUTIVE SUMMARY

Site Details	Area: Approximately 25 ha NGR: SD 891 437 Main use: Farmland and small Sewage Works
Site History	Historical maps show the site comprised Open fields until c.1933 when a Sewage Disposal Works was located on the centre of the western boundary of the site. This was labelled a Sewage Farm from c.1964. A Railway was located adjacent to the site from at least 1894 to c.1973 when it was dismantled. Other surrounding past land uses have included a Gasometer located 120m south c.1894-1912, and an excavated area located 60m southwest c.1894-1970.
Current Condition & Activities	The majority of the site comprises fields using for grazing animals. Some fields along the western boundary are unused. There is a small Sewage Works located in the central part of the site along the western boundary. Surrounding land uses are a canal to the west and fields to the north and east. The south is mainly occupied by a car park with some small businesses.
Geology	According to published geological maps for the area, the site is likely to be underlain by Alluvium (a few metres thickness) and Millstone Grit (at least 500m thickness).
Hydrology/ Hydrogeology	The site is located on a Minor Aquifer (associated with the underlying Alluvium and Millstone Grit). The nearest licensed surface water abstraction is located approximately 145m southwest and the use is not known. The nearest groundwater abstraction is located 175m northeast for private water supply. The nearest watercourse is New Cut located on site. The river quality is Grade A (very good).
Risk Assessment	Given the site has been Open Fields with a small Sewage Works located on site since c.1933 there is a low to

	moderate potential for localised ground contamination at the site. Environmental sensitivity is moderate to high based on the proximity to sensitive receptors (minor aquifer, surface water and residential properties) Pendle Borough Council has confirmed that there are no legally determined contaminated land sites within 800m of the subject site and that they have no specific concerns regarding the site. RPS has not identified any significant risks of third party liability or regulatory action associated with ground conditions at the site. RPS understands that the site is proposed for redevelopment for light industrial land use (B1, B2 and B8).
Recommendations & Costings	An ecological scoping survey of the site should be undertaken to inspect the site and its surroundings. This would identify any features, habitats or species which may represent a constraint to the proposed development of the site. *Cost Estimate: £1,250 - £3,000+VAT* A historical Environment Risk Assessment should be undertaken to identify any archaeological features at the site. *Cost Estimate (for desk based research only): £1,400+VAT* Part of the site has been identified as being in a floodplain. Consequently a full Flood Risk Assessment should be undertaken to qualify the potential risk. *Cost Estimate: £2,500 - £10,000+VAT*

2.0 INTRODUCTION

RPS Health, Safety & Environment (RPS) was commissioned by **Indigo Planning Limited** on behalf of **Pendle Borough Council** to undertake an environmental review of *Land North of Foulridge Wharf, BB18 6XY*.

The principal aim of the review was to determine whether there was potential for contamination to be present which would significantly constrain the use of the site, or give rise to the risk of significant environmental liability.

The environmental review comprised:

i) a site walkover assessment;

ii) a review of the historical land uses associated with the site to assess the potential for ground contamination;

iii) a review of the environmental setting to assess the sensitivity of the surrounding environment to contamination/pollution;

iv) consultation with the regulatory authorities to establish whether there are any significant environmental issues that may impact upon the site, including records of any landfills in the vicinity;

Details of the limitations of this type of study are attached at Appendix B.

3.0 SITE SETTING AND DESCRIPTION

This section of the report is based upon observations made during a site visit on 31st May 2005. The site location and site boundary plans are shown in Appendix A.

3.1 *The Site*

The site is located at Foulridge Wharf just west of Foulridge village at National Grid Reference SD 891 437. It is approximately triangular in shape and occupies an area of approximately 25 ha. Adjacent to the west is the Leeds and Liverpool Canal. The site comprises 90% fields mainly used for farming with a small Sewage Works located in the centre of the southern boundary.

RPS understands that the site as a whole is proposed for redevelopment for light industrial land use (B1, B2 and B8).

In general the surface topography rises away from the canal in a south-easterly direction.

There is a small Sewage Works located on the central part of the western boundary. This was fenced off and locked hence full access to the Works was not possible. This is called Foulridge Waste Water Treatment Works and is operated by Yorkshire Water.

The surface cover at the Sewage Works comprised hardcore across the site which appeared in good condition. Along the northern boundary was a row of sand bags (approximately x10). In the northeast of the site there was a small square building measuring approximately 5m by 5m. This was of a breeze block construction with a corrugated metal roof and appeared to be in good condition. Also in the north-eastern corner a bulk storage tank (contents unknown), this appeared to be in good condition. On the southern boundary were three raised brick pits (approximately 0.5m in depth). The pit furthest east showed grass growth, the centre consisted of damp earthy material and the pit furthest west comprised dried earth. Adjacent to these to the north was an adjacent circular pit with metal walkway above and a small metal circular cover adjacent. Adjacent to this to the west was a metal container (use unknown) with associated pipework. This did appear to be rusty in parts.

The entrance gate was positioned on the southern boundary towards the west corner. Adjacent to this was a large plastic tank with associated plastic flexible pipes. Along the western boundary there was a raised concrete platform containing two pits

(labelled deep water), above these are metal walkways. At the furthest north of the platform was a shoot leading to a skip adjacent to the north of the platform, the contents appeared to comprise general waste (e.g. plastics). A grassy mound occupied the northwest corner of the site. In the centre of the site there were three operational sewage filter beds.

The remainder of the site (approximately 90%) comprises fields used for the grazing of livestock (cows and sheep) or unused fields. On the eastern boundary towards the northern corner there was a small wooden barn and a rubbish heap. This heap contained mainly wood and vegetation but also had some scrap metal, metal canisters, radiators and tyres. There were also two animal pens one measuring approx 20m by 10m and a second adjacent measuring 10m by 10m. The smaller contained a pen used to isolate cows and the larger had a small disused horse box, hay, large plastic containers and a pile of plastic bags. There was also an area where burning activities had been undertaken. The western boundary of the site housed many mature trees and hedgerows.

There were two main ditches with running water one running south to north with an outlet pipe approximately 50m northeast from the sewage works boundary. Another outlet pipe could be seen on the eastern boundary approximately 10m east of the barn. This ran into a drain running west across the fields.

Located in the centre of the site there were mounds observed which did not concur with the natural topography of the site. These were located in grazing fields and one had a dry stone wall built over it. It is possible these are man-made features of archaeological value.

No evidence of vegetation stress or ground contamination was noted.

3.2 *The Surrounding Area*

The Leeds Canal runs parallel to the site along the western boundary. This appears to be clean as fishing is abundant and fish were observed. A car park and a few houses and sheds can be found adjacent to the southern corner of the site.

Running parallel to the eastern boundary is a dismantled railway which has since grassed over with hedges and trees on either side, here the soil appears black. To the north of the site are additional fields.

4.0 SITE HISTORY

The following account of the history of the site is based upon available past editions of Ordnance Survey (OS) maps dated 1892 to 2001. Extracts from the historical maps are given at Appendix A.

Maps Reviewed (publication dates)	***Map Scale***
1892/95, 1896, 1914/15, 1909/11, 1933, 1956	25" to 1 mile scale
1894, 1909, 1912, 1932, 1964/70, 1964/81, 1970, 1981, 1993, 1995	1:2,500 scale
1973/79, 1979/93, 1999/2001	1:10,000 scale

4.1 *The Site*

Site Features	***Dates***
Open fields with a footpath running through the centre of the site east/west orientation. Drain flowing south to north with a smaller drain joining it running from the southeast.	1892-<1933
Open Fields with a small Sewage Disposal Works in centre on the western boundary with a footpath running through the centre of the site east/west orientation. Drain flowing south to north with a smaller drain joining it running from the southeast.	1933-<1964
Open Fields with area labelled works and Sewage Farm with a footpath running through the centre of the site east/west orientation. Drain flowing south to north with a smaller drain joining it running from the southeast.	1964-<1973
Open Fields with a small Sewage Farm with a footpath running through the centre of the site east/west orientation. Drain flowing south to north with a smaller drain joining it running from the southeast.	1973-2001

4.2 *The Surrounding Area*

Surrounding Features (250m radius)	***Orientation***	***Distance***	***Dates***
Railway *Then* Dismantled Railway	East	Adjacent	1894-<1973 1973-2001
Limekiln *Then* Old Limekiln	Southwest	Adjacent	1848-<1894 1912-<1956
Canal	West	Adjacent	1848-2001
Warehouse	South	40m	1894-2001
Unlabelled Excavated Area *Then* Old Quarry *Then* Unlabelled Excavated Area	Southwest	60m	1894-<1912 1912-<1932 1932-<1970
Gasometer	South	120m	1894-<1912
Cotton Mill	South	130m	1894-2001
Cotton Mill	Southeast	140m	1894-<2001
Quarry	Southeast	190m	1894-<1970
Garage *Then* Unlabelled Building	East	200m	1970-<2001 2001
Engineering Works *Then* Works	Southwest	240m	1970-<1981 1981-<2001

Surrounding Features (250m radius)	***Orientation***	***Distance***	***Dates***
Then Unlabelled Building			2001
Garage *Then* Unlabelled Building	Southwest	240m	1970-<2001 2001
Engineering Works *Then* Works *Then* Unlabelled Building	South	250m	1970-<1981 1981-<2001 2001

5.0 ENVIRONMENTAL SETTING

5.1 *Geology*

Based on British Geological Survey 1:50,000 scale survey sheet No 68 the stratigraphic sequence in the vicinity of the site is as follows:

- Alluvium (*Recent*)
- Millstone Grit (*Upper Carboniferous*)

Made Ground

Made Ground is likely to be present at the Sewage Works as a result of past construction activities. No site investigation reports have been reviewed to verify this

Alluvium

These deposits comprise variable proportions of sand, silt and clay with some gravels and very occasional peat lenses, likely to be a few metres in thickness beneath the site.

Millstone Grit

Comprising beds of sandstone, conglomerates and grit with sequences of mudstones and shales, likely to be over 500m in thickness beneath the site.

5.2 *Hydrogeology*

According to the Environment Agency Groundwater Vulnerability map, the site is located on above a Minor Aquifer relating to the Coal Measures. These formations will seldom produce large quantities of water for abstraction though they are important both for local supplies and in supplying base flow to rivers.

Groundwater is likely to flow generally in a southwest direction due to the topographic gradient.

The site is not located on a groundwater Source Protection Zone (SPZ).

6.0 CONSULTATIONS & ADDITIONAL INFORMATION

6.1 *Surface Water*

Environment Agency data indicates that there are three watercourses within 800m of the site which are classified under the General Quality Assessment (GQA) scheme. These are the New Cut located on site, the Leeds and Liverpool Canal which lies adjacent to the west of the site and the Lancashire Gill which has various monitoring points in tributaries on and nearby to the site. These watercourse are classified as New Cut-Grade A (Very Good), Leeds and Liverpool Canal-Grade C (Fairly Good), and Lancashire Gill-Grade B (Good) quality watercourse.

Environment Agency data indicates that the site is located within an indicative flood plain of the Lancashire Gill tributary named Earby Beck. This is classed as a low risk site.

6.2 *Water Abstractions*

Information provided by the Environment Agency indicates that there are records of three licensed water abstractions within 800m of the site. The details of these are as follows:

Licence Holder	Source	Use	Approx. Distance and Direction from Site
British Waterways Board	Surface Water	Not supplied	145m Southwest
F M Brown	Groundwater	Private Water Supply	175m Northeast
Mr & Mrs S & G Connah	Groundwater	Household Private Water Supply (including drinking water)	600m East

6.3 *Discharge Consents*

Environment Agency data shows that there are 14 licensed discharge consents within 250m of the site. The details of these are outlined in the table below:

Licence Holder	Receiving Medium	Type of Discharge	Approx. Distance and Direction from Site
Yorkshire Water Services Ltd	Culverted tributary of County Dyke	Sewage Discharges – Final/Treated Effluent	On site
Burnley Rural District Council	Culverted tributary of County Dyke	Sewage Discharges – Final/Treated Effluent	On Site
Mr G. Whittaker	Soakaway adjacent to Foulridge Farm	Sewage Discharges – Final/Treated Effluent	30m Southwest
D & B Wilkinson	Tributary of Lancashire	Sewage Discharges	120m Northeast

Licence Holder	Receiving Medium	Type of Discharge	Approx. Distance and Direction from Site
	Gill	– Final/Treated Effluent	
Alan & Lynne Robinson	Tributary of Lancashire Gill	Sewage Discharges – Final/Treated Effluent	120m Northeast
Andrew & Miriam Thompson	Tributary of Lancashire Gill	Sewage Discharges – Final/Treated Effluent	120m Northeast
Carl Wilkinson	Tributary of Lancashire Gill	Sewage Discharges – Final/Treated Effluent	120m Northeast
Harry Rupert Taylor & Lillian Taylor	Tributary of Lancashire Gill	Sewage Discharges – Final/Treated Effluent	120m Northeast
F.M & H.M Brown	Tributary of Lancashire Gill	Sewage Discharges – Final/Treated Effluent	120m Northeast
Mr S Fort & Mrs B Crossley	Tributary of Lancashire Gill	Sewage Discharges – Final/Treated Effluent	120m Northeast
T Johnson	Soakaway	Sewage Effluent	140m Southeast
Acornlee Hall Farm	County Brook	Sewage Discharges – Final/Treated Effluent	230m East
Armabord Ltd	Leeds and Liverpool Canal	Trade Effluent	285m Southwest

6.4 *Waste Disposal Sites*

Information provided by the Environment Agency shows that there is one recorded landfill sites within 500m of the property. The details of these are listed in the table below.

Licence Holder	Waste Deposited	Approx. Distance and Direction from Site
Birchenlee Foundry Co Ltd	Foundry Sand, Soil, Rock, Clay, Similar Waste N.O.S (dated approximately 1988)	335m Southeast

Pendle Borough Council has advised that it holds records of three pre-licensing landfill sites within 500m of the site. The details of these are outlined in the table below:

Location	Waste Deposited	Approx. Distance and Direction from Site
Skipton Old Road, Foulridge	Not Supplied	125m Southeast
Foulridge Municipal, Skipton Road, Foulridge	Inert, Household (closed 1947)	165m Southwest
Nonya Quarry, Off Nonya Road, Foulridge	Inert, Industrial	500m Southeast

6.5 *Pollution Incidents/Contaminated Land*

Environment Agency data indicates that there are three records of major or significant pollution incidents within 500m of the site. These are outlined in the following table:

Location/Address	Receiving Medium	Type of Pollution Incident	Approx. Distance and Direction from Site
Gargrave/Source Aire Afu	Freshwater Stream/River	Silage Liquor	190m Northeast
Gargrave/Source Aire Afu	Freshwater Stream/River	Silage Liquor	190m Northeast
Gargrave/Source Aire Afu	Freshwater Stream/River	Silage Liquor	260m Northeast

Pendle Borough Council has confirmed that there are no legally determined contaminated land sites within 800m of the subject site and that they have no specific concerns regarding the site.

6.6 *Prescribed Processes*

Data supplied by the Environment Agency shows that there are no Part A (IPC) or IPPC processes authorised under the Environmental Protection Act 1990 or Pollution Prevention and Control Act 1999 within 500m of the site.

Pendle Borough Council has advised that there are records is one record of a Part B (APC) processes authorised under the Environmental Protection Act 1990 within 500m of the site. The details of this are outlined in the table below:

Licence Holder	Prescribed Process	Approx. Distance and Direction from Site
Pendle Polymer Engineering	Coating of metal and plastic	250m South

6.7 *Sites of Environmentally Sensitive Land Use*

Data supplied by English Nature indicates that there are two protected/sensitive environmental areas within 800m of the site. The details of these are outlined in the table below:

Sensitive Land Use Type	Description	Approx. Distance and Direction from Site
Area of Unadopted Green Belt	N/A	310m South
Nitrate Vulnerable Zone	Surface Water	424m Southeast

6.8 *Coal Authority*

The Coal Authority Coal Mining report for the site indicates that the property is not within the zone of likely physical influence on the surface from past or present underground coal workings. Nor is the property within a geographical area for which a license to extract coal by underground or opencast methods is awaiting determination or has been granted by the Coal Authority. The site is not located within a zone of influence of past or present open cast mining. No reserves of coal exist in the locality,

which could be worked at some time in the future subject to feasibility, licenses, and planning consents. Furthermore, the Coal Authority have no record of any notice of the risk of the land being affected by subsidence being given under S.46 of the Coal Mining Subsidence Act 1991.

6.9 *Petroleum Records*

Lancashire County Council Petroleum Officer has confirmed there are no records of petroleum storage at this site.

6.10 *Radon*

According to the National Radiological Protection Board's Radon Atlases of England, Wales and Scotland, this site is at not at risk of radon gas ingress.

6.11 *Existing Reports / Correspondence*

RPS has not been provided with any existing reports or correspondence regarding the site.

7.0 ENVIRONMENTAL RISK ASSESSMENT

7.1 Introduction

This section assesses the significance of the environmental issues which have been identified on the site or in the surrounding area. The issues have been classified under three broad categories.

The classes of significance referred to are as follows:

- **low risk -** it is considered unlikely that issues within the category will give rise to a liability/cost for the owner of the site.

- **moderate risk -** it is possible but not certain that issues within the category will give rise to a liability/cost for the owner of the site.

- **high risk -** there is a high potential that issues within the category will give rise to a liability/cost for the owner of the site.

7.2 Land Contamination/Pollution

Risk:	**Low/Moderate**
Comments:	Historical maps show the site comprised Open Fields until c.1933 when a Sewage Disposal Works was located on the centre of the western boundary. This was labelled a Sewage Farm/Works from c.1964 and remains to date. No evidence of significant contamination was observed during the walkover, however there is the potential for localised contamination. No other potentially contaminative land uses have been identified on site. The Sewage Works represents a moderate risk of localised contamination whilst the remainder of the site is low risk. Surrounding land uses are unlikely to significantly impact the site. Pendle Borough Council has confirmed that they have no specific concerns regarding the site.

7.3 Groundwater Contamination/Pollution

Risk:	**Low/Moderate**
Comments:	The site is located on a Minor Aquifer relating to the underlying Alluvium and Millstone Grit. The nearest groundwater abstraction is located 175m northeast for private water supply. In view of the presence of abstracted groundwater, the risk is therefore considered to be low to moderate.

7.4 Surface Water Contamination/Pollution

Risk:	**Moderate/High**
Comments:	The nearest surface watercourse is located on site (New Cut). This is a sensitive watercourse due to its classification as a "Very Good" quality watercourse under the GQA scheme. The nearest surface water abstraction is located 145m southwest. Details on exact use are unknown. The site holds two discharge consents for the Sewage Works. Overall the risk associated with surface water contamination is considered to be moderate to high due to the proximity and sensitivity of the watercourse.

7.5 Air Pollution

Risk:	**Low**
Comments:	No air pollution issues have been identified at this site.

7.6 Other Environmental Issues

Risk:	**Moderate**
Comments:	The site is located within a flood plain of New Cut. According to the Environment Agency this represents a low risk to the site. In view of the rural nature of the site setting and its present undeveloped status, ecological issues may represent a significant development constraint.

	Due to the potential features of archaeological value observed on-site, further specific advice is recommended.

7.7 Overall Risk

Risk:	**Low/Moderate**
Comments:	Given the site has been partly used for a Sewage Works since c.1933 there is a low to moderate potential for ground contamination to have affected the site as a whole. Environmental sensitivity is considered to be moderate/high based on the proximity of sensitive receptors (minor aquifer, surface watercourses and residential properties). The overall risk associated with the site is considered to be low/moderate.

8.0 CONCLUSIONS & RECOMMENDATIONS

8.1 Conclusions

Ground conditions at the site represent a low to moderate risk with respect to its current and past uses.

RPS has not identified any significant risks of third party liability or regulatory action which could affect the site whilst it remains in its current use. With regard to the proposed development of the site, the following actions should be undertaken:

8.2 Recommendations

We recommend the following actions to reduce the environmental risks at the site:

Action	Anticipated Cost
An ecological scoping survey of the site should be undertaken to inspect the site and its surroundings. This would identify any features, habitats or species which may represent a constraint to the proposed development of the site.	£1,250 - £3,000+VAT
A Historical Environment Risk Assessment should be undertaken to identify any archaeological features at the site.	£1,400+ VAT (desk based only)
Part of the site has been identified as being in a floodplain. Consequently it would be prudent to undertake a full Flood Risk Assessment should be undertaken to qualify the potential risk.	£2,500- £10,000+VAT

APPENDIX A: FIGURES

Appendix A - 8 Pages

Project:	Land North of Foulridge Wharf
Project No:	FLL12761
Date:	June 2005
Scale:	NTS
Figure 1:	Site Location

RPS Health, Safety and Environment

1 Stamford Street
London
SE1 9NT
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020-7928-0708
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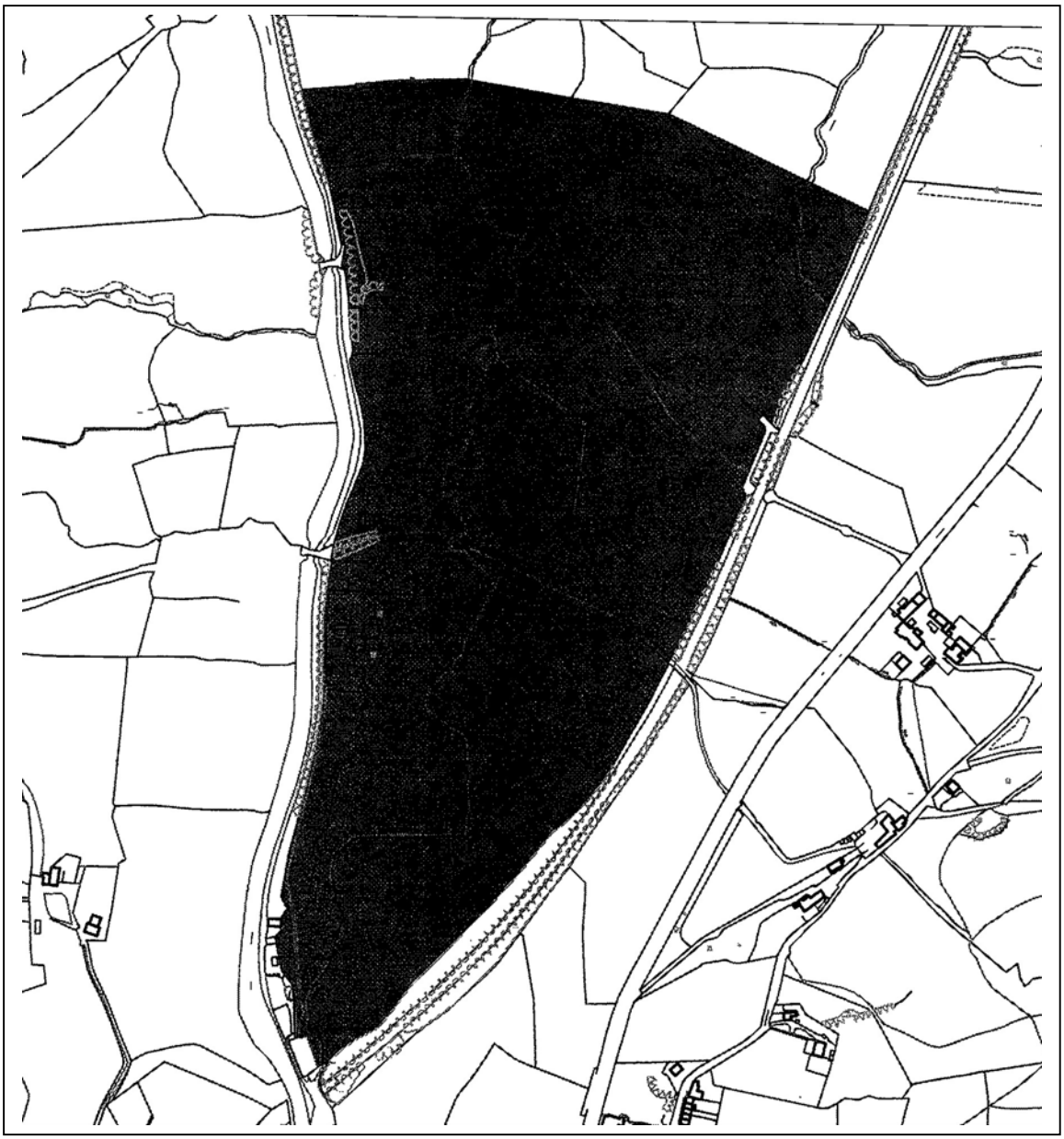

Project:	Land North of Foulridge Wharf
Project No:	FLL12761
Date:	June 2005
Scale:	NTS
Figure 2:	Site Location Plan

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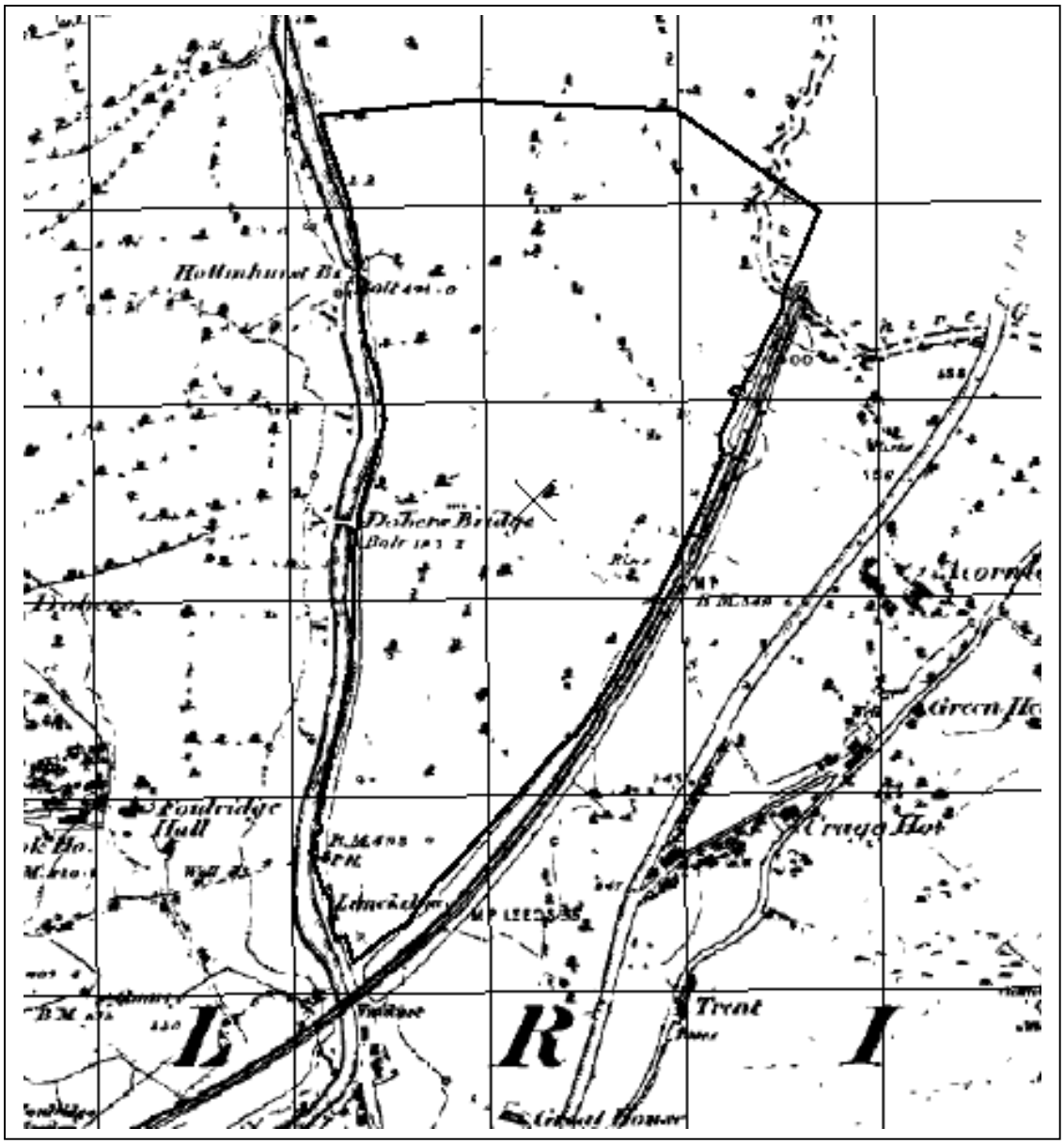

Project:	Land North of Foulbridge Wharf
Project No:	FLL12761
Date:	June 2005
Scale:	NTS
Figure 3:	Historical Map Extract (1846/48)

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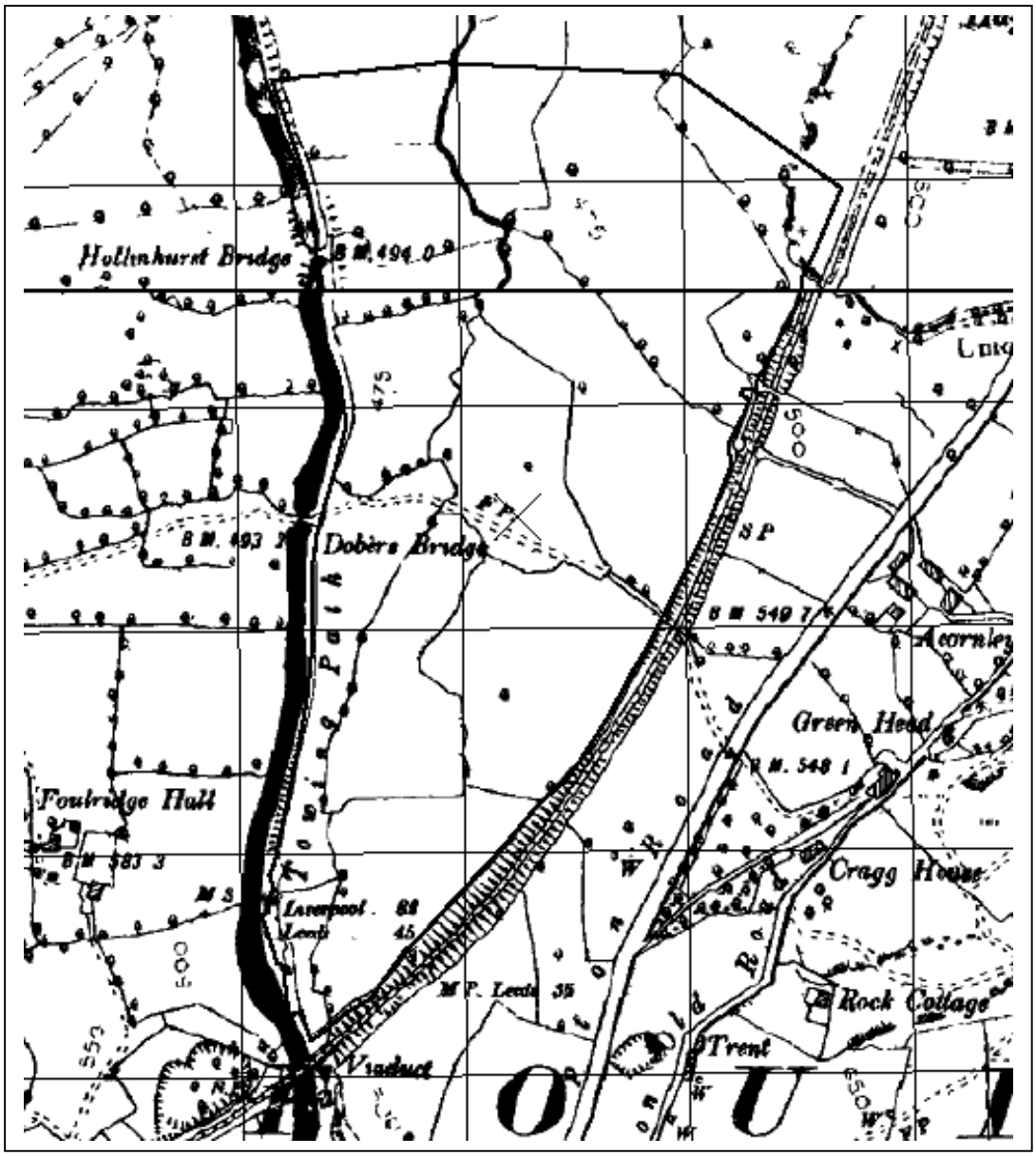

Project:	Land North of Foulbridge Wharf
Project No:	FLL12761
Date:	June 2005
Scale:	NTS
Figure 4:	Historical Map Extract (1892/95)

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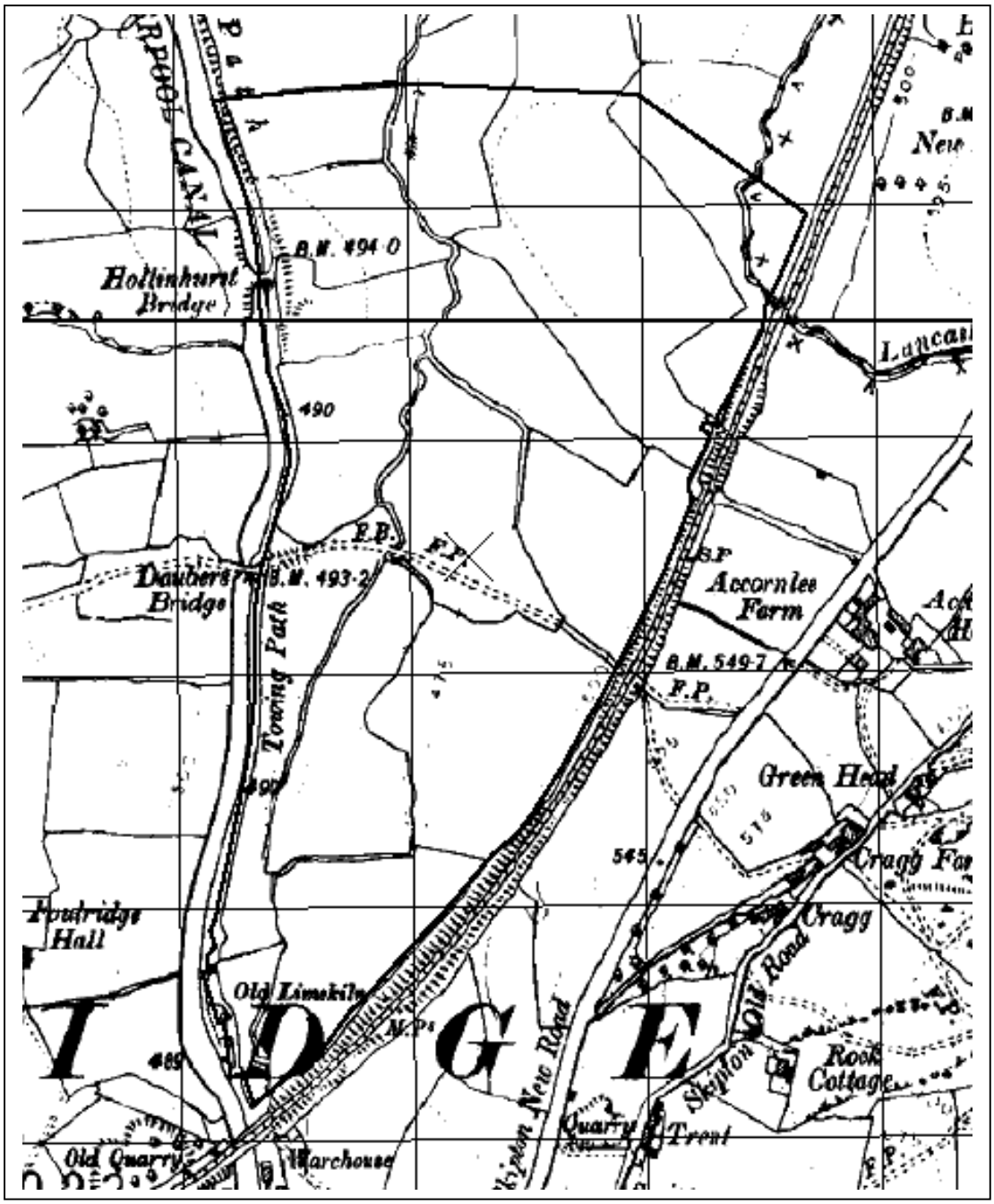

Project:	Land North of Foulbridge Wharf
Project No:	FLL12761
Date:	June 2005
Scale:	NTS
Figure 5:	Historical Map Extract (1914/15)

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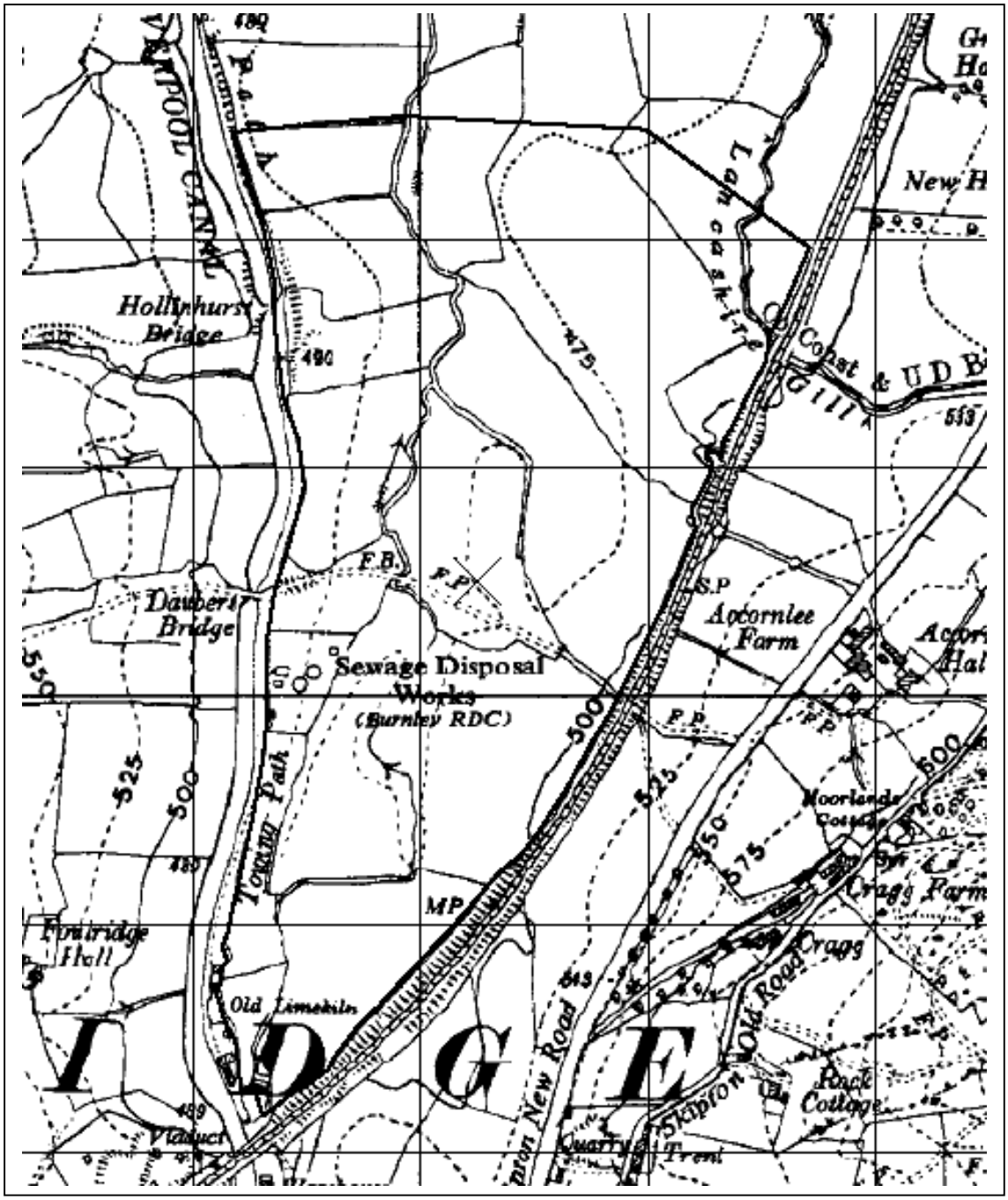

Project:	Land North of Foulbridge Wharf
Project No:	FLL12761
Date:	June 2005
Scale:	NTS
Figure 6:	Historical Map Extract (1956)

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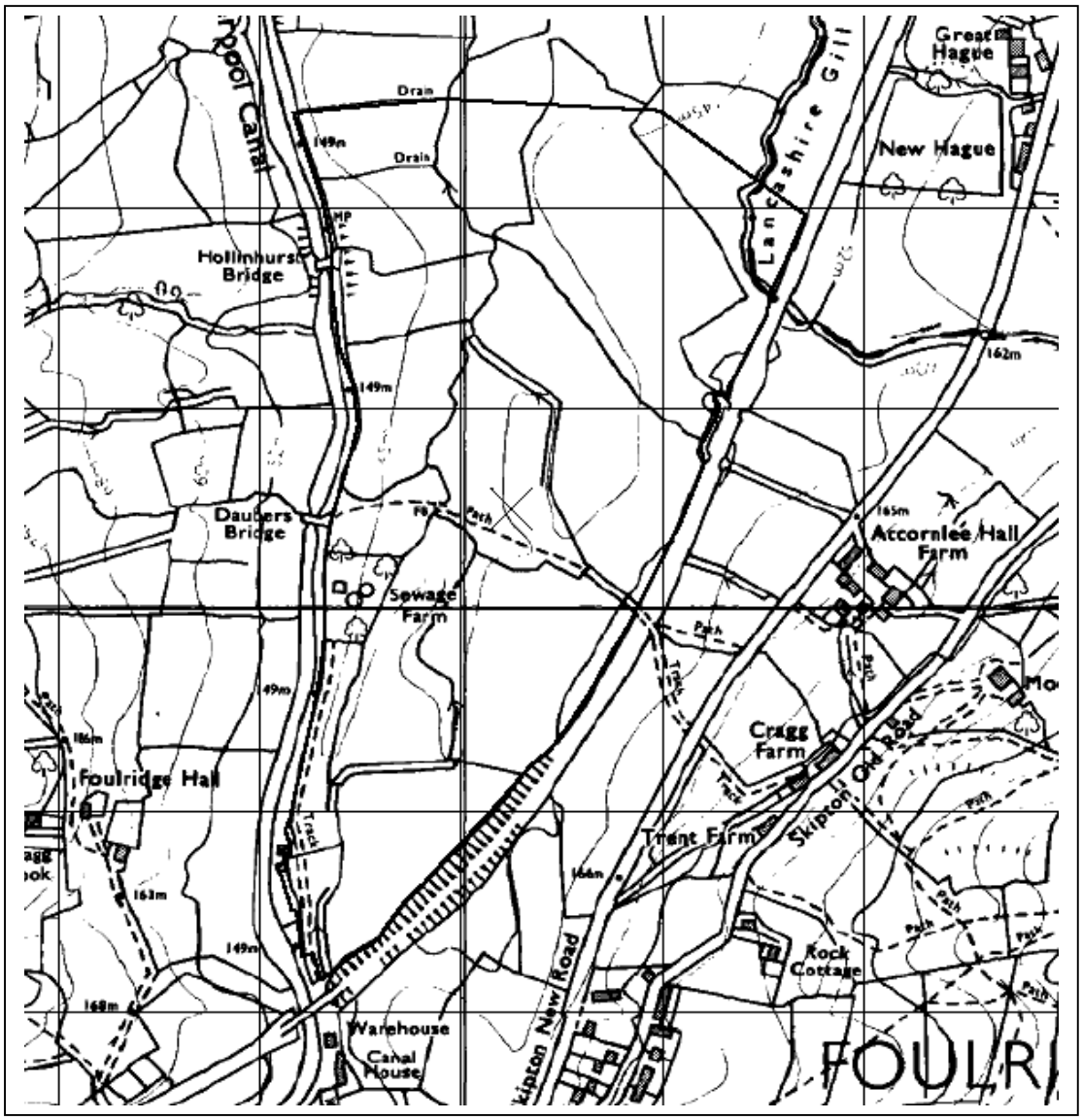

Project:	Land North of Foulbridge Wharf
Project No:	FLL12761
Date:	June 2005
Scale:	NTS
Figure 7:	Historical Map Extract (1973/79)

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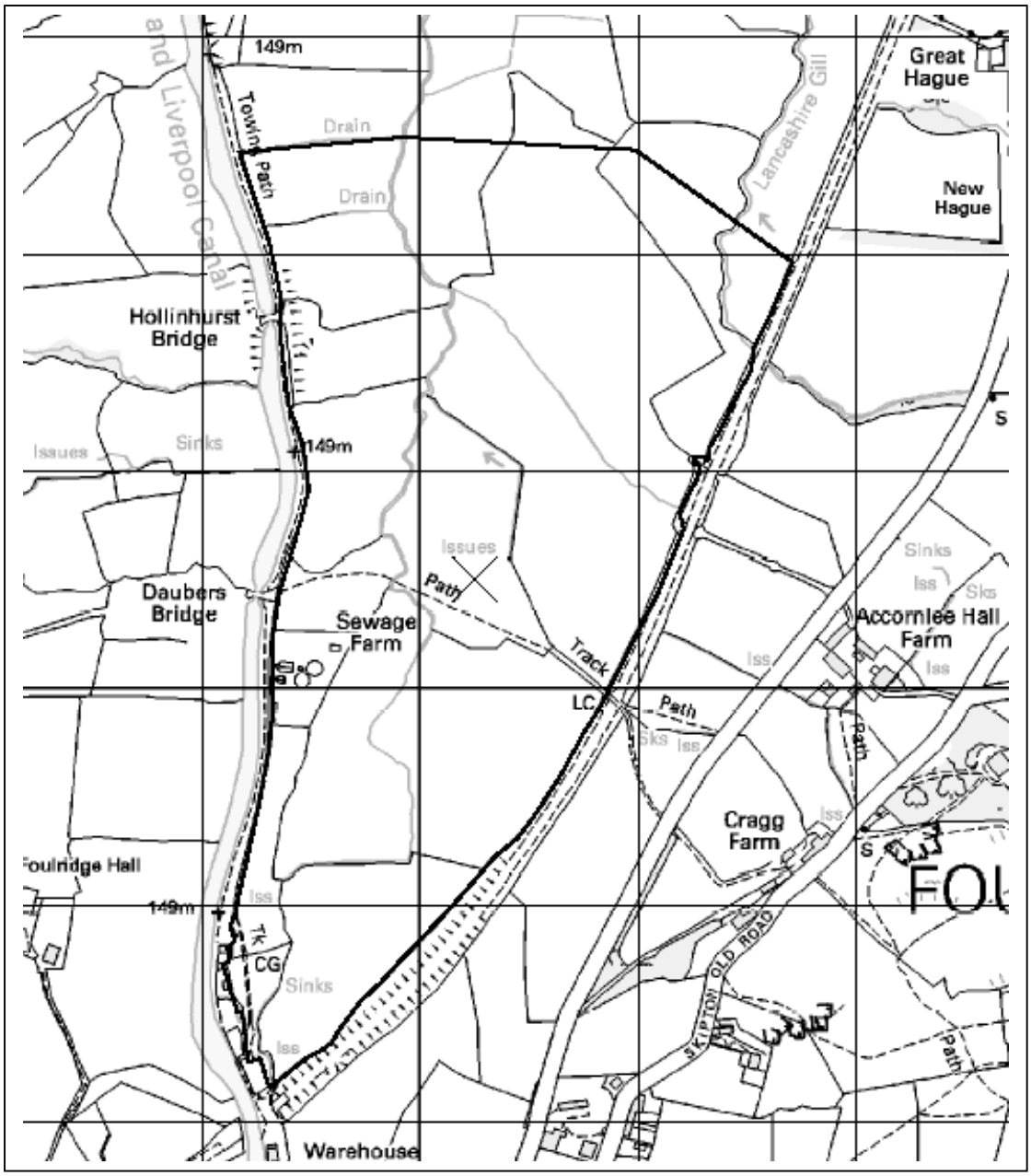

Project:	Land North of Foulbridge Wharf
Project No:	FLL12761
Date:	June 2005
Scale:	NTS
Figure 8:	Historical Map Extract (1999/2001)

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Appendix G

Greenhead Road

Greenhead Lane Environmental review

Contents

1 Executive Summary

Site Details	Area: Main Use: Agricultural Pasture
Site History	The site has a history of landfill on its eastern edge an of quarrying in the 19th Century. A former sewage works was located to the south and there is a current sewage plant to the south west. Quarrying has taken place on the south and south east boundaries of the site.
Current Conditions & Activities	The land is currently used for agriculture
Geology	Sandstone (carboniferous), Mudstone, Siltstone and sandstone, Till Devensian
Hydrology	Part of a minor aquifer on the eastern side of the site. A small watercourse adjoins the site to the west which flows into Pendle water situated immediately below the site. The landfill is found adjacent to this which increases the risks of contamination.
Risk Assessment	The principal risk with the development is that of pollution through landfill. This is however a known risk and with a detailed assessment should be able to be overcome. Other risks are low.

1 Introduction

1.1 This assessment has been undertaken as part of the assessment of the potential site for an employment land allocation in the Pendle Borough Council Core Strategy. It is an overview of the environmental conditions present on the site referred to as Greenhead Road. In line with the assessments carried out by RPS consulting the review comprised of:

i) A walkover of the site
ii) A review of the historic land uses to assess likely contamination
iii) A review of the environmental setting to assess the surrounding environment to contamination/pollution
iv) Consultation with regulatory bodies to establish whether there are any significant environmental issues that may impact on the site including landfill.

2 Site Setting and Description

2.1 The site is found in green bet in an isolated countryside location. It is roughly square in nature and comprises of agricultural fields. It slopes down in a generally north to south direction and has hedges which cross the site forming a grouping of distinct fields. There is a small woodland on the north side above which there is a house. Trees and a hedge line the east side of the site with Greenhead Lane.

2.2 There is a steep sided gully on the west of the site which runs down towards a sewage treatment plant and group of farm buildings and dwellings. A stream runs down the gully.

2.3 The site's topography is that of fields that are relatively flat in their upper northern sections. These fall away increasingly steeply towards the south of the site. The land is steep sloping towards its south and south west boundaries.

3 Site History

3.1 The site has been reviewed using maps published :

1848	1:10,560
1891	1:10,560
1913/14	1:10,560
1932	1:10,560
1955	1:10,560
1965-68	1:10,560
1978-92	1:10,000

3.2 Surrounding features:

- Pendle water 221m east
- Leeds and Liverpool Canal (1848) 600m east
- Sewage works 70m south west

- Mine (disused) — Adjacent to the south
- "Duck" Pits and Higher Duck Pits — Adjacent south east
- Sewage works (disused) to south east — 380m south east

3.3 The earliest maps show that the site had sandstone quarries that were in operation on the south east corner. These were found on either side of Pendle Water. Burnley sewage works was located 380m on the south east established between 1848 and 1891. A sand pit was also created in the centre of the site between 1848 and 1891.

3.4 The expansion of Burnley and Nelson required sewage works to have its capacity increased and a new works had started to be constructed by 1913. This is found on the south west of the land and is still in operation. There were no land use changes of note until a reservoir was constructed at Wood End Pit (adjacent to the south) shown on the 1955 map.

3.5 The next change shown on the maps was the building of the M65 which opened in 1981. The smaller sewage works was removed to make way for the motorway.

4 Environmental Setting

4.1 Base on the British Geological Survey 1:50,000 scale survey

- Sandstone (carboniferous)
- Mudstone, Siltstone and sandstone
- Till Devensian

4.2 Borehole data is not available for the site. Made ground is likely where tipping activities took place on the west of the site.

4.3 A small section of the north east side of the site is identified by the as being a secondary aquifer with lower permeability layer which will yield limited amounts of water.

5 Consultations and Additional Information

5.1 The records of the Environment Agency show that there is one rive within 300m of the site which has water quality data available on it. Pendle Water has a Grade A water quality grading. The site is not within flood zones 2 or 3.

5.2 There are no abstraction licenses within 1 km of the site.

5.3 Environment data show that there are five landfill sites within 1 km of the site. A site is located directly opposite to the site on the immediate north side of the M65 motorway bridge. A site is situated 1 km to the north known as Waterside Farm. A site is found to the south of the existing sewage treatment works and one at Higher Duckpits 800m to the south. Barden tip is situated immediately to the east of Pendle Water adjacent to Barden Lane.

5.4 Part of the site lies in a standing coal advice area. No part lies in a coal referral area.

5.5 Radon levels in the area are low and not an environmental constraint.

6 Environmental Risk Assessment

6.1 This section of the report assesses the significance of the risks which have been identified. These are broad assessments based on the desktop study undertaken and any available published information. It is not based on intrusive investigation.

6.2 The significance is based on three categories

- Low risk – unlikely that issues within the category will give rise to a labiality/cost toe the owner
- Moderate risk – possible but not probable that issues within the category will give rise to a liability/cost.
- High risk – there is a high potential that the issues identified will give rise to a liability/cost

6.3 Assessment

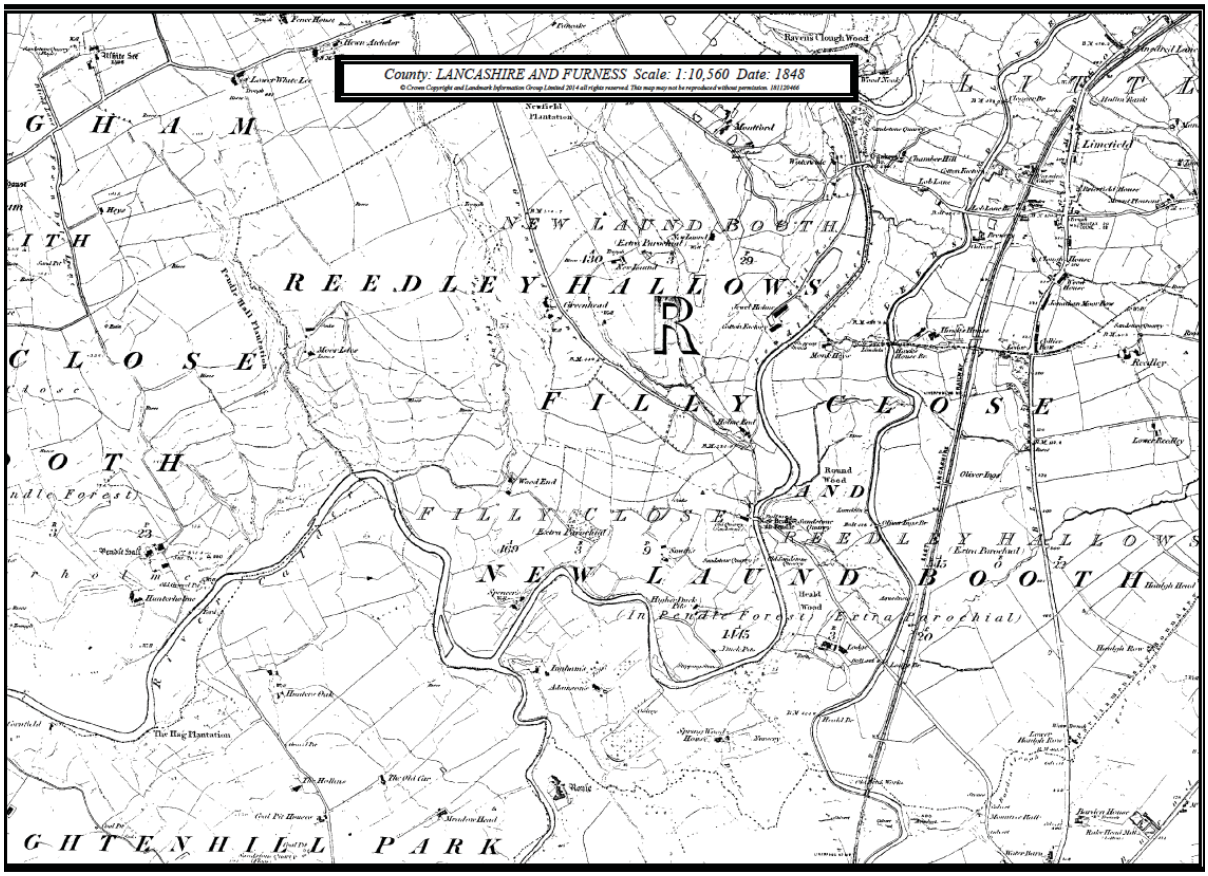
Risk	
Contamination/ Pollution	Moderate risk
	The site has had some landfill which has occurred on it on the western side. This was approved by Lancashire County Council on 12th November 2001 under reference 13/99/0170P. There are historic landfill sites within 800m of it, in particular one which sits immediately adjacent to the site on the opposite side of Greenhead Lane. Although the general use of the site has been for agriculture with a small amount of extraction of minerals in the 19th Century, the risk of contamination is not significant. The location of the landfill sites presents a moderate risk of contamination.
Groundwater Contamination/Pollution	Low
	The site is underlain by a minor aquifer but that is located in a small area of the site. Risks to groundwater from the site is low
Surface Water Contamination / Pollution	Low/Moderate
	A small watercourse adjoins the site to the west which

	flows into Pendle water situated immediately below the site. The landfill is found adjacent to this which increases the risks of contamination.
Air Pollution	Low
	There is a low risk of air pollution on and adjacent to the subject site
Other Environmental Issues	Low
	There is need to undertake surveys to identify other features such as habitats or species which may be present on or near the site
Overall Risk	Low/Moderate
	The principal risk with the development is that of pollution through landfill. This is however a known risk and with a detailed assessment should be able to be overcome. Other risks are low.

7 Conclusions

8.1 The risk assessment does not identify significant risks form the data available. The main element of risk is from landfill both present on the west of the site and from adjoining sites. There is overall a low risk of an environmental liability.

1848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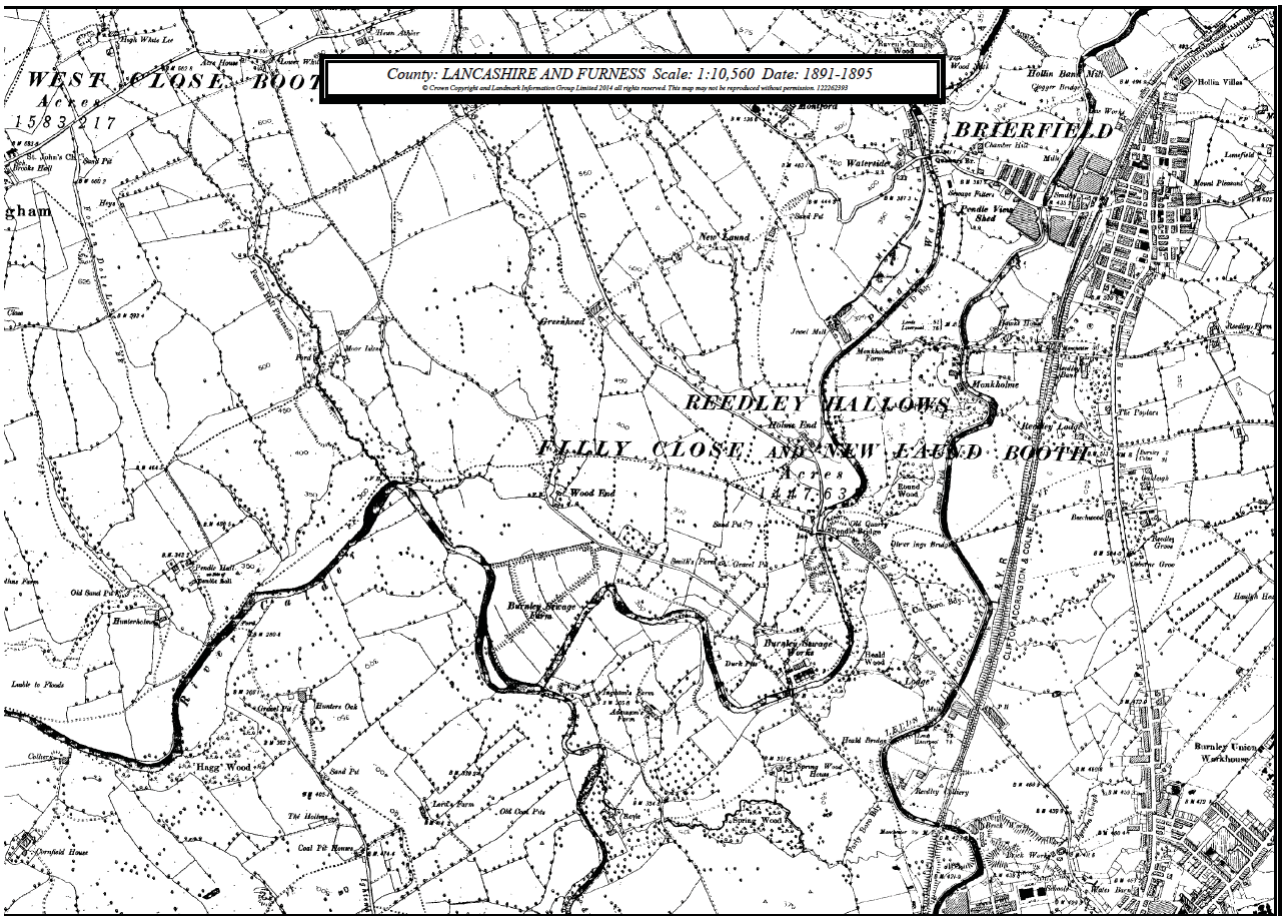
FILLY CLOSE
NEW LAUND BOOTH
CLOSE
GHTENHILL PARK

1891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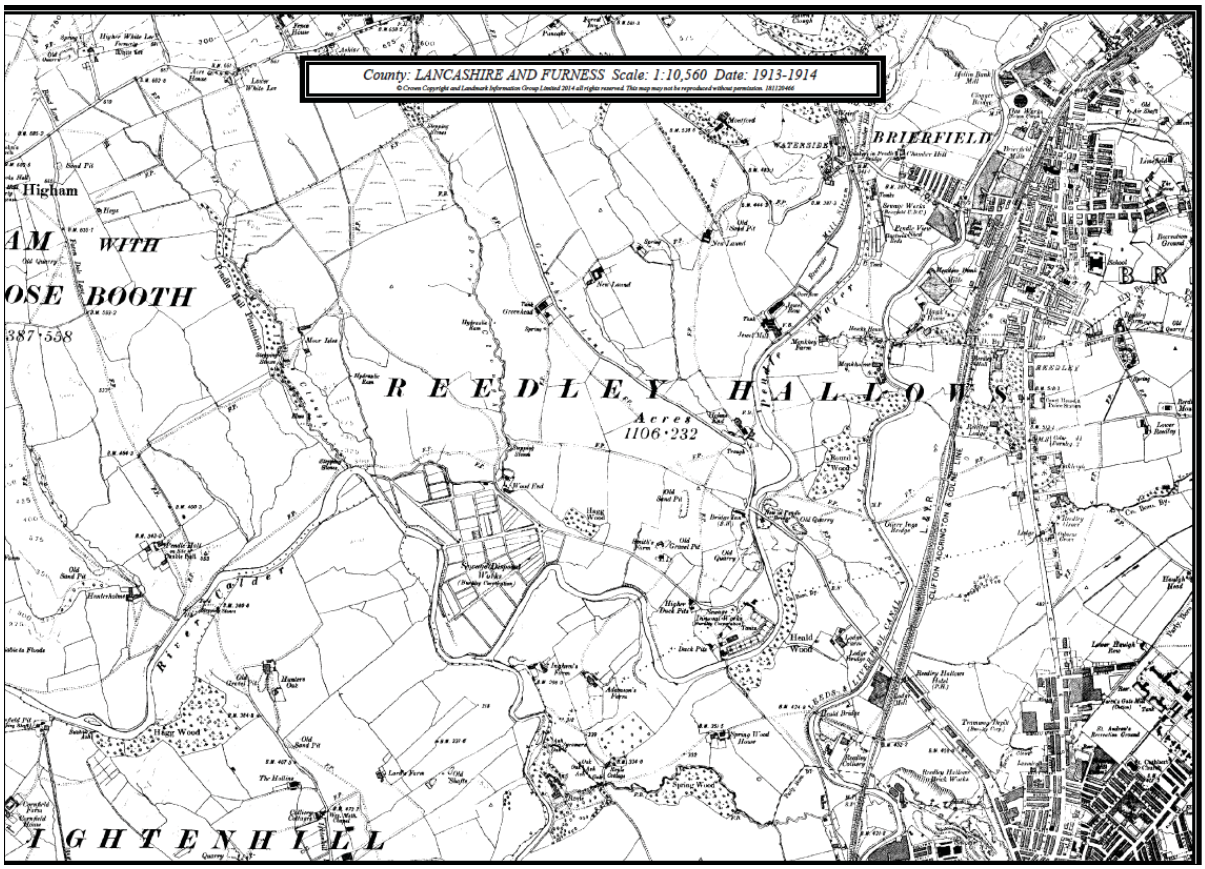
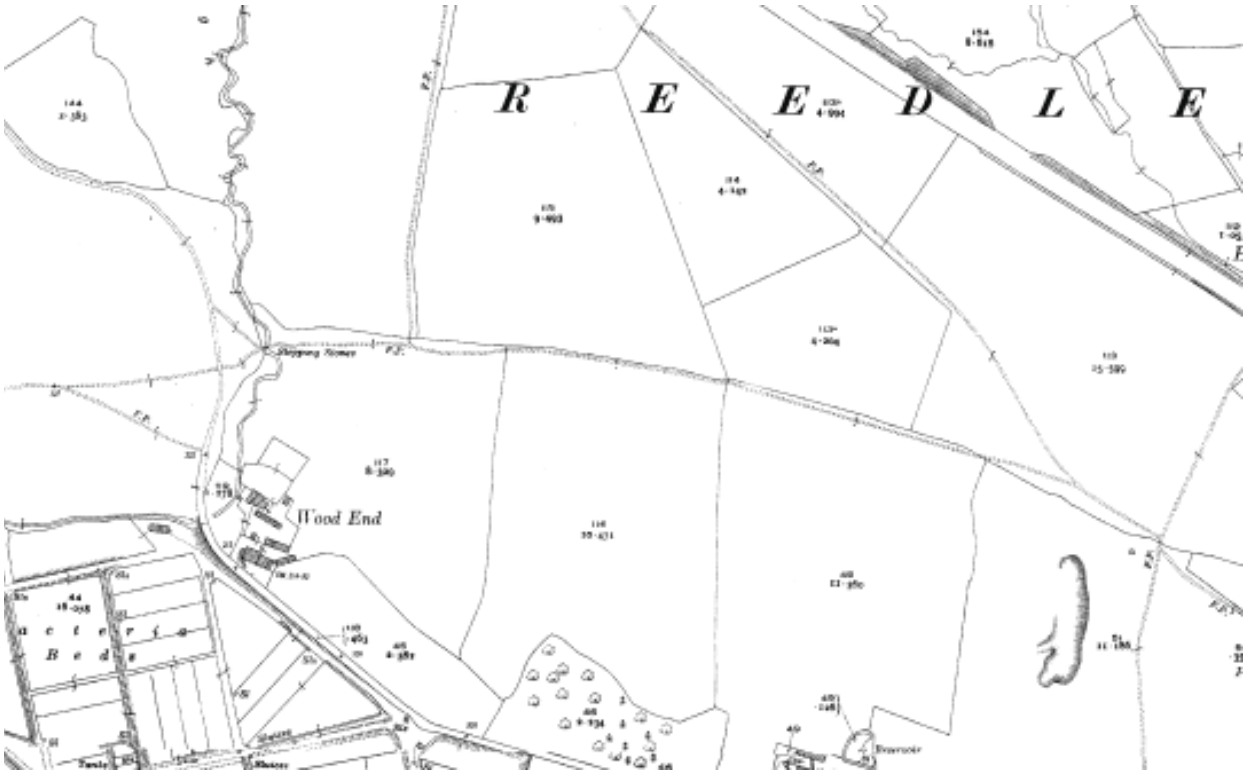
BRIERFIELD
REEDLEY HALLOWS
FILLY CLOSE AND NEW LAUND BOOTH

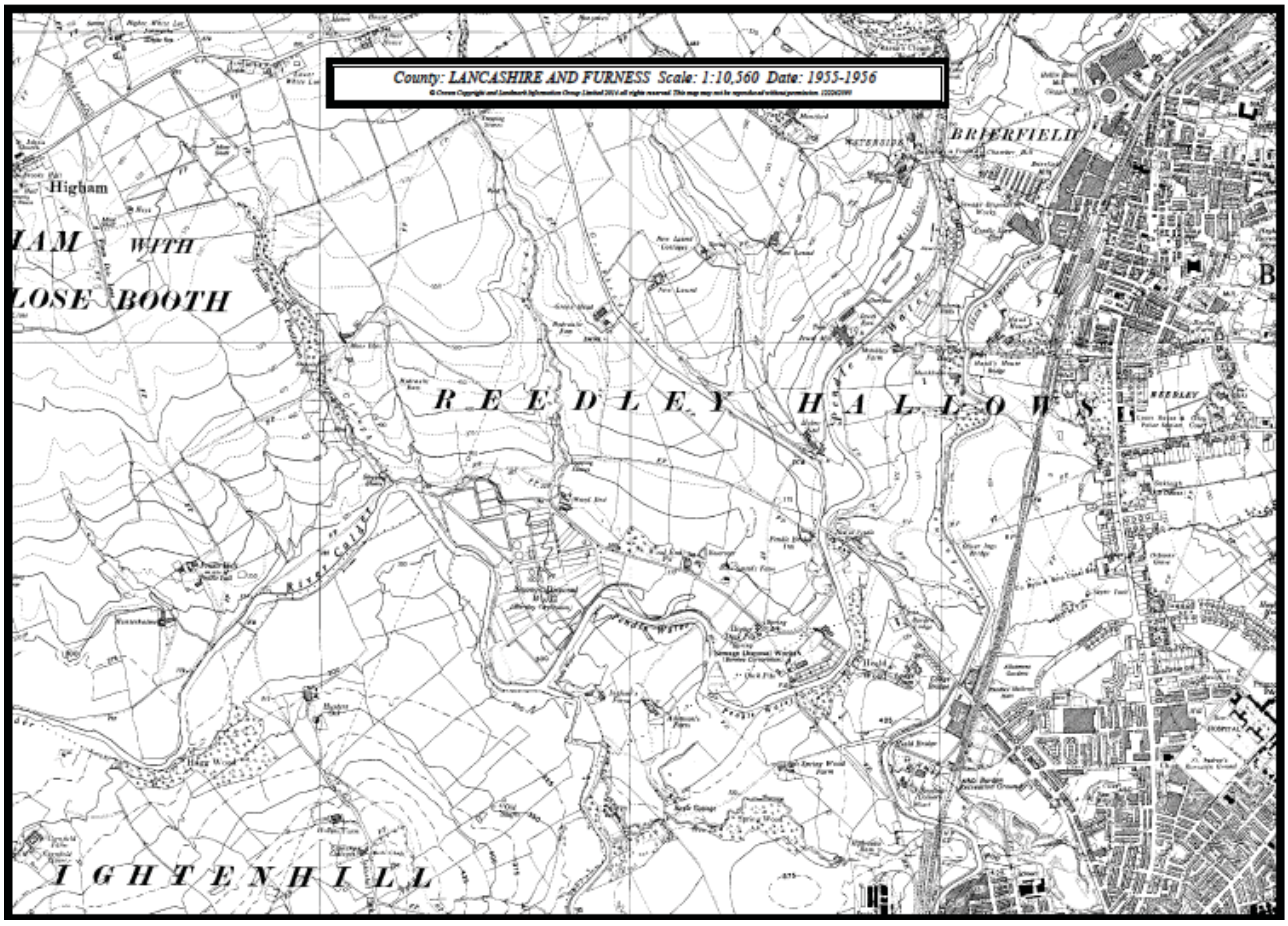
1913-14


County: LANCASHIRE AND FURNESS Scale: 1:10,560 Date: 1913-1914
BRIERFIELD
Higham
WITH
OSE BOOTH
387·538
R E E D L E Y H A L L O W S
Acres
1106·232
Wood
IGHTENHILL

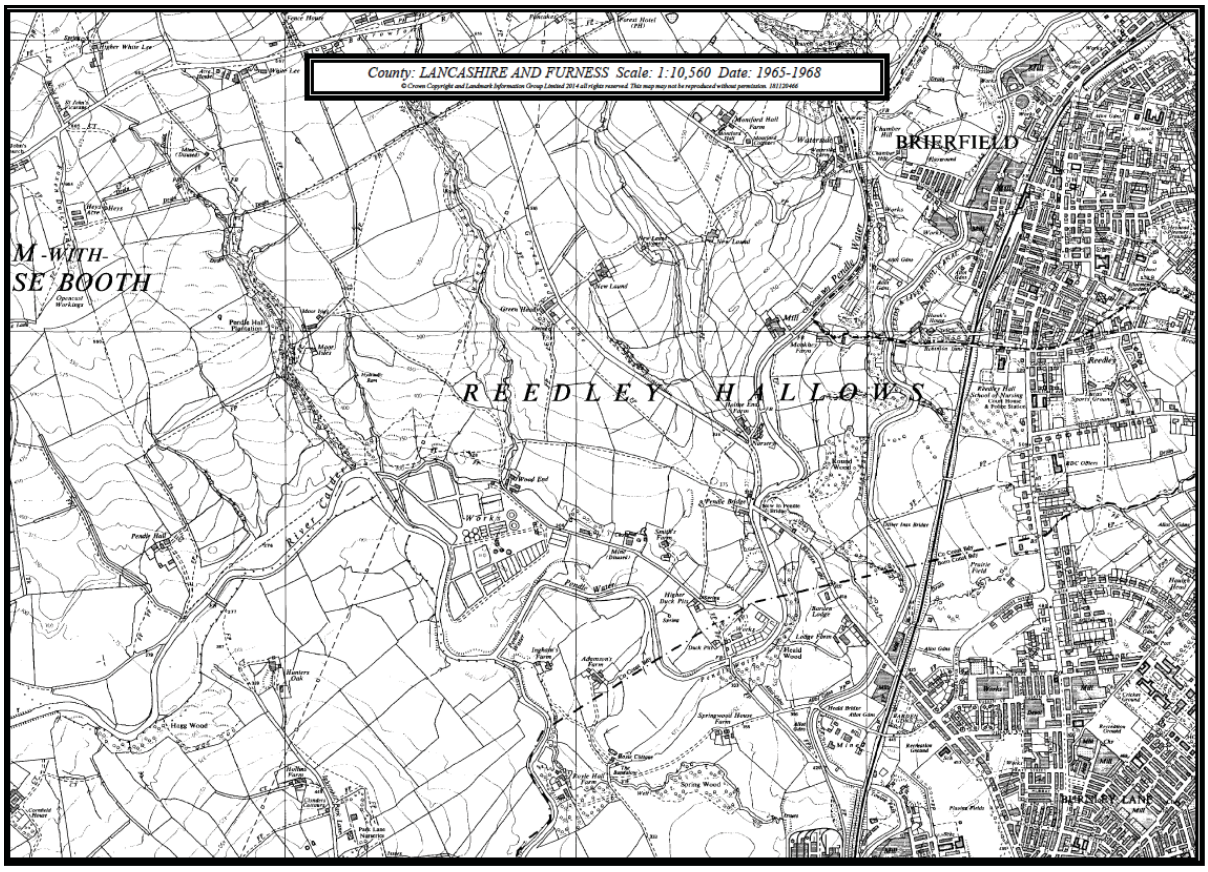
1932


R E E D L E
Wood End

1955


County: LANCASHIRE AND FURNESS Scale: 1:10,560 Date: 1955-1956
BRIERFIELD
Higham
WITH
BOOTH
REEDLEY HALLOWS
RIVER CALDER

1965-68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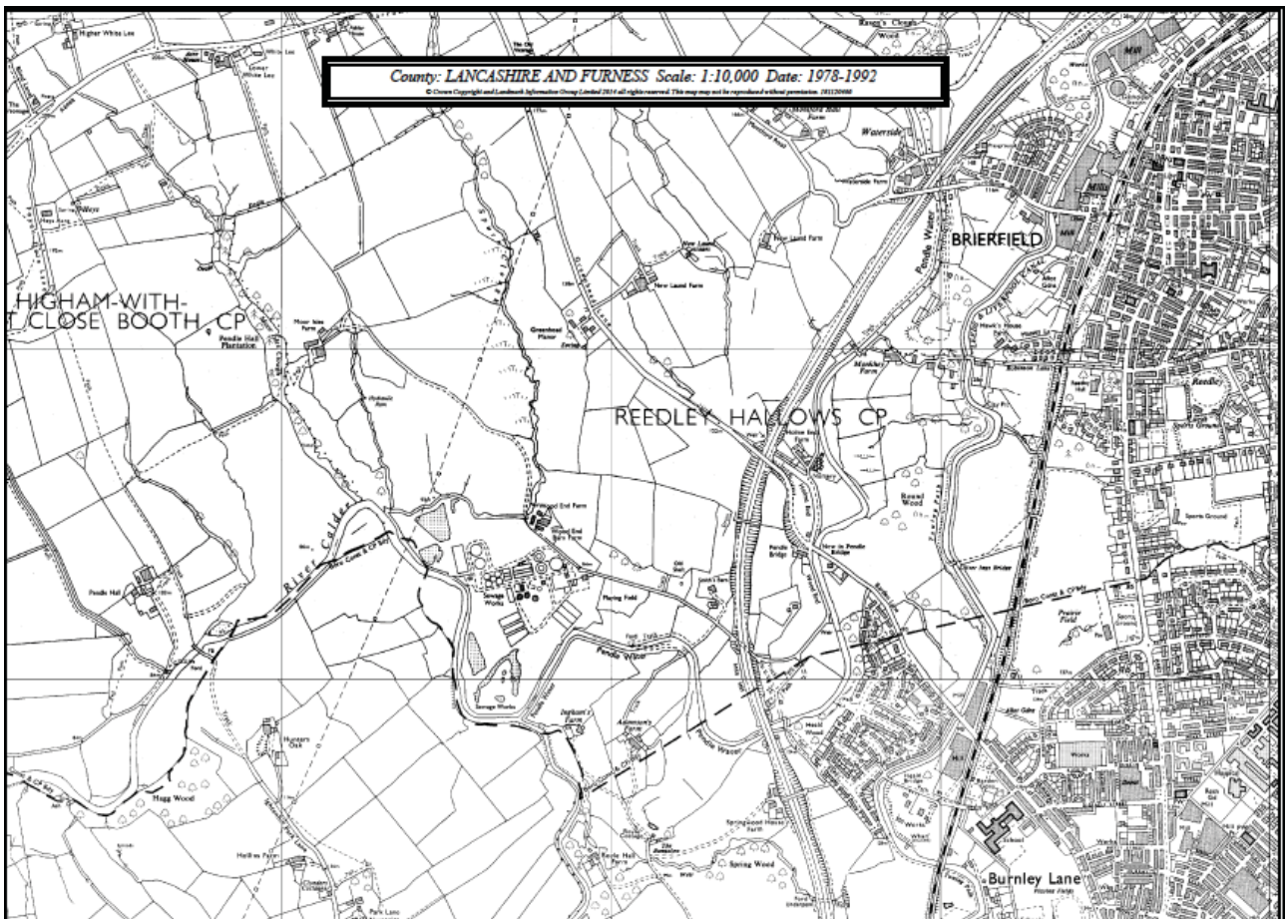
BRIERFIELD
-WITH-
BOOTH
REEDLEY HALLOWS
RIVER CALDER

1978-92


County: LANCASHIRE AND FURNESS Scale: 1:10,000 Date: 1978-1992
BRIERFIELD
REEDLEY HALLOWS CP
Burnley Lane

Appendix H

FLOOD RISK CONSULTANCY LIMITED

Level 2 Flood Risk Assessment (Scoping Study)

Proposed Extension to Lomeshaye Industrial Estate, Nelson

Report No: 2014-038-02 Revision C

Date: 11/08/2014

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Document Control

Document Title: Level 2 Flood Risk Assessment (Scoping Study)

Project Number: 2014-038

Revision	Date	Issued to	Comments
/	06/05/14	Pendle Borough Council	DRAFT
A	11/07/14	Pendle Borough Council Environment Agency	DRAFT
B	11/08/14	Pendle Borough Council	FINAL
C	11/08/14	Pendle Borough Council	FINAL –minor amendment

Contract

This report describes work commissioned by Pendle Borough Council following written instruction dated 31st March 2014. Donna Metcalf and Chris Vose of the Flood Risk Consultancy Limited carried out the work.

Disclaimer

This document has been prepared solely as a Flood Risk Assessment for Pendle Borough Council. The Flood Risk Consultancy Limited accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

Executive Summary

The proposed development forms a strategic employment site within Pendle Borough Council's Local Plan; and is located within land to the west of the existing Lomeshaye Industrial Estate in Nelson, covering a gross area of 28.4 Hectares. The site is shown to be largely positioned within Flood Zone 1; and partially located in Flood Zones 2 and 3 on the Environment Agency's Flood Map.

This Level 2 Flood Risk Assessment has been undertaken to ascertain the risk of flooding from all sources and provide recommendations for mitigating against such risk, as the project moves forwards through the planning process.

The primary sources of flood risk to the development are identified to be from the Pendle Water (fluvial), and an increase in surface water runoff resulting from the development.

The site is currently undeveloped and is used for agricultural purposes.

The land is divided into 2No distinct areas i.e. Area 1 (land north of Old Laund Clough and Pendle Water); and Area 2 (land west of Pendle Water and either side of Old Laund Clough).

Proposals for each area incorporate commercial and industrial development.

Following an appraisal of data provided by the Environment Agency for Pendle Water and its tributaries; and topographical ground level information available within the site, it is concluded that Area 1 within the development is predominantly located within Flood Zone 1; with Area 2 located largely within Flood Zones 2; 3a; and 3b.

Flood Zone 3b is designated as functional floodplain; and in accordance with the requirements of the National Planning Policy Framework, the only development types suitable for this flood zone include water compatible development and essential infrastructure.

It is further highlighted that any development and/or land raising undertaken within the existing flood extent for Zone 3a will result in the requirement for compensatory flood storage. This must be provided on a level-by-level basis as close to the development site as possible, and is required to prevent an increase in flood risk to neighbouring land or development, resulting from a loss of flood storage volume within the site as a result of the development.

Pendle Borough Council has provided a preliminary development layout. It is emphasised that plans do not represent the final development proposals, which may undergo alteration as the project progresses; however it is advised that careful consideration has been undertaken in regard to the placement of units and access roads particularly within Area 2, to ensure that the impact of flood risk to the businesses and people who will utilise the site is reduced to an acceptable level.

Careful design of the final layout will ensure the following:

- Finished floor levels for commercial/industrial units will be set a minimum of 150mm above external ground levels within Flood Zone 1.
- Finished floor levels for commercial/industrial units within Flood Zones 2 and 3 will be set:
    - A minimum of 600mm above the 1 in 100 year plus climate change flood level i.e. 105.54m – 106.07mAOD + 0.6 = 106.14m – 106.67mAOD; or

  - A minimum of 300mm above the 1 in 100 year plus climate change flood level i.e. 105.54m – 106.07mAOD + 0.3 = 105.84m – 106.37mAOD plus an additional 300mm flood resistance/resilience.
- No land raising will occur or building footprints will be placed within Flood Zone 3b (functional floodplain) in order to prevent the loss of flood storage; an increase in flood risk to others; and minimise the impedance of natural flood routes.
- Encroachment of the development into Flood Zone 3b (high risk) will be minimised as much as possible for the same reasons; and any land raising required to accommodate the development within the area will be compensated for on a level-by-level basis.
- Compensatory flood storage areas must be placed outside of the floodplain; and this will need to be demonstrated within detailed proposals for development at the site.
- The access road linking Development Areas 1 & 2 is shown to be located within Flood Zone 1 in order to provide dry access/egress at all times to people, including workers and visitors to the site.
- It is recommended that appropriate signage is provided at appropriate locations within Area 2, to warn workers and visitors with regard to the flood risk during periods of elevated water levels within Pendle Water.
- Minimum 8 metre easement is provided from the river bank to facilitate pollution prevention requirements and also inspection and maintenance of the watercourse; as required by the Environment Agency.
- Due to the proximity of the site to Pendle Water, it is recommended that businesses within Area 2 in particular, are advised to sign up to receive free flood alerts from the Environment Agency; and develop a flood evacuation plan in association with Pendle Council's Emergency Planning Team.

As previously mentioned the development layout has yet to be finalised, however using the latest plans indicates that following development the impermeable area within the site will be increased as follows:

- Area 1 – 7.60 Hectares (approximates to 30% of the total site area).
- Area 2 – 1.76 Hectares (approximates to 41% of the development area).

In accordance with the National Planning Policy Framework, surface water should be carefully managed so as not to increase runoff rates and volumes leaving the site in comparison to existing values; with additional runoff generated by the development attenuated on-site prior to discharge. Outflows from the proposed development directed to a receiving watercourse or sewer must be restricted using an orifice plate, Hydrobrake, or other flow control device.

Approved Document H of the current Building Regulations sets out a hierarchy for disposal of surface water from new development, as listed below in order of preference:

- Infiltration via soakaway or other infiltration device
- Watercourse
- Sewer

Investigations suggest that infiltration methods may be viable, however generic percolation rates for ground described as 'loamy' are likely to be poor; and as such for the purposes of this assessment the preliminary drainage strategy will utilise the disposal of surface water via partial infiltration with a restricted discharge into Pendle Water.

It is noted that full infiltration options indicate 'half drain down times' in excess of 24 hours as stipulated within BRE Digest 365; and as such the ground within the development area is considered unlikely to accept subsequent rainfall events occurring in quick succession.

In order to determine the overall suitability for infiltration devices, it is highly recommended that percolation testing is undertaken at strategic locations within the site.
An evaluation of SUDS indicates that source control methods such as permeable paving, green roof technology, bioretention systems or rainwater harvesting are suitable; along with swales; and online/offline attenuation in the form of large diameter pipes or storage tanks and infiltration systems; for inclusion with a drainage strategy for the proposed development.

Using the Source Control Module of MicroDrainage Windes, the 'worst case' estimated overall volume for each development area for the 1 in 100 year plus 20% climate change event, based on the above impermeable areas are 2560m^3 (Area 1); and 705m^3 (Area 2).

This equates to a 2560m^2 x 2.0m deep infiltration/retention basin within Area 1; which allows infiltration to ground and also permits a restricted discharge to Pendle Water. Due to limited space available within Area 2, it is considered unlikely that a basin structure will be utilised; with attenuation provided using permeable paving (where appropriate).

These structures are able to provide adequate volume to ensure that surface flooding during the 1 in 100 year plus climate change event is prevented from leaving the site or migrating unabated towards the watercourse.

It is noted that a single attenuation basin for large swathes of development are not encouraged; and it is preferable to utilised a range of SUDS measures throughout the site.

Furthermore, it is advised that the calculated volumes provided within the report are only estimates at this stage of the project, and it is highly recommended that the calculations are refined during the detailed design stage of the project.

The assessment highlights a surface water flow route through Area 2. The depth of flow is anticipated to be less than 300mm with flow velocity in excess of 025m/s. Whilst this is considered to present a low hazard to pedestrians, in order to minimise the impact to development within this area, it is advised that the flow route should be incorporated into any revised development plans for Area 2.

Secondary sources of flooding such as artificial water sources; surface water; groundwater; infrastructure failure; and overland flows have been investigated; and are deemed to present a low risk of flooding at the proposed development site.

Contents

Figures

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Appendices

1.0 Introduction

1.1 Terms of Reference

The Flood Risk Consultancy has been appointed by Pendle Borough Council to provide a Level 2 Strategic Flood Risk Assessment (SFRA) as part of the Core Strategy preparation; and to support a future outline planning application for commercial development forming an extension to Lomeshaye Business Park in Nelson, Lancashire.

This assessment has been undertaken in accordance with the National Planning Policy Framework (Communities and Local Government; March 2012) or NPPF, and the supporting Planning Practice Guidance for Flood Risk and Coastal Change (March 2014), available on the new Government Services Website i.e. www.gov.uk

The outline development plan covers an overall area approximating 28.4 Hectares and is divided into 2No distinct areas:

- Area 1 – 24.1Ha located to the north of Old Laund Clough and Pendle Water.
- Area 2 – 4.3Ha located west of Pendle Water and along the north and south banks of Laund Clough.

Area 1 within the application site is shown to lie wholly within Zone 1 (low risk) of the Environment Agency Flood Map.

Area 2 within the application site is located within Flood Zones 1 (low risk); 2 (medium risk); 3a (high risk); and 3b (functional floodplain) of the Environment Agency Flood Map.

The definition for each flood zone is provided in detail within Section 2.2.2 of this report.

Pendle Water is classified as 'Main River' and forms the site boundary along the south east part of the site.

Old Laund Clough is classified as 'Ordinary Watercourse' and is a tributary of Pendle Water.

The overall development plan is in excess of 1 Hectare and therefore in accordance with the National Planning Policy Framework (NPPF), sites in excess of 1 Hectare require a flood risk assessment undertaking in order to address surface water management issues which may result from the development.

1.2 Objectives

The objective of this Level 2 assessment is to evaluate the following issues in regard to flood risk at the application site i.e. the proposed extension to Lomeshaye Industrial Estate in Nelson, Lancashire:

- Suitability of the proposed development in accordance with current planning policy.
- Identify the risk to both the proposed development and people from all forms of flooding.
- Provide a preliminary assessment of foul and surface water management.
- Increasing the risk of flooding elsewhere i.e. surface water flows; flood routing; and loss of floodplain storage.
- Recommendation of appropriate measures to mitigate against flooding both within the proposed development, and neighbouring land and property.

1.3 Data Sources

This assessment is based on desk-top study of information from the following sources:

- National Planning Policy Framework (2012)
- Planning Practice Guidance at www.gov.uk (March 2014)
- Building Regulations Approved Document H
- Environment Agency Flood Mapping.
- Pendle Borough Council SFRA Report and Mapping (Entec 2006).
- Lancashire Areas Preliminary Flood Risk Assessment (PFRA) (May 2011).
- Areas Susceptible to Surface Water Flooding Map; Pendle
- Flood Estimation Handbook (FEH CD-ROM Version 3.0)
- British Geological Society – Historic Borehole Logs
- Cranfield University's Soilscape Viewer
- CIRIA C697 The SUDS Manual
- MicroDrainage Windes
- Chronology of British Hydrological Events (Dundee University)
- United Utilities Sewer Record Maps

2.0 Planning Policy Context

2.1 Approach to the Assessment

The project is currently at outline planning stage and consequently a detailed site specific flood risk assessment is required.

A Level 2 Scoping Study is designed to provide a qualitative appraisal of flood risk both within the application site and any potential impact that the development will have on flood risk elsewhere; and provide recommendations for mitigation measures which may be included within the design of the development to reduce the overall risk of flooding.

An initial assessment indicates that the primary flood risk at the proposed development is from fluvial sources and an increase in surface water following development due to an increase in impermeable area.

Consideration has also been given to the site flooding from secondary sources such as groundwater; artificial water bodies; infrastructure failure; overland flow and ponding.

2.2 National Planning Policy Framework (NPPF)

The requirements for undertaking a site specific flood risk assessments are generally as set out in Guidance Point 10 from the Planning Practice Guide – Flood Risk & Coastal Change (www.gov.uk).

The information provided in the flood risk assessment should be credible and fit for purpose.

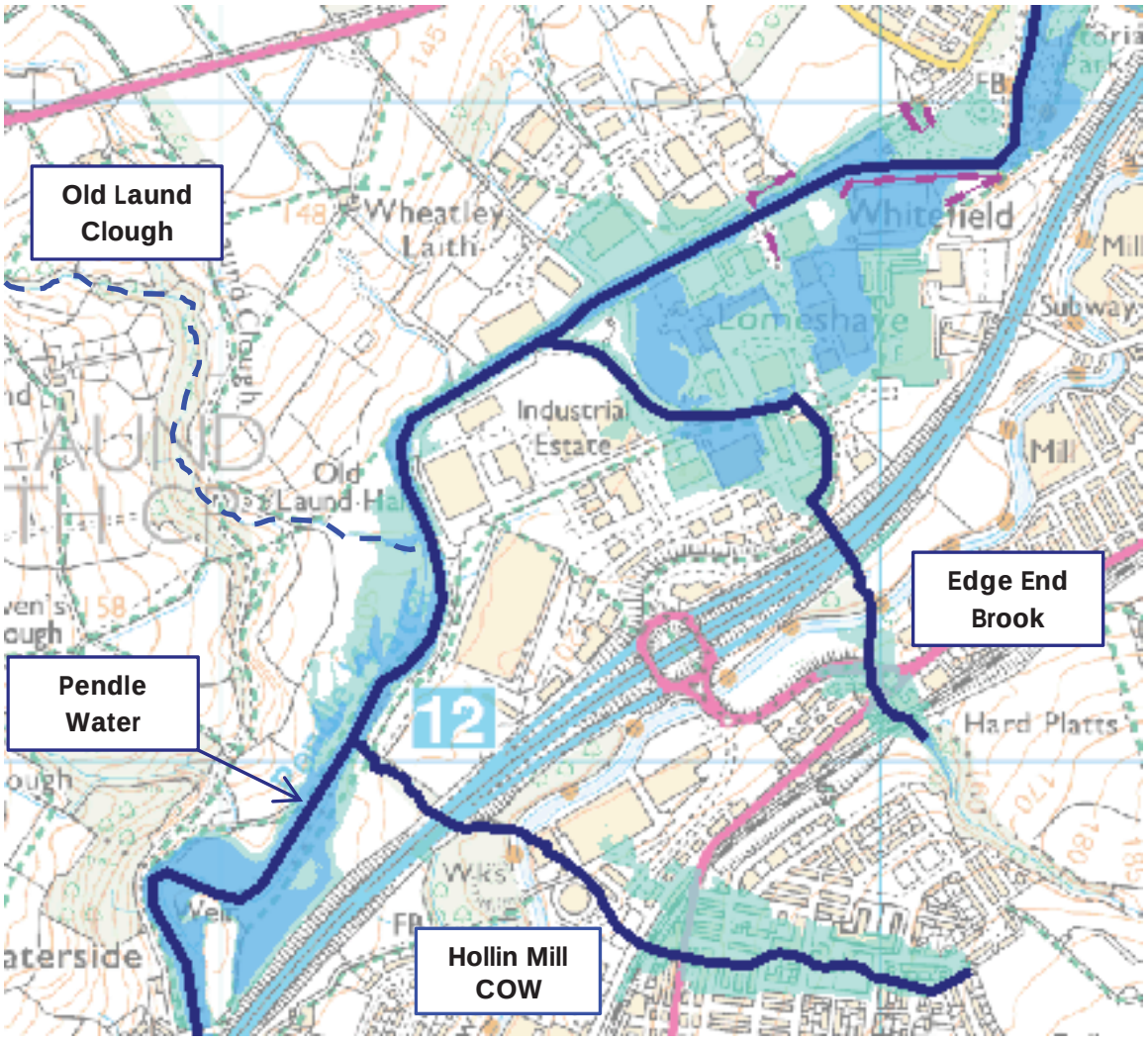
Site-specific flood risk assessments should always be proportionate to the degree of flood risk and make optimum use of information already available, including information in a Strategic Flood Risk Assessment for the area, and the interactive flood risk maps available on the Environment Agency's web-site.

A flood risk assessment should also be appropriate to the scale, nature and location of the development.

2.2.1 Sources of Flooding

- **Rivers (fluvial):** Flooding occurs when flow within river channels exceeds capacity; and the type of flood event experienced e.g. flash flooding; depends upon the characteristics of the river catchment.
- **The sea (tidal):** Flooding at low lying coastline and tidal estuaries is caused by storm surges and high tides; with overtopping and breach failure of sea defences possible during extreme storm events.
- **Pluvial (surface flooding or overland flows):** Heavy rainfall, which is unable to soak away via infiltration or enter drainage systems can flow overland, resulting in localised flooding. Topography generally influences the direction and depth of flooding caused by this mechanism.
- **Groundwater:** Caused when ground water levels rise to the surface; and is most likely to occur in low lying areas underlain by aquifers.
- **Sewers and drains:** Generally occurs in more urban areas; where sewers and drains are overwhelmed by heavy rainfall or blocked pipes and gullies.
- **Artificial Sources (reservoirs, canals, lakes and ponds):** Reservoir and canal flooding may occur as a result of capacity exceedance or structural failure.

Figure 2.1: Environment Agency Flood Map



Source: www.environment-agency.gov.uk

Key

- Flooding from rivers or sea without defences (Flood Zone 3)
- Extent of extreme flood (Flood Zone 2)
- Flood defences
- Areas benefiting from flood defences
- Main rivers
- COW Critical Ordinary Watercourse

2.2.2 Flood Zones

- **Flood Zone 1:** Low probability (less than 1 in 1,000 year (<0.1% AEP) annual probability of river or sea flooding in any year.

- **Flood Zone 2:** Medium probability (between 1 in 100 year (1.0% AEP) and 1 in 1,000 year (0.1% AEP) annual probability of river flooding; or between 1 in 200 year (0.2% AEP) and 1 in 1,000 year (0.1% AEP) annual probability of sea flooding in any year).
- **Flood Zone 3a:** High probability (1 in 100 year (1.0% AEP) or greater annual probability of river flooding in any year or 1 in 200 year (0.5% AEP) or greater annual probability of sea flooding in any year).
- **Flood Zone 3b:** This zone comprises land where water has to flow or be stored in times of flood. Land which would flood with an annual probability of 1 in 20 (5% AEP), or is designed to flood in an extreme flood (0.1%) should provide a starting point for discussions to identify functional floodplain.

2.2.3 Vulnerability of Different Development Types

- **Essential Infrastructure:** Transport infrastructure (railways and motorways etc…); utility infrastructure (primary sub-stations, water treatment facilities; power stations; and wind turbines)
- **Water Compatible Development:** Flood control infrastructure; water and sewage infrastructure; navigation facilities
- **Highly Vulnerable:** Emergency services; basement dwellings; mobile home parks; industrial or other facilities requiring hazardous substance consent.
- **More Vulnerable:** Hospitals; residential dwellings; educational facilities; landfill sites caravan and camping sites
- **Less Vulnerable:** Commercial premises; emergency services not required during a flood; agricultural land.

2.2.4 Sequential & Exceptions Test

The site is located within Flood Zones 1, 2 & 3 (see Figure 2.1).

Table 1: Flood Risk Vulnerability and Flood Zone 'Compatibility'[1]

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

✓ Development is appropriate
× Development should not be permitted

As set out in the National Planning Policy Framework, the aim of the Sequential Test is to steer new development to areas at the lowest probability of flooding.

[1] Extracted from Table 3 of the Technical Guidance to the National Planning Policy Framework Document (March 2012)

The Flood Zones are the starting point for the sequential approach.

The current outline development proposals indicate industrial and commercial development to the west side of the existing Lomeshaye Industrial Estate, within the Pendle area known as Nelson.

In simple terms, this type of development is classified as a 'less vulnerable' type of development in accordance with Table 2 'Flood Risk Vulnerability Classification' of the Technical Guidance to the National Planning Policy Framework.

The 'Less Vulnerable' development type is acceptable within Flood Zones 1, 2 and 3a; however placement within Flood Zones 2 & 3 will require the undertaking of a Sequential Test.

The following statement in regard to the application of the Sequential and Exceptions Tests has been extracted from guidance notes available from www.gov.uk.

The aim of the Sequential Test is to steer new development to Flood Zone 1 (areas with a low probability of river or sea flooding).

Where there are no reasonably available sites in Flood Zone 1, local planning authorities in their decision making should take into account the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2 (areas with a medium probability of river or sea flooding), applying the Exception Test if required.

Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in Flood Zone 3 (areas with a high probability of river or sea flooding) be considered, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required.

The Sequential Test Process involves the undertaking of an assessment to compare the application site with other potential alternative sites identified within the Local Development Plan.

A Sequential Test has been undertaken for this development and is presented within document reference 2014-038.

2.2.5 Climate Change

The NPPF requires the application of climate change over the lifetime of a development as tabulated below:

Table 2: Climate Change Allowances[2]

Parameter	1990 - 2025	2025 - 2055	2055 - 2085	2085 - 2115
Peak Rainfall Intensity	+5%	+ 10%	**+ 20%**	+ 30%
Peak River Flow	+10%	+ 20%		
Offshore Wind Speed	+ 5%		+ 10%	
Extreme Wave Height	+ 5%		+ 10%	

[2] Extracted from Table 5 of the Technical Guidance to the National Planning Policy Framework Document (March 2012)

Design Lifetime:

Commercial development – 60 years

2.2.6 Sustainable Urban Drainage Systems (SUDS)

The key planning objectives in the NPPF are to appraise, manage and where possible, reduce flood risk.

Sustainable Urban Drainage Systems (SUDS) are designed to reduce the potential impact of new and existing developments with respect to surface water drainage discharges, thereby providing a suitable way of achieving some of these objectives.

Furthermore the NPPF and Building Regulations Approved Document Part H direct developers towards the use of SUDS wherever possible.

The Floods and Water Management Act 2010 also reinforces the requirements for SUDS to be implemented where practicable.

Once fully implemented the FWMA 2010 will require adoption by the SUDS Approval Body (SAB). This body will be an organisation within County Councils and Unitary Authorities specifically established to deal with the design, approval and adoption of sustainable urban drainage systems (SUDS) within any new development consisting of two or more properties.

The latest information indicates that the SUDS Approval Bodies will become operational in April 2015 at the earliest.

Part H of the Building Regulations requires that surface water should be discharged from new development in accordance with the following hierarchy in order of preference:

- By infiltration to the ground via soakaway or other infiltration device
- To a watercourse
- To a public sewer.

2.2.7 Local Planning Policy

Work is currently underway to produce a Core Strategy for development within the Borough moving forward; and it is proposed that the site at Lomeshaye will form a strategic site for employment development.

The following policies and guidance relating to flood risk have been considered within this Scoping Study:

Environment – Policy 6 – Development and Flood Risk

Policy 6.1:

Development will not be permitted where it would:

Be at risk of flooding and no appropriate flood alleviation measures exist or will be provided by the developer.

Increase the risk of flooding elsewhere by reducing the capacity of the floodplain, installing a culvert, or increasing the flow of water into the floodplain.

Harm existing flood defences or have an impact on proposed flood defence schemes.
Restrict adequate access to the river and existing flood defences for routine maintenance or improvement.

Policy 6.2:

Appropriate flood alleviation measures may include the use of Sustainable Urban Drainage Systems (SUDS). However any measure would have to first be approved by the Council and the Environment Agency.

Policy 6.3:

Proposals for development within areas liable to flood8 must be accompanied by an appropriate Flood Risk Assessment where the development is perceived to be at risk of flooding or the development is likely to increase the risk of flooding elsewhere.

Environment – Policy 7 – Water Resource Protection

Policy 7.1:

Development proposals that have an adverse impact on the Borough's groundwater resources with regard to quantity and quality will not be permitted.

Policy 7.2:

Proposals that will detrimentally affect the Borough's surface water bodies and courses will not be granted, unless there are overriding economic or social benefits and the developer introduces mitigation measures to avoid, or sufficiently minimise damage.

Policy 7.3:

Development proposals that include the construction of new culverts will only be permitted if the culvert is essential for either access purposes or reasons of public safety.

Environment – Policy 8 – Contamination and Pollution

Policy 8.1:

Proposals for industrial development or those developments where odours, noise, or vibration are likely, should be accompanied by a statement illustrating the levels of potential pollution and any remedial action to be undertaken. A statement will be required for applications involving outdoor lighting. Development will be permitted where:

There is likely to be no harmful pollution or contamination, or
Any proposed remedial action is sufficient to reduce the risk of pollution, and
The application does not involve the storage of hazardous substances where such storage would pose a potential risk to nearby residents or visitors.

Policy 8.2:

In addition planning permission will only be granted where the Council are satisfied that the proposed development would not:

Expose the occupiers of the development and neighbouring land uses to unacceptable risk.
Threaten the structural integrity of any existing or proposed building on or adjoining the site.

Lead to the contamination of any watercourse, water body, or groundwater

Cause the contamination of adjoining land or allow such contamination to continue.

Policy 8.3:

Developers proposing to develop any brownfield site or land within 250 metres of a landfill site must conduct an investigation and assessment to identify the types, nature and extent of any contamination, including the potential risk from migrating landfill gas, potentially affecting the application site and environs. A comprehensive remediation scheme should be included with the application where appropriate. Only where the Council's Environmental Health Department and associated pollution control authorities are satisfied that the risk from pollution is adequately controlled will permission be granted.

3.0 Details of the Site

3.1 Site Details

Table 3: Development Location

Site Name:	Land West of Lomeshaye Industrial Estate
Purpose of Development:	Industrial/Commercial
Existing Land Use:	Undeveloped Land/Agricultural
OS NGR:	SD 842 372
Country:	England
County:	Lancashire
Local Planning Authority:	Pendle Borough Council
Internal Drainage Board:	Not Applicable
Other Authority (e.g. British Waterways/ Harbour Authority)	Not Applicable

Location Plan:

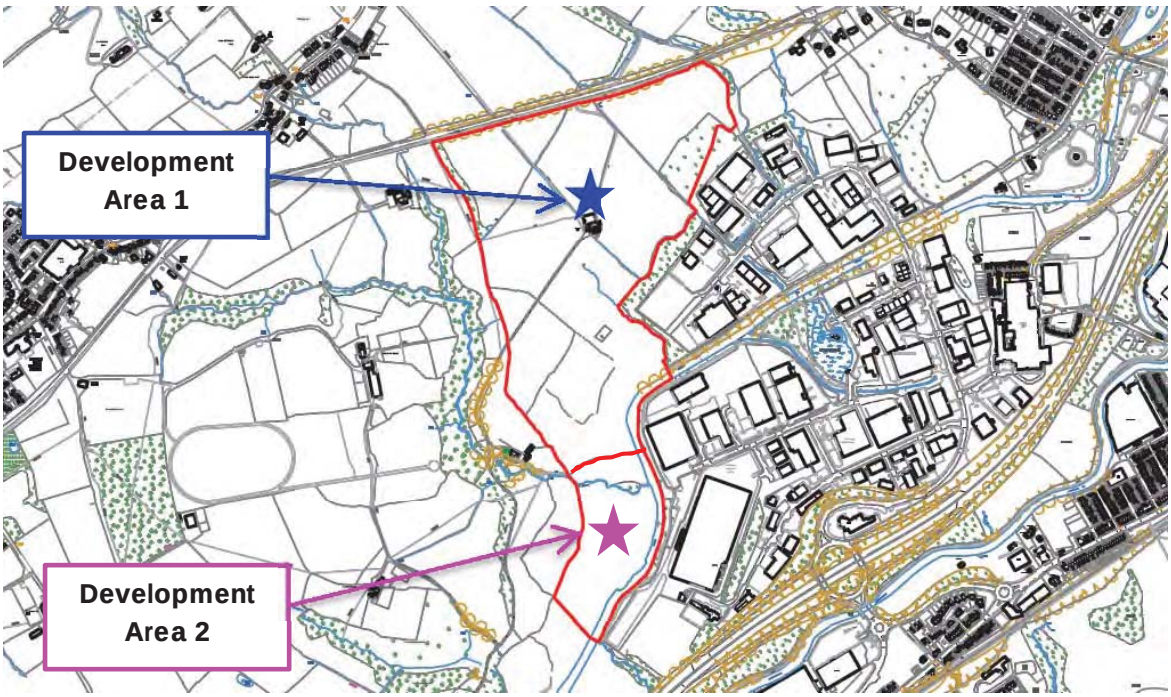


Image produced from the Ordnance Survey Get-a-map service.
Image reproduced with kind permission of Ordnance Survey and Ordnance Survey of Northern Ireland.

3.2 Site Description

The application site covers a gross area approximating 28.4 Hectares and is located within the Nelson area Rudheath area of Northwich.

It is understood that the site is currently used for agricultural purposes and is divided into 2No distinct areas:

- Area 1 – 24.1Ha located to the north of Old Laund Clough and Pendle Water.
- Area 2 – 4.3Ha located west of Pendle Water and along the north and south banks of Old Laund Clough.

The parcels of land are undeveloped and are currently used for agricultural purposes.

Vehicular access into each part of the site is currently available from Barrowford Road along the north boundary; and Clitheroe Road from the south.

Pendle Water, a 'Main River' and tributary of the River Calder forms the south west boundary of the development site

A small tributary of Pendle Water, known as Old Laund Clough, traverses through the north part of Development Area 2.

A topographical survey calibrated using GPS provides the following data:

Table 4: Relevant Site Levels & Description

Location	Ground Level (mAOD)
Area 1: Land North of Old Laund Clough & Pendle Water	
North Boundary	158.0 – 142.0
South West Boundary	110.0 – 106.4
South East Boundary	106.4 – 108.0
West Boundary	158.0 – 110.0
East Boundary	142.0 – 108.0
Description: Irregular in shape, ground within this development area generally slopes in a south easterly direction towards Pendle Water. Site is bounded to the north by the A6068 Barrowford Road, with agricultural land and the upper reach of Old Laund Clough situated to the immediate west; with the east boundary formed by agricultural land and residential development forming the western fringe of Barrowford. Development area 2 forms the south boundary of the development area.	
Area 2: Land West of Pendle Water	
North West Boundary	110.0 – 106.4
North East Boundary	106.4 – 108.0
South Boundary	106.0 – 104.0
West Boundary	110.0 – 106.0
East Boundary	106.4 – 106.0
Description: Roughly rectangular in shape, ground to the north side of Old Laund Clough generally slopes in a south easterly direction towards the watercourses; whilst land to the south of Old Laund Clough slopes eastwards slightly towards Pendle Water. The site is bounded to the north by Development Area 1; to the west by existing agricultural land (including Old Laund Hall and Raven's Clough Farms). The south boundary is bounded by undeveloped land and Raven's Clough Wood; with the east boundary formed by Pendle Water; with the existing development contained within Lomeshaye Industrial estate located between the east bank of the watercourse and the M65 motorway.	

3.3 Development Proposals

It is highlighted that the development plans associated with the outline planning submission are not yet finalised however for the purposes of this assessment, proposals involve the following:

- **Area 1:**
  - New access via roundabout from Barrowford Road along the north boundary.
  - Main access road leading through from Barrowford Road and providing a link to existing commercial development along Churchill Road.
  - Secondary access roads to the east within the north part of the site to service the new commercial development.

  - Secondary access road leading southwards to service new development within Development Area 2.
  - Approximately 18No units of varying sizes and orientation, with associated parking, service yards and other areas of hardstanding.

- **Area 2:**
  - Access provided by spur road labelled as the 'South Extension Road' from main development access road within Development Area 1.
  - Approximately 10No units of varying sizes and orientation, with associated parking, service yards and other areas of hardstanding.

The current development layout options are provided for reference within Appendix B of this report.

4.0 Historic Flooding

4.1 Lancashire PFRA

Table 4.1 from the Preliminary Flood Risk Assessment (PFRA) undertaken for the Lancashire Area in 2011, entitled 'Summary of Locally Significant Historic Floods in Lancashire', indicates only a single incident of historic flooding within the Pendle Area as follows:

- 20th August 2004 – Gibfield Road, Colne – Surface Water Runoff

4.2 Pendle SFRA

A Strategic Flood Risk Assessment (SFRA) for Pendle Borough Council was published by Entec in 2006. Table 5.1 within Section 5.2 of the report provides detailed information regarding incidents of historical flooding within the Borough.

Historical flooding specifically listed within the Lomeshaye area is provided below for reference:

- February 1920 – Lomeshaye area badly flooded
- January 1992 – Flooding of Lomeshaye Industrial Estate
- December 2001 – Pendle Water overtopped defences just upstream of Lomeshaye (23No residences and 7No industrial premises were inundated by up to 0.75m water.

Section 5.3 of the SFRA report indicates that the primary source of flood risk within the Pendle area is from fluvial sources; and is largely caused as a result of encroachment of the floodplain over time by Victorian mills and factories particularly within the Colne and Trawden areas; residential development within Barrowford; and new commercial and industrial development such as factories and warehouses within Lomeshaye.

The report concludes that the development mentioned above has constricted Colne and Pendle Waters as they flow through the Pendle area; with significant development located within the natural floodplain.

Figure 4.1 overleaf, extracted from the SFRA document indicates that historic flooding within the Lomeshaye Industrial Estate was concentrated within the area along the south/south east bank of Pendle Water.

4.3 Internet Search

Lomeshaye Industrial Estate is considered to have a high risk from fluvial flooding and is specifically identified within Pendle Council's Local Civil Emergency Plan.

A major flood defence scheme was constructed in 2006, to help alleviate flood risk to homes and businesses along the route of Pendle Water, however it is noted that a risk of overtopping or breaching of the constructed defences still remains.

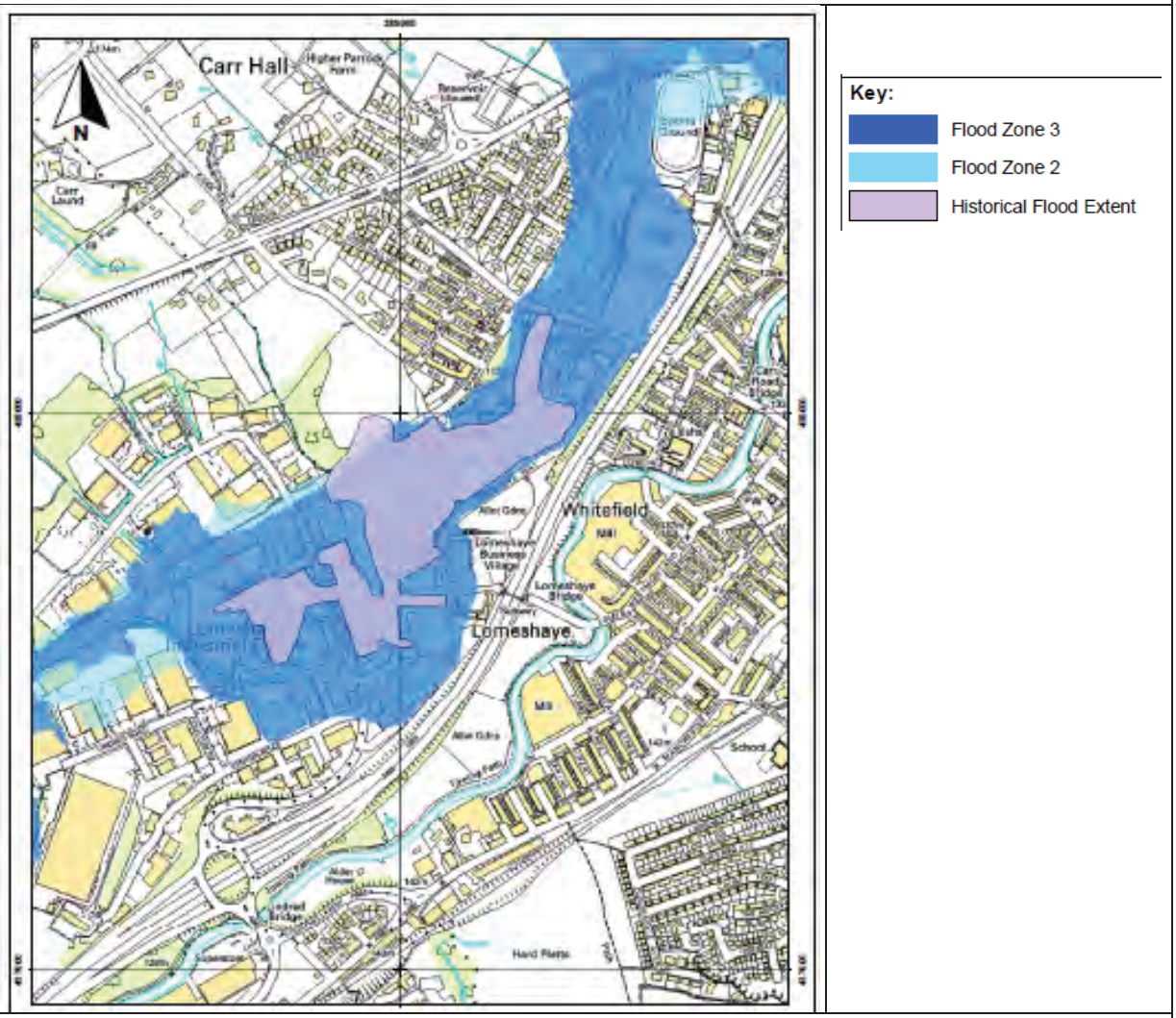
No specific reports of historic flooding within the Industrial Estate following the completion of this work was been identified during the search.

4.4 Chronology of British Hydrological Events[3]

Undertaking a search on the Chronology of British Hydrological Events database provides details of 3No incidents of significant historical flooding within the Lomeshaye area, as follows:

- Lomeshaye, Barrowford, Lancashire: "The flood marks at Lomeshaye are:- November 16th 1866; February 10th 1920; September 15th 1877. These heights are dependent on the combined floods from Pendle Water and Colne Water"

Figure 4.1: SFRA Map Historical Flooding at Lomeshaye Industrial Estate (1992 Flood Event)



Source: Pendle SFRA (Entec 2006)

[3] http://134.36.96.5/FMPro?-db=Hydrochronology.FP3&-lay=Layout%20%232&-format=search.htm&-view

5.0 Initial Evaluation of Flood Risk

5.1 The Environment Agency Flood Map

The Environment Agency Flood Map illustrated within Figure 2.1, confirms the following:

- **Area 1** – Wholly within Flood Zone 1 (low risk).
- **Area 2** – Predominantly within Flood Zones 2 (medium risk); 3a (high risk); and 3b (functional floodplain).

The definition for each of the flood zones highlighted above is provided for reference within Section 2.2.2 of this report.

5.2 Sources of Flooding

Table 5: Possible Flooding Mechanisms

Source/Pathway	Significant?	Comment/Reason
Fluvial (river)	Yes	Pendle Water; Old Laund Clough
Tidal (river/sea)	No	River Ribble at Fishwick Bottoms – approximately 31 kilometres south west of Lomeshaye Industrial Estate.
Pluvial (surface water)	Yes	Increased surface water runoff from proposed development works.
Overland Flows	No	Local topography is typical of the Pennines, with a peak reaching 281mAOD at Higher Town to the north west of Fence.
Ponding	No	Existing ponds – no ponds identified within the red-line development boundary associated with the outline planning application.
Artificial Water Sources i.e. canals, lakes and reservoirs	No	Lower Foulridge (Canal & Rivers Trust) Upper Foulridge (Canal & Rivers Trust) Ogden Upper (United Utilities) Ogden Lower (United Utilities) Coldwell Upper (United Utilities) Reservoir flooding is extremely unlikely to happen. There has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs must be inspected and supervised by reservoir panel engineers. As the enforcement authority for the Reservoirs Act 1975 in England, the EA ensure that reservoirs are inspected regularly and essential safety work is carried out.
	No	Leeds Liverpool Canal is situated approx. 300m south east of the application site; and is not elevated above natural ground levels at this location. Flood risk highlighted within the SFRA at locations where watercourses pass under the Canal.
	No	No lakes or significant bodies of open water identified within the red-line boundary.
Groundwater	No	No recorded major occurrences of groundwater flooding within the local vicinity.

Table 5: Possible Flooding Mechanisms

Source/Pathway	Significant?	Comment/Reason
Mechanical, Structural or Operational Failure	Yes	Road bridge across Pendle Water at Churchill Way upstream of the proposed site for commercial extension; and 3No road bridges in close succession downstream of Development Area 2 i.e. Montford Road; M65 Motorway; and Clitheroe Road.

From the initial assessment it is concluded that the primary source of flood risk is from fluvial and pluvial sources, i.e. river flooding and an increase in surface water runoff resulting from development within the red-line boundary area.

Fluvial: Pendle Water

Pendle Water is a tributary of the River Calder within the Ribble Catchment area and is designated as 'Main River'.

The watercourse is located immediately adjacent to a small part of the south boundary associated with Development Area 1; and forms the east boundary for Development Area 2.

The watercourse is formed on the steep eastern slopes of Pendle Hill, above Barley and flows initially southeast, and then southwest after its confluence with Colne Water.

The upper catchment within Pendle is comprised of grit, shale and limestone, with coal measures and limestone in the valley floors. Cover of hill peat on Pendle Hill, with a boulder clay drift covering the lower catchment.

The catchment area serving Pendle Water responds rapidly to rainfall events; and encompasses the reservoirs named Black Moss and Ogden.

The Environment Agency Flood Map does not indicate the presence of formal protection in the form of flood walls or embankments along the route of the watercourse; however it is appears that the existing development within Lomeshaye Industrial Estate is has been elevated to a level above the natural river bank associated with the watercourse. As such the mechanism of overtopping of the natural river bank needs to be investigated in greater detail; along with the potential impact in the event of blockage or structural collapse of bridges and culverts along the route of the watercourse within the vicinity of the site.

The Environment Agency has modelled flood levels for the watercourse which will be reviewed and compared to existing ground levels within the site in detail within Sections 6.2.2 and 6.2.3 of this report.

Fluvial: Old Laund Clough

The watercourse is a tributary of Pendle Water and appears to rise near to Lower Spen Farm north of Noggarth Road. Old Laund Clough flows generally in a south easterly direction; and joins with another stream to the north east side of Higher Old Laund. The channel continues to flow south / south east, along the south side of the farmhouse associated with Old Laund Hall Farm, where it flows east and into Pendle Water near to Lindred Road.

Old Laund Clough is classified as 'Ordinary Watercourse' and as such is riparian owned.

The channel associated with the watercourse has a steep longitudinal gradient; and is also characterised by a steep valley type channel. This suggests that elevated water levels within

the watercourse are likely to be retained close to the route of Old Laund Clough, with little flooding beyond the natural banks of the watercourse.

The Environment Agency maps indicate that there is some flooding anticipated around the confluence with Pendle Water; and it is noted that this would be expected to occur predominantly where the watercourse flattens out within the valley floor area associated with Pendle Water.

As such it can be surmised that there is some flood risk to Development Area 2, immediately adjacent to the watercourse; however the impact of flooding within the site caused by Pendle Water is considered to form the dominant flood risk to any development situated within this area.

As such further assessment of this watercourse is not considered to be necessary.

Fluvial: Blocked or Insufficient Capacity – Culverted Watercourses

Where watercourses have been culverted there can be a potential for blockage or insufficient capacity to accept flood flows. Flooding is likely to back up the culvert, causing flow to overtop open sections of channel upstream, causing flooding.

Collapsed culverts, fallen trees or other debris are common causes of blockage within culverted watercourses. It is also highlighted that poorly designed trash screens at culvert entrances can also impact by exacerbating the risk of flooding; through the accumulation of trapped debris on the screen structure.

The SFRA indicates that the areas within Pendle which are most likely to be affected by this flood source include Earby, Barnoldswick, and beneath Walverden Water Reservoir in Newbridge.

Pluvial: Increase in Surface Water Runoff

The existing site is currently undeveloped; and therefore following completion of development, the increase in roof and paved areas within each area of the site will be significantly increased; subsequently increasing surface water runoff rates and volumes emanating from the site.

As such further assessment of existing and proposed surface water runoff and a detailed evaluation of suitable measures to manage surface water runoff rates and volumes leaving the site will be undertaken within Section 6.4 of the assessment document.

Pluvial: Sewer Flooding

Sewers pose a potential flood risk to development via a number of mechanisms as follows:

- Exceedance of capacity within the sewer network.
- Backflow from outfalls when water levels are high within the receiving watercourse.
- Blockages
- Increased loading by new development

DG5 sewer flooding records obtained from United utilities and Yorkshire Water are provided within Appendix C of the SFRA document.

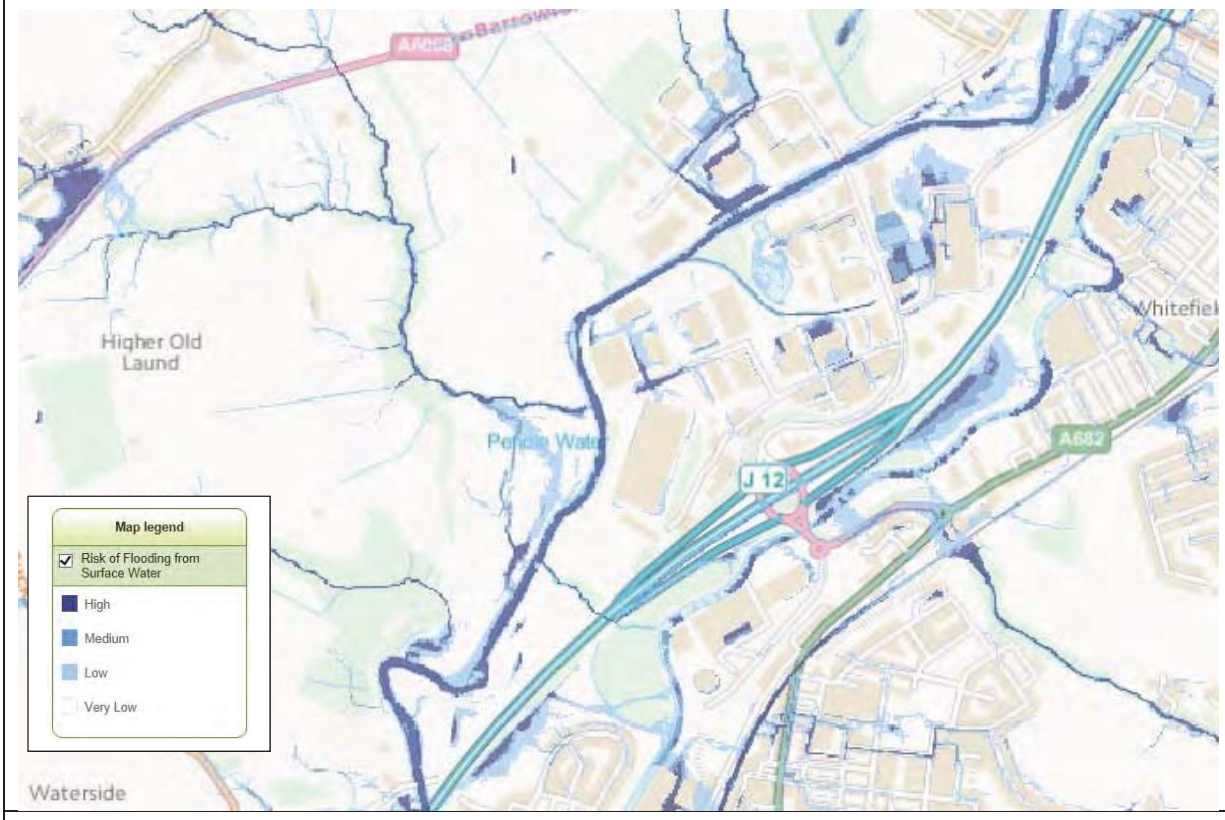
The data indicates that both internal and external flooding has occurred previously within the area comprising the Lomeshaye Industrial Estate.

Pluvial: Surface Water Flooding

Undertaking a review of the Environment Agency's Risk of Flooding from Surface Water, indicates that in general there is a negligible risk from this source; with the exception of the area to the south side of Old Laund Clough, where the risk from surface water runoff is increased.

Additional mapping indicates that whilst the depth of flooding within the flood route is shallow i.e. less than 300mm, the velocity of flow is fairly significant at more than 0.25m/s.

Figure 5.1: Environment Agency Map – Risk of Flooding from Surface Water (Extent)



Source: www.environment-agency.gov.uk

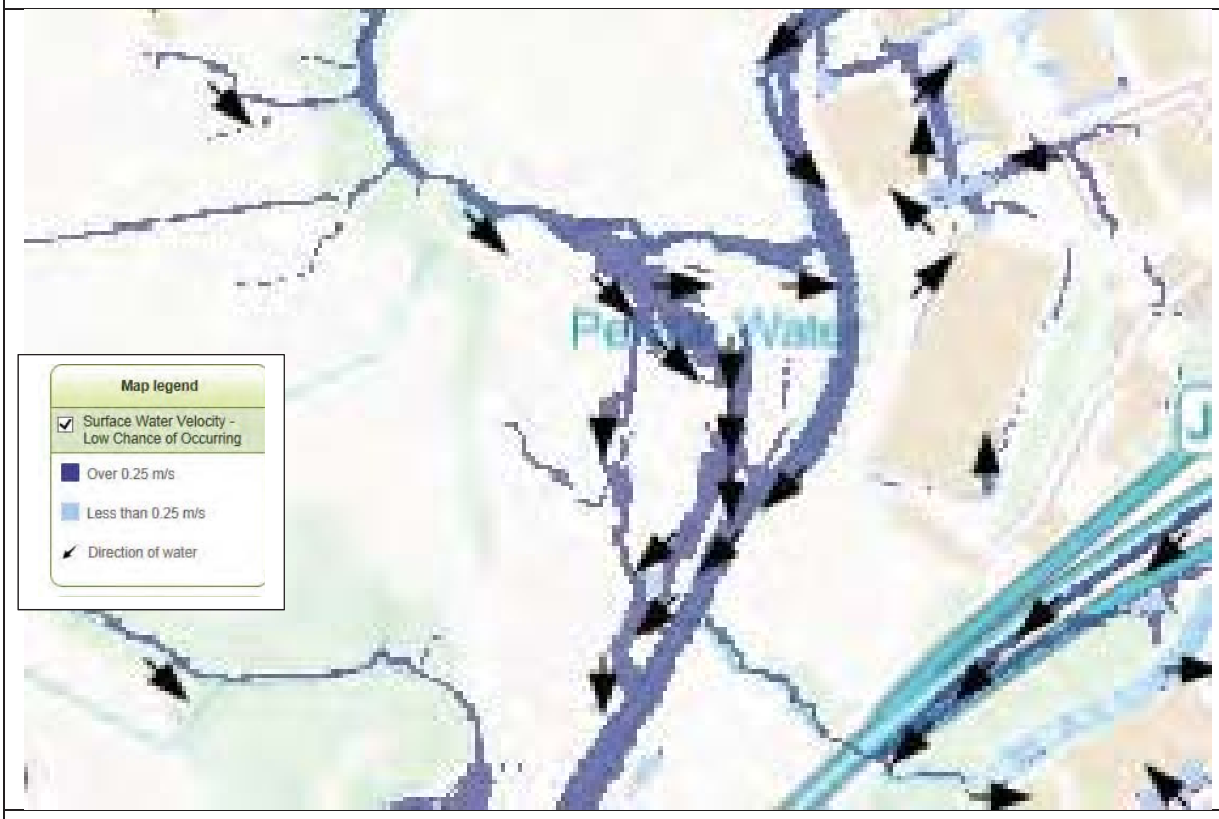
Appendix D from the SFRA provides a table of surface water 'hot spots' within Pendle Borough.

The table does not indicate the location of such a 'hot spot' for properties within the Lomeshaye Industrial Estate area.

Figure 5.2: Environment Agency Map – Risk of Flooding from Surface Water (Flood Depth)

Source: www.environment-agency.gov.uk

Figure 5.3: Environment Agency Map – Risk of Flooding from Surface Water (Flow Velocity)



Source: www.environment-agency.gov.uk

Pluvial: Exceedance and Local System Failure

The following text has been extracted from CIRIA 2906 'Managing Extreme Events by Designing for Exceedance January 2013':

'*Climate change and urbanisation is already contributing to increased surface water flooding, where the capacity of the existing drainage systems are overwhelmed (or exceeded).*

The traditional approach to fixing the problem is to build bigger pipes or provide underground storage. Ofwat, the Environment Agency and others believe that this approach is unsustainable and unaffordable and are encouraging sewerage undertakers, Lead Local Flood Authorities and highway authorities to look at different approaches to managing sewer and surface water flooding.

One approach being promoted is "designing for exceedance".

Designing for exceedance is an approach to manage flood risk (particularly from extreme events) by planning, designing and retrofitting drainage schemes that can safely accommodate rainfall and flooding that exceeds their design capacity (normally a 1 in 30 rainfall event). This is often achieved by considering flood pathways (such as managing runoff on highways) or providing additional storage (preferably on the surface through car parks, or multifunctional detention basins).

In England and Wales Sewers for Adoption and the National Planning Policy Framework encourage the consideration of drainage exceedance, it is a flexible approach to manage extreme events that can be used to reduce the need for more traditional, expensive underground approaches to manage surface water and often complement sustainable drainage and other local urban design initiatives.'

The impact of extreme rainfall events and/or local system failure will therefore need to be assessed as part of the overall surface water management strategy for the proposed development.

Groundwater

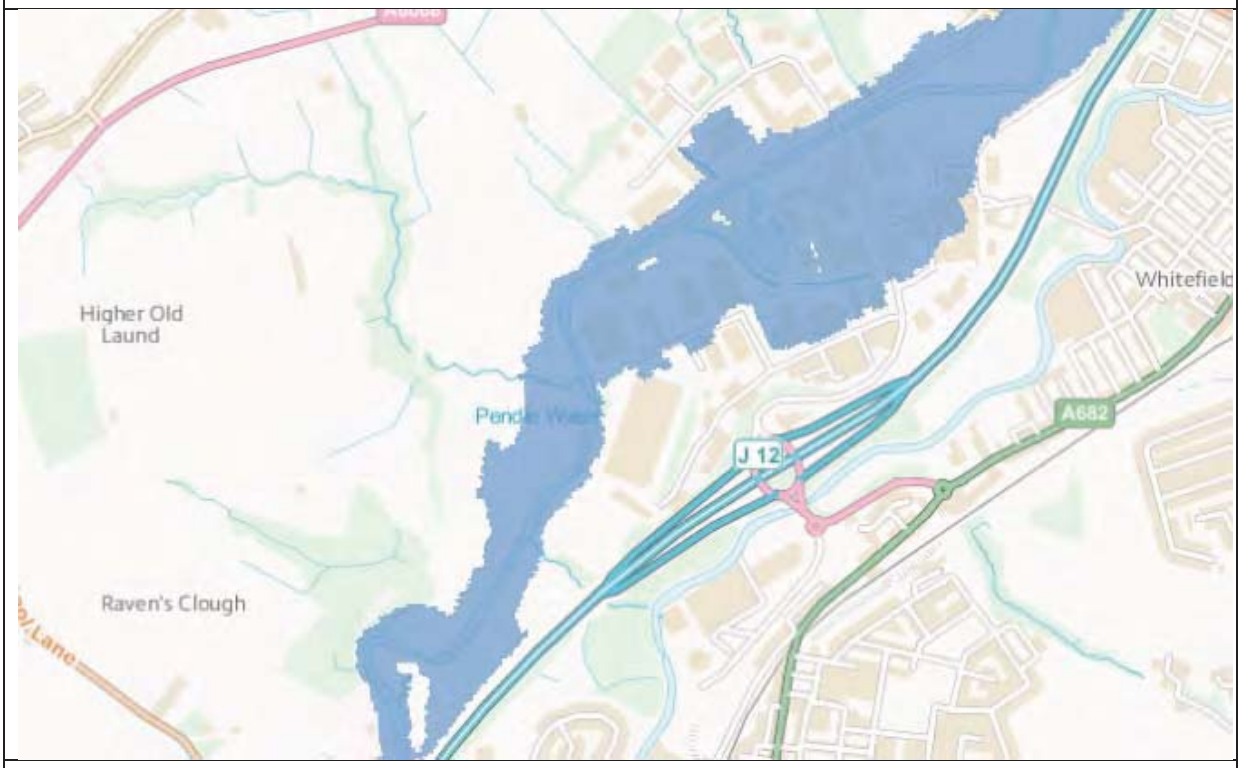
The Pendle SFRA states:

'No incidents specifically attributed to groundwater flooding have been identified within Pendle Borough to date. In June 2000, cellar flooding occurred in Newbridge, Barrowford; however this appears to due to surface water flooding entering cellars rather than groundwater. Despite this there is a minor risk that should be considered hen planning new development, particularly in areas where there are existing springs or the potential for new springs to emerge as a result of excess rainfall and elevated groundwater levels.'

It is considered that the risk of flooding at the application site, from this mechanism is likely to be low.

Artificial Watercourses: Reservoirs

Figure 5.4: Environment Agency Maps – Flooding from Reservoirs



Source: www.environment-agency.gov.uk

A number of reservoirs are located upstream of the proposed development at Lomeshaye Industrial Estate (see Table 5)

The Environment Agency Reservoir Flood Map illustrated above, illustrates the largest area that might be flooded if the storage area were to fail and release the water it is designed to hold during a flood event.

Reservoir flooding is extremely unlikely to happen. There has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs must be inspected and supervised by reservoir panel engineers. As the enforcement authority for the Reservoirs Act 1975 in England, we ensure that reservoirs are inspected regularly and essential safety work is carried out.

Inspection and maintenance of the reservoir structures is carried out on a regular basis by the respective operators and consequently the probability of flooding the site is considered to be low.

Artificial Watercourses: Leeds Liverpool Canal

The Leeds Liverpool Canal is maintained and operated by the Canal and Rivers Trust, and is located at a distance approximating 300 metres east of the outline application site.

The mechanism for flooding from canal structures is as follows:

- Culverting of watercourses under the canal
- Obstruction to overland flow routes or floodplain flow

- Operational issues leading to flooding from canal
- Embankment or breach failure

The Canal in is not elevated above natural ground levels within the Lomeshaye area and as such breach failure along this stretch of the waterway is considered to be low.

The primary flood risk associated with the canal within the Pendle Borough is identified to be at locations where watercourses are directed under the canal structure.

The area known as Foulridge at the location of the Foulridge Tunnel is one such area which has been identified as having a risk of flooding from the canal via the transfer of flood water from Wanless Water (fluvial source) to the canal.

Furthermore a historic instance of flooding from the Leeds Liverpool Canal was recorded at Salterforth in 2002 due to an operational issue relating to a sluice flow control.

The canal is located to the east side of the M65 Motorway and as such the highway presents a physical barrier to flooding which may occur near to the application site.

As such the flood risk attributed to the Leeds Liverpool Canal is considered to be low.

6.0 Quantitative Flood Risk Assessment

6.1 National Planning Policy Framework

6.1.1 Site Specific Flood Risk Assessment Checklist

The following checklist has been extracted from Flood Risk & Coastal Change Section available from www.gov.uk , published in March 2014.

1. Development Description and Location

a. What type of development is proposed (e.g., new development, an extension to existing development, a change of use etc.) and where will it be located?
b. What is its flood risk vulnerability classification?
c. Is the proposed development consistent with the Local Plan for the area? (Seek advice from the local planning authority if you are unsure about this).
d. What evidence can be provided that the Sequential Test and where necessary the Exception Test has/have been applied in the selection of this site for this development type?
e. Will your proposal increase overall the number of occupants and/or users of the building/land, or the nature or times of occupation or use, such that it may affect the degree of flood risk to these people? (Particularly relevant to minor developments (alterations & extensions) & changes of use).

2. Definition of the Flood Hazard

a. What sources of flooding could affect the site?
b. For each identified source, can you describe how flooding would occur, with reference to any historic records where these are available?
c. What are the existing surface water drainage arrangements for the site?

3. Probability

a. Which flood zone is the site within?
b. If there is a Strategic Flood Risk Assessment covering this site (check with the local planning authority). Does this show the same or a different flood zone compared with the Environment Agency's flood map?
c. What is the probability of the site flooding, taking account of the maps of flood risk from rivers and the sea and from surface water, on the Environment Agency's site, and the Strategic Flood Risk Assessment, and of any further flood risk information for the site?
d. If known, what (approximately) are the existing rates and volumes of surface water run-off generated by the site?

4. Climate Change

How is flood risk at the site likely to be affected by climate change? (The local planning authority's Strategic Flood Risk Assessment should have taken this into account. Further information on climate change and development and flood risk is available on the Environment Agency's website.

5. Detailed Development Proposals

Where appropriate, are you able to demonstrate how land uses most sensitive to flood

damage have been placed in areas within the site that are at least risk of flooding (including providing details of the development layout)?

6. Flood Risk Management Measures

How will the site/building be protected from flooding, including the potential impacts of climate change, over the development's lifetime?

7. Off-site Impacts

a. How will you ensure that your proposed development and the measures to protect your site from flooding will not increase flood risk elsewhere?
b. How will you prevent run-off from the completed development causing an impact elsewhere?
c. Are there any opportunities offered by the development to reduce flood risk elsewhere?

8. Residual Risks

a. What flood-related risks will remain after you have implemented the measures to protect the site from flooding?
b. How, and by whom, will these risks be managed over the lifetime of the development? (E.g., flood warning and evacuation procedures).

6.2 Fluvial: Pendle Water

6.2.1 Pendle Water: Modelled Flood Levels

The modelled flood data available provides water levels at a number of locations along Pendle Water for a range of probabilities or return periods.

The relevant flood levels for each node have been tabulated below.

Table 6: Modelled Flood Levels for Pendle Water

Node Ref	Modelled Flood Levels (mAOD)			
	1 in 10 year	1 in 100 year	1 in 100 year (defended)	1 in 1000 year
1	108.6	109.06	109.27	110.39
2	107.69	108.28	108.28	109.58
3	106.28	106.74	106.77	107.50
4	105.66	106.11	106.15	106.83
5	104.00	104.21	104.22	104.69

Locations:

- Node 1 – Between Churchill Way and Edge End Brook
- Node 2 – Confluence of Edge End Brook with Pendle Water
- Node 3 – Between Edge End Brook and Old Laund Clough (at bend in watercourse)
- Node 4 – Confluence of Old Laund Clough with Pendle Water
- Node 5 – Confluence of Hollin Mill watercourse with Pendle Water

Figure 6.1: Pendle Water Viewed Downstream from Churchill Way

Source: : Google Earth

6.2.2 Pendle Water: Overtopping (General)

Table 7: Comparison of River Bank Levels against Modelled Water Levels

Node Ref	West Bank Level (m)	East Bank Level (m)	Comments
1	-	-	No ground levels available within the survey to undertake comparison.
2	-	108.8	Level of footbridge crossing Edge End Brook. This is elevated above the 1 in 100 year (defended) scenario; but will become inundated during the 1 in 1000 year extreme flood event.
3	107.00	107.00	Levels taken from contours within the survey are elevated above the 1 in 100 year (defended) scenario; but will become inundated during the 1 in 1000 year extreme flood event.
4	105.60	-	Ground will become inundated during the 1 in 10 year event; and therefore the site is located partially within Flood Zone 3b (functional floodplain).
5	104.40	-	Ground is elevated above the 1 in 100 year (defended) scenario; but will become inundated during the 1 in 1000 year extreme flood event.

In general the ground levels within Development Area 1 are elevated significantly above the modelled water levels over the full range of return periods and as such it is concluded that Pendle Water presents a low flood risk to this part of the proposed development.

It is noted however that flooding is anticipated within the part of the development referenced as Development Area 2 for a flood event with a frequency approximating 1 in 10 years.

Flooding for return periods with a frequency greater than 1 in 20 years is considered to lie within functional floodplain and is therefore unsuitable for development types which are not considered to be 'water compatible' in nature.

6.2.3 Pendle Water: Overtopping (Development Area 2)

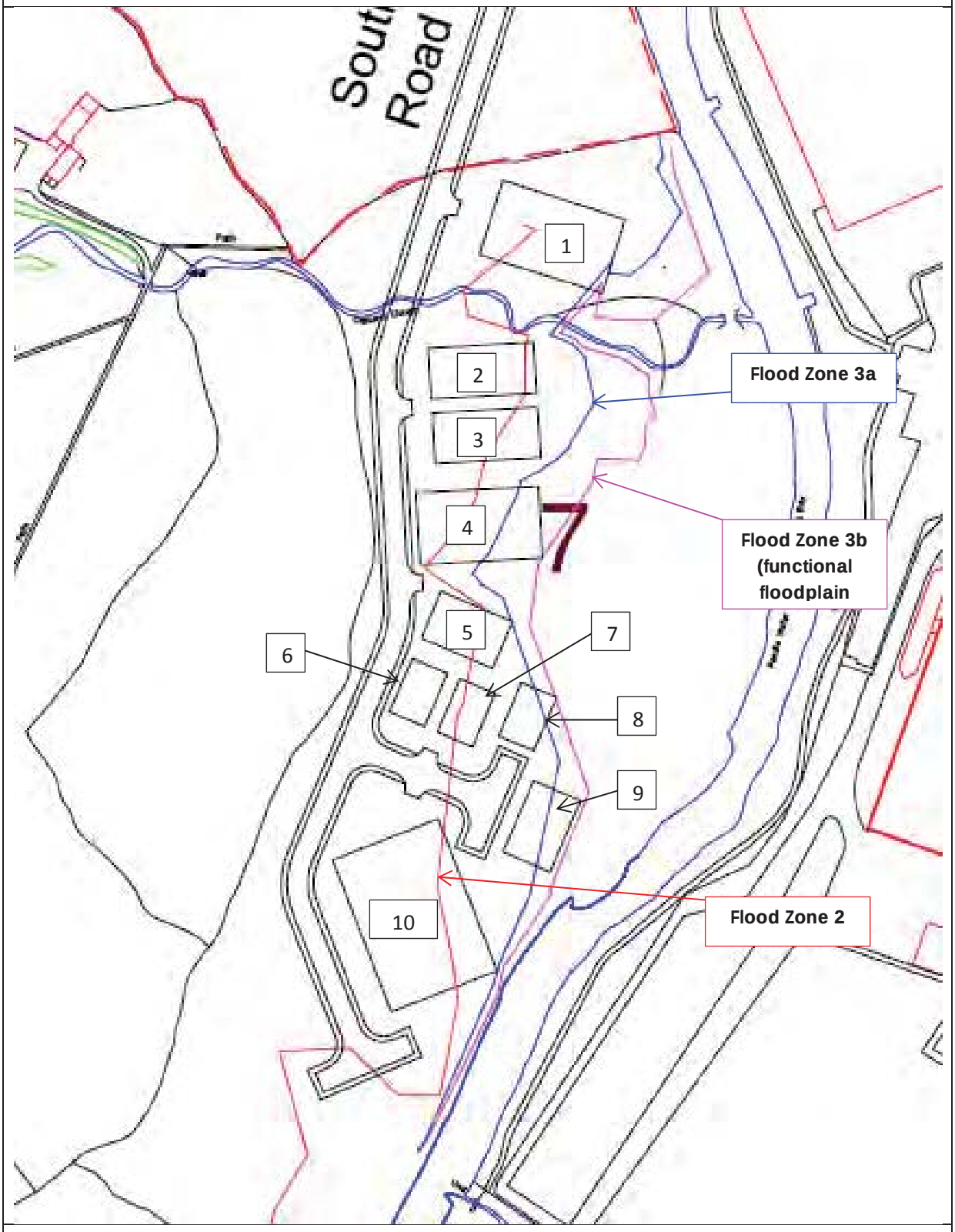
Unfortunately the 1 in 20 year flood level within Pendle Water adjacent to the proposed development site is not available at the time of writing. In order to determine the full extent of the area located within functional floodplain it has been assumed for the purposes of the assessment that water levels within Pendle Water have a logarithmic relationship with regard to return period of a flood event.

Therefore using this logarithmic relationship, the anticipated water level within Pendle Water for the 1 in 20 year return period for assessment purposes estimated to be 105.8mAOD.

Undertaking a more detailed review of the current layout plans indicates the following:

- **Unit 1**: Shown to lie within predominantly within Flood Zones 1 and 2; with very minor encroachment into Flood Zone 3. It is understood that the size of the unit can be adjusted to ensure that the building is placed outside of the high risk area.
- **Units 2, 3, 5, 7 & 10:** Shown to lie within Flood Zones 1 and 2 and therefore has a medium risk of flooding which is acceptable for commercial development.
- **Unit 4**: Shown to lie within Flood Zones 1, 2 & 3a, but outside of the functional floodplain. Flood storage compensation will be required on a level-by-level basis to offset any flood volume displaced from the site at this location.
- **Unit 6**: Shown to lie wholly within Flood Zone 1 and has a low risk from fluvial flooding.
- **Unit 8 & 9**: Shown to lie within Flood Zones 2 & 3a, but outside of the functional floodplain. Flood storage compensation will be required on a level-by-level basis to offset any flood volume displaced from the site at this location.
- **Access Road Extension:** Average ground levels 108.3mAOD at boundary with Development Area 1 falling to 104.5mAOD at the turning head within the south part of the site. This southern area lies partially within Flood Zone 2; however the access road lies predominantly within Flood Zone 1 and as such provides a safe and dry means of access and egress into the development for both vehicles and pedestrians alike.

Figure 6.2: Outline Layout for Development Area 2 (Unit Reference Numbers)



Source: Pendle Borough Council

6.2.4 Pendle Water: Climate Change

Unfortunately the Environment Agency has not provided modelled flood levels for Pendle Water with an application of climate change.

It is however noted that climate change will have a detrimental impact on flood levels within Pendle Water and the Flood Zones 3a and 3b envelopes are likely to be extended within the proposed development area.

6.2.5 Pendle Water: Conclusion

It is concluded that there is currently a low risk of flooding from Pendle Water within Development Area 1.

In contrast it is concluded that Pendle Water presents a risk of fluvial flooding within part of Development Area 2. However careful placement of the proposed commercial units and access road has been made within flood zones 1 and 2; with only limited encroachment into flood zone 3a; and no encroachment of development within the functional floodplain.

It is advised that compensatory flood storage will need to be provided to offset any displacement of existing flood storage at the site on a level-by-level basis up to the 1 in 100 year flood level.

6.3 Pendle Flood Alleviation Scheme

A multi-million pound project was commenced in 2006 to provide protection to approximately 500 properties within the Nelson and Barrowford areas within Pendle.

The scheme included the reconstruction of the wall at the rear of Sandy Lane while river walls upstream near Romney Avenue and Wilton Street were repointed and grouted.

The works also included improvements to the local environment. Reedyford Weir was removed to service the migration of fish upstream; and the riverbed was also lowered to retain the natural course of the river; and bed checks were introduced to assist in the prevention of erosion.

6.4 Surface Water Runoff

6.4.1 General

The gross area is comprised of undeveloped land as follows:

- Area 1 – 24.1Ha located to the north of Old Laund Clough and Pendle Water.
- Area 2 – 4.3Ha located west of Pendle Water and along the north and south banks of Laund Clough.

Outline proposals incorporate commercial and industrial development by way of an extension to the existing Lomeshaye Industrial Estate located to the north of the M65 Motorway within the Nelson area of Pendle.

6.4.2 Existing Public Drainage Network

Undertaking a review of the public sewer network within the vicinity of the proposed development site indicates a combined sewer running in a north easterly direction from Old

Laund Hall Farm, through the north part of the Lomeshaye Industrial Estate. It is presumed that waste water is ultimately directed to the United Utilities Wastewater Treatment Works at Whitewalls Drive in Nelson.

The existing sewer is located within the area of the site referenced within this report as Development Area 1.

Surface water is currently directed overland following natural topography towards Pendle Water and its tributaries.

It is noted that surface water from the existing Industrial Estate is directed to watercourse.

6.4.3 Surface Water Runoff Calculation: Existing Site

The Interim Code of Practice for Sustainable Drainage or ICP SUDS provides support for developers in promoting and implementing a sustainable approach to water management and in particular sustainable drainage systems (SUDS), to ensure their long-term viability and to promote consistent use.

The existing site is <50 Hectares in size; and is wholly undeveloped.

Therefore in order to determine the existing greenfield runoff rates, the ICPSUDS Module of MicroDrainage Windes has been utilised, and the results are tabulated below for the 1 in 1, 1 in 30 and 1 in 100 year return periods.

Table 8: Surface Water Runoff from the Existing Site: Area 1 (24.1 Hectares)

Return Period	Hydrometric Area	Q_{BAR} (l/s)	Flow Rate for Site l/s
1 in 1 year	10	250.0	217.5
1 in 30 year			423.9
1 in 100 year			520.0

Table 9: Surface Water Runoff from the Existing Site: Area 2 (4.3 Hectares)

Return Period	Hydrometric Area	Q_{BAR} (l/s)	Flow Rate for Site l/s
1 in 1 year	10	43.6	37.9
1 in 30 year			73.9
1 in 100 year			90.6

6.4.4 Hierarchy of Disposal

The hierarchy for disposal of surface water from new development is outlined within The Building Regulations Approved Document H; and the National Standards for Sustainable Drainage Systems (2011) and specifies the following methods in order of preference:

- Infiltration via soakaway or other suitable infiltration device
- Discharge to watercourse
- Discharge to public sewer

Infiltration

Historic Borehole Logs

A site investigation report was undertaken by Lancashire CC Highways Laboratory in 1993 to inform proposals for extension of Lomeshaye Industrial Estate to the north side of Pendle Water.

A total of 6No boreholes were drilled and indicate that ground underlying the proposed site is comprised of the following:

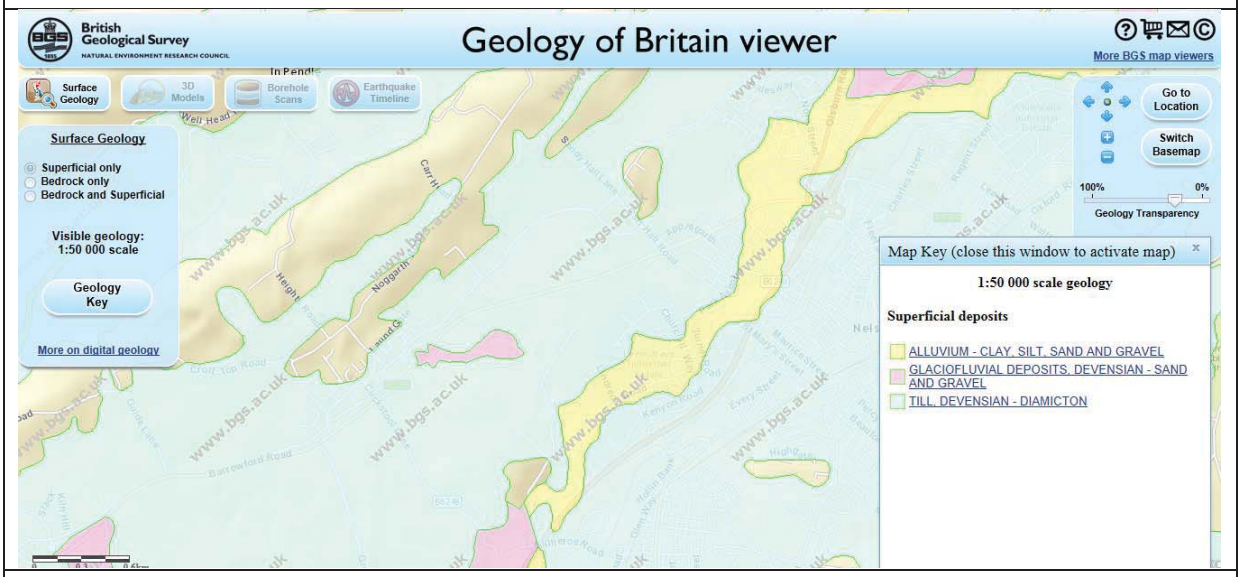
Table 10: Borehole Records

Strata Type	BH1	BH2	BH3	BH4	BH5	BH6
Topsoil	✓	✓	✓	✓	✓	✓
Sandy Subsoil	✓					
Clayey Subsoil			✓	✓	✓	✓
Slightly Sandy Silty Clay	✓	✓				
Silty Peat				✓		
Silty clay with organic traces		✓		✓	✓	✓
Silty clay with gravel sized stones					✓	✓
Sand, Silty Clay & Silt		✓				
Clayey Silty Sand with gravel & cobbles	✓					
Firm - Stiff Silty Clay	✓	✓	✓	✓		✓
Soft – Firm Silty Clay	✓	✓	✓	✓		
Soft Clayey Silt with gravel and bands of Silty Clay	✓					✓
Gravelly Sand				✓		
Soft Silty Clay			✓			
Clayey Silty Sandy Gravel	✓					
Clayey Silty Gravelly Sand			✓			
Stiff – Very Stiff Sandy Silty Clay		✓	✓	✓		✓
Clayey Silt			✓			✓
Mudstone		✓		✓		
Water Struck at Depth (m)	1.3m	2.1m	1.2m	1.5m	Dry	Dry

Although percolation tests do not appear to have been conducted at the site; it is evident from the borehole records which are available, that the ground underlying the development is largely composed of clays.

BGS Surface Geology

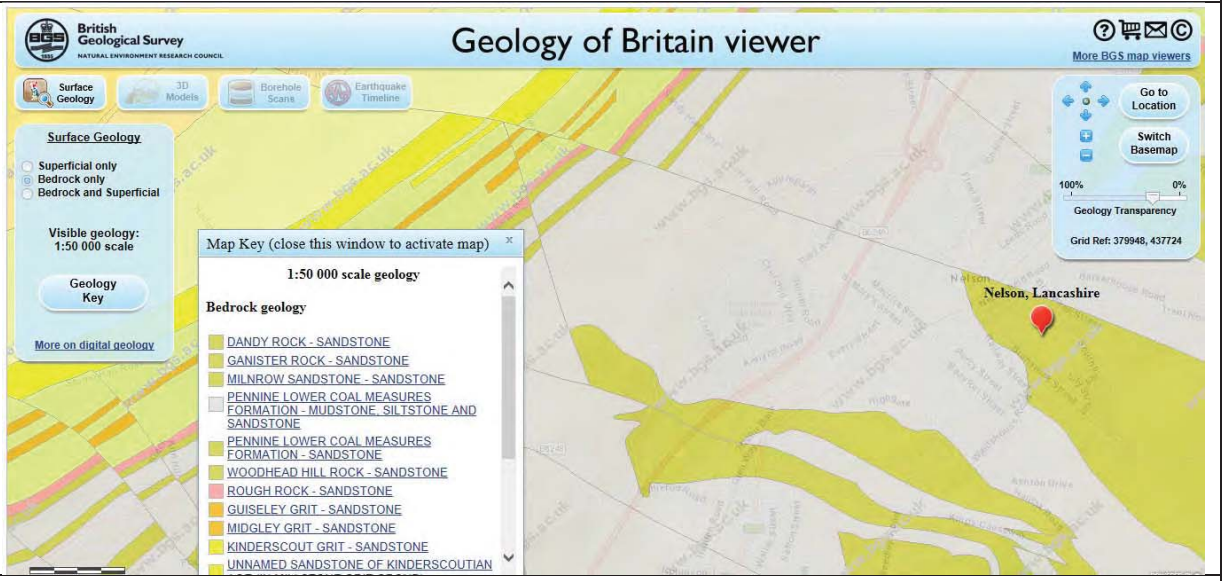
Figure 6.3: Superficial Deposits



Alluvium: Flandrian age - Normally soft to firm consolidated, compressible silty clay, but can contain layers of silt, sand, peat and basal gravel. A stronger, desiccated surface zone may be present.
Till Devensian - Diamicton: Devensian age - sediment that consists of a wide range of non-sorted to poorly sorted terrigenous sediment, i.e. sand or larger size particles that are suspended in a mud matrix.

Source: www.bgs.ac.uk

Figure 6.4: Bedrock

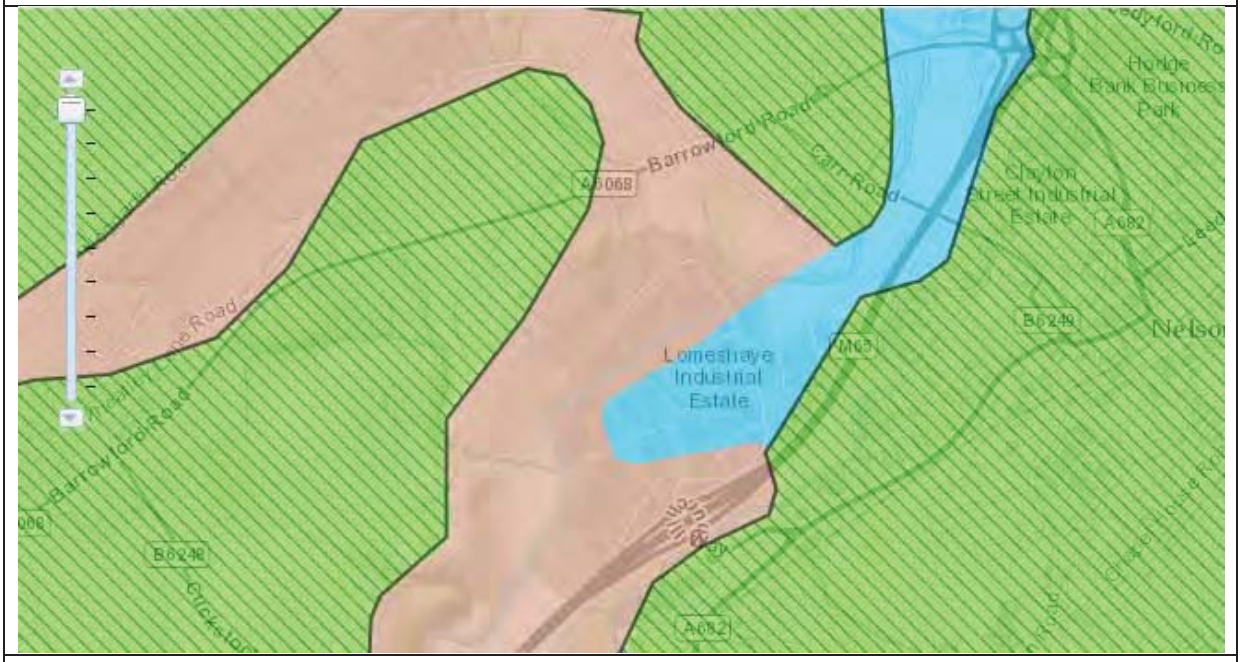


Pennine Lower Coal Measures Formation Mudstone, Siltstone and Sandstone: Lansettian sub-age - Interbedded grey mudstone, siltstone and pale grey sandstone, commonly with mudstones containing marine fossils in the lower part, and more numerous and thicker coal seams in the upper part.
Dandy Rock - Sandstone: Lansettian sub-age.

Source: www.bgs.ac.uk

Soilscape Maps

Figure 6.5: Soilscape Map



Source: http://www.landis.org.uk/soilscapes/

Figure 6.6: Soilscape Map Key

Soilscape description: Slowly permeable seasonally wet acid loamy and clayey soils	**Soilscape description:** Freely draining slightly acid loamy soils
Texture: Loamy and clayey	**Texture:** Loamy
Coverage: England: 7% Wales: 15.1% England &Wales: 8.2%	**Coverage:** England: 15.5% Wales: 24.4% England &Wales: 16.7%
Drainage: Impeded drainage	**Drainage:** Freely draining
Fertility: Low	**Fertility:** Low
Habitats: Seasonally wet pastures and woodlands	**Habitats:** Neutral and acid pastures and deciduous woodlands; acid communities such as bracken and gorse in the uplands
Landcover: Grassland with some arable and forestry	**Landcover:** Arable and grassland
Carbon: Medium	**Carbon:** Low
Drains to: Stream network	**Drains to:** Local groundwater and rivers
Water protection: Main risks are associated with overland flow from compacted or poached fields. Organic slurry, dirty water, fertiliser, pathogens and fine sediment can all move in suspension or solution with overland flow or drain water	**Water protection:** Groundwater contamination with nitrate; siltation and nutrient enrichment of streams from soil erosion on certain of these soils
General cropping: Mostly suited to grass production for dairying or beef; some cereal production often for feed. Timeliness of stocking and fieldwork is important, and wet ground conditions should be avoided at the beginning and end of the growing season to prevent damage to soil structure. Land is tile drained and periodic moling or subsoiling will assist drainage	**General cropping:** Suitable for range of spring and autumn sown crops; under grass the soils have a long grazing season. Free drainage reduces the risk of soil damage from grazing animals or farm machinery. Shortage of soil moisture most likely limiting factor on yields, particularly where stony or shallow

Source: http://www.landis.org.uk/soilscapes/

FEH Catchment Descriptors

The catchment descriptor referenced as SPRHOST represents the standard percentage runoff attributed to the relevant ground conditions within a particular catchment area.

The SPRHOST for the application site, obtained from the FEH CD-ROM (Version 3.0) is 31.1%; and is representative of ground which may have some potential to accept surface water via infiltration methods.

Conclusion

The desk-top investigation indicates that a large proportion of the area contained within Development Area 1 is not suited for the disposal of surface water via infiltration methods alone; and is underlain largely by clay.

In contrast Development Area 2 is shown to be located within an area believed to comprise freely draining soils; and as such is considered to offer an opportunity to dispose of surface water wholly via infiltration methods.

It is however highly recommended that percolation testing in accordance with the requirements set out within BRE DIGEST 365 is undertaken at the site to obtain site specific percolation rates, prior to the detailed design phase of the project to inform the overall drainage plan for this strategic commercial development site.

Watercourse

Where percolation tests indicate poor infiltration rates, surface water will need to be directed to watercourse.

The nearest watercourse to the proposed development is Pendle Water.
Flows discharged to the watercourse will need to be restricted to pre-development rates with attenuation provided to ensure that additional surface water runoff resulting from the 1 in 100 year plus climate change rainfall event is contained within the site and cannot migrate beyond the site boundary or into Pendle Water or its tributaries.

This is to prevent the exacerbation of flooding downstream from the development site.

Sewer

Surface water runoff from the site will be directed to infiltration units or watercourse and not to sewer.

Only foul flows generated as a result of the development will be discharged to the public sewer system.

6.4.5 Sustainable Urban Drainage Systems (SUDS)

In accordance with the Flood Water and Management Act 2010; there is a requirement to incorporate sustainable drainage systems i.e. SUDS into new development.

The main objective for the inclusion of SUDS is treatment and control of runoff as near to the source as possible, protecting downstream habitats and enhancing the amenity value of the site and surrounding area.

The overarching SUDS philosophy is to add value to engineering design through habitat enhancement, landscape design, provision of an amenity resource, and promotion of

source control techniques. Landscape and ecological issues, where appropriate, should be given equal priority to the engineering issues and, at times, may have higher priority in the sizing and detailing options.

Undertaking an assessment of a range of SUDS revealed that a number of different methods would be suitable for inclusion within the proposed drainage strategy for the development. A summary of the results is tabulated overleaf:

Table 11: SUDS Appraisal

SUDS Group	Type	Comment
Retention	Pond	May be used to attenuate surface water runoff prior to discharge into receiving watercourse. Outflows regulated using a Hydrobrake or orifice plate flow control. Able to provide amenity value; however there may be local issues relating to safety. May be designed to provide infiltration to underlying strata depending on percolation test/site investigation results. Pond type solutions are not recommended on land with significant slopes due to the increased footprint required to accommodate the structure.
	Sub-surface Storage	Large diameter pipes/culverts, concrete storage tanks; can be used to attenuate surface water runoff, and reduce the land take required for ponds & basins. It is noted that geo-cellular crate systems will not be accepted for adoption under a Section 104 agreement with United Utilities; and liaison with the LLFA (Lancashire CC) indicates that due to the maintenance burden throughout the lifetime of the development; this type of attenuation structure is not considered to be favourable.
Wetland	Shallow Wetland	Extended detention wetlands are predominantly utilised where significant pollution removal would be required; and as such other types of wetland are more suited to residential development sites. A wetland is considered the most appropriate solution for attenuation at surface level, in areas where there are high groundwater levels; and the base of the structure intersects groundwater to provide a permanent body of water. Similar to the retention basin solution, such structures are better sited within ground which is relatively flat in nature to prevent excess land take to accommodate the footprint of the wetland arrangement.
	Extended Detention Wetland	
	Pond	
	Pocket Wetland	
	Submerged Gravel	
	Wetland Channel	
Infiltration	Infiltration Trench	Viable solution for part of the development; where soil types are assumed to be suitable for infiltration methods. Percolation testing is required to fully determine suitability for this method; in accordance with BRE Digest 365. It is noted that the cut-off point in terms of viability for most infiltration systems is 0.001m/hour
	Infiltration Basin	
	Soakaway	

Table 11: SUDS Appraisal

SUDS Group	Type	Comment
Filtration	Surface Sand Filter	Sand filters are not commonly used within the UK; and although suitable for use within a residential setting are more widely used for development which may require high pollutant removal i.e. commercial & industrial sites. Bioretention systems (rain gardens) are aimed at managing & treating runoff from frequent rainfall events; can be incorporated into landscape features; and connected to a drainage system in the event that disposal via infiltration is not feasible. Filter strips and trenches are commonly used adjacent to large impermeable areas such as road and car parks to provide conveyance and some treatment of flow prior; however this method is unable to provide significant volumes for attenuation purposes.
	Sub-surface sand filter	
	Bioretention	
	Surface Sand Filter	
Detention	Detention Basin	In its basic form, a detention basin is used to manage water quantity while having a limited effectiveness in protecting water quality, unless it includes a permanent pool feature. Designed normally to remain dry unless required to attenuate surface water runoff, such features may provide usable space for leisure activities during dry weather; and be operational only during periods when attenuation of surface water is required. Again however this type of attenuation structure is best placed within ground with relatively flat topography to limit the footprint of the structure within the development layout.
Swales	Conveyance Swale	Swales are linear vegetated conveyance structures, which are designed to promote low flow velocities in order to provide pollutant removal; and can replace conventional gullies and drainage pipes, when located adjacent to roads. It is noted that the land take required for swales is considered to be relatively high; but can provide a green link or corridor between separate areas of development.
	Enhanced Dry Swale	
	Enhanced Wet Swale	
Source Control	Green Roof	Provides interception storage for first flush of rainfall; and can act to offset any increase in surface water runoff volume generated as a result of the development in accordance with the mandatory requirements of BREAAM's POL 03 (surface water runoff) for non-domestic development; and the National Standards for Sustainable Drainage Systems (DEFRA 2011).
	Rainwater Harvesting	
	Permeable Pavements	Can be designed to infiltrate to ground; or to provide shallow attenuation for discharge to a receiving watercourse or sewer, where infiltration methods are not considered feasible. This type of source control is ideally placed within shared driveway or car park areas; and is not usually permitted within the adoptable road network.

Drainage Features – Site Placement:

Ponds; wetlands and basins should ideally be sited within areas of the red-line development area as close to the discharge point or outfall into the receiving watercourse or sewer network, as possible or at the downstream end of a SUDS train (for infiltration basins); and within public open space in order to maintain suitable access for inspection and maintenance.

Large diameter pipes, or box culvert arrangements, should be sited within estate roads, or public open space, again to maintain access for inspection and/or maintenance.

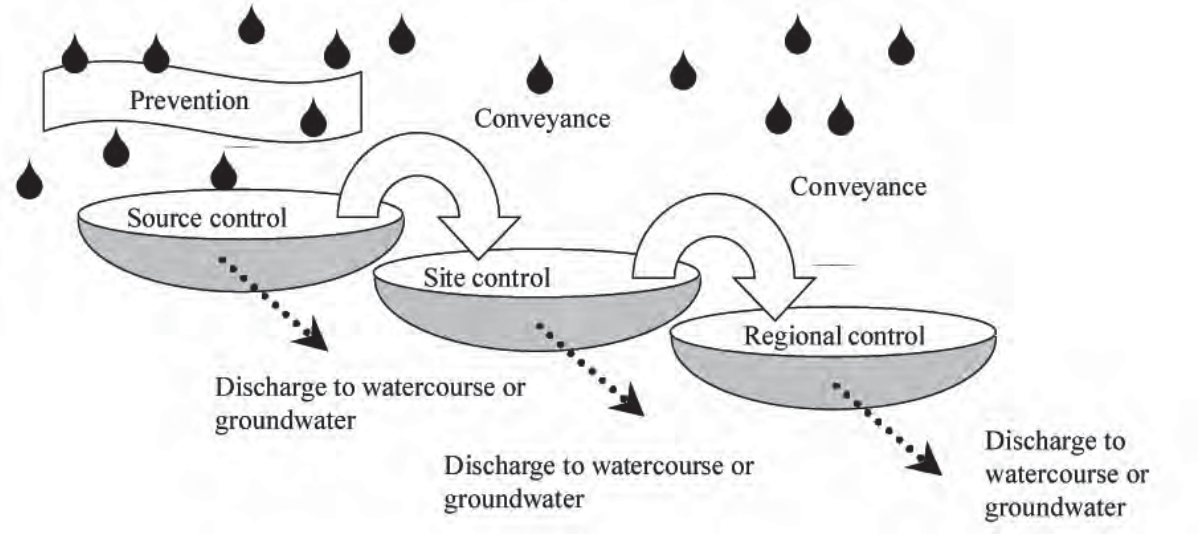
Tank systems for attenuation purposes should be sited within public open space or under car park areas.

Bioretention areas or rain gardens are ideally placed within proposed landscaped areas throughout the development; and may be used as source control elements i.e. within individual plots.

In the event that **swale systems** are used then, it is recommended that they are placed immediately adjacent to the estate road network. It is noted that such systems are recommended to serve areas not greater than 2 Hectares at a time.

It is highly recommended that source control methods such as **green roof technology, permeable paving, or rainwater harvesting systems** are considered for inclusion at the earliest stage of the project; as these types of systems provide the benefit of offsetting additional surface water volume generated by new development; which in turn assists new development in achieving the mandatory requirements for BREAAM accreditation in terms of POL03 (surface water runoff) if required.

Figure 6.7: Typical SUDS Train



6.4.6 Preliminary Drainage Strategy and Attenuation Requirements

The outline development plan indicates an overall increase in roof and hardstanding area within the site boundary in comparison to the existing site.

At this stage, the impermeable area within the proposed development is unknown. However, for calculation purposes it has been taken to cover the following:

- Area 1 – 7.6 Hectares (approximates to 30% of the total site area).
- Area 2 – 1.76 Hectares (approximates to 41% of the development area).

It is however recommended that re-evaluation of the drained areas within the proposed development, including the production of a drainage layout, is undertaken during the detailed design stage of the project.

The preliminary drainage strategy should incorporate the most appropriate ranked SUDS methods resulting from the evaluation detailed within Section 6.4.5 of this report.

The suitability for utilising permeable paving; green roof technology and/or rainwater harvesting is to be determined by the Developer and Architect during the detailed design phase of the project. It is however recommended that at least one of these methods is implemented in order to offset any additional surface water runoff volume generated by the site due to future climate change; and provide an element of pollution control within the SUDS train.

The natural drainage path i.e. topography of the development; along with the drainage hierarchy set out within the Approved Document H of the Building Regulations; has determined that the discharge of surface water from the development will be as follows:

- **Area 1** – full infiltration or partial infiltration to ground, subject to percolation testing, with additional flow discharged to watercourse and restricted to pre-development runoff rates, . It is noted that the actual method for draining this area within the site will be dependent upon the outcome of site specific infiltration tests.
- **Area 2** – same as Area 1.

Using the quick storage estimate facility within the Source Control Module of MicroDrainage Windes, the following results with regard to approximating the overall volume of surface water attenuation required on-site have been obtained.

Summaries of the calculation results are tabulated below and overleaf.

Development Area 1

The Soilscape maps describe the ground underlying this development area as 'loamy and clayey soils' within the north part of the site; and 'loamy' within the southern part of the development area.

Typical infiltration coefficients for this type of soil range from 0.001m/hour to 0.1m/hour.

For calculation purposes and to provide a conservative estimate of attenuation requirements at the site, a relatively poor infiltration rate (0.002m/hour) has been utilised within this study.

Table 12: Indicative Volume of Attenuation: Area 1 (Full Infiltration)

Return Period	Storage Volume (m^3)
1 in 1 year	1544 – 4450
1 in 30 year	3081 - 7474
1 in 100 year	3905 - 8854
1 in 100 year + 20% climate change	4679 - 10625

Table 13: Indicative Volume of Attenuation: Area 1 (Part Infiltration & Discharge to Pendle Water)

Return Period	Storage Volume (m^3)
1 in 1 year	226 - 566
1 in 30 year	679 – 1453
1 in 100 year	925 - 1959
1 in 100 year + 20% climate change	1280 - 2560

It is highlighted that infiltration devices placed within the drainage strategy will only be acceptable of they are able to drain down by half the stored volume within a 24 hour period, in order to accept subsequent rain storms.

It is generally recognised that infiltration rates less than 0.001m/hour are not considered to be feasible for disposal of surface water via infiltration devices such as soakaways or infiltration trenches etc…

Using the 'worst case' estimated volume i.e. 10625m^3; a single infiltration basin of size approximating 11068m^2 (A) x 2.0m (D) should be suitable to accommodate the infiltration only option up to the 1 in 100 year plus climate change event; without surface flooding from occurring; and provision of a 600mm depth of freeboard to the water surface from the top of bank.

This was tested within the Source Control Module of MicroDrainage Windes; and the model results indicate that owing to the assumption of a low infiltration rate, the half drain down time from such a structure exceeds 7 days for the 1 in 1 year event and beyond; therefore making the disposal of surface water via infiltration methods alone largely unfeasible.

Under such circumstances, a combined system which promotes infiltration, and allows a restricted surface water to discharge into the nearby watercourse i.e. Pendle Water would be preferable.

Using the 'worst case' estimated volume i.e. 2560m^3; an infiltration basin with a restricted outflow to Pendle Water, of size approximating 2560m^2 x 2.0m (D) is suitable to accommodate this option up to the 1 in 100 year plus climate change event; without surface flooding from occurring. Flow is restricted to greenfield runoff rates using a Hydrobrake, with design head of 1.4m and outflow of 441.4l/s; to provide a minimum 600mm freeboard from the top of the basin.

The following table provides a summary of the modelled output from the MicroDrainage calculations.

Table 14: Preliminary Outflow for Area 1 (Mixed Infiltration & Outflow to Pendle Water)

Return Period	Outflow from Site (l/s)
1 in 1 year	166.5
1 in 10 year[4]	344.7
1 in 30 year	421.9
1 in 100 year	434.8
1 in 100 year + 20% climate change	434.9

[4] Infiltration devices such as soakaways and infiltration basins etc…are usually designed to accommodate he 1 in 10 year storm event, in accordance with BREEAM Digest 365.

It is noted that a single attenuation structure within the downstream part of the site is not encouraged; and it is preferable to provide a mixture of SUDS methods throughout the site as a whole.

As such it is suggested that swales, permeable paving and number of small areas set aside for a combination of infiltration/discharge to watercourse/discharge to downstream SUDS elements or piped system, by way of a basin structure or bioretention area; along with more traditional drainage methods such as filter drainage and large diameter pipework where necessary, incorporated into the preliminary drainage strategy for the proposed extension to the Lomeshaye Industrial Estate.

Development Area 2

Underlying ground is believed to be comprised of 'loamy' soils and therefore may also support the disposal or partial disposal of surface water runoff via infiltration method.

The same infiltration rate and calculation methodology has therefore been utilised to ascertain typical surface water runoff attenuation volumes, necessary for inclusion within the drainage strategy for the development.

Table 15: Indicative Volume of Attenuation: Area 2 (Full Infiltration)

Return Period	Storage Volume (m^3)
1 in 1 year	429 - 1288
1 in 30 year	790 - 2100
1 in 100 year	986 – 2466
1 in 100 year + 20% climate change	1181 - 2935

Table 16: Indicative Volume of Attenuation: Area 2 (Part Infiltration & Discharge to Pendle Water)

Return Period	Storage Volume (m^3)
1 in 1 year	64 – 171
1 in 30 year	188 – 400
1 in 100 year	259 - 540
1 in 100 year + 20% climate change	349 - 705

Using the 'worst case' estimated volume i.e. $2935m^3$; a single infiltration basin of size approximating $2935m^2$ (A) x 2.0m (D) should be suitable to accommodate the infiltration only option up to the 1 in 100 year plus climate change event; without surface flooding from occurring.

Testing this unit within the Source Control Module of MicroDrainage Windes, it is noted that the above structure is sufficiently sized to accommodate the required volume. However, similar to the calculations presented for Area 1, owing to assumption of a low infiltration rate, the half drain down time from such a structure exceeds 7 days for the 1 in 1 year event and beyond.

Under such circumstances, a combined system which promotes infiltration, and allows a restricted surface water to discharge into the nearby watercourse i.e. Pendle Water would again be preferable.

Using the 'worst case' estimated volume i.e. $705m^3$; an infiltration basin with a restricted outflow to Pendle Water, of size approximating $705m^2$ x 2.0m (D) is suitable to accommodate this option up to the 1 in 100 year plus climate change event; without surface flooding from

occurring. Flow is restricted to greenfield runoff rates using a Hydrobrake, with design head of 1.4m and outflow of 38l/s; to provide 400mm freeboard from the top of the basin.

The following table provides a summary of the modelled output from the MicroDrainage calculations.

Table 17: Preliminary Outflow for Area 2 (Mixed Infiltration & Outflow to Pendle Water)

Return Period	Outflow from Site (l/s)
1 in 1 year	37.8
1 in 10 year[5]	38.1
1 in 30 year	38.1
1 in 100 year	38.1
1 in 100 year + 20% climate change	40.7

It is re-iterated within this assessment that a single attenuation structure within the downstream part of the site is not encouraged; as it is preferable to provide a mixture of SUDS methods throughout the site as a whole, and as such it is suggested that swales, permeable paving and number of small areas set aside for infiltration by way of a basin structure or bioretention are; along with more traditional drainage methods such as filter drainage and large diameter pipework where necessary are incorporated into the preliminary drainage strategy for the development at Lomeshaye Industrial Estate.

It is noted that the figures tabulated within this section of the report are only estimates at this stage of the project, based on only an approximation of the increase in impermeable area suggested by the initial development plans; and must not be used for detailed design purposes.

It is highly recommended that more detailed calculations are undertaken once the development masterplan has been finalised, in order to inform the final drainage strategy for the proposed development moving forwards towards the construction phase of the project.

6.5 Residual Flood Risk

The proposed drainage system should be designed such that attenuation will be provided to accommodate surface water runoff for storms with a return period of up to the 1 in 100 year event incorporating an additional 30% to accommodate climate change over the lifetime of the development; in accordance with the Environment Agency's requirements.

Within the on-site drainage system, the 1 in 100 year plus climate change event is allowed to flood at surface level within the development. However it is highlighted that the resulting flood water must be retained within the site; and will not be allowed to inundate property within the development; migrate beyond the boundary of the site; or be allowed to flow uncontrolled into Pendle Water or its tributaries, thereby increasing flood risk elsewhere.

6.6 Foul Flows

It is proposed that foul flows generated as a result of the proposed development will be directed to the existing public sewers which are shown to traverse the development area.

[5] Infiltration devices such as soakaways and infiltration basins etc…are usually designed to accommodate he 1 in 10 year storm event, in accordance with BREEAM Digest 365.

6.7 Maintenance

6.7.1 General

It is understood that the detailed design of separate foul and surface water drainage systems will be undertaken in accordance with the Flood and Water Management Act 2010 and Sewers for Adoption 7th Edition, and submitted to Lancashire County Council as the Lead Local Flood Authority; and also United Utilities for adoption via a Section 104 Agreement, where appropriate.

Following the adoption process, United Utilities will take over responsibility of inspection and maintenance of the drainage assets covered by the Section 104 agreement.

It is advised that the SUDS (Sustainable Drainage System) Approval Bodies or SAB's will not be operational until October 2014, when adoption of SUDS drainage schemes by the LLFA will be required.

Until the proposed adoption process is implemented, the inspection and maintenance of non-adoptable drainage components such green roof technology; bioretention systems; permeable paving; rainwater harvesting; or detention/infiltration basins will remain the responsibility of the plot owner within the curtilage of the individual commercial sites; or the Developer and/or Land Owner for the communal areas within the development site.

As such it is recommended that inspection and maintenance of drainage components such as infiltration devices and outfalls are undertaken by responsible persons by way of a maintenance contract.

6.7.2 SUDS Maintenance

Like all drainage systems, SUDS components should be inspected and maintained. This ensures efficient operation and prevents failure.

Usually SUDS components are on or near the surface and most can be managed using landscape maintenance techniques.

For below-ground SUDS such as permeable paving the manufacturer or designer should provide maintenance advice. This should include routine and long-term actions that can be incorporated into a maintenance plan.

The final design process should consider the maintenance of the components (access, waste management etc.) including any corrective maintenance to repair defects or improve performance.

A detailed SUDS management plan for the maintenance of SUDS and other non-adopted elements within the drainage system should be prepared.

The table presented overleaf provides a breakdown of typical maintenance requirements. This should include an overview of the design concepts and a maintenance schedule for the scheme to ensure that it continues to function as intended.

In the absence of legislation, funding for the adopter to maintain SUDS may need to be resolved at the start of the development process to ensure that either the local authority, a maintenance company, local residents or the water company have sufficient resources to maintain the system in the long-term.

The level of inspection and maintenance will vary depending on the type of SUDS component and scheme, the land use, types of plants as well as biodiversity and amenity requirements.

Further information on maintenance can be found in The SUDS Manual (CIRIA publication C697).

The SUDS scheme is unlikely to be handed over for maintenance until all parties are confident that the scheme is constructed and performs as designed.

As such, due to the potential scale of the development at Lomeshaye Industrial Estate, an interim maintenance plan is recommended for incorporation into the development plans.

Table 18: Typical Inspection and Maintenance Requirements

Activity	Indicative Frequency	Typical Tasks
Routine/regular maintenance	Monthly (for normal care of SUDS)	Litter picking Grass cutting Inspection of inlets, outlets and control structures.
Occasional Maintenance	Annually (dependent on the design)	Silt control around components Vegetation management around components Suction sweeping of permeable paving Silt removal from catchpits, soakaways and cellular storage.
Remedial maintenance	As required (tasks to repair problems due to damage or vandalism)	Inlet/outlet repair Erosion repairs Reinstatement of edgings Reinstatement following pollution Removal of silt build up.

7.0 Mitigation Measures

7.1 Development Levels Finished

Detailed assessment of flood risk resulting from overtopping of Pendle Water and its tributaries confirms that Development Area 1 is located wholly within Flood Zone 1 and as such as a low risk from fluvial flooding.

For development with a low flood risk it is usual to set the finished floor level for commercial development at a minimum of 150mm above external ground levels.

In contrast, the assessment confirms that Development Area 2 is located predominantly within Flood Zones 2, 3a and 3b; and as such is concluded to have a medium to very high risk from fluvial flooding.

Development within the area designated as Flood Zone 3b is not likely to be permitted.

However proposals for development within Flood Zones 2 and 3a will require the finished floor levels of commercial buildings to be set as follows:

- Minimum of 600mm above the 1 in 100 year flood level i.e. 106.15 + 0.6 = 106.75mAOD; or
- Minimum of 300mm above the 1 in 100 year flood level i.e. 106.15 + 0.3 = 106.45mAOD plus an additional 300mm flood resistance/resilience measures.

7.2 Flood Resistance/Resilience

Consideration should be given to proposed buildings which are located within Flood Zones 2 and 3, to reduce the residual damages if an extreme flood was to occur. It is proposed that any flood proofing measures are designed to a level of 106.75mAOD.

Table 19: Typical Flood Proofing Measures

Feature	Consideration to Improve Flood Proofing of Buildings
External Walls	Careful consideration of materials: use low permeability materials to limit water penetration if dry proofing required. Avoid using timber frame and cavity walls. Consider applying a water resistant coating. Provide fitting for flood boards or other temporary barriers across openings in the walls.
Internal Walls	Avoid use of gypsum plaster and plasterboards; use more flood resistant linings (e.g. hydraulic lime, ceramic tiles). Avoid use of stud partition walls.
Floors	Avoid use of chipboard floors. Use concrete floors with integrated and continuous damp proof membrane and damp proof course. Solid concrete floors are preferable; if a suspended floor is to be used, provide facility for drainage of sub-floor void. Use solid insulation materials.
Fitting, Fixtures and Services	If possible, locate all fittings, fixtures and services above design floor level. Avoid chipboard and MDF. Consider use of removable plastic fittings. Use solid doors treated with waterproof coatings. Avoid using double-glazed window units that may fill with flood water. Use solid wood staircases. Avoid fitted carpets. Locate electrical, gas and telephone equipment and systems above flood level. Fit anti-flooding devices to drainage systems.

Flood proofing is a technique by which buildings are designed to withstand the effects of flooding. There are two main categories of flood proofing, which are dry proofing and wet proofing.

Dry proofing methods are designed to keep water out of the building, and wet proofing methods are designed to improve the ability of the property to withstand the effects of flooding once the water has entered the building.

Where wet proofing is required it is important that a flood warning and evacuation plan should be prepared and practised regularly, so that the occupants and any contents of the building can be moved to areas above the predicted flood level if required. In addition fixtures and fittings should be built to withstand immersion in water or designed to be easily replaced.

Figure 7.1: Typical Flood Resistance/Resilience Measures for Commercial Development

Source: www.ukfloodbarriers.co.uk

1	Demountable flood barriers
2	
4	Anti-flood air brick
5	Anti-flood air brick cover
7	Sealant – assists prevention of water seepage through brickwork
8	Non-return valve installed on drainage system to prevent back-up of flow into the building
9	Small backwater valve to prevent the back up of sewage into the building
10	Heavy duty flood barrier
11	Fire & flood door

The differential pressures across load bearing walls and the flotation effect that will occur during flood events should be taken into account when considering dry proofing techniques.

For most existing properties this means that dry flood proofing should only be considered if the expected flood depth is under 0.9m.

The table provided above summarises a set of typical recommendations for flood proofing measures which can be incorporated within the design of the new buildings, which are shown to be located within Flood Zones 2 and 3a.

Such measures are put forward in accordance with 'Development and Flood Risk Guidance for the Construction Industry' CIRIA C624, London 2004.

It would be preferable to avoid external doors as this would remove a potential point of flood inflows. However since free access and egress into the building will be required, flood resistant doors and/or the use of flood resistant stop logs or flood boards should be considered.

Full details of manufacturer's or suppliers of flood protection equipment may be obtained from the Flood Protection Association (website: www.thefpa.org.uk).

Alternatively a pictorial guide to typical flood resistant measures which may be incorporated into the design for commercial units located within flood zone areas is provided within the figure above.

7.3 Access and Egress

In accordance with the requirements set out within the National Planning Policy Framework, it is essential to ensure that the routes into and out of the application site will not present a danger to people due to flooding.

A summary of the access and egress arrangements for each development area is outlined below:

- **Area 1 –** access and egress from this part of the development is available via Barrowford Road and Churchill Way. It is advised that both points are located within Flood Zone 1 and as such dry access and egress from the site will be available for businesses including staff, customers and other visitors to the site at all times**.**
- **Area 2 –** As there is only a single access rout proposed into this part of the development, careful consideration has been placed in regard to maintaining the safety of people access and egressing from the site during flood conditions within Pendle Water. It is advised that the road has been sited within flood zone 1 and as such dry access and egress will be available at all times.

7.4 Flood Alerts and Evacuation

In many places the Environment Agency is able to provide both flood alerts and flood warnings. But in some places they are only able to provide flood alerts.

Flood alerts are issued when flooding is possible; and cover larger areas than flood warnings; and are issued more frequently. On receipt of a flood alert people should be prepared for flooding and to take action.

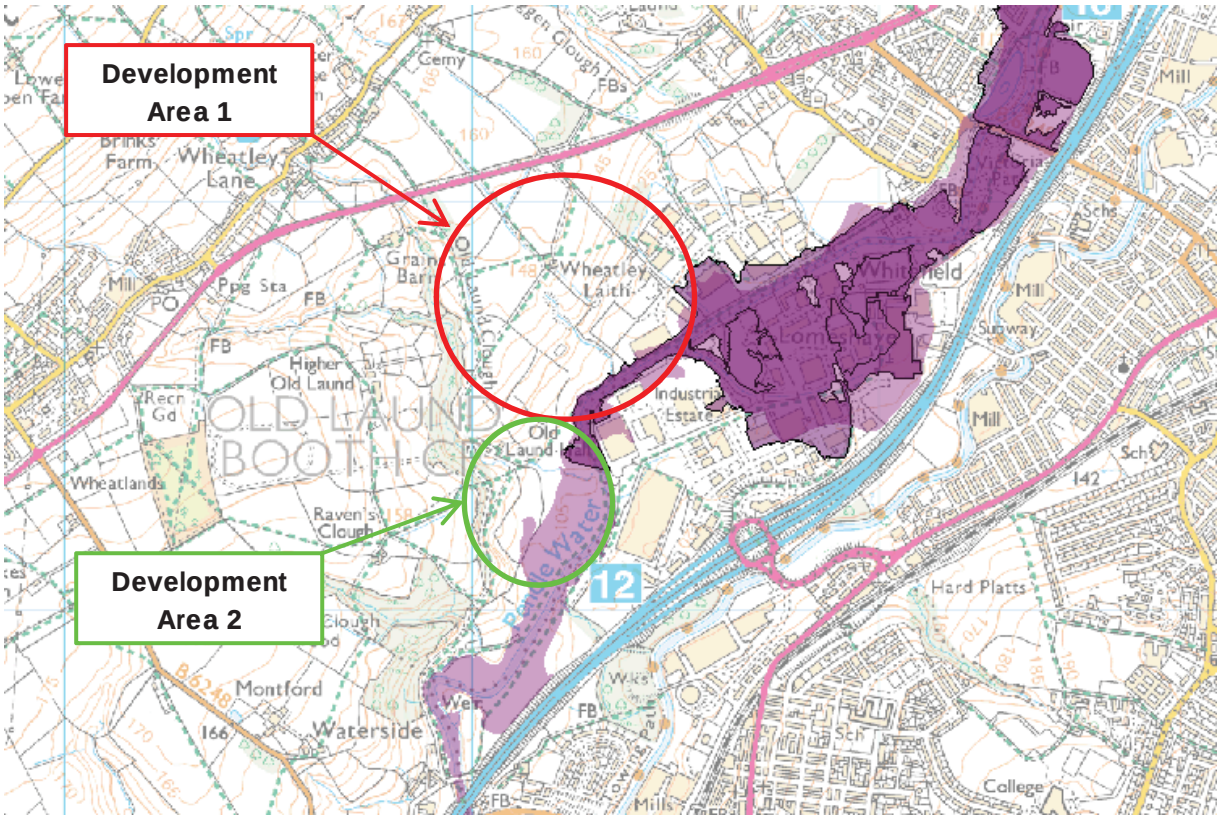
Although the current development plans for the site have been carefully considered, due to the proximity of the proposed development to the floodplain associated with Pendle Water, it is highly recommended that businesses are advised to sign up to receive free flood alerts from the Environment Agency.

A map showing the current extent of the Flood Alert and Warning areas is shown below.

Additional information in regard to signing up to receive flood alerts or warnings can be found from the www.gov.uk website:

https://www.gov.uk/browse/environment-countryside/flooding-extreme-weather

Figure 7.2: Environment Agency Flood Alert & Warning Map



Source: www.environment-agency.gov.uk

Key

- Areas where flood alerts are issued
- Areas where flood warnings are issued

7.5 Signage

Although careful consideration has been undertaken to design the layout of Development Area 2 to ensure placement of buildings and road outside of the area with the highest flood risk; due to the proximity of Pendle Water; it is recommended that signs are erected at strategic locations throughout the development, to provide a warning to people that the area is liable to flooding.

A typical sign is provided below for reference.

Figure 7.3: Typical Flood Warning Sign

Source: www.environment-agency.gov.uk

7.6 Flood Storage Compensation

Development Area 1 is located wholly within Flood Zone 1 and as such flood storage compensation will not be required.

The latest development layout plan for Area 2 has been carefully considered; and places the development predominantly within Flood Zones 1 and 2; and hence outside of the areas adjacent to Pendle Water which are considered to have a high flood risk.

It is noted that the footprint of some buildings is shown to encroach marginally into Flood Zone 3a; with no development located within Flood Zone 3b i.e. the functional floodplain.

To put this into context, the total footprint of development within Area 2 approximates 1.76 Hectares' with building footprint encroaching into flood zone 3 approximating 0.06 Hectares i.e. 3.4%.

As such it is considered that there will be some displacement of flood storage resulting from the development; which will need to be compensated for on a level-by level basis through the re-grading of ground levels; where space permits.

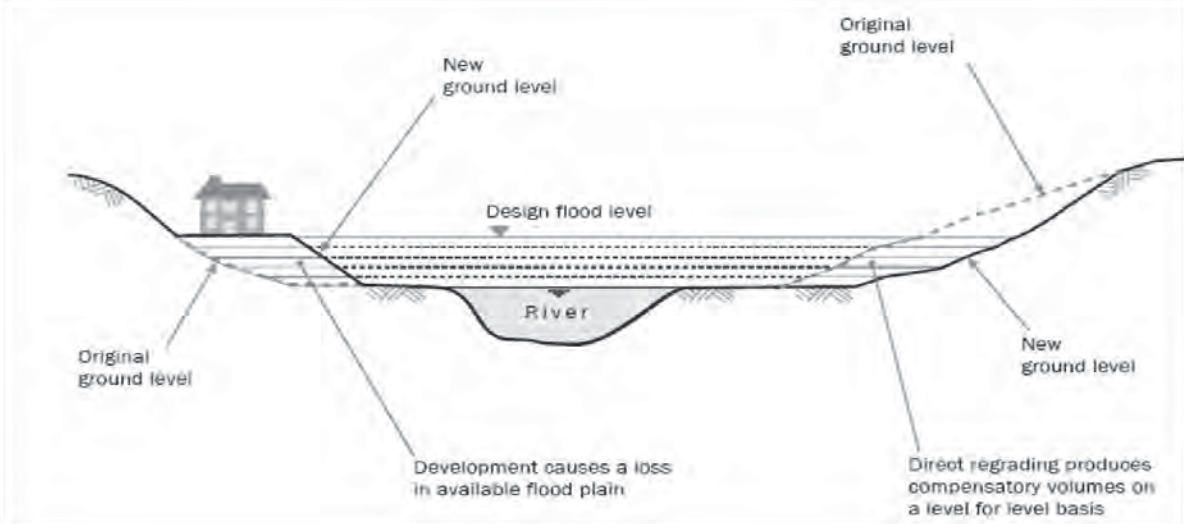
Compensatory flood storage areas must be sited outside of the floodplain and this must be demonstrated during the detailed design stage of the project.

Discussions with Pendle Council suggest that there is sufficient space available to the rear of the proposed units and within the south part of the site, where ground levels are higher to provide the necessary flood storage.

Such a requirement is necessary to prevent the development from increasing the flood risk to neighbouring land or development.

Figure 7.4 overleaf provides a pictorial explanation of this requirement; and Figure 7.5 overleaf illustrates the areas of the site affected.

Figure 7.4: Compensatory Flood Storage



www.sepa.gov.uk

7.7 Easements

Reasonable clearance and access is needed for all public sewers and is covered by a statutory easement arrangement or 'protective strip'.

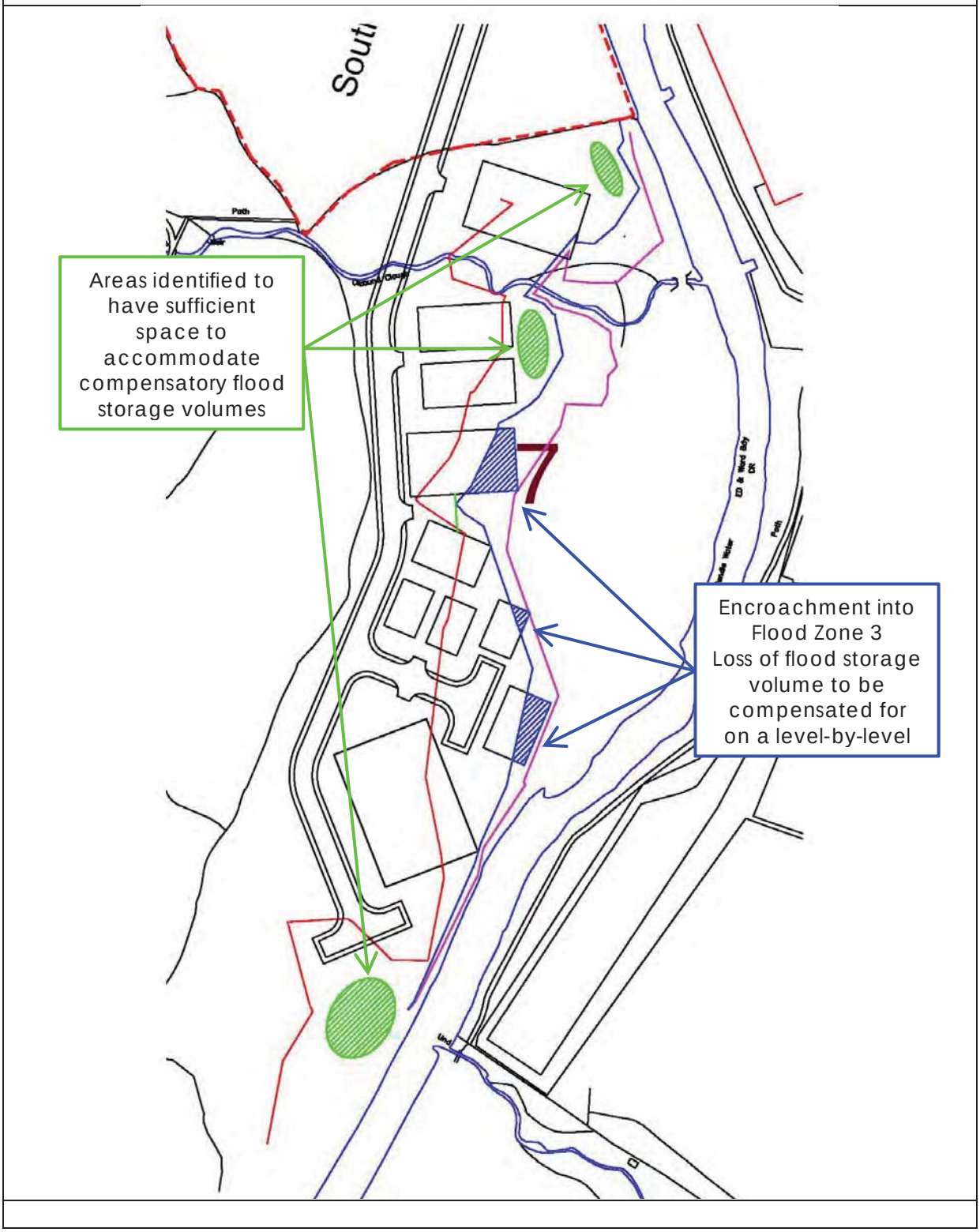
The size of the existing sewer which currently traverses the site is unknown, however fir pipes up to 450mm diameter and less than 4 metres deep, the required easement is 3.0 metres either side of the pipe.

The Environment Agency usually requires an 8 metre easement adjacent to the river bank of a watercourse which is designated as 'Main River' to facilitate inspection and maintenance works; and assist pollution prevention.

7.8 Consents

In accordance with the requirements of the Water Resources Act 1991 and the Flood and Water Management Act 2010, any scheme to discharge surface water to Pendle Water will require formal consent from the Environment Agency.

Figure 7.5: Areas of Encroachment & Compensation



7.9 Foul and Surface Water Drainage Design

Design and construction of the drainage system, which is able to suitably manage flows and volumes resulting from the development to appropriate levels; will ensure the following:

- Separate foul and surface water systems.
- Designed in accordance with Sewers for Adoption 7th Edition; current Building Regulations; and any other appropriate drainage design criteria.
- The designed system will be offered for adoption to United Utilities in accordance with Section 104 of the Water Industry Act 1991.
- Any SUDS elements will be designed in accordance with CIRIA C697 The SUDS Manual.
- Post-development 1 in 1 year surface water runoff will be maintained within the pipes and manholes of the drainage system.
- Post-development 1 in 30 year surface water runoff is allowed to surcharge, but no surface flooding is permitted.
- Post-development 1 in 100 year plus 30% climate change surface water runoff is allowed to flood at surface level, but the development must be designed to prevent surface water from entering buildings within the site; migrating beyond the development boundary; or allowed to spill into Pendle Water, in order to prevent the increase in flood risk to neighbouring development or land downstream of the site.
- Source control methods such as rainwater harvesting and/or green roof technology; and permeable paving should be considered for incorporation into the proposed drainage strategy for the development; to ensure interception of the first 5mm rainfall; and also minimise any increase in surface water runoff volumes leaving the development site.

8.0 Conclusions & Recommendations

The proposed development at land located to the west of the existing Lomeshaye Industrial Estate covers a total area of 28.4 Hectares.

A detailed assessment indicates that the development is predominantly located within Flood Zone 1; with the southernmost part of the development situated within Flood Zones 2 and 3 of the Environment Agency Flood Map.

The site therefore ranges in fluvial flood risk from low to high; and the primary sources of flood risk identified to be from Pendle Water, and an increase in surface water runoff resulting from the development.

The current development plans are not yet finalised; however the site is divided into 2No distinct areas as follows:

- Area 1 – 24.1Ha located to the north of Old Laund Clough and Pendle Water.
- Area 2 – 4.3Ha located west of Pendle Water and along the north and south banks of Laund Clough.

Following assessment of each development area it is concluded that Area 1 is principally elevated above the fluvial floodplain associated with Pendle Water; however Area 2, is located within Flood Zones 1, 2, 3a and 3b.

In terms of vulnerability only water compatible and essential development is permitted within Flood Zone 3b, which is defined as functional flood plain.

Furthermore, any development located within Flood Zone 3a, will require the provision of compensatory flood storage.

The latest development layout available for this area of the site indicates an arrangement of 10No. Units; which lie predominantly within Flood Zones 1 and 2; with minor encroachment into Flood Zone 3a; with no development shown within Flood Zone 3b i.e. the functional floodplain.

There are areas identified within the development plan where the provision of suitable flood storage compensation could be sited. It is highlighted that such flood storage areas must be provided outside of the existing floodplain on a level-by-level basis. The final development proposals must be able to demonstrate this in order to ensure that the flood risk to others is not increased as a result of the development.

Furthermore, it is identified that the access road lies mostly within Flood Zone 1 and as such during flood conditions within Pendle Water there is an assurance that a safe and access and egress is available from the site at all times.

For development located within Flood Zone 1, it is recommended that the ground floor levels of the proposed buildings are set at a minimum of 150mm above external ground levels.

For the road and buildings within Flood Zone 2, the finished floor levels must be set as follows:

- Minimum of 600mm above the 1 in 100 year flood level i.e. 106.15 + 0.6 = 106.75mAOD; or
- Minimum of 300mm above the 1 in 100 year flood level i.e. 106.15 + 0.3 = 106.45mAOD plus an additional 300mm flood resistance/resilience measures.

It is also recommended that installation of suitable signage is provided as part of the development plans within Area 2 to warn people, including business owners, staff and visitors to the site of the possibility of flooding within this part of the development.

In accordance with the National Planning Policy Framework, surface water from new development should be carefully managed; and must not exceed existing runoff rates and volumes.

Post development surface water runoff rates which exceed these values must be attenuated on-site prior to discharge to a receiving watercourse or sewer; or to ground via an infiltration device.

Approved Document H of the current Building Regulations sets out a hierarchy for disposal of surface water from new development, as listed below in order of preference:

- Infiltration via soakaway or other infiltration device
- Watercourse
- Sewer

Desktop investigations suggest that either full or partial infiltration from the development areas within the site may be viable. It is highly recommended therefore that percolation testing in accordance with BRE Digest 365 is undertaken to provide site specific infiltration rates for the ground to fully determine the suitability of such methods.

The ground in part is described as 'loamy'; and as such for the purposes of this assessment an infiltration rate of 0.002m/hour has been utilised. This provides a relatively conservative value for this type of soil; and indicates that due to the relatively poor rate, the disposal of surface water via infiltration methods within the required 24 hour period is not possible. As such it is suggested that a mix of infiltration and discharge to watercourse is the most efficient method for disposal of surface water from the proposed development.

An evaluation of SUDS indicates that source control methods such as permeable paving, green roof technology, or rainwater harvesting are suitable; along with bioretention areas; grassed conveyance swales; and online/offline attenuation in the form of large diameter pipes or storage tanks; and infiltration devices for inclusion with a drainage strategy for the proposed development.

It is recommended that a full evaluation of the drained areas and appropriate methods to attenuate surface water within the development is undertaken during the detailed design stage of the project.

It is highlighted that the Environment Agency will require an easement from the banks along Pendle Water approximating 8 metres; and any work within this easement area will require formal consent from them.

Investigations undertaken as part of the assessment indicate that there is an established surface water flood route within the area designated as Area 2. The depth of flooding is estimated to be less than 300mm with a flow velocity in excess of 0.25m/s. The hazard matrix provided within Table 21 indicates this to present a low hazard to people, however it is advised that this flow route cannot be impeded and should be incorporated into the final design for the site.

Secondary sources of flooding such as artificial water sources; groundwater; infrastructure failure; overland flows; and ponding have been investigated; and are deemed to present a low risk of flooding at the proposed development site.

APPENDICES

Appendix A: - Existing Site Topographical Survey

BARROWFORD ROAD
A 6069
Issues
Path (um)
Grains Barn
Old Laund Clough
Old Laund Wood
Sinks
Old Laund Hall Farm
Lomeshaye Industrial Estate
Pendle Water
Higham Clough
Path
Weir
Tanks
El Sub Sta
Garage
Raven's Clough Wood

Subject to
geotechnical
investigation

Path
Weir
Old Laund Clough
Path
Path
Tks
El Sub Sta
18
WATER
103.256
5
102.877
POINT
105.461
8
POINT
105.527
7
POINT
105.072
6
Pendle Water
WATER
102.467
3
Path
POINT
105.505
9
POINT
105.118
10
POINT
104.746
11
102.113
WATER
4
POINT
105.616
13
POINT
105.060
12
POINT
104.938
14
POINT
104.785
15
101.526
WATER
5
POINT
103.997
17
POINT
104.361
16
POINT
104.379
18
POINT
104.141
19
Track

Appendix B: - Preliminary Development Plans

Development layout for the south of the site has been superseded (see next page)

Subject to geotechnical investigation

BARROWFORD ROAD

A 6068

Issues

Path (um)

Old Laund Clough

Hagan Clough

Pendle Water

Lomeshaye Industrial Estate

Lomeshaye Industrial Estate

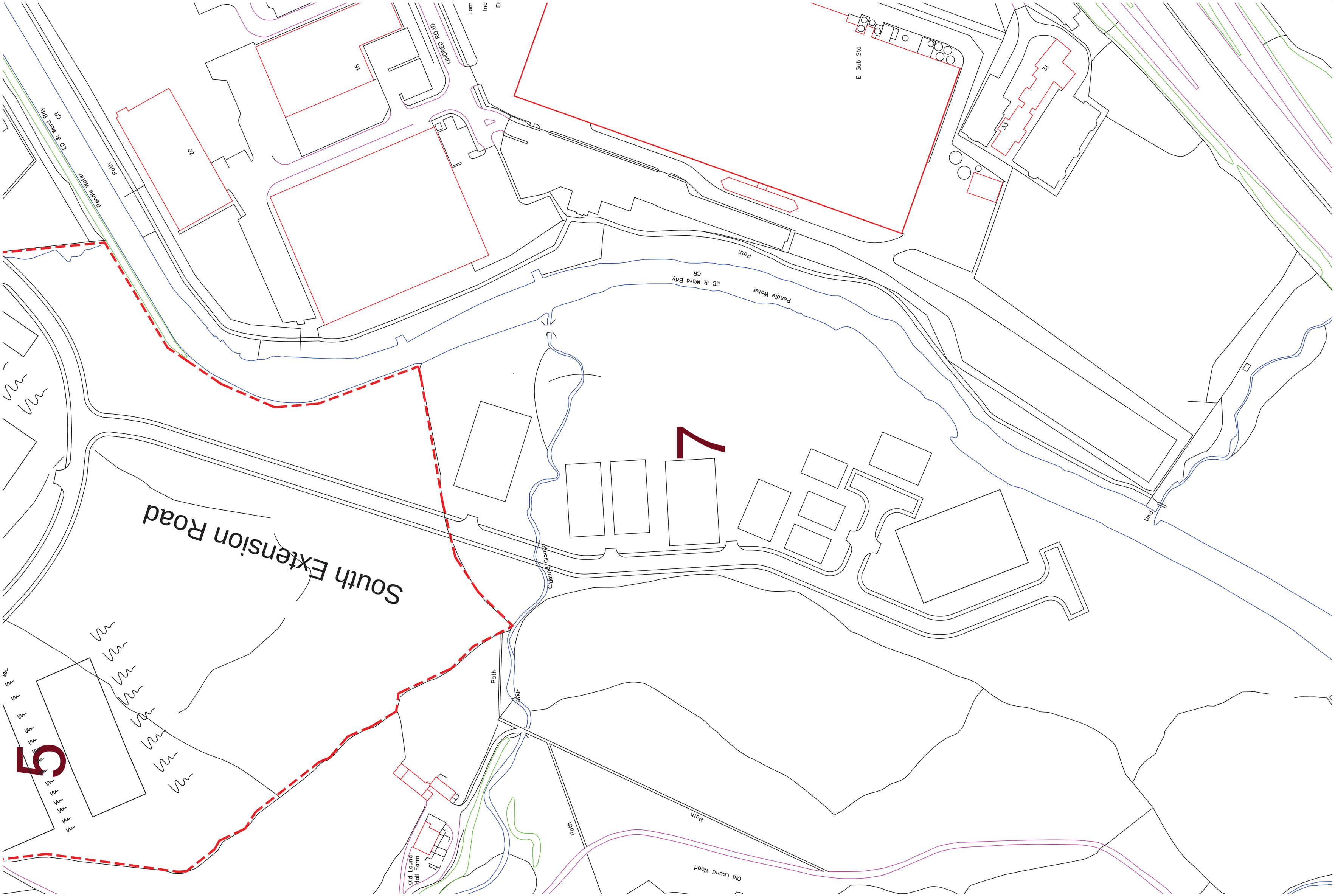
Old Laund Wood

Sinks

Grains Barn

Clough

aven's Clough Wood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Path
Pendle Water
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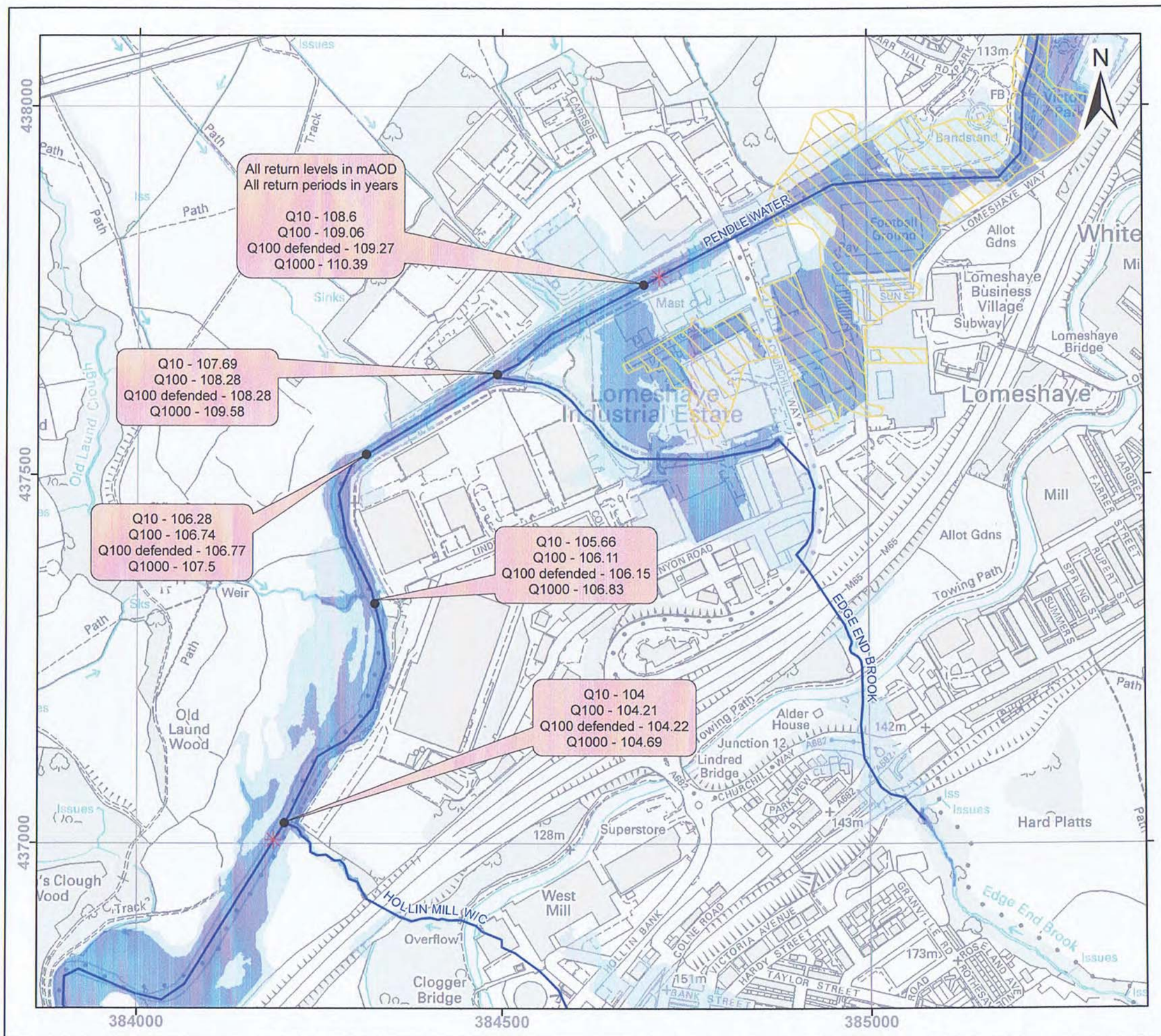
Pendle Water
ED & Ward Bdy
CR
7
South Extension Road
5
Path
Weir
Path
Path
Old Lound Wood
Old Lound Hall Farm
Ogburn Clough
Und

Appendix C: -Environment Agency Data



Environment Agency

Flood Level Map: Pendle Water, Lomeshaye

Produced: 01 November 2013
Our Ref: NTH-0393HR
NGR: SD8418837003 to SD8471637769

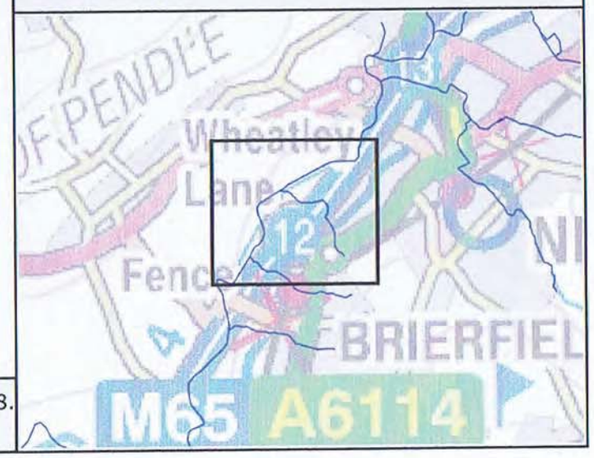
Key

- Main River
- Historic Flooding
- Flood Zone 3
- Flood Zone 2

Flood Zone 3 shows the are that could be affected by flooding:
- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

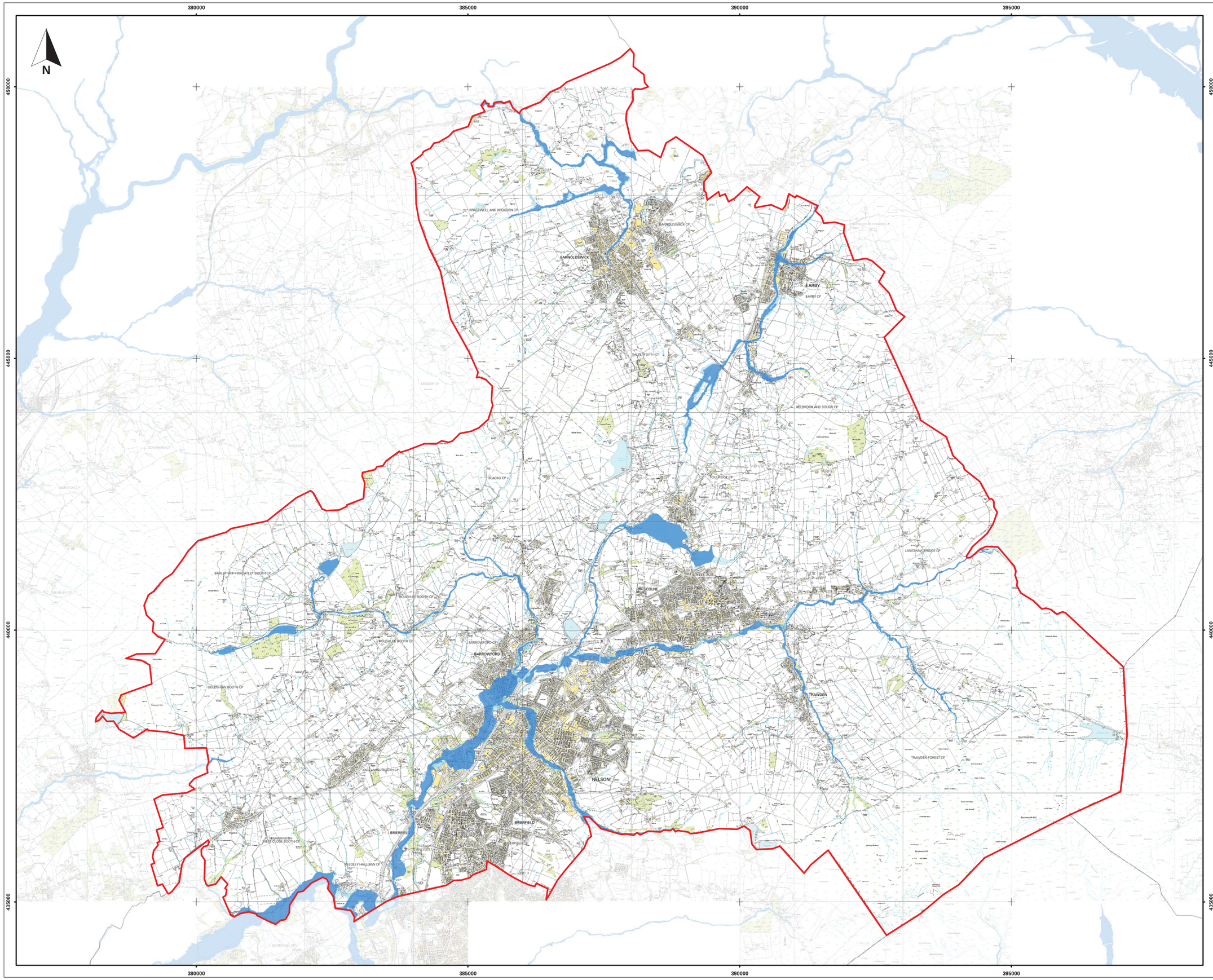
Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occurring each year.

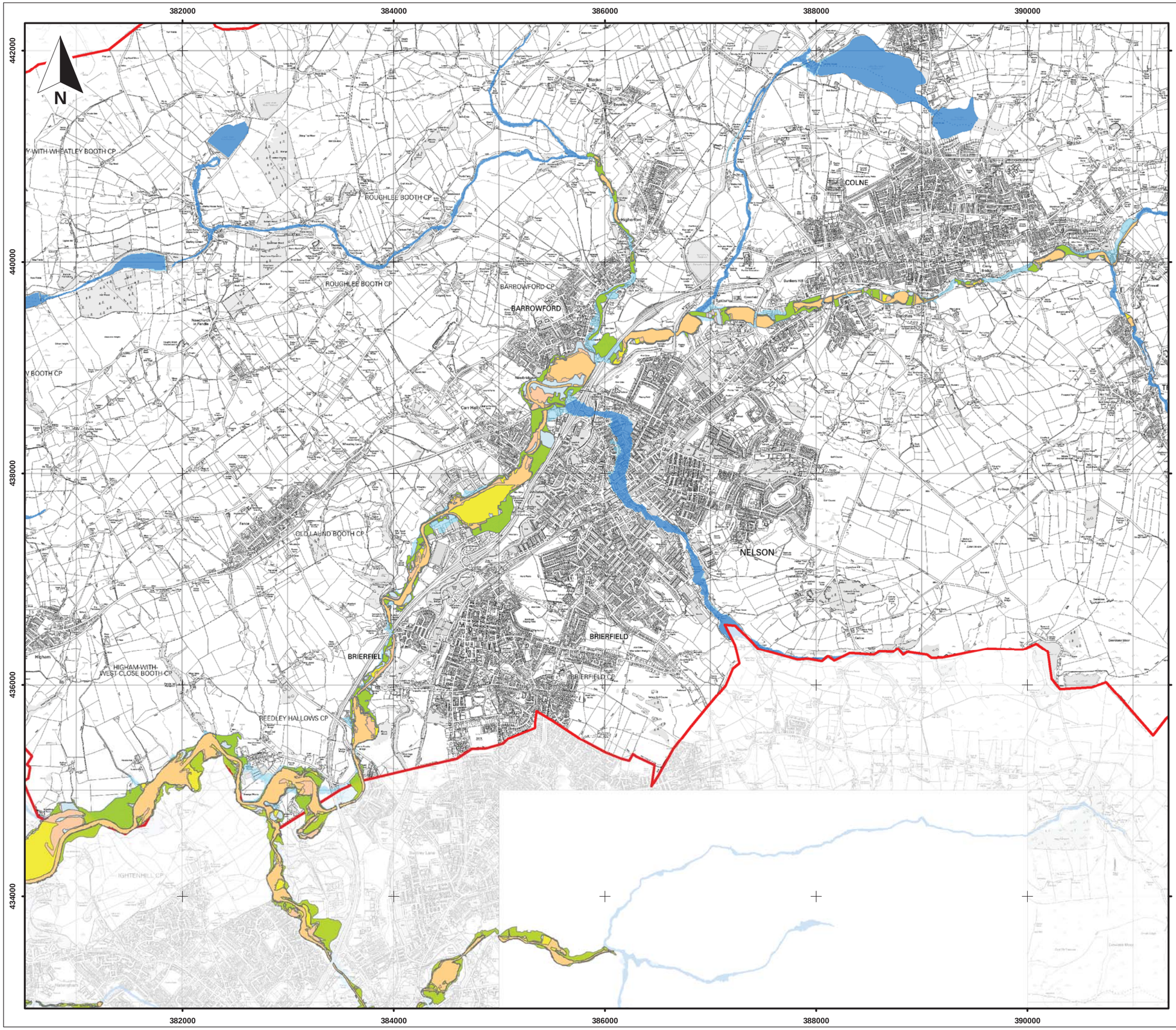
ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 1 in 200 tidal, or 1 in 100 fluvial flood event.



Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Appendix D: - SFRA Mapping





Project Path: G:/MODEL/PROJECTS/HM-250/18108/Figures/Figures August 2006/18108_s10a_Fig_5-6.mxd

Pendle Borough Council
SFRA Stage 2 Report

Figure 5.6
Section 105 Modelled Flood Extents - Calder Catchment

October 2006
18108-S10a cookc

Entec

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Planning & Building Control
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If you would like this information in a way which is better for you, please telephone us.

اگر آپ یہ معلومات کسی ایسی شکل میں چاہتے ہیں، جو کہ
آپ کے لئے زیادہ مُفید ہو تو برائے مہربانی ہمیں ٹیلیفون کریں۔