

FLOODING & DRAINAGE ASSESSMENT

FOR A PROPOSED MIXED RESIDENTIAL AND EDUCATION LAND ALLOCATION FOR LAND OFF LOWER EDGE ROAD AND SHAW LANE, ELLAND IN SUPPORT OF DRAFT CALDERDALE LOCAL PLAN ALLOCATION LP0978

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1.0 INTRODUCTION

- 1.01 Following instructions from Walker Morris on behalf of P & J Boyle & Son on 04 February 2016, CoDA Structures have undertaken an assessment of flooding and drainage issues in relation to a proposed site off Lower Edge Road and Shaw Lane, Elland for a proposed mixed residential use and education land allocation.
- 1.02 The report has been prepared in support of draft Calderdale Local Plan allocation LP0978.
- 1.03 The site is currently fields.
- 1.04 The local authority is Calderdale Metropolitan District Council (CMDC).

2.0 POLICY CONSIDERATIONS AND OBJECTIVES

2.01 National Planning Policy Framework:

Section 10 of the National Planning Policy Framework (NPPF) published in March 2012 sets out Government policy on development and flood risk for England. It aims to ensure that flood risk is taken into account at all stages of the planning process, to avoid inappropriate developments in areas at risk of flooding, and to direct development away from areas of highest risk. Where new development is thought necessary in areas of flood risk, the NPPF aims to make it safe, without increasing flood risk elsewhere, and, where possible, reduce the overall flood risk.

The NPPF promotes a sequential risk-based approach to determine the suitability of land for development in flood risk areas. The broad aim of the NPPF is to reduce the number of people and properties within the natural and built environment at risk of flooding. To achieve this aim, planning authorities are required to ensure that flood risk is properly assessed during the initial planning stages of any development.

2.02 Consideration and Objectives:

This Flooding and Drainage Assessment Report will consider the following:-

- whether the proposed development is likely to be affected by flooding.
- whether the proposed development will increase flood risk to adjacent properties.

The report will also demonstrate that any existing flood risk or flood risk associated with the proposed development can satisfactorily managed. This will include:-

- whether the proposed development is likely to be affected by flooding and whether it will increase flood risk elsewhere.

- specifying the measures proposed to deal with the identified risks, including, where appropriate, proposals to reduce existing and/or future flood risk levels.
- satisfy the Local Authority that any flood risk to the development or additional risk arising from the proposal will be successfully managed so the site can be developed and occupied safely without risk to adjacent properties.

3.0 FLOODING ISSUES

3.01 The Site:

The site is located to the north of Lower Edge Road and lies approximately 1.0km to the northeast of Elland Town Centre. A site location plan (Fig. 1) is attached in Appendix A.

The Ordnance Survey co-ordinates for the centre of the site are 412070mE, 421530mN.

The site is approximately 8.4 hectares in area.

The site is currently grassland.

The general fall of the site is to the northeast.

A site aerial photograph is attached in Appendix C.

There is a watercourse in the north western sector of the site which is associated with a groundwater issue adjacent the southern boundary. The Environment Agency River Network Map also indicates a culverted watercourse runs into the open watercourse on the site from the south.

The Environmental Agency River Network Map also indicates there is a culverted watercourse in the north eastern sector of the site. This watercourse (part open, part culverted) lies adjacent the eastern boundary in the southern sector of the site. The source of this watercourse again appears to be associated with groundwater issues in the vicinity of the site.

From the inspection of OS maps and the Environment Agency River Network Map, there are further watercourses in the vicinity of the site as follows:-

- Culverted watercourse adjacent the northern boundary.
- Unnamed watercourse approximately 30m to the northeast.
- River Calder approximately 100m to the northeast.
- Unnamed watercourse approximately 375m to northeast
- Culverted watercourse approximately 750m to the northeast
- Unnamed watercourse approximately 800m to the west

There are groundwater issues approximately 700m to the southwest and 950m to the south of the site.

The Calder and Hebble Navigation is approximately 650m to the north of the site.

The position of the watercourses are indicated on the Site Location Plan (Fig. 1) attached in Appendix A and the Environment Agency River Network Map attached in Appendix D.

3.02 Flood Zone Classification:

The site is located within Flood Zone 1 on the EA flood map. This zone comprises land assessed as having less than 1 in 1000 (<0.1%) annual probability of tidal or river flooding in any year.

A copy of the EA flood map is attached in Appendix E.

3.03 Sources of Flood Risk:

The following table shows a summary of the forms of flood and the potential issues in relation to the site that require further assessment.

| Flood Source | Applicable | Comment |
|--------------------------|------------|--|
| Fluvial | ✓ | Water courses are present on the site |
| Tidal | X | |
| Run Off | ✓ | Potential for run off from higher land to the south of the site. |
| Groundwater | ✓ | Groundwater emergence may occur on the hillside. |
| Sewers | ✓ | There is a public combined sewer in Lower Edge Road adjacent the site. |
| Reservoirs, Canals, etc. | ✓ | Calder and Hebble Navigation approximately 650m to the north. |

3.04 Flood Risk Assessment:

The site is within Flood Zone 1. This zone comprises land assessed as having less than a 1 in 1000 (<0.1%) annual probability of tidal or river flooding in any one year.

Modelled and recorded flood levels for the River Calder have been requested from the EA but these have not yet been received.

The watercourses on the site may be a source of localised fluvial flooding that has not been captured on the EA flood map.

From inspection of the EA Website Risk of Flooding from Surface Water Maps, it would appear there is a very low risk (less than 1 in 1000 [0.1%]) of surface water flooding affecting the majority of the site. However, there is a low risk (between 1 in 1000 [0.1%] and 1 in 100 [1.0%]) of surface water flooding affecting two areas of the northern sector. These areas appear to correspond with the open and culverted

watercourses on the site. There is a low to high chance of less than 300mm depth of flooding affecting these areas of the site. It should be noted that surface water flooding can be difficult to predict and occurs when rainwater does not drain away through the 'normal' drainage systems or soaks into the ground but lies on or flows over the ground instead.

The EA Website Risk of Flooding from Surface Water Maps are attached in Appendix F.

The site owner has advised that the site did not flood on 26 December 2015.

The site is not considered to be at risk from potential overland flood waters from higher ground to the south as any such flood waters would tend to flow onto Lower Edge Road and along the road past the site to the west or on to Shaw Lane and along the road to the north.

As the site is on a hillside, groundwater emergence may occur on the site particularly after prolonged periods of rainfall.

The site is not considered to be at risk from potential overland flood waters from possible overloading of the public combined sewer in Lower Edge Road adjacent the site as any such flood waters would tend to run along the road past the site to the west.

3.05 **Sequential Test:**

The Sequential Test should be applied at all stages of planning. Its aim is to steer new development to areas at the lowest probability of flooding.

Table 2 of the Technical Guidance to the NPPF (which categorises the flood risk vulnerability of land uses) indicates the proposed development is categorised as a 'more vulnerable' land use.

From the EA flood zone map site is identified as being Flood Zone 1.

Table 3 of the Technical Guidance to the NPPF indicates where the proposed land use is 'more vulnerable' development is appropriate in Flood Zone 1. Therefore the Sequential Test has been passed.

3.06 **Exception Test**

Table 3 of the Technical Guidance to the NPPF indicates where the proposed land use is 'more vulnerable' development is considered appropriate in Flood Zone 1 and the Exception Test is not required.

Notwithstanding the above the following sections of this report will demonstrate that the proposed development will be safe from flooding and will not increase flood risk to the surrounding catchment.

3.07 Effect of Development on the Wider Catchment:

The proposed development will result in impermeable area on the site and unattenuated surface water flows from the development would increase flood risk to the receiving watercourses in the wider catchment. This is assessed in detail in the drainage section of this report.

3.08 Flood Risk Mitigation:

To protect the dwellings within the building from potential fluvial flooding from the watercourses on the site, the ground floor levels on the development should be set 0.15 – 0.30m above existing level.

All existing overland flood routes on the site should be maintained.

The external levels around the development should be set to route any overland flood waters away from the proposed building to the north as the existing situation.

4.0 DRAINAGE

4.01 Public Sewers:

There is a combined sewer in Lower Edge Road adjacent the site.

An extract from the public sewer record is attached in Appendix G.

4.02 Existing Drainage:

There are no known or recorded drainage systems on the site.

4.03 Geology:

BGS Geological Sheet 77 Huddersfield indicates the following:-

- The site is underlain by the Lower Coal Measures Formation of the Westphalian Age.
- The Middle Band Coal Seam outcrops in the northern sector of the site.
- No faults or abnormal features appear to be present on or in the vicinity of the site.
- Glacial fluvial deposits (sand and gravel with thin bands of clay) are likely to be present at the surface in the northern sector.
- There is an area of recorded made ground adjacent the northern boundary of the site.

- There is a large area of recorded made ground 100m to the north of the site.
- There is an area of infilled ground adjacent the eastern boundary of the site.

A record mine shaft log (Ref: SE12SW35/C) viewed on the BGS website, undertaken adjacent Shaw Lane approximately 50m to the east of the site, indicates the following sequence of strata:-

| Shaft (SE12SW35/C) | |
|---------------------------|----------------------|
| Strata | Thickness (m) |
| Black shale | 10.06 |
| Coal | 0.15 |
| Fire clay | 1.37 |
| Hard bed band coal | 0.30 |
| Fire clay | 0.91 |
| Mudstone? | 2.74 |
| Black shale | 3.66 |
| 'Mussel Bed' bind | 1.83 |
| Black shale | 21.03 |
| Grey shale | 0.91 |
| Black shale | 0.30 |
| Hard bed coal | 0.71 |
| Ganister rock | 0.20 |
| Fire clay | 3.04 |
| Middle band coal | 0.30 |
| Black shale | 7.92 |
| Seat stone | 0.76 |
| Mudstone? | 0.61 |
| Shale and ironstone balls | 9.45 |
| Soft bed coal | 0.46 |
| Seat earth | 0.91 |

4.04 **Ground Conditions:**

A ground investigation has not been undertaken on the site. However, the Phase 1 Environmental Assessment on the site indicates the site may have been a landfill site.

4.05 **Foul Water:**

A separate foul water drainage system should be provided on the development discharging to the public combined sewer in Lower Edge Road adjacent the site. In view of the site topography a foul pumping station will be required on the development.

4.06 **Environmental Setting:**

The site is underlain by a bedrock aquifer designated as a Secondary Aquifer – A which is strata which contains permeable layers capable of supporting water supplies at a local rather than strategic scale and in some cases forming an important source of

base flow to rivers.

The site is underlain by a superficial aquifer which is designated as a Secondary Aquifer – A which is strata which contains permeable layers capable of supporting water supplies at a local rather than strategic scale and in some cases forming an important source of base flow to rivers.

There are 9 no. water abstraction licenses held within 1000m of the site and details are summarised as follows:-

- surface abstraction for general use (2 no.) 165m to the northeast
- surface abstraction for unclassified use 165m to the northeast
- surface abstraction for cooling 407m to the north
- surface abstraction for general use (3 no.) 593m to the southeast
- groundwater abstraction for domestic use 889m to the north
- groundwater abstraction for domestic use 989m to the north
- groundwater abstraction for general use 989m to the north

The site does not lie within a Source Protection Zone.

The use of infiltration drainage on the site has not yet been discussed with the EA Groundwater Protection Team. However, it is considered that, if ground conditions are suitable, the use of infiltration drainage on the development would be acceptable in principle. Any scheme will need to include adequate treatment prior to infiltration and this should follow the guidance given in the CIRIA 697 The SUDS Manual.

4.07 **Surface Water Drainage:**

The ground conditions on the site, except possibly in the northern sector if landfill materials are not present, are likely to be such that the use of soakaways on the development are unlikely to be feasible or appropriate.

In addition, use of soakaways on a hillside is not recommended, even if ground conditions prove favourable, as percolating water could possibly break out the hillside 'down slope' causing flooding.

It is therefore proposed to discharge surface water from the development to one of the watercourses on the site at greenfield run-off.

The greenfield run-off for the site has been calculated using the IH124 method as 3.42 l/sec. The calculation is attached in Appendix H.

Stormwater storage on the development should be designed on a 1:100 storm return period with a 30% increase on rainfall intensity to cater for climate change. In order to provide a 'treatment' on the surface water prior to discharge to water course the storage should be in the form of swales or dry detention basins.

In addition, the hardcover area of the development should be increased by 10% to cater for Urban Creep in the future.

5.0 SUMMARY

| | |
|------------------------------|---|
| The Site | <p>The site is located to the north of Lower Edge Road and lies approximately 1.0km to the northeast of Elland Town Centre.</p> <p>The Ordnance Survey co-ordinates for the centre of the site are 412070mE, 421530mN. The site is approximately 8.4 hectares in area.</p> <p>The site is currently grassland.</p> <p>The general fall of the site is to the northeast.</p> <p>There is a watercourse in the north western sector of the site which is associated with a groundwater issue adjacent the southern boundary. The Environment Agency River Network Map also indicates a culverted watercourse runs into the open watercourse on the site from the south.</p> <p>The Environmental Agency River Network Map also indicates there is a culverted watercourse in the north eastern sector of the site. This watercourse (part open, part culverted) lies adjacent the eastern boundary in the southern sector of the site. The source of this watercourse again appears to be associated with groundwater issues in the vicinity of the site.</p> <p>From the inspection of OS maps and the Environment Agency River Network Map, there are further watercourses in the vicinity of the site as follows:-</p> <ul style="list-style-type: none"> - Culverted watercourse adjacent the northern boundary. - Unnamed watercourse approximately 30m to the northeast. - River Calder approximately 100m to the northeast. - Unnamed watercourse approximately 375m to northeast - Culverted watercourse approximately 750m to the northeast - Unnamed watercourse approximately 800m to the west <p>There are also groundwater issues approximately 700m to the southwest and 950m to the south of the site.</p> <p>The Calder and Hebble Navigation is approximately 650m to the north of the site.</p> |
| Flood Risk Assessment | <p>The site is within Flood Zone 1. This zone comprises land assessed as having less than a 1 in 1000 (<0.1%) annual probability of tidal or river flooding in any one year.</p> <p>Modelled and recorded flood levels for the River Calder have been requested from the EA but these have not yet been received</p> <p>From inspection of the EA Website Risk of Flooding from Surface Water Maps, it would appear there is a very low risk (less than 1 in 1000 [0.1%]) of surface water flooding affecting the majority of the site. However, there is a low risk (between 1 in 1000 [0.1%] and 1 in 100 [1.0%]) of surface water flooding affecting two areas of the northern sector.</p> <p>These areas appear to correspond with the open and culverted watercourses on the site.</p> <p>There is a low to high chance of less than 300mm depth of flooding affecting these areas of the site. It should be noted that surface water flooding can be difficult to predict and occurs when rainwater does not drain away through the 'normal' drainage systems or soaks into the ground but lies on or flows over the ground instead.</p> <p>The site owner has advised that the site did not flood on 26 December 2015.</p> <p>The watercourses on the site may be a source of localised fluvial flooding that has not been captured on the EA flood map.</p> <p>The site is not considered to be at risk from potential overland flood waters from higher ground to the south as any such flood waters would tend to flow onto Lower Edge Road and along the road past the site to the west or on to Shaw Lane and along the road to the north.</p> <p>As the site is on a hillside, groundwater emergence may occur on the site particularly after prolonged periods of rainfall.</p> <p>The site is not considered to be at risk from potential overland flood waters from possible overloading of the public combined sewer in Lower Edge Road adjacent the site as any such flood waters would tend to run along the road past the site to the west or on</p> |

| | |
|------------------------------|--|
| | to Shaw Lane and along the road to the north. |
| Sequential Test | <p>The Sequential Test should be applied at all stages of planning. Its aim is to steer new development to areas at the lowest probability of flooding.</p> <p>Table 2 of the Technical Guidance to the NPPF (which categorises the flood risk vulnerability of land uses) indicates the proposed development is categorised as a 'more vulnerable' land use.</p> <p>From the EA flood zone map site is identified as being Flood Zone 1.</p> <p>Table 3 of the Technical Guidance to the NPPF indicates where the proposed land use is 'more vulnerable' development is appropriate in Flood Zone 1. Therefore the Sequential Test has been passed.</p> |
| Exception Test | <p>Table 3 of the Technical Guidance to the NPPF indicates where the proposed land use is 'more vulnerable' development is considered appropriate in Flood Zone 1 and the Exception Test is not required.</p> <p>Notwithstanding the above the following sections of this report will demonstrate that the proposed development will be safe from flooding and will not increase flood risk to the surrounding catchment.</p> |
| Flood Risk Mitigation | <p>To protect the dwellings within the building from potential fluvial flooding from the watercourses on the site, the ground floor levels on the development should be set 0.15 – 0.30m above existing level.</p> <p>The existing overland flood routes on the site should be maintained.</p> <p>The external levels around the development should be set to route any overland flood waters away from the proposed building to the north as the existing situation.</p> |
| Foul Drainage | <p>A separate foul water drainage system should be provided on the development discharging to the public combined sewer in Lower Edge Road adjacent the site. In view of the site topography a foul pumping station will be required on the development.</p> |
| Surface Water | <p>The ground conditions on the site, except possibly in the northern sector if landfill materials are not present, are likely to be such that the use of soakaways on the development are unlikely to be feasible or appropriate.</p> <p>In addition, use of soakaways on a hillside is not recommended, even if ground conditions prove favourable, as percolating water could possibly break out the hillside 'down slope' causing flooding.</p> <p>It is therefore proposed to discharge surface water from the development to one of the watercourses on the site at greenfield run-off.</p> <p>The greenfield run-off for the site has been calculated using the IH124 method as 3.42 l/sec. The calculation is attached in Appendix H.</p> <p>Stormwater storage on the development should be designed on a 1:100 storm return period with a 30% increase on rainfall intensity to cater for climate change. In order to provide a 'treatment' on the surface water prior to discharge to water course the storage should be in the form of swales or dry detention basins.</p> <p>.In addition, the hardcover area of the development should be increased by 10% to cater for Urban Creep in the future.</p> |

6.0 CAVEATS

- 6.01 The comments given in this report and recommendations made are based on the information that could be obtained from reasonably accessible sources. Detailed discussions have not yet been held with statutory bodies and the local authority.
- 6.02 This report has been prepared for the sole use of P & J Boyle & Son and their development funders, unless agreed otherwise in writing by CoDA Structures.

Signed:



J Lawrence B Eng C Eng M I Struct E

CoDa Structures

Consulting Civil & Structural Engineers
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Guiseley
Leeds LS20 8FD

**FLOODING & DRAINAGE ASSESSMENT
FOR A PROPOSED MIXED RESIDENTIAL AND
EDUCATION LAND ALLOCATION FOR LAND OFF
LOWER EDGE ROAD AND SHAW LANE, ELLAND**

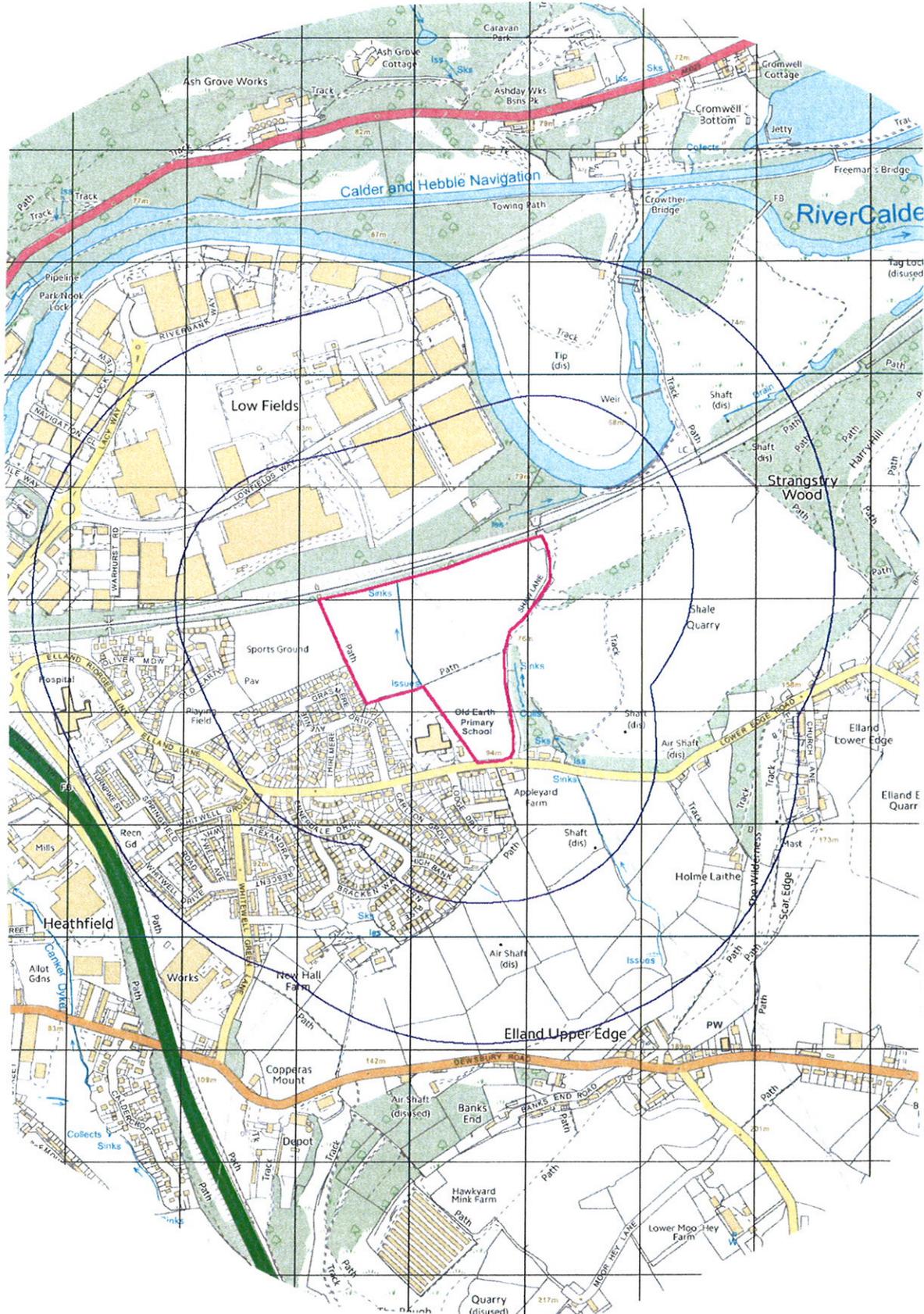
APPENDIX A

SITE LOCATION PLAN - FIG. 1

CoDa Structures

Consulting Civil & Structural Engineers
No 2 Harewood Yard
Harewood
Leeds LS17 9LF
Tel: 0113 288 6766
Fax: 0113 288 6765

| | | | | | | | |
|---------|------------------------|---------|-------|---------|-----------|------|---|
| Project | Lower Edge Road Elland | | | | | | |
| Title | Site Location Plan | | | | | | |
| Drawn | JL | Date | 02.16 | Dr. No. | 7587/Fig1 | Rev. | - |
| Scale | 1:10000 | Checked | JL | | | | |



CoDa Structures

Consulting Civil & Structural Engineers
14 Springfield Court
Guiseley
Leeds LS20 8FD

**FLOODING & DRAINAGE ASSESSMENT
FOR A PROPOSED MIXED RESIDENTIAL AND
EDUCATION LAND ALLOCATION FOR LAND OFF
LOWER EDGE ROAD AND SHAW LANE, ELLAND**

APPENDIX B

SITE PLAN - FIG. 2



Notes

| Rev. | Content | Date |
|------|---------|------|
| | | |

| | | | |
|----------|---------------------------|---------|----------|
| Client | P & J Boyle & Son Ltd | | |
| Project | Lower Edge Road, Elland | | |
| Title | Site Topographical Survey | | |
| Drawn | RD | Date | 26.02.16 |
| Scale | 1:1000 @A1 | Checked | JL |
| Drg. No. | 7587/Fig2 | | Rev. |
| | | | - |

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**FLOODING & DRAINAGE ASSESSMENT
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APPENDIX C

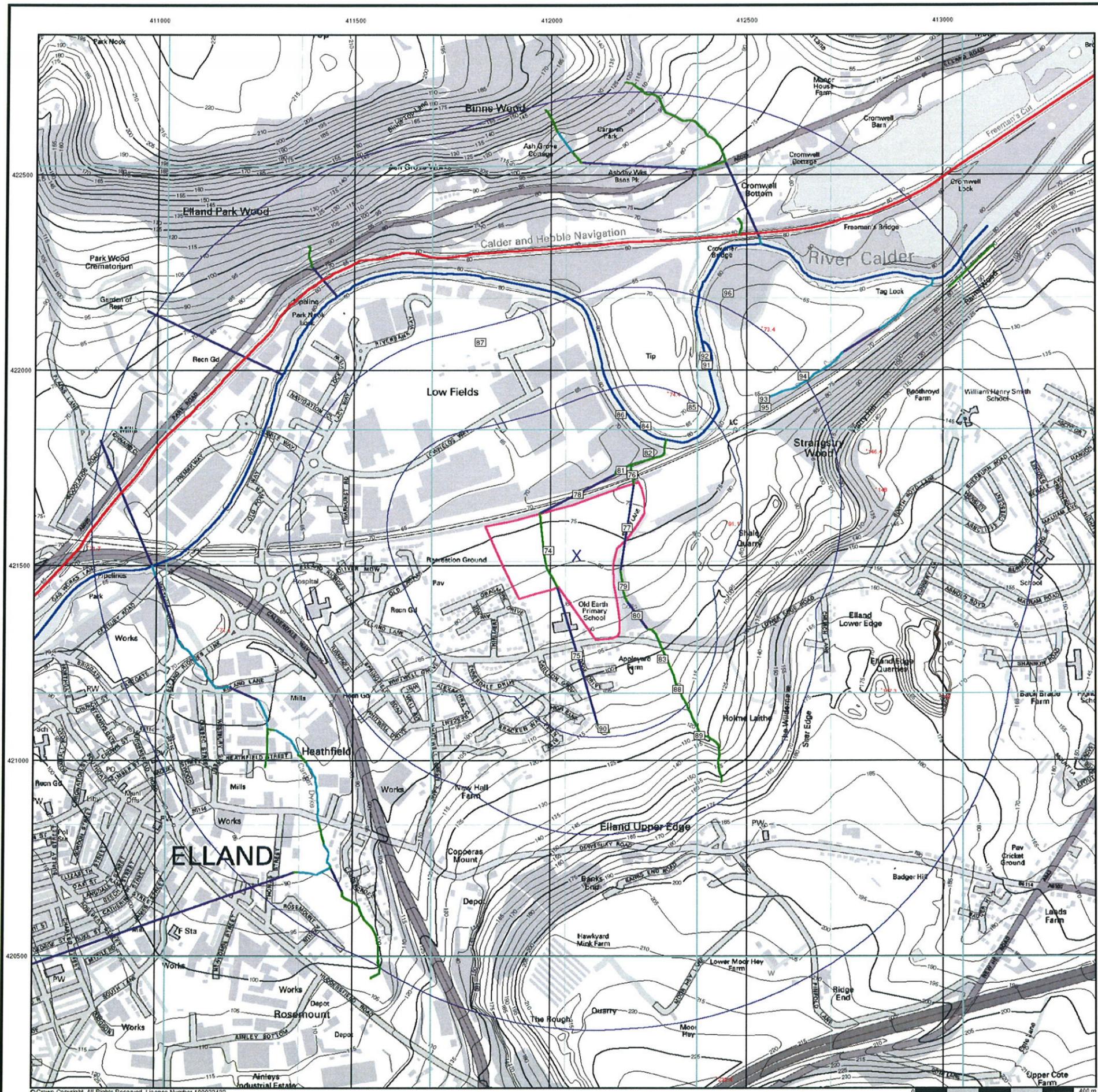
SITE AERIAL PHOTOGRAPH



1. Site Aerial Photograph.

APPENDIX D

ENVIRONMENT AGENCY RIVER NETWORK MAP



General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Map ID

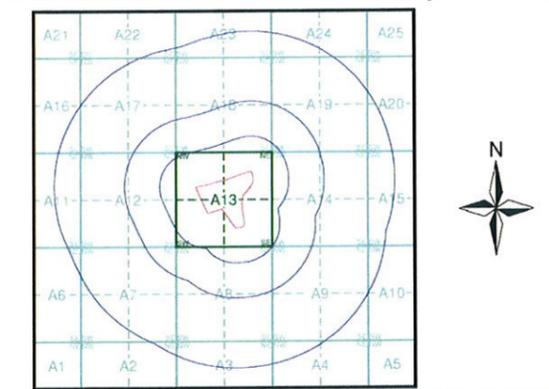
Detailed River Network Data

- Primary River
- Secondary River
- Tertiary River
- Canal
- Canal Tunnel
- Undefined River
- Lake/Reservoir
- Offline Drainage Feature
- Extended Culvert (greater than 50m)
- Underground River (inferred)
- Underground River (local knowledge)
- Downstream of High Water Mark
- Downstream of Seaward Extension
- Not assigned River feature

Contours (height in metres)

- Standard Contour
- Master Contour
- Spot Height
- MLW - Mean Low Water
- MHW - Mean High Water

EA/NRW Detailed River Network Map - Slice A



Order Details

Order Number: 79453468_1_1
 Customer Ref: 7587
 National Grid Reference: 412070, 421530
 Slice: A
 Site Area (Ha): 8.42
 Search Buffer (m): 1000

Site Details

Lower Edge Road, ELLAND, West Yorkshire, HX5 9PL



Tel: 0844 844 9952
 Fax: 0844 844 9951
 Web: www.envirocheck.co.uk

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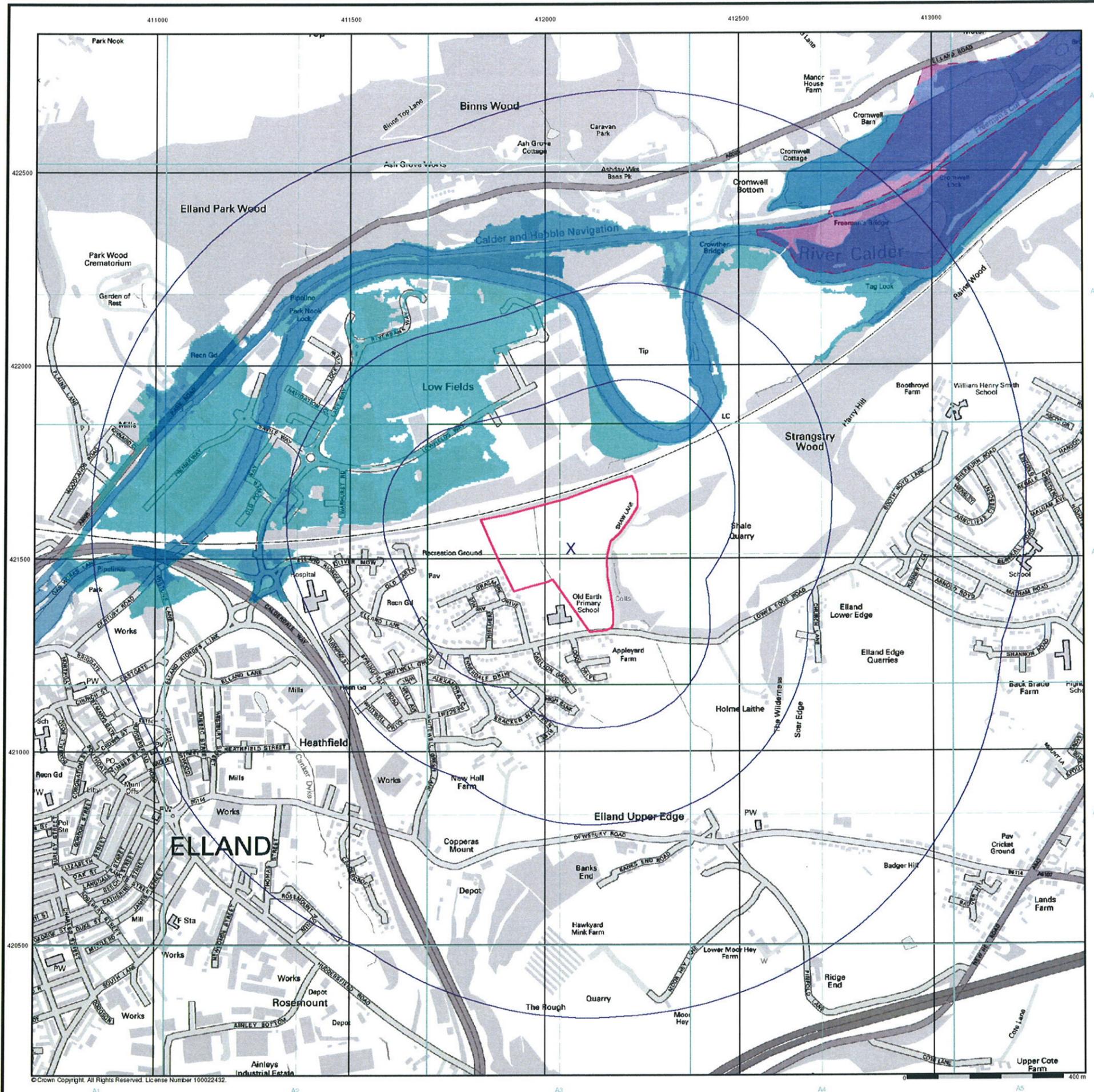
CoDa Structures

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APPENDIX E

ENVIRONMENT AGENCY FLOOD MAP



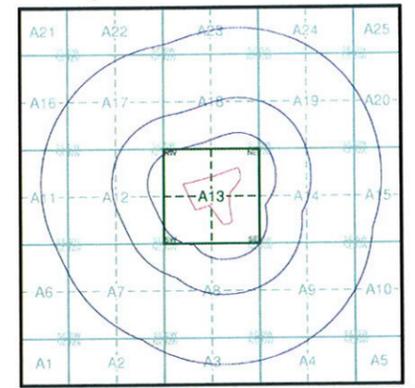
General

- Specified Site
- Specified Buffer(s)
- X Bearing Reference Point

Agency and Hydrological (Flood)

- Extreme Flooding from Rivers or Sea without Defences (Zone 2)
- Flooding from Rivers or Sea without Defences (Zone 3)
- ▨ Area Benefiting from Flood Defence
- Flood Water Storage Areas
- - - Flood Defence

Flood Map - Slice A



Order Details

Order Number: 79453468_1_1
 Customer Ref: 7587
 National Grid Reference: 412070, 421530
 Slice: A
 Site Area (Ha): 8.42
 Search Buffer (m): 1000

Site Details

Lower Edge Road, ELLAND, West Yorkshire, HX5 9PL



Tel: 0844 844 9952
 Fax: 0844 844 9951
 Web: www.envirocheck.co.uk

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APPENDIX F

ENVIRONMENT AGENCY WEBSITE RISK OF FLOODING FROM SURFACE WATER MAPS

Risk of Flooding from Surface Water

Surface water flooding happens when rainwater does not drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead.

The shading on the map shows the risk of flooding from surface water in this particular area.

Click on the map for a more detailed explanation.

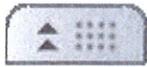
Map of HX5 9PL at scale 1:10,000

Data search



| Map legend | |
|-------------------------------------|---|
| <input checked="" type="checkbox"/> | Risk of Flooding from Surface Water |
| | High |
| | Medium |
| | Low |
| | Very Low |
| <input checked="" type="checkbox"/> | Other national environmental organisations |
| | Natural Resources Wales Area of responsibility |
| | Scottish Environment Protection Agency Area of responsibility |

Customers in Wales - From 1 April 2013 Natural Resources Wales (NRW) will take over the responsibilities of the Environment Agency in Wales.
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Surface Water Depth - Low Chance of Occurring

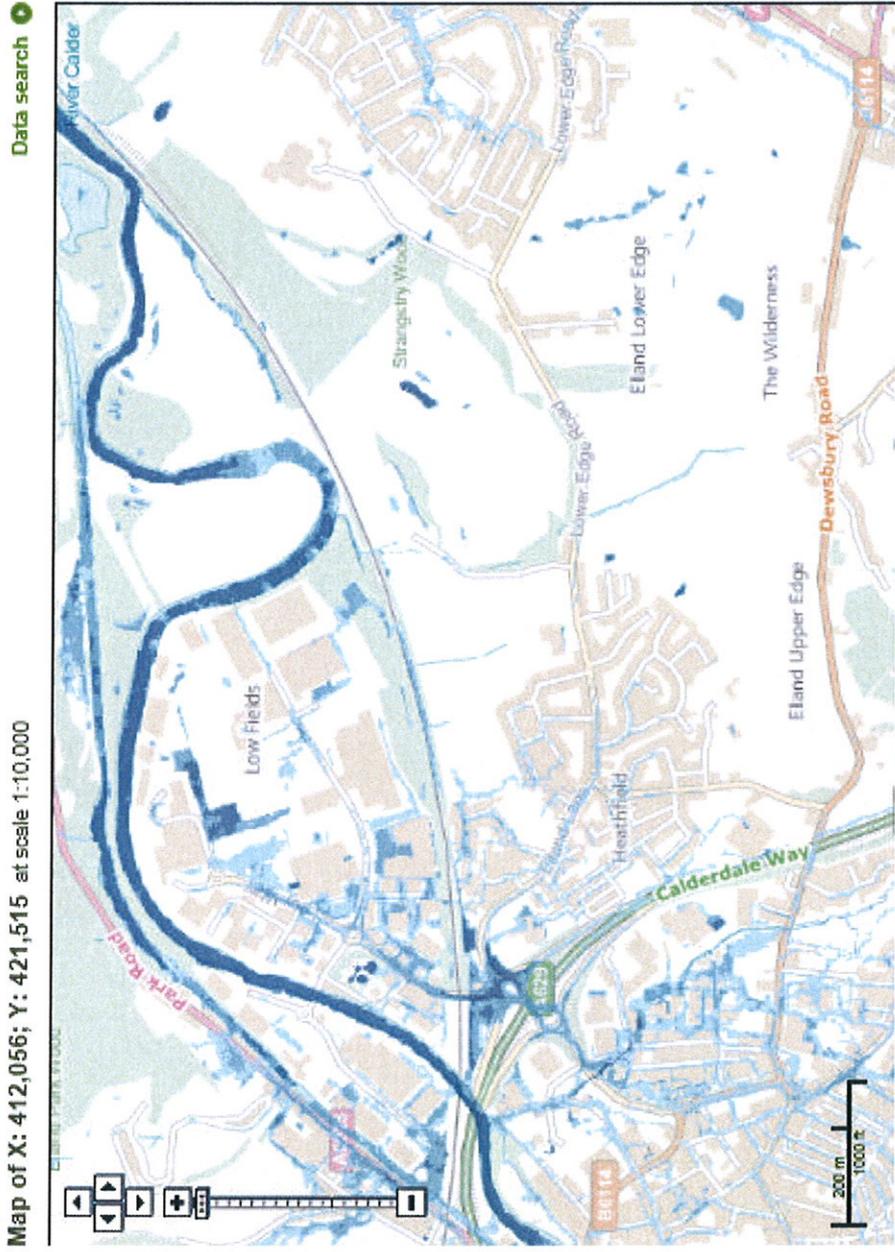
Surface water flooding happens when rainwater does not drain away through the normal drainage systems or soaks into the ground, but lies on or flows over the ground instead.

The shading on the map shows the estimated water depth when there is a low chance of flooding.

Click in the legend to see estimated water depths for high and medium chances of flooding, and for estimated velocity (speed and direction of the water).

Map of X: 412,056; Y: 421,515 at scale 1:10,000

| | |
|---|---|
| Map legend | |
| <input checked="" type="checkbox"/> | Surface Water Depth - Low Chance of Occurring |
| <input type="checkbox"/> | Over 800mm |
| <input type="checkbox"/> | 300-800mm |
| <input type="checkbox"/> | Below 300mm |
| Other national environmental organisations | |
| <input checked="" type="checkbox"/> | Natural Resources Wales Area of responsibility |
| <input type="checkbox"/> | Scottish Environment Protection Agency Area of responsibility |
| Chance of occurring | |
| <input checked="" type="radio"/> | Low |
| <input type="radio"/> | Medium |
| <input type="radio"/> | High |
| Other layers | |
| Switch to layer: | |
| <input type="checkbox"/> | Surface water extent |
| <input type="checkbox"/> | Surface water velocity |



Customers in Wales - From 1 April 2013 Natural Resources Wales (NRW) will take over the responsibilities of the Environment Agency in Wales.
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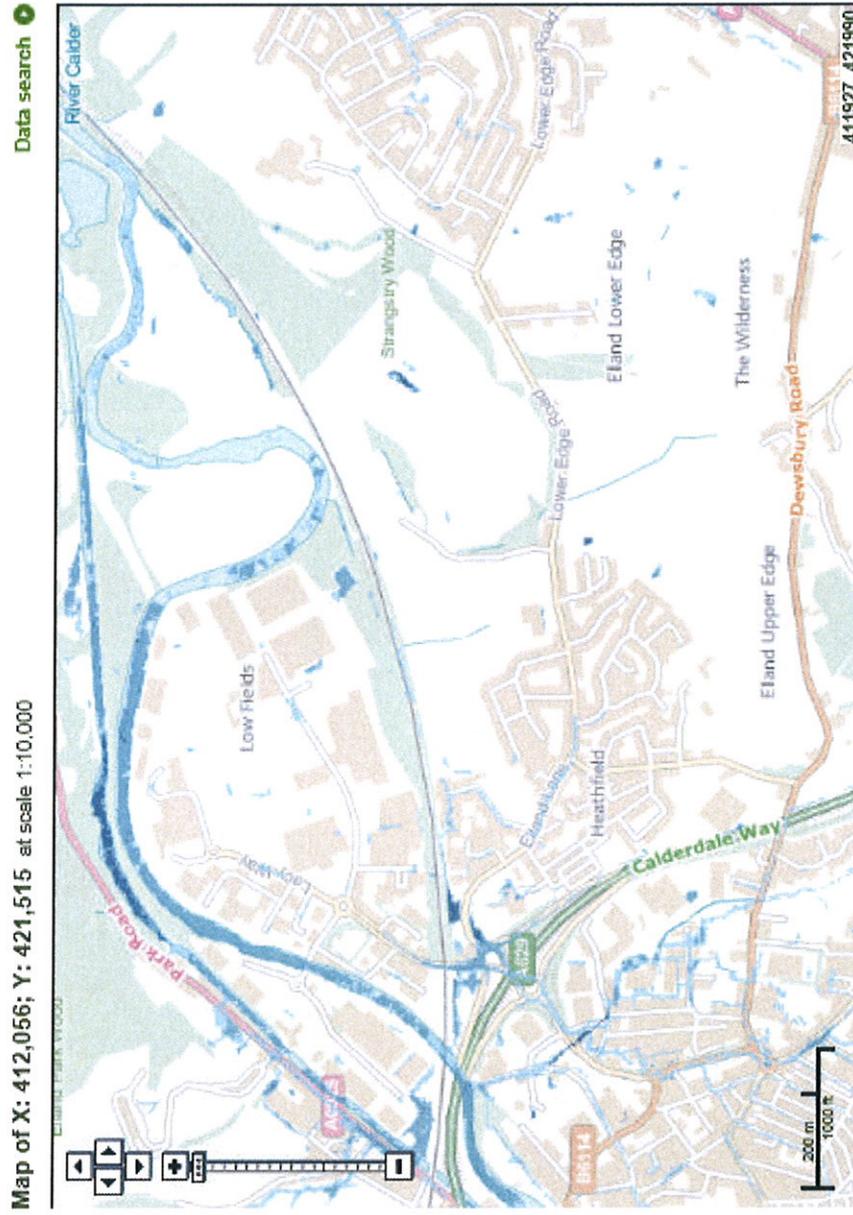
Surface Water Depth - Medium Chance of Occurring

Surface water flooding happens when rainwater does not drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead.

The shading on the map shows the estimated water depth when there is a medium chance of flooding.

Click in the legend to see estimated water depths for high and low chances of flooding, and for estimated velocity (speed and direction of the water).

Map of X: 412,056; Y: 421,515 at scale 1:10,000



[Data search](#)

Map legend

- Surface Water Depth - Medium Chance of Occurring
 - Over 800mm
 - 300-800mm
 - Below 300mm
- Other national environmental organisations
 - Natural Resources Wales Area of responsibility
 - Scottish Environment Protection Agency Area of responsibility

Chance of occurring

- Low
- Medium
- High

Other layers

Switch to layer:

- Surface water extent
- Surface water velocity

Customers in Wales - From 1 April 2013 Natural Resources Wales (NRW) will take over the responsibilities of the Environment Agency in Wales.
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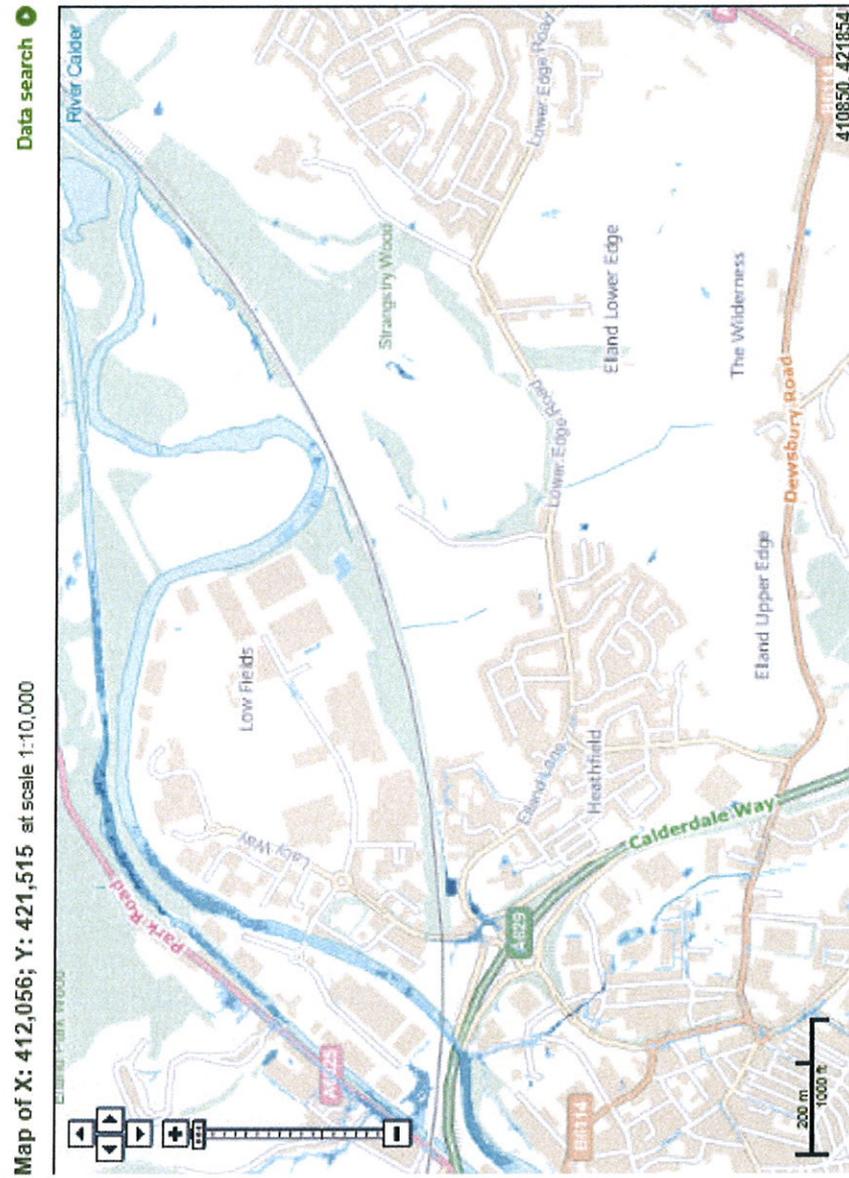


Surface Water Depth - High Chance of Occurring

Surface water flooding happens when rainwater does not drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead.

The shading on the map shows the estimated water depth when there is a high chance of flooding.

Click in the legend to see estimated water depths for medium and low chances of flooding, and for estimated velocity (speed and direction of the water).



| | |
|-------------------------------------|---|
| Map legend | |
| <input checked="" type="checkbox"/> | Surface Water Depth - High Chance of Occurring |
| <input type="checkbox"/> | Over 600mm |
| <input type="checkbox"/> | 300-600mm |
| <input type="checkbox"/> | Below 300mm |
| <input checked="" type="checkbox"/> | Other national environmental organisations |
| <input type="checkbox"/> | Natural Resources Wales Area of responsibility |
| <input type="checkbox"/> | Scottish Environment Protection Agency Area of responsibility |
| Chance of occurring | |
| <input type="radio"/> | Low |
| <input type="radio"/> | Medium |
| <input checked="" type="radio"/> | High |
| Other layers | |
| Switch to layer: | |
| <input checked="" type="checkbox"/> | Surface water extent |
| <input checked="" type="checkbox"/> | Surface water velocity |

Customers in Wales - From 1 April 2013 Natural Resources Wales (NRW) will take over the responsibilities of the Environment Agency in Wales.
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CoDa Structures

Consulting Civil & Structural Engineers
14 Springfield Court
Guiseley
Leeds LS20 8FD

**FLOODING & DRAINAGE ASSESSMENT
FOR A PROPOSED MIXED RESIDENTIAL AND
EDUCATION LAND ALLOCATION FOR LAND OFF
LOWER EDGE ROAD AND SHAW LANE, ELLAND**

APPENDIX G

EXTRACT FROM THE PUBLIC SEWER RECORDS

APPENDIX H

GREENFIELD RUN-OFF CALCULATION

2 Harewood Yard
Harewood
Leeds LS17 9LF

Date 25/02/2016 09:49

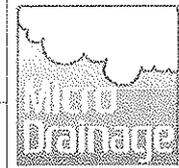
Designed by TomM

File

Checked by

Elstree Computing Ltd

Source Control 2014.1.1

IH 124 Mean Annual Flood

Input

| | | | |
|-----------------------|--------|---------------|-----------|
| Return Period (years) | 100 | Soil | 0.300 |
| Area (ha) | 50.000 | Urban | 0.000 |
| SAAR (mm) | 1200 | Region Number | Region 10 |

Results 1/s

QBAR Rural 171.2
QBAR Urban 171.2

Q100 years 356.1

Q1 year 148.9
Q2 years 159.5
Q5 years 203.7
Q10 years 236.3
Q20 years 269.2
Q25 years 280.8
Q30 years 290.3
Q50 years 316.7
Q100 years 356.1
Q200 years 404.0
Q250 years 419.4
Q1000 years 520.4

$$\therefore \frac{171.2}{50} = 3.42 \text{ l/s/ha.}$$