# GENESIS TOWN PLANNING

# FLOOD RISK APPRAISAL

# AT

# COLEBROOK LANE, CULLOMPTON

## O.S. GRID REFERENCE: ST 01180 06473

## REPORT NO P9841/G201/A

## JUNE 2013

**Jubb Consulting Engineers Ltd**
Plymouth City Airport
Crownhill
Plymouth
PL6 8BW

Tel: 01752 797000
Fax: 01752 797001
Email: Plymouth@jubb.uk.com

# REPORT CONTROL SHEET

**Client:** Genesis Town Planning

**Project:** Colebrook Lane, Cullompton

**Job No:** P9841

**Title:** Flood Risk Appraisal

**Report No:** P9841/G201/A

**Prepared by:** S D Hurdwell
B.Sc. (Hons)., I.Eng., MICE.

**Reviewed by:** P Webber
B.Sc. (Hons).

**To be Approved by:** M Hadley

| Version | Date | Detail | Prepared | Reviewed | Approved |
|---|---|---|---|---|---|
| - | 27/06/2013 | DRAFT (First Issue) | *S Hurdwell* | *P Webber* | |
| A | 28/06/2013 | Second Issue | *S Hurdwell* | *P Webber* | |
| | | | | | |
| | | | | | |

## CONTENTS



## APPENDICES

# 1.0 INTRODUCTION

## 1.1 Commission

This report has been commissioned by Genesis Town Planning to support a feasibility review for the potential redevelopment of land at Colebrook Lane, Cullompton

This report has been prepared exclusively for Genesis Town Planning and their professional consultees in relation to the current proposed redevelopment of the site; it may not be relied upon or reproduced by any third-party without the written agreement of Jubb Consulting Engineers Ltd.

## 1.2 Objective

The objective of this Flood Risk Appraisal is to review the flood risk to the site and identify the possibilities for the site's development.

The information provided uses currently available information provided by mapping and data provided by the Environment Agency (EA) and national hydrological research bodies.

The advice in this report regarding flood risk at the subject site does not constitute a full flood risk assessment in accordance with current planning guidance.

## 2.0 THE SITE & DEVELOPMENT PROPOSALS

### 2.1 Site Location

The site is located on "greenfield" land to the west of Cullompton both north and south of Colebrook Lane.

The Ordnance Survey National Grid reference for the site centre is ST 01180 06473. A location plan and aerial photograph is reproduced for reference in **Appendix A.**

### 2.2 Site Description

The site is an irregularly shaped parcel of land which extends west from the outskirts of Cullompton. Colebrook Lane runs through the southern section of the site. The site is currently occupied by open farm land used for the grazing of animals. The site is divided into 4 separate fields with Herons farm located in the western end of the site.

A Site Walkover inspection of the site was carried out on the 25th June 2013 by Sam Hurdwell of Jubb Consulting Engineers. A visual inspection of the site including a general review of the sites' condition and its setting was undertaken. A photographic record was taken and reproduced for reference in **Appendix D.**

The site is shown as lying partly within the Environment Agency's indicative flood plain (see **Appendix B**).

Topography

The site slopes generally down to the east. Shallow gradients are noted across the site. Along the valley bottom of the two watercourses a flatter 'flood plain' area is noted. The site is divided into 4 large fields by banks with hedging on top. Land drainage is noted along the low lying edge of the fields which route water to the Cole Brook.

Hydrology

The Cole Brook (a designated as a main river) is noted as flowing along the southern boundary of the site from west to east.

A small un-named tributary to the Cole Brook is noted flowing through the northern parts of the site. This tributary flows either side of a dividing hedge before passing beneath a Colebrook Lane. An 'Irish bridge' is noted where a gated entrance onto the north eastern field is accessed internally. This is noted to be 'outflanked' during high fluvial flows.

The culvert beneath Colebrook Lane is a known flood risk problem which will require further detailed assessment.

The site is within a largely rural catchment upstream of the subject site.

Downstream of the site the watercourse is identified as being 'perched' and does not follow the valley bottom. The means there is a known problem with erosion where the watercourse is trying to find the lower areas of the flood plain.

Downstream of the site the watercourse has had extensive area of residential land identified as within the flood plain and subject to possible flooding during extreme events.

Geology

The British Geological Survey Map for Exeter (sheet No. 325, 1:50,000 scale, Solid & Drift Edition) indicates a complex geological succession in the area beneath the site.

Along the watercourse corridor and to the south east of the site alluvial deposits are noted which in turn overlie head deposits/river terrace deposits and Alphington Breccia of the Exeter Group of Sherwood Sandstone.

The solid geology of the site which is defined as Permo-Triassic Sandstones and Mudstones principally comprises the Lower Sandstone in this area. These deposits will commonly weather to sands, or clays if mudstone is locally present.

Soils

Soil Survey of England and Wales, 1984 (1:250,000 Scale) – Map Sheet No.5 identifies two soil types beneath the site –

- 541e – Crediton – *'Permian and Carboniferous reddish breccia - Well drained gritty reddish loamy soils over breccia, locally less stoney. Steep Slopes in places.'*
- 712e - Hallsworth 2 – *'Drift from Paleozoic shale - Slowly permeable seasonally waterlogged clayey, fine loamy and fine silty soils.'*
- 811c Hollington – *'Reddish River Alluvium - Deep stoneless reddish fine silty and clayey soils variably affected by groundwater. Flat Land, Risk of flooding.'*

According to the *Wallingford Procedure* Winter Rainfall Acceptance Potential (WRAP) map, the site has a low acceptance potential (WRAP Class 1), with an associated 'SOIL' classification of 0.1. This SOIL parameter indicates that, on an annual basis, approximately 10% of rainfall does not infiltrate into the underlying ground but is shed as surface water runoff.

The standard percentage runoff derived using the hydrology of soils types (SPRHOST) provides a measure of the volumetric characteristic of the runoff response to rainfall. SPRHOST has been obtained for the site from the *Flood Estimation Handbook* (FEH) CD-ROM for the catchment of the Colebrook (of which the subject site is part). The Colebrook catchment covers a small area of approximately 5.99km$^2$. An SPR Host value of 0.38 has been obtained, indicating that approximately 38% of rainfall is shed as rapid response surface water runoff in this catchment. An SPRHOST value of 38% corresponds to a SOIL value of 0.38. This is the value for the whole catchment.

As discussed above, the soil survey identifies the site to be underlain by Crediton (541e), Hallsworth 2 (712e) and Hollington (811c). Using the FEH volume 4, a specific assessment of the SPR for the site can be calculated from its 29 index soil classes using the percentages which make up the soil type. The SPR is estimated from HOST soil class fractions, the table below showing how the soil beneath the site is divided up and pro-rata'd to give a site specific SPR.

| Soil Type | HOST Classes | HOST Class Percentage | SPR value for HOST Class | Totals |
|---|---|---|---|---|
| 541e - Crediton | Class 2 | 22.22% | 2 % | 0.444 % |
| | Class 3 | 77.78 % | 14.5 % | 11.278 % |
| | | | Total | **11.72 %** |
| 712e - Hallsworth2 | Class 24 | 100 % | 39.70 % | 39.70 % |
| | | | Total | **39.70 %** |
| 811c - Hollington | Class 8 | 11.11 % | 44.30 % | 4.922 % |
| | Class 9 | 88.89 % | 25.30 % | 22.489 % |
| | | | Total | **27.41%** |

| | | SPR Total | Proportion of site | Totals |
|---|---|---|---|---|
| The ratios to which these soil types occur across the site are estimated to be — | 541e - Crediton | 11.72% | @80% | 9.38% |
| | 712e - Hallsworth 2 | 39.70% | @10% | 3.97% |
| | 811c – Hollington | 27.41% | @10% | 2.74% |
| | | | Total | **16.01%** |

An SPR value of 16% corresponds to a SOIL value of 0.16. This is the specific value for the application site only.

From our experience on the sites to the north of the site we have identified a significant difference between the WRAP soil parameter, the SPRHOST and the SPR for the site. The SPRHOST and SPR values are derived using 29 soil classes as opposed to the five defined on the WRAP map; accordingly it is generally considered that SPR values provide a more accurate representation of soil characteristics and variation in run-off between soil types. Soils encountered on the land immediately adjacent site to the north are shallow reddish, frequently waterlogged soils, possibly due to slowly permeable subsoils. Soakaway test undertaken across that site by T& P Regeneration in 2011 indicate best subsoil permeability of between $10^{-5}$ |& $10^{-6}$ m/s (average 0.48m/day) despite high sand and silt contents (WRAP Class between 2 and 4; cf WRAP map indicates WRAP class 1 or 4). For SuDS design the most conservative value of SPR has been recommended in the estimation of greenfield runoff rates from the proposed site. Further work will be required to determine further the specific soil runoff parameters to confirm the actual runoff from the site and catchment.

Hydrogeology

The Environment Agency online indicative aquifer mapping identifies that both the solid geology and the superficial deposits beneath the site are identified as a Secondary A aquifer.

Secondary A aquifers are classified as 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. These are generally aquifers formerly classified as minor aquifers.

The subject site is not located within an Environment Agency (EA) Source Protection Zone.

## 3.0 FLOOD RISK & PLANNING POLICY

### 3.1 National Planning Policy

The National Planning Policy Framework and associated Technical Guidance were published on the 27th March 2012 and supersede a number of previous planning policy documents.

Section 10 of the NPPF deals with Climate Change, Flooding and Coastal Change. The role of this chapter is to provide a framework to which local councils can provide policy to their own local plans. The NPPF also has a technical guidance document which includes advice on assessment of flood risk, descriptive targets for climate change and includes land use vulnerability classifications.

#### 3.1.3 Building Regulations

The principal purpose of Building Regulations is to protect the health and safety of building occupants, with secondary considerations for sustainability and comfort). Nevertheless the Building Regulations and Approved Documents do not currently advise on flood protection measures for buildings.

### 3.2 Local Planning Policy

The Mid Devon District council Core Strategy includes the following policy in relation to Flooding.

*"COR 11 - Flooding*
*The impact of flooding, taking account of the likely impact of climate change, will be managed in order to:*
*a) reduce the risk of flooding to life and property where possible;*
*b) guide development to sustainable locations with the lowest flood risk by applying a sequential test, and locate appropriate development in areas of higher flood risk only where the benefits outweigh the risk of flooding;*
*c) ensure that development does not increase the risk of flooding of properties elsewhere."*

In addition to the above Cullompton is included in the following policy:-
*"COR14 - Cullompton*
*Cullompton will continue to develop as a small, growing market town with an expanding rural hinterland in the Culm Valley and adjacent areas. The strategy will aim to increase the self– sufficiency of the town and its area by improving access to housing, employment and services for its population and nearby rural areas. Proposals will provide for the following average annual development rates:*

*a.) 67 market dwellings*
*b.) 28 affordable dwellings*
*c.) 4000 square metres employment gross floorspace.*

*The Council will guide high quality development and other investment to:*

*d.) Promote the removal of through traffic from the town centre and improve local air quality by enhancing walking and cycling opportunities around the town, completing a relief road system and implementing air quality action plan initiatives.*
*e.) Ensure developments within, adjoining or affecting the Air Quality Management Area provide measures to meet air quality objectives, taking full account of cumulative development impacts and based on air quality assessments giving realistic "baseline" and "with development" scenarios.*
*f.) Make any necessary improvements to the motorway junction.*
*g.) Promote further public transport improvements within Cullompton and to other urban centres (particularly Tiverton and Exeter) and improve access to the rail network.*
*h.) Manage the town centre so that economic regeneration and heritage reinforce each other by promoting new homes, shops, leisure, offices and other key town centre uses which are well designed and contribute to vitality and viability, including an additional 1,950 square metres of convenience and 700 square metres of comparison net retail floorspace by 2016 in accordance with the sequential and other PPS6 retail policy considerations.*
*i.) Reduce the risk of flooding.*
*j.) Enhance the tourism and visitor role of the town and area."*

As well as the above specific policy for Cullompton above part of the subject site is allocated as a Contingency Housing Site.

*"AL/CU/20 - Colebrook*
*A site of 4.8 hectares at Colebrook is identified as a contingency site for residential development, to be released in accordance with policy AL/DE/1 subject to the following:*
*a.) 100 dwellings with 35% affordable housing;*
*b.) Provision of two points of access from Siskin Chase;*
*c.) Provision of 2.7 hectares of Green Infrastructure, to include the retention of land in the floodplain as informal amenity open space;*
*d.) Measures to protect and strengthen trees, hedgerows and other environmental features which contribute to the character and biodiversity, maintaining a wildlife network within the site and linking to the surrounding countryside;*
*e.) Provision of a Sustainable Urban Drainage Scheme to deal with all surface water from the development and arrangements for future maintenance;*
*f.) Detailed archaeological investigation and measures to record, and where necessary, protect the archaeological interest of the site through appropriate design, layout and mitigation."*

For reference a plan showing the Local Plan allocations is reproduced in **Appendix G.**

### 3.3 Strategic Flood Risk Assessment (SFRA)

Mid Devon District Council has produced a Level 1 Coarse Assessment SFRA (July 2006) to cover their area, updated in June 2009 to include a Level 2 Assessment.

This document has been produced to inform the Local Development Framework (LDF) and the spatial planning process at a local scale.

The Level 1 SFRA does not contain any prescriptive details on defending sites at risk of flooding.

The Level 2 SFRA includes specific recommendations for development/redevelopment in Flood Zones 3 generally, the key action being the application of an appropriate Sequential Test. The SFRA recommendations distinguish between defended and undefended sites (with more onerous restrictions on the latter) but do not address the case where no physical development or change of use is proposed.

This SFRA is a generic document providing a framework of principles; it does not include any site specific guidance or recommendations.

It identifies the application site as lying within Flood Zones 1, 2 and 3 as discussed earlier in this FRA report.

For more details refer to the SFRA flood mapping reproduced for reference in **Appendix G.**

### 3.4 Other Policy

Access to the Watercourse

The Environment Agency have powers which allow them access to any land for the purpose of any functions/obligations required by them to the adjacent river (i.e. maintenance of the river bank etc.). This access is granted under the Land Drainage Act 1991 Chapter 59, Part V, Section 64. New development is usually required, therefore, to maintain or provide an access strip alongside watercourses.

In order for the site to be developed adjacent to a river, access has to be taken into account when developing the development proposals. The Environment Agency's standard requirement for access is an 8 metre "no build zone" from the top of the river bank.

Also any construction within 8 metres of the top (brink) of the river bank requires land drainage consent from the Environment Agency.

This may provide a constraint on the proposals for the site, but due to the size and shape of the site it is not considered a significant issue.

Insurance

The Insurance Industry is typically concerned with the 0.5% annual probability flood for both fluvial and tidal flooding. The proposed development site is outside the 1% flood line. This, for buildings within the Flood Zone 2 areas (1.0% > annual probability of flooding > 0.1%), there maybe increase insurance premiums with regards to fluvial flood risk.

# 4.0 FLOOD RISK SOURCES, POTENTIAL EXTENT AND IMPACTS OF FLOODING

## 4.1 Flood Extent and Consequence of Flooding

The Environment Agency's indicative flood plain maps (one of which is reproduced in **Appendix C**) indicate that the land bordering the watercourses is in Flood Zone 3. The extents of this flood zone are based on raw data from the EA's flood model. Further assessment, modelling and delineation will be required to confirm the exact extent of the high risk flood zone.

## 4.2 Flooding History

The site has not been identified as flooded in the past. It is conceivable that the site has flooded previously. However, due to it being open farm fields the flooding has not been reported specifically. There have been a number of significant flooding events in the recent past which has affected the downstream areas within Cullompton. The most recent flooding was in the winter of 2012 where wide spread flooding across the region was found.

## 4.3 Sources of Flooding

There are two significant sources of flood risk to any proposed development: from extreme fluvial flows from the Cole Brook and its northern tributary and from surface water run-off disposal.

There are, therefore, four matters to address –

- extent, depth, speed and volume of possible extreme fluvial flooding (as a residual risk);
- collection and disposal of surface water due to the rainfall runoff, so as to avoid flooding on site;
- control of surface water discharges from the site ensuring that there is no increased risk of flooding downstream; and,
- control /routing of offsite and onsite excess surface water run-off or overflow discharges from drainage systems in residual risk conditions so as to ensure that existing flood escape routes are maintained or improved with regard to offsite flood risk impacts and consequences.

Whilst not a significant flood risk; in addition to these two main sources there is noted shallow groundwater which will have to be carefully managed when assessing the options for surface water disposal and SuDS.

## 4.4 Environment Agency Flood Model Data

The Environment Agency does not have any hydraulic modelling information for this area of the catchment. The EA's flood zone mapping is based on raw data and it is possible that when modelled the extents of flooding identified will be different to that shown on the indicative mapping.

## 4.5 Future Flood Risks

The site will remain at high risk of flooding in the low lying areas of the site. The extent and depth of flooding will increase with the adverse impacts of climate change.

## 5.0 PROPOSALS FOR FLOOD DEFENCE

### 5.1 Existing Land Use

The majority of the site is currently "greenfield" land used for the grazing of animals. The site is divided up to form four large fields. Colebrook Lane divides the site in two.

### 5.2 Possible Proposed Uses and Constraints

Provided that the Sequential Test issues can be dealt with, development should be viable, with habitable buildings sited in the lowest flood risk areas. Current guidelines seek development away from the high risk Flood Zone (Flood Zone 3).

The extent of any possible development at this site will need to provide dwellings outside the extreme flood extent and at a level where flooding will not occur during a 1-in-100 year event (plus due allowance for climate change during the design lifetime of the development). This means currently that housing development are generally required to be protected from flood events having an annual probability of occurrence of 1% or more for at least 100 years from construction.

### 5.3 Development Proposals

The site is capable of a residential development providing the flood risk constraints can be met.

Hydraulic modelling will be required to be undertaken to confirm the exact extent of possible flood plain. This will supersede the indicative flood mapping which the EA currently has. It's possible that the extents of flooding noted are less than those shown indicatively on their mapping.

The modelling will be required to assess the issues around the culvert beneath Colebrook Lane. Works to reduce the flood risk form this structure should be assessed also.

Surface water drainage will also require to be considered. The proposals will seek to mimic the existing, largely greenfield, regime. The provision of a SuDS scheme to accommodate the runoff form proposed roofs and impermeable surfacing will meet the requirements for sustainable development as well and improving the risk of flooding from this source. The EA are likely to require betterment to the existing greenfield regime. This is to try and reduce the current flood risks downstream of the site.

## 6.0 FLOOD RISK SUMMARY

### 6.1 Further work

Once the outline development proposals have been drawn up a full flood risk assessment should be undertaken to establish the extents of potential flooding and the impacts to the site and surrounding areas from development on the subject site.

- Flood modelling
  Modelling will need to -
  - Confirm the extent of flood plain
  - Model a blockage scenario for the Colebrook Lane culvert
  - Establish an appropriate level of FFL's to proposed buildings
  - Establish appropriate management of the watercourse and floodplain to ensure adequate maintenance is provided an continued as part of the proposals

- Outline surface water drainage design to ensure the proposals do not increase surface water flooding downstream of the subject site.
- Soakaway testing across the site to assess the soil properties for establishment of greenfield runoff rates.
- Flood Management and Evacuation plan to confirm the proposed measures for flood warning and evacuation.

### 6.2 Hydraulic Modelling

The Environment Agency have identified that they do not hold any hydraulic modelling for the site or up-stream catchment. Therefore hydraulic modelling will be required to delineate the extent of high risk flood zone.

The EA have raised concern over the Colebrook Lane culvert also and this will require assessment to determine if a replacement structure should be installed.

A full topographic survey of the site and culvert and downstream channel would be required for any such assessment.

### 6.3 Surface Water Drainage

A comprehensive surface water drainage solution incorporating SUDS techniques will be required to service the proposals at the site. The use of soakaways should be considered as a priority over other less sustainable measure. The primary objectives of the surface water drainage system are to capture and control water within the site, whilst reducing runoff rates and volumes and provide water quality protection to offsite discharges.

The Environment Agency has identified that the Cole Brook catchment as one where it is likely to be made a critical drainage catchment under the terms of the NPPF. This will require more onerous surface water drainage criteria to be adhered to. Betterment on the existing greenfield regime is likely to be implemented as a result of this allocation tot eh catchment.

Further work will be required to assess the soils within the catchment for the run off characteristics. This will confirm the baseline runoff rates to which the surface water drainage will seek to mimic / improve on. The site is located on the border of a WRAP Class 1 and a WRAP Class 4. The difference between the two is significant and from our experience on the land to the north we'd expect to be able to improve on the WRAP Class 1 to say a Class 2-3.

### 6.4 Flood Warning / Evacuation

A flood management plan will be required to be produced to ensure the safety of the occupiers of the site. Management of overland flow routes and surface water drainage implications will need to be confirmed as part of the flood management plan.

### 6.5 Conclusions

The site is capable for economic development. Further works are required to delineate the fluvial flood risks to the site.

Discussions have been held with the EA regarding the proposals at this site and their main concern was regarding surface water disposal and the fluvial flood risks associated with the two watercourses. They were able to make us aware of their concerns regarding the Colebrook Lane culvert also. Further discussion and dialog is recommended prior to further works being progressed.

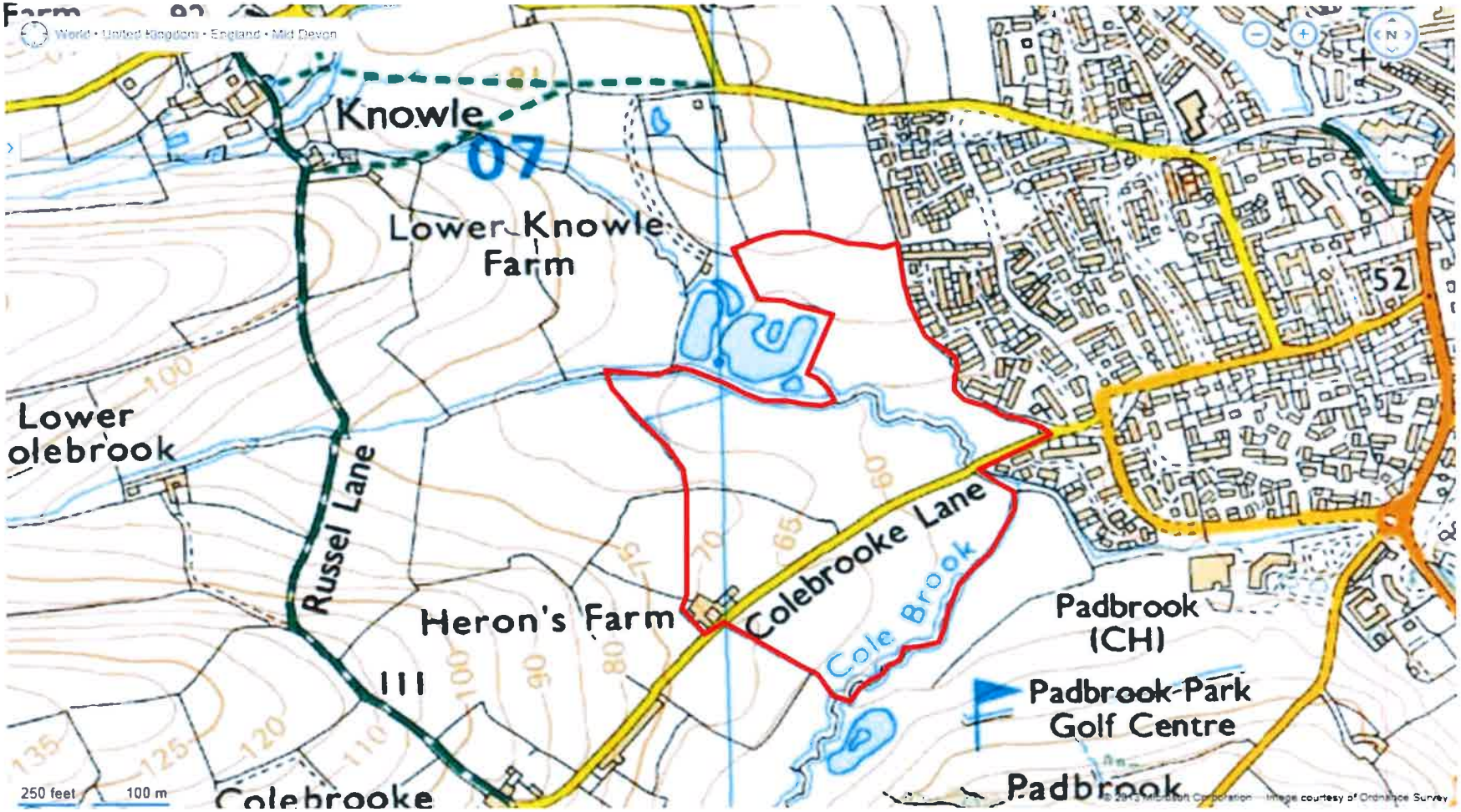
There is potential for shallow ground water to be present in the lower lying area of the site. Whilst this should not pose a significant flood risk issue it will have a bearing on the requirements for surface water disposal.

Hydraulic flood modelling will be required to confirm the extent of the flood plain which is to remain undeveloped. It should be noted that EA's own mapping the extents of the flood zones on these plans are indicative and will be refined by hydraulic modelling.

No development will be permitted within the high risk flood zone. In addition to this the watercourses will require an 8m easement along both sides for access and maintenance.

# Appendix A

# Site Location Plan & Aerial Photograph




| | | | | | |
|---|---|---|---|---|---|
| Project: Colebrook Lane, Cullompton | By | SDH | Checked | SDH | |
| | Date | 26/06/2013 | Date | 26/06/2013 | |
| Title: Site Location Plan | Job Number P9841 | | Figure Appendix A | | |

CONSULTING ENGINEERS LIMITED


| | | | | | |
|---|---|---|---|---|---|
| **Project:** **Colebrook Lane, Cullompton** | By | SDH | Checked | SDH | |
| | Date | 26/06/2013 | Date | 26/06/2013 | |
| **Title:** **Aerial Photograph** | Job Number **P9841** | | Figure **Appendix A** | | |

CONSULTING ENGINEERS LIMITED


| | | | | | |
|---|---|---|---|---|---|
| **Project:** | By | SDH | Checked | SDH | |
| **Colebrook Lane, Cullompton** | Date | 26/06/2013 | Date | 26/06/2013 | |
| **Title:** | Job Number | | Figure | | |
| **Aerial Photograph (2002)** | **P9841** | | **Appendix A** | | |

CONSULTING ENGINEERS LIMITED


| | | | | | |
|---|---|---|---|---|---|
| **Project:** **Colebrook Lane, Cullompton** | By | SDH | Checked | SDH | |
| | Date | 26/06/2013 | Date | 26/06/2013 | |
| **Title:** **Aerial Photograph (2007)** | Job Number **P9841** | | Figure **Appendix A** | | |

CONSULTING ENGINEERS LIMITED


| | | | | | |
|---|---|---|---|---|---|
| Project: **Colebrook Lane, Cullompton** | By | SDH | Checked | SDH | |
| | Date | 26/06/2013 | Date | 26/06/2013 | |
| Title: **Aerial Photograph (2010)** | Job Number **P9841** | | Figure **Appendix A** | | |

CONSULTING ENGINEERS LIMITED


| | | | | | |
|---|---|---|---|---|---|
| Project: **Colebrook Lane, Cullompton** | By | SDH | Checked | SDH | |
| | Date | 26/06/2013 | Date | 26/06/2013 | |
| Title: **Aerial Photograph (Facing North)** | Job Number **P9841** | | Figure **Appendix A** | | |

CONSULTING ENGINEERS LIMITED


| | | | | | |
|---|---|---|---|---|---|
| **Project:** | By | SDH | Checked | SDH | |
| **Colebrook Lane, Cullompton** | Date | 26/06/2013 | Date | 26/06/2013 | |
| **Title:** | Job Number | | Figure | | |
| **Aerial Photograph (Facing East)** | **P9841** | | **Appendix A** | | |

CONSULTING ENGINEERS LIMITED


| | | | | | |
|---|---|---|---|---|---|
| **Project:** | By | SDH | Checked | SDH | |
| **Colebrook Lane, Cullompton** | Date | 26/06/2013 | Date | 26/06/2013 | |
| **Title:** | Job Number | | Figure | | |
| **Aerial Photograph (Facing South)** | **P9841** | | **Appendix A** | | |

CONSULTING ENGINEERS LIMITED


| | | | | | |
|---|---|---|---|---|---|
| **Project:** | By | SDH | Checked | SDH | |
| **Colebrook Lane, Cullompton** | Date | 26/06/2013 | Date | 26/06/2013 | |
| **Title:** | Job Number | | Figure | | |
| **Aerial Photograph (Facing West)** | **P9841** | | **Appendix A** | | |

CONSULTING ENGINEERS LIMITED

# Appendix B

# Environment Agency Indicative Mapping

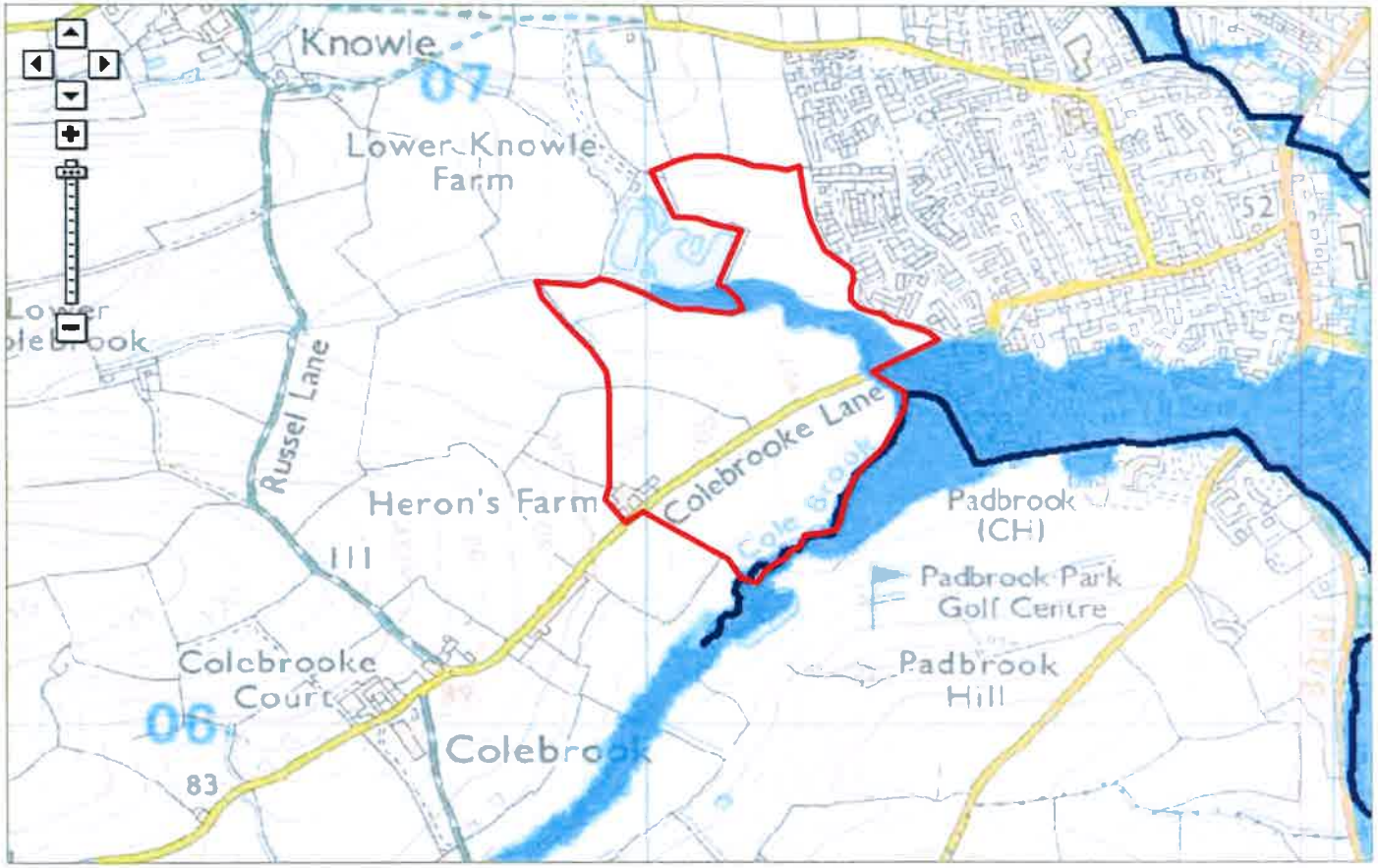
**Map legend**

Click on the map to see what is the Risk of Flooding at a particular location.

Flood Maps

- Flooding from rivers or sea without defences
- Extent of extreme flood
- Flood defences (Not all may be shown*)
- Areas benefiting from flood defences (Not all may be shown*)
- Main rivers

**X: 301,065;Y: 106,447** at scale 1:10,000





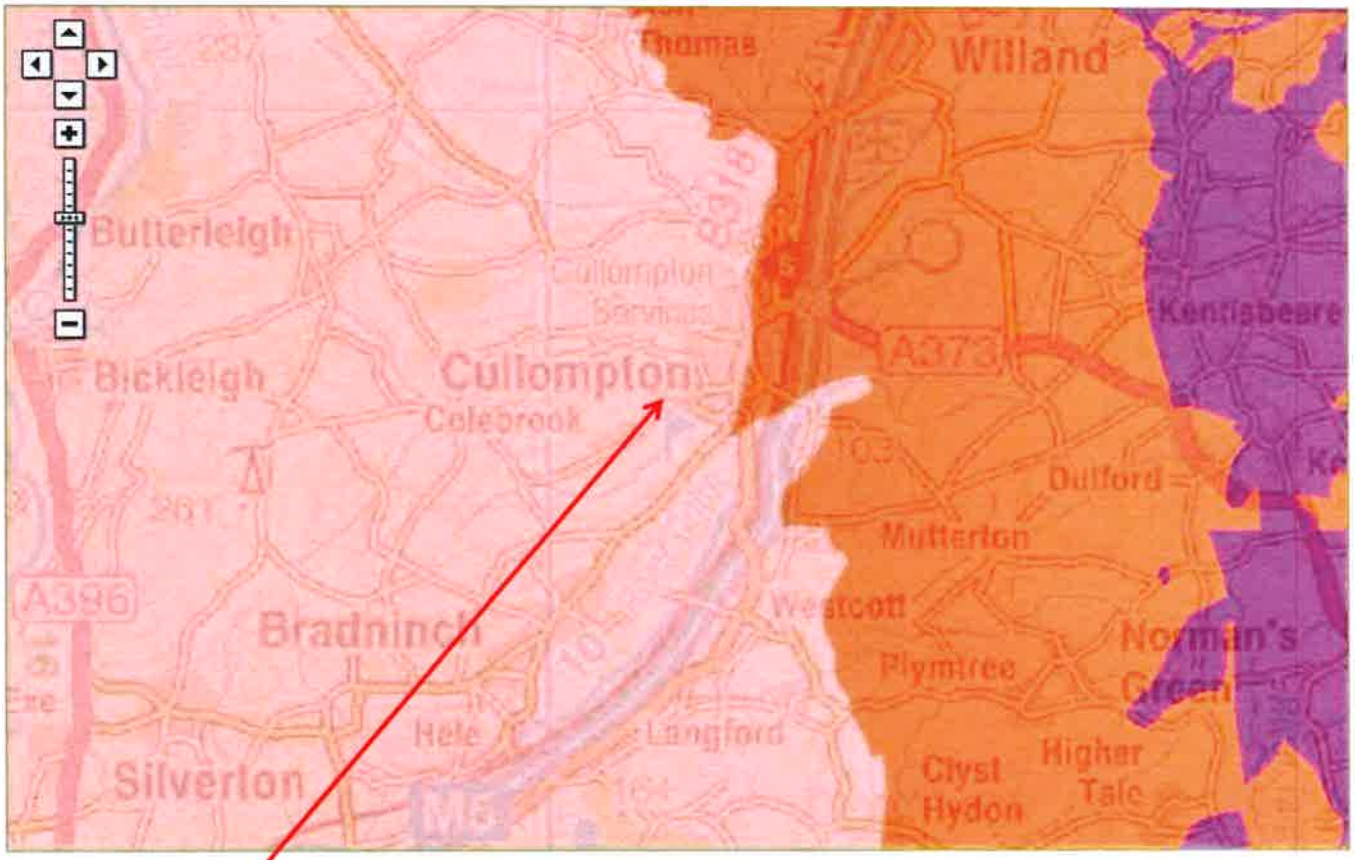

| | | | | | |
|---|---|---|---|---|---|
| **Project:** **Colebrook Lane, Cullompton** | By | SDH | Checked | SDH | |
| | Date | 26/06/2013 | Date | 26/06/2013 | |
| **Title:** **Environment Agency Flood Map** | Job Number **P9841** | | Figure **Appendix B** | | |

JUBB CONSULTING ENGINEERS LIMITED

**Map legend**

- Groundwater source protection zones
- Aquifer Maps - Superficial Deposits Designation
- Aquifer Maps - Bedrock Designation
  - Principal
  - Secondary A
  - Secondary B
  - Secondary (undifferentiated)
- Groundwater Vulnerability Zones

**X: 301,460;Y: 106,225** at scale 1:75,000





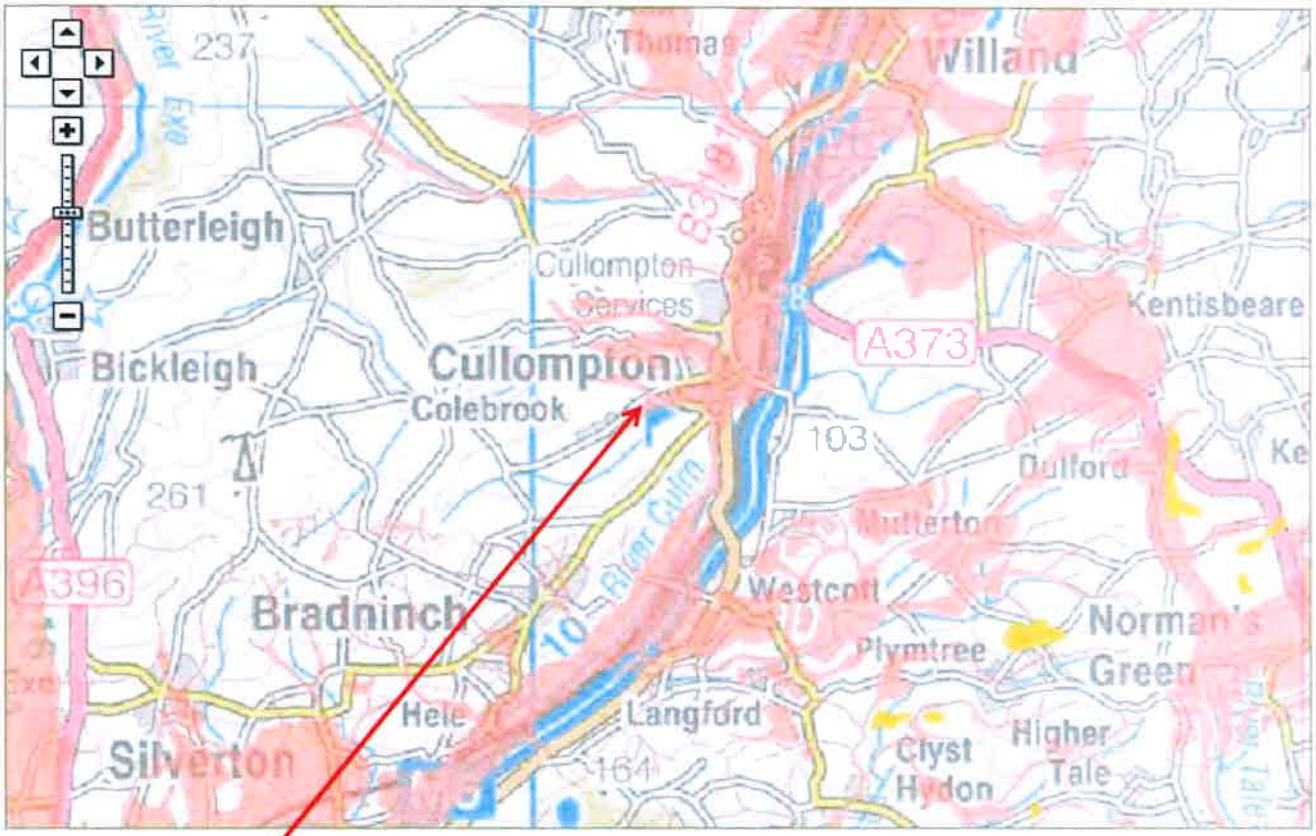

| | | | | | |
|---|---|---|---|---|---|
| Project: **Colebrook Lane, Cullompton** | By | SDH | Checked | SDH | |
| | Date | 26/06/2013 | Date | 26/06/2013 | |
| Title: **Environment Agency Groundwater Mapping (Bedrock)** | Job Number **P9841** | | Figure **Appendix B** | | |

CONSULTING ENGINEERS LIMITED

**Map legend**

- Groundwater source protection zones
- Aquifer Maps - Superficial Deposits Designation
  - Principal
  - Secondary A
  - Secondary B
  - Secondary (undifferentiated)
  - Unknown (lakes and landslip)
- Aquifer Maps - Bedrock Designation
- Groundwater Vulnerability Zones

**X: 301,460;Y: 106,225** at scale 1:75,000






SITE

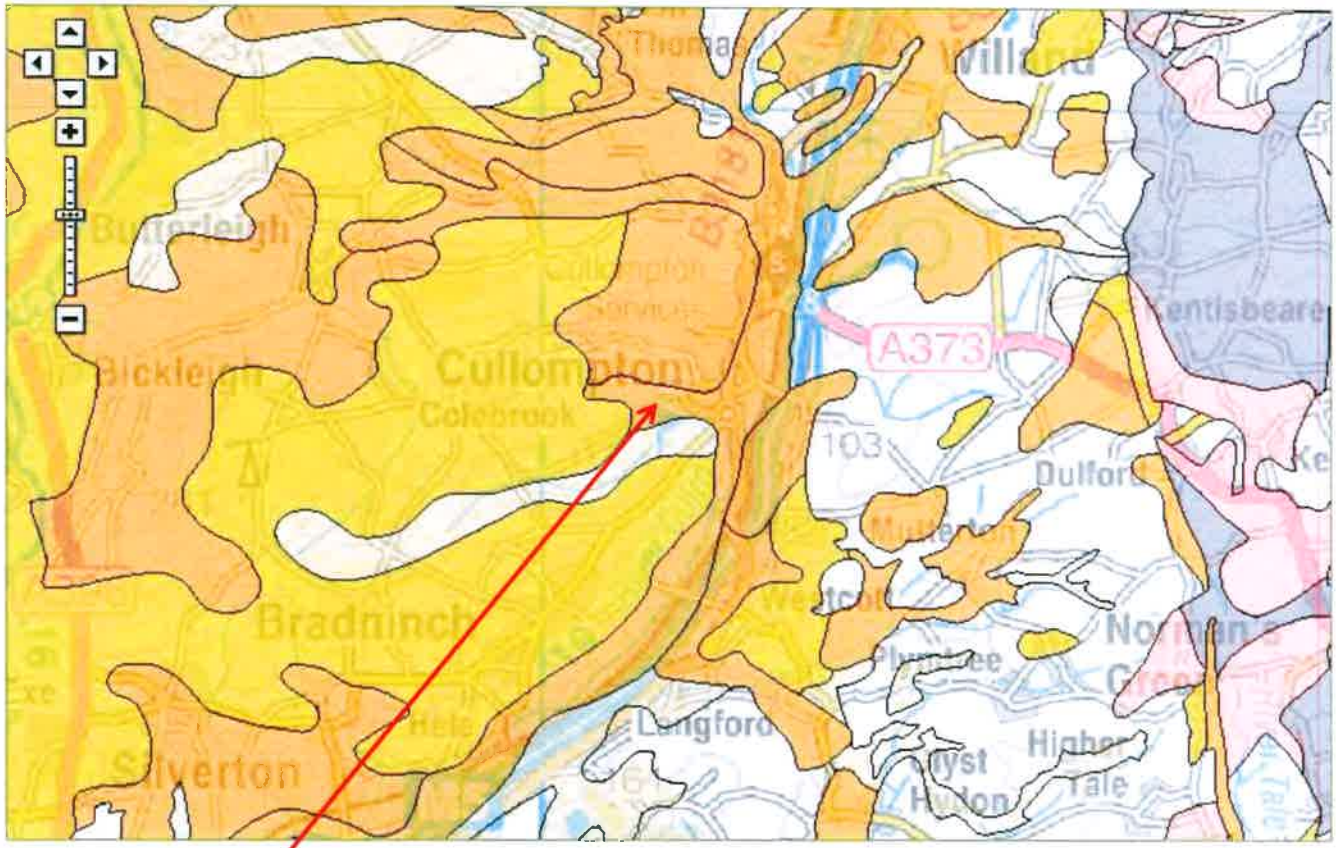
| | | | | |
|---|---|---|---|---|
| Project: **Colebrook Lane, Cullompton** | By | SDH | Checked | SDH |
| | Date | 26/06/2013 | Date | 26/06/2013 |
| Title: **Environment Agency Groundwater Mapping (Superficial Deposits)** | Job Number **P9841** | | Figure **Appendix B** | |

CONSULTING ENGINEERS LIMITED

**Map legend**

- Groundwater source protection zones
- Aquifer Maps - Superficial Deposits Designation
- Aquifer Maps - Bedrock Designation
- Groundwater Vulnerability Zones
  - Major Aquifer High
  - Major Aquifer Intermediate
  - Major Aquifer Low
  - Minor Aquifer High
  - Minor Aquifer Intermediate
  - Minor Aquifer Low

**X: 301,460;Y: 106,225** at scale 1:75,000






| | | | | | |
|---|---|---|---|---|---|
| Project: **Colebrook Lane, Cullompton** | | By | SDH | Checked | SDH |
| | | Date | 26/06/2013 | Date | 26/06/2013 |
| Title: **Environment Agency Groundwater Mapping (Vulnerability Zones)** | | Job Number **P9841** | | Figure **Appendix B** | |

CONSULTING ENGINEERS LIMITED

# Appendix C

# NPPF Technical Guidance Tables 1, 2 and 3

indicates the need to apply the Exception Test (as set out in the National Planning Policy Framework), the scope of a Strategic Flood Risk Assessment will be widened to consider the impact of the flood risk management infrastructure on the frequency, impact, speed of onset, depth and velocity of flooding within the flood zones considering a range of flood risk management maintenance scenarios. Where a Strategic Flood Risk Assessment is not available, the Sequential Test will be based on the Environment Agency flood zones.

5. The overall aim should be to steer new development to Flood Zone 1. Where there are no reasonably available sites in Flood Zone 1, local planning authorities allocating land in local plans or determining planning applications for development at any particular location should take into account the flood risk vulnerability of land uses (see table 2) and consider reasonably available sites in Flood Zone 2, applying the Exception Test if required (see table 3). Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in Flood Zone 3 be considered, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required.

**Table 1: Flood zones**

*(Note: These flood zones refer to the probability of river and sea flooding, ignoring the presence of defences)*

**Zone 1 - low probability**

**Definition**
This zone comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%).

**Appropriate uses**
All uses of land are appropriate in this zone.

**Flood risk assessment requirements**
For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a flood risk assessment. This need only be brief unless the factors above or other local considerations require particular attention.

**Policy aims**
In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage systems[2].

[2] Sustainable drainage systems cover the whole range of sustainable approaches to surface drainage management. They are designed to control surface water run off close to where it falls and mimic natural drainage as closely as possible.

## Zone 2 - medium probability

**Definition**
This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year.

**Appropriate uses**
Essential infrastructure and the water-compatible, less vulnerable and more vulnerable uses, as set out in table 2, are appropriate in this zone. The highly vulnerable uses are *only* appropriate in this zone if the Exception Test is passed.

**Flood risk assessment requirements**
All development proposals in this zone should be accompanied by a flood risk assessment.

**Policy aims**
In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage systems.

## Zone 3a - high probability

**Definition**
This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

**Appropriate uses**
The water-compatible and less vulnerable uses of land (table 2) are appropriate in this zone. The highly vulnerable uses should not be permitted in this zone.

The more vulnerable uses and essential infrastructure should only be permitted in this zone if the Exception Test is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood.

**Flood risk assessment requirements**
All development proposals in this zone should be accompanied by a flood risk assessment.

**Policy aims**
In this zone, developers and local authorities should seek opportunities to:

- reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage systems;

- relocate existing development to land in zones with a lower probability of flooding; and
- create space for flooding to occur by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage.

## Zone 3b - the functional floodplain

**Definition**
This zone comprises land where water *has* to flow or be stored in times of flood.

Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. But land which would flood with an annual probability of 1 in 20 (5%) or greater in any year, or is designed to flood in an extreme (0.1%) flood, should provide a starting point for consideration and discussions to identify the functional floodplain.

**Appropriate uses**
Only the water-compatible uses and the essential infrastructure listed in table 2 that has to be there should be permitted in this zone. It should be designed and constructed to:

- remain operational and safe for users in times of flood;
- result in no net loss of floodplain storage;
- not impede water flows; and
- not increase flood risk elsewhere.

Essential infrastructure in this zone should pass the Exception Test.

**Flood risk assessment requirements**
All development proposals in this zone should be accompanied by a flood risk assessment.

**Policy aims**
In this zone, developers and local authorities should seek opportunities to:

- reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage systems;
- relocate existing development to land with a lower probability of flooding.

## Table 2: Flood risk vulnerability classification

| |
|---|
| **Essential infrastructure**<br>• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk.<br>• Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood.<br>• Wind turbines. |
| **Highly vulnerable**<br>• Police stations, ambulance stations and fire stations and command centres and telecommunications installations required to be operational during flooding.<br>• Emergency dispersal points.<br>• Basement dwellings.<br>• Caravans, mobile homes and park homes intended for permanent residential use[3].<br>• Installations requiring hazardous substances consent[4]. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as "essential infrastructure")[5]. |
| **More vulnerable**<br>• Hospitals.<br>• Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels.<br>• Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels.<br>• Non–residential uses for health services, nurseries and educational establishments.<br>• Landfill and sites used for waste management facilities for hazardous waste[6].<br>• Sites used for holiday or short-let caravans and camping, *subject to a specific warning and evacuation plan.*[7] |
| **Less vulnerable**<br>• Police, ambulance and fire stations which are *not* required to be operational during flooding.<br>• Buildings used for shops, financial, professional and other services, |

[3] For any proposal involving a change of use of land to a caravan, camping or chalet site, or to a mobile home site or park home site, the Sequential and Exception Tests should be applied.
[4] See Circular 04/00: *Planning controls for hazardous substances* (paragraph 18) at: www.communities.gov.uk/publications/planningandbuilding/circularplanningcontrols
[5] In considering any development proposal for such an installation, local planning authorities should have regard to planning policy on pollution in the National Planning Policy Framework.
[6] For definition, see *Planning for Sustainable Waste Management: Companion Guide to Planning Policy Statement 10* at www.communities.gov.uk/publications/planningandbuilding/planningsustainable
[7] See footnote 3.

| |
|---|
| restaurants and cafes, hot food takeaways, offices, general industry, storage and distribution, non–residential institutions not included in "more vulnerable", and assembly and leisure.<br>• Land and buildings used for agriculture and forestry.<br>• Waste treatment (except landfill and hazardous waste facilities).<br>• Minerals working and processing (except for sand and gravel working).<br>• Water treatment works which do *not* need to remain operational during times of flood.<br>• Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place). |
| **Water-compatible development**<br>• Flood control infrastructure.<br>• Water transmission infrastructure and pumping stations.<br>• Sewage transmission infrastructure and pumping stations.<br>• Sand and gravel working.<br>• Docks, marinas and wharves.<br>• Navigation facilities.<br>• Ministry of Defence defence installations.<br>• Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location.<br>• Water-based recreation (excluding sleeping accommodation).<br>• Lifeguard and coastguard stations.<br>• Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms.<br>• Essential ancillary sleeping or residential accommodation for staff required by uses in this category, *subject to a specific warning and evacuation plan.* |

**Notes to table 2:**

a. This classification is based partly on Department for Environment, Food and Rural Affairs and Environment Agency research on *Flood Risks to People* (*FD2321/TR2*)[8] and also on the need of some uses to keep functioning during flooding.

b. Buildings that combine a mixture of uses should be placed into the higher of the relevant classes of flood risk sensitivity. Developments that allow uses to be distributed over the site may fall within several classes of flood risk sensitivity.

c. The impact of a flood on the particular uses identified within this flood risk vulnerability classification will vary within each vulnerability class. Therefore, the flood risk management infrastructure and other risk mitigation measures needed to ensure the development is safe may differ between uses within a particular vulnerability classification.

[8] See website for further details.
www.defra.gov.uk/science/Project_Data/DocumentLibrary/FD2320_3364_TRP.pdf

**Table 3: Flood risk vulnerability and flood zone 'compatibility'**

| Flood risk vulnerability classification (see table 2) | | Essential infrastructure | Water compatible | Highly vulnerable | More vulnerable | Less vulnerable |
|---|---|---|---|---|---|---|
| Flood zone (see table 1) | Zone 1 | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Zone 2 | ✓ | ✓ | Exception Test required | ✓ | ✓ |
| | Zone 3a | Exception Test required | ✓ | × | Exception Test required | ✓ |
| | Zone 3b functional floodplain | Exception Test required | ✓ | × | × | × |

**Key:** ✓ Development is appropriate.
× Development should not be permitted.

**Notes to table 3:**
This table does not show:
a. the application of the Sequential Test which guides development to Flood Zone 1 first, then Zone 2, and then Zone 3;
b. flood risk assessment requirements; or
c. the policy aims for each flood zone.

# Flood risk assessment

6. Properly prepared assessments of flood risk will inform the decision-making process at all stages of development planning. A Strategic Flood Risk Assessment is a study carried out by one or more local planning authorities to assess the risk to an area from flooding from all sources, now and in the future, taking account of the impacts of climate change, and to assess the impact that changes or development in the area will have on flood risk. It may also identify, particularly at more local levels, how to manage those changes to ensure that flood risk is not increased. A site-specific flood risk assessment is carried out by, or on behalf of, a developer to assess the risk to a development site and demonstrate how flood risk from all sources of flooding to the development itself and flood risk to others will be managed now, and taking climate change into account. There should be iteration between the different levels of flood risk assessment.

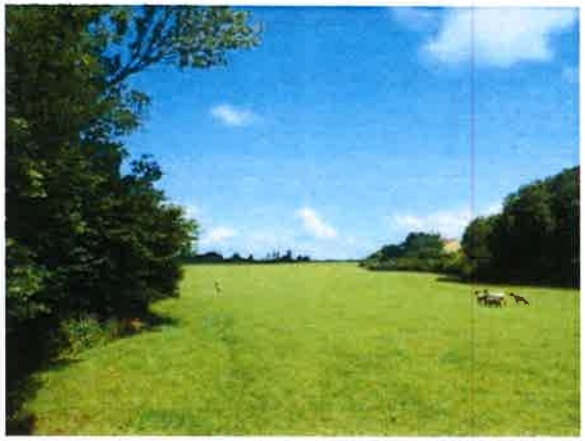
## Strategic Flood Risk Assessment

7. As set out in the National Planning Policy Framework, Local Plans should be supported by Strategic Flood Risk Assessment. The Strategic Flood Risk Assessment should be prepared in consultation with the Environment Agency,

# Appendix D

# Site Photographs



























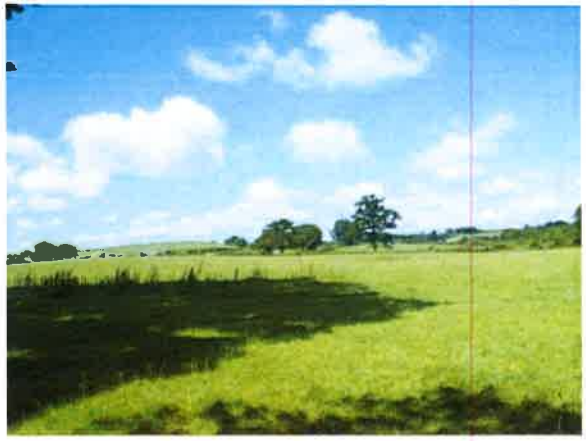











# Appendix E

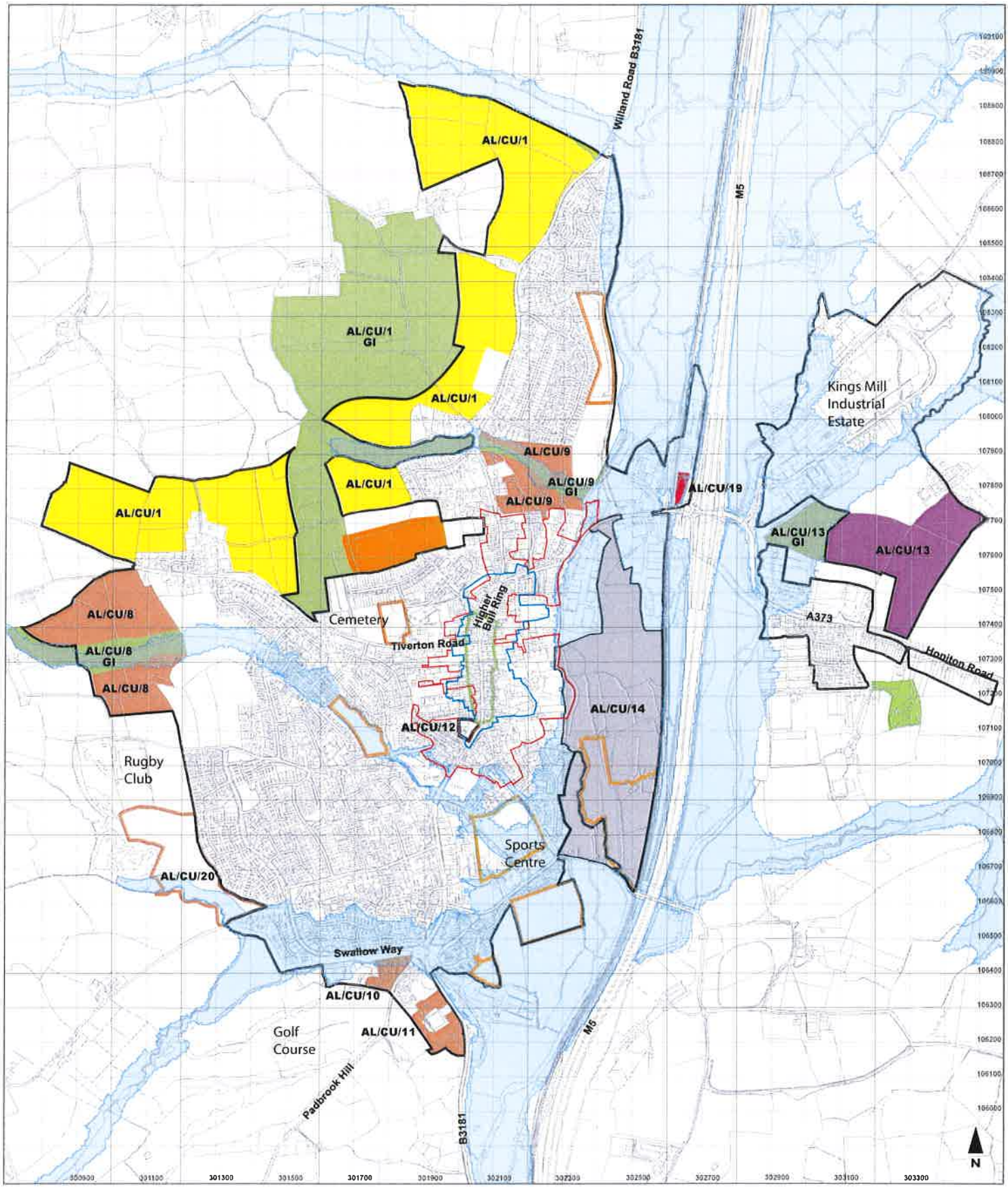
# Environment Agency Information Ref:

# Appendix F

# Outline Development Plan Ref: 13035/SK/03

# Appendix G

# Local Plan and SFRA Mapping Extracts




| | | | |
|---|---|---|---|
| Settlement Limit | | Community Use | |
| Residential | | Railway Station Car Park | |
| Contingency Housing Site | | Area for Eastern Relief Road | |
| Mixed Use | | Conservation Area | |
| Green Infrastructure | | Important Land for Sport and Recreation | |
| Employment | | Ancient Monument | |
| Town Centre Boundary | | County Wildlife Site | |
| Proposed Primary Shopping Area | | Floodplain | |

*Deleted Important Land for Sport and Recreation*

**Mid Devon Local Plan Part III**

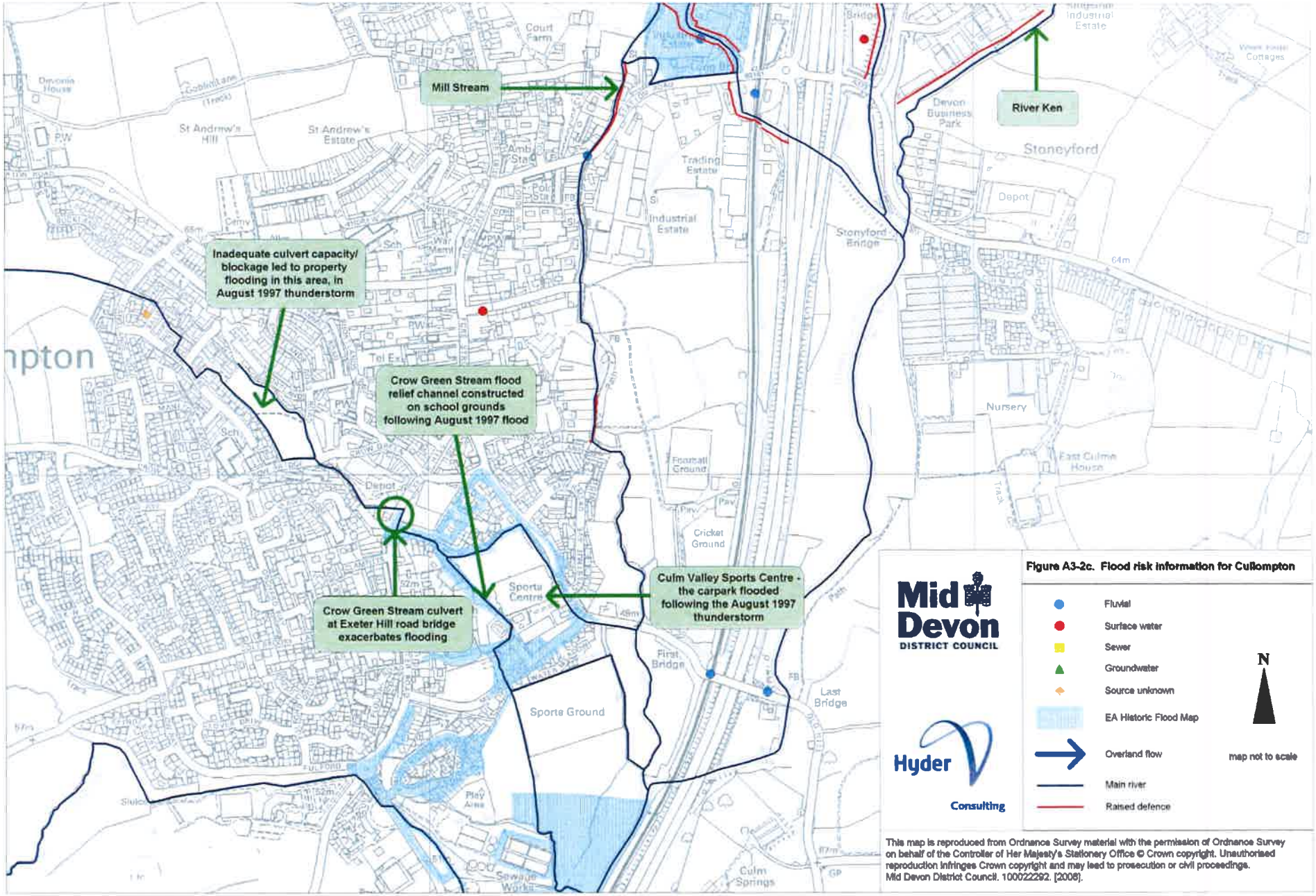
## Proposed Policies Map

# Cullompton

Scale 1:10,000



July 2012



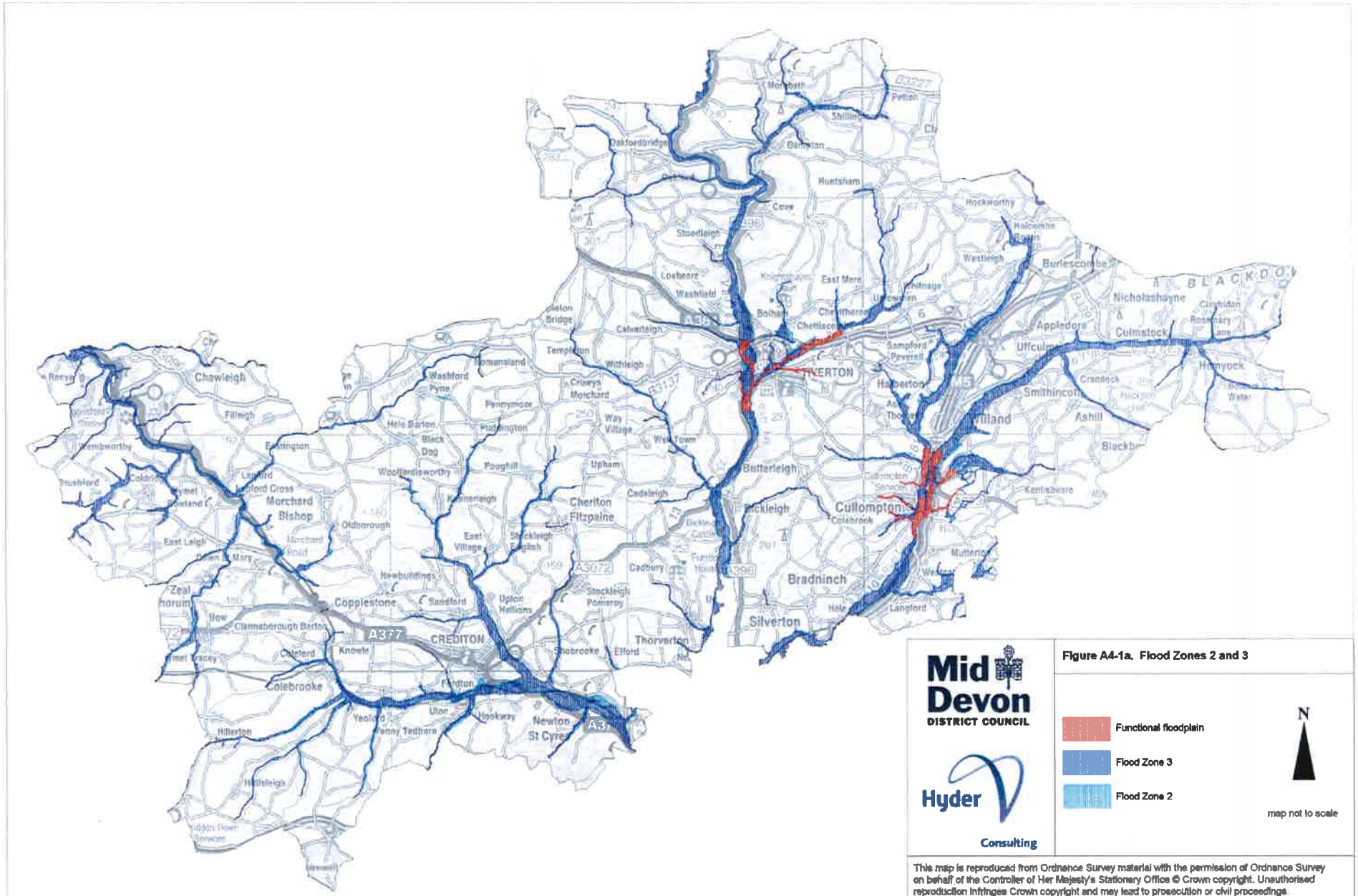
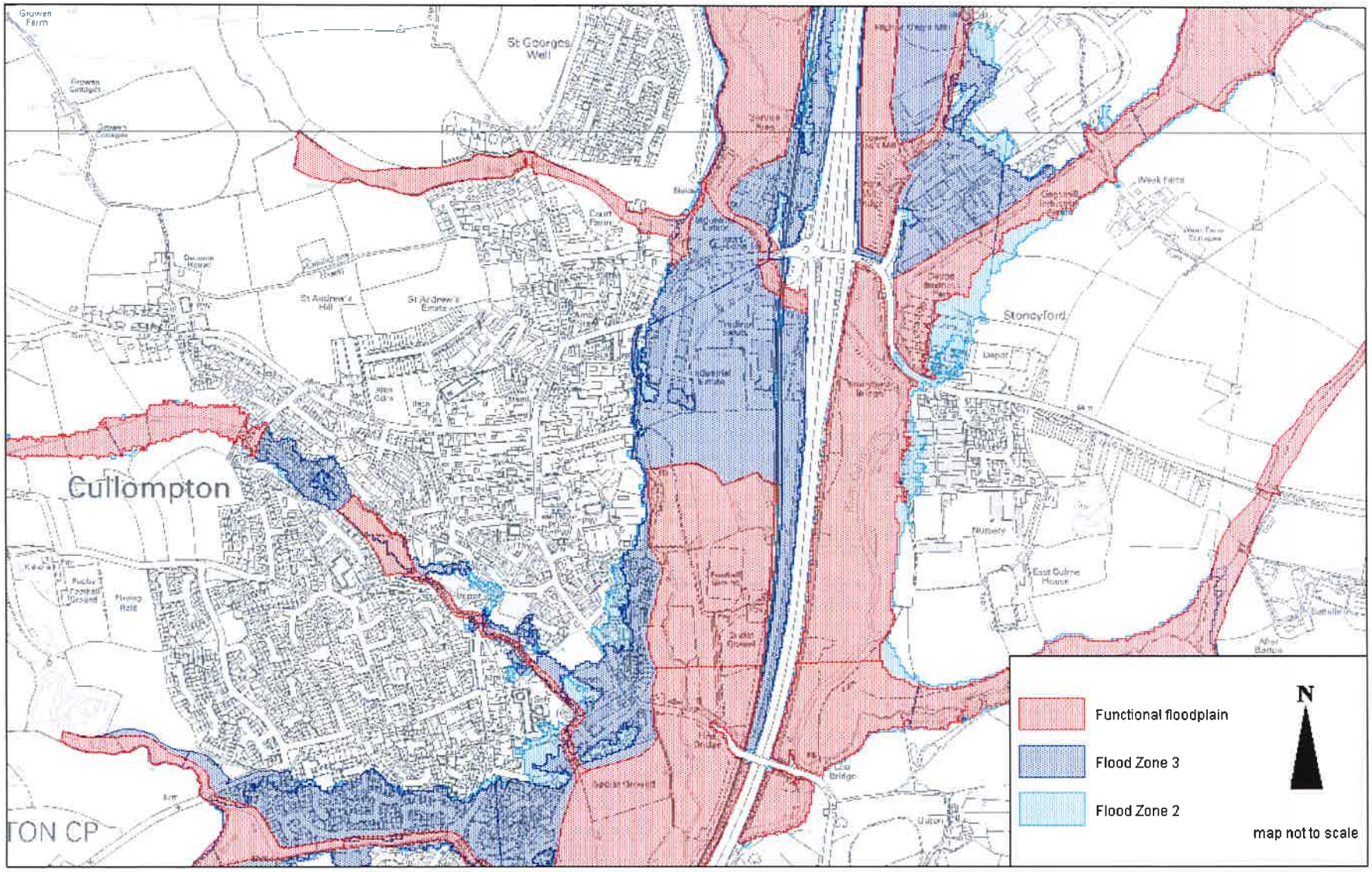

Mid Devon
DISTRICT COUNCIL
Hyder
Consulting
Figure A4-1a. Flood Zones 2 and 3
Functional floodplain
Flood Zone 3
Flood Zone 2
N
map not to scale
This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings
Mid Devon District Council. 100022292. [2008].

**Figure A4-1c. Flood Zones 2 and 3**
**Cullompton**



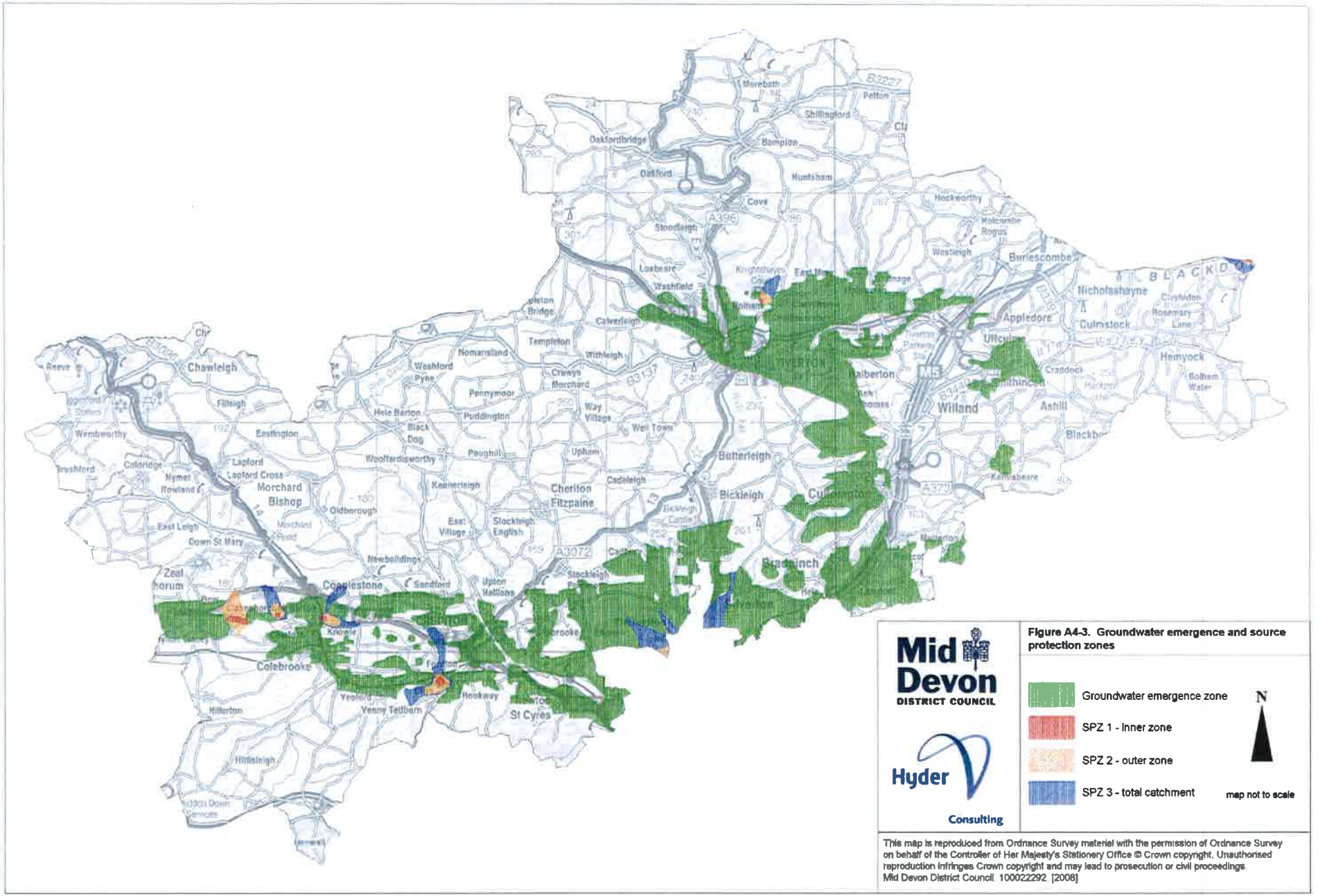
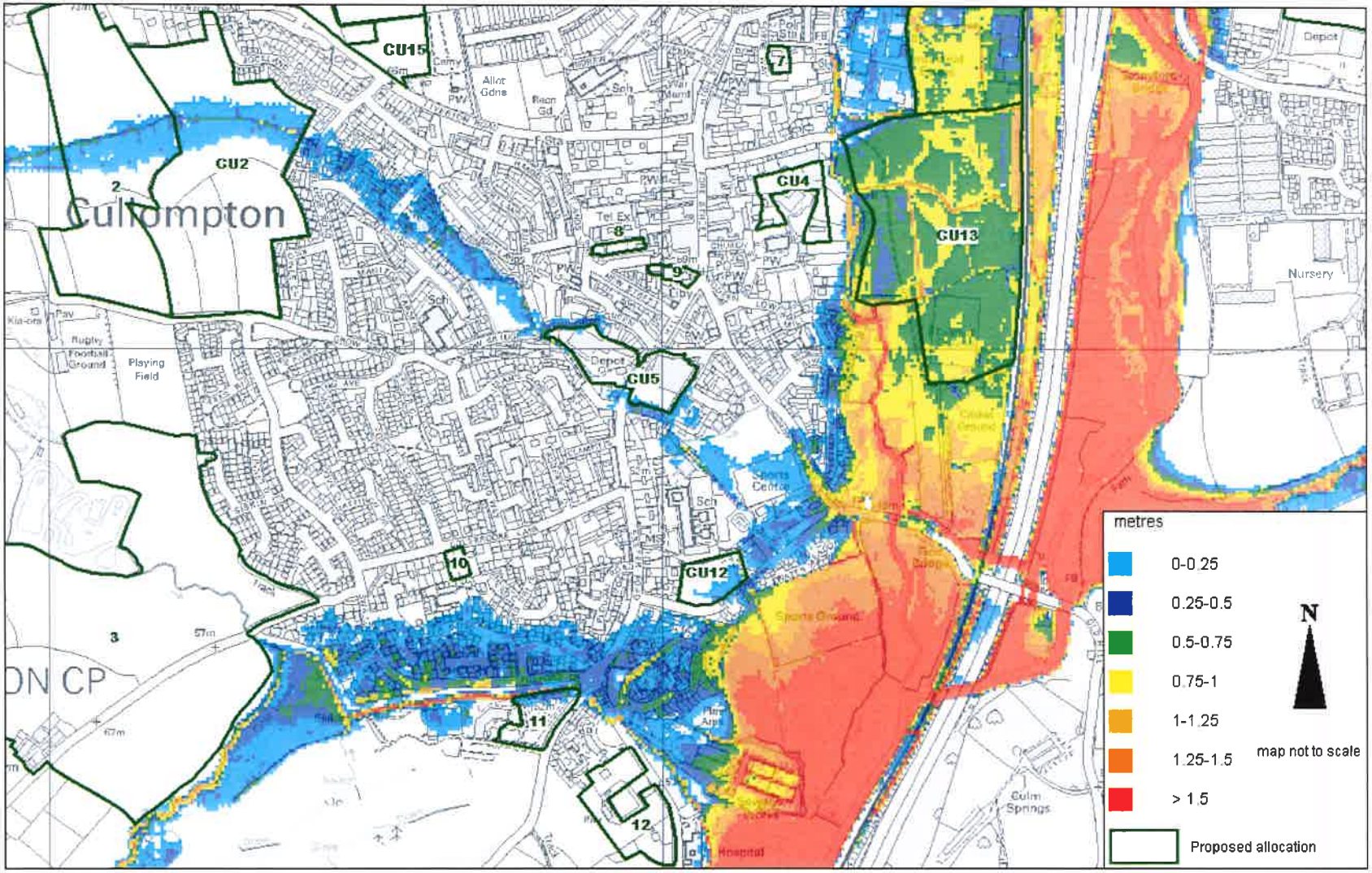
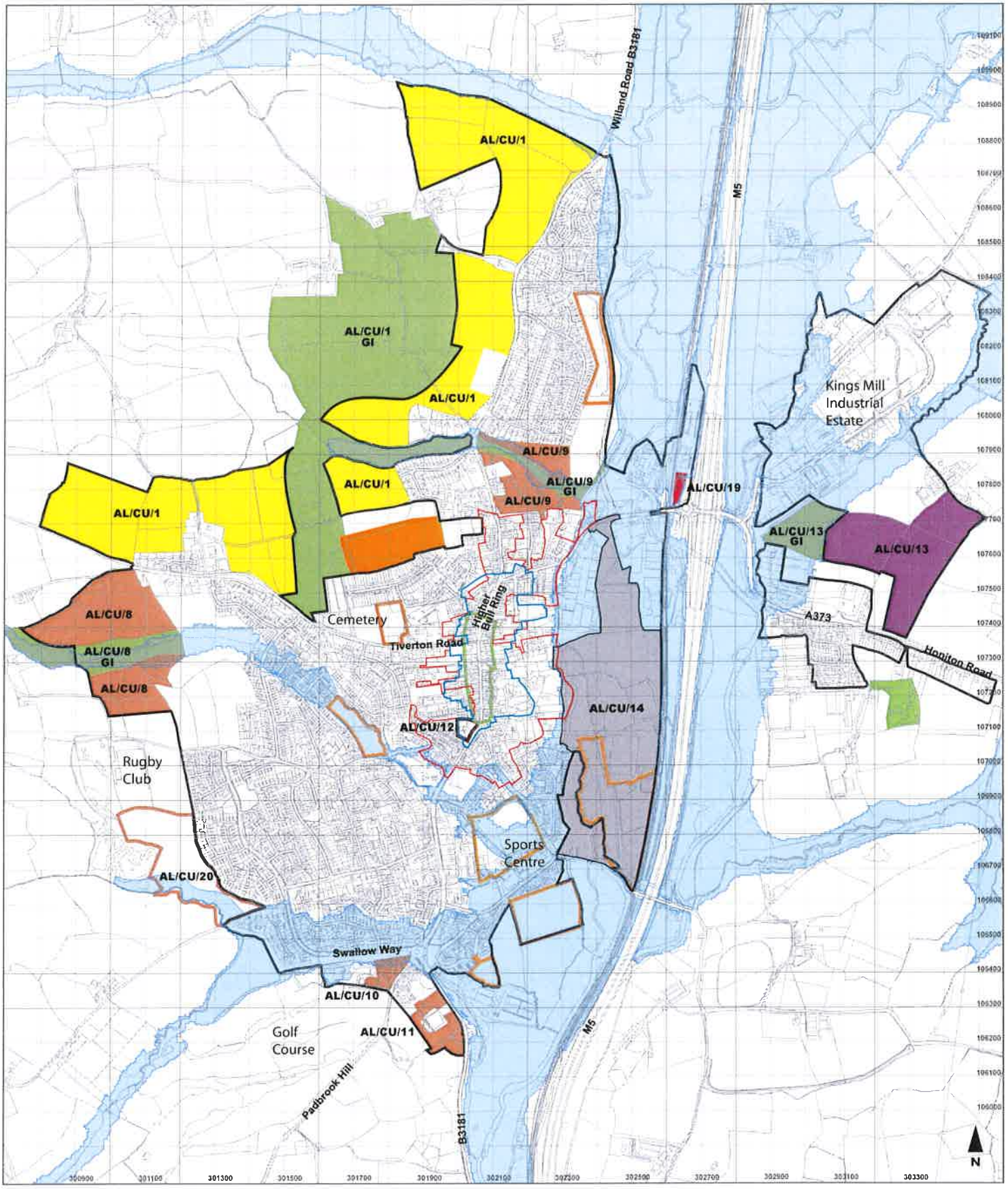

Mid Devon
DISTRICT COUNCIL
Hyder
Consulting
Figure A4-3. Groundwater emergence and source protection zones
Groundwater emergence zone
SPZ 1 - Inner zone
SPZ 2 - outer zone
SPZ 3 - total catchment
N
map not to scale
This map is reproduced from Ordinance Survey material with the permission of Ordinance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings.
Mid Devon District Council. 100022292. [2008]

**Figure A6-1b-part ii. Flood depths during a 1 in 100 year event**
**Cullompton (South)**






- Settlement Limit
- Residential
- Contingency Housing Site
- Mixed Use
- Green Infrastructure
- Employment
- Town Centre Boundary
- Proposed Primary Shopping Area
- Community Use
- Railway Station Car Park
- Area for Eastern Relief Road
- Conservation Area
- Important Land for Sport and Recreation
- Ancient Monument
- County Wildlife Site
- Floodplain

*Deleted Important Land for Sport and Recreation*

**Mid Devon Local Plan Part III**

## Proposed Policies Map

# Cullompton

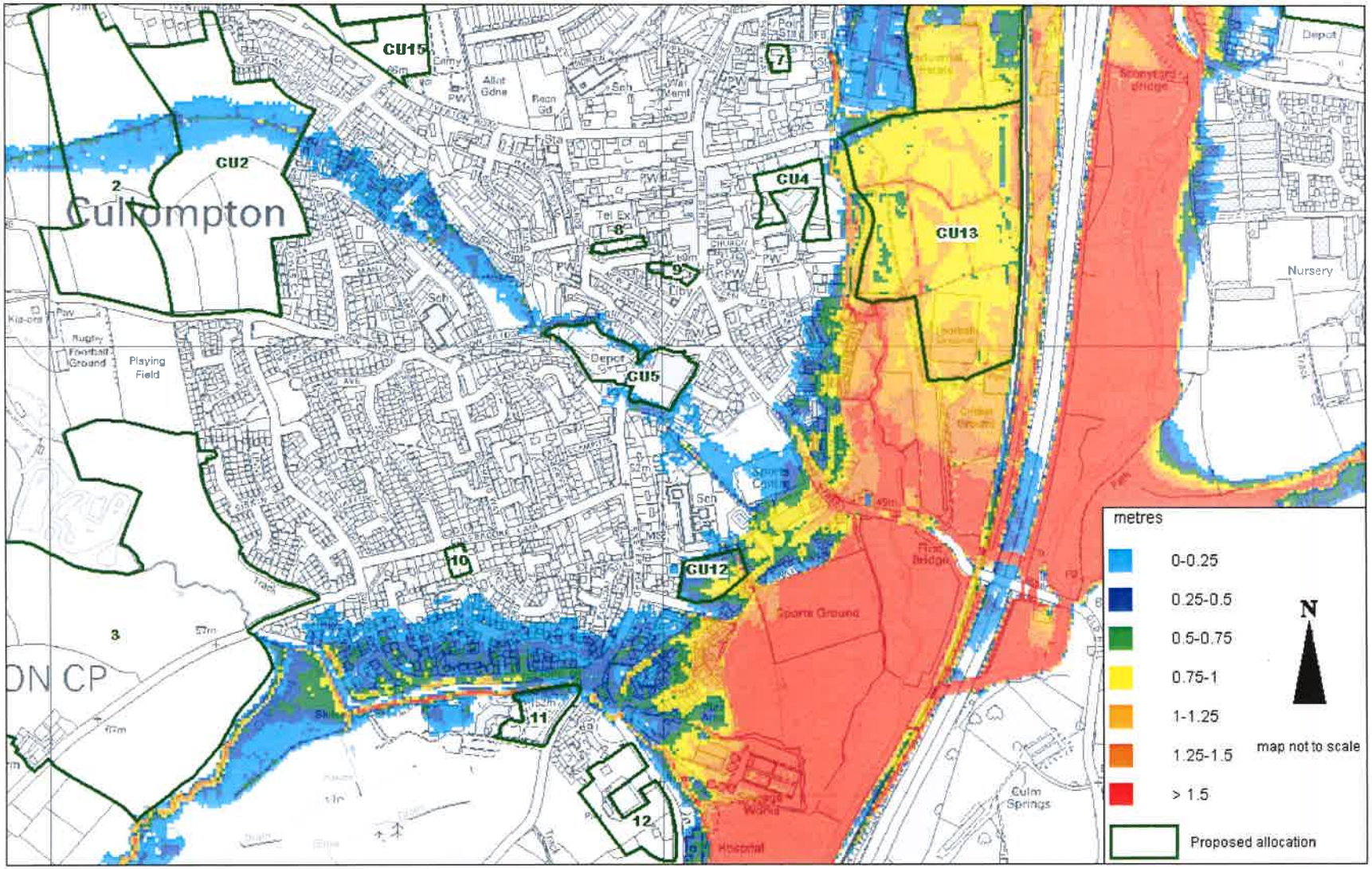
**Note:** The Ordnance Survey will not have updated the base to show recent changes. Consequently not all development may be shown.



**Scale** 1:10,000

**July** 2012

**Figure A6-2b-part ii. Flood depths during a 1 in 1000 year event**
**Cullompton (South)**



# Appendix H

# Outline Surface Water Drainage Information

**CALCULATION SHEET**

**Details:** Preliminary Surface Water Drainage Calculations

**Project:** Colebrook Lane, Cullompton
**Project No:** P9841

CONSULTING ENGINEERS LIMITED

**Date:** 20/06/2013
**Prepared By:** S.Hurdwell
**Checked By:** T.Shipp

## Downstream Flood Risk and Surface Water Discharge Rates Assessment

**Institution of Hydrology Report 124 method** - Calculating greenfield discharge rates (*original unmodified version*)

| | |
|---|---|
| Total Development Area (ha): | 19.80 |
| SAAR (mm): | 980 |
| WRAP Class: | 1 |
| SOIL: | 0.15 |
| Hydrological Region: | 8 |
| Climate Change since 1990 (cc): | 5.0% |
| $Q_{BAR}$ (l/s): | 13.8 |
| $Q_{BAR}$ (l/s/ha): | 0.7 |

IoH 124 Equation:

$$Q_{BAR} = 0.00108\, A^{0.89}\, SAAR^{1.17}\, SOIL^{2.17} + cc$$

A = Area ($km^2$)
SAAR = Average Annual Rainfall (mm) - (From FEH CD-ROM catchment descriptors)
SOIL = SOIL Index Derived from WRAP map

| Return Period (Years) | Growth Factors (from IoH124 and based on corresponding Hydro Region) | Unit Area Run-off Rate (l/s/ha) | Site Specific Run-off Rate (l/s) |
|---|---|---|---|
| **1** | **0.88** | **0.6** | **12.2** |
| **2.33** | **1.00** | **0.7** | **13.8** |
| **5** | 1.23 | 0.9 | 17.0 |
| **10** | 1.49 | 1.0 | 20.6 |
| **25** | 1.84 | 1.3 | 25.4 |
| **30** | **1.89** | **1.3** | **26.1** |
| **50** | 2.12 | 1.5 | 29.3 |
| **100** | **2.42** | **1.7** | **33.4** |
| **200** | 2.92 | 2.0 | 40.4 |
| **500** | 3.41 | 2.4 | 47.1 |

**CALCULATION SHEET**

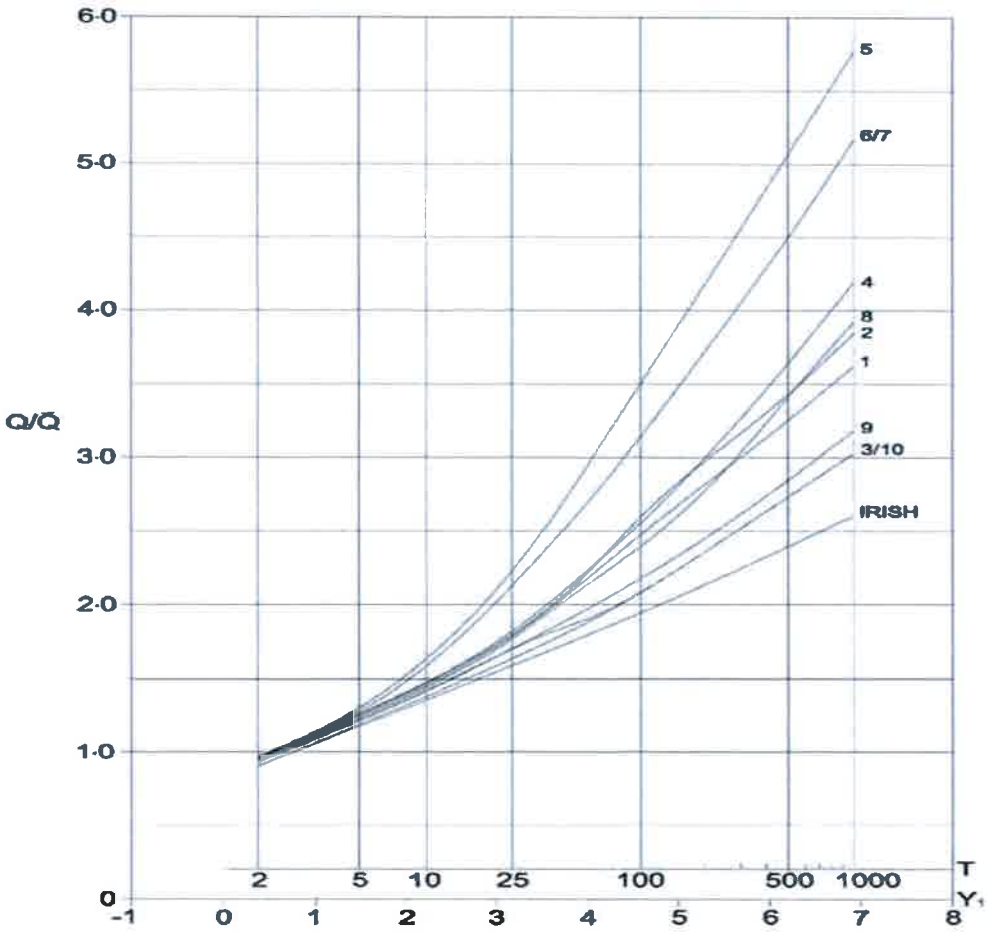
**Details:** Preliminary Surface Water Drainage Calculations

**Project:** Colebrook Lane, Cullompton
**Project No:** P9841

CONSULTING ENGINEERS LIMITED

**Date:** 20/06/2013
**Prepared By:** S.Hurdwell
**Checked By:** T.Shipp

UK Growth Curves




Uk Growth Curve Factors

| Hydrometric Area | Return Period | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2.33 | 5 | 10 | 25 | 30 | 50 | 100 | 200 | 500 |
| 1 | 0.90 | 1.00 | 1.20 | 1.45 | 1.81 | | 2.12 | 2.48 | | 3.25 |
| 2 | 0.91 | 1.00 | 1.11 | 1.42 | 1.81 | | 2.17 | 2.63 | | 3.45 |
| 3 | 0.94 | 1.00 | 1.25 | 1.45 | 1.70 | | 1.90 | 2.08 | | 2.73 |
| 4 | 0.89 | 1.00 | 1.23 | 0.49 | 1.87 | | 2.20 | 2.57 | | 3.62 |
| 5 | 0.89 | 1.00 | 1.29 | 1.65 | 2.25 | | 2.83 | 3.56 | | 5.02 |
| 6 / 7 | 0.88 | 1.00 | 1.28 | 1.62 | 2.14 | | 2.62 | 3.19 | | 4.49 |
| 8 | 0.88 | 1.00 | 1.23 | 1.49 | 1.84 | 1.89 | 2.12 | 2.42 | | 3.41 |
| 9 | 0.93 | 1.00 | 1.21 | 1.42 | 1.71 | | 1.94 | 2.18 | | 2.86 |
| 10 | 0.93 | 1.00 | 1.19 | 1.38 | 1.64 | | 1.85 | 2.08 | | 2.73 |
| Ireland | 0.95 | 1.00 | 1.20 | 1.37 | 1.60 | | 1.77 | 1.96 | | 2.40 |


Figure 1: Hydrological Areas Map

**CALCULATION SHEET**

**Details:** Preliminary Surface Water Drainage Calculations

**Project:** Colebrook Lane, Cullompton
**Project No:** P9841

CONSULTING ENGINEERS LIMITED

**Date:** 20/06/2013
**Prepared By:** S.Hurdwell
**Checked By:** T.Shipp

**Institution of Hydrology Report 124 method** - Calculating greenfield discharge rates (*as modified by EA Technical Report W5-074/A/TR/1 Rev.D*)

| | |
|---|---|
| Total Development Area (ha): | **19.80** |
| SAAR (mm): | **980** |
| WRAP Class: | **1** |
| SPR (Site - from WRAP-SPR table): | **0.15** |
| SPRHOST (Catchment): | **38.00%** |
| SPR (Site - from SOIL HOST classes): | **0.16** |
| Hydrological Region: | **9** |
| Climate Change since 1990 (cc): | **5.0%** |
| $Q_{BAR\ (50ha\ area)}$ (l/s): | ***36.3*** |
| $Q_{BAR\ (site)}$ (l/s): | ***14.4*** |
| $Q_{BAR}$ (l/s/ha): | ***0.7*** |

IoH 124 Equation (modified):

$$Q_{BAR} = 0.00108\, A^{0.89}\, SAAR^{1.17}\, SPR^{2.17} + cc$$

A = A notional area of 0.5 km$^2$; the site discharge is then calculated from the pro-rata'd site area.
SAAR = Average Annual Rainfall (mm) - (From FEH CD-ROM catchment descriptors)
SPR = site specific Standard Percentage Run-off (derived from SOIL [=WRAP] class to SPR correlation as tabulated in W5-074/A/TR/1 Rev.D ) or from proportioned HOST SOIL classes given in FEH Volume 4.

SPRHOST = catchment Standard Percentage Run-off (from FEH catchment descriptors)

| Return Period (Years) | Growth Factors (from IoH124 and based on corresponding Hydro Region) | Unit Area Run-off Rate (l/s/ha) | Site Specific Run-off Rate (l/s) |
|---|---|---|---|
| **1** | **0.88** | **0.6** | **12.6** |
| **2.33** | **1.00** | **0.7** | **14.4** |
| **5** | 1.23 | 0.9 | 17.7 |
| **10** | 1.49 | 1.1 | 21.4 |
| **25** | 1.84 | 1.3 | 26.4 |
| **30** | **1.89** | **1.4** | **27.1** |
| **50** | 2.12 | 1.5 | 30.4 |
| **100** | **2.42** | **1.8** | **34.7** |
| **200** | 2.92 | 2.1 | 41.9 |
| **500** | 3.41 | 2.5 | 49.0 |

**ADAS Reference Book 345 "Design of Field Drainage systems"** - Calculating greenfield discharge rates

## Introduction

This guidance indicates an acceptable method for the assessment of greenfield run-off rates from small sites in the South Western Region of the Environment Agency. The method is based on the ADAS reference book 345 '*The design of field drainage systems*' combined with the regional growth curves developed by South West Water Authority as well as area data on soil and rainfall statistics. Reviews of small catchments in the region have been carried out that demonstrate that this method produces results that, when extrapolated to a larger area, give a reasonable degree of agreement with the *Flood Estimation Handbook (FEH)* estimates.

The method for assessing run-off rates in this region has been adapted to cover sites outside this region.

## Methodology

The ADAS 345 method first assess the Mean Annual Flood which is used as an index run-off rate. The index run-off rate is then multiplied by a range of multipliers, which indicate increasing run-off rates with increasing return period/severity of storm event.

The steps involved in this process are given below.

## Site area and slope

The ADAS 345 method was designed for calculating allowable discharges from field systems. As such, where the proposed development site is of a large size, of a complicated shape, has complicated topography or even a watercourse running through it, it may necessary to break down the area into smaller more uniform areas and derive index run-off rates from each of these individually.

The site area is input in hectares; the maximum length of the site area, or the length across the typical slope of the area is input in metres; the maximum height difference across the site area is also input in metres, and typical slope gradients (derived therefrom) are input as decimal fractions.

## Site/Catchment characteristic flood flow intensity relationship

Figure 1 below relates the site topography via the Average Annual Rainfall (***AAR***) rate to a Flood Flow Factor ***F***.

The slope and length of the site are used to determine a site/catchment characteristic ***C***. The ***AAR*** can either be taken the *Wallingford Procedure* maps, which gives a broad region-wide indication of this value, or, more accurately, local values can be obtained from the Agency, the Met Office or the *FEH* CD-ROM or the *FEH* printed lists of soil characteristics and HOST classes .

In the case of the application site in, the ***AAR*** has been taken from the *Wallingford Procedure* mapping.
The soil *Winter Rainfall Acceptance Potential (WRAP)* class has also been read from the *Wallingford Procedure* maps.

**CALCULATION SHEET**

**Details:** Preliminary Surface Water Drainage Calculations

**Project:** Colebrook Lane, Cullompton
**Project No:** P9841

CONSULTING ENGINEERS LIMITED

**Date:** 20/06/2013
**Prepared By:** S.Hurdwell
**Checked By:** T.Shipp

## Assessment of Standard Percentage Run-off (SPR) from soil type and HOST classes

| Soil Type | HOST Classes | HOST Class Percentage | SPR value for HOST Class | Totals | Soil Description | Comment |
|---|---|---|---|---|---|---|
| 541e - Crediton | Class 2 | 22.22% | 2.00% | 0.444% | Permian and Carboniferous reddish breccia - Well drained gritty reddish loamy soils over breccia, locally less stoney. Steep Slopes in places. | |
| | Class 3 | 77.78% | 14.50% | 11.278% | | |
| | | | Site SPR = TOTAL | 11.72% | | |

| Soil Type | HOST Classes | HOST Class Percentage | SPR value for HOST Class | Totals | Soil Description | Comment |
|---|---|---|---|---|---|---|
| 712e - Hallsworth 2 | Class 24 | 100.00% | 39.70% | 39.700% | Drift from Paleozoic shale - Slowly permeable seasonally waterlogged clayey, fine loamy and fine silty soils. | |
| | | | Site SPR = TOTAL | 39.70% | | |

| Soil Type | HOST Classes | HOST Class Percentage | SPR value for HOST Class | Totals | Soil Description | Comment |
|---|---|---|---|---|---|---|
| 811c Hollington | Class 8 | 11.11% | 44.30% | 4.922% | Reddish River Alluvium - Deep stoneless reddish fine silty and clayey soils variably affected by groundwater. Flat Land, Risk of flooding. | |
| | Class 9 | 88.89% | 25.30% | 22.489% | | |
| | | | Site SPR = TOTAL | 27.41% | | |

The ratios to which these soil types occur across the site are estimated to be :--

| | | | |
|---|---|---|---|
| 541e - Crediton | 11.72% | @ 80% | 9.38% |
| 712e - Hallsworth 2 | 39.70% | @ 10% | 3.97% |
| 811c Hollington | 27.41% | @ 10% | 2.74% |

| Total |
|---|
| **16.09%** |

**Assessment of Standard Percentage Run-off (SPR) from soil type and HOST classes (cont....)**

There is a significant difference in the WRAP soil parameter, the SPRHOST and the SPR for the site. The SPRHOST and SPR values are derived using 29 soil classes as opposed to the five defined on the WRAP map; it is generally considered that SPR values provide a more accurate representa tion of soil characteristics and variation in run-off between soil types. The most realistic value, SPR, has therefore been adopted in the estimation of greenfield run-off rates from the proposed site.

**Greenfield run-off rates**

The Mean Annual Flood (MAF) is estimated at step 9 below. For this the Soil Type factor $S_T$ is multiplied by the Flood Flow Factor $F$ and the site area to give the MAF $Q_o$.

Based upon the MAF $Q_o$ figure calculated, an adjustment is made for increases in peak rainfall due to climate change since AD1990 (= MAF $Q_o$ +cc); then an appropriate "growth factor" is applied to the adjusted MAF $Q_o$ +cc determine the peak run-off rates that would occur from the site during more intense storms. To estimate these more extreme conditions the UK Growth Curve multipliers are taken from the Neil Whittier figures published by the Environment Agency for the South West Region or those from W5-074/A/TR/1 Rev.D, as considered most appropriate.

**CALCULATION SHEET**

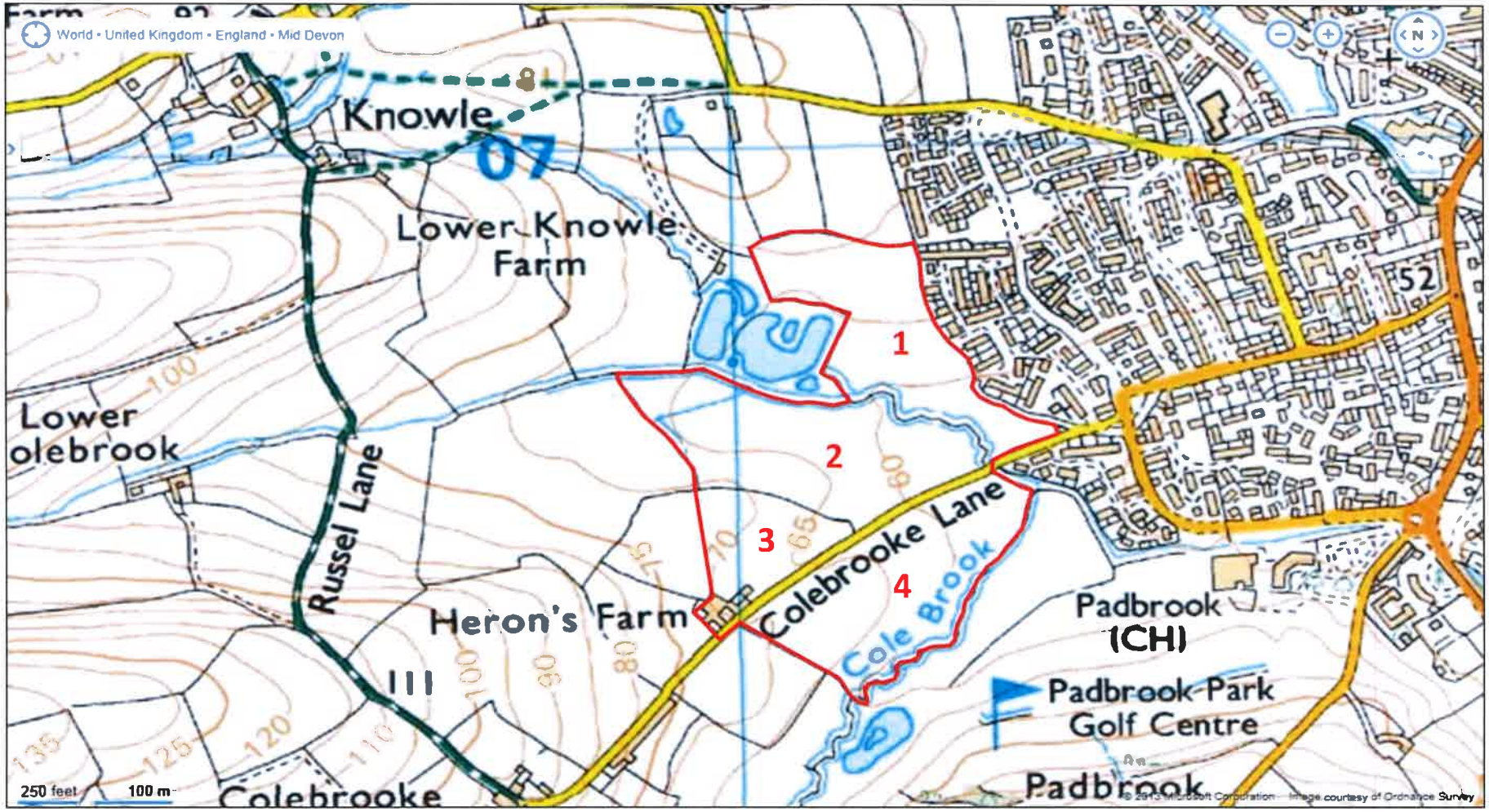
**Details:** Preliminary Surface Water Drainage Calculations

**Project:** Colebrook Lane, Cullompton
**Project No:** P9841

CONSULTING ENGINEERS LIMITED

**Date:** 20/06/2013
**Prepared By:** S.Hurdwell
**Checked By:** T.Shipp

**Site Areas--**



**CALCULATION SHEET**

**Details:** Preliminary Surface Water Drainage Calculations

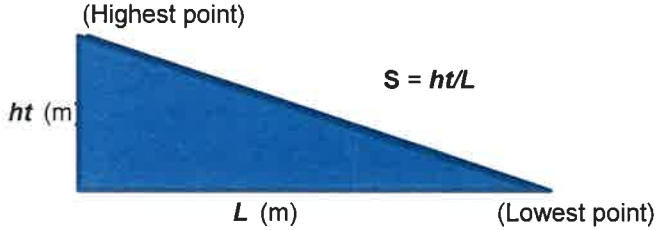
**Project:** Colebrook Lane, Cullompton
**Project No:** P9841

CONSULTING ENGINEERS LIMITED

**Date:** 20/06/2013
**Prepared By:** S.Hurdwell
**Checked By:** T.Shipp

## Determination of mean Annual Flood $Q_0$

| | | AREA 1 | AREA 2 | AREA 3 | AREA 4 | Total Area |
|---|---|---|---|---|---|---|
| 1. Locate a suitable map of the area and determine the catchment area ***A*** in hectares. | ***A*** = | **5.10 ha** | **6.10 ha** | **2.73 ha** | **5.9 ha** | **19.83 ha** |
| 2. Determine the maximum length of catchment ***L*** in metres | ***L*** = | **220 m** | **180 m** | **190 m** | **270 m** | |
| 3. Determine the average slope of the catchment ***S*** | = | 68 – 60 / 220 | 70 – 60 / 180 | 72 – 62 / 190 | 71 – 60 / 270 | |
| | **S** = | **0.036** | **0.056** | **0.053** | **0.041** | |




| | | | | | | |
|---|---|---|---|---|---|---|
| 4. Determine the catchment characteristic ***C*** | ***C*** = 0.0001 x ***L/S*** | ***C*** = | **0.61** | **0.32** | **0.36** | **0.66** |
| 5. Determine the dominant crop type | Grass / Arable / Horticultural | = | **G** | **G** | **G** | **G** |
| 6. Determine the average annual rainfall ***AAR*** in mm | | ***AAR*** = | **980 mm** | **980 mm** | **980 mm** | **980 mm** |

7. Determine the soil type factor $S_T$

| Permeability Class | Range (m/day) | WRAP Class | Soil Index | $S_T$ |
|---|---|---|---|---|
| ---- | ---- | 5 | 0.50 | 1.3 |
| Very Slow | < 0.01 - 0.1 | 4 | 0.45 | 1.0 |
| Slow - Mod | 0.1 - 0.3 | 3 | 0.40 | 0.8 |
| Moderate | 0.3 - 1.0 | 2 | 0.30 | 0.5 |
| Mod - Rapid | 1.0 - 10.0 | 1 | 0.15 | 0.1 |
| Rapid | >10 | 1 | | 0.1 |

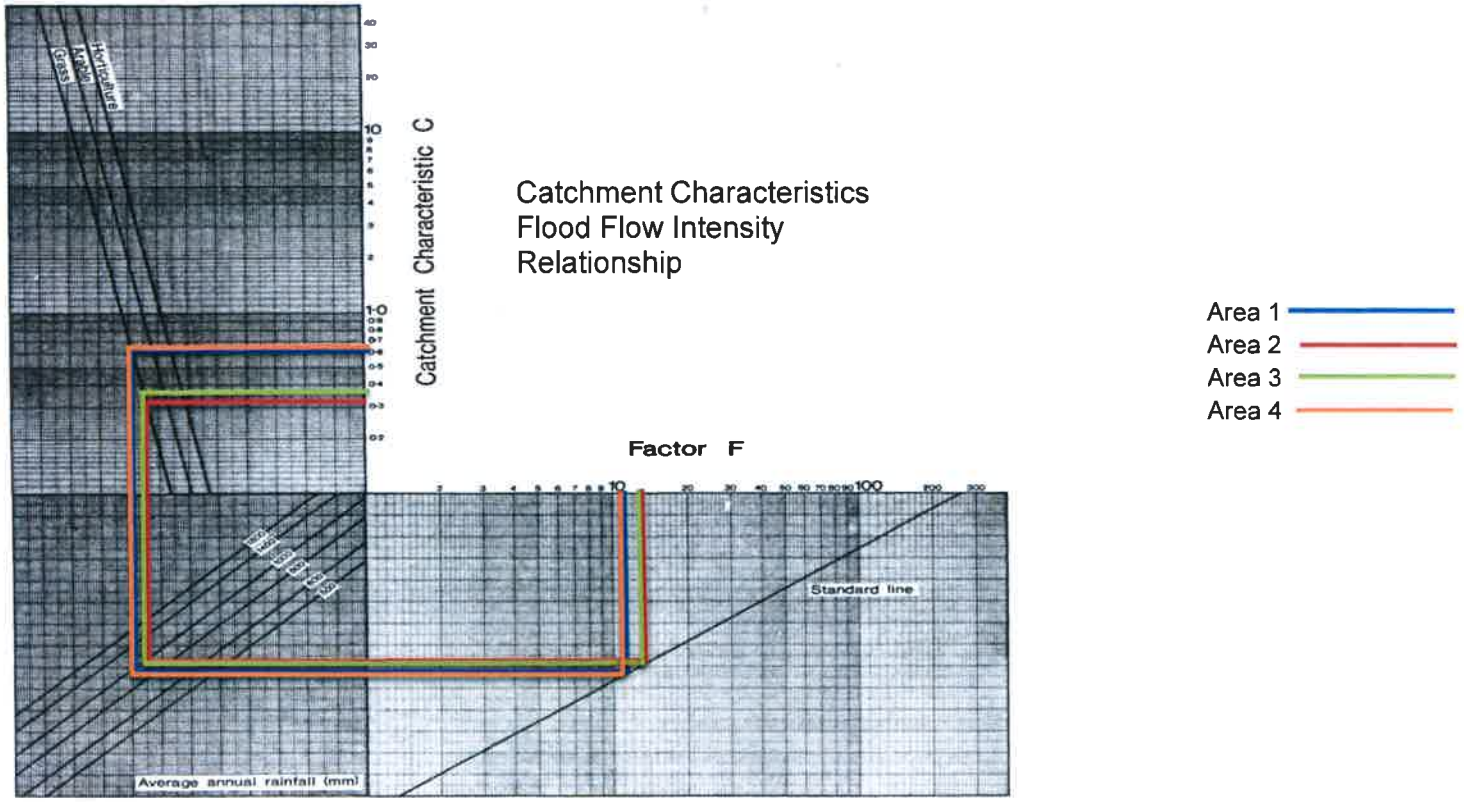
| | | | | | |
|---|---|---|---|---|---|
| $S_T$ = | **0.1** | **0.1** | **0.1** | **0.1** | |

**Determination of mean Annual Flood $Q_0$ Cont....**

8. At figure 4 below, enter the graph at ***C***. Move across (left) to crop type, down to average annual rainfall (***AAR***), across (right) to the standard line and up to ***F*** number.

| | | | | |
|---|---|---|---|---|
| ***F*** = | 11 | 13 | 12.5 | 10.5 |

Figure 1. Flood Flow Intensity Relationship



**CALCULATION SHEET**

**Details:** Preliminary Surface Water Drainage Calculations

**Project:** Colebrook Lane, Cullompton
**Project No:** P9841

CONSULTING ENGINEERS LIMITED

**Date:** 20/06/2013
**Prepared By:** S.Hurdwell
**Checked By:** T.Shipp

**Determination of mean Annual Flood $Q_0$ Cont....**

9. Peak flood Flow $Q_o = S_T \times F \times A$ — $Q_0$ = **5.6** **7.9** **3.4** **6.2**

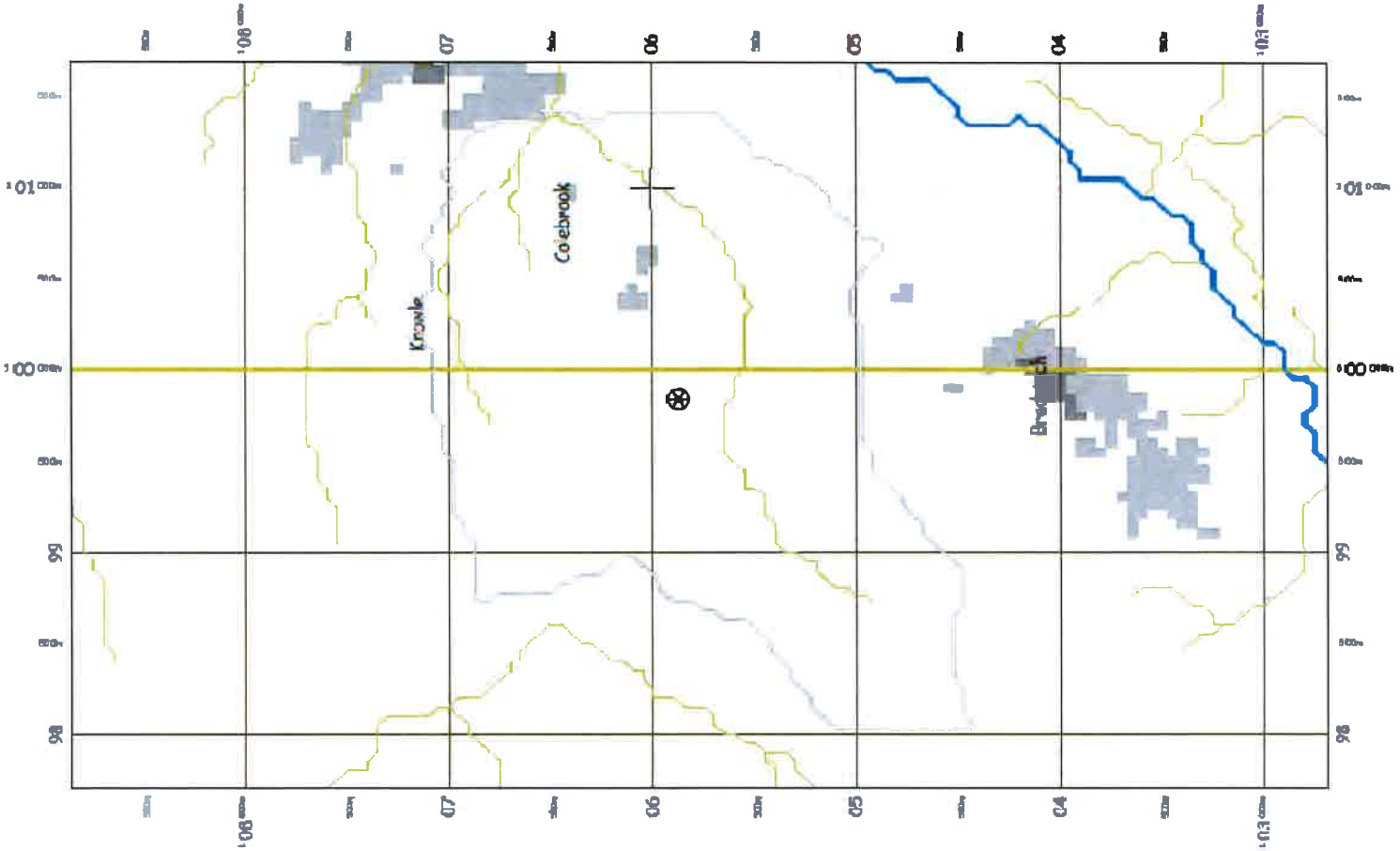
10. Mean Annual Estimated peak flow (+5% for climate change from 1990 figures) — $Q_0 + cc$ = **5.9** **8.3** **3.6** **6.5**

11. Greenfield run-off Rates -

| Return Period (Years) | $Q_2$ | MAF (2013) $Q_0$+cc | $Q_5$ | $Q_{10}$ | $Q_{30}$ | $Q_{50}$ | $Q_{100}$ |
|---|---|---|---|---|---|---|---|
| South West Region Multiplier | 0.88 | 1 | 1.23 | 1.49 | 1.89 | 2.12 | 2.42 |
| Mean Annual Probability | 63% | MAF (2011) | 18% | 10% | 3.30% | 2% | 1% |
| Greenfield Discharge Rates (l/s) | *5.18* | *5.89* | *7.25* | *8.78* | *11.13* | *12.49* | *14.26* |
| Greenfield Discharge Rates (l/s) | *7.33* | *8.33* | *10.24* | *12.41* | *15.74* | *17.65* | *20.15* |
| Greenfield Discharge Rates (l/s) | *3.15* | *3.58* | *4.41* | *5.34* | *6.77* | *7.60* | *8.67* |
| Greenfield Discharge Rates (l/s) | *5.72* | *6.50* | *8.00* | *9.69* | *12.29* | *13.79* | *15.74* |
| Totals (l/s) | 21.39 | 24.30 | 29.89 | 36.21 | 45.94 | 51.53 | 58.82 |
| Totals (l/s/ha) | 1.08 | 1.23 | 1.51 | 1.83 | 2.32 | 2.60 | 2.97 |

## Flood Estimation Handbook Catchment Characteristics

Catchment Plan



**CALCULATION SHEET**

**Details:** Preliminary Surface Water Drainage Calculations

**Project:** Colebrook Lane, Cullompton
**Project No:** P9841

CONSULTING ENGINEERS LIMITED

**Date:** 20/06/2013
**Prepared By:** S.Hurdwell
**Checked By:** T.Shipp

**Flood Estimation Handbook Catchment Characteristics**

Catchment Parametres

| | | | | | |
|---|---|---|---|---|---|
| AREA | = | 5.99 | C | = | -0.02417 |
| ALTBAR | = | 120 | D1 | = | 0.37397 |
| ASPBAR | = | 69 | D2 | = | 0.2838 |
| ASPVAR | = | 0.34 | D3 | = | 0.33345 |
| BFIHOST | = | 0.795 | E | = | 0.281 |
| DPLBAR | = | 2.26 | F | = | 2.49692 |
| DPSBAR | = | 113.4 | C(1 km) | = | -0.026 |
| FARL | = | 0.993 | D1(1 km) | = | 0.378 |
| LDP | = | 4.8 | D2(1 km) | = | 0.293 |
| PROPWET | = | 0.42 | D3(1 km) | = | 0.34 |
| RMED-1H | = | 11 | E(1 km) | = | 0.288 |
| RMED-1D | = | 33.4 | F(1 km) | = | 2.488 |
| RMED-2D | = | 42.1 | | | |
| SAAR | = | 928 | | | |
| SAAR4170 | = | 981 | | | |
| SPRHOST | = | 18.05 | | | |
| URBCONC1990 | = | -999999 | | | |
| URBEXT1990 | = | 0 | | | |
| URBLOC1990 | = | -999999 | | | |

**CALCULATION SHEET**

**Details:** Preliminary Surface Water Drainage Calculations

**Project:** Colebrook Lane, Cullompton
**Project No:** P9841

CONSULTING ENGINEERS LIMITED

**Date:** 20/06/2013
**Prepared By:** S.Hurdwell
**Checked By:** T.Shipp

**Summary table of Surface Water Runoff Rates for Comparison**

| Method of Calculation | $Q_2$ | MAF (2013) $Q_0$+cc | $Q_5$ | $Q_{10}$ | $Q_{30}$ | $Q_{50}$ | $Q_{100}$ |
|---|---|---|---|---|---|---|---|
| Institution of Hydrology Report 124 method (original unmodified version) | 0.6 l/s/ha | 0.7 l/s/ha | 0.9 l/s/ha | 1.0 l/s/ha | 1.3 l/s/ha | 1.5 l/s/ha | 1.7 l/s/ha |
| Institution of Hydrology Report 124 method (as modified by EA Technical Report W5-074/A/TR/1 Rev.D) | 0.6 l/s/ha | 0.7 l/s/ha | 0.9 l/s/ha | 1.1 l/s/ha | 1.4 l/s/ha | 1.5 l/s/ha | 1.8 l/s/ha |
| ADAS Reference Book 345 "Design of Field Drainage systems" | 1.1 l/s/ha | 1.2 l/s/ha | 1.5 l/s/ha | 1.8 l/s/ha | 2.3 l/s/ha | 2.6 l/s/ha | 3.0 l/s/ha |

Discussion:

Whilst we understand the ADAS 345 method to be the most realistic we would using the lowest result to give the most conservative baseline rates from the site.