



**THE FOUNDRY
MOUNT STREET, RHOSTYLLEN**

FLOOD CONSEQUENCE ASSESSMENT



For

S G Estates
5 Churchlea
Main Road
Rhosrobin
Wrexham
LL11 4RB



JANUARY 2014

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**THE FOUNDARY
MOUNT STREET, RHOSTYLLEN**

FLOOD CONSEQUENCE ASSESSMENT

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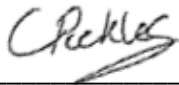
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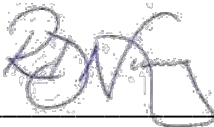
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EXECUTIVE SUMMARY

This Flood Consequence Assessment was commissioned by Cartwright Architectural & Planning Services on behalf of S G Estates, referred to hereafter as 'the client'. The Flood Consequence Assessment has been prepared to support a planning application and also to satisfy the mandatory requirements of the Code for Sustainable Homes for a residential development complete with external works, footpaths, car parking, landscaping, boundary walls, fencing, external services and drainage.

The site is in an area identified as having a 'very low' probability of flooding on the Environment Agency Flood Map and is identified as Flood Zone A on the Welsh Assembly Government's Development Advice Maps. The residential nature of the development proposals means the classification of the site is 'highly vulnerable' from TAN15 Table 2 and development of this type is acceptable within Flood Zone A.

The Flood Consequence Assessment has reviewed all sources of flood risk to both the proposed development and to the existing adjacent development as a result of the proposals, including; fluvial, tidal, pluvial, groundwater, sewers and flooding from artificial sources. Based on the low flood risk identified from all of the sources reviewed the emphasis is on the effective management of the surface water run-off generated by the proposed development.

Based on the ground conditions identified during the Ground Investigation works undertaken by Betts Geo-Environmental infiltration drainage will not provide a suitable means of surface water disposal for the flows generated by the proposed development due to the presence of shallow groundwater.

As infiltration is not viable and there is no watercourse in close proximity to the proposed development it is proposed that the flows generated by the development continue to discharge to the existing public sewer network mimicking the pre-development situation.

This report has been prepared in consultation with the relevant interested parties and incorporates their comments where possible. The Flood Consequence Assessment is considered to be commensurate with the development proposals and in summary, the development can be considered appropriate.

The Flood Consequence Assessment is considered to be commensurate with the development proposals and in summary, the development can be considered appropriate in accordance with TAN15, and is considered to satisfy the mandatory Flood Risk requirements of SUR1 of the Code for Sustainable Homes.

CONTENTS

Document Tracking Sheet.....	iii
EXECUTIVE SUMMARY	v
Figures & Tables.....	7
Specialist Software.....	8
Abbreviations & Acronyms	8
1.0 INTRODUCTION.....	9
1.1 Planning Policy Context	9
1.2 Site Context.....	9
1.3 Consultation.....	9
2.0 EXISTING SITE SITUATION	10
2.1 Location.....	10
2.2 Existing and Historical Land Use	10
3.0 DEVELOPMENT PROPOSALS	11
3.1 Nature of the development	11
4.0 SOURCES OF FLOOD RISK.....	12
4.1 Fluvial & Tidal Flood Risk	12
<i>Fluvial Flooding</i>	12
<i>Tidal Flooding</i>	12
<i>Flood Zone Classification</i>	13
4.2 Surface Water Flood Risk.....	13
<i>Overland Run-off (Pluvial)</i>	13
<i>Sewers</i>	14
4.3 Groundwater Flood Risk	14
4.4 Artificial Sources of Flood Risk.....	14
<i>Reservoirs</i>	15
<i>Canals</i>	15
4.5 Historical Flooding	15
4.6 Flood Risk Mitigation Measures & Residual Risks	16
<i>Mitigation Measures</i>	16
<i>Residual Risks</i>	16
5.0 SURFACE WATER MANAGEMENT	17
5.1 Pre-development Surface Water Run-off	17
5.2 Post-development Surface Water Run-off	17
5.3 Sustainable Drainage Systems (SuDS).....	17
5.4 Methods of Surface Water Management.....	18
5.5 Discharge via Infiltration.....	18
5.6 Discharge to Watercourse	18
5.7 Discharge to Sewer	19
5.8 Climate Change	19
6.0 FOUL WATER MANAGEMENT	20
7.0 SUMMARY AND CONCLUSIONS	21
8.0 RECOMMENDATIONS	22

BIBLIOGRAPHY & REFERENCES	23
APPENDIX A: LOCATION PLAN	25
APPENDIX B: TOPOGRAPHIC SURVEY	27
APPENDIX C: PROPOSED PLANNING LAYOUT	29
APPENDIX D: NRW/EA INFORMATION & CORRESPONDENCE	31
APPENDIX E: FEH CATCHMENT DATA & DESCRIPTORS	33
APPENDIX F: TAN15 EXTRACTS.....	35
APPENDIX G: WW SEWER RECORDS & CORRESPONDENCE	37
APPENDIX H: WREXHAM CBC CORRESPONDENCE	39
APPENDIX I: SURFACE WATER RUN-OFF CALCULATIONS.....	41
APPENDIX J: IMPERMEABLE AREAS PLAN.....	43
APPENDIX K: STORMWATER STORAGE ESTIMATES	45
APPENDIX L: PFRA INFORMATION	47
APPENDIX M: NOTES OF LIMITATION	49

Figures & Tables

Figure 1: Aerial Photograph of site (Bing Maps 2014).....	10
Figure 2: Planning Layout Extract (Cartwright Architectural & Planning Services 2014)	11
Figure 3: Flood Zone Map Extract (Environment Agency 2014).....	12
Figure 4: Surface Water Flood Map Extract (Environment Agency 2014).....	13
Figure 5: Reservoir Flood Map Extract (Environment Agency 2014).....	15

Specialist Software

- Flood Estimation Handbook FEH CD-ROM (v.3.0) – *Determination of Catchment Descriptors and depths of rainfall*
- MicroDrainage WinDES (v.12.6.1) – *Calculation of Greenfield run-off rates IH124/ICP-SUDS, Greenfield run-off volumes, rates of rainfall and stormwater storage estimates*

Abbreviations & Acronyms

AEP	Annual Exceedance Probability	NGR	National Grid Reference
BGL	Below Ground Level	NPPF	National Planning Policy Framework
BGS	British Geological Survey	NRW	National Resources Wales
CC	Climate Change	NSRI	National Soil Resource Institute
DAM	Development Advice Map	OS	Ordnance Survey
EA	Environment Agency	PFRA	Preliminary Flood Risk Assessment
FEH	Flood Estimation Handbook	PPW	Planning Policy Wales
FCA	Flood Consequence Assessment	QSE	Quick Storage Estimate
FZ	Flood Zone	SFCA	Strategic Flood Consequence Assessment
Ha	Hectare	SuDS	Sustainable Urban Drainage Systems
IDB	Internal Drainage Board	TAN15	Technical Advice Note 15
LLFA	Lead Local Flood Authority	TWL	Top Water Level
LPA	Local Planning Authority	UKCIP	United Kingdom Climate Impacts Programme
mAOD	Metres Above Ordnance Datum	WW	Welsh Water
		WCBC	Wrexham County Borough Council

1.0 INTRODUCTION

1.1 Planning Policy Context

- 1.1.1 All forms of flooding and their impact on the natural and built environment are material planning considerations. Planning Policy Wales (PPW) sets out the Government's objectives for the planning system, and how planning should facilitate and promote sustainable patterns of development, avoiding flood risk and accommodating the impacts of climate change.
- 1.1.2 Technical Advice Note 15: Development and Flood Risk (TAN15) provides further information and guidance on the requirements of the Flood Consequence Assessment.
- 1.1.3 A Flood Consequence Assessment (FCA) is being prepared to satisfy the mandatory requirements of the Code for Sustainable Homes (SUR1).

1.2 Site Context

- 1.2.1 This Flood Consequence Assessment has been prepared to support a planning application and also to satisfy the mandatory requirements of the Code for Sustainable Homes for a residential development complete with external works, footpaths, car parking, landscaping, boundary walls, fencing, external services and drainage.

1.3 Consultation

- 1.3.1 The preparation of this report has been undertaken in consultation with the following interested parties; Wrexham County Borough Council (WCBC), Natural Resources Wales (NRW) and Welsh Water (WW).
- 1.3.2 The Local Planning Authority (LPA), Wrexham County Borough Council, will make the final decision with regard to any planning permission. Wrexham County Borough Council also acts as the Lead Local Flood Authority (LLFA). The NPPF advises that the LPA should consult with Natural Resources Wales who will provide advice and guidance on flood issues at a strategic level and in relation to planning applications.
- 1.3.3 The Natural Resources Wales was contacted to discuss the nature and extent of information to be provided in this Flood Consequence Assessment (FCA) and for any background knowledge of flood risk specific to the site (correspondence is included in Appendix D).
- 1.3.4 Welsh Water Developer Services were contacted to discuss whether WW have any historical flooding issues in the area or any background knowledge on flood risk specific to the site (correspondence is included in Appendix G).
- 1.3.5 Wrexham County Borough Council were contacted to discuss the nature and extent of information to be provided in this Flood Consequence Assessment (FCA) and for any background knowledge of flood risk specific to the site (correspondence is included in Appendix H).

2.0 EXISTING SITE SITUATION

2.1 Location

- 2.1.1 The development is accessed off Mount Street, Rhostyllen. The Ordnance Survey National Grid Reference (OS NGR) for the site is 331246 (Easting), 348883 (Northing) and the nearest postcode is LL14 4AU. The site location plan is shown in Appendix A.
- 2.1.2 The site is bounded; to the north by residential development fronting Wilkinson Drive, to the east residential dwellings fronting Station Road, to the south by residential dwellings fronting Mount Street and to the east by residential dwellings fronting Hill Street. The site is edged in red in Figure 1 (below).



Figure 1: Aerial Photograph of site (Bing Maps 2014)
Aerial view of the proposed development area

2.2 Existing and Historical Land Use

- 2.2.1 The site was historically a foundry; demolition of the former buildings has been completed, but large impermeable areas remain.

3.0 DEVELOPMENT PROPOSALS

3.1 Nature of the development

- 3.1.1 This Flood Consequence Assessment has been prepared to support a planning application and also to satisfy the mandatory requirements of the Code for Sustainable Homes for a residential development complete with external works, footpaths, car parking, landscaping, boundary walls, fencing, external services and drainage.
- 3.1.2 The pertinent planning drawings are included in Appendix B; an extract of the development proposal is shown in Figure 2 (below).
- 3.1.3 The total site area is approximately 0.703ha, the site is considered to be 95% impermeable (determined from the topographic survey and aerial photographs) for the purposes of determining the pre-development surface water run-off.

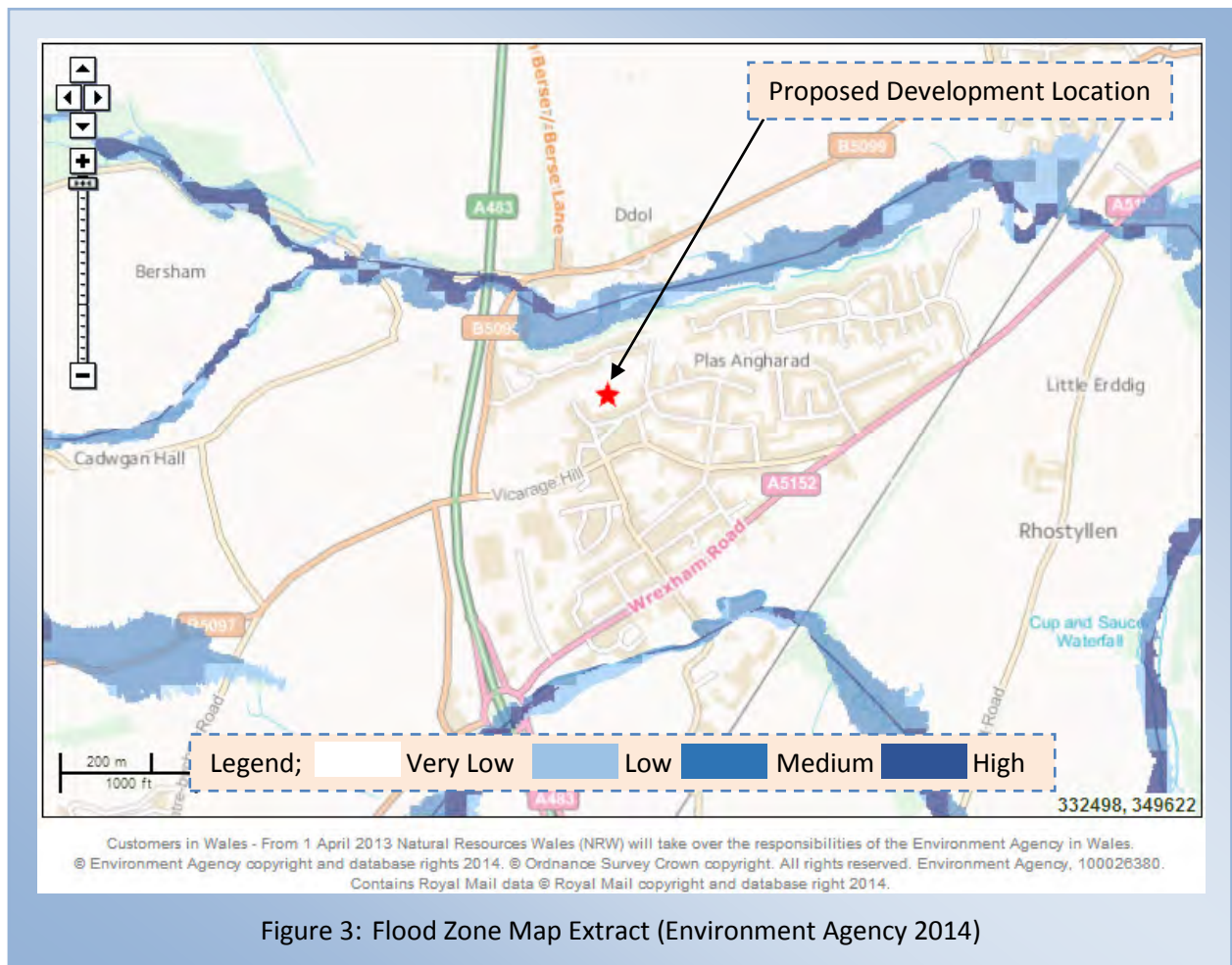


Figure 2: Planning Layout Extract (Cartwright Architectural & Planning Services 2014)

4.0 SOURCES OF FLOOD RISK

4.1 Fluvial & Tidal Flood Risk

- 4.1.1 Information relating to the flood risk at the site has been obtained from the Environment Agency's (EA) website and online Flood Map, an extract of which is shown in Figure 3 (below).



Fluvial Flooding

- 4.1.2 The site is considered to be at 'very low' risk of flooding from watercourses as identified in the EA's Flood Mapping data as shown in Figure 3 (above).

Tidal Flooding

- 4.1.3 Due to the distance from the coast and estuarine waterways the risk of flooding from tidal sources is considered to be 'very low' as identified in the EA's Flood Mapping data shown in Figure 3 (previous page).

Flood Zone Classification

- 4.1.4 Examination of the Development Advice Map (DAM) shows that the site is located within Flood Zone A, and is summarised to be at 'very low' risk; Appendix D shows the online flood map and statement in full.
- 4.1.5 The development is 'residential' in its nature and as such is classified as 'highly vulnerable' in TAN15 and this type of land use is appropriate for Flood Zone A.

4.2 Surface Water Flood Risk

- 4.2.1 Surface Water flooding occurs when rainwater is unable to drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead. The blue shading on Figure 4 (below) shows the varying risk of flooding from surface water.

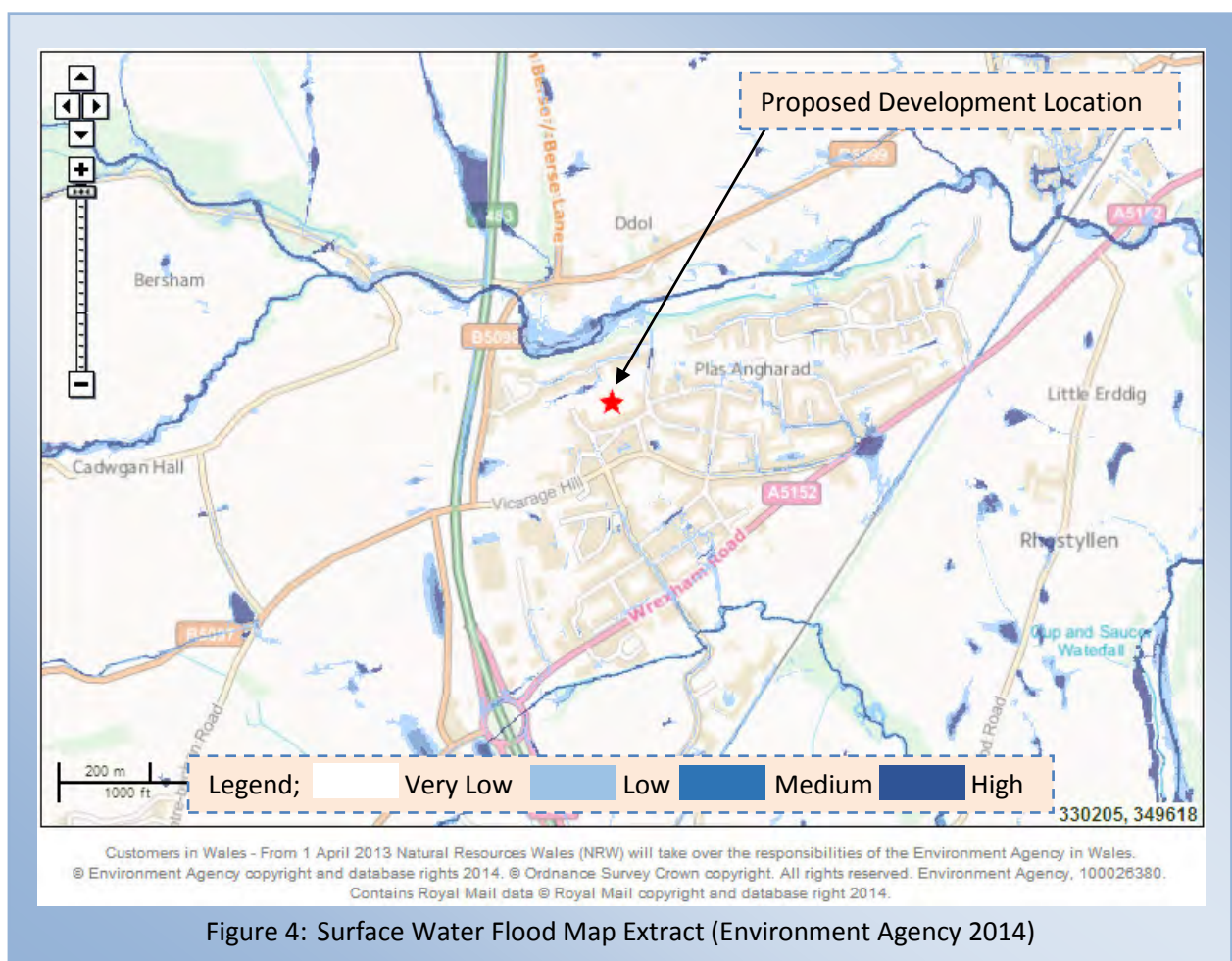


Figure 4: Surface Water Flood Map Extract (Environment Agency 2014)

Overland Run-off (Pluvial)

- 4.2.2 Intense rainfall that is unable to soak into the ground or enter drainage systems can run-off land and result in flooding. Local topography and the land use can have a strong influence on the direction and depth of flow. Large catchment areas are particularly prone to this type of flooding. The volume and rate of overland flow from land can be exacerbated if development increases the percentage of impermeable area.

- 4.2.3 The topography of the development and surrounding area means there is little likelihood of significant flows impacting on the proposed development or on land and property adjacent to the development. The only flows that are likely to be present on site are from direct rainfall on areas of hardstanding.
- 4.2.4 Any overland flows generated by the proposed development must be carefully controlled; safe avenues of overland flow away from the existing and proposed dwellings are advised.

Sewers

- 4.2.5 In urban areas, rainwater is frequently drained into surface water sewers or sewers containing both surface and waste water known as 'combined sewers'. Foul water flooding often occurs in areas prone to overland flow and can result when the sewer is overwhelmed by heavy rainfall and will continue until the water drains away. It can also occur when the sewer becomes blocked or is of inadequate capacity, this could lead to there being a high risk of internal property flooding with contaminated water.
- 4.2.6 Consultation with various parties has not identified any existing sewer flood risk issues or historical flooding of the immediate site area.

4.3 Groundwater Flood Risk

- 4.3.1 In general terms groundwater flooding can occur from three main sources: - raised water tables, seepage and percolation and groundwater recovery or rebound.
- 4.3.2 If groundwater levels are naturally close to the surface then this can present a flood risk during times of intense rainfall.
- 4.3.3 Seepage and percolation occur where embankments above ground level hold water. In these cases water travels through the embankment material and emerges on the opposite side of the embankment. At present there are no reported problems with groundwater flooding.
- 4.3.4 Groundwater recovery / rebound occurs where the water table has been artificially depressed by abstraction. When the abstraction stops the water table makes a recovery to its original level. There is the potential for groundwater flooding in low lying areas where groundwater levels have been depressed below their pre-pumping conditions, where these were at or close to ground level. As with the seepage scenario the likelihood of flooding from this source is low.
- 4.3.5 The EA's online mapping data indicates that the site is at high groundwater vulnerability from a major aquifer. No historical groundwater flooding of the site has been identified during consultation with the various interested parties; however setting Finished Floor Levels a minimum of 150mm above the external levels following any re-grade should mitigate any risk of flooding from this source.

4.4 Artificial Sources of Flood Risk

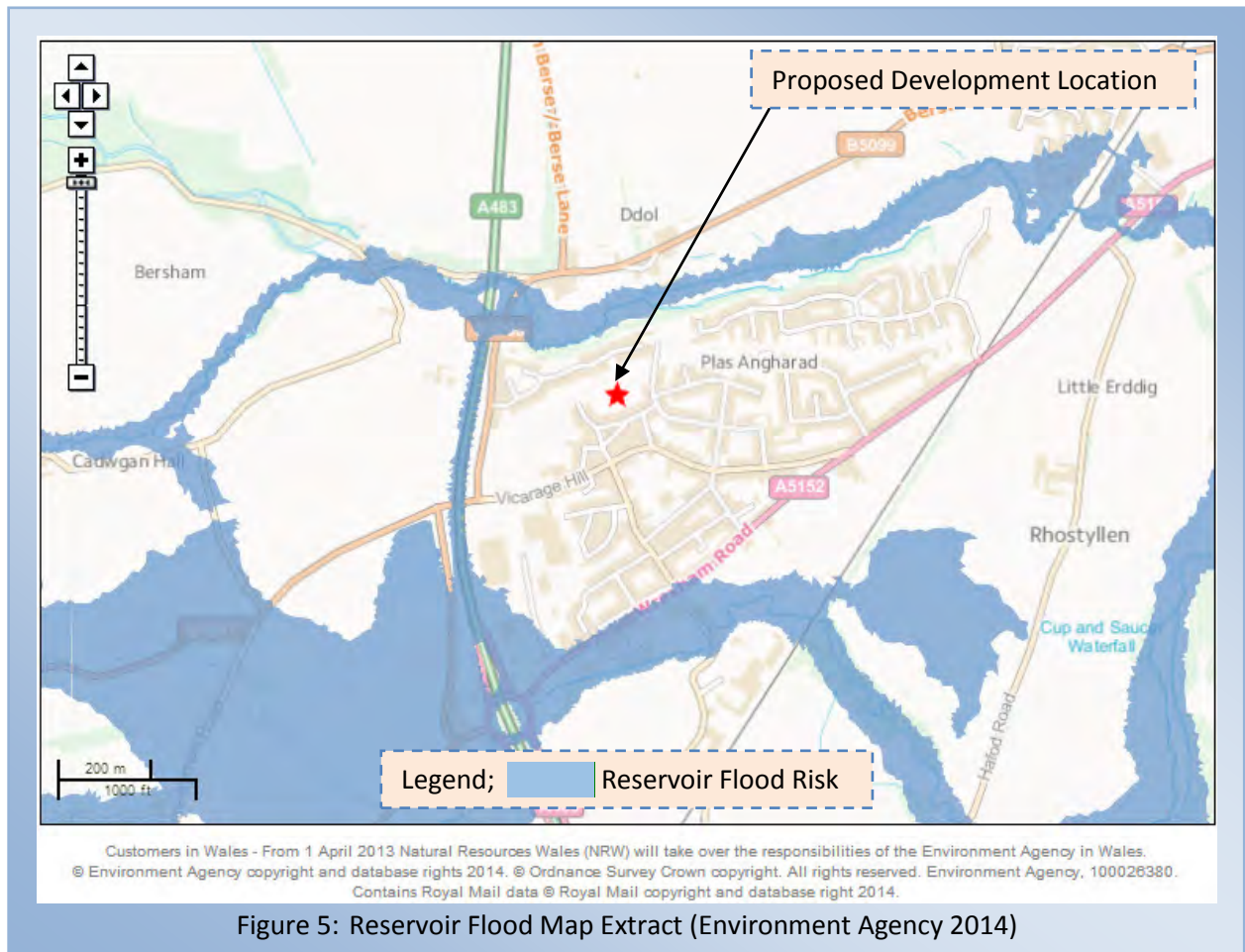
- 4.4.1 Figure 5 (subsequent page) shows an extract of the EA's online Reservoir flood map; Appendix D shows the EA's reservoir flood map in full.

Reservoirs

- 4.4.2 Due to the site location and elevation relative to any reservoirs the risk of flooding from this source is considered low; as indicated in Figure 5 (below).

Canals

- 4.4.3 There are no canals within the immediate vicinity of the proposed development, as such the risk from this source is considered to be 'very low'.



4.5 Historical Flooding

- 4.5.1 An Internet based search for flooding events did not recall any historical flooding in the immediate site area, including review of the Chronology of British Hydrological Events.
- 4.5.2 Consultation with various interested parties (Wrexham County Borough Council, Natural Resources Wales and Welsh Water) also failed to highlight any historical flooding pertinent to this Flood Risk Assessment.
- 4.5.3 There is no Strategic Flood Consequence Assessment available and the Preliminary Flood Risk Assessment (PFRA) did not indicate specific risks to the proposed development area; some mapping information has been included within Appendix L indicating this.

4.6 Flood Risk Mitigation Measures & Residual Risks

- 4.6.1 No specific flood risk mitigation measures are proposed as the development is located within Flood Zone A.

Mitigation Measures

- 4.6.2 Setting Finished Floor Levels a minimum of 150mm above the external levels following any re-grade should mitigate any risk of flooding from a variety of sources.
- 4.6.3 As with any development it is also advised that external levels fall away from property to minimise the flood risk from a variety of sources.
- 4.6.4 Overland flows generated by the proposed development must be carefully controlled; safe avenues of overland flow away from any existing and proposed buildings are advised.
- 4.6.5 To minimise the flood risk to neighboring development it is proposed that surface water run-off generated by the proposed development be managed effectively and ideally with the peak rates of run-off being restricted to the equivalent of the pre-development situation. It is proposed that this be achieved using a Hydrobrake flow control device with stormwater storage for events up to and including the 100yr event with a 30% allowance for climate change.

Residual Risks

- 4.6.6 The development is accessible for emergency access and egress during the 100 year storm event as the floodplain does not extend into the proposed development.
- 4.6.7 The development and its drainage systems should be designed to cope with intense storm events up to and including the 100 year return period rainfall event with an allowance for Climate Change (CC). If an extreme rainfall event exceeds the design criteria for the drainage system it is likely that there will be some overland flows that are unable to enter the system, it is important that these potential overland flows are catered for within the proposed planning layout in the event that the capacity of the drainage system is exceeded.
- 4.6.8 Any overland flows generated by the proposed development must be carefully controlled; safe avenues of overland flow away from the existing and proposed dwelling are advised.
- 4.6.9 As with any drainage system blockages within either the foul or surface water system have the potential to cause flooding or disruption. It is important that should any drainage systems not be offered for adoption to either the Water Company or the Local Authority then an appropriate maintenance regime be scheduled with an appropriate management company for these private drainage systems.

5.0 SURFACE WATER MANAGEMENT

5.1 Pre-development Surface Water Run-off

- 5.1.1 For the purposes of determining the existing rate of surface water run-off the site is considered to be 95% impermeable; the total area of the site is 0.703ha.
- 5.1.2 The surface water run-off rates have been calculated using the Modified Rational Method and rainfall catchment characteristics from the Flood Estimation Handbook (FEH), details of which are included Appendix E.
- 5.1.3 The existing impermeable area of site generates a peak run-off rate of 92.8l/s based on an area of 0.668ha and a rainfall intensity of 50mm/hr.
- 5.1.4 The approximate surface water run-off volume generated by the impermeable area based on the 1 in 100 year return period storm event is 447.6m³; estimated using the FEH rainfall catchment characteristics (6hr duration event).

5.2 Post-development Surface Water Run-off

- 5.2.1 The residential nature of the development proposals means that there will be a reduction in the impermeable area of the site to approximately 0.320ha (46%), resulting in a reduction in both the volume and the peak rate of surface water run-off if flows are unrestricted.
- 5.2.2 The approximate surface water run-off volume generated by the impermeable area based on the 1 in 100 year return period storm event with a 30% allowance for climate change is 278.7m³; estimated using the FEH rainfall catchment characteristics (6hr duration event).

5.3 Sustainable Drainage Systems (SuDS)

- 5.3.1 In accordance with the NPPF, Sustainable Drainage Systems (SuDS) should be specified wherever possible to manage surface water. This in turn reduces the burden downstream on both watercourses and sewerage systems.
- 5.3.2 SuDS have the ability to address three core objectives; water quantity, water quality and amenity value. With the appropriate system specified, all three core objectives can be satisfied. Where possible, peak surface water discharge rates to watercourses and sewers should be reduced.
- 5.3.3 Preference should always be given to SuDS over the traditional methods of buried sewers wherever possible and practical. Runoff from car parking areas and roads could be conveyed through swales, permeable pavements, bio-retention areas and petrol interceptors to provide a degree of treatment before flows are carried to public sewers.
- 5.3.4 Opportunities should be taken to provide soft landscaping where at all possible on site to assist in minimising surface water run-off. Added benefits include biodiversity and visual enhancements.

5.4 Methods of Surface Water Management

- 5.4.1 At present the site is Brownfield; the total site area is 0.703ha and is considered to be 95% impermeable.
- 5.4.2 The proposed impermeable area of the development is approximately 0.320ha, 46% of the total site area.
- 5.4.3 There are three methods that have been reviewed for the management and discharge of surface water detailed below; these may be applied individually or collectively to form a complete strategy. They should be applied in the order of priority listed below.
- Discharge via infiltration
 - Discharge to watercourse
 - Discharge to sewerage system

5.5 Discharge via Infiltration

- 5.5.1 Any impermeable areas that can drain to soakaway or an alternative method of infiltration would significantly improve the sustainability of any surface water systems.
- 5.5.2 The British Geology Survey (BGS) mapping data indicates that ground conditions are as follows: -

1:50 000 scale bedrock geology description: *Etruria Formation - Mudstone. Sedimentary Bedrock formed approximately 307 to 313 million years ago in the Carboniferous Period. Local environment previously dominated by rivers.*

Setting: *rivers. These rocks were formed from rivers depositing mainly sand and gravel detrital material in channels to form river terrace deposits, with fine silt and clay from overbank floods forming floodplain alluvium, and some bogs depositing peat; includes estuarine and coastal plain deposits mapped as alluvium.*

1:50 000 scale superficial deposits description: *Till, Devensian - Diamicton. Superficial Deposits formed up to 2 million years ago in the Quaternary Period. Local environment previously dominated by ice age conditions.*

Setting: *ice age conditions. These rocks were formed in cold periods with Ice Age glaciers scouring the landscape and depositing moraines of till with outwash sand and gravel deposits from seasonal and post glacial meltwaters.*

- 5.5.3 Based on the ground conditions identified on the BGS maps and the Ground Investigation undertaken by Betts Geo Environmental it can be considered that infiltration drainage is not a suitable means of surface water disposal for the flows generated by the proposed development. This is due to shallow groundwater encountered across site.

5.6 Discharge to Watercourse

- 5.6.1 There is no watercourse in close proximity to the development that would provide a suitable outfall for the surface water flows generated by the proposed development.

5.7 Discharge to Sewer

- 5.7.1 It is understood that at present the surface water run-off generated by the proposed development discharges to the public sewer network in Mount Street.
- 5.7.2 The peak rate of surface water discharge to the public sewer network will need to be restricted to the pre-development peak rates of discharge for storm events up to and including the 100 year return period event.
- 5.7.3 Restricting the rate of surface water discharge can be achieved using a Hydrobrake® or similar approved product.
- 5.7.4 Restricting the rate of discharge for the surface water generates a storage requirement during the extreme rainfall events. For the annual storm event storage requirements are estimated to be between 0.0 and 9.8cu.m when restricting flows to 26.3l/s. During the 100 year return period storm event with an allowance of 30% to account for climate change the storage requirements are estimated to be between 23 and 75cu.m when restricting flows to 80.0l/s.
- 5.7.5 The stormwater storage figures quoted above are estimates only and the detailed drainage design will determine with accuracy the stormwater storage requirements.

5.8 Climate Change

- 5.8.1 There are indications that the climate in the UK is changing significantly and it is widely believed that the nature of climate change will vary greatly by region. Current expert opinion indicates the likelihood that future climate change would produce more frequent short duration and high intensity rainfall events with the addition of more frequent periods of long duration rainfall.
- 5.8.2 The NPPF Technical Guidance Table 5 states that the recommended national precautionary sensitivity ranges for increase of peak rainfall intensity is 30% until 2115. It is widely believed that the impact of climate change means there is likely to be a long term increase in the average sea levels, with an expectation that sea levels will rise gradually.
- 5.8.3 An increase in flood water levels means that future flooding events will occur more frequently and will have a greater impact.
- 5.8.4 Any increase in the level of flood risk to the proposed development from climate change is likely to be related to the increase in rainfall intensity and duration and its impact upon the surface water drainage system.
- 5.8.5 Climate Change should be accounted for within the design and it is recommended that an increase in peak rainfall intensity of 30% is allowed for.

6.0 FOUL WATER MANAGEMENT

- 6.1 It is understood that prior to demolition any foul water flows discharged to the public sewer network in Mount Street.
- 6.2 Based on the proposals for the construction of 14no. residential dwellings the approximate foul water flows generated are 0.7l/s. This is based on 4000 litres per dwelling per 24 hours; the guidance contained within Sewers for Adoption (SfA).
- 6.3 It is proposed that the foul water generated by the development continue to discharge to the public sewer network via the existing connection. A copy of the sewer records and correspondence is included in Appendix G.

7.0 SUMMARY AND CONCLUSIONS

- 7.1 This Flood Consequence Assessment has been prepared to support a planning application and also to satisfy the mandatory requirements of the Code for Sustainable Homes for a residential development complete with external works, footpaths, car parking, landscaping, boundary walls, fencing, external services and drainage.
- 7.2 The site is in an area identified as having a 'very low' probability of flooding on the Environment Agency Flood Map and based on the Development Advice Maps is located within Flood Zone A.
- 7.3 The proposed development is classified as 'highly vulnerable' and this is considered appropriate development within Flood Zone A.
- 7.4 The Flood Consequence Assessment (FCA) has reviewed all sources of flood risk to both the proposed development and to the existing adjacent development as a result of the proposals, including; fluvial, tidal, pluvial, groundwater, sewers and flooding from artificial sources.
- 7.5 An Internet based search for flooding events did not recall any historical flooding in the immediate site area. Consultation with various interested parties also failed to highlight any historical flooding in or adjacent to the proposed development area.
- 7.6 As a result of the relatively low flood risk from all of the sources reviewed, the principle focus of the Flood Consequence Assessment is on the effective management of surface water drainage.
- 7.7 As infiltration is not viable and there is no watercourse in close proximity to the proposed development it is proposed that the flows generated by the development continue to discharge to the existing public sewer network mimicking the pre-development situation.
- 7.8 The rate of surface water discharge is proposed to be restricted to the pre-development situation to achieve the requirements for the Code for Sustainable Homes with stormwater storage being provided for events up to and including the 100 year return period event with an allowance for climate change.
- 7.9 The development is accessible for emergency access and egress during times of extreme flooding as the floodplain does not extend into the development area.
- 7.10 As with any drainage system blockages within either the foul or surface water sewer systems have the potential to cause flooding or disruption.
- 7.11 The Flood Consequence Assessment is considered to be commensurate with the development proposals and in summary, the development can be considered appropriate in accordance with TAN15, and is considered to satisfy the mandatory Flood Risk requirements of SUR1 of the Code for Sustainable Homes.

8.0 RECOMMENDATIONS

- 8.1 Opportunities should be taken to provide soft landscaping where at all possible on site to assist in minimising surface water run-off. Added benefits include biodiversity and visual enhancements.
- 8.2 Any overland flows generated by the proposed development must be directed away from residential properties; safe avenues of overland flow are advised.
- 8.3 The proposed onsite surface water drainage system will still need to be sized to cater for storm events up to and including the 100 year return period storm event with a 30% allowance for climate change.

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Environment Agency – www.environment-agency.gov.uk/
FloodProBE – <http://www.floodprobe.eu/>
Flood Forum – <http://www.floodforum.org.uk/>
Flood London – <http://www.floodlondon.com/>
Flood Resilience Group – <http://www.floodresiliencgroup.org/frg/>
Google Maps – <http://maps.google.co.uk/>
London Resilience – <http://www.londonprepared.gov.uk/>
Shire Group of IDB's – <http://www.shiregroup-idbs.gov.uk/default.asp>
Streetmap – <http://www.streetmap.co.uk/>
US Army Corps of Engineers – <http://www.hec.usace.army.mil/software/hec-ras/>
Watertight International – <http://www.watertightinternational.com/>

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APPENDIX A: LOCATION PLAN

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Location Plan

The Foundry, Mount Street, Rhostyllen



OS X (Eastings)	331246
OS Y (Northings)	348883
Nearest Post Code	LL14 4AU
Lat (WGS84)	N53:01:58 (53.032790)
Long (WGS84)	W3:01:36 (-3.026703)
LR	SJ312488
mX	-336931
mY	6954902

APPENDIX B: TOPOGRAPHIC SURVEY

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Symbols/Abbreviations (Where Applicable):

[illegible]

FENCE DESCRIPTIONS:	
B/W:	BARBED WIRE FENCE
C/W:	CLOSE LINK FENCE
C/L:	CLOSE LINK FENCE
C/C:	CHESTNUT PALING FENCE
C/C/P:	CONCRETE PANEL FENCE
I/R:	IRON RAILING FENCE
P/R:	POST AND RAIL FENCE
P/W:	POST AND WIRE FENCE
P/H:	POST AND RAIL PALISADE FENCE
S/PAL:	STEEL PALISADE FENCE
S/B:	SAFETY BARRIER
T/PAL:	TIMBER PALISADE FENCE

[illegible]

INFORMATION

2) Only services located during the site survey are shown on this plan. Further investigation may be required to ascertain the full extent of the site services.

3) Copyright of this drawing remains the property of PM Surveys UK Ltd. Do not scale from this drawing. In the event of any discrepancy, refer always to PM Surveys UK Ltd.

NOTES

NOTES

Ordnance Survey Bench Mark Used		Yes		No	
Location					
1					
2					



PM SURVEYS UK



PM Surveys UK Ltd
Unit 4, Expressway Business Park
Station Road, Queensterry
Flintshire, CH5 2TF
Tel: 01244 821777 Fax: 01244 821002
Email: info@pmsurveys.co.uk

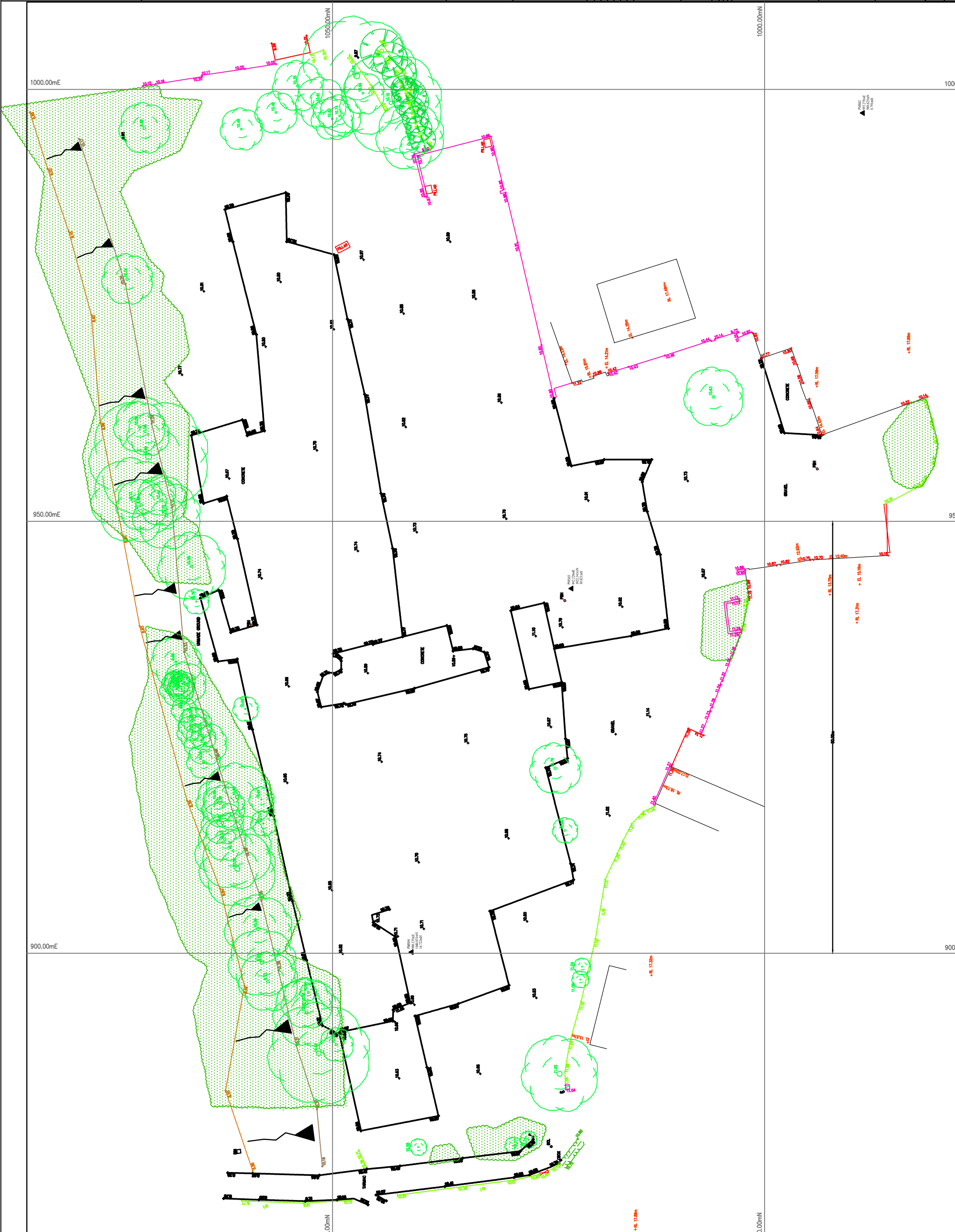
Client Info

SG Estates
10 Maxwell Close
Gresford Wrexham
LL12 8UD

Tel: 07841372641
Email: steve@sgestates.co.uk

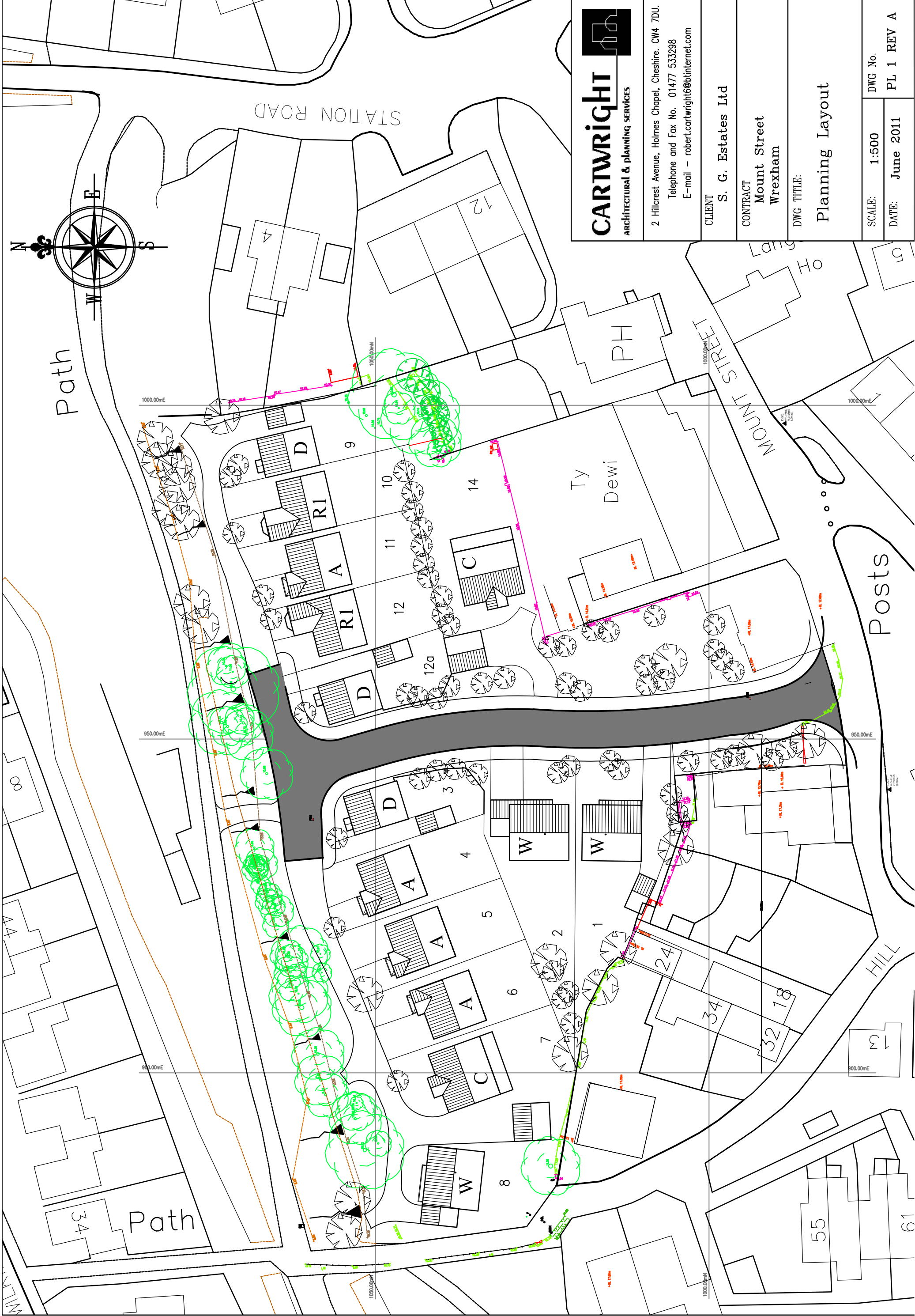
Project
Old Foundry Rhostyllen
Topographic Survey

Project No	Sheets A1	Surveyed By: II
PMS13205	Scaler 1200	Drawn By: SW
		Approved By: PM
Dwg PMS13205		Issued: 25/10/2013



APPENDIX C: PROPOSED PLANNING LAYOUT

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CARTWRIGHT
ARCHITECTURAL & PLANNING SERVICES

2 Hillcrest Avenue, Holmes Chapel, Cheshire. CW4 7DU.
Telephone and Fax No. 01477 533298
E-mail - robert.cartwright6@btinternet.com

CLIENT
S. G. Estates Ltd

CONTRACT
Mount Street
Wrexham

DWG TITLE:
Planning Layout

SCALE: 1:500	DWG No.
DATE: June 2011	PL 1 REV A

APPENDIX D: NRW/EA INFORMATION & CORRESPONDENCE

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Richard Nicholas

From: Richard Nicholas
Sent: 23 January 2014 19:28
To: Lucy.Stephenson@cyfoethnaturiolcymru.gov.uk
Subject: The Foundry, Mount Street, Rhostyllen
Attachments: Location Plan.pdf

Good Evening Lucy,
(not sure if this is your area or not)

The Foundry, Mount Street, Rhostyllen

Please could you confirm whether you have any information that you feel would be valuable to a Flood Consequence Assessment for the above site (location plan attached), including details of historical flooding; this would be greatly appreciated.

In a nutshell; site is 0.7ha, Flood Zone A, pre-dev. 95% imp., post-dev. 46% imp., infiltration is not viable due to shallow groundwater, no watercourse in close proximity so discharge of SW proposed to public sewer in Mount Street (as it does currently), flow restricted to mimic the pre-dev. rates up to the 100yr RP event with stormwater storage being provided for the 100yr RP event with a 30% allowance for CC.

Please do not hesitate to contact me on the details below to discuss further should you require additional information or clarification.

Kind regards

Richard Nicholas
Associate

Betts Associates Ltd
Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire, CH5 2LY
T - 01244 288178
F - 01244 288516
richard.nicholas@betts-associates.co.uk
www.betts-associates.co.uk

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Data

C1: Served by significant infrastructure, including flood defences

C2: Without significant flood defence infrastructure

B: Areas known to have been flooded in the past

A: Considered to be at little or no risk of fluvial or coastal/tidal flooding

(C2 based on Environment Agency's Extreme Flood Outline $\geq 0.1\%$ (River, Tidal or Coastal))



Enter a postcode or place name:

Other topics for this area...

Go

Risk of Flooding from Rivers and Sea ▼

[View other Interactive Maps](#)

Risk of Flooding from Rivers and Sea

River flooding happens when a river cannot cope with the amount of water draining into it from the surrounding land. Sea flooding happens when there are high tides and stormy conditions.

The shading on the map shows the risk of flooding from rivers and the sea in this particular area.

Click on the map for a more detailed explanation.

Map of X: 331,252; Y: 348,833 at scale 1:10,000

[Data search](#)

Map legend

☒ Risk of Flooding from Rivers and Sea

- High
- Medium
- Low
- Very Low



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Author: The Environment Agency | enquiries@environment-agency.gov.uk
 Last updated: 23 January 2014

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Interactive Maps

Risk of Flooding from Rivers and Sea for X:331228, Y:348927

The location you have selected is in an area that has a very low chance of flooding from rivers or the sea.



What does 'very low' mean?

Very low means that each year, this area has a chance of flooding of less than 1 in 1000 (0.1%).

This takes into account the effect of any flood defences that may be in this area. Flood defences reduce, but do not completely stop the chance of flooding as they can be overtopped or fail.

Floods Destroy. Be prepared

It is important to remember that while the risk is low, we can never eliminate all flooding. Surrounding roads and services may still be affected and could impact you.

- [Check if you can receive free flood warnings](#)
- [Complete a flood plan](#)
- [Find out how to prepare your property for flooding](#)

Planning a development

This information is not suitable for use in land-use planning. If you are planning a development, you need to use the [Risk of Flooding for Land-Use Planning \(Rivers and Sea\) for England](#) or [Development Advisory Map for Wales](#). This is because for planning purposes you need to use information based on flooding without defences.

Further information

You can also check the [level and flow estimates for rivers and sea](#), and the [latest river and sea levels](#).

If you have questions about how the map was produced, please call Floodline on 0845 988 1188.

This area may be at risk from other types of flooding.

- [Check your risk of flooding from surface water.](#)
- [Check your risk of flooding from reservoirs.](#)

For the purposes of the Flood Risk Regulations 2009 and the EU Directive 2007/60/EC on the assessment and management of flood risks, this is a Flood Hazard Map

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Author: The Environment Agency | enquiries@environment-agency.gov.uk
Last updated: 23 January 2014

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Enter a postcode or place name:

Other topics for this area...

Go

Risk of Flooding from Reservoirs

[View other Interactive Maps](#)

Risk of Flooding from Reservoirs

Reservoir flooding is extremely unlikely to happen.

The shading on the map shows the area that could be flooded if a large reservoir were to fail and release the water it holds. A large reservoir is one that holds over 25,000 cubic metres of water, equivalent to approximately 10 Olympic sized swimming pools. Since this is a worst case scenario, it's unlikely that any actual flood would be this large.

Click on the shading to see details of reservoirs that could cause flooding in this area.

Map legend

☒ Risk of Flooding from Reservoirs

☐ Maximum extent of flooding

Map of X: 331,252; Y: 348,833 at scale 1:10,000

[Data search](#)



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Interactive Maps

Risk of Flooding from Surface Water for X:331207, Y:348916

The location you have selected is in an area that has a very low chance of flooding from surface water.

Very Low



Low

Medium

High

What does 'very low' mean?

Very low means that each year, this area has a chance of flooding of less than 1 in 1000 (0.1%).

This type of flooding can be difficult to predict, much more so than river or sea flooding as it is hard to forecast exactly where or how much rain will fall in any storm.

This is based on the best information we have available, such as ground levels and drainage.

Floods Destroy. Be prepared

Don't wait until it's too late. Prepare for flooding by taking some simple steps to reduce the impact on your home or business.

[Complete a flood plan](#)

[Find out how to prepare your property for flooding](#)

[Check the three-day flood risk forecast](#)

Further Information

The map has been produced by the Environment Agency, using information from Lead Local Flood Authorities where it is available. Lead Local Flood Authorities are responsible for managing the risk from surface water flooding.

If you have questions about how the map was produced, please call Floodline on 0845 988 1188.

If you would like more information on how surface water is being managed in this area, you can speak to [Wrexham County Borough Council](#).

You can use the information in this area to see the approximate areas that would flood, and which parts would be shallower or deeper.

The potential impact of surface water flooding can vary according to the depth of the water, and its velocity (speed and direction that it is flowing in).

This area may be at risk from other types of flooding.

[Check your risk of flooding from rivers and sea.](#)

[Check your risk of flooding from reservoirs.](#)

For the purposes of the Flood Risk Regulations 2009 and the EU Directive 2007/60/EC on the assessment and management of flood risks, this is a Flood Hazard Map.

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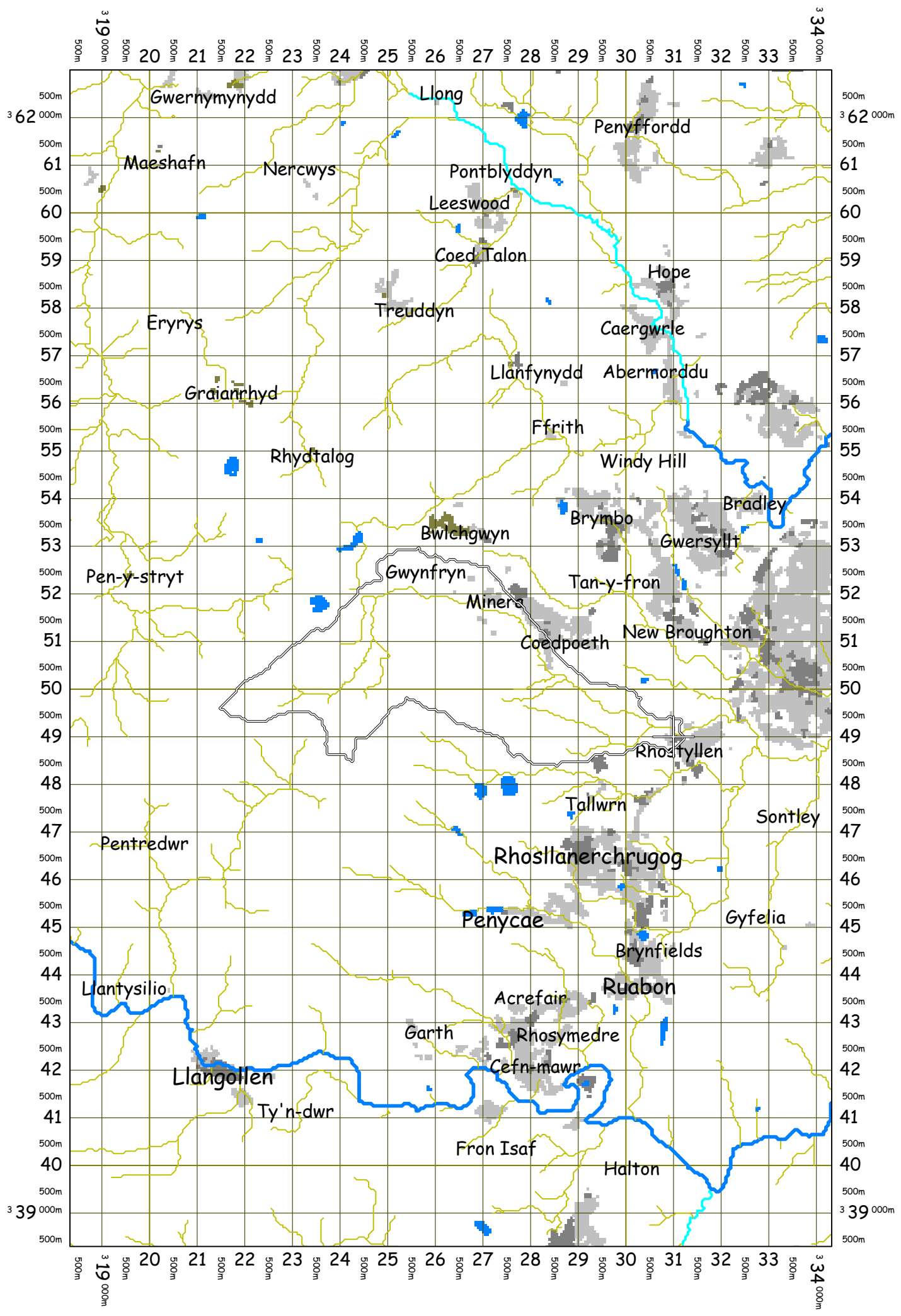
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Author: The Environment Agency | enquiries@environment-agency.gov.uk
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APPENDIX E: FEH CATCHMENT DATA & DESCRIPTORS

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VERSION	FEH CD-ROM	Version	3	exported at	11:08:25 GMT Thu 23-Jan-14
CATCHMENT	GB	331150	349050	SJ 31150 49050	
CENTROID	GB	326279	350401	SJ 26279 50401	
AREA		21.22			
ALTBAR		324			
ASPBAR		83			
ASPVAR		0.48			
BFIHOST		0.389			
DPLBAR		7.21			
DPSBAR		102.1			
FARL		1			
LDP		14.1			
PROPWET		0.51			
RMED-1H		10.6			
RMED-1D		38.2			
RMED-2D		48.4			
SAAR		1019			
SAAR4170		1007			
SPRHOST		43.17			
URBCONC1990		0.516			
URBEXT1990		0.0091			
URBLOC1990		0.719			
C		-0.02689			
D1		0.39085			
D2		0.42821			
D3		0.32077			
E		0.28782			
F		2.46132			
C(1 km)		-0.026			
D1(1 km)		0.384			
D2(1 km)		0.398			
D3(1 km)		0.313			
E(1 km)		0.288			
F(1 km)		2.391			

Design Rainfall

Calculate : **Design rainfall** for

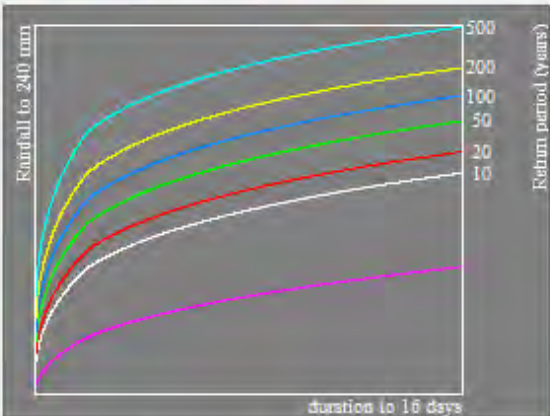
☒ catchment 331150 349050 [SJ 31150 49050]
☐ 1 km grid point 331000 349000 [SJ 31000 49000]
☐ Manually entered values ☐ for a point

Area : 21.2225 km²

C : -0.02689 D3 : 0.32077
D1 : 0.39085 E : 0.28782
D2 : 0.42821 F : 2.46132

Duration : 6 Hours ☐ Fixed ☒ Sliding
Return period : 1.0004 Years ☒ AM ☐ POT

Rainfall depth 13.5885 mm



 An areal reduction factor of 0.942 has been applied to a point rainfall of 14.4 mm to yield a catchment design rainfall of 13.6 mm.



Calculate : **Design rainfall** for

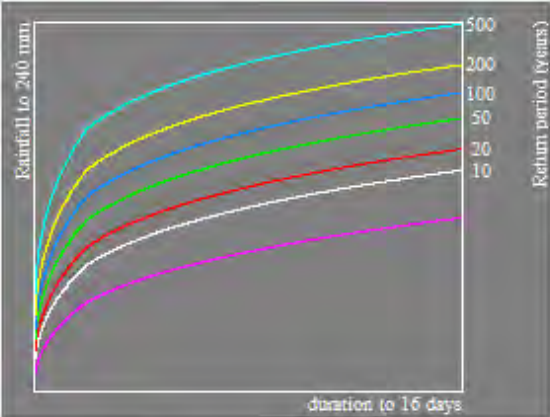
☒ catchment 331150 349050 [SJ 31150 49050]
☐ 1 km grid point 331000 349000 [SJ 31000 49000]
☐ Manually entered values ☐ for a point

Area : 21.2225 km²

C : -0.02689 D3 : 0.32077
D1 : 0.39085 E : 0.28782
D2 : 0.42821 F : 2.46132

Duration : 6 Hours ☐ Fixed ☒ Sliding
Return period : 2.0 Years ☒ AM ☐ POT

Rainfall depth 24.2897 mm



 An areal reduction factor of 0.942 has been applied to a point rainfall of 25.8 mm to yield a catchment design rainfall of 24.3 mm.



Calculate : Design rainfall for

☒ catchment 331150 349050 [SJ 31150 49050]
☐ 1 km grid point 331000 349000 [SJ 31000 49000]
☐ Manually entered values ☐ for a point

Area : 21.2225 km²

C : -0.02689 D3 : 0.32077

D1 : 0.39085 E : 0.28782

D2 : 0.42821 F : 2.46132

Duration : 6 Hours ☐ Fixed ☒ Sliding

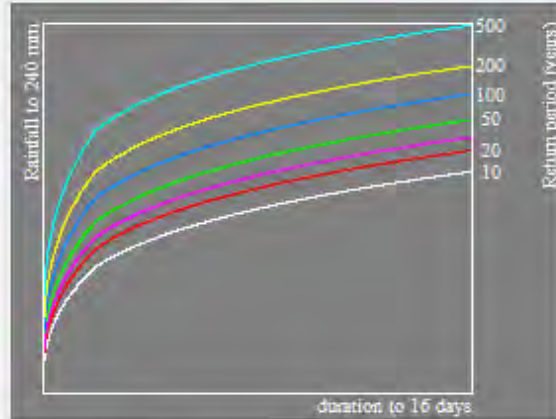
Return period : 30.0 Years ☒ AM ☐ POT

Rainfall depth 50.0604 mm

Calculate... Export... Cancel

 An areal reduction factor of 0.942 has been applied to a point rainfall of 53.1 mm to yield a catchment design rainfall of 50.1 mm.





Calculate : Design rainfall for

☒ catchment 331150 349050 [SJ 31150 49050]
☐ 1 km grid point 331000 349000 [SJ 31000 49000]
☐ Manually entered values ☐ for a point

Area : 21.2225 km²

C : -0.02689 D3 : 0.32077

D1 : 0.39085 E : 0.28782

D2 : 0.42821 F : 2.46132

Duration : 6 Hours ☐ Fixed ☒ Sliding

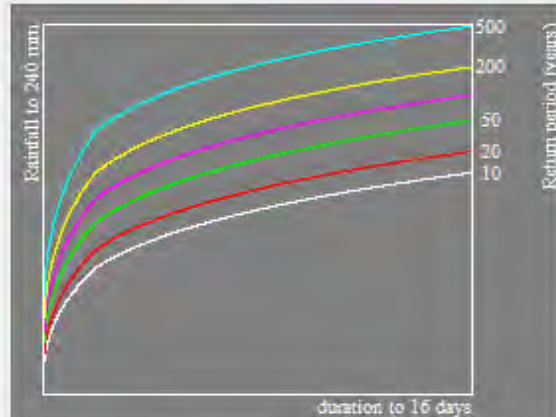
Return period : 100.0 Years ☒ AM ☐ POT

Rainfall depth 66.9937 mm

Calculate... Export... Cancel

 An areal reduction factor of 0.942 has been applied to a point rainfall of 71.1 mm to yield a catchment design rainfall of 67.0 mm.





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APPENDIX F: TAN15 EXTRACTS

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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 systems².
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 <i>only</i> 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 • Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. • 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. • Wind turbines.
Highly vulnerable • Police stations, ambulance stations and fire stations and command centres and telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use³. • Installations requiring hazardous substances consent⁴. (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 • Hospitals. • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. • Non-residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities for hazardous waste⁶. • Sites used for holiday or short-let caravans and camping, <i>subject to a specific warning and evacuation plan</i>.⁷
Less vulnerable • Police, ambulance and fire stations which are <i>not</i> required to be operational during flooding. • Buildings used for shops, financial, professional and other services,
restaurants and cafes, hot food takeaways, offices, general industry, storage and distribution, non-residential institutions not included in "more vulnerable", and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment works which do <i>not</i> need to remain operational during times of flood. • Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).
Water-compatible development • Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel working. • Docks, marinas and wharves. • Navigation facilities. • Ministry of Defence defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, <i>subject to a specific warning and evacuation plan</i>.

APPENDIX G: WW SEWER RECORDS & CORRESPONDENCE

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Richard Nicholas

From: Richard Nicholas
Sent: 23 January 2014 19:10
To: Evans Miriam (Miriam.Evans@dwrcymru.com)
Subject: The Foundry, Mount Street, Rhostyllen
Attachments: Location Plan.pdf

Good Evening Miriam,

The Foundry, Mount Street, Rhostyllen

Please could you confirm whether you have any information that you feel would be valuable to a Flood Consequence Assessment for the above site (location plan attached), including details of historical flooding; this would be greatly appreciated.

In a nutshell; site is 0.7ha, Flood Zone A, pre-dev. 95% imp., post-dev. 46% imp., infiltration is not viable due to shallow groundwater, no watercourse in close proximity so discharge of SW proposed to public sewer in Mount Street (as it does currently), flow restricted to mimic the pre-dev. rates up to the 100yr RP event with stormwater storage being provided for the 100yr RP event with a 30% allowance for CC.

Please do not hesitate to contact me on the details below to discuss further should you require additional information or clarification.

Kind regards

Richard Nicholas
Associate

Betts Associates Ltd
Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire, CH5 2LY
T - 01244 288178
F - 01244 288516
richard.nicholas@betts-associates.co.uk
www.betts-associates.co.uk

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APPENDIX H: WREXHAM CBC CORRESPONDENCE

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Richard Nicholas

From: Richard Nicholas
Sent: 23 January 2014 19:09
To: 'charlotte.beattie@wrexham.gov.uk'
Subject: The Foundry, Mount Street, Rhostyllen
Attachments: Location Plan.pdf

Good Evening Charlotte,

The Foundry, Mount Street, Rhostyllen

Please could you confirm whether you have any information that you feel would be valuable to a Flood Consequence Assessment for the above site (location plan attached), including details of historical flooding; this would be greatly appreciated.

In a nutshell; site is 0.7ha, Flood Zone A, pre-dev. 95% imp., post-dev. 46% imp., infiltration is not viable due to shallow groundwater, no watercourse in close proximity so discharge of SW proposed to public sewer in Mount Street (as it does currently), flow restricted to mimic the pre-dev. rates up to the 100yr RP event with stormwater storage being provided for the 100yr RP event with a 30% allowance for CC.

Please do not hesitate to contact me on the details below to discuss further should you require additional information or clarification.

Kind regards

Richard Nicholas
Associate

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CIVIL | STRUCTURAL | GEO-ENVIRONMENTAL | TECHNICAL DUE DILIGENCE
FLOOD RISK MANAGEMENT | STRUCTURAL SURVEYS | PARTY WALL DUTIES | ECOLOGY

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APPENDIX I: SURFACE WATER RUN-OFF CALCULATIONS

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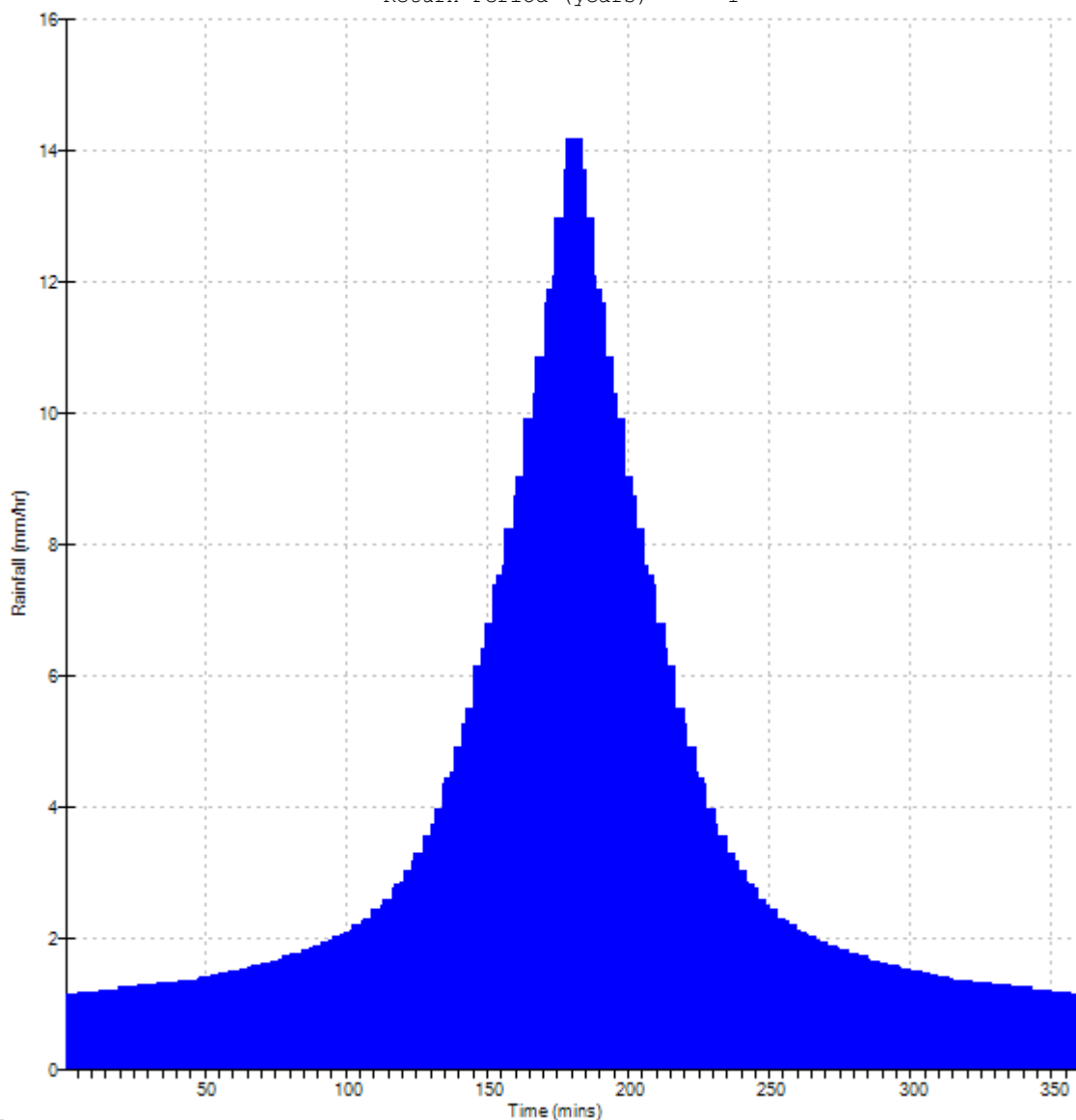
Betts Associates Ltd		Page 1
Old Marsh Farm Barns Welsh Road Sealand Flintshire ...	The Foundry Mount Street, Rhostyllen S G Estates	
Date 23.01.2014 File	Designed by RDN Checked by	
Micro Drainage	Network W.12.6.1	

Rainfall profile

Storm duration (mins) 360

FEH Data

C (1km)	-0.026
D1 (1km)	0.384
D2 (1km)	0.398
D3 (1km)	0.313
E (1km)	0.288
F (1km)	2.391
Peak Intensity (mm/hr)	14.202
Ave. Intensity (mm/hr)	3.623
Return Period (years)	1



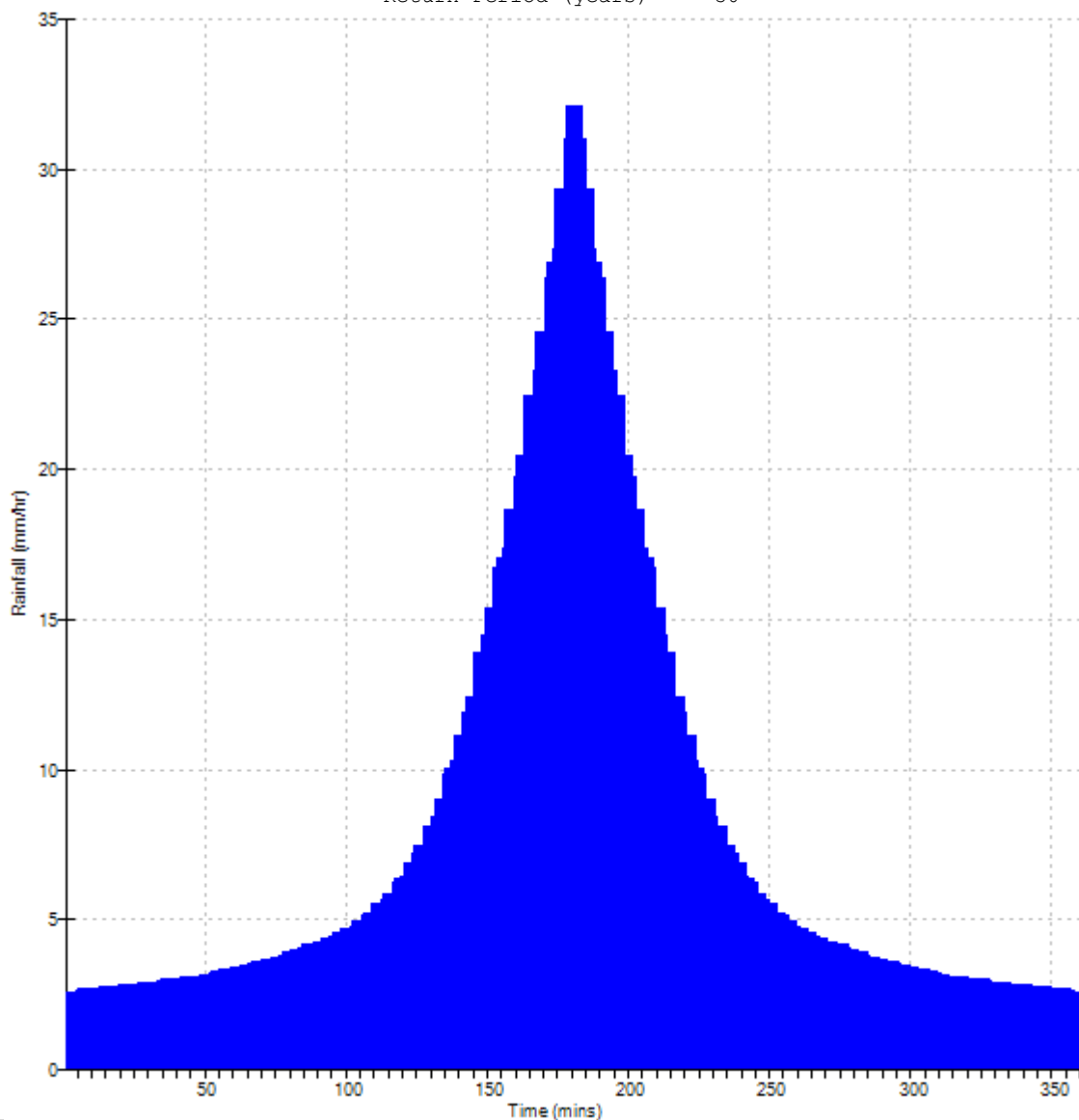
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Old Marsh Farm Barns Welsh Road Sealand Flintshire ...	The Foundry Mount Street, Rhostyllen S G Estates	
Date 23.01.2014	Designed by RDN	
File	Checked by	
Micro Drainage	Network W.12.6.1	

Rainfall profile

Storm duration (mins) 360

FEH Data

C (1km)	-0.026
D1 (1km)	0.384
D2 (1km)	0.398
D3 (1km)	0.313
E (1km)	0.288
F (1km)	2.391
Peak Intensity (mm/hr)	32.149
Ave. Intensity (mm/hr)	8.201
Return Period (years)	30



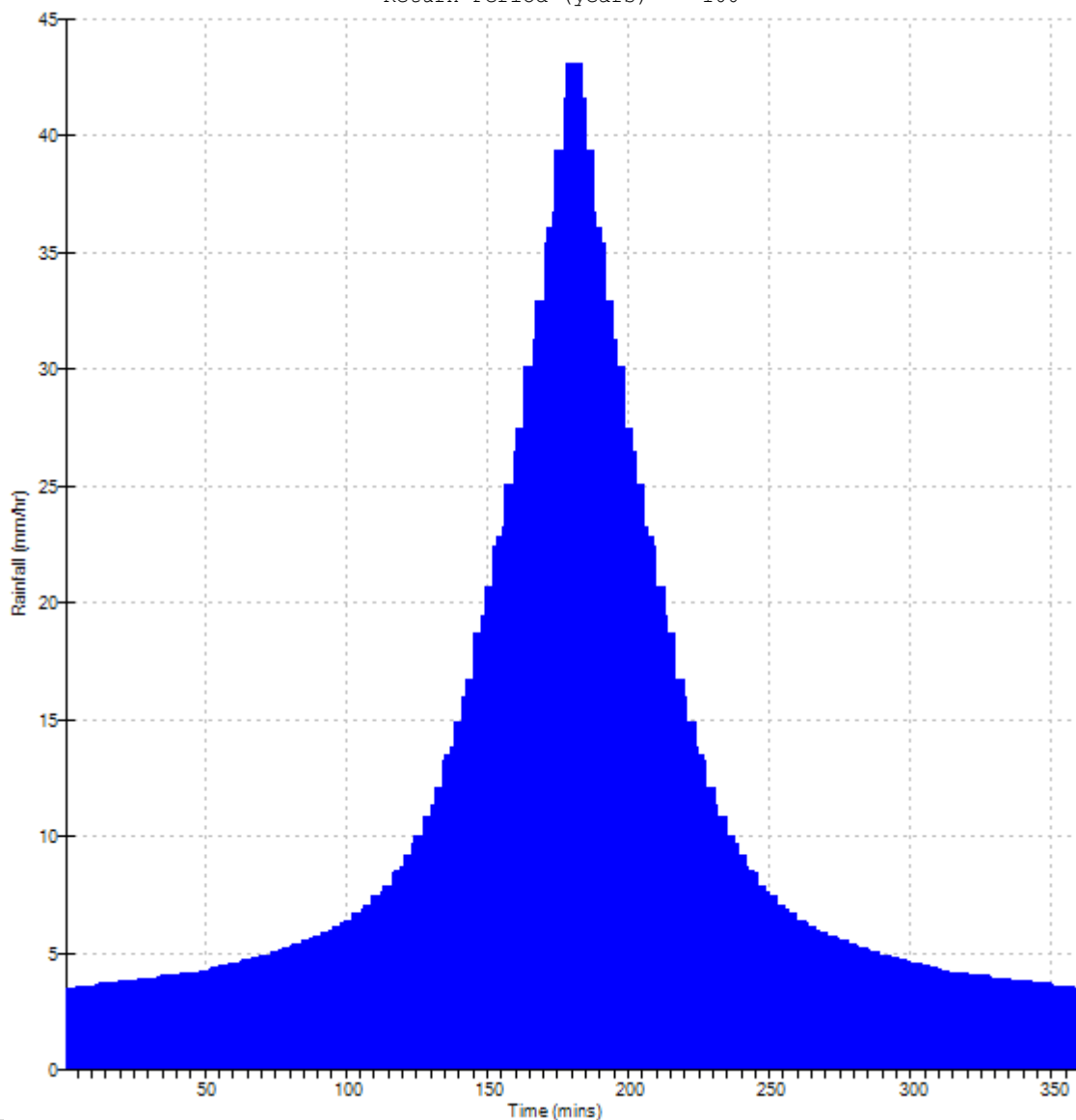
Betts Associates Ltd		Page 1
Old Marsh Farm Barns Welsh Road Sealand Flintshire ...	The Foundry Mount Street, Rhostyllen S G Estates	
Date 23.01.2014 File	Designed by RDN Checked by	
Micro Drainage	Network W.12.6.1	

Rainfall profile

Storm duration (mins) 360

FEH Data

C (1km)	-0.026
D1 (1km)	0.384
D2 (1km)	0.398
D3 (1km)	0.313
E (1km)	0.288
F (1km)	2.391
Peak Intensity (mm/hr)	43.117
Ave. Intensity (mm/hr)	10.999
Return Period (years)	100



SURFACE WATER RUN-OFF CALCULATION SHEET

Development The Foundry, Mount Street, Rhosyllen
Project No. SGE02

Revision 1.0 **Completed by** RDN
Date 24.01.2014 **Checked by** CP



Areas

Total Site	0.703	ha
Existing Impermeable	0.668	ha
Existing pervious	0.035	ha
Proposed Impermeable (total)	0.320	ha
Proposed Impermeable (domestic only)		ha

Catchment Characteristics

SAAR	1019	mm
SPR	43.17	%
i_1	14.2	mm/hr
i_{100}	43.1	mm/hr
d_1	13.6	mm
d_{100}	67.0	mm

Run-off Rates

Pre-development			
Impermeable	1yr	26.3	l/s
	100yr	80.0	l/s
	50mm/hr	92.8	l/s
Pervious	1yr		l/s
	100yr		l/s
	QBar		l/s
Total	1yr	26.3	l/s
	100yr	80.0	l/s
Post-development			
Impermeable (total)	1yr	12.6	l/s
	100yr+CC	49.8	l/s
Impermeable (domestic only)	1yr	0.0	l/s
	100yr+CC	0.0	l/s

Volumes

Pre-development			
Impermeable	1yr	90.8	cu.m
	100yr	447.6	cu.m
Pervious	1yr		cu.m
	100yr		cu.m
Total	1yr	90.8	cu.m
	100yr	447.6	cu.m
Post-development			
Impermeable (total)	1yr	43.5	cu.m
	100yr+CC	278.7	cu.m
Impermeable (domestic only)	1yr	0.0	cu.m
	100yr+CC	0.0	cu.m
Reduction (total)	38%	168.8	cu.m
Reduction (domestic only)			cu.m

Quick storage Estimate

		low	high	mean	Imp. Area (cu.m)	Max. Discharge (l/s)	Rainfall	CC
Return Period	1yr	0.0	9.8	4.9	0.320	26.3	FEH	0
Return Period	30yr	2.2	33.0	17.6	0.320	59.6	FEH	0
Return Period	100yr+CC	23.0	75.0	49.0	0.320	80.0	FEH	30%
Return Period	1yr	0.0	10.0	5.0	0.320	26.3	FSR	0
Return Period	30yr	0.0	27.0	13.5	0.320	59.6	FSR	0
Return Period	100yr+CC	4.7	56.0	30.4	0.320	80.0	FSR	30%

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APPENDIX J: IMPERMEABLE AREAS PLAN

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DO NOT SCALE

LEGEND

POST-DEVELOPMENT IMPERMEABLE
AREA = 0.320ha (46%)



TOTAL SITE AREA = 0.703ha

P1	23.01.2014	RN	ISSUED TO SUPPORT THE FRA	CP
REV	DATE	BY	DESCRIPTION	CHK

DRAWING STATUS: PRELIMINARY

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**SG ESTATES**
AWARD WINNING HOUSING DEVELOPER

PROJECT:
**THE FOUNDARY
MOUNT STREET, RHOSTYLLLEN**

TITLE:
**POST-DEVELOPMENT
IMPERMEABLE AREAS PLAN**

DATE: JAN 2014	SCALE @ SIZE: 1:500 @ A3	DRAWN: RDN	CHECKED: CP
PROJECT No: FRA251	DRAWING No: 100	REV: P1	

APPENDIX K: STORMWATER STORAGE ESTIMATES

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Micro Drainage Variables Results Design Overview 2D Overview 3D Vt	Results Global Variables require approximate storage of between 0.0 m³ and 9.8 m³. These values are estimates only and should not be used for design purposes.
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FSR Rainfall – 1 year Return Period

Micro Drainage		Variables			
Variables Results Design Overview 2D Overview 3D Vt	FSR Rainfall		Cv (Summer)	0.750	
	Return Period (years)		1	Cv (Winter)	0.840
	Region		England and Wales	Impervious Area (ha)	0.320
	Map	M5-60 (mm)	18.000	Maximum Allowable Discharge (l/s)	26.3
		Ratio R	0.294	Infiltration Coefficient (m/hr)	0.00000
			Safety Factor	2.0	
			Climate Change (%)	0	

Micro Drainage		Results
Variables Results Design Overview 2D Overview 3D Vt	Global Variables require approximate storage of between 0.0 m³ and 10 m³. These values are estimates only and should not be used for design purposes.	

FEH Rainfall – 30 year Return Period

Micro Drainage		Variables		
Variables Results Design Overview 2D Overview 3D Vt	FEH Rainfall		Cv (Summer)	0.750
	Return Period (years) 30		Cv (Winter)	0.840
	Site Location		Impervious Area (ha)	0.320
	GB 331150 349050 SJ 31150 49051		Maximum Allowable Discharge (l/s)	59.6
	C (1km) -0.026	D3 (1km) 0.313	Infiltration Coefficient (m/hr)	0.00000
	D1 (1km) 0.384	E (1km) 0.288	Safety Factor	2.0
	D2 (1km) 0.398	F (1km) 2.391	Climate Change (%)	0

Micro Drainage		Results
		Global Variables require approximate storage of between 2.2 m³ and 33 m³. These values are estimates only and should not be used for design purposes.
Variables		
Results		
Design		
Overview 2D		
Overview 3D		
Vt		

FSR Rainfall – 30 year Return Period

Micro Drainage		Variables	
Variables Results Design Overview 2D Overview 3D Vt	FSR Rainfall ▼		Cv (Summer) 0.750
	Return Period (years) 30		Cv (Winter) 0.840
	Region England and Wales ▼		Impervious Area (ha) 0.320
	Map	M5-60 (mm) 18.000	Maximum Allowable Discharge (l/s) 59.6
	Ratio R 0.294		Infiltration Coefficient (m/hr) 0.00000
			Safety Factor 2.0
			Climate Change (%) 0

Micro Drainage		Results
Variables Results Design Overview 2D Overview 3D Vt	Global Variables require approximate storage of between 0.0 m³ and 27 m³. These values are estimates only and should not be used for design purposes.	

FEH Rainfall – 100 year Return Period plus 30% allowance for Climate Change

Micro Drainage		Variables	
Variables Results Design Overview 2D Overview 3D Vt	FEH Rainfall		Cv (Summer) 0.750
	Return Period (years) 100		Cv (Winter) 0.840
	Site Location		Impermeable Area (ha) 0.320
	GB 331150 349050 SJ 31150 49050		Maximum Allowable Discharge (l/s) 80.0
	C (1km) -0.026	D3 (1km) 0.313	Infiltration Coefficient (m/hr) 0.00000 Safety Factor 2.0 Climate Change (%) 30
	D1 (1km) 0.384	E (1km) 0.288	
	D2 (1km) 0.398	F (1km) 2.391	

Micro Drainage		Results
Variables Results Design Overview 2D Overview 3D Vt		Global Variables require approximate storage of between 23 m³ and 75 m³. These values are estimates only and should not be used for design purposes.

FSR Rainfall – 100 year Return Period plus 30% allowance for Climate Change

Micro Drainage		Variables			
Variables Results Design Overview 2D Overview 3D Vt	FSR Rainfall		Cv (Summer)	0.750	
	Return Period (years)		100	Cv (Winter)	0.840
	Region		England and Wales	Impervious Area (ha)	0.320
	Map	M5-60 (mm)	18.000	Maximum Allowable Discharge (l/s)	80.0
	Ratio R		0.294	Infiltration Coefficient (m/hr)	0.00000
			Safety Factor	2.0	
			Climate Change (%)	30	

Micro Drainage		Results
		Global Variables require approximate storage of between 4.7 m³ and 56 m³. These values are estimates only and should not be used for design purposes.
Variables		
Results		
Design		
Overview 2D		
Overview 3D		
Vt		

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APPENDIX L: PFRA INFORMATION

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flooding then the area is defined as an Indicative Flood Risk Area. The WCBC area has 20 locations above Flood Risk Thresholds (Signified by the red squares in figure 6 below), However the population of these squares is still below the threshold of 5000 people meaning that they are not classed as an IFRA.

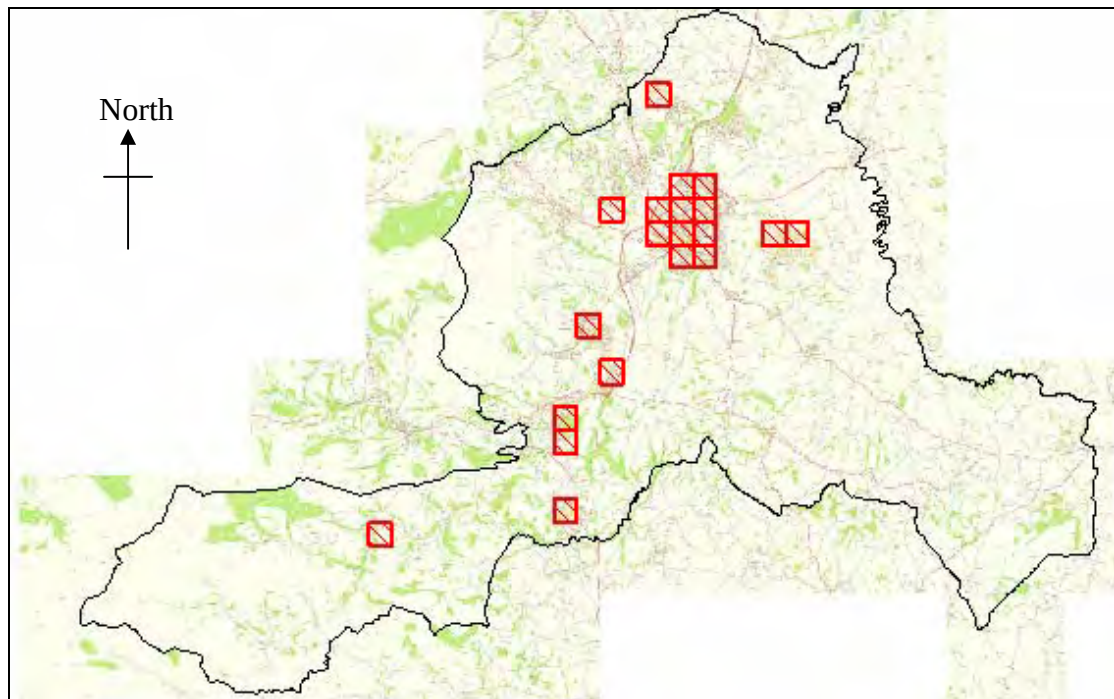


Figure 6 - Indicative Flood Risk Areas

6.3. Review of indicative Flood Risk Areas

As part of the PFRA process reviewing the areas defined by the EA as IFRA must be undertaken. Having collected, collated and assessed the numerous data sets from a range of organisations it is clear that there shall be no amendments to the IFRA as identified by the EAW, or the need to include any new ones as there are no areas that match the criteria set by DERFA/WAG. Due to this WCBC shall return a nil return for the spreadsheet for updating and reviewing of the IFRA.

For the future review of the PFRA, which shall be undertaken in 2017 there is likely to be a change to the indicative flood risk areas due to the expanding population and constraints they will place upon the local drainage infrastructure. It is predicted that the thresholds for what constitutes a flood risk area shall also be redefined for future work, which will also have an impact upon the areas defied as being at risk.

APPENDIX M: NOTES OF LIMITATION

The data essentially comprised a study of available documented information from various sources together with discussions with relevant authorities and other interested parties. There may also be circumstances at the site that are not documented. The information reviewed is not exhaustive and has been accepted in good faith as providing representative and true data pertaining to site conditions. If additional information becomes available which might impact our conclusions, we request the opportunity to review the information, reassess the potential concerns and modify our opinion if warranted.

It should be noted that any risks identified in this report are perceived risks based on the available information.

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