Berse Road, Wrexham

Flood Consequences Assessment

April 2016

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w1892-160406-FCA

DOCUMENT VERIFICATION RECORD

CLIENT:

Plas Power Estates.

SCHEME:

Flood Consequences Assessment for a residential development at land off Berse Road, Wrexham, LL11 6TP. The purpose of this report is to support the Planning Application.

INSTRUCTION:

The instruction to carry out this Flood Consequences Assessment was received from Ms Jo Redmond of Strutt & Parker LLP acting on behalf of the client.

REPORT FORMAT:

This report has been prepared in accordance with Technical Advice Note 15: Development and Flood Risk (TAN15).

ISSUE HISTORY:

Issue Date	Comment
07/12/2015	First issue
06/04/2016	Additional blockage simulation

DOCUMENT REVIEW & APPROVAL

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Waterco Document Reference Number.....w1892-160406-FCA

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Supporting Documents:

Waterco Consultants Hydraulic Modelling Report (document reference: w3183-150812-HMR).

Abbreviations

AEP	*Annual Exceedance Probability*
CC	*Climate Change*
DCWW	*Dwr Cymru Welsh Water*
EA	*Environment Agency*
FCA	*Flood Consequences Assessment*
m AOD	*metres Above Ordnance Datum*
NRW	*Natural Resources Wales*
PFRA	*Preliminary Flood Risk Assessment*
SUDS	*Sustainable Drainage Systems*
TAN15	*Welsh Government Technical Advice Note 15: Development & Flood Risk*

1 Introduction

1.1 Waterco Consultants have been instructed to prepare a Flood Consequences Assessment report in respect of a proposed residential development at land off Berse Road, Wrexham, LL11 6TP (grid reference: 331335E, 351004N). A location plan and an aerial image of the site are included in Appendix A.

1.2 The existing site comprises of agricultural land. The application site boundary covers an area of approximately 3.45ha. Approximately 48% of the site (1.67ha) will be developed with the remaining 52% designated as open space.

1.3 The site is bordered by residential properties and Berse Road to the north, agricultural land and a public footpath to the east, agricultural land and a dismantled railway to the south and Stryt-Y-Bydden (road) and agricultural land to the west.

1.4 A Topographical Survey of the site was undertaken by Geomatic Surveys Ltd in May 2015 and is included in Appendix B. The site generally slopes from north-west to south-east. The topographical survey identifies an earth mound which will be removed as part of the development.

1.5 The proposed development is for 34 residential properties with associated access roads and landscaping. A proposed development plan is included in Appendix B.

1.6 Waterco Consultants have undertaken hydraulic flood modelling of the nearby Afon Gwenfro to support this assessment. The modelling results are discussed in this report. Full details of the modelling methodology are provided in the associated Hydraulic Modelling Report (document reference: w3183-150812-HMR) which should be read in conjunction with this FCA.

2 Flood Zone Category and TAN15 Requirements

Flood Zone Classification

2.1 The Welsh Government Development Advice Map included in Appendix C shows that the majority of the site is located in Flood Zone A – an area with a less than 0.1% (1 in 1000) annual probability of flooding. However, there is a flow route through the site identified as Flood Zone C2 – an area at flood risk, without significant defence infrastructure, with a 0.1% (1 in 1000) or greater annual probability of flooding.

2.2 The NRW 'Flood Risk without Defences (Rivers & Sea)' map (Appendix C) shows that the majority of the site is located within Flood Zone 1 - an area considered to have the lowest probability of fluvial flooding. It is assessed as having a less than 1 in 1000 annual probability of flooding (<0.1%). Approximately 20% of the site is located within Flood Zone 2 – an area at risk with between a 1% (1 in 100) and 0.1% annual probability of flooding.

2.3 The flood zone C2 / 2 classification is derived by a generalised national scale modelling approach which provides a limited representation of local structures and topographical features. NRW have confirmed that they do not hold detailed flood modelling for this area. Therefore in order to determine the accurate flood extent, depths and velocities for the site, detailed 1-Dimensional / 2-Dimensional hydraulic modelling of Afon Gwenfro has been undertaken by Waterco Consultants. The results, discussed further in this report, confirm the Flood Zone C2 / 2 classification.

Planning Policy Requirements

2.4 Technical Advice Note 15 (TAN15) of Planning Policy Wales (PPW) provides technical guidance in relation to development and flooding. Figure 2 of TAN15 classifies residential development as 'highly vulnerable'.

2.5 Section 9 within TAN15 states that 'the flooding consequences associated with highly vulnerable development are not considered to be acceptable'. Therefore highly vulnerable development should not be proposed within Flood Zone C2. Highly vulnerable development is considered appropriate within Flood Zone A.

2.6 In order to achieve TAN15 compliance all buildings and access / egress routes will be located outside of the extreme 0.1% Annual Exceedance Probability (AEP) flood extent.

3 Potential Sources of Flooding and Probability

Fluvial flooding

3.1 The nearest watercourse is the Afon Gwenfro which is located immediately south-east of the site. The Afon Gwenfro flows east in this location and joins the Afon Clywedog approximately 3.6km from the site.

3.2 Fluvial flooding could occur if the Afon Gwenfro overtopped its banks during or following an extreme rainfall event. There are no records of fluvial flooding at or in the immediate vicinity of the site.

3.3 Detailed hydraulic modelling of the Afon Gwenfro has been undertaken by Waterco Consultants. The modelling results, including flood depth and velocity mapping are included in Appendix D, with map extracts provided below and overleaf:

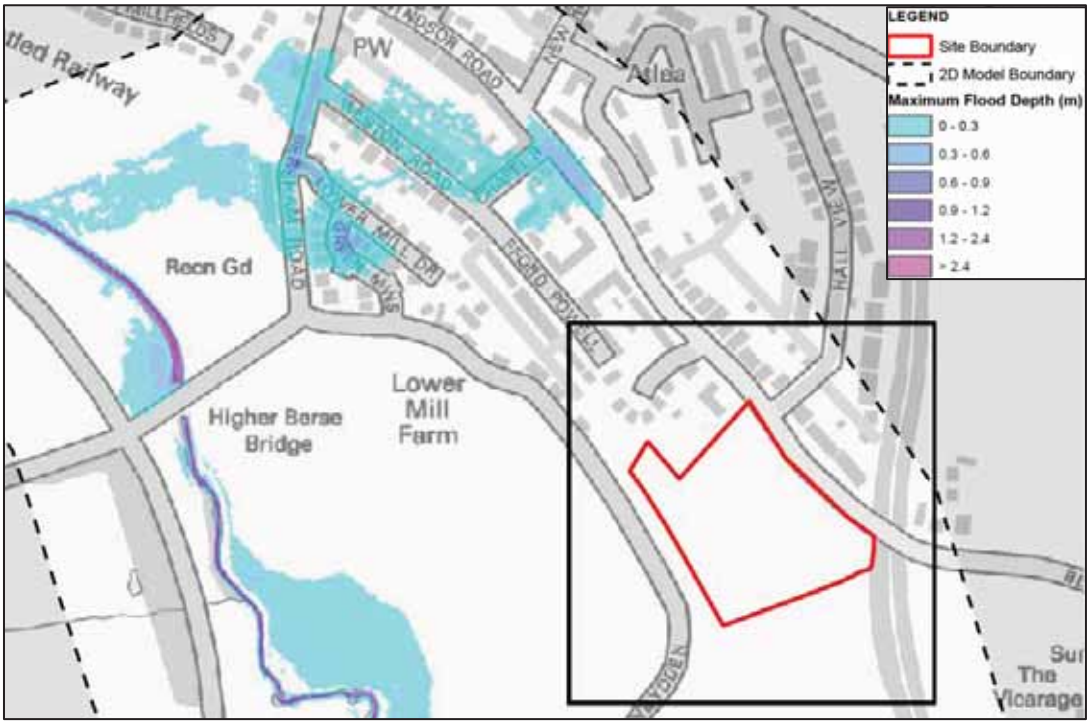


Figure 1 – 1% AEP + CC Event – Normal Flow Conditions

*Application boundary in Figures now superseded – see site layout plan in Appendix B.

3.4 As shown in Figure 1 the site is shown to be flood free during the 1% Annual Exceedance Probability (AEP) event including an allowance for climate change (CC) under normal

conditions. Overtopping occurs upstream of the site at the recreational ground, causing flooding to residential properties north-west of the site.

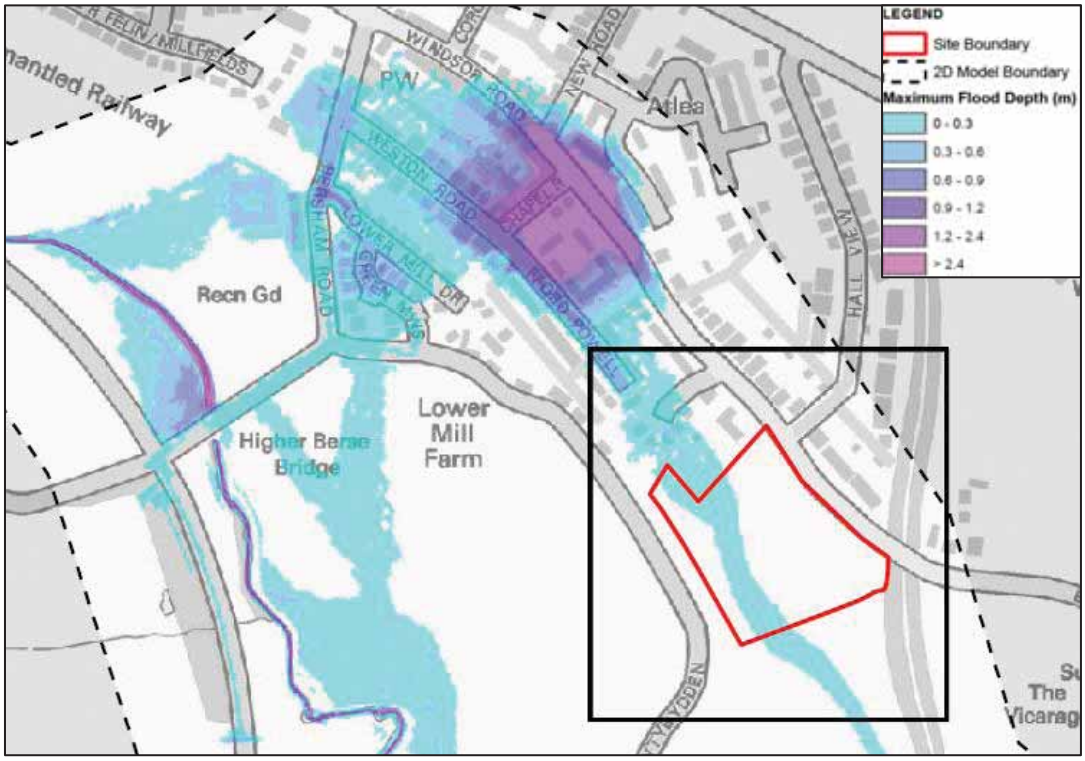


Figure 2 – 0.1% AEP – Normal Flow Conditions

3.5 As shown in Figure 2, the flood extent and depths increase in the residential area to the north-west of the site during the 0.1% AEP event. This results in a flow route through the site with flood waters directed into the Afon Gwenfro immediately south-east of the site. The flood depths associated with the flow route are less than 300mm. maximum velocities during the 0.1% AEP event are 0.75 m/s.

<u>Blockage Scenarios</u>

3.6 Two blockage scenarios of Higher Berse Road Culvert have been investigated; namely a 66% blockage during the Q100CC event (BL1-66) and a 95% blockage during the Q1000 event (BL1-95).

3.7 During a 66% blockage of Higher Berse Road culvert coinciding with a 1% AEP + CC event, the flood extent is increased when compared with the 0.1% AEP event. Flood depths are generally less than 300mm and velocities are up to 0.75 m/s. An extract of the flood map is included as Figure 3 below.

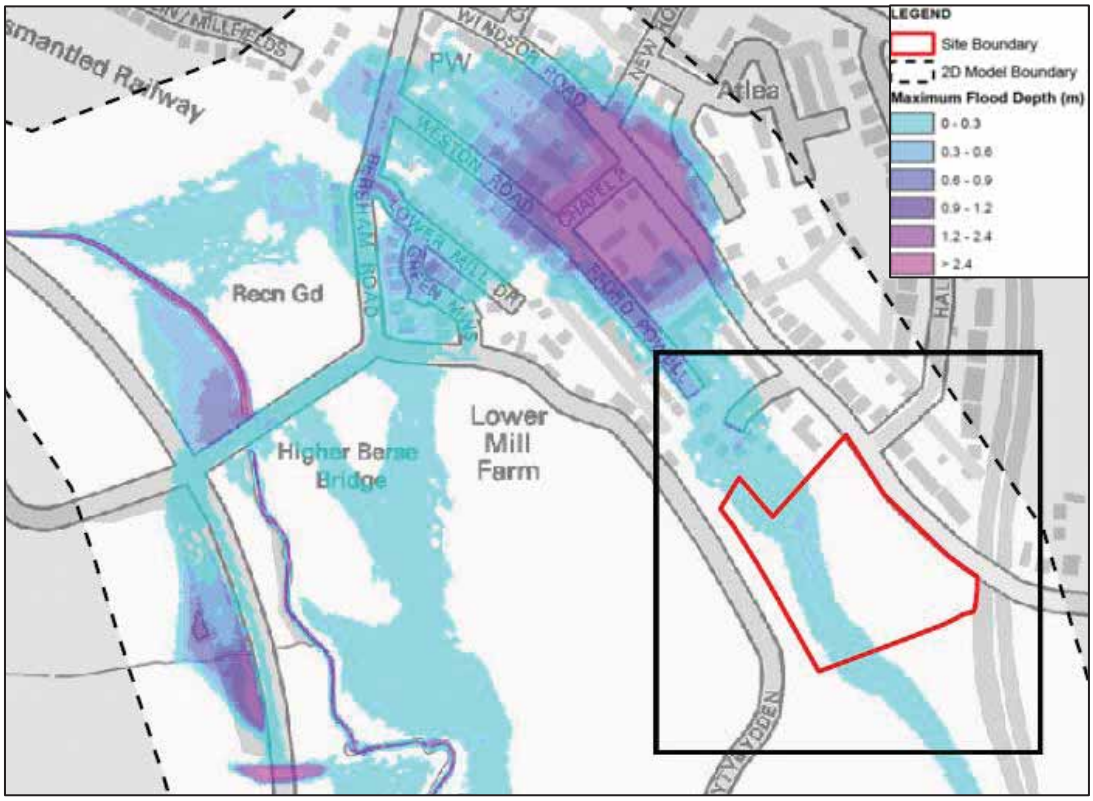


Figure 3 – 1% AEP + CC – 66% Blockage

3.8 During a 95% blockage of Higher Berse Road culvert coinciding with a 0.1% AEP event approximately 35% of the site is shown to flood with maximum flood depths reaching up to 0.59m. Flood depths in the location of proposed properties are less than 300mm and the flood hazard is 'low' (Caution). An extract of the BL1-95 flood depth map showing the locations of the proposed houses is given in Figure 4 overleaf for information.

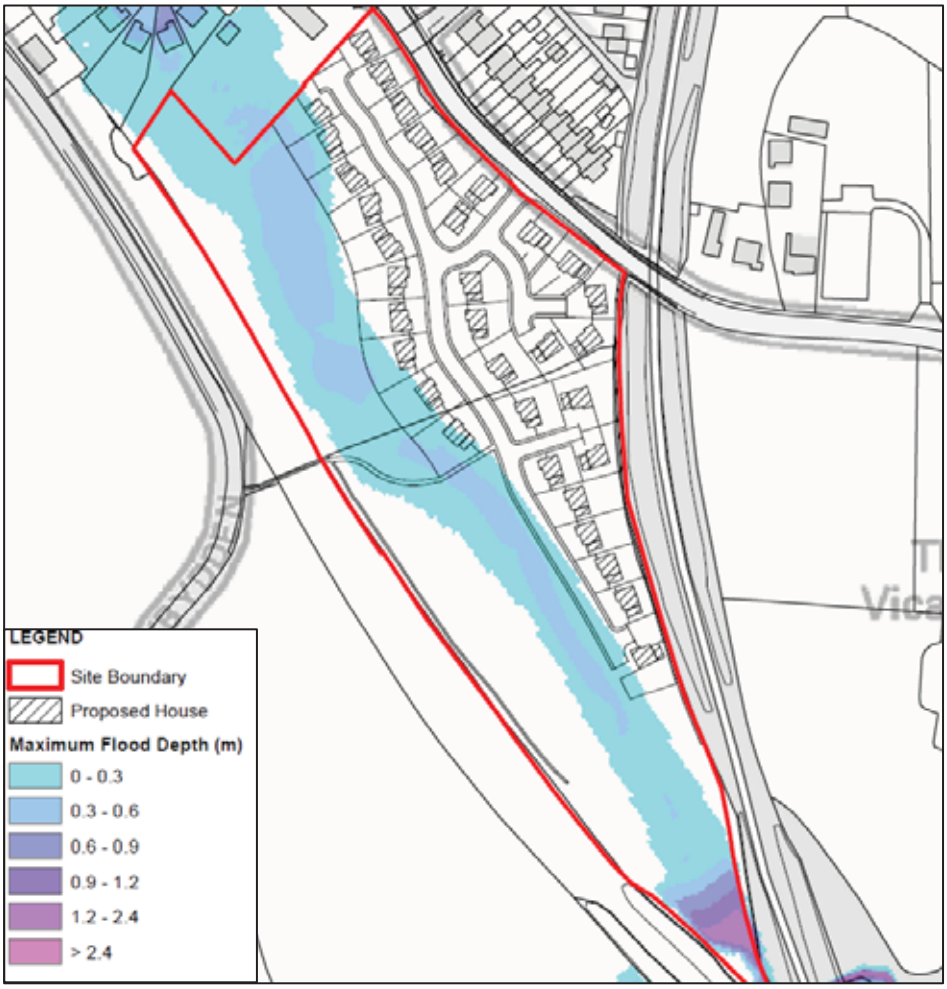


Figure 4 – 0.1% AEP – 95% Blockage

3.9 It can be concluded that the site is at low risk of flooding under normal conditions during all events up to and including the 1% AEP + CC event. Shallow depth flooding is estimated during the 0.1% AEP event and when applying a 66% blockage to Higher Berse Road culvert during the 1% AEP + CC event. Flood extents and depths are increased during a 95% blockage of Higher Berse Road culvert coinciding with the 0.1% AEP event.

Tidal flooding

3.10 The site is situated at a minimum of 100.35m AOD and is significantly above sea level. Therefore the site is not at risk of tidal flooding.

Pluvial flooding

3.11 Pluvial flooding is defined as local flooding in areas not normally associated with natural or manmade watercourses, which results from rainfall-generated overland flow before the runoff enters any watercourse or sewer. It is usually associated with high intensity rainfall events, but

can also occur with lower intensity rainfall or melting snow, where the ground is saturated, frozen or developed, resulting in overland flow and ponding in depressions in topography. Pluvial flooding is unpredictable to the extent that the localised heavy rainfall can occur anywhere without warning. However, flow paths and depths can be determined by consideration of contours and relative levels.

3.12 The Envirocheck Flood Report (Appendix E) shows that the site is not at risk from pluvial flooding during all events up to and including the 1 in 1000 year event.

3.13 The NRW 'Risk of Flooding from Surface Water' map (Appendix C) shows that the majority of the site is not at risk of surface water flooding. Isolated areas of the site are shown to be at low risk of surface water flooding (between a 1% and 0.1% annual probability of flooding). These areas are located outside of the developable site area.

3.14 There are no records of surface water flooding at or in the immediate vicinity of the site. Any potential surface water flooding arising at or near to the site would be directed south-east, away from the site, following the local topography. It can therefore be concluded that the risk of pluvial flooding is low.

Groundwater flooding

3.15 Groundwater flooding occurs when water levels underneath the ground rise above normal levels. Prolonged heavy rainfall soaks into the ground and can cause the ground to become saturated. This results in rising groundwater levels which leads to flooding above ground.

3.16 The ESI Groundwater Flood Map included in the Envirocheck Flood Report (Appendix E) shows that the site has a negligible risk of groundwater flooding. The PFRA states that 'there were no records of past groundwater flooding within WCBC; this is due to the topography and geology of the area'. It can therefore be concluded that the risk of groundwater flooding is low.

Sewer flooding

3.17 Flooding from sewers can occur when a sewer is overwhelmed by heavy rainfall, becomes blocked, is damaged or is of inadequate capacity. This is mostly applicable to combined and surface water sewers.

3.18 The Dwr Cymru Welsh Water (DCWW) sewer records show that there is a 225mm public combined sewer located in Berse Road immediately north of the site. There is also a 150mm public foul sewer located in Berse Gardens (road) approximately 25m north-west of the site.

3.19 The PFRA contains no records of sewer flooding at or in the immediate vicinity of the site. There are no distinct flow routes that would direct any potential sewer flooding arising on Berse Road towards the site. It can therefore be concluded that the risk of sewer flooding is low.

Artificial sources of flooding

3.20 There are no canals in the vicinity of the site. The NRW 'Risk of Flooding from Reservoirs' map (Appendix C) shows the site is not at risk of flooding from reservoirs.

Summary of Potential Flood Sources

3.21 It can be concluded that fluvial flooding from the Afon Gwenfro during extreme events is considered to be the main source of flooding at this site.

4 Flood Resistant Design / Consideration of Layout

4.1 All buildings and roads will be located outside of the flood extent associated with both the 0.1% AEP event and 1% AEP + CC including 66% structure blockage event. Therefore the development is compliant with Section A1.14 of TAN15.

4.2 Shallow depth flooding is shown to encroach into the location of properties 18, 19, 20, 22 and 26 (see site plan in Appendix B for plot numbers) during the 0.1% AEP event when accounting for 95% culvert blockage. Estimated flood depths in the location of these properties are less than 300mm. The development is therefore compliant with A1.15 of TAN15.

4.3 It is recommended that finished floor levels of properties are set above the 0.1% AEP plus 95% structure blockage event. The maximum estimated water level for the 0.1% AEP plus 95% structure blockage, adjacent to properties, is shown in table 1 below. The required finished floor levels are also provided in Table 1:

Table 1 –Recommended Finished Floor Levels

Property Number	0.1% AEP + 95% blockage flood level (m AOD)	Finished Floor Level (m AOD)
27	110.62	110.8
26	110.57	110.8
25	110.53	110.8
24	110.47	110.65
23	110.42	110.65
22	110.37	110.55
21	110.30	110.45
20	110.03	110.18
19	109.77	109.92
18	109.26	109.41
17	106.95	107.1

16	107.69	107.84
15	107.98	108.13
14	108.21	108.36
13	108.44	108.59
12	108.82	108.97

4.4 Construction / design of all properties referenced in Table 1 should follow the guidance contained in the RIBA publication 'Improving the Flood Performance of New Buildings, Flood Resilient Construction' dated May 2007.

4.5 Finished floor levels for all properties not referenced in Table 1 should be set at a minimum of 150mm above surrounding ground levels.

5 Flood Emergency Plans and Procedures

5.1 The NRW Flood Alert service covers this area. This is a free service that provides fluvial flood alerts direct by telephone, mobile, email, SMS text message and fax. Residents should register to receive flood alerts.

5.2 In the event of a flood it is considered safe for residents to remain within their properties. A safe access / egress route for use during times of flood is available along Berse Road, heading south-east. A safe access / egress route plan is included as Appendix F.

6 No Increase in Flooding Elsewhere

6.1 All properties, garages and roads will be located outside of the extreme 0.1% AEP flood extent. The development will not remove flood storage space from the floodplain. In addition, no ground raising or modification is proposed within the flood extent.

6.2 The rear gardens of plots 18, 19, 20, 21, 25, 26 and 27 are shown within the 0.1% AEP plus 95% blockage flood extent. In order to ensure no impact on the flow route and flood risk elsewhere, no close-board fences should be located in the rear gardens of these properties.

6.3 Surface water runoff will be appropriately managed as discussed in the following section.

7 Surface Water – No Adverse Impact

7.1 In accordance with TAN15 new development should not create additional runoff when compared with the undeveloped situation.

7.2 The existing runoff rates for the developable site area of 1.67ha have been calculated in accordance with current best practice (see Appendix G). The existing QBAR runoff rate is 4.3 l/s. A discharge rate of 5 l/s is proposed for this site. A discharge rate of 5 l/s is required to ensure that the drainage system self-cleanses and remains within optimum working order.

7.3 On site attenuation will be required to restrict post-development runoff rates to 5 l/s.

7.4 Using MicroDrainage modelling to provide a provisional analysis of the surface water drainage, the required storage volume has been calculated as approximately 317m^3 in order to provide the value of storage required for the 1 in 100 year plus 30% allowance for climate change event. MicroDrainage calculations are shown in Appendix G. The attenuation volume is based on storage within oversized pipes (double pipe storage) and an impervious area of 5936m². Detailed drainage design will be required at the detailed design stage.

7.5 The potential options for surface water discharge have been considered below:

Soakaway

7.6 The Cranfield University 'Soilscapes' map indicates that the site is underlain by 'freely draining loamy soils'. Therefore soakaways appear to be a feasible option.

7.7 It is recommended that infiltration tests are carried out in accordance with the BRE 365 specification to determine the feasibility of soakaways.

Watercourse

7.8 Where soakaways are not suitable, discharge to watercourse is the preferred option. The nearest watercourse is the Afon Gwenfro which is located immediately south-east of the site. A gravity connection to this watercourse appears to be a suitable option.

Sewer

7.9 The final option considered for surface water disposal is sewer. There is a 225mm public combined sewer located in Berse Road immediately north of the site. However as soakaways or a connection to watercourse appear feasible a connection to the public combined sewer is not required.

Sustainable Drainage Systems

7.10 Attenuation storage should be provided in the form of Sustainable Drainage Systems (SuDS) where practical. The following SuDS options have been considered:

Swales, Basins and Ponds

7.11 The proposal comprises a large area (approximately 1.78ha) of public open space in the southern extent of the site. Approximately 1ha of public open space is within the flood extent. Due to potential impact on flood flow routes and impact on functionality of the system during a flood, it is not considered practical to locate a pond or swale within the flood extent.

7.12 There is scope to provide a basin or pond in the eastern extent of the site, outside of the flood extent. However an open surface water attenuation feature such as a pond or a swale in a residential or urban area presents a significant safety risk, the hazards and appropriate mitigation should be considered at the detailed design stage.

Soakaways

7.13 Reference to Cranfield University soil mapping indicates that the site is underlain by freely draining loamy soils. It is considered that soakaways may be a feasible method for the disposal of surface water runoff from the site. Infiltration testing will be required in order to determine the feasibility of soakaways.

Rainwater Harvesting

7.14 The attenuation benefits provided through the use of rainwater harvesting are considered to be limited, and would only be realised when the tanks were not full. However, rainwater harvesting techniques could be incorporated within the final design.

Green Roofs

7.15 The proposed development comprises construction of residential dwellings. The proposed development plans do not identify green roofs for the proposed buildings.

Porous / Permeable Paving

7.16 Internal roads (private roads), driveways and car parking areas are potential areas in which permeable paving could be provided. For this site, roads cover an area of approximately 0.33ha.

7.17 Based on an area of 0.33ha and a depth of 300mm, with a void ratio of 0.3, there is potential to provide up to 297m^3 of attenuation for the site prior to discharge to watercourse or through infiltration. Storage would be provided within the sub-grade material. There is limited scope for the use of permeable paving where roads are adopted.

Modular Underground Attenuation Tanks

7.18 Underground tanks and oversized pipes could be provided to attenuate surface water runoff. Oversized pipes could be placed beneath roads. An attenuation tank could be sited within public open space in the eastern extent of the site.

Summary of Surface Water Drainage System

7.19 Where infiltration is feasible (subject to infiltration testing) all dwellings should drain to private soakaways within garden areas. Highway drainage could discharge to a soakaway(s) within public open space, outside of the flood extent.

7.20 Where soakaways are not feasible, a connection to the Afon Gwenfro is a feasible option. Discharge into the Afon Gwenfro would be restricted to 5 l/s and attenuation provided on site.

Exceedance Flooding

7.21 Exceedance events of the surface water drainage system, in excess of the 1 in 100 year plus climate change storm event, should be permitted to produce shallow depth flooding within landscaped areas or roads. Finished floor levels will be set above surrounding ground levels ensuring no property flooding.

Management and Maintenance

7.22 The surface water drainage system will be privately owned and maintained. Maintenance of individual soakaways within private gardens will be the responsibility of property owners. Maintenance of shared attenuation storage systems i.e. oversized pipes will be the responsibility of the site owner. The site owner will be responsible for arranging maintenance through appointment of a site management company.

7.23 Maintenance of soakaways includes:

- Regular monitoring for performance
- Removal of sediment from silt traps.

7.24 Maintenance of permeable paving includes:

- Regular jetting to unclog voids.

7.25 Maintenance of modular storage tanks and oversized pipes include:

- Removal of sediment from silt traps.

8 Other Considerations

8.1 Foul flows should be discharged to the public combined sewer in Berse Road. The cover level of this sewer is 112.69m AOD. DCWW have no information regarding the invert level of the sewer. A survey of the nearby DCWW manhole in Berse Road should be undertaken to establish the invert level which will determine whether a pumped solution is required. A 15m easement will be required from any habitable dwellings to the wet well of the pumping station.

8.2 Storage would be required to accommodate for pump failure. In accordance with Sewers for Adoption 7th Edition the storage requirement is 160 litres per dwelling. The provision of standby pumps, an automated pump exercise regime and a pump failure alarm system would reduce the risk of pump failure.

9 Summary and Conclusions

9.1 The proposed development at land off Berse Road, Wrexham is for 34 detached dwellings with associated garages, roads and landscaping. The development is classified as 'highly vulnerable' development in accordance with TAN15.

9.2 The majority of the site is located within Flood Zone A on the Welsh Government Development Advice Map, with the central area of the site shown to be within Flood Zone C2.

9.3 Detailed hydraulic modelling of the Afon Gwenfro shows that the site is flood free during all events up to and including the 1% AEP + CC event under normal conditions.

9.4 Fluvial flooding is estimated during the 0.1% AEP event under normal conditions and when applying a 95% blockage to Higher Berse Road culvert. Flooding is also estimated during the 1% AEP + CC event when accounting for a 66% culvert blockage. All properties and road will be situated outside of the 1% AEP + CC plus 66% blockage scenario event. Flooding encroaches to properties 18, 19, 26 and 27 during the 0.1% AEP + 95% blockage scenario event. Flood depths in the location of properties during this event are less than 300mm and the hazard rating is low.

9.5 In order to achieve TAN15 compliance all residential development including access roads will be located outside of the extreme 0.1% AEP and 1% AEP + CC including 66% blockage flood extents. Furthermore finished floor levels will be raised to ensure no internal flooding during the 0.1% AEP + 95% blockage scenario event.

9.6 No ground level modifications are proposed within the flood extent and therefore the development will not impact on flood flow routes or flood storage.

9.7 The site is currently greenfield. The proposed development will increase surface water runoff rates and volumes through the increase in impermeable area. The increase in runoff will be dealt with on site by using sustainable drainage techniques. Soakaways will be used where ground condition allow. Alternatively surface water will be directed into the Afon Gwenfro at a limited rate of 5 l/s with attenuation storage provided to accommodate the 1 in 100 year plus 30% climate change allowance storm event.

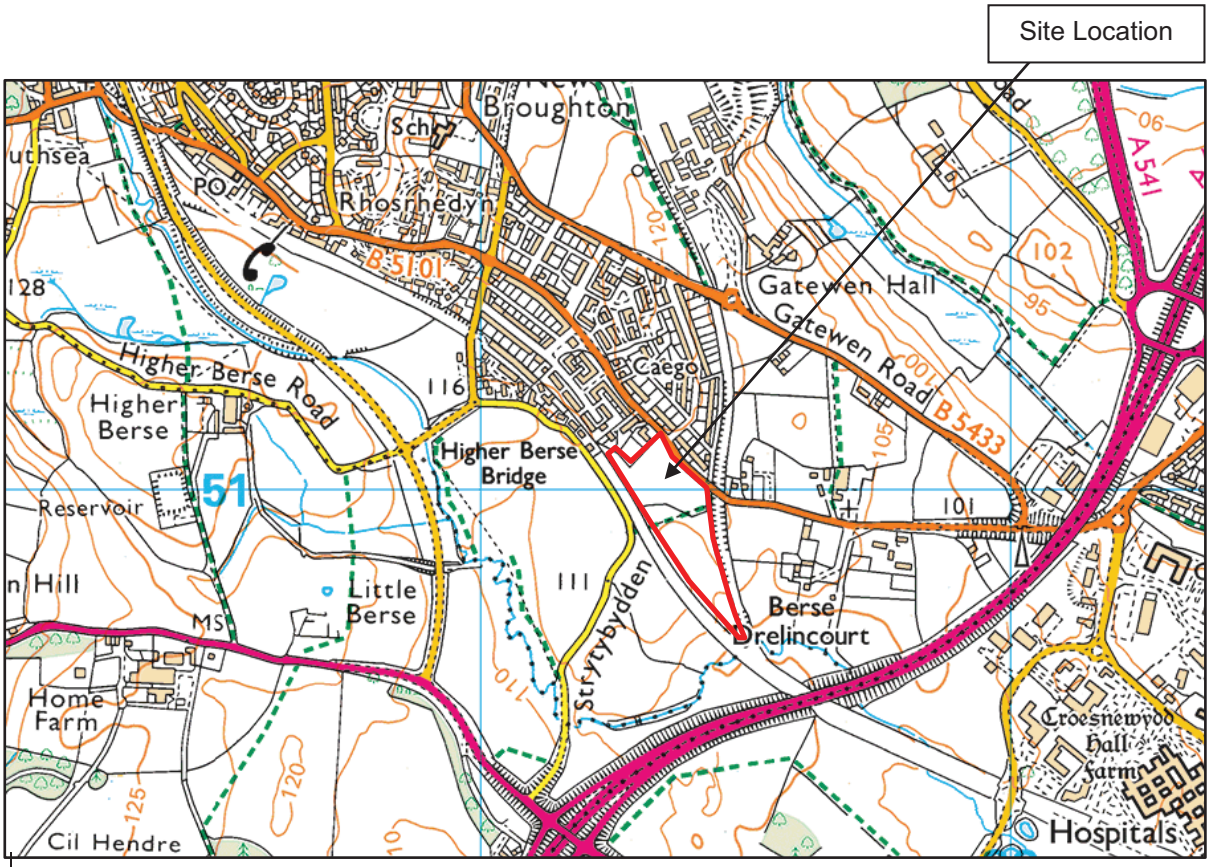
10 Recommendations

10.1 Set finished floor levels as detailed in Table 1, Section 4.

10.2 Following planning consent, infiltration tests and a survey of the combined sewer should be undertaken.

10.3 Submit this Flood Consequences Assessment to the Local Planning Authority in support of the planning application.

Appendix A – Location Plan and Aerial Image



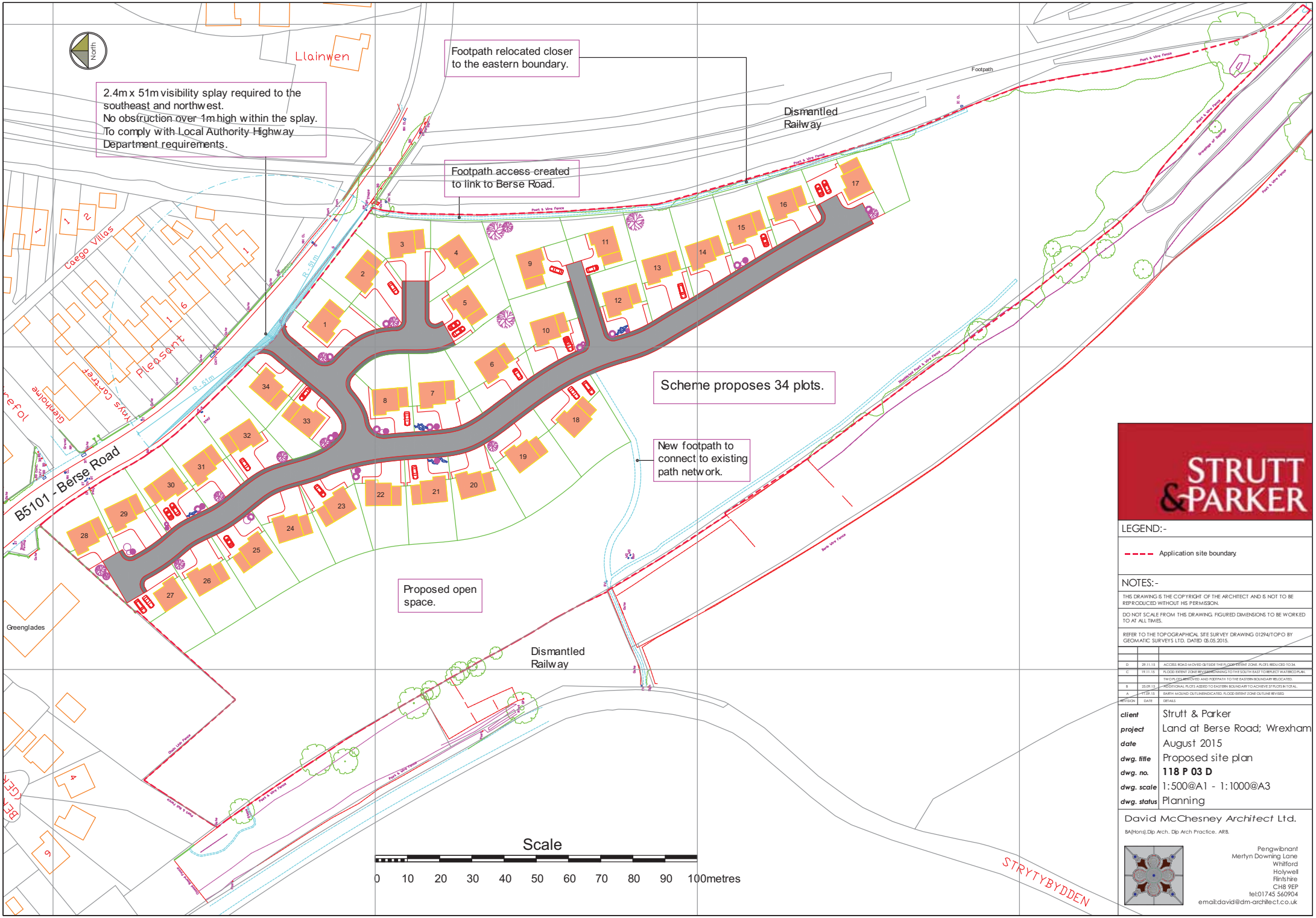
Location Plan

(Source: Streetmap)

Aerial Photograph

(Source: Google Maps)

Appendix B – Proposed Development Plan and Topographical Survey



STRUTT & PARKER

LEGEND:-

Application site boundary

NOTES:-

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DO NOT SCALE FROM THIS DRAWING. FIGURED DIMENSIONS TO BE WORKED TO AT ALL TIMES.

REFER TO THE TOPOGRAPHICAL SITE SURVEY DRAWING 01294/TOPO BY GEOMATIC SURVEYS LTD. DATED 05.05.2015.

REVISION	DATE	DETAILS
D	29.11.15	ACCESS ROAD MOVED OUTSIDE THE FLOOD EXTENT ZONE, PLOTS REDUCED TO 34.
C	19.11.15	FLOOD EXTENT ZONE REVISED ACCORDING TO THE SOUTH EAST TO REFLECT WATERCO PLAN.
		TWO PLOTS REMOVED AND FOOTPATH TO THE EASTERN BOUNDARY RELOCATED.
B	25.09.15	ADDITIONAL PLOTS ADDED TO EASTERN BOUNDARY TO ACHIEVE 37 PLOTS IN TOTAL.
A	17.09.15	EARTH MOUND OUTLINE INDICATED. FLOOD EXTENT ZONE OUTLINE REVISED

client	Strutt & Parker
project	Land at Berse Road; Wrexham
date	August 2015
dwg. title	Proposed site plan
dwg. no.	**118 P 03 D**
dwg. scale	1:500@A1 - 1:1000@A3
dwg. status	Planning

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LEGEND

- CONTROL STATIONS
- MANHOLE — MH CL 31.20
- BUSH
- TREE
- DROP KERB
- EMBANKMENT — TOP BANK / BOTTOM BANK
- OVERHEAD ELECTRICITY LINE
- OVERHEAD TELEPHONE LINE
- FOOTPATH
- FENCE
- HEDGE
- FOLIAGE
- DITCH
- VERGE
- EXISTING BUILDING
- MAIN CONTOUR — 50.00
- CONTOUR — 49.50
- SW SEWER
- FW SEWER

AH	Arch Height
BH	Borehole
BD	Bollard
BM	Bench Mark
BS	Bus Stop
BT	BT Inspection Chamber
BL	Bed Level
CATV	Cable TV Cover
CL	Cover Level
C/L	Chain Link Fence
CP	Catch Pit
CPS	Concrete Paving Slab
ECB	Electricity Control Box
EH	Building Eaves Level
ER	Earthing Rod
FB	Flower Bed
FH	Fire Hydrant
FL	Floor Level
GH	Greenhouse
GP	Gate Post
GR	Grate
GV	Gas Valve
G	Gully
IC	Inspection Chamber
IL	Invert Level
KO	Kerb Outlet
JB	Junction Box
LP	Lamp Post
MH	Man Hole
MK	Marker Post
MS	Mile Stone Marker
NP	Street Name Plate
O/H	Overhead
P	Post
PB	Post Box
PI	Pipe
PM	Parking Meter
P/R	Post & Rail Fence
P/W	Post & Wire Fence
PYL	Electricity Pylon
RE	Rodding Eye
RH	Building Ridge Level
RSJ	Reinforced Steel Joist
R/W	Retaining Wall
RWP	Rainwater Pipe
SH	Spring Height
SL	Soffit Level
SP	Sign Post
ST	Stop Tap
SV	Stop Valve
SY	Stay Wire
TC	Tactile Crossing
TOW	Top Of Wall Level
TH	Trial Hole
TL	Traffic Light
TP	Telegraph Pole
UTL	Unable To Lift
WM	Water Meter
WL	Water Level
VH	Building Valley Level

Disclaimer

Man Entry to sewers has not been undertaken. Depths, Pipesizes etc are measured from the ground. All sewers and inverts to be checked prior to any works commencing on site. Geomatic Surveys Limited are not resposible for manholes, services, information not surveyed which may have an impact on site development.

Boundaries shown are physical and may not represent legally conveyed ownership

Tree species have only been identified using basic identification techniques. For precise tree species identification, it is recommended that a qualified aboroculturist is used prior to tree removal.

REV	DATE	DESCRIPTION	BY	APP.

Sheet Layout

Sheet 1

Survey Information

The Survey is related to Ordnance Survey National Grid and Datum, using GPS. A central location for OSNG Grid is Survey Station '2002'. The Scale Factor is 1.0000000.

SURVEY CONTROL STATIONS

STN	EASTING	NORTHING	HEIGHT
2001	331438.599	350838.129	106.301
2002	331366.859	351011.020	114.571
2003	331275.974	350971.541	111.596
2004	331225.270	351048.242	112.707
2005	331339.408	351126.017	113.914
2006	331363.570	351079.284	112.566
2008	331448.895	351007.294	111.531
2009	331433.249	350759.776	107.995
2010	331467.508	350728.110	106.016
2011	331508.289	350704.093	98.862
2012	331299.751	350863.153	111.069
2013	331398.648	350749.701	108.367

Geomatic Surveys Ltd
LAND SURVEYORS AND CONSULTING ENGINEERS
Bank House, The Paddock
Wilmslow Road
Handforth
Cheshire
SK9 3HQ
Tel/Fax:– 01625 521405
Email: info@geomaticsurveys.co.uk
Web: www.geomaticsurveys.co.uk

Client

PLAS POWER ESTATE

Project Title

BERSE ROAD
NEW BROUGHTON
WREXHAM

Drawing Title

TOPOGRAPHICAL SURVEY

Drawn	Checked	Surveyed Date
MRW	IRH	01/05/2015
Date: 05/05/2015	Scale: 1:500 @ A0	Sheet No.: SHEET 1 OF 1
Drg. No.: 01294/Topo		Rev

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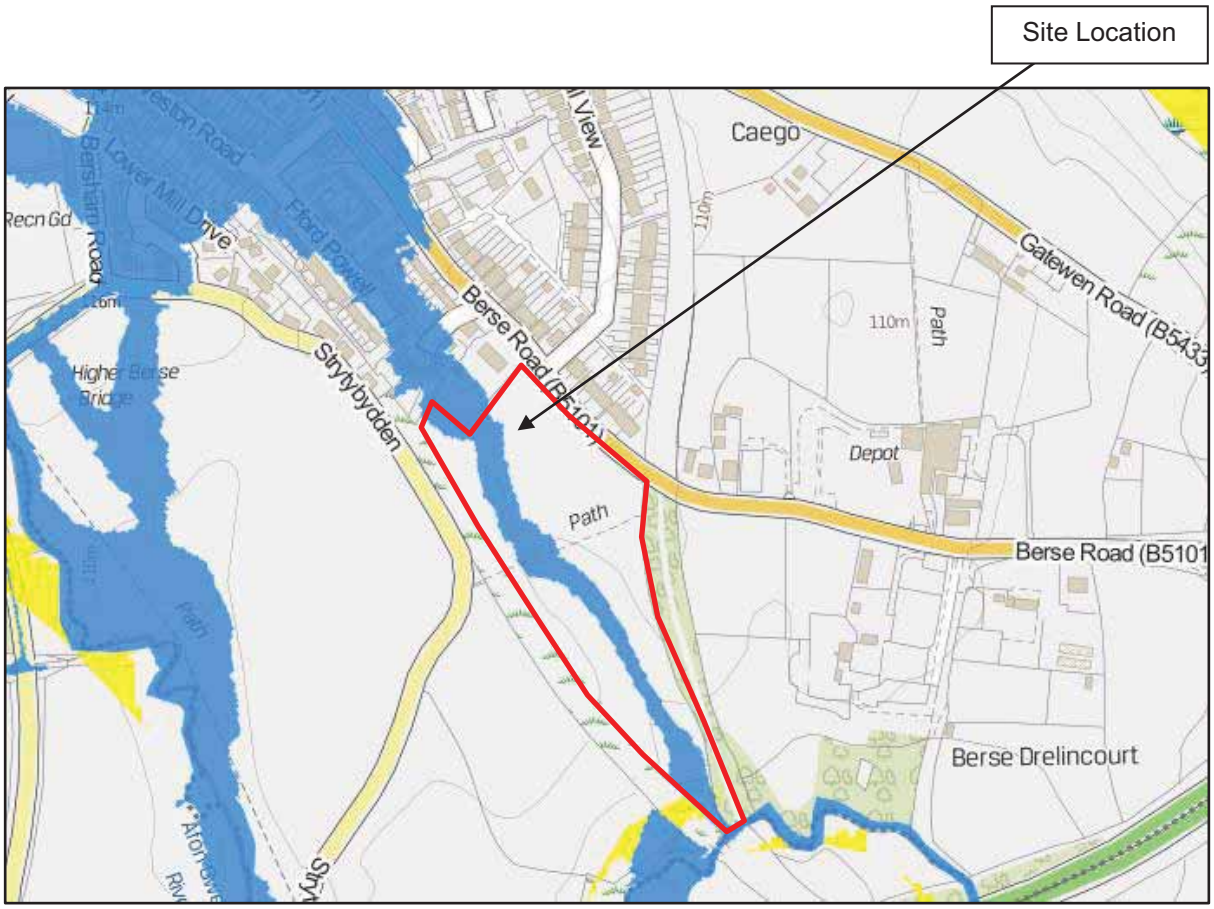
Appendix C – NRW / Welsh Government Flood Maps

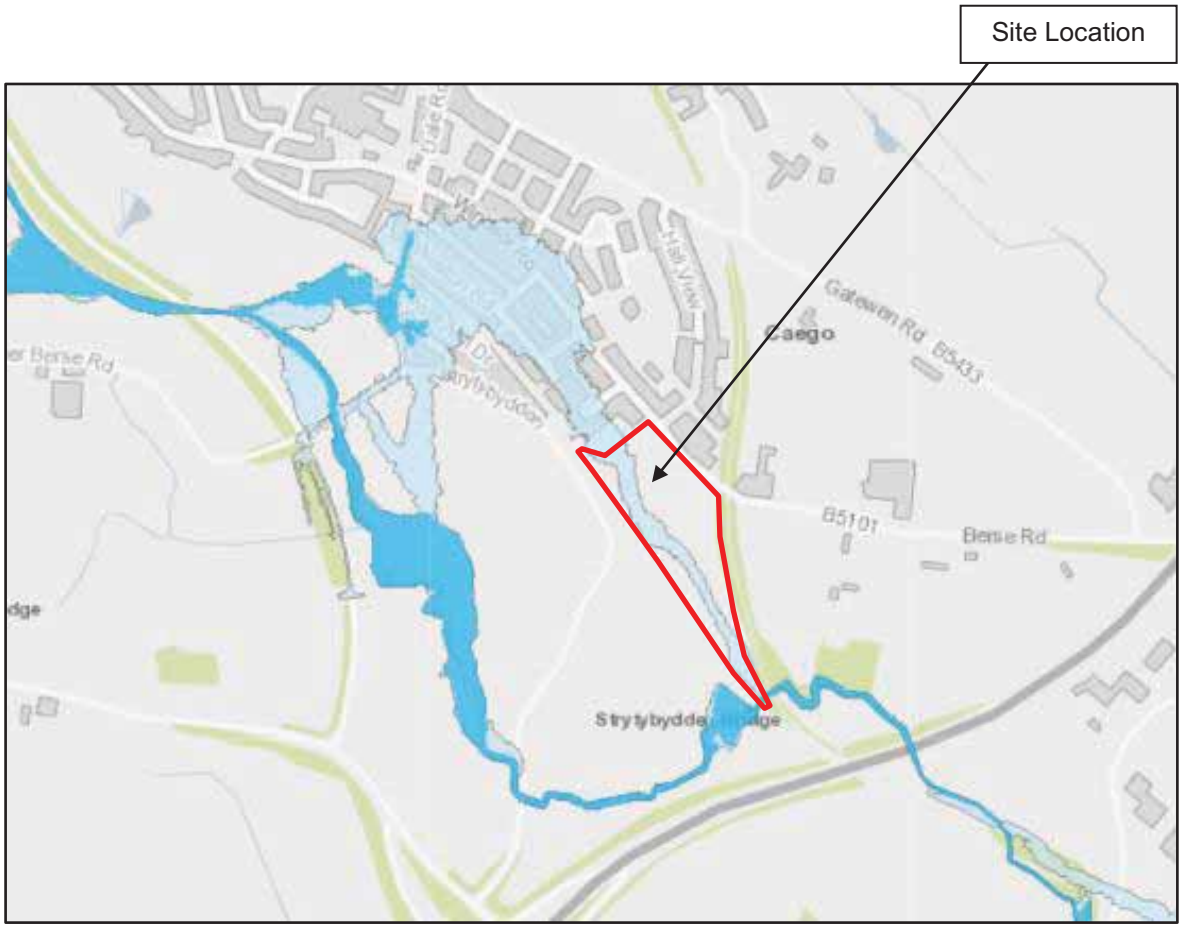


Welsh Government TAN15 Development Advice Map

(April 2016)

- Zone C1: Served by significant infrastructure, including flood defences
- Zone C2: Without significant flood defence infrastructure
- Zone B: Areas known to have been flooded in the past
- Zone A: Considered to be at little or no risk of fluvial or coastal/tidal flooding

Zones C1 and C2 based on Environment Agency's Extreme Flood Outline >= 0.1% (River, Tidal or Coastal)



NRW Flood Risk without Defences (Rivers & Sea)

(April 2016)

Flood Information

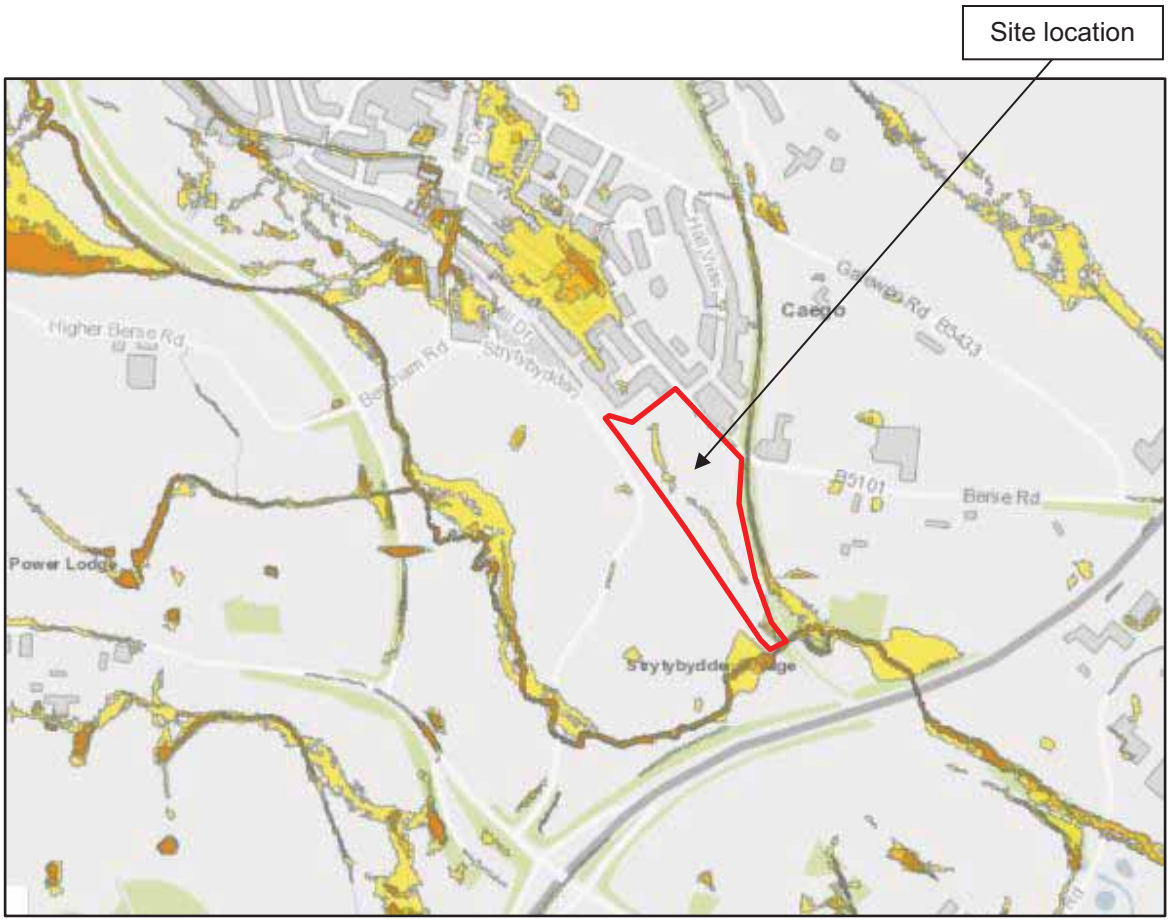
Main rivers

Flood zone 3

Floodmap Flood Zone 3

Flood zone 2

Floodmap Flood Zone 2



NRW Risk of Flooding from Surface Water

(April 2016)

Flood Information

Main rivers

High

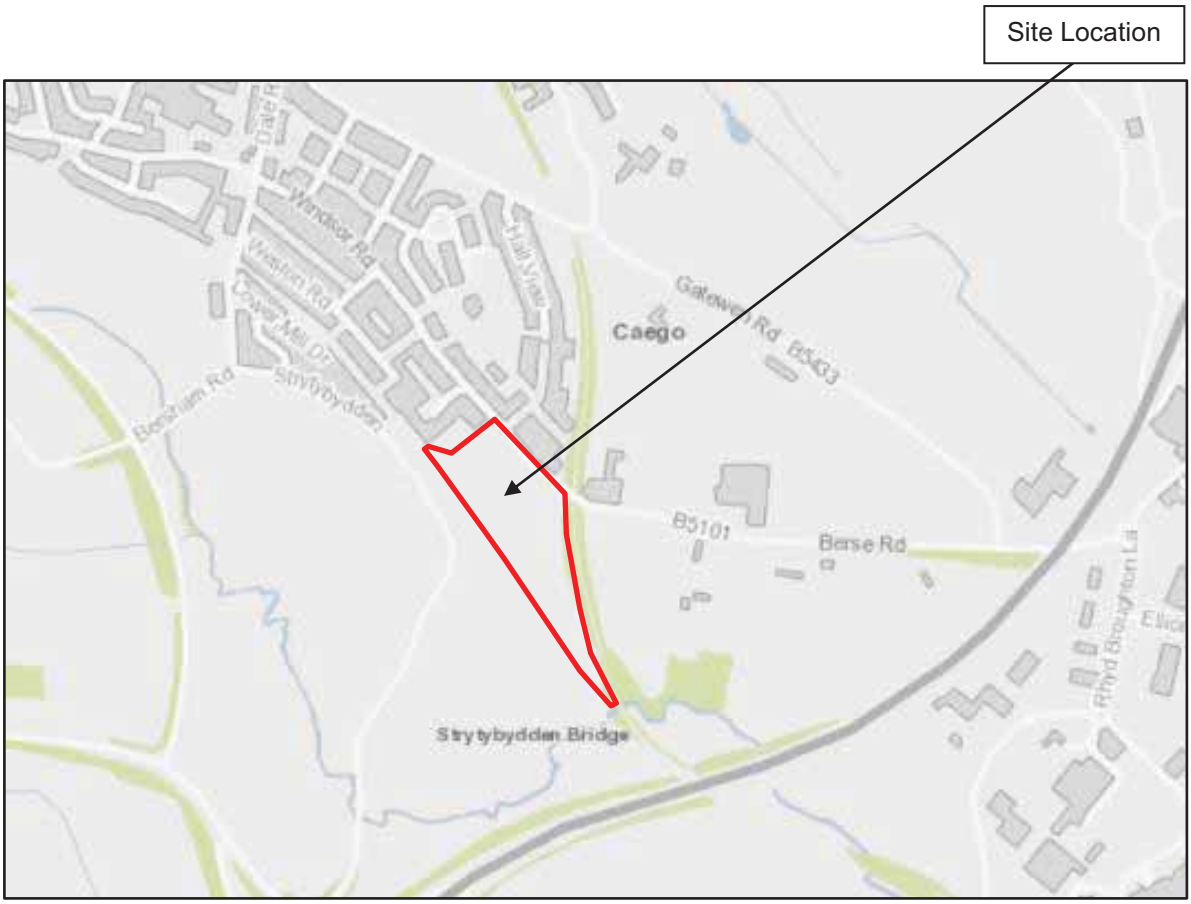
Risk of Flooding from Surface Water

Medium

Risk of Flooding from Surface Water

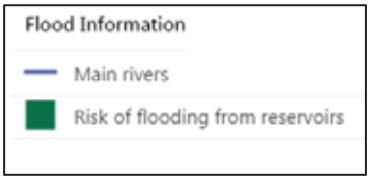
Low

Risk of Flooding from Surface Water



NRW Risk of Flooding from Reservoirs

(April 2016)



Johanne Williams

From: Thomas, Gareth <Gareth.Thomas@cyfoethnaturiolcymru.gov.uk>
Sent: 29 June 2015 11:16
To: Johanne Williams
Cc: Knowles, Ryan
Subject: FW: w1892-Berse Road, Caego, Wrexham, LL11 6TP -Pre-Planning Opinion for Residential Development - 1018
Attachments: image002.gif; C608-206-BerseRoad.pdf

Categories: Information received

Dear Johanne,

Thank you for your pre-application enquiry relating to the above, which we received on 15 June 2015.

Flood Risk
The application site lies partially within Zone C2, as defined by the Development Advice Map referred to under TAN15: Development & Flood Risk (July 2004). Our Flood Map information confirms the site to be partially within the extreme flood risk outline.

We would refer you to Annex E of TAN15 to establish the technical requirements for assessing flooding consequences at this site. We would also recommend that you refer to the contents of the recent correspondence between the Welsh Government and all Chief Planning Officers in Wales.

http://gov.wales/topics/planning/policy/dear-cpo-letters/flood-risk-and-insurance-changes/?lang=en

The contents of this correspondence will be of direct relevance during the determination of this application. Of particular note is reference to paragraph 6.2 of TAN15, which identifies that Highly Vulnerable development (e.g. housing) should not be permitted in Zone C2.

Welsh Government advise that for new development the following criteria should be met:

- Flood defences (if present) must be shown by the developer to be structurally adequate particularly under extreme overtopping conditions (i.e. that flood with a 1 in 1000 chance of occurring in any year).
- The cost of future maintenance for all new/approved flood mitigation measures, including defences must be accepted by the developer and agreed with the Natural Resources Wales.
- The developer must ensure that future occupiers of the development are aware of the flooding risks and consequences.
- Effective flood warnings are provided at the site
- Escape/evacuation routes are shown by the developer to be operational **under all conditions**
- Flood emergency plans and procedures produced by the developer must be in place
- The development is designed by the developer to allow the occupier the facility for rapid movement of goods/possessions to areas away from floodwaters.
- Development is designed to minimise structural damage during a flooding event and is flood proofed to enable it to be returned to its prime use quickly in the aftermath of the flood.
- **No flooding elsewhere i.e. no adverse impacts on flood flow routes or flood storage volumes**
- **Developer is required to demonstrate that the site is designed to be flood free for the lifetime (A1.5) of development for either a 1 in 100 chance (fluvial) flood event, or a 1 in 200 chance (tidal) flood event including an allowance for climate change (depending on the type of flood risk present) in accordance with table A1.14.**
- In respect of the residual risk to the development it should be designed so that over its lifetime (A1.5) in an extreme (1 in 1000 chance) event there would be less than 600mm of water on access roads and within

properties, the velocity of any water flowing across the development would be less than 0.3 m/second on access roads and 0.15m/second in properties, and the maximum rate of rise of floodwater would not exceed 0.1m/hour. (see table A1.15).

Natural Resources Wales does not hold any records of historical flooding affecting the site. It would be advisable for you to contact the Lead Local Flood Authority (Wrexham County Borough Council) who may have records of pluvial flooding.

Flood risk information and outputs from our "River Gwenfro at New Broughton Flood Risk Study" (JBA, February 2013) will be of assistance in the production of an FCA for this site. You can make a data request for a copy of this report via our accesstoinformationteam@naturalresourceswales.gov.uk .

We would expect for the development to be connected to the main sewer for the foul drainage.

The site is 600 metres from Gatewen Marsh SSSI, and we have records of Great Crested Newts and Bats within the area, therefore we would fully expect that a planning application would also include a phase 1 habitat survey as a minimum.

Kind regards,

Gareth Thomas
Swyddog Cyswllt Cynllunio / Planning Liaison Officer
Cyfoeth Naturiol Cymru / Natural Resources Wales

Ffôn/Tel: (0300) 065 3786 **Siaradwr Cymraeg / Welsh Speaker**

E-bost/E-mail: Gareth.Thomas@cyfoethnaturiolcymru.gov.uk Gareth.Thomas@naturalresourceswales.gov.uk

Gwefan / Website: www.cyfoethnaturiolcymru.gov.uk / www.naturalresourceswales.gov.uk

Ein diben yw sicrhau bod adnoddau naturiol Cymru yn cael eu cynnal, eu gwella a'u defnyddio yn gynaliadwy, yn awr ac yn y dyfodol.
Our purpose is to ensure that the natural resources of Wales are sustainably maintained, enhanced and used, now and in the future.

From: Johanne Williams <Johanne.Williams@waterco.co.uk>
Sent: 15 June 2015 11:19
To: Planning
Subject: w1892-Berse Road, Wrexham-Pre-Planning Opinion

Development site at land off Berse Road, Wrexham, LL11 6TP. Grid Reference: 331335E 351004N

Dear Sir / Madam,

Please could you provide me with a Pre-Planning Opinion for a site at the above address.

The proposed development is for residential properties. I have attached a location plan for reference.

Please could you advise if there will be any specific requirements for a Flood Consequences Assessment at this site and if you have any records of historical flooding in this area?

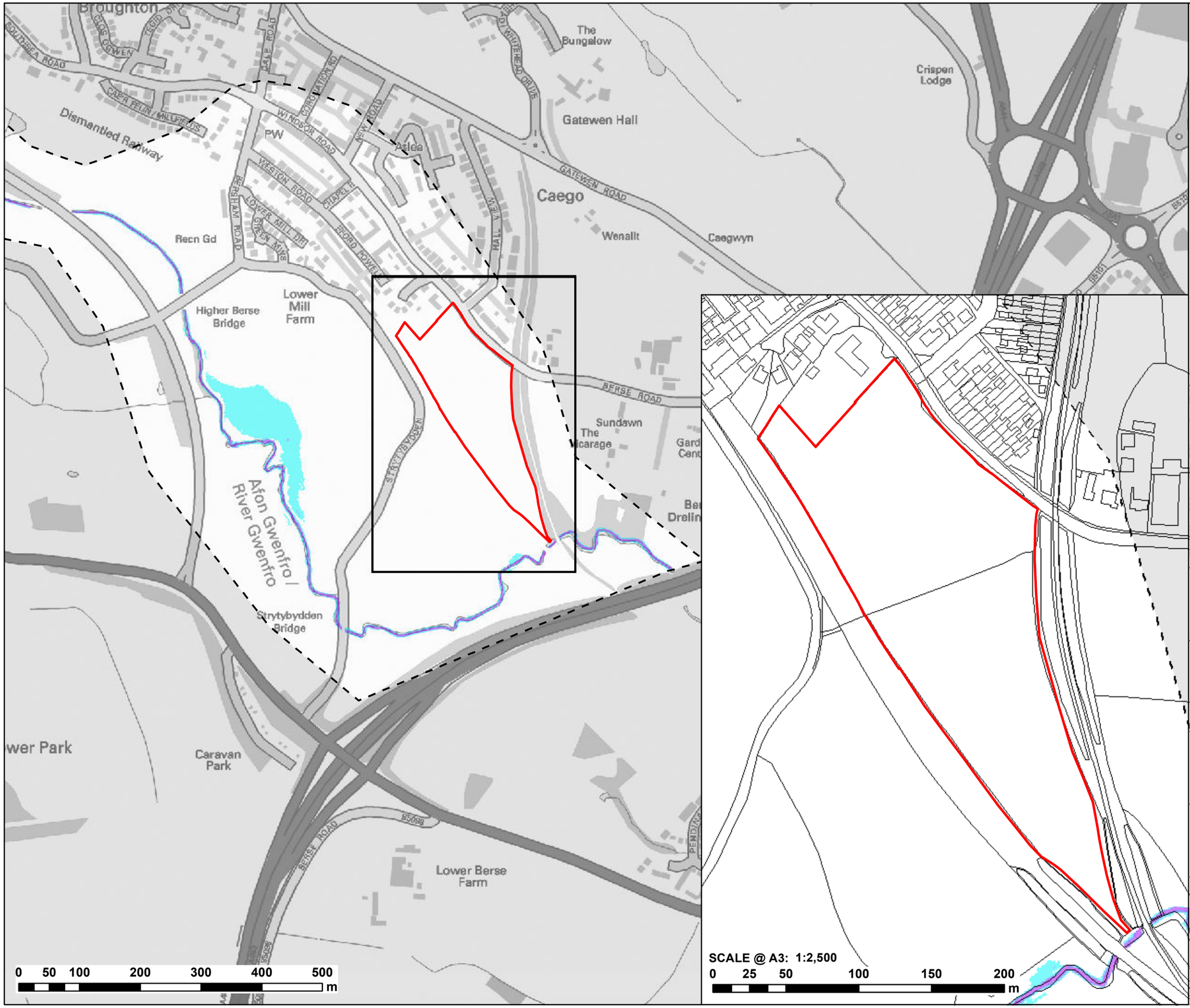
If you have any questions or require any further information, please do not hesitate to contact me.

Kind Regards,

Johanne Williams

Waterco Ltd, Lon Parcwr Business Park, Ruthin LL15 1NJ
01824 702220 - www.waterco.co.uk - Johanne.Williams@waterco.co.uk

Appendix D – Waterco Modelled Flood Maps

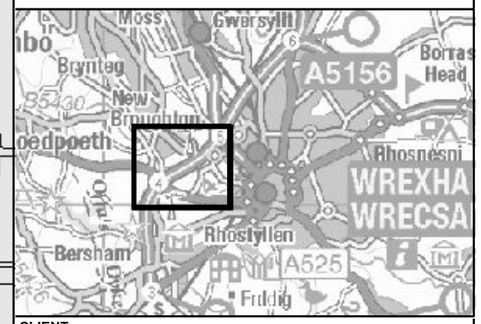


LEGEND

- Site Boundary
- 2D Model Boundary

Maximum Flood Depth (m)

- 0 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- 1.2 - 2.4
- > 2.4



CLIENT:

PLAS POWER ESTATES

waterco consultants

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ
01824 702220
www.waterco.co.uk

SCHEME:

LAND OFF BERSE ROAD WREXHAM

PLOT TITLE:

MAXIMUM FLOOD DEPTH
5% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT

PLOT STATUS:

ISSUE

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
SB	DH	RCL	1:6,000 (UNLESS STATED OTHERWISE)

DATE:	PLOT NAME:	REV:
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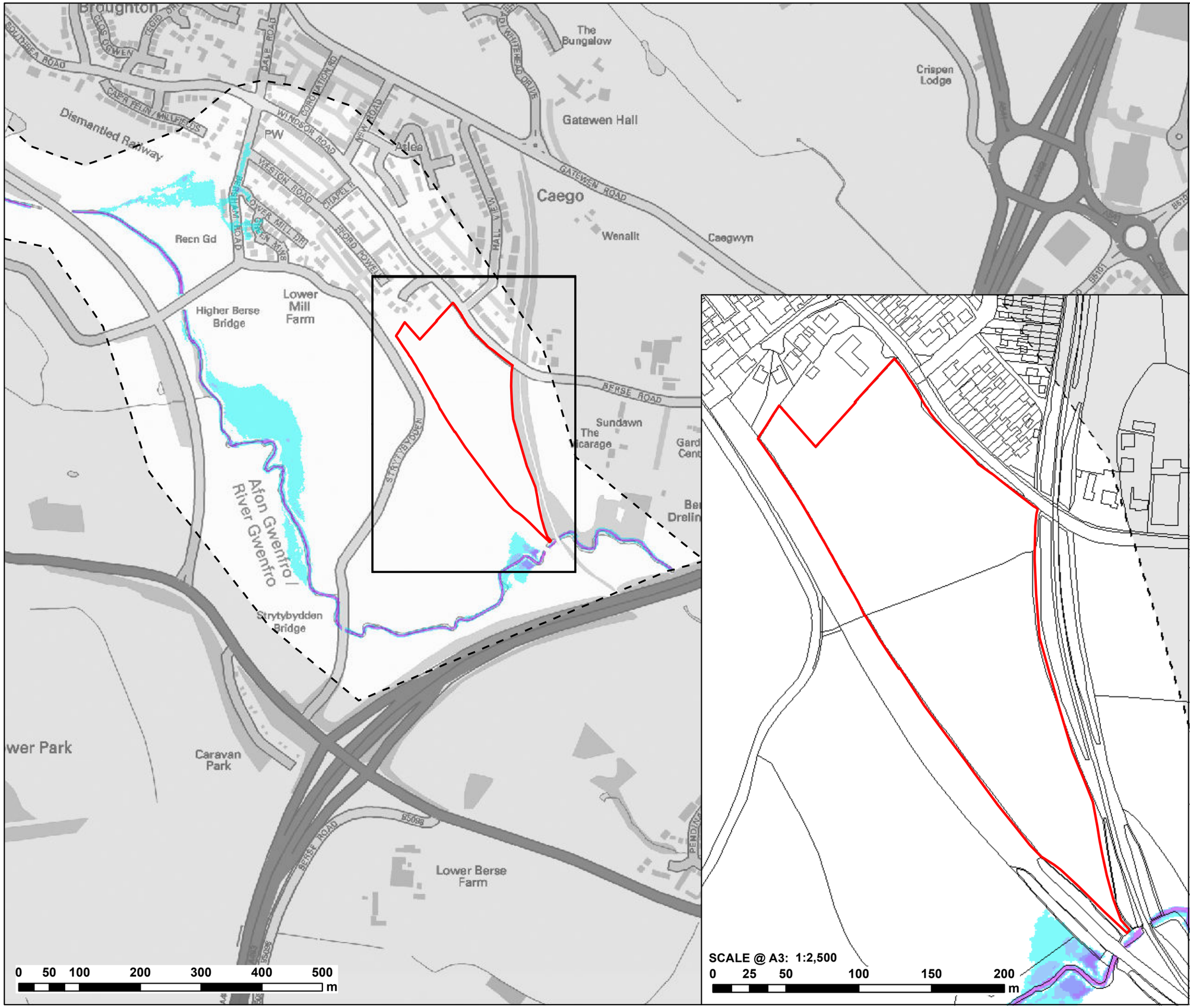
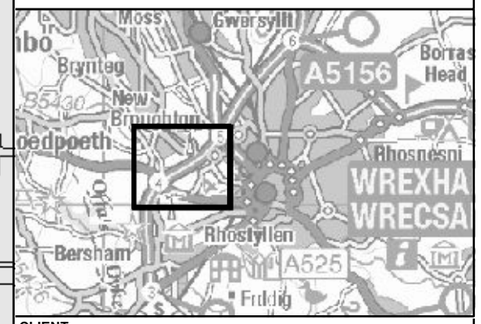


LEGEND

- Site Boundary
- 2D Model Boundary

Maximum Flood Depth (m)

- 0 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- 1.2 - 2.4
- > 2.4



CLIENT:

PLAS POWER ESTATES

waterco consultants

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ
01824 702220
www.waterco.co.uk

SCHEME:

LAND OFF BERSE ROAD WREXHAM

PLOT TITLE:

MAXIMUM FLOOD DEPTH
1% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT

PLOT STATUS:

ISSUE

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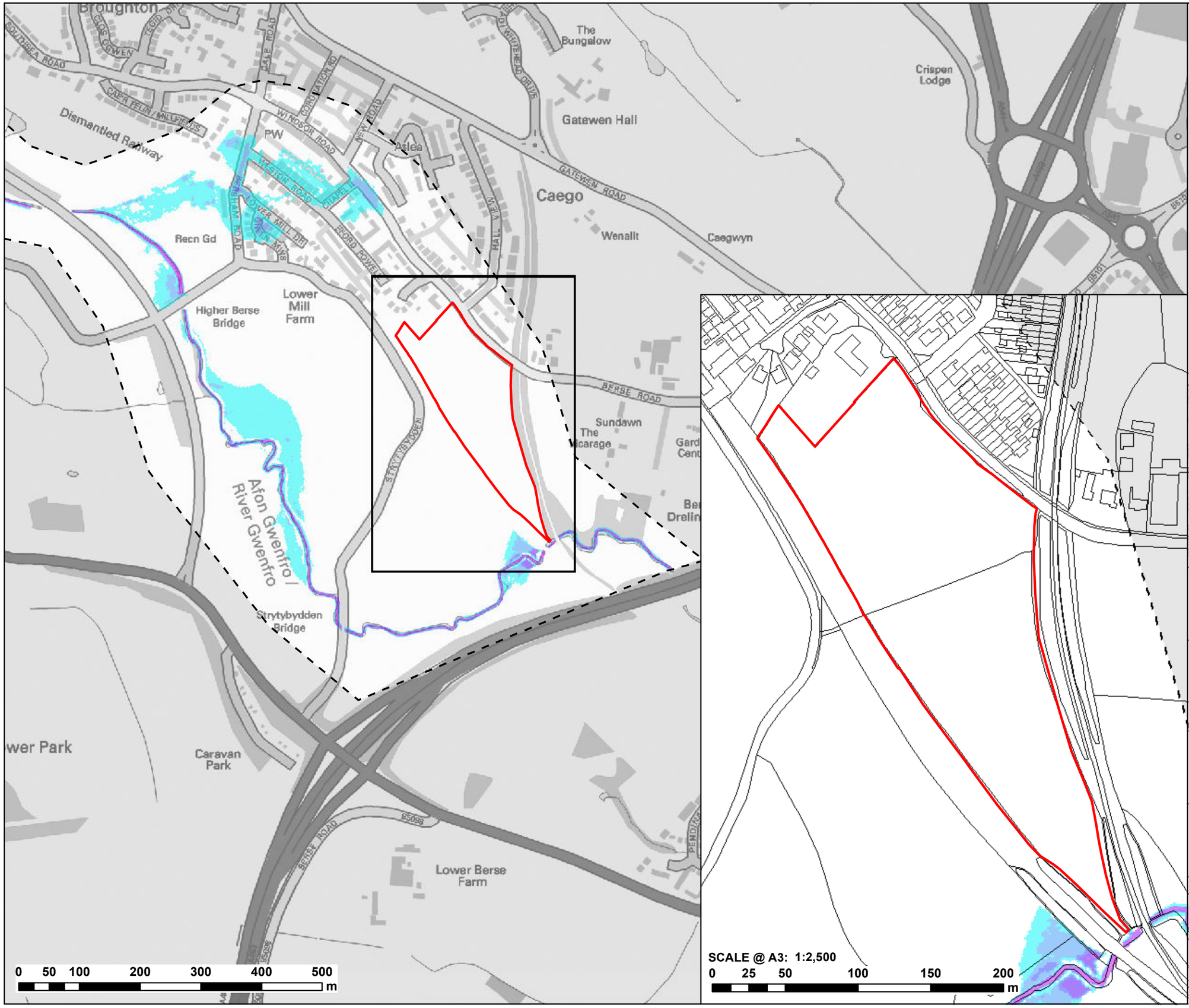
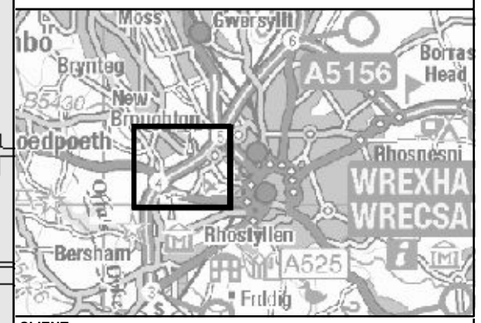


LEGEND

- Site Boundary
- 2D Model Boundary

Maximum Flood Depth (m)

- 0 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- 1.2 - 2.4
- > 2.4



CLIENT:

PLAS POWER ESTATES

waterco consultants

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ
01824 702220
www.waterco.co.uk

SCHEME:

LAND OFF BERSE ROAD WREXHAM

PLOT TITLE:

MAXIMUM FLOOD DEPTH

1% AEP + CCA FLUVIAL EVENT

EXISTING SITE LAYOUT

PLOT STATUS:

ISSUE

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
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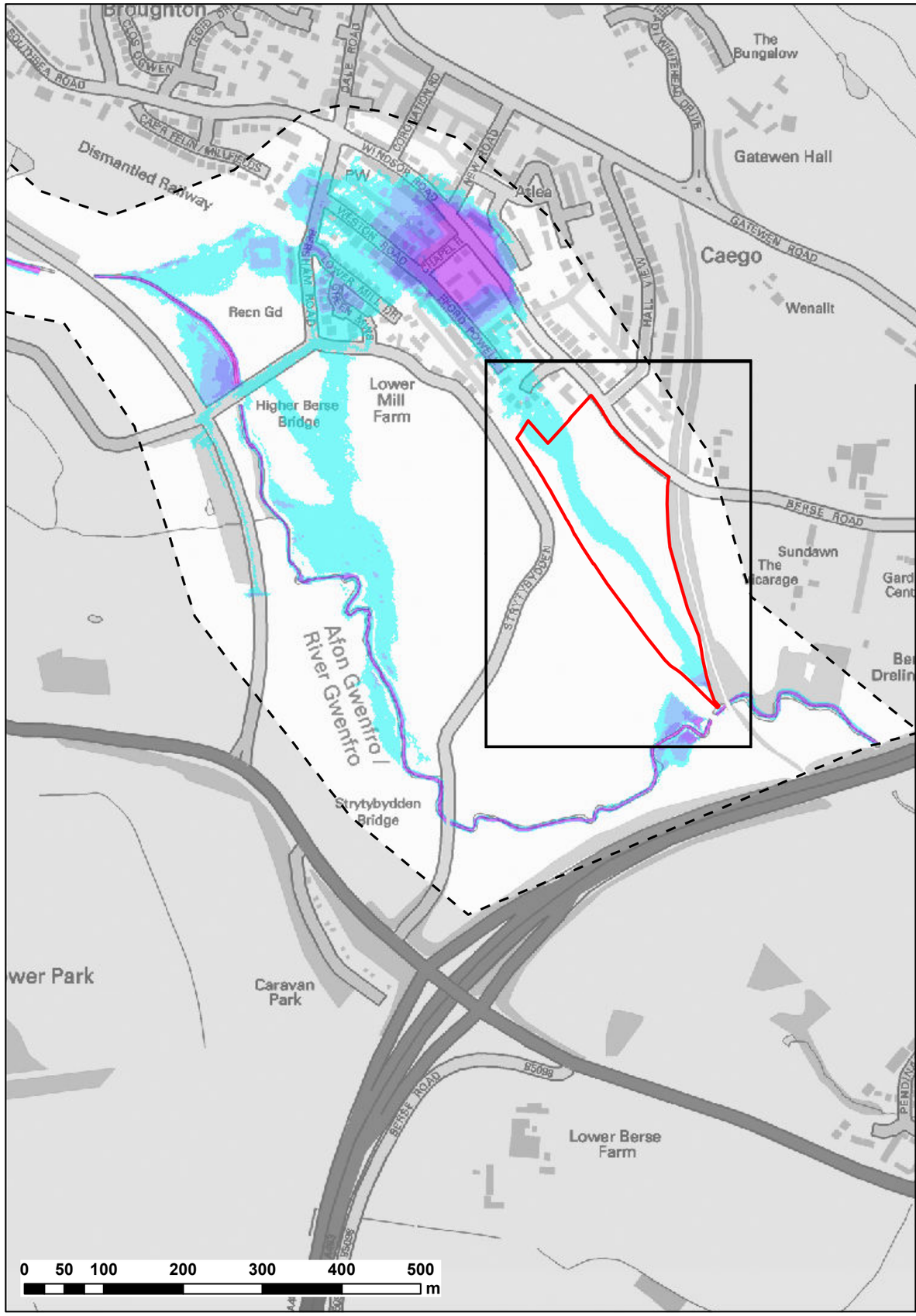
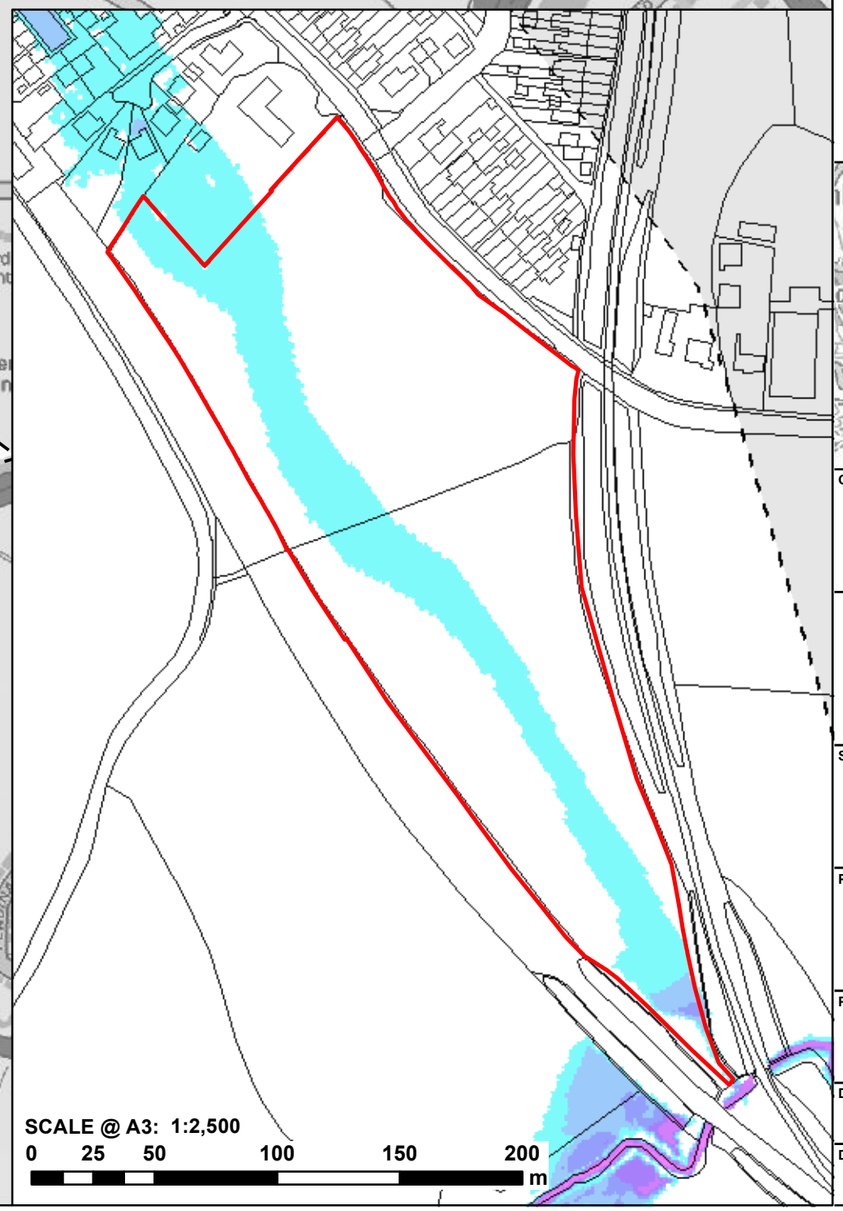


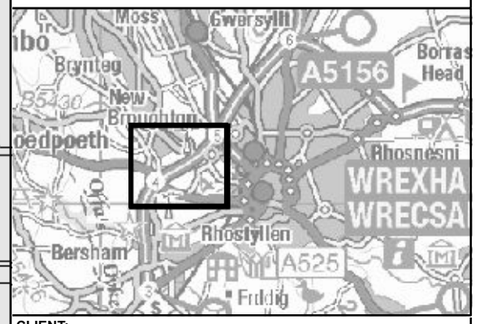


LEGEND

- Site Boundary
- 2D Model Boundary

Maximum Flood Depth (m)

- 0 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- 1.2 - 2.4
- > 2.4



CLIENT:

PLAS POWER ESTATES

waterco consultants

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ

01824 702220
www.waterco.co.uk

SCHEME:

LAND OFF BERSE ROAD WREXHAM

PLOT TITLE:

MAXIMUM FLOOD DEPTH
0.1% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT

PLOT STATUS:

ISSUE

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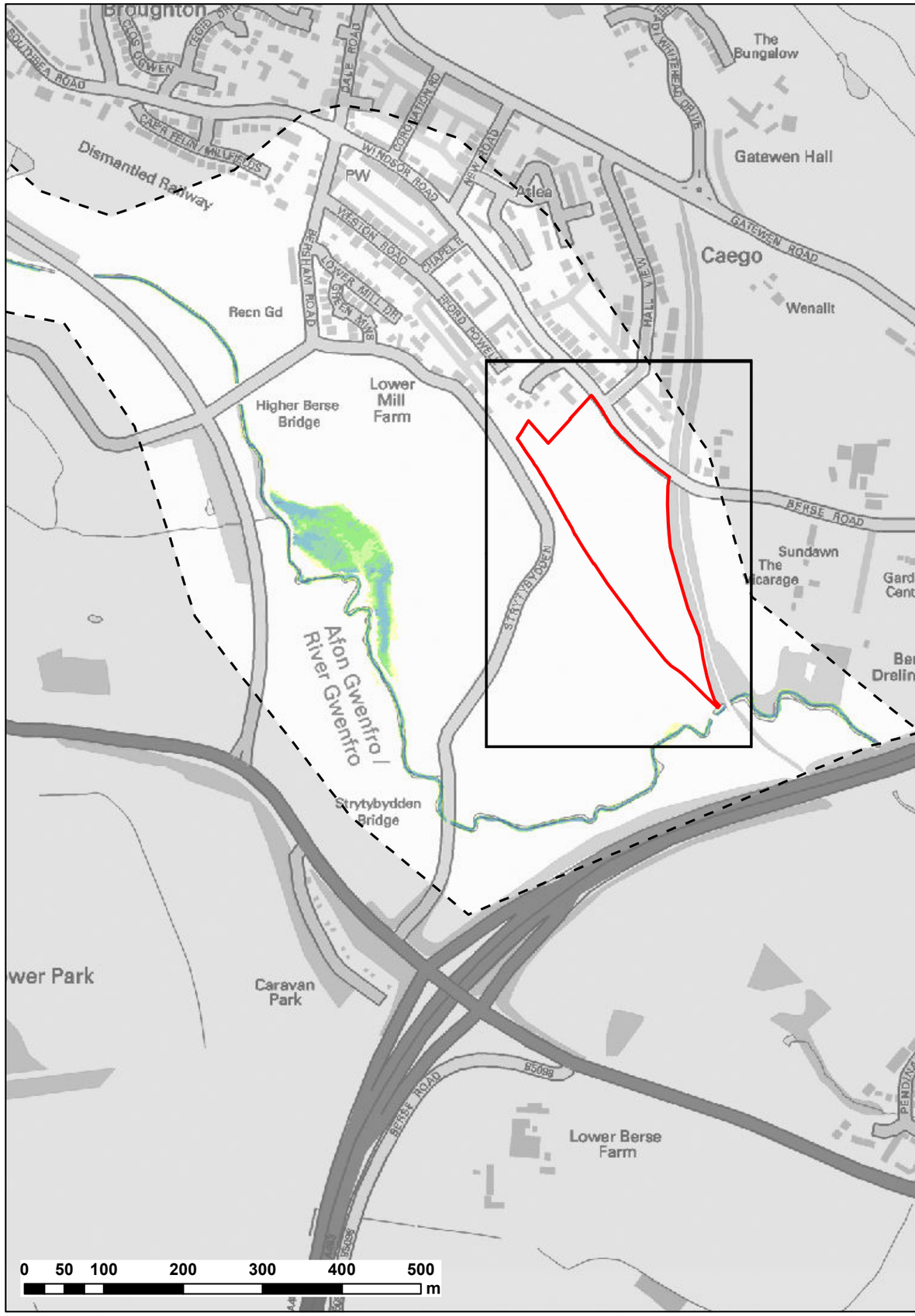
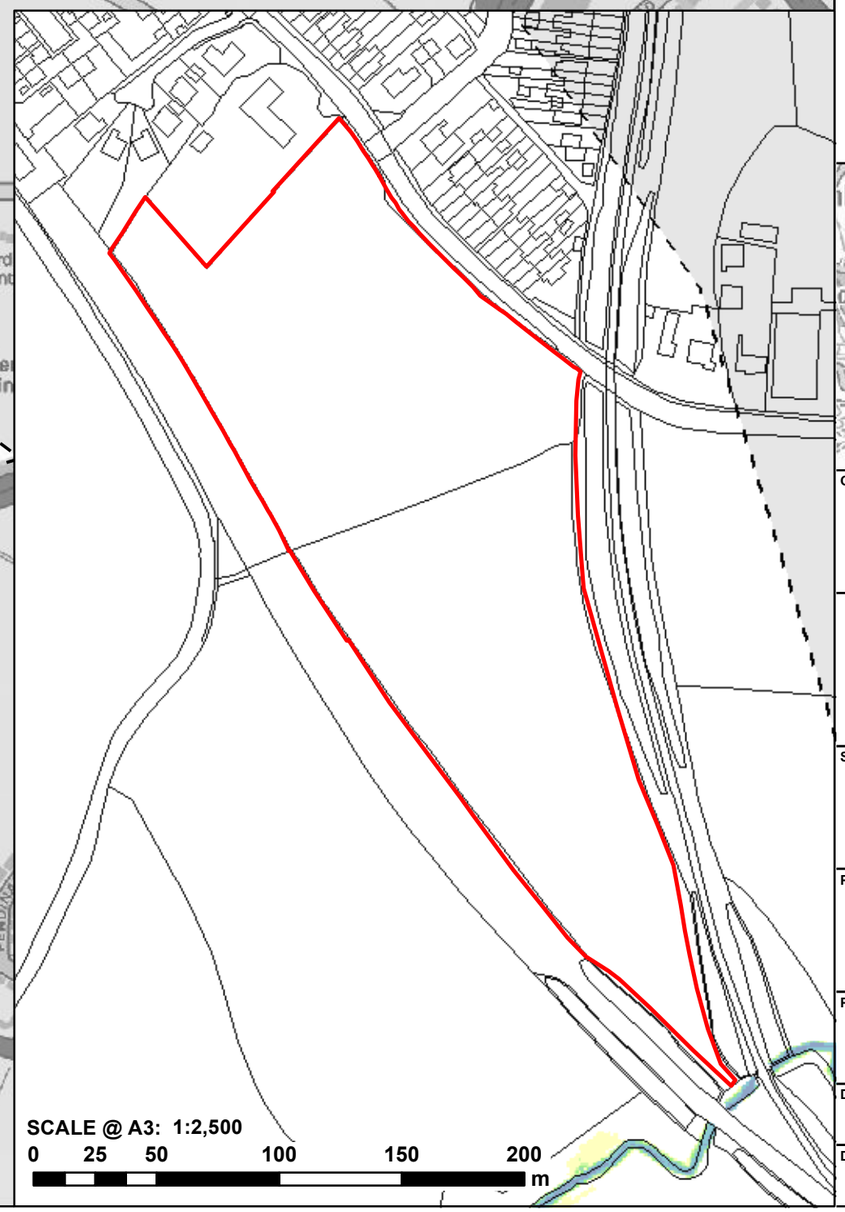


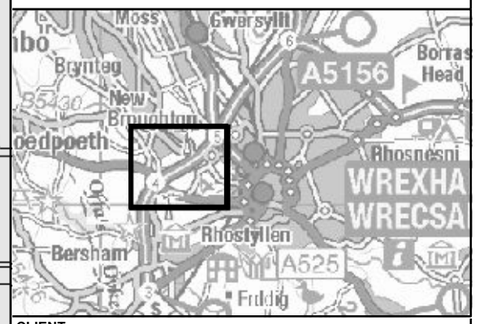


LEGEND

- Site Boundary
- 2D Model Boundary

Maximum Velocity (m/s)

- 0 - 0.15
- 0.15 - 0.3
- 0.3 - 0.45
- 0.45 - 0.6
- 0.6 - 1.2
- 1.2 - 2.4
- > 2.4



CLIENT:

PLAS POWER ESTATES

waterco consultants

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ

01824 702220
www.waterco.co.uk

SCHEME:

LAND OFF BERSE ROAD WREXHAM

PLOT TITLE:

MAXIMUM VELOCITY
5% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT

PLOT STATUS:

ISSUE

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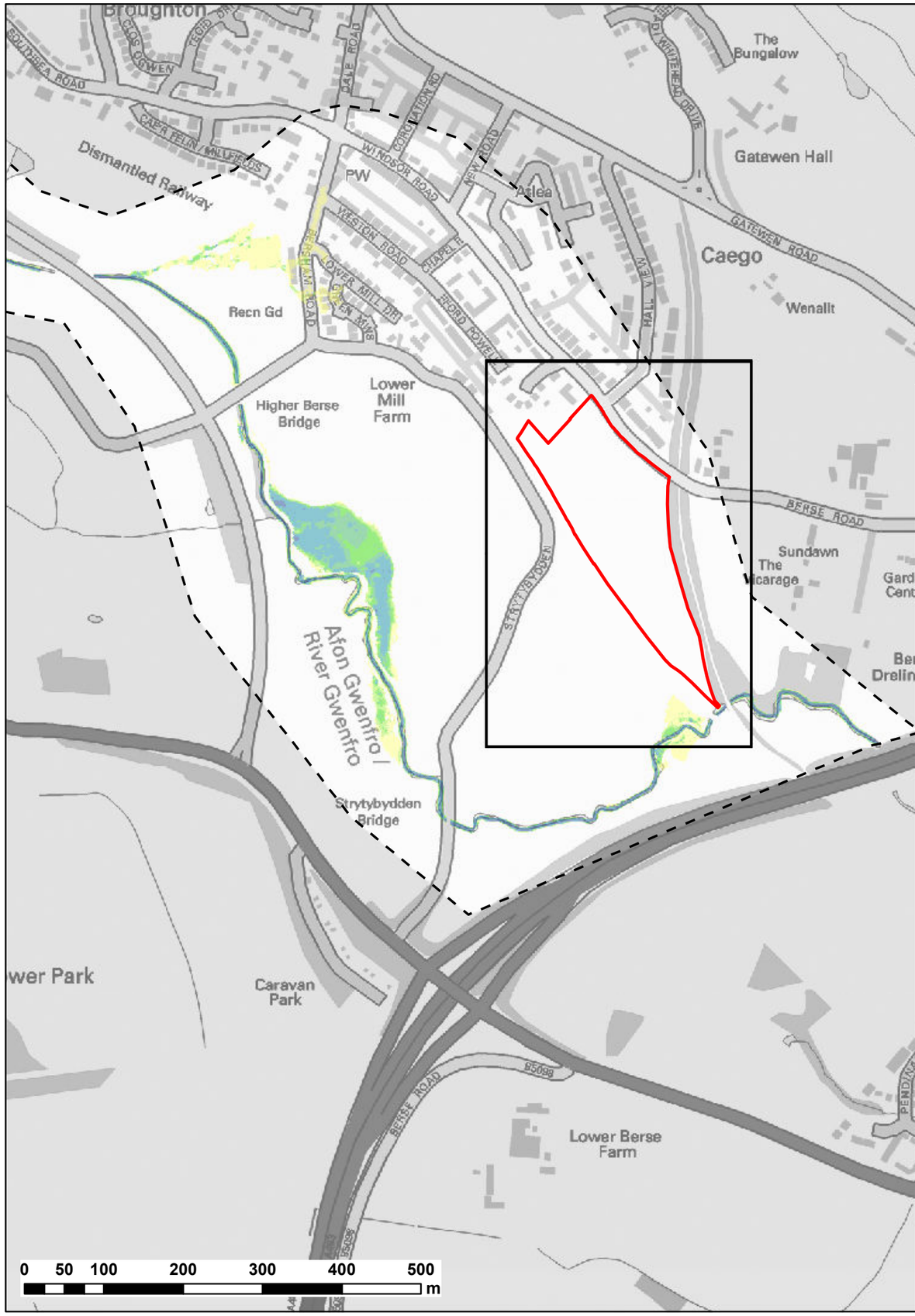

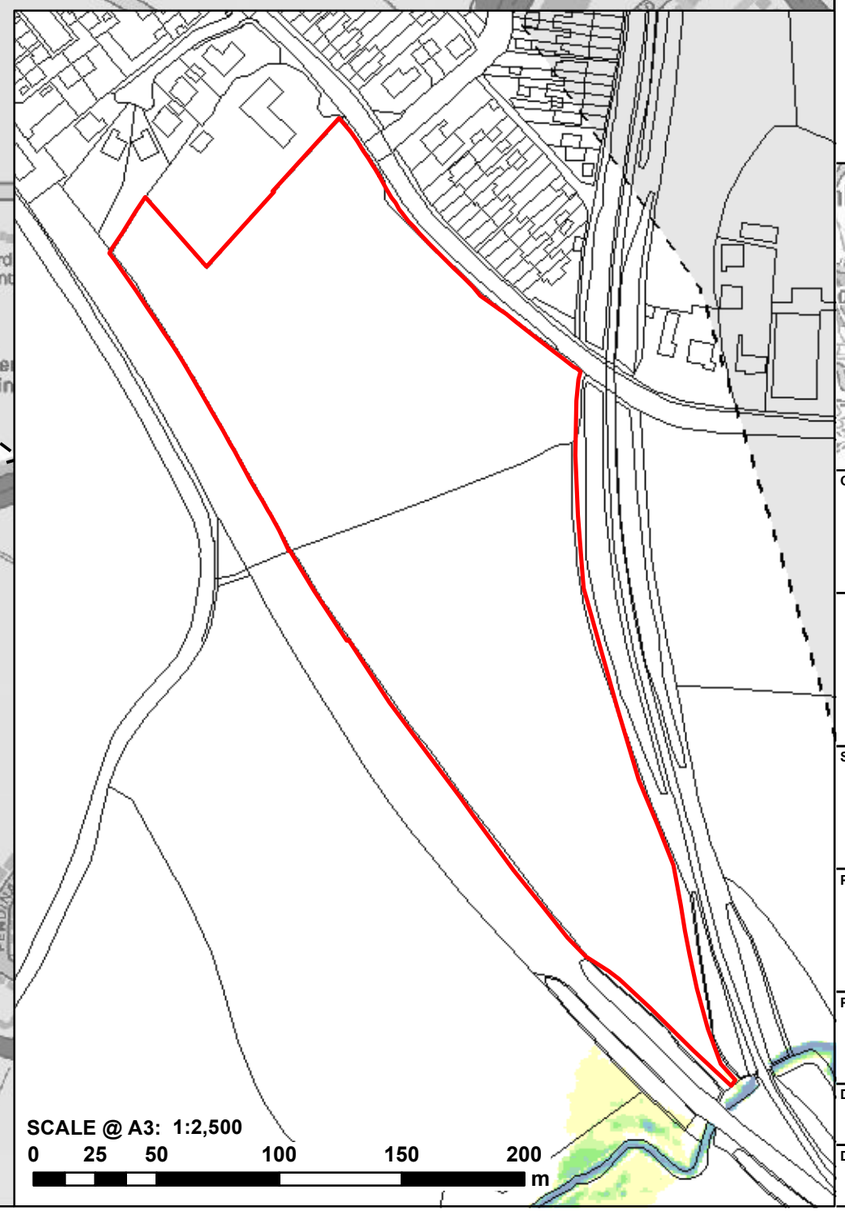

LEGEND

- Site Boundary
- 2D Model Boundary

Maximum Velocity (m/s)

- 0 - 0.15
- 0.15 - 0.3
- 0.3 - 0.45
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- 0.6 - 1.2
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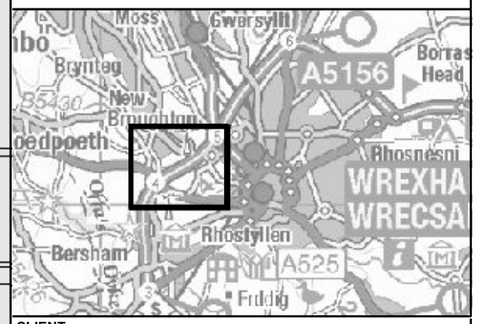

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waterco consultants

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01824 702220
www.waterco.co.uk

SCHEME:

LAND OFF BERSE ROAD WREXHAM

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MAXIMUM VELOCITY
1% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT

PLOT STATUS:

ISSUE

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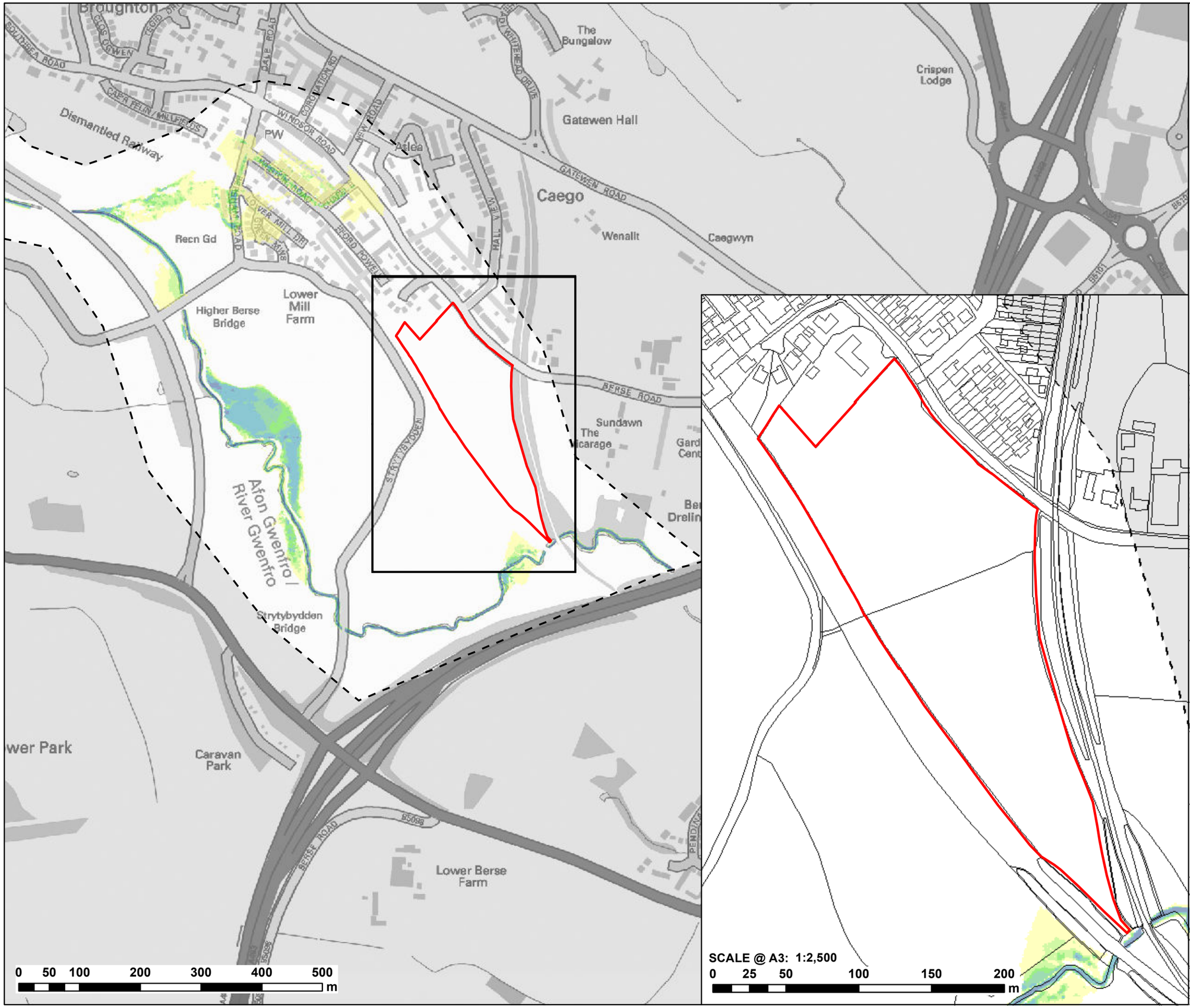

LEGEND

- Site Boundary
- 2D Model Boundary

Maximum Velocity (m/s)

- 0 - 0.15
- 0.15 - 0.3
- 0.3 - 0.45
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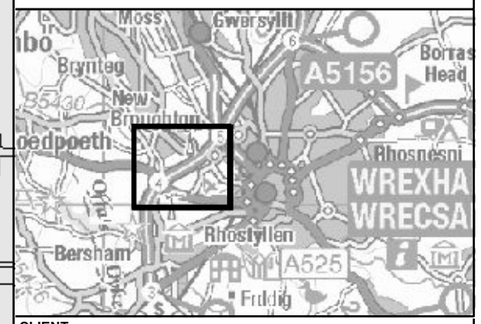

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PLAS POWER ESTATES

waterco consultants

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Eden Court, Ruthin, LL15 1NJ

01824 702220
www.waterco.co.uk

SCHEME:

LAND OFF BERSE ROAD WREXHAM

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MAXIMUM VELOCITY

1% AEP + CCA FLUVIAL EVENT

EXISTING SITE LAYOUT

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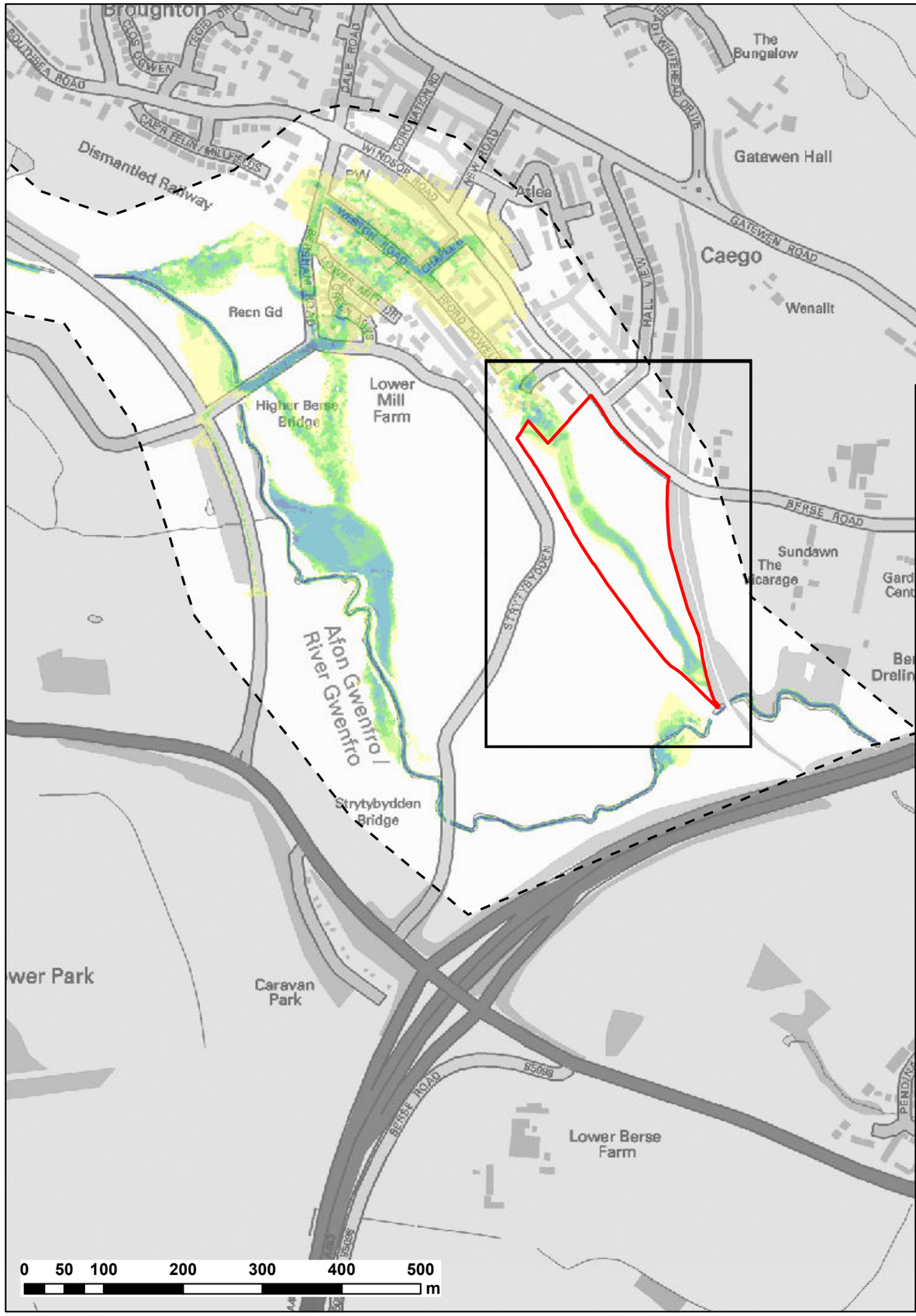
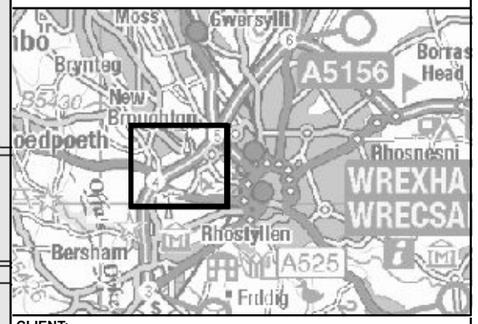


LEGEND

- Site Boundary
- 2D Model Boundary

Maximum Velocity (m/s)

- 0 - 0.15
- 0.15 - 0.3
- 0.3 - 0.45
- 0.45 - 0.6
- 0.6 - 1.2
- 1.2 - 2.4
- > 2.4



CLIENT:

PLAS POWER ESTATES

waterco consultants

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ

01824 702220
www.waterco.co.uk

SCHEME:

LAND OFF BERSE ROAD WREXHAM

PLOT TITLE:

MAXIMUM VELOCITY
0.1% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT

PLOT STATUS:

ISSUE

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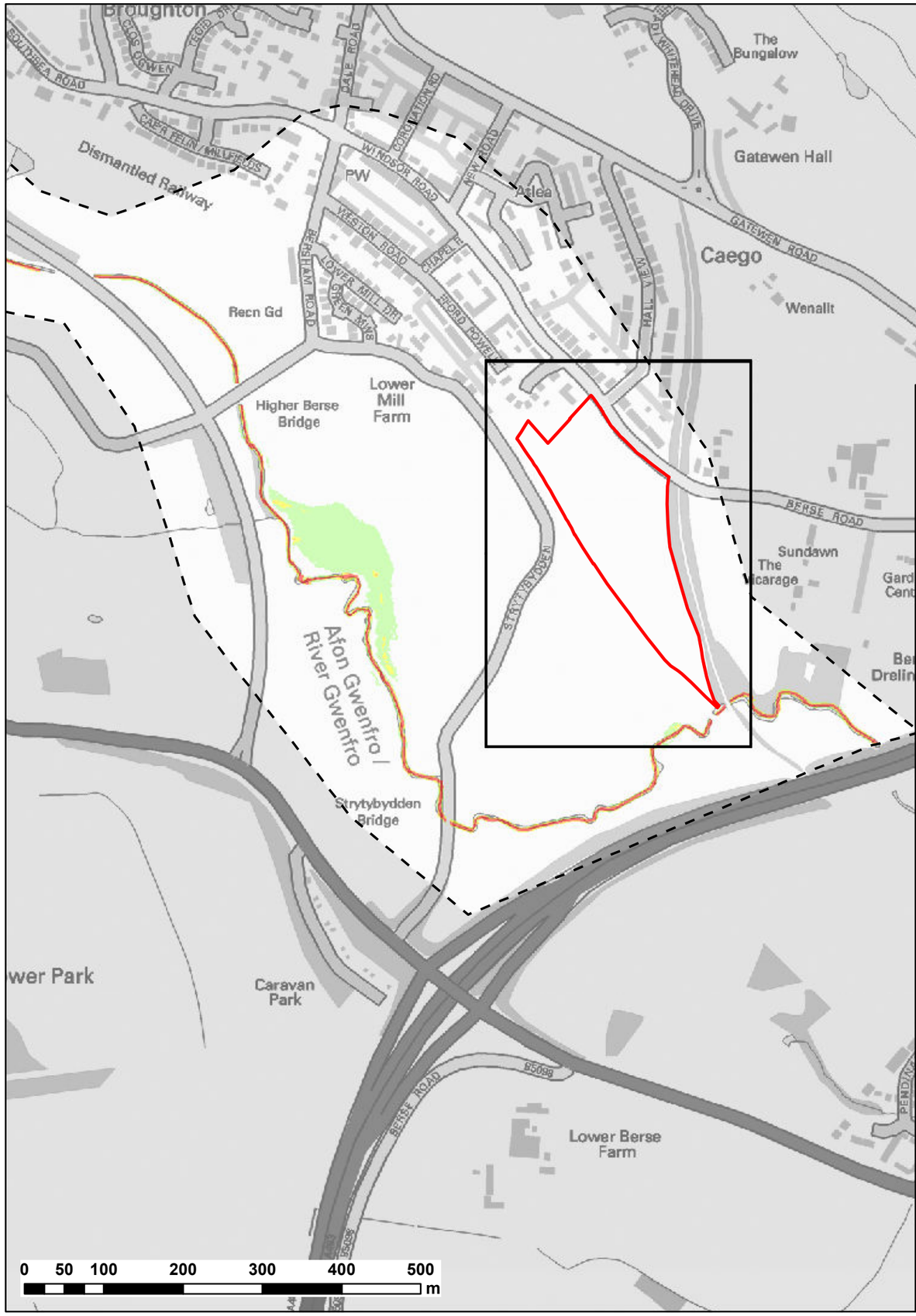
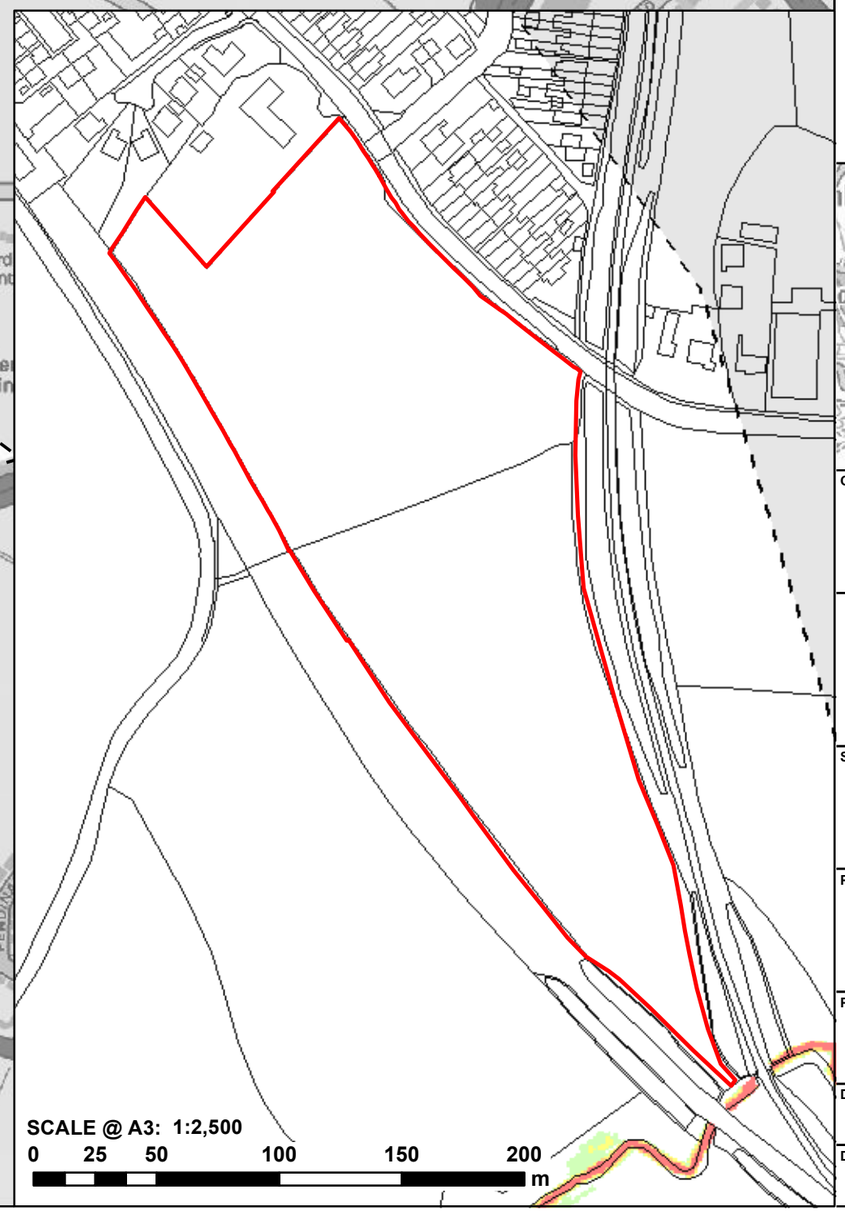
DATE:	PLOT NAME:	REV:
04/04/2016	w3183-Q1000_EXG_V	A



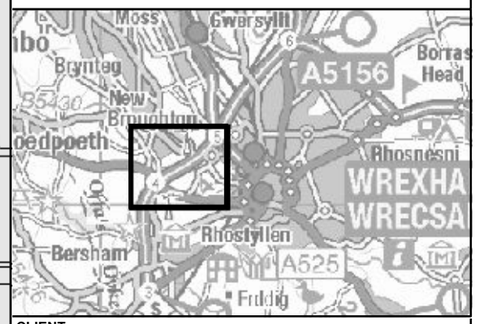


LEGEND

- Site Boundary
- 2D Model Boundary

Maximum Flood Hazard Rating (FD2320)

- < 0.75 (Caution)
- 0.75 - 1.25 (Danger for Some)
- 1.25 - 2 (Danger for Most)
- > 2.0 (Danger for All)



CLIENT:

PLAS POWER ESTATES

waterco consultants

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ

01824 702220
www.waterco.co.uk

SCHEME:

LAND OFF BERSE ROAD WREXHAM

PLOT TITLE:

MAXIMUM FLOOD HAZARD

5% AEP FLUVIAL EVENT

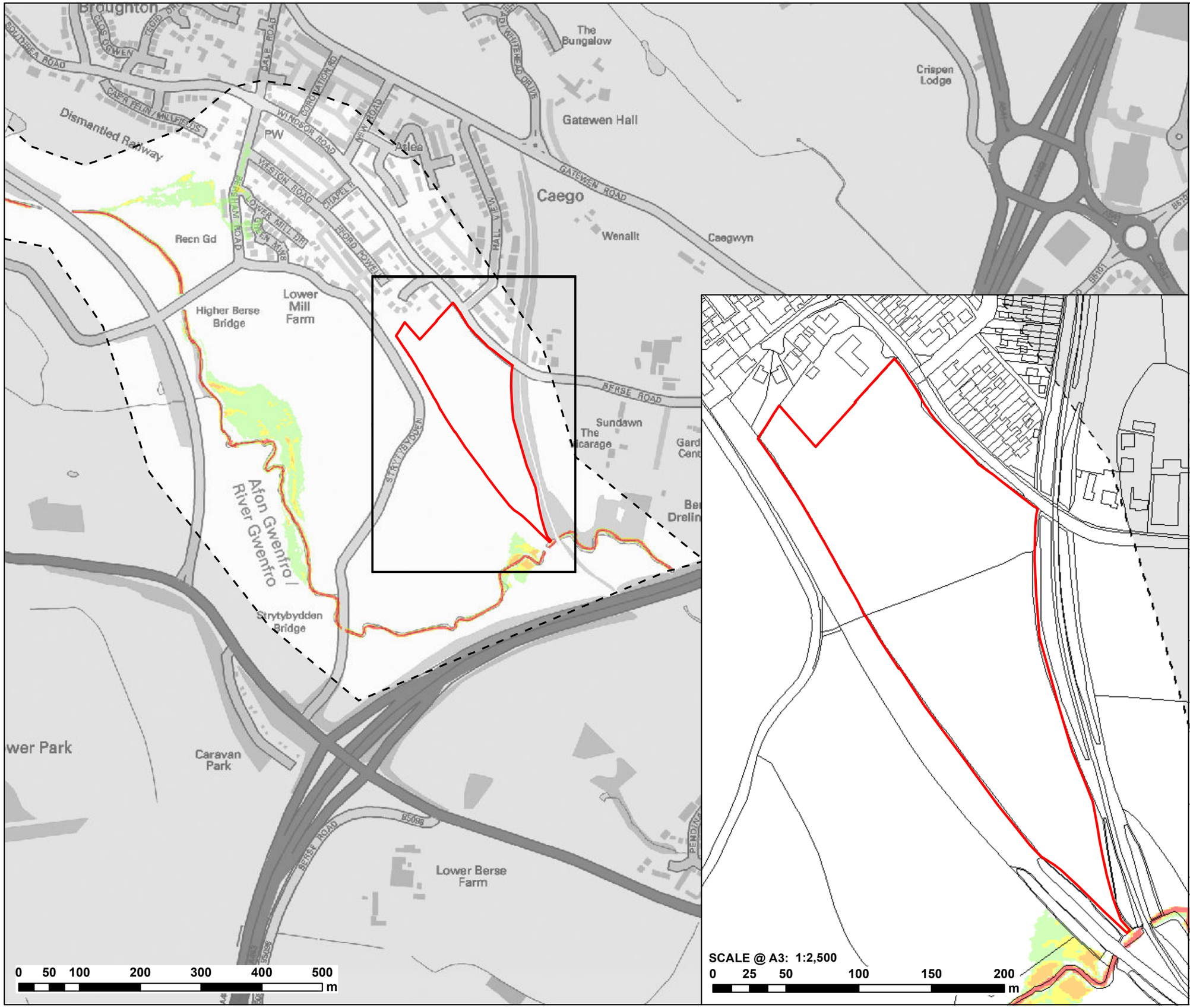
EXISTING SITE LAYOUT

PLOT STATUS:

ISSUE

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
SB	DH	RCL	1:6,000 (UNLESS STATED OTHERWISE)

DATE:	PLOT NAME:	REV:
04/04/2016	w3183-Q20_EXG_H	A

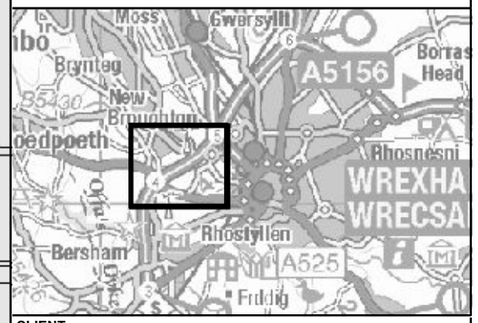


LEGEND

- Site Boundary
- 2D Model Boundary

Maximum Flood Hazard Rating (FD2320)

- < 0.75 (Caution)
- 0.75 - 1.25 (Danger for Some)
- 1.25 - 2 (Danger for Most)
- > 2.0 (Danger for All)



CLIENT:

PLAS POWER ESTATES

waterco consultants

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ
01824 702220
www.waterco.co.uk

SCHEME:

LAND OFF BERSE ROAD WREXHAM

PLOT TITLE:

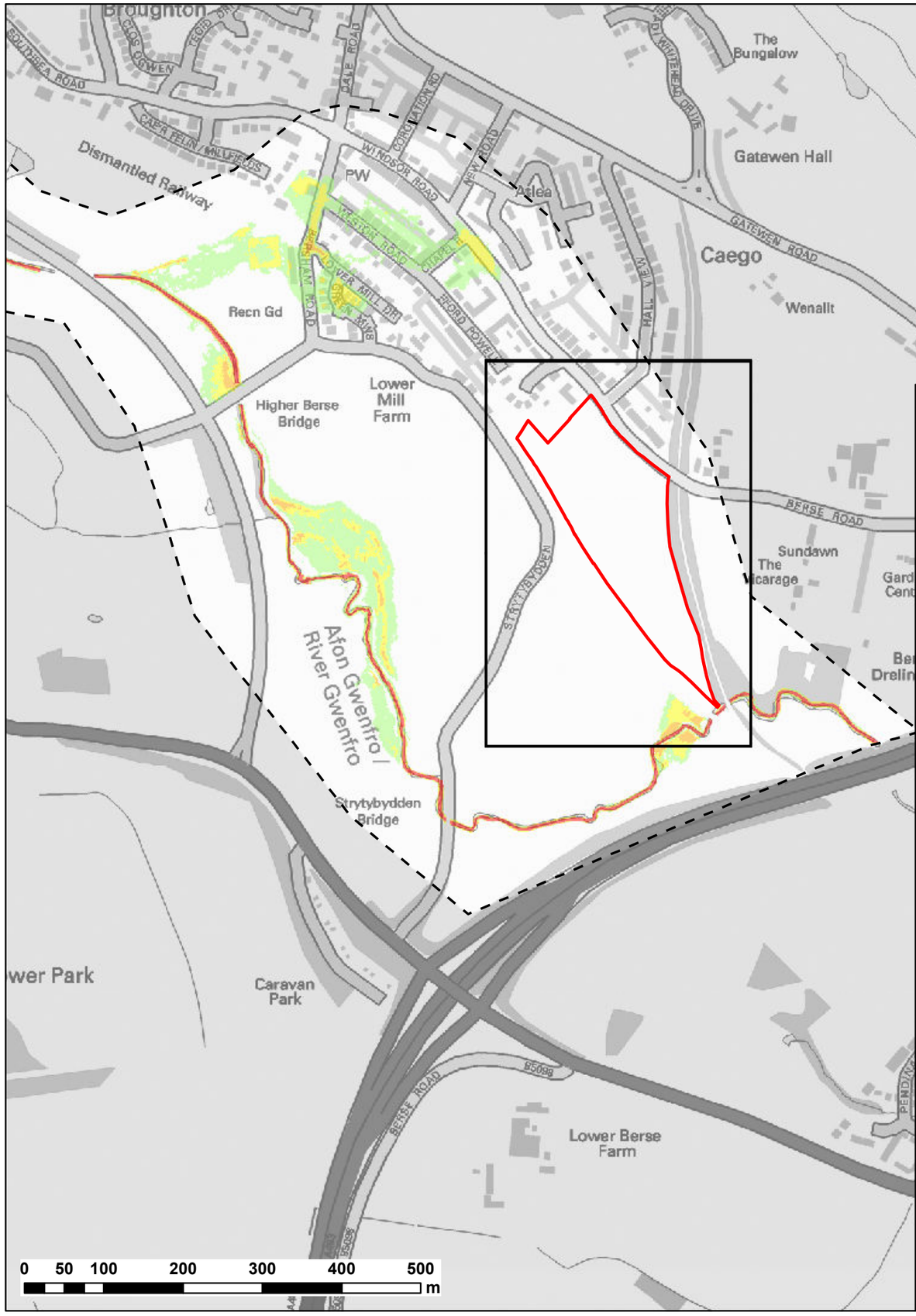
MAXIMUM FLOOD HAZARD
1% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT

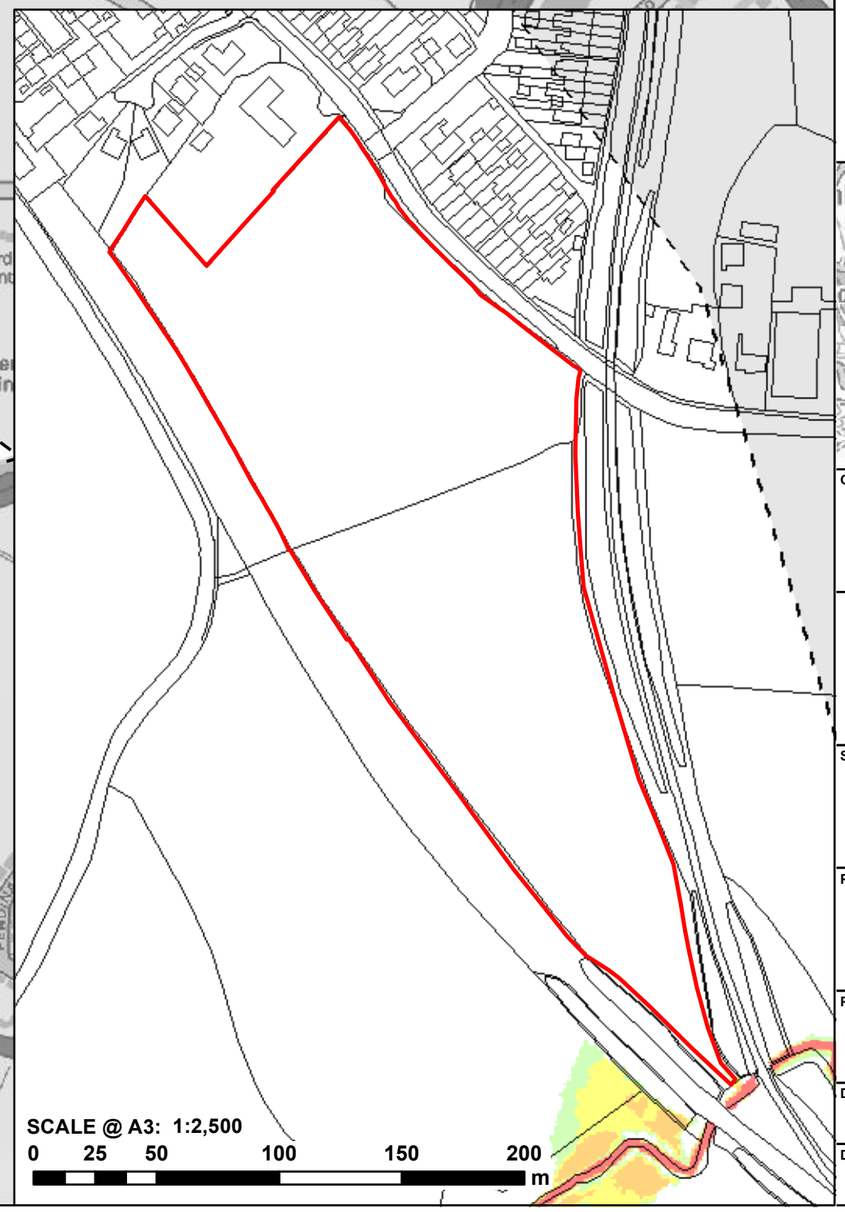
PLOT STATUS:

ISSUE

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
SB	DH	RCL	1:6,000 (UNLESS STATED OTHERWISE)

DATE:	PLOT NAME:	REV:
04/04/2016	w3183-Q100_EXG_H	A





LEGEND

- Site Boundary
- 2D Model Boundary

Maximum Flood Hazard Rating (FD2320)

- < 0.75 (Caution)
- 0.75 - 1.25 (Danger for Some)
- 1.25 - 2 (Danger for Most)
- > 2.0 (Danger for All)

CLIENT:

PLAS POWER ESTATES

waterco consultants

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ

01824 702220
www.waterco.co.uk

SCHEME:

LAND OFF BERSE ROAD WREXHAM

PLOT TITLE:

MAXIMUM FLOOD HAZARD

1% AEP + CCA FLUVIAL EVENT

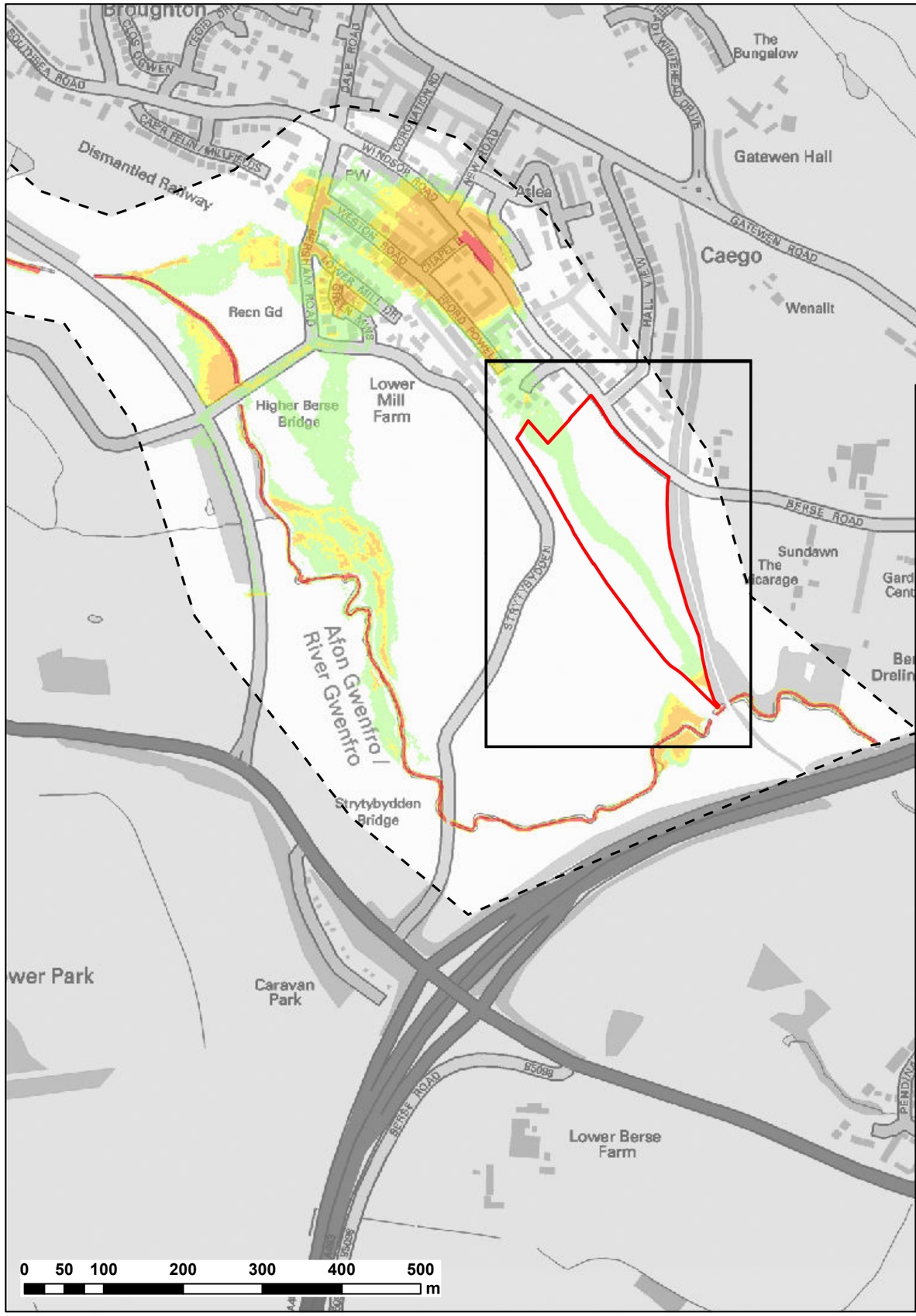
EXISTING SITE LAYOUT

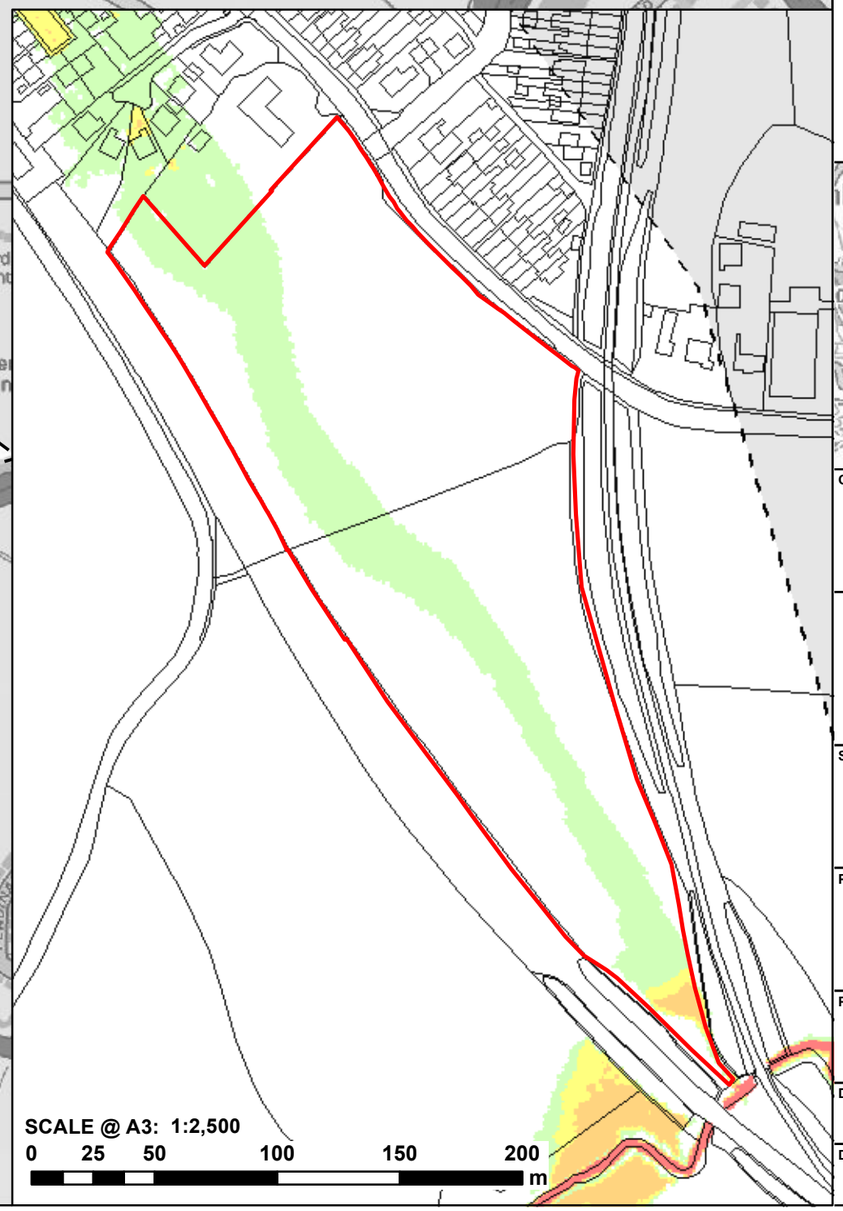
PLOT STATUS:

ISSUE

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
SB	DH	RCL	1:6,000 (UNLESS STATED OTHERWISE)

DATE:	PLOT NAME:	REV:
04/04/2016	w3183-Q100CC_EXG_H	A



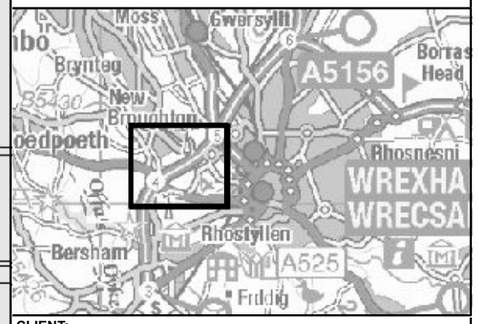


LEGEND

- Site Boundary
- 2D Model Boundary

Maximum Flood Hazard Rating (FD2320)

- < 0.75 (Caution)
- 0.75 - 1.25 (Danger for Some)
- 1.25 - 2 (Danger for Most)
- > 2.0 (Danger for All)



CLIENT:

PLAS POWER ESTATES

waterco consultants

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ
01824 702220
www.waterco.co.uk

SCHEME:

LAND OFF BERSE ROAD WREXHAM

PLOT TITLE:

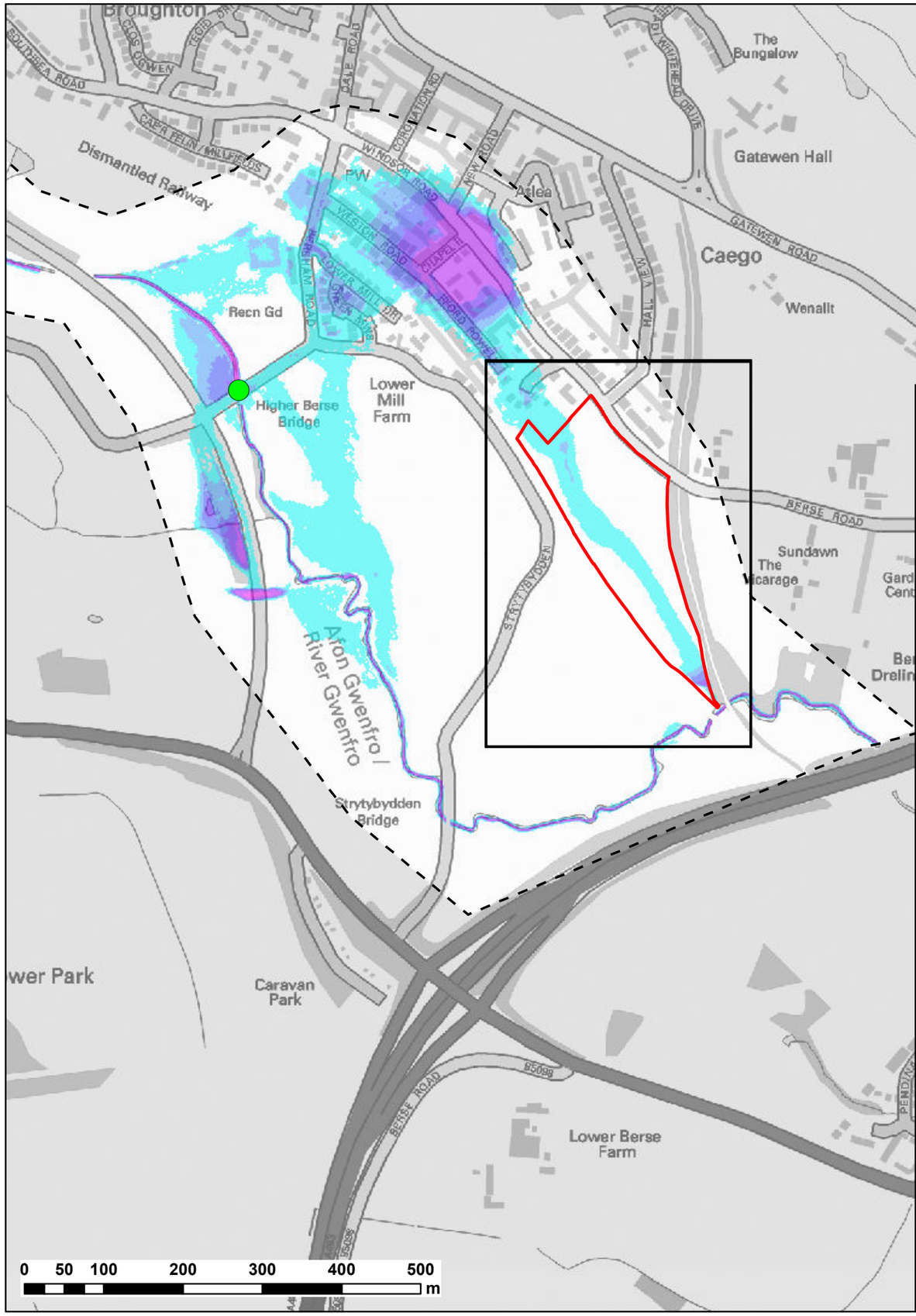
MAXIMUM FLOOD HAZARD
0.1% AEP FLUVIAL EVENT
EXISTING SITE LAYOUT

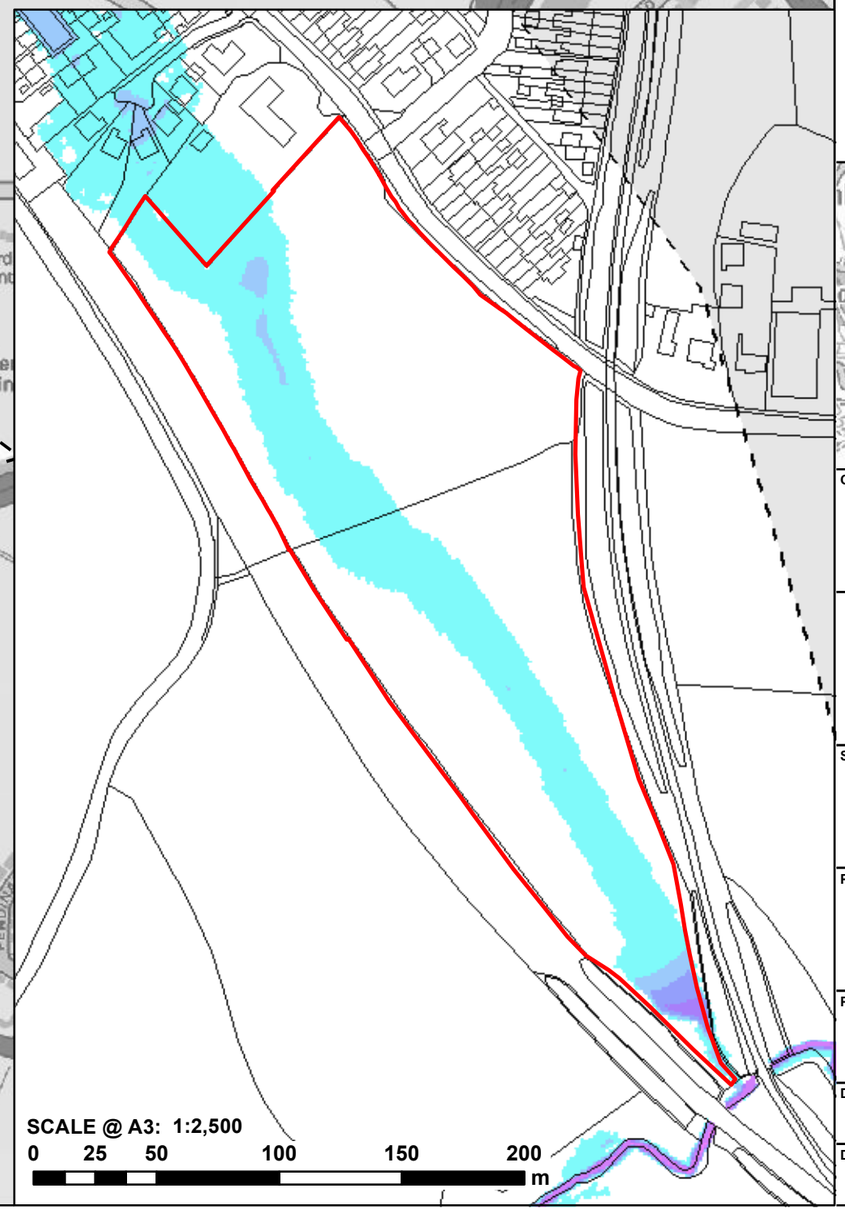
PLOT STATUS:

ISSUE

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
SB	DH	RCL	1:6,000 (UNLESS STATED OTHERWISE)

DATE:	PLOT NAME:	REV:
04/04/2016	w3183-Q1000_EXG_H	A



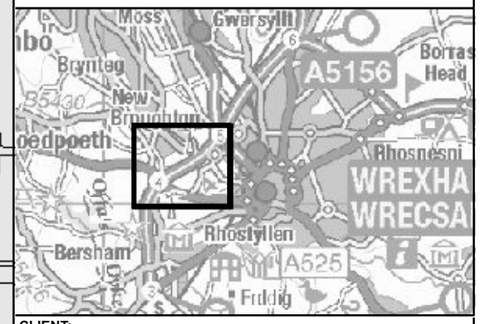


LEGEND

- Site Boundary
- 2D Model Boundary
- Higher Berse Rd Blockage Location

Maximum Flood Depth (m)

- 0 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- 1.2 - 2.4
- > 2.4



CLIENT:

PLAS POWER ESTATES

waterco consultants

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ

01824 702220
www.waterco.co.uk

SCHEME:

LAND OFF BERSE ROAD WREXHAM

PLOT TITLE:

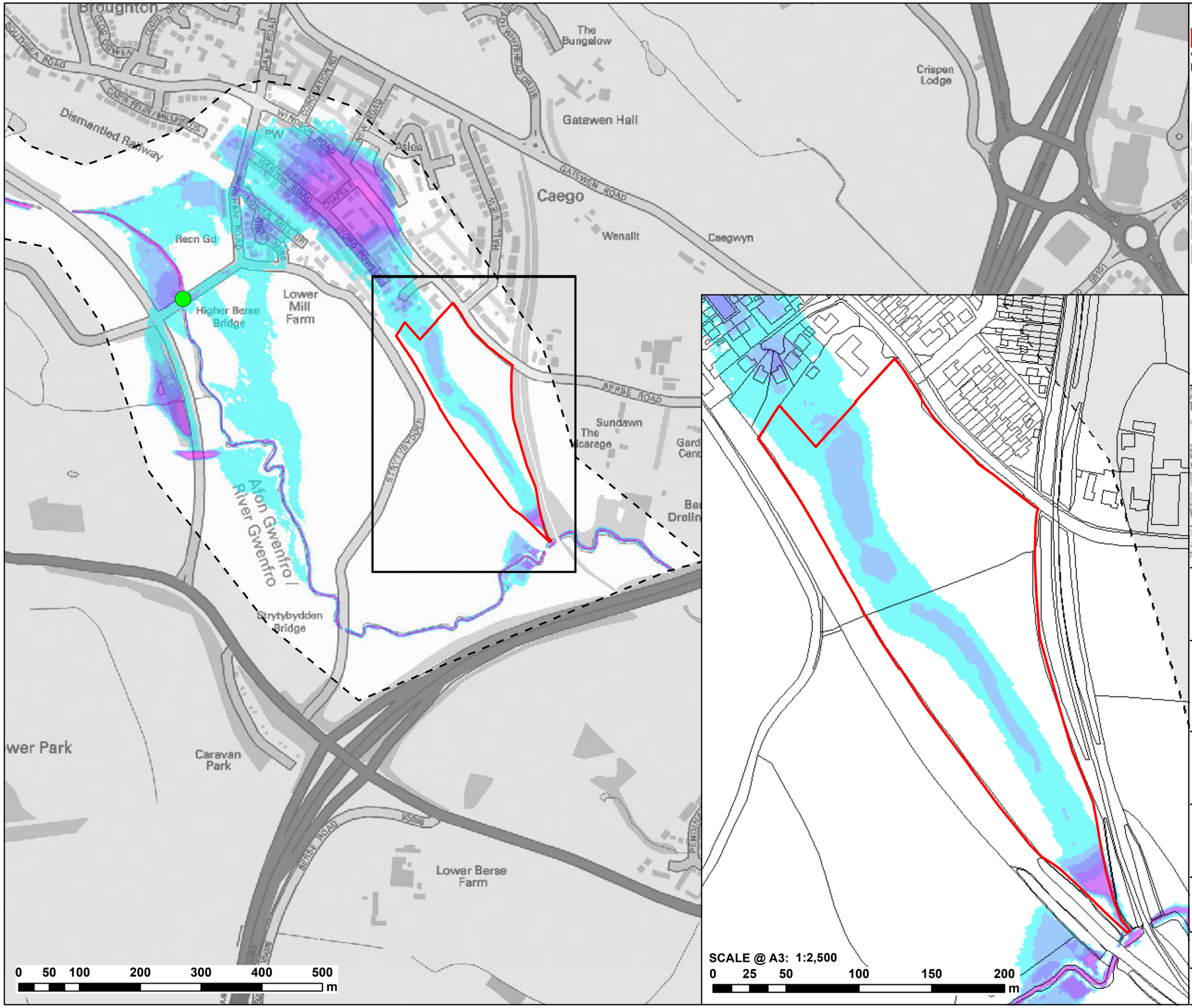
MAXIMUM FLOOD DEPTH
1% AEP + CCA FLUVIAL EVENT
HIGHER BERSE RD 66% BLOCKAGE

PLOT STATUS:

ISSUE

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
SB	DH	RCL	1:6,000 (UNLESS STATED OTHERWISE)

DATE:	PLOT NAME:	REV:
04/04/2016	w3183-Q100CC_BL1-66_D	A

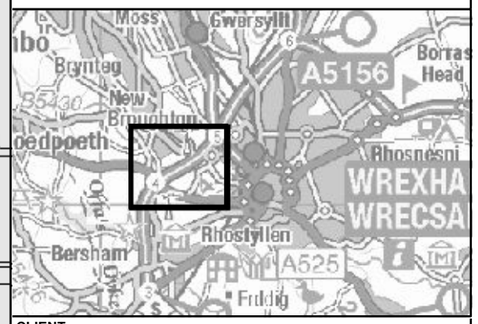


LEGEND

- Site Boundary
- 2D Model Boundary
- Higher Berse Rd Blockage Location

Maximum Flood Depth (m)

- 0 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- 1.2 - 2.4
- > 2.4



CLIENT:

PLAS POWER ESTATES

waterco consultants

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ

01824 702220
www.waterco.co.uk

SCHEME:

LAND OFF BERSE ROAD WREXHAM

PLOT TITLE:

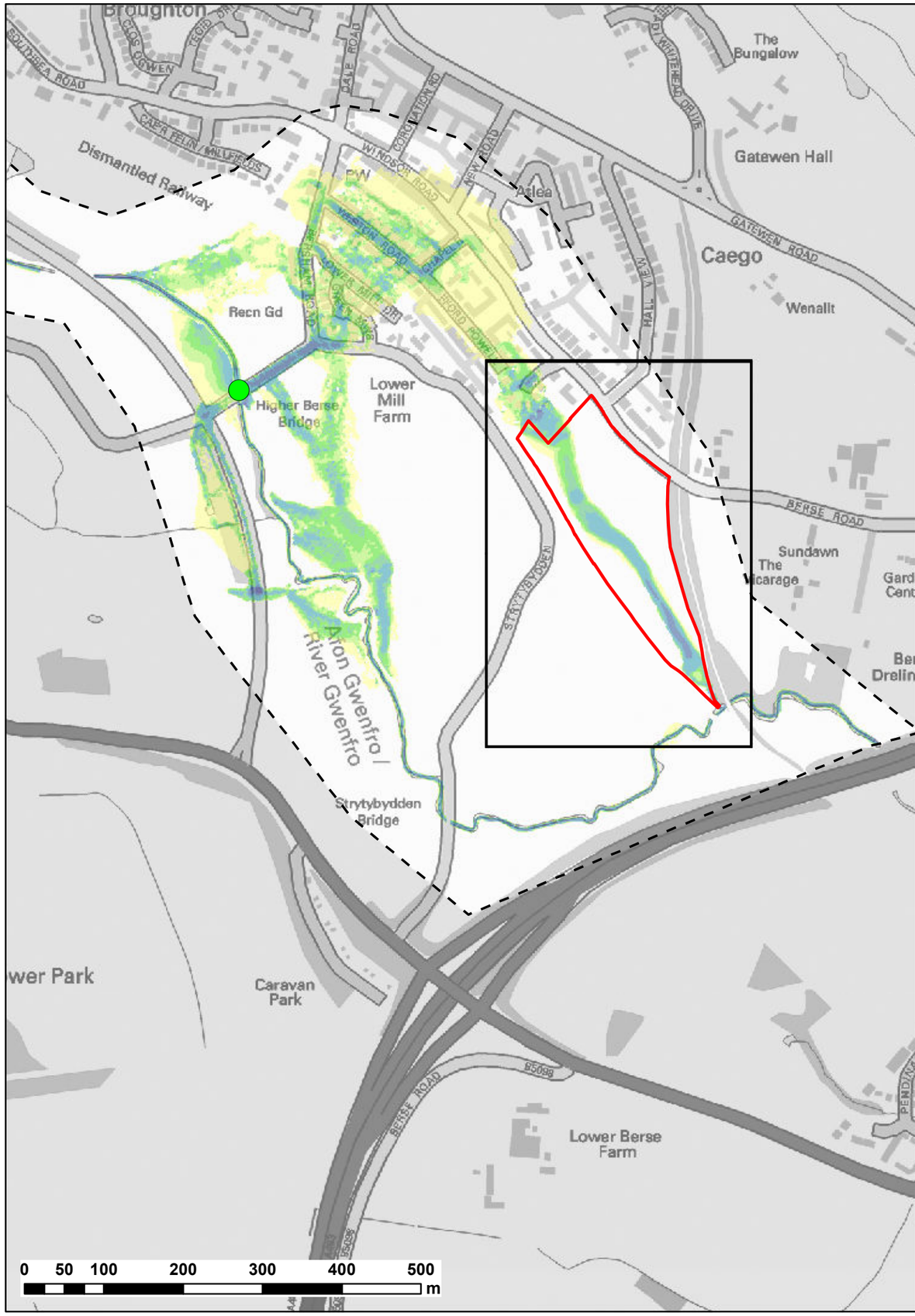
MAXIMUM FLOOD DEPTH
0.1% AEP FLUVIAL EVENT
HIGHER BERSE RD 95% BLOCKAGE

PLOT STATUS:

ISSUE

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
SB	DH	RCL	1:6,000 (UNLESS STATED OTHERWISE)

DATE:	PLOT NAME:	REV:
04/04/2016	w3183-Q1000_BL1-95_D	A

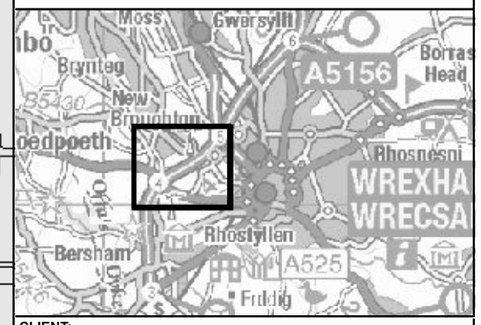


LEGEND

- Site Boundary
- 2D Model Boundary
- Higher Berse Rd Blockage Location

Maximum Velocity (m/s)

- 0 - 0.15
- 0.15 - 0.3
- 0.3 - 0.45
- 0.45 - 0.6
- 0.6 - 1.2
- 1.2 - 2.4
- > 2.4



CLIENT:

PLAS POWER ESTATES

waterco consultants

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ

01824 702220
www.waterco.co.uk

SCHEME:

LAND OFF BERSE ROAD WREXHAM

PLOT TITLE:

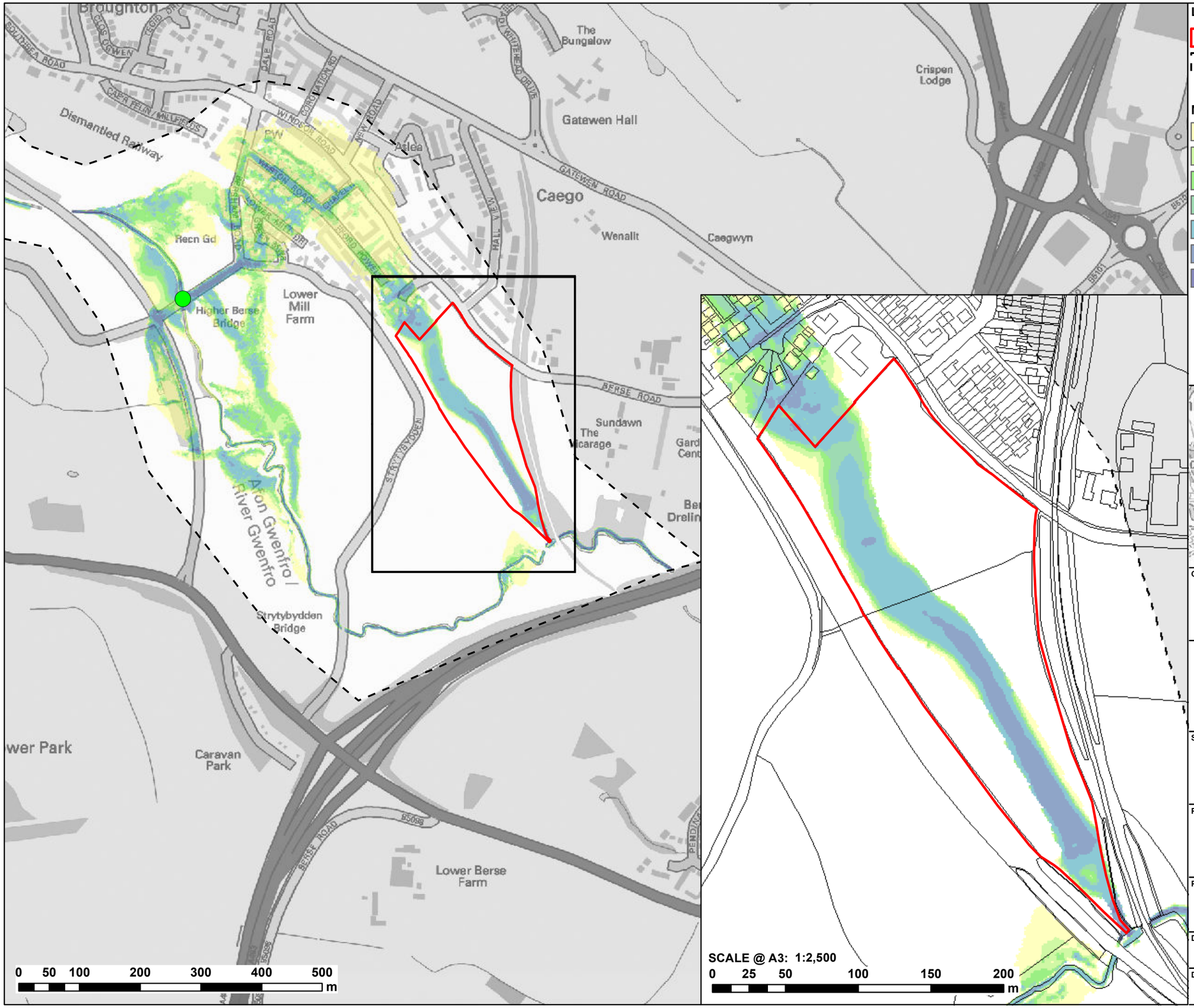
MAXIMUM VELOCITY
1% AEP + CCA FLUVIAL EVENT
HIGHER BERSE RD 66% BLOCKAGE

PLOT STATUS:

ISSUE

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
SB	DH	RCL	1:6,000 (UNLESS STATED OTHERWISE)

DATE:	PLOT NAME:	REV:
04/04/2016	w3183-Q100CC_BL1-66_V	A

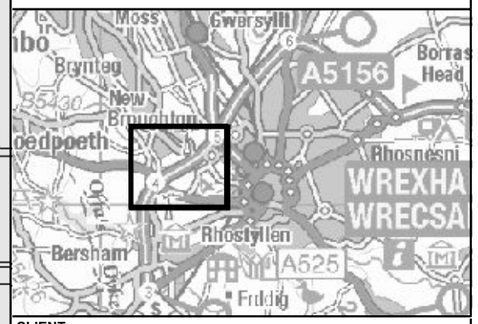


LEGEND

- Site Boundary
- 2D Model Boundary
- Higher Berse Rd Blockage Location

Maximum Velocity (m/s)

- 0 - 0.15
- 0.15 - 0.3
- 0.3 - 0.45
- 0.45 - 0.6
- 0.6 - 1.2
- 1.2 - 2.4
- > 2.4



CLIENT:

PLAS POWER ESTATES

waterco consultants

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ

01824 702220
www.waterco.co.uk

SCHEME:

LAND OFF BERSE ROAD WREXHAM

PLOT TITLE:

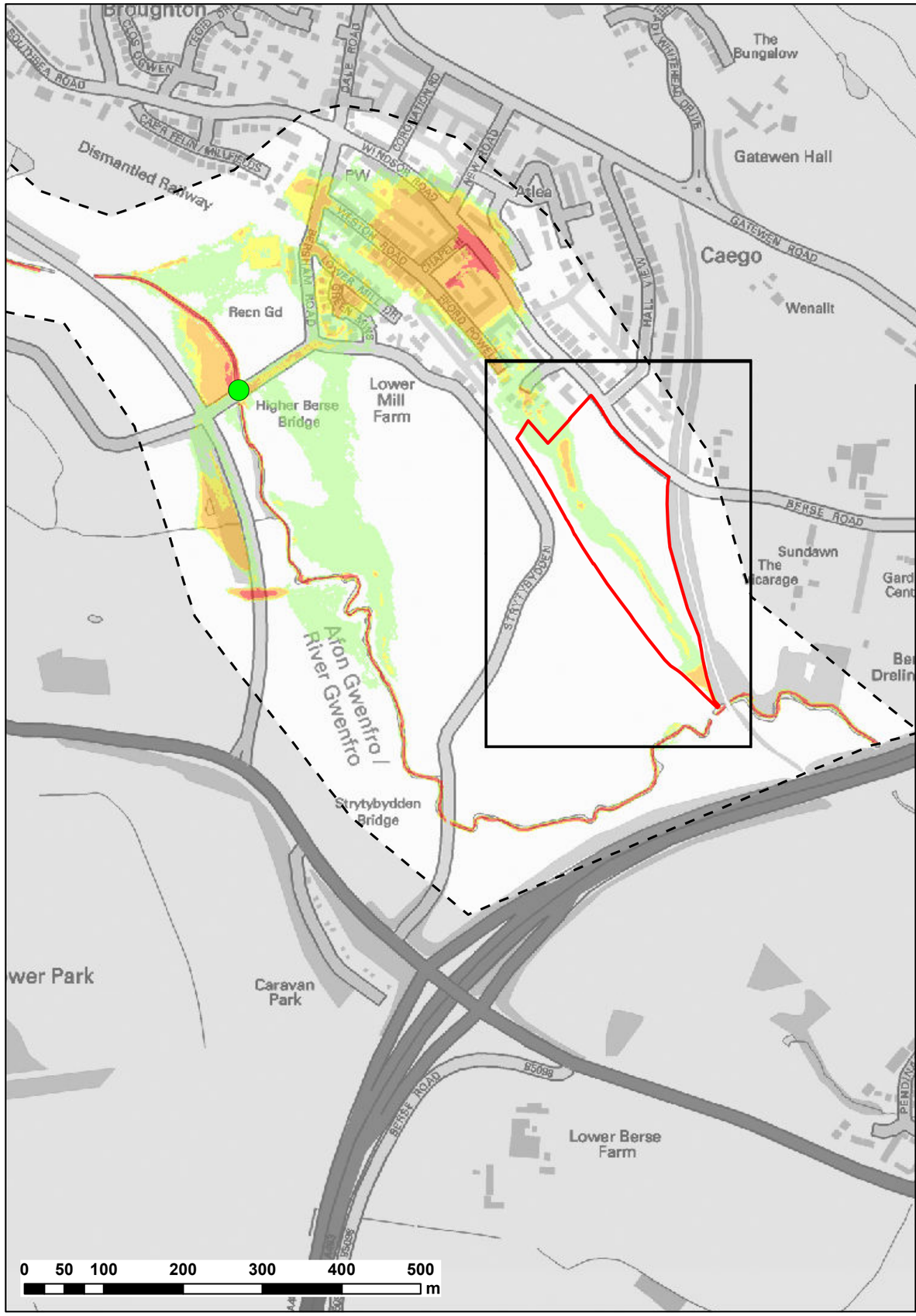
MAXIMUM VELOCITY
0.1% AEP FLUVIAL EVENT
HIGHER BERSE RD 95% BLOCKAGE

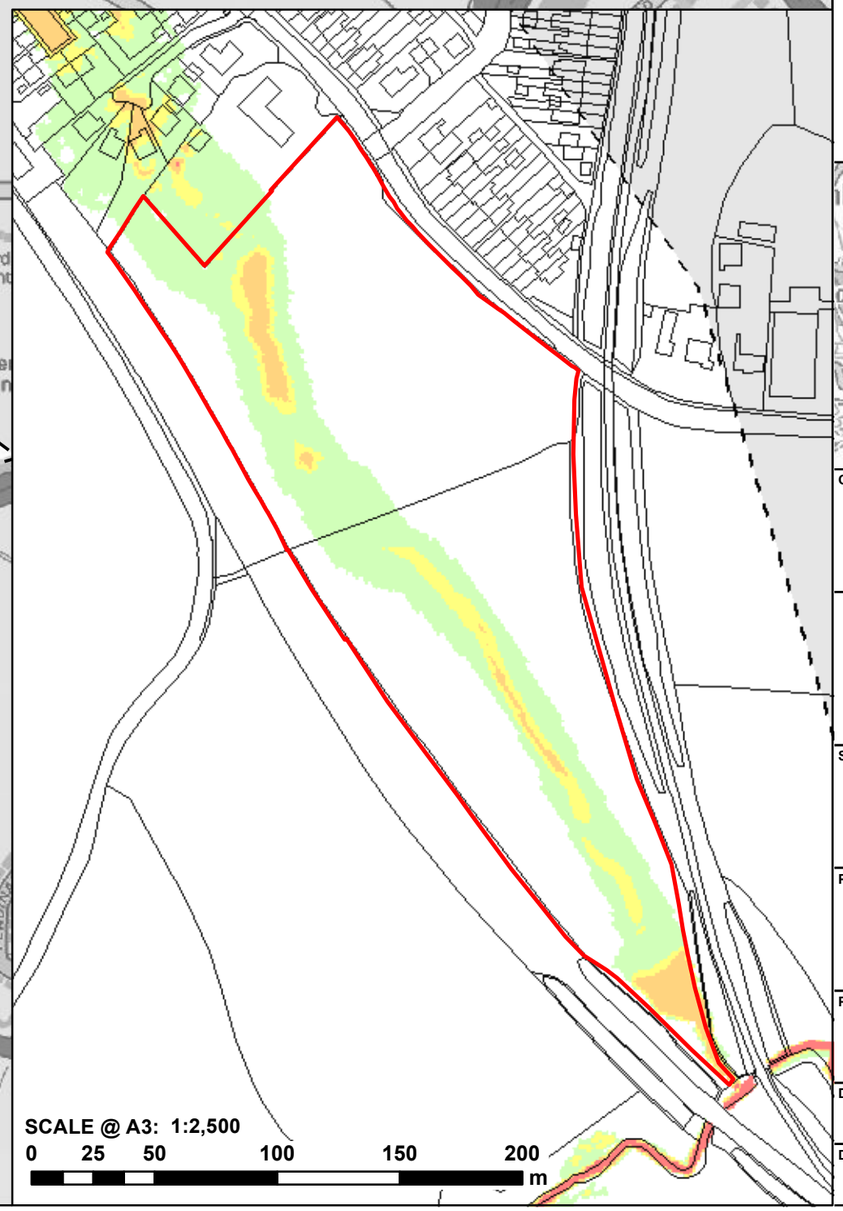
PLOT STATUS:

ISSUE

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
SB	DH	RCL	1:6,000 (UNLESS STATED OTHERWISE)

DATE:	PLOT NAME:	REV:
04/04/2016	w3183-Q1000_BL1-95_V	A



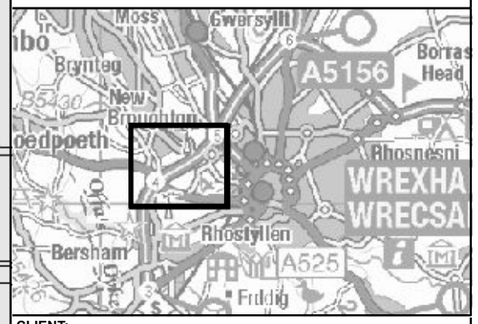


LEGEND

- Site Boundary
- 2D Model Boundary
- Higher Berse Rd Blockage Location

Maximum Flood Hazard Rating (FD2320)

- < 0.75 (Caution)
- 0.75 - 1.25 (Danger for Some)
- 1.25 - 2 (Danger for Most)
- > 2.0 (Danger for All)



CLIENT:

PLAS POWER ESTATES

waterco consultants

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ

01824 702220
www.waterco.co.uk

SCHEME:

LAND OFF BERSE ROAD WREXHAM

PLOT TITLE:

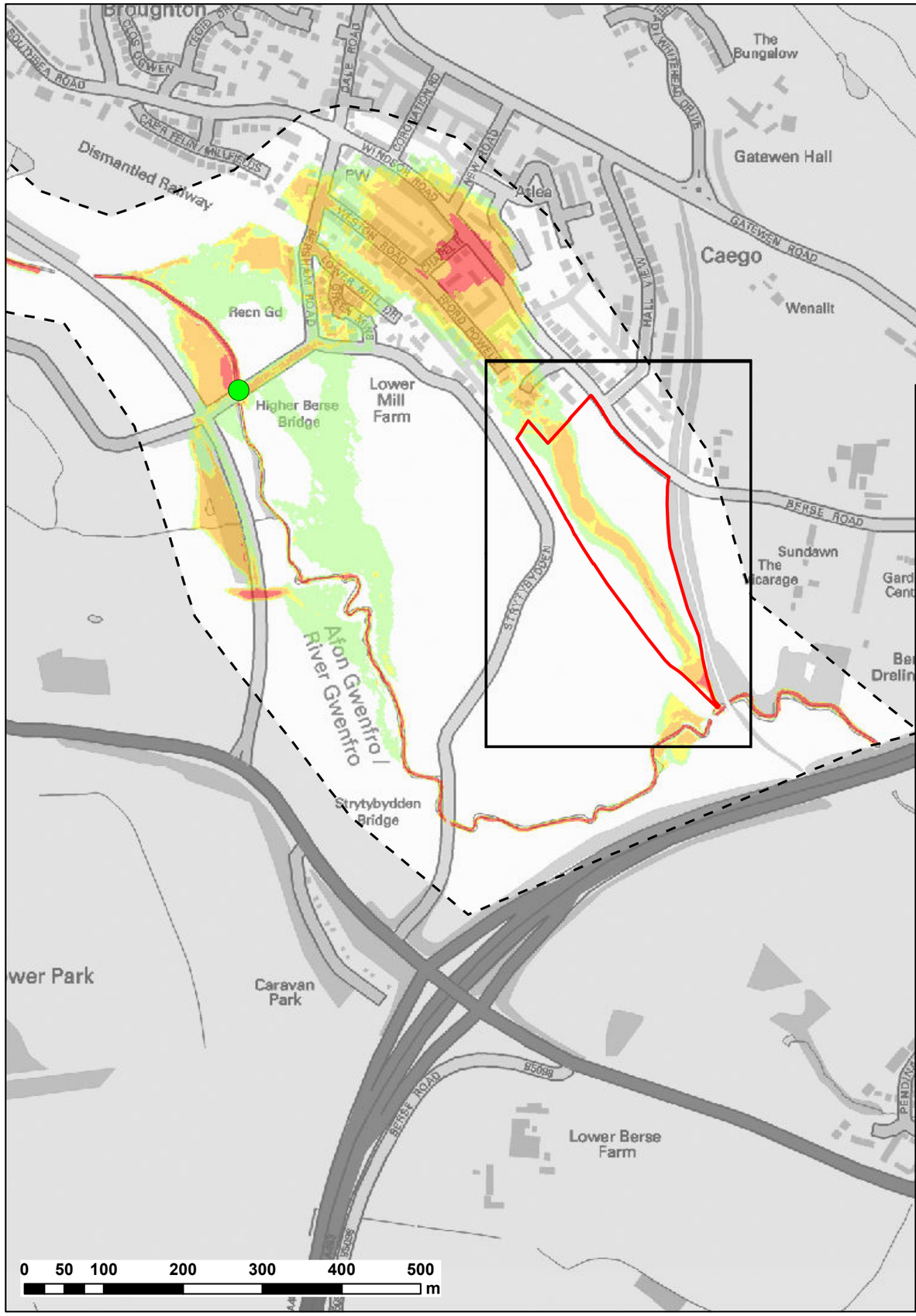
MAXIMUM FLOOD HAZARD
1% AEP + CCA FLUVIAL EVENT
HIGHER BERSE RD 66% BLOCKAGE

PLOT STATUS:

ISSUE

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
SB	DH	RCL	1:6,000 (UNLESS STATED OTHERWISE)

DATE:	PLOT NAME:	REV:
04/04/2016	w3183-Q100CC_BL1-66_H	A

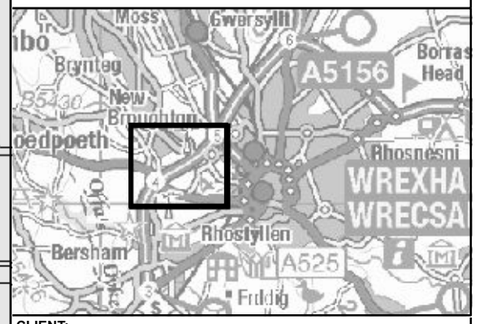


LEGEND

- Site Boundary
- 2D Model Boundary
- Higher Berse Rd Blockage Location

Maximum Flood Hazard Rating (FD2320)

- < 0.75 (Caution)
- 0.75 - 1.25 (Danger for Some)
- 1.25 - 2 (Danger for Most)
- > 2.0 (Danger for All)



CLIENT:

PLAS POWER ESTATES

waterco consultants

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Eden Court, Ruthin, LL15 1NJ

01824 702220
www.waterco.co.uk

SCHEME:

LAND OFF BERSE ROAD WREXHAM

PLOT TITLE:

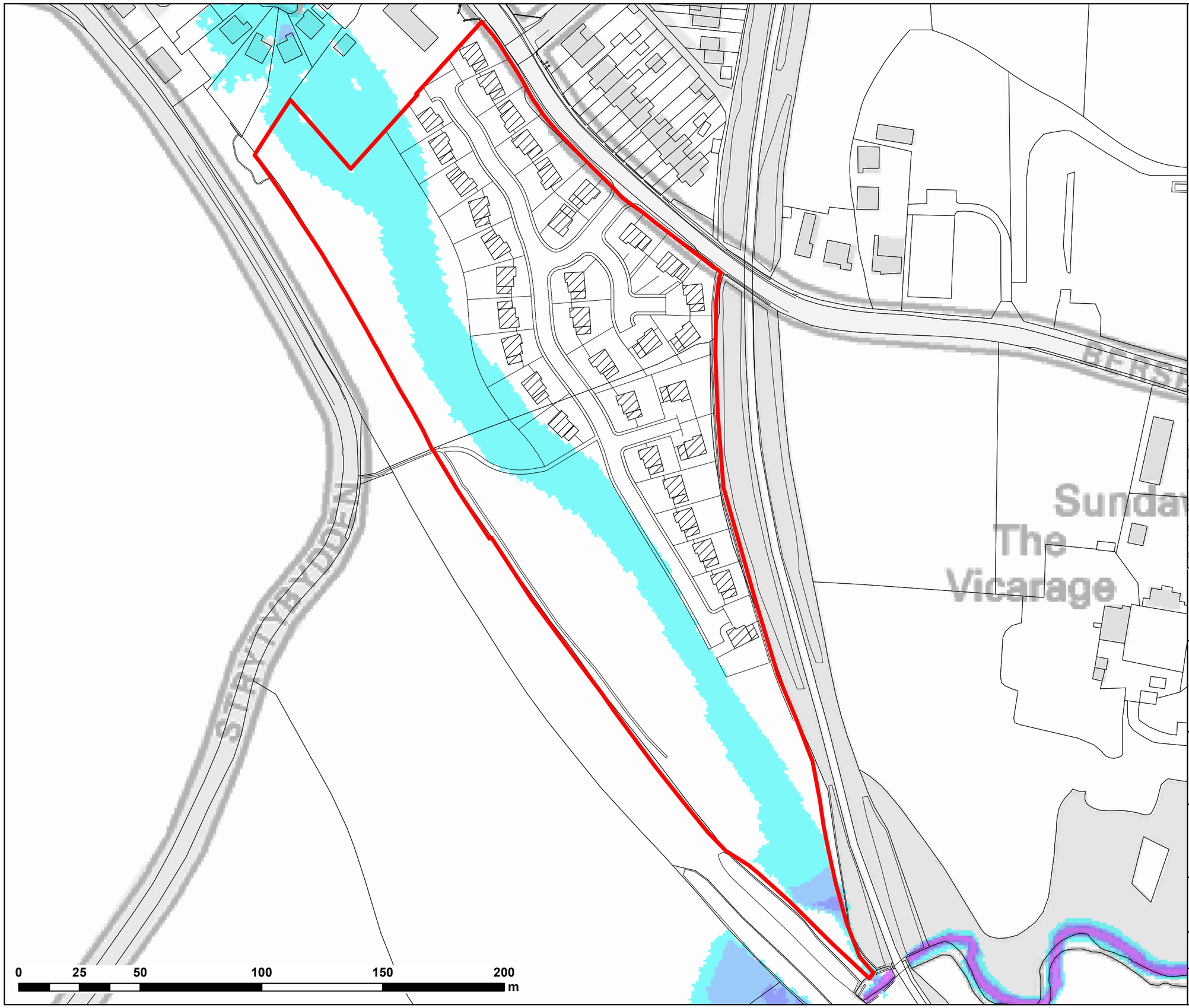
MAXIMUM FLOOD HAZARD
0.1% AEP FLUVIAL EVENT
HIGHER BERSE RD 95% BLOCKAGE

PLOT STATUS:

ISSUE

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
SB	DH	RCL	1:6,000 (UNLESS STATED OTHERWISE)

DATE:	PLOT NAME:	REV:
04/04/2016	w3183-Q1000_BL1-95_H	A



LEGEND

- Site Boundary
- Proposed House

Maximum Flood Depth (m)

- 0 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- 1.2 - 2.4
- > 2.4

CLIENT:

PLAS POWER ESTATES

waterco consultants

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ

01824 702220
www.waterco.co.uk

SCHEME:

LAND OFF BERSE ROAD WREXHAM

PLOT TITLE:

MAXIMUM FLOOD DEPTH

0.1% AEP FLUVIAL EVENT

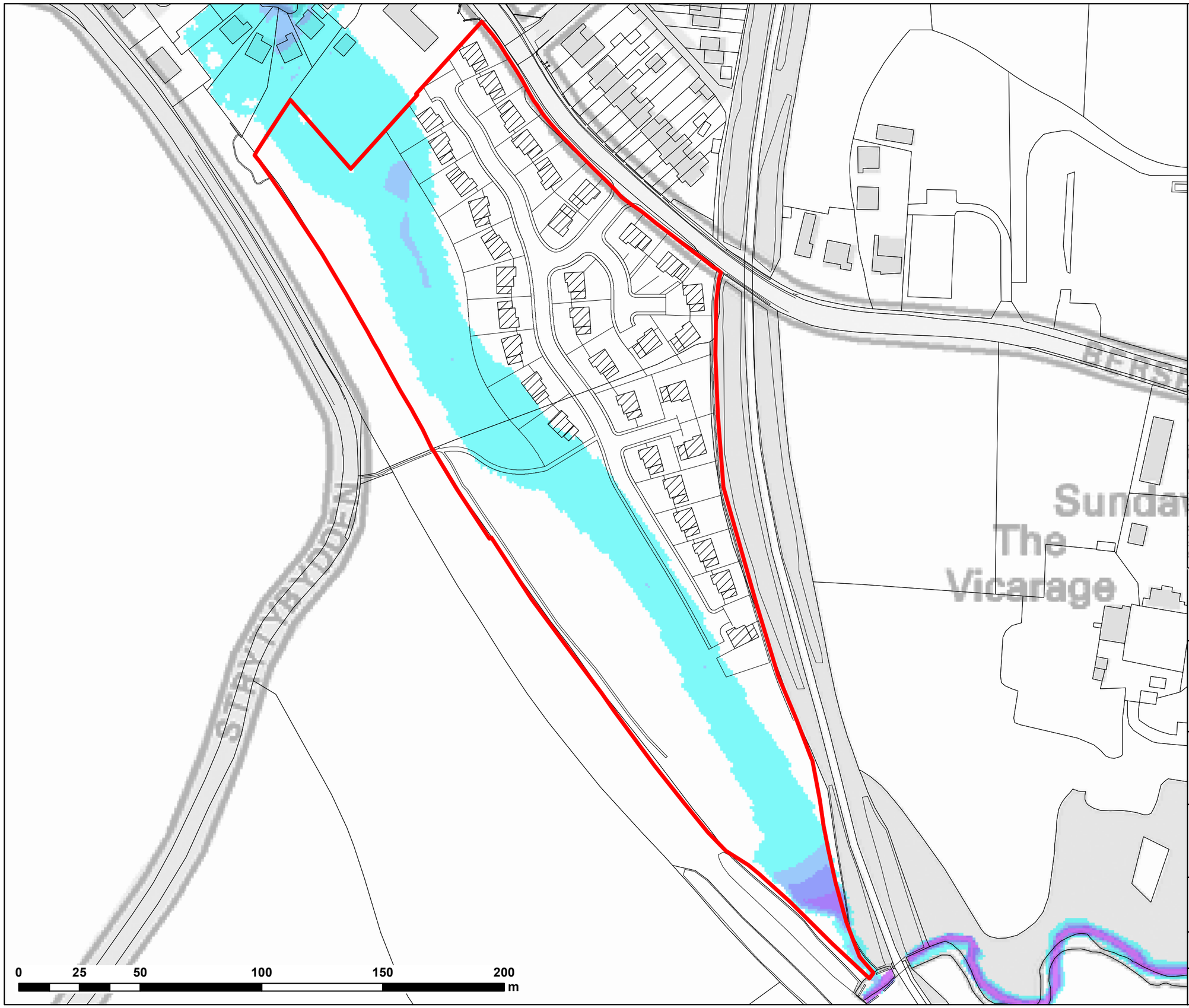
EXISTING SITE LAYOUT

PLOT STATUS:

ISSUE

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
RCL	JW	AW	1:1,500 (UNLESS STATED OTHERWISE)

DATE:	PLOT NAME:	REV:
04/04/2016	w3183-Extent_Q1000_EXG_D	-



LEGEND

- Site Boundary
- Proposed House

Maximum Flood Depth (m)

- 0 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- 1.2 - 2.4
- > 2.4

CLIENT:

PLAS POWER ESTATES

waterco consultants

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01824 702220
www.waterco.co.uk

SCHEME:

LAND OFF BERSE ROAD WREXHAM

PLOT TITLE:

MAXIMUM FLOOD DEPTH

1% AEP + CCA FLUVIAL EVENT

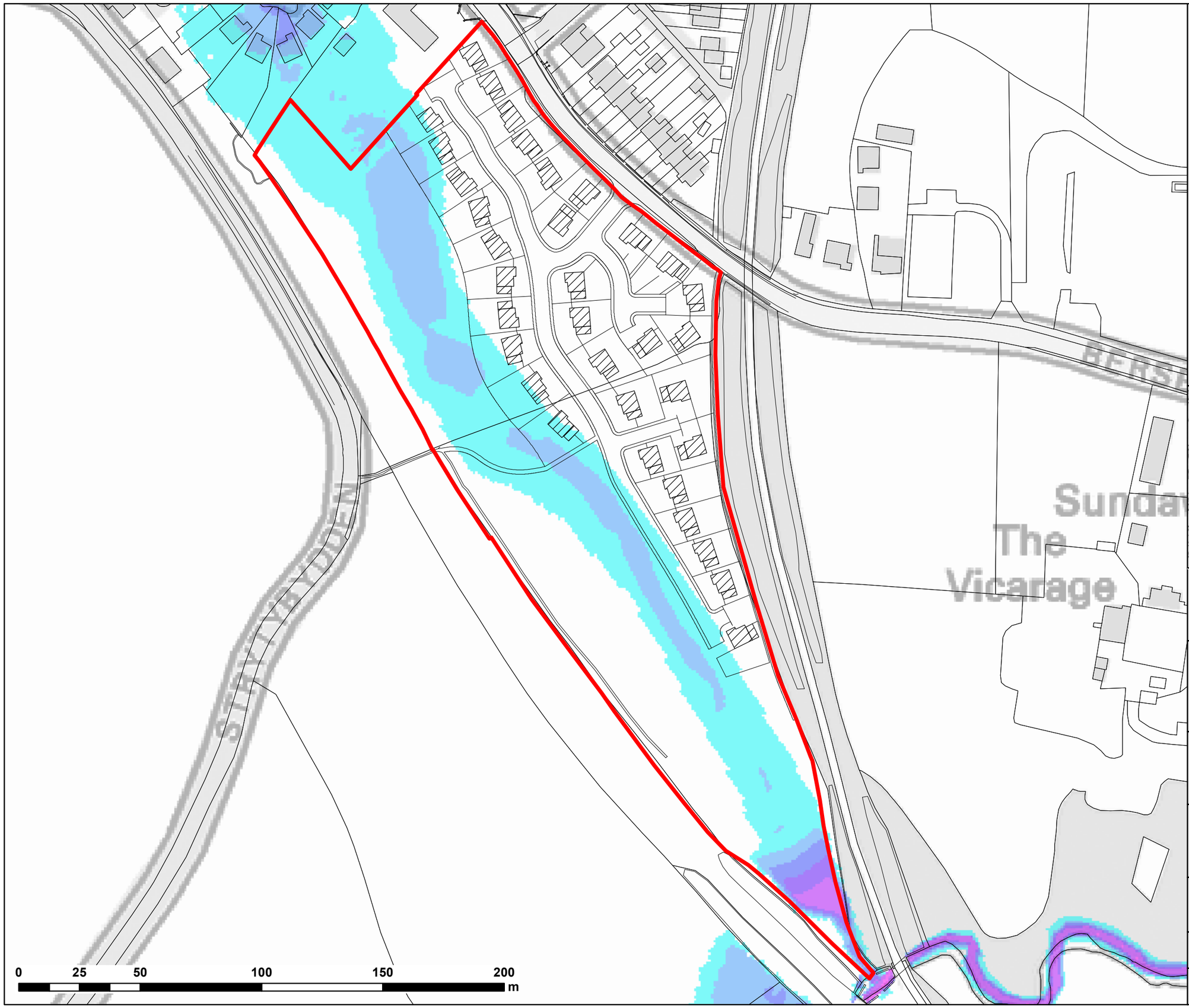
HIGHER BERSE RD 66% BLOCKAGE

PLOT STATUS:

ISSUE

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
RCL	JW	AW	1:1,500 (UNLESS STATED OTHERWISE)

DATE:	PLOT NAME:	REV:
04/04/2016	w3183-Extent_Q100CC_BL1-66_D	-



LEGEND

- Site Boundary
- Proposed House

Maximum Flood Depth (m)

- 0 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- 1.2 - 2.4
- > 2.4

CLIENT:

PLAS POWER ESTATES

waterco consultants

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01824 702220
www.waterco.co.uk

SCHEME:

LAND OFF BERSE ROAD WREXHAM

PLOT TITLE:

MAXIMUM FLOOD DEPTH

0.1% AEP FLUVIAL EVENT

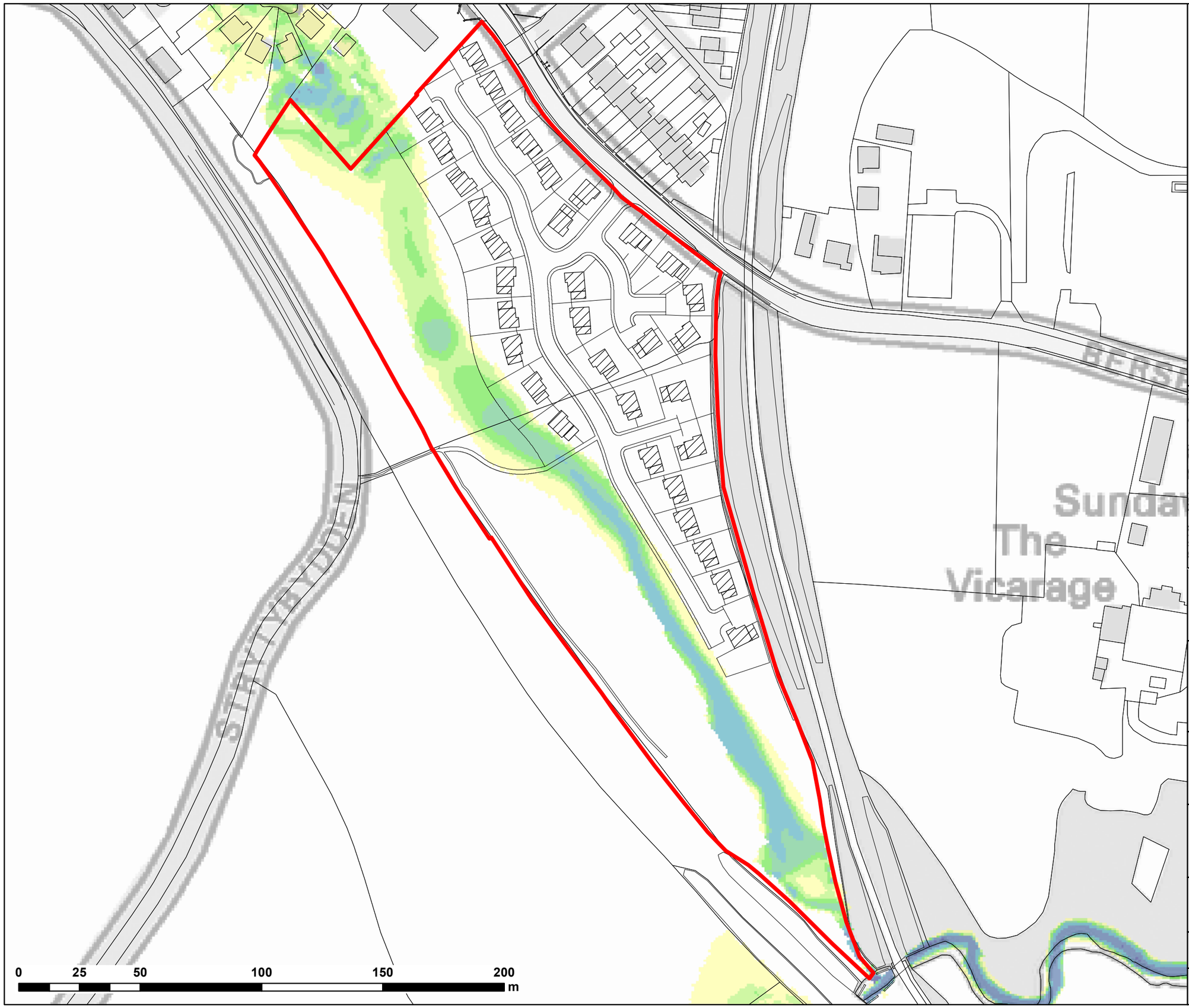
HIGHER BERSE RD 95% BLOCKAGE

PLOT STATUS:

ISSUE

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
RCL	JW	AW	1:1,500 (UNLESS STATED OTHERWISE)

DATE:	PLOT NAME:	REV:
04/04/2016	w3183-Extent_Q1000_BL1-95_D	-



LEGEND

- Site Boundary
- Proposed House

Maximum Velocity (m/s)

- 0 - 0.15
- 0.15 - 0.3
- 0.3 - 0.45
- 0.45 - 0.6
- 0.6 - 1.2
- 1.2 - 2.4
- > 2.4

CLIENT:

PLAS POWER ESTATES

waterco consultants

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01824 702220
www.waterco.co.uk

SCHEME:

LAND OFF BERSE ROAD WREXHAM

PLOT TITLE:

MAXIMUM VELOCITY

0.1% AEP FLUVIAL EVENT

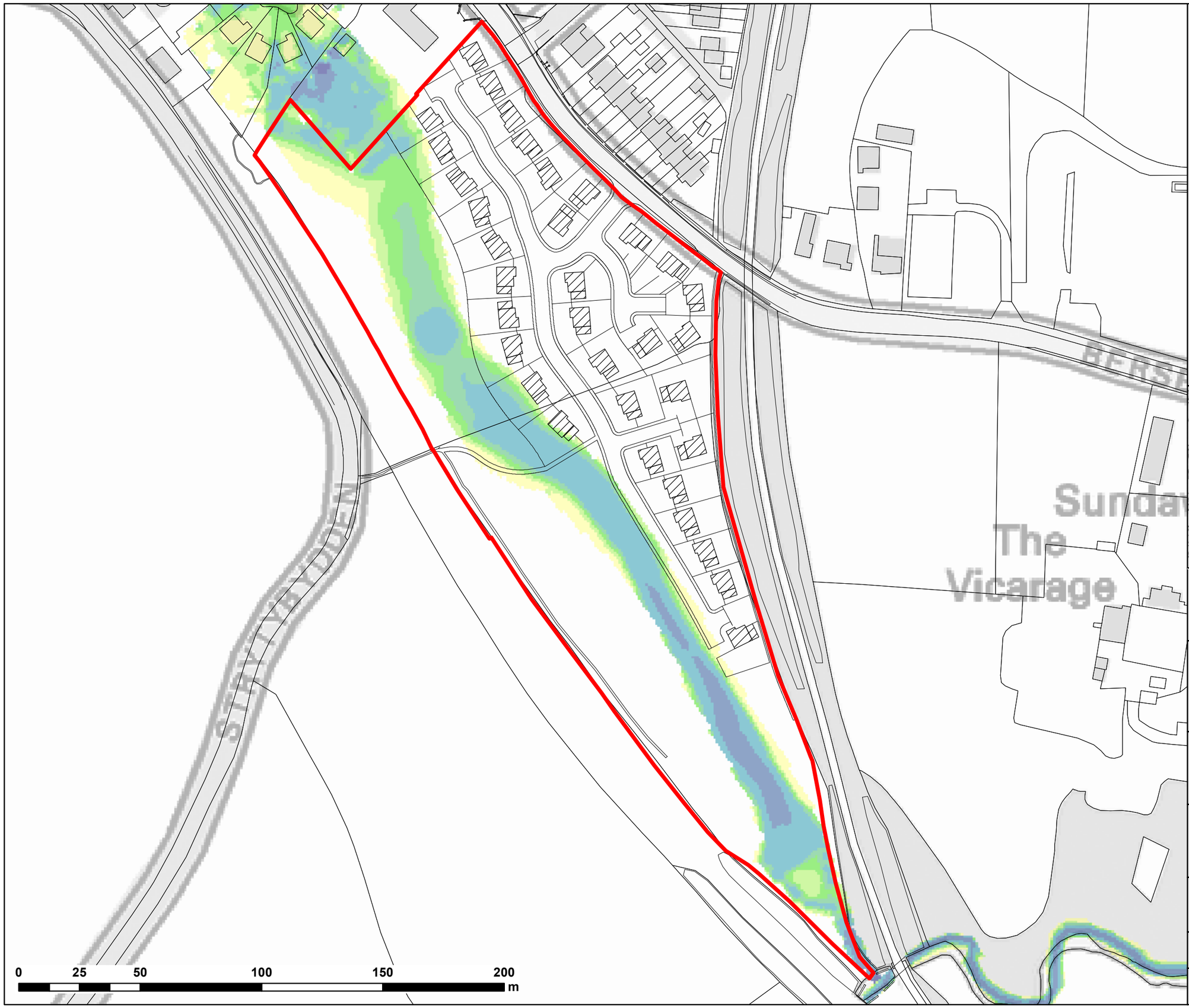
EXISTING SITE LAYOUT

PLOT STATUS:

ISSUE

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
RCL	JW	AW	1:1,500 (UNLESS STATED OTHERWISE)

DATE:	PLOT NAME:	REV:
04/04/2016	w3183-Extent_Q1000_EXG_V	-



LEGEND

- Site Boundary
- Proposed House

Maximum Velocity (m/s)

- 0 - 0.15
- 0.15 - 0.3
- 0.3 - 0.45
- 0.45 - 0.6
- 0.6 - 1.2
- 1.2 - 2.4
- > 2.4

CLIENT:

PLAS POWER ESTATES

waterco consultants

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ
01824 702220
www.waterco.co.uk

SCHEME:

LAND OFF BERSE ROAD WREXHAM

PLOT TITLE:

MAXIMUM VELOCITY

1% AEP + CCA FLUVIAL EVENT

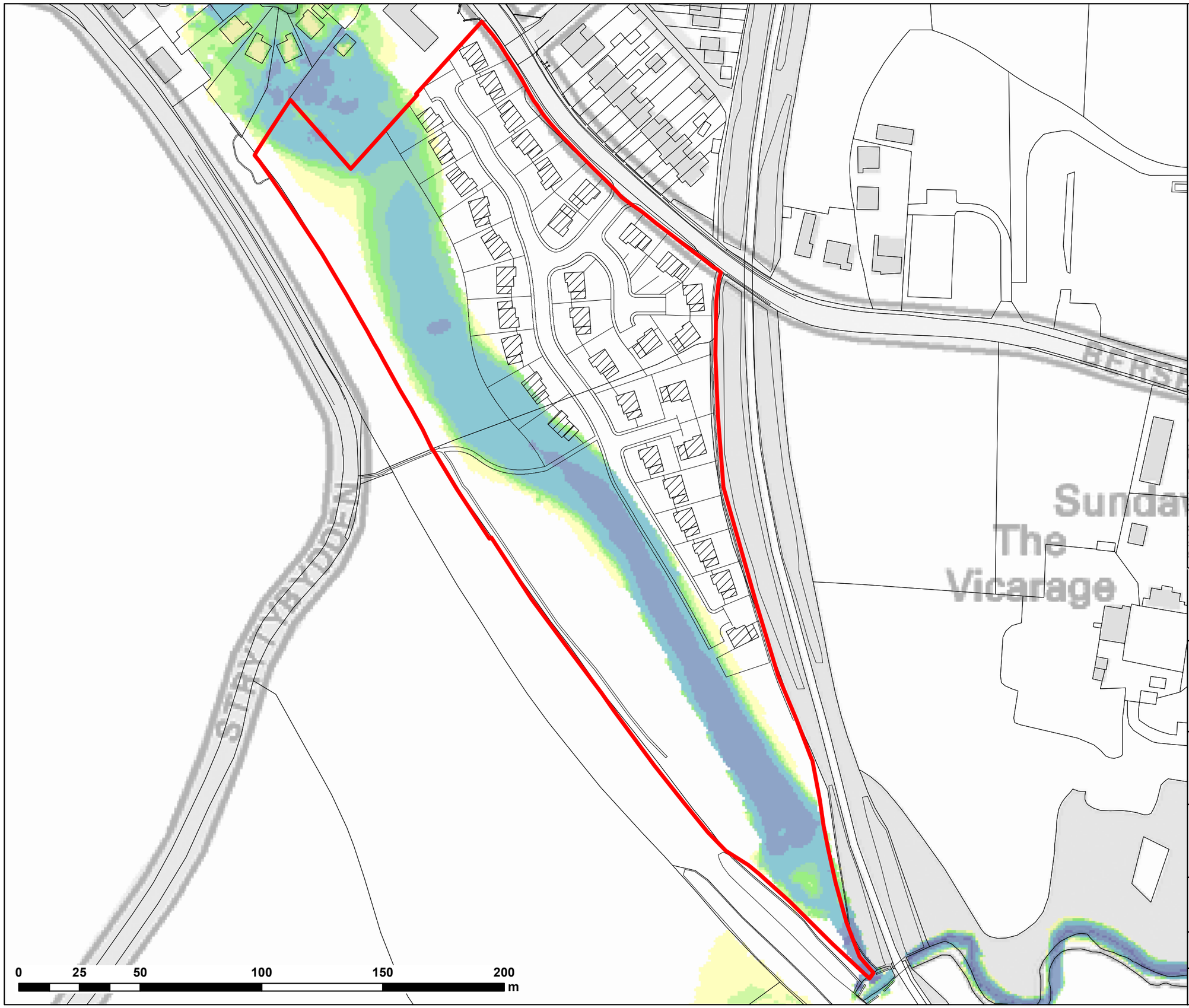
HIGHER BERSE RD 66% BLOCKAGE

PLOT STATUS:

ISSUE

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
RCL	JW	AW	1:1,500 (UNLESS STATED OTHERWISE)

DATE:	PLOT NAME:	REV:
04/04/2016	w3183-Extent_Q100CC_BL1-66_V	-



LEGEND

- Site Boundary
- Proposed House

Maximum Velocity (m/s)

- 0 - 0.15
- 0.15 - 0.3
- 0.3 - 0.45
- 0.45 - 0.6
- 0.6 - 1.2
- 1.2 - 2.4
- > 2.4

CLIENT:

PLAS POWER ESTATES

waterco consultants

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ

01824 702220
www.waterco.co.uk

SCHEME:

LAND OFF BERSE ROAD WREXHAM

PLOT TITLE:

MAXIMUM VELOCITY
0.1% AEP FLUVIAL EVENT
HIGHER BERSE RD 95% BLOCKAGE

PLOT STATUS:

ISSUE

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
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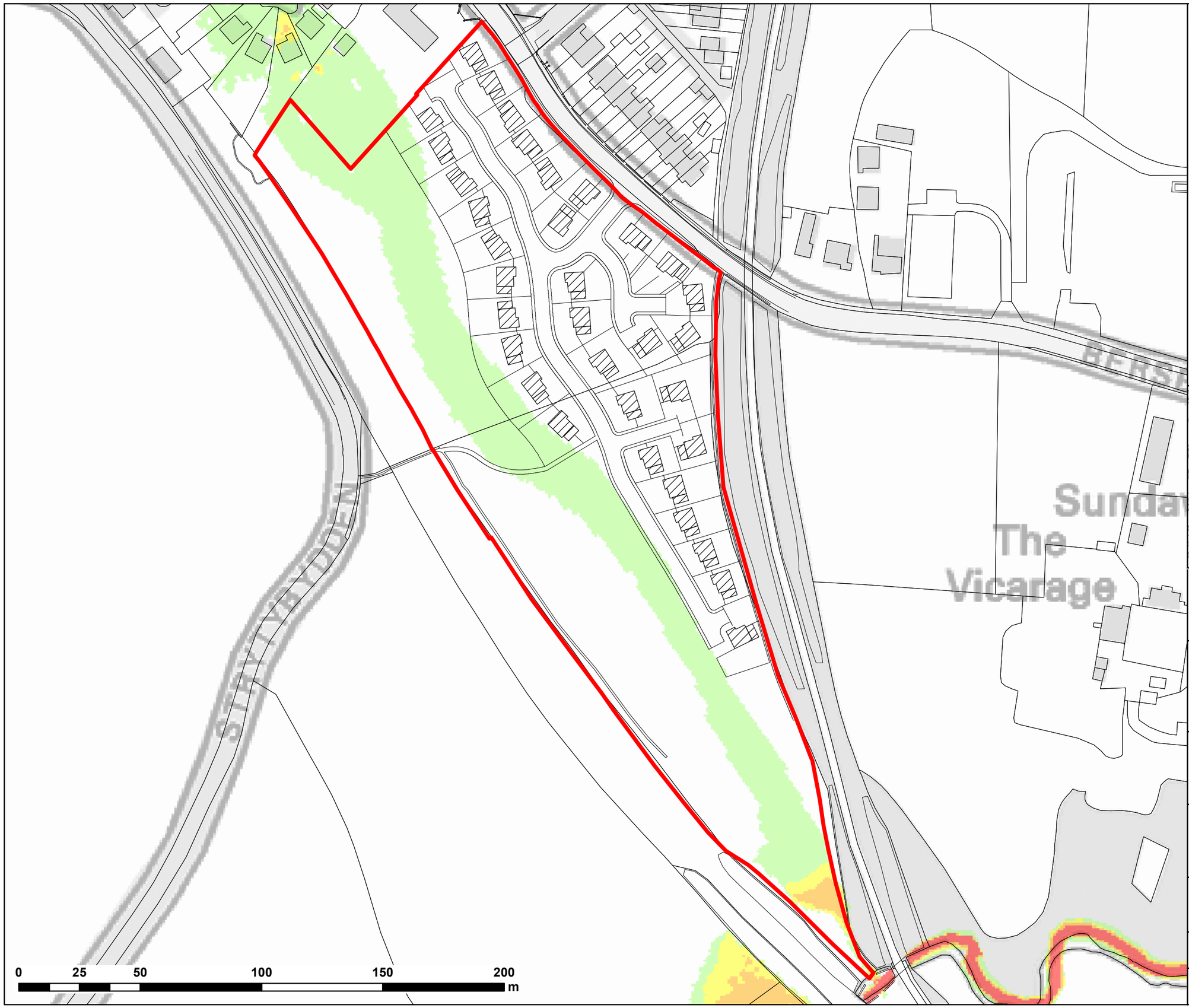
DATE:	PLOT NAME:	REV:
04/04/2016	w3183-Extent_Q1000_BL1-95_V	-



LEGEND

- Site Boundary
- Proposed House

Maximum Flood Hazard Rating (FD2320)

- < 0.75 (Caution)
- 0.75 - 1.25 (Danger for Some)
- 1.25 - 2 (Danger for Most)
- > 2.0 (Danger for All)

CLIENT:

PLAS POWER ESTATES

waterco consultants

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ

01824 702220
www.waterco.co.uk

SCHEME:

LAND OFF BERSE ROAD WREXHAM

PLOT TITLE:

FLOOD HAZARD RATING

0.1% AEP FLUVIAL EVENT

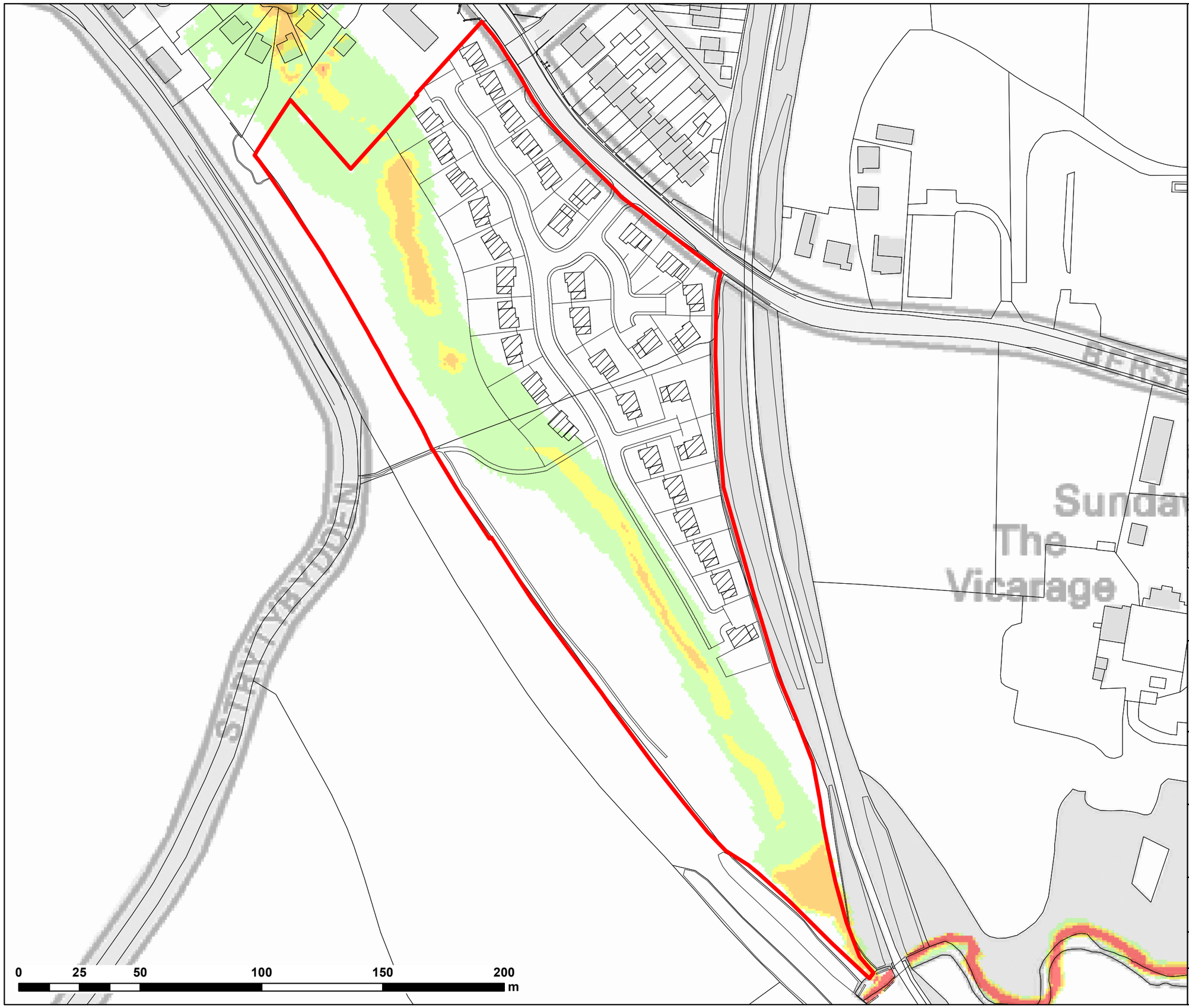
EXISTING SITE LAYOUT

PLOT STATUS:

ISSUE

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
RCL	JW	AW	1:1,500 (UNLESS STATED OTHERWISE)

DATE:	PLOT NAME:	REV:
04/04/2016	w3183-Extent_Q1000_EXG_H	-



LEGEND

- Site Boundary
- Proposed House

Maximum Flood Hazard Rating (FD2320)

- < 0.75 (Caution)
- 0.75 - 1.25 (Danger for Some)
- 1.25 - 2 (Danger for Most)
- > 2.0 (Danger for All)

CLIENT:

PLAS POWER ESTATES

waterco consultants

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ

01824 702220
www.waterco.co.uk

SCHEME:

LAND OFF BERSE ROAD WREXHAM

PLOT TITLE:

FLOOD HAZARD RATING

1% AEP + CCA FLUVIAL EVENT

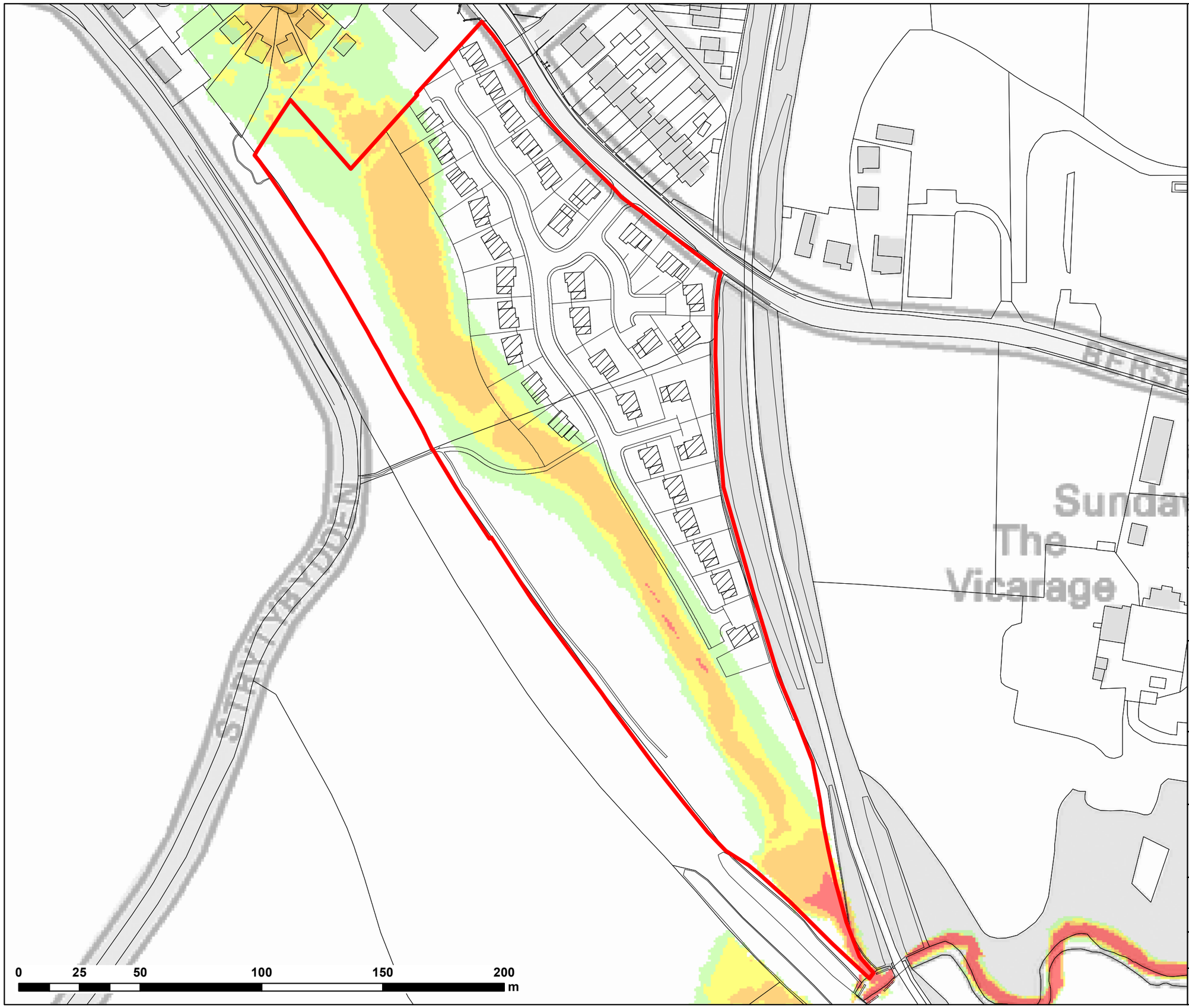
HIGHER BERSE RD 66% BLOCKAGE

PLOT STATUS:

ISSUE

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
RCL	JW	AW	1:1,500 (UNLESS STATED OTHERWISE)

DATE:	PLOT NAME:	REV:
04/04/2016	w3183-Extent_Q100CC_BL1-66_H	-



LEGEND

- Site Boundary
- Proposed House

Maximum Flood Hazard Rating (FD2320)

- < 0.75 (Caution)
- 0.75 - 1.25 (Danger for Some)
- 1.25 - 2 (Danger for Most)
- > 2.0 (Danger for All)

CLIENT:

PLAS POWER ESTATES

waterco consultants

Waterco Ltd
Eden Court, Ruthin, LL15 1NJ

01824 702220
www.waterco.co.uk

SCHEME:

LAND OFF BERSE ROAD WREXHAM

PLOT TITLE:

FLOOD HAZARD RATING

0.1% AEP FLUVIAL EVENT

HIGHER BERSE RD 95% BLOCKAGE

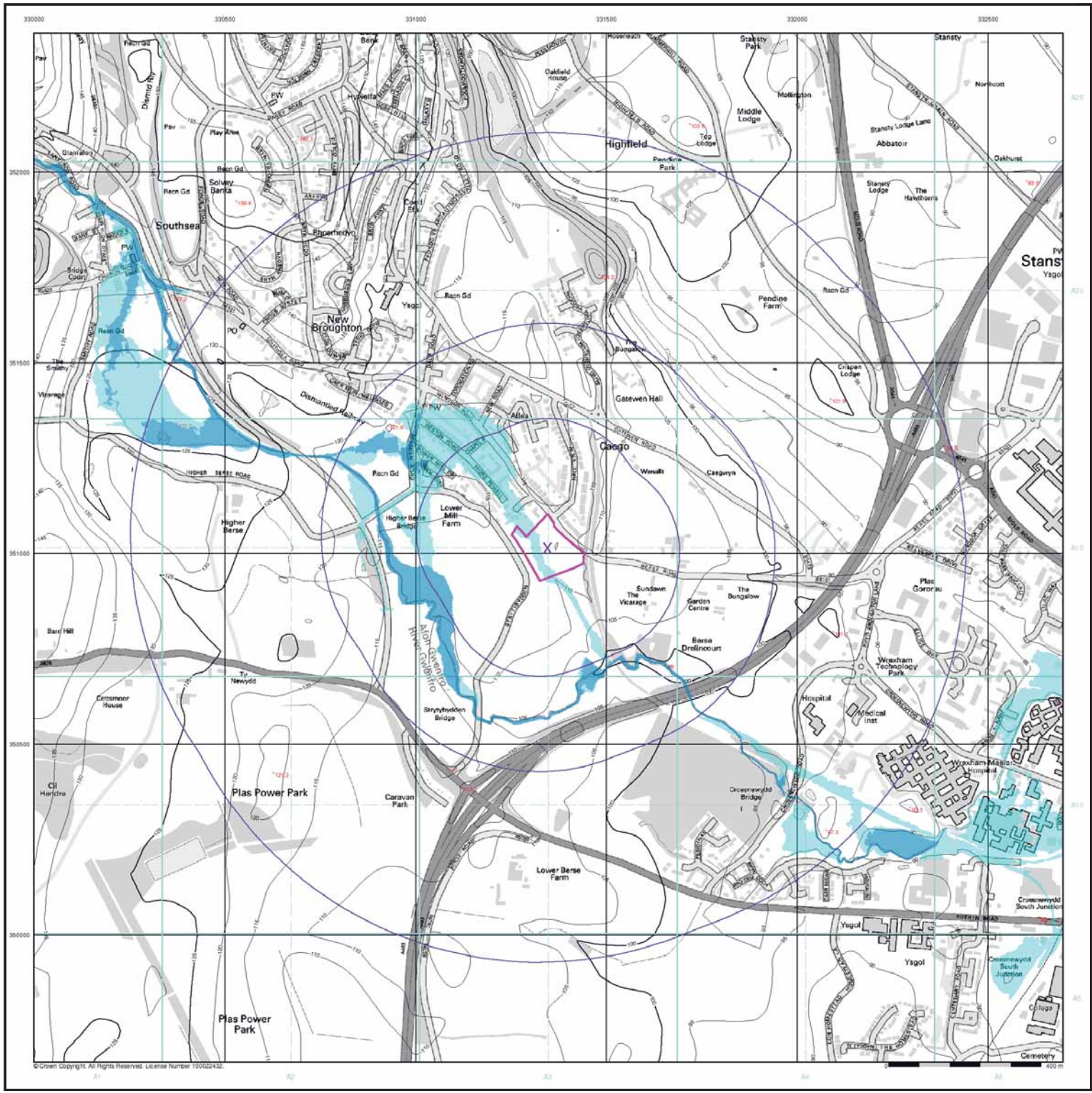
PLOT STATUS:

ISSUE

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE @ A3:
RCL	JW	AW	1:1,500 (UNLESS STATED OTHERWISE)

DATE:	PLOT NAME:	REV:
04/04/2016	w3183-Extent_Q1000_BL1-95_H	-

Appendix E – Envirocheck Flood Report



Envirocheck® Flood

EA/NRW Flood Data Map (1:10,000)

General

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

Flood Data

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

Contours (height in meters)

Standard Contour — 105, 100, 95

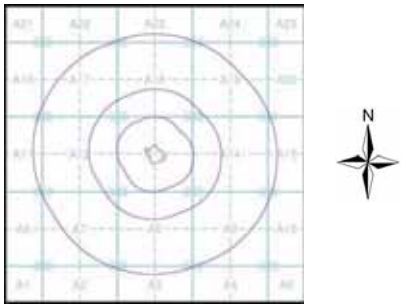
Master Contour

Spot Height 167.8

MLW Mean Low Water

MHW Mean High Water

EA/NRW Flood Data Map - Slice A



Order Details

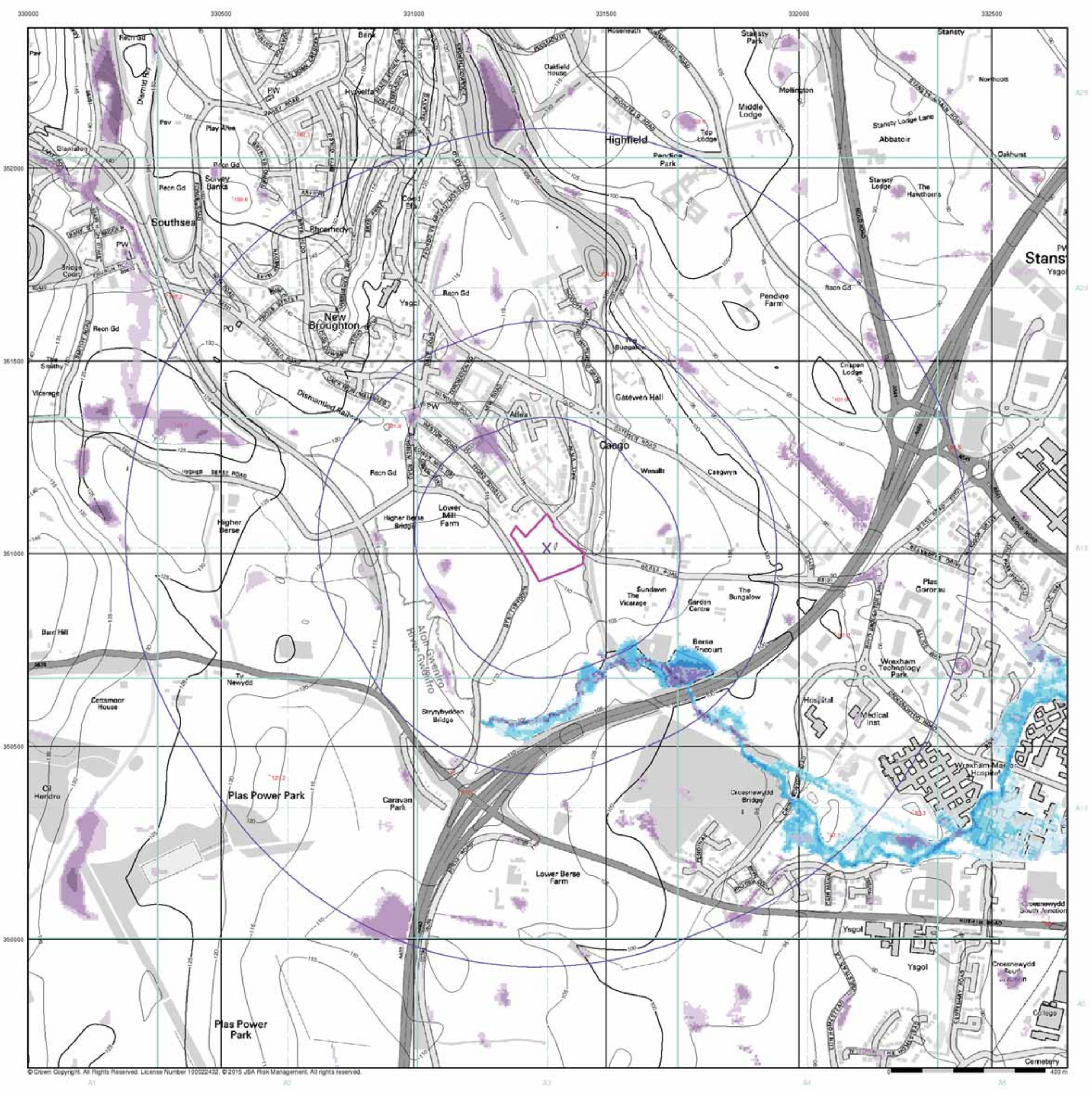
Order Number:	68740378_1_1
Customer Ref:	w1892
National Grid Reference:	331350, 351020
Slice:	A
Site Area (Ha):	1.7
Search Buffer (m):	1000

Site Details

3 Berse Road, Caego, WREXHAM, Clwyd, LL11 6TP

Landmark Information Group

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



Envirocheck Flood

JBA 75 Year Return Flood Map (Undefended) (1:10,000)

General

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

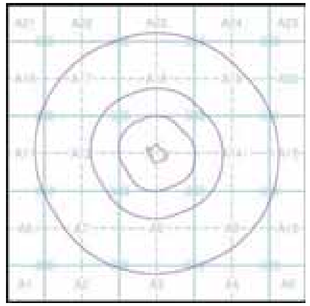
Modelled Flood Depth

Pluvial Depth	Fluvial Depth	Coastal Depth
< 1cm	0.5mm - 10cm	< 10cm
1cm - 10cm	10cm - 30cm	10cm - 30cm
10cm - 30cm	30cm - 1m	30cm - 1m
30cm - 1m	>1m	>1m
>1m		

Contours (height in meters)

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

JBA 75 Year Return Flood Map (Undefended) - Slice A



Order Details

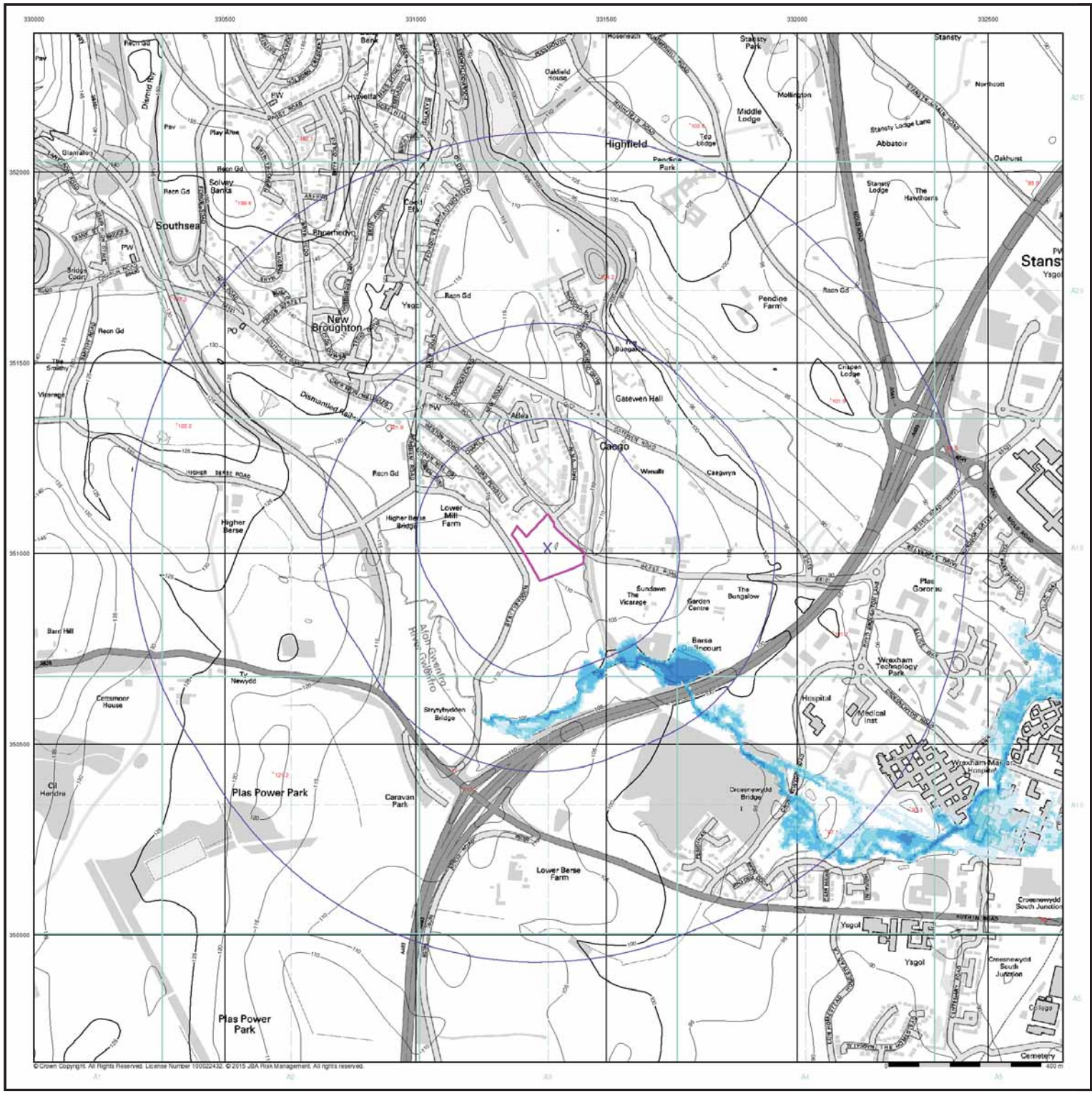
Order Number:	68740378_1_1
Customer Ref:	w1892
National Grid Reference:	331350, 351020
Slice:	A
Site Area (Ha):	1.7
Search Buffer (m):	1000

Site Details

3 Berse Road, Caego, WREXHAM, Clwyd, LL11 6TP

Landmark Information Group

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



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Envirocheck® Flood

JBA 100 Year Return Flood Map (Undefended) (1:10,000)

General

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

Modelled Flood Depth

Fluvial Depth	Coastal Depth
0.5mm - 10cm	< 10cm
10cm - 30cm	10cm - 30cm
30cm - 1m	30cm - 1m
>1m	>1m

Contours (height in meters)

Standard Contour — 105, 100, 95

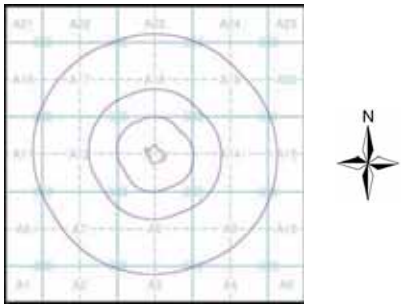
Master Contour

Spot Height — 167.8

MLW — Mean Low Water

MHW — Mean High Water

JBA 100 Year Return Flood Map (Undefended) - Slice A



Order Details

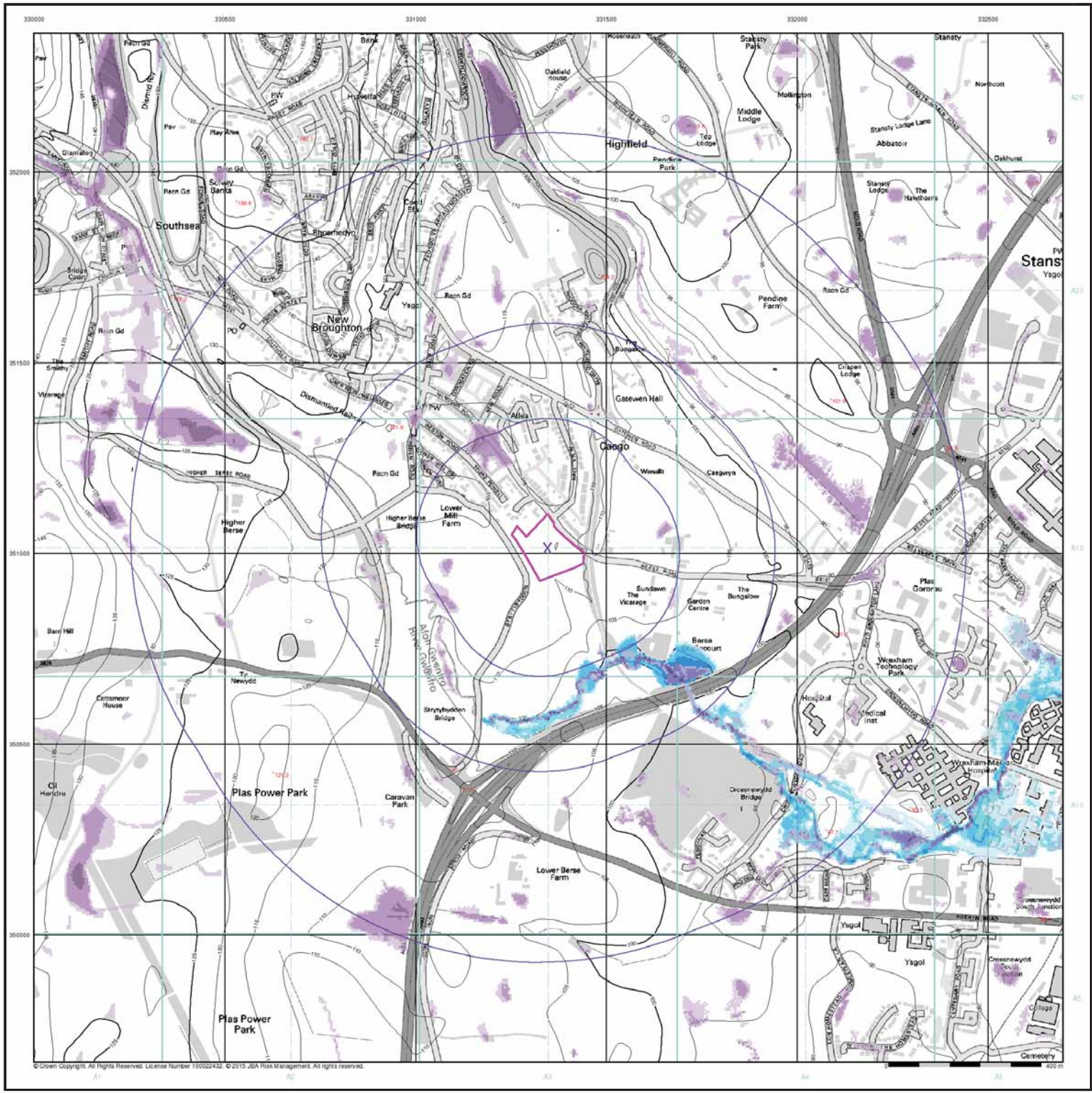
Order Number:	68740378_1_1
Customer Ref:	w1892
National Grid Reference:	331350, 351020
Slice:	A
Site Area (Ha):	1.7
Search Buffer (m):	1000

Site Details

3 Berse Road, Caego, WREXHAM, Clwyd, LL11 6TP

Landmark Information Group

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



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Envirocheck® Flood

JBA 200 Year Return Flood Map (Undefended) (1:10,000)

General

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

Modelled Flood Depth

Pluvial Depth	Fluvial Depth	Coastal Depth
< 1cm	0.5mm - 10cm	< 10cm
1cm - 10cm	10cm - 30cm	10cm - 30cm
10cm - 30cm	30cm - 1m	30cm - 1m
30cm - 1m	>1m	>1m
>1m		

Contours (height in meters)

Standard Contour — 105, 100, 95

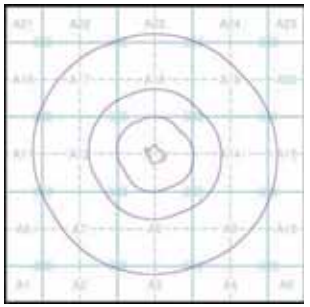
Master Contour

Spot Height 167.8

MLW Mean Low Water

MHW Mean High Water

JBA 200 Year Return Flood Map (Undefended) - Slice A



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Order Details

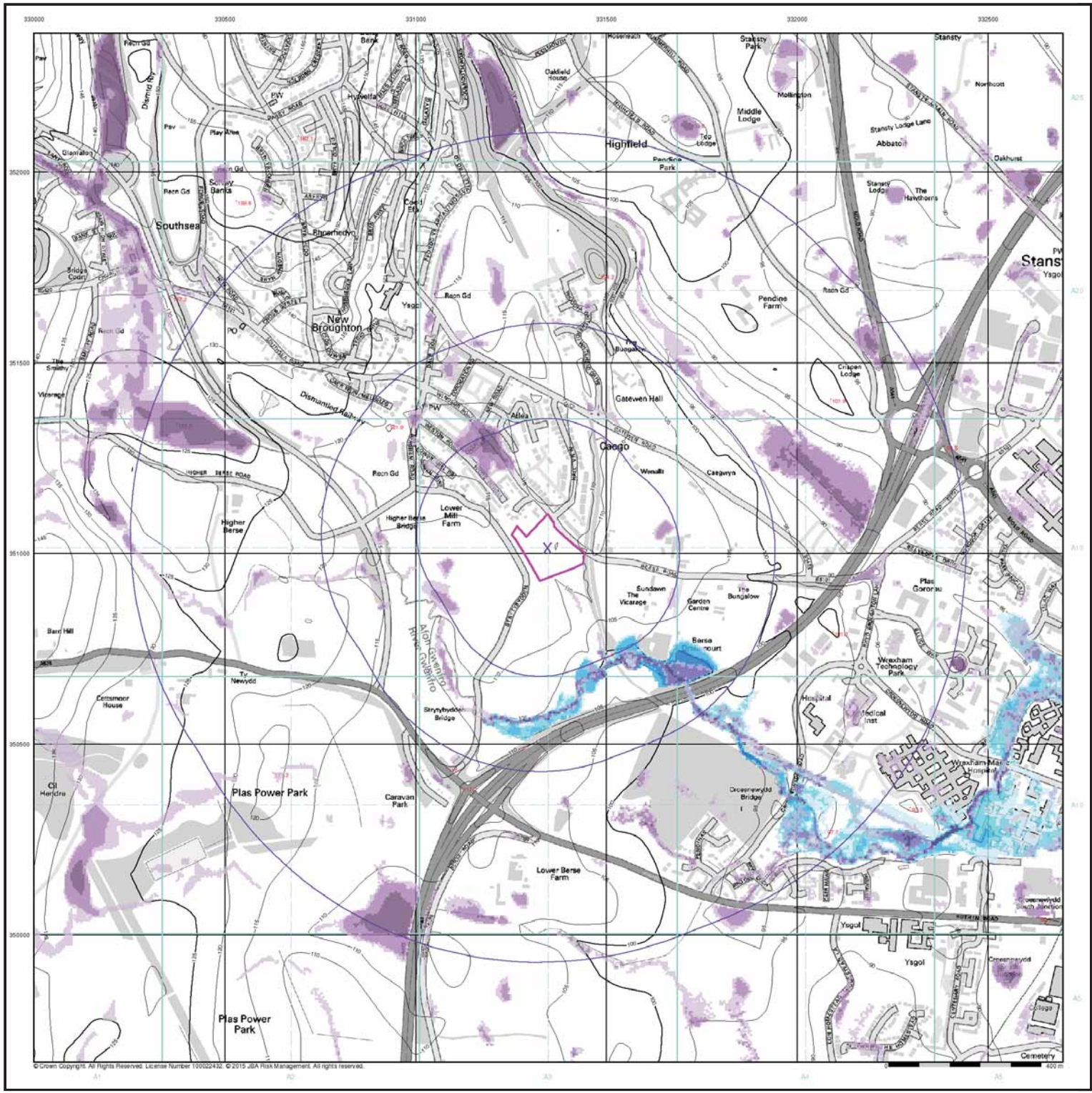
Order Number:	68740378_1_1
Customer Ref:	w1892
National Grid Reference:	331350, 351020
Slice:	A
Site Area (Ha):	1.7
Search Buffer (m):	1000

Site Details

3 Berse Road, Caego, WREXHAM, Clwyd, LL11 6TP

Landmark Information Group

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



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Envirocheck® Flood

JBA 1000 Year Return Flood Map (Undefended) (1:10,000)

General

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

Modelled Flood Depth

Pluvial Depth	Fluvial Depth	Coastal Depth
< 1cm	0.5mm - 10cm	< 10cm
1cm - 10cm	10cm - 30cm	10cm - 30cm
10cm - 30cm	30cm - 1m	30cm - 1m
30cm - 1m	>1m	>1m
>1m		

Contours (height in meters)

Standard Contour — 105, 100, 95

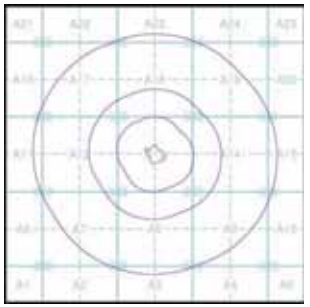
Master Contour

Spot Height 167.8

MLW Mean Low Water

MHW Mean High Water

JBA 1000 Year Return Flood Map (Undefended) - Slice A



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Order Details

Order Number:	68740378_1_1
Customer Ref:	w1892
National Grid Reference:	331350, 351020
Slice:	A
Site Area (Ha):	1.7
Search Buffer (m):	1000

Site Details

3 Berse Road, Caego, WREXHAM, Clwyd, LL11 6TP

Landmark Information Group

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

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Envirocheck® Flood

JBA Canal Failure Map (1:10,000)

General

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

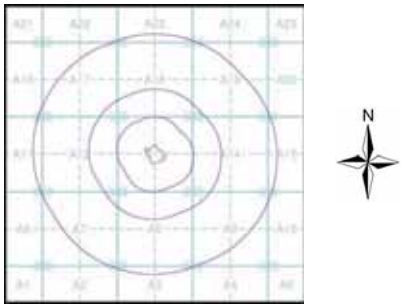
Flood Data

- Canal Failure
- Coverage

Contours (height in meters)

- Standard Contour — 105, 100, 95
- Master Contour
- Spot Height — 167.8
- MLW — Mean Low Water
- MHW — Mean High Water

JBA Canal Failure Flood Map - Slice A



Order Details

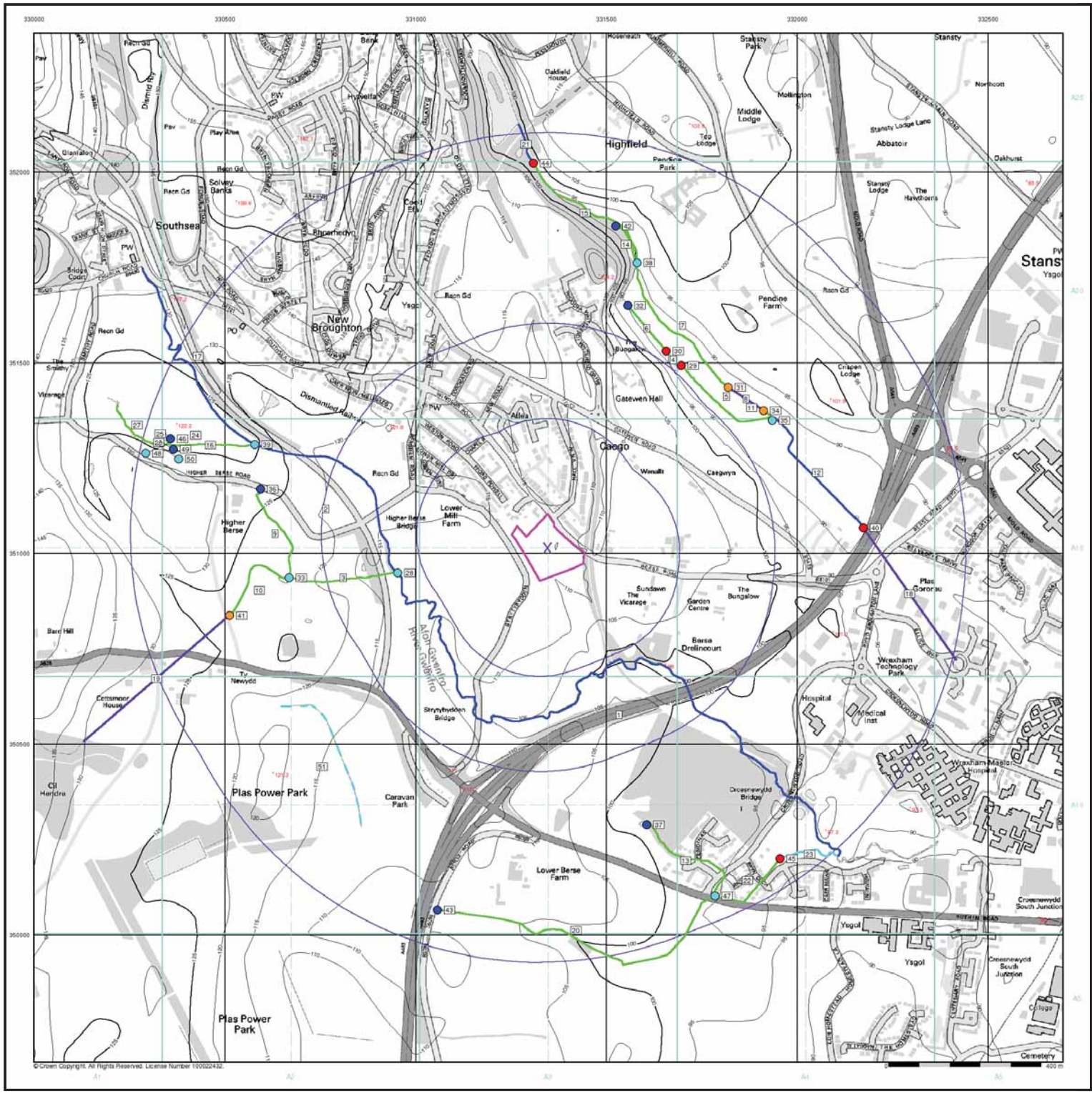
Order Number:	68740378_1_1
Customer Ref:	w1892
National Grid Reference:	331350, 351020
Slice:	A
Site Area (Ha):	1.7
Search Buffer (m):	1000

Site Details

3 Berse Road, Caego, WREXHAM, Clwyd, LL11 6TP

Landmark Information Group

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



Envirocheck® Flood

Detailed River Network Map (1:10,000)

General

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

Detailed River Network Data

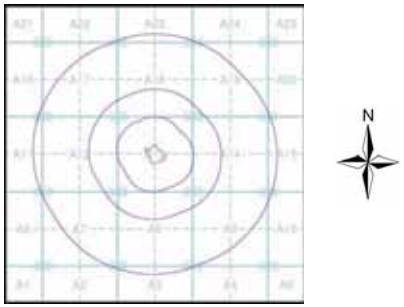
- Primary River
- Secondary River
- Tertiary River
- Canal
- Canal Tunnel
- Undefined River
- Lake/Reservoir
- Extended Culvert (greater than 50m)
- Underground River (inferred)
- Underground River (local knowledge)
- Downstream of High Water Mark
- Downstream of Seaward Extension
- Not assigned River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

- Source
- Junction
- Sink
- Non-interactive Node
- Offline Drainage Feature
- Not assigned River feature
- Pseudo Node (general)
- Pseudo Node (High Water Mark)
- Pseudo Node (OS MasterMap polygon boundary)

Contours (height in meters)

Standard Contour — 105, 100, 95
Master Contour
Spot Height — 167.3
MLW — Mean Low Water
MHW — Mean High Water

Detailed River Network Map - Slice A



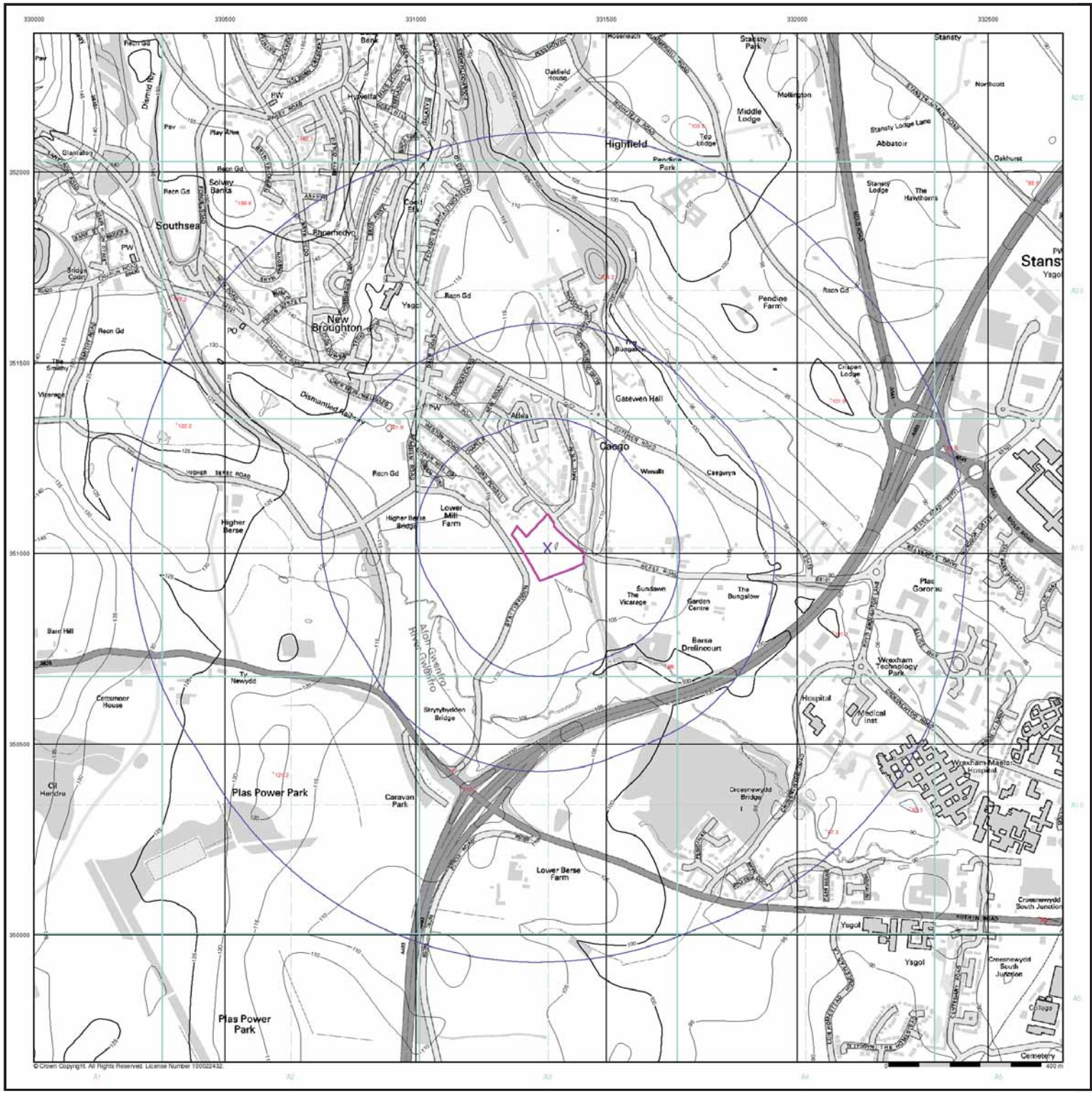
Order Details

Order Number:	68740378_1_1
Customer Ref:	w1892
National Grid Reference:	331350, 351020
Slice:	A
Site Area (Ha):	1.7
Search Buffer (m):	1000

Site Details

3 Berse Road, Caego, WREXHAM, Clwyd, LL11 6TP

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



Envirocheck® Flood

EA/NRW Historic Flood Map (1:10,000)

General

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

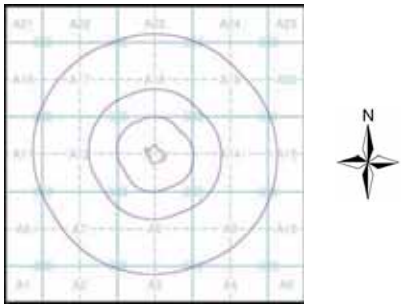
Historic Flood Events Data

- Channel Capacity Exceeded (no raised defences)
- Groundwater/High Water Table
- Local Drainage/Surface Water
- Mechanical Failure
- Obstruction/Blockage - Bridge
- Obstruction/Blockage - Channel
- Obstruction/Blockage - Culvert
- Obstruction/Blockage - Debris Screen
- Operational Failure/ Breach of Defence
- Other
- Overtopping of Defences
- Unknown
- Historical Flood Liabilities

Contours (height in meters)

- Standard Contour (105, 100, 95)
- Master Contour
- Spot Height (157.8)
- MLW Mean Low Water
- MHW Mean High Water

EA/NRW Historic Flood Map - Slice A



Order Details

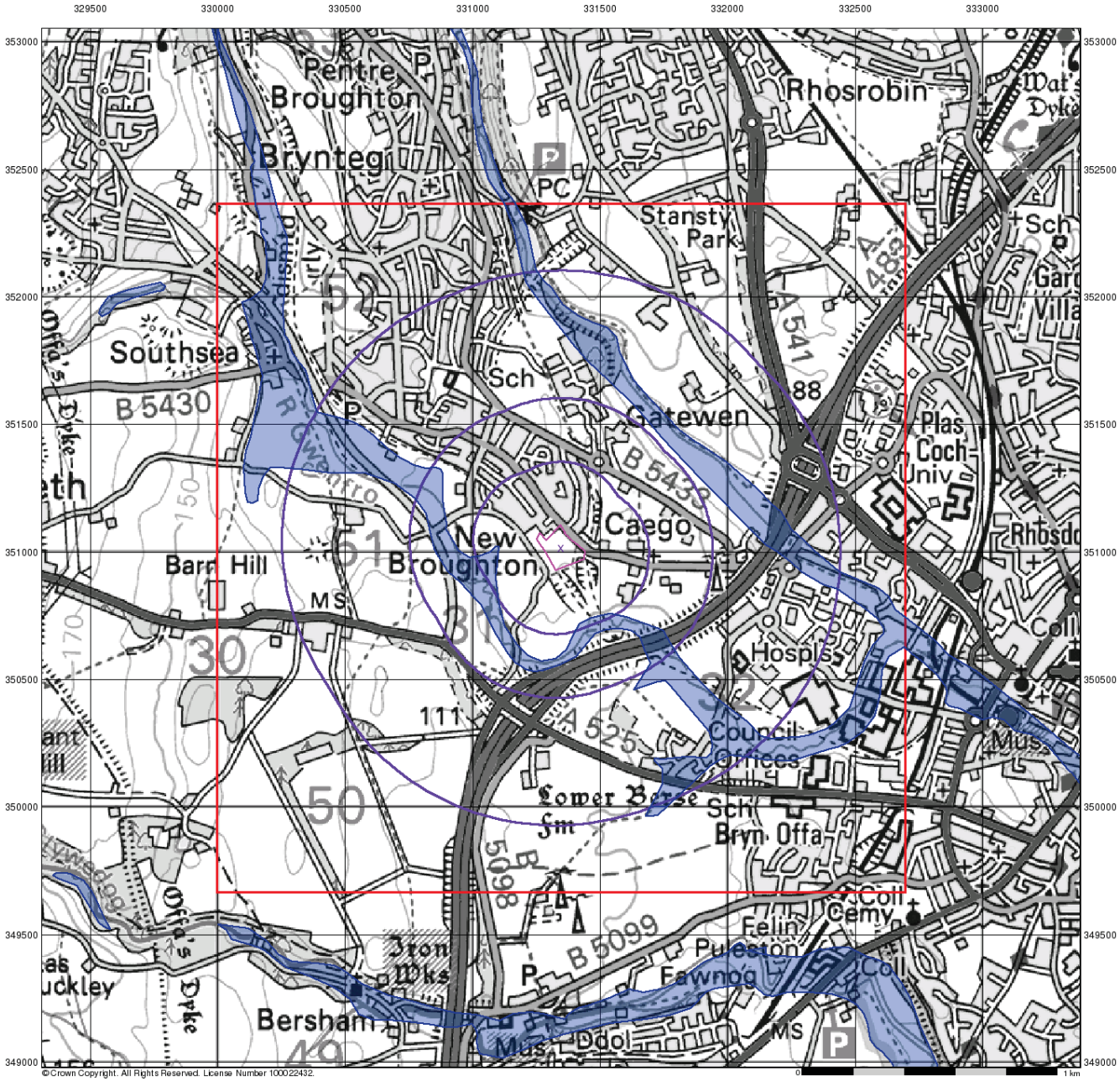
Order Number:	68740378_1_1
Customer Ref:	w1892
National Grid Reference:	331350, 351020
Slice:	A
Site Area (Ha):	1.7
Search Buffer (m):	1000

Site Details

3 Berse Road, Caego, WREXHAM, Clwyd, LL11 6TP

Landmark Information Group

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



Envirocheck® Flood

BGS Flood Data (1:50,000)

General

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

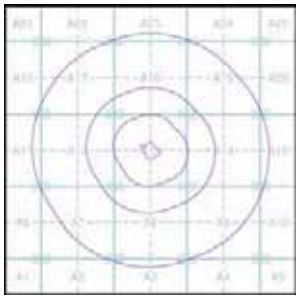
BGS Geological Indicators of Flooding

Coastal

Inland

Bodies of Water

BGS Flood Data Map - Slice A



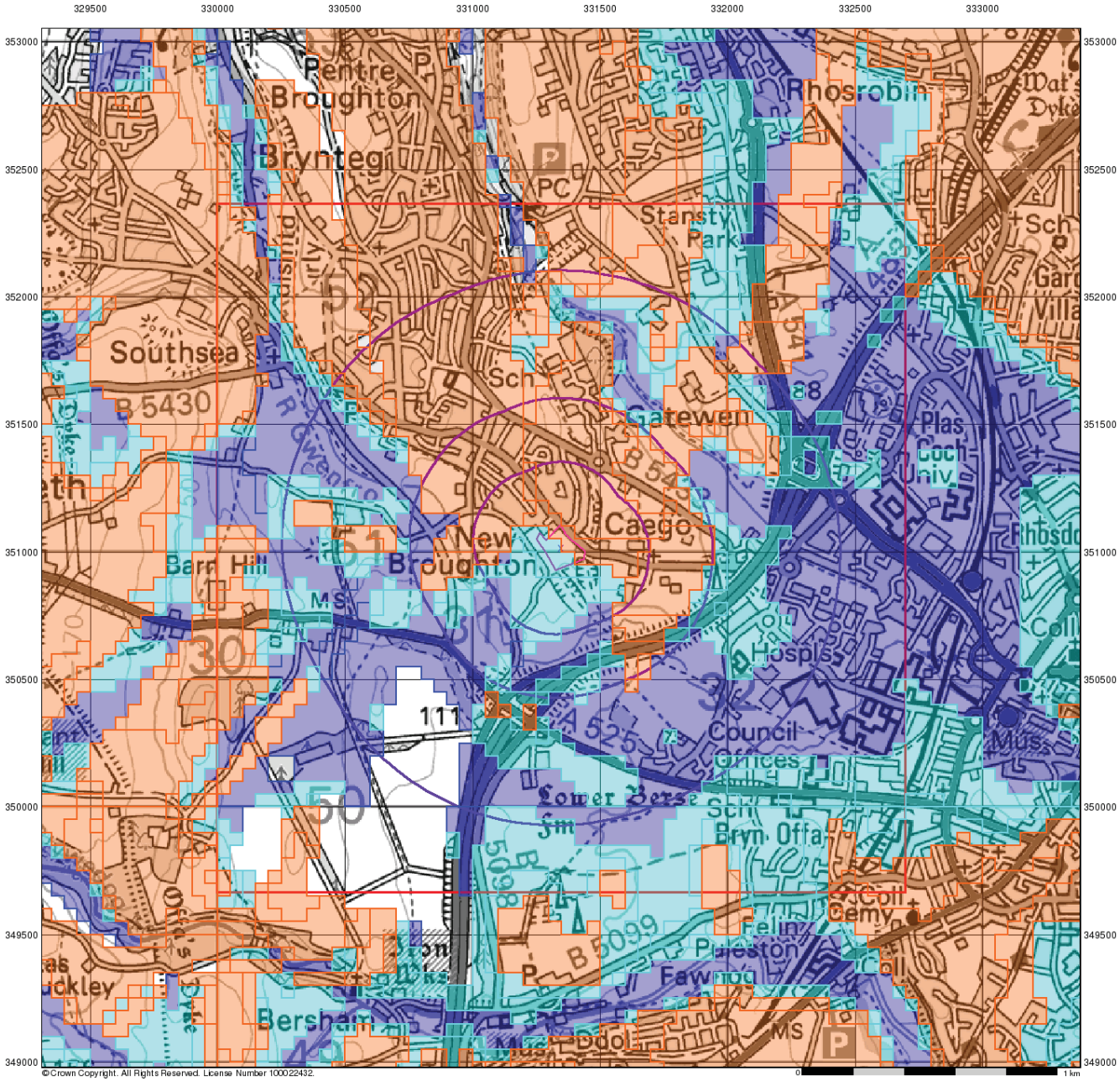
Order Details

Order Number:	68740378_1_1
Customer Ref:	w1892
National Grid Reference:	331350, 351020
Slice:	A
Site Area (Ha):	1.7
Search Buffer (m):	1000

Site Details

3 Berse Road, Caego, WREXHAM, Clwyd, LL11 6TP

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



Envirocheck® Flood

BGS Flood Data (1:50,000)

General

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

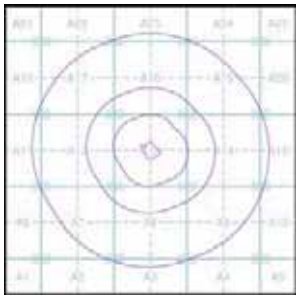
BGS Groundwater Flooding Susceptibility

Potential for Groundwater Flooding to Occur at Surface

Potential for Groundwater Flooding of Property Situated Below Ground Level

Limited Potential for Groundwater Flooding to Occur

BGS Flood Data Map - Slice A



N

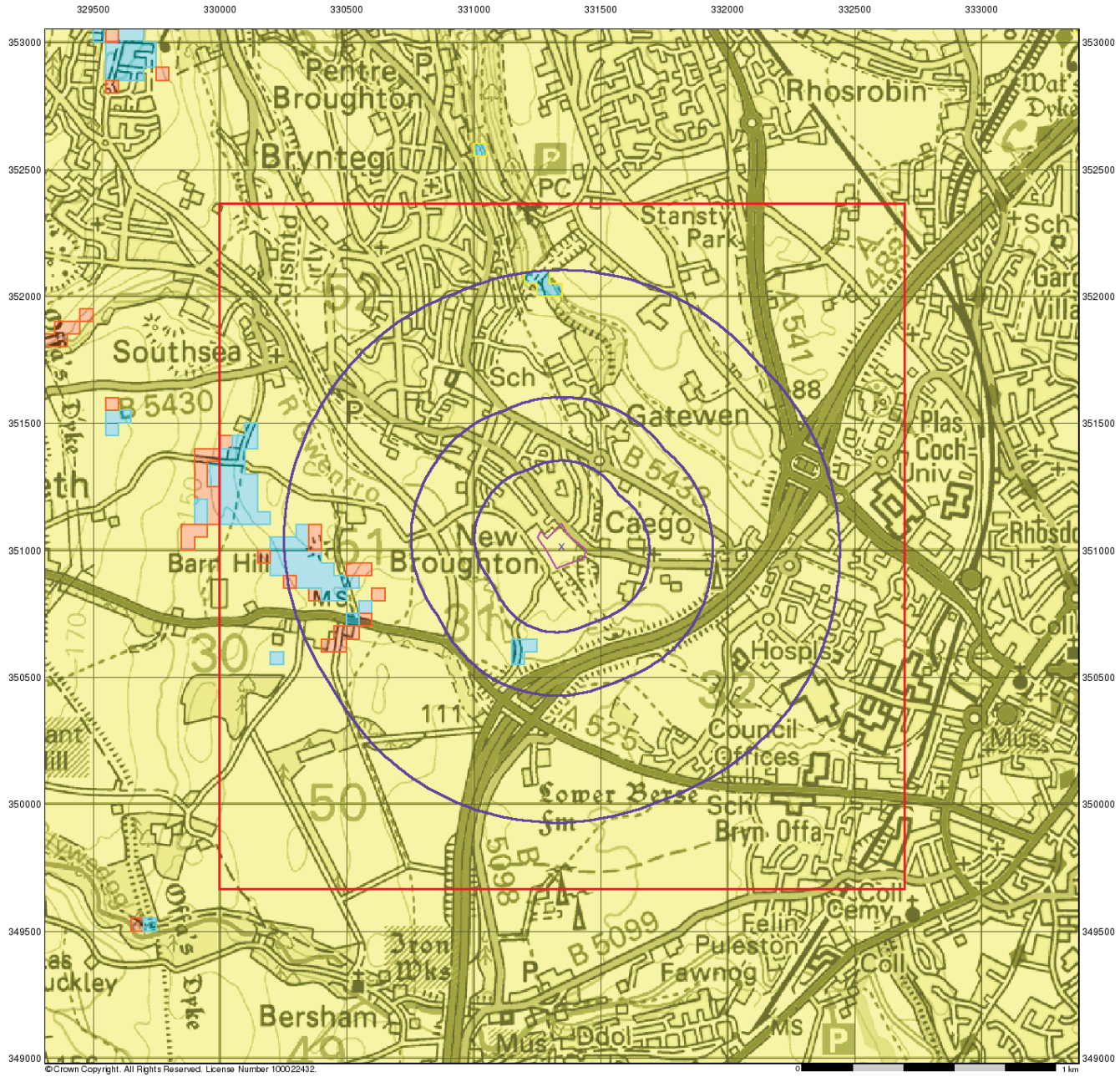
Order Details

Order Number:	68740378_1_1
Customer Ref:	w1892
National Grid Reference:	331350, 351020
Slice:	A
Site Area (Ha):	1.7
Search Buffer (m):	1000

Site Details

3 Berse Road, Caego, WREXHAM, Clwyd, LL11 6TP

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



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Envirocheck® Flood

ESI Groundwater Flood Map (1:50,000)

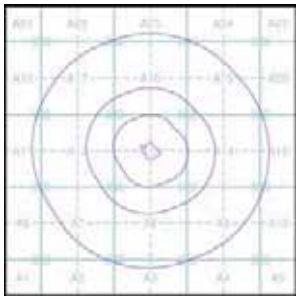
General

Specified Site
Specified Buffer(s)
Bearing Reference Point
Slice

ESI Groundwater Flooding Risk

High Risk
Moderate Risk
Low Risk
Negligible Risk

ESI Groundwater Flood Map - Slice A



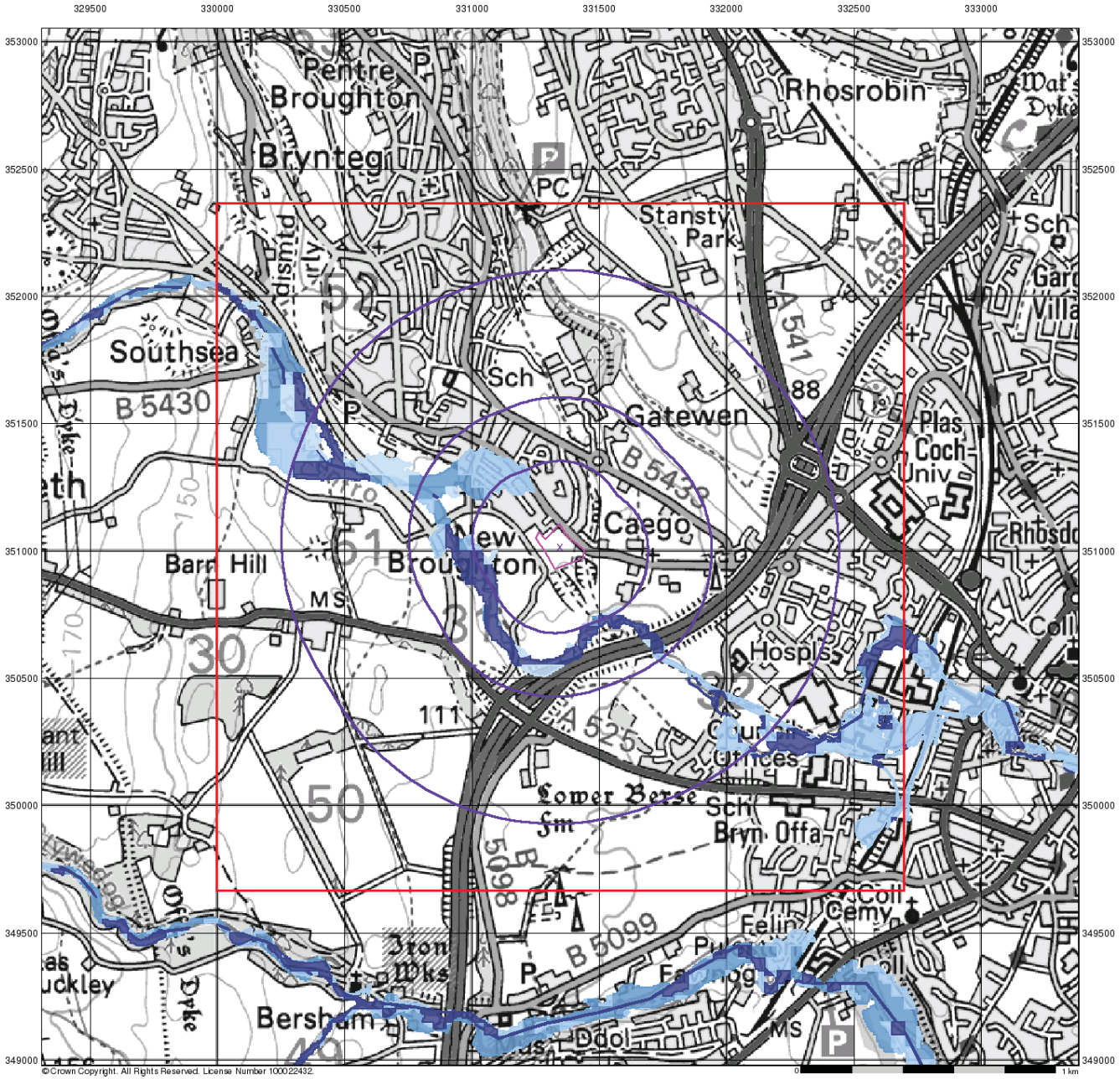
Order Details

Order Number:	68740378_1_1
Customer Ref:	w1892
National Grid Reference:	331350, 351020
Slice:	A
Site Area (Ha):	1.7
Search Buffer (m):	1000

Site Details

3 Berse Road, Caego, WREXHAM, Clwyd, LL11 6TP

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



Envirocheck® Flood

EA/NRW RoFRS Data (1:50,000)

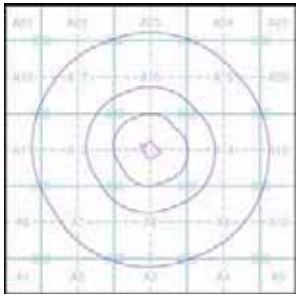
General

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

Risk of Flooding from Rivers and Sea (RoFRS)

High Risk
Medium Risk
Low Risk
Very Low Risk

EA/NRW RoFRS Data Map - Slice A



Order Details

Order Number:	68740378_1_1
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Slice:	A
Site Area (Ha):	1.7
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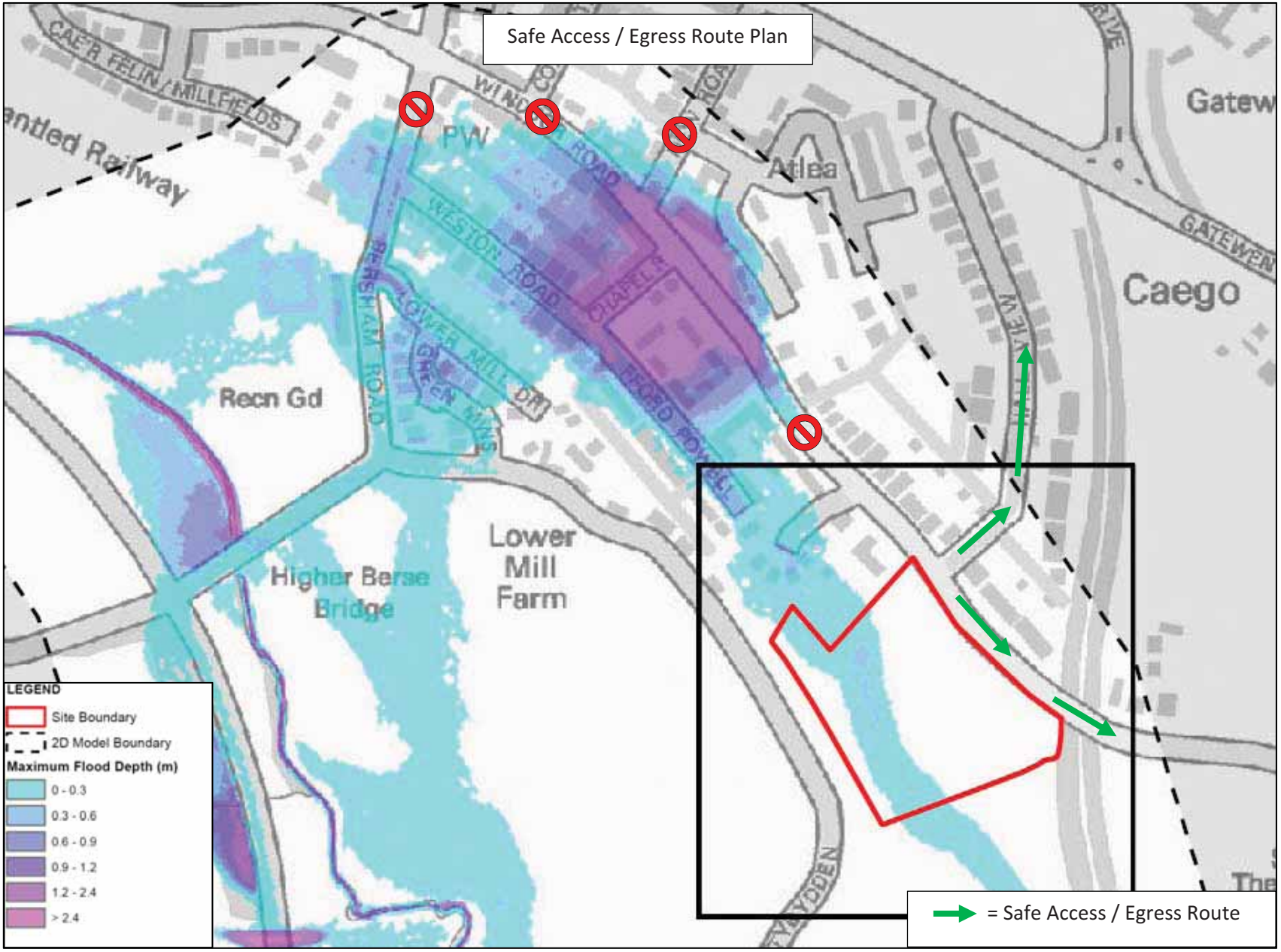
Site Details

3 Berse Road, Caego, WREXHAM, Clwyd, LL11 6TP

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

Appendix F – Safe Access / Egress Route Plan


Safe Access / Egress Route Plan
CAE'R FELIN / MILLFIELDS
Railway
PW
WESTON ROAD
CHAPEL R
LOWER MILL DR
GREEN MINS
BERSHAM ROAD
FEORD POWELL
Atlea
Gatew
GATEWEN
Caego
Recn Gd
Higher Berse Bridge
Lower Mill Farm
LEGEND
Site Boundary
2D Model Boundary
Maximum Flood Depth (m)
0 - 0.3
0.3 - 0.6
0.6 - 0.9
0.9 - 1.2
1.2 - 2.4
> 2.4
= Safe Access / Egress Route

Appendix G – MicroDrainage Runoff & Storage Calculations

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.300
Area (ha)	1.670	Urban	0.000
SAAR (mm)	933	Region Number	Region 9

Results	**l/s**
QBAR Rural	4.3
QBAR Urban	4.3
Q100 years	9.3
Q1 year	3.7
Q30 years	7.5
Q100 years	9.3

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Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.567	0.567	4.9	108.4	O K
30 min Summer	9.678	0.678	4.9	148.5	O K
60 min Summer	9.796	0.796	4.9	192.0	O K
120 min Summer	9.911	0.911	4.9	233.9	Flood Risk
180 min Summer	9.968	0.968	4.9	253.7	Flood Risk
240 min Summer	9.995	0.995	4.9	263.1	Flood Risk
360 min Summer	10.013	1.013	4.9	269.2	Flood Risk
480 min Summer	10.008	1.008	4.9	267.4	Flood Risk
600 min Summer	9.997	0.997	4.9	263.6	Flood Risk
720 min Summer	9.986	0.986	4.9	260.1	Flood Risk
960 min Summer	9.966	0.966	4.9	253.2	Flood Risk
1440 min Summer	9.925	0.925	4.9	238.9	Flood Risk
2160 min Summer	9.859	0.859	4.9	215.2	O K
2880 min Summer	9.792	0.792	4.9	190.4	O K
4320 min Summer	9.638	0.638	4.9	133.9	O K
5760 min Summer	9.499	0.499	4.9	85.2	O K
7200 min Summer	9.390	0.390	4.9	51.2	O K
8640 min Summer	9.302	0.302	4.9	28.3	O K
10080 min Summer	9.227	0.227	4.9	14.2	O K
15 min Winter	9.606	0.606	4.9	122.3	O K
30 min Winter	9.731	0.731	4.9	167.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	103.568	0.0	115.3	26
30 min Summer	71.433	0.0	159.1	40
60 min Summer	47.182	0.0	210.2	70
120 min Summer	30.112	0.0	268.3	128
180 min Summer	22.787	0.0	304.6	186
240 min Summer	18.543	0.0	330.4	244
360 min Summer	13.812	0.0	369.3	362
480 min Summer	11.202	0.0	399.3	468
600 min Summer	9.512	0.0	423.8	522
720 min Summer	8.317	0.0	444.6	586
960 min Summer	6.722	0.0	479.2	714
1440 min Summer	4.967	0.0	531.1	988
2160 min Summer	3.660	0.0	587.0	1408
2880 min Summer	2.942	0.0	629.1	1820
4320 min Summer	2.158	0.0	692.2	2600
5760 min Summer	1.732	0.0	740.7	3288
7200 min Summer	1.461	0.0	781.2	3960
8640 min Summer	1.272	0.0	816.2	4584
10080 min Summer	1.132	0.0	847.0	5248
15 min Winter	103.568	0.0	129.2	26
30 min Winter	71.433	0.0	178.2	40

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Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	9.866	0.866	4.9	217.5	O K
120 min Winter	10.006	1.006	4.9	266.7	Flood Risk
180 min Winter	10.082	1.082	4.9	291.1	Flood Risk
240 min Winter	10.125	1.125	4.9	303.8	Flood Risk
360 min Winter	10.165	1.165	5.0	314.8	Flood Risk
480 min Winter	10.172	1.172	5.0	316.6	Flood Risk
600 min Winter	10.159	1.159	5.0	313.3	Flood Risk
720 min Winter	10.137	1.137	4.9	307.4	Flood Risk
960 min Winter	10.101	1.101	4.9	296.9	Flood Risk
1440 min Winter	10.034	1.034	4.9	276.0	Flood Risk
2160 min Winter	9.925	0.925	4.9	239.0	Flood Risk
2880 min Winter	9.817	0.817	4.9	199.8	O K
4320 min Winter	9.566	0.566	4.9	108.0	O K
5760 min Winter	9.363	0.363	4.9	43.5	O K
7200 min Winter	9.207	0.207	4.8	11.4	O K
8640 min Winter	9.107	0.107	4.4	2.4	O K
10080 min Winter	9.067	0.067	4.0	0.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	47.182	0.0	235.4	68
120 min Winter	30.112	0.0	300.5	126
180 min Winter	22.787	0.0	341.2	182
240 min Winter	18.543	0.0	370.0	240
360 min Winter	13.812	0.0	413.5	354
480 min Winter	11.202	0.0	447.2	464
600 min Winter	9.512	0.0	474.7	570
720 min Winter	8.317	0.0	497.9	664
960 min Winter	6.722	0.0	536.6	754
1440 min Winter	4.967	0.0	594.7	1068
2160 min Winter	3.660	0.0	657.6	1524
2880 min Winter	2.942	0.0	704.6	1968
4320 min Winter	2.158	0.0	775.2	2728
5760 min Winter	1.732	0.0	829.6	3344
7200 min Winter	1.461	0.0	875.0	3832
8640 min Winter	1.272	0.0	914.1	4408
10080 min Winter	1.132	0.0	948.7	5128

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Shortest Storm (mins)	15
Ratio R	0.302	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.594

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.198	4	8	0.198	8	12	0.198

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Model Details

Storage is Online Cover Level (m) 10.200

Double Pipe Structure

Diameter (m)	1.200	Length (m)	155.000
Slope (1:X)	500.000	Invert Level (m)	9.000

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0102-5000-1200-5000
Design Head (m)	1.200
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	102
Invert Level (m)	8.950
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.200	5.0
Flush-Flo™	0.353	4.9
Kick-Flo®	0.740	4.0
Mean Flow over Head Range	-	4.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	3.4	1.200	5.0	3.000	7.6	7.000	11.4
0.200	4.7	1.400	5.3	3.500	8.2	7.500	11.8
0.300	4.9	1.600	5.7	4.000	8.7	8.000	12.1
0.400	4.9	1.800	6.0	4.500	9.2	8.500	12.5
0.500	4.8	2.000	6.3	5.000	9.7	9.000	12.8
0.600	4.6	2.200	6.6	5.500	10.2	9.500	13.2
0.800	4.1	2.400	6.9	6.000	10.6		
1.000	4.6	2.600	7.1	6.500	11.0		

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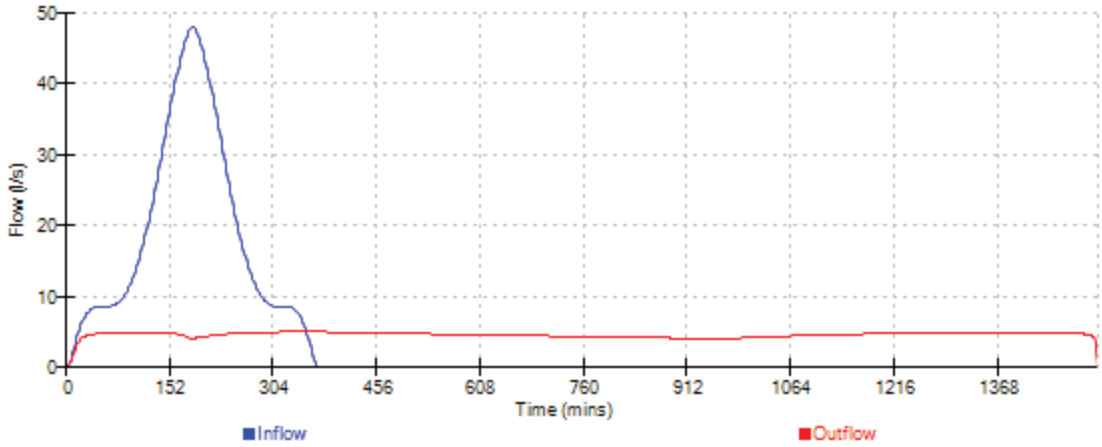
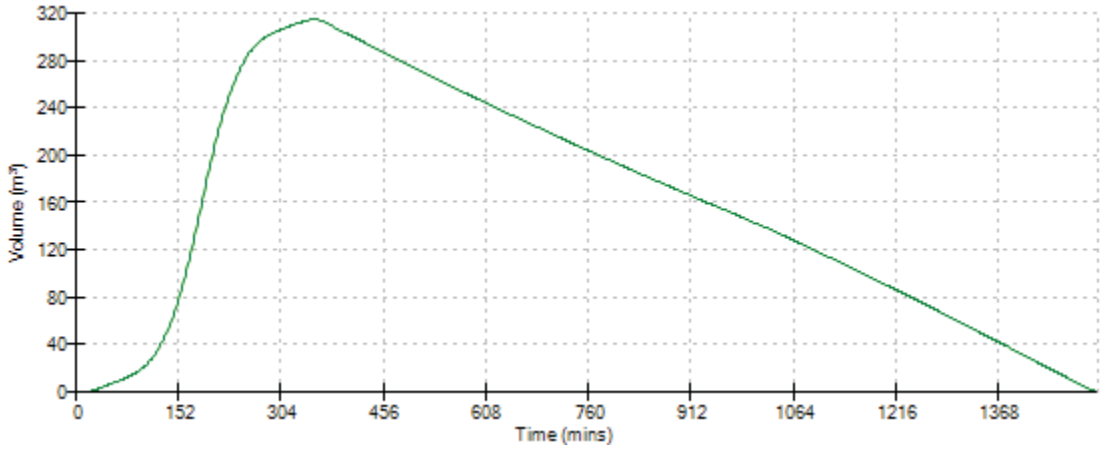
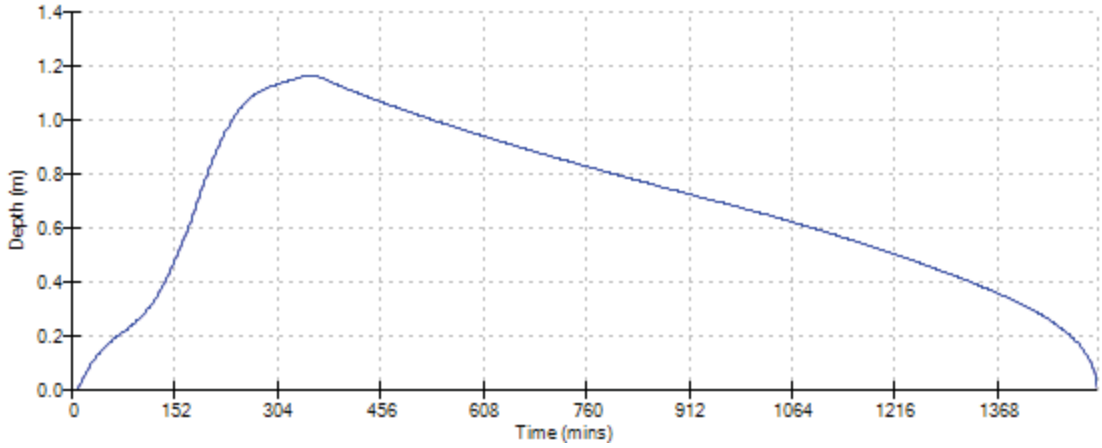
Event: 360 min Winter







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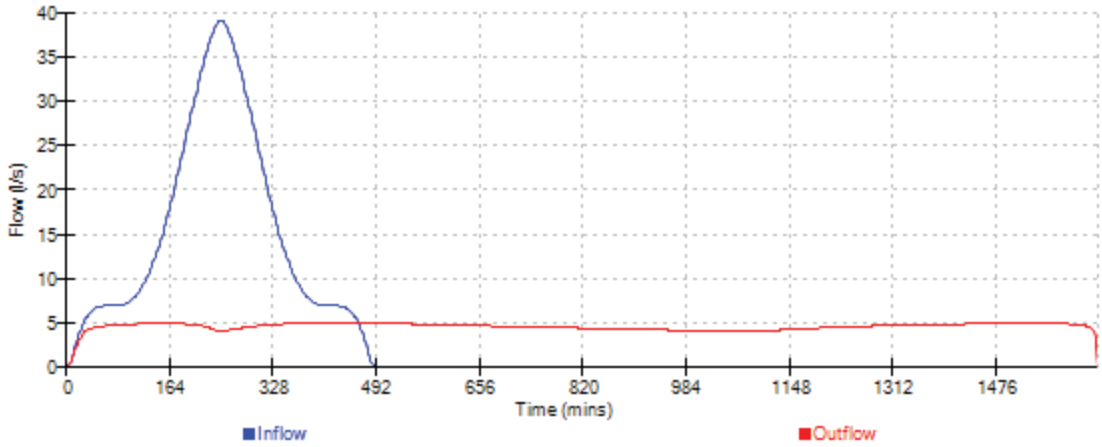
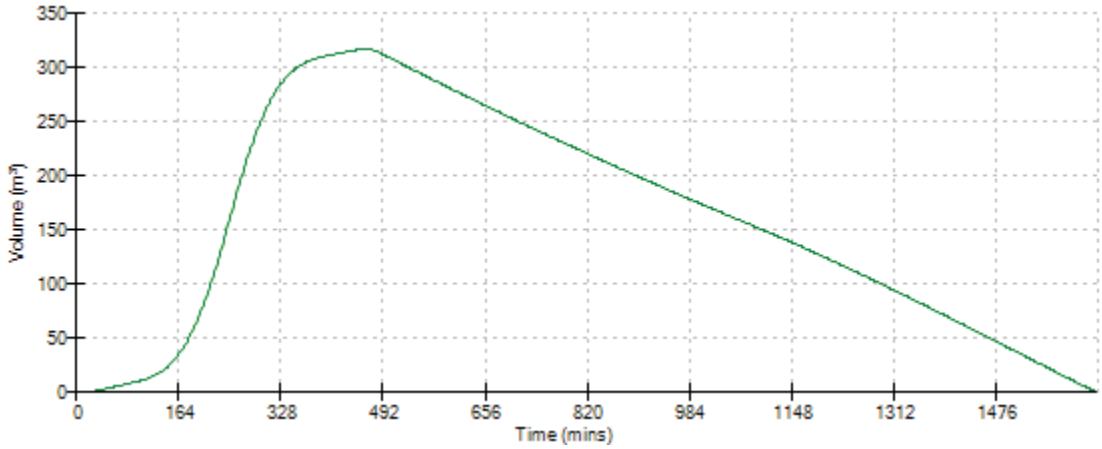
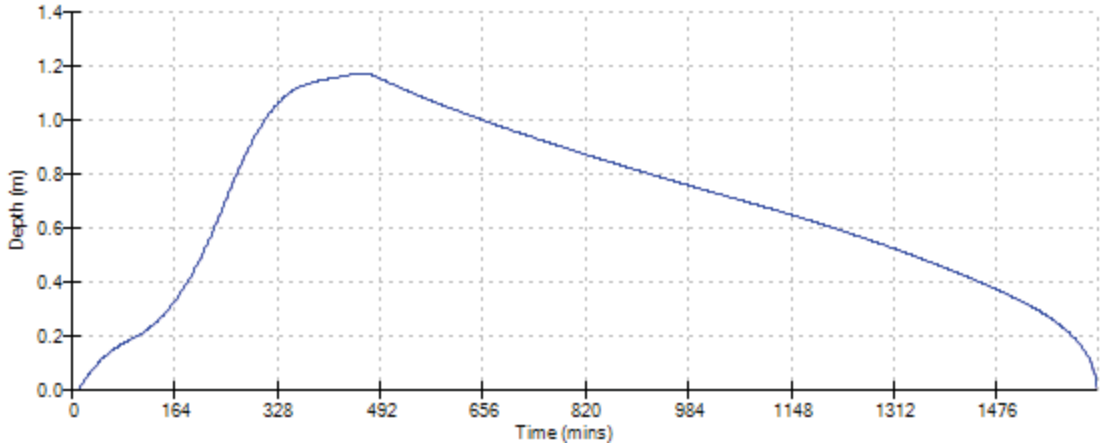
Event: 480 min Winter







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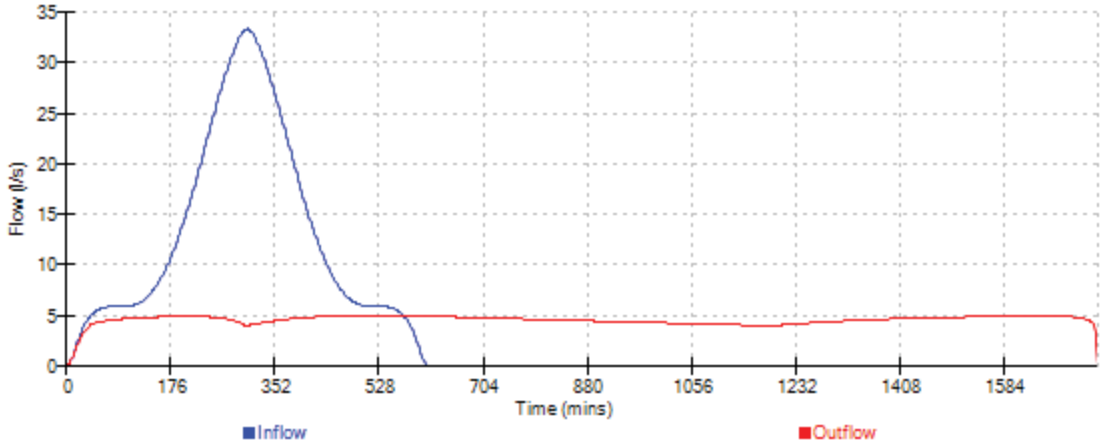
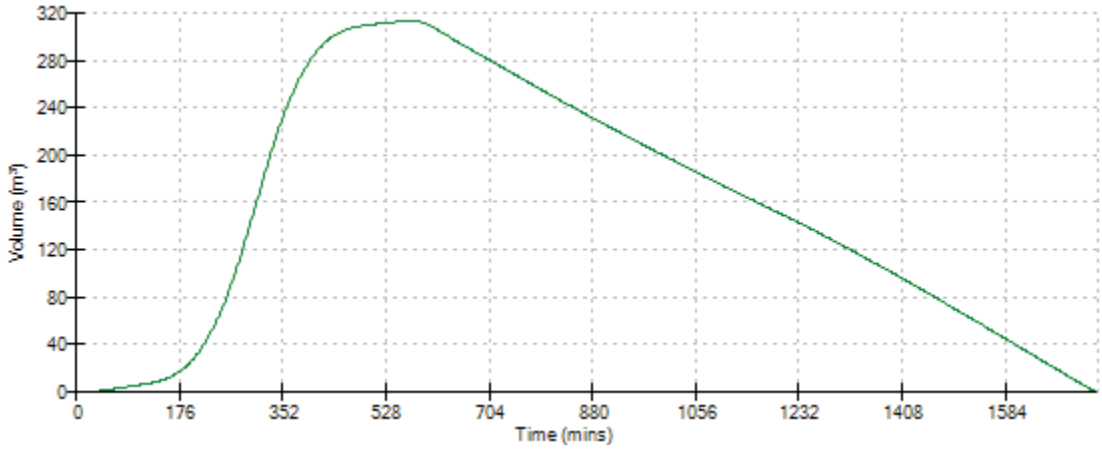
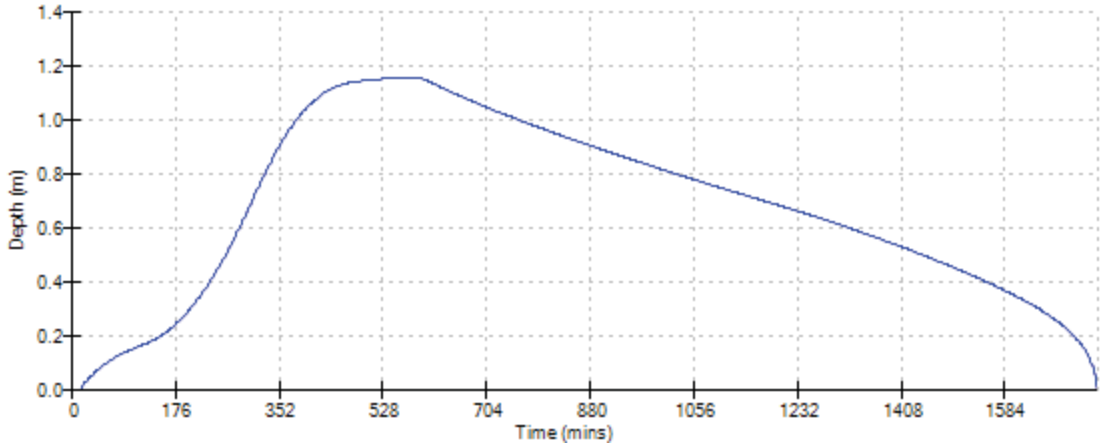
Event: 600 min Winter







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