Environmental Statement

Appendix 11.1: Flood Consequences Assessment and Drainage Strategy

Land at Lower Berse Farm, Wrexham

On behalf of Redrow Homes Ltd

July 2024



Lower Berse Farm, Ruthin Road, Wrexham

Flood Consequences Assessment & Drainage Strategy

July 2024



Waterco

Assessment | Modelling | Design

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This report will remain valid for a period of twelve months (from the date of last issue) after which the source data should be reviewed in order to reassess the findings and conclusions on the basis of latest available information.

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Introduction

Waterco has been instructed to prepare a Flood Consequences Assessment (FCA) and Drainage Strategy in respect of a proposed residential led development at land south of Ruthin Road, Wrexham, LL11 3BW.

The purpose of this report is to outline the potential flood risk to the site, the impact of the proposed development on flood risk elsewhere, and the proposed measures which could be incorporated to mitigate the identified flood risk. This report has been prepared in accordance with the guidance contained in Planning Policy Wales (PPW) and Technical Advice Note 15 (TAN15): Development and Flood Risk.

This report also includes a Sustainable Drainage Strategy. The aim of the Sustainable Drainage Strategy is to identify water management measures, including Sustainable Drainage Systems (SuDS), to provide surface water runoff reduction and treatment. This report has been prepared in accordance with the Welsh Government 'Statutory standards for sustainable drainage systems – designing, constructing, operating and maintaining surface water drainage systems' (2018) – herein referred to as 'the Statutory Standards for SuDS'.

Existing Conditions

The site covers an area of approximately 72.85ha and is centred on National Grid Reference (NGR) 331500, 349700. A location plan and an aerial image are included in Appendix A.

Online mapping (including Google Maps / Google Streetview imagery, accessed July 2024) shows that the majority of the site comprises agricultural land. Notable features on site include Lower Berse Farm in the north-western extent, a watercourse (unnamed) flowing east through the northern extent of the site and a bridleway crossing the centre of the site. Berse Lane intersects the site in the south-western extent. The site surrounds an existing telecommunications mast in the south-western extent.

The site is bordered by the A525 (Ruthin Road) to the north, agricultural land, Brickfield Rangers Football Club and Homestead Lane to the east, the B5099 (Bersham Road) to the south, commercial units to the south-west, and the A483 (road) to the west. Access to the site is provided from Ruthin Road, Berse Lane and Bersham Road.

Local Topography

A topographical survey has been undertaken by RJP Surveying Consultants Ltd in December 2013. The topographical survey shows that the site slopes from 87.03 metres Above Ordnance Datum (m AOD) in the south-east to 110.97m AOD in the north-west.

Topographic levels to m AOD have also been derived from a 1m resolution Natural Resources Wales (NRW) composite 'Light Detecting and Ranging' (LiDAR) Digital Terrain Model (DTM). The LiDAR data generally corroborates with the topographical survey. A LiDAR extract is provided as Appendix B.

Ground Conditions

Published Geology

The British Geological Survey (BGS) online mapping (1:50,000 scale) indicates that the central extent of the site is underlain by superficial deposits of Devensian Till, comprising diamicton. The eastern and western extents of the site are identified as being underlain by superficial Devensian Glaciofluvial Sheet Deposits comprising sand and gravel. A small extent of the site at the northern boundary is identified as being underlain by superficial deposits of Alluvium, comprising clay, silt, sand and gravel.

The superficial deposits are identified as being underlain by the Etruria Formation comprising mudstone and the Pennine Lower and Middle Coal Measures Formations comprising mudstone, siltstone and sandstone.

The geological mapping is available at a scale of 1:50,000 and as such may not be accurate on a site-specific basis.

Ground Investigations

Ground investigations have been undertaken by E3P between 27th July and 3rd August 2021 to establish ground conditions at the site and to assess the infiltration potential. In total, 23no. trial pits were excavated to depths of between 1.8 and 2.9 metres below ground level (m.bgl), soakaway testing was undertaken at each location. 10no. windowless sample boreholes were also excavated at the site to depths of between 4.45-5.45m.bgl.

The soakaway test results, borehole logs and an exploratory location plan are included in Appendix C.

Geology

The geology identified in the windowless sample boreholes and trial pits generally comprised a mixture of sand, clay and gravel. The clay content within the trail pits varied across the site.

Made Ground was encountered within 2no. trial pits in the land parcel west of Berse Lane (trial pits 115 and 116). Made Ground generally comprised brown very gravelly sand and clay with fine to coarse, subangular to angular mudstone and sandstone and occasional coal fragments and cobbles.

Infiltration Testing

Infiltration testing in accordance with the BRE3655 specification was carried out within the 23no. trial pits. The infiltration test results show the ground to be of mixed permeability. At SA102 (north-western extent), SA103 (northern extent), SA108 (central extent) and SA123 (south-western extent) no reduction in water level was recorded after 48 hours and the infiltration tests failed. This is due to localised clay content within the trial pits. The infiltration rates for the remaining trial pits ranged from 6.35×10^{-3} m/s to 9.80×10^{-6} m/s.

Hydrogeology

According to NRW's Aquifer Designation data, obtained from the BGS GeoIndex's online mapping [accessed July 2024], the underlying Devensian Till is classified as a Secondary A Aquifer. Secondary A Aquifers are 'permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as

minor aquifers'. The Devensian Glaciofluvial Sheet Deposits are classified as Secondary Undifferentiated Aquifers. Secondary Undifferentiated Aquifers are assigned in 'cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type'.

The underlying Etruria Formation and Pennine Lower and Middle Coal Measures Formations are also classified as Secondary A Aquifers.

Local Drainage

Public sewer records have been obtained from Dŵr Cymru Welsh Water (DCWW) and are included in Appendix D. The DCWW sewer records show that there is a public combined sewer crossing the site flowing south-east. The public combined sewer varies in diameter across the site and is a maximum of 600mm.

There is no record of a formal drainage system serving the site.

Development Proposals

An outline planning application is being submitted for residential development in the region of 1,450 dwellings, plus associated roads, open space, community facilities and a site for a primary school. An illustrative masterplan is included in Appendix E.

Flood Zone Category and Policy Context

Flood Zone Category

The Welsh Government Development Advice Map, included in Appendix F, shows that the majority of the site is located within Flood Zone A – an area considered to be at little or no risk of fluvial or tidal flooding, with a less than 0.1% (1 in 1000) annual probability of flooding.

Land at the north-eastern boundary adjoining Ruthin Road is identified as being located within Flood Zone C2 – an area considered at flood risk, without significant defence infrastructure, with a 0.1% (1 in 1000) or greater annual probability of flooding. The Flood Zone C2 extent in this location is associated with the unnamed watercourse which crosses the northern extent of the site and becomes culverted beneath Ruthin Road. The flood extent is shown immediately upstream of the Ruthin Road culverts indicating that the culverts are not of sufficient capacity to accommodate flood flows.

Land in the north-western extent of the site is also shown within Flood Zone C2. The Flood Zone C2 extent in this location is associated with the unnamed watercourse which crosses the northern extent of the site and generates as a result flood flows backing up behind an existing culvert beneath an agricultural land crossing.

Land immediately adjacent to the Flood Zone C2 extent is shown within Flood Zone B – an area known to have flooded in the past evidenced by sedimentary deposits.

The NRW 'Flood Risk from Rivers' map (Appendix F), shows that the majority of the site is outside of the extreme flood extent, meaning it has a less than 0.1% annual probability of flooding. Land at the north-eastern boundary adjoining Ruthin Road is identified is shown at 'high' risk of flooding from rivers, with a 3.3% (1 in 30) or greater annual probability of fluvial flooding. The high risk flood extent concurs with the Flood Zone C2 extent.

Land in the north-western extent of the site (concurring with the Flood Zone C2 extent) is shown at low risk of fluvial flooding, with between a 1% (1 in 100) and 0.1% annual probability of flooding.

Development Vulnerability Classification

The proposed residential development is considered to be 'highly vulnerable' development in accordance with Figure 2 of the Welsh Government's Technical Advice Note 15 – Development and Flood Risk (TAN15).

TAN15 states that highly vulnerable development is considered appropriate in Flood Zone A subject to not increasing flood risk elsewhere.

TAN15 states that highly vulnerable development is not considered appropriate within Flood Zone C2. As part of the development, the following flood mitigation measures are proposed to ensure that all development will be located outside of the 0.1% annual probability (Flood Zone C2) extent:

- Maintain a flood storage area south-east of the Ruthin Road culvert.
- Raise the proposed access road off Ruthin Road (which will cross through the Flood Zone C2 extent) so that it is flood free during the 1% annual probability plus climate change and 0.1% annual probability events. Flood relief culverts (a box culvert) will be required beneath the raised access road to enable flood flows to be conveyed from the watercourse to the flood storage area in the north-eastern corner of the site.
- Size culverts beneath new access road crossings appropriately as to maintain the existing flow capacity of the channel.

Local Policy

The Wrexham Unitary Development Plan 1996-2011 (adopted February 2005) is the current development plan for the county and contains the following policies relating to flood risk & drainage:

'Policy GDP1 – Development Objectives

All new development should:…

i) Ensure that development does not result in, or is subject to, flooding, soil erosion, landslides or contamination either on or off the site…

Policy EC12 – Development and Flood Risk

Development (including the raising of land) within defined flood plains will only be permitted if it:

a) Would not be subject to an unacceptable risk of flooding on-site; and/or

b) Does not result in an unacceptable risk of flooding on or off-site; and/or

c) Does not adversely affect flood management or maintenance schemes.

Policy EC13 – Surface Water Runoff

Development which would result in an unacceptable adverse impact on the water environment due to additional surface water run-off will not be permitted.

Policy EC14 – Protection of Controlled Waters

Development which would have an unacceptable adverse impact upon the capacity, flow, quality or availability of controlled waters and associated land will not be permitted.'

Draft policies from the emerging Local Development Plan pertaining to flood risk include:

'Policy SP19: Climate Change

To mitigate against the effects of climate change and adapt to its impacts, development proposals will need to demonstrate that they have taken into account the following:

vi) Avoiding areas susceptible to flood risk in the first instance in accordance with the sequential approach set out in national guidance

vii) Preventing development that increases flood risk, and

vii) Assesses the potential effects of climate change when preparing a Flood Consequences Assessment for the site.

Policy DM1: Development Management Considerations

Development Proposals, where relevant, must:

i) Not increase the risk of flooding but makes adequate provision for sustainably dealing with foul and surface water drainage and not result in an unacceptable impact upon the water environment.'

Local guidance documents including the Wrexham County Borough Council (WCBC) Preliminary Flood Risk Assessment (PFRA) (June 2011 and its 2017 addendum) have been reviewed and inform this report.

Consultation

A pre-planning opinion request was submitted to NRW in April 2021. In their response (Appendix F), NRW have stated that:

'Flood Risk Management

We understand the proposal is for highly vulnerable development housing and access roads. Our Flood Risk Map confirms the site to be partially within Zone C2 of the Development Advice Map (DAM) contained in TAN15.

We refer you to Section 6 of TAN15 and the Chief Planning Officer letter from Welsh Government, dated 9 January 2014, which affirms that highly vulnerable development and emergency services should not be permitted in Zone C2 (paragraph 6.2 of TAN15). The justification tests in paragraph 6.2 of TAN15 do not apply to highly vulnerable development or emergency services in Zone C2.

In consideration of the above, we will not provide any pre-application advice regarding flood risk, unless we receive written confirmation from the Planning Authority that there are overriding reasons for them to consider the proposals despite the site's location within Zone C2. In such circumstances, we would then review any submitted FCA. If the FCA fails to demonstrate that the consequences of flooding can be acceptably managed over the lifetime of the development, then we would object to the application.

Finally, as you may be aware, under the Town & Country Planning (Notification) (Wales) Direction 2012 and more specifically Category I relating to Flood Risk Area Development, where the Planning Authority is minded to grant permission, there is a requirement to refer applications for emergency services or highly vulnerable development within Zone C2 to Welsh Government.

Watercourses

An un-named ordinary watercourse runs through the site. An Ordinary Watercourse Consent may be required from the Lead Local Flood Authority for any works in, over, under or near an ordinary watercourse'.

A meeting was held between Waterco, the Lead Local Flood Authority (LLFA) (Wrexham County Borough Council) and Redrow on 13th March 2024 to discuss concerns raised by the LLFA with regards to flooding and drainage. A summary of the meeting is provided below:

- It was acknowledged that the north-easternmost extent of the site (land within Flood Zone B and C2) is prone to frequent flooding, as recently as January 2024, and that flood water (surface water flooding) remains within this area (a known topographical depression) for several days following prolonged rainfall, or an extreme rainfall event.

- It was agreed that no residential development will be proposed within the existing flood extent in the north-eastern corner of the site and that the proposed access road which encroaches into the flood extent will be raised so that it is flood free during all considered flood events up to and including the 0.1% annual probability plus 45% climate change event. The access road is required in this location due to highway reasons (it is located at an existing field access and in the location of existing traffic signals on Ruthin Road).

- It was acknowledged that box culverts are preferred for all proposed access road crossings and that box culverts should be used beneath the proposed access road off Ruthin Road to link the existing watercourse in the northern extent of the site to the flood storage area in the north-eastern extent of the site.
- It was acknowledged that provision of a sustainable drainage system restricting runoff rates to the 1 in 1 year greenfield runoff rate for all events up to and including the 1 in 100 year plus 40% climate change event will reduce the surface water and fluvial flood risk in the north-eastern extent of the site during more extreme events i.e. the 1 in 30 and 1 in 100 year events.
- The flood risk in the north-eastern extent of the site can further be reduced through use of this area for public open space and planting, thereby reducing soil compaction and improving the drainage characteristics when compared to the current agricultural use.
- An ordinary watercourse consent will be required for all proposed watercourse access road crossings (new culverts).
- The existing culverts beneath Ruthin Road will be cleared of silt / debris and the inlets will be formalised with headwalls for ease of maintenance access.

Sources of Flooding and Probability

Fluvial

An unnamed watercourse flows east through the northern extent of the site and is culverted beneath Ruthin Road. The unnamed watercourse flow north-east beyond the site and joins the River Gwenfro approximately 385m north-east of the site. There is also an unnamed watercourse crossing the south-western extent of the site flowing south-east. The location of this watercourse is identified on the NRW 'Flood Risk from Surface Water and Minor Watercourses' map in Appendix F.

Other watercourses in the area include the River Clywedog which is located approximately 30m south of the site at its nearest point. The River Clywedog flows north-east in this location.

Fluvial flooding could occur if the unnamed watercourses overtopped their banks during or following an extreme rainfall event. The flood risk from the River Clywedog is considered to be very low. The site is situated approximately 10m above the River Clywedog and is outside of the extreme 0.1% annual probability flood extent associated with the River Clywedog.

The NRW 'Historic Flood Risk' map (Appendix F) indicates that there are no records of fluvial flooding affecting the site. However anecdotal information and online records (from social media posts and news articles) shows that flooding has previously occurred on Ruthin Road north of the site (north of the Flood Zone C2 extent on site). Frequent flooding is also recorded in the north-easternmost extent of the site (corresponding to land in Flood Zone C2), however the source is understood to be surface water flooding.

Modelled Outputs

A hydraulic modelling study of the unnamed watercourses which cross the northern and south-western extents of the site has been undertaken by Waterco. Modelled outputs have been processed to create flood depth, velocity, hazard and water level mapping. Modelled outputs are provided for the existing (baseline) scenario and the development scenario (with proposed access road crossing culverts). Modelled output mapping is provided in Appendix G.

Existing Scenario

As shown in Figure 1, during the 1% Annual Exceedance Probability (AEP) plus 20% climate change (CC) event, flooding is shown behind an existing culvert towards the centre of the site and is constrained to a wooded area. The Ruthin Road culverts are also shown to exceed their capacity with flood water collecting in the north-eastern extent of the site. The maximum water level in the north-eastern extent of the site is 93.86m AOD. The water level is sufficient for flood water to spill onto Ruthin Road.

Land in the north-eastern extent of the site currently shown at flood risk will be free of any development (proposed as an area of open space) and the existing flood storage function will be retained as part of the proposed development.

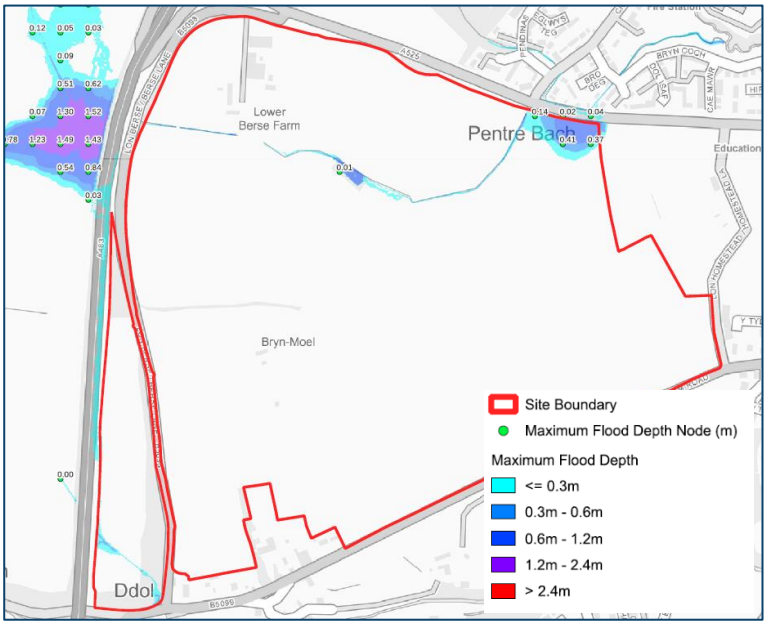


Figure 1 – Existing Scenario 1% AEP plus 20% CC Event – Flood Depths (m)

As shown in Figure 2, during the 1% AEP plus 45% CC event, the flood extent is marginally increased when compared to the 1% AEP plus 20% CC event. The maximum water level in the north-eastern extent of the site increases to 93.89m AOD.

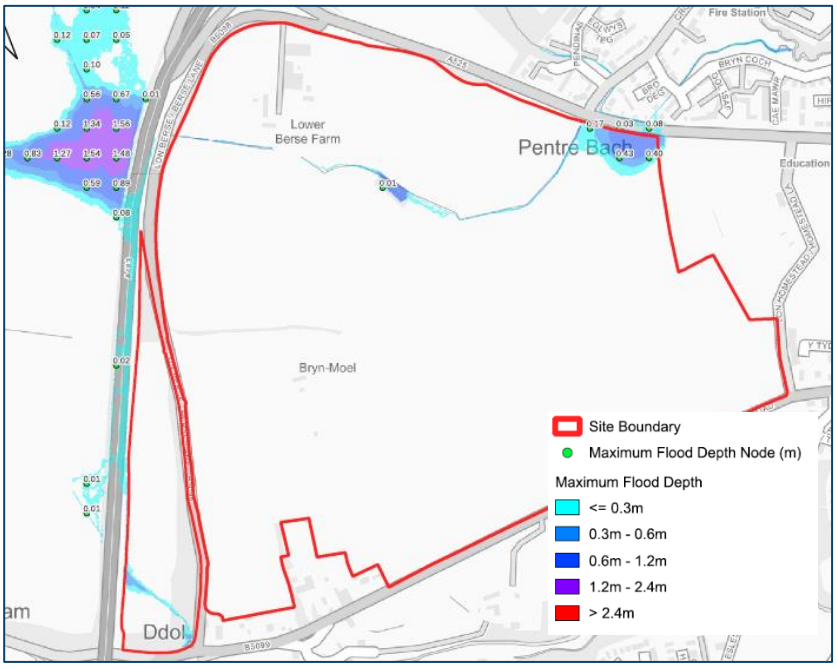


Figure 2 – Existing Scenario 1% AEP plus 45% CC Event – Flood Depths (m)

Modelled outputs (Appendix G) show that during the 0.1% AEP event, the water level in the north-eastern extent of the site increases to 93.9m AOD. The water level increases slightly to 93.92m AOD during the 0.1% AEP plus 20% CC event and 93.93m AOD during the 0.1% AEP plus 45% CC event.

During all considered events, the flood mechanism is similar and flood flows are contained in the north-eastern corner of the site (which will be free of any built development) and in an area of existing woodland (which will be retained) towards the centre of the site.

The risk of flooding from the watercourse which crosses the south-western extent of the site has also been considered in the Waterco hydraulic modelling. As shown on the model outputs (Appendix G), flood flows are generally constrained to land immediately adjacent to the channel. No flooding is estimated in the location of the proposed development. An extract of the 0.1% AEP plus 45% CC flood depth map focusing on the watercourse in the south-western extent of the site is provided as Figure 3.



Figure 3 – Existing Scenario 0.1% AEP plus 45% CC Event - South-Western Watercourse – Flood Depths (m)

Existing Blockage Scenario

A number of blockage scenarios have been run for the existing scenario with outputs provided as Appendix G. Blockages have been simulated for the A483 Road Culvert west of the site, an existing 450mm culvert (which is to be retained) in the north-western extent of the site, and the Ruthin Road culverts. A 67% blockage amount has been applied.

As shown on the modelled outputs (Appendix G), a 67% blockage of the A483 road culvert and a 67% blockage of the existing 450mm culvert in the north-western extent of the site results in no increase in flood extents and depths within the site during all considered events. A 67% blockage of the Ruthin Road culverts results in an increased depth of flooding in the flood storage area in the north-eastern extent of the site and results in additional flood water spilling onto Ruthin Road.

Development Scenario

As part of the proposed development, the following measures are proposed:

- Raise the proposed access road off Ruthin Road so that it is flood free during all considered events. The level of the proposed access off Ruthin Road has been set at to 95.36m AOD within the hydraulic model as to be flood free whilst also tying in with the existing level of Ruthin Road. 6no. 300mm pipes have been placed beneath the raised access road in the model to enable flood flows to be conveyed from the watercourse to the flood storage area in the north-eastern corner of the site. The culvert arrangement beneath the proposed access road will be reviewed further at the detailed design stage with preference given to the use of box culverts.

- Provide improvements to the watercourse channel within the site (re-profiling upstream of the Ruthin Road culvert) as to maximise the flood storage capacity on site.

- Introduce new culverts beneath new access road watercourse crossings on site. Land raising will be required adjacent to the access road watercourse crossings as to provide suitable ground cover above the proposed culverts. Box culverts are preferred for all new access road crossings.

The flood storage area south-east of the Ruthin Road culvert will be retained. The existing Ruthin Road culverts will also be retained to ensure no additional flow is conveyed downstream. The existing Ruthin Road culverts will be extended southward into the site beneath the proposed access road. New headwalls will be formed for ease of maintenance access.

A plan showing the flood mitigation measures / modifications proposed as part of the development is included as Appendix H. Modelled outputs for the proposed development scenario, inclusive of the proposed flood mitigation measures, are included in Appendix G.

With outline planning permission being sought and no information available at this stage in relation to final proposed site levels, the development scenario modelling of the proposed flood mitigation measures is considered conceptual and is provided as proof of concept. The development scenario modelling will be further refined at the reserved matters stage when proposed site levels are known and following detailed design of the proposed flood mitigation measures.

As shown in Figure 4, during the development scenario 1% AEP plus 20% CC event, the flood extent is similar to the existing scenario, however additional flood storage is shown within the watercourse channel on site. This is due to the proposed re-profiling of the channel to increase flood storage capacity on site. All proposed roads and properties are flood free. The flood extent and depths are similar (within 100mm) during the 1% AEP plus 45% CC event, 0.1% AEP event and 0.1% AEP plus 20% CC event.



Figure 4 - Development Scenario 1% AEP plus 20% CC Event – Flood Depths (m)

As shown in Figure 5, during the development scenario 0.1% AEP plus 45% CC event, the majority of the site is flood free. Minimal flooding encroachment is shown in the location of a proposed attenuation pond immediately south-west of the site access off Ruthin Road. The flood extents and depths to the proposed attenuation pond will be reviewed at the reserved matters stage once final site levels are known.

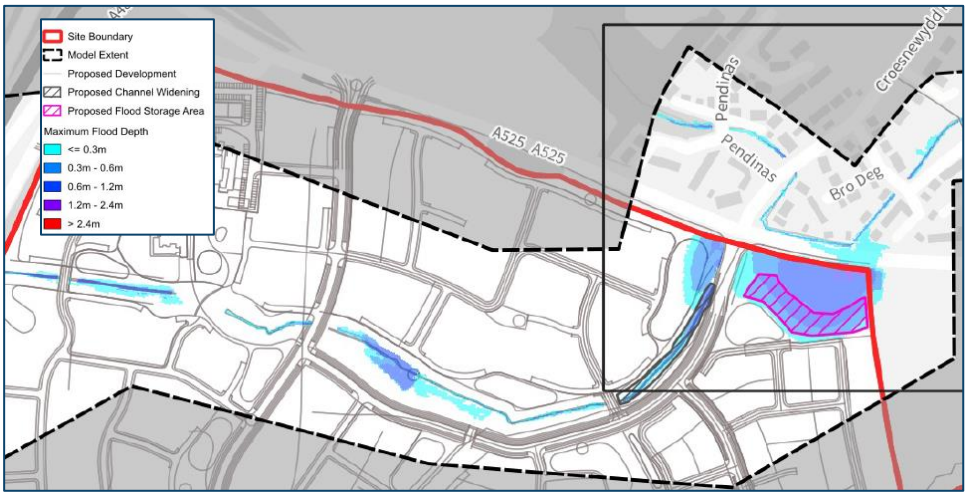


Figure 5 - Development Scenario 0.1% AEP plus 45% CC Event – Flood Depths (m)

When accounting for the proposed flood mitigation measures, it can be concluded that the risk of fluvial flooding to all developable areas of the site is very low. The north-eastern extent of the site, south-east of the Ruthin Road culvert, will be retained as a flood storage area.

Tidal

The site is situated at a minimum of 87.03m AOD and is significantly above sea level. It can therefore be concluded that there is no risk from tidal flooding.

Surface Water

Surface water flooding occurs when rainwater does not drain away through the normal drainage system or soak into the ground. 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. Surface water flooding can occur anywhere without warning. However, flow paths can be determined by consideration of contours and relative levels.

The NRW 'Flood Risk from Surface Water and Minor Watercourses' map (Appendix F) shows that the majority of the site is at very low risk of surface water flooding, meaning it has a less than 0.1% annual probability of flooding. Isolated topographical low points within the site are shown at risk of surface water flooding.

There are no distinct flow routes in the area which would direct any potential off-site surface water flooding towards the site.

Surface water flooding is known to occur in a topographical low point the north-easternmost extent of the site (corresponding to land in Flood Zone C2). Flood water is known to pool for several days in this location following prolonged rainfall or an extreme rainfall event. No development is proposed within the surface water flood extent in the north-easter extent of the site.

The flood risk associated with surface water ponding within isolated low points will be removed or reduced post-development through provision of a sustainable drainage system which will limit surface water discharge to the 1 in 1 year greenfield runoff rate during all storm events up to and including the 1 in 100

year plus 40% climate change event.

It can therefore be concluded that the risk of surface water flooding is very low across all developable areas of the site.

Sewer

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

The DCWW sewer records show that there is a public combined sewer of varying diameter crossing the site. There are also public sewers serving adjacent urbanised areas.

There are no records of sewer flooding at or near to the site. The site forms a relative high point within the wider local topography and there are no distinct flow routes in the area which would direct any potential sewer flooding towards the site.

It can be concluded that the risk of sewer flooding is very low.

Groundwater

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.

During ground investigations, groundwater strikes were encountered within 6 of the windowless sample boreholes and 1no. trial pit. Groundwater strikes were generally encountered as seepages, varying in depths of between 2m.bgl and 4m.bgl.

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.

Artificial Sources

There are no canals in the immediate vicinity of the site. The NRW 'Flood Risk from Reservoirs' map (Appendix F) shows that the site is not at risk of flooding from reservoirs.

It can therefore be concluded that the risk of flooding from artificial sources is very low.

Summary of Potential Flooding

It can be concluded that fluvial flooding is the main potential source of flood risk at this site. The associated risk has been used to inform mitigation design.

Mitigation

As part of the development the following flood mitigation measures are proposed to ensure all development will be located outside of the 0.1% annual probability (Flood Zone C2) extent:

- Raise the proposed access road off Ruthin Road so that it is flood free during all considered events. Culverts (box culverts) will be placed beneath the raised access road to enable flood flows to be conveyed from the watercourse to the flood storage area in the north-eastern corner of the site.
- Provide improvements to the watercourse channel within the site (re-profiling immediately upstream of the Ruthin Road culvert) as to maximise the flood storage capacity on site.
- Introduce new box culverts beneath new access road watercourse crossings on site. Land raising will be required adjacent to the access road watercourse crossings as to provide suitable ground cover above the proposed culverts.

The flood storage area south-east of the Ruthin Road culvert will be retained. The diameter of the existing Ruthin Road culverts will also be retained to ensure no additional flow is conveyed downstream. The existing Ruthin Road culverts will be extended southward into the site beneath the proposed access road.

All properties and roads will be flood free during the 0.1% AEP plus 45% CC event A flood free safe access / egress is available to all properties during this event. The mitigation measures will ensure that the development is compliant with Sections A1.14 and A1.15 of TAN15.

Impact on Flood Risk Elsewhere

In order to quantify the impact of the development on flood risk elsewhere, a series of flood level difference maps have been created comparing the flood depths between the existing (baseline) and proposed development scenario modelling. Flood depth difference mapping is provided in Appendix G and has been produced for the 1% AEP plus 20% CC, 1% AEP plus 45% CC, 0.1% AEP, 0.1% AEP plus 20% CC and 0.1% AEP plus 45% CC events.

As shown in Figure 6, during the 0.1% AEP plus 45% CC event, a reduction in flood risk is noted to Ruthin Road. There is also a reduction in the in-channel water level downstream of the site. There is also a reduction in flood risk to Ruthin Road and downstream in-channel water levels during the 0.1% AEP and 0.1% AEP plus 20% CC events.

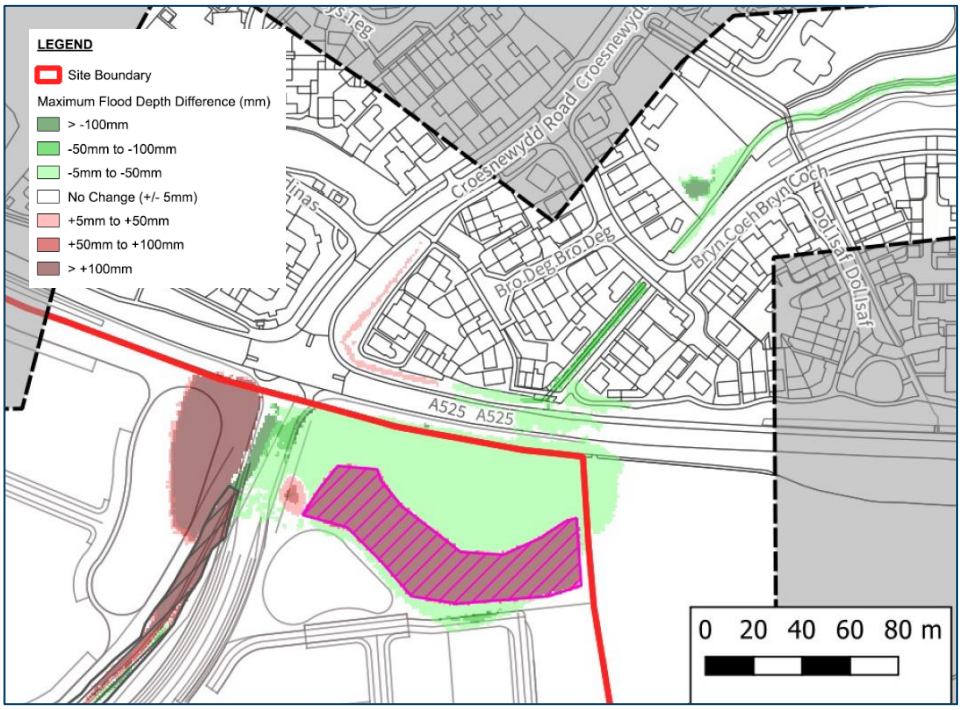


Figure 6 – 0.1% AEP plus 45% CC Depth Difference

During the 1% AEP plus 20% CC event, the flood extent off-site remains unchanged, however a minimal increase (9mm) in flood depth is shown to a small section of Ruthin Road. There is no increase in flood risk to private land or property downstream (no increased flood risk to dwellings or their curtilage). Existing flood depths to Ruthin Road during the 1% AEP plus 20% CC event are generally less than 90mm. A similar scenario is shown during the 1% AEP plus 45% CC event.

As previously discussed, the impact on flood risk elsewhere will be further reviewed at the reserved matters stage when details of proposed site levels are known and following the detailed design of the proposed flood mitigation measures (channel re-profiling). Mitigation measures will ensure that there is no increase in flood risk to third party property or land.

Surface Water Management

In accordance with TAN15, new development should not create additional runoff when compared with the undeveloped situation. In order to ensure the proposed development will not increase flood risk elsewhere, surface water discharge from the site will be controlled.

Discharge Method

Standard S1 of the Statutory Standards for SuDS sets out the following hierarchy of drainage options:

Priority Level 1: Surface water runoff is collected for use;

Priority Level 2: Surface water runoff is infiltrated to ground;

Priority Level 3: Surface water runoff is discharged to a surface water body;

Priority Level 4: Surface water runoff is discharged to a surface water sewer, highway drain, or another drainage system;

Priority Level 5: Surface water runoff is discharged to a combined sewer.

Priority Level 1: Surface water runoff collected for use

In line with section G1.4 of the Statutory Standards for SuDS, rainwater harvesting is not proposed for this site as:

1. There is no foreseeable need to harvest water at the site as DCWW water resources and drought management plans do not identify potential stresses on mains water supplies;

2. The use of rainwater harvesting is not a viable/ cost-effective part of the solution for managing surface water runoff on the site, taking account of the potential water supply benefits of such a system.

With regards to point 2 above, section G1.6 of the Statutory Standards for SuDS states that; in most cases, rainwater harvesting alone will not be adequate to deal with the site drainage and provision will be required for an overflow to a Level 2 or lower priority runoff destination. As downstream provision of attenuation storage will be required to accommodate for rainwater harvesting system overflows, rainwater harvesting is not considered a cost-effective solution for managing surface water runoff.

Water butts will be used as to encourage external water re-use.

Priority Level 2: Surface water runoff is infiltrated to ground

Ground Investigations have been undertaken by E3P between 27th July and 3rd August 2021 to establish the infiltration potential. The infiltration test results show the ground to be of mixed permeability. At SA102, SA103, SA108 and SA123 no reduction in water level was recorded after 48 hours and infiltration techniques would therefore not be suitable in these locations.

The infiltration rates for the remaining trial pits range from 6.35 x 10^{-3} m/s to 9.80 x 10^{-6} m/s and appear

sufficient to support infiltration drainage techniques.

Where ground conditions allow, infiltration techniques such as individual property soakaways and permeable driveways will be utilised. Targeted infiltration testing should be undertaken at the reserved matters stage to inform the suitability and design of infiltration techniques.

Soakaways should be located a minimum of 5m from buildings and will be designed to accommodate the 1 in 100 year plus 40% climate change event.

Priority Level 3: Surface water runoff is discharged to a surface water body

Where infiltration techniques are not suitable, a connection to watercourse is the next consideration.

Unnamed watercourses cross the northern and south-western extents of the site and form a suitable point of gravity discharge for runoff from the development in the northern and south-western extents of the site. To facilitate gravity drainage, development in the southern extent of the site would need to drain to the River Clywedog. It is understood that landowner agreement is in place to form a new piped connection for surface water flows from the site to the River Clywedog.

Proposed Discharge Rates

In order to ensure the proposed development does not increase flood risk elsewhere, discharge to watercourse will be made at a limited discharge rate.

In order to establish the proposed limited discharge rate, the existing greenfield runoff rates have been estimated using the Revitalised Flood Hydrograph Model (ReFH2) method. A summary of the greenfield runoff rates for a range of events is provided as Appendix G. A summary of the 1 in 1 year greenfield runoff rate for each development parcel is included in Table 1.

Table 1 - Greenfield Runoff Rates

Development Area (Taken from Masterplan)	Total Area (ha)	1 in 1 Greenfield Runoff Rate (l/s)
Development Parcel A	2.57	4.7
Development Parcel B	0.79	1.4
Development Parcel C	3.12	5.7
Development Parcel D	5.95	10.1
Development Parcel E	1.27	2.3
Development Parcel F	3.51	10.7
Development Parcel G	0.89	2.6

Development Parcel H	1.52	2.8
Development Parcel I	1.84	3.4
Development Parcel J	3.53	6.4
Development Parcel K	3.74	6.9
Development Parcel L	2.15	3.9
Development Parcel M	2.94	5.4
Development Parcel N	1.89	3.5
Development Parcel O	2.39	4.4
School	1.62	3
Local Centre Re-development	1.46	2.7
		Total greenfield runoff rate = 79.9 l/s

The overall discharge rate from the site will be limited to 79.9 l/s. This will provide significant runoff reduction during extreme storm events such as the 1 in 30 year event and 1 in 100 year plus 40% climate change event.

Attenuation Storage

In order to achieve a limited discharge rate, attenuation storage will be required. Attenuation storage estimates have been provided using MicroDrainage and are included in Appendix H. The attenuation storage estimates are based on the 1 in 100 year plus 40% Climate Change (CC) design event, storage within a pond structure and hydro-brake flow control.

In absence of a detailed site layout, a contributing drainage area equivalent to 40% of the area of each residential development parcel has been applied. For the proposed school site, a contributing drainage area of 50% of the entire development parcel has been applied. For the proposed local centre, a contributing drainage area of 80% of the entire development parcel has been applied.

A summary of the estimated attenuation storage volume for each development parcel is provided in Table 2.

Table 2 - Attenuation Storage Estimates

Development Area	Contributing Drainage Area (ha)	Attenuation Storage Required (m^3)
Development Parcel A	1.03	1,122
Development Parcel B	0.31	341
Development Parcel C	1.25	1,364
Development Parcel D & G	2.73	2,983
Development Parcel E	0.51	553
Development Parcel F	1.4	1,528
Development Parcel H	0.61	660
Development Parcel I	0.74	797
Development Parcel J	1.41	1,538
Development Parcel K	1.5	1,631
Development Parcel L	0.86	1,382
Development Parcel M	1.18	1,274
Development Parcel N	0.76	819
Development Parcel O	0.956	1037
School	0.81	916
Local Centre Re-development	1.17	1,454
		Total attenuation storage required = 19,399m^3

The attenuation volumes are provided for indicative purposes only and should be reviewed at the reserved matters stage.

Sustainable Drainage Systems

Where infiltration techniques are not feasible, attenuation storage should be provided in the form of Sustainable Drainage Systems (SuDS) where practical. It is proposed to utilise attenuation ponds within each development parcel for attenuation storage purposes. Swales will be used for flow conveyance and treatment along the main site access spine roads.

A summary of the proposed attenuation features and surface water discharge locations is provided in Table 3.

Table 3 – SuDS Summary & Surface Water Discharge Locations

Development Area	SuDS Type and Location	Surface Water Discharge Location
Development Parcel A	Attenuation pond in northern extent	Watercourse crossing the northern extent of site
Development Parcel B	Attenuation pond in north-western extent	Watercourse crossing the northern extent of site
Development Parcel C	Attenuation pond in north-eastern extent	Watercourse crossing the northern extent of site
Development Parcels D and G Attenuation will be split due to the large contributing drainage area.	Attenuation ponds in the eastern and southern extent of Parcel D	Watercourse crossing the northern extent of site
Development Parcel E	Attenuation pond in north-eastern extent	Watercourse crossing the northern extent of site
Development Parcel F.	Attenuation ponds in the north-eastern extent	Watercourse crossing the northern extent of the site
Development Parcel H	Attenuation pond in the south-eastern extent	Watercourse crossing the northern extent of site
Development Parcel I	Attenuation pond in the eastern extent	Watercourse crossing the northern extent of site
Development Parcel J Attenuation will be split due to the large contributing drainage area and split topography	Attenuation ponds in the north-eastern and south-eastern extents	Watercourse crossing the northern extent of site & the River Clywedog (via tributary)

Development Parcel K	Attenuation ponds in the southern extent	River Clywedog (via tributary)
Development Parcel L	Attenuation pond in the western extent of Parcel 0	River Clywedog (via tributary)
Development Parcel M	Attenuation pond in the south-eastern extent	River Clywedog (via tributary)
Development Parcel N	Attenuation pond in the southern extent	Unnamed watercourse crossing southern extent of development parcel
Development Parcel O	Attenuation pond in the western extent	River Clywedog (via tributary)
Primary School	Permeable Paving, below ground storage (attenuation tank), rain gardens	River Clywedog (via tributary)
Local Centre Re-development		Watercourse crossing the northern extent of site

A plan showing the route of the proposed piped connection to the River Clywedog, via a small tributary of the River Clwyedog south of the site, is included in Appendix I. Based on discharge at the limited 1 in 1 year greenfield runoff rate, up to 26.8 l/s will be discharged to the River Clywedog. A 300mm pipe diameter is likely to be sufficient. A 3m standoff (protection strip) should be provided either side of the proposed pipe discharging to the River Clywedog.

Concept Surface Water Drainage Scheme

Where feasible, infiltration drainage techniques will be used in the form of individual property soakaways and permeable paving on private driveways.

Where infiltration techniques are not feasible, surface water runoff will be discharged to the unnamed watercourses crossing the site and the River Clywedog (via an unnamed tributary). Discharge will be made at the limited 1 in 1 year greenfield runoff rate. Attenuation storage will be required to accommodate storm events up to and including the 1 in 100 year plus 40% CC allowance event. Attenuation storage in the form of attenuation ponds will be distributed across the site. Swales will be utilised alongside the main access spine roads.

The proposed surface water drainage scheme will ensure no increase in runoff over the lifetime of the development.

Exceedance Event

Storage will be provided for the 1 in 100 year plus 40% CC event. Storm events in excess of the 1 in 100 year plus 40% CC event should be permitted to produce temporary shallow depth flooding within access roads

and public open spaces.

Surface Water Treatment

The Statutory Standards for SuDS sets out the following guidance for surface water treatment:

S3 - Surface water quality management

Treatment for surface water runoff should be provided to prevent negative impacts on the receiving water quality and/or protect downstream drainage systems, including sewers.

In accordance with the CIRIA C753 publication 'The SuDS Manual' (2015), residential roofs have a 'very low' pollution hazard level, with roads (with greater than 300 traffic movements per day) classified as having a 'medium' pollution hazard level. Other roofs (applicable to the school and local centre), individual property driveways and low traffic roads are classified as having a 'low' pollution hazard level. Table 4 shows the pollution hazard indices for each land use.

Table 4 – Pollution Hazard Indices

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential roofs	Very Low	0.2	0.2	0.05
Other roofs (typically commercial/industrial roofs)	Low	0.3	0.2	0.05
Individual property driveways, residential car parks, low traffic roads and non-residential car parking with infrequent change i.e. <300 traffic movements/day	Low	0.5	0.4	0.4
All roads except low traffic roads and trunk roads	Medium	0.7	0.6	0.7

Table extract taken from the CIRIA C753 publication 'The SuDS Manual' – Table 26.2

* Indices values range from 0-1.

Runoff from roofs and roads within individual development parcels will be directed to attenuation ponds. Runoff from the main site access spine roads will be directed to swales and attenuation ponds. Table 5 demonstrates that ponds and swales will provide sufficient treatment.

Table 5 – SuDS Mitigation Indices

	Mitigation Indices		
Type of SuDS	**Total Suspended Solids (TSS)**	**Metals**	**Hydrocarbons**
Swale	0.5	0.6	0.6
Pond	0.7	0.7	0.5
Swale & Pond in Series	0.5 + (0.7 x 0.5) = 0.85	0.6 + (0.7 x 0.5) = 0.95	0.6 + (0.5 x 0.5) = 0.75

Table extract taken from the CIRIA C753 publication 'The SuDS Manual' – Table 26.3

Amenity

The Statutory Standards for SuDS provide the following guidance in relation to Standard S4 – Amenity:

'The design of the surface water management system should maximise amenity benefits.'

The proposed development will include attenuation ponds, swales and other SuDS features which will maximise the amenity value of the proposed drainage system.

Biodiversity

The Statutory Standards for SuDS provide the following guidance in relation to Standard S5 – Biodiversity:

'The design of the surface water management system should maximise biodiversity benefits.'

The proposed development will include attenuation ponds, swales and other SuDS features which will maximise the biodiversity value of the proposed drainage system.

Construction, Operation and Maintenance

Standard S6 of the Statutory Standards for SuDS states:

S6 – Design of drainage for Construction, Operation and Maintenance

1) All elements of the surface water drainage system should be designed so that they can be constructed easily, safely, cost-effectively, in a timely manner, and with the aim of minimising the use of scarce resources and embedded carbon (energy).

2) All elements of the surface water drainage system should be designed to ensure maintenance and operation can be undertaken (by the relevant responsible body) easily, safely, cost-effectively, in a timely manner, and with the aim of minimising the use of scarce resources and embedded carbon (energy).

3) The surface water drainage system should be designed to ensure structural integrity of all

elements under anticipated loading conditions over the design life of the development site, taking into account the requirement for reasonable levels of maintenance.

All drainage systems will be readily accessible for maintenance access. The proposed drainage system will be offered to the SAB for adoption.

Maintenance schedules for an attenuation pond, swales and permeable paving are included in Appendix J.

Foul Drainage

Foul flows will be discharged to the public sewer which crosses through the site, or at a point downstream of the site. The connection point(s) have been agreed with DCWW through completion of a Hydraulic Modelling Assessment (HMA). The HMA has identified options for upgrading the sewer network (with options including both off-site upgrades and on-site upgrades) in order to ensure foul flows generated by the development do not cause detriment elsewhere. Upgrades to the public sewer network will be made prior to first occupation of the proposed dwelling.

It is understood (from discussion with DCWW) that the DCWW Five Fords wastewater treatment works can provide sufficient phosphate reduction. This enables connections from new developments to be made without the requirement for developers to provide on or off-site phosphate mitigation. DCWW have advised that the Five Fords wastewater treatment works will be upgraded in the next AMP (Asset Management Plant) cycle (between 2025 and 2030) to increase its capacity, ensuring foul flows from the proposed development will not increase spill volumes at the treatments works overflow (CSO).

Other Considerations

Maintenance access to the unnamed watercourses should be retained. Maintenance access can be ensured by providing an 8m buffer either side of the watercourse.

An ordinary watercourse consent will be required for any new access road crossings (culverts) over existing watercourses within the site.

New headwalls will be required on the Ruthin Road culvert as to improve ease of maintenance. The existing culverts will require jetting / clearance to remove siltation.

The public combined sewer crossing the site will be diverted as part of the development. The diversion design and route will be agreed with DCWW.

Conclusions

An outline planning application is being submitted for residential development in the region of 1,450 dwellings, plus associated roads, open space, community facilities and a site for a primary school.

Flood Risk

The majority of the site is located within Flood Zone A on the Welsh Government Development Advice Map – an area considered to be at little or no risk of fluvial or tidal flooding, with a less than 0.1% (1 in 1000) annual probability of flooding.

Land at the north-eastern boundary adjoining Ruthin Road is identified as being located within Flood Zone C2 – an area considered at flood risk, without significant defence infrastructure, with a 0.1% (1 in 1000) or greater annual probability of flooding. The Flood Zone C2 extent in this location is associated with the unnamed watercourse which crosses the northern extent of the site and becomes culverted beneath Ruthin Road. The flood extent is shown immediately upstream of the Ruthin Road culvert indicating the culvert is not of sufficient capacity to accommodate flood flows.

Land in the north-western extent of the site is also shown within Flood Zone C2. The Flood Zone C2 extent in this location is associated with the unnamed watercourse which crosses the northern extent of the site and generates as a result flood flows backing up behind an existing culvert beneath an agricultural land crossing.

The risk of flooding from all sources has been assessed. The main potential source of flooding at this site is fluvial flooding from the unnamed watercourse which flows through the northern extent of the site. There is also a risk of surface water flooding (from rainfall ponding) within an isolated topographical low point in the north-eastern extent of the site (corresponding to land in Flood Zone C2). Surface water flooding in this location occurs frequently.

Detailed hydraulic modelling of the watercourse which crosses through the northern extent of the site has been undertaken.

As part of the development the following flood mitigation measures are proposed to ensure all development will be located outside of the 0.1% annual probability (Flood Zone C2) extent and compliant with A1.14 and A1.15 of TAN15:

- Raise the proposed access road off Ruthin Road so that it is flood free during all considered events. Box culverts will be placed beneath the raised access road to enable flood flows to be conveyed from the watercourse to the flood storage area in the north-eastern corner of the site.
- Provide improvements to the watercourse channel within the site (re-profiling upstream of the Ruthin Road culvert) as to maximise the flood storage capacity on site.
- Introduce new culverts beneath new access road watercourse crossings on site. Some land raising will be required adjacent to the access road watercourse crossings as to provide suitable ground cover above the proposed culverts.

The flood storage area south-east of the Ruthin Road culvert will be retained. The diameter of the existing Ruthin Road culverts will also be retained to ensure no additional flow is conveyed downstream. The existing Ruthin Road culverts will be extended southward into the site beneath the proposed access road.

The impact of the proposed development on flood risk elsewhere has been considered by comparing modelled outputs for the existing (baseline) and proposed development scenarios. The proposed development does not increase flood risk elsewhere during the 0.1% AEP, 0.1% AEP plus 20% CC and 0.1% AEP plus 45% CC events. During the 1% AEP plus 20% CC event and the 1% AEP plus 45% CC event, no impact is shown to private land or properties.

Drainage

The proposed development will introduce impermeable drainage area in the form of buildings and access roads. This will result in an increase in surface water runoff. In order to ensure the increase in surface water runoff will not increase flood risk elsewhere, sustainable drainage systems will be used to accommodate storm events up to and including the 1 in 100 year plus 40% climate change event on site.

All methods of surface water discharge have been assessed. Ground investigations including infiltration testing shows that infiltration techniques appear feasible in a number of locations on site. However, due to clay content across parts of the site, infiltration techniques will not be suitable to accommodate surface water runoff from the entirety of the site.

Where infiltration techniques are feasible, individual property soakaways will be used together with permeable surfacing on private driveways.

Where infiltration techniques are not feasible, surface water runoff will be discharged to the unnamed watercourses crossing the site and the River Clywedog. Discharge will be made at the limited 1 in 1 year greenfield runoff rate during all events up to and including the 1 in 100 year plus 40% CC event, thereby providing flood risk reduction during extreme rainfall events over the current scenario. Attenuation storage will be required to accommodate storm events up to and including the 1 in 100 year plus 40% CC allowance event. Attenuation storage in the form of attenuation ponds. Swales will be placed along the main site access spine roads to provide flow conveyance and treatment.

Foul flows will connect to the public sewer subject to upgrades of the public sewer system and timely completion of the DCWW Five Fords wastewater treatment works upgrades.

A Concept Designer's Risk Assessment (cDRA) has been prepared to inform future designers of any identified hazards associated with the scheme. The cDRA has been included in Appendix K.

Recommendations

1. Submit this Flood Consequences Assessment and Drainage Strategy to the Planning Authority in support of the Planning Application.

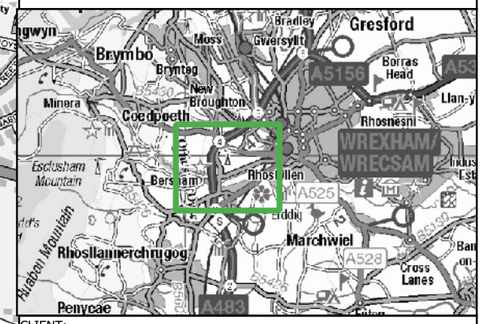
2. Verify the attenuation volumes included in this report when undertaking detailed drainage design.
3. Undertake targeted infiltration testing in accordance with the BRE365 specification at the reserved matters stage as to determine the potential for infiltration drainage techniques.
4. Submit an Ordinary Watercourse Consent for any proposed access road crossings (new culverts).

Appendix A Location Plan and Aerial Image

Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Area not included within site bounadary
- Watercourses



CLIENT:
Redrow Homes Ltd

waterco
www.waterco.co.uk

SCHEME:
Ruthin Road, Wrexham

PLOT TITLE:
Location Plan

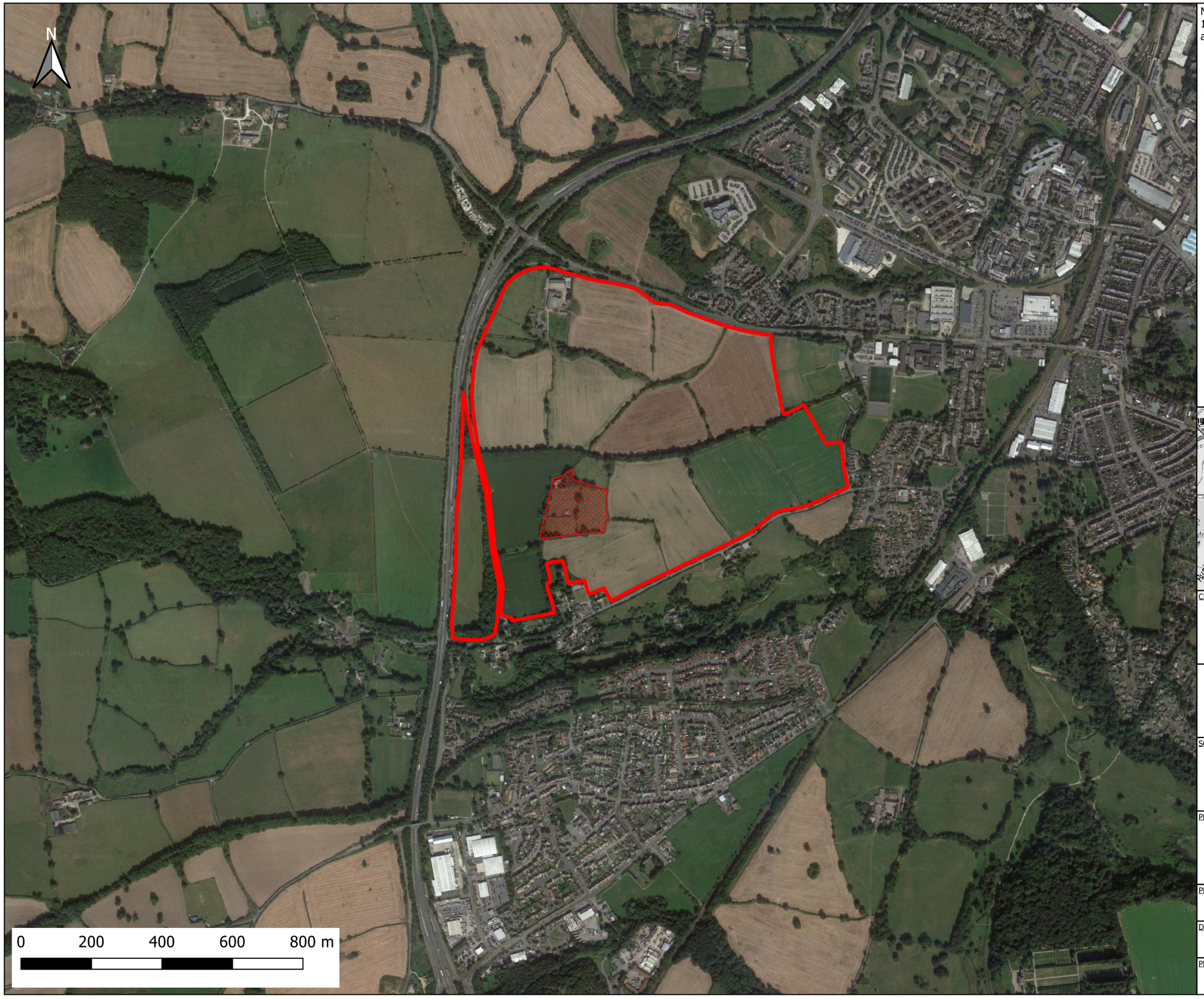
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FINAL	06-12-2022

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
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PLOT NAME:	REVISION:
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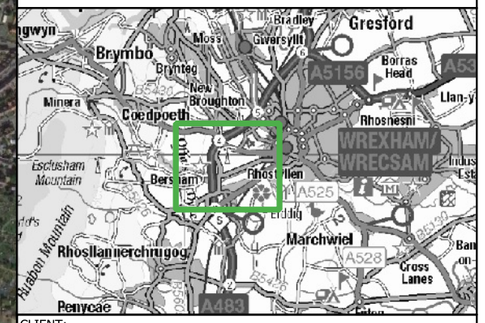
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Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Area not included within site bounadary



CLIENT:
Redrow Homes Ltd

waterco
www.waterco.co.uk

SCHEME:
Ruthin Road, Wrexham

PLOT TITLE:
Aerial Plan

PLOT STATUS:	DATE:
FINAL	06-12-2022

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
PB	AW	NJ	1:10400

PLOT NAME:	REVISION:
13840_Aerial_Plan	-

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BASEMAP: WORLD IMAGERY. SOURCES: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, GIS USER COMMUNITY

Appendix B Topographical Data

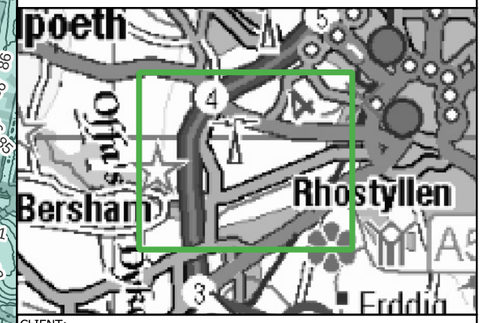
Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Area not included within site boundary
- Site Levels (m AOD)

Ground Elevations (m AOD)

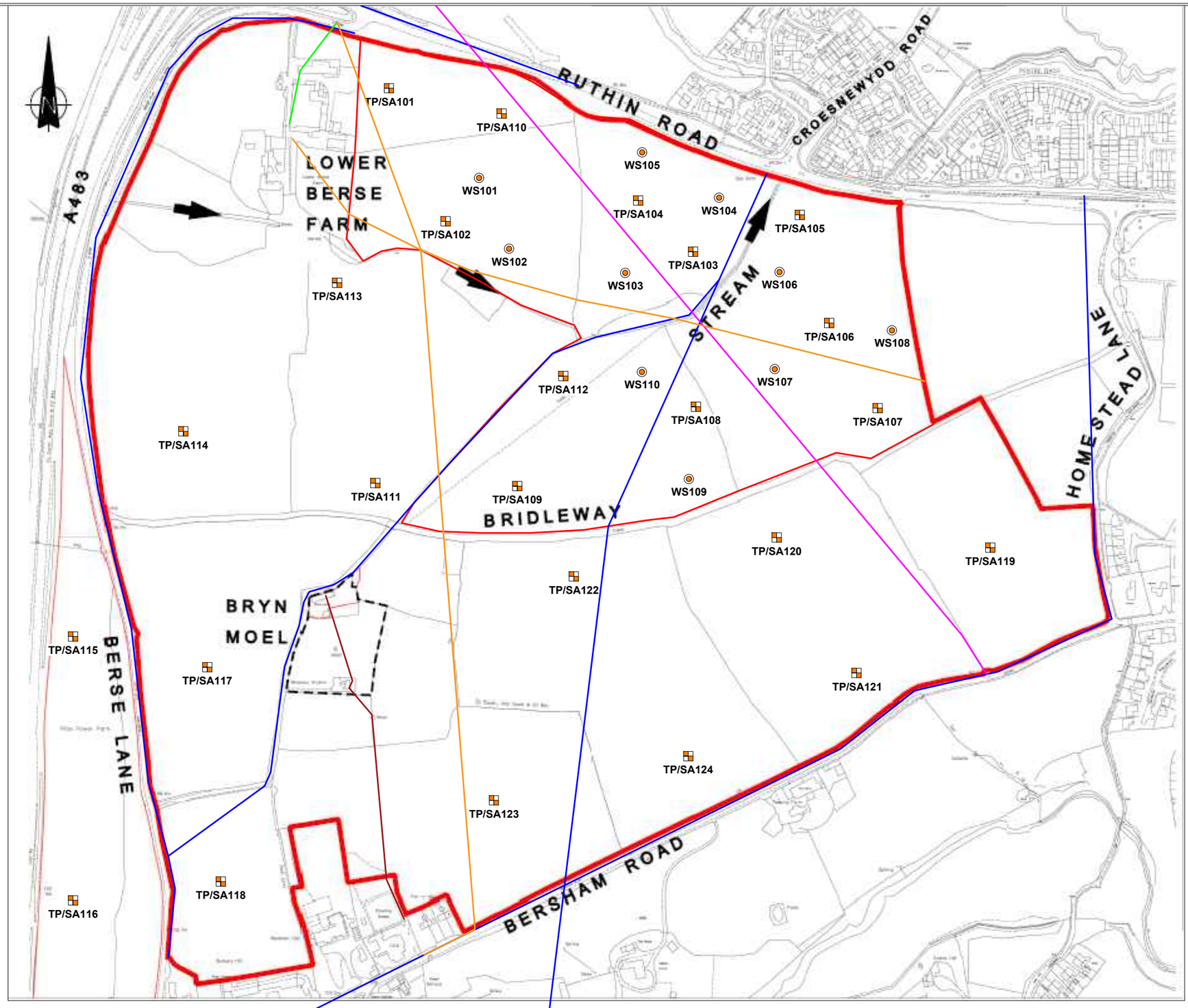
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- 80 - 90
- 90 - 100
- 100 - 110
- > 110



CLIENT:	Redrow Homes Ltd
	www.waterco.co.uk
SCHEME:	Ruthin Road, Wrexham
PLOT TITLE:	LiDAR Plan 1m Resolution Data from Natural Resources Wales
PLOT STATUS: FINAL	DATE: 06-12-2022
DRAWN: PB / CHECKED: AW / APPROVED: NJ	PLOT SCALE AT A3: 1:7500
PLOT NAME: 13840_LiDAR_Plan	REVISION: -

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Appendix C Ground Investigation Results



Location Symbols

- Approximate Window Sample Probehole Location
- Approximate Trial Pit and Soakaway Test Location

Utilities

- Electricity - Low Voltage
- Electricity - High Voltage
- BT
- Gas - Medium Pressure
- Water Main

Notes:

Client: Redrow

Job No: 14-854

Date: 17.08.2021

Drawing No: 005

Scale: NTS@ A3

P1	REVA	17.08.2021	EB	AR
Phase	Issue	Date	Drawn	Checked

Job Title: Ruthin Road, Wrexham

Drawing Title: Exploratory Hole Location Plan

Environmental Engineering Partnership Ltd
Taylor Road, Trafford Park
Urmston, Manchester, M41 7JQ
Tel: 0161 707 9612
E-mail: info@e3p.co.uk
Website: www.e3p.co.uk

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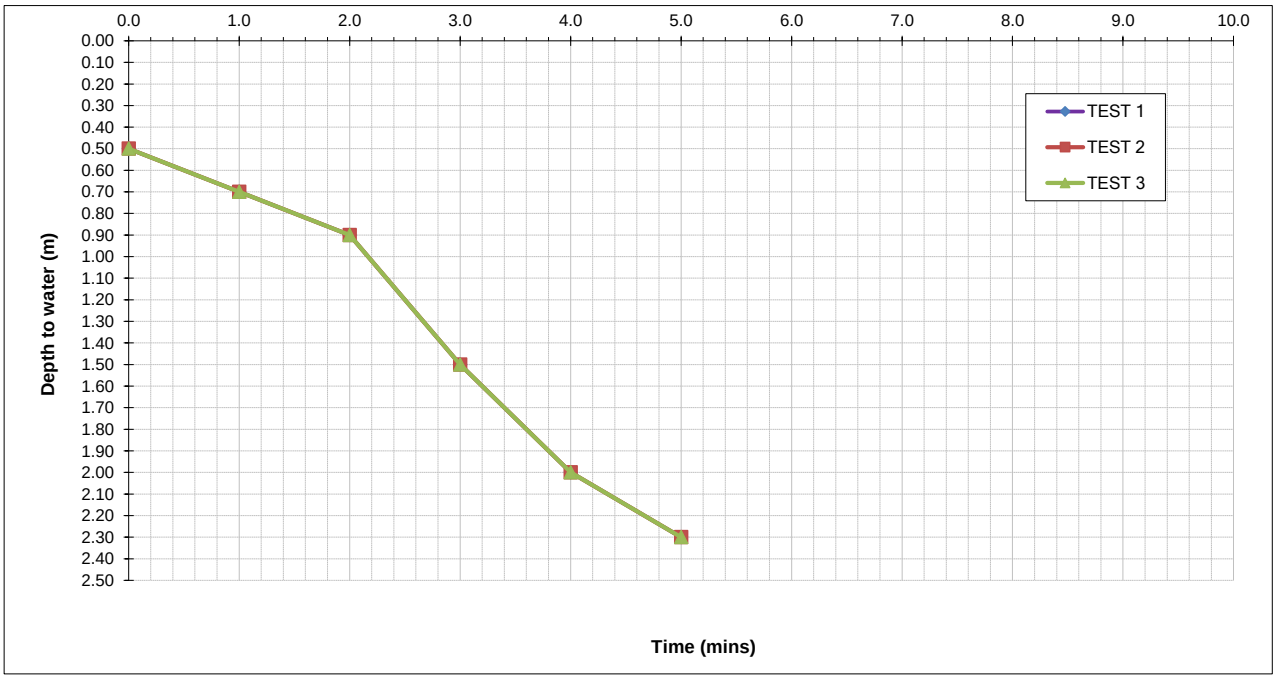
e3p	**Site:** Ruthin Road, Wrexham **Job Number:** 14-854 **Date of Test:** 30/07/2021	**Trial Pit Number:**	SA101
		Length:	2.30 m
		Width:	0.70 m
		Depth:	2.30 m
		Groundwater Level:	N/A m

Soakaway locaiton could not be completely filled as water began to soakaway during filling. 3 tests completed with 1000l into each test all completely soaked away within 5 minutes

	TEST 1		TEST 2		TEST 3	
	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
	0	0.50	0	0.50	0	0.50
	1	0.70	1	0.70	1	0.70
	2	0.90	2	0.90	2	0.90
	3	1.50	3	1.50	3	1.50
	4	2.00	4	2.00	4	2.00
	5	2.30	5	2.30	5	2.30

Effective Storage Depth	m	1.80	1.80	1.80
75% Effective Storage Depth	m	1.35	1.35	1.35
(i.e. depth below GL)	m	0.95	0.95	0.95
25% Effective Storage Depth	m	0.45	0.45	0.45
(i.e. depth below GL)	m	1.85	1.85	1.85
Effective Storage Depth 75%-25%	m	0.90	0.90	0.90
Time to fall to 75% effective depth	mins	2.10	2.10	2.10
Time to fall to 25% effective depth	mins	3.70	3.70	3.70
V (75%-25%)	m3	1.45	1.45	1.45
a (50%)	m2	7.01	7.01	7.01
t (75%-25%)	mins	1.60	1.60	1.60
SOIL INFILTRATION RATE	m/s	**2.15E-03**	**2.15E-03**	**2.15E-03**

DESIGN SOIL INFILTRATION RATE, f	**2.15E-03**



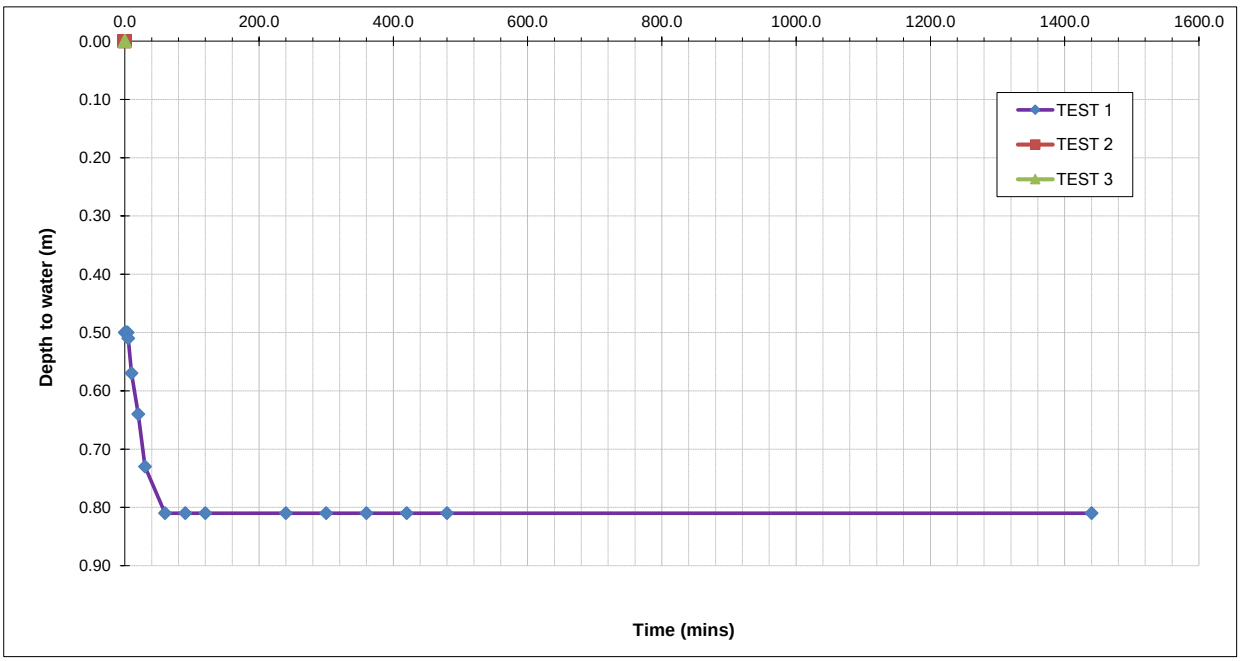
e3p	**Site:** Ruthin Road, Wrexham **Job Number:** 14-854 **Date of Test:** 30/07/2021	**Trial Pit Number:** SA102 **Length:** 2.20 m **Width:** 0.70 m **Depth:** 2.50 m **Groundwater Level:** N/A m	

Soakaway test did not fall below 75% or 25% effective storage over the full monitoring period.

TEST 1		TEST 2		TEST 3	
Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
0	0.50				
1	0.50				
2	0.50				
3	0.50				
4	0.50				
5	0.51				
10	0.57				
20	0.64				
30	0.73				
60	0.81				
90	0.81				
120	0.81				
240	0.81				
300	0.81				
360	0.81				
420	0.81				
480	0.81				
1440	0.81				

Effective Storage Depth	m	2.00		
75% Effective Storage Depth	m	1.50		
(i.e. depth below GL)	m	1.00		
25% Effective Storage Depth	m	0.50		
(i.e. depth below GL)	m	2.00		
Effective Storage Depth 75%-25%	m	1.00		
Time to fall to 75% effective depth	mins	N/A		
Time to fall to 25% effective depth	mins	N/A		
V (75%-25%)	m3	1.54		
a (50%)	m2	7.34		
t (75%-25%)	mins	N/A		
SOIL INFILTRATION RATE	m/s	**N/A**		

DESIGN SOIL INFILTRATION RATE, f **N/A**



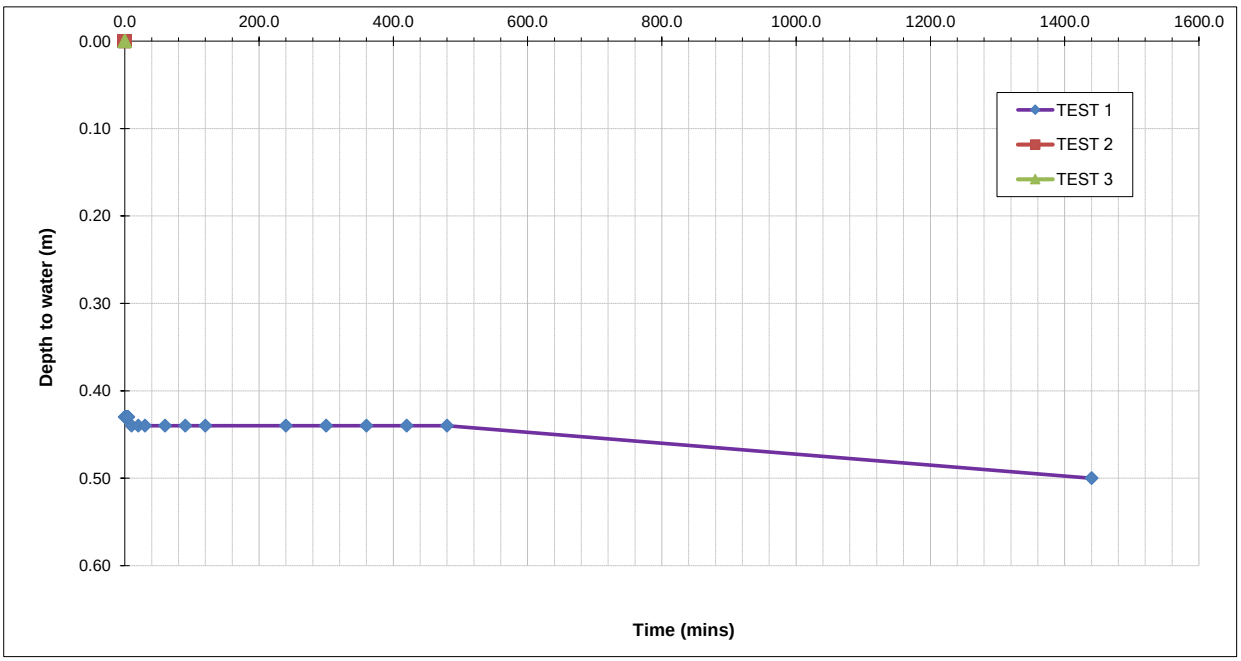
e3p	**Site:** Ruthin Road, Wrexham **Job Number:** 14-854 **Date of Test:** 30/07/2021	**Trial Pit Number:**	SA103
		Length:	2.90 m
		Width:	0.70 m
		Depth:	2.50 m
		Groundwater Level:	N/A m

Soakaway test did not fall below 75% or 25% effective storage over the full monitoring period

TEST 1		TEST 2		TEST 3	
Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
0	0.43				
1	0.43				
2	0.43				
3	0.43				
4	0.43				
5	0.43				
10	0.44				
20	0.44				
30	0.44				
60	0.44				
90	0.44				
120	0.44				
240	0.44				
300	0.44				
360	0.44				
420	0.44				
480	0.44				
1440	0.50				

Effective Storage Depth	m	2.07		
75% Effective Storage Depth	m	1.55		
(i.e. depth below GL)	m	0.95		
25% Effective Storage Depth	m	0.52		
(i.e. depth below GL)	m	1.98		
Effective Storage Depth 75%-25%	m	1.04		
Time to fall to 75% effective depth	mins	N/A		
Time to fall to 25% effective depth	mins	N/A		
V (75%-25%)	m3	2.10		
a (50%)	m2	9.48		
t (75%-25%)	mins	N/A		
SOIL INFILTRATION RATE	m/s	**N/A**		

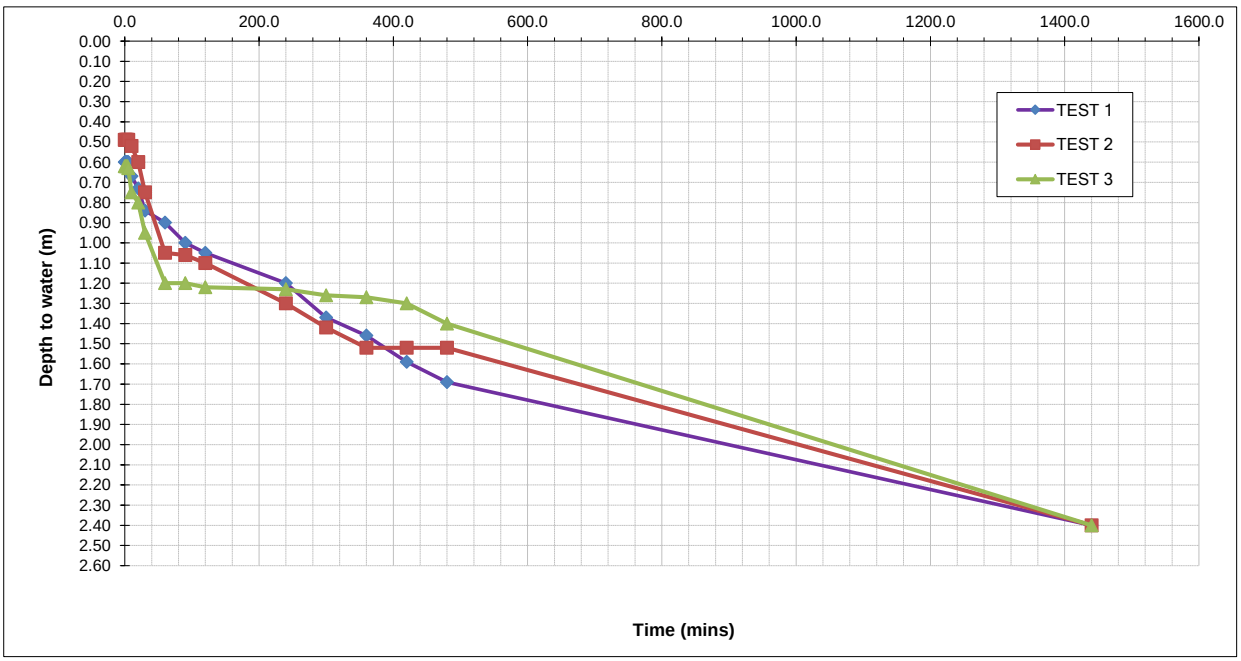
DESIGN SOIL INFILTRATION RATE, f	**N/A**



e3p	**Site:** Ruthin Road, Wrexham **Job Number:** 14-854 **Date of Test:** 30/07/2021	**Trial Pit Number:**	SA104
		Length:	2.20 m
		Width:	0.70 m
		Depth:	2.40 m
		Groundwater Level:	N/A m

	TEST 1		TEST 2		TEST 3	
	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
	0	0.60	0	0.49	0	0.62
	1	0.60	1	0.49	1	0.62
	2	0.60	2	0.49	2	0.62
	3	0.60	3	0.49	3	0.62
	4	0.60	4	0.49	4	0.62
	5	0.60	5	0.49	5	0.63
	10	0.67	10	0.52	10	0.75
	20	0.73	20	0.60	20	0.80
	30	0.84	30	0.75	30	0.95
	60	0.90	60	1.05	60	1.20
	90	1.00	90	1.06	90	1.20
	120	1.05	120	1.10	120	1.22
	240	1.20	240	1.30	240	1.23
	300	1.37	300	1.42	300	1.26
	360	1.46	360	1.52	360	1.27
	420	1.59	420	1.52	420	1.30
	480	1.69	480	1.52	480	1.40
	1440	2.40	1440	2.40	1440	2.40
Effective Storage Depth	m	1.80		1.91		1.78
75% Effective Storage Depth	m	1.35		1.43		1.34
(i.e. depth below GL)	m	1.05		0.97		1.07
25% Effective Storage Depth	m	0.45		0.48		0.45
(i.e. depth below GL)	m	1.95		1.92		1.96
Effective Storage Depth 75%-25%	m	0.90		0.96		0.89
Time to fall to 75% effective depth	mins	100.00		48.00		43.00
Time to fall to 25% effective depth	mins	840.00		920.00		1020.00
V (75%-25%)	m3	1.39		1.47		1.37
a (50%)	m2	6.76		7.08		6.70
t (75%-25%)	mins	740.00		872.00		977.00
SOIL INFILTRATION RATE	m/s	**4.62E-06**		**3.97E-06**		**3.49E-06**

DESIGN SOIL INFILTRATION RATE, f	**3.49E-06**



Site:	Ruthin Road, Wrexham	**Trial Pit Number:**	SA105
Job Number:	14-854	**Length:**	2.20 m
Date of Test:	30/07/2021	**Width:**	0.70 m
		Depth:	2.35 m
		Groundwater Level:	N/A m

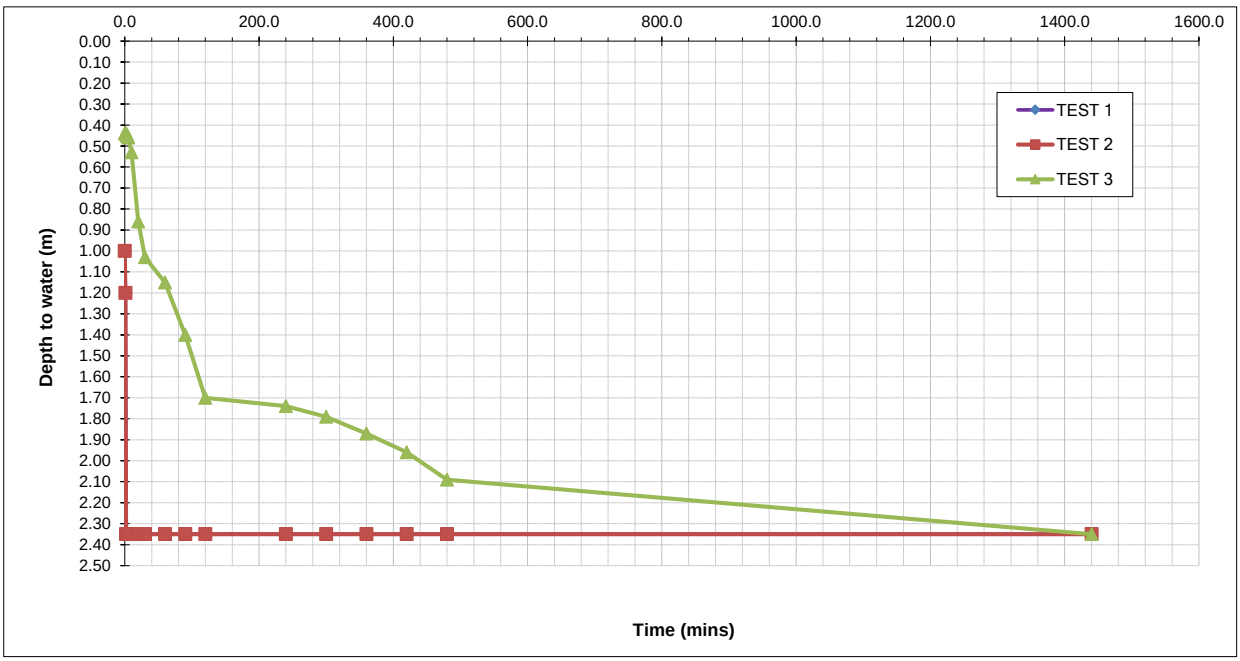
First two tests - Pit could not been filled to top due to soakage - 1000l input

Last test notably slower discharge.

TEST 1		TEST 2		TEST 3	
Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
0	1.00	0	1.00	0	0.44
1	1.20	1	1.20	1	0.44
2	2.35	2	2.35	2	0.44
3	2.35	3	2.35	3	0.45
4	2.35	4	2.35	4	0.45
5	2.35	5	2.35	5	0.46
10	2.35	10	2.35	10	0.53
20	2.35	20	2.35	20	0.86
30	2.35	30	2.35	30	1.03
60	2.35	60	2.35	60	1.15
90	2.35	90	2.35	90	1.40
120	2.35	120	2.35	120	1.70
240	2.35	240	2.35	240	1.74
300	2.35	300	2.35	300	1.79
360	2.35	360	2.35	360	1.87
420	2.35	420	2.35	420	1.96
480	2.35	480	2.35	480	2.09
1440	2.35	1440	2.35	1440	2.35

Effective Storage Depth	m	1.35	1.35	1.91
75% Effective Storage Depth	m	1.01	1.01	1.43
(i.e. depth below GL)	m	1.34	1.34	0.92
25% Effective Storage Depth	m	0.34	0.34	0.48
(i.e. depth below GL)	m	2.01	2.01	1.87
Effective Storage Depth 75%-25%	m	0.68	0.68	0.96
Time to fall to 75% effective depth	mins	1.00	1.00	19.00
Time to fall to 25% effective depth	mins	1.50	1.50	421.00
V (75%-25%)	m3	1.04	1.04	1.47
a (50%)	m2	5.46	5.46	7.08
t (75%-25%)	mins	0.50	0.50	402.00
SOIL INFILTRATION RATE	m/s	**6.35E-03**	**6.35E-03**	**8.61E-06**

DESIGN SOIL INFILTRATION RATE, f	**8.61E-06**



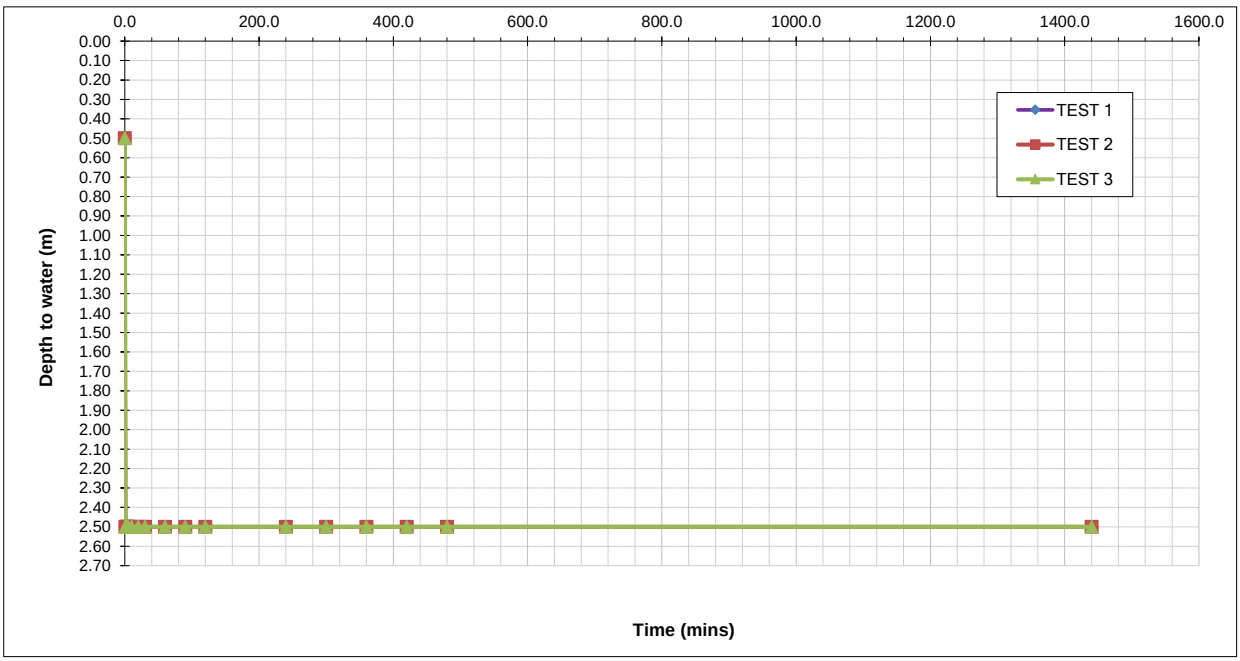
e3p	**Site:** Ruthin Road, Wrexham **Job Number:** 14-854 **Date of Test:** 30/07/2021	**Trial Pit Number:** SA106 **Length:** 2.40 m **Width:** 0.70 m **Depth:** 2.50 m **Groundwater Level:** N/A m	

3000L Water placed into test (1000L per test) no water was retainied.

TEST 1		TEST 2		TEST 3	
Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
0	0.50	0	0.50	0	0.50
1	2.50	1	2.50	1	2.50
2	2.50	2	2.50	2	2.50
3	2.50	3	2.50	3	2.50
4	2.50	4	2.50	4	2.50
5	2.50	5	2.50	5	2.50
10	2.50	10	2.50	10	2.50
20	2.50	20	2.50	20	2.50
30	2.50	30	2.50	30	2.50
60	2.50	60	2.50	60	2.50
90	2.50	90	2.50	90	2.50
120	2.50	120	2.50	120	2.50
240	2.50	240	2.50	240	2.50
300	2.50	300	2.50	300	2.50
360	2.50	360	2.50	360	2.50
420	2.50	420	2.50	420	2.50
480	2.50	480	2.50	480	2.50
1440	2.50	1440	2.50	1440	2.50

Effective Storage Depth	m	2.00	2.00	2.00
75% Effective Storage Depth	m	1.50	1.50	1.50
(i.e. depth below GL)	m	1.00	1.00	1.00
25% Effective Storage Depth	m	0.50	0.50	0.50
(i.e. depth below GL)	m	2.00	2.00	2.00
Effective Storage Depth 75%-25%	m	1.00	1.00	1.00
Time to fall to 75% effective depth	mins	0.50	0.50	0.50
Time to fall to 25% effective depth	mins	1.00	1.00	1.00
V (75%-25%)	m3	1.68	1.68	1.68
a (50%)	m2	7.88	7.88	7.88
t (75%-25%)	mins	0.50	0.50	0.50
SOIL INFILTRATION RATE	m/s	**7.11E-03**	**7.11E-03**	**7.11E-03**

DESIGN SOIL INFILTRATION RATE, f	**7.11E-03**



	Site:	Ruthin Road, Wrexham	
	Job Number:	14-854	
	Date of Test:	30/07/2021	

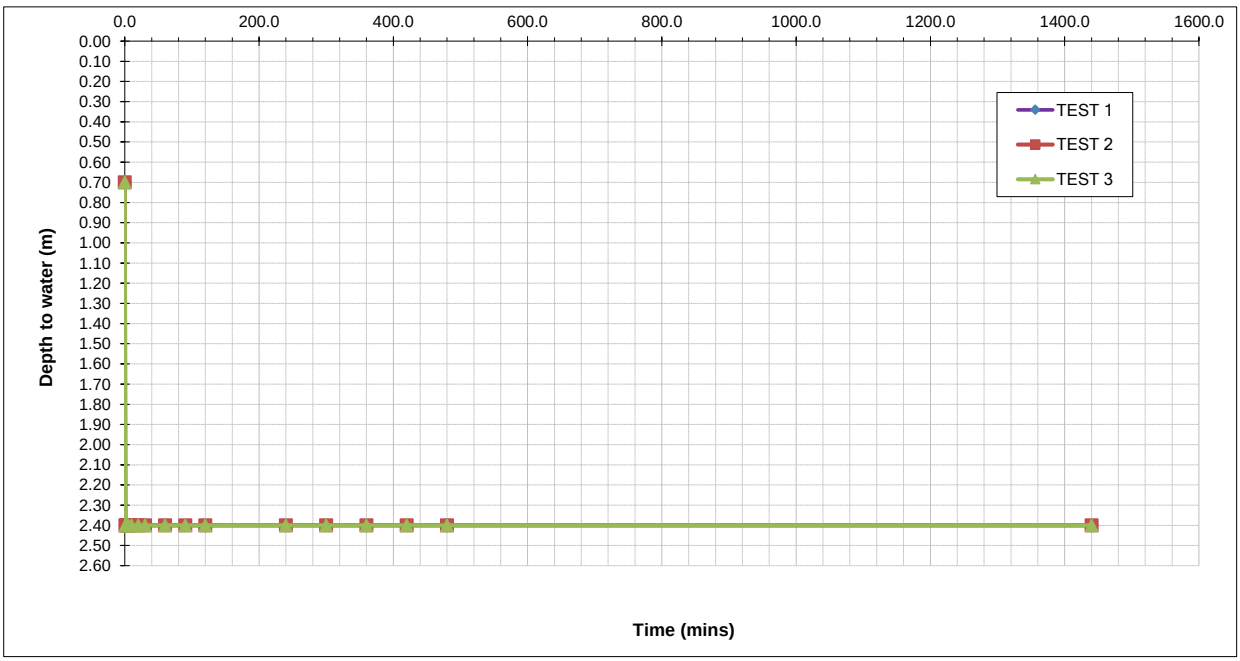
Trial Pit Number:	SA107	
Length:	2.40	m
Width:	0.70	m
Depth:	2.40	m
Groundwater Level:	N/A	m

1000L water placed into pit per test - no water retained

TEST 1		TEST 2		TEST 3	
Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
0	0.70	0	0.70	0	0.70
1	2.40	1	2.40	1	2.40
2	2.40	2	2.40	2	2.40
3	2.40	3	2.40	3	2.40
4	2.40	4	2.40	4	2.40
5	2.40	5	2.40	5	2.40
10	2.40	10	2.40	10	2.40
20	2.40	20	2.40	20	2.40
30	2.40	30	2.40	30	2.40
60	2.40	60	2.40	60	2.40
90	2.40	90	2.40	90	2.40
120	2.40	120	2.40	120	2.40
240	2.40	240	2.40	240	2.40
300	2.40	300	2.40	300	2.40
360	2.40	360	2.40	360	2.40
420	2.40	420	2.40	420	2.40
480	2.40	480	2.40	480	2.40
1440	2.40	1440	2.40	1440	2.40

Effective Storage Depth	m	1.70	1.70	1.70
75% Effective Storage Depth	m	1.28	1.28	1.28
(i.e. depth below GL)	m	1.13	1.13	1.13
25% Effective Storage Depth	m	0.43	0.43	0.43
(i.e. depth below GL)	m	1.98	1.98	1.98
Effective Storage Depth 75%-25%	m	0.85	0.85	0.85
Time to fall to 75% effective depth	mins	0.50	0.50	0.50
Time to fall to 25% effective depth	mins	1.00	1.00	1.00
V (75%-25%)	m3	1.43	1.43	1.43
a (50%)	m2	6.95	6.95	6.95
t (75%-25%)	mins	0.50	0.50	0.50
SOIL INFILTRATION RATE	m/s	**6.85E-03**	**6.85E-03**	**6.85E-03**

DESIGN SOIL INFILTRATION RATE, f	**6.85E-03**



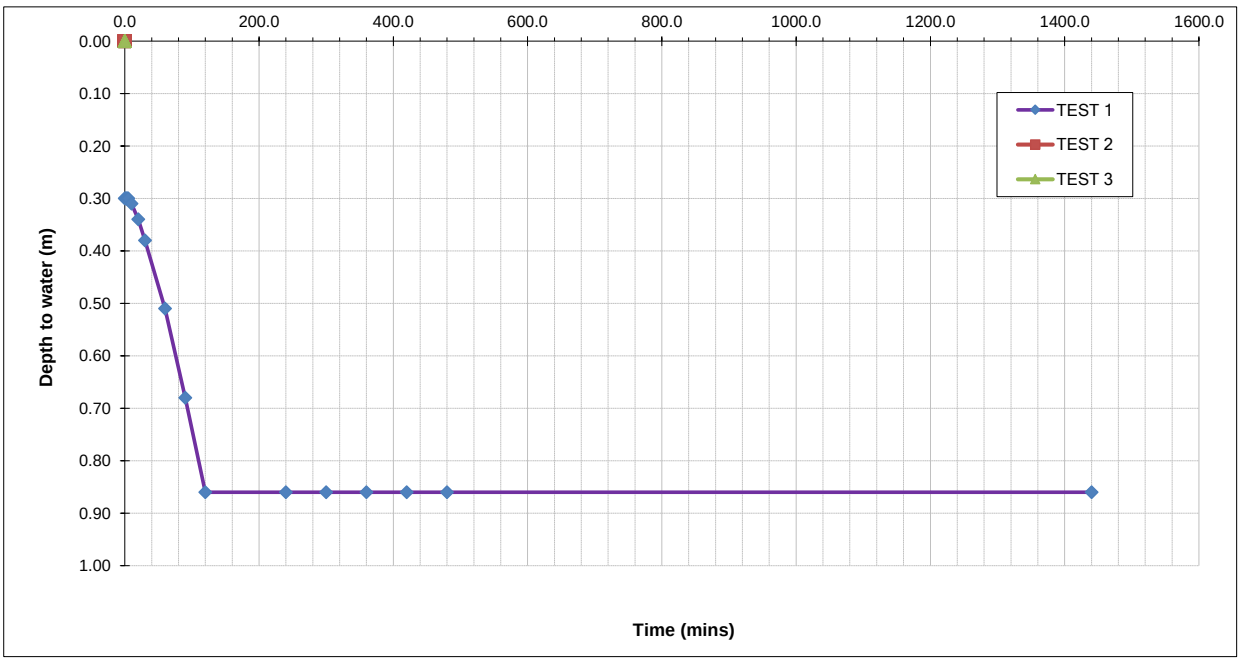
e3p	**Site:** Ruthin Road, Wrexham **Job Number:** 14-854 **Date of Test:** 30/07/2021	**Trial Pit Number:** SA108 **Length:** 2.40 m **Width:** 0.70 m **Depth:** 2.50 m **Groundwater Level:** N/A m	

Water level did not fall below the 75% and 25% effective storage depths over the 24 hour period.

TEST 1		TEST 2		TEST 3	
Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
0	0.30				
1	0.30				
2	0.30				
3	0.30				
4	0.30				
5	0.30				
10	0.31				
20	0.34				
30	0.38				
60	0.51				
90	0.68				
120	0.86				
240	0.86				
300	0.86				
360	0.86				
420	0.86				
480	0.86				
1440	0.86				

Effective Storage Depth	m	2.20		
75% Effective Storage Depth	m	1.65		
(i.e. depth below GL)	m			
25% Effective Storage Depth	m	0.55		
(i.e. depth below GL)	m			
Effective Storage Depth 75%-25%	m	1.10		
Time to fall to 75% effective depth	mins	N/A		
Time to fall to 25% effective depth	mins	N/A		
V (75%-25%)	m3	1.85		
a (50%)	m2	8.50		
t (75%-25%)	mins	N/A		
SOIL INFILTRATION RATE	m/s	**N/A**		

DESIGN SOIL INFILTRATION RATE, f	**N/A**



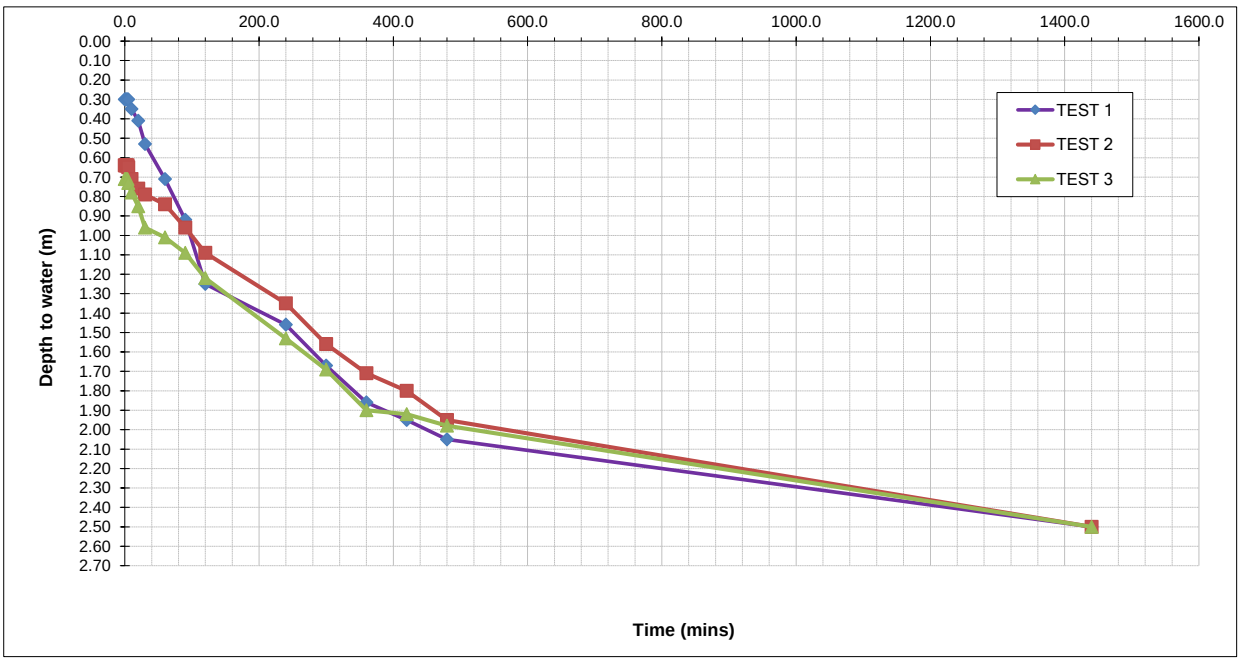
	Site:	Ruthin Road, Wrexham	
	Job Number:	14-854	
	Date of Test:	30/07/2021	

Trial Pit Number:	SA109	
Length:	2.40	m
Width:	0.70	m
Depth:	2.50	m
Groundwater Level:	N/A	m

TEST 1		TEST 2		TEST 3	
Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
0	0.30	0	0.64	0	0.71
1	0.30	1	0.64	1	0.71
2	0.30	2	0.64	2	0.71
3	0.30	3	0.64	3	0.71
4	0.30	4	0.64	4	0.71
5	0.30	5	0.65	5	0.73
10	0.35	10	0.71	10	0.78
20	0.41	20	0.76	20	0.85
30	0.53	30	0.79	30	0.96
60	0.71	60	0.84	60	1.01
90	0.92	90	0.96	90	1.09
120	1.25	120	1.09	120	1.22
240	1.46	240	1.35	240	1.53
300	1.67	300	1.56	300	1.69
360	1.86	360	1.71	360	1.90
420	1.95	420	1.80	420	1.92
480	2.05	480	1.95	480	1.98
1440	2.50	1440	2.50	1440	2.50

Effective Storage Depth	m	2.20	1.86	1.79
75% Effective Storage Depth	m	1.65	1.40	1.34
(i.e. depth below GL)	m	0.85	1.11	1.16
25% Effective Storage Depth	m	0.55	0.47	0.45
(i.e. depth below GL)	m	1.95	2.04	2.05
Effective Storage Depth 75%-25%	m	1.10	0.93	0.90
Time to fall to 75% effective depth	mins	80.00	130.00	104.00
Time to fall to 25% effective depth	mins	430.00	680.00	640.00
V (75%-25%)	m3	1.85	1.56	1.50
a (50%)	m2	8.50	7.45	7.23
t (75%-25%)	mins	350.00	550.00	536.00
SOIL INFILTRATION RATE	m/s	**1.04E-05**	**6.36E-06**	**6.47E-06**

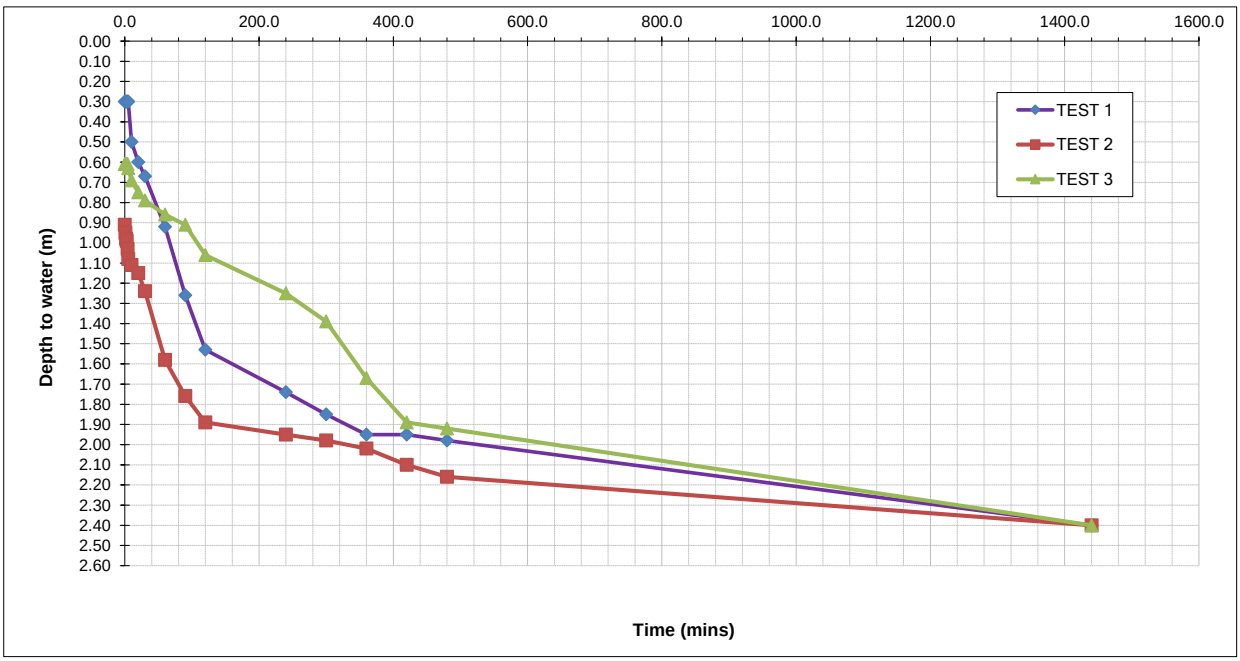
DESIGN SOIL INFILTRATION RATE, f	**6.36E-06**



e3p	**Site:** Ruthin Road, Wrexham **Job Number:** 14-854 **Date of Test:** 30/07/2021	**Trial Pit Number:**	SA110
		Length:	2.00 m
		Width:	0.70 m
		Depth:	2.40 m
		Groundwater Level:	N/A m

	TEST 1		TEST 2		TEST 3	
	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
	0	0.30	0	0.91	0	0.61
	1	0.30	1	0.95	1	0.61
	2	0.30	2	0.98	2	0.61
	3	0.30	3	0.99	3	0.61
	4	0.30	4	1.03	4	0.61
	5	0.30	5	1.08	5	0.63
	10	0.50	10	1.11	10	0.69
	20	0.60	20	1.15	20	0.75
	30	0.67	30	1.24	30	0.79
	60	0.92	60	1.58	60	0.86
	90	1.26	90	1.76	90	0.91
	120	1.53	120	1.89	120	1.06
	240	1.74	240	1.95	240	1.25
	300	1.85	300	1.98	300	1.39
	360	1.95	360	2.02	360	1.67
	420	1.95	420	2.10	420	1.89
	480	1.98	480	2.16	480	1.92
	1440	2.40	1440	2.40	1440	2.40
Effective Storage Depth	m	2.10		1.49		1.79
75% Effective Storage Depth	m	1.58		1.12		1.34
(i.e. depth below GL)	m	0.83		1.28		1.06
25% Effective Storage Depth	m	0.53		0.37		0.45
(i.e. depth below GL)	m	1.88		2.03		1.95
Effective Storage Depth 75%-25%	m	1.05		0.75		0.90
Time to fall to 75% effective depth	mins	45.00		38.00		120.00
Time to fall to 25% effective depth	mins	320.00		365.00		580.00
V (75%-25%)	m3	1.47		1.04		1.25
a (50%)	m2	7.07		5.42		6.23
t (75%-25%)	mins	275.00		327.00		460.00
SOIL INFILTRATION RATE	m/s	**1.26E-05**		**9.80E-06**		**7.28E-06**

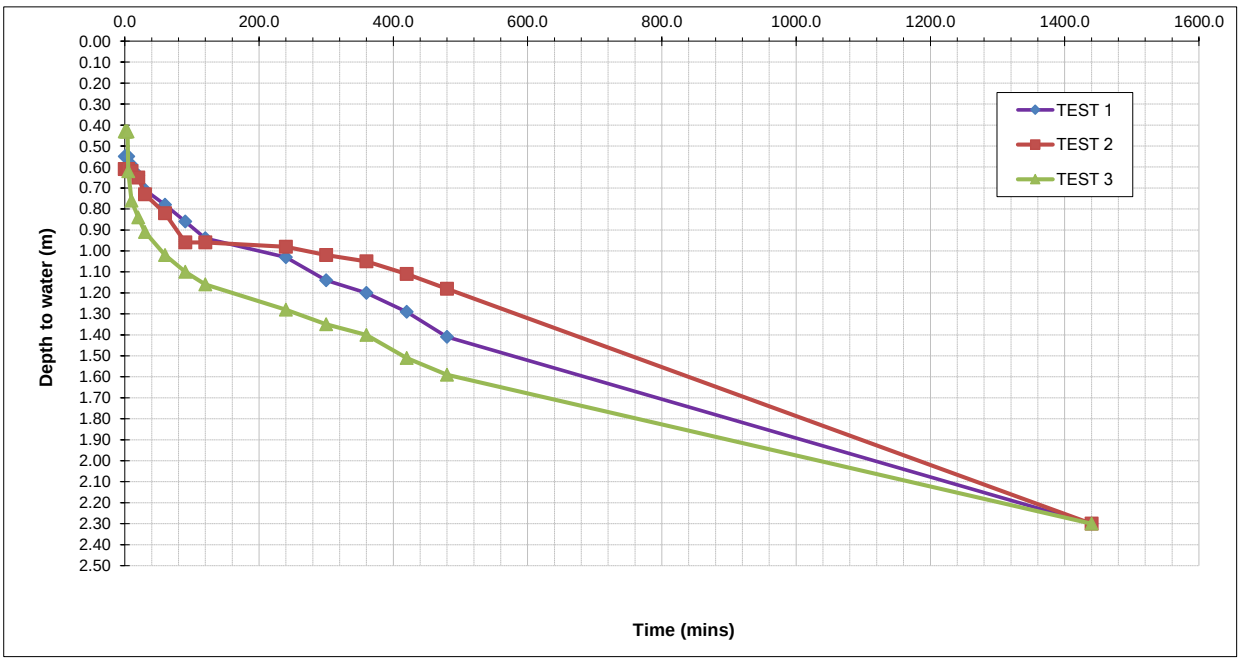
DESIGN SOIL INFILTRATION RATE, f	**7.28E-06**



e3p	**Site:** Ruthin Road, Wrexham **Job Number:** 14-854 **Date of Test:** 30/07/2021	**Trial Pit Number:**	SA111
		Length:	2.10 m
		Width:	0.70 m
		Depth:	2.30 m
		Groundwater Level:	N/A m

	TEST 1		TEST 2		TEST 3	
	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
	0	0.55	0	0.61	0	0.43
	1	0.55	1	0.61	1	0.43
	2	0.55	2	0.61	2	0.43
	3	0.55	3	0.61	3	0.43
	4	0.55	4	0.61	4	0.43
	5	0.55	5	0.61	5	0.62
	10	0.59	10	0.62	10	0.76
	20	0.64	20	0.65	20	0.84
	30	0.71	30	0.73	30	0.91
	60	0.78	60	0.82	60	1.02
	90	0.86	90	0.96	90	1.10
	120	0.94	120	0.96	120	1.16
	240	1.03	240	0.98	240	1.28
	300	1.14	300	1.02	300	1.35
	360	1.20	360	1.05	360	1.40
	420	1.29	420	1.11	420	1.51
	480	1.41	480	1.18	480	1.59
	1440	2.30	1440	2.30	1440	2.30
Effective Storage Depth	m	1.75		1.69		1.87
75% Effective Storage Depth	m	1.31		1.27		1.40
(i.e. depth below GL)	m	0.99		1.03		0.90
25% Effective Storage Depth	m	0.44		0.42		0.47
(i.e. depth below GL)	m	1.86		1.88		1.83
Effective Storage Depth 75%-25%	m	0.88		0.85		0.94
Time to fall to 75% effective depth	mins	180.00		305.00		28.00
Time to fall to 25% effective depth	mins	960.00		842.00		800.00
V (75%-25%)	m3	1.29		1.24		1.37
a (50%)	m2	6.37		6.20		6.71
t (75%-25%)	mins	780.00		537.00		772.00
SOIL INFILTRATION RATE	m/s	**4.31E-06**		**6.22E-06**		**4.42E-06**

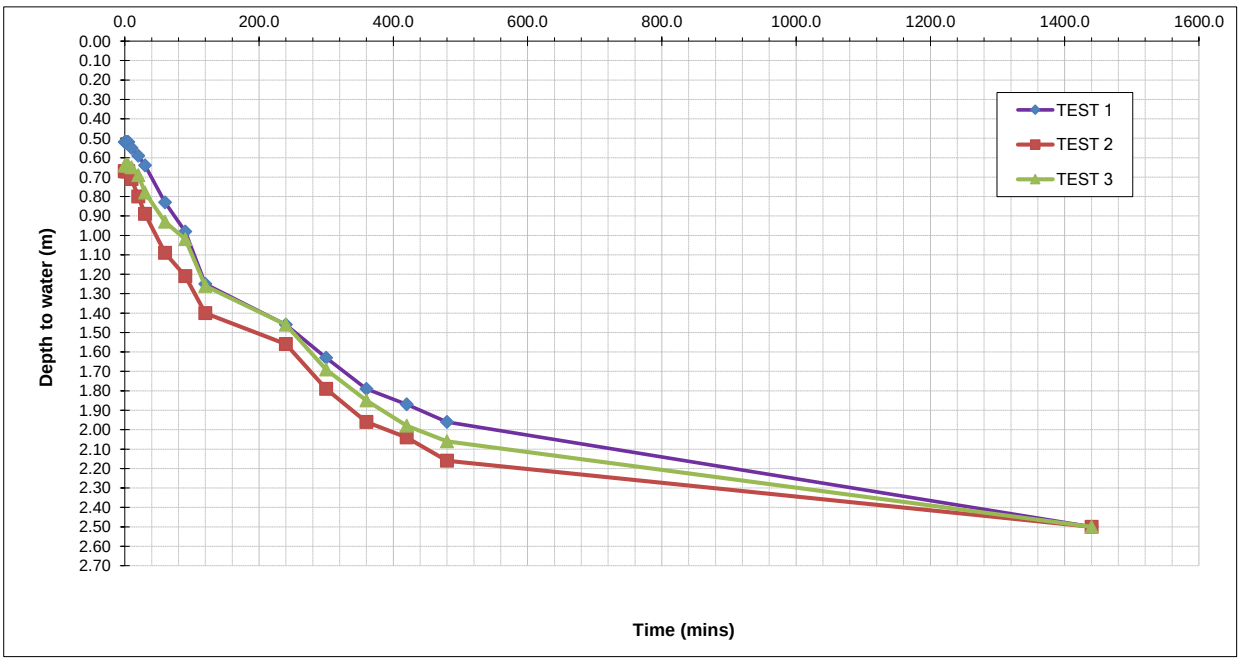
DESIGN SOIL INFILTRATION RATE, f	**4.31E-06**



e3p	**Site:** Ruthin Road, Wrexham **Job Number:** 14-854 **Date of Test:** 30/07/2021	**Trial Pit Number:**	SA112
		Length:	2.30 m
		Width:	0.70 m
		Depth:	2.50 m
		Groundwater Level:	N/A m

	TEST 1		TEST 2		TEST 3	
	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
	0	0.52	0	0.67	0	0.64
	1	0.52	1	0.67	1	0.64
	2	0.52	2	0.67	2	0.64
	3	0.52	3	0.67	3	0.64
	4	0.52	4	0.67	4	0.64
	5	0.52	5	0.67	5	0.64
	10	0.55	10	0.71	10	0.65
	20	0.59	20	0.80	20	0.69
	30	0.64	30	0.89	30	0.78
	60	0.83	60	1.09	60	0.93
	90	0.98	90	1.21	90	1.02
	120	1.25	120	1.40	120	1.26
	240	1.46	240	1.56	240	1.46
	300	1.63	300	1.79	300	1.69
	360	1.79	360	1.96	360	1.85
	420	1.87	420	2.04	420	1.98
	480	1.96	480	2.16	480	2.06
	1440	2.50	1440	2.50	1440	2.50
Effective Storage Depth	m	1.98		1.83		1.86
75% Effective Storage Depth	m	1.49		1.37		1.40
(i.e. depth below GL)	m	1.02		1.13		1.11
25% Effective Storage Depth	m	0.50		0.46		0.47
(i.e. depth below GL)	m	2.01		2.04		2.04
Effective Storage Depth 75%-25%	m	0.99		0.92		0.93
Time to fall to 75% effective depth	mins	91.00		76.00		90.00
Time to fall to 25% effective depth	mins	600.00		420.00		472.00
V (75%-25%)	m3	1.59		1.47		1.50
a (50%)	m2	7.55		7.10		7.19
t (75%-25%)	mins	509.00		344.00		382.00
SOIL INFILTRATION RATE	m/s	**6.91E-06**		**1.01E-05**		**9.09E-06**

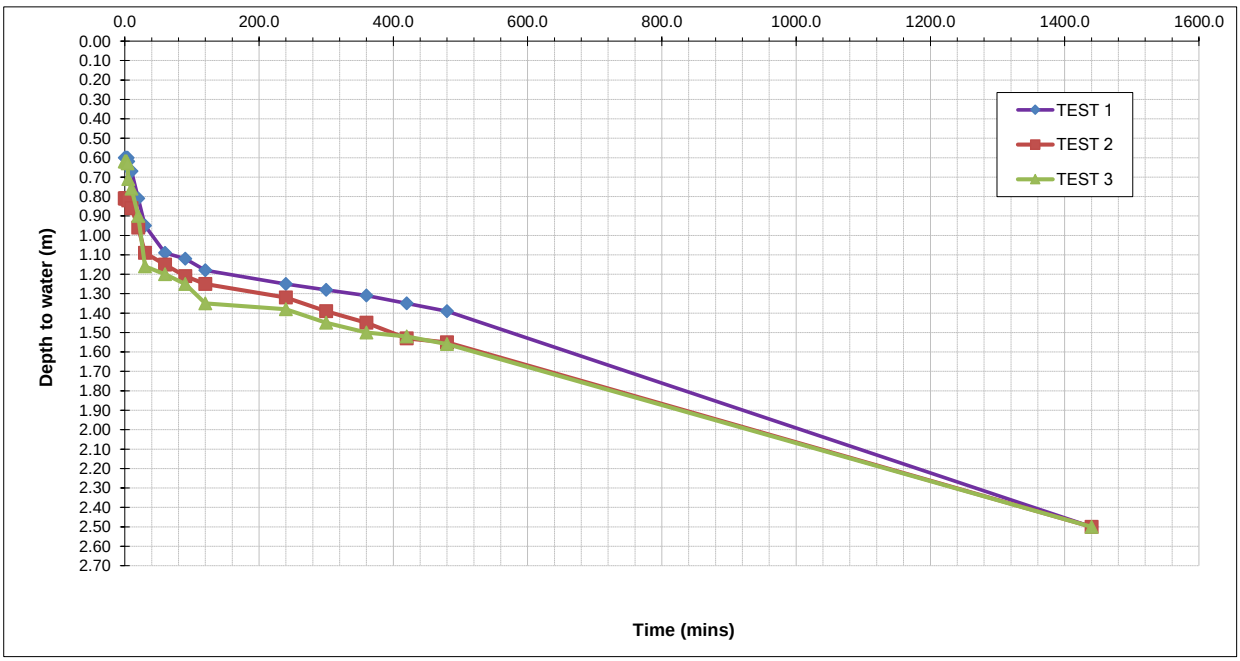
DESIGN SOIL INFILTRATION RATE, f	**6.91E-06**



e3p	**Site:** Ruthin Road, Wrexham **Job Number:** 14-854 **Date of Test:** 30/07/2021	**Trial Pit Number:**	SA113
		Length:	2.10 m
		Width:	0.70 m
		Depth:	2.50 m
		Groundwater Level:	N/A m

	TEST 1		TEST 2		TEST 3	
	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
	0	0.60	0	0.81	0	0.62
	1	0.60	1	0.81	1	0.62
	2	0.60	2	0.81	2	0.62
	3	0.60	3	0.81	3	0.62
	4	0.60	4	0.81	4	0.63
	5	0.62	5	0.82	5	0.71
	10	0.67	10	0.86	10	0.76
	20	0.81	20	0.96	20	0.90
	30	0.95	30	1.09	30	1.16
	60	1.09	60	1.15	60	1.20
	90	1.12	90	1.21	90	1.25
	120	1.18	120	1.25	120	1.35
	240	1.25	240	1.32	240	1.38
	300	1.28	300	1.39	300	1.45
	360	1.31	360	1.45	360	1.50
	420	1.35	420	1.53	420	1.52
	480	1.39	480	1.55	480	1.56
	1440	2.50	1440	2.50	1440	2.50
Effective Storage Depth	m	1.90		1.69		1.88
75% Effective Storage Depth	m	1.43		1.27		1.41
(i.e. depth below GL)	m	1.08		1.23		1.09
25% Effective Storage Depth	m	0.48		0.42		0.47
(i.e. depth below GL)	m	2.03		2.08		2.03
Effective Storage Depth 75%-25%	m	0.95		0.85		0.94
Time to fall to 75% effective depth	mins	45.00		105.00		35.00
Time to fall to 25% effective depth	mins	1040.00		1000.00		960.00
V (75%-25%)	m3	1.40		1.24		1.38
a (50%)	m2	6.79		6.20		6.73
t (75%-25%)	mins	995.00		895.00		925.00
SOIL INFILTRATION RATE	m/s	**3.45E-06**		**3.73E-06**		**3.70E-06**

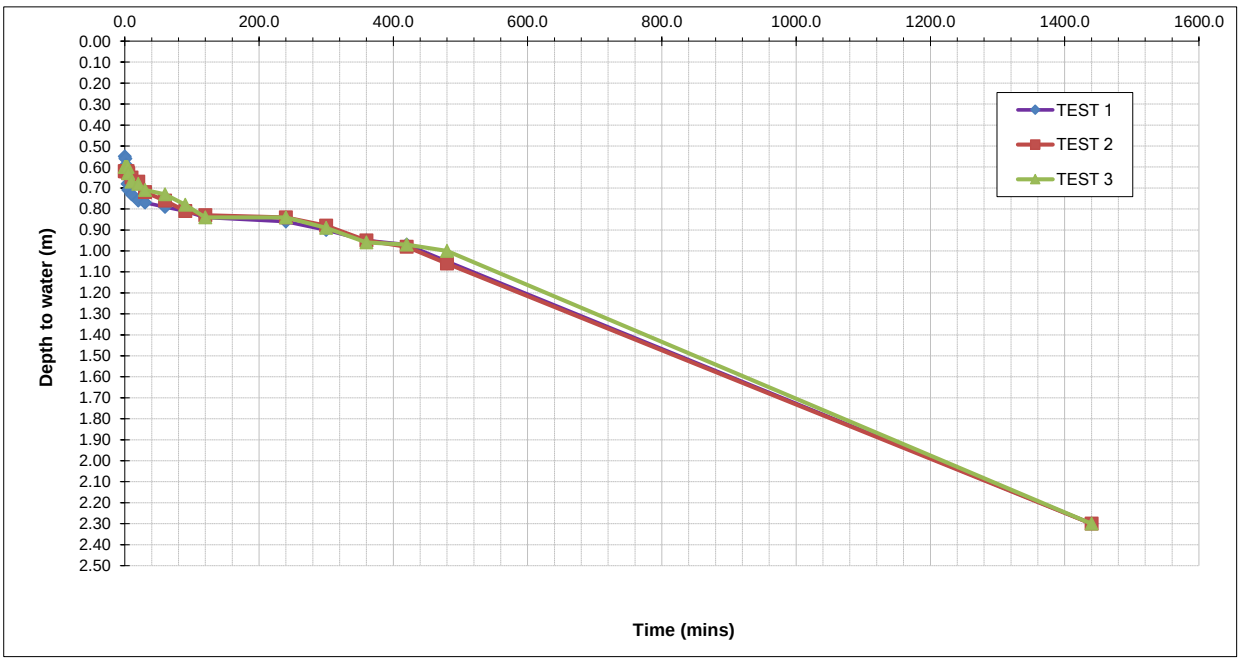
DESIGN SOIL INFILTRATION RATE, f	**3.45E-06**



e3p	**Site:** Ruthin Road, Wrexham **Job Number:** 14-854 **Date of Test:** 30/07/2021	**Trial Pit Number:**	SA114
		Length:	2.10 m
		Width:	0.70 m
		Depth:	2.30 m
		Groundwater Level:	N/A m

	TEST 1		TEST 2		TEST 3	
	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
	0	0.55	0	0.62	0	0.60
	1	0.56	1	0.62	1	0.60
	2	0.59	2	0.62	2	0.60
	3	0.64	3	0.62	3	0.60
	4	0.68	4	0.62	4	0.60
	5	0.71	5	0.63	5	0.63
	10	0.73	10	0.65	10	0.67
	20	0.76	20	0.67	20	0.68
	30	0.77	30	0.72	30	0.71
	60	0.79	60	0.76	60	0.73
	90	0.81	90	0.81	90	0.78
	120	0.84	120	0.83	120	0.84
	240	0.86	240	0.84	240	0.84
	300	0.90	300	0.88	300	0.89
	360	0.95	360	0.95	360	0.96
	420	0.97	420	0.98	420	0.97
	480	1.05	480	1.06	480	1.00
	1440	2.30	1440	2.30	1440	2.30
Effective Storage Depth	m	1.75		1.68		1.70
75% Effective Storage Depth	m	1.31		1.26		1.28
(i.e. depth below GL)	m	0.99		1.04		1.03
25% Effective Storage Depth	m	0.44		0.42		0.43
(i.e. depth below GL)	m	1.86		1.88		1.88
Effective Storage Depth 75%-25%	m	0.88		0.84		0.85
Time to fall to 75% effective depth	mins	430.00		470.00		485.00
Time to fall to 25% effective depth	mins	1120.00		1120.00		1120.00
V (75%-25%)	m3	1.29		1.23		1.25
a (50%)	m2	6.37		6.17		6.23
t (75%-25%)	mins	690.00		650.00		635.00
SOIL INFILTRATION RATE	m/s	**4.88E-06**		**5.13E-06**		**5.26E-06**

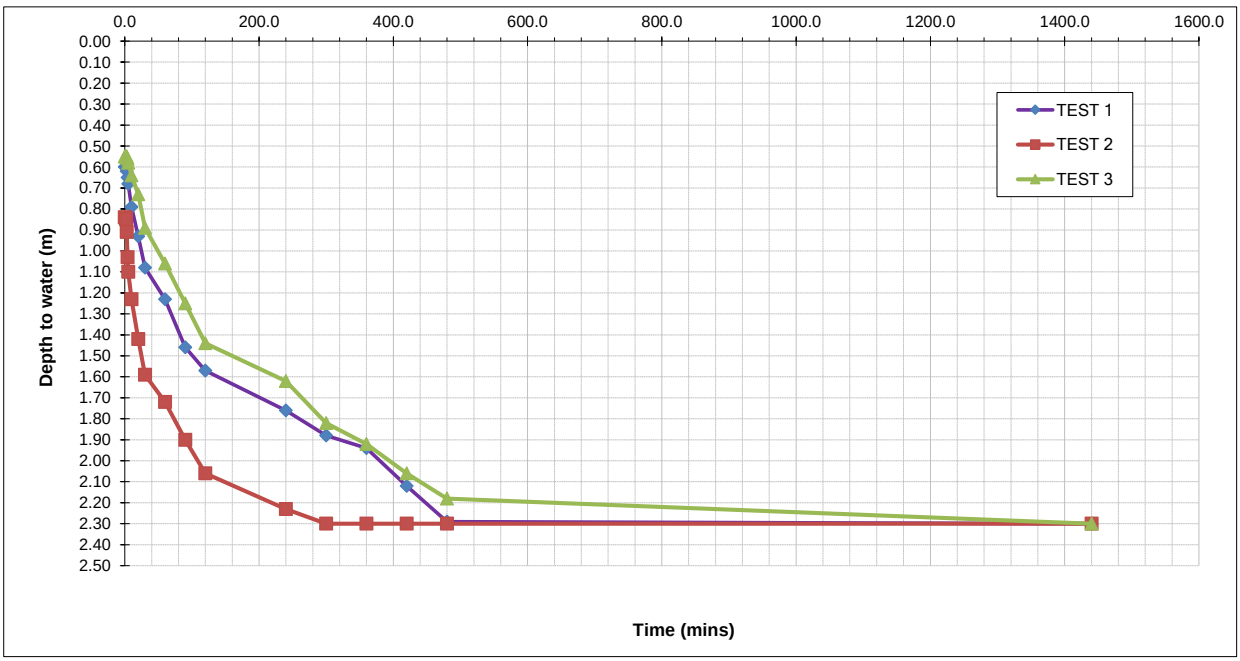
DESIGN SOIL INFILTRATION RATE, f	**4.88E-06**



e3p	**Site:** Ruthin Road, Wrexham **Job Number:** 14-854 **Date of Test:** 30/07/2021	**Trial Pit Number:**	SA115
		Length:	2.30 m
		Width:	0.70 m
		Depth:	2.30 m
		Groundwater Level:	N/A m

	TEST 1		TEST 2		TEST 3	
	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
	0	0.60	0	0.84	0	0.55
	1	0.60	1	0.84	1	0.55
	2	0.60	2	0.85	2	0.55
	3	0.62	3	0.91	3	0.55
	4	0.65	4	1.03	4	0.56
	5	0.68	5	1.10	5	0.58
	10	0.79	10	1.23	10	0.64
	20	0.93	20	1.42	20	0.73
	30	1.08	30	1.59	30	0.89
	60	1.23	60	1.72	60	1.06
	90	1.46	90	1.90	90	1.25
	120	1.57	120	2.06	120	1.44
	240	1.76	240	2.23	240	1.62
	300	1.88	300	2.30	300	1.82
	360	1.94	360	2.30	360	1.92
	420	2.12	420	2.30	420	2.06
	480	2.29	480	2.30	480	2.18
	1440	2.30	1440	2.30	1440	2.30
Effective Storage Depth	m	1.70		1.46		1.75
75% Effective Storage Depth	m	1.28		1.10		1.31
(i.e. depth below GL)	m	1.03		1.21		0.99
25% Effective Storage Depth	m	0.43		0.37		0.44
(i.e. depth below GL)	m	1.88		1.94		1.86
Effective Storage Depth 75%-25%	m	0.85		0.73		0.88
Time to fall to 75% effective depth	mins	26.00		9.00		53.00
Time to fall to 25% effective depth	mins	300.00		98.00		310.00
V (75%-25%)	m3	1.37		1.18		1.41
a (50%)	m2	6.71		5.99		6.86
t (75%-25%)	mins	274.00		89.00		257.00
SOIL INFILTRATION RATE	m/s	**1.24E-05**		**3.67E-05**		**1.33E-05**

DESIGN SOIL INFILTRATION RATE, f	**1.24E-05**



e3p	**Site:** Ruthin Road, Wrexham **Job Number:** 14-854 **Date of Test:** 30/07/2021	**Trial Pit Number:**	SA116
		Length:	1.80 m
		Width:	0.70 m
		Depth:	2.30 m
		Groundwater Level:	N/A m

	TEST 1		TEST 2		TEST 3	
	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
	0	0.55	0	0.61	0	0.60
	1	0.55	1	0.61	1	0.60
	2	0.56	2	0.62	2	0.60
	3	0.57	3	0.64	3	0.63
	4	0.59	4	0.65	4	0.68
	5	0.62	5	0.67	5	0.72
	10	0.67	10	0.76	10	0.74
	20	0.74	20	0.86	20	0.79
	30	0.84	30	0.91	30	0.83
	60	1.04	60	1.07	60	1.00
	90	1.14	90	1.21	90	1.10
	120	1.29	120	1.35	120	1.26
	240	1.54	240	1.61	240	1.53
	300	1.79	300	1.86	300	1.70
	360	1.98	360	2.04	360	1.90
	420	2.30	420	2.20	420	2.10
	480	2.30	480	2.30	480	2.30
	1440	2.30	1440	2.30	1440	2.30
Effective Storage Depth	m	1.75		1.69		1.70
75% Effective Storage Depth	m	1.31		1.27		1.28
(i.e. depth below GL)	m	0.99		1.03		1.03
25% Effective Storage Depth	m	0.44		0.42		0.43
(i.e. depth below GL)	m	1.86		1.88		1.88
Effective Storage Depth 75%-25%	m	0.88		0.85		0.85
Time to fall to 75% effective depth	mins	52.00		55.00		65.00
Time to fall to 25% effective depth	mins	330.00		310.00		350.00
V (75%-25%)	m3	1.10		1.06		1.07
a (50%)	m2	5.64		5.49		5.51
t (75%-25%)	mins	278.00		255.00		285.00
SOIL INFILTRATION RATE	m/s	**1.17E-05**		**1.27E-05**		**1.14E-05**

DESIGN SOIL INFILTRATION RATE, f	**1.14E-05**



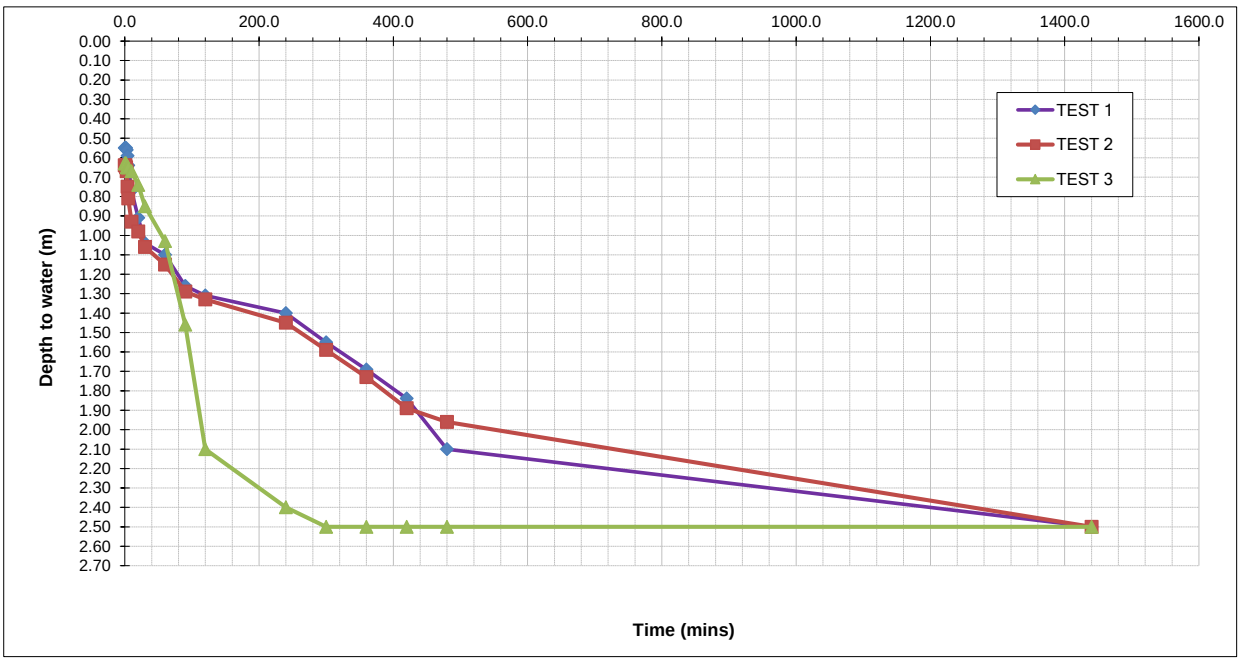
	Site:	Ruthin Road, Wrexham	
	Job Number:	14-854	
	Date of Test:	30/07/2021	

Trial Pit Number:	SA117	
Length:	2.00	m
Width:	0.70	m
Depth:	2.50	m
Groundwater Level:	N/A	m

TEST 1		TEST 2		TEST 3	
Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
0	0.55	0	0.64	0	0.63
1	0.55	1	0.64	1	0.63
2	0.55	2	0.65	2	0.63
3	0.56	3	0.67	3	0.65
4	0.59	4	0.75	4	0.65
5	0.64	5	0.81	5	0.65
10	0.77	10	0.93	10	0.67
20	0.91	20	0.98	20	0.74
30	1.04	30	1.06	30	0.85
60	1.10	60	1.15	60	1.03
90	1.26	90	1.29	90	1.46
120	1.31	120	1.33	120	2.10
240	1.40	240	1.45	240	2.40
300	1.55	300	1.59	300	2.50
360	1.69	360	1.73	360	2.50
420	1.84	420	1.89	420	2.50
480	2.10	480	1.96	480	2.50
1440	2.50	1440	2.50	1440	2.50

Effective Storage Depth	m	1.95	1.86	1.87
75% Effective Storage Depth	m	1.46	1.40	1.40
(i.e. depth below GL)	m	1.04	1.11	1.10
25% Effective Storage Depth	m	0.49	0.47	0.47
(i.e. depth below GL)	m	2.01	2.04	2.03
Effective Storage Depth 75%-25%	m	0.98	0.93	0.94
Time to fall to 75% effective depth	mins	30.00	50.00	65.00
Time to fall to 25% effective depth	mins	460.00	640.00	120.00
V (75%-25%)	m3	1.37	1.30	1.31
a (50%)	m2	6.67	6.42	6.45
t (75%-25%)	mins	430.00	590.00	55.00
SOIL INFILTRATION RATE	m/s	**7.94E-06**	**5.73E-06**	**6.15E-05**

DESIGN SOIL INFILTRATION RATE, f	**5.73E-06**



e3p	**Site:** Ruthin Road, Wrexham **Job Number:** 14-854 **Date of Test:** 30/07/2021	**Trial Pit Number:**	SA118
		Length:	2.20 m
		Width:	0.70 m
		Depth:	2.50 m
		Groundwater Level:	N/A m

	TEST 1		TEST 2		TEST 3	
	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
	0	0.60	0	0.61	0	0.60
	1	0.60	1	0.61	1	0.61
	2	0.62	2	0.61	2	0.63
	3	0.65	3	0.63	3	0.65
	4	0.71	4	0.67	4	0.68
	5	0.75	5	0.73	5	0.71
	10	0.89	10	0.90	10	0.85
	20	1.03	20	1.06	20	1.00
	30	1.29	30	1.23	30	1.19
	60	1.50	60	1.46	60	1.40
	90	1.65	90	1.61	90	1.60
	120	1.80	120	1.75	120	1.80
	240	2.10	240	2.06	240	2.00
	300	2.30	300	2.29	300	2.30
	360	2.50	360	2.46	360	2.48
	420	2.50	420	2.50	420	2.50
	480	2.50	480	2.50	480	2.50
	1440	2.50	1440	2.50	1440	2.50
Effective Storage Depth	m	1.90		1.89		1.90
75% Effective Storage Depth	m	1.43		1.42		1.43
(i.e. depth below GL)	m	1.08		1.08		1.08
25% Effective Storage Depth	m	0.48		0.47		0.48
(i.e. depth below GL)	m	2.03		2.03		2.03
Effective Storage Depth 75%-25%	m	0.95		0.95		0.95
Time to fall to 75% effective depth	mins	25.00		22.00		25.00
Time to fall to 25% effective depth	mins	210.00		220.00		242.00
V (75%-25%)	m3	1.46		1.46		1.46
a (50%)	m2	7.05		7.02		7.05
t (75%-25%)	mins	185.00		198.00		217.00
SOIL INFILTRATION RATE	m/s	**1.87E-05**		**1.74E-05**		**1.59E-05**

DESIGN SOIL INFILTRATION RATE, f	**1.59E-05**



	Site:	Ruthin Road, Wrexham	
	Job Number:	14-854	
	Date of Test:	30/07/2021	

Trial Pit Number:	SA119	
Length:	2.00	m
Width:	0.80	m
Depth:	2.50	m
Groundwater Level:	N/A	m

	TEST 1		TEST 2		TEST 3	
	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
	0	0.60	0	0.41	0	0.71
	1	0.61	1	0.46	1	0.71
	2	0.65	2	0.55	2	0.75
	3	0.69	3	0.61	3	0.82
	4	0.73	4	0.68	4	0.88
	5	0.78	5	0.70	5	0.94
	10	0.84	10	0.79	10	1.01
	20	0.89	20	0.85	20	1.04
	30	0.95	30	0.96	30	1.06
	60	1.20	60	1.16	60	1.25
	90	1.45	90	1.35	90	1.49
	120	1.70	120	1.51	120	1.80
	240	1.94	240	2.04	240	2.28
	300	2.20	300	2.16	300	2.39
	360	2.40	360	2.30	360	2.50
	420	2.50	420	2.50	420	2.50
	480	2.50	480	2.50	480	2.50
	1440	2.50	1440	2.50	1440	2.50
Effective Storage Depth	m	1.90		2.09		1.79
75% Effective Storage Depth	m	1.43		1.57		1.34
(i.e. depth below GL)	m	1.08		0.93		1.16
25% Effective Storage Depth	m	0.48		0.52		0.45
(i.e. depth below GL)	m	2.03		1.98		2.05
Effective Storage Depth 75%-25%	m	0.95		1.05		0.90
Time to fall to 75% effective depth	mins	45.00		25.00		40.00
Time to fall to 25% effective depth	mins	260.00		235.00		280.00
V (75%-25%)	m3	1.52		1.67		1.43
a (50%)	m2	6.92		7.45		6.61
t (75%-25%)	mins	215.00		210.00		240.00
SOIL INFILTRATION RATE	m/s	**1.70E-05**		**1.78E-05**		**1.50E-05**

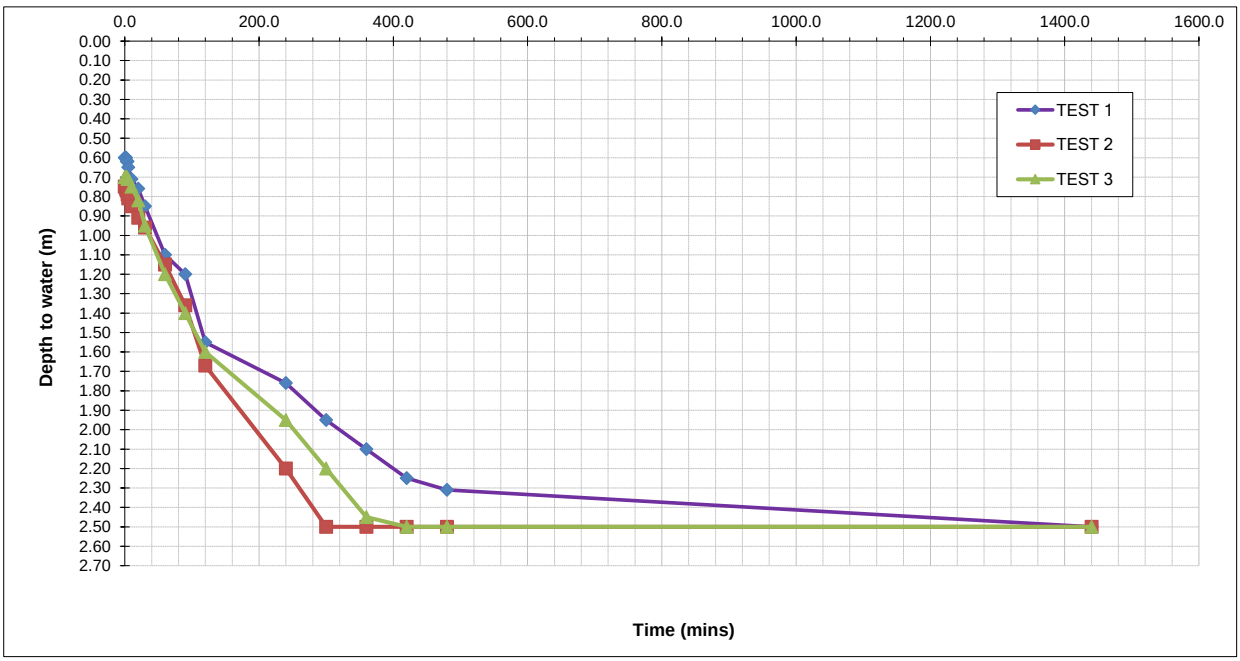
DESIGN SOIL INFILTRATION RATE, f	**1.50E-05**



Site:	Ruthin Road, Wrexham	**Trial Pit Number:**	SA220
Job Number:	14-854	**Length:**	2.10 m
Date of Test:	30/07/2021	**Width:**	0.70 m
		Depth:	2.50 m
		Groundwater Level:	N/A m

	TEST 1		TEST 2		TEST 3	
	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
	0	0.60	0	0.75	0	0.70
	1	0.60	1	0.75	1	0.70
	2	0.60	2	0.76	2	0.70
	3	0.62	3	0.77	3	0.70
	4	0.62	4	0.79	4	0.71
	5	0.65	5	0.81	5	0.71
	10	0.71	10	0.85	10	0.75
	20	0.76	20	0.91	20	0.82
	30	0.85	30	0.96	30	0.95
	60	1.10	60	1.15	60	1.20
	90	1.20	90	1.36	90	1.40
	120	1.55	120	1.67	120	1.60
	240	1.76	240	2.20	240	1.95
	300	1.95	300	2.50	300	2.20
	360	2.10	360	2.50	360	2.45
	420	2.25	420	2.50	420	2.50
	480	2.31	480	2.50	480	2.50
	1440	2.50	1440	2.50	1440	2.50
Effective Storage Depth	m	1.90		1.75		1.80
75% Effective Storage Depth	m	1.43		1.31		1.35
(i.e. depth below GL)	m	1.08		1.19		1.15
25% Effective Storage Depth	m	0.48		0.44		0.45
(i.e. depth below GL)	m	2.03		2.06		2.05
Effective Storage Depth 75%-25%	m	0.95		0.88		0.90
Time to fall to 75% effective depth	mins	50.00		70.00		55.00
Time to fall to 25% effective depth	mins	330.00		210.00		260.00
V (75%-25%)	m3	1.40		1.29		1.32
a (50%)	m2	6.79		6.37		6.51
t (75%-25%)	mins	280.00		140.00		205.00
SOIL INFILTRATION RATE	m/s	**1.22E-05**		**2.40E-05**		**1.65E-05**

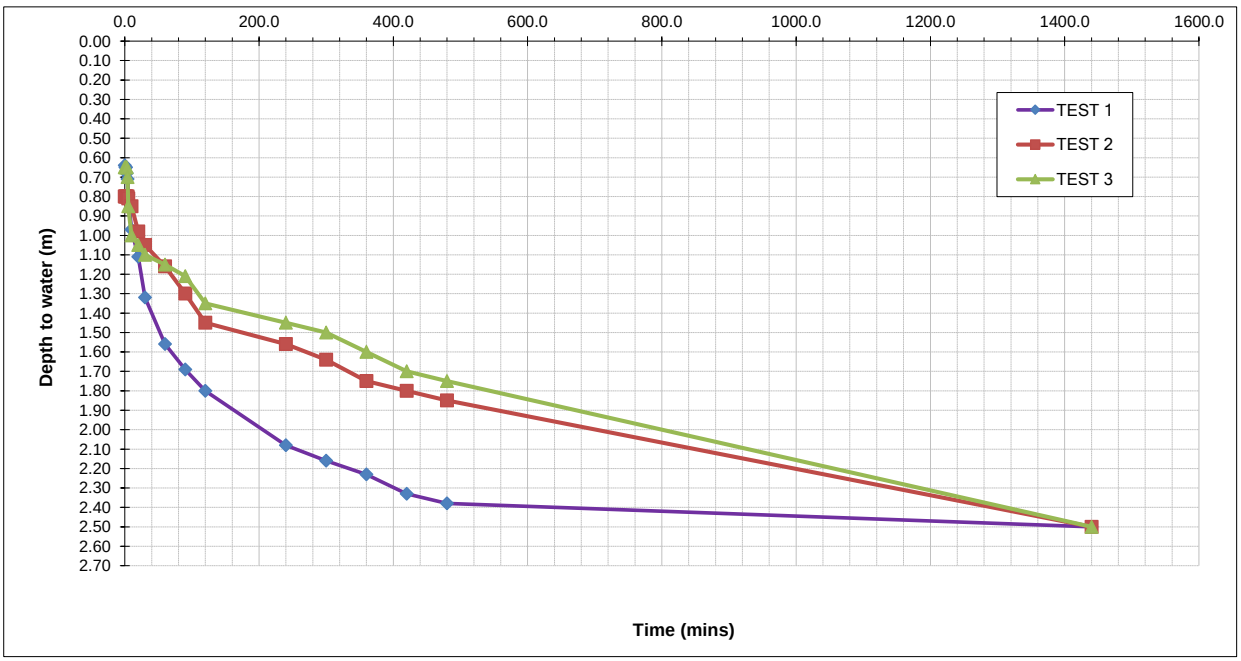
DESIGN SOIL INFILTRATION RATE, f	**1.22E-05**



e3p	**Site:** Ruthin Road, Wrexham **Job Number:** 14-854 **Date of Test:** 30/07/2021	**Trial Pit Number:**	SA121
		Length:	2.10 m
		Width:	0.70 m
		Depth:	2.50 m
		Groundwater Level:	N/A m

	TEST 1		TEST 2		TEST 3	
	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
	0	0.64	0	0.80	0	0.65
	1	0.65	1	0.80	1	0.65
	2	0.65	2	0.80	2	0.65
	3	0.68	3	0.80	3	0.65
	4	0.71	4	0.80	4	0.70
	5	0.79	5	0.81	5	0.85
	10	0.97	10	0.85	10	1.00
	20	1.11	20	0.98	20	1.05
	30	1.32	30	1.05	30	1.10
	60	1.56	60	1.16	60	1.15
	90	1.69	90	1.30	90	1.21
	120	1.80	120	1.45	120	1.35
	240	2.08	240	1.56	240	1.45
	300	2.16	300	1.64	300	1.50
	360	2.23	360	1.75	360	1.60
	420	2.33	420	1.80	420	1.70
	480	2.38	480	1.85	480	1.75
	1440	2.50	1440	2.50	1440	2.50
Effective Storage Depth	m	1.86		1.70		1.85
75% Effective Storage Depth	m	1.40		1.28		1.39
(i.e. depth below GL)	m	1.11		1.23		1.11
25% Effective Storage Depth	m	0.47		0.43		0.46
(i.e. depth below GL)	m	2.04		2.08		2.04
Effective Storage Depth 75%-25%	m	0.93		0.85		0.93
Time to fall to 75% effective depth	mins	20.00		35.00		32.00
Time to fall to 25% effective depth	mins	235.00		800.00		880.00
V (75%-25%)	m3	1.37		1.25		1.36
a (50%)	m2	6.68		6.23		6.65
t (75%-25%)	mins	215.00		765.00		848.00
SOIL INFILTRATION RATE	m/s	**1.59E-05**		**4.37E-06**		**4.02E-06**

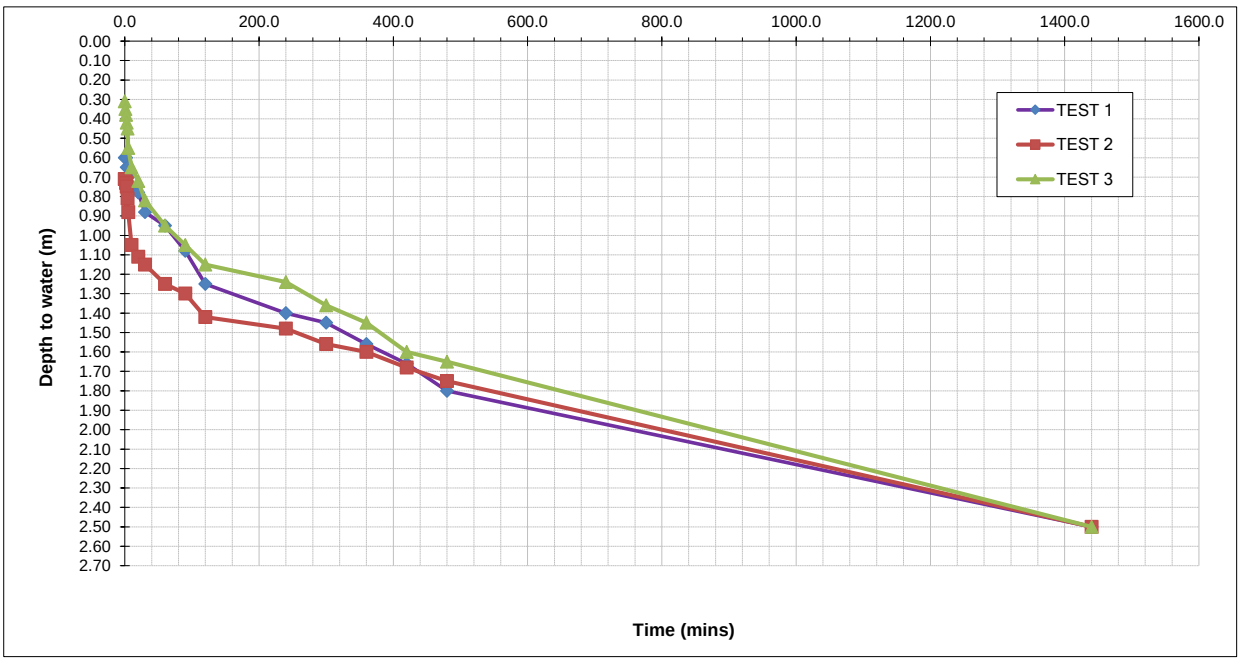
DESIGN SOIL INFILTRATION RATE, f	**4.02E-06**



e3p	**Site:** Ruthin Road, Wrexham **Job Number:** 14-854 **Date of Test:** 30/07/2021	**Trial Pit Number:**	SA122
		Length:	2.50 m
		Width:	0.70 m
		Depth:	2.50 m
		Groundwater Level:	N/A m

	TEST 1		TEST 2		TEST 3	
	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
	0	0.60	0	0.71	0	0.31
	1	0.60	1	0.71	1	0.35
	2	0.60	2	0.73	2	0.38
	3	0.65	3	0.75	3	0.42
	4	0.65	4	0.81	4	0.45
	5	0.70	5	0.88	5	0.55
	10	0.75	10	1.05	10	0.65
	20	0.78	20	1.11	20	0.72
	30	0.88	30	1.15	30	0.82
	60	0.95	60	1.25	60	0.95
	90	1.08	90	1.30	90	1.05
	120	1.25	120	1.42	120	1.15
	240	1.40	240	1.48	240	1.24
	300	1.45	300	1.56	300	1.36
	360	1.56	360	1.60	360	1.45
	420	1.66	420	1.68	420	1.60
	480	1.80	480	1.75	480	1.65
	1440	2.50	1440	2.50	1440	2.50
Effective Storage Depth	m	1.90		1.79		2.19
75% Effective Storage Depth	m	1.43		1.34		1.64
(i.e. depth below GL)	m	1.08		1.16		0.86
25% Effective Storage Depth	m	0.48		0.45		0.55
(i.e. depth below GL)	m	2.03		2.05		1.95
Effective Storage Depth 75%-25%	m	0.95		0.90		1.10
Time to fall to 75% effective depth	mins	90.00		35.00		38.00
Time to fall to 25% effective depth	mins	800.00		840.00		820.00
V (75%-25%)	m3	1.66		1.57		1.92
a (50%)	m2	7.83		7.48		8.76
t (75%-25%)	mins	710.00		805.00		782.00
SOIL INFILTRATION RATE	m/s	**4.98E-06**		**4.34E-06**		**4.66E-06**

DESIGN SOIL INFILTRATION RATE, f	**4.34E-06**



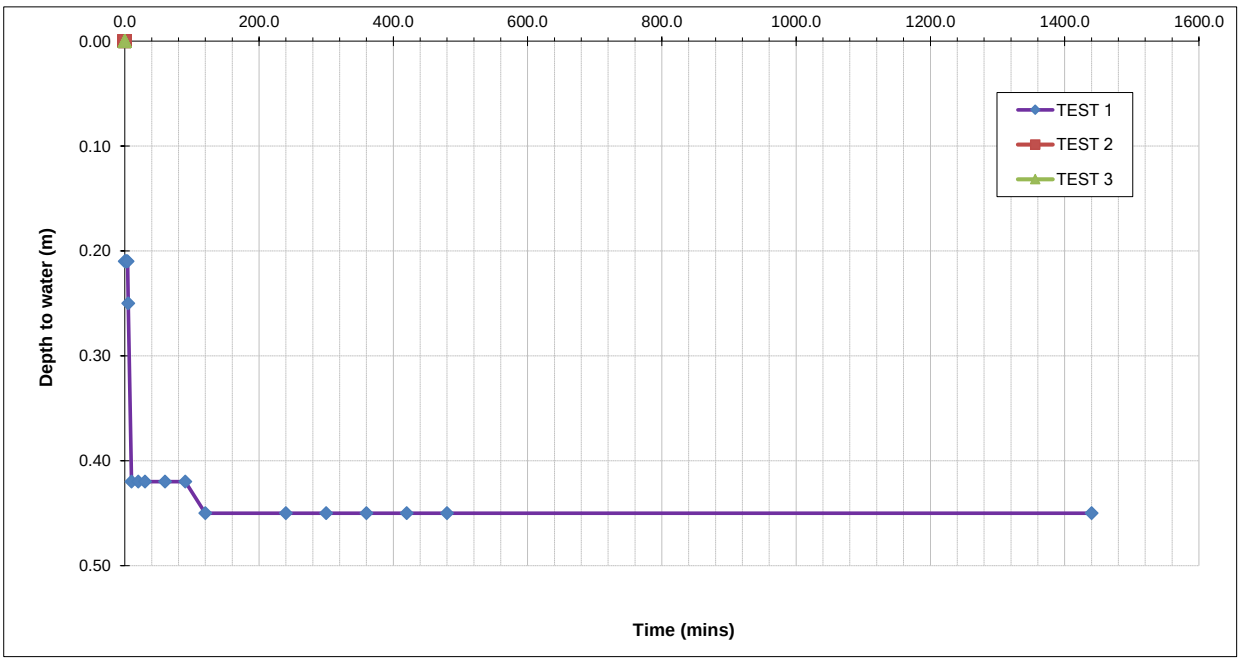
e3p	**Site:** Ruthin Road, Wrexham **Job Number:** 14-854 **Date of Test:** 30/07/2021	**Trial Pit Number:** SA123 **Length:** 2.50 m **Width:** 0.70 m **Depth:** 2.50 m **Groundwater Level:** N/A m	

Test completed in predominantly cohesive materials did not fall below 75% or 25% effective storage.

TEST 1		TEST 2		TEST 3	
Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
0	0.21				
1	0.21				
2	0.21				
3	0.21				
4	0.21				
5	0.25				
10	0.42				
20	0.42				
30	0.42				
60	0.42				
90	0.42				
120	0.45				
240	0.45				
300	0.45				
360	0.45				
420	0.45				
480	0.45				
1440	0.45				

Effective Storage Depth	m	2.29		
75% Effective Storage Depth	m	1.72		
(i.e. depth below GL)	m	0.78		
25% Effective Storage Depth	m	0.57		
(i.e. depth below GL)	m	1.93		
Effective Storage Depth 75%-25%	m	1.15		
Time to fall to 75% effective depth	mins	N/A		
Time to fall to 25% effective depth	mins	N/A		
V (75%-25%)	m3	2.00		
a (50%)	m2	9.08		
t (75%-25%)	mins	N/A		
SOIL INFILTRATION RATE	m/s	**N/A**		

DESIGN SOIL INFILTRATION RATE, f	**N/A**



Trial Pit Log

TrialPit No: TP101
Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331328.00 - 350192.00 Level:	Date 27/08/2021
Location: Wrexham		Dimensions (m): 3.00 x 0.80 Depth 2.50	Scale 1:30
Client: Redrow Homes			Logged A. Rae

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20			Light brown slightly clayey SAND. Sand is fine to coarse. Frequent rootlets. (TOPSOIL)
				0.40			Light reddish brown clayey SAND. Sand is coarse. Occasional rootlets.
				1.50			Light reddish brown clayey slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse subangular to subrounded of mudstone and sandstone.
				2.50			Light reddish brown slightly clayey SAND. Sand is coarse. Coal at circa 2.4 m bgl.
							End of Pit at 2.50m

Trial Pit Photographs



Trial Pit 101



Trial Pit 101 Spoil

Remarks: 1. Complete 2. Very friable CLAY unable to complete HSV test.

Stability: Stable

Trial Pit Log

TrialPit No: TP102
Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331378.00 - 350054.00 Level:	Date 27/08/2021
Location: Wrexham		Dimensions (m): 3.00 × 0.80 Depth 2.40	Scale 1:30
Client: Redrow Homes			Logged A. Rae

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20			Light brown slightly clayey fine to SAND. Sand is coarse. Frequent rootlets. (TOPSOIL)
				0.50			Soft light reddish brown sandy CLAY.
	2.00			2.40			Stiff light brown slighty gravelly CLAY. Gravel is fine to coarse subrounded of mudstone with occasional coal.
							End of Pit at 2.40m

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Trial Pit Photographs



Trial Pit 102



Trial Pit 102 Spoil

Remarks: 1. Complete

Stability: Stable

Trial Pit Log

TrialPit No: TP103
Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331677.00 - 350019.00 Level:	Date 27/08/2021
Location: Wrexham		Dimensions (m): 3.00 x 0.80 Depth 2.40	Scale 1:30
Client: Redrow Homes			Logged A. Rae

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			Light brown slightly clayey fine to SAND. Sand is coarse. Frequent rootlets. (TOPSOIL)
				2.40			Light reddish brown slightly clayey slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse subrounded of mudstone. Pockets of light brown clay. End of Pit at 2.40m

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Trial Pit Photographs



Trial Pit 103



Trial Pit 103 Spoil

Remarks: 1. Complete 2. Very friable CLAY unable to complete HSV test.

Stability: Stable

Trial Pit Log

TrialPit No: TP104
Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331601.00 - 350067.00 Level:	Date 27/08/2021
Location: Wrexham		Dimensions (m): 3.00 × 0.80 Depth 2.50	Scale 1:30
Client: Redrow Homes			Logged A. Rae

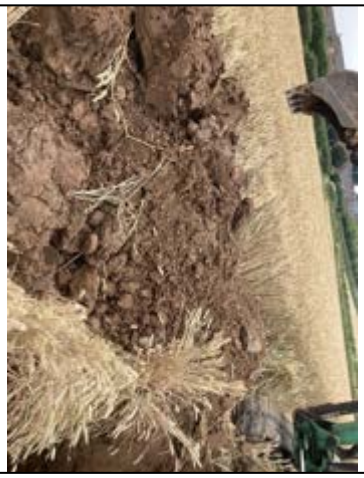
Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			Light brown slightly clayey SAND. Sand is fine to coarse. Frequent rootlets. (TOPSOIL)
				0.90			Light brown very gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse subrounded of mudstone with occasional coal.
	2.00			1.90			Stiff light brown slighty gravelly CLAY. Gravel is fine to coarse rounded to subrounded of mudstone with occasional rounded cobbles (< 130 mm).
				2.50			Firm light orangish brown gravelly CLAY. Gravel is fine to coarse rounded to subrounded of mudstone. Pockets of grey clay.
							End of Pit at 2.50m

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Trial Pit Photographs



Trial Pit 104



Trial Pit 104 Spoil

Remarks: 1. Complete

Stability: Stable

Trial Pit Log

TrialPit No: TP105
Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331771.00 - 350058.00 Level:	Date 27/08/2021
Location: Wrexham		Dimensions (m): 3.00 x 0.80 Depth 2.60	Scale 1:30
Client: Redrow Homes			Logged A. Rae

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			Light brown slightly clayey SAND. Sand is fine to coarse. Frequent rootlets. (TOPSOIL)
				1.70			Light brown slightly clayey slightly gravelly SAND. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone with occasional boulders (< 300 mm).
				2.60			Brown slightly clayey slightly sandy GRAVEL. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone with frequent boulders (< 250 mm) and coal.
							End of Pit at 2.60m

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Trial Pit Photographs



Trial Pit 105



Trial Pit 105 Spoil

Remarks: 1. Complete 2. Very friable CLAY unable to complete HSV test.

Stability: Unstable at 2.3 m bgl

Trial Pit Log

TrialPit No: TP106
Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331786.00 - 349954.00	Date 27/08/2021
Location: Wrexham		Dimensions (m): 3.00 x 0.80	Scale 1:30
Client: Redrow Homes		Depth 2.40	Logged A. Rae

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			Light brown slightly clayey SAND. Sand is fine to coarse. Frequent rootlets. (TOPSOIL)
				1.20			Light brown slightly clayey gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse subangular to subrounded of mudstone and sandstone.
				2.40			Brown sandy slightly clayey GRAVEL. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone with frequent boulders (< 250 mm) and coal.
							End of Pit at 2.40m

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Trial Pit Photographs



Trial Pit 106



Trial Pit 106 Spoil

Remarks: 1. Complete 2. Very friable CLAY unable to complete HSV test.

Stability: Unstable at 1.2 m bgl

Trial Pit Log

TrialPit No: TP107
Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331822.00 - 349853.00 Level:	Date 27/08/2021
Location: Wrexham		Dimensions (m): 3.00 × 0.80 Depth 2.30	Scale 1:30
Client: Redrow Homes			Logged A. Rae

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			Light brown slightly clayey SAND. Sand is fine to coarse. Frequent rootlets. (TOPSOIL)
				0.50			Brown slightly clayey slightly gravelly SAND. Sand if fine to coarse. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone.
	1.00						Firm greyish brown CLAY.
▼ 2.20				2.10			Dark grey slightly sandy GRAVEL. Gravel is fine to coarse rounded subrounded of mudstone and sandstone with frequent boulders (< 250 mm).
				2.30			End of Pit at 2.30m

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Trial Pit Photographs



Trial Pit 107



Trial Pit 107 Spoil

Remarks: 1. Complete. 2. Water strike encountered at 2.2m bgl.

Stability: Unstable at 2.1 m bgl

Trial Pit Log

TrialPit No: TP108
Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331642.00 - 349868.00 Level:	Date 27/08/2021
Location: Wrexham		Dimensions (m): 3.00 × 0.80 Depth 2.50	Scale 1:30
Client: Redrow Homes			Logged A. Rae

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			Light brown slightly clayey SAND. Sand is fine to coarse. Frequent rootlets. (TOPSOIL)
	1.00			1.20			Soft light brown sandy slightly gravelly CLAY. Gravel is fine to medium subrounded of mudstone and sandstone. Pockets of ligh orangeish brown clay. Occasional rootlets.
				2.50			Soft light brown slightly gravelly slightly sandy CLAY. Gravel is fine to medium rounded to subrounded of mudstone and sandstone with occasional coal.
							End of Pit at 2.50m

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Trial Pit Photographs



Trial Pit 108



Trial Pit 108 Spoil

Remarks: 1. Complete

Stability: Stable

Trial Pit Log

TrialPit No: TP109
Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331483.00 - 349797.00 Level:	Date 27/08/2021
Location: Wrexham		Dimensions (m): 3.00 × 0.80 Depth 2.30	Scale 1:30
Client: Redrow Homes			Logged A. Rae

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			Light brown slightly clayey slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to medium rounded to subrounded of mudstone and sandstone. Frequent rootlets. (TOPSOIL)
				1.20			Light brown very gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse subrounded of mudstone and sandstone with frequent cobbles (< 200 mm) and coal at 0.5 m bgl.
				2.30			Brown slightly clayey sandy GRAVEL. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone with coal.
							End of Pit at 2.30m

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Trial Pit Photographs



Trial Pit 109



Trial Pit 109

Remarks: 1. Complete 2. Very friable CLAY unable to complete HSV test.

Stability: Unstable at 1.0 m bgl

Trial Pit Log

TrialPit No: TP110
Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331433.00 - 350151.00 Level:	Date 27/08/2021
Location: Wrexham		Dimensions (m): 3.00 x 0.80 Depth 2.40	Scale 1:30
Client: Redrow Homes			Logged A. Rae

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			Light brown slightly clayey SAND. Sand is fine to coarse. Frequent rootlets. (TOPSOIL)
				0.50			Light orangeish brown sandy slightly gravelly CLAY. Gravel is fine to coarse subangular to subrounded of mudstone and sandstone. Soft light reddish brown sandy CLAY.
				1.90			Soft light reddish brown sandy slightly gravelly CLAY. Gravel is fine to coarse subangular to subrounded of mudstone with occasional cobbles (< 200 mm).
				2.40			End of Pit at 2.40m

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Trial Pit Photographs



Trial Pit 110



Trial Pit 110 Spoil

Remarks: 1. Complete 2. Very friable CLAY unable to complete HSV test.

Stability: Stable

Trial Pit Log

TrialPit No: TP111
Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331301.00 - 349783.00 Level:	Date 27/08/2021
Location: Wrexham		Dimensions (m): 3.00 x 0.80 Depth 2.30	Scale 1:30
Client: Redrow Homes			Logged A. Rae

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			Light brown slightly clayey SAND. Sand is fine to coarse. Frequent rootlets. (TOPSOIL)
				1.30			Brown slightly clayey gravelly SAND. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone with frequent cobbles (< 200 mm) and coal at 0.7 m bgl.
				2.30			Dark brown slightly clayey sandy GRAVEL. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone with frequent cobbles (< 200 mm) and coal.
							End of Pit at 2.30m

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Trial Pit Photographs



Trial Pit 111



Trial Pit 111 Spoil

Remarks: 1. Complete 2. Very friable CLAY unable to complete HSV test.

Stability: Unstable at 1.2 m bgl

Trial Pit Log

TrialPit No: TP112
Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331450.00 - 349873.00 Level:	Date 27/08/2021
Location: Wrexham		Dimensions (m): 3.00 × 0.80 Depth 2.50	Scale 1:30
Client: Redrow Homes			Logged A. Rae

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			Light brown slightly clayey SAND. Sand is fine to coarse. Frequent rootlets. (TOPSOIL)
				0.80			Soft light reddish brown sandy slightly gravelly CLAY. Gravel is fine to coarse rounded to subrounded of mudstone with occasional cobbles (< 150 mm) and coal.
				1.50			Brown slightly clayey gravelly SAND. Sand is coarse. Gravel is fine to medium subrounded of mudstone with occasional cobbles (< 100 mm).
				2.30			Brown clayey slightly sandy GRAVEL. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone with boulders (< 300 mm).
				2.50			Firm light brown gravelly CLAY. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone.
							End of Pit at 2.50m

1 2 3 4

Trial Pit Photographs



Trial Pit 112



Trial Pit 112 Spoil

Remarks: 1. Complete 2. Very friable CLAY unable to complete HSV test.

Stability: Stable

Trial Pit Log

TrialPit No: TP113
Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331288.00 - 349981.00 Level:	Date 27/08/2021
Location: Wrexham		Dimensions (m): 3.00 x 0.80 Depth 2.50	Scale 1:30
Client: Redrow Homes			Logged A. Rae

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			Light brown slightly clayey slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to medium rounded to subrounded of mudstone and sandstone. Frequent rootlets. (TOPSOIL)
				0.40			Light brown slightly clayey gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse subangular to subrounded of mudstone and sandstone.
							Soft light reddish brown sandy slightly gravelly CLAY. Gravel is fine to coarse subangular to subrounded of mudstone and sandstone with coal.
				2.50			End of Pit at 2.50m

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4

Trial Pit Photographs



Trial Pit 113



Trial Pit 113 Spoil

Remarks: 1. Complete 2. Very friable CLAY unable to complete HSV test.

Stability: Stable

Trial Pit Log

TrialPit No: TP114
Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331128.00 - 349844.00 Level:	Date 27/08/2021
Location: Wrexham		Dimensions (m): 3.00 × 0.80 Depth 2.30	Scale 1:30
Client: Redrow Homes			Logged A. Rae

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			Light brown slightly clayey slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to medium rounded to subrounded of mudstone and sandstone. Frequent rootlets. (TOPSOIL)
				1.10			Brown gravelly SAND. Sand is coarse. Gravel is fine to medium subangular to subrounded of mudstone and sandstone with occasional cobbles (< 200 mm) and coal at 0.5 m bgl.
				2.30			Brown slightly clayey sandy GRAVEL. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone with frequent boulders (< 250 mm) and coal.
							End of Pit at 2.30m

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Trial Pit Photographs



Trial Pit 114



Trial Pit 114 Spoil

Remarks: 1. Complete 2. Very friable CLAY unable to complete HSV test.

Stability: Unstable at 0.9 m bgl

Trial Pit Log

TrialPit No: TP115
Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331013.00 - 349582.00 Level:	Date 28/07/2021
Location: Wrexham		Dimensions (m): 3.00 x 0.80 Depth 2.30	Scale 1:30
Client: Redrow Homes			Logged A. Rae

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			Light brown slightly clayey slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse subangular of mudstone and sandstone. Frequent rootlets. (TOPSOIL)
				0.60			MADE GROUND: Brown slightly clayey very gravelly SAND. Sand is coarse. Gravel is fine to coarse subangular of mudstone with occasional coal.
	1.00						MADE GROUND: Firm dark greyish brown gravelly CLAY. Gravel is fine to coarse angular to subangular of mudstone and sandstone with frequent boulders (< 300 mm). (Reworked clay)
	2.00						
				2.30			End of Pit at 2.30m

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Trial Pit Photographs



Trial Pit 115



Trial Pit 115 Spoil

Remarks: 1. Complete

Stability: Stable

Trial Pit Log

TrialPit No: TP116
Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331005.00 - 349385.00 Level:	Date 28/07/2021
Location: Wrexham		Dimensions (m): 3.00 x 0.80 Depth 2.30	Scale 1:30
Client: Redrow Homes			Logged A. Rae

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			Light brown slightly clayey slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse subangular of mudstone and sandstone. Frequent rootlets. (TOPSOIL)
				0.60			MADE GROUND: Light brown slightly clayey very gravelly SAND. Sand is coarse. Gravel is fine to coarse subangular of mudstone and sandstone with frequent boulders (< 250 mm) and coal.
				1.40			MADE GROUND: Dark greyish brown very gravelly SAND. Sand is coarse. Gravel is fine to coarse subangular of mudstone and sandstone with frequent boulders (< 300 mm).
				2.30			MADE GROUND: Light grey slightly clayey very gravelly SAND. Sand is coarse. Gravel is fine to coarse angular to subangular of mudstone and sandstone with frequent cobbles (< 200 mm). Pockets of grey clay.
							End of Pit at 2.30m

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Trial Pit Photographs



Trial Pit 116



Trial Pit 116 Spoil

Remarks: 1. Complete 2. Very friable CLAY unable to complete HSV test.

Stability: Stable

Trial Pit Log

TrialPit No: TP117
Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331108.00 - 349638.00 Level:	Date 28/07/2021
Location: Wrexham		Dimensions (m): 3.00 x 0.80 Depth 2.50	Scale 1:30
Client: Redrow Homes			Logged A. Rae

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			Brown slightly clayey SAND. Sand is fine to coarse. Frequent rootlets. (TOPSOIL)
	1.00						Stiff light orangish brown slightly sandy CLAY.
	2.00			1.90			Stiff light brown clayey gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone with boulders (< 250 mm).
				2.20			Grey very gravelly SAND. Sand is coarse. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone.
				2.50			End of Pit at 2.50m

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Trial Pit Photographs



Trial Pit 117



Trial Pit 117 Spoil

Remarks: 1. Complete

Stability: Stable

Trial Pit Log

TrialPit No: TP118
Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331141.00 - 349338.00 Level:	Date 28/07/2021
Location: Wrexham		Dimensions (m): 3.00 × 0.80 Depth 2.50	Scale 1:30
Client: Redrow Homes			Logged A. Rae

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			Brown slightly clayey SAND. Sand is fine to coarse. Frequent rootlets. (TOPSOIL)
				0.90			Soft light orangish brown sandy slightly gravelly CLAY. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone.
				1.60			Soft light orangeish brown slightly sandy gravelly CLAY. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone.
				2.50			Light orangeish brown clayey very gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone.
							End of Pit at 2.50m

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Trial Pit Photographs



Trial Pit 118



Trial Pit 118 Spoil

Remarks: 1. Complete 2. Very friable CLAY unable to complete HSV test.

Stability: Stable

Trial Pit Log

TrialPit No: TP119
Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331976.00 - 349710.00 Level:	Date 28/07/2021
Location: Wrexham		Dimensions (m): 3.00 × 0.80 Depth 2.50	Scale 1:30
Client: Redrow Homes			Logged A. Rae

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			Dark brown slightly clayey slightly gravelly SAND. Sand is coarse. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone. Frequent rootlets. (TOPOSIL)
	2.00			2.30			Brown slightly clayey slightly gravelly SAND. Sand if fine to coarse. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone with frequent cobbles (< 150 mm).
				2.50			Stiff light reddish brown CLAY. End of Pit at 2.50m

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4

Trial Pit Photographs



Trial Pit 119



Trial Pit 119 Spoil

Remarks: 1. Complete

Stability: Unstable at 0.6 m bgl

Trial Pit Log

TrialPit No: TP120
Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331758.00 - 349712.00	Date 28/07/2021
Location: Wrexham		Dimensions (m): 3.00 x 0.80, Depth 2.50	Scale 1:30
Client: Redrow Homes			Logged A. Rae

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			Dark brown slightly clayey slightly gravelly SAND. Sand is coarse. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone. Frequent rootlets. (TOPOSIL)
				0.50			Light orangeish brown slightly clayey slightly gravelly SAND. Sand is coarse. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone with occasional cobbles (< 200 mm).
							Light brown clayey gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone.
				2.50			End of Pit at 2.50m

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Trial Pit Photographs



Trial Pit 120



Trial Pit 120 Spoil

Remarks: 1. Complete 2. Very friable CLAY unable to complete HSV test.

Stability: Unstable at 1.6 m bgl

Trial Pit Log

TrialPit No: TP121
Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331836.00 - 349587.00	Date 28/07/2021
Location: Wrexham		Dimensions (m): 3.00 x 0.80 Depth 2.50	Scale 1:30
Client: Redrow Homes			Logged A. Rae

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			Dark brown slightly clayey slightly gravelly SAND. Sand is coarse. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone. Frequent rootlets. (TOPOSIL)
							Light orangish brown slightly clayey gravelly SAND. Sand is coarse. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone with coal.
				2.50			End of Pit at 2.50m

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Trial Pit Photographs



Trial Pit 121



Trial Pit 121 Spoil

Remarks: 1. Complete 2. Very friable CLAY unable to complete HSV test.

Stability: Unstable at 1.5 m bgl

Trial Pit Log

TrialPit No: TP122
Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331493.00 - 349630.00 Level:	Date 28/07/2021
Location: Wrexham		Dimensions (m): 3.00 x 0.80 Depth 2.50	Scale 1:30
Client: Redrow Homes			Logged A. Rae

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			Dark brown slightly clayey slightly gravelly SAND. Sand is coarse. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone. Frequent rootlets. (TOPOSIL)
				0.50			Light brown slightly clayey slightly gravelly SAND. Sand is coarse. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone.
							Brown slightly clayey gravelly SAND. Sand is coarse. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone with coal.
				2.50			End of Pit at 2.50m

1
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Trial Pit Photographs



Trial Pit 122



Trial Pit 122 Spoil

Remarks: 1. Complete 2. Very friable CLAY unable to complete HSV test.

Stability: Unstable at 1.2 m bgl

Trial Pit Log

TrialPit No: TP123
Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331444.00 - 349468.00 Level:	Date 28/07/2021
Location: Wrexham		Dimensions (m): 3.00 x 0.80 Depth 2.50	Scale 1:30
Client: Redrow Homes			Logged A. Rae

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			Brown slightly clayey slightly gravelly SAND. Sand is coarse. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone. Frequent rootlets. (TOPOSIL)
				0.90			Soft light brown slightly gravelly sandy CLAY. Gravel is fine to coarse subrounded of mudstone and sandstone.
	1.00						Stiff brown sandy slightly gravelly CLAY. Gravel is fine to medium subrounded of mudstone and sandstone.
				2.50			End of Pit at 2.50m

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4

Trial Pit Photographs



Trial Pit 123



Trial Pit 123 Spoil

Remarks: 1. Complete 2. Very friable CLAY unable to complete HSV test.

Stability: Stable

Trial Pit Log

TrialPit No: TP124
Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331672.00 - 349470.00 Level:	Date 28/07/2021
Location: Wrexham		Dimensions (m): 3.00 × 0.80 Depth 2.50	Scale 1:30
Client: Redrow Homes			Logged A. Rae

Water Strike	Samples & In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30			Dark brown slightly clayey slightly gravelly SAND. Sand is coarse. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone. Frequent rootlets. (TOPOSIL)
				0.90			Light orangish brown slightly clayey gravelly SAND. Sand is coarse. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone with cobbles (< 200 mm).
				2.30			Brown clayey GRAVEL. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone with occasional boulders (< 300 mm).
				2.50			Brown slightly clayey GRAVEL. Gravel is fine to coarse subrounded of mudstone and sandstone with boulders (<300 mm).
							End of Pit at 2.50m

1
2
3
4

Trial Pit Photographs



Trial Pit 124



Trial Pit 124 Spoil

Remarks: 1. Complete 2. Very friable CLAY unable to complete HSV test.

Stability: Unstable at 1.2 m bgl

Borehole Log

Borehole No. **WS101**

Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331418E - 350087N	Hole Type WS
Location: Wrexham		Level:	Scale 1:50
Client: Redrow Homes		Dates: 27/07/2021	Logged By A. Rae

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	ES		0.20			Brown slightly clayey SAND. Sand is fine to coarse. Frequent rootlets. (TOPSOIL)
		0.50 - 1.00	U		0.50			Stiff medium strength light orangeish brown CLAY. Occasional rootlets.
		1.00 1.00	D SPT	N=12 (2,2/3,3,3,3)				Stiff medium strength light reddish brown mottled grey CLAY with occasional coal.
		1.80	ES					
		2.00 2.00	D SPT	N=7 (2,2/1,2,2,2)				
					2.50			Firm low strength light reddish brown sandy CLAY.
		3.00 3.00	D SPT	N=12 (2,2/3,3,3,3)				
	▼ 3.30				3.30			Stiff medium strength brown slightly sandy CLAY with coal band at circa 3.80 m bgl.
		4.00 4.00	D SPT	N=11 (2,3/2,3,3,3)				
		5.00 5.00	D SPT	N=18 (3,4/4,5,4,5)				
					5.45			End of Borehole at 5.45m

Remarks

1. Complete. 2. Final depth 5.45m bgl. 3. Water strike encountered at 3.3m bgl.

Borehole Log

Borehole No. **WS102**

Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331438E - 350043N	Hole Type WS
Location: Wrexham		Level:	Scale 1:50
Client: Redrow Homes		Dates: 27/07/2021	Logged By A. Rae

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	ES		0.20			Brown slightly clayey SAND. Sand is fine to coarse. Frequent rootlets. (TOPSOIL)
		0.50	ES+L					Stiff medium strength light reddish brown sandy CLAY.
		1.00	D		0.90			Stiff medium strength brown CLAY with occasional coal. Pocket of sand at 2.00 m bgl.
		1.00	SPT	N=8 (2,1/2,2,2,2)				
		1.50 - 2.00	U					
		2.00	D		2.10			Stiff medium strength reddish brown slightly sandy slightly gravelly CLAY. Gravel is fine to medium rounded to subrounded of mudstone.
		2.00	SPT	N=11 (2,2/3,3,2,3)				
	▼ 3.00	3.00	D		3.10			Very stiff very high strength dark brown slightly sandy slightly gravelly CLAY. Gravel is fine subrounded of mudstone.
		3.00	SPT	N=16 (3,3/4,4,4,4)				
		4.00	SPT	50 (3,7/50 for 260mm)				
					4.45			End of Borehole at 4.45m

Remarks

1. Complete. 2. Final depth 4.45m bgl. 3. Water strike encountered at 3m bgl. 4. Refused on gravel at 4.45 m bgl.

Borehole Log

Borehole No. **WS103**

Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331582E - 349984N	Hole Type WS
Location: Wrexham		Level:	Scale 1:50
Client: Redrow Homes		Dates: 27/07/2021	Logged By A. Rae

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	ES		0.20			Brown slightly clayey slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse rounded to subrounded of mudstone. Frequent rootlets. (TOPSOIL)
		1.00	SPT	N=14 (5,6/5,3,3,3)				Medium dense brown slightly clayey gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse subangular to subrounded of mudstone with occasional cobbles (< 90 mm). Coal at circa 1.3 m bgl.
		1.50	ES+L		1.60			
		2.00	SPT	N=8 (3,3/2,2,2,2)	2.10			Loose brown slightly clayey gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse subangular to subrounded of mudstone with occasional cobbles (< 90 mm) with frequent coal.
		2.50 - 3.00	U					Stiff medium strength brown sandy gravelly CLAY. Gravel is fine to coarse subrounded of mudstone.
		3.00	D					
		3.00	SPT	N=13 (3,3/4,3,3,3)	3.30			Medium dense dark brown grey sandy GRAVEL. Gravel is fine to medium subrounded of mudstone.
	▼ 4.00	4.00	SPT	N=17 (3,4/4,5,4,4)				
		5.00	SPT	N=19 (5,4/4,5,5,5)	5.45			End of Borehole at 5.45m

Remarks

1. Complete. 2. Final depth 5.45m bgl. 3. Water strike encountered at 4m bgl.

Borehole Log

Borehole No. **WS104**

Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331688E - 350084N	Hole Type WS
Location: Wrexham		Level:	Scale 1:50
Client: Redrow Homes		Dates: 27/07/2021	Logged By A. Rae

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	ES		0.20			Brown slightly clayey SAND. Sand is fine to coarse. Frequent rootlets. (TOPSOIL)
		0.50 - 1.00	U					Stiff medium strength light brown sandy slightly gravelly CLAY. Gravel is fine to coarse subrounded of mudstone.
		1.00	D					
		1.00	SPT	N=8 (2,3/2,2,2,2)				
					1.70			Very loose brown clayey slightly gravelly SAND. Sand is coarse. Gravel is fine to coarse subrounded of mudstone.
		2.00	D					
		2.00	SPT	N=8 (2,2/2,2,2,2)				
		2.50	ES					
		3.00	SPT	N=4 (1,1/1,1,1,1)				
					3.80			Loose reddish brown clayey slightly gravelly SAND. Sand is coarse. Gravel is fine rounded to subrounded.
	4.00	4.00	SPT	N=7 (1,2/1,2,2,2)				
		5.00	SPT	N=7 (2,2/2,1,2,2)				
					5.45			End of Borehole at 5.45m

Remarks

1. Complete. 2. Final depth 5.45m bgl. 3. Water strike encountered at 4m bgl.

Borehole Log

Borehole No. **WS105**

Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331604E - 350123N	Hole Type WS
Location: Wrexham		Level:	Scale 1:50
Client: Redrow Homes		Dates: 27/07/2021	Logged By A. Rae

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	ES		0.20			Brown slightly clayey SAND. Sand is fine to coarse. Frequent rootlets. (TOPSOIL)
		1.00	D					Firm low strength light brown slightly sandy CLAY. Coal at circa 1.2 m bgl.
		1.00	ES					
		1.00	SPT	N=7 (2,2/1,2,2,2)				
		1.50 - 2.00	U					
		2.00	D					
		2.00	SPT	N=8 (2,2/1,2,3,2)				
	▼ 3.10	3.00	SPT	N=5 (1,1/1,1,1,2)	3.10			Loose brown slightly clayey SAND. Sand is fine to coarse.
					3.40			Firm low strength light brown sandy CLAY.
					3.60			Dense brown slightly sandy GRAVEL. Gravel is fine to coarse subangular to subrounded of mudstone with occasional cobbles (< 90 mm).
		4.00	SPT	50 (10,13/50 for 280mm)				
					4.45			End of Borehole at 4.45m

Remarks

1. Complete. 2. Final depth 4.45m bgl. 3. Water strike encountered at 3.1m bgl. 4. Refused on gravel at 4.45 m bgl.

Borehole Log

Borehole No. **WS106**

Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331742E - 349982N	Hole Type WS
Location: Wrexham		Level:	Scale 1:50
Client: Redrow Homes		Dates: 28/07/2021	Logged By A. Rae

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	ES		0.20			Dark brown gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse subangular to subrounded of mudstone. Frequent rootlets. (TOPSOIL)
					0.60			Very loose brown gravelly slightly clayey SAND. Gravel is fine to coarse subangular to subrounded of mudstone and sandstone.
		1.00	SPT	N=3 (1,1/0,1,1,1)				Very loose brown very gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse subangular to subrounded of mudstone and sandstone. Frequent coal.
		1.30	ES		1.20			
		1.50 - 2.00	U					Firm low strength light brown very sandy slightly gravelly CLAY. Gravel is fine to coarse subangular to subrounded of mudstone and sandstone.
		2.00	SPT	N=8 (1,2/2,1,2,3)	1.90			Medium dense greyish brown sandy GRAVEL. Gravel is fine to coarse subangular to subrounded of mudstone and sandstone. Pockets of light brown coarse sand.
		3.00	SPT	N=19 (4,6/5,5,6,3)				
		4.00	SPT	50 (8,8/50 for 230mm)				
					4.45			End of Borehole at 4.45m

1 2 3 4 5 6 7 8 9 10

Remarks

1. Complete. 2. Final depth 4.45m bgl. 3. Refused on gravel at 4.45 m bgl.

Borehole Log

Borehole No. **WS107**

Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331746E - 349876N	Hole Type WS
Location: Wrexham		Level:	Scale 1:50
Client: Redrow Homes		Dates: 28/07/2021	Logged By A. Rae

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	ES		0.20			Dark brown gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse subangular to subrounded of mudstone. Frequent rootlets. (TOPSOIL)
		0.50 0.50 - 1.00	ES U		0.80			Medium dense brown gravelly slightly clayey SAND. Gravel is fine to coarse subangular to subrounded of mudstone and sandstone.
		1.00	SPT	N=15 (4,5/6,4,2,3)				Medium dense greyish brown very gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone with frequent coal.
		2.00	SPT	N=7 (2,1/1,2,2,2)	1.80 2.00			Loose brown very gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse subangular to subrounded of mudstone and sandstone. Frequent coal.
		3.00 3.00	D SPT	N=4 (1,1/1,1,1,1)	2.50			Loose greyish brown very gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone with frequent coal. Very loose light brown slightly clayey slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone.
		4.00	SPT	N=31 (4,5/8,7,8,8)	3.90			Very loose light greyish brown slightly gravely clayey SAND. Sand is fine to coarse. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone.
		5.00	SPT	50 (25 for 45mm/50 for 5mm)	4.80			Very stiff high strength greyish brown gravelly sandy CLAY. Gravel is fine to medium rounded to subrounded of mudstone and sandstone.
					5.45			End of Borehole at 5.45m

Remarks

1. Complete. 2. Final depth 5.45m bgl.

Borehole Log

Borehole No. **WS108**

Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331864E - 349926N	Hole Type WS
Location: Wrexham		Level:	Scale 1:50
Client: Redrow Homes		Dates: 28/07/2021	Logged By A. Rae

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	ES		0.20			Dark brown gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse subangular to subrounded of mudstone. Frequent rootlets. (TOPSOIL)
		1.00	SPT	N=12 (3,4/4,3,2,3)	1.10			Medium dense brown gravelly slightly clayey SAND. Gravel is fine to coarse subangular to subrounded of mudstone and sandstone.
		1.50 - 2.00	U		1.60			Medium dense grey sandy GRAVEL. Gravel is fine to coarse subangular to subrounded of mudstone and sandstone.
		2.00 2.10	SPT ES	N=11 (2,3/2,3,3,3)				Medium dense brown slightly gravelly slightly clayey SAND. Sand is fine to coarse. Gravel is fine to coarse subrounded of mudstone and sandstone.
		3.00 3.00	D SPT	N=7 (2,2/1,1,2,3)	2.80 3.10			Firm low strength brown very sandy slightly gravelly CLAY. Gravel is fine to coarse subrounded of mudstone and sandstone.
		4.00	SPT	N=10 (2,3/3,2,3,2)				Stiff medium strength light brown CLAY. Pockets of orangish grey coarse sand.
		5.00	SPT	N=39 (10,13/15,8,9,7)	4.80			Very stiff very high strength dark brown gravelly CLAY. Gravel is fine to coarse subangular to subrounded of mudstone.
					5.45			End of Borehole at 5.45m

Remarks

1. Complete. 2. Final depth 5.45m bgl.

Borehole Log

Borehole No. **WS109**

Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331666E - 349793N	Hole Type WS
Location: Wrexham		Level:	Scale 1:50
Client: Redrow Homes		Dates: 28/07/2021	Logged By A. Rae

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	ES		0.20			Dark brown gravelly slightly clayey SAND. Sand is fine to coarse. Gravel is fine to coarse subangular to subrounded of mudstone and sandstone. Frequent rootlets. (Topsoil)
		0.50 - 1.00	U					Firm low strength brown slightly gravelly sandy CLAY. Gravel is fine to coarse subangular to subrounded of mudstone and sandstone.
		1.00	SPT	N=5 (1,2/2,1,1,1)				
		1.50	ES					
		2.00	D		2.00			Loose brown sandy slightly clayey GRAVEL. Gravel is fine to coarse rounded to subrounded of mudstone and sandstone.
		2.00	SPT	N=8 (2,2/1,2,2,3)				
					2.50			Stiff medium strength brown slightly sandy CLAY.
		3.00	SPT	N=10 (3,2/3,3,2,2)				
					3.30			Firm low strength light brown sandy slightly gravelly CLAY. Gravel is fine to medium subrounded of mudstone and sandstone.
		4.00	SPT	N=8 (2,2/2,2,2,2)				
		5.00	SPT	N=24 (5,6/7,6,5,6)				
					5.45			End of Borehole at 5.45m

Remarks

1. Complete. 2. Final depth 5.45m bgl.

Borehole Log

Borehole No. **WS110**

Sheet 1 of 1

Project Name: Ruthin Road	Project No. 14854	Co-ords: 331579E - 349891N	Hole Type WS
Location: Wrexham		Level:	Scale 1:50
Client: Redrow Homes		Dates: 28/07/2021	Logged By A. Rae

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	ES		0.20			Dark brown gravelly slightly clayey SAND. Sand is fine to coarse. Gravel is fine to coarse subangular to subrounded of mudstone and sandstone. Frequent rootlets. (Topsoil)
		0.80	ES+L					Medium strength dark brown very sandy slightly gravelly CLAY. Gravel isfine to coarse rounded to subrounded of mudstone and sandstone.
		1.00	SPT	N=8 (1,2/2,2,2,2)	1.10			Loose brown sandy slightly clayey GRAVEL. Gravel is fine to coarse subangular to subrounded of mudstone and sandstone.
					1.30			Firm low strength dark brown very sandy gravelly CLAY. Gravel is fine to coarse subrounded of mudstone and sandstone.
	▼ 2.00	2.00	D					
		2.00	SPT	N=7 (1,1/2,2,1,2)				
		2.50 - 3.00	U					
		3.00	SPT	N=15 (3,3/4,3,4,4)				
		4.00	SPT	50 (6,11/50 for 250mm)				
					4.45			End of Borehole at 4.45m

Remarks

1. Complete. 2. Final depth 4.45m bgl. 3. Water strike encountered at 2m bgl. 4. Refused on gravel at 4.45 m bgl.

Appendix D DCWW Sewer Records

Dŵr Cymru
Welsh Water

SEWER PLAN PPA0005680

N
W E
S

LEGEND(Representative of most common features)

Waste network:

	Foul chamber		Outfall
	Surface water chamber	LH	Lamphole
	Combined chamber		Storm Overflow
CO	Combined sewer overflow		Rising main
SPC	Special purpose chamber		Gravity sewer
	Treatment works		Private sewer
	Pumping station	S 104	Private sewer subject to Sect. 104 adoption agreement
			Private Sewer Transfer
			Lateral Drain
			Inspection Chamber

NB: Sewer symbol colour indicates the type.
RED - Combined
GREEN - Surface Water
BROWN - Foul
Purple - Former S24 sewers (for indicative purposes only)

Notes:

Whilst every reasonable effort has been taken to correctly record the pipe material of DCWW assets, there is a possibility that in some cases pipe material (other than Asbestos Cement or Pitch Fibre) may be found to be asbestos cement (AC) or Pitch Fibre (PF) . It is therefore advisable that the possible presence of AC or PF pipes be anticipated and considered as part of any risk assessment prior to excavation

Dŵr Cymru Cyfyngedig ('the Company') gives this information as to the position of its underground apparatus by way of general guidance only and on the strict understanding that it is based on the best information available and no warranty as to its correctness is relied upon in the event of excavations or other works made in the vicinity of the company's apparatus. The onus of locating apparatus before carrying out any excavations rests entirely on you. The information which is supplied by the Company, is done so in accordance with statutory requirements of sections 198 and 199 of the Water Industry Act 1991 which is based upon the best Information available and, in particular, but without prejudice to the generality of the foregoing, it should be noted that the records that are available to the Company may not disclose the existence of a water main, service pipe, sewer, lateral drain or disposal main and any associated apparatus laid before 1 September 1989, or, if they do, the particulars thereof including their position underground may not be accurate. It must be understood that the furnishing of this information is entirely without prejudice to the provision of the New Roads and Street Works Act 1991 and the Company's right to be compensated for any damage to its apparatus.

Service pipes are not generally shown but their presence should be anticipated.

EXACT LOCATIONS OF ALL APPARATUS TO BE DETERMINED ON SITE.

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Map Ref:	331444,349746
Map scale:	1:5000
Printed by:	Natalie Walmsley
Printed on:	19 May 2021

Appendix E Illustrative Masterplan



1	Residential development up to 1,450 dwellings
2	Two site access points onto the A525 Ruthin Road
3	Two site access points onto Bersham Road
4	Main access roads suitable for buses with active travel walking and cycling routes, tree avenue planting and landscape verges with swales for drainage
5	Site for a primary school up to 2FE located close to the existing high school
6	Local centre reflecting historic courtyard layout with Lower Berse Farmhouse and associated buildings of heritage value retained and enhanced
7	Development blocks to front onto existing and proposed roads and open space to create active frontages
8	Development overlooking Ruthin Road and set back to create a green frontage to the road
9	Development to sensitively integrate with Bersham Conservation Area and create a rural character along Bersham Road and Berse Lane
10	Variations in density and building heights to be used to create different character areas with lower density development to the south and west to respect the Conservation Area and rural character
11	Development set back from the existing dwelling Bryn-moel at the site centre
12	East-west green corridor and active travel route along the PRoW Bridleway with buffers to development and central open space
13	Northeast southwest green link and active travel route along PRoW connecting Bersham to Wrexham and providing a wildlife corridor
14	Retention of the existing watercourse as a wildlife corridor and feature providing a green link through the northern part of the site
15	Retention of existing landscape features to create a strong landscape framework, including important hedgerows, veteran trees, and ancient woodland
16	Drainage attenuation basins integrated at low parts of the site and along primary roads as swales
17	Land to the south of the site retained as a strategic green space and Green Wedge to Bersham
18	Series of distinctive and attractive green spaces through the development to create a sense of place and legibility with play provision focused along the PRoW Bridleway at the centre of the site
19	Ancient Woodland adjacent Berse Lane protected and sensitively integrated with development with public access restricted
20	Access to the western development parcel from Berse Lane or if feasible from development on the east side of Berse Lane. Consider potential access/interconnectivity between development if Berse Lane closed and becomes a Greenway; or provide emergency access and ped cycle connection
21	Potential to close Berse Lane and Holmestead Lane to vehicles and create Greenways as active travel walking and cycling routes

Key

Existing

- Application Boundary (72.85ha)
- Trees/Woodland
- Hedgerow
- Watercourse
- Public Right of Way (PRoW) Footpath
- Public Right of Way (PRoW) Bridleway
- Public Right of Way (PRoW) BOAT

Proposed

- Residential Development in the region of 1,450 dwellings (38.10ha)
- 2FE Primary School Site (1.62ha)
- Local Centre with possible nursery, shops, cafe, public house and community facilities subject to viability(1.46ha)
- Land Reserved for Potential Future Highways Scheme (2.54ha excluding spine road)
- Telecom Mast Exclusion Zone
- Spine Road with Tree Avenue, Landscape Verge and Swale
- Secondary Road/Shared Drive
- Emergency Access
- Footpath
- Footpath Cycleway
- Footpath Cycleway Off Road
- Public Open Space (15.39ha)
- Strategic Open Space (7.89ha)
- Drainage Attenuation (1.96ha)
- Tree Planting
- Hedgerow Planting
- Neighbourhood Equipped Area for Play (NEAP)
- Multi Use Games Area (MUGA)
- Locally Equipped Area for Play (LEAP)
- Local Area for Play (LAP)

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Rev	Description	Drawn	Approved	Date
G	Updates in relation to land for future highways scheme and removal of WWTW	SO	NKH	12/06/24
F	Title amended to Option 1	SO	NKH	07/08/23
E	Spine Road and NDA amended	NKH	NKH	23/03/23
D	Removal of WG highway scheme	NKH	NKH	17/03/23
C	Parcel L update	AJG	NKH	01/02/23
B	Update to primary school site	EL	NKH	09/12/22
A	Updates following DTM 06/12/22	EL	NKH	08/12/22

THE ENVIRONMENT PARTNERSHIP
Genesis Centre, Birchwood Science Park, Warrington WA3 7BH
Tel 01925 844004 e-mail tep@tep.uk.com www.tep.uk.com

Project
Lower Berse Farm, Ruthin Road, Wrexham

Title
Masterplan Framework

Drawing Number
PS9730.001G

Scale
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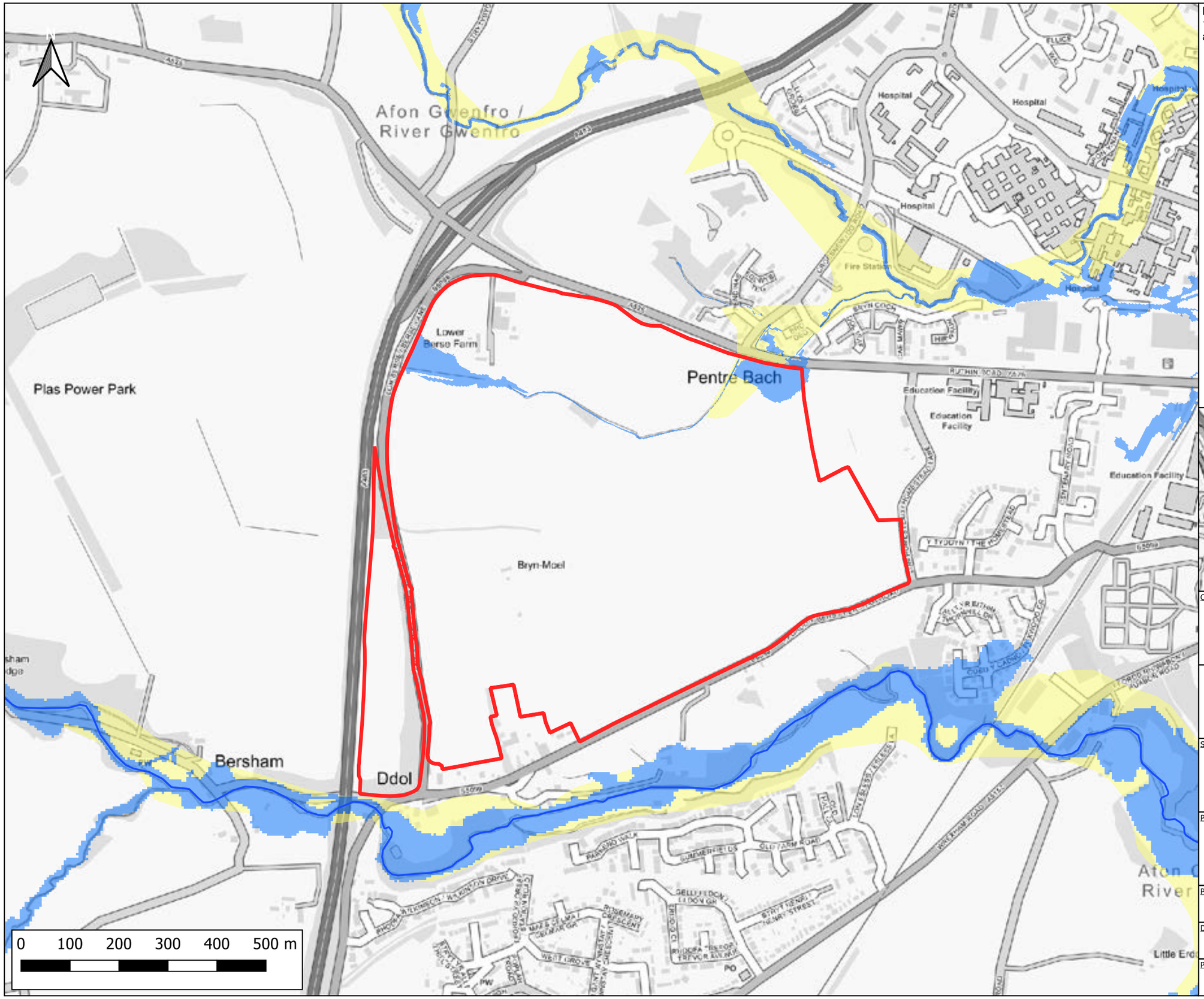
Date
24/11/2022

Drawn
EL

Checked
NKH

Approved
NKH

Appendix F NRW Maps and Correspondence



Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Main Rivers

Development Advice Map (TAN15)

- Zone A
- Zone B
- Zone C1
- Zone C2



CLIENT: REDROW

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SCHEME: Ruthin Road, Wrexham

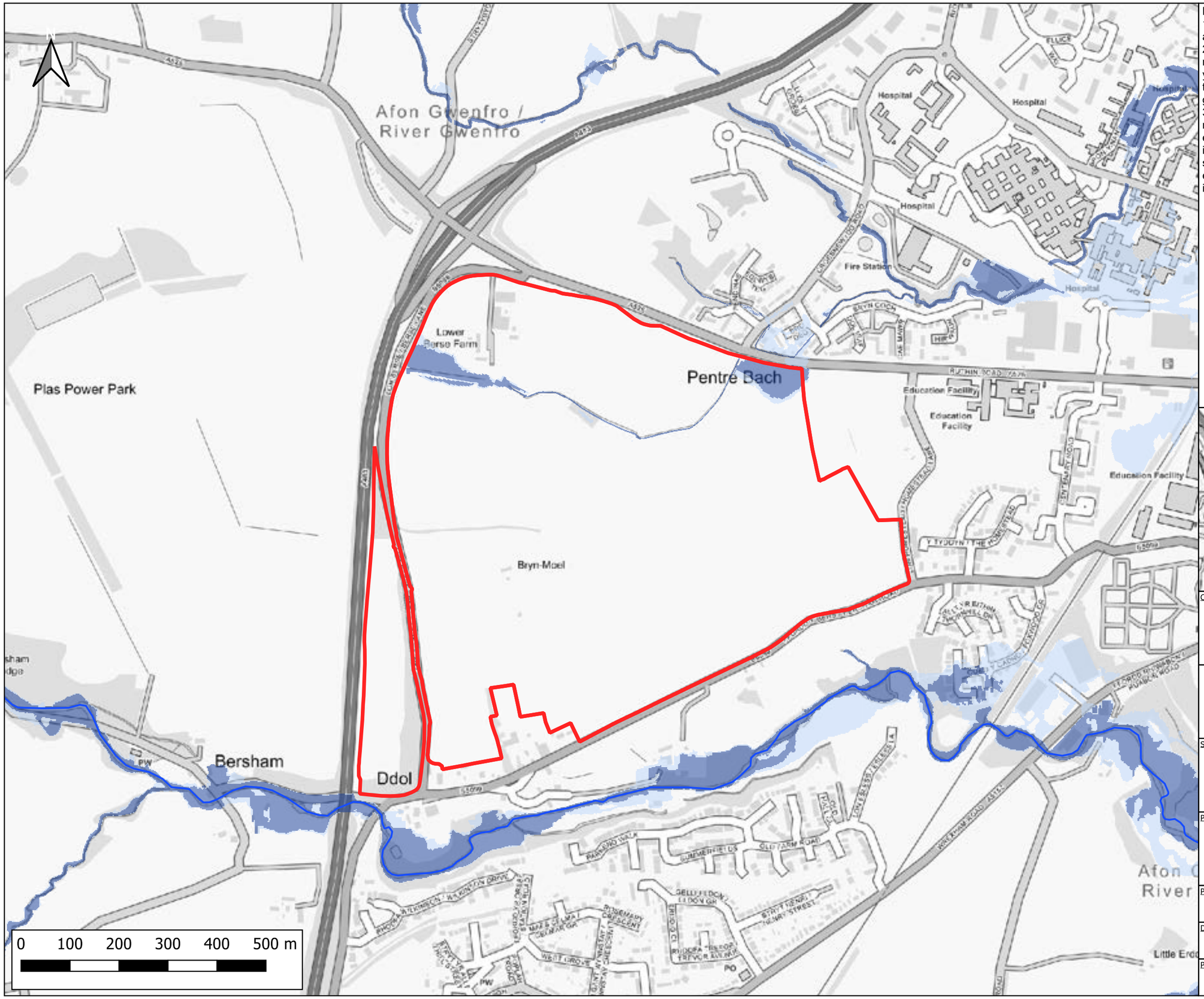
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Data accessed October 2023

PLOT STATUS:	DATE:
FINAL	31-10-2023

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PLOT NAME:	REVISION:
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Notes:
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2) Flood Zone 3 displays the extent of flooding from rivers with a 1% AEP or greater of flooding in a given year including and allowance for climate change and the sea with a 0.5% AEP or greater of flooding in a given year including and allowance for climate change
3) Flood Zone 2 displays the extent of flooding from rivers with a less than 1% AEP but greater than or equal to 0.1% AEP of flooding in a given year including and allowance for climate change and the sea with a less than 0.5% AEP but greater than or equal to 0.1% AEP of flooding in a given year including and allowance for climate change

LEGEND

- Site Boundary
- Main Rivers

NRW Flood Map for Planning

- Flood Zone 2
- Flood Zone 3



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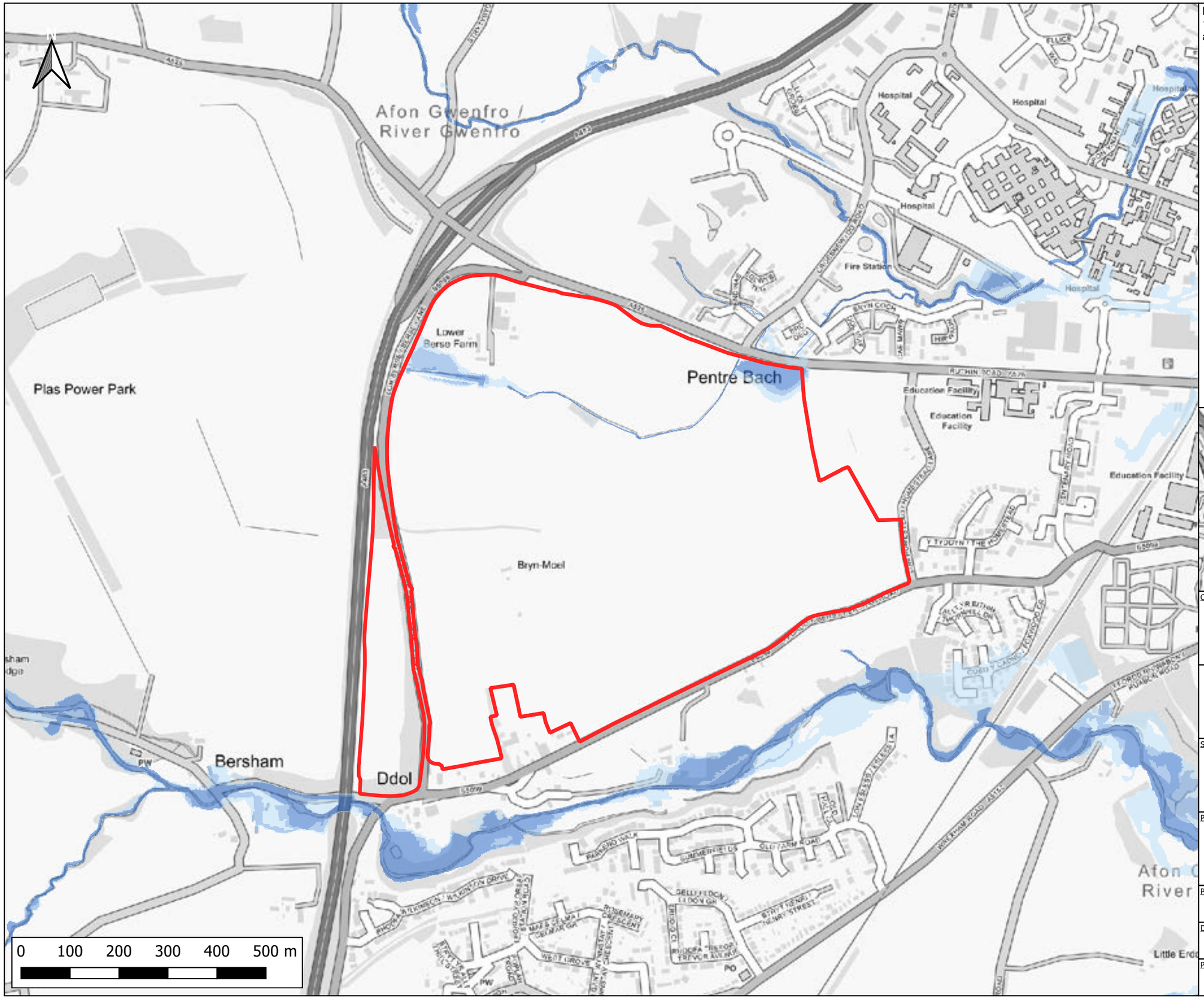
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Notes:
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LEGEND

- Site Boundary

Flood Risk from Rivers

- High (greater than 3.3% AEP)
- Medium (between 1% and 3.3% AEP)
- Low (between 0.1% and 1% AEP)



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SCHEME: Ruthin Road, Wrexham

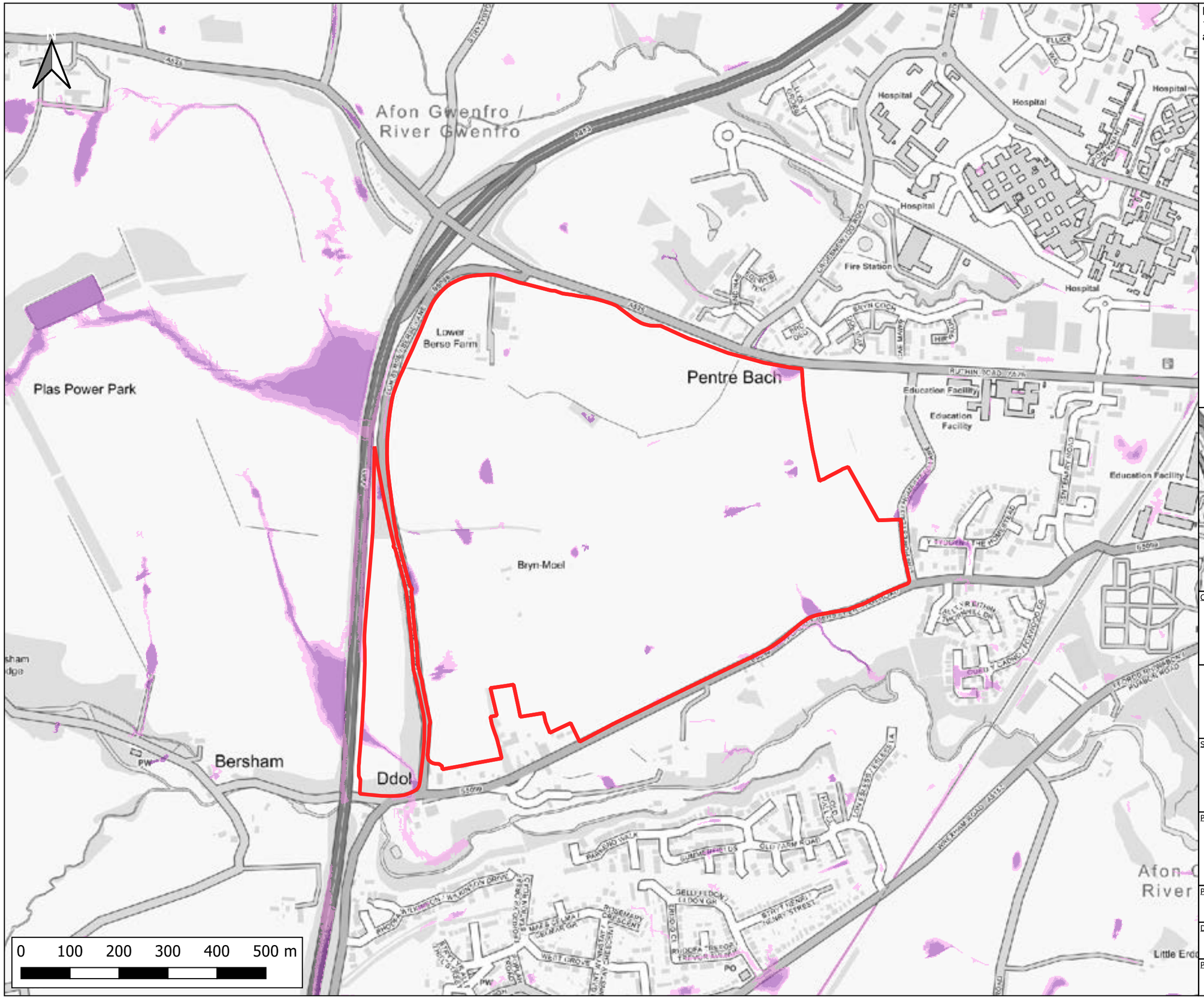
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Data accessed October 2023

PLOT STATUS:	DATE:
FINAL	31-10-2023

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LEGEND

- Site Boundary

Flood Risk from Surface Water & Small Watercourses

- High (greater than 3.3% AEP)
- Medium (between 1% and 3.3% AEP)
- Low (between 0.1% and 1% AEP)



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www.waterco.co.uk

SCHEME: Ruthin Road, Wrexham

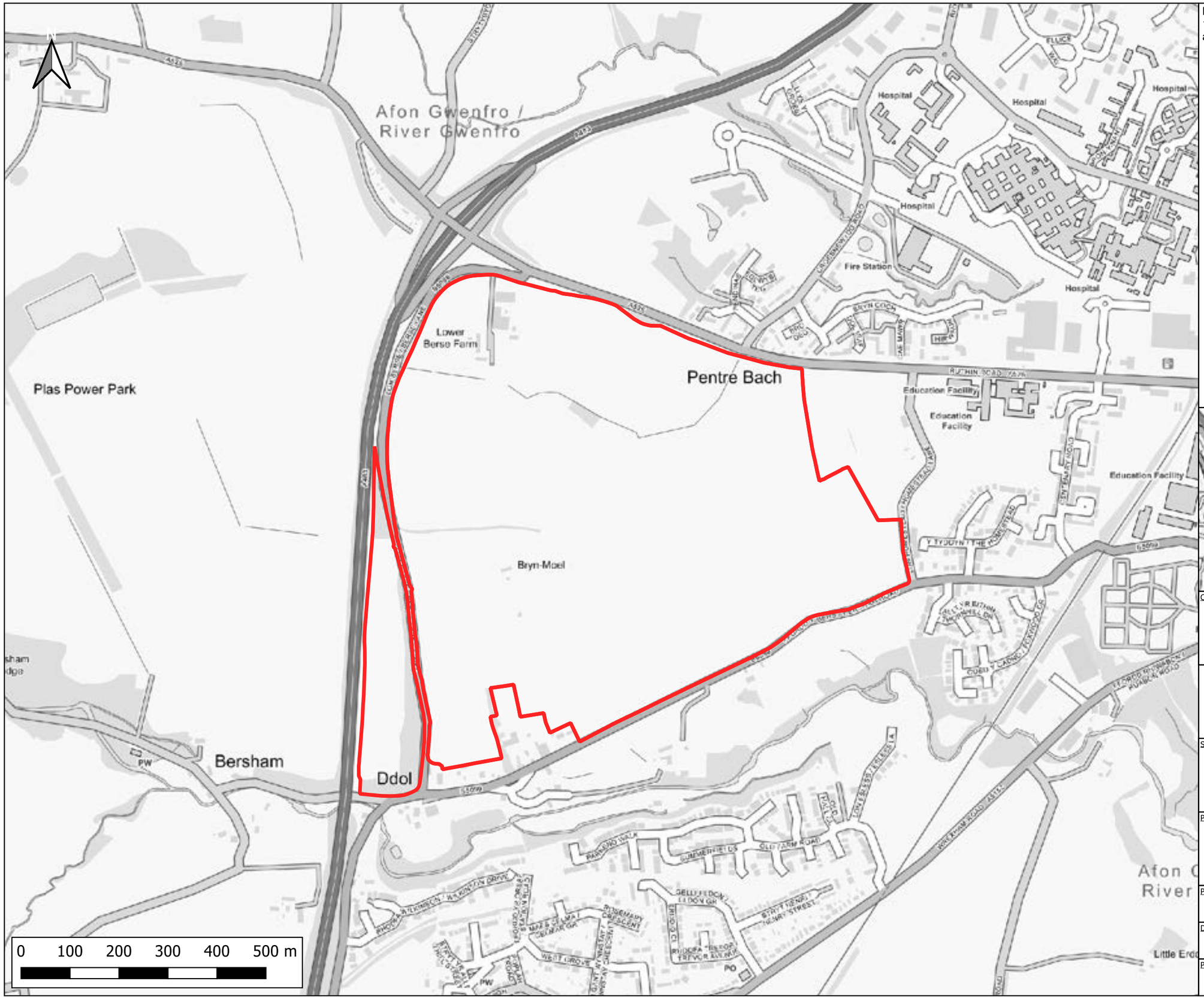
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Data accessed October 2023

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FINAL	31-10-2023

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13840_NRW_Flood_Risk_from_Surface_Water	-

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LEGEND

- Site Boundary

Flood Risk from the Sea

- High (greater than 3.3% AEP)
- Medium (between 0.5% and 3.3% AEP)
- Low (between 0.1% and 0.5% AEP)



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SCHEME: Ruthin Road, Wrexham

PLOT TITLE: NRW Flood Risk from the Sea
Data accessed October 2023

PLOT STATUS:	DATE:
FINAL	31-10-2023

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PLOT NAME:	REVISION:
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LEGEND

- Site Boundary
- Flood Risk from Reservoirs Extent



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waterco
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SCHEME:

Ruthin Road, Wrexham

PLOT TITLE:

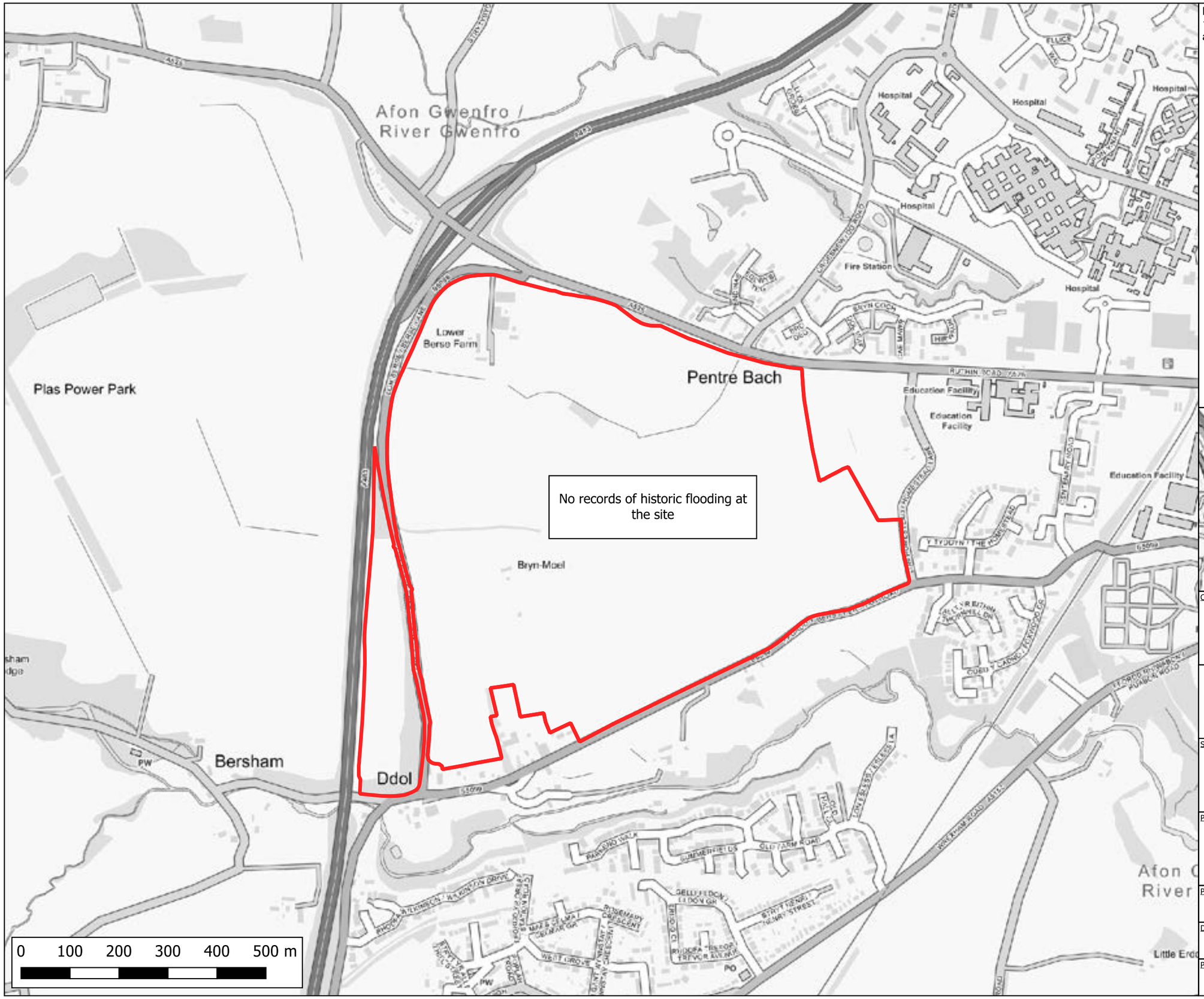
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Data accessed October 2023

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FINAL	31-10-2023

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LEGEND

- Site Boundary
- NRW Historic Flood Map



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SCHEME: Ruthin Road, Wrexham

PLOT TITLE: NRW Historic Flood Risk
Data accessed October 2023

PLOT STATUS:	DATE:
FINAL	31-10-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
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Cyfoeth Naturiol Cymru
Natural Resources Wales

Ein cyf/Our ref: CAS-147202-M5T1
Eich cyf/Your ref: 13840

Maes Y Ffynnon,
Penrhosgarnedd,
Bangor,
Gwynedd
LL572DW

ebost/email:
northplanning@cyfoethnaturiolcymru.gov.uk

Waterco Ltd
Eden Court
Ruthin
LL15 1NJ

25/05/2021

Dear Sir/Madam

PRELIMINARY PRE-APPLICATION ADVICE

PROPOSAL: THE SITE IS ALLOCATED FOR 1,500 DWELLINGS WITH 400 DWELLINGS EXPECTED TO BE DELIVERED DURING THE PLAN PERIOD WHICH RUNS UP TO 2028 AND THE REMAINING 1,100 EXPECTED AFTERWARD.

LOCATION: LAND OFF RUTHIN ROAD, WREXHAM

Thank you for consulting Cyfoeth Naturiol Cymru / Natural Resources Wales about the above pre-application enquiry, which we received on 28th April 2021.

We have considered your enquiry in relation to our Development Planning Consultations Topics document (September 2018). We advise that the following matters are relevant to your site / proposed development and suggest you consider these further prior to the submission of any planning application:

Flood Risk Management

We understand the proposal is for highly vulnerable development housing and access roads. Our Flood Risk Map confirms the site to be partially within Zone C2 of the Development Advice Map (DAM) contained in TAN15.

We refer you to Section 6 of TAN15 and the Chief Planning Officer letter from Welsh Government, dated 9 January 2014, which affirms that highly vulnerable development and emergency services should not be permitted in Zone C2 (paragraph 6.2 of TAN15). The justification tests in paragraph 6.2 of TAN15 do not apply to highly vulnerable development or emergency services in Zone C2.

In consideration of the above, we will not provide any pre-application advice regarding flood risk, unless we receive written confirmation from the Planning Authority that there are overriding reasons for them to consider the proposals despite the site's location within Zone

C2. In such circumstances, we would then review any submitted FCA. If the FCA fails to demonstrate that the consequences of flooding can be acceptably managed over the lifetime of the development, then we would **object** to the application.

Finally, as you may be aware, under the Town & Country Planning (Notification) (Wales) Direction 2012 and more specifically Category I relating to Flood Risk Area Development, where the Planning Authority is minded to grant permission, there is a requirement to refer applications for emergency services or highly vulnerable development within Zone C2 to Welsh Government.

Flood Risk Activity Permit
The proposed development is near the Afon Clywedog, a designated main river. If development works in this area are within 8 metres of the river, you may need to apply for a Flood Risk Activity Permit. We refer you to our website for further advice.

Watercourses
An un-named ordinary watercourse runs through the site. An Ordinary Watercourse Consent may be required from the Lead Local Flood Authority for any works in, over, under or near an ordinary watercourse

European Protected Species (EPS)
Our records show there may be protected species on and in the vicinity of the site including Triturus cristatus (great crested newt) and several species of bats. We advise liaison with the LPA ecologist to discuss and agree the scope of any surveys required.

We refer you to our website for further advice.

Foul Drainage
We note the site is within the catchment of the River Dee Special Area of Conservation (SAC).

On the 21st January 2021, NRW published an evidence package outlining phosphate levels for all river SACs across Wales. As part of this package, we issued a Planning Position Statement, in which we advised that any proposed development that might increase the amount of phosphate within the catchment could lead to damaging effects to the SAC. Therefore, such proposals should be screened through a Habitats Regulations Assessment (HRA) by the Local Planning Authority (LPA) to determine whether they are likely to have a significant effect on the SAC.

The suitability of foul drainage arrangements for the proposed development is a matter for the LPA to determine. We therefore advise that as part of any future planning application submission, you provide the LPA with sufficient details of the proposed method of foul drainage to inform their HRA

For further information, please refer to the Planning Advice on our website. The Planning Advice is in the process of being updated. We advise that you check our website regularly and consider the updated Planning Advice (version 2) when available.

Historic Landfill
The proposal site is approximately 519m from a historic landfill site. The Environment Agency provided the Local Authority with Historic Landfill data in 2007. You may wish to consult the Local Authority's Environmental Health department with regard to this aspect.

Protected Sites
The site lies within 1.1km of Gatewen Marsh SSSI and 1.9km of the Johnstown Newt Sites SAC & Stryt Las a'r Hafod SSSI.

Special Area of Conservation (SAC)

The Local Planning Authority is a Competent Authority for the purposes of the *Conservation of Habitats and Species 2017 Regulations*. As such, they must not agree to any plan or project unless they are certain that it will not adversely affect the integrity of a Special Area of Conservation (SAC).

The Local Planning Authority should carry out a test of likely significant effects (TLSE) for the SAC, which is required under Regulation 63 of the *Conservation of Habitats and Species Regulations 2017*. This test applies to impacts on the SACs from the proposed works, either alone or in combination with other plans and projects.

If the test concludes there is likely to be a significant effect then an appropriate assessment of the impacts on the SAC from the proposed works, either alone or in combination with other plans and projects, will be required. We would be able to assist with that assessment in our role as the statutory nature conservation body under the above Regulations.

Site of Special Scientific Interest (SSSI)

The Wildlife and Countryside Act 1981 (as amended) places a duty on public authorities in exercising their functions, so far as this is likely to affect the flora, fauna, geological or physiographical features of a SSSI, to take reasonable steps consistent with the proper exercise of their functions to further the conservation and enhancement of those features.

By satisfying the requirements regarding the SACs, as indicated above, it is likely the requirements for the SSSIs will also be met.

We refer you to our website for further advice.

Landscape
The site is located approximately 3km the Clwydian Range and Dee Valley AONB. You are advised to consult with the Local Planning Authority and consider the need for Landscape Assessments in accordance with published best practice guidance.

We refer you to our website for further advice.

Provision of Data
In addition to the above, please note, we can also provide certain data free of charge, as set out in our Open Data Policy. Customers can access our data via our website.

Other Matters

Please note the view expressed in this letter is a response to a pre-planning enquiry only. We trust these comments will prove helpful but they should not set a precedent for any future Natural Resources Wales' response to any formal application for planning permission or other legal consent. Such applications shall be assessed on the information submitted and regulations of relevance at that time. The details contained in this letter are based on the information available to date.

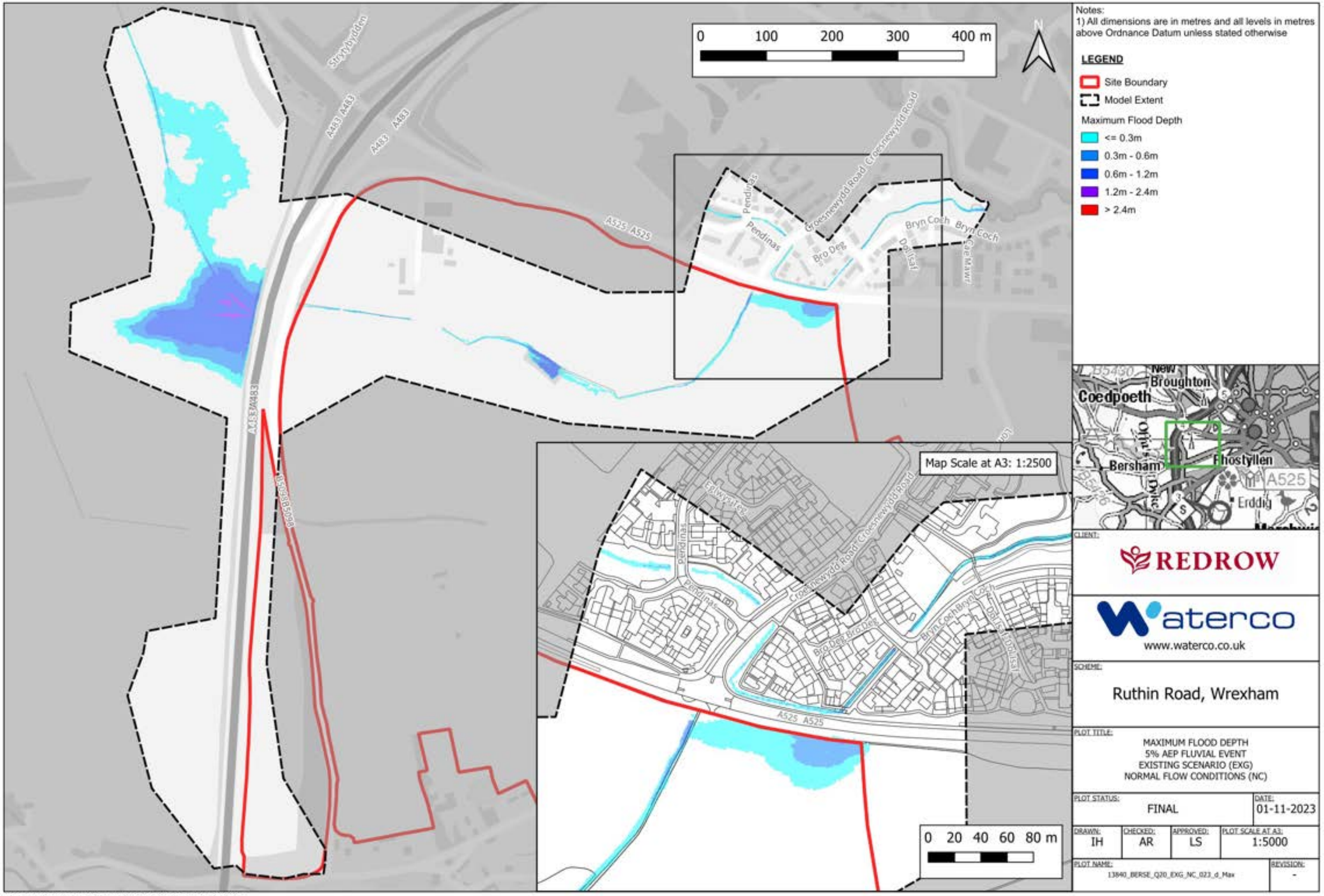
As part of our discretionary advice service we can provide further advice relating to land contamination, groundwater and flood risk prior to your planning application being submitted. There is a charge for this service. Further details are available on our website.

If you have any queries on the above please do not hesitate to contact us.

Yn gywir / Yours faithfully

Rachael Burke
Cynghorydd - Cynllunio Datblygu / Advisor - Development Planning
Cyfoeth Naturiol Cymru / Natural Resources Wales

Appendix G Modelled Outputs



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CLIENT: REDROW

waterco
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SCHEME: Ruthin Road, Wrexham

PLOT TITLE:
MAXIMUM FLOOD DEPTH
5% AEP FLUVIAL EVENT
EXISTING SCENARIO (EXG)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:			DATE:
FINAL			01-11-2023
DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q20_EXG_NC_023_d_Max

REVISION: -

0 100 200 300 400 m

N

Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Model Extent
- Proposed Development
- Proposed Channel Widening
- Proposed Flood Storage Area

Maximum Flood Depth

- <= 0.3m
- 0.3m - 0.6m
- 0.6m - 1.2m
- 1.2m - 2.4m
- > 2.4m

Map Scale at A3: 1:2500

0 20 40 60 80 m



CLIENT: REDROW

waterco
www.waterco.co.uk

SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD DEPTH
5% AEP FLUVIAL EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:	DATE:
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DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

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REVISION: -

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0 100 200 300 400 m

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DEV-EXG
NORMAL FLOW CONDITIONS (NC)

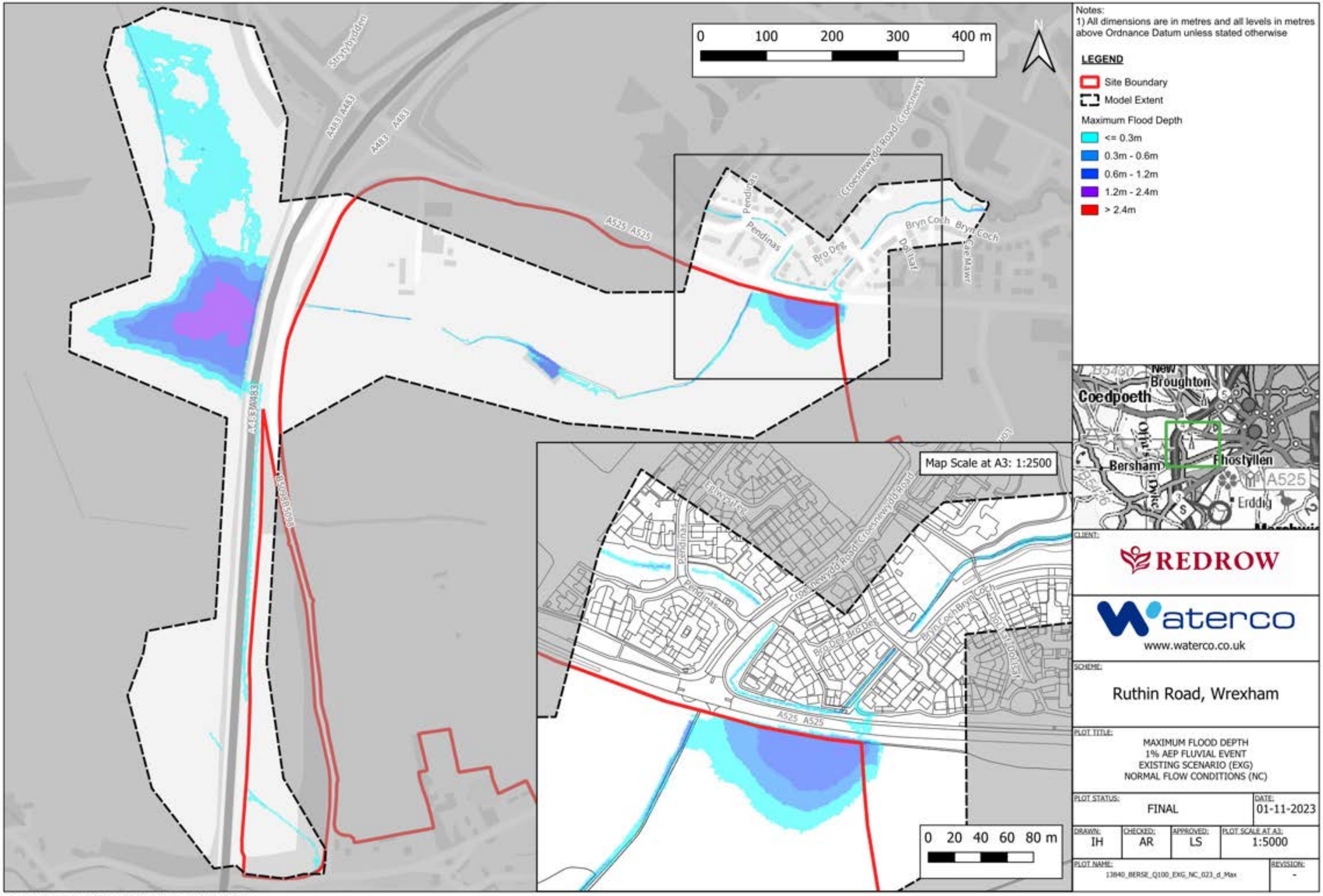
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FINAL	01-11-2023

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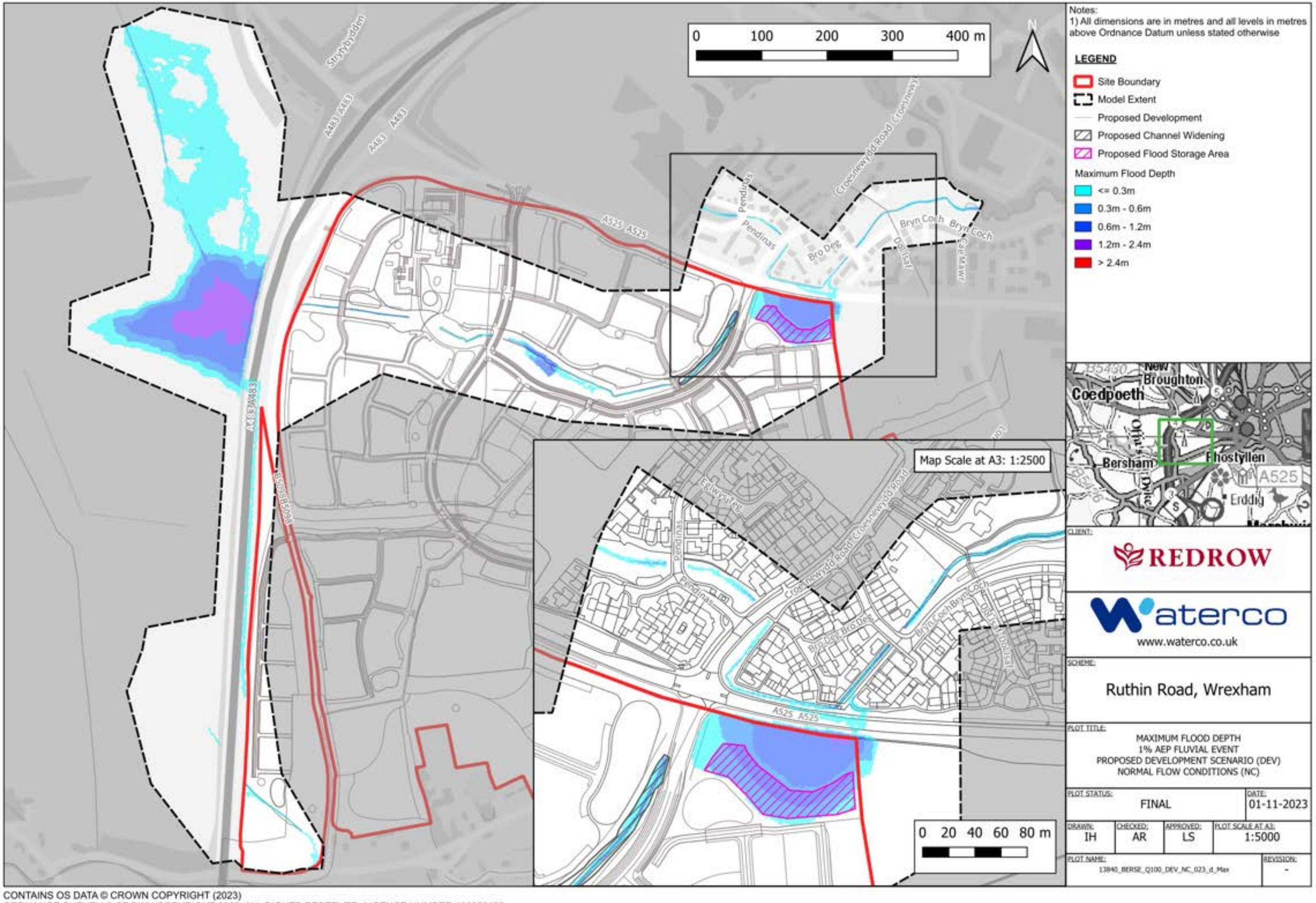
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REVISION: -

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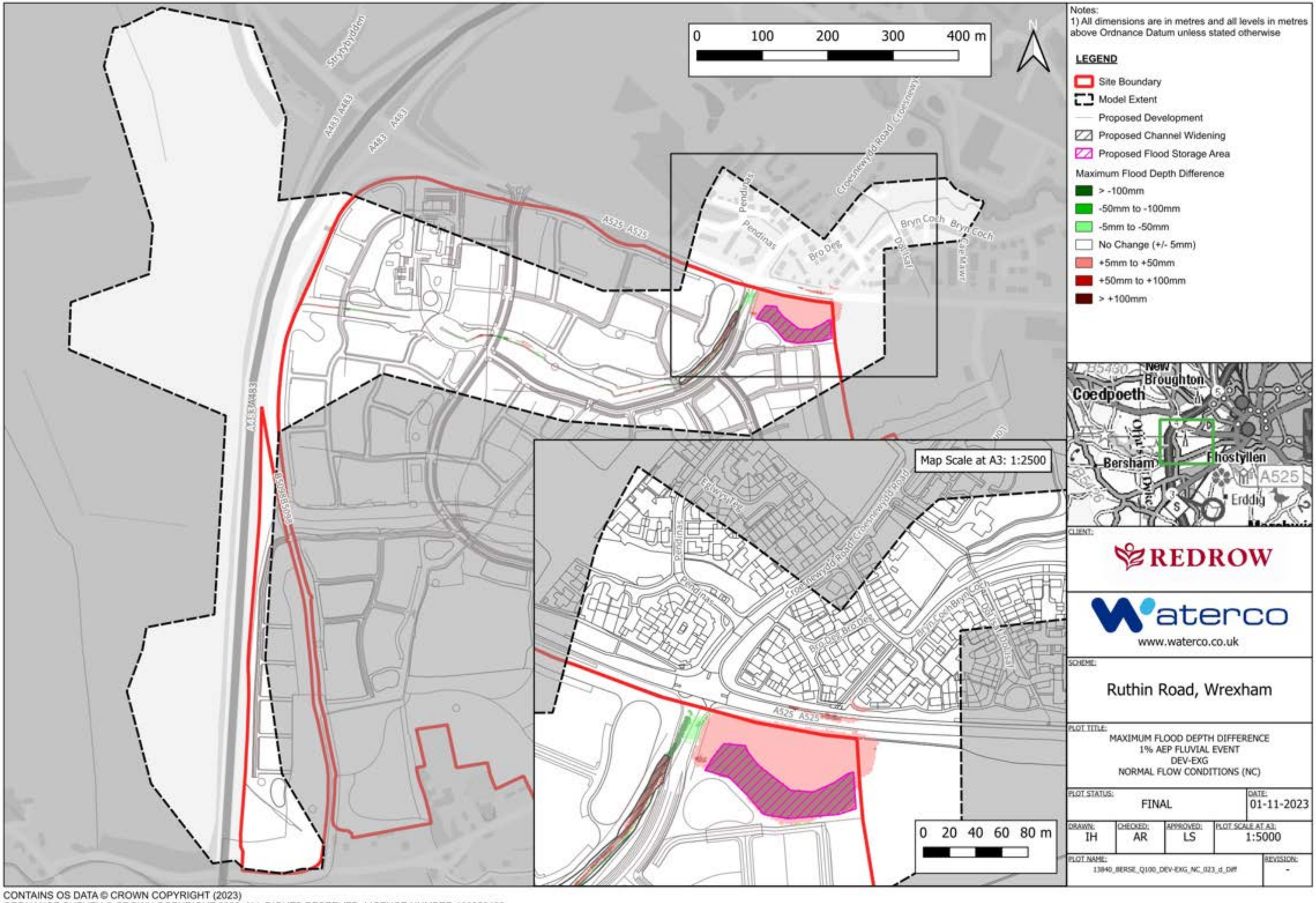
waterco
www.waterco.co.uk

SCHEME: Ruthin Road, Wrexham

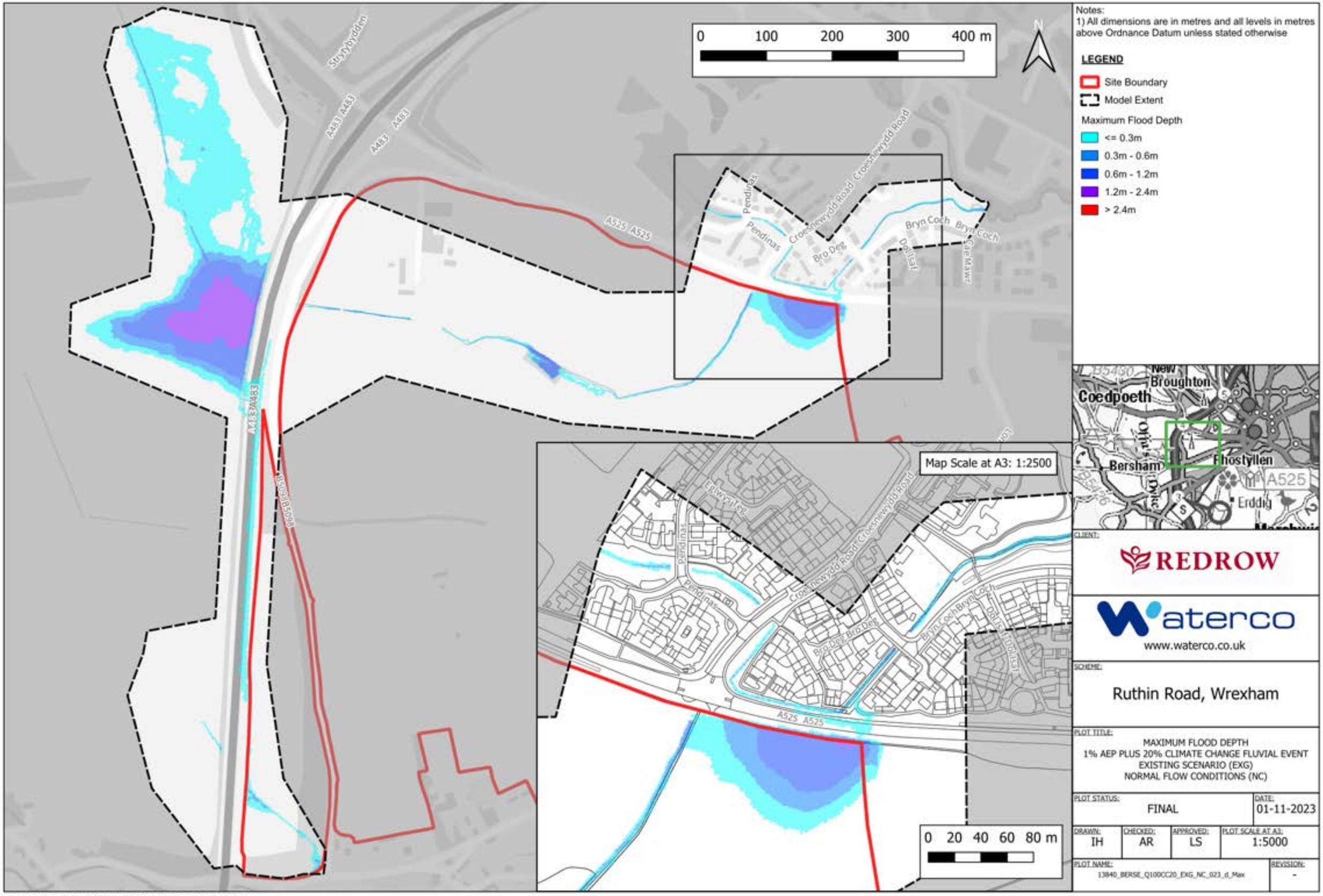
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1% AEP FLUVIAL EVENT
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NORMAL FLOW CONDITIONS (NC)

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PLOT NAME: 13840_BERSE_Q100_DEV_NC_023_d_Max
REVISION: -



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CLIENT: REDROW

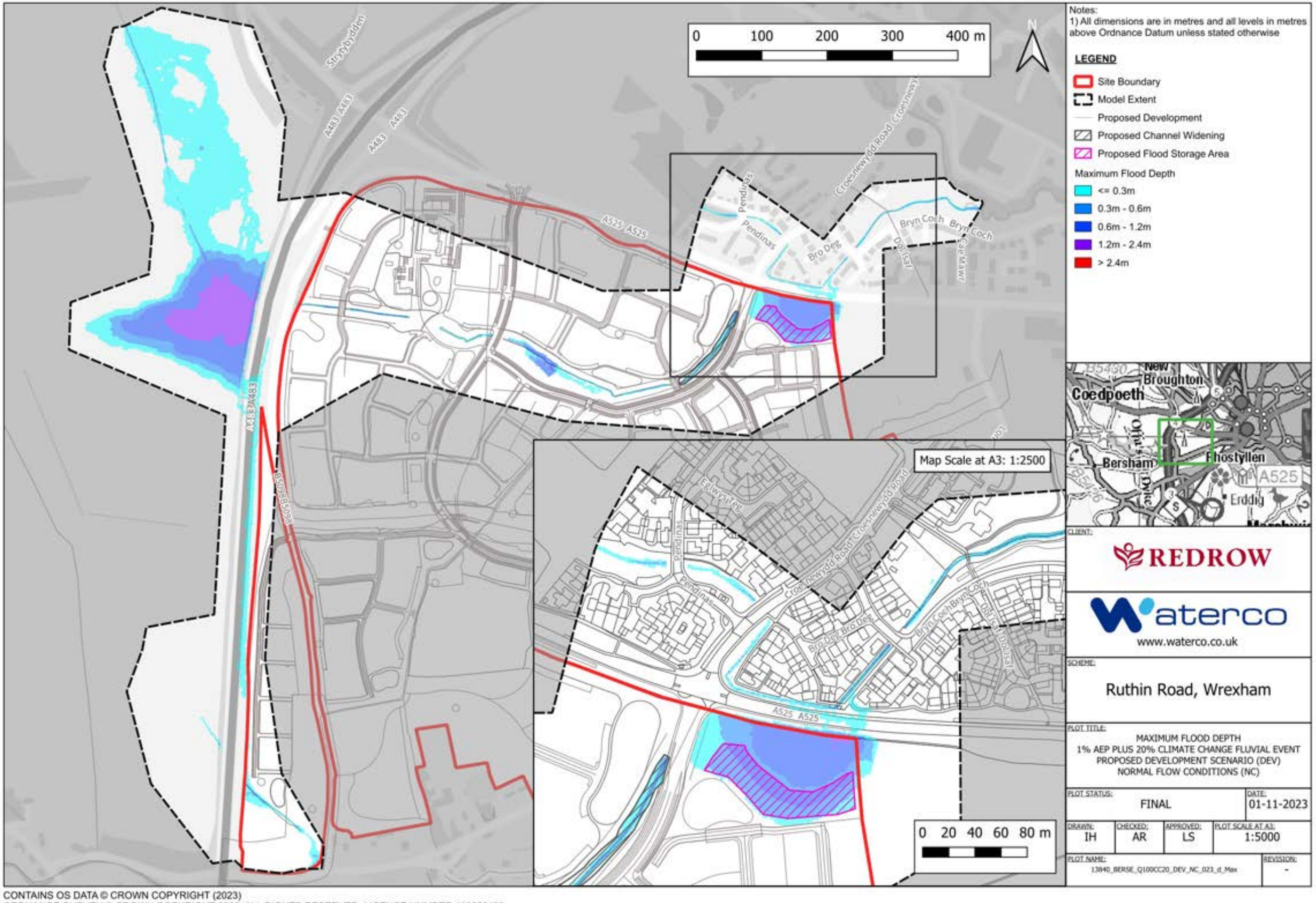
waterco
www.waterco.co.uk

SCHEME: Ruthin Road, Wrexham

PLOT TITLE:
MAXIMUM FLOOD DEPTH
1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
EXISTING SCENARIO (EXG)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:			DATE:
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PLOT NAME: 13840_BERSE_Q100CC20_EXG_NC_023_d_Max			REVISION: -

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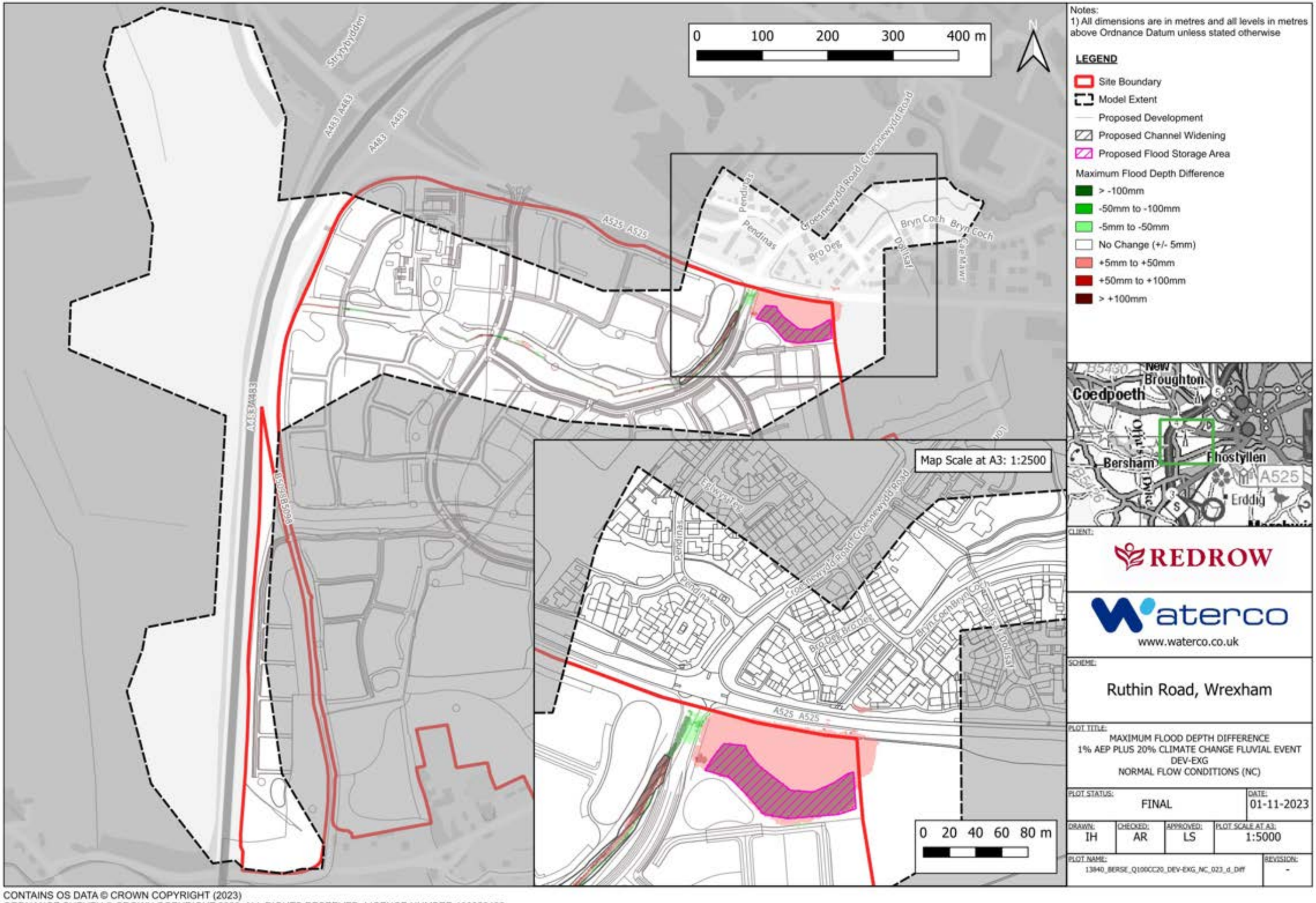
CLIENT: REDROW

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SCHEME: Ruthin Road, Wrexham

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1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
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- Proposed Flood Storage Area

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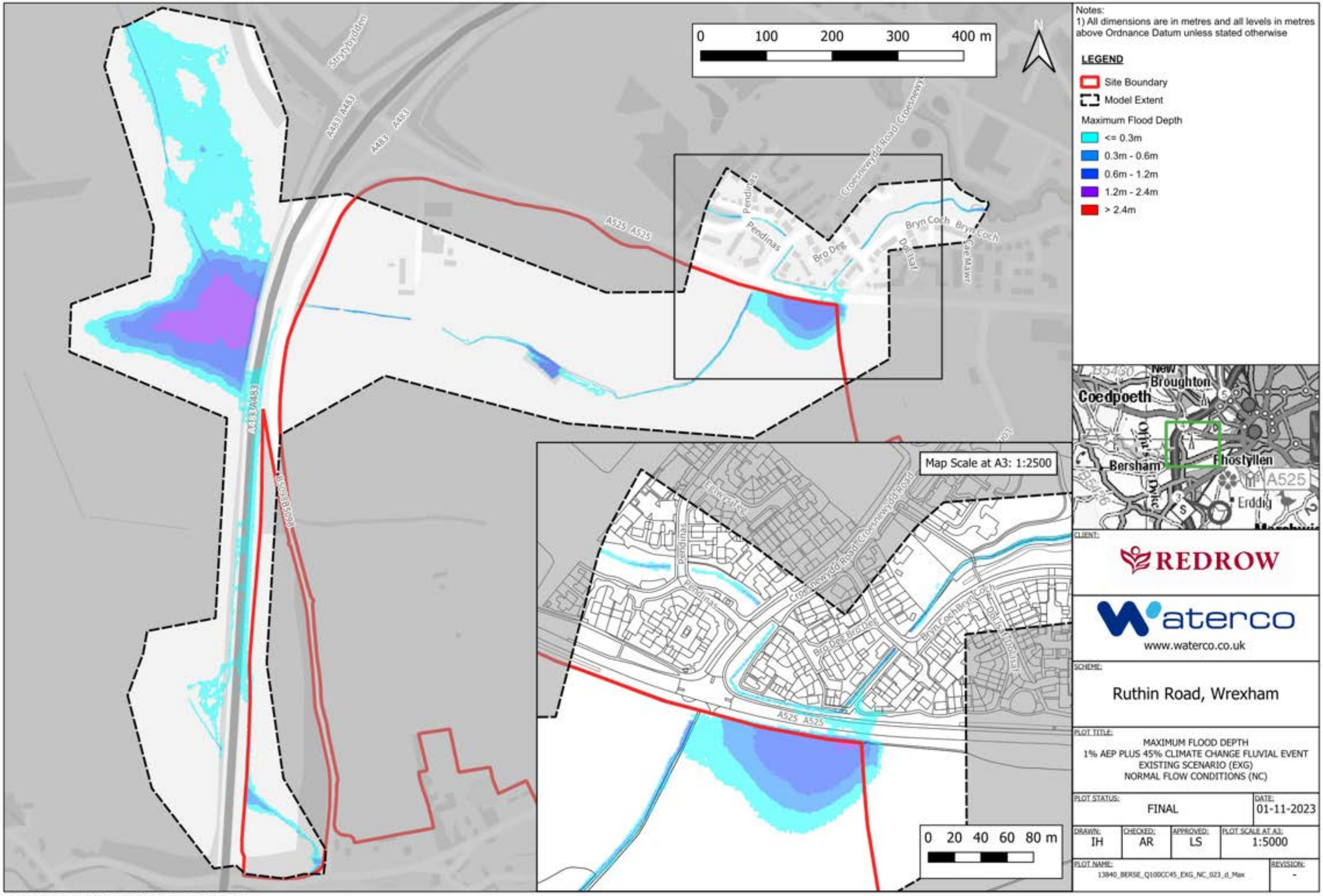
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1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
DEV-EXG
NORMAL FLOW CONDITIONS (NC)

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CLIENT: REDROW

waterco
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SCHEME: Ruthin Road, Wrexham

PLOT TITLE:
MAXIMUM FLOOD DEPTH
1% AEP PLUS 45% CLIMATE CHANGE FLUVIAL EVENT
EXISTING SCENARIO (EXG)
NORMAL FLOW CONDITIONS (NC)

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0 100 200 300 400 m

N

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Map Scale at A3: 1:2500

0 20 40 60 80 m



CLIENT: REDROW

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PROPOSED DEVELOPMENT SCENARIO (DEV)
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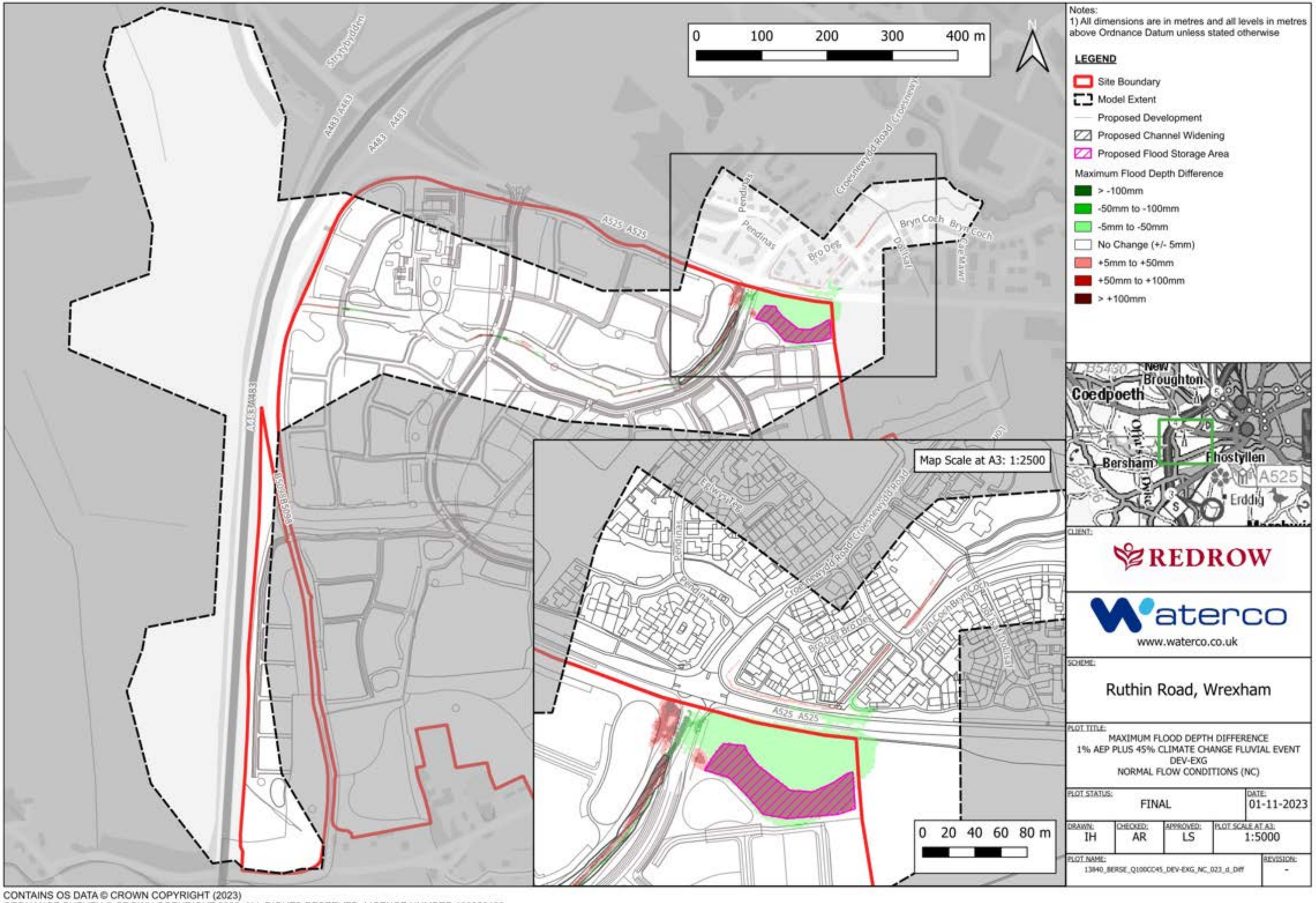
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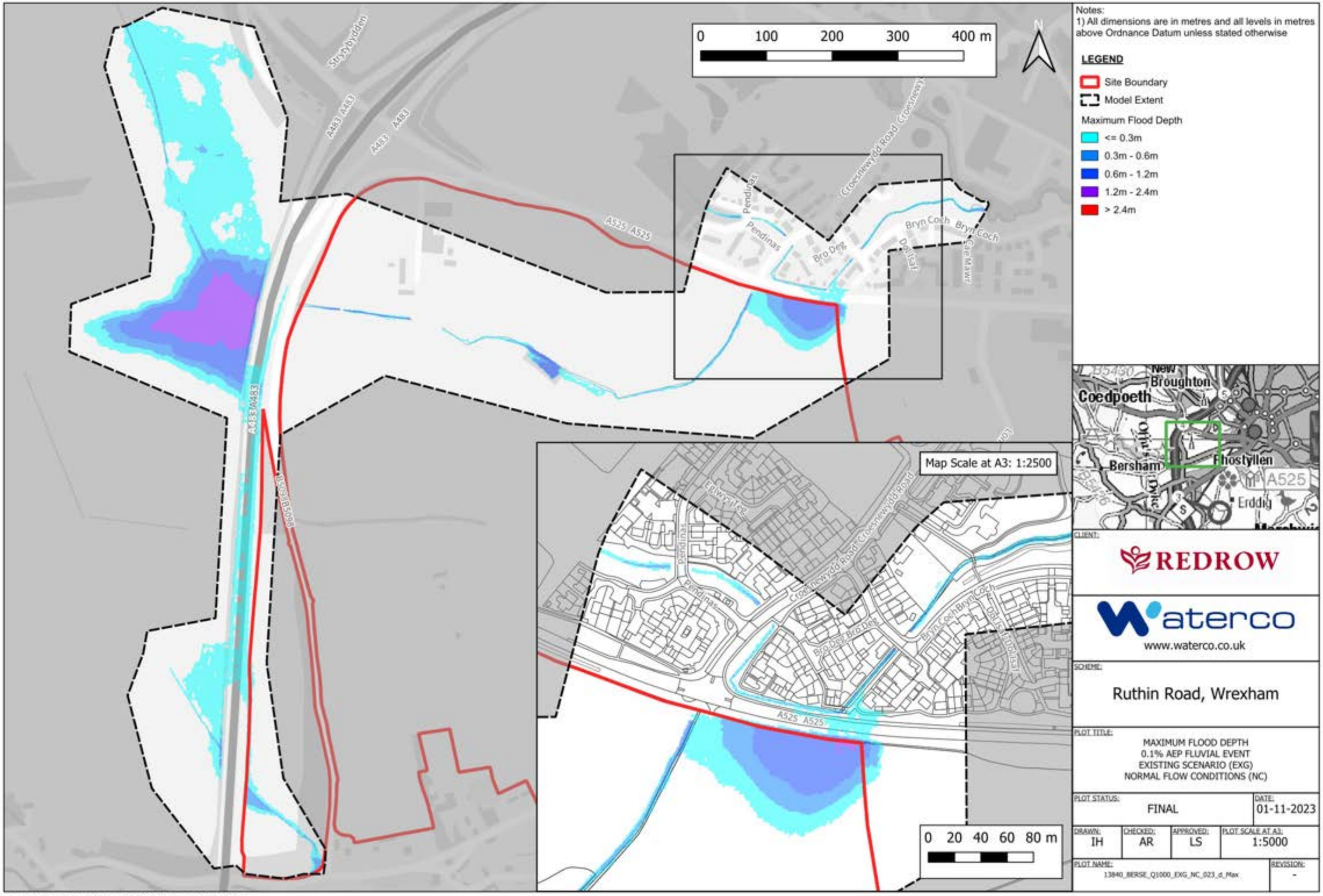
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CLIENT: REDROW

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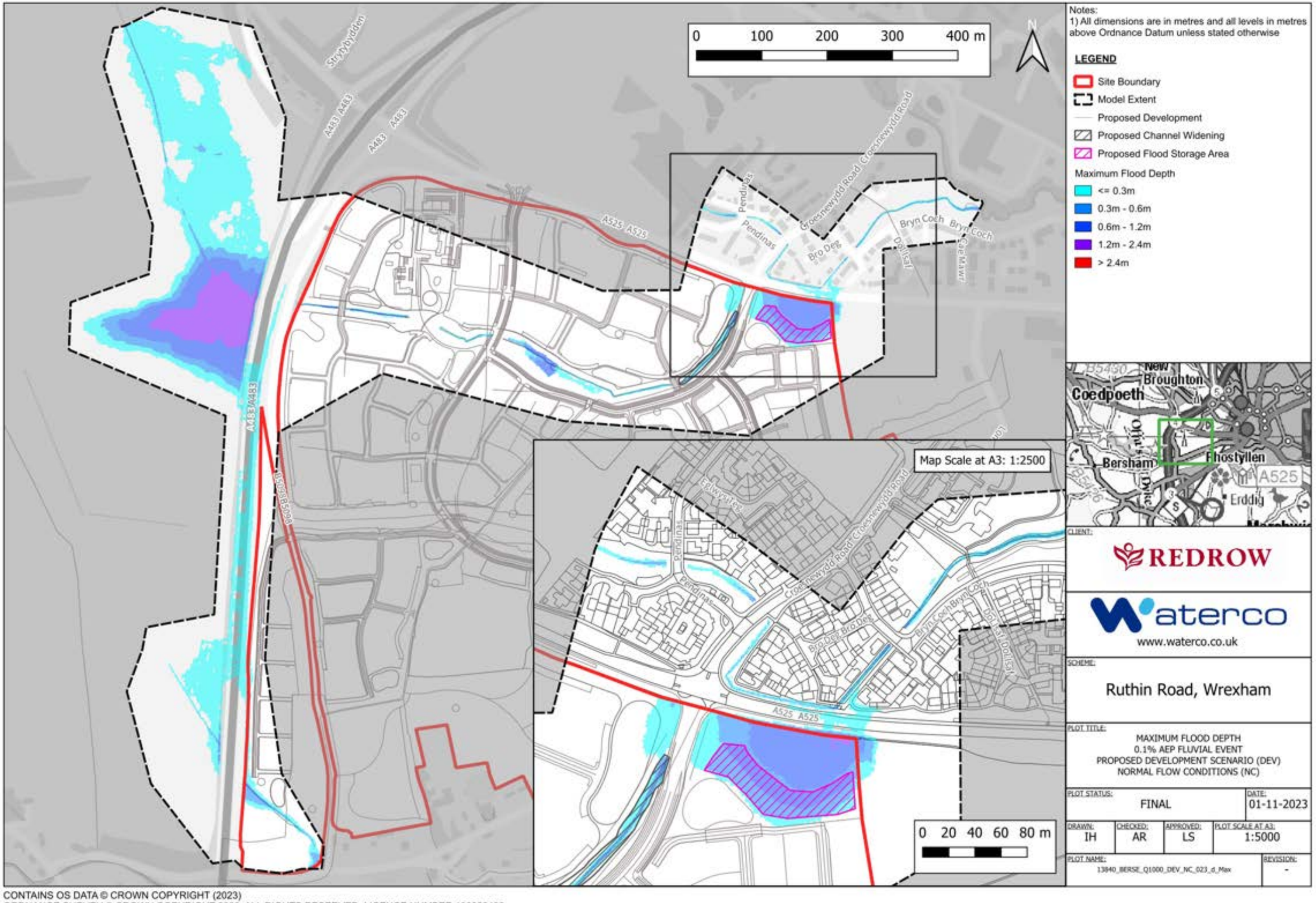
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EXISTING SCENARIO (EXG)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:			DATE:
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PLOT NAME: 13840_BERSE_Q1000_EXG_NC_023_d_Max
REVISION: -

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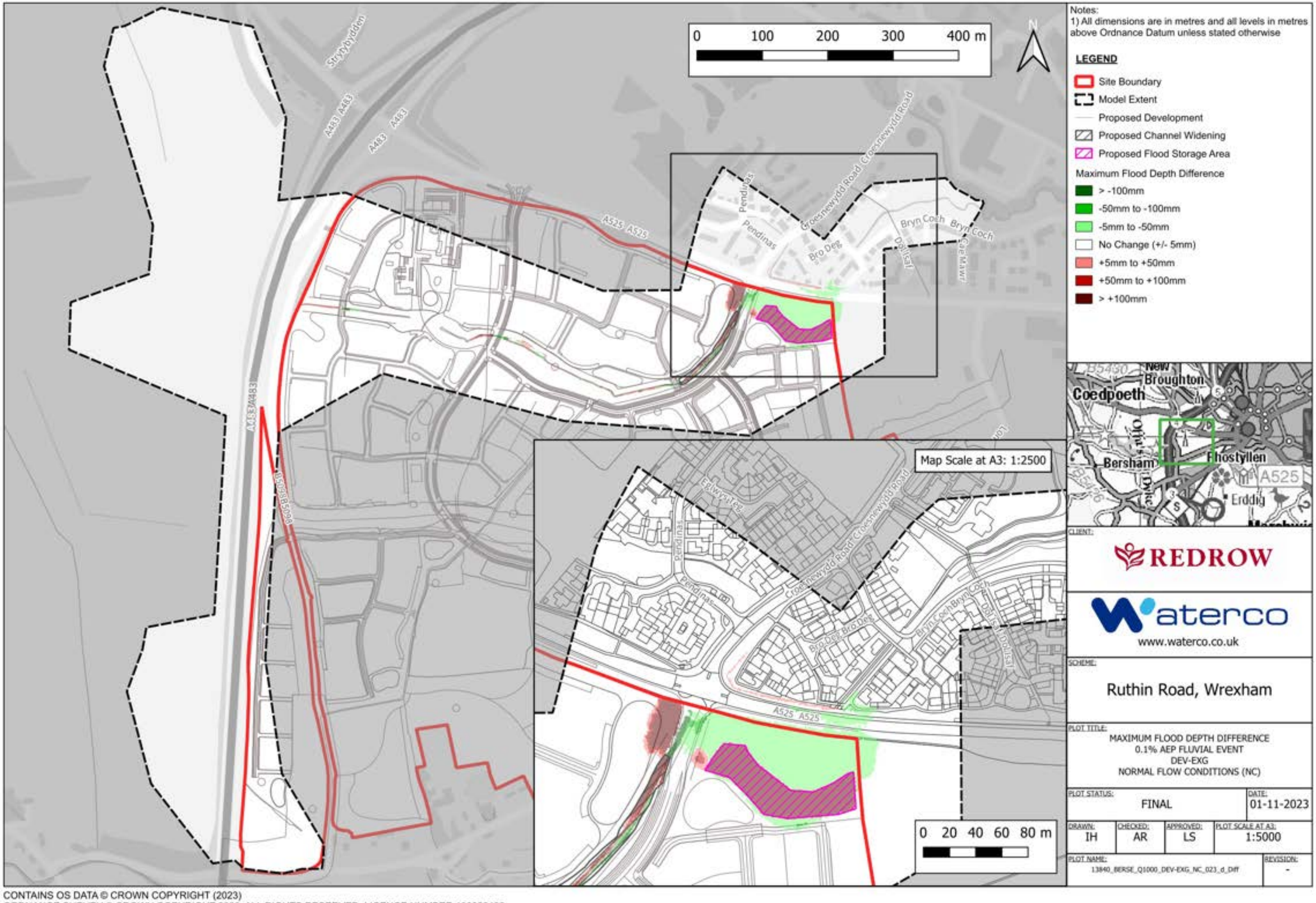
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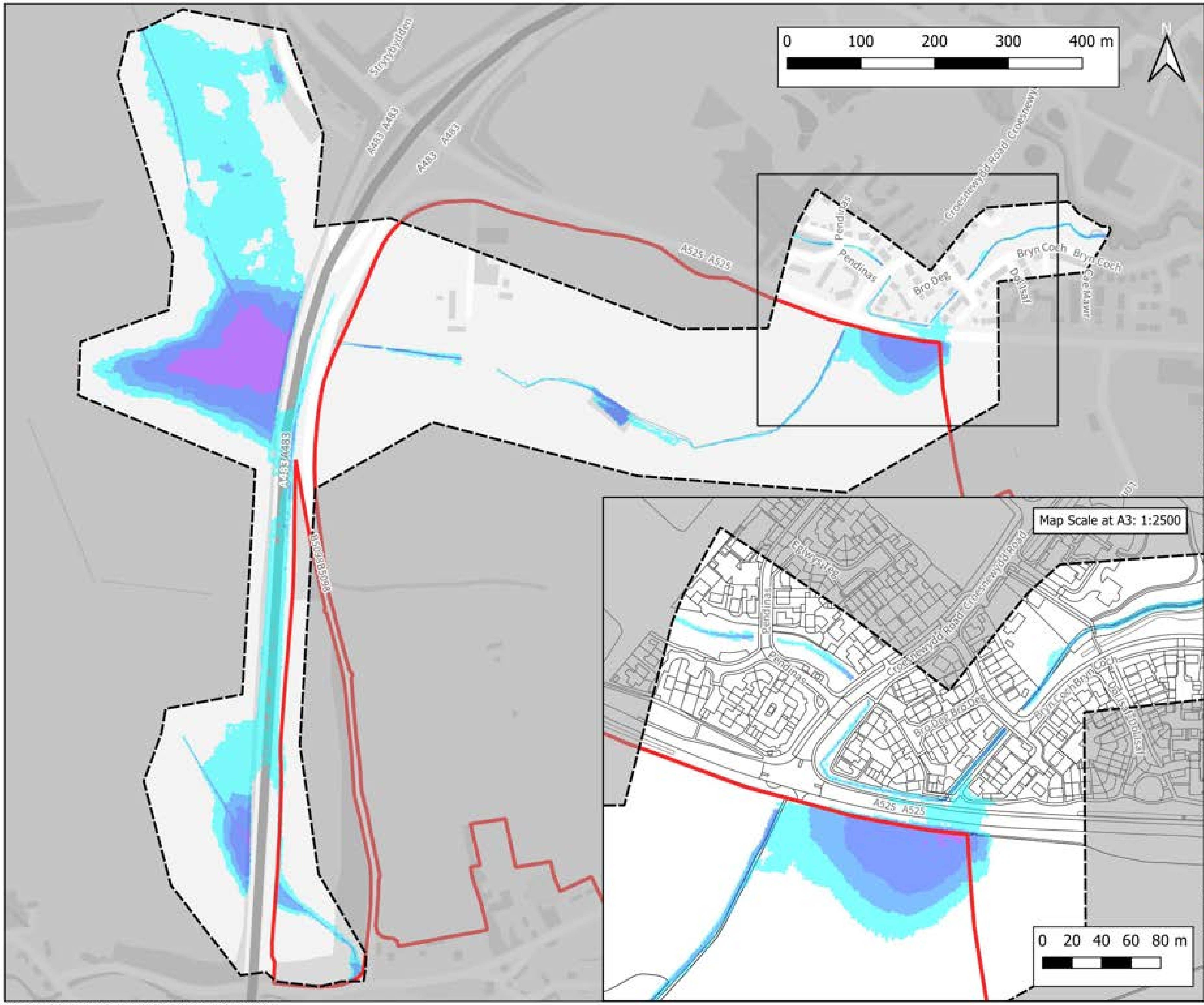
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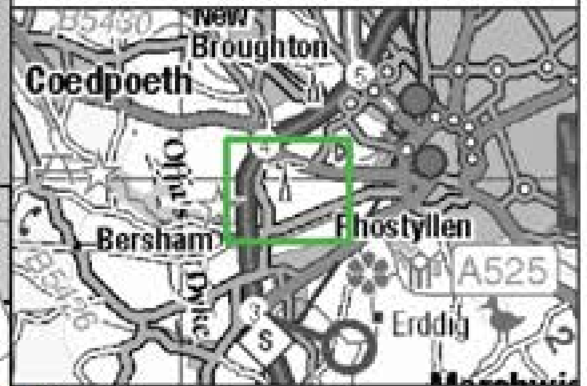
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PLOT NAME: 13840_BERSE_Q1000CC20_EXG_NC_023_d_Max			REVISION: -

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Map Scale at A3: 1:2500

0 20 40 60 80 m



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PROPOSED DEVELOPMENT SCENARIO (DEV)
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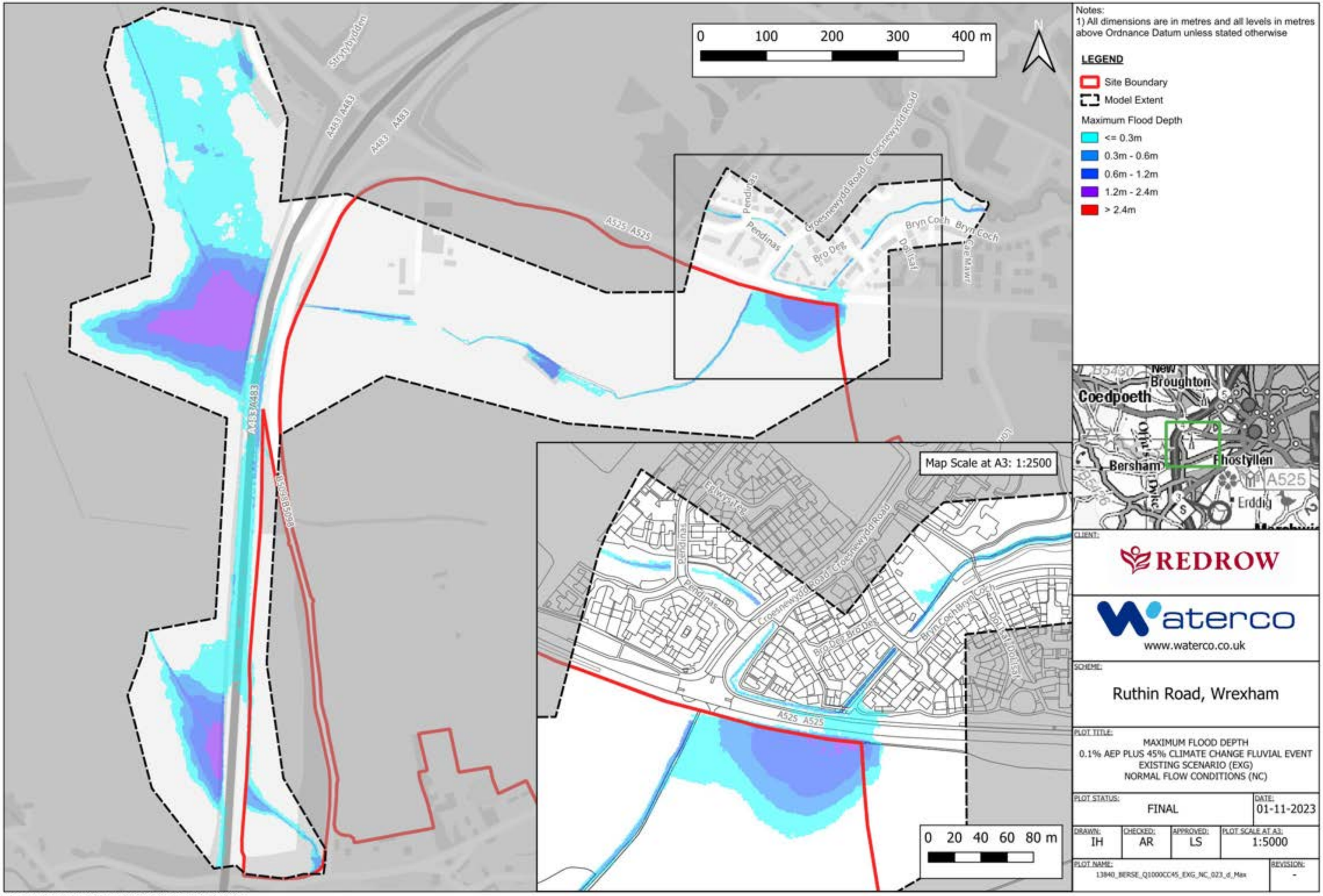
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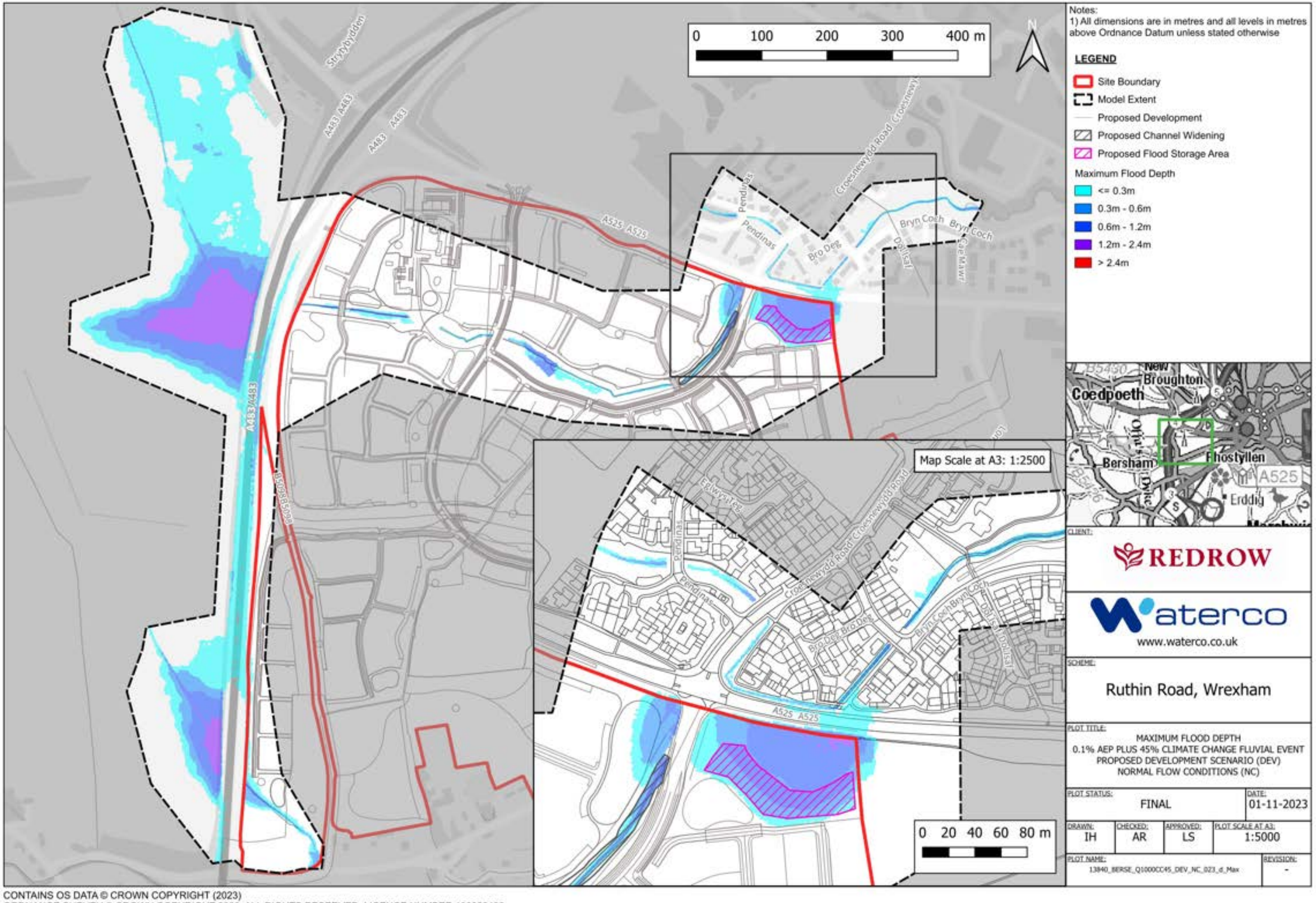
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CLIENT: REDROW

waterco
www.waterco.uk

SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD DEPTH
0.1% AEP PLUS 45% CLIMATE CHANGE FLUVIAL EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:			DATE:
FINAL			01-11-2023
DRAWN: IH	CHECKED: AR	APPROVED: LS	PLOT SCALE AT A3: 1:5000

PLOT NAME: 13840_BERSE_Q1000CC45_DEV_NC_023_d_Max
REVISION: -

0 100 200 300 400 m

N

Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Model Extent
- Proposed Development
- Proposed Channel Widening
- Proposed Flood Storage Area

Maximum Flood Depth Difference

- > -100mm
- -50mm to -100mm
- -5mm to -50mm
- No Change (+/- 5mm)
- +5mm to +50mm
- +50mm to +100mm
- > +100mm

Map Scale at A3: 1:2500

0 20 40 60 80 m



CLIENT: REDROW

waterco
www.waterco.co.uk

SCHEME: Ruthin Road, Wrexham

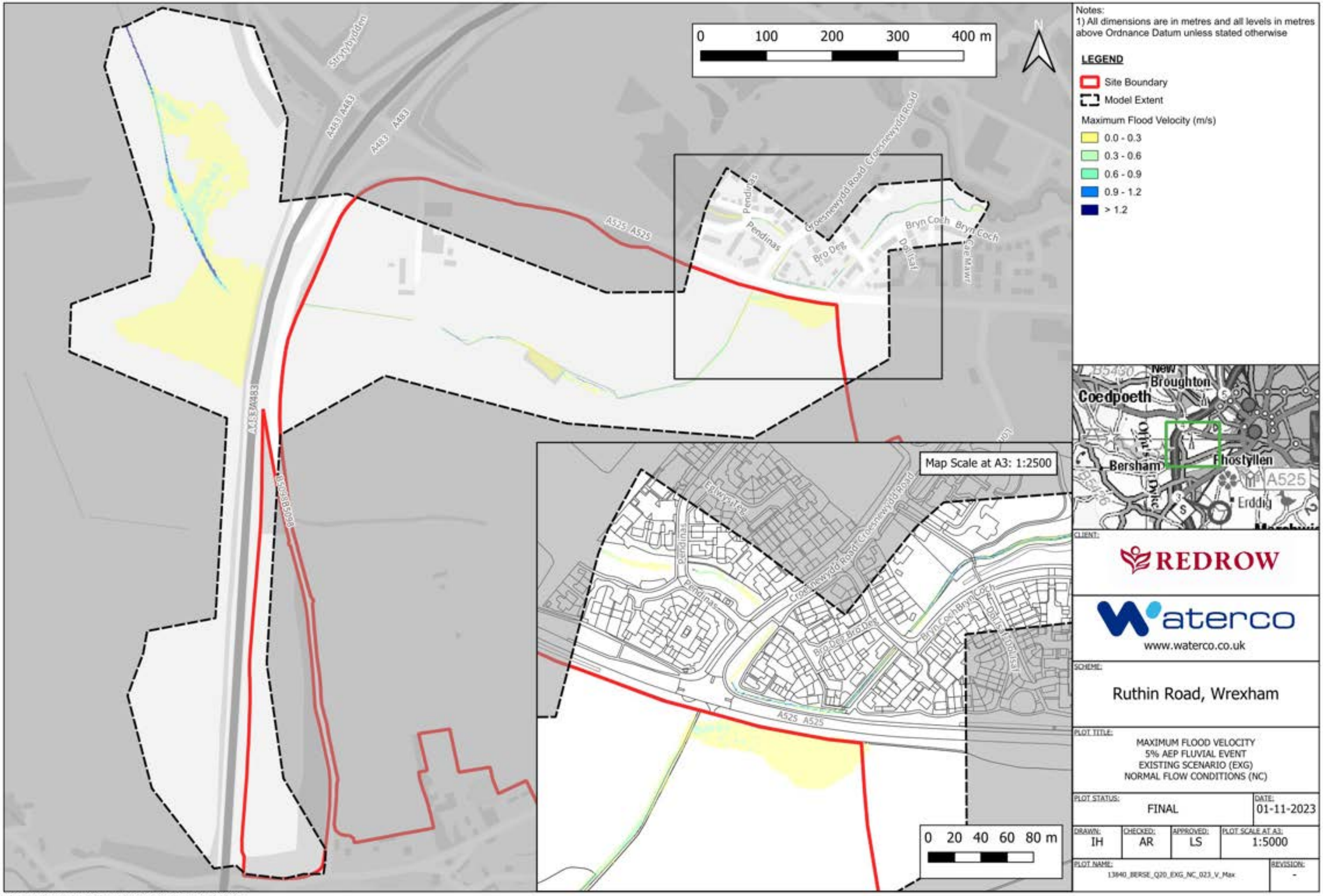
PLOT TITLE: MAXIMUM FLOOD DEPTH DIFFERENCE
0.1% AEP PLUS 45% CLIMATE CHANGE FLUVIAL EVENT
DEV-EXG
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:			DATE:
FINAL			01-11-2023
DRAWN: IH	CHECKED: AR	APPROVED: LS	PLOT SCALE AT A3: 1:5000

PLOT NAME: 13840_BERSE_Q1000CC45_DEV-EXG_NC_023_d_Diff

REVISION: -

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CLIENT: REDROW

waterco
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SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD VELOCITY
5% AEP FLUVIAL EVENT
EXISTING SCENARIO (EXG)
NORMAL FLOW CONDITIONS (NC)

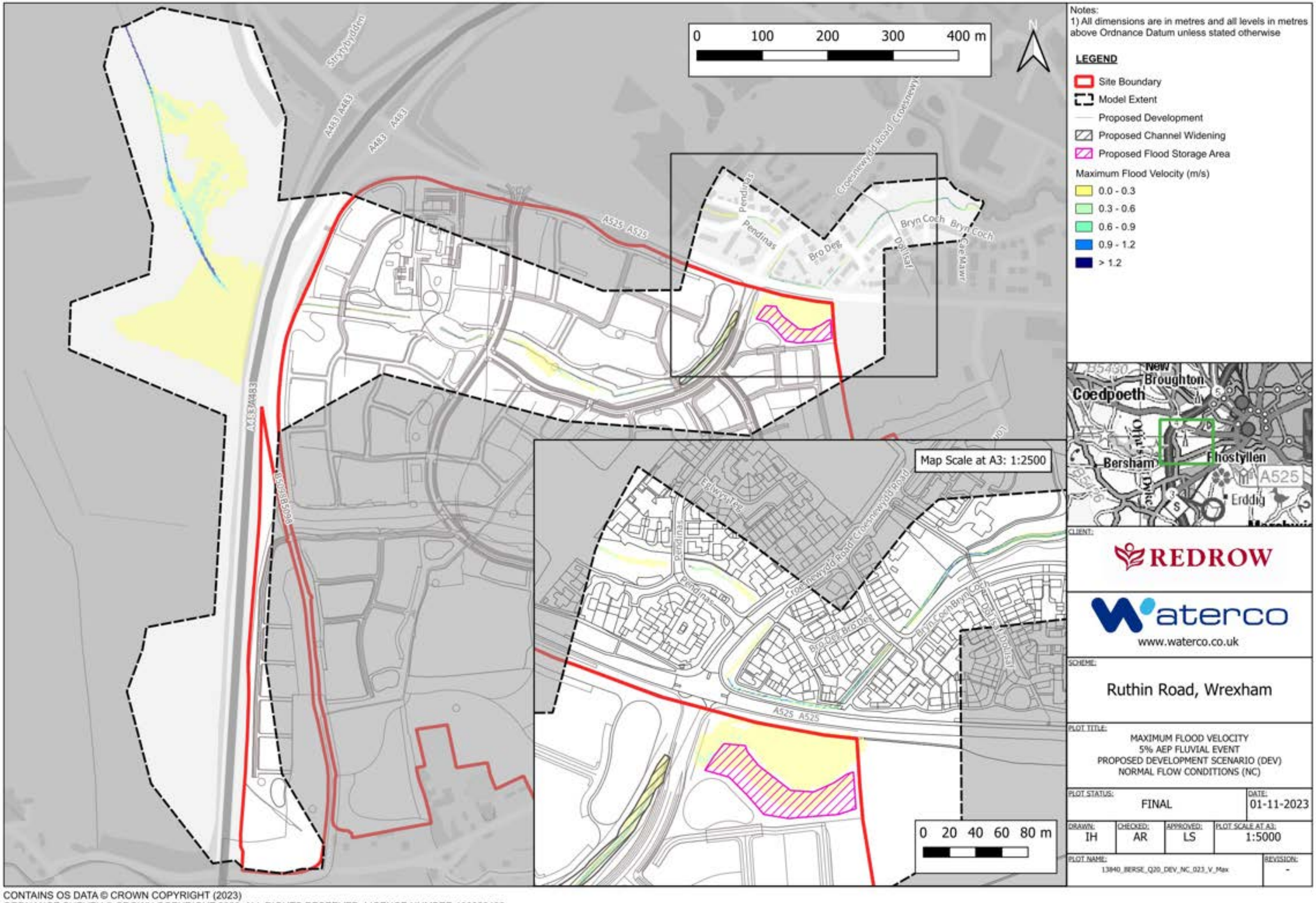
PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

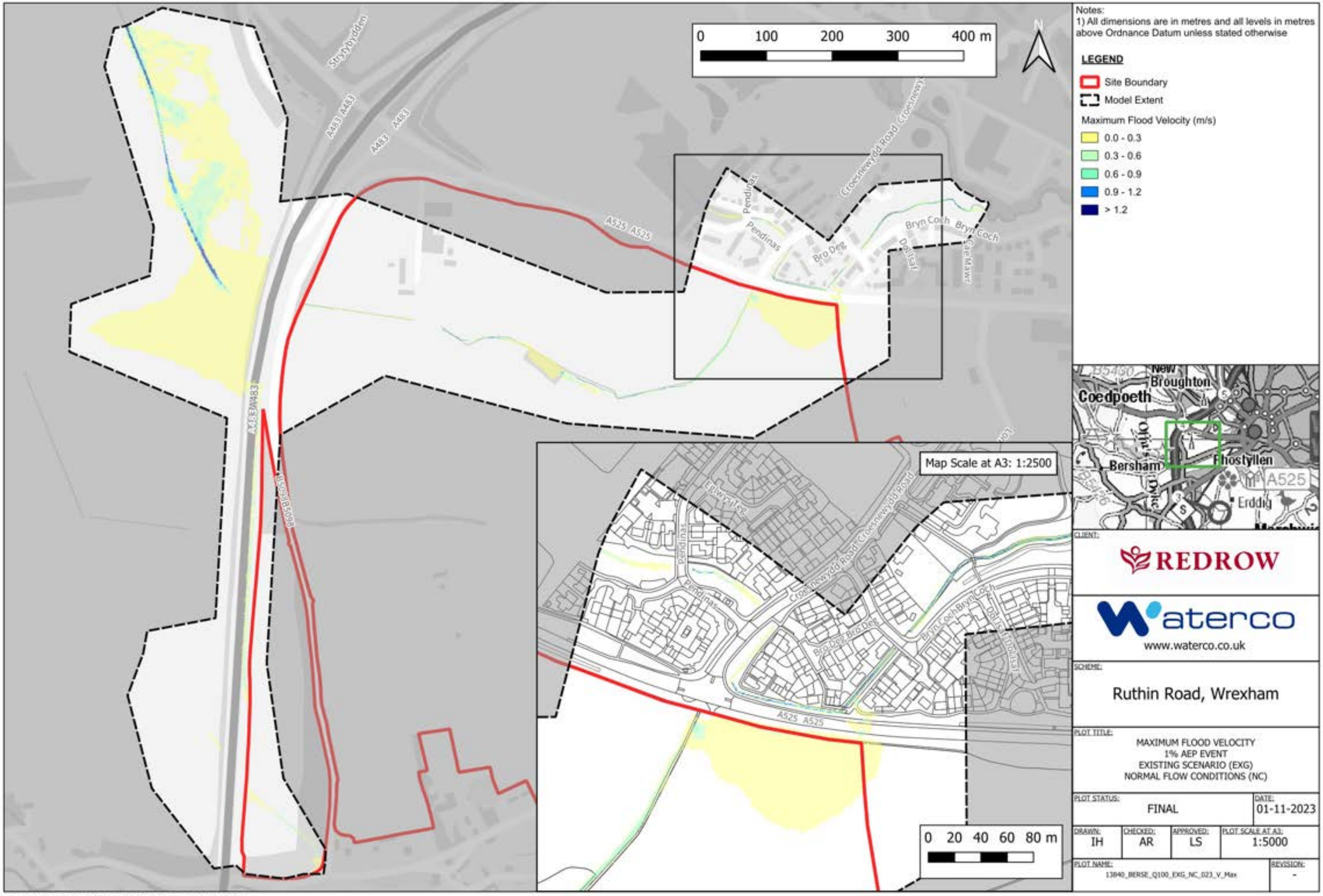
PLOT NAME: 13840_BERSE_Q20_EXG_NC_023_V_Max

REVISION: -

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Notes:
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LEGEND

- Site Boundary
- Model Extent

Maximum Flood Velocity (m/s)

- 0.0 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

CLIENT: REDROW

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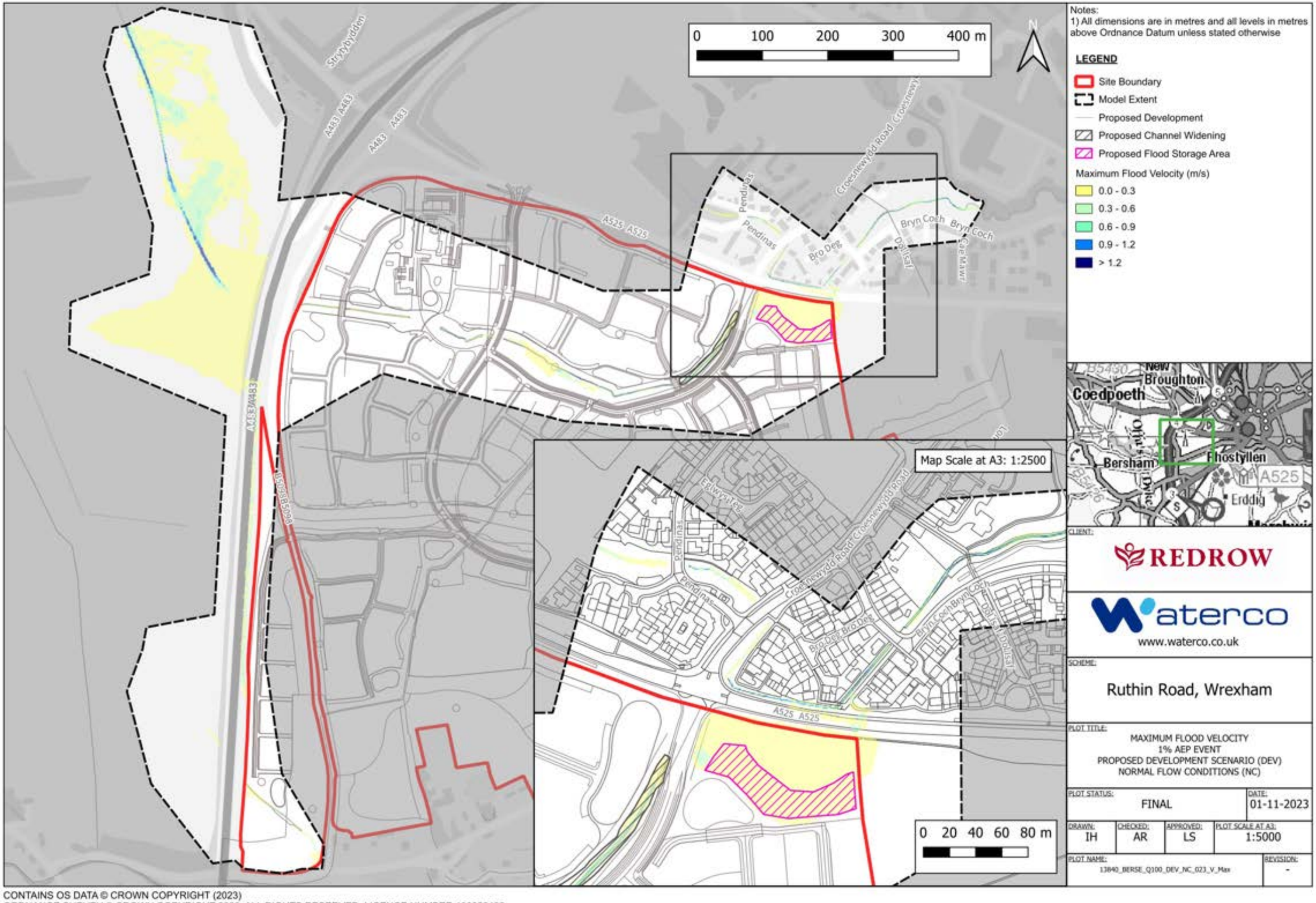
SCHEME: Ruthin Road, Wrexham

PLOT TITLE:
MAXIMUM FLOOD VELOCITY
1% AEP EVENT
EXISTING SCENARIO (EXG)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:			DATE:
FINAL			01-11-2023
DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q100_EXG_NC_023_V_Max
REVISION: -

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0 100 200 300 400 m

N

Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

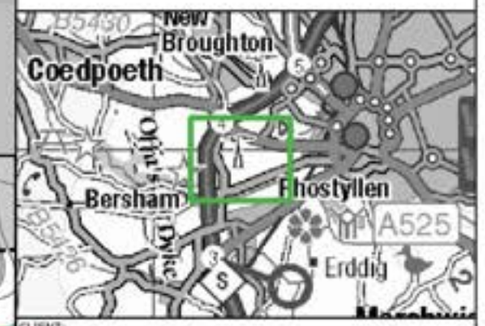
- Site Boundary
- Model Extent

Maximum Flood Velocity (m/s)

- 0.0 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

Map Scale at A3: 1:2500

0 20 40 60 80 m



CLIENT: REDROW

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SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD VELOCITY
1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
EXISTING SCENARIO (EXG)
NORMAL FLOW CONDITIONS (NC)

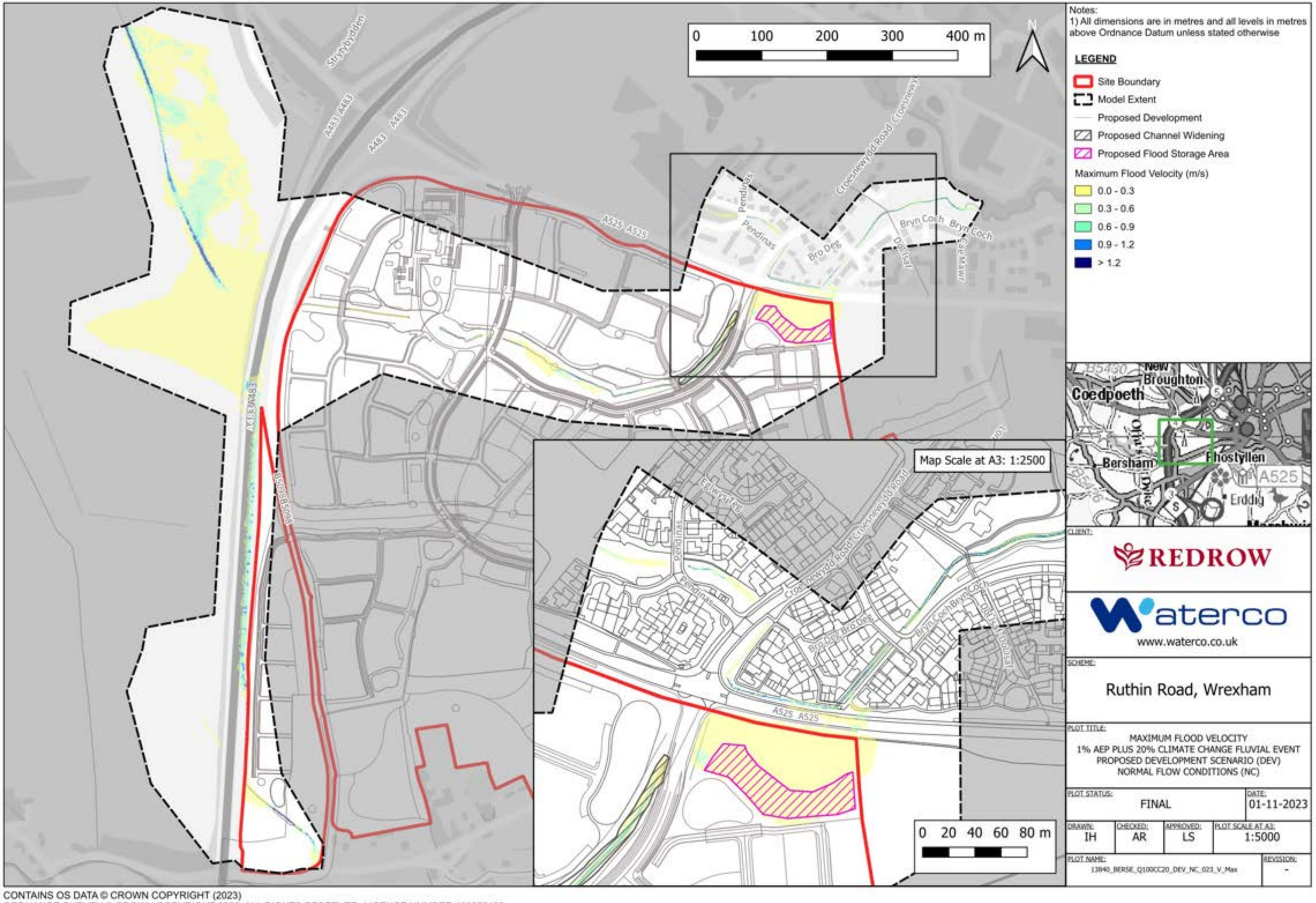
PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q100CC20_EXG_NC_023_V_Max

REVISION: -

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CLIENT: REDROW

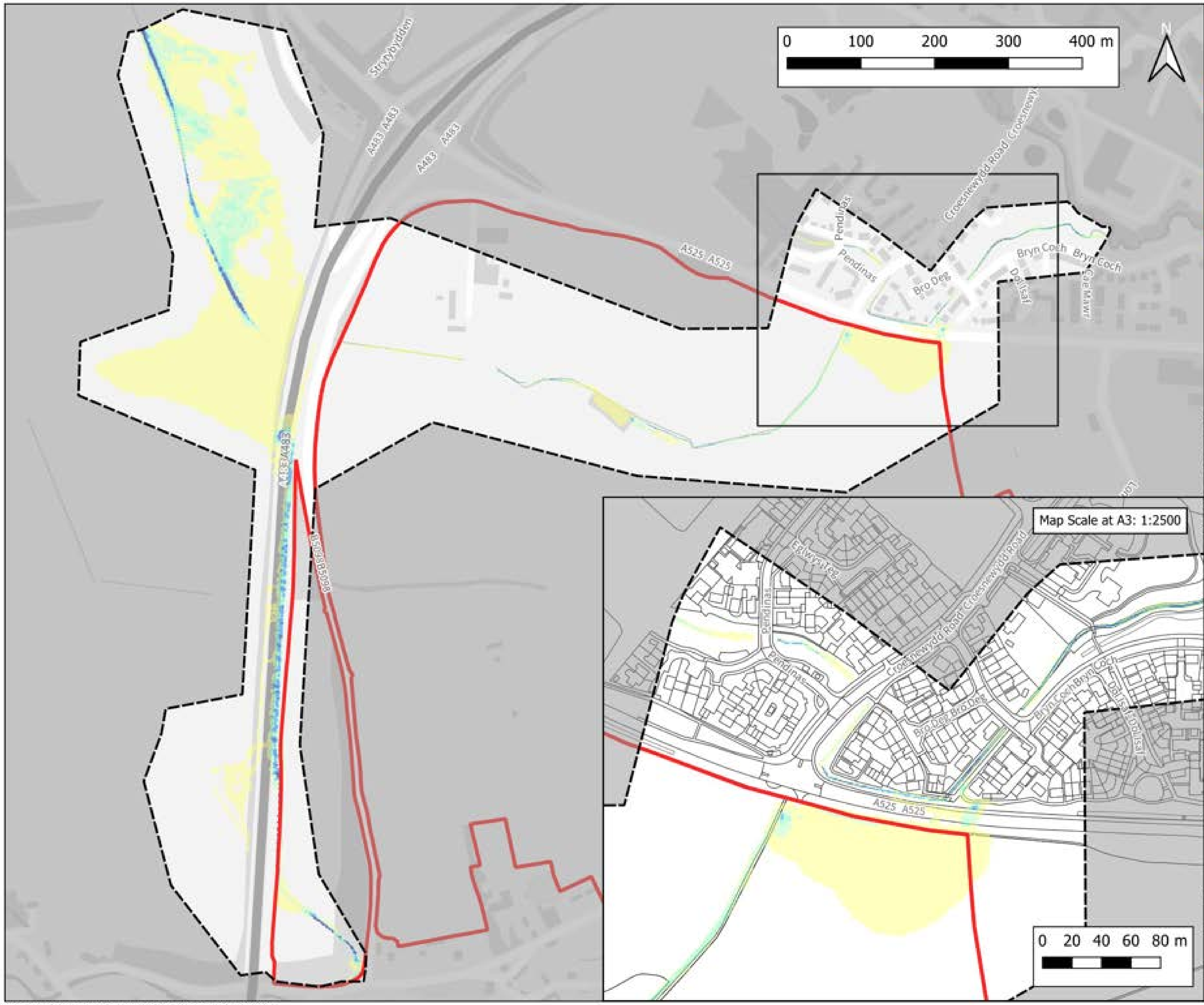
waterco
www.waterco.co.uk

SCHEME: Ruthin Road, Wrexham

PLOT TITLE:
MAXIMUM FLOOD VELOCITY
1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:			DATE:
FINAL			01-11-2023
DRAWN: IH	CHECKED: AR	APPROVED: LS	PLOT SCALE AT A3: 1:5000

PLOT NAME: 13840_BERSE_Q100CC20_DEV_NC_023_V_Max
REVISION: -



Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Model Extent

Maximum Flood Velocity (m/s)

- 0.0 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

CLIENT: REDROW

Waterco
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SCHEME: Ruthin Road, Wrexham

PLOT TITLE:
MAXIMUM FLOOD VELOCITY
1% AEP PLUS 45% CLIMATE CHANGE FLUVIAL EVENT
EXISTING SCENARIO (EXG)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME:	REVISION:
13840_BERSE_Q100CC45_EXG_NC_023_V_Max	-

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0 100 200 300 400 m

N

Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Model Extent
- Proposed Development
- Proposed Channel Widening
- Proposed Flood Storage Area

Maximum Flood Velocity (m/s)

- 0.0 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

Map Scale at A3: 1:2500

0 20 40 60 80 m



CLIENT: REDROW

waterco
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SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD VELOCITY
1% AEP PLUS 45% CLIMATE CHANGE FLUVIAL EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
NORMAL FLOW CONDITIONS (NC)

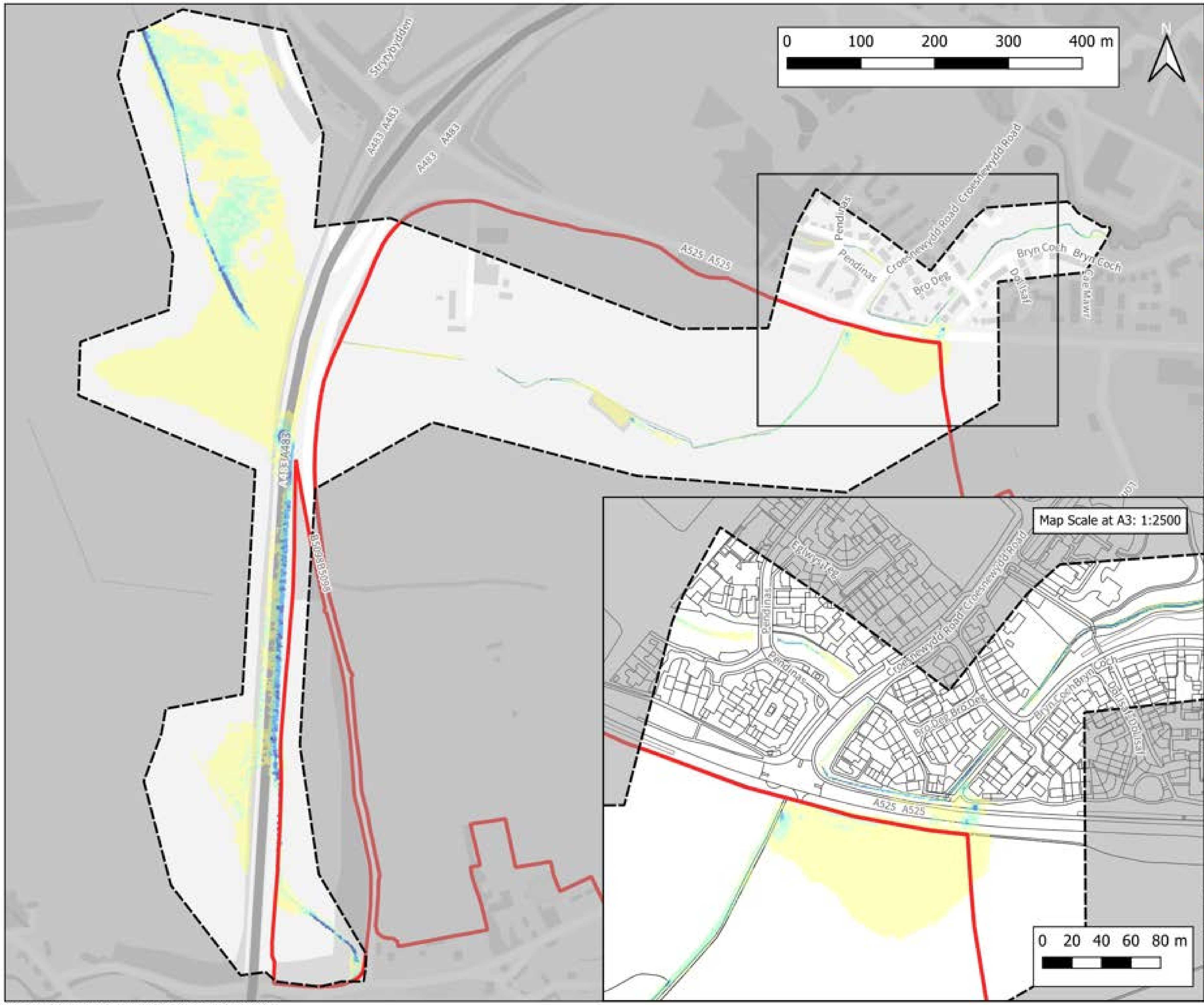
PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q100CC45_DEV_NC_023_V_Max

REVISION: -

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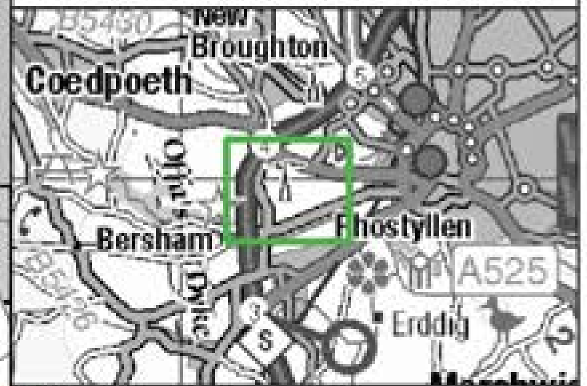
Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Model Extent

Maximum Flood Velocity (m/s)

- 0.0 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2



CLIENT:

REDROW

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SCHEME:

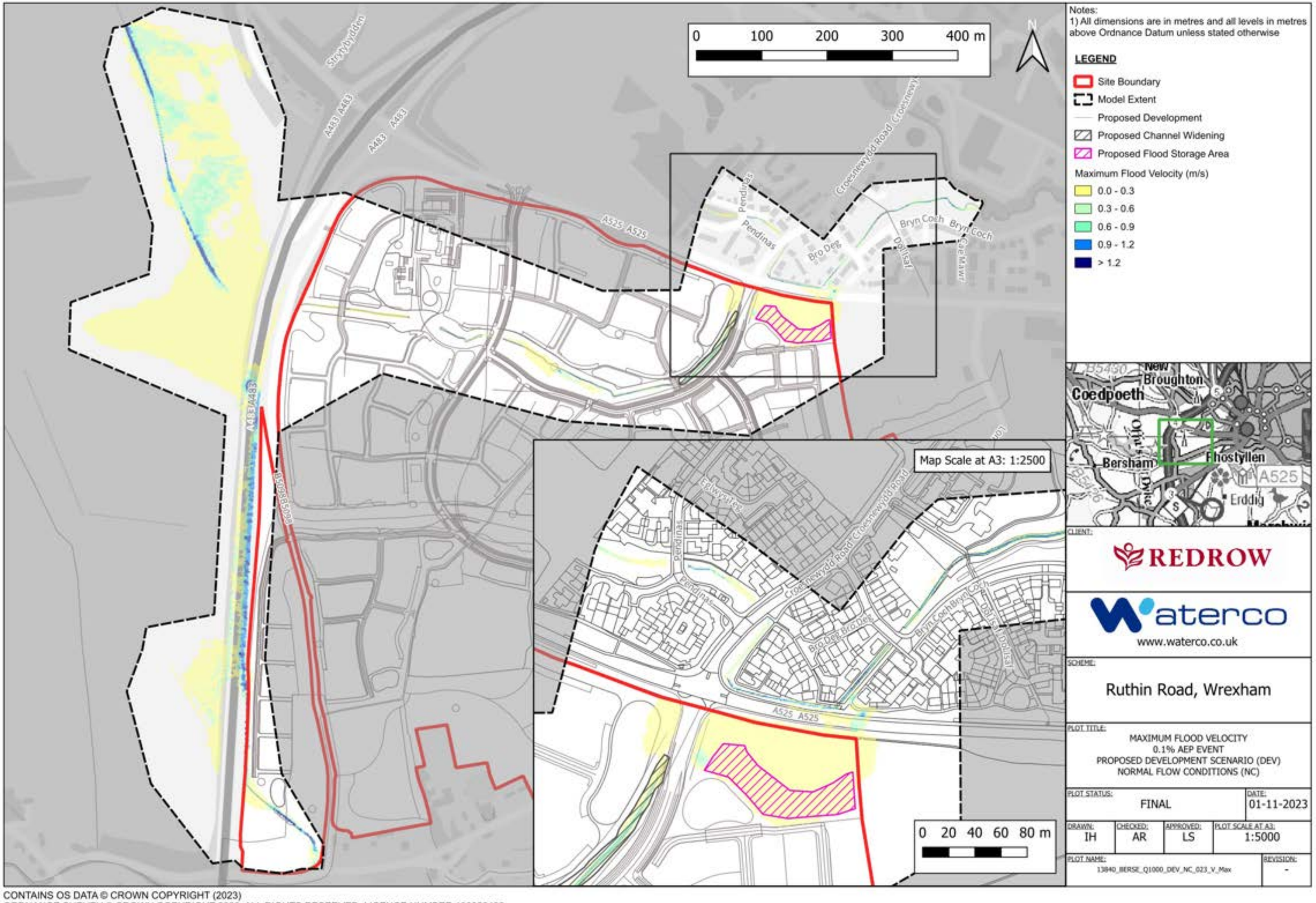
Ruthin Road, Wrexham

PLOT TITLE:

MAXIMUM FLOOD VELOCITY
0.1% AEP EVENT
EXISTING SCENARIO (EXG)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:			DATE:
FINAL			01-11-2023
DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000
PLOT NAME:			REVISION:
13840_BERSE_Q1000_EXG_NC_023_V_Max			-

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Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Model Extent
- Proposed Development
- Proposed Channel Widening
- Proposed Flood Storage Area

Maximum Flood Velocity (m/s)

- 0.0 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

CLIENT: REDROW

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SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD VELOCITY
0.1% AEP EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
NORMAL FLOW CONDITIONS (NC)

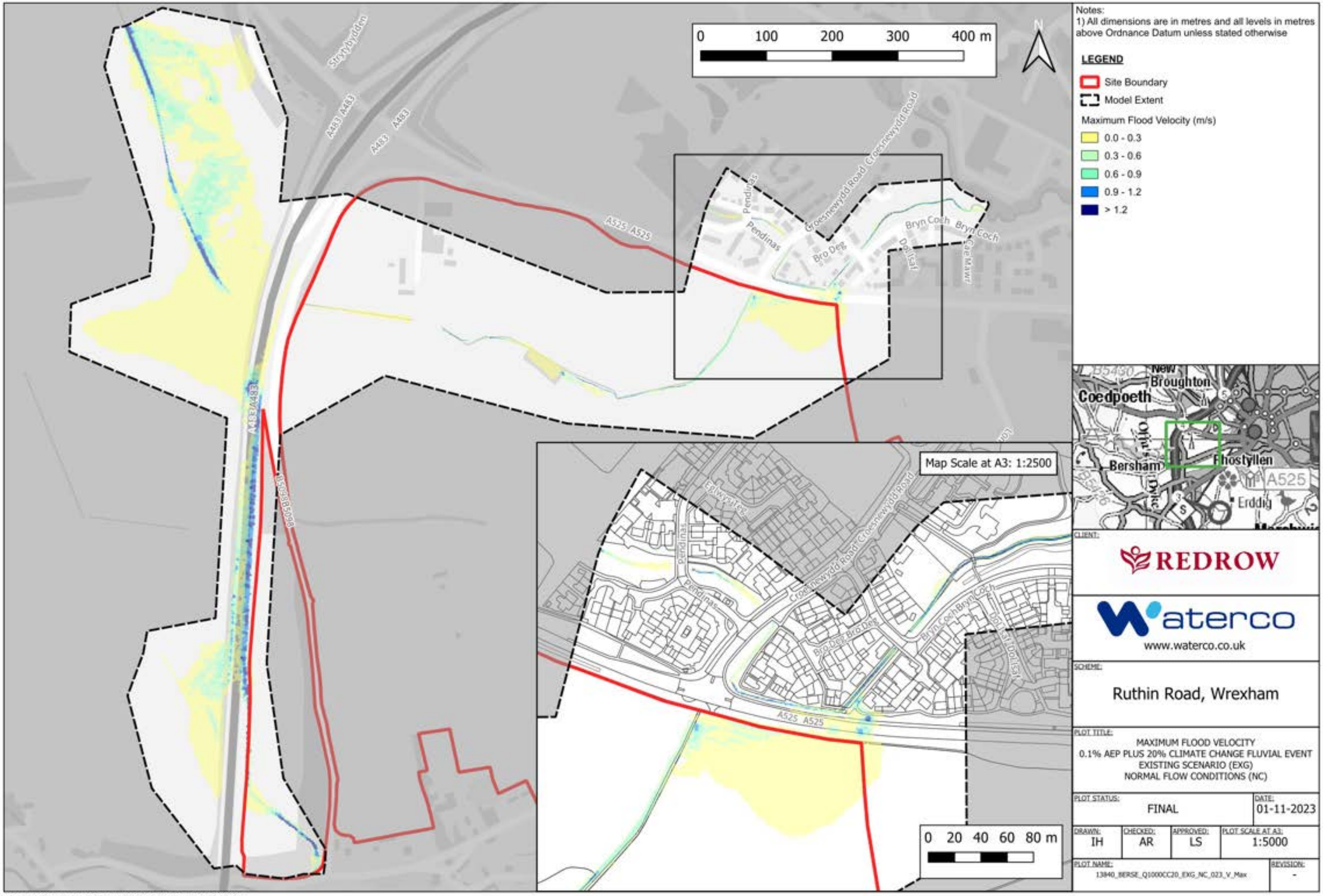
PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q1000_DEV_NC_023_V_Max

REVISION: -

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Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Model Extent

Maximum Flood Velocity (m/s)

- 0.0 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

CLIENT: REDROW

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www.waterco.co.uk

SCHEME: Ruthin Road, Wrexham

PLOT TITLE:
MAXIMUM FLOOD VELOCITY
0.1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
EXISTING SCENARIO (EXG)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q1000CC20_EXG_NC_023_V_Max

REVISION: -

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0 100 200 300 400 m

N

Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Model Extent
- Proposed Development
- Proposed Channel Widening
- Proposed Flood Storage Area

Maximum Flood Velocity (m/s)

- 0.0 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

Map Scale at A3: 1:2500

0 20 40 60 80 m



CLIENT: REDROW

waterco
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SCHEME: Ruthin Road, Wrexham

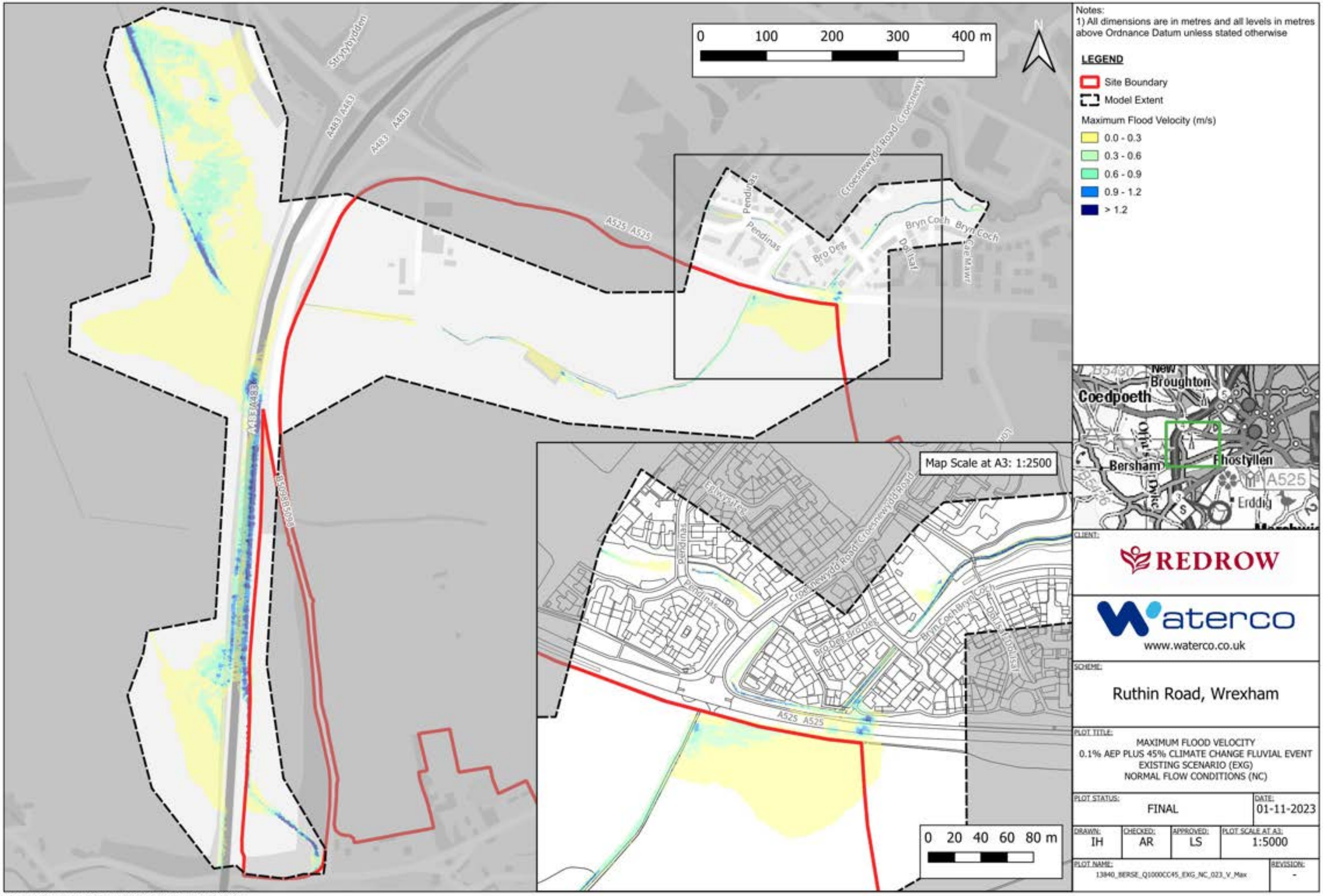
PLOT TITLE: MAXIMUM FLOOD VELOCITY
0.1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:			DATE:
FINAL			01-11-2023
DRAWN: IH	CHECKED: AR	APPROVED: LS	PLOT SCALE AT A3: 1:5000

PLOT NAME: 13840_BERSE_Q1000CC20_DEV_NC_023_V_Max

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Notes:
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LEGEND

- Site Boundary
- Model Extent

Maximum Flood Velocity (m/s)

- 0.0 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

REDROW

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SCHEME:
Ruthin Road, Wrexham

PLOT TITLE:
MAXIMUM FLOOD VELOCITY
0.1% AEP PLUS 45% CLIMATE CHANGE FLUVIAL EVENT
EXISTING SCENARIO (EXG)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:			DATE:
FINAL			01-11-2023
DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q1000CC45_EXG_NC_023_V_Max
REVISION: -

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0 100 200 300 400 m

N

Notes:
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LEGEND

- Site Boundary
- Model Extent
- Proposed Development
- Proposed Channel Widening
- Proposed Flood Storage Area

Maximum Flood Velocity (m/s)

- 0.0 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

Map Scale at A3: 1:2500

0 20 40 60 80 m



CLIENT: REDROW

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SCHEME: Ruthin Road, Wrexham

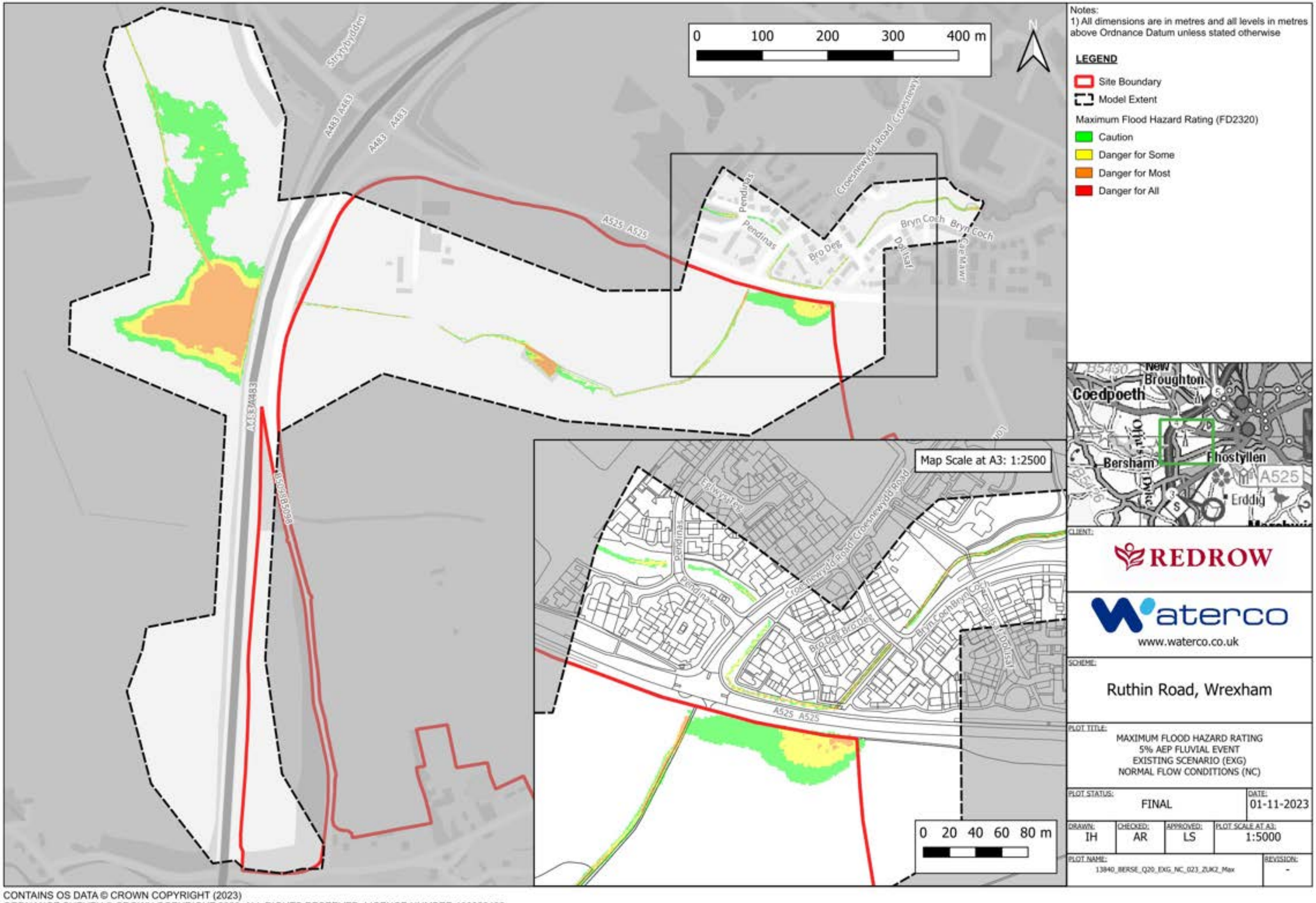
PLOT TITLE: MAXIMUM FLOOD VELOCITY
0.1% AEP PLUS 45% CLIMATE CHANGE FLUVIAL EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:			DATE:
FINAL			01-11-2023
DRAWN: IH	CHECKED: AR	APPROVED: LS	PLOT SCALE AT A3: 1:5000

PLOT NAME: 13840_BERSE_Q1000CC45_DEV_NC_023_V_Max

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Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Model Extent

Maximum Flood Hazard Rating (FD2320)

- Caution
- Danger for Some
- Danger for Most
- Danger for All

CLIENT: REDROW

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SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD HAZARD RATING
5% AEP FLUVIAL EVENT
EXISTING SCENARIO (EXG)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q20_EXG_NC_023_ZUK2_Max

REVISION: -

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0 100 200 300 400 m

N

Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Model Extent
- Proposed Development
- Proposed Channel Widening
- Proposed Flood Storage Area

Maximum Flood Hazard Rating (FD2320)

- Caution
- Danger for Some
- Danger for Most
- Danger for All

Map Scale at A3: 1:2500

0 20 40 60 80 m



CLIENT: REDROW

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www.waterco.co.uk

SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD HAZARD RATING
5% AEP FLUVIAL EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:			DATE:
FINAL			01-11-2023
DRAWN: IH	CHECKED: AR	APPROVED: LS	PLOT SCALE AT A3: 1:5000

PLOT NAME: 13840_BERSE_Q20_DEV_NC_023_ZUK2_Max

REVISION: -

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0 100 200 300 400 m

N

Notes:
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LEGEND

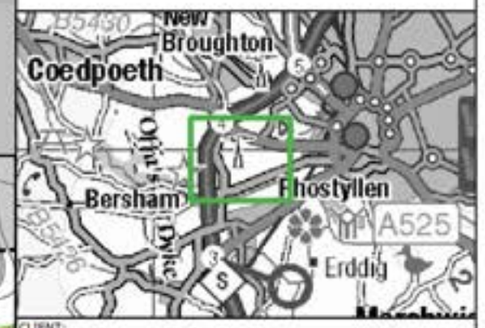
- Site Boundary
- Model Extent

Maximum Flood Hazard Rating (FD2320)

- Caution
- Danger for Some
- Danger for Most
- Danger for All

Map Scale at A3: 1:2500

0 20 40 60 80 m



CLIENT: REDROW

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SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD HAZARD RATING
1% AEP EVENT
EXISTING SCENARIO (EXG)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q100_EXG_NC_023_ZUK2_Max

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Notes:
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LEGEND

- Site Boundary
- Model Extent
- Proposed Development
- Proposed Channel Widening
- Proposed Flood Storage Area

Maximum Flood Hazard Rating (FD2320)

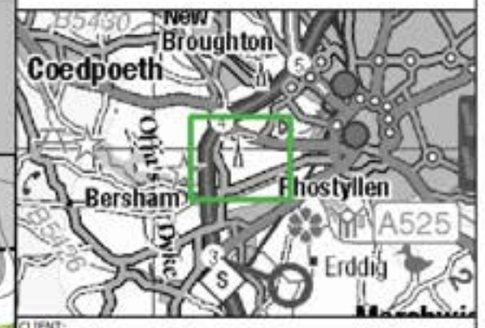
- Caution
- Danger for Some
- Danger for Most
- Danger for All

0 100 200 300 400 m

N

Map Scale at A3: 1:2500

0 20 40 60 80 m



CLIENT: REDROW

waterco
www.waterco.co.uk

SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD HAZARD RATING
1% AEP EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
NORMAL FLOW CONDITIONS (NC)

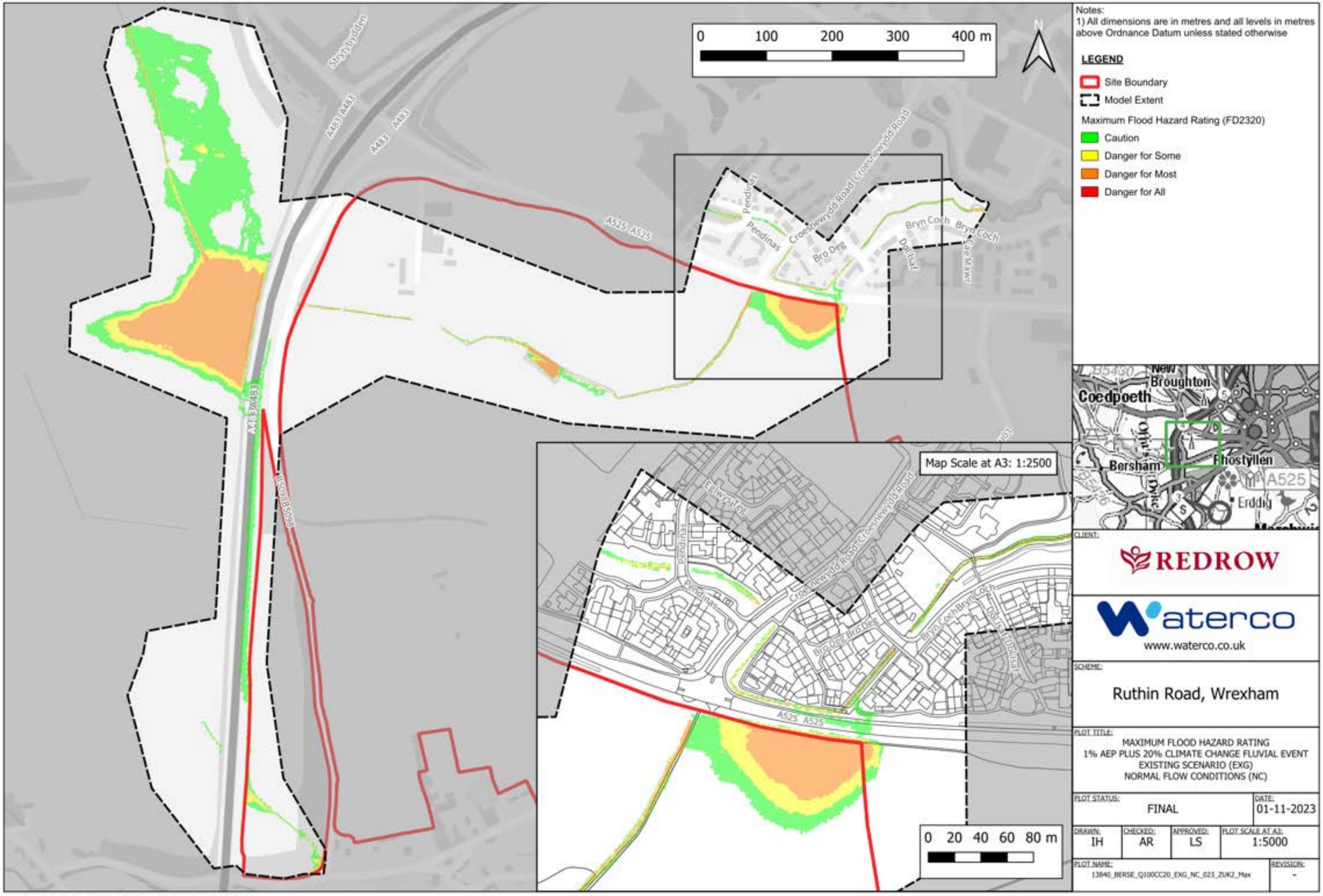
PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: L3840_BERSE_Q100_DEV_NC_023_ZUK2_Max

REVISION: -

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Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Model Extent

Maximum Flood Hazard Rating (FD2320)

- Caution
- Danger for Some
- Danger for Most
- Danger for All

CLIENT: REDROW

waterco
www.waterco.co.uk

SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD HAZARD RATING
1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
EXISTING SCENARIO (EXG)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q100CC20_EXG_NC_023_ZUK2_Max

REVISION: -

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0 100 200 300 400 m

N

Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Model Extent
- Proposed Development
- Proposed Channel Widening
- Proposed Flood Storage Area

Maximum Flood Hazard Rating (FD2320)

- Caution
- Danger for Some
- Danger for Most
- Danger for All

Map Scale at A3: 1:2500

0 20 40 60 80 m



CLIENT: REDROW

waterco
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SCHEME: Ruthin Road, Wrexham

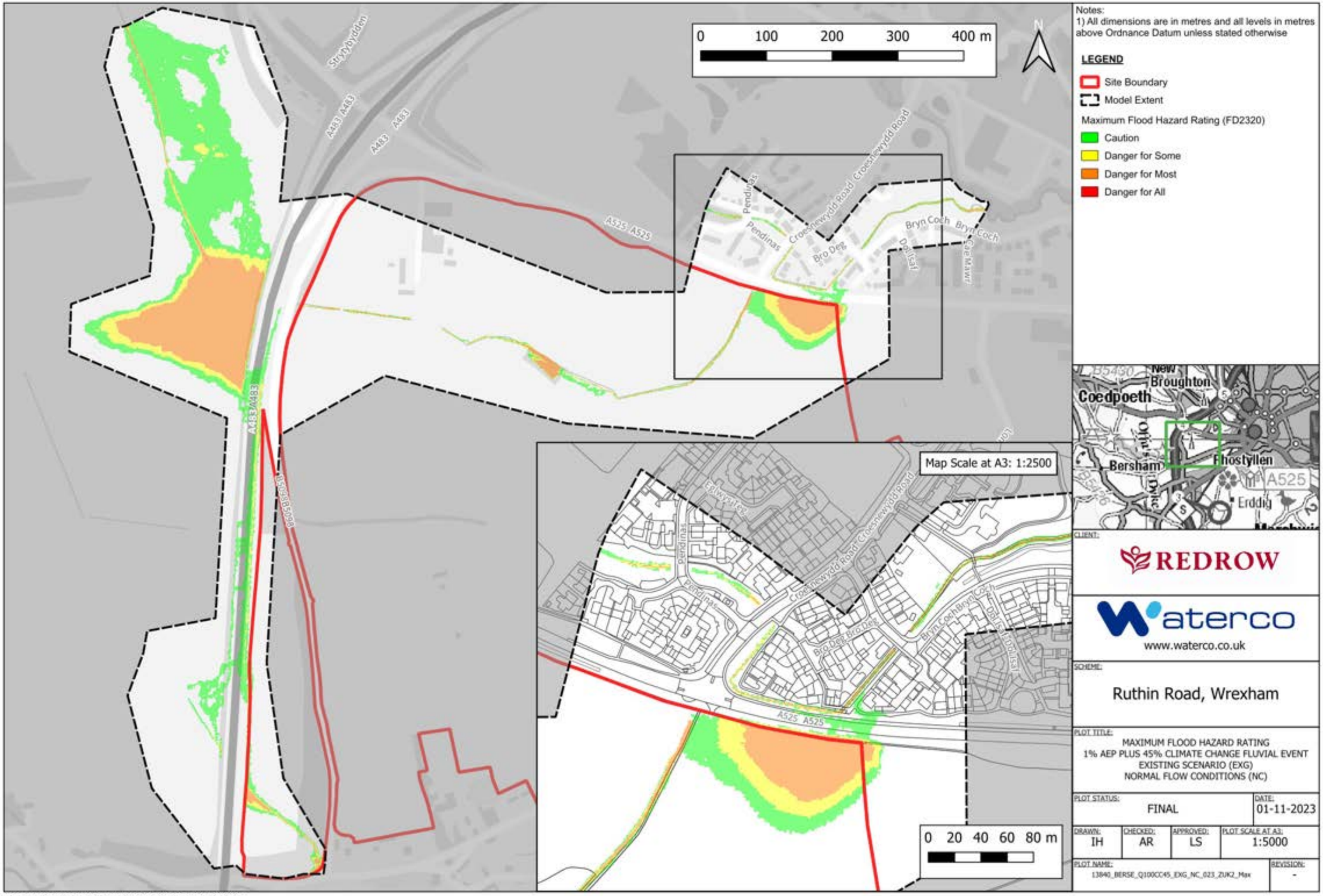
PLOT TITLE: MAXIMUM FLOOD HAZARD RATING
1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:			DATE:
FINAL			01-11-2023
DRAWN: IH	CHECKED: AR	APPROVED: LS	PLOT SCALE AT A3: 1:5000

PLOT NAME: 13840_BERSE_Q100CC20_DEV_NC_023_ZUK2_Max

REVISION: -

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Notes:
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LEGEND

- Site Boundary
- Model Extent

Maximum Flood Hazard Rating (FD2320)

- Caution
- Danger for Some
- Danger for Most
- Danger for All

CLIENT: REDROW

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SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD HAZARD RATING
1% AEP PLUS 45% CLIMATE CHANGE FLUVIAL EVENT
EXISTING SCENARIO (EXG)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:			DATE:
FINAL			01-11-2023
DRAWN: IH	CHECKED: AR	APPROVED: LS	PLOT SCALE AT A3: 1:5000

PLOT NAME: 13840_BERSE_Q100CC45_EXG_NC_023_ZUK2_Max
REVISION: -

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0 100 200 300 400 m

N

Notes:
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LEGEND

- Site Boundary
- Model Extent
- Proposed Development
- Proposed Channel Widening
- Proposed Flood Storage Area

Maximum Flood Hazard Rating (FD2320)

- Caution
- Danger for Some
- Danger for Most
- Danger for All

Map Scale at A3: 1:2500

0 20 40 60 80 m



CLIENT: REDROW

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SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD HAZARD RATING
1% AEP PLUS 45% CLIMATE CHANGE FLUVIAL EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:			DATE:
FINAL			01-11-2023
DRAWN: IH	CHECKED: AR	APPROVED: LS	PLOT SCALE AT A3: 1:5000

PLOT NAME: 13840_BERSE_Q100CC45_DEV_NC_023_ZUK2_Max

REVISION: -

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0 100 200 300 400 m

N

Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

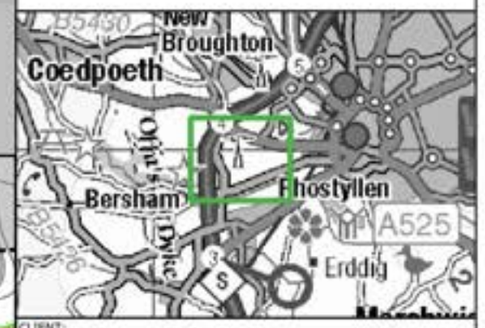
- Site Boundary
- Model Extent

Maximum Flood Hazard Rating (FD2320)

- Caution
- Danger for Some
- Danger for Most
- Danger for All

Map Scale at A3: 1:2500

0 20 40 60 80 m



CLIENT: REDROW

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SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD HAZARD RATING
0.1% AEP EVENT
EXISTING SCENARIO (EXG)
NORMAL FLOW CONDITIONS (NC)

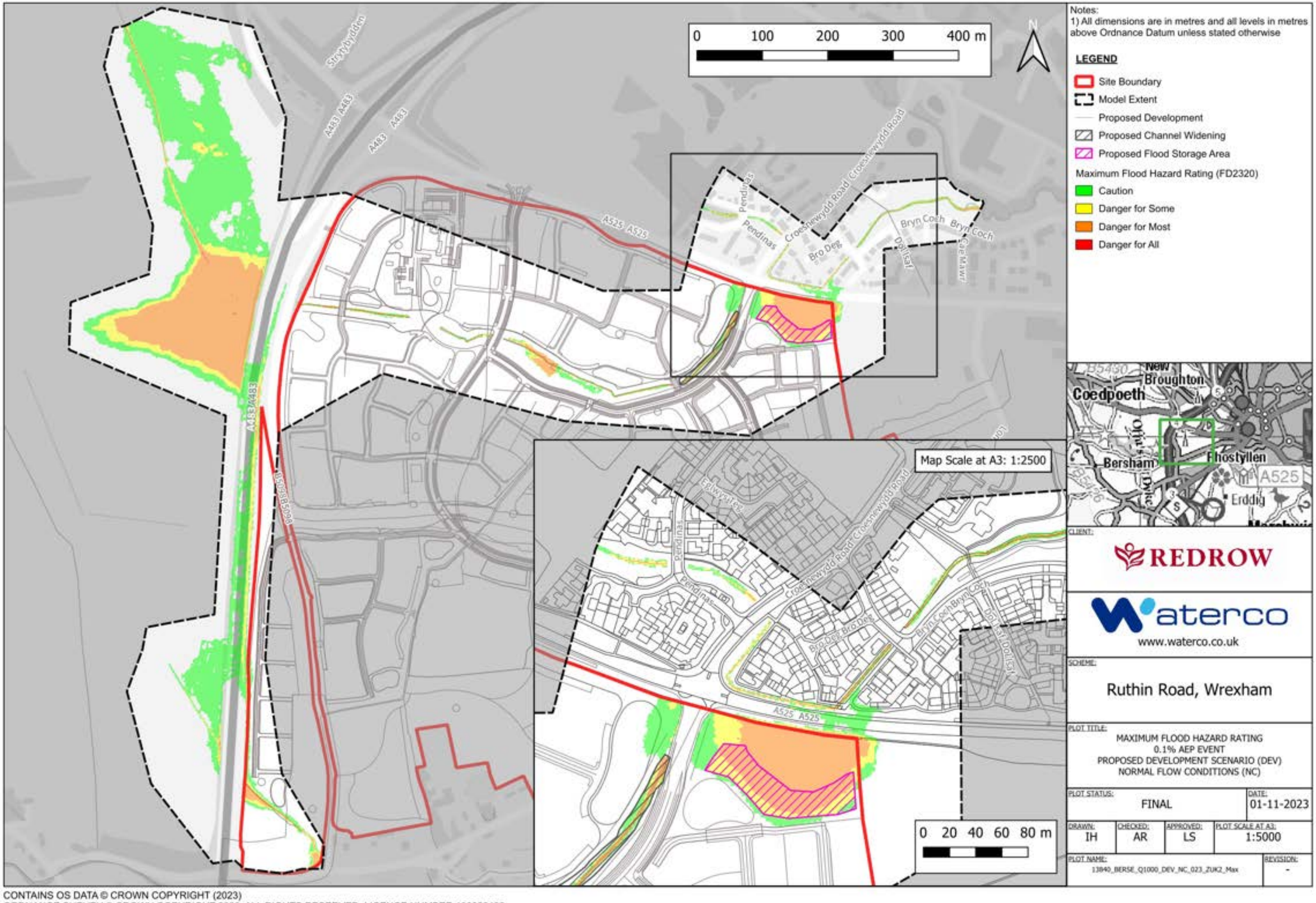
PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q1000_EXG_NC_023_ZUK2_Max

REVISION: -

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Notes:
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LEGEND

- Site Boundary
- Model Extent
- Proposed Development
- Proposed Channel Widening
- Proposed Flood Storage Area

Maximum Flood Hazard Rating (FD2320)

- Caution
- Danger for Some
- Danger for Most
- Danger for All

CLIENT: REDROW

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SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD HAZARD RATING
0.1% AEP EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
NORMAL FLOW CONDITIONS (NC)

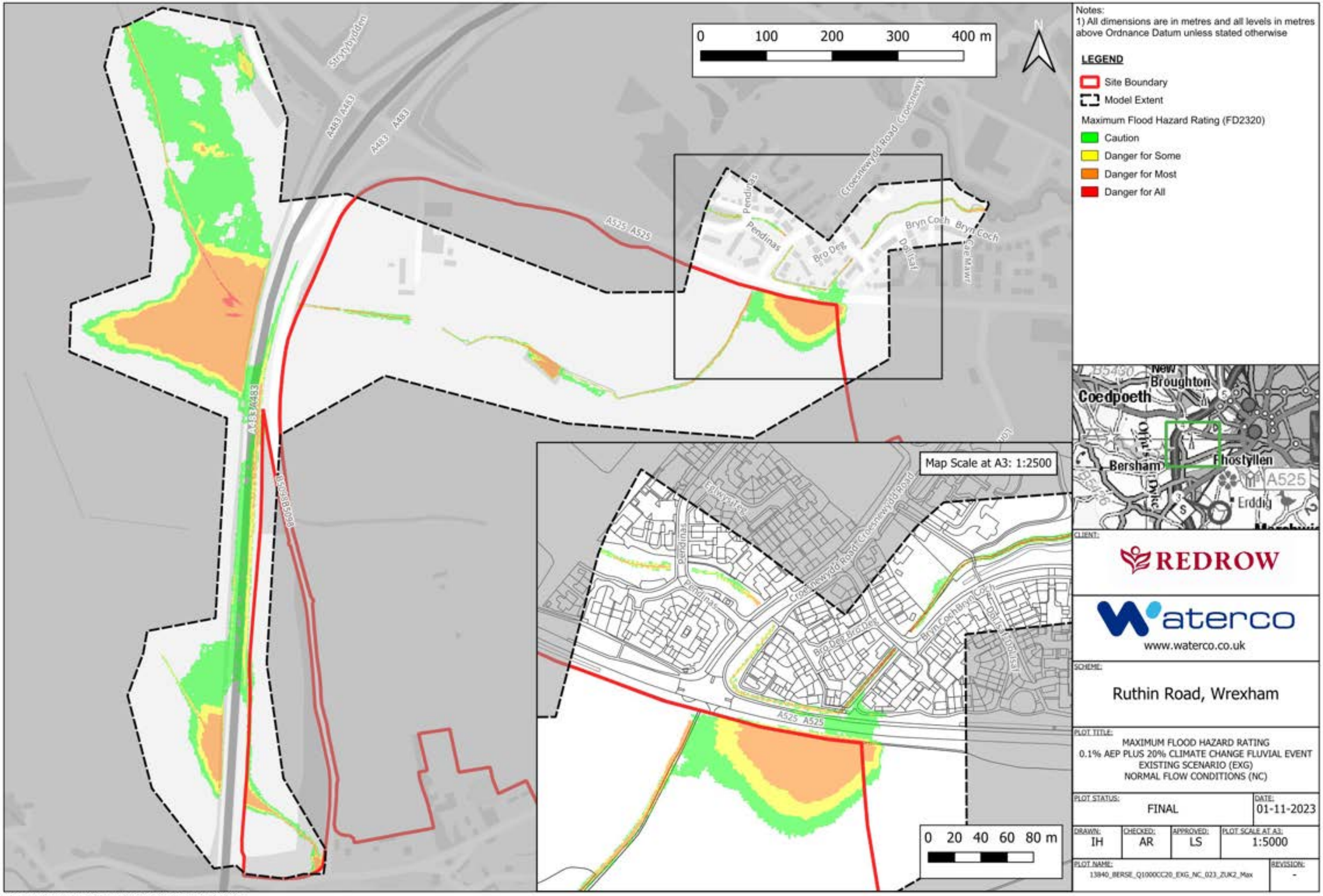
PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q1000_DEV_NC_023_ZUK2_Max

REVISION: -

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Notes:
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LEGEND

- Site Boundary
- Model Extent

Maximum Flood Hazard Rating (FD2320)

- Caution
- Danger for Some
- Danger for Most
- Danger for All

CLIENT: REDROW

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SCHEME: Ruthin Road, Wrexham

PLOT TITLE:
MAXIMUM FLOOD HAZARD RATING
0.1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
EXISTING SCENARIO (EXG)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q1000CC20_EXG_NC_023_ZUK2_Max

REVISION: -

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0 100 200 300 400 m

N

Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Model Extent
- Proposed Development
- Proposed Channel Widening
- Proposed Flood Storage Area

Maximum Flood Hazard Rating (FD2320)

- Caution
- Danger for Some
- Danger for Most
- Danger for All

Map Scale at A3: 1:2500

0 20 40 60 80 m



CLIENT: REDROW

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SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD HAZARD RATING
0.1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q1000CC20_DEV_NC_023_ZUK2_Max

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0 100 200 300 400 m

N

Notes:
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LEGEND

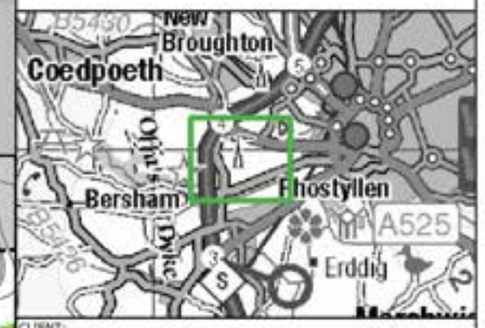
- Site Boundary
- Model Extent

Maximum Flood Hazard Rating (FD2320)

- Caution
- Danger for Some
- Danger for Most
- Danger for All

Map Scale at A3: 1:2500

0 20 40 60 80 m



CLIENT: REDROW

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SCHEME: Ruthin Road, Wrexham

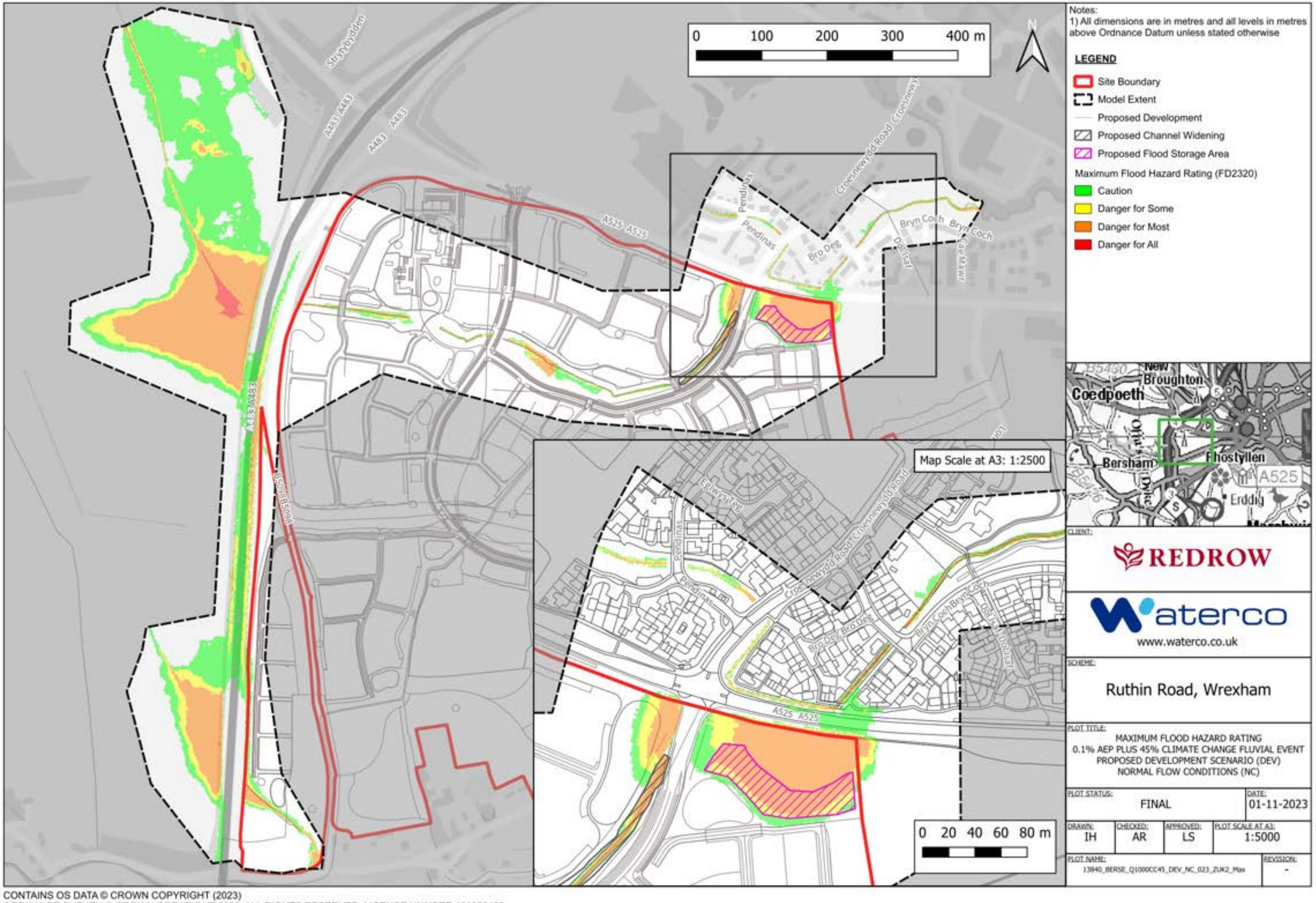
PLOT TITLE: MAXIMUM FLOOD HAZARD RATING
0.1% AEP PLUS 45% CLIMATE CHANGE FLUVIAL EVENT
EXISTING SCENARIO (EXG)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:			DATE:
FINAL			01-11-2023
DRAWN: IH	CHECKED: AR	APPROVED: LS	PLOT SCALE AT A3: 1:5000

PLOT NAME: 13840_BERSE_Q1000CC45_EXG_NC_023_ZUK2_Max

REVISION: -

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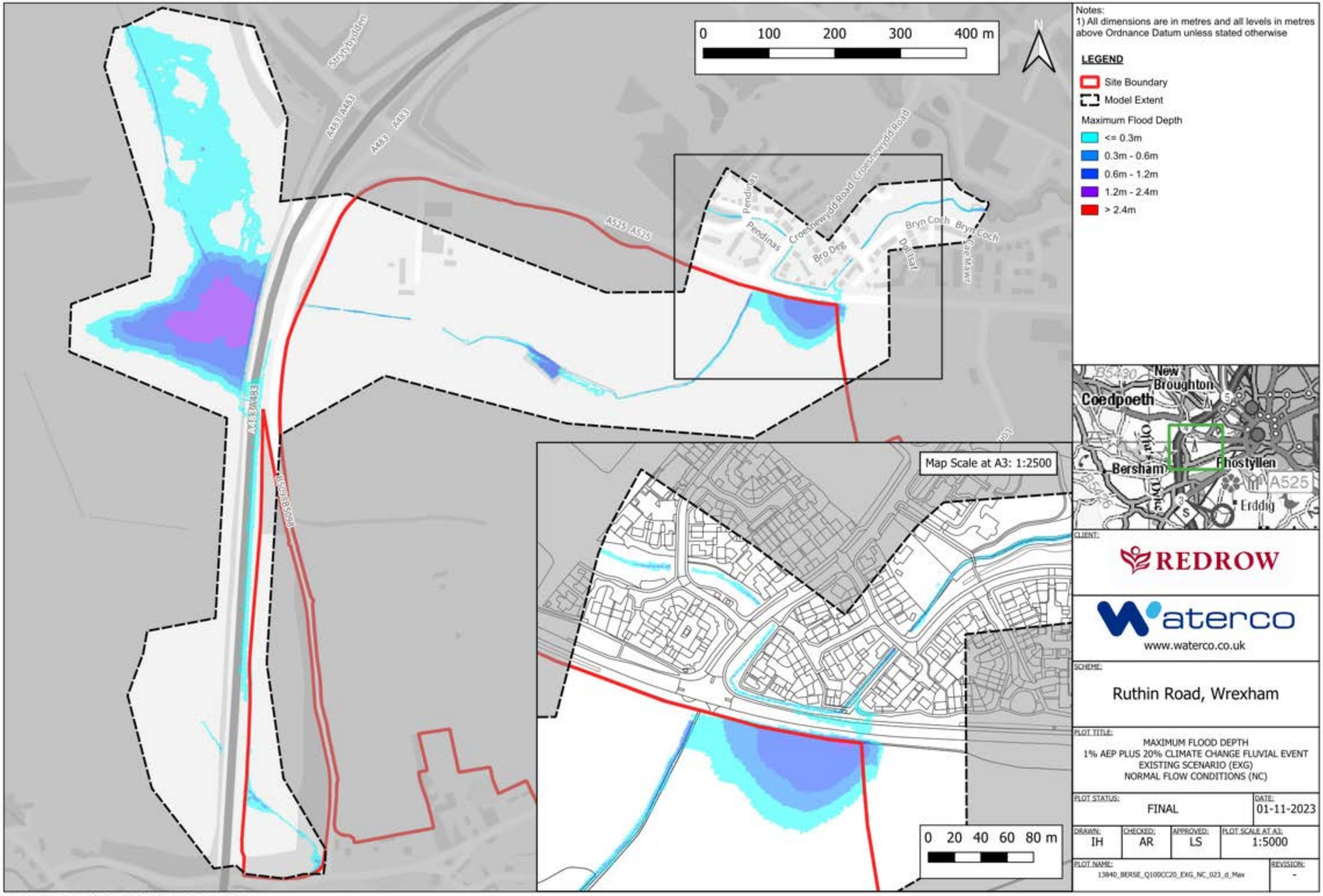
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SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD HAZARD RATING
0.1% AEP PLUS 45% CLIMATE CHANGE FLUVIAL EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:			DATE:
FINAL			01-11-2023
DRAWN: IH	CHECKED: AR	APPROVED: LS	PLOT SCALE AT A3: 1:5000

PLOT NAME: 13840_BERSE_Q1000CC45_DEV_NC_023_ZUK2_Max
REVISION: -



Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Model Extent

Maximum Flood Depth

- <= 0.3m
- 0.3m - 0.6m
- 0.6m - 1.2m
- 1.2m - 2.4m
- > 2.4m

CLIENT: REDROW

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SCHEME: Ruthin Road, Wrexham

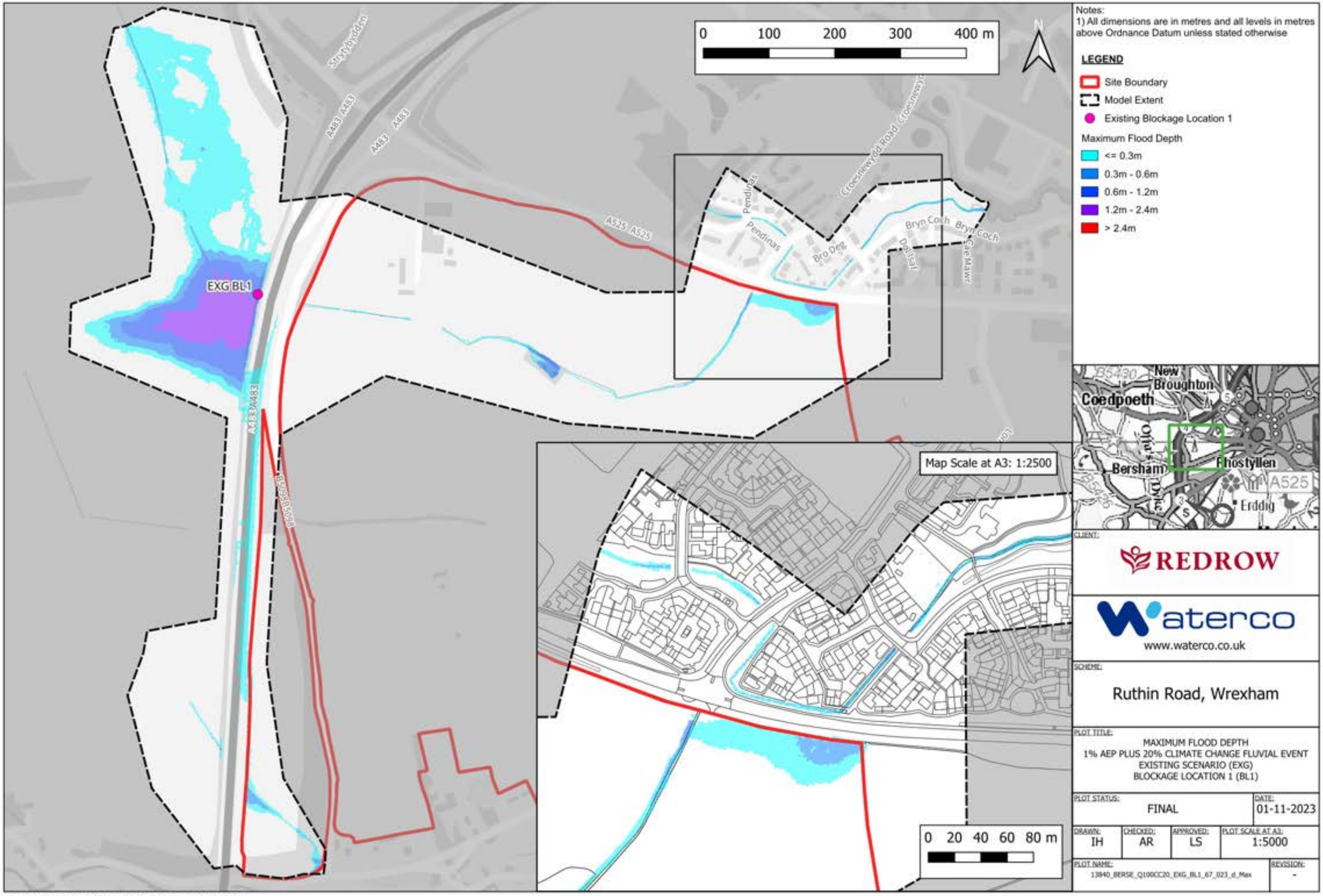
PLOT TITLE:
MAXIMUM FLOOD DEPTH
1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
EXISTING SCENARIO (EXG)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME:	REVISION:
13840_BERSE_Q100CC20_EXG_NC_023_d_Max	-

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SCHEME: Ruthin Road, Wrexham

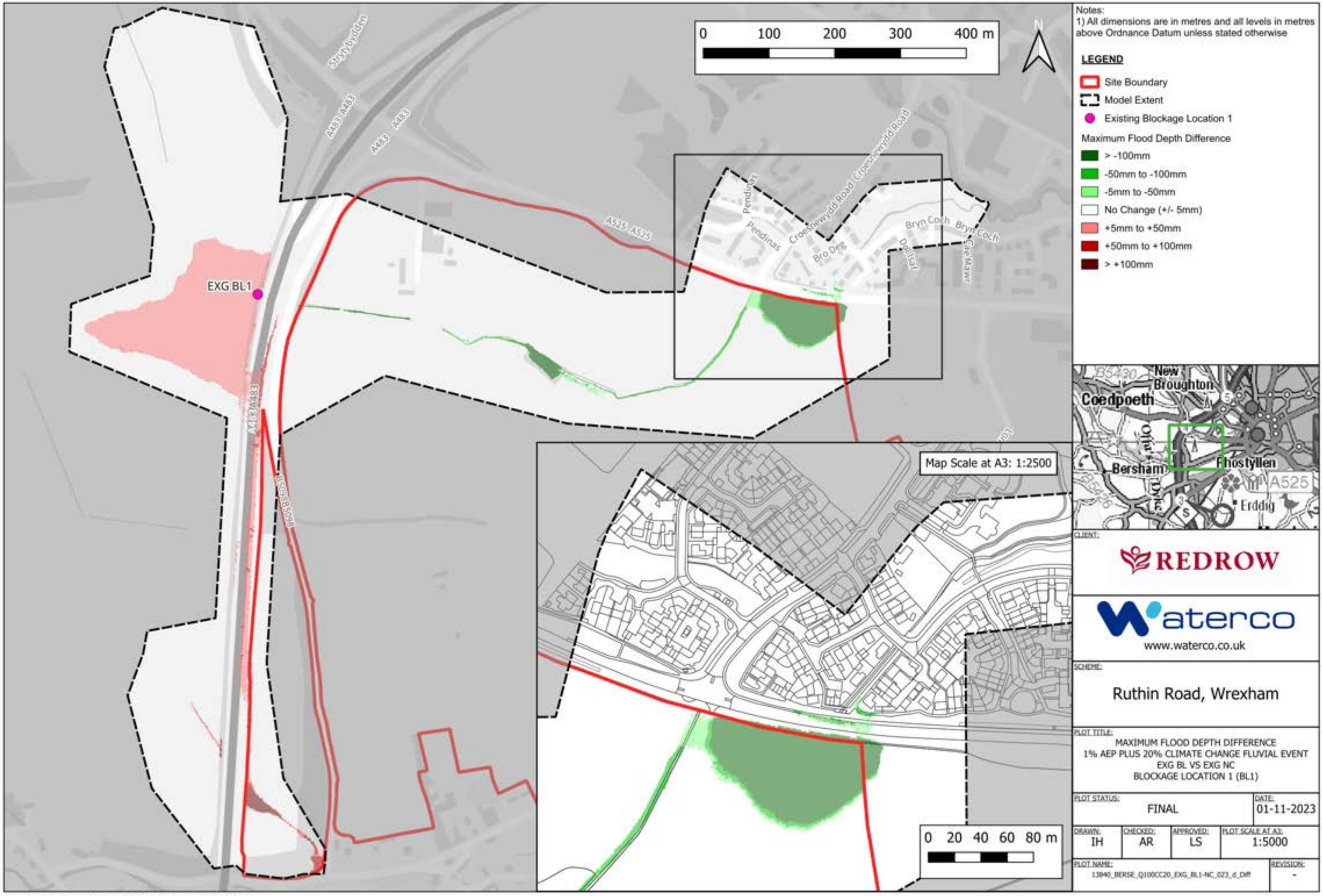
PLOT TITLE: MAXIMUM FLOOD DEPTH
1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
EXISTING SCENARIO (EXG)
BLOCKAGE LOCATION 1 (BL1)

PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q100CC20_EXG_BL1_67_023_d_Max
REVISION: -

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Notes:
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LEGEND

- Site Boundary
- Model Extent
- Existing Blockage Location 1

Maximum Flood Depth Difference

- > -100mm
- -50mm to -100mm
- -5mm to -50mm
- No Change (+/- 5mm)
- +5mm to +50mm
- +50mm to +100mm
- > +100mm

CLIENT: REDROW

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SCHEME: Ruthin Road, Wrexham

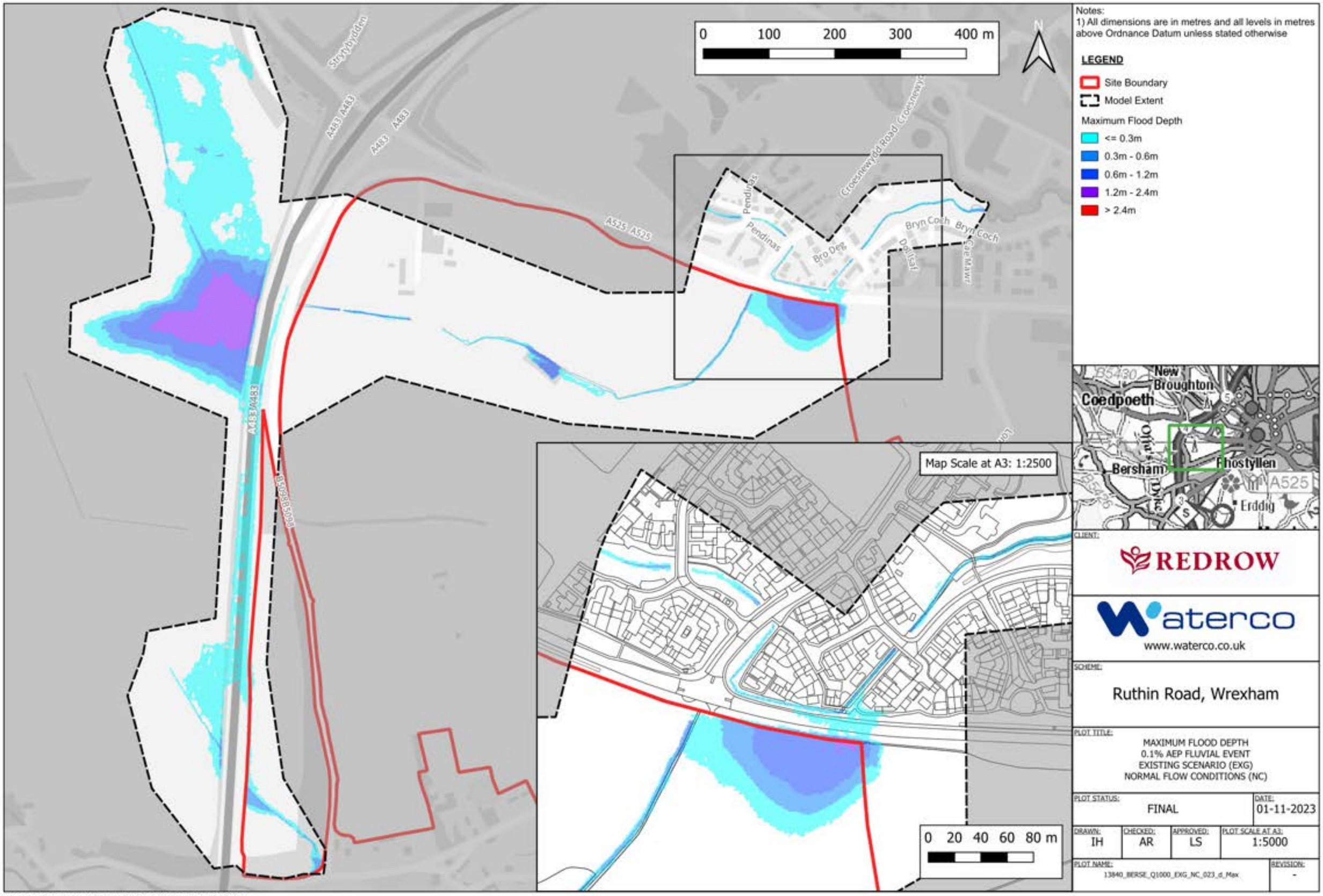
PLOT TITLE: MAXIMUM FLOOD DEPTH DIFFERENCE
1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
EXG BL VS EXG NC
BLOCKAGE LOCATION 1 (BL1)

PLOT STATUS:	DATE:
FINAL	01-11-2023

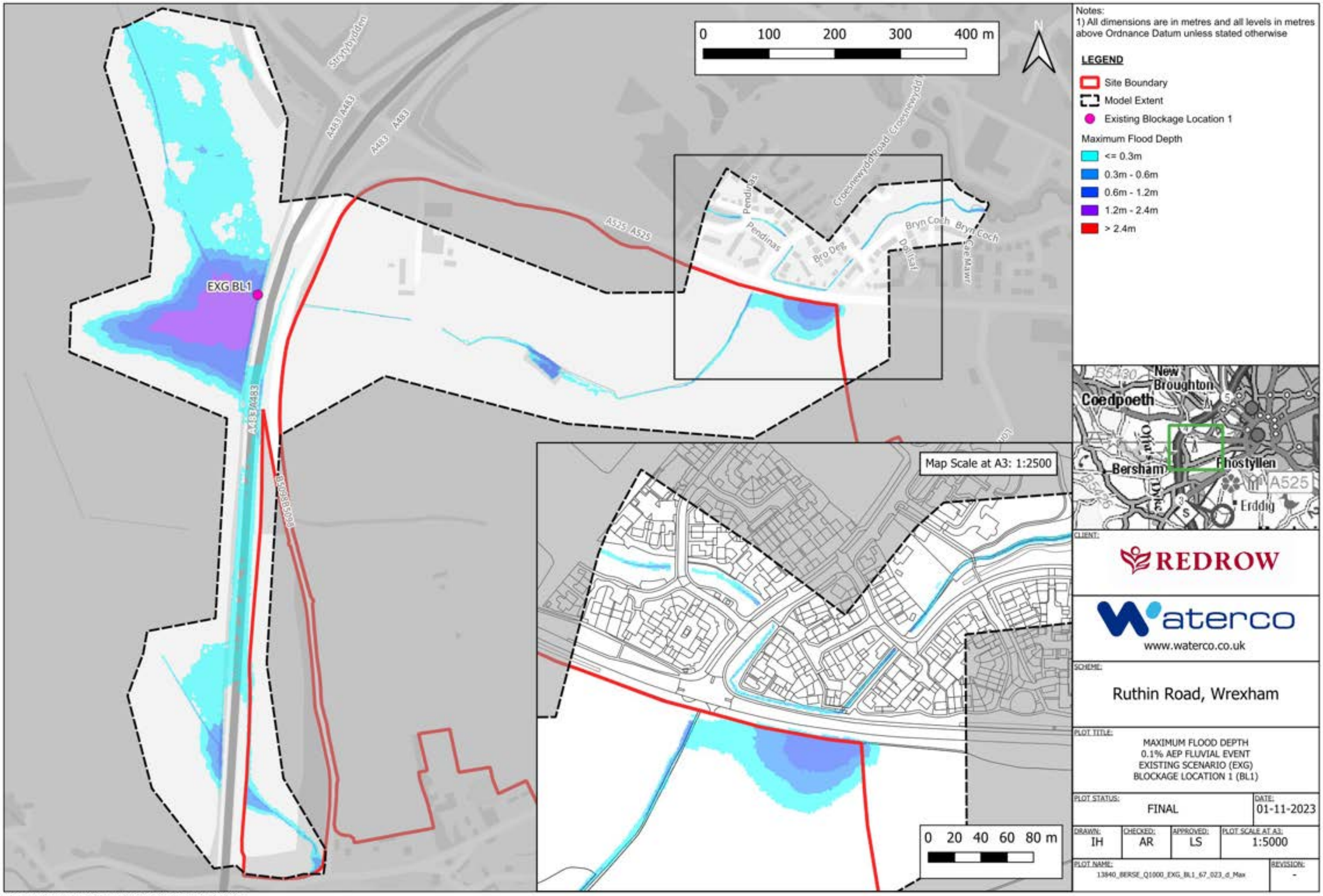
DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q100CC20_EXG_BL1-NC_023_d_Diff
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Notes:
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LEGEND

- Site Boundary
- Model Extent
- Existing Blockage Location 1

Maximum Flood Depth

- <= 0.3m
- 0.3m - 0.6m
- 0.6m - 1.2m
- 1.2m - 2.4m
- > 2.4m

CLIENT: REDROW

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SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD DEPTH
0.1% AEP FLUVIAL EVENT
EXISTING SCENARIO (EXG)
BLOCKAGE LOCATION 1 (BL1)

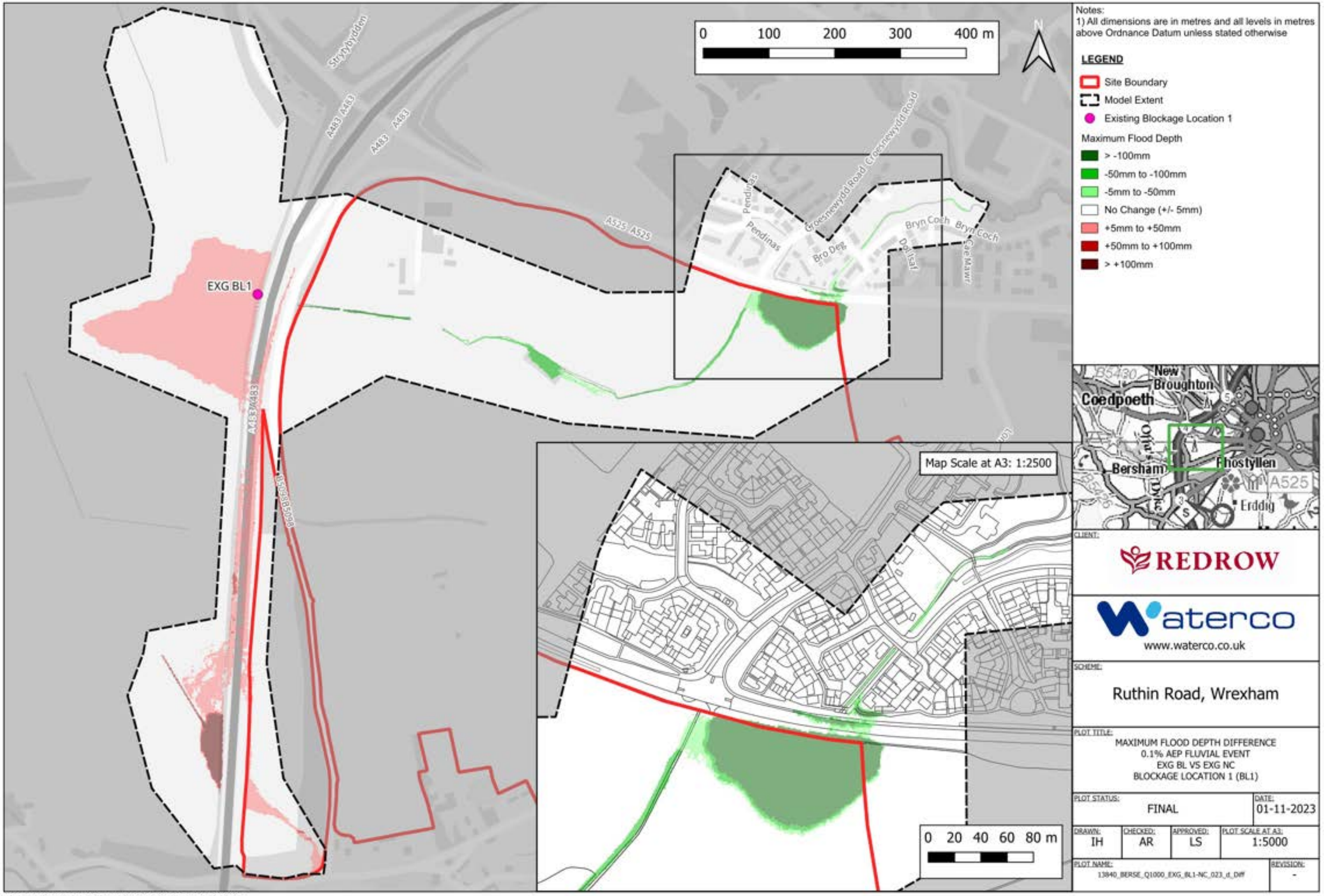
PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q1000_EXG_BL1_67_023_d_Max

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Notes:
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LEGEND

- Site Boundary
- Model Extent
- Existing Blockage Location 1

Maximum Flood Depth

- > -100mm
- -50mm to -100mm
- -5mm to -50mm
- No Change (+/- 5mm)
- +5mm to +50mm
- +50mm to +100mm
- > +100mm

CLIENT: REDROW

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SCHEME: Ruthin Road, Wrexham

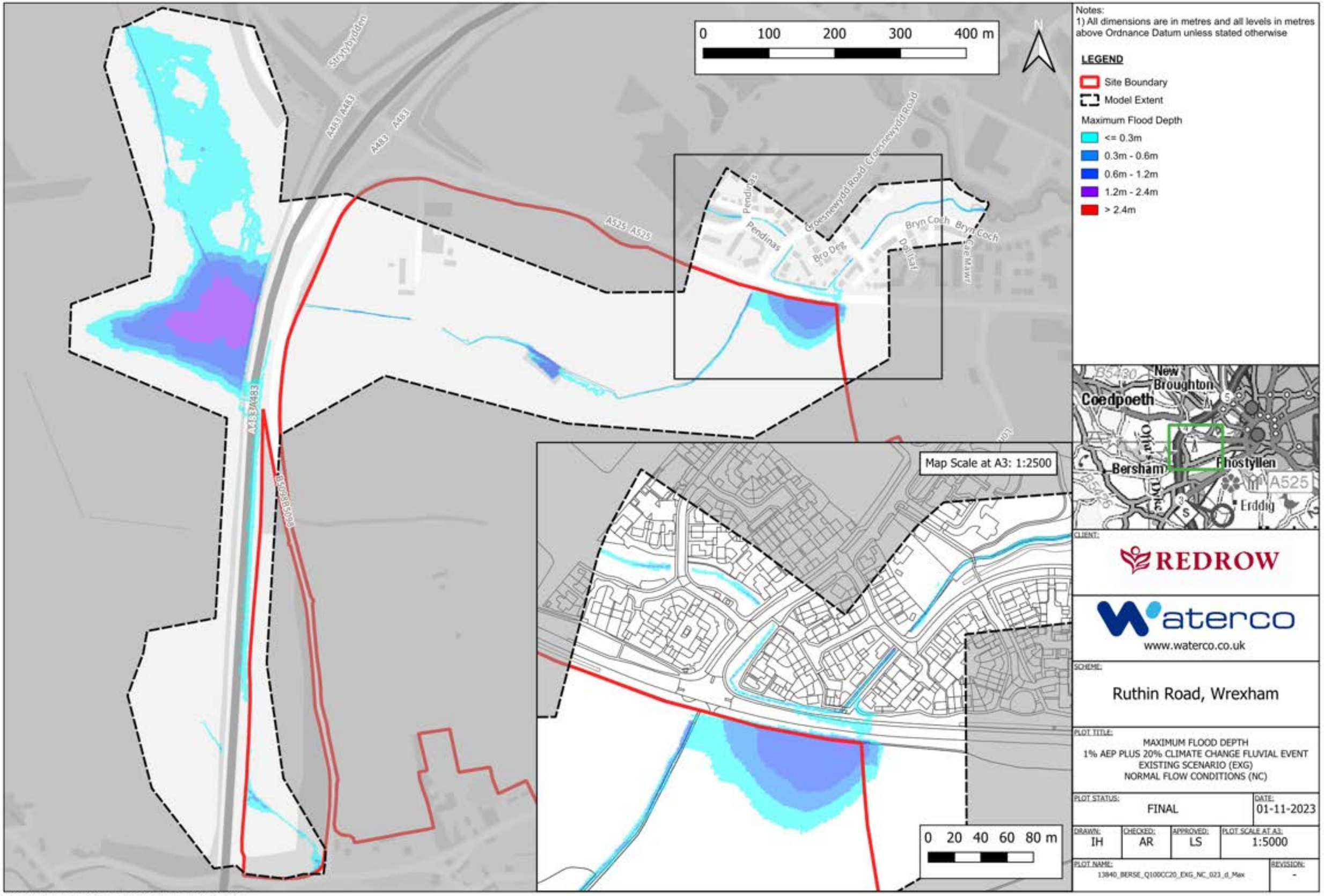
PLOT TITLE:
MAXIMUM FLOOD DEPTH DIFFERENCE
0.1% AEP FLUVIAL EVENT
EXG BL VS EXG NC
BLOCKAGE LOCATION 1 (BL1)

PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q1000_EXG_BL1-NC_023_d_Diff
REVISION: -

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SCHEME: Ruthin Road, Wrexham

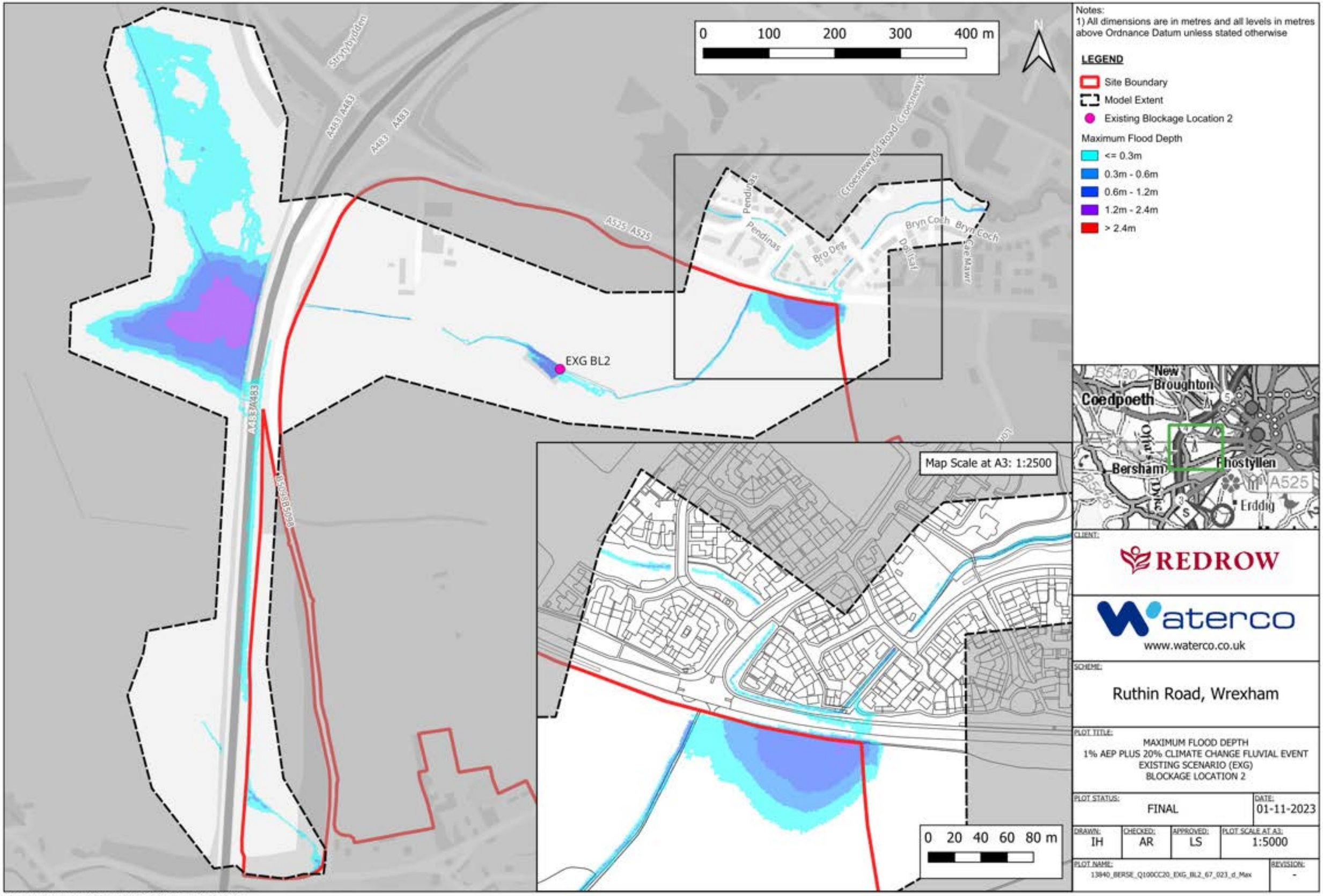
PLOT TITLE: MAXIMUM FLOOD DEPTH
1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
EXISTING SCENARIO (EXG)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:		DATE:
FINAL		01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q100CC20_EXG_NC_023_d_Max
REVISION: -

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Notes:
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LEGEND

- Site Boundary
- Model Extent
- Existing Blockage Location 2

Maximum Flood Depth Difference

- > -100mm
- -50mm to -100mm
- -5mm to -50mm
- No Change (+/- 5mm)
- +5mm to +50mm
- +50mm to +100mm
- > +100mm

0 100 200 300 400 m

N

EXG BL2

Map Scale at A3: 1:2500

0 20 40 60 80 m



CLIENT: REDROW

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SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD DEPTH DIFFERENCE
1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
EXG BL VS EXG NC
BLOCKAGE LOCATION 2

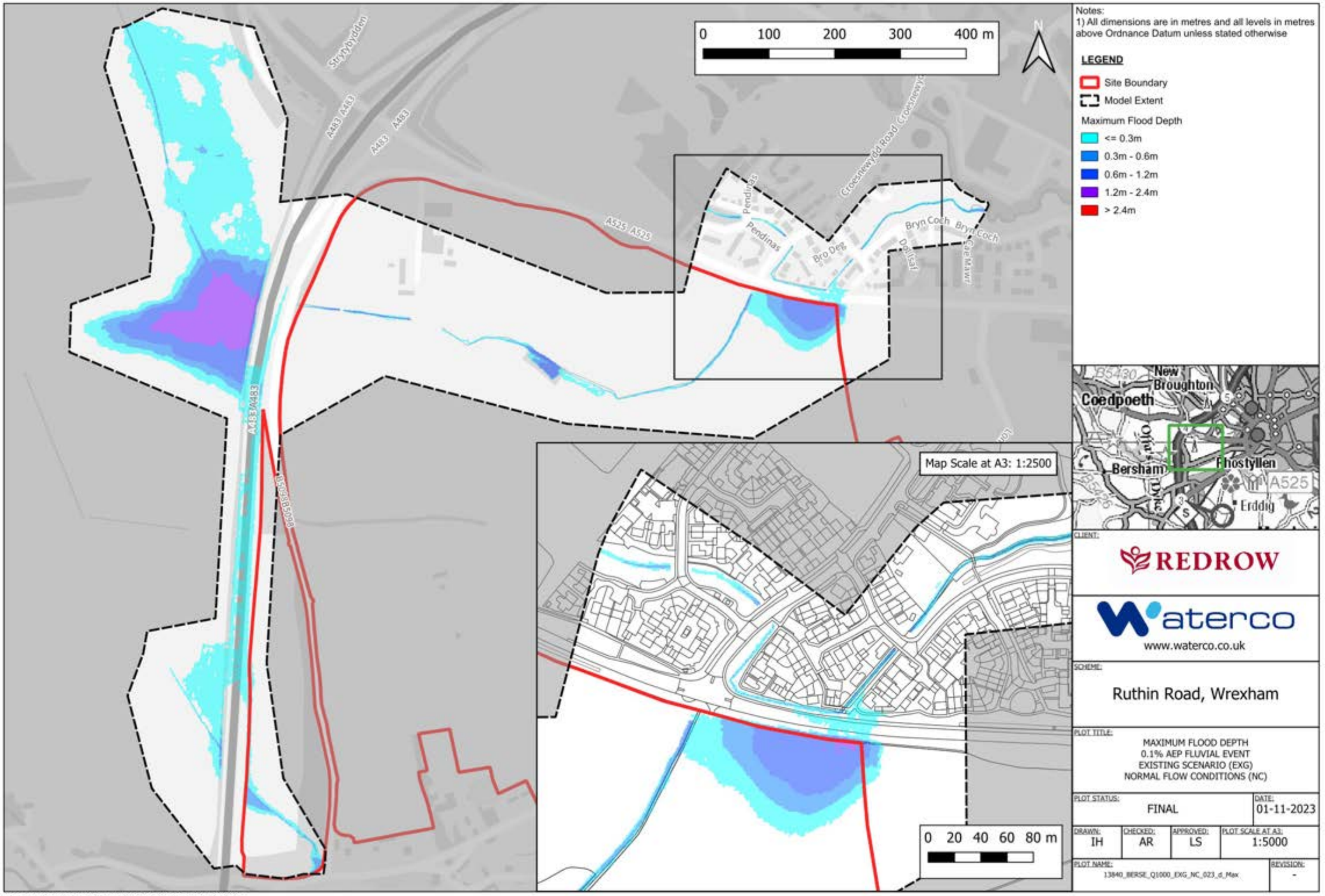
PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

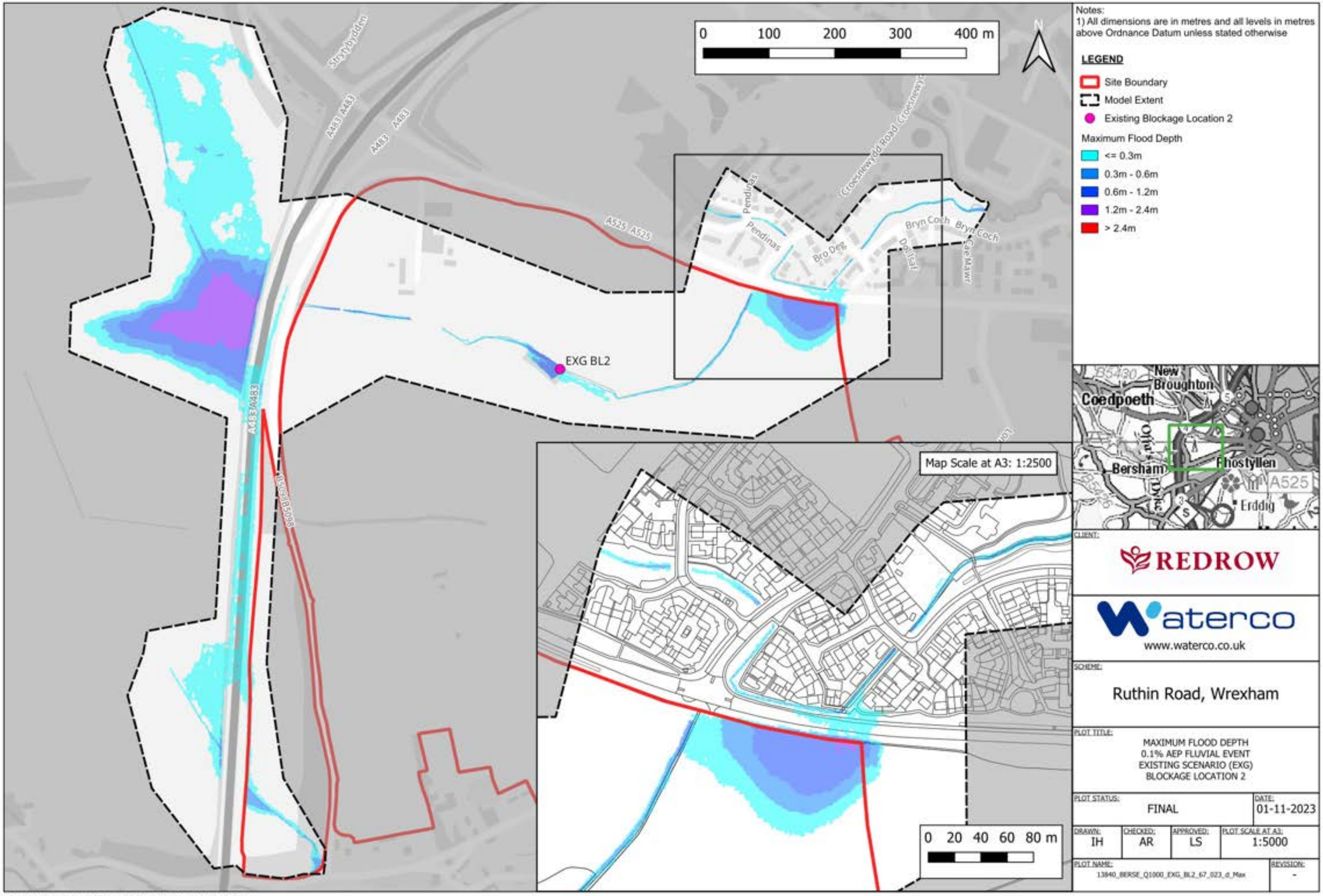
PLOT NAME: 13840_BERSE_Q100CC20_EXG_BL2-NC_023_d_Diff

REVISION: -

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SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD DEPTH
0.1% AEP FLUVIAL EVENT
EXISTING SCENARIO (EXG)
BLOCKAGE LOCATION 2

PLOT STATUS:			DATE:
FINAL			01-11-2023
DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q1000_EXG_BL2_67_023_d_Max
REVISION: -

Notes:
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LEGEND

- Site Boundary
- Model Extent
- Existing Blockage Location 2

Maximum Flood Depth Difference

- > -100mm
- -50mm to -100mm
- -5mm to -50mm
- No Change (+/- 5mm)
- +5mm to +50mm
- +50mm to +100mm
- > +100mm

0 100 200 300 400 m

N

EXG BL2

Map Scale at A3: 1:2500

0 20 40 60 80 m



CLIENT: REDROW

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SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD DEPTH DIFFERENCE
0.1% AEP FLUVIAL EVENT
EXG BL VS EXG NC
BLOCKAGE LOCATION 2

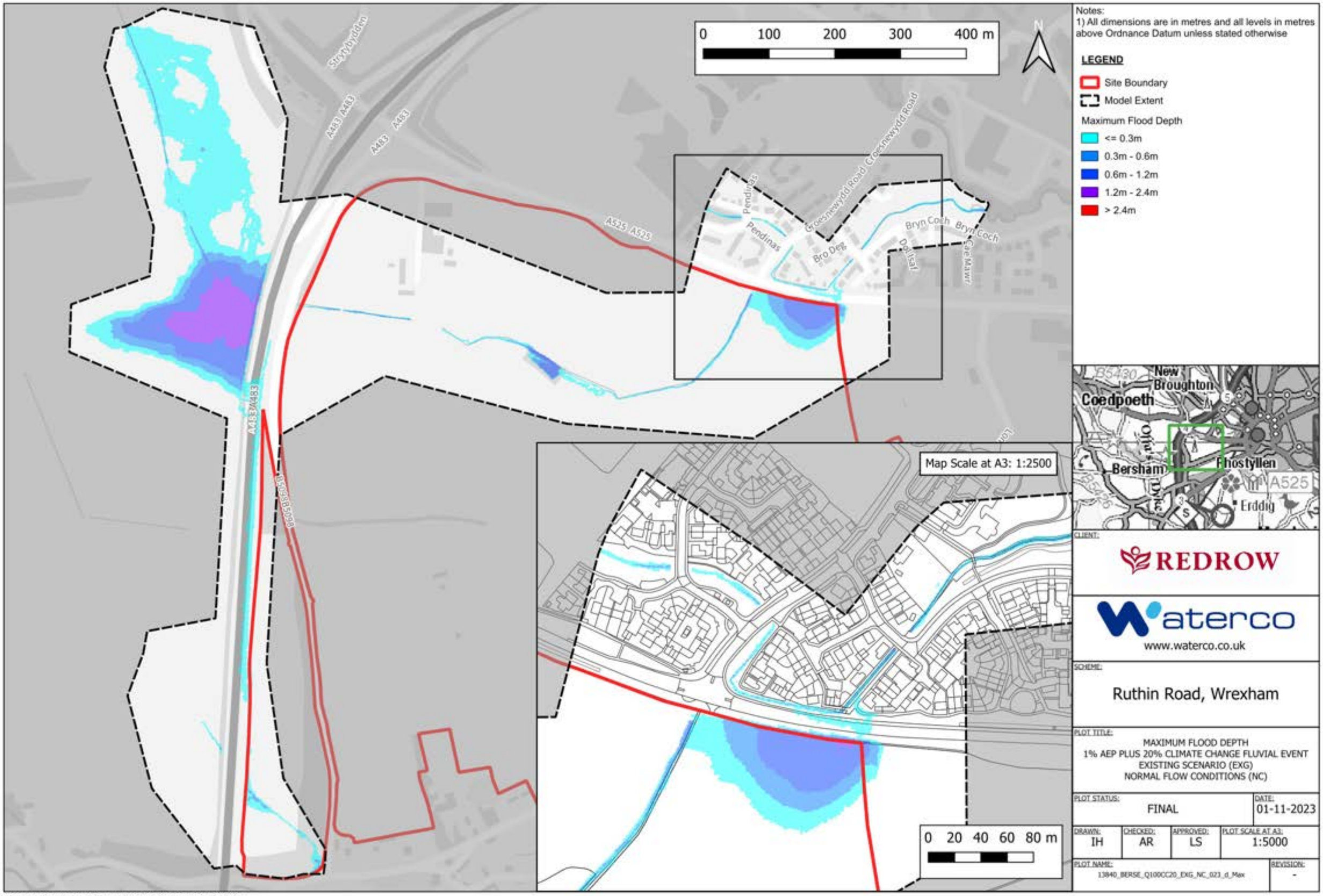
PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q1000_EXG_BL2-NC_023_d_Diff

REVISION: -

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Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Model Extent

Maximum Flood Depth

- <= 0.3m
- 0.3m - 0.6m
- 0.6m - 1.2m
- 1.2m - 2.4m
- > 2.4m

CLIENT: REDROW

waterco
www.waterco.co.uk

SCHEME: Ruthin Road, Wrexham

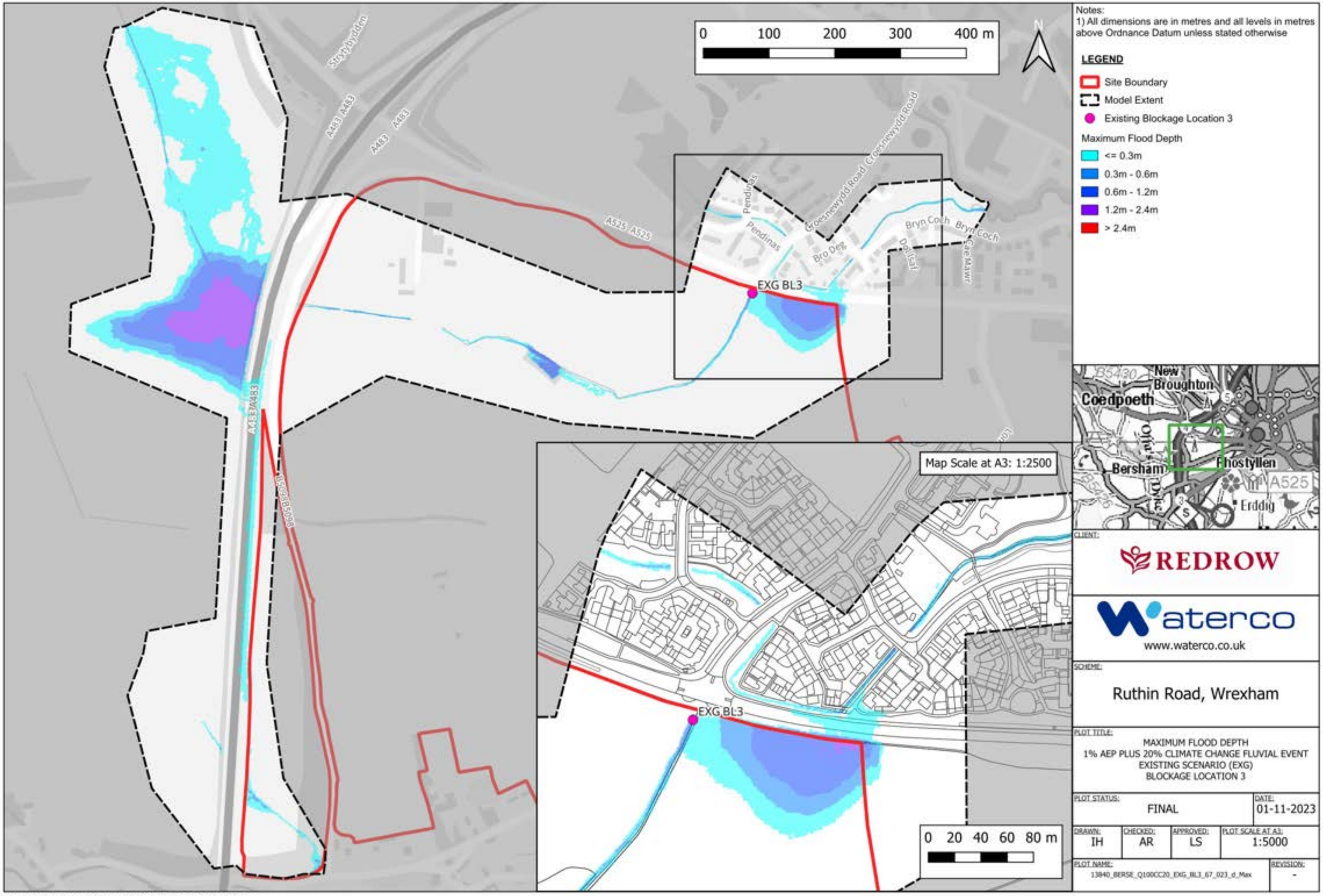
PLOT TITLE: MAXIMUM FLOOD DEPTH
1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
EXISTING SCENARIO (EXG)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q100CC20_EXG_NC_023_d_Max
REVISION: -

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CLIENT: REDROW

waterco
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SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD DEPTH
1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
EXISTING SCENARIO (EXG)
BLOCKAGE LOCATION 3

PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13940_BERSE_Q100CC20_EXG_BL3_67_023_d_Max
REVISION: -

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Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Model Extent
- Existing Blockage Location 3

Maximum Flood Depth Difference

- > -100mm
- -50mm to -100mm
- -5mm to -50mm
- No Change (+/- 5mm)
- +5mm to +50mm
- +50mm to +100mm
- > +100mm

0 100 200 300 400 m

N

EXG BL3

Map Scale at A3: 1:2500

EXG BL3

0 20 40 60 80 m



CLIENT: REDROW

waterco
www.waterco.co.uk

SCHEME: Ruthin Road, Wrexham

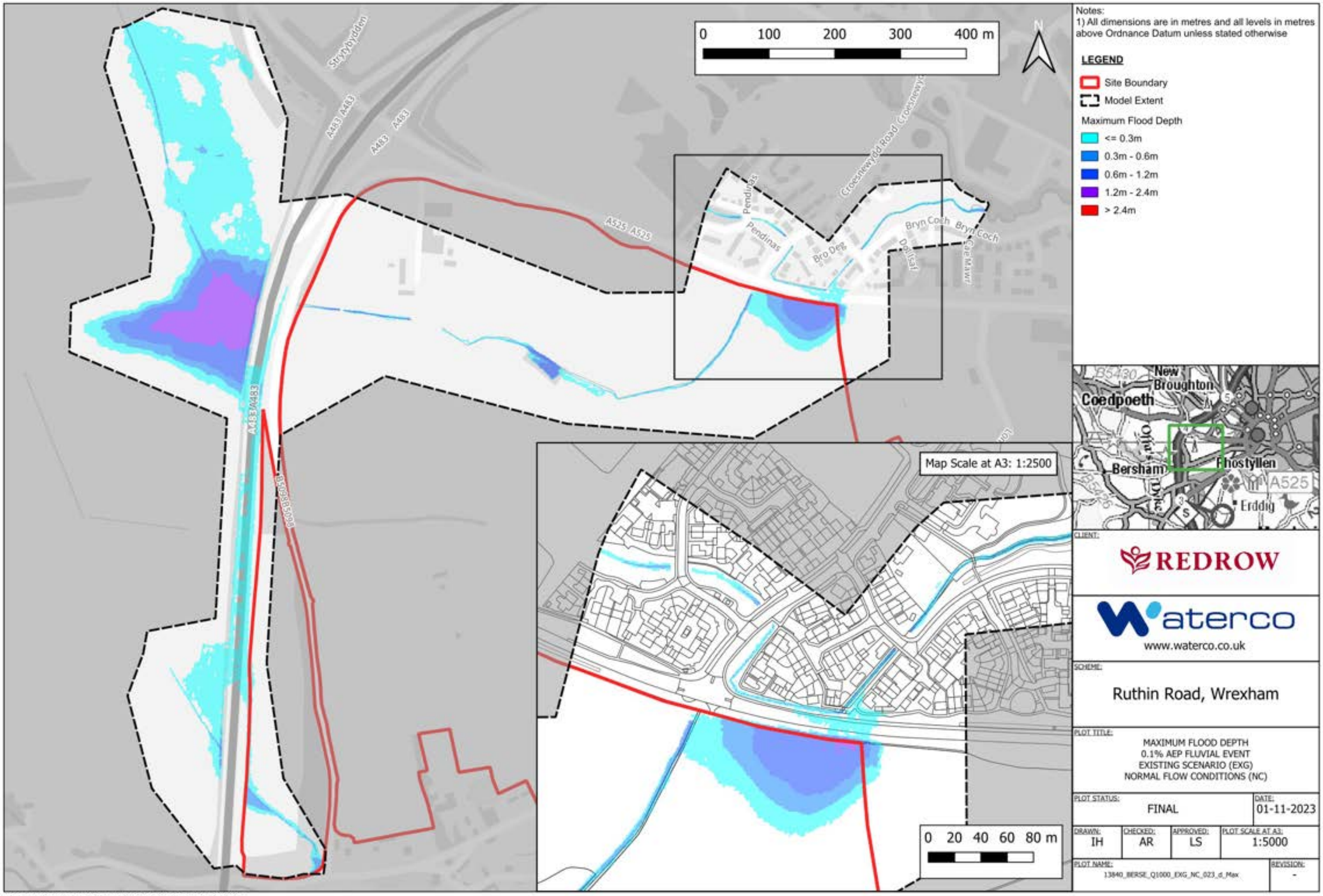
PLOT TITLE: MAXIMUM FLOOD DEPTH DIFFERENCE
1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
EXG BL VS EXG NC
BLOCKAGE LOCATION 3

PLOT STATUS:			DATE:
FINAL			01-11-2023
DRAWN: IH	CHECKED: AR	APPROVED: LS	PLOT SCALE AT A3: 1:5000

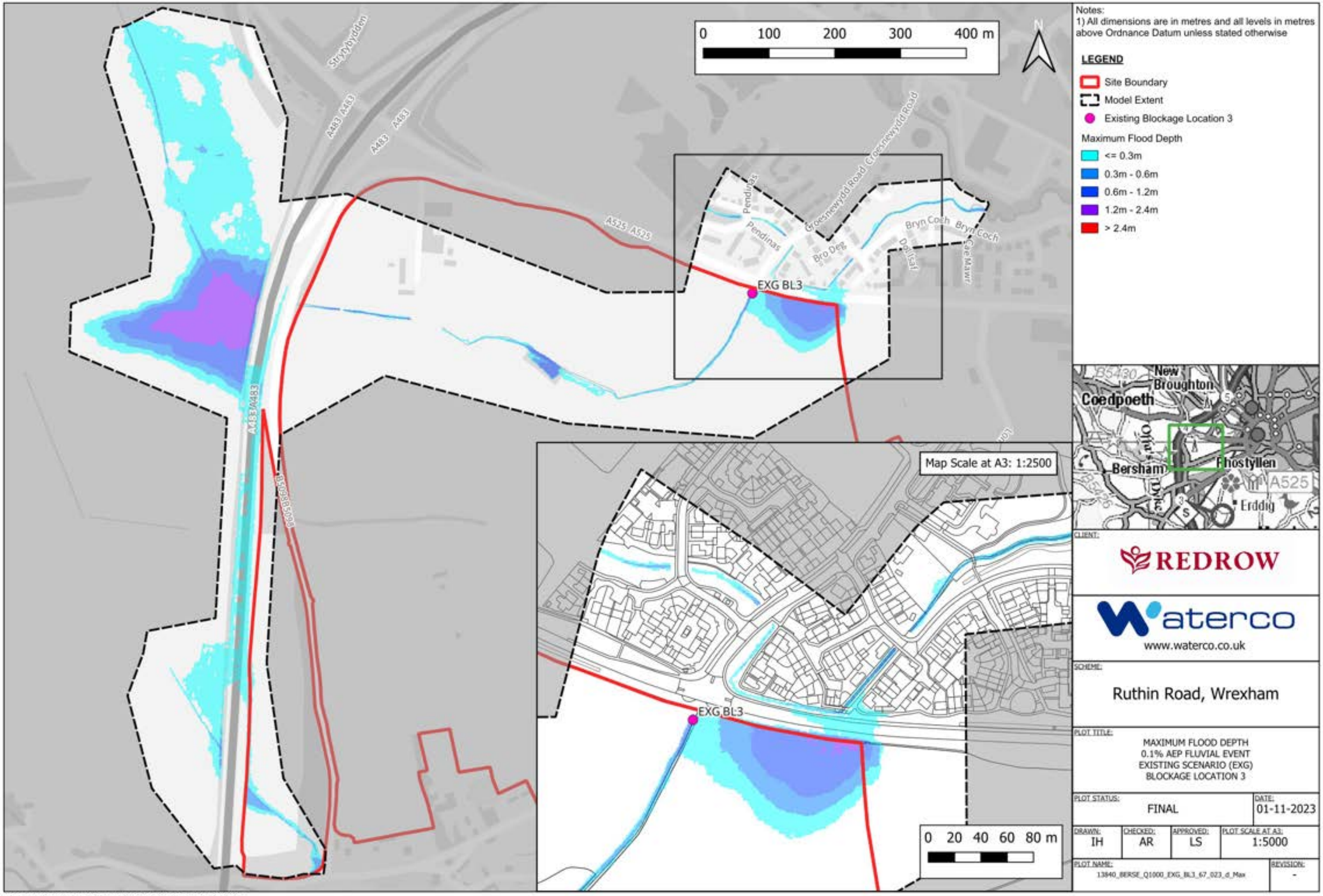
PLOT NAME: 13840_BERSE_Q100CC20_EXG_BL3-NC_023_d_Diff

REVISION: -

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CLIENT: REDROW

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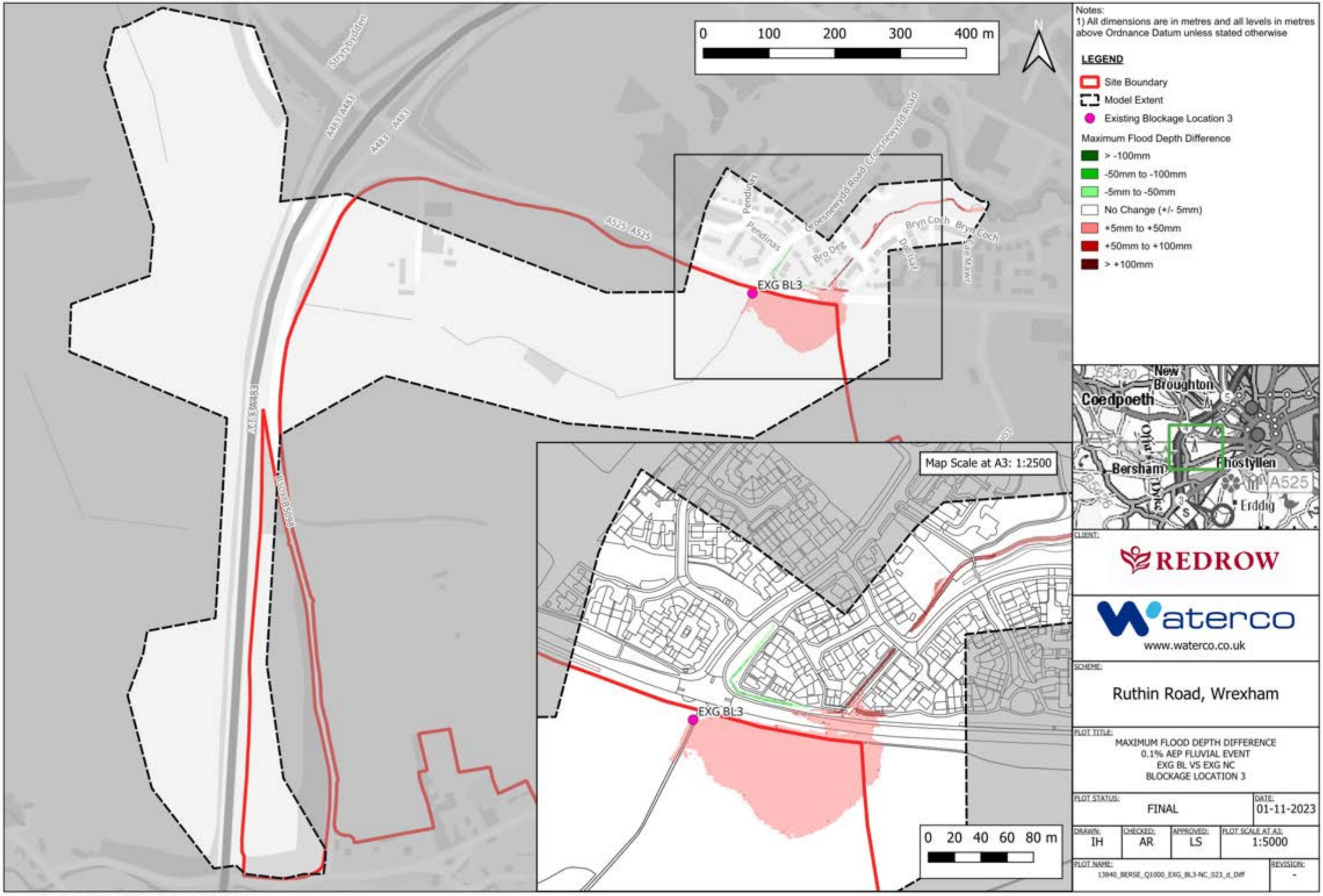
SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD DEPTH
0.1% AEP FLUVIAL EVENT
EXISTING SCENARIO (EXG)
BLOCKAGE LOCATION 3

PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q1000_EXG_BL3_67_023_d_Max
REVISION: -



Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Model Extent
- Existing Blockage Location 3

Maximum Flood Depth Difference

- > -100mm
- -50mm to -100mm
- -5mm to -50mm
- No Change (+/- 5mm)
- +5mm to +50mm
- +50mm to +100mm
- > +100mm

CLIENT: REDROW

waterco
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SCHEME: Ruthin Road, Wrexham

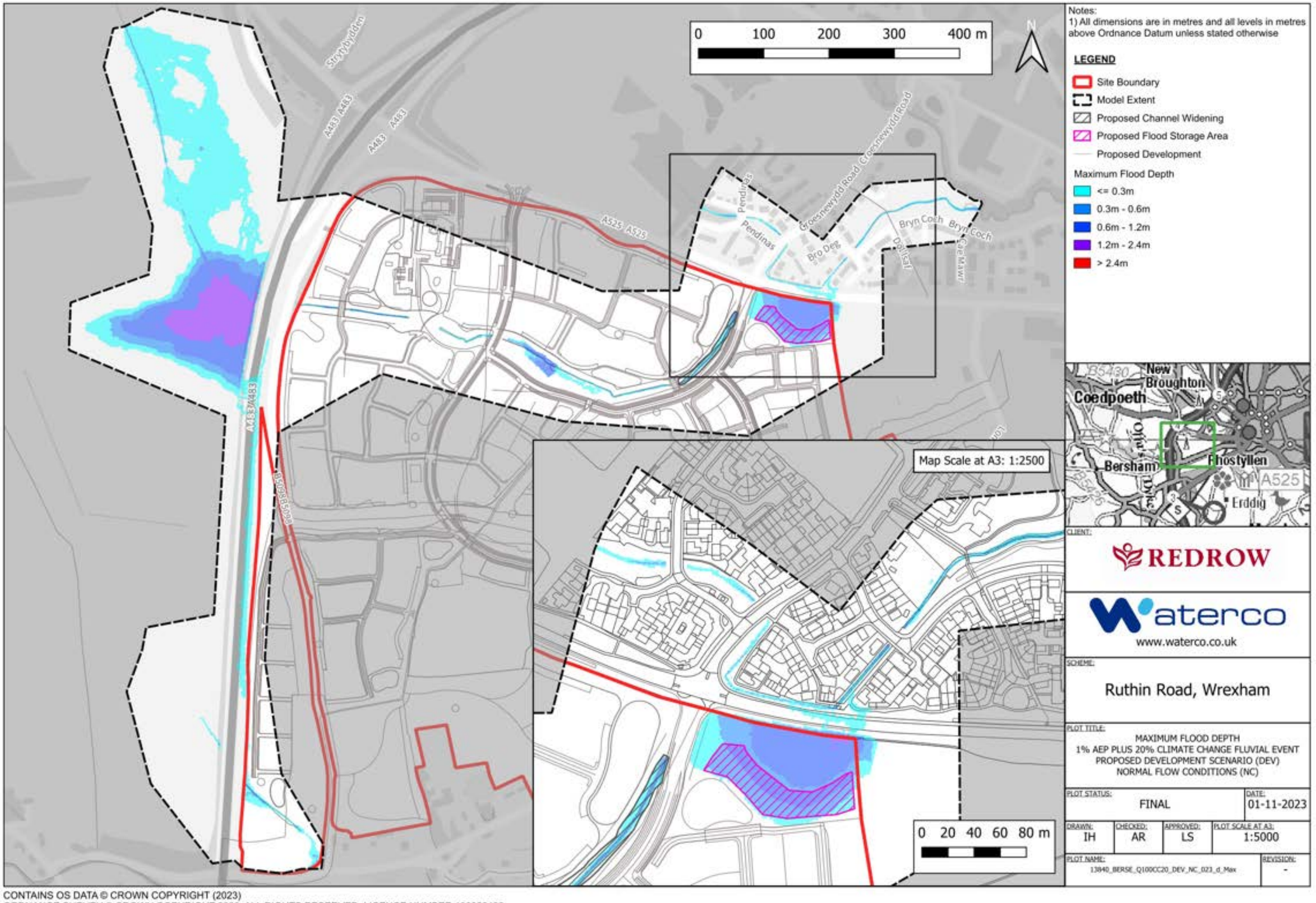
PLOT TITLE: MAXIMUM FLOOD DEPTH DIFFERENCE
0.1% AEP FLUVIAL EVENT
EXG BL VS EXG NC
BLOCKAGE LOCATION 3

PLOT STATUS:		DATE:
FINAL		01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q1000_EXG_BL3-NC_023_d_Diff
REVISION: -

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Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Model Extent
- Proposed Channel Widening
- Proposed Flood Storage Area
- Proposed Development

Maximum Flood Depth

- <= 0.3m
- 0.3m - 0.6m
- 0.6m - 1.2m
- 1.2m - 2.4m
- > 2.4m

CLIENT: REDROW

waterco
www.waterco.co.uk

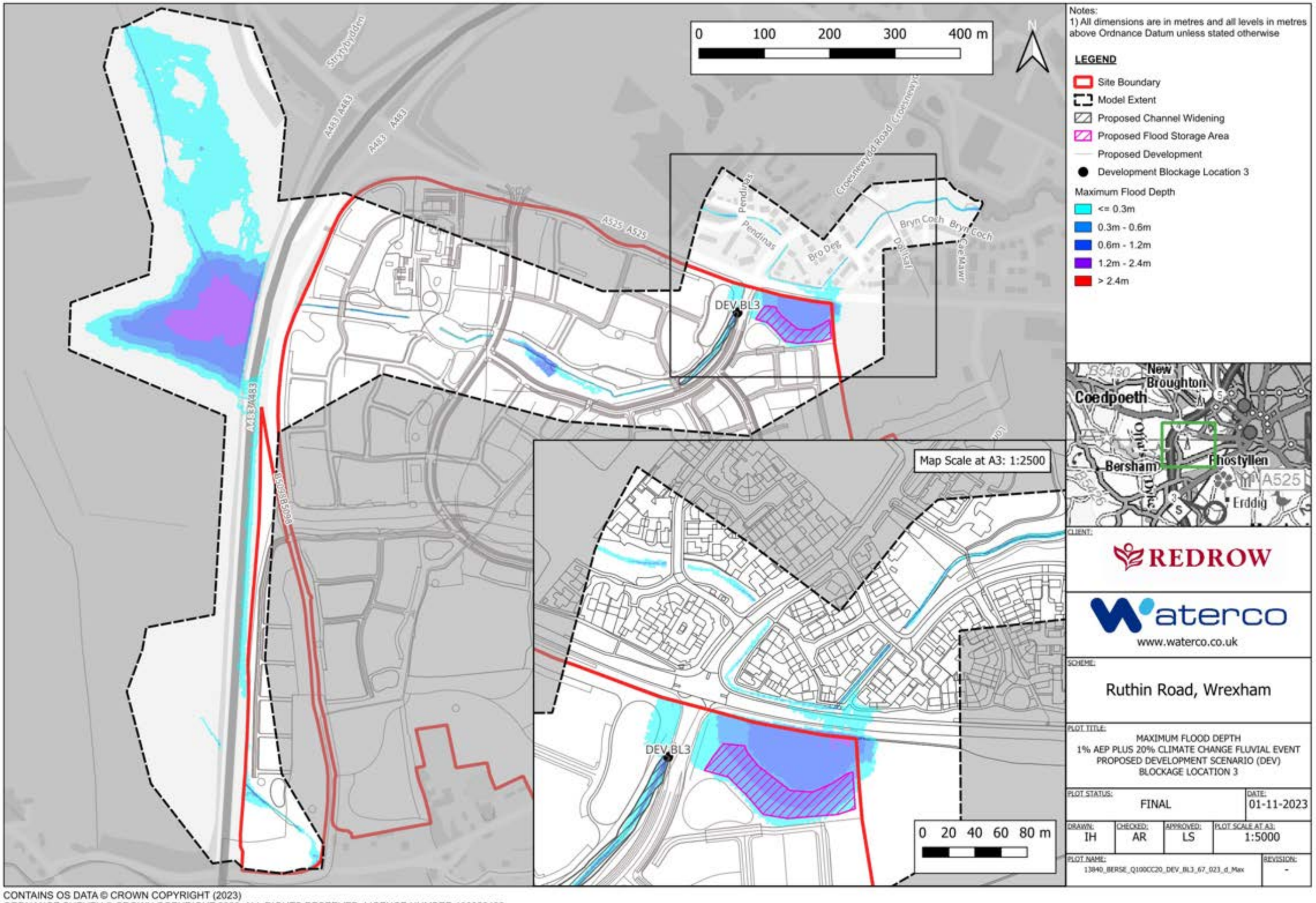
SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD DEPTH
1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
NORMAL FLOW CONDITIONS (NC)

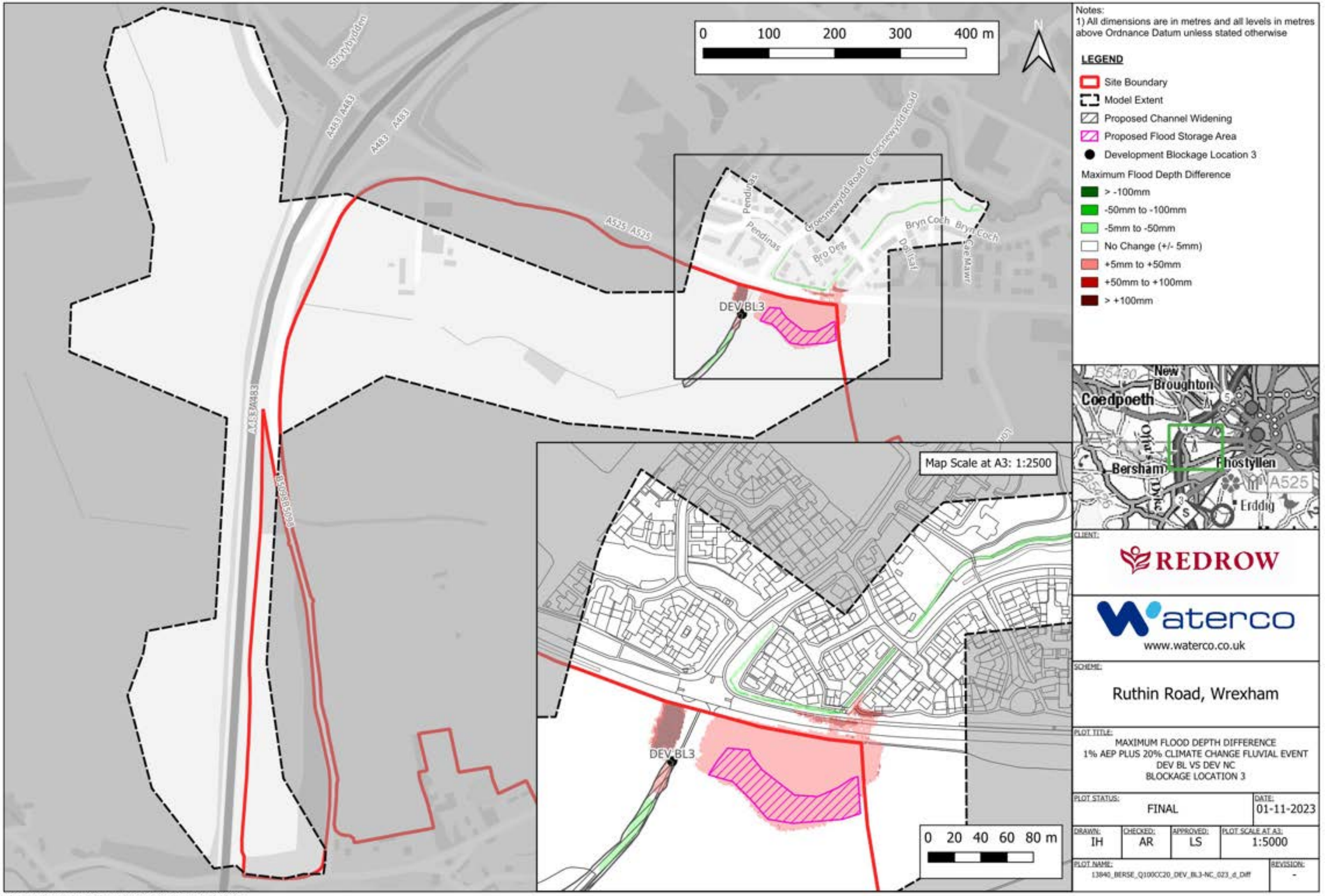
PLOT STATUS:			DATE:
FINAL			01-11-2023
DRAWN: IH	CHECKED: AR	APPROVED: LS	PLOT SCALE AT A3: 1:5000

PLOT NAME: 13840_BERSE_Q100CC20_DEV_NC_023_d_Max
REVISION: -

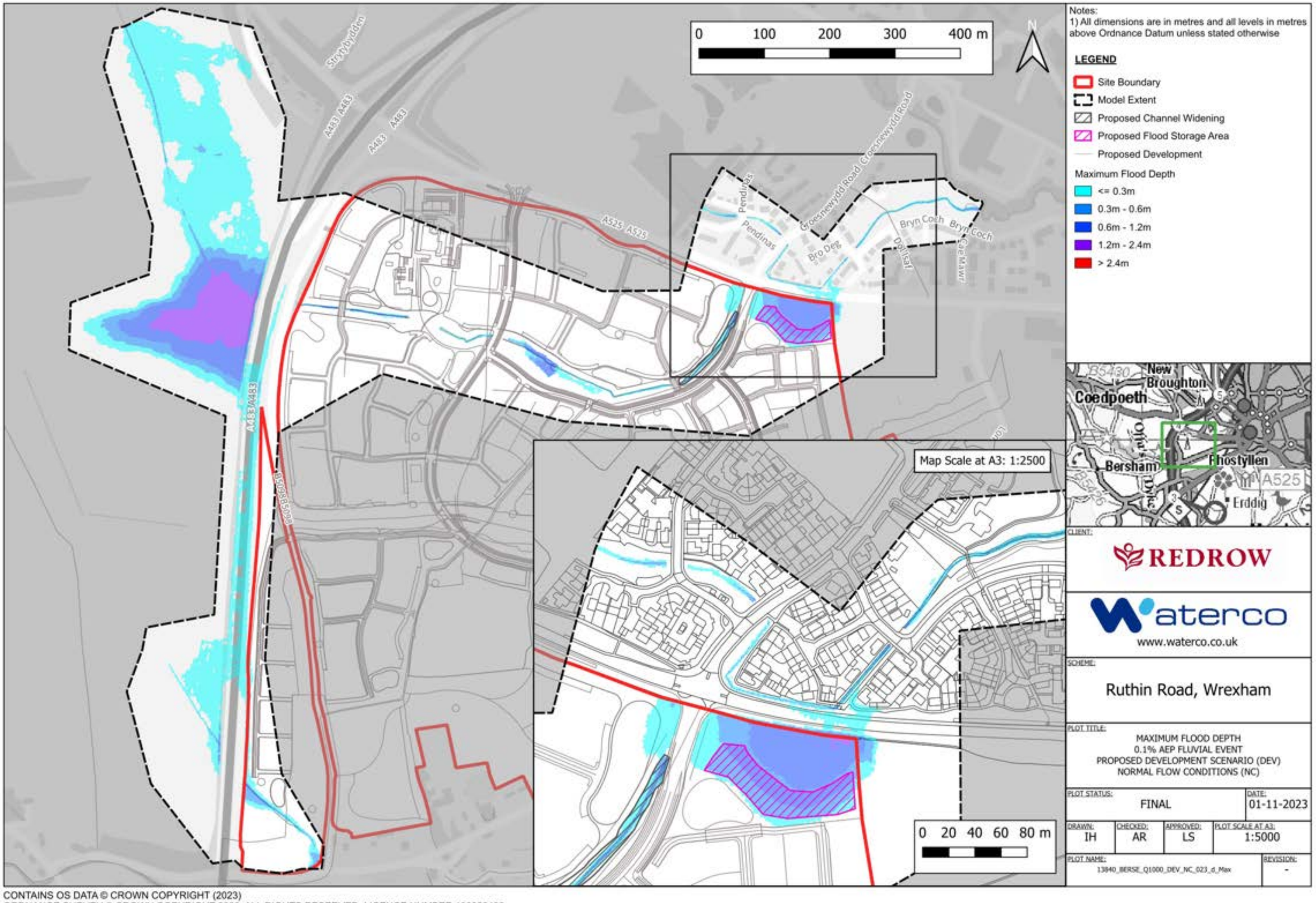
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Notes:
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LEGEND

- Site Boundary
- Model Extent
- Proposed Channel Widening
- Proposed Flood Storage Area
- Proposed Development

Maximum Flood Depth

- <= 0.3m
- 0.3m - 0.6m
- 0.6m - 1.2m
- 1.2m - 2.4m
- > 2.4m

CLIENT: REDROW

waterco
www.waterco.co.uk

SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD DEPTH
0.1% AEP FLUVIAL EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
NORMAL FLOW CONDITIONS (NC)

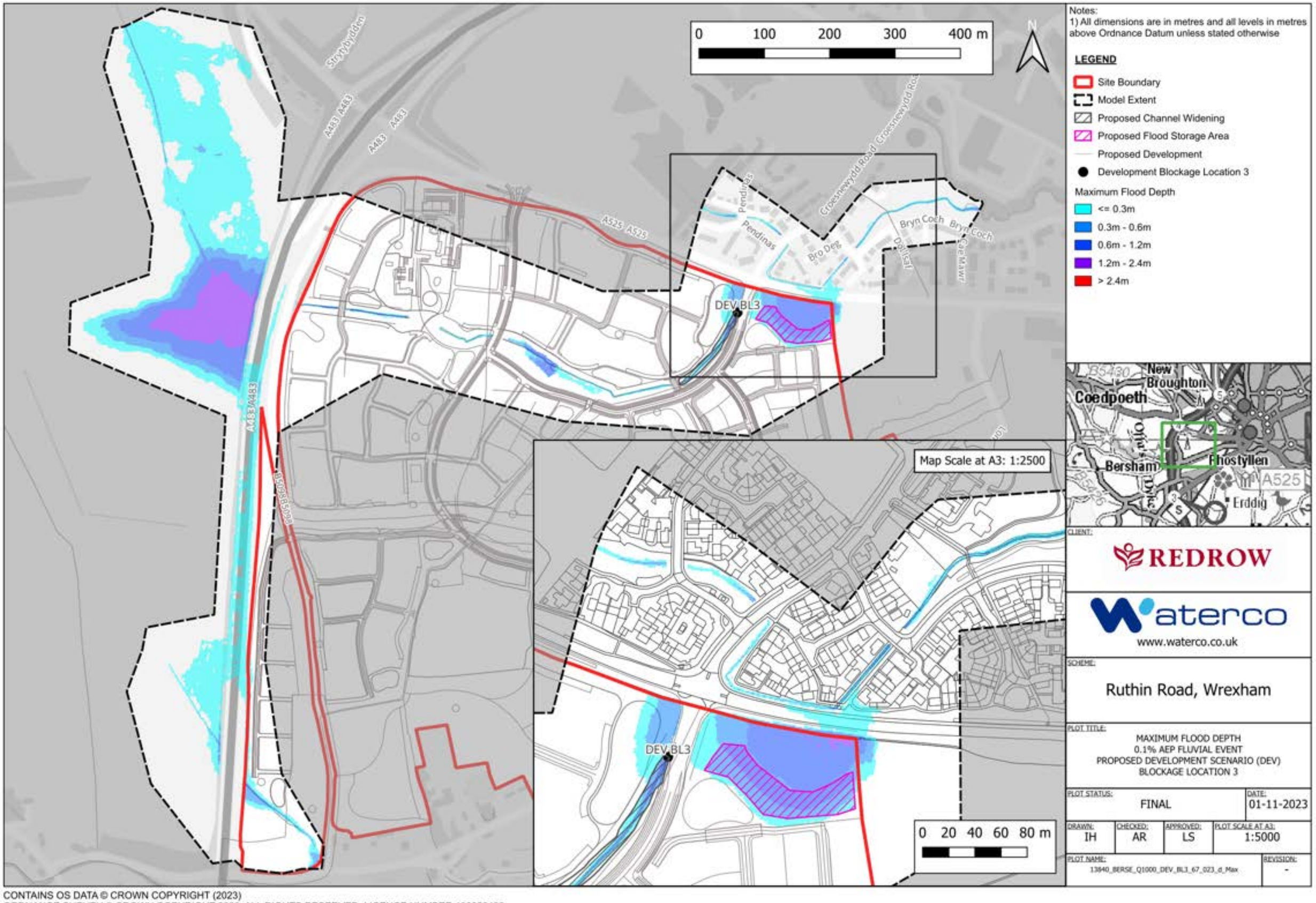
PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13940_BERSE_Q1000_DEV_NC_023_d_Max

REVISION: -

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Notes:
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LEGEND

- Site Boundary
- Model Extent
- Proposed Channel Widening
- Proposed Flood Storage Area
- Proposed Development
- Development Blockage Location 3

Maximum Flood Depth

- <= 0.3m
- 0.3m - 0.6m
- 0.6m - 1.2m
- 1.2m - 2.4m
- > 2.4m

CLIENT: REDROW

waterco
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SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD DEPTH
0.1% AEP FLUVIAL EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
BLOCKAGE LOCATION 3

PLOT STATUS:			DATE:
FINAL			01-11-2023
DRAWN: IH	CHECKED: AR	APPROVED: LS	PLOT SCALE AT A3: 1:5000

PLOT NAME: 13840_BERSE_Q1000_DEV_BL3_67_023_d_Max

REVISION: -

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Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Model Extent
- Proposed Channel Widening
- Proposed Flood Storage Area
- Development Blockage Location 3

Maximum Flood Depth Difference

- > -100mm
- -50mm to -100mm
- -5mm to -50mm
- No Change (+/- 5mm)
- +5mm to +50mm
- +50mm to +100mm
- > +100mm

0 100 200 300 400 m

N

DEV BL3

Map Scale at A3: 1:2500

0 20 40 60 80 m



CLIENT: REDROW

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SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD DEPTH DIFFERENCE
0.1% AEP FLUVIAL EVENT
DEV BL VS DEV NC
BLOCKAGE LOCATION 3

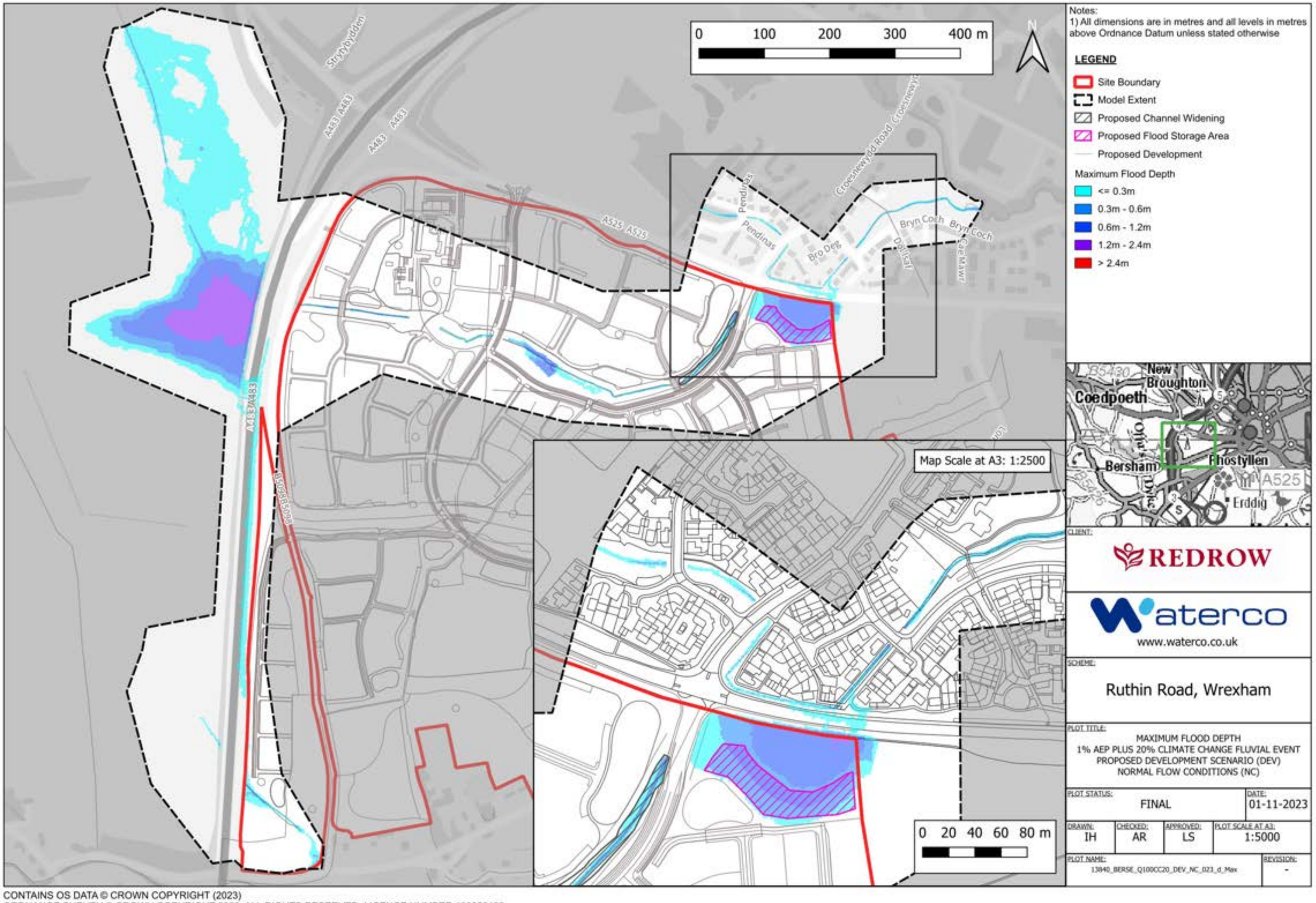
PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13940_BERSE_Q1000_DEV_BL3-NC_023_d_Diff

REVISION: -

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Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Model Extent
- Proposed Channel Widening
- Proposed Flood Storage Area
- Proposed Development

Maximum Flood Depth

- <= 0.3m
- 0.3m - 0.6m
- 0.6m - 1.2m
- 1.2m - 2.4m
- > 2.4m

CLIENT: REDROW

waterco
www.waterco.co.uk

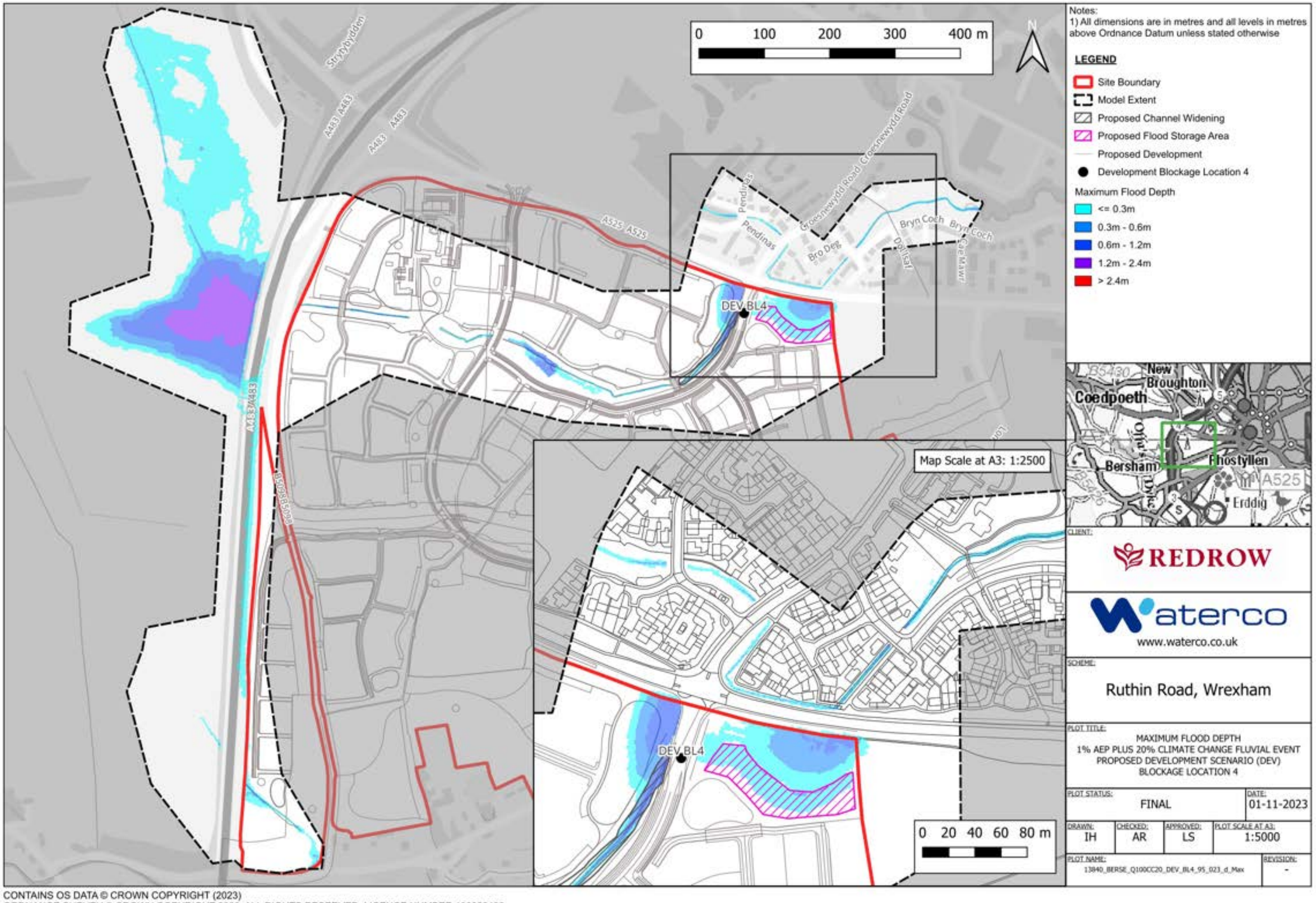
SCHEME: Ruthin Road, Wrexham

PLOT TITLE:
MAXIMUM FLOOD DEPTH
1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:			DATE:
FINAL			01-11-2023
DRAWN: IH	CHECKED: AR	APPROVED: LS	PLOT SCALE AT A3: 1:5000

PLOT NAME: 13840_BERSE_Q100CC20_DEV_NC_023_d_Max
REVISION: -

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Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Model Extent
- Proposed Channel Widening
- Proposed Flood Storage Area
- Proposed Development
- Development Blockage Location 4

Maximum Flood Depth

- <= 0.3m
- 0.3m - 0.6m
- 0.6m - 1.2m
- 1.2m - 2.4m
- > 2.4m

CLIENT: REDROW

waterco
www.waterco.co.uk

SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD DEPTH
1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
BLOCKAGE LOCATION 4

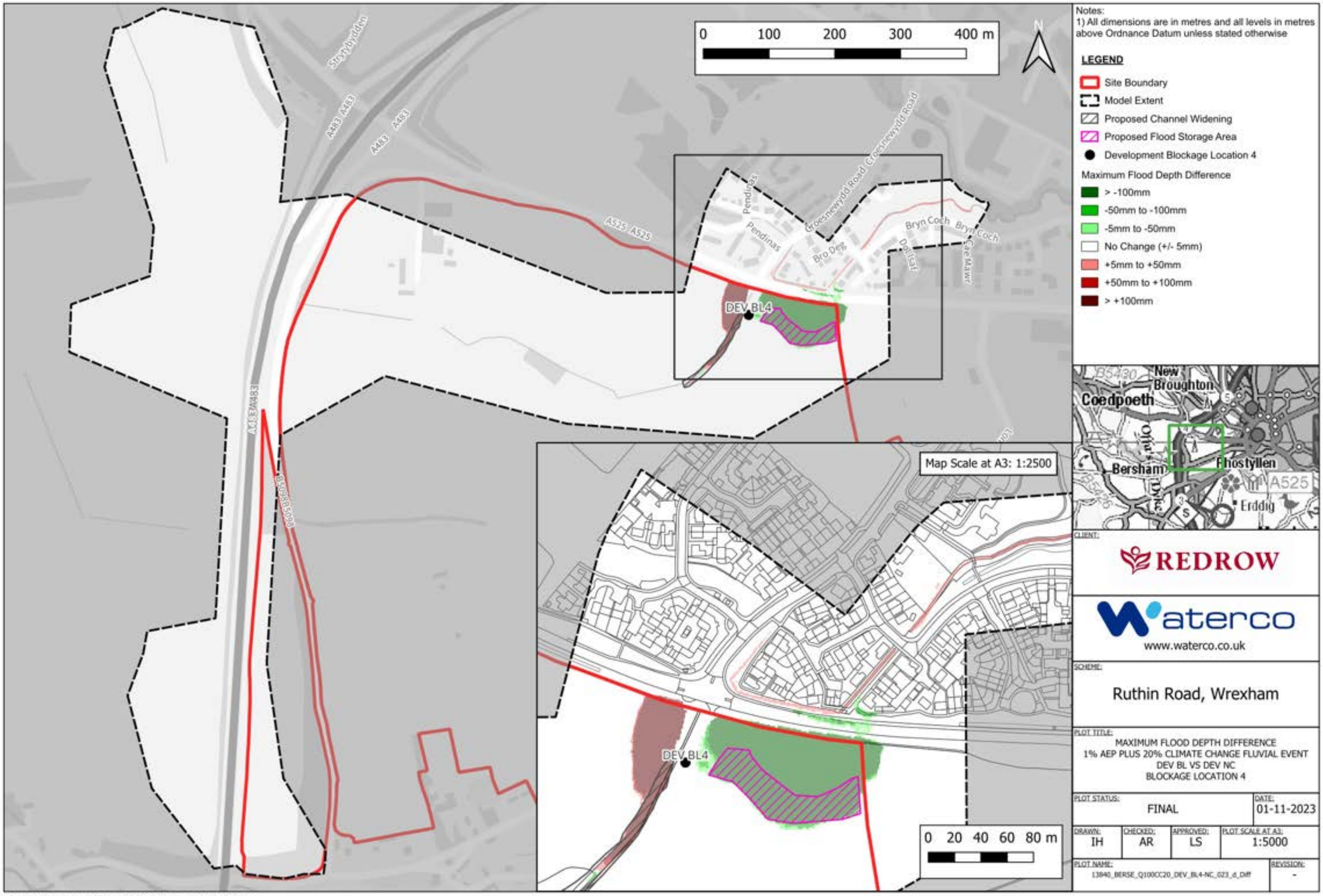
PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q100CC20_DEV_BL4_95_023_d_Max

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Notes:
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LEGEND

- Site Boundary
- Model Extent
- Proposed Channel Widening
- Proposed Flood Storage Area
- Development Blockage Location 4

Maximum Flood Depth Difference

- > -100mm
- -50mm to -100mm
- -5mm to -50mm
- No Change (+/- 5mm)
- +5mm to +50mm
- +50mm to +100mm
- > +100mm

CLIENT: REDROW

waterco
www.waterco.co.uk

SCHEME: Ruthin Road, Wrexham

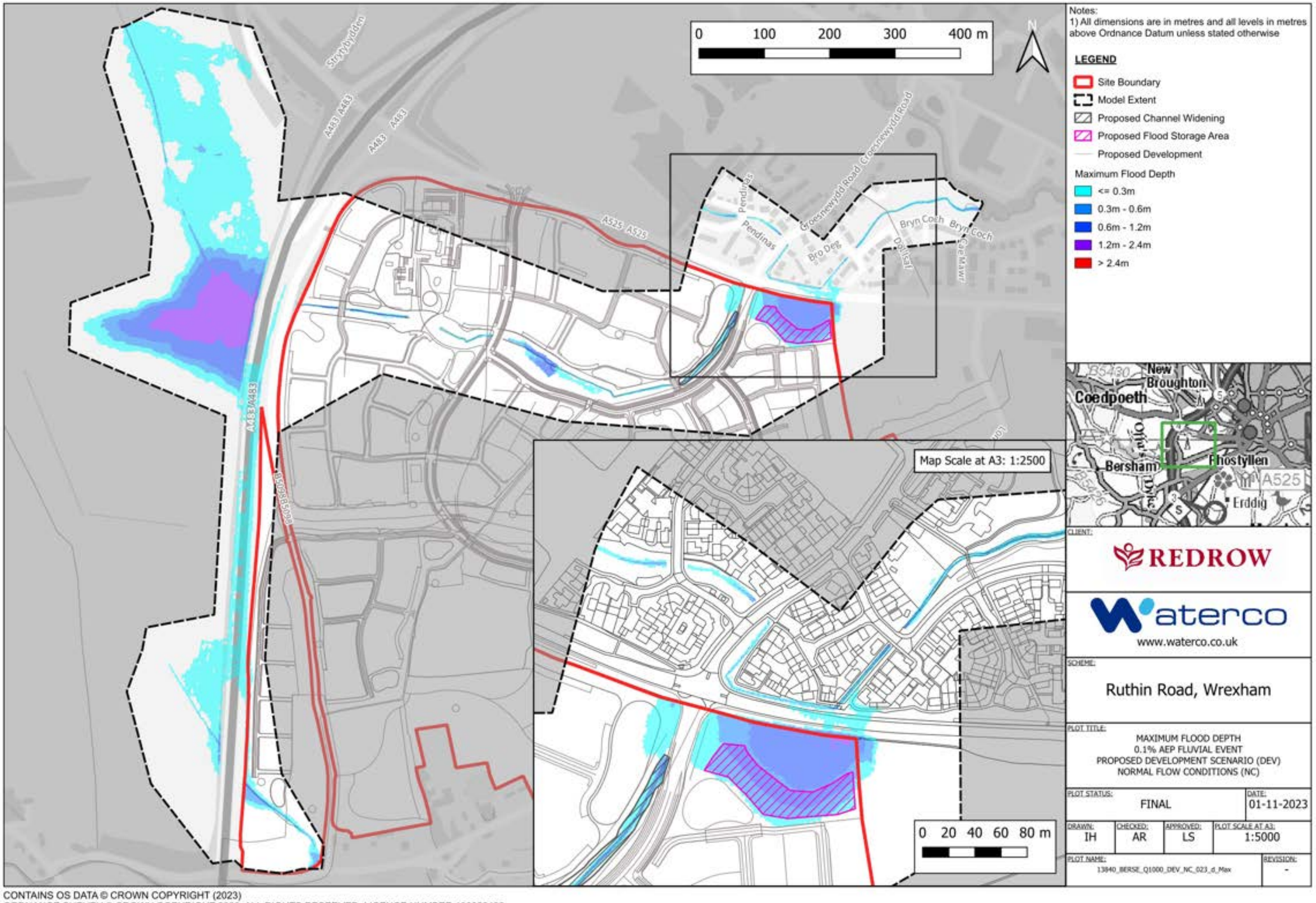
PLOT TITLE:
MAXIMUM FLOOD DEPTH DIFFERENCE
1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
DEV BL VS DEV NC
BLOCKAGE LOCATION 4

PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q100CC20_DEV_BL4-NC_023_d_Diff
REVISION: -

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Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Model Extent
- Proposed Channel Widening
- Proposed Flood Storage Area
- Proposed Development

Maximum Flood Depth

- <= 0.3m
- 0.3m - 0.6m
- 0.6m - 1.2m
- 1.2m - 2.4m
- > 2.4m

CLIENT: REDROW

waterco
www.waterco.uk

SCHEME: Ruthin Road, Wrexham

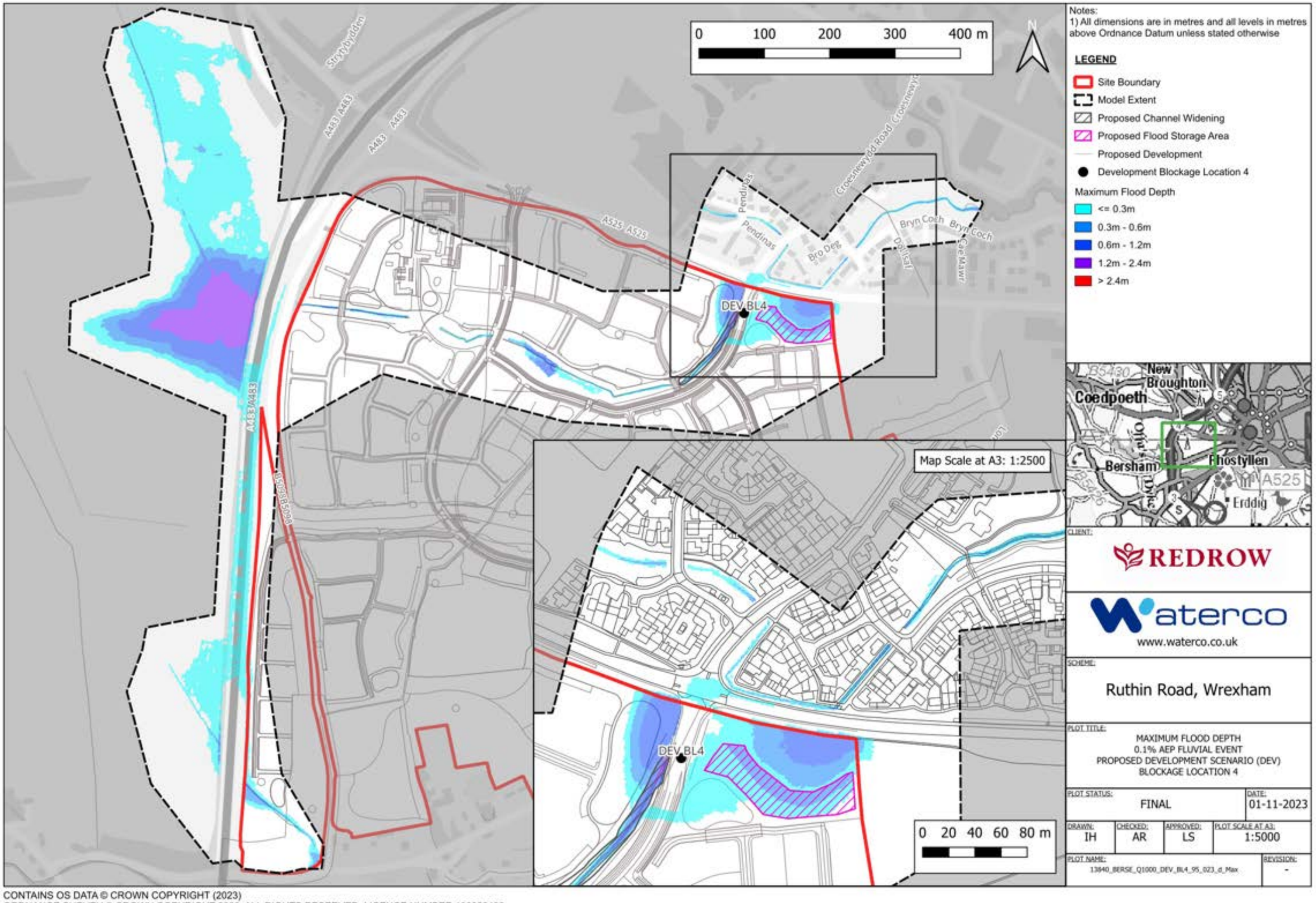
PLOT TITLE: MAXIMUM FLOOD DEPTH
0.1% AEP FLUVIAL EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13940_BERSE_Q1000_DEV_NC_023_d_Max
REVISION: -

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Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Model Extent
- Proposed Channel Widening
- Proposed Flood Storage Area
- Proposed Development
- Development Blockage Location 4

Maximum Flood Depth

- <= 0.3m
- 0.3m - 0.6m
- 0.6m - 1.2m
- 1.2m - 2.4m
- > 2.4m

CLIENT: REDROW

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SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD DEPTH
0.1% AEP FLUVIAL EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
BLOCKAGE LOCATION 4

PLOT STATUS:			DATE:
FINAL			01-11-2023
DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q1000_DEV_BL4_95_023_d_Max

REVISION: -

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Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Model Extent
- Proposed Channel Widening
- Proposed Flood Storage Area
- Development Blockage Location 4

Maximum Flood Depth Difference

- > -100mm
- -50mm to -100mm
- -5mm to -50mm
- No Change (+/- 5mm)
- +5mm to +50mm
- +50mm to +100mm
- > +100mm

0 100 200 300 400 m

N

DEV BL4

Map Scale at A3: 1:2500

0 20 40 60 80 m



CLIENT: REDROW

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SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD DEPTH DIFFERENCE
0.1% AEP FLUVIAL EVENT
DEV BL VS DEV NC
BLOCKAGE LOCATION 4

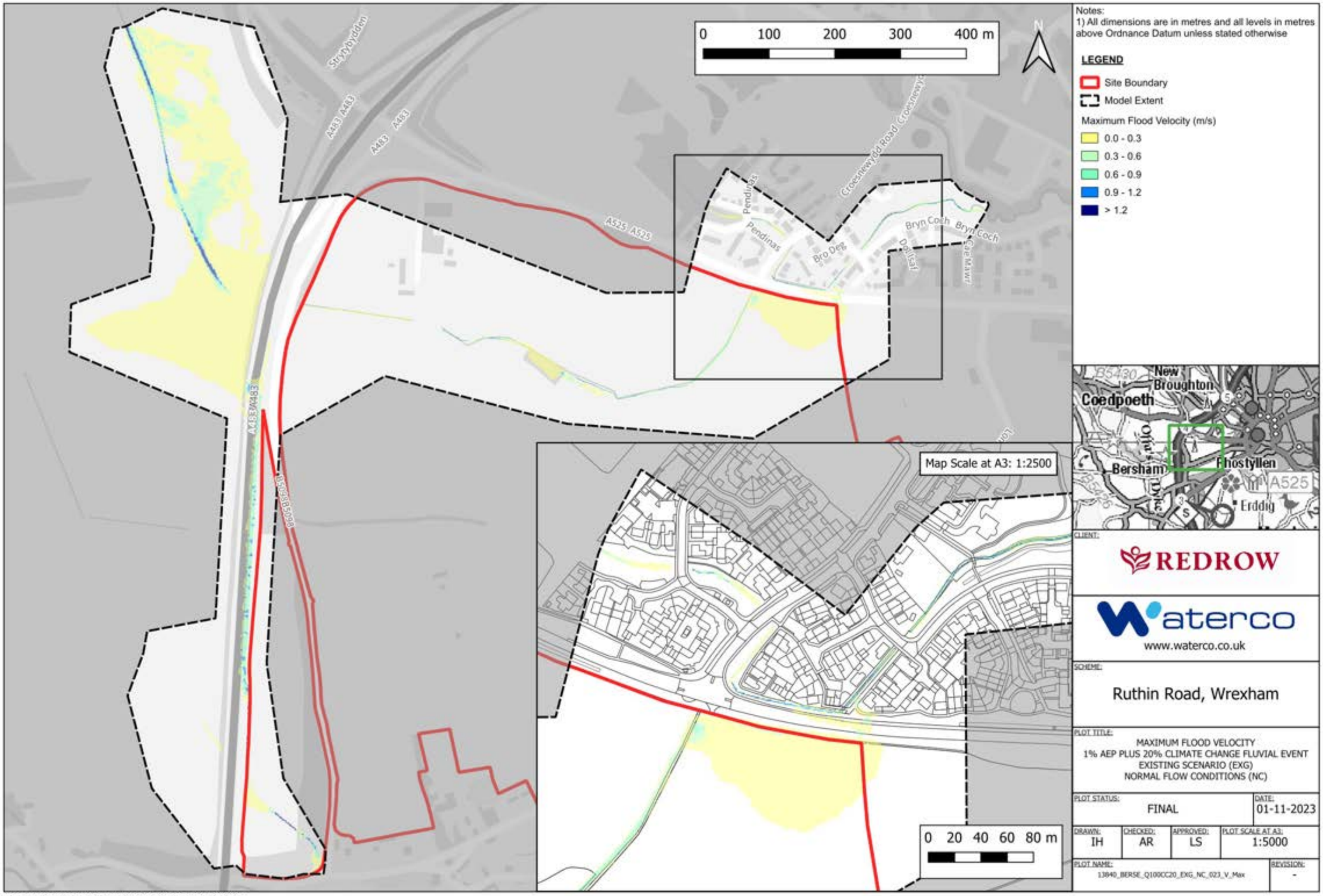
PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13940_BERSE_Q1000_DEV_BL4-NC_023_d_Diff

REVISION: -

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Notes:
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LEGEND

- Site Boundary
- Model Extent

Maximum Flood Velocity (m/s)

- 0.0 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

CLIENT: REDROW

waterco
www.waterco.co.uk

SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD VELOCITY
1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
EXISTING SCENARIO (EXG)
NORMAL FLOW CONDITIONS (NC)

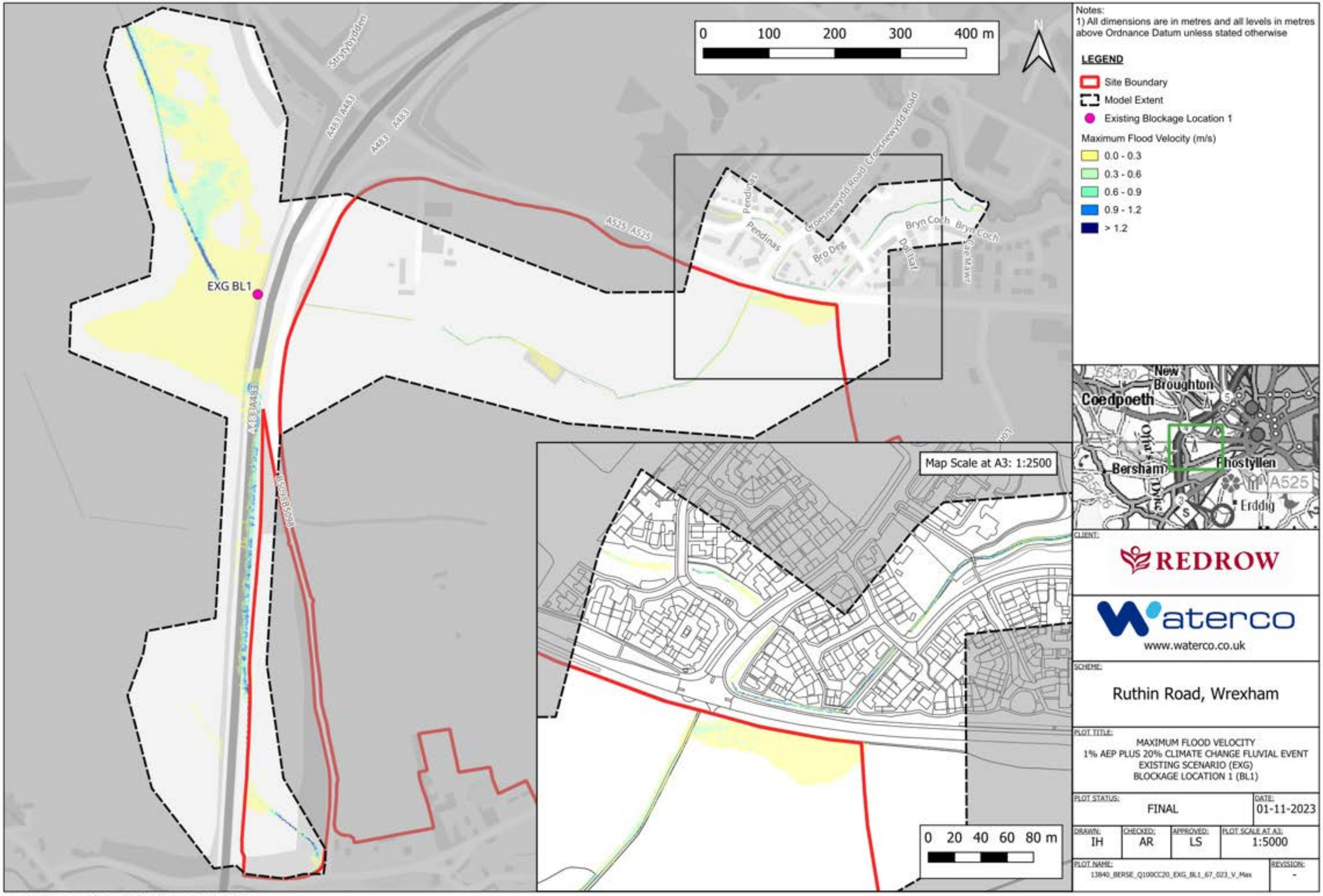
PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13940_BERSE_Q100CC20_EXG_NC_023_V_Max

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Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Model Extent
- Existing Blockage Location 1

Maximum Flood Velocity (m/s)

- 0.0 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

CLIENT: REDROW

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www.waterco.co.uk

SCHEME: Ruthin Road, Wrexham

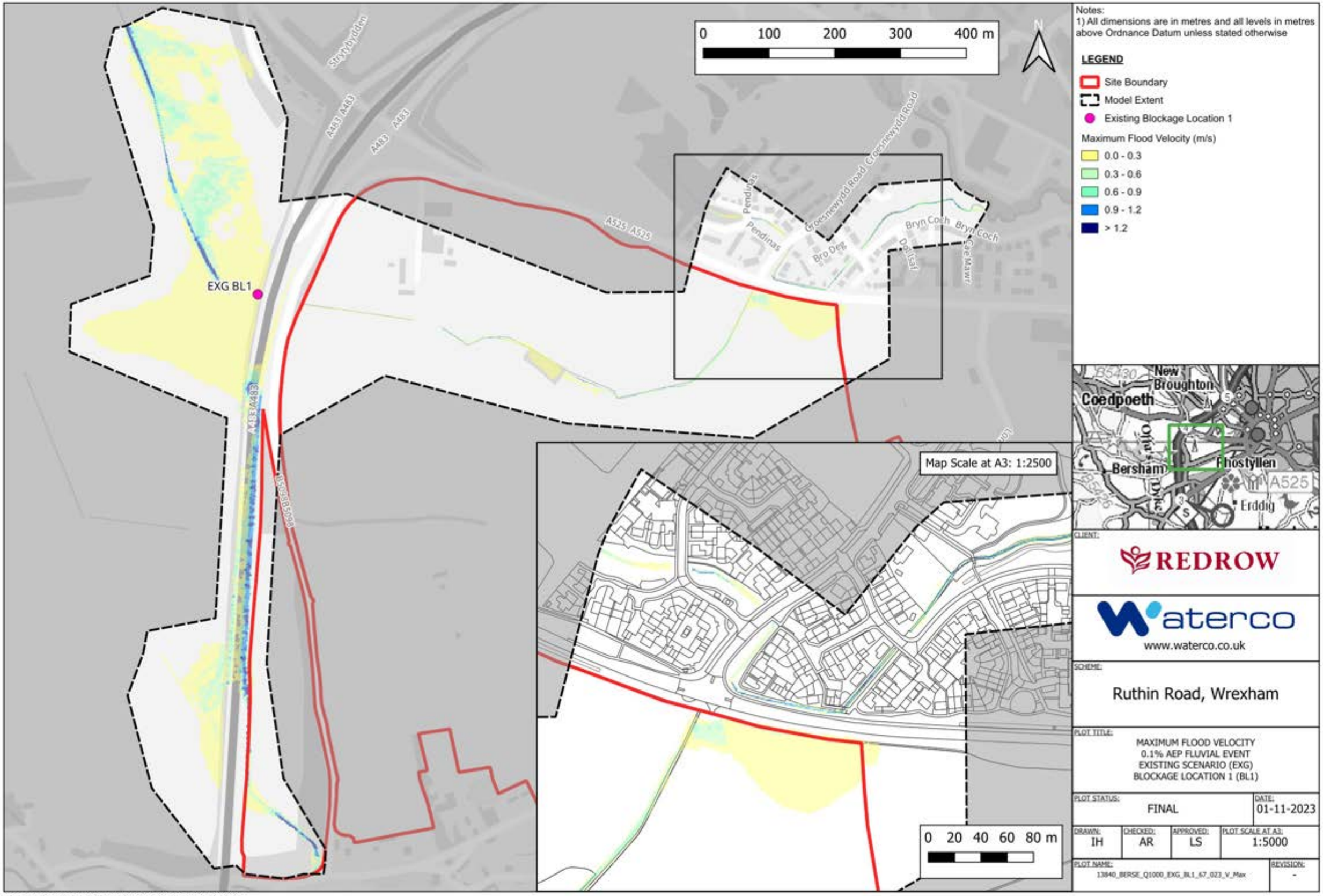
PLOT TITLE: MAXIMUM FLOOD VELOCITY
1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
EXISTING SCENARIO (EXG)
BLOCKAGE LOCATION 1 (BL1)

PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q100CC20_EXG_BL1_67_023_V_Max
REVISION: -

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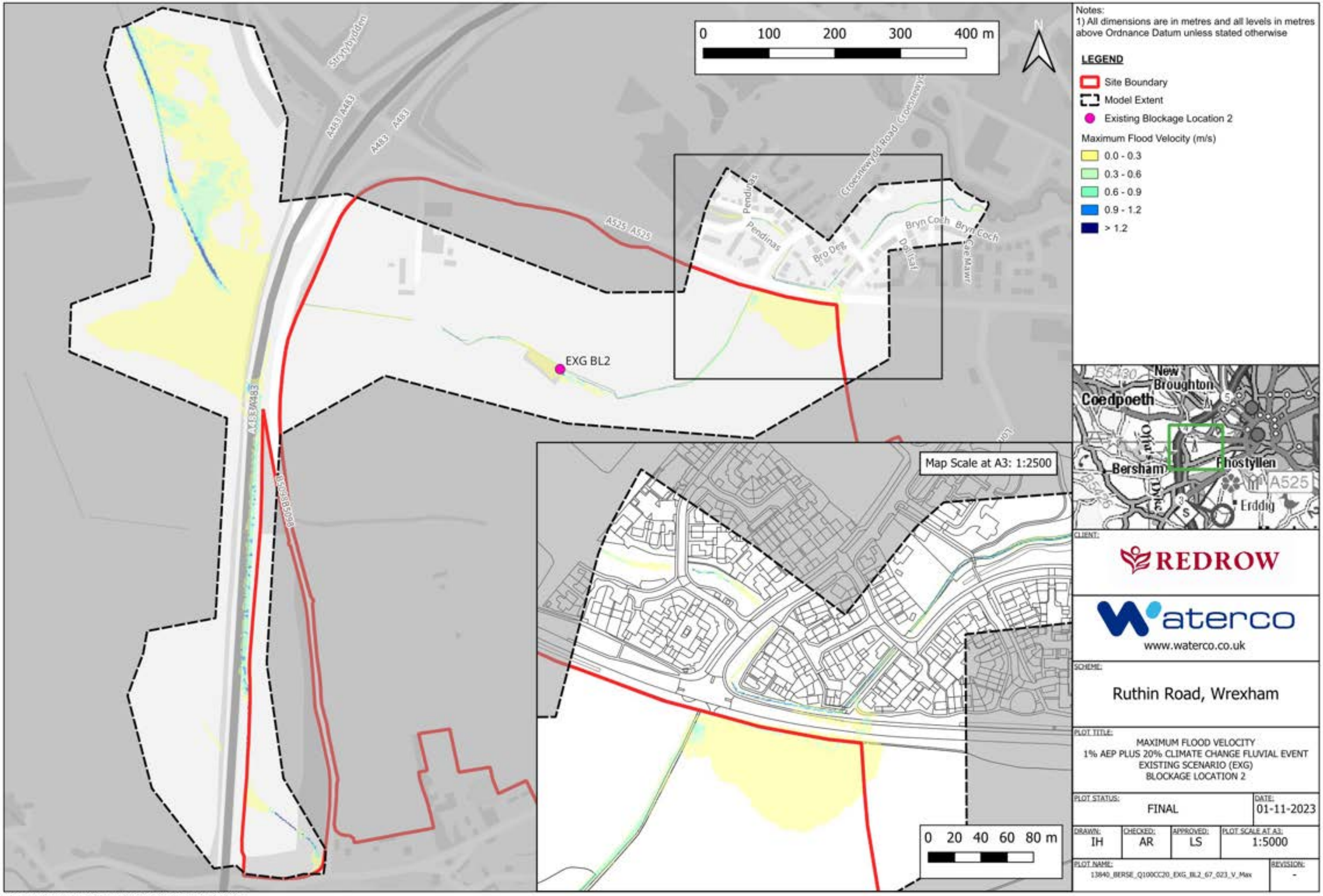
PLOT TITLE: MAXIMUM FLOOD VELOCITY
0.1% AEP FLUVIAL EVENT
EXISTING SCENARIO (EXG)
BLOCKAGE LOCATION 1 (BL1)

PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q1000_EXG_BL1_67_023_V_Max
REVISION: -

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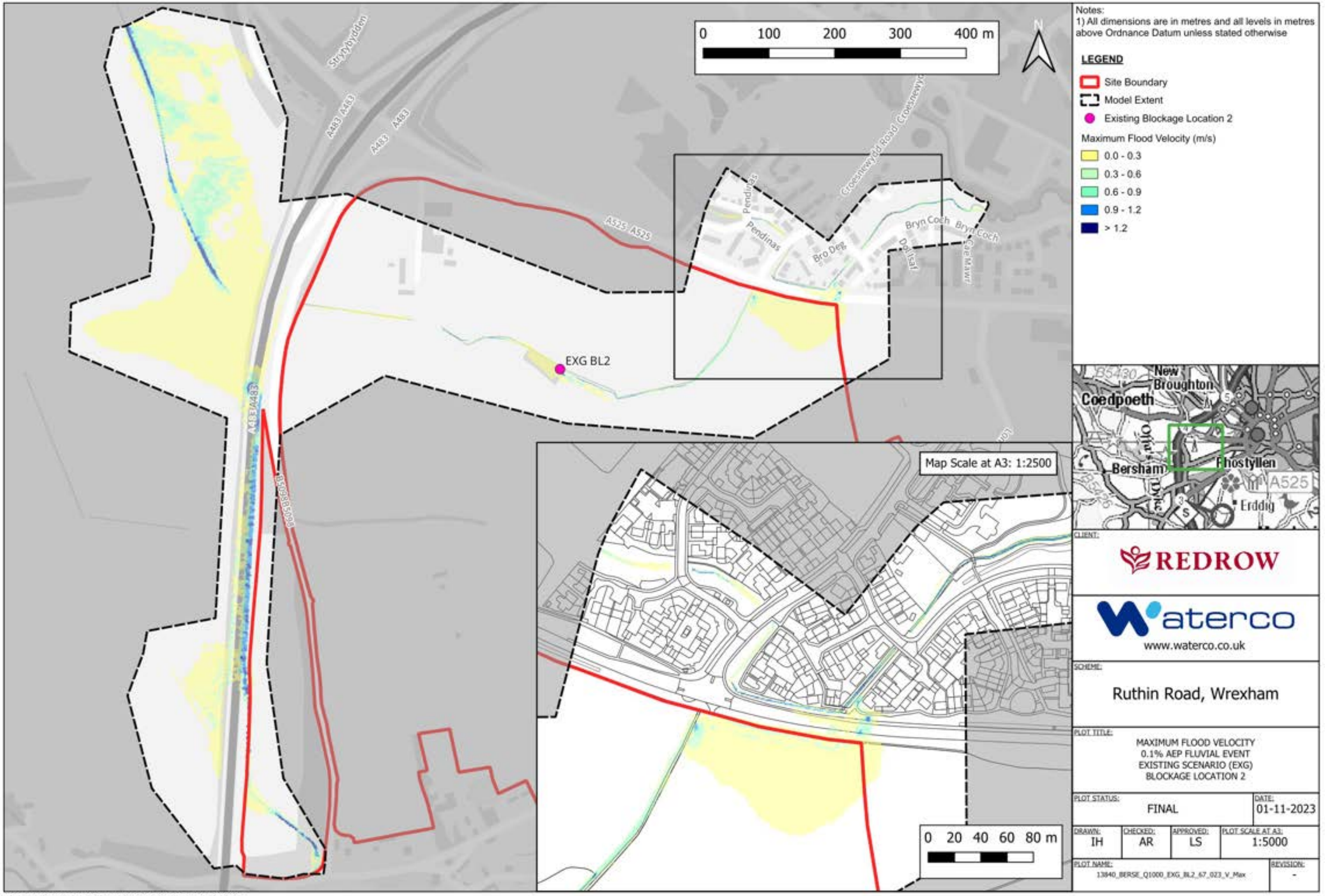
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1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
EXISTING SCENARIO (EXG)
BLOCKAGE LOCATION 2

PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q100CC20_EXG_BL2_67_023_V_Max
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Notes:
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LEGEND

- Site Boundary
- Model Extent
- Existing Blockage Location 2

Maximum Flood Velocity (m/s)

- 0.0 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

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PLOT TITLE: MAXIMUM FLOOD VELOCITY
0.1% AEP FLUVIAL EVENT
EXISTING SCENARIO (EXG)
BLOCKAGE LOCATION 2

PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q1000_EXG_BL2_67_023_V_Max
REVISION: -

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Notes:
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LEGEND

- Site Boundary
- Model Extent
- Existing Blockage Location 3

Maximum Flood Velocity (m/s)

- 0.0 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

0 100 200 300 400 m

N

EXG BL3

Map Scale at A3: 1:2500

0 20 40 60 80 m



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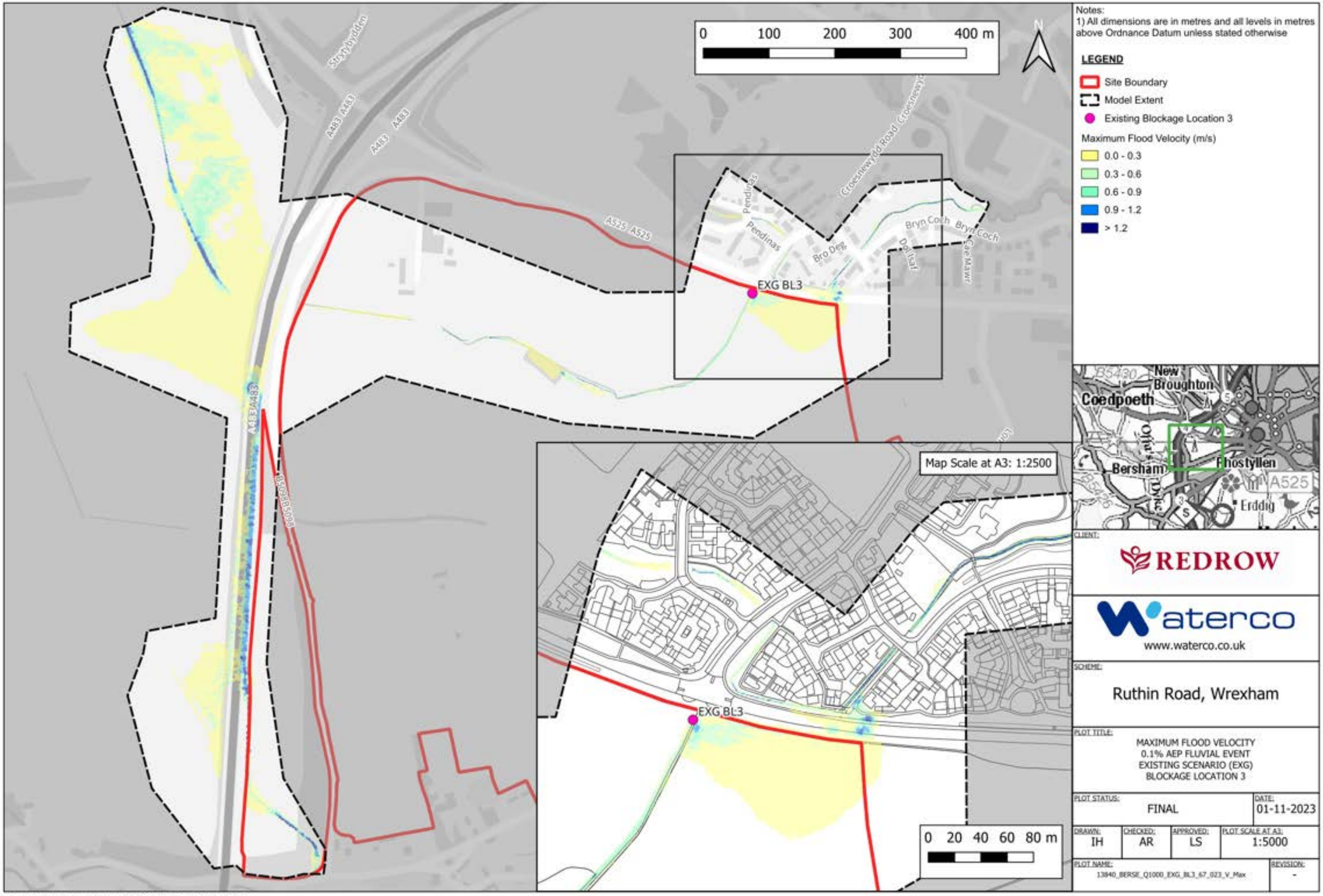
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1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
EXISTING SCENARIO (EXG)
BLOCKAGE LOCATION 3

PLOT STATUS:	DATE:
FINAL	01-11-2023

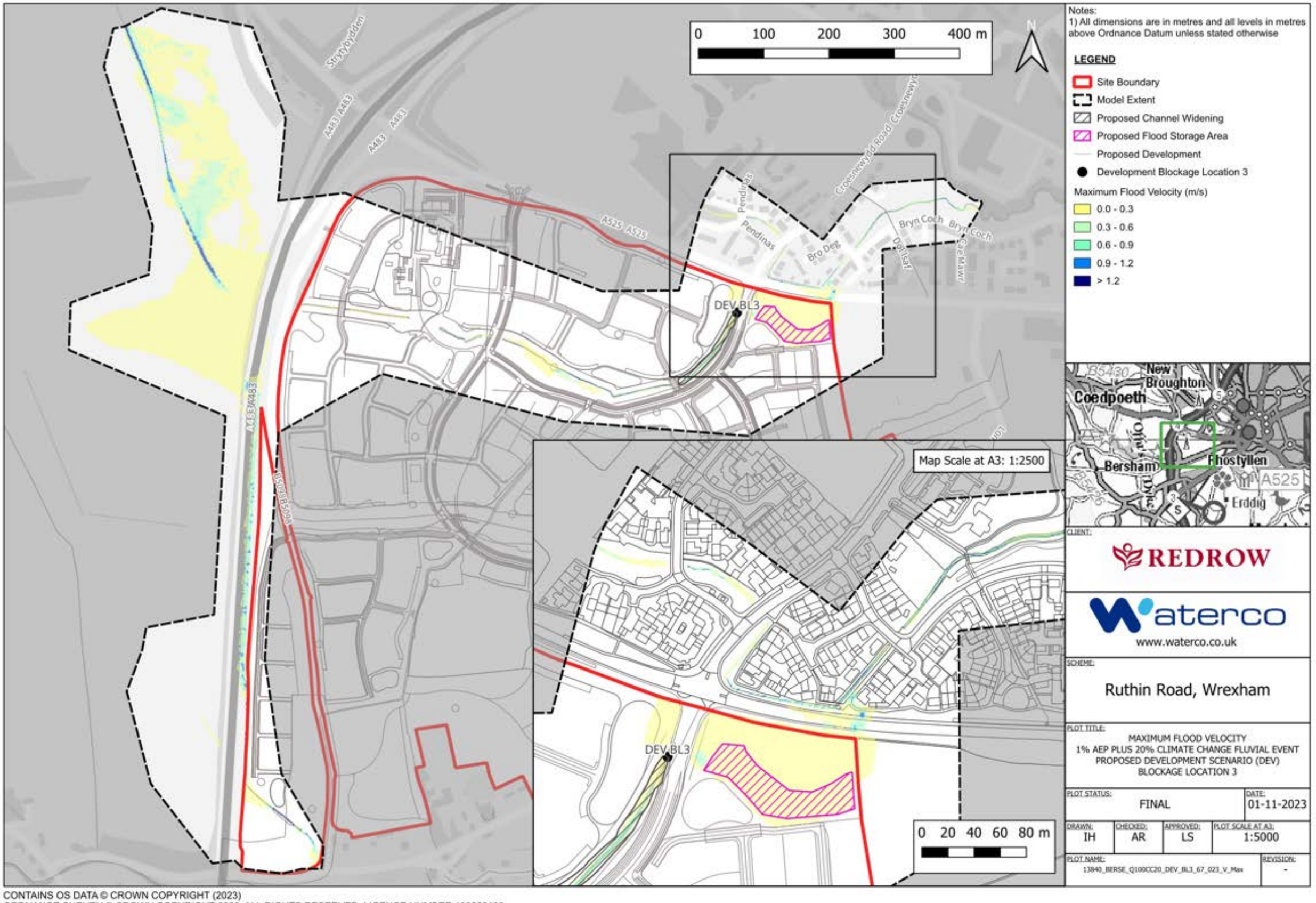
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PLOT NAME: 13840_BERSE_Q100CC20_EXG_BL3_67_023_V_Max
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Notes:
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LEGEND

- Site Boundary
- Model Extent
- Proposed Channel Widening
- Proposed Flood Storage Area
- Proposed Development
- Development Blockage Location 3

Maximum Flood Velocity (m/s)

- 0.0 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

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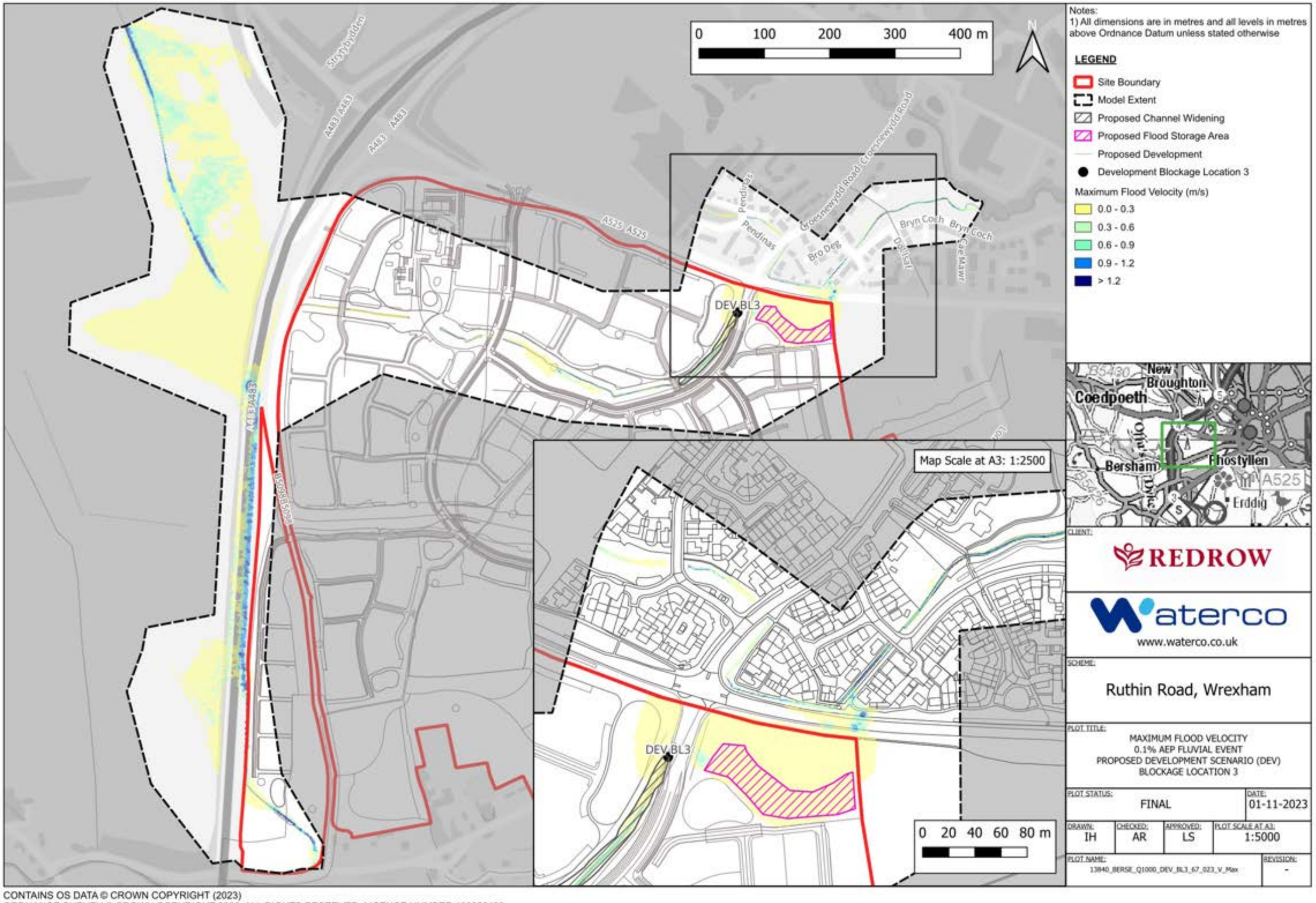
SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD VELOCITY
1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
BLOCKAGE LOCATION 3

PLOT STATUS:			DATE:
FINAL			01-11-2023
DRAWN: IH	CHECKED: AR	APPROVED: LS	PLOT SCALE AT A3: 1:5000

PLOT NAME: 13840_BERSE_Q100CC20_DEV_BL3_67_023_V_Max
REVISION: -

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Notes:
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LEGEND

- Site Boundary
- Model Extent
- Proposed Channel Widening
- Proposed Flood Storage Area
- Proposed Development
- Development Blockage Location 3

Maximum Flood Velocity (m/s)

- 0.0 - 0.3
- 0.3 - 0.6
- 0.6 - 0.9
- 0.9 - 1.2
- > 1.2

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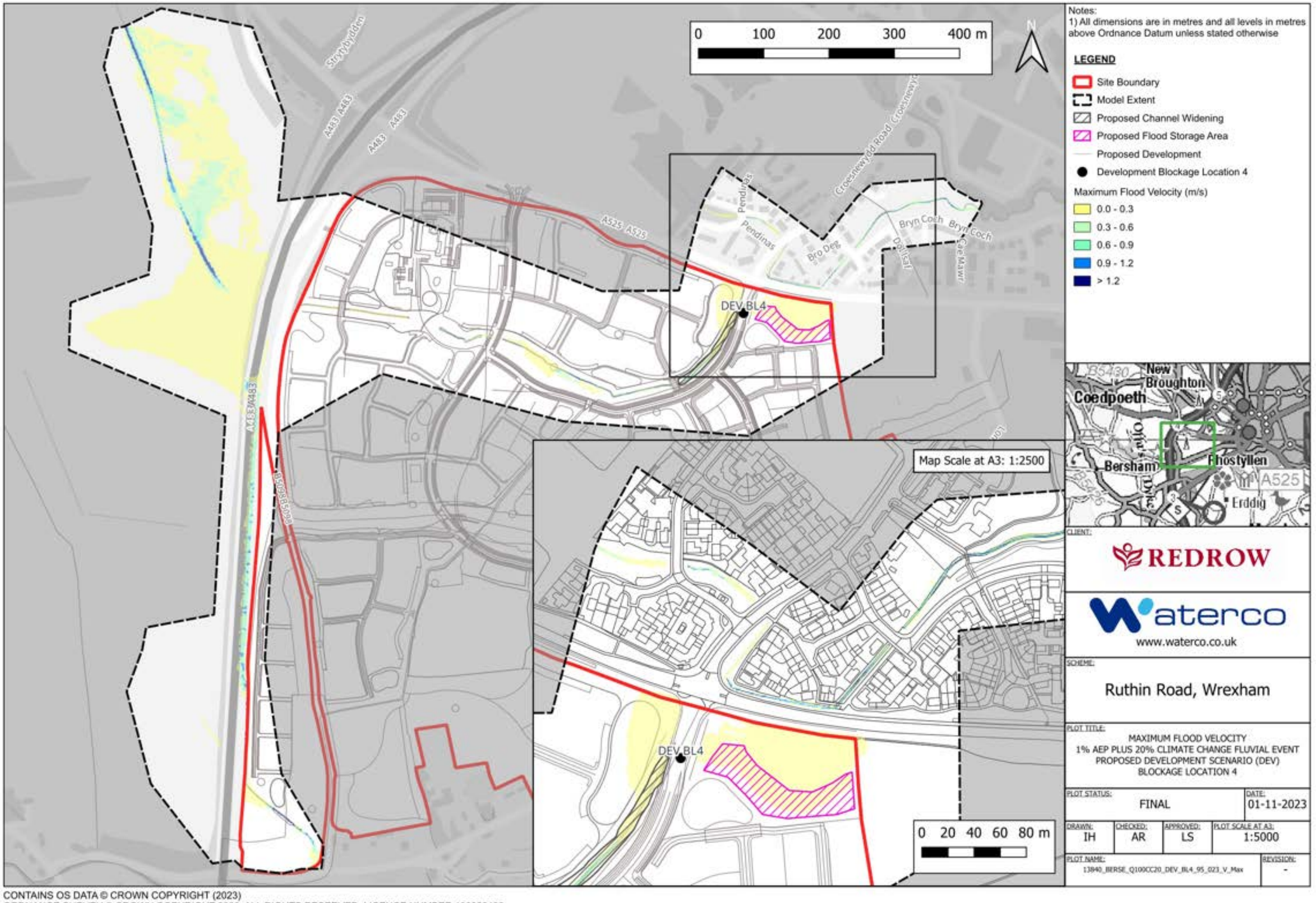
SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD VELOCITY
0.1% AEP FLUVIAL EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
BLOCKAGE LOCATION 3

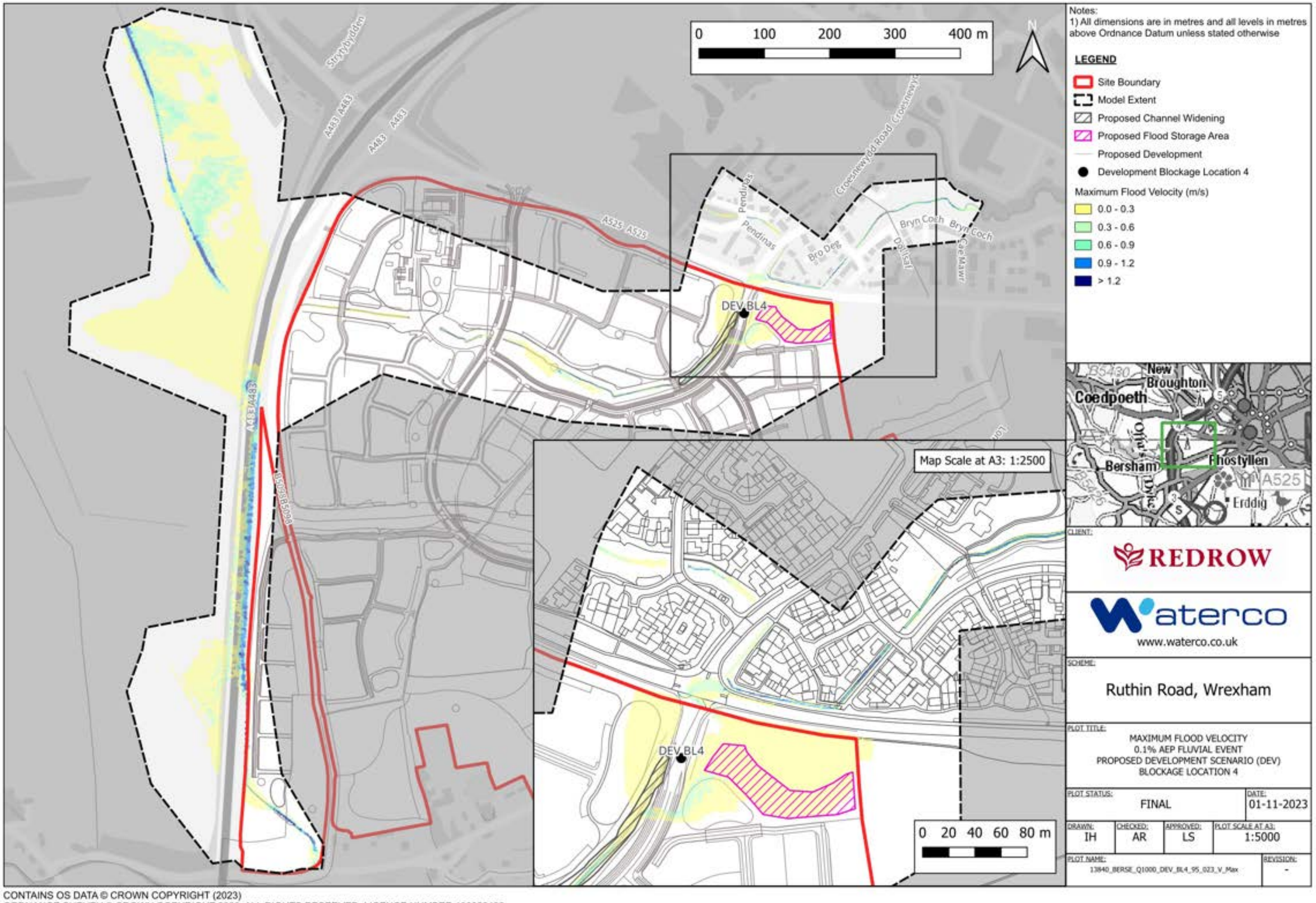
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FINAL			01-11-2023
DRAWN: IH	CHECKED: AR	APPROVED: LS	PLOT SCALE AT A3: 1:5000

PLOT NAME: 13840_BERSE_Q1000_DEV_BL3_67_023_V_Max
REVISION: -

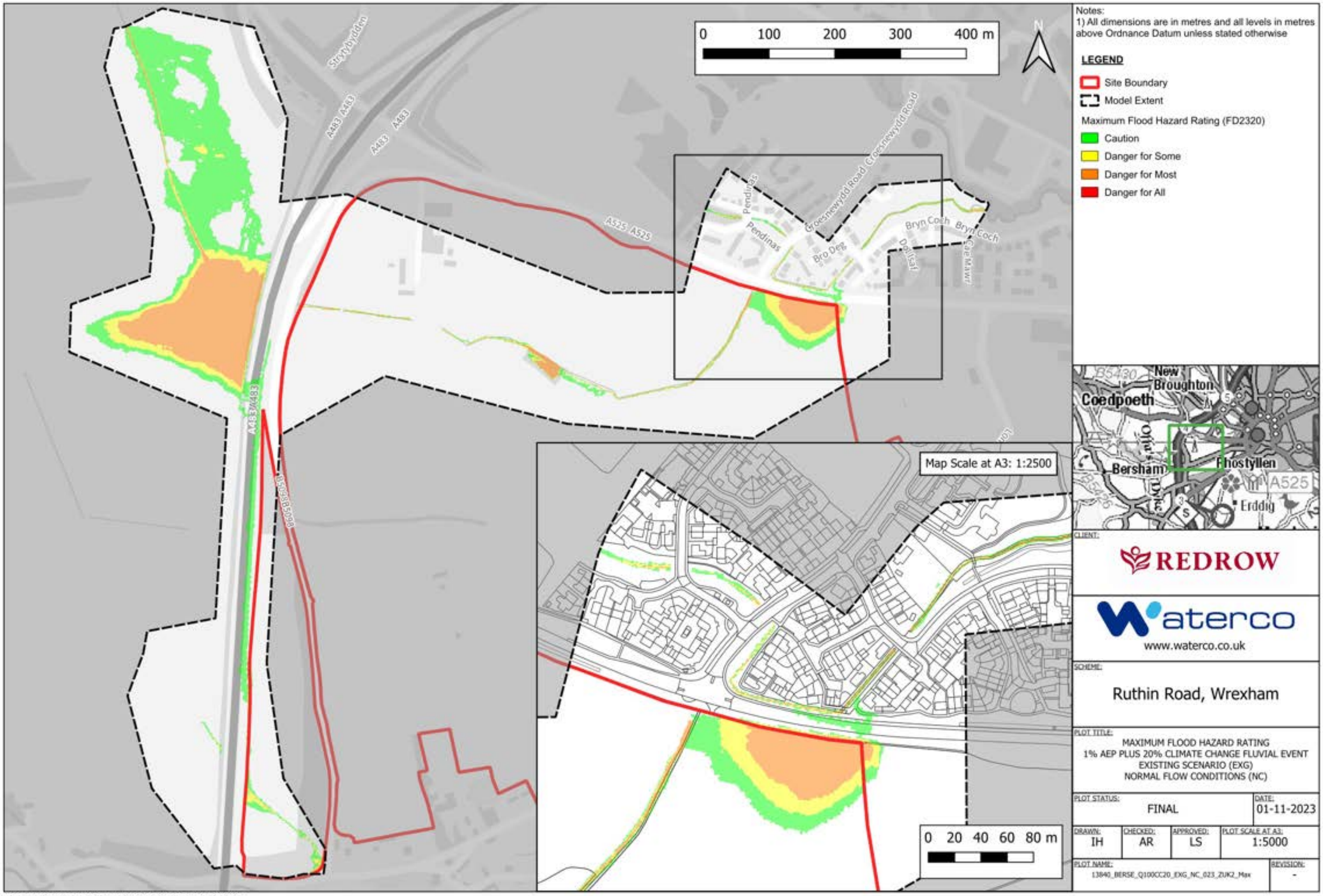
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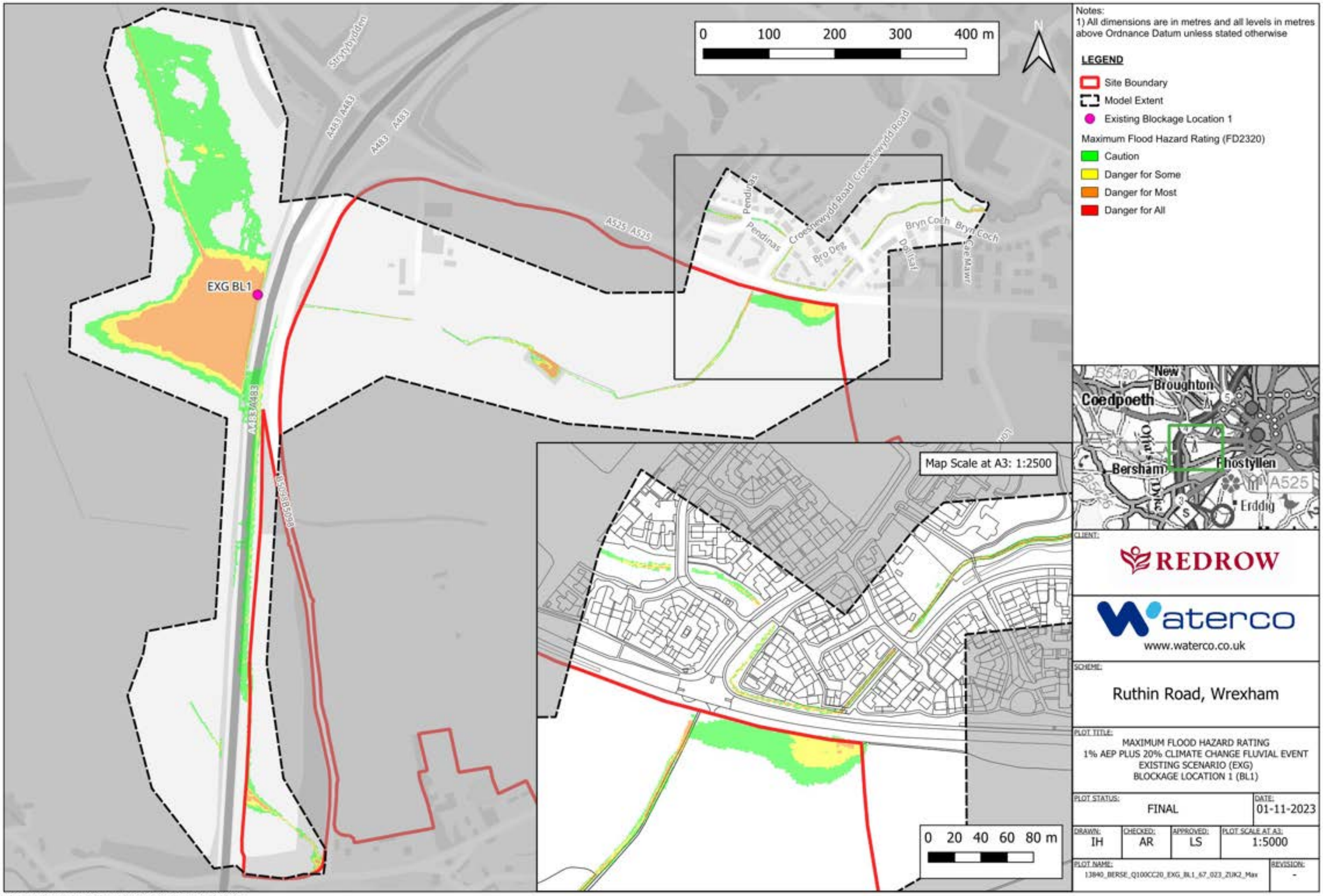
PLOT TITLE: MAXIMUM FLOOD HAZARD RATING
1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
EXISTING SCENARIO (EXG)
NORMAL FLOW CONDITIONS (NC)

PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q100CC20_EXG_NC_023_ZUK2_Max
REVISION: -

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LEGEND

- Site Boundary
- Model Extent
- Existing Blockage Location 1

Maximum Flood Hazard Rating (FD2320)

- Caution
- Danger for Some
- Danger for Most
- Danger for All

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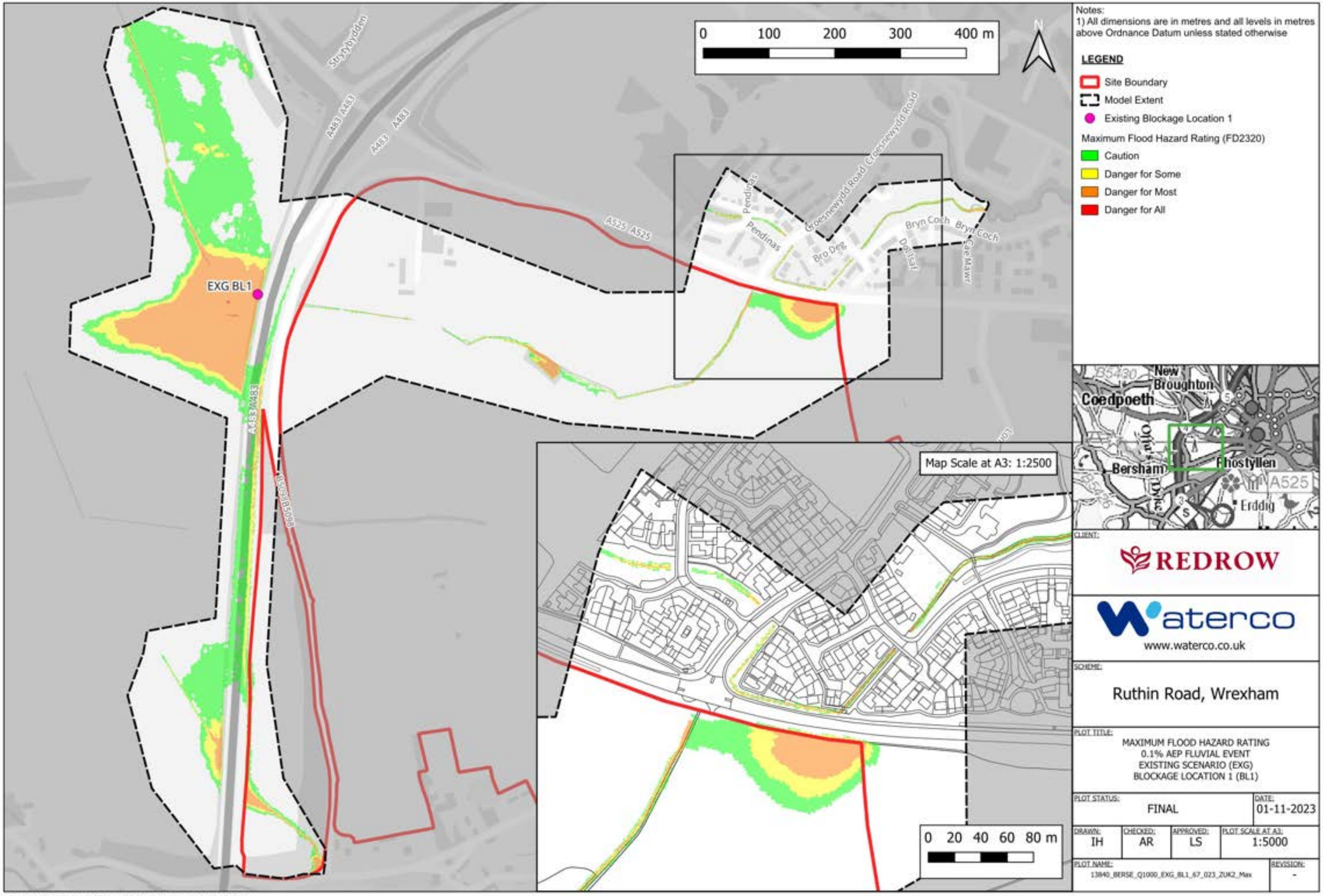
PLOT TITLE: MAXIMUM FLOOD HAZARD RATING
1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
EXISTING SCENARIO (EXG)
BLOCKAGE LOCATION 1 (BL1)

PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q100CC20_EXG_BL1_67_023_ZUK2_Max
REVISION: -

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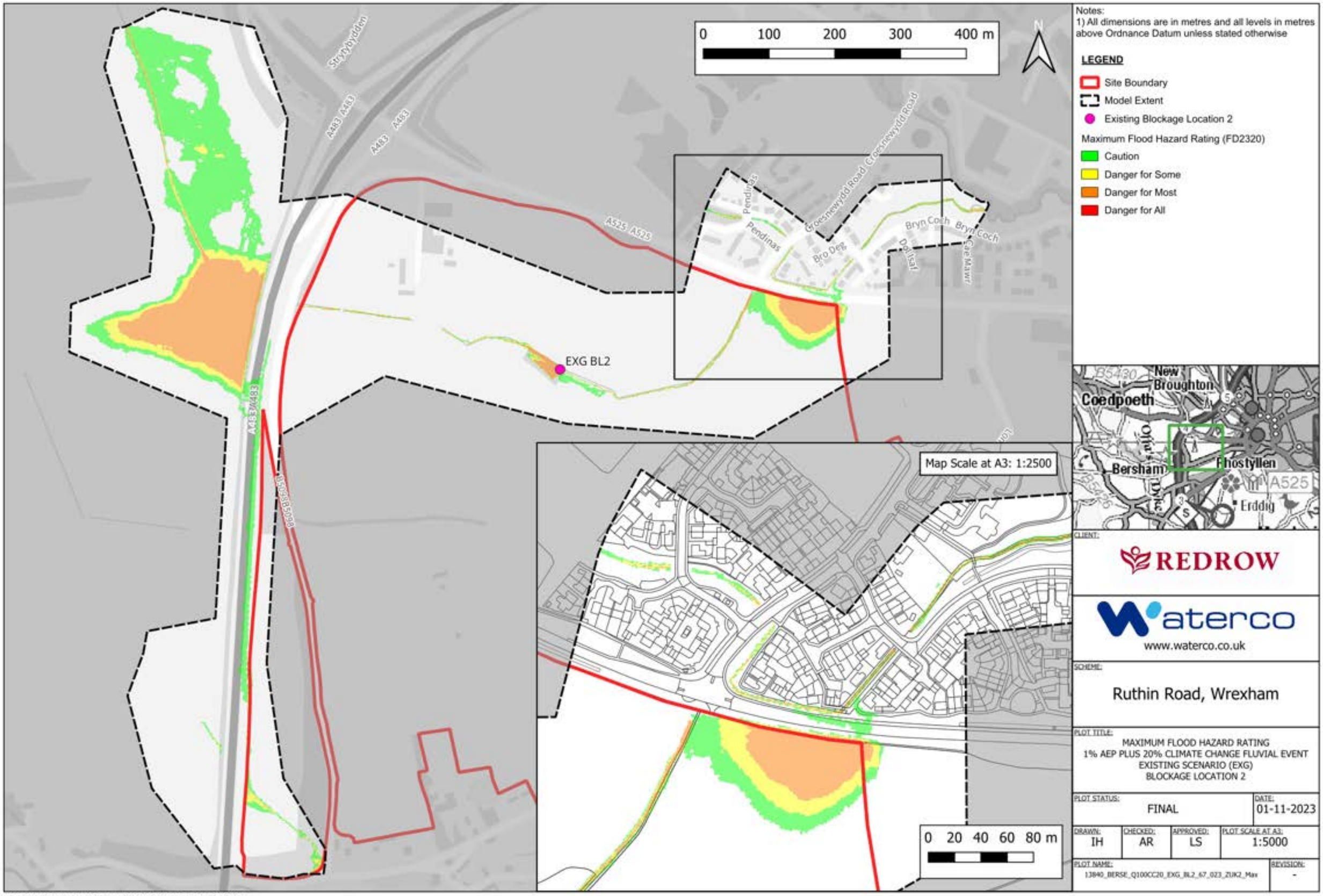
PLOT TITLE: MAXIMUM FLOOD HAZARD RATING
0.1% AEP FLUVIAL EVENT
EXISTING SCENARIO (EXG)
BLOCKAGE LOCATION 1 (BL1)

PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q1000_EXG_BL1_67_023_ZUK2_Max
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LEGEND

- Site Boundary
- Model Extent
- Existing Blockage Location 2

Maximum Flood Hazard Rating (FD2320)

- Caution
- Danger for Some
- Danger for Most
- Danger for All

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SCHEME: Ruthin Road, Wrexham

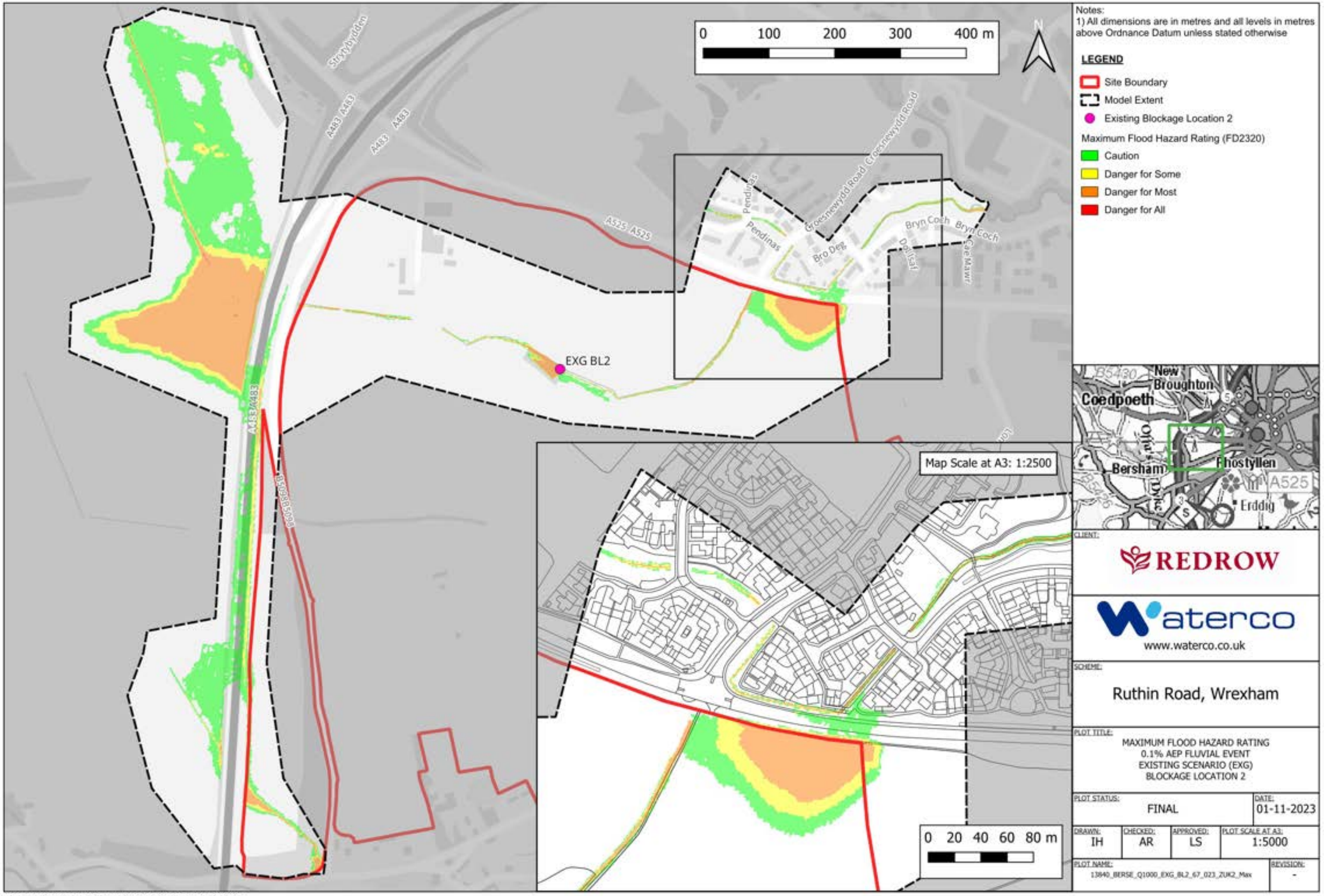
PLOT TITLE: MAXIMUM FLOOD HAZARD RATING
1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
EXISTING SCENARIO (EXG)
BLOCKAGE LOCATION 2

PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q100CC20_EXG_BL2_67_023_ZUK2_Max
REVISION: -

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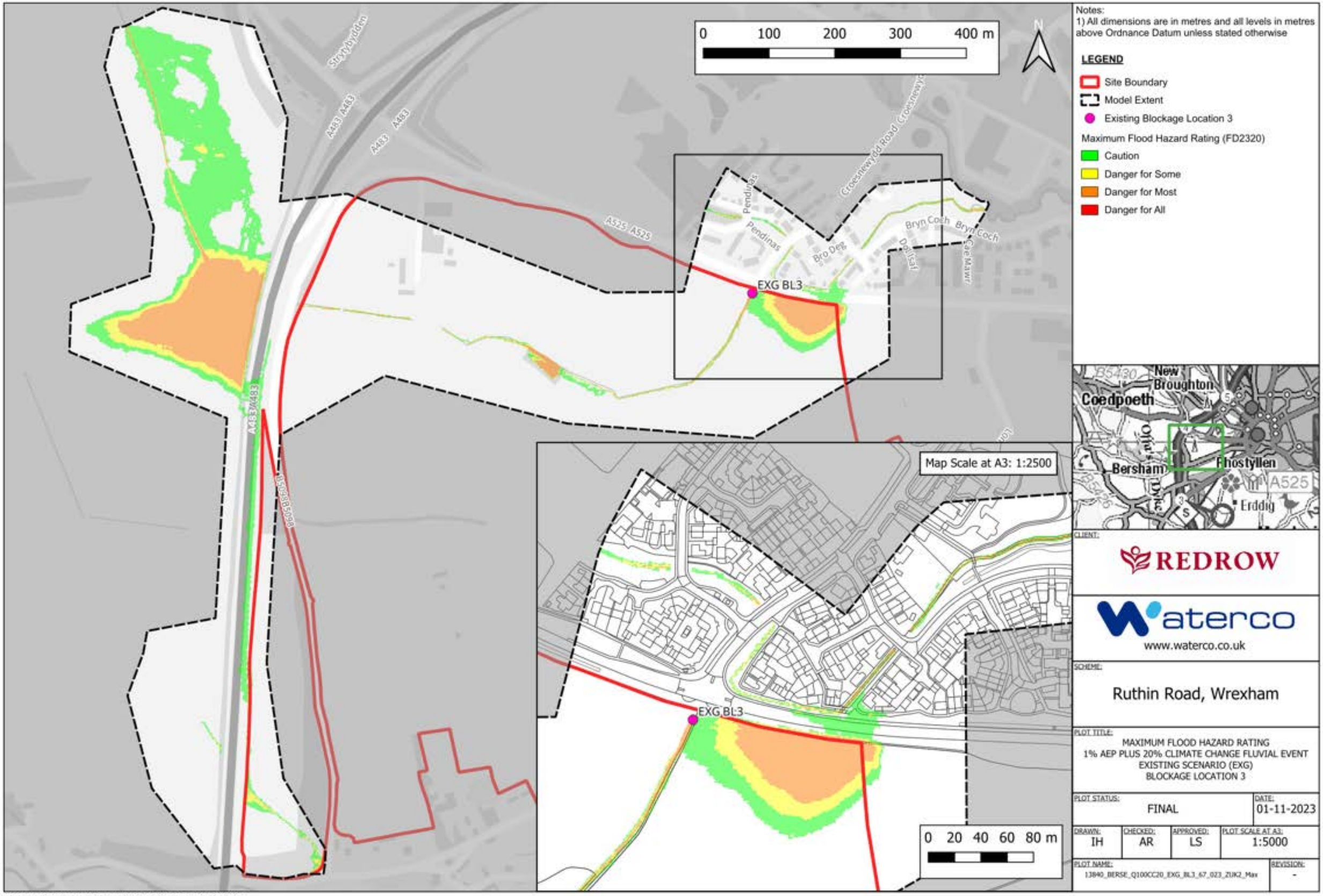
SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD HAZARD RATING
0.1% AEP FLUVIAL EVENT
EXISTING SCENARIO (EXG)
BLOCKAGE LOCATION 2

PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q1000_EXG_BL2_67_023_ZUR2_Max
REVISION: -



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SCHEME: Ruthin Road, Wrexham

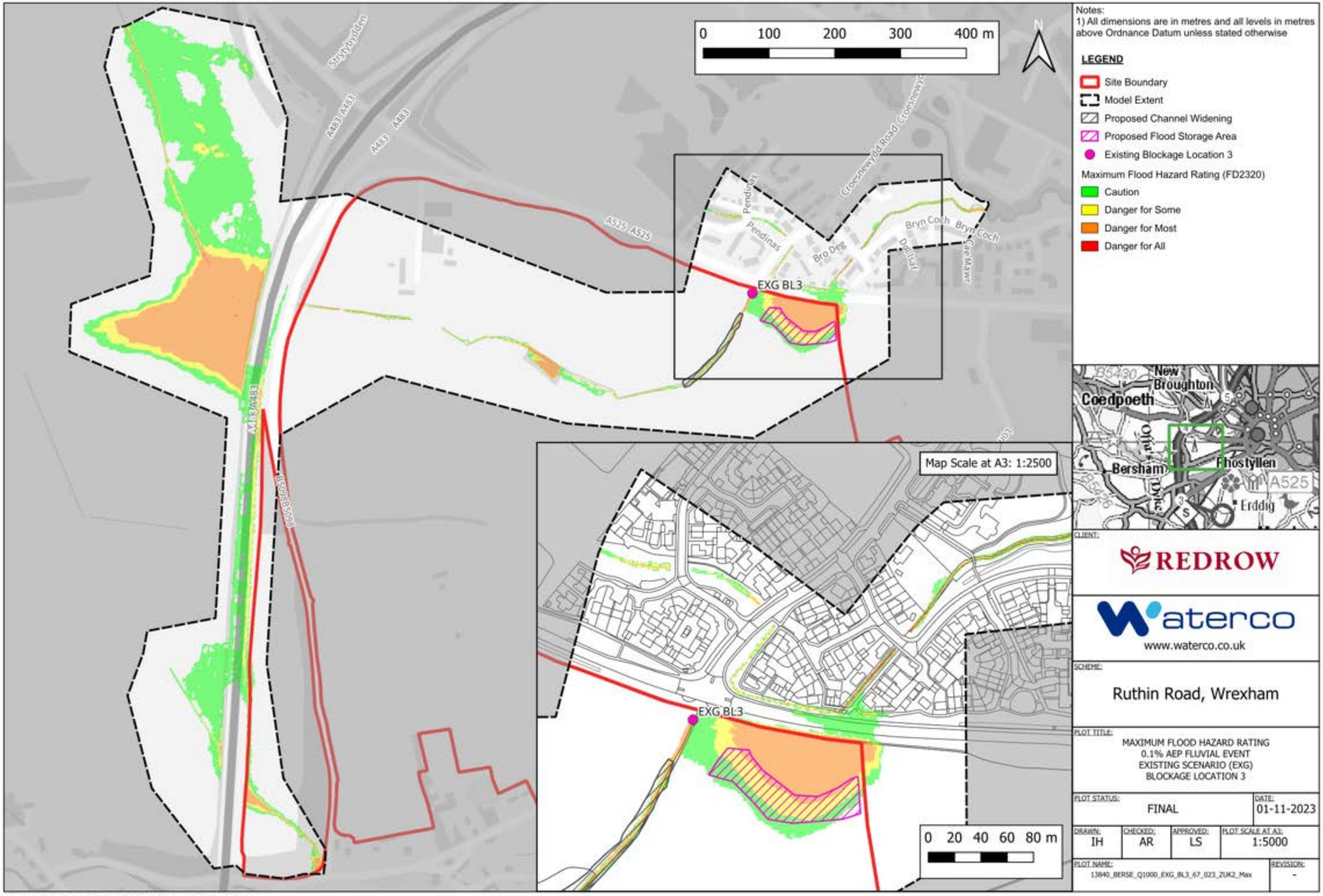
PLOT TITLE: MAXIMUM FLOOD HAZARD RATING
1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
EXISTING SCENARIO (EXG)
BLOCKAGE LOCATION 3

PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q100CC20_EXG_BL3_67_023_ZUK2_Max
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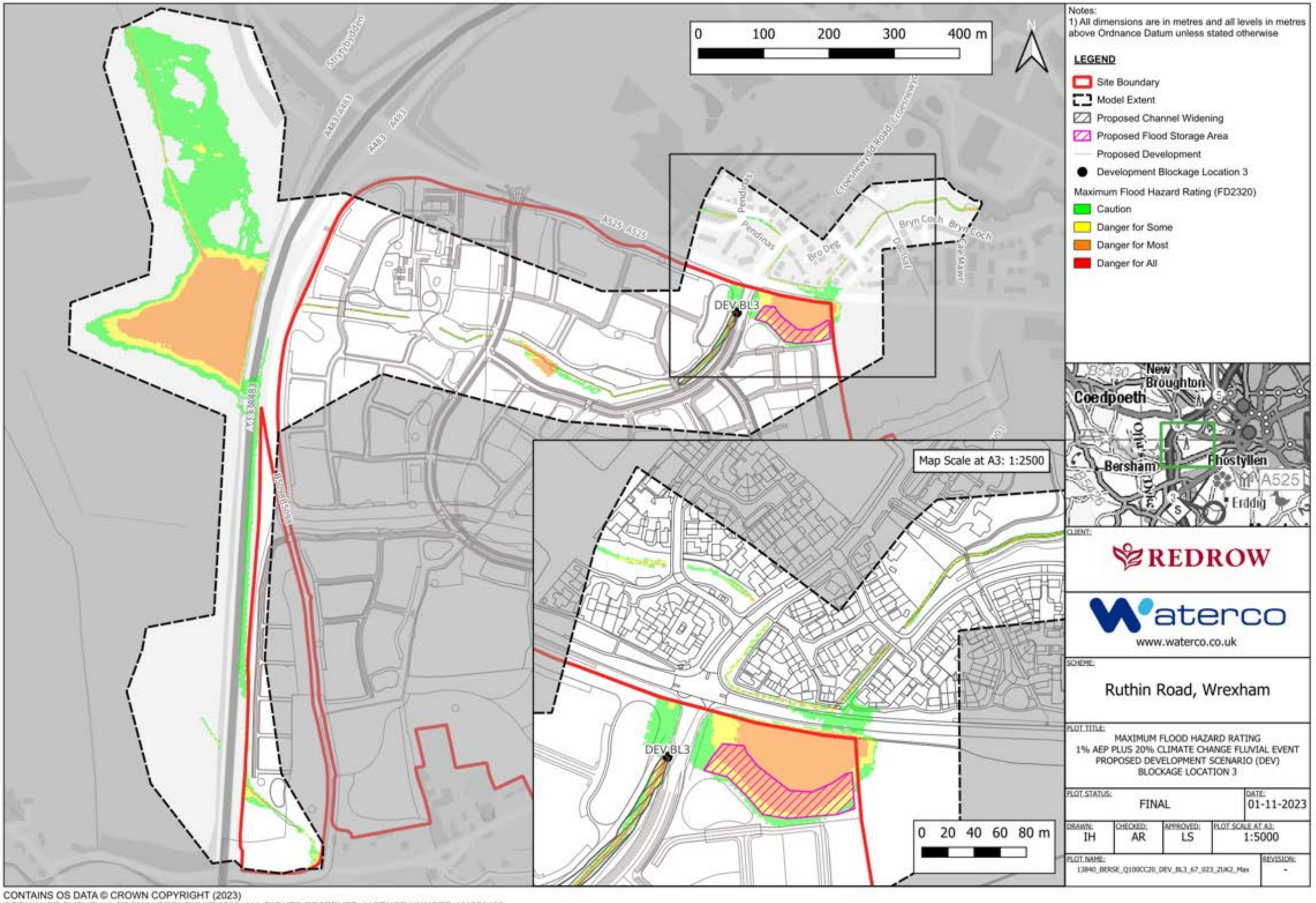
PLOT TITLE: MAXIMUM FLOOD HAZARD RATING
0.1% AEP FLUVIAL EVENT
EXISTING SCENARIO (EXG)
BLOCKAGE LOCATION 3

PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q1000_EXG_BL3_67_023_ZUK2_Max
REVISION: -

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Notes:
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LEGEND

- Site Boundary
- Model Extent
- Proposed Channel Widening
- Proposed Flood Storage Area
- Proposed Development
- Development Blockage Location 3

Maximum Flood Hazard Rating (FD2320)

- Caution
- Danger for Some
- Danger for Most
- Danger for All

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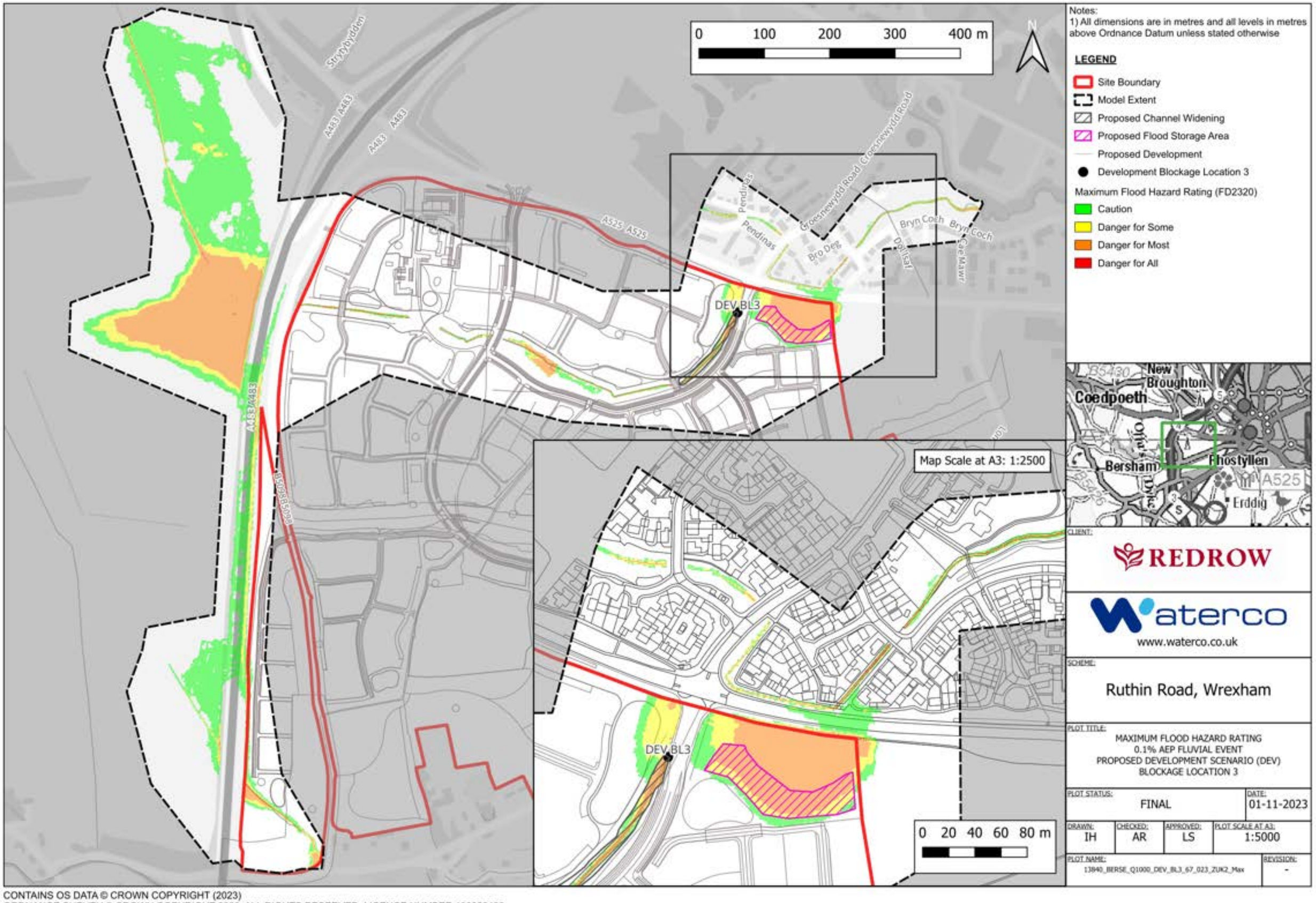
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1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
BLOCKAGE LOCATION 3

PLOT STATUS:			DATE:
FINAL			01-11-2023
DRAWN: IH	CHECKED: AR	APPROVED: LS	PLOT SCALE AT A3: 1:5000

PLOT NAME: 13840_BERSE_Q100CC20_DEV_BL3_67_023_ZUK2_Max

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Notes:
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LEGEND

- Site Boundary
- Model Extent
- Proposed Channel Widening
- Proposed Flood Storage Area
- Proposed Development
- Development Blockage Location 3

Maximum Flood Hazard Rating (FD2320)

- Caution
- Danger for Some
- Danger for Most
- Danger for All

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SCHEME: Ruthin Road, Wrexham

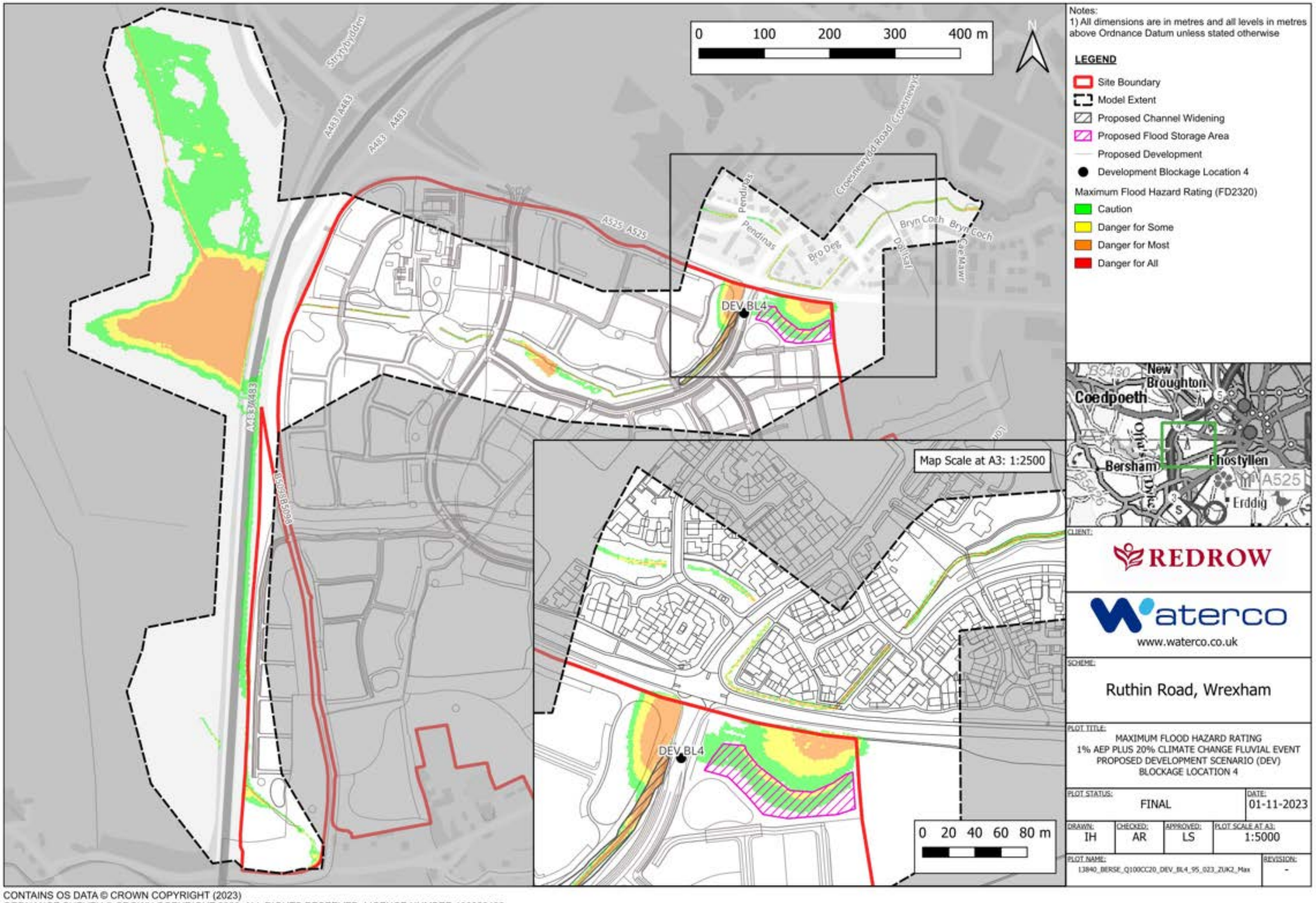
PLOT TITLE: MAXIMUM FLOOD HAZARD RATING
0.1% AEP FLUVIAL EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
BLOCKAGE LOCATION 3

PLOT STATUS:			DATE:
FINAL			01-11-2023
DRAWN: IH	CHECKED: AR	APPROVED: LS	PLOT SCALE AT A3: 1:5000

PLOT NAME: 13840_BERSE_Q1000_DEV_BL3_67_023_ZUK2_Max

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Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Model Extent
- Proposed Channel Widening
- Proposed Flood Storage Area
- Proposed Development
- Development Blockage Location 4

Maximum Flood Hazard Rating (FD2320)

- Caution
- Danger for Some
- Danger for Most
- Danger for All

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SCHEME: Ruthin Road, Wrexham

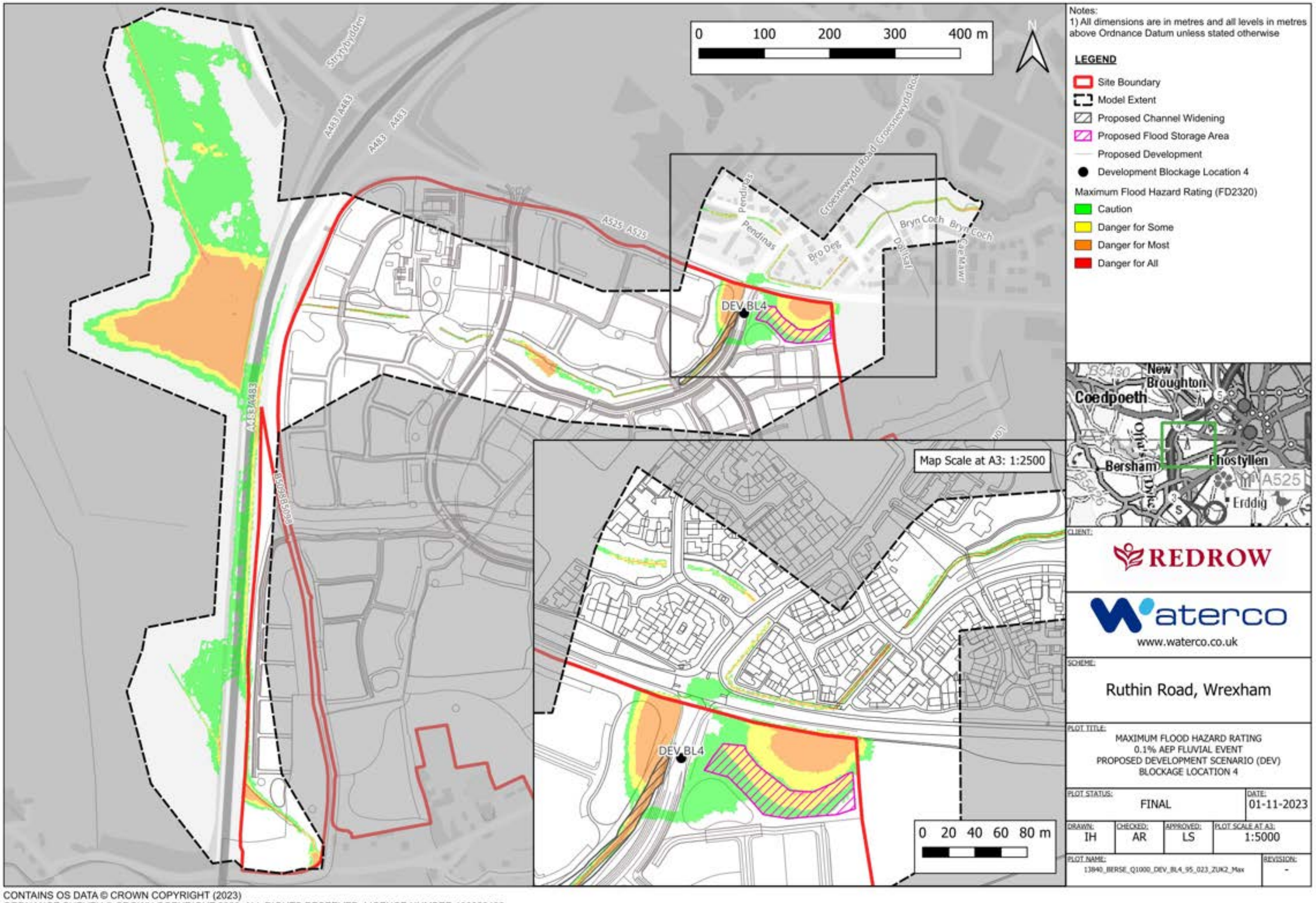
PLOT TITLE: MAXIMUM FLOOD HAZARD RATING
1% AEP PLUS 20% CLIMATE CHANGE FLUVIAL EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
BLOCKAGE LOCATION 4

PLOT STATUS:			DATE:
FINAL			01-11-2023
DRAWN: IH	CHECKED: AR	APPROVED: LS	PLOT SCALE AT A3: 1:5000

PLOT NAME: I3840_BERSE_Q100CC20_DEV_BL4_95_023_ZUK2_Max

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SCHEME: Ruthin Road, Wrexham

PLOT TITLE: MAXIMUM FLOOD HAZARD RATING
0.1% AEP FLUVIAL EVENT
PROPOSED DEVELOPMENT SCENARIO (DEV)
BLOCKAGE LOCATION 4

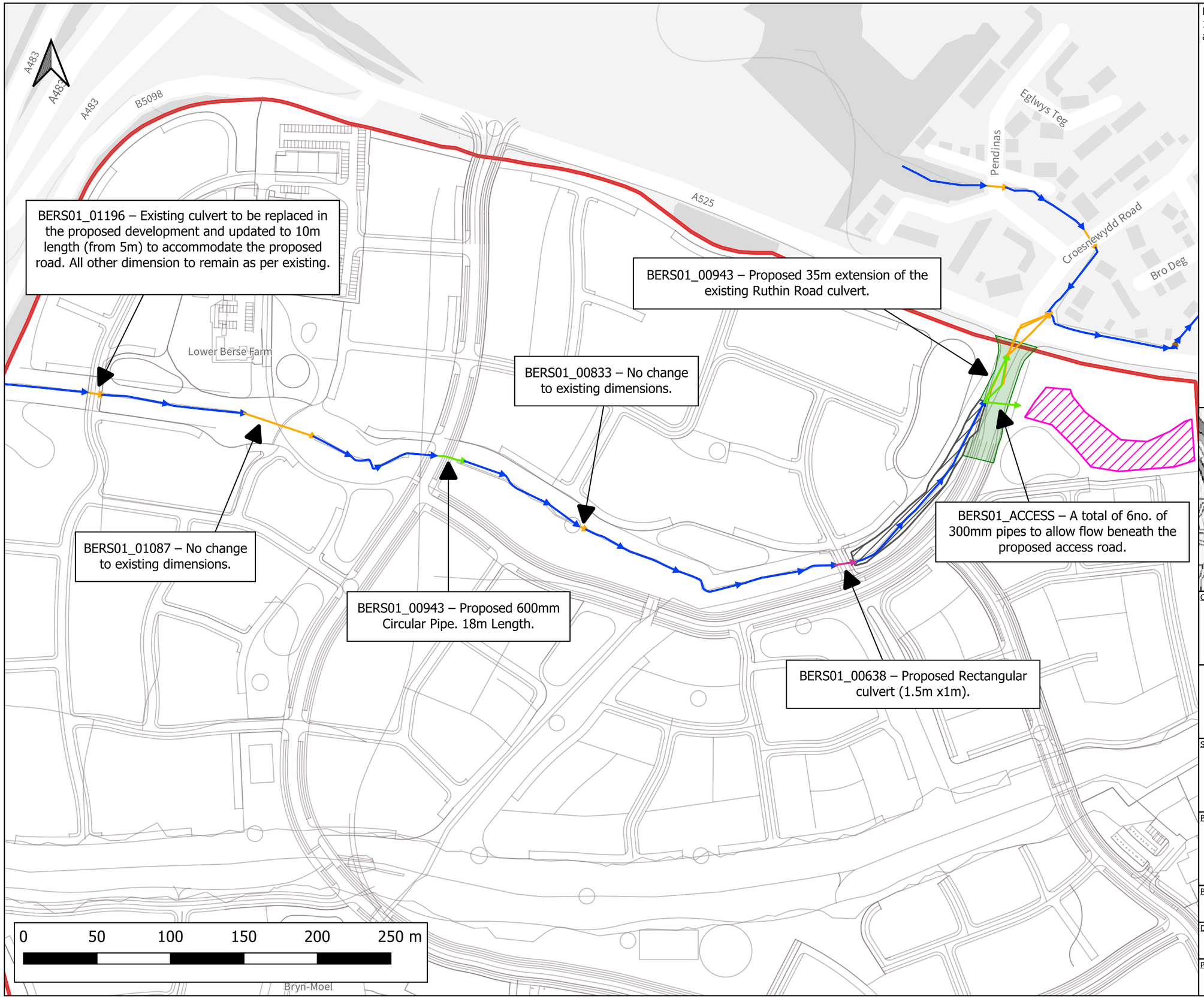
PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:5000

PLOT NAME: 13840_BERSE_Q1000_DEV_BL4_95_023_ZUK2_Max

REVISION: -

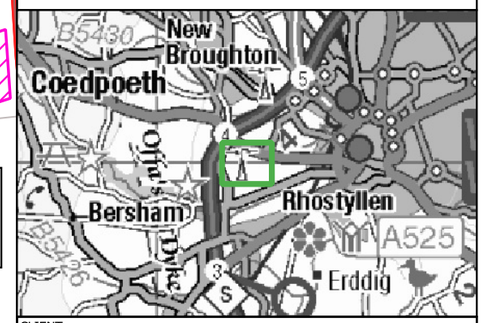
Appendix H Flood Mitigation Proposals Plan



Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Proposed Development
- Proposed Access Road
- Proposed Channel Widening
- Proposed Flood Storage Area
- Channel
- Bridge
- Proposed Circular Culvert
- Existing Circular Culvert
- Proposed Rectangular Culvert



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SCHEME: Ruthin Road, Wrexham

PLOT TITLE: Proposed Layout Plan

PLOT STATUS:	DATE:
FINAL	01-11-2023

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
IH	AR	LS	1:2500

PLOT NAME:	REVISION:
13840_Proposed_Layout_Plan	-

CONTAINS OS DATA © CROWN COPYRIGHT (2023)

Appendix I ReFH2 Greenfield Runoff Rates

DOCUMENT VERIFICATION RECORD	
Project:	13840 – Ruthin Road (Development Parcel A)
Client:	Redrow Homes Ltd
Report Title:	13840-FCA & Drainage Strategy-01
Date:	24/11/2022

DOCUMENT REVIEW & APPROVAL	
Author:	Paige Blundell BSc (Hons) PGCE
Checker:	Aled Williams BSc (Hons) MCIWEM C.WEM
Approver:	Mike Wellington BEng (Hons) MSc CEng CEnv FICE FCIWEM C.WEM IMaPS MAPM

ReFH2 RUNOFF RATES*	
Return Period (Years)	**As-rural Peak Flow (l/s)**
1	4.691655
2	5.455742
5	8.216777
10	10.52715
30	15.1625
50	17.82962
75	20.18681
100	21.98384
200	26.67986
1000	39.39378

*Runoff Rates printed from the ReFH Flood Modelling software package

DOCUMENT VERIFICATION RECORD	
Project:	13840 – Ruthin Road (Development Parcel B)
Client:	Redrow Homes Ltd
Report Title:	13840-FCA & Drainage Strategy-01
Date:	24/11/2022

DOCUMENT REVIEW & APPROVAL	
Author:	Paige Blundell BSc (Hons) PGCE
Checker:	Aled Williams BSc (Hons) MCIWEM C.WEM
Approver:	Mike Wellington BEng (Hons) MSc CEng CEnv FICE FCIWEM C.WEM IMaPS MAPM

ReFH2 RUNOFF RATES*	
Return Period (Years)	**As-rural Peak Flow (l/s)**
1	1.4279
2	1.660538
5	2.501262
10	3.204851
30	4.616686
50	5.429143
75	6.14724
100	6.694721
200	8.125514
1000	11.99984

*Runoff Rates printed from the ReFH Flood Modelling software package

DOCUMENT VERIFICATION RECORD	
Project:	13840 – Ruthin Road (Development Parcel C)
Client:	Redrow Homes Ltd
Report Title:	13840-FCA & Drainage Strategy-01
Date:	24/11/2022

DOCUMENT REVIEW & APPROVAL	
Author:	Paige Blundell BSc (Hons) PGCE
Checker:	Aled Williams BSc (Hons) MCIWEM C.WEM
Approver:	Mike Wellington BEng (Hons) MSc CEng CEnv FICE FCIWEM C.WEM IMaPS MAPM

ReFH2 RUNOFF RATES*	
Return Period (Years)	**As-rural Peak Flow (l/s)**
1	5.692432
2	6.619434
5	9.969091
10	12.77193
30	18.39517
50	21.63062
75	24.49005
100	26.66996
200	32.3664
1000	47.78833

*Runoff Rates printed from the ReFH Flood Modelling software package

DOCUMENT VERIFICATION RECORD	
Project:	13840 – Ruthin Road (Development Parcel D)
Client:	Redrow Homes Ltd
Report Title:	13840-FCA & Drainage Strategy-01
Date:	24/11/2022

DOCUMENT REVIEW & APPROVAL	
Author:	Paige Blundell BSc (Hons) PGCE
Checker:	Aled Williams BSc (Hons) MCIWEM C.WEM
Approver:	Mike Wellington BEng (Hons) MSc CEng CEnv FICE FCIWEM C.WEM IMaPS MAPM

ReFH2 RUNOFF RATES*	
Return Period (Years)	**As-rural Peak Flow (l/s)**
1	10.83163
2	12.59501
5	18.96632
10	24.29699
30	34.99047
50	41.14258
75	46.57938
100	50.72396
200	61.55378
1000	90.86942

*Runoff Rates printed from the ReFH Flood Modelling software package

DOCUMENT VERIFICATION RECORD	
Project:	13840 – Ruthin Road (Development Parcel E)
Client:	Redrow Homes Ltd
Report Title:	13840-FCA & Drainage Strategy-01
Date:	24/11/2022

DOCUMENT REVIEW & APPROVAL	
Author:	Paige Blundell BSc (Hons) PGCE
Checker:	Aled Williams BSc (Hons) MCIWEM C.WEM
Approver:	Mike Wellington BEng (Hons) MSc CEng CEnv FICE FCIWEM C.WEM IMaPS MAPM

ReFH2 RUNOFF RATES*	
Return Period (Years)	**As-rural Peak Flow (l/s)**
1	2.322591
2	2.700943
5	4.068209
10	5.212401
30	7.508236
50	8.829339
75	9.996978
100	10.88717
200	13.21356
1000	19.51262

*Runoff Rates printed from the ReFH Flood Modelling software package

DOCUMENT VERIFICATION RECORD	
Project:	13840 – Ruthin Road (Development Parcel F)
Client:	Redrow Homes Ltd
Report Title:	13840-FCA & Drainage Strategy-01
Date:	24/11/2022

DOCUMENT REVIEW & APPROVAL	
Author:	Paige Blundell BSc (Hons) PGCE
Checker:	Aled Williams BSc (Hons) MCIWEM C.WEM
Approver:	Mike Wellington BEng (Hons) MSc CEng CEnv FICE FCIWEM C.WEM IMaPS MAPM

ReFH2 RUNOFF RATES*	
Return Period (Years)	**As-rural Peak Flow (l/s)**
1	6.401623
2	7.444063
5	11.2108
10	14.36257
30	20.68574
50	24.32386
75	27.53913
100	29.99028
200	36.39549
1000	53.73588

*Runoff Rates printed from the ReFH Flood Modelling software package

DOCUMENT VERIFICATION RECORD	
Project:	13840 – Ruthin Road (Development Parcel G)
Client:	Redrow Homes Ltd
Report Title:	13840-FCA & Drainage Strategy-01
Date:	24/11/2022

DOCUMENT REVIEW & APPROVAL	
Author:	Paige Blundell BSc (Hons) PGCE
Checker:	Aled Williams BSc (Hons) MCIWEM C.WEM
Approver:	Mike Wellington BEng (Hons) MSc CEng CEnv FICE FCIWEM C.WEM IMaPS MAPM

ReFH2 RUNOFF RATES*	
Return Period (Years)	**As-rural Peak Flow (l/s)**
1	1.610591
2	1.872985
5	2.821236
10	3.614805
30	5.207176
50	6.123513
75	6.933422
100	7.550898
200	9.164605
1000	13.53418

*Runoff Rates printed from the ReFH Flood Modelling software package

DOCUMENT VERIFICATION RECORD	
Project:	13840 – Ruthin Road (Development Parcel H)
Client:	Redrow Homes Ltd
Report Title:	13840-FCA & Drainage Strategy-01
Date:	24/11/2022

DOCUMENT REVIEW & APPROVAL	
Author:	Paige Blundell BSc (Hons) PGCE
Checker:	Aled Williams BSc (Hons) MCIWEM C.WEM
Approver:	Mike Wellington BEng (Hons) MSc CEng CEnv FICE FCIWEM C.WEM IMaPS MAPM

ReFH2 RUNOFF RATES*	
Return Period (Years)	**As-rural Peak Flow (l/s)**
1	2.778643
2	3.23126
5	4.866879
10	6.235613
30	8.981936
50	10.56224
75	11.95895
100	13.02378
200	15.80651
1000	23.34101

*Runoff Rates printed from the ReFH Flood Modelling software package

DOCUMENT VERIFICATION RECORD	
Project:	13840 – Ruthin Road (Development Parcel I)
Client:	Redrow Homes Ltd
Report Title:	13840-FCA & Drainage Strategy-01
Date:	24/11/2022

DOCUMENT REVIEW & APPROVAL	
Author:	Paige Blundell BSc (Hons) PGCE
Checker:	Aled Williams BSc (Hons) MCIWEM C.WEM
Approver:	Mike Wellington BEng (Hons) MSc CEng CEnv FICE FCIWEM C.WEM IMaPS MAPM

ReFH2 RUNOFF RATES*	
Return Period (Years)	**As-rural Peak Flow (l/s)**
1	3.36204
2	3.909652
5	5.888519
10	7.544457
30	10.86697
50	12.77878
75	14.46846
100	15.75664
200	19.123
1000	3.36204

*Runoff Rates printed from the ReFH Flood Modelling software package

DOCUMENT VERIFICATION RECORD	
Project:	13840 – Ruthin Road (Development Parcel J)
Client:	Redrow Homes Ltd
Report Title:	13840-FCA & Drainage Strategy-01
Date:	24/11/2022

DOCUMENT REVIEW & APPROVAL	
Author:	Paige Blundell BSc (Hons) PGCE
Checker:	Aled Williams BSc (Hons) MCIWEM C.WEM
Approver:	Mike Wellington BEng (Hons) MSc CEng CEnv FICE FCIWEM C.WEM IMaPS MAPM

ReFH2 RUNOFF RATES*	
Return Period (Years)	**As-rural Peak Flow (l/s)**
1	6.437982
2	7.486341
5	11.27446
10	14.44412
30	20.80317
50	24.46193
75	27.69544
100	30.1605
200	36.60205
1000	54.04077

*Runoff Rates printed from the ReFH Flood Modelling software package

DOCUMENT VERIFICATION RECORD	
Project:	13840 – Ruthin Road (Development Parcel K)
Client:	Redrow Homes Ltd
Report Title:	13840-FCA & Drainage Strategy-01
Date:	31/05/2023

DOCUMENT REVIEW & APPROVAL	
Author:	Paige Blundell BSc (Hons) PGCE
Checker:	Aled Williams BSc (Hons) MCIWEM C.WEM
Approver:	Mike Wellington BEng (Hons) MSc CEng CEnv FICE FCIWEM C.WEM IMaPS MAPM

ReFH2 RUNOFF RATES*	
Return Period (Years)	**As-rural Peak Flow (l/s)**
1	6.861555
2	7.979384
5	12.01901
10	15.39964
30	22.1831
50	26.08662
75	29.53675
100	32.16712
200	39.04126
1000	57.65466

*Runoff Rates printed from the ReFH Flood Modelling software package

DOCUMENT VERIFICATION RECORD	
Project:	13840 – Ruthin Road (Development Parcel L)
Client:	Redrow Homes Ltd
Report Title:	13840-FCA & Drainage Strategy-01
Date:	31/05/2023

DOCUMENT REVIEW & APPROVAL	
Author:	Paige Blundell BSc (Hons) PGCE
Checker:	Aled Williams BSc (Hons) MCIWEM C.WEM
Approver:	Mike Wellington BEng (Hons) MSc CEng CEnv FICE FCIWEM C.WEM IMaPS MAPM

ReFH2 RUNOFF RATES*	
Return Period (Years)	**As-rural Peak Flow (l/s)**
1	3.933958
2	4.574847
5	6.890901
10	8.829128
30	12.71831
50	14.95633
75	16.9344
100	18.44248
200	22.38365
1000	33.05534

*Runoff Rates printed from the ReFH Flood Modelling software package

DOCUMENT VERIFICATION RECORD	
Project:	13840 – Ruthin Road (Development Parcel M)
Client:	Redrow Homes Ltd
Report Title:	13840-FCA & Drainage Strategy-01
Date:	24/11/2022

DOCUMENT REVIEW & APPROVAL	
Author:	Paige Blundell BSc (Hons) PGCE
Checker:	Aled Williams BSc (Hons) MCIWEM C.WEM
Approver:	Mike Wellington BEng (Hons) MSc CEng CEnv FICE FCIWEM C.WEM IMaPS MAPM

ReFH2 RUNOFF RATES*	
Return Period (Years)	**As-rural Peak Flow (l/s)**
1	5.36499
2	6.23869
5	9.395766
10	12.03748
30	17.33752
50	20.38704
75	23.08216
100	25.1368
200	30.50596
1000	45.04196

*Runoff Rates printed from the ReFH Flood Modelling software package

DOCUMENT VERIFICATION RECORD	
Project:	13840 – Ruthin Road (Development Parcel N)
Client:	Redrow Homes Ltd
Report Title:	13840-FCA & Drainage Strategy-01
Date:	24/11/2022

DOCUMENT REVIEW & APPROVAL	
Author:	Paige Blundell BSc (Hons) PGCE
Checker:	Aled Williams BSc (Hons) MCIWEM C.WEM
Approver:	Mike Wellington BEng (Hons) MSc CEng CEnv FICE FCIWEM C.WEM IMaPS MAPM

ReFH2 RUNOFF RATES*	
Return Period (Years)	**As-rural Peak Flow (l/s)**
1	3.453163
2	4.015612
5	6.048089
10	7.748883
30	11.16138
50	13.12496
75	14.8604
100	16.18346
200	19.64097
1000	29.00222

*Runoff Rates printed from the ReFH Flood Modelling software package

DOCUMENT VERIFICATION RECORD	
Project:	13840 – Ruthin Road (Development Parcel O)
Client:	Redrow Homes Ltd
Report Title:	13840-Drainage Strategy-01
Date:	01/07/2024

DOCUMENT REVIEW & APPROVAL	
Author:	Megan Williams BSc (Hons) MSc MCIWEM
Checker:	Aled Williams BSc (Hons) MCIWEM C.WEM
Approver:	Mike Wellington BEng (Hons) MSc CEng CEnv FICE FCIWEM C.WEM IMaPS MAPM

ReFH2 RUNOFF RATES*	
Return Period (Years)	**As-rural Peak Flow (l/s)**
1	4.37
2	50.8
5	7.66
10	9.81
30	14.13
50	16.62
75	18.82
100	20.50
200	24.88
1000	36.74

*Runoff Rates printed from the ReFH Flood Modelling software package

DOCUMENT VERIFICATION RECORD	
Project:	13840 – Ruthin Road (School)
Client:	Redrow Homes Ltd
Report Title:	13840-FCA & Drainage Strategy-01
Date:	24/11/2022

DOCUMENT REVIEW & APPROVAL	
Author:	Paige Blundell BSc (Hons) PGCE
Checker:	Aled Williams BSc (Hons) MCIWEM C.WEM
Approver:	Mike Wellington BEng (Hons) MSc CEng CEnv FICE FCIWEM C.WEM IMaPS MAPM

ReFH2 RUNOFF RATES*	
Return Period (Years)	**As-rural Peak Flow (l/s)**
1	2.960995
2	3.443305
5	5.186217
10	6.644726
30	9.571158
50	11.25509
75	12.74338
100	13.87803
200	16.84319
1000	24.87161

*Runoff Rates printed from the ReFH Flood Modelling software package

DOCUMENT VERIFICATION RECORD	
Project:	13840 – Ruthin Road (Local Centre Re-development)
Client:	Redrow Homes Ltd
Report Title:	13840-FCA & Drainage Strategy-01
Date:	24/11/2022

DOCUMENT REVIEW & APPROVAL	
Author:	Paige Blundell BSc (Hons) PGCE
Checker:	Aled Williams BSc (Hons) MCIWEM C.WEM
Approver:	Mike Wellington BEng (Hons) MSc CEng CEnv FICE FCIWEM C.WEM IMaPS MAPM

ReFH2 RUNOFF RATES*	
Return Period (Years)	**As-rural Peak Flow (l/s)**
1	2.669214
2	3.104011
5	4.675241
10	5.990099
30	8.628335
50	10.14644
75	11.48819
100	12.51112
200	15.18436
1000	22.42245

*Runoff Rates printed from the ReFH Flood Modelling software package

Appendix J MicroDrainage Storage Estimates

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.330	0.330	4.7	396.5	O K
30 min Summer	9.451	0.451	4.7	541.3	O K
60 min Summer	9.590	0.590	4.7	707.4	O K
120 min Summer	9.699	0.699	4.7	839.2	O K
180 min Summer	9.760	0.760	4.7	911.9	Flood Risk
240 min Summer	9.800	0.800	4.7	960.6	Flood Risk
360 min Summer	9.853	0.853	4.7	1023.8	Flood Risk
480 min Summer	9.886	0.886	4.7	1062.7	Flood Risk
600 min Summer	9.906	0.906	4.7	1087.7	Flood Risk
720 min Summer	9.920	0.920	4.7	1103.7	Flood Risk
960 min Summer	9.932	0.932	4.7	1118.6	Flood Risk
1440 min Summer	9.923	0.923	4.7	1108.1	Flood Risk
2160 min Summer	9.878	0.878	4.7	1053.5	Flood Risk
2880 min Summer	9.836	0.836	4.7	1002.9	Flood Risk
4320 min Summer	9.759	0.759	4.7	910.6	Flood Risk
5760 min Summer	9.698	0.698	4.7	837.9	O K
7200 min Summer	9.661	0.661	4.7	792.8	O K
8640 min Summer	9.636	0.636	4.7	762.9	O K
10080 min Summer	9.623	0.623	4.7	748.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	155.452	0.0	338.3	17
30 min Summer	106.486	0.0	395.0	32
60 min Summer	69.995	0.0	675.3	62
120 min Summer	41.971	0.0	748.7	122
180 min Summer	30.743	0.0	744.9	182
240 min Summer	24.555	0.0	737.0	242
360 min Summer	17.821	0.0	724.1	362
480 min Summer	14.163	0.0	714.7	482
600 min Summer	11.834	0.0	707.4	602
720 min Summer	10.209	0.0	701.1	722
960 min Summer	8.073	0.0	690.7	960
1440 min Summer	5.765	0.0	674.6	1440
2160 min Summer	4.088	0.0	1401.5	1884
2880 min Summer	3.199	0.0	1359.6	2276
4320 min Summer	2.258	0.0	1233.7	3028
5760 min Summer	1.778	0.0	1750.1	3872
7200 min Summer	1.508	0.0	1852.8	4752
8640 min Summer	1.337	0.0	1967.2	5536
10080 min Summer	1.225	0.0	2091.5	6360

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	9.330	0.330	4.7	396.4	O K
30 min Winter	9.451	0.451	4.7	541.2	O K
60 min Winter	9.589	0.589	4.7	707.3	O K
120 min Winter	9.699	0.699	4.7	838.8	O K
180 min Winter	9.760	0.760	4.7	911.7	Flood Risk
240 min Winter	9.800	0.800	4.7	960.6	Flood Risk
360 min Winter	9.853	0.853	4.7	1024.1	Flood Risk
480 min Winter	9.886	0.886	4.7	1063.5	Flood Risk
600 min Winter	9.908	0.908	4.7	1089.0	Flood Risk
720 min Winter	9.921	0.921	4.7	1105.6	Flood Risk
960 min Winter	9.935	0.935	4.7	1121.8	Flood Risk
1440 min Winter	9.929	0.929	4.7	1114.3	Flood Risk
2160 min Winter	9.884	0.884	4.7	1060.4	Flood Risk
2880 min Winter	9.831	0.831	4.7	997.7	Flood Risk
4320 min Winter	9.737	0.737	4.7	884.5	Flood Risk
5760 min Winter	9.650	0.650	4.7	779.7	O K
7200 min Winter	9.576	0.576	4.7	691.8	O K
8640 min Winter	9.525	0.525	4.7	630.3	O K
10080 min Winter	9.491	0.491	4.7	589.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	155.452	0.0	338.3	17
30 min Winter	106.486	0.0	395.1	32
60 min Winter	69.995	0.0	675.3	62
120 min Winter	41.971	0.0	749.0	122
180 min Winter	30.743	0.0	745.3	180
240 min Winter	24.555	0.0	737.4	240
360 min Winter	17.821	0.0	724.4	358
480 min Winter	14.163	0.0	715.0	474
600 min Winter	11.834	0.0	707.6	590
720 min Winter	10.209	0.0	701.3	708
960 min Winter	8.073	0.0	690.8	940
1440 min Winter	5.765	0.0	675.0	1386
2160 min Winter	4.088	0.0	1403.1	2032
2880 min Winter	3.199	0.0	1365.2	2308
4320 min Winter	2.258	0.0	1252.6	3240
5760 min Winter	1.778	0.0	1750.5	4160
7200 min Winter	1.508	0.0	1854.2	4976
8640 min Winter	1.337	0.0	1969.9	5792
10080 min Winter	1.225	0.0	2098.1	6648

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 331208 350156 SJ 31208 50156
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.028

Time (mins) From:	To:	Area (ha)
0	2	1.028

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Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 9.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1200.0	1.000	1200.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0102-4700-1000-4700
Design Head (m)	1.000
Design Flow (l/s)	4.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	102
Invert Level (m)	8.995
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

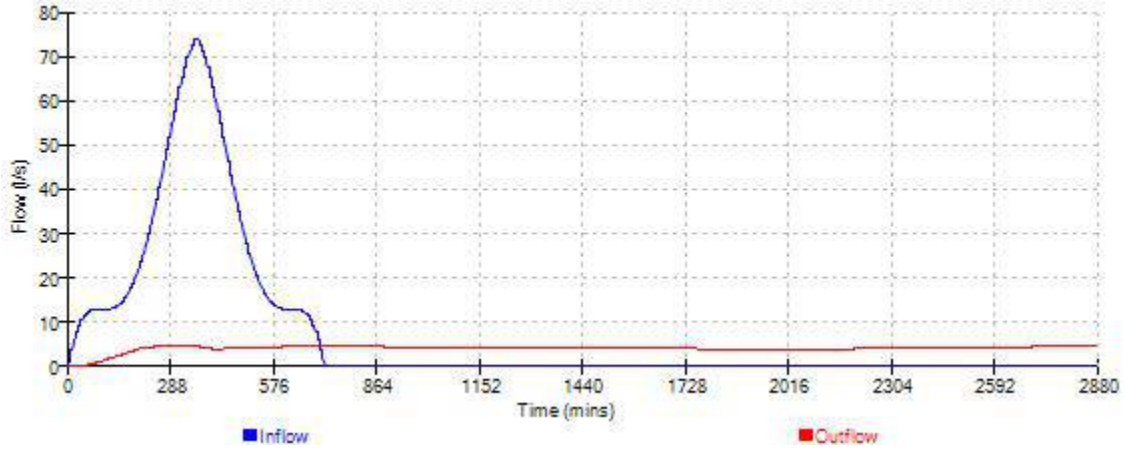
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	4.7
Flush-Flo™	0.299	4.7
Kick-Flo®	0.640	3.8
Mean Flow over Head Range	-	4.1

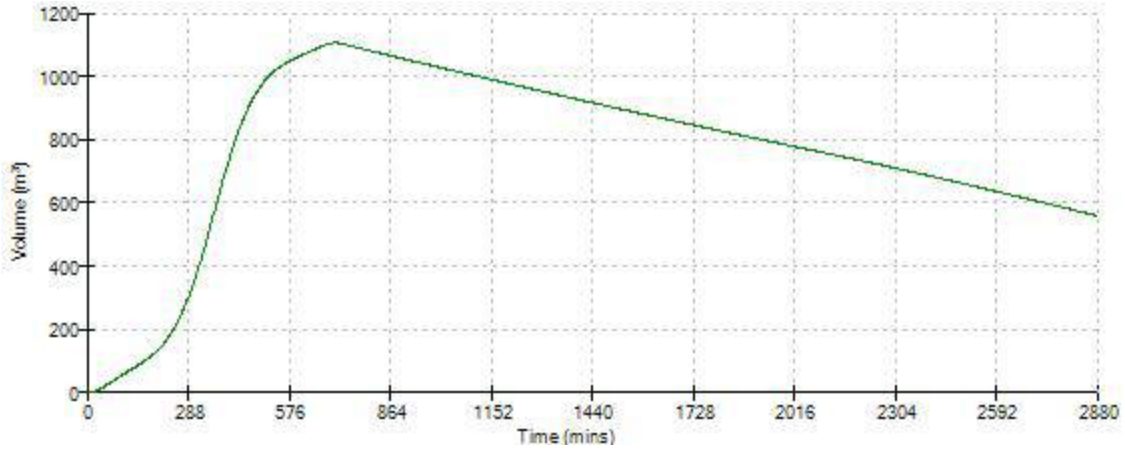
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

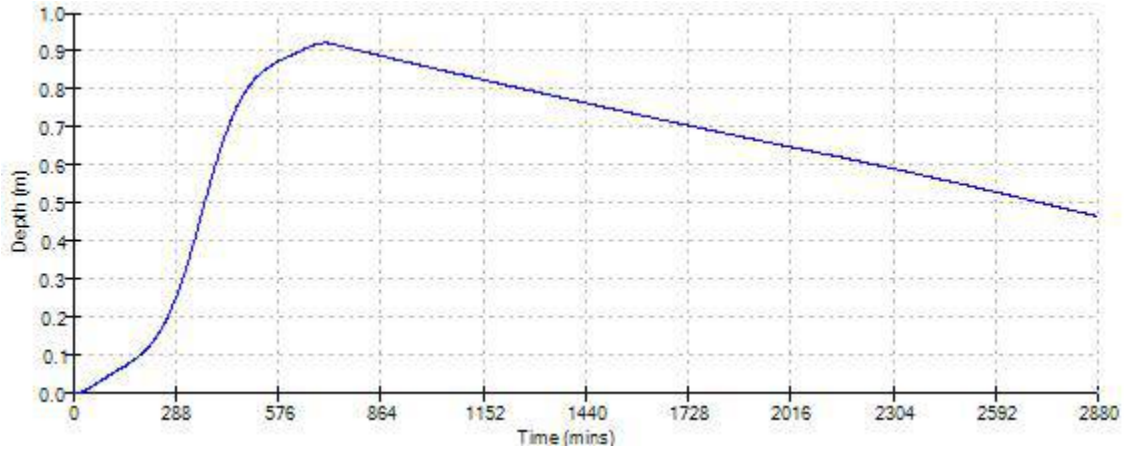
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.4	1.600	5.8	5.000	10.0
0.200	4.6	1.800	6.2	5.500	10.5
0.300	4.7	2.000	6.5	6.000	10.9
0.400	4.6	2.200	6.8	6.500	11.3
0.500	4.5	2.400	7.1	7.000	11.7
0.600	4.1	2.600	7.3	7.500	12.1
0.800	4.2	3.000	7.9	8.000	12.5
1.000	4.7	3.500	8.4	8.500	12.9
1.200	5.1	4.000	9.0	9.000	13.2
1.400	5.5	4.500	9.5	9.500	13.6

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Event: 720 min Winter

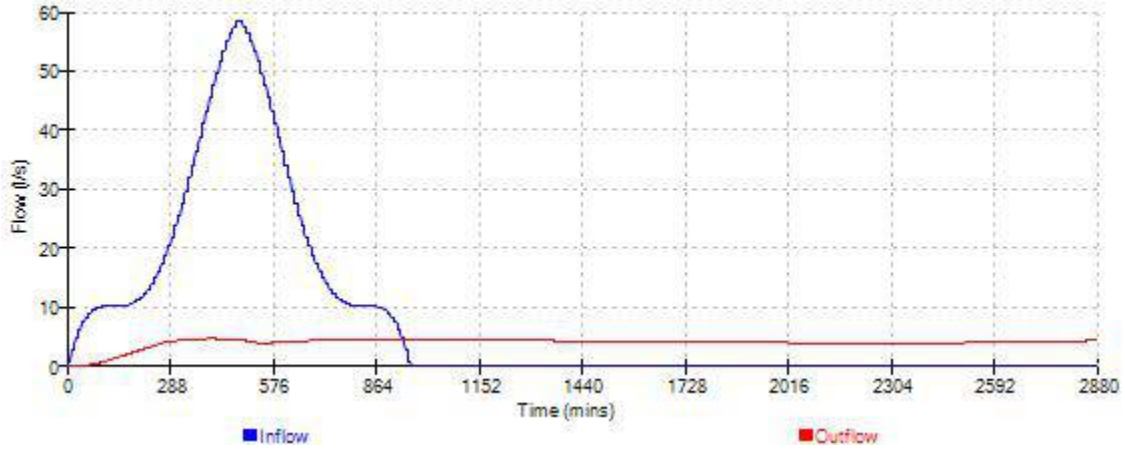


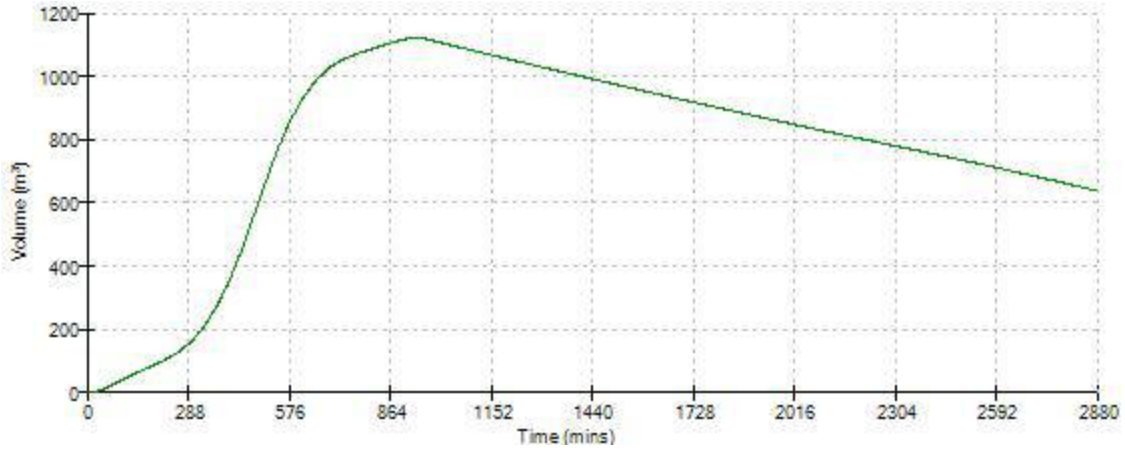


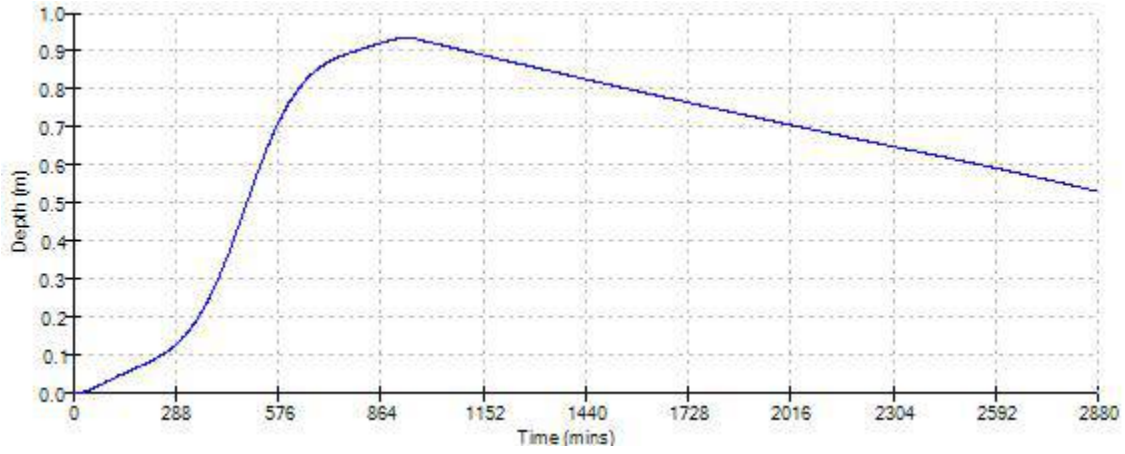


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Event: 960 min Winter

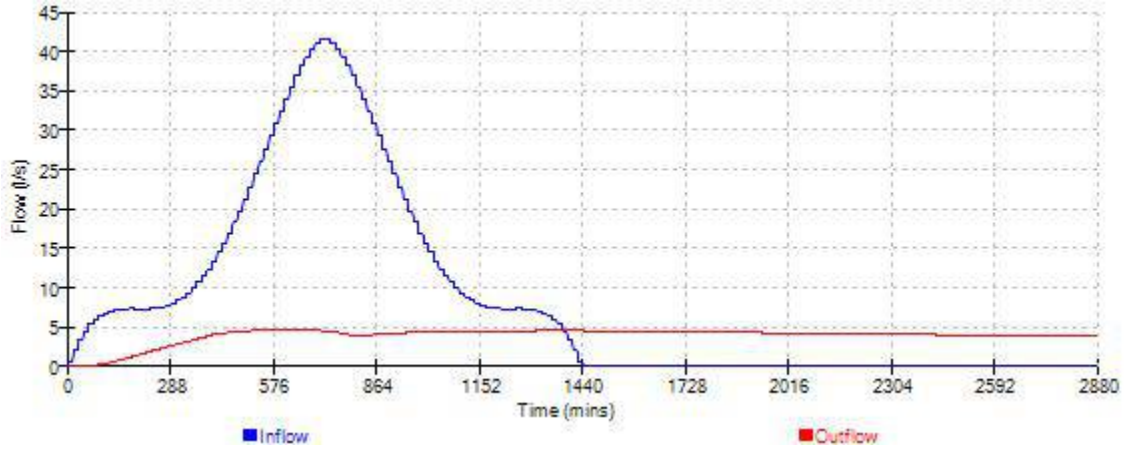


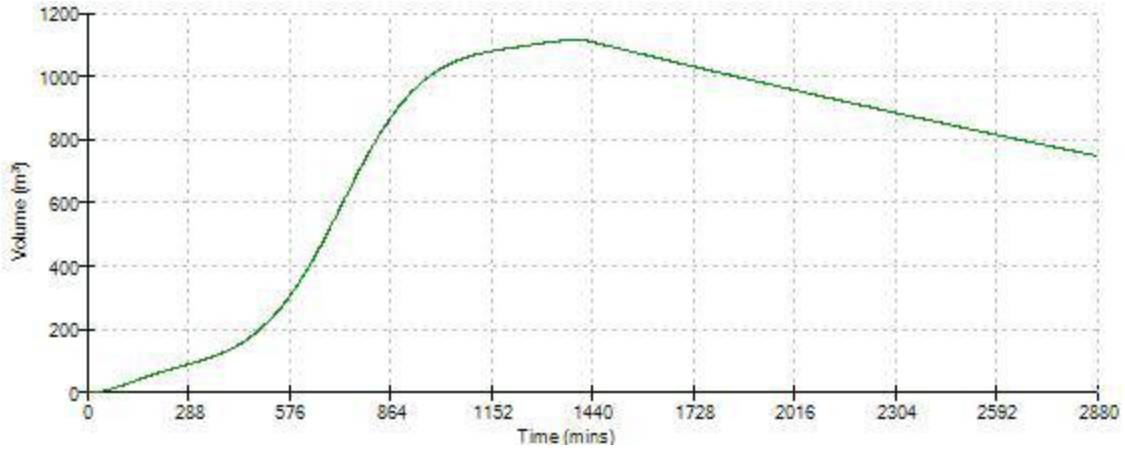


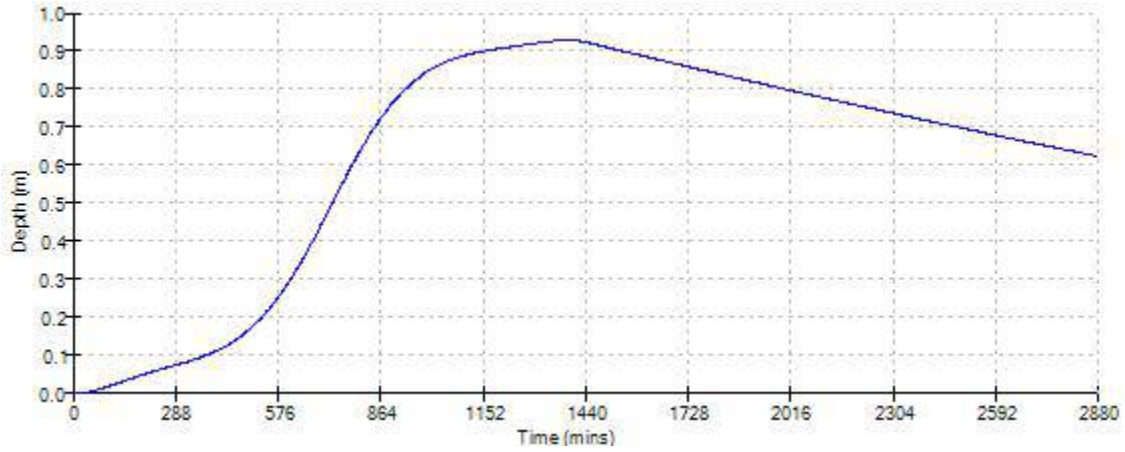


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Event: 1440 min Winter







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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.344	0.344	1.3	120.4	O K
30 min Summer	9.470	0.470	1.3	164.4	O K
60 min Summer	9.614	0.614	1.3	215.0	O K
120 min Summer	9.728	0.728	1.3	254.7	Flood Risk
180 min Summer	9.791	0.791	1.3	276.7	Flood Risk
240 min Summer	9.833	0.833	1.3	291.4	Flood Risk
360 min Summer	9.887	0.887	1.3	310.5	Flood Risk
480 min Summer	9.921	0.921	1.4	322.3	Flood Risk
600 min Summer	9.943	0.943	1.4	329.9	Flood Risk
720 min Summer	9.956	0.956	1.4	334.7	Flood Risk
960 min Summer	9.969	0.969	1.4	339.3	Flood Risk
1440 min Summer	9.960	0.960	1.4	336.1	Flood Risk
2160 min Summer	9.913	0.913	1.3	319.5	Flood Risk
2880 min Summer	9.870	0.870	1.3	304.4	Flood Risk
4320 min Summer	9.793	0.793	1.3	277.6	Flood Risk
5760 min Summer	9.737	0.737	1.3	258.0	Flood Risk
7200 min Summer	9.707	0.707	1.3	247.4	Flood Risk
8640 min Summer	9.691	0.691	1.3	241.8	O K
10080 min Summer	9.687	0.687	1.3	240.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	155.452	0.0	102.0	16
30 min Summer	106.486	0.0	104.0	31
60 min Summer	69.995	0.0	198.3	62
120 min Summer	41.971	0.0	199.8	122
180 min Summer	30.743	0.0	199.1	182
240 min Summer	24.555	0.0	198.9	242
360 min Summer	17.821	0.0	199.5	362
480 min Summer	14.163	0.0	200.6	482
600 min Summer	11.834	0.0	202.3	602
720 min Summer	10.209	0.0	204.1	722
960 min Summer	8.073	0.0	206.1	960
1440 min Summer	5.765	0.0	205.1	1440
2160 min Summer	4.088	0.0	398.4	1884
2880 min Summer	3.199	0.0	386.1	2276
4320 min Summer	2.258	0.0	356.3	3028
5760 min Summer	1.778	0.0	532.4	3864
7200 min Summer	1.508	0.0	564.1	4688
8640 min Summer	1.337	0.0	598.6	5536
10080 min Summer	1.225	0.0	629.9	6360

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	9.344	0.344	1.3	120.4	O K
30 min Winter	9.470	0.470	1.3	164.4	O K
60 min Winter	9.614	0.614	1.3	214.9	O K
120 min Winter	9.728	0.728	1.3	254.7	Flood Risk
180 min Winter	9.791	0.791	1.3	276.8	Flood Risk
240 min Winter	9.833	0.833	1.3	291.6	Flood Risk
360 min Winter	9.888	0.888	1.3	311.0	Flood Risk
480 min Winter	9.923	0.923	1.4	323.0	Flood Risk
600 min Winter	9.945	0.945	1.4	330.8	Flood Risk
720 min Winter	9.960	0.960	1.4	335.9	Flood Risk
960 min Winter	9.974	0.974	1.4	341.0	Flood Risk
1440 min Winter	9.969	0.969	1.4	339.0	Flood Risk
2160 min Winter	9.924	0.924	1.4	323.3	Flood Risk
2880 min Winter	9.872	0.872	1.3	305.1	Flood Risk
4320 min Winter	9.782	0.782	1.3	273.8	Flood Risk
5760 min Winter	9.707	0.707	1.3	247.6	Flood Risk
7200 min Winter	9.658	0.658	1.3	230.2	O K
8640 min Winter	9.623	0.623	1.3	218.1	O K
10080 min Winter	9.602	0.602	1.3	210.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	155.452	0.0	102.0	16
30 min Winter	106.486	0.0	104.0	31
60 min Winter	69.995	0.0	198.3	62
120 min Winter	41.971	0.0	199.8	122
180 min Winter	30.743	0.0	199.0	180
240 min Winter	24.555	0.0	198.8	240
360 min Winter	17.821	0.0	199.3	358
480 min Winter	14.163	0.0	200.4	474
600 min Winter	11.834	0.0	201.9	590
720 min Winter	10.209	0.0	203.7	708
960 min Winter	8.073	0.0	205.5	940
1440 min Winter	5.765	0.0	204.3	1384
2160 min Winter	4.088	0.0	397.5	2032
2880 min Winter	3.199	0.0	385.5	2308
4320 min Winter	2.258	0.0	357.5	3240
5760 min Winter	1.778	0.0	532.4	4152
7200 min Winter	1.508	0.0	564.2	5048
8640 min Winter	1.337	0.0	598.9	5968
10080 min Winter	1.225	0.0	633.6	6864

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 331208 350156 SJ 31208 50156
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.312

Time (mins) From:	To:	Area (ha)
0	1	0.312

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Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 9.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	350.0	1.000	350.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0056-1400-1000-1400
Design Head (m)	1.000
Design Flow (l/s)	1.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	56
Invert Level (m)	8.995
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

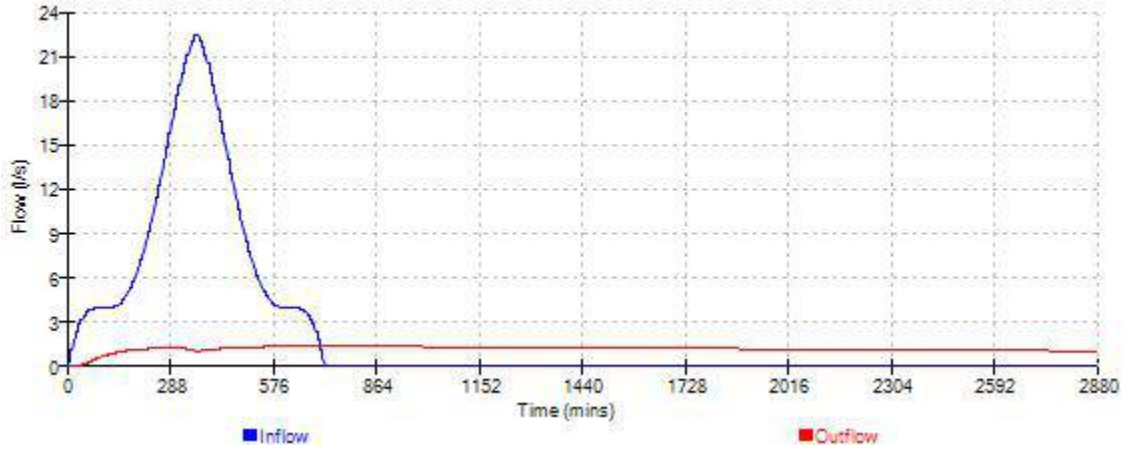
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	1.4
Flush-Flo™	0.245	1.3
Kick-Flo®	0.497	1.0
Mean Flow over Head Range	-	1.2

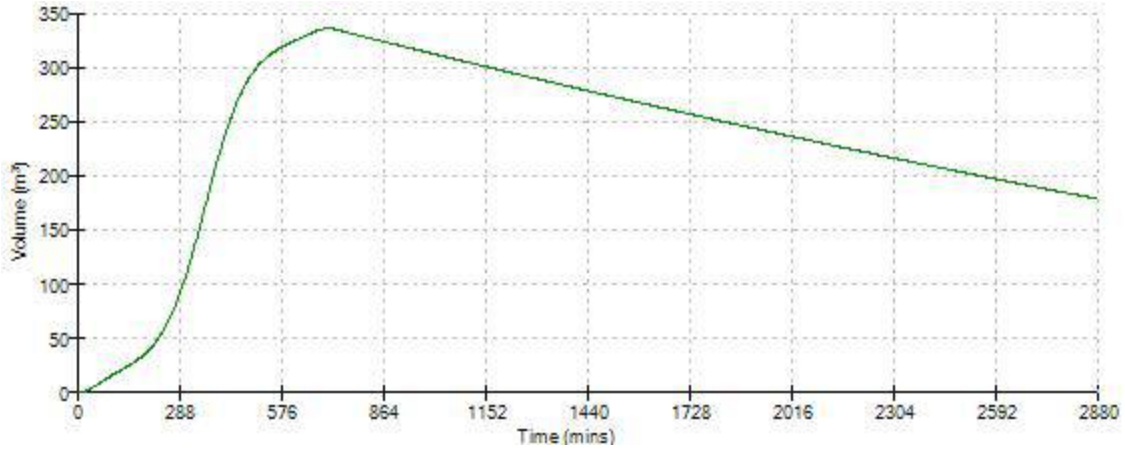
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

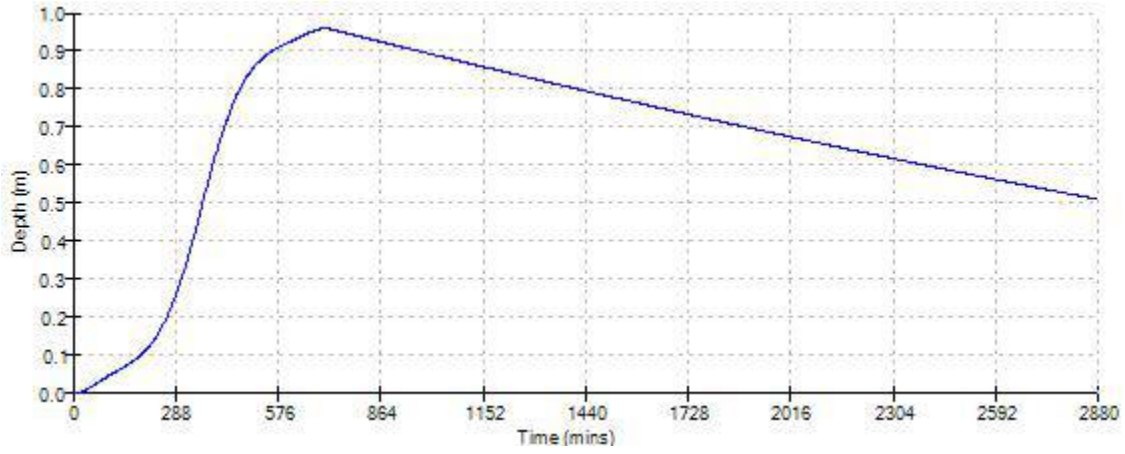
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.1	1.600	1.7	5.000	2.9
0.200	1.2	1.800	1.8	5.500	3.1
0.300	1.2	2.000	1.9	6.000	3.2
0.400	1.2	2.200	2.0	6.500	3.3
0.500	1.0	2.400	2.1	7.000	3.4
0.600	1.1	2.600	2.2	7.500	3.5
0.800	1.3	3.000	2.3	8.000	3.6
1.000	1.4	3.500	2.5	8.500	3.7
1.200	1.5	4.000	2.6	9.000	3.8
1.400	1.6	4.500	2.8	9.500	3.9

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Event: 720 min Winter

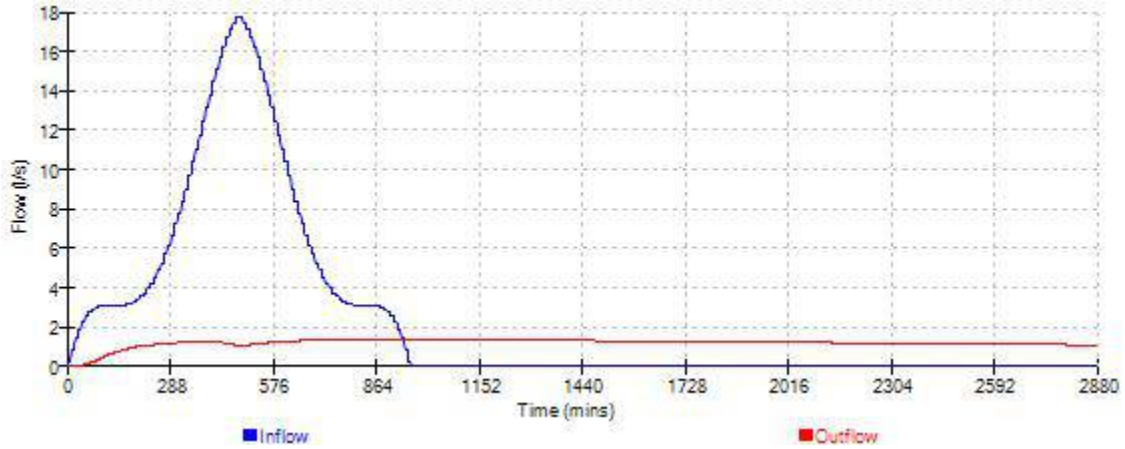


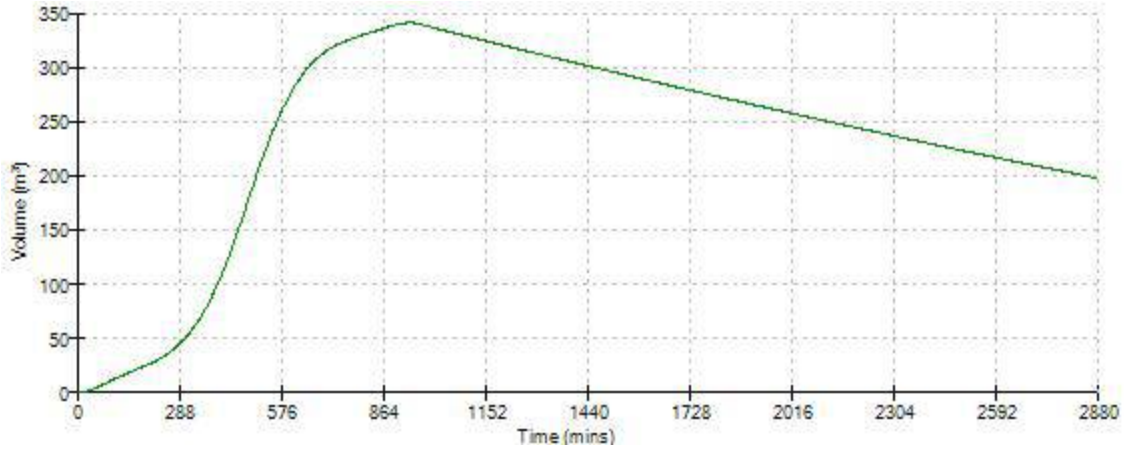


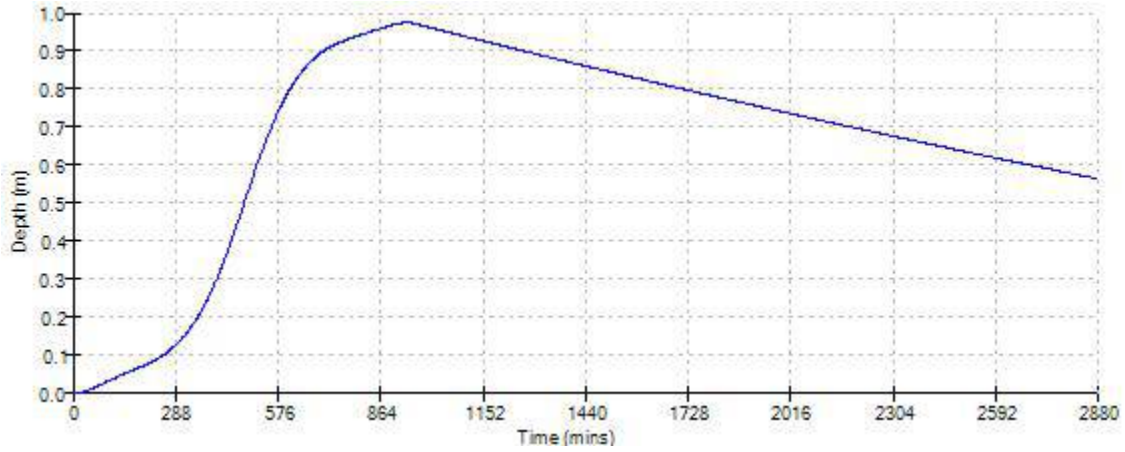


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Event: 960 min Winter

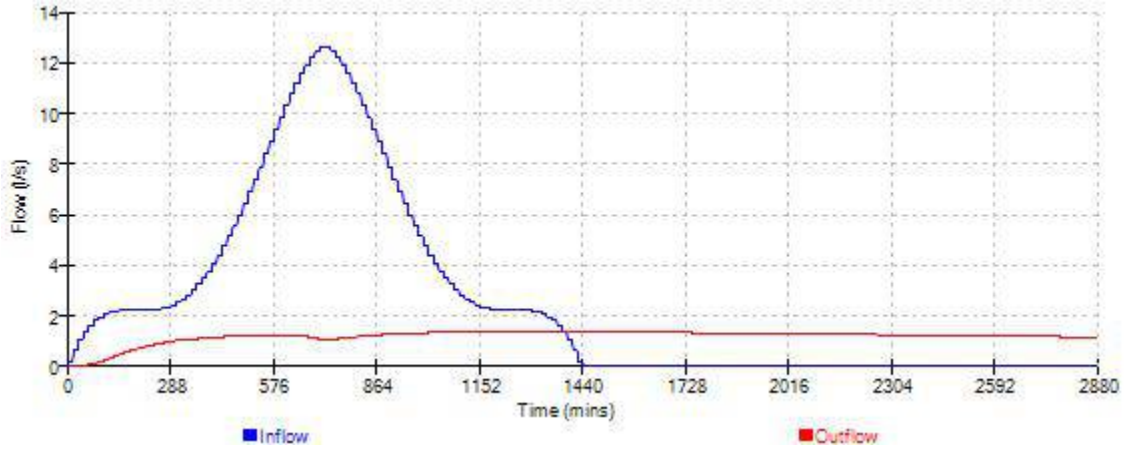


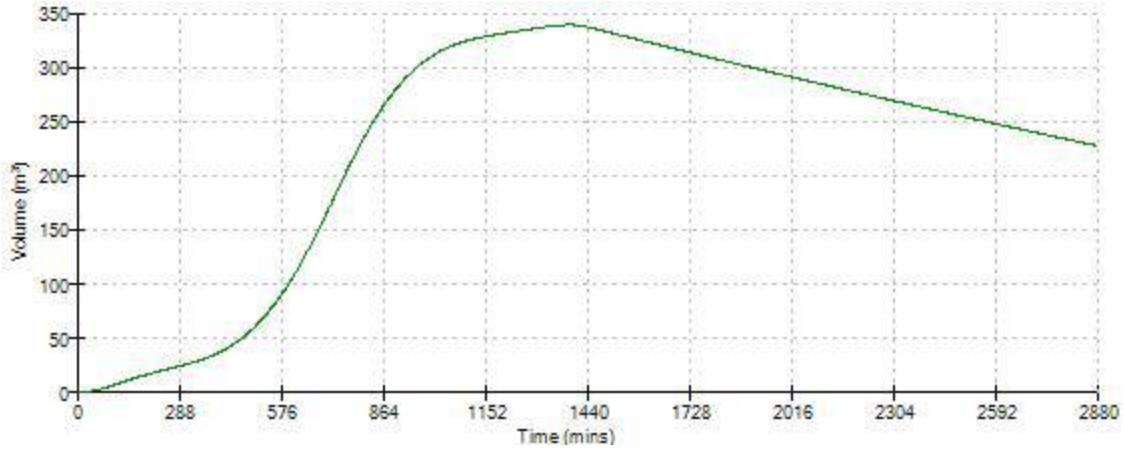


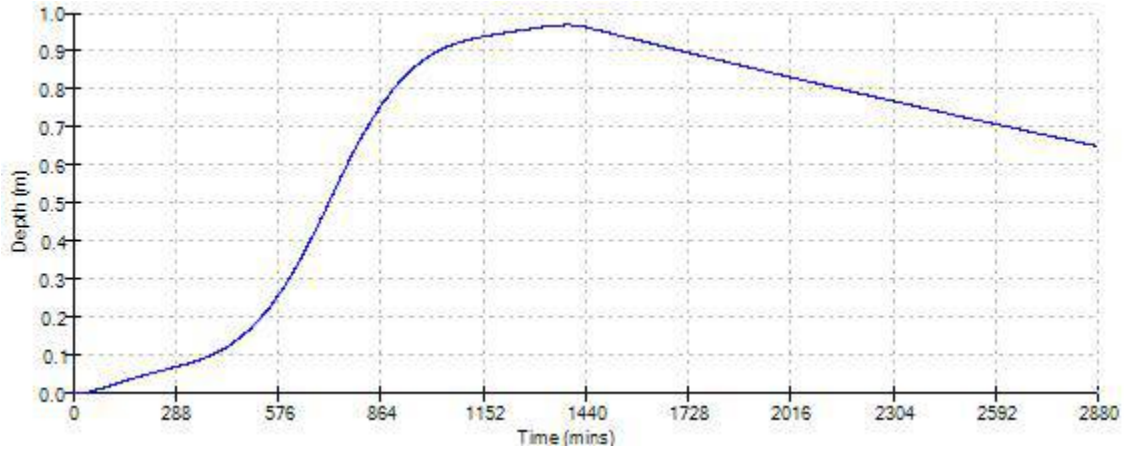


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Event: 1440 min Winter







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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.332	0.332	5.7	481.4	O K
30 min Summer	9.453	0.453	5.7	657.3	O K
60 min Summer	9.592	0.592	5.7	859.1	O K
120 min Summer	9.703	0.703	5.7	1019.2	Flood Risk
180 min Summer	9.764	0.764	5.7	1107.7	Flood Risk
240 min Summer	9.805	0.805	5.7	1167.0	Flood Risk
360 min Summer	9.858	0.858	5.7	1244.0	Flood Risk
480 min Summer	9.891	0.891	5.7	1291.6	Flood Risk
600 min Summer	9.912	0.912	5.7	1322.3	Flood Risk
720 min Summer	9.926	0.926	5.7	1342.0	Flood Risk
960 min Summer	9.938	0.938	5.7	1360.7	Flood Risk
1440 min Summer	9.930	0.930	5.7	1348.8	Flood Risk
2160 min Summer	9.885	0.885	5.7	1283.9	Flood Risk
2880 min Summer	9.844	0.844	5.7	1223.6	Flood Risk
4320 min Summer	9.768	0.768	5.7	1113.0	Flood Risk
5760 min Summer	9.707	0.707	5.7	1025.8	Flood Risk
7200 min Summer	9.670	0.670	5.7	972.1	O K
8640 min Summer	9.647	0.647	5.7	937.6	O K
10080 min Summer	9.635	0.635	5.7	920.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	155.452	0.0	405.8	17
30 min Summer	106.486	0.0	477.1	32
60 min Summer	69.995	0.0	814.4	62
120 min Summer	41.971	0.0	904.0	122
180 min Summer	30.743	0.0	899.9	182
240 min Summer	24.555	0.0	890.3	242
360 min Summer	17.821	0.0	874.9	362
480 min Summer	14.163	0.0	863.9	482
600 min Summer	11.834	0.0	855.2	602
720 min Summer	10.209	0.0	847.8	722
960 min Summer	8.073	0.0	835.3	960
1440 min Summer	5.765	0.0	815.7	1440
2160 min Summer	4.088	0.0	1693.2	1884
2880 min Summer	3.199	0.0	1640.9	2276
4320 min Summer	2.258	0.0	1487.8	3028
5760 min Summer	1.778	0.0	2122.7	3872
7200 min Summer	1.508	0.0	2246.9	4752
8640 min Summer	1.337	0.0	2384.8	5536
10080 min Summer	1.225	0.0	2533.3	6360

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	9.332	0.332	5.7	481.3	O K
30 min Winter	9.453	0.453	5.7	657.1	O K
60 min Winter	9.592	0.592	5.7	858.9	O K
120 min Winter	9.703	0.703	5.7	1018.8	Flood Risk
180 min Winter	9.764	0.764	5.7	1107.4	Flood Risk
240 min Winter	9.805	0.805	5.7	1166.9	Flood Risk
360 min Winter	9.858	0.858	5.7	1244.4	Flood Risk
480 min Winter	9.891	0.891	5.7	1292.5	Flood Risk
600 min Winter	9.913	0.913	5.7	1323.8	Flood Risk
720 min Winter	9.927	0.927	5.7	1344.2	Flood Risk
960 min Winter	9.941	0.941	5.7	1364.4	Flood Risk
1440 min Winter	9.935	0.935	5.7	1356.3	Flood Risk
2160 min Winter	9.891	0.891	5.7	1292.1	Flood Risk
2880 min Winter	9.840	0.840	5.7	1217.3	Flood Risk
4320 min Winter	9.746	0.746	5.7	1081.7	Flood Risk
5760 min Winter	9.660	0.660	5.7	956.9	O K
7200 min Winter	9.588	0.588	5.7	852.0	O K
8640 min Winter	9.536	0.536	5.7	777.5	O K
10080 min Winter	9.502	0.502	5.7	728.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	155.452	0.0	405.8	17
30 min Winter	106.486	0.0	477.2	32
60 min Winter	69.995	0.0	814.5	62
120 min Winter	41.971	0.0	904.4	122
180 min Winter	30.743	0.0	900.5	180
240 min Winter	24.555	0.0	890.9	240
360 min Winter	17.821	0.0	875.5	358
480 min Winter	14.163	0.0	864.4	474
600 min Winter	11.834	0.0	855.6	590
720 min Winter	10.209	0.0	848.1	708
960 min Winter	8.073	0.0	835.5	940
1440 min Winter	5.765	0.0	816.3	1384
2160 min Winter	4.088	0.0	1695.2	2032
2880 min Winter	3.199	0.0	1647.7	2308
4320 min Winter	2.258	0.0	1510.0	3240
5760 min Winter	1.778	0.0	2123.3	4160
7200 min Winter	1.508	0.0	2248.7	4976
8640 min Winter	1.337	0.0	2388.6	5800
10080 min Winter	1.225	0.0	2543.1	6656

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 331208 350156 SJ 31208 50156
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.248

Time (mins) From:	To:	Area (ha)
0	2	1.248

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Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 9.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1450.0	1.000	1450.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0112-5700-1000-5700
Design Head (m)	1.000
Design Flow (l/s)	5.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	112
Invert Level (m)	8.995
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

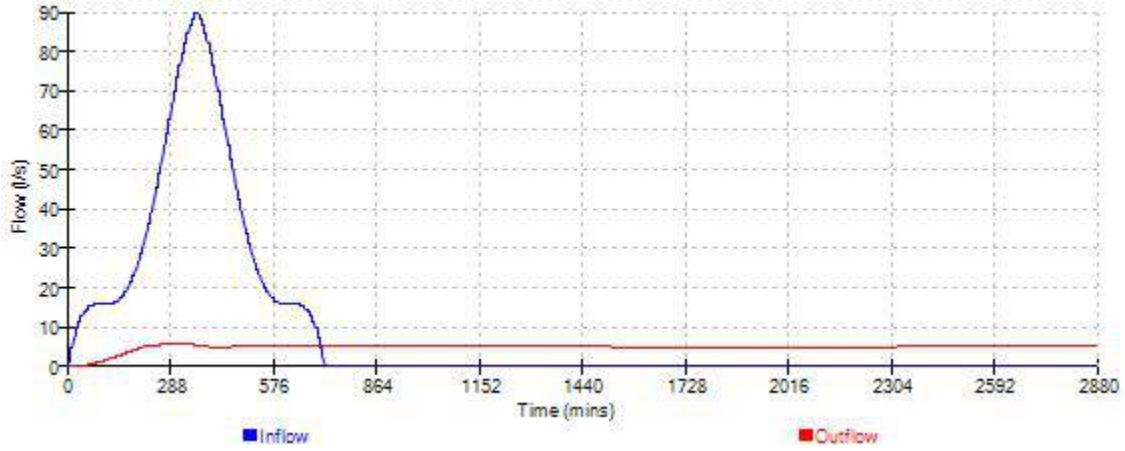
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	5.7
Flush-Flo™	0.296	5.7
Kick-Flo®	0.642	4.6
Mean Flow over Head Range	-	4.9

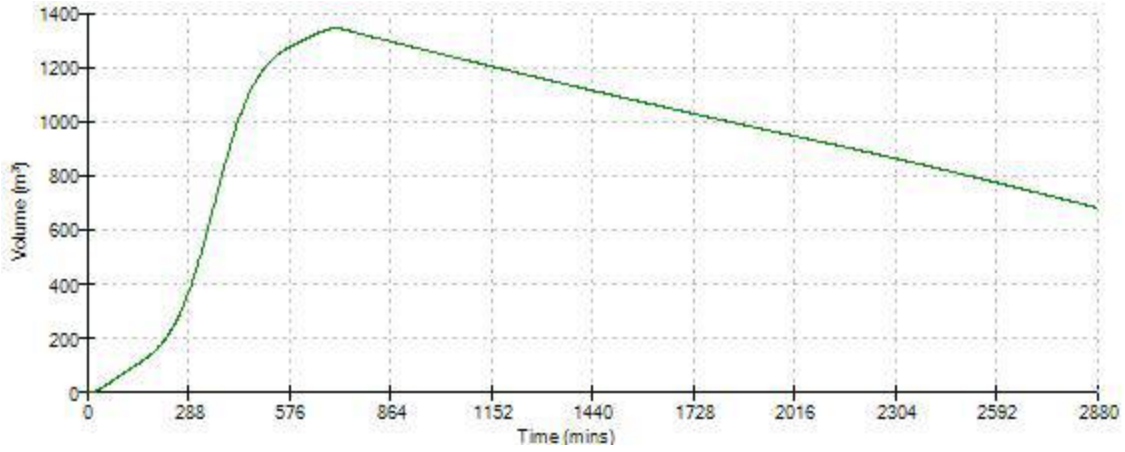
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

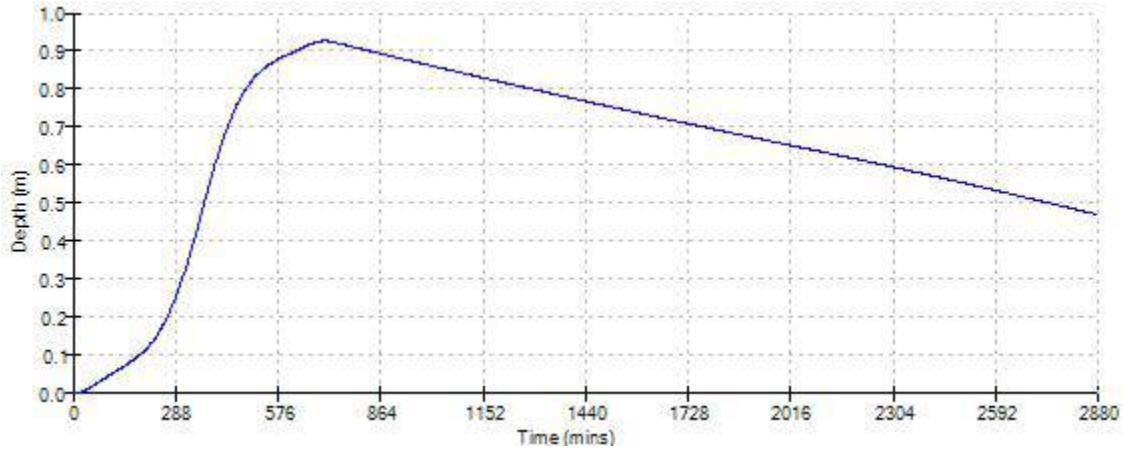
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.9	1.600	7.1	5.000	12.2
0.200	5.5	1.800	7.5	5.500	12.7
0.300	5.7	2.000	7.9	6.000	13.3
0.400	5.6	2.200	8.2	6.500	13.8
0.500	5.4	2.400	8.6	7.000	14.3
0.600	5.0	2.600	8.9	7.500	14.7
0.800	5.1	3.000	9.5	8.000	15.2
1.000	5.7	3.500	10.3	8.500	15.7
1.200	6.2	4.000	10.9	9.000	16.1
1.400	6.7	4.500	11.6	9.500	16.5

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Event: 720 min Winter

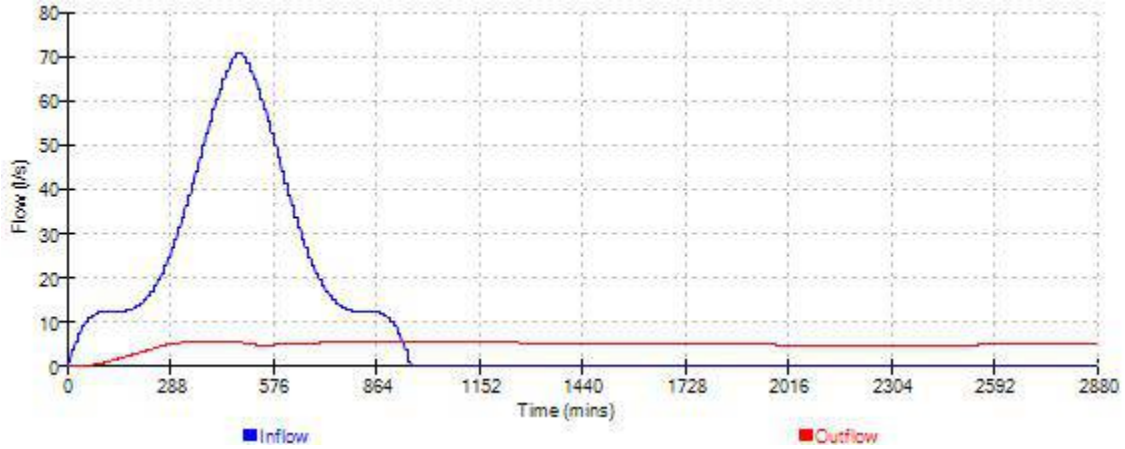


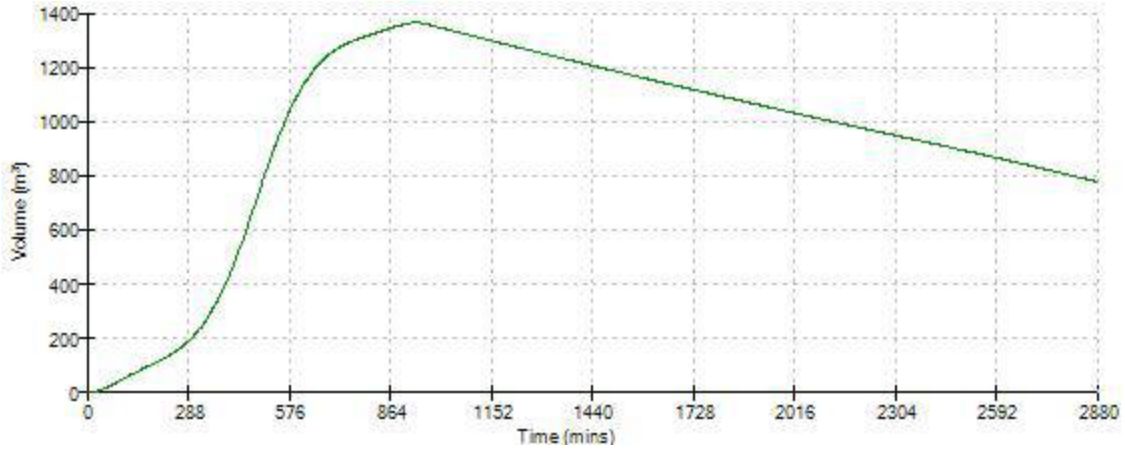


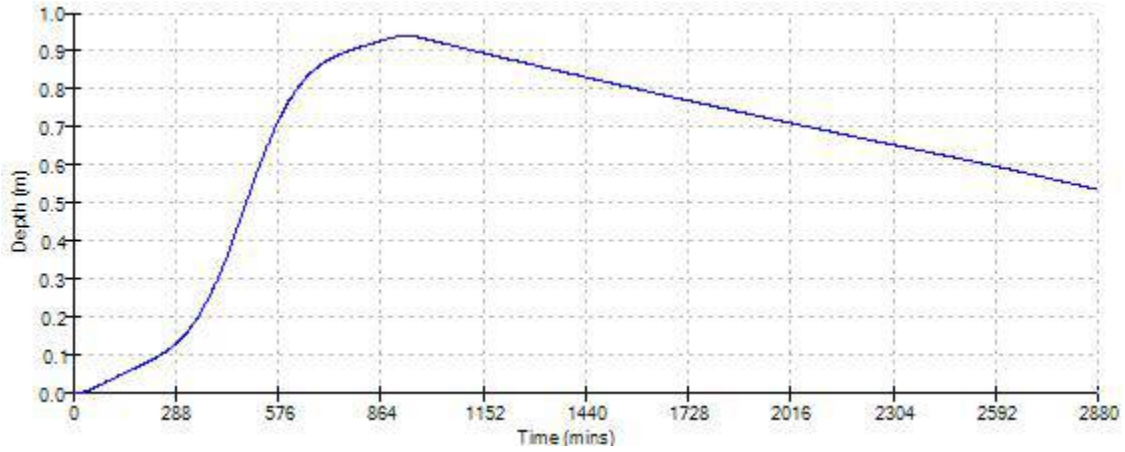


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Event: 960 min Winter

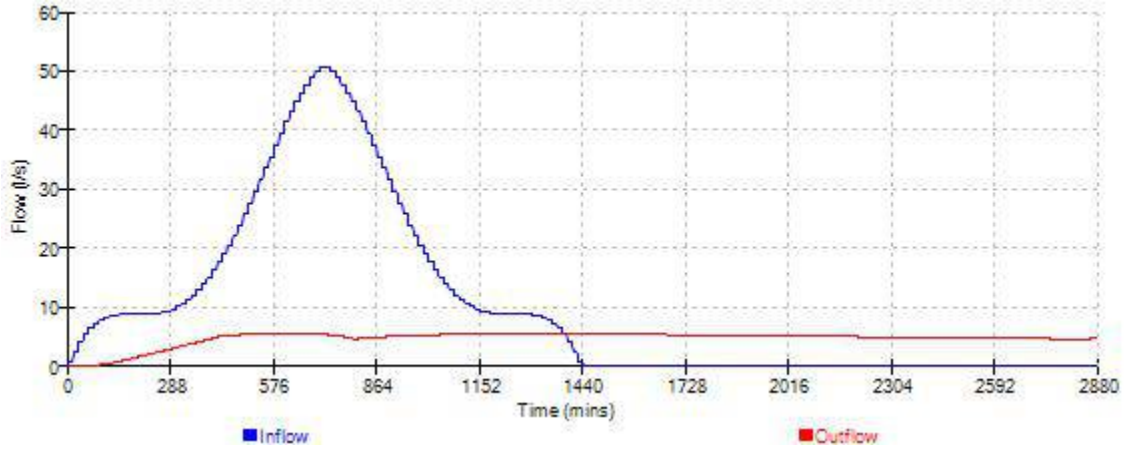


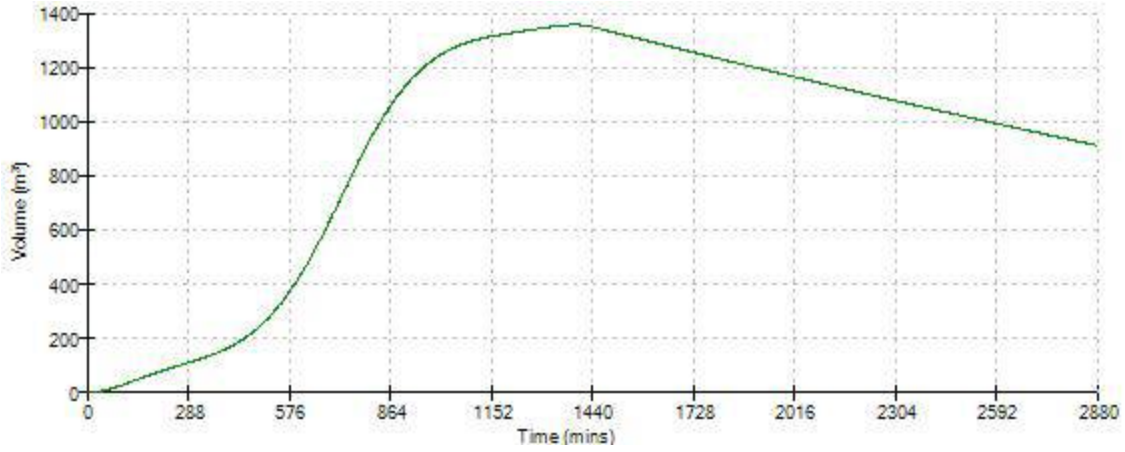


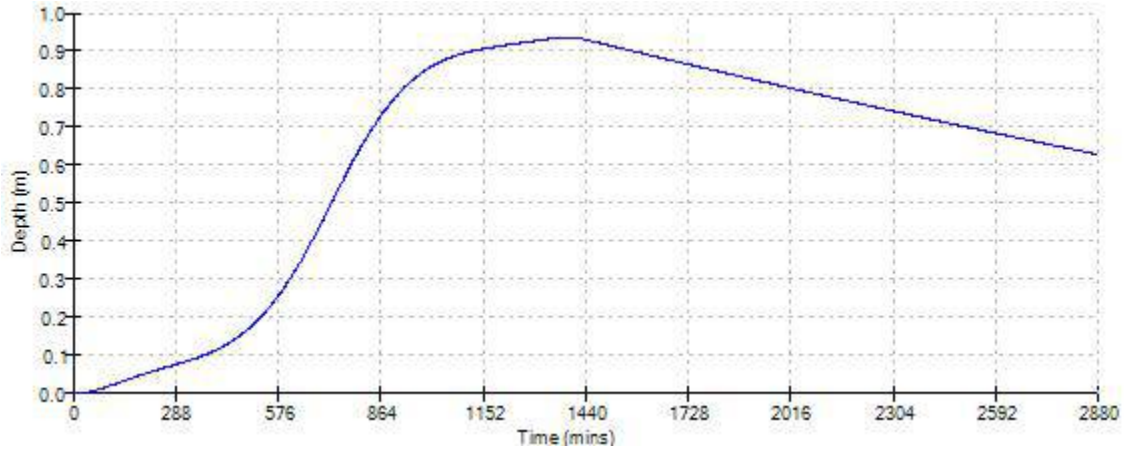


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Event: 1440 min Winter







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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.079	0.479	12.4	1053.3	O K
30 min Summer	9.254	0.654	12.4	1438.4	O K
60 min Summer	9.455	0.855	12.4	1880.0	O K
120 min Summer	9.614	1.014	12.4	2230.2	O K
180 min Summer	9.701	1.101	12.4	2423.3	Flood Risk
240 min Summer	9.760	1.160	12.4	2553.0	Flood Risk
360 min Summer	9.837	1.237	12.4	2721.3	Flood Risk
480 min Summer	9.884	1.284	12.4	2825.0	Flood Risk
600 min Summer	9.914	1.314	12.4	2891.6	Flood Risk
720 min Summer	9.934	1.334	12.4	2934.1	Flood Risk
960 min Summer	9.952	1.352	12.4	2973.7	Flood Risk
1440 min Summer	9.939	1.339	12.4	2945.6	Flood Risk
2160 min Summer	9.874	1.274	12.4	2801.8	Flood Risk
2880 min Summer	9.813	1.213	12.4	2668.9	Flood Risk
4320 min Summer	9.703	1.103	12.4	2427.2	Flood Risk
5760 min Summer	9.618	1.018	12.4	2238.6	O K
7200 min Summer	9.566	0.966	12.4	2124.2	O K
8640 min Summer	9.533	0.933	12.4	2053.4	O K
10080 min Summer	9.519	0.919	12.4	2022.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	155.452	0.0	895.4	18
30 min Summer	106.486	0.0	1042.5	33
60 min Summer	69.995	0.0	1786.3	64
120 min Summer	41.971	0.0	1968.2	124
180 min Summer	30.743	0.0	1953.0	184
240 min Summer	24.555	0.0	1932.2	242
360 min Summer	17.821	0.0	1900.5	362
480 min Summer	14.163	0.0	1878.6	482
600 min Summer	11.834	0.0	1861.9	602
720 min Summer	10.209	0.0	1848.0	722
960 min Summer	8.073	0.0	1825.7	962
1440 min Summer	5.765	0.0	1795.5	1440
2160 min Summer	4.088	0.0	3706.8	1884
2880 min Summer	3.199	0.0	3587.7	2272
4320 min Summer	2.258	0.0	3252.0	3028
5760 min Summer	1.778	0.0	4645.2	3864
7200 min Summer	1.508	0.0	4917.5	4688
8640 min Summer	1.337	0.0	5219.9	5536
10080 min Summer	1.225	0.0	5544.7	6448

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	9.079	0.479	12.4	1053.2	O K
30 min Winter	9.254	0.654	12.4	1438.0	O K
60 min Winter	9.454	0.854	12.4	1879.6	O K
120 min Winter	9.614	1.014	12.4	2230.1	O K
180 min Winter	9.702	1.102	12.4	2423.5	Flood Risk
240 min Winter	9.761	1.161	12.4	2553.7	Flood Risk
360 min Winter	9.838	1.238	12.4	2722.8	Flood Risk
480 min Winter	9.885	1.285	12.4	2827.6	Flood Risk
600 min Winter	9.916	1.316	12.4	2895.6	Flood Risk
720 min Winter	9.936	1.336	12.4	2939.9	Flood Risk
960 min Winter	9.956	1.356	12.4	2983.1	Flood Risk
1440 min Winter	9.947	1.347	12.4	2963.7	Flood Risk
2160 min Winter	9.882	1.282	12.4	2821.5	Flood Risk
2880 min Winter	9.808	1.208	12.4	2657.8	Flood Risk
4320 min Winter	9.674	1.074	12.4	2362.1	O K
5760 min Winter	9.552	0.952	12.4	2094.8	O K
7200 min Winter	9.451	0.851	12.4	1872.9	O K
8640 min Winter	9.373	0.773	12.4	1700.8	O K
10080 min Winter	9.323	0.723	12.4	1589.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	155.452	0.0	895.5	18
30 min Winter	106.486	0.0	1042.8	33
60 min Winter	69.995	0.0	1786.4	64
120 min Winter	41.971	0.0	1969.0	122
180 min Winter	30.743	0.0	1954.0	180
240 min Winter	24.555	0.0	1933.2	240
360 min Winter	17.821	0.0	1901.3	358
480 min Winter	14.163	0.0	1879.1	476
600 min Winter	11.834	0.0	1862.0	592
720 min Winter	10.209	0.0	1847.9	708
960 min Winter	8.073	0.0	1825.3	940
1440 min Winter	5.765	0.0	1795.4	1386
2160 min Winter	4.088	0.0	3709.8	2032
2880 min Winter	3.199	0.0	3599.8	2308
4320 min Winter	2.258	0.0	3296.1	3240
5760 min Winter	1.778	0.0	4646.1	4152
7200 min Winter	1.508	0.0	4921.0	5040
8640 min Winter	1.337	0.0	5228.5	5872
10080 min Winter	1.225	0.0	5568.6	6656

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 331208 350156 SJ 31208 50156
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 2.732

Time (mins) From:	To:	Area (ha)
0	3	2.732

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Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 8.600

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2200.0	1.400	2200.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0155-1240-1400-1240
Design Head (m)	1.400
Design Flow (l/s)	12.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	155
Invert Level (m)	8.595
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

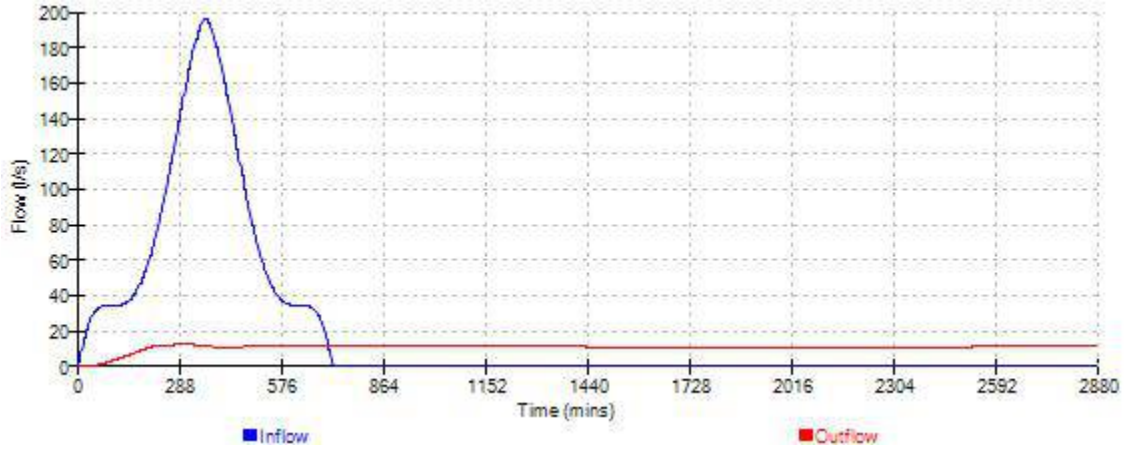
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.400	12.4
Flush-Flo™	0.410	12.4
Kick-Flo®	0.891	10.0
Mean Flow over Head Range	-	10.8

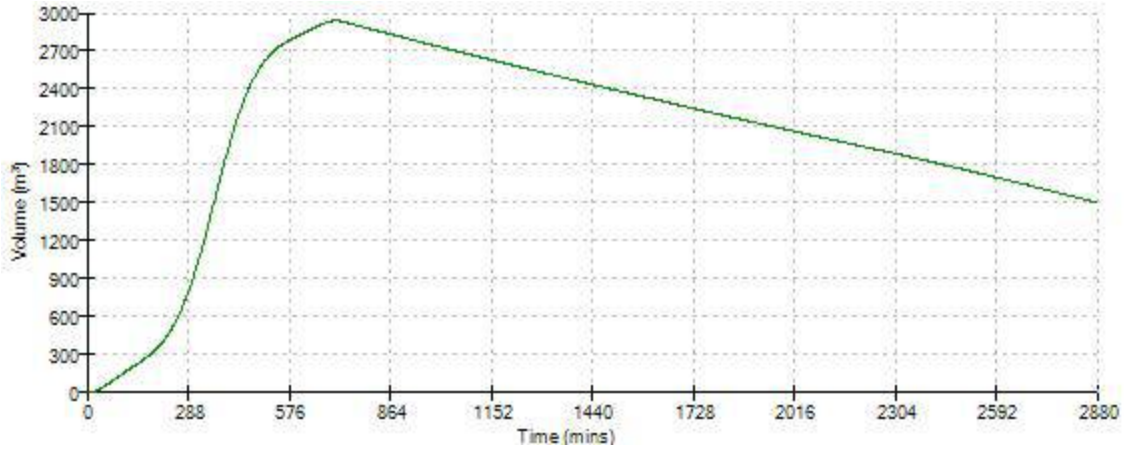
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

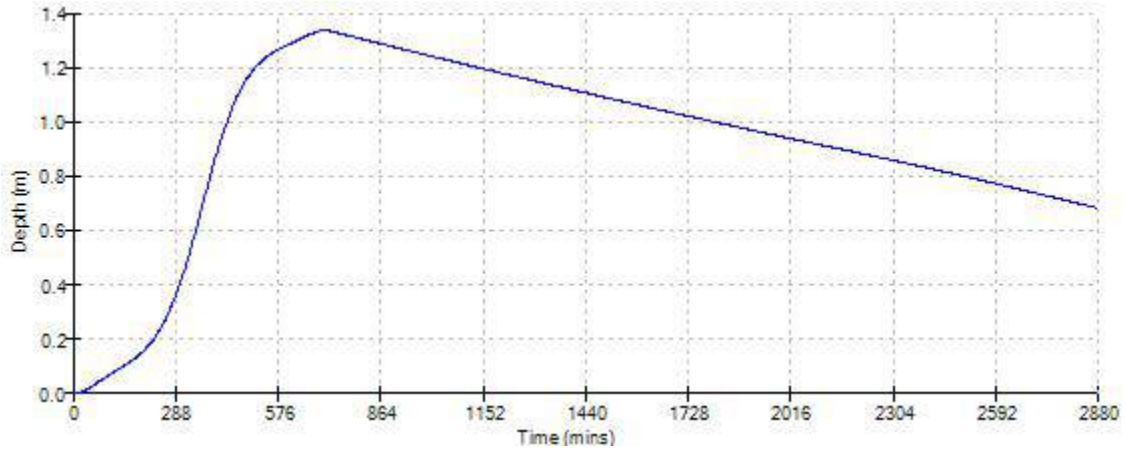
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.6	1.600	13.2	5.000	22.7
0.200	11.4	1.800	14.0	5.500	23.8
0.300	12.2	2.000	14.7	6.000	24.8
0.400	12.4	2.200	15.4	6.500	25.8
0.500	12.3	2.400	16.0	7.000	26.7
0.600	12.1	2.600	16.6	7.500	27.6
0.800	11.1	3.000	17.8	8.000	28.5
1.000	10.6	3.500	19.2	8.500	29.3
1.200	11.5	4.000	20.4	9.000	30.2
1.400	12.4	4.500	21.6	9.500	31.0

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Event: 720 min Winter

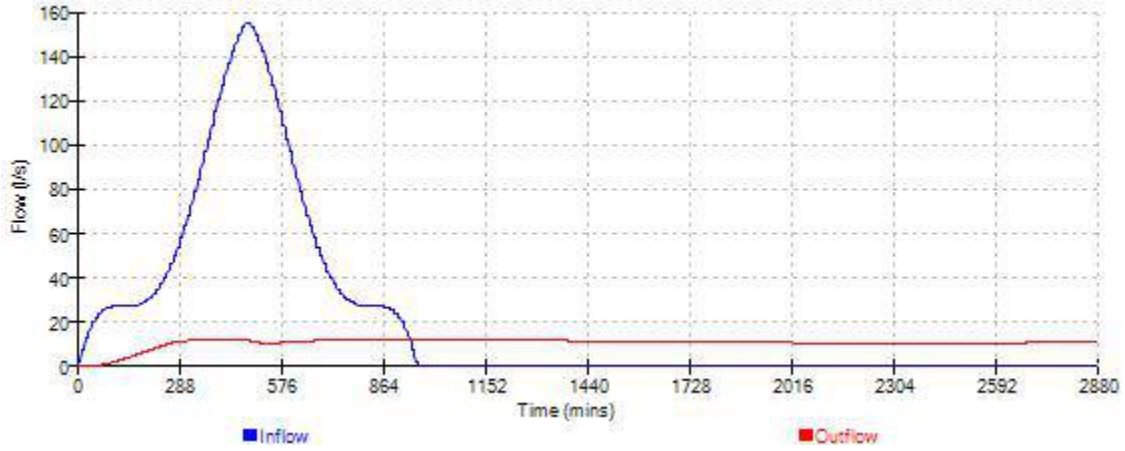


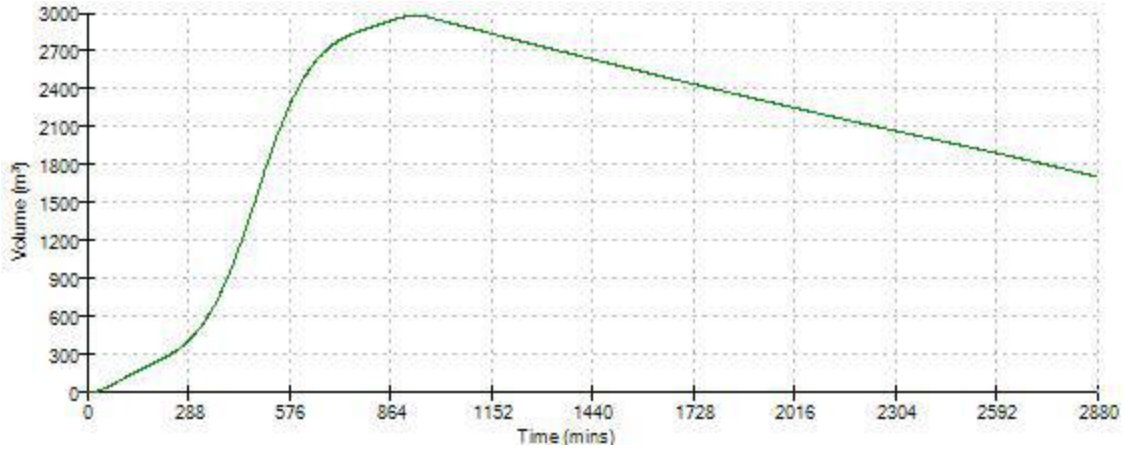


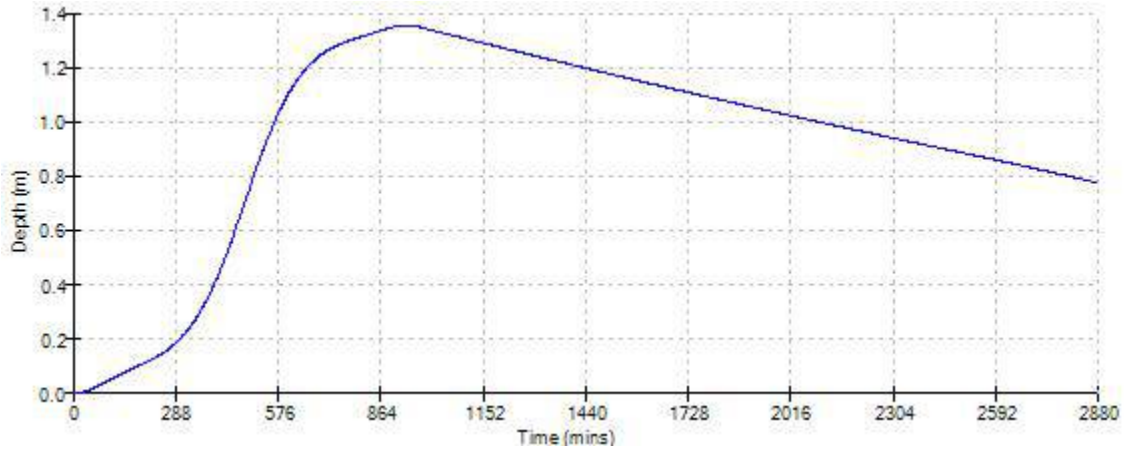


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Event: 960 min Winter

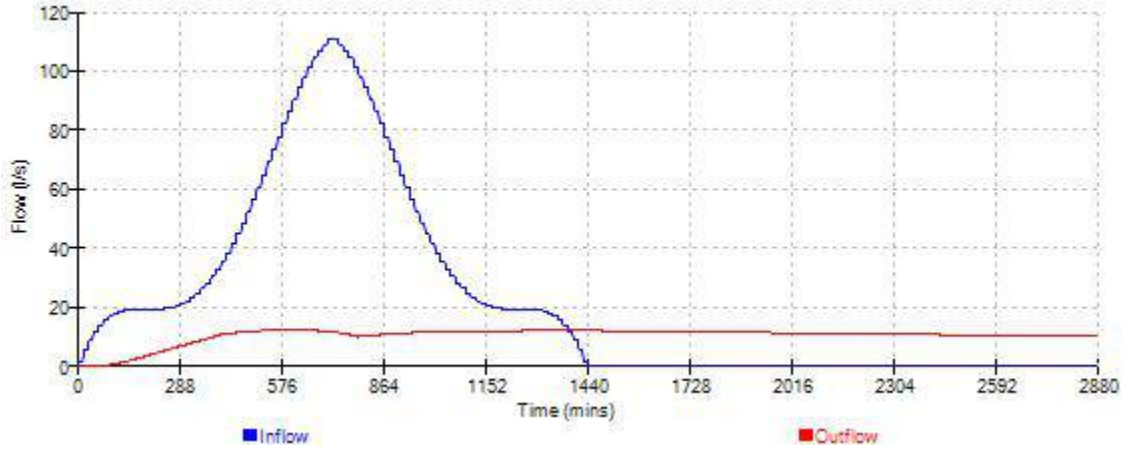


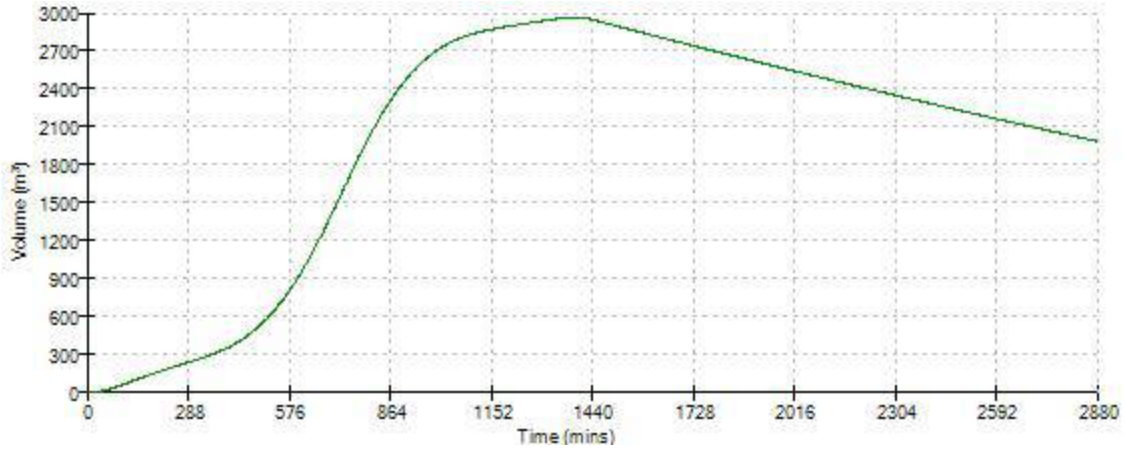


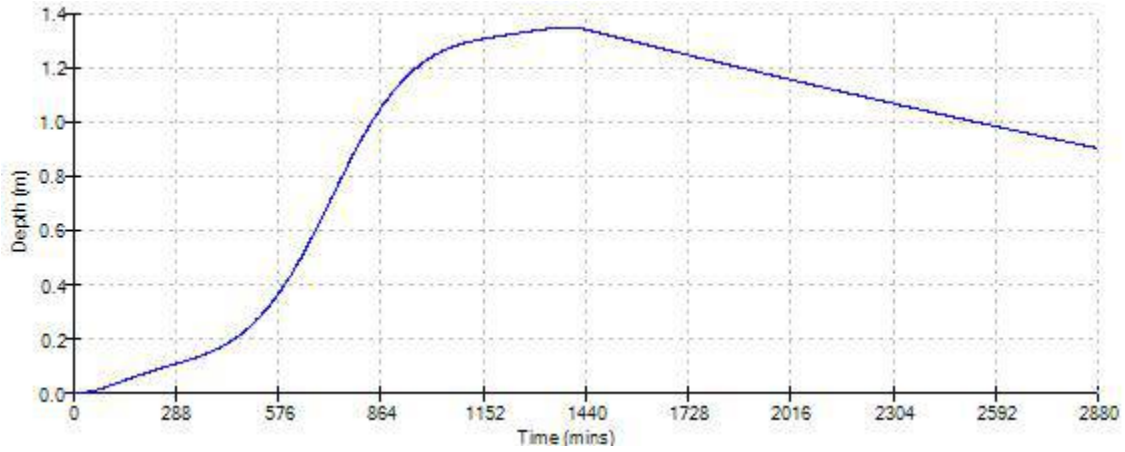


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Event: 1440 min Winter







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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.327	0.327	2.3	196.0	O K
30 min Summer	9.446	0.446	2.3	267.5	O K
60 min Summer	9.582	0.582	2.3	349.4	O K
120 min Summer	9.691	0.691	2.3	414.4	O K
180 min Summer	9.750	0.750	2.3	450.2	Flood Risk
240 min Summer	9.790	0.790	2.3	474.2	Flood Risk
360 min Summer	9.842	0.842	2.3	505.2	Flood Risk
480 min Summer	9.874	0.874	2.3	524.3	Flood Risk
600 min Summer	9.894	0.894	2.3	536.5	Flood Risk
720 min Summer	9.907	0.907	2.3	544.3	Flood Risk
960 min Summer	9.919	0.919	2.3	551.5	Flood Risk
1440 min Summer	9.910	0.910	2.3	546.0	Flood Risk
2160 min Summer	9.864	0.864	2.3	518.2	Flood Risk
2880 min Summer	9.821	0.821	2.3	492.3	Flood Risk
4320 min Summer	9.743	0.743	2.3	445.9	Flood Risk
5760 min Summer	9.683	0.683	2.3	410.0	O K
7200 min Summer	9.647	0.647	2.3	388.1	O K
8640 min Summer	9.623	0.623	2.3	373.9	O K
10080 min Summer	9.612	0.612	2.3	367.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	155.452	0.0	171.2	16
30 min Summer	106.486	0.0	193.0	31
60 min Summer	69.995	0.0	338.2	62
120 min Summer	41.971	0.0	366.1	122
180 min Summer	30.743	0.0	363.3	182
240 min Summer	24.555	0.0	359.5	242
360 min Summer	17.821	0.0	353.5	362
480 min Summer	14.163	0.0	349.2	482
600 min Summer	11.834	0.0	345.8	602
720 min Summer	10.209	0.0	343.0	722
960 min Summer	8.073	0.0	338.6	960
1440 min Summer	5.765	0.0	332.5	1440
2160 min Summer	4.088	0.0	689.0	1924
2880 min Summer	3.199	0.0	668.4	2280
4320 min Summer	2.258	0.0	608.5	3068
5760 min Summer	1.778	0.0	866.7	3912
7200 min Summer	1.508	0.0	917.9	4752
8640 min Summer	1.337	0.0	975.1	5616
10080 min Summer	1.225	0.0	1037.5	6448

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	9.327	0.327	2.3	195.9	O K
30 min Winter	9.446	0.446	2.3	267.4	O K
60 min Winter	9.582	0.582	2.3	349.4	O K
120 min Winter	9.690	0.690	2.3	414.3	O K
180 min Winter	9.750	0.750	2.3	450.2	Flood Risk
240 min Winter	9.790	0.790	2.3	474.2	Flood Risk
360 min Winter	9.843	0.843	2.3	505.5	Flood Risk
480 min Winter	9.875	0.875	2.3	524.8	Flood Risk
600 min Winter	9.896	0.896	2.3	537.3	Flood Risk
720 min Winter	9.909	0.909	2.3	545.5	Flood Risk
960 min Winter	9.922	0.922	2.3	553.3	Flood Risk
1440 min Winter	9.915	0.915	2.3	549.3	Flood Risk
2160 min Winter	9.870	0.870	2.3	522.3	Flood Risk
2880 min Winter	9.817	0.817	2.3	490.4	Flood Risk
4320 min Winter	9.723	0.723	2.3	434.0	Flood Risk
5760 min Winter	9.637	0.637	2.3	382.5	O K
7200 min Winter	9.566	0.566	2.3	339.5	O K
8640 min Winter	9.516	0.516	2.3	309.5	O K
10080 min Winter	9.483	0.483	2.3	290.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	155.452	0.0	171.2	16
30 min Winter	106.486	0.0	193.0	31
60 min Winter	69.995	0.0	338.3	62
120 min Winter	41.971	0.0	366.2	122
180 min Winter	30.743	0.0	363.4	180
240 min Winter	24.555	0.0	359.7	240
360 min Winter	17.821	0.0	353.6	358
480 min Winter	14.163	0.0	349.1	476
600 min Winter	11.834	0.0	345.7	590
720 min Winter	10.209	0.0	342.9	708
960 min Winter	8.073	0.0	338.4	940
1440 min Winter	5.765	0.0	332.4	1386
2160 min Winter	4.088	0.0	689.6	2032
2880 min Winter	3.199	0.0	670.7	2336
4320 min Winter	2.258	0.0	617.3	3244
5760 min Winter	1.778	0.0	866.8	4200
7200 min Winter	1.508	0.0	918.4	4976
8640 min Winter	1.337	0.0	976.1	5800
10080 min Winter	1.225	0.0	1040.4	6656

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 331208 350156 SJ 31208 50156
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.508

Time (mins) From:	To:	Area (ha)
0	1	0.508

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Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 9.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	600.0	1.000	600.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0072-2300-1000-2300
Design Head (m)	1.000
Design Flow (l/s)	2.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	72
Invert Level (m)	8.995
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

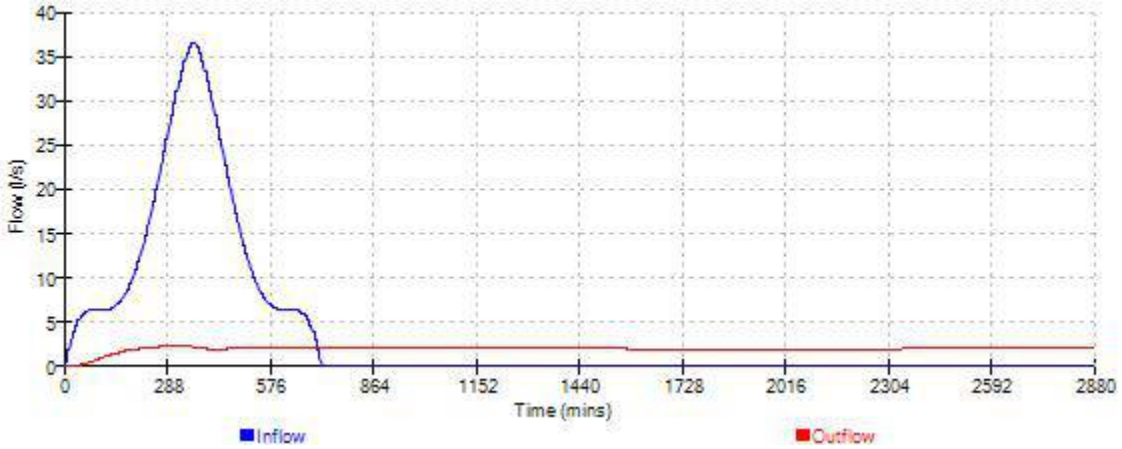
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	2.3
Flush-Flo™	0.307	2.3
Kick-Flo®	0.625	1.9
Mean Flow over Head Range	-	2.0

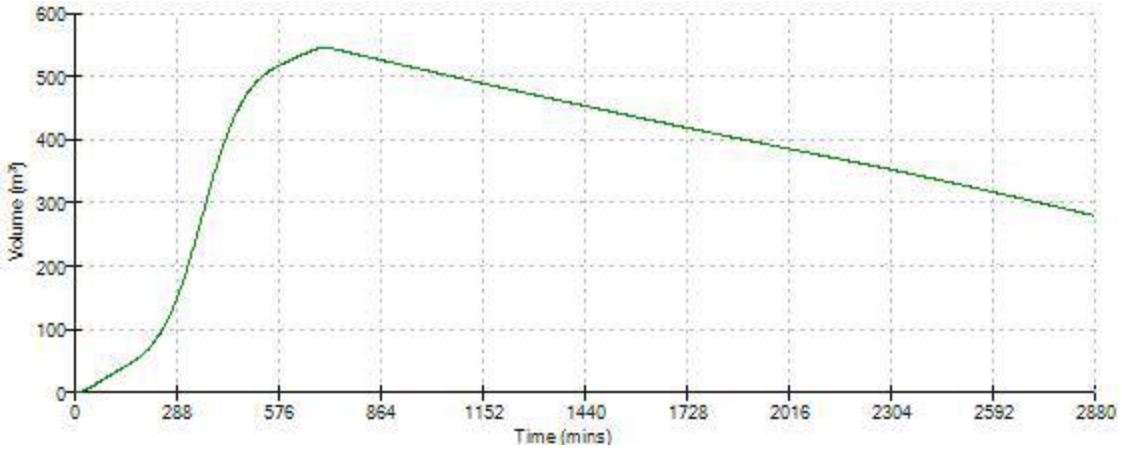
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

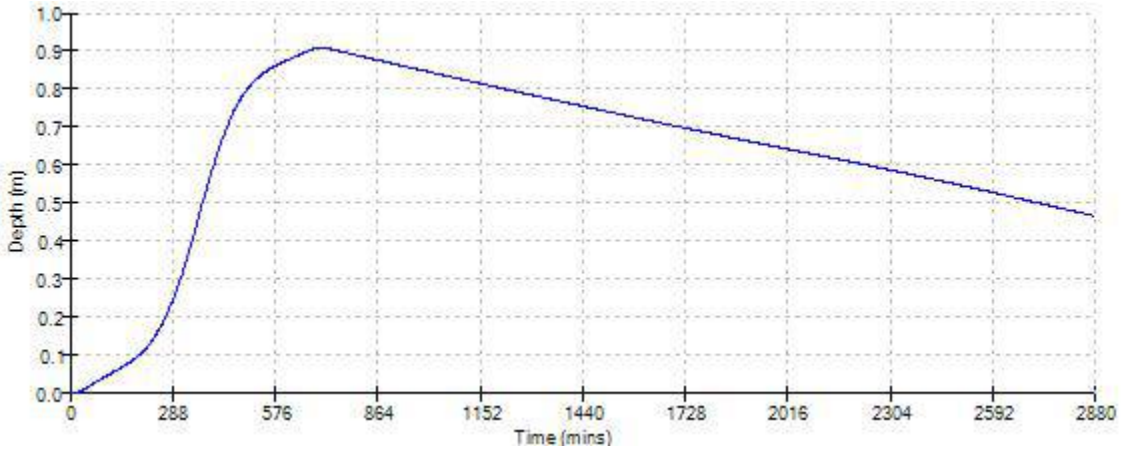
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.9	1.600	2.9	5.000	4.8
0.200	2.2	1.800	3.0	5.500	5.1
0.300	2.3	2.000	3.2	6.000	5.3
0.400	2.3	2.200	3.3	6.500	5.5
0.500	2.2	2.400	3.4	7.000	5.7
0.600	2.0	2.600	3.6	7.500	5.9
0.800	2.1	3.000	3.8	8.000	6.0
1.000	2.3	3.500	4.1	8.500	6.2
1.200	2.5	4.000	4.4	9.000	6.4
1.400	2.7	4.500	4.6	9.500	6.6

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Event: 720 min Winter

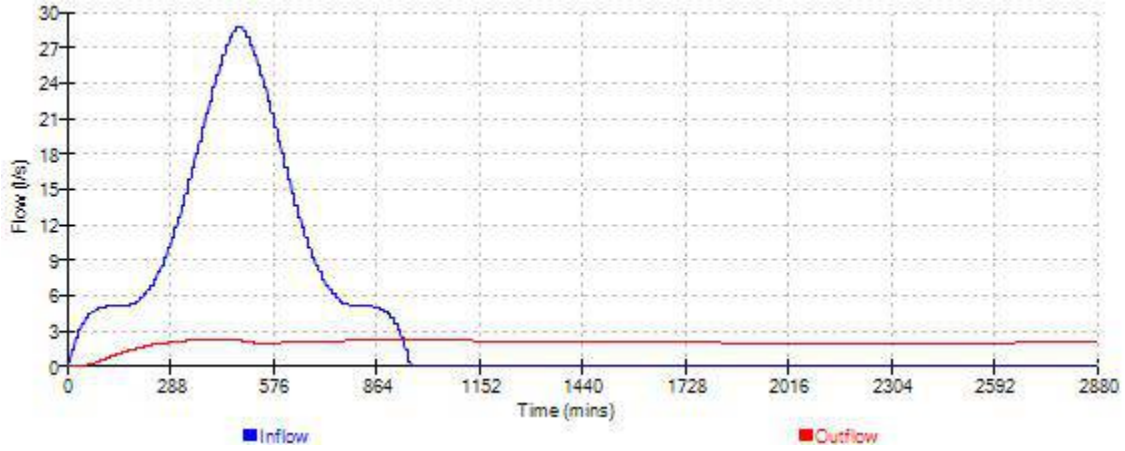


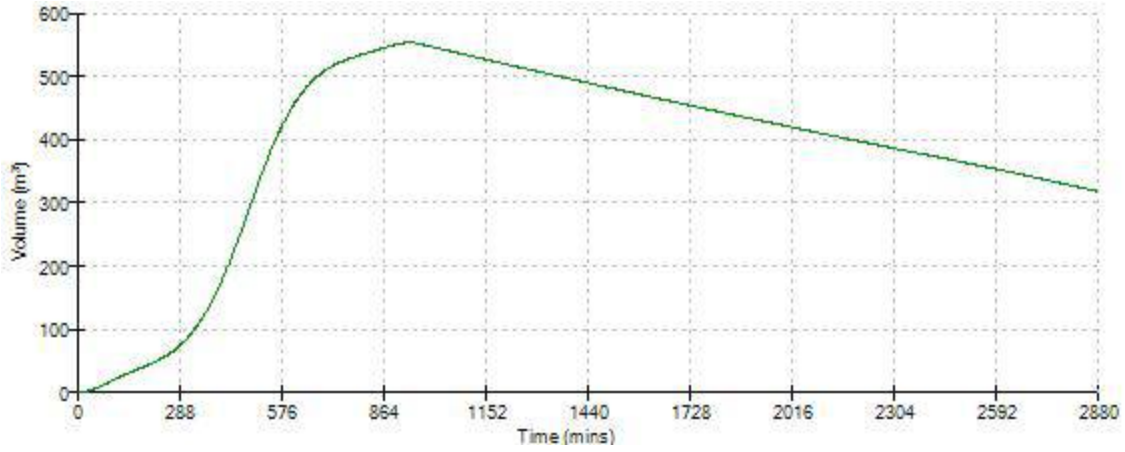


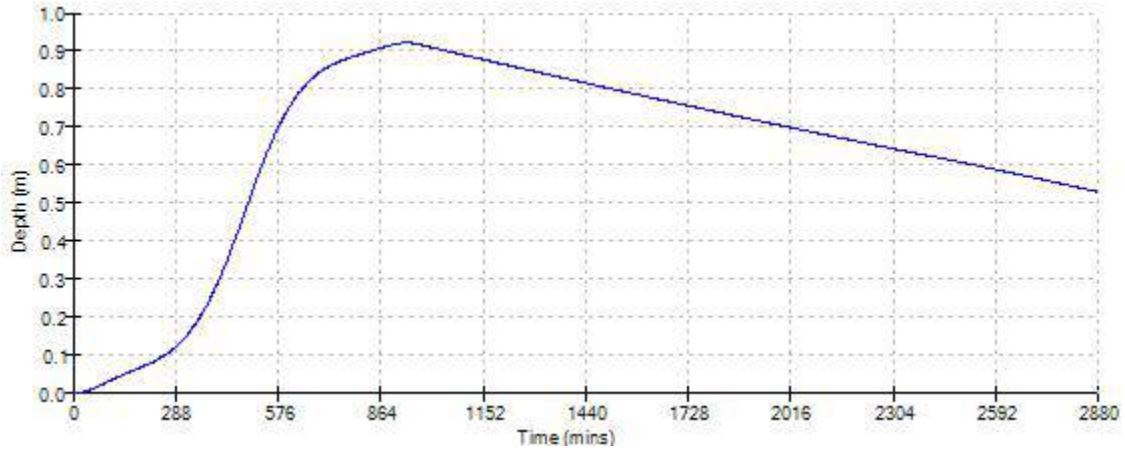


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Event: 960 min Winter

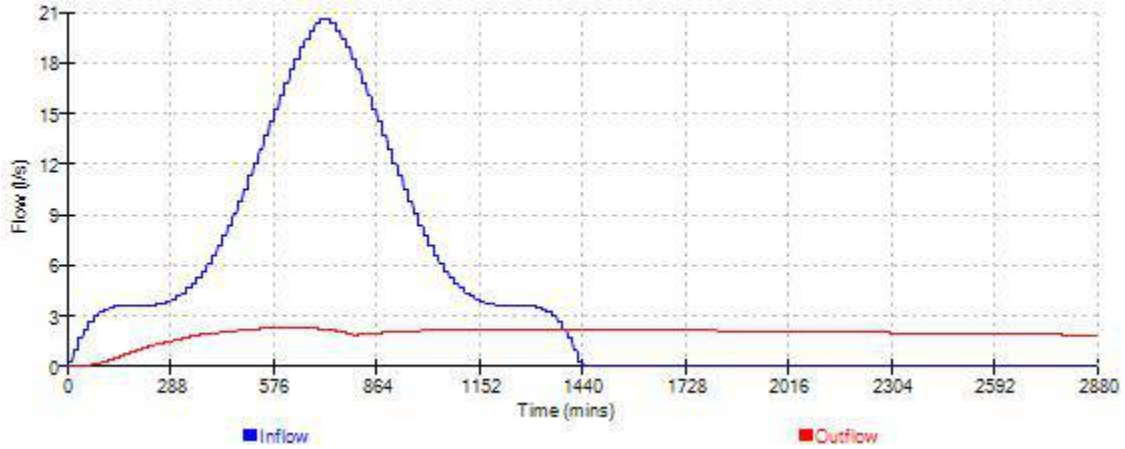


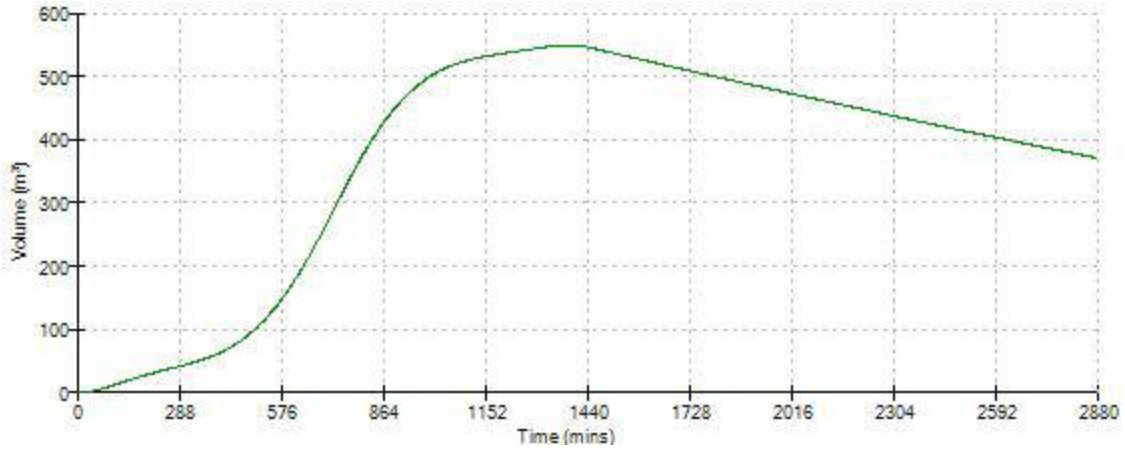


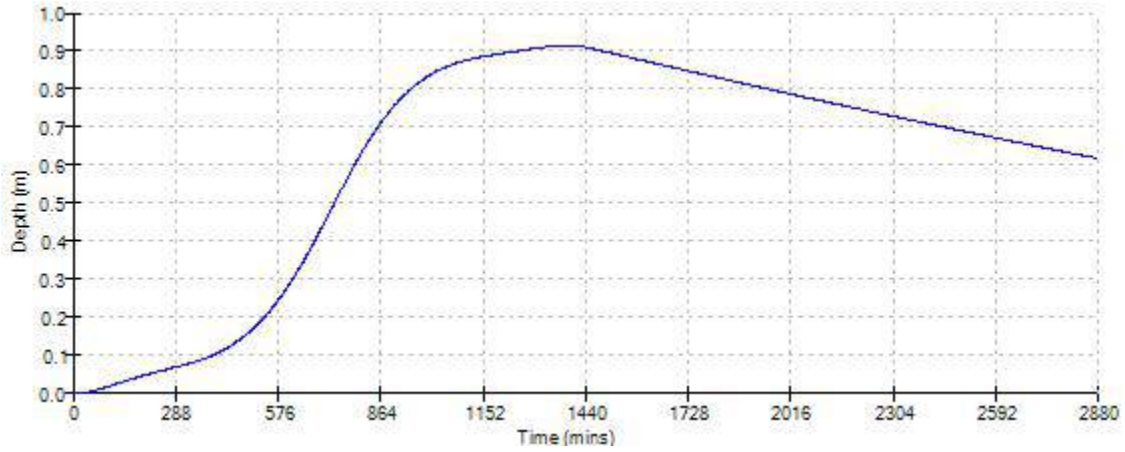


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Event: 1440 min Winter







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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.217	0.417	6.4	541.5	O K
30 min Summer	9.369	0.569	6.4	739.2	O K
60 min Summer	9.543	0.743	6.4	966.4	O K
120 min Summer	9.681	0.881	6.4	1145.8	O K
180 min Summer	9.757	0.957	6.4	1244.6	Flood Risk
240 min Summer	9.808	1.008	6.4	1310.7	Flood Risk
360 min Summer	9.874	1.074	6.4	1396.2	Flood Risk
480 min Summer	9.914	1.114	6.4	1448.7	Flood Risk
600 min Summer	9.940	1.140	6.4	1482.1	Flood Risk
720 min Summer	9.956	1.156	6.4	1503.3	Flood Risk
960 min Summer	9.971	1.171	6.4	1522.4	Flood Risk
1440 min Summer	9.958	1.158	6.4	1505.5	Flood Risk
2160 min Summer	9.900	1.100	6.4	1429.4	Flood Risk
2880 min Summer	9.846	1.046	6.4	1359.8	Flood Risk
4320 min Summer	9.750	0.950	6.4	1234.6	Flood Risk
5760 min Summer	9.675	0.875	6.4	1137.9	O K
7200 min Summer	9.631	0.831	6.4	1080.0	O K
8640 min Summer	9.604	0.804	6.4	1044.6	O K
10080 min Summer	9.592	0.792	6.4	1029.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	155.452	0.0	468.3	17
30 min Summer	106.486	0.0	535.3	32
60 min Summer	69.995	0.0	925.6	62
120 min Summer	41.971	0.0	1010.2	122
180 min Summer	30.743	0.0	1002.8	182
240 min Summer	24.555	0.0	993.4	242
360 min Summer	17.821	0.0	979.3	362
480 min Summer	14.163	0.0	969.6	482
600 min Summer	11.834	0.0	962.3	602
720 min Summer	10.209	0.0	956.4	722
960 min Summer	8.073	0.0	947.2	960
1440 min Summer	5.765	0.0	935.6	1440
2160 min Summer	4.088	0.0	1915.9	1880
2880 min Summer	3.199	0.0	1856.6	2252
4320 min Summer	2.258	0.0	1685.6	3028
5760 min Summer	1.778	0.0	2391.0	3864
7200 min Summer	1.508	0.0	2531.7	4688
8640 min Summer	1.337	0.0	2688.2	5536
10080 min Summer	1.225	0.0	2857.3	6360

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	9.216	0.416	6.4	541.4	O K
30 min Winter	9.369	0.569	6.4	739.1	O K
60 min Winter	9.543	0.743	6.4	966.2	O K
120 min Winter	9.681	0.881	6.4	1145.4	O K
180 min Winter	9.757	0.957	6.4	1244.6	Flood Risk
240 min Winter	9.808	1.008	6.4	1311.0	Flood Risk
360 min Winter	9.875	1.075	6.4	1397.1	Flood Risk
480 min Winter	9.916	1.116	6.4	1450.3	Flood Risk
600 min Winter	9.942	1.142	6.4	1484.6	Flood Risk
720 min Winter	9.959	1.159	6.4	1506.8	Flood Risk
960 min Winter	9.975	1.175	6.4	1527.8	Flood Risk
1440 min Winter	9.966	1.166	6.4	1515.7	Flood Risk
2160 min Winter	9.908	1.108	6.4	1440.1	Flood Risk
2880 min Winter	9.842	1.042	6.4	1355.2	Flood Risk
4320 min Winter	9.725	0.925	6.4	1202.2	Flood Risk
5760 min Winter	9.620	0.820	6.4	1066.0	O K
7200 min Winter	9.536	0.736	6.4	957.0	O K
8640 min Winter	9.466	0.666	6.4	866.0	O K
10080 min Winter	9.422	0.622	6.4	808.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	155.452	0.0	468.3	17
30 min Winter	106.486	0.0	535.4	32
60 min Winter	69.995	0.0	925.6	62
120 min Winter	41.971	0.0	1010.5	122
180 min Winter	30.743	0.0	1003.1	180
240 min Winter	24.555	0.0	993.7	240
360 min Winter	17.821	0.0	979.4	358
480 min Winter	14.163	0.0	969.5	474
600 min Winter	11.834	0.0	962.0	590
720 min Winter	10.209	0.0	955.8	708
960 min Winter	8.073	0.0	946.5	940
1440 min Winter	5.765	0.0	934.9	1384
2160 min Winter	4.088	0.0	1916.6	2028
2880 min Winter	3.199	0.0	1861.5	2304
4320 min Winter	2.258	0.0	1706.4	3240
5760 min Winter	1.778	0.0	2391.4	4152
7200 min Winter	1.508	0.0	2533.0	5048
8640 min Winter	1.337	0.0	2691.8	5872
10080 min Winter	1.225	0.0	2868.2	6656

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 331208 350156 SJ 31208 50156
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.404

Time (mins) From:	To:	Area (ha)
0	2	1.404

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Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 8.800

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1300.0	1.200	1300.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0116-6400-1200-6400
Design Head (m)	1.200
Design Flow (l/s)	6.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	116
Invert Level (m)	8.795
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

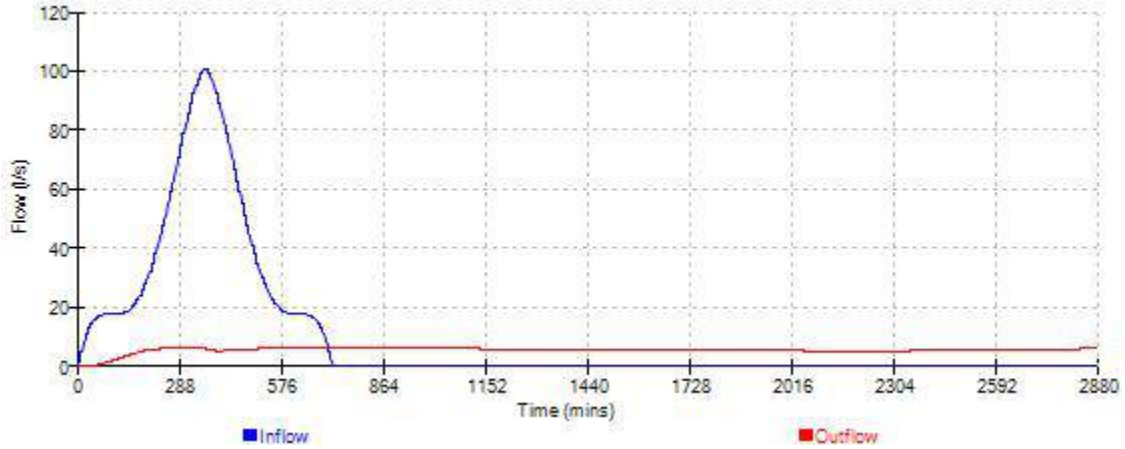
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	6.4
Flush-Flo™	0.354	6.4
Kick-Flo®	0.751	5.1
Mean Flow over Head Range	-	5.6

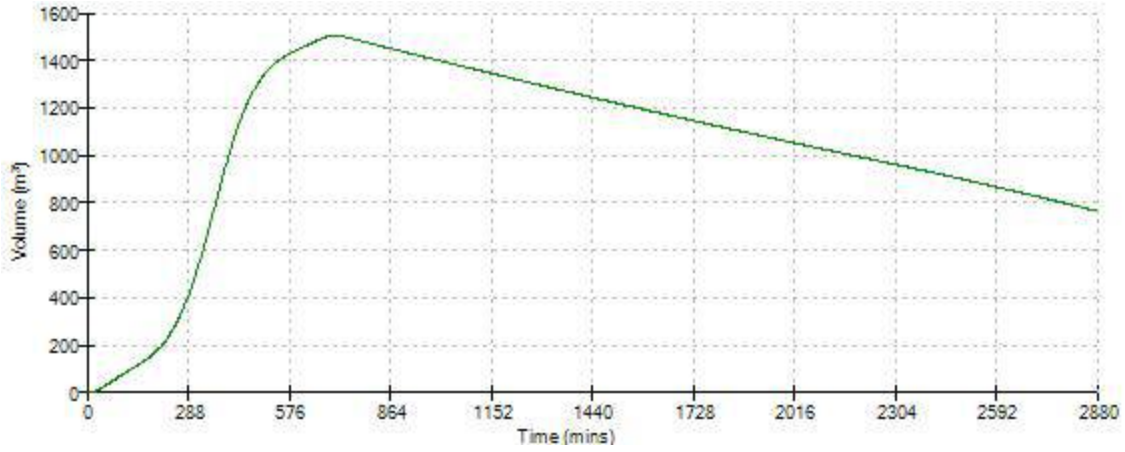
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

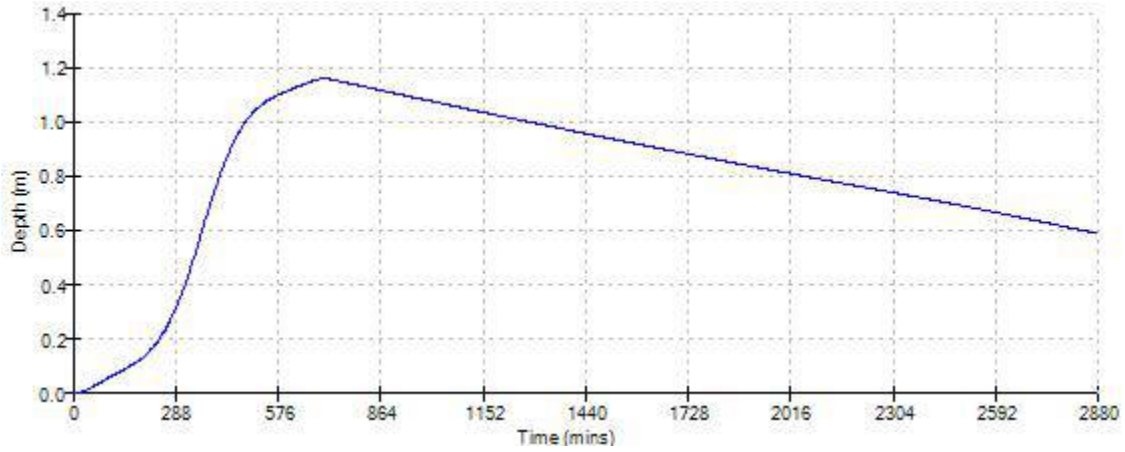
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.1	1.600	7.3	5.000	12.5
0.200	6.0	1.800	7.7	5.500	13.1
0.300	6.3	2.000	8.1	6.000	13.7
0.400	6.3	2.200	8.5	6.500	14.2
0.500	6.2	2.400	8.9	7.000	14.7
0.600	6.0	2.600	9.2	7.500	15.2
0.800	5.3	3.000	9.8	8.000	15.7
1.000	5.9	3.500	10.6	8.500	16.2
1.200	6.4	4.000	11.3	9.000	16.6
1.400	6.9	4.500	11.9	9.500	17.0

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Event: 720 min Winter

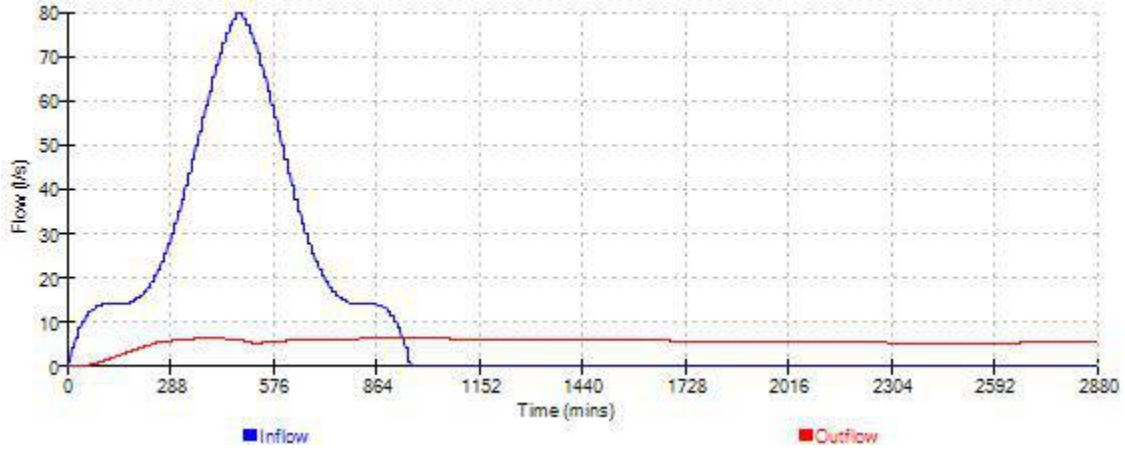


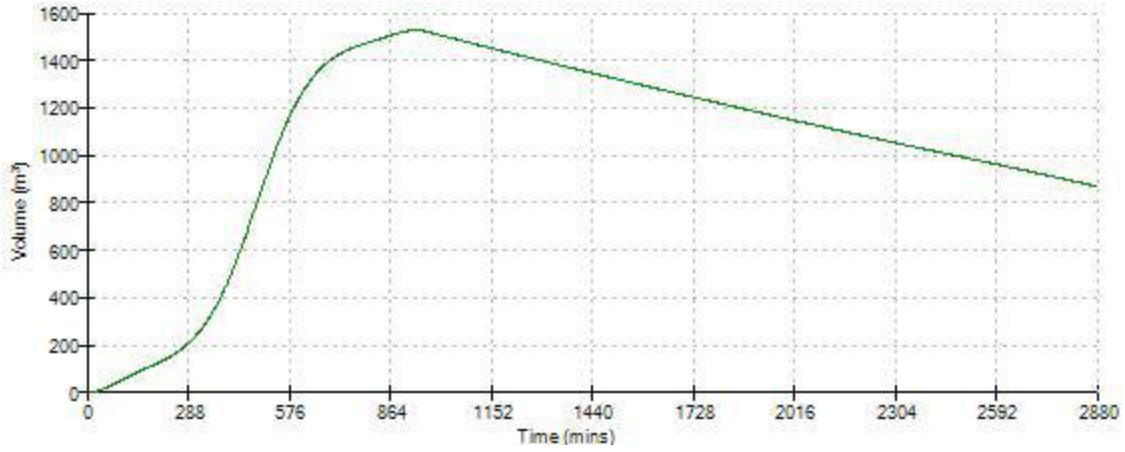


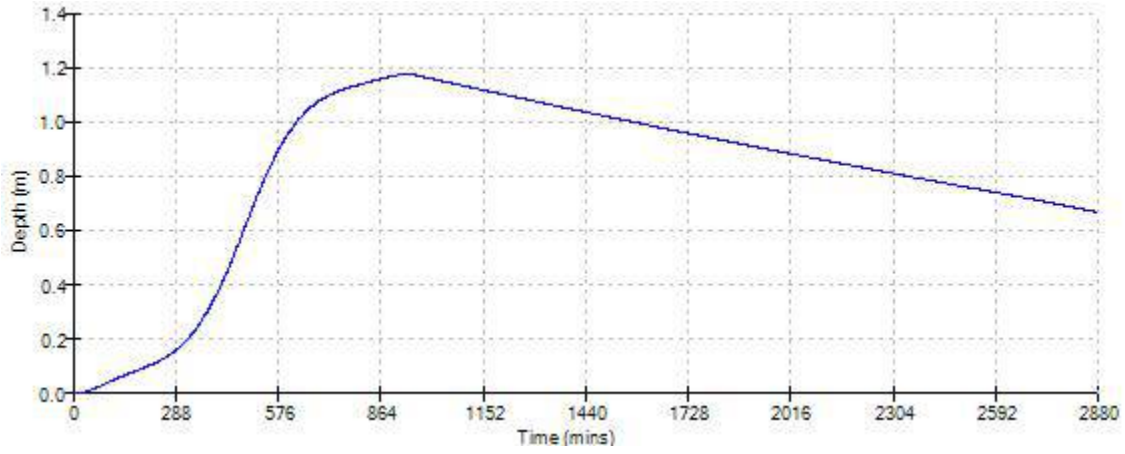


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Event: 960 min Winter

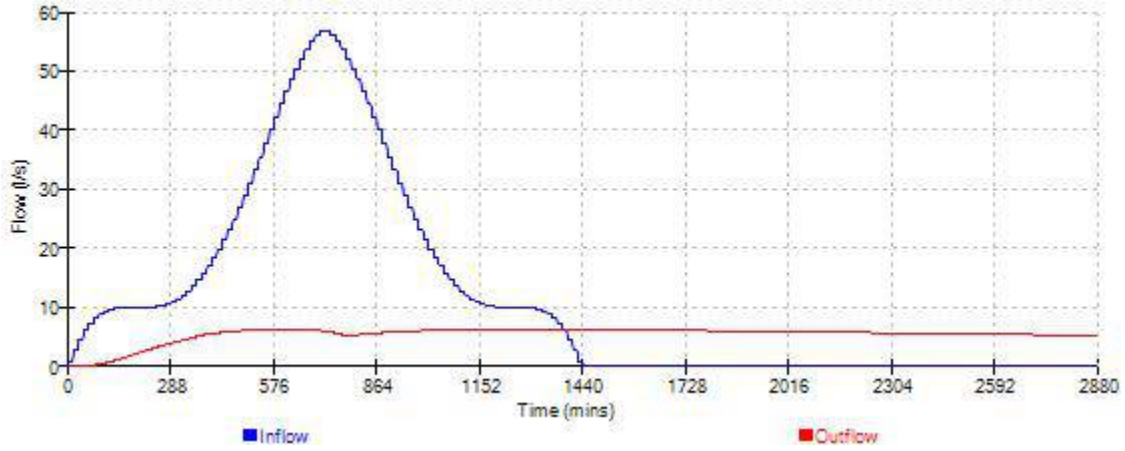


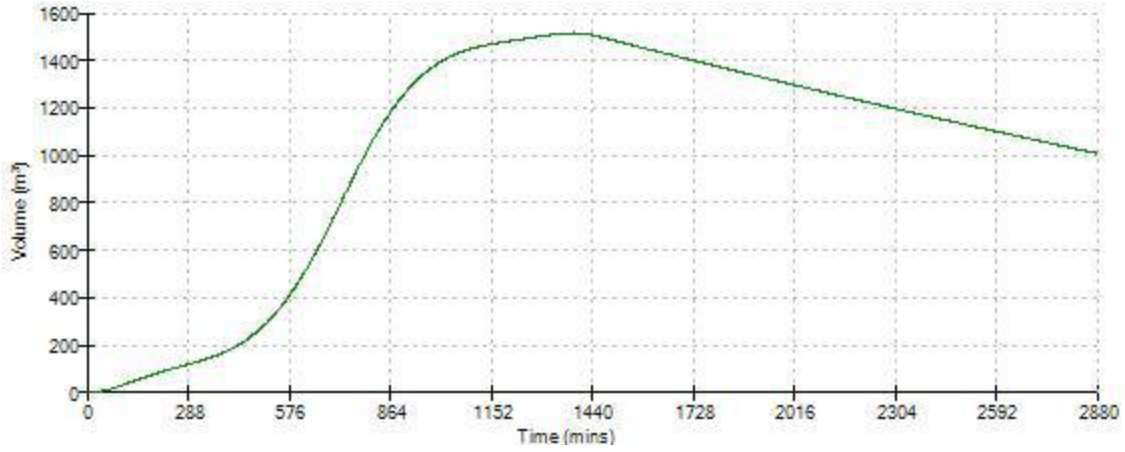


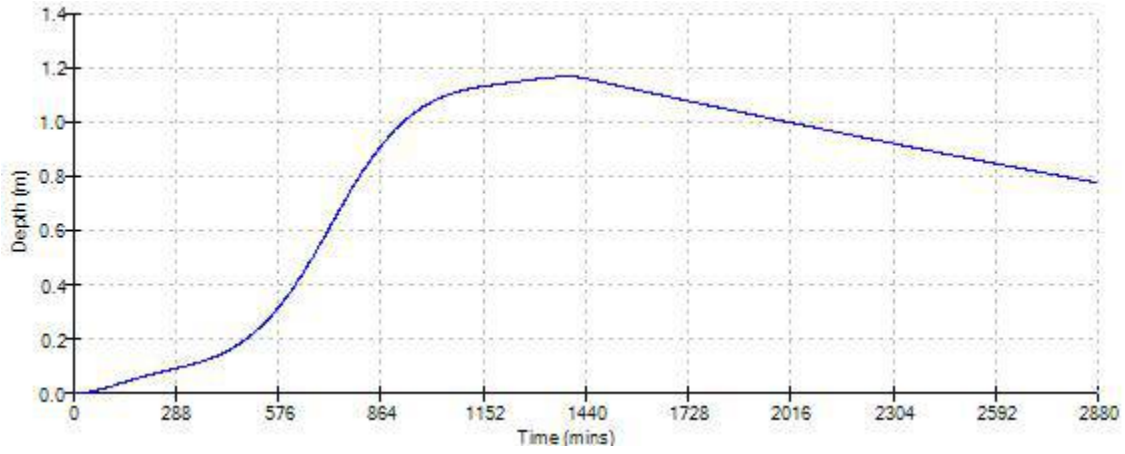


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Event: 1440 min Winter







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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.335	0.335	2.8	234.5	O K
30 min Summer	9.457	0.457	2.8	320.1	O K
60 min Summer	9.597	0.597	2.8	418.2	O K
120 min Summer	9.708	0.708	2.8	495.8	Flood Risk
180 min Summer	9.769	0.769	2.8	538.5	Flood Risk
240 min Summer	9.810	0.810	2.8	567.0	Flood Risk
360 min Summer	9.863	0.863	2.8	603.8	Flood Risk
480 min Summer	9.895	0.895	2.8	626.4	Flood Risk
600 min Summer	9.915	0.915	2.8	640.7	Flood Risk
720 min Summer	9.928	0.928	2.8	649.7	Flood Risk
960 min Summer	9.940	0.940	2.8	657.7	Flood Risk
1440 min Summer	9.928	0.928	2.8	649.8	Flood Risk
2160 min Summer	9.880	0.880	2.8	616.0	Flood Risk
2880 min Summer	9.836	0.836	2.8	585.0	Flood Risk
4320 min Summer	9.757	0.757	2.8	529.6	Flood Risk
5760 min Summer	9.695	0.695	2.8	486.5	O K
7200 min Summer	9.657	0.657	2.8	460.2	O K
8640 min Summer	9.633	0.633	2.8	443.4	O K
10080 min Summer	9.622	0.622	2.8	435.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	155.452	0.0	206.0	16
30 min Summer	106.486	0.0	235.0	31
60 min Summer	69.995	0.0	405.2	62
120 min Summer	41.971	0.0	443.9	122
180 min Summer	30.743	0.0	441.3	182
240 min Summer	24.555	0.0	437.1	242
360 min Summer	17.821	0.0	430.2	362
480 min Summer	14.163	0.0	425.3	482
600 min Summer	11.834	0.0	421.5	602
720 min Summer	10.209	0.0	418.3	722
960 min Summer	8.073	0.0	413.2	960
1440 min Summer	5.765	0.0	406.4	1440
2160 min Summer	4.088	0.0	837.4	1884
2880 min Summer	3.199	0.0	813.8	2272
4320 min Summer	2.258	0.0	739.7	3028
5760 min Summer	1.778	0.0	1037.1	3864
7200 min Summer	1.508	0.0	1098.3	4688
8640 min Summer	1.337	0.0	1166.7	5536
10080 min Summer	1.225	0.0	1241.7	6448

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	9.335	0.335	2.8	234.5	O K
30 min Winter	9.457	0.457	2.8	320.0	O K
60 min Winter	9.597	0.597	2.8	418.1	O K
120 min Winter	9.708	0.708	2.8	495.7	Flood Risk
180 min Winter	9.769	0.769	2.8	538.5	Flood Risk
240 min Winter	9.810	0.810	2.8	567.1	Flood Risk
360 min Winter	9.863	0.863	2.8	604.2	Flood Risk
480 min Winter	9.896	0.896	2.8	627.1	Flood Risk
600 min Winter	9.917	0.917	2.8	641.7	Flood Risk
720 min Winter	9.930	0.930	2.8	651.1	Flood Risk
960 min Winter	9.943	0.943	2.8	659.9	Flood Risk
1440 min Winter	9.934	0.934	2.8	654.1	Flood Risk
2160 min Winter	9.886	0.886	2.8	620.5	Flood Risk
2880 min Winter	9.832	0.832	2.8	582.6	Flood Risk
4320 min Winter	9.735	0.735	2.8	514.5	Flood Risk
5760 min Winter	9.647	0.647	2.8	452.9	O K
7200 min Winter	9.572	0.572	2.8	400.7	O K
8640 min Winter	9.519	0.519	2.8	363.2	O K
10080 min Winter	9.484	0.484	2.8	338.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	155.452	0.0	206.0	16
30 min Winter	106.486	0.0	235.1	31
60 min Winter	69.995	0.0	405.2	62
120 min Winter	41.971	0.0	444.0	122
180 min Winter	30.743	0.0	441.4	180
240 min Winter	24.555	0.0	437.2	240
360 min Winter	17.821	0.0	430.3	358
480 min Winter	14.163	0.0	425.2	474
600 min Winter	11.834	0.0	421.3	590
720 min Winter	10.209	0.0	418.1	708
960 min Winter	8.073	0.0	413.0	940
1440 min Winter	5.765	0.0	406.2	1384
2160 min Winter	4.088	0.0	837.9	2032
2880 min Winter	3.199	0.0	816.4	2308
4320 min Winter	2.258	0.0	750.2	3240
5760 min Winter	1.778	0.0	1037.2	4152
7200 min Winter	1.508	0.0	1098.9	4976
8640 min Winter	1.337	0.0	1168.0	5792
10080 min Winter	1.225	0.0	1245.1	6648

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 331208 350156 SJ 31208 50156
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.608

Time (mins) From:	To:	Area (ha)
0	1	0.608

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Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 9.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	700.0	1.000	700.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0080-2800-1000-2800
Design Head (m)	1.000
Design Flow (l/s)	2.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	80
Invert Level (m)	8.995
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

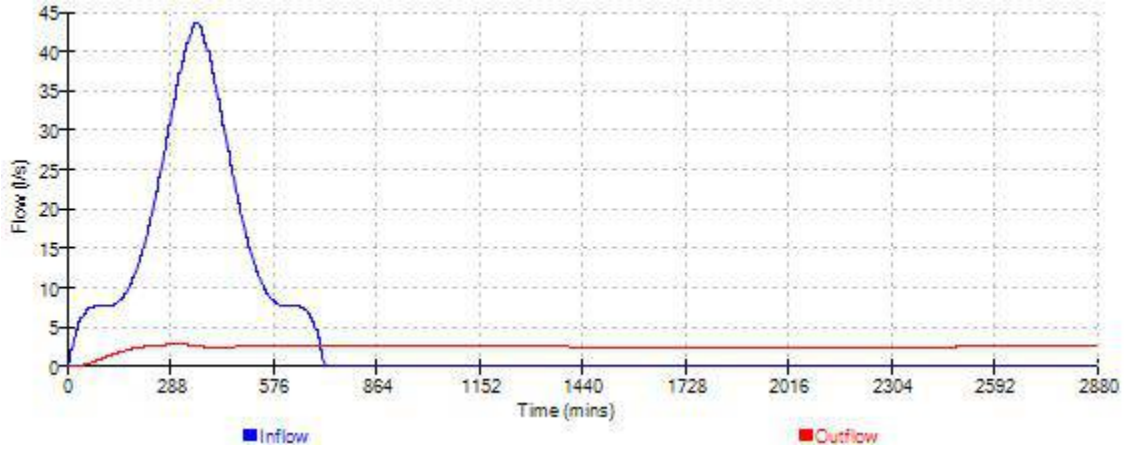
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	2.8
Flush-Flo™	0.299	2.8
Kick-Flo®	0.623	2.3
Mean Flow over Head Range	-	2.5

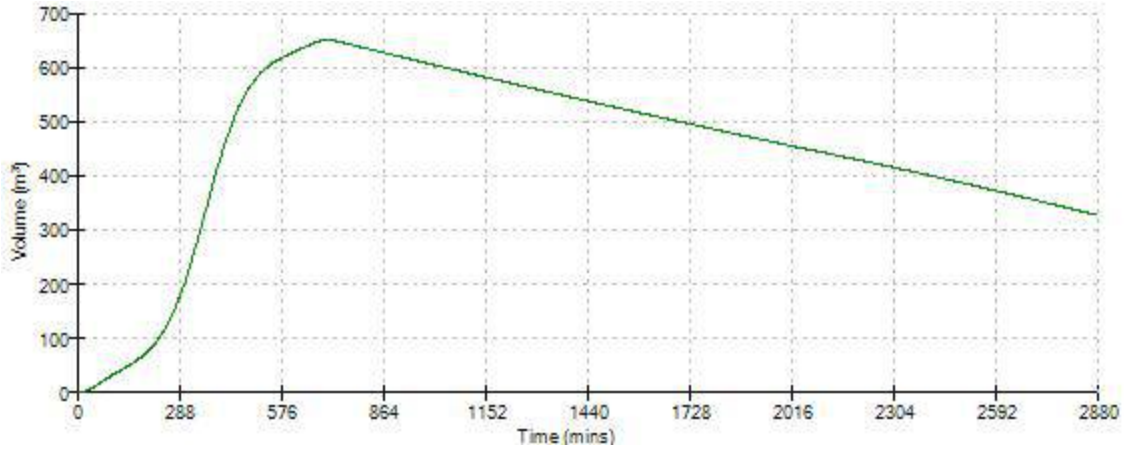
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

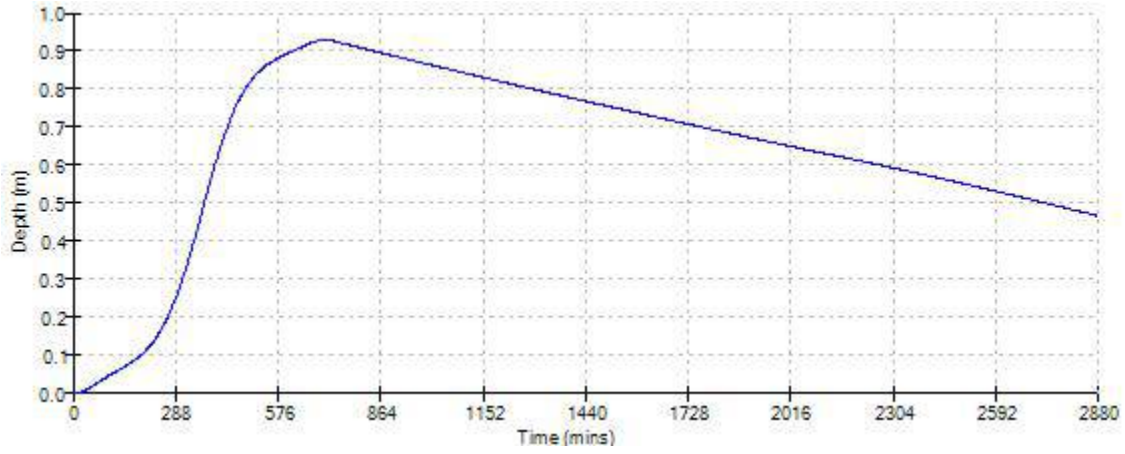
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.3	1.600	3.5	5.000	5.9
0.200	2.7	1.800	3.7	5.500	6.2
0.300	2.8	2.000	3.9	6.000	6.4
0.400	2.8	2.200	4.0	6.500	6.7
0.500	2.6	2.400	4.2	7.000	6.9
0.600	2.4	2.600	4.4	7.500	7.2
0.800	2.5	3.000	4.7	8.000	7.4
1.000	2.8	3.500	5.0	8.500	7.6
1.200	3.0	4.000	5.3	9.000	7.8
1.400	3.3	4.500	5.6	9.500	8.0

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Event: 720 min Winter

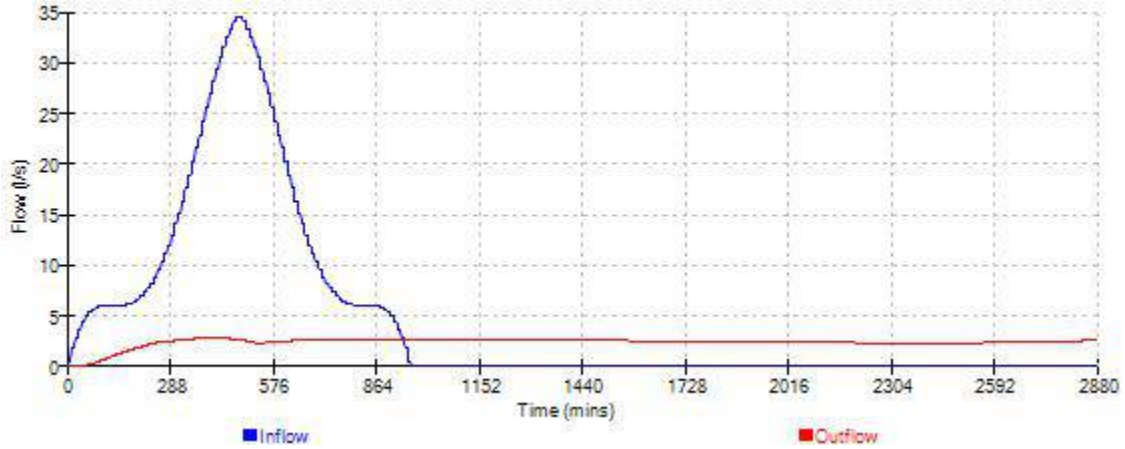


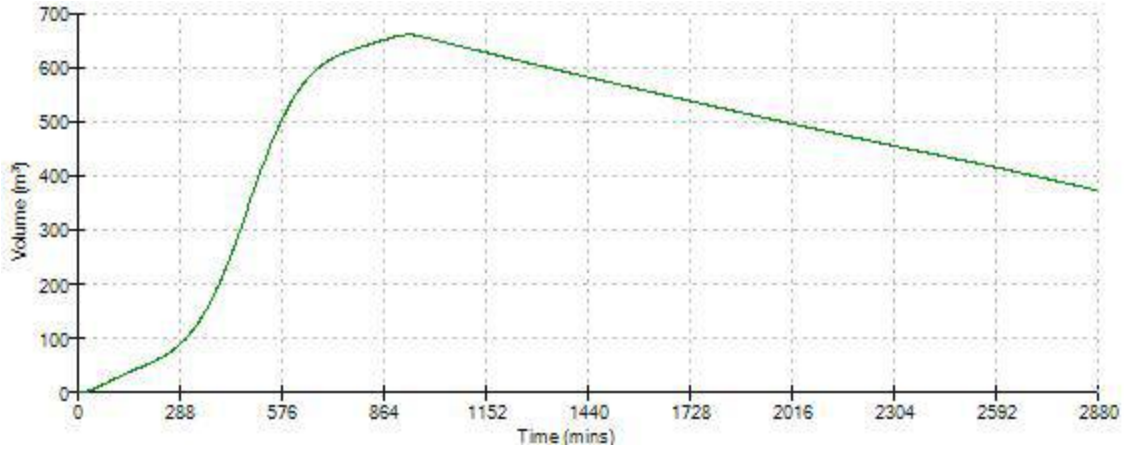


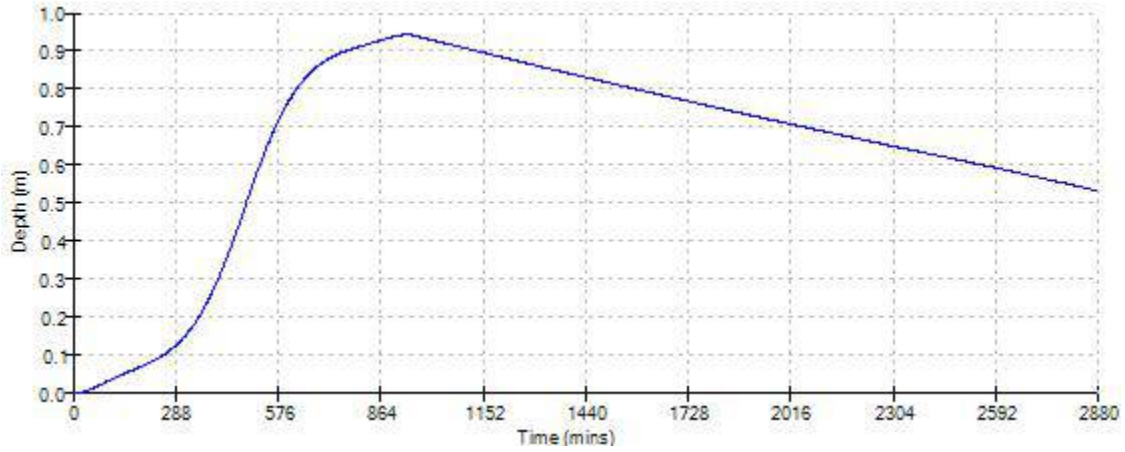


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Event: 960 min Winter

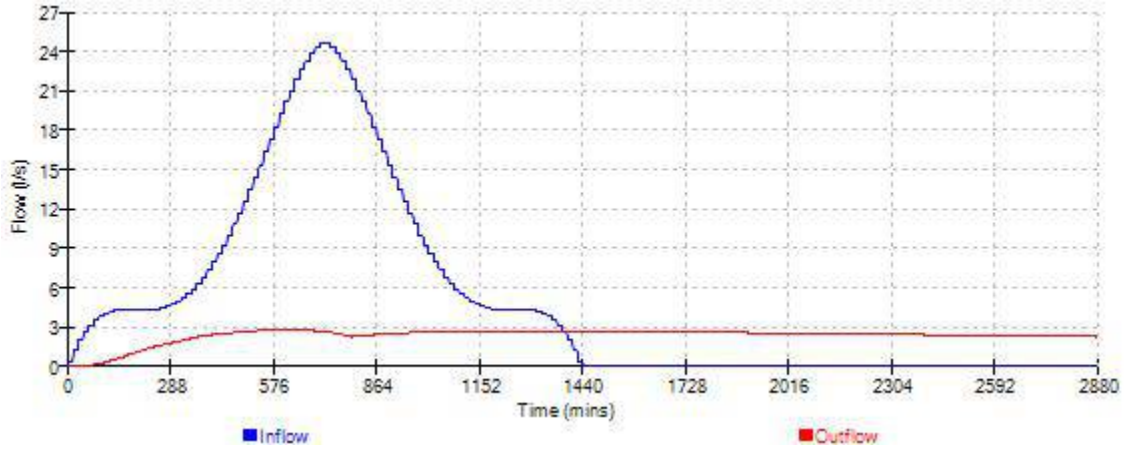


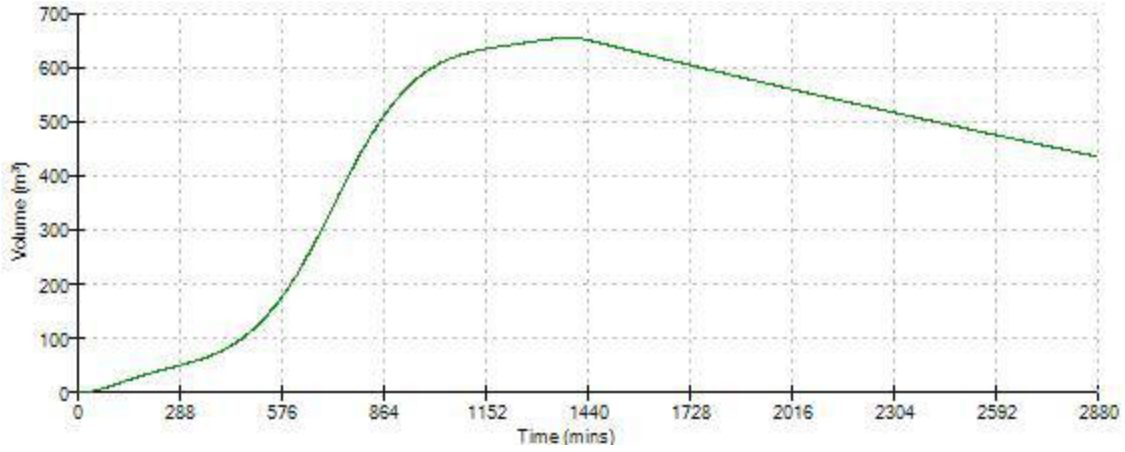


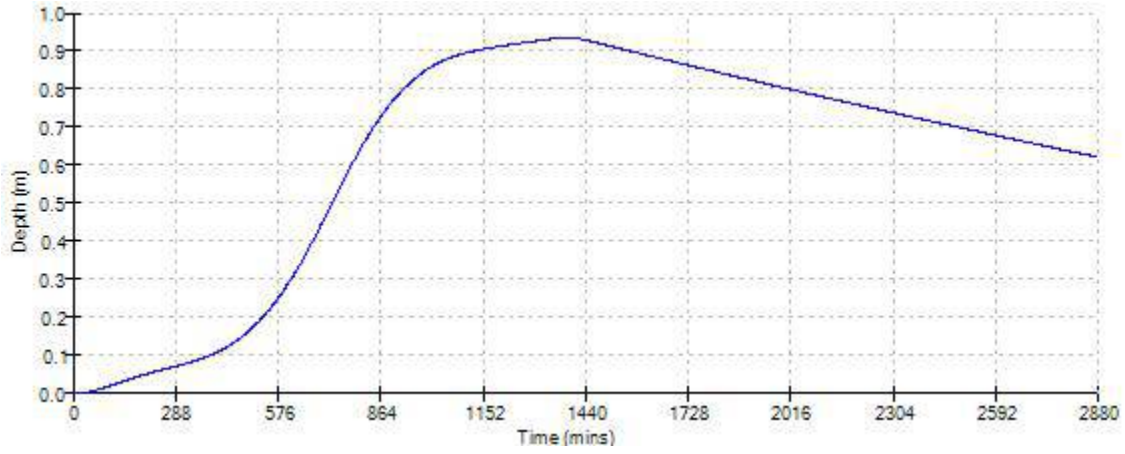


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Event: 1440 min Winter







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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.355	0.355	3.4	283.9	O K
30 min Summer	9.484	0.484	3.4	387.5	O K
60 min Summer	9.633	0.633	3.4	506.4	O K
120 min Summer	9.750	0.750	3.4	600.1	Flood Risk
180 min Summer	9.814	0.814	3.4	651.5	Flood Risk
240 min Summer	9.857	0.857	3.4	685.9	Flood Risk
360 min Summer	9.913	0.913	3.4	730.2	Flood Risk
480 min Summer	9.946	0.946	3.4	757.1	Flood Risk
600 min Summer	9.968	0.968	3.4	774.1	Flood Risk
720 min Summer	9.981	0.981	3.4	784.7	Flood Risk
960 min Summer	9.992	0.992	3.4	793.7	Flood Risk
1440 min Summer	9.979	0.979	3.4	783.0	Flood Risk
2160 min Summer	9.927	0.927	3.4	741.8	Flood Risk
2880 min Summer	9.881	0.881	3.4	704.6	Flood Risk
4320 min Summer	9.798	0.798	3.4	638.2	Flood Risk
5760 min Summer	9.734	0.734	3.4	587.1	Flood Risk
7200 min Summer	9.696	0.696	3.4	556.5	O K
8640 min Summer	9.672	0.672	3.4	537.5	O K
10080 min Summer	9.661	0.661	3.4	529.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	155.452	0.0	249.6	16
30 min Summer	106.486	0.0	284.3	31
60 min Summer	69.995	0.0	489.4	62
120 min Summer	41.971	0.0	536.3	122
180 min Summer	30.743	0.0	533.8	182
240 min Summer	24.555	0.0	529.6	242
360 min Summer	17.821	0.0	523.0	362
480 min Summer	14.163	0.0	518.4	482
600 min Summer	11.834	0.0	514.9	602
720 min Summer	10.209	0.0	512.0	720
960 min Summer	8.073	0.0	507.5	960
1440 min Summer	5.765	0.0	501.8	1440
2160 min Summer	4.088	0.0	1019.7	1860
2880 min Summer	3.199	0.0	992.2	2224
4320 min Summer	2.258	0.0	901.4	3024
5760 min Summer	1.778	0.0	1255.1	3864
7200 min Summer	1.508	0.0	1329.2	4688
8640 min Summer	1.337	0.0	1411.8	5536
10080 min Summer	1.225	0.0	1502.2	6360

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	9.355	0.355	3.4	283.9	O K
30 min Winter	9.484	0.484	3.4	387.4	O K
60 min Winter	9.633	0.633	3.4	506.3	O K
120 min Winter	9.750	0.750	3.4	599.9	Flood Risk
180 min Winter	9.815	0.815	3.4	651.6	Flood Risk
240 min Winter	9.858	0.858	3.4	686.1	Flood Risk
360 min Winter	9.913	0.913	3.4	730.8	Flood Risk
480 min Winter	9.948	0.948	3.4	758.2	Flood Risk
600 min Winter	9.970	0.970	3.4	775.6	Flood Risk
720 min Winter	9.983	0.983	3.4	786.7	Flood Risk
960 min Winter	9.996	0.996	3.4	796.8	Flood Risk
1440 min Winter	9.986	0.986	3.4	788.8	Flood Risk
2160 min Winter	9.934	0.934	3.4	747.1	Flood Risk
2880 min Winter	9.878	0.878	3.4	702.2	Flood Risk
4320 min Winter	9.776	0.776	3.4	620.7	Flood Risk
5760 min Winter	9.686	0.686	3.4	548.5	O K
7200 min Winter	9.614	0.614	3.4	491.0	O K
8640 min Winter	9.553	0.553	3.4	442.1	O K
10080 min Winter	9.514	0.514	3.4	411.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	155.452	0.0	249.7	16
30 min Winter	106.486	0.0	284.4	31
60 min Winter	69.995	0.0	489.4	62
120 min Winter	41.971	0.0	536.4	122
180 min Winter	30.743	0.0	534.0	180
240 min Winter	24.555	0.0	529.7	240
360 min Winter	17.821	0.0	522.9	358
480 min Winter	14.163	0.0	518.2	474
600 min Winter	11.834	0.0	514.5	590
720 min Winter	10.209	0.0	511.5	706
960 min Winter	8.073	0.0	506.9	940
1440 min Winter	5.765	0.0	501.2	1384
2160 min Winter	4.088	0.0	1019.8	2012
2880 min Winter	3.199	0.0	994.5	2280
4320 min Winter	2.258	0.0	912.3	3200
5760 min Winter	1.778	0.0	1255.2	4152
7200 min Winter	1.508	0.0	1329.7	5048
8640 min Winter	1.337	0.0	1413.4	5800
10080 min Winter	1.225	0.0	1506.7	6656

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 331208 350156 SJ 31208 50156
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.736

Time (mins) From:	To:	Area (ha)
0	1	0.736

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Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 9.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	800.0	1.000	800.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0088-3400-1000-3400
Design Head (m)	1.000
Design Flow (l/s)	3.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	88
Invert Level (m)	8.995
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

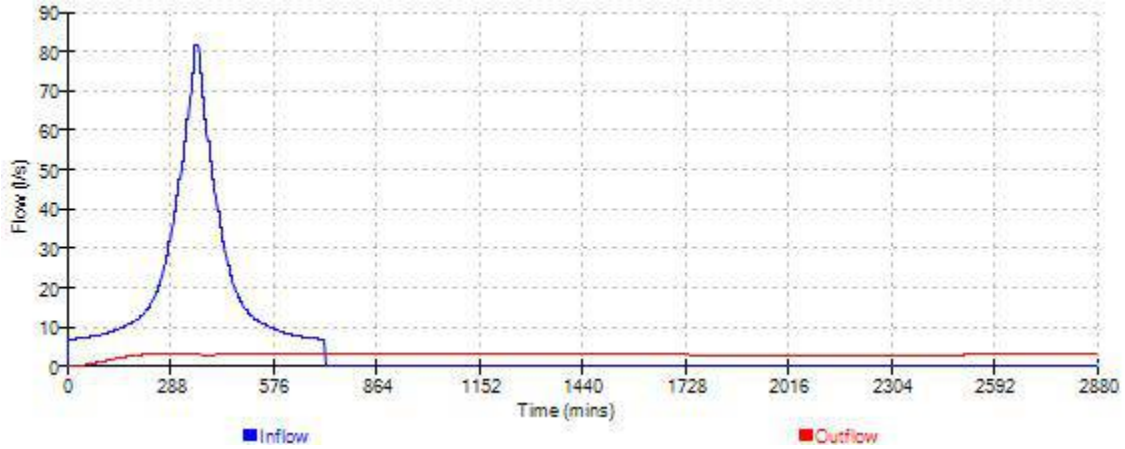
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.4
Flush-Flo™	0.297	3.4
Kick-Flo®	0.624	2.7
Mean Flow over Head Range	-	3.0

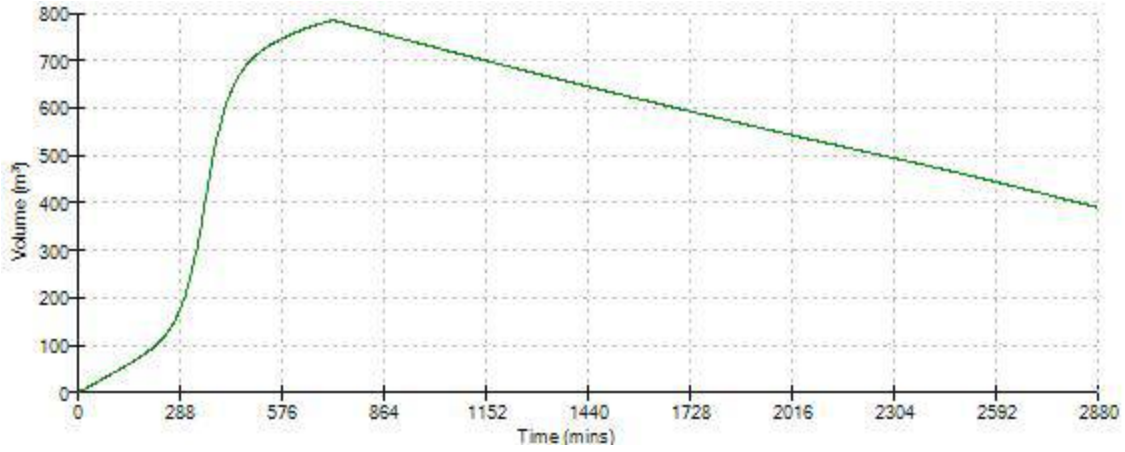
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

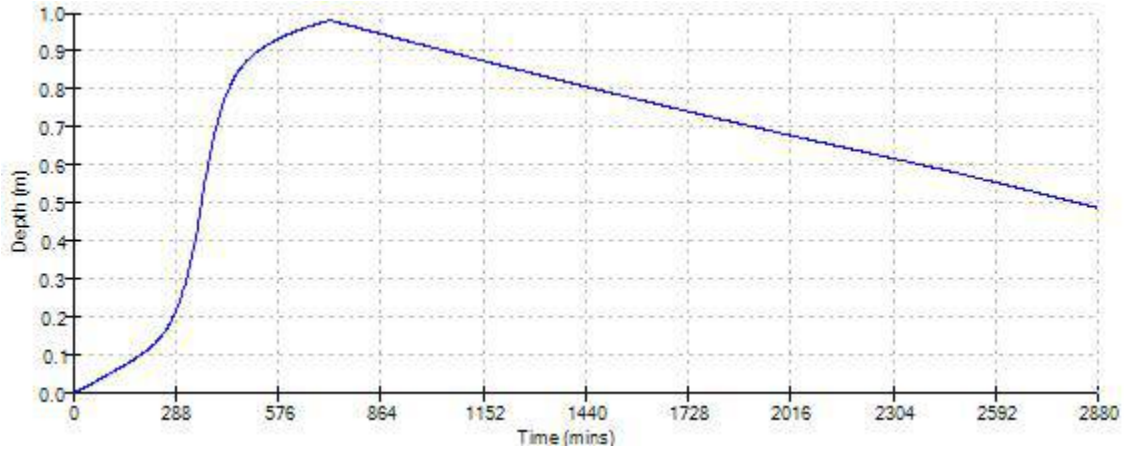
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.7	1.600	4.2	5.000	7.2
0.200	3.3	1.800	4.5	5.500	7.5
0.300	3.4	2.000	4.7	6.000	7.8
0.400	3.3	2.200	4.9	6.500	8.2
0.500	3.2	2.400	5.1	7.000	8.4
0.600	2.9	2.600	5.3	7.500	8.7
0.800	3.1	3.000	5.7	8.000	9.0
1.000	3.4	3.500	6.1	8.500	9.3
1.200	3.7	4.000	6.5	9.000	9.5
1.400	4.0	4.500	6.9	9.500	9.8

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Event: 720 min Summer

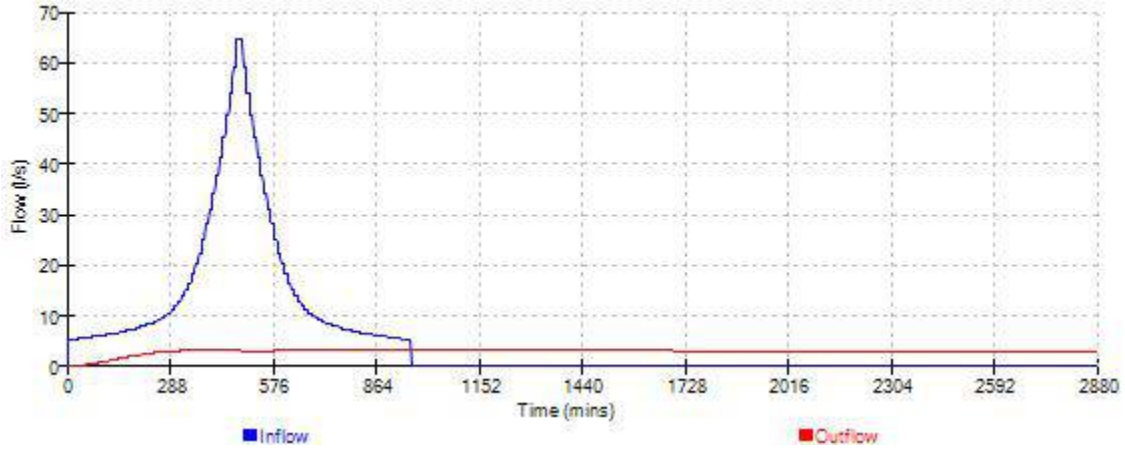


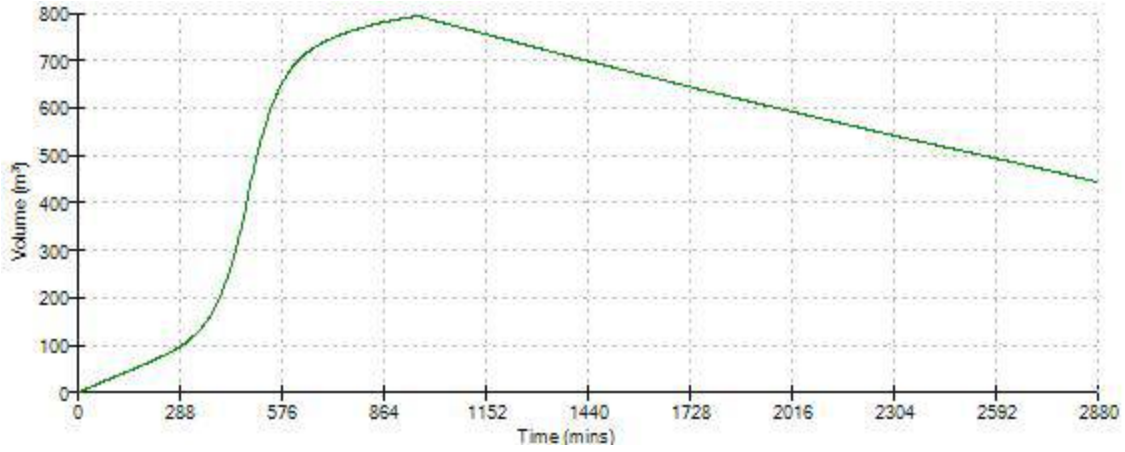


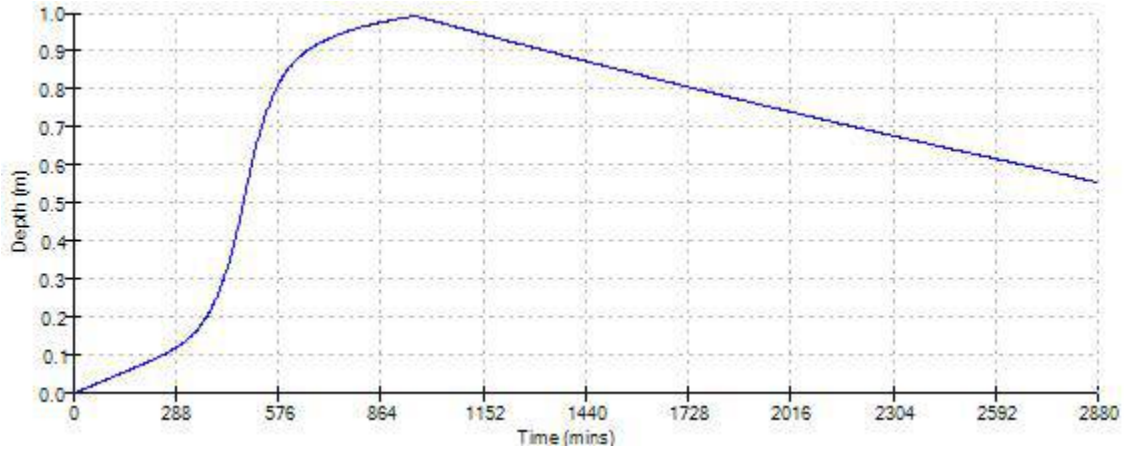


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Event: 960 min Summer

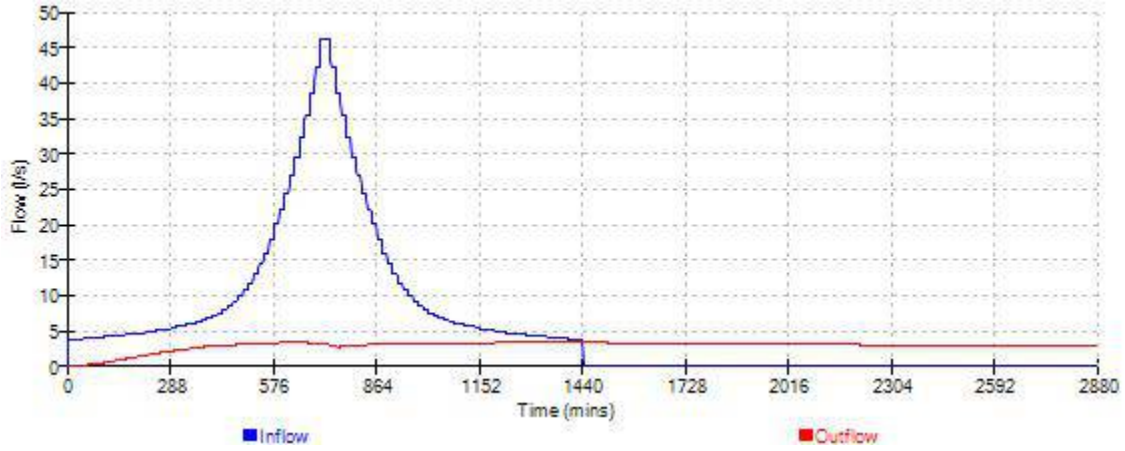


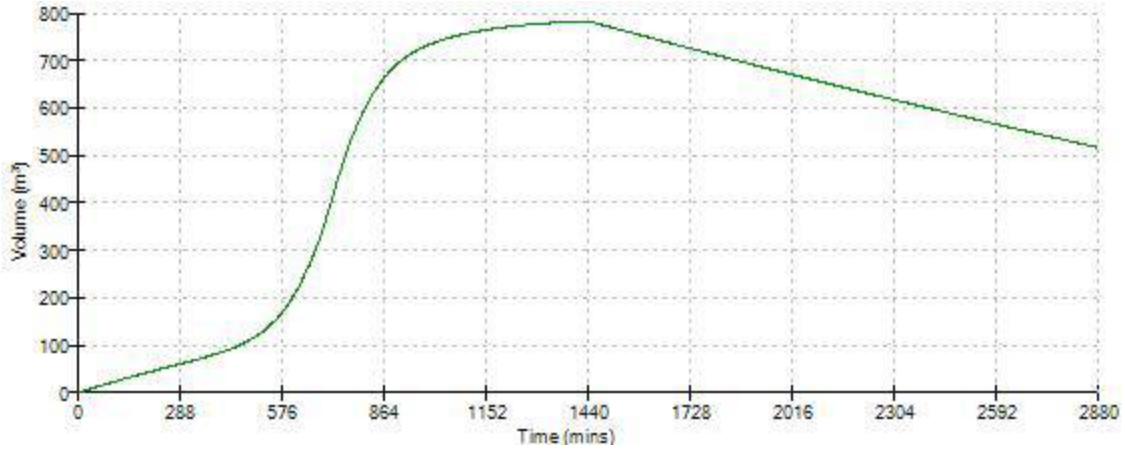


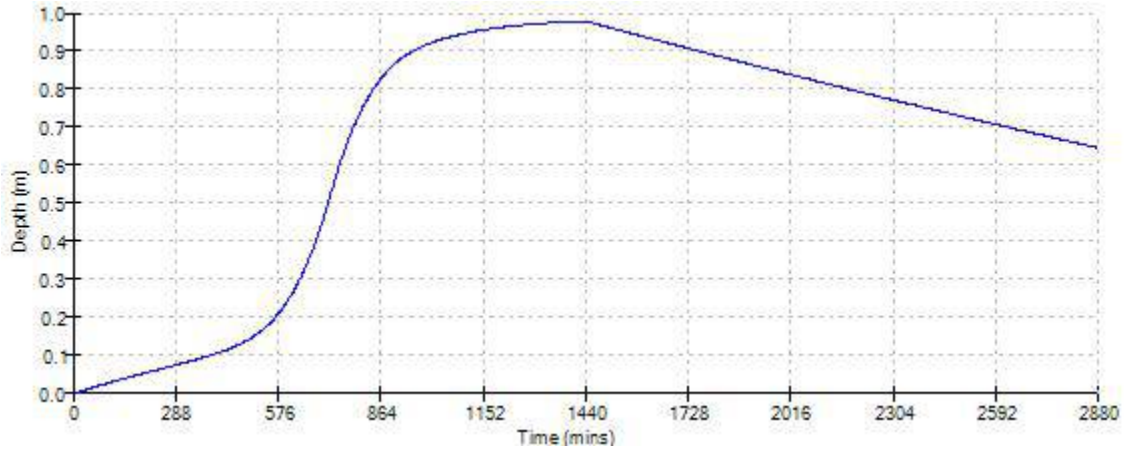


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Event: 1440 min Summer







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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.219	0.419	6.4	544.6	O K
30 min Summer	9.372	0.572	6.4	743.5	O K
60 min Summer	9.548	0.748	6.4	972.0	O K
120 min Summer	9.686	0.886	6.4	1152.4	O K
180 min Summer	9.763	0.963	6.4	1251.8	Flood Risk
240 min Summer	9.814	1.014	6.4	1318.4	Flood Risk
360 min Summer	9.880	1.080	6.4	1404.6	Flood Risk
480 min Summer	9.921	1.121	6.4	1457.4	Flood Risk
600 min Summer	9.947	1.147	6.4	1491.2	Flood Risk
720 min Summer	9.963	1.163	6.4	1512.5	Flood Risk
960 min Summer	9.978	1.178	6.4	1532.0	Flood Risk
1440 min Summer	9.966	1.166	6.4	1515.4	Flood Risk
2160 min Summer	9.907	1.107	6.4	1439.2	Flood Risk
2880 min Summer	9.853	1.053	6.4	1369.4	Flood Risk
4320 min Summer	9.757	0.957	6.4	1243.9	Flood Risk
5760 min Summer	9.682	0.882	6.4	1147.2	O K
7200 min Summer	9.638	0.838	6.4	1089.6	O K
8640 min Summer	9.611	0.811	6.4	1054.7	O K
10080 min Summer	9.600	0.800	6.4	1040.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	155.452	0.0	470.4	17
30 min Summer	106.486	0.0	535.5	32
60 min Summer	69.995	0.0	929.8	62
120 min Summer	41.971	0.0	1010.3	122
180 min Summer	30.743	0.0	1002.4	182
240 min Summer	24.555	0.0	993.1	242
360 min Summer	17.821	0.0	979.2	362
480 min Summer	14.163	0.0	969.9	482
600 min Summer	11.834	0.0	962.9	602
720 min Summer	10.209	0.0	957.3	722
960 min Summer	8.073	0.0	948.9	960
1440 min Summer	5.765	0.0	938.4	1440
2160 min Summer	4.088	0.0	1919.4	1880
2880 min Summer	3.199	0.0	1858.6	2252
4320 min Summer	2.258	0.0	1687.8	3028
5760 min Summer	1.778	0.0	2404.5	3864
7200 min Summer	1.508	0.0	2545.9	4688
8640 min Summer	1.337	0.0	2703.1	5536
10080 min Summer	1.225	0.0	2872.4	6360

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	9.219	0.419	6.4	544.5	O K
30 min Winter	9.372	0.572	6.4	743.3	O K
60 min Winter	9.548	0.748	6.4	971.9	O K
120 min Winter	9.686	0.886	6.4	1152.1	O K
180 min Winter	9.763	0.963	6.4	1251.9	Flood Risk
240 min Winter	9.814	1.014	6.4	1318.7	Flood Risk
360 min Winter	9.881	1.081	6.4	1405.5	Flood Risk
480 min Winter	9.922	1.122	6.4	1459.1	Flood Risk
600 min Winter	9.949	1.149	6.4	1493.7	Flood Risk
720 min Winter	9.966	1.166	6.4	1516.1	Flood Risk
960 min Winter	9.983	1.183	6.4	1537.5	Flood Risk
1440 min Winter	9.974	1.174	6.4	1525.8	Flood Risk
2160 min Winter	9.916	1.116	6.4	1450.3	Flood Risk
2880 min Winter	9.850	1.050	6.4	1365.1	Flood Risk
4320 min Winter	9.732	0.932	6.4	1212.1	Flood Risk
5760 min Winter	9.628	0.828	6.4	1076.4	O K
7200 min Winter	9.547	0.747	6.4	970.7	O K
8640 min Winter	9.476	0.676	6.4	878.3	O K
10080 min Winter	9.431	0.631	6.4	819.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	155.452	0.0	470.4	17
30 min Winter	106.486	0.0	535.6	32
60 min Winter	69.995	0.0	929.8	62
120 min Winter	41.971	0.0	1010.6	122
180 min Winter	30.743	0.0	1002.8	180
240 min Winter	24.555	0.0	993.3	240
360 min Winter	17.821	0.0	979.3	358
480 min Winter	14.163	0.0	969.7	474
600 min Winter	11.834	0.0	962.5	590
720 min Winter	10.209	0.0	956.7	708
960 min Winter	8.073	0.0	948.1	940
1440 min Winter	5.765	0.0	937.6	1384
2160 min Winter	4.088	0.0	1920.0	2032
2880 min Winter	3.199	0.0	1863.2	2304
4320 min Winter	2.258	0.0	1708.0	3240
5760 min Winter	1.778	0.0	2404.9	4152
7200 min Winter	1.508	0.0	2547.2	5112
8640 min Winter	1.337	0.0	2706.9	5880
10080 min Winter	1.225	0.0	2884.1	6664

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 331208 350156 SJ 31208 50156
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.412

Time (mins) From:	To:	Area (ha)
0	2	1.412

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Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 8.800

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1300.0	1.200	1300.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0116-6400-1200-6400
Design Head (m)	1.200
Design Flow (l/s)	6.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	116
Invert Level (m)	8.795
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

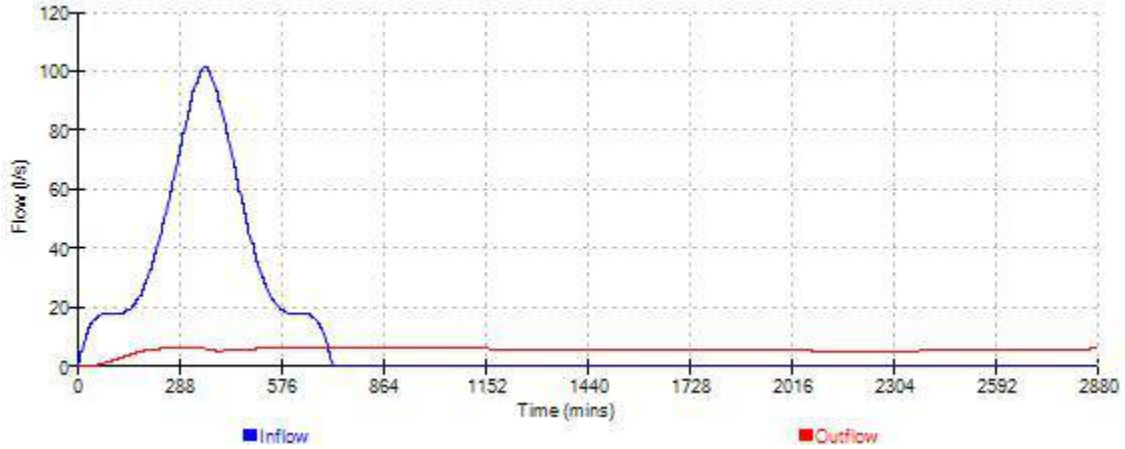
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	6.4
Flush-Flo™	0.354	6.4
Kick-Flo®	0.751	5.1
Mean Flow over Head Range	-	5.6

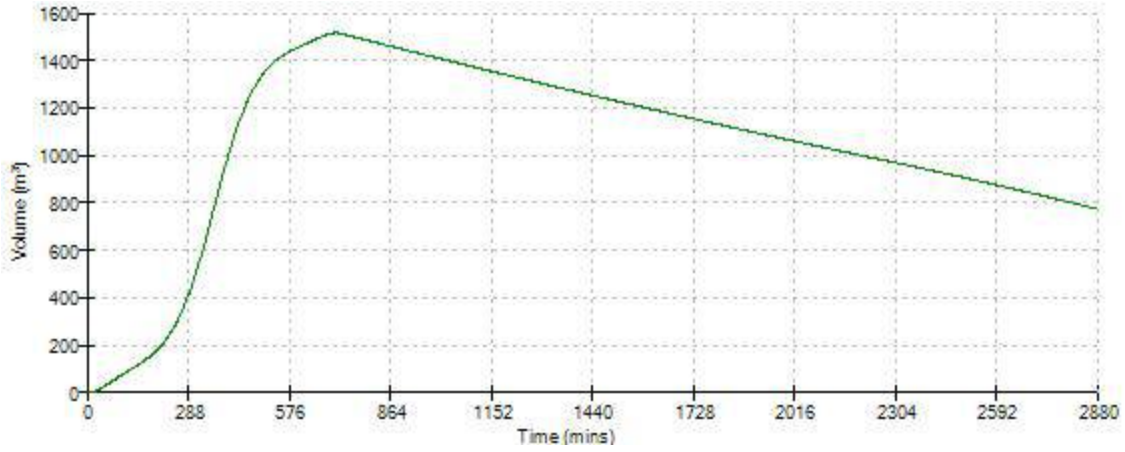
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

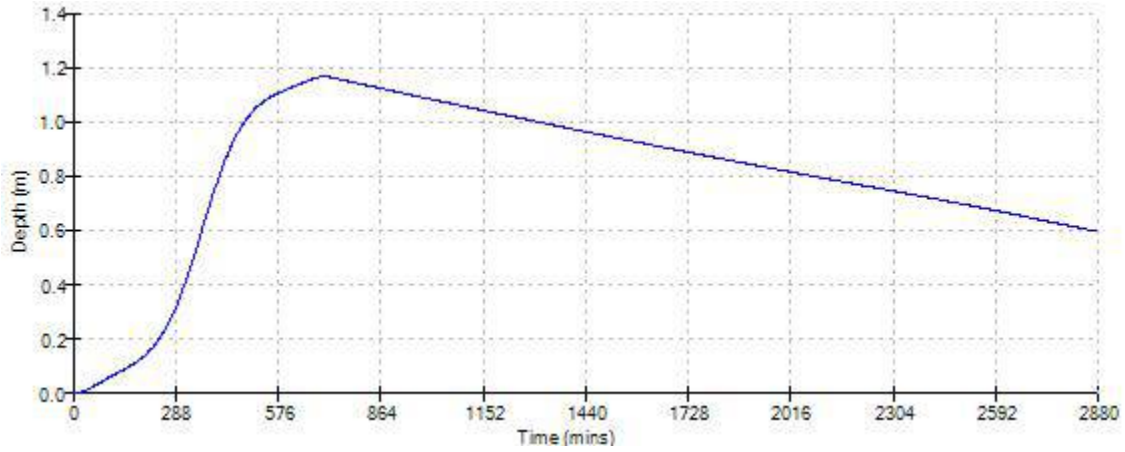
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.1	1.600	7.3	5.000	12.5
0.200	6.0	1.800	7.7	5.500	13.1
0.300	6.3	2.000	8.1	6.000	13.7
0.400	6.3	2.200	8.5	6.500	14.2
0.500	6.2	2.400	8.9	7.000	14.7
0.600	6.0	2.600	9.2	7.500	15.2
0.800	5.3	3.000	9.8	8.000	15.7
1.000	5.9	3.500	10.6	8.500	16.2
1.200	6.4	4.000	11.3	9.000	16.6
1.400	6.9	4.500	11.9	9.500	17.0

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Event: 720 min Winter

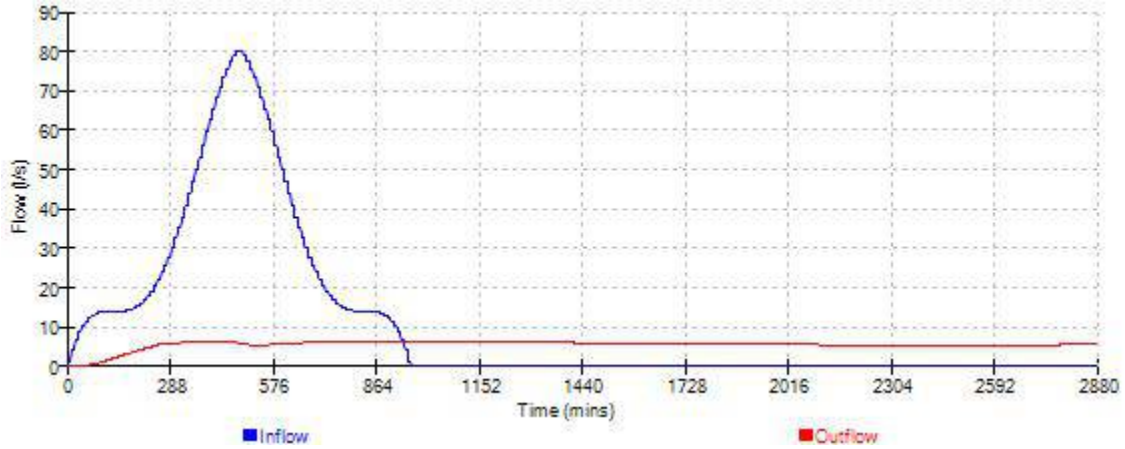


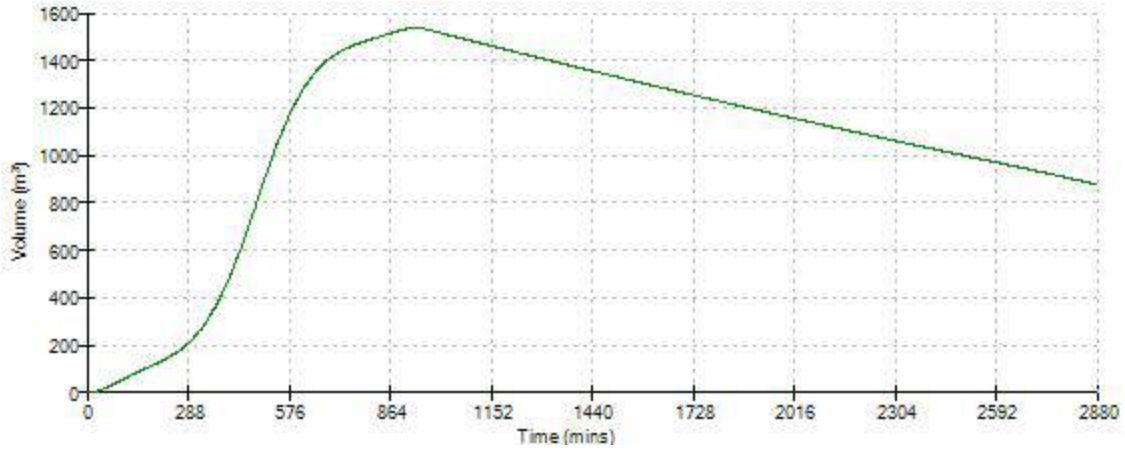


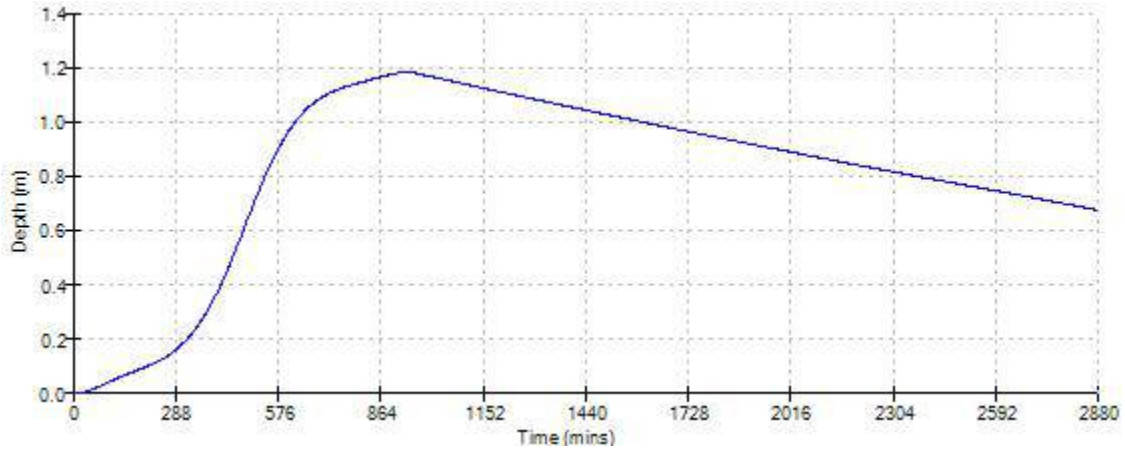


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Event: 960 min Winter

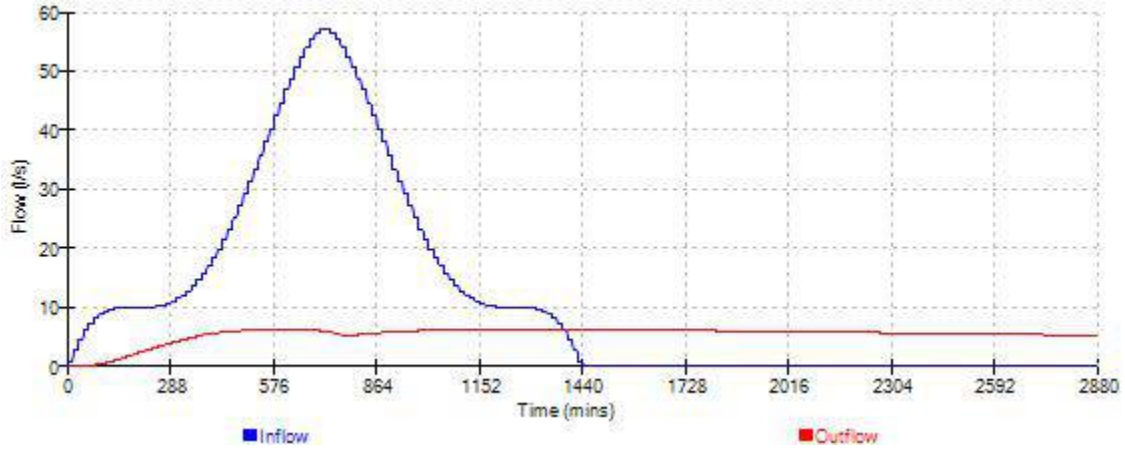


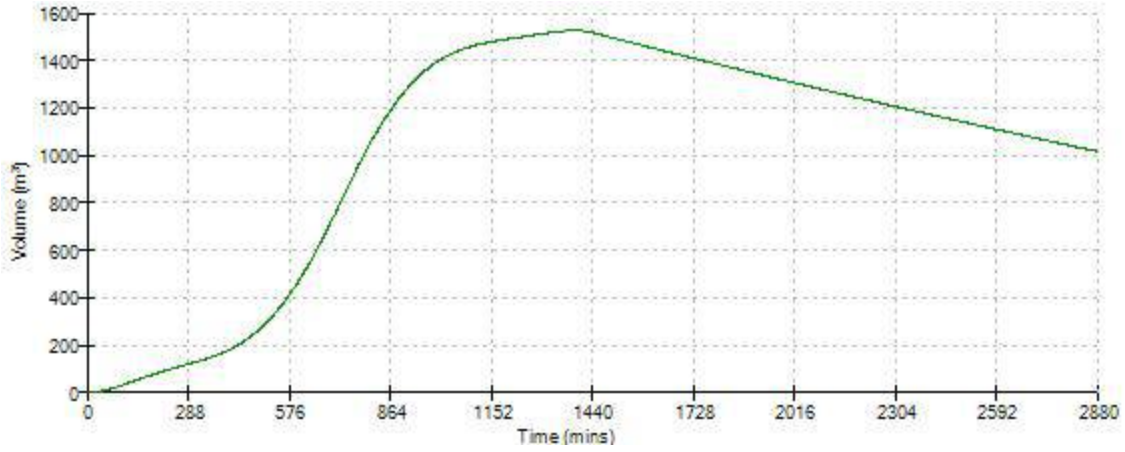


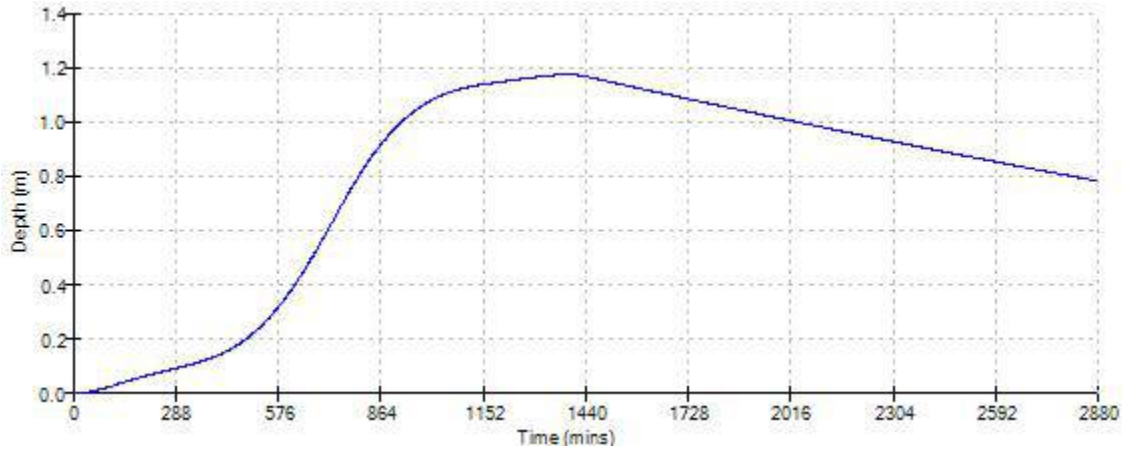


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Event: 1440 min Winter







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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.213	0.413	6.9	578.2	O K
30 min Summer	9.364	0.564	6.9	789.5	O K
60 min Summer	9.537	0.737	6.9	1031.8	O K
120 min Summer	9.674	0.874	6.9	1223.4	O K
180 min Summer	9.749	0.949	6.9	1328.9	Flood Risk
240 min Summer	9.800	1.000	6.9	1399.6	Flood Risk
360 min Summer	9.865	1.065	6.9	1491.1	Flood Risk
480 min Summer	9.905	1.105	6.9	1547.0	Flood Risk
600 min Summer	9.930	1.130	6.9	1582.6	Flood Risk
720 min Summer	9.947	1.147	6.9	1605.1	Flood Risk
960 min Summer	9.961	1.161	6.9	1625.1	Flood Risk
1440 min Summer	9.948	1.148	6.9	1606.5	Flood Risk
2160 min Summer	9.889	1.089	6.9	1524.9	Flood Risk
2880 min Summer	9.836	1.036	6.9	1450.3	Flood Risk
4320 min Summer	9.740	0.940	6.9	1315.6	Flood Risk
5760 min Summer	9.665	0.865	6.9	1210.7	O K
7200 min Summer	9.619	0.819	6.9	1146.8	O K
8640 min Summer	9.590	0.790	6.9	1106.5	O K
10080 min Summer	9.577	0.777	6.9	1088.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	155.452	0.0	500.1	18
30 min Summer	106.486	0.0	579.5	33
60 min Summer	69.995	0.0	989.9	64
120 min Summer	41.971	0.0	1093.6	124
180 min Summer	30.743	0.0	1087.5	184
240 min Summer	24.555	0.0	1077.2	242
360 min Summer	17.821	0.0	1060.6	362
480 min Summer	14.163	0.0	1048.9	482
600 min Summer	11.834	0.0	1039.9	602
720 min Summer	10.209	0.0	1032.3	722
960 min Summer	8.073	0.0	1020.1	962
1440 min Summer	5.765	0.0	1003.4	1440
2160 min Summer	4.088	0.0	2062.6	1880
2880 min Summer	3.199	0.0	2003.7	2248
4320 min Summer	2.258	0.0	1817.7	3028
5760 min Summer	1.778	0.0	2554.0	3864
7200 min Summer	1.508	0.0	2704.4	4688
8640 min Summer	1.337	0.0	2871.8	5536
10080 min Summer	1.225	0.0	3054.1	6360

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	9.213	0.413	6.9	578.1	O K
30 min Winter	9.364	0.564	6.9	789.3	O K
60 min Winter	9.537	0.737	6.9	1031.5	O K
120 min Winter	9.674	0.874	6.9	1223.5	O K
180 min Winter	9.749	0.949	6.9	1329.2	Flood Risk
240 min Winter	9.800	1.000	6.9	1400.2	Flood Risk
360 min Winter	9.866	1.066	6.9	1492.1	Flood Risk
480 min Winter	9.906	1.106	6.9	1548.7	Flood Risk
600 min Winter	9.932	1.132	6.9	1585.2	Flood Risk
720 min Winter	9.949	1.149	6.9	1608.6	Flood Risk
960 min Winter	9.965	1.165	6.9	1630.7	Flood Risk
1440 min Winter	9.955	1.155	6.9	1617.1	Flood Risk
2160 min Winter	9.897	1.097	6.9	1535.3	Flood Risk
2880 min Winter	9.832	1.032	6.9	1444.1	Flood Risk
4320 min Winter	9.713	0.913	6.9	1278.5	Flood Risk
5760 min Winter	9.606	0.806	6.9	1129.1	O K
7200 min Winter	9.517	0.717	6.9	1003.3	O K
8640 min Winter	9.449	0.649	6.9	908.4	O K
10080 min Winter	9.405	0.605	6.9	846.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	155.452	0.0	500.2	18
30 min Winter	106.486	0.0	579.6	33
60 min Winter	69.995	0.0	990.0	64
120 min Winter	41.971	0.0	1093.9	122
180 min Winter	30.743	0.0	1088.0	180
240 min Winter	24.555	0.0	1077.6	240
360 min Winter	17.821	0.0	1060.9	358
480 min Winter	14.163	0.0	1048.9	476
600 min Winter	11.834	0.0	1039.7	592
720 min Winter	10.209	0.0	1032.0	708
960 min Winter	8.073	0.0	1019.6	940
1440 min Winter	5.765	0.0	1003.1	1386
2160 min Winter	4.088	0.0	2063.8	2028
2880 min Winter	3.199	0.0	2010.1	2304
4320 min Winter	2.258	0.0	1842.6	3240
5760 min Winter	1.778	0.0	2554.5	4152
7200 min Winter	1.508	0.0	2706.0	5040
8640 min Winter	1.337	0.0	2875.7	5800
10080 min Winter	1.225	0.0	3064.3	6648

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 331208 350156 SJ 31208 50156
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.500

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	1	0.500	1	2	0.500	2	3	0.500

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Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 8.800

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1400.0	1.200	1400.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0120-6900-1200-6900
Design Head (m)	1.200
Design Flow (l/s)	6.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	120
Invert Level (m)	8.795
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

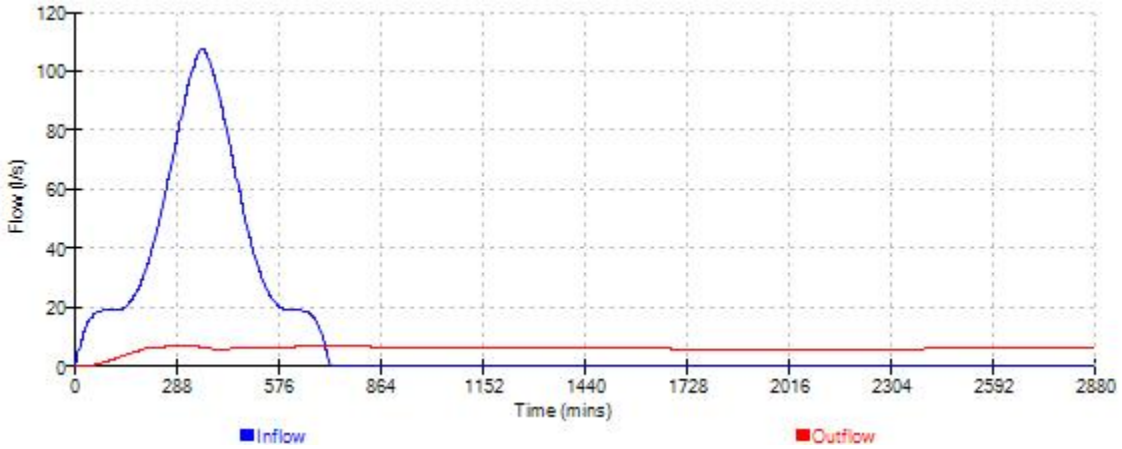
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	6.9
Flush-Flo™	0.356	6.9
Kick-Flo®	0.760	5.6
Mean Flow over Head Range	-	6.0

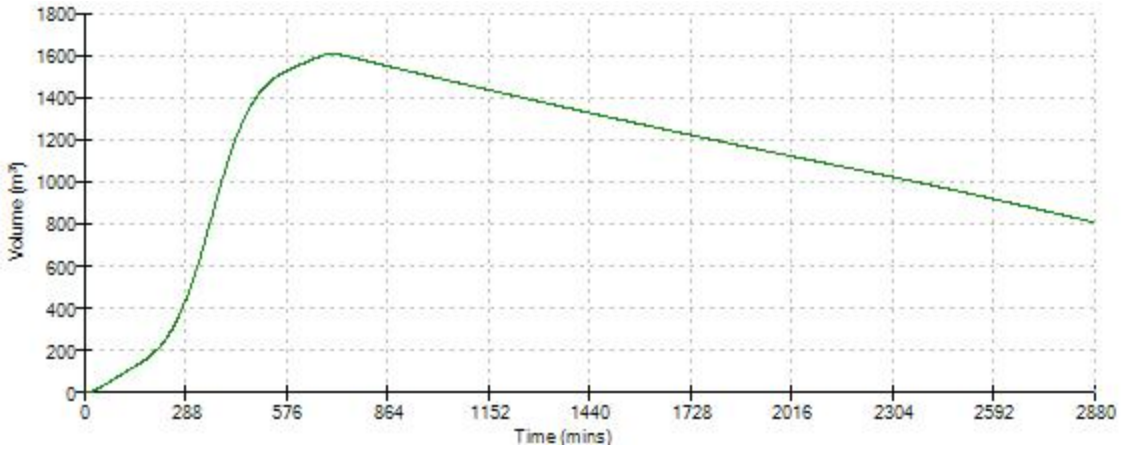
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

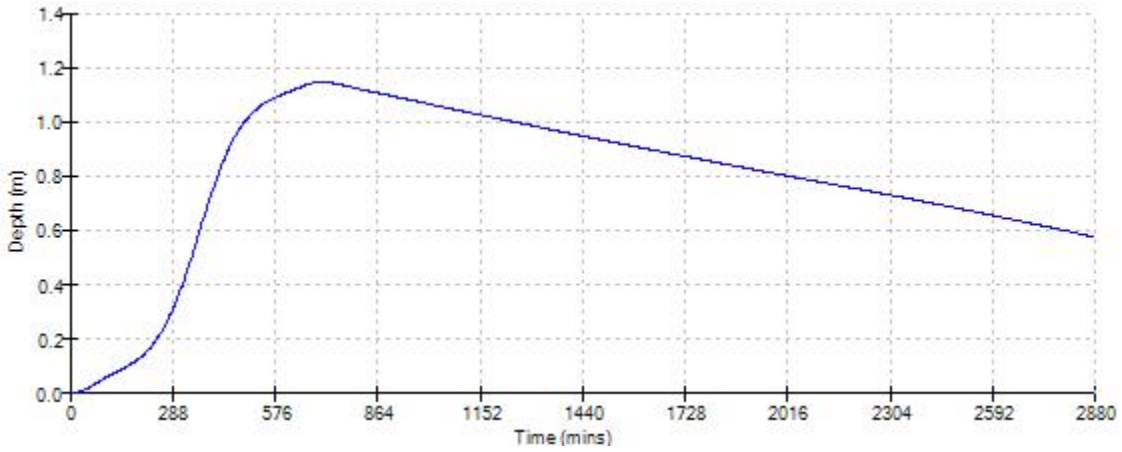
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.2	1.600	7.9	5.000	13.5
0.200	6.5	1.800	8.3	5.500	14.2
0.300	6.9	2.000	8.8	6.000	14.8
0.400	6.9	2.200	9.2	6.500	15.3
0.500	6.8	2.400	9.5	7.000	15.9
0.600	6.5	2.600	9.9	7.500	16.4
0.800	5.7	3.000	10.6	8.000	16.9
1.000	6.3	3.500	11.4	8.500	17.4
1.200	6.9	4.000	12.2	9.000	17.9
1.400	7.4	4.500	12.9	9.500	18.4

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Event: 720 min Winter

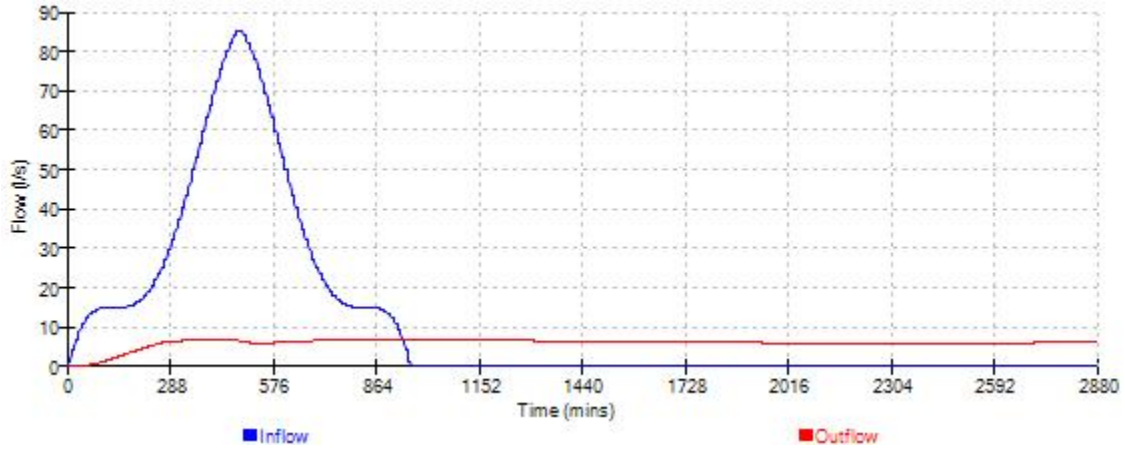


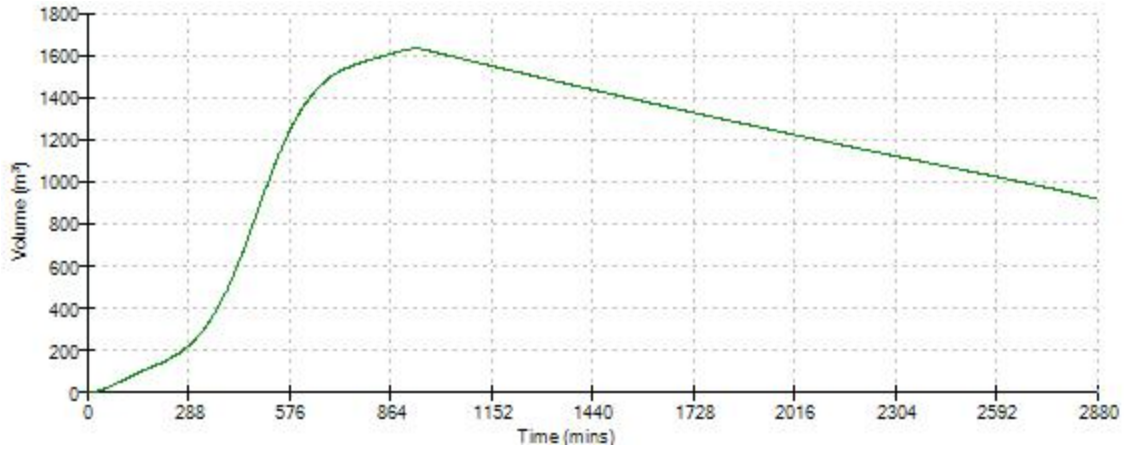


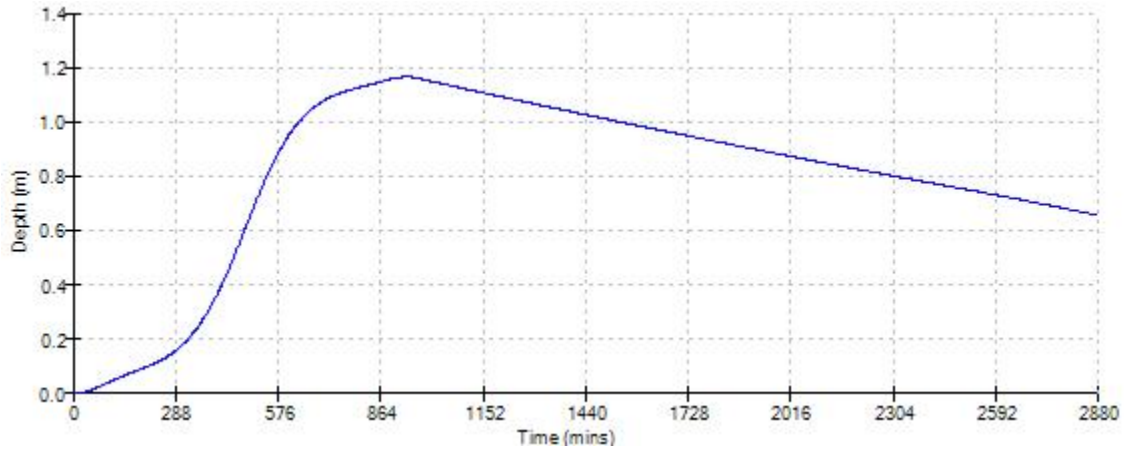


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Event: 960 min Winter

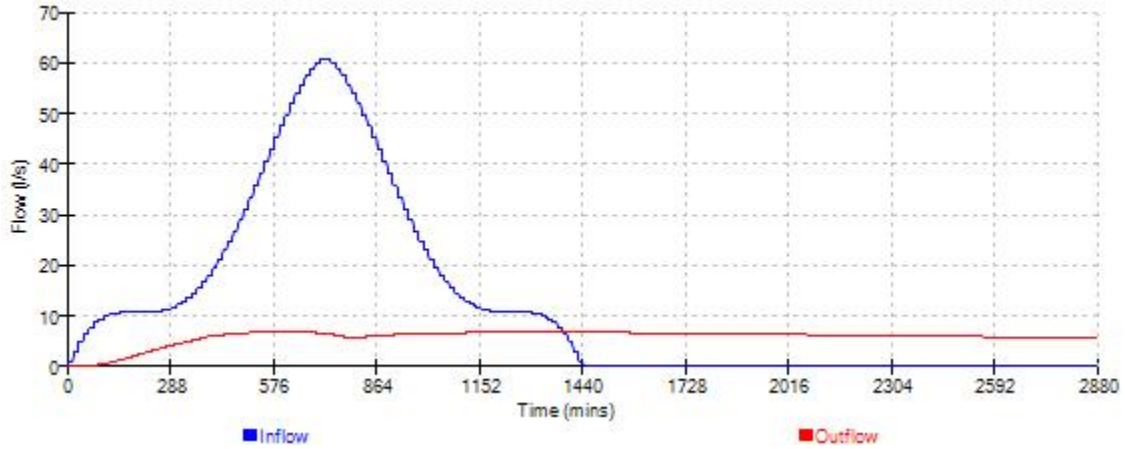


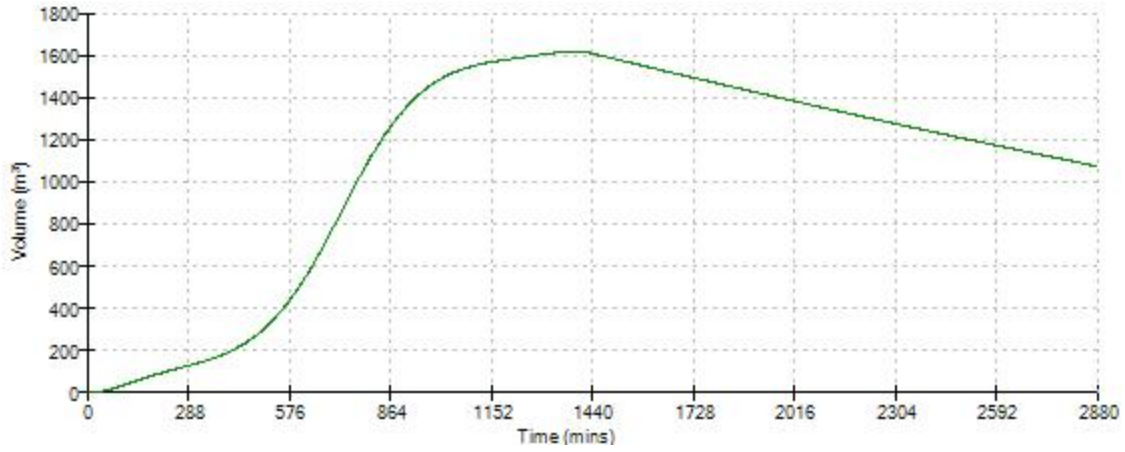


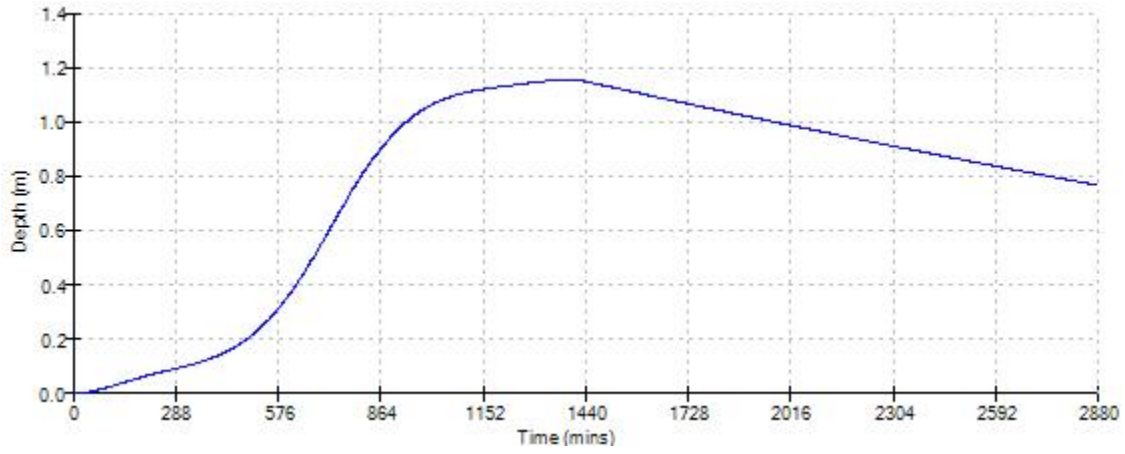


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Event: 1440 min Winter







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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.324	0.324	5.7	486.1	O K
30 min Summer	9.442	0.442	5.7	663.7	O K
60 min Summer	9.578	0.578	5.7	867.5	O K
120 min Summer	9.686	0.686	5.7	1029.4	O K
180 min Summer	9.746	0.746	5.7	1119.0	Flood Risk
240 min Summer	9.786	0.786	5.7	1179.3	Flood Risk
360 min Summer	9.838	0.838	5.7	1257.7	Flood Risk
480 min Summer	9.871	0.871	5.7	1306.3	Flood Risk
600 min Summer	9.892	0.892	5.7	1337.9	Flood Risk
720 min Summer	9.906	0.906	5.7	1358.4	Flood Risk
960 min Summer	9.919	0.919	5.7	1378.4	Flood Risk
1440 min Summer	9.912	0.912	5.7	1368.6	Flood Risk
2160 min Summer	9.870	0.870	5.7	1304.4	Flood Risk
2880 min Summer	9.829	0.829	5.7	1243.9	Flood Risk
4320 min Summer	9.755	0.755	5.7	1132.6	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	155.452	0.0	406.2	17
30 min Summer	106.486	0.0	477.2	32
60 min Summer	69.995	0.0	818.9	62
120 min Summer	41.971	0.0	907.0	122
180 min Summer	30.743	0.0	901.0	182
240 min Summer	24.555	0.0	890.4	242
360 min Summer	17.821	0.0	873.7	362
480 min Summer	14.163	0.0	861.8	482
600 min Summer	11.834	0.0	852.4	602
720 min Summer	10.209	0.0	844.4	722
960 min Summer	8.073	0.0	831.0	960
1440 min Summer	5.765	0.0	809.9	1440
2160 min Summer	4.088	0.0	1691.9	1924
2880 min Summer	3.199	0.0	1635.8	2280
4320 min Summer	2.258	0.0	1483.4	3068

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
5760 min Summer	9.696	0.696	5.7	1044.6	O K
7200 min Summer	9.660	0.660	5.7	990.4	O K
8640 min Summer	9.636	0.636	5.7	954.2	O K
10080 min Summer	9.625	0.625	5.7	937.4	O K
15 min Winter	9.324	0.324	5.7	486.0	O K
30 min Winter	9.442	0.442	5.7	663.5	O K
60 min Winter	9.578	0.578	5.7	867.3	O K
120 min Winter	9.686	0.686	5.7	1028.9	O K
180 min Winter	9.746	0.746	5.7	1118.8	Flood Risk
240 min Winter	9.786	0.786	5.7	1179.1	Flood Risk
360 min Winter	9.839	0.839	5.7	1257.9	Flood Risk
480 min Winter	9.871	0.871	5.7	1307.0	Flood Risk
600 min Winter	9.893	0.893	5.7	1339.1	Flood Risk
720 min Winter	9.907	0.907	5.7	1360.3	Flood Risk
960 min Winter	9.921	0.921	5.7	1381.8	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
5760 min Summer	1.778	0.0	2142.2	3912
7200 min Summer	1.508	0.0	2267.3	4752
8640 min Summer	1.337	0.0	2406.0	5544
10080 min Summer	1.225	0.0	2554.7	6360
15 min Winter	155.452	0.0	406.2	17
30 min Winter	106.486	0.0	477.3	32
60 min Winter	69.995	0.0	819.0	62
120 min Winter	41.971	0.0	907.3	122
180 min Winter	30.743	0.0	901.6	180
240 min Winter	24.555	0.0	891.1	240
360 min Winter	17.821	0.0	874.4	358
480 min Winter	14.163	0.0	862.4	476
600 min Winter	11.834	0.0	853.0	590
720 min Winter	10.209	0.0	845.0	708
960 min Winter	8.073	0.0	831.5	940

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
1440 min Winter	9.917	0.917	5.7	1375.4	Flood Risk
2160 min Winter	9.875	0.875	5.7	1312.9	Flood Risk
2880 min Winter	9.825	0.825	5.7	1237.3	Flood Risk
4320 min Winter	9.734	0.734	5.7	1101.4	Flood Risk
5760 min Winter	9.650	0.650	5.7	975.0	O K
7200 min Winter	9.580	0.580	5.7	869.9	O K
8640 min Winter	9.531	0.531	5.7	796.5	O K
10080 min Winter	9.499	0.499	5.7	748.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
1440 min Winter	5.765	0.0	810.8	1386
2160 min Winter	4.088	0.0	1694.4	2032
2880 min Winter	3.199	0.0	1643.2	2336
4320 min Winter	2.258	0.0	1506.5	3244
5760 min Winter	1.778	0.0	2142.9	4200
7200 min Winter	1.508	0.0	2269.3	4976
8640 min Winter	1.337	0.0	2410.1	5800
10080 min Winter	1.225	0.0	2565.0	6656

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 331208 350156 SJ 31208 50156
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.260

Time (mins) From:	To:	Area (ha)
0	2	1.260

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Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 9.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1500.0	1.000	1500.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0112-5700-1000-5700
Design Head (m)	1.000
Design Flow (l/s)	5.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	112
Invert Level (m)	8.995
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	5.7
Flush-Flo™	0.296	5.7
Kick-Flo®	0.642	4.6
Mean Flow over Head Range	-	4.9

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	3.9	0.400	5.6	0.800	5.1	1.400	6.7
0.200	5.5	0.500	5.4	1.000	5.7	1.600	7.1
0.300	5.7	0.600	5.0	1.200	6.2	1.800	7.5

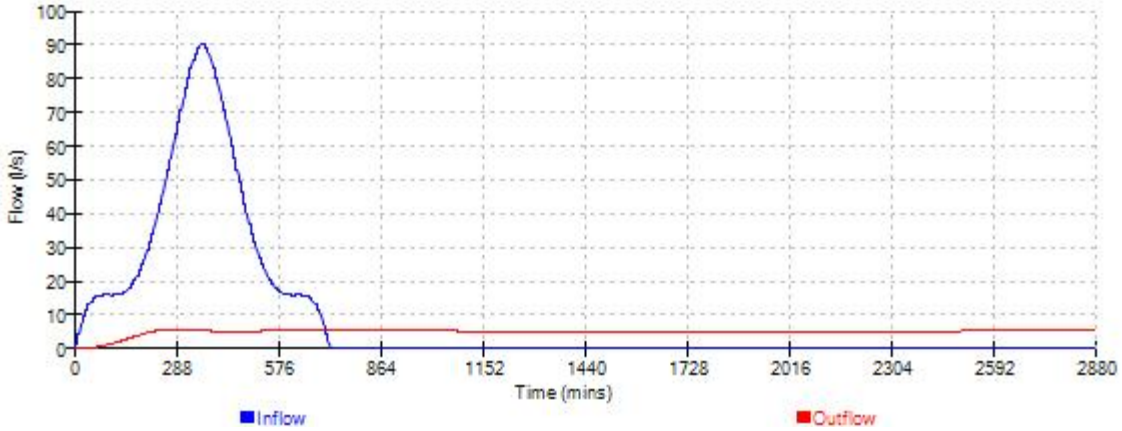
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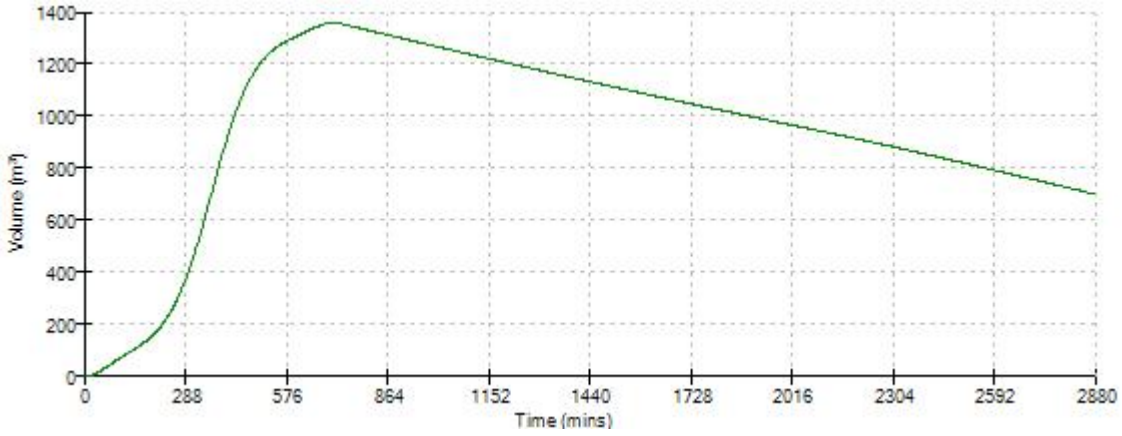
Hydro-Brake® Optimum Outflow Control

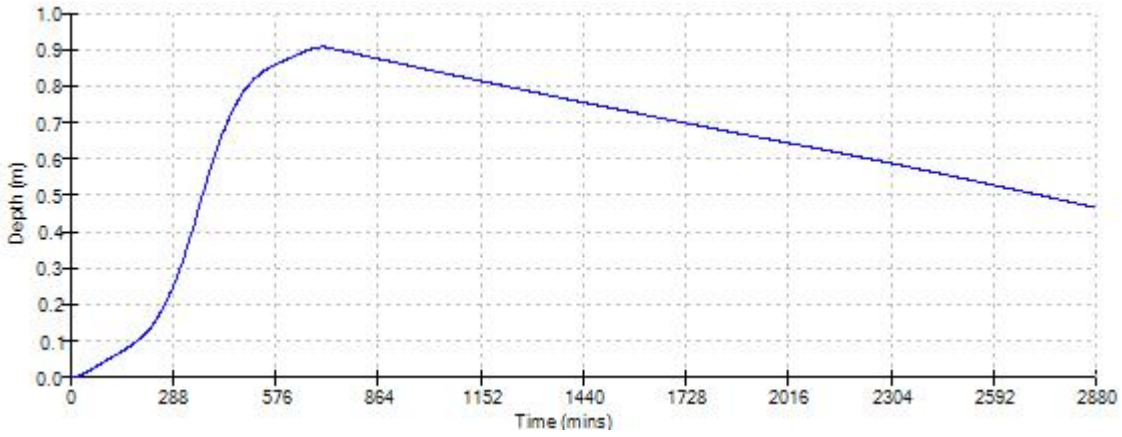
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
2.000	7.9	3.500	10.3	6.000	13.3	8.500	15.7
2.200	8.2	4.000	10.9	6.500	13.8	9.000	16.1
2.400	8.6	4.500	11.6	7.000	14.3	9.500	16.5
2.600	8.9	5.000	12.2	7.500	14.7		
3.000	9.5	5.500	12.7	8.000	15.2		

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Event: 720 min Winter

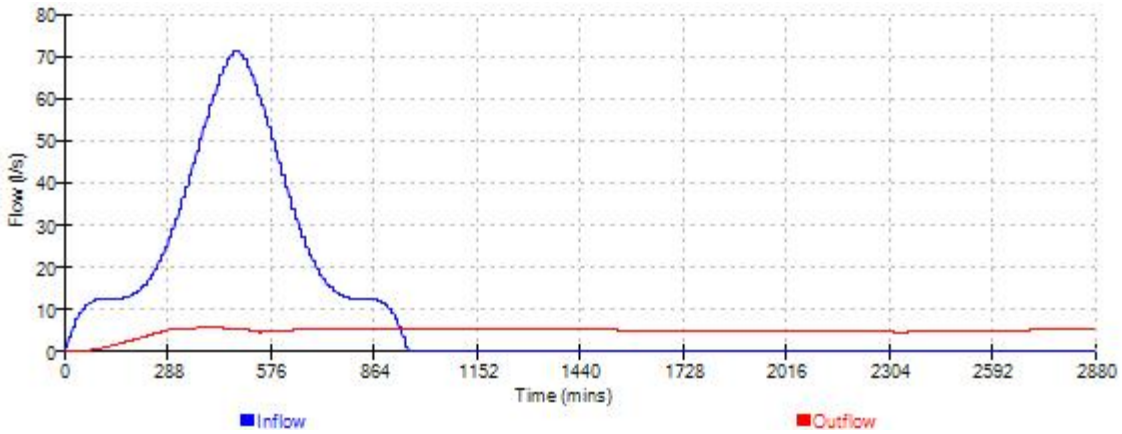


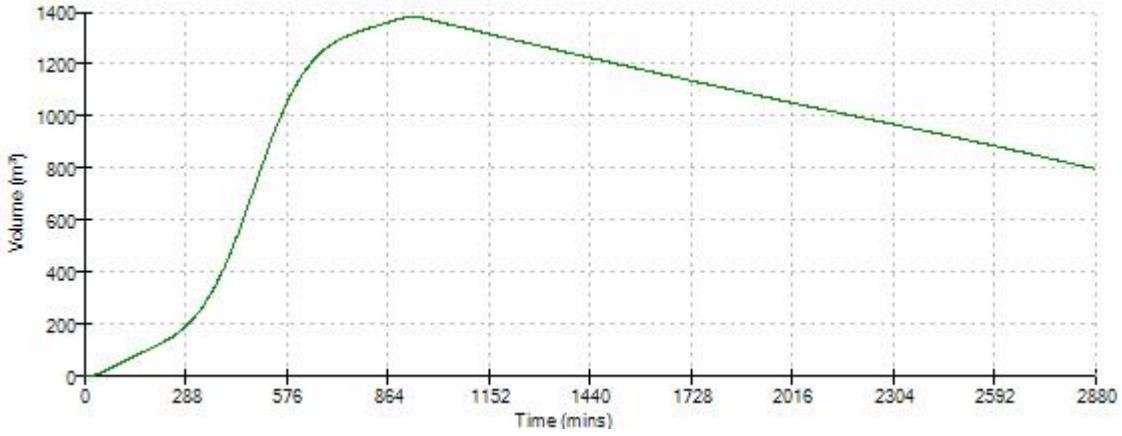


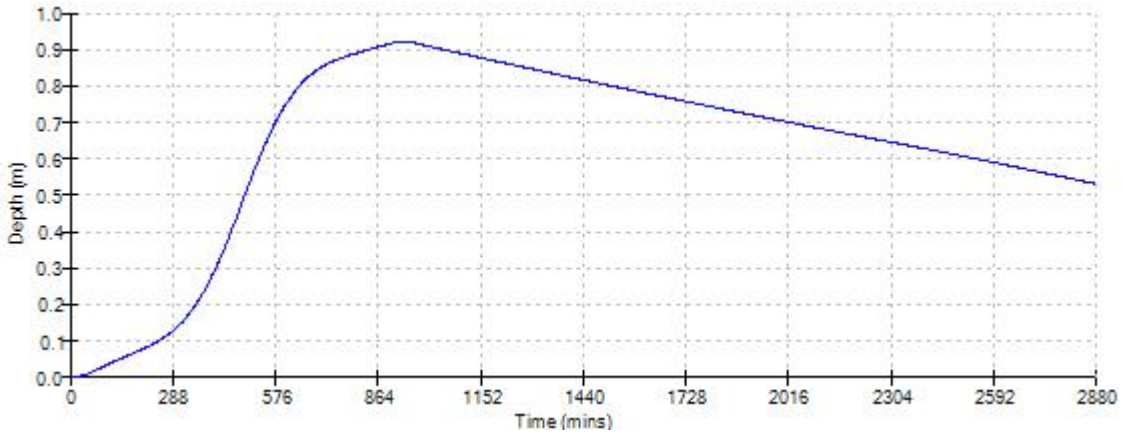


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Event: 960 min Winter

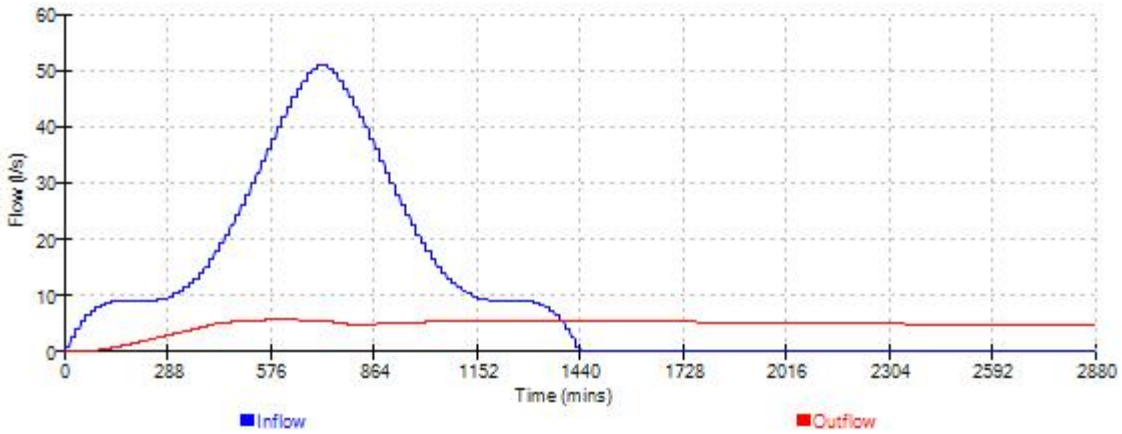


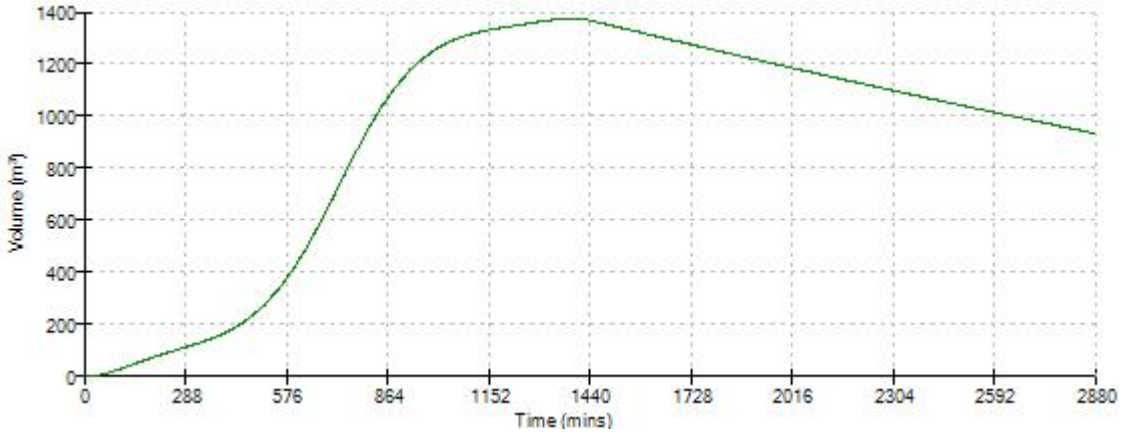


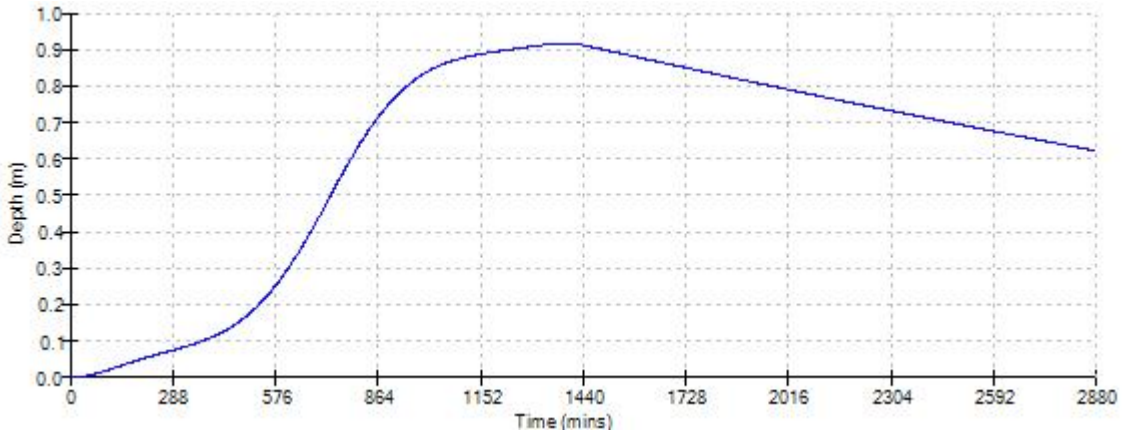


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Event: 1440 min Winter







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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.349	0.349	3.9	331.5	O K
30 min Summer	9.476	0.476	3.9	452.6	O K
60 min Summer	9.623	0.623	3.9	591.6	O K
120 min Summer	9.738	0.738	3.9	701.5	Flood Risk
180 min Summer	9.802	0.802	3.9	761.9	Flood Risk
240 min Summer	9.845	0.845	3.9	802.5	Flood Risk
360 min Summer	9.900	0.900	3.9	854.9	Flood Risk
480 min Summer	9.934	0.934	3.9	887.1	Flood Risk
600 min Summer	9.955	0.955	3.9	907.6	Flood Risk
720 min Summer	9.969	0.969	3.9	920.5	Flood Risk
960 min Summer	9.981	0.981	3.9	932.1	Flood Risk
1440 min Summer	9.970	0.970	3.9	921.7	Flood Risk
2160 min Summer	9.921	0.921	3.9	875.0	Flood Risk
2880 min Summer	9.876	0.876	3.9	832.2	Flood Risk
4320 min Summer	9.795	0.795	3.9	755.3	Flood Risk
5760 min Summer	9.733	0.733	3.9	695.9	Flood Risk
7200 min Summer	9.695	0.695	3.9	660.3	O K
8640 min Summer	9.672	0.672	3.9	638.5	O K
10080 min Summer	9.662	0.662	3.9	629.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	155.452	0.0	287.6	18
30 min Summer	106.486	0.0	328.1	33
60 min Summer	69.995	0.0	568.0	64
120 min Summer	41.971	0.0	619.5	124
180 min Summer	30.743	0.0	615.0	184
240 min Summer	24.555	0.0	609.3	242
360 min Summer	17.821	0.0	600.5	362
480 min Summer	14.163	0.0	594.6	482
600 min Summer	11.834	0.0	590.0	602
720 min Summer	10.209	0.0	586.3	722
960 min Summer	8.073	0.0	580.6	962
1440 min Summer	5.765	0.0	573.2	1440
2160 min Summer	4.088	0.0	1174.6	1880
2880 min Summer	3.199	0.0	1138.6	2252
4320 min Summer	2.258	0.0	1034.1	3028
5760 min Summer	1.778	0.0	1465.5	3864
7200 min Summer	1.508	0.0	1551.7	4688
8640 min Summer	1.337	0.0	1647.7	5536
10080 min Summer	1.225	0.0	1751.5	6360

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	9.349	0.349	3.9	331.5	O K
30 min Winter	9.476	0.476	3.9	452.6	O K
60 min Winter	9.623	0.623	3.9	591.5	O K
120 min Winter	9.738	0.738	3.9	701.5	Flood Risk
180 min Winter	9.802	0.802	3.9	762.1	Flood Risk
240 min Winter	9.845	0.845	3.9	802.8	Flood Risk
360 min Winter	9.901	0.901	3.9	855.6	Flood Risk
480 min Winter	9.935	0.935	3.9	888.1	Flood Risk
600 min Winter	9.957	0.957	3.9	909.1	Flood Risk
720 min Winter	9.971	0.971	3.9	922.6	Flood Risk
960 min Winter	9.985	0.985	3.9	935.5	Flood Risk
1440 min Winter	9.977	0.977	3.9	928.0	Flood Risk
2160 min Winter	9.928	0.928	3.9	881.5	Flood Risk
2880 min Winter	9.873	0.873	3.9	829.3	Flood Risk
4320 min Winter	9.774	0.774	3.9	735.3	Flood Risk
5760 min Winter	9.686	0.686	3.9	651.6	O K
7200 min Winter	9.615	0.615	3.9	584.1	O K
8640 min Winter	9.557	0.557	3.9	528.7	O K
10080 min Winter	9.519	0.519	3.9	493.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	155.452	0.0	287.6	18
30 min Winter	106.486	0.0	328.2	33
60 min Winter	69.995	0.0	568.0	64
120 min Winter	41.971	0.0	619.7	122
180 min Winter	30.743	0.0	615.2	180
240 min Winter	24.555	0.0	609.4	240
360 min Winter	17.821	0.0	600.6	358
480 min Winter	14.163	0.0	594.5	476
600 min Winter	11.834	0.0	589.8	592
720 min Winter	10.209	0.0	586.0	708
960 min Winter	8.073	0.0	580.1	940
1440 min Winter	5.765	0.0	572.8	1386
2160 min Winter	4.088	0.0	1175.1	2028
2880 min Winter	3.199	0.0	1141.7	2304
4320 min Winter	2.258	0.0	1047.0	3240
5760 min Winter	1.778	0.0	1465.7	4152
7200 min Winter	1.508	0.0	1552.5	5048
8640 min Winter	1.337	0.0	1649.9	5872
10080 min Winter	1.225	0.0	1758.0	6656

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 331208 350156 SJ 31208 50156
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.860

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	1	0.287	1	2	0.287	2	3	0.287

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Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 9.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	950.0	1.000	950.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0094-3900-1000-3900
Design Head (m)	1.000
Design Flow (l/s)	3.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	94
Invert Level (m)	8.995
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

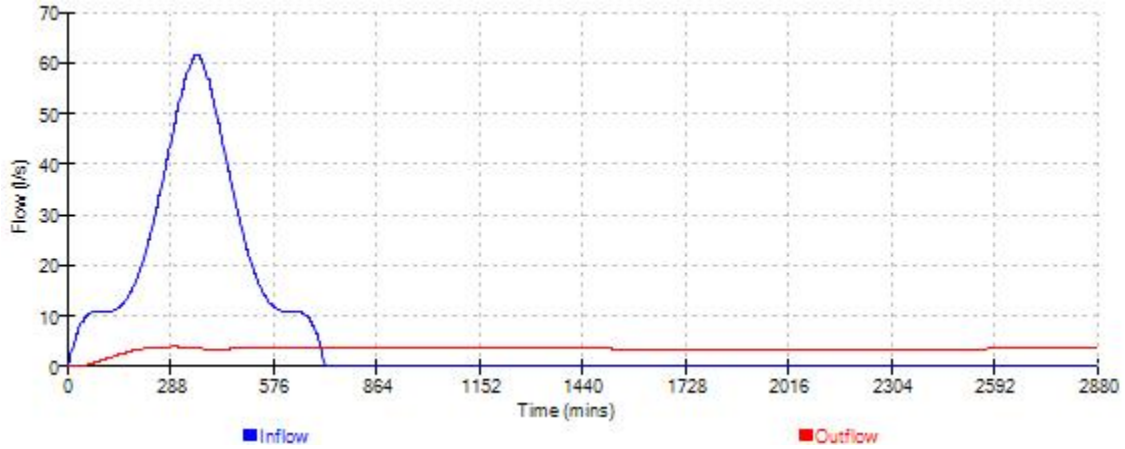
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.9
Flush-Flo™	0.297	3.9
Kick-Flo®	0.632	3.2
Mean Flow over Head Range	-	3.4

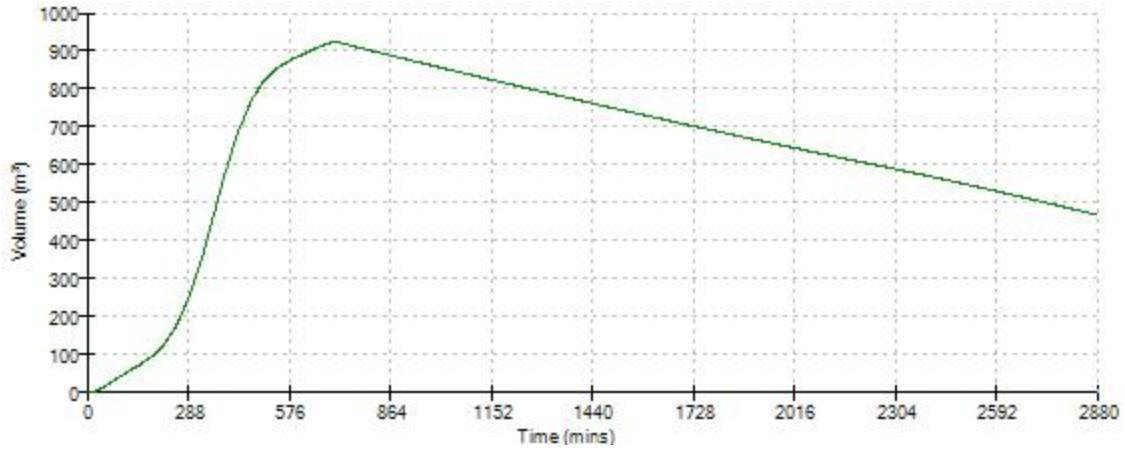
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

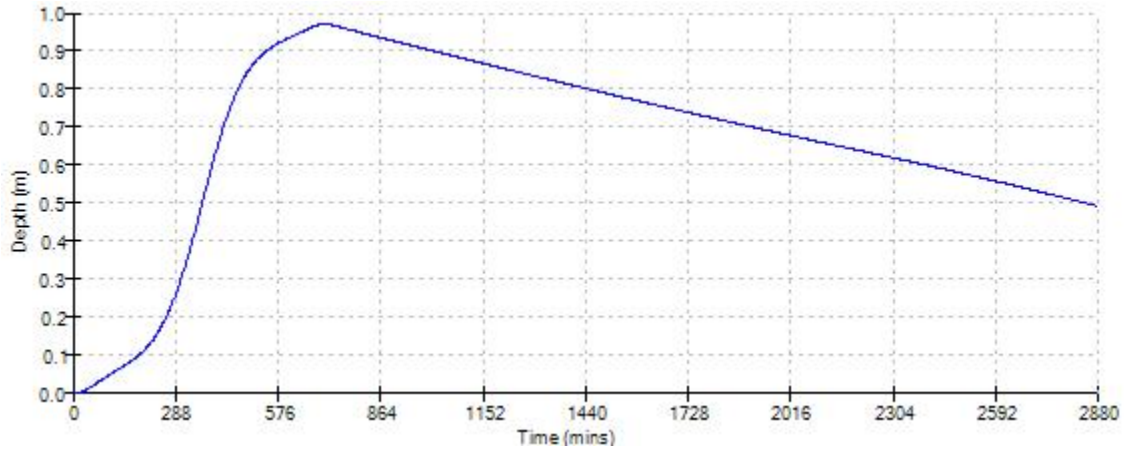
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.0	1.600	4.8	5.000	8.3
0.200	3.8	1.800	5.1	5.500	8.7
0.300	3.9	2.000	5.4	6.000	9.0
0.400	3.8	2.200	5.6	6.500	9.4
0.500	3.7	2.400	5.9	7.000	9.7
0.600	3.4	2.600	6.1	7.500	10.0
0.800	3.5	3.000	6.5	8.000	10.4
1.000	3.9	3.500	7.0	8.500	10.7
1.200	4.2	4.000	7.4	9.000	10.9
1.400	4.6	4.500	7.9	9.500	11.2

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Event: 720 min Winter

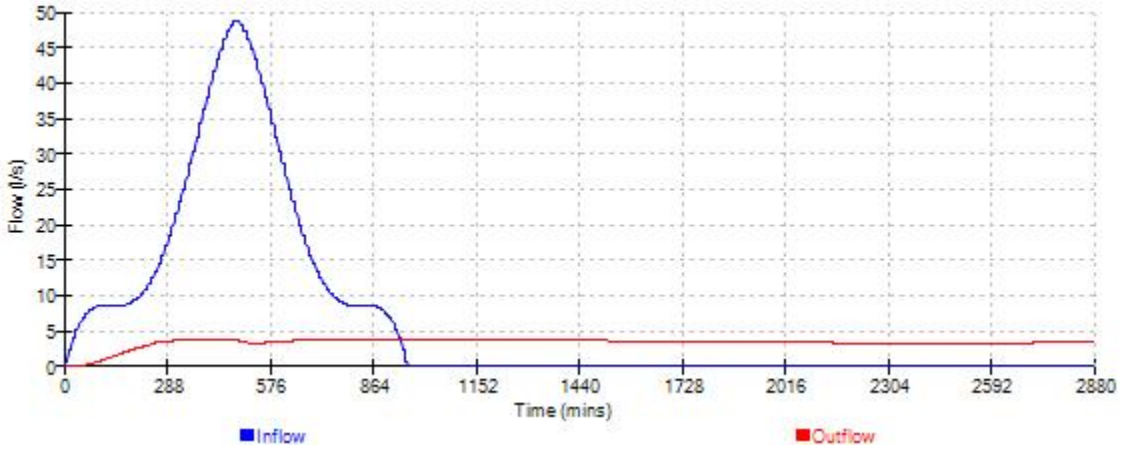


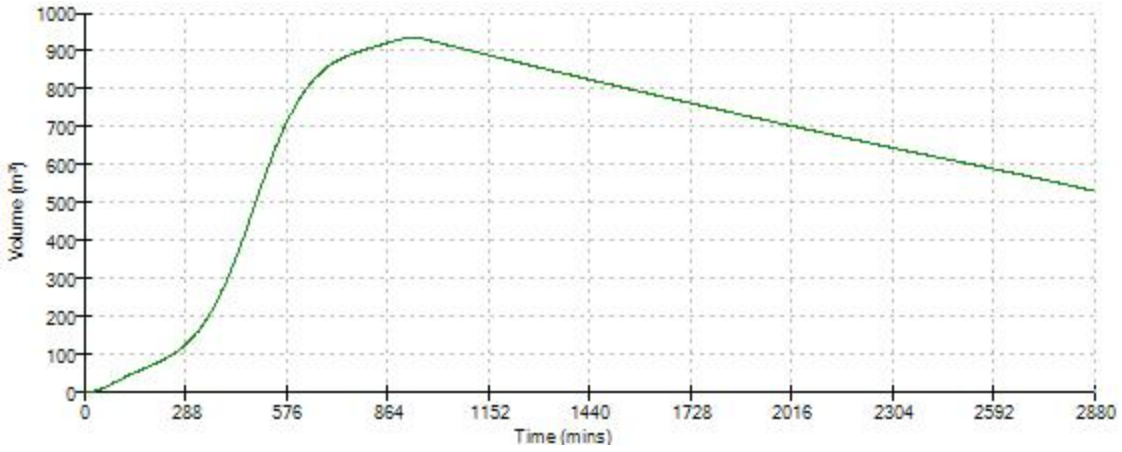


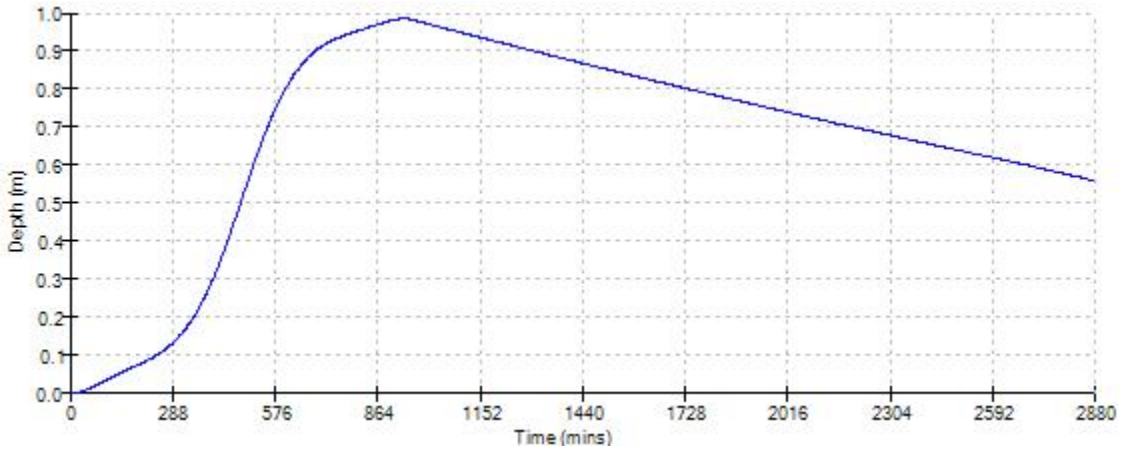


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Event: 960 min Winter

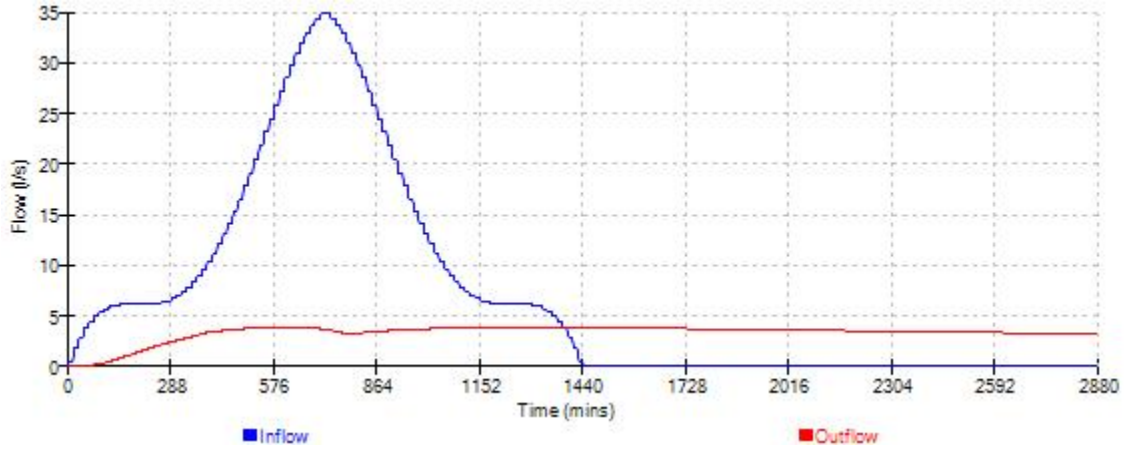


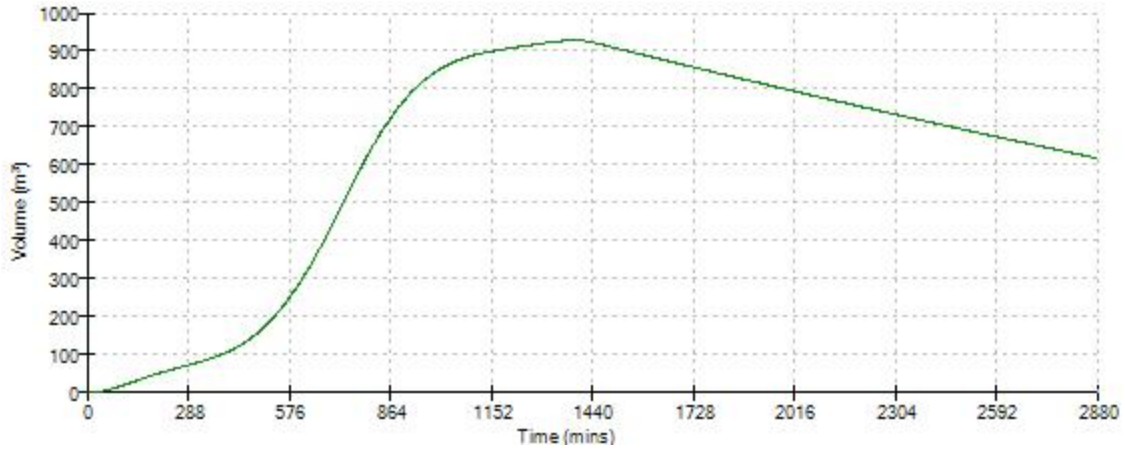


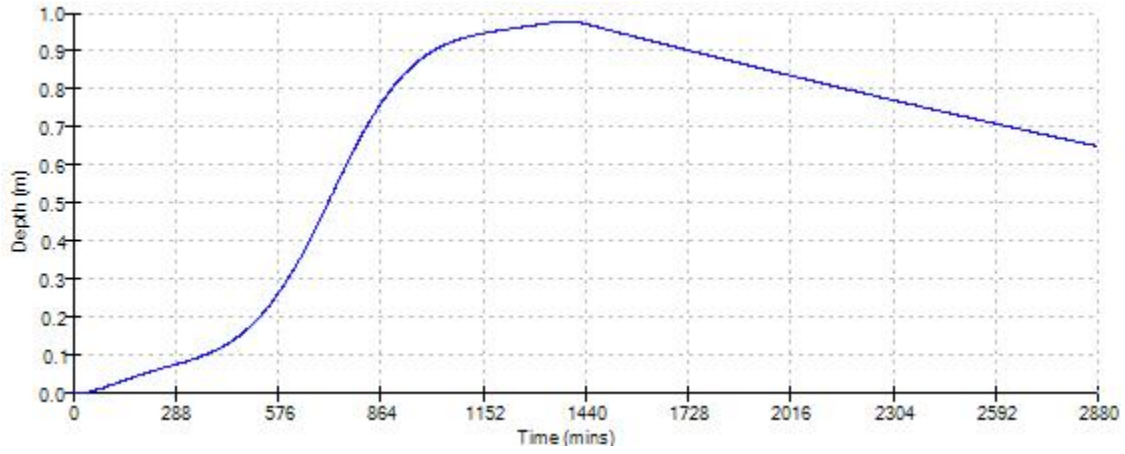


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Event: 1440 min Winter







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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.153	0.453	5.4	453.4	O K
30 min Summer	9.319	0.619	5.4	618.9	O K
60 min Summer	9.509	0.809	5.4	809.1	O K
120 min Summer	9.659	0.959	5.4	958.9	O K
180 min Summer	9.741	1.041	5.4	1041.2	Flood Risk
240 min Summer	9.796	1.096	5.4	1096.2	Flood Risk
360 min Summer	9.867	1.167	5.4	1167.1	Flood Risk
480 min Summer	9.910	1.210	5.4	1210.3	Flood Risk
600 min Summer	9.938	1.238	5.4	1237.6	Flood Risk
720 min Summer	9.955	1.255	5.4	1254.7	Flood Risk
960 min Summer	9.969	1.269	5.4	1269.4	Flood Risk
1440 min Summer	9.953	1.253	5.4	1252.9	Flood Risk
2160 min Summer	9.887	1.187	5.4	1186.9	Flood Risk
2880 min Summer	9.827	1.127	5.4	1127.0	Flood Risk
4320 min Summer	9.720	1.020	5.4	1020.4	Flood Risk
5760 min Summer	9.639	0.939	5.4	938.6	O K
7200 min Summer	9.590	0.890	5.4	889.5	O K
8640 min Summer	9.559	0.859	5.4	859.3	O K
10080 min Summer	9.546	0.846	5.4	846.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	155.452	0.0	400.4	17
30 min Summer	106.486	0.0	453.4	32
60 min Summer	69.995	0.0	783.5	62
120 min Summer	41.971	0.0	852.6	122
180 min Summer	30.743	0.0	847.3	182
240 min Summer	24.555	0.0	839.7	242
360 min Summer	17.821	0.0	827.9	362
480 min Summer	14.163	0.0	819.9	482
600 min Summer	11.834	0.0	813.8	602
720 min Summer	10.209	0.0	809.1	722
960 min Summer	8.073	0.0	802.2	960
1440 min Summer	5.765	0.0	794.2	1440
2160 min Summer	4.088	0.0	1621.7	1880
2880 min Summer	3.199	0.0	1575.1	2248
4320 min Summer	2.258	0.0	1430.8	3028
5760 min Summer	1.778	0.0	2004.8	3864
7200 min Summer	1.508	0.0	2123.4	4688
8640 min Summer	1.337	0.0	2255.8	5536
10080 min Summer	1.225	0.0	2400.7	6360

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	9.153	0.453	5.4	453.3	O K
30 min Winter	9.319	0.619	5.4	618.8	O K
60 min Winter	9.509	0.809	5.4	809.0	O K
120 min Winter	9.659	0.959	5.4	958.6	O K
180 min Winter	9.741	1.041	5.4	1041.3	Flood Risk
240 min Winter	9.797	1.097	5.4	1096.6	Flood Risk
360 min Winter	9.868	1.168	5.4	1168.0	Flood Risk
480 min Winter	9.912	1.212	5.4	1211.9	Flood Risk
600 min Winter	9.940	1.240	5.4	1240.0	Flood Risk
720 min Winter	9.958	1.258	5.4	1257.9	Flood Risk
960 min Winter	9.974	1.274	5.4	1274.3	Flood Risk
1440 min Winter	9.962	1.262	5.4	1262.1	Flood Risk
2160 min Winter	9.896	1.196	5.4	1196.0	Flood Risk
2880 min Winter	9.823	1.123	5.4	1123.4	Flood Risk
4320 min Winter	9.693	0.993	5.4	992.8	O K
5760 min Winter	9.577	0.877	5.4	877.1	O K
7200 min Winter	9.483	0.783	5.4	783.2	O K
8640 min Winter	9.405	0.705	5.4	705.4	O K
10080 min Winter	9.356	0.656	5.4	655.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	155.452	0.0	400.5	17
30 min Winter	106.486	0.0	453.5	32
60 min Winter	69.995	0.0	783.5	62
120 min Winter	41.971	0.0	852.8	122
180 min Winter	30.743	0.0	847.5	180
240 min Winter	24.555	0.0	839.8	240
360 min Winter	17.821	0.0	827.8	358
480 min Winter	14.163	0.0	819.5	474
600 min Winter	11.834	0.0	813.3	590
720 min Winter	10.209	0.0	808.4	708
960 min Winter	8.073	0.0	801.3	940
1440 min Winter	5.765	0.0	793.3	1384
2160 min Winter	4.088	0.0	1622.0	2028
2880 min Winter	3.199	0.0	1578.9	2304
4320 min Winter	2.258	0.0	1448.7	3240
5760 min Winter	1.778	0.0	2005.1	4152
7200 min Winter	1.508	0.0	2124.2	5048
8640 min Winter	1.337	0.0	2258.2	5872
10080 min Winter	1.225	0.0	2407.8	6656

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 331208 350156 SJ 31208 50156
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.176

Time (mins) From:	To:	Area (ha)
0	2	1.176

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Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 8.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1000.0	1.300	1000.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0105-5400-1300-5400
Design Head (m)	1.300
Design Flow (l/s)	5.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	105
Invert Level (m)	8.695
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

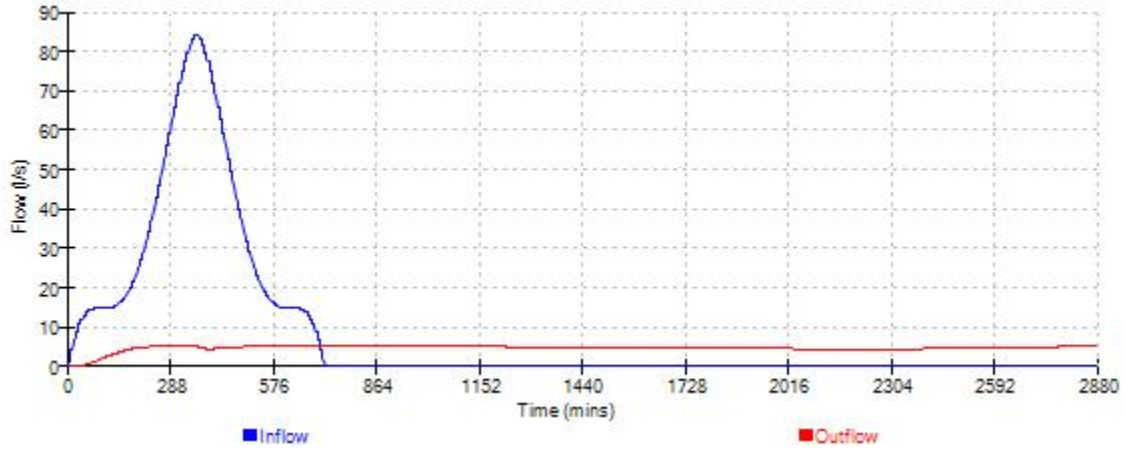
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.300	5.4
Flush-Flo™	0.385	5.4
Kick-Flo®	0.803	4.3
Mean Flow over Head Range	-	4.7

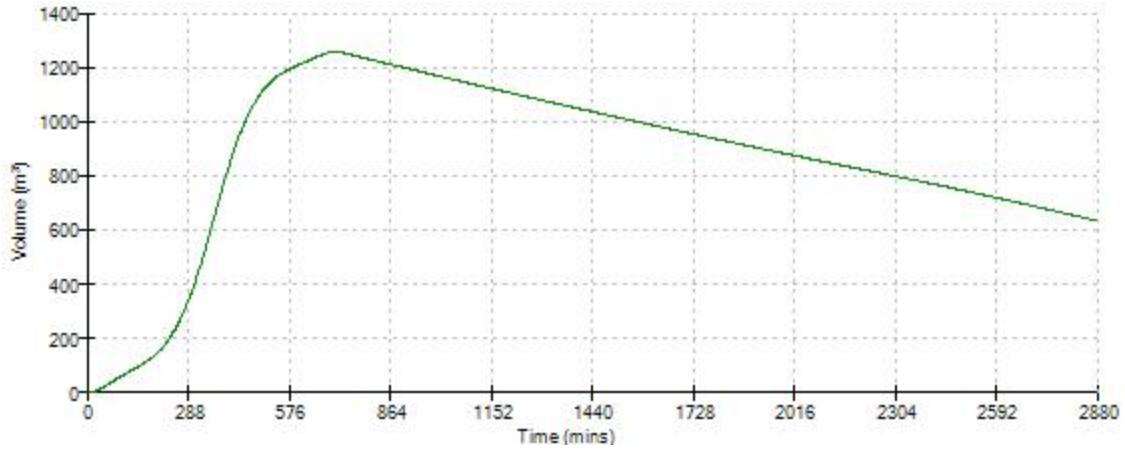
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

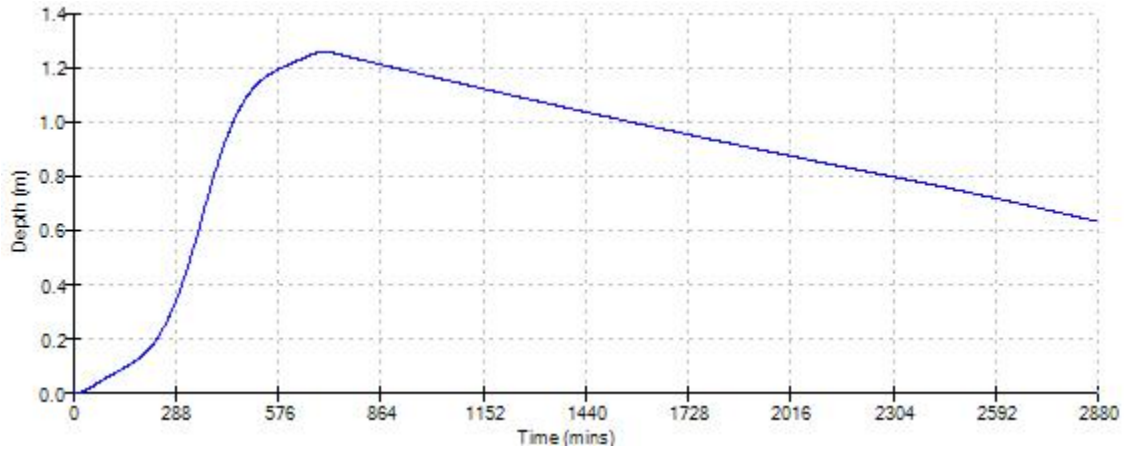
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.5	1.600	5.9	5.000	10.2
0.200	5.0	1.800	6.3	5.500	10.6
0.300	5.3	2.000	6.6	6.000	11.1
0.400	5.4	2.200	6.9	6.500	11.5
0.500	5.3	2.400	7.2	7.000	11.9
0.600	5.2	2.600	7.5	7.500	12.3
0.800	4.4	3.000	8.0	8.000	12.7
1.000	4.8	3.500	8.6	8.500	13.1
1.200	5.2	4.000	9.1	9.000	13.5
1.400	5.6	4.500	9.7	9.500	13.8

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Event: 720 min Winter

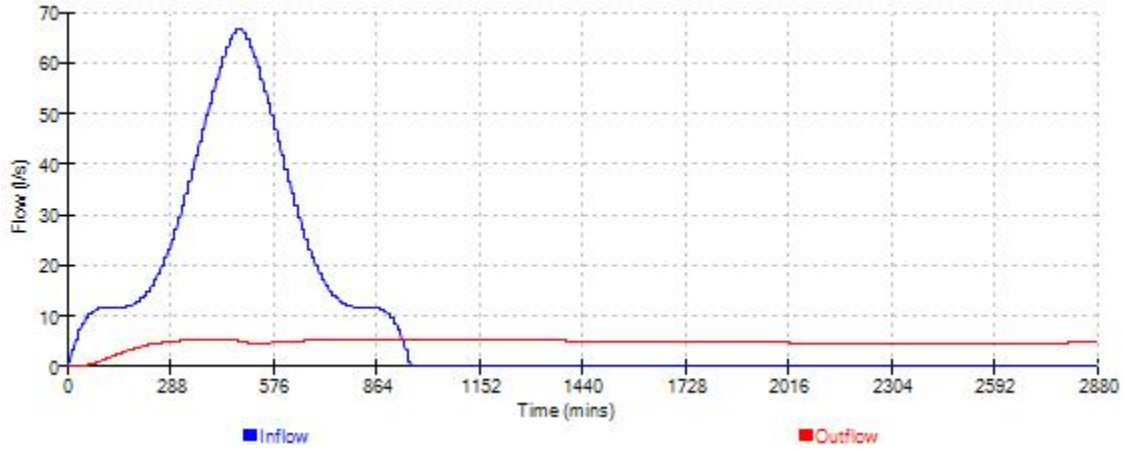


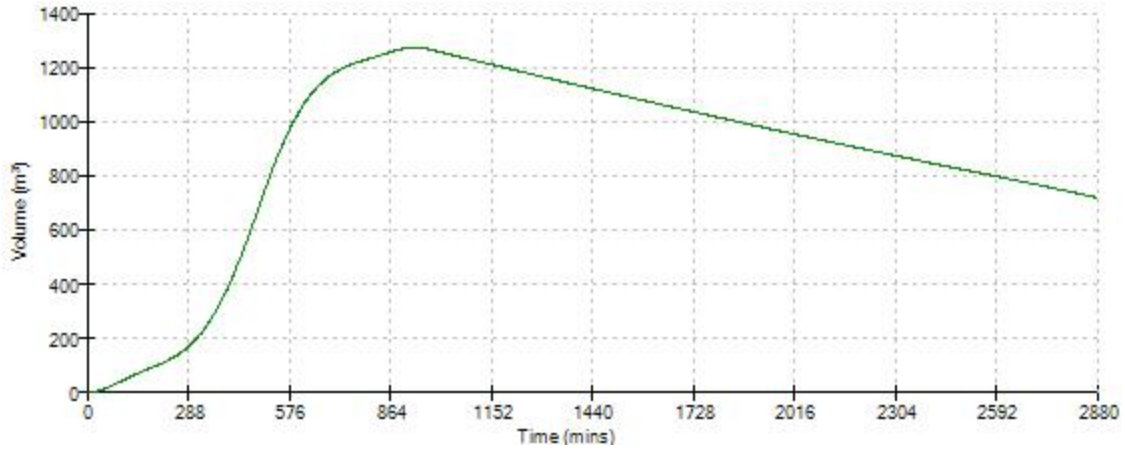


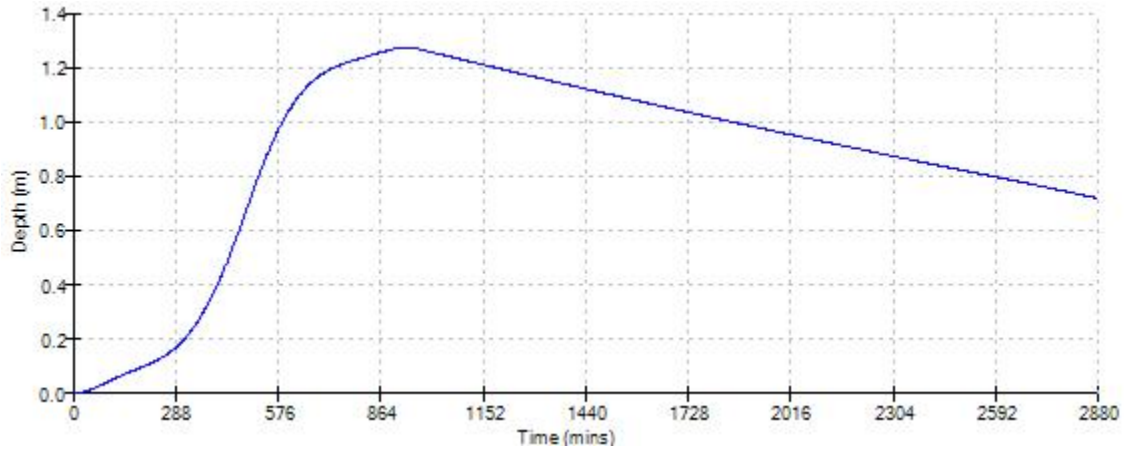


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Event: 960 min Winter

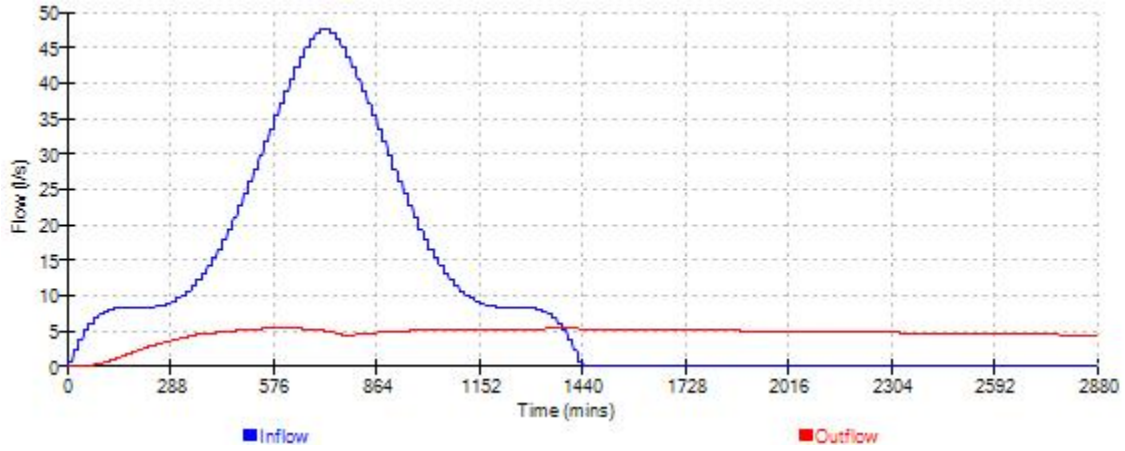


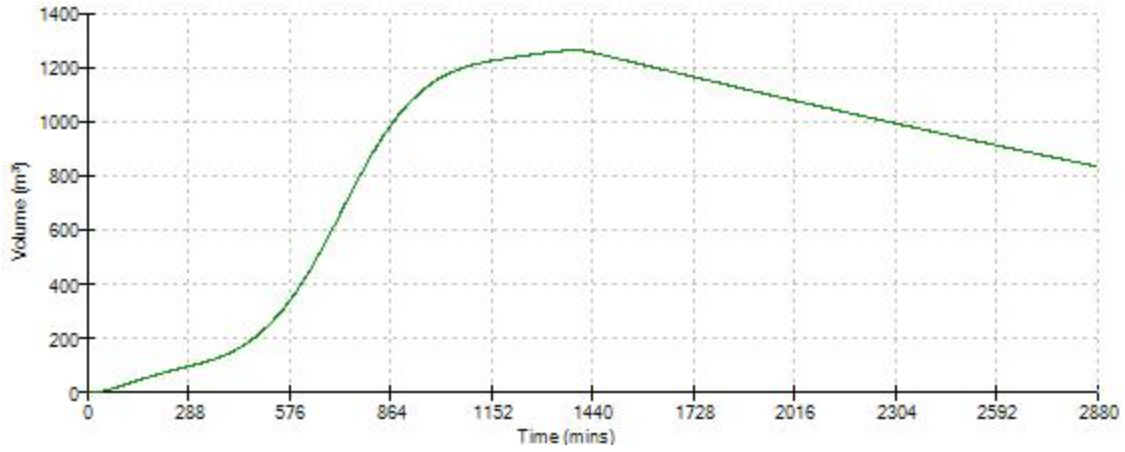


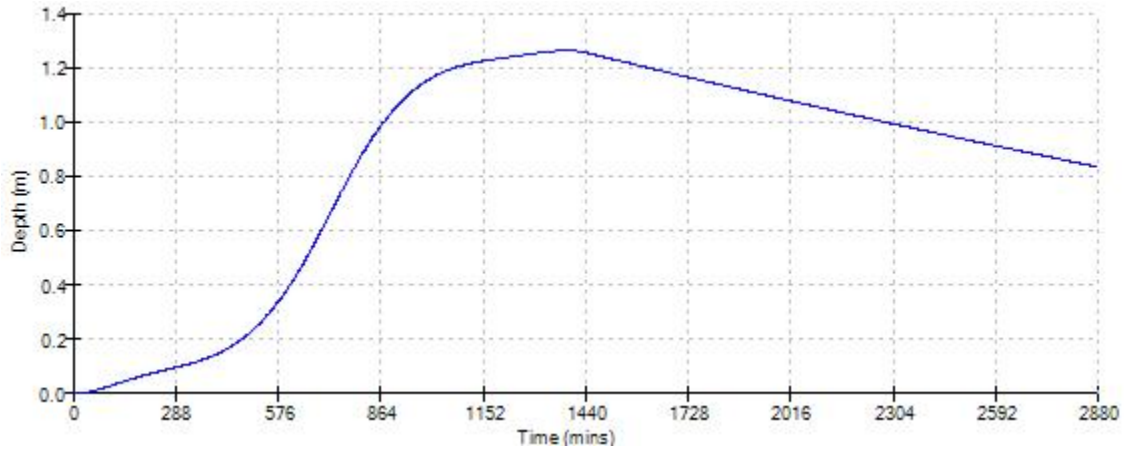


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Event: 1440 min Winter







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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.353	0.353	3.5	291.6	O K
30 min Summer	9.482	0.482	3.5	398.0	O K
60 min Summer	9.630	0.630	3.5	520.1	O K
120 min Summer	9.747	0.747	3.5	616.4	Flood Risk
180 min Summer	9.811	0.811	3.5	669.3	Flood Risk
240 min Summer	9.854	0.854	3.5	704.6	Flood Risk
360 min Summer	9.909	0.909	3.5	750.1	Flood Risk
480 min Summer	9.943	0.943	3.5	777.8	Flood Risk
600 min Summer	9.964	0.964	3.5	795.3	Flood Risk
720 min Summer	9.977	0.977	3.5	806.1	Flood Risk
960 min Summer	9.988	0.988	3.5	815.5	Flood Risk
1440 min Summer	9.975	0.975	3.5	804.5	Flood Risk
2160 min Summer	9.924	0.924	3.5	762.3	Flood Risk
2880 min Summer	9.878	0.878	3.5	724.0	Flood Risk
4320 min Summer	9.795	0.795	3.5	655.6	Flood Risk
5760 min Summer	9.731	0.731	3.5	602.7	Flood Risk
7200 min Summer	9.692	0.692	3.5	570.7	O K
8640 min Summer	9.668	0.668	3.5	550.7	O K
10080 min Summer	9.657	0.657	3.5	541.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	155.452	0.0	256.2	16
30 min Summer	106.486	0.0	293.4	31
60 min Summer	69.995	0.0	503.0	62
120 min Summer	41.971	0.0	553.5	122
180 min Summer	30.743	0.0	551.1	182
240 min Summer	24.555	0.0	546.7	242
360 min Summer	17.821	0.0	539.4	362
480 min Summer	14.163	0.0	534.2	482
600 min Summer	11.834	0.0	530.2	602
720 min Summer	10.209	0.0	526.9	720
960 min Summer	8.073	0.0	521.6	960
1440 min Summer	5.765	0.0	514.6	1440
2160 min Summer	4.088	0.0	1048.8	1860
2880 min Summer	3.199	0.0	1021.4	2224
4320 min Summer	2.258	0.0	927.8	3024
5760 min Summer	1.778	0.0	1289.1	3864
7200 min Summer	1.508	0.0	1365.2	4688
8640 min Summer	1.337	0.0	1450.1	5536
10080 min Summer	1.225	0.0	1543.2	6360

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	9.353	0.353	3.5	291.6	O K
30 min Winter	9.482	0.482	3.5	397.9	O K
60 min Winter	9.630	0.630	3.5	520.0	O K
120 min Winter	9.747	0.747	3.5	616.2	Flood Risk
180 min Winter	9.811	0.811	3.5	669.4	Flood Risk
240 min Winter	9.854	0.854	3.5	704.8	Flood Risk
360 min Winter	9.910	0.910	3.5	750.7	Flood Risk
480 min Winter	9.944	0.944	3.5	778.8	Flood Risk
600 min Winter	9.966	0.966	3.5	796.8	Flood Risk
720 min Winter	9.980	0.980	3.5	808.2	Flood Risk
960 min Winter	9.992	0.992	3.5	818.6	Flood Risk
1440 min Winter	9.982	0.982	3.5	810.4	Flood Risk
2160 min Winter	9.930	0.930	3.5	767.5	Flood Risk
2880 min Winter	9.874	0.874	3.5	721.2	Flood Risk
4320 min Winter	9.772	0.772	3.5	637.0	Flood Risk
5760 min Winter	9.681	0.681	3.5	562.0	O K
7200 min Winter	9.606	0.606	3.5	499.9	O K
8640 min Winter	9.547	0.547	3.5	451.0	O K
10080 min Winter	9.508	0.508	3.5	419.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	155.452	0.0	256.3	16
30 min Winter	106.486	0.0	293.4	31
60 min Winter	69.995	0.0	503.0	62
120 min Winter	41.971	0.0	553.6	122
180 min Winter	30.743	0.0	551.3	180
240 min Winter	24.555	0.0	546.8	240
360 min Winter	17.821	0.0	539.4	358
480 min Winter	14.163	0.0	534.1	474
600 min Winter	11.834	0.0	529.9	590
720 min Winter	10.209	0.0	526.5	706
960 min Winter	8.073	0.0	521.1	940
1440 min Winter	5.765	0.0	514.1	1384
2160 min Winter	4.088	0.0	1049.1	2016
2880 min Winter	3.199	0.0	1024.1	2280
4320 min Winter	2.258	0.0	939.7	3200
5760 min Winter	1.778	0.0	1289.3	4152
7200 min Winter	1.508	0.0	1365.8	5040
8640 min Winter	1.337	0.0	1451.7	5800
10080 min Winter	1.225	0.0	1547.6	6648

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 331208 350156 SJ 31208 50156
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.756

Time (mins) From:	To:	Area (ha)
0	1	0.756

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Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 9.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	825.0	1.000	825.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0089-3500-1000-3500
Design Head (m)	1.000
Design Flow (l/s)	3.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	89
Invert Level (m)	8.995
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

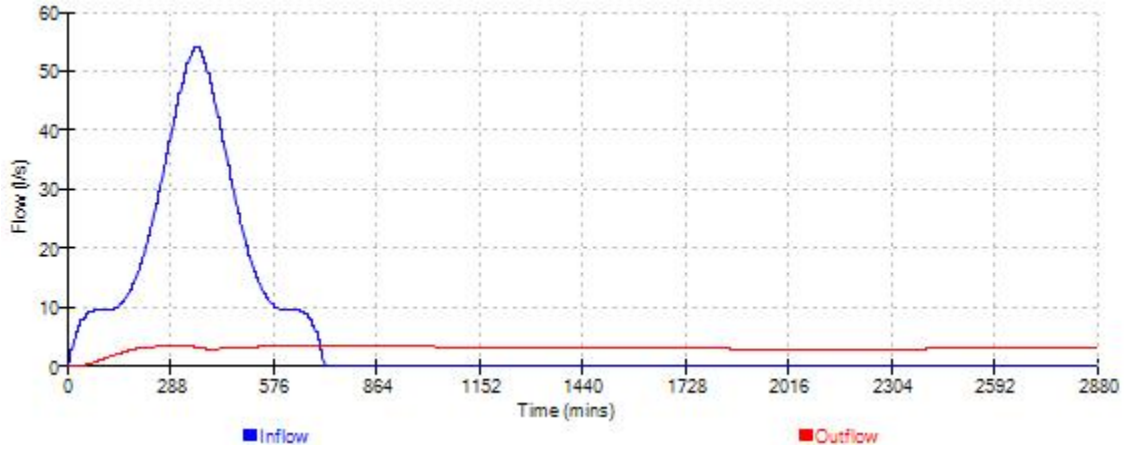
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.5
Flush-Flo™	0.300	3.5
Kick-Flo®	0.632	2.8
Mean Flow over Head Range	-	3.1

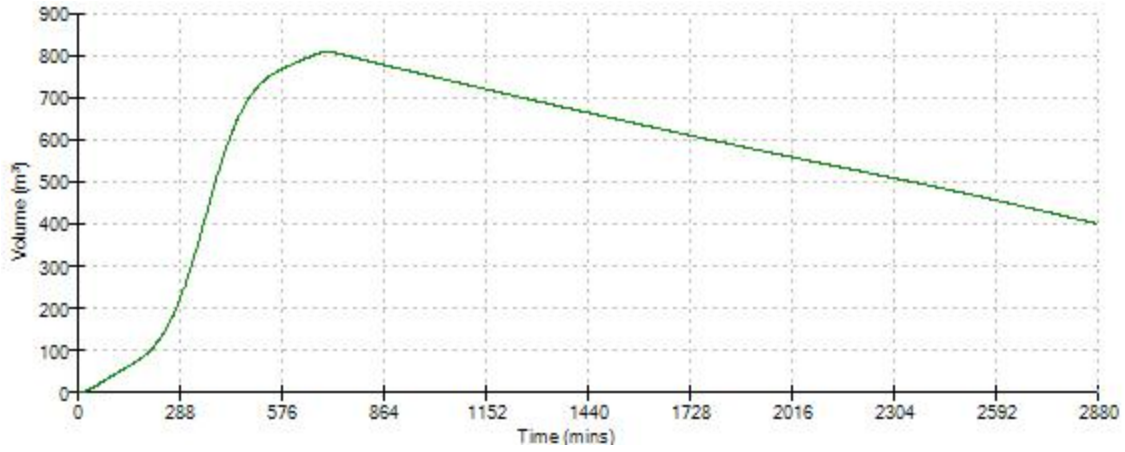
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

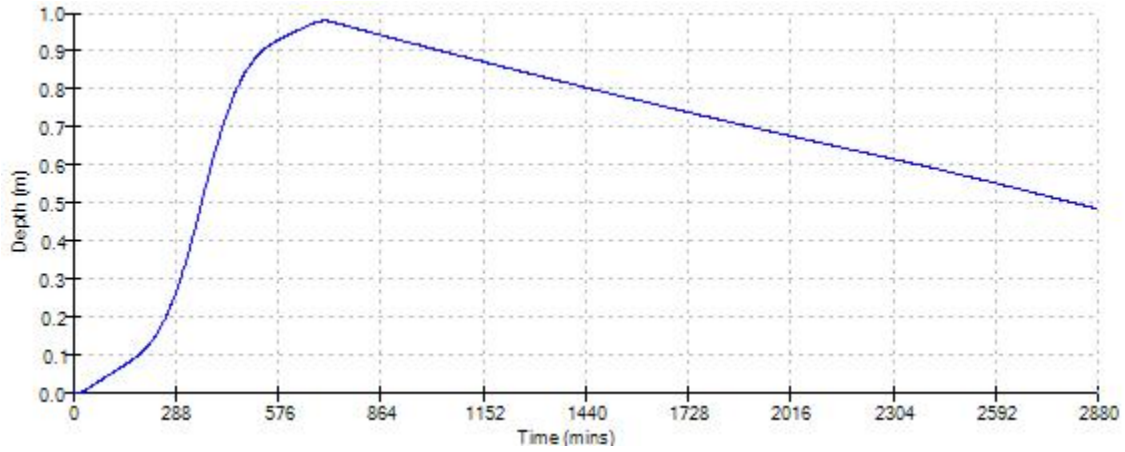
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.7	1.600	4.3	5.000	7.4
0.200	3.4	1.800	4.6	5.500	7.7
0.300	3.5	2.000	4.8	6.000	8.1
0.400	3.4	2.200	5.0	6.500	8.4
0.500	3.3	2.400	5.2	7.000	8.7
0.600	3.0	2.600	5.4	7.500	9.0
0.800	3.1	3.000	5.8	8.000	9.2
1.000	3.5	3.500	6.2	8.500	9.5
1.200	3.8	4.000	6.7	9.000	9.8
1.400	4.1	4.500	7.0	9.500	10.0

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Event: 720 min Winter

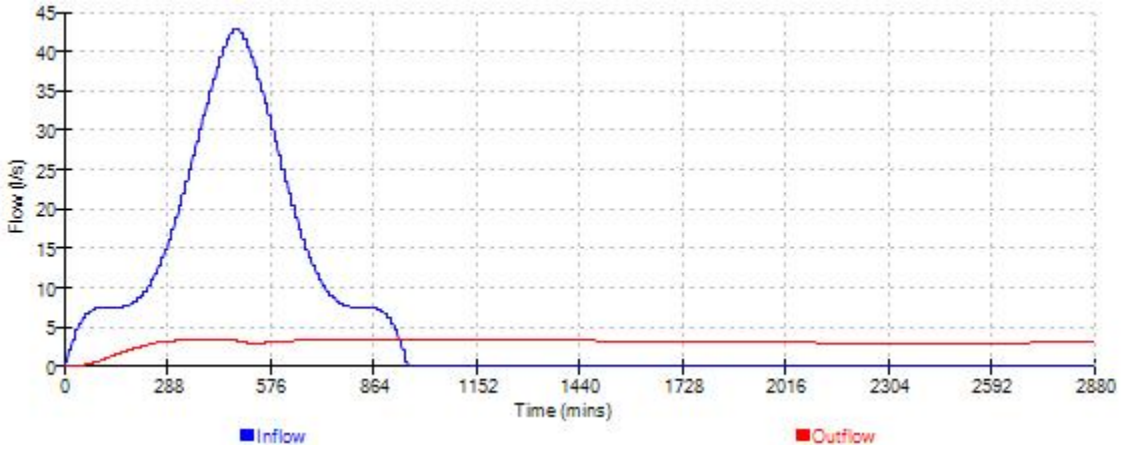


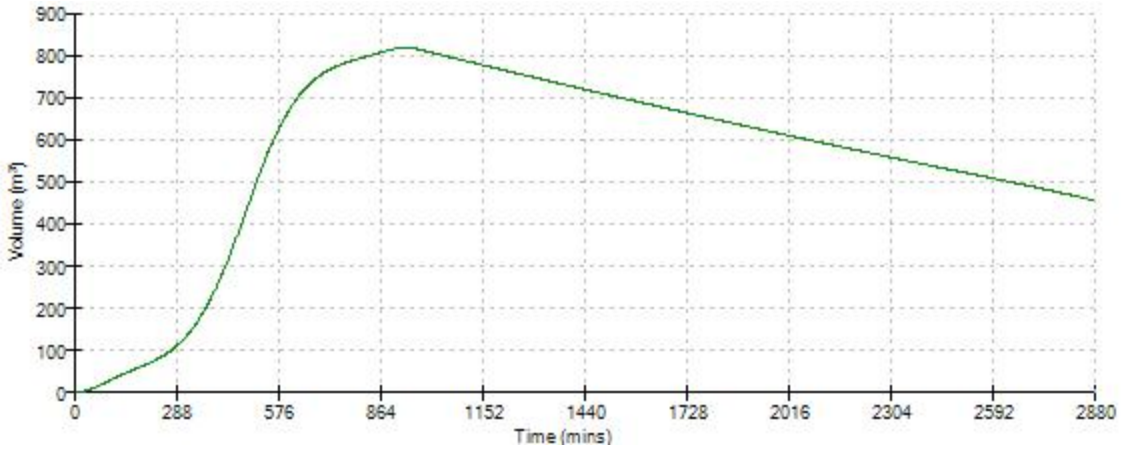


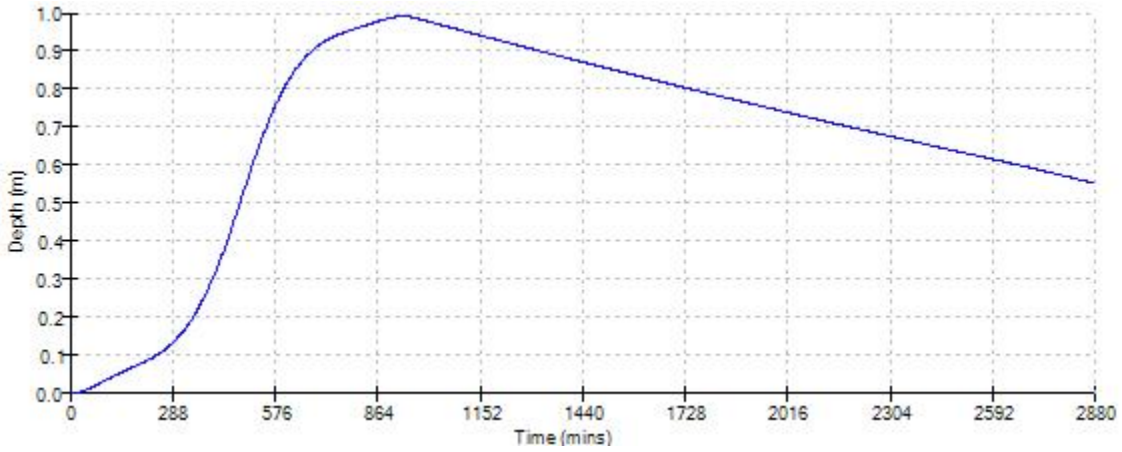


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Event: 960 min Winter

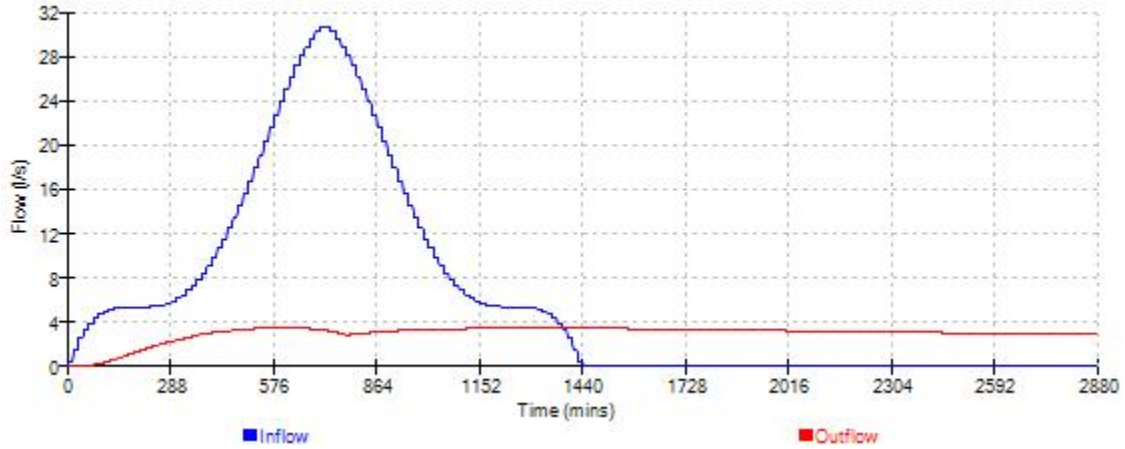


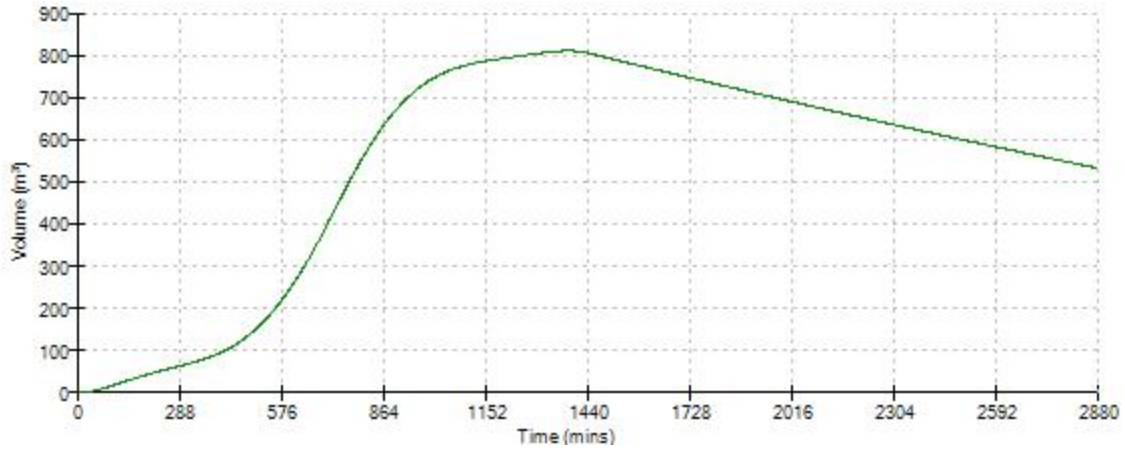


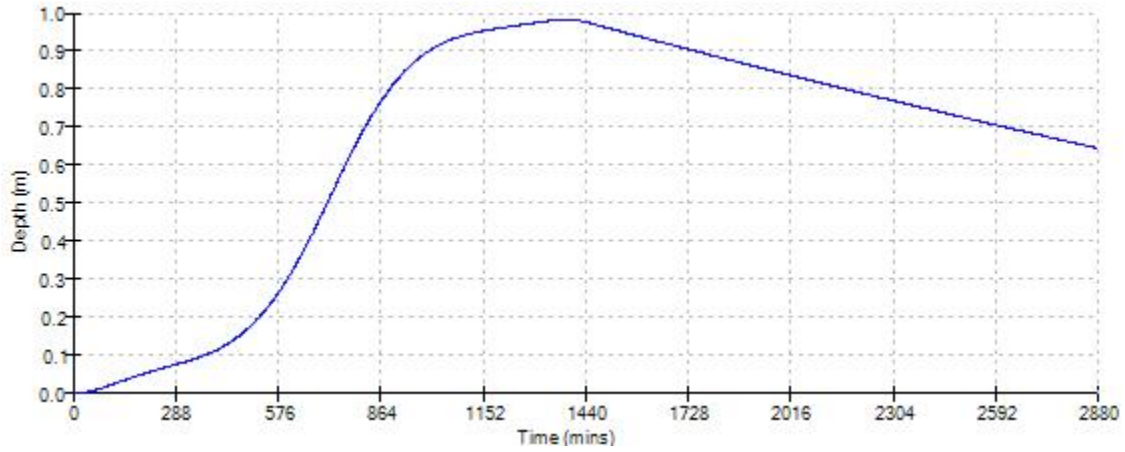


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Event: 1440 min Winter







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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.355	0.355	4.4	368.5	O K
30 min Summer	9.485	0.485	4.4	503.1	O K
60 min Summer	9.634	0.634	4.4	657.6	O K
120 min Summer	9.752	0.752	4.4	779.5	Flood Risk
180 min Summer	9.816	0.816	4.4	846.5	Flood Risk
240 min Summer	9.860	0.860	4.4	891.4	Flood Risk
360 min Summer	9.915	0.915	4.4	949.3	Flood Risk
480 min Summer	9.949	0.949	4.4	984.6	Flood Risk
600 min Summer	9.971	0.971	4.4	1006.9	Flood Risk
720 min Summer	9.984	0.984	4.4	1020.9	Flood Risk
960 min Summer	9.996	0.996	4.4	1033.0	Flood Risk
1440 min Summer	9.984	0.984	4.4	1019.9	Flood Risk
2160 min Summer	9.933	0.933	4.4	967.4	Flood Risk
2880 min Summer	9.887	0.887	4.4	919.7	Flood Risk
4320 min Summer	9.804	0.804	4.4	834.0	Flood Risk
5760 min Summer	9.740	0.740	4.4	767.5	Flood Risk
7200 min Summer	9.701	0.701	4.4	727.3	Flood Risk
8640 min Summer	9.677	0.677	4.4	702.3	O K
10080 min Summer	9.667	0.667	4.4	691.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	155.452	0.0	320.6	18
30 min Summer	106.486	0.0	369.8	33
60 min Summer	69.995	0.0	632.3	64
120 min Summer	41.971	0.0	697.8	124
180 min Summer	30.743	0.0	694.8	184
240 min Summer	24.555	0.0	689.0	242
360 min Summer	17.821	0.0	679.7	362
480 min Summer	14.163	0.0	673.3	482
600 min Summer	11.834	0.0	668.3	602
720 min Summer	10.209	0.0	664.1	722
960 min Summer	8.073	0.0	657.4	962
1440 min Summer	5.765	0.0	648.3	1440
2160 min Summer	4.088	0.0	1321.6	1860
2880 min Summer	3.199	0.0	1286.1	2224
4320 min Summer	2.258	0.0	1167.2	3024
5760 min Summer	1.778	0.0	1628.9	3864
7200 min Summer	1.508	0.0	1724.8	4688
8640 min Summer	1.337	0.0	1831.7	5536
10080 min Summer	1.225	0.0	1948.1	6360

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	9.355	0.355	4.4	368.4	O K
30 min Winter	9.485	0.485	4.4	503.0	O K
60 min Winter	9.634	0.634	4.4	657.5	O K
120 min Winter	9.752	0.752	4.4	779.5	Flood Risk
180 min Winter	9.816	0.816	4.4	846.7	Flood Risk
240 min Winter	9.860	0.860	4.4	891.8	Flood Risk
360 min Winter	9.916	0.916	4.4	950.0	Flood Risk
480 min Winter	9.951	0.951	4.4	985.8	Flood Risk
600 min Winter	9.973	0.973	4.4	1008.7	Flood Risk
720 min Winter	9.987	0.987	4.4	1023.4	Flood Risk
960 min Winter	10.000	1.000	4.4	1036.8	Flood Risk
1440 min Winter	9.991	0.991	4.4	1027.2	Flood Risk
2160 min Winter	9.939	0.939	4.4	973.8	Flood Risk
2880 min Winter	9.883	0.883	4.4	916.1	Flood Risk
4320 min Winter	9.782	0.782	4.4	810.6	Flood Risk
5760 min Winter	9.691	0.691	4.4	716.5	O K
7200 min Winter	9.617	0.617	4.4	639.8	O K
8640 min Winter	9.557	0.557	4.4	577.4	O K
10080 min Winter	9.518	0.518	4.4	537.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	155.452	0.0	320.6	18
30 min Winter	106.486	0.0	369.9	33
60 min Winter	69.995	0.0	632.3	64
120 min Winter	41.971	0.0	698.1	122
180 min Winter	30.743	0.0	695.1	180
240 min Winter	24.555	0.0	689.2	240
360 min Winter	17.821	0.0	679.8	358
480 min Winter	14.163	0.0	673.2	476
600 min Winter	11.834	0.0	668.0	592
720 min Winter	10.209	0.0	663.7	708
960 min Winter	8.073	0.0	656.9	940
1440 min Winter	5.765	0.0	647.8	1384
2160 min Winter	4.088	0.0	1322.0	2016
2880 min Winter	3.199	0.0	1289.6	2280
4320 min Winter	2.258	0.0	1181.9	3200
5760 min Winter	1.778	0.0	1629.2	4152
7200 min Winter	1.508	0.0	1725.7	5040
8640 min Winter	1.337	0.0	1834.0	5800
10080 min Winter	1.225	0.0	1954.5	6656

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 331208 350156 SJ 31208 50156
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.956

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	1	0.319	1	2	0.319	2	3	0.319

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Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 9.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1037.0	1.000	1037.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0099-4400-1000-4400
Design Head (m)	1.000
Design Flow (l/s)	4.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	99
Invert Level (m)	8.995
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

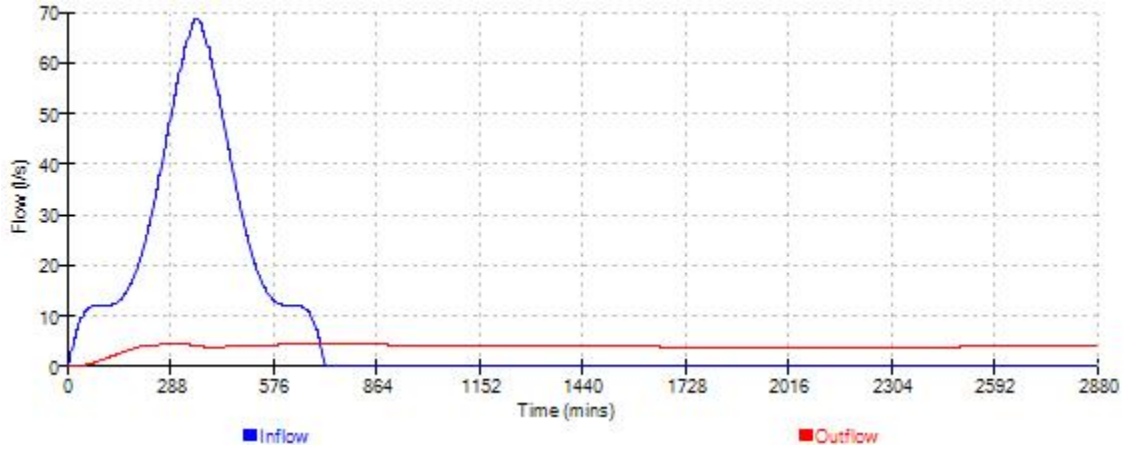
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	4.4
Flush-Flo™	0.297	4.4
Kick-Flo®	0.636	3.6
Mean Flow over Head Range	-	3.8

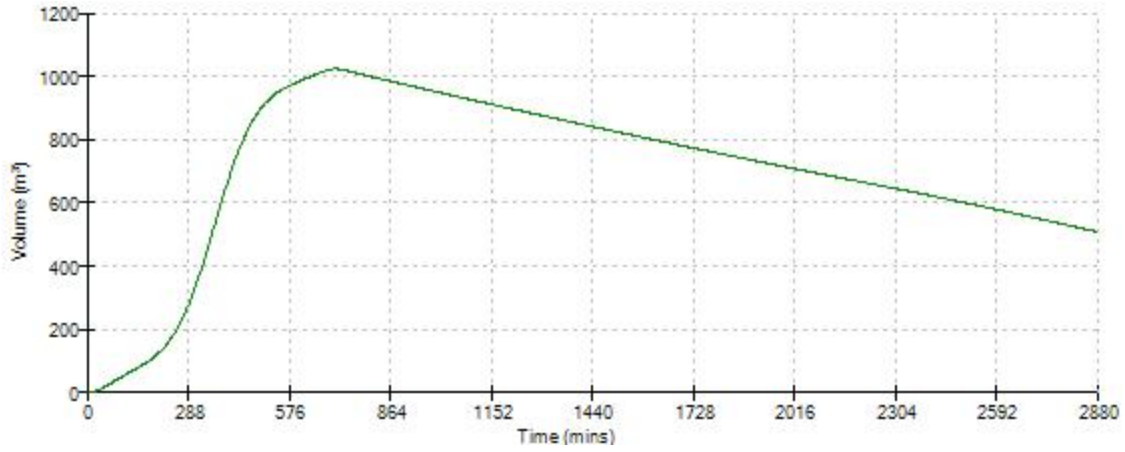
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

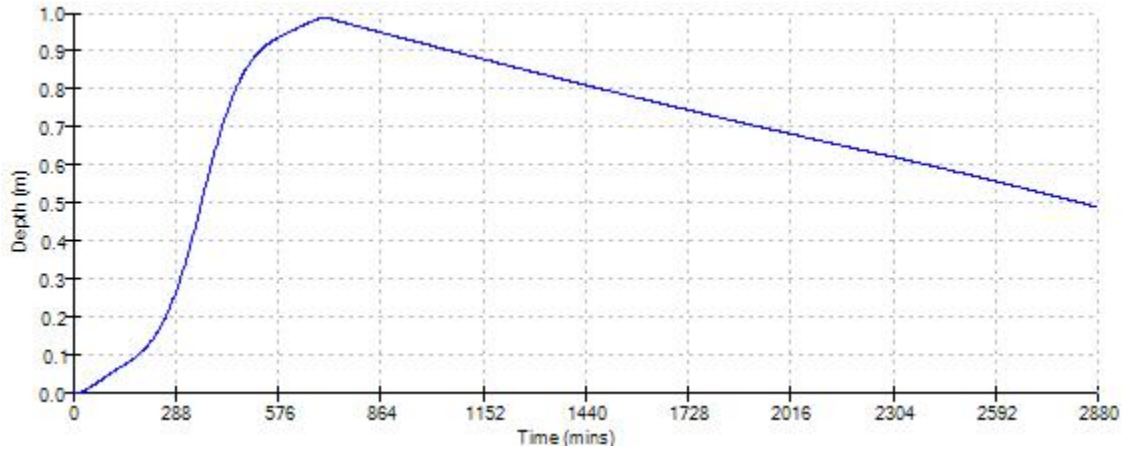
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.3	1.600	5.5	5.000	9.4
0.200	4.3	1.800	5.8	5.500	9.8
0.300	4.4	2.000	6.1	6.000	10.2
0.400	4.3	2.200	6.4	6.500	10.6
0.500	4.2	2.400	6.6	7.000	11.0
0.600	3.8	2.600	6.9	7.500	11.3
0.800	4.0	3.000	7.3	8.000	11.7
1.000	4.4	3.500	7.9	8.500	12.0
1.200	4.8	4.000	8.4	9.000	12.4
1.400	5.1	4.500	8.9	9.500	12.7

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Event: 720 min Winter

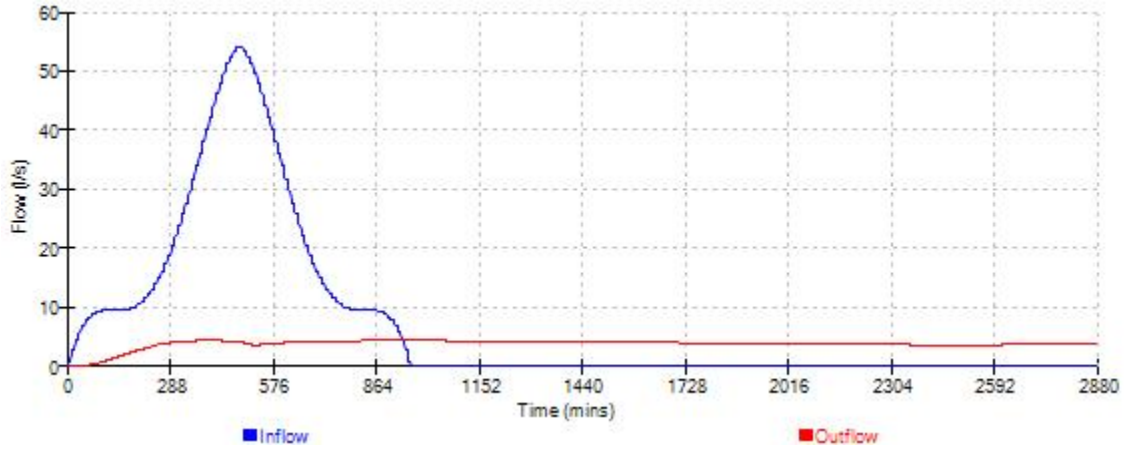


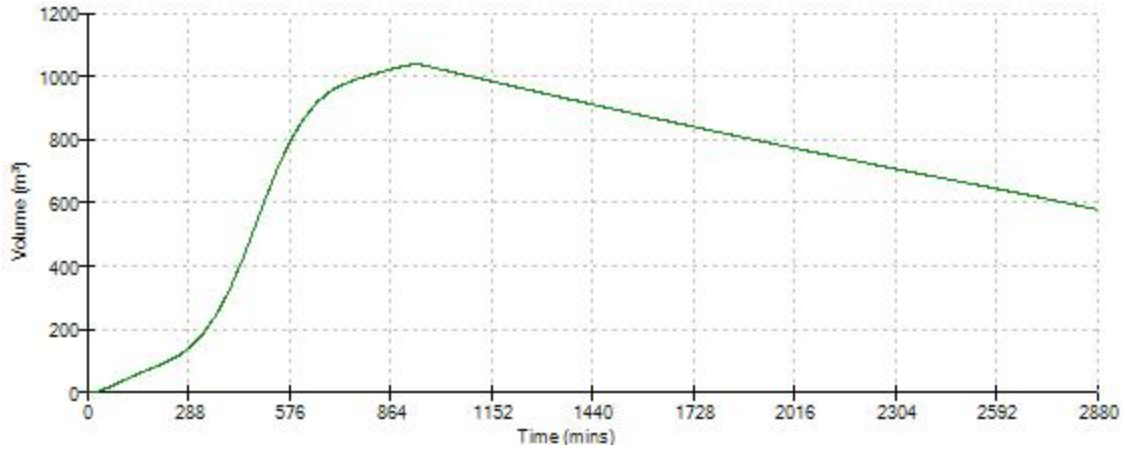


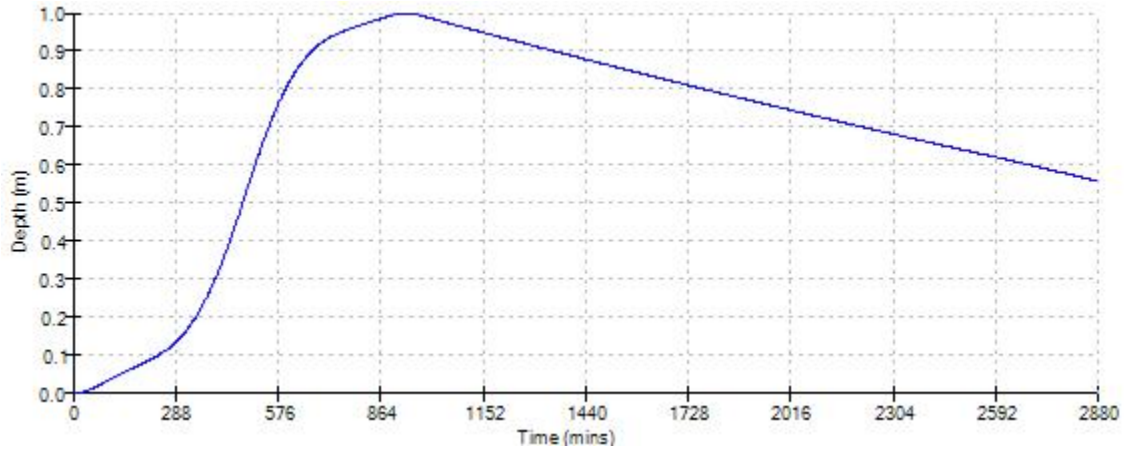


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Event: 960 min Winter

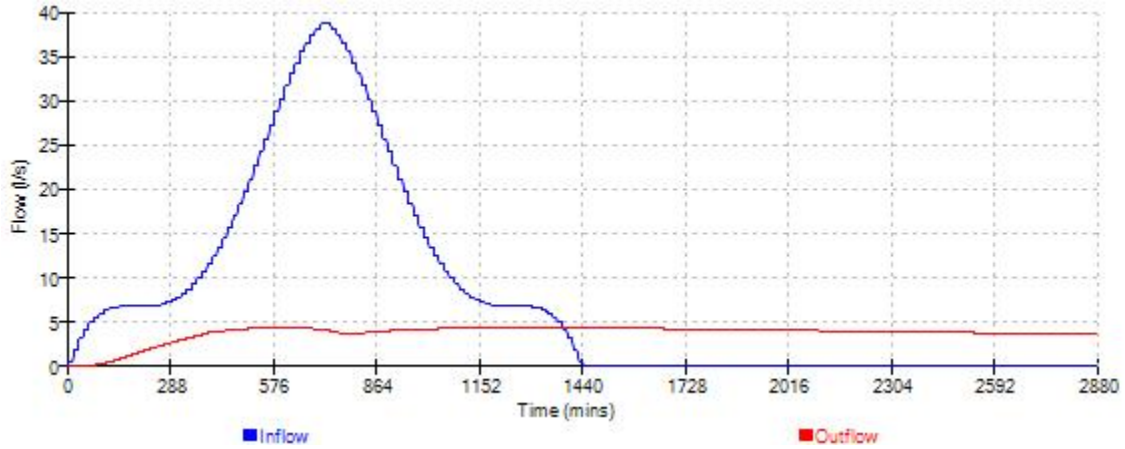


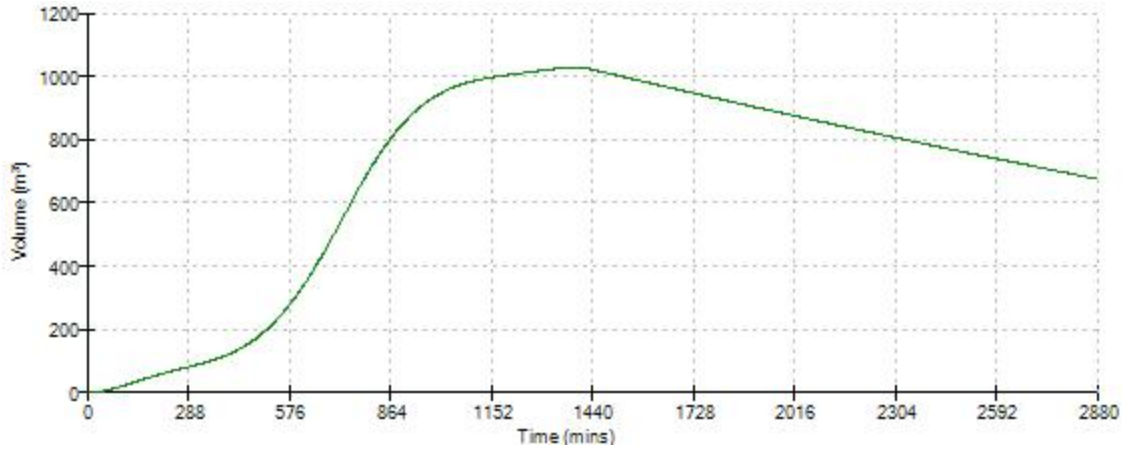


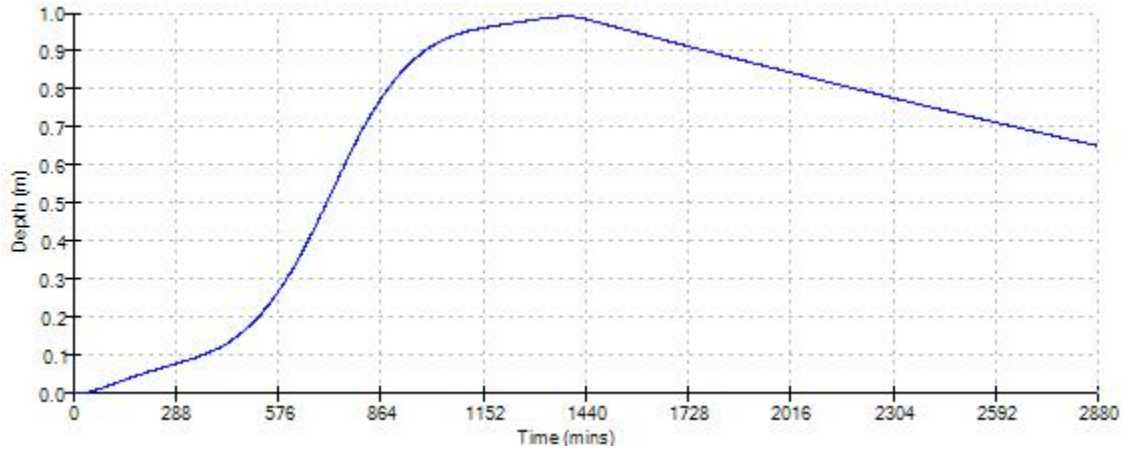


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Event: 1440 min Winter







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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.338	0.338	3.0	312.9	O K
30 min Summer	9.462	0.462	3.0	427.4	O K
60 min Summer	9.604	0.604	3.0	559.1	O K
120 min Summer	9.718	0.718	3.0	664.3	Flood Risk
180 min Summer	9.782	0.782	3.0	723.2	Flood Risk
240 min Summer	9.825	0.825	3.0	763.2	Flood Risk
360 min Summer	9.883	0.883	3.0	816.3	Flood Risk
480 min Summer	9.919	0.919	3.0	850.4	Flood Risk
600 min Summer	9.944	0.944	3.0	873.5	Flood Risk
720 min Summer	9.962	0.962	3.0	889.4	Flood Risk
960 min Summer	9.981	0.981	3.0	907.8	Flood Risk
1440 min Summer	9.986	0.986	3.0	911.9	Flood Risk
2160 min Summer	9.953	0.953	3.0	881.4	Flood Risk
2880 min Summer	9.912	0.912	3.0	843.8	Flood Risk
4320 min Summer	9.840	0.840	3.0	777.4	Flood Risk
5760 min Summer	9.788	0.788	3.0	728.6	Flood Risk
7200 min Summer	9.760	0.760	3.0	703.5	Flood Risk
8640 min Summer	9.748	0.748	3.0	691.8	Flood Risk
10080 min Summer	9.748	0.748	3.0	692.2	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	155.452	0.0	243.0	16
30 min Summer	106.486	0.0	254.2	31
60 min Summer	69.995	0.0	487.3	62
120 min Summer	41.971	0.0	474.7	122
180 min Summer	30.743	0.0	464.5	182
240 min Summer	24.555	0.0	458.5	242
360 min Summer	17.821	0.0	452.0	362
480 min Summer	14.163	0.0	449.1	482
600 min Summer	11.834	0.0	448.3	602
720 min Summer	10.209	0.0	448.8	722
960 min Summer	8.073	0.0	451.9	960
1440 min Summer	5.765	0.0	450.0	1440
2160 min Summer	4.088	0.0	903.1	2160
2880 min Summer	3.199	0.0	872.9	2452
4320 min Summer	2.258	0.0	807.6	3200
5760 min Summer	1.778	0.0	1376.1	4032
7200 min Summer	1.508	0.0	1452.8	4832
8640 min Summer	1.337	0.0	1524.0	5704
10080 min Summer	1.225	0.0	1501.5	6552

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	9.338	0.338	3.0	312.9	O K
30 min Winter	9.462	0.462	3.0	427.3	O K
60 min Winter	9.604	0.604	3.0	559.0	O K
120 min Winter	9.718	0.718	3.0	664.2	Flood Risk
180 min Winter	9.782	0.782	3.0	723.2	Flood Risk
240 min Winter	9.825	0.825	3.0	763.3	Flood Risk
360 min Winter	9.883	0.883	3.0	816.7	Flood Risk
480 min Winter	9.920	0.920	3.0	851.1	Flood Risk
600 min Winter	9.946	0.946	3.0	874.6	Flood Risk
720 min Winter	9.963	0.963	3.0	890.9	Flood Risk
960 min Winter	9.984	0.984	3.0	910.2	Flood Risk
1440 min Winter	9.991	0.991	3.0	916.4	Flood Risk
2160 min Winter	9.962	0.962	3.0	889.6	Flood Risk
2880 min Winter	9.918	0.918	3.0	849.0	Flood Risk
4320 min Winter	9.833	0.833	3.0	770.2	Flood Risk
5760 min Winter	9.764	0.764	3.0	706.7	Flood Risk
7200 min Winter	9.719	0.719	3.0	665.1	Flood Risk
8640 min Winter	9.688	0.688	3.0	636.4	O K
10080 min Winter	9.671	0.671	3.0	620.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	155.452	0.0	243.0	16
30 min Winter	106.486	0.0	254.2	31
60 min Winter	69.995	0.0	487.4	62
120 min Winter	41.971	0.0	474.9	122
180 min Winter	30.743	0.0	464.7	180
240 min Winter	24.555	0.0	458.6	240
360 min Winter	17.821	0.0	452.0	358
480 min Winter	14.163	0.0	449.0	476
600 min Winter	11.834	0.0	448.1	594
720 min Winter	10.209	0.0	448.5	708
960 min Winter	8.073	0.0	451.4	942
1440 min Winter	5.765	0.0	449.3	1398
2160 min Winter	4.088	0.0	902.5	2072
2880 min Winter	3.199	0.0	873.4	2680
4320 min Winter	2.258	0.0	812.7	3332
5760 min Winter	1.778	0.0	1376.5	4272
7200 min Winter	1.508	0.0	1454.0	5192
8640 min Winter	1.337	0.0	1531.6	6136
10080 min Winter	1.225	0.0	1544.1	7064

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 331208 350156 SJ 31208 50156
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.810

Time (mins) From:	To:	Area (ha)
0	1	0.810

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Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 9.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	925.0	1.000	925.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0082-3000-1000-3000
Design Head (m)	1.000
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	82
Invert Level (m)	8.995
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

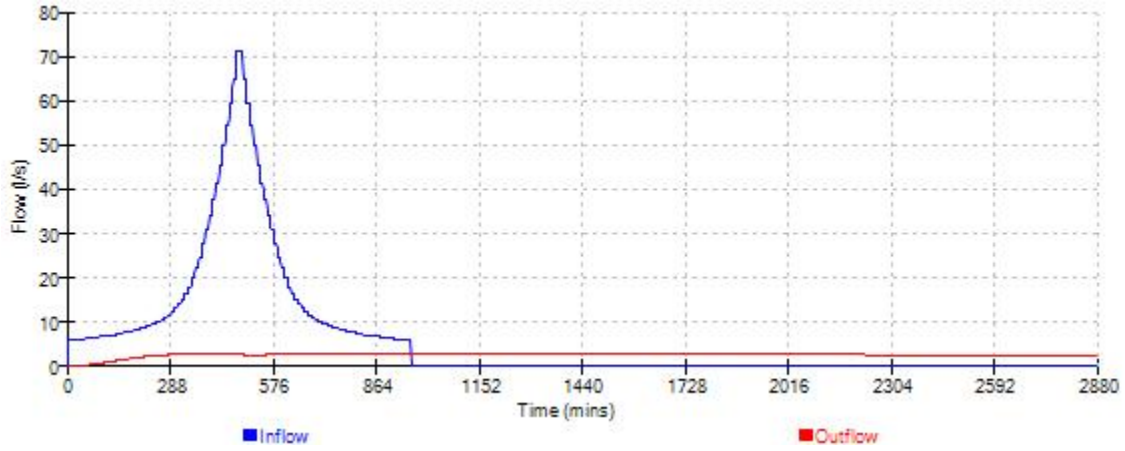
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.0
Flush-Flo™	0.297	3.0
Kick-Flo®	0.623	2.4
Mean Flow over Head Range	-	2.6

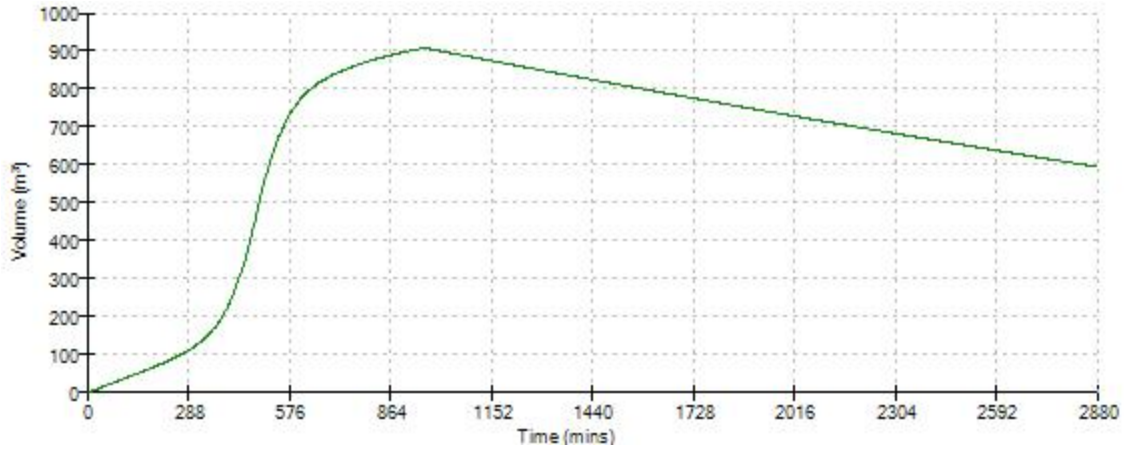
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

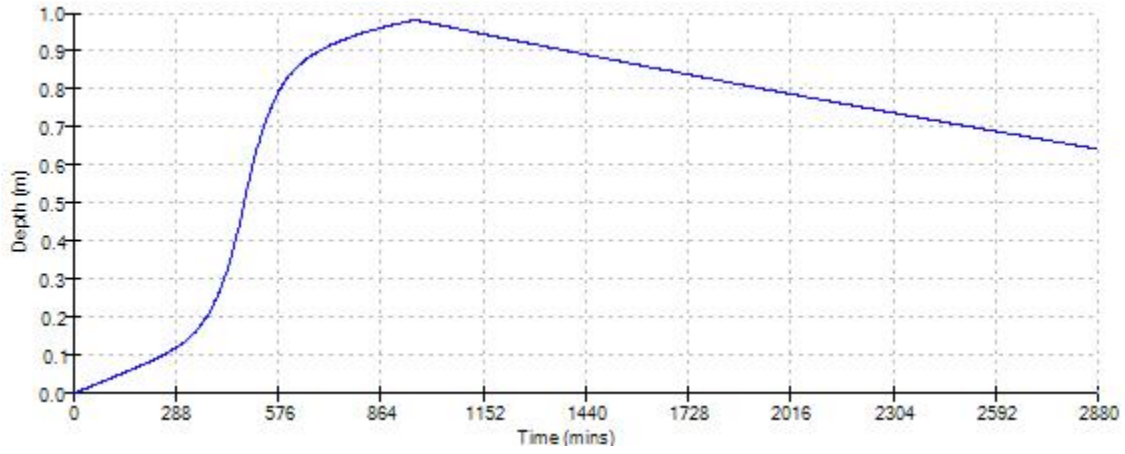
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.4	1.600	3.7	5.000	6.3
0.200	2.9	1.800	3.9	5.500	6.6
0.300	3.0	2.000	4.1	6.000	6.9
0.400	2.9	2.200	4.3	6.500	7.2
0.500	2.8	2.400	4.5	7.000	7.4
0.600	2.5	2.600	4.7	7.500	7.7
0.800	2.7	3.000	5.0	8.000	7.9
1.000	3.0	3.500	5.4	8.500	8.2
1.200	3.3	4.000	5.7	9.000	8.4
1.400	3.5	4.500	6.0	9.500	8.6

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Event: 960 min Summer

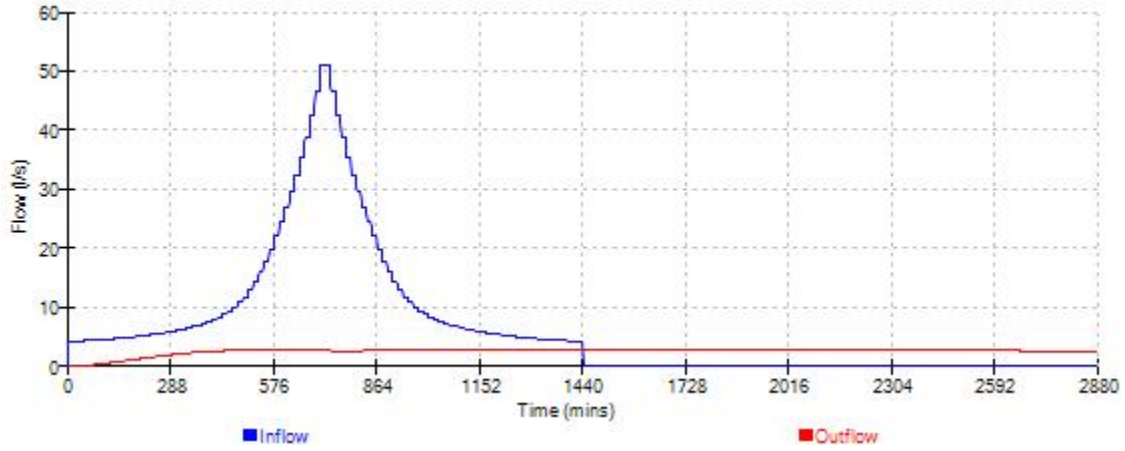


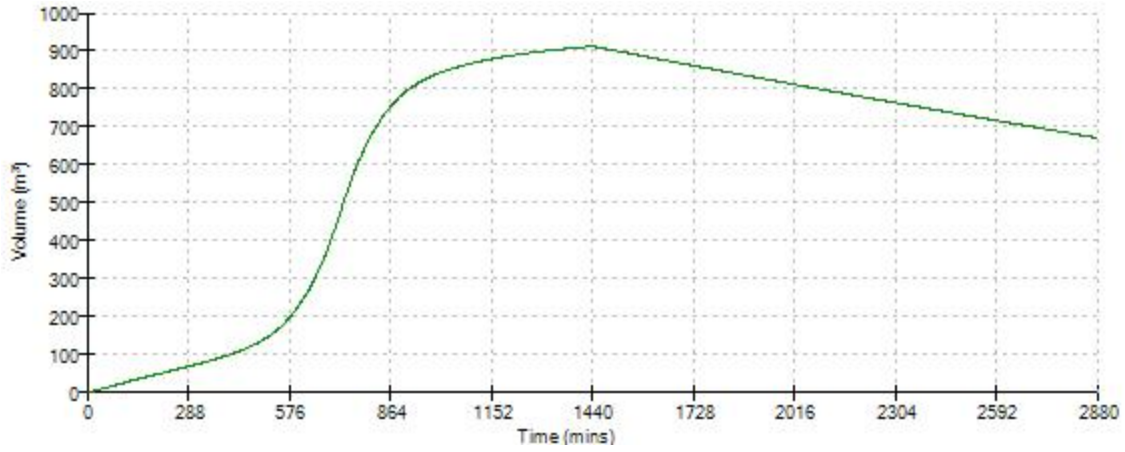


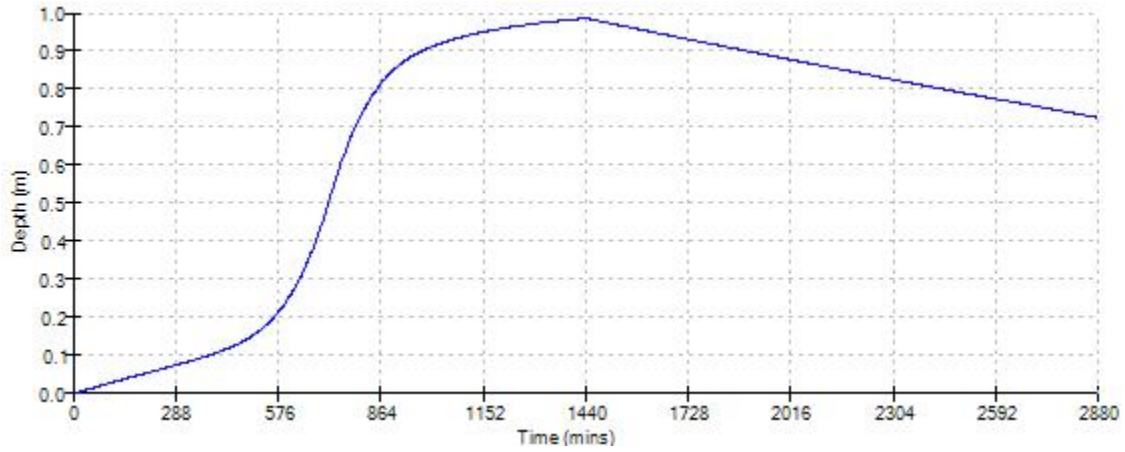


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Event: 1440 min Summer

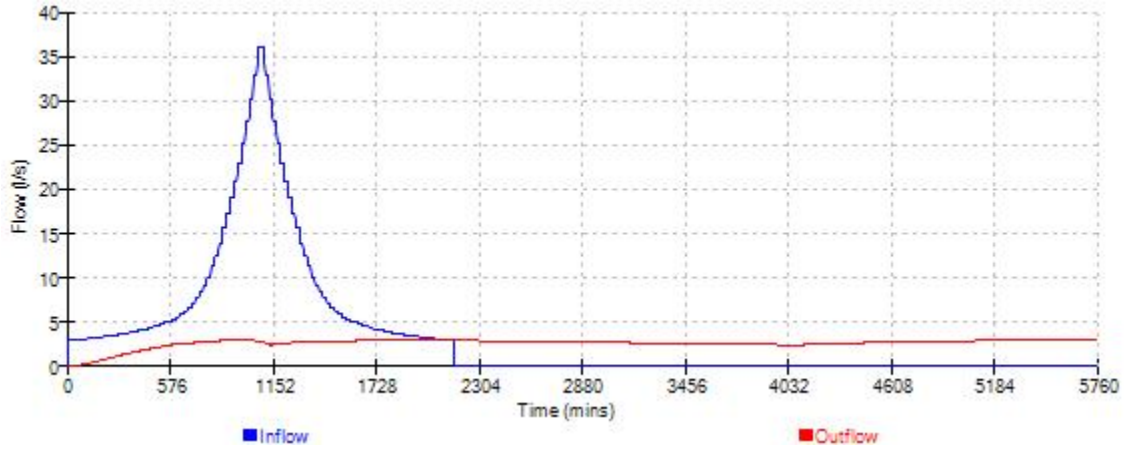


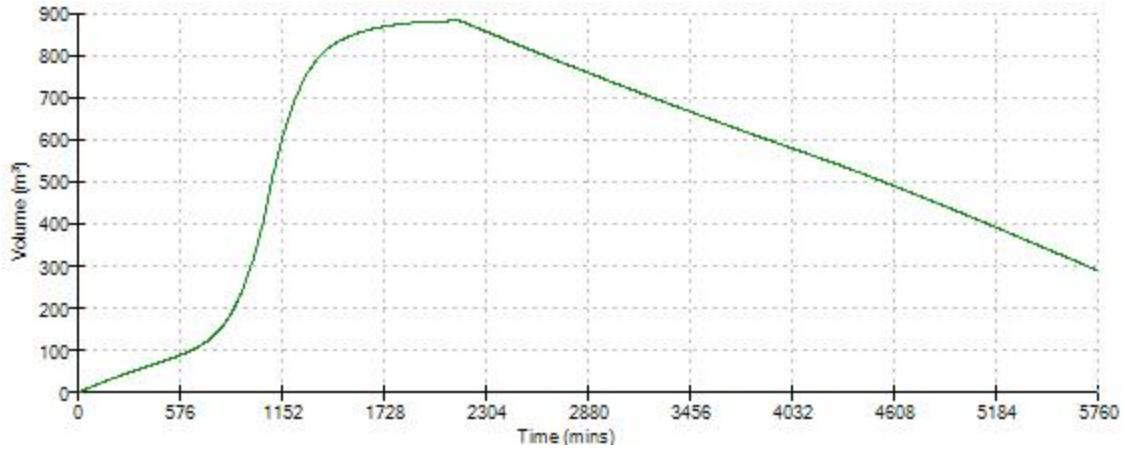


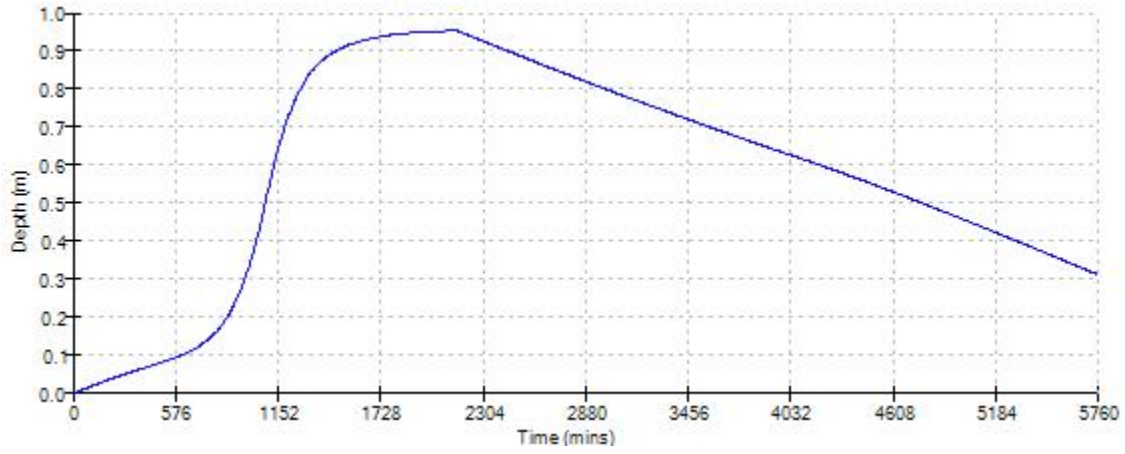


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Event: 2160 min Summer







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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	8.952	0.452	2.3	452.3	O K
30 min Summer	9.119	0.619	2.3	618.8	O K
60 min Summer	9.311	0.811	2.3	811.3	O K
120 min Summer	9.467	0.967	2.3	967.4	O K
180 min Summer	9.557	1.057	2.3	1057.1	O K
240 min Summer	9.620	1.120	2.4	1119.8	O K
360 min Summer	9.707	1.207	2.4	1206.6	Flood Risk
480 min Summer	9.766	1.266	2.5	1266.1	Flood Risk
600 min Summer	9.810	1.310	2.5	1309.7	Flood Risk
720 min Summer	9.843	1.343	2.6	1343.0	Flood Risk
960 min Summer	9.890	1.390	2.6	1389.9	Flood Risk
1440 min Summer	9.935	1.435	2.6	1435.4	Flood Risk
2160 min Summer	9.946	1.446	2.7	1446.3	Flood Risk
2880 min Summer	9.931	1.431	2.6	1430.6	Flood Risk
4320 min Summer	9.864	1.364	2.6	1363.5	Flood Risk
5760 min Summer	9.814	1.314	2.5	1313.5	Flood Risk
7200 min Summer	9.800	1.300	2.5	1300.5	Flood Risk
8640 min Summer	9.808	1.308	2.5	1308.4	Flood Risk
10080 min Summer	9.835	1.335	2.6	1335.1	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	155.452	0.0	193.4	17
30 min Summer	106.486	0.0	178.5	32
60 min Summer	69.995	0.0	341.0	62
120 min Summer	41.971	0.0	347.7	122
180 min Summer	30.743	0.0	363.1	182
240 min Summer	24.555	0.0	373.1	242
360 min Summer	17.821	0.0	386.0	362
480 min Summer	14.163	0.0	393.7	482
600 min Summer	11.834	0.0	398.6	602
720 min Summer	10.209	0.0	401.7	722
960 min Summer	8.073	0.0	404.2	962
1440 min Summer	5.765	0.0	400.8	1442
2160 min Summer	4.088	0.0	793.7	2160
2880 min Summer	3.199	0.0	786.0	2880
4320 min Summer	2.258	0.0	752.4	4020
5760 min Summer	1.778	0.0	1448.1	4680
7200 min Summer	1.508	0.0	1438.6	5472
8640 min Summer	1.337	0.0	1430.2	6232
10080 min Summer	1.225	0.0	1414.5	7064

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	8.952	0.452	2.3	452.3	O K
30 min Winter	9.119	0.619	2.3	618.8	O K
60 min Winter	9.311	0.811	2.3	811.3	O K
120 min Winter	9.467	0.967	2.3	967.4	O K
180 min Winter	9.557	1.057	2.3	1057.2	O K
240 min Winter	9.620	1.120	2.4	1120.2	O K
360 min Winter	9.707	1.207	2.4	1207.3	Flood Risk
480 min Winter	9.767	1.267	2.5	1267.1	Flood Risk
600 min Winter	9.811	1.311	2.5	1311.2	Flood Risk
720 min Winter	9.845	1.345	2.6	1345.0	Flood Risk
960 min Winter	9.893	1.393	2.6	1392.7	Flood Risk
1440 min Winter	9.940	1.440	2.7	1440.1	Flood Risk
2160 min Winter	9.954	1.454	2.7	1454.4	Flood Risk
2880 min Winter	9.943	1.443	2.7	1442.5	Flood Risk
4320 min Winter	9.883	1.383	2.6	1382.5	Flood Risk
5760 min Winter	9.822	1.322	2.5	1321.7	Flood Risk
7200 min Winter	9.805	1.305	2.5	1304.8	Flood Risk
8640 min Winter	9.807	1.307	2.5	1307.0	Flood Risk
10080 min Winter	9.827	1.327	2.6	1326.5	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	155.452	0.0	193.4	17
30 min Winter	106.486	0.0	178.5	32
60 min Winter	69.995	0.0	341.0	62
120 min Winter	41.971	0.0	347.6	122
180 min Winter	30.743	0.0	362.9	180
240 min Winter	24.555	0.0	372.9	240
360 min Winter	17.821	0.0	385.5	360
480 min Winter	14.163	0.0	393.1	478
600 min Winter	11.834	0.0	397.7	596
720 min Winter	10.209	0.0	400.6	714
960 min Winter	8.073	0.0	402.7	950
1440 min Winter	5.765	0.0	398.4	1414
2160 min Winter	4.088	0.0	790.6	2116
2880 min Winter	3.199	0.0	782.0	2792
4320 min Winter	2.258	0.0	747.1	4104
5760 min Winter	1.778	0.0	1443.6	5184
7200 min Winter	1.508	0.0	1435.0	5624
8640 min Winter	1.337	0.0	1427.2	6568
10080 min Winter	1.225	0.0	1412.2	7560

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 331208 350156 SJ 31208 50156
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.168

Time (mins) From:	To:	Area (ha)
0	2	1.168

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Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 8.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1000.0	1.500	1000.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0071-2700-1500-2700
Design Head (m)	1.500
Design Flow (l/s)	2.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	71
Invert Level (m)	8.495
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

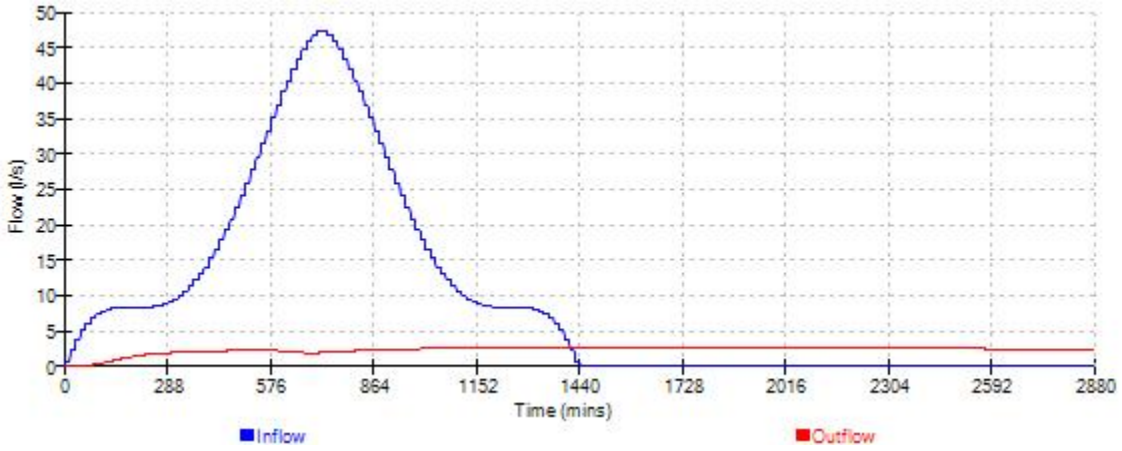
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	2.7
Flush-Flo™	0.310	2.3
Kick-Flo®	0.635	1.8
Mean Flow over Head Range	-	2.2

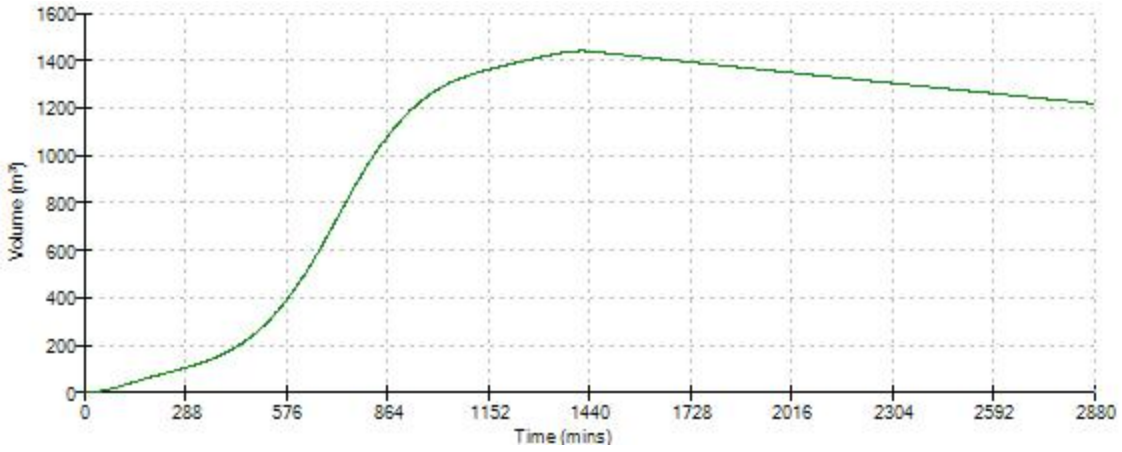
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

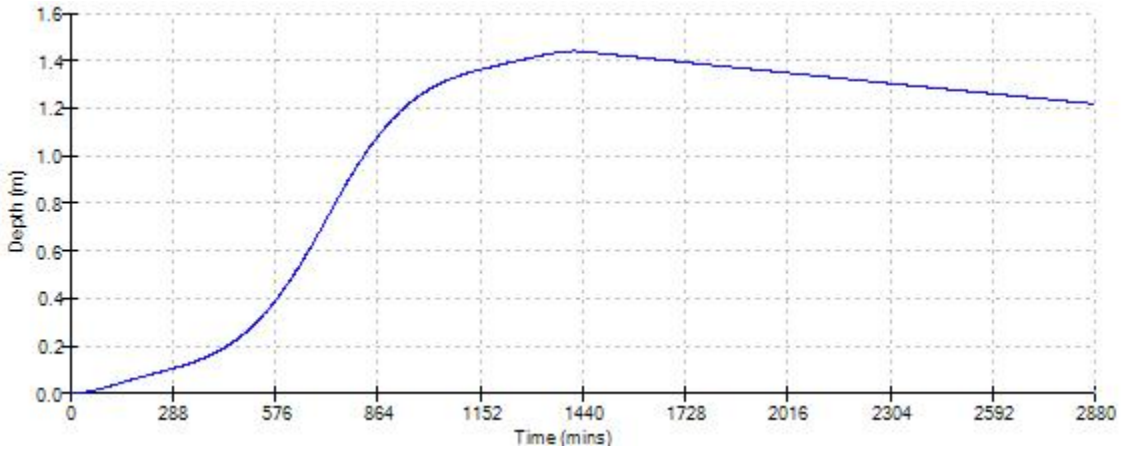
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.9	1.600	2.8	5.000	4.7
0.200	2.2	1.800	2.9	5.500	4.9
0.300	2.3	2.000	3.1	6.000	5.1
0.400	2.2	2.200	3.2	6.500	5.3
0.500	2.2	2.400	3.3	7.000	5.5
0.600	2.0	2.600	3.5	7.500	5.7
0.800	2.0	3.000	3.7	8.000	5.9
1.000	2.2	3.500	4.0	8.500	6.1
1.200	2.4	4.000	4.2	9.000	6.2
1.400	2.6	4.500	4.5	9.500	6.4

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Event: 1440 min Winter

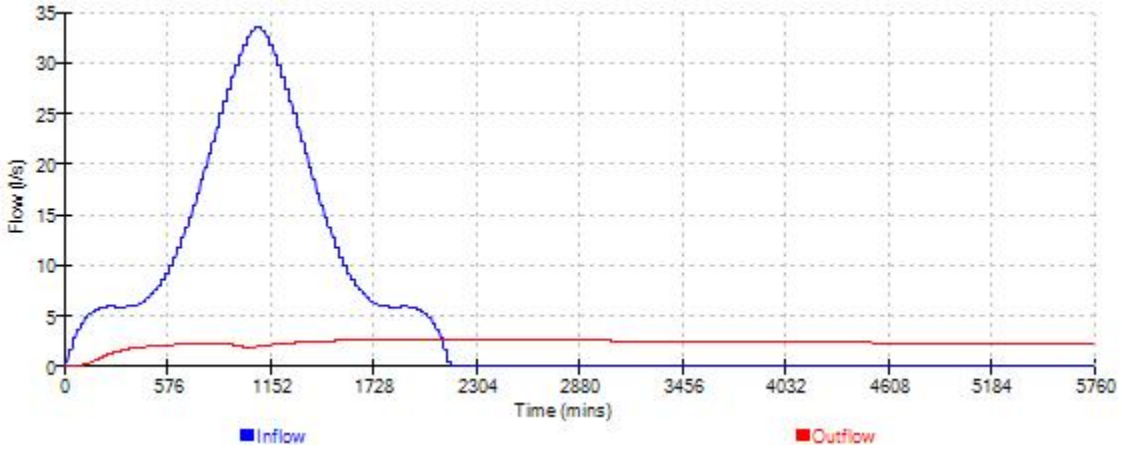


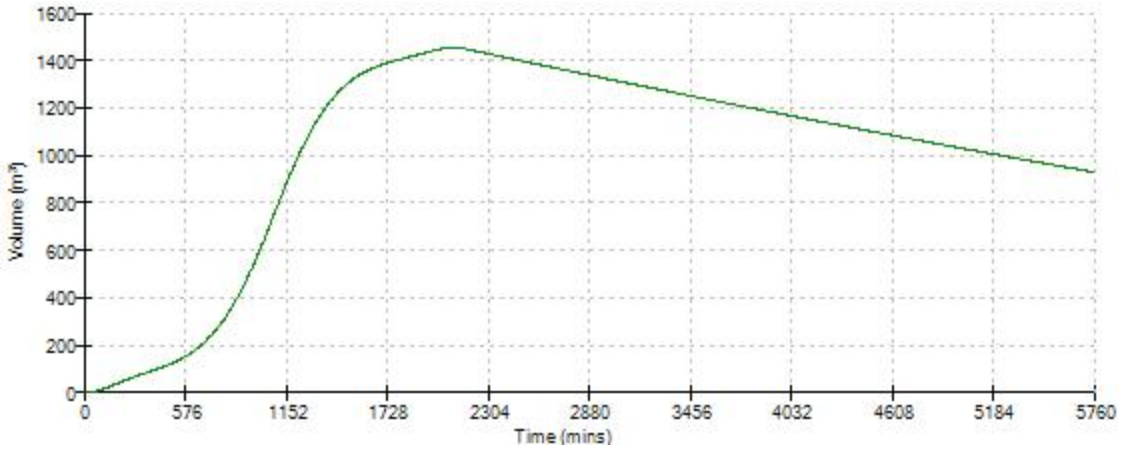


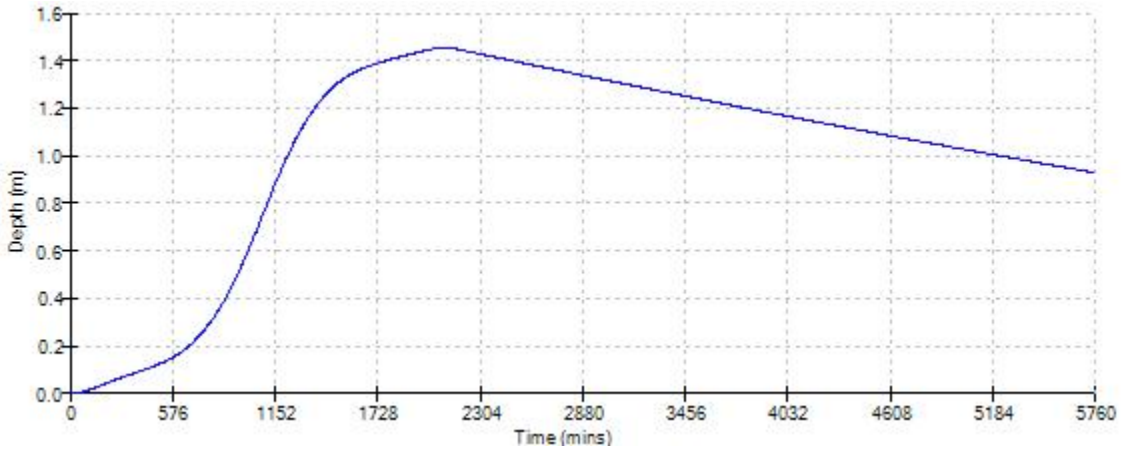


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Event: 2160 min Winter

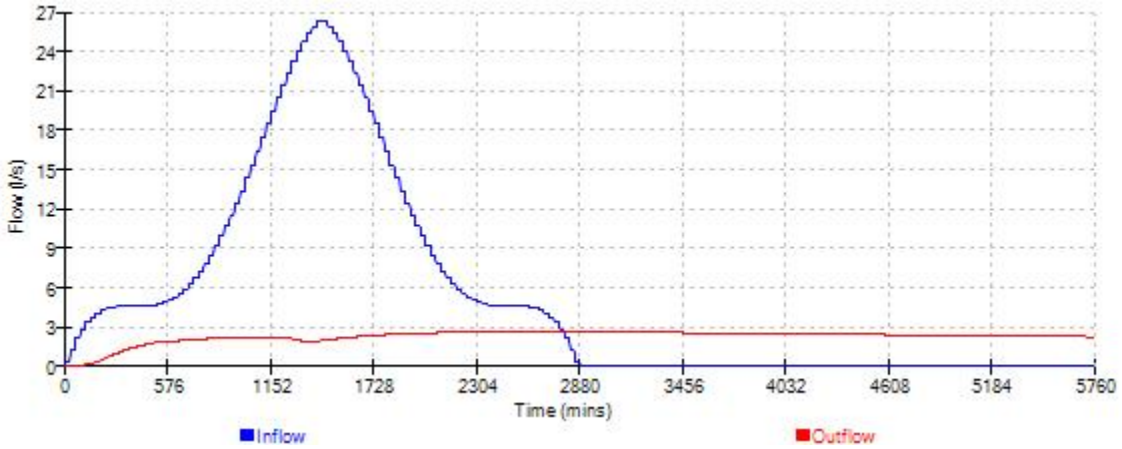


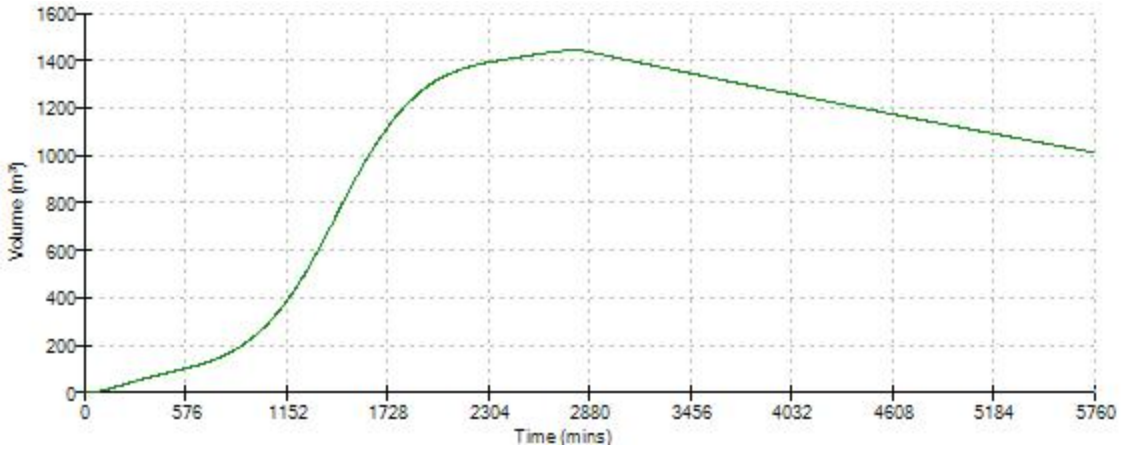


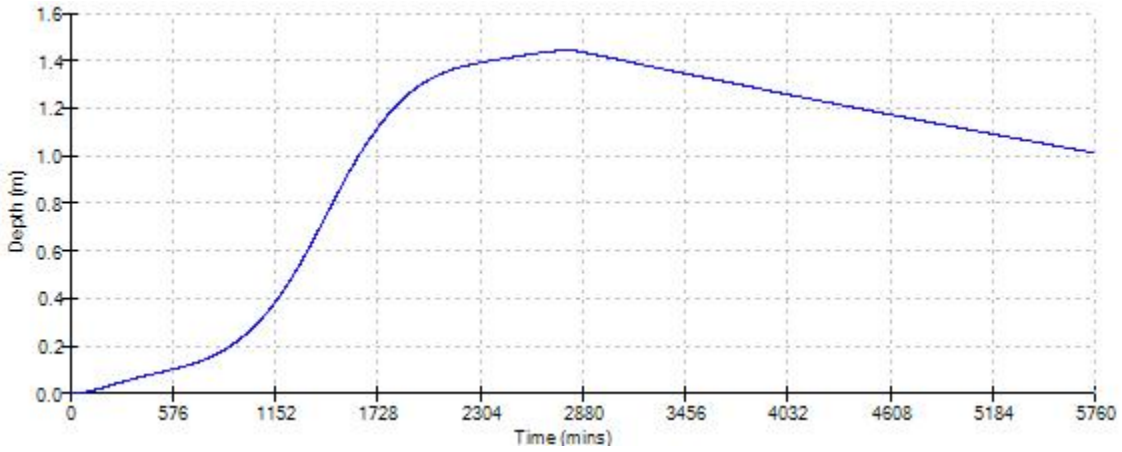


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Event: 2880 min Winter







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Appendix K Discharge Route Plan to River Clywedog

Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise

LEGEND

- Site Boundary
- Area not included within site bounadary
- Watercourses
- Proposed route of connection to River Clywedog

0 200 400 600 800 m

CONTAINS OS DATA © CROWN COPYRIGHT (2022)

CLIENT: Redrow Homes Ltd

www.waterco.co.uk

SCHEME: Ruthin Road, Wrexham

PLOT TITLE: Connection to River Clywedog

PLOT STATUS:	DATE:
FINAL	06-12-2022

DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
PB	AW	NJ	1:10400

PLOT NAME:	REVISION:
13840_Conncetion_to_River_Clywedog	-

Appendix L Maintenance Schedules

Operation and Maintenance Requirements for Permeable Paving

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and move contributing and adjacent areas	As required
	Removal of weeds or management using glyphospate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level or the paving	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Inspect for evidence of poor operation and / or weed growth – if required, take remedial action	Three-monthly, 48hr after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Ref. Table 20.15, CIRIA C753 'The SuDS Manual'

The maintenance requirements detailed above are to be undertaken by the site owner.

Name :

Position :

Date :

Signed on behalf of the site owner :

Operation and Maintenance Requirements for Swale

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Cut the grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as Required
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours	Monthly, or when required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
Occasional maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or if bare soil is exposed over 10% or more of the swales treatment area
Remedial actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oil or petrol residues using safe standard practices	As required

Ref. Table 17.1 CIRIA C753 'The SuDS Manual'

The maintenance requirements detailed above are to be undertaken by the site owner.

Name :

Position :

Date :

Signed on behalf of the site owner :

Operation and Maintenance Requirements for Ponds and Wetlands

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Cut the grass – public areas	Monthly (during growing season), or as required
	Inspect marginal and bankside vegetation and remove nuisance plants (for first 3 years)	Monthly (at start, then as required)
	Inspect inlets, outlets, banksides, structures, pipework etc for evidence of blockage, and / or physical damage.	Monthly
	Inspect water body for signs of poor water quality	Monthly (May – October)
	Inspect silt accumulation rates in any forebay and in main body of the pond and establish appropriate removal frequencies; undertake contamination testing once some build-up has occurred, to inform management and disposal options.	Half yearly
	Check any mechanical devices e.g. penstocks	Half yearly
	Hand cut submerged and emergent aquatic plants (at minimum of 0.1m above pond base; include max 25% of pond surface)	Annually
	Remove 25% of bank vegetation from water's edge to a minimum of 1m above water level	Annually
	Remove sediment from any forebay	Every 1 – 5 years, or as required
	Remove sediment and planting from one quadrant of the main body of ponds without sediment forebays	Every 5 years, or as required
Occasional maintenance	Remove sediment from the main body of big ponds when pool volume is reduced by 20%	With effective pre-treatment, this will only be required rarely, e.g. 25-50 years
Remedial actions	Repair erosion or other damage	As required
	Replant where necessary	As required
	Aerate pond when signs of eutrophication are detected	As required
	Realign rip-rap or repair other damage	As required
	Repair/rehabilitate of Inlets, outlets and overflows	As required

Ref. Table 23.1 CIRIA C753 'The SuDS Manual'

The maintenance requirements detailed above are to be undertaken by the site owner.

Name :

Position :

Date :

Signed on behalf of the site owner :

Appendix M CDRA

CONCEPT DESIGNER'S RISK ASSESSMENT

Project:	Ruthin Road, Wrexham	**Project No:**	13840
Client:	Redrow Homes Ltd		
Report Reference:	13840-FCA & Drainage Strategy-01-V1		

Prepared by:	Paige Blundell	**Date:**	21/11/2022
Checked by:	Aled Williams	**Date:**	23/11/2022
Reviewed by:	Mike Wellington	**Date:**	23/11/2022

Requirement:

The Construction (Design and Management) Regulations 2015 (CDM 2015) place an obligation on the Designer to take all reasonable steps to provide, with the design, sufficient information about the design, construction or maintenance of the structure, to adequately assist the client, other designers and contractors to comply with their duties under CDM. The Designer has undertaken this assessment to identify any extra-ordinary risks, or those that would not be expected on this particular project by an experienced and competent Contractor. The aim is to avoid needless paperwork and bureaucracy and ensure the assessment is project specific, relevant and proportionate to the risk.

DRA Summary

Each of the following risk areas has been considered using the question below. Is a risk present which is considered to be **extra-ordinary or unexpected** in this instance?

If **YES** - A detailed risk assessment is required at design stage
If **UNKNOWN** - Insufficient information has been provided at concept design stage and the risks are unknown. Further consideration must be given at design stage(s)
If **NO** - No further action is required.

Hazard Ref.	Risk Areas	YES, UNKNOWN or NO	Comments
1	Ground Conditions	Unknown	Refer to ground investigation by E3P. Litte to no contamination
2	Hazardous Environment	No	Refer to ground investigation by E3P
3	Existing Working Environment	Yes	Lower Berse Farm in north-west and communications mast
4	Existing Services	Unknown	Full suite of utility searches not undertaken. Searches should be undertake by Principal Designer and Principal Contractor and included in construction phase plan
5	Proximity to Other Structure(s)	Unknown	Communications mast encircled by site
6	Near Waterbody / flood risk	Yes	Two unnamed watercourses crossing the site
7	Proximity to Other Activities	Unknown	To be determined at detail design stage
8	Sequence of Construction	Unknown	To be determined at detail design stage
9	Access	Unknown	To be determined at detail design stage
10	Interfaces	Unknown	To be determined at detail design stage
11	Confined Space Working	Unknown	To be determined at detail design stage
12	Maintenance Considerations	Unknown	Maintenance of SuDS required
13	Working at Height	Unknown	To be determined at detail design stage
14	Steep Slopes	No	Limited fall identified by topographical survey
15	Demolition / Refurbishment / Repair	Yes	Re-development of buildings in northern extent of site
16	Welfare	Unknown	To be determined at detail design stage
17	Occupational Health	Unknown	To be determined at detail design stage
18	Environmental Issues	Unknown	To be determined at detail design stage
19	Other Significant Hazards not Identified Above	Unknown	To be determined at detail design stage
20	Residual Risk to Future Users	Unknown	To be determined at detail design stage