



BRYMBO PARK

FLOOD CONSEQUENCES ASSESSMENT
AUGUST 2020



BRYMBO DEVELOPMENTS LTD

FORMER BRYMBO STEELWORKS, WREXHAM

FLOOD CONSEQUENCE ASSESSMENT

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1 INTRODUCTION

1.1 General

1.1.1 Wardell Armstrong LLP has been commissioned to undertake a Flood Consequence Assessment (FCA) on behalf of Brymbo Developments Ltd, relating to the proposed mixed development of residential and commercial properties and a primary school along with areas of public open space at Brymbo, Wrexham as shown on Drawing No ST16882-008 '*Site Location Plan*'.

1.1.2 This assessment has been carried out in accordance with the guidance set out in the Welsh Government Technical Advice Note 15 '*Development and Flood Risk*' (TAN15).

1.2 Methodology

1.2.1 The methodology for this FCA has comprised a desktop study supplemented by liaison with the Lead Local Flood Authority (Wrexham County Borough Council) and Natural Resources Wales.

1.2.2 In accordance with TAN15, the following has been carried out in preparing this assessment:

- an assessment of the consequences of flooding to the development from a range of sources;
- an assessment of the consequences of flooding from the proposed development site; and
- consideration of recommendations for the management of the identified consequences.

1.2.3 In carrying out this assessment, reference has been made to relevant plans and documents, including:

- Planning Policy Wales (2004) *Technical Advice Note 15: Development and Flood Risk*;
- Wrexham Borough Council (2011) *Preliminary Flood Risk Assessment*;
- Wrexham Borough Council (2013) *Local Flood Risk Management Strategy*; and
- Wrexham County Borough Council (2016) *Flood Risk Management Plan 2016 – 2021*.

Planning Policy Wales

- 1.2.4 Technical Advice Note 15 (TAN15) “Development and Flood Risk” was published in July 2004 by the Welsh Assembly Government (WAG) and supplements the policy set out in Planning Policy Wales (PPW), 2016 (Edition 9). It gives guidance to planning authorities in Wales on how to respond on flood risk grounds to development proposals. TAN15 expects planning authorities to apply a risk-based approach to development planning and control through a Sequential Test involving location justification, type of development and flooding consequences.
- 1.2.5 In October 2017, the Welsh Government published the latest TAN15 Development Advice Maps (DAM’s) which show areas potentially at risk from flood events of a 0.1% annual probability for river, tidal or coastal areas (ie 1 in 1,000 year). The Development Advice Maps divide the land area of Wales into three flood risk zones. These are denoted A, B and C, with Zone C further sub-divided into Zones C1 and C2. The Flood Zones are described in further detail in Table 1 below.

Table 1: TAN15 Development Advice Map Flood Zones		
Zone	Description	Use within the precautionary framework
A	Considered to be at little or no risk of fluvial or tidal/coastal flooding.	Used to indicate that Justification Test is not applicable and no need to consider flood risk further.
B	Areas known to have been flooded in the past evidenced by sedimentary deposits.	Used as part of a precautionary approach to indicate where site levels should be checked against the extreme (0.1%) flood level. If site levels are greater than the flood levels used to define adjacent extreme flood outline there is no need to consider flood risk further.
C	Based on Environment Agency extreme flood outline, equal to or greater than 0.1% (river, tidal or coastal).	Used to indicate that flooding issues should be considered as an integral part of decision making by the application of the Justification Test including assessment of consequences.
C1	Areas of the floodplain which are developed and served by significant infrastructure, including flood defences.	Used to indicate that development can take place subject to application of Justification Test, including acceptability of consequences.
C2	Areas of the floodplain without significant flood defence infrastructure.	Used to indicate that only less vulnerable development should be considered subject to application of Justification Test, including acceptability of consequences. Emergency services and highly vulnerable development should not be considered.

- 1.2.6 Section 5 of TAN15 categorises development according to its vulnerability to flooding. There are three categories: emergency services; highly vulnerable development; and less vulnerable development. All residential premises and vulnerable industrial developments are categorised as highly vulnerable developments. Commercial, retail and general industrial development are categorised as less vulnerable developments.

Wrexham County Borough Council Preliminary Flood Risk Assessment

- 1.2.7 A Preliminary Flood Risk Assessment (PFRA) is a high-level screening exercise to identify areas where there is significant flood risk from local sources, namely ordinary watercourses, surface water runoff and groundwater. It does not directly consider flooding from main rivers or from sewers. PFRAs have been produced by Lead Local Flood Authorities (LLFAs) to fulfil statutory requirements in the Flood Risk Regulations 2009. In this case the LLFA is the Wrexham County Borough Council and the PFRA¹ was published in 2011.

Wrexham County Borough Council Local Flood Risk Management Strategy

- 1.2.8 The Local Flood Risk Management Strategy (LFRMS) report sets out the principles, objectives and measures for the management of local flood risk by Wrexham County Borough Council as the LLFA (where “local flood risk” is defined as “*surface water runoff, ground water and ordinary watercourses and included any lake, pond or other body of water that feeds from an ordinary watercourse*”). The report was published in April 2013.

Wrexham County Borough Council Local Flood Risk Management Plan 2016-2021

- 1.2.9 The Local Flood Risk Management Plan (LFRMP) was produced by Wrexham County Borough Council to build on the 2013 LFRMS report and aims to quantify the scale of the risk of local flooding across the County Borough and the relevant actions and measures required to reduce this within communities at risk. The plan was produced in July 2016.

¹ WREXHAM COUNTY BOROUGH COUNCIL (2011) *Preliminary Assessment Report*

2 SITE AND CATCHMENT CHARACTERISTICS

2.1 Site Description and Location

The site forms part of the wider land holding associated with the former Brymbo Steelworks in the village of Brymbo near Wrexham, some of which has already been significantly redeveloped. The site location is as shown on Drawing No ST16882-008 'Site Location Plan'.

Table 2: Site Summary	
Site Name	Iron Park (Former Brymbo Steelworks)
Site Address	Off Phoenix Drive, Brymbo, Wrexham, LL11 5BT
Site Area	13.41ha
National Grid Reference	329743, 353316 (approximate centre of site)
Proposed Development	Redevelopment of former steelworks
Local Planning Authority	Wrexham County and Borough Council
Lead Local Flood Authority	Wrexham County and Borough Council
Sewerage Undertaker	Welsh Water

- 2.1.1 The site area is approximately 13.41ha in size and irregular in shape. The former steelworks buildings which previously occupied this area have now been demolished and the land was the subject of a major land reclamation project from 2003 to 2005. The reclaimed area now generally consists of open ground and areas of rough vegetation.
- 2.1.2 The area is bounded to the north and east by open ground falling away from the site to the B5101 (New Road/Kent Road) and to the south by residential areas. Two link roads, Phoenix Drive and Blast Road run adjacent to the western boundary, meeting at a roundabout, with Phoenix Drive crossing the site area in a north-eastwards direction to join the B5101.
- 2.1.3 To the west of the site is the Ty Cerrig area separated from the site by an area of woodland. This area was formerly an opencast coal site during 1970s which was backfilled with the natural excavated materials and restored to open fields and hedgerows. Whilst Ty Cerrig formed part of the former steelworks development, this area is not included within the planning application and is not assessed further in this FCA.

- 2.1.4 This area of the site consists primarily of two gently-sloping plateaux separated by the Phoenix Drive link road (the “northern plateau” and “southern plateau”). The larger southern plateau falls generally northwards from a maximum elevation of approximately 203.40mAOD at the southern boundary to a minimum elevation of approximately 193.65mAOD at its northern extent at an approximate gradient of 1 in 60. At the northern and eastern extents, ground levels slope steeply away from the plateaux areas.
- 2.1.5 The northern plateau area is situated up to 2.0m lower than the unnamed adjacent access road to the west. Ground levels fall in a south-eastwards direction from a maximum elevation of 204.92mAOD adjacent to the unnamed access road in the north-western corner, down a 1 in 2.5 slope to a flatter area. Ground levels in this area also fall in a south-eastwards direction at a gradient of approximately 1 in 50 to a minimum elevation of 193.03mAOD adjacent to Phoenix Drive.
- 2.1.6 The topography of the site is shown on Drawing No ST16882-006 (Sheet 1 – 3) ‘*Topographic Survey*’.

2.2 Existing Drainage Regime

- 2.2.1 There are no Main Rivers within the site area. The nearest Main River is the River Cegidog (Afon Cegidog) located approximately 1.3km to the north of the site at its closest point. There are also no Ordinary Watercourses within the site areas.
- 2.2.2 Welsh Water’s public sewer records (see Appendix 1) show a public combined sewer flowing in a south-eastwards direction from an access road adjacent to the steelworks’ ‘heritage site’ buildings, crossing both plateaux areas and discharging to a public combined sewer in the B5101 approximately 300m to the east of the site.
- 2.2.3 The sewer is understood to have previously linked the former steelworks’ buildings within the heritage site to a sewage treatment plant located within the main steelworks’ site. The buildings of the Enterprise Centre to the north of the heritage site are served by a separate public combined sewer in Blast Road. The sewage treatment plant was demolished along with the steelworks and this sewer is considered to be redundant. There are no manholes or gullies shown along the route of the sewer on the topographic survey of the site (see Drawing No ST16882-006 (Sheet 1 – 3) ‘*Topographic Survey*’) and it is not known whether the sewer is still present following the reclamation works.

- 2.2.4 It is assumed that any private drainage network serving the former steelworks was removed during the reclamation works and it is considered, therefore, that these previously developed areas of the site now have characteristics similar to that of a greenfield site with surface water runoff dispersing by a combination of infiltration and evapotranspiration with no discharge to a private or public drainage network.
- 2.2.5 Public surface water, foul water sewers and highway drains are located along Phoenix Drive which runs adjacent to, and subsequently crosses, the site area as shown on Drawing No P 47067923/43 Rev G '*Site Wide Drainage Proposals*'. The sewers flow generally in a northwards direction within the road, with the surface water sewer discharging to an existing culvert flowing in a south-eastwards direction adjacent to the B5101. This culvert formerly received flows from the Brymbo Steelworks but this upstream catchment was closed off during the reclamation of the steelworks and it no longer receives flows from this catchment. The foul sewer connects to the existing public foul sewer flowing in a south-eastwards direction along the B5101.
- 2.2.6 Surface water and foul water stub connections in Phoenix Drive have been provided on the sewers in anticipation of the adjacent future development and do not currently accept any flows other than surface water road drainage. Following development at the site it is proposed that these are adopted by Welsh Water.

2.3 Ground Conditions

- 2.3.1 The British Geological Survey 'Geology of Britain Viewer', available online², shows that the majority of the site area is underlain by mudstone, siltstone and sandstone of the Pennine Lower Coal Measures Formation. Small areas in the north-eastern and south-western parts of the site are underlain by sandstone of the Pennine Lower Coal Measures Formation. The online DEFRA 'Magic' Map Application³ shows the bedrock is classified as a 'Secondary A' aquifer, defined as '*permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers*'.
- 2.3.2 A narrow section of superficial alluvium deposits is aligned along a north-west/south-east axis and extends into the north-eastern corner of the site area. These deposits are classified as a 'Secondary A' aquifer.

² BRITISH GEOLOGICAL SURVEY *Geology of Britain Viewer*. Available from <http://mapapps.bgs.ac.uk/geologyofbritain/home.html>

³ DEFRA *Magic Map Application* Available from: <http://magic.defra.gov.uk/MagicMap.aspx>

- 2.3.3 The online Cranfield Soil and Agrifood Institute 'Soilscales' viewer ⁴shows that soils at the site area are '*slowly permeable, seasonably wet acid loamy and clayey soils*'.
- 2.3.4 During the 240 years development of the Steelworks site, the natural strata were overtipped with waste iron/steel-making slags to create development plateaux for the expanding operations. The mudstones, siltstones excavated during the recent reclamation works, in particular an excavation in the central area of the site to recover the shallow residual coal and remove the risk of ground instability, were used subsequently to cover the slag wastes with a minimum of 5m cover of compacted material to facilitate subsequent built development. This has formed a relatively impermeable cover across the site such that it is considered that surface rainwater disperses more by runoff and evapotranspiration rather than infiltration.

⁴ CRANFIELD SOIL AND AGRIFOOD INSTITUTE *Soilscales*. Available from <http://www.landis.org.uk/soilscales/>
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3 DEVELOPMENT PROPOSALS

3.1 Description of Proposals

- 3.1.1 Outline planning permission for up to 300 dwellings (Class C3 use), provision of a primary school (2-form entry), small district centre comprising up to 1,395sqm of Class A1 Retail, up to 372sqm of Class A3 Restaurant/Public House, up to 465sqm of Class D1 use, multi-functional green infrastructure, including children's play areas and informal open space, surface water attenuation, vehicle accesses, car parking, engineering works, public footpaths and hard and soft landscaping, underground services, and all ancillary and enabling works, with all matters reserved except for vehicular access from Brymbo Road.
- 3.1.2 The proposed layout is as shown on Drawing No RG-M-05 (Revision K) '*Land Use Plan*'.
- 3.1.3 In Figure 2 of TAN15, residential developments and public buildings such as schools are both categorised as '*Highly Vulnerable*' developments'. Commercial and retail developments are categorised as a '*Less Vulnerable*' development'.
- 3.1.4 The 'Development Advice Map' for flood risk obtained from the Natural Resources Wales website (see Appendix 2) shows that the majority of the site is located within Zone A, described in TAN15 as an area '*considered to be at little or no risk of fluvial or tidal/coastal flooding*'. A small section of the eastern boundary is shown to be located within Zone B, described in TAN15 as '*areas known to have been flooded in the past evidenced by sedimentary deposits*'.

3.2 Flood Risk Vulnerability

- 3.2.1 The nature of the proposed development, which includes residential premises and public buildings, is classified as a '*Highly Vulnerable*' development based on Section 5 of TAN15.

3.3 Justification Test

- 3.3.1 The Justification Test aims to direct new development away from Zone C and towards land in Zone A (or otherwise Zone B). A new '*Highly Vulnerable*' development would only be permitted within Zone C) if it is deemed to be justified in that location.
- 3.3.2 The majority of land within the site is located within Zone A. A small area of residential development in the eastern part of the site will, however, extend into the area of Zone B.

3.3.3 As all development will be located outside of Zone C, the Justification Test is considered to be passed.

4 FLOOD CONSEQUENCE ASSESSMENT

4.1 Historical Flooding

4.1.1 Historical flood mapping in the Wrexham County Borough Council LFRMS and PFRA reports and on the Natural Resource Wales Flood Risk website⁵ do not show any historic flooding incidents in the vicinity of the site.

4.1.2 Wrexham County Borough Council state in response to the enquiry submitted as part of this assessment (see Appendix 3) that they hold no information of any flooding events within the site boundary.

4.2 Consequences of Flooding to the Development

4.2.1 Flooding can occur from a range of sources including, but not limited to rivers, tidal waters and the sea, surface water runoff, groundwater, sewers and drains, and artificial sources such as canals and reservoirs. The presence of a potential flooding source does not, however, necessarily translate into a high risk of flooding. Following the source-pathway-receptor approach, flooding can only affect the site (receptor) if there is a pathway from the identified sources.

4.3 Flooding Consequences to the Proposed Development

Fluvial Flooding

4.3.1 The site is not located in the vicinity of a Main River or Ordinary Watercourse. The closest Main River to the site is located approximately 1.3km to the north of the site at its closest point and is situated approximately 100m lower than the lowest elevation of the site. Consequently, this watercourse is not considered to pose a risk of flooding to the site. The Natural Resources Wales 'Flood Risk Map' for fluvial flooding (see Figure 1) shows that an area of Flood Zone 3 is located adjacent to the River Gwenfrom approximately 1km to the south of the site. Areas of Flood Zone 3 are defined as land with a greater than 1 in 100 year annual probability of fluvial flooding. Due to the distance from the site and that the site is approximately 50m higher than the area of Flood Zone 3, it is not considered to pose a risk of flooding.

4.3.2 As shown on the Development Advice Map (see Appendix 2), a small area near the eastern boundary is shown to be located within Zone B. This is coincident with a section of alluvium bedrock extending to the River Gwenfro/Afon Gwenfro, located

⁵ NATIONAL RESOURCES WALES *Flood Risk Map* Available from: <https://www.naturalresources.wales/our-evidence-and-reports/maps/flood-risk-map/?lang=en>

approximately 1km to the south of the site. Based on the definition of Zone B in TAN15 'Areas known to have been flooded in the past evidenced by sedimentary deposits' it is considered that the Zone B classification is based on the presence of alluvium deposits only. As the River Gwenfro is situated approximately 30m lower than the site, it is not considered to pose a risk of fluvial flooding to the site.

Tidal Flooding

- 4.3.3 Due to the distance of the site from the sea and tidally-influenced watercourses, the risk of tidal flooding is discounted.

Surface Water Flooding

- 4.3.4 The Natural Resources Wales 'Flood Risk Map' for surface water flooding (see Figure 2) shows the majority of the site is not at risk of surface water flooding. Areas in the north are shown to be at risk of surface water flooding.

Groundwater Flooding

- 4.3.5 The Wrexham County Borough Council PFRA identifies no record of past groundwater flooding incidents and states that information ascertained from the British Geological Survey and Environment Agency shows the Wrexham County Borough Council area is not susceptible to groundwater flooding due to its geology.

Sewer Flooding

- 4.3.6 It is considered that any sewers serving the former steelworks in the site area have been removed during the reclamation works. Sewers and highway drainage are present in Phoenix Drive which runs adjacent to the western boundary as shown on Drawing No P 47067923/43 Rev G 'Site Wide Drainage Proposals'. Public sewer records (see Appendix 1) also show a public sewer crossing the site area from the former steelworks' buildings of the 'heritage site' to the B5101.

Artificial Flooding

- 4.3.7 The Natural Resources Wales 'Flood Risk Map' shows the site is not located in an area considered to be at risk from reservoir flooding. There are no canals or impounded bodies of water in the vicinity of the site.

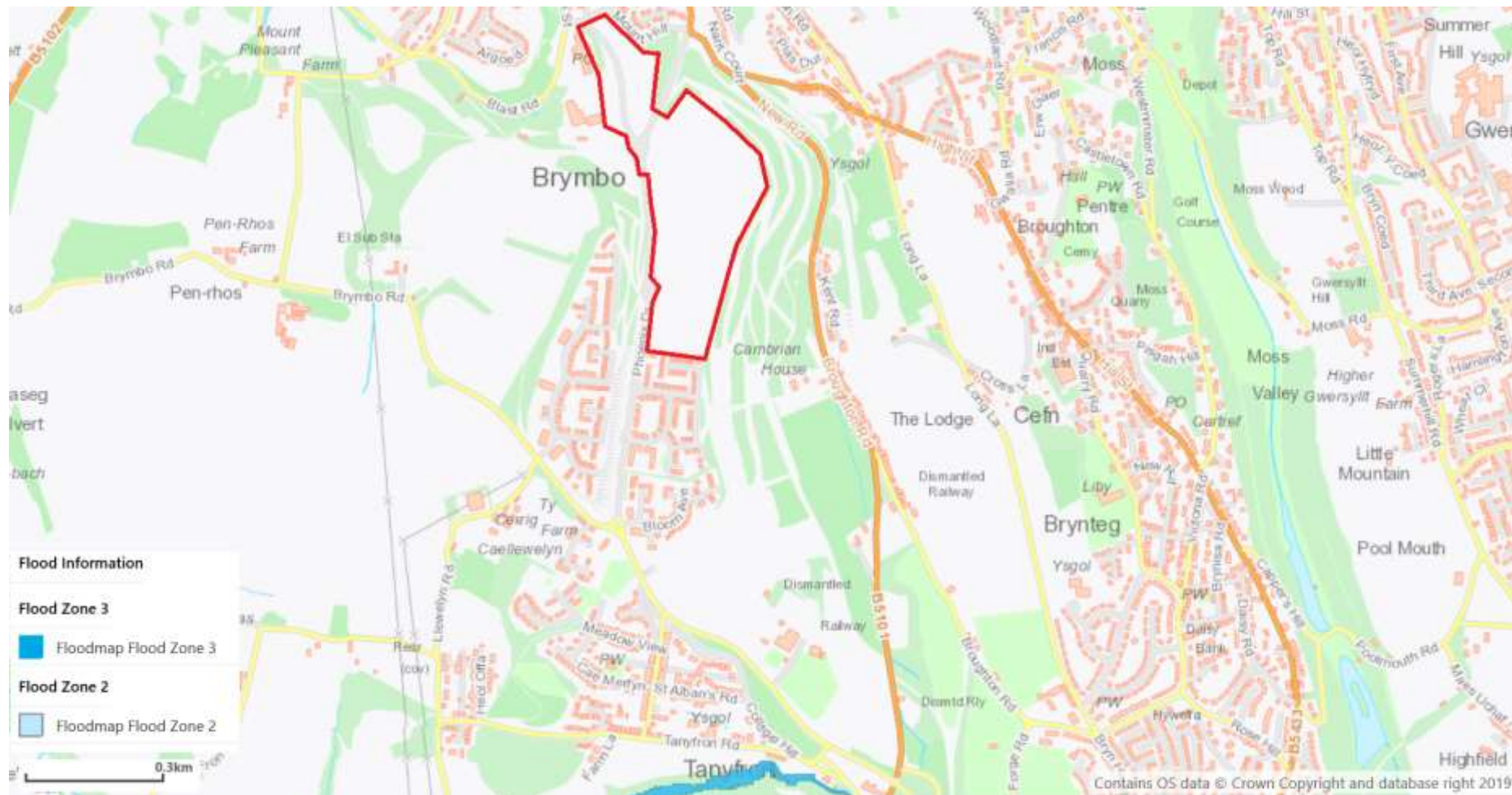


Figure 1. Fluvial Flood Risk



Figure 2. Surface Water Runoff (Overland Flow) Flooding Extent

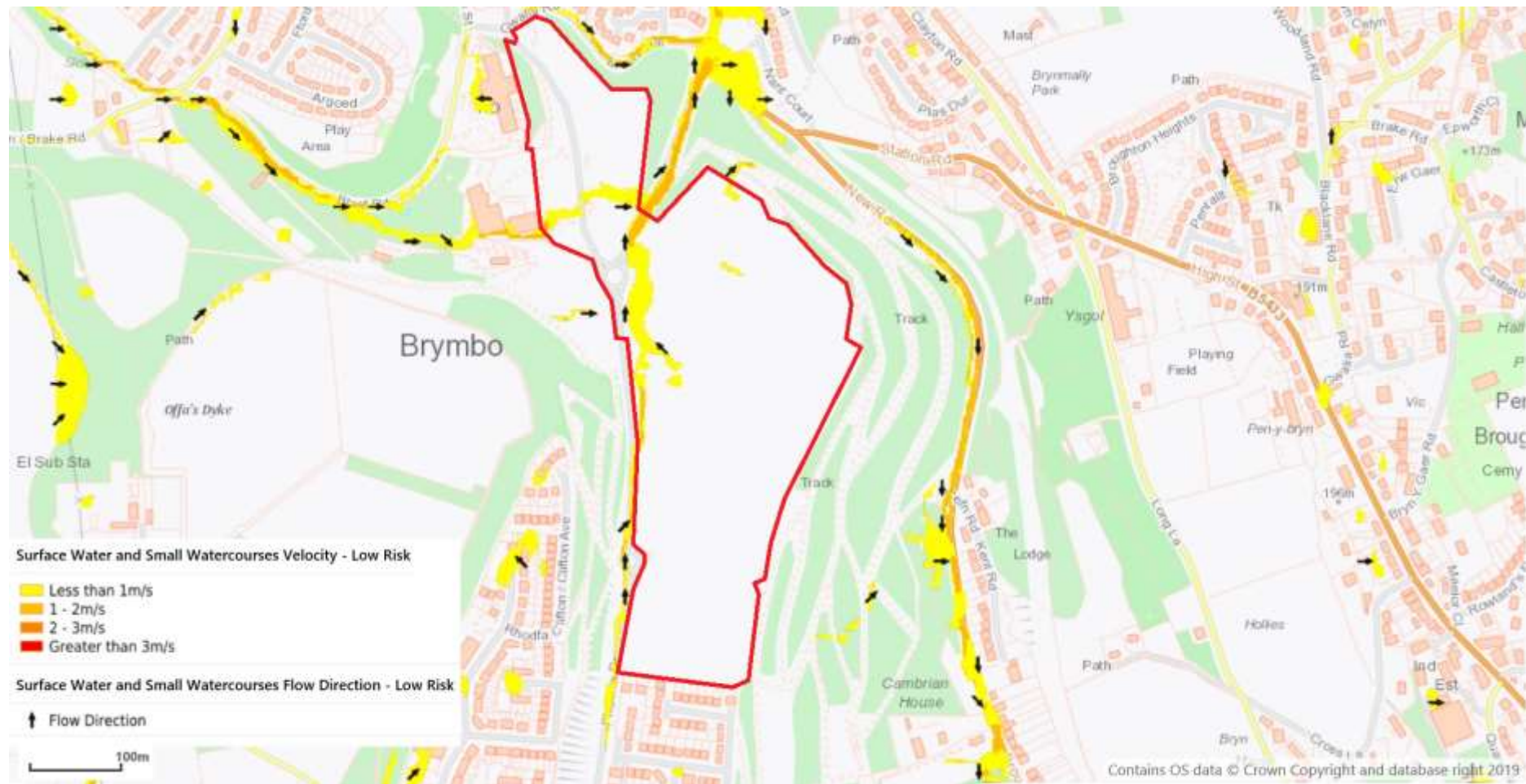


Figure 3. Surface Water Runoff (Overland Flow) Flooding Velocities

4.4 Potential Sources of Flooding

4.4.1 Table 2 summarises the flood consequences to the proposed development.

Table 2: Summary of Flood Consequences to the Site			
Type	Source	Pathway	Risk
Fluvial Flooding (Rivers)	N	N	n/a
Tidal Flooding	N	N	n/a
Surface Water Runoff	Y	Y	Low
Groundwater Flooding	Y	N	n/a
Sewer/Drain Flooding	Y	Y	Low
Artificial Flooding	N	N	n/a

4.4.2 The potential sources with a pathway to the site are, therefore, as follows:

- surface water; and
- sewers.

Surface Water Runoff (Overland Flow) Flooding

4.4.3 On land where there is impermeable surfacing or where the ground infiltration capacity is exceeded there is the potential for surface water runoff to occur.

4.4.4 Based on National Resources Wales mapping (see Figure 2), the majority of this area of the site and its vicinity are shown to be at a Very Low risk of surface water flooding (defined as an annual probability of flooding of less than 1 in 1000 (0.1%)). Small isolated areas in central and southern areas are shown to be at Low risk (defined as an annual probability of flooding between 1 in 1000 (0.1%) and 1 in 100 (1%)) and are considered to be coincident with low-lying areas and do not represent a risk of flooding to the wider site area.

4.4.5 An area at the northern extent of the southern plateau is shown to be at Low risk and is the upstream extent of a small valley-like feature extending northwards from the site to the B5101. Any surface water runoff accumulating in this area would flow away from the site following the topography as indicated by the flow direction arrows on Figure 3.

- 4.4.6 A second area in the northern plateau is shown to be at Medium to High risk (where Medium risk is defined as an annual probability of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%), and High risk is defined as an annual probability of greater than 1 in 30 (3.3%)). This area extends eastwards from Blast Road, to the west of the site, through the area of historic buildings to the B5101 via Phoenix Drive crossing a narrow section of the northern plateau area of the site. The mapping would suggest that this is part of a wider overland flow route which follows the natural topography.
- 4.4.7 To confirm the presence of any overland flow routes crossing the site, a survey of the area between Blast Road and the site was undertaken in January 2020. The survey (see Drawing No ST16882-026 '*Overland Flow Routes*') indicates that based on topography, surface water runoff could accumulate to the rear of the existing buildings within the 'heritage site' and progress around the northern extent of the buildings onto land adjacent to Phoenix Drive as indicated on Figure 3. As this land is marginally lower than land to the east, there would be minimal opportunity for runoff to progress further into the wider site area in the majority of storm events. A bund could be constructed in this area to further limit pathways into the wider site area.
- 4.4.8 As shown on Drawing No ST16882-060 '*Overland Flow Routes*', a second potential pathway could exist for runoff to continue eastwards along a track towards an area of woodland. It is proposed that a soft landscape barrier is constructed in this area to divert flows northwards towards the heritage site.
- 4.4.9 The risk of surface water flooding in this area of the site is, therefore, considered to be **LOW**.

Sewer Flooding

- 4.4.10 Welsh Water's public sewer records (see Appendix 1) show a public combined sewer crossing in a south-eastwards direction from the heritage site through the site area. The depth of the sewer is not shown on the sewer records. The sewer previously served the buildings within the heritage site, connecting these to a sewage treatment plant within the main steelworks site. The status of this sewer is not known following the demolition and remediation works at the site. It is assumed that there are no remaining private sewers within the former steelworks area.
- 4.4.11 No manholes were recorded on the topographic survey of the site and it is considered that there would be no pathways for any flooding from sewers to emerge within the site area.

- 4.4.12 As shown on Drawing No P 47067923/43 Rev G '*Site Wide Drainage Proposals*', surface water and foul water sewers are present within Phoenix Drive which runs adjacent to the western boundary of the site area and crosses between the two plateau areas to join the B5101.
- 4.4.13 It is understood that these surface water sewers are over 1.2m below ground level. They are considered to be at a sufficient depth to assume that the risk of flooding from surcharged manholes is minimal. Furthermore, it is understood that the sewer network has been designed to receive flows from developed areas and highways within the site area only and has been suitably-sized (based on MicroDrainage modelling undertaken at the design stage) to accommodate all flows up to and including the 1 in 100 year storm event (including an allowance for climate change).
- 4.4.14 It is understood that the foul water sewers are over 1.4m below ground level. They are considered to be at a sufficient depth to assume that the risk of flooding is minimal. As with the surface water network, it is understood that the foul water sewer network will receive flows from the proposed development only and has been suitably-sized (based on MicroDrainage modelling).
- 4.4.15 Based on the available information, the risk of sewer flooding in this area is considered to be **LOW**.

4.5 **Flooding Consequences from the Proposed Development**

- 4.5.1 New development can pose a risk of flooding to neighbouring properties and areas downstream of the site often as a result of the loss of floodplain storage, an increase in impermeable area which has the effect of increasing the rate and volume of surface water runoff, or alterations to the surface water flow regime.

Fluvial Flooding

- 4.5.2 The proposed development is not located in the vicinity of a Main River and there will be no loss of floodplain storage or diversion of flood flows as a result of the proposed development.

Surface Water Flooding

- 4.5.3 The site currently consists of large areas of open ground and rough vegetation. Despite the brownfield nature of the site, it is considered that the site currently displays the characteristics of a 'greenfield' site in terms of surface water drainage, with surface water dispersing by a combination of infiltration and evapotranspiration.

- 4.5.4 As a result of the proposed development, the impermeable area of the site will increase and, as a result, the rate and volume of surface water runoff generated during storm events could also be expected to increase. Without mitigation, this could lead to an increase in flood risk to areas downstream of the site.

Climate Change

- 4.5.5 It is also necessary to take account of climate change for the lifetime of the development when assessing future flood risk. New climate change guidance was published by the Environment Agency in February 2016⁶. The guidance provides predictions of anticipated change to peak rainfall intensity. In assessing surface water runoff from the proposed development, the climate change predictions for peak rainfall intensity for the lifetime of the development need to be taken into account.
- 4.5.6 Wrexham County Borough Council (the Lead Local Flood Authority) state that an increased intensity of 30% is acceptable (see Appendix 3).
- 4.5.7 It is considered, therefore, that the risk of surface water flooding could increase as a result of the proposed development and that mitigation measures are required.

4.6 Flood Management Plan

Surface Water Management

- 4.6.1 To mitigate the potential increase in flood risk to areas downstream of the site, surface water runoff from the proposed development which exceeds the restricted discharge rates will be retained and attenuated within the site areas for all storm events up to and including the 1 in 100 year event, including a 30% allowance for climate change recommended by Wrexham County Borough Council in correspondence (see Appendix 3). To help to achieve this, Sustainable Drainage Systems (SuDS) will be incorporated into the development to provide attenuation. Further details are included in the Drainage Strategy (see Section 5).
- 4.6.2 Any incoming overland flow from higher land to the west of the site will be retained in open space within the site area for the majority of storm events. Were the capacity of this area to be exceeded during extreme storm events, any exceedance flows will progress through the site north-eastwards to the B5101 as indicated on Figure 2 without diversion to other off-site areas previously unaffected.

- 4.6.3 The risk of flooding to areas downstream of the site will not, therefore, increase as a result of the proposed development.

Residual Risk

- 4.6.4 There is always a possibility of a storm event that exceeds the design standards of the proposed flood risk management measures for new developments. Potential risks include exceedance of the on-site surface water attenuation facilities during storm events.
- 4.6.5 On-site attenuation will be provided for storm events up to and including the 1 in 100 year storm event, including an appropriate allowance for climate change. For storm events with an annual probability of occurrence greater than this the on-site attenuation may be exceeded. It is considered that the probability of the attenuation facilities being exceeded is extremely low (eg freeboard included within detention basins for safety reasons will provide additional temporary storage during extreme storm events). Furthermore, all SuDS features will be located within shared spaces and open ground away from properties. Were the attenuation capacity of these features to be exceeded, exceedance flows could be managed by landscaping and features such as kerbing or speed humps to prevent properties and off-site areas from being affected.

⁶ GOV.UK (February 2016). *Guidance – Flood Risk Assessments: Climate Change Allowances*. Available from: <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

5 DRAINAGE STRATEGY

Surface Water Runoff Attenuation

- 5.1.1 Surface water runoff from the development will be controlled on site to ensure that there is no increase in the risk of flooding to areas downstream of the site, and to the development itself. To help to achieve this, Sustainable Drainage Systems (SuDS) will be incorporated into the development to provide attenuation.
- 5.1.2 An indicative Surface Water Management Plan is shown on Drawing No ST16882-007 '*Indicative Surface Water Management Plan*'.
- 5.1.3 The Building Regulations (2010) Part H stipulate a hierarchy for the disposal of surface water, which should be followed as part of any surface water drainage design. This hierarchy is as follows:
- i. an adequate soakaway or some other adequate infiltration system; or, where that is not practicable,
 - ii. a watercourse; or, where that is not practicable,
 - iii. a sewer.
- 5.1.4 Due to the historical land use at the former steelworks site and the large sub-surface volumes of Made Ground (including waste iron and steel slags), it is not considered feasible to use infiltration drainage within the area of the site. Surface water inundation of the sub-surface materials would risk unacceptable ground settlement and risk the mobilisation of any contaminants, which may be present.
- 5.1.5 It is proposed, therefore, to discharge surface water runoff from the site to the culverted watercourse located to the north of the site via the existing drainage network in Phoenix Drive, which was designed and constructed to serve future developments at the site.
- 5.1.6 Discharge from the sewer network to the culverted watercourse will be restricted to a rate of 769 l/s for all storm events up to the 1 in 100 year storm event (including an allowance for climate change), as agreed with Welsh Water in 2016 as part of a previous planning application and S106 Agreement.
- 5.1.7 This discharge rate is based on the rate at the outfall from the site for the 1 in 100 year storm event determined, from modelling undertaken by URS Infrastructure and Environment Ltd in 2015 (see Appendix 4). This models the sewer network within the

highways in the site area and includes runoff from the roads and incoming flows from the heritage site and enterprise centre located outside of the site boundary.

5.1.8 The model assigns nominal impermeable areas to six of the seven existing 'stub' connections into the main sewer within Phoenix Drive in order to calculate the flows entering the sewer network. These modelled flow rates are shown on Drawing No. P 47067923/43 Rev G 'Site Wide Drainage Proposals'

5.1.9 For the proposed surface water drainage strategy the site will be divided into seven subcatchments each discharging via an existing stub connection. The agreed discharge rate for each outfall and contributing impermeable areas within the associated subcatchment, based on the proposed site layout, is shown in Table 3 below.

5.1.10 The outfall from Catchment C does not have an agreed discharge rate and the proposed rate of 10 l/s for the 1 in 100 year storm event is based on the rate proposed for the "Ty Cerrig" catchment in the 2015 model. This area, located to the west of the site, will no longer be developed as part of the planning application and there will be no discharge into the Phoenix Drive drainage network.

Table 3: Restricted Discharge Rates and Contributing Areas				
Catchment	Contributing Impermeable Area		Discharge Rate (1 in 30 year)	Discharge Rate (1 in 100 year)
	Buildings/Infrastructure ¹	Access Roads		
A	1.35 ha	0.30 ha	101.1 l/s	125 l/s
B	0.89 ha	0.55 ha	32.8 l/s	39 l/s
C ²	0.71 ha	0.27 ha	6.8 l/s	10 l/s
D	0.37 ha	-	18.7 l/s	22 l/s
E	0.39 ha	-	14.8 l/s	17 l/s
F	0.36 ha	-	62.4 l/s	72 l/s
Additional flows (off site areas and access roads)			484 l/s	484 l/s
Total	4.07 ha	1.12 ha	720.6 l/s	769 l/s
1. Impermeable area based on density of 35% for residential areas, 60% for district centre and 95% for retail and leisure 2. Discharge rate for outfall C not specified on Drawing No. P 47067923/43 Rev G. Proposed rate based on rate of nearby land of Ty Cerrig.				

5.1.11 It is proposed that flows in excess of the restricted discharge rate will be attenuated within each subcatchment or adjacent areas of public open space for all storm events up to and including the 1 in 100 year event (including an allowance for climate change). The required attenuation for each subcatchment was calculated using Causeway software. Calculations are contained in Appendix 5 and summarised in Table 4 below.

Table 4: Summary of Flood Consequences to the Site					
Catchment	Restricted Discharge Rate		Impermeable Area	Estimated Attenuation	
	1 in 30 year	1 in 100 year		1 in 30 year	1 in 100 year (+ 30% climate change)
A	101.1 l/s	125 l/s	1.65 ha	193	398
B	32.8 l/s	39 l/s	1.44 ha	285	569
C	6.8 l/s	10 l/s	0.98 ha	317	552
D	18.7 l/s	22 l/s	0.37 ha	49	102
E	14.8 l/s	17 l/s	0.39 ha	60	125
F	62.4 l/s	72 l/s	0.36 ha	20	47
Attenuation calculations exclude infiltration to provide a 'worst case' estimate					

5.1.12 An indicative surface water drainage strategy is shown on Drawing No. ST16882-007 '*Indicative Surface Water Management Plan*'. The management plan shows potential locations of larger attenuation features such as swales and detention basins within areas of open space, however, the internal layout within land parcels is unconfirmed and specific SuDS features feasible for use within each area are not specified at this stage.

5.1.13 A variety of SuDS techniques are discussed within The SUDS Manual⁷ (CIRIA 753) and many of these could, as outlined in Table 5, potentially be suitable for use of the site.

⁷ CIRIA (2015) *The SuDS Manual* (C753)

Table 5. Sustainable Drainage System (SuDS) Options and Suitability			
Type	Device	Description	Suitability
Source Control	Green roof	Green roofs are systems which cover a building's roof with vegetation. They are laid over a drainage layer, with other layers providing protection, waterproofing and insulation.	Green roofs are not generally suitable for private dwellings within large scale development sites, however, may be suitable for non-residential buildings.
	Infiltration devices	Infiltration devices temporarily store runoff from a development and allow it to percolate into the ground.	Due to the brownfield nature of the development and presence of Made Ground at the former steelworks site, the ground conditions are unsuitable for infiltration drainage.
	Pervious surfaces	Pervious surfaces allow rainwater to infiltrate through the surface into an underlying storage layer, where water is stored before infiltration to the ground, reuse, or release to surface water or sewers.	Permeable paving would be suitable for roadways and parking areas within this site. This would allow surface water to be filtered through the paving before being collected underground and connected to attenuation areas.
	Bioretention systems	Shallow landscaped depressions (eg tree pits, rain gardens) generally used for intercepting, managing and treating runoff from frequent rainfall events.	Suitable for use in shared open space. Runoff would be filtered through soils and vegetation and collected in an underdrain system and discharged to attenuation areas.
	Rainwater harvesting	Rainwater harvesting reduces the amount of runoff from a site by re-using the water for non-potable uses.	Rainwater harvesting may potentially be suitable for use within the development.
Permeable Conveyance	Filter strips	These are wide, gently sloping areas of grass or other dense vegetation that treat runoff from adjacent impermeable areas.	Filter strips may potentially be suitable for use within the development.
	Swales	Swales are broad, shallow channels covered by grass or other suitable vegetation. They are designed to convey and/or store runoff and can infiltrate the water into the ground (if ground conditions allow).	Swales may potentially be suitable for use within land parcels as conveyance and storage. Site ground conditions do not facilitate ground infiltration.
Passive treatment/ end of pipe treatment	Infiltration basins	Infiltration basins are depressions in the surface that are designed to store runoff and infiltrate the water to the ground. They may also be landscaped to provide aesthetic and amenity value.	Due to the brownfield nature of areas of the development and presence of Made Ground, the ground conditions are unsuitable for infiltration drainage.

Table 5. Sustainable Drainage System (SuDS) Options and Suitability			
Type	Device	Description	Suitability
	Detention basins	Detention basins are depressions which are designed to store runoff prior to discharge to a watercourse or sewer. They may also be landscaped to provide aesthetic and amenity value.	Detention basins are considered to be suitable within areas of open space at the site.
	Wet ponds	Wet ponds are basins that have a permanent pool of water for water quality treatment. They provide temporary storage for additional storm runoff above the permanent water level. Wet ponds may provide amenity and wildlife benefits.	Wet ponds may potentially be suitable for use within areas of open space at the site.
	Constructed wetlands	Constructed wetlands are ponds with shallow areas and wetland vegetation to improve pollutant removal and enhance wildlife habitat.	Constructed wetlands may potentially be suitable for use on the site.
	Underground attenuation	Underground attenuation can be used where other forms of SuDS are not appropriate for the site. Underground attenuation stores water for volumes above the allowable discharge rate and releases the water at the restricted discharge rate.	Underground attenuation would be suitable for use on the site and could be used in conjunction with permeable paving. Unlined underground attenuation stores are not considered appropriate.

Surface Water Quality

5.1.14 In accordance with ‘good practice design’ in the SuDS Manual, the quality of surface water runoff will be managed within the proposed development to treat and remove pollutants to protect receiving waters downstream of the site. Treatment will be provided within SuDS features individually or as part of a chain of features forming a treatment ‘train’.

5.1.15 SuDS features provide treatment by ‘velocity control’ (sediment deposition and filtration by the control of velocities within SuDS components) and ‘retention time’ (removal of contaminants through settling, adsorption and other treatment over the time that the water is in contact with the ‘treatment media’ within the SuDS components).

- 5.1.16 SuDS features proposed in the Indicative Surface Water Management Plan which could be incorporated into the drainage strategy for the site include swales, bioretention systems, permeable paving and detention basins.
- 5.1.17 Dividing the proposed development into subcatchments, each with its own drainage network, will allow runoff to be treated closer to the source rather than being conveyed downstream to a single site control feature and will allow more stages of treatment to be incorporated upstream of the discharge point.

6 CONCLUSIONS

- 6.1.1 This report gives details of the Flood Consequence Assessment, which has been carried out in accordance with TAN15. The majority of the site area is located within Zone A, described in TAN15 as an area *'considered to be at little or no risk of fluvial or tidal/coastal flooding'* on the Welsh Government's Development Advice Map. A small section adjacent to the eastern boundary is shown to be located within Zone B described in TAN15 as *'areas known to have been flooded in the past evidenced by sedimentary deposits'*.
- 6.1.2 The proposed development comprises a mixed use of residential and commercial properties and a primary school, along with areas of public open space. In Figure 2 of TAN15, residential developments and public buildings are categorised as 'Highly vulnerable' developments. Commercial and retail developments are categorised as 'Less vulnerable' developments. As the proposed development will be located within Zone A and Zone B the Justification Test, which aims to direct new developments away from land within Zone C, is considered to be passed.
- 6.1.3 Based on the source-pathway-receptor approach, the risk of flooding from fluvial, tidal, groundwater and artificial sources has been discounted as there is considered to be no pathway from the identified sources onto the site.
- 6.1.4 The existing sewer network within the Phoenix Drive access road has been designed as part of earlier works to serve the proposed development at the site and is considered to be suitably-sized to accommodate all flows., The risk of flooding from this source is considered to be Low.
- 6.1.5 Surface water flood risk mapping shows that the majority of the site is at a Very Low or Low risk of surface water flooding. Based on the topography, there are minimal pathways for runoff from higher ground to the west of the site to enter the site area. It is proposed that any overland flows from this area are retained within open ground within the site boundary and are not diverted to off-site areas previously unaffected by surface water runoff.
- 6.1.6 A Flood Management Plan will be implemented to ensure that the risk of flooding to areas downstream of the site is not increased as a result of the development. Surface water runoff will be managed in a sustainable manner. Ground conditions are not appropriate to infiltration due to the unacceptable risk of ground settlement and the potential mobilisation of contaminants. Surface water runoff, therefore, will be

discharged to the culverted watercourse via the existing surface water sewer network at a restricted rate of 742 l/s, as agreed with Welsh Water as part of a previous planning application.

- 6.1.7 The surface water management rationale is based on dividing the site area into six subcatchments each discharging to the wider surface water sewer network at a restricted rate via a flow control device. On-site attenuation will be provided within each subcatchment by Sustainable Drainage Systems (SuDS) features to accommodate flows in exceedance of the discharge rate in extreme storm events up to and including the 1 in 100 year storm event, including an appropriate allowance for climate change. Surface water runoff will be regulated by a system of flow control.
- 6.1.8 On the basis of the findings of this report it is concluded that the flooding consequences to and from the site are negligible and the Justification Test is passed. The site is, therefore, considered suitable for the type of development proposed.

APPENDICES

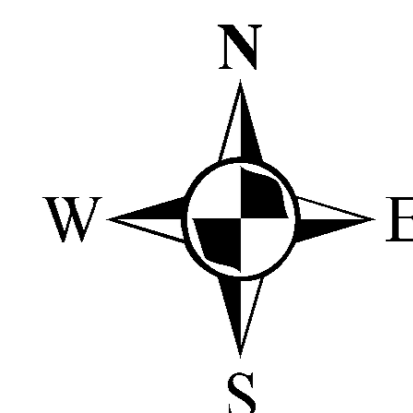
APPENDIX 1

Welsh Water Public Sewer Records



Dŵr Cymru
Welsh Water

Former Brymbo Steelworks



LEGEND(Representative of most common features)

- Waste network:**
- Foul chamber
 - Surface water chamber
 - Combined chamber
 - Combined sewer overflow
 - Special purpose chamber
 - Treatment works
 - Pumping station
 - Outfall
 - Lamp hole
 - Storm Overflow
 - Rising main
 - Gravity sewer
 - Private sewer
 - 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 Cyllyngefy (the Company) gives this information as to the position of the underground apparatus by way of general guidance only and on the basis of the best information available and to the best of its knowledge and belief. The Company is not responsible for any loss or damage to property or for any injury to persons or animals caused by the use of this information. The Company is not responsible for any loss or damage to property or for any injury to persons or animals caused by the use of this information. The Company is not responsible for any loss or damage to property or for any injury to persons or animals caused by the use of this information.

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

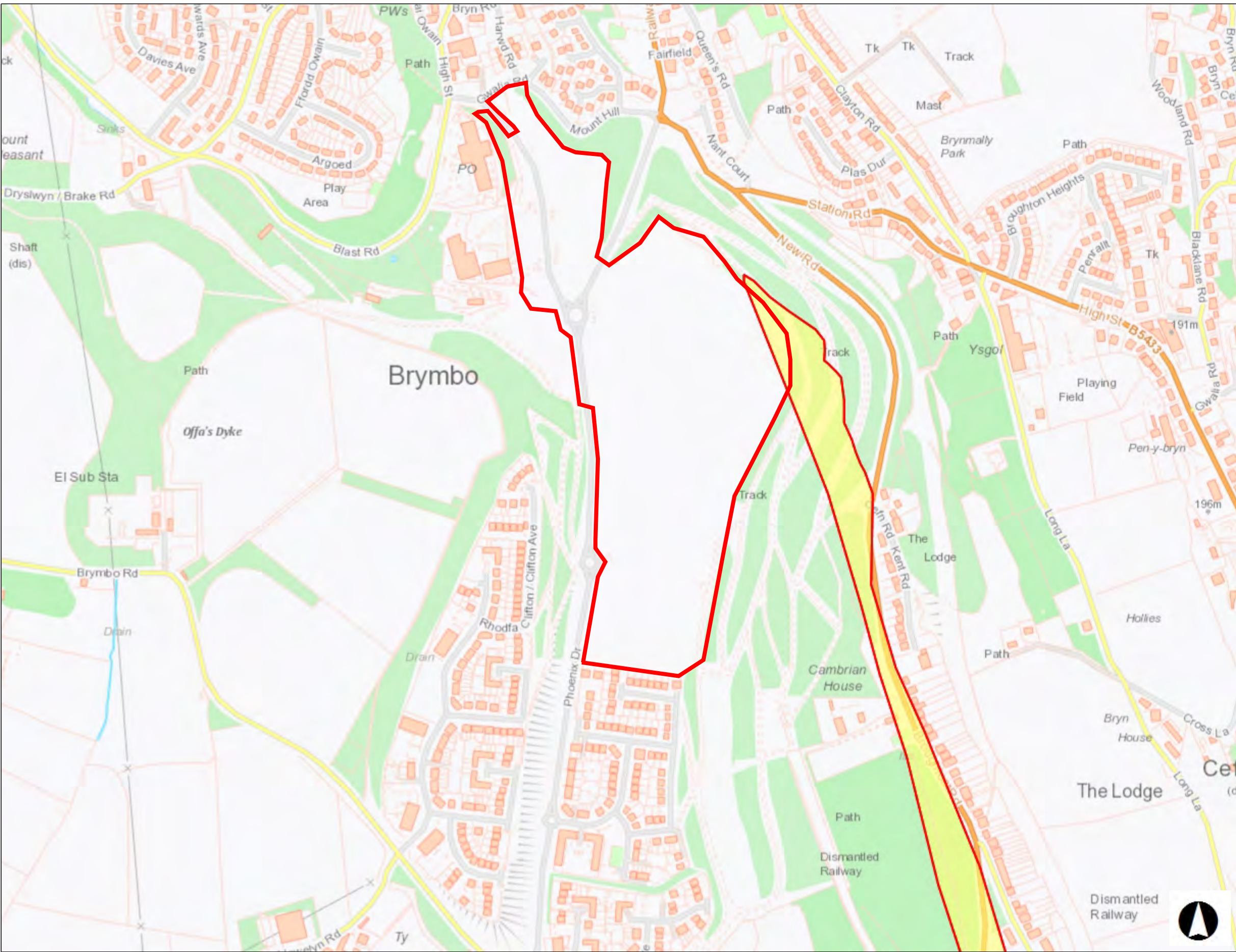
EXACT LOCATIONS OF ALL APPARATUS TO BE DETERMINED ON SITE.

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Map Ref: 329506,353267
Map scale: 1:1250
Printed by: John Emma
Printed on: 20 Sep 2018

APPENDIX 2

TAN15 Development Advice Map



Map Title

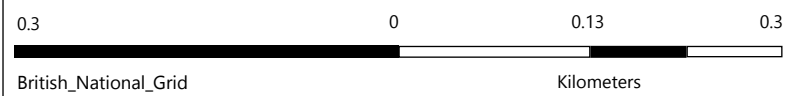
Map Perygl Llifogydd / Flood Risk Map

Allwedd / Map Key

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

Graddfa / Scale 1:5,001

Dyddiad / Date
12/02/2020



APPENDIX 3

Lead Local Flood Authority Correspondence

Griffiths, Bryn

From: Neil Taunt <Neil.Taunt@wrexham.gov.uk>
Sent: 18 September 2018 12:04
To: Griffiths, Bryn
Cc: Sharon Williams; Matthew Phillips
Subject: RE: Flood Consequence Assessment guidance - Brymbo, Wrexham
Attachments: Former Brymbo Steelworks.pdf; Management of Surface Water Generated from New Dev_E.pdf

Categories: Saved

Good Afternoon Bryn,

In response to your request for flood related information for the above site, I can provide the following comments:

The attached plan outlines the latest flood related information for the site. We hold no specific information relating to flood incidents within the site boundary.

With regards to surface water management for the site I have attached a guidance note detailing the level of information normally required to support any planning application.

In addition to the attached guidance note there is a significant change to drainage requirements will impact new developments from January 2019.

From January 7th 2019, all new developments of at least 2 properties or over 100m2 of construction area will require sustainable drainage to manage on-site surface water. The Surface water drainage systems must be designed and built in accordance with national standards for sustainable drainage published by Welsh Ministers. These systems must be approved by the local authority acting in its SuDS Approving Body (SAB) role before construction work begins. The SAB will have a duty to adopt compliant systems that serve more than one property.

Schedule 3 of the Flood and Water Management Act (FWMA) 2010 requires surface water drainage for new developments to comply with mandatory National Standards for sustainable drainage (SuDS). The statutory standards will be published by Welsh Government in the autumn but in the meantime, we recommend that you refer to the Non-Statutory Ministerial National Standards and the CIRIA 753: The SuDS Manual . Schedule 3 also places a duty on local authorities as SuDS Approving Body to approve, adopt and maintain systems compliant with section 17 of the Act. For further information on the legislation, please go to the Schedule 3 of the Flood & Water Management Act.

If you anticipate an application being made after the 7th January 2019, or that any reserved matters or conditions would not be discharged prior to 7th January 2020, you will be required to obtain SAB approval prior to the commencement of any development. If it is likely that SAB approval will be required then consideration of how the development will incorporate sustainable drainage and demonstrate compliance with the nation standards should be made at the earliest possible stage.

Many thanks

Neil

Neil Taunt MCIWEM C.WEM CEnv CSci
Uwch Swyddog Rheoli Llifogydd / Senior Flood Management Officer



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✉ Environment & Planning, Wrexham County Borough Council, Abbey Road South, Wrexham Industrial Estate, Wrexham LL13 9PW
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🐦 twitter.com/cbswrexham | twitter.com/wrexhamcbc
📘 facebook.com/cyngorwrexham | facebook.com/wrexhamcouncil

From: Sharon Williams
Sent: 11 September 2018 14:08
To: Neil Taunt
Cc: bgriffiths@wardell-armstrong.com
Subject: FW: Flood Consequence Assessment guidance - Brymbo, Wrexham

Hi Neil,

Please see email below asking for your comments I would be grateful if you could copy Matthew Phillips in Planning into any response you may have.

Regards

Sharon

Sharon Williams
Business Support Officer (Development Control)



☎ 01978 298785
✉ Cyngor Bwrdeistref Sirol Wrexham, Adran Amgylchedd a Chynllunio, 16 Stryt yr Arglwydd, Wrexham LL11 1LG
✉ Wrexham County Borough Council, Environment and Planning Department, 16 Lord Street, Wrexham LL11 1LG
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📘 facebook.com/wrexhamcouncil | facebook.com/cyngorwrexham

From: Griffiths, Bryn [<mailto:bgriffiths@wardell-armstrong.com>]
Sent: 10 September 2018 12:46
To: planning
Subject: Flood Consequence Assessment guidance - Brymbo, Wrexham

Good afternoon,

I am working on a Flood Consequence Assessment for a mixed commercial and residential development at the former Brymbo Steelworks in Brymbo, Wrexham, LL11 5BT – approximate grid reference 329743, 353316, (see attached Development Advice Map). As shown on the Development Advice Map, the majority of the site is located within Zone A, with a small area within Zone B, which appears to coincide with a section of alluvial deposits in this area.

In order to assist with the assessment, I would welcome any pre-planning comments that you wish to make with respect to flood risk and drainage at the site. In particular, if you have any local knowledge of historic flood incidents or drainage problems with respect to ordinary watercourses, surface water and groundwater, I would be grateful if you could comment. I would also be grateful for any advice on local guidance and policies relating to surface water management/SuDS in this area.

Please let me know if you require any further information to assist you. Also, if this is not the correct department to contact with this enquiry it would be very much appreciated if you could forward this on to the team able to advise on this request.

Regards,
Bryn

Bryn Griffiths | Senior Environmental Scientist
Wardell Armstrong LLP
Sir Henry Doulton House, Forge Lane, Etruria, Staffordshire, UK
t: 01782 276700 m: 07469 856653



Rydym yn croesawu gohebiaeth yn Gymraeg. Byddwn yn ymateb i unrhyw ohebiaeth yn Gymraeg ac ni fydd hyn yn arwain at unrhyw oedi.

Ewch i weld - mi fedrwch chi dalu, rhoi gwybod, gwneud cais, dweud eich dweud, a dod o hyd i wybodaeth ar-lein yn www.wreccsam.gov.uk. Arbedwch bapur - meddyliwch cyn argraffu!

Mae'r neges e-bost hon ac unrhyw atodiadau wedi eu bwriadu ar gyfer yr unigolyn neu'r sefydliad ydy cyfeirir atynt yn unig. Am yr amodau llawn ynglŷn â chynnwys a defnyddio'r neges e-bost hon, ac unrhyw atodiadau, cyfeiriwch at www.wreccsam.gov.uk/top_navigation/disclaimersw.htm

We welcome correspondence in Welsh. We will respond to any correspondence in Welsh and this will not lead to any delay.

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Legend

★ Flood Events to date Symology

— Main River

— Ordinary Watercourse

DAM

Zone_B

Zone_C1

Zone_C2

Surface Water

1 in 30

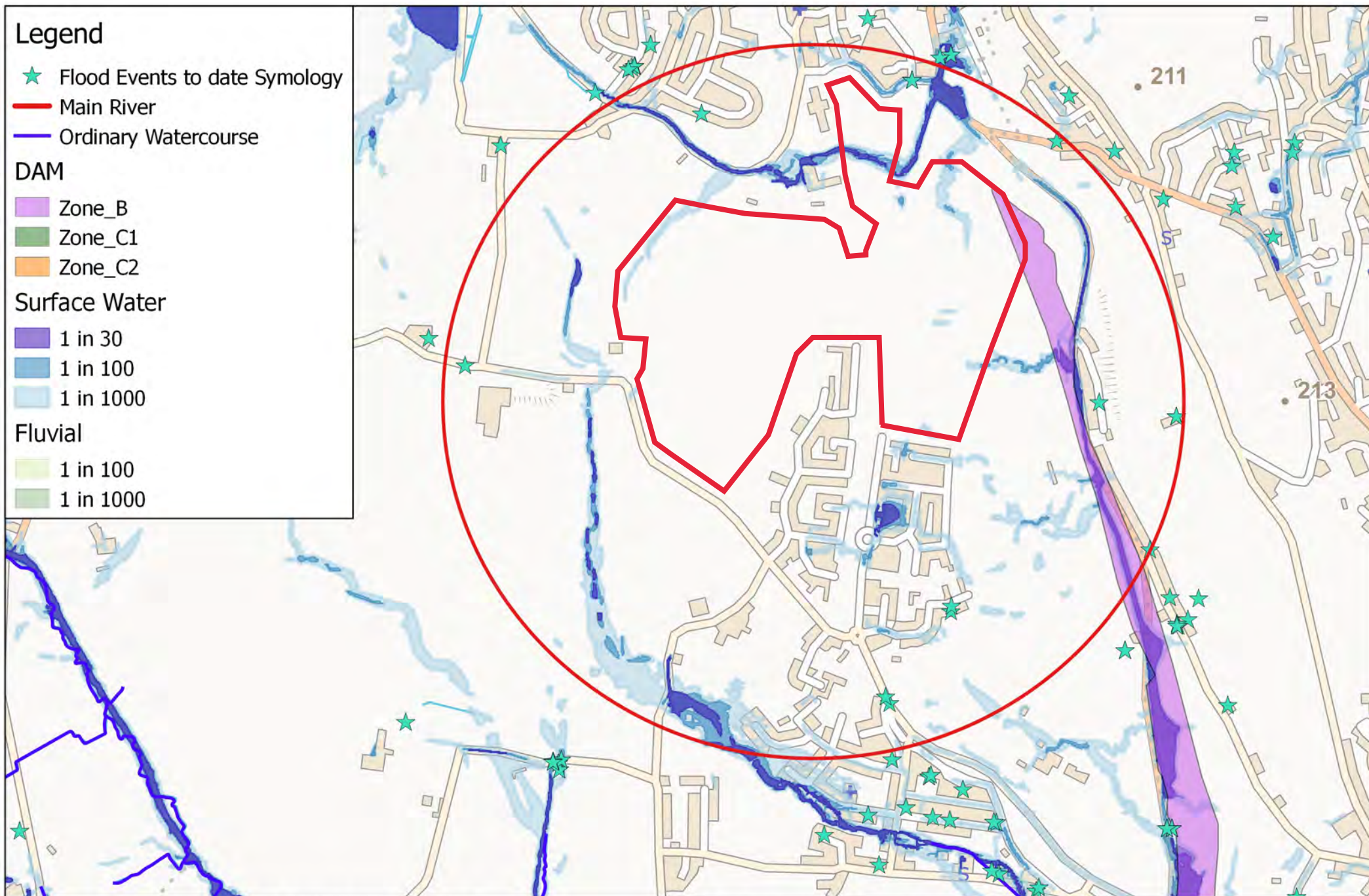
1 in 100

1 in 1000

Fluvial

1 in 100

1 in 1000



Former Brymbo Steelworks in Brymbo, Wrexham, LL11 5BT

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Griffiths, Bryn

From: Neil Taunt <Neil.Taunt@wrexham.gov.uk>
Sent: 11 October 2018 07:47
To: Griffiths, Bryn
Subject: RE: Flood Consequence Assessment guidance - Brymbo, Wrexham

Categories: Saved

Hi Bryn,

We normally accept a minimum 30% increase unless a more appropriate figure can be evidenced as being appropriate.

Thanks

Neil

From: Griffiths, Bryn [mailto:bgriffiths@wardell-armstrong.com]
Sent: 09 October 2018 11:11
To: Neil Taunt
Subject: RE: Flood Consequence Assessment guidance - Brymbo, Wrexham

Hi Neil,

Thank you for the information provided last month. I have also been consulting with Natural Resources Wales as part of my FCA. One thing I was looking for clarification on to assist with designing suitably-sized SuDS features for the drainage strategy is the a climate change allowance to use in runoff calculations. My experience is primarily in Flood Risk Assessments in England where we would apply an allowance of 40% to models based on guidance in the February 2016 "Flood risk assessments: climate change allowances" report. The reports states this is only applicable to English sites.

I have been on the Welsh Government website "CL-03-16 - Climate change allowances for Planning purposes" and looked at the report "Flood Consequence Assessments: Climate change allowances". This gives allowances for river flow and sea level height but not for rainfall intensity. I spoke with Daniel Davies at NRW but he said that they do not have a specific allowance for rainfall intensity to be applied to calculations, but he advised me to speak with yourself to see if the LLFA in the Wrexham area has a preferred rainfall intensity percentage to apply in an FCA for a residential development.

Regards,
Bryn

Bryn Griffiths | Senior Environmental Scientist
Wardell Armstrong LLP
Sir Henry Doulton House, Forge Lane, Etruria, Staffordshire, UK
t: 01782 276700 m: 07469 856653



From: Neil Taunt <Neil.Taunt@wrexham.gov.uk>
Sent: 18 September 2018 12:04
To: Griffiths, Bryn <bgriffiths@wardell-armstrong.com>
Cc: Sharon Williams <Sharon.Williams@wrexham.gov.uk>; Matthew Phillips <Matthew.Phillips@wrexham.gov.uk>
Subject: RE: Flood Consequence Assessment guidance - Brymbo, Wrexham

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Many thanks

Neil

Neil Taunt MCIWEM C.WEM CEnv CSci

Uwch Swyddog Rheoli Llifogydd / Senior Flood Management Officer



☎ 01978 729734 / 07808 787632

✉ Amgylchedd a Chynllunio, Cyngor Bwrdeistref Sirol Wrecsam, De Ffordd yr Abaty, Ystad Ddiwydiannol Wrecsam, Wrecsam LL13 9PW

✉ Environment & Planning, Wrexham County Borough Council, Abbey Road South, Wrexham Industrial Estate, Wrexham LL13 9PW

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📘 facebook.com/cyngorwrecsam | facebook.com/wrexhamcouncil

From: Sharon Williams
Sent: 11 September 2018 14:08
To: Neil Taunt
Cc: bgriffiths@wardell-armstrong.com
Subject: FW: Flood Consequence Assessment guidance - Brymbo, Wrexham

Hi Neil,

Please see email below asking for your comments I would be grateful if you could copy Matthew Phillips in Planning into any response you may have.

Regards

Sharon

Sharon Williams
Business Support Officer (Development Control)



01978 298785
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twitter.com/wrexhamcbc | twitter.com/cbswrexsam
facebook.com/wrexhamcouncil | facebook.com/cyngorwrexsam

From: Griffiths, Bryn [<mailto:bgriffiths@wardell-armstrong.com>]
Sent: 10 September 2018 12:46
To: planning
Subject: Flood Consequence Assessment guidance - Brymbo, Wrexham

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Click [here](#) if the original attachments are required (justification needed).

Good afternoon,

I working on a Flood Consequence Assessment for a mixed commercial and residential development at the former Brymbo Steelworks in Brymbo, Wrexham, LL11 5BT – approximate grid reference 329743, 353316, (see attached Development Advice Map). As shown on the Development Advice Map, the majority of the site is located within Zone A, with a small area within Zone B, which appears to coincide with a section of alluvial deposits in this area.

In order to assist with the assessment, I would welcome any pre-planning comments that you wish to make with respect to flood risk and drainage at the site. In particular, if you have any local knowledge of historic flood

incidents or drainage problems with respect to ordinary watercourses, surface water and groundwater, I would be grateful if you could comment. I would also be grateful for any advice on local guidance and policies relating to surface water management/SuDS in this area.

Please let me know if you require any further information to assist you. Also, if this is not the correct department to contact with this enquiry it would be very much appreciated if you could forward this on the team able to advise on this request.

Regards,
Bryn

Bryn Griffiths | Senior Environmental Scientist
Wardell Armstrong LLP
Sir Henry Doulton House, Forge Lane, Etruria, Staffordshire, UK
t: 01782 276700 m: 07469 856653



Rydym yn croesawu gohebiaeth yn Gymraeg. Byddwn yn ymateb i unrhyw ohebiaeth yn Gymraeg ac ni fydd hyn yn arwain at unrhyw oedi.

Ewch i weld - mi fedrwch chi dalu, rhoi gwybod, gwneud cais, dweud eich dweud, a dod o hyd i wybodaeth ar-lein yn www.wreccsam.gov.uk. Arbedwch bapur - meddyliwch cyn argraffu!

Mae'r neges e-bost hon ac unrhyw atodiadau wedi eu bwriadu ar gyfer yr unigolyn neu'r sefydliad y?i cyfeirir atynt yn unig. Am yr amodau llawn yngl?n ? chynnwys a defnyddio'r neges e-bost hon, ac unrhyw atodiadau, cyfeiriwch at www.wreccsam.gov.uk/top_navigation/disclaimersw.htm

We welcome correspondence in Welsh. We will respond to any correspondence in Welsh and this will not lead to any delay.

Take a look - you can pay, report, request, have your say and find information online at www.wrexham.gov.uk. Save paper - think before you print!

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Rydym yn croesawu gohebiaeth yn Gymraeg. Byddwn yn ymateb i unrhyw ohebiaeth yn Gymraeg ac ni fydd hyn yn arwain at unrhyw oedi.

Ewch i weld - mi fedrwch chi dalu, rhoi gwybod, gwneud cais, dweud eich dweud, a dod o hyd i wybodaeth ar-lein yn www.wreccsam.gov.uk. Arbedwch bapur - meddyliwch cyn argraffu!

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APPENDIX 4

Drainage Network Modelling

URS Infrastructure & Environment UK Ltd		Page 0
Scott House Alencon Link Basingstoke RG21 7PP		
Date 05/10/2015 12:32 File No D Road ModelA flow a...	Designed by 32961sjc Checked by	
XP Solutions	Network 2014.1.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for NO D ROAD MODELA.SWS









Pipe Sizes NO D ROAD MODELA Manhole Sizes NO D ROAD MODELA

FSR Rainfall Model - England and Wales

Return Period (years)	2	Add Flow / Climate Change (%)	10
M5-60 (mm)	18.000	Minimum Backdrop Height (m)	0.200
Ratio R	0.322	Maximum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	0	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	0.75
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		


Designed with Level Soffits

Network Design Table for NO D ROAD MODELA.SWS














PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
S1.000	70.724	1.469	48.1	0.128	5.00	0.0	0.600	o	225	
S1.001	55.001	0.917	60.0	0.103	0.00	0.0	0.600	o	225	
S2.000	24.540	0.282	87.0	0.062	5.00	0.0	0.600	o	225	
S1.002	51.978	0.711	73.1	0.108	0.00	0.0	0.600	o	300	
S1.003	35.591	0.487	73.1	0.039	0.00	0.0	0.600	o	300	
S1.004	65.542	0.906	72.3	0.101	0.00	0.0	0.600	o	300	
S3.004	15.217	0.076	200.2	0.000	0.00	0.0	0.600	o	300	
S1.005	55.431	1.500	37.0	0.060	0.00	0.0	0.600	o	300	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	0.00	5.62	200.113	0.128	0.0	0.0	0.0	1.89	75.1	0.0
S1.001	0.00	6.17	198.644	0.231	0.0	0.0	0.0	1.69	67.3	0.0
S2.000	0.00	5.29	198.009	0.062	0.0	0.0	0.0	1.40	55.8	0.0
S1.002	0.00	6.64	197.652	0.401	0.0	0.0	0.0	1.84	130.1	0.0
S1.003	0.00	6.96	196.941	0.440	0.0	0.0	0.0	1.84	130.2	0.0
S1.004	0.00	7.55	196.454	0.541	0.0	0.0	0.0	1.85	130.8	0.0
S3.004	0.00	6.48	195.624	1.900	0.0	0.0	0.0	1.11	78.3	0.0
S1.005	0.00	7.90	195.548	2.501	0.0	0.0	0.0	2.59	183.4	0.0

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Network Design Table for NO D ROAD MODEL A.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
S4.005	15.059	0.075	200.8	0.000	0.00	0.0	0.600	o	300	
S5.002	14.360	0.084	171.0	0.000	0.00	0.0	0.600	o	225	
S1.006	68.961	0.575	119.9	0.098	0.00	0.0	0.600	o	525	
S1.007	38.127	0.379	100.6	0.070	0.00	0.0	0.600	o	675	
S6.000	26.414	2.247	11.8	0.062	5.00	0.0	0.600	o	225	
S7.005	10.515	1.945	5.4	0.000	0.00	0.0	0.600	o	225	
S6.001	31.534	1.757	17.9	0.037	0.00	0.0	0.600	o	225	
S6.002	36.208	2.017	18.0	0.074	0.00	0.0	0.600	o	225	
S6.003	40.412	2.251	18.0	0.042	0.00	0.0	0.600	o	225	
S6.004	30.619	1.480	20.7	0.043	0.00	0.0	0.600	o	225	
S8.005	16.767	0.099	169.4	0.000	0.00	0.0	0.600	o	225	
S6.005	73.915	0.863	85.6	0.104	0.00	0.0	0.600	o	375	
S9.005	16.991	0.085	199.9	0.000	0.00	0.0	0.600	o	300	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S4.005	0.00	7.74	194.123	0.355	0.0	0.0	0.0	1.11	78.2	0.0
S5.002	0.00	5.49	194.207	0.300	0.0	0.0	0.0	1.00	39.6	0.0
S1.006	0.00	8.47	193.823	3.254	0.0	0.0	0.0	2.04	442.5	0.0
S1.007	0.00	8.71	193.098	3.324	0.0	0.0	0.0	2.61	935.1	0.0
S6.000	0.00	5.11	205.144	0.062	0.0	0.0	0.0	3.84	152.6	0.0
S7.005	0.00	5.58	204.842	0.498	0.0	0.0	0.0	5.67	225.3	0.0
S6.001	0.00	5.75	202.897	0.597	0.0	0.0	0.0	3.10	123.4	0.0
S6.002	0.00	5.95	201.140	0.671	0.0	0.0	0.0	3.10	123.4	0.0
S6.003	0.00	6.16	199.123	0.713	0.0	0.0	0.0	3.10	123.4	0.0
S6.004	0.00	6.34	196.872	0.756	0.0	0.0	0.0	2.89	114.9	0.0
S8.005	0.00	6.17	195.491	0.200	0.0	0.0	0.0	1.00	39.8	0.0
S6.005	0.00	6.97	195.242	1.060	0.0	0.0	0.0	1.96	216.4	0.0
S9.005	0.00	6.29	194.539	0.520	0.0	0.0	0.0	1.11	78.3	0.0

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Alencon Link

Basingstoke RG21 7PP

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File No D Road ModelA flow a...


















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Network Design Table for NO D ROAD MODELA.SWS


PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
S6.006	34.855	0.407	85.6	0.058	0.00	0.0	0.600	o	450	
S6.007	48.941	0.953	51.4	0.060	0.00	0.0	0.600	o	450	
S1.008	9.047	0.023	393.4	0.000	0.00	0.0	0.600	o	750	
S1.009	20.342	0.043	473.1	0.094	0.00	0.0	0.600	o	750	
S1.010	4.682	0.047	99.6	0.000	0.00	0.0	0.600	o	750	
S1.011	21.513	0.127	169.4	0.060	0.00	0.0	0.600	o	600	
S1.012	30.932	0.245	126.3	0.027	0.00	0.0	0.600	o	600	
S1.013	34.953	2.148	16.3	0.045	0.00	0.0	0.600	o	600	
S10.005	14.649	1.361	10.8	0.000	0.00	0.0	0.600	o	225	
S1.014	24.154	2.237	10.8	0.038	0.00	0.0	0.600	o	600	
S1.015	37.098	3.702	10.0	0.052	0.00	0.0	0.600	o	600	
S11.007	20.815	1.857	11.2	0.000	0.00	0.0	0.600	o	300	
S1.016	67.917	6.860	9.9	0.061	0.00	0.0	0.600	o	600	
S1.017	23.792	2.379	10.0	0.027	0.00	0.0	1.500	o	600	
S1.018	25.392	2.539	10.0	0.040	0.00	0.0	1.500	o	600	
S1.019	16.009	0.640	25.0	0.028	0.00	0.0	1.500	o	600	
S1.020	10.549	0.264	40.0	0.000	0.00	0.0	1.500	o	600	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)	
S6.006	0.00	7.23	194.304	1.638		0.0	0.0	0.0	2.20	349.6	0.0
S6.007	0.00	7.52	193.897	1.698		0.0	0.0	0.0	2.84	452.0	0.0
S1.008	0.00	8.82	192.644	5.022		0.0	0.0	0.0	1.40	620.6	0.0
S1.009	0.00	9.08	192.621	5.116		0.0	0.0	0.0	1.28	565.5	0.0
S1.010	0.00	9.11	192.578	5.116		0.0	0.0	0.0	2.80	1238.8	0.0
S1.011	0.00	9.30	192.531	5.176		0.0	0.0	0.0	1.87	528.2	0.0
S1.012	0.00	9.54	192.404	5.203		0.0	0.0	0.0	2.17	612.4	0.0
S1.013	0.00	9.64	192.159	5.248		0.0	0.0	0.0	6.06	1712.5	0.0
S10.005	0.00	5.85	191.747	0.155		0.0	0.0	0.0	4.01	159.5	0.0
S1.014	0.00	9.69	190.011	5.441		0.0	0.0	0.0	7.44	2103.1	0.0
S1.015	0.00	9.77	187.774	5.493		0.0	0.0	0.0	7.72	2183.2	0.0
S11.007	0.00	5.75	186.229	0.644		0.0	0.0	0.0	4.72	333.8	0.0
S1.016	0.00	9.92	184.072	6.198		0.0	0.0	0.0	7.77	2196.5	0.0
S1.017	0.00	9.97	177.212	6.225		0.0	0.0	0.0	6.87	1943.6	0.0
S1.018	0.00	10.04	174.833	6.265		0.0	0.0	0.0	6.87	1943.5	0.0
S1.019	0.00	10.10	172.294	6.293		0.0	0.0	0.0	4.34	1228.3	0.0
S1.020	0.00	10.15	171.654	6.293		0.0	0.0	0.0	3.43	971.0	0.0

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<p align="center"><u>Simulation Criteria for NO D ROAD MODELA.SWS</u></p> <table> <tr> <td>Volumetric Runoff Coeff</td> <td>0.840</td> <td>Additional Flow - % of Total Flow</td> <td>0.000</td> </tr> <tr> <td>Areal Reduction Factor</td> <td>1.000</td> <td>MADD Factor * 10m³/ha Storage</td> <td>0.000</td> </tr> <tr> <td>Hot Start (mins)</td> <td>0</td> <td>Inlet Coefficient</td> <td>0.800</td> </tr> <tr> <td>Hot Start Level (mm)</td> <td>0</td> <td>Flow per Person per Day (l/per/day)</td> <td>0.000</td> </tr> <tr> <td>Manhole Headloss Coeff (Global)</td> <td>0.500</td> <td>Run Time (mins)</td> <td>60</td> </tr> <tr> <td>Foul Sewage per hectare (l/s)</td> <td>0.000</td> <td>Output Interval (mins)</td> <td>1</td> </tr> <tr> <td colspan="2">Number of Input Hydrographs</td> <td>0</td> <td>Number of Storage Structures</td> </tr> <tr> <td colspan="2">Number of Online Controls</td> <td>8</td> <td>Number of Time/Area Diagrams</td> </tr> <tr> <td colspan="2">Number of Offline Controls</td> <td>1</td> <td>Number of Real Time Controls</td> </tr> </table> <p align="center"><u>Synthetic Rainfall Details</u></p> <table> <tr> <td>Rainfall Model</td> <td>FSR</td> <td>Profile Type</td> <td>Winter</td> </tr> <tr> <td>Return Period (years)</td> <td>2</td> <td>Cv (Summer)</td> <td>0.750</td> </tr> <tr> <td>Region</td> <td>England and Wales</td> <td>Cv (Winter)</td> <td>0.840</td> </tr> <tr> <td>M5-60 (mm)</td> <td>18.000</td> <td>Storm Duration (mins)</td> <td>30</td> </tr> <tr> <td>Ratio R</td> <td>0.322</td> <td></td> <td></td> </tr> </table>			Volumetric Runoff Coeff	0.840	Additional Flow - % of Total Flow	0.000	Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000	Hot Start (mins)	0	Inlet Coefficient	0.800	Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000	Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60	Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1	Number of Input Hydrographs		0	Number of Storage Structures	Number of Online Controls		8	Number of Time/Area Diagrams	Number of Offline Controls		1	Number of Real Time Controls	Rainfall Model	FSR	Profile Type	Winter	Return Period (years)	2	Cv (Summer)	0.750	Region	England and Wales	Cv (Winter)	0.840	M5-60 (mm)	18.000	Storm Duration (mins)	30	Ratio R	0.322		
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Summary of Results for 30 minute 2 year Winter (NO D ROAD MODELA.SWS)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

			Water	Surcharged	Flooded			Pipe	
		US/MH	Level	Depth	Volume	Flow /	Overflow	Flow	
	PN	Name	(m)	(m)	(m³)	Cap.	(l/s)	(l/s)	Status
Catchment A	S1.000	S1	200.183	-0.155	0.000	0.21	0.0	15.3	OK
	S1.001	S2	198.745	-0.124	0.000	0.41	0.0	26.6	OK
	S2.000	S3	198.066	-0.168	0.000	0.15	0.0	7.5	OK
	S1.002	S4	197.779	-0.173	0.000	0.37	0.0	45.8	OK
	S1.003	S5	197.076	-0.165	0.000	0.42	0.0	49.8	OK
	S1.004	S6	196.602	-0.152	0.000	0.48	0.0	60.5	OK
	S3.000	S7	196.399	-1.475	0.000	0.01	0.0	55.8	OK
	S3.001	S57	196.399	-1.317	0.000	0.02	0.0	75.6	OK
	S3.002	S58	196.398	-1.182	0.000	0.02	0.0	79.7	OK
	S3.003	S60	196.396	-1.068	0.000	0.03	0.0	84.1	OK
	S3.004	S59	196.395	0.471	0.000	1.16	0.0	76.5	SURCHARGED
	S1.005	S8	195.750	-0.098	0.000	0.79	0.0	136.8	OK
Catchment B	S4.000	S9	194.724	-0.674	0.000	0.02	0.0	8.5	OK
	S4.001	S65	194.657	-0.663	0.000	0.03	0.0	16.0	OK
	S4.002	S61	194.507	-0.634	0.000	0.04	0.0	22.3	OK
	S4.003	S62	194.443	-0.542	0.000	0.05	0.0	24.0	OK
	S4.004	S63	194.436	-0.461	0.000	0.08	0.0	25.2	OK
	S4.005	S64	194.434	0.011	0.000	0.37	0.0	24.5	SURCHARGED
	S5.000	S10	194.922	-0.863	0.000	0.01	0.0	22.1	OK
	S5.001	S134	194.922	-0.823	0.000	0.01	0.0	18.7	OK
	S5.002	S135	194.922	0.490	0.000	0.15	0.0	5.2	SURCHARGED
	S1.006	S11	194.062	-0.286	0.000	0.43	0.0	172.9	OK
	S1.007	S12	193.325	-0.448	0.000	0.23	0.0	179.1	OK
	S6.000	S13	205.177	-0.192	0.000	0.05	0.0	7.5	OK
Catchment D	S7.000	S14	212.464	-0.741	0.000	0.02	0.0	20.0	OK
	S7.001	S66	212.273	-0.713	0.000	0.05	0.0	38.4	OK
	S7.002	S67	212.115	-0.668	0.000	0.06	0.0	56.7	OK
	S7.003	S68	212.093	0.160	0.000	0.33	0.0	50.2	SURCHARGED
	S7.004	S69	211.943	3.540	0.000	0.20	0.0	37.9	SURCHARGED
	S7.005	S70	204.910	-0.157	0.000	0.20	0.0	37.9	OK
	S6.001	S15	202.998	-0.124	0.000	0.42	0.0	48.3	OK
	S6.002	S16	201.251	-0.114	0.000	0.48	0.0	56.5	OK
	S6.003	S17	199.239	-0.109	0.000	0.52	0.0	61.1	OK
	S6.004	S18	197.000	-0.097	0.000	0.61	0.0	65.9	OK
	S8.000	S19	195.821	-0.708	0.000	0.01	0.0	4.8	OK
	S8.001	S71	195.788	-0.638	0.000	0.02	0.0	8.4	OK
Catchment D	S8.002	S72	195.786	-0.582	0.000	0.02	0.0	11.1	OK
	S8.003	S73	195.785	-0.518	0.000	0.03	0.0	12.5	OK
	S8.004	S74	195.783	-0.477	0.000	0.04	0.0	14.3	OK
	S8.005	S75	195.783	0.067	0.000	0.40	0.0	14.0	SURCHARGED
	S6.005	S20	195.416	-0.201	0.000	0.44	0.0	89.5	OK
	S9.000	S21	194.935	-1.093	0.000	0.01	0.0	12.1	OK
	S9.001	S76	194.926	-0.987	0.000	0.02	0.0	19.1	OK
	S9.002	S77	194.925	-0.966	0.000	0.02	0.0	28.9	OK
	S9.003	S78	194.921	-0.859	0.000	0.04	0.0	28.6	OK
	S9.004	S79	194.920	-0.840	0.000	0.05	0.0	36.4	OK

URS Infrastructure & Environment UK Ltd		Page 2
Scott House Alencon Link Basingstoke RG21 7PP		
Date 05/10/2015 12:30 File No D Road ModelA flow a...	Designed by 32961sjc Checked by	
XP Solutions Network 2014.1.1		

Summary of Results for 30 minute 2 year Winter (NO D ROAD MODELA.SWS)


PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
S9.005	S80	194.919	0.080	0.000	0.53	0.0	35.6	SURCHARGED
S6.006	S22	194.508	-0.246	0.000	0.42	0.0	128.8	OK
S6.007	S23	194.075	-0.272	0.000	0.33	0.0	134.9	OK
S1.008	S24	193.213	-0.181	0.000	1.04	0.0	312.7	OK
S1.009	S44	193.158	-0.213	0.000	0.86	0.0	319.8	OK
S1.010	S45	192.996	-0.332	0.000	0.60	0.0	319.9	OK
S1.011	S46	192.979	-0.152	0.000	0.91	0.0	324.6	OK
S1.012	S47	192.759	-0.245	0.000	0.66	0.0	326.0	OK
S1.013	S47A	192.353	-0.406	0.000	0.23	0.0	328.8	OK
S10.000	S140	192.667	-0.536	0.000	0.01	0.0	3.7	OK
S10.001	S122	192.651	-0.498	0.000	0.03	0.0	6.9	OK
S10.002	S123	192.648	-0.485	0.000	0.05	0.0	10.2	OK
S10.003	S124	192.637	-0.458	0.000	0.08	0.0	16.4	OK
S10.004	S125	192.626	-0.063	0.000	0.12	0.0	14.8	OK
Catchment E S10.005	S126	192.613	0.641	0.000	0.09	0.0	13.1	SURCHARGED
S1.014	S48	190.205	-0.406	0.000	0.23	0.0	344.0	OK
S1.015	S49	187.950	-0.424	0.000	0.19	0.0	347.5	OK
S11.000	S50	190.145	-1.396	0.000	0.00	0.0	10.9	OK
S11.001	S127	190.136	-1.344	0.000	0.01	0.0	31.2	OK
S11.002	S128	190.106	-1.310	0.000	0.03	0.0	51.4	OK
S11.003	S129	190.073	-1.312	0.000	0.04	0.0	71.6	OK
S11.004	S130	189.917	-1.423	0.000	0.01	0.0	71.3	OK
S11.005	S131	188.801	-1.433	0.000	0.01	0.0	71.4	OK
S11.006	S132	187.768	-0.976	0.000	0.01	0.0	66.3	OK
Catchment F S11.007	S133	187.768	1.239	0.000	0.15	0.0	43.5	SURCHARGED
S1.016	S51	184.253	-0.419	0.000	0.20	0.0	394.7	OK
S1.017	S52	177.418	-0.394	0.000	0.26	0.0	396.6	OK
S1.018	S53	175.036	-0.397	0.000	0.25	0.0	399.2	OK
S1.019	S54	172.594	-0.300	0.000	0.50	0.0	400.9	OK
S1.020	S55	172.053	-0.201	0.000	0.78	0.0	400.7	OK
S1.021	S56	170.252	-0.375	0.000	0.64	0.0	404.4	OK
S1.022	S200	169.940	-0.635	0.000	0.22	0.0	404.9	OK

Catchment C not modelled

Summary of Results for 30 minute 30 year Winter (NO D ROAD MODELA.SWS)

			Water	Surcharged	Flooded			Pipe	
		US/MH	Level	Depth	Volume	Flow /	Overflow	Flow	
	PN	Name	(m)	(m)	(m³)	Cap.	(l/s)	(l/s)	Status
	S1.000	S1	200.212	-0.126	0.000	0.40	0.0	29.1	OK
	S1.001	S2	198.800	-0.069	0.000	0.81	0.0	52.4	OK
	S2.000	S3	198.089	-0.145	0.000	0.28	0.0	14.2	OK
	S1.002	S4	197.846	-0.106	0.000	0.74	0.0	90.5	OK
	S1.003	S5	197.179	-0.062	0.000	0.82	0.0	98.1	OK
	S1.004	S6	196.887	0.133	0.000	0.90	0.0	111.8	SURCHARGED
Catchment A	S3.004	S59	196.827	0.903	0.000	1.54	0.0	101.1	SURCHARGED
	S1.005	S8	196.185	0.337	0.000	1.11	0.0	192.8	SURCHARGED
Catchment B	S4.005	S64	194.618	0.195	0.000	0.50	0.0	32.8	SURCHARGED
	S5.002	S135	195.404	0.972	0.000	0.20	0.0	6.8	SURCHARGED
	S1.006	S11	194.119	-0.229	0.000	0.60	0.0	245.2	OK
	S1.007	S12	193.457	-0.316	0.000	0.33	0.0	256.9	OK
	S6.000	S13	205.192	-0.177	0.000	0.10	0.0	14.2	OK
	S7.005	S70	204.912	-0.155	0.000	0.22	0.0	40.7	OK
	S6.001	S15	203.015	-0.107	0.000	0.54	0.0	61.9	OK
	S6.002	S16	201.277	-0.088	0.000	0.68	0.0	79.0	OK
	S6.003	S17	199.271	-0.077	0.000	0.76	0.0	88.7	OK
	S6.004	S18	197.042	-0.055	0.000	0.92	0.0	98.8	OK
Catchment D	S8.005	S75	195.963	0.247	0.000	0.53	0.0	18.7	SURCHARGED
	S6.005	S20	195.469	-0.148	0.000	0.67	0.0	138.2	OK
	S9.005	S80	195.167	0.328	0.000	0.73	0.0	48.5	SURCHARGED
	S6.006	S22	194.561	-0.193	0.000	0.62	0.0	188.9	OK
	S6.007	S23	194.120	-0.227	0.000	0.49	0.0	201.2	OK
	S1.008	S24	193.411	0.017	0.000	1.52	0.0	456.9	SURCHARGED
	S1.009	S44	193.371	0.000	0.000	1.28	0.0	474.4	OK
	S1.010	S45	193.245	-0.083	0.000	0.88	0.0	472.9	OK
	S1.011	S46	193.208	0.077	0.000	1.35	0.0	482.7	SURCHARGED
	S1.012	S47	192.879	-0.125	0.000	0.98	0.0	488.0	OK
	S1.013	S47A	192.402	-0.357	0.000	0.35	0.0	495.0	OK
Catchment E	S10.005	S126	192.855	0.883	0.000	0.11	0.0	14.8	SURCHARGED
	S1.014	S48	190.253	-0.358	0.000	0.34	0.0	515.2	OK
	S1.015	S49	187.992	-0.382	0.000	0.28	0.0	522.6	OK
Catchment F	S11.007	S133	189.330	2.801	0.000	0.21	0.0	62.4	SURCHARGED
	S1.016	S51	184.295	-0.377	0.000	0.30	0.0	589.1	OK
	S1.017	S52	177.470	-0.342	0.000	0.38	0.0	592.1	OK
	S1.018	S53	175.087	-0.346	0.000	0.37	0.0	598.2	OK
	S1.019	S54	172.687	-0.207	0.000	0.75	0.0	602.6	OK
	S1.020	S55	172.323	0.069	0.000	1.17	0.0	603.2	SURCHARGED
	S1.021	S56	170.430	-0.197	0.000	0.96	0.0	609.0	OK
	S1.022	S200	170.012	-0.563	0.000	0.32	0.0	610.9	OK

Catchment C not modelled

URS Infrastructure & Environment UK Ltd		Page 0																																																								
Scott House Alencon Link Basingstoke RG21 7PP																																																										
Date 05/10/2015 12:26 File No D Road ModelA flow a...	Designed by 32961sjc Checked by																																																									
XP Solutions Network 2014.1.1																																																										
<p align="center"><u>Simulation Criteria for NO D ROAD MODELA.SWS</u></p> <table> <tr> <td>Volumetric Runoff Coeff</td> <td>0.840</td> <td>Additional Flow - % of Total Flow</td> <td>20.000</td> </tr> <tr> <td>Areal Reduction Factor</td> <td>1.000</td> <td>MADD Factor * 10m³/ha Storage</td> <td>0.000</td> </tr> <tr> <td>Hot Start (mins)</td> <td>0</td> <td>Inlet Coeffiecient</td> <td>0.800</td> </tr> <tr> <td>Hot Start Level (mm)</td> <td>0</td> <td>Flow per Person per Day (l/per/day)</td> <td>0.000</td> </tr> <tr> <td>Manhole Headloss Coeff (Global)</td> <td>0.500</td> <td>Run Time (mins)</td> <td>60</td> </tr> <tr> <td>Foul Sewage per hectare (l/s)</td> <td>0.000</td> <td>Output Interval (mins)</td> <td>1</td> </tr> </table> <table> <tr> <td>Number of Input Hydrographs</td> <td>0</td> <td>Number of Storage Structures</td> <td>0</td> </tr> <tr> <td>Number of Online Controls</td> <td>8</td> <td>Number of Time/Area Diagrams</td> <td>0</td> </tr> <tr> <td>Number of Offline Controls</td> <td>1</td> <td>Number of Real Time Controls</td> <td>0</td> </tr> </table> <p align="center"><u>Synthetic Rainfall Details</u></p> <table> <tr> <td>Rainfall Model</td> <td>FSR</td> <td>Profile Type</td> <td>Winter</td> </tr> <tr> <td>Return Period (years)</td> <td>100</td> <td>Cv (Summer)</td> <td>0.750</td> </tr> <tr> <td>Region</td> <td>England and Wales</td> <td>Cv (Winter)</td> <td>0.840</td> </tr> <tr> <td>M5-60 (mm)</td> <td>18.000</td> <td>Storm Duration (mins)</td> <td>30</td> </tr> <tr> <td>Ratio R</td> <td>0.322</td> <td></td> <td></td> </tr> </table>			Volumetric Runoff Coeff	0.840	Additional Flow - % of Total Flow	20.000	Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000	Hot Start (mins)	0	Inlet Coeffiecient	0.800	Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000	Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60	Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1	Number of Input Hydrographs	0	Number of Storage Structures	0	Number of Online Controls	8	Number of Time/Area Diagrams	0	Number of Offline Controls	1	Number of Real Time Controls	0	Rainfall Model	FSR	Profile Type	Winter	Return Period (years)	100	Cv (Summer)	0.750	Region	England and Wales	Cv (Winter)	0.840	M5-60 (mm)	18.000	Storm Duration (mins)	30	Ratio R	0.322		
Volumetric Runoff Coeff	0.840	Additional Flow - % of Total Flow	20.000																																																							
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Hot Start (mins)	0	Inlet Coeffiecient	0.800																																																							
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<p align="center">©1982-2014 XP Solutions</p>																																																										

Summary of Results for 30 minute 100 year Winter (NO D ROAD MODELA.SWS)

	PN	US/MH Name	Water	Surcharged	Flooded	Pipe			Status
			Level	Depth	Volume	Flow /	Overflow	Flow	
			(m)	(m)	(m³)	Cap.	(l/s)	(l/s)	
Catchment A	S1.000	S1	200.249	-0.089	0.000	0.62	0.0	45.5	OK
	S1.001	S2	199.861	0.992	0.000	1.06	0.0	68.5	SURCHARGED
	S2.000	S3	198.978	0.744	0.000	0.39	0.0	20.2	SURCHARGED
	S1.002	S4	198.941	0.989	0.000	0.90	0.0	110.8	SURCHARGED
	S1.003	S5	198.376	1.135	0.000	0.98	0.0	117.7	SURCHARGED
	S1.004	S6	197.909	1.155	0.000	1.14	0.0	141.8	SURCHARGED
	S3.004	S59	197.429	1.505	0.000	1.91	0.0	125.9	FLOOD RISK
Catchment B	S1.005	S8	196.760	0.912	0.000	1.27	0.0	220.6	SURCHARGED
	S4.005	S64	194.813	0.390	0.000	0.59	0.0	39.0	SURCHARGED
	S5.002	S135	197.133	2.701	0.000	0.31	0.0	10.7	FLOOD RISK
	S1.006	S11	194.148	-0.200	0.000	0.70	0.0	282.8	OK
	S1.007	S12	193.670	-0.103	0.000	0.39	0.0	300.5	OK
	S6.000	S13	205.203	-0.166	0.000	0.16	0.0	22.2	OK
	S7.005	S70	204.916	-0.151	0.000	0.24	0.0	44.6	OK
	S6.001	S15	203.032	-0.090	0.000	0.66	0.0	76.7	OK
	S6.002	S16	201.334	-0.031	0.000	0.88	0.0	102.7	OK
	S6.003	S17	199.833	0.485	0.000	0.97	0.0	114.0	SURCHARGED
	S6.004	S18	197.701	0.604	0.000	1.19	0.0	127.4	SURCHARGED
	S8.005	S75	196.178	0.462	0.000	0.65	0.0	23.0	SURCHARGED
	S6.005	S20	195.517	-0.100	0.000	0.88	0.0	180.6	OK
	S9.005	S80	195.435	0.596	0.000	0.88	0.0	59.0	SURCHARGED
	S6.006	S22	194.613	-0.141	0.000	0.81	0.0	247.0	OK
	S6.007	S23	194.162	-0.185	0.000	0.65	0.0	265.2	OK
	S1.008	S24	193.614	0.220	0.000	1.83	0.0	551.1	SURCHARGED
	S1.009	S44	193.556	0.185	0.000	1.53	0.0	570.4	SURCHARGED
	S1.010	S45	193.468	0.140	0.000	1.06	0.0	571.1	SURCHARGED
	S1.011	S46	193.415	0.284	0.000	1.63	0.0	583.3	SURCHARGED
	S1.012	S47	193.075	0.071	0.000	1.19	0.0	588.6	SURCHARGED
	S1.013	S47A	192.429	-0.330	0.000	0.42	0.0	597.5	OK
Catchment E	S10.005	S126	193.239	1.267	0.000	0.12	0.0	17.3	SURCHARGED
	S1.014	S48	190.280	-0.331	0.000	0.41	0.0	621.8	OK
Catchment F	S1.015	S49	188.017	-0.357	0.000	0.34	0.0	632.1	OK
	S11.007	S133	190.491	3.962	0.000	0.25	0.0	72.6	SURCHARGED
	S1.016	S51	184.321	-0.351	0.000	0.36	0.0	717.6	OK
	S1.017	S52	177.501	-0.311	0.000	0.47	0.0	723.7	OK
	S1.018	S53	175.118	-0.315	0.000	0.46	0.0	732.9	OK
	S1.019	S54	173.050	0.156	0.000	0.92	0.0	738.4	SURCHARGED
	S1.020	S55	172.505	0.251	0.000	1.44	0.0	738.8	SURCHARGED
	S1.021	S56	170.627	0.000	0.000	1.19	0.0	755.4	OK
	S1.022	S200	170.057	-0.518	0.000	0.40	0.0	755.8	OK

Catchment C not modelled

APPENDIX 5

Surface Water Attenuation Calculations

Calculation Sheet



REF:

CLIENT: Brymbo Developments Ltd.	PROJECT: Former Brymbo Steelworks	JOB NO.: ST16882	CALC. REF. NO.:
		PAGE:	OF
CALCULATION	CALC. BY:	CHECKED BY:	APPROVED BY:
Attenuation Calculation - Outfall A 1 in 30 year and 1 in 100 year storm event	(NAME AND SIGNATURE)	(NAME AND SIGNATURE)	(NAME AND SIGNATURE)
	P Maddock		
	DATE: 12/02/2020	DATE:	DATE:

Causeway Quick Storage Estimate

Rainfall Methodology	FSR
FSR Region	England & Wales
M5-60 (mm)	17.000
Ratio-R	0.300
Summer CV	<input checked="" type="checkbox"/> 0.750
Winter CV	<input checked="" type="checkbox"/> 0.840
Analysis Speed	Normal
Skip Steady State	<input type="checkbox"/>
Drain Down Time (mins)	240
Additional Storage (m³/ha)	20.0
<input checked="" type="checkbox"/> Check Discharge Rate(s)	Calc
1 year (l/s)	27.8
30 year (l/s)	56.9
100 year (l/s)	68.9
<input type="checkbox"/> Check Discharge Volume	Calc
100 year 360 minute (m³)	
Storage Estimate	Calc

Attenuation calculations are based on no infiltration to ground as a 'worst case' estimate. Discharge rates based on rates agreed during Phase 1 design

Storage Estimate

Return Period (years)	30
Climate Change (%)	0
Impermeable Area (ha)	1.650
Peak Discharge (l/s)	101.100
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	125
to	261
With infiltration (m³)	
from	
to	

Storage Estimate

Return Period (years)	100
Climate Change (%)	30
Impermeable Area (ha)	1.650
Peak Discharge (l/s)	125.000
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	264
to	532
With infiltration (m³)	
from	
to	

Based on the calculations, approximately 193m³ of storage would be required to attenuate for the 1 in 30 year storm event and 398m³ of storage would be required to attenuate for the 1 in 100 year storm event.

Calculation Sheet



REF:

CLIENT: Brymbo Developments Ltd.	PROJECT: Former Brymbo Steelworks	JOB NO.: ST16882	CALC. REF. NO.:
		PAGE:	OF
CALCULATION	CALC. BY:	CHECKED BY:	APPROVED BY:
Attenuation Calculation - Outfall B 1 in 30 year and 1 in 100 year event	(NAME AND SIGNATURE)	(NAME AND SIGNATURE)	(NAME AND SIGNATURE)
	P Maddock		
	DATE: 12/02/2020	DATE:	DATE:

Causeway Quick Storage Estimate

Rainfall Methodology	FSR
FSR Region	England & Wales
M5-60 (mm)	17.000
Ratio-R	0.300
Summer CV	<input checked="" type="checkbox"/> 0.750
Winter CV	<input checked="" type="checkbox"/> 0.840
Analysis Speed	Normal
Skip Steady State	<input type="checkbox"/>
Drain Down Time (mins)	240
Additional Storage (m³/ha)	20.0
<input checked="" type="checkbox"/> Check Discharge Rate(s)	Calc
1 year (l/s)	27.8
30 year (l/s)	56.9
100 year (l/s)	68.9
<input type="checkbox"/> Check Discharge Volume	Calc
100 year 360 minute (m³)	
Storage Estimate	Calc

Attenuation calculations are based on no infiltration to ground as a 'worst case' estimate. Discharge rates based on rates agreed during Phase 1 design

Storage Estimate

Return Period (years)	30
Climate Change (%)	0
Impermeable Area (ha)	1.440
Peak Discharge (l/s)	32.800
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	203
to	366
With infiltration (m³)	
from	
to	

Storage Estimate

Return Period (years)	100
Climate Change (%)	30
Impermeable Area (ha)	1.440
Peak Discharge (l/s)	39.000
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	424
to	713
With infiltration (m³)	
from	
to	

Based on the calculations, approximately 285m³ of storage would be required to attenuate for the 1 in 30 year storm event and 569m³ of storage would be required to attenuate for the 1 in 100 year storm event.

Calculation Sheet



REF:

CLIENT: Brymbo Developments Ltd.	PROJECT: Former Brymbo Steelworks	JOB NO.: ST16882	CALC. REF. NO.:
		PAGE:	OF
CALCULATION	CALC. BY:	CHECKED BY:	APPROVED BY:
Attenuation Calculation - Outfall C 1 in 30 year and 1 in 100 year storm event	(NAME AND SIGNATURE)	(NAME AND SIGNATURE)	(NAME AND SIGNATURE)
	P Maddock		
	DATE: 12/02/2020	DATE:	DATE:

Causeway Quick Storage Estimate

Rainfall Methodology	FSR
FSR Region	England & Wales
M5-60 (mm)	17.000
Ratio-R	0.300
Summer CV	<input checked="" type="checkbox"/> 0.750
Winter CV	<input checked="" type="checkbox"/> 0.840
Analysis Speed	Normal
Skip Steady State	<input type="checkbox"/>
Drain Down Time (mins)	240
Additional Storage (m³/ha)	20.0
<input checked="" type="checkbox"/> Check Discharge Rate(s)	Calc
1 year (l/s)	27.8
30 year (l/s)	56.9
100 year (l/s)	68.9
<input type="checkbox"/> Check Discharge Volume	Calc
100 year 360 minute (m³)	
Storage Estimate	Calc

Attenuation calculations are based on no infiltration to ground as a 'worst case' estimate. Discharge rates based on rates agreed during Phase 1 design

Storage Estimate

Return Period (years)	30
Climate Change (%)	0
Impermeable Area (ha)	0.960
Peak Discharge (l/s)	6.800
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	241
to	393
With infiltration (m³)	
from	
to	

Storage Estimate

Return Period (years)	100
Climate Change (%)	30
Impermeable Area (ha)	0.960
Peak Discharge (l/s)	10.000
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	431
to	672
With infiltration (m³)	
from	
to	

Based on the calculations, approximately 317m³ of storage would be required to attenuate for the 1 in 30 year storm event and 552m³ of storage would be required to attenuate for the 1 in 100 year storm event.

Calculation Sheet



REF:

CLIENT: Brymbo Developments Ltd.	PROJECT: Former Brymbo Steelworks	JOB NO.: ST16882	CALC. REF. NO.:
CALCULATION		CALC. BY:	APPROVED BY:
Attenuation Calculation - Outfall D 1 in 30 year and 1 in 100 year storm event		(NAME AND SIGNATURE)	(NAME AND SIGNATURE)
		P Maddock	
		DATE: 12/02/2020	DATE:

Causeway Quick Storage Estimate

Rainfall Methodology	FSR
FSR Region	England & Wales
M5-60 (mm)	17.000
Ratio-R	0.300
Summer CV	<input checked="" type="checkbox"/> 0.750
Winter CV	<input checked="" type="checkbox"/> 0.840
Analysis Speed	Normal
Skip Steady State	<input type="checkbox"/>
Drain Down Time (mins)	240
Additional Storage (m³/ha)	20.0
<input checked="" type="checkbox"/> Check Discharge Rate(s)	Calc
1 year (l/s)	27.8
30 year (l/s)	56.9
100 year (l/s)	68.9
<input type="checkbox"/> Check Discharge Volume	Calc
100 year 360 minute (m³)	
Storage Estimate	Calc

Attenuation calculations are based on no infiltration to ground as a 'worst case' estimate. Discharge rates based on rates agreed during Phase 1 design

Storage Estimate

Return Period (years)	30
Climate Change (%)	0
Impermeable Area (ha)	0.370
Peak Discharge (l/s)	18.700
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	32
to	65
With infiltration (m³)	
from	
to	

Storage Estimate

Return Period (years)	100
Climate Change (%)	30
Impermeable Area (ha)	0.370
Peak Discharge (l/s)	22.000
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	70
to	134
With infiltration (m³)	
from	
to	

Based on the calculations, approximately 49m³ of storage would be required to attenuate for the 1 in 30 year storm event and 102m³ of storage would be required to attenuate for the 1 in 100 year storm event.

Calculation Sheet



REF:

CLIENT: Brymbo Developments Ltd.	PROJECT: Former Brymbo Steelworks	JOB NO.: ST16882	CALC. REF. NO.:
		PAGE:	OF
CALCULATION	CALC. BY:	CHECKED BY:	APPROVED BY:
Attenuation Calculation - Outfall E 1 in 30 year and 1 in 100 year storm event	(NAME AND SIGNATURE)	(NAME AND SIGNATURE)	(NAME AND SIGNATURE)
	P Maddock		
	DATE: 12/02/2020	DATE:	DATE:

Causeway Quick Storage Estimate

Rainfall Methodology	FSR
FSR Region	England & Wales
M5-60 (mm)	17.000
Ratio-R	0.300
Summer CV	<input checked="" type="checkbox"/> 0.750
Winter CV	<input checked="" type="checkbox"/> 0.840
Analysis Speed	Normal
Skip Steady State	<input type="checkbox"/>
Drain Down Time (mins)	240
Additional Storage (m³/ha)	20.0
<input checked="" type="checkbox"/> Check Discharge Rate(s)	Calc
1 year (l/s)	27.8
30 year (l/s)	56.9
100 year (l/s)	68.9
<input type="checkbox"/> Check Discharge Volume	Calc
100 year 360 minute (m³)	
Storage Estimate	Calc

Attenuation calculations are based on no infiltration to ground as a 'worst case' estimate. Discharge rates based on rates agreed during Phase 1 design

Storage Estimate

Return Period (years)	30
Climate Change (%)	0
Impermeable Area (ha)	0.390
Peak Discharge (l/s)	14.800
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	41
to	79
With infiltration (m³)	
from	
to	

Storage Estimate

Return Period (years)	100
Climate Change (%)	30
Impermeable Area (ha)	0.390
Peak Discharge (l/s)	17.000
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	88
to	161
With infiltration (m³)	
from	
to	

Based on the calculations, approximately 60m³ of storage would be required to attenuate for the 1 in 30 year storm event and 125m³ of storage would be required to attenuate for the 1 in 100 year storm event.

Calculation Sheet



REF:

CLIENT: Brymbo Developments Ltd.	PROJECT: Former Brymbo Steelworks	JOB NO.: ST16882	CALC. REF. NO.:
		PAGE:	OF
CALCULATION	CALC. BY:	CHECKED BY:	APPROVED BY:
Attenuation Calculation - Outfall F 1 in 30 year and 1 in 100 year storm event	(NAME AND SIGNATURE)	(NAME AND SIGNATURE)	(NAME AND SIGNATURE)
	P Maddock		
	DATE: 12/02/2020	DATE:	DATE:

Causeway Quick Storage Estimate

Rainfall Methodology	FSR
FSR Region	England & Wales
M5-60 (mm)	17.000
Ratio-R	0.300
Summer CV	<input checked="" type="checkbox"/> 0.750
Winter CV	<input checked="" type="checkbox"/> 0.840
Analysis Speed	Normal
Skip Steady State	<input type="checkbox"/>
Drain Down Time (mins)	240
Additional Storage (m³/ha)	20.0
<input checked="" type="checkbox"/> Check Discharge Rate(s)	Calc
1 year (l/s)	27.8
30 year (l/s)	56.9
100 year (l/s)	68.9
<input type="checkbox"/> Check Discharge Volume	Calc
100 year 360 minute (m³)	
Storage Estimate	Calc

Attenuation calculations are based on no infiltration to ground as a 'worst case' estimate. Discharge rates based on rates agreed during Phase 1 design

Storage Estimate

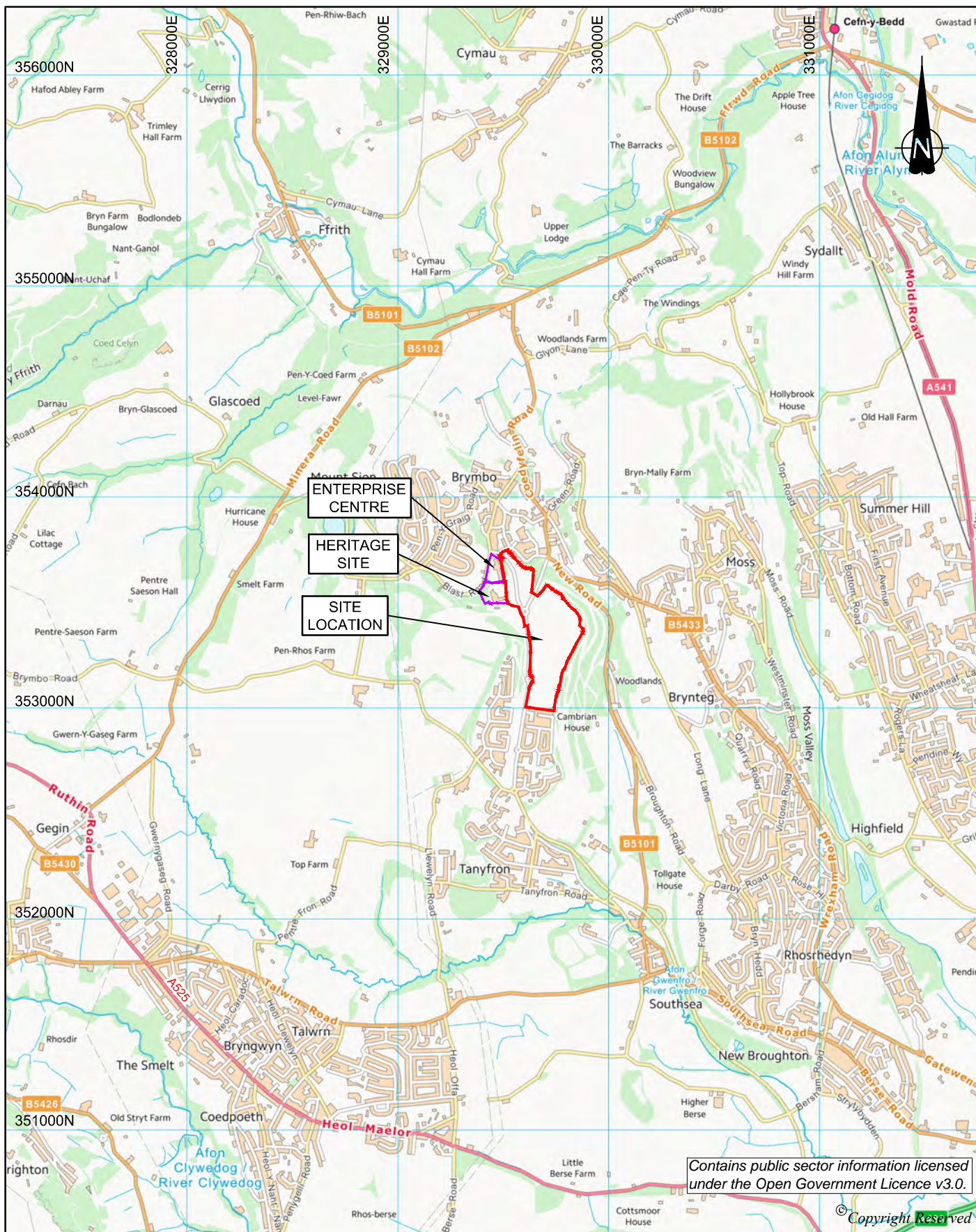
Return Period (years)	30
Climate Change (%)	0
Impermeable Area (ha)	0.360
Peak Discharge (l/s)	62.400
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	9
to	31
With infiltration (m³)	
from	
to	

Storage Estimate

Return Period (years)	100
Climate Change (%)	30
Impermeable Area (ha)	0.360
Peak Discharge (l/s)	72.000
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	
Required Storage (m³)	Calc
from	25
to	68
With infiltration (m³)	
from	
to	


Based on the calculations, approximately 20m³ of storage would be required to attenuate for the 1 in 30 year storm event and 47m³ of storage would be required to attenuate for the 1 in 100 year storm event.

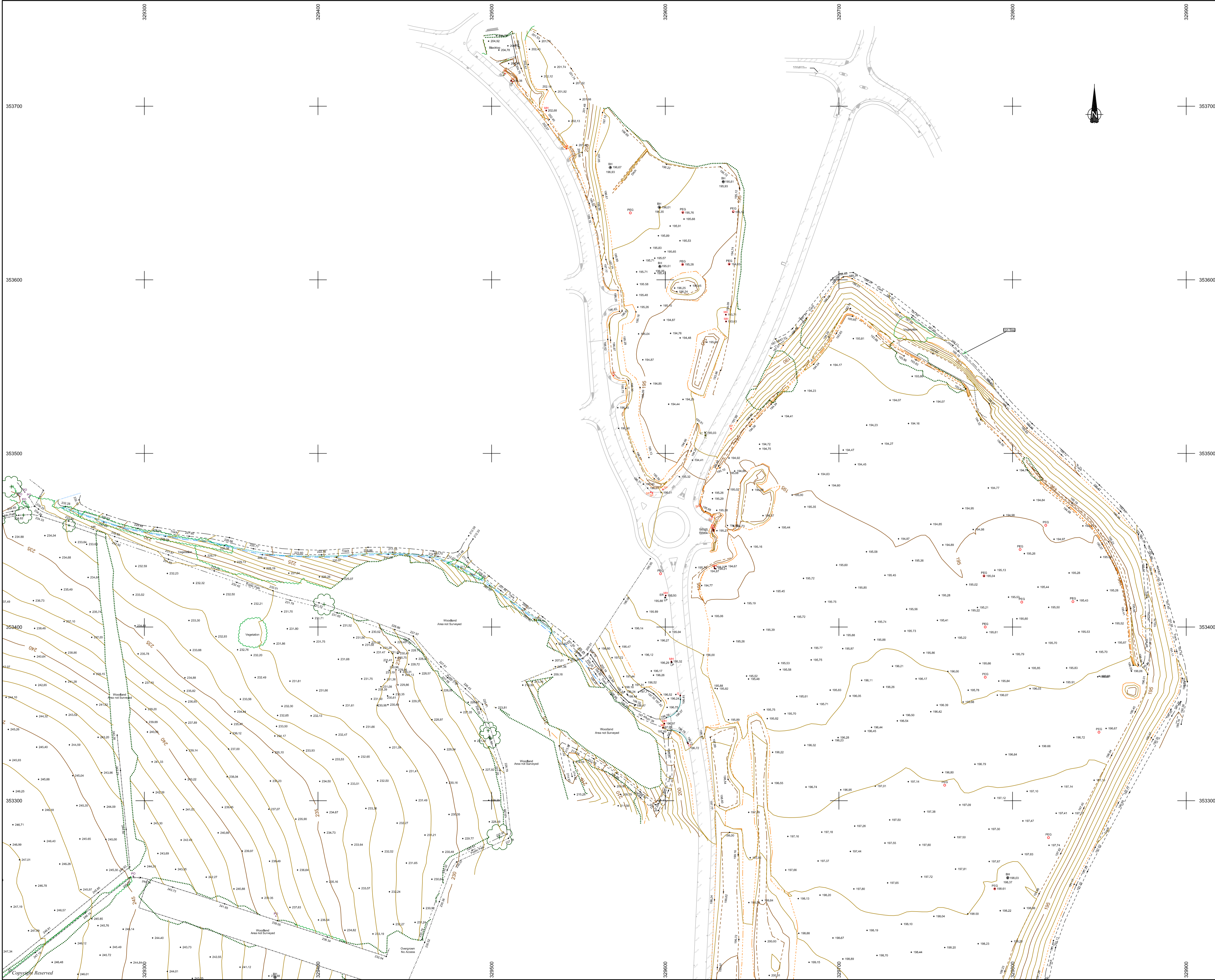
DRAWINGS



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CLIENT Parkhill Estates	DRG No. ST16882-008	REV A
PROJECT Former Brymbo Steelworks, Wrexham: Link Road Development Module	SIZE A4	SCALE 1:25,000
DRAWING TITLE Site Location	DRAWN BY DR	CHECKED BY BG
		DATE 07-11-18 APPROVED BY JG



DO NOT SCALE FROM THIS DRAWING

KEY

Post and Wire Fence 1.0m height

Wooden Fence 1.0m height

.....

Canopy

Bottom of Bank

Top of Bank

Tarmac Edge

Wall

Crash Barrier

Gate

Vegetation

Palisade Security Fencing 2.10m

Ditch

Building

Bottom Kerb

Drop Kerb

Overhead Cable

Normal Contours 1m interval

Prominent Contours 5m interval

+

Trees

○

Iron Peg

BH

Borehole

MH

Manhole

202.68

Spot Level

194.23

Spot Level

PO

Post

IC

Inspection Cover

EH

Eave Height

249.0

Spot Level

SV

Stop Valve

WO

Wash Out

EP

Electric Pole

MR

Marker Point

GV

Gas Valve

IB

Inspection Box

B

Bollard

SP

Sign Post

ER

Earth Rod

G

Gully

GRID AND LEVELS TO NATIONAL GRID
PROJECTION OSTN 15 AND OSGM 15

Note:

As Built drawing in Light Grey provided by Parkhill Estates

REVISION	DETAILS	DATE	DRAWN	CHECKED	APP'D

CLIENT

Parkhill Estates

PROJECT

Former Brymbo Steelworks, Wrexham

DRAWING TITLE

Topographic Survey
Date of Survey 14 - 08 - 2018

DRG No.	ST16882-006 1 of 3	REV	
DRG SIZE	A1	SCALE	1:1000
DRAWN BY	GP	CHECKED BY	SR
		APPROVED BY	SW

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TEL 0192 278700

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BIRMINGHAM

GLASGOW

MANCHESTER

CARLISLE

LEIGH

SHEFFIELD

CRYSDON

LONDON

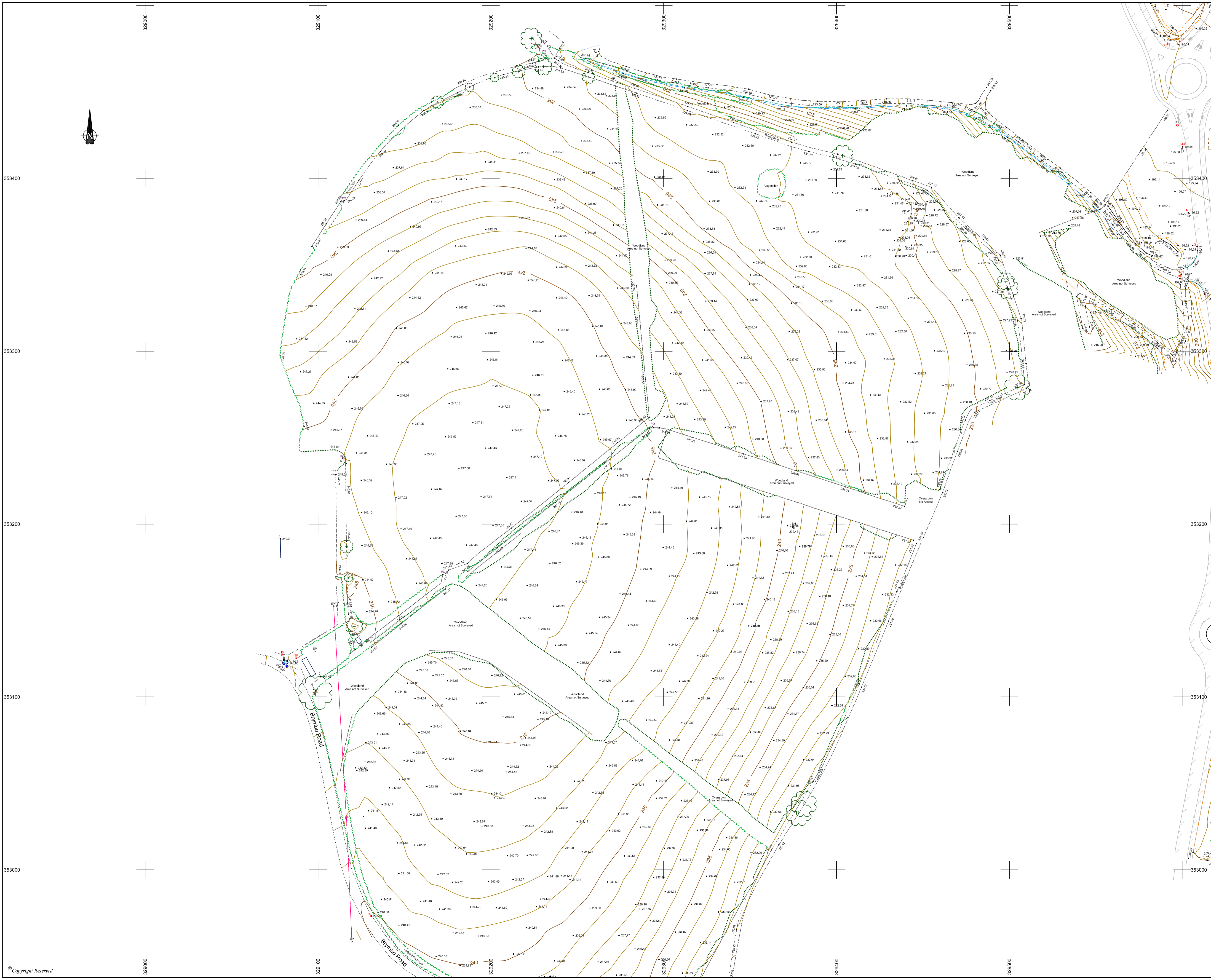
TAUNTON

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N:\ST16882-FORMER BRYMBO STEELWORKS\3-D\GDAUTOCAD\ST16882-006-PL1\TOPOGRAPHICAL SURVEY.DWG



DO NOT SCALE FROM THIS DRAWING


KEY

- Post and Wire Fence 1.0m height
- Wooden Fence 1.0m height
- Canopy
- Bottom of Bank
- Top of Bank
- Tarmac Edge
- Wall
- Crash Barrier
- Gate
- Vegetation
- Palisade Security Fencing 2.10m
- Ditch
- Building
- Bottom Kerb
- Drop Kerb
- Overhead Cable
- Normal Contours 1m interval
- Prominent Contours 5m interval
- Trees
- PEG
- BH
- MH 202.68
- 194.23
- PO
- IC
- EH 249.0
- SV
- WO
- EP
- MR
- GV
- IB
- B
- SP
- ER
- G
- 239.84

GRID AND LEVELS TO NATIONAL GRID
PROJECTION OSTN 15 AND OSGM 15

Note:
As Built drawing in Light Grey provided by Parkhill Estates

REVISION	DETAILS			DATE	DRAWN
CLIENT	Parkhill Estates				
PROJECT	Former Brymbo Steelworks, Wrexham				
DRAWING TITLE					
Topographic Survey Date of Survey 14 - 08 - 2018					
DRG No.	ST16882-006 2 of 3			REV	
DRG SIZE	A1	SCALE	1:1000	DATE	31 - 08 - 2018
DRAWN BY	GP	CHECKED BY	SR	APPROVED BY	SW
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<div><input type="checkbox"/> BIRMINGHAM</div>		<div><input type="checkbox"/> CARDIFF</div>		<div><input type="checkbox"/> CARLISLE</div>	
<div><input type="checkbox"/> EDINBURGH</div>		<div><input type="checkbox"/> GLASGOW</div>		<div><input type="checkbox"/> LEIGH</div>	
<div><input type="checkbox"/> MANCHESTER</div>		<div><input type="checkbox"/> NEWCASTLE UPON TYNE</div>		<div><input type="checkbox"/> SHEFFIELD</div>	
				<div><input type="checkbox"/> CROYDON</div>	
				<div><input type="checkbox"/> LONDON</div>	
				<div><input type="checkbox"/> TAUNTON</div>	



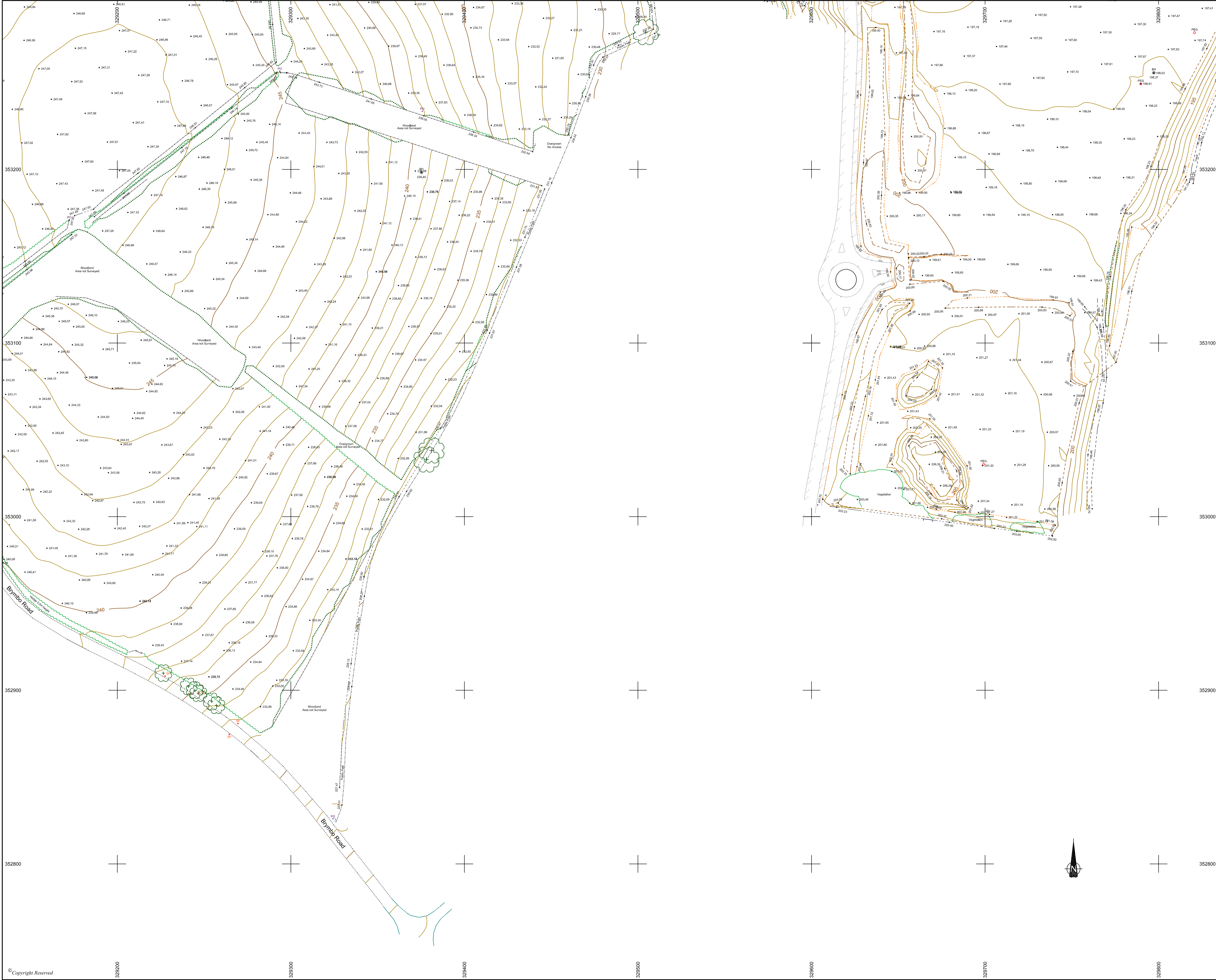
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DO NOT SCALE FROM THIS DRAWING

- KEY
- Post and Wire Fence 1.0m height
 - Wooden Fence 1.0m height
 - Canopy
 - Bottom of Bank
 - Top of Bank
 - Tarmac Edge
 - Wall
 - Crash Barrier
 - Gate
 - Vegetation
 - Palisade Security Fencing 2.10m
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 - Drop Kerb
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 - SV
 - WO
 - EP
 - MR
 - GV
 - IB
 - B
 - SP
 - ER
 - G

GRID AND LEVELS TO NATIONAL GRID
PROJECTION OSTN 15 AND OSGM 15

Note:
As Built drawing in Light Grey provided by Parkhill Estates

REVISION	DETAILS	DATE	DRAWN	CHECKED	APPROVED
1					

CLIENT
Parkhill Estates

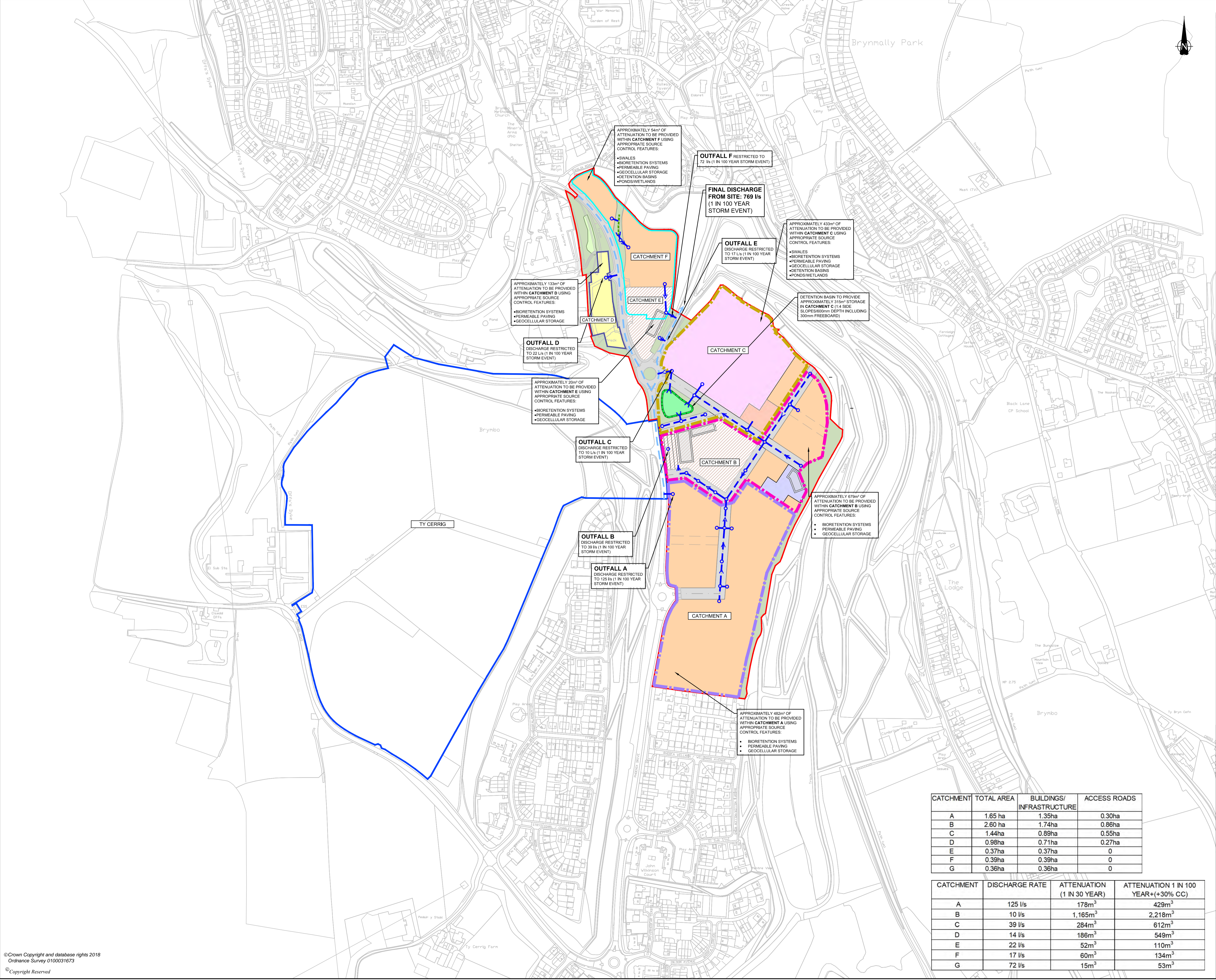
PROJECT
Former Brymbo Steelworks, Wrexham

DRAWING TITLE
Topographic Survey
Date of Survey 14 - 08 - 2018

DRG No.	ST16882-006 3 of 3	REV	
DRG SIZE	A1	SCALE	1:1000
DRAWN BY	GP	CHECKED BY	SR
		APPROVED BY	SW

<input type="checkbox"/> BIRMINGHAM	<input type="checkbox"/> CARDIFF	<input type="checkbox"/> CARLISLE	<input type="checkbox"/> CROYDON
<input type="checkbox"/> EDINBURGH	<input type="checkbox"/> GLASGOW	<input type="checkbox"/> LEIGH	<input type="checkbox"/> LONDON
<input type="checkbox"/> MANCHESTER	<input type="checkbox"/> NEWCASTLE UPON TYNE	<input type="checkbox"/> SHEFFIELD	<input type="checkbox"/> TAUNTON





DO NOT SCALE FROM THIS DRAWING

NOTES

1. TO BE READ IN CONJUNCTION WITH FLOOD RISK ASSESSMENT REPORT.

2. DRAINAGE STRATEGY IS INDICATIVE ONLY AND SUBJECT TO DETAILED DESIGN.

KEY

SITE BOUNDARY

ADJACENT LAND IN APPLICANT OWNERSHIP

PROPOSED SURFACE WATER DRAIN

EXISTING SURFACE WATER DRAIN

PROPOSED DETENTION BASIN

PROPOSED SWALE (CONVEYANCE)

PROPOSED HEADWALL

RESIDENTIAL (0.35 DENSITY)

RESIDENTIAL DISTRICT CENTRE (0.60 DENSITY)

RETAIL AND LEISURE (0.95 DENSITY)

HEALTH CENTRE (0.95 DENSITY)

PRIMARY SCHOOL (0.2 DENSITY)

ACCESS / INFRASTRUCTURE

SHARED CAR PARKING AND PUBLIC REALM (0.95 DENSITY)

PUBLIC OPEN SPACE

FOOTPATH NETWORK

REVISIONS

B	Catchment Areas Ty Cerrig Catchment Removed	24/02/20	PM		
A	First Issue	25/03/19	5.8	BG	TJP

CLIENT

Parkhill Estates

PROJECT

Former Brymbo Steelworks, Wrexham:
Link Road Development Module

DRAWING TITLE

Indicative Surface Water Management Plan

DRG No.

ST16882-007

REV

A

DRG SIZE

A1

SCALE

1:2500

DATE

15-10-18

DRAWN BY

DR

CHECKED BY

BG

APPROVED BY

TJP

STOKE ON TRENT (TEL: 01782 278700)
WWW.WARDELL-ARMSTRONG.COM

BIRMINGHAM

BOLTON

CARDIFF

CHATHAM

EDINBURGH

GLASGOW

LONDON

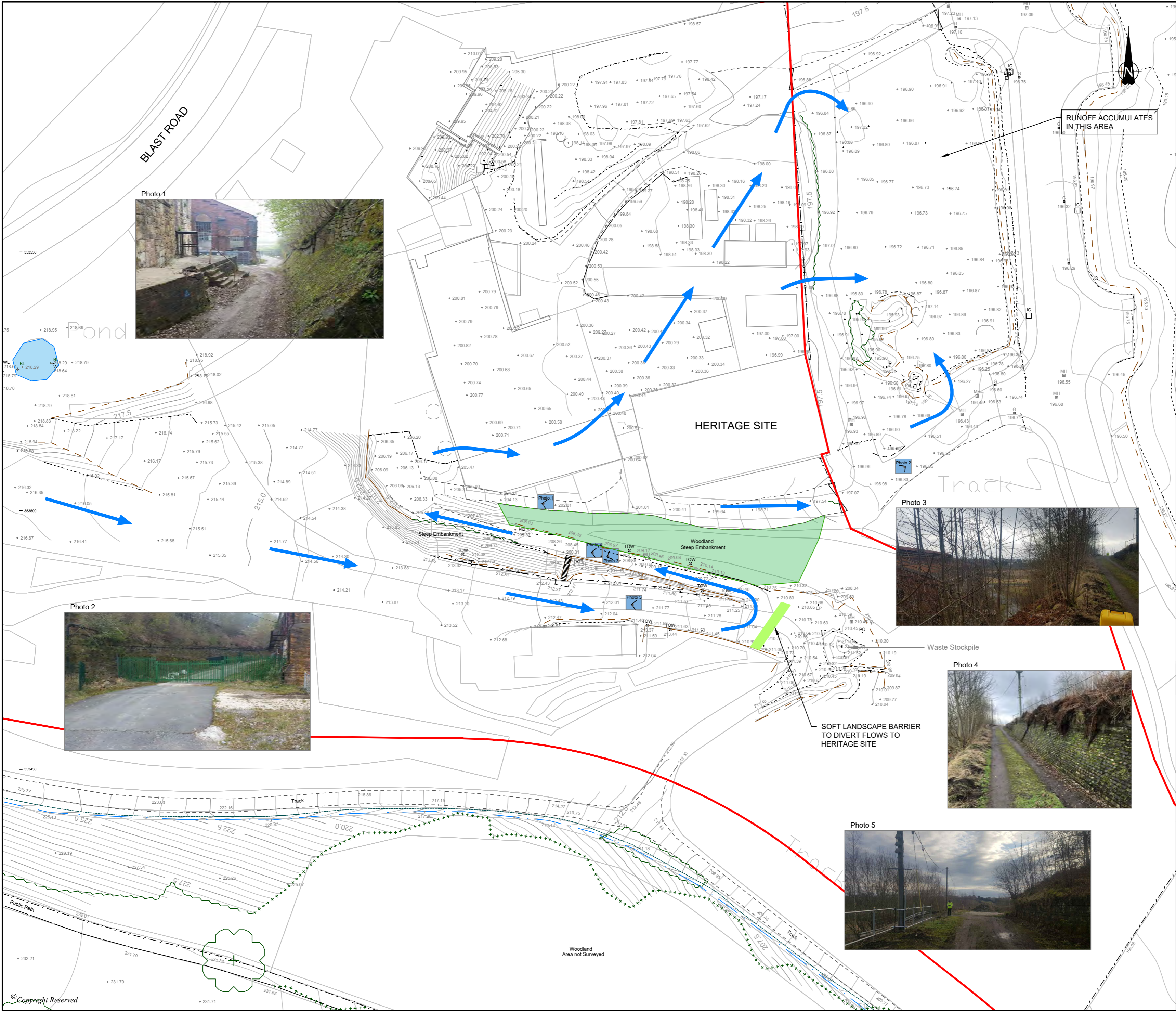
MANCHESTER

MANCHESTER

SHEFFIELD

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N:\ST16882 - FORMER BRYMBO STEELWORKS\3 - DESIGN\AUTOCAD\SCRATCH\ST16882-007-3 - INDICATIVE SURFACE WATER MANAGEMENT PLANNING



DO NOT SCALE FROM THIS DRAWING

- NOTES:
1. TO BE READ IN CONJUNCTION WITH FLOOD CONSEQUENCE ASSESSMENT REPORT (REF ST16882-0002).
 2. TOPOGRAPHY BASED ON TOPOGRAPHICAL SURVEYS UNDERTAKEN BY WARDELL ARMSTRONG IN 2019 AND 2020.

- KEY
- SITE BOUNDARY
 - EXISTING OVERLAND FLOW ROUTE (INDICATIVE)
 - PROPOSED SOFT LANDSCAPE BARRIER

RUNOFF ACCUMULATES IN THIS AREA

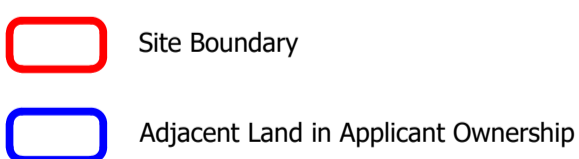
HERITAGE SITE

Photo 4

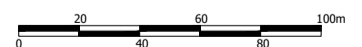
SOFT LANDSCAPE BARRIER TO DIVERT FLOWS TO HERITAGE SITE

Photo 5

A	FIRST ISSUE				03-03-20	DR	BG	JG
REVISION	DETAILS				DATE	DRAWN	CHKD	APPD
CLIENT								
PARKHILL ESTATES LTD								
PROJECT								
FORMER BRYMBO STEELWORKS, WREXHAM LINK ROAD DEVELOPMENT MODULE								
DRAWING TITLE								
OVERLAND FLOW ROUTES								
DRG No. ST16882-060					REV A			
DRG SIZE A2		SCALE 1:500			DATE 02-03-20			
DRAWN BY DR		CHECKED BY BG			APPROVED BY JG			
<div><div><div>wardell armstrong</div></div><div><div><div>■</div><div>STOKE ON TRENT TEL 01782 276700 WWW.WARDELL-ARMSTRONG.COM</div></div><div><div><div><input type="checkbox"/> BIRMINGHAM</div><div><input type="checkbox"/> GLASGOW</div><div><input type="checkbox"/> BOLTON</div><div><input type="checkbox"/> LEEDS</div><div><input type="checkbox"/> CARDIFF</div><div><input type="checkbox"/> LONDON</div><div><input type="checkbox"/> CARLISLE</div><div><input type="checkbox"/> MANCHESTER</div><div><input type="checkbox"/> EDINBURGH</div><div><input type="checkbox"/> NEWCASTLE UPON TYNE</div></div></div></div></div>								

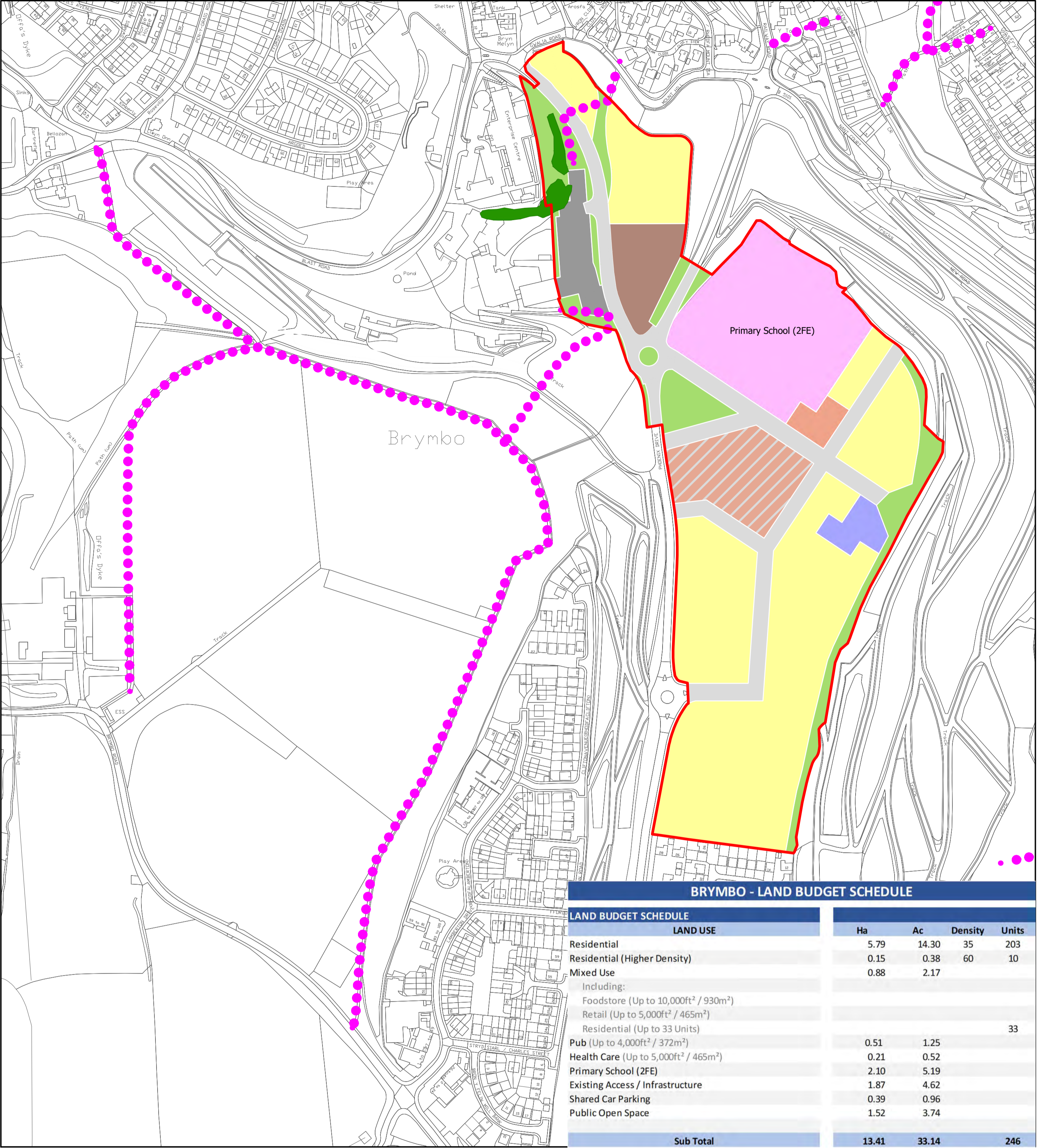


Drawing Title			
Site Boundary			
Date	Scale	Drawn by	Check by
06.09.18	1:2500@A2	ALC	VA
Project No	Drawing No	Revision	
27968	RG-M-04	B	



Planning • Master Planning & Urban Design • Architecture •
Landscape Planning & Design • Environmental Planning • Graphic
Communication • Public Engagement • Development Economics





- Site Boundary Boundary
- Residential
- Residential (Higher Density)
- Pub/Restaurant
- Mixed Use
(Foodstore, retail & residential)
- Non Residential Use
- Primary School (2FE)
- Existing Access / Infrastructure
- Shared Car Parking and Public Realm
- Public Open Space
- Existing Public Right of Way

Project
Brymbo Park

Drawing Title
Land Use Plan

Date
06.09.18

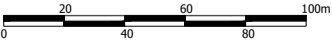
Scale
1:2500@A2

Project No
27968

Drawn by
ALC

Check by
VA

Revision
K

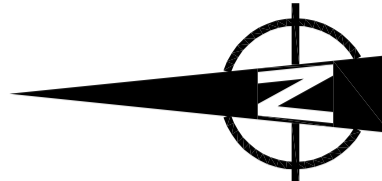
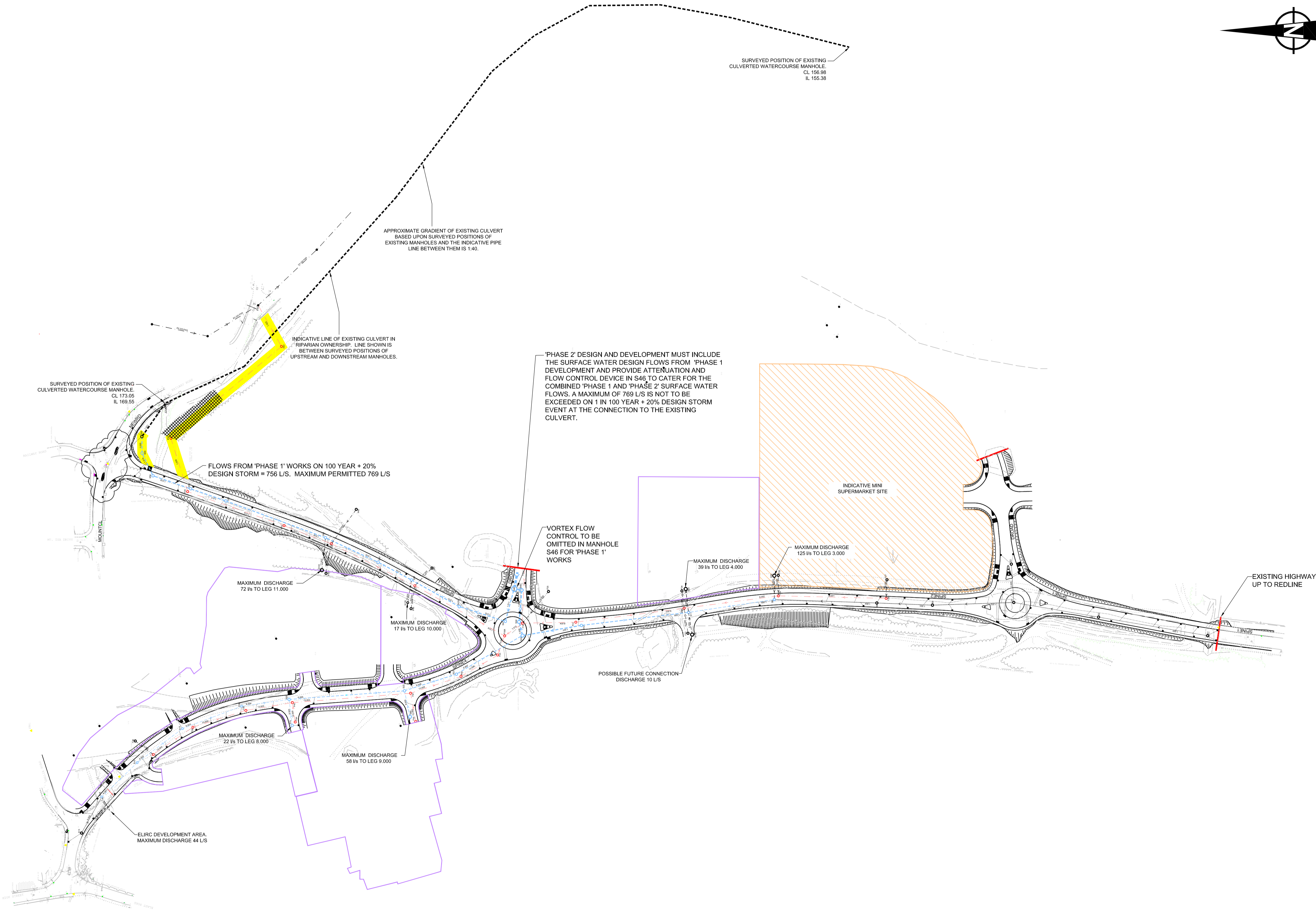


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Communication • Public Engagement • Development Economics
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2001
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This drawing is for Preliminary purposes only and is subject to amendment during design development. UNDER NO CIRCUMSTANCES MUST THIS DRAWING BE USED FOR CONSTRUCTION PURPOSES

KEY

- PROPOSED S104 SURFACE WATER DRAIN.
- PROPOSED S104 FOUL WATER DRAINAGE.
- PROPOSED GULLY AND CONNECTION.
- PROPOSED HIGHWAY DRAIN.
- PRIVATE FOUL WATER CONNECTION.
- PRIVATE STORM WATER CONNECTION.
- PROPOSED S104 SEWER EASEMENT.
- DRAINAGE AREA BOUNDARIES.
- CULVERT IN RIPARIAN OWNERSHIP

NOTES

- IF RECEIVED ELECTRONICALLY IT IS THE RECIPIENT'S RESPONSIBILITY TO PRINT TO THE CORRECT SCALE. ONLY WRITTEN DIMENSIONS SHALL BE USED.
- ALL ADOPTABLE DRAINAGE WORKS TO BE INCLUDED IN THE S104 AGREEMENT IS TO BE IN ACCORDANCE WITH 'SEWERS FOR ADOPTION 8th EDITION' AND ALL REQUIREMENTS OF DWR CYMRU WELSH WATER AS THE STATUTORY SEWERAGE UNDERTAKER.
- THE CONTRACTOR IS TO CONFIRM POSITION LEVELS & SIZE OF EXISTING DRAINAGE & WATERCOURSES PRIOR TO THE COMMENCEMENT OF DRAINAGE WORKS, WHERE APPLICABLE.
- THE FOLLOWING PIPE TYPES & BEDDING HAVE BEEN ASSUMED IN THE DESIGN:
 - (i) CARRIER DRAIN 150MM DIA VITRIFIED CLAY TO BS EN 295, MIN CRUSHING STRENGTH 28 KNM ON TYPE S TRENCH & BEDDING (DEPTH OF COVER 1.2M OR GREATER), OR 150MM CONCRETE BED AND SURROUND (DEPTH OF COVER LESS THAN 1.2M.
 - (ii) CARRIER DRAIN 225 & 300MM DIA VITRIFIED CLAY TO BS EN 295, MIN STRENGTH CLASS 160 ON TYPE S TRENCH & BEDDING (DEPTH OF COVER 1.2M OR GREATER), OR 150MM CONCRETE BED AND SURROUND (DEPTH OF COVER LESS THAN 1.2M, OR AS SPECIFIED ON RELEVANT LONG SECTIONS.
 - (iii) CARRIER DRAINS 375mm DIA AND ABOVE TO COMPRISE CONCRETE CLASS 120 ON TRENCH AND BEDDING AS SPECIFIED ON RELEVANT LONGITUDINAL SECTIONS.
 - (iv) GULLY CONNECTIONS TO COMPRISE 150MM DIA VITRIFIED CLAY TO BS EN 295, MIN STRENGTH 28KN/m WITH 150MM CONCRETE BED AND SURROUND WHERE COVER IS LESS THAN 1.2M.
- BACKFILLING OF DRAINS AND SEWERS SITUATED BELOW CARRIAGEWAYS, PAVED AREAS AND FOOTWAYS SHALL BE WITH TYPE 1 SUBBASE TO SHW CLAUSE 803.
- EXISTING ROADS TO BE REINSTATED IN ACCORDANCE WITH THE SPECIFICATION FOR THE REINSTATEMENT OF OPENINGS IN HIGHWAYS SECOND EDITION DATED JUNE 2002, ROAD CATEGORY TYPE 2 ALL PERMANENT WHERE APPLICABLE.
- FOR COVER AND INVERT LEVELS REFER TO THE LONGITUDINAL SECTIONS AND CHAMBER SCHEDULES.
- ALL HIGHWAY DRAINS TO BE ADOPTED AS PART OF THE SECTION 38 AGREEMENT ARE TO BE CONSTRUCTED TO THE HIGHWAY AUTHORITY (WREXHAM BC) STANDARDS.

DRAWING UPDATED TO URS BORDER AND JOB NUMBER. UPDATED TOPOGRAPHICAL SURVEY ADDED ALIGNMENTS AND DRAINAGE ADJUSTED TO SUIT. DRAINAGE REVISED TO SUIT PHASE 1 TO ROAD REMOVED.	SJ/CJ/CH	12.02.14	G
SURFACE WATER OUTFALL AMENDED EXISTING CULVERT INFORMATION ADDED.	SJ/CJ/AL	26.01.12	F
PLOT REFERENCES ADDED.	SJ/CJ/AL	02.06.11	E
EASEMENT AT SURFACE WATER OUTFALL EXTENDED 3m. CULVERTED WATERCOURSE COLOUR AMENDED.	SJ/CJ/AL	12.06.11	D
STRT AMENDMENTS: FOUL OUTFALL AMENDED TO SUIT. REVISED OUTFALL POINT.	SJ/CJ/AL	27.01.11	C
MINOR REVISIONS TO SURFACE AND FOUL WATER NETWORKS.	SJ/CJ/AL	20.05.10	B
DRAINAGE RE-DESIGN PLAN AMENDED TO SUIT.	SJ/CJ/AL	14.12.09	A

Revision Details

By Check Date Suffix

Drawing Status

P - PRELIMINARY

Client

BRYMBO DEVELOPMENTS LTD

Project Title

BRYMBO DEVELOPMENT
BRYMBO
WREXHAM

Drawing Title

SITE WIDE DRAINAGE
PROPOSALS

Drawn SJC	Checked CEH	Approved	Date 16/12/13
URS Internal Project No. 47067923	Subsidiary N/A		
Scale @ A1 1:500	Zone / Mileage N/A		

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P 47067923/43	G

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