



WALES & WEST HOUSING ASSOCIATION

**DEVELOPMENT OF
FORMER GAS WORKS
RIVULET ROAD
WREXHAM**

FLOOD CONSEQUENCES ASSESSMENT

**DECEMBER 2009
Ref: 3609**

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*DEVELOPMENT OF FORMER GAS WORKS, RIVULET ROAD, WREXHAM
Flood Consequences Assessment*



PREFACE

The following report was prepared on behalf of Gower Homes in July 2005, reviewed in August 2006, and approved by Environment Agency Wales on 06 December 2007.

The layout drawings appended to the original report have now been substituted to show the scheme as now proposed by Wales and West Housing Association

The data and analysis used in compilation of the 2006 Report remain unchanged and the revised site plan does not affect the conclusions drawn.

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RICHARD BROUN ASSOCIATES
December 2009



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~~Lovelock Mitchell~~

05-46-002-P1 Proposed Site Plan

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1.0 INTRODUCTION

- 1.1 This report records the results of a flood consequences assessment for a proposed residential development at the former Gas Works site, Rivulet Road, Wrexham which has been undertaken at the instruction of Gower Homes.
- 1.2 The assessment has been prepared in accordance with the Planning Policy Wales Technical Advice Note 15: Development and Flood Risk, which was issued by the Welsh Assembly Government in July 2004.
- 1.3 This document provides a recommended methodology for assessing the flooding consequences on any new development and represents the best information available at the current time.

2.0 BACKGROUND

- 2.1 The proposed development is located on the former Gas Works site, Rivulet Road, Wrexham (see Site Location Plan, **Drawing N° 3116/01 in Appendix A**).
- 2.2 The Afon Gwenfro flows adjacent to one end of the site and indicative flood maps (IFM) available on the Environment Agency's web site and Development Advice Maps (DAM) issued by the Welsh Assembly Government (WAG) indicate that the area lies on the edge of the fluvial flood plain and is therefore potentially "at risk" during extreme storm conditions should overtopping of the river banks occur (see **Drawings N° 3116/02 & 03 in Appendix A**).
- 2.3 Based on this information, it is considered possible that the Agency may advise the Planning Authority that it **OBJECTS** in principle to the development proposals which would result in increased occupancy within a flood risk zone.
- 2.4 The Agency has, however, previously commissioned an hydrological assessment of the contributing catchment (in accordance with Section 105 of the Water Resources Act) to establish the predicted flood envelope for a 1% annual probability storm (*ie* 1 in 100 year return period event). This suggests that only a narrow margin of the development site adjacent to Rivulet Road floods during extreme storm conditions.
- 2.5 It is considered possible, therefore, that the Environment Agency may be prepared to confirm that it has no objections to the development of the site, provided a flood consequence assessment has been prepared and any required mitigation works are incorporated into the proposals to minimise the effect of any future flooding on the new houses.
- 2.6 This report therefore examines the extent of any flooding, assesses the risks associated with the proposed development and suggests mitigation measures which would reduce the effect of any future inundation.



3.0 DEVELOPMENT PROPOSALS

- 3.1 The former gas works site is generally on two levels, a flat lower area adjacent to Rivulet Road and a sloping upper area adjoining Greenbank Street. A series of retaining structures and steep embankments currently separate the two parts of the site.
- 3.2 The current proposals involve the construction of a mixed residential development comprising two/three storey town houses and three to five storey apartment blocks on the lower area, with vehicular access to the site provided off Rivulet Road (via existing entrances) and Greenbank Street.
- 3.3 Due to its previous uses, the site is contaminated and although a remedial scheme has already been undertaken to make the site suitable for industrial development, it is likely that further work will be required as part of the current proposals.
- 3.4 At this stage it is anticipated that this will involve the introduction of a clean imported capping layer, approximately 600mm thick to raise the level of all of the lower area and parts of the upper area.

4.0 JUSTIFICATION OF THE SITE DEVELOPMENT

- 4.1 Although the site lies adjacent to an area where there is a potential risk of future flooding, development provides a significant environmental advantage by treating a contaminated, "brownfield" site and bringing it back into beneficial use.
- 4.2 This strategy is consistent with the aims and objectives of Planning Policy Wales (PPW) and Local Planning Policies which state a preference for the use of previously-developed land before "greenfield" sites and makes it clear that redevelopment of this type of land in built up areas can assist in meeting sustainability objectives.



5.0 FLOOD CONSEQUENCES ASSESSMENT

5.1 Existing Conditions

- 5.1.1 A Site Location Plan (**Drawing N ° 3116/01**) showing the relationship of the site to the Afon Gwenfro is included in **Appendix A**. Photographs of the site and the surround area are included in **Appendix B**.
- 5.1.2 Results of an hydraulic assessment of this watercourse (in accordance with Section 105 of the Water Resources Act) commissioned by the Environment Agency, indicate that a narrow margin of the development site adjacent to Rivulet Road floods under 1% annual probability storm conditions (ie 1 in 100 year return period events).
- 5.1.3 However, this assessment is 'theoretical' in nature in that it is based on "unrestricted" flow conditions and can therefore only occur if and when the undersized culverts and channels upstream of the site have been replaced/improved.
- 5.1.4 In reality, however, local knowledge (particularly that of Wrexham County Borough Council (WCBC)) suggests that, despite the existing flow restrictions, localised flooding does occur in the immediate vicinity of the site due to the inadequate capacity of these culverts.
- 5.1.5 In particular, the appraisal of the Cambrian Industrial Estate culvert undertaken for WCBC, as part of a Project Appraisal Report (PAR), confirms that its cross section reduces significantly from the upstream to the downstream end, with the result that during extreme storm events it regularly causes water to back up and over-top the left hand riverbank into the Musical Theatre car park and from there onto the public highway.
- 5.1.6 During these events, flood water runs along Rivulet Road (past the frontage of the development site) where it is generally contained within the carriageway by the deployment of sandbags on each kerb line in order to prevent inundation of the adjacent residential properties.
- 5.1.7 An inspection of the local topography suggests that, without this intervention, part of the site may flood during particularly extreme storm events. However, the existing road levels are such that any flood water would tend to flow away from the site toward the junction of Rivulet Road and Hightown Road. It is therefore considered that the maximum depth of flooding of the site that is likely to occur will be less than 100mm.



5.0 FLOOD CONSEQUENCES ASSESSMENT (continued)

5.2 Existing and Proposed Site Levels

- 5.2.1 The existing ground levels across the lower area of the site range from approximately 71.08m AOD to 73.66m AOD with road levels in Rivulet Road adjacent to the site extending between approximately 70.85m AOD to 72.02m AOD. The road levels generally fall towards the junction with Hightown Road (see **Drawing N° 3116/04** in **Appendix A.**)
- 5.2.2 Because of the need to treat the site to contain the contamination resulting from previous uses, it is proposed to raise the existing ground levels by approximately 600mm by the introduction of imported fill material to form a clean capping layer.
- 5.2.3 It is anticipated that, following these remediation works, the ground levels on the lower area of the site will range from approximately 71.5m AOD to 72.40m AOD with the road levels in Rivulet Road remaining substantially unaltered.

5.3 Consideration of 0.1% Annual Probability Storm Events

- 5.3.1 The EA's Section 105 model currently only considers a 1% flood event. Whilst it is understood that this model is to be updated to include 0.1% conditions, this information is not yet available.
- 5.3.2 For the purposes of this report, the 0.1% fluvial flow has therefore been estimated as 31.89m³/s (based on the factors provided in the Flood Studies Report (FSR)).
- 5.3.3 Based on a preliminary hydraulic analysis, it is probable that for "unrestricted" flow conditions, the existing site would flood to a slightly greater depth than for the 1% storm events.
- 5.3.4 However, once the site levels are raised as part of the remedial scheme, the new properties would not be at risk.

5.4 Other Potential Sources of Flooding

- 5.4.1 In addition to the potential fluvial flooding, any surface water or highway drainage systems which discharge into the Afon Gwenfro could be adversely affected by high water levels and could therefore back up.
- 5.4.2 However, the volume of water generated by the existing drainage systems would be insignificant in relation to the fluvial waters and therefore would not exacerbate the situation already considered.
- 5.4.3 Until such time as improvements are made to the existing culverts/channels upstream of the site, it is anticipated that the river will continue to break its banks at the Musical Theatre car park and the resulting flood water will flow down Rivulet Road during extreme storm events. Since the inundation resulting from this event replicates the "unrestricted" flow scenario, the effect on the development site would be no worse than already considered.



5.0 FLOOD CONSEQUENCES ASSESSMENT (continued)

5.5 Extent and Depth of Predicted Flood Events

- 5.5.1 The hydraulic analysis of the Afon Gwenfro undertaken as part of the PAR suggests that, as a result of the undersized nature of the Cambrian Road culvert, water will flood into the Musical Theatre car park and then onto Rivulet Road.
- 5.5.2 Following development, analysis shows that the proposed ground levels will be sufficiently high to prevent the site from being inundated, even during extreme storm events.
- 5.5.3 The extent of the predicted flood events following development of the site is shown on **Drawing N° 3116/06 in Appendix A.**

5.6 Emergency Access/Evacuation Routes

- 5.6.1 It is proposed that the finished ground floor levels of the buildings which are to be constructed on the lower area as part of the new development, be raised so that they are at least 600mm above the predicted 1 in 100 year flood level (ie to between 71.90 and 74.50m AOD). The remaining sections of the site will be raised as part of the remediation scheme to maintain vehicular and pedestrian access.
- 5.6.2 Whilst it is predicted that no flooding of the site will occur following development, it is possible that the surrounding roads may be affected. There will, however, still be a safe route for emergency access/evacuation if required, via the proposed footpath between the upper and lower areas of the site which leads to Greenbank Street. These routes are indicated on **Drawing N° 3116/06 in Appendix A.**
- 5.6.3 In addition, it is anticipated that the depth of flood water in Rivulet Road will not be sufficient to impede the progress of emergency vehicles.

5.7 Speed of Flooding

- 5.7.1 It is not possible at this stage to predict the speed at which flooding of the road surrounding the development site might occur, particularly if it results from overtopping of the riverbank by the Musical Theatre car park.
- 5.7.2 It is also possible that any future flooding may occur at night and it is therefore considered that it would be prudent to include the new development in any existing Flood Warning Scheme currently operated by the Environment Agency. This would allow the occupants of the building to secure their belongings by removing any valuable items from areas which could potentially be affected by flood waters (ie cars parked in Rivulet Road), if they so wished.



5.0 FLOOD CONSEQUENCES ASSESSMENT (continued)

5.8 Volume of Displaced Water

- 5.8.1 The need to raise the site levels as part of the remediation proposals will slightly reduce the volume of flood water that could be stored on the site during future inundation events if "unrestricted" flow conditions existed.
- 5.8.2 However, preliminary analysis demonstrates that raising the site level as part of the remediation scheme has little or no discernible effect on the volume of flood storage. The development will therefore have no significant adverse effect on adjacent properties.

6.0 CONCLUSIONS

- 6.1 Based on the assessment of the existing and proposed conditions, it is concluded that:
- During extreme storm events the inadequate capacity of the Cambrian Industrial Estate culvert causes flood water to flow along Rivulet Road where it is contained by WCBC before draining back into the Afon Gwenfro upstream of Cookes Weir.
 - Even if "unrestricted" flow conditions existed the inundation that would occur during extreme storm conditions is unlikely to be significantly worse than occurs at present
 - The former gas works site does not therefore form a significant part of the active flood plain and there will be no loss of storage capacity if the existing ground levels are raised as part of the proposed contaminated land remedial scheme.
 - The raising of the site will not have a significant effect on adjacent properties



7.0 MITIGATION MEASURES

- 7.1 **General:** It is clear from the assessment that the development site is adjacent to a flood risk area, although the site itself is not significantly affected by flood water. The following measures should however be incorporated into the development proposals to minimise the impact of any future inundation.
- 7.2 **Finished Floor Levels:** The new buildings on the lower area of the site should be at least two storey constructed with finished ground floor levels raised to between 71.70m AOD and 72.55m AOD, ie approximately 600mm above the predicted 1% flood level.
- 7.3 **Emergency Access/Evacuation Route:** An emergency access/evacuation route for pedestrians should be made available from the site via the proposed footpath between the upper and lower areas, although vehicles may be required to drive through flood water up to 150mm deep.
- 7.4 The new properties on the lower area of the site should be included in any Flood Warning System operated by WCBC or EAW.
- 7.5 **Foundation Construction:** The foundations of the new buildings constructed in the lower area should be designed to ensure that they are not adversely affected by high water levels in the Afon Gwenfro.
- 7.6 **Superstructure Construction:** The construction of the new buildings in the lower area should incorporate techniques recommended by 'Preparing for Floods' issued by the Office of the Deputy Prime Minister in October 2003 where applicable.
- 7.7 **Services:** Service entries into properties in the lower area should be located at a minimum height of 0.5m above the finished ground floor level.
- 7.8 **External Drainage:** Access covers to new manholes within the lower area should be fitted with locking devices which will prevent the covers being displaced by internal water pressure during flooding events.



8.0 SUMMARY

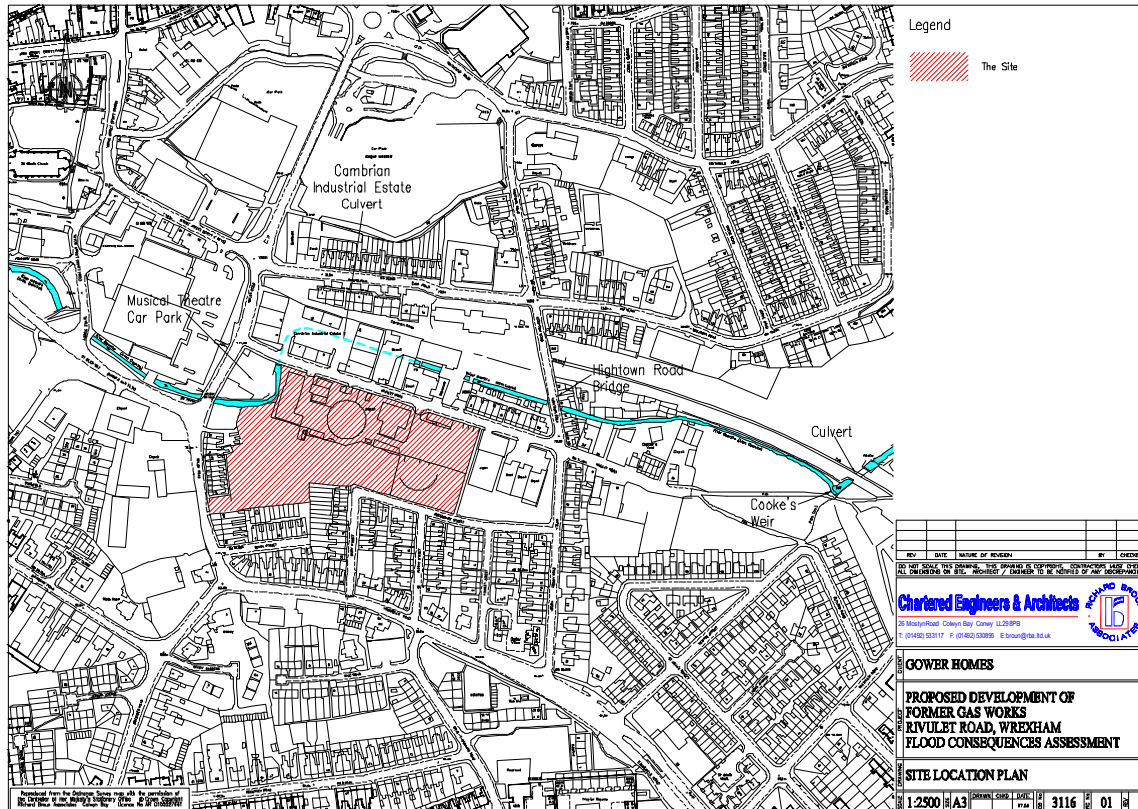
- 8.1 The Flood Consequences Assessment indicates that, whilst the development is within an area which is at risk of flooding during extreme storm conditions, the site itself is only marginally affected as a result of the Afon Gwenfro breaking its banks adjacent to the site.
- 8.2 Consideration has been given to the justification for developing the site, in view of the potential risk to the occupants of the proposed houses/apartments. It has been concluded, however, that the risks are minimal and that the environmental benefits that will result from the treatment of this contaminated "brownfield" site warrant its development.
- 8.3 The consequences of any future flooding of the area surrounding the site have been assessed and mitigation measures incorporated into the development proposals to reduce the impact of any future inundation. The extent of these works is detailed in Section 7.0 of this report.

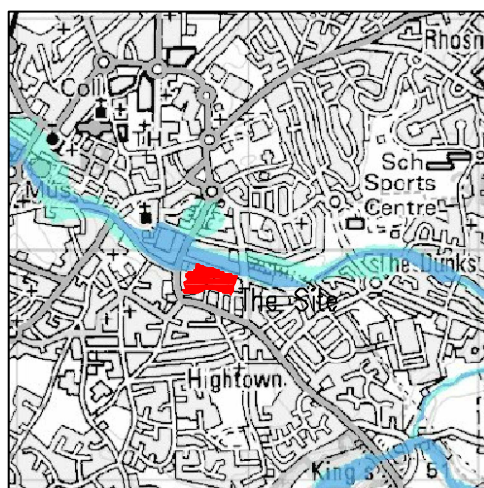
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RICHARD BROUN ASSOCIATES
July 2005 (Reviewed August 2006)

APPENDIX A:

DRAWINGS





					CLIENT					GOWER HOMES							
					PROJECT					PROPOSED DEVELOPMENT OF FORMER GAS WORKS RIVULET ROAD, WREXHAM FLOOD CONSEQUENCES ASSESSMENT							
					DRAWING					ENVIRONMENT AGENCY INDICATIVE ASSESSMENT OF FLOODING FOR 100 YEAR RETURN PERIOD STORMS							
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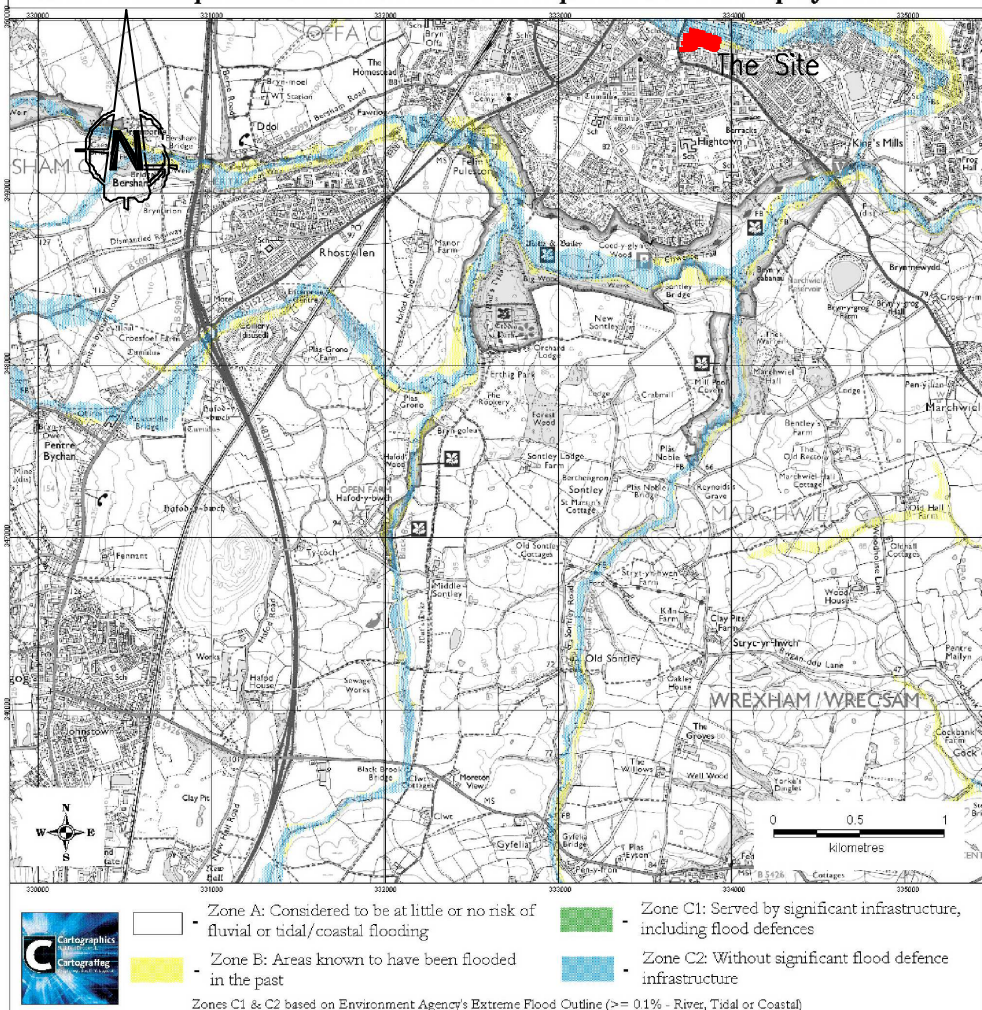
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TAN15 Development and Flood Risk: Development Advice Map SJ34NW



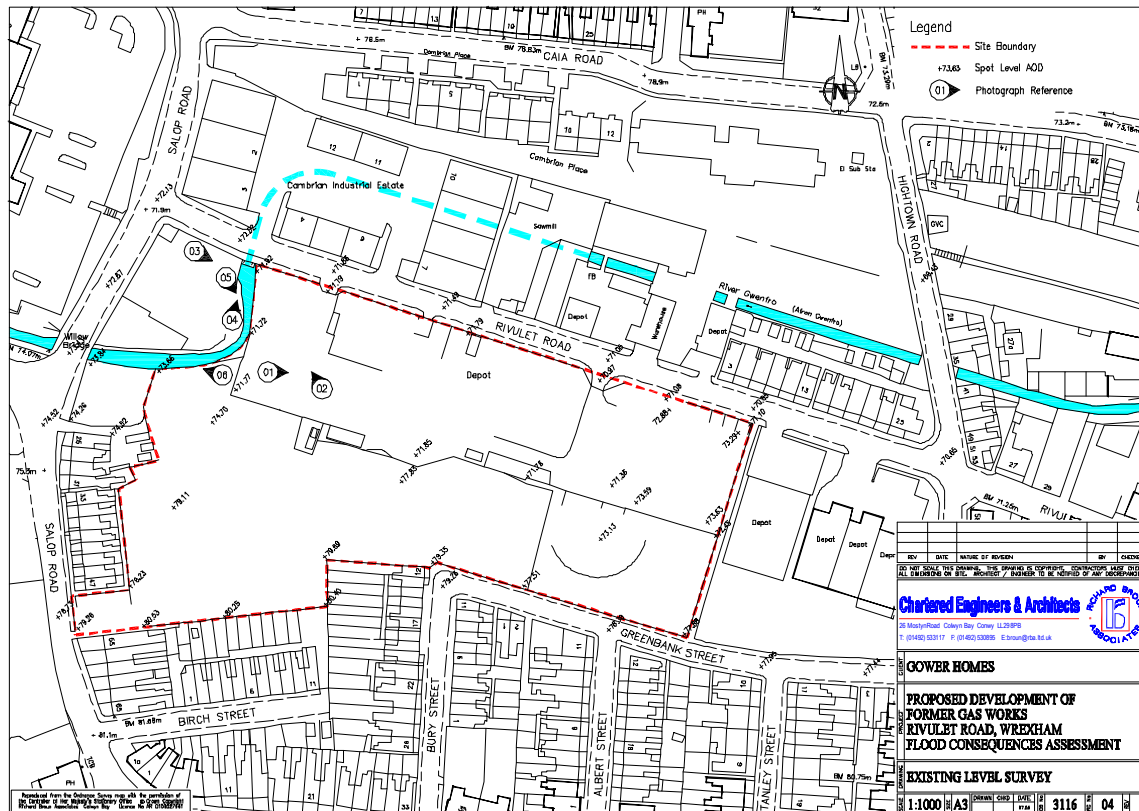
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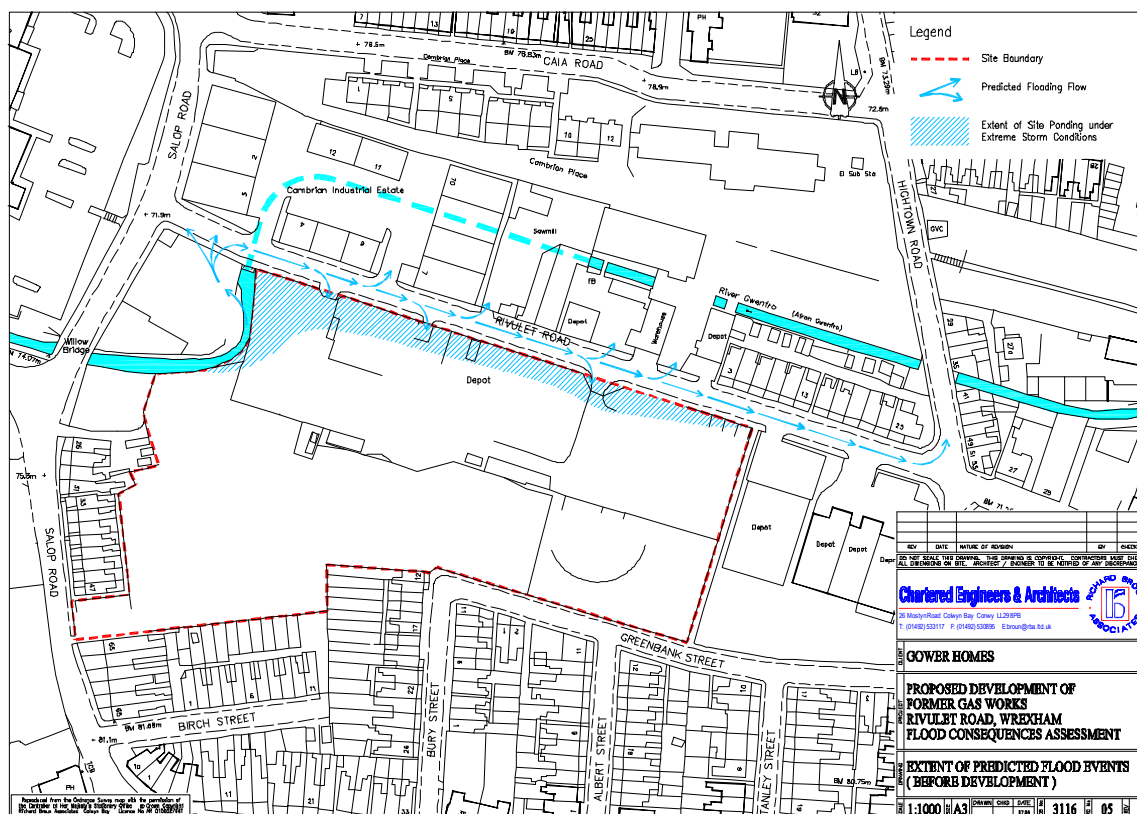
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					DRAWING	WELSH ASSEMBLY GOVERNMENT TAN 15 DEVELOPMENT AND FLOOD RISK ADVICE MAP SJ34NW											
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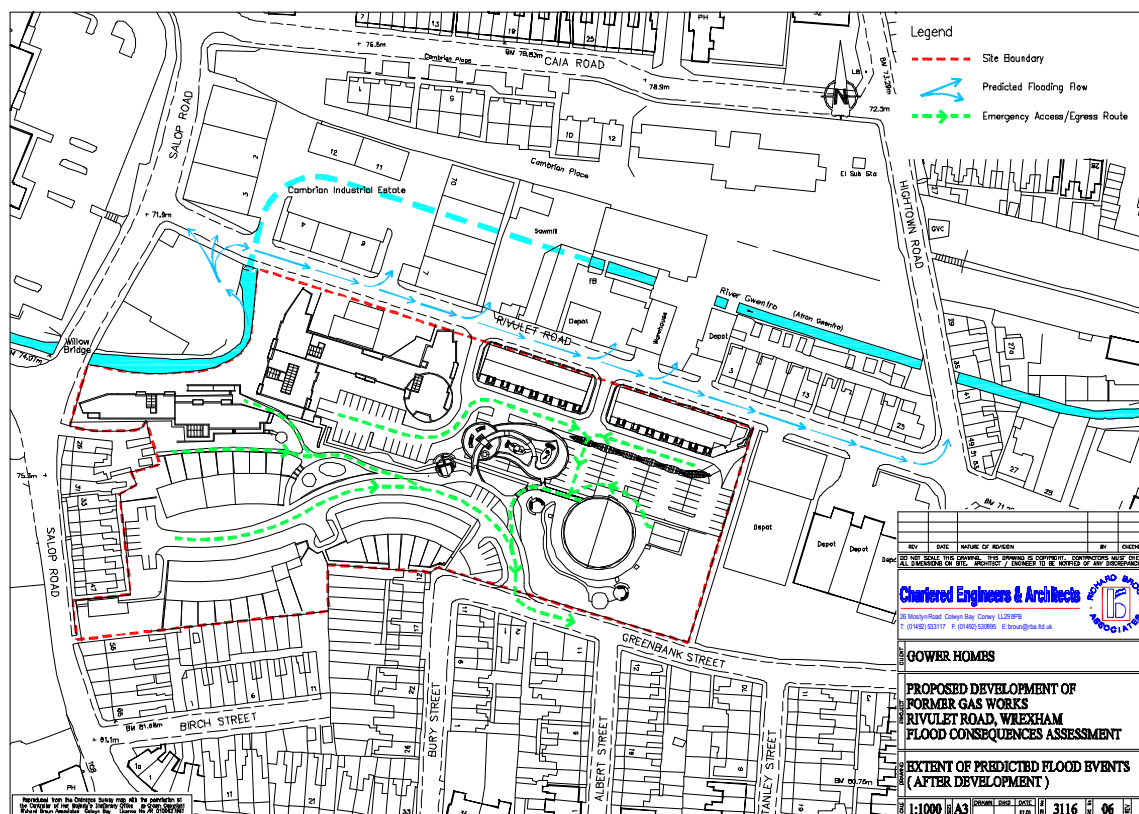
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RICHARD BROUW ASSOCIATES









APPENDIX B:
PHOTOGRAPHS

*DEVELOPMENT OF FORMER GAS WORKS, RIVULET ROAD, WREXHAM
Flood Consequences Assessment*



Photograph 3116/01



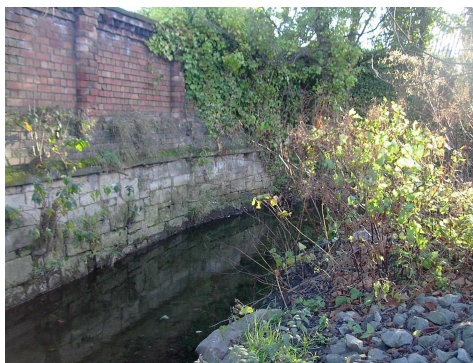
Photograph 3116/02



Photograph 3116/03



Photograph 3116/04



Photograph 3116/05



Photograph 3116/06