Dale Road, Selly Oak

Flood Risk Assessment

Victoria Halls Ltd and University of Birmingham

5 September 2011
Final Report
9W7956

VICTORIA HALL Student Accommodation

UNIVERSITY OF BIRMINGHAM

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1 INTRODUCTION

In August 2011, Royal Haskoning were commissioned by Victoria Hall Ltd (VHL) and University of Birmingham (UoB) to carry out a Flood Risk Assessment (FRA) for the development of land on the right bank of the Bourn Brook in Selly Oak, Birmingham. This work follows on from a modelling study of the site undertaken by Royal Haskoning in June 2011[1].

In consultation with the Environment Agency, this study has included the modelling of flood mitigation measures to minimise flood risk to the site, including the construction of a 700mm wall along the north side of the site and raising of Finished Floor Levels (FFLs). The analysis has also included consideration of the residual risks to the proposed development as a result of overtopping of the proposed flood wall and the impact this has on access and egress to and from the site.

This FRA reflects the requirements of PPS25 in consideration of the proposed site design and layout. It fulfils the requirements of a Level 3 Detailed Study in terms of the guidance given in PPS25 Practice Guidance (December 2009), including:

1. A quantitative appraisal of the potential flood risk to the development;
2. A quantitative appraisal of the potential impact of the development site on flood risk elsewhere; and
3. A quantitative demonstration of the effectiveness of any proposed mitigation measures.

Appendix A includes the PPS25 Pro Forma for an FRA and refers to the relevant sections in this report, thus demonstrating the compliance.

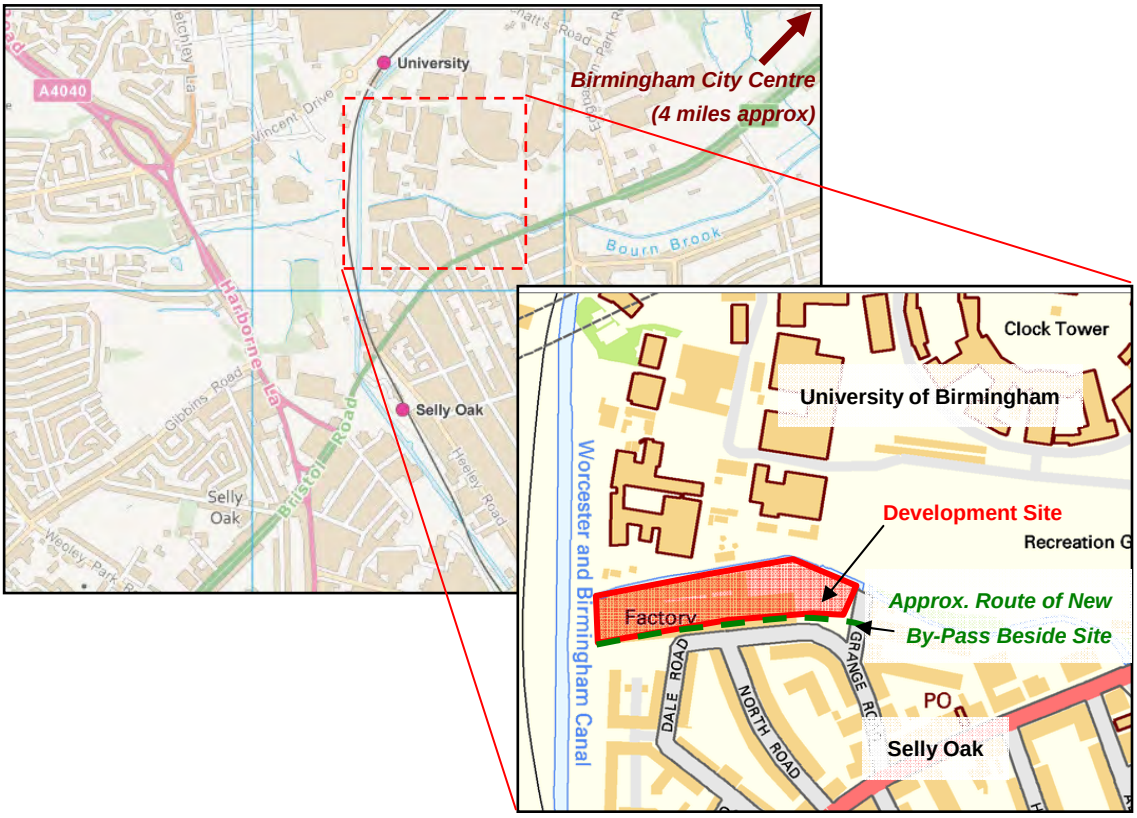
[1] Bourn Brook Flood Modelling Study, June 2011, Royal Haskoning

2 DEVELOPENT DESCRIPTION AND LOCATION

2.1 Nature of the Proposed Development

The development site covers an area of approximately 0.9ha and is currently classified as undeveloped Brownfield land. It is located on the southern edge of the University of Birmingham campus, bounded to the south by the new Selly Oak bypass (with Dale Road beyond), to the east by Grange Road and to the north by the Bourn Brook watercourse, as shown in **Figure 2.1** below. Prior to its Brownfield status, the development site was occupied, for approximately 100 years, by a warehouse building, demolished in 2010 as part of the construction of the Selly Oak Bypass. This building is still visible on the mapping below.

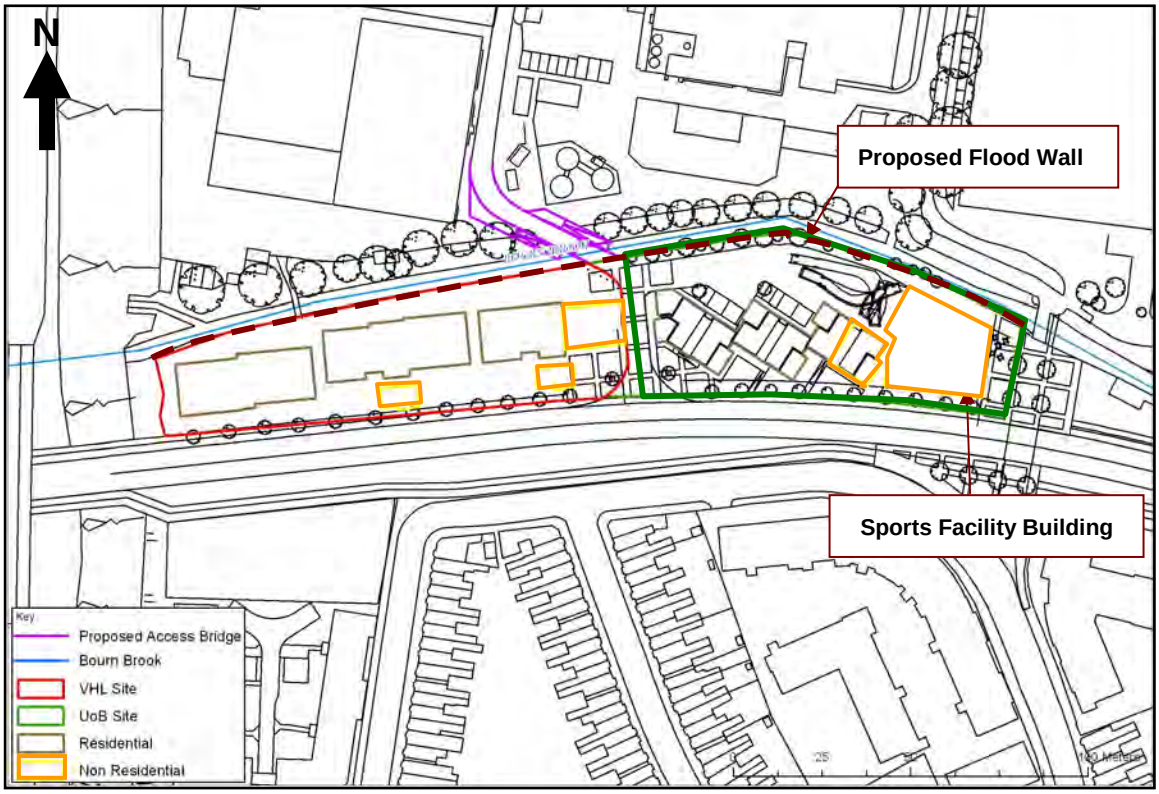
Figure 2.1 - Location of the Development Site



Mapping taken from OS Open Source

The development site has been split into two areas (VHL site and UoB site), both of which are covered by this single FRA (agreed with the Environment Agency in a face to face meeting dated 3rd August 2011), as illustrated in **Figure 2.2**. The western half of the site is being developed by VHL and the eastern half by UoB to provide student accomodation and sports facilities. As a result this development will increase the number of occupants and use of the land from its current state. It is unknown how many users of the land were associated with the previous warehouse.

Figure 2.2 - Proposed Development Site Layout



The VHL development consists of three accommodation blocks. Two of the blocks are comprised soley of student rooms, whereas the third also contains utility rooms, including water tanks, sub station, laundry and refuse store. The UoB development consists of three partially connected blocks of student flats, one of which also includes the refuse store, linen store and bicycle store. In addition, a fourth sports facility block is located to the western end of the UoB site, consisting of a café, changing rooms, equipment stores and offices. This block does not contain any residential accomodation. Detailed site layouts for both developments are included in **Appendix B**.

In addition to the building developments listed above, the development proposal also includes the construction of an access road bridge across the Bourn Brook from the development site to the University campus. It will be located approximatley half way along the northern boundary of the development site. To assist in the mitigation of flood risk, the developemnt designs also include the construction of a 700mm wall along the northern perimeter of the site. These features are marked on **Figure 2.2**.

2.2 Topography

The topography of the site has been assessed using 1m resolution LIDAR data, provided by the Environment Agency within the South Birmingham model[2]. This data has been compared to, and provides an accurate match, with topographic survey data

[2] South Birmingham Hazard Mapping Study, Royal Haskoning, July 2010

held by the developers. Ground levels across the site vary from 123.4mAOD to 123.9 mAOD.

2.3 Local Development Plans

The development site has not been specifically identified within Birmingham City Council's Strategic Housing Land Availability Assessment (SHLAA) or Core Strategy. However, their Draft Core Strategy[3] does include the following statements, all of which are relevant to this development:

1. (Policy S5) The Selly Oak area will be **promoted for major mixed use development**. This will include the following:
   - ***The role, function and importance of Selly Oak Centre… will be promoted and enhanced…. The centre will be a focus for new development including retail, leisure and offices.***
   - ***The University of Birmingham will remain a major centre of higher education, research and development, and supporting activities. Proposals that maintain and enhance the University's facilities will be encouraged.***
   - ***Investment will be encouraged in order to improve the quality and variety of residential accommodation and the residential environment and supporting services will be improved to make Selly Oak/Bournbrook an attractive, balanced and sustainable residential community, supporting the city's growth agenda and graduate retention.***
2. (Supporting Evidence 9.41) Selly Oak centre straddles the Bristol Road, and contains retail warehousing, a superstore and numerous smaller shops, many providing for the needs of the local student population… further extensive areas of underused land and buildings are likely to come forward for development...
3. (Supporting Evidence 9.42) Over the plan period, Selly Oak… will therefore be a **key focus for further new development**… Selly Oak is well placed to deliver **more** employment, **retail and office development**… The aims are to maximise the potential of this sustainable location… and to ensure that the area **benefits from significant spin off benefits from new development**.
4. (Supporting Evidence 9.44) **Investment in the University will be encouraged**…
5. (Supporting Evidence 9.50) … There is a need to ensure that the provision of student accommodation does not adversely impact on the local community…
6. (Supporting Evidence 9.51) The City Council **will work with the private sector including** key landowners such as the **University of Birmingham**.

In addition, the following clauses from Birmingham City Council's Selly Oak Local Action Plan, 2011 are directly relevant to, and support, this development:

> In recent years, many of the manufacturing firms in th[e Grange Road and Dale Road] area have closed, although a few businesses remain including Westley Richards and The Binding Site (BDS). There have been a number of new developments and proposals for student housing in the area, replacing the former industrial premises. Residential uses will continue to be encouraged, subject to the safeguarding of land for the new road. Where the new road or

[3] http://consult.birmingham.gov.uk/portal/ps/csd/csdraft

other redevelopment proposals affects existing firms, the City Council will assist where possible in relocation to suitable premises. (10.15: pp36)

11.21 The City Council will support any future plans by Birmingham University to provide more purpose built student accommodation on appropriate sites. Limited new purpose built student accommodation should be provided around the Dale Road area close to Birmingham University, ensuring sufficient space is provided for the new (11.21: 41).

3 DEFINITION OF THE FLOOD HAZARD AND PROBABILITY

3.1 Potential Sources of Flooding

Fluvial

The site is identified within the Environment Agency's published Flood Zones and the Birmingham City Level 1 Strategic Flood Risk Assessment (SFRA)[4] as being within Flood Zones 2 and 3 (the 0.1% AEP and 1% AEP flood outlines, respectively). Since the SFRA and latest Environment Agency flood maps were published, the Selly Oak bypass road has been constructed, resulting in a number of structural changes in proximity to the Bourn Brook and the development site. These changes include reprofiling of the channel sides and bed, widening of a culvert downstream to accommodate the bypass road crossing and construction of walls along the channel downstream of the development site.

As a result of these modifications, the old Flood Maps are no longer considered valid and Royal Haskoning were commissioned to assess any changes in flood risk by updating the existing 2D TUFLOW modelling along this section of the Bourn Brook. This was undertaken in consultation with the Environment Agency and using the bypass design drawings[5]. The model was run for the 20%, 10%, 5%, 2%, 1.33%, 1% and 0.1% AEP flood events. Due to the existence of a warehouse building, covering much of the site until very recently, it was agreed with the Environment Agency that a 'defended' scenario could be used to represent the site during the time in which the warehouse was in existence through inclusion of a 600mm wall along the northern boundary of the site. All return periods were run for the 'defended' and 'undefended' scenarios (i.e. with and without the 600mm wall). The resulting flood outlines for the 5%, 1% and 0.1% AEP events are shown in **Figure 3.1** below.

The results of this modelling have identified the development site as currently being partially within the 5%, 1% and 0.1% AEP flood extents in the undefended scenario. In the defended scenario the site is partially located within the 1% and 0.1% AEP flood extents.

The new assessment identifies there is a risk of flooding to the site which has been significantly increased following demolition of the warehousing building on the site. Prior to demolition, the development site was almost entirely (with the exception of the very western end) within Flood Zone 2. Following demolition (i.e. within the last few months), the site has remained within Flood Zone 2, but is also now partially located within Flood Zone 3 and, more significantly, partially within Flood Zone 3b[6]. These issues are addressed within this detailed FRA.

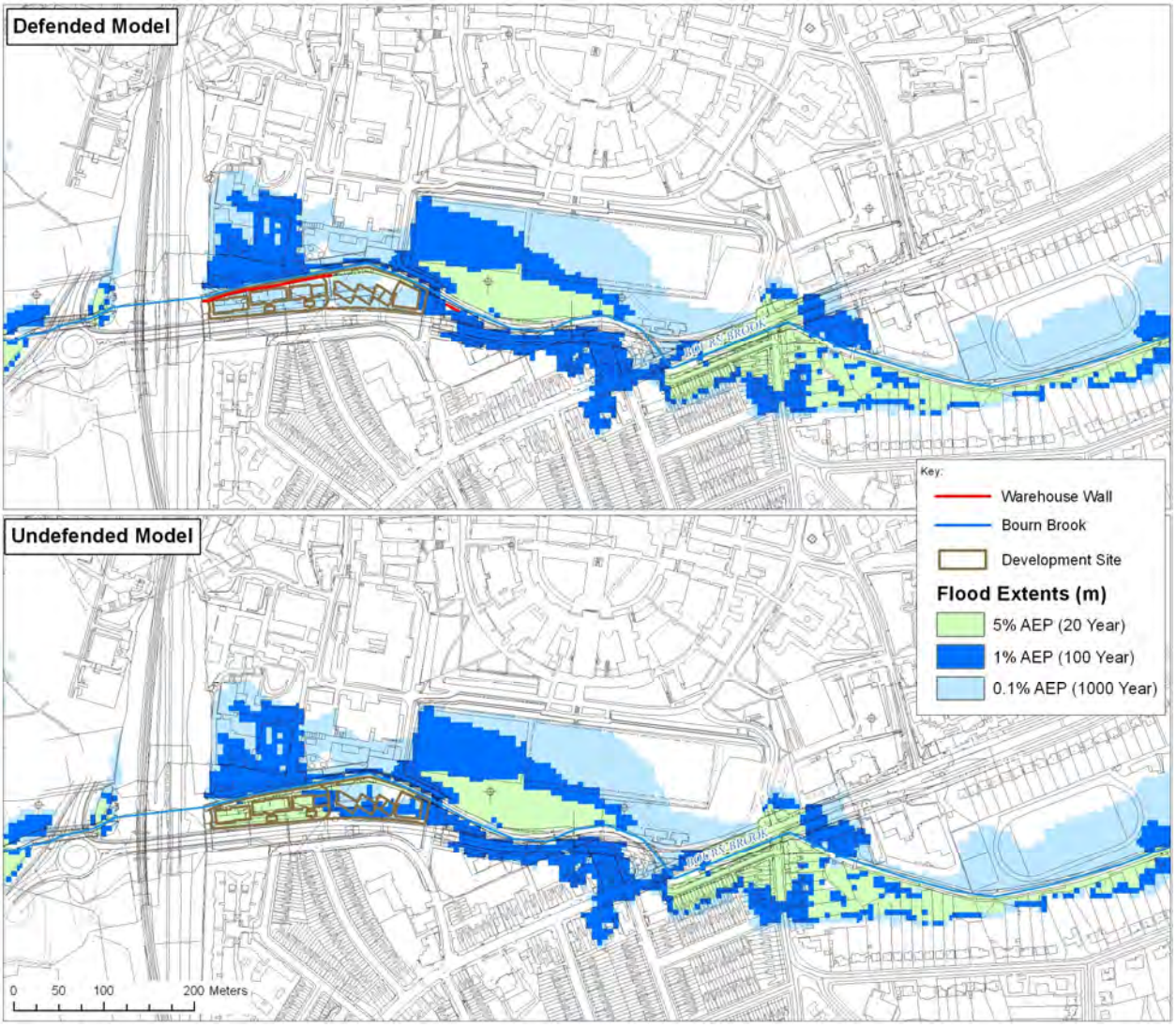
The Level 1 SFRA does not identify any records of historic fluvial flooding within the vicinity of the development site.

[4] Completed in September 2009

[5] Details of amendments made to the model can be found in the Bourn Brook Modelling Report, Royal Haskoning, July 2011.

[6] The Functional Floodplain. Considered to be the extent of the flood event with an Annual Exceedence Probability (AEP) of between 4-5%.

Figure 3.1 - Fluvial Flood Zones Defined within the Bourn Brook Modelling Study, 2011



Reservoirs

Due to the location of the Bartley reservoir approximately 3 miles upstream, the development site, along with large swathes of Birmingham, is located within an area at risk of flooding from reservoirs. However, as stated on the Environment Agency's website, reservoirs in the UK have a very good safety record, with no record of incidents resulting in the loss of life since 1925. In addition, the present day maintenance regime of such structures is very strict and, as a result, reservoir flooding is very unlikely to happen. This risk is therefore not quantitatively considered within this FRA.

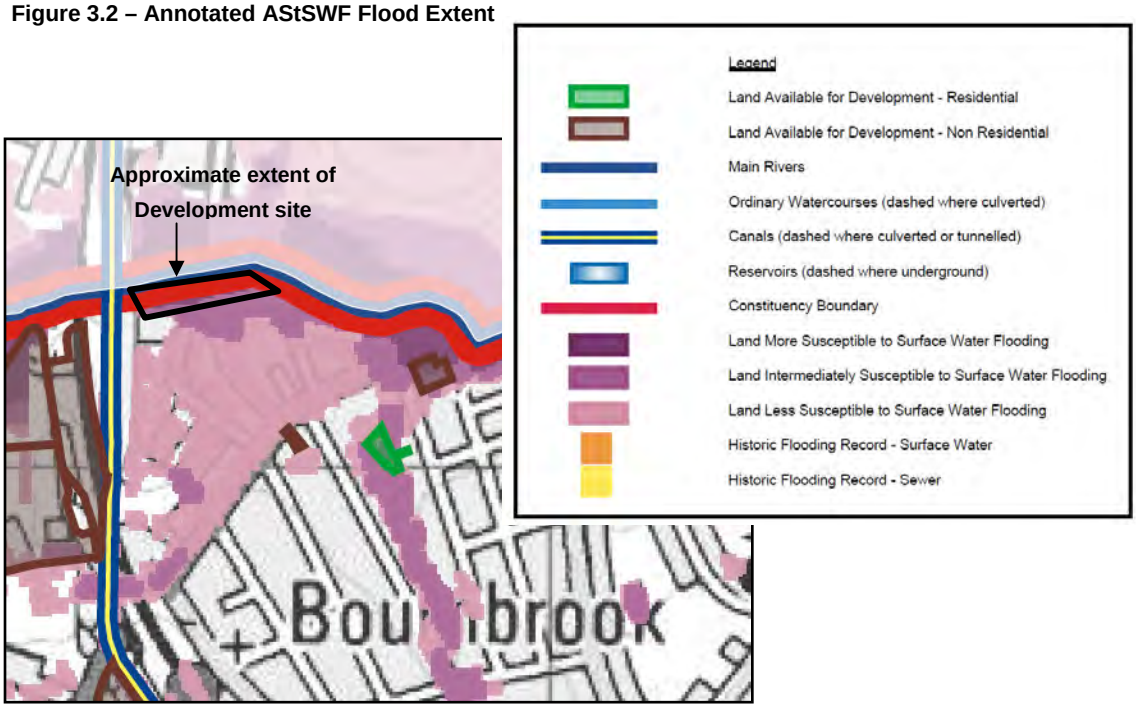
Tidal Flooding

The development site is not located within a tidal zone.

Surface Water

The Level 1 SFRA identifies the extent of the Environment Agency's first edition surface water flood zones (Areas Susceptible to Surface Water Flooding, AStSWF). Due to the proximity of the development site to the watercourse it is difficult to disassociate the influence of fluvial flooding to the site from the surface water flood outlines. As illustrated in **Figure 3.2** below, the site is located in zone that is 'Intermediately Susceptible to Surface Water Flooding', with the surface water possibly draining towards the site from the southwest. It must be noted that this surface water flood outline does not account for buildings or the capacity of the underground drainage network and the SFRA does not identify any historic records of surface water or sewer flooding in the vicinity of the development site.

Figure 3.2 – Annotated AStSWF Flood Extent



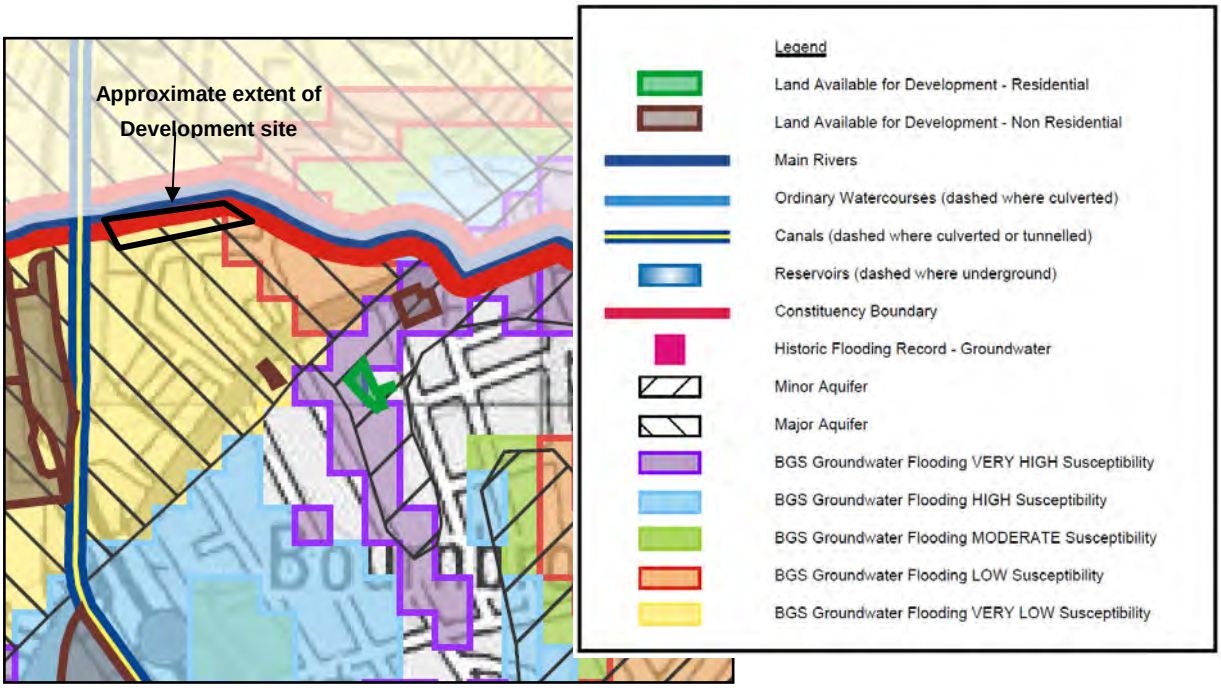
Birmingham Level 1 SFRA, 2009, Figure 5045289/06/02, available from Birmingham City Council[7]

[7] Please see http://www.birmingham.gov.uk/cs/Satellite?c=Page&childpagename=Development-Planning%2FPageLayout&cid=1223346397007&pagename=BCC%2FCommon%2FWrapper%2FInlineWrapper

Groundwater

Risk of groundwater flooding has been assessed within the SFRA using the British Geological Society's Groundwater Flood Susceptibility dataset. The majority of the development site is located within an area classified as having 'Very Low' susceptibility to groundwater flooding, with the exception of the western tip of the site, which is classified as having 'Low' susceptibility, as illustrated in **Figure 3.3**. The site is, however, located above a Major Aquifer. There are no records of historic groundwater flooding in the vicinity of the development site identified within the SFRA.

Figure 3.3 - Susceptibility to Groundwater Flooding



3.2 Existing Flood Defences and Management Structures

Currently there are no formal flood defences located in proximity to the development site. However, the Bourn Brook channel is heavily modified and new channel walls have been constructed downstream of the development site as a result of the bypass development.

As shown by the modelling results, discussed and presented in Section 3.1 above, the northern wall of the warehouse, previously located on the site, could have been considered a defacto defence for this location, up to the 1% AEP flood event, during its 100 year existence.

3.3 Extent of Known Flood Information

There are no records of historical flood events impacting the site within the Level 1 SFRA and no known occurrences of flooding to the site following completion of the Level 1 SFRA in September 2009.

3.4 Flooding Mechanisms

3.4.1 Overtopping of the Bourn Brook

Current Situation

In the current situation, where there is no wall between the development site and the Bourn Brook, the site is at risk of flooding from the watercourse. In accordance with the Bourn Brook Modelling Study outputs and PPS25 Table D.1, the western half of the development site is classified as Flood Zone 3b. Part of the eastern half of the site is classified as Flood Zone 3a and most of the remaining area of the site as Flood Zone 2. A very small area in the northeast of the site is classified as Flood Zone 1, as shown in **Figure 3.2**.

Situation 1 Year Ago

Less than one year ago a warehouse was present on the site. If that building was still standing today the majority of the development site would be located in Flood Zone 2 with only a small section at the western end of the site located in Flood Zone 3a and none of the site located in Flood Zone 3b. The same small area at the northeast of the site would remain in Flood Zone 1. Please refer to **Figure 3.2** for details.

A comparison of the current water levels between the defended and undefended scenarios, at the upstream extent of the development site, is shown in **Table 3.2**[8] below. These results indicate that although the defended and undefended scenarios significantly alter the flood extent across the development site, the two scenarios do not result in a noticeable difference to water levels within the watercourse.

Table 3.2 - Bourn Brook Modelled Flood Water Levels

Chance of Flooding in Any Year (AEP)	Current Situation (undefended) mAOD	Previous Situation (defended)[9] mAOD
20%	123.64	123.64
10%	123.89	123.89
5%	124.10	124.10
2%	124.31	124.32
1.3%	124.37	124.38
1%	124.41	124.42
1% plus Climate Change	124.49	124.48
0.1%	124.61	124.61

[8] Taken from Appendix B of the Bourn Brook Modelling Report, June 2011 at ISIS node BOUB_2117

[9] With warehouse in situ, represented by 600mm wall on northern perimeter of site

3.4.2 Other Flood Mechanisms

As discussed in Section 3.1 above, the only other sources of flood risk to which this site is susceptible are reservoir inundation, emanating from the Bourn Brook and surface water flooding from the southwest. The risk of reservoir inundation is considered extremely low and therefore does not required consideration within this FRA. Due to the limitations of the AStSWF mapping and lack of historic records, the risk of surface water flooding is considered 'Low'. As it is hard to disassociate the surface water flood extent from the fluvial flood extent, the risk of flooding from surface water is covered within this FRA.

3.5 Climate Change Impacts

Annex B of PPS25 (Table B.2) recommends the following increases upon rainfall intensity and peak river flow to allow for climate change:

Table 3.3 - Recommended national precautionary sensitivity ranges

Parameter	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	+5%	+10%	+20%	+30%
Peak river flow	+10%	+20%		

The impact of climate change on the 1% AEP flood event, in the current situation, is provided in **Table 3.2** above, with a water level of just under 124.5mAOD. Consideration of this event on the proposed development is discussed within Section 5 of this FRA.

4 DEVELOPMENT PROPOSALS

4.1 Classification of the Development Under PPS25

As outlined in Section 2.1, the aim of the proposed development is to utilise disused Brownfield land between Selly Oak centre and the University of Birmingham as student residential accommodation and sports facilities. No basement dwellings will be included in the final designs.

Road access to the site will be primarily from the Selly Oak bypass to the south of the site, with the access point located approximately 50% of the way along the southern boundary. Additional road access will be available from the University grounds to the north of the site, across the proposed new bridge. Foot access will be available to the western end of the site: from the north across the existing foot bridge from the University grounds; and from the south across a new pelican crossing over the Selly Oak bypass.

In terms of flood risk and vulnerability, the majority of the proposed development is classified as **'More Vulnerable'** as per Table D.2 of PPS25. However, as it does not include any residential accommodation, the most easterly building included on the UoB's design drawings (the sports facility block) is classified as **'Less Vulnerable'**. This building is highlighted on **Figure 2.2**. Under these classifications none of the development is permitted within the Functional Floodplain (Flood Zone 3b, 4-5% AEP) and the residential units require the completion of the Exception Test if they are to be located in Flood Zone 3a (1% AEP), see **Table 4.1** below:

Table 4.1 - Flood Risk Vulnerability and Flood Zone 'Compatibility' (PPS25 Table D.3)

Flood Risk Vulnerability classification (see Table D2)		Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone (see Table D.1)	Zone 1	✔	✔	✔	✔	✔
	Zone 2	✔	✔	Exception Test required	✔	✔
	Zone 3a	Exception Test required	✔	✗	Exception Test required	✔
	Zone 3b 'Functional Flood plain'	Exception Test required	✔	✗	✗	✗

Key:

✔ Development is appropriate

✗ Development should not be permitted

4.2 Sequential and Exception Tests

There are no alternative available development sites in proximity to the University and Selly Oak at the current time and the chosen site is too small to consider the redistribution of buildings to a lower risk Flood Zone. In, addition, as this proposed development supports the aims of the draft Core Strategy outlined in Section 2.3 and the site is current unused Brownfield, it is considered that the Sequential Test is passed for this development.

To pass the Exception Test the following three criteria must be met (as per Section D9 of PPS25, 2010):

> a) It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared. If the DPD has reached the 'submission' stage – see Figure 4 of PPS12: Local Development Frameworks – the benefits of the development should contribute to the Core Strategy's Sustainability Appraisal;
>
> b) the development should be on developable previously-developed land or, if it is not on previously developed land, that there are no reasonable alternative sites on developable previously-developed land; and
>
> c) a FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.
>
> ***(PPS25, Section D9, March 2010)***

In response to these criteria:

- → Section 2.3 of this FRA outlines the current policies relevant to the development site in the Birmingham draft Core Strategy and illustrates how this development assists in meeting the aims for sustainable development;
- → the site is located on previously developed Brownfield land; and
- → this FRA demonstrates how the proposed flood risk mitigation measures reduce flood risk to the site without impacting on the flood risk elsewhere.

4.3 Consultation with the Environment Agency

The Environment Agency has been consulted during the preparation of this FRA and the preceding modelling study. As such they are fully aware of the proposed development and flood risk mitigation measures. It is however recommended that the Environment Agency is invited to comment on this report.

4.4 Fluvial Flood Risk Mitigation

To reduce the risk of fluvial flooding to the development site, it is proposed, following discussion with the Environment Agency, that a 700mm wall is constructed along the northern perimeter of the development site, replicating the pre-existing defended situation, when the warehouse was still present on the site, plus 100mm. As illustrated in the results of the modelling (discussed in Section 5), this wall will be designed to

withstand the 5% and 1% AEP flood events and overtop in the 1%+CC AEP and 0.1% AEP flood events. In addition, a trash screen is being moved from the Bristol Road crossing of the Bourn Brook to upstream of the new Selly Oak roundabout (to the west of the canal embankment).

Also, inline with the requirements of the Birmingham SFRA and requirements of the Environment Agency, consideration is given within this FRA to raising the Finished Floor Levels (FFLs) of all residential buildings on the site to be level with the current 'in channel' 1% plus climate change (1%+CC) AEP water level from the Bourn Brook modelling study plus 600mm (there is no recommendation for the non residential buildings). As stated in **Table 3.2** above, the maximum water level in proximity to the development site from the Bourn Brook model is at the upstream extent of the site and is 124.49mAOD for the undefended scenario and 124.48mAOD for the defended scenario. The current Bourn Brook model levels therefore result in a recommended residential FFL of 125.09mAOD at the upstream extent of the site. The applicability of this level following implementation of the flood risk mitigation measures specified above is debated within this FRA.

5 FLOOD RISK MODELLING

5.1 Model Adjustments

To simulate the proposed development and mitigation measures, the 2D modelling undertaken within the Bourn Brook modelling study has been adapted to reflect the following[10]:

- 700mm wall along the northern perimeter of the development site (right bank of the Bourn Brook);
- Addition of the access road bridge approximately 50% of the way along the site, connecting the Selly Oak bypass to the University of Birmingham; and
- Relocation of a trash screen from the Bristol Road crossing to the west of the canal embankment[11].

This model has been run for the 5%, 1%, 1% + climate change and 0.1% AEP flood events.

5.2 Model Results

The mapped results of this adapted FRA model are included in **Appendix C** and the resulting water levels are included in **Appendix D**, shown alongside the defended and undefended ('existing' and 'previous') scenarios from the Bourn Brook modelling study. A summary of these water level comparisons at the upstream and downstream limits of the development site is given in **Table 5.1** below. The location of the ISIS nodes referenced are illustrated in **Figure C5** in **Appendix C**.

These results indicate that, with regards to 'in channel' water levels, the development proposals do not have a significant effect. In most cases the water levels are comparable to, or lower than, the current situation (both with and without the warehouse). For the 1% plus climate change AEP scenario, the water levels are reduced by 0.02m at the upstream extent of the development site and 0.06m at the downstream extent of the development site. This reduction is the result of water 'backing' up behind the Selly Oak bypass roundabout and behind the new road access bridge.

Regarding flood extent, the modelling identifies that, following construction of the 700mm flood wall, trash screen and new road bridge, flood risk to the site is significantly reduced. None of the site floods during the 5% or 1% AEP scenarios and only minor overtopping occurs during the 1%+CC AEP event. This overtopping results in flooding of a small portion of the western and northern ends of the UoB site to a maximum depth of 0.12m (123.85mAOD). These flood outlines are illustrated in **Figure 5.1** below:

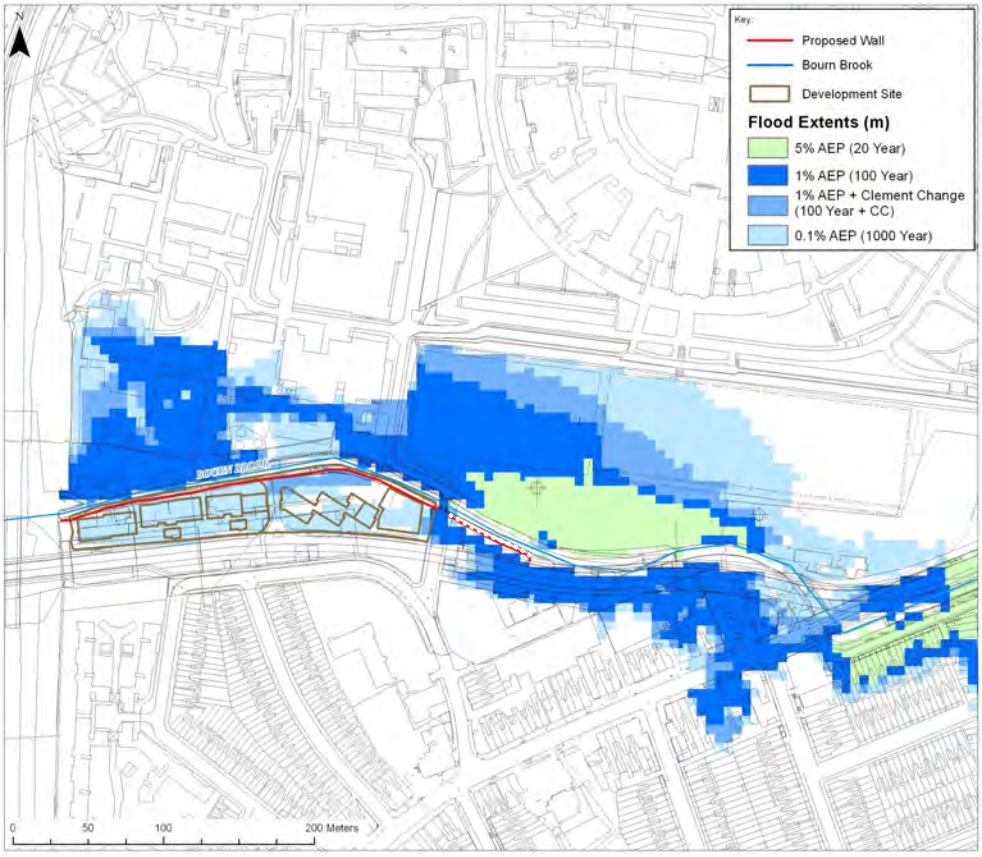
[10] N.B. the hydrology has remained unchanged from the South Birmingham Hazard Mapping Study, 2010 and Bourn Brook Modelling Study, 2011.

[11] N.B. this has resulted in an adjustment to the representation of the roundabout structure upstream of the canal embankment within the model from a bridge to a culvert.

Table 5.1 - Comparison of Current and Proposed 'In Channel' Water Levels

Location of Water Level Readings	Chance of Flooding in Any Year (AEP)	Bourne Brook Modelling Study (mAOD)		FRA Adjusted Model (mAOD)
		Current Situation (undefended)	*Previous Situation (defended)*[12]	*Proposed Situation (defended)*[13]
Upstream Extent of Development Site (ISIS node BOUB_2117)	5%	124.10	124.10	124.14
	1%	124.41	124.42	124.41
	1% plus Climate Change	124.49	124.48	124.47
	0.1%	124.61	124.61	124.58
Downstream Extent of Development Site (ISIS node BOUB_1856)	5%	122.95	122.96	122.91
	1%	123.29	123.29	123.23
	1% plus Climate Change	123.38	123.37	123.32
	0.1%	123.54	123.54	123.53

Figure 5.1 - Flood Risk to the Development Site Following Implementation of Proposed Mitigation Measures



[12] With warehouse in situ, represented by 600mm wall on northern perimeter of site

Please note the inclusion of a wall alongside the Birmingham City Council land to the east of the development site (depicted by the red and white dashed line in **Figure 5.1**), linking the proposed development site flood wall with a new wall constructed further downstream as part of the Selly Oak bypass project. A partial wall is already located along this stretch, but is in a poor state of repair (see image on the front cover of this FRA). Within the FRA model the 700mm wall around the development site was continued along this stretch to determine whether improvement to the current structure would impact upon the flood risk to the development site. The flood extents resulting from this modelling have indicated that the presence of this wall has no impact on the flood risk to the development site or downstream. As depicted on **Figure 5.1** above and within the Bourn Brook modelling study report, the Bourn Brook overtops in the location of the footbridge upstream of this extra wall and subsequently spills to the southeast. This occurs regardless of whether the wall is present. As such the repair of the existing partial wall is not considered necessary for this development and should not be viewed as part of the development proposals.

5.3 Post Construction Fluvial Flood Risk

A summary of the post construction 'in channel' water levels, flood wall freeboard and 'on site' water depths is given below:

Table 5.2 - Post Construction In Channel Water Levels and Flood Wall Freeboard

Flood Event (AEP)	'In Channel' Water Levels (mAOD)			Flood Wall Freeboard (m)		
	Upstream BOUB_2117	Middle BOUB_1992d	Downstream BOUB_1856	Upstream BOUB_2117	Middle BOUB_1992d	Downstream BOUB_1856
5%	124.14	123.54	122.91	0.64	0.30	0.86
1%	124.41	123.83	123.23	0.37	0.01	0.54
1% + CC	124.47	123.90	123.32	0.31	0	0.45
0.1%	124.58	124.10	123.53	0.20	0	0.24

Table 5.3 - Post Construction 'On Site' Water Depths

Flood Event (AEP)	'On Site' Maximum Water Depths (m above current ground level)			
	VHL Site	UoB Site	Road Access (to south)	Pedestrian Access (to south)
5%	0	0	0	0
1%	0	0	0	0.19
1% + CC	0	0.12	0	0.35
0.1%	0.77	0.77	0.19	0.58

With the exception of the pedestrian access to the site, the proposed floodwall will mitigate against the risk of flooding to the site up to and including the 1% AEP flood event, albeit with very minimal freeboard in the middle section. Overtopping of the flood wall will occur during the 1%+CC AEP and 0.1% AEP events from the middle section of the wall, with the 1%+CC AEP flood event only affecting the UoB part of the site.

[13] Inclusion of 700mm wall along northern perimeter of development site, relocation of trash screen to upstream of the canal embankment and inclusion of new road access bridge.

As a result of these modelled outputs, the requested residential FFLs of 125.09mAOD are therefore very conservative, being 620mm above the worst case 'in channel' modelled 1%+CC AEP water levels at the upstream end of the site and 1.77m above the 'in channel' modelled 1%+CC at the downstream end of the site. They are also 600mm above the worst case 'on site 0.1% water depths.

The FRA modelling suggests that FFLs of 125.07mAOD will meet the requirements of 1%+CC AEP plus 600mm for the western (VHL) half of the development site and FFLs of 124.5mAOD[14] are equivalent for the eastern (UoB) half. This is the result of the channel bed sloping significantly along the length of the development site, with a decrease of almost 1m in water levels from the upstream extent to the downstream extent, reflected in **Table 5.1** above.

The main access and egress route, via the road link to the Selly Oak bypass is routed away from the watercourse and is not affected by the 5%, 1% or 1% plus climate change AEP flood events following implementation of the proposed mitigation measures. In addition the entrance cores to VHL's blocks are from the south side and will be designed as 150mm below FFL. As a result these will provide a dry escape route to the west. The secondary main access/egress route from the site (pedestrian access to the south from the western end of the site) is flooded from the 1%AEP event. It can be deemed to be impassable from the 1%+CC AEP event, with a possibility it cannot be used during the 1%AEP event. This risk can be mitigated through implementation of an appropriate flood evacuation plan and signing of a flood evacuation route, directing residents to the main road entrance. It is recommended this action is progressed prior to the commencement of the development.

The Environment Agency's flood warning service is not available for this location.

5.4 Post Construction Surface Water Flood Risk

Surface water discharge has not explicitly been considered within the modelling, although it is recognised that there is a link between surface water and fluvial flooding in this urban location. It was agreed with the Environment Agency[15] that surface water runoff from the development site can be discharged directly to the Bourn Brook, subject to a Land Drainage Consent Application and providing the runoff is not greater than the discharge from the previous industrial buildings minus 20%. The reduction in surface water drainage will be dealt with on VHL's site through incorporation of 20% grassed surface area. UoB are currently investigating the use of suitable Sustainable Drainage System (SuDS), such as rainwater harvesting, permeable pavements and/or utilisation of rainwater storage tanks or basins with restricted outflows. Due to its location above a major aquifer and proximity to the Bourn Brook, it is possible that infiltration systems will not be suitable for this site. This should be checked during development of a drainage strategy for the site, which must demonstrate that the 1%+CC AEP rainfall event can be accommodated using the techniques stated in the Interim Code of Practice for SUDS and CIRIA publication C697 (The SuDS Manual).

14 Water Level of 123.9AOD (see node BOUB01_1992d) in Appendix D.

[15] See meeting minutes in **Appendix E**

As stated in Section 3.1 the site is located in an area susceptible to surface water flooding, although with no historical records of such flooding this risk is considered to be low. With elevated FFLs, the proposed buildings are not deemed to be at risk of surface water ingress. However, the potential for surface water to accumulate on the site from neighbouring development to the southeast (for events above the design capacity of the existing underground drainage system, usually the 3.3% AEP rainfall event) should be considered in the design of the drainage scheme. The potential for such surface water to accumulate behind the proposed flood wall should also be addressed through inclusion of flapped outfalls into the watercourse. This should be accommodated into the detailed design of the flood wall.

5.5 Site Management (During Construction)

Maintenance of the flood wall will be the responsibility of the riparian owners, in this case VHL and UoB. It will require regular inspection to ensure it remains sound and functional along its entire length and height. An evacuation plan should be drawn up for implementation during the 1%+CC or 0.1% AEP flood events, when overtopping will occur, and during construction of the flood wall. This will enable safe egress away from the site to Flood Zone 1. Dissemination and implementation of the plan will be the responsibility of VHL and UoB.

Appropriate maintenance and inspection regimes should be implemented to maintain the capacity of any SuDS accommodated on the site and the functioning of surface water discharge points.

6 IMPACT ON LOCAL FLOOD REGIME

6.1 Floodplain Volume

When former industrial buildings were present on the site, they occupied an area of 0.84ha. The proposed defended development site covers an area of just over 0.85ha (with the building footprints occupying an area of just under 0.3ha). As a result there is a negligible loss of floodplain volume as a result of the proposed development, as compared with the situation approximately 1 year ago. Compared to the current Brownfield situation, the defended area of the site represents a loss in floodplain storage of approximately 0.85ha. However, this area of floodplain has not been utilised since the demolition of the former industrial buildings. As such the loss of floodplain will have no noticeable effect on the area.

6.2 Floodplain Flow

As the site was previously occupied by a large building and, as there are no records of historical flooding on the site, the development proposal is not considered to have an impact on floodplain flow in the area.

6.3 Impact on Neighbouring Properties

A full comparison of water levels along the Bourn Brook, representing the current defended (with the warehouse is place) and undefended (as present day) situations and the predicted water levels following construction of the proposed development is given in **Appendix D**. These results indicate that the proposed development will result in an improved flood risk situation along a significant length of the Bourn Brook - from the canal embankment to the King Edward School sports pitches - with water levels decreasing between 0-0.37m from the undefended current situation for the 1%+CC AEP event. There is minimal impact on flood extents along this reach, with many decreasing as a result in the change in water level.

Within the University playing fields, the maximum water depth in the floodplain varies as follows, showing a significant decrease in water level as a result of the development:

Table 6.1 - Changes to Maximum Water Levels in the University Playing Fields

Chance of Flooding in Any Year (AEP)	Current Situation (undefended)	Previous Situation (defended)	Proposed Situation (defended)
5%	0.32	0.32	0.28
1%	0.69	0.68	0.6
1% plus Climate Change	0.8	0.79	0.72
0.1%	1.02	1.02	0.94

Upstream of the Selly Oak bypass roundabout water levels are predicted to increase by between 0.1m and 0.2m from the undefended current situation for the 1%+CC AEP event. This is the result of a slight backing up of water behind the new trash screen location and results in a slightly extended flooding of the scrubland area, west of the A4040 (Harborne Lane). It does not impact any current buildings. In addition, a slight backing of water is experienced behind the proposed road access bridge to the development site with a maximum increase of 0.04m in the 0.1% AEP event. The only noticeable difference to the flood extent as a result of this change in water level is the addition of a flow route between the university buildings opposite the development site. This route follows the existing road layout and reaches a maximum depth of 0.2m.

As a result of the proposed development, the impact on neighbouring properties can be concluded as being minimal. The flood risk is slightly increased to the scrubland area west of Harborne Lane, but does not affect any existing buildings, and slightly increased between the university buildings to the north of the development site, although to a depth that should not cause any internal flooding. For the rest of the modelled reach, as far as the King Edward school playing fields, the flood extents and depths remain unchanged or slightly decreased, thereby improving the situation.

6.4 Surface Water Runoff

There is currently limited surface water drainage provision from the site, with surface water currently draining off the hard standing as Brownfield runoff directly into the Bourn Brook. As the Environment Agency require the proposed development to reduce the runoff from the previous industrial buildings by 20%, less surface water will be entering the watercourse following development than at the present time. As such there will be a positive impact on the local surface water flooding regime in relation to fluvial flows. In addition, as the site will not be discharging surface water into the underground network, there will be no negative impact on the risk of surface water sewer flooding to neighbouring properties.

6.5 Fluvial Morphology

Due to the highly modified and urban nature of the Bourn brook, no negative impact is expected on the fluvial morphology.

7 RESIDUAL RISKS

7.1 Introduction

The residual risks posed to the development site and neighbouring properties following construction of the proposed mitigation measures relate to the overtopping of the flood wall.

7.2 Overtopping

The risk of overtopping of the flood wall has been assessed within the modelling undertaken for this FRA. The flood wall will be designed to overtop during the 1%+CC AEP and 0.1% AEP flood events and mitigated against through the raising of FFLs. The raising of floor levels also mitigates the potential impact of overtopping during the 1% AEP flood event. The results and implications of this are discussed above. It is, however, crucial that the flood wall is appropriately designed so it can withstand the pressure of water against it during a flood event and an appropriate maintenance regime is undertaken to maintain the wall at its design height of 700mm above the bank level.

7.3 Other Residual Risks and Maintenance

A residual risk of surface water flooding remains from the failure or blockage of any on site drainage systems. They will require ongoing maintenance to ensure they are operating at capacity at all times. The management of this residual risk over the lifetime of the development should be addressed by the developers, identifying the maintenance and ownership regime. Discussions have been held with the Environment Agency Operations Delivery team (Andy Wilson) - please see **Appendix E**. Regarding access to the channel, it was concluded that the relocation of the trash screen upstream of the site removes the requirement for vehicular access to the watercourse from the development site (points 7 and 8 in **Appendix E**). However, as part of the development, pedestrian access to the watercourse will be provided adjacent to the new road access bridge.

A suitable maintenance regime should also be agreed with the Environment Agency for inspection and clearance of the relocated trash screen upstream of the development site. It is assumed this will fall with the Environment Agency. The trash screen should be designed in accordance with the trash screen design manual and approved by the Environment Agency. To eliminate blockage risk and ensure safe access, it is recommended that a separate FRA is undertaken for this structure.

The impact of the new road bridge has been assessed within this FRA and deemed not to increase flood risk to the development site. However, once the design is finalised it is recommended this FRA should be reviewed to ensure flood risk is not increased.

8 CONCLUSIONS

This FRA has considered the change in use of an area of currently Brownfield land (previously occupied for approximately 100years by a warehouse building) on the banks of the Bourn Brook to a mixture of student accommodation and sport facilities. It has included detailed modelling of the site and proposed mitigation measures (including a 700mm flood wall) and considered residual risks to the development site from the overtopping of the flood wall. The final conclusion is that the development should be permitted, but with inclusion of the recommended measures outlined in this report and summarised below:

1. The Flood Zones shown in the Birmingham City SFRA, 2009 and the Environment Agency's fluvial flood maps are considered to have been superseded by the Bourn Brook modelling study, 2011.
2. As a result, areas of the development site are considered to be located in Flood Zones 3a, 3b, 2 and 1 for the undefended scenario, but only Flood Zones 3b (marginally), 2 and 1 for the defended scenario. The defended scenario represents the inclusion of the warehouse, demolished only a few months prior to the Bourn Brook modelling study, as a 600mm wall. As the warehouse was in existence as a 'defacto' defence for such a long period of time and, as no flooding has occurred in vicinity of the site since its demolition, the effects of its removal have not been witnessed.
3. It is considered that the Sequential and Exception Tests are passed for this site.
4. The results of the FRA modelling have determined that, following implementation of the proposed flood risk mitigation measures and development structures (700mm wall along the northern perimeter of the development site, relocation of a trash screen from the Bristol Road to upstream of the canal embankment and construction of a road access bridge across the Bourn Brook), the site is only at risk from flooding in the 1%+CC AEP (marginally) and 0.1% AEP events. The flood wall must, however, be appropriately designed to withstand the pressure of water expected when the channel is full and to allow overtopping onto the site during the low frequency flood events.
5. Residual flood risk remains from the overtopping of flood walls during the 1%+CC AEP and 0.1% AEP events, although water depths and extents are low (see **Table 5.2** and **Figure 5.1**). There is also a risk of minor overtopping occurring during the 1% AEP flood event.
6. The required residential Finished Floor Levels using the Bourn Brook 1%+CC AEP water level plus 600mm (125.09mAOD) is disputed as a set level across the whole development site. It is recommended that the 1%+CC AEP water levels from the modelling undertaken within this FRA are used instead and the residential FFLs allowed to vary between the two halves of the development site. As a result it is proposed that a minimum FFL of 125.07mAOD is used in the VHL development and a minimum of 124.5mAOD is used in the UoB development (summarised in **Table 8.1** below).
7. It is recommended that the access and egress routes from the buildings are raised to be equivalent to, or higher than, the 1%+CC AEP level (124.49mAOD) and appropriate evacuation plans are emplaced, directing residents out via the southern

road access (summarised in **Table 8.1** below) when overtopping of the flood wall does occur.

8. For the protection of users and stock, it is recommended that the non residential buildings have FFLs of 124.49mAOD or higher for the VHL development and 123.9mAOD for the UoB development and have appropriate individual property resilience measures to protect stock if water ingress did occur (summarised in **Table 8.1** below).

9. The site should be signed up to receive Environment Agency flood warnings in the future, if they are extended to the Bourn Brook and a flood evacuation plan should be implemented during the 1%+CC and 0.1% AEP flood events.

10. It has been deemed that the development will not impact on floodplain storage or flow and will have negligible negative impacts and potentially beneficial impacts to neighbouring properties.

11. A sustainable surface water drainage design should be developed for the site, whereby surface water runoff is reduced by 20% from the previous industrial buildings and consideration is given to the accommodation and release of surface water flows encroaching the site from neighbouring residential areas. A Land Drainage Consent application will be required for the site.

12. Once the designs of the new trash screen and road bridge are finalised, a review of this FRA may be required or independent FRAs for the structures undertaken.

Table 8.1 - Suggested Ground and Floor Levels Resulting from this FRA

Location	Suggested Finished Levels (mAOD)	
	VHL Development (Western Half of Site)	UoB Development (Eastern Half of Site)
Finished Floor Levels (Residential)	125.07	124.5
Finished Floor Levels (Non- Residential)	≥ 124.49	≥ 123.9
Key Access/Egress Route Levels	≥ 124.49	≥ 124.49

Please note, there is no requirement within the SFRA for the Level of Access/Egress routes or Non Residential FFLs. The Levels provided are simply conservative suggestions, based on the water levels of the 1%+CC AEP flood taken from the FRA model.. The final required height should be negotiated between VHL, UoB and the Environment Agency.

Appendix A
PPS25 Proforma

PLANNING POLICY STATEMENT 25 REQUIREMENTS (December 2009)	*FRA REPORT COMPLIANT SECTION*
1 Development description and location	
1a. What type of development is proposed and where will it be located? Include whether it is new development, an extension to existing development or change of use etc.	***2.1***
1b. What is its vulnerability classification?	***4.1***
1c. Is the proposed development consistent with the Local Development Documents?	***2.3 & 4.2***
1d. Please provide evidence that the Sequential Test and, where necessary, the Exception Test has been applied in the selection of this site for this development type?	***4.2***
1e. Will the proposal increase overall the number of occupants and/or users of the building/land; or the nature or times of occupation or use, such that it may affect the degree of flood risk to these people?	***2.1***
2. Definition of the flood hazard	
2a. What sources of flooding could affect the site? (see Annex C PPS25).	***3.1***
2b. For each identified source, describe how flooding would occur, with reference to any historic records wherever these are available.	***3***
2c. What are the existing surface water drainage arrangements for the Site?	***6.4***
3. Probability	
3a Which flood zone is the site within?	***3.1 & 5.2***
3b If there is a Strategic Flood Risk Assessment covering this site, what does it show?	***3***
3c What is the probability of the site flooding taking account of the contents of the SFRA and of any further site-specific assessment?	***3 & 5.2***
3d What are the existing rates and volumes of run-off generated by the site?	***6.4***
4. Climate change	
4a How is flood risk at the site likely to be affected by climate change?	***3.5, 5***

5. Detailed development proposals	
5 Where appropriate, are you able to demonstrate how land uses most sensitive to flood damage have been placed in areas within the site that are at least risk of flooding, including providing details of the development layout?	***4.2, 5***
6. Flood risk management measures	
6. How will the site be protected from flooding, including the potential impacts of climate change, over the development's lifetime?	***4.4, 5***
7. Off site impacts	
7a How will you ensure that your proposed development and the measures to protect your site from flooding will not increase flood risk elsewhere?	***6.3***
7b How will you prevent run-off from the completed development causing an impact elsewhere?	***5.4, 6.4***
8. Residual risks	
8a What flood-related risks will remain after you have implemented the measures to protect the site from flooding?	***7***
8b How, and by whom, will these risks be managed over the lifetime of the development?	***5.5, 7***

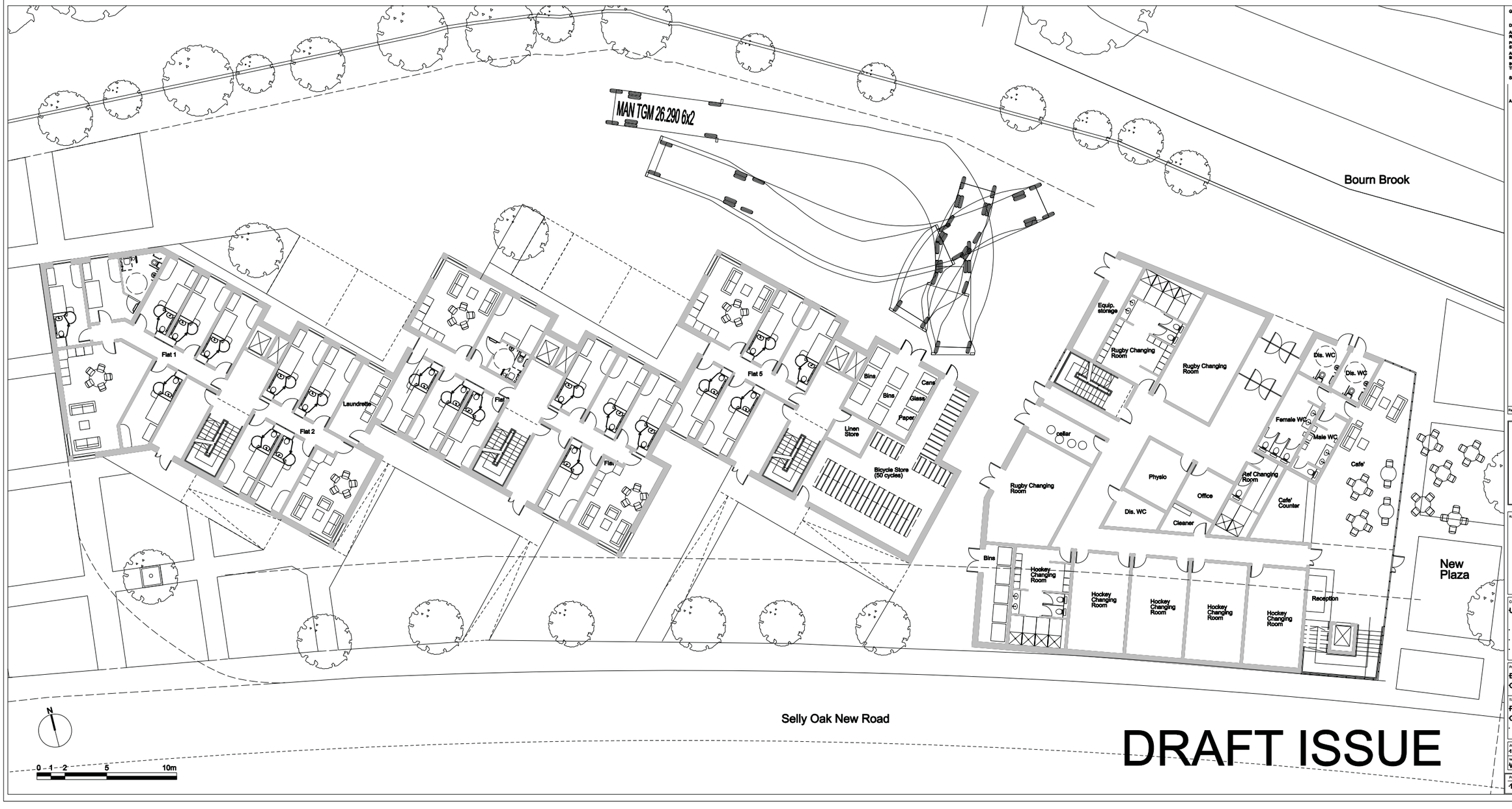
Appendix B
Development Designs

North

Bourne Brook

Laundrette

Selly Oak By-Pass



GENERAL NOTES

DO NOT SCALE DRAWINGS. USE FIGURED DIMENSIONS ONLY.

ALL DIMENSIONS TO BE CHECKED ON SITE DISCREPANCIES TO BE REPORTED IMMEDIATELY TO THE ARCHITECT

FOR STRUCTURAL DIMENSIONS AND SETTING OUT SEE STRUCTURAL ENGINEERS DRAWINGS

ALL INFORMATION SUBJECT TO STATUTORY APPROVALS BEING OBTAINED

INFORMATION NOT TO BE USED OTHER THAN AS DEFINED BY THE DRAWING STATUS

SPECIFIC NOTES:-

Rev	Date	Description	By	Chk	App
A	21.07.11	Info Added	SA	SH	

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MacCormac Jamieson Prichard Ltd Registered in England No 03160770

Key

Client
University Of Birmingham

Project
Edgbaston Campus
Grange Road

Title
Preliminary Ground Floor
GA Plan

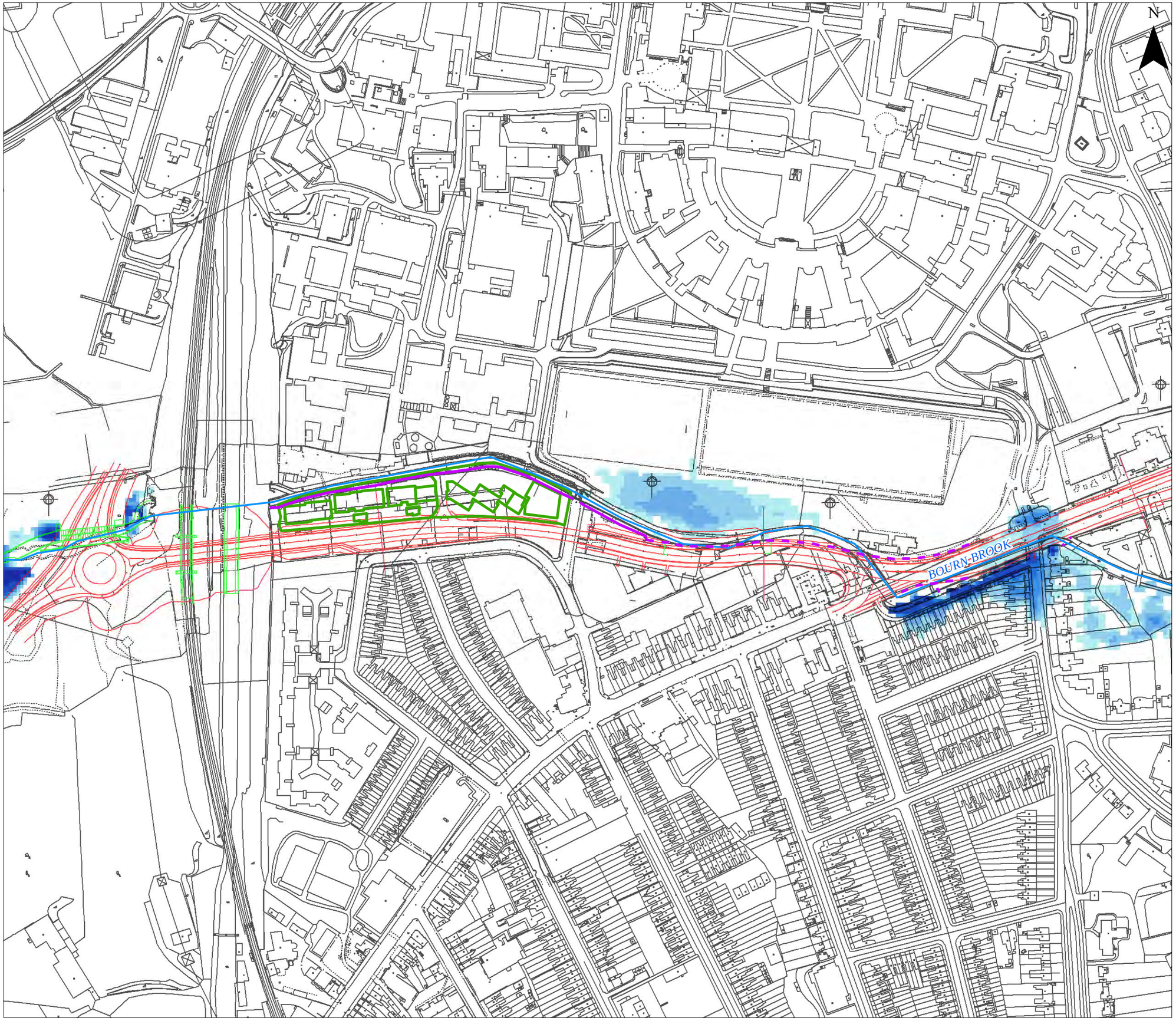
JobNo.	Scale	Date
4102	1:100@A1; 1:200@A3	20/07/11

Issue/Status
WORK IN PROGRESS

Projectno.	Dist.	Zone	Drg Set	Serial	Rev.
4102	A	-	03	160	A

DRAFT ISSUE

Appendix C
FRA Model Outputs



Key:

- Wall
- Bypass
- Bourn Brook
- Development Site

Flood Depths (m)

- 0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 1
- 1 - 2
- >2

Title:
20 Year Model Results
Proposed Development

Project:
Dale Road Flood Risk Assessment

Client:
Victoria Hall Ltd

Date:	Scale:
August 2011	1:3,000 @ A3

Figure:
C1

ROYAL HASKONING

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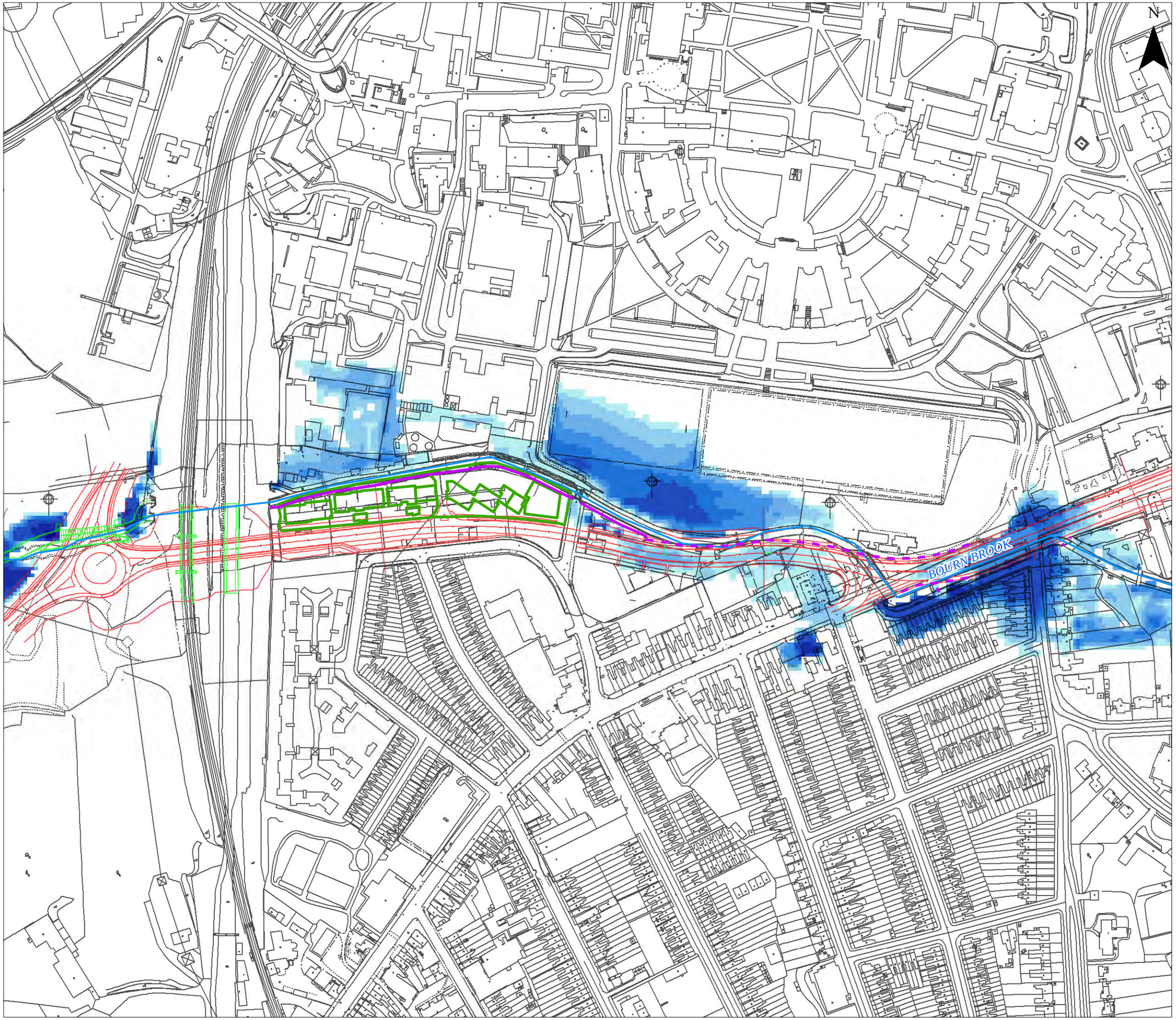

Key:

- Wall
- Bypass
- Bourn Brook
- Development Site

Flood Depths (m)

- 0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 1
- 1 - 2
- >2

Title:
100 Year Model Results
Proposed Development

Project:
Dale Road Flood Risk Assessment

Client:
Victoria Hall Ltd

Date:	Scale:
August 2011	1:3,000 @ A3

Figure:
C2

ROYAL HASKONING

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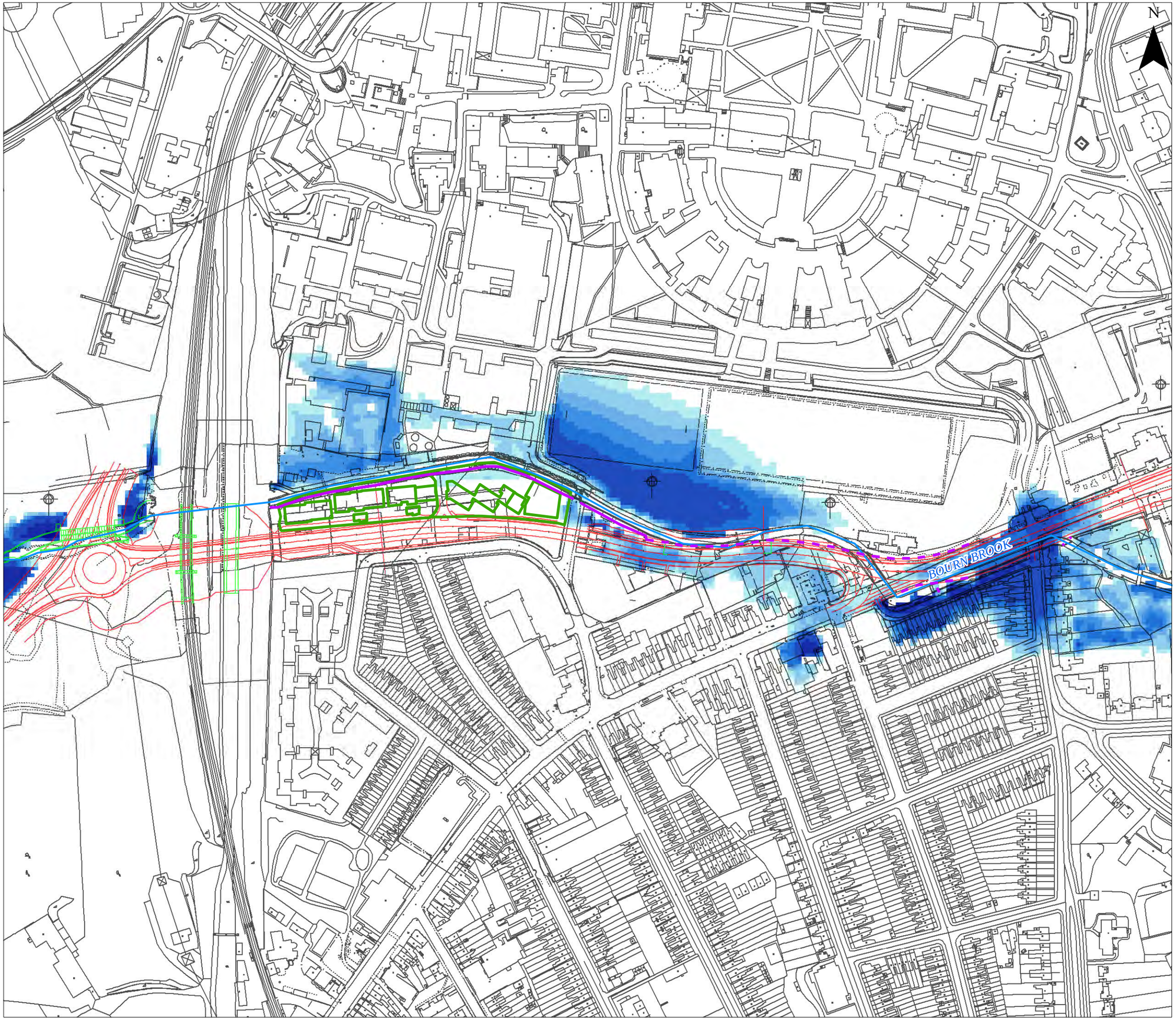

Key:

- Wall
- Bypass
- Bourn Brook
- Development Site

Flood Depths (m)

- 0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 1
- 1 - 2
- >2

Title:
100 Year Climent Change Model Results Proposed Development

Project:
Dale Road Flood Risk Assessment

Client:
Victoria Hall Ltd

Date:	Scale:
August 2011	1:3,000 @ A3

Figure:
C3

ROYAL HASKONING

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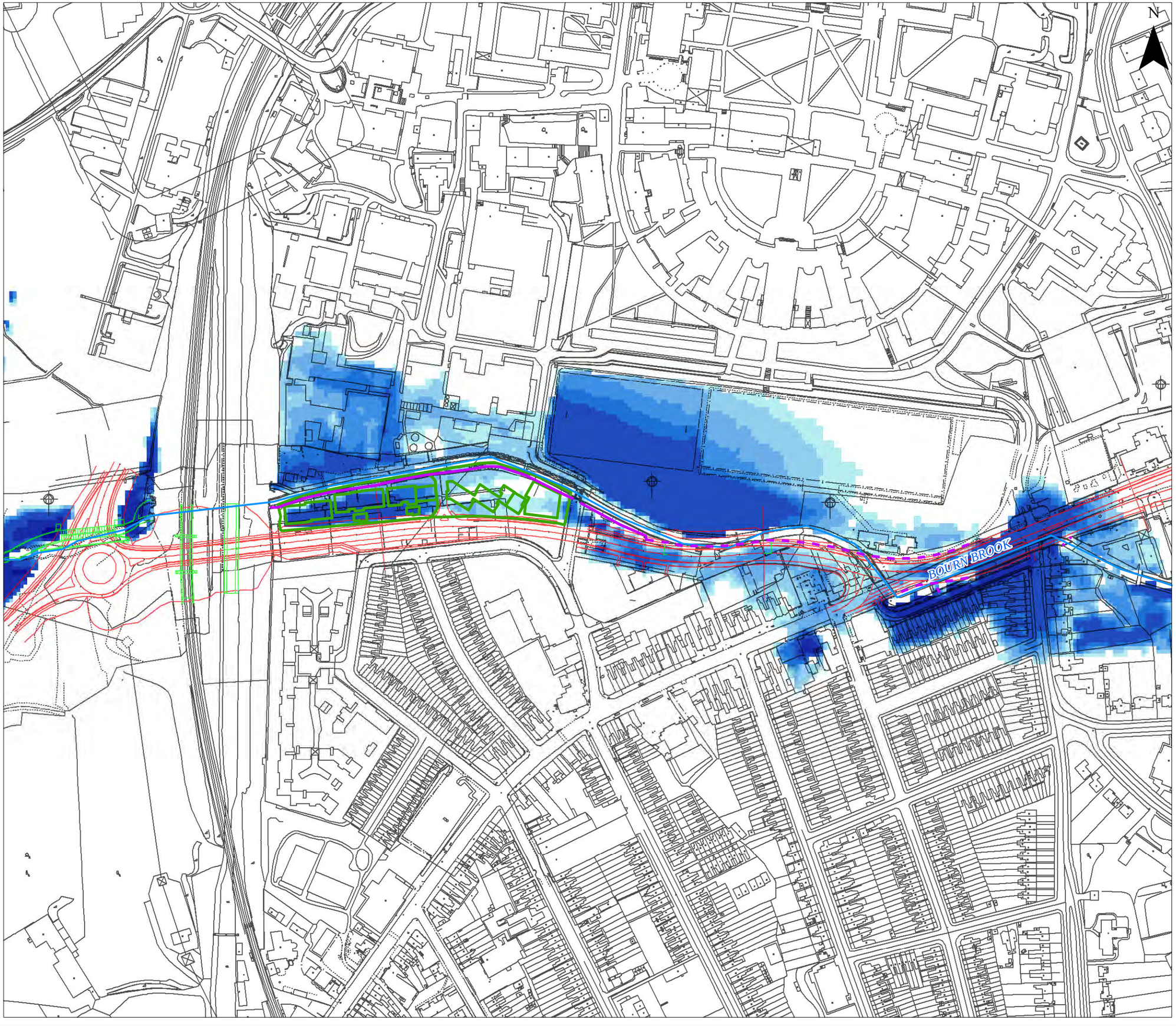

Key:

- Wall
- Bypass
- Bourn Brook
- Development Site

Flood Depths (m)

- 0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 1
- 1 - 2
- >2

Title:
1000 Year Model Results
Proposed Development

Project:
Dale Road Flood Risk Assessment

Client:
Victoria Hall Ltd

Date:
August 2011

Scale:
1:3,000 @ A3

Figure:
C4

ROYAL HASKONING

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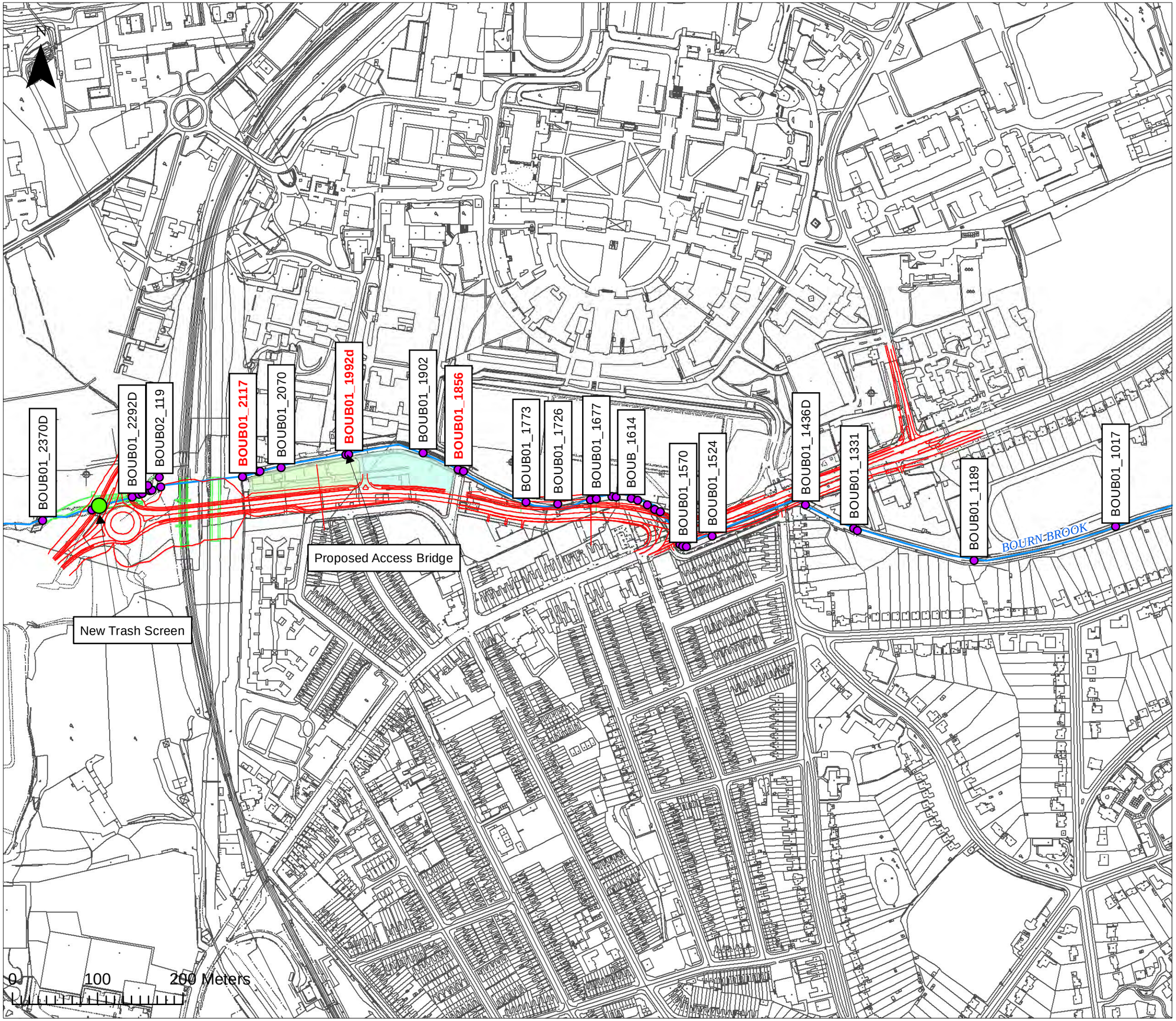

Key:

- ISIS Node Points
- Bypass
- Bourn Brook
- East Development Site (UoB)
- West Development Site (VHL)

Title:
ISIS Cross Sections

Project:
Dale Road Flood Risk Assessment

Client:
Victoria Hall Ltd

Date:
August 2011

Scale:
1:4,000 @ A3

Figure:
C5

ROYAL HASKONING

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Appendix D
Water Level Comparisons

Appendix D - Bourn Brook Modelling Study and FRA Model Water Level Comparisons

	Maximum Water Level mAOD																					
	Bourn Brook Modelling Study - Defended								Bourn Brook Modelling Study - Undefended								FRA Model - Defended				Comparison Between Bourn Brook Defended Model and FRA Defended Model (mAOD)			
ISIS Node	5 year	10 year	20 year	50 year	75 year	100 year	100 year+CC	1000 year	5 year	10 year	20 year	50 year	75 year	100 year	100 year+CC	1000 year	20yr	100yr	100yr+cc	1000yr	20yr	100yr	100yr+cc	1000yr
BOUB01_2370D	125.165	125.351	125.545	125.757	125.847	125.895	126.017	126.394	125.165	125.351	125.545	125.757	125.847	125.896	126.017	126.412	125.722	126.018	126.13	126.509	0.177	0.123	0.113	0.115
BOUB_2370i1	125.12	125.31	125.513	125.751	125.851	125.899	126.016	126.387	125.12	125.31	125.513	125.751	125.851	125.899	126.016	126.412	125.715	126.018	126.134	126.504	0.202	0.119	0.118	0.117
BOUB_2370i2	125.08	125.267	125.463	125.699	125.811	125.874	126.027	126.406	125.08	125.267	125.463	125.699	125.811	125.875	126.027	126.428	125.679	126.029	126.153	126.531	0.216	0.155	0.126	0.125
BOUB_2370i3	125.036	125.223	125.42	125.658	125.761	125.824	125.984	126.447	125.036	125.223	125.42	125.658	125.761	125.824	125.984	126.459	125.65	126.003	126.151	126.536	0.23	0.179	0.167	0.089
BOUB_2370i4	124.988	125.174	125.371	125.612	125.716	125.78	125.943	126.468	124.988	125.174	125.371	125.612	125.716	125.78	125.943	126.485	125.618	125.974	126.125	126.616	0.247	0.194	0.182	0.148
BOUB01_2292	124.932	125.117	125.315	125.559	125.665	125.73	125.898	126.431	124.932	125.117	125.315	125.559	125.665	125.73	125.898	126.449	125.583	125.942	126.095	126.592	0.268	0.212	0.197	0.161
BOUB01_2292D	124.866	125.036	125.223	125.457	125.558	125.625	125.793	126.25	124.866	125.036	125.223	125.457	125.558	125.624	125.793	126.256	125.396	125.749	125.911	126.393	0.173	0.124	0.118	0.143
BOUB_2292i1	124.816	124.985	125.177	125.435	125.552	125.629	125.808	126.293	124.816	124.985	125.177	125.435	125.552	125.629	125.808	126.299	125.379	125.761	125.932	126.437	0.202	0.132	0.124	0.144
BOUB01_2262	124.788	124.958	125.152	125.415	125.534	125.613	125.794	126.283	124.788	124.958	125.152	125.415	125.534	125.613	125.794	126.289	125.364	125.75	125.924	126.431	0.212	0.137	0.13	0.148
BOUB01_2226	124.788	124.958	125.152	125.415	125.534	125.613	125.794	126.283	124.788	124.958	125.152	125.415	125.534	125.613	125.794	126.289	125.364	125.75	125.924	126.431	0.212	0.137	0.13	0.148
BOUB_2226i1	124.781	124.95	125.145	125.409	125.525	125.603	125.791	126.292	124.781	124.95	125.145	125.409	125.525	125.603	125.79	126.298	125.363	125.75	125.929	126.455	0.218	0.147	0.138	0.163
BOUB_2226i2	124.775	124.944	125.14	125.404	125.52	125.598	125.786	126.288	124.775	124.944	125.14	125.404	125.52	125.598	125.785	126.293	125.363	125.75	125.928	126.455	0.223	0.152	0.142	0.167
BOUB01_2226u	124.769	124.938	125.134	125.399	125.515	125.594	125.781	126.284	124.769	124.938	125.134	125.399	125.515	125.594	125.781	126.289	125.362	125.749	125.928	126.454	0.228	0.155	0.147	0.17
BOUB01_2226D	124.614	124.873	125.097	125.376	125.497	125.577	125.769	126.276	124.614	124.873	125.097	125.376	125.497	125.577	125.768	126.282	124.919	125.291	125.457	125.973	-0.178	-0.286	-0.312	-0.303
BOUB01_2214	124.606	124.879	125.113	125.402	125.527	125.61	125.807	126.338	124.606	124.879	125.113	125.402	125.527	125.61	125.806	126.343	124.871	125.268	125.442	125.957	-0.242	-0.342	-0.365	-0.381
BOUB_2214c1	123.859	124.085	124.295	124.711	124.898	125.022	125.27	125.969	123.859	124.085	124.294	124.701	124.88	125.002	125.27	125.973	124.251	124.798	124.99	125.543	-0.044	-0.224	-0.28	-0.426
BOUB_2157c2	123.722	124.03	124.303	124.667	124.801	124.891	125.069	125.545	123.722	124.03	124.301	124.66	124.787	124.875	125.069	125.548	124.297	124.742	124.884	125.255	-0.006	-0.149	-0.185	-0.29
BOUB_2117c3	123.751	124.033	124.274	124.56	124.661	124.732	124.857	125.202	123.751	124.033	124.272	124.555	124.647	124.717	124.859	125.205	124.276	124.637	124.748	125.018	0.002	-0.095	-0.109	-0.184
BOUB01_2117	123.636	123.893	124.103	124.315	124.377	124.42	124.482	124.613	123.636	123.893	124.101	124.31	124.366	124.407	124.485	124.61	124.14	124.409	124.472	124.575	0.037	-0.011	-0.01	-0.038
BOUB01_2070	123.501	123.773	123.996	124.22	124.291	124.351	124.441	124.664	123.501	123.773	123.996	124.222	124.294	124.347	124.465	124.672	123.954	124.254	124.354	124.552	-0.042	-0.097	-0.087	-0.112
BOUB01_2070D	123.501	123.773	123.996	124.22	124.291	124.351	124.441	124.664	123.501	123.773	123.996	124.222	124.294	124.347	124.465	124.672	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BOUB_2002i	123.069	123.374	123.598	123.809	123.874	123.92	123.932	124.122	123.069	123.374	123.597	123.813	123.877	123.924	123.934	124.131	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BOUB01_1992u	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	123.537	123.829	123.903	124.096	N/A	N/A	N/A	N/A
BOUB01_1992d	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	123.537	123.829	123.903	124.09	N/A	N/A	N/A	N/A
BOUB_1952i	122.746	123.103	123.338	123.526	123.553	123.576	123.753	124.042	122.746	123.103	123.337	123.526	123.552	123.575	123.753	124.042	123.312	123.574	123.649	123.909	-0.026	-0.002	-0.104	-0.133
BOUB01_1902	122.409	122.847	123.112	123.298	123.302	123.301	123.303	123.303	122.409	122.847	123.111	123.299	123.301	123.301	123.301	123.296	123.066	123.312	123.323	123.342	-0.046	0.011	0.02	0.039
BOUB01_1856	122.146	122.682	122.956	123.196	123.251	123.289	123.373	123.539	122.146	122.682	122.954	123.196	123.249	123.288	123.379	123.54	122.908	123.228	123.319	123.528	-0.048	-0.061	-0.054	-0.011
BOUB01_1856D	122.146	122.341	122.501	122.652	122.722	122.761	122.853	123.066	122.146	122.341	122.5	122.652	122.721	122.766	122.861	123.067	122.475	122.679	122.772	122.967	-0.026	-0.082	-0.081	-0.099
BOUB01_1773	121.926	122.137	122.31	122.471	122.558	122.604	122.705	122.929	121.926	122.137	122.309	122.472	122.556	122.606	122.712	122.932	122.283	122.525	122.633	122.852	-0.027	-0.079	-0.072	-0.077
BOUB01_1726	121.733	121.944	122.143	122.326	122.418	122.47	122.577	122.818	121.733	121.944	122.142	122.326	122.416	122.472	122.583	122.819	122.106	122.377	122.499	122.732	-0.037	-0.093	-0.078	-0.086
BOUB01_1687D	121.63	121.85	122.052	122.237	122.329	122.385	122.495	122.757	121.63	121.85	122.051	122.237	122.328	122.386	122.501	122.76	122.014	122.284	122.412	122.663	-0.038	-0.101	-0.083	-0.094
BOUB01_1677	121.446	121.649	121.835	121.993	122.084	122.138	122.243	122.532	121.446	121.649	121.834	121.994	122.082	122.139	122.249	122.535	121.797	122.035	122.164	122.421	-0.038	-0.103	-0.079	-0.111
BOUB_1654	121.238	121.436	121.725	121.934	122.044	122.106	122.214	122.521	121.238	121.436	121.724	121.935	122.041	122.105	122.22	122.523	121.671	121.984	122.131	122.401	-0.054	-0.122	-0.083	-0.12
BOUB_1654D	121.238	121.436	121.725	121.934	122.044	122.106	122.214	122.521	121.238	121.436	121.724	121.935	122.041	122.105	122.22	122.523	121.671	121.984	122.131	122.401	-0.054	-0.122	-0.083	-0.12
BOUB_1614	120.917	121.108	121.327	121.676	121.758	121.81	121.92	122.307	120.917	121.108	121.326	121.676	121.756	121.81	121.925	122.31	121.289	121.712	121.835	122.15	-0.038	-0.098	-0.085	-0.157
BOUB_1614D	120.869	121.057	121.277	121.639	121.722	121.776	121.886	122.281	120.869	121.057	121.276	121.64	121.72	121.775	121.891	122.285	121.238	121.676	121.801	122.121	-0.039	-0.1	-0.085	-0.16
BOUB01_1590D	120.527	120.787	121.164	121.482	121.594	121.663	121.796	122.163	120.527	120.787	121.162	121.479	121.592	121.66	121.801	122.166	121.097	121.521	121.692	122.027	-0.067	-0.142	-0.104	-0.136
BOUB01_1581	120.431	120.895	121.27	121.562	121.671	121.737	121.869	122.215	120.431	120.895	121.268	121.562	121.67	121.735	121.875	122.218	121.212	121.604	121.767	122.092	-0.058	-0.133	-0.102	-0.123
BOUB01_1574	120.502	120.954	121.324	121.618	121.73	121.797	121.933	122.285	120.502	120.954	121.322	121.619	121.729	121.795	121.939	122.288	121.266	121.663	121.828	122.158	-0.058	-0.134	-0.105	-0.127
BOUB_1574bu	120.414	120.854	121.193	121.446	121.537	121.591	121.692	121.942	120.414	120.854	121.192	121.447	121.537	121.588	121.693	121.944	121.148	121.486	121.621	121.861	-0.045	-0.105	-0.071	-0.081
BOUB_1549	120.421	120.832	121.163	121.407	121.493	121.543	121.634	121.861	120.421	120.831	121.162	121.408	121.493	121.541	121.636	121.863	121.119	121.446	121.571	121.789	-0.044	-0.097	-0.063	-0.072
BOUB_1549c1	120.421	120.832	121.163	121.407	121.493	121.543	121.634	121.861	120.421	120.831	121.162	121.408	121.493	121.541	121.636	121.863	121.119	121.446	121.571	121.789	-0.044	-0.097	-0.063	-0.072
BOUB_1574c1	120.401	120.803	121.126	121.357	121.437	121.484	121.563	121.76	120.401	120.803	121.125	121.358	121.437	121.481	121.564	121.762	121.083	121.395	121.509	121.7	-0.043	-0.089	-0.054	-0.06
BOUB_1549c2	120.421	120.832	121.163	121.407	121.493	121.543	121.634	121.861	120.421	120.831	121.162	121.408	121.493	121.541	121.636	121.863	121.119	121.446	121.571	121.789	-0.044	-0.097	-0.063	-0.072
BOUB_1574c2	120.401	120.803	121.126	121.357	121.437	121.484	121.563	121.76	120.401	120.803	121.125	121.358	121.437	121.481	121.564	121.762	121.083	121.395	121.509	121.7	-0.043	-0.089	-0.054	-0.06
BOUB01_1574D	120.401	120.803	121.126	121.357	121.437	121.484	121.563	121.76	120.401	120.803	121.125	121.358	121.437	121.481	121.564	121.762	121.083	121.395	121.509	121.7	-0.043	-0.089	-0.054	-0.06
BOUB01_1570	120.395	120.803	121.144	121.377	121.461	121.511	121.598	121.809	120.395	120.803	121.143	121.378	121.46	121.507	121.6	121.81	121.092	121.415	121.537	121.742	-0.052	-0.096	-0.061	-0.067
BOUB01_1570D	120.378	120.788	121.131	121.363	121.445	121.495	121.581	121.788	120.378	120.788	121.13	121.363	121.444	121.492	121.583	121.79	121.078	121.399	121.521	121.723	-0.053	-0.096	-0.06	-0.065
BOUB01_1524	120.121	120.565	120.926	121.219	121.319	121.38	121.497	121.789	120.121	120.564	120.924	121.216	121.317	121.378	121.501	121.791	120.874	121.261	121.416	121.692	-0.052	-0.119	-0.081	-0.097
BOUB_1524cu	119.882	120.312	120.615	120.881	120.976	121.035	121.148	121.449	119.882	120.312	120.613	120.879	120.974	121.032	121.152	121.451	120.57	120.921	121.07	121.344	-0.045	-0.114	-0.078	-0.105
BOUB_1524beu	119.699	119.968	120.192	120.417	120.509	120.563	120.673	121.035	119.699	119.968	120.19	120.416	120.505	120.561	120.678	121.023	120.156	120.456	120.602	120.869	-0.036	-0.107	-0.071	-0.166
BOUB_1524bed	119.66	119.914	120.125	120.344	120.435	120.489	120.598	120.959	119.66	119.914	120.124	120.344	120.431	120.487	120.603	120.948	120.091	120.383	120.528	120.794	-0.034	-0.106	-0.07	-0.165
BOUB_1524cd	119.649	119.899	120.107	120.324	120.415	120.468	120.578	120.944	119.649	119.899	120.105	120.324	120.411	120.467	120.582	120.932	120.073	120.363	120.507	120.774	-0.034	-0.105	-0.071	-0.17
BOUB01_1436D	119.511	119.681	119.818	119.988	120.065	120.111	120.208	120.544	119.511	119.681	119.817	119.988	120.061	120.11	120.211	120.537	119.793	120.021	120.147	120.389	-0.025	-0.09	-0.061	-0.155
BOUB01_1331	119.218	119.38	119.5	119.642	119.708	119.752	119.845	120.354	119.218	119.38	119.5	119.643	119.706	119.75	119.846	120.356	119.481	119.673	119.784	120.053	-0.019	-0.079	-0.061	-0.301
BOUB01_1331D	119.218	119.38	119.5	119.639	119.7	119.74	119.824	120.098	119.218	119.38	119.5	119.639	119.699	119.739	119.825	120.099	119.481	119.668	119.77	120.007	-0.019	-0.072	-0.054	-0.091
BOUB01_1189	118.54	118.724	118.858	118.988	119.03	119.06	119.136	119.29	118.54	118.724	118.856	118.984	119.025	119.055	119.128	119.28	118.834	118.989	119.054	119.21	-0.024	-0.071	-0.082	-0.08
BOUB01_1017	117.657	117.756	117.885	118.053	118.1	118.131	118.184	118.294	117.657	117.756	117.885	118.053	118.1	118.131	118.184	118.294	117.885	118.131	118.184	118.294	0	0	0	0
BOUB02_141	124.736	124.903	125.097	125.365	125.487	125.568	125.753	126.254	124.736	124.903	125.097	125.365	125.486	125.567	125.753	126.259	125.313	125.707	125.886	126.404	0.216	0.139	0.133	0.15
BOUB02_119	124.586	124.778	124.984	125.249	125.366	125.443	125.62	126.095	124.586	124.778	124.984	125.249	125.366	125.443	125.62	126.1	125.198	125.578	125.745	126.239	0.214	0.135	0.125	0.144
BOUB02_119c	124.048	124.227	124.403	124.607	124.686	124.74	124.853	125.137	124.048	124.227	124.403	124.606	124.685	124.738	124.858	125.14	124.551	124.824	124.924	125.185	0.148	0.084	0.071	0.048
BOUB02_060	123.86	124.075	124.303	124.548	124.635	124.7	124.813	125.129	123.86	124.075	124.303	124.548	124.634	124.696	124.821	125.136	124.461	124.784	124.888	125.138	0.158	0.084	0.075	0.009
BOUB02_023c	123.877	124.105	124.327	124.566	124.651	124.714	124.829	125.127	123.877	124.105	124.326	124.566	124.651	124.71	124.837	125.133	124.482	124.797	124.896	125.138	0.155	0.083	0.067	0.011

Appendix E
Meeting Minutes 03/08/2011

M1585 - Dale Road,Selly Oak, Birmingham

Notes of Meeting held at Birmingham University on 03 August 11

Present:

Tony Hayes	-	Bailey Johnson Hayes
Paul O'Connell	-	O'Connell East Architects
Laura Sanderson	-	Royal Haskoning
Simon Shakespeare	-	University of Birmingham
Liz Pride	-	MJP Architects
Dave Hughes	-	Environment Agency
Paul Gethen	-	Environment Agency
Bethany Flynn	-	Environment Agency
Andy Wilson	-	Environment Agency

The purpose of the meeting was to present the findings of the updated flood model for the section of Bourn Brook between the Canal Embankment to A38 and to agree the approach for the flood risk assessment for the proposed developments.

Item	Note	Action
1	TH outlined the scope of the study completed by Royal Haskoning confirming that both defended and undefended river boundaries had been modelled to provide a full understanding of potential flood conditions. TH reiterated that both sites had, up until very recently, large industrial buildings on them built circa 1900 with substantial walls adjacent to Bourn Brook.	
2	LS provided a summary of the main changes made to the model based on construction information provided by Birse, contractors to Birmingham CC carrying out SONR. These are: Bristol Road structure changed from bridge to culvert; weir structure replaced by rock ramp; weir removed from channel; channel realignments; floodplain levels adjusted to suit construction levels; overflow culvert included at canal embankment; ground levels revised adjacent to new roundabout west of embankment.	
3	LS presented the results of the modelling for 5, 20 & 100 years flood events. The defended condition, modelled by inclusion of a 600 high boundary wall adjacent to the brook, resulted in no flooding on either of the sites. The undefended condition showed no flooding on either site for 5yr event; Western site - minor flooding at 20yrs with moderate flooding for 100 year event; Eastern site – no flooding at 20yrs with minor flooding for the 100 year event. The results showed very little difference for off site flooding for either defended or undefended conditions.	
4	Based on these results TH proposed that both development sites could treated as defended sites for development purposes provided the FRA could clearly demonstrate that the extent of offsite flooding was essentially the same for defended or undefended conditions. The development proposals would include a new riverside flood defence wall along the full river boundary extending from the canal embankment to the existing pedestrian footbridge. Although considered insignificant, any flood water excluded from the development sites would be diverted to the University playing fields without increasing downstream flooding elsewhere. LS to confirm additional flood depth within the FRA. DH agreed to this proposal in principle but stated that UOB would have to confirm agreement to the FRA results.	LS / UOB

5	LP confirmed that UOB intended to include the new access road in the planning application for the Eastern Site and the FRA would need to include details of the new bridge over the brook. LS to confirm soffit / abutment levels in relation to flood modelling. Options to increase bridge span / open abutment arrangement to be considered if required. LP confirmed that the position of the bridge coincided with a gap if the existing trees however it was likely that the width of the gap was insufficient particularly if ramps into the steam bed were required at this point. A number of trees would need to be removed to accommodate the new bridge.	LS
6	DH agreed that both sites could be covered by a single FRA.	VHL/ UOB
7	Options to provide access to the river bed were tabled. AW confirmed that the main feature the EA required access to was to clear the trash screen upstream of the A38 culvert and ideally the ramp should be located directly adjacent to this structure. AW confirmed the SONR scheme included a ramp upstream of the existing pavilion. VHL /UOB had considered options for ramps located adjacent to the proposed UOB access road bridge. Ramps adjacent to the proposed bridge would not be required if the EA mechanical equipment could pass under the existing and proposed foot bridges. AW to confirm the height of the equipment.	AW
8	DH suggested that the trash screens would be better located to the west of the canal embankment where Birse had already constructed a ramp to the river bed and where flood compensation was already built. If costs for relocating the screen were reasonable and the FRA modelling did not show increased flooding downstream this option would be a preferable solution to all parties. AW confirmed pedestrian step access points would still be required adjacent to the existing pavillion and adjacent to the new access road bridge.	TH/PO'C/LS /LP
9	AW to confirm the details of mechanical equipment used to clear debris from the brook. BJH / OEA & MJP would need to demonstrate there was sufficient access adjacent to the river for maintenance equipment. AW confirmed the machines would require an access strip of 3.0m wide as a minimum.	AW
10	DH to check any EA specific requirements for an Ecology Study. BCC Ecology Officer also to be consulted re scope of report.	DH
11	DH confirmed that surface water could discharge directly to the Bourn Brook subject to a Land Drainage Consent Application and also the sw drainage design being based on the existing brownfield runoff less 20%.	VHL / UOB
12	BF advised that a flood map challenge could be made before or after producing the FRA. TH indicated that VHL were planning to submit a planning application shortly and therefore this challenge would be made at a later date. VHL & UOB would benefit from this challenge if flood maps removed the sites from the 1:100year flood zones.	
13	The FRA modelling to include:- 1. Relocation of the trash screen to the west of the canal embankment 2. Pedestrian Access adjacent to the new UOB access road bridge 3. New UOB access road bridge 4. 600mm flood wall covering the length of both sites	LS

14	LS confirmed that the FRA would take 2 – 3 weeks to complete once fees are agreed and data received. Fees to be confirmed asap.	LS
15	Data required for completion of the FRA to include:- 1. Planning drawings of the proposed developments at both VHL and UOB sites (.dwg) If further data is found to be required, LS will contact the relevant parties asap.	UOB/VHL
16	DH / AW confirmed that new tree planting along river bank would be acceptable subject to allowing sufficient space between for maintenance river maintenance.	