BRUNSWICK SITE, CAMBRIDGE

Flood Risk Assessment

Berkeley Homes (South East London) Ltd

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Preface

This Flood Risk Assessment prepared by WSP on behalf of Berkeley Homes has been compiled in support of contemporaneous planning applications for the comprehensive redevelopment of the former Cambridge Regional College City Centre Campus – "The Brunswick Site", together with land to the south west currently known as Brunswick House, 61 - 69 Newmarket Road, Cambridge (known as the Rear and Front Sites respectively).

The information contained within this Flood Risk Assessment relates to the redevelopment of the combined sites to provide 205 Residential Units, 251 Student Rooms (in lieu of Affordable Housing), Café, Public Open Spaces (including a new public thoroughfare through the site) and associated works. This document should be read in conjunction with both the Detailed Planning Applications and Conservation Area Consents for the Rear & Front Sites respectively. These applications have, in agreement with officers from Cambridge City Council's Planning Department, been submitted contemporaneously and will be considered jointly by the Council in due course.

Where necessary, specific reference has been made within this Flood Risk Assessment to matters which relate solely to either of the applications for the purpose of ensuring that each application may be considered independently should the need arise.

It remains the applicant's firm intention that both the Rear & Front Sites are redeveloped comprehensively in the event that the respective applications are approved simultaneously.

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1 Introduction

1.1 BACKGROUND

1.1.1 WSP Development and Transportation was commissioned by Berkeley Homes (South East London) Ltd to prepare a Flood Risk Assessment and Preliminary Surface and Foul Water Drainage Strategies for a proposed redevelopment at Brunswick Site, Cambridge.

1.1.2 This report is an updated version of the initial report that will be submitted as part of the revised /wider site application. The initial site application included the Cambridge Regional College site only (1.64 ha). This was withdrawn due to concerns raised in relation to the access strategy, which included vehicular access being taken from Walnut Tree Avenue, through the Riverside Area. In order to address this concern BHSEL purchased the site known as Brunswick House abutting the south west edge of the Cambridge Regional College through which access is provided from the rear site, onto Newmarket Road. As a result, the original Flood Risk Assessment has been updated to include the extended site area (1.84 ha) and some additional changes to the proposed development.

1.1.3 This report has taken account of the consultation response letter of the Environment Agency dated 10 July 2008 (refer to section 2.3 and Appendix C).

1.1.4 The site is brownfield with an approximate area of 1.84 hectares and is currently occupied by Cambridge Regional College and its associated teaching and administration buildings.

1.1.5 The revised application includes an additional 0.2 hectares of land purchased by Berkeley homes to overcome access issues and allow a simpler urban design approach.

1.1.6 The Environment Agency's Flood Zone Map shows the combined 1.84 ha site area comprising of the Cambridge Regional College site (1.64 ha) and Brunswick House (0.20 ha) to be located entirely within Flood Zone 1. Table D1 of Planning Policy Statement 25 – Development and Flood Risk (PPS25) states that Zone 1 areas (Low Probability of flooding) are assessed as having less than a 0.1% (1 in 1,000 year) annual probability of flooding. Refer to Figure 1 in Appendix A.

1.1.7 Although the site is categorised as being within Flood Zone 1, it has a total area greater than one hectare and therefore the Environment Agency requires that a Flood Risk Assessment (FRA) be carried out.

1.2 REPORT STRUCTURE

1.2.1 This report will take the form of a Flood Risk Assessment in accordance with the Environment Agency's FRA Guidance Note 1 (Development greater than 1 hectare in Flood Zone 1) and Annexe E of Planning Policy Statement 25 (PPS25). Refer to Appendix B.

1.2.2 The report outlines a preliminary surface water drainage strategy for the site, as required by PPS25 and Environment Agency guidance. This will ensure that new developments adequately control surface water run-off so as to prevent adverse effects on catchment-wide flooding.

1.2.3 Consultation with the Environment Agency, Cambridge County Council and Anglian Water has taken place during the preparation of this report.

2 Background

2.1 PROPOSED DEVELOPMENT

2.1.1 The approximate post code for the site is CB5 8EU and the grid reference is (546058, 258887). The proposed development is located in Cambridge, east of the city centre.

2.1.2 The development proposal is for the demolition of the Cambridge Regional College, its adjacent buildings, Brunswick House and the redevelopment of the site constructing approximately 205 residential units and up to up to 251 student rooms. The development will include access roads, landscaped and garden areas and associated parking. Refer to the proposed Architect's layout (Appendix F, Johnson Thompson & Partners Drawing No. S001).

2.2 POLICY BACKGROUND

2.2.1 The Government's sustainable development strategy makes it a requirement to assess appropriate forms of development for areas at risk of flooding. This is to avoid any unnecessary increase in the requirement for flood defences.

2.2.2 A requirement of PPS25 is that developers, making planning applications on sites that are potentially at risk of flooding, should consult with the Environment Agency and, where appropriate, produce a Flood Risk Assessment for their proposals. Consultation with the Environment Agency has confirmed that the site is not located within a floodplain. However, as the site is over 1 hectare in size, a Flood Risk Assessment is required to demonstrate that the site does not increase the risk of flooding elsewhere.

2.2.3 The Environment Agency's 'Policy and Practice for the Protection of Flood Plains' (1997), provides guidance to local authorities on the control of development. In addition, the Environment Agency has published Flood Maps that show three zones of varying flood risk probability for areas adjacent to tidal or fluvial water bodies with up to 0.1% annual probability. A copy of the Flood Map for the site and the surrounding area is included in Appendix A as Figure 1.

2.2.4 The Environment Agency's Flood Map shows the application site to be situated within Flood Zone 1. Table D.1, PPS25 assesses sites within Zone 1 as having less than a 0.1% (1 in 1,000 years) annual probability of flooding from either fluvial or tidal sources and categorises Flood Zone 1 areas as appropriate for all uses of land.

2.2.5 Environment Agency's FRA Guidance note 1: Development Greater than 1ha in Flood Zone 1 provides guidance on the detail of the FRA (refer to Appendix B).

2.3 ENVIRONMENT AGENCY CONSULTATION

2.3.1 The Environment Agency has confirmed that the site is located in Flood Zone 1 and that they do not hold any records of historical flooding from rivers or groundwater. Refer to correspondence from the Environment Agency in Appendix C.

2.3.2 The Environment Agency responded to an earlier application on 10 July 2008 (refer to Appendix C) with a condition that prior to construction a detailed drainage design, in accordance with the FRA, should be agreed with the Local Authority. The letter further provided notes to WSP as the author of the FRA. WSP has taken account of these notes and has amended this report to reflect these recommendations. A brief description of the issues addressed is provided below:

- Access to the proposed underground car park

During extreme flood events vehicles were unable to enter or leave the underground car park via Walnut Tree Avenue due to flooding on the entrance road.

Action: a new access strategy for the underground car park has been defined in order to address the above concern. Access to the underground car park shall be provided via New Market Road to the south of the site. For further details, refer sections 7.1.2 of this report and to Proposed Basement Layout: Johnson Thompson & Partners Drawing No.B01 in Appendix F.

- Greenfield runoff calculations

The Agency advised that Existing Greenfield runoff rates should not be added to the overall perceived impermeable runoff from the site and then used to compare to the proposed development runoff.

Action: the existing and proposed Greenfield runoff rates were not included to the overall impermeable runoff from the site. For further details, refer to Chapter 6 and Hand Calculations in Appendix I of this report.

3 Requirements of the Flood Risk Assessment

3.1 REPORT STRUCTURE

3.1.1 PPS25 – Development and Flood Risk, Annex E and Flood Risk Assessment Guidance Note 1: Development greater than 1 hectare in Flood Zone 1 (FRA Note 1), sets out the requirements of a Flood Risk Assessment. Refer to Appendix B.

3.1.2 The guidance specifies that the report shall contain the following:

- Location Plan – see Appendix D and Section 4 of this report
- Level Plan – see Appendix E and Section 5
- Details of flood alleviation measures – see Section 7
- Sources of Flooding – see Section 8
- Flood Plain – see Appendix A and Section 9
- Structures influencing Local Hydraulics – see Section 10
- Flood Volume Displaced – see Section 11
- Climate Change impacts – see Section 12
- Strategic Flood Risk Assessment – see Section 13

3.1.3 The following paragraphs address each of the above points referring to the relevant paragraph in PPS25, Annex E and FRA Note 1.

4 Site Location

4.1 SITE LOCATION

4.1.1 The proposed development is located in Cambridge, east of the city centre. The site is bounded by the Elizabeth Way Bridge to the east, Midsummer Common to the north, residential properties to the west, and to the south by Newmarket Road being its principal vehicular access. The River Cam flows west to east approximately 150 metres north of the site. Refer to the enclosed location plans (Refer to Appendix D Figures 2 and 3).

4.2 PROPOSED DEVELOPMENT

4.2.1 The development proposal is for the demolition of the Regional College, its adjacent buildings, Brunswick House and the redevelopment of the site constructing approximately 205 residential units and 251 student rooms. The development will include access roads, landscaped and garden areas and associated parking. Refer to the proposed Architect's layout (Appendix F, Johnson Thompson & Partners Drawing No. S001).

5 Level Plan

5.1 SITE SURVEY

5.1.1 According to the Environment Agency, the nearest recorded flood levels occurred in May 1978 and October 2001, just downstream of Elizabeth Way Bridge, at a level of 5.25m AOD and 5.16m AOD. Refer to Appendix C for Environment Agency correspondence.

5.1.2 The Environment Agency has provided a predicted 1 in 100 year flood level associated with the River Cams of 5.63m AOD at the site. Refer to Environment Agency correspondence dated 25 July 2007. The modelling along this stretch of the watercourse does not include an allowance for climate change.

5.1.3 The topographical survey (Refer to Appendix E, Laser Surveys, Drawing No L.3284/1& 2 Rev 0) shows that the existing site slopes from approximately 12.35m AOD at the entrance on Newmarket Road to approximately 8.00m AOD on the northern boundary with the Midsummer Common.

6 Surface and Foul Water Drainage Strategy for the Proposed Development

6.1 EXISTING SURFACE WATER DRAINAGE REGIME

6.1.1 The site currently accommodates a mix of single to three storey buildings with associated car parks and landscaped courtyards. Approximately 68% of the site is considered to be impermeable. WSP assessed the run-off rate generated by the existing site using the Modified Rational method. The existing run-off rate for the combined site is approximately 173 l/s for a one year rainfall event. Refer to Appendix I for hand calculations.

6.1.2 The topographical survey carried out for the site indicates that the site is positively drained by a traditional gully and private gravity sewer system. Information gathered indicates that the on-site drainage system is likely to be connected to the Anglian Water (AW) surface water network. Sewer records from Anglian Water show a 225mm diameter surface water sewer running east along Newmarket Road. This sewer connects to a 225mm diameter surface water sewer draining to the north along Elizabeth Way and Walnut Tree Avenue ultimately discharging to the Cam River under Elizabeth Way Bridge, close to the site. Anglian Water and Cambridge County Council have confirmed that they have no records of their infrastructures flooding in the vicinity of the site.

6.2 EXISTING FOUL WATER DRAINAGE REGIME

6.2.1 Sewer records from Anglian Water confirm the existence of a 300mm diameter foul sewer running east along Newmarket Road and a 225mm diameter foul sewer running north along Walnut Tree Avenue respectively. Sewer records also indicate the presence of an Anglian Water 225mm diameter foul sewer running east and crossing the Midsummer Common. Refer to Anglian Water sewer records in Appendix G.

6.3 DRAINAGE STRATEGY REQUIREMENTS

6.3.1 The proposed surface water drainage strategy should seek to replicate the site's existing hydrology. Changes in the volume and rate of surface water run-off from the development could increase the risk of flooding downstream unless sufficient steps are taken within the proposed development to prevent this from happening.

6.3.2 A fundamental principle of sustainable development in terms of flood defence is the reduction of surface water run-off from new developments. The Environment Agency's policy for sustainability requires that run-off from new developments is limited to that of existing "Greenfield" run-off rates wherever possible. Any increase in run-off above the allowable discharge limit must be attenuated on site.

6.3.3 Sustainable Drainage Systems (SUDS) can be used to reduce the amount of rainfall collected at source and where appropriate, to improve water quality.

6.4 PROPOSED SURFACE WATER DRAINAGE STRATEGY

6.4.1 The existing combined site (1.84ha) is approximately 68% hard standing (1.25ha). Refer to the topographical survey for the site (Laser Surveys, Drawing No L.3284/1& 2 Rev 0) enclosed. Therefore, the existing surface water run-off from the site is approximately 173 l/s for a one year rainfall event. Refer to Appendix I for hand calculations and WSP Drawing 2117/D/01.

6.4.2 The hard standing area for the proposed development is approximately 1.29 ha, providing a slight increase in surface water run-off.

6.4.3 Correspondence from the Environment Agency states that *"We are currently seeking betterment for brownfield redevelopment sites, where practicably possible, as appropriate mitigation. This is particularly topical with regard to the recent flooding around the country."*

6.4.4 Anglian Water (A.W) has confirmed that a discharge equivalent to the existing proven discharge from the previous/current use of the site would be permitted for the proposed development. Surface water that exceeds the maximum allowable discharge will require some form of on-site attenuation. Refer to Appendix G for A.W. report.

6.4.5 The below strategy proposes to reduce the runoff considerably to meet the Code for Sustainable home requirement of at least a 50% improvement over the existing situation

6.4.6 It is proposed to use tanked cellular storage to attenuate the runoff generated by the site. Three locations for cellular storage are proposed, as shown on WSP drawing 2117-D-06 in Appendix I.

- Block A,D,E (0.656ha) drain to Tanked Cellular Storage (TCS) 1
- The student accommodation and student car park (0.340ha) drain to TCS 2
- Block C1 & C2 (0.298ha) drains to TCS3

6.4.7 The proposed TCS1 has a storage depth of 0.8m. The proposed TCS2 and TCS3 has a storage depth of 0.4m. TCS1 and TCS2 have a proposed new outfall to the 225mm diameter A.W surface water sewer in Newmarket Road. TCS3 has a proposed new outfall to the A.W surface water sewer in Elizabeth Way.

6.4.8 Consent has to be obtained from AW through a Section 104 agreement for the new connections to their sewer system

6.4.9 Proposed outfall rates for the various TCS's are given in below table and are based on Microdrainage calculations (see Appendix I).

Return period / Tanked cellular storage number	**1 yr (l/s)**	**30yr (l/s)**	**100yr (l/s)**	**100yr +30% (l/s)**
1	17.0	61.8	73.5	86.7
2	6.7	27.9	41.4	55.7
3	6.5	25.4	57.3	53.3
Total	30.2	115.1	172.2	195.7

6.4.10 Therefore the comparison between the existing runoff and the proposed total runoff from the site is as follows:

Return Period	1 yr	30yr	100yr	100yr +30%
Existing runoff (l/s)	173.7	392.7	500.0	650.0
Proposed runoff (l/s)	30.2	115.1	172.2	195.7
% of reduction	82.6	70.7	65.5	69.8

6.4.11 Therefore the proposed strategy is robust and provides betterment over the existing situation by reducing the existing runoff by approximately 65% for a 1 in 100 return period storm event and is sustainable in terms of flood risk. This provides a robust solution and demonstrates that there will be no impact on or off-site as a result of the development.

6.4.12 However, the exact discharge rates and reduction of the surface water discharge will be defined at the detailed design stage.

6.5 PROPOSED FOUL WATER DRAINAGE STRATEGY

6.5.1 Anglian Water has confirmed that the foul drainage from the proposed development can be accommodated within the existing sewerage system without the need of any offsite reinforcements. They confirmed that the connection point would be to Manhole Ref. 0004 located in Walnut Tree Avenue or Manhole Ref. 1901 located in the Midsummer Common. Refer to Anglian Water Pre Development Report in Appendix G.

6.5.2 It is proposed that the existing connection points to Anglian Water foul sewers be retained and re-used by the proposed re-development. The current manhole connections need to be confirmed at detailed design stage but is assumed to be Manhole Ref. 1901 as this is the most direct route and WSP also propose a new surface water connection to Walnut Tree Avenue.

6.5.3 Details regarding the number of occupants in both the existing situation and of the proposed development were used to assess the foul loadings. Refer to housing Schedule in Appendix F.

6.5.4 The proposed below calculations assume 256 student accommodations which is in excess of the student accommodations planned at the site.

6.5.5 Discharge rate results are given in below table and are based on Sewer for Adoption 6th Edition.

Existing Foul Loadings:

Occupants	No.	Hours per day (hrs)	Loading l/day	Peak Factor	Peaked Loadings (l/s per person)	Development Loading (l/s)
Day Students	2,233	24	180	6.6	0.01375	30.704
Evening Students	148	24	240	6.6	0.01833	2.713
Staff	90	24	180	6.6	0.01375	1.238
					Total Existing Foul Loadings =	34.655

Proposed Foul Loadings:

Development Type	persons	Hours per Day (hrs)	Loading l/day (per person)	Peak Factor	Peaked Loadings (l/s per person)	Development Loading (l/s)
Studios/No1 Bed units	146	24	200	6.6	0.01528	2.231
No2 Bed units	360	24	200	6.6	0.01528	5.500
No3 Bed units	192	24	200	6.6	0.01528	2.933
No5 bed units	100	24	200	6.6	0.01528	1.528
Student Hall	243	24	240	6.6	0.01833	4.455
					Total Proposed Foul Loadings =	16.647
					Foul Loading balance (Prop Loading - Ex Loading) =	**-18.008**

Balance:

6.5.6 Foul Loading balance (Prop Loading - Ex Loading) = 34.655 – 16.647= **-18.008 l/s**

6.5.7 Above calculations show a decrease in peak foul flows from the proposed development, and therefore provides betterment over the existing situation and is sustainable in terms of flood risk.

7 Flood Mitigation Measures

7.1 PROPOSED FLOOD MITIGATION

7.1.1 The combined site is shown to lie entirely within Flood Zone 1 and proposed floor levels are to be set at a minimum level of 9.50m AOD with a minimum access level of 7.00m AOD for the proposed footpath connecting to Walnut Tree Avenue. These levels are 3.87m and 1.37m above the predicted 1 in 100 year level respectively. Therefore no flood mitigation measures are required.

7.1.2 Proposals for the site include the development of a new underground car park with 195 car parking spaces. A review of the proposed basement layout for the site indicates that the underground car park will be set no lower than 7.05 m AOD with access planned via a new road connection to Newmarket Road with road access levels to be set no lower than 11.16 m AOD. Therefore there is no risk of fluvial flooding to the underground car park. Refer to the proposed Architect's basement layout (Appendix F, Johnson Thompson & Partners Drawing No. B01).

8 Sources Of Flooding

8.1 FLUVIAL FLOODING

8.1.1 According to the Environment Agency's Flood Zone Map, the site is located entirely in Flood Zone 1. The principal perceived risk of flooding is presented by the tidal Cams, which flows approximately 150m north of the site.

8.1.2 According to the Environment Agency, there is no record or knowledge of the site flooding in the past. The nearest recorded flood levels occurred in May 1978 and October 2001, just downstream of Elizabeth Way Bridge, at a level of 5.25m AOD and 5.16m AOD. Refer to Appendix C for Environment Agency correspondences.

8.1.3 The Environment Agency has provided a predicted 1 in 100 year flood level associated with the River Cams of 5.63m AOD. Refer to Environment Agency correspondence dated 25 July 2007. The modelling along this stretch of the watercourse does not include an allowance for climate change.

8.2 SEWER AND HIGHWAY FLOODING

8.2.1 Anglian Water has confirmed that they have no records of incidents of sewers flooding as a result of surcharging in the vicinity of the development site. Refer to enclosed Anglican Water correspondence dated 18 July 2007 in Appendix G.

8.2.2 Cambridge County Council has confirmed that the council keep no record of highway flooding in the vicinity of the site. Refer to Cambridge County Council correspondence dated 9 July 2007 (Appendix H).

8.3 GROUNDWATER FLOODING

8.3.1 A desk study and ground investigation report was prepared for the site. This investigation has confirmed that the site is underlain by a moderate thickness of made ground, River Terrace Gravel and by Gault Clay at depth. Refer to Appendix J Desk Study and Ground Investigation Report carried out by GEA in January 2006.

8.3.2 The basement level of the proposed underground car park is to be set at a minimum level of 7.05m AOD. This provides a freeboard of 1.42m above the 1 in 100 year flood level associated with the River Cam, which runs approximately 150m north of the site. The risk of groundwater flooding is considered unlikely to occur at the site, however more detailed assessment will be undertaken to ensure the structural design of the underground car park should incorporate flood proofing material at the detailed design stage. Refer to Appendix C Environment Agency Correspondence and Appendix F Proposed Basement Layout Drawing No.B01.

9 Flood Plain

9.1 FLOOD PLAIN EXTENT

9.1.1 At present the Environment Agency's Flood Map shows that the site is located entirely within Flood Zone 1 (Low Probability). Refer to Figure 1 of Appendix A,

9.1.2 The topographical survey (Appendix E Laser Surveys, Drawing No L.3284/1& 2 Rev 0) shows that the existing site slopes from approximately 12.35m AOD at the entrance on Newmarket Road to approximately 8.00m AOD on the northern boundary with the Midsummer Common. The lowest part of the site is 2.4 metres above the 1 in 100 year flood level. It is therefore considered that the site is not at risk of flooding from the River Cams during the 1 in 100 year event.

10 Hydraulic Structures

10.1 RESTRICTIONS TO FLOW

10.1.1 The Environment Agency confirmed that there are no significant structures that would restrict flood flow during an extreme event in the vicinity of the site. Refer to correspondence with the Environment Agency correspondence in Appendix C.

11 Flood Volume Displaced

11.1.1 The Environment Agency has confirmed that the development site is outside a flood risk area, placing the site in Flood Zone 1 (Low probability) where the annual probability of river flooding is less than 1 in 1000 year (<0.1%) in any year. Refer to Environment Agency correspondence in Appendix C.

11.1.2 As such, the development will not result in any displacement of flood waters.

12 Climate Change Impacts

12.1 CLIMATE CHANGE

12.1.1 The Environment Agency has confirmed that the site lies outside a flood risk area and is considered to be in Flood Zone 1 for planning purposes. Refer to Environment agency email dated 11 January 2008 in Appendix C.

12.1.2 The proposed surface water drainage strategy was assessed for the 1 in 100 year +30% rainfall event which takes into account increase in rainfall due to climate change.

12.1.3 Therefore the effects of climate change have been taken into account as required by PPS25 and it has been shown that there is no significant increase in flood risk to the development or downstream areas due to climate change.

13 Strategic Flood Risk Assessment

13.1.1 Due to the low flood risk that the site is exposed to, it is not expected that a SFRA, would highlight any flood risk constraints with regards to the proposed redevelopment of the site.

14 Conclusions and Recommendations

14.1 CONCLUSIONS

14.1.1 The existing site is not at risk from flooding during a 1 in 100 year flood event associated with the River Cam. Minimum finished floor levels are to be set well above the predicted 1 in 100 year levels thereby ensuring that buildings and their occupants remain free from flood risk during the 1 in 100 year event for the lifetime of the development.

14.1.2 Should the site be affected by an event more extreme than the 1 in 100 year, safe access is available at levels of 7.05m AOD and above 12.00m AOD to Newmarket Road and Elizabeth Way, south and east of the site respectively.

14.1.3 The proposed strategy results in a 65% reduction in surface water discharge from the site (and does not flood for all rainfall events including the 1 in 100 year +30% event thereby offering betterment over the existing drainage regime). The proposed foul flows are also lower than the existing loadings and therefore the foul strategy provides betterment. Anglian Water has confirmed that both the proposed foul and surface water discharges to their network is acceptable.

14.1.4 The proposed development is robust and sustainable in terms of flood risk and meets the requirements of PPS25.

Appendices, Figures & Tables

Appendix A (Figure 1) Environment Agency Flood Map

Appendix B FRA Guidance Note 1 : Development Greater than 1 Hectare in Flood Zone 1

Appendix C Environment Agency Correspondence

Appendix D Location Plan (Figure 2 & Figure 3)

Appendix E Site Survey (Laser Surveys, Drawing No L.3284/1& 2 Rev0)

Appendix F Proposed Layout: Johnson Thompson & Partners Drawing No. S001, Housing Schedule, Proposed Basement Layout: Johnson Thompson & Partners Drawing No.B01, Changes to Scheme – Extract From Schedules & Densities Presentation

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