

Flood Risk Assessment

HCC STRATEGIC

For and on behalf of:

Land and Development Advisory Limited

August 2022

Report title:

Flood Risk Assessment

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For and on behalf of:

Land and Development Advisory Limited

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1 INTRODUCTION

- 1.1 This Flood Risk Assessment (FRA) has been prepared by Andy Clay Consulting (ACC) on behalf of Land and Development Advisory Limited (LDA) for a proposed development of land around the Ageas Bowl, to the south of Botley Road, West End, Southampton. The FRA was issued in May 2022.
- 1.2 The Local Planning Authority (LPA) for this area are Eastleigh Borough Council (EBC) and the Lead Local Flood Authority (LLFA) are Hampshire County Council (HCC). Southern Water (SW) are the local sewerage provider.

Background

- 1.3 Details of the proposed development are included as **Appendix A**, and which is described as a:

“The erection of 185 new homes, a 71-bedroom care home (Use Class C2), a 142-bedroom hotel (Use Class C1), a well-being centre (Use Class E / F2), a new pavilion building and improvements to existing stadium, new vehicular access, car parking, pedestrian circulation and processional ramp, together with tree planting, landscaping, SuDS and biodiversity enhancements.”

- 1.4 The proposed development is comprised of a number of areas, summarised below in relation to their location to the Ageas Bowl:

- **Area 1:** Northern Gateway to the north and north-east;
- **Area 2:** Budget Hotel to the east;
- **Area 3:** Pavilion and Maintenance to the south-east;
- **Area 4:** Southern Gateway to the south; and
- **Area 5:** Residential and Wellbeing to the west and north-west.

Planning History

- 1.5 A large number of planning permissions are associated with the site. However, the most significant permission is Ref. F/07/61830 (as subsequently amended).

This permitted the erection of a hotel, hospitality uses, a conference facilities, media centre, restaurant and bar, retail units as well as new stadium stands.

- 1.6 This planning permission also allowed for comprehensive improvements across the Ageas Bowl complex, including the redesign, re-contouring and extension of the existing golf course. This also included the re-alignment of the lower sections of the watercourse that passed through the site, known as Telegraph Brook, and the creation of a series of lakes.
- 1.7 Additionally, planning permission Ref. F/18/83908 is also relevant, which relates to land at Thorneydown Farm. This granted consent for an extension to the golf course and the use of land for occasional car parking for major events.
- 1.8 Furthermore, an application for full planning permission (Ref. F/20/88655) is currently being considered by the LPA. This concerns the proposed development of a golf course clubhouse, located off Moorhill Road, within the southern part of the wider Ageas Bowl complex. This application is being considered by EBC in the context of the envisaged revisions to Policy WE4.

Scope of the Assessment

- 1.9 This FRA has been based on the following appended information:
- **Appendix A:** Details of the proposed development;
 - **Appendix B:** Site topographical survey;
 - **Appendix C:** Long section of culverted watercourse;
 - **Appendix D:** Sewerage network information from Southern Water;
 - **Appendix E:** Surface water drainage calculations;
 - **Appendix F:** Drainage strategy;
 - **Appendix G:** Flood modelling technical note; and
 - **Appendix H:** Details from the proposed landscape strategy.
- 1.10 This FRA has been produced to support the submission of a full planning application for the proposed development of the site.
- 1.11 A drainage strategy has been produced together with Tumu Consultants Ltd using industry standard software (MicroDrainage), included as **Appendix F**.

- 1.12 A flood modelling study has been completed by Thomas Mackay Ltd of the existing watercourse that passes through the site, with a Technical Note included as **Appendix G** and summarised as part of this FRA. However, the post-development flood modelling study of the alterations proposed to the watercourse and lakes was not available at the time of writing this FRA, and will therefore be submitted subsequently as a Technical Appendix.
- 1.13 The proposed landscape strategy for the site has been completed by Johns Associates Ltd. Key extracts of this information are included as **Appendix H**, given the relevance to the hydrological and drainage strategy.
- 1.14 The FRA has been undertaken in accordance with the National Planning Policy Framework (NPPF) and the Planning Practice Guidance (PPG) as well as the local planning policy of EBC as the LPA and of HCC as the LLFA.
- 1.15 The aim of this FRA is to demonstrate that the site can be developed safely and sustainably, without exposing it to unacceptable risks from flooding or increasing the flood risk to third parties.

Limitations of the Assessment

- 1.16 The general limitations of this assessment are that:
- A number of sources have been used to compile this FRA. Whilst ACC believes them to be trustworthy; ACC is unable to guarantee the accuracy of the information provided by others.
 - This FRA is based on information available at the time of preparation. Consequently, there is potential for further information to become available. This may lead to future alteration to the conclusions that have been drawn in this report, for which ACC cannot be held responsible.

2 PLANNING POLICY

National Planning Policy

- 2.1 The NPPF sets out the national policies for flood risk management in a land use planning context within England and how these are expected to be applied, with the latest update published in July 2021.

Planning Practice Guidance

- 2.2 The PPG accompanies the NPPF and defines how the planning policies should be applied. The tables in the section on Flood Risk and Coastal Change define the approach for assessing flood risk vulnerability and compatibility.
- 2.3 Table 1 of the PPG (Flood Zones) classifies each Flood Zone, which refer to the probability of river and sea flooding, ignoring the presence of flood defences (and are also current day flood extents without the projected increase resulting from climate change). These Flood Zones are shown on the Flood Map for Planning (Rivers and Sea), available on the EA's web site.
- 2.4 Table 2 of the PPG (Flood Risk Vulnerability Classification) then considers the vulnerability of the proposed land use or development to flooding. Buildings that are for a residential use are classified as 'More Vulnerable' whereas those that are for recreational purposes would typically be 'Less Vulnerable'.
- 2.5 Table 3 of the PPG (Flood Risk Vulnerability and Flood Zone Compatibility) compares Tables 1 and 2. This confirms that all types of development are considered to be appropriate for locating in Flood Zone 1, and therefore that the Sequential Test and Exception Test would not need to be applied.

Non-Statutory Technical Standards

- 2.6 The NTS for sustainable drainage systems were produced by the Department for Environment, Food and Rural Affairs (DEFRA) in March 2015.
- 2.7 For greenfield developments, the peak runoff rate to a highway drain, sewer or surface water body for the 1 in 1-year rainfall event and the 1 in 100-year rainfall event should not exceed the peak greenfield rate for the same event.

- 2.8 Similarly, where reasonably practicable, the runoff volume to a highway drain, sewer or surface water body in the 1 in 100-year, 6 hour duration rainfall event should not exceed the greenfield runoff volume for the same event.
- 2.9 Surface water conveyance routes under exceedance conditions must also be planned for to ensure that life and property over the site and surrounding area are not put at risk in the event of drainage system failure or from storms in excess of the design standards.

Strategic Flood Risk Assessment

- 2.10 The Strategic Flood Risk Assessment (SFRA) for the Partnership for Urban South Hampshire (PUSH) was updated in 2016. PUSH is a partnership of a number of authorities, including EBC. The SFRA provides information of relevance to the assessment of flood risk, such as surface water flooding and groundwater.

Local Planning Policy

- 2.11 The draft Local Plan for EBC (2011-2029) sets out a number of policies with sections of relevance to flood risk and drainage as summarised below.
- 2.12 Policy DM2 on environmentally sustainable development requires for all new build residential development to achieve a predicted main internal water consumption of no more than 110 litres / day and non-residential to achieve a predicted main internal water consumption of no more than 90 litres / day.
- 2.13 Policy DM3 on adaptation to climate change requires for all development to be designed to reduce the potential impacts of surface water flooding using sustainable drainage systems implemented as part of an integrated SuDS strategy and as part of the landscape framework for the site including green open space and green roofs where appropriate.
- 2.14 Policy DM5 on managing flood risk advises that development should not increase flooding elsewhere and will only be permitted within the areas at risk of flooding, now and in the future, provided that:

- a) It meets the sequential and exception test (where required) as outlined in Government guidance;
- b) A site-specific flood risk assessment demonstrates that the development, including the access, will be safe without increasing flooding elsewhere, and where possible, will reduce flood risk overall;
- c) The scheme incorporates flood protection, flood resilience and resistance measures appropriate to the character and biodiversity of the area and the specific requirements of the site;
- d) Appropriate flood warning and evacuation plans are in place; and
- e) New site drainage systems are designed taking account of events which exceed the normal design standard.

2.15 Policy DM6 on sustainable surface water and watercourse management advises that development in flood risk areas or with more than 10 dwelling (etc) will only be permitted if they include SuDS systems which should:

- a) Manage surface water runoff as close to its source as possible and include at least three forms of naturalised filtration within the treatment train wherever feasible;
- b) Be designed in accordance with the CIRIA C697 SuDS Manual or equivalent national or local guidance;
- c) Ensure that discharge rates at least mirror greenfield rates before development;
- d) Where discharge is to a wetland or wet woodland habitat, flows off site must mirror the natural hydrological pathways;
- e) Include clear arrangements for their whole life management and maintenance.

2.16 Policy DM6 also advises that where a watercourse is present on a development site, it should be retained or restored into a natural state and enhanced where possible. The culverting of any watercourse will not generally be permitted, and development should wherever possible remove

any existing culverts and increase on-site flood storage. Development should be laid out to enable maintenance of the watercourse.

Lead Local Flood Authority

- 2.17 The LLFA for this area are HCC. This means that HCC have a leadership and co-ordinating role for flood risk resulting from surface water runoff, ordinary watercourses and groundwater across the planning authority area of EBC.
- 2.18 HCC provide Surface Water and Sustainable Drainage guidance for developers, designers and planners. This guidance has informed the approach of the surface water drainage strategy for the proposed development.
- 2.19 HCC advise that SuDS should be designed to mimic the natural drainage of surface water, typically managing rainfall close to where it falls. Surface water flows are then slowed down and discharged at a controlled rate before it enters a watercourse. They can also store water, allow it to soak into the ground or enable evaporation.
- 2.20 SuDS offer a wide range of benefits, as they can:
- Manage flood risk;
 - Maintain and improve water quality;
 - Maintain and increase biodiversity;
 - Provide amenity and green open spaces; and
 - Maintain groundwater recharge through infiltration.

Sequential Test

- 2.21 The NPPF states that developers and LPAs should try to locate development in zones with the lowest probability of flooding. This should be achieved using the Sequential Test, which aims for a sequential approach to be followed to steer new development to areas with the lowest probability of flooding.
- 2.22 The flood zones provide the basis for the Sequential Test. The aim is to steer development to sites located in Flood Zone 1 (low probability of river or sea

flooding). Where there are no reasonably available sites in Flood Zone 1, then consideration should be given to sites located in Flood Zone 2 (medium probability of river or sea flooding) followed by sites in Flood Zone 3 (high probability of river or sea flooding), applying the Exception Test if required.

- 2.23 The site is within Flood Zone 1, with this considered appropriate for locating all types of land use. As such, the proposed development is considered to be an appropriate land use and the Sequential Test does not need to be applied.

Summary

- 2.24 The approach taken with the management of flood risk and surface water drainage for the proposed mixed-use development of the site is consistent with the policies within the NPPF and practices of the PPG and also with the requirements of EBC as the LPA and HCC as the LLFA.

3 SITE DESCRIPTION

- 3.1 The site is the Ageas Bowl complex, located to the south of Botley Road and within the West End part of Southampton. The site includes an area to the west and to the north-east of the stadium, and an adjoining area to the north.
- 3.2 The site has a central post code of SO30 3XH and OS NGR of E: 447716 and N: 114209. A site location plan is included as **Figure 3.1**.

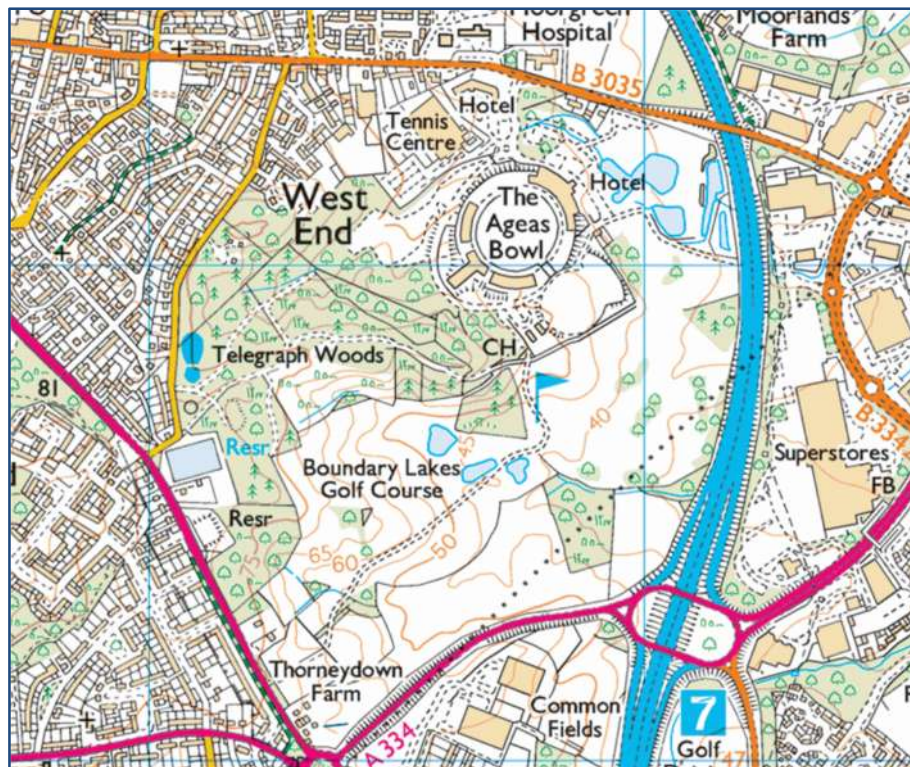


Figure 3.1 – Site Location Plan (www.streetmap.co.uk)

- 3.3 The site includes the Ageas Bowl stadium and the integral Hilton hotel, part of Marshall Drive and the Marshall Drive car park, and part of the existing Boundary Lakes Golf Course including a part of the lakes. To the west of the stadium, the site includes an area of hardstanding, which is used for match day coach and car parking, and as a drop-off area for event attendees.
- 3.4 In addition to the existing built form and areas of hardstanding, the site is characterised by a watercourse which flows through the site, the semi-formal landscape of the golf course and the lakes, areas of open grassland, planted trees and areas of woodland and vegetated strips and boundaries.

3.5 An aerial view of the site and surrounds is provided as **Figure 3.2**.



Figure 3.2 – Aerial View of Site and Surrounds (Google Earth)

3.6 The western part of the site is currently used as a car parking area during matches. There is an internal access road to the north of the stadium, which adjoins Marshall Drive roundabout. The north-eastern and eastern part of the site is currently used as a car parking area, and also a part of the golf course.

3.7 The site is within the following wider setting:

- To the west is Telegraph Woods from where Telegraph Brook rises and drains. Telegraph Brook passes into a culvert that is just outside of the site, and then drains through a culvert. Hanger Copse is an adjacent woodland area, and to the south-west of the site. The site borders residential dwellings located off Telegraph Road and Westgate Mews.
- To the north are residential dwellings associated with Telegraph Heights and Kenilworth Gardens. There is a leisure facility (David Lloyd Gym and Tennis Centre), a hotel (Holiday Inn Express) and a vehicle hire dealer (Pitter Commercial Truck Dealership. A roundabout adjoins the internal access road to Marshall Drive. There is a small woodland known as Westwood Copse. Marshall Drive from the site then adjoins Botley Road (B3035) which connects to the M27 motorway.
- To the east are residential dwellings adjacent to Botley Road. A part of the golf course and their lakes are to the south-east of the site. Further

to the east is situated the M27 motorway, as well as a retail estate and industrial areas, beyond which lies the residential area of Hedge End.

- Centrally and to the south is the Ageas Bowl stadium, which includes a cricket pitch and associated stands within which is a hotel (Hilton), spa, restaurant (Beefys) and shop for the golf course. To the south of the stadium is a nursery pitch and practice nets. Further to the south is a part of the golf course and beyond this are the new parking facilities being constructed at Thorneydown Farm (off Charles Watts Way).

Proposed Development

- 3.8 Details of the proposed development are included as **Appendix A**.
- 3.9 Consistent with emerging Policy WE4, this includes community facilities, new homes, extra care facilities and retirement living accommodation. These are to be provided alongside new offices / flexible accommodation for businesses and a sports science university / further education building, with integrated halls of residence. A budget hotel is proposed to the east of the stadium, on the site of existing staff accommodation.

Local Topography

- 3.10 A contour levels map of the area surrounding the site is included as **Figure 3.3**.



Figure 3.3 – Surrounding Topography (www.en-gb-topographic-map.com)

- 3.11 This shows that ground levels are most elevated to the west of the site, associated with the Telegraph Wood and western side of the site, and that the generally fall to the east towards the M27 motorway and beyond.
- 3.12 A topographical survey of ground levels across the site was completed by Sterling Surveys Ltd in August 2020, and included as **Appendix B**. All surveyed levels were completed in accordance with an ordnance datum (m AOD).
- 3.13 The general fall in ground levels is from Telegraph Woods and Hanger Copse to the west and south-west of the site. Ground levels fall from here to the east and south-east across the site and towards the M27 motorway.
- 3.14 However, natural ground levels across the site have been modified in relation to previous developments in and around the site. Ground levels across the western area have been raised and levelled, resulting in an embankment adjacent to the western and northern boundaries. The land adjacent to the stadium has also been re-profiled to provide a level cricket pitch.
- 3.15 The lower section of Telegraph Brook, as it passes through the eastern site area, has been re-profiled. The previous course of the watercourse from Marshall Drive roundabout followed the eastern and north-eastern boundary of the site. However, this was re-aligned with the construction of the Hilton hotel and car parking. The watercourse currently flows in a wooden sleeper lined channel and drains to the lakes in the south-eastern part of the site.

Geology

- 3.16 The 1 to 50,000 scale British Geological Survey (BGS) online mapping provides an understanding of the bedrock geology and also whether there are any superficial deposits recorded.
- 3.17 The bedrock geology adjacent to the western site boundary and beneath Telegraph Wood is the Marsh Farm Formation (clay, silt and sand). The remainder of the site is underlain by the Earnley Sand Formation (sand, silt and clay). There is not shown to be any superficial deposits across the site.

Hydrogeology

- 3.18 The GeoIndex Onshore Maps available as 1 to 625,000 scale online mapping from the BGS provides an understanding of the underlying hydrogeology.
- 3.19 The site is underlain by rock units of the Bracklesham Group and Barton Group (undifferentiated), and classified as a moderately productive aquifer. This is described as a variable and multi-layered aquifer that is locally important.
- 3.20 The BGS online mapping shows there to be boreholes to the north of the site associated with the West End Institution, with the nearest adjacent to Botley Way (SU41SE514). This borehole was taken to 21.3m and recorded a top layer of gravel, followed by clay, and then a thin layer of ironstone. After a depth of 10.7m, the borehole recorded sand.
- 3.21 The BGS online mapping also shows boreholes further to the south adjacent to Charles Watts Way (SU41SE40 and SU41SE41). These were part of a series completed by the Ministry of Transport (MoT) in 1968 and record rocks of the Thames Group, and essentially have no groundwater.
- 3.22 The western MoT borehole (SU41SE40) was taken to 45.7m and recorded a topsoil layer, silty clay with sand, followed then by a stiff sandy clay. The eastern MoT borehole (SU41SE41) was taken to 57.9m and recorded a topsoil layer, soft clay, firm sandy clay, silty clay with sand, and then a stiff sandy clay.
- 3.23 In terms of the site, the northern borehole is likely to represent the underlying substrate more closely than the boreholes further to the south.

Soils

- 3.24 The soils on the site will be influenced by the underlying geology and also by the historical uses of the land. As described earlier, ground levels across the site have been modified by previous developments and anthropogenic activities, which would therefore alter the character of the local soils.
- 3.25 The Cranfield University Soilscales website has been used to characterise the local soils. This provides a simplified data-set at 1:250,000 scale, to provide a

general understanding of the variations that occur between different natural soil types across England and Wales, and how these affect the environment.

- 3.26 The western and northern site areas, and most of the north-eastern site area, are underlain by sandy and loamy soils, which would typically be naturally wet. The eastern part of the north-eastern site area is underlain by a loamy clay soil, which would typically have impeded drainage.

Catchment Hydrology

- 3.27 The site is in the overall catchment of the River Hamble, located ~4.3km to the east of the site. This watercourse then drains south-west into Southampton Water near Hamble-le-Rice ~8.4km to the south of the site. The River Hamble is tidal for approximately half of its length, and navigable in its lower reaches.
- 3.28 The drainage of water from the site into the River Hamble is achieved through a tributary of Pudbrook Lake. This flows within a culverted section to the east of the M27 motorway, adjacent to the eastern boundary of the overall site.
- 3.29 There are designations and sensitivities in the wider hydrological catchment of relevance to the proposed development. This includes the Solent Maritime Special Areas of Conservation (SAC) and the Solent and Southampton Water Special Protection Area (SPA). The proposed development will need to ensure that it does not adversely affect the features protected by these designations.

Local Hydrology – Existing

- 3.30 The site is within the local catchment of Telegraph Brook, which is a small watercourse that drains from the central part of Telegraph Wood.
- 3.31 Telegraph Brook rises in Telegraph Wood to the west of the site. Water would ordinarily be conveyed into an inlet within Telegraph Wood that is just outside of the site and then through a culverted section of the watercourse that is situated beneath the western part of the site. The position of the watercourse and inlet into the culverted section are illustrated indicatively as **Figure 3.4**.

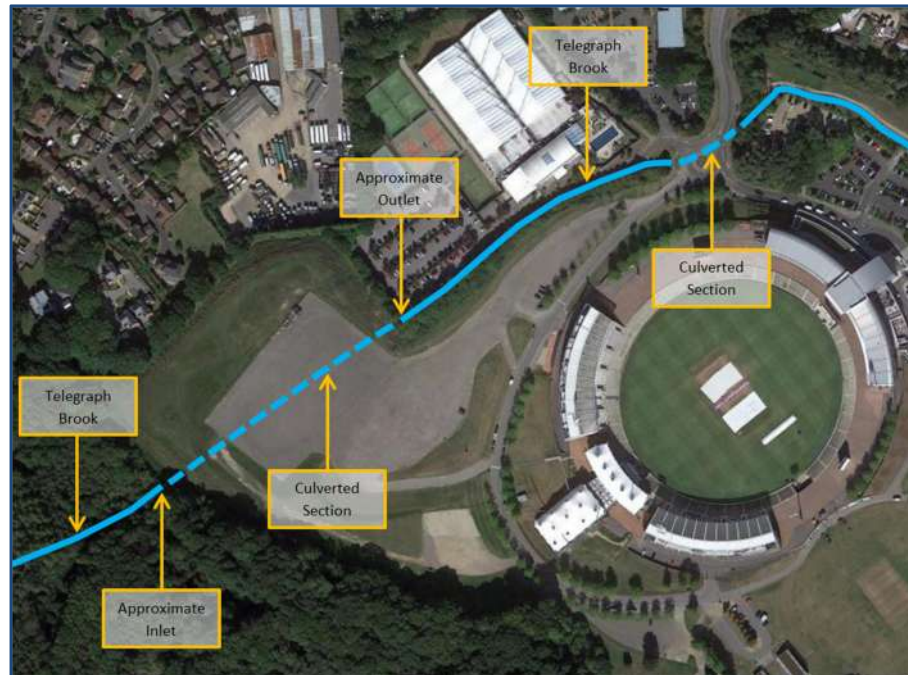


Figure 3.4 – Telegraph Brook Upper and Central Sections

- 3.32 However, the culvert inlet from Telegraph Wood has become blocked, restricting the flow of water along the culverted section. It was not possible for the topographic survey to locate the inlet, and accurate levels of this feature could not be collected. It is understood that the inlet is within local authority ownership. It was also not possible to obtain levels from within the culvert.
- 3.33 A long-section of the culvert was provided as part of a previous development proposals, included here as **Appendix C** and with the manhole levels summarised as **Table 3.1**. This indicated that the culvert is approximately 200m long with an initial gradient of 1 in 88 (Inlet to MH1), then a gradient of 1 in 18 (MH2 to MH1), and the last section with a gradient of 1 in 88 (MH1 to Outlet).
- 3.34 The information on the existing culvert also illustrates the depth of the culvert, with the invert level 6.80m beneath ground level (BGL) at its deepest point.
- 3.35 There is a culvert outlet at the downstream-end of the culvert which drains into an open section of channel located along the northern site boundary and adjacent to the David Lloyd Gym and Tennis Centre as illustrated in **Figure 3.4**. The outlet into the open watercourse has a 300mm diameter and invert level of 46.05m. This section of watercourse is semi-natural in that it is a

simple trapezoidal channel aligned with trees and hedges. It then flows into a culverted section that passes beneath Marshall Road roundabout.

Location	Chainage (m)	Ground Level (m AOD)	Invert Level (m AOD)	Culvert Depth (m BGL)
Culvert Inlet	215.00	52.25	52.50	+0.25
Manhole 2	174.25	54.10	51.85	-2.25
Manhole 1	88.00	53.80	47.00	-6.80
Culvert Outlet	0.00	48.00	46.00	-2.00

Table 3.1 – Summary of Assumed Culvert Levels

- 3.36 The lower section of Telegraph Brook flows within a less natural channel. It has a very shallow gradient with the channel banks formed by wooden sleepers. This drains through the eastern part of the site.
- 3.37 The watercourse then drains into an upper and lower lake separated by a weir at the edge of the site. The sleeper lined channel and the lakes are illustrated indicatively as **Figure 3.5**.

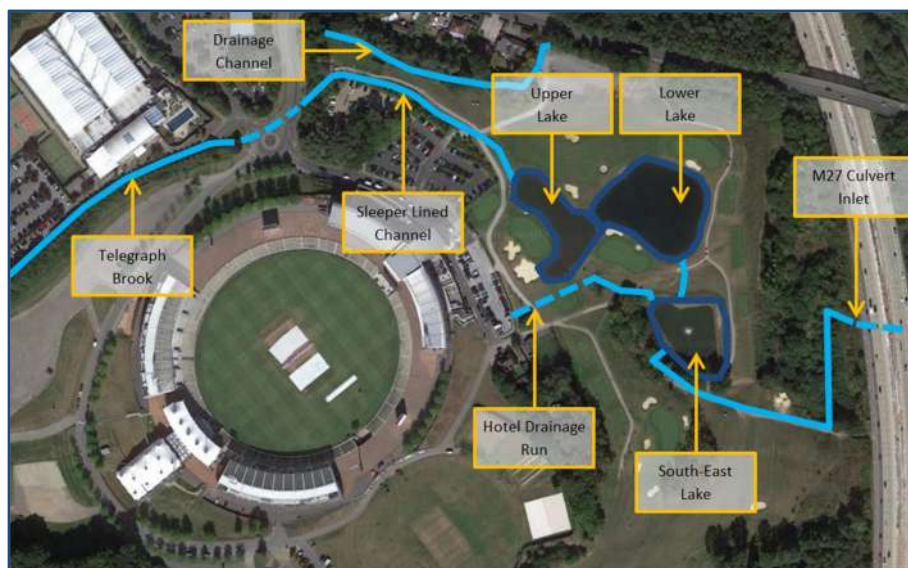


Figure 3.5 – Telegraph Brook Lower Section and Lakes

- 3.38 The survey recorded ground levels around the perimeter of the upper lake, taken at the crest of the bank perimeter. Levels ranged from 39.77m (next to the inlet) to 39.07m (next to the weir) and with 39.03m to the south-west.
- 3.39 The upper lake is connected to the lower lake via a weir, on the eastern side of the upper lake and which is on the western side of the lower lake. The survey recorded a weir crest spill level of 38.655m AOD.
- 3.40 The survey recorded ground levels around the perimeter of the upper lake, taken at the crest of the bank perimeter. These levels ranged from 38.42m (to the north) to 37.67m (to the east) also with crest levels low around a section of the southern perimeter (37.78m).
- 3.41 The lower lake then drains via another lake to the south-east, with this located outside of the site extent. It then drains to another culverted section under the M27 motorway. This culverted section is understood to continue under the retail estate to the east of the site, eventually draining into the River Hamble.
- 3.42 There is also a drainage channel further to the north, close to the northern boundary of the site, as shown in **Figure 3.5**. This drainage channel currently conveys water from this part of the site, passing through vegetated areas and with a number of culverted sections for providing local access.
- 3.43 The drainage channel drains east and then south-east into the woodland area that is to the east of the site, before then adjoining the drainage system upstream of the culverted section under the M27 motorway.

Local Hydrology – Proposed

- 3.44 The proposed development would replace and re-align the culverted section of the watercourse in the western part of the site, presenting the opportunity to improve the inlet from Telegraph Wood.
- 3.45 The re-aligned culvert would flow towards the Ageas Bowl, and into a new section of open channel. The inclusion of a longer section of open channel was investigated, but unfortunately this was limited due to the depth of the culvert in the ground and the location of the inlet from Telegraph Wood.

- 3.46 Sections of new open channel for Telegraph Brook have been designed as a two-stage channel, as illustrated in **Figure 3.6**. This profile is suited to low and high flow conditions. The low flow will occupy the lower stage of the channel, and promote a flowing watercourse and the associated benefits. Whereas the upper stage will provide a storage volume to accommodate high flows.

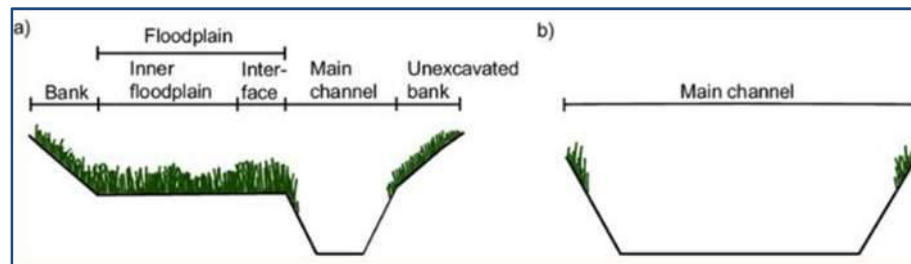


Figure 3.6 – Cross-section of a Two-Stage Channel vs Trapezoidal Channel

- 3.47 The watercourse in the eastern part of the site will also be re-aligned, with the channel improved to a more natural appearance. Sections of two-staged channel would also be used to provide additional habitat areas and benefit landscape and water quality. It will then drain into the existing lakes, with the lower lake re-profiled slightly to accommodate the car parking proposals.
- 3.48 The northern drainage channel would also be utilised, with the continued drainage of surface water from this part of the site into this drainage feature.
- 3.49 A flood modelling study has been completed by Thomas Mackay of the baseline scenario, which is of the existing alignment and character of Telegraph Brook, with a Technical Note included as **Appendix G**.
- 3.50 A 1D-2D linked model of Telegraph Brook was constructed using BMT's TUFLOW Classic and their ESTRY solver for the 1D components. The software and approach used for this study are commensurate with EA guidance and industry best practice.
- 3.51 The baseline flood modelling scenario has demonstrated that there is an existing flood risk from the eastern section of Telegraph Brook, with water overtopping the left bank (east side) during the 1 in 20-year event (and

above) and flowing north-east to affect existing bungalows and reaching the western side of the M27 motorway.

- 3.52 The post-development flood modelling study is also underway, to ensure that there are no adverse flood and drainage impacts resulting from the alterations proposed to the watercourse and lakes. However, this flood modelling study was not available at the time of writing this FRA, and will therefore be submitted subsequently as a Technical Appendix.

Soil Infiltration

- 3.53 Soakaway testing has not been completed at the site, partly due to the site being operational and therefore restricting these works. However, soakaway testing from nearby schemes has been reviewed and is referenced below.
- 3.54 An FRA was produced for the proposed development of Thorneydown Farm (F-18-83908). The proposals are to extend the current golf course and to use the fairways of the expanded golf course as temporary car parking area.
- 3.55 Soil infiltration testing was completed for the Thorneydown Farm scheme. This site is located to the south-east of the proposed development.
- 3.56 This soakaway testing was undertaken in November 2017 by Ruddlesden Geotechnical in accordance with the BRE Digest 365 methodology.
- 3.57 The soil types encountered were a mix of dark grey-brown slightly gravelly and slightly clayey silt and orange brown-grey silty clay. The soakaway testing concluded that the ground in this area has low permeability and no infiltration rate calculations were possible.
- 3.58 Based on the soakaway testing completed in the adjacent scheme, it is reasonable to conclude that an infiltration-led surface water drainage solution would not be viable for the proposed development of the site.

Public Drainage Infrastructure

- 3.59 Consultation with SW was completed to obtain information on the type and location of public sewerage in the area, with this included as **Appendix D**.

- 3.60 There are public sewers serving the residential area to the north-west of the site. The nearest foul sewer is 150mm diameter and located at the junction of Westgate Mews with Kenilworth Gardens, draining north-west along this road. There is also a 150mm diameter surface water sewer along this same route.

4 ASSESSMENT OF FLOOD RISK

Fluvial and Tidal Flood Risk

- 4.1 An extract from the Flood Map for Planning is included as **Figure 4.1**. The dark blue areas are Flood Zone 3, light blue areas are Flood Zone 2 and areas with no colour are Flood Zone 1. This shows the site to be wholly located in Flood Zone 1, indicating a low level of flood risk from fluvial and tidal sources.
- 4.2 These flood extents do not account for the impact of climate change over the development design life. However, given the distance of the site from the nearest flood zone and also the elevation, this is not likely to have an impact.

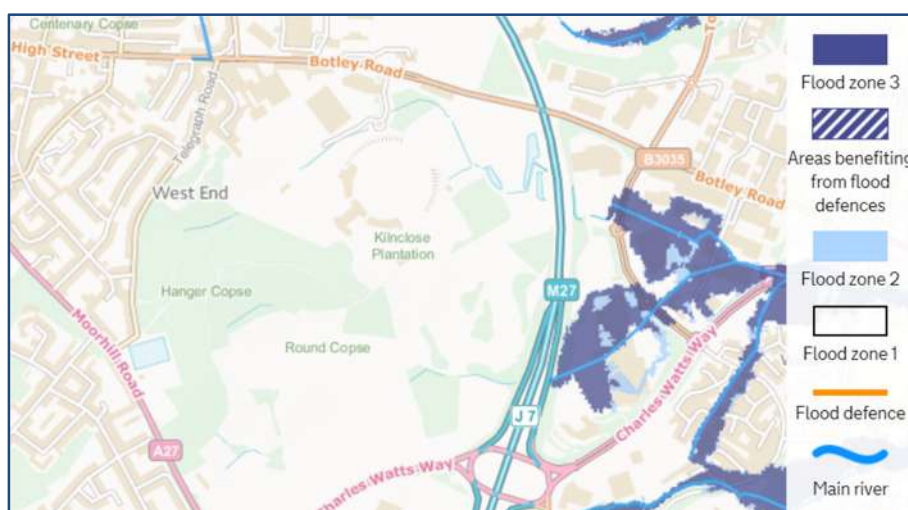


Figure 4.1 – Flood Map for Planning (Fluvial and Tidal Flooding)

- 4.3 Flood Zone 1 is described in the NPPF as an area of low fluvial and/or tidal flood risk, with the flood risk vulnerability of this area deemed to be compatible for all development types.

Telegraph Brook Flood Risk

- 4.4 Telegraph Brook rises in Telegraph Wood to the west of the site. Water would ordinarily be conveyed into an inlet within Telegraph Wood that is just outside of the site and then through a culverted section of the watercourse that is beneath the western part of the site.

- 4.5 However, the inlet from Telegraph Wood has become blocked, restricting the flow of water along the culverted section. Observations made during two separate site visits show that this has caused water to back up in Telegraph Wood, with evidence of tree die back and damage. It is understood that the culvert inlet is within local authority ownership. The proposed development would replace and re-align the culverted section of the watercourse, presenting the opportunity to improve the culvert inlet from Telegraph Wood.
- 4.6 A baseline flood modelling study of Telegraph Brook has been completed and with a post-development flood modelling study underway, as summarised earlier in this FRA and with the Technical Note included as **Appendix G**.
- 4.7 The modelled maximum flood depths for the baseline scenario have been mapped, with this assuming that the culvert inlet is not currently blocked. The model indicates that there is no overtopping in the 1 in 10-year flood event. However, with the 1 in 20-year flood event (and above), the model shows water overtopping a section of the watercourse. This is a section on the left bank of the Telegraph Brook in the eastern part of the site, just upstream of a culvert under a golf access track. The flood water is shown to flow north-east, affecting bungalows located on Botley Road. In the 1 in 20-year event the flood water reaches across Botley Road. In the 1 in 100 and 1 in 1000-year events, the flood water reaches the western side of the M27 motorway.
- 4.8 The flood modelling study has therefore demonstrated that there is an existing flooding risk from the eastern section of Telegraph Brook, albeit assuming that the culvert inlet is not blocked. This is shown to affect bungalows and road infrastructure. The proposed development will aim to reduce and potentially remove this flood flow path, and therefore reduce flood risk overall.

Surface Water Flood Risk

- 4.9 Surface water flooding is a result of overland flow and ponding due to saturated ground and overloaded drains or sewers that can follow a heavy rainfall event and before the runoff enters a watercourse or sewer. This is shown on the Long Term Flood Map, with an extract included as **Figure 4.2**.



Figure 4.2 – Long Term Flood Risk Map Extract (Surface Water)

- 4.10 Dark blue areas indicate surface water flooding with a 1 in 30-year chance of occurrence (3.33% AEP); blue indicates surface water flooding with a 1 in 100-year chance of occurrence (1% AEP); and light blue indicates surface water flooding with a 1 in 1000-year chance of occurrence (0.1% AEP).
- 4.11 This shows the risk from surface water flooding across the majority of the site to be very low, with a less than 1 in 1000-year chance of occurrence. There is a flow path associated with Telegraph Brook that flows from Telegraph Wood through the western site area and along the northern boundary. It is adjoined by a flow path from Botley Road at Marshall Road roundabout, and is then shown to follow the route of the old channel. There is also a surface water flow path to the south of the stadium, which is adjoined by flow paths from within the stadium itself. This drains east and then north-east towards the lakes.

Water Depth

- 4.12 The Long Term Flood Map provides information on the possible water depth from surface water flooding. Water depth is classified in three categories – greater than 0.90m, between 0.30m and 0.90m and below 0.30m.
- 4.13 For the flood event with a low risk of occurrence, the water depth within the flow paths across the site is generally in the lowest category and therefore

below 0.30m. There are some locations where the depth between 0.30m and 0.90m, although with these generally within the channel of Telegraph Brook

- 4.14 For the flood events with a medium and in particular with a high risk of occurrence, the flood extent is considerably reduced and with a water depth that is mainly 0.30m but with a few locations between 0.30m and 0.90m.

Flow Velocity

- 4.15 The Long Term Flood Map also provides information on the possible water flow velocity from surface water flooding. The water flow velocity is classified in two categories – over 0.25 m/sec and less than 0.25 m/sec.
- 4.16 For the flood event with a low risk of occurrence, the water flow velocity within the flow paths across the site is typically over 0.25 m/sec.
- 4.17 For the flood events with a medium and in particular with a high risk of occurrence, the flood extent of the flow paths is considerably reduced and with a water flow velocity that is still typically over 0.25 m/sec, but with some locations where it is less than 0.25 m/sec.
- 4.18 However, the parts of the site where there is shown to be a flow path would need to be considered further to ensure that this does not adversely affect or be affected by the proposed development.
- 4.19 The site is served by a drainage infrastructure in the internal roads and also within the stadium, as well as by Telegraph Brook and the lakes. There are also highway drains in Botley Road that drain surface water from this area.
- 4.20 The modelling to map the surface water flood extents will probably not take into account this existing drainage infrastructure, and as such the actual flood extents would differ from those as shown by the Long Term Flood Map.
- 4.21 The risk of surface water flooding across the majority of the site is considered to be low, although with some areas where the risk is higher. Whilst surface water flooding is something that the proposed development would need to consider, the surface water drainage strategy combined by measures

introduced for Telegraph Brook would provide an appropriate level of mitigation for managing the surface water flood risk.

Groundwater Flood Risk

- 4.22 Groundwater flooding can occur when the water table enters basements and cellars or rises above the ground surface. This type of flooding is more typically associated with low-lying areas underlain by permeable rocks, although it can occur where the groundwater table is perched. This is where groundwater is held within a porous media at an elevation that is higher than the local or regional groundwater table, such as with superficial floodplain deposits.
- 4.23 The updated SFRA for PUSH describes that a number of areas in Winchester, Test Valley and East Hampshire have been affected by groundwater flooding most notably during the flood events of 2013/14. The site is located in Eastleigh, and which was not mentioned in the SFRA as being of particular risk from groundwater flooding.
- 4.24 Based on the underlying geology and hydrogeology as described earlier, groundwater flooding is not considered to be a risk for the proposed development. Furthermore, as the site is locally elevated compared to the surrounding area, if groundwater were to issue from the ground it would tend to drain away to lower lying areas to the south-east and not affect the site.

Drainage and Infrastructure Flood Risk

- 4.25 Drainage and infrastructure flooding can occur when sewers become overwhelmed and result in flooding. This type of flooding may occur alone or be combined with other flood sources (e.g. fluvial or surface water).
- 4.26 A summary of the local sewerage infrastructure is provided earlier, which describes the nearest public sewers to be located to the north-west of the site at the junction of Westgate Mews with Kenilworth Gardens, draining north-west. It is not known if there is a history of flooding associated with these sewers, however given the location there is not likely to be flood risk to the site.

Artificial and Other Sources of Flood Risk

- 4.27 Artificial and other sources of flooding include impounded waters, such as reservoirs, lakes and canals.
- 4.28 There are a series of lakes associated with the lower section of Telegraph Brook, to the south of the site. These include a conjoined upper and lower lake separated by a weir and a separate lake further to the south-east.
- 4.29 However, there are no known impounded waters in the vicinity of the site, and as such no risk from these sources of flooding.

5 FLOOD MITIGATION AND MANAGEMENT

- 5.1 Following the assessment of flood risk, a series of mitigation and management measures are suggested for the proposed development of the site.

Fluvial and Tidal Flooding

- 5.2 The site is wholly located in Flood Zone 1, with this classified as an area of low fluvial and tidal flood risk. The proposed development is considered to be an appropriate land use for this area.
- 5.3 From the assessment of fluvial and tidal flooding, there is no requirement for specific flood mitigation measures to manage the identified risks.

Telegraph Brook Flooding

- 5.4 The proposed development provides the opportunity for significant improvements to be made to Telegraph Brook, which currently flows in a culverted section and then in a wooden sleeper lined channel.
- 5.5 Policy DM6 on sustainable surface water and watercourse management sets out the position of EBC. The watercourse will be retained and restored into a natural state and enhanced. The watercourse is currently culverted. A section of the watercourse will need to stay in a culvert due to the position of the inlet from Telegraph Woods and the depth below ground level. However, by re-aligning the culvert, it has been possible to include an open section of channel. The proposed development will use section of two-stage channel to increase in-channel flood storage capacity whilst keeping a low flow channel.
- 5.6 The proposed development would also present an opportunity to improve the culvert inlet, which is located in Telegraph Wood outside of the site. The culvert inlet is currently blocked with evidence of tree die back and damage.
- 5.7 A post-development flood modelling study is underway, to ensure that there are no adverse flood and drainage impacts resulting from the alterations proposed to the watercourse and lakes.

- 5.8 The baseline flood modelling scenario has demonstrated that there is an existing flood risk from the eastern section of Telegraph Brook, with water overtopping the left bank and flowing north-east to affect existing bungalows and reaching the western side of the M27 motorway.
- 5.9 The proposed development will aim to reduce and potentially remove this flood flow path, and therefore in accordance with EBC Policy DM5 on managing flood risk, would reduce flood risk overall.

Surface Water Flooding

- 5.10 The risk of surface water flooding across the majority of the site is very low, and would not therefore represent a significant flood risk to the proposed development. There are some surface water flow paths across the site, where the risk from surface water flooding would be higher.
- 5.11 There is a surface water flow path associated with the Telegraph Brook, including a north-easterly flood flow path from the eastern section of the watercourse as also indicated by the baseline flood modelling scenario. Therefore the improvements that are to be made to the watercourse would help to reduce and potentially remove the risk from this flood source.
- 5.12 In addition, a surface water drainage strategy will be incorporated into the proposed development to manage the impacts on surface water runoff, as described in the next section of this FRA. This has been completed in accordance with EBC Policy DM5 on managing flood risk and DM6 on sustainable surface water and watercourse management. Therefore as a consequence, the surface water drainage strategy would also help to mitigate the surface water flooding from these overland flows of water.
- 5.13 It will be important to ensure that there will be no adverse impacts resulting from the proposed development on surface water flooding across the site and also in the surrounding area. The key to this will be the measures to manage the surface water runoff, as described in the next section on this FRA.

Groundwater Flooding

- 5.14 From the assessment of groundwater flooding, there is no requirement for specific flood mitigation measures for the management of the identified risks.

Drainage and Infrastructure Flooding

- 5.15 From the assessment of drainage and infrastructure flooding, there is no requirement for specific flood mitigation measures for the management of the identified risks.

Artificial and Other Sources of Flooding

- 5.16 From the assessment of other sources of flooding, there is no requirement for specific flood mitigation measures for the management of the identified risks.

Additional Mitigation Measures

- 5.17 It is suggested for the finished floor levels (FFL) of buildings to be elevated above surrounding ground levels by at least 150mm.
- 5.18 This measure is in accordance with building regulations and to protect against the possibility of shallow ponding, which can sometimes occur after heavy or prolonged rainfall.

6 SURFACE WATER DRAINAGE STRATEGY

- 6.1 The NPPF states that flood risk to land and property must not be increased as a result of development, and would need to make an appropriate allowance for the projected impacts resulting from climate change in the future.
- 6.2 The Local Plan of EBC provides planning policies that set out the approach to take for the management of flood risk and surface water drainage.
- 6.3 HCC as the LLFA also set out technical guidance to follow for the surface water drainage strategy and use of SuDS features.
- 6.4 The national guidance in the NPPF and PPG, the technical design requirements of the NTS, the local guidance of EBC and of HCC as the LLFA have been followed in completing in the surface water drainage assessment.
- 6.5 These requirements form the basis of the surface water drainage strategy for the proposed development of the site, as described below.
- 6.6 The key components of a surface water drainage strategy are to:
- Consider the potential for infiltration of water into the ground;
 - Determine an appropriate and available discharge receptor, selected in accordance with the sustainable discharge hierarchy;
 - The conveyance routes across and from the site, taking into consideration the topography, layout and levels of drainage features and infrastructure; and
 - Assess the impact of the development on the surface water runoff regime, and the mitigation measures to be used to manage these to an acceptable level.

Surface Water Discharge Receptor

- 6.7 The guidance in the NPPF on the use of SuDS promotes the use of the sustainable discharge hierarchy for the discharge of surface water from a site.

6.8 The sustainable discharge hierarchy requires that the following preference should be given when identifying an appropriate discharge receptor:

1. Into the ground (infiltration); then
2. To a surface water body; then
3. To a surface water sewer; and then
4. To a combined sewer.

Into the ground:

6.9 An infiltration-led drainage solution is not anticipated to be appropriate, based on the underlying soil type and geology. Although soakaway testing has not been completed within the site, results from the development proposals at Thorneydown Farm near to the site indicate that an infiltration-led surface water drainage solution is not likely to be viable.

6.10 Whilst infiltration features that promote source control could still be used, an attenuation-led surface water drainage strategy will be required. Attenuation features will be incorporated into the site to manage the surface water runoff from the proposed development to an appropriate discharge receptor.

To a surface water body:

6.11 Telegraph Brook flows through the site, from Telegraph Woods to the west and to the lakes on the edge of the Boundary Lakes Golf Course to the south-east.

6.12 The western section of this watercourse currently flows in a deep culvert, the northern section in an open trapezoidal channel, and the eastern section in a wooden sleeper lined channel and which has a very shallow gradient.

6.13 The proposed development would re-align and improve sections of this watercourse, including de-culverting a section and introducing an open channel. The re-alignment of the watercourse has taken into consideration the requirements of the drainage strategy in the route it has taken to enable a controlled discharge of surface water from the drainage strategy and also the shape and size of the watercourse which has used a two-stage channel.

- 6.14 In addition, there is a drainage channel close to the northern boundary of the site. This currently conveys water from this part of the site, and drains east and then south-east into the woodland area before then adjoining the drainage system upstream of the culverted section under the M27 motorway. This northern drainage channel would also be utilised, with the continued drainage of surface water from this part of the site into this drainage feature

To a surface water / combined sewer:

- 6.15 There are public sewers serving the residential area to the north-west of the site. The nearest surface water sewer is 150mm diameter and located at the junction of Westgate Mews with Kenilworth Gardens, draining north-west along this road. A discharge of surface water runoff into a sewer is therefore a possibility, although less preferable than a discharge to a surface water body.

Summary:

- 6.16 A discharge to a surface water body is towards the top of the sustainable drainage hierarchy. Telegraph Brook passes through the site, and the proposed development would re-align and improve section of this watercourse. There is also a drainage channel close to the northern boundary that currently conveys water from this part of the site.
- 6.17 Features would be included within the site to attenuate and convey the surface water runoff from developed areas at an appropriate runoff rate and volume to these drainage features and also to protect and enhance the surface water quality.

Surface Water Drainage Design

- 6.18 MicroDrainage was used to determine the greenfield runoff rates, and then the likely attenuation volume to manage the surface water runoff from a 1 in 100-year rainfall event plus 40% for climate change event to the Q_{bar} runoff rate. The Q_{bar} runoff rate has been used as it would manage the surface water runoff rate and volume. The attenuation volume was determined for the assumed impermeable site area within each part of the site. The calculations are included as **Appendix E**, and summarised in **Table 6.1**.

Site Area	Impermeable Area (ha)	Attenuation Volume (m³)
1 – Northern Gateway	2.70	1,998 to 2,787
2 and 3 – Budget Hotel and Pavilion and Maintenance	0.61	452 to 631
4 – Southern Gateway	0.52	383 to 534
5 – Residential and Wellbeing	2.00	1,476 to 2,059

Table 6.1 – Summary of Attenuation Volumes

Surface Water Drainage Features

- 6.19 The drainage strategy for the site is included as **Appendix F**. This is provided for the overall site, and demonstrates the approach to manage the surface water runoff from the proposed development.
- 6.20 Surface water runoff would be managed from the proposed development through the incorporation of attenuation-led SuDS solutions at locations throughout the site, with landscaped features also illustrated in **Appendix H**.
- 6.21 Permeable paving would be incorporated within appropriate areas of the site, to provide an attenuation volume and a source control solution.
- 6.22 There is potential to include green roofs on some of the buildings within the scheme which would help to reduce surface water runoff from the associated building and possibly also blue / green roofs to provide an attenuation volume to manage the surface water runoff rates and volumes.
- 6.23 In the western site area, surface water runoff would drain to the re-aligned section of watercourse and also the original alignment adjacent to the northern site boundary. In the eastern site area, surface water runoff would either drain towards the re-aligned watercourse or directly to the lakes.
- 6.24 The de-culverting of the watercourse also provides a number of benefits to the management of surface water, with the two-stage channel providing an additional storage volume to accommodate high flows. There would also be

detention basins included to provide an attenuation volume, and these would drain into the open section of watercourse at a controlled rate.

- 6.25 The site already includes lakes, with the lower lake to be re-profiled slightly to accommodate the car parking proposals. The upper lake would also be re-profiled as part of the proposed landscape strategy to accommodate a pool around the budget hotel, as indicated in **Appendix H**.
- 6.26 These lakes form an important part of the overall surface water drainage strategy, as the Telegraph Brook drains into and then back out of them to another lake located to the south-east. This then drains to a culverted section under the M27 motorway and under the retail estate to the east of the site.

Conveyance of Surface Water Exceedance

- 6.27 The surface water drainage strategy has been designed to manage a 1 in 100-year rainfall event with a 40% allowance for climate change. This therefore provides additional attenuation for managing current rainfall events. An allowance has been made in residential areas for urban creep. Furthermore, landscaped SuDS features would include a suitable freeboard.
- 6.28 Rainfall events in excess of the design standard event could surcharge from the surface water drainage strategy. EBC Policy DM5 on managing flood risk advises that the design of drainage systems should take account of events that exceed the normal design standards. They should be managed in conveyance routes across a site that minimise risk to people and property.
- 6.29 In an exceedance event, surface water runoff from the site would still drain in an easterly and then south-easterly direction towards the lakes. If water were to surcharge, then this would be through conveyance along the proposed and existing road carriageways, such as the road around the Ageas Bowl.
- 6.30 If the lakes were then to fill and also surcharge, then water would spill out from the lower part of the bank perimeter, and therefore to the lower lying land areas to the south-east. These are areas of the Boundary Lakes golf course, and therefore a suitable area for accommodating surcharged surface water.

Water Quality

- 6.31 Water quality control features have been considered in accordance with the CIRIA SuDS Manual. This advises that any proposed drainage scheme must demonstrate that the hazard index for the particular land use is less than the mitigation index of the proposed SuDS features.
- 6.32 Surface water runoff would be managed by permeable paving, by the re-aligned watercourse and by the lakes, assessed here as a pond. The water quality benefits of these features have been assessed below, as they are commensurate to the whole scheme.
- 6.33 The pollution hazard indices for the proposed development are summarised in **Table 6.2**. This is based on the water quality management indices for different land uses as set out in Section 26 of the CIRIA SuDS Manual.

Land Use	Pollution Hazard Indices		
	Total Suspended Solids	Metals	Hydrocarbons
Residential Roofs	0.20	0.20	0.05
Individual property driveways etc with infrequent change	0.50	0.40	0.40
Total	0.70	0.60	0.45

Table 6.2: Pollution Hazard Indices for Proposed Development (SuDS Manual)

- 6.34 The water quality management section of the CIRIA SuDS Manual then provides guidance on the indicative SuDS mitigation indices for discharges to surface water bodies. The mitigation measures for the residential components of the scheme are summarised in **Table 6.3**.
- 6.35 A factor of 0.5 has been applied to the pollution mitigation values typically associated with a pond to account for the reduced performance of secondary or tertiary components associated with the already reduced inflow concentrations, as advised in the CIRIA SuDS Manual.
- 6.36 In all of the assessed parameters, the total of the pollution mitigation indices exceeds the total of the pollution hazard indices. The assessment of water

quality demonstrates that an adequate level of mitigation would be provided for the potential polluting effects resulting from the proposed development.

Mitigation Measure	Pollution Mitigation Indices		
	Total Suspended Solids	Metals	Hydrocarbons
Permeable Pavement	0.70	0.60	0.70
Pond	$0.5 * 0.70 = 0.35$	$0.5 * 0.70 = 0.35$	$0.5 * 0.50 = 0.25$
Total	1.05	0.95	0.95

Table 6.3: SuDS Mitigation Indices for Proposed Development (SuDS Manual)

Operation and Maintenance

- 6.37 It is anticipated that the surface water drainage infrastructure across and from the site would be maintained by a private management company. As the site is a part of an active sports facility, these maintenance requirements would be brought into the current operational works of the groundskeeper.
- 6.38 The operation and maintenance requirements as suggested within the CIRIA SuDS Manual are included below as **Figure 6.1** for permeable pavements, **Figure 6.2** for ponds and **Figure 6.3** for detention basins. Additional drainage features could include green roofs, included below as **Figure 6.4**.
- 6.39 It is proposed that the northern drainage channel and other similar features would also be maintained by the private management company, with the operation and maintenance requirements for swales included as **Figure 6.5**.

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Figure 6.1 – Permeable Pavement Operation and Maintenance

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Cut the grass – public areas	Monthly (during growing season)
	Cut the meadow grass	Half yearly (spring, before nesting season, and autumn)
	Inspect marginal and bankside vegetation and remove nuisance plants (for first 3 years)	Monthly (at start, then as required)
	Inspect inlets, outlets, banksides, structures, pipework etc for evidence of blockage and/or physical damage	Monthly
	Inspect water body for signs of poor water quality	Monthly (May – October)
	Inspect silt accumulation rates in any forebay and in main body of the pond and establish appropriate removal frequencies; undertake contamination testing once some build-up has occurred, to inform management and disposal options	Half yearly
	Check any mechanical devices, eg penstocks	Half yearly
	Hand cut submerged and emergent aquatic plants (at minimum of 0.1 m above pond base; include max 25% of pond surface)	Annually
	Remove 25% of bank vegetation from water's edge to a minimum of 1 m above water level	Annually
	Tidy all dead growth (scrub clearance) before start of growing season (Note: tree maintenance is usually part of overall landscape management contract)	Annually
	Remove sediment from any forebay.	Every 1–5 years, or as required
	Remove sediment and planting from one quadrant of the main body of ponds without sediment forebays.	Every 5 years, or as required
Occasional maintenance	Remove sediment from the main body of big ponds when pool volume is reduced by 20%	With effective pre-treatment, this will only be required rarely, eg every 25–50 years
Remedial actions	Repair erosion or other damage	As required
	Replant, where necessary	As required
	Aerate pond when signs of eutrophication are detected	As required
	Realign rip-rap or repair other damage	As required
	Repair / rehabilitate inlets, outlets and overflows.	As required

Figure 6.2 – Pond Operation and Maintenance

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly
	Cut grass – for spillways and access routes	Monthly (during growing season), or as required
	Cut grass – meadow grass in and around basin	Half yearly (spring – before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), then annually or as required
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebay	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually (as set out in Chapter 23)
Occasional maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial actions	Repair erosion or other damage by reseedling or re-turfing	As required
	Realignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

Figure 6.3 – Detention Basin Operation and Maintenance

Maintenance schedule	Required action	Typical frequency
Regular inspections	Inspect all components including soil substrate, vegetation, drains, irrigation systems (if applicable), membranes and roof structure for proper operation, integrity of waterproofing and structural stability	Annually and after severe storms
	Inspect soil substrate for evidence of erosion channels and identify any sediment sources	Annually and after severe storms
	Inspect drain inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system	Annually and after severe storms
	Inspect underside of roof for evidence of leakage	Annually and after severe storms
Regular maintenance	Remove debris and litter to prevent clogging of inlet drains and interference with plant growth	Six monthly and annually or as required
	During establishment (ie year one), replace dead plants as required	Monthly (but usually responsibility of manufacturer)
	Post establishment, replace dead plants as required (where > 5% of coverage)	Annually (in autumn)
	Remove fallen leaves and debris from deciduous plant foliage	Six monthly or as required
	Remove nuisance and invasive vegetation, including weeds	Six monthly or as required
	Mow grasses, prune shrubs and manage other planting (if appropriate) as required – clippings should be removed and not allowed to accumulate	Six monthly or as required
Remedial actions	If erosion channels are evident, these should be stabilised with extra soil substrate similar to the original material, and sources of erosion damage should be identified and controlled	As required
	If drain inlet has settled, cracked or moved, investigate and repair as appropriate	As required

Figure 6.4 – Green Roof Operation and Maintenance

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly, or as required
	Cut grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours	Monthly, or when required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
Occasional maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or if bare soil is exposed over 10% or more of the swale treatment area
Remedial actions	Repair erosion or other damage by re-turfing or reseeded	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

Figure 6.5 – Swale Operation and Maintenance

7 CONCLUSIONS

- 7.1 This Flood Risk Assessment (FRA) has been prepared by ACC on behalf of LDA for a proposed development of land around the Ageas Bowl.
- 7.2 A description of the proposed development was provided, followed by a summary of the recent planning history relating to the site and relevant to the assessment of flooding and drainage.
- 7.3 As summary of the assessment approach was then provided, including the additional appended information which included the surface water drainage strategy and a flood modelling study of the watercourse through the site.
- 7.4 A summary of the national and local planning policy was provided, with key sections from the NPPF, the PPG and the NTS for sustainable drainage systems, and also the Local Plan from EBC as the LPA and of HCC as the LLFA.
- 7.5 A background understanding on local topography, geology, hydrogeology, soils and catchment and local hydrology was provided. In particular, this included the Telegraph Brook watercourse which drains though the site and a drainage channel further to the north, close to the northern site boundary.
- 7.6 There is an inlet adjacent to the site in Telegraph Wood, although this is currently blocked, and a deep culverted section under the western part of the site. There is an open section of channel along the northern site boundary. The lower section of Telegraph Brook flows within a wooden sleeper lined channel and which has a very shallow gradient. The watercourse then drains into an upper and lower lake separated by a weir at the edge of the site.
- 7.7 The proposed development would replace and re-align the culverted section of the watercourse in the western part of the site, presenting the opportunity to improve the inlet from Telegraph Wood. The re-aligned culvert would flow into a new section of open channel. The inclusion of a longer section of open channel was limited due to the depth of the culvert and position of the inlet.
- 7.8 This is in keeping with EBC Policy DM6, which advises that watercourses present on a development site should be retained or restored into a natural

state and enhanced where possible. An existing and presumably blocked culvert is being removed and replaced with a re-aligned culvert and open section of channel in the western part of the site and a more natural two-stage channel in the eastern part of the site. This will improve the watercourse and increase in-channel flood storage capacity. The proposed development has been laid out to enable access and maintenance of the re-aligned culvert and open section of channel.

- 7.9 An assessment of flood sources to the site and surrounds was completed. The site is wholly located in Flood Zone 1, indicating a low level of risk from fluvial and tidal sources. A flood modelling study to investigate the flood risk from Telegraph Brook was completed. The baseline flood modelling scenario demonstrated an existing flood risk from the eastern section of Telegraph Brook, with flood water overtopping the bank and flowing north-east to affect existing bungalows and reaching the western side of the M27 motorway.
- 7.10 The risk from other sources of flooding was investigated, including surface water flooding, groundwater, drainage and infrastructure and artificial and other sources. These flood sources were generally found to be of a low level of risk to the site and surrounds. There are some surface water flow paths across the site, with a flow path associated with Telegraph Brook and therefore investigated by the flood modelling study.
- 7.11 Some flood mitigation and management measures are suggested for the proposed development. The FFL of buildings would be elevated above the surrounding ground levels by at least 150mm. A surface water drainage strategy would be incorporated in accordance with EBC Policy DM5 and DM6, to manage surface water runoff and surface water flow paths. The re-alignment and improvements to the watercourse will increase in-channel flood storage capacity and reduce and potentially remove an existing flood flow path. This has been demonstrated by baseline flood modelling, and will be investigated by post-development flood modelling to ensure there are no adverse flood and drainage impacts from the proposed development.

- 7.12 A surface water drainage strategy has been incorporated into the proposed development, designed in accordance with the NPPF and PPG, EBC Policy DM6 and the guidance of HCC as the LLFA. HCC advise that SuDS should be designed to mimic the natural drainage of surface water, typically managing rainfall close to where it falls. Surface water flows are then slowed down and discharged at a controlled rate before it enters a watercourse. The surface water drainage strategy would drain into the re-aligned watercourse that flows across the site and also locally into the northern drainage channel, providing an integrated flood and drainage solution.
- 7.13 A surface water drainage assessment considered the impact of the proposed development on surface water runoff. This assessed viable discharge options for the runoff, and suggested a discharge to Telegraph Brook and also locally into the northern drainage channel. Telegraph Brook would be re-aligned with a route that would enable a controlled discharge of surface water from the drainage strategy also with the watercourse improved where possible to a two-stage channel, to increase in-channel capacity.
- 7.14 A surface water drainage strategy was presented, which incorporated features for the management of the surface water runoff. This included permeable paving incorporated into areas of the site, to provide an attenuation volume and a source control solution.
- 7.15 There is potential to include green roofs on some of the buildings, to reduce surface water runoff, and possibly also blue / green roofs to provide an attenuation volume to manage the surface water runoff rates and volumes.
- 7.16 The de-culverting of the watercourse also provides a number of benefits to the management of surface water, with the two-stage channel providing an additional storage volume to accommodate high flows. There would also be detention basins included to provide an attenuation volume, and these would drain into the open section of watercourse at a controlled rate.
- 7.17 The site already includes lakes, with these to be re-profiled slightly to accommodate the development proposals. The lakes form an important part

of the overall surface water drainage strategy, as the Telegraph Brook drains into and then back out of them to another lake located to the south-east.

- 7.18 The drainage strategy would manage the surface water runoff, and allows for climate change. Rainfall events exceeding the design standard would be managed to avoid adverse impacts on adjacent people and property.
- 7.19 Based on the assessment approach set out in the CIRIA SuDS Manual, the SuDS features included in the surface water drainage strategy would offer sufficient water quality mitigation for the land use classification. This is of particular note, given that the wider hydrological catchment includes the Solent Maritime SAC and the Solent and Southampton Water SPA.
- 7.20 It is anticipated that the surface water drainage infrastructure across and from the site would be maintained by a private management company. As the site is a part of an active sports facility, these maintenance requirements would be brought into the current operational works of the groundskeeper.
- 7.21 In summary, the proposed development of the site is considered to be appropriate in terms of flood risk. A surface water drainage strategy would be incorporated to manage the drainage resulting from the proposed development of the site in an appropriate way. This strategy would provide additional benefits in particular to landscape, biodiversity and water quality.

Appendix A

Details of the proposed development

