

Appendix 7.1

Flood Risk Assessment

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**OLDLANDS FARM BUSINESS PARK OFF A29 SHRIPNEY ROAD AT BOGNOR REGIS
 IN WEST SUSSEX**

Flood Risk Assessment

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The flood risk issues, their implications for the development in question and the resulting land drainage and flood protection and mitigation measures that are required for the development are addressed in the following itemised PPS 25 referenced flood risk assessment:

- (1) Planning Policy Statement 25 (PPS 25) "Development and Flood Risk" was published in December 2006 by the Department of Communities and Local Government (DCLG). It replaces Planning Policy Guidance 25 (PPG 25) "Development and Flood Risk" published in July 2001 by the Department of the Environment, Food and Rural Affairs (DEFRA). PPS 25 gives guidance to planning authorities in England on how to respond on flood risk grounds to development proposals. It expects planning authorities to apply a sequential risk-based approach to development planning and control through a sequential test, which forms the core of PPS 25. The main points of the guidance are summarised as follows:
 - (a) Table D.1 in annex D of PPS 25 divides the land area of England into four flood risk zones in relation to flooding from the coast and watercourses. These are flood risk zone 1 (low probability), 2 (medium probability), 3a (high probability) and 3b (functional flood plain). The 1 in 1000 (0.1%) annual probability (1000 year return period) of either tidal or fluvial flooding defines the boundary between flood risk zones 1 and 2. The 1 in 200 (0.5%) annual probability (200 year return period) of tidal flooding or the 1 in 100 (1.0%) annual probability (100 year return period) of fluvial flooding defines the boundary between flood risk zones 2 and 3a. Flood risk zones 1, 2 and 3a are defined ignoring the presence of flood defences. Flood risk zone 3b represents the functional flood plain and is defined as land having a 1 in 20 (5.0%) annual probability (20 year return period) or greater of either tidal or fluvial flooding or is specifically designed to flood at a lower annual probability.
 - (b) Table D.2 in annex D of PPS 25 classifies development according to vulnerability to flooding. There are five classes, which are highly vulnerable, more vulnerable, less vulnerable, essential infrastructure and water-compatible development. Emergency services stations, basement dwellings and caravans, mobile homes and park homes intended for permanent use are classified as highly vulnerable. All residential premises, educational establishments, hotels, public houses, nightclubs and caravan and camping sites used for temporary holiday accommodation are classified as more vulnerable. Commercial, retail, leisure and general industrial development, buildings used for agriculture, horticulture and forestry and water and sewage treatment plants are all classified as less vulnerable. The essential infrastructure classification relates to strategic transport and utility infrastructure. Water-compatible development includes outdoor sports and recreation, together with essential facilities such as changing rooms.
 - (c) The aim of the sequential test is to steer new development to areas with the lowest probability of flooding from the coast and watercourses, namely flood risk zone 1. If there is no reasonably available site in zone 1, the development can be located, subject to its vulnerability to flooding, in zone 2 and then zone 3. Table D.3 in annex D of PPS 25 details the compatibility criteria between flood risk zone and vulnerability to flooding. It indicates that highly vulnerable, more vulnerable and less vulnerable development should not be permitted in zone 3b. Highly vulnerable development should also not be permitted

in zone 3a. Essential infrastructure in zones 3a and 3b, more vulnerable development in zone 3a and highly vulnerable development in zone 2 should only be permitted if the exception test is passed.

- (d) The exception test is only appropriate for use where the sequential test cannot deliver a reasonably available site, but development is necessary to avoid social or economic blight. It is passed by satisfying all of the following criteria:
 - (i) The development provides demonstrably wider sustainability benefits to the community that outweigh flood risk.
 - (ii) The development is on previously developed land or, if it is not, that there are no reasonable alternative sites on previously developed land.
 - (iii) The development will be safe from flooding, without increasing, and where possible decreasing, flood risk elsewhere.
- (e) Minor development and changes of use should not be subject to the sequential or exception tests. Minor development is defined as:
 - (i) Non-residential (eg industrial, commercial, retail, leisure etc) extensions with a footprint of less than 250 m².
 - (ii) Alterations that do not increase the building footprint.
 - (iii) Residential extensions, including shed, garage, games room etc within the curtilage of a dwelling, but excluding the creation of an additional separate dwelling within the curtilage, which includes the sub-division of a dwelling into apartments or flats.
- (f) Flooding can occur from sources other than watercourses and the coast, as identified in annex C of PPS 25. These other forms of flooding arise from:
 - (i) The rate of rainfall exceeding the rate of infiltration into the ground, resulting in "sheet run-off" of the residual. This can occur from either heavy rainfall on ground saturated through prolonged wet weather in the winter or an intense summer thunderstorm.
 - (ii) The water level in the ground rising above the surface level. This is most likely to occur in low-lying areas underlain by permeable rock formations during wet winter months.
 - (iii) Sewers or drains being overwhelmed by heavy rainfall, becoming blocked or having inadequate capacity.
 - (iv) The overtopping, or even breach, of canals and impoundments, where water is retained above natural ground level.

New development within a flood risk zone should be directed first to sites at the lowest probability of flooding from all sources. Within each site, higher vulnerability uses should be located on parts of the site at the lowest vulnerability of flooding from all sources, with the more flood-compatible uses, such as parking and open space, on parts of the site at the highest probability of flooding.

- (g) Annex F of PPS 25 highlights the need to mitigate for the effect of increased surface water run-off caused by development, so as not to increase, and if possible decrease, the flood risk elsewhere. This can be achieved by the provision of attenuation storage, infiltration into the underlying subsoil where ground conditions and water table permit or a combination of both. These are normally provided on-site but are, occasionally, located off-site.
 - (h) It should be demonstrated that the residual risks remaining after applying the sequential approach and implementing flood protection and mitigation measures can be safely managed. This requirement is addressed in annex G of PPS 25, which draws particular attention to development behind flood defences and the residual risk due to the defences being overtopped or breached. The management of residual flood risk may incorporate one or more of the following:
 - (i) Flood-resilient construction is designed to reduce the consequences of flooding and facilitate the recovery from the effects of flooding sooner than conventional buildings. Water resistant materials for floors, walls and fixtures and the positioning of electrical controls, cables and appliances at higher than normal levels are examples of flood-resilient construction.
 - (ii) Flood-resistant construction is designed to prevent or limit floodwater entering a building. Raised floor levels and removable doorway barriers are examples of flood-resistant construction.
 - (iii) A flood risk management and evacuation procedure that is linked to Environment Agency (EA) flood warning alerts. Such a procedure is only viable if there is sufficient response time after a flood warning alert. Particular attention should be given to the communication of evacuation plans, including how such plans are triggered.
 - (i) A planning application for development should be accompanied by a flood risk assessment that demonstrates how the flood risk from all sources will be managed and the effect of the development on flood risk elsewhere. Minor development and changes of use are not excluded from this requirement. The only exception is a development site of area less than one hectare in flood risk zone 1. Annex E of PPS 25 gives the minimum criteria for a flood risk assessment.
- (2) "A Practice Guide Companion to PPS 25" was published in February 2007 by the DCLG. The main additional points of the PPS 25 practice guide are summarised as follows:
- (a) Paragraph 5.5 recommends a minimum acceptable standard of protection for new property within flood risk areas. For fluvial flooding the minimum standard is protection against the adjacent 1 in 100 (1.0%) annual probability (100 year return period) fluvial flood peak level in the watercourse, with an allowance for peak discharge increase due to climate change over the design life of the property. Table B.2 in annex B of PPS 25 recommends a 20% increase in the 100 year return period flood peak discharge for a design life ending after 2025. For tidal flooding the minimum standard is protection against the adjacent 1 in 200 (0.5%) annual probability (200 year return period) still-water tidal peak in the watercourse or at the coast, with an allowance for relative sea level rise due to climate change over the design life of the property. Table B.1 in annex B of PPS 25 recommends annual relative sea level rises for the coast of England. An annual

allowance to limit overtopping through wave action is also required for coastal flood defences. This too is subject to increase through climate change as recommended in table B.2 of annex B of PPS 25.

- (b) Referring to paragraphs 5.25 and 5.26, car parking areas may be subject to flooding provided there is a flood warning and evacuation procedure that allows sufficient response time for drivers to remove their vehicles and it is accompanied by appropriately located and worded signs. Where the depth of flooding exceeds 0.3 metres for the level of flood protection defined in (2)(a) above, then the car parking area should be designed to prevent vehicles floating out of it. Car parking areas for residential premises and long term car parking are unlikely to be acceptable where the depth of flooding exceeds 0.3 metres for the level of flood protection defined in (2)(a) above, because of the risk of vehicle owners being away from the area when flooding occurs and, therefore, unable to move their vehicles.
- (c) Paragraphs 5.46 to 5.48 require new developments in flood risk areas to have, wherever possible, an access / escape route for occupants that is protected against flooding to at least the minimum standard stated in (2)(a) above. Appropriately located and worded signs should indicate this route if it is not immediately obvious (reference paragraph 5.50). Emergency services' vehicles should normally also be able to access the development during flood peak levels specified in (2)(a) above (reference paragraph 5.47).
- (d) Raising ground levels or constructing flood defences to protect development proposed on undefended areas of fluvial flood plain will, in order to avoid increasing the flood risk elsewhere, require compensatory flood storage and, if applicable, conveyance to the level of flood protection defined in (2)(a) above. This is not the case on undefended areas of tidal flood plain because of the negligible impact on peak tidal levels (reference paragraphs 2.43, 2.44 and 5.27 to 5.32). Development proposed on defended areas should ensure that the effect on the residual flood risk elsewhere caused by the loss of flood storage due to the development is insignificant (reference paragraphs 2.45 and 2.46).
- (e) All sewers that are subsequently adopted by a sewerage undertaker are designed and built in accordance with the sixth edition of "Sewers for Adoption" published in March 2006 by WRC plc for Water UK. This requires no surface flooding from the sewerage system for the 1 in 30 (3.33%) annual probability (30 year return period) storm of critical duration. Surface flooding from the sewerage system should not flood new property for the 1 in 100 (1.0%) annual probability (100 year return period) storm of critical duration, with an allowance for an increase in peak rainfall intensity due to climate change over the design life of the property (reference paragraphs 4.6 and 4.7). Table B.2 in annex B of PPS 25 recommends increases in peak rainfall intensity due to climate change.
- (f) It is necessary to mitigate for the effect of the increased surface water run-off caused by development, so as not to increase, and if possible decrease, the flood risk elsewhere. The peak rate of surface water run-off post development should be no greater, and if possible less, than that pre development for storms of critical duration up to and including the 1 in 100 (1.0%) annual probability (100 year return period), with an allowance for an increase in peak rainfall intensity due to climate change over the design life of the development (reference paragraph 4.9).

- (3) The EA has a duty under the Water Resources Act 1991 and the Land Drainage Act 1991, as amended by the Land Drainage Act 1994, to exercise general supervision over all matters relating to land drainage and flood defence in England and Wales. Accordingly, it is a statutory consultee in the planning process with regard to land drainage and flood defence. PPS 25 endorses and reinforces this consultee role in England. In practice, the approval of the EA in respect of matters relating to land drainage and flood protection and mitigation is, invariably, a prerequisite for planning permission.
- (4) The EA normally requires development to be protected against flooding to at least the minimum standards recommended in the PPS 25 practice guide (reference (2)(a), (2)(b), (2)(c) and (2)(e) above). However, usually the EA additionally requires floor levels of all buildings on the development to be protected against flooding to at least the recommended minimum standard in the PPS 25 practice guide (reference (2)(a) above) plus 0.6 metres of freeboard.
- (5) The site of the proposed business park, which extends to some 8.8 hectares, is presently arable farmland. Commercial and retail development are proposed for the business park. The national grid reference for the approximate centre of the site is SU 942015. The site is bounded by the A29 Shripney Road to the west, the Southern Cross Industrial Estate to the south and arable farmland to the east and north. A short length of the proposed Bognor Regis northern relief road next to its junction with the A29 Shripney Road will subsequently form part of the northern boundary of the site. The disused farm buildings of Oldlands Farm are located next to the south-east corner of the site. The access to the business park will be from the A29 Shripney Road at the roundabout junction with the proposed Bognor Regis northern relief road.
- (6) The topographical survey plan of the site and its immediate surrounds shows existing ground levels on the site between 2.0 and 3.9 m AOD, with levels generally rising gradually from north-east to south-west. In fact, the site is restricted to land with ground levels at or above 2.0 m AOD. This results in the eastern and part of the northern boundary of the site, which cross the arable farmland, being defined by the 2.0 m AOD contour. The land falls gently away from the site in an easterly and north-easterly direction to meet the low-lying flat flood plain of Lidsey Rife, where ground levels are as low as 0.7 m AOD. The A29 Shripney Road alongside the western boundary of the site rises gradually from 2.7 m AOD in the north to 3.9 m AOD in the south.
- (7) Surface water run-off from the site presently drains to a ditch that flows in a northerly direction from the south-east corner of the site. In fact, this ditch forms the boundary to the south-east corner of the site. The ditch outfalls to a tributary of Lidsey Rife about 0.3 kilometres from the south-east corner of the site. The tributary flows approximately from west to east, crossing beneath the railway line to Bognor Regis, to outfall to Lidsey Rife about 0.6 kilometres from its confluence with the ditch. Lidsey Rife has a length of some 1.4 kilometres from its confluence with the aforementioned tributary upstream and its confluence with Aldingbourne Rife downstream. Aldingbourne Rife, of which Lidsey Rife is the main tributary, outfalls to the English Channel at Bognor Regis, some 1.5 kilometres downstream of its confluence with Lidsey Rife on the outskirts of the town. The outfall has twin culverts beneath the sea defence wall, which is continuous along the coastline, with a flap valve to each to prevent the ingress of seawater. There is also a pumping station at the outfall, which operates if water levels become high during tide-locked periods. Aldingbourne Rife has a catchment area of 96.3 km² to its outfall to the English Channel and 53.3 km² to just upstream of its confluence with Lidsey Rife. The catchment area of Lidsey Rife to its confluence with Aldingbourne Rife is 41.3 km².

- (8) The relevant extract from the EA's flood risk zoning map on which the site in question is located shows that the whole of the site is within flood risk zone 3a (reference (1)(a) above). The risk is from tidal flooding emanating from the English Channel, which is some 2.3 kilometres to the south of the site. It must be remembered, however, that flood risk zones are defined ignoring the presence of flood defences, which is particularly relevant in this case, as the site, like a large part of Bognor Regis and its surrounding area, is protected against tidal flooding to a high standard by a continuous sea defence along the coastline.
- (9) Development is classified according to vulnerability to flooding. Retail and commercial development are classified as less vulnerable (reference (1)(b) above). Less vulnerable development in flood risk zone 3a is compatible, subject to the planning authority applying the sequential test (reference (1)(c) above). Since the site is in ADC's adopted Local Plan of 2003, it would be somewhat surprising if ADC now said that it did not satisfy the sequential test.
- (10) Consulting engineers Capita Symonds are presently finalising a strategic flood risk assessment (SFRA) for Arun District Council (ADC). This assessment, which covers the whole of the Council's area of jurisdiction, is being undertaken in accordance with PPS 25. A draft of the SFRA report was presented by Capita Symonds in May 2007. The report has yet to be fully endorsed by both the EA and ADC, following which, presumably, the final SFRA report will be published. The draft SFRA indicates that the continuous sea defence along the coastline protects against tidal flooding from the 1 in 200 (0.5%) annual probability (200 year return period) event occurring now, in 50 years time or even in 100 years time. It also indicates that the sea defence protects against the 1 in 1000 (0.1%) annual probability (1000 year return period) event occurring now or in 50 years time. Therefore, the buildings and access and parking areas of the proposed business park and an ingress and egress route from the developed site will be protected against tidal flooding to the required standards (reference (2)(a) and (4), (2)(b) and (2)(c) above respectively).
- (11) Consulting engineers WSP Development have undertaken a comprehensive flood study of Aldingbourne Rife and Lidsey Rife through Bognor Regis and its surrounding area. Detailed hydrological and hydraulic analyses, including hydrodynamic mathematical modelling, and an extensive cross section survey of the two watercourses and their flood plains formed the core of this study. Flood storage rather than flood conveyance is invariably the critical factor with regard to fluvial flood risk from watercourses on low-lying flat areas that are defended against tidal flooding, because the watercourses are subject to tide-locking. This is certainly the case for Aldingbourne Rife and its tributary Lidsey Rife where they flow through Bognor Regis and its surrounding area. Accordingly, the WSP Development flood study was based on unsteady flood flow conditions. The "Aldingbourne and Lidsey Rife Flood Study Report" published in June 2003 by WSP Development estimates the present 1 in 100 (1.0%) annual probability (100 year return period) fluvial flood peak level alongside the development site from Lidsey Rife as 1.70 m AOD. When flood flows are increased by 20% to allow for climate change over the next 50 years, the study report estimates the 50 years hence 1 in 100 (1.0%) annual probability (100 year return period) fluvial flood peak level alongside the development site from Lidsey Rife as 1.82 m AOD. Both flood peak levels have been conservatively estimated because the pumping station at the Aldingbourne Rife outfall to the English Channel has been ignored.
- (12) Buildings on the proposed business park will have floor levels of at least $1.82 + 0.60 = 2.42$ m AOD so that they will be protected against fluvial flooding from Lidsey Rife to the required standards (reference (2)(a), (4) and (11) above). Comparing site ground levels in (6) above with fluvial flood peak levels in (11) above demonstrates that the access and parking areas of

the proposed business park and an ingress and egress route from the developed site will be protected against fluvial flooding from Lidsey Rife to the required standards (reference (2)(b) and (2)(c) above respectively). It also demonstrates that the developed site will not require compensatory fluvial flood storage or conveyance (reference (2)(d) above).

- (13) The peak rate of surface water run-off from the site post development will not exceed the peak rate of surface water run-off from the site pre development (i.e. the "greenfield" site). Because the underlying subsoil on the site is not conducive to infiltration as a result of its clay content, the peak rate of surface water run-off from the developed site will be restricted by the provision of flood attenuation storage with an outlet structure that controls the flow passing forward.
- (14) A flood attenuation storage ditch will be located immediately on the development side of the site boundary between where it meets the proposed Bognor Regis northern relief road to the north and the existing ditch to the south-east. Consequently, the top of the far bank of the storage ditch will be at a level of 2.0 m AOD throughout its approximately 300 metres length (reference (6) above). The top of the near bank of the storage ditch will be at a slightly higher level because the ground rises gradually into the site. The outlet control structure will be located where the flood attenuation storage ditch meets the existing ditch in the south-east corner of the site. A vortex flow device, known more commonly by its trade name "hydrobrake", will most probably be used to control the flow through the outlet structure. Although the outlet structure will incorporate a trash screen to minimise the risk of blockage by debris of the flow control device, an emergency overflow will also be included as a safeguard.
- (15) The flood attenuation storage ditch will have a trapezoidal cross section with 1:1 side slopes and a bed level of 0.8 m AOD throughout its length. This level corresponds to the bed level in the existing ditch where the storage ditch will connect to it. The bed width of the storage ditch will be substantial, probably 5 metres at least. Subsequent hydrological and hydraulic analyses will establish the required storage capacity and, therefore, the necessary bed width. The water level in the storage ditch at its design capacity will not exceed 1.82 m AOD. This level will also be the threshold for the emergency overflow in the outlet structure. The flood attenuation storage ditch will form a significant wetland wildlife amenity of extensive reedbed habitat.
- (16) The peak "greenfield" run-off rate will be limited to 5 litres/second/hectare for the 1 in 100 (1.0%) annual probability (100 year return period) storm of critical duration. This rate has been agreed to by the EA for development proposals within the Aldingbourne Rife catchment in the recent past. The resulting flood attenuation storage requirement for the developed site will be increased by 20% to allow for an increase in peak rainfall intensity due to climate change over the next 50 years. Referring also to (13), (14) and (15) above, this will result in the developed site not increasing the risk of flooding elsewhere (reference (1)(g) and (2)(f) above).
- (17) The surface water run-off from the developed site will drain to surface water sewers that will all outfall to the flood attenuation storage ditch. These sewers will adhere to the following hydraulic design criteria:
 - (a) No surcharging of sewers (i.e. water level not to exceed soffit level) under "free" outfall for 2 year return period storm of duration critical for sewer length.

- (b) No flooding out of manholes (i.e. water level not to exceed cover level) under "free" outfall for 30 year return period storm of duration critical for sewer length.
- (c) No flooding out of manholes (i.e. water level not to exceed cover level) under "drowned" outfall level of 1.82 m AOD for 2 year return period storm of duration critical for sewer length.

Conditions (a) and (b) are the design criteria set by the sixth edition of "Sewers for Adoption" published in March 2006 by WRC plc for Water UK. Condition (c) is included as an additional safeguard.

- (18) Although the ground levels of the redeveloped site will remain predominantly as existing, any hollows will be filled and humps levelled to produce even grades in all directions. This will minimise the ponding of floodwater within the redeveloped site should ever an exceptionally extreme event result in its flooding, whether from a watercourse, the coast or through the surcharging of adjacent sewers or drains. As an additional precaution to ensuring compliance with the minimum standard of protection to buildings against flooding from sewers and drains (reference (2)(e) above) and to managing the residual flood risk (reference (1)(h) above), the floor levels of proposed buildings will be at least 0.3 metres above the highest ground level around the building. With regard to the residual flood risk, the draft SFRA produced by Capita Symonds gives a flood peak level alongside the development site of 1.19 m AOD from tidal flooding if a breach occurred in the sea defences during a present 1 in 200 (0.5%) annual probability (200 year return period) event.
- (19) The developed site will not be at risk of flooding from any other sources than those already addressed (reference (1)(f) above).

The above information, together with the incorporation of the land drainage and flood protection and mitigation measures described above, demonstrate that the proposed business park fully complies with the requirements of PPS 25 and the EA.