

Report on

SALTBOX SITE – BOGNOR REGIS

FLOOD RISK ASSESSMENT

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Prepared by	G.WILBY
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Revision History

Rev:	Description:	Date:	Rev by:	Chk by:
P1	Draft Issued for Planning	07/06/2017	GW	MS
P2	Renumbered. Planning Issue	09/08/2017	KJ	KJ
P3	Changes to included Mango planning amendments	09/08/2011	KJ	KJ
P4	General amendments following the issue of the revised SFRA and the main modification version of the Local Plan	21/09/2011	GW	KJ

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1. Executive Summary

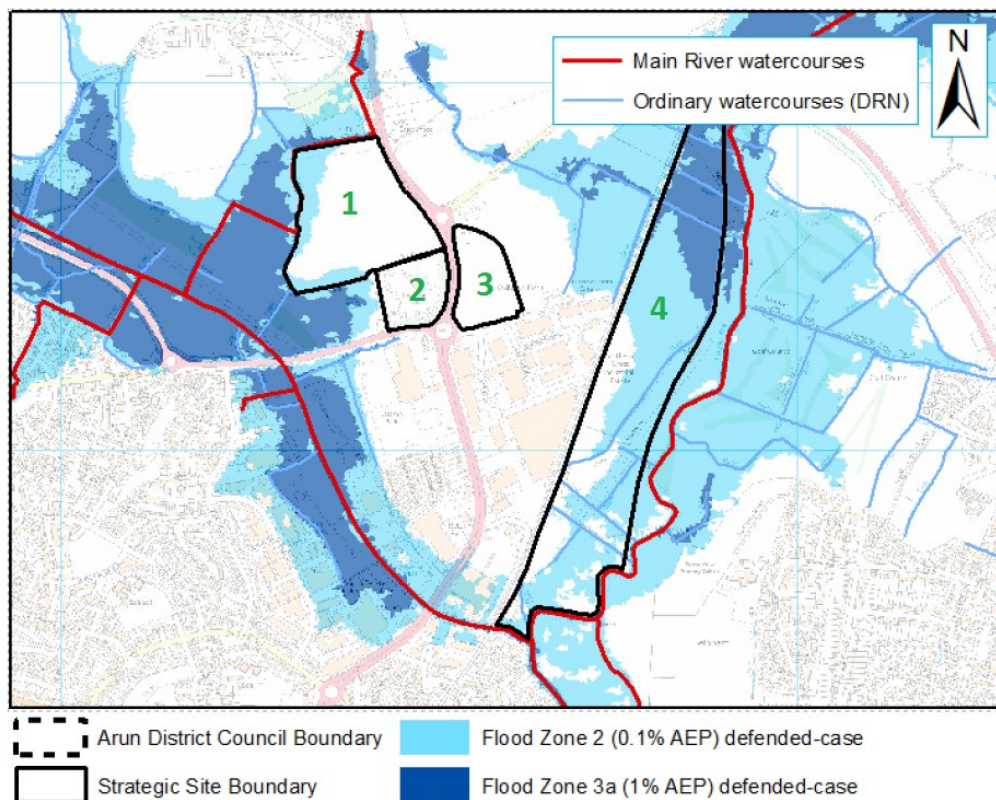
Kirksaunders (KSA) has been commissioned by Landlink Estates to undertake a site-specific Flood Risk Assessment (FRA) for the proposed Saltbox site development north of Bognor Regis.

Enterprise Bognor Regis is a 70 hectare commercial and employment development opportunity located on the northern edge of Bognor Regis in West Sussex.

It comprises four adjoining sites that can support a mix of business accommodation for advanced manufacturing, warehousing, offices and small business/studio units (B1, B2 & B8 uses). The development parcels are listed as follows:

1. Salt Box
2. Rowan Caravan Park
3. Oldlands Farm
4. Airfield Park

Table 1: Flood Zones Map (Present Day) with Enterprise Bognor Regis Parcels Illustrated.



This FRA relates to the Saltbox parcel only, listed above as parcel number 1 on figure 1.

Full planning permission is sought for the Phase 1 development of 6.492 hectares of employment space (B1, B2 and B8) with associated parking, landscaping and public open space. In addition, outline planning permission is sought for the Phase 2 development of 5.512 hectares for additional

employment units, warehousing, hotel, drive thru's, public house, gym and associated works. Based on Table 2 (Flood Risk Vulnerability Classification) of the NPPF Planning Practice Guide, the Proposed Development is classified as 'Less Vulnerable'.

The site is located within Flood Zones 1, 2 and 3. However coastal flood defences protect the site from tidal flooding up to the 0.5% (1 in 200 year) annual probability event and the modelled level of flood risk from fluvial sources is less than 1% (1 in 100 year) annual probability to all built development. As all built development is effectively in Flood Zone 2 the Proposed Development is considered appropriate development in accordance with Table 3 of the NPPF Technical Guidance.

Flood risk to and arising from the Proposed Development has been classified as low to negligible and the proposed buildings are located outside all areas of flood zone 2 and 3.

A drainage strategy has been prepared to support the Proposed Development through the planning process. The strategy demonstrates the Proposed Development can comply with the requirements of the NPPF and does not increase flood risk either to or from the Proposed Development.

This FRA demonstrates that the Proposed Development site can be drained in a sustainable manner through attenuation and infiltration and that the development is not at flood risk from all sources and will not increase flood risk to other parties.

This FRA has been reissued in September 2017 to revision P4, to take account of the updated Strategic Flood Risk Assessment (SFRA) and main modification version of the local plan.

2. Planning Policy

2.1 National Planning Policy Framework (NPPF)

The National Planning Policy Framework (NPPF) provides a clear and concise framework to ensure sustainability through planning and development. The framework sets out the Government's expectations as to how planning policies should be applied. The NPPF replaces previous Guidance and Policy set out in PPS25:- Development and Flood Risk.

The NPPF identifies flood risk as a specific material consideration in Section 10; "Meeting the challenge of climate change, flooding and coastal change" which provides guidance in determining planning applications whilst reducing the current and future threats of flood risk.

As outlined in the NPPF, a Flood Risk Assessment is generally required for any site which is designated as being within Flood Zone 2 and Flood Zone 3, including minor developments or changes in use. FRA's are required within Flood Zone 1 areas for development over 1 hectare; or less than 1 hectare but may be affected by sources of flooding other than rivers and sea and for sites which may encounter critical drainage problems as notified by the Environment Agency.

There are four levels to the designated Flood Zones, with Zone 1 being the 'least risk' and Zone 3b being a functional floodplain. The Flood Zones are defined as follows:

- Flood Zone 1 has a low risk of flooding having a less than 1 in 1,000 annual probability of river or sea flooding.
- Flood Zone 2 has a moderate risk of flooding with land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding.
- A Flood Zone 3A has high risk of flooding with a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea in any year.
- Flood Zone 3B is land considered to act as functional flood plain

The above criteria does not account for any previous flood defences, unless otherwise stated, and estimate current levels of risk not taking into account future uncertainties of climate change.

The NPPF builds on previous legislation to empower Local Authorities in implementing suitable plans to mitigate flood risk. The NPPF expects Local Authorities to adopt a risk-based approach at all levels of planning by applying the 'Source – Pathway – Receptor' model to development in flood-susceptible areas.

Local Plans are guided by the NPPF and should account for the future uncertainty of climate change and avoid development in areas which are vulnerable to flooding. Unavoidable development in flood risk zones must undergo a Sequential Test to assess the extent of flood risk, followed by an Exception test to demonstrate that the site has wider sustainable benefits that outweigh flood risk, that the site is previously developed land and that the development will be safe for the lifetime of the development. Highly vulnerable developments such as Police/Ambulance stations which are required to remain operational during flooding are not suitable for High Risk Zone 3 sites. More vulnerable development

such as housing, nurseries and educational establishments are suitable for Flood Zone 3A provided they pass the Exception test. The NPPF also states that “For individual developments on sites allocated in development plans through the Sequential Test, applicants need not apply the Sequential Test. Applications for minor development and changes of use should not be subject to the Sequential or Exception Tests but should still meet the requirements for site-specific flood risk assessments”.

Local Plans should be supported by a Strategic Flood Risk Assessment to develop policies which involve contributions from all stakeholders such as the Environment Agency and other statutory bodies.

2.2 The Water Resources Act 1991

The Water Resources Act 1991 (Section 105) also requires the Environment Agency to exercise a general supervision over all flood defence matters, including flood plains and washlands which accommodate waters during periods of flood. The Environment Agency is a statutory consultee in the planning process, providing current information on Flood Risk Maps. The EA are able to define the extent of the flood plain that is under threat from flood risk.

2.3 Further Guidance

Further Guidance from CIRIA publication ‘C624 Development and Flood Risk Guidance for the Construction Industry’¹ define three levels of FRA which can be undertaken:

FRA Level	Description/Scope
Level 1	Screening Study to identify whether there is any flooding or surface water management issues related to a development site that may warrant further consideration. This should be based on readily available existing information, including the SFRA, Environment Agency Flood Map and Standing Advice. The Screening Study will ascertain whether a FRA is required.
Level 2	Scoping Study to be undertaken if the Level 1 FRA indicates that the site may lie within an area that is at risk of flooding or that the site may increase flood risk due to increased run-off. This Study should confirm the sources of flooding which may affect the site and should include the following: - an appraisal of the availability and adequacy of existing information; - a qualitative appraisal of the flood risk posed to the site, and potential impact of the development on flood risk elsewhere; - an appraisal of the scope of possible measures to reduce the flood risk to acceptable levels.

¹ CIRIA Publication: *C624 Development and Flood Risk – Guidance for Construction Industry*, 2004

	The Scoping Study may identify that sufficient quantitative information is already available to complete a FRA appropriate to the scale and nature of the development.
Level 3	Detailed Study to be undertaken if the Level 2 FRA concludes that further quantitative analysis is required to assess flood risk issues related to the development site. The Study should include: - quantitative appraisal of the potential flood risk to the development; - quantitative appraisal of the potential impact of development site on flood risk elsewhere; - quantitative demonstration of the effectiveness of any proposed mitigation measures.

3. Local Planning Policy

3.1 Updated Strategic Flood Risk Assessment (SFRA) for Arun District Council

This work was commissioned to update the Strategic Flood Risk Assessment for the District outside of the National Park. This was necessary to support decisions around Main Modifications to the Arun Local Plan 2011-2031 during the period of suspension during the examination process. The SFRA Level 1 published in August 2016 and also a hybrid report incorporating Levels 1 & 2. The hybrid report sets out the current situation regarding flooding from differing sources across the District, supported by Appendices A - I, followed by a broad assessment of strategic sites/locations being considered by the Local Plan with more detailed assessments of the flood risk for each, contained in Appendix J, which the Bognor enterprise zone is included from pages 25 – 34.

3.2 General Summary of SFRA Recommendations

3.2.1 Site allocations

It is recommended that the outputs from this study are used as an evidence base for the allocation of potential development areas, directing new development to areas of lowest risk. The Council should use the information provided within this SFRA to apply the Sequential Test to their potential site allocations.

The Level 2 detailed site summary tables provided in Appendix A should be used by the Council to apply the Exception Test. In order to pass the Exception Test, a number of criteria will need to be met:

- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk;
- It must be demonstrated that the development will be safe, without increasing flood risk elsewhere, and where possible, reduce flood risk overall;
- These tables also provide information and guidance for developers at the detailed flood risk assessment and planning application stage.

3.3 Policy

3.3.1 Future development

The Council should consult the Environment Agency's 'Flood Risk Standing Advice (FRSA) for Local Planning Authorities', published in March 2014, when reviewing planning applications for proposed developments at risk of flooding. Planning permission for development affecting watercourses should normally only be granted where

- the natural watercourse system which provides drainage of land is not adversely affected;
- a minimum 8m width access strip is provided adjacent to the top of both banks of any Main River (5m for Ordinary Watercourses) for maintenance purposes and is appropriately landscaped for open space and biodiversity benefits;
- it would not result in the loss of open water features through draining, culverting or enclosure by other means and culverts are opened up where ever possible;
- surface water drainage is delivered by SuDS;

- betterment in the surface water runoff regime is achieved; with any residual risk of flooding, from drainage features either on or off site not placing people and property at unacceptable risk; and
- the application is compliant with the conditions set out by the Lead Local Flood Authority (LLFA).

At the planning application stage, developers need to undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood extent, inform development zoning within the site and prove, if required, whether the Sequential and Exception Tests can be satisfied. The assessment should also identify the risk of existing flooding to adjacent land and properties to establish whether there is a requirement to secure land to implement strategic flood risk management measures to alleviate existing and future flood risk.

3.3.2 Surface water management

Planners should be aware of the conditions set by the LLFA for surface water management so that development proposals and applications are compliant with the Council's policy. These policies should also be incorporated into the Local Plan.

3.3.3 Infrastructure and Access

Safe access and egress will need to be demonstrated at development sites. Consideration of alternative access and egress routes should be made in the event that primary routes are inundated with flood water. Resilience measures will be required if buildings are situated in the flood risk area, and opportunities to enhance green infrastructure and reduce flood risk by making space for water should be sought.

3.3.4 Green Infrastructure and WFD

Opportunities to enhance green infrastructure and reduce flood risk by making space for water should be sought. In addition, opportunities where it may be possible to improve the WFD status of watercourses, for example by opening up culverts, weir removal, and river restoration, should be considered. Green infrastructure should be considered within the mitigation measures for surface water runoff from development.

3.3.5 Strategic solutions

The information provided in the SFRA should be used as a base for investigating potential strategic flood risk solutions within Arun District. Opportunities to incorporate strategic flood risk solutions, such as storage areas, defences, land raising and attenuation ponds should be investigated as part of potential development proposals.

3.3.6 Assessing Flood Risk and Developments

- The NPPF supports a risk-based and sequential approach to development and flood risk in England, so that development is located in the lowest flood risk areas where possible; it is recommended that this approach is adopted for all future developments within the district;

- A site-specific FRA is required for all developments which are located in the Environment Agency's Flood Zones 2 and 3, or developments greater than 1ha in size in Flood Zone 1. They are also required for developments less than 1ha in Flood Zone 1 where there is a change in use to a more vulnerable development where they could be affected by sources of flooding other than rivers and the sea (e.g. surface water drains, reservoirs). All developments located in areas of Flood Zone 1 highlighted as having critical drainage problems must also be accompanied by an FRA. The FRA should be proportionate to the degree of flood risk, as well as the scale, nature and location of the development;
- It is recommended that the impact of climate change to a proposed site is considered in FRAs and that the percentage increases which relate to the proposed lifetime of the development and the vulnerability classification of the development is identified and taken into account. The Environment Agency and LLFA should be consulted to confirm a suitable approach to climate change in light of the latest guidance;
- Opportunities to reduce flood risk to wider communities could be sought through the regeneration of Brownfield sites, through reductions in the amount of surface water runoff generated on a site;
- Arun District Council, the Environment Agency and LLFA should be consulted to confirm the level of assessment required and to provide any information on any known local issues;
- When assessing sites not identified in the Local Plan (windfall sites), developers should use evidence provided in this SFRA to apply the Sequential Test as well as provide evidence to show that they have adequately considered other reasonably available sites.

3.3.7 Promotion of SuDS

Planners should be aware of the conditions set by the LLFA for surface water management so that development proposals and applications are compliant with the Council's policy. These policies should also be incorporated into the Local Plan.

- A detailed site-specific assessment of SuDS would be needed to incorporate SuDS successfully into the development proposals. New or re-development should adopt source control SuDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff.
- For proposed developments, it is imperative that a site-specific infiltration test is conducted early on as part of the design of the development, to confirm whether the water table is low enough to allow for SuDS techniques that are designed to encourage infiltration;
- 2016s3756 - Arun District Council Level 1 and Level 2 SFRA - Final Report (v5 November 2016).docx 115;
- Where sites lie within or close to Groundwater Source Protection Zones or aquifers, there may be a requirement for a form of pre-treatment prior to infiltration. Further guidance can be found in the CIRIA SuDS manual on the level of water quality treatment required for drainage via infiltration. Further restrictions may still be applicable and guidance should be sought from the LLFA;
- Developers need to ensure that new development does not increase the surface water runoff rate from the site and should therefore contact the LLFA and other key stakeholders at an early stage to ensure surface water management is undertaken and that SuDS are promoted and implemented, designed to overcome site-specific constraints;

- In coastal areas consideration should be given to increased volumes of discharge from new development particularly in areas where discharges are affected by tide levels. The effect of changes to mean sea level as a consequence of climate change must also be taken into account;
- Arun District Council will need to consider drainage schemes for major applications, but it is advised developers utilise the LLFA's Policies and Guidance to develop their drainage scheme for minor applications.

3.3.8 Use of SFRA data and future updates

It is important to recognise that the SFRA has been developed using the best available information at the time of preparation. This relates both to the current risk of flooding from rivers, and the potential impacts of future climate change.

The Environment Agency regularly reviews their flood risk mapping, and it is important that they are approached to determine whether updated information is available prior to commencing a detailed Flood Risk Assessment.

The SFRA should be periodically updated when new information on flood risk, flood warning or new planning guidance or legislation becomes available. New information on flood risk may be provided by Arun District Council, the Highways Authority, West Sussex County Council, Southern Water and the Environment Agency. It is recommended that the SFRA is reviewed internally on an annual basis, allowing a cycle of review, by checking with the above bodies for any new information to allow a periodic update.

3.3.9 Note on the Environment Agency Flood Map for Planning

Where outlines are not informed by detailed hydraulic modelling, the Flood Map for Planning is based on generalised modelling to provide an indication of flood risk. Whilst the generalised modelling is generally accurate on a large scale, they are not provided for specific sites or for land where the catchment of the watercourse falls below 3km². For this reason, the Flood Map for Planning may not be of an appropriate resolution to be used as application evidence, where details are material with respect to possible flooding for individual properties or sites and for any sites with watercourses on, or adjacent to the site. Accordingly, for site specific assessments it may be necessary to perform more detailed studies in circumstances where flood risk is an issue.

3.3.10 Implications of potential future development

It is noted in the SFRA that developers should ensure that third party property and land are not adversely affected by future development, both in terms of flood risk and other environmental factors (e.g. water quality and ecology). Future development at this site may have potential to influence the following receptors:

- Property and land located in the adjacent areas of Shripney, South Bersted
- Industrial Estate and Felpham;
- The Lidsey Rife, Shripney Manor Ditch and ordinary watercourses flowing
- through the site boundary;
- Settlements downstream of these watercourses, such as North Bersted, Felpham and Bognor Regis.

3.4 Sequential and Exception Test

3.4.1 Sequential Test (General)

The NPPF requires a Sequential Approach to ensure preference is given to land within Flood Zone 1 prior to Flood Zones 2 and 3. It also ensures that flood vulnerability of the development proposals is taken into consideration when locating development in Flood Zones 2 and 3.

3.4.2 Sequential Test (Specific to the Bognor Enterprise Zone)

The Arun Local Plan (2011 – 2031) Sequential & Exception Tests October 2014 paper, sets out the approach that has been taken to ensure that the Local Plan has been prepared taking account of flood risk, now and in the future. This paper has helped to inform the Sustainability Appraisal for the Local Plan.

On the basis of this sequential test, due to the flood risk (and therefore vulnerability) alone, some sites would be suitable for locating both housing and employment uses, as they satisfy this test. Others would only be suitable for employment and/or would require an exception test to be satisfied. The split as to which use would be appropriate at this stage. The Saltbox site is deemed to be acceptable in terms of employment development, and not for housing.

Due to the number of locations affected by flood risks, some clear exceptions should be taken forward for an exception test to see if these residual risks can be lowered or dealt with adequately.

This site is about 12 hectares in size. It is located on the northern edge of Bognor Regis, opposite Oldlands Farm, to the west of the A29. It has Rowan Park Caravan Park on its southern boundary and Shripney village built up area to the north with open fields to the west. Currently it is used for horticulture.

In terms of tidal flooding, apart from an oval pool in the middle of the site, it falls within either Flood Zone 2 or 3. In terms of fluvial flooding, the whole of the site is outside both of the higher flood risk zones and there have been no recorded incidents of flooding. The exact amounts are laid out within Appendix 3. There have been no actual events recorded. The application of the 50-year County level climate change scenario shows that the whole site would then fall within the highest risk Flood Zone extents.

In summary table 2 of the The Arun Local Plan (2011 – 2031) Sequential & Exception Tests October 2014 paper states that the saltbox site is suitable for employment, not housing and the exception test should be completed.

3.4.3 Exception Test (General)

The Exception test is a method to demonstrate and help ensure that the flood risk will be managed satisfactorily, while allowing necessary development to go ahead in situations where suitable sites with lower flood risks are not available. For the Exception Test to be passed, the following must be demonstrated:

- The development provides sustainability benefits to the community that outweigh the flood risk, informed by the SFRA if applicable;

The development should be on developable, previously developed land or, if not, then there are no other reasonable alternative sites on developable or previously developed land; and

A FRA must establish that the development will be safe, without increasing the flood risk on site or elsewhere, and where possible will reduce the overall flood risk.

As stated above the NPPF paragraph 104 states that “For individual developments on sites allocated in development plans through the Sequential Test, applicants need not apply the Sequential Test. Applications for minor development and changes of use should not be subject to the Sequential or Exception Tests but should still meet the requirements for site-specific flood risk assessments.”²

The advice regarding flooding matters in the NPPF is supplemented by additional guidance in the National Planning Policy Guidance (NPPG). Table 3 sets out the Flood Risk Vulnerability and Flood Zone “Compatibility”. Outdoor sports and recreation is defined within the Water-Compatible Development classification and car parking is defined as Less Vulnerable Development. According to Table 3 such use classifications are acceptable within a Flood Zone 2 and 3 provided that the Sequential Test is passed. (There is no requirement to pass the Exception Test).

The normal approach for a Sequential Test is to demonstrate that there are no sequentially preferable “reasonably available” sites at a lower flood risk (i.e. in flood Zone 1 or 2) within a defined area. Such an approach is feasible when there are realistic available options to site a new development in alternative locations. However, such options clearly do not exist for this scheme (which is seeking to enhance an existing operation which does not have any alternative business premises).

Paragraph 033 of the NPPG provides advice on how the Sequential Test should be reasonably applied. It states that “When applying the Sequential Test, a pragmatic approach on the availability of alternatives should be taken. For example, in considering planning applications for extensions to existing business premises it might be impractical to suggest that there are more suitable alternative locations for that development elsewhere.”³

² National Planning Policy Framework, Planning Practice Guidance website:

http://planningguidance.communities.gov.uk/blog/policy/achieving-sustainable-development/delivering-sustainable-development/10-meeting-the-challenge-of-climate-change-flooding-and-coastal-change/#paragraph_104

³ National Planning Policy Framework, Planning Practice Guidance website:

http://planningguidance.communities.gov.uk/blog/guidance/flood-risk-and-coastal-change/applying-the-sequential-test-to-individual-planning-applications/#paragraph_033

3.4.4 Exception Test (Specific to the Bognor Enterprise Zone)

Would development make a positive contribution towards the sustainable development objectives outlined in the draft Local Plan (the Sustainability Objectives)?

a) To achieve successful and inclusive communities – YES

Development of the sites will have to make a substantial contribution to the regeneration agenda for Bognor Regis which is a key priority of the Council. Furthermore, development of the sites will increase linkages between business and education as well as increased employment opportunities for residents, which helps to ensure a vibrant and mixed population

b) To ensure Arun delivers high quality housing and provides excellent social infrastructure - YES

Development of the sites will ensure that there is increased access to employment opportunities as well as to improve educational attainments and skills within the population. In addition, there is also the potential for benefits for the community and to increase the provision of open space as an important factor of the development, as well as sustainable means of movement.

c) Ensure a Diverse and Thriving Economic Base to support Arun's growth – YES

Development of these sites will be critical in terms of ensuring the overall regeneration of Bognor Regis, as well as improving access to employment opportunities and improving both educational attainment and skills through links between business and employers. Critically, development of these sites will allow for differing provision in terms of type, space and size of businesses. All of the above are required to ensure that there is inward investment to the area and its economic performance increases.

d) To improve the vibrancy of Arun's town centres – YES

Due to the positioning of the majority of the sites, improved access into Bognor Regis town centre and also increased numbers of workers will mean that there will be a positive impact on encouraging businesses and shops into the town centre. Furthermore, due to an expected increase in wages associated with office workers there can often be an increase in the variety of shops. As well as the impact on Bognor Regis employment sited at the edge of Angmering will help to improve the vibrancy of the local centre through the retention of people within the village, as well as attracting more into the centre.

e) To ensure efficient and sustainable movement within and beyond Arun – YES

Development of the sites, but especially on the eastern side will allow for substantial improvements to the efficient and sustainable movement in and beyond the District, as it is intended that contributions will allow for delivery of a connection from the new relief road to Bognor Regis town centre. It would also be intended that on site there would be substantial improvements to sustainable modes of transport through increased provision of cycle and pedestrian routes and accesses

f) To enhance Arun's environmental integrity – YES

As the buildings and design of the development will require high environmental standards to be met there will be a positive impact on the distinctive character of the area and through the intended Country Park as part of the development a positive contribution to biodiversity and wildlife. In addition, development will also ensure that, through the intended use of SUDS and positioning of buildings away from the rife, water quality will be maintained and potentially improved. Furthermore, the use of SUDS

and high environmental standards will ensure there is a positive impact on flooding over and through the sites. Finally, development will also allow for the remediation of any contaminated land to be dealt with.

g) To maximise natural resource efficiency – YES

Development of the sites due to the high environmental standards that will be required will minimise the amount of waste produced and water used, as well as the incorporation of SUDS and flood measures that fit with the existing function of the location, plus the need to ensure that there is a connection to an adequate sewerage supply will ensure that there is a positive contribution towards issues that are pertinent to drainage and sewerage in the area, as well as that there will be no additional pressures on resources. As mentioned in the previous section there would also be a positive impact on land condition through the need for development to deal with and include remediation strategies for contaminated land.

Are the sites on land that is developable or where there are no reasonably available alternatives on brownfield land? – YES

Land on the former LEC site is considered to be brownfield. Also, due to the fact that Rowan Park is currently used as a touring caravan site, it may be considered the reuse of an existing site rather than a complete greenfield site. There is a clear intention from landowners working through negotiation with the Council for the sites to be developed.

3.4.5 Additional Flood Risk Information The Arun Local Plan (2011 – 2031) Sequential & Exception Tests October 2014 paper

Source/Pathway: The site is centrally located between Lidsey Rife to the east and Aldingbourne Rife to the west which runs in proximity to the south-western boundary of the site.

Level of flood Risk: Due to location of the Aldingbourne Rife the tidal flood zone extent comes from the west and south-western edges extending across along the south west and north-east boundaries of the site, meaning that these are within flood zone 3. Although the site is protected by the defences in front of the Butlins complex, it is still at risk from any breach of these that may occur. The associated hazards of this (high velocities and/or depths) will need more consideration in any site FRAs.

Vulnerability (as Table 2 in Technical Guidance to NPPF): See Table 2 of Sequential Test.

Off-site strategic measures: Ensure continued maintenance of the defences in front of Butlins. Consideration of work to investigate heightening them to reduce the risk associated with breaching occurring, accounting for climate change projections.

Additionally, some regard of minor alteration to road embankment on eastern side as a future soft landscaping solution.

On-site strategic: Incorporation of SUDS, particularly swales to try and create a slower rate of flow into any attenuation ponds or other storage solutions (basins).

On-site measures: Inclusion of green roofing in whole or part of buildings, particularly if hotel included, permeable paving, landscaping along the northern boundary along with a small basin and oversized pipes under the areas of permeable paving.

Adjacent off-site: Sealed sewerage system at closest point for connection with adequate capacity required.

Analysis of flood risk relating to potential sites;

- B2/ B8 units - Less vulnerable.
- Offices - Less vulnerable.
- Hotel – More.

3.4.6 Arun Strategic Surface Water Management Study Stage 2 Report August 2016

Enterprise Bognor Regis is a site designated for industrial units and is within both tidal and fluvial flood zones 2 and 3. Due to the high percentage of impermeable area and the industrial use of the site, storage at source and pollution control is particularly important for the surface water management.

Green roofs are recommended across the site to capture the first occurrence of rainfall. Lined permeable paving is also recommended to both capture, store and convey surface water flow. Additional storage could be provided in the form of rain gardens or swales throughout the site. Downpipes from the green roofs could connect directly into the swales, instead of using deep pipework.

Due to the large amount of hardstanding and industrial use of the site, there is a risk of pollution to surface water, typically from oil spills from vehicles. The site will require pollution prevention measures under the Environment Agency's Pollution Prevention Guidelines (PPG3). Oil interceptors are often used for removing oil from surface water; however, the SuDS measures recommended can provide this function without the need for underground tanks. The granular subbase of the permeable paving acts to filter oil from surface water. Additionally, a geotextile membrane designed to remove hydrocarbons can be installed within the subbase of the paving. Tree pits could also be incorporated to provide surface water treatment through filtration and phytoremediation.

3.4.7 Record of meeting/discussion 11/05/16 (Section 1.2 relating to the meeting minutes Bognor Enterprise Zone);

- Area highlighted on plan as a potential surface water management area is already a flood compensation area. Various issues due to water not draining – assume this is resolved for the purposes of this study;
- Potential to increase area;
- Standing water issues with flood tunnels and adjacent service road adjacent to the Oldlands Farm site need to be resolved;
- Tesco's car park is designed to flood regularly;
- Proposed impermeable area less than previously suggested. Potential for more natural SuDS features;
- Potential to utilise excavated material from flood compensation areas;

- To raise land (out of floodplain) on Enterprise site. Alternatively raise units above flood level, or design to allow flooding.
- Culverts under railway line – may need additional culverts for drainage;
- Network Rail to be involved’;
- The Brooks - confirm ownership and look to extend beyond the Arun district boundary;
- A29 realignment could potentially affect site;
- ADC to confirm the Bognor golf course development proposals;
- Potential SuDS opportunities;
- Aldingbourne Rife project currently undertaken by EA has additional information on reducing flood risk within the area;
- Close public consultation will be required with Shripney Village.

Note, not all of the items listed above relate specifically to the Saltbox application.

3.4.8 Implications of the Environment Agency’s FCERM programme

There are several FCERM schemes that cover different parts of Arun District. It is recommended that the outcomes and actions from these schemes are considered in the development proposals for this site. The FCERM schemes relevant to the Bognor Enterprise Zone as a whole include:

- Lidsey Surface Water Management Plan (SWMP) and Actions – the scheme was managed by West Sussex County Council, and the SWMP was published in October 2014 to help understand the flood risk from local sources and establish a long-term action plan for surface water management;
- Aldingbourne Rife Integrated Flood Risk Management Project – the project is investigating approaches in which flood risk from combined sources can be managed within the Aldingbourne Rife catchment. The project is managed by the Environment Agency;
- Arun Partnership Watercourse Management – extensive capitalised improvement work is planned in order to improve the condition of the assets throughout the District and contribute to recommendations of the local strategies currently being prepared. This scheme is managed by Arun District Council and is expected to commence between 2016 and 2018.

3.4.9 Key Policies

There are a number of regional and local key policies which have been considered with the SFRA (refer to sections 2 and 5.5). The regional policies include the Beachy Head to Selsey Bill SMP (2006), Adur CFMP (2009) and Arun and Western Streams CFMP (2009) and the South-East River Basin District FRMP (March 2016), whilst local policies include three flood and erosion risk management strategies applicable to the Arun District coastline.

Further details can be found within Section 15.1.2 of the SRFA.

4. Scope of Flood Risk Assessment

4.1 General

The detail and complexity of a Flood Risk Assessment should reflect the level of risk to the site. The NPPF lists the general requirements of a Flood Risk Assessment and provides that Flood Risk Assessments should:

- be proportionate to the risk and appropriate to the scale, nature, and location of the site;
- consider the risk of flooding arising from development in addition to the risk of flooding to the site;
- take the impacts of climate change into account;
- consider both the potential adverse and beneficial effects of flood risk management infrastructure including raised defences, flow channels, flood storage areas and other artificial features together with the consequences of their failure;
- consider the vulnerability of those that could occupy and use the site, taking account of the Sequential and Exception Tests and the vulnerability, including arrangements for safe access;
- consider and quantify the different types of flooding (whether from natural and human sources and including joint and cumulative effects) and identify flood risk reduction measures, so that assessments are fit for the purpose of the decisions being made;
- consider the effects of a range of flooding events including extreme events on people, property, the natural and historic environment and river and coastal processes;
- include the assessment of the remaining (known as 'residual') after risk reduction measures have been considered and demonstrate that this is acceptable for the particular development or land use;
- consider how the ability of water to soak into the ground may change with development, along with how the proposed layout of development may affect drainage systems; and
- be supported by appropriate data and information, including historical information on previous events.

4.2 Sources of Flooding

Based on the CIRIA Report 624, Table A2, and as shown above, the following potential sources of flooding could be considered to apply to the site:

- Fluvial – Flooding as a result of rising water levels in nearby river;
- Overland Flow – Flooding as a result of overland surface water run-off from higher ground; and
- Infrastructure Failure – Flooding as a result of failure of infrastructure designated to store or carry water or pipe blockage

4.3 Site Overview

Flood risk at the site is generally low from rivers, the sea and intense rainfall (surface water flooding) in the western parcel of the site.

Groundwater flooding may also be likely, with the available datasets showing the entire site to be located within a 1km grid square where between 25-50% of the 1km² area may be susceptible to

groundwater flooding. Note: information on the exact location, frequency and magnitude of this flooding is unclear.

A small proportion of the Saltbox site is located in Flood Zone 3a, meaning that it has greater than 1% and 0.5% annual probability of flooding from the Rivers and Sea respectively. Much of the land in Flood Zone 3a is located across western-most boundary of the Saltbox parcel of the site.

However, there are defences that are influential at protecting the Saltbox site from flooding. Therefore, the actual flood risk to the site may differ from that represented by the Flood Zone information.

5. Flood Risk Assessment

5.1 General Requirements for the Site-Specific Flood Risk Assessment

- The peak flows of the Lidsey Rife and the Shripney Manor Ditch, and potential flooding of the site, should be considered when designing site drainage and attenuation;
- Assessment of runoff should include allowances for climate change effects, and discharge rates from the site should not increase downstream;
- Safe access and egress would need to be demonstrated. This should include consideration of the effects of climate change to ensure that access and egress remains safe throughout the lifetime of the development;
- New development should seek opportunities to reduce the overall level of flood risk at the site and in surrounding areas. This may include:
 - reducing volume rate and runoff;
 - relocating development to zones with lower flood risk, and
 - creating space (where possible) for flooding
- Consultation with the Local Authority and the Environment Agency should be undertaken at an early stage.

5.2 Actual Flood Risk (Overview)

A raised wall and embankment is located at Bognor Regis Promenade (located between Gloucester Road to the west, Sea Road to the east, and to the south of Felpham Pumping station) which provides protection against ingress of coastal flood water. Whilst Flood Zones (representing an undefended case) show flooding in Flood Zone 3a (0.5% AEP tidal event), the site and the surrounding area has a less than a 0.5% annual probability of tidal flooding when defences are considered.

Actual fluvial flood risk is present from the Aldingbourne Rife, Lidsey Rife and Shripney Manor Ditch. Flood Risk from ordinary watercourses is not captured by this flood risk information and should be considered as development proposals are taken forward. The actual fluvial flood risk is shown in as figure 1 of this report.

Proposed infrastructure in locations of actual risk should be implemented along with appropriate measures so that development is safe from fluvial flood risk. A commitment must be made to the long-term management and maintenance of such measures and to any additional requirements to address the residual risk that may be attached. The commitment required to long term contributions to the tidal defences should also be included when developing development details.

The maps provided within appendix J of the SRFA (Page 34) display the predicted depth, velocity and hazard rating of flood water at the site in the Flood Zone 3a event. These provide an indication of the level of hazard from fluvial flooding.

Flood depths and velocities are typically predicted to be up to 0.50m and 0.20m/s, respectively where flooding is predicted on the site.

Given the relatively short length of the Shripney Manor Ditch flowing along the site's western boundary, the timing of the rise and fall in flood levels associated with a flood event will be fairly consistent for the western parcel of the site. However, since it contributes to the Aldingbourne Rife that subsequently discharges to the Lidsey Rife, consideration should be given to the potential effects of reduced discharges during high tide events.

The Lidsey Rife at this location is a larger watercourse compared with Shripney Manor Ditch with a greater contributing catchment (including Barnham Rife for instance). Therefore, the timing of the rise and fall in flood levels associated with a flood event may be more variable for the eastern parcel of the site.

It has been noted in the SFRA that there may be longer duration of flooding, but also potential for double peaked events if rainfall over the Lidsey Rife and Barnham Rife catchments varies. Ground levels are relatively flat, with relatively wide and extensive flooding predicted, suggesting flood water may be resident on floodplain for some time (e.g. several days) before it is able to drain away.

Any groundwater flooding will typically last for longer durations than fluvial and surface water flooding, often for periods of days/weeks.

5.3 Flood Zones (General)

The map shown in figure 1 of this report displays the location of Flood Zones at the site.

There is a band of Flood Zone 3a, much of which is located across western-most boundary of the site. Although smaller proportions of Flood Zone 3b and 2 are predicted in both parcels of land, a significant proportion of the western parcel of the site is located in Flood Zone 1; the lowest flood risk zone. Ordinary watercourses may also present a flood risk that is not captured in the Flood Zone information.

The Shripney Manor Ditch runs along the majority of the western boundary, and can be seen on page 11 of the part 1 of Appendix B to the SFRA update.

5.4 Fluvial Flooding

Three Main Rivers are located in the vicinity of the site (refer to figures in Appendix D), these are:

- Aldingbourne Rife, 200m to the west;
- Lidsey Rife, 600m to the east;
- Shripney Manor Ditch which forms the boundary to the north and most of the west of the site, before flowing (north east to south west) into the Aldingbourne Rife.

The Site drains to the Shripney Manor Ditch and the Aldingbourne Rife. The Site is located within the Arun Internal Drainage District (IDB), which is managed by the Environment Agency as the Internal Drainage Board (IDB). There are a number of ordinary watercourses located in and within the vicinity of the site managed by the Arun IDB, these include the following:

- Oldlands Farm Ditch;
- Bersted Brooks to the west of the Rowan Caravan Park that flows southwards and then beneath Rowan Way to join a drainage channel that runs westwards along the southern side of Rowan Way (refer to figure in Appendix D);

- Several unnamed drainage ditches on the western boundary of the site that flow into the Aldingbourne Rife.

The Environment Agency's detailed flood mapping (refer to Appendix D) shows that the Site is located within Flood Zone 2 and 3. This mapping shows the flood risk without the presence of flood defences (i.e. the tidal flood risk).

To establish the risk from fluvial flooding, modelled flood levels have been obtained from the Environment Agency. The modelled flood level for the 0.1% (1 in 1000 year) annual probability fluvial flood event is 1.67m AOD for the Site. This indicates that the majority of the site is not affected by this event. No further information is available for more frequent fluvial flood events from the Environment Agency's modelling.

The land adjacent to the Shripney Manor Ditch is predominantly soft landscaped, and it is intended that proposed site levels for the buildings and external areas are to be situated away from this zone and designed to be higher than these levels by a minimum of 600mm and or a minimum of 150mm above the existing site levels. Refer to Section 5.2 of this report for more details regarding the Lidsey Rife which is located CIRCA 600m east of the development site.

The risk of flooding from fluvial sources to the developed area of the Site is considered to be low for the majority of the site and moderate for a small area as part of the Proposed Development is located within Flood Zone 2 and 3, however the risk to the majority of the site from fluvial flooding is less than 1% (1 in 100 year) annual probability.

The Proposed Development will not impact on the floodplain as there will be no development in areas of the site subject to fluvial flood risk. The Proposed Development will have no impact on flood risk from this source on neighbouring property.

5.5 Pluvial and Overland Flow

Climate change is predicted to increase rainfall intensity in the future by up to 40%, 53 under the new range of allowances published by the Environment Agency. This will increase the likelihood and frequency of surface water flooding, particularly in impermeable urban areas, and areas that are already susceptible. Changes to predicted rainfall should be incorporated into flood risk assessments and drainage and surface water attenuation schemes associated with developments.

The Environment Agency's Flood Map for Surface Water (refer to Appendix D) shows that the site is mostly at very low risk of surface water flooding less than 0.1% (1 in 1000 year) chance in any given year. However, there are some small isolated areas of low risk (less than 1 in 100 (1%) but greater than or equal to 1 in 1000 (0.1%) chance in any given year).

The site is located outside of the smaller event magnitudes tested as part of the uFMfSW extent.

The risk of pluvial or overland flooding to the Application Site is considered to be low to negligible.

By developing the site, there is a risk of pluvial/overland flows from the Proposed Development increasing. The risk of flooding to and arising from the Proposed Development, regarding

pluvial/overland flow, is moderate as overland flow will be managed through SuDS and flow routes to less vulnerable areas such as soft landscaped areas and car parks and the proposed surface water management and drainage strategy for the site will be designed as to manage surface water flows from the development Site.

5.5 Coastal flood risk

5.5.1 General Bognor Enterprise Zone

In coastal locations, the risk of flooding is linked to the stability of the coastline. If the coast is eroding, then the potential effect is that tidal flood defences near to the sea will be lost and flood risk will increase. To maintain an appropriate standard of safety from flooding it is sometimes necessary to implement works to slow down or stop the rate of coastal erosion and so maintain the integrity of the tidal defences. The Shoreline Management Plan 37 describes the arrangements and strategy for managing coastal erosion and the influential measures.

More detailed strategies have been developed to address coastal erosion and flood risk, describing the approach to meeting the outcomes of the SMP, and these are described in the following documents:

- Rivers Arun to Adur flood and erosion management strategy (2010)³⁸;
- River Arun to Pagham flood and coastal erosion risk management strategy (2015)³⁹;
- Pagham to East Head coastal defence strategy (2009)⁴⁰.

Historic flooding information held by the Environment Agency does not report historic coastal flooding events within Arun District, but it should be noted that this dataset cannot be guaranteed to capture all events. Incidences of wave overtopping events are known to have occurred in the district, but it is unclear whether these resulted in flooding.

Climate change is predicted to influence the rate of sea level rise, in addition to offshore wind speed and extreme wave height. However, sea level rise will influence the tidal levels which propagate upstream along the tidal rivers in the district, thereby impacting flood risk. Guidance on required net sea level rise allowances (after adjustment for land movement changes) is presented within the updated guidance released by the Environment Agency. The adjustments to the allowances from previous guidance are less marked. However, the information presented within the Level 1 SFRA remains as per the previous guidance and it is expected that development applications use the updated guidance to inform their assessment of flood risk.

5.5.2 Defences

Preparation of the SFRA has included within Section 6.0, a high-level review of available information on formal flood defences and involved interrogation of existing evidence on asset condition and standards of protection. Details of the flood defence locations and condition were provided by the Environment Agency for the purpose of preparing this assessment, in addition to some supplementary explanation on asset performance. Defences are categorised as either raised flood defences (e.g. walls/embankments) or flood storage areas (FSAs). The assessment has considered man-made defences and not natural defences which may arise for instance due to the presence of naturally high ground adjacent to a settlement.

This site is not protected by any formal flood defences within the immediate vicinity of the site. However, coastal flood defences to the south at Felpham in Bognor Regis offer a standard of protection of approximately 1 in 200 years (0.5%) from tidal flooding. A foreshore and wave return wall forms the primary defence, with a concrete wall forming the secondary defence. These are fronted by a shingle beach which is controlled by timber and rock groynes.

The foreshore and wave return wall measures approximately 800m in length and the crest levels vary between 6.5m AOD and 5.64m AOD. The concrete secondary defence mirrors the primary defence in both length and crest level.

Environment Agency records show the foreshore and wave return wall to be in good condition, whilst the concrete wall is in both fair and poor condition along its length.

The Environment Agency's detailed flood mapping (refer to Appendix C) shows that a large part of the Site is located within Flood Zones 2 and 3. The Environment Agency's modelled flood level for the 0.5% (1 in 200 year) annual probability tidal event is 2.74m AOD.

This mapping shows the flood risk without the presence of flood defences. The tidal flood risk area in Bognor Regis which affects this site protected by coastal flood defences.

The coastal flood defences provide a standard of protection of 0.5% (1 in 200 year) annual probability. Therefore, the site is at a residual risk of flooding in the event that these tidal defences fail or are overtopped.

It is acknowledged that part of the Proposed Development is located in Flood Zone 2 and 3, however due to the presence of coastal flood defences the residual risk to the site from tidal flooding is less than 0.5% (1 in 200 year) annual probability. Also, the proposed development will be comprised of 'Less Vulnerable' Site uses appropriate to the Flood Zone.

The Proposed Development will have no impact on flood risk from this source on neighbouring property.

5.5.3 Additional Note

Appendix J of the SFRA includes site summaries for all the locations that were being considered for inclusion in the Main Modifications, including Bognor Enterprise. In particular, responding to a question from the new Inspector there is an additional bullet point that is being inserted into policy SP1 a Strategic Approach, specifically covering the need to take account of the coastal topography and incorporation of adaptations to deal with climate change particularly in high risk flood areas. This is MM5 in ADCED49 on the Local Plan Examination Page.

5.6 Flood history

The Environment Agency's historic flood map for the Bognor Enterprise Zone as a whole, shows that the northern part of the eastern parcel of land has flooded in the past. However, this area is outside the Saltbox application site. In addition, dataset does not necessarily capture all historic flooding and

further information provided by the Environment Agency confirms that the area also flooded during 2012.

5.7 Infrastructure Failure

Southern Water sewer records do not show any Southern Water infrastructure within the Application Site. Assets are located to the south of the site in Bognor Regis and to the north in Shripney.

No other records have been made available of sewer flooding at the Application Site.

The risk of flooding from sewers and drainage infrastructure at the Application Site is considered to be low.

Southern Water has not been consulted regarding capacity of their infrastructure to meet the increased demand for foul sewerage provision from the Proposed Development.

All surface water drainage will be routed to the nearby watercourses and therefore there will be no impact from the Proposed Development on the local public surface water sewer system.

The proposed loading on the foul sewer is not known, any infrastructure improvements needed to cope with increases in foul sewer loading due to the development of the site will be made as required.

The risk of flooding to and arising from the Proposed Development, regarding sewers, is low.

5.8 Artificial Sources

Flooding can occur because of infrastructure failure, for example breach and/or overtopping of retaining structures for raised bodies of water such as canals or reservoirs.

The site does not lie within the inundation area of any reservoirs. There are no raised sections of canal within 500m of the Application Site.

The risk of flooding from dam and canal infrastructure at the Application Site is considered to be negligible.

The site is not within a 500m search radius of any dams or canal infrastructure.

The risk of flooding to and arising from the Proposed Development, regarding artificial sources, is negligible.

5.9 Groundwater

AStGWF mapping indicates that the site is located within a 1km grid area where the susceptibility to groundwater flooding is $\geq 25\%$ but $< 50\%$.

The areas at risk of groundwater flooding are based on the Environment Agency's strategic-scale map which shows the Areas Susceptible to Groundwater Flooding (AStGWF) on a 1km square grid. The data shows the proportion of each 1km grid square, where geological and hydrogeological conditions indicate that groundwater might emerge and has been used to define areas at risk of groundwater flooding.

Chalk aquifers such as that which underlies the Application Site are more likely to cause groundwater flooding because of its geological formation. However, it notes that there are no historical records of groundwater flooding in Arun District.

Existing borehole records for the Application Site do not indicate groundwater near the surface.

The risk of groundwater flooding to the Application Site is low.

Basements or underground car parks are not proposed as part of the Proposed Development and foundations for the buildings will be of typical construction with piled foundations which may be terminated in chalk. It is considered unlikely there will be any laterally continuous barrier to ground water created by the Proposed Development.

The Proposed Development will not exacerbate the risk of groundwater flooding to the surrounding area.

5.10 Groundwater Source Protection Zone

The site is not located within any Environment Agency designated Source Protection Zone.

6. Residual Risks and Impacts

6.1 Residual Risks

Table 2 outlines the initial qualitative assessment of risk posed by the potential source of flooding, the mechanisms for flooding and the likely consequences. The tables also include potential mitigation measures to minimise the residual risk.

Categories of risk have been qualitatively defined as:

- 'High' Risk: flooding is likely to result in significant damage to property and pose a significant risk to life;
- 'Medium' Risk: flooding may result in possible minor damage to property but flood progress would allow adequate time for residents to be warned and safely evacuated to higher ground or appropriate places of safety;
- 'Low' Risk: flooding is unlikely to result in any damage to property damage and pose little or no risk to life.

6.2 Flood Probability

The SFRA and EA show that the development site areas are largely situated within Flood Zone 1 with small areas of the site situated within Flood Zone 2 and 3. The EA Flood data and levels show that the site would be affected from fluvial flooding. However, there is no development planned within these areas.

The SFRA and EA Flood information show that the 1 in 100-year climate change flood level is 1.330m AOD for the site. The proposed site levels will be designed to be above this.

6.3 Flood Impact

The Proposed Development will be comprised of 'Less Vulnerable' Site uses appropriate to the Flood Zone and will not impact on the floodplain as there will be no development in areas of the site subject to fluvial flood risk and due to the presence of coastal flood defences the residual risk to the site from tidal flooding is less than 0.5% (1 in 200 year) annual probability for areas of built development subject to tidal flooding.

The Proposed Development will have no impact on flood risk from this source on neighbouring property.

6.4 Impact of Displaced Water

Redevelopment of the site will not result in the displacement of floodwaters. The proposed development will be comprised of 'Less Vulnerable' and 'Water Compatible' site uses.

According to information published by the EA new development must provide level for level and volume for volume compensation as a replacement for volumes lost from the flood plain through development with new flood plain volume by reducing nearby ground levels. The compensatory volume must be at the same level (within reasonable working limits) as the lost storage. The proposals ensure that there is no loss in flood plain storage as a direct result of the development by not increasing levels within the

1 in 100-year climate change flood event. The proposed levels within the flood extents will be at or below that of the existing ground level, therefore providing an overall increase of the existing flood plain volume. In tidal areas, raising ground levels is unlikely to impact on maximum tidal levels so the provision of compensatory storage should not be necessary.

The proposed redevelopment will not have any significant impact on the volumes of storage available on site.

6.5 SRFA Residual Risks

It is worth noting, the SFRA (refer to section 6.6) does not assess the probability of failure other than noting that such events are very rare. However, in accordance with NPPF, all sources of flooding need to be considered. If a breach or overtopping event were to occur, then the consequences to people and property could be high. There is also advice within the SFRA that developers should be aware that any site that is at or below defence level may be subject to flooding if an event occurs that exceeds the design capacity of the defences, or the defences fail and this should be considered when building resilience into low level properties.

6.6 Impact of Fluvial Morphology

It is considered there will be no impact on the fluvial morphology as a result of this development.

Table 2: Qualitative Assessment of Residual Flood Risk

Flood Hazard	Flood Mechanism and Possible Consequence	Initial Assessment of Risk	Comments/Recommended Mitigation Measures	Residual Risk
Tidal		MODERATE	All built development is located in areas assessed as having less than 0.5% annual probability (equivalent to the 1 in 200 year) of tidal flooding. Safe and dry access to the Proposed Development is available from the A29 for all events up to the 0.5% annual probability (1 in 200 year) tidal and 0.1% annual probability (1 in 1,000 year) fluvial events. Despite this it is recommended that all buildings have finished floor levels set a minimum of 150mm above the existing ground levels, providing	

Flood Hazard	Flood Mechanism and Possible Consequence	Initial Assessment of Risk	Comments/Recommended Mitigation Measures	Residual Risk
			mitigation from localised flooding from extreme events.	
Fluvial Flooding	Site located within a Flood Zone 3 shown on the EA/SFRA maps, considered high risk of fluvial flooding. Site is affected by a 1 in 100-year flood level of 16.330m AOD including climate change.	MODERATE	All built development (i.e. residential dwellings, and onsite highways) are located in areas assessed as having less than 1% annual probability (equivalent to the 1 in 100 year) of river flooding. Safe and dry access to the Proposed Development is available from the A29 for all events up to the 0.5% annual probability (1 in 200 year) tidal and 0.1% annual probability (1 in 1,000 year) fluvial events. Despite this it is recommended that all buildings have finished floor levels set a minimum of 150mm above the existing ground levels, providing mitigation from localised flooding from extreme events.	LOW
Pluvial and Overland Flooding	Minor overland/ surface water flooding due to surface water ponding in low lying areas of the site	LOW	Overland flow to be managed through SuDS and flow routes to less vulnerable areas such as soft landscaped areas and car parks.	LOW
Infrastructure Failure	Minor flooding from culverted watercourse	LOW	The culverted watercourse situated west of the site is a maintained watercourse and the risk and likelihood of this blocking and flooding is fairly low.	LOW
Artificial Sources		LOW		LOW
Groundwater		LOW		LOW

6.7 Climate Change

The NPPF outlines the importance of Climate Change with respect to planning. The issues of Climate Change are discussed with impacts likely on sea levels, peak rainfall intensities, peak river flows, wind speeds and wave heights.

The national maps were updated in March 2017 taking into account the new Emsworth to Littlehampton model. The revised peak river flows are shown as table 3 below.

Table 3: Peak river flow allowances

River basin district	Allowance category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
South East	Upper end	25%	50%	105%
	Higher central	15%	30%	45%
	Central	10%	20%	35%

6.7 Climate Change SFRA

Hydraulic modelling was completed as part of the updated SFRA to provide updated climate change flood mapping in the Arun District for Flood Zone 3a. This modelling followed the latest guidance for climate change in FRAs/SFRAs released by the Environment Agency in February 2016 (and updated in April 2016).

Climate change for fluvial events was based on the Higher Central estimates for the years 2031, 2061 and 2111. Arun District is within the South-East River Basin District and therefore allowances were: 2031 = +15% flows, 2061 = +30% flows and 2111 = + 45% flows.

For tidal/coastal models, undefended case still water levels and defended case still water levels with wave overtopping simulations have been completed to inform future flood risk within the Arun District. Again, climate change allowance predictions are for the years 2031, 2061 and 2111, with present day outputs for comparison.

The site is likely to be affected by fluvial flooding and the additional climate change effects in terms of increases in peak river flows and rainfall intensities will therefore affect the site. These have been taken into account and the FRA demonstrates how these risks are to be managed so that the development is safe.

7. Drainage Strategy

7.1 General Design

The NPPF requires that flood risk to land and property is not increased as a result of development.

Changes in the volume and rate of surface water runoff from the development as a result of increases in impermeable land uses could increase the risk of flooding downstream unless sufficient steps are taken within the Proposed Development to prevent this happening.

A fundamental principle of sustainable development in terms of flood defence is the reduction of surface water run-off from new developments. It is best practice that the surface water drainage arrangements should be such that the volumes and peak discharge rates of surface water leaving a development site are no greater than the rates prior to the Proposed Development, and where possible are returned to those associated with the greenfield conditions of the site. Any increase in run-off (rates and/or volumes) above the pre-development (or greenfield) volumes must be attenuated on site.

The drainage network is to be designed as a gravity system to accommodate run off from a:

- 1 in 2 year storm event with no surcharge,
- The network is to be checked for a 1 in 30-year storm event with surcharge permitted but with no surface flooding,
- The network is to be checked for a 1 in 100-year storm event with surface flooding permitted providing that there is no risk of flooding to buildings and there is no off site overland flow.

7.2 Existing Site Drainage Regime

The site is classified as a Greenfield development, with a gross area of approximately 12 ha. The site is not currently served by an existing sewer system; therefore, it is assumed that the site drains via infiltration and overland flows towards watercourses on the boundaries of the site.

As the Proposed Development area is less than 50ha, the Institute of Hydrology (IoH) Report 124

Flood Estimation for Small Catchments (1994) method has been used to estimate the Greenfield site peak flow rate, which is an approved methodology specified within the Environment Agency's Rainfall Runoff Management for Developments Report4.

Table 4 summarises the Greenfield discharge rates for 1 ha of developable area and the estimated discharge rates for the current site. Full calculations are provided in the drainage calculation pack in Appendix.

Table 4 – Greenfield Runoff Rates

Annual Rainfall Event	Greenfield Runoff Rates (litres/sec/ha)	Development Runoff Rates (litres/ sec)
Qbar	2.90	34.20

1 in 1 year	2.40	28.30
1 in 30 year	6.50	76.70
1 in 100 year	9.10	107.40

7.3 Proposed Drainage Strategy

For the purposes of this Planning Application the site has been split into two phases. Phase 1 is seeking full planning permission with an area of 6.492ha and Phase 2 is seeking only outline permission with a total area of 5.512ha.

The Proposed Development will result in a net increase of impermeable area at the Application site. Of the total site area, an area of 8.3 ha will be developed. It has been assumed that the Percentage Impervious (PIMP) factor at the site will be 80% of the developed area. Therefore, it has been assumed for this drainage strategy that the Proposed Development will have a total impermeable area of 6.65ha.

It is proposed that the development will discharge to the watercourse flowing along the Western boundary of the site; Bersted Brooks (Ordinary Watercourse). In order to comply with the guidance for providing long-term storage as outlined in the Environment Agency's Rainfall Runoff Management for Developments, the proposed discharge rate from the Site has been restricted to 2 l/s/ha.

Table 5 – Proposed Peak Surface Water Discharge Flow Rates

Annual Rainfall Event	Proposed Flow Rates (litres/ sec)	Proposed Betterment (%)
1 in 1 year	23.60	17%
1 in 30 year	23.60	70%
1 in 100 year	23.60	78%
1 in 100 year +45% C/C	23.60	N/A

Due to the requirement to provide a betterment on the existing surface water discharge rates post development for all storm events up to and including the 100-year return period +45% allowance for climate change, the surface water will be restricted via flow control devices and attenuated with a total required storage volume of approximately 7,650m³. There is potential scope for the storage volume to be rationalised at a later stage following detailed design and further hydraulic modelling.

It is proposed that onsite attenuation will be provided by a series of attenuation basins and permeable pavements. The site control structures will be located primarily in the topographical low points of each catchment. These will be in the form of retention/detention basins.

These structures will be designed to attenuate flow prior to discharge to the ordinary watercourse via a control structure to achieve the maximum allowable peak discharge rates for the 1 in 1 the 1 in 30 and 1 in 100-year events (plus a 45% allowance for climate change). The location of the

retention/detention basin will be within an area designated as public open space. It will provide significant ecological and amenity benefit for the residents.

The site has been split into three catchment areas each with individual outfalls to the watercourse. The proposed surface water discharge rates and attenuation requirements are further broken down in Table 6 below:

Table 6 – Proposed Peak Surface Water Discharge Flow Rates

Catchment	Proposed Flow Rates (litres/ sec)	Proposed Attenuation (m ³)
1	11.30	3900
2	2	500
3	10.30	3250

As per the Environment Agency's Rainfall Runoff Management for Developments, long term storage can be provided to store the additional runoff caused by the development compared to the volume that would have been contributed from the Site in its Greenfield state. The current design rule is to use the 100-year 6-hour event to determine this additional volume.

Long term storage can be incorporated through one of three basic approaches:

1. Ensure that the drainage system provides sufficient infiltration volume to dispose of the volume difference,
2. Design a storage system which only comes into effect above a storm size threshold (effectively an off-line design) which captures the required volume and discharges at the appropriate rate,
3. Design a storage system which comes into effect for all events (effectively an on-line design) that captures the required volume difference which is designed to empty at a rate of less than 2 l/s/ha.

Approaches 1 and 2 provide the long-term storage volume in a separate system from the attenuation storage or offset the volume of runoff via infiltration devices. This allows the long-term storage to be activated for specific events and the volume difference discharged at the appropriate rate or infiltrated to ground, in order to mimic the behaviour of the Site in its Greenfield state.

The drainage strategy for the site proposes to adopt approach 3. By storing the additional volume in a central storage area, the long-term storage volume will be appropriately activated and discharged at a rate (2 l/s/ha) that would mimic the Greenfield behaviour of the Site, which is the overall aim of providing long term storage.

8. Sustainable Urban Drainage Systems (SuDS)

8.1 SuDS constraints

Most source control techniques are likely to be suitable for the Saltbox site.

Infiltration may be suitable. Mapping suggests a medium risk of groundwater flooding and areas of the site have been designated as containing historic landfill. Therefore, a further site investigation should be carried out and the potential for infiltration techniques should be assessed. Infiltration should typically be avoided in areas where the depth to the water table is <1m. However, shallow soakage tests results should be carried out to confirm if infiltration is suitable and permit the use of shallow infiltration features. All tests to be in accordance with BRE 365. The attenuation volumes stated within this report, do not take account of infiltration.

Mapping suggests that the site slopes are suitable for all forms of detention. A liner may be required to prevent the possible egress of groundwater and address any contamination issues from designated landfill within the site boundary.

All filtration techniques are likely to be suitable. A liner may be required to prevent the possible egress of groundwater and address any contamination issues from designated landfill within the site boundary.

All forms of conveyance are likely to be suitable. As a general note, where the slopes are >5% features should follow contours, or utilise check dams to slow flows. A liner may be required to prevent the possible egress of groundwater and address any contamination issues from designated landfill within the site boundary.

For the Saltbox site, proposed site gradients are not expected to be greater than 5%.

8.2 SuDS selection

The following destinations must be considered for surface runoff in order of preference:

1. Discharge into the ground (infiltration)
2. Controlled discharge to a surface water body
3. Controlled discharge to a surface water sewer

Surface water must not be discharged into the foul sewer system. Infiltration structures include soakaways, basins, swales and permeable paving. Discharge to surface water bodies and surface water sewers must be restricted to an agreed rate.

8.3 Flow exceedance routes

The drainage design should show flow routes through the proposed development, demonstrating where surface water will be conveyed for three types of flow:

1. Low flow routes Regular flow from source control features such as permeable pavements should travel in low flow channels through the development in a controlled way contributing to landscape quality.

2. Overflows in the event of local blockages or surcharge a simple overflow arrangement should allow water to bypass the obstruction and return to the management train sequence until conditions return to normal.

3. Exceedance routes When SuDS are overwhelmed by exceptional rainfall, then exceedance routes are required to protect people and property. These provide unobstructed overland flow routes from the development and should be considered for all drainage schemes.

The proposed levels have been designed, to fall towards the west. Hence in the event of an exceedance, the overland flow path will direct the water towards the storm water outfall and away from the proposed buildings. The levels will not increase flooding offsite as a result of the development.

8.4 Responsibilities for SuDS maintenance

Development shall not commence until full details of the maintenance and management of the SuDS system is set out in a site-specific maintenance manual and submitted to, and approved in writing, by the Local Planning Authority.

As a minimum requirement, the manual is to include:

- (a) details of financial management of the site including arrangements made in the event that the management company (or any subsequent management company) is no longer able to fulfil its duties; and
- (b) arrangements for the replacement of major components at the end of the manufacturers recommended design life.

Further information on maintenance and management of SuDS is provided in section 8.6 of the main SFRA report.

8.5 Implementation of SuDS for the Saltbox Site

The proposed drainage strategy which can be found as appendix D of this report, demonstrates that a combination of permeable paving, swales, and ponds can be incorporated within the design.

This is in accordance with the advice within the SFRA and Arun Strategic Surface Water Management Study, in particular the workshop section appendices B and C which refers to the Bognor Regis Enterprise site as a whole.

All SuDS should be designed in accordance with CIRIA 753. In summary, the updated SuDS Manual incorporates the very latest research, industry practice and guidance. In delivering SuDS there is a requirement to meet the framework set out by the Government's 'non-statutory technical standards' and the revised SuDS Manual complements these but goes further to support the cost-effective delivery of multiple benefits.

9. Conclusions

Kirksaunders (KSA) has been commissioned by Landlink Estates to undertake a site-specific Flood Risk Assessment (FRA) for the proposed Saltbox site development north of Bognor Regis, Sussex.

Full planning permission is sought for the Phase 1 development of 6.492 hectares of employment space (B1, B2 and B8) with associated parking, landscaping, and public open space. In addition, outline planning permission is sought for the Phase 2 development of 5.512 hectares for additional employment units, warehousing, hotel, drive thru's, public house, gym and associated works. Based on Table 2 (Flood Risk Vulnerability Classification) of the NPPF Planning Practice Guide, the Proposed Development is classified as 'Less Vulnerable'.

The site is located within Flood Zones 1, 2 and 3. However coastal flood defences protect the site from tidal flooding up to the 0.5% (1 in 200 year) annual probability event and the modelled level of flood risk from fluvial sources is less than 1% (1 in 100 year) annual probability to all built development. As all built development is effectively in Flood Zone 2 the Proposed Development is considered appropriate development in accordance with Table 3 of the NPPF Technical Guidance.

The updated SRFA dated November 2016 and the main modification version of the local plan have been considered within this site-specific FRA.

The surface water network for the site is designed to convey and store surface water from site for all storms up to and including the 1 in 30-year storm event without flooding on site habitable spaces or to adjoining properties with controlled flooding during the 1 in 100-year storm event (plus a 45% allowance for climate change). It is proposed that the Site discharge at 2 l/s/ha to comply with the rate and volume of runoff requirements.

The total required storage volume for the Site is 7,650m³. There may be scope for the storage volume to be rationalised at a later stage following detailed design and specific hydraulic modelling. This attenuation volume will be provided in the form of retention/detention basins, swales and permeable pavements.

Flood risk to and arising from the Proposed Development has been classified as low to negligible.

A drainage strategy has been prepared to support the Proposed Development through the planning process. The strategy demonstrates the Proposed Development can comply with the requirements of the NPPF and does not increase flood risk either to or from the Proposed Development.

The proposed areas of car parking will require treatment in line with the water quality parameters for the outfall watercourse / stream.

The on-site drainage should be maintained and inspected on a regular basis to ensure it remains fit for purpose. Maintenance plans are to be submitted in accordance with the approving authorities' requirements.

This FRA demonstrates that the Proposed Development site can be drained in a sustainable manner through attenuation and infiltration and that the development is not at flood risk from all sources and will not increase flood risk to other parties. All SuDS are to be designed and implemented in accordance with CIRCIA 753.

Appendix A – Site Masterplan

Appendix B – Site Phasing Plan

Appendix C – Topographical Survey

Appendix D – Proposed Drainage Strategy

Appendix E – Proposed Drainage Calculations
