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# **FRA for Southport Marine Park**

**2015s3315 - Final Report**

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## Contract

This report describes work commissioned by Andrea O'Connor, on behalf of Sefton Council, by a letter dated 30 November 2015. Sefton Council's representative for the contract was Andrea O'Connor. Mike Williamson and Howard Keeble of JBA Consulting carried out this work.

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## Abbreviations

ABD.....	Area Benefitting from Defences
AEP.....	Annual Exceedance Probability
AOD .....	Above Ordnance Datum
ARFQ .....	Advanced Request for Quotation
AStGWF.....	Areas Susceptible to Ground Water Flooding
CDA .....	Critical Drainage Area
EA .....	Environment Agency
FEH.....	Flood Estimation Handbook
FFL.....	Finished Floor Level
FRA.....	Flood Risk Assessment
IH .....	Institute of Hydrology
LIDAR .....	Light Detection And Ranging
NPPF .....	National Planning Policy Framework
PPG .....	Planning Practice Guidance
SFRA .....	Strategic Flood Risk Assessment
SuDS.....	Sustainable Drainage Systems
SWMP.....	Surface Water Management Plan
uFMfSW .....	updated Flood Map for Surface Water
UU .....	United Utilities

# Definitions

## Flood Zones

The following table is a reproduction of Table 1 of the Planning Practice Guidance<sup>1</sup>. These flood zones refer to the probability of river and sea flooding (disregarding the presence of defences) as shown on the EA Flood Map for Planning (Rivers and Sea).

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	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. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)

<sup>1</sup> <http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/flood-zone-and-flood-risk-tables/table-1-flood-zones/>

# 1 Introduction

## 1.1 Overview

This report has been prepared in response to a request from Sefton Council for the following:

***Undertaking of a Site Flood Risk Assessment (FRA) for draft Local Plan Site ED8, Southport Marine Park, Southport, which is proposed for leisure and tourism uses in the draft Local Plan.***

The proposed site covers an area of approximately 17.5 ha with 42% of this area within tidal Flood Zone 3a and a further 20% within tidal Flood Zone 2 of the Environment Agency (EA) Flood Map for Planning. The area within Flood Zone 3a is included within an Area Benefitting from Defences (ABD) as per the EA ABD dataset. There is no fluvial risk associated with the site. The development is considered appropriate in these flood zones according to the Flood Risk and Coastal Change Planning Practice Guidance<sup>2</sup> of the National Planning Policy Framework (NPPF).

## 1.2 Information provided

The following information has been provided by the Council:

- EA Flood Map for Planning (River and Sea) - flood zones 3a and 2 (August 2015 version)
- EA Risk of Flooding from Rivers and Sea map (defended)
- EA updated Flood Map for Surface Water (uFMfSW)
- Sefton Surface Water Management Plan (SWMP), 2011, surface water flood mapping including depths and hazards
- EA Areas Susceptible to Ground Water Flooding
- Strategic Flood Risk Assessment (SFRA), 2013 outputs
- High resolution LIDAR (1 m resolution)

## 1.3 Scope of FRA

The assessment of flood risk is based on flood and hazard mapping products provided by Sefton Council and includes consideration of safe access and egress in times of flood. Owing to tight timescales for this study, direct consultation with the Environment Agency (EA) and United Utilities (UU) has not been possible.

It should be noted that no site investigation or contaminated land results are available at this initial stage. This assessment has therefore been prepared in order to establish indicative finished floor levels and to quantify likely attenuation volumes required onsite to ensure that development of the proposed leisure and tourism site does not increase flood risk elsewhere. It should also be noted that this assessment does not include consideration of detailed ecological issues, detailed drainage design or the design of Sustainable Drainage Systems (SuDS). Appropriate SuDS will need to be considered at the detailed design stage, when development proposals have been confirmed.

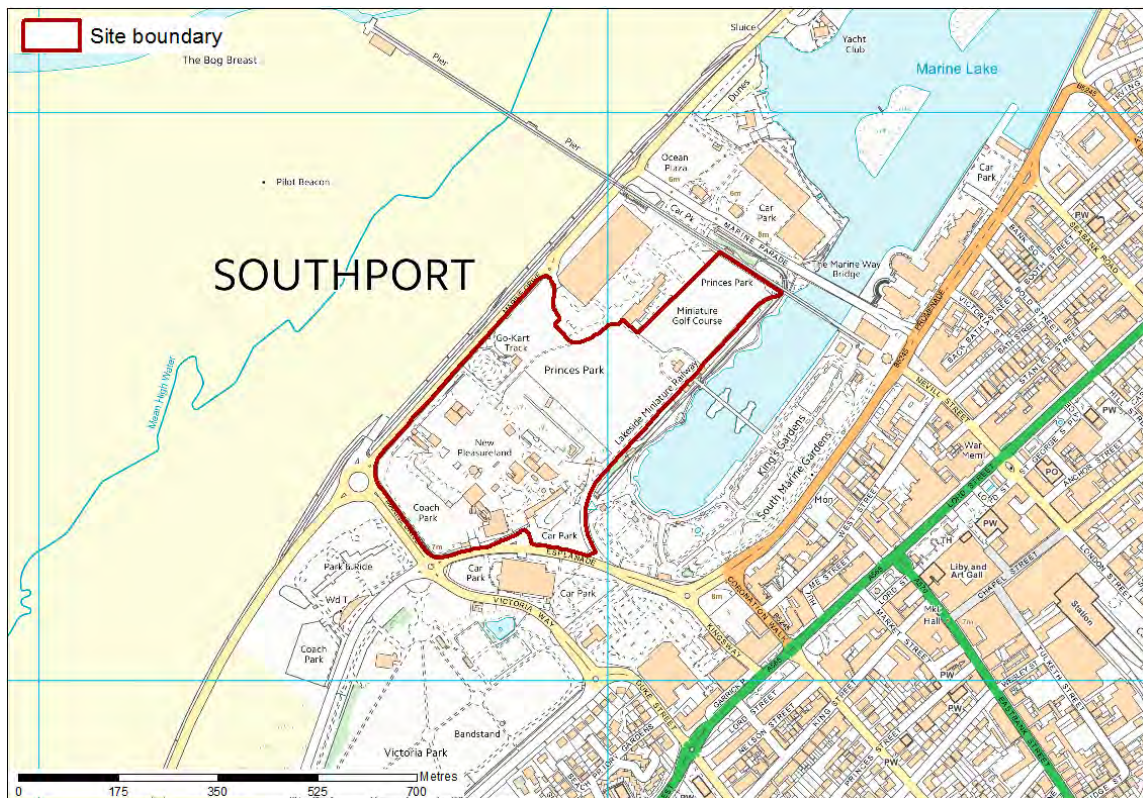
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<sup>2</sup> <http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/>  
2015s3315 - Southport Marine Park FRA Final Report v1.0 (15-11-13)

## 2 Development description and location

The proposed allocation is for a mixed leisure and tourism development at Southport Marine Park (Figure 2-1). Based on information provided by Sefton Council, the site covers an area of approximately 17.5 ha of Brownfield land, although it is noted that a significant proportion of this area comprises open parkland (Princes Park). The site is bounded by Marine Drive and the coast to the west, a Cinema complex and Pier to the north, part of a Marine Lake to the east, and Marine Drive and the Esplanade highways to the south. Vehicular access to the site is via existing entrance and exit off the Esplanade. In addition to areas of parkland, the existing site includes leisure facilities and associated coach and car parking.

Figure 2-1: Site location



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We understand that the proposed allocation is to be a major visitor-based development which could for example entail the expansion of the existing fairground and provision of new outdoor leisure facilities. It is assumed that future access to and from the site will be gained from the existing points on the Esplanade. In terms of layout considerations, Sefton Council's draft policy for this site involves the following:

- Incorporation of active frontages to both Marine Drive and Esplanade;
- Landscaped pedestrian link connecting the Venetian Bridge in King's Gardens to the seafront;
- Retaining of open seafront setting;
- New on-site buildings which may result in the loss of some or all of Princes Park;
- New open space and green infrastructure to compensate the loss of any open space, such as the existing Princes Park.

In accordance with NPPF Planning Practice Guidance (PPG) Table 2<sup>3</sup>, the flood risk vulnerability classification for this development is 'Less Vulnerable'.

<sup>3</sup> <http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/flood-zone-and-flood-risk-2015s3315> - Southport Marine Park FRA Final Report v1.0 (15-11-13)



The majority of the site that is within tidal Flood Zone 3a is also within Areas Benefitting from Defences (ABDs). The site is also partially within a Flood Warning Area (FWA) designated by the EA.

## 2.1 Flood History

There are 12 recorded flood incidents in the southern part of the site near the existing Coach Park. This is based on DG5 data received from United Utilities. The Sefton Strategic Flood Risk Assessment (SFRA) does not have any details of flood history at the allocation site. The allocation site is not covered by the EA Historic Flood Map.

### 3 Tidal Flood Risk

Figure 3-1 below shows the coverage of Flood Zones 3a and 2. The source of these flood zones is entirely tidal with no risk from fluvial flooding from Main River or Ordinary Watercourses. Those parts of the site in Flood Zone 3a are assessed as having a 1 in 200 or greater annual probability of flooding from the sea (>0.5% Annual Exceedance Probability (AEP)). Those parts in Flood Zone 2 are assessed as having between a 1 in 200 and 1 in 1,000 annual probability of flooding from the sea (between 0.5% and 0.1% AEP).

Figure 3-1: Tidal Flood Mapping (EA Flood Map for Planning)



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As identified in Section 2, the flood risk vulnerability classification for this development is 'Less Vulnerable'. Planning Practice Guidance Table 3<sup>4</sup> states that 'Less Vulnerable' development, and therefore the proposed leisure and tourism allocation at Southport Marine Park, is appropriate in Flood Zones 3a and 2.

The site is currently protected by a man-made sea defence wall, according to the EA defence data, though the site is at risk of overtopping or breaching of coastal flood defences when accounting for the effects of climate change. According to the SFRA, however, there is no information on the consequences of any failure of these defences, therefore residual tidal risk cannot be assessed as part of this FRA. The EA should be asked to review this as they may have additional investigations for this site before they agree to any development.

The SFRA states that at the time of writing, in 2013,

*...there are no existing model outputs or mapped flood extents to present the extent of the tidal Flood Zone 3 with an allowance for climate change and it is therefore recommended that where a site lies within the currently (2013) defined tidal Flood Zone 2 that the identification of the consequences of climate change on these flood extents is investigated within a site-specific Flood Risk Assessment.*

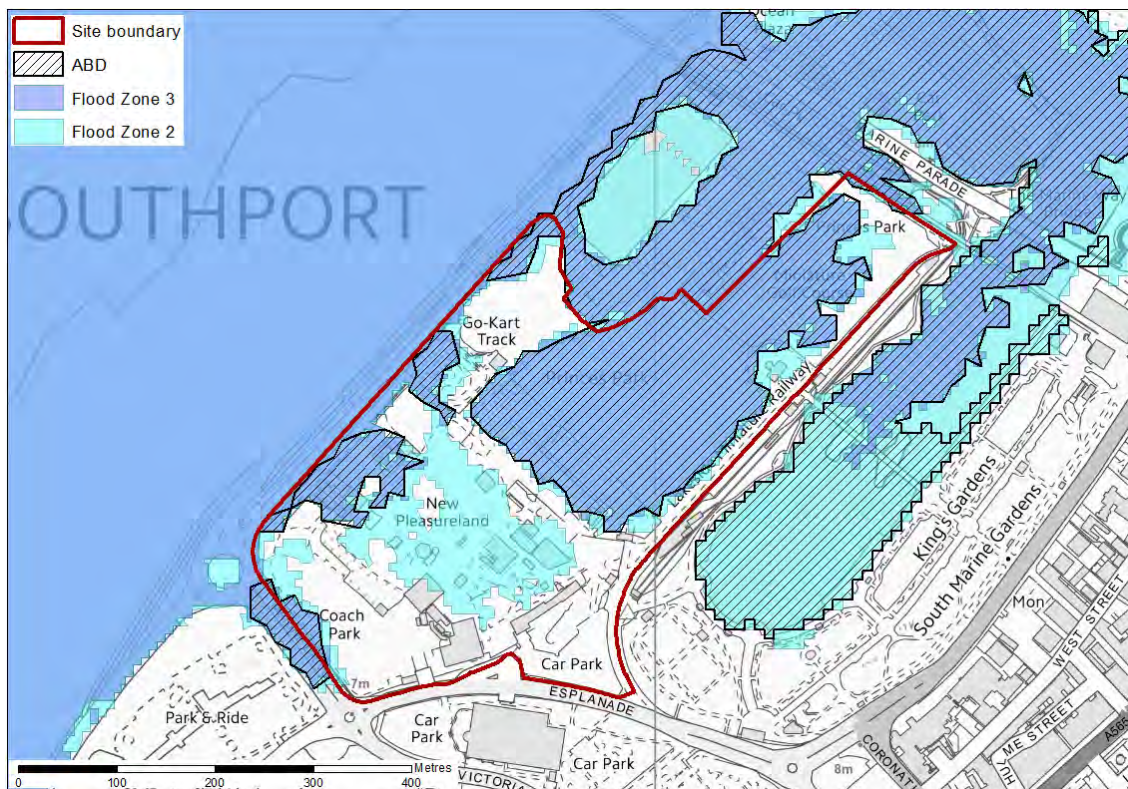
4 <http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/flood-zone-and-flood-risk-tables/table-3-flood-risk-vulnerability-and-flood-zone-compatibility/>  
2015s3315 - Southport Marine Park FRA Final Report v1.0 (15-11-13)

The EA Flood Map for Planning was updated in August 2015 and reveals much greater risk from Flood Zone 3. It is the August 2015 Flood Map that is used in this FRA. The SFRA states that sea level rise at the Southport Seafront could rise from a current level of 6.11 m AOD for the 1 in 200 AEP event to 7.06 m AOD when accounting for climate change up to 2115.

The area of Flood Zone 3a within the site is shown to be entirely within the EA Areas Benefitting from Defences (ABD) outline, as shown on Figure 3-2. The ABD outline therefore suggests that this site is wholly protected against a 1 in 200 AEP tidal event. This does not however account for possible defence breach or failure. The defence condition is described in the SFRA as being in 'fair' condition and maintained by Sefton Council.

Modelled tidal or breach model outputs have not been made available for this FRA at this stage.

Figure 3-2: ABD and Tidal Flood Mapping (EA Flood Map for Planning)



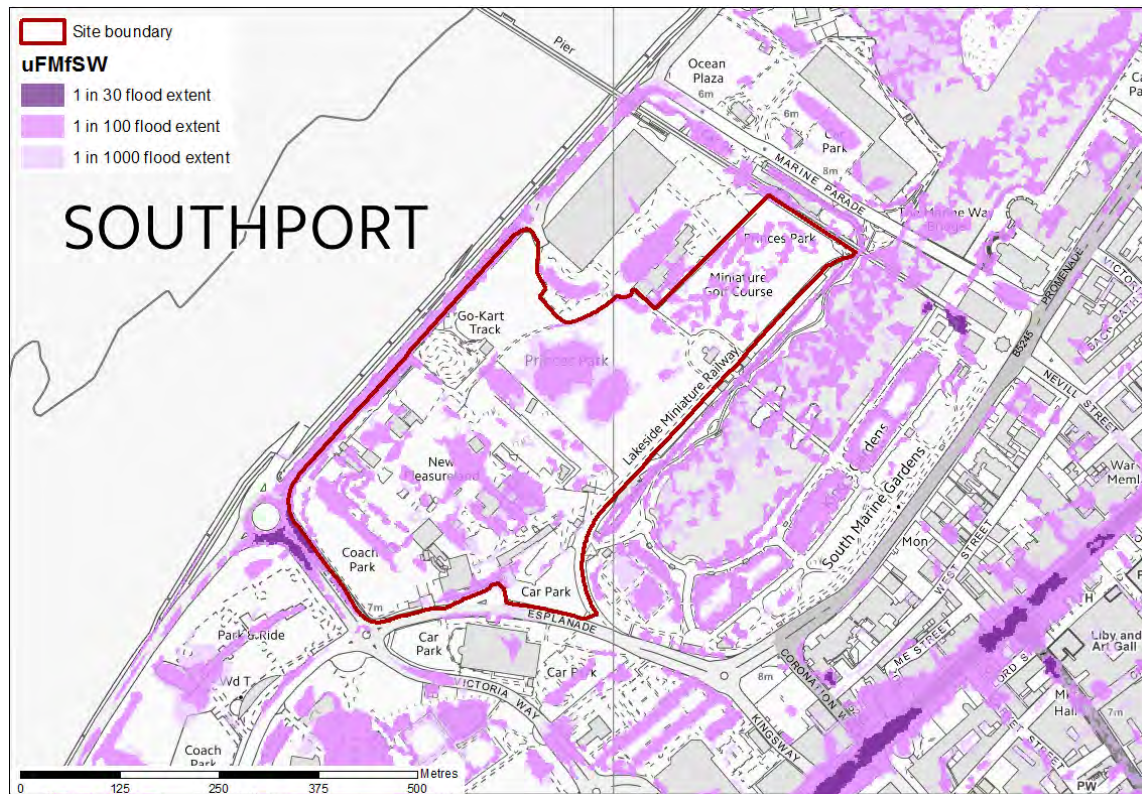
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## 4 Surface Water Flood Risk

The updated Flood Map for Surface Water (uFMfSW) indicates sporadic surface water flood risk across the site (Figure 4-1). The site is not at risk from the more frequent 1 in 30 year (3.33% AEP) event, though 21.5% (3.8 ha) of the site is at risk from the 1 in 100 year (1% AEP) event. The site is not situated within a locally-designated Critical Drainage Area (CDA) defined through the SWMP 2011 and SFRA 2013. It should also be noted that no uFMfSW flood depth data has been provided by Sefton Council at this stage.

Figure 4-1: updated Flood Map for Surface Water



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The total area at risk of surface water flooding according to the uFMfSW is broken down in Table 4-1:

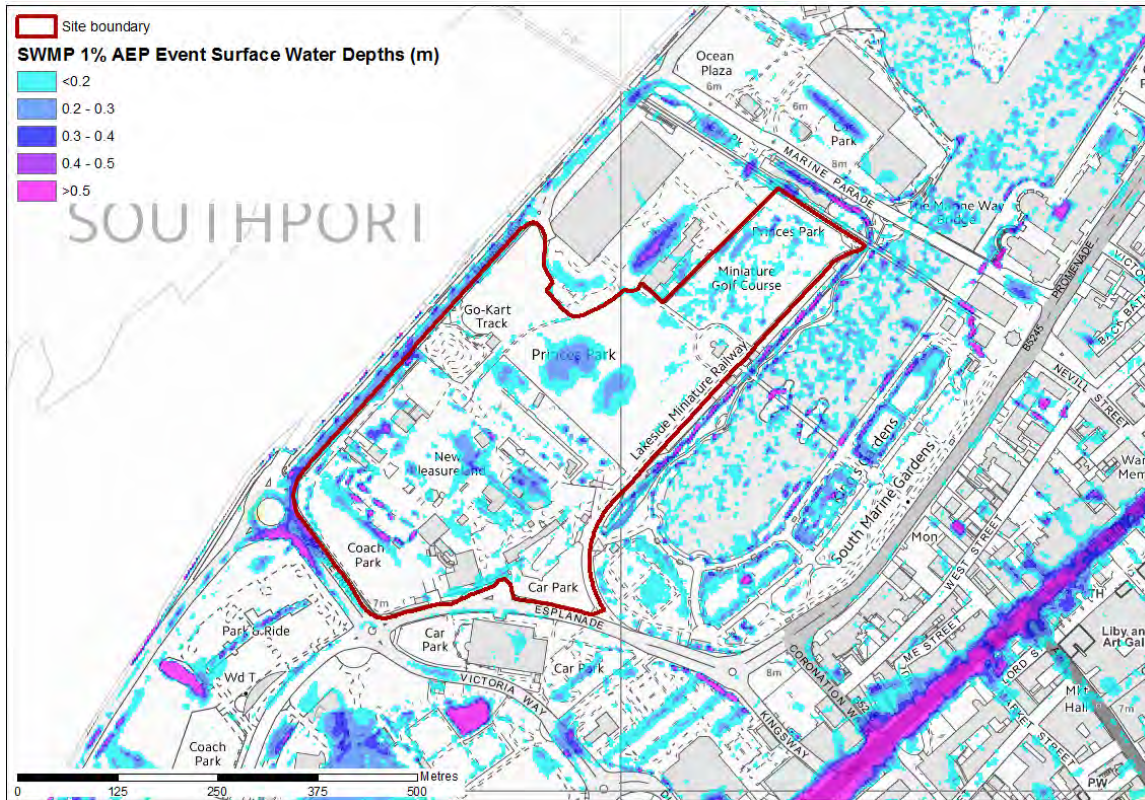
Table 4-1: Site area at risk of surface water flooding

Storm event	Area (ha) at Risk	% Area at Risk
1 in 30 year (3.33% AEP)	0	0
1 in 100 year (1% AEP)	3.8	21.5
1 in 1000 year (0.1% AEP)	1.5	8.4

SWMP mapping for the 1 in 100 year storm event indicates a similar flood extent to that given by the uFMfSW for the same design event (see Figure 4-2). According to the SWMP depth information, flood depths on the site rarely exceed 0.5 m with the deepest depths occurring on the Coach Park. Flood depths along Marine Drive adjacent to the site can reach up to 0.5 m. The average hazard rating, taken from the SWMP information, indicates 'Danger for Some' as defined by the DEFRA/EA FD2321 document. This does not change with climate change, according to the SWMP information.



Figure 4-2: updated Flood Map for Surface Water



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## 5 Other Sources of Flood Risk

### 5.1 Fluvial

The EA Flood Map for Planning (Rivers and Sea) indicates that the site is not at risk of fluvial flooding.

### 5.2 Groundwater

The EA Areas Susceptible to Ground Water Flooding (AStGWF) map indicates that the site is located within an area considered to be susceptible to groundwater emergence. There are two 1 km grid squares covering the site. One covers the eastern half of Princes Park and the Miniature Golf Course, the other covers the western parts of the site. The eastern square suggests that greater or equal to 50% but less than 75% of the grid square area could be susceptible to groundwater emergence from superficial deposits. The western square suggests that greater or equal to 25% but less than 50% of the grid square area could be susceptible to groundwater emergence from superficial deposits. It should be noted that the AStGWF dataset does not take account of the chance of flooding from groundwater rebound.

### 5.3 Reservoir

Reservoir inundation mapping from the SFRA indicates that the site is not at risk from uncontrolled releases from reservoirs.

### 5.4 Canal

Canal risk mapping from the SFRA indicates that the site is not at risk of flooding from any canals.

## 6 Flood Risk Management Measures

### 6.1 Tidal Risk

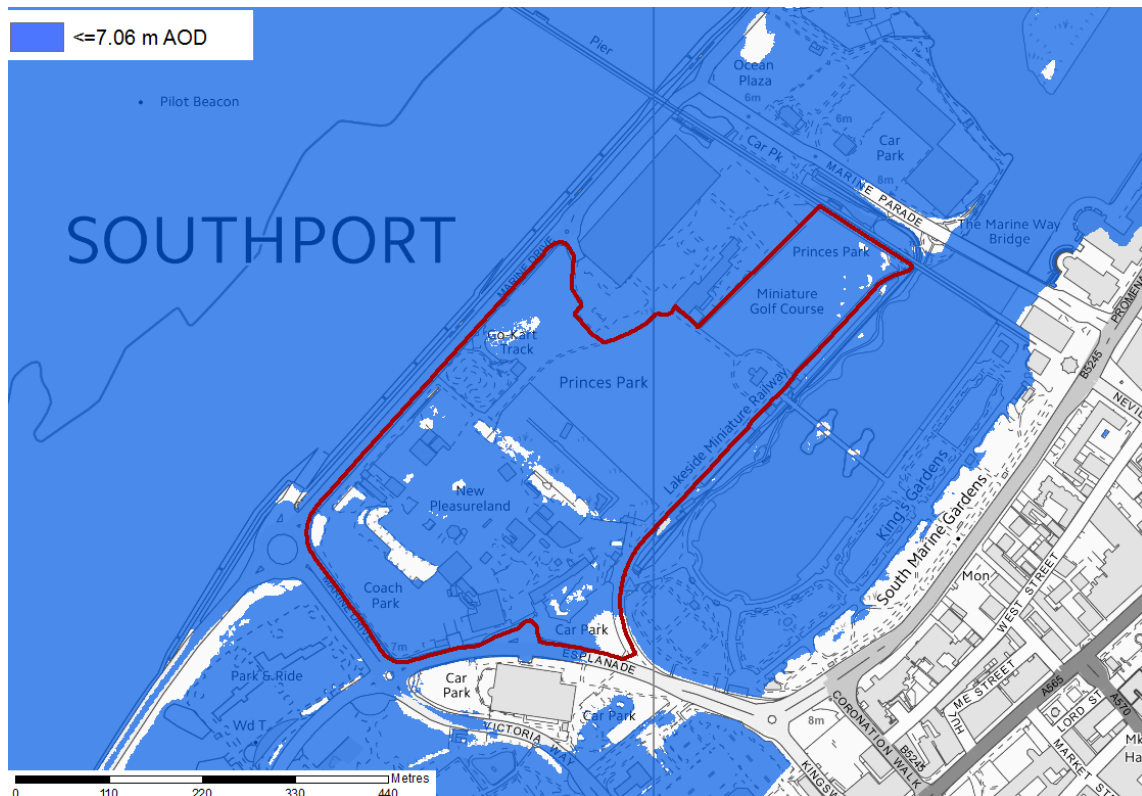
The vulnerability classification of the site means, according to the PPG, development of this site is appropriate. However, where possible, the areas within Flood Zones 3a and 2 should be left as open space and free from development so as to not hinder the natural flow of water nor remove any area from the floodplain. As 62% of the site is currently at tidal risk, when existing defences are not taken into account, and the flood zone coverage within the site is such that avoidance would be difficult (see Figure 3-1), detailed design may have to include for the raising of ground levels. Another option would be to allow flood water to flow through any structures so as to not impede flows or reduce the floodplain area, for example through ground level carparks underneath any buildings.

### 6.2 Finished Floor Levels

For all new development, the Sefton SFRA states that it is good practice and it is recommended to have Finished Floor Levels (FFLs) at least 0.3 m above the finished ground level. In addition to this general guidance, developers should seek to ensure any internal floor levels are at least 600 mm above the 1 in 200 AEP tidal flood level plus allowance for climate change, however this applies to 'More Vulnerable' developments. According to Table 4-6 of the SFRA (taken from the Extreme Sea Level Study, 2008), the predicted extreme sea level for a 1 in 200 AEP event + climate change to the year 2115 could be 7.06 m AOD for the Southport Seafront. FFLs should apply to all new buildings and any essential infrastructure, however detail will depend on the proposed development layout and further discussion with the EA.

In the absence of a modelled 1 in 200 year + climate change outline or modelled flood levels, Figure 6-1 shows the extent of land on-site that would flood up to the predicted climate change level of 7.06 m AOD.

Figure 6-1: Surface topography that is at 7.06 m AOD or less



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It is clear from Figure 6-1 that the majority of the site would be expected to flood in a 1 in 200 year AEP + climate change event. Further information from the EA on the capabilities of the sea defences would be required before the detailed design stage. Any development of buildings or major infrastructure on the site must therefore have FFLs of at least 7.36 m AOD, assuming the whole site can be confirmed as 'Less Vulnerable'.

In terms of surface water risk the developer should review the depth outputs from the SWMP for the 1 in 100 annual probability event, and use this information so that their development proposals specify floor levels that are at least 300 mm higher. The SFRA states that flood resistant and flood resilient design should be incorporated into any development, as appropriate to the depth of flooding expected in residual flood risk events.

Future master planning and subsequent detailed design for the proposed leisure and tourism development should therefore take into account the SWMP 1 in 100 year surface water mapping and ensure that FFLs are at least 300 mm above predicted flood depths, which on average, according to the SWMP information are <0.1 m when accounting for climate change.

Raised FFLs will also help to mitigate against any potential groundwater emergence.

### 6.3 Safe Access and Egress

It is assumed that future access to and from the site will be gained from the existing access points from the Esplanade. The EA Flood Map for Planning and available surface water mapping indicate very little risk on the Esplanade. However, based on an estimated level of 7.06 m AOD for the 1 in 200 AEP plus climate change event, much of the Esplanade would be at risk as shown on Figure 6-1. The eastern part of the Esplanade, where the current Car Park is situated, is however still within Flood Zone 1. Detailed design should look at this point as being the safest access and egress route. It may be that the Esplanade will need to be raised above the 7.06 m AOD level or the Esplanade is freely drained by gravity and discharged to the sea.

The SFRA states that where access and egress routes cannot remain dry then safe refuge areas must be made available.



## 7 Surface Water Management

In accordance with the PPG, this FRA assesses the volumes of surface water runoff likely to be generated by the proposed development. Proposals for surface water management are made to ensure any increased runoff does not cause flood risk elsewhere and, in accordance with Sefton SFRA requirements for brownfield sites, where a minimum reduction in total site runoff of 20% should be provided. The SFRA also states that volumes for a 1 in 100 year AEP 6 hour storm event should be no greater than from the pre-development site in the same event. Where these requirements cannot be met then sufficient information should be provided to satisfactorily demonstrate why this is the case. The developer will need to consider the implications of this as and when development proposals for the site are made.

We have made allowances for the impact of climate change on increasing rainfall. The SFRA states that internal ground floor levels of new developments should be above the 1 in 100 AEP + climate change surface water flood level and that flood resistant and flood resilient design is incorporated into the development, as appropriate to the depth of flooding expected in residual flood risk events.

As mentioned in Section 2, the proposed plans for the site may result in the total loss of the open space at Princes Park. However, the Council's policy for the site states that any loss of open space to development will be compensated for through new open space and / or green infrastructure. Based on this, we have assumed that the impermeable area of the site will increase by 10% beyond current levels which, based on Bing Maps aerial imagery<sup>5</sup>, is approximately 30%. As the site is to be redeveloped with an extension to the funfair, we have therefore assumed a post development impermeable area of 40% which means an additional 10%. This equates to an assumed 1.7 ha increase in impermeable area.

Detailed ground investigation results were not available at the time of writing this FRA. Furthermore, indicative infiltration SuDS suitability mapping from the SFRA suggests that the site is likely to have a predominantly very low potential for infiltration SuDS due to the low permeability of the bedrock and drift Geology on the site, and also due to the medium to high susceptibility of groundwater emergence at the site. We have therefore based our review on providing a fully compensated surface water management scheme on site to restrict surface water runoff from the development.

### 7.1 Surface Water Risk

Rainfall depths for the 30 year and 100 year rainfall events at the site were abstracted from the FEH CD-ROM. The rainfall depths were increased by an allowance of 30% to account for the effects of climate change (Table 7-1 below).

Table 7-1: Design rainfall depths (FEH CD-ROM)

Duration (hours)	30-year rainfall (mm)	30-year rainfall plus 30% (mm)	100-year rainfall (mm)	100-year rainfall plus 30% (mm)
0.25	22.36	29.07	32.88	42.74
0.5	26.71	34.72	38.50	50.05
0.75	29.64	38.53	42.22	54.89
1	31.92	41.50	45.08	58.60
1.5	35.42	46.05	49.44	64.27
2	38.13	49.57	52.78	68.61
3	42.32	55.02	57.89	75.26
4	45.56	59.23	61.80	80.34
6	50.56	65.73	67.78	88.11
8	54.44	70.77	72.36	94.07
10	57.65	74.95	76.13	98.97
12	60.41	78.53	79.36	103.17
18	67.01	87.11	87.00	113.10
24	72.13	93.77	92.86	120.72

5 <http://www.bing.com/maps/default.aspx?cp=53.6490021920989~-3.01546971579652&lvl=16&style=a&v=2>

Duration (hours)	30-year rainfall (mm)	30-year rainfall plus 30% (mm)	100-year rainfall (mm)	100-year rainfall plus 30% (mm)
36	80.01	104.01	101.79	132.33
48	86.12	111.96	108.65	141.25

## 7.2 Assessment of surface water flood attenuation assuming a discharge of 10 l/s

Likely attenuation volumes for the proposed development, based on an assumed increase in impermeable area of 10%, are provided in Table 7-2 below. These values are based on limiting discharge to 10 l/s in the absence of further details.

Table 7-2: Estimated attenuation volumes (assumed discharge of 10 l/s)

Drainage Area	Design event (including climate change)	Critical storm duration (hrs)	Inflow volume m <sup>3</sup>	Outflow volume m <sup>3</sup>	Attenuation required m <sup>3</sup>	Time empty (assuming no infiltration) (hrs)
Existing Brownfield land Permeable discharge based on 10 l/s	30-year rainfall plus 30%	24	1595	432	1163	64
	100-year rainfall plus 30%	24	2054	432	1622 (459 m <sup>3</sup> of exceedance storage)	90

The attenuation volumes estimated above in Table 7-2 assume a gravity outfall to the Sea or a nearby Ordinary Watercourse draining away from the site. The final point of discharge is to be determined at detailed design.

## 7.3 Outline Drainage Strategy

As stated above, detailed ground investigation results were not available at the time of writing this FRA. Furthermore, indicative SuDS suitability mapping from the SFRA suggests that the allocation site is likely to have very low potential for SuDS due to the possibility of groundwater emergence at the site. We have therefore based our review on providing a fully compensated surface water management scheme on site to restrict surface water runoff from the development. A conventional piped surface water drainage system including a combination of storage tanks or oversized pipes is envisaged at this stage as a means of regulating surface water discharge to the sewer network.

In accordance with Table 7-2 and in the absence of any infiltration drainage for impermeable areas, the total attenuation required for the proposed development for the 1 in 30 year and 1 in 100 year design events including climate change are estimated to be 1,200 m<sup>3</sup> and 1,600 m<sup>3</sup> respectively. These volumes are based on a discharge rate limited to 10 l/s. As estimated attenuation volumes are small relative to the size of the site, it is anticipated that surface water could be managed on site to provide sufficient storage for the 1 in 100 year design event including an allowance for climate change.

Although SUDS options have not been investigated as part of this study due to the absence of ground investigations and percolation tests, owing to the availability of open space on site it is possible that attenuation could be provided in an attenuation pond. This would also provide significant ecological benefits and added public amenity value. However, as groundwater depths could be shallow in this area, fully sealed systems are likely to be required.

Even if attenuation basins could provide sufficient storage for the 1 in 100 year climate change runoff volume, the capacity of the piped drainage system connecting the developed area is likely to be designed to a 1 in 30 year standard. It is therefore recommended that additional storage should be provided within the developed area to accommodate the estimated exceedance volume of 460 m<sup>3</sup> to limit offsite impacts. This could be achieved by landscaping and making

best use of available green space to contain exceedance flows in swales. Use of raised kerbs could also provide some storage within internal road areas and car parks. These approaches can be used to allow certain areas of the site to flood to shallow depths when the capacity of the onsite drainage network is exceeded. Flood water will then be able to pond before gradually discharging back into the site drainage system.

Owing to the absence of ground investigations and percolation tests to date, a fully attenuated surface water system has been appraised at this outline planning stage. However, opportunities for SuDS should be fully investigated at detailed design stage.

Sewer maps have not been obtained at this stage. It is assumed that site surface water could discharge directly to the sea. This will need to be confirmed at detailed design.

## 8 Conclusion and Discussion

This report has been prepared in response to a request from Sefton Council for a Site Flood Risk Assessment (FRA) for draft Local Plan Site ED8 SMP, Southport Marine Park, Southport, which is proposed for leisure and tourism in the draft Local Plan.

The proposed development site covers an area of 17.5 ha and is located within the EA Flood Map for Planning Flood Zone 3. As shown by the EA Risk of Flooding from Rivers and Sea map (which accounts for the presence of defences) and the EA Areas Benefitting from Defences (ABD) dataset, the site is assumed to be wholly protected against a 1 in 200 AEP tidal event. This does not however account for possible defence breach or failure. Modelled tidal or breach model outputs have not been made available for this FRA at this stage.

Upon assessment of possible climate change impacts, based on an estimated extreme sea level rise up to the year 2115 of 7.06 m AOD for the Southport Seafront (level taken from Sefton SFRA in the absence of modelled level information), virtually the whole site would be at risk from a 1 in 200 AEP + climate change tidal flood event. Finished floor levels on-site should therefore look to be 7.36 m AOD across this site

We have based our review of surface water risk on providing a fully compensated surface water management scheme on site to restrict surface water runoff from the site. Exceedance flows up to the 1 in 100 AEP event including climate change will need to be effectively contained. The total attenuation required for the proposed development for the 1 in 30 year and 1 in 100 year design events including climate change are estimated to be 1,200 m<sup>3</sup> and 1,600 m<sup>3</sup> respectively. These volumes are based on a discharge rate limited to 10 l/s. As estimated attenuation volumes are small relative to the size of the site, it is anticipated that surface water could be managed on site to provide sufficient storage for the 1 in 100 year design event including an allowance for climate change.

Based on SWMP information, maximum and average surface water depths for the 1 in 100 AEP event are not expected to increase significantly with climate change. This is also true of the associated flood hazard to people with average hazard over the site considered moderate which means 'Danger to Some'. The SFRA states that developers should look to ensure that the velocity of flood water is sufficiently low to result in a hazard rating that is no greater than 'Danger to Some'

Although SUDS options have not been investigated as part of this study due to the absence of ground investigations and percolation tests, owing to the availability of open space on site it is possible that attenuation could be provided in an attenuation pond. This would also provide significant ecological benefits and added public amenity value. However, as groundwater depths could be shallow in this area, fully sealed systems are likely to be required.

Even if attenuation basins could provide sufficient storage for the 1 in 100 year climate change runoff volume, the capacity of the piped drainage system connecting the developed area is likely to be designed to a 1 in 30 year standard. It is therefore recommended that additional storage should be provided within the developed area to accommodate the estimated exceedance volume of 460 m<sup>3</sup> to limit offsite impacts. This could be achieved by landscaping and making best use of available green space to contain exceedance flows in swales. Use of raised kerbs could also provide some storage within internal road areas and car parks. These approaches can be used to allow certain areas of the site to flood to shallow depths when the capacity of the onsite drainage network is exceeded. Flood water will then be able to pond before gradually discharging back into the site drainage system.

Owing to the absence of ground investigations and percolation tests to date, a fully attenuated surface water system has been appraised at this outline planning stage. However, opportunities for SuDS should be fully investigated at detailed design stage.

Mitigation measures including appropriate FFLs and provision for safe access and egress should ensure that the proposed development of Southport Marine Park will be safe for the lifetime of the development. In addition to the surface water management measures provided in the Outline Drainage Strategy, this should ensure that flood risk is not increased elsewhere following development of the site.





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