

**07211301WFR**  
**Proposed Leisure Development, South Beach**  
**Parade**  
**for**  
**Pleasure & Leisure Corporation**

Flood Risk Assessment on:  
Proposed Leisure Development,  
'The Edge'  
South Beach Parade  
Great Yarmouth

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Our ref: RAC/PMB/07211301WFR

**FLOOD RISK ASSESSMENT ON:  
PROPOSED LEISURE DEVELOPMENT, 'THE EDGE',  
SOUTH BEACH PARADE, GREAT YARMOUTH**

**1.0 INTRODUCTION**

- 1.1 We were instructed by Pleasure & Leisure Corporation to undertake a flood risk assessment in respect of the above development.
  
- 1.2 Planning consent is sought for the development that comprises a large multi-use leisure development, incorporating a hotel, casino, restaurants, bowling alley, cinema and a multi-storey car park. A flood risk assessment is required in accordance with Planning Policy Statement 25.
  
- 1.3 This report is compiled with the benefit of our findings from local research, topographical survey, walk-over survey, soil investigation, and liaison with the Environment Agency with regard to potential flood levels.

## **2.0 SITE DESCRIPTION**

- 2.1 The site is situated immediately south of the existing Pleasure Beach off South Beach Parade, Great Yarmouth. The site is a long strip of land between South Beach Parade and the Esplanade that overlooks the South Beach. The Ordnance Survey Grid Reference for the site is TG 531 058.
  
- 2.2 Part of the site is currently vacant, however, it was previously used for many years as a caravan site for holiday use. The remainder of the site forms part of the existing Pleasure Beach Amusement Park. The site is hard paved in part but is mostly scrub with a total area of 2.43 hectares (6.02 acres).
  
- 2.3 A location plan is included in Appendix A.
  
- 2.4 The site is immediately adjacent to the South Beach and within 100m of the North Sea coastline.

### **3.0 RESEARCH**

3.1 Environment Agency Flood Zone Mapping identifies areas at risk of tidal or fluvial flooding with three levels of probability/severity. Zone 3 is a high probability zone that comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (greater than 1%) or 1 in 200 or greater annual probability of flooding from the sea (greater than 0.5%) in any year.

Zone 2 is a medium probability zone and comprises land assessed as having between a 1 in 100 and a 1 in 1000 annual probability of river flooding (1% - 0.1%) or between 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% - 0.1%) in any year.

Zone 1 is a low probability zone and comprises land assessed as having less than 1 in 1000 annual probability of river or sea flooding in any year (less than 0.1%). The flood zone mapping does not however, take into account the presence of any flood defences.

3.2 Information has been obtained from the Environment Agency relating to risk of flooding from the North Sea coastline as follows:

3.2.1 The 1 in 20 year (5% annual probability of occurrence) flood return level is 2.69m AOD.

3.2.2 The 1 in 200 year (0.5% annual probability of occurrence) flood return level for this site is 3.23m AOD.

3.2.3 The 1 in 1000 year (0.1% annual probability of occurrence) flood return level is 3.61m AOD.

Environment Agency correspondence is included in Appendix B.

These levels were derived from current modelled data and need to be adjusted to include PPS 25 climate change allowances over the lifetime of the development. For non residential development, the default life time should be taken as 60 years and the climate change allowances contained in Annexe B, PPS 25 applied for that period.

- 3.3 There is no record of historic flooding to the development site. During the 1953 floods, which affected large parts of the Great Yarmouth area, a flood height of 3.28m AOD was reached. A map showing the extent of this flooding is included in Appendix C. The site was not affected.
- 3.4 There are no formal flood defences to the North Sea frontage of the site but the site is protected from flooding by the adjacent sea walls. These walls are owned by Great Yarmouth Borough Council who are responsible for their maintenance.
- 3.5 The site survey has been undertaken to obtain land levels to enable the development proposals to be assessed in relation to the extreme North Sea flood levels. Site survey details are included in Appendix D.
- 3.6 Public sewers in the area are operated and maintained by Anglian Water. These are combined sewers taking both foul and surface water flows. A plan showing public sewers in the vicinity of the site is included in Appendix E. A pre-development report prepared by Anglian Water for this development is also included. It should be noted that Anglian Water have advised that there are no public surface water/combined sewers within the vicinity of this development with available capacity and that alternative methods of surface water drainage disposal will need to be investigated.

## **4.0 DISCUSSION**

- 4.1 The proposal for the site is a multi use leisure development with car parking.
- 4.2 The site survey drawing demonstrates site ground levels in the range 6.0m AOD to 5.25m AOD. The proposed finished floor level of the casino/hotel is 6.0m AOD and the cinema/bowling complex 5.25m AOD.
- 4.3 From Environment Agency Flood Mapping, site survey information and following consultation with the Environment Agency, it is concluded the proposed development lies in Flood Zone 1. Flood Zone 1 is defined in PPS 25, Development and Flood Risk, Table D1 as 'low probability' of flooding. This zone comprises land assessed as having a 1 in 1000 year or greater annual probability of tidal flooding (less than 0.1%) in any year. Operational development sites of 1 hectare or greater in Zone 1 are required under PPS 25 to provide a flood risk assessment.
- 4.4 PPS 25 states that all uses of land are appropriate in Zone 1 and the sequential and exception tests are not required.
- 4.5 PPS 25 requires developers to take into account allowances for climate change over the lifetime of the development as listed in Table D.1 PPS 25 'Recommended Contingency Allowances for Nett Sea Level Rise'. For the East of England, the nett sea level rise over the 60 year lifetime of the development is 471mm. Thus the extreme flood levels as advised by the Environment Agency could increase over the lifetime of the development to:
- 1 in 20 year flood return period - 3.161m AOD
  - 1 in 200 year flood return period - 3.701m AOD
  - 1 in 1000 year flood return period - 4.081m AOD.

It can be seen from the above levels that the whole of the proposed development will continue to be over one metre above the 1 in 1000 year return period with allowance for climate change over the lifetime of the development.

4.6 The Environment Agency provide guidance on requirements for undertaking a flood risk assessment for proposed developments in Flood Zone 1. This guidance note principally relates to commissioning and undertaking assessment studies and is designed:

- a) to consider the principles of sustainable drainage of the surface water;
- b) for use where works may affect the water courses or flood defences; or
- c) for use where a known drainage problem exists.

In Flood Zone 1 where the risk of flooding from rivers or the sea is classified as low, the flood risk assessment is required to focus on the management of surface water run-off.

4.7 Guidance note 1 requires developers to consider other potential sources of flooding that may affect the site such as streams, surface water run-off, sewers, ground water and other artificial sources. This area of Great Yarmouth is relatively flat and the likelihood of surface water run-off affecting the site is remote. Road levels along Marine Parade and South Beach Parade are falling away from the site to the north and any surface run-off that exceeds the capacity of the local highway drainage system would be directed away from the development area. Given the site's urban location, there are no other potential sources of flooding that may affect the site.

4.8 The Building Regulations 2000 Approved Document H3 requires that rainwater from buildings and paved areas shall discharge to one of the following, listed in order of priority:

- a) An adequate soakaway or some other adequate infiltration system; or where that is not reasonably practicable;
- b) A watercourse; or where that is not reasonably practicable;
- c) A sewer.

The Building Regulations therefore adopt a design philosophy that accords with sustainable drainage systems (SUDS).

4.9 Environment Agency guidance of requirements for surface water run-off from the development is principally to deal with surface water run-off as close to its source as possible and balance all three objectives of:

- 1) To control the quality of run-off from a development;
- 2) To improve the quality of the run-off; and
- 3) To enhance the nature conservation, landscape and amenity value of the site and its surroundings.

In recognition of this, local plans require that applicants should in the first instance aim to incorporate surface infiltration into the development proposals.

4.10 Anglian Water have stated in their pre-development report prepared for this development that there is no spare capacity within the combined sewer system in South Beach Parade. Consequently, other methods of surface water disposal need to be investigated.

- 4.11 A series of trial excavations with percolation tests were undertaken in various locations on the site in order to assess the infiltration characteristics of the subsoil. Percolation test results indicated rapid infiltration of water within the test holes with a range of infiltration rates (f) of between  $1.23 \times 10^{-3}$  m/s and  $1.32 \times 10^{-4}$  m/s. This coefficient of permeability indicates an extremely good soakage rate and suggests that total infiltration systems will be suitable for the development.
- 4.12 A series of preliminary calculations are included in Appendix F together with a drawing illustrating the surface water drainage strategy for the development. The preliminary designs for infiltration devices have been prepared using a 1 in 100 year storm return period with a 20% allowance for climate change.

It is proposed that rainwater from the roof areas of the casino/hotel and the cinema/bowling complex will be harvested and re-used within the development for toilet flushing and irrigation. Holding tanks will be provided to collect roof rainwater and incorporate an emergency overflow to the adjacent beach area.

The two open areas comprising the coach parking and visitor entrance area will be constructed using permeable paving with a voided sub-base designed to accommodate a 1 in 100 year storm return period with a 20% allowance for climate change. In addition, the permeable paving to the coach parking area shall accommodate the northern end of the multi-storey car park roof drainage.

The remainder of the multi-storey car park comprising the middle and southern sections will drain to a series of concrete ring soakaways situated to the south of the multi-storey car park. The soakaways are to be designed for a 1 in 100 year storm return period with a 20% allowance for climate change. As a precaution, the soakaways will include an overflow direct to the beach area.

4.13 Flood warning is managed by the Environment Agency who operate a three staged approach, flood watch, flood warning and severe flood warning. This procedure would form an intrinsic part of any evacuation plan in relation to flooding in the area. For Great Yarmouth the relevant flood warning levels are

Flood watch 1.9m AOD

Flood warning +2.4m AOD

Severe flood warning +3.41m AOD.

A tidal graph is included in Appendix G which illustrates the peak tides leading up to and including an extreme 1 in 1000 year event with climate change. This demonstrates that the site levels will remain above this extreme occurrence and evacuation plans and procedures are not required.

In the event of a severe flood warning being given by the Environment Agency, evacuation of the premises would not normally be expected except in very extreme situations. The development itself would provide a safe refuge within the local community in the event of a flood.

## 5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 As a result of this assessment the following conclusions have been reached.

- ? The proposed development is not in a functional flood plain as defined by PPS 25.
  
- ? From examination of site levels and by reference to Environment Agency mapping and modelled flood data, it is demonstrated that the site is shown to be in Flood Zone 1 with a greater than 1 in 1000 annual probability of occurrence. Zone 1 is categorised as 'low probability' of flooding in PPS 25.
  
- ? PPS 25 states that all types of development are appropriate in Flood Zone 1. The sequential and exception tests are not required.
  
- ? When an allowance for climate change over the lifetime of the development is added to the modelled flood data the site remains above extreme flood events, including the 1 in 1000 year event. Given the Zone 1 location, the inside of all of the buildings would remain dry during such a flood event and access/egress/rescue plans are not required.
  
- ? The development proposals will increase surface water run-off from the area however, the development is to adopt a sustainable approach to storm water management. Rainwater from roof areas to the casino/hotel and the cinema/bowling complex will be harvested and re-used within the development. Other open areas will adopt a permeable paving approach with storage of peak flows within a voided sub-base and infiltration into the subsoil. The multi-storey car park will drain into a series of soakaways on the southern boundary of the site. All areas will include an overflow to the beach area to the east.

All infiltration devices are to be designed for a 1 in 100 year storm return period with an allowance for climate change.

## **6.0 POSTSCRIPT**

The comments in this flood risk appraisal have been made after consideration of historical information, level survey and walk-over survey. The report assesses the risk and advises on precautionary measures that should be considered.

We cannot guarantee against flooding, which in some instances may be dependent upon maintenance of downstream watercourses and existing river flood protection.

For and on behalf of Scott Wilson

**R A Coe IEng AMICE**

Associate

**APPENDIX A**  
**LOCATION PLAN**

**APPENDIX B**  
**ENVIRONMENT AGENCY CORRESPONDENCE**

**APPENDIX C**  
**1953 FLOOD MAP**

**APPENDIX D**  
**SURVEY DRAWINGS**

**APPENDIX E**  
**ANGLIAN WATER REPORT**

## **APPENDIX F**

### **PRELIMINARY SURFACE WATER CALCULATIONS**

**APPENDIX G**

**TIDAL GRAPH**