

**FLOOD RISK ASSESSMENT
&
SUDS Strategy for Planning
(focus on residual surface water flood risk)**

Compliant with LLFA SUDS Guidance
NPPF 2019 Compliant

ADC Ref: P/120/18/PL

**Demolish existing dwelling; erect replacement dwelling;
Better protected and flood future-proofed than existing
Raised ground FFL as high as feasible
Maximise porous / permeable areas
Drainage already approved by ADC Drainage Engineer**

- Site in EA FZ3 Tidal but EA official LOW risk
 - Not in Critical Drainage area
 - In NO – LOW surface water hazard
- **Results in better protected and flood future-proofed property than is existing**

at:

31 Lagoon Road, Pagham, PO21 4TQ

August 2019

ARK Environmental Consultancy Ltd

Table of Contents

If this report has been released electronically, the appendices referred to herein can be found in the annexed zip folder/s as .pdf or .dwg files. If this report has been released in hard copy the appendices will be bound into the back of this report. Plans may be annexed separately as A1 or A0 copies where a bound-in A3 copy is not appropriate.

1.0	Scope	4
2.0	Executive Summary	4
3.0	Introduction.....	5
4.0	Purpose of the Report	5
5.0	Report Information Sources.....	5
6.0	Consultation	5
7.0	Overview of British Legislation	5
7.1	National Planning Policy	5
8.0	Site Status and Environmental Setting	6
8.1	Site Location and Status	6
8.2	Existing Flood Risk.....	6
8.3	Geology (for SUDS)	9
8.4	Surface Water Risk and Hazard Summary	9
8.5	SFRA / LFRMS Surface Water Mapping & Hazard	10
8.6	Detailed Site Specific Flood Levels: not available / relevant	10
8.7	Design Response: address SUDS hierarchy and climate change	10
9.0	Assessment of Proposed Development.....	11
9.1	Proposed Development.....	11
9.2	Drainage Connections & SUDS	11
9.3	Pipe sizes / Manholes / Pipe runs.....	11
9.4	SUDS Hierarchy Check.....	12
9.5	Flood Resilience	12
9.6	Refuge and Evacuation	13
9.7	Annual Monitoring	14
9.8	Surface Water Runoff – Flood Risk from the Development.....	15
9.9	Climate Change including New Allowances.....	15
10.0	Flood Storage	15
11.0	Conclusion.....	15

12.0 Appendices.....	16
----------------------	----

1.0 Scope

This report contains the details of a Flood Risk Assessment carried out by Ark Environmental Consultancy Limited ("ARK Ltd") for 31 Lagoon Road Pagham PO21 4TQ, henceforth referred to as "the site" in this report. This report has been prepared for Bruno Raworth and must not be relied upon by any other party without the explicit written permission of ARK Ltd. All parties to this report do not intend any of the terms of the Contracts (Right of Third Parties Act 1999) to apply to this report. Please note this report does not purport to provide definitive legal advice nor can it be used to demonstrate that the site will never flood in the future.

The Executive Summary contains an overview of key findings and conclusions. However, no reliance should be placed on the Executive Summary until the whole of the report has been read. Other sections of the report may contain information which puts into context the findings noted within the Executive Summary.

All rights reserved. No part of this report may be copied, edited, transmitted, reproduced, hired, lent, sold or disclosed without the prior written consent of ARK Ltd. Any action taken or omitted to be taken in reliance upon the content of this report is not permitted and may be unlawful. Copyright © ARK Ltd 2019.

2.0 Executive Summary

This FRA&SUDS Strategy for Planning has been carried out in accordance with the National Planning Policy Framework (NPPF) 2019 and NPPG 2018 to assist the council and EA in their assessment of the planning application.

The proposed development is for demolition of existing dwelling and erect a replacement dwelling with new porous & permeable areas maximized and new SUDS commensurate with the flood setting, scale and sensitivity of the scheme.

- Site is in EA FZ3: EA official LOW risk
- Within NO - VERY LOW surface water hazard based on site specific mapping
- **REDUCES FLOOD RISK OVERALL**
 - Maximise porous and permeable areas
- SUDS commensurate with scale and sensitivity of scheme. Drainage already approved by ADC Drainage Engineer for this application: P/120/18/PL
- Resilient and resistant measures
- **Results in better protected and flood future proofed dwelling than existing**

This is categorized as a "More Vulnerable" in part FZ1 and part FZ3: in accordance with the NPPF classifications the NPPF/PPG Exception Test does need to be passed.

Given the residual risk flood setting, the level, extent and depth of flooding on the site can be managed in terms of resistant and resilient measures and precautionary mitigation measures.

Based on the likely flooding risk and small scale of the proposed development, it is considered that the proposed development can be constructed and continue to be operated safely in flood risk terms, without increasing flood risk elsewhere; it is therefore considered appropriate development in accordance with the NPPF / PPG.



3.0 Introduction

The FRA combined a desktop study, review of available information, consultations and an assessment of all sources of flooding posed to and from the site and proposed development, in accordance with NPPF & NPPG. Appropriate flood mitigation measures were then considered, either as already incorporated within the scheme or recommended for inclusion at detailed design stage. The suitability of the proposed development was also reviewed in the context of the NPPF/NPPG and any relevant technical guidance accompanying the NPPF.

4.0 Purpose of the Report

This FRA has been carried out in accordance with National Planning Policy Framework (NPPF) & PPG.

The report provides the following information in accordance with the NPPF:

- An assessment of the flood risk posed to the site based on flood information and mapping provided by the EA and Strategic Flood Risk Assessment (SFRA);
- An assessment of the proposed development in terms of surface water run-off; and
- Proposals for measures to mitigate the flood risks posed to and from the development where appropriate.

5.0 Report Information Sources

The information source used to undertake this FRA has been collected from the following sources:

- British Geological Survey Website & iGeology App
- EA Website & Data
- Arun District Council (ADC) Strategic Flood Risk Assessment (2008/2016 and as updated)
- ADC (Joint) Preliminary Flood Risk Assessment (2011 and as updated);
- West Sussex County Council as the Lead Local Flood Authority (LLFA) SUDS Policies and Guidance
- Internet mapping and searches.

6.0 Consultation

Where appropriate, the EA and local council will have been contacted to request any available and relevant flooding data.

7.0 Overview of British Legislation

7.1 National Planning Policy

The National Planning Policy Framework (NPPF) and NPPG supercede all Planning Policy Statements (PPS's) and Planning Policy Guidance (PPG's). Flood risk is retained as a key development consideration.



The Sequential and Exception Tests are retained. The accompanying NPPF Technical Guidance / NPPG also include Tables 2 and 3 to assist with flood risk vulnerability classifications and development suitability.

NPPG 2019, New Climate Change Allowances and Government & LLFA SUDS guidance compliant.

7.2 Local Policy

The Strategic Flood Risk Assessment (SFRA) is a key source of flood risk specific information for the area. The SFRA provides a more detailed review of flood risks and recommendations for ensuring developments can be constructed and operated safely in accordance with the NPPF. Greater detail of the SFRA is provided in the report where appropriate.

8.0 Site Status and Environmental Setting

8.1 Site Location and Status

The site is located to the south side of Lagoon Road and is currently occupied by an existing dwelling and outbuilding, soft and hard landscaping. Location plan included in Appendix A.

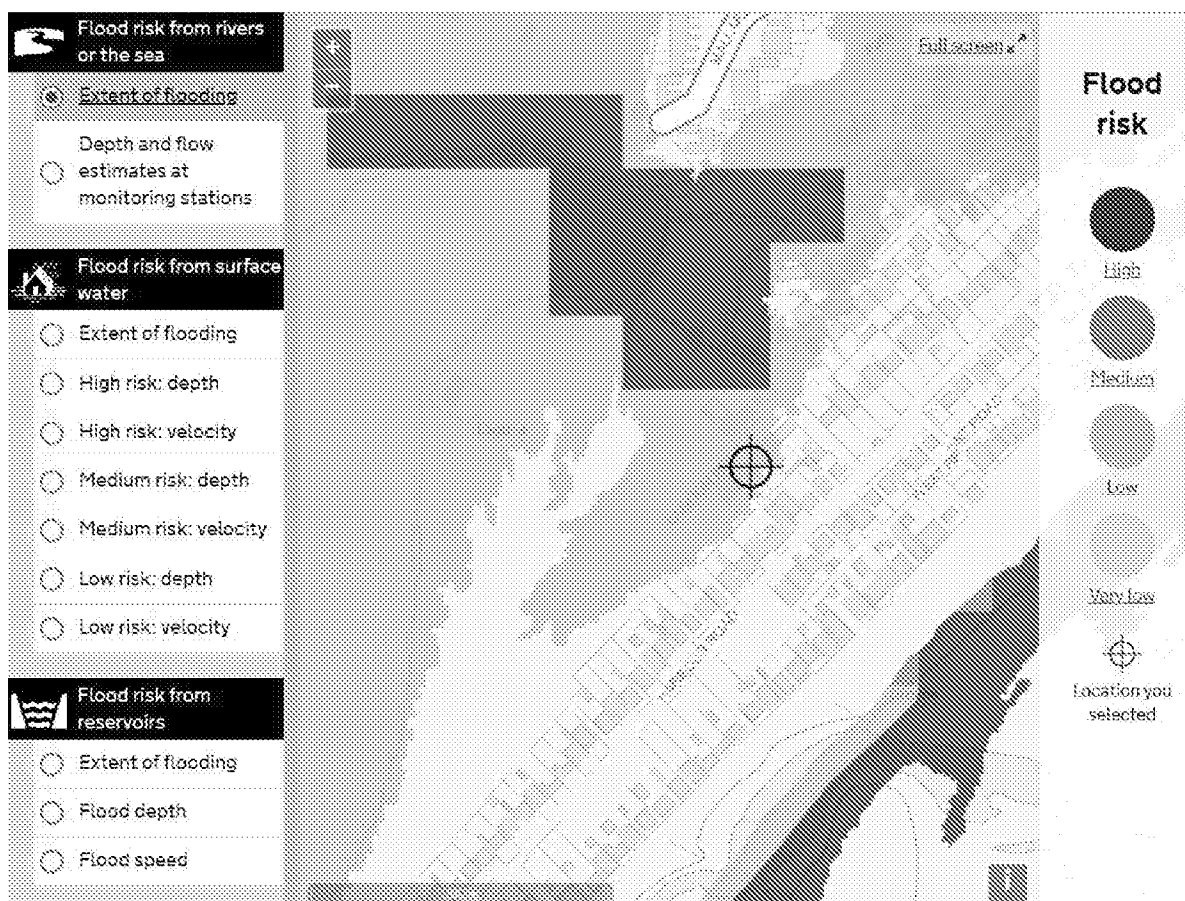
There is FZ1 within the site: the site is at the edge of FZ3 tidal.

8.2 Existing Flood Risk

Flood Sources	Site Status	Comment on flood risk posed to / from the development
Fluvial / Tidal	Site is in part Flood Zone 1 and part edge of FZ3 Tidal EA's LOW risk Pagham Lagoon located ~90m to north of site at closest point	Replacement dwelling is appropriate in FZ3 tidal and the scheme can incorporate suitable mitigation measures to address residual surface water risk and access to FZ1 in always LOW hazard. Raised ground floor above extreme event for lifetime of the scheme Results in better protected and flood future proofed dwelling than existing.
Groundwater	SFRA indicates site is on boundary of 50%-75% area and >75% area susceptible to groundwater flooding	Ground floor is raised above site level: suitable mitigation given this type of flood source The proposed development will not increase the risk of groundwater flooding; New slabs can be engineered / waterproofed appropriately to industry standard Non return valves and sump Low Risk
Artificial Sources	No artificial sources within 250m	Low Risk
Surface Water / Sewer Flooding	Site is in NO – VERY LOW hazard area Evacuation route which is to the north always in NO – VERY LOW hazard Condition, depth and location of surrounding infrastructure uncertain	Scheme can REDUCE FLOOD RISK OVERALL : see main sections below Development will utilise existing connection to sewers, gravity drainage and non-return valves Development will not increase the peak flow or volume of discharge from the site: Low Risk No further drainage assessment required
Climate Change including new allowances	Included in the flood modelling extents Site already partially within Flood Zone 3a, entire site by 2111	Development will not increase the peak flow and volume of discharge from the site Low risk posed to and from the development

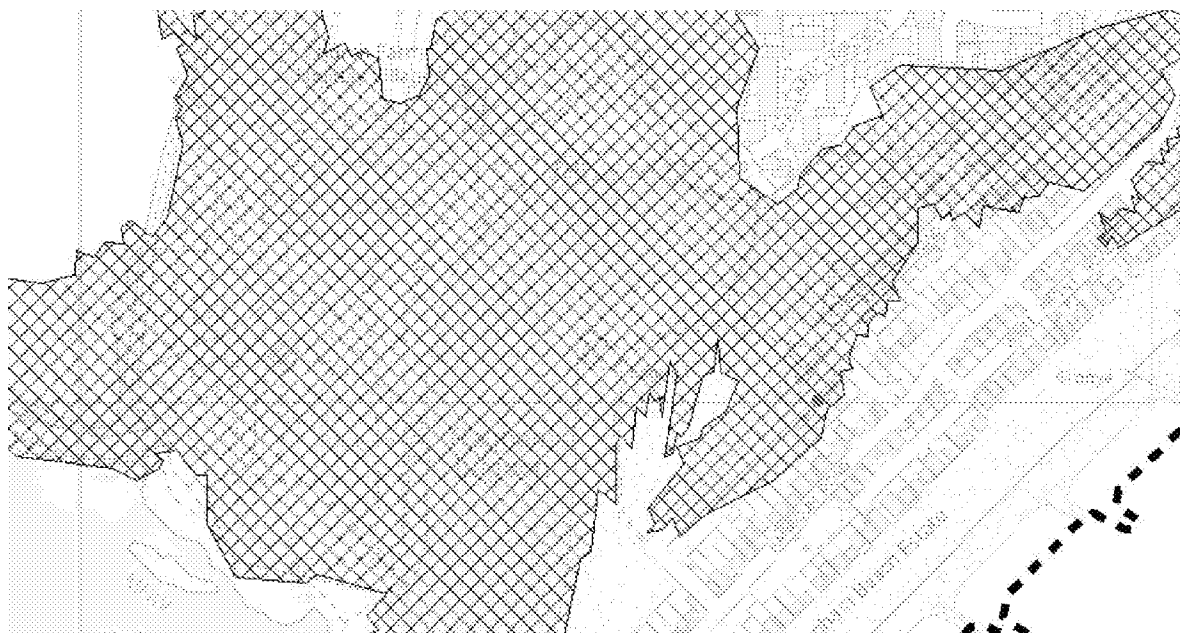


Site is in official EA LOW risk



Appendix G to SFRA Flood Warning Areas - Sheet 1 of 46

Area covered by Flood Warning Area (FWA) 065FWC2402

**Appendix F to SFRA Areas Susceptible to Groundwater Flooding - Sheet 1 of 46**

Development site on boundary of 50%-75% area and >75% area susceptible to groundwater flooding.



8.3 Geology (for SUDS)

Based on BGS mapping and surrounding adjacent boreholes:

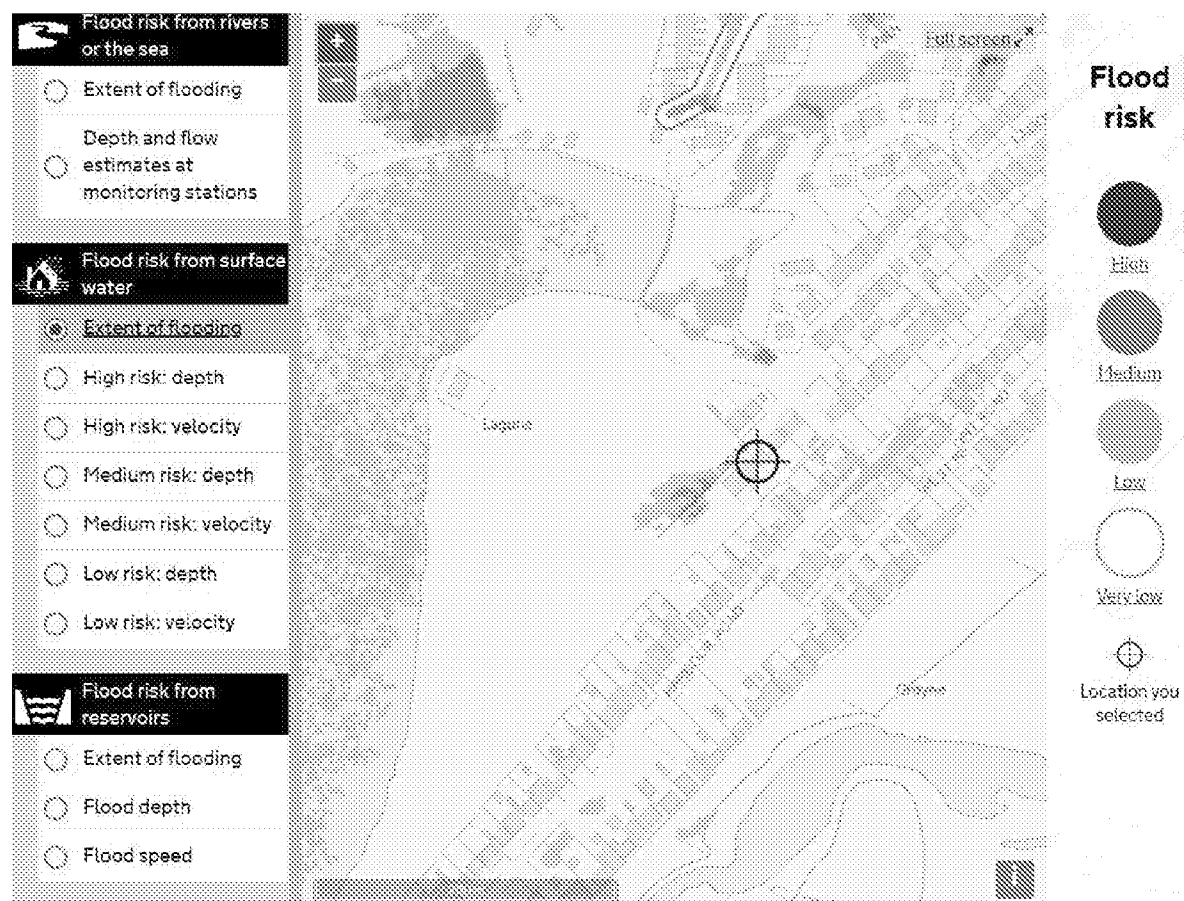
- Bedrock: London Clay formation – Clay Silt Sand.
- Superficial: Undifferentiated beach and tidal flat deposits – Clay Silt Sand Gravel

No lost / underground rivers documented at the site or near the site nor identifiable by the local geology mapping.

Infiltration is a) not likely feasible given London Clay as bedrock and b) not to be recommended given potential elevated groundwater; informal infiltration of porous areas to the below gravels is considered appropriate and accepted by ADC drainage engineers.

8.4 Surface Water Risk and Hazard Summary

- Property itself is not inundated:
 - In No hazard in all EA risk scenarios
- Access & Egress is always in NO hazard
- NO need for evacuation given surface water risk but still feasible
- Scheme will reduce this flood risk by reducing surface water discharge



8.5 SFRA / LFRMS Surface Water Mapping & Hazard

NOTE: the resolution of the SFRA and SWMP mapping is not appropriate to be site specific. The mapping corroborates the data in the more detailed mapping above.

- Floodwaters not likely to immediately reach or inundate the site
- Regardless: scheme can address this residual risk and **REDUCE FLOOD RISK OVERALL**

8.6 Detailed Site Specific Flood Levels: not available / relevant

Given the flood setting and proposed scheme, there is not a need to raise floor levels to above a standard guidance level for this specific site and flood setting.

There is FZ1 within the site: the site is at the edge of FZ3 tidal.

- There are no site-specific data.
- Further raising is in fact not feasible: see below
- If any more detailed data do become available, this does not alter the scheme or the flood risk assessment given those data will not affect the designs
- Replacement scheme: residential at this location is not in question as part of this planning application

If the EA object on the grounds of site specific data not being used, it indicates they have not read the report or understood the scheme or flood setting.

As per EA comments on various proximate applications: Harbour Road junction can be inundated in extreme tidal scenario hence to be considered in the evacuation / flood response plan.

8.7 Design Response: address SUDS hierarchy and climate change

- Replacement dwelling is located in EA LOW hazard
 - Dwelling has raised Ground FFL as high as is feasible to meet EA guidance
 - 300mm rise in ground FFL is considered appropriate given LOW hazard

DESIGNS TO REDUCE FLOOD RISK OVERALL

- Full flood resilience
- Maximise porous and permeable areas – significant betterment
- Highest forms of SUDS feasible and suitable for the site to be used for a previously un-attenuated site
 - Permeable and Porous areas
 - Granular subbase as necessary / feasible

This report demonstrates that the scheme can pass the Exception Test

- **Results in better protected and flood future-proofed dwelling than is existing**
 - **NPPF compliant**

8.8 For Clarity: Design Constraints: upper floor / further raising

It is not feasible to add an upper floor or to raise the ground floor further given planning constraints (existing and surrounding ridge / roof heights).

The scheme balances the requirements of planning, flood risk and EA guidance to ensure the scheme results in a **better protected and flood future-proofed dwelling than is existing.**

We write this again from experience of EA responses: if the EA object on not raising the ground floor further it suggests they have not read the report or understood the scheme or flood setting.

9.0 Assessment of Proposed Development

9.1 Proposed Development

The proposed development can be seen in Appendix B.

The proposed development comprises:

- Demolish existing dwelling and remove impermeable areas where appropriate
- Erect replacement dwelling with maximised porous / permeable areas
 - Increase in footprint is acceptable in FZ3 tidal: no flood compensation required
- Raised ground floor c. 300mm is appropriate response
- **Reduces flood risk overall**
 - New modern flood resilience – see below
 - New porous / permeable and granular storage if feasible – see below
- Given the site constraints and LOW hazard setting: further raised floor levels are not considered necessary

As an appropriate response, the site will operate as existing with an improvement based on the design:

- 1) robust resilient construction techniques in order to minimise the damage caused by water entry and also to reduce the time taken to return the property to use after a flood (see later sections)
- 2) Reduce flood risk overall with new lower water demand white goods: betterment of surface water management on the site as a result of the scheme where feasible

9.2 Drainage Connections & SUDS

Foul

The existing connections will be retained / new connections installed subject to agreement with the water company.

Surface Water

As per ADC Engineer (Drainage & Coastal) response to this planning application P/120/18/PL: no additional SUDS are considered necessary.

The scheme maximises porous and permeable areas.

Drainage to be designed and installed in accordance with Building Regulations

9.3 Pipe sizes / Manholes / Pipe runs

These will be confirmed as part of detailed designs; specifications of landscaping and drainage products need to be confirmed through Buildings Regs.

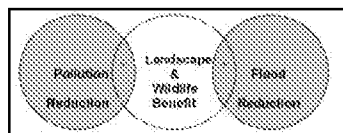
Not required at this stage to demonstrate scheme can accommodate the surface water flows or meet LLFA requirements.

9.4 SUDS Hierarchy Check

The scheme offers tangible benefit in that it maximises permeable / porous areas.

Concept SUDS Strategy

The following diagram indicates the philosophy behind the proposed SUDS strategy, and is taken from the EA's SUDS guidance:



(Source: Environment Agency, 2009)

Table 2 indicates the SUDS Hierarchy Appraisal for the site and proposed development:

Table 2: Site Specific SUDS Appraisal

SUDS Hierarchy	SUDS Technique	Potential Benefits			Site Specific	
		Flood Reduction	Pollution Reduction	Landscape & Wildlife Benefit	?	Scheme Specific SUDS Suitability Appraisal and Comment
Most Sustainable ↑ ↓ Least Sustainable	Living Roofs	•	•	•	*	Not likely feasible given nature of build
	Ponds / Basins	•	•	•	X	Site is a single dwelling plot; not necessary
	Swales	•	•	•	X	Site is a single dwelling plot; not necessary
	Infiltration Techniques	•	•		X	Soakaways not likely feasible or suitable given strata and flood setting and potential for elevated groundwater
	Permeable and Porous Surfaces with granular subbase storage if feasible and restricted discharge to sewer	•	•		✓	To meet LLFA Scheme can incorporate additional permeable surfaces with areas not covered by building
	Tanked Systems	•			*	Incorporated as necessary by drainage strategy to meet and better the LLFA requirements

Key:

Potentially suitable at the site: * Incorporated in the scheme: ✓ Not suitable / possible at the site: X

9.5 Flood Resilience

The proposed development will utilize the flood resilient techniques recommended in the NPPF Technical Guidance where appropriate and also the recommendations that have previously been issued by various local authorities:



As per previous correspondence with planning officers and as agreed:

The FRA provides the recommended resilient measures that can be incorporated, it will depend on the construction team as to what construction will actually need to be undertaken and what materials are used exactly. This does not invalidate the point and recommendations of this FRA. The FRA cannot simply specify the exact measures that need to be changed; they are not required of planning.

- Non-return valves as standard for ground
- Waterproofing to be tied in to ground floor slab as appropriate; details to be provided at detailed design to building regulations requirements: to reduce the turnaround time for returning the property to full operation after a flood event.
- Waterproofing to be installed above ground level as appropriate
- Plasterboards will be installed in horizontal sheets on ground levels rather than conventional vertical installation methods to minimise the amount of plasterboard that could be damaged in a flood event
- Wall sockets will be raised to as high as is feasible and practicable in order to minimise damage if flood waters inundate the property
- Any wood fixings on ground floor will be robust and/or protected by suitable coatings in order to minimise damage during a flood event
- Airbricks will be raised to as high as is feasible and practicable
- The Damp Proof Membrane / ground waterproofing will be installed above the main floor slab and tied in to the walls where appropriate, to reduce the turnaround time for returning the property to full operation after a flood event.

9.6 Refuge and Evacuation

Based on the likely flood risk and associated warning time, evacuation is usually preferred and feasible at this site, floodwaters are also not likely to enter the building; refuge is a preferred flood response for the upper dwelling.

Range of Flood Events

The site is in part FZ1, partly at the edge of FZ3 tidal and in EA LOW hazard; it is not in a rapid inundation zone. The evacuation and flood management does not need to consider this fastest type of flood inundation.

It is therefore considered likely that there would be sufficient time to evacuate to an area outside of the tidal flooding; there is also meteorological advanced flood warning with tidal sources at this location.

As per EA comments on various proximate applications: Harbour Road junction can be inundated in extreme tidal scenario hence to be considered in the evacuation / flood response plan.

Preferred evacuation route is:

- egress to the north to Lagoon Road
- continue east for c. 35m
- south for 10m: into FZ1 and reach Harbour Road
- Continue east and north on Harbour Road
 - Into unrestricted FZ1

All site users have access to the raised ground floor level and there is FZ1 to the rear of the site.

The property itself will be a modern protected and resilient dwelling as a result of the scheme.



9.7 Annual Monitoring

It is recommended that tenants should contact the EA on an annual basis to confirm the flood status of the property.

If the flood status has changed, the evacuation and refuge plan should be reviewed and updated by suitable flood risk consultants as appropriate.

9.8 Surface Water Runoff – Flood Risk from the Development

In accordance with the NPPF / NPPG, this FRA also considers the risks posed from the development to surrounding areas.

The scheme is compliant with ADC & LLFA SUDS policy. SUDS are commensurate with scale and sensitivity of scheme and as approved by ADC Drainage Engineer for this application: P/120/18/PL: maximise porous and permeable areas.

No additional SUDS are considered necessary.

The proposals will incorporate new low-water demand devices such that despite no likely increase in peak flow and volume of flow, this can be managed appropriately for the lifetime of the scheme.

Given the small scale of the proposed development it is considered likely that the development will have a negligible effect on surrounding infrastructure. There will not be any significant increase in overland flow from the site.

9.9 Climate Change including New Allowances

The impact of climate change in accordance with the NPPF / PPG is likely to be an increase in the rainfall intensity in the future, which will increase peak storm flows to sewer. The proposed development will incorporate low flush and reduced water demand showers and toilets, such that the combined flows to sewer are likely to have a negligible impact. It is considered therefore that flows in the future are not likely to have a significant impact, even with an allowance for climate change.

There is unlikely to be an unacceptable impact on the receiving sewers owing to the small scale of the development and the fact that the scheme reduces discharge rates from the site.

The scheme retains existing and includes new porous / permeable areas to address residual surface water risk and to encourage storage within the site.

The EA data incorporate likely increases in flood levels including an accommodation for climate change.

10.0 Flood Storage

It is considered that flood compensation is not required given the footprint is wholly within tidal floodplain.

11.0 Conclusion

The EA website map, SFRA and available data indicate the proposed development site is within EA Flood Zone 1.

The proposed development is categorised as “More Vulnerable” in accordance with the NPPF; it is therefore an appropriate type of development within EA Flood Zone 1 without the need to pass the Exception Test.

The proposed scheme has the ability to REDUCE FLOOD RISK OVERALL:

- **Results in better protected and flood future-proofed property than is existing**
- Fully NPPF and LLFA compliant
- New modern resilient and resistant building construction techniques
- SUDS commensurate with scale and sensitivity of scheme and as approved by ADC Drainage Engineer for this application: P/120/18/PL

Based on the likely flooding risk, it is considered that the proposed development could be constructed and operated safely in flood risk terms and is therefore appropriate development in accordance with the NPPF/NPPG.

12.0 Appendices

- A. Site Location & Existing Layout
- B. Proposed Development Plans