Waterman Civils
Consulting Engineers

T.P. OFFICE COPY

BOROUGH OF WORTHING
DEPOSITED 17/12/07
TP REF NO
WB / 07 / 1511/FUL

28 & 30 Marine Drive, Goring-by-Sea, BN12 4QN

Flood Risk Assessment

for

Leslie Christopher Homes Ltd

WORTHING BOROUGH COUNCIL
14 MAY 2008
CONSENT GRANTED
SUBJECT TO CONDITIONS

30th November 2007

Report reference: 37075/FRA/F4

Dippen Hall, Eastbourne Road, Blindley Heath, Lingfield, Surrey, RH7 6JX
Tel: 01342 893800 Fax: 01342 894212
E-mail: wbc@waterman-group.co.uk www.waterman-group.co.uk

Contents

Section	Title	Page
	Executive Summary	**3**
1	**Introduction**	**4**
2	**Site Description**	**8**
3	**Proposed Development**	**10**
4	**Flood Risk Assessment (upon site)**	**11**
5	**Assessment of Consequences of Flooding (Exception Test)**	**16**
6	**Flood Risk Assessment (of proposals upon flooding elsewhere)**	**16**
7	**Sustainable Drainage Systems (SuDS)**	**17**
8	**Conclusions**	**21**
9	**Principal Recommendations**	**21**

Appendices

A	**Environment Agency Correspondence**
B	**Development Proposals**
C	**Southern Water Information**
D	**Flood Risk Pro-Forma**

Rev	Date	Purpose	Notes
P1	07 Aug '07	Preliminary Issue for comment	
P2	08 Aug '07	Preliminary issue	
F1	09 Aug '07	Planning issue	
F2	13 Aug '07	Planning issue	Sewer record info added.
F3	30 Nov '07	Revised planning issue	Layout amended. Flood displacement included
F4	04 Dec '07	Revised planning issue	LGF layout drawing changed

Prepared by:		Approved by:	
	N J Price		S B Jackman
Position:	Associate Director	Position:	Divisional Director
Date:	03rd Dec 2007	Date:	03rd Dec 2007

This document has been prepared for the titled project or named part thereof and should not be relied upon or used for any other project without an independent check being carried out as to its suitability and prior written authority of Waterman Civils Ltd being obtained. Waterman Civils Ltd accepts no responsibility or liability for the consequence of this document being used for a purpose other than the purposes for which it was commissioned. Any person using or relying on the document for such other purpose agrees, and will by such use or reliance be taken to confirm his agreement to indemnify Waterman Civils Ltd for all loss or damage resulting therefrom. Waterman Civils Ltd accepts no responsibility or liability for this document to any party other than the person by whom it was commissioned.

To the extent that the report commissioned is to be based on information supplied by other parties, Waterman Civils Ltd accepts no responsibility for any loss or damage suffered by the Client, whether contractual or tortuous, stemming from any conclusions based on data supplied by other parties other than Waterman Civils Ltd in preparing this report.

EXECUTIVE SUMMARY

It is proposed to re-develop two sea-front properties into 8 apartments over 3 floors, including the Ground Floor. A Lower Ground Floor will accommodate car parking and storage.

The site is at risk of tidal flooding by the sea overflowing the bund at the back of the foreshore and being trapped in the behind the bund. The tidal flood level has been assessed as being 5.5m AOD. Other, small risks from overland flooding and lack of drainage have also been identified.

Although the 5.5m AOD level includes allowances for sea level rise, it does not include waves, so it is prudent to set a flood defence level for the site of 5.8m AOD.

Mitigation measures can be used to prevent the premises from being flooded. These include either raising the Ground Floor level to above 5.8m AOD or providing a flood wall to this level, with any openings fitted with flood gates.

The Lower Ground Floor can be further protected by extending the retaining walls to at least 5.8m AOD and installing a pump to deal with any rainfall or water ingress.

Contingency plans should be formulated and residents provided with instructions about what to do during a flood.

Due to tidal flooding being predictable and short duration, the stress of being flooded upon occupants should be low. As the depth of flooding at the northern end of the site is shallow, evacuation and provision of emergency assistance during a flood event is considered not to be hazardous. Therefore the consequences of a flood upon the residents of the re-development (the "Exception Test") are acceptable.

The existing site is already walled and gateways would be sandbagged in the event of flooding. Therefore the existing site would not store any floodwater and so the proposals do not increase the risk of flooding elsewhere due to displacement.

The use of SuDS techniques for draining the site means that the proposed development should reduce the risk of flooding elsewhere when compared with the existing situation. SuDS measures proposed include permeable construction over the Lower Ground Floor and draining the roofs and balconies as slowly as possible.

Rainwater harvesting should also be considered.

1 INTRODUCTION

1.1 It is proposed to demolish two existing sea-front properties and redevelop the site with apartments, including a basement car park.

1.2 The Environment Agency (EA) have advised that the site is at risk of tidal flooding and their letter is attached in Appendix A. This Flood Risk Assessment addresses this concern.

1.3 This report is based upon the proposals submitted for planning.

1.4 The location of the 0.19 Ha site is shown in figure 1.

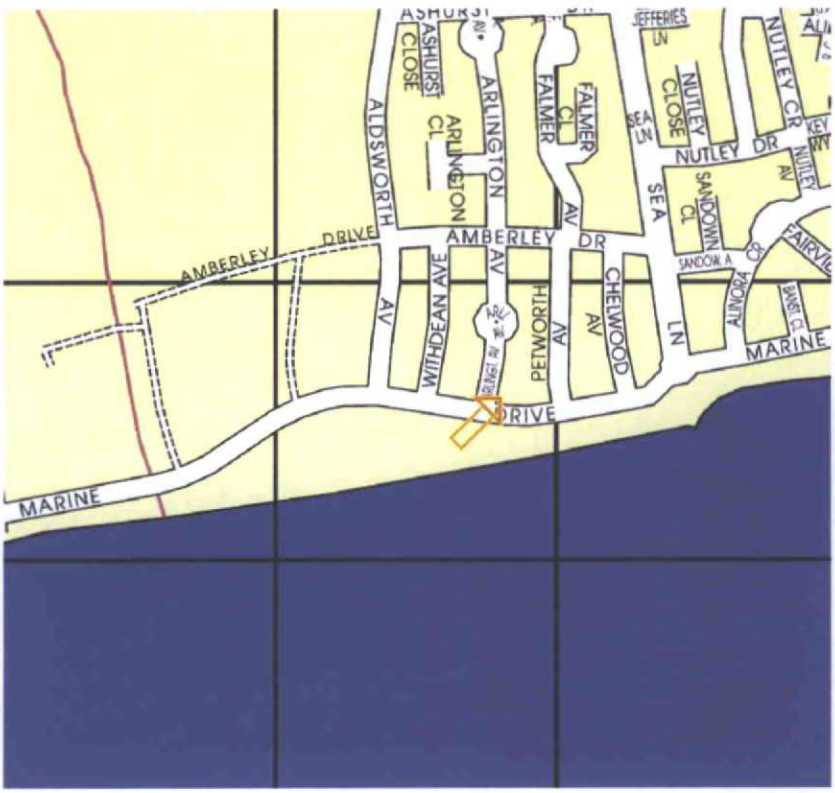


Figure 1a. Location map. 500m grid

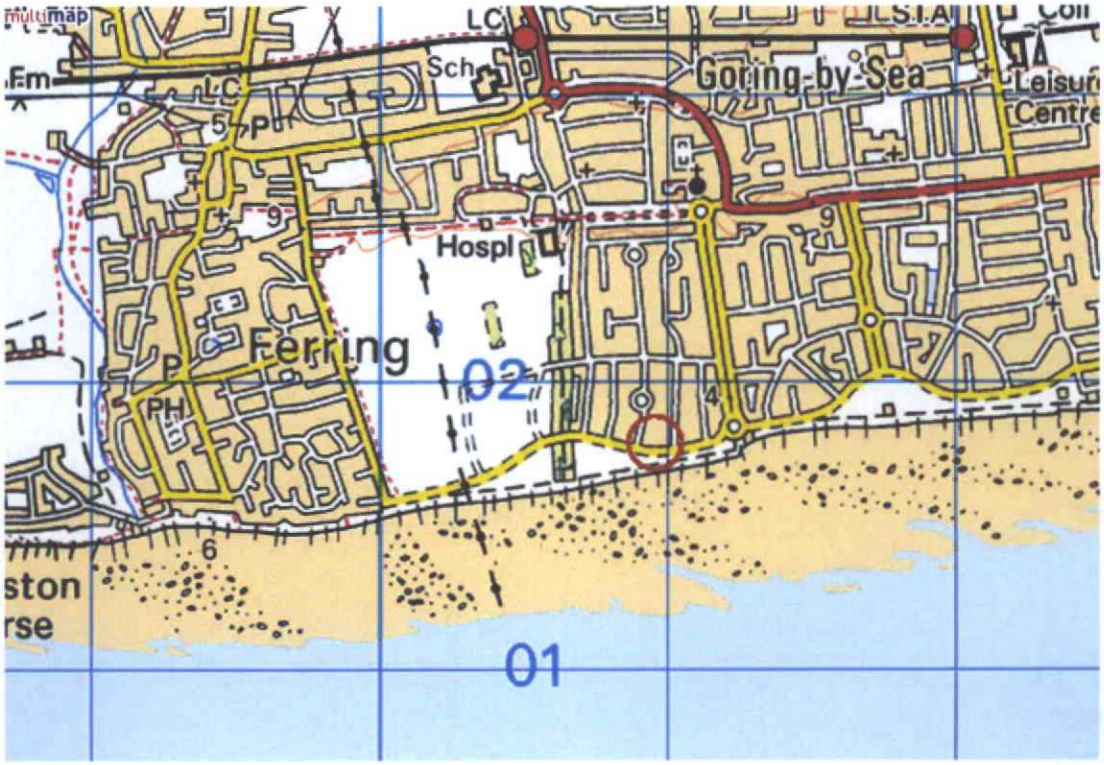


Figure 1b. Location map. 1 km grid

1.5 The site is shown in the aerial photograph in figure 2.

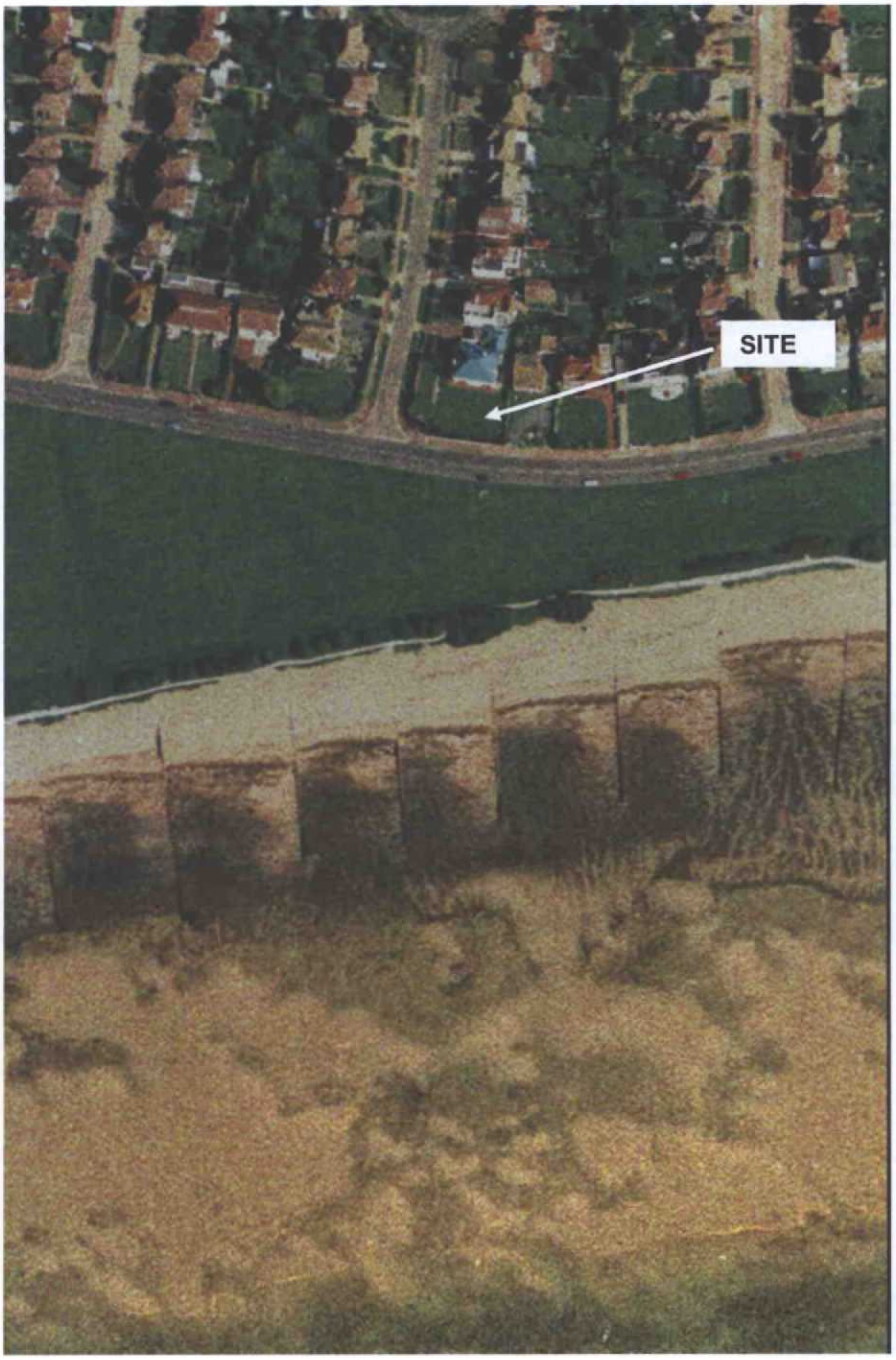


Figure 2. Aerial photograph

Planning Guidance

1.6 This report takes account of the recommendations of PPS 25 "Development and Flood Risk" and its Practice Guide Companion. The purpose of the report is to establish whether:

A. the site is at risk of flooding, and
B. the proposed development increases the risk of flooding elsewhere

and consequently to make appropriate recommendations.

1.7 This report makes proposals for the surface water drainage of the site, taking account of CIRIA document C522 "Sustainable Urban Drainage Systems – Design Manual for England and Wales" and the Interim Code of Practice for Sustainable Drainage Systems.

1.8 The development site lies within Flood Zone 1 which has been designated by the Environment Agency (EA) as being at risk of flooding so although the area is less than 1 Ha, PPS 25 (clause E9) states that a Flood Risk Assessment (FRA) should be undertaken.

2 SITE DESCRIPTION

2.1 The site was visited on 2nd August 2007. The weather was dry, following an extended period of wet weather.

2.2 The general fall of the land is from north to south. There is also a west-to-east fall along Marine Drive, from a high point at Aldsworth Avenue to a low point at Chelwood Avenue, from where the land rises towards Sea Lane. The gradients are illustrated in figures 3, 4 & 5, with the blue arrows indicating surface gradient.



Figure 3. View of site from north along Arlington Avenue



Figure 4. Looking eastwards along Marine Drive



Figure 5. Looking westwards along Marine Drive

2.3 Between the site and the sea there is a grassed area, with a raised bank at the edge of the sea, as shown in figures 6 and 7.



Figure 6. View across Marine Drive towards the sea, showing grassed area



Figure 7. Raised bank at edge of sea from land side

2.4 The topography means that Marine Drive is in a bowl, relying upon drainage to prevent flooding.

2.5 There were no signs of watercourses in the vicinity of the site, so it is assumed that the area is drained by surface water sewer.

2.6 There are no indications of springs or other groundwater issues in the area. There were no indications that the shingle bank is permeable (ie. there were no signs of seepage through the grassed face).

2.7 The roads in the area are drained by gulleys.

2.8 The existing properties are enclosed within substantial walls.

3 PROPOSED DEVELOPMENT

3.1 The proposed development comprises 8 apartments arranged over three floors, including the Ground Floor, above a Lower Ground Floor used for car parking and storage.

3.2 Therefore the proposals would be classified under PPS 25 Table D2 as being "More Vulnerable".

3.3 A drawing of the proposed re-development is given in Appendix B.

3.4 Pedestrian access into the development is from Marine Drive, at a level of approximately 5.0m AOD. This is 0.5m lower than the predicted tidal flooding level.

3.5 The entrance into the Lower Ground Floor is off Arlington Avenue, at a level of approximately 5.5m AOD. This is the same level as the predicted tidal flooding.

4 FLOOD RISK ASSESSMENT (UPON SITE) "SEQUENTIAL TEST"

4.1 SOURCES OF FLOODING

4.1.1 There are several potential sources of flooding for this site, which have been identified as:

- tidal
- river (fluvial);
- overland flows;
- sewer flooding;
- lack of drainage (pluvial);
- groundwater; and
- infrastructure failure.

4.2 TIDAL

4.2.2 The Environment Agency's Indicative flood map, shown in Figure 8, indicates that the site is located in Flood Zone 1 (un-coloured). This suggests that the site is at little or no risk of flooding, with an annual predictability of less than 0.1% (1:1000 year return period). However, the EA letter of 27 July 2007, attached in Appendix A, provides additional detail for this area. It explains that a storm surge would overtop the shingle bank between Marine Drive and the sea, leading to an estimated flood level of 5.50m AOD. This flood level takes account of climate change and sea level rises but not waves. Therefore the site is classified as being in Flood Zone 3a.

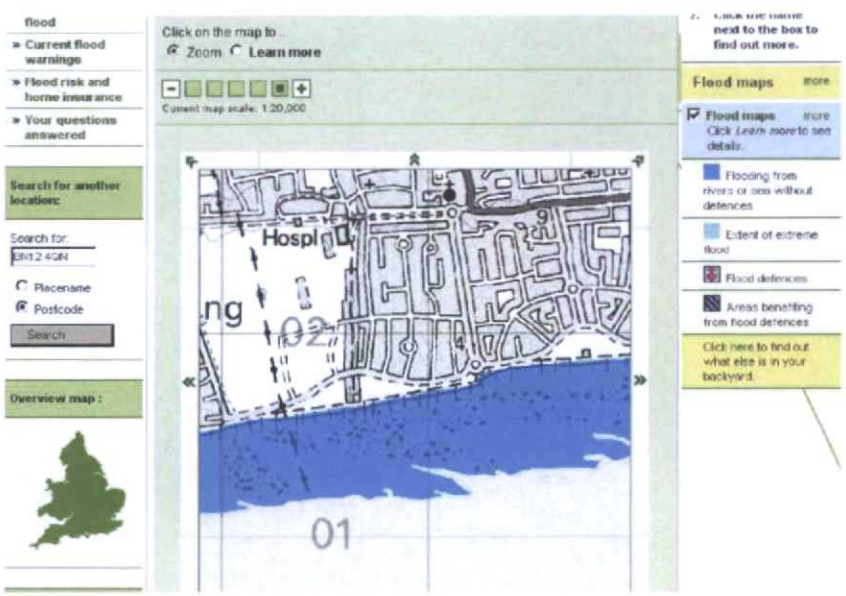


Figure 8. Environment Agency Indicative Flood Plain Map

4.2.3 The ground level of the site rises from approximately 5.00m AOD at Marine Drive to approximately 5.5m AOD at the northern boundary of the site. Therefore part of the site would be flooded during a tidal surge, by up to 0.5m. This would then fill the Lower Ground Floor.

Conclusion: Risk of tidal flooding.

4.2.4 The flood level does not take account of waves etc, so it would be prudent to add a freeboard to this level of, say, 300mm to the design of any flood mitigation measures, ie. a level of 5.80mAOD.

4.2.5 The risk of a tidal flooding in the living accommodation is best mitigated by raising the ground floor level to a minimum of 5.80m AOD.

Recommendation: Minimum ground floor should be 5.80m AOD, if practicable.

4.2.6 Due to restrictions on the height of the building, the FFL cannot be raised to 5.8m AOD. An alternative would be to use flood resistant construction below 5.80m AOD. However, due to the presence of patio doors that cannot effectively be made flood-resistant, protection can be provided to the whole site by means of a perimeter wall, with a top level of not less than 5.8m AOD. Because the maximum height of flooding is low and the duration short, any seepage through the wall and any rainfall can be accommodated in the low part of the site; a pump discharging over the wall will give increased protection. Any gates should be protected by flood gates. The flood wall should be designed to resist full hydrostatic pressure,

Recommendation: If ground floor cannot be raised to 5.80m AOD, flood walls around the site boundary to be used up to at least 5.8m AOD, with flood gates.

4.2.7 The use of a flood wall around the site boundary, with a flood gate at the vehicle entry similar to the one illustrated in figure 9, will also protect the Lower Ground Floor from flooding. Additional security may be provided by raising the ramp retaining walls to at least 5.80m AOD to prevent any water that may get onto the site from entering the open section of ramp (eg. due to overtopping, breach or pedestrian gate not being closed). The disadvantage of flood gates is that they rely upon human intervention to close them when a storm surge is forecast; automation would reduce the risk (but not eliminate it due to breakdown, power failure etc) and would also provide security. A lower cost alterative to flood gates would be dam boards or stop logs; these have additional disadvantages of needing to be stored when not in use and being slower to employ.

Recommendation: Walls to ramp should be constructed in watertight concrete designed to BS 8007 and with a minimum top level of 5.80m AOD.

Recommendation: Entrance to ramp to be protected with automated flood gates.



Figure 9. Flood gates

4.2.8 In order to deal with rainfall into the open part of the ramp and any leakage through the flood gate, drainage should be provided at the bottom of the ramp. This should be connected to a pumped system that discharges above the 5.8m level, to avoid backflow. The pump discharge can be to an open area and does not necessarily need a direct connection to drain.

Recommendation: Pumped drainage to be provided at base of ramp.

4.2.9 It would be prudent to install an automatic alarm to warn of the presence of water in the basement, so that the flood gates can be closed (if safe to do so). The alarm would not only warn of tidal flooding but any other form of water ingress, such as a burst water pipe within the building. A contingency plan should also be prepared to outline the measure to be taken in the event of various flooding scenarios.

Recommendation: Provide an automatic alarm in basement.

4.3 RIVER FLOODING

4.3.1 There are no watercourses in the vicinity of the site. The nearest watercourse is the un-named stream approximately 2km to the west.

4.3.2 The Environment Agency's Indicative flood map, shown in Figure 8, indicates that the site is located in Flood Zone 1 (un-coloured). This suggests that the site is at little or no risk of fluvial flooding, with an annual predictability of less than 0.1% (1:1000 year return period).

Conclusion: Risk of being flooded from rivers is acceptable using PPS25 criteria

4.4 OVERLAND FLOWS

4.4.1 A large area of land falls towards the site, from at least Ashhurst Drive, a distance of about 1km and around 200m wide. If the flow exceeds the capacity of the drainage system, overland flow would occur down

Arlington Avenue, then eastwards along Marine Drive. The site is protected by the back of the footway being higher than the road channel level. The bowl-shaped area described in Section 2, would gradually fill but the capacity of the bowl is considered to be sufficient to balance the flow before flooding of the site occurs.

Conclusion: Small risk of overland flooding onto the site.

4.4.2 Because Arlington Avenue will act as a flood route in times of extreme rainfall, the vehicle access into the site should be no lower than the existing back of kerb level.

Recommendation: Vehicle access into site to be no lower than existing back of kerb level.

4.5 SEWER FLOODING

4.5.1 Southern Water record sewer records are attached in Appendix C. These show that the site is drained by a surface water sewer that flows eastwards along Marine Drive, presumably to a sea outfall protected with a tide flap. The manhole on the junction of Marine Drive and Petworth Avenue is the low point of the sewer, so any surcharging would be expected to occur here, with flow coming out of the road gulleys; surcharge flows would then flow westwards down Marine Drive. Therefore flooding from surface water sewer is not considered to be a risk.

4.5.2 However, if the area is flooded from the sea, sewers and drains will back up to flood level. Therefore, any open drains (eg. gulleys) should be sited above the flood level of 5.8m. If this is not possible, then drains should be pumped above this level or anti-flooding valves installed.

Conclusion: Risk of backflow through drains.

Recommendation: Open drains should be above 5.8m AOD. Pumps or anti-flooding valves should be fitted to any drains below 5.8m AOD.

4.5.3 The foul sewer runs eastwards along Marine Drive. Assuming that the covers do not lift in Marine Drive, any surcharging would result in flows coming out of the connections to the properties along Marine Drive. However, the precautions against backflow through drains during tidal flooding will also protect against sewer flooding, so this risk may be ignored.

4.6 LACK OF DRAINAGE (PLUVIAL FLOODING)

4.6.1 Lack of drainage can be a problem where the topography is bowl-shaped and relies upon drainage to prevent flooding. The area is such a bowl-shape but the capacity of the bowl is considered to be sufficient to balance the flow before flooding of the site occurs, even when tide levels effectively mean that drainage capacity is restricted.

Conclusion: Risk of site flooding due to lack of drainage.

4.6.2 The measure in place to prevent tidal flooding will also mitigate against the effects of pluvial and overland flooding.

Conclusion: No additional mitigation needed for pluvial and overland flooding.

4.7 GROUNDWATER FLOODING

4.7.1 Groundwater levels can be assumed to follow the general ground contours down to mean sea level. There is no reason to suspect that there is anything in the ground to cause the springs to appear (eg. an impermeable stratum across the gravel).

Conclusion: Assumed to be no risk of site flooding from groundwater.

4.7.2 This does mean that the basement is likely to in the groundwater. As the basement needs to be constructed in watertigtht concrete to prevent ingress of tidal flooding, this should also cater for the groundwater.

Conclusion: Basement at risk of groundwater ingress.

Recommendation: Basement to be constructed in watertight concrete designed to BS 8007 against a minimum water level of 5.80m AOD.

4.7.3 The basement should be designed against flotation. Because the uplift forces can be calculated with confidence, only a small factor of safety is necessary. However, consideration needs to be given to the risk of flooding occurring after the basement has been built and before the superstructure has been constructed; this may mean having to flood the basement to prevent flotation.

Recommendation: Basement to be designed against flotation caused by a water level at 5.80m AOD.

4.8 INFRASTRUCTURE FAILURE

4.8.1 No reservoirs or water retaining structures have been identified in the area (whose failure could cause site flooding).

Conclusion: No risk of infrastructure failure which could cause site flooding.

5 ASSESSMENT OF CONSEQUENCES OF FLOODING ("EXCEPTION TEST")

5.1 Section 4 has identified that there is a risk of the site being flooded, with tidal flooding being the principal source. However, Section 4 also identifies mitigation measures that may be used to prevent the premises from being flooded. This section examines the acceptability of the proposals within a flood zone from a health and safety viewpoint, referred to as the "Exception Test".

5.2 The worst case flood level, caused by tidal flooding, is 5.5m AOD. By its nature tidal flooding is relatively short lived (with there normally being around 6 hours between high and low tides, so tidal flooding may be expected to last a around an hour each side of high tide) and predictable.

5.3 The short duration of flooding and its predictability means that residents can prepare for flooding and therefore will suffer far less trauma than other flood victims.

5.4 The maximum depth of water at the northern site boundary on Arlington Avenue will be in the order of 0.1m, so evacuation and emergency assistance during a flood is not a problem.

5.5 It is concluded that the consequences of a flood upon the residents of the re-development are acceptable.

Conclusion: Consequences of flooding acceptable.

6 FLOOD RISK ASSESSMENT (OF PROPOSALS ON FLOODING ELSEWHERE)

6.1 TIDAL

6.1.1 The houses are protected by substantial walls. In the event of a tidal flood warning, entrances will be sandbagged so the existing site will not accommodate any floodwater. Therefore the proposals will not make the tidal flooding any worse.

Conclusion: Tidal flooding will not be affected.

6.2 SEWERS AND WATERCOURSES

6.2.1 The existing hardened area of the two houses and hardstandings is 678m²; this will increase to 772m² plus a further 157m² over the new basement. Without mitigation, the increased hardening will increase the amount of surface water drainage and could increase the risk of flooding elsewhere.

Conclusion: Without mitigation, increased surface water run-off increases flooding risk elsewhere.

6.2.2 The increased hardening can be mitigated by using Sustainable Drainage Systems, as described in Section 7.

6.3 GROUNDWATER

6.3.1 The proposed basement will have local effect upon groundwater flows. However, as the size of the basement is relatively small, the effects are considered to be negligible.

Conclusion: Groundwater will not be significantly affected.

6.4 OVERLAND FLOW

6.4.1 Overland flows will not be altered and therefore there will be no increase in flood risk elsewhere.

Conclusion: Overland flow will not be affected.

7 SUSTAINABLE DRAINAGE SYSTEMS (SuDS)

7.1 Sustainable Drainage Systems (SuDS) principles can be thought of as replicating as far as possible the site drainage prior to any development. The greenfield runoff (ie. the overland flow off the site before any development occurred) would be in the order of 0.1 l/s, which is a very low rate.

7.2 Currently the site is assumed to be drained to surface water sewer, with soft landscaping being undrained, allowing rainwater to soak into the ground. It is proposed to also drain the redeveloped site to sewer, with soft landscaping being undrained.

7.3 Types of SuDS techniques that could be used to minimize drainage flows from it are listed in Table 7.1, together with their suitability. (based upon HR Wallingford report SR666 "Use of SUDS in High Density Developments").

Table 7.1. SuDS measures for high density developments

SuDS technique	SuDS description	Likely suitability for this development
Rainwater harvesting	Storage for irrigation or domestic use (toilets etc)	Particularly suitable to reduce volume discharged but current EA policy is not to reduce drainage requirements, therefore could be an additional cost.
Permeable pavements	Car parks (and potentially minor roads) and other paved surfaces which provide storage of rainwater in the underlying construction	Suitable but will act principally as attenuation above basement and assumed high groundwater and low permeability sub-soil.

SuDS technique	SuDS description	Likely suitability for this development
Filter drains	Linear drains/trenches filled with granular material, often with a perforated pipe in the base of the trench	Less suitable due to presence of assumed high groundwater and low permeability sub-soil but may be useful for improving water quality and reducing catchment response to low intensity rainfall.
Filter strips	Vegetated strips of gently sloping ground designed to drain water using sheet flow from roads and parking areas	Not applicable as no above-ground roads or parking.
Swales	Shallow vegetated channels that conduct and infiltrate runoff. The vegetation filter sediments	Unsuitable in domestic scale development.
Ponds	Areas of permanent water used for storing and treating runoff. They are also used to attenuate runoff. They have a permanent pool and usually some aquatic vegetation.	Suitable.
Wetlands	Similar to ponds but the runoff flows slowly and preferably continuously through aquatic vegetation. They are less suited to use as attenuation structures	Unsuitable due to scale in this urban context.
Detention basin	Vegetated depressions designed to store water to meet specific attenuation requirements.	Unsuitable in domestic scale development.
Soakaways	Sub-structures that infiltrate runoff	Unsuitable due to presence of assumed high groundwater table and low permeability sub-soil plus need for 5m clearance from foundations.
Infiltration trenches	As soakaways but provided as a trench	Unsuitable due to presence of assumed high water table and low permeability sub-soil.
Infiltration basins	Depressions that store and dispose of water via infiltration.	Unsuitable due to presence of assumed high groundwater and low permeability sub-soil.

SuDS technique	SuDS description	Likely suitability for this development
Green roofs	Vegetated roofs that reduce the volume and rate of runoff and remove pollution	Very suitable for reducing volume of runoff but current EA policy is not to reduce drainage requirements, therefore could be an additional cost.
Bioretention areas	Vegetated areas similar to swales but with emphasis on a variety of vegetation, including the use of wetland plants. Greater emphasis on treatment.	Unsuitable due to scale in this domestic context.
Underground storage	Oversized sewers or attenuation tanks to reduce stormwater runoff rate.	Suitable.
Proprietary drainage units	Range of units: screens, propriety sedimentation units etc	Suitable.
Pipes and manholes	Conduits and their accessories normally underground as conveyance measures.	Suitable.

7.4 From Table 7.1, the SuDS techniques that would be most suitable for this development are:

- permeable construction above the basement, which allows rainwater that falls on this area to soak into the construction and then flow sideways in the adjacent soft landscaping and infiltrate, albeit slowly;
- draining the roof very slowly.

Recommendation: Use permeable construction over the basement.

7.5 The flat roofs and balconies provide an opportunity to attenuate rainfall where it lands. This can be simply accomplished by installing a small outlet and downpipe (DN50 is considered to be a practical minimum), temporarily storing the water on the roof or balcony.

7.6 On the main roof, a green roof construction would also minimize the volume of discharge, as a large percentage of the rainfall will be absorbed and then evaporate or be transpired. The green roof would also increase insulation and provide habitat similar to the foreshore habitat lost by development. However, the use of a green roof has been ruled out as being unsympathetic to the style of development.

7.7 The balconies could incorporate raised pavings to accommodate rainfall until it drains away.

Recommendation: Attenuate rainfall on roofs and balconies.

7.8 Rainwater harvesting of the roof drainage should be considered, where the roof drainage would be stored in underground tanks and then used for toilet flushing. This would not only reduce the volume of surface water discharged but also the volume of potable water needed. Unfortunately, the current Environment Agency policy is for both of these techniques to be ignored for the purposes of drainage calculation (ie. assumes that the rainwater harvesting or greenroof capacity is full when a severe rainfall event takes place). This makes it difficult to make a financial case for their inclusion and means that there will be a reluctance to use these techniques which do provide drainage benefits for the majority of rainfall events in addition to other benefits, such as reduction in mains water consumption and provision of habitat. However, exemplar projects are using these techniques and there is a move for rainwater harvesting to become mandatory in London, which if adopted will probably become the norm for other parts of the south-east.

Recommendation: Consider the use of rainwater harvesting.

7.9 If rainwater harvesting were to be used, the use of attenuation on balconies and roofs would be unnecessary, other than to provide habitat using the green roof.

7.10 Even if rainwater harvesting is not adopted, then it would be useful for the roof drainage to discharge to rainbutts, with an overflow to sewer, for use in irrigation.

Recommendation: Discharge roof drainage via water butts if rainwater harvesting is not used,

7.11 By inclusion of the SuDS techniques described above, the runoff from the site will be no greater than the existing and as close as practicable to greenfield runoff. Therefore, the proposed development will not increase the risk of flooding elsewhere.

Conclusion: Risk of flooding elsewhere not increased.

8 CONCLUSIONS

8.1 Having considered the potential flood risks to the site, there is a potential tidal flood risk from the sea overflowing the shingle bund and being trapped in the behind the bund. There are also other, smaller risks from overland flooding and lack of drainage, which will also be covered by the mitigation proposed against the tidal flooding.

8.2 Mitigation measures can be used to prevent the premises from being flooded.

8.3 The consequences of a flood upon the residents of the re-development (the "Exception Test") are acceptable.

8.4 The use of SuDS techniques for drainage the site means that the proposed development should reduce the risk of flooding elsewhere compared to the existing situation.

9 PRINCIPAL RECOMMENDATIONS

9.1 The Ground Floor level should ideally be set no lower than 5.8m AOD. However, this is not practical so a flood wall around the site boundary should be provided, with a top level of not less than 5.8m AOD. All openings below 5.8m AOD should be fitted with flood gates.

9.2 Additional protection should be provided to the Lower Ground Floor by extending the retaining walls on the open section of the ramp to above 5.8m AOD and a flood barrier across the entrance. A pump should be installed to deal with any ingress.

9.3 Open drains should be above 5.8m AOD. Pumps or anti-flooding valves should be fitted to any drains below 5.8m AOD.

9.4 The ground above the basement could be permeable, in order to allow attenuation and sideways flow into the adjacent soft landscaping, where it can infiltrate.

9.5 Rainwater harvesting should be considered.

9.6 If rainwater harvesting not used, rainfall should be attenuated on the roof and balconies. Rainwater butts should be installed.

9.7 Contingency plans should be formulated and residents provided with instructions about what to do during a flood.

APPENDIX A

ENVIRONMENT AGENCY CORRESPONDENCE

Mr P Devonport
Worthing Borough Council
Planning Policy
Portland House Richmond Road
Worthing
West Sussex
BN11 1LF

Our ref: SX/2007/102898/02-L01
Your ref: WB/07/1078/FULL

Date: 20 November 2007

Dear Mr Devonport

DEMOLITION OF 28 & 30 MARINE DRIVE AND THE ERECTION OF 8 RESIDENTIAL UNITS AND UNDERGROUND CAR PARKING.
28 & 30 MARINE DRIVE, WORTHING

We refer to our letter dated 9 November in which we recommended you not to grant planning permission until the developer has estimated the level of flooding with and without the development. The main reason for making the estimate was to ensure no exacerbation of the depth of flooding experienced by neighbours if the flood wall included in the development were to displace floodwater from the development site. Another reason was to confirm the minimum level of the perimeter wall (or the minimum level of the habitable rooms if the wall was omitted).

We can **REMOVE** our recommendation not to grant permission on grounds of flood risk as described below.

Waterman Civils, the company which prepared the Flood Risk Assessment (FRA), emailed us on 12 November, stating that there is an existing flood wall at the site boundary, the gaps in which could be sandbagged during a flood. Waterman Group argued that floodwater already is excluded from the site, so floodwater displacement from the development is not relevant. Having visited the site, we conclude this is a reasonable supposition.

We remain uncertain about the future flood level at the site, as although the 0.5% annual probability sea level predicted is 5.5 metres above Ordnance Datum (m AOD), it is unclear if an elevated inland level would occur for instance due to the tidal defences being breached or overtopped by waves. Tide locking holding back surface water flows could also result in elevated inland flood levels. In this case the site is shown on the formal flood map as current flood zone 1, so it is prudent to accept the Waterman Civils' recommended 5.8m AOD flood level on the site without further comment.

Please could you copy us your Decision Notice.

I trust that the above comments are satisfactory but if you require any further information please contact me.

Yours sincerely

HELEN TIER
Planning Liaison Officer

Direct dial 01903 703862
Direct fax 01903 215884
Direct e-mail TierH@environment-agency.gov.uk

Cc Nick Price Waterman Group
Strutt & Parker

End

Mr P Devonport
Worthing Borough Council
Planning Policy
Portland House Richmond Road
Worthing
West Sussex
BN11 1LF

Our ref: SX/2007/102898/01-L01
Your ref: WB/07/1078/FULL

Date: 09 November 2007

Dear Mr Devonport

DEMOLITION OF 28 & 30 MARINE DRIVE AND THE ERECTION OF 8 RESIDENTIAL UNITS AND UNDERGROUND CAR PARKING.
28 & 30 MARINE DRIVE, WORTHING

Thank you for your consultation regarding the above which was received on 15 October. Please quote our reference number on any correspondence.

We have the following comments to make:

Flood Risk

We are very concerned that the development will exacerbate flood risk to neighbouring properties, as described below.

The developer's Flood Risk Assessment (FRA) identifies that general land levels in the vicinity of the site are below the 5.5 metres above Ordnance Datum (m AOD) 0.5% annual probability extreme tide level predicted in 2115. This date corresponds to the approximate lifetime of new dwellings. Surface water sewers run though the land. The land forms a local low point. These things indicate a strong potential for the local low area to flood by a combination of waves overtopping tidal defences, the sea breaching these defences, and surface water drainage affected by tide locking . The duration of this flooding could be long, as the sewer is the only drainage outfall. The FRA does not quantify the maximum level of this flooding, and indeed it gives no ground levels, development levels or tidal defence details. This lack of detail is a significant shortcoming.

In order to protect the development from this type of flooding, the developer proposes a perimeter wall to exclude floodwater. The habitable floors and basements would flood if the wall was omitted.

If the low lying area were to flood, this perimeter wall would displace floodwater and could increase the depth of flooding to neighbours. This would be unsatisfactory.

Additional measurements and calculations by the developer might prove that the depth of flooding is small, and flood displacement is not an issue. However, in the absence of such proof, **we recommend that you take the precautionary approach and not grant permission until the level of flooding before and after the development is properly estimated.** This estimate would serve also to confirm the appropriate level of the perimeter wall or the minimum level of the habitable rooms. Omitting the wall and raising the development is preferred as this removes the need to ensure the wall and its flood gates are maintained in perpetuity.

Government policy on flooding, as set out in Planning Policy Statement 25 - "Development and Flood Risk" (PPS25) restricts our ability to object in this case. We request, however, that your Local Planning Authority (LPA) takes our concerns into account when determining the application.

Protection of Controlled Waters

We have assessed the information provided on this site and have determined that any risks associated with potential land contamination are likely to be low with respect to Controlled Waters. As a direct consequence of this we will not be providing detailed site-specific advice or comments with regards to land contamination issues for this site.

If circumstances change or other information comes to light that may affect this decision, please contact us again.

The LPA should ensure the principles of Planning Policy Statement 23 – "Planning and Pollution Control" (PPS23) Annex 2: 'Development on Land Affected by Contamination' are followed. This means that all risks from contamination (to human health, buildings and other property, the natural and historic environment) need to be identified so that appropriate action can be taken to address these risks.

We recommend that the applicant:

· Applies the risk- based framework set out in the Model Procedures for the Management of Land Contamination (CLR 11) and follows the guidance in that document so that they can make the best decisions for the site

· Refers to our guidance on requirements for land contamination reports

· Uses BS 10175 2001, *Investigation of potentially contaminated site - Code of Practice* as a guide to undertaking the desk study and site investigation scheme.

· Use MCERTS accredited methods for testing contaminated soils at the site

· Consults our website at www.environment-agency.gov.uk for details.

I trust that the above comments are satisfactory but if you require any further information please contact me.

Cont/d..

Yours sincerely

HELEN TIER
Planning Liaison Officer

Direct dial 01903 703862
Direct fax 01903 215884
Direct e-mail TierH@environment-agency.gov.uk

cc Strutt & Parker

End

Mr Pierre Dowsett
Senior Planner
Strutt & Parker
201 High Street
Lewes
East Sussex
BN7 2NR

Our ref: SX/2007/102157/01-L01
Your ref: PAD/vaw

Date: 27 July 2007

Dear Mr Dowsett

DEMOLITION OF 28 & 30 MARINE DRIVE AND THE ERECTION OF 8 RESIDENTIAL UNITS AND UNDERGROUND CAR PARKING.
28 & 30 MARINE DRIVE, WORTHING

Thank you for your letter dated 13 July regarding the above proposal. We appreciate having the opportunity to comment on the proposal prior to the submission of a planning application.

As you correctly state the site is not identified as being within a flood zone on our flood risk maps on the internet. This is due to an oversight on the original mapping project which excluded some raised defences under local authority control.

However, the site is situated landward of a raised shingle embankment with ground levels in the region of approximately 4.9m AOD.

The predicted 1 in 200 year surge tide level along this coastline for the year 2115 is 5.5m AOD. This figure includes an allowance for global warming, sea level rise and tidal surges but does not include any allowance for potential wave heights.

As such this site is set 0.7 m below the predicted surge tide level and must be considered to be set within Flood Zone 3a, as defined by Planning Policy Statement 25 'Development and Flood Risk' (PPS25). Therefore any planning application will need to be accompanied by a Flood Risk Assessment (FRA). The minimum requirements for a FRA are set out within PPS25.

Sustainable Development

We are keen to help ensure that new development is as sustainable as possible and therefore appreciate the opportunity to comment on development proposals at this early stage.

Our **guide for developers** is designed to give practical advice on the environmental issues that may affect your site and provides some examples of sites where good practice has already been applied. Some of the topics covered in the guide include, managing the risk of flooding, using water wisely, wildlife & green space, managing waste and land affected by contamination. You can find this guide and links to further information at www.environment-agency.gov.uk/developers.

I trust that this information is satisfactory, if however, you have any further questions do not hesitate to contact me.

Yours sincerely

Kate Entwistle

Kate Entwistle
Planning Liaison Team Leader

Direct dial: 01903 703972
Direct fax: 01903 215884
Direct e-mail: kate.entwistle@environment-agency.gov.uk

End

APPENDIX B

DEVELOPMENT PROPOSALS

Morrison Design Associates' drawings:

01 Site & Location Plans
04 Proposed Lower Ground Floor GA
05 Proposed Ground Floor GA
06 Proposed First Floor GA
07 Proposed Second Floor GA

Proposed block plan @ 1:200 scale

Existing block plan @ 1:200 scale

Location plan @ 1:1250 scale

Client		Drawing title	
Address		Drawing number	
Planning Authority		Date	
Scale		Drawn by	

Planning Drawing

Issue	Description	Date

Architectural Design Limited
Unit 1 Cloud Business Park
Cloud Road
Cloud
Co. Cloud
T: 01 000 0000
E: info@cloud.ie

Do not scale from this drawing. All dimensions to be checked on site before commencing any work. Any discrepancies to be reported to the architect before proceeding.

Drawing © Architectural Design Limited

PROPOSED LOWER GROUND FLOOR LAYOUT

1:100 @ A1

Proposed Lower Ground Floor Plan

36 & 38 Belgrave Drive

Project

Mr J Taylor

Client

Issue	Date	Description
A	10.5.20	To Planning Officer Comments

Drawn by	Checked by	Date
KM	DJ	10.5.20

Scale	Paper size
1:100	A1

Planning	Building Regs	Tender	Construction

Drawing number: 1 of 3

Phone: 0151 515 6524

Email: info@designsolutionsnw.co.uk

Design Solutions (NW) Ltd

The drawing is copyright and shall not be used, reproduced or transmitted in any form or by any means without the written permission of the copyright owner.

All dimensions are to be checked on site before any work is put in hand and any discrepancies are to be reported to the architect before any work is put in hand.

This drawing is copyright and must not be reproduced nor used for any purpose without the written permission of the architect.
All dimensions must be read in preference to scaled drawings and discrepancies must be reported to the architect before proceeding with the work.

No	Date	Revision
A		
B		

Name

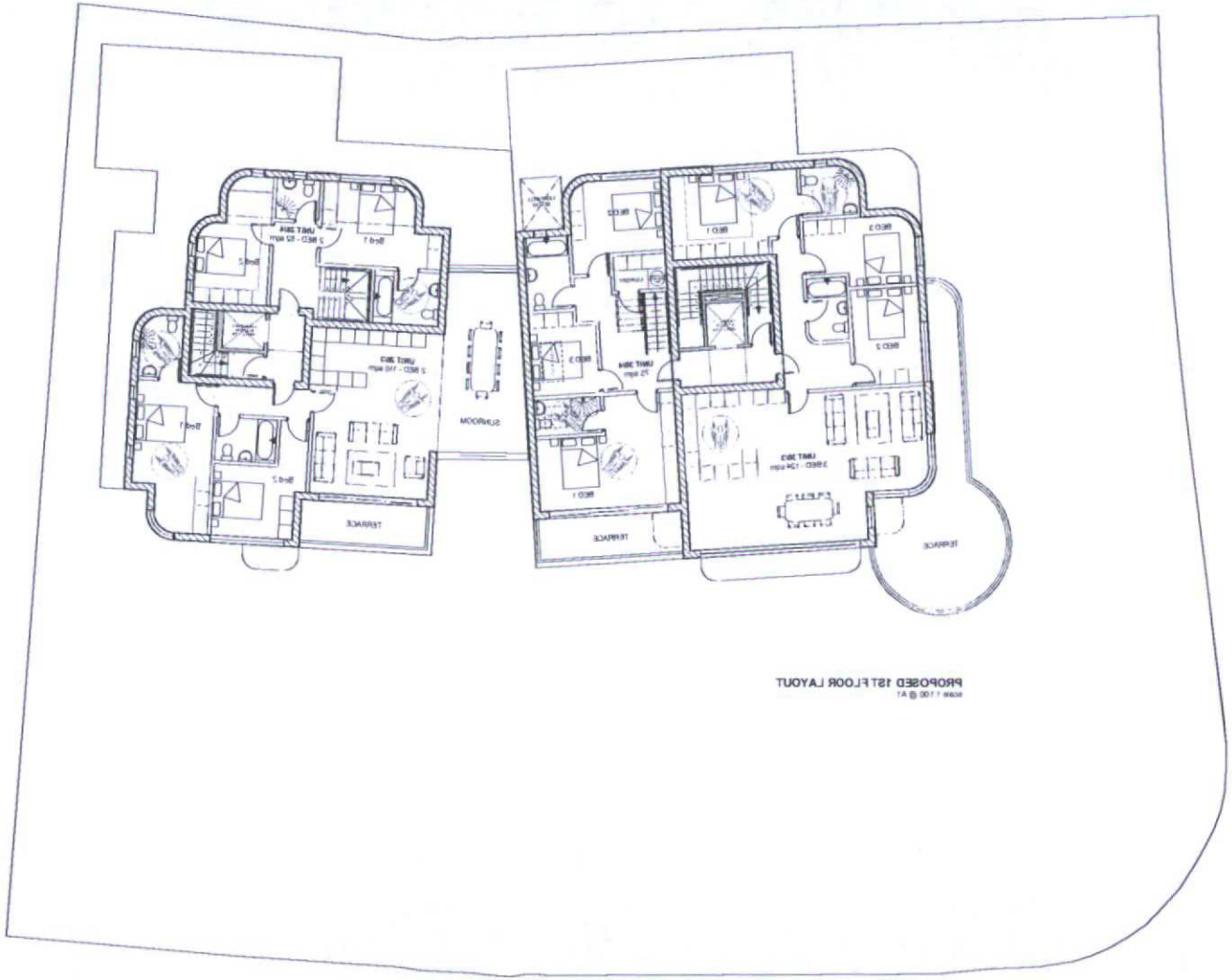
Architect
Mr J Taylor
Client
Mr & Mrs Smith
Project
36 & 38 Marine Drive
Drawing Title
Proposed Ground Floor Plan
Date 25.10.07 | Drawn by KS | Check by CH | Scale 1:100
Drawing no. MD 008.08 | Rev
Planning | Tender | Preliminary | Working Dwg | Construction | As Built
Tel 01515 555454
Fax 01515 555454
www.mrjtaylorarchitect.com
Any new three storey dwelling 36 and 38 Marine Drive

This drawing is copyright and shall not be reproduced nor used for any other purpose without the written permission of the designer.

This drawing must be read in conjunction with all other related drawings and documents.

Notes

Rev	Date	Note	By



PROPOSED 1ST FLOOR LAYOUT
scale 1:100 @ A1

morrison design associates
thirty three st johns road, Hove, Ind 2th
t: 01273 731824
f: 01273 731824
www.morrisondesign.net

Preliminary		Building Regs	X	Planning	
Tender		Construction		As Built	

Client
Mr L Fisher

Project
30 & 28 Marine Drive

Drawing Title
Proposed 1st Floor Plan

Date	Drawn by	Checked by	Scale
20-10-07	KAS	CM	1:100

Drawing No	Rev	Job No
MD 008.08		MD 008

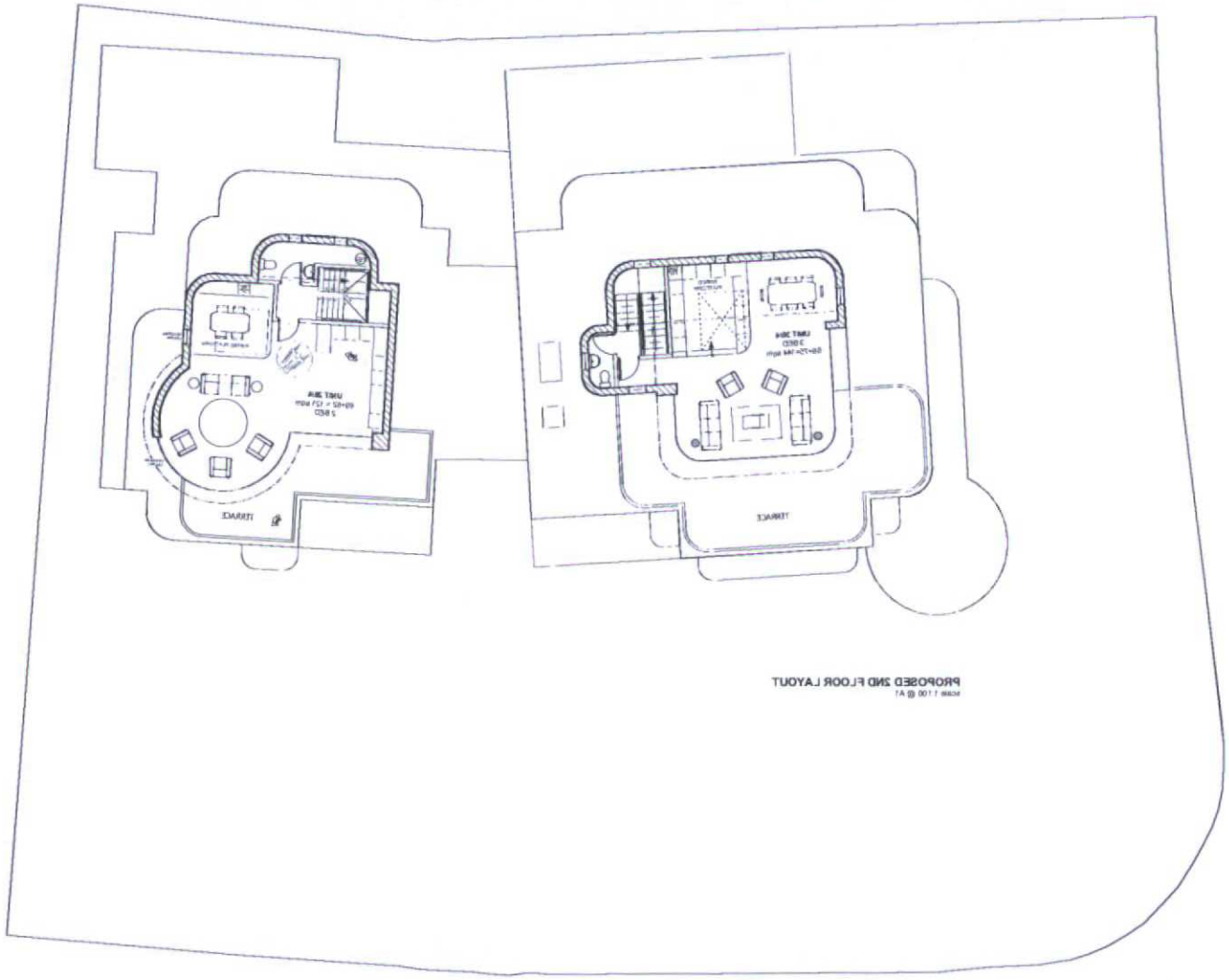
©CM 2007

This drawing is copyright and shall not be reproduced nor used for any other purpose without the written permission of the designer.

This drawing must be read in conjunction with all other related drawings and documents.

Notes

Rev	Date	Note	By



PROPOSED 2ND FLOOR LAYOUT
scale 1:100 @ A1

morrison design associates
Bring Street at Johns road, Hove, Bn3 2Rb
t 01273 731824
f 01273 731824
www.morrisondesign.net

Preliminary		Building Reg	X	Planning	
Tender		Construction		As Built	

Client
Mr L Fisher

Project
30 & 28 Marine Drive

Drawing Title
Proposed 2nd Floor Plan

Date	Drawn by	Checked by	Scale
20-10-07	KAS	CM	1:100

Drawing No	Rev	Job No
MD 008.07		MD 008

©CM 2007

MAIN FLOOR DESIGNS
1/4" = 1'-0"

date					
by					

APPENDIX C

SOUTHERN WATER INFORMATION

Southern Water

Waterman Civils Consulting Engineers
Dippen Hall
Eastbourne Road
Blindley Heath
Lingfield
Surrey RH7 6JX

Your Ref	33383-095/NJP/JHC342483
Our Ref	63498
Date	10 August 2007
Contact	Tel 01634 824100 Fax 01634 844514

Attention: N J Price

Dear Sirs

Provision of Sewer/Water Main Record Extracts – VAT Receipt
28 and 30 Marine Drive, Goring-by-Sea BN12 4QN

Further to your recent enquiry regarding the provision of Southern Water apparatus record extracts for the above location.

Please find enclosed extracts from our records, which show the approximate location of our apparatus in the area of interest.

Please be aware that there are areas within Southern Waters region in which there are neither sewers nor water mains.

I confirm payment of the appropriate fee in the sum of £41.13

The breakdown of costs is as follows: -

- Provision of record extracts £35.00
- VAT @ 17.5% £6.13

VAT Registration Number 543 9000 63

Should you require any additional information regarding this matter please contact this office at the address given at the foot of this letter.

Yours faithfully

Land Search Department

Letter B

SEWER RECORDS PAGE 1 OF 2

Title:	28-30 Marine Drive, Goring
Date:	10/08/2007
Scale:	1:1250
Drawn by:	Coxan

The position of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy.
The actual positions should be determined on site.

Based upon Ordnance Survey Digital Data with the permission of the controller of H.M.S.O. Crown Copyright Reserved
Licence No. VAN 268930.

TQ1001NE

O.S. REF.

Southern Water

N

5108?9

5111?8

1019?1

1019?9

SEWER RECORDS PAGE 2 OF 2

Date:	10/08/2007
Title:	28-30 Marine Drive, Goring
Datum by:	OSGN

Southern Water

Drawn by: Cooper
Scale: 1:250
Date: 10/08/2017
Title: 28-30 Marine Drive, Goring
O.S.Ref: TQ 10011NE
Southern Water
N
Blind paper Ordnance Survey Digital Data with the permission of H.M.S.O. Crown copyright reserved. Licence No. MU 0036382
The position of plots shown on this plan are believed to be correct but Southern Water Services Ltd. accept no responsibility if it be found to be otherwise. The actual position of sewers and mains may be ascertained on site.
MATERIALS
LEGEND - MAINS
Distribution Main / Communication pipe
Trunk Main
Blue water main
Blue pipe plastic
Abandoned main
Proposed Main
Lead 50m3
Brick sewer
Closed water
Air valve
Butterfly valve
Pressure reducing valve
Sluice valve
Pressure sustaining valve
Scour valve
Non return Overflow Spray Point
Valve
Hydrant
Washout
Access point / manhole
Meter
Sluice valve
Reservoir
Water Pump Station
Water Treatment Works
Water tower
Service reservoir
Water Pipe Major Plant
Booster station
Chlorine station
Pumping station
Chlorine gas
Spun (pre-stressed) concrete
Spun iron
Ductile iron
Cast iron
Glass reinforced plastic
Concrete Asbestos Cement
Steel
Polyethylene
Asbestos cement
Cement mortar lined
Concrete pressure pipeline
Concrete non pressure
Concrete pipeline
Overhead
Underground
Pumping station
Treatment works
Service reservoir
Water tower
Chlorine station
Booster station
Water Pipe Major Plant
Water treatment
Sewage pumping station
Sewage treatment works
Sewage Pipe Major Plant
Sewage treatment
Sewage pumping station
Sewage Pipe Major Plant
Sewage treatment works

APPENDIX D

FLOOD RISK PRO-FORMA

FRA Pro-forma

Flood risk assessment for new development

This pro-forma should be completed and submitted with the planning application for developments for which a Flood Risk Assessment (FRA) is required. Guidance notes are provided at the end of this form to help you complete it. Your planning authority and the Environment Agency will be able to advise you on the detailed scope of the FRA and their guidance should be sought prior to completing the pro-forma.

1	Development description and location
1a	What type of development is proposed and where will it be located? **Residential re-development of 28 & 30 Marine Drive, Goring-by-Sea, BN12 4QN.** **8 apartments arranged over 3 floors, including the ground floor. A Lower Ground Floor will provide car parking and storage but no habitable rooms.**
1b	What is its vulnerability classification? **Residential use is classified as "More vulnerable".** **The Lower Ground Floor car park and storage is classified as "Less vulnerable".**
1c	Is the proposed development consistent with the Local Development Documents? **Not known.**
1d	Please provide evidence that the Sequential Test or Exception Test has been applied in the selection of this site for this development type? **The various sources of flooding have been considered in Section 4 of the Flood Risk Assessment report. This identified that the site is at risk of tidal flooding plus, to a lesser degree, pluvial and overland flooding. Therefore the Sequential Test is not satisfied.** **Section 5 of the Flood Risk Assessment report identifies the fact that the flooding will be short duration and predictable, which is less stressful to occupants. There will also be very shallow at the site boundary, making evacuation and emergency assistance during a flood event unhazardouus. Therefore the Exception Test is satisfied.**

2	Definition of the flood hazard		
2a	What sources of flooding could affect the site? (see Annex C PPS25) (If yes to any below please provide further details in this FRA) **Please see Section 4 of the Flood Risk Assessment report.**		
	Flooding type	*PPS25 ref*	
i.	Could the site be affected by fluvial (watercourses, rivers etc) flooding? **Nearest water 1km from site and no fluvial flooding indicated on the EA Indicative Flood Map.**	C4	YES/NO **No**
ii.	Could the site be affected by tidal or coastal flooding? **Flood level of 5.5m AOD, taking account of climate change and sea level rise**	C5	YES/NO **Yes**
iii.	Could the site be affected by pluvial flooding, due to inadequate drainage? (Are there adequate flow paths for very severe rainfall to flow off the site above ground) **Topography is bowl shaped with water trapped between rising ground to the north and the bund along the back of the foreshore. This area relies upon drainage to prevent flooding - which may have reduced capacity when tide-locked.** **Risk considered to be small.**	C6	YES/NO **Yes**
iv.	Could runoff from surrounding land flow across the site (Overland flow routes)? **Yes, but as flows will generally be along roads, risk considered to be small.**	C6	YES/NO **Yes**
v.	Could the rising groundwater cause flooding on this site? **Potential flooding of car park if construction not watertight. Risk of flotation.**	C7	YES/NO **Yes**
vi.	If there was flooding from sewers or highway drains could it flow across the site? **Potential of backflow in sewers during tidal flooding.**	C8	YES/NO **Yes**
vii.	Could the site be affected by flooding as a result of infrastructure failure (eg. dams, canals)? **No infrastructure identified that would constitute a flood risk.**	C9	YES/NO **No**

2b	For each identified source, describe how flooding would occur, with reference to any historic records wherever these are available. **Tidal flooding would overtop bund at rear of foreshore and fill the bowl-shaped land. This would drain down once drains no longer tide-locked.** **Other flood risks are considered to be small and will be taken care of by tidal flooding mitigation.**
2c	What are the existing surface water drainage arrangements for the site? **The site drains to Southern Water surface water sewers.**
3	**Probability**
3a	Which flood zone is the site within? **The site is shown on the Indicative Flood Risk Map as being in Zone 1 but EA correspondence indicate that it is in Zone 3a, due to tidal flooding.**
3b	If there is a Strategic Flood Risk Assessment covering this site, what does it show? **N/A**
3c	What is the probability of the site flooding taking account of the contents of the SFRA and of any further site-specific assessment? **The tidal flooding level is based upon a surge tide with a 1 in 200-year return period, taking account of sea level rise and climate change.**
3d	What are the existing rates and volumes of run-off generated by the site? **The total site area is 0.19Ha and the current hardened area is 678m². Applying a rainfall intensity of 0.014 l/s/m² (50mm/hr) gives a discharge rate of 9.5 l/s.** **Using the SuDS Interim Code of Practice (ICOP) method, the greenfield run-off is 0.1 l/s.**
4	**Climate change**
4a	How is flood risk at the site likely to be affected by climate change? **Unchanged - climate change allowance made in tidal flood level.**
5	**Detailed development proposals**
5a	Please provide details of the development layout, referring to the relevant drawings. **Please see Appendix B of the Flood Risk Assessment report.**

5b	Where appropriate, demonstrate how land-uses most sensitive to flood damage have been placed in areas within the site that are at least risk of flooding. **Access to Lower Ground Floor from higher, northern edge of site.**
6	**Flood risk assessment measures**
6a	How will the site be protected from flooding, including the potential impacts of climate change, over the development's lifetime? **By either lifting the FFL of the Ground Floor and access to the Lower Ground Floor to above 5.8m AOD or by using water-resistant construction to this level and flood gates on access.**
7	**Off site impacts**
7a	How will you ensure that your proposed development and the measures to protect your site from flooding will not increase flood risk elsewhere? **SuDS measures include the proposed use of attenuation upon roofs and balconies.** **Rainwater harvesting will be considered and water butts provided.** **By adopting these measures, the risk of flooding elsewhere will be decreased.**
7b	How will you prevent run-off from the completed development causing an impact elsewhere? **As 7a.**
8	**Residual risks**
8a	What flood-related risks will remain after you have implemented the measures to protect the site from flooding? **There is a residual risk of flooding of Lower Ground Floor in the event of the flood gates not being closed or of very exceptional overtopping of the walls.** **A flood alarm will be installed in the Lower Ground Floor.**
8b	How, and by whom, will these risks be managed over the lifetime of the development? **Contingency plans will be prepared and instructions given to occupants for actions to be taken in the event of a flood warning being given.** **The Building Owner will be responsible for maintaining the Contingency Plan and ensuring occupants are aware of risks and actions.**