Appendix A Hotspots A & B: Town Centre

A.1 Area Description

These hotspots centre on the High Street and the immediate roads around it in the centre of Deal Town, extending along a north-south axis from Clanwilliam Road in the South to Horsa Road to the North. This is the central shopping and business area of Deal and densely urbanised. The roads between Victoria Road and Prince of Wales terrace have a number of basement properties.

The ground falls down towards the sea immediately to the east of these areas. However there is a ridge running between the high street and the beach.

These areas are drained via the SW Public Sewer network. The sewer records provided by SW indicate an absence of surface water sewers and therefore we assume that the designated foul sewer is actually combined (draining both surface water and foul runoff). The sewers drain northwards, reaching Royal Cinque Ports Golf Club pumping station from where it is pumped to Weatherlees treatment works near Ramsgate. There are two sewers running under the High Street of 1050 and 225mm diameter.

A.2 Development Plans and Opportunities

There are no allocation sites in the vicinity of these areas in the DDC Land Allocations Pre-submission Local Plan (Dec 2012 and the May 2013 Addendum).

A.3 Environmental Designations and Other Possible Constraints

The following are noted:

- There are a significant number of listed properties in the vicinity of these areas.

A.4 Flood Risk

A.4.1 Historic Flooding

Flooding was been recorded along the High Street in 2010 and basement flooding was recorded in Farrier Street in 2004.

A.4.2 Predicted Flood Risk

Please refer to Figure 2 for the properties at risk and Figures 203 to 207.

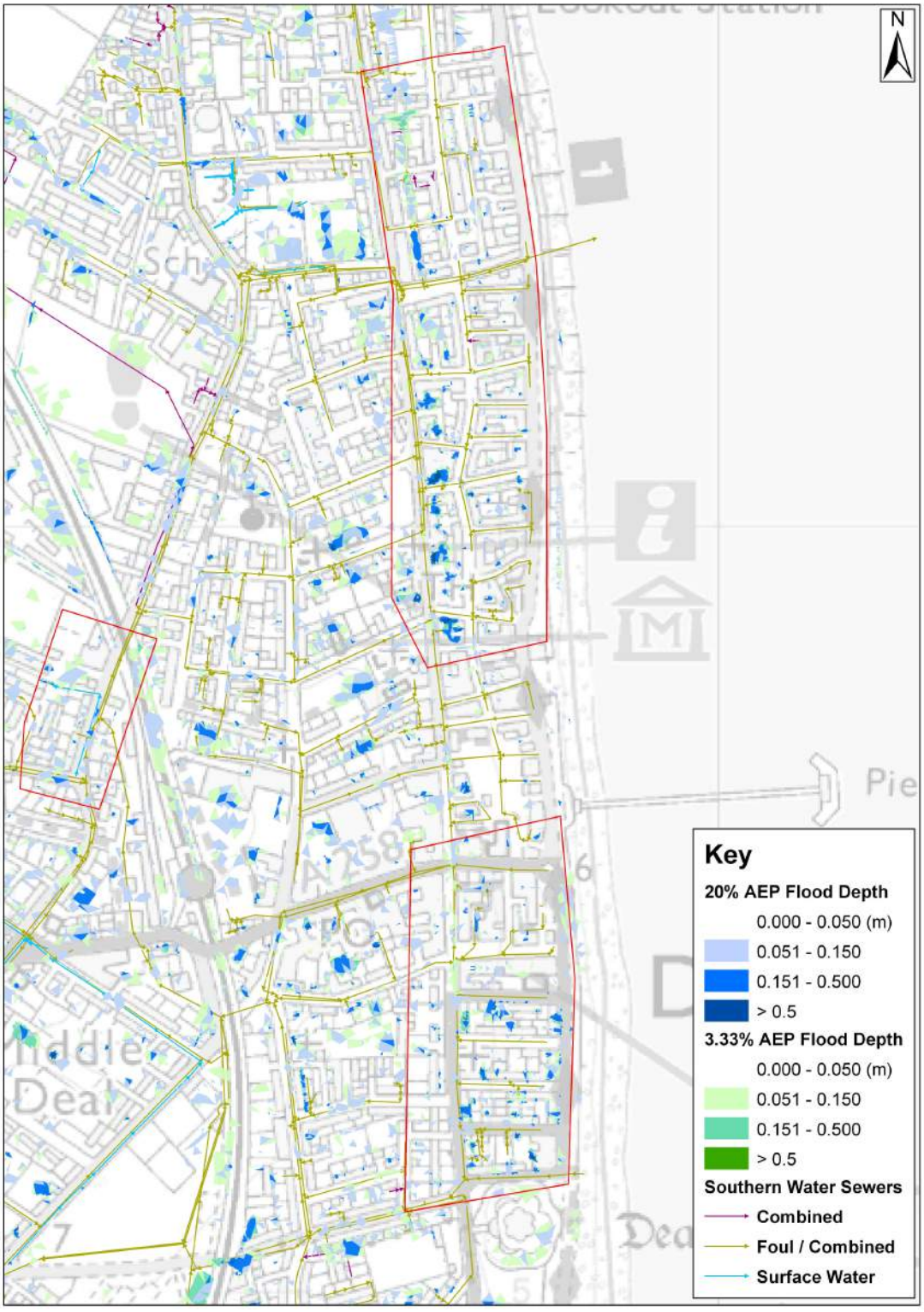
The estimated number of residential and commercial properties at risk are summarised in Table 7 and their location is included in Figure 2.

Table 7: Predicted Flood Risk in Hotspots A and B

Rainfall Event (AEP%)	20	10	3.3	2	1.3	1	0.5
No. at Risk	3	1	1	2	0	8	16
Cumulative	3	4	5	7	7	15	31

The flooding mechanism is described in Table 8.

Figure 2: Predicted Flood Risk in Hotspots A and B



NB: Flood depths below 50mm removed for clarity

Table 8: Summary of Predicted Flood Risk in Hotspots A and B

Rainfall Event (AEP)	Key Pattern of Flooding
20% (1 in 5)	Isolated ponding of direct rainfall in A with very limited ponding in B.
3% (1 in 30)	Pockets of ponding along the High Street, frequently to depths greater than 0.5m. In a few locations the flood depth is greater than 0.8m. There are areas of significant flood hazard due to depth rather than velocity.
1.3% (1 in 75)	Flooding at the junction of Victoria Road and South Street of up to 0.4m.Depths of up to 0.8m to the east of the High Street although in pockets rather than a continuous area of flooding.
1% (1 in 100)	Continuous ponding along the High Street, from King Street southwards to Stanley Road. Additionally further north to the east of the High Street to depths >0.6m. There are areas of significant flood hazard as a result of flood depth as there are no locations with a surface flow velocity > 1.0m/s.

A.4.3 Key Elements

The following were key observations from the site visit undertaken for the Initial Flood Risk Assessment:

- Sections of the High Street are identified on the EA FMfSW. There are areas classified as 'deep' flooding (greater than 300mm) on Victoria Road and the pedestrianised area between there and Queen Street. This is confirmed by reported flood incidents along the length of the High Street, with this area known to have been affected by significant flooding in the past.
- There are a number of properties with low thresholds and low kerb levels. Many retail premises have no threshold, increasing the risk of property flooding. The roads are fairly flat increasing the likelihood of widespread shallow flooding which could affect properties with low thresholds.
- There are a number of properties with basements. These properties are at risk of deep flooding and there is a risk to life if the flood waters move rapidly.
- There is a recorded flood incident where College Road joins the High Street, in the vicinity of Alfred Square.
- The pedestrianised section of the High Street between King Street and South Street mainly contains commercial and retail properties which all contain low or street-level thresholds. There is a record of past flooding along this stretch of the road, with the shopkeepers indicating flood depths of approximately 0.5m on several previous occasions.
- As the area is flat there is potential for widespread ponding affecting the majority of properties in the area. There are a number of basements and cellars attached to the properties here however they do not appear to be used for residential purposes;
- Ponding is constrained by the sea wall, which maintains high water levels.

A.5 Surface Water Management

A.5.1 Key Concepts for the Options

In addition to a series of generic options for improved surface water management included in the Outline Action Plan, the following concepts are particularly relevant to the two town centre areas:

- Basement properties should be protected from water ponding on the roads. This may include raising thresholds or kerbs;
- The sea wall and the rise in ground level towards the sea prevent overland flow progressing eastwards to the sea, causing it to pond in these areas, without

pumping capacity.
- Existing (and any proposed) gravity outfalls to the sea will be periodically tide-locked preventing their operation;
- As the area is served by a combined drainage system there is a risk of contamination of flood water

A.5.2 Location-Specific Options

A number of location-specific potential flood mitigation measures for hotspot areas A and B have been identified and are listed in Table 9. These could be considered in isolation or in some cases in conjunction with other options.

Table 9: Hotspots A&B Mitigation Measures

Option Ref	Description	Comment
AB-01	New sea outfall • Construct a new sea outfall from the worst affected areas: South St. and Sondes Rd in Area A • The same in Farrier St, in Area B	• This would be tide-locked periodically • Relatively expensive • Discharge consent required • Risk of polluted runoff reaching bathing waters
AB-02	Sewer separation • Install a new Surface water sewer to receive surface water drainage and overland flows in extreme events	• New sewer in congested street • Would require a new outfall or pumping capacity. • Favourably received by SW as will reduce their capital costs by reducing flow to WwTW.
AB-03	Temporary pumping • Provide temporary pumping capacity from the worst ponding areas to the sea. Construction of sumps at key locations. • Pump operated by Kent Fire and Rescue Service (there is a Fire station in Deal).	• Requires warning of event to minimise disruption • Ongoing storage and maintenance costs • Training required • Limited time to respond before flooding occurs • Long riser required (>150m)
AB-04	Flood boards / Individual Property Protection • Protect commercial properties from flooding (due to their low thresholds)	• Relatively cheap and easy to install • If only temporary types are applicable then will rely on sufficient warning for measures to be put in place • Uncertainty regarding effectiveness, • Requires community support

A.6 Economic Appraisal

A.6.1 Damages assessment

Based on the modelled flood extents we have estimated the Present Value Damages (PVd) as summarised in Table 10.

A.6.2 Cost Benefit Analysis

We have estimated the maximum whole-life cost of a potentially viable scheme as summarised in Table 10. Please refer to Section 3.4 for an explanation of how this is calculated.

Table 10: Estimate of Hotspots A and B Maximum Scheme Cost

Hotspot	PV Damages (£k)	iBCR	Maximum PV Scheme Cost (£k)
A	1,682	1	892
B	2,268	1	1,502

Appendix B Hotspot C: Church Street

B.1 Area Description

Church Street is a residential road located to the east of Walmer Station (NGR: TQ 36840 50328). The key flooding location is a local low spot at the head of a dry valley running south-westwards.

The area is served by a 300mm diameter SW surface water public sewer running West to East and then northwards along London Road towards Deal town centre which outfalls to the sea in Walmer.

B.2 Development Plans and Opportunities

There are no site allocations in this flooding hotspot. However there is an allocation site to the south-west: Land between 51 and 77 Station Road, Walmer. The allocation site is close to the overland flow path but is not within any of the areas of predicted flood depth.

B.3 Environmental Designations and Other Possible Constraints

The following designations are noted:

- The medieval manor house in Walmer is a scheduled monument. It is located to the south of Church Street and although the option proposals do not directly impact upon the monument, its proximity will need to be considered.
- Church Street is designated as a Conservation Area therefore proposed changes will require planning approval and will need to be sympathetic to the historic buildings and environment.

B.4 Flood Risk

B.4.1 Historic Flooding

Basement and Cellar flooding has been recorded in Church Street in 2006, 2007 and 2010, which could be a result of high groundwater levels rather than a rainfall event. However rainfall induced flooding did occur in 2010.

B.4.2 Predicted Flood Risk

The public sewer in this area flows eastwards along Church Street and then northwards along London Road to Walmer. Modelling suggests that this sewer is overloaded by events in excess of a 20% AEP event and when this occurs the hydraulic gradient exceeds the ground level on Church Street (which is in a bowl) inducing flooding. When flooding occurs it is prevented from escaping south-westwards by a stone wall on the Southern side of the road. Flood water therefore ponds and places the properties at risk. The historic flood records demonstrate that there are basements in this area.

Flooding is observed for the 3.33% AEP event with depths of approximately 0.6m. Flood depths for the 1% AEP event increase to 1.0m.

The model does predict flows in excess of $1m^3$ for the 1% AEP event, but not for the 3.33% event. Generally flood hazard is restricted to Low except for where ponding is the deepest on the highway.

There are generally low thresholds and kerbs in the Church Street area, posing potential flood risk to properties. There is evidence on site that sandbags have been used in the area and local threshold protection measures have been implemented.

The residents of Church Street who responded to the questionnaire reported regularly experiencing flooding inside and outside of properties as well as in the road. Numerous past flooding events were recorded, with many respondents claiming to experience flooding after all heavy rainfall event, with surface runoff entering Church Street from Dover Road and Green Lane.

The predicted property flood risk is summarised in Table 11 and ,

Table 11: Predicted Flood Risk in Hotspot C

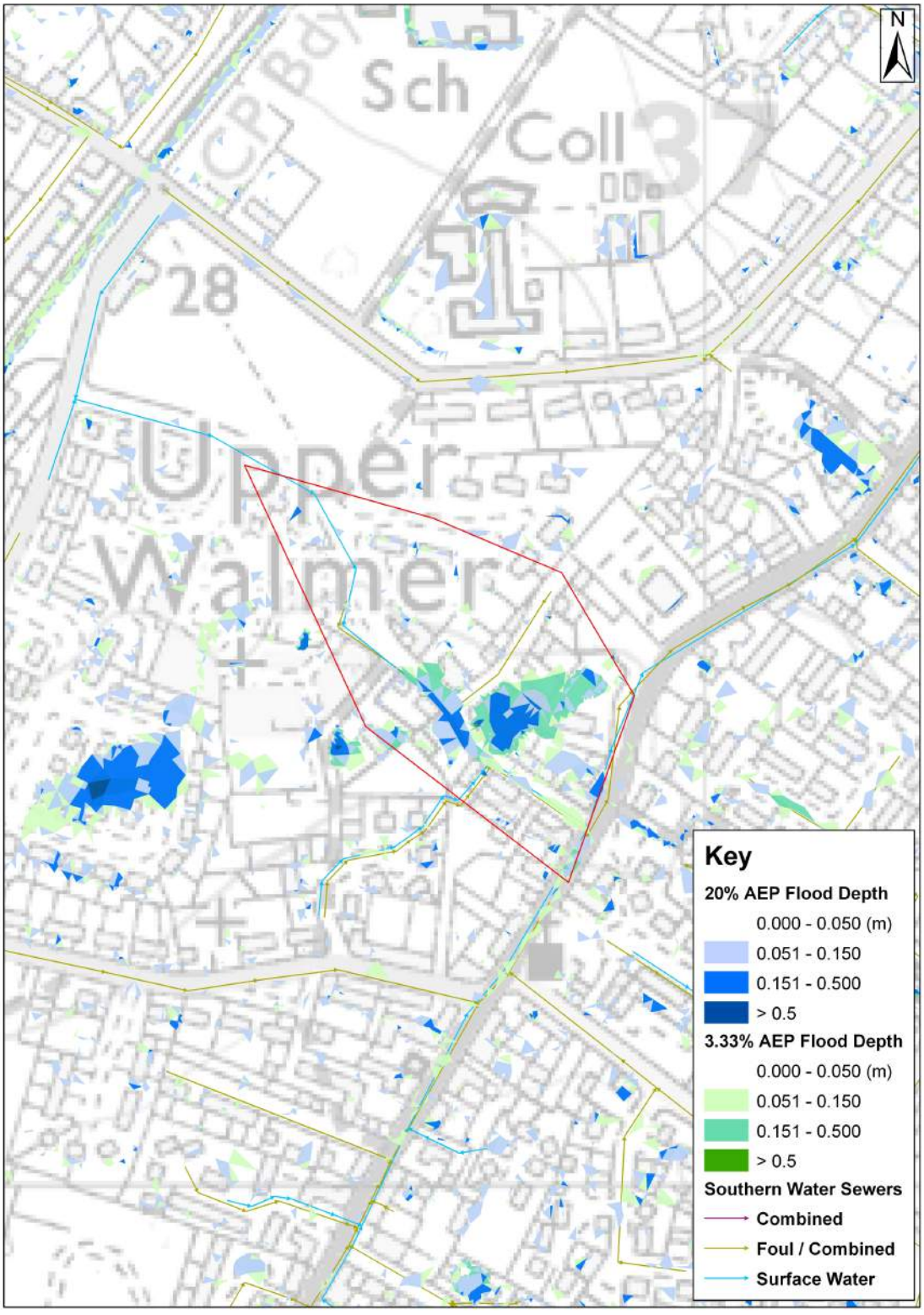
Rainfall Event (AEP%)	20	10	3.33	2	1	0.5
No. at Risk	0	4	30	3	0	2
Cumulative	0	4	34	37	37	39

The flooding mechanism is described in Table 12.

Table 12: Summary of Predicted Flood Risk in the High Street Area

Rainfall Event (AEP)	Key Pattern of Flooding
20% (1 in 5)	Flooding leading to ponding to the north of Church Street from the public sewer.
3.33% (1 in 30)	More extensive flooding in Church Street and further to the west at Reading Close. The peak flood depth at Church Street is typically 0.6m
1.3% (1 in 75)	A virtually continuous flow path runs westwards from Church Street. Peak flood depths in Church Street are approx 0.9m
1% (1 in 100)	Peak flow depths on Church Street are approx 1.0m.

Figure 3: Predicted Flood Risk in Hotspot C



NB: Flood depths below 50mm removed for clarity

B.4.3 Key Elements

The site visit for the Initial FRA and inspection of the hydraulic model indicate the following key elements related to flood risk:

- Flooding appears to be as a result of overloading of the public sewer which runs along Church Street and then London Road;
- This location is lower than the hydraulic gradient in the pipe leading to sewer flooding;
- Additionally as it is in a bowl, this location receives localised overland flow from the West and East;
- Topography and local obstructions prevent the progress of floodwaters along the valley;
- There are properties at the low point of Church Street just east of Green Lane with basements, if flooded rapidly could pose a **risk to life**;
- Generally the kerbs and property thresholds are low;
- There is evidence of the use of sandbags and local protection measures to properties and internal property flooding was recorded in August 2010.

B.5 Surface Water Management

B.5.1 Key Concepts for the Options

In addition to a series of generic options for improved surface water management included in the Outline Action Plan, the following concepts are particularly relevant to Church Street:

- The public sewer is a key contributory factor to the flooding therefore a solution should include SW.
- This location is hydraulically connected to Hotspot E (Walmer) via the SW sewer. It may be possible that there is spare capacity in the network in Area E that could benefit Church Street via sewer upsizing. However the distance between the two is significant and SW have previously investigated the upsizing of the sewer to alleviate flooding and found it to be too expensive.
- A comprehensive solution will have to address overland flow and sewer flooding. Therefore a package of measures will be required and may have to be delivered incrementally.

B.5.2 Location Specific Options

A number of location-specific potential flood mitigation measures for Church Street have been identified and are listed in Table 13. These could be considered in isolation or in some cases in conjunction with other options.

Table 13: Hotspot C Mitigation Measures

Option Ref	Description	Comment
C01	Road verges	• Existing road verges on Church Street could be utilised to re-direct and store overland flow
C02	Soakaways 1	• Overland flow could be directed to soakaways constructed in the grounds of Walmer Science College
C03	Soakaways 2	• Construct a new soakaway connected to the road gullies at the low point on Church Street.
C04	Seal gullies	• Assuming flooding is from the public sewer the manholes and road gullies could be sealed and any high levels in the sewer directed to new soakaways.
C05	Pump	• Install a pump to convey floodwaters eastwards to the public sewer in London Road (assuming it has capacity); this could be combined with storage to allow for flood levels to reduce prior to pumping.

B.5.3 Rejected Option

This location is hydraulically connected to Hotspot E (Walmer) via the SW sewer. It may be possible that there is spare capacity in the network in Area E that could benefit Church Street via sewer upsizing. However the distance between the two is significant and SW have previously investigated the upsizing of the sewer to alleviate flooding but found it to be too expensive.

B.6 Economic Appraisal

B.6.1 Damages assessment

Based on the modelled flood extents we have estimated the Present Value Damages (PVd) and the maximum viable scheme cost as summarised in Table 14.

Table 14: Estimate of Hotspot C Maximum Scheme Cost

Hotspot	PV Damages (£k)	iBCR	Maximum PV Scheme Cost (£k)
C	456	1	153

Appendix C Hotspots D & E: Walmer

C.1 Area Description

Walmer is located to the South of the main Deal Town. Surface water drainage in the area is predominantly combined although there are certain lengths of surface water drainage, the main sewer running beneath London Road, northwards towards the centre of Deal Town. There is a separate surface water sewer under Granville Road which discharges directly to the sea via an outfall.

C.2 Development Plans and Opportunities

There are no allocation sites in the vicinity of the flooding hotspots in Walmer that could be used to mitigate flood risk. However there remains (as with other areas) the opportunity to use windfall sites as opportunities to modify flood risk.

C.3 Environmental Designations and Other Possible Constraints

The land adjacent to Liverpool Road is designated as BAP Priority Habitat (woodlands) which could place restrictions on proposed works. There are two Listed properties located at the northern end of Liverpool Road.

C.4 Flood Risk

C.4.1 Historic Flood Risk

There was a report of highway flooding during the August 2010 event.

C.4.2 Predicted Flood Risk

The model predicts two key locations for surface water flood risk within Walmer. The properties at risk are summarised in Table 15 and Table 16 and the flood extents in Figure 4.

(a) Hotspot D – Upper Walmer

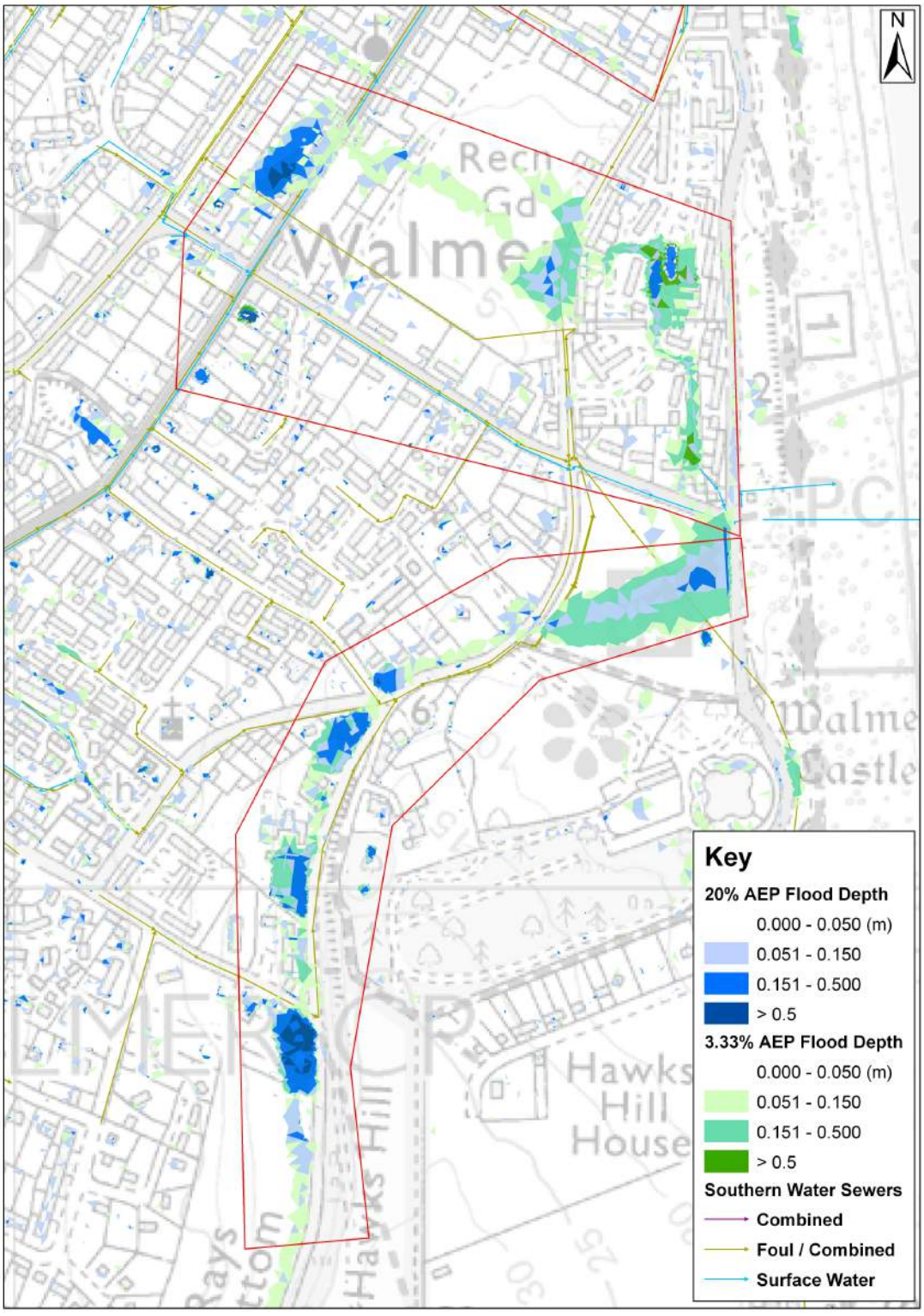
The overland flow path predicted by the model rises from the chalk valley to the south and flows along Liverpool Road. The actual flow path is slightly to the west of the highway and therefore the flow passes through properties between Gram's Road and Clare Road (NGR: TR 37296 00005). Further north on Liverpool Road properties are set back and therefore only the gardens are predicted to flood. The flow path is evident during the 10% AEP event. Depths are predicted at the junction of Gram's Road and Liverpool road in excess of 0.8m. The flood depth elsewhere is typically 0.5m.

There is an element of uncertainty regarding the risk to property in this hotspot. The model does not include road kerbs. The flowpath is predicted to be to the west of Liverpool Row, at the low point of the valley. However, if the flow path is actually on the highway then it would remain on the highway as predicted flow depths are less than a typical kerb height of 150mm. Consequently the properties would be at a reduced risk of flooding to that predicted in the model.

(b) Hotspot E – Walmer

The second area identified within Walmer is to the west of Marke Wood recreation Ground. However the model only predicts two properties at risk in this are although it does coincide with reported flooding to properties on Dover Road. There are properties at risk further to the east but at significantly less frequent return periods.

Figure 4: Predicted Flood Risk In Hotspots D and E



NB: Flood depths below 50mm removed for clarity

Table 15: Predicted Flood Risk in Hotspot D

Rainfall Event (AEP%)	20	10	3.3	2	1	0.5
No. at Risk	4	1	3	0	2	3
Cumulative	4	5	8	8	10	13

Table 16: Predicted Flood Risk in Hotspot E

Rainfall Event (AEP%)	20	10	3.3	2	1	0.5
No. at Risk	3	1	0	0	0	7
Cumulative	3	4	4	4	4	11

The flooding mechanism is described in .

Table 17: Summary of Predicted Flood Risk in Hotspots D and E

Rainfall Event (AEP)	Key Pattern of Flooding
20% (1 in 5)	A flow path alongside Liverpool Road. Generally the depth is shallow (<150mm) however where it meets an obstruction and ponds behind it flooding could result – four properties are predicted at risk to the south of Gram road. The model predicts flooding up to approx 0.5m. The ponding of flooding to the rear of properties on Dover Road.
3.3% (1 in 30)	A similar picture to the 20% AEP event with deeper flooding predicted up to 0.8m in depth.
1.3% (1 in 75)	Flood depths increase to 1m.
1% (1 in 100)	The flow path is almost continuous alongside Liverpool Road with the exception of the junction with Gram's Road. Peak flood depths at this location are 1.1m. There are other locations with significant (>0.5m) depths of water. There is extensive ponding to the north-west of Walmer Castle.

C.4.3 Key Elements

Flooding in Walmer is limited to a few isolated properties as a result of exceedance of the surface water drainage system with the exception of the area along Dover Road. Here an overland flow path is predicted to run alongside the road flooding properties where its path is restricted. The flow path also receives flow from the west via two overland flow paths.

There is some uncertainty regarding the location of this flow path as there is no record of flooding at this location.

As there is limited evidence of recorded flooding the properties along Liverpool Road could be at risk of groundwater flooding from the chalk.

C.5 Surface Water Management

Further work, including liaison with householders, should be undertaken to confirm if the predicted flood risk is an accurate reflection of reality. Assuming that it is, the key option would be to try and retain the runoff on the highway as the topography does not allow for it to be conveyed to the eastern side of the road.

C.5.1 Location Specific Options Identified

Table 18 summarises the location specific flood mitigation measures identified.

Table 18: Hotspots D and E Mitigation Measures

Option Ref	Description	Comment
D01	Kerb raising	• Modify the kerb along Liverpool Road to retain the flow path on the highway
D02	Tanking	• Tank properties to protect against the possibility of groundwater flooding via the chalk
E01	Offline Storage	• Construct storage in/under Marke Wood Rec. • Intercept flows in the public sewer and re-direct them to offline storage with attenuated return to the sewer in Granville Road. This could also relive flooding in Church Street (Hotspot C).
E02	Flow Re-direction	• Direct flows in the Dover Road sewer to the Granville Road sewer

C.6 Economic Appraisal

C.6.1 Damages assessment

Based on the modelled flood extents we have estimated the Present Value Damages (PVd) and the maximum viable scheme cost as summarised in Table 19.

Table 19: Estimate of Hotspot C Maximum Scheme Cost

Hotspot	PV Damages (£k)	iBCR	Maximum PV Scheme Cost (£k)
D	1,248	1	775
E	452	1	220

Appendix D Hotspot F: Lower Walmer

D.1 Area Description

Lower Walmer is located between Deal town centre to the north and Walmer Castle to the South. It is an urbanised area consisting of Victorian and Georgian houses, many of which are expected to have basements.

The model predicts a cluster of properties to be at risk of a frequent flooding and there is recorded history of flooding in the area.

D.2 Development Plans and Opportunities

There are no allocation sites in the vicinity of Lower Walmer.

D.3 Environmental Designations and Other Possible Constraints

There are no designations in the vicinity of Dover Road in Lower Walmer.

D.4 Flood Risk

D.4.1 Historic Flood Risk

There is a repeated history of flooding in this area. Flooding has been recorded in Herschell Square twice: cellar flooding in 2004 and highway flooding in 2010. Flooding has been recorded in King Street in 2006. Highway flooding was also recorded on Archery Square in 2010. Further west property flooding was recorded on Downs Road in 2004.

D.4.2 Predicted Flood Risk

There is an overall fall in the topography from south-west to north-east which overland flow paths follow while being channelled by the roads. There is also a flow path to the east against the railway embankment where the flow cannot progress to the lower ground to the north-west.

There are two areas of properties at risk within Lower Walmer:

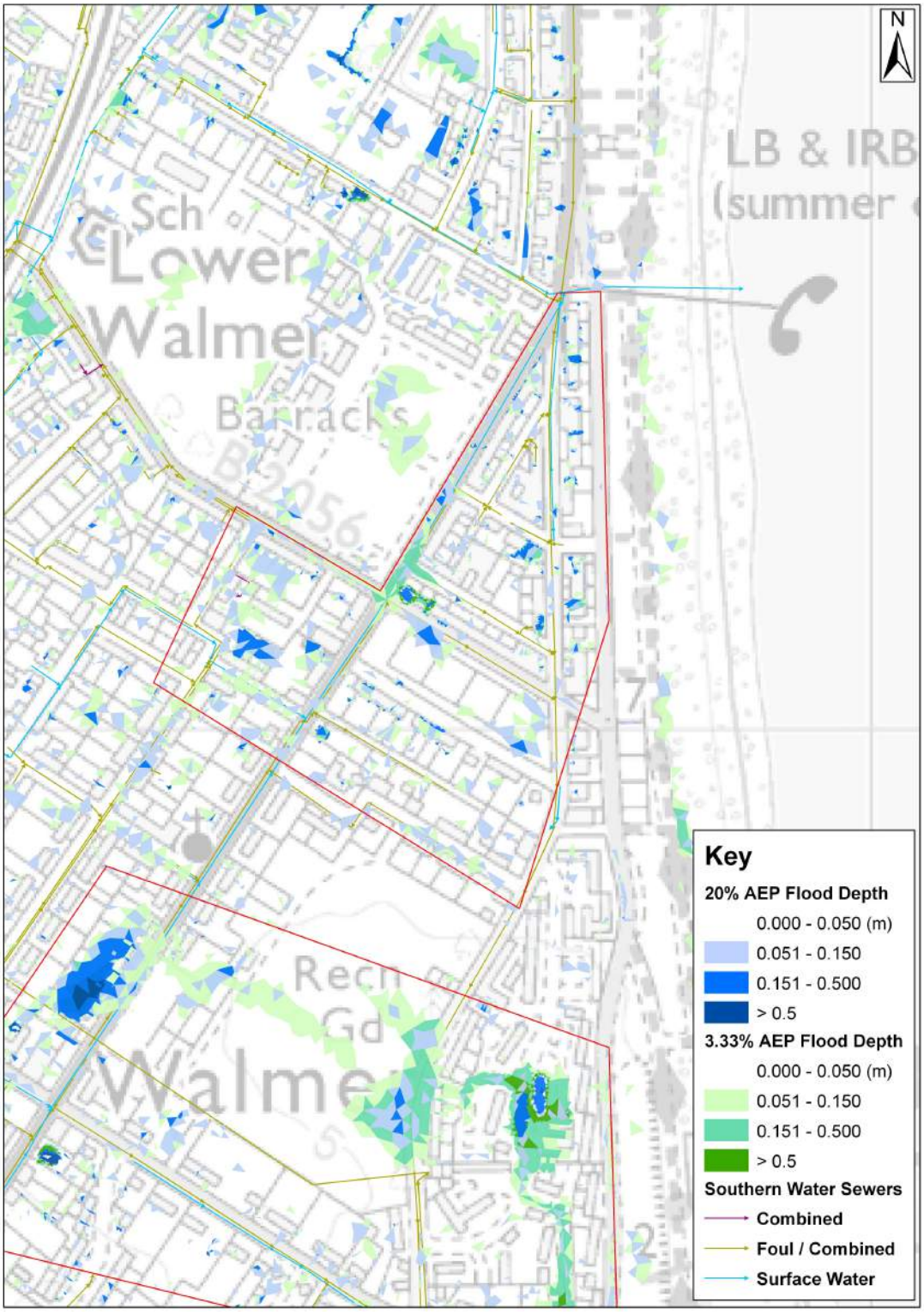
- Havelock Street – Three properties at risk from a 3.3% AEP event. These properties are with a localised low spot and flood waters pond behind the railway embankment. Peak depths in this event reach 0.5m.
- Herschell Square / King Street / Archery Square – Properties are at risk from a 20% AEP event in these locations which correlates with reported historic flooding. Flooding generally appears to be due to localised ponding from exceedance of the drainage system

Predicted flood risk in hotspot F is summarised in Table 20 and Figure 5.

Table 20: Predicted Flood Risk in Hotspot F

Rainfall Event (AEP%)	20	10	3.3	2	1	0.5
No. at Risk	11	5	4	4	2	7
Cumulative	11	16	20	24	26	33

Figure 5: Predicted Flood Risk in Hotspot F



NB: Flood depths below 50mm removed for clarity

The flooding mechanism is described in Table 21.

Table 21: Summary of Flooding Mechanisms in Hotspot F

Rainfall Event (AEP)	Key Pattern of Flooding
20% (1 in 5)	Localised pockets of flooding, ponding in the region of Havelock Street to a depth of 0.3-0.5m.
3.3% (1 in 30)	As the 20% AEP event with a ponding occurring at Archery Square although this appears to be representation in the DTM of a basement.
1.3% (1 in 75)	More extensive flow paths along roads. The flow path extends along the foot of the railway embankment and is no longer isolated ponding.
1% (1 in 100)	Extensive ponding in Archery Square although on the tennis courts.

D.4.3 Key Elements

There is extensive ponding across the area. Flow paths are channelled along streets resulting in limited property damage. There is a flow path and in places deep ponding to the east of the railway line.

Given the extensive nature of the flooding (i.e. a diffuse source rather than a single overland flow path) solutions will need to consider the widespread capacity in the system along with localised measures.

There are a number of basement properties in Archery Square.

D.5 Surface Water Management

D.5.1 Key Concepts for the Options

Given the densely urbanised nature of this area there is limited space to provide above-ground storage. Therefore immediate mitigation will have to focus on improvements to the surface water drainage network or localised protection measures.

D.5.2 Location Specific Options Identified

In addition to generic interventions a number of location specific flood mitigation measures have been identified and are summarised in Table 22. Additionally this area could benefit from improvements in the surface water drainage network upstream associated with Hotspots C and E.

Table 22: Hotspot F Mitigation Measures

Option Ref	Description	Comment
F01	New outfall	• Construct a new sea outfall to provide additional capacity in the surface water drainage network
F02	Bunding	• Localised protection to properties in Havelock Street
F03	Individual Property Protection	• Measures specifically to protect properties in Havelock Street and to basements in Archery Square

D.6 Economic Appraisal

D.6.1 Damages assessment

Based on the modelled flood extents we have estimated the Present Value Damages (PVd) and the maximum viable scheme cost as summarised in Table 23.

Table 23: Estimate of Hotspot F Maximum Scheme Cost

Hotspot	PV Damages (£k)	iBCR	Maximum PV Scheme Cost (£k)
F	1,450	1	931

Appendix E Hotspot G: North Deal

E.1 Area Description

North Deal encompasses the industrial estates to the north of Southwall Road. It includes a network of drainage ditches, the responsibility for which is split between the Internal Drainage Board and the EA. There are a number of industrial units and a waste recycling centre.

E.2 Development Plans and Opportunities

Dover DC has been consulting on the proposals to develop part of the industrial estate. Therefore any proposals would need to integrate the safe conveyance of the predicted overland flow path which passes through the proposed development site.

E.3 Environmental Designations and Other Possible Constraints

Part of the area is designated as BAP priority habitat which could restrict mitigation proposals.

E.4 Flood Risk

E.4.1 Historic Flood Risk

Flooding was recorded at the junction of Southwall Road and Church Lane in August 2010.

E.4.2 Predicted Flood Risk

The model identifies a flow path running northwards along Church Lane to the junction with Southwall Road. From the junction it then flows northwards via open, undeveloped ground between the industrial estate and the recycling centre to the drainage ditches. Therefore while there is extensive highway flooding there is no property damage predicted.

There is a cluster of properties on Church Street near the junction of Orchard Avenue at risk of flooding from a 3.3% AEP event upwards. They appear to be in a localised depression making them susceptible to runoff from the overland flow path on the highway.

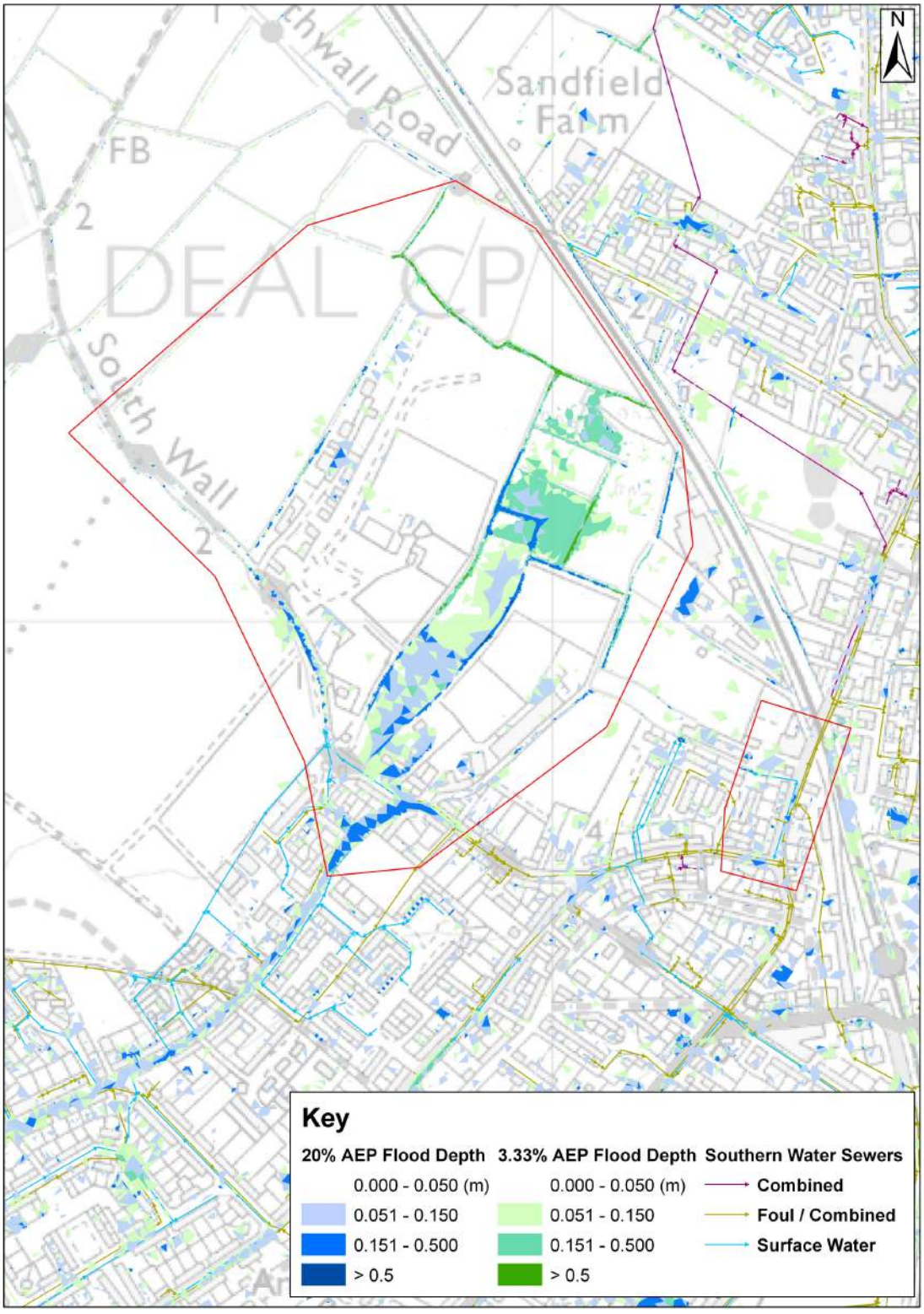
Table 24: Predicted Flood Risk in Hotspot G

Rainfall Event (AEP%)	20	10	3.3	2	1.3	1	0.5
No. at Risk	0	0	0	0	0	0	0
Cumulative	0	0	0	0	0	0	0

As Table 24 indicates there is no risk of flooding to existing property in this hotspot but as we believe this area is being considered for further development.

The flooding mechanism is described in Table 25 and Figure 6.

Figure 6: Predicted Flood Risk in Hotspot G



NB: Flood depths below 50mm removed for clarity

Table 25: Summary of Flood Risk Mechanisms in Hotspot G

Rainfall Event (AEP)	Key Pattern of Flooding
20% (1 in 5)	Localised ponding at the junction of Church Lane and Southwall Road of approx 0.3m depth. This remains on the highway.
3.33% (1 in 30)	The flow path is more extensive along Church Lane.
1.3% (1 in 75)	The Church Street flow path extends northwards from the junction with Southwall Road through the industrial estate. Peak flood depths at the junction are approx 0.5m.
1% (1 in 100)	Similar to the 1.3% AEP event with deeper flooding.

E.5 Surface Water Management

E.5.1 Key Concepts for the Options

There is limited property damage in this area currently to justify expenditure, however if there are any plans to develop in the vicinity of the industrial estate predicted flood risk will need to be considered.

There is a SW pumping station in the vicinity of the junction of Church Lane and Southwall Road, which could be critical infrastructure and may require protection.

E.5.2 Location Specific Options Identified

An option has been identified to try and reduce flood depths on the highway and to potentially reduce the flooding adjacent to the industrial estate as summarised in Table 26 .

Table 26: Hotspot G Mitigation Measures

Option Ref	Description	Comment
G1	Upstream storage	• Install offline storage at the playing field south of the Church Lane / Southwall Road junction to reduce flood depths at the junction

E.6 Economic Appraisal

E.6.1 Damages assessment

As no property damage is predicted by the model there is no justification for a flood mitigation scheme.

Appendix F Hotspot H: Albert Road

F.1 Area Description

Albert Road is located to the north-west of Deal town centre. Topographically the area of flood risk is at a low point and overland flow from the south is trapped by the railway embankment. The properties on Albert Road do not have basements.

F.2 Development Plans and Opportunities

There are proposals to develop an area of Court Marsh Farm to the west of Albert Road. This is downstream of the existing flooding location and therefore will not contribute to the mitigation of existing flooding. However the predicted flood risk needs to be considered as part of the any re-development proposals.

F.3 Environmental Designations and Other Possible Constraints

There are no environmental designations in the vicinity of Albert Road.

F.4 Flood Risk

F.4.1 Historic Flood Risk

Flooding has been reported in the vicinity in 2006 and in August 2010.

F.4.2 Predicted Flood Risk

The model predicts that a cluster of properties are at risk of flooding, but only under a 0.5% AEP event. The results are summarised in Table 27 and Figure 7. This is contradicted by the instances of recorded flooding (twice in four years) and therefore the model may be under-predicted flood risk at this location.

Table 27: Predicted Flood Risk in Hotspot H

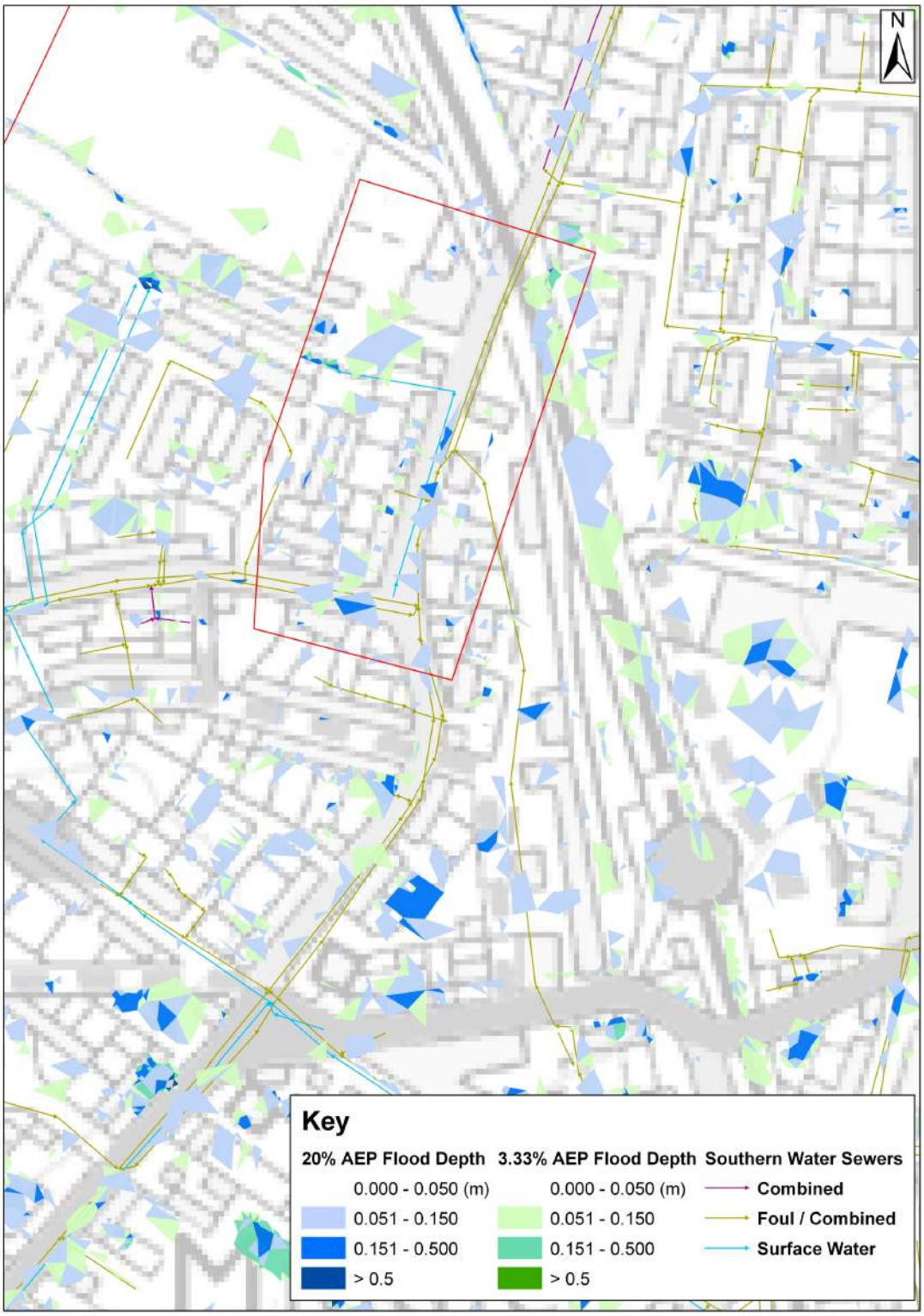
Rainfall Event (AEP%)	20	10	3.3	2	1	0.5
No. at Risk	0	0	0	0	0	11
Cumulative	0	0	0	0	0	11

The flooding mechanism is described in Table 28.

Table 28: Summary of Flood Risk Mechanisms in Hotspot H

Rainfall Event (AEP)	Key Pattern of Flooding
20% (1 in 5)	The model predicts very little flooding in the vicinity of Albert Road.
3.33% (1 in 30)	Little flooding is predicted by the model.
1.3% (1 in 75)	There is extensive flooding along Albert Road and entering Court Marsh Farm. A flow path is evident flowing northwards along Albert Road. Peak flood depths are approximately 0.5m.
1% (1 in 100)	The flow path along Albert Road is more pronounced. Peak water levels are 0.6m. The flow path turns westwards into Court Marsh Farm once past the properties in Albert Road.

Figure 7:Predicted Flood Risk in Hotspot H



NB: Flood depths below 50mm removed for clarity

F.4.3 Key Elements

Flow paths from Church Street and the southern end of Albert Road converge at the low point and cannot flow northwards because of the railway embankment and therefore place properties to the west of Albert Road at risk.

Flooding in this location could lead to significant traffic disruption.

F.5 Surface Water Management

F.5.1 Key Concepts for the Options

Options have been identified for the mitigation of flooding. However given the lack of damages at frequent storm events they are unlikely to be economically viable. With reference to Section F.4.2 it may be that the model is under-predicting flood risk at this location, which would require further investigation to increase the viability of an intervention.

F.5.2 Location Specific Options Identified

Options to mitigate flooding in Albert Road have been identified and are summarised in Table 29.

Table 29: Hotspot H Mitigation Measures

Option Ref	Description	Comment
H01	Attenuation	• Implement measures (e.g. kerb raising) to retain the flow on the highway
H02	Storage	• Construct below-ground storage to increase capacity in the drainage system along the contributory flow paths

F.6 Economic Appraisal

F.6.1 Damages assessment

Based on the modelled flood extents we have estimated the Present Value Damages (PVd) and the maximum viable scheme cost as summarised in Table 30. There are limited damages in this hotspot and therefore limited scope to support mitigation works.

Table 30: Estimate of Hotspot H Maximum Scheme Cost

Hotspot	PV Damages (£k)	iBCR	Maximum PV Scheme Cost (£k)
F	15	1	0

Appendix G Hotspot I: Mill Hill

G.1 Area Description

Mill Hill is located to the west of the centre of Deal and is a residential area.

G.2 Development Plans and Opportunities

There are no allocation sites in the vicinity of Mill Hill.

G.3 Environmental Designations and Other Possible Constraints

There are no environmental designations in the vicinity of Hotspot I.

G.4 Flood Risk

G.4.1 Historic Flood Risk

SW has recorded flooding in the area in 2004 in Manor Road and 2010 at St. Leonard's Road and Allenby Avenue. Flooding has also been recorded in 2007 in St. Leonard's Road with a lower ground flat affected.

G.4.2 Predicted Flood Risk

The model predicts overland flow paths from the south-west moving in a northerly direction to the west of Bruce Close. There are a number of properties at risk of flooding on this flow path.

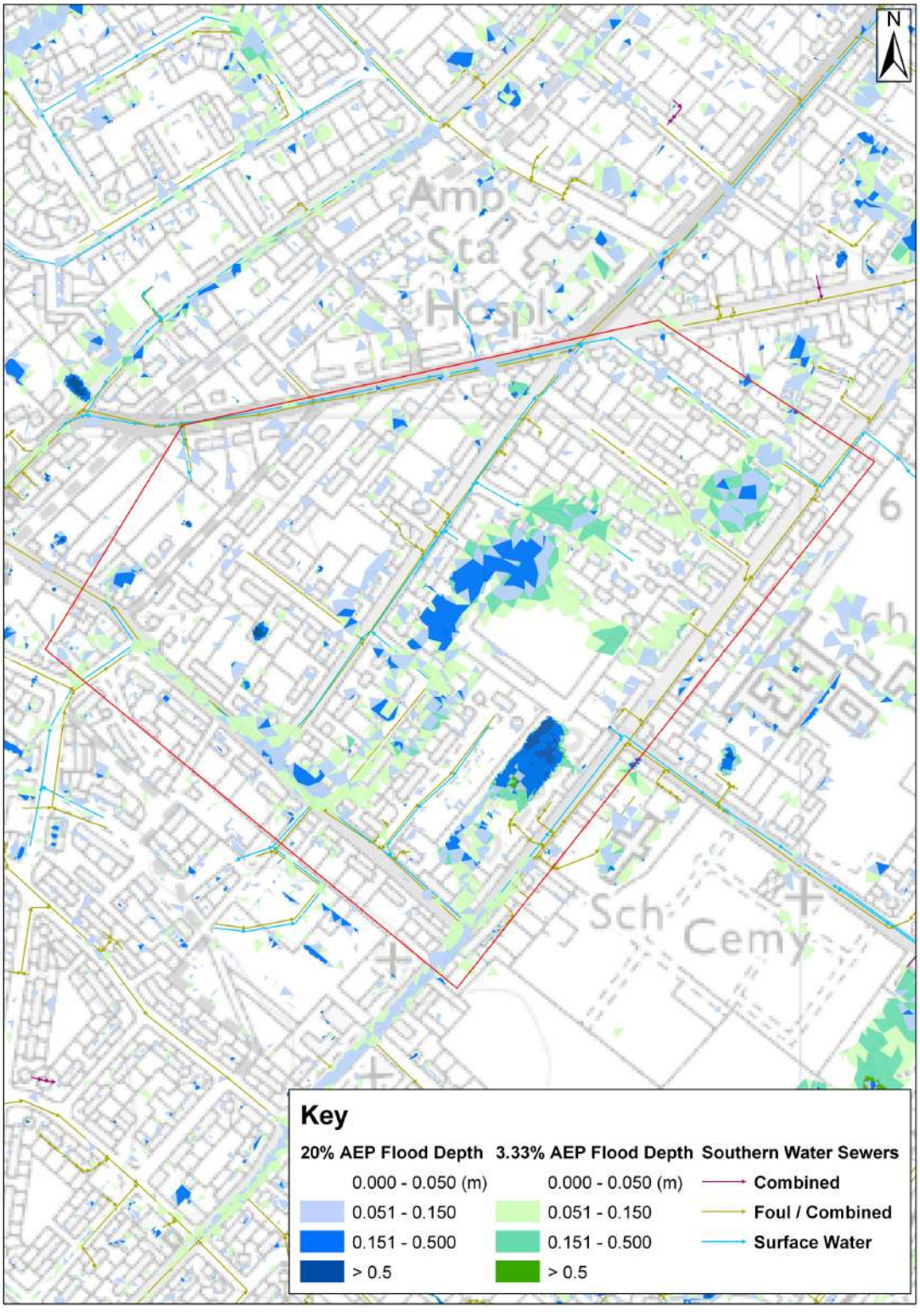
A second area of flood risk centres upon properties in Mildale Close. Flooding at this location is caused by an overland flow path along Mill Road which then enters the Close as it is in a depression. From there it can only be drained by the surface water network as the ground rises to the north.

Flood risk to property is summarised in Table 31 and Figure 8.

Table 31: Predicted Flood Risk in Hotspot I

Rainfall Event (AEP%)	20	10	3.3	2	1	0.5
No. at Risk	9	2	6	9	12	16
Cumulative	9	11	17	26	38	54

Figure 8: Predicted Flood Risk in Hotspot I



NB: Flood depths below 50mm removed for clarity

The flooding mechanism is described in Table 32.

Table 32: Summary of Flooding Mechanisms in Hotspot I

Rainfall Event (AEP)	Key Pattern of Flooding
20% (1 in 5)	Localised depths greater than 0.15m on the flow path to the east of St. Leonard's Road. Flooding to properties in Mildale Close.
3.33% (1 in 30)	A greater extent of flooding on the overland flow path, peak flood depths of 0.4m. More extensive flooding in Mildale Close, peak flood depths of 0.8m.
1.3% (1 in 75)	The flow path is evident along manor road with depths in excess of 0.3m. Flood depths in Mildale Close in excess of 1.0m.
1% (1 in 100)	A contiguous flow path in excess of 0.15m deep is visible through the area. Peak flood depths in Mildale Close are approx 1.5m.

G.4.3 Key Elements

The following key elements for flood risk in this hotspot have been identified:

- Three properties in Golham Grove are predicted to flood and it was noted on the site visit that properties slope down from the road which does not have a kerb;
- Flooding in Mildale Close appears to be as a result of a flow path running northwards along Mill Road entering the Close which is a low point. The only way flood water can exit is via the public sewer and pumping station.

G.5 Surface Water Management

G.5.1 Key Concepts for the Options

Options have been identified for Mildale Close and for the overland flow path crossing the area. As this is a densely urbanised area there is limited scope for large-scale mitigation schemes and therefore small-scale, incremental schemes will need to be implemented.

The sewers in this are generally full. There is little scope therefore to try and increase inflow to them from the overland flow paths.

G.5.2 Location Specific Options Identified

Options to mitigate flooding have been identified and are summarised in Table 33.

Table 33: Hotspot I Mitigation Measures

Option Ref	Description	Comment
I01	Offline storage	• Intercept the overland flow path along Mill Road and re-direct flow to the playing field to the north of Freemen's Way. • This will reduce the inflow to Mildale Close.
I02	Raised Kerbs	• Retain water on the highway via raised kerbs
I03	Offline Storage	• Redirect the surface water sewers into the recreation ground to increase capacity.

G.6 Economic Appraisal

G.6.1 Damages assessment

Based on the modelled flood extents we have estimated the Present Value Damages (PVd) and the maximum viable scheme cost as summarised in Table 34. There are limited damages in this hotspot and therefore very little scope to progress any mitigation works.

Table 34: Estimate of Hotspot H Maximum Scheme Cost

Hotspot	PV Damages (£k)	iBCR	Maximum PV Scheme Cost (£k)
I	1,856	1	1,136