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Dover Surface Water Management Plan

Volume 1 – Summary Report and Action Plan

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Glossary and Abbreviations Used in This Report

Term	Definition
AEP	Annual Exceedance Probability. A flood or rainfall event with a 1 in 100 (1%) chance of being exceeded in any year has an AEP of 1/100 or 1%.
Climate Change	Long term variations in global temperature and weather patterns caused by natural and human actions.
Culvert	A channel or pipe that carries water below the level of the ground.
Defra	Department for Environment, Food and Rural Affairs
DDC	Dover District Council
EA	Environment Agency
FMfSW	Environment Agency Flood Map for Surface Water
Flood & Water Management Act	Part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, the aim of which (partly) is to clarify the legislative framework for managing surface water flood risk in England.
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a river.
KCC	Kent County Council
KHS	Kent Highway Services
LLFA / Lead Local Flood Authority	Local Authority responsible for taking the lead on local flood risk management (for Dover this is KCC)
Main River	A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers. N.B. Main River designation is not an indication of size, although it is often the case that they are larger than Ordinary Watercourses.
MCA	Multi Criteria Analysis (MCA) is a tool to assist decision-making where there are a number of different factors to consider. Each factor is scored and weighted to weigh up the benefits of different intervention options.
NPD	National Property Dataset – a collection of risk receptors produced by the Environment Agency
Partner	A person or organisation with responsibility for the decision or actions that need to be taken.
Resilience Measures	Measures designed to reduce the impact of water that enters property and businesses; could include measures such as raising electrical appliances.
Resistance Measures	Measures designed to keep flood water out of properties and businesses; could include flood guards for example.
Risk	In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
Stakeholder	A person or organisation affected by the problem or solution, or interested in the problem or solution. They can be individuals or organisations, includes the public and communities.
SuDS / Sustainable Drainage Systems	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.
Surface water	Rainwater (including snow and other precipitation) which is on the surface of the ground (whether or not it is moving), and has not entered a watercourse, drainage system or public sewer.
SW	Southern Water

Term	Definition
Swale	A shallow vegetated channel designed to conduct and retain water, but also may permit infiltration. The vegetation filters particulate matter.
SWMP / Surface Water Management Plan	A SWMP (Surface Water Management Plan) identifies the risk of surface water flooding in a local area as well as viable measures to manage that risk.
UKCP09	The UK Climate Projections provide climate information designed to help those needing to plan how they will adapt to a changing climate. The data is focussed on the UK.

1 Summary of the Dover SWMP

1.1 Background and Motivation

Based on national mapping provided by the Environment Agency, Defra identified that a significant number of properties in the urban area of Dover may be susceptible to surface water flooding. Subsequently, Kent County Council (KCC), as the Lead Local Flood Authority (LLFA) was allocated funding to prepare a Surface Water Management Plan (SWMP) covering the urban area of Dover.

Surface water flooding in Dover could be caused by intense rainfall before it enters the River Dour or sewer network, overland flow resulting from high groundwater levels, exceedance of the capacity of the surface water or combined sewer networks and 'out of bank flow' from open-channel or culverted sections of the River Dour which results from runoff within the urban area. In addition to damage to properties, roads and other infrastructure, the onset of surface water flooding can be relatively sudden and can lead to both high velocity flows in steep areas and deep ponding of flood water. There is, therefore, a risk to life associated with surface water flooding.

The purpose of the SWMP study is to identify sustainable responses to manage surface water flooding and to prepare an Action Plan. The Action Plan provides an evidence base for future decisions and funding applications for putting the recommendations into practice. Preparation of the Action Plan for Dover has followed the latest Defra guidance. The Action Plan is presented in Chapter 2 of this Summary Report. Full technical detail can be found in the supporting reports which are listed in Table 1.1.

Table 1.1 Structure of the Dover SWMP reports

Report Volume	Title	Defra Guidance Stage
Volume 1 (this report)	SWMP Summary Report and Action Plan	Implementation and Review
Volume 2(i)	Preliminary Risk Assessment	Preparation
Volume 2(ii)	Detailed Modelling Report	Risk Assessment
Volume 2(iii)	Options Report	Options

1.2 Partnership Approach to Flood Risk Management

The SWMP project started in February 2010 and has followed on from previous studies, particularly the Strategic Flood Risk Assessment[1,2] and the Flood Risk Appraisal of the River Dour. The partnership approach to integrated flood risk management, as encouraged by the Flood & Water Management Act 2010[3], has been strengthened in this SWMP through integrated working between KCC (lead partner), Dover District Council (DDC), the Environment Agency (EA) and Southern Water (SW). The vision for the project was agreed by the SWMP Partnership as shown in Figure 1.1.

[1] JBA (2007) Dover District Council Strategic Flood Risk Assessment. Final Report. September 2007
[2] Capita (2010) Flood Risk Appraisal of the River Dour. Report for Dover District Council. May 2010
[3] http://www.legislation.gov.uk/ukpga/2010/29/contents

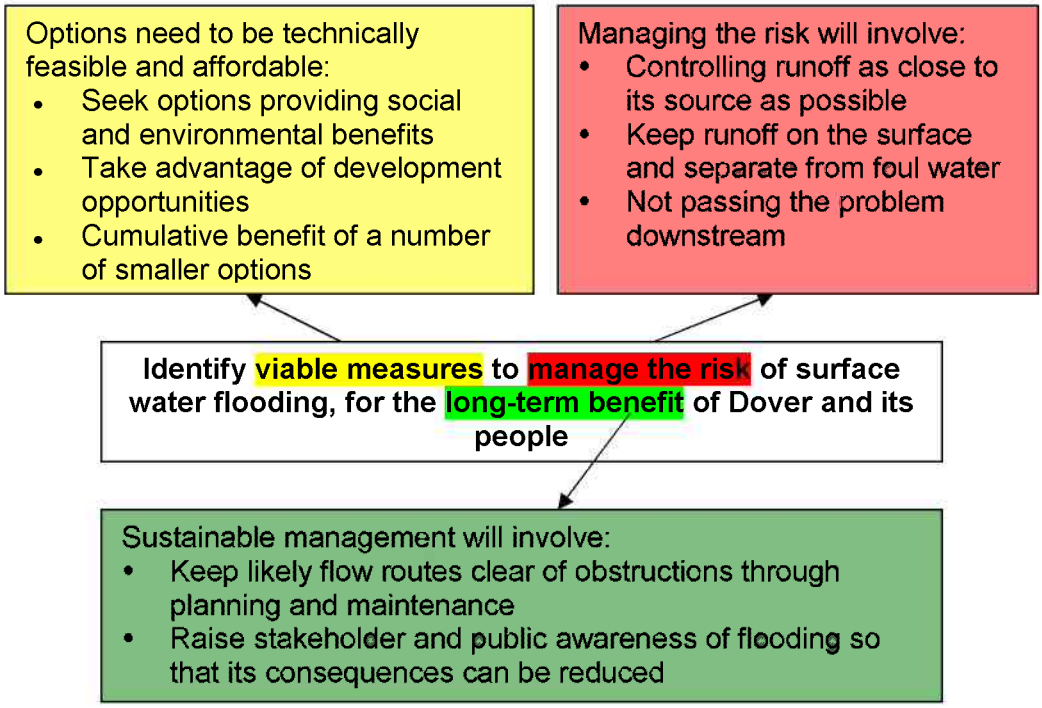


Figure 1.1 The SWMP vision statement highlighting key concepts

Consultation with partner organisations, stakeholders and representatives of the public has been a key element throughout development of the SWMP. Following the agreed Communication & Engagement Plan, a 'stakeholder workshop' was held on 15 December 2010 with a number of councillors and technical experts in the councils to discuss key flooding issues and gather local information to help direct the study. There was general confirmation of the evidence upon which the study was being founded and support for the project and its direction.

Key flooding issues identified at the outset of this SWMP are summarised in Box 1. More detailed observations for each key risk area are provided in the following sections, presented in clockwise order:

Appendix A: Folkestone Road Area
Appendix B: Tower Hamlets Area
Appendix C: Coombe Valley Road
Appendix D: River and Crabble
Appendix E: Temple Ewell and Kearsney
Appendix F: Buckland
Appendix G: Mid Town

1.3 Risk Assessment through Detailed Modelling

A detailed two dimensional hydraulic model has been developed to support the SWMP Action Plan. The model has been used to better understand the locations and mechanisms of flooding and inform identification and development of management options. The model covers the highest risk locations within the urban area of Dover and is able to represent:

Key flooding issues identified in the urban area of Dover

- There is demonstrable history of surface water and groundwater flooding across the urban area of Dover, for example in June 2007 and the winter of 2000/1. The flooding has affected both residential and non-residential properties as well as critical transport links.
- There are some significant natural drainage paths entering the urban area from the surrounding chalk valleys. Although these are typically dry, they could become conduits for surface water flow during intense rainfall and/or when the surrounding chalk hills become saturated or frozen. A number of these flowpaths are down steep roads. The velocity of flow could present a significant hazard.
- There are numerous basement premises throughout Dover with entrances at or near road level where surface water could readily flow into the basement if it overtops the kerbs. There is evidence of deep flooding in some of these basements which poses a significant hazard.
- The River Dour channel is complex with numerous culverted sections. It is severely constrained and includes potential obstructions to high flows. There are numerous surface water drains discharging into the River Dour which could quickly become 'tide-locked' by high levels in the River Dour.

Box 1 Key flooding issues

- direct rainfall on the urban area;
- overland flow through the built environment at a suitably high resolution;
- groundwater discharge from the surrounding Chalk valleys;
- interaction with Southern Water's surface water and combined sewer network; and
- interaction with the River Dour and the influence of the tidal boundary.

The model has been used to predict the maximum flood depths and velocities for the following range of design rainfall events: 50% (1 in 2) AEP, 3.33% (1 in 30) AEP, 1% (1 in 100) AEP and 0.5% (1 in 200) AEP. The potential impacts of climate change have been represented in the models by increasing the rainfall intensities for the 1% (1 in 100) AEP events by 12%, in accordance with the latest UKCP09 guidance[4]. A summary of the pattern of flooding in each key risk area, as predicted by the detailed model, is provided in Appendices A to G. General observations from the modelling are summarised in Box 2. It is noted that the model represents a large and hydrologically complex area and that a number of simplifications have had to be made. Therefore, the model should only be used for large-scale purposes similar to this study and any detailed design should include necessary improvements and refinements to the model.

Maximum depths at individual properties in the Environment Agency National Property Database have been used to estimate economic damages due to surface water flooding in the existing ('do minimum') situation. Assuming a standard property threshold level of 0.15m above surrounding ground level, it is estimated that

[4] http://ukclimateprojections.defra.gov.uk/

approximately £250M of damage (including indirect, intangible and emergency service costs where applicable) due to surface water flooding will be experienced across the modelled urban area of Dover in the next 100 years. For the 2,300 or so residential properties which are predicted to experience flooding, the average annual damage could be around £3,500 which equates to approximately £100,000 of damage per residential property over the next 100 years. These high values are due in part to the predicted shallow flooding in high frequency events. However, they are in line with Defra guidance on flood damage which assumes £30,000 of damage per property per flood event. The proportion of total residential properties in the modelled area experiencing flooding at some point in the 100 years is about 20%.

General observations from the detailed modelling

- Predictions of deep and/or extensive flooding are largely consistent with recorded evidence of surface water flooding. Key risk areas identified by the model and historical evidence include locations along Folkestone Road, Tower Hamlets Street and East Street, Coombe Valley Road, London Road and the junction with Crabble Hill and in Mid Town. Little flooding is predicted in Crabble (except Crabble Avenue), River, Temple Ewell and Kearsney which is consistent with anecdotal evidence.

- In Folkestone Road, Tower Hamlets, Buckland and Mid Town the extent of flooding predicted by the SWMP model and the EA Flood Map for Surface Water (FMfSW) is very similar. In Crabble, River, Temple Ewell and Kearsney the SWMP model predicts less flooding than the FMfSW which is most likely due to the different assumptions about runoff from the permeable Chalk which dominates in these less urbanised areas.

- During the summer and autumn months, the large Chalk catchments draining to Dover are likely to be unresponsive to extreme rainfall (e.g. 1% AEP storm of 5 hours duration). The effective rainfall first recharges the aquifer so the impact evident in the outflow is delayed for a number of months. Should such an extreme storm occur on a typical wet catchment, peak outflows will substantially increase but only after a few weeks. If an extreme storm occurs on a saturated catchment, the catchment responds in a matter of days although the peak flows are not substantially higher.

- The maximum flood depths within the urban area of Dover are not substantially influenced by the different flows from the chalk valleys (including in the River Dour at Kearsney) arising from typical wet or dry catchments. The influence of outflows from the Chalk similar to those experienced in the winter of 2000/1 have not been tested since the long term rainfall leading to the 2000/1 event had a probability less than 1% and the coincidence of a further extreme storm over Dover urban area is a highly unlikely scenario.

- Comparison of the maximum flood depths in the 1% (1 in 100) AEP event indicates that a 12% increase in rainfall intensity due to climate change could result in an increase in flood depths of approximately 15%.

Box 2 General observations from the detailed modelling

1.4 Options for Sustainable Management of Surface Water Flooding

Undertaking no maintenance on existing infrastructure and not planning for any improvement in flood risk management will result in an increasing flood risk as existing drainage capacity, resistance and resilience deteriorates and future climate change increases the frequency of extreme events. Therefore, a range of options has been identified to improve management of surface water flooding across the urban area of Dover. The options have been developed from a review of previous studies, Multi-Criteria Analysis (MCA) of individual measures, site inspection, detailed modelling and consultation with project partners and stakeholder organisations. The options have been designed to fit within the overall philosophy as outlined in Box 3.

Philosophy for the Identified Options

- Seek management options providing social and environmental benefits – schemes with multiple benefits are more likely to attract funding
- Manage runoff and sediment transport close to its source and keep runoff on the surface wherever possible – this will be sustainable and have reduced maintenance costs
- Keep likely flow routes clear of obstructions through planning and maintenance – to reduce both the likelihood and consequences of flooding
- Raise stakeholder and public awareness of flooding – this will reduce the consequences of flooding and improve reporting and evidence of issues
- Implement identified options incrementally and take advantage of opportunities as they arise – 'piggy-back' flood risk management activities with other schemes

Box 3 Philosophy for the identified options

Options have been developed by combining individual measures (which are introduced in Table 1.2) under the following headings:

- **Source control and Sustainable Drainage Systems (SuDS)**: Source control measures aim to reduce the rate and volume of surface water runoff through infiltration or storage. In constrained and highly developed urban areas like Dover, controlling inflows entering the urban area will be a particularly desirable option.

- **Design for exceedance:** Roads, buildings and other features can be designed to control overland flow and direct it safely through the urban environment, such that floodwater is less likely to enter buildings or other structures. Designing for exceedance recognises that flows that exceed the below ground drainage capacity are always possible but can be managed to some degree by creating designated flow routes or other measures such as threshold raising at access points. These measures could be particularly successful in Dover which has limited available open space along some key natural flow routes. However, potentially high flow velocities will require careful coordination with emergency planners.

- **Increasing capacity:** Adding storage and/or increasing the capacity of the sewer network and the River Dour could improve the conveyance of floodwater

and limit overland flow and flooding. This may be particularly relevant to the highly culverted and constrained River Dour through Mid Town.

- **Separation of foul and surface water:** Alongside effective surface water management, this can reduce flooding and pollution. Misconnections between the surface water and foul systems should be rectified as opportunities arise throughout Dover.

- **Non-structural measures:** Non-structural measures can reduce the consequences for the receptors of flooding, e.g. people, property and the environment. In most cases, these are likely to be implemented across Dover through the introduction of council policy.

The principal concepts for improved surface water management are listed for each key risk area in Appendices A to G. In these sections, the potential location-specific options for improved surface water management in the area are listed, separated into those which have been considered during the study but subsequently discounted and those which are included in the Action Plan in Chapter 2. Options have been appraised through an analysis of the following criteria:

- **Technical** – Is the option technically possible and will it actually improve management of surface water flooding? Where possible, the detailed model has been used to represent the proposed option or otherwise inform its technical feasibility.

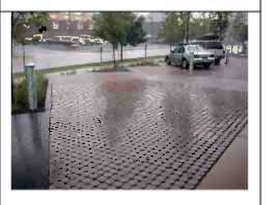
- **Economic** – Is there a sufficient demonstrable flood risk and is the reduction in risk from implementing the option likely to outweigh the financial cost of the option? Where possible, the model representation of option has been used to estimate the number of properties protected.

- **Social** – Will the community benefit or suffer from implementation of the option?

- **Environmental** – Will the environment benefit or suffer from implementation of the option?

- **SWMP** – The majority of proposed options were discussed at an Options Workshop held on 20 June 2011, to which all SWMP Partners and other stakeholders were invited. The degree of support for each option has informed selection those options included in the Action Plan in Chapter 2.

Table 1.2 Introduction to individual measures considered to improve surface water flood risk management

Category	Measure	Illustration	Category	Measure	Illustration	Category	Measure	Illustration
Source control and Sustainable Drainage Systems (SuDS)	**Fringe Interception** of runoff could reduce the volume of water entering the Dover urban area via overland flow or in the River Dour. The hills to the west of Dover are characterised by a number of dry valleys. Potentially, runoff from the saturated Chalk could be attenuated in detention basins or through alternative land management practices (e.g. contour ditching or afforestation).		Source control and SuDS	**Soakaways** are filled excavations which store runoff from single properties or larger developments and roads and allow infiltration into the surrounding soil. They only work in freely draining soils.		Separation of foul and surface water	**Greenfield developments** are usually separately sewered and such opportunities should be maximised. **Brownfield development** opportunities are generally as for Greenfield but the existing drainage system may be combined. Opportunities should be taken to convert to a separate piped system where practical.	
	Detention basins are surface water storage areas which provide flow control and reduction through attenuation. They are normally dry and therefore could be used as car parks (including underground car parks), recreational facilities etc for much of the time. It may be possible to reuse the stored water on site (e.g. irrigation or aquifer recharge) depending on storage arrangements.			**Water butts** are used to collect rainwater from individual properties for outside use although some capacity must be available at the start of a storm. Alternatively, downpipes can be disconnected from discharging directly into surface water drains and be routed through a SuDS attenuation feature. **Rainwater harvesting** collects rainwater for non-potable reuse both internally and externally.			**Misconnections** between the surface water and foul systems should be rectified as opportunities arise. This can reduce pollution associated with surface water flooding.	
	Ponds and wetlands are designed to be areas of permanent standing water which can provide attenuation of flows and a certain degree of treatment. In doing so they can provide some improvement in water quality. They can provide ecological, aesthetic and amenity benefits.		Design for exceedance	**Surface flow routes**, formalised through road profiling etc, can be used to safely route exceedance flows through urban areas. **Green Streets** use attractive kerbside planters into which surface water on the road is directed. The plants provide some cleaning of the water, attenuation of peak flows and possibly infiltration of the stored water.			**Maintenance, desilting and removal of obstructions** can ensure that the River Dour and drainage infrastructure (particularly road gullies) are operating to their design potential. In the case of surface water features (e.g. watercourses, ponds, swales etc) this also provides improved amenity and aesthetic value.	
	Swales are shallow linear vegetated drainage features which can store and convey surface water. As part of an engineered flowpath, they can pass water from one storage/treatment area to the next and provide infiltration where underground conditions are suitable. Swales can be designed to be permanently wet or generally dry and are often located next to roads, car parks or other open spaces.			**Resistance and resilience** measures can be fitted to prevent surface water entering buildings and minimise the damage caused by flood water. Some form of grant assistance could be allocated to property owners for installation. The practicality of resistance or resilience measures that are deployed upon receipt of a flood warning would need to be carefully considered.			**Raising Awareness** of surface water flood risk within the councils, partner organisations and with the public may encourage property owners to consider property level resistance and resilience measures; discourage paving over property curtilage, building over the Dour or otherwise blocking natural drainage routes; and encourage reporting and recording of flooding.	
	Green roofs covered with vegetation can intercept and retain precipitation to reduce the volume of runoff and attenuate peak rainfall. Large flat or gently sloping roofs (e.g. commercial buildings, schools and hospitals) are particularly suited and cost-effective.		Increasing capacity	**Increasing the capacity of the current drainage network** may be possible through enlarging existing sewers, adding new sewers (which can be oversized to provide additional storage) or providing overground storage through interruption of the existing sewers. These could reduce the likelihood of discharge of potentially polluted floodwater through Combined Sewer Overflows.		Non-structural measures	**Flood Warning:** the Met Office and the EA operate an Extreme Rainfall Alert Service which provides county-scale alerts of extreme rainfall to Category 1 and 2 responders. Given the knowledge of areas most susceptible to surface water flooding, these alerts could be used to target responsive action.	
	Pervious pavements are suitable for pedestrian and vehicular traffic. Construction can use porous material which permits infiltration across the entire surface or material which is impervious to water but which is laid with void spaces to permit infiltration. The sub-base of the pavement may use geocellular block systems which provide storage.			**Widening and/or regrading of the watercourse** and opening up of culverted sections have the potential to improve the capacity of the watercourses to receive and convey flood flows. Where rapidly passing peak flows could cause flooding downstream, any local improvement in conveyance should be offset with increased storage to attenuate the peak.			**Planning policies** could be developed and adopted by DDC to steer new development away from known surface water flood risk areas and flow paths or, if necessary, to control their development. Basements should be given particular consideration. Policies should also aim to control or limit urban creep.	

2 SWMP Action Plan

2.1 Generic and Location-specific Actions

Based on the work summarised in Chapter 1, the Action Plan presented in Table 2.2 and Table 2.3 presents the list of the most viable options to manage the risk of surface water flooding, for the long-term benefit of Dover and its people.

Table 2.2 lists the options which could be implemented generically across the area. Table 2.3 lists the location-specific options which are illustrated on the map in Appendix B of the *Options Report*. Both tables provide the following information:

- **Where?** For location-specific options, the location.
- **What?** The description of the option.
- **How?** The suggested approach to implementing the option, including any identified priority actions.
- **Who?** The partner organisation which is best placed to lead implementation.
- **When?** An indication of the timescales within which the option is suggested to be implemented:
  - Priority 1: A 'quick win' or action urgently required within 12 months
  - Priority 2: Consider now for implementation in the next 1-5 years
  - Priority 3: Consider now for longer term implementation (5 years+)
  - Priority O: Consider implementing if opportunity arises

  This priority therefore balances the degree of flood risk with the likely required timescale for implementation.
- **Multi-Criteria Appraisal:** For location-specific options, the sum of scores based on criteria in Table 2.1 (maximum score of 10 per option). Where applicable, technical (T) and economic (Ec) scores have been assigned on the basis of detailed modelling. SWMP scores have been assigned based on feedback from the Options Workshop.

Ideas for funding opportunities are provided in Section 2.3.

Table 2.1 Criteria and scoring for Multi-Criteria Appraisal of actions

Criteria	Description	Score
Technical (T)	Is it technically possible and do-able? Will the option actually reduce flood risk?	-2 severe negative outcome -1 moderate negative outcome 0 neutral outcome 1 moderate positive outcome 2 high positive outcome
Economic (Ec)	Is there a sufficient existing risk? Will benefits exceed costs?	
Social (S)	Will the community benefit or suffer from its implementation	
Environmental (Env)	Will the environment benefit or suffer from its implementation	
SWMP	Did the wider SWMP Partnership support this option via discussion at the Options Workshop?	

Table 2.2 Generic management options (in order of indicative priority)

Generic Option ('What?')	Priority Actions ('How?)	Primary Action Owners ('Who?')[1]	Priority ('When?')[2]
Develop and implement a targeted maintenance schedule KCC, EA and SW should develop and implement a targeted maintenance schedule so that the highway gullies, drains and other drainage assets (including SuDS), the River Dour and sewers operate effectively to their design capacity.	1. Identify and record where existing drainage infrastructure is and who owns and/or is responsible for maintaining it. Records of assets should be available to all partners. 2. Partners to develop a coordinated maintenance schedule using information in the SWMP (areas at high risk of flooding, natural flow routes).	• KCC • EA • SW	1
	3. Communicate coordinated maintenance activities with the public to manage expectations.	• KCC • DDC	1
Raise awareness of surface water flood risk Raise awareness of surface water flood risk within DDC and with the wider public, particularly focussing on basement properties. Link with encouraging use of rainwater harvesting, rain gardens and other source control measures, as well as uptake of property level resistance and resilience measures. Improved recording of flood events will benefit future funding applications.	1. Brief DDC (and KCC) council teams (particularly Development Management officers) on surface water flood risk using SWMP materials 2. Improve record keeping of flood events as evidence to support grant applications. Link with KCC role as LLFA 3. Investigate opportunities to build longer-term drainage expertise within DDC through partnering with KCC as LLFA 4. Provide guidance on use of rainwater harvesting, water butts, other source control measures and property level resistance and resilience measures. 5. Using information in this SWMP, maintain a list of properties with basements and target owners for awareness raising and guidance on resistance/resilience measures.	• DDC	1
	6. EA and DDC to work jointly to enforce policy of not paving over front gardens and not extending properties into River Dour channel. 7. Remain vigilant for future government grants for property level resistance/resilience works	• DDC • EA	1
Develop and implement a policy to use green roofs and permeable paving where practicable Where practicable, green roofs should be the preferred option for new large non-residential buildings and retrofitted where existing roofs are being replaced. Similarly, car parks should be designed to allow shallow storage of surface water and/or use pervious paving during re-surfacing works or as part of new development.	1. DDC and EA to agree on common policy position regarding use of green roofs and pervious paving so responses to planning applications are consistent.	• DDC • EA	1
	2. Using information in the SWMP, identify existing buildings and car parks with potential for green roofs or shallow storage/pervious paving	• DDC	1
	3. Develop DDC policy regarding use of green roofs and pervious paving where practicable	• DDC	2
Further develop DDC planning policy with respect to flood risk (including use of SuDS) Adopt a map indicating natural drainage routes which future development should respect. Development should also respect local landform to ensure sufficient property thresholds. Adopt a map indicating the suitability of locations for appropriate SuDS. Where appropriate, develop Supplementary Planning Documents (SPDs) to encourage developers of a particular site to contribute to flood risk management of the wider area.	1. EA, DDC and KCC to agree that the SWMP material can be used in response to planning applications and to develop policy. 2. Brief DDC council teams on natural drainage routes and suitability of locations for appropriate SuDS using simplified maps 3. Promote use of appropriate SuDS through enhancing council policy (currently DM17) using information in the SWMP	• DDC • EA • KCC	1
	4. Investigate feasibility of developing SPDs which can inform applications for redevelopment of strategic sites	• DDC	2
Improve flood warning Investigate the feasibility of a flood warning service on the River Dour. Encourage emergency responders to link Flood Forecasting Centre alerts with mapping of areas at risk of surface water flooding.	1. DDC and KCC to use information in this SWMP for emergency planning and response.	• DDC • KCC	1
	2. EA to investigate the feasibility of extending their flood warning service to cover flooding from the River Dour, particularly through Mid Town	• EA	2
Develop KHS policy for highways to be used as exceedance routes Develop policies to permit temporary routing of surface flow along roads, using traffic calming as required.	1. Develop KHS policy regarding use of roads for temporary flow routing, using traffic calming as required. Also consider shallow storage in lowered roundabouts and use of green street planters for kerb-side drainage.	• KCC (KHS)	2

Generic Option ('What?')	Priority Actions ('How?)	Primary Action Owners ('Who?')[1]	Priority ('When?')[2]
Misconnections and surface water sewer interruption SW (with council support) should proactively seek to rectify misconnections. SW should develop a policy (in conjunction with other Partners) which could permit schemes to interrupt surface water sewers to provide overground attenuation and storage in extreme events. Individual schemes would still need to be justified.	1. SW (supported by DDC) to proactively identify/rectify misconnections between the foul and surface water sewers 2. SW to develop policy of sewer interruption based on discussions with Ofwat and other providers	• SW • DDC	2
Improve management of agricultural land to reduce runoff volume and sediment transport Maintain and further improve land management practices on the urban fringe to reduce surface runoff and associated erosion and sediment transport.	1. Using information in the SWMP identify agricultural land adjacent to primary natural flow routes which could be considered for Higher Level Stewardship schemes. 2. Promote and assist with applications to Higher Level Stewardship which tackle potential impacts of climate change, diffuse pollution, erosion, water quality and quantity.	• DDC	2

Notes:
[1] EA – Environment Agency; DDC – Dover District Council; KCC – Kent County Council; KHS – Kent Highway Services; SW – Southern Water
[2] Priority 1: A 'quick win' or action urgently required within 12 months; Priority 2: Consider now for implementation in the next 1-5 years; Priority 3: Consider now for longer term implementation (5 years+); Priority O: Consider implementing if opportunity arises

Table 2.3 Location-specific management options (in order of indicative priority)

Area	Option Location ('Where?')	Location-specific Option ('What?')	Priority Actions ('How?')	Primary Action Owners ('Who?')[1]	Priority ('When?')[2]	Multi-Criteria Appraisal: Technical	Economic[3]	Social	Environ-mental	SWMP	Overall MCA Score (max. 10)
Mid Town	Maison Dieu Road	***Property resistance/ resilience*** Improve property resistance and resilience measures for selected properties adjacent to Maison Dieu Road.	1. Encourage uptake of resistance/ resilience measures at identified properties adjacent to Maison Dieu Road.	• DDC	**1** Urgent/ quick win with available funding	2 Products available	2 £26-£50k funding secured to protect 6 properties	0 No wider social benefits	0 No wider environmental benefits	2 Strong support	**6**
Folkestone Road	Folkestone Road	***Property resistance/ resilience*** Improve property resistance/ resilience for selected properties adjacent to Folkestone Road.	1. Encourage uptake of resistance/ resilience measures at identified properties adjacent to Folkestone Road opposite junction with Malvern Road.	• DDC	**1** Urgent/ quick win with available funding	2 Products available	2 £51-£100k funding secured to protect 14 properties	0 No wider social benefits	0 No wider environmental benefits	2 Strong support	**6**
Tower Hamlets	Tower Hamlets Street, East Street	***Property resistance/ resilience*** Improve property resistance and resilience measures for selected properties adjacent to Tower Hamlets Street and East Street.	1. Encourage uptake of resistance/ resilience measures at identified properties adjacent to East Street.	• DDC	**1** Urgent/ quick win with available funding	2 Products available	2 £51-£100k funding secured to protect 10 properties	0 No wider social benefits	0 No wider environmental benefits	2 Strong support	**6**
Crabble	Crabble Avenue	***Property resistance/ resilience*** Improve property resistance and resilience measures for selected properties adjacent to Crabble Avenue.	1. Submit a funding bid to EA/Defra for property level protection supplemented by any property-owner evidence of flood history. 2. Encourage uptake of resistance/ resilience measures at identified properties adjacent to East Street.	• DDC	**1** High priority due to flood history	2 Products available	1 If £26-£50k funding can be secured to protect 1-5 properties (based on judgement from model)	0 No wider social benefits	0 No wider environmental benefits	1 Likely to be supported by partnership	**5**
Temple Ewell & Kearsney	London Road between junctions with Kearsney Avenue and Alkham Road	***Property resistance/ resilience*** Improve property resistance for the properties adjacent to the hospital on the south side of London Road by raising kerbs between the junctions of Kearsney Avenue and Alkham Road.	1. Site investigation to consider 'quick win' raising of kerbs on London Road to protect properties adjacent to the hospital if resurfacing works are being undertaken anyway.	• KHS	**1** Quick win if road works already planned	1 Possible depending on access requirements	2 <£25k to protect 1-5 properties (based on judgement from model)	0 No wider social benefits	0 No wider environmental benefits	1 Weak support due to low perceived risk	**4**
Coombe Valley Road	Coombe Valley Road	***Property resistance/ resilience*** Improve property resistance/ resilience for identified properties along Coombe Valley Road.	1. Encourage uptake of resistance/ resilience measures at identified properties adjacent to Coombe Valley Road. 2. Submit a funding bid to EA/Defra for property level protection if any property-owner evidence indicates a flood history.	• DDC	**2** Low perceived risk	2 Products available	1 If £26-£50k funding can be secured to protect 1-5 properties (based on judgement from model)	0 No wider social benefits	0 No wider environmental benefits	1 Weak support due to low perceived risk	**4**
Folkestone Road	Folkestone Road and Elms Vale Road	***Attenuation of surface flows*** Detention basins in the playing field of Harbour School adjacent to Elms Vale Road and the Dover College cricket and hockey ground (bordered by Folkestone Road, Cow Lane and Church Road).	1. Investigate feasibility of lowering portions of Harbour School playing field and Dover College cricket and hockey ground to temporarily store surface runoff.	• DDC	**2** Time required for feasibility study	1 Possible depending on lowering of ground levels	1 £101-250k to protect 5-20 properties (based on judgement from model)	0 No wider social benefits	0 No wider environmental benefits	1 Support to investigate feasibility	**3**

Area	Option Location ('Where?')	Location-specific Option ('What?')	Priority Actions ('How?')	Primary Action Owners ('Who?')[1]	Priority ('When?')[2]	Multi-Criteria Appraisal: Technical	Economic[3]	Social	Environ-mental	SWMP	Overall MCA Score (max. 10)
Buckland Valley and Buckland	Buckland Valley Sports Ground to junction of Crabble Hill and Buckland Avenue	***Attenuation and routing of surface flows*** Attenuate upstream flows in a detention basin in Buckland Valley Sports Ground. Route exceedance flows along Sheridan Road and across Roosevelt Road into a detention basin upstream of Winant Way. Route exceedance flows along Glenfield Road, Brookfield Avenue and Old Park Road. Raise pedestrian crossing at junction of Crabble Hill and Buckland Avenue to direct flow into the River Dour. Improve property resistance/ resilience along route as required.	1. Raise pedestrian crossing at junction of Crabble Hill and Buckland Avenue to stop continuation flow along Brookfield Place and route surface flows into the River Dour. 2. Raise kerb adjacent to NHS establishment on Brookfield Avenue opposite junction with Glenfield Road 3. Investigate feasibility of detention basins and designing exeedance routes.	• DDC • KHS	**2** Time required for feasibility study	1 Individual elements technically possible but requires feasibility study	1 £251-500k to protect 20-50 properties in 3.33% AEP event (based on modelling of option)	0 No wider social benefits	0 No wider environmental benefits	2 Strong support	**4**
Mid Town	Frith Road / Maison Dieu Road / Crafford Street	***Surface flow routing and attenuation*** Route exceedance flows from Frith Road into the River Dour adjacent to Morrison's supermarket, and route exceedance flows from Maison Dieu Road into (i) the River Dour via Crafford Street and (ii) a pond or wetland sited in the existing Maison Dieu Road car park.	1. Consider raised pedestrian crossing of Maison Dieu Road at Morrisons to direct surface flow from Frith Road into the River Dour 2. Investigate feasibility of designing Crafford Street for routing exceedance flows from Maison Dieu Road into the River Dour. In addition, investigate feasibility of developing Maison Dieu car park as a pond or wetland storage for high flows from the River Dour and runoff from Maison Dieu Road.	• DDC • KHS	**2** Time required for feasibility study	1 Individual elements technically possible but requires feasibility study	1 £251-£500k to protect 20-50 properties in 3.33% AEP event (based on modelling of option)	0 Loss of car park space offset by improved social environment	2 Improved environment from pond or wetland	1 Support for reduced flooding in Dour Street and improved environment in Mid Town	**5**
	Western Docks	***Increase channel capacity*** Fit tide-excluding gates at outlet of Wellington Dock Manage tide levels in the dock during periods of high river flow to maintain low tide levels and improve conveyance in the Dour channel.	1. Investigate feasibility of changing water level management rules in the Dock and closing tide-excluding gates upon receipt of a warning of high flows in the Dour	• DDC • EA	**3** Time required for feasibility study, construction and impact of sea level rise	1 Requires feasibility study	1 £51-£100k if Dover Harbour Board pays for gate. Number of properties protected not known.	0 No wider social benefits	0 No wider environmental benefits	1 Support to investigate feasibility	**3**
Folkestone Road	Great Farthingloe	***Attenuation of surface flows*** Attenuate upstream flows in a detention basin, pond or wetland as part of redevelopment of Great Farthingloe. Route exceedance flows from Folkestone Road into a pond or wetland sited adjacent to the Government Immigration Buildings off St John's Road as part of any redevelopment.	1. Consider requirement for an 'oversized' detention basin, pond or wetland in Great Farthingloe as part of any redevelopment, in order to reduce flood risk downstream. 2. Investigate feasibility of a pond or wetland adjacent to the Government Immigration Buildings to receive surface runoff from Folkestone Road as part of any redevelopment of the site	• DDC • SW	**O** Seek to include with proposed development	1 Individual elements technically possible but requires feasibility study	2 £101-£250k to protect 20-50 properties in 3.33% AEP event if developers pay for ponds (based on modelling of similar option)	1 Social environment improved by ponds	1 Environment improved by ponds	1 Support for works as part of site development	**6**

Area	Option Location ('Where?')	Location-specific Option ('What?')	Priority Actions ('How?')	Primary Action Owners ('Who?')[1]	Priority ('When?')[2]	Multi-Criteria Appraisal: Technical	Economic[3]	Social	Environ-mental	SWMP	Overall MCA Score (max. 10)
Coombe Valley Road	Coombe Valley Road / Lorne Road	***Attenuation and routing of surface flows*** Route exceedance flows along Coombe Valley Road and Lorne Road and into the River Dour, with an off-line detention basin or pond at the Buckland Hospital site as part of site redevelopment. Improve property resistance/ resilience along route as required.	1. Consider raised pedestrian crossing of London Road at the junction of Coombe Valley Road and Lorne Road to direct flow into Lorne Road and then the River Dour 2. Consider alternative access route to the Coombe Valley Industrial Estate, via Barwick Road if depression on Poulton Close becomes flooded. 3. Investigate feasibility of surface flow route and detention basin/pond in hospital site as part of any future redevelopment	• DDC • KHS	**O** Seek to include with proposed developme nt	1 Individual elements technically possible but requires feasibility study	1 £51-£100k to protect 5-20 properties in the 3.33% AEP event assuming developer pays for pond (based on modelling of option)	1 Social environment improved by pond	1 Environment improved by pond	1 Weak support due to low perceived risk	**5**
Temple Ewell & Kearsney	Temple Side and High Street, Temple Ewell	***Surface flow route and property resistance/ resilience*** Check footpath/flood barrier will protect Temple Side properties. Improve property resistance/ resilience for low threshold properties along High Street.	1. Site investigation to check that surface water cannot enter properties on Temple Side from the rear, and that flows are routed down the footpath to the existing flood barrier. 2. Identify properties with low thresholds along the High Street and encourage uptake of resistance/ resilience measures in case of exceedance flows from Temple Side.	• DDC	**O** Low perceived risk but seek funding	2 Products available	1 If £51-£100k funding can be secured to protect 5-20 properties (based on judgement)	0 No wider social benefits	0 No wider environment al benefits	1 Weak support due to low perceived risk	**4**
	Kearsney Lakes	***Increase capacity*** Increase storage of flows in the River Dour in the existing ponds at Kearsney.	1. Establish arrangements with Kearsney Lakes operators to draw down lake levels in advance of a predicted high flow event	• DDC	**O** Upon forecast of a flood event	2 Process has previously been followed	0 <£25k to protect an unknown number of properties	0 No wider social benefits	0 No wider environment al benefits	1 Support due to previous experience	**3**
River & Crabble	Cowper Road / Common Lane	***Property resistance/ resilience*** Improve property resistance/resilience measures for selected properties in the valley between Cowper Road and Common Lane	1. Identify properties with low thresholds adjacent to Cowper Road and encourage uptake of resistance/ resilience measures 2. Submit a funding bid to EA/Defra for property level protection if any property-owner evidence indicates a flood history.	• DDC	**O** Low perceived risk but seek funding if any flood evidence	2 Products available	1 If £26-£50k funding can be secured to protect 1-5 properties (based on judgement from model)	0 No wider social benefits	0 No wider environment al benefits	1 Weak support due to low perceived risk	**4**
	Minnis Lane	***Surface flow route*** Route exceedance flows down Minnis Lane and into the River Dour on the upstream side of Minnis Lane. Improve property resistance/ resilience along route as required.	1. Investigate feasibility of designing Minnis Lane for exceedance.	• KHS • DDC	**O** Low perceived risk but seek to link with any planned works	1 Individual elements technically possible and could be beneficial if resurfacing works being undertaken anyway	1 <£25 protect 1-5 properties (based on judgement from model)	0 No wider social benefits	0 No wider environment al benefits	1 Weak support due to low perceived risk	**3**

Notes:
[1] EA – Environment Agency; DDC – Dover District Council; KCC – Kent County Council; KHS – Kent Highway Services; SW – Southern Water
[2] Priority 1: A 'quick win' or action urgently required within 12 months; Priority 2: Consider now for implementation in the next 1-5 years; Priority 3: Consider now for longer term implementation (5 years+); Priority O: Consider implementing if opportunity arises
[3] Indicative cost bands are <£25k, £26-£50k, £51-£100k, £101-£250k, £251-£500k, £500k-£1M, £1-£10M, >£10M – see accompanying *Options Report* for details. Properties protected bands are 1-5, 5-20, 20-50 and 50-100 – see accompanying *Modelling Report* for details

2.2 Implementation and Review

Improved and sustainable management of surface water flooding is unlikely to arise through implementation of some of the proposed options alone. Instead, the overall philosophy developed through the SWMP study is for *incremental* change which *takes advantage of opportunities* as they arise to implement options which *cumulatively* have the effect of better managing flood risk. Therefore, all options should be kept in mind by the key DDC, KCC, EA and SW teams and their potential reviewed on a regular basis. To this end, it is **strongly recommended that the SWMP Partnership continues to meet bi-annually** (in the first instance) to review the progress of implementing the options and identify further opportunities. An ongoing forum may be best facilitated by KCC in its Lead Local Flood Authority role. Box 3 highlights some similar key messages which have been developed throughout the SWMP study. It is **recommended that these key messages are considered alongside the options** in Table 2.2 or Table 2.3.

Key SWMP Messages

Sustainable surface water flood risk management requires considering flood risk when undertaking other council or stakeholder activities. If this is done:

- flood risk will be managed through the cumulative benefit of numerous smaller schemes;
- opportunities for 'piggy-backing' flood management activities onto other works will be identified and could result in cost savings and efficiencies;
- Dover will incrementally adapt to the potential impacts of climate change through creative water management, leading to multiple benefits and win-win solutions; and
- awareness will be raised and maintained which will develop expertise.

Examples of putting these into practice should include:

- When **new developments** are being considered – Could the layout be modified to better respect the natural drainage routes? Could larger SuDS features be created which also store high flows from outside the site?
- When **existing developments** are being modified – Could the building support a green roof or rainwater harvesting? Could the car park be made permeable or support shallow temporary storage? Could the resistance or resilience to flooding be improved?
- When **road works** are being undertaken – Could existing road drainage be cleaned or 'quick win' improvements be made? Could the road be re-surfaced so that surface water drains more easily?
- When **sewers** are being maintained – Could oversized pipes be retrofitted? Could misconnections be identified and rectified?

Box 4 Key SWMP messages

2.3 Funding Opportunities

The following streams may provide opportunities to fund implementation of the options:

- **Kent County Council:** As the Lead Local Flood Authority for the county which includes Dover District, KCC will be in receipt of formula grant funding provided by Defra to undertake the lead authority role. This grant is not ring fenced and so KCC will need to determine, in consultation with the other risk management authorities, how much is spent on which local priorities. Although KCC will retain overall responsibility for managing local flood risk, some of its responsibilities can be delegated. Therefore, there may be opportunities for DDC to work with KCC to build expertise and invest some of the available funding in improving surface water management in Dover.

- **Environment Agency/Defra Flood Defence Grant-in-Aid (FDGiA) funding**: The EA administers Flood Defence Grant in Aid (FDGiA) which is government money allocated to Risk Management Authorities, which now includes local authorities. The funding is for capital works which manage and reduce flooding, including for property level flood protection. Projects arising from flooding from ordinary watercourses, surface runoff, or from groundwater, are now eligible, although those arising from flooding from sewerage systems are not. To allocate FDGiA funding, the EA collates and appraises applications on an annual basis. From 2012/13 onwards, a fixed amount of FDGiA funding will be offered to any project, based on the outcomes it will deliver. Projects whose costs do not qualify for full FDGiA funding will require cost savings to be found and/or local contributions to proceed.

- **Developer's Section 106 contribution / Community Infrastructure Levy (CIL):** When new development occurs within Dover, a levy can be charged by the council which is designed to cover the cost of new public facilities. The larger strategic developments proposed within Dover (e.g. Mid Town) have the potential to use Section 106 / CIL contributions to fund options proposed in this SWMP and especially those which will have multiple benefits, e.g. pond or wetlands which can receive surface water as well as providing improved amenity value.

- **Southern Water - Investment Plan 2010 – 2015:** By 2015, Southern Water has committed to reduce flooding to around 80 properties on its 'risk register' which have flooded internally and around 90 which have flooded externally at least once every twenty years. For Southern Water to consider implementing a scheme to reduce flooding, the cause must be related to the hydraulic inadequacy of the public sewerage system. Southern Water works within a framework of cost and benefit so that where solution options do not meet specific criteria for affordability or benefit they do not proceed and more local measures (e.g. property resistance/resilience) may be considered. Working with the councils and the EA to implement some of the schemes proposed in this SWMP may be more cost-beneficial than, for example, enlarging the sewers. However, Southern Water investment in any scheme will have to be justified by the severity and frequency of sewer flooding and must be agreed with Ofwat at the start of the next five year period (2016 - 2020). Reporting sewer flooding to Southern Water is therefore crucial to seeking future investment.