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EPSOM & EWELL BOROUGH COUNCIL

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1 Background to the Development of the Options

1.1 Introduction

This report documents the development and appraisal of options to improve sustainable management of surface water flooding in the Borough of Epsom & Ewell. It is emphasised that the SWMP does not consider the direct risk of flooding from Main Rivers in the Borough but does consider the impacts that fluvial flooding may have on surface water flooding. This report follows on from the *Preliminary Assessment Report* and *Detailed Modelling Report* and supports the Surface Water Management Plan (SWMP) Action Plan for the Borough. The Action Plan summarises an evidence base upon which future decisions and funding applications for putting the recommendations into practice can be put forward.

As agreed at the outset of the SWMP project, the vision and supporting aims of the study were:

The Epsom & Ewell SWMP Vision

Identify viable options to manage the risk of surface water flooding, for the benefit of the Borough of Epsom & Ewell and its people, both now and in the future.

Supporting aims

1. Reduce the consequences of flooding on the people of Epsom & Ewell Borough
2. All partners will work together to improve the understanding of the specific flood issues affecting the Borough of Epsom & Ewell
3. Establish clarity over responsibilities and agree roles and working arrangements both now and going forward
4. Inform spatial and emergency planning policies and assist long term sustainable development and regeneration
5. Raise awareness so that people at risk are better prepared and able to respond appropriately
6. Identify the preferred options to manage surface water flood risk, from an economic, environmental, technical, social and project perspective
7. Seek options that will provide other benefits in addition to better management of flood risk
8. Develop a prioritised SMART[1] action plan that is evidence-based and addresses flood risks in the short, medium and longer term, including 'quick wins'
9. Identify funding options available to implement the preferred deliverables

Planning for surface water management is really planning for 'all sources of flooding'. Water that could flood properties and infrastructure in the Borough could occur from a number of sources:

- from rainfall running off the North Downs;
- exceedance of soakaways;
- rainfall in areas where there are no surface water sewers;
- groundwater emerging from the Chalk;

[1] Specific, Measurable, Achievable, Relevant, Time-Bound

- exceedance of the capacity of the surface water sewers; and
- from the Greens Lane Stream, River Hogsmill or other recognised watercourse.

Flooding in urban areas may be more complex than in rural areas, due to the inadvertent modification of natural processes and flow paths. Streams may have been culverted many years ago and their presence forgotten. There is thought to be one such case beneath Church Street in Epsom. Culverts, like storm sewers, are unlikely to be sized for extreme events and once their capacity is exceeded the roads, properties and other infrastructure built close to them may be damaged by floodwater. The lack of space close to both culverted and open water courses leaves many developments at risk of flooding, with the risk likely to increase as a consequence of a changing climate.

Implementing a solution to the flooding problem will involve a range of stakeholders and involve both social planning and technical solutions. Stakeholders will include Epsom & Ewell Borough Council, as well as neighbouring local authorities, Surrey County Council, the Environment Agency and Thames Water. With surface water flooding, the source of flooding, the impact and who should be responsible is not always clear. Therefore, the challenge is to create a framework in which all stakeholders can operate together to reduce flood risk.

1.2 Source, Pathway and Receptors

Engineers have known for some time that drainage system capacities cannot easily be increased without increasing the flood risk downstream. The challenge is to find ways in urban areas of replicating natural processes that reduce flooding. Buildings cannot easily be moved out of the path of water, but longer term planning can provide opportunities to replicate the natural processes which reduce runoff and make space for water.

A common approach to assessing flood risk is to look at the 'Source' the 'Pathway' (route taken and mechanism of flooding) and the 'Receptor' (what is flooded). Runoff is best controlled close to the source where it is easier to manage rather than further along the pathway where volumes are much greater. Where surface water sewers are separate from the foul sewer system, there are greater opportunities for storm water to be managed on the surface. The Borough of Epsom and Ewell is fortunate in having mostly separate surface water and foul sewers and it is important that it is kept that way.

Flood modelling and mapping identifies where flood water for different rainfall events is likely to go. We have the opportunity now to develop measures to hold water up as close to the source as possible, even on the roofs of buildings or on the Downs, or modify the routes where surface water flows. We can reshape the streets and the parks to direct flood water to safe places and hold it there until the peak flows in the watercourses and drains have subsided. This will reduce flood risk to others downstream and our neighbours in the Royal Borough of Kingston.

1.3 Integrated Delivery

In many cases, the options to better manage surface water flooding will not be quick fixes. The options need to be sustainable and holistic addressing all sources of flooding and considering social and environmental aspects. Such schemes are likely to be implemented:

- incrementally over time;

- taking advantage of opportunities as they arise with other development work or maintenance; and

- through planning policy and control.

With many stakeholders we need to identify options providing multiple and mutual benefits in order to share costs of implementation and/or gain support. As a principle we would aim to keep water on the ground surface rather than underground wherever possible. Surface options are generally less expensive, easier to maintain and provide more opportunities for social and environmental enhancement. We now know that this can only be done by planners, engineers and political leaders working with, and within, the organisations responsible for land drainage in an integrated way.

There is a need to plan to reduce risk in an integrated, holistic and sustainable way and this can be aided by incorporating techniques from international best practice. Two significant elements relating to best practice and techniques are worth highlighting

- **Organisational Structure:** The more integrated an organisational structure is, the easier it is to manage. So for best practice solutions it is first necessary to establish an organisation with the powers to influence all of the drainage system and then develop a cogent plan.

- **Measures and Options**: Measures are the techniques and features that are implemented to reduce flood risk. Measures are the component parts of the overall options considered within the feasibility and implementation of a scheme. It is important to put the available measures within the overall context of integrated drainage

1.4 Taking a Wider and Longer-term View

The concept of shared space is the reintegration of all the functions of space. The relevance of shared space to integrated drainage is that planners should arrive at the understanding that the space can be designed for a wider range of uses: not only cars, wheelchairs, bikes and pedestrians but also for managing surface water and flood risk by creating spaces for water to flow and to be stored safely. Conceptually, this issue is common in social planning and also relevant to infrastructure related issues where a large number of stakeholders need to take an integrated approach to solving common problems. Solutions primarily require organisation, but also of the implementation of sustainable measures. Best practice examples are most evident in cities where the organisational role is largely with a singular authority and that has the power and leadership to implement policy, incentives and measures to implement change.

It is evident that the required changes to infrastructure and its management need to be planned for and implemented over the medium to long term and that all stakeholders need to be involved throughout. There are a range of measures available related to controlling surface water runoff at its source, along its pathway or as a last resort, at the location of the receptor. However, the choice of and delivery of a flood management option may depend on incentives, funding and coordinating implementation. It is important to note that flood risk can be reduced but never totally eliminated. Sometimes it may be more appropriate, at least in the short term, to ensure people are risk aware and to issue flood warnings rather than implement engineered solutions. However, over time, with effective planning and

implementation of sustainable measures, flood risk can be significantly reduced in a sustainable way as part of redevelopment.

1.5 Sustainability

The Flood and Water Management Act 2010 includes a duty for local authorities to contribute to sustainable development in discharging their Flood and Coastal Risk Management (FCRM) functions. In a recent consultation on this duty, Defra listed the following ten themes of sustainable development that apply to flood and coastal erosion risk management:

1. **Risk Management.** Manage flood and coastal erosion risks to people and property, the economy and the environment.
2. **Adaptation.** Take account of climate change and other long-term uncertainties in decision making.
3. **Resilience.** Develop infrastructure and buildings which perform satisfactorily under a wide range of lifetime flood and erosion loadings, without suffering permanent loss of functionality during extreme events.
4. **Integration.** Develop solutions that integrate flood and erosion risk management as part of integrated catchment management and coastal zone management.
5. **Engagement.** Work with all those affected by flooding and erosion, empowering those affected to take appropriate actions to reduce risks.
6. **Appraisal.** Adopt appraisal methods that are rigorous, coherent and open and consider long term social, environmental and economic costs and benefits.
7. **Environment.** Protect natural and heritage assets and enhance the environment where it is most degraded.
8. **Consumption & Production.** Promote sustainable consumption and production in all flood and erosion risk management activities.
9. **Knowledge.** Develop the knowledge, skills and awareness to improve our understanding of risk and to promote sustainable solutions.
10. **Well-being and social justice.** Ensure that FCRM activities continue to contribute to community well-being and address issues of social justice.

The generic and specific options proposed by this SWMP seek to embed these principles throughout. However, it is recommended that these themes are considered during any future revision to council policy on sustainable development.

1.6 Structure of this Report

This Options Report documents the work undertaken and findings of the Options stage of the project:

Section 2: Identified Measures
Section 3: Development and Appraisal of Options
Section 4: Summary
Section 5: References

2 Identified Measures

2.1 Overview of Methodology

Initially, individual measures to manage surface water flooding across the Borough of Epsom & Ewell have been identified and scored according to the following four criteria: technical, economic, social and environmental benefits. A wide range of measures has been considered which will provide differing levels of protection and these measures have a range of benefits and costs associated with them. These measures have been grouped in Section 2.2 under the following broad headings:

- Do nothing
- Source control and Sustainable Drainage Systems (SuDS)
- Design for exceedance
- Increasing capacity
- Separation of foul and surface water
- Non-structural measures

Individual measures have then been grouped together in Chapter 3 to form options. Potential management options have been identified through consideration of:

- review of previous studies;
- initial multi-criteria scoring analysis of measures;
- site inspections;
- detailed modelling showing likely flow routes; and
- consultation with project partners and stakeholder organisations.

These options have been assessed using the same technical, economic, social and environmental criteria to score and then prioritise them.

2.2 Introduction to Measures Considered

2.2.1 Do Nothing

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.

2.2.2 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. Controlling inflows entering the urban area will be a particularly desirable option

- **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, recreational facilities etc for much of the time. It may be possible to later reuse the stored water on site (e.g. irrigation or aquifer recharge) depending on storage arrangements.

- **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.

- **Swales** are shallow linear vegetated drainage features which can store and convey surface water. As part of a management train, 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.

- **Green roofs** covered with vegetation can intercept and retain precipitation to reduce the volume of runoff and attenuate peak rainfall flows. Large flat or gently sloping roofs (e.g. commercial buildings, schools and hospitals) are particularly suited and cost-effective.

- **Pervious pavements** are suitable for pedestrian and vehicular traffic and allow rainwater to infiltrate through the surface where it can be temporarily stored, reused or released into a drainage system. 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 high storage capacity.

- **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.

- **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.

2.2.3 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 does not enter a building or other structures to a given depth. 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.

- **Surface flow routes**, formalised through road profiling, kerb heights, speed bumps etc. can be used to safely route exceedance flows through urban areas. Use of lower floors of, for example, multi-storey car parks for temporary flood storage could be considered as long safety is sufficiently addressed.

- **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, given suitable ground conditions, infiltration of the stored water.

- **Raising property thresholds** at access points can provide additional flood protection. Retail and other premises which must permit disabled access can consider gentle ramping, although sufficient space must be available. Vehicular entrances to underground car parks or basement areas should also be considered – raised ramping across the entrance may be sufficient to mitigate surface water flood risk.

2.2.4 Increasing Capacity

Adding storage and/or increasing the capacity of the sewer network and the watercourses may improve the conveyance of floodwater and limit overland flow.

- **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 (sometimes referred to as SuDS retrofit). Increased network capacity could reduce the likelihood of flooding and the discharge of potentially polluted floodwater through Combined Sewer Outfalls.

- **Widening and/or deepening of the watercourse channels** 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.

2.2.5 Separation of Foul and Surface Water Sewers

- **Greenfield development** opportunities usually have separate foul and surface water drainage systems and such opportunities should be maximised. **Brownfield development** opportunities are generally as for Greenfield but the existing drainage system may be combined. In such cases opportunities should be taken to convert to a separate surface water piped system where practical.

- **Misconnections** between the surface water and foul systems should be rectified as opportunities arise. This can reduce pollution associated with surface water flooding.

2.2.6 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 the Borough through introduction of policy. These include:

- **Maintenance, desilting and removal of obstructions** can ensure that the watercourses and drainage infrastructure (particularly road gulleys and associated soakaways) 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.

- **Flood Warning:** the Met Office and the Environment Agency 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. Any warning service relies on a rapid and effective response from professionals and those at risk and therefore a programme of awareness raising should also be considered in parallel.

- **Planning policies** could be developed and adopted by the council to steer new development away from known surface water flood risk areas and flow paths or, if necessary, to control their development through requiring specific flood management measures implemented through planning or building control.

- **Resistance and resilience** measures can be fitted to prevent surface water entering properties and minimise the damage caused by flood water. Measures can be fitted to new properties or retrofitted to existing properties. Some form of grant assistance could be allocated to property owners for installation. Implementation of resistance or resilience measures that are only deployed upon receipt of a flood warning would need to link with the above measure.

2.3 Scoring of Measures

Nineteen individual measures (including the do nothing scenario) have been identified which could be used to manage surface water flooding across the Borough of Epsom & Ewell. To provide an initial indication of which of these should be considered in more detail, the criteria and scoring proposed in the SWMP Technical Guidance have been applied. As shown in Table 2.1 Technical (T), Economic (Ec), Social (S) and Environmental (Env) criteria have been used to score each measure. Note that the additionally recommended criteria 'meets SWMP Objectives' has not been included in this appraisal as the objectives specified largely duplicate other criteria (see Section 1.1).

Table 2.2 lists the individual measures in order of decreasing total score. On the basis that those options scoring 2 or more will be considered further, the only options which are discounted at this stage are the do nothing option and the separation of currently combined sewer systems into separate systems. Although it is recognised that in some local situations doing nothing may be justified economically, this measure will not provide any social or environmental benefits. Since the sewers in the Borough of Epsom and Ewell are almost exclusively separate then there will be limited opportunities for further separation and it is likely to be prohibitively expensive.

Table 2.1 Scoring criteria (taken from SWMP Technical Guidance Table 8.2)

Criteria	Description	Score
Technical	Is it technically possible and buildable? Will it be robust and reliable?	U (unacceptable) – measure eliminated from further consideration -2 severe negative outcome -1 moderate negative outcome +1 moderate positive outcome +2 high positive outcome
Economic	Will benefits exceed costs?	
Social	Will the community benefit or suffer from implementation of the measure?	
Environmental[1]	Will the environment benefit or suffer from implementation of the measure?	
Objectives	Will it help to achieve the objectives of the SWMP partnership?	

Table 2.2 Scoring of individual measures in the Borough

Individual Measure	T	Ec	S	Env	Total
Maintenance	2	1	2	2	7
Ponds & wetlands	2	0	2	2	6
Green Streets	2	0	2	2	6
Planning policy to influence development	2	1	1	2	6
Green roofs	2	1	1	1	5
Detention basins	2	2	0	0	4
Swales	1	1	1	1	4
Building resilience & resistance	2	1	1	0	4
Soakaways	2	1	0	0	3
Surface flow routes	2	1	0	0	3
Increase property thresholds	1	2	0	0	3
Rectify sewer misconnections	1	0	1	1	3
Flood warning	1	1	1	0	3
Pervious pavements	1	1	0	0	2
Water butts & rainwater harvesting	2	-1	0	1	2
Increase capacity in drainage system	1	0	0	1	2
Improve channel capacity	1	1	1	1	2
Do nothing	2	0	2	0	0
Separation of foul & surface water sewers	1	-1	1	1	0

Note: T = Technical, Ec = Economic, S = Social and Env = Environmental

3 Development and Appraisal of Options

3.1 Options Development

The previous section has identified potential individual measures which were considered to reduce surface water flood risk in Epsom & Ewell. Locations within Epsom and Ewell where these measures could be applied are detailed in Appendix A. However, whilst these individual measures may provide benefits combinations of these measures are likely to provide additional benefits and a more sustainable solution overall. Therefore, various measures were grouped together to form a number of options.

The measures listed in Section 2 were further refined into a set of possible generic (most likely through introduction of council policy) and location specific options based on:

- a review of previous studies (see *Preliminary Assessment Report*);
- initial multi-criteria scoring analysis of measures (see Table 2.2);
- site inspection;
- detailed modelling showing likely flow routes; and
- consultation with project partners and stakeholder organisations.

The options are illustrated on the map in Appendix B and more detailed information is provided in Appendix C through to Appendix P.

3.2 Options Workshop

A draft list of generic and location-specific options was discussed at an Options Workshop held in Epsom Town Hall on Tuesday 29 March 2011. Representatives from all the key stakeholder organisations were invited and those listed in Table 3.1 attended. The purpose of the workshop was for the invited stakeholders to comment on and discuss reasons for:

- what they believe to be the most viable options;
- any perceived constraints; and
- their priorities, both individually and collectively.

The format of the workshop was:

- short context setting introduction from the SWMP Partnership;
- general questions and answers;
- break out into small groups to discuss options; and
- plenary feedback session.

Feedback on each generic and location specific option as presented at the workshop is documented in Appendix Q. (Note that the draft nature of the options listed in Appendix Q means that they may appear different to those listed in this Section.) The feedback has been taken into account and the final options presented in this Section refined accordingly.

The following additional points were noted from the workshop which do not relate to a specific option:

- Incremental implementation will need to be carefully managed such that implementing one part of an option does not worsen the risk in the period until the remainder of the option is implemented.
- Funding for some improved management of surface water may be available through the Plan E regeneration of Epsom Town Centre
- SCC as LLFA will be preparing its Local Strategy. There may be opportunity to formalise some recommendations from the SWMP in the Local Strategy which may provide an avenue for funding.

Table 3.1 Attendees of the Options Workshop

Stakeholder Organisation	Representative
Environment Agency (EA)	Richard Poddle
	Andy Thraker
Epsom & Ewell Borough Council (EEBC)	Mark Berry
	Stewart Cucker
	Karol Jakubczyk
	Kate Turner
Reigate & Banstead Borough Council	Jillian Holford
	Peter Russell
Surrey County Council (SCC)	Deborah Fox
	Mark Franklin
	Owen Lee
	Eric Turner
Jacobs	David Cobby
	Richard Horlor

3.3 Modelling and Costing of Selected Options

3.3.1 Representation in the Detailed Model

As part of the development of the options, and to test their impact, ten location-specific options were represented in the detailed model. The ten were judged the most likely to have a substantial flood risk benefit and were suitable for being represented in the model. The details of their representation and their impact are reported in the accompanying *Detailed Modelling Report*. The options were represented in conceptual terms in the model with 'reasonable' sizes and characteristics. In other words, schematisation of the options did not focus to reduce flood risk in any particular annual probability event. This approach is consistent with the overall strategy of incremental benefits across the Borough. However, the comparison between the base case and 'with option' models was undertaken for the 3.33% (1:30 year) annual probability event since this links with typical sewer design standards.

Table 3.3 summarises the outcome of the detailed modelling, where the options have been ranked in decreasing order of the number of properties estimated to be protected in the 3.33% event.

Based on the economic analysis of damages undertaken on the basecase modelling (also documented in the *Detailed Modelling Report*), Table 3.3 indicates the damages avoided through protecting the given number of properties in the 3.33% event. The annual average and present value damages over 100 years shown in Table 3.2 were calculated from the basecase modelling results and based on those properties sustaining damage across the Borough in all annual probability events.

Table 3.2 Rounded annual average and present value damages

Property Type	Annual Average Damage (per property)	Present Value Damage (per property)
Residential	£1,500	£45,000
Non-residential	£6,000	£180,000

In Table 3.3, the present value damage values (i.e. over 100 years) have been multiplied by the number of properties of each type which are indicated to be protected from flooding in the 3.33% event through implementation of the options. Whilst a fuller and more detailed economic analysis of damages avoided should be undertaken for more detailed studies, this indication is justified for this level of study. The following two limitations with the method are noted but are judged to approximately cancel out:

- The damages avoided in Table 3.3 will be *overestimated* since the properties may still flood within the 100 year period from less frequent events.
- The damages avoided in Table 3.3 will be *underestimated* since the properties surrounding those counted will likely suffer shallower flooding and reduced damages in high frequency events.

3.3.2 Option Costing

Indicative costs for the considered options have been estimated from the best available information. The cost estimates have been derived as follows:

1. Estimate construction costs based on the assumed characteristics (e.g. size, area, length) of the various elements of the option and unit costs obtained from published sources (see below).
2. Add 30% to the construction cost to cover preliminaries (feasibility studies, detailed design etc).
3. Add 20% to the subtotal of preliminaries and construction costs to cover risk.
4. Add a final 60% to this subtotal (preliminaries + construction + risk) to cover optimism bias.

The majority of the options involve SuDS and, from the CIRIA SUDS Manual[2] the costs of annual maintenance are relatively small. Therefore, it has been assumed that costs of maintenance are covered by the inclusion of risk and optimism bias. Similarly, the options (if implemented) are assumed to be completed in the first few years of the 100 year planning horizon such that the affects of discounting the costs will be minimal.

The estimated costs of the options have then been classified in the following broad bands:

- < £25k
- £26k - £50k
- £51k - £100k
- £101k - £250k
- £251k - £500k
- £501k - £1M
- £1M - £10M
- > £10M

[2] Woods-Ballard et al. (2007) The SUDS Manual. CIRIA C697

The sources used to estimate unit costs of construction which are listed in Appendix R include:

- Woods-Ballard et al. (2007) The SUDS Manual – CIRIA C697
- Greater London Authority (2011) Prioritisation Matrix Guidance Drain London Forum 24 January 2011.
- Spon's (2010) Civil Engineering and Highway Works Price Book

Applying these unit costs to the conceptual representation of the options used in the detailed model provides the indication of costs of the option, as given in Table 3.3.

It is emphasised that the costs calculated are indicative only and more detailed cost estimates should be sought through feasibility studies into any of the options. Through the allowances for preliminaries, risk and optimism bias the cost estimates presented are indicative of stand-alone projects. For some of the options which could be undertaken locally without many of the overheads of stand-alone projects, the allowances made for preliminaries, risk and optimism bias may be high or even not required and the actual cost of implementing the options could be much lower. Examples may be raising of kerbs whilst undertaking other planned road works in the same area. For this reason, it is important that this SWMP is used as an evidence base, circulated amongst the various council teams and reviewed regularly so that opportunities for implementation can be identified as they arise.

3.3.3 Benefit:Cost Ratio

The indicative benefit:cost ratios given in Table 3.3 largely follow the number of properties protected, with the proposed options centred on the Stamford Pond, Langley Vale (RAC) and Nonsuch Park obtaining the highest ratios.

3.4 Options Appraisal

3.4.1 Generic Options

Following discussion of the draft options and feedback from the Options Workshop, Table 3.5 presents those options which are proposed for generic implementation across the Borough. In addition to brief descriptions of the options and links to sections where further information can be found, the table shows the following:

- **Primary Action Owner:** the partnership organisation which is responsible, in the first instance, for implementation of the option
- **Priority:** an indicative priority for implementation according to the following classification:
  - 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+)

Table 3.3 Prioritisation of modelled options based on reduction in number of properties flooded in the 3.33% (1:30 year) event

Priority based on model results	Location (Drainage Area)	Option Description	Predicted Impact in 3.33% (1:30 year event)	Indication of Damages Avoided (Benefit; to nearest £0.1M)	Indicative Cost of Option (Cost; to nearest £10k)	Indicative Cost Band	Indicative Benefit: Cost Ratio
1 (Opt. no. 9)	Rosebery School / Stamford Pond (Epsom West)	Intercept surface water sewer upstream of overground attenuation area to reduce downstream volumes, the risk of sewer flooding and attenuate flows to reduce peak runoff. Store surface water runoff in Stamford Pond and reduce runoff into Greens Lane Stream.	Approx. 60 fewer properties flooded	£3.6M (60 res. properties)	£250k (excluding delivery of sewer interruption scheme)	£101k - £250k	14:1
2 (Opt. no. 1)	Langley Vale / Woodcote (Epsom Centre)	Store surface water runoff from Langley Vale in a reservoir, detention basin, pond or wetland to reduce the runoff rate and volume. Use stored water either for (i) irrigation for RAC Golf Club or (ii) artificial recharge of aquifer. Increase storage capacity of existing Woodcote Millennium Pond	Approx. 14 fewer properties flooded	£0.9M (12 res. and 2 non-res. properties)	£80k (excluding construction of ponds in RAC course)	£51k - £100k	11:1
3 (Opt. no. 10)	Clarendon Park / Horton Country Club (Horton & West Ewell)	Store surface water runoff in a swale to the south of McKenzie Way which directs water into the surface water sewer. Re-profile Horton Lane at junction with Long Grove Road for drainage to runoff into open land to north east. Store surface water runoff in detention basin, pond or wetland at junctions of Horton Lane with B284 and B2200. Store surface water runoff from Horton Country Club Golf Course in a reservoir, detention basin pond or wetland to reduce the runoff rate and volume. Use stored water for irrigation for Golf Club	Approx. 6 fewer properties flooded	£0.3M (6 res. properties)	£660k	£501k - £1M	<1:1
4 (Opt no. 7)	Nonsuch Park (Stoneleigh)	Store surface water runoff in a series of detention basins, ponds or wetlands to reduce the runoff rate and volume. Intercept surface water sewer upstream of Stoneleigh allotment gardens to reduce downstream volumes, the risk of sewer flooding and attenuate flows to reduce peak runoff.	Approx. 6 fewer properties flooded	£0.3M (6 res. properties)	£40k (excluding delivery of sewer interruption scheme)	£26k - £50k	8:1
5 (Opt. no. 3)	Epsom Town Centre (including Utilities Site, East Street) (Epsom Centre)	Route flows which exceed the drainage capacity along Ashley Road and the High Street to the B284 railway underpass. Install new drainage infrastructure to convey surface water to a detention basin, pond or wetland in the Utilities Site, East Street.	Approx. 5 fewer properties flooded	£0.9M (5 non-res. properties)	£1.2M	£1M - £10M	<1:1
6 (Opt. no. 2)	Woodcote Green Road / Dorking Road / Ashley Road / Rosebery Park (Epsom Centre)	Route flows which exceed the drainage capacity along (i) Woodcote Green Road and Dorking Road into Rosebery Park via existing footpath and western gate (ii) along Ashley Road and into Rosebery Park. Store surface water runoff in Rosebery Park in series of low terraces and an enlargement of the existing pond.	Approx. 5 fewer properties flooded	£0.9M (5 non-res. properties)	£410k	£251k - £500k	2:1
7 (Opt. no. 5)	Reigate Road at Drift Bridge / Cuddington Golf Course (Drift	Store surface water runoff from Reigate Road (Nork, Reigate & Banstead) in swales or detention basins adjacent to Reigate Road.	Approx. 3 fewer properties flooded and over 50% reduction in flood depth on Reigate Road	£0.1M (3 res. properties)	£840k (excluding construction of pond in Cuddington Golf Course)	£501k - £1M	<1:1

Priority based on model results	Location (Drainage Area)	Option Description	Predicted Impact in 3.33% (1:30 year event)	Indication of Damages Avoided (Benefit; to nearest £0.1M)	Indicative Cost of Option (Cost; to nearest £10k)	Indicative Cost Band	Indicative Benefit: Cost Ratio
	Bridge)	Store surface water runoff from Cuddington Golf Course in a reservoir, detention basin, pond or wetland to reduce the runoff rate and volume. Use stored water either for (i) irrigation for Cuddington Golf Club or (ii) artificial recharge of aquifer.					
8 (Opt. no. 6)	Grounds of church on Longmead Road, Gibraltar Recreation Ground and existing Allotment Gardens and pond in Utilities Site, East Street (Epsom Centre)	Intercept surface water sewer upstream of overground attenuation areas to reduce downstream volumes, the risk of sewer flooding and attenuate flows to reduce peak runoff.	Approx. 3 fewer properties flooded	£0.5M (3 non-res. properties)	£820k (excluding delivery of sewer interruption scheme)	£501k - £1M	<1:1
9 (Opt. no. 8)	King George Field (Auriol Park) and Wandgas Athletic Ground (Hogsmill North)	Intercept surface water sewer upstream of overground attenuation areas to reduce downstream volumes, the risk of sewer flooding and attenuate flows to reduce peak runoff.	Approx. 1 less property flooded	<£0.1M (1 res. property)	N/A	N/A	N/A
10 (Opt. no. 4)	Epsom College area (Ewell)	Store surface water runoff arriving at Epsom College sports ground. Route flows which exceed the drainage capacity along Downs Avenue and store in the park adjacent to the junction with Downs Road	Approx. 1 less property flooded	<£0.1M (1 res. property)	£280k	£251k - £500k	<1:1

- **Multi-Criteria Appraisal:** building on the scoring of measures in Section 2.3, each option has been scored according to the criteria in Table 3.4. Where applicable and available, technical and economic scores have been assigned on the basis of detailed modelling. SWMP scores have been assigned based on feedback from the Options Workshop.

Table 3.4 Refined criteria for MCA of recommended options

Criteria	Description	Score
Technical (T)	Is it technically possible and do-able? Is it a priority to implement?	-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?	

See further information provided in the appropriate appendices (Appendix C - Appendix P) and discussion at Options Workshop (Appendix Q) for indication of constraints. Based on the overall score from the Multi-Criteria Appraisal, the options have been ranked in order of decreasing score.

As per the comments recorded in Appendix Q, the final generic option listed in Table 3.5 is recommended to be subjected to further refinement before being considered for implementation.

In the Core Strategy, EEBC recognises that the avoidance and management of flood risk can make a positive contribution to the development of sustainable communities. Policy CS6, which is concerned with encouraging sustainability of future development, states that EEBC will ensure that new development will avoid increasing the risk of, or from, flooding. It is recognised that this policy was adopted before the new responsibilities for managing local flood risk introduced by the Flood & Water Management Act. Therefore, through the generic options listed in Table 3.5, it is recommended that council policy is strengthened to improve sustainability with respect to flood risk (see also Section 1.5). It is recommended that EEBC and SCC work in partnership under the new arrangements to produce revised and consistent planning policy.

Table 3.5 Generic management options (incorporating Options Workshop feedback)

Generic Option	Purpose	Primary Action Owner[3]	Further Information	Priority[1]	Multi-Criteria Appraisal[2] T	Ec	S	Env	SWMP	Overall (max. 10)
Existing and new SuDS (particularly soakaways) and road drainage should be properly maintained (including reprofiling of roads as required) to ensure their continued effectiveness. In addition, maintain existing watercourses, trash screens etc. ***Priority Action*** *Identify where existing infrastructure is and who owns and/or is responsible for maintaining it. Provide guidance on asset ownership and responsibility for maintenance.*	To reduce runoff rate and volume from buildings and roads in low to moderate events. To locally improve conveyance of moderate to high flows and reduce the risk of overtopping.	EEBC, SCC, EA	Appendix N Appendix G	1	2	2	1	1	2	8
Raise awareness of surface water flood risk both within EEBC and potentially with the public. Link with encouraging use of rainwater harvesting, other source control measures and uptake of property level resistance and resilience measures. ***Priority Action*** *Produce Partnership position statement on paving over front gardens which is used in response to planning applications..*	To improve awareness of flood risk and encourage appropriate responses to reduce likelihood and consequences of flooding in low to moderate events	EEBC	Appendix H Appendix J Appendix L	1	2	1	2	1	2	8
Accept a map indicating natural drainage routes which future development should respect. Development should also respect local landform to ensure sufficient property thresholds. In addition, adopt a map indicating the suitability of locations for appropriate SuDS across the Borough ***Priority Action*** 1. *Identify ways to promote use of the map showing natural drainage routes* 2. *Consider removing Permitted Development rights without an agreement to reduce runoff to greenfield rate.*	To equip building control and planning functions to consider surface water flood risk and promote the use of appropriate SuDS.	EEBC	Appendix E Appendix O	1	2	2	0	1	2	7
Policy to fit green roofs to new buildings and retrofit where existing roofs are being replaced. In addition, fit pervious pavement car parking where practicable.	To reduce rainfall runoff rate and volume from buildings in low to moderate events	EEBC	Appendix K Appendix M	2	1	1	1	2	2	7
Build capacity for drainage expertise within EEBC including improved record keeping of flood events ***Priority Action*** 1. *Improve record keeping of flood events as evidence to support grant applications* 2. *Include link to National Flood Forum Blue Pages on council flood related websites.*	To improve local knowledge and understanding of drainage in the Borough and cooperation between all Boroughs in the same river catchments (Hogsmill & Beverley Brook). Evidence of past flooding is required to support some applications for funding.	EEBC, SCC	Appendix I	2	2	1	1	0	1	5
Develop a policy which requires rectification of any reasonable existing drainage problem (e.g. blinded soakaways, sewer misconnections) before permission for improvement works is granted. Consider introducing incentives for those who rectify existing problems.	To incrementally improve the operation and sustainability of the drainage infrastructure of the Borough	EEBC	Appendix P	3	0	1	0	1	0	2

Notes: [1]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+)
[2]T = Technical, Ec = Economic, S = Social, Env = Environmental and SWMP = Surface Water Management Plan project
[3]EA = Environment Agency, EEBC = Epsom & Ewell Borough Council, SCC = Surrey County Council, SESW = Sutton & East Surrey Water, TW = Thames Water

3.4.2 Location-Specific Options

Similarly to Section 3.4.1, following discussion of the draft options and feedback from the Options Workshop (see Appendix Q) Table 3.6 presents those options which are proposed for implementation at the specific sites identified. Where possible, the location of these options has been marked on the map in Appendix C. See further information provided in the appropriate appendices (Appendix C - Appendix P) and discussion at Options Workshop (Appendix Q) for indication of constrairts. Where the options (or similar draft options) were represented in the detailed model, the Economic MCA score is based on the Benefit Cost ratio (Section 3.3.3). Based on the overall score from the Multi-Criteria Appraisal, the options have been ranked in order of decreasing score.

The following should be noted for the location-specific options:

- **Woodcote Green Road / Dorking Road / Ashley Road / Rosebery Park:** Consider phased implementation or only the Rosebery Park element if sufficient surface water flows will enter the Park without designation of surface flow routes as modelled in this SWMP.
- **West Park:** Opportunity to clean up potentially contaminated site of landfilled pond (adjacent Stew Pond) as part of West Park development.
- **Epsom Town Centre (including Utilities Site, East Street):** Need to determine where the Church Road underground river goes.
- **Nonsuch Park:** Consider initial investigations as an environmental enhancement project involving local volunteer groups (e.g. Friends of Nonsuch Park) as advocated by the 'Big Society'.

Table 3.6 Location specific management options (incorporating Options Workshop feedback)

Option Location (Drainage Area)	Description	Key Components	Primary Action Owner[2]	Further Information	Priority[3]	Multi-Criteria Appraisal[4] T	Ec	S	Env	SWMP	Overall (max. 10)
Langley Vale / Woodcote (Epsom Downs)	Store surface water runoff from Langley Vale in a reservoir, detention basin, pond or wetland to reduce the runoff rate and volume. Use stored water either for (i) irrigation for RAC Golf Club or (ii) artificial recharge of aquifer. Increase storage capacity of existing Woodcote Millennium Pond.	1. Reservoir, detention basin, pond or wetland adjacent to Langley Vale Road on RAC Golf Course land or adjacent Thames Water pumping station. 2. Detention basin or pond at north end of RAC Golf Course land 3. Low bund around lane containing existing pond on Woodcote Green Road to increase storage 4. Surface flow route along Woodcote Hurst	• RAC Club • EEBC	Appendix C Appendix D	1	2 All elements technically possible. RAC reservoir application makes this element a high priority to implement	2 Indicative b/c ratio 1:1 (excludes construction of ponds in RAC golf course)	1 Ponds will enhance golf course	2 Ponds will enhance biodiversity and reduce water use	2 Strong support at Workshop	9
West Park	Store surface water runoff in a detention basin, pond or wetland north of Stew pond in site of filled-in pond, and downstream of West Park development.	1. Detention basin, pond or wetland in site of filled-in pond to the north of Stew Pond 2. Pond or wetland immediately downstream of West Park	• EEBC	Appendix D	1	1 Potentially contaminated land could be an issue	1 Could be cost beneficial if West Park developer contributes, although degree of risk is uncertain	2 Reinstatement of historical ponds	1 Further enhance local environment	1 Supported at Workshop	6
North East Surrey College of Technology (NESCOT)	Store surface water runoff in a detention basin, pond or wetland to reduce the runoff rate and volume.	1. Detention basin, pond or wetland in the grounds adjacent to the NESCOT development	• NESCOT	Appendix D	2	2 All elements technically possible	0 Could be cost beneficial if developer contributes	1 Pond would enhance social environment of site	2 Pond will enhance biodiversity	1 Supported at Workshop	6
Nonsuch Park	Store surface water runoff in a series of detention basins, ponds or wetlands to reduce the runoff rate and volume.	1. Detention basins, ponds or wetlands in Nonsuch Park	• SCC • EEBC • Sutton	Appendix D	1	1 All elements technically possible, although TW policy of sewer interruption at this site to be clarified	2 Indicative b/c ratio 8:1 (excludes delivery of sewer interruption scheme)	-1 May not be able to use open areas during extreme events	1 Further enhance local biodiversity	2 Strong support at Workshop	5
Rosebery School / Stamford Pond	Interrupt surface water sewer upstream of overground attenuation area to reduce downstream volumes, the risk of sewer flooding and attenuate flows to reduce peak runoff. Store surface water runoff in Stamford Pond and reduce runoff into Greens Lane Stream.	1. Interrupt surface water sewer upstream of Rosebery School playing field, provide storage in a detention basin and permit re-entry of flows to the sewer system 2. Detention basin in land surrounding Stamford Pond	• TW • SCC • EEBC	Appendix D Appendix F	2	2 Detention basin in school could be for sewer interruption or rainfall runoff	2 Indicative b/c ratio 14:1	-1 May not be able to use open areas during extreme events	0 Neutral environmental benefit	2 Strong support at Workshop	5
Cuddington Golf Course	Store surface water runoff from Cuddington Golf Course in a reservoir, detention	1. Reservoir, detention basin, pond or wetland on Cuddington Golf Course land.	• LB Sutton	Appendix C Appendix D	1	1 All elements technically possible.	0 Cuddington Golf Course would be expected to	1 Pond will enhance golf course	2 Pond will enhance biodiversity	1 Supported at Workshop	5

Option Location (Drainage Area)	Description	Key Components	Primary Action Owner[3]	Further Information	Priority[4]	Multi-Criteria Appraisal[5] T	Ec	S	Env	SWMP	Overall (max. 10)
	basin, pond or wetland to reduce the runoff rate and volume. Use stored water either for (i) irrigation for Cuddington Golf Club or (ii) artificial recharge of aquifer.					although not flood risk benefit is not clear	fund pond		and reduce water use		
Woodcote Green Road / Dorking Road / Ashley Road / Rosebery Park	Route flows which exceed the drainage capacity along (i) Woodcote Green Road and Dorking Road into Rosebery Park via existing footpath and western gate (ii) along Ashley Road and into Rosebery Park. Store surface water runoff in Rosebery Park in series of low terraces and an enlargement of the existing pond.	1. Surface flow route connecting Woodcote Green Road Dorking Road and Rosebery Park 2. Surface flow route connecting Ashley Road and Rosebery Park 3. Shallow detention basins and bund around northern perimeter of Rosebery Park	• SCC • EEBC	Appendix D Appendix E	2	2 All elements technically possible.	1 Indicative bcr ratio 2:1	0 Neutral social benefit	0 Neutral environmental benefit	1 Strong support for the Rosebery Park element	**4**
Land adjacent TA building on Primrose Walk, West Ewell playing field (adjacent Horton Stream) and various locations adjacent Hogsmill River	Interrupt surface water sewer upstream of overground attenuation areas to reduce downstream volumes, the risk of sewer flooding and attenuate flows to reduce peak runoff. These will have a particular benefit to reducing peak flows down the Hogsmill River into Kingston.	1. Interrupt surface water sewer upstream of open land adjacent Primrose Walk, provide storage in a detention basin and permit re-entry of flows to the sewer system 2. Interrupt surface water sewer upstream of various areas of open space adjacent Hogsmill River 3. Interrupt surface water sewer upstream of West Ewell playing field.	• TW • Individual land owner	Appendix F	2	1 Whilst technically possible. TW policy of sewer interruption at this site to be clarified	1 Could be cost beneficial (depending on delivery of sewer interruption scheme) and likely downstream benefits for Kingston	-1 May not be able to use open areas during extreme events	1 Misconnections would have to be sorted before option can be implemented	2 Strong support at Workshop	**4**
Clarendon Park / Horton Country Club	Store surface water runoff in a swale to the south of McKenzie Way which directs water into the surface water sewer. Re-profile Horton Lane at junction with Long Grove Road for drainage to runoff into open land to north east. Store surface water runoff in detention basin, pond or wetland at junctions of Horton Lane with B284 and B2200. Store surface water runoff from Horton Country Club Golf Course in a reservoir, detention basin, pond or wetland to reduce the runoff rate and volume. Use stored	• Swale to the south of McKenzie Way to direct surface runoff into surface water sewer • Detention basin, pond or wetland adjacent to junctions of Horton Lane with B284 and B2200 • Reservoir, detention basin, pond or wetland in Horton Country Club Golf Course adjacent disused railway embankment	• EEBC • Horton Country Club • Individual land owners	Appendix C Appendix D Appendix E	2	2 All elements technically possible.	-1 Indicative bcr ratio <1:1	0 Neutral social benefit	1 Swale will enhance biodiversity and use of pond for golf course irrigation could reduce water use	1 Supported at Workshop if works at Clarendon Park still required	3

Option Location (Drainage Area)	Description	Key Components	Primary Action Owner[3]	Further Information	Priority[4]	Multi-Criteria Appraisal[5] T	Ec	S	Env	SWMP	Overall (max. 10)
	water for irrigation for Golf Club.										
Epsom Town Centre (including Utilities Site, East Street)	Route flows which exceed the drainage capacity along Ashley Road and the High Street to the B284 railway underpass. Install new drainage infrastructure to convey surface water to a detention basin, pond or wetland in the Utilities Site, East Street. Use green street planters along High Street.	1. Surface flow route connecting Ashley Road and the High Street 2. Drainage infrastructure to convey surface water to Utilities Site East Street 3. Detention basin, pond or wetland in Utilities Site, East Street	• EEBC • SCC	Appendix D Appendix E Appendix F	2	1 New surface water drainage will have shallow gradient	-2 Indicative b:c ratio <1:1	1 Green street planters along High Street and pond in Utilities site could improve social environment	1 Further enhance local biodiversity	1 Supported at Workshop although use of green street planters and property resistance/ resilience may be more feasible	2
Longmead Road, Gibraltar Recreation Ground and Utilities Site, East Street	Interrupt surface water sewer upstream of overground attenuation areas to reduce downstream volumes. Inc risk of sewer flooding and attenuate flows to reduce peak runoff. Attenuate high flows in Greens Lane Stream in swales.	1. Interrupt surface water sewer upstream of open ground adjacent the church on Longmead Avenue, provide storage in a detention basin and permit re-entry of flows to the sewer system 2. Interrupt surface water sewer upstream of Allotment Gardens and existing pond in Utilities Site, provide storage in a detention basin and permit re-entry of flows to the sewer system 3. Increase storage in surface water sewer near West Street via underground tank or lowering of Gibraltar Recreation Ground. 4. Swales adjacent Greens Lane Stream on Longmead Avenue	• TW • Individual land owners • EA	Appendix F	3	1 Whilst technically possible, TW policy of sewer interruption at this site to be clarified	0 Indicative b:c ratio <1:1 (excludes delivery of sewer interruption scheme)	-1 May not be able to use open areas during extreme rainfall	1 Misconnections would have to be sorted before option can be implemented	1 Support for closer partnership with TW	2
Reigate Road at Crift Bridge	Store surface water runoff from Reigate Road (Nork, Reigate & Banstead) in swales or detention basins adjacent to Reigate Road.	1. Swale or detention basin on west side of Reigate Road between railway underpass and roundabout with A2022. 2. Swale or detention basin on west side of Reigate Road north of roundabout with A2022. Connected to previous swale with drainage pipe. 3. Swale or detention basin on east side of Reigate Road before junction with road to North Looe.	• SCC	Appendix D	3	2 All elements technically possible	-2 Indicative b:c ratio <1:1	1 Ponds will enhance leisure centre	1 Further enhance local biodiversity	0 Supported at Workshop although quick wins may be obtained through maintenance and lowering kerbs to get water off the road or to the adjacent land	2
Bourne Hall	Route flows from the High Street which exceeds the drainage capacity into the channel between the road and Bourne Hall.	1 Reprofile kerbs and walls to enable surface water which exceeds the drainage capacity of the High Street to enter the channel between the road and Bourne Hall.	• SCC	Appendix F	1	1 All elements technically possible	1 Likely to be high b:c ratio	0 Neutral social benefit	0 Neutral environmental benefit	0 Supported at Workshop although quick win maintenance may be more feasible	2

Option Location (Drainage Area)	Description	Key Components	Primary Action Owner[3]	Further Information	Priority[1]	Multi-Criteria Appraisal[2] T	Ec	S	Env	SWMP	Overall (max. 10)
King George Field (Auriol Park) Wandgas Athletic Ground and Shadbolt Park	Interrupt surface water sewer upstream of overground attenuation areas to reduce downstream volumes, the risk of sewer flooding and attenuate flows to reduce peak runoff.	1. Interrupt surface water sewer upstream of King George Field, provide storage in a detention basin and permit re-entry of flows to the sewer system 2. Interrupt surface water sewer upstream of Wandgas Athletic Ground, provide storage in a detention basin and permit re-entry of flows to the sewer system 3. Interrupt surface water sewer upstream of Shadbolt Park, provide storage in a detention basin and permit re-entry of flows to the sewer system	• TW • Individual land owners	Appendix F	3	1 Whilst technically possible. TW policy of sewer interruption at this site to be clarified	1 Could be cost beneficial (excludes delivery of sewer interruption scheme)	-1 May not be able to use open areas during extreme events	1 Misconnections would have to be sorted before option can be implemented	0 Supported at Workshop if driven forward by TW	2
Court Recreation Ground	Store surface water runoff or flows which exceed the capacity of Pound Lane ditch in a detention basin to reduce the runoff rate and volume.	1. Detention basin in Court Recreation Ground	• EEBC	Appendix D	3	2 All elements technically possible.	-1 Unlikely to lead to significant benefits	-1 May not be able to use open areas during extreme events	0 Neutral environmental benefit	1 Supported at Workshop	1
Epsom College area	Store surface water runoff arriving at Epsom College sports ground. Route flows which exceed the drainage capacity along Downs Avenue and store in the park adjacent to the junction with Downs Road.	1. Surface flow route connecting Downs Avenue and the park 2. Detention basin, pond or wetland in the park adjacent to the junction of Downs Avenue and Downs Road 3. Detention basin or swale to store water adjacent College Road in Epsom College sports ground	• Individual land owners	Appendix D Appendix E	3	1 All elements technically possible, although routing flows into Elizabeth Welsh park will need consideration	-2 Indicative b:c ratio <1:1	-1 May not be able to use open areas during extreme events	0 Neutral environmental benefit	1 Supported at Workshop	-1

Notes: [1]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+)
[2]T = Technical, Ec = Economic, S = Social, Env = Environmental and SWMP = Surface Water Management Plan project
[3] EA – Environment Agency; EEBC – Epsom & Ewell Borough Council; SCC – Surrey County Council; SESW – Sutton & East Surrey Water; TW – Thames Water

3.5 Summary of Options Appraisal

Individual measures to improve management of surface water flooding in the Borough have been grouped into six generic options and sixteen location-specific options. These options have been prioritised based on their Multi-Criteria Appraisal (MCA) score, which considers the benefits and feasibility from technical, economic, social, environmental and SWMP project perspectives. For ten of the location-specific options, the indicative reduction in the number of properties flooded in the 3.33% (1:30 year) annual probability event and the indicative cost of implementing the option have been used to determine an indicative benefit:cost ratio which has been used in the MCA. The MCA also includes feedback from the wider SWMP partnership as obtained through the Options Workshop. This feedback includes a suggested priority for implementation. The top scoring generic and location-specific options according to the MCA score are:

- **Joint top scoring generic options in MCA:**
  - Existing and new SuDS (particularly soakaways) and road drainage should be properly maintained (including reprofiling of roads as required) to ensure their continued effectiveness. In addition, maintain existing watercourses, trash screens etc.
  - Raise awareness of surface water flood risk both within EEBC and potentially with the public. Link with encouraging use of rainwater harvesting, other source control measures and uptake of property level resistance and resilience measures.

- **Top scoring location-specific option in MCA:** Store surface water runoff from Langley Vale in a reservoir, detention basin, pond or wetland to reduce the runoff rate and volume. Use stored water either for (i) irrigation for RAC Golf Club or (ii) artificial recharge of aquifer. Increase storage capacity of existing Woodcote Millennium Pond

However, it is important to note that there are a number of ways that all the proposed options could be viewed, in addition to this overall MCA scoring:

- **Incremental/opportunity-based implementation:** Improved and sustainable management of surface water flooding is unlikely to arise through implementation of the above options alone. Instead, implementing any of the proposed options when the opportunities arise (e.g. as part of existing development plans) will have a beneficial effect, providing that implementation of only part of an option will not adversely impact flood risk before the whole option is realised.

- **Benefit:cost ratio:** The indicative benefits and costs for ten of the location-specific options identified a different prioritisation than in the final MCA. For example, the option with the highest benefit:cost ratio concerns attenuation of high flows entering Greens Lane Stream, which is also likely to have a benefit further downstream the River Hogsmill into Kingston. However, this option is unlikely to provide many social and environmental enhancements which is why it scored less highly in the MCA. However, the indicative benefit:cost ratio provides a useful prioritisation in terms of flood risk, although the high level nature of the assessment should be highlighted.

- **SWMP Partnership**: Through the Options Workshop, the wider SWMP partnership indicated strong support for some options and more tentative support for other options, including an indication of priority for implementation. For example, the following options received strong support:

  - Langley Vale / Woodcote attenuation and reuse of surface water
  - Nonsuch Park increased attenuation of flows in existing wetland
  - Rosebery School / Stamford Pond attenuation of flows upstream of Greens Lane Stream
  - The Rosebery Park element of the option also considering a surface flow route along Woodcote Green Road / Dorking Road / Ashley Road
  - Various locations for sewer interrupt on adjacent Hogsmill River

  Whilst this was based on analysis of the facts of the options, it also provides an important indication of the direction of travel of the key partner organisations, for example as Surrey County Council take on their new responsibilities under the Flood & Water Management Act.

The different methods used for appraisal and prioritisation of the options presented comprise an evidence base from which appropriate options can be consider further as opportunities arise. A number of opportunities have already been identified in the council Infrastructure Delivery Plan, including for implementation of options relating to Epsom and Ewell town centres and for implementation of generic measurers relating to the use of pervious paving and maintenance.

4 Summary

A range of options has been identified to improve management of surface water flooding across the Borough of Epsom & Ewell. The options have been developed from a review of previous studies, Multi-Criteria Analysis 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 illustrated in Figure 4.1 as initially outlined in the vision for the project

Figure 4.1 Overall philosophy for the identified options

Six options have been identified for generic implementation across the Borough, most likely through introduction of EEBC policy, and sixteen for implementation at specific locations. Options have been appraised using the following procedures:

- **Indicative benefit:cost ratio**: For ten of the location-specific options, the potential benefits (i.e. damages avoided) and costs have been estimated. This provides an indicative benefit:cost ratio for each of the ten options which has been used to provide one indicator of priority which considers the degree of flood risk. The high level nature of this assessment should be noted.

- **SWMP Partnership priority**: At the Options Workshop, the Partnership discussed which of the following indicative priorities would be preferable for the options:

- 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+)

These priorities, and the associated indication of support for the option, provides a second indicator of priority

- **Multi-Criteria Analysis**: Each option has been scored on its feasibility and/or benefits according to the following criteria: technical, economic, social, environmental and SWMP project objectives. Where available, the benefit:cost analysis has been used to inform the economic score and the SWMP partnership priority has been used to inform the SWMP project objectives score. The options have been ranked on this overall score which provides a third indicator of priority.

Table 4.1 lists the generic and location-specific options which have been identified as most preferable in each of the above three appraisal techniques. For example, each of the options listed in Table 4.1 received strong support at the Options Workshop whereas only one of the options obtained the highest indicative benefit:cost ratio.

The different methods used for appraisal and prioritisation of the options presented comprise an evidence base from which appropriate options can be considered further as opportunities arise. Indeed, a number of opportunities have already been identified in the council Infrastructure Delivery Plan, including for implementation of options relating to Epsom and Ewell town centres and for implementation of generic measures relating to the use of pervious paving and maintenance.

However, improved and sustainable management of surface water flooding is unlikely to arise through implementation of one or two of these options alone. Instead, implementing any of the options proposed in this report, when the opportunities arise (e.g. as part of existing development plans) will have a beneficial effect, providing that implementation of only part of an option will not adversely impact flood risk before the whole option is realised. Therefore, it is strongly recommended that all options are kept in mind by the various key council teams for implementation and their potential reviewed on a regular basis.

Table 4.1 Options identified as most preferable through benefit:cost. SWMP priority and MCA appraisal techniques

	Description	B:C Ratio[1]	SWMP Priority[2]	MCA[3]
Generic	Existing and new SuDS (particularly soakaways) and road drainage should be properly maintained to ensure their continued effectiveness. In addition, maintain existing watercourses, trash screens etc	Not Applicable	✓ (2)	✓ (8)
	Raise awareness of surface water flood risk both within EEBC and potentially with the public. Link with encouraging use of rainwater harvesting, other source control measures and uptake of property level resistance and resilience measures.		✓ (2)	✓ (8)
	Adopt a map indicating natural drainage routes which future development should respect. Development should also respect local landform to ensure sufficient property thresholds. In addition, adopt a map indicating the suitability of locations for appropriate SuDS across the Borough.		✓ (2)	
	Policy to fit green roofs to new buildings and retrofit where existing roofs are being replaced. In addition, fit impervious pavement car parking where practicable.		✓ (2)	
Location Specific	Store surface water runoff from Langley Vale in a reservoir detention basin, pond or wetland to reduce the runoff rate and volume. Use stored water either for (i) irrigation for RAC Golf Club or (ii) artificial recharge of aquifer. Increase storage capacity of existing Woodcote Millennium Pond.		✓ (2)	✓ (9)
	Store surface water runoff in a series of detention basins, ponds or wetlands in Nonsuch Park to reduce the runoff rate and volume.		✓ (2)	
	Interrupt surface water sewer upstream of overground Rosebery Park attenuation area to reduce downstream volumes, the risk of sewer flooding and attenuate flows to reduce peak runoff. Store surface water runoff in Stamford Pond and reduce runoff into Greens Lane Stream.	✓ (14:1)	✓ (2)	
	Interrupt surface water sewer upstream of various overground attenuation areas (mainly adjacent River Hogsmill) to reduce downstream volumes, the risk of sewer flooding and attenuate flows to reduce peak runoff. These will have a particular benefit in reducing peak flows down the Hogsmill River into Kingston.		✓ (2)	

Notes: [1] Highest benefit:cost ratio stated
[2] All listed options scored the maximum of 2 for this criterion
[3] Highest overall MCA score out of a maximum of 10 stated

5 References

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Appendix A Location Specific Management Measures

Specific Option	Option Type	Description	Locations	Primary Action Owners^	Further Information
Store surface water such that it can be later used on site	SuDS –source control	Store surface water runoff in a reservoir, detention basin, pond or wetland to reduce the runoff rate and volume in moderate to extreme events. Use stored water on site	• RAC Golf Course • Cuddington Golf Course (Sutton) • Hurtan Park Country Club • Epsom Polo Club • Hurtan Park Farm	• Individual and owners	Appendix C
Store surface water such that it can be used to recharge the aquifer for later abstraction (Artificial Recharge and Recovery)	SuDS source control – detention basin	Store surface water runoff in a detention basin to reduce the runoff rate and volume in moderate to large events Use stored water to recharge aquifers for water supply.	• Thames Water installation at Langley Vale	• TW • SESW • EA	
Store surface water runoff in detention basin, ponds or wetlands	SuDS source control – detention basin	Store surface water runoff to reduce runoff rate and volume moderate to extreme events	• Woodcote Green Road pond (increase current storage capacity) • Epsom Spurts Club on Woodcote Road • Ruseberry Park (construction of a series of low bunds and/or increase capacity of existing pond) • Epsom College Sports Ground • Land adjacent to Reigate Road to the north of Drift Bridge (Nork, Reigate & Banstead) • Nonsuch Park • McKenzie Way • Gibraltar Recreation Ground • Stamford Green pond (improve current storage to increase capacity of Greens Lane Stream) • North East Surrey College of	• Individual and owners	Appendix D

Specific Option	Option Type	Description	Locations	Primary Action Owners*	Further Information
			Technology • Playing fields of Rusebery School • Land adjacent to railway line and Cricket Ground at Harefield Bridge • The Walch Memorial Sports Ground (Sutton Grammar School for Boys) • The Old Haileyburians Rugby Football Club, Ruxley Lane • Land to the south of Horton Lane • The site of the filled-in pond to the north of Stew Pond (Epsom Common) • Court Recreation Ground		
Design for exceedance (may include raising kerbs or thresholds of properties, reprofiling roads or traffic calming measures or installation of 'green street' planters)	Design for exceedance	Route flows which exceed the drainage capacity through the built environment without causing flood damage in moderate to extreme events	• Langley Vale (including storage of runoff in RAC Golf Course and formalised water crossing of Langley Vale Road) • Woodcote Hurst • Woodcote Road • Ashley Road and High Street (Epsom) • High Street Ewell (adjacent to Bourne Hall)	• SCC • EEBC	Appendix E
Interrupt surface water sewer upstream of an attenuation area to increase capacity in the system	Increase sewer capacity	Provide overground storage and attenuation of flows in the surface water sewer. This will reduce downstream volumes and the risk of sewer flooding in moderate to extreme events	• Utilities Site, East Street • Land adjacent Longmead Road • Playing fields of Blenheim High School • Various parcels of land adjacent Hogsmill River at Chamber Mead and Pack Horse Bridge • Allotment Gardens adjacent Park Avenue West in Stoneleigh	• TW • Individual land owners	Appendix F
Provide new	Increase sewer	During development of	• Epsom High Street / East Street	• EEBC	

Specific Option	Option Type	Description	Locations	Primary Action Owners*	Further Information
surface water drainage	capacity	East Street Utilities Site lay a new drainage pipe from the High Street railway underpass into storage in the new development	Utilities Site		
Increase local conveyance and storage capacity of watercourses	Increase capacity	Provide additional storage for high flows in ordinary watercourses during moderate to extreme events and ensure ongoing maintenance to locally improve conveyance	• Court Recreation Ground (Pound Lane Stream) • Brenheim Road Business Park (during any future redevelopment, incorporate additional storage for Greens Lane Stream)	• EEBC • EA	Appendix G

Appendix B Location-specific Options Map

Appendix C Artificial Aquifer Recharge

General Description

Sustainable water management seeks solutions where one measure achieves at least two objectives and provides benefits to multiple stakeholders. The upland geology of the Hogsmill catchment is Chalk into which rainfall naturally infiltrates and recharges the aquifer and from which drinking water is abstracted by Sutton & East Surrey Water and, to a lesser degree, Thames Water. However, as rainfall intensity increases, a higher percentage of rainfall runs off overland into dry valleys. This mechanism may be increasingly experienced under a changing climate. Major overland flow paths pass through Langley Vale toward Epsom town centre, and through the Boroughs of Banstead and Reigate and Sutton towards East Ewell and Nonsuch Park. By intercepting this runoff, potential flood water can be reduced in the urban areas whilst optimising water resources. Artificial aquifer recharge could be promoted.

Langley Vale abstraction borehole

Surface water detention in Australia is used to recharge aquifers

- By creating infiltration swales across a flowpath to intercept runoff and distribute it along contour lines to optimise infiltration but without affecting land-use. Other arduse measures on flowpaths which could promote recharge include swales, vegetation margins and hedgerows.

- By storing surface water which can later be used on site for irrigation or other purposes which naturally recharge the aquifer

- By creating detention areas around suitable locations and positively pumping water into the aquifer, after suitable cleaning.

Of these three options, the first and second will provide aquifer recharge via 'natural' processes, i.e. through water emerging at the surface being re-distributed over the land surface and naturally infiltrating downwards (assuming the Chalk is not saturated).

To achieve its aim of protecting and best managing groundwater resources for present and future generations, the Environment Agency is aiming to manage surface water and groundwater as an integrated whole. Two policies in the *Groundwater: Policy, Protection and Practice* (GP3) document, which indicate the Environment Agency's support in principle to artificial aquifer recharge are:

- P6-10: Providing there is no pollution, we will encourage the augmentation of groundwater resources through techniques such as SuDS and artificial recharge, particularly where resources are scarce, or where such activities would reduce flood risk from development.

- P6-1: We will control all artificial recharge and subsequent re-abstraction to ensure effective development of water resources whilst at the same time protecting the

environment and other abstractors. In particular, schemes must be sustainable in terms of quantities recharged and re-abstracted.

Potential Locations within the Borough of Epsom & Ewell

- North Downs, south of Langley Vale across flow paths in open fields. The infiltration swales would form 'prongs' which stretch along the contours at suitable locations below the surface so as not to impact on land-use.

- Royal Automobile Club (RAC) Golf Course on the 5th fairway. The RAC may be receptive to a detention pond/wetland across the flowpath to retain surface water. They would then either pump the water to a high-level storage reservoir or directly to fairways and greens where it will infiltrate back to the aquifer.

- Cuddington Golf Course. Cuddington have also expressed an interest in creating a reservoir which if created could be on similar lines to the RAC. However, to the North of the site there is an ideal location, a natural depression between the sports fields and Northey Avenue which could be formalised.

Possible Considerations and Constraints

- Langley Vale. The contour recharge scheme requires agreements with landowners but water companies may be willing to invest in a trial.

- RAC. The scheme would include improving the directing of flow from Langley Vale Road into the pond via a wetland with interceptor if needed. Infiltration directly from the pond may be discouraged as the site is within Source Protection Zone 1. Therefore distributing the water to the fairways is a win-win.

- The Environment Agency's GP3 policy states that Artificial Recharge and Recovery is a key development option in its water resources strategy. However, the option creates a series of complex technical challenges and requires considerable investment in research and development at each proposed site with no guarantee of success. However, the Environment Agency encourages developers of proposed schemes to liaise with them from the outset and meetings held during the SWMP project have initiated this dialogue which should be followed up on.

Appendix D Detention Basins, Ponds and Wetlands and Swales

General Description

Control of surface water runoff near to its source can be achieved through the use of ponds, wetlands, detention basins and swales. The flood risk management purpose of these features is to detain surface water in a safe place until the flood peak has passed.

There are a number of ponds and wetlands across the Borough which are areas of permanent standing water providing storage of flows and a certain degree of water treatment. They also have high ecological, aesthetic and amenity benefits. A number of these existing areas could be further used to attenuate and store surface water flows without significant additional land-take. This could include restricting high outflows from the pond and constructing low bunds around the land surrounding the pond to provide storage for the attenuated flows. Treatment of the surface runoff for contaminants and sediment may be required in order to preserve the existing ecology of the permanent pond. We are aware of one pond in Epsom Common, to the north of Stew Pond, which has been filled in but which could provide useful additional storage for potential flows towards the West Park development, if opened up.

Detention basins can be designed to act similarly to ponds during wet weather whilst remaining dry otherwise. Therefore, the areas can be used as e.g. recreational facilities for much of the time. For example, Rosebery Park could be re-landscaped to incorporate a series of shallow terraces so as not to impede access and recreational use. In these situations, appropriate signage to warn of potentially deep water is required. In areas of vulnerable groundwater (i.e. source protection zones), detention basins may need to be lined. As proposed in Appendix C, stored water has the potential to be reused on site if it can be transferred to somewhere more permanent, e.g. a reservoir on a golf course.

Swales are shallow linear vegetated drainage features which can store and convey surface water. They can be designed to be permanently wet or generally dry and have little or no impact on land use. Swales may be wide and shallow to intercept flow but much of the storage area should still be able to be used normally when dry.

Existing pond adjacent Woodcote Green Road

Existing pond in Rosebery Park

Existing pond in Nonsuch Park

Epsom College, adjacent College Road

Ponds and swales within School playing fields should drain well to facilitate normal use for most periods but may include defined wetland areas for habitat reserves.

Potential Locations within the Borough of Epsom & Ewell

- The following existing ponds and wetlands could be considered for providing additional stormwater attenuation:
    - Woodcote Millennium Green (http://www.woodcotemillenniumgreen.org.uk/) and Rosebery Park for flows towards Epsom Town Centre.
    - Stamford Pond for flows down Greens Lane Stream
    - Pond adjacent to the Allotment Gardens near the Utilities Site, East Street for flows from Epsom Town Centre
    - Horton Country Park Golf Course for flows into the Horton Stream
    - Nonsuch Park for flows along Briarwood Road and the Ewell Court Stream
- The following locations could be considered for new ponds, wetlands or detention basins:
    - RAC Golf Course, Woodcote Park – pond or detention basin
    - Historic pond in Epsom Common near the Stew Pond – pond
    - To the north of the planned West Park development – pond and wetland (already being considered by developers)
    - The natural depression in the Walch Memorial Sports Ground (Sutton Grammar School for Boys, Northey Avenue) – detention basin
    - Cuddington Golf Course (Sutton) – pond or detention basin

Possible Considerations and Constraints

- The West Park developers are already planning a pond and wetland downstream of the development which will serve surface water discharge. However, an additional pond, on the site of the historic pond in Epsom Common, upstream of the development site may limit the surface water flood risk to the site.
- Use of existing ponds and wetlands as temporary stores for surface water runoff may require some treatment of the runoff so that any contaminants do not disturb the existing ecology.
- If land around the permanent pond is designed to flood and store high flows then there will be shallow water depths around the perimeter and deep water towards the centre. This health and safety risk must be properly addressed through signage and awareness raising.
- Nonsuch Park comprises about 250 acres of mature parkland and formal gardens. Land and buildings at Nonsuch Park is leased by SCC to the Borough of Sutton and EEBC. The Park is designated green belt land and its use restricted to public open space, pleasure grounds and other activities related to outdoor games or recreation. The Park is now designated as a strategic open space.
- The Epsom Common Association (http://www.epsomcommon.org.uk/) is a voluntary organisation whose patron is the Mayor of Epsom & Ewell, and who manage the common jointly with EEBC.

Appendix E Design for Exceedance

General Description

Highway drainage and surface water sewers are designed to carry water below ground in pipes that could otherwise cause flooding on the surface. Sewers have a limited capacity typically carrying storm flows of between a 10% and 3.33% annual probability event.

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. Roads, buildings and other features can be designed to control overland flow and direct it safely through the urban environment. It may be as simple as removing speed ramps so as not to obstruct flow or even placing them to slow flow. Roads should be shaped to direct flow into drains and safely away to storage. For example on Langley Vale road, it appears that the intention was to drain the road via side gulleys but the road cambers the wrong way.

Use of 'green street' planters as in Portland USA demonstrates that designing for exceedance can bring important social and environmental benefits

Green street planters in Portland, Oregon

Central conduit for runoff along road in Anger, France

This concept is already promoted in Surrey Design Principa 4.4 which states that making water a feature rather than being hidden underground can add to biodiversity, provide wildlife corridors and generally improve visual quality. Maintenance of features for managing surface flow will typically be easier and less expensive than maintenance of underground infrastructure.

The following three aspects could be considered to develop designs at various locations across the Borough:

- **Surface flow routes**, formalised through the use of road profiling, kerb heights, speed bumps etc.
- **Green Streets** use attractive kerbside planters into which surface water on the road is directed.
- **Raising property thresholds** at access points can provide an increase in flood protection.

Outside of the built environment, surface runoff will follow the natural topography. Before this surface water reaches any recognised watercourse, it could be viewed as runoff which has exceeded the natural infiltration capacity. Therefore, in the same way as for built environments, future development should be designed to accommodate exceedance flows along these drainage routes. The Hogsmill Integrated Urban Drainage project recommended that corridors along natural drainage routes are reserved to permit conveyance of surface water. The Strategic Flood Risk Assessment emphasised that careful consideration to overland flow routes and avoidance of their obstruction, as part of

the site design, should be encouraged. This SWMP fully supports and re-emphasises these recommendations. To encourage implementation, a map showing the likely natural drainage routes as well as topographic depressions where water could pond to depth, is provided which could be used by council planners.

Potential Locations within the Borough of Epsom & Ewell

Analysis of the bare earth topography of the Borough has provided a map showing natural drainage routes in the absence of the built environment. Exceedance routes could be planned along the following portions of these natural drainage routes:

- Linking Woodcote Green Road and Rosebery Park via the existing footpath and crossing Avenue Road. This will require kerb height adjustment along Woodcote Green Road, formalising the conduit along the footpath, use of traffic calming measures to maintain flow across Avenue Road.

- Linking Ashley Road with Rosebery Park via Ladbroke Grove. This will require kerb height adjustment along Ashley Road and Ladbroke Road, appropriate property resistance and resilience measures and use of traffic calming measures to direct the flow.

- Linking Ashley Road with the High Street in Epsom. This will require kerb height adjustment along Ashley Road and the High Street, with appropriate property resistance and resilience measures. Green street planters would be used along the centre of the High Street to attenuate the flow and provide social and environmental benefits. Other adjacent roads could also be considered: South Street, Ashley Avenue, Church Street and Upper High Street, all of which carry surface water to a low point under the railway bridge at East Street.

Possible Considerations and Constraints

- Thought should be given to the 'Total Space' in an urban setting so that kerbs, channels and street furniture direct flow without obstructing access to wheelchairs, pedestrians and cars which could share the same space.

- Stakeholder engagement will be integral to the process of Total Space and designing for exceedance and key stakeholders will be Surrey County Council (SCC) as the highway authority, residents associations to discuss concerns about increased flood risk to properties and EEBC/SCC emergency planning.

- Street shaping, or 'reprofiling' opportunities occur whenever re-surfacing is planned so as to keep cost to a minimum.

- Formalising overland flow routes should consider steep slopes where velocities may be high.

Appendix F Increase Surface Water Sewer Capacity

General Description

In general, managing surface water on the land surface (a) is more cost-effective and easier to maintain (b) permits attenuation of peak flows to reduce risk downstream and (c) provides opportunities for social and environmental benefits. However, in some situations, particularly in densely developed areas, adding storage and/or increasing the capacity of the sewer network may have to be considered to limit overland flow and flooding and the discharge of potentially polluted floodwater through misconnections with the foul sewer.

Similarly, as a general principle we do not want to increase the conveyance of surface water downstream but rather control it as close to source as practicable. However, sometimes there may be a need to move potential flood water from a wet-spot to a safe storage area. A new drainage sewer could collect exceedance surface water and convey it safely through a low area to a point where it can either break to the surface within an open detention pond or to an underground storage tank.

Railway underpass at junction of East Street and High Street, Epsom

Increasing surface water sewer capacity could be possible through:

- Including on-line or off-line storage tanks in the sewer.
- Adding new sewers which can be oversized to provide additional storage.
- Enlarging existing sewers during maintenance work.
- Providing overground storage through interruption of the existing sewers.

Surface water sewers have a limited capacity typically carrying storm flows of between a 10% and 3.33% annual probability event. Greater events will exceed the capacity and flooding may occur. Interruption is an opportunity to determine where any exceedance flooding occurs. The opportunities for interrupting surface water sewers may be:

- Where the sewer is reaching its capacity in certain storm events the water company may traditionally seek to increase the capacity of the sewer to reduce the risk of local flooding. If this happens then the flood problem may be moved downstream and may exacerbate flooding overall and not reduce it. In this case, a sewer run could be interrupted by removing pipes and water allowed to be stored in an open space. The water could then be allowed to discharge back into the sewer at a controlled rate. Overground storage is thus permitted in a controlled space.
- Where a deliberate policy is employed to reduce SW runoff into watercourse. In this case, a sewer may be shortened so that water again flows through a storage space just outside the floodplain before entering the watercourse.

Both measures of opportunities for habitat creation. The open spaces could be in parks, school and recreation playing fields, allotments and margins of even waste ground as above

Potential Locations within the Borough of Epsom & Ewell

- Possible locations for sewer interruption could include:
    - King Georges Field, Auriol Park, Salisbury Road, Ewell
    - Wandgas Athletic Ground, Grafton Road, Ewell
    - Blenheim High School, Longmead Road, Epsom
    - Gasholder site & Pavilion, Victoria Place, Epsom
- A potential location for a new sewer would be between Epsom High Street via the low railway underpass to discharge into the Utilities Site (East Street). The sewer would collect surface water at the junction of the High Street, Upper High Street, Church Street and East Street and then run under the low spot (railway bridge, Epsom - Chessington line) on East Street, along the Hook Road to the Gas Works car park where it would run adjacent to the Epsom – Ewell West railway line to the open spaces between the Gas Works and Stones Road.
- Gibraltar Recreation Ground is a potential site for off-line storage in the surface water sewer which runs down West Gardens and then on down West Street.

Possible Considerations and Constraints

- Sewers are typically laid 1.2m below ground level. Dependant on local topography downstream invert levels etc. the interrupted sewer may need to be brought to the open space by a new pipe from an upstream manhole.
- Thames Water, like many water companies traditionally, may object to receiving back surface water which has left their sewer. However, this position is beginning to change. Provided a sewer improvement scheme is justified and specific conditions are met, e.g. water quality standards, Thames Water may see this as a benefit when compared to increasing capacity or providing tank storage
- A closed sewer pipe can be used to generate a siphon effect that can push water through a low spot in the sewer to a higher elevation but one which is still lower than the start point and hence still work by gravity. This would be the case if a sewer was to be run between the High Street and Utilities Site in East Street, via the low spot in the railway underpass. In this situation, surface water would have to be collected at a busy road junction without affecting access. The sewer would be laid along a road to avoid costly pipe-jacking under the gas works but would have to negotiate various utilities in the road
- Problems relating to sewer flooding are often reported to Local Authorities and the information is not made known to Thames Water. In these cases, the information is not recorded on its regulatory DG5 register and properties that are not on the register cannot benefit from Thames Water funded investigations or investment. Therefore, the councils and the EA must work together - encouraging residents as required - to report all flood events which are believed to relate to the sewer system to Thames Water.

Appendix G Increase Conveyance and Storage in Watercourses

General Description

Clearing watercourses of excessive vegetation and debris, and unblocking trash screens and other structures will improve conveyance and may locally reduce the likelihood of flooding. In terms of surface water, reducing peak levels in the watercourse may improve the discharge of surface water from drains and sewers. However, increasing the flow in one area may pass problems further downstream. For example, the Hogsmill IUD study showed that decreasing peak flow in the Greens Lane Stream reduced flood levels in the Hogsmill downstream in Kingston.

Good practice for surface water management is to attenuate as much of the surface runoff as possible at source. Therefore, whilst local improvements in conveyance may locally reduce the risk of flooding, these should be balanced by the improvements in storage to attenuate high flows overall.

The Hogsmill River, Greens Lane Stream and Horton Stream are designated Environment Agency Main River within Epsom & Ewell. Other watercourses (e.g. Ewell Court Stream) and drains (e.g. Pound Lane) are the responsibility of EEBC under the Land Drainage Act 1991, now extended under the Flood & Water Management Act.

Potential Locations within the Borough of Epsom & Ewell

- Greens Lane Stream has flooded in the past (particularly along Longmead Road), will be sensitive to downstream levels in the Hogsmill River and has been found to have an impact on water levels downstream in Kingston. It is recommended that any future opportunities to increase the storage available for high flows in Greens Lane Stream should be taken, for example during any further development of the Business Centre on Longmead Road. This long-term aspiration could balance local improvements in conveyance of Greens Lane Stream through maintenance.

Possible Considerations and Constraints

- Greens Lane Stream was designated Main River in 2004/5 so the Environment Agency has powers to maintain and improve it to ensure the efficient passage of flood flow and to manage water levels. However, these powers do not oblige the Environment Agency to carry out either maintenance or construction of new works on Main Rivers and therefore EEBC may need to work with the EA to develop a business case.

Appendix H Raise Awareness of Surface Water Flood Risk

General Description

The widespread flooding of summer 2007 substantially increased our awareness of surface water flooding. The subsequent Pitt Review highlighted raising awareness linked with education about flood risk as a key priority to ensure improved management. There are a number of areas where this could be beneficial:

Ground sloping down from road towards low threshold properties in new St Ebbas development

Clarendon Park development possibly blocking natural drainage path

- **General public awareness:** careful education of the public about the possibility of flooding from surface water as a risk distinct from flooding from watercourses will be beneficial and could be linked to encouraging property owners to consider property level resistance and resilience measures (Appendix J) and to discourage dumping of garden or other waste in watercourses. It is also important that property owners understand that reporting flooding to the councils, Thames Water and the EA enables evidence of a problem to be gathered which can be used to secure funding in the future. This is particularly relevant for Defra's Property Level Flood Protection grants and Thames Water's investment strategy.

- **Specific public awareness:** any future schemes to manage surface water flooding could be accompanied by explanations that the council is seeking multiple benefits through managing flood risk, e.g. construction of ponds or green streets as well as the appropriate health and safety notices (e.g. for unexpected deep water).

- **Awareness within EEBC:** the SWMP has highlighted that further raising awareness of surface water flood risk in the following council functions could benefit sustainable flood risk management (Appendix I): planning control, building control and emergency planning. Two issues which have been highlighted by recent developments are (i) development should avoid blocking natural drainage routes and (ii) developments should take account of natural landform to avoid water flowing towards low property thresholds.

- **Awareness across political boundaries and areas of responsibility:** a holistic catchment approach to flood management will require experts in EEBC to work across administrative boundaries, particularly with the Borough of Reigate & Banstead (upstream) and the Royal Borough of Kingston (downstream). Furthermore, the partnership approach to flood management facilitated by this SWMP should be continued. This is required to be coordinated by Surrey County Council as the Local Flood Authority and should continue to involve, at least, the Environment Agency.

and water companies in addition to the council s.

- **Developer awareness:** developers should be made aware at the earliest possible stage of any natural flow routes or areas of surface water risk so that they can incorporate suitable mitigation in their proposals.

Considerations and Constraints

- Consultation with councillors, officers representatives of resident's associations during the SWMP received a positive response and follow-up communication was requested. Large clear maps showing various information (e.g. predictive mapping, critical infrastructure, natural drainage routes, historic incidents of flooding) were said to be particularly helpful.

- The emergency planning divisions of EEBC and SCC could use the SWMP mapping to understand which roads or major pedestrian routes may be blocked by surface water flooding and plan traffic and pedestrian diversions.

Appendix I Build Capacity Within EEBC

General Description

The Lead Local Flood Authority with overall responsibility for management of local flood risk in Epsom & Ewell is Surrey County Council (SCC). However, Epsom & Ewell, along with the Environment Agency, water companies and others, have a duty to cooperate with SCC in a partnership arrangement. Responsibilities of Epsom & Ewell are likely to include:

- Assisting SCC to develop a strategy to manage local flood risk and to fulfil the requirements of the Flood Risk Regulations 2009
- Duty to contribute to sustainable development
- Powers to do works on Ordinary Watercourses
- Powers to designate structures as important for flood management

Epsom & Ewell Borough Council (EEBC) already perform a number of functions which could have an impact on management of local flood risk. For example:

- Planning control: to pursue opportunities for development to respect the natural passage of water and provide mutual benefits of management of flooding and water resources, social and environmental improvement and adaptation to climate change.
- Building control: to pursue opportunities for future development to respect natural landform (e.g. ensure sufficiently high property thresholds) and rectify existing drainage problems (e.g. sewer misconnections).
- Emergency planning: to incorporate knowledge of likely 'hotspots' caused by surface water flooding into multi-agency flood plans, designation of rest centres, safe access routes avoiding deep or fast flowing water etc.

Consultation with these functions during the SWMP has highlighted that additional expertise in EEBC to advise these functions could benefit sustainable flood risk management. Furthermore, it will be beneficial to adopt a holistic catchment approach to flood management and drainage and for experts in EEBC to work across Borough boundaries, particularly Reigate & Banstead (upstream) and Kingston (downstream).

Funding to support the new local authority responsibilities for flood risk management goes directly to SCC via the unring-fenced formula grant. However, SCC can decide how to apportion the available funding and can delegate some of its responsibilities to second tier authorities. Therefore, opportunities for closer working between SCC and EEBC and building capacity within EEBC exist.

Considerations and Constraints

- Continue to build closer working relationships with SCC and identify where SCC delegation of tasks to EEBC (along with appropriate funding) could provide mutual

benefits

- Monitoring Defra's developing *strategy for skills and capacity building in local authorities for local flood risk management* to identify any funding opportunities for capacity building

Appendix J Property Level Resistance & Resilience

General Description

Resistance measures can be fitted to prevent flood water entering properties and resilience measures can reduce the damage caused by flood water. Installing flood resistant and resilient measures can:

- Yield long-term financial savings to properties in flood risk areas.
- Significantly reduce the disruption caused by flooding and provide homeowners with an increased peace of mind.
- Potentially increase the value of properties in flood-prone areas and can make homes easier to insure, with a greater likelihood of securing better terms from insurers than would otherwise be the case.

For households that are expected to flood more than once in every ten years the economic benefits outweigh the up-front investment by a factor of between five and ten. Temporary flood resistant measures (flood guards, air brick covers) were shown to reduce damage costs by up to 50% if properly deployed before flooding.

Installation of flood resistant and resilient measures *as part of refurbishment* to a flood-damaged property is only marginally more expensive than refurbishing a property 'normally', although this is often not done. Until Building Regulations incorporate resistance and resilience requirements, the Pitt Review recognised local authorities have powers to make home improvement grants and duties to promote business continuity which could encourage change immediately. The review recommended that all local authorities should extend eligibility for home improvement grants and loans to include flood resistance and resilience products for properties in high flood-risk areas. This would be in line with EEBC's Core Strategy Policy CS6 which promotes sustainability in development. One mechanism to deliver CS6 is stated as "by encouragement to the building industry locally to implement emerging good practice".

Considerations and Constraints

- If properties in the Borough are flooded, the councils (FFRC and/or Surrey County Council as the Lead Local Flood Authority) could consider funding the additional cost of installing flood resistance and resilience measures over and above standard repairs as a means of encouraging their uptake.
- Defra has recently requested a further round of applications for property level resistance and resilience grants. Similarly to previous rounds, a funding limit of

approximately £5,000 per property is set, of which up to 10% could be used for surveys to determine appropriate measures. Eligibility for the scheme on the basis of surface water or groundwater flood risk requires demonstration that the property has previously flooded. Reliable record keeping of flooding incidents is therefore important. It is recommended that EEBC discuss future plans for record keeping with SCC as the Lead Local Flood Authority, and remain vigilant to future funding opportunities.

- From various pilot schemes, it is apparent that property owners are unsure what the correct property-level measures to use are. The councils (EEBC and/or SCC) could consider raising awareness of which products are recognised and approved by the insurance industry and the recent British Standards Institute 'Kitemark' Certification Scheme for such products. As a minimum, council webpages could link to the following examples of practice in the UK:

    - the National Flood Forum's Blue Pages (www.bluepages.org.uk) which provide an independent directory of flood protection products and services;

    - the Association of British Insurers *Consumer Guide. A Guide to Resistant and Resilient Repair After a Flood*; and the

    - Defra (2007) Flood resistance and resistance solutions: an independent R&D scoping study. R&D Technical Report. May 2007

Appendix K Green Roofs

General Description

Green roofs, i.e. intentionally vegetated roofs, are an increasingly common feature on buildings. For most types of roofs, they may provide a range of benefits:

- Surface water source control (with respect to water quantity and quality)
- Improved durability of the roof
- Aesthetic and amenity value (where accessible) and enhancement of biodiversity
- Promotion of evaporative cooling and reduction of urban heat island effect

Due to the extra thermal insulation and protection to the underlying roof structure provided by the green roof, the whole life cost of a green roof may well be less when compared with a standard flat roof.

Green roofs may therefore help to improve surface water management in urban areas, particularly those with little open space for attenuation on the ground. Research shows that green roofs can have a considerable benefit in reducing surface runoff, compared to traditional roofs, although seasonal effects can be significant.

The actual realisable runoff from a green roof during storm conditions is largely dependent on the depth of the green roof (in particular the substrate depth), the antecedent weather conditions (e.g. the number of dry days before a storm and the temperature) and the total storm rainfall depth. However, the concept is to replace the rapid runoff of a hard roof with one that replicates or betters the original Greenfield runoff rate, with reductions of between 50% and 80%. Water can be stored and discharged at a controlled rate like a detention system or it can be harvested for use in the building (see Appendix L).

Extensive green roofs require little input during their lifetime. They typically take the form of a carpet of plants supported by a lightweight growing medium and overlying a drainage layer. Conversely, intensive green roofs require more input and tend to incorporate more deeply planted vegetation.

Retrofitting green roofs is feasible on many buildings providing spare load capacity is available. Intensive as well as extensive roofs can be retrofitted whether supported by wood, steel or concrete. Although the capital cost of retrofitting a green roof will typically be greater than simply replacing a traditional flat roof, the whole life cost of the green roof may well be less, and could be considered if the existing roof is in need of replacement.

Potential Locations within the Borough of Epsom & Ewell

- Retrofitting green roofs should be required as a matter of policy when replacing any large flat or gently sloping roof, particularly municipal office buildings (e.g. EEBC offices and Bourne Hall), schools (e.g. North East Surrey College of Technology), hospitals

(Epsom General Hospital) and multi-storey car parks

- Inclusion of green roofs for new build properties with large roof areas

Possible Considerations and Constraints

- Case studies of green roofs retrofitted to buildings in the UK are provided in: Murray, B (2005) Feasibility Study for the Retrofitting of Green Roofs CIV405 Final Report Department of Civil and Structural Engineering, University of Sheffield. May 2005.
- Green roof systems are often resisted within the UK because the building structures may need to be strengthened to carry additional loads. However, this is often only true for lightweight frame structures of typical single storey industrial warehouses, which are unlikely to have spare capacity for retrofitting green roofs.
- Green roof is a principle not a material, roofs are rarely grass, more often Sedum succulents which can survive short drought periods but equally, gravel or other surfaces can be used provided voids are available to store water and a control to discharge is put in place.
- The principle will not work if the roof storage for runoff is also the reservoir for water supply, the system must be 'empty' before the next storm event. This also applies to the water-butt for gardens (see Appendix L).

Appendix L Reuse of Rainwater

General Description

Water butts are commonly used to collect rainwater from individual properties for outside use, although modifications are generally required to make them effective to control stormwater runoff. Modifications could include:

- A throttled overflow so that excess water is directed to a soakaway or other attenuation area.
- Linking two or more butts in series so that at least one retains storage capacity and one retains water for external use.

Disconnected drainpipe discharging into a small pond (http://www.portlandonline.com)

Water butts have been shown by the Environment Agency to provide economic benefits via savings in the cost of water as long as the butts are used.

Alternatively, downpipes which discharge directly into the surface water sewer network can be disconnected and be routed instead away from the property across a grassed area or through a SuDS attenuation feature. Portland USA provides detailed instructions on how property owners can effectively disconnect downpipes and provides incentives for doing so.

Roof down-pipe disconnection directed to planters

Rainwater harvesting more generally collects rainwater for non-potable reuse both internally and externally. As promoted in the Surrey Design guide rainwater is collected stored, possibly mixed with 'grey' water and, after filtration and cleaning, made available for a variety of domestic purposes as 'green water'.

Although systems can be complex and expensive to install with careful design they can provide stormwater attenuation as well as substantially reducing mains water demand. Use of rainwater harvesting systems on larger non residential properties will therefore have multiple benefits.

Potential Locations within the Borough of Epsom & Ewell

- Water butts or disconnected downpipes could be widely applied across the Borough, to residential as well as non-residential developments. Downpipe disconnections can be applied in almost any building where above or below ground storage is available.
- Rainwater harvesting could be considered for large developments, particularly those who may also consider fitting a green roof.

Possible Considerations and Constraints

- Principle 4.2 in Surrey Design describes the potential for water butts and rainwater harvesting, in possible combination with 'grey water' reuse. Adopting this principle could be further encouraged by building control and planning control, perhaps through the use of incentives.

Appendix M Car Park and Urban Space Storage

General Description

The control of runoff close to the source can be applied to hard open-space surfaces such as car parks which can rapidly generate significant volumes of runoff which may otherwise flow directly into the sewer.

Pervious pavements are suitable for pedestrian and vehicles and allow rainwater to infiltrate through the surface where it can be temporarily stored, reused or released into a drainage system once the peak has passed. 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 high storage capacity. However, although the pervious pavement surface and the geocellular base have relatively low maintenance burdens, use of sand as a filter as part of the design could have a much higher maintenance burden, especially in situations where there is a high silt load which can clog the system.

Multi storey car park

Depot Road car park

The Environment Agency has shown pervious paving costs less on a lifecycle basis than traditional surfaces and that reduced maintenance costs outweigh increased capital costs.

An alternative approach is to provide temporary storage for storm water on the surface of the car park or other large area of hard-standing, using simple ramping and kerb design, to maintain maximum depths of between 150 - 200mm. The water could then be drained off site via swales to provide some improvement in water quality. If linked to a forecast system for heavy rainfall, this may render parts of the car park out of service for a time. Otherwise, the water depths will not cause damage to cars already in the park. Water on the ground surface remains easier to manage and the system will be easier to maintain.

Potential Locations within the Borough of Epsom & Ewell

- The main car parks in Epsom town centre (e.g. Depot Road car park) would be priority as well as car parks at the schools, colleges and hospitals.
- There are also large expanses of hard-standing in industrial areas e.g. Longmead Road, Nonsuch Industrial Estate, the Bus Park and superstores off Kiln Lane.

Possible Considerations and Constraints

- Above ground storage could use gradients and curbs to direct water to an area closed off in extreme weather. If space is permitting then infiltration or non-infiltration swales (subject to geology) at the perimeter of hard-standing can be used. In every case, discharge should be passed through an interceptor to remove hydrocarbons etc.
- Wherever possible the drainage should be by gravity to avoid pumping costs and the risk of the void being full due to pump failure.

Appendix N Maintenance of SuDS

General Description

The Flood & Water Management Act establishes a Sustainable Drainage Systems (SuDS) Approving Body (SAB), which is typically a body to be set up within the Lead Local Flood Authority, i.e. Surrey County Council. The SAB will have a duty to adopt and maintain SuDS which serve more than one property, where they have been approved. Optionally, an approving body may voluntarily adopt all or part of a SuDS to which the duty to adopt does not apply.

Section 59(1)(c) of the Building Act 1984 provides that where a cesspool, private sewer, drain or other specified types of drainage work which are provided for a building are in such a condition so as to be prejudicial to health or a nuisance, the local authority may require the owner of the building to carry out work. Paragraph 26 in Part 2 of the Flood and Water Management Act extends the power in this section so that it also applies to sustainable drainage systems (whether or not they are adopted) in the same way as it applies to cesspools, sewers, drains, etc.

Maintenance requirements of SuDS likely to be most suitable in Epsom & Ewell can be summarised as:

- Medium: green roofs, rainwater harvesting, swales, ponds and wetlands
- Low: soakaways, water butts, pervious pavements and detention basins

Surrey Highways will be responsible for maintaining SuDS in public roads in the Borough – the Highways Agency does not own any assets. Because of the geology of the Borough, the drainage of all roads (as well as other areas) to the south of the Borough, on areas underlain by Chalk, is to soakaways. SCC has locations of 749 soakaways and 7685 road gulleys in its database for the Borough. There is limited information for the majority of these soakaways. Maintenance of gulleys and soakaways currently appears to be driven primarily by issues raised and logged on the Surrey County Council's 'wetspots' database. This contains records of reported drainage/flooding issues as well as the results of any investigations and attempts to rectify the issues. In the October 2010 update of the database there are 38 wetspots across the Borough. Although causes are not attributed to a number of these, 13 incidents specifically mention maintenance and/or soakaways as the likely cause of the issue, including the following key locations:

- Bottom of Langley Vale Road
- On the three junctions formed by intersection of Grandstand Road, Old London Road and Tattenham Corner Road
- Woodcote Green Road adjacent Epsom General Hospital
- Ashley Road adjacent Rosebery Park
- Reigate Road downstream of Drift Bridge
- Christ Church Road adjacent Stamford Green Pond

- Upper Court Road near Greens Lane Stream
- Cheam Road adjacent Ewell East railway station
- Chessington Road adjacent Horton Park Country Club

In addition to proactively resolving these issues, it is suggested that future SCC maintenance of soakaways and gulleys concentrates on those identified flow routes and areas most at risk of surface water flooding.

Potential Locations within the Borough of Epsom & Ewell

In addition to rectifying the above 'wetspot' issues, future SCC maintenance schedules could focus on the following locations where surface water runoff is most likely (identified by selecting SCC soakaways within 50m of a natural drainage route):

- Rosebery Road / Langley Vale Road
- College Road
- Reigate Road downstream of Drift Bridge
- Cheam Road and adjoining roads (e.g. St Annes Way and Hurstwood Road) and particularly adjacent Ewell East Station and roundabout junction with Nonsuch Walk

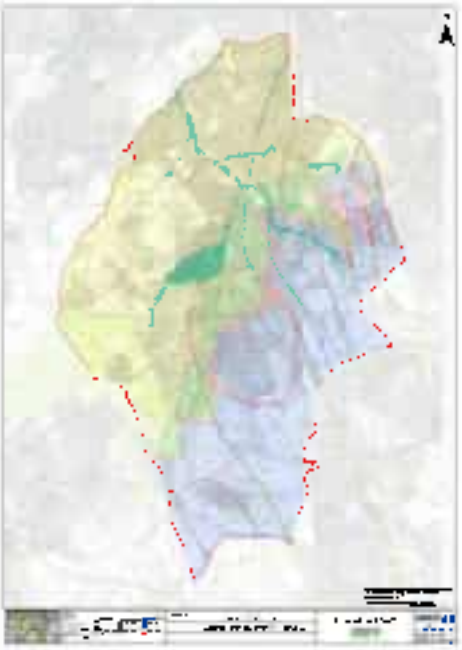
Possible Considerations and Constraints

- Government has recently reassured councils that funding to maintain adopted SuDS will be provided so that SuDS can be promoted.

Appendix O Promote Suitable SuDS

General Description

The Strategic Flood Risk Assessment (SFRA) and Survey Design state that there are a range of SuDS design options that can fit into almost any setting. However, there are a number of considerations to selecting suitable SuDS options, for example available space and maintenance requirements. Whilst there is generic guidance available to assist developers in answering these questions (e.g. CIRIA C697 and listed in the SFRA), issues specific to the Borough could be approached using the prepared SuDS map. The following layers are shown on the map and could be used to highlight the following site-specific issues:



The proposed Sustainable Drainage System considerations map

- **Solid and superficial geology** - Is the underlying geology suitable for infiltration-based SuDS?
- **EA Source Protection Zones** - Is the underlying aquifer designated as a Source Protection Zone which may impose constraints on infiltration-based SuDS?
- **Fluvial flood zone and Groundwater Emergence Map** - Will SuDS storage or infiltration still operate when groundwater and/or watercourses rise to levels with an annual probability of 1% (1:100 year) plus climate change?

The following interpretation of the map is suggested:

- Chalk – suitable for all SuDS techniques including infiltration. However this area is designated major aquifer with soils of high leaching potential. Whilst infiltration will work well it would be easy to pollute the aquifer. Reference should be made to the EA Source Protection Zones and Groundwater Protection: Policy and Practice (GP3).
- Lambeth Group, Thanet Sands and London Clay (i.e. the rest of the map area) – the bedrock and or overlying deposits suggest that infiltration techniques may not be suitable but local infiltration tests should be undertaken as the deposits are highly variable. All other SuDS techniques are likely to be suitable.
- Fluvial flood zone 3, Groundwater Emergence Map - groundwater levels may be seasonally close to the surface so that infiltration techniques may not always function.

Possible Considerations and Constraints

- National standards for sustainable drainage are currently being prepared. The national standards will set out the criteria by which the form of drainage appropriate to any particular site or development can be determined, as well as requirements for the design, construction, operation and maintenance of SuDS.
- Data licensing issues may need to be overcome to display the information in a manner agreeable to all data owners.

Appendix P Proactive Rectification of Drainage Problems

General Description

An overall objective of effective surface water management is to reduce the volume of surface water runoff exceeding designed drainage systems during normal and, where practicable, during more extreme events. Instead of rectifying drainage problems only as their consequences become apparent, redevelopment of any site could provide opportunities for proactive rectification of any problems. Such a policy would widen the now rescinded policy SE3 in the Surrey Structure Plan which stated that proposals for redevelopment of existing buildings and their curtilage within areas where there is a high risk of flooding should aim to improve conditions locally and not worsen flood risk elsewhere in the catchment. A new policy could apply throughout the Borough, not only in areas identified as at high risk of flooding.

The cumulative impact of these rectifications across the Borough would provide a strategic benefit and incentives for the owner or developer (e.g. reduction in rates, council contribution or reduction in planning fees) could be considered. This could be similar to the Clean River Rewards offered by the authorities in Portland (USA) where discounts on utility bills are offered to those who contain stormwater safely on their property. Such a scheme also promotes sustainable development and flood risk management which, under the Flood & Water Management Act 2010, local authorities now have a duty to contribute towards.

In Epsom & Ewell, drainage is generally by infiltration systems (e.g. soakaways) or piped sewers. The following two drainage problems could be considered:

1. **Soakaways** are typically designed to permit infiltration of runoff for between a 10% (1:10 year) to 2.33% (1:30 year) event. Even in normal conditions silts and fines are carried into the soakaway. Over time these begin to block the voids within the soil reducing permeability and thus function. This process is referred to as 'blinding'. A blinded soakaway behaves much like a blocked sewer and flooding to the surface is likely to occur earlier and more frequently. Under a new policy, soakaways could be tested for performance to a standard to be determined.

   - Whenever drainage from the property is affected by increasing the hard surfaces on the site including roof materials, roofed area change, paved surfaces, paved area change or otherwise any change to drainage as result of Planning Consented or Permitted Development works.
   - Whenever the Council or authorised representative requires it based on evidence of inadequate performance.
   - Minimum every 10 years

   Soakaways that do not meet the required standard and requiring works could be:

   - brought back to original performance standard as a minimum (at owner's cost), or
   - enhanced by resizing as appropriate to meet the council's strategic objectives (at Council's cost of enhancement).

2. **Sewer misconnections** can happen by mistake and sometimes deliberately for 'convenience'. On occasions they are misconnected because soakaways are not performing adequately and there are no surface water sewers to connect to. The Council has an objective to ensure that surface water runoff is always kept separate

from foul sewerage. This is to ensure that:

- any flooding from surface water sewers does not present a contamination hazard and health risk and can be managed safely on the surface and
- that foul sewers operate at optimum capacity without risk of flooding

Under a new policy, sewers could be checked for correct connectivity:

- Whenever drainage from the property is affected by increasing the hard surfaces on the site including roof materials, mofec area change, paved surfaces, paved area change or otherwise any change to drainage as result of Planning Consent or Permitted Development works
- Whenever the Council or authorised representative requires it based on evidence of suspected misconnection.
- Minimum every 10 years, although the practicality of this and when does it needs to be determined.

Sewers that are misconnected will be:

- disconnected from the incorrect service and reconnected to the correct sewer or soakaway (at owner's cost); or
- disconnected from the incorrect service and reconnected to a SuDS scheme as appropriate to meet the Council's strategic objectives (at Council's cost of enhancement).

Possible Considerations and Constraints

- As highlighted in Appendix N, Section 59(1)(c) of the Building Act 1984 provides that where a cesspool, private sewer, drain or other specified types of drainage work which are provided for a building are in such a condition so as to be prejudicial to health or a nuisance, the local authority may require the owner of the building to carry out work. Paragraph 26 in Part 2 of the Flood and Water Management Act extends the power in this section so that it also applies to sustainable drainage systems (whether or not they are adopted) in the same way as it applies to cesspools, sewers, drains, etc.

Appendix Q Feedback from the Options Workshop on Draft Proposed Options

Proposed Generic Management Options

Generic Option	Purpose	Primary Action Owner	Suggested Priority*	Would you support this option?	Do you agree with the suggested priority?	What opportunities for implementation can you foresee?	What constraints to implementation can you foresee?
Adopt a map indicating natural drainage routes which future development should respect. Development should also respect local landform to ensure sufficient property thresholds.	To equip building control and planning functions to consider surface water flood risk	EEBC	1	All supported this option - the information is available and the best use should be made of it. Council can't have a 'secret map. Link this with the SuDS suitability map.	Yes (1) – could be readily done.	Opportunity for EEBC and SCC to collaborate and provide single set of information. Information could support wetspots database and vice versa so opportunity for a single map. Useful for management of sustainable development and could form a planning policy through an SPD/DPD. Consider using Infrastructure Delivery Plan to remove Permitted Development unless agreement to reduce runoff to greenfield rates, not just match existing runoff rate.	Need to ensure that appropriate context is given for the maps. Need to manage public perception of the risk and there will be concern over insurance blight. If EEBC have a map and neighbouring authorities do not then could be differences in perception. Consider not putting on council website in the first instance.
Raise awareness of surface water flood risk both within EEBC and potentially with the public	To improve awareness of flood risk and encourage appropriate responses to reduce risk	EEBC	1 - 2	All supported this option as people's focus on flooding from Main Rivers is still evident. Improved education could improve information received during/after flooding. Combine with encouraging (i) use of rainwater harvesting and other source control measures and (ii) property level resistance and resilience measures	Yes (1) – could be started now (in highest risk areas as a priority) and implemented gradually.	Use existing media e.g. Borough magazine and website. However, important opportunity to combine all sources of information at both tiers of local authority. It will help educate all property owners to do something for the common good – link to Big Society. Opportunities for flood warning since EA only provide service for Main Rivers – could link in with annual EA roadshows. Refer to SWMP in planning application documents. Encourage green rear gardens of properties	Need to manage public expectation – it will be important to communicate why people are being given this information Councils could see large rise in number of communications from public – limited council resources. Dissemination could be limited to existing media. It will be important to get public feedback to the SWMP partnership
Adopt a map indicating the suitability of locations for SuDS across the Borough	To equip building control and planning functions to promote the use of SuDS	EEBC	1	Yes - a simple map is required which emphasises that some locations may be appropriate for a certain type of SuDS. Link this with the map showing natural drainage routes.	Yes (1)	Primary opportunity is incoming requirement to consider SuDS as primary drainage method for all developments. A map may help prevent unsuitable SuDS being considered. A useful planning tool for both tiers of local authority. Indeed, important that information held by both tiers of authority should be incorporated into this map. Could be linked with a discharge/infiltration rate calculator which could be included with planning applications?	Will require mixture of building control ('stick') and incentives ('carrot'). Will be important to capture small developments in addition to large ones since these will be the majority. SuDS approval (e.g. runoff rates) needs to be consistent between the Boroughs and SuDS Approval Body (SAB). Consider the London Plan as an example.
Existing and new SuDS (particularly soakaways) and road drainage should be properly maintained to ensure their continued effectiveness	To reduce runoff rate and volume from buildings and roads in low to moderate events	EEBC, SCC	1	Yes - combine this with maintenance of watercourses etc. This will reduce the risk of drainage assets being lost and forgotten and should reduce long-term costs.	Yes (1)	Asset register for key features which may affect flood risk. Both tiers of authority have worked well to improve efficiency of maintaining gullies – need this to continue. Important first step is to identify where existing infrastructure is and who owns and/or is responsible for maintaining it Provide guidance on asset ownership and responsibility for maintenance. Enforce policy of not paving over front gardens.	Knowledge of where the assets are and whose responsibility they are. Need to understand what will motivate owners to undertake maintenance. May require Community Infrastructure Levy or Sect 106 funding. Road drainage is designed to cope with storms of higher probability than 1% - could specification be increased in order to match runoff from properties? Need to reverse current trend for tarmacing grass verges which increases runoff. Also need to enforce vehicle cross-overs.

Generic Option	Purpose	Primary Action Owner	Suggested Priority*	Would you support this option?	Do you agree with the suggested priority?	What opportunities for implementation can you foresee?	What constraints to implementation can you foresee?
						Big Society could provide incentive for residents to maintain privately owned assets.	
Maintain existing watercourses, trash screens etc	To locally improve conveyance of moderate to high flows and reduce the risk of overtopping	EA, EEBC	2	Yes – combine this with maintenance of SuDS.	Yes, although should be (1) with revised definitions	Ensure that riparian duties and responsibilities are understood by those who have such responsibilities. Map asset ownership and maintenance responsibilities initially at high level with a database on individual ownership/ responsibilities following. Opportunities for greater partnership between councils and EA. Raise awareness of benefits of maintenance.	Need to understand asset ownership and maintenance responsibilities. Need to get Operational teams in the council and EA on board, based in part on evidence from SWMP modelling.
Build capacity for drainage expertise within EEBC	To improve local knowledge and understanding of drainage in the Borough and cooperation between all Boroughs in the same river catchments (Hogsmill & Beverley Brook)	EEBC, SCC	2	Yes – include better record keeping of flood events. Also could start small by linking with raising awareness within council using available maps and expertise.	Yes (2)	Maximise use of existing experts through stronger partnership with SCC as LLFA. This will promote consistency and minimise discrepancies across political boundaries. SCC does not currently have a drainage engineer SCC has not yet decided where expertise (including SuDS Approving Body) should reside – EEBC or SCC Improve record keeping of flood events as evidence to support grant applications Include link to National Flood Forum Blue Pages on council flood related websites.	Limited resources. FRAs can be too complicated – use examples of simple clear FRAs and tools which can be clearly understood and used by busy Planners Specialist technical advice may still be needed - if EEBC has to outsource then use Service level Agreements
Encourage uptake of property level resistance and resilience measures	To reduce the consequences of flooding in low to moderate events	EEBC	2	Yes, but should form a council policy and be linked into raising awareness of flood risk.	Yes (1) or (2) as per raising awareness option above	Provide guidance for individual owners as part of awareness raising. Joint campaigns with the Environment Agency may be beneficial.	Lack of awareness of need for protection by property owners between flood events. Need to develop incentives to overcome potential resistance from property owners.
Fit green roofs to new buildings and retrofit where existing roofs are being replaced. In addition, encourage use of rainwater harvesting and pervious pavement car parking where practicable.	To reduce rainfall runoff rate and volume from buildings in low to moderate events	EEBC	3	Yes, should form a council policy and be linked to raising awareness of flood risk and multiple benefits of better management.	Should be (1) or (2) with revised definitions	Consider educational value of SuDs visible schemes where the interest could improve maintenance and be communicated back to parents.	Develop incentives
Develop a policy which requires rectification of any reasonable existing drainage problem (e.g. blinded soakaways, sewer misconnections) before permission for improvement works is granted. Consider introducing incentives for those who rectify existing problems.	To incrementally improve the operation and sustainability of the drainage infrastructure of the Borough.	EEBC	3	Yes, but could be difficult to implement. This should be strongly linked to SCC and the SuDS Approval Body.	Yes (2) – (3) with new definitions	Misconnections can be managed by water companies. Soakaway maintenance could be incorporated in Infrastructure Plan if not eligible for Section 106 or Community Infrastructure Levy (CIL) funding. Consider varying Business Rates for compliance.	Need to bring Building regulations/controls in line with Planning needs otherwise this will not be enforceable Possible lack of precedents in the UK. This policy may discourage any improvement works. Lack of resources for incentives. There could be legal issues associated with requirements to address existing problems rather than those which are required to make the development acceptable.

*Note: Priority 1: A 'quick win' or action urgently required; Priority 2: Consider in the next 12 months; Priority 3: Longer term implementation

Proposed Location-Specific Management Options

Area	Option Location	Description	Key Components	Primary Action Owner	Suggested Priority*	Would you support this option?	Do you agree with the suggested priority?	What opportunities for implementation can you foresee?	What constraints to implementation can you foresee?
Epsom South	Langley Vale / Woodcote	Store surface water runoff from Langley Vale in a reservoir, detention basin, pond or wetland to reduce the runoff rate and volume. Use stored water either for (i) irrigation for RAC Golf Club or (ii) artificial recharge of aquifer. Increase storage in existing Woodcote Millennium Pond.	1. Reservoir, detention basin pond or wetland adjacent to Langley Vale Road on RAC Golf Course land or adjacent Thames Water pumping station. 2. Interception swale at north end of RAC Golf Course land 3. Low bund around land containing existing pond on Woodcote Green Road to increase storage	RAC Club	1 - links with ongoing RAC reservoir application Woodcote Green pond will be longer term	All supported this option, and noted discussions with landowner are ongoing	Yes (1) - possibly a quick win	Clear opportunity with RAC reservoir application. Opportunity to maximise biodiversity and recharge of reservoir and/or aquifer Stewart Cocker is keen to work with RAC in a scheme	Water quality issues, especially regarding road runoff – treatment will be required. Area is likely to be within a Source Protection Zone 1 Any local conservation issues
	Woodcote Green Road / Dorking Road / Ashley Road / Rosebery Park	Route flows which exceed the drainage capacity along (i) Woodcote Green Road and Dorking Road into Rosebery Park via existing footpath and western gate (ii) along Ashley Road and into Rosebery Park. Store surface water runoff in Rosebery Park in series of low terraces and an enlargement of the existing pond.	1. Surface flow route connecting Woodcote Green Road, Dorking Road and Rosebery Park 2. Surface flow route connecting Ashley Road and Rosebery Park 3. Shallow detention basins and pond in Rosebery Park	SCC, EEBC	3	There was some support for this option: • Woodcote Road and Rosebery Park elements supported as key priority in the built up area (1) • Cricket Club was less favoured and priority (3) • C of E School / WS Atkins area off Ashley Road – only supported if needed after others, priority (3)	See adjacent notes – Rosebery Park element is the favoured priority with others following if necessary	Opportunity to protect the town centre and not to disrupt the park There is an improvement scheme in place for Rosebery Park - Chris Frost at SCC – low bund that does not impact on current scheme could be OK May get WS Atkins to cooperate	Public perception may need to be carefully managed. Private owners (e.g. school or WS Atkins) may not welcome proposal. Check drainage from existing Woodcote Millennium pond and property levels upstream
Epsom West	Grounds of church on Longmead Road. Gibraltar Recreation Ground and existing Allotment Gardens and pond in Utilities Site, East Street	Intercept surface water sewer upstream of overground attenuation areas to reduce downstream volumes, the risk of sewer flooding and attenuate flows to reduce peak runoff.	1. Intercept surface water sewer upstream of open ground adjacent the church on Longmead Avenue, provide storage in a detention basin and permit re-entry of flows to the sewer system 2. Intercept surface water sewer upstream of Allotment Gardens and existing pond in Utilities Site, provide storage in a detention basin and permit re-entry of flows to the sewer system 3. Increase storage in surface water sewer near West Street via underground tank in Gibraltar Recreation Ground.	TW, Individual land owners	3	All supported this option, although recognised that there will be obstacles to implementation.	Suggest priority (2)	Church on Longmead Avenue is council owned Land Gibraltar Park is council owned, however could be opportunity to use the upper field for storage Greater partnership working with Thames Water	Part of Utilities Site is a Great Crested newt area (GSSI) but could enhance area so not a show stopper Thames Water policy change may be required to accept surface water back into the system. There will be concerns over water quality, including use of Allotment gardens. In Gibraltar Park, will need to find a suitable route from West Street into the park and may be difficult to bring water to the surface

Area	Option Location	Description	Key Components	Primary Action Owner	Suggested Priority^	Would you support this option?	Do you agree with the suggested priority?	What opportunities for implementation can you foresee?	What constraints to implementation can you foresee?
	Rosebery School / Stamford Pond	Interrupt surface water sewer upstream of overground attenuation area to reduce downstream volumes, the risk of sewer flooding and attenuate flows to reduce peak runoff. Store surface water runoff in Stamford Pond and reduce runoff into Greens Lane Stream	1. Interrupt surface water sewer upstream of Rosebery School playing field, provide storage in a detention basin and permit re-entry of flows to the sewer system 2. Detention basin in land surrounding Stamford Pond	TW, SCC, EEBC	3	All supported this option	Suggested to be higher priority (1)	Property downstream of Stamford pond is known to flood. Consider using triangle of open land d/s of road Noted that a FRA for a proposed development on Manor Green Road has modelled the Greens Lane Stream.	Sewer interruption constraints same as above. Epsom Pond is a conservation area and flat Triangle of open land is an SSSI but could be managed.
	Court Recreation Ground	Store surface water runoff or flows which exceed the capacity of Pound Lane ditch in a detention basin to reduce the runoff rate and volume	1. Detention basin in Court Recreation Ground	EEBC	2	There was general support for this option is there was sufficient evidence of benefits.	Suggested priority (1) or (2)	EEBC owned so good potential - similar to Gibraltar Park	Similar to Gibraltar Park likely concern over disruption to playing area
	West Park	Store surface water runoff in a detention basin, pond or wetland north of Stew pond in site of filled-in pond, and downstream of West Park development.	1. Detention basin, pond or wetland in site of filled-in pond to the north of Stew Pond 2. Pond or wetland immediately downstream of West Park	EEBC	1 link with ongoing West Park development, pond on Epsom Common will be longer term	There was general support for this option is there was sufficient evidence of benefits.	Yes (1)	Current discussions with Stewart Cocker suggest offline attenuation but online treatment via wetland. Former pond was landfilled – suspect leaching contaminated water – and therefore presents an opportunity to clean this up. Possible opportunity for the developer to contribute to the protect site	The cost of removing contaminated material from the former pond to tip will need consideration. Water quality testing should be carried out by EEBC.
	Clarendon Park / Horton Country Club	Store surface water runoff in a swale to the south of McKenzie Way which directs water into the surface water sewer. Re-profile Horton Lane at junction with Long Grove Road for drainage to runoff into open land to north east. Store surface water runoff in detention basin, pond or wetland at junctions of Horton Lane with B284 and B2200. Store surface water runoff from Horton Country Club Golf Course in a reservoir, detention basin, pond or wetland to reduce the runoff rate and volume. Use stored water for irrigation for Golf Club.	1 Swale to the south of McKenzie Way to direct surface runoff into surface water sewer. 2. Detention basin, pond or wetland adjacent to junctions of Horton Lane with B284 and B2200 3. Reservoir, detention basin pond or wetland in Horton Country Club Golf Course adjacent disused railway embankment	EEBC, Horton Country Club, Individual land owners	2 – Golf course pond will be longer term	There was general support for this option is there was sufficient evidence of benefits, and depending on work already done at McKenzie Way.	Yes (2)	Stewart Cocker is keen to use embankment in Horton Country Club and reprofile margins of the watercourse upstream for storage	Need to check what work has already been done at McKenzie Way Noted that Horton Golf Club is privately owned (EEBC land with 150 year lease) but could be considered as per proposed RAC course option.

Area	Option Location	Description	Key Components	Primary Action Owner	Suggested Priority*	Would you support this option?	Do you agree with the suggested priority?	What opportunities for implementation can you foresee?	What constraints to implementation can you foresee?
Epsom Town Centre	Epsom Town Centre (including Utilities Site, East Street)	Route flows which exceed the drainage capacity along Ashley Road and the High Street to the B284 railway underpass. Install new drainage infrastructure to convey surface water to a detention basin, pond or wetland in the Utilities Site, East Street.	1. Surface flow route connecting Ashley Road and the High Street 2. Drainage infrastructure to convey surface water to Utilities Site, East Street 3. Detention basin, pond or wetland in Utilities Site East Street	EEBC	1 – link with Plan E development of Utilities Site, East Street	There was general support for this option is there was sufficient evidence of benefits, but some concern that there were possibly cheaper options?	More likely to be (2)	Key opportunity to demonstrate the council's commitment, raise public awareness and support economic development. Indeed, economic development may offer funding opportunities. Return the Utilities Site to Greenfield runoff.	Multiple land ownership. Financial constraints. Multiple utility diversions. Major traffic route but Plan E is already trying to address this. Potential clay subsoil and presence of springs. Need to determine where the Church Road underground river goes. Need to understand who would own the drainage infrastructure.
Epsom East	Epsom College area	Store surface water runoff arriving at Epsom College sports ground. Route flows which exceed the drainage capacity along Dower's Avenue and store in the park adjacent to the junction with Downs Road	1. Surface flow route connecting Downs Avenue and the park 2. Detention basin, pond or wetland in the park adjacent to the junction of Downs Avenue and Downs Road 3. Detention basin or swale to store water adjacent College Road in Epsom College sports ground	Individual land owners	3	There was general support for this option is there was sufficient evidence of benefits	Could consider as priority (1) – (2)	Chalk geology may provide opportunity for a deep bore soakaway particularly for water arriving in the park.	Will need to avoid tree roots in Epsom College grounds.
	Reigate Road at Drift Bridge	Store surface water runoff from Reigate Road (Nork, Reigate & Banstead) in swales or detention basins adjacent to Reigate Road.	1. Swale or detention basin on west side of Reigate Road between railway underpass and roundabout with A2022 2. Swale or detention basin on west side of Reigate Road north of roundabout with A2022. Connected to previous swale with drainage pipe. 3. Swale or detention basin on east side of Reigate Road before junction with road to North Looe.	SCC	3	Yes, although a potential quick win could be to clean out the existing beanie blocks and grips and ensure ongoing maintenance.	Quick win could be to clean out the existing beanie blocks and grips and ensure ongoing maintenance. Flooding of the footpath adjacent busy road is a health & safety issue.	Quick win could be to clean out the existing beanie blocks and grips and ensure ongoing maintenance Flooding of the footpath adjacent busy road is a health & safety issue.	None noted.
	Cuddington Golf Course	Store surface water runoff from Cuddington Golf Course in a reservoir, detention basin, pond or wetland to reduce the runoff rate and volume. Use stored water either for (i) irrigation for Cuddington Golf Club or (ii) artificial recharge of aquifer.	1. Reservoir, detention basin pond or wetland on Cuddington Golf Course land	Cuddington Golf Course	3	There was support for this option if there was sufficient evidence of benefits, but thought to be a lower priority	Yes (3) – low priority	Future application for reservoir on Golf Club site	As per similar option on RAC course.
	North East Surrey College of Technology (NESCOT)	Store surface water runoff in a detention basin, pond or wetland to reduce the runoff rate and volume.	1. Detention basin, pond or wetland in the grounds adjacent to the NESCOT development	NESCOT	2	There was support for on site attenuation as part of redevelopment, but it was noted to be a relatively small catchment.	Yes (2)	Existing planning application for redevelopment	None noted

Area	Option Location	Description	Key Components	Primary Action Owner	Suggested Priority*	Would you support this option?	Do you agree with the suggested priority?	What opportunities for implementation can you foresee?	What constraints to implementation can you foresee?
	Nonsuch Park	Store surface water runoff in a series of detention basins, ponds or wetlands to reduce the runoff rate and volume	1. Detention basins, ponds or wetlands in Nonsuch Park	SCC, EEBC, Sutton	3	Yes, strong support for this option	Suggested that initial investigations should be a high priority (1)	Consider as an environmental enhancement project. Links to Big Society	Need to involve Friends of Nonsuch and Surrey Wildlife Trust.
Ewell	Bourne Hall	Route flows from the High Street which exceeds the drainage capacity into the channel between the road and Bourne Hall.	1. Reprofile kerbs and walls to enable surface water which exceeds the drainage capacity of the High Street to enter the channel between the road and Bourne Hall.	SCC	1	Yes, although immediate maintenance may help to solve issue.	Yes (1) – although consider maintenance of existing infrastructure in the first instance	Problem thought to be related to leaves and absence of main line drainage. Clearing gullies to aid discharge of surface water into the river may help. Link into EA maintenance of drainage outfalls into the River Hogsmill.	Funding for maintenance activities.
	Land adjacent TA building on Primrose Walk, West Ewell playing field (adjacent Horton Stream) and various locations adjacent Hogsmill River	Interrupt surface water sewer upstream of overground attenuation areas to reduce downstream volumes, the risk of sewer flooding and attenuate flows to reduce peak runoff. These will have a particular benefit to reducing peak flows down the Hogsmill River into Kingston.	1. Interrupt surface water sewer upstream of open land adjacent Primrose Walk, provide storage in a detention basin and permit re entry of flows to the sewer system 2. Interrupt surface water sewer upstream of various areas of open space adjacent Hogsmill River 3. Interrupt surface water sewer upstream of West Ewell playing field	TW, Individual land owner	3	Yes – strong support for this option	Suggest higher priority (2) or (3)	EA own the bed and the banks of the River Hogsmill. Opportunity for closer partnership working involving TW, EA and EEBC. Could provide multiple benefits in terms of biodiversity, leisure and heritage.	None noted, although interruption of sewers will raise same concerns as noted above.
Epsom North	King George Field (Auriol Park), Wandgas Athletic Ground and Shadbolt Park	Interrupt surface water sewer upstream of overground attenuation areas to reduce downstream volumes, the risk of sewer flooding and attenuate flows to reduce peak runoff.	1. Interrupt surface water sewer upstream of King George Field, provide storage in a detention basin and permit re-entry of flows to the sewer system 2. Interrupt surface water sewer upstream of Wandgas Athletic Ground, provide storage in a detention basin and permit re-entry of flows to the sewer system 3. Interrupt surface water sewer upstream of Shadbolt Park, provide storage in a detention basin and permit re-entry of flows to the sewer system	TW, Individual land owners	3	There was support for this option if there was sufficient evidence of benefits, but thought to be a lower priority	Yes (3) – low priority	Thames Water will need to lead this one	Funding for works that are unlikely to be cheap – will need to demonstrate clear benefits. Will need to ensure no damage to existing trees.

*Note: Priority 1: A 'quick win' or action urgently required; Priority 2: Consider in the next 12 months; Priority 3: Longer term implementation

Appendix R Costing of Options

The following table lists the unit costs of construction used to estimate option costs. The build up of option costs is provided on the following pages

Measure	Unit Cost of Construction	Reference
Detention basin	£20/m³	CIRIA SUDS Manual (2007)
Ponds and Wetlands	£30/m³	CIRIA SUDS Manual (2007)
Swales	£15/m²	CIRIA SUDS Manual (2007)
Green roofs	£145/m²	Prioritisation Matrix Guidance Drain London Forum 24 January 2011 : Table 5
Pervious pavements	£40/m²	CIRIA SUDS Manual (2007)
Soakaways	£219/m³	Prioritisation Matrix Guidance Drain London Forum 24 January 2011 : Table 5
Water butts	£40 per 200l capacity	http://www.waterbuttsdirect.co.uk
Rainwater harvesting	£1.1k/m³	Prioritisation Matrix Guidance Drain London Forum 24 January 2011 : Table 5
Surface flow route - kerb raising or lowering	£50/m	Spon's Civil Engineering and Highway Works Price Book 2010
Surface flow route – installing/ removing speed bump	£910/each	Spon's Civil Engineering and Highway Works Price Book 2010
Raising property threshold	£1.5k/property	Flood Resistance and Resilience Solutions an R & D Scoping Study R & D technical Report (Defra May 2007)
Increase capacity of drainage network	£750/m	Spon's Civil Engineering and Highway Works Price Book 2010[2]
Improved property resistance/resilience	£22k/property	Prioritisation Matrix Guidance Drain London Forum 24 January 2011 : Table 5
Earthworks to landscape parkland	£6/m³	Spon's Civil Engineering and Highway Works Price Book 2010
Earth bund	£50/m³	Spon's Civil Engineering and Highway Works Price Book 2010[2]

Notes: [1] Upper values within given ranges have been taken, to allow for inflation since publication

[2] Assumes ~1000mm diameter pipe at max depth of 2m, plus all excavation and reinstatement costs

N

Legend

Solid Geology
- Lambeth Group
- Upper Chalk Formation
- London Clay Formation
- Thanet Sand Formation

Superficial Geology
- Alluvium
- Head
- River Terrace Deposits
- EA Flood Zone 3 (1%)

Source Protection Zones
- Zone 1 (Inner)
- Zone 2 (Outer)
- Zone 3 (Total)
- Spring Zone

Groundwater Emergence Map

0 0.5 1 2 Kilometers

Drawing Title: Epsom & Ewell SWMP

Drawing Number: Sustainable Drainage System Considerations

Epsom & Ewell SWMP

EPSOM EWELL BOROUGH COUNCIL

JACOBS
1180 Eskdale Road, Winnersh, Wokingham, RG41 5TU

Produced	DC	Mar 2011
Checked	SM	Mar 2011
Approved	DC	Mar 2011

N

Disconnect surface water sewer upstream of green open space areas to provide overground storage and attenuation

Disconnect surface water sewer upstream of green open space areas to provide overground storage and attenuation

Increase capacity of exting pond to store surface runoff for later reuse on site

Increase storage in existing wetland and formalise road embankment

Pond or detention basin in Cuddington Golf Course, or detention basin in Walch Memorial Sports Ground

Swale to convey water to surface water sewer

Pond and wetlands area as part of West Park development

Reopen disused pond on Epsom Common

Swales to attenuate road runoff

Bund around existing pond on Woodcote Millenium Green to increase storage of surface runoff

New surface water drainage and pond, wetland or detention basin as part of Utilities Site redevelopment

Pond, detention basin or swale with potential to reuse water on site

Design for exceedance to safely convey surface water down High Street, including green street planters

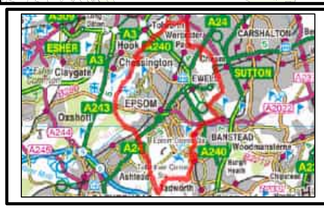
Reservoir, pond, wetland or detention basin with potential to reuse water on site

Landscaping in Rosebery Park to include shallow terraces for flood storage

Detention basin coupled with artificial recharge and recovery

Green roofs, rainwater harvesting and permeable paving in larger developments

Design for exceedance by raising kerbs, traffic calming measures and property resistance and resilience. Safely convey surface runoff into Rosebery Park.



Legend

- Surface Flow Routes
- Green Roof
- Sewer Interruption
- Detention Basin, Pond or Wetland
- Increase Draiage Capacity

Maximum Depth (m) 1:30y

- <0.1m
- 0.1 - 0.25m
- 0.25 - 0.5m
- 0.5 - 1.0m
- 1.0 - 1.5m
- >1.5m

Drawing Title

Location-specific Options Map

Drawing Number

Figure B.1

0 0.5 1 2 Kilometers

Epsom & Ewell SWMP

EPSOM & EWELL BOROUGH COUNCIL

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