# 4. Phase 3: Options

## 4.1 OBJECTIVES

4.1.1 The purpose of Phase 3 is to identify a range of structural and non-structural measures for alleviating flood risk, and assess them to eliminate those that are not feasible or cost beneficial. The remaining options are then developed and tested against their relative effectiveness, benefits and costs. The target level of flood protection has been set at 1.3% AEP (1 in 75 annual probability) to align solutions with the likely level of insurance cover available to the general public.

4.1.2 To maintain continuity within the report and to reflect the flooding mechanisms within the Borough, the option identification has taken place on an area-by-area (site-by-site) basis following the process established in Phase 2. Therefore, the options assessment undertaken as part of the SWMP assesses and short-lists the measures for each CDA and identifies any non-standard measures available.

4.1.3 Phase 3 delivers a high level option assessment for each of the CDAs identified in Phase 2. No monetised damages have been calculated and flood mitigation costs have been determined using engineering judgement, but have not undergone detailed analysis. Costs should be treated at an order of magnitude level of accuracy. The options assessment presented here follows that described in the Defra SWMP Guidance but is focussed on highlighting areas for further detailed analysis and immediate 'quick win' actions. Further detailed analysis may occur for high priority CDAs as defined by the Prioritisation Matrix during the next Tier (Tier 3) of the Drain London project.

4.1.4 To summarise, the options selection process has been completed on three levels:

1. Complete an Opportunity Assessment to identify *all potential measures* that could be investigated further. No monetised damages or costs have been associated with measures at this point (see Appendix E, Table 4-2 and Table 4-3).
2. Hold an Options Assessment meeting with the Borough to select a number of *preferred options* to be further assessed and broadly costed (discussed in section 4.3.2 to 4.3.16 and presented in Table 4-5).
3. Highlight capital schemes from each CDA to be taken forward to the Drain London Prioritisation Matrix, including an assessment of cost band and % mitigation offered by each potential measure (Table 4-5 and Table 4-6).

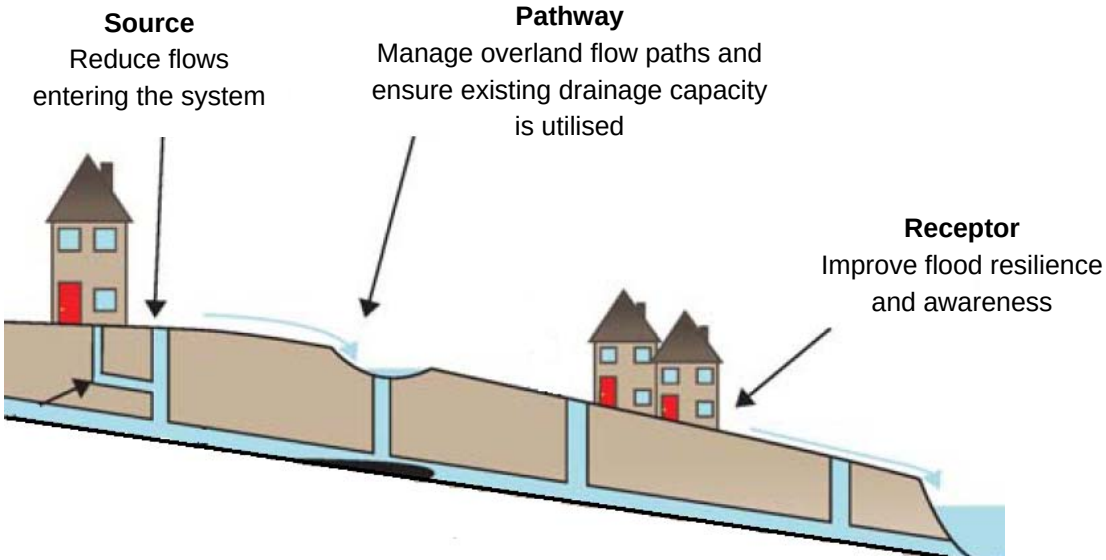
## 4.2 MEASURES

4.2.1 This stage aims to identify a number of measures that have the potential to alleviate surface water flooding in the Royal Borough of Kingston upon Thames. It has been informed by the knowledge gained as part of the Phase 1 and Phase 2 work. Where possible options have been identified that have multiple benefits, for example to alleviate flooding from more than one source, or provide environmental benefits such as water quality, biodiversity and amenity benefits. At this stage the option identification pays no attention to constraints such as funding or delivery mechanisms to enable a robust assessment.

*IDENTIFY MEASURES*

4.2.2 As detailed in the Defra SWMP Guidance, measures have been identified regardless of the potential mechanism or funding. A standard set of structural and non-structural measures has been specified by the Drain London Forum for consideration within each CDA (Table 4-1) which follow the source-pathway-receptor model (Figure 4-1).

**Figure 4-1 Source Pathway Receptor Model**




4.2.3 Structural measures are considered to be those which require fixed or permanent assets to mitigate flood risks. Non-structural measures are those which are responses to urban flood risk that may not involve fixed or permanent facilities, and whose positive contribution to the reduction of flood risk is most likely through a process of influencing behaviour.

**Table 4-1: Drain London Structural and Non-Structural Measures for Consideration**

| Source | Pathway | Receptor |
|---|---|---|
| Green roofs | Increasing capacity in drainage systems | Improved weather warning |
| Soakaways | Separation of foul and surface water sewers | Planning policies to influence development |
| Swales | Improved maintenance regimes | Temporary or demountable flood defences |
| Permeable Paving | Managing overland flows | Social change, education and awareness |
| Rainwater Harvesting | Land management practices | Improved resilience and resistance measures |

4.2.4 An opportunity assessment was undertaken for each CDA to evaluate where there were opportunities for the implementation of structural and non-structural measures identified by the Drain London Forum and through consultation with relevant stakeholders. The results from the Opportunity Assessment are summarised in Table 4-2 below and full details are included in Appendix E (option assessment tables).

**Table 4-2: Measures Opportunity Assessment**

| CDA ID | CDA Name | Source | | | | | | | | Pathway | | | | | | | Receptor | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Green Roof | Soakaways | Swales | Permeable Paving | Rainwater Harvesting | Detention Basins | Ponds and Wetlands | Other 'Source' Measures | Increasing Capacity in Drainage Systems | Separation of Foul and Surface Water Sewers | Managing Overland Flows (Online Storage) | Managing Overland Flows (Preferential Flow paths) | Land Management Practices | Deculverting Watercourse(s) | Other 'Pathway' Measures | Improved Weather Warning | Planning Policies to Influence Development | Temporary or Demountable Flood Defences | Social Change, Education and Awareness | Improved Resilience and Resistance Measures | Other 'Receptor' Measures |
| CDA_008 | Acre Rd/Nth Kingston | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | × | | ✓ | × | ✓ | ✓ | × | × | | ✓ | ✓ | × | ✓ | ✓ | |
| CDA_009 | New Malden | ✓ | ✓ | ✓ | ✓ | ✓ | × | × | | ✓ | × | ✓ | ✓ | × | × | | ✓ | ✓ | × | ✓ | ✓ | |
| CDA_010 | Kingston Town Centre | ✓ | × | ✓ | ✓ | ✓ | × | × | | ✓ | ✓ | ✓ | ✓ | × | × | | ✓ | ✓ | ✓ | ✓ | ✓ | |
| CDA_011 | New Malden | ✓ | × | × | ✓ | ✓ | × | × | | ✓ | × | ✓ | ✓ | × | × | | ✓ | ✓ | × | ✓ | ✓ | |
| CDA_012 | Surbiton Crescent | ✓ | ✓ | × | ✓ | ✓ | × | × | | ✓ | ✓ | × | ✓ | × | × | | ✓ | ✓ | × | ✓ | ✓ | |
| CDA_013 | Rail Main Line | ✓ | × | ✓ | ✓ | ✓ | × | × | | ✓ | ✓ | × | ✓ | × | × | | ✓ | ✓ | × | ✓ | ✓ | |
| CDA_014 | Berrylands/Alexandra | ✓ | × | ✓ | ✓ | ✓ | ✓ | × | | ✓ | × | ✓ | ✓ | × | × | | ✓ | ✓ | ✓ | ✓ | ✓ | |
| CDA_015 | A3 Strategic Red Route | × | × | ✓ | × | × | ✓ | ✓ | | ✓ | × | ✓ | ✓ | × | × | | ✓ | ✓ | ✓ | ✓ | ✓ | |
| CDA_016 | Old Malden | ✓ | × | ✓ | ✓ | ✓ | ✓ | × | | ✓ | × | ✓ | ✓ | × | × | | ✓ | ✓ | × | ✓ | ✓ | |
| CDA_017 | King George Trad Est | ✓ | × | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | × | ✓ | ✓ | × | × | | ✓ | ✓ | × | ✓ | ✓ | |
| CDA_018 | Hook/Kelvin Grove | ✓ | × | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | × | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | × | ✓ | ✓ | |
| CDA_019 | Chessington North | ✓ | × | ✓ | ✓ | ✓ | × | × | | ✓ | × | × | ✓ | × | × | | ✓ | ✓ | × | ✓ | ✓ | |
| CDA_020 | Barwell Business Park | ✓ | × | ✓ | ✓ | ✓ | × | × | | ✓ | × | ✓ | ✓ | × | × | | ✓ | ✓ | × | ✓ | ✓ | |
| CDEA_021 | Malden Rushett | ✓ | × | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | × | ✓ | ✓ | ✓ | × | | ✓ | ✓ | × | ✓ | ✓ | |

**Measures Opportunity Assessment Criteria**

| | |
|---|---|
| ✓ | There are opportunities for implementation of this mitigation measure within the CDA. Measure should be considered in the Options Assessment. |
| × | There are no opportunities for implementation of measure within CDA. The measure is not suitable or required to address the surface water flood risk within the |
| N/A | Not applicable - to be used where no other measures are identified. |

Note: The above assessment is taken from Options Assessment spreadsheets complete for each CDA. A tick is used for both measures that have opportunity for implementation within the CDA and those where further investigation will be required. All measures identified with a ✓ will be taken forward for consideration within the next level of option assessment. Measures identified with a × have no opportunity for implementation within the CDA and will not be assessed further as part of this SWMP.

**Table 4-3 Identification of Potential Options**

| Description | | Standard Measures Considered |
|---|---|---|
| Do Nothing | Make no intervention / maintenance | None |
| Do Minimum | Continue existing maintenance regime | None |
| Improved Maintenance | Improve existing maintenance regimes e.g. target improved maintenance to critical points in the system. | Improved Maintenance Regimes |
| Planning Policy | Use forthcoming development control policies to direct development away from areas of surface water flood risk or implement flood risk reduction measures. | Planning Policies to Influence Development |
| Source Control, Attenuation and SuDS | Source control methods aimed to reduce the rate and volume of surface water runoff through infiltration or storage, and therefore reduce the impact on receiving drainage systems. | Green Roof<br>Soakaways<br>Swales<br>Permeable paving<br>Rainwaterharvesting<br>Ponds and Wetlands<br>Land Management Practices |
| Flood Storage / Permeability | Large-scale SuDS that have the potential to control the volume of surface water runoff entering the urban area, typically making use of large areas of green space. Upstream flood storage areas can reduce flows along major overland flow paths by attenuating excess water upstream. | Detention Basins<br>Ponds and Wetlands<br>Managing Overland Flows (Online Storage)<br>Land Management Practices |
| Separate Surface Water and Foul Water Sewer Systems | Where the CDA is served by a combined drainage network, separation of surface water from the combined system should be considered. In growth areas separation creates capacity for new connections. | Separation of Foul and Surface Water Sewers |
| De-culvert / Increase Conveyance | De-culverting of watercourses and improving in-stream conveyance of water. | Deculverting Watercourse(s) |
| Preferential / Designated Overland Flow Routes | Managing overland flow routes through the urban environment to improve conveyance and routing water to watercourses or storage locations. | Managing Overland Flows (Preferential Flowpaths)<br>Temporary or Demountable Flood Defences |
| Community Resilience | Improve community resilience and resistance of existing and new buildings to reduce damages from flooding, through, predominantly, non-structural measures. | Improved Weather Warning<br>Temporary or Demountable Flood Defences<br>Social Change, Education and Awareness<br>Improved Resilience and Resistance Measures |
| Infrastructure Resilience | Improve resilience of critical infrastructure in the CDA that is likely to be impacted by surface water flooding e.g. electricity substations, pump houses. | Improved Resilience and Resistance Measures |
| Other - Improvement to Drainage Infrastructure | Add storage to, or increase the capacity of, underground sewers and drains and improving the efficiency or number of road gullies. | Increasing Capacity in Drainage Systems |
| Other or Combination of Above | Any alternative options that do not fit into above categories and any combination of the above options where it is considered that multiple options would be required to address the surface water flooding issues. | |

*IDENTIFY & SHORT LIST OPTIONS*

4.2.5 Following the identification of measures that should be considered within the Borough (Table 4-2 and Appendix E), options have been identified and short listed for each CDA. As a detailed appraisal of cost and benefits of each of the measures is not deemed to be practical, a high-level scoring system for each of the options has been developed. The approach to short-listing the measures is based the guidance in FCRM[11] and Defra's SWMP Technical Guidance[12]. The scoring criteria are provided in Table 4-4.

**Table 4-4: Options Assessment Short-Listing Criteria**

| Criteria | Description | Score |
|---|---|---|
| Technical | • Is it technically possible and buildable?<br>• Will it be robust and reliable?<br>• Would it require the development of a new technique for its implementation? | U: Unacceptable (measure eliminated from further consideration)<br>-2: Severe negative outcome<br>-1: Moderate negative outcome<br>0: Neutral<br>+1: Moderate positive outcome<br>+2: High positive outcome |
| Economic | • Will benefits exceed costs?<br>• Is the measure within the available budget?<br>• Estimate the whole life costs of the option including asset replacement, operation and maintenance. The scoring of this measure will depend on the budget available from the local authority although it should be remembered that alternative routes of funding could be available such as Thames Region Flood Defence Committee. | |
| Social | • Will the community benefit or suffer from implementation of the measure?<br>• Does the option promote social cohesion or provide an improved access to recreation/open space?<br>• Does the option result opposition from local communities for example if an option involves the displacement of houses? | |
| Environmental | • Will the environment benefit or suffer from implementation of the measure?<br>• Would the option provide a positive or negative on the environment for example, water quality and biodiversity? | |
| Objectives | • Will it help to achieve the objectives of the SWMP partnership?<br>• Does the option meet the overall objective of alleviating flood risk? | |

4.2.6 An options workshop was held on the 31st March 2011 at the Royal Borough of Kingston upon Thames offices. This was attended by members of their planning team, street scene team and the Environment Agency. The purpose of the meeting was to discuss and agree short-listed options identified for each CDA and to discuss works currently in progress.

4.2.7 The process aimed to ensure that inappropriate measures are eliminated early in the process to avoid investigation of options that are not acceptable to stakeholders. The agreed

[11] Environment Agency (March 2010) *'Flood and Coastal Flood Risk Management Appraisal Guidance',* Environment Agency: Bristol.

[12] Defra (March 2010) *'Surface water management plan technical guidance',* Defra: London

shortlisted options have been progressed to the Preferred Options stage where they will be costed and further developed.

## 4.3 PREFERRED OPTIONS

### *BOROUGH-WIDE PREFERRED OPTIONS*

4.3.1 A number of Borough-wide options and policies have been identified that the Royal Borough of Kingston upon Thames and relevant stakeholders may consider adopting as part of their responsibility as LLFA for local flood risk management. These measures are described further below.

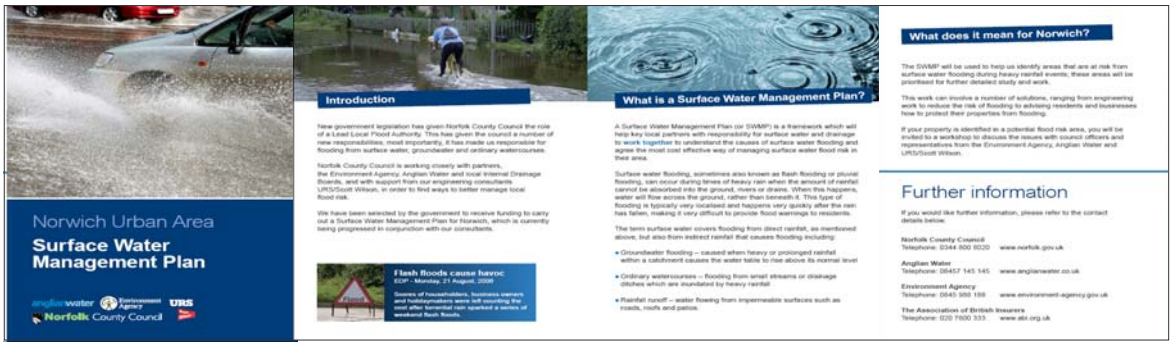
**1. Raising Community Awareness (Covering the whole Policy Area/Borough)**

4.3.2 A 'quick win' action that should be implemented in the short term is to increase awareness of flooding within communities at risk and across the Policy Area/Borough as a whole. This could be achieved through a number of measures including:

- Newsletters;
- Drop-in surgeries; and,
- Promotion on Royal Borough of Kingston upon Thames website (see Figure 4-2 below).

4.3.3 The aim of these actions is to raise awareness and improve understanding of the risks and consequences of surface water flooding amongst local communities and, through this, encourage residents to take up measures to combat flooding. Such measures may include installation of water butts to capture roof runoff and consideration of the extent and materials used when replacing permeable areas within hard standing areas within their property e.g. through the installation of driveways and patios.

**Figure 4-2 Example Newsletter (URS Scott Wilson, 2011)**




4.3.4 Other more specific campaigns that could be taken forward which are discussed below:

4.3.5 Thames Water and the Borough could undertake a joint publicity and education campaign urging residents to report anyone pouring inappropriate materials into the sewerage system. This could be combined with advice for local business on the responsible disposal of waste e.g. a fat collection service where the waste is turned into bio diesel. Perhaps such a scheme could be jointly taken forward across adjacent Boroughs to ensure demand.

4.3.6 Gully maintenance teams often raise issues with parked cars which prevent access for cleaning. The Borough could raise awareness of the need for and importance of regular Gully cleaning.

| | |
|---|---|
| **Option 1a:** | The Borough and Thames Water jointly campaign to urge residents to report the disposal of inappropriate materials to the sewer network. |
| **Option1b:** | The Borough and Thames Water jointly campaign for the recycling of fat to bio diesel. This should be investigated further at Flood Group Meetings. |
| **Option 1c:** | The Borough to raise awareness of gully clearing and parked vehicles. |
| **Option 1d:** | The Borough to undertake a publicity campaign promoting the use of permeable surfaces for paved front and back gardens (see planning and development section). |

**2. Ongoing Improvements of Drainage Network**

4.3.7 The management and maintenance of the urban drainage network in the Royal Borough of Kingston upon Thames is the responsibility of a number of organisations:

- Royal Borough of Kingston upon Thames – highways drainage including gully pots and carrier pipes;
- Thames Water – main sewers, lateral sewers;
- Transport for London – highway drainage along red routes (A3, A243);
- Environment Agency – culverts, raised defences, trash screens, Main River channels;
- Network Rail – railway drainage and culverts beneath raised rail embankments.

Royal Borough of Kingston upon Thames Operations: Effective cleansing of gully pots is fundamental to the drainage across the Borough (particularly important for more frequent lower magnitude events (3.3% AEP) (<1:30 annual probability) and the Royal Borough of Kingston upon Thames operates a regular maintenance regime for gully cleansing. Fallen leaves and build up of silt are the main causes of blockages in the highway drainage network. In addition, on highways located on steeper gradients surface water is noted to flow too quickly to enter the gully pots and drain away.

Thames Water Maintenance: The sewer network in the Royal Borough of Kingston upon Thames is mostly Victorian and in places struggles to meet modern demands. Thames Water has a long term strategy for improvements on this system. In addition to long term strategies, Thames Water provides sewer cleaning to Trunk Sewers into which local surface water drainage connects.

4.3.8 The most significant cause of blockages in the Thames Water network is cooking fat and builder's washings.

| | |
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| **Option 2a:** | Thames Water provides sewer cleaning schedules for the Royal Borough of Kingston upon Thames. Meeting this requirement should be facilitated through the Local Flood Group which Thames Water attends. |
| **Option2b:** | Thames Water to record date and location of inappropriate material being removed from the Thames Water network to help enforcement where necessary. |

| | |
|---|---|
| **Option 2c:** | Gullies that are known to flood be painted yellow to encourage local residents to check if they are blocked and avoid parking directly over them to help with access for cleaning. |
| **Option 2d:** | The cleaning of gullies should be, where possible, scheduled into the wider scheme to deep clean roads. Coordinate timing of gully cleansing rounds to ensure that they do not coincide with school opening and closing times and other peak times that would prevent gaining access to gullies. |
| **Option 2e:** | Focus attention on the maintenance of gully pots in the identified Critical Drainage Areas (CDAs) which are considered to be high risk. |
| **Option 2f:** | Investigate the potential to acquire another gully clearing vehicle, be it shared with adjacent Boroughs, or hired for a shorter period of time, e.g. 6 weeks in the summer.<br>In June 2008 the cost of hiring a gully clearance vehicle for a six week period including staff was estimated to be approximately £11,400. |
| **Option 2g:** | Develop a GIS database of all Borough-owned drainage assets (in line with FWMA requirements). |
| **Option 2h:** | As LLFA, the Borough must record and investigate incidents of flooding. It is recommended that the source of flooding be recorded, e.g. gully surcharging, to inform maintenance priorities. |

**3. Planning & Development Policies**

4.3.9 As part of this phase of work Policy Areas have been defined across the Borough within which appropriate planning policies should be applied to manage flood risk. Due to similarities in geology across the Borough (largely London Clay, Silts and Alluvium, Figure 2) only one Policy Area has been defined for the Royal Borough of Kingston upon Thames. The Policy Area follows the Borough boundary and is not limited to CDA extents. The reason for the inclusion of the Policy Area is to highlight the fact that even if an area does not fall within a CDA it does not mean that surface water discharge from these areas can be uncontrolled, merely that the need for considering direct options for the area is not so critical.

4.3.10 A summary of measures that could be applied through policy across the whole Policy Area/ Borough is included below.

**Paved Gardens**

4.3.11 Impermeable paving in gardens can significantly increase surface water runoff entering the local drainage network. From the 1st October 2008 the permitted development rights that allow householders to pave their front garden with hard standing without planning permission was removed. Residents should be encouraged to design their gardens in a way that optimises drainage and reduces runoff. The Council should publicise this issue and refer to standard guidance on the surfacing of front gardens provided by the CLG and Environment Agency in September 2008[13].

[13] Department for Communities and Local Government, 2008, Guidance on the Permeable Surfacing of Front Gardens http://www.communities.gov.uk/documents/planningandbuilding/pdf/pavingfrontgardens.pdf

**Figure 4-3 Permeable front gardens allowing for parking**

*Source CLG/EA Guidance on the permeable surfacing of front gardens 2008 and Richmond Scrutiny Report 2008*

**Council Owned Car Parks**

4.3.12 Car parks across the Borough account for a significant proportion of hard surfacing; which in turn contributes surface water runoff and increases pressure on the local drainage network. The Royal Borough of Kingston upon Thames does not currently require the use of permeable surfaces when resurfacing old car parks or building new ones. It is vital that if the Borough is encouraging local residents to use sustainable drainage, they are seen to be leading the way.

| | |
|---|---|
| ***Option 3a:*** | The Borough could encourage residents to ensure that paved areas in front gardens drain onto flower beds rather than running onto the highway. |
| ***Option3b:*** | The Borough could aim to raise awareness of the options for installation and maintenance of permeable surfaces within property grounds. |
| ***Option 3c:*** | The Borough could aim to provide an information portal that residents can consult for further information on permeable paving, including a list of 'approved suppliers' whom residents can contact to install permeable driveways etc. |
| ***Option 3d:*** | All new Borough-owned car parks and newly resurfaced car parks should be built with permeable surfaces to reduce runoff. They should be designed to incorporate surface water storage and should not be connected to the local drainage network wherever possible. |
| ***Option 3e:*** | The Borough should look into planning policy with regard to privately owned car parks and potential for use of SUDS. |

**Sustainable Drainage Systems (SuDS)**

4.3.13 A number of policies have already been implemented within the Royal Borough of Kingston upon Thames to ensure that new development incorporates Sustainable Drainage Systems (SuDS) wherever possible. It is recommended that these are reviewed and updated where necessary in the light of the Groundwater Assessment (Appendix C2) and the SuDS Suitability Map shown in Figure 4.3.1.

4.3.14 SuDS techniques can be used to reduce the rate and volume and improve the water quality of surface water discharges from sites to the receiving environment (i.e. natural watercourse or public sewer etc). Various SuDS techniques are available and operate on two main

principles; attenuation and infiltration. All systems generally fall into one of these two categories, or a combination of the two.

*Infiltration SuDS*

4.3.15 Infiltration SuDS are reliant on the local ground conditions (i.e. permeability of soils and geology, the groundwater table depth and the importance of underlying aquifers as a potable resource) for their successful operation.

4.3.16 Development pressures and maximisation of the developable area may reduce the area available for infiltration systems. This can be overcome through the use of a combined approach with both attenuation and infiltration techniques e.g. attenuation storage may be provided in the sub-base of a permeable surface, within the chamber of a soakaway or as a pond/water feature.

4.3.17 Permeable surfaces are designed to intercept rainfall and allow water to drain through to a sub-base. The use of a permeable sub-base can be used to temporarily store infiltrated run-off underneath the surface and allows the water to percolate into the underlying soils. Alternatively, stored water within the sub-base may be collected at a low point and discharged from the site at an agreed rate.

4.3.18 Permeable paving prevents runoff during low intensity rainfall, however during intense rainfall events some runoff may occur from these surfaces.

4.3.19 Programmes should be implemented to ensure that permeable surfaces are kept well maintained to ensure the performance of these systems is not reduced. The use of grit and salt during winter months may adversely affect the drainage potential of certain permeable surfaces.

4.3.20 Types of permeable surfaces include:

- Grass/landscaped areas;
- Gravel;
- Solid Paving with Void Spaces; and,
- Permeable Pavements.

4.3.21 Where permeable surfaces are not a practical option more defined infiltration systems are available. In order to infiltrate surface water runoff into the ground, a storage system is provided that allows the infiltration of the stored water into the surrounding ground through both the sides and base of the storage element. These systems are constructed below ground and therefore may be advantageous with regards to the developable area of the site. Consideration needs to be given to construction methods, maintenance access and depth to the water table. The provision of large volumes of infiltration/sub-surface storage has potential cost implications. In addition, these systems should not be built within 5m of buildings, beneath roads or in soil that may dissolve or erode.

4.3.22 Various methods for providing infiltration below the ground include:

- Geocellular Systems;
- Filter Drains; and,
- Soakaways (Chamber, Trench or Granualr Soakaways).

4.3.23 The infiltration SuDS suitability assessment shown on Figure 4.3.1 is based on minimum permeability data obtained from the BGS. Maximum permeability data is also available, however, only the minimum permeability has been used, as this is understood to be more representative of the bulk permeability.

4.3.24 Three permeability zones have been identified:

- Infiltration SUDS potentially suitable: Minimum permeability is high or very high for bedrock (and superficial deposits if they exist).
- Infiltration SUDS potentially unsuitable: Minimum permeability is low or very low for bedrock (and superficial deposits if they exist).
- Infiltration SUDS suitability uncertain: Minimum permeability is low or very low for bedrock and high or very high for superficial deposits OR minimum permeability is low or very low for superficial deposits and high or very high for bedrock.

4.3.25 Figure 4.3.1 shows that across much of the Borough the use of infiltration measures are not suitable, for the remainder further site level investigations would be required.

4.3.26 It is noted that this is a high level assessment and only forms an approximate guide to infiltration SUDS suitability; a site specific investigation is required to confirm local ground conditions.

*Attenuation SuDS*

4.3.27 If ground conditions are not suitable for infiltration techniques then management of surface water runoff prior to discharge should be undertaken using attenuation techniques. This technique stores runoff and slowly discharges flows in a controlled manner in order to reduce flood risk both within a site and the surrounding area. It is important to assess the volume of water required to be stored prior to discharge to ensure adequate provision is made for storage on site. The required storage volume should be calculated prior to detailed design of the development to ensure that surface water flooding issues are not created within the site.

4.3.28 The rate of discharge from the site should be agreed with the Local Planning Authority and the Environment Agency. If surface water cannot be discharged to a local watercourse then liaison with the Sewer Undertaker should be undertaken to agree rates of discharge and the adoption of the SuDS system.

4.3.29 Large volumes of water may be required to be stored on site, and storage areas may be constructed above or below ground. Depending on the attenuation/storage systems implemented, appropriate maintenance procedures should be implemented to ensure continued performance of the system. On-site storage measures include basins, ponds, and other engineered forms consisting of underground storage.

4.3.30 Basins are areas that have been contoured (or alternatively embanked) to allow for the temporary storage of runoff from a developed site. Basins are designed to drain free of water and remain waterless in dry weather, therefore they may form areas of public open space or recreational areas. Basins also provide areas for treatment of water by settlement of solids in ponded water and the absorption of pollutants by aquatic vegetation or biological activity. The construction of basins uses relatively simple techniques. Local varieties of vegetation should be used wherever possible which should be fully established before the basins are used. Access to the basin should be provided so that inspection and maintenance is not restricted. This may include inspections, regular cutting of grass, annual

clearance of aquatic vegetation and silt removal as required. Health and safety aspects must also be considered during the design stage.

4.3.31 Ponds are designed to control discharge rates by storing the collected runoff and releasing it slowly once the risk of flooding has passed. Ponds can provide wildlife habitat and water features to enhance the urban landscape, and where water quality and flooding risks are acceptable, they can be used for recreation. It may be possible to integrate ponds and wetlands into public areas to create new community ponds. Ponds and wetlands trap silt which may need to be removed periodically to ensure the available storage volume is not reduced. Ideally, the contaminants should be removed at source to prevent silt from reaching the pond or wetland in the first place. However in situations where this is not possible, consideration should be given to a small detention basin placed at the inlet to the pond for the purpose of trapping and subsequently removing the silt. Depending on the setting of a pond, health and safety issues may be important issues that need to be taken into consideration. The design of the pond can help to minimise any health and safety issues (i.e. shallower margins to the pond reduce the danger of falling in, fenced margins).

4.3.32 Various types of ponds are available for utilising as SuDS measures. These include:

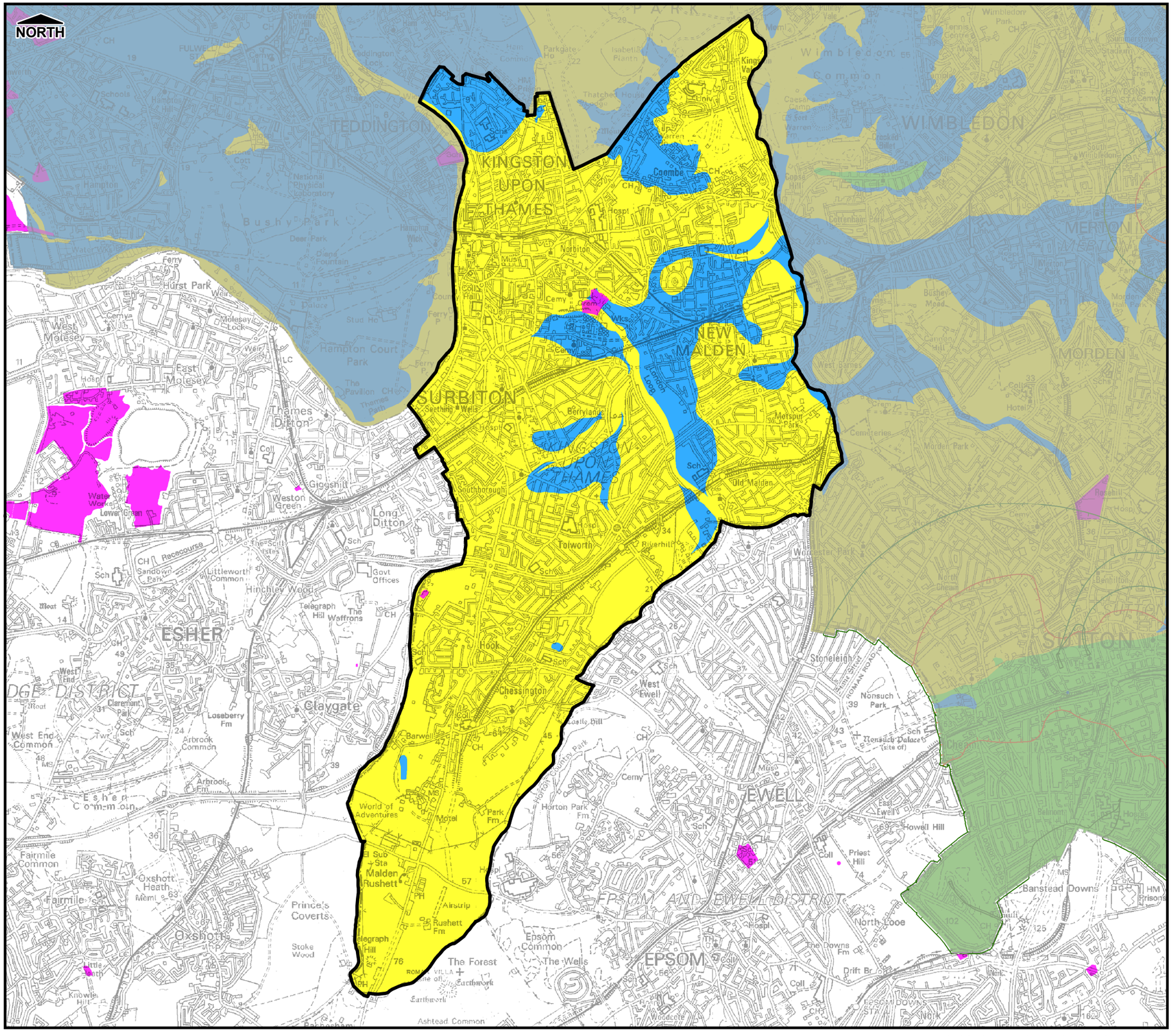
- Balancing/Attenuating Ponds;
- Flood Storage Reservoirs;
- Lagoons;
- Retention Ponds; and,
- Wetlands.

4.3.33 Site constraints and limitations such as developable area, economic viability and contamination may require engineered solutions to be implemented. These methods predominantly require the provision of storage beneath the ground surface, which may be advantageous with regards to the developable area of the site but should be used only if methods in the previous section cannot be used. When implementing such approaches, consideration needs to be given to construction methods, maintenance access and to any development that takes place over the storage facility. The provision of large volumes of storage underground also has potential cost implications.

4.3.34 Methods for providing alternative attenuation include:

- Deep Shafts;
- Geocellular Systems;
- Oversized Pipes;
- Rainwater Harvesting;
- Tanks; and,
- Green and brown bio-diverse roofs.

4.3.35 Where possible, it is often preferable to combine infiltration and attenuation systems to maximise the benefits in terms of surface water runoff management, developable area and green open space.




THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

## Legend

- Kingston Borough Council

**EA Groundwater Source Protection Zone**

- Inner Zone
- Outer Zone
- Historic Landfill Site

**Infiltration SUDS Suitability**

- Infiltration SUDS potentially suitable
- Infiltration SUDS potentially unsuitable
- Infiltration SUDS Suitability Uncertain -Site investigation required

## Notes

This map forms an approximate guide to Infiltration SUDS Suitability. However, for all new developments, site investigation is required to confirm local geology, depth to groundwater and infiltration rates.

# London Borough of Kingston

Royal Kingston

# Surface Water Management Plan



| Scale at A3 | Date | Drawn by | Approved by |
|---|---|---|---|
| 1:50,000 | 22/03/2011 | C.Woolhouse | S.Cox |

## Infiltration SUDS Suitability Map

Consultants

CAPITA SYMONDS Scott Wilson
Flood Risk Management

URS / Scott Wilson
6 - 8 Greencoat Place
London
SW1P 1PL

Drain London Programme Board Members

Environment Agency · Thames Water · LONDON COUNCILS · GREATERLONDONAUTHORITY

## FIGURE 4.3.1

Filepath: D134786 Drain London_Tier 2_Group 8\700 Technical\711 GIS\01 Layout\Kingston\Infiltration SUDS suitability Map.mxd

**Water Conservation**

4.3.36 Water conservation is an option that should be considered for reducing peak discharges and in turn downstream flood risk. This can be applied using a number of options including planning led encouragement of the use of rainfall in greywater systems and property level use of water butts. Both are described in more detail below.

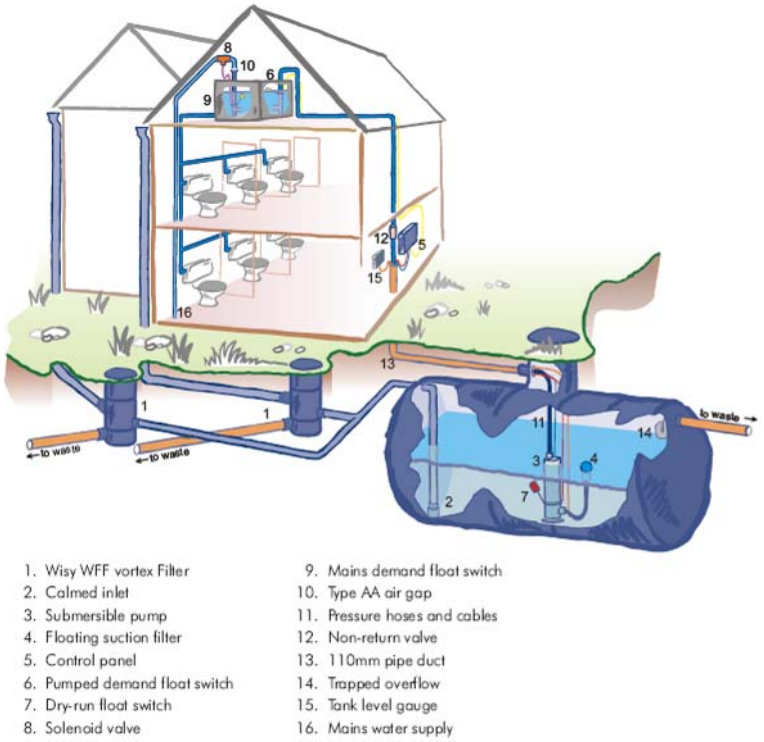
*Rainwater Harvesting*

4.3.37 The potential for the use of rainwater should be jointly led by Thames Water and the London Borough of Kingston upon Thames. Promotion of the benefits of such schemes could be rolled out across multiple Boroughs to reduce costs. The principle of rainwater harvesting in both domestic and commercial property is the same. Rainwater from roof areas is passed through a filter and stored within large tanks. When water is required, it is delivered from the storage tank to toilets, washing machines and garden taps for use. If the tank becomes low on stored water, demand is topped up from the mains supply. Any excess water can be discharged via an overflow to a soakaway or local drainage network.

4.3.38 Rainwater harvesting systems could be retrofitted to local schools within the Borough. A case study for Southampton University Student Services Building is described below, with an example layout of a system illustrated in Figure 4-4 below. A summary of the specification is listed below:

- Roof Area: 1000m2
- Underground storage tank: 15,000 litres
- Building occupancy: 150 people
- Planned usage: 21 WCs and 3 urinals
- Expected annual rainwater collection: 410,000 litres
- Capital cost: £4325
- Expected pay back time 5.3 years (based on Southern Water 2006 tariff)

**Figure 4-4 Example Rainwater Harvesting system in a commercial property**




*(Source: Rainwaterharvesting systems Uk):*

| | |
|---|---|
| **Option 3f** | The Council could consider providing an incentive scheme for the use of rainwater harvesting systems across the Borough. This may be linked to the Council's sustainability checklist. |

*Water Butts*

4.3.39 One of the preferred measures to reduce peak discharges and downstream flood risk, is the robust implementation of water butts on all new development within the Borough, and, retrofitting to existing properties where a higher surface water flooding risk has been identified. Given the constraints associated with the largely impermeable geology across the Borough, the wholesale implementation of water butts may significantly reduce peak discharges.

4.3.40 Water butts often have limited storage capacity as when a catchment is in flood, water butts are often full, however it is still considered that they have a role to play in the sustainable use of water and there are potentials to provide overflow devices to soakaways or landscaped areas to ensure that there is always a volume of storage available within the water butt.

4.3.41 The Royal Borough of Kingston upon Thames should provide general advice to residents encouraging the use of water butts. The Borough may choose to make a bid to the Climate Change Fund to provide water butts and rainwater harvesting systems to residents at discounted rates.

| Rainwater Harvesting – Water Butts | | |
|---|---|---|
| **Description** | **Benefits** | **Impacts** |
| Installation of water butts for all new development within Opportunity Areas | Ties in with SuDS hierarchy and reduces peak discharges of surface water | Positive impacts to sustainability and water re-use. |
| Retrofit water butts on all existing development (as shown on Figure 4-5) | Supplementary benefits beyond regeneration and redevelopment sites (volumetric reduction with opportunity for complimentary water quality improvements) | Currently no available incentives to encourage homeowners to install water butts. |

**Figure 4-5 Example of a 100L water butt retrofitted to existing development**

| | |
|---|---|
| **Option 3g** | It is recommended that the Borough should promote the use of water butts across the Borough and provide information on costs, suppliers, installation and benefits. |

**Property Resilient Measures (Increasing Property or Gate Thresholds)**

4.3.42 One method to reduce the risk of surface water flooding to properties is raising property or gate thresholds. Raising the threshold of entrances levels to property land, i.e. where there are currently gates adjacent to paved walls may offer flood resilience benefits, especially where the property contains a basement. Property level thresholds should also be increased where possible to improve resilience to surface water flooding, especially where roads are predicted to flood and properties contain no front gardens.

| | |
|---|---|
| **Option 3h:** | It is recommended that the Borough aim to raise the awareness of the options for increasing property thresholds to protect against flooding. |
| **Option 3i:** | The Borough could encourage residents to ensure that property thresholds are raised at least 100mm above surrounding ground levels, particularly in areas where roads / properties are known / identified to be susceptible to surface water flooding. |

**Figure 4-6 Raised Driveway, Croydon**


*CDA LEVEL PREFERRED OPTIONS*

4.3.43 Following the Options Workshop and consultation with relevant stakeholders (to discuss results of the Opportunity Assessment, Appendix E), the preferred options (including combinations of measures) have been identified and further assessed to:

- Estimate benefits; and,
- Estimate the approximate implementation costs.

4.3.44 For most CDAs, a range of options have been identified that could be further explored to alleviate flooding. These are identified in Section 4.3.3 to 4.3.16 and have been included within the Borough Action Plan as short, medium or long-term actions with an associated priority. A summary of the preferred options is provided within Table 4-5.

4.3.45 Where there is a preferred capital scheme identified within a CDA, this has been identified for inclusion in a London wide Drain London Prioritisation Matrix for review by the GLA (Table 4-6). Note: Only capital schemes have been presented to the GLA, and as outlined in Table 4-6 not every CDA has a capital scheme taken forward for inclusion within the GLA Prioritisation Matrix.

**Benefits**

4.3.46 For the purpose of the Drain London Prioritisation Matrix, it is necessary to determine the potential benefits of each preferred option (Table 4-6). The potential benefits of the scheme are measured using an estimated percentage of units removed from the predicted floodplain (eliminated) or where flood frequency is reduced (mitigated). This percentage has been determined by calculating the number of units within the LFRZ that the particular scheme has been designed to mitigate, as a percentage of the number of units within the CDA as a whole. The input is restricted to multiples of five percent. It should be noted that the information within Table 4-6 is purely for input into the Drain London Prioritisation Matrix and should be treated as such. Further detailed modelling would be required to determine more accurately the potential benefits of the suggested schemes.

**Costs**

4.3.47 An estimated cost for the preferred flood mitigation option for each identified CDA has been calculated based on standard unit costs provided as part of Tier 1 of the Drain London Project, to mitigate the 3.3% AEP (1 in 75 annual probability) event (Table 4-5). No monetised damages have been calculated, and flood mitigation costs have been determined using engineering judgement, but have not undergone detailed analysis. The following standard assumptions have been applied, as determined in the Drain London Prioritisation Matrix Guidance:

- The costs are the capital costs for implementation of the scheme only.
- Costs do not include provisions for consultancy, design, supervision, planning process, permits, environmental assessment or optimism bias.
- No provision is made for weather (e.g. winter working).
- No provision is made for access constraints.
- Where required, it will be stated if costs include approximate land acquisition components.
- No operational or maintenance costs are included.
- No provision is made for disposal of materials (e.g. for flood storage or soakaway clearance).

4.3.48 As a result, costs should be treated at an order of magnitude level of accuracy and have therefore been stated within the reports as a series of cost bands.

*CDA_008 ACRE ROAD/NORTH KINGSTON*

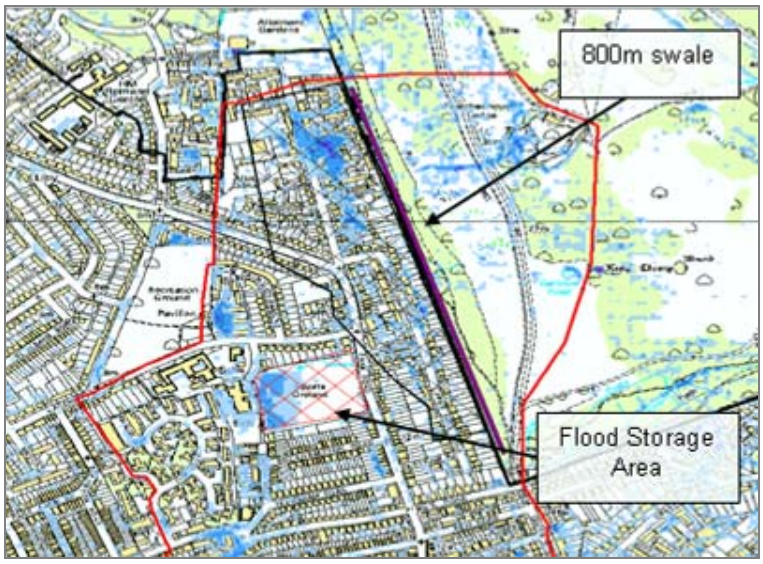
4.3.49 This CDA has the most documented flood history within the Borough having suffered severe flooding in July 2007. Pluvial modelling has also identified this CDA as having some of the worst predicted future flood risk across the Borough.

**Preferred option: Combination of measures**

The preferred option for this CDA is a mixture of a capital scheme and smaller 'quick win' measures as outlined below.

4.3.50 The north of CDA_008 is defined by high ground to the east in Richmond Park with a fall towards Wilmer Crescent and Wingfield Road. A swale could be included along the boundary of Richmond Park (approximately 800m) to intercept runoff from the park. This option could be combined with the construction of a flood storage area at Latchmere Lane Recreational Ground. Initial high level calculations of a flood storage area at this location are based on a volume of 11,200m3 which has an estimated scheme cost of between £250k and £501k. This option requires further feasibility assessment including a re-run of the pluvial modelling to accurately estimate the impact of this scheme on the LFRZ. Any scheme at this location should be completed in liaison with the London Borough of Richmond upon Thames which forms the northern boundary of the CDA.

**Figure 4-7 Location of Preferred Option within CDA_008**






4.3.51 On-going liaison with Thames Water through the strategic flood group should be used to carry out a capacity check of the surface water network at this location. Depending on the results of such a study, there may be potential to increase capacity within the existing drainage network either through increases in pipe size or through the incorporation of additional gullies in the vicinity of Acre Road.

4.3.52 In the July 2007 flood event it was noted that once the storm had subsided, water quickly drained away. This may suggest that there is sufficient capacity within the Thames Water network, however surface water could not physically enter the system quick enough (see Figure 4-8 below). A desk study and inclusion of additional gullies to the existing network is estimated to cost <£25k. Figure 4-8 also identifies how local features in the highway, in this case a raised approach to the junction has created local flow paths. These should be assessed in more detail to determine if there is potential to alter local flow paths to alleviate local pooling of water.

**Figure 4-8 Flooding in July 2007 on Acre Road**

Source: by NRSCLARK www.Flickr.co.uk

4.3.53 The final LFRZ within this CDA is located at Kingston Station underpass. The preferred option for mitigation of risk at this location is the installation of surface water pumps

connected to the local drainage network. This option would be a quick win as it could be incorporated on a relatively short timescale. However, a capacity study of the network would first be required to confirm if this measure is a viable option.

*CDA_009 New Malden North*

4.3.54 Flooding within this large CDA is confined to <0.5m depths and as such no large capital schemes are recommended. In addition, reference to the Thames Water drainage network has identified a large (1050mm diameter) surface water sewer located within Clarence Avenue which the local surface water drainage connects. The influence of this sewer is not included within the pluvial model instead a standard loss of 6.5mm/hr was used, in accordance with Thames Water guidance for this London wide strategic study. There is therefore potential that surface water flood risk is overestimated within this CDA. A combination of 'quick win' mitigation measures which may be taken forward for further investigation are outlined below:

- *Improvement to drainage infrastructure* – The number of gullies at Carlton Road and Selbourne Road within the LFRZ should be increased. Based on the provision of 20 gullies, the cost of such a scheme would be <£25k.
- *Preferential/Designated overland flow routes* – The potential to raise kerb heights throughout the LFRZ should be investigated to contain surface water within the highway and away from property. This should be combined with the provision of additional gullies if required.
- *Planning Policy* – The use of SuDS and rainwater harvesting should be promoted throughout the CDA especially within the two schools within the local catchment.

*CDA_010 Kingston Town Centre (South)*

4.3.55 The primary flood source within this CDA is fluvial flood risk from the River Hogsmill. Therefore, no capital schemes have been suggested as part of this surface water management plan. Instead liaison should be sought with the Environment Agency with regard to fluvial flood risk mitigation measures. However, there are some good management practices which should be applied within the CDA including:

- *On-going maintenance* – The existing drainage network should be maintained to ensure that it is working to its design capacity.
- *Improvement to drainage infrastructure* – Thames Water have made improvements to the existing surface water drainage infrastructure on Park Road to reduce the risk of surcharging of the network. Any surface water outfalls to local watercourses should be maintained by Thames Water including checks that the outfall levels are correct and won't become submerged during low return period storms. The strategic flood group should be used to ensure that Thames Water complete maintenance at this location.
- *Community Resilience* – Awareness of the flood risk should be raised within this CDA through liaison with the Environment Agency and reference to their Flood Warning Service. This can be used to discuss property resilience measures with local homeowners.

*CDA_011 New Malden High Street*

4.3.56 Surface water flooding at this location occurs under the rail bridge on the High Street. This has been validated by Royal Borough of Kingston upon Thames records.

**Preferred option: Install pumps at High Street rail bridge**

The suggested mitigation option for this CDA is an improvement to existing drainage infrastructure. The option to install pumps at the road bridge connecting to the Coombe Stream (approximately 600m) to the north should be further investigated. This would require both the construction of a new surface water sewer and new pumps estimated to cost between £101k and £250k.

4.3.57 In addition, liaison with Thames Water should be sought to establish if there is capacity within the network at the rail bridge crossing. If there is capacity, additional gullies could be added to the highway at this location to help alleviate surface water flooding. It is estimated that an addition of 6 gullies would cost <£25k.

*CDA_012 Surbiton Hill Road/Surbiton Crescent*

4.3.58 Shortlisted options for capital works within this CDA include the following:

- Thames Water separation of the existing combined sewer network at Surbiton Crescent and Palace Road. A 300m length of new surface water sewer connecting to the River Thames would be required which may cost upwards of £500k.
- Creation of preferential flow paths through raising kerb heights along Surbiton Crescent and Palace Road. A new speed bump on Palace Road will already reduce water flowing onto this section of highway but may increase the risk at Surbiton Crescent.
- Sewer capacity check by Thames Water of the Surbiton Crescent area and based on the results of this survey improve the drainage infrastructure including additional gullies. The addition of 10 gullies would cost <£25k.
- Promote the use of rainwater harvesting in local schools in the area.
- Continue maintenance regime of gullies including Surbiton Hill Road which contributes to flooding in the lower catchment.

**Preferred option: Thames Water capacity check and potential increase to local network capacity**

4.3.59 Following the scoring of shortlisted options and discussion at the Borough's Options Workshop, the preferred option to be taken forward for this CDA is collaborative working with Thames Water to complete a capacity assessment of the drainage infrastructure at this location with the view to increase its capacity. The completion of an initial capacity assessment is estimated to be within the capital cost band of <£25k. However, the cost of providing a new surface water sewer link to the River Thames may be prohibitively costly (potentially >£500k) although it would deliver benefits throughout the whole CDA including water quality improvements.

4.3.60 In the short term, the Royal Borough of Kingston upon Thames should target this CDA for raising of kerb heights and on-going maintenance of drainage infrastructure. In addition, the

use of rainwater recycling should be promoted within local schools.

*CDA_013 NETWORK RAIL MAIN LINE*

**Preferred option: Combination of measures**

There are a number of measures which could be applied across the CDA which may help to improve the local drainage network, these include (from east to west):

- On-going maintenance of drainage infrastructure at Kingston Road rail crossing. The highway enters a relatively localised dip with surface water flowing from the adjacent highway. It is therefore important that existing gullies at this location are cleared regularly. Confirmation from Thames Water should be sought to see where the existing surface water drainage network at this location connects to, based on the results of this survey there may be potential to increase the number of gullies at the rail crossing. The cost of a survey and addition of 6 new gullies would be <£25k, however as no properties are shown to be at risk at this location a road diversion may be a preferred option for extreme rainfall events.
- Improvements to drainage infrastructure at Rose Walk. This section of the CDA is identified as being a LFRZ and properties are potentially at risk of surface water flooding. Drainage infrastructure on Rose Walk is limited, with few gullies and a single connection to the River Hogsmill to the east. A drainage survey should be completed on this section of infrastructure in liaison with Thames Water to confirm the condition of the pipe network and outfall to the River Hogsmill. New gullies should be added to the highway. The cost of a survey and addition of 10 new gullies is estimated to be <£25k.
- Drainage survey in the vicinity of Berrylands Station at Chiltern Drive. Thames Water network shows a surface water system channelled to the east towards the River Hogsmill but there does not appear to be a full connection. The status of the drainage at this location needs to be confirmed followed by some improvements e.g. linear drainage at the end of the highway of Chiltern Drive linking to the existing drainage infrastructure. Property thresholds appear to be raised and there are speed bumps holding water within the highway. Access to the station may be restricted in a flood event. The cost of a survey and these works is estimated to be <£25k.

4.3.61 Note no measures are outlined for Elm Road. This is an area identified to be at risk, however it has not been prioritised as there are no properties at risk at this location and it is not a major road. On-going maintenance of gullies at this location should be provided as a quick win measure.

4.3.62 General policy measures to encourage the use of green roofs, rainwater re-use and ongoing maintenance of existing drainage infrastructure should be promoted across the CDA.

*CDA_014 BERRYLANDS ALEXANDRA DRIVE*

4.3.63 There are no capital measures proposed within this CDA, instead smaller quick win options should be further progressed as outlined below.

4.3.64 Remedial works have already been completed in the local area in 1999 when the Royal Borough of Kingston upon Thames and Thames Water installed additional gullies at the front of properties along Alexandra Drive. However, the Borough should continue with their

ongoing maintenance of highway drainage and should liaise with Thames Water to ensure that they are maintaining their drainage outfalls to the Surbiton Steam.

4.3.65 The dominant flood source within this CDA is the Surbiton Stream and the Borough should use planning policy to ensure that any future development within this CDA will have no detrimental impact in terms of flood risk.

4.3.66 The Borough should also work with the Environment Agency to fully understand and promote awareness of the flood risk posed by the Surbiton Stream and to further investigate the potential to create a flood storage area in the adjacent recreational ground.

### *CDA_015 A3 HIGHWAY*

**Preferred option: Install pumps at low points in highway**

The preferred option for this CDA is improved/targeted maintenance of the existing drainage infrastructure located along the length of the A3 within the Borough. In addition, TFL should consider installation of pumps at crossing points where the existing drainage infrastructure relies on a positive drainage system. A check should be completed to make sure that surface water from adjacent highways does not cross into the A3's drainage infrastructure and overwhelm it. If this were the case there is potential for existing pumps to be overwhelmed during a flood event.

### *CDA_016 OLD MALDEN*

4.3.67 A number of options have been shortlisted for this CDA as outlined below:

- The creation of a swale on open land adjacent to the highway at Sheephouse Way. A similar swale could be created along the eastern boundary of Malden Road to prevent overland flow from Manor Park from flowing onto the A2043 Malden Road. A swale length of 450m along Sheephouse Way is estimated to cost <£25k. However, a further feasibility study is required to confirm the scale of mitigation that such a scheme would provide.
- Creation of a detention basin on green area by the Harvester Pub at Malden Road/Church Road junction. Based on the incorporation of a 800m$^3$ storage area it is estimated that the cost of the scheme would be <£25k. Further feasibility study is required to confirm the potential mitigation that such a scheme may provide.

4.3.68 A discussion at the Options Workshop highlighted a large surface water sewer located at Sheephouse Way (1200mm diameter) and Malden Road (900mm). It is therefore considered that pluvial modelling at this location may provide an overestimate of associated surface water flood risk. This would link to local knowledge as the Borough has no records of flooding at this location. The preferred option is therefore to continue with maintenance of the existing highway drainage in liaison with Thames Water and the use of high level planning policy to promote rainwater harvesting, permeable surfaces and the use of SuDS in all new developments within the CDA.

### *CDA_017 KING GEORGE'S TRADING ESTATE*

4.3.69 Flooding within this CDA is confined to industrial areas served by private drainage systems and there are no residential properties identified as being at risk. However, the bus depot serving the Borough is identified as being at risk. Following the Options Workshop with

Royal Borough of Kingston upon Thames, the following options were shortlisted for further consideration:

- The creation of a storage area within King George's field. This would provide mitigation to the bus depot but is located downstream of the Trading Estate and would have no impact on drainage from this site unless existing surface water drainage is altered. This measure would require further investigation to confirm the scale of mitigation provided. Initial cost estimates are between £101k and £250k for the construction of a storage area with a volume of 10,000$m^3$ at this location.
- Construction of a swale and bund around the perimeter of the bus depot. The cost of this scheme is estimated to be <£25k based on a swale length of 300m. Further investigation is required to confirm the scale of mitigation provided by this measure.
- Improvements to existing drainage infrastructure through the provision of additional gullies at the Cox Lane crossing of the rail network. An additional 6 gullies at this location would cost <£25k, liaison would be required with Thames Water to confirm that there is capacity within the receiving drainage system.

4.3.70 The scale of the flooding experienced within this CDA and the number of properties at risk led to the decision to not take any of the capital schemes listed above to the central Drain London Prioritisation Matrix. Instead it is suggested that the Borough continue with their existing highway maintenance regime and use planning policy to promote the use of rainwater recycling and SuDS on industrial sites as they come forward for redevelopment.

*CDA_018 HOOK/KELVIN GROVE*

4.3.71 The Royal Borough of Kingston upon Thames do not have a detailed flood history for this location, however pluvial modelling shows the potential for severe flooding during climate change scenarios at Kelvin Grove. The Environment Agency need to be involved in all potential options at this location as the majority of the CDA is located within fluvial Flood Zone 2. Three options have been shortlisted to provide some mitigation of this risk:

- Survey of the Surbiton Stream and drainage ditch tributaries to the west of the CDA, including culvert crossing of the A3. The primary source of flood risk to Kelvin Grove is overland flow from the Surbiton Stream.
- Provision of a bund and potential flood storage to the south of Kelvin Grove within the recreational area. Land profiles should be managed to ensure that flood water remains within open land and does not flow towards Kelvin Grove. Assuming creation of a storage area of 7400$m^3$, it is estimated that this scheme would cost between £101k and £250k to construct.
- A flood alleviation scheme 'the Bridge Road Scheme' was constructed to the east of this CDA including the installation of a 1800mm diameter surface water pipe along Bridge Road and Mansfield Road which links into a 1050mm pipe positioned in a north/south alignment at the rear of properties on Hartfield Road. Pluvial modelling does not take this system into account and it is suggested that modelling be revised run at this location to include the large diameter underground drainage network. This is required to establish if the existing flood

alleviation scheme mitigates the predicted surface water flood risk shown. Re running of the pluvial model would cost >£25k.

**Preferred Option: Re-run pluvial model accounting for Bridge Road scheme**

It is suggested that the starting point for this CDA is to establish the alleviation that the Bridge Road scheme provides within the local area. This should then be used to inform further mitigation measures.

*CDA_019 CHESSINGTON NORTH RAIL*

4.3.72 Chessington North was discussed at the Options Meeting and it was highlighted that a flood relief culvert 'the Bridge Road Sewer' may provide significant alleviation of surface water flood risk shown through the pluvial modelling. This explanation would explain why there are no recorded surface water flood incidents at this location. No large capital schemes have been suggested for this CDA, instead a combination of the following quick wins have been outlined:

- Improvement to Drainage Infrastructure - Check gullies at Bridge Road with view to increase the number linking to the Bridge Road sewer. Based on the addition of 20 gullies a scheme of this nature would cost <£25k.
- Preferential/Designated Overland Flow Routes - The contributing catchment to LFRZ at Moor Lane includes overland flow from Buckland Road and Mount Road. Speed bumps have been placed at the southern junction of these roads with Moor Lane which will reduce overland flow. Gullies should be in close proximity to these speed bumps to prevent the pooling of water. The addition of some gullies at this location would be £25k assuming no more than 20 gullies were added.
- Improved Maintenance - Continue with existing maintenance regime and combine with raising awareness of risk to local businesses.

*CDA 020 BARWELL BUSINESS PARK*

4.3.73 Surface water from the adjacent highway flows into Barwell Business Park which is served by a private drainage network linking to a Thames Water culvert.

**Preferred option: Combination of measures**

It is suggested that a combination of measures be further investigated as outlined below:

- Improved Maintenance - Liaison with Thames Water to ensure that the two culvert crossings of the railway line (both 600mm diameter) are clear and confirm the maintenance regime to the Borough and site users. A contact at Thames Water should be provided to the site users in case of flooding at this location.
- Preferential/Designated overland flow routes - Install speed bump at entrance to Business Park as a way of reducing overland flows into the car park area. Borough to ensure that highway drainage on Leatherhead Road is working to capacity.
- Community Resilience - Site occupiers should be educated on local surface water flood risk and on site water reduction measures which could be applied such as water recycling within buildings and the use of permeable paving.

*CDA 021 MALDEN RUSHETT*

4.3.74 The primary flood source at this location is overland flow from the adjacent farmland, golf course and highways.

**Preferred option: Combination of measures**

The preferred mitigation option is a combination of 'quick win' measures outlined below:

- Improved Maintenance – Inspection, identification and maintenance of highway drainage including grips, drainage ditches and culvert crossing at Rushett Lane. This may require enforcement on riparian owners. It is estimated that this would cost <£25k to complete.
- Improvement to Drainage Infrastructure – Provision of additional grips along the Leatherhead Road and re-instatement of land drainage ditch at the rear of properties to the east of the Leatherhead Road.
- Land Management Practices - Improvement of land management practices to reduce runoff from open land. This should be coupled with raising awareness of riparian owner's responsibilities with regard to land drainage.

## 4.4 OPTIONS SUMMARY

4.4.1 A summary of mitigation options is presented in Table 4-5 below.

## 4.5 RECOMMENDATIONS FOR NEXT STEPS AND QUICK WINS

4.5.1 Taking into account the nature of the surface water flooding in the Royal Borough of Kingston upon Thames, the options identified through the Phase 3 Options Assessment, and requirements under the FWMA and FRR2009, it is considered that the Royal Borough of Kingston upon Thames should prioritise the following actions in the short to medium term:

- Continue to identify and record surface water assets as part of the Royal Borough of Kingston upon Thames existing Asset Register, prioritising those areas that are known to regularly flood and are therefore likely to require maintenance or upgrading in the short-term.
- Consider the development of an 'Information Portal' via the Royal Borough of Kingston upon Thames website, for local flood risk information including links to the relevant Environment Agency web pages that provide advice on measures that can be taken by residents to mitigate surface water flooding to and around their property. This could be developed in conjunction with the South West London Flood Group and include:
    - A list of appropriate property level flood risk resilience measures that could be installed in a property;
    - A list of 'approved' suppliers for providing local services, such as repaving of driveways;
    - A link to websites / information sources providing further information;
    - An update on work being undertaken by the Borough and/or other Stakeholders to address surface water flood risk; and,
    - A calendar showing when gullies are to be cleaned in given areas, to encourage residents to ensure that cars are not parked over gullies / access is not blocked during these times.

- Prepare a Communication Plan to effectively communicate and raise awareness of surface water flood risk to different audiences using a clearly defined process for internal and external communication with stakeholders and the public.
- Use the findings of the SWMP to review the priority areas that are currently targeted for gully cleansing and maintenance and amend if necessary.
- Continue to collate and review information on Ordinary Watercourses in the Borough to gain an improved understanding of surface water flooding in the vicinity of these watercourses as well as ownership and maintenance responsibility for each watercourse.
- Continue to survey the Surbiton Stream and other ordinary watercourses within the Borough and include data within the Councils Asset Register.
- Create preferential flow paths at Acre Road and run a capacity check (with the support of Thames Water) into existing drainage at this location (CDA_008)
- Assess the capacity of the Bridge Road sewer (CDA_018) – there is a possibility that the Drain London modelling is overestimating flooding at this location as the Bridge Road sewer is not currently included in the pluvial modelling
- Thames Water to survey culvert crossings of the railway line at Barwell Business Park (CDA_020)
- Feasibility study into the installation of pumps at New Malden High Street (CDA_011)
- Complete a feasibility study into the creation of a swale and storage area to reduce existing flood risk at Kelvin Grove
- TFL to install pumps on A3 at crossing points where they currently do not exist. TFL to survey condition of existing pumps on the A3.
- Complete survey works of existing surface water network at Rose Wlak, Berrylands Station, Chiltern Drive, Kingston Road (CDA_013). Thames Water may make their network data available to the council for further more detailed investigations.

4.5.2 Further details are included within Appendix I Action Plan.

**Table 4-5 Summary of Preferred Options for Critical Drainage Areas**

| CDA_ID | CDA Name | Options Category | Option Description | Combination Scheme? | Indicative Dimensions & Costings | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Measures | Cost (£) | Unit Description | Unit | Length | Area | Depth | Volume | Number | Drain London Cost Band | Cost Band for Combination of Measures |
| Grouop 8_008 | Acre Road/ North Kingston | Source Control, Attenuation and SUDS | Swale along the edge of Richmond Park | ✓ | Swales | 16 | m2 of swale area | m2 | 800 | 1200 | 1 | N/A costed on area | 1 | <£25k | £250k-501k |
| | | Flood Storage / Permeability | Flood storage area at Latchmere Lane sports Ground | ✓ | Detention Basins | 22 | m3 of detention volume | m3 | N/A | 11200 | 1 | 11200 | 1 | £250k-501k | |
| | | Preferential / Designated Overland Flow Routes | Overland flow routes to be modified in the vicinity of Acre Road | ✓ | Managing Overland Flows (Preferential Flowpaths) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | <£25k | <£25k |
| | | Other - Improvement to Drainage Infrastructure | Thames Water to run a capacity check on drainage network in Acre Road area with the potential to increase capacity | ✓ | Increasing Capacity in Drainage Systems | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | <£25k | |
| | | Other - Improvement to Drainage Infrastructure | Install pumps at Kingston Station bridge | | Increasing Capacity in Drainage Systems | Further assessment required | Number of pumps | numbe r of pumps | N/A | N/A | N/A | N/A | Further assessment required | Dependant on the number of pumps and size required | N/A |
| Group8_009 | New Malden North | Source Control, Attenuation and SUDS | Coombe School rainwater harvesting | ✓ | Rainwater Harvesting | N/A | Assessment based on 150 people using the building in accordance with Section 4.3.1 of the SWMP report | N/A | N/A | N/A | N/A | N/A | Based on 150 people | <£25k | £101k-£250k |
| | | Other - Improvement to Drainage Infrastructure | Increase in gullies at Carlton Road and Selborne Road | ✓ | Increase the number or size of gullies to collect runoff and discharge to sewer | 215 | Per Gully | Pe | N/A | N/A | N/A | N/A | 20 | <£25k | |
| | | Preferential / Designated Overland Flow Routes | Raising of kerb heights to contain surface water within the highway | ✓ | Managing Overland Flows (Preferential Flowpaths) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | <£25k | |
| Group8_010 | Kingston Town Centre | Improved Maintenance | On-going maintenance of drainage network including checks on outfalls re surcharging potential | ✓ | Improved Maintenance Regimes | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | <£25k | £101k-£250k |
| | | Community Resilience | Raise awareness of EA flood zones and mitigation measures at the household level | ✓ | Social Change, Education and Awareness | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | <£25k | |
| | | Other - Improvement to Drainage Infrastructure | Thames Water have improved drainage on Park Road to reduce the risk of surcharging. Thames Water to continue with maintenance of their network | ✓ | Increasing Capacity in Drainage Systems | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | >£10m | |
| Group8_011 | New Malden High Street | Other - Improvement to Drainage Infrastructure | Install pumps at the rail bridge linked to the Coombe Stream in the north | ✓ | Increasing Capacity in Drainage Systems | Further assessment required | Per pump | Per pump | N/A | N/A | N/A | N/A | 1 | Dependant on the number and size required | £101 - £250k |
| | | Other - Improvement to Drainage Infrastructure | TW to complete a capacity check to confirm if there is capacity within their network. If there is, install new gullies at this location | ✓ | Other 'Source' Measures | 215 | Per Gully | Pe | N/A | N/A | N/A | N/A | 6 | <£25k | |

| CDA_ID | CDA Name | Options Category | Option Description | Combination Scheme? | Indicative Dimensions & Costings | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Measures | Cost (£) | Unit Description | Unit | Length | Area | Depth | Volume | Number | Drain London Cost Band | Cost Band for Combination of Measures |
| Group8_012 | Surbiton Crescent | Separate Surface Water and Foul Water Sewer Systems | The provision of a new surface water sewer linking Surbiton Crescent with the River Thames to the west (<300m away) | | Separation of Foul and Surface Water Sewers | 465 | m2 of separation catchment area | m2 | 300m length of pipe required from Surbiton Crescent to River Thames | catchment area estimated to be 24,000m2 | N/A | N/A | | >£500k | N/A |
| | | Preferential / Designated Overland Flow Routes | Raising of kerb heights and use of speed bumps etc to control surface water flow | ✓ | Managing Overland Flows (Preferential Flowpaths) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | <£25k | <£25k |
| | | Planning Policy | Promote the use of rainwater harvesting in local schools | ✓ | Rainwater Harvesting | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | Further assessment required | |
| | | Other - Improvement to Drainage Infrastructure | Increased gullies on Surbiton Crescent | ✓ | Increase the number or size of gullies to collect runoff and discharge to sewer | 215 | Per Gully | Pe | N/A | N/A | N/A | N/A | 10 | <£25k | |
| Group8_013 | Rail Main Line | Other - Improvement to Drainage Infrastructure | Survey of existing drainage at Chiltern Drive/Berrylands Station | ✓ | Increase the number or size of gullies to collect runoff and discharge to sewer | 215 | Per Gully | Pe | N/A | N/A | N/A | N/A | 6 | <£25k | £101 - £250k |
| | | Other - Improvement to Drainage Infrastructure | TW survey of infrastructure and addition of 10 new gullies on Rose Walk by the Council | ✓ | Increase the number or size of gullies to collect runoff and discharge to sewer | 215 | Per Gully | Pe | N/A | N/A | N/A | N/A | 10 | <£25k | |
| | | Other - Improvement to Drainage Infrastructure | TW survey of infrastructure and installation of 6 new additional gullies at rail crossing on Kingston Road | ✓ | Increase the number or size of gullies to collect runoff and discharge to sewer | 215 | Per Gully | Pe | N/A | N/A | N/A | N/A | 5 | <£25k | |
| Group8_014 | Berrylands/ Alexandra Drive | Flood Storage / Permeability | Liaise with the Environment Agency to discuss the potential of providing additional flood storage in the recreational ground at Alexandra Drive. | ✓ | Detention Basins | 22 | m3 of detention volume | m3 | | 10000 | 1 | 10000 | 1 | £101k - 250k | N/A |
| Group8_015 | A3 | Improved Maintenance | Target maintenance to low points in the highway where pumps are installed | ✓ | Improved Maintenance Regimes | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | <£25k | Further assessment required |
| | | Other - Improvement to Drainage Infrastructure | Pumps could be installed at crossing points of the A3 where currently drainage relies on a positive drainage system | ✓ | Increasing Capacity in Drainage Systems | Further assessment required | Per pump | N/A | N/A | N/A | N/A | N/A | Further assessment required | | |
| Group8_016 | Old Malden | Source Control, Attenuation and SUDS | Addition of a swale on Sheephouse Lane | | Swales | 16 | m2 of swale area | m2 | 450 | 675 | | N/A costed on area | 1 | <£25k | N/A |
| | | Source Control, Attenuation and SUDS | Creation of a detention basin at Church Road / Malden Road intersection | | Detention Basins | 22 | m3 of detention volume | m3 | | 800 | 1 | 800 | 1 | <£25k | |
| | | Improved Maintenance | Continue with maintenance regime of highway drainage at this location | | Improved Maintenance Regimes | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | <£25k | |

| CDA_ID | CDA Name | Options Category | Option Description | Combination Scheme? | Indicative Dimensions & Costings | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Measures | Cost (£) | Unit Description | Unit | Length | Area | Depth | Volume | Number | Drain London Cost Band | Cost Band for Combination of Measures |
| Group8_017 | King George's Trading Estate | Flood Storage / Permeability | Creation of a detention basin within King Georges Field. Further assessment would be required to confirm the scale of mitigation provided by such a scheme. | | Detention Basins | 22 | m3 of detention volume | m3 | | 10000 | 1 | 10000 | | £101k - 250k | N/A |
| | | Source Control, Attenuation and SUDS | Swale and bund at perimeter of bus garage | ✓ | Swales | 16 | m2 of swale area | m2 | 300 | 450 | N/A | N/A costed on area | N/A | <£25k | £101 - £250k |
| | | Other - Improvement to Drainage Infrastructure | increase gully provision at rail crossing of Cox Lane | ✓ | Increase the number or size of gullies to collect runoff and discharge to sewer | 215 | Per Gully | Pe | N/A | N/A | N/A | N/A | 6 | <£25k | |
| | | Improved Maintenance | Continue with existing Council maintenance of highway drainage system and liaise with TW regarding maintenance of the trunk sewer network. | ✓ | Improved Maintenance Regimes | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | <£25k | |
| Group8_018 | Hook/Kelvin Grove | De-culvert / Increase Conveyance | Survey of Surbiton Stream and its tributaries with a view to carry out maintenance and increase conveyance as deemed necessary | ✓ | Increasing Capacity in Drainage Systems | Further assessment required | N/A | N/A | N/A | N/A | N/A | N/A | N/A | >£10m | Further assessment required |
| | | Flood Storage / Permeability | Provision of flood storage and bund to the west of Kelvin Grove | ✓ | Detention Basins | 22 | m3 of detention volume | m3 | | 7400 | 1 | 7400 | 1 | £101k - 250k | |
| | | Other - Improvement to Drainage Infrastructure | Re-run pluvial modelling including the Bridge Road mitigation scheme to confirm the mitigation that this scheme provides to the CDA | ✓ | Increasing Capacity in Drainage Systems | Further assessment required | N/A | N/A | N/A | N/A | N/A | N/A | N/A | >£10m | |
| Group8_019 | Chessington North | Improved Maintenance | Ensure that on going maintenance is maintained at current levels | ✓ | Improved Maintenance Regimes | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | <£25k | £101 - £250k |
| | | Other - Improvement to Drainage Infrastructure | Increase the number of gullies on Bridge Road connecting to the large flood relief culvert (Bridge Road Sewer) | ✓ | Increase the number or size of gullies to collect runoff and discharge to sewer | 215 | Per Gully | Pe | N/A | N/A | N/A | N/A | 20 | <£25k | |
| | | Preferential / Designated Overland Flow Routes | Much of this work has been completed through the use of speed bumps. This will slow flow down and contain water within sections of road. | ✓ | Managing Overland Flows (Preferential Flowpaths) | Further assessment required | N/A | N/A | N/A | N/A | N/A | N/A | N/A | <£25k | |
| Group8_020 | Barwell Business Park | Improved Maintenance | Thames Water maintenance of culvert crossing railway embankment and education of site owners and their responsibility for maintenance of private drainage network | ✓ | Improved Maintenance Regimes | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | <£25k | £101 - £250k |
| | | Preferential / Designated Overland Flow Routes | Creation of overland flow routes to divert water away from property. This is a private scheme, landowners would have to take on this measure | ✓ | Managing Overland Flows (Preferential Flowpaths) | Further assessment required | N/A | N/A | N/A | N/A | N/A | N/A | N/A | <£25k | |
| | | Community Resilience | Education of site owners and users of the potential future surface water flood risk | ✓ | Social Change, Education and Awareness | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | <£25k | |

| CDA_ID | CDA Name | Options Category | Option Description | Combination Scheme? | Indicative Dimensions & Costings | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Measures | Cost (£) | Unit Description | Unit | Length | Area | Depth | Volume | Number | Drain London Cost Band | Cost Band for Combination of Measures |
| Group8_021 | Malden Rushett | Improved Maintenance | Inspection and maintenance of highway drainage including grips, drainage ditches and culvert at Rushett Lane. This may require enforcement on riparian owners | ✓ | Improved Maintenance Regimes | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | <£25k | £101 - £250k |
| | | Other - Improvement to Drainage Infrastructure | Creation of additional grips along the Leatherhead Road and re-instatement of local drainage ditches at rear of property | ✓ | Other 'Pathway' Measures | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | <£25k | |
| | | Other or Combination of Above | Liaison with landowners with the potential to alter land management practices, highlight the importance of land drainage and outline their responsibilities | ✓ | Land Management Practices | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | <£25k | |

**Note:** This table has been produced to assist with the preliminary cost estimates as part of the SWMP for the Royal Borough of Kingston upon Thames. All dimensions and costs are indicative and should only be used for preliminary estimates due to the generalised nature of the information used to compile it.

An estimated cost for the preferred flood mitigation option for each identified CDA has been calculated based on standard unit costs provided as part of Tier 1 of the Drain London Project to mitigate the 3.3% AEP (1 in 75 year event). No monetised damages have been calculated, and flood mitigation costs have been determined using engineering judgement, but have not undergone detailed analysis. The following standard assumptions have been applied, as determined in the Drain London Prioritisation Matrix Guidance:

- The costs are the capital costs for implementation of the scheme only.
- Costs do not include provisions for consultancy, design, supervision, planning process, permits, environmental assessment or optimism bias.
- No provision is made for weather (e.g. winter working).
- No provision is made for access constraints.
- Where required, it will be stated if costs include approximate land acquisition components.
- No operational or maintenance costs are included.
- No provision is made for disposal of materials (e.g. for flood storage or soakaway clearance).

As a result, costs should be treated at an order of magnitude level of accuracy and have therefore been stated within this table and reporting text as a series of cost bands.

Swales are assumed to be 1.5m wide for the purposes of costing. The exact size of swales would need to be confirmed as part of site specific options assessments.

## 4.6 Option Prioritisation

4.6.1 The Prioritisation Matrix was developed out of the need for a robust, simple and transparent methodology to prioritise the allocation of funding for surface water management schemes across the 33 London Boroughs by the Drain London Programme Board. As such, the prioritisation should be understood in the high-level decision-making context it was designed for. It is not intended to constitute a detailed cost-benefit analysis of individual surface water flood alleviation schemes.

4.6.2 The information within Table 4-5 and 4-6 will used by the Drain London Programme Board to populate the Drain London Prioritisation Matrix and identify capital schemes to be taken forward under the Tier 3 package of works.

**Table 4-6 Phase 3 Summary of Preferred Options – (*For input into Drain London Prioritisation Matrix only)***

Note: The Drain London Prioritisation Matrix requires an estimation of the percentage of total number of units that have the potential to benefit from the proposed scheme. This has been determined by calculating the number of units within the Local Flood Risk Zone that the scheme has been designed to mitigate, as a percentage of the number of units within the CDA as a whole. The input is restricted to multiples of five percent. It should be noted that the information within this table is purely for input into the Drain London Prioritisation Matrix and should be treated as such.

| CDA ID | Scheme Location | Scheme Category | Infrastructure | | | | | | Households | | | | Commercial / Industrial | | Capital Cost Band |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Essential | | Highly Vulnerable | | More Vulnerable | | Non-Deprived (All) | | Deprived (All) | | All | | |
| | | | Eliminated (%) | Mitigated (%) | Eliminated (%) | Mitigated (%) | Eliminated (%) | Mitigated (%) | Eliminated (%) | Mitigated (%) | Eliminated (%) | Mitigated (%) | Eliminated (%) | Mitigated (%) | |
| CDA_008 | Richmond Park and Park Road Sports Ground | Source Control/Attenuation/SUDS – provision of detention basin and swale | 0 | 0 | 0 | 0<br>N.B. No highly vulnerable infrastructure within CDA | 0 | 12 | 0 | 17 | 0<br>N.B. No deprived households within CDA | 0 | 0 | 1 | £501k - £1m |
| CDA_009 | Carlton Road and Selbourne Rod | New Malden North - No capital measures identified for inclusion within the Drain London Prioritisation Matrix. It is suggested that 'quick win' measures be applied | | | | | | | | | | | | | |
| CDA_010 | Kingston Town Centre | Kingston Town Centre - No capital measures identified for inclusion within the Drain London Prioritisation Matrix (flood risk is primarily caused by fluvial flooding at the EA should lead on mitigation). It is suggested that 'quick win' measures be applied | | | | | | | | | | | | | |
| CDA_011 | New Malden High Street Rail Bridge | Improvement to Drainage infrastructure – installation of pumps | 0 | 0 | 0<br>N.B. No highly vulnerable infrastructure within CDA | 0 | 0 | 0 | 0 | 0<br>N.B. No deprived households within CDA | 0 | 0 | 22 | £101k - £250k | |
| CDA_012 | Surbiton crescent | Improvement to drainage infrastructure – separation of drainage network | 0<br>N.B. No essential infrastructure within CDA | 0 | 0<br>N.B. No highly vulnerable infrastructure within CDA | 0 | 0<br>N.B. No more vulnerable infrastructure within CDA | 0 | 0 | 36 | 0<br>N.B. No deprived households within CDA | 0 | 0 | 23 | <£25k | |
| CDA_013 | Rose Walk and Kingston Road | Improvement to Drainage infrastructure – drainage survey and addition of gullies | 0 | 0 | 0<br>N.B. No highly vulnerable infrastructure within CDA | 0 | 0 | 0 | 0 | 7 | 0<br>N.B. No deprived households within CDA | 0 | 0 | 8 | £101k-£250k | |
| CDA_014 | Alexandra Drive | Alexandra Drive - No capital measures identified for inclusion within the Drain London Prioritisation Matrix (some remedial works already completed and primary risk is fluvial). It is suggested that 'quick win' measures be applied | | | | | | | | | | | | | |
| CDA_015 | Crossing points of A3 | Pumps at A3 crossings – No capital measures taken forward to Drain London prioritisation matrix, TFL to progress | | | | | | | | | | | | | |
| CDA_016 | Sheephouse Lane | Source Control/attenuation/SUDS – provision of swale (note flooding at this location may be an overestimate) | 0<br>N.B. No essential infrastructure within CDA | 0 | 0<br>N.B. No highly vulnerable infrastructure within CDA | 0 | 0<br>N.B. No more vulnerable infrastructure within CDA | 0 | 0 | 11 | 0<br>N.B. No deprived households within CDA | 0 | 0 | 0 | Further assessment required | |
| CDA_017 | King George's Field | King George's Trading Estate- No capital measures identified for inclusion within the Drain London Prioritisation Matrix (no residential property at risk and private drainage serving industrial areas). It is suggested that 'quick win' measures be applied | | | | | | | | | | | | | |
| CDA_018 | Kelvin Grove | Kelvin Grove – No capital measures identified for inclusion within the Drain London Prioritisation Matrix (surface water flooding may be an overestimate at this location due to Bridge Road Sewer). It is suggested that 'quick win' measures be applied and further assessment be completed. | | | | | | | | | | | | | |
| CDA_019 | Bridge Road | Bridge Road – No capital measures identified for inclusion within the Drain London Prioritisation Matrix (surface water flooding may be an overestimate at this location due to Bridge Road Sewer). It is suggested that 'quick win' measures be applied. | | | | | | | | | | | | | |
| CDA_020 | Barwell Business Park | Barwell Business Park – No capital measures identified for inclusion within the Drain London Prioritisation Matrix. It is suggested that 'quick win' measures be applied. | | | | | | | | | | | | | |
| CDA_021 | Leatherhead Road | Leatherhead Road – No capital measures identified for inclusion within the Drain London Prioritisation Matrix. It is suggested that 'quick win' measures be applied. | | | | | | | | | | | | | |