LONDON STRATEGIC SUDS PILOT STUDY

SuDS Evaluation Scenarios, Technical Note

DECEMBER 2020

1 SUMMARY

This technical note covers the proposed scenarios developed to evaluate the benefit of various Distributed SuDS strategies. SuDS Scenarios have been formulated to understand the magnitude and variation of benefit based on SuDS feature types, location, and scale of implementation.

2 STAGE 1, ASSESSMENT CONCEPT DEVELOPMENT SCENARIOS

The SuDS Evaluation Scenarios provide a range of potential technical and logistical mechanisms to deliver the Distributed SuDS approach. Each scenario defines which SuDS Features to incorporate based on their purpose, with specific geographical constraints applied in some cases.

The scenarios were split into three key types:

- **Strategic Scenarios** – Represent the full implementation of the optimised SuDS Features based purely on flood risk benefit and the maximisation of investment potential
- **Common Scenarios** - Holistically applicable approaches to implementing Distributed SuDS, potentially applicable to any catchment, focusing on potential common delivery mechanisms and to understand the impact of spatial variation
- **Local Scenarios** – Designed scenarios aligned to prospective delivery mechanisms specific to each CDA

2.1 SuDS Evaluation Scenarios

2.1.1 Strategic Scenarios

The feature selection process provides an optimised and ranked set of SuDS Features for each CDA, representing the complete implementation of the Distributed SuDS approach. The All SuDS Scenario has been formulated to represent the full implementation of the most optimal SuDS feature type for each location, as shown in Table 1.

Scenario	Description	Property Raised Planter	Property Rain Garden	Swale	Bioretention Rain Garden	Tree Pits
All SuDS	The optimised feature selection process provides an optimised and ranked set of SuDS Features for each CDA, representing the complete implementation of the Distributed SuDS approach. This scenario has been formulated to represent this complete implementation, based on the highest ranked components and with no geographic constraints	✓	✓	✓	✓	✓
GLA SuDS Opportunity Mapping	Utilisation of GLA SuDS Opportunity Mapping 'Dominant Option' to select the relevant SuDS configurations based their dimensions, spatial overlap and proximity to the GLA SuDS Opportunity Mapping polygons.	✓	✓	✓	✓	✓

Table 1 - Strategic Scenarios

2.1.2 Common Scenarios

The common scenarios devised are listed in Table 2.

Scenario	Description	Property Raised Planter	Property Rain Garden	Swale	Bioretention Rain Garden	Tree Pits
Community Land	Focus on Council owned land to limit potential need for cross-authority maintenance agreements *(commuted sums)* and / or land purchase. This scenario only considers SuDS Features within council ownership, such as community housing land and schools.	✓	✓			
Traffic Calming Integration	Application of SuDS Features which could be designed to provide traffic calming, applied across all residential streets and distributor roads *(except TfL)*.				✓	✓
Upper Catchment Source Control	Implementation the Maximised Hydraulic Function Strategic Scenario, limited to locations within the upper 50%ile of elevation *(based on EA LiDAR data)* to ascertain the potential value of focusing on upper catchment runoff sources.	✓	✓	✓	✓	✓
Mid Catchment Pathway Management	Implementation of relevant pathway management SuDS Features only, limited to locations within the middle 20-50%ile of elevation *(based on EA LiDAR data)* to ascertain the potential value of focusing on removing flows from key pathways.			✓	✓	✓
Lower Catchment Receptor Mitigation	Implementation of relevant SuDS Features, limited to locations within the lower 20%ile of elevation *(based on EA LiDAR data)* to ascertain the potential value of seeking to reduce water depths within areas with a typically higher number of flood receptors.			✓	✓	✓
Street Tree Replacement	Addition and retrofit of existing street trees *(with SuDS tree pits)*, representing a strategic approach to urban greening and aligning within ongoing street tree replacement and maintenance programmes.					✓

Table 2 – Common Scenarios

2.1.3 Local Scenarios – Enfield

The local scenarios devised for Enfield Town Centre and Moore Brook Culvert were developed through consultations with London Borough of Enfield (LBE), looking to identify key urban regeneration programmes and highways development initiatives which could be aligned with the vision of this project. These scenarios are listed in Table 3.

Scenario	CDA	Description	Property Raised Planter	Property Rain Garden	Swale	Bioretention Rain Garden	Tree Pits
Enfield Town Centre	ETC	Implementation of SuDS Features within the commercial centre of Enfield, aligned to the programme of streetscape and traffic upgrades.				✓	✓
Cycle Enfield	Enfield Town Centre / MBC	Implementation of bioretention SuDS Features as integral elements within the Cycle Enfield Scheme, as shown in the Final Post Consultation Drawings *(http://cycleenfield.co.uk/wp-content/uploads/2016/04/B240G001-UD-57-A105-Final-Post-Consultation-Drawings_Rev00.compressed.pdf)*. The selected SuDS Features restricted to the extent of the proposed scheme.				✓	
TFL A10 Pathway Intersection	MBC	Usage of swale components along the A10 to intersect overland flow pathways, providing increased protection downstream and enhancing highway easements			✓		

Table 3 – Enfield Local Scenarios (inc. Enfield Town Centre and Moore Brook Culvert CDAs)

2.1.4 Local Scenarios – Hillingdon

A single local scenario which reflected the Eastcote Town Centre Public Realm Improvement project[1], developed in consultation with London Borough of Hillingdon (LBH).

2.2 Realisation Levels

The projected value of Distributed SuDS was predicated on the concept of its large-scale application, with the flood risk (and wider) benefits generated increasing as more features are installed. The SuDS Evaluation Scenarios effectively represent an aspirational long-term investment, defined in terms of the cost-benefit and actual flood risk benefit. A set of Realisation Levels (created for each scenario) were defined to understand the relationship between benefit and staggered long-term commitment to implementing Distributed SuDS.

For each Realisation Level, SuDS features were selected in order from highest benefit-cost ratio down, until the sum of the CAPEX costs equate the defined percentage of the total projected CAPEX. A graphic representation of the derivation of the Realisation Levels is shown in Figure 1.

[1] https://archive.hillingdon.gov.uk/article/32118/Eastcote-Town-Centre---public-realm-improvements

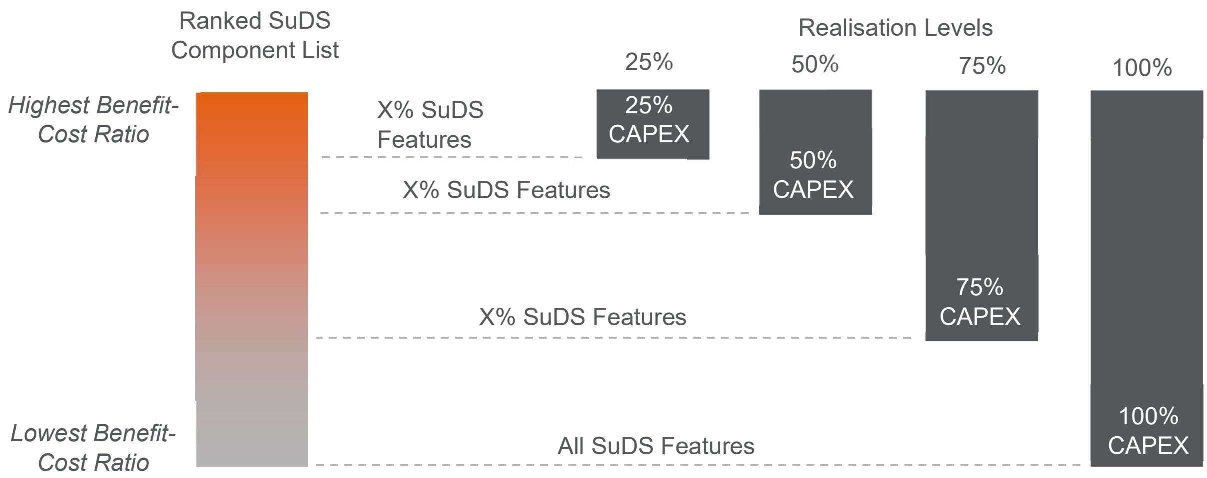

Figure 1 –Graphic Representation of The Derivation of Conceptual Implementation Scenario Realisation Levels

Developing Realisation Levels based on SuDS Features with the highest Benefit-Cost Ratios down to the lowest aims to focus on those locations which will provide the most significant catchment-level benefit, specifically in terms of flood risk. The expectation was that some scenarios may demonstrate a point of diminishing return on investment which could provide a unique insight into the investability of the concept of Distributed SuDS.

3 STAGE 2, COMPREHENSIVE ECONOMIC VALUATION SCENARIOS

3.1 SuDS Evaluation Scenarios

Three strategic approaches have been evaluated in Stage 2:

- **Public Realm Implementation** - Adaptation of the public streetscape to incorporate engineered bioretention features to manage highway runoff at source, optimised for maximum hydraulic benefit
- **Private Realm Implementation** - Implementation of discrete SuDS features to manage public and private property roof runoff
- **Full Implementation** – Integration of both public and private realm opportunities

3.1.1 Public Realm Implementation

This approach will be split into two main SuDS types – Bioretention and Street Trees. This reflects the dominance of benefit generated by these two types during Stage 1 and the anticipated applicability within the more densely developed and urbanised landscape of the Stage 2 study area.

3.1.1.1 Streetscape Bioretention

This scenario provides strategic insight into the benefit of engineered bioretention SuDS opportunities (typically engineered raingardens / bioretention strips) within public highway / shared hard standing (e.g. pedestrian areas). It is analogous to the All SuDS scenario developed for Stage 1 without the inclusion of property raingardens / rain boxes and street trees (both of which have specific scenarios for Stage 2).

These features have been derived using a guided GIS process which automatically digitises potential footprints within pavements and urban hardstanding, based on defined design standards and case studies (e.g. minimum pavement width, general SuDS construction approaches etc.). The derivation of these figures is explained in the SuDS Feature, Technical Note. The defined depths and other hydraulic parameters are consistent for every SuDS location, based on the defined design standards and case studies. The bioretention feature footprints are the primary variable used to define the effective capacity of each SuDS opportunity.

3.1.1.2 Street Tree Replacement

This scenario will assume the inclusion of tree pit storage SuDS features at existing street tree locations. The structural and hydraulic parameters will be split into the following:

- **Highway Tree Pit** – trees adjacent to the carriageway that runoff could directly flow into *(via an inlet)*
- **Pavement / hardstanding Tree Pit** – trees located away from the highway which could drain non-highway paved areas *(via a permeable surrounding)*

The defined structural and hydraulic parameters will be consistent for each type based on the defined design standards and case studies, explained in the SuDS Feature, Technical Note.

3.1.1.3 New Street Trees

The defined structural and hydraulic parameters will be consistent for each type based on the defined design standards and case studies, explained in the SuDS Feature, Technical Note.

3.1.2 Private Realm Implementation

This approach will be split into two main SuDS types – living roofs and rainwater planters. These are considered technically and financially challenging to realise but are expected to generate significant benefits due to the potential scale of opportunities, justifying their inclusion as alternatives to works in the public realm (i.e. bioretention and street tree pits).

3.1.2.1 Living Roofs

Due to the significant uncertainty around where living roofs are likely to be feasible, or realised as part of redevelopment projects, all potential locations (i.e. roofs over a specified minimum size) will be modelled. The effective depth of the living roof growing media will be used to vary the net scale of implementation, used as a proxy for the number of living roofs constructed (e.g. for the 25% realisation level a depth of 0.1 would be input into the model as 0.025m).

The selection of opportunities for living roofs across the study area is defined in the SuDS Feature, Technical Note.

3.1.2.2 Rainwater Planters Retrofit

This scenario will be based on the use of the Thames Water rainwater planters, based on design information provided. Similar to living roofs they will be applied to all relevant buildings in the model, with the effective capacity (i.e. volume) adjusted to vary the net scale of implementation (e.g. for the 25% realisation level the volume of 0.21m^3 would be input into the model as 0.053m^3).

The selection of opportunities for rainwater planters across the study area is defined in the SuDS Feature, Technical Note.

3.1.3 Full Implementation

This scenario will represent the combined benefit of all the Public Realm and Private Realm SuDS feature opportunities.

3.2 Realisation Levels

3.2.1 Public Realm Implementation Scenarios

Realisation levels represent the staggered implementation of each scenario based on a defined percentage of the total SuDS features (based on CAPEX). The schedule of SuDS features were ranked based on their projected 'effectiveness', calculated as the ratio between flood damages avoided and CAPEX. This effectiveness figure was summed within the TfL hex grid SuDS 'clusters', used to create each realisation level. This is aimed at achieving the highest return on investment, comparable to Stage 1, but skewed towards the realisation of maximum hydraulic benefit.

The 'maximum' level of investment has been assumed to be 100% of all identified opportunities, to provide a full range of potential benefit outcomes from which deliverable targets can be identified.

Given the expected number of SuDS opportunities, due to the scale of the catchment, the realisation levels have been specified as non-linear to enable a more detailed understanding of the benefits generated by more minor initial investments in SuDS. The selected realisation levels are:

- 1% of projected CAPEX
- 2% of projected CAPEX
- 5% of projected CAPEX
- 25% of projected CAPEX (to enable comparison with Stage 1 results)
- 100% of projected CAPEX

3.2.2 Private Realm Improvements Scenarios

For these scenarios the attenuation capacity information (as defined in the SuDS Feature, Technical Note*)* will be used to 'adjust' all property roof subcatchments considered candidates for living roofs by the percentage defined for each realisation level. The potential locations (identified in the SuDS Feature Schedule) will not be sorted based on their benefit-cost ratio, as there is no way to spatially link the hydraulic benefit from roof drainage to catchment flood reduction or network headroom.

This is to account for inability to estimate the location that private realm improvements may be possible *(due to the uncertainty over feasibility, property ownership, location of development, long-term economic influences etc.)*. Instead, a net catchment consideration for incremental delivery of living roofs and rain boxes will be applied.

4 RAINFALL EVENTS

The SuDS Evaluation Scenarios will be assessed using a range of design rainfall events, selected to ensure a pragmatic and relatable understanding of benefit for both Thames Water and the LLFAs. A single critical rainfall duration will be identified following Thames Water standards.

4.1 Return Periods

The return periods proposed are as follows:

- **1 in 10 yr** – Provide prediction of damages to enable the definition of the UPFC OM2 very significant risk band
- **1 in 30 yr** – Public sewerage system design standard
- **1 in 50 yr** – Provide prediction of damages to enable the definition of the UPFC OM2 significant risk band

The Public Realm and Private Realm scenarios will be run with the 1 in 10, 30 and 50-year events.

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