
# SuDS Retrofit Design Note

This Design Note is an internal Kildare County Council document. It serves as a resource for Kildare Council staff who are considering the design and implementation of retrofit Sustainable Drainage Systems (SuDS) in existing urban areas. With increasing urbanisation and climate change intensifying flood risks, retrofitting SuDS offers an effective approach to managing surface water runoff while enhancing urban resilience and sustainability.

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Kildare County Council

## *Preface*

This Design Note serves as a companion document to the **KCC Sustainable Drainage Systems Guidance Document (2024)**. The purpose of this design note is to outline the differences in design approach when considering SuDS retrofit in contrast to going through the planning process where County Development Policies are required to be fully demonstrated.

SuDS retrofit structures have a primary drainage function but if designed correctly and integrated with the wider landscape they can deliver co-benefits such as climate change adaptation, enhancements to public realm and improve the provision for amenity and biodiversity. KCC encourage SuDS which are nature-based in the design of all Council and public projects in accordance with best practice.

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# 1 Introduction

*There has been an increasing awareness over recent years that traditional piped drainage does not meet our aspirations for sustainably managing rainfall in cities. Sustainable Drainage Systems (SuDS) not only reduce the risk of flooding but dramatically reduce the pollution of watercourses whilst potentially providing significant benefits to both people and wildlife.*


Photo: Retrofit bioretention raingardens alongside a busy high street with street tree planting.

## 1.1 What are Retrofit SuDS?

**SuDS** deal with rainfall runoff from **new development**. This includes regeneration schemes and re-development schemes where there is substantial work being undertaken which may include modification to existing drainage.

**SuDS retrofit** deal with runoff from **existing urban development** and is therefore likely to require adaptation of the existing urban hard and soft landscape to collect and manage rainfall in a more sustainable manner.

SuDS retrofit structures / techniques, can be used to reduce the amount and rate of rainfall runoff going to the stormwater drainage network or combined sewer network, provide water quality benefits by removing and treating pollutants from urban runoff, or provide flood risk mitigation. Well-designed SuDS retrofit schemes can also provide improved amenity and biodiversity along with improved climate resilience.

*Photograph: Malmo – early retrofit SuDS scheme*

*Design note: SuDS retrofit can be more difficult than on new (or re-development) schemes where the whole area of development is being altered. Depending upon the specific site constraints for SuDS retrofit projects, KCC will have discretionary powers on determining the extent to which SuDS hydraulic requirements will be applied to SuDS retrofit projects.*

Retrofitting SuDS into Kildare public buildings, streets, roads, parks and green spaces has the potential to provide benefits to the issues of capacity of the sewer, flooding and pollution, but also deliver many other co-benefits to people and wildlife, such as:

- Proven health and well-being benefits of access to quality green spaces and nature
- Improve appearance and attractiveness to people.
- Increase variety and quality or urban areas.
- Enhance ways in which spaces can be used and enjoyed.
- Reduce urban heat island effect.
- Improve urban comfort.
- Provide shade and shelter.
- Improve air quality.
- Reduce the demand for irrigation.
- Create greener urban landscapes.
- Support wildlife and create valuable habitats.

SuDS retrofit can be undertaken at different scales.

- **Strategic SuDS retrofit schemes** considers a scheme of significance or a catchment wide role out of smaller schemes as part of an overarching strategy.
- **Opportunistic SuDS retrofit schemes** are usually smaller schemes considered in isolation and would include schemes that had not originally been considered for SuDS functionality that could be adapted.

## 1.2 The role of retrofit SuDS

Retrofit SuDS should seek to balance the functional objectives of reducing flooding and pollution with delivering places that contribute to the character, value, climate resilience and biodiversity.

Because retrofit SuDS will impact areas that communities and businesses already have a relationship with, it is critical that any interventions do not have a negative impact on the quality or usability of those spaces, and ideally provide benefits.

**Flood risk -** SuDS is particularly useful in tackling locally occurring **surface water flooding**, when rainfall can't get into the sewer fast enough, or the drainage network is already at capacity. Where there is sufficient coverage of SuDS introduced in the urban catchment, flood risk in the wider catchment will be materially reduced by relieving the pressure on main sewers and watercourses.

**Water quality -** To reduce the impacts of diffuse urban pollution on our rivers, SuDS should ensure that the most polluted 'first flush' of runoff is captured and treated as part of SuDS retrofit design. It is generally accepted that **the first 10-15mm of rainfall flushes most accumulated pollution from hard surfaces**. This is often called the 'first flush' volume.

Using **source control SuDS features** such as bioretention raingardens and porous surfaces to remove pollutants will protect subsequent SuDS features. Where source control features cannot be installed, forebays to trap pollutants should located at the point of inlet to the SuDS feature.

**Amenity -** SuDS features can incorporate various amenity activities nature based play structure and be designed as **'play on the way'**, where the play features are located along an active route rather than within a dedicated playground space. At the same time, they can be designed to be beautiful landscapes that add character and quality to the urban landscapes throughout Kildare County.

**Biodiversity** - Clean water that is managed at the surface will help improve habitats and create a biodiversity rich environment. The design and choice of planting, shape and complexity of nature based SuDS retrofit features, whether they contain wetland areas and inclusion of habitat features, such as hibernacula, can generate valuable urban oases for wildlife, which if located in enough appropriate areas could create a network of corridors for nature to thrive within highly urbanised areas.

*Design note: The need to restore ecosystems and biodiversity is a key theme of the EU Biodiversity Strategy 2030.*

Image: A retrofit SuDS scheme conveying polluted runoff from the street network into a series of lined and infiltration basins.

# 2 Needs and Opportunities for retrofit SuDS

*Incorporating well designed retrofit SuDS as part of a project will help improve climate resilience of the local area as well as providing opportunities for improvements to under-used or under-valued urban spaces.*

## 2.1 Understanding the needs of the urban catchment

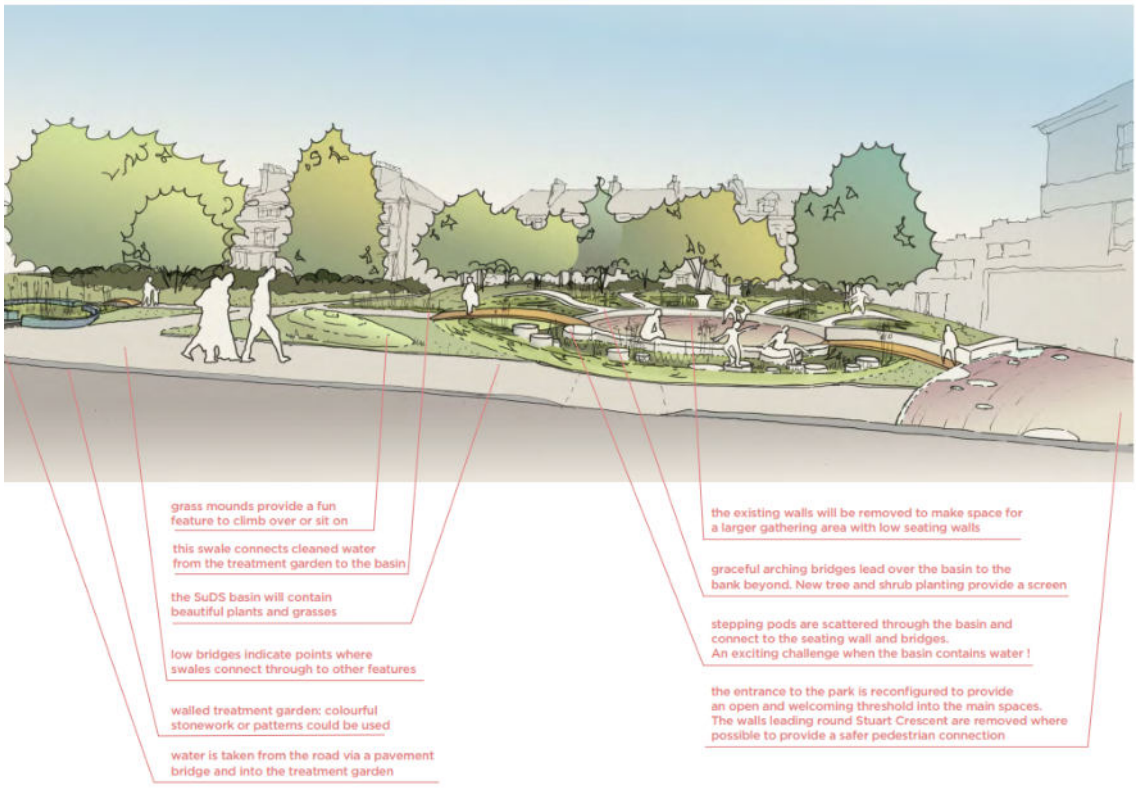
The issues which the SuDS retrofit scheme is addressing should be identified at the commencement of the design as this may influence the hydraulic strategy. Typical needs to be addressed may include

- Localised (or catchment level) surface water flooding
- Poor water quality within water courses
- Reduction in pollution risk to groundwater
- Regeneration or urban renewal requirements
- Lack of provision for biodiversity (fragmentation through no provision of ecological corridors, lack of diversity of planting)

## 2.2 Understanding the needs of communities and stakeholders

Positive engagement with communities, businesses and other stakeholder whose relationship and use of the project area may be affected by the scheme is very important for successful outcomes. This should be first conducted early in the process before designs have been formed to introduce them to potential change, determine the needs of those stakeholders and reassure them that designs will respond positively to those needs.

Visual aids such as artistic impressions from bird's eye view and eye level will provide members of the public and other stakeholders with a non-technical background a realistic sense of what the scheme will look like (compared with information presented on layout plans and cross sections).




## 2.3 Establishing opportunities for retrofitting SuDS

When approaching these schemes consideration should always be given to maximising the potential for;

- Improved water quality to rivers, streams and other waterbodies
- Separating rainfall runoff from the combined sewer (in areas of combined sewer system)
- Improving habitats for biodiversity
- Making provision for amenity

The following is provided as initial guidance when identifying suitable locations for SuDS retrofit.

- Sites that are affected by (or have the ability to intercept) an exceedance surface water flow path may have the potential to store runoff from a more extensive catchment.
- Publicly owned lands within KCC control are likely to be preferred as these sites are less likely to be reliant upon the permission of 3rd party landowners.
- Sites which are highly valued by the local community may meet resistance where proposals are designed to hold volumes of rainfall runoff. Designing open space to incorporate retrofit SuDS needs to be handled sensitively with early engagement with the community to demonstrate how proposals would enhance the space, without affecting its functionality.

### *2.3.1 Wherever we are redeveloping a current urbanised space or place*

Any redevelopment generates opportunities for retrofit SuDS. Retrofit SuDS will be most cost-effective when it is carried out as part of another infrastructure or regeneration project.

Consideration should be given to.

- Public realm schemes (both hard landscape and refurbishment of existing parks)
- Transport infrastructure schemes including greenways, cycle ways and bus lanes.
- New roads / road improvement schemes
- Park / open space upgrades
- Village improvement works.
- Local environmental improvement schemes
- Estate regeneration schemes and other upgrades to council housing

*Image: park in Copenhagen which has been adapted to store excess water at ground level – Images courtesy of Niels Nielsen from Carlsberg Byen P/S*

Wherever we are planning a project we should ask, ***"How can this project better manage rainfall?"***

For example, a project aimed at planting new street trees and replacing an area of tarmac with paving could be adapted to have permeable surfaces and SuDS tree pits. In this way, incorporation of SuDS will have minimal additional cost in comparison to a project which does not contain SuDS.

A new cycle highway or bus lane project intending to have strips of green infrastructure between lanes could introduce bioretention raingardens into that strip requiring simply gaps in the kerb, a lower soil level, sub-surface drainage layers and a flow controlled outlet.

*Image: Bioretention raingardens positioned between street/road and pedestrian pathway, constructed with robust, slotted roadside kerb inlets.*

Their location at the edge of footpaths means they will often be built over existing gully locations so connection and controlled outflow to existing sewers can be easily facilitated.

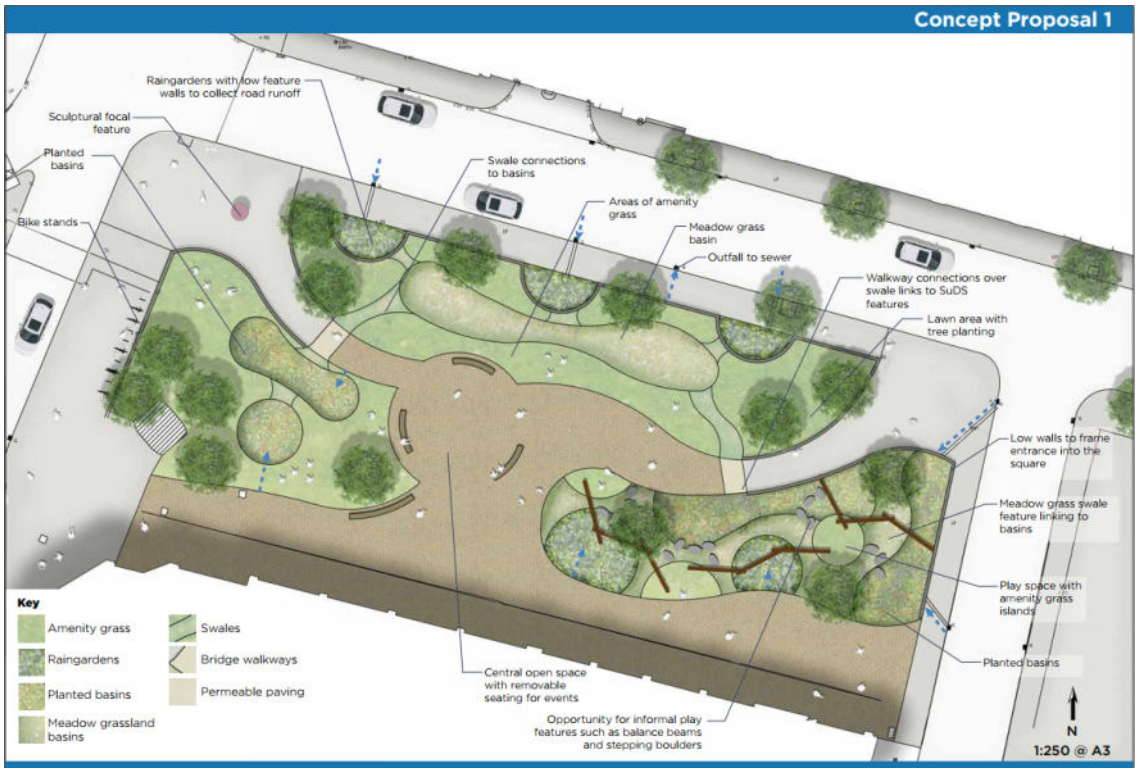



*Image: Plans to rejuvenate an underused park through introduction of SuDS. Runoff is taken from adjacent roads through the footpath and introduced to the park via forebays at shallow depth.*

### *2.3.2 Underused greenspace*

Opportunities to retrofit SuDS can also be found where we don't already have plans for improvement projects.

Existing greenspace between buildings or next to roads or car parks will offer the most cost-effective retrofit SuDS opportunities as they typically require less modification to existing hard surfaces and reprofiling soft landscape areas to manage volumes of runoff is relatively inexpensive.

Most urban towns and villages will have a range of green spaces, from parks to small grassed corners at junctions and along footpath verges, as well as public open space provision within residential areas.

Image: A retrofit SuDS scheme featuring several bioretention raingardens specifically designed to collect and slow the 'first flush' of polluted runoff from the adjacent highway before the water is conveyed into secondary raingardens.

With concerns around air pollution and health and well-being, there is the potential for green spaces and retrofitting SuDS to bring significant co-benefits to local communities and wildlife, as well as flood mitigation and water quality improvements.

Image: Example of missed opportunity. Flows enter gully pot rather than being directed into greenspace. The gully pot could be sealed and rainfall runoff from the road could be directed into the adjacent green space.

### 2.3.3 *Buildings and adjacent shared space*

Developing schemes which directly benefit the local residents such as Integration of informal play structures can improve engagement and buy in from the local community / residents. Presence of water and health and safety is a key consideration in the design process and must be carefully communicated with residents to ensure that the level of risk is not exaggerated.

Images below show pre and post construction for a residential SuDS retrofit scheme *installed as part of a social housing development to reduce pluvial flood risk.*

| *Before* | *After* |
|---|---|
|  |  |
| *Image shows shared residential green space with limited amenity value. All rainwater downpipes connect directly to an underground piped drainage network. The residential housing is located in an area of high surface water flood risk.* | *Image shows SuDS retrofit scheme where rainwater downpipes have been disconnected and directed into landscape depressions. Nature based Play features have been added using balance beams and stepping stones. Rainwater will pond to shallow depths and be released slowly through the gabion headwall outlet located in the foreground of the image.* |

Consideration should also be given to the

- community (householder) initiatives such as installation of rainwater butts, rain planters / rain gardens and de-paving of front gardens / driveways.
- introduction of green and blue roofs where suitable roofs are present (flat roofs with sufficient load bearing) on public buildings and council buildings.

## 2.4 Don't focus solutions solely on where it floods

Pluvial (surface water) flooding generally happens when excess rainfall runoff from a wider catchment does not enter the drainage network and accumulates at low points. To tackle surface water flooding, the contributing catchment can be assessed to identify ways of reducing the rate and / or volume of flow reaching the location where it is causing flooding.

Image: surface water flow routes determined by a linked 1D2D hydraulic model.

SuDS should not be focussed on the location of flooding but on the source of rainfall runoff – i.e. the wider urban catchment. An analysis of landscape and streetscape character will help assist identifying 'easy win' locations.

## 2.5 Flow Route Analysis – how does water currently flow at the surface and via drainage?

SuDS seeks to keep water 'at or near the surface' to mimic natural drainage patterns and provide a more resilient response to rainfall.

SuDS is therefore more influenced by topography than conventional drainage.

A flow route analysis is critical to inform retrofit SuDS design.

In an urban landscape natural flow pathways may be obstructed by man-made structures and artificial levels may have been created as part of development. For example, the kerb lines and crown of a road can influence flow path.

Image shows Outputs from detailed hydraulic analysis with kerb lines influence on flow route.

Topographical surveys with contours at appropriate elevation intervals supplemented with simple flow direction arrows will give a clear visual expression of how water flows over hard surfaces and where obstructions to flow exist in the urban landscape. These findings can be fundamental to the design.

The generation of the flow analysis as the starting point for Retrofit SuDS design helps to identify;

- where runoff can be collected,
- the potential location of 'source control' features,
- possible conveyance routes
- places where further storage of runoff can be accommodated.

SuDS Retrofit design should consider:

1. How different scales of rainfall are managed.
2. How existing flow routes are modified.
3. Overflow arrangements.
4. Exceedance routes when storage areas are exceeded.

## 2.6 Hydraulic considerations that influence design

In many Kildare town centre locations, there will be no alternative than discharging rainfall runoff to the sewer. Detailed consideration should be given to how flows can be managed to deliver greatest benefit to the receiving drainage network.

- **Maximise interception losses** through wetting of the surface of trees and plants and wetting of the topsoil.
- **Maximise evapotranspiration and infiltration** (where ground conditions are suitable).
- Attenuate runoff releasing it slowly to the drainage network. There are clear discharge rate and attenuation objectives for SuDS in greenfield and re-development sites and these are covered in detail in the KCC SuDS Design & Evaluation Guide.

Due to the constrained nature of many of Kildare's urban centres, there will be many occasions where it will not be possible or practicable to store the 1 in 100 year rainfall. KCC accept that due to constraints in urban environments, providing large attenuation volumes may not be feasible, practical or offer effective cost-benefit.

Retrofit SuDS should assess the ability and value of managing large volumes of runoff but always consider the first flush volume, often expressed as 'everyday rainfall', as a priority for management.

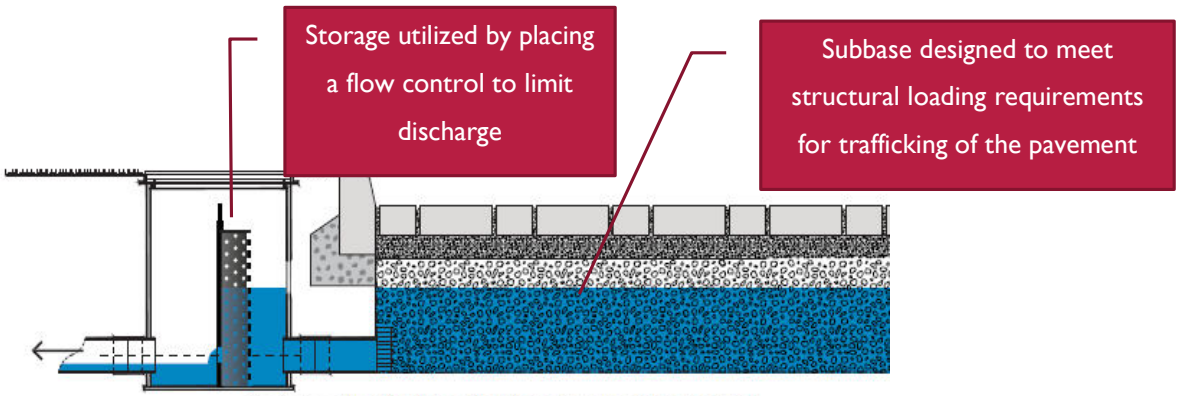
*Design Note: intercepting the first flush volume for treatment and slow release will provide significant benefits to both the combined sewer network and received water courses (separate sewer network). Providing storage for the first 15mm of rainfall generated from the contributing subcatchments should serve as the minimum target for attenuation storage.*

A suitable starting point for design is to establish the size of the SuDS feature based on other essential design criteria.

Examples of this approach would include.

- SuDS treepit designed for the amount of root zone required for prolonged healthy growth.
- Permeable pavement subbase designed to ensure structural performance will take required loading.

The inherent storage within these SuDS techniques can be used to temporarily store runoff.




Controflow® controlling outlet from a permeable pavement

Using this approach ensures that incorporating storage volume into SuDS retrofit does not introduce additional costs, which are solely attenuation storage costs, as the hydraulic design utilises storage potential which already exists for other design requirements.

[DESIGN NOTE END]