CEDR
Conférence Européenne des Directeurs des Routes
Conference of European Directors of Roads

SuDS

Sustainable Drainage Systems

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The WATCH project





CEDR: most important high frequency causes of road flooding

- Water in area around the road
  - Surface run-off
  - Pluvial flooding
- Heavy rain on the road itself

The WATCH project

- CEDR call: Climate Change: From Desk to Road
- September 2016 – April 2018
- Partners
  - Deltares (coordinator, The Netherlands)
  - ROD-IS (Ireland)
  - Egis (France)
  - Danish Road Directorate (Denmark)
  - KNMI (The Netherlands)

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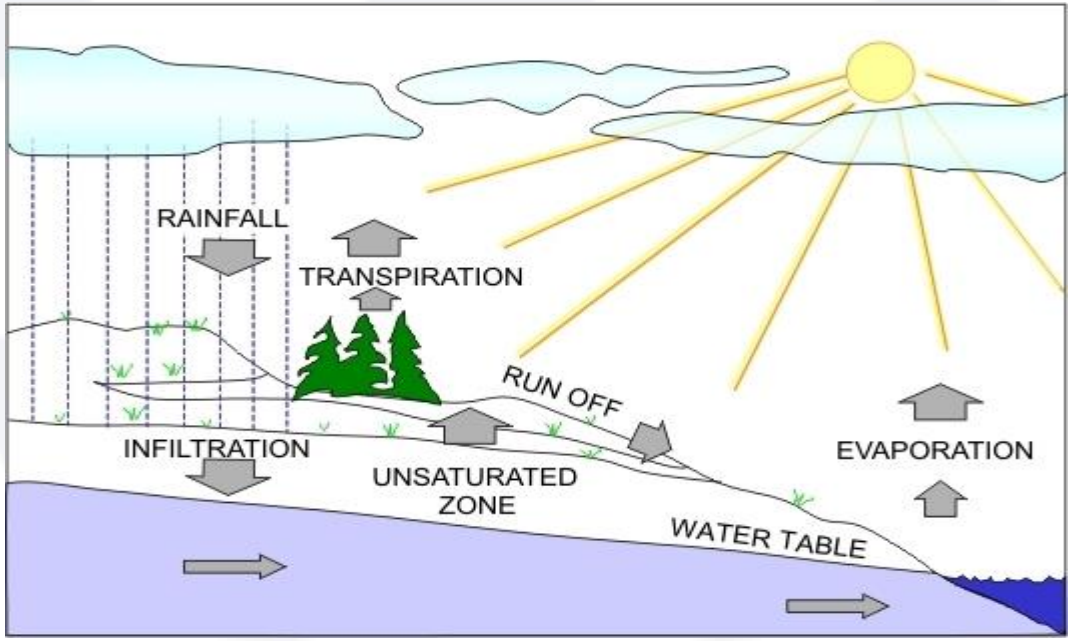
WATCH deliverables

- A **country comparison report** showing the state of practice of existing water management and drainage approaches
- **Guidelines for application of climate information** to be used in road drainage design and maintenance
- A **climate analogues tool** for rainfall extremes in Europe
- A **protocol for adapting SuDS** systems for climate change
- **Guidelines for a CBA** of adaptation and maintenance approaches for water management
- Culminating into one document,

"How to do" manual on water management assessment of resilience, understanding and applying consequences for design, inspection and maintenance

What is SuDS

Sustainable Drainage Systems (SuDS) philosophy highlights the need to support the natural hydrological cycle



The Hydrological Cycle (Geological Survey of Ireland, 2015)

SuDS Protocol for New & Existing Roads

- Description of SuDS features
- Concept of the SuDS management train
  - SuDS features linked together
  - Treat and attenuate runoff close to the source
- Climate change
  - Better treatment compared to traditional systems during intense rain
  - Improvement of chemical and biological treatment due to temp rise

What is SuDS (cont)

The construction of roads inevitably causes land to be covered with impermeable surfaces that alter the natural drainage regime.

SuDS offer integration with nature, by promoting: the temporary storage of surface water (ponding), infiltration, evaporation, evapotranspiration, groundwater recharge and the re-use of stormwater *(Roy et al. 2008).*

SuDS can increase morphology, provide amenity and biodiversity value, minimise the rate and quantity of discharge and protect or enhance the quality of receiving watercourses.

SuDS Protocol for New & Existing Roads

Some ‘typical’ SuDS features found in Roads

Filter Strip

Runoff from an impermeable area is allowed to flow across a grassed or otherwise densely planted area to promote sedimentation and filtration.

SuDS Protocol for New & Existing Roads

Some 'typical' SuDS features found in Roads (cont)

Swale

A swale is a shallow, wide channel with grass or other vegetation growing in the channel. It is normally unlined, but, if necessary it can be lined with an impermeable membrane.

Some 'typical' SuDS features found in Roads (cont)

Detention Basin

During a rainfall event, runoff drains to a landscaped depression with an outlet that restricts flows, so that the basin fills and provides attenuation.

Generally, basins are dry, except during and immediately following a rainfall event.

If vegetated, runoff will be treated as it is conveyed and filtered across the base of the basin.

SuDS Protocol for New & Existing Roads

Some ‘typical’ SuDS features found in Roads

Pond

A pond is a depression containing a permanent pool of water, with aquatic vegetation growing at the edges.

SuDS Protocol for New & Existing Roads

Some ‘typical’ SuDS features found in Roads

Wetland

Sometimes called a constructed wetland, it consists of an artificially constructed vegetated marshy area, which collects and treats water before discharging to a watercourse. It is similar to a pond but shallower.

The Benefits of SuDS over 'traditional' drainage practices

- Climate change predictions suggest that some types of extreme events will become more frequent, such as flooding caused by extreme rainfall, heat waves and drought.
- The SuDS approach is more **robust and adaptable** than the traditional approach of underground piped drainage systems.
- In shallow surface based systems, such as swales, water levels rise **gradually and visibly**. Conversely, flooding from underground piped drainage systems can occur suddenly and rapidly when the design capacity is exceeded.
- When the capacity of the SuDS feature is exceeded, the excess water can be directed to **safe storage zones**.

Factors Influencing the Selection of SuDS Components

There is no unique solution and each situation has to be evaluated on its own merits and suitable SuDS solutions applied, although the means to achieving these objectives are many and varied!!

Factors Influencing the Selection of SuDS Components (cont)

The key considerations are:

- **Site suitability,** such as:

  soil permeability; groundwater vulnerability; sensitivity of the receiving watercourse/groundwater; groundwater levels; climate ...

- **Space available**
- **Cost**

  SuDS systems are accepted as being cheaper than traditional drainage systems for new roads, however, SuDS 'retrofit' schemes are considered to be more expensive when the wider ecological, social and environmental benefits of SuDS are ignored.

Factors Influencing the Selection of SuDS Components (cont)

The key considerations are:

- **maintenance regimes**

  grass cutting, pruning, planting vegetation, removal of contaminated soil etc, and

- **community acceptance**

  requires stakeholder engagement and education

The SuDS 'Management Train'

The individual components described above do not constitute SuDS, if applied in isolation!!!

The SuDS philosophy, and effective stormwater management in general, requires **a series of SuDS features**, **linked together**, to form a stormwater **management system to attenuate and treat surface water runoff** as close to the source of runoff as possible, before being conveyed downstream for **further treatment and storage**.

SuDS Protocol for New & Existing Roads – An Overview

The objectives of this protocol are:

- to provide guidance for assessing the resilience of Sustainable Drainage Systems (SuDS) to climate change - during periods of drought, flash flooding, temperature extremes and periods of persistent rainfall and

- to propose appropriate resilient SuDS strategies to manage stormwater runoff arising from severe rainfall events now and into the future.

The SuDS Protocol.....Example....

Step 1

- Where the Outfall is a stream or river (the most common scenario for road authorities).

Other situations are developed in the protocol including where outfalls are;

- *stormwater sewers,*
- *combined sewers,*
- *discharge to groundwater and*
- *'zero discharge' evapotranspiration systems*

SuDS Protocol for New & Existing Roads

The SuDS Protocol – for discharge to Streams/Rivers

Step 2 – Establish Allowable Discharge Rates & Water Quality Discharge Limits

In New Roads, the considerations include;

- Develop a 'modular' SuDS system, to allow for future modifications
- Sensitivity & Assimilative Capacity of receiving watercourses,
- Review of River Basin Management Plans,
- Control of Accidental Spillage,
- Is the stream/river a source of potable water?

In Existing Roads , **further considerations include;**

- Presence of existing SuDS components,
- Topography,
- Space Available,
- Local environmental needs

Note: In existing roads, fewer 'options' may be available due to restricted availability of land, however, there is a greater opportunity for the designer to gather relevant data.

The SuDS Protocol – for discharge to Streams/Rivers

Step 3 – Determine the Most Appropriate SuDS features – based on Local Environmental Considerations

a) If the risk of groundwater pollution is within acceptable limits, then infiltration may be possible, subject to the findings of infiltration test results – ***Move to Step 4***

b) If the risk of groundwater pollution is outside acceptable parameters, then a 'sealed' system may be required. Options include:
   - Lined filter strips
   - Lined swales
   - Lined Detention Basin
   - Lined Ponds
   - Retention Ponds

The SuDS Protocol – for discharge to Streams/Rivers

Step 4 – Develop a 'SuDS Management Train'

Scenario 1

'Ideal Scenario' – Subject to Wet & Dry conditions with sufficient permeability and acceptable risk to groundwater:

Filter Strip → Swale/grassed channel → Detention Basin → Outfall

Scenario 2.

Infiltration not permitted due to risk of groundwater pollution:

Lined Filter Strip → Lined Swale/Grassed channel → Lined Detention Basin → Outfall

The SuDS Protocol – for discharge to Streams/Rivers

Step 4 – Develop a 'SuDS Management Train'

Scenario 3 – Example of a ***'Modular SuDS System'***

When infiltration is not permitted, and legislation/policy dictates that a greater standard of treatment or flood resilience is required, additional SuDS components can be incorporated now or in the future, to provide Tertiary Treatment and/or greater flood resilience.

Lined Filter Strip → Lined Swale/Grassed channel → Lined Detention Basin

→ Lined Pond/Retention Basin → Outfall

Scenario 4: *Subject to the findings of a monitoring regime, it may be found that **more frequent maintenance** of the SuDS components (e.g. grass cutting, disposal of contaminated soil and planting **may negate the requirement for additional SuDS features.***

Thank you for your attention

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