

Adaptation measures to control exceeding flow in urban catchments

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Hamburg University of Technology

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Belgrade, September 6th 2012

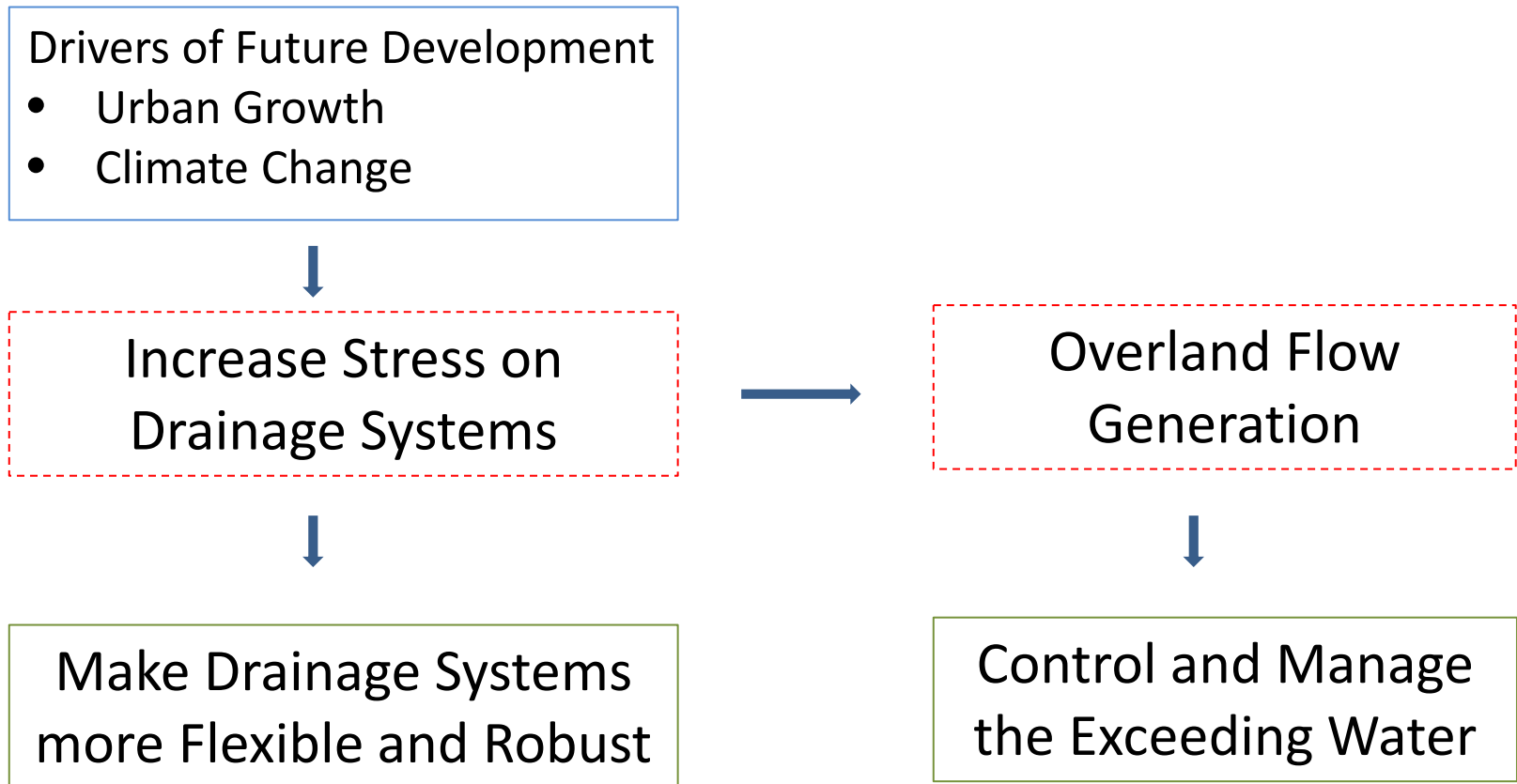
Content

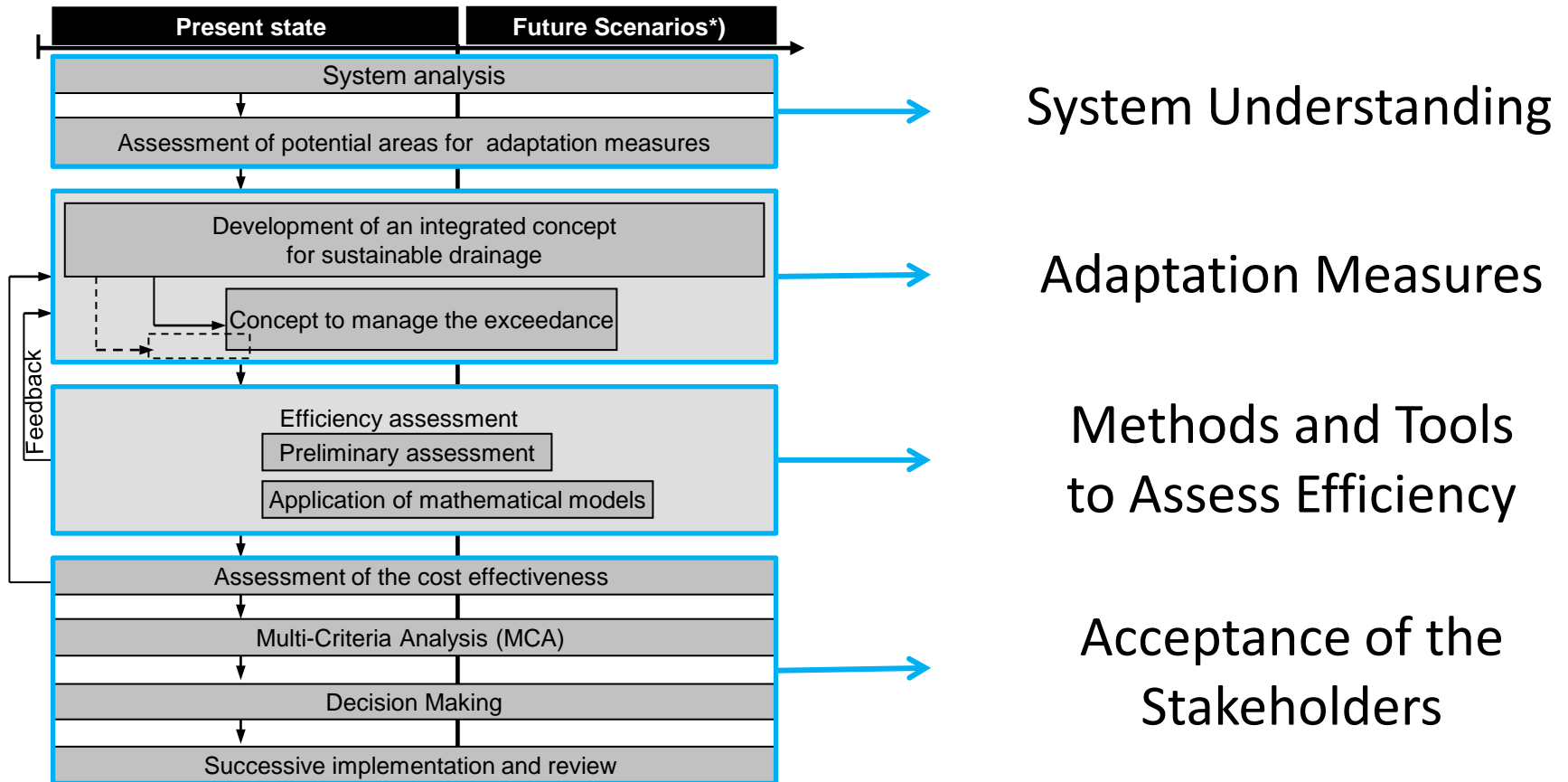
1. Introduction
2. Theoretical Approach
3. Integrated Concepts for Rainwater Management
4. Efficiency Assessment Approach
5. Application on a Case Study
6. Conclusion and Outlook

IPCC Predicts Rise in Extreme Climate Events (Special Report March 2012)



Hamburg (June 6th 2011, up to 60 l/m² (Hamburg Wasser) in few hours); Source: Dennis Dorendorf





*) climate change, socio economic projections

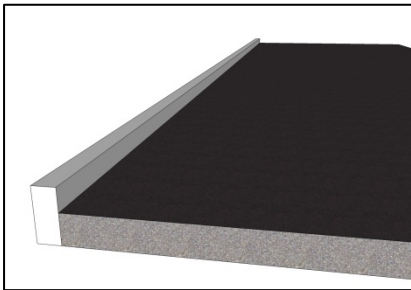
Source: Giovanni Palmaricciotti, Natasa Manojlovic, Sandra Hellmers

Elements for the Conveyance and Storage of the Exceeding Flow

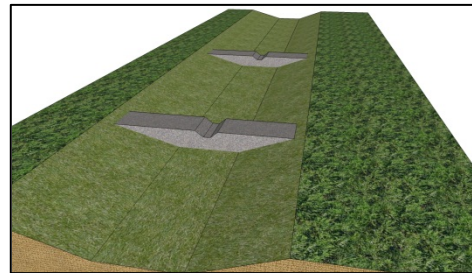
- Diversion Structures
- Conveyance Structures
- Green Reservoirs
- Multipurpose Spaces
- Underground Storage

Elements for the Conveyance of the Exceeding Flow

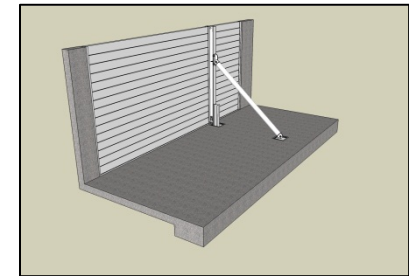
- Diversion Structures



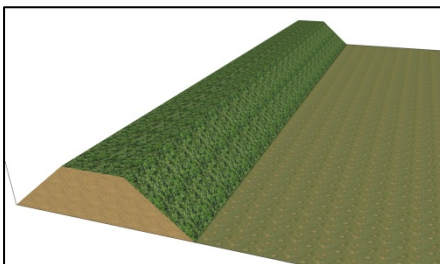
Curbs



Check dams



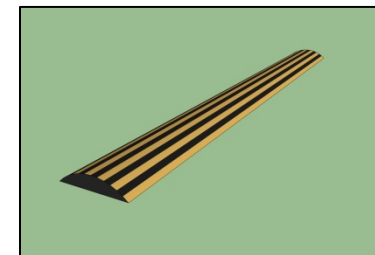
Flood abatement systems



Earth dykes



Property walls

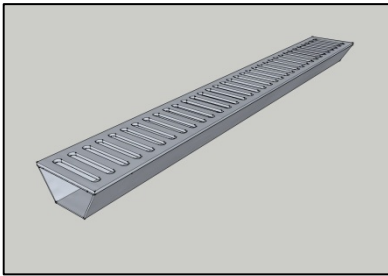


Speed bumps

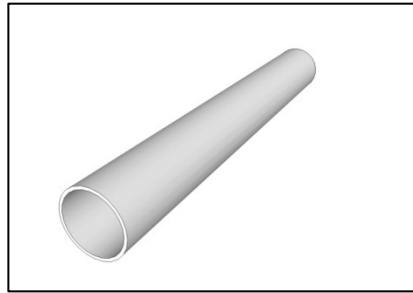
Source: Giovanni Palmaricciotti; Software Application Google Sketchup

Elements for the Conveyance of the Exceeding Flow

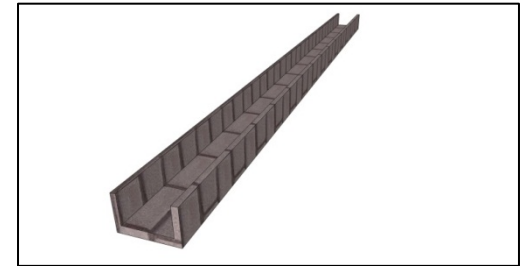
- Conveyance Structures



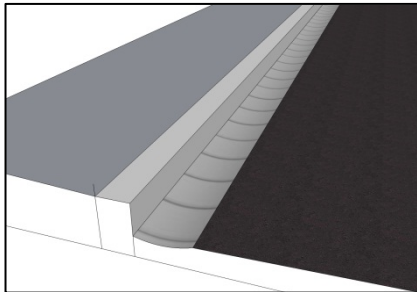
Metal gutters



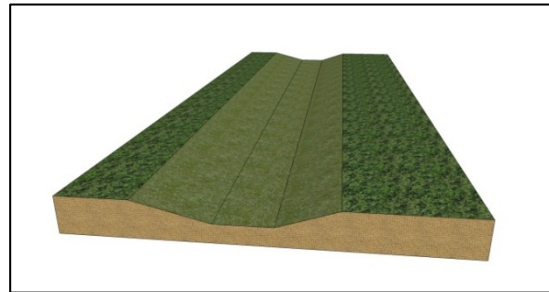
Pipes



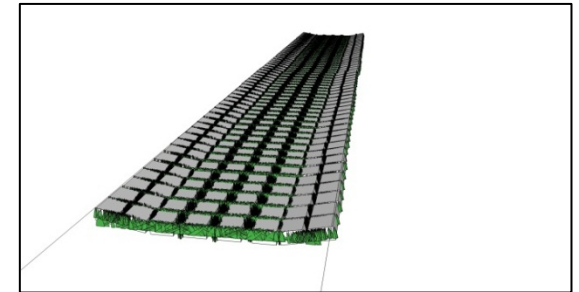
Ditches



Street gutters



Swales

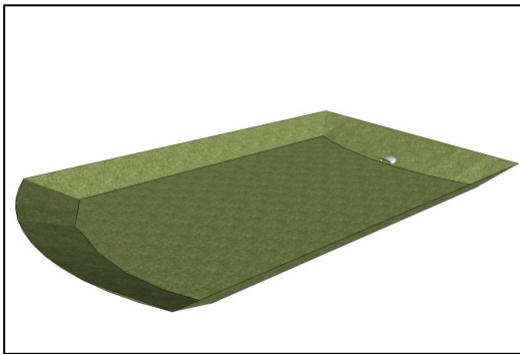


Rills

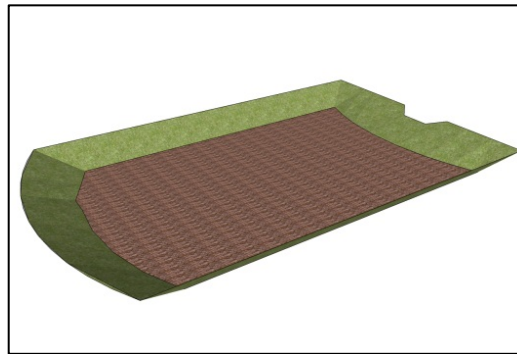
Source: Giovanni Palmaricciotti; Software Application Google Sketchup

Elements for the Storage of the Exceeding Flow

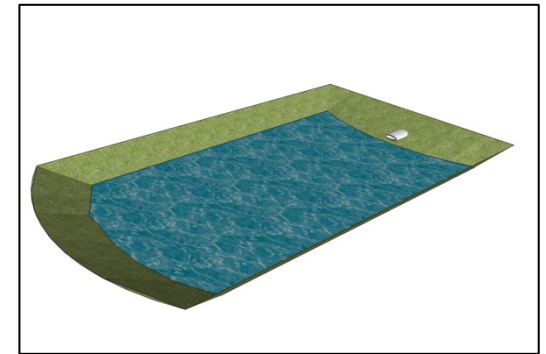
- Green Reservoirs



Detention basin



Infiltration basin

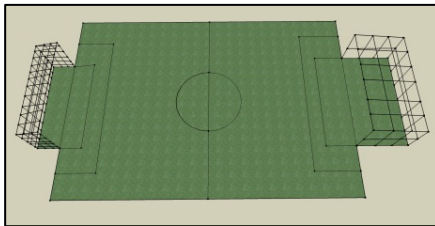


Retention basin

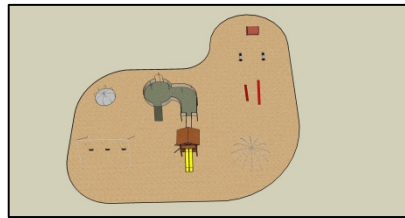
Source: Giovanni Palmaricciotti; Software Application Google Sketchup

Elements for the Storage of the Exceeding Flow

- Multipurpose Spaces



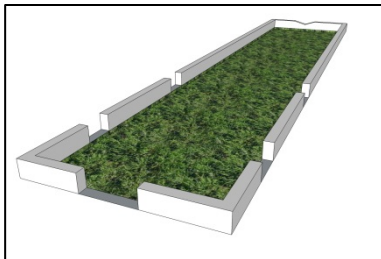
Sport courts



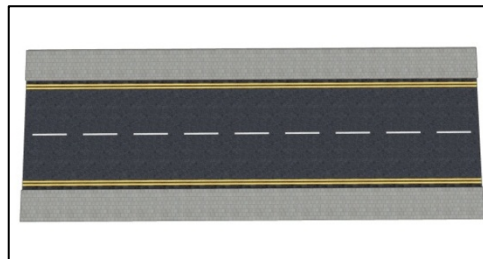
Play grounds



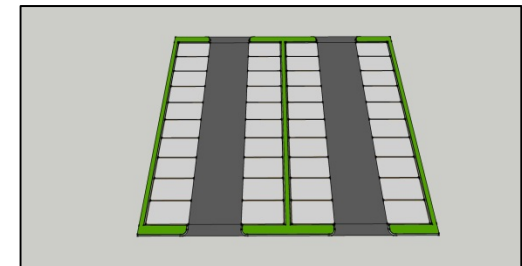
Green areas



Traffic islands



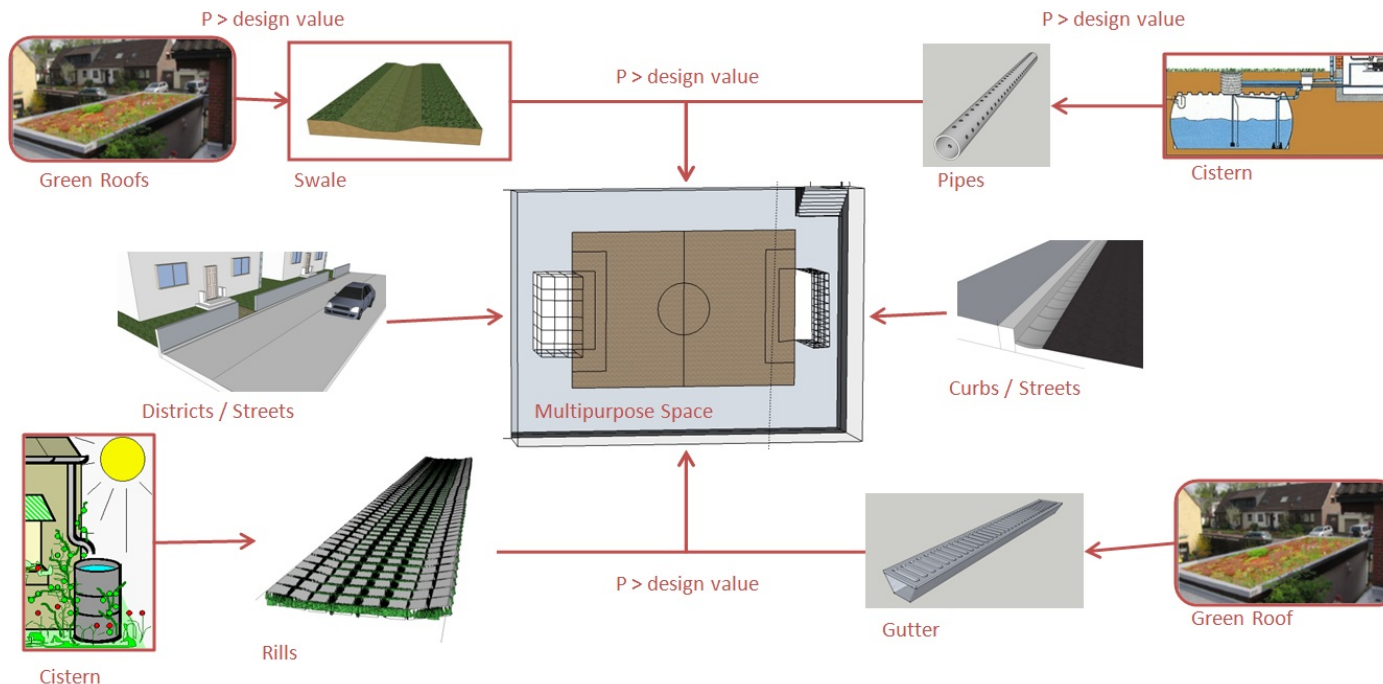
Small roads



Parking spots

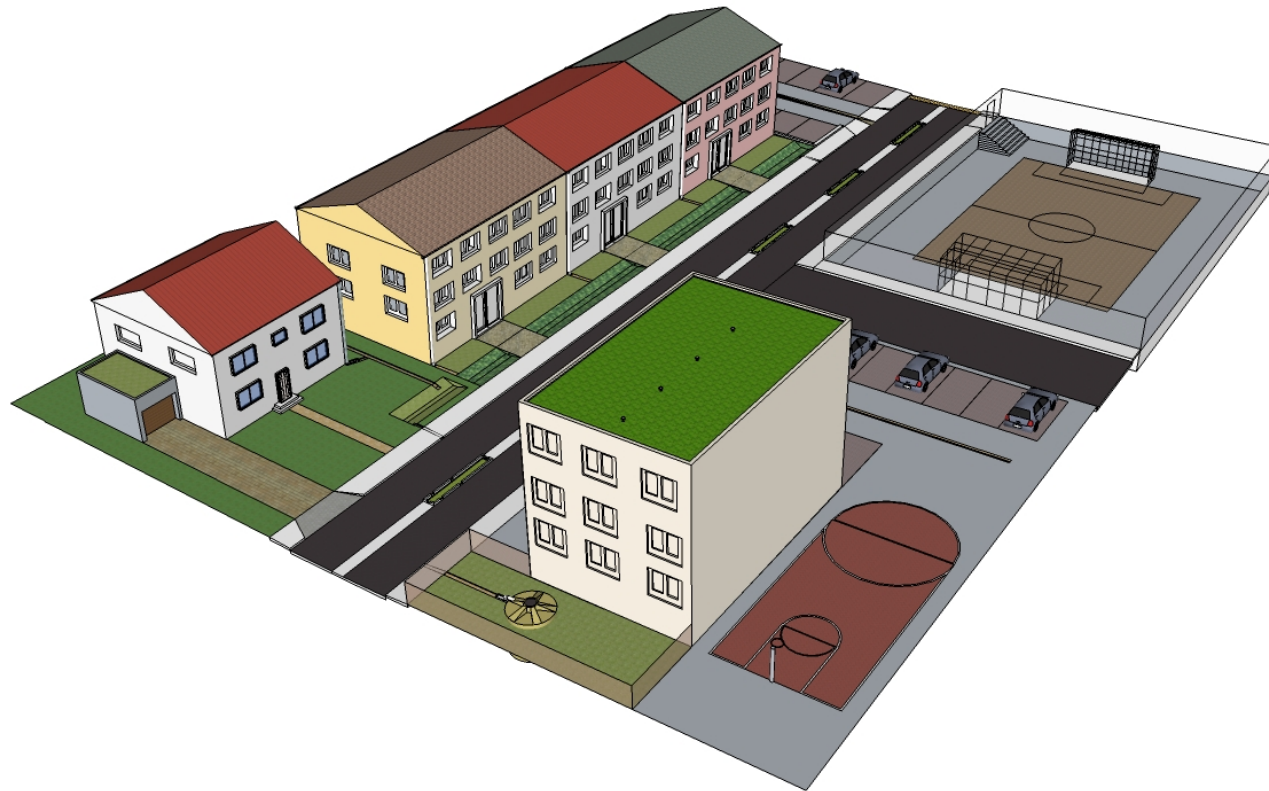
Source: Giovanni Palmaricciotti; Software Application Google Sketchup

Multi-Scale Approach (Micro Scale → Macro Scale)



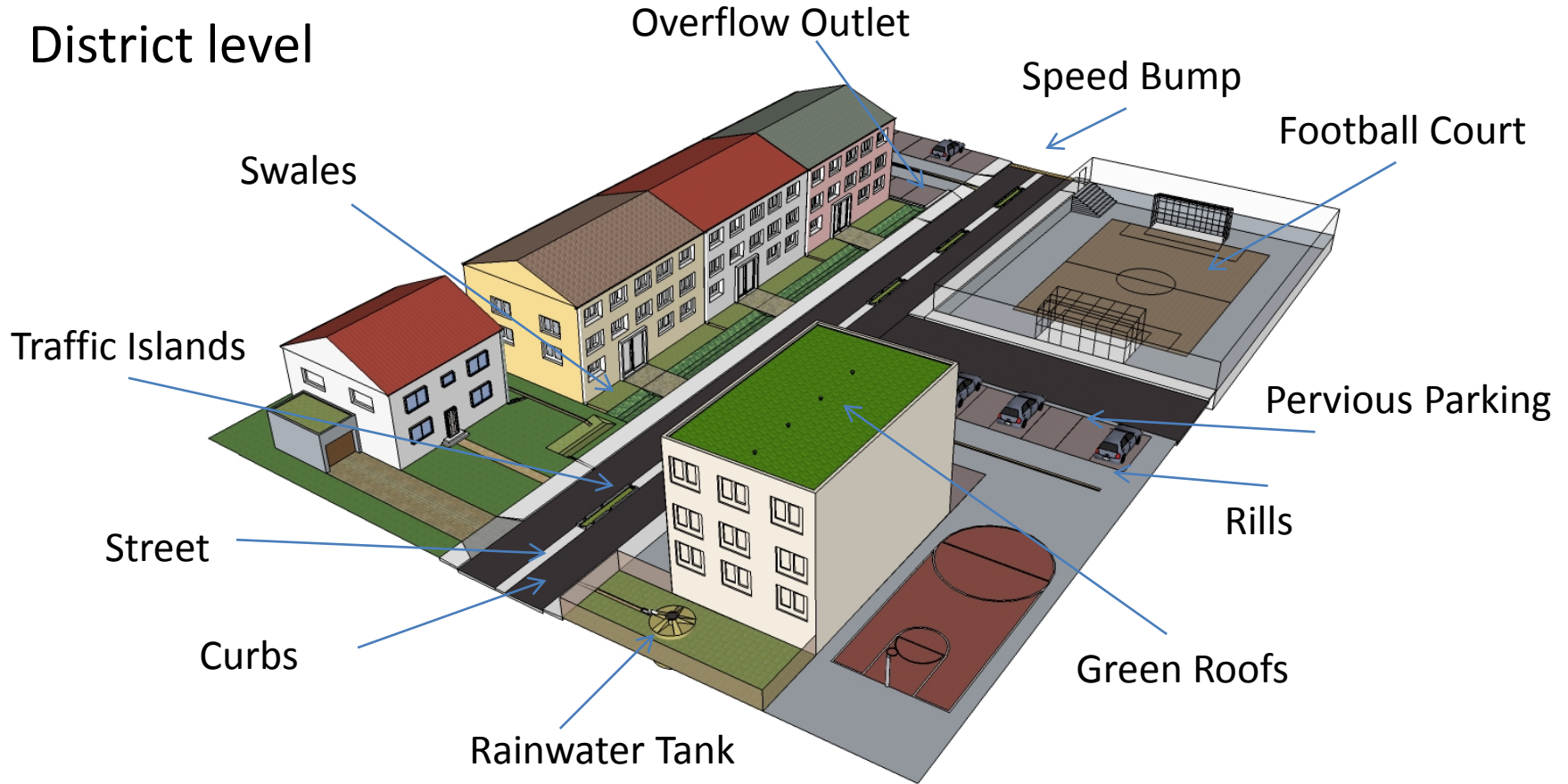
Source: Giovanni Palmaricciotti; Sandra Hellmers; Software Application Google Sketchup

District level



Source: Giovanni Palmaricciotti; Software Application Google Sketchup

Integrated Concepts for Rainwater Management



Source: Giovanni Palmaricciotti; Software Application Google Sketchup

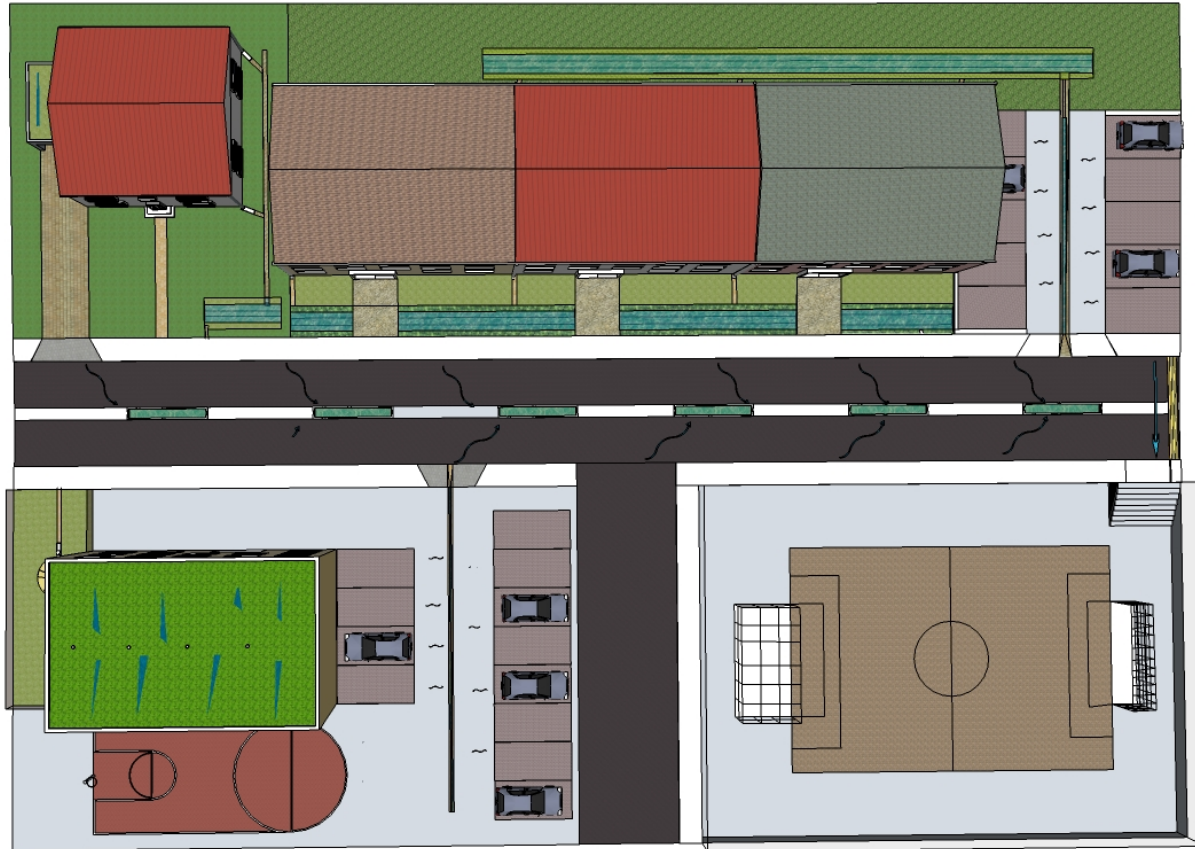
District level

Dry



Source: Giovanni Palmaricciotti; Software Application Google Sketchup

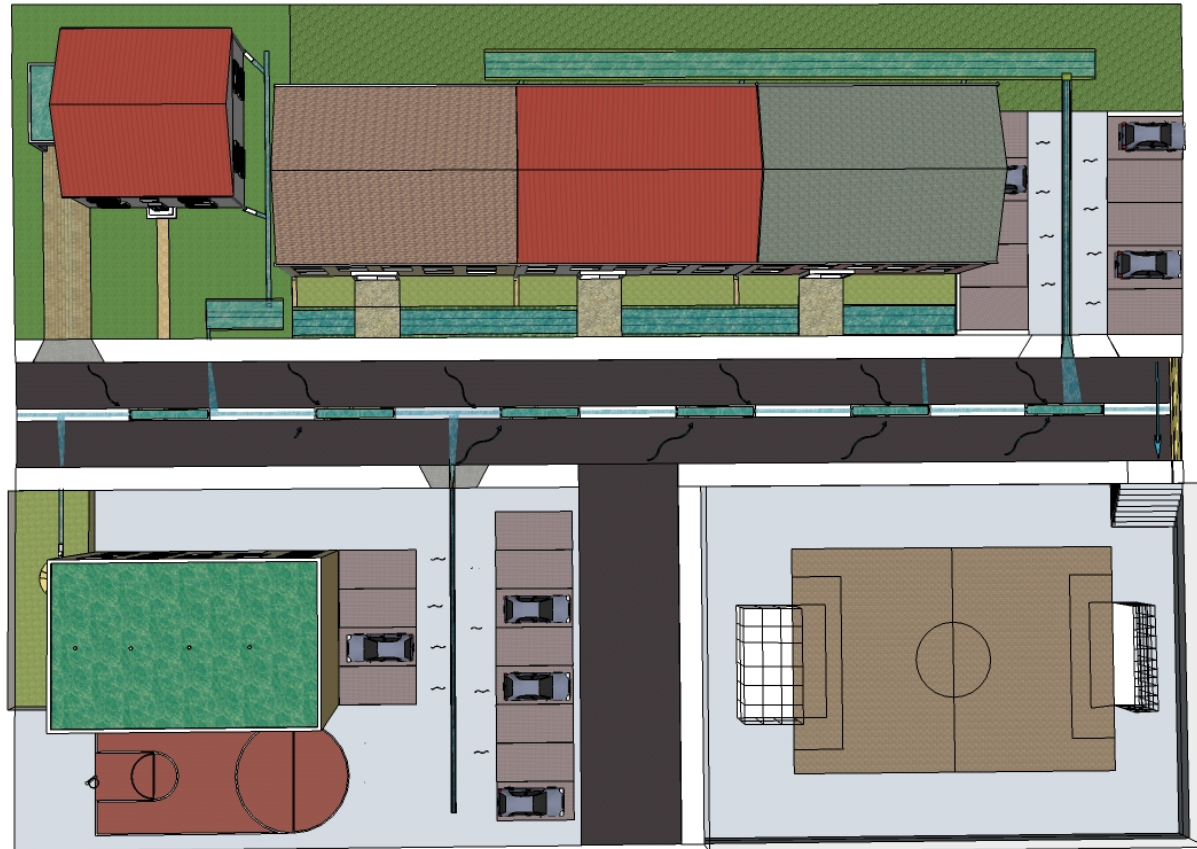
District level



Event below the
Drainage Capacity

Source: Giovanni Palmaricciotti; Software Application Google Sketchup

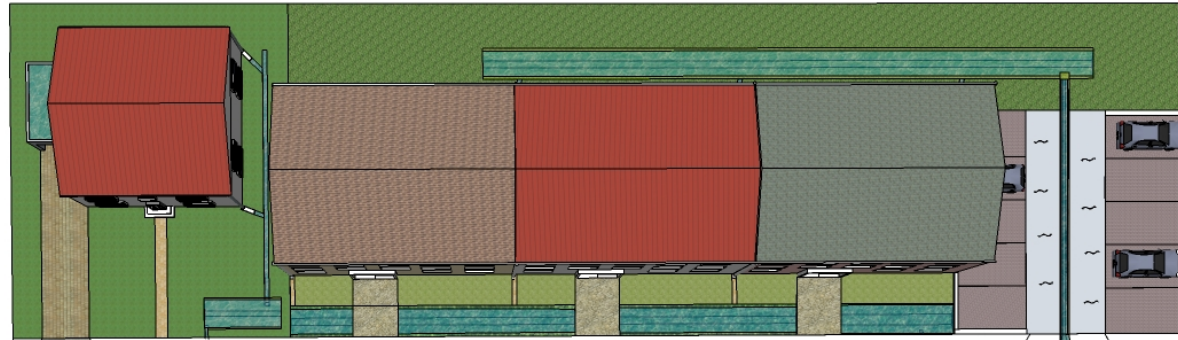
District level



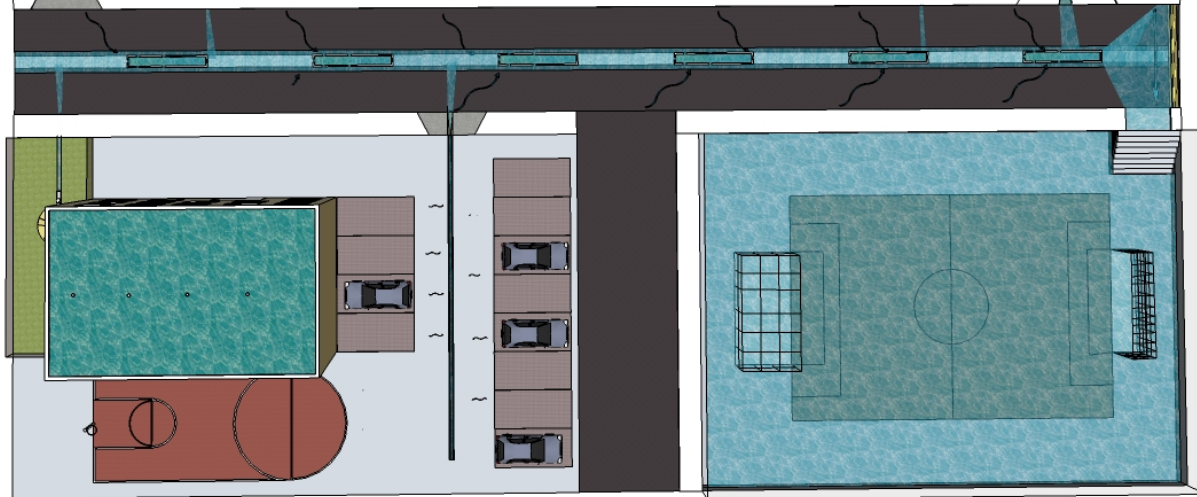
Low Frequency Event
(above Local
Measures Capacity)

Source: Giovanni Palmaricciotti; Software Application Google Sketchup

District level



Extreme Event



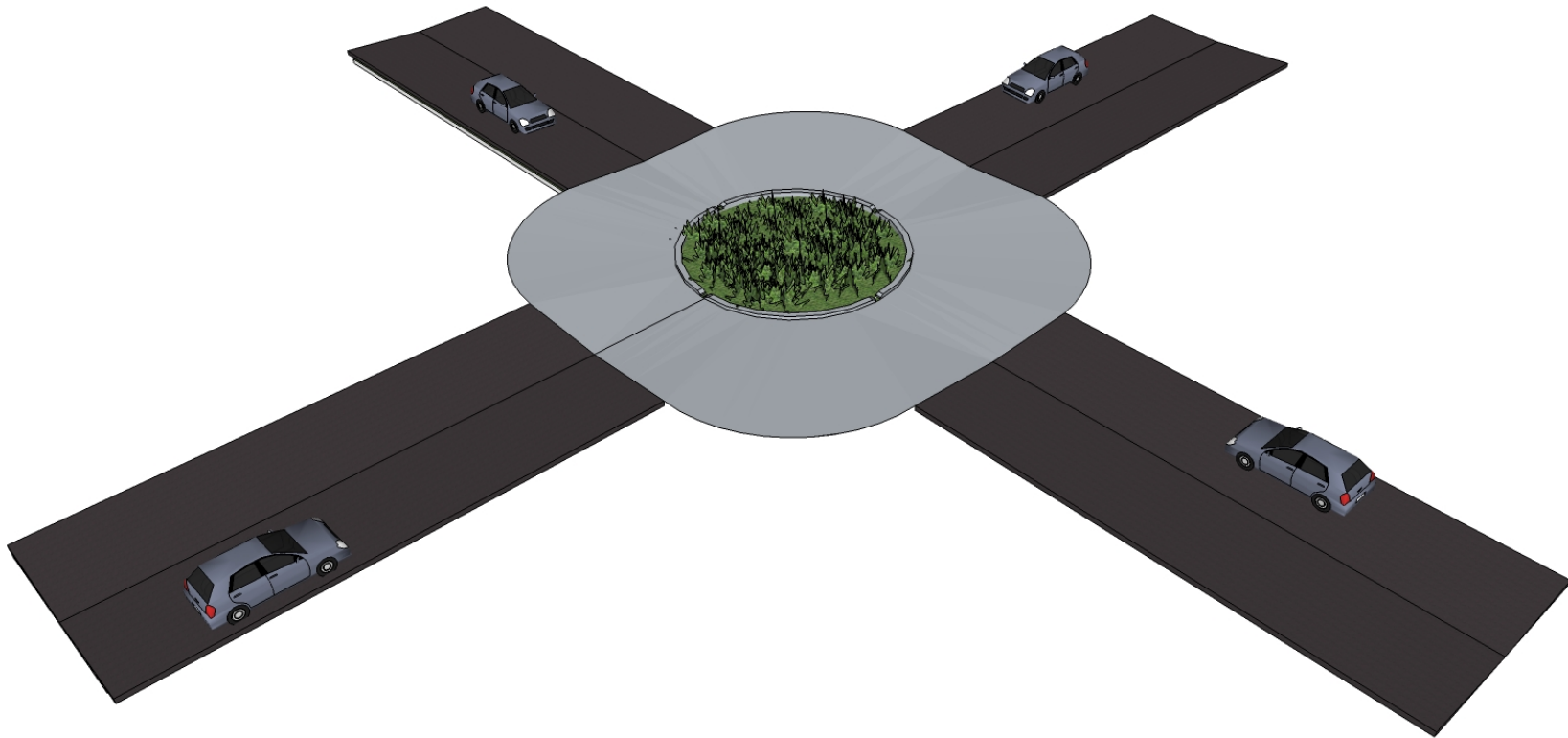
Source: Giovanni Palmaricciotti; Software Application Google Sketchup

Retention of Rainwater in a Roundabout Traffic (street level)



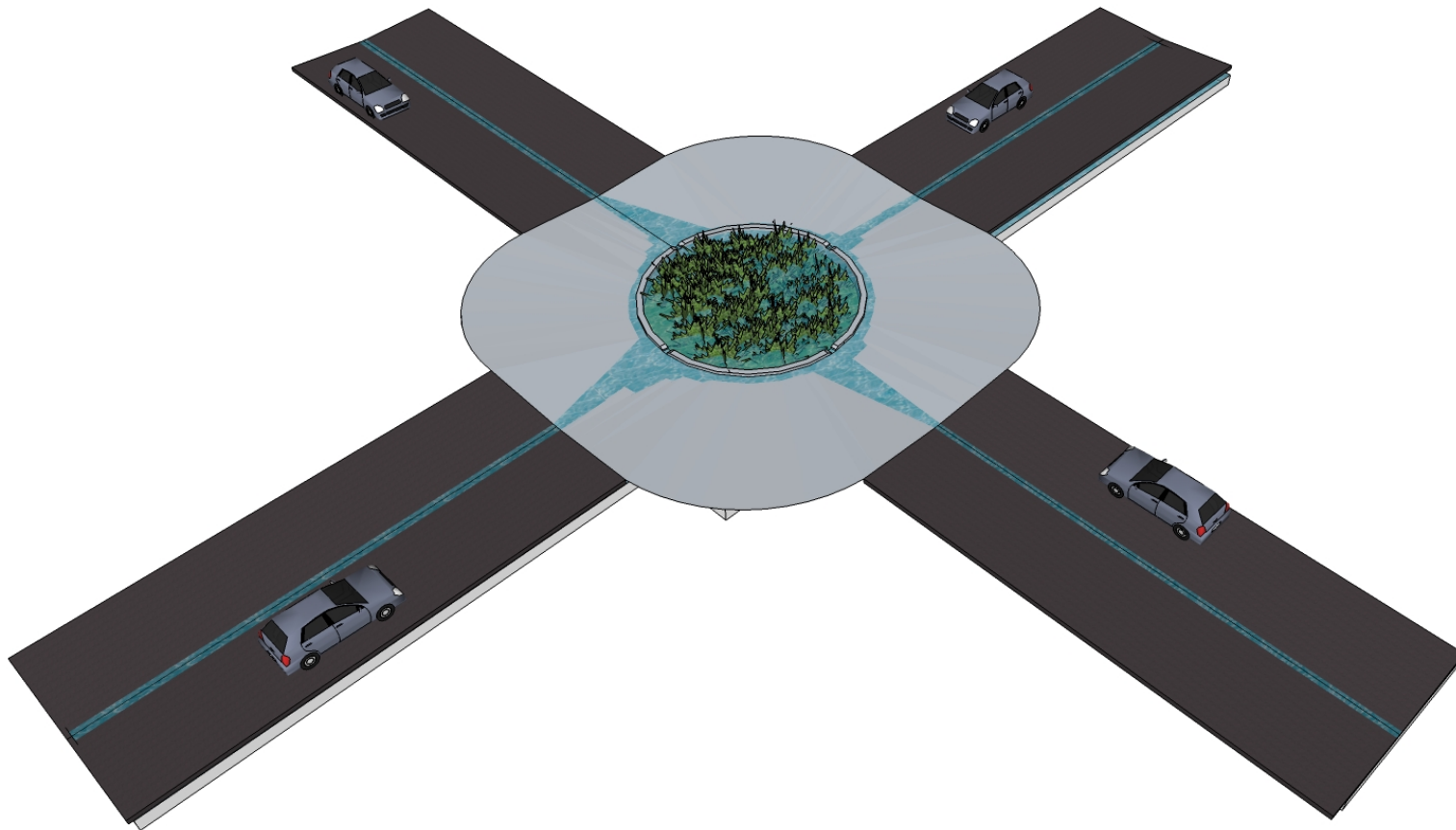
Source: Giovanni Palmaricciotti; Software Application Google Sketchup

Retention of Rainwater in a Roundabout Traffic (street level)



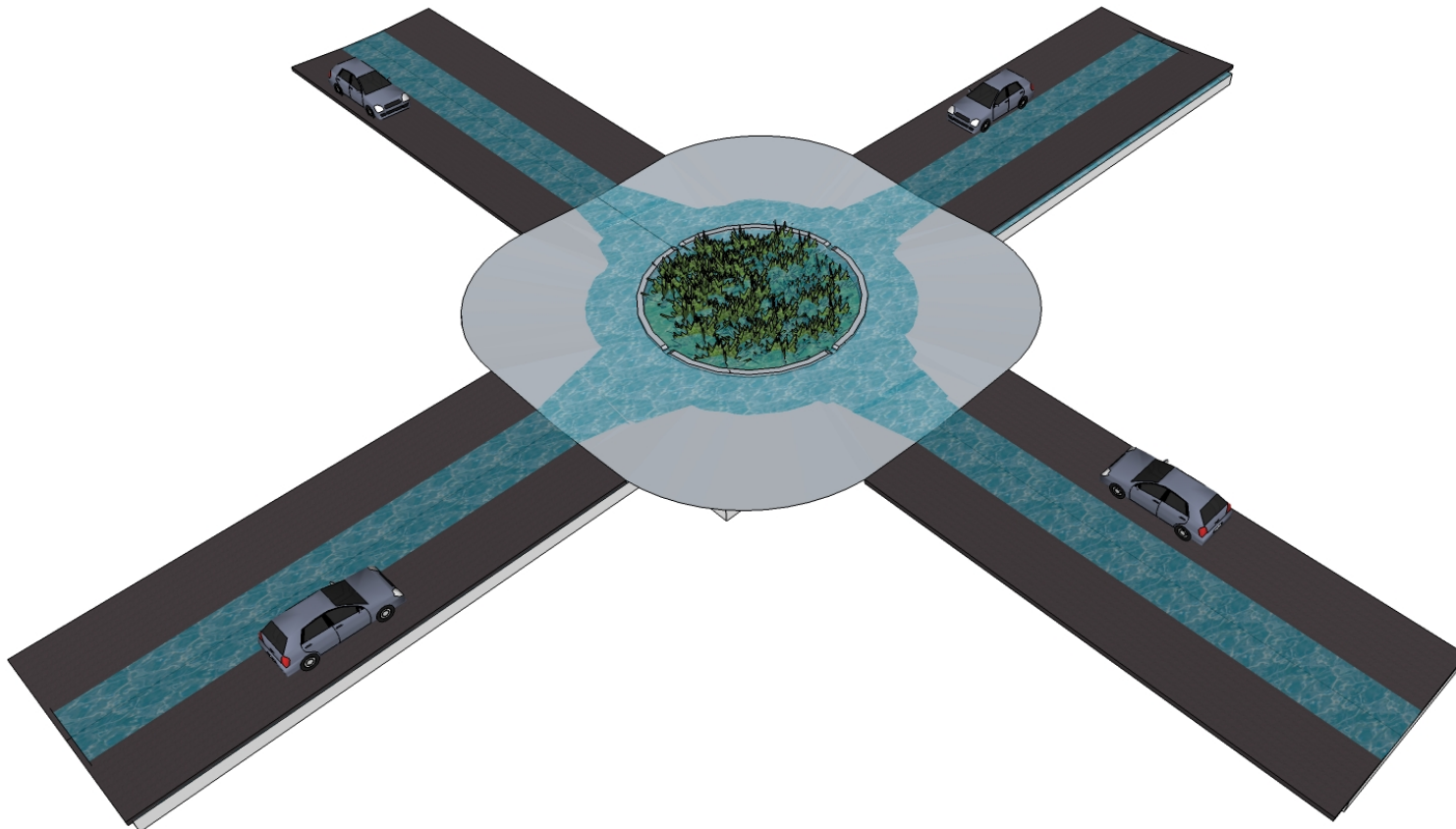
Source: Giovanni Palmaricciotti; Software Application Google Sketchup

Retention of Rainwater in a Roundabout Traffic (street level)



Source: Giovanni Palmaricciotti; Software Application Google Sketchup

Retention of Rainwater in a Roundabout Traffic (street level)



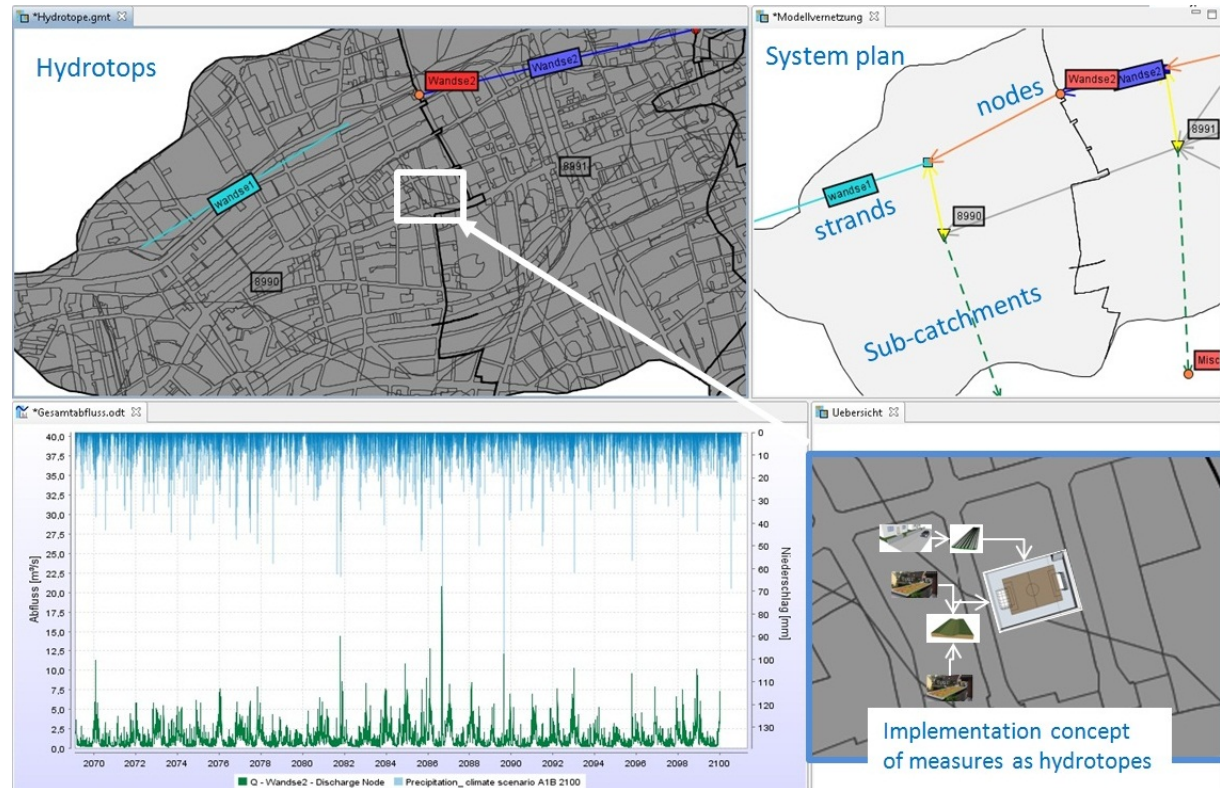
Source: Giovanni Palmaricciotti; Software Application Google Sketchup

Hydrological numerical model

- Detailed simulation of the single measures (micro-scale → hydrological response units)
- Interaction of the measures (macro-scale → sub-catchment)

Current Work:

Implementation of the measures with the features of hydrotops (micro-scale), but interacting on the river system plan on the macro-scale.

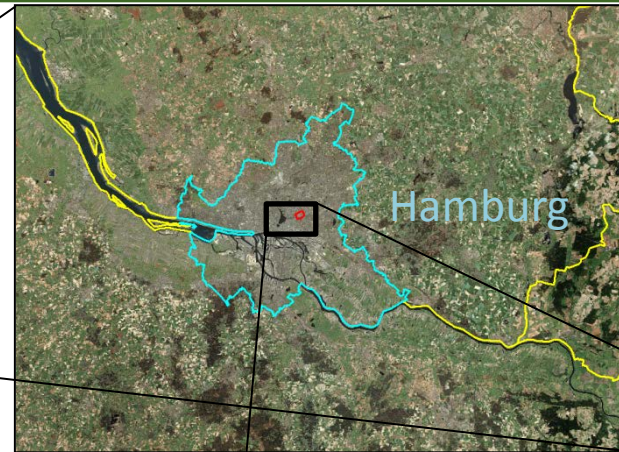


Source: Sandra Hellmers

For more information:

- <http://sourceforge.net/projects/kalypso/>
- www.tu-harburg.de/wb/forschung/software-entwicklung/kalypso/kalypso-na.html

Geographic Localization of the Study Area



Source: Giovanni Palmaricciotti, Microsoft Bing Maps, BSU (Hamburg Ministry of Urban Development and Environment)

Problem: Need for a more Robust Drainage System

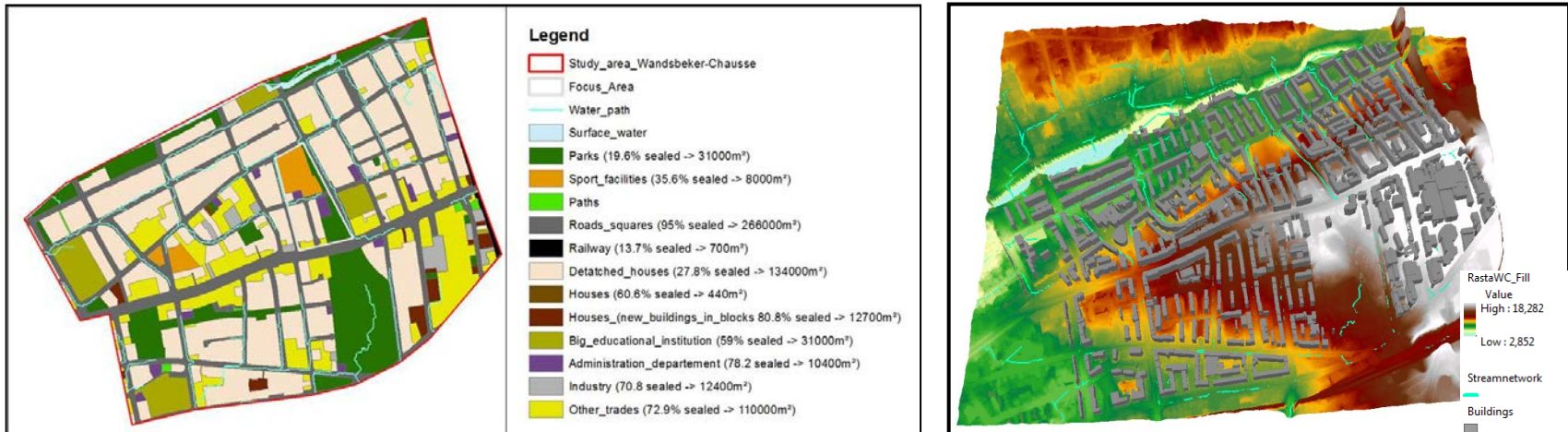
The image shows two screenshots of the Hamburg website (hamburg.de) from different dates, illustrating a recurring problem of high water in the Wandsbek district.

Left Screenshot (22.12.2011):
 Title: Hochwasser an den Gewässern im Bezirk Wandsbek
 Date: 22.12.2011
 Text: "Die starken Regenfälle der letzten Tage haben dazu geführt, dass die Gewässer im Bezirk Wandsbek Hochwasser führen und Uferregionen sowie Wanderwege nicht mehr gefahrlos passierbar sind."
 Text: "Das Bezirksamt Wandsbek warnt Fußgänger und andere Verkehrsteilnehmer davor, die überschwemmten Bereiche zu betreten, da nicht sichtbare und gefährliche Unterwasserstrudel entstehen können. Besonders betroffen ist der Bereich entlang der Alster zwischen Duvenstedt und Ohlsdorf."

Right Screenshot (08.02.2011):
 Title: Hochwasser an den Gewässern im Bezirk Wandsbek
 Date: 08.02.2011, 17:21 Uhr
 Text: "Die starken Regenfälle der letzten Tage haben dazu geführt, dass die Gewässer im Bezirk Wandsbek Hochwasser führen und Uferregionen sowie Uferwege überschwemmt sind."
 Text: "Das Bezirksamt Wandsbek warnt Fußgänger und andere Verkehrsteilnehmer davor, die überschwemmten Bereiche zu betreten oder zu befahren. Auch die Wasserwege sind gefährlich, da starke, nicht sichtbare und gefährliche Unterwasserstrudel entstehen können. Besonders betroffen sind die Verkehrs- und Wanderwege im Bereich der Alster zwischen Duvenstedt und Ohlsdorf."

Source: www.hamburg.de

Analysis of the Study Area



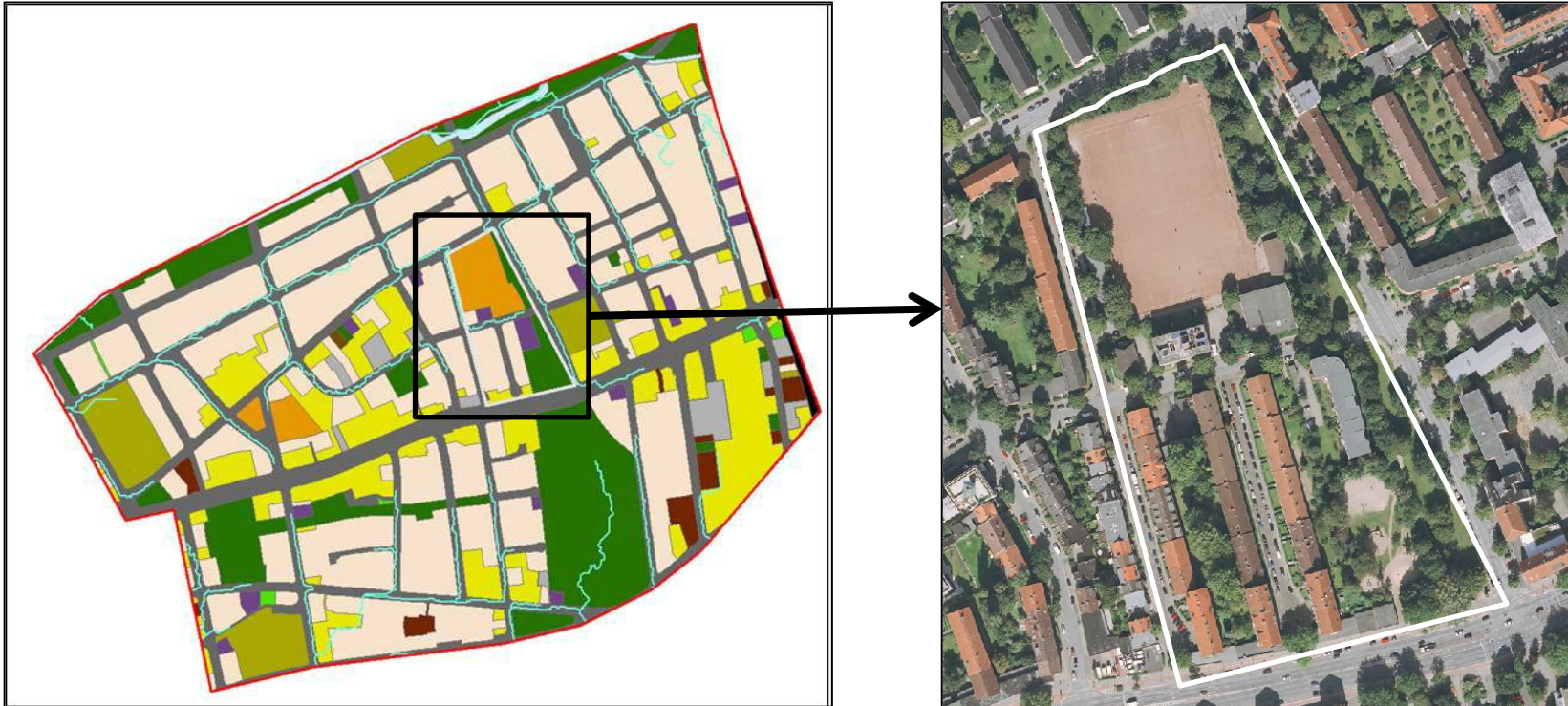
- Topography
- Hydrology
- Soil Properties
- Land Use



**Assessment of the Potential for
Adaptation Strategies
(present and future)**

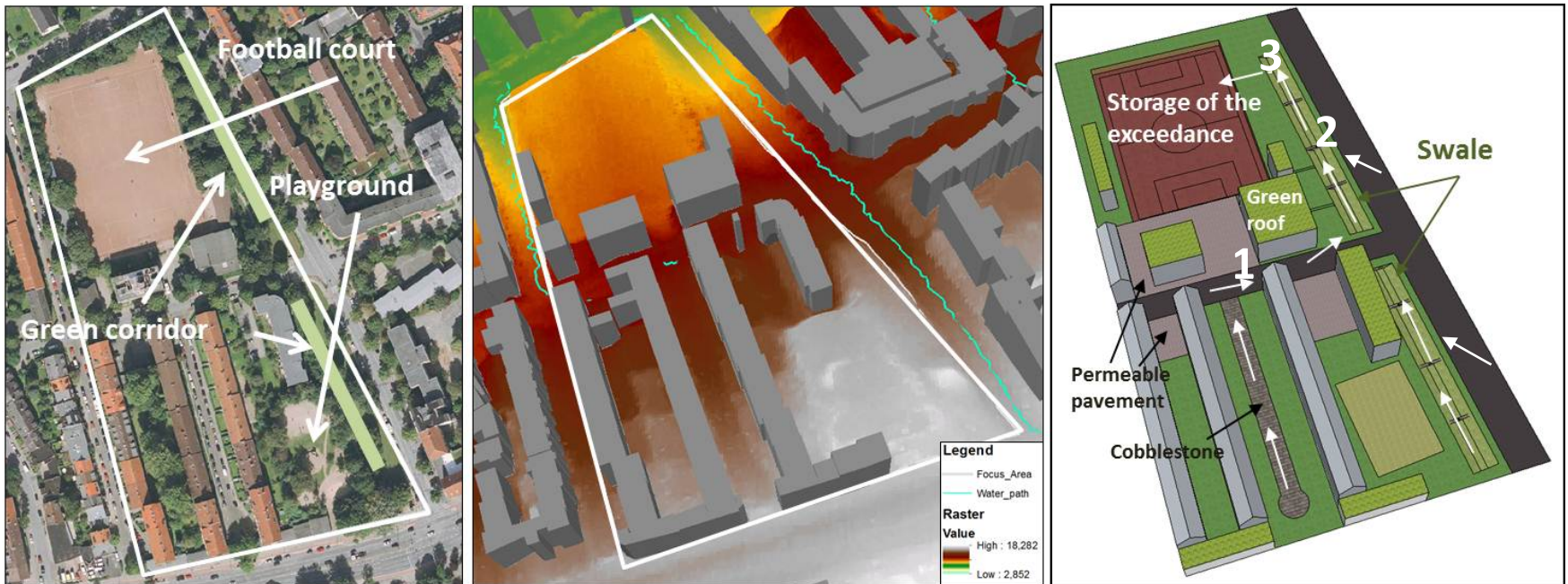
Source: Giovanni Palmaricciotti, BSU (Hamburg Ministry of Urban Development and Environment); Software Application ArcGIS

Chosen Focus Block



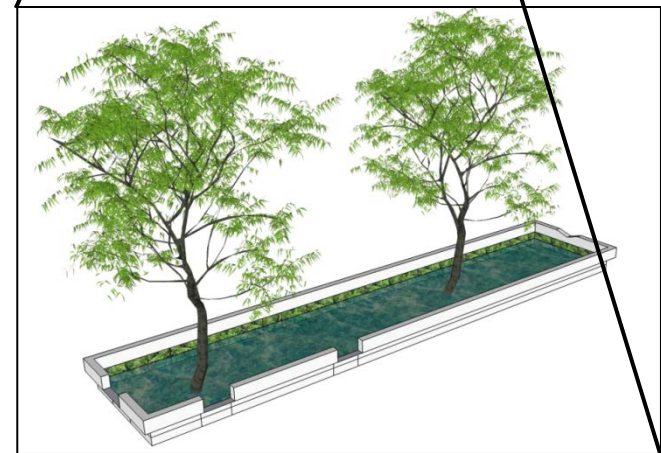
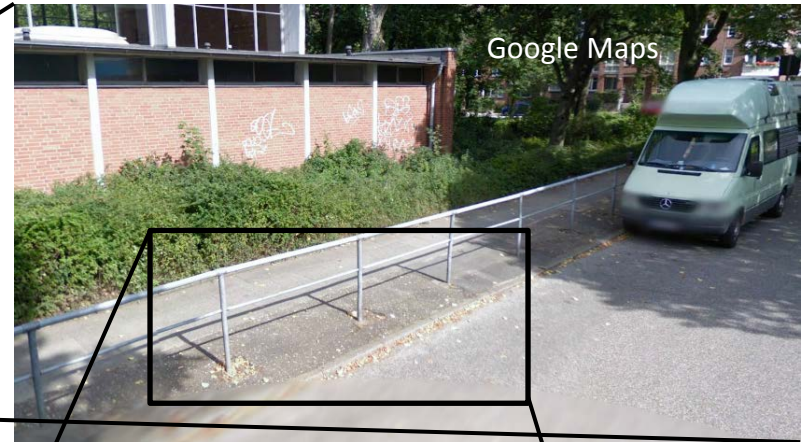
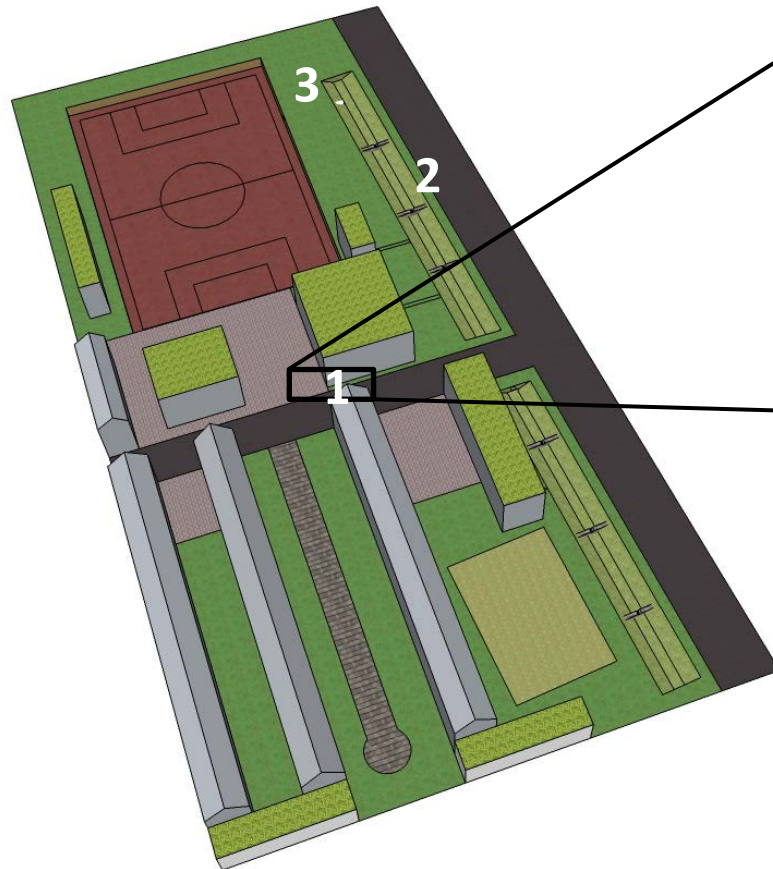
Source: Giovanni Palmaricciotti, BSU (Hamburg Ministry of Urban Development and Environment); Software Application ArcGis

Example of Conveyance + Storage of Exceeding Water



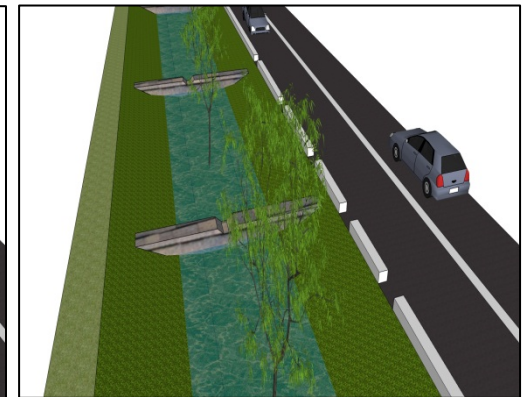
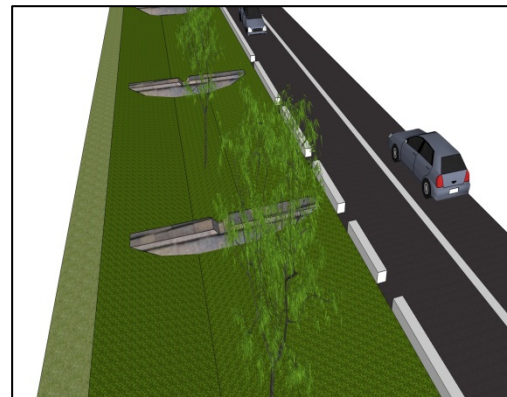
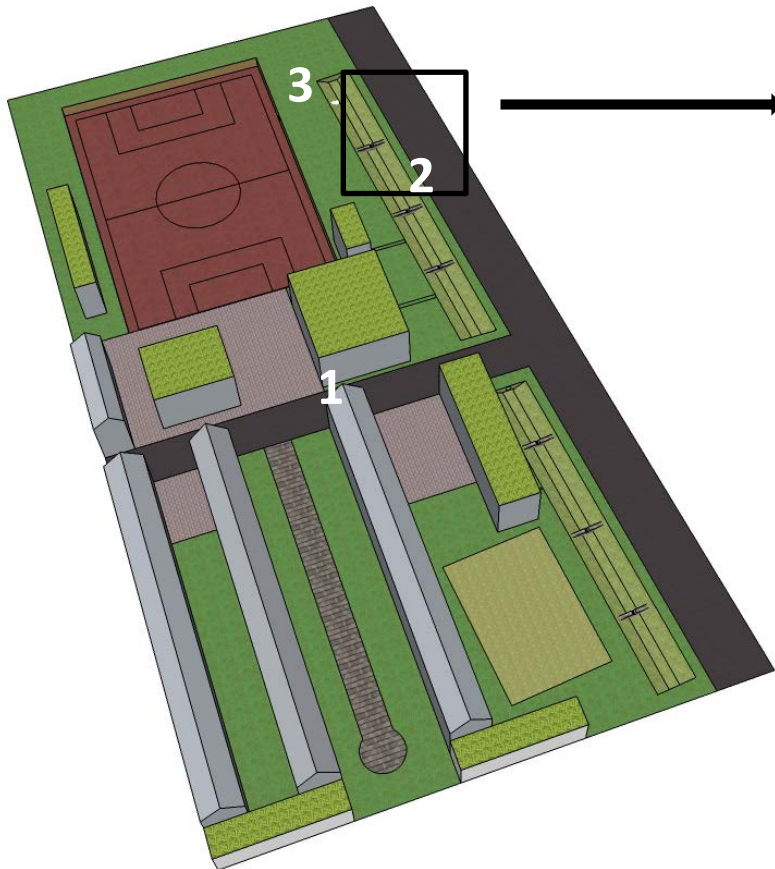
Source: Giovanni Palmaricciotti, BSU (Hamburg Ministry of Urban Development and Environment); Software Application Google Sketchup, ArcGis

1. Infiltration in Traffic Islands



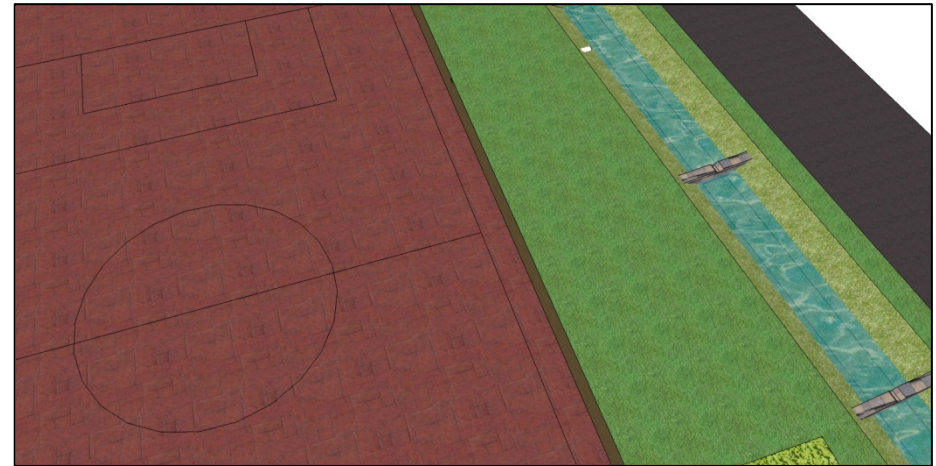
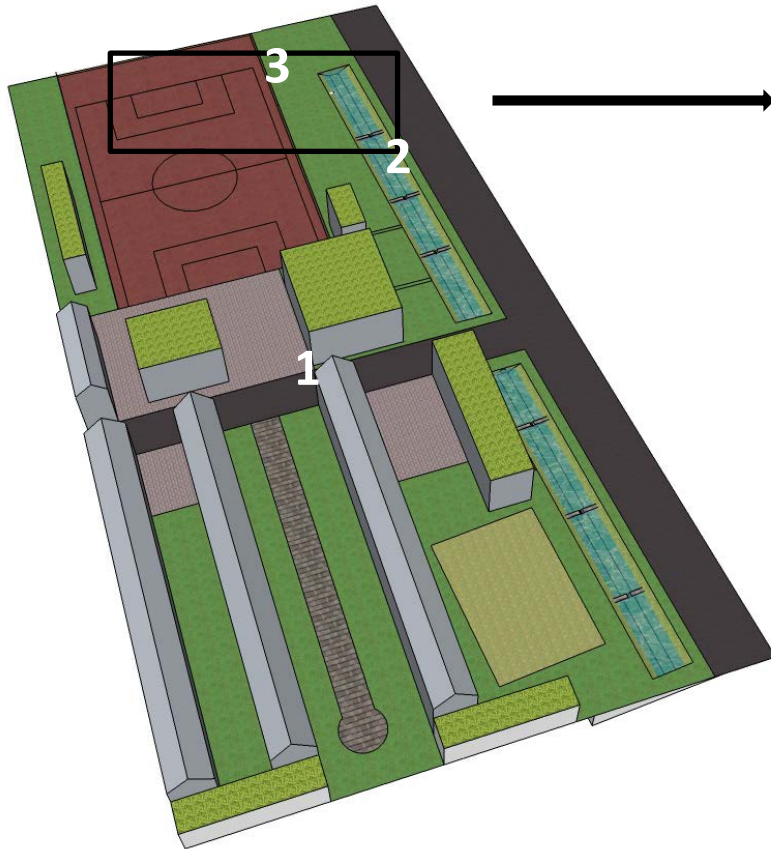
Source: Giovanni Palmaricciotti; Software Application Google Sketchup

2. Infiltration + Conveyance in Swales



Source: Giovanni Palmaricciotti; Software Application Google Sketchup

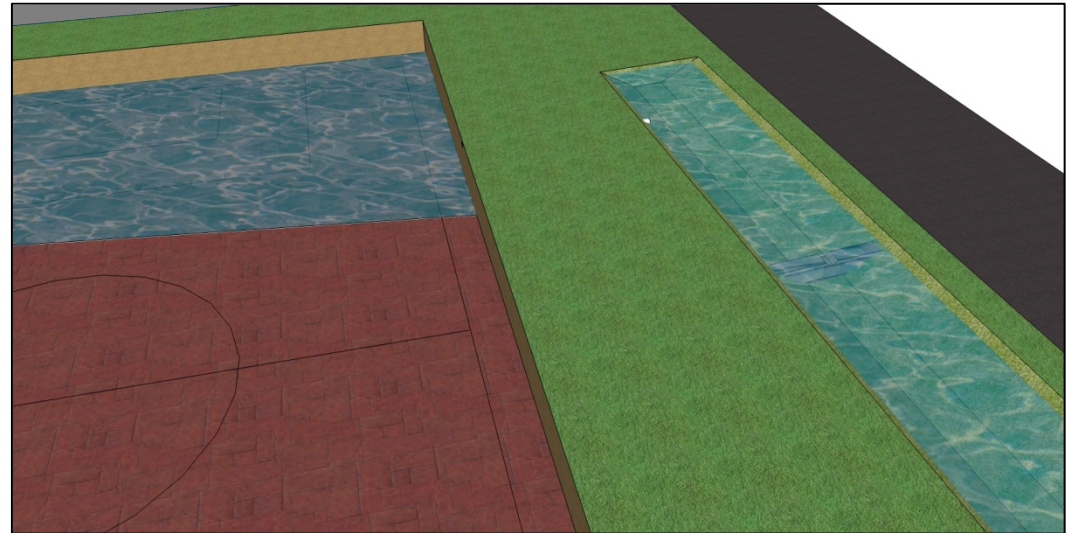
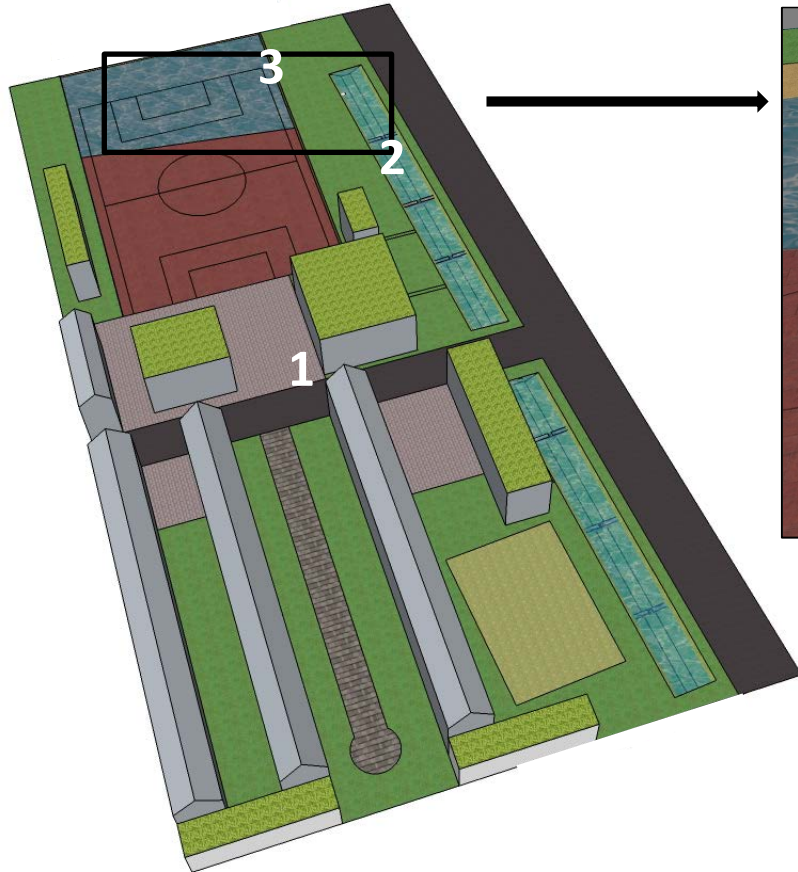
3. Temporary Storage in Sport Area



Below Design Event

Source: Giovanni Palmaricciotti; Software Application Google Sketchup

3. Temporary Storage in Sport Area



Extreme Event

Source: Giovanni Palmaricciotti; Software Application Google Sketchup

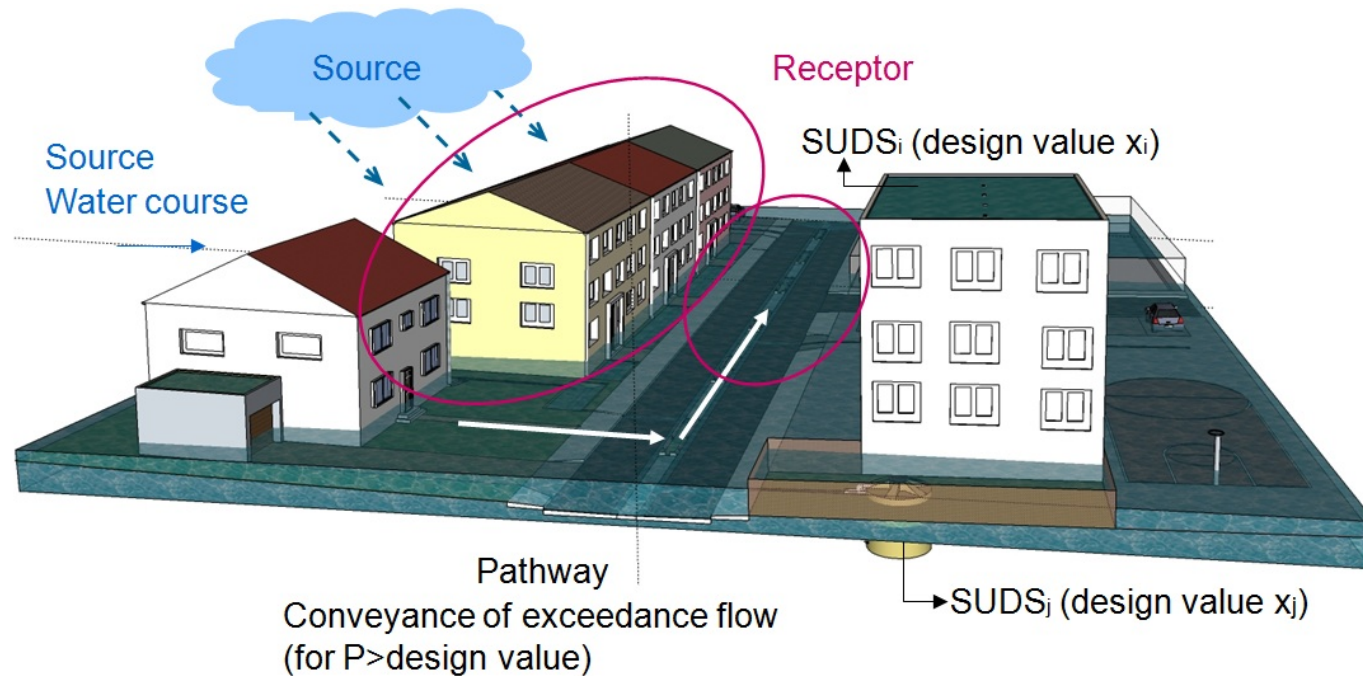
- Need for Development of Integrated Concepts for Storm Water Management i.e. Systems which are Able to Cope with Different Return Periods und with Future Scenarios Related Uncertainties (Quantity)
 - Need for a Multi-Disciplinary Approach to Analyse the Study Case from Different Points of View (Quality)
 - Need for Involvement of the Public in the Decision Making Process (Awareness + Acceptance)
 - Need for Legal Regulations (Guidelines)
-
- Implementation of the Adaptation Measures (Conveyance and Storage Systems) into the Hydrological Model to Assess Efficiency
 - Creation of Physical Models to Study and Optimize the Systems and to Compare to Numerical Models

Thank you for your attention

Acknowledgment:



Source-Pathway-Receptor Model



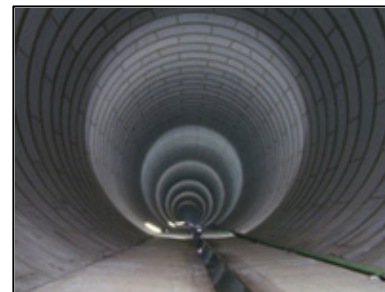
Source: Giovanni Palmaricciotti; Natasa Manojlovic; Software Application Google Sketchup

Elements for the Conveyance and Storage of the Exceeding Flow

- Underground Storage



G-cans project, Tokyo (Japan)



Loop 7, Tokyo (Japan)

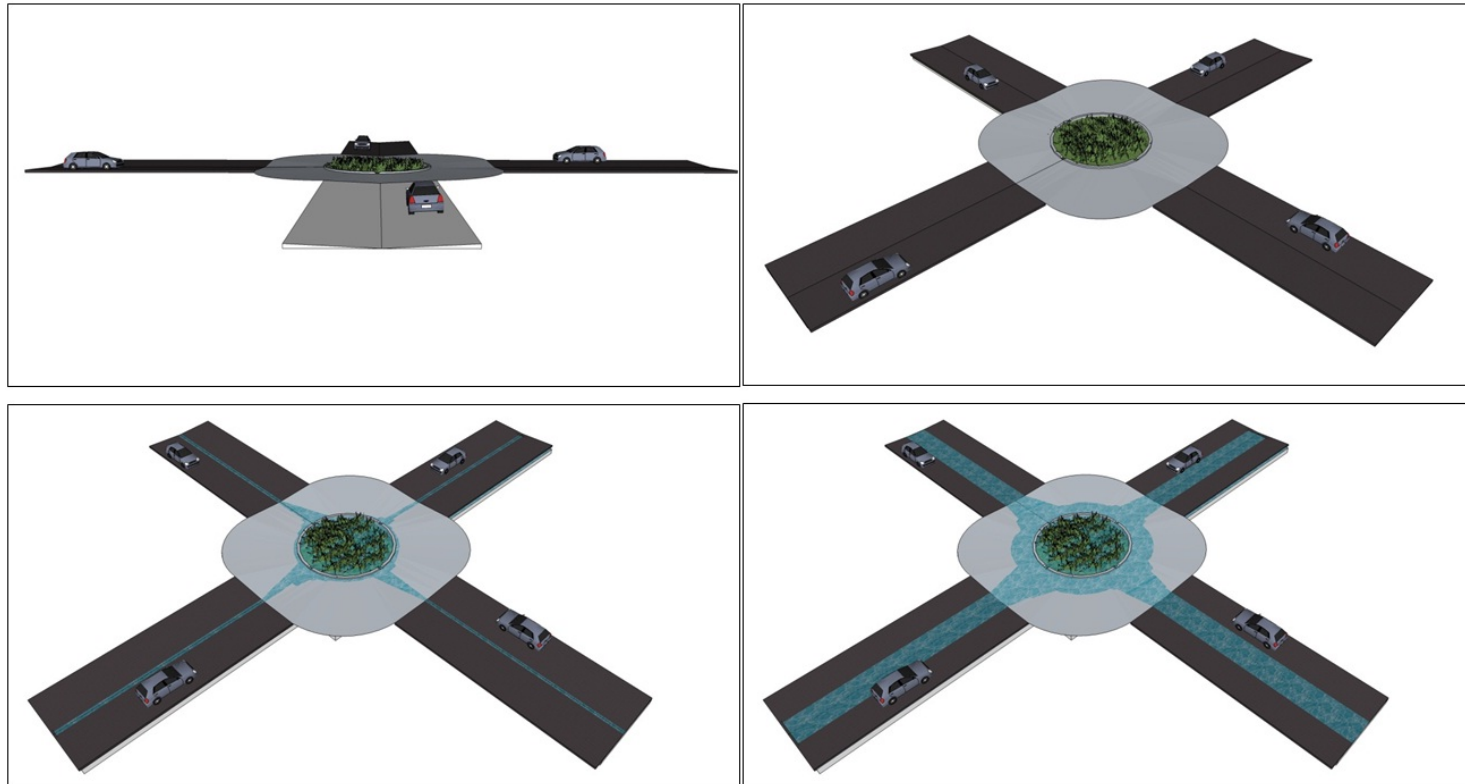


TARP, Chicago (USA)



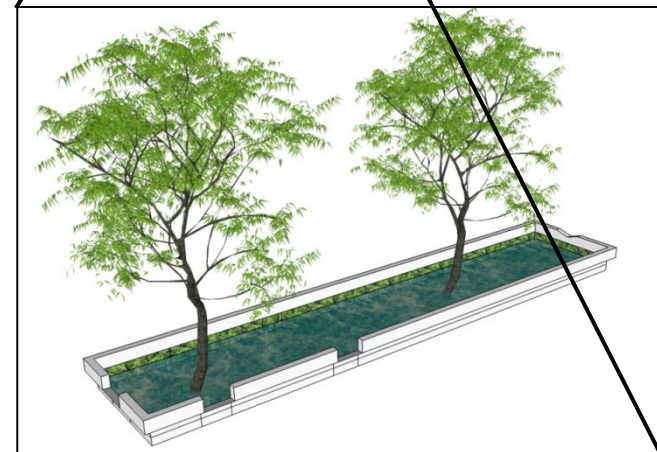
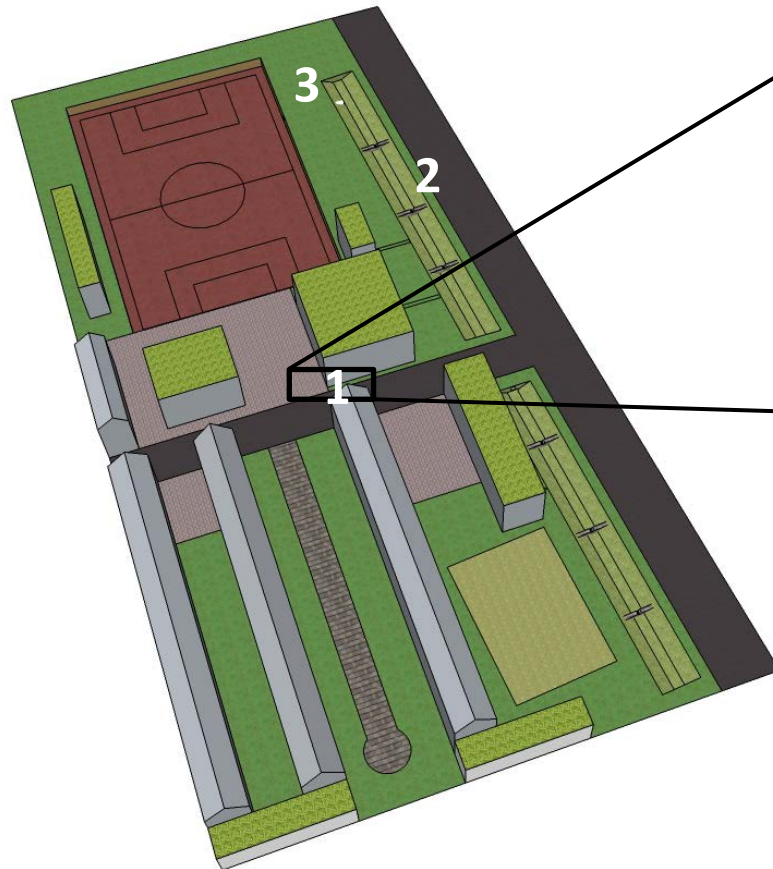
SMART, Kuala Lumpur (Malaysia)

Retention of Rainwater in a Roundabout Traffic (street level)



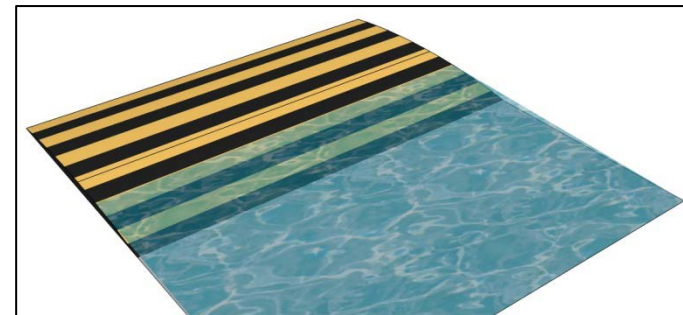
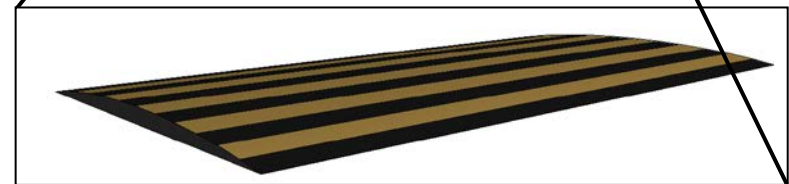
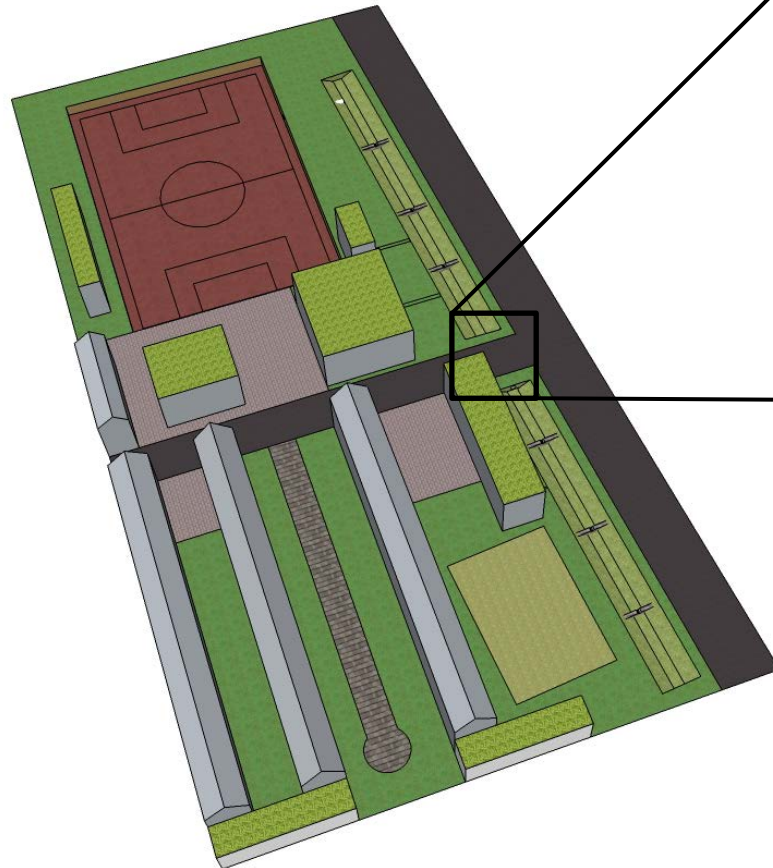
Source: Giovanni Palmaricciotti; Software Application Google Sketchup

1. Infiltration in Traffic Islands



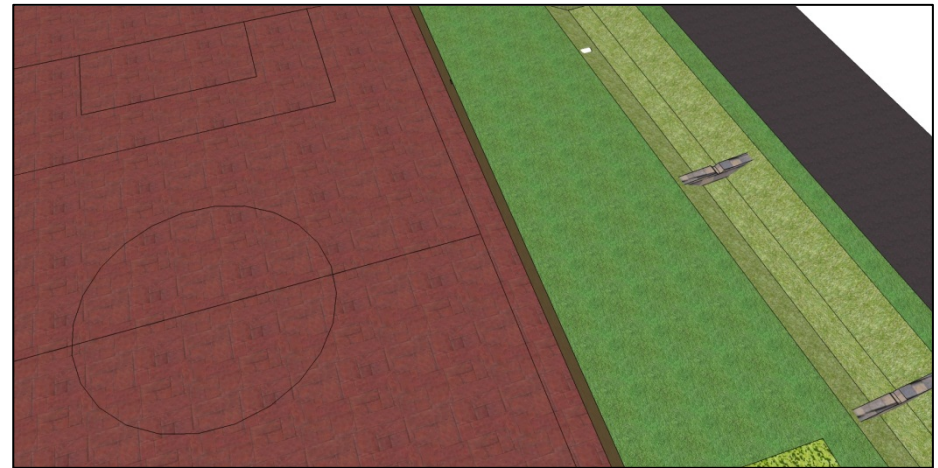
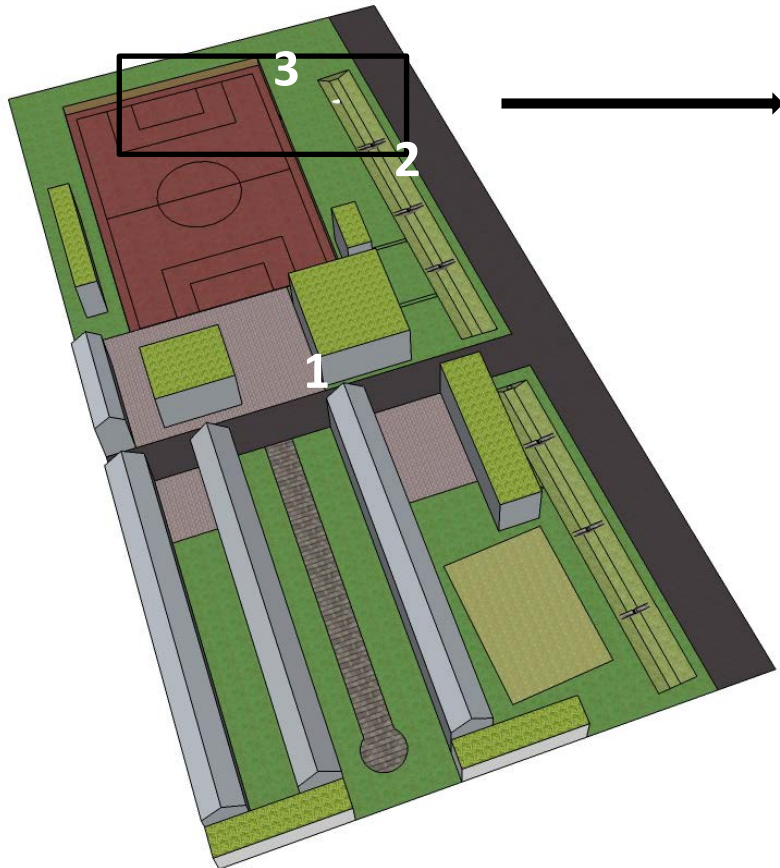
Source: Giovanni Palmaricciotti; Software Application Google Sketchup

2. Water Ponding on the Street



Source: Giovanni Palmaricciotti; Software Application Google Sketchup

3. Temporary Storage in Sport Area



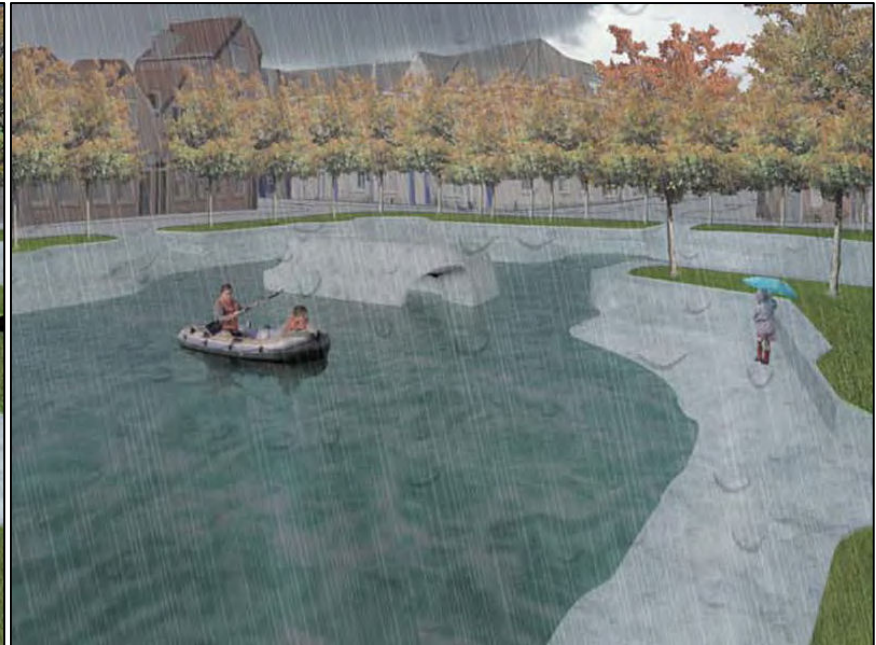
Dry

Source: Giovanni Palmaricciotti; Software Application Google Sketchup

Example: Water Square Project Rotterdam (De Urbanisten)



During Dry Periods



During heavy Rainfall Events

Source: www.worldarchitecturenews.com



