Quantifing added benefit of sustainable urban drainage systems
- Quick scan tool -

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EUROPEAN UNION
2 Seas Mers Zeeën
Water Resilient Cities
European Regional Development Fund

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Introduction

- Climate change projections show it is likely that heavy rainfall and flooding will become more frequent
- Urban areas are more vulnerable to weather extremes due to the high amount of impermeable area's and the outdated drainage systems

=> Problems due to existing developments (grey & outdated infrastructure) and increasing risks (natural hazards) due to climate change

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Overall objective water resilient cities

- Improve adaptive capacity of cities to heavy rainfall by retrofiting SuDS in public areas
- Demonstrate reduced flooding while protecting or improving amenities, biodiversity, well-being,…

What are SUDS

- Definition CIRIA:
  - SUDS are defined as a way of managing rainfall that minimizes the negative impacts on the quantity and quality of runoff whilst **maximizing the benefits of amenity and biodiversity** for people and the environment.

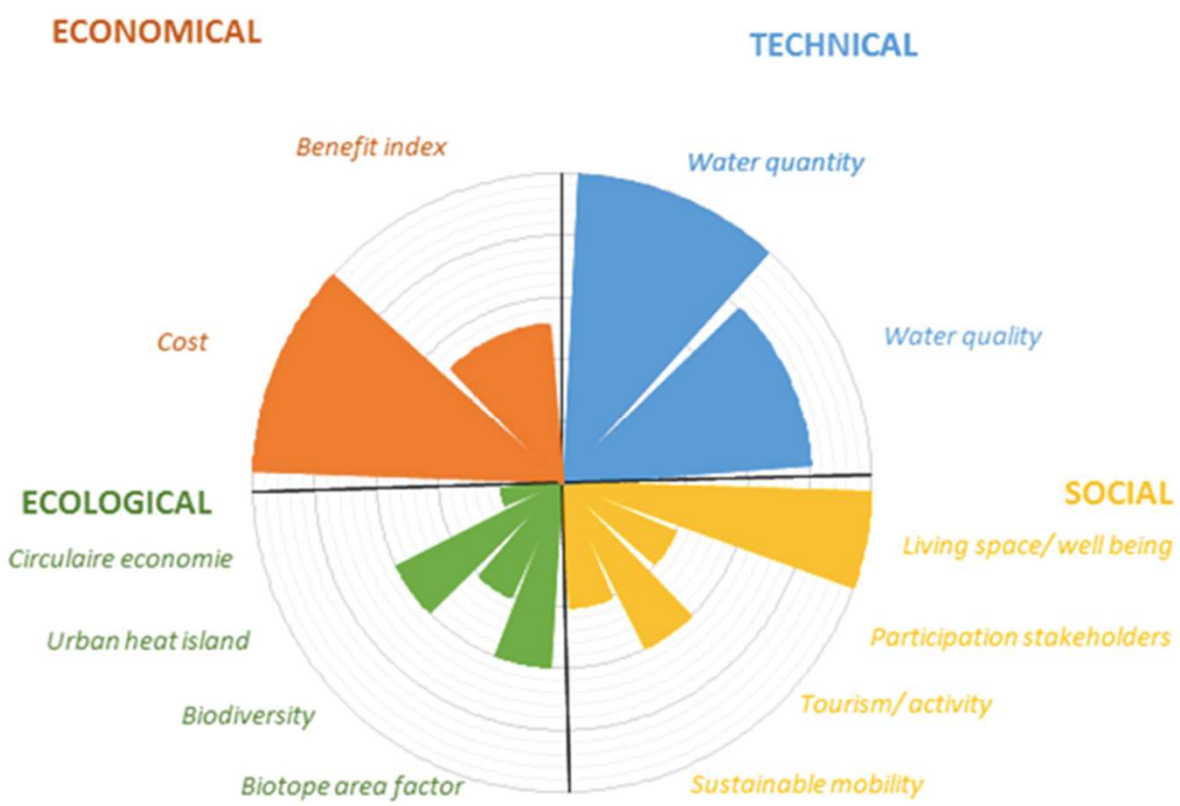
- Definition (D)Rain for life:
  - The basic idea of SUDS is not so much in a specific technique as a general design approach, characterised by the following features:
    - Integrated system of managing storm runoff, consisting of a number of treatment stages;
    - Ability to handle stormwater runoff in extreme rain events;
    - Multi-functionality, **delivery of other functions (amenity, ecology)** by stormwater management measures and adding water management features to public space elements;
    - Cost-efficiency and ease of maintenance.

What are SuDS?

- How to quantify these added benefits?
  => SuDS Quick Scan Tool

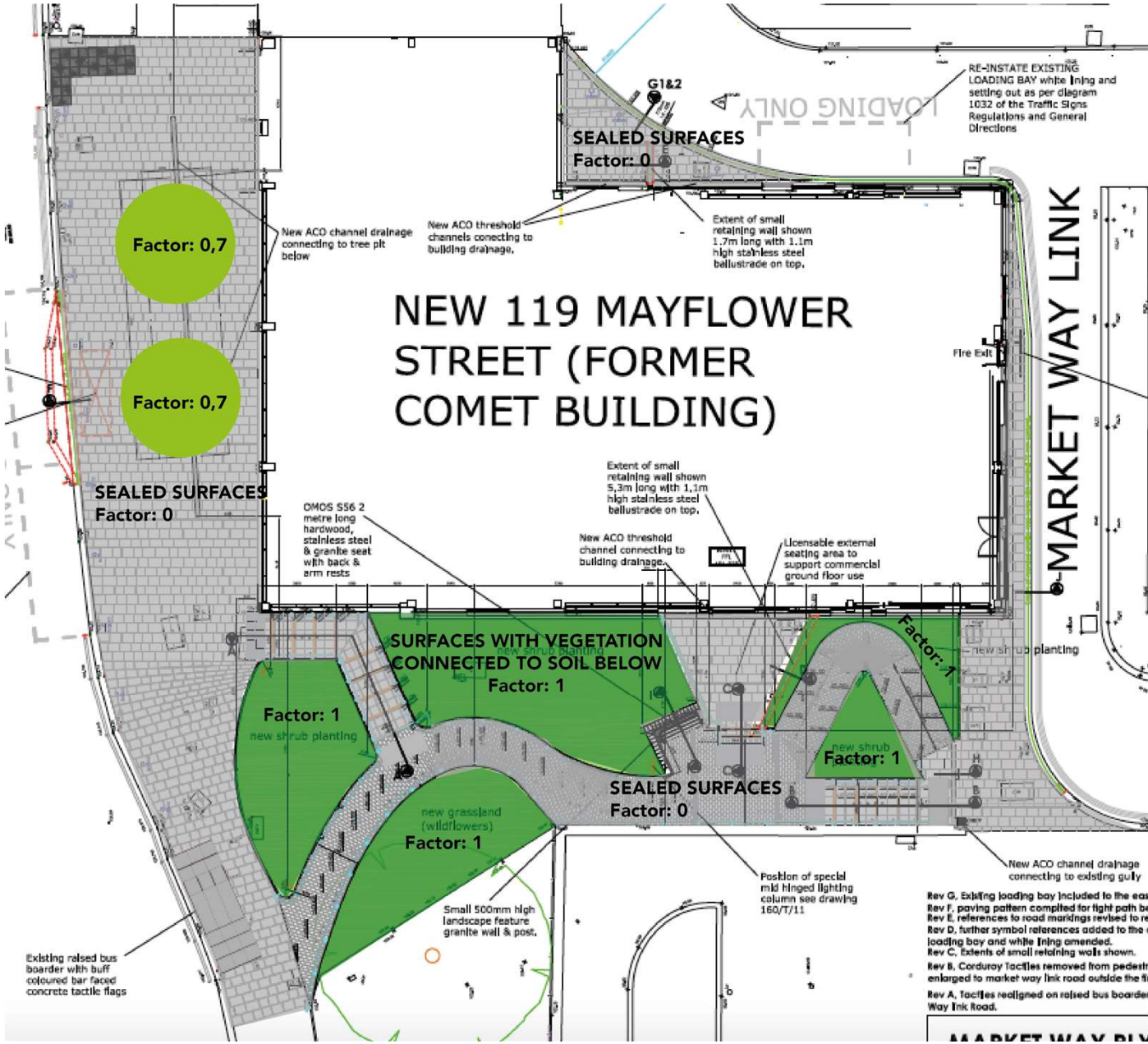
Quick scan tool

- Goal:
  - Map and visualize added benefits of proposed SuDS
  - Allow the evaluation of different factors of SuDS and makes these score visual
  - “Keep it simple” – minimum of input data required



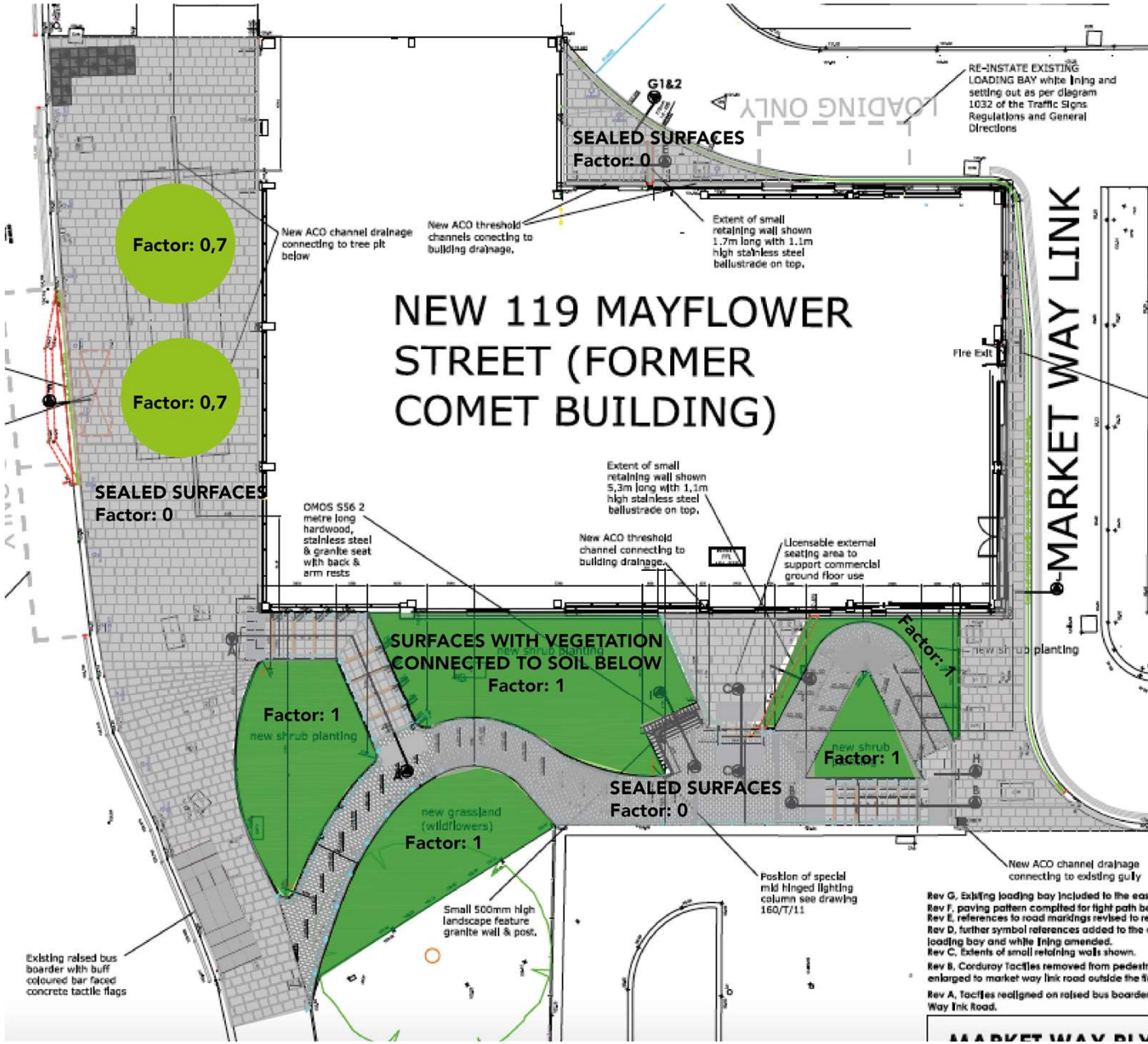
Material and method

- Combination of qualitative and quantitative data
- Bonus points are gathered based on elements in the SUDS
- The evaluation tool makes it possible to compare two projects on **the same location** with each other



Required input data

- Map of the project
- Components of location before and after implementation (benches, street furniture, …)
- Vegetation information (number of trees, height of bushes, underground…)



Added benefits of SuDS

- 4 main factors
  - **Technical** – the prevention of damage caused by heavy rainfalls or droughts
  - **Social** – the provision of additional amenity benefits
  - **Ecological** – the provision of additional nature conservation benefits
  - **Economical** – cost benefit analyses

Multiple benefits of SuDS: technical

- Prevention of damage caused by heavy rainfalls or droughts, by holding and treating surface water run-off
- Key performance indicators (KPI):
  - Water quality
  - Water quantity

Multiple benefits of SuDS: technical

- Example questionnaire water quality

Factors	Score
Disconnection sewer	+1
Oxygen supply	+1
(addition) Presence of vegetation	+1
Connection between soil and water	+1
Light	+1

Multiple benefits of SuDS: social

- the provision of additional amenity benefits
- KPI's:
  - Living space/well-being
  - Participation stakeholders
  - Leisure/activity
  - Sustainable mobility

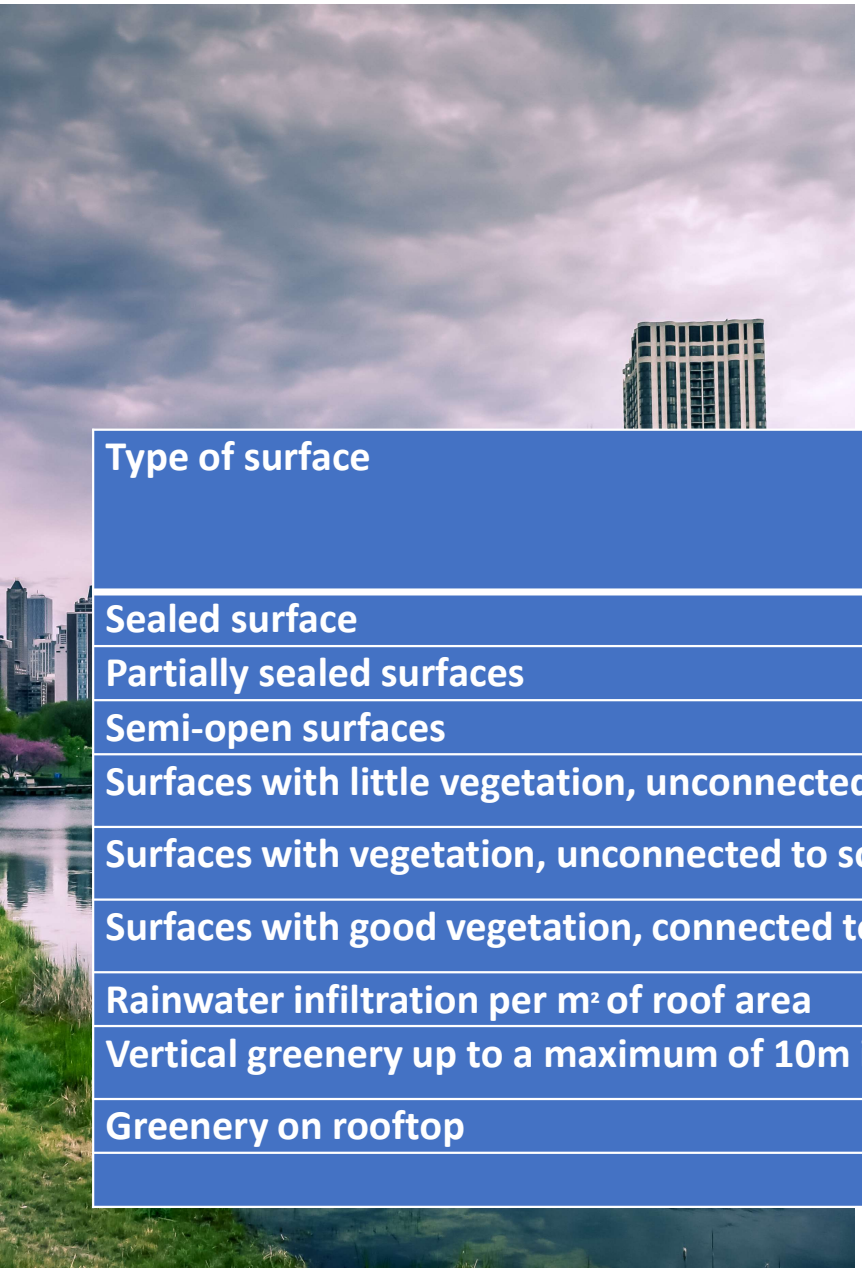
Multiple benefits of SuDS: social

- Example questionnaire participation:

Scale of involvement	Score
Ignorance: people didn't know what was happening	0
Awareness: people knew that something was happening	1
Informed: people were informed	2
Consultation: people were consulted	3
Participation: people were fully participating	4
Ownership: people had mandate to act	5

Multiple benefits of SUDS: ecological

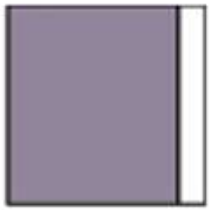
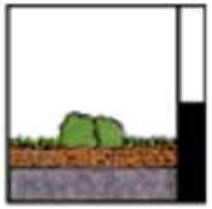
- The provision of additional nature conservation benefits
- KPI's:
  - Biotope area factor
  - Biodiversity
  - Urban heat Island
  - Circular economy

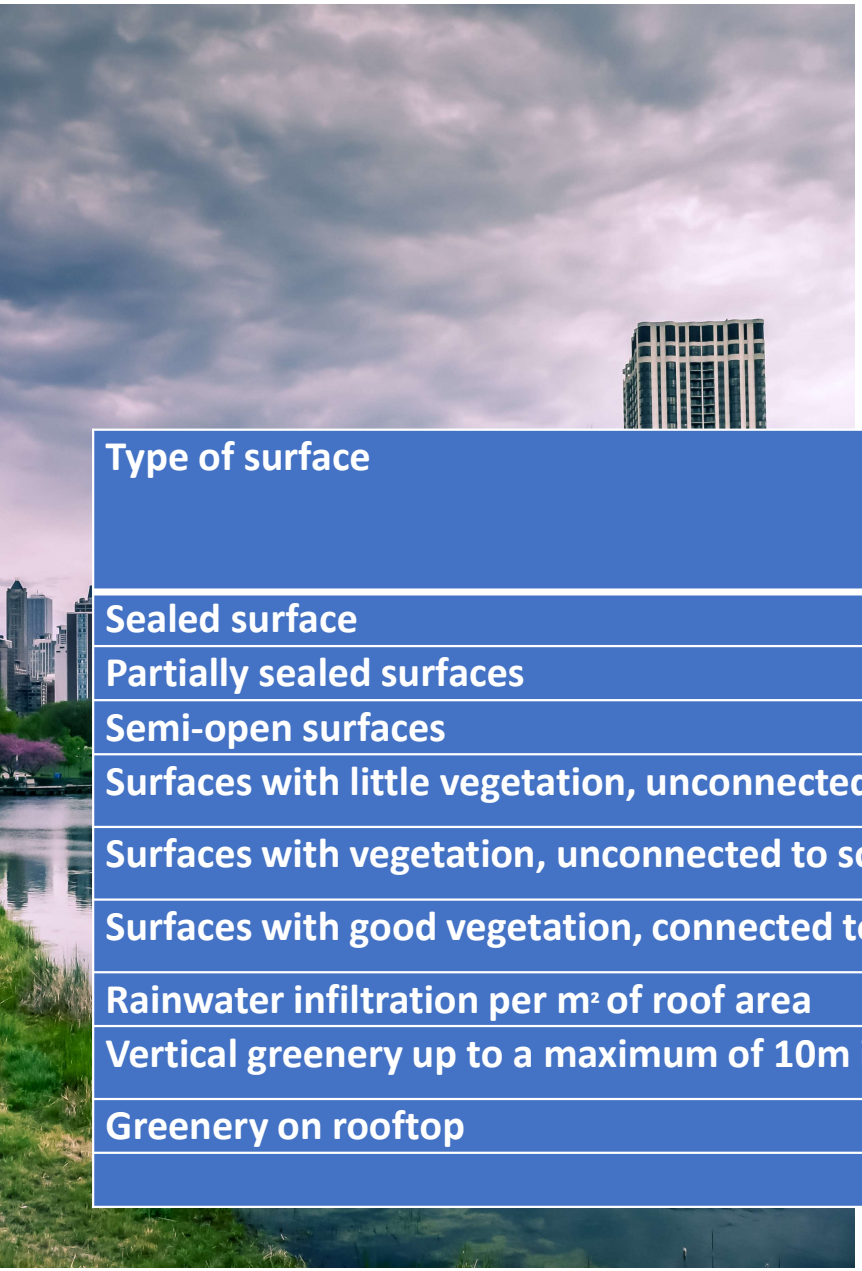


Multiple benefits of SUDS: ecological

- Example biotope area factor: portion of ecologically effective surface area to the total land area

Type of surface	Weighting factor	m^2 in project	Ecologically-effective surface area
Sealed surface	0		
Partially sealed surfaces	0,3		
Semi-open surfaces	0,5		
Surfaces with little vegetation, unconnected to soil below (on thin substrate)	0,5		
Surfaces with vegetation, unconnected to soil below (on thick substrate)	0,7		
Surfaces with good vegetation, connected to soil below (in open ground)	1		
Rainwater infiltration per m^2 of roof area	0,2		
Vertical greenery up to a maximum of 10m in height	0,5		
Greenery on rooftop	0,7		
	Total		

Weighting factor / per m² of surface type		Description of surface types
	Sealed surfaces **0.0**	Surface is impermeable to air and water and has no plant growth (e.g., concrete, asphalt, slabs with a solid subbase)
	Partially sealed surfaces **0.3**	Surface is permeable to water and air; as a rule, no plant growth (e.g., clinker brick, mosaic paving, slabs with a sand or gravel subbase)
	Semi-open surfaces **0.5**	Surface is permeable to water and air; infiltration; plant growth (e.g., gravel with grass coverage, wood-block paving, honeycomb brick with grass)
	Surfaces with vegetation, unconnected to soil below **0.5**	Surfaces with vegetation on cellar covers or underground garages with less than 80 cm of soil covering
	Surfaces with vegetation, unconnected to soil below **0.7**	Surfaces with vegetation that have no connection to soil below but with more than 80 cm of soil covering
	Surfaces with vegetation, connected to soil below **1.0**	Vegetation connected to soil below, available for development of flora and fauna
	Rainwater infiltration per m² of roof area **0.2**	Rainwater infiltration for replenishment of groundwater; infiltration over surfaces with existing vegetation
	Vertical greenery up to a maximum of 10 m in height **0.5**	Greenery covering walls and outer walls with no windows; the actual height, up to 10 m, is taken into account
	Greenery on rooftop **0.7**	Extensive and intensive coverage of rooftop with greenery



Multiple benefits of SUDS: ecological

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	Total		

Multiple benefits of SUDS: ecological

- Example biotope area factor: portion of ecologically effective surface area to the total land area
- $BAF = \frac{Ecologically\ effective\ surface\ area}{Total\ m^2\ in\ project}$

BAF	Score
0 – 0,2	1
0,2 – 0,4	2
0,4 – 0,6	3
0,6 – 0,8	4
0,8 - 1	5

Summary of added benefits

Before we start with the economical factor. A brief summary is made which will help to fill in the economical factor.

Project name:		
Factors	**Added benefits**	**Score**
TECHNICAL	Water quantity	
	Water quality	
SOCIAL	Living space/ well-being	
	Participation stakeholders	
	Leisure/ activity	
	Sustainable mobility	
ECOLOGICAL	Biotope area factor	
	Biodiversity	
	Urban heat island	
	Circular economy	
BENEFITS	**TOTAL BENEFITS SCORE**	
	MAX SCORE	45

Multiple benefits of SUDS: economical

- Cost benefit analyses based on scores on previous factors and objectives.
- Factors:
  - Benefit index
  - Cost
  - Prize per benefit

Multiple benefits of SUDS: economical

- Benfit index
  - Sum of benefits/Maximum score (45)
  - indicates how much benefits were scored on the first three objectives (technical, social and ecological) and is compared to the maximum amount of benefits that can be scored. The higher this index, the better
- Cost
  - Total cost of the project
- Prize per benefit
  - Prize/sum of benefits
  - How much money is spend per benefit. The lower this index is, the less you pay to get a benefit, and thus the more benefits this proposal generates within a certain amount of money. “Value for money”

Case 1 : Zandpoortvest Mechelen

- Zandpoortvest as implemented in the project
  - Opening of culvert under parking lot
  - Street furniture
  - Facilities for people with a disability
  - Tree pits
  - Cost price: 1.700.000

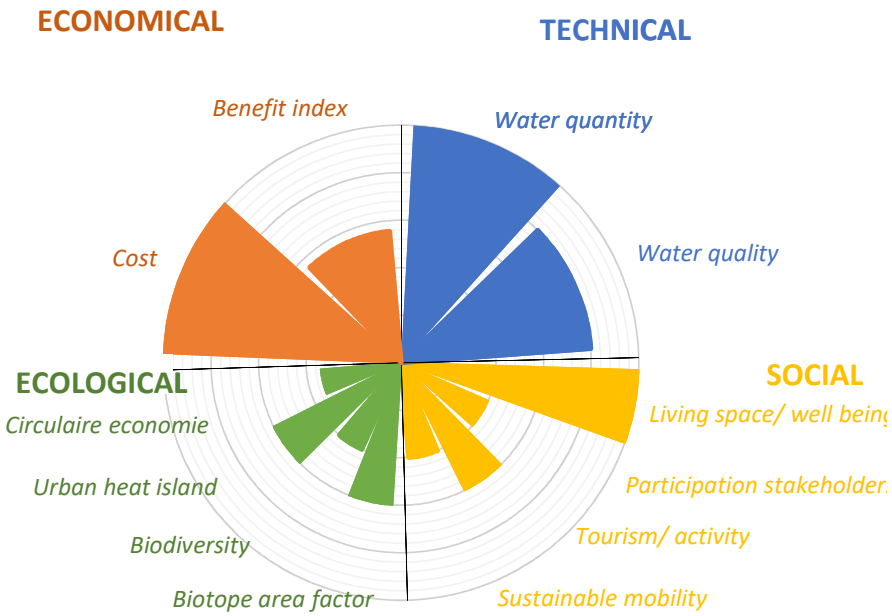
Case 2: Zandpoortvest Mechelen

- Zandpoortvest proposal without street furniture
  - Opening of culvert
  - No street furniture, mere concrete
  - No tree pits
  - Cost price: 1.300.00

	Added benefits	CASE 1	CASE 2
TECHNICAL	Water quantity	*5*	*5*
	Water quality	*4*	*4*
	Total technical score (10)	**9**	**9**
SOCIAL	Living space/ well-being	5	2
	Participation stakeholders	2	2
	leisure/ activity	3	1
	Sustainable mobility	2	1
	Total social score (19)	**12**	**6**
ECOLOGICAL	Biotope area factor	3	1
	Biodiversity	2	1
	Urban heat island	3	2
	Circular economy	1	1
	Total ecological score (16)	**9**	**5**
BENEFITS	**TOTAL BENEFITS SCORE**	**30**	**20**
	MAX SCORE	**45**	**45**

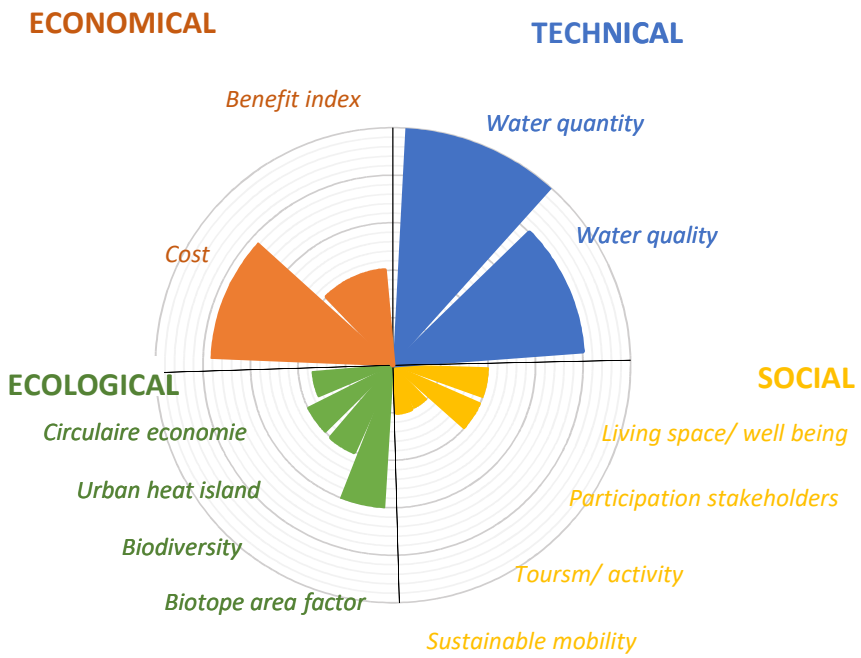
Results quick scan tool

Case 1



- Benefit index = 0,67
- Cost = € 1.700.000
- Prize per benefit = 56.667

Case 2



- Benefit index = 0,44
- Cost = € 1.300.000
- Prize per benefit = 65.000

Results

- Results show that the tool is easy to fill in.
  - Average time to fill in 2h30
- Tool also acts as quality control tool
  - reminds designers/developers which factors could possibly be integrated in the SuDS design
- Tool is modular.
  - At this stage the tool is designed for urban drainage systems.
  - Depending on specific situations, some KPIs could be added/deleted
    - For example, in the case of a drainage system in a rural area the ecological factors could be more important, whereas the social factors could hardly be considered as added benefits.

More information?

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- https://waterresilientcities.eu/