Deltares

enabling delta life

Deltares

Workshop: Ecosystem-based Adaptation

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20 November 2020

Project Objectives

1. Develop an urban resilience and adaptation tool for planning Ecosystem-based Adaptation (EbA) measures for Nur Sultan

2. Identify key flood prone areas to plan for EbA

3. Perform a pre-feasibility study of suitable EbA measures for a pilot area for the city of Nur Sultan.

AFP/Getty Images

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Program

Time	Topic
14.00 – 14.30	Session I-a: Proposed project area between Akhmet Baitursynuly Street and Jumeken Najimedenov Street Introduction to the pilot area and the Nur Sultan CRC Toolbox
14.30 – 15.00	Session I-b: Introduction to Eco-system Based Adaptation
15.00 – 15.45	Session II: Split up in two groups - Setting adaptation targets and discussion on challenges for the project area
15.45 – 16.00	Break
16.00 – 17.00	Session III: Split up in two groups and develop climate resilience plan
17.00 – 17.30	Session IV: Present designs of the group and find no-regret options and strong points in each of the plans
17.30 – 18.00	Session V: Lessons learned and follow-up activities

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Hazards for our urban environment

- Climate change: more severe extremes
  - Flooding
  - Drought
  - Heat
- Socio-economic changes in society

Flooding

- **Fluvial:** Extreme rainfall in river basin + hydraulic overloaded rivers + failing levees
- **Pluvial: Extreme rainfall in urban area + insufficient storage and drainage capacity**
- **Coastal:** Cyclone, tsunami + failing levees and dunes.
- **Groundwater:** Flooding due to seepage and high groundwater levels

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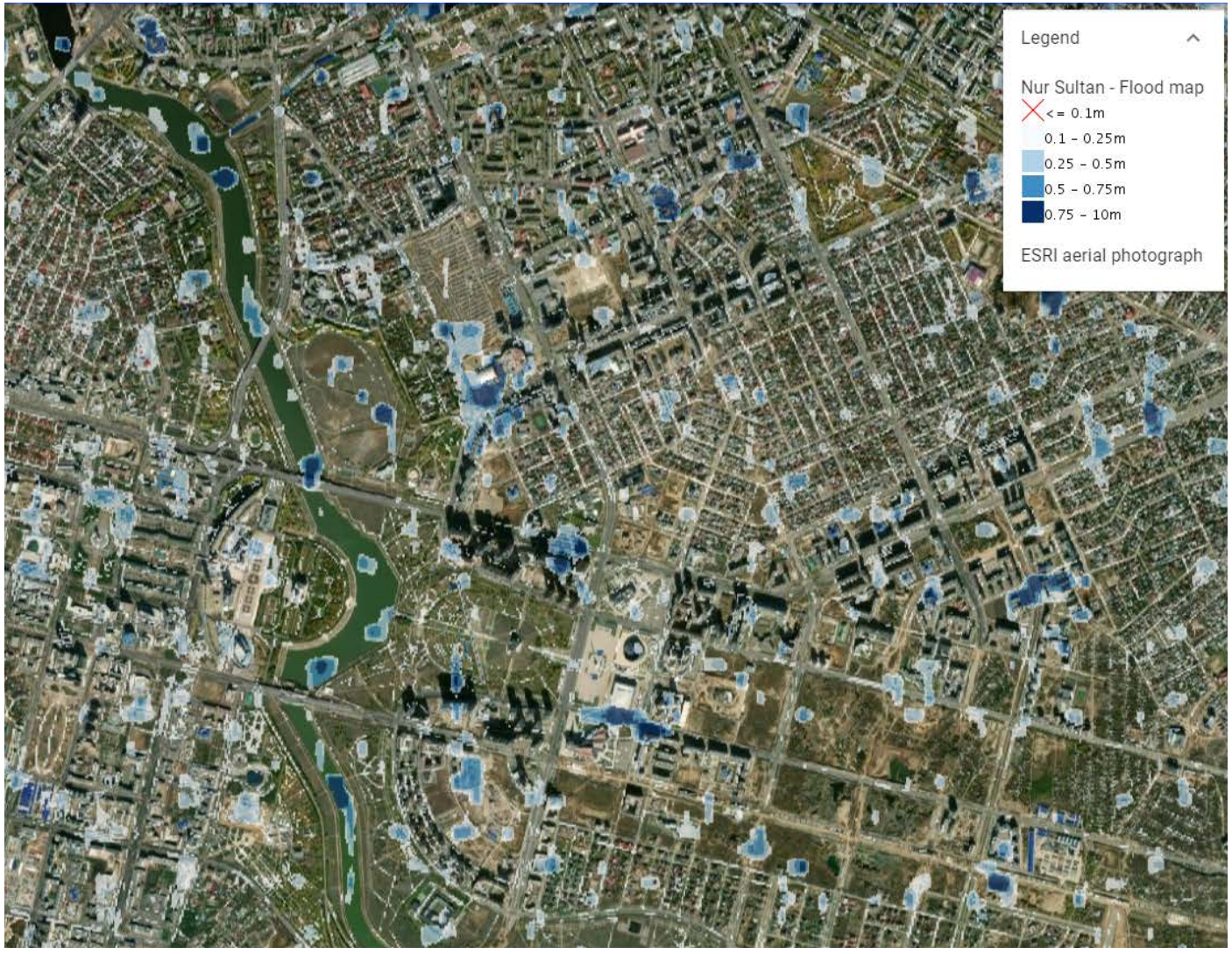
It starts with: understanding the system, its developments and hazards

Flood hazard map Nur Sultan



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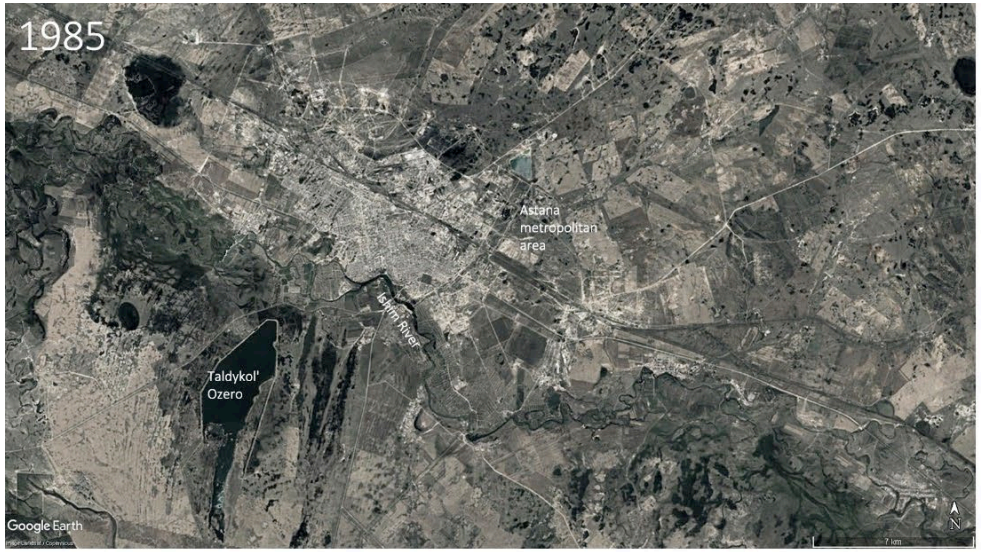
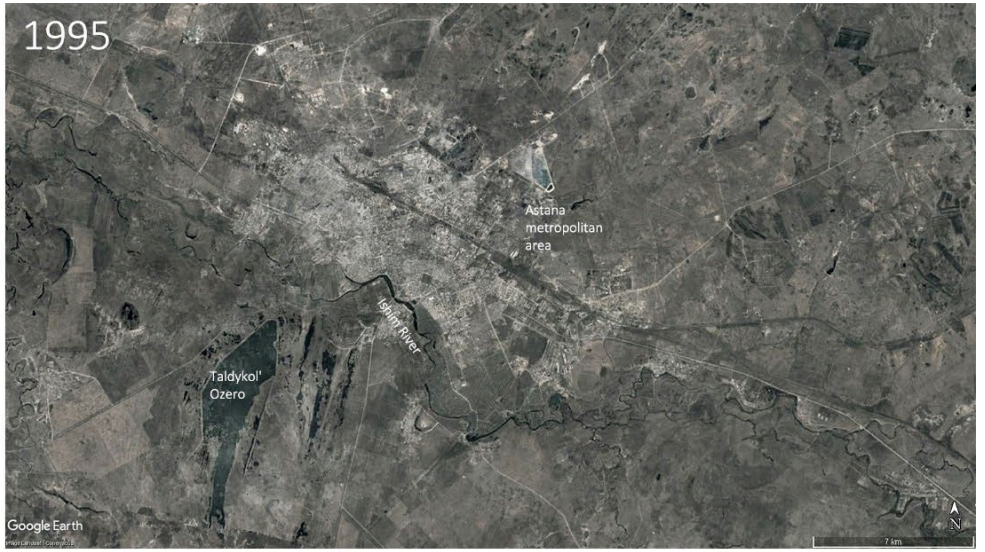
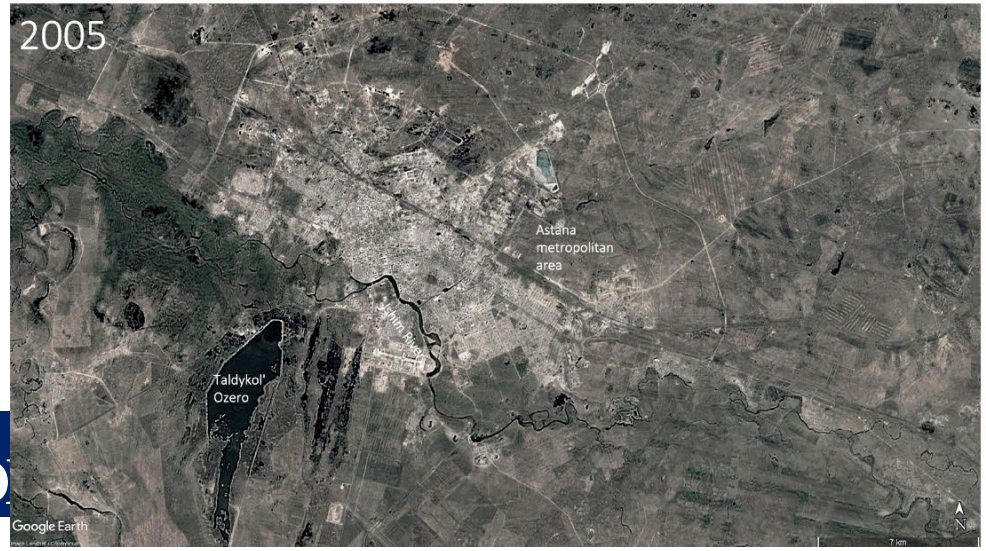
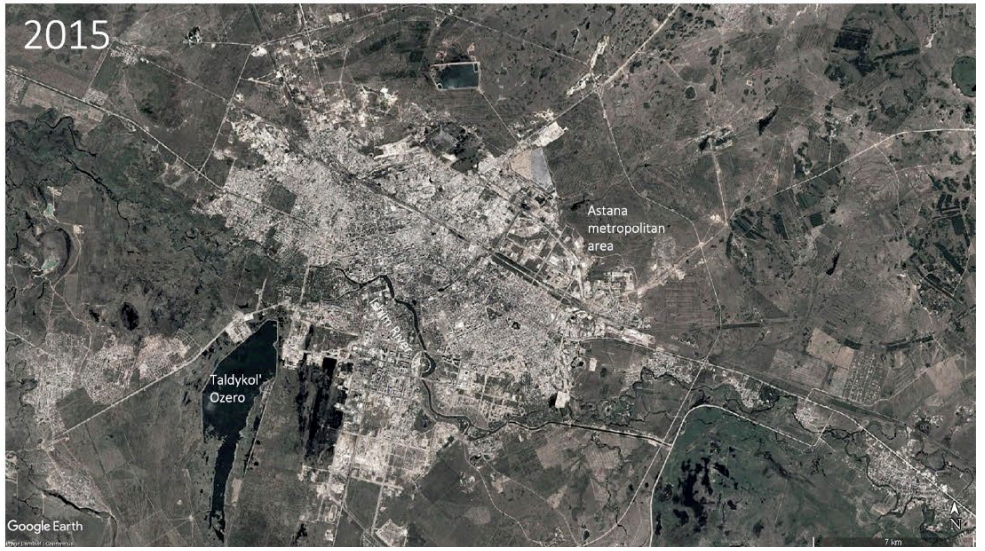
Nur Sultan Urban Expansion

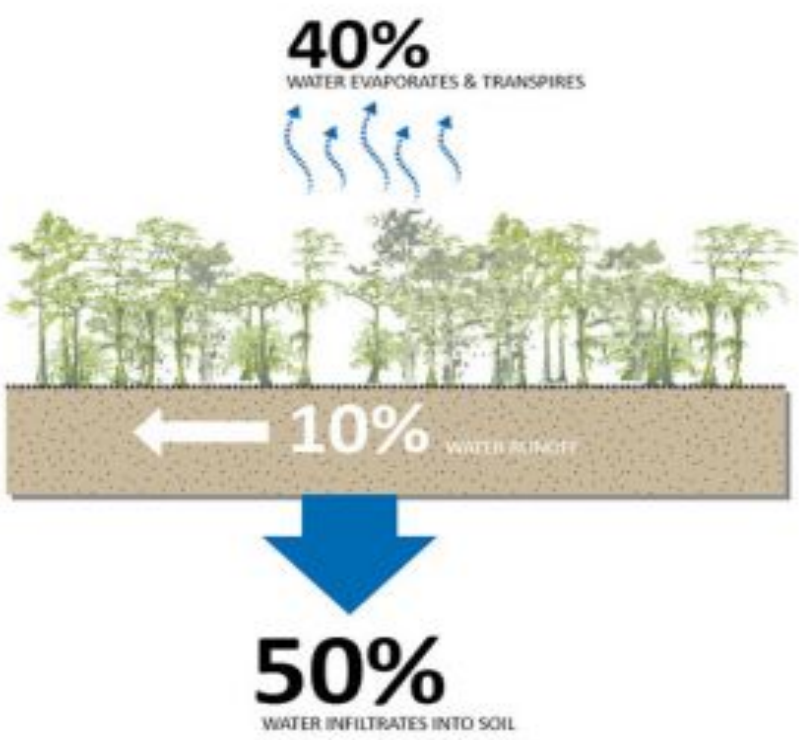






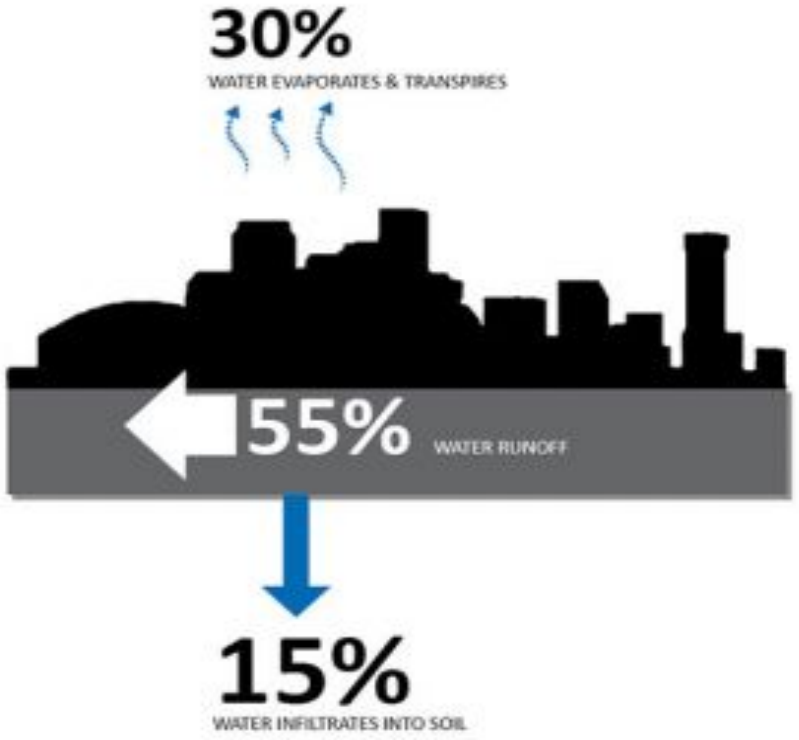


Urbanization and the water system



Natural Landscape

Soil and vegetation naturally absorb 90 percent of rainfall through infiltration into the ground and evapotranspiration into the air. Plants on the delta, like bald cypress and swamp iris, have adapted to live in a wet landscape.



Hard City Surfaces

Asphalt, pavement, and roofs rapidly shed water, creating huge volumes of fast flowing runoff. Developed areas create over 500 percent more runoff than natural areas of the same size.

3. Need to retrofit adaptation measures

Cities are designed for the conditions of the past

- **retrofitting adaptation measures** for new conditions is required
- vulnerability is to be reduced
  - reduce exposure to the Hazards
  - reduce Sensitivity
- Urban RESILIENCE is to be strengthened

Urban Nature Based Solutions

- We will use this brief definition:
- Urban Nature-based solutions (NBS) refer to the sustainable management and use of nature (e.g. (Blue-)Green Infrastructure) for tackling societal challenges.

Ecosystem based solutions

Hybrid solutions

SOFT ENGINEERING

HARD ENGINEERING

Ecosystem-based adaptation to climate change

Harnessing ecosystem services and functions in infrastructure and planning in order to:

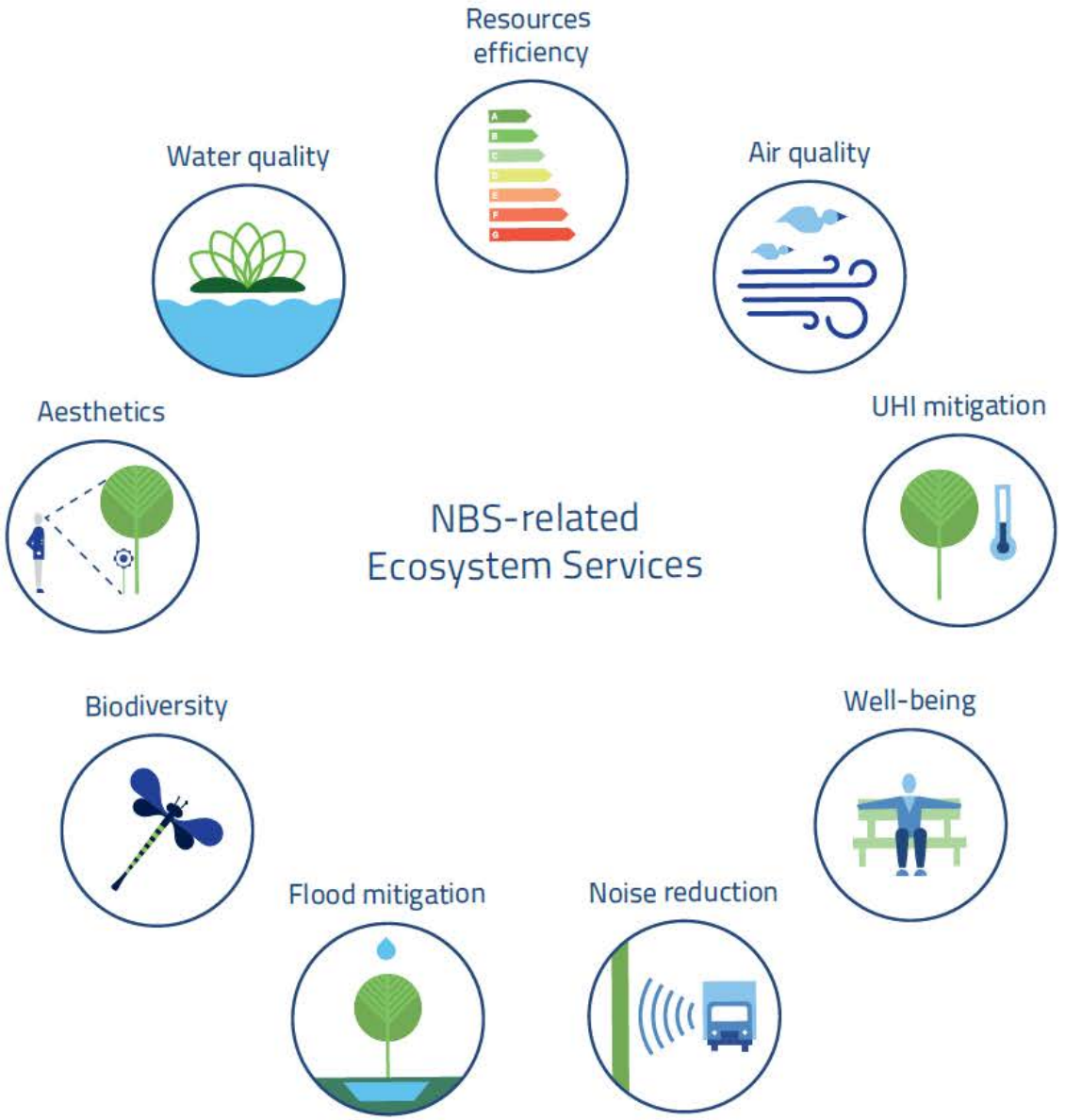
- Minimize climate related hazards:
- Flooding
- Heat stress
- Drought

- Maximize resilience:
- Livability / urban regeneration
- Health potential
- Sustainable economic development

NBS can have different functions and can provide various co-benefits

Urban context:

- The provision of ecosystem services in cities depends on the quality and quantity of urban green infrastructure. Green infrastructure includes parks, gardens, urban allotments, urban forests, wetlands, lakes and ponds in cities, but also the natural areas – such as forests, mountains and wetlands – surrounding urban spaces.



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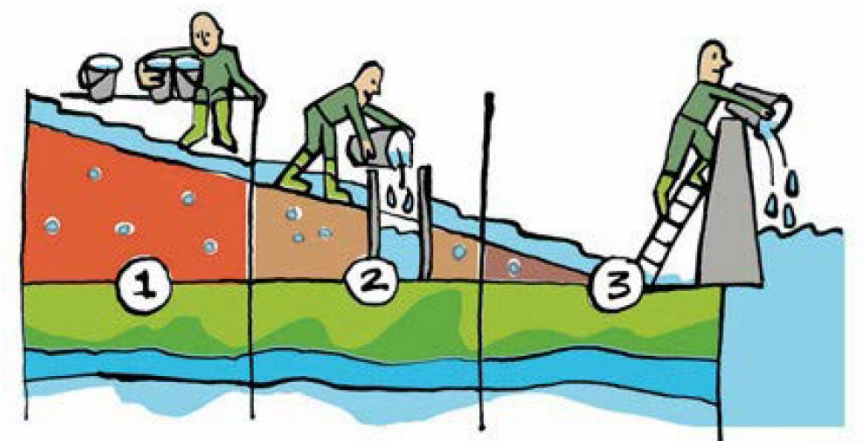
Types of NBS for climate resilience – Key principles

- Water storage, instead of drainage (flood and drought prevention)
- Infiltration, instead of drainage (flood and drought prevention)
- Handling stormwater locally instead of draining
- Vegetation Evapotranspiration (heat-stress reduction)

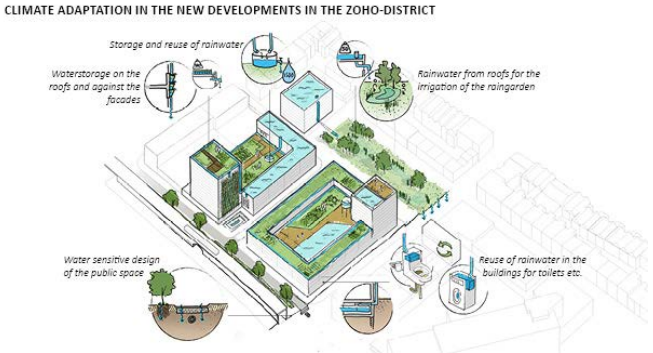
Retain – Store - Drain strategy:

Retain and Detain and Store at the source to avoid overloading the drainage capacity downstream

Retain Store Drain



NEVER SHIFT PROBLEMS !



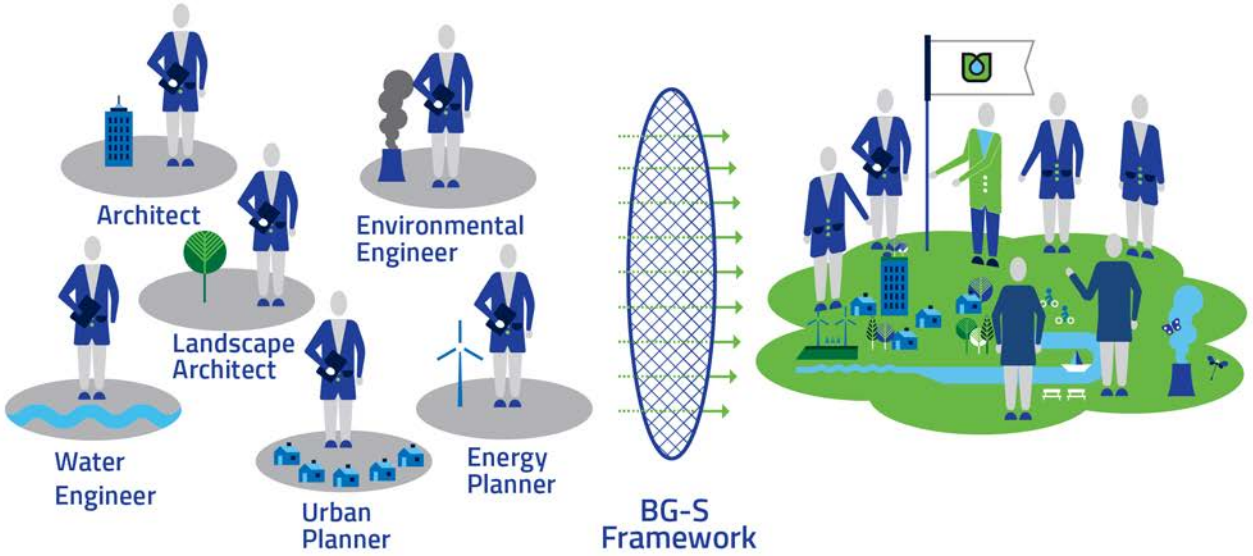
De Urbanisten

BOTKYRKA KOMMUN

http://www.chinadaily.com.cn/opinion/2017-09/26/content_32491069.htm

Collaborative planning

experts from many disciplines + local stakeholders



Božović, R., Č. Maksimović, A. Mijić, M. Van Reeuwijk, K. Smith, I. Suter, 2017, Blue Green Solutions, A Systems Approach to Sustainable, Resilient and Cost-Efficient Urban Development, (BGS Planning guide developed in Blue Green Dream project funded by Climate_KIC, EIT, European Institute for Innovation and Technology).

Nur Sultan stakeholder setting

Time / project phase

	1 - Project Initiative Phase	2 - Feasibility study (including Initial Environmental Examination)	3 - Project set-up	4 - Preliminary design	5 - Project design (including Environmental Impact Assessment)	6 - Construction	7 - Maintenance		Entity
Execution	Fuel and Energy Complex and Utilities Unit, NS Akimat								Akimat
	Environment Protection and Nature Use Unit of NS Akimat								Akimat - District
	Yelorda Ecosystem		Yelorda Ecosystem						Akimat's Subordinates
		Astanagenplan, Astanagorarchitectura or design entities							Province/State
		Architecture, City Building and Land Relations Unit of NS Akimat							National
						Construction companies			Private
							District Akimats		
Approval/permits	Akimat Management	Environment Protection and Nature Unit of NS Akimat			Environment Protection and Nature Unit of NS Akimat				
		Committee of Environmental Regulation and Control			Committee of Environmental Regulation and Control				
		Private companies with a license							
		State Expertise RSE							
		Economy and Budget Planning Unit of NS Akimat within its competence							
		PPP Center							

Climate Resilient City Toolbox

- CRCTool: collection of various tools
- Measure-pre-ranking, overview of adaptation options
  - Adaptation support tool, rapid evaluations
  - Creative design
  - Participatory elaboration, modelling, evaluation
- CRCTool in the adaptation process:

  To see:

  a. What can be done,
  b. Where in the project area
  c. How effective that is

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The Climate Resilient City Tool

- What does the CRCTool look like?
  - Online user interface, easy to use
  - IT structure

Nur Sultan customized version:

https://nursultan.crctool.org/en

https://nursultan.crctool.org/nl

https://nursultan.crctool.org/ru

ОБЛАСТЬ ПРОЕКТА | ЦЕЛЕВОЕ ЗАДАНИЕ ПРОЕКТА

Размер Области: **268081m²** ИЗМЕНИТЬ ОБЛАСТЬ

Название Сценария

Выбрать Сценарий

Способность Климатической Устойчивости

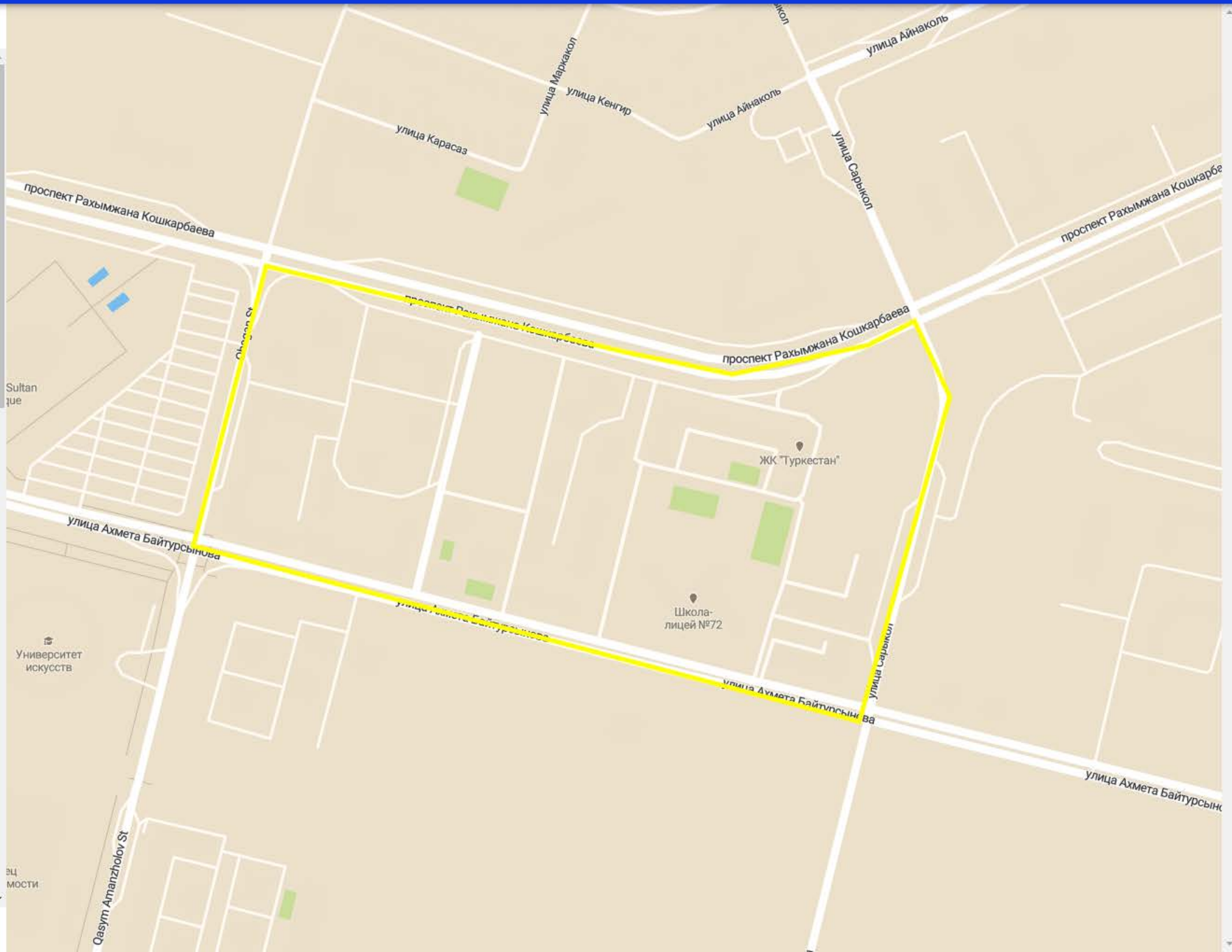
- [x] Тепловой стресс
- [x] Засуха
- [x] Плювиальное наводнение
- [ ] Водная безопасность

- (•) Не важно
- ( ) Важно
- ( ) Очень важно

Уровень масштаба

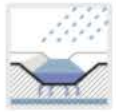
- [x] Город
- [ ] Окрестности
- [ ] Улица
- [ ] Здание

СЛЕДУЮЩИЙ



1 Выбрать меру — 2 Нарисовать область

search

Канавы

42.8
УЗНАТЬ БОЛЬШЕ ВЫБРАТЬ

Добавление деревьев в уличный пейзаж

41.3
УЗНАТЬ БОЛЬШЕ ВЫБРАТЬ

Биодренажные канавы (с дренажем)

38.2
УЗНАТЬ БОЛЬШЕ ВЫБРАТЬ

Дренажно-Инфильтрационно-транспортные (ДИТ) сливы

31.1
УЗНАТЬ БОЛЬШЕ ВЫБРАТЬ

Слои гравия

18.7
УЗНАТЬ БОЛЬШЕ ВЫБРАТЬ

Городское сельское хозяйство

57.3
УЗНАТЬ БОЛЬШЕ ВЫБРАТЬ

Интенсивная зеленая крыша

52.7
УЗНАТЬ БОЛЬШЕ ВЫБРАТЬ

городской лес

50.6
УЗНАТЬ БОЛЬШЕ ВЫБРАТЬ

Полые дороги

49.1
УЗНАТЬ БОЛЬШЕ ВЫБРАТЬ

Проницаемые асфальтированные системы покрытия (инфильтрация)

47.0
УЗНАТЬ БОЛЬШЕ ВЫБРАТЬ

Убрать асфальт, чтобы посадить зеленые насаждения

47.0
УЗНАТЬ БОЛЬШЕ ВЫБРАТЬ

Проницаемые тротуары (хранение)

47.0
УЗНАТЬ БОЛЬШЕ ВЫБРАТЬ

Зеленые крыши с задержкой водоотвода

47.0

green roofs magweg

47.0

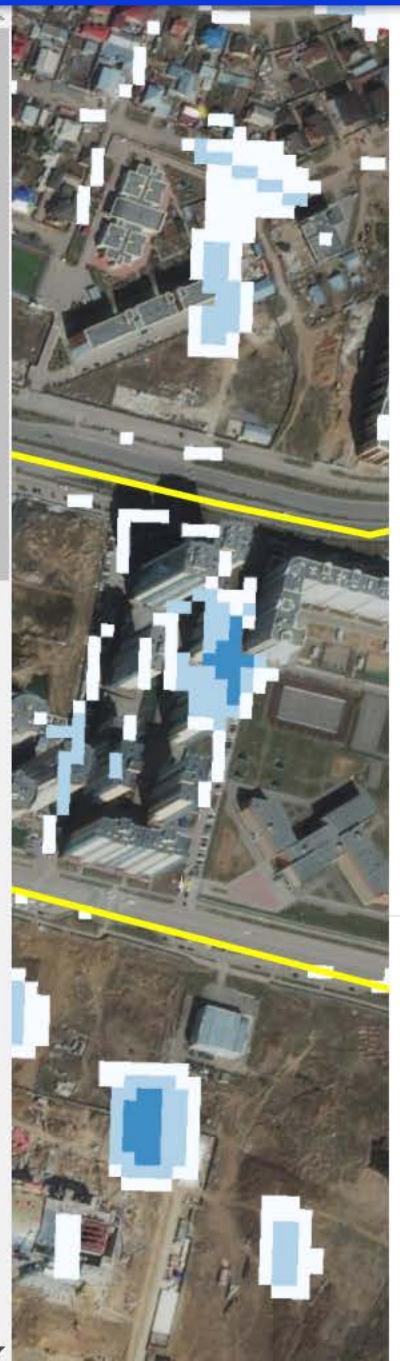
Обширные зеленые крыши

46.2

Водяная крыша

43.7

CANCEL



Результаты

Климат
Вместимость хранилища (m3):	0
Коэффициент времени возврата (-):	0
Пополнение подземных вод (mm/Год):	0
эвапотранспирация (суммарное испарение) (mm/Год):	0
Снижение тепловыделения (°C):	0
Прохладные зоны (число):	0

Стоимость
Строительство (€):	0
Техническое обслуживание (€/Год):	0

Качество воды
Снижение содержания патогена (%):	0
Снижение содержания питательных веществ (%):	0
Адсорбирующие загрязнители (%):	0

ПОКАЗАТЬ В ВИДЕ ТАБЛИЦЫ

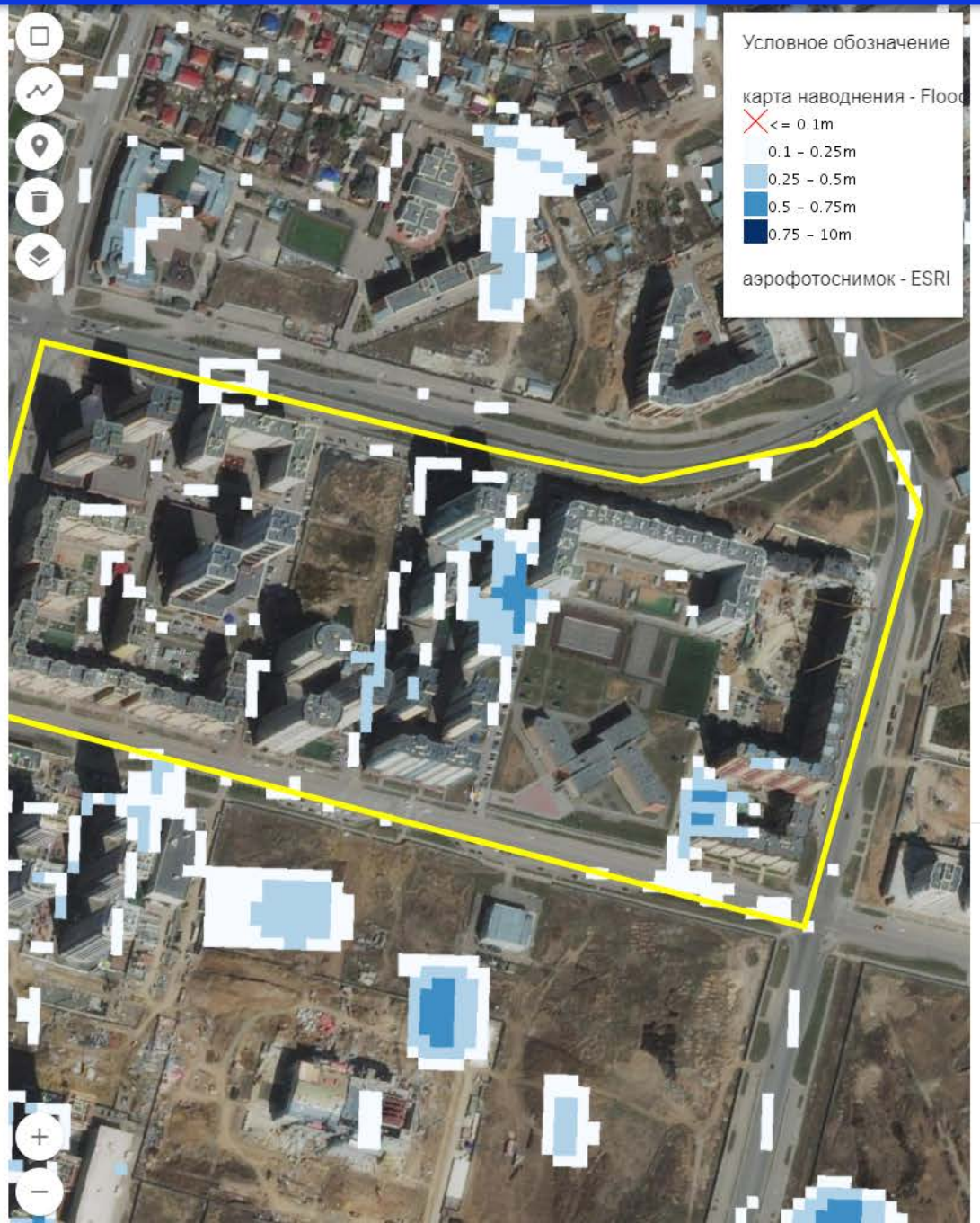
НАЗАД

ВЫБРАТЬ

Биодренажные канавы (с дренажем)

Биосвал (Биодренажные канавы) - это ров с растительностью, пористым дном и ниже него слой гравия, наполненный геотекстилем с инфильтрационной трубой/дренажной трубой. Он обеспечивает хранение, инфильтрацию и транспортировку дождевой воды, способствуя при этом повышению биологического разнообразия и качества жизни.

Wadi Culemborg, Eva Lanxmeer, atelier GroenBlauw



Результаты

Климат

Вместимость хранилища (m3):	0
Коэффициент времени возврата (-):	0
Пополнение подземных вод (mm/Год):	0
эвапотранспирация (суммарное испарение) (mm/Год):	0
Снижение тепловыделения (°C):	0
Прохладные зоны (число):	0

Стоимость

Строительство (€):	0
Техническое обслуживание (€/Год):	0

Качество воды

Снижение содержания патогена (%):	0
Снижение содержания питательных веществ (%):	0
Адсорбирующие загрязнители (%):	0

ПОКАЗАТЬ В ВИДЕ ТАБЛИЦЫ

Применяемые Меры

Биодренажные канавы (с дренажем)

+ МЕРА

Результаты

Климат

Вместимость хранилища (m3):	716
Коэффициент времени возврата (-):	4.19
Пополнение подземных вод (mm/Год):	14.54
эвапотранспирация (суммарное испарение) (mm/Год):	0.18
Снижение тепловыделения (°C):	0.02
Прохладные зоны (число):	0

Стоимость

Строительство (€):	153354
Техническое обслуживание (€/Год):	1534

Качество воды

Снижение содержания патогена (%):	0.69
Снижение содержания питательных веществ (%):	0.61
Адсорбирующие загрязнители (%):	0.69

ПОКАЗАТЬ В ВИДЕ ТАБЛИЦЫ

CRCT: Effectiveness of measures

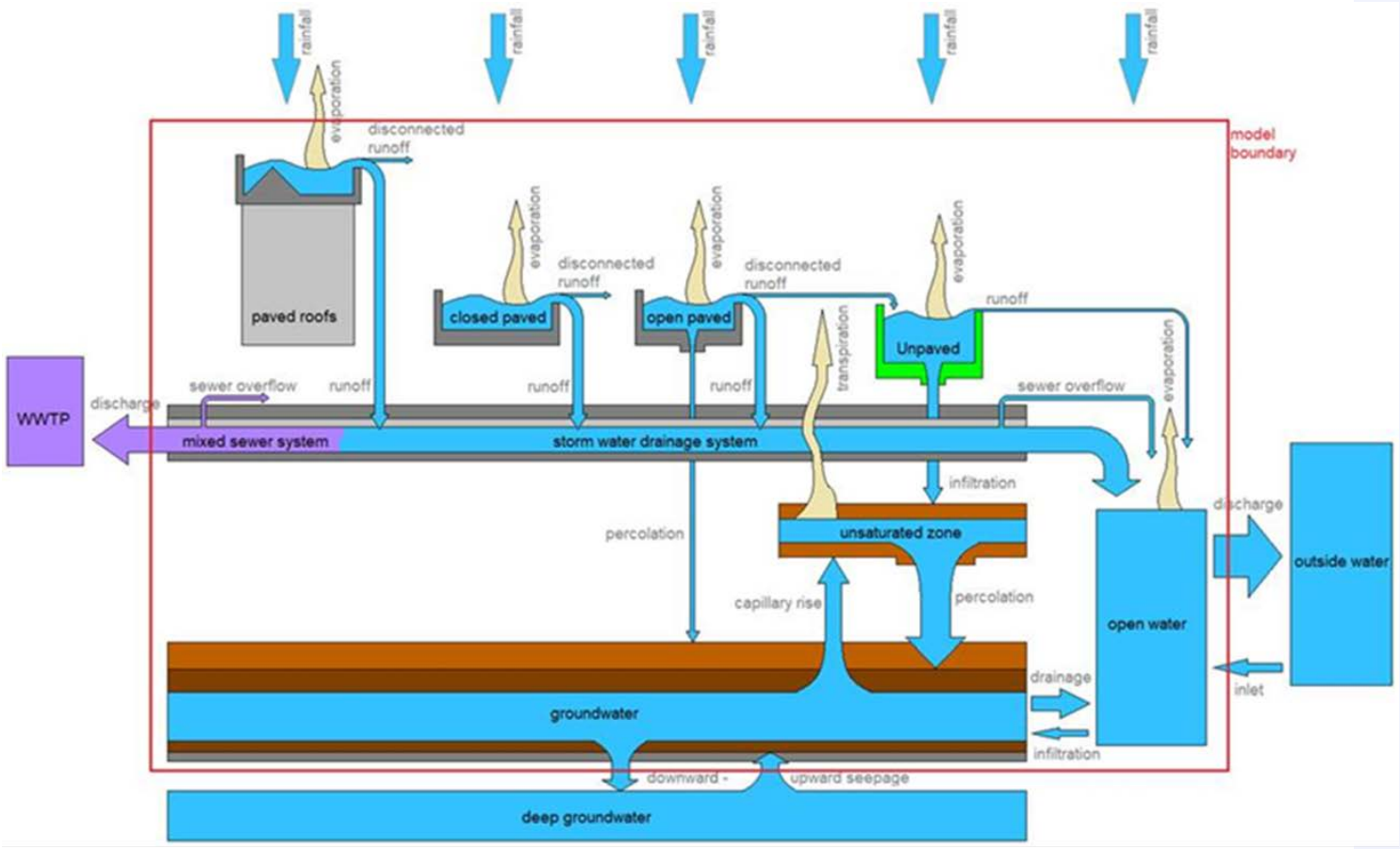
Adaptation goal	Key performance	Calculation method
Pluvial flooding	Storage capacity [m3] Return time factor [-]	Map and user input
Drought reduction	Groundwater recharge (infiltration) [m/y]	Urban Water Balance Model
Heat stress reduction	Evapotranspiration [mm/y] Coolspots [-]	Urban Water Balance Model Literature and geometry
Water quality improvement	Pathogen reduction Nutrient reduction Adsorbing polutants	Conceptual model
Cost	Construction cost Maintenance cost	Guidelines and practice

Urban Water Balance model

The hydrological effects of the adaptation measures are determined by means of a **multi-reservoir water balance rainfall-runoff model**

based on (ideally) long (30 years or more) time series of meteorological data, using hourly time steps.

- **Hydrological boundary conditions** of the water balance model are based on local conditions
- **Runoff** is calculated for measures with varying storage depths and rainfall events with varying intensities with known return periods.



宜水环境 Ewaters

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Pre-feasibility study of confirmed ecosystem-based adaptation measures for Xiangtan

Deltares
Frans van de Ven
Reinder Brolsma
Helena Hulsman
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Ewaters
Weijun Zhang
Ran Zhu
Tingting Hao
Zhengmin Lei

20 November 2020

Pilot areas

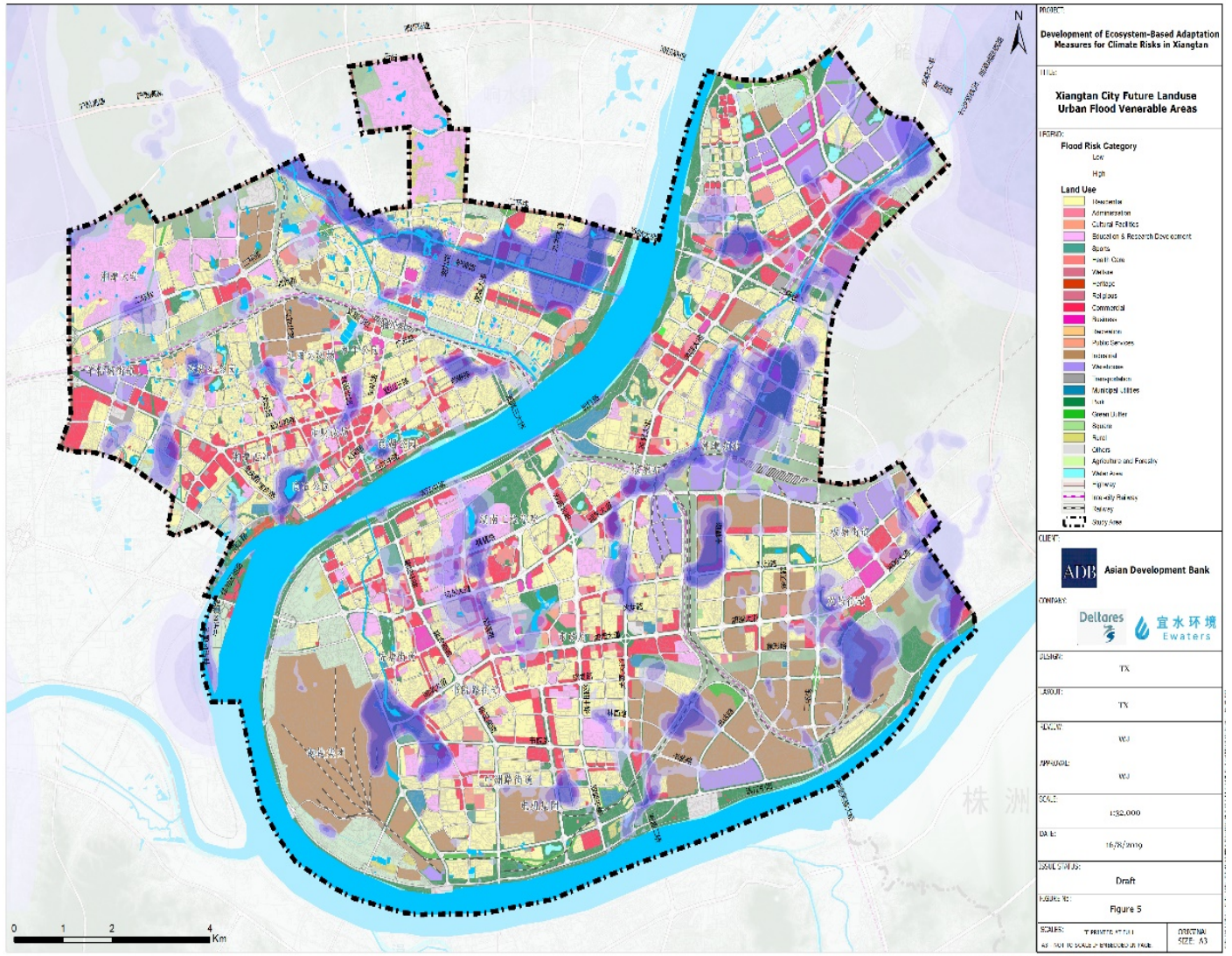
Fuxing Middle Road

New Chinese Medicine Hospital design and building site

Flood risk assessment

Preliminary flood hazard map combined with land existing and future land use

This map is the basis for the selection of the pilot areas

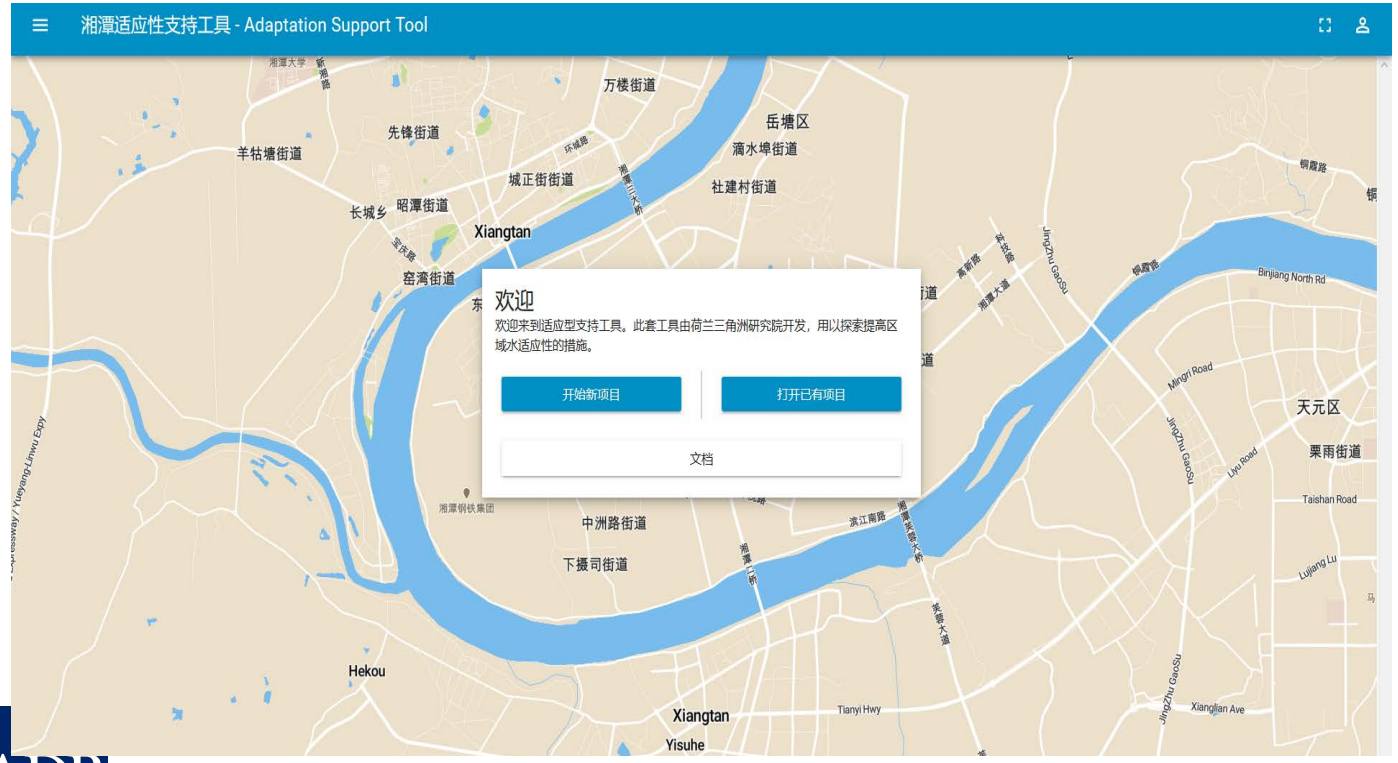


Relevant actors

- Xiangtan Municipal Commission of Development and Reform
- Xiangtan Water Conservancy Bureau
- Xiangtan Bureau of Housing and Urban Rural Construction
- Ecology and Environment Department of Xiangtan
- Xiangtan City Administration and Comprehensive Law Enforcement Bureau
- Nature Resources and Planning Bureau of Xiangtan City
- Xiangtan Finance Bureau
- Xiangtan Meteorological Bureau

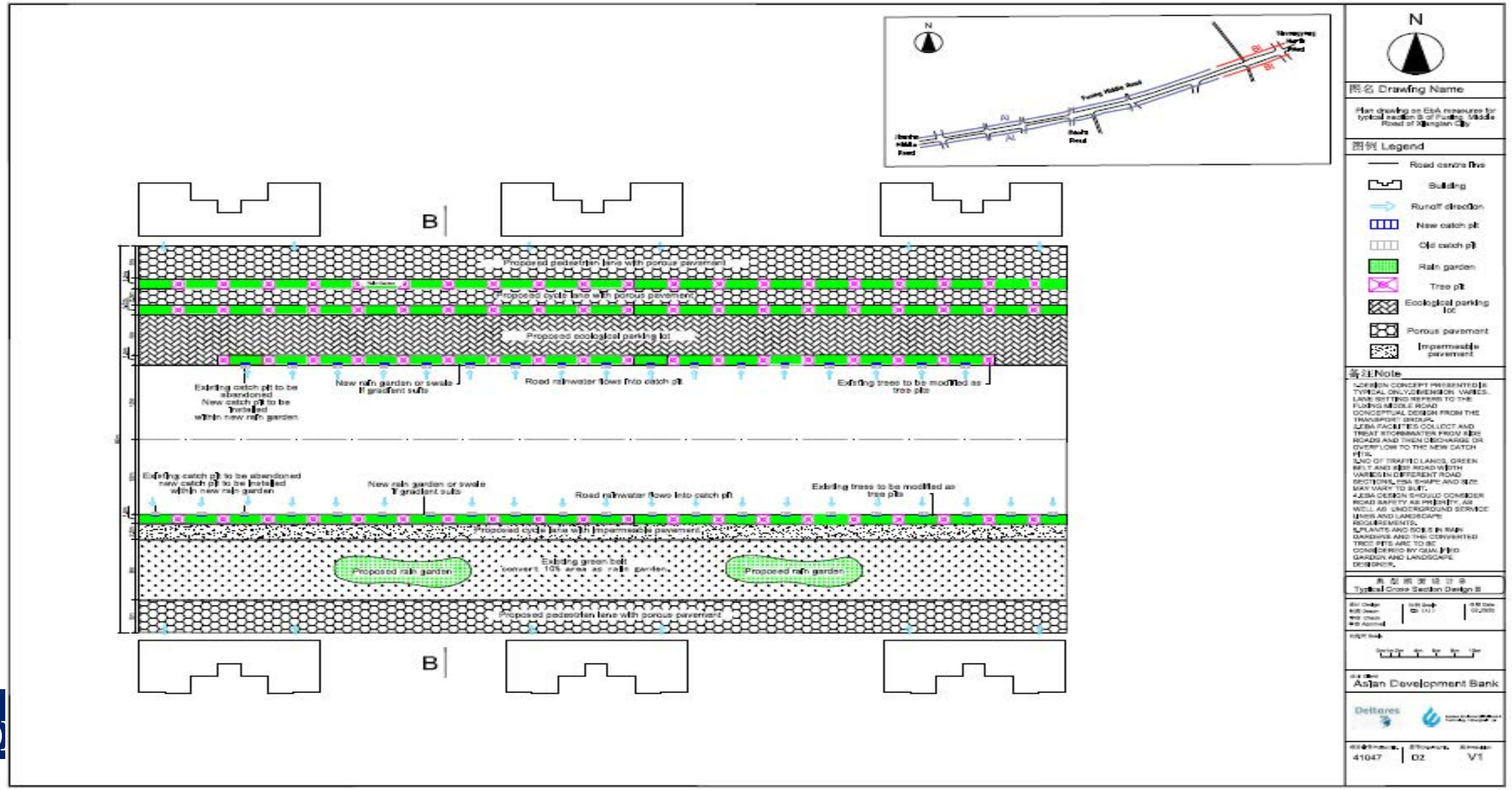
Xiangtan Climate Resilient City Tool https://xiangtan.crctool.org/zh_cn/)

- The Climate Resilient City Toolbox was customized for use in Xiantan and is available to all actors
- Customization included assessment of adaptation measures effectiveness based on the local climate and local cost estimates for construction and maintenance of the measures



Training sessions and design workshop

Conceptual design Fuxing Middle Road



Applicability of EbA measures in the low carbon communities

Name of Community	tree pits	raingarden/ bioswale	porous paving	rainwater tank	sponge city gardens
Lubandian	✓		✓	✓	
Chezhanlu	✓	✓	✓	✓	
Heping	✓		✓	✓	
Jintang	✓	✓	✓	✓	✓
Shanshuxiang	✓		✓	✓	
Luozudian	✓		✓	✓	
Yanzhu	✓	✓	✓	✓	✓
Sanjiaoping	✓	✓	✓	✓	
Wulidui			✓		
Banbianjie	✓	✓	✓		
Xuewei	✓	✓	✓		✓
Xiaguang	✓	✓	✓		
Wayaotang	✓		✓		
Xiaotang	✓	✓	✓	✓	✓
Xintang	✓	✓	✓	✓	
Daqiao	✓	✓	✓	✓	
Yunhe	✓	✓	✓	✓	
Pajin	✓		✓		
Huxiang	✓	✓	✓	✓	

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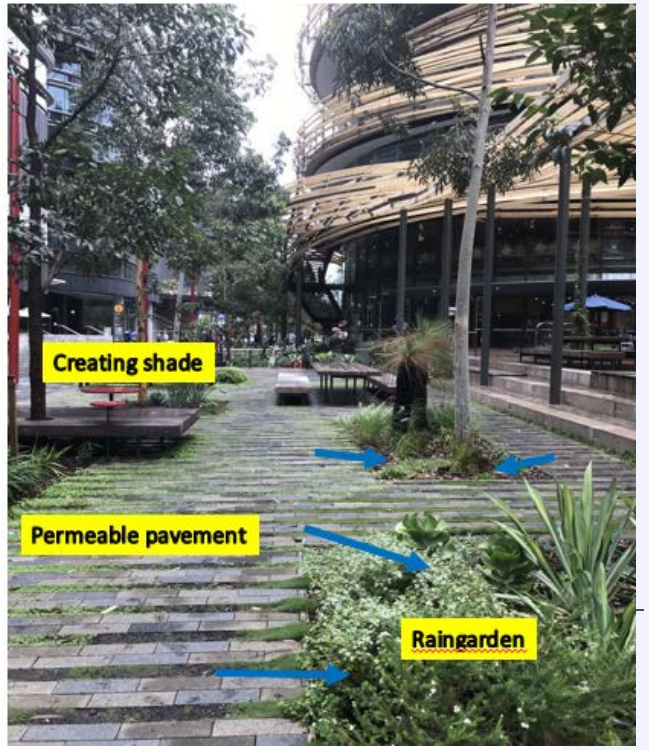
Examples of typical EbA measures (Sydney, Australia)



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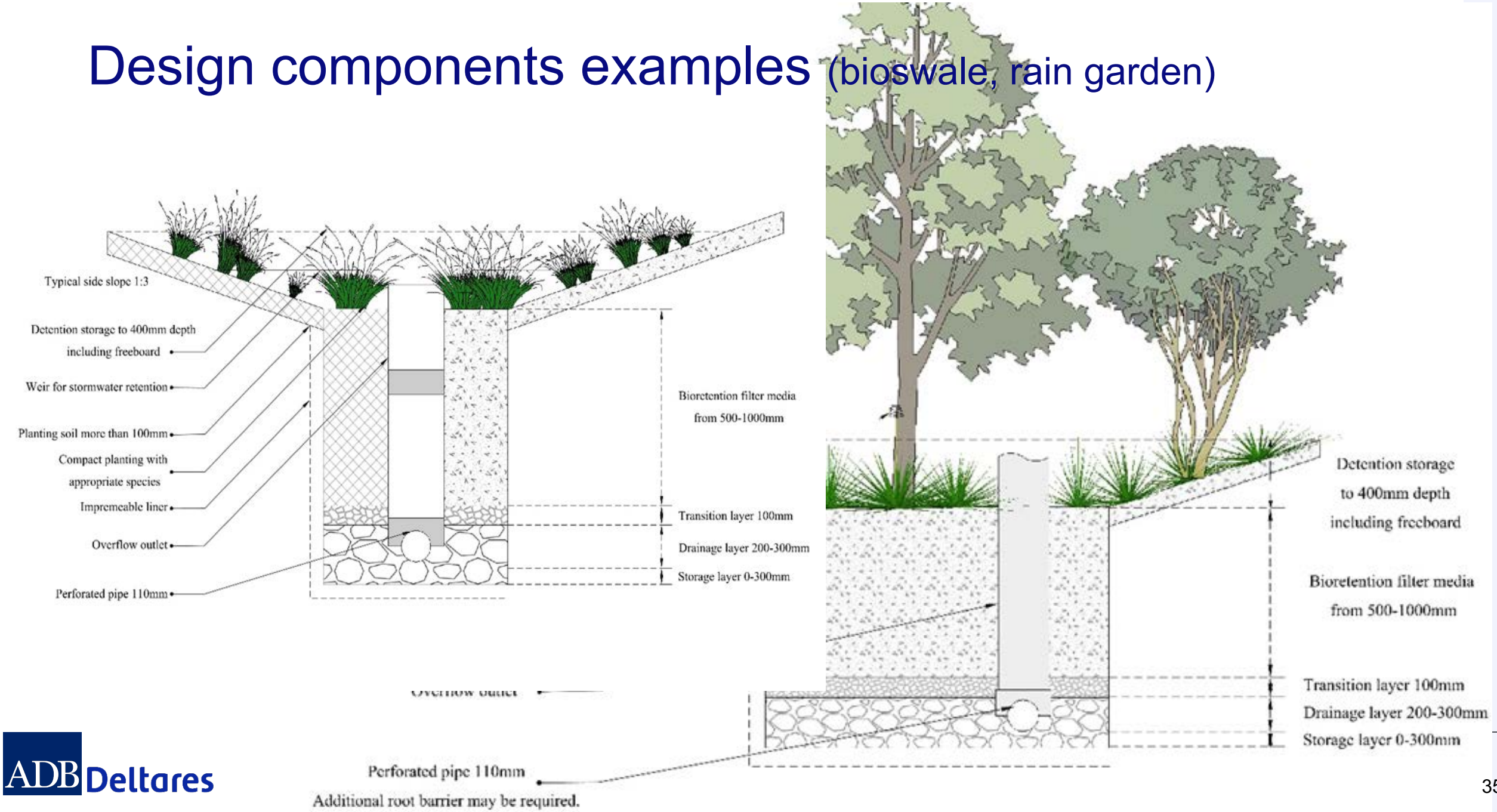
Design components examples (bioswale, rain garden)



Results and Next steps

- Ecosystem-based Adaptation proved to be a feasible way of creating a climate resilient urban environment
- Heavy rainfall events in the city require a substantial stormwater detention (sponge) capacity to avoid pluvial flooding; Space is however availabe to create this
- Estimated cost prices for implementation and maintenance of EbA facilities are highly indivcative as reliabe data is missing.
- Training on Ecosystem-based Adaptation and the use of the Xiangtan CRCTool were an effective way to bring representatives of different bureaus together and co-design effective solutions.

➢ Results are input to new investments in the city and show the directions for detailed design

➢ Loan for implementation of the plans was approved by ADB mid October 2020

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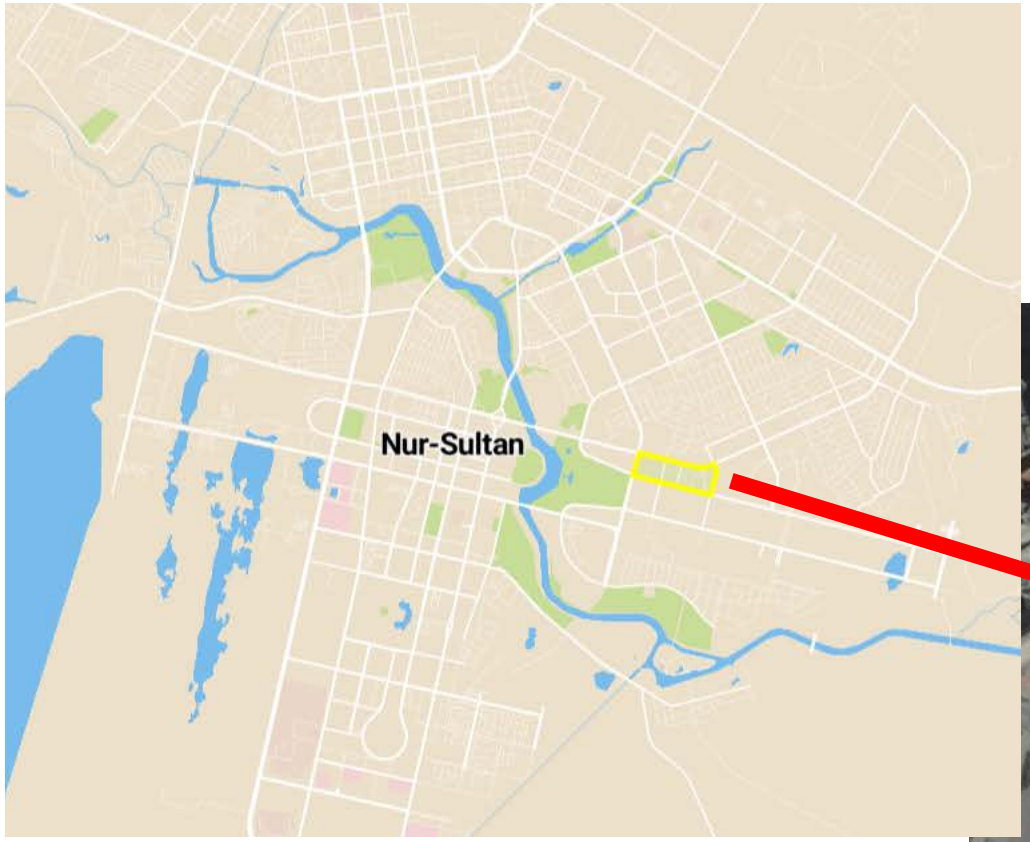
Pilot area



Defining a pilot area along Raqymjan Qoshqarbayev Avenue

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The Pilot area

Source: Google Streetview and Maps

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Pluvial Flooding - 2018

“August 4, had the half monthly rainfall of 14 mm at a monthly rate of 29 mm. So, according to construction norms of Kazakhstan, all the heavy shower sewage in the city for 20 minutes, rain maximum intensity.

When precipitation is above the norm, the elimination of flooding and emptying of storm sewers requires a time of 2 to 4 hours. Given that the duration of the rain was 2 hours, and the volley rain was 30 minutes, some parts of the streets were flooded.”

Cosman Aimukhametova in http://astana.gov.kz/en/news/news/11350

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Pluvial Flooding

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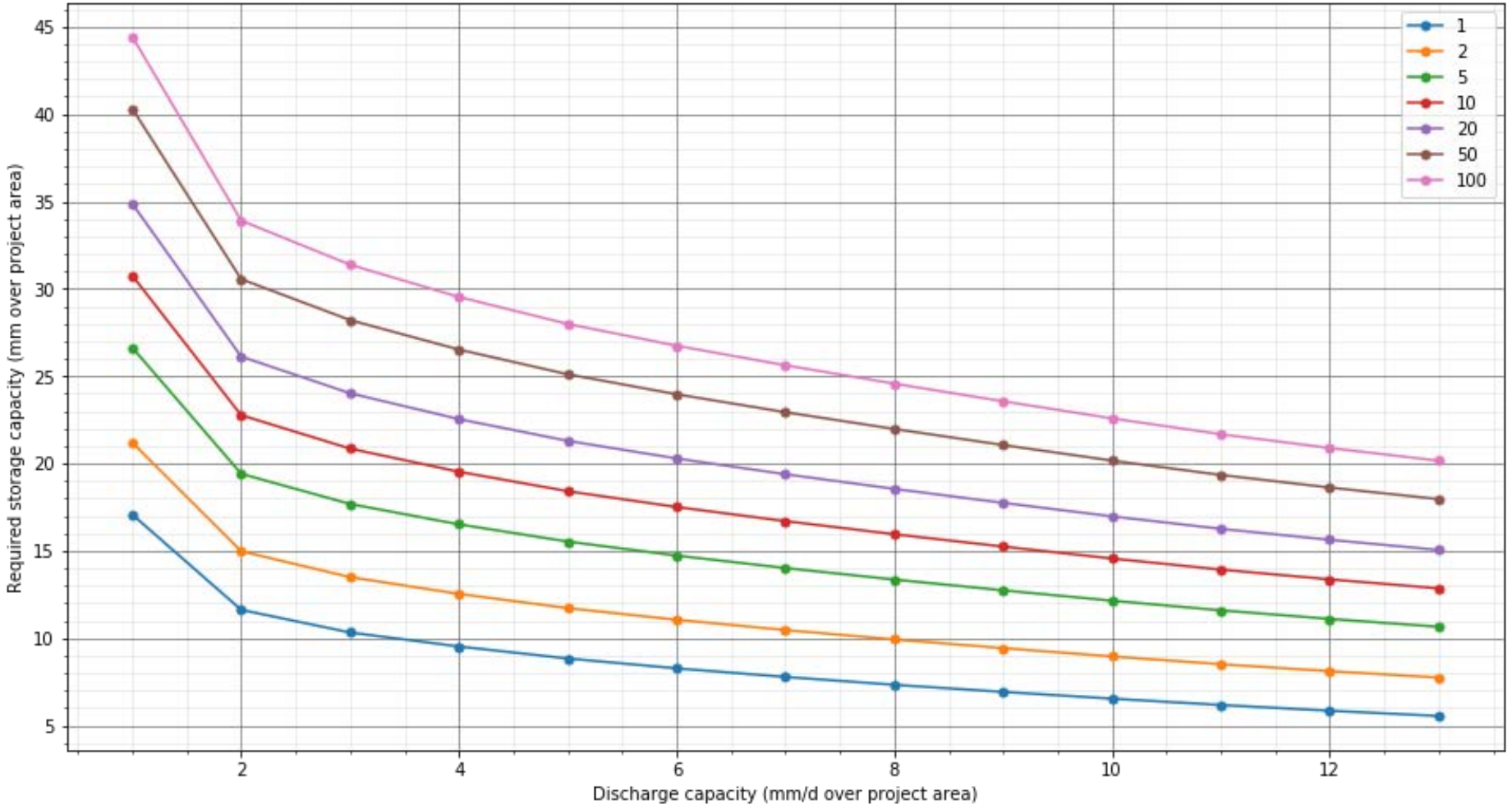
Pluvial flooding - Storage requirement



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Drought reduction?

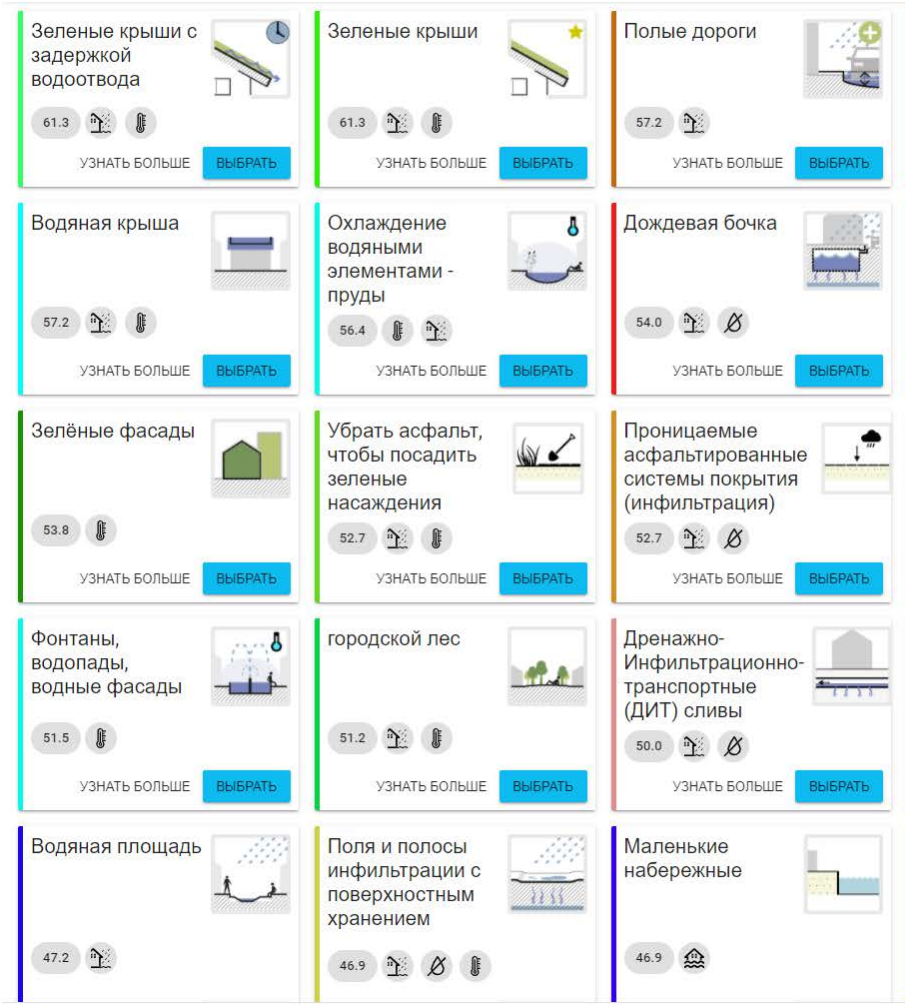
Heat stress reduction?

Session II

Discussing and setting adaptation targets

Challenges for the project area

Which measures would you suggest to implement?



Session III

Which measures are supported by the group?

Where can these measures be implemented?

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Thank you for your attention

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