Deltares

enabling delta life

Deltares

Training 2: Climate Resilient City Tool

Backgrounds and application for design of urban ecosystem-based adaptation measures

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21 October 2020

Program – Day 2

Time		Topic
14:00 – 14:30	Session I	Adaptation at house, street or district level
14:30 – 15:15	Session II	Introduction to the CRC Toolbox and backgrounds, including demo and Q&A
15.15 – 15.45	Session III	Application of the Toolbox in practice; structuring and facilitating an adaptation planning workshop, setting adaptation targets including Q&A
15.45 – 16.15		Break
16.15 – 17.15	Session IV	Hands-on training of the use of the Nur Sultan CRC Toolbox: Create a climate resilient design
17.15 – 17.30	Session V	Setting the adaptation targets
17.30 – 18.00	Session VI	Application of the CRC Toolbox in Nur Sultan

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CRCTool –
Training Objectives

- Overview of the planning process for urban adaptation
- Understanding the elements of the CRCTool
- Becoming familiair with the CRCTool
- Understanding the parameters in the Toolbox, the model and process steps
- Ability to use and apply the CRCTool independently in your work

AFP/Getty images

CRCTool – Training components

1. Planning for urban adaptation (context)
2. CRCTool in planning process
3. Climate Resilient City Tool
4. Underlying parameters, conceptual model
5. Examples, best practices and case studies
6. Process: steps to take to use the tool

AFP/Getty images

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1. Planning for urban adaptation

1. Planning for urban adaptation

- Context of urban adaptation
- What are the main challenges AND opportunities?
  Results of the stress test
  - Physical vulnerability
  - Governance vulnerability

  Opportunities created by adaptation actions
- What are key considerations for urban adaptation planning?
- What is the role of toolbox in this process?

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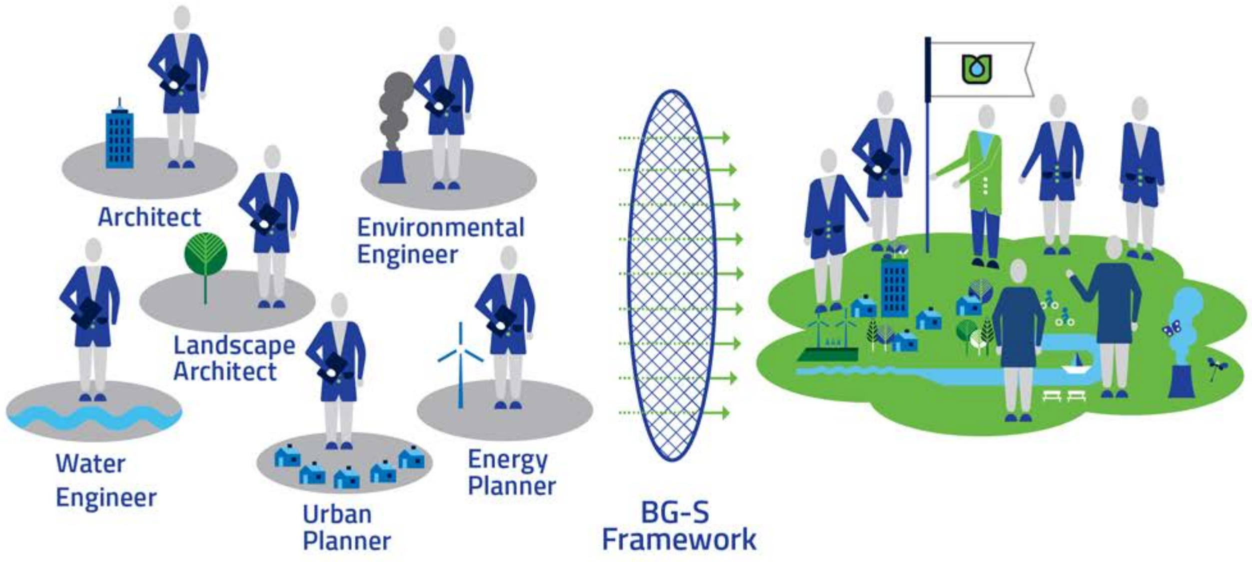
Collaborative planning

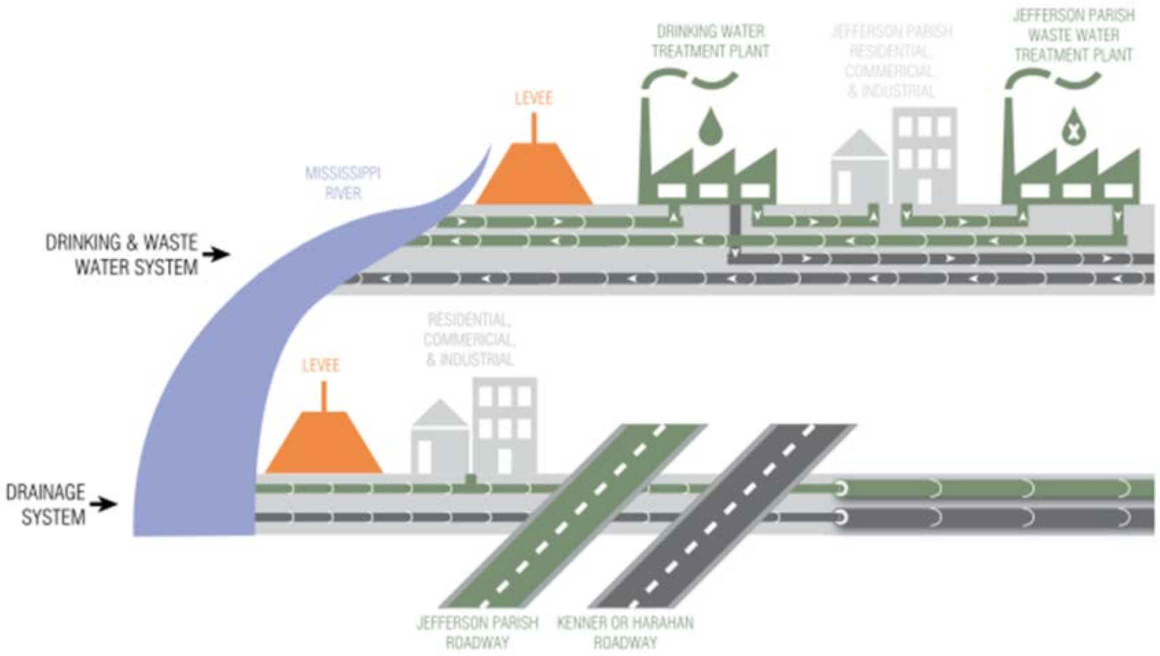
experts from many disciplines + local stakeholders



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).

Stakeholders

Stakeholder analysis: Who is to be involved?



Public

- State
- Province
- City
- Water board

each with many Bureaus, Departments, Divisions, …

Private

- Owner-occupier
- Real estate developers
- Housing associations
- Water supply companies
- Power companies
- Telecom companies
- Insurance companies
- Mortgage banks

Note: different parties involved in each phase of a (re)development process !

Nur Sultan stakeholder setting

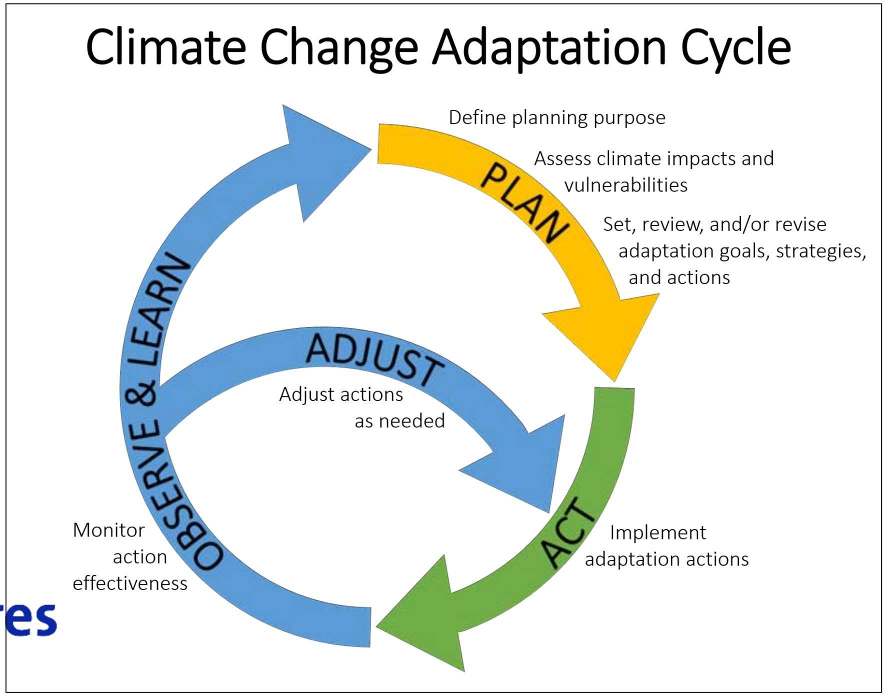
Time / project phase

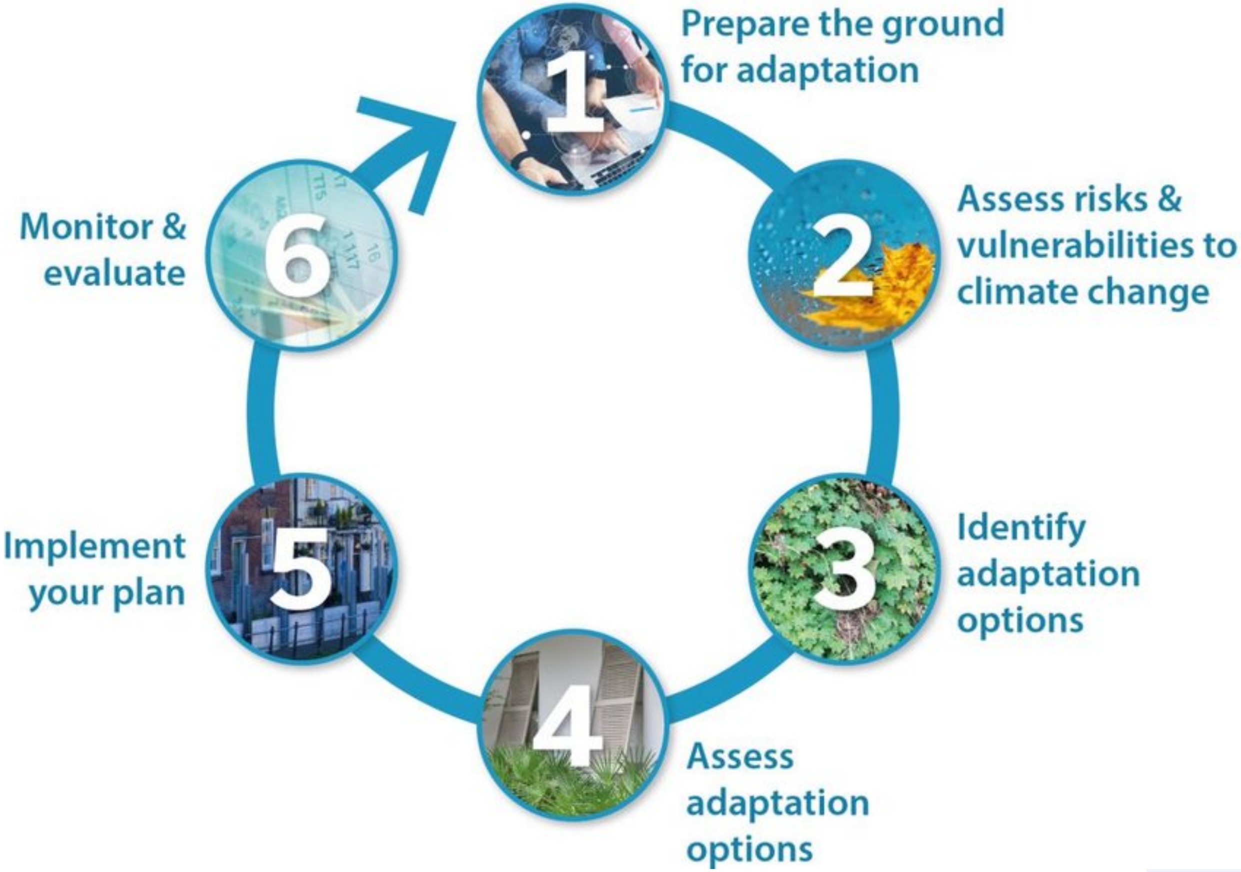
	1 - Project Initiative Phase	2 - Feasibility study (including Initial Environmental Examination)	3 - Project set-up	4 - Preliminary design	5 - Project design (including Environmental Impact Assessment)	6 - Construction	7 - Maintenance
Execution	Fuel and Energy Complex and Utilities Unit, NS Akimat						
	Environment Protection and Nature Use Unit of NS Akimat						
	Yelorda Ecosystem		Yelorda Ecosystem				
		Astanagenplan, Astanagorarchitectura or design entities					
		Architecture, City Building and Land Relations Unit of NS Akimat					
						Construction companies	
							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					

Entity
Akimat
Akimat - District
Akimat's Subordinates
Province/State
National
Private

Tools to support planning

- Plan process overview
- Requirements for a practical tool：
  - Human centred, interactive, inclusive
  - Visualisation
  - Open data





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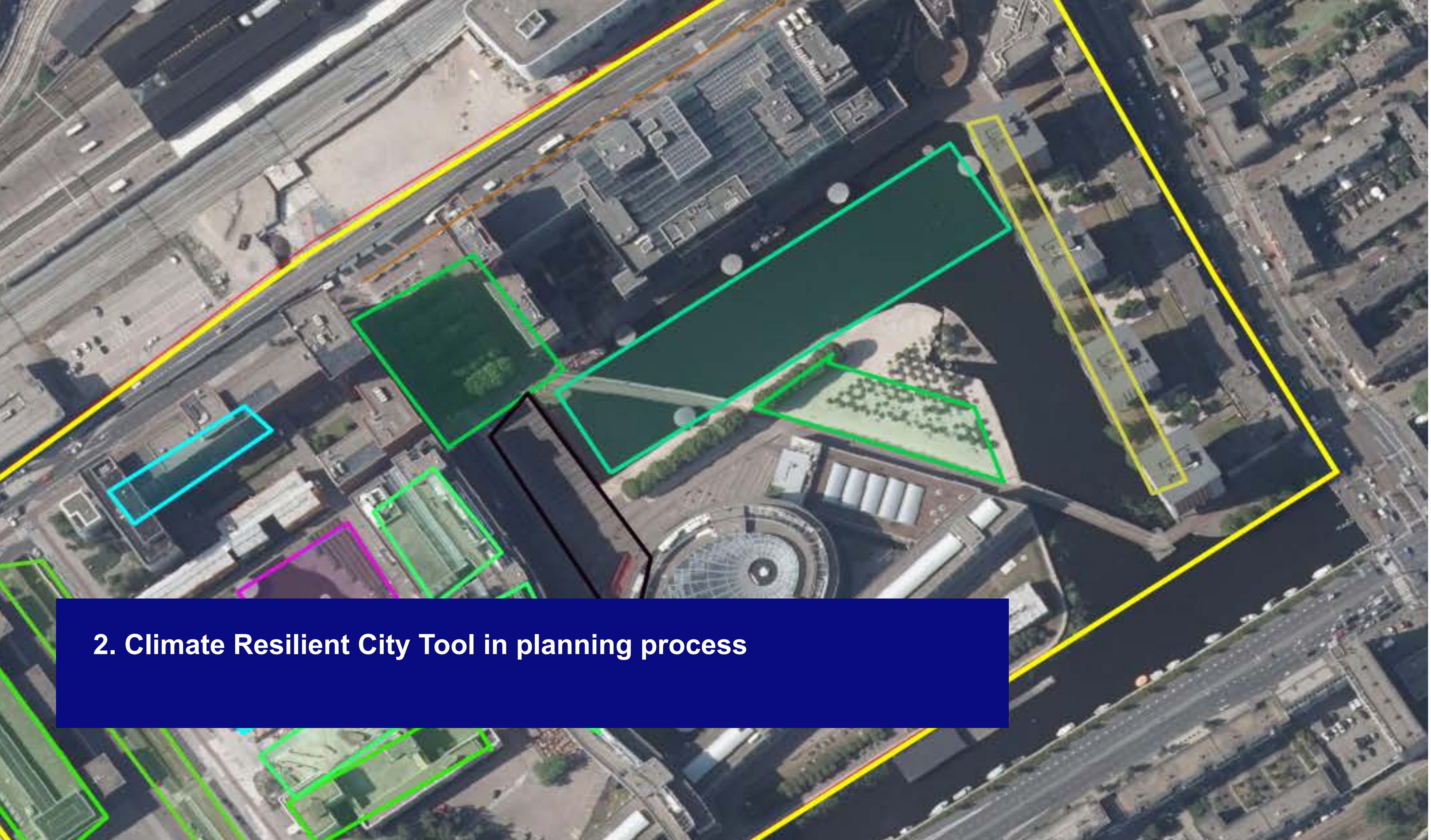
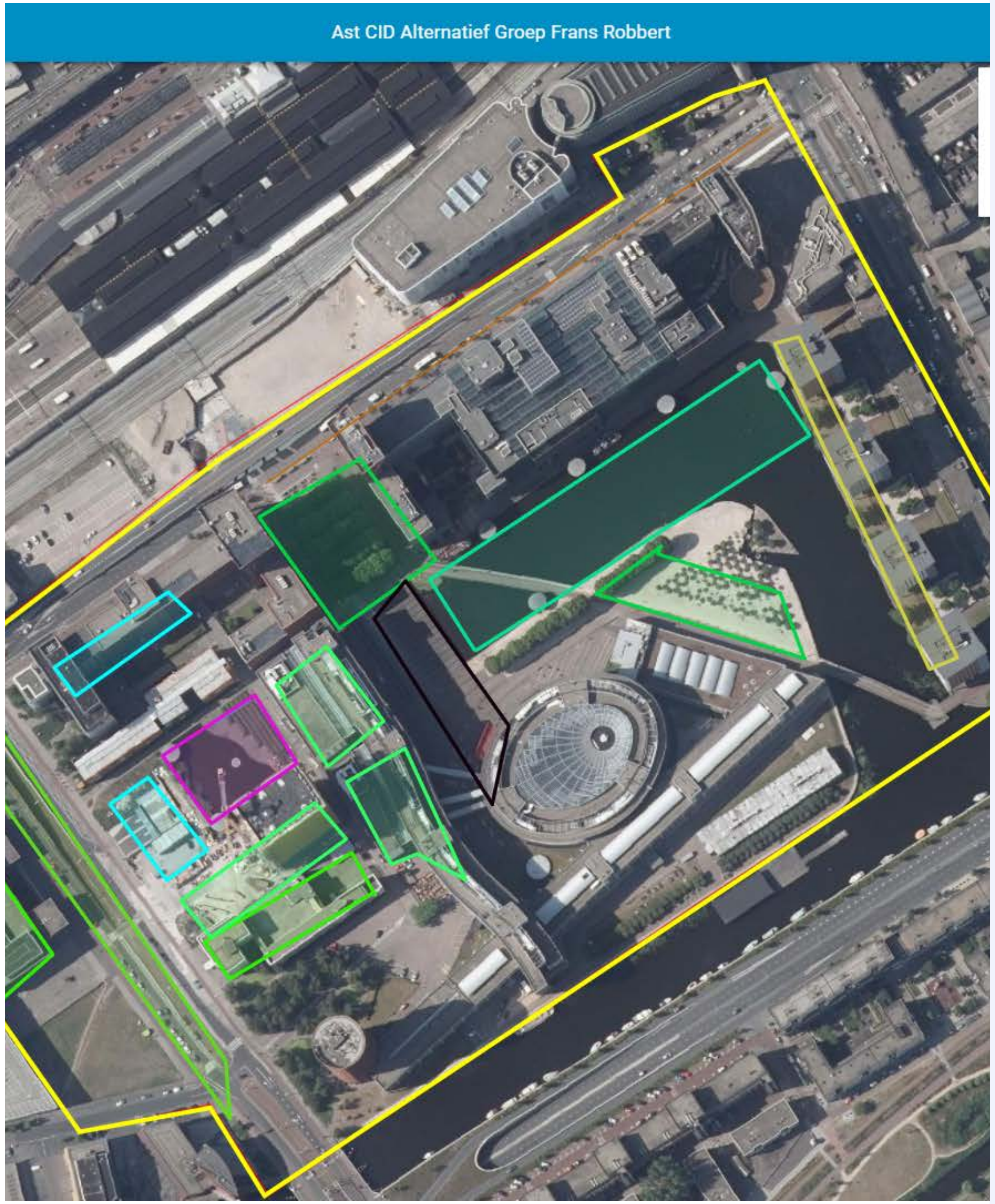


2. Climate Resilient City Tool in planning process

2. Climate Resilient City Tool in planning process

What are the main steps in the adaptation planning process?

- What is the function of the Resilient City Tool (how to use?)
- Which elements are in the CRCTool?
- Which role does the CRCTool play in the adaptation planning process?



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Adaptation planning process

Initiative phase
- research and analysis
- program development

Design phase
- conceptual design
- preliminary design
- site plan
- implementation plan
- construction

Activities

Vulnerability scan

Strategy, approach

Selection of measures

….

…. design

…. construct

…. operate and maintain

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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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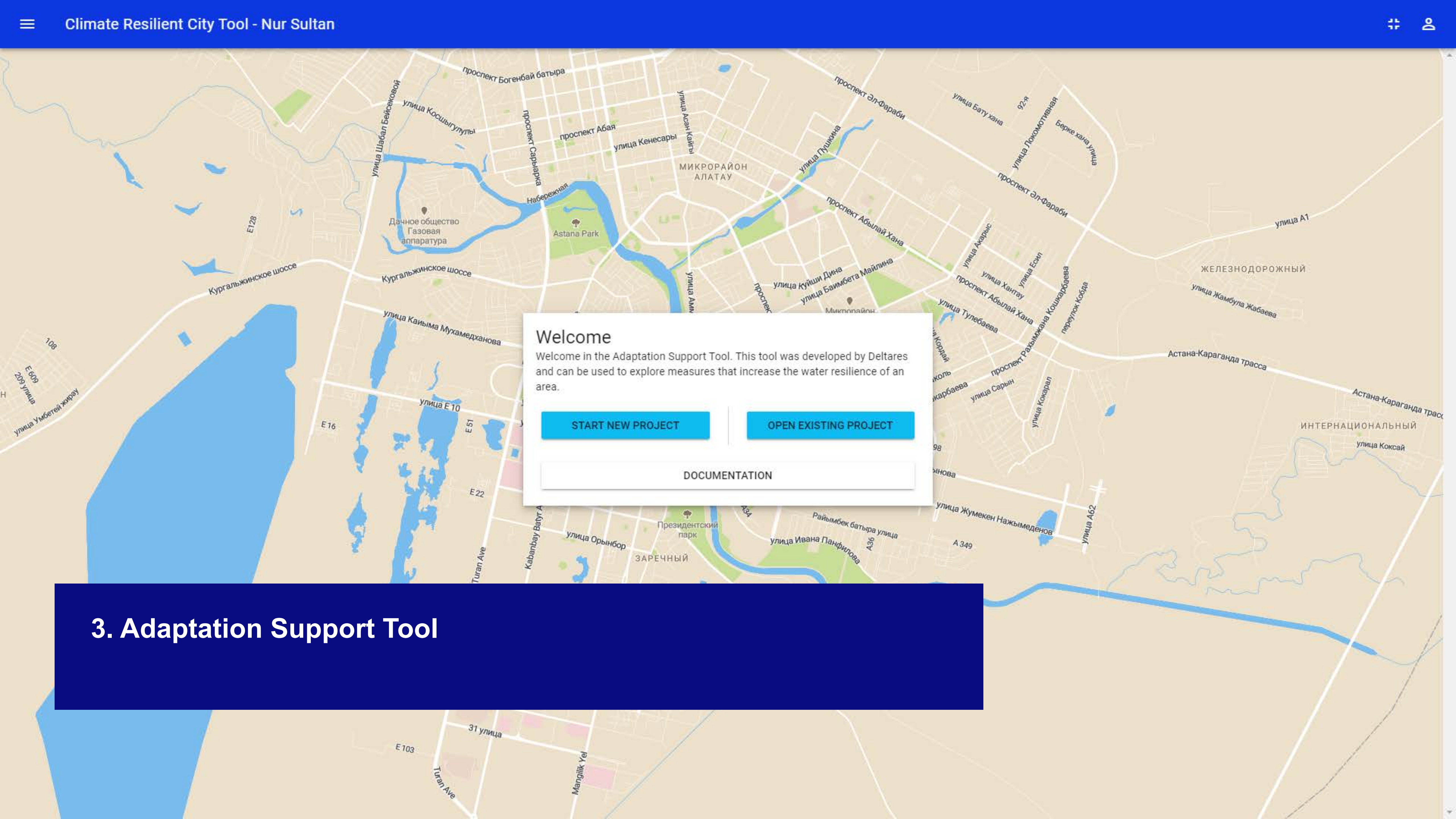
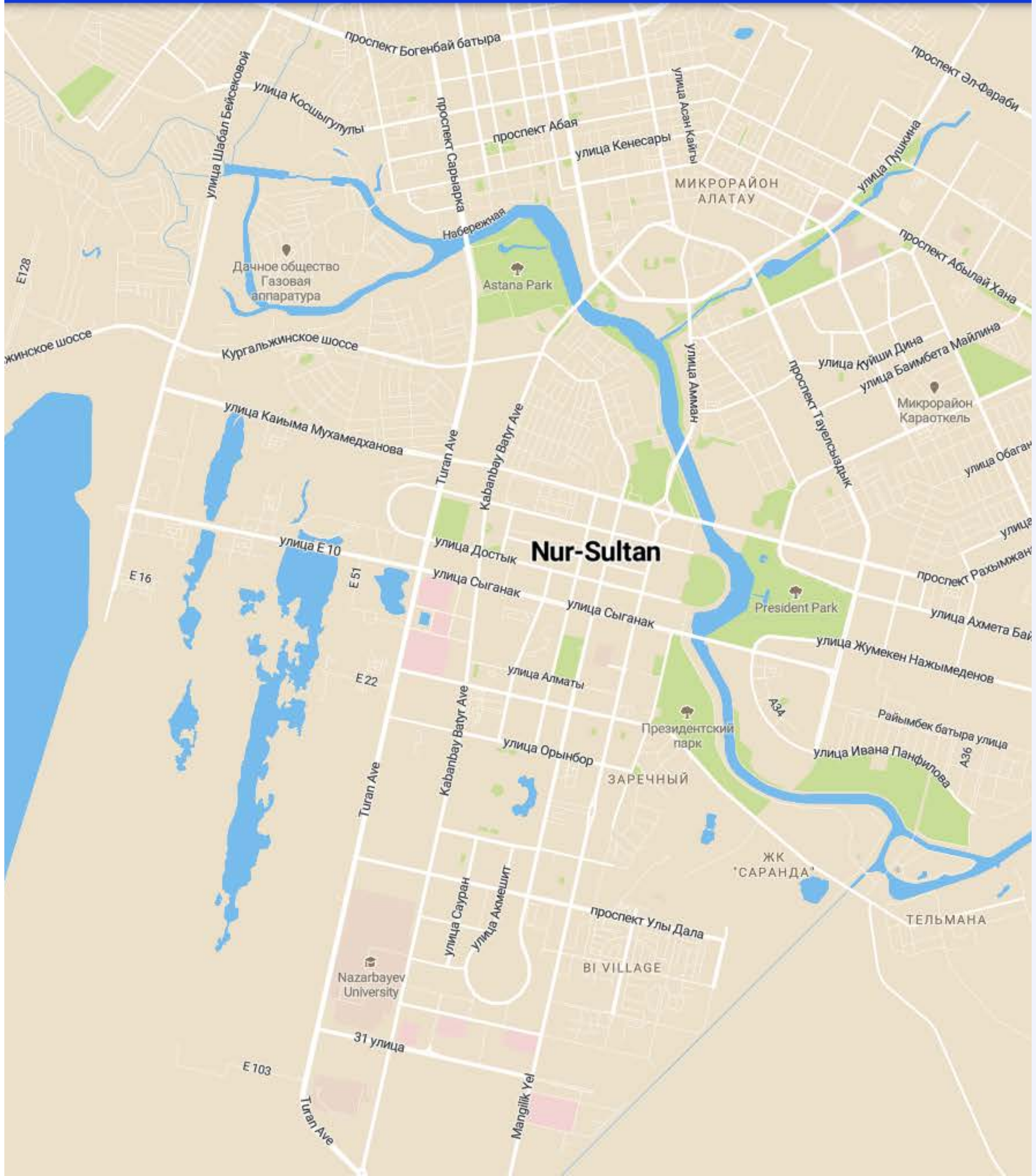


3. Adaptation Support Tool

3. Adaptation Support Tool (AST)

- What does the AST look like?
- How does the AST work?
- What can the AST do?
- What can't the AST do?



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The Climate Resilient City Tool

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

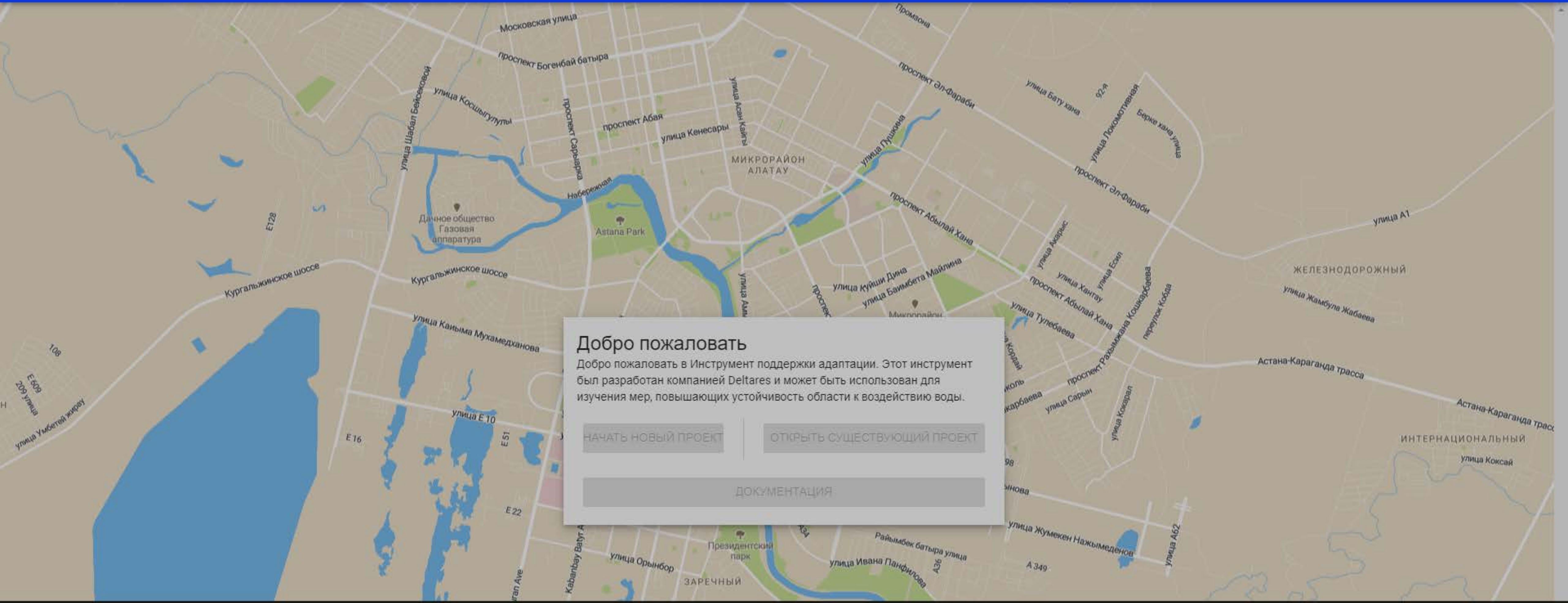
Nur Sultan customized version:

https://nursultan.crctool.org/en

https://nursultan.crctool.org/nl

https://nursultan.crctool.org/ru

Инструмент Климатически Устойчивых Городов



Toolbox Klimaatbestendige Stad (Climate Resilient City Toolbox) website User Agreement

You can print and file this legal agreement on the user terms and conditions of this Toolbox Klimaatbestendige Stad (Climate Resilient City Toolbox) website (hereinafter "User Agreement"), e.g. prior to accepting these terms and conditions.

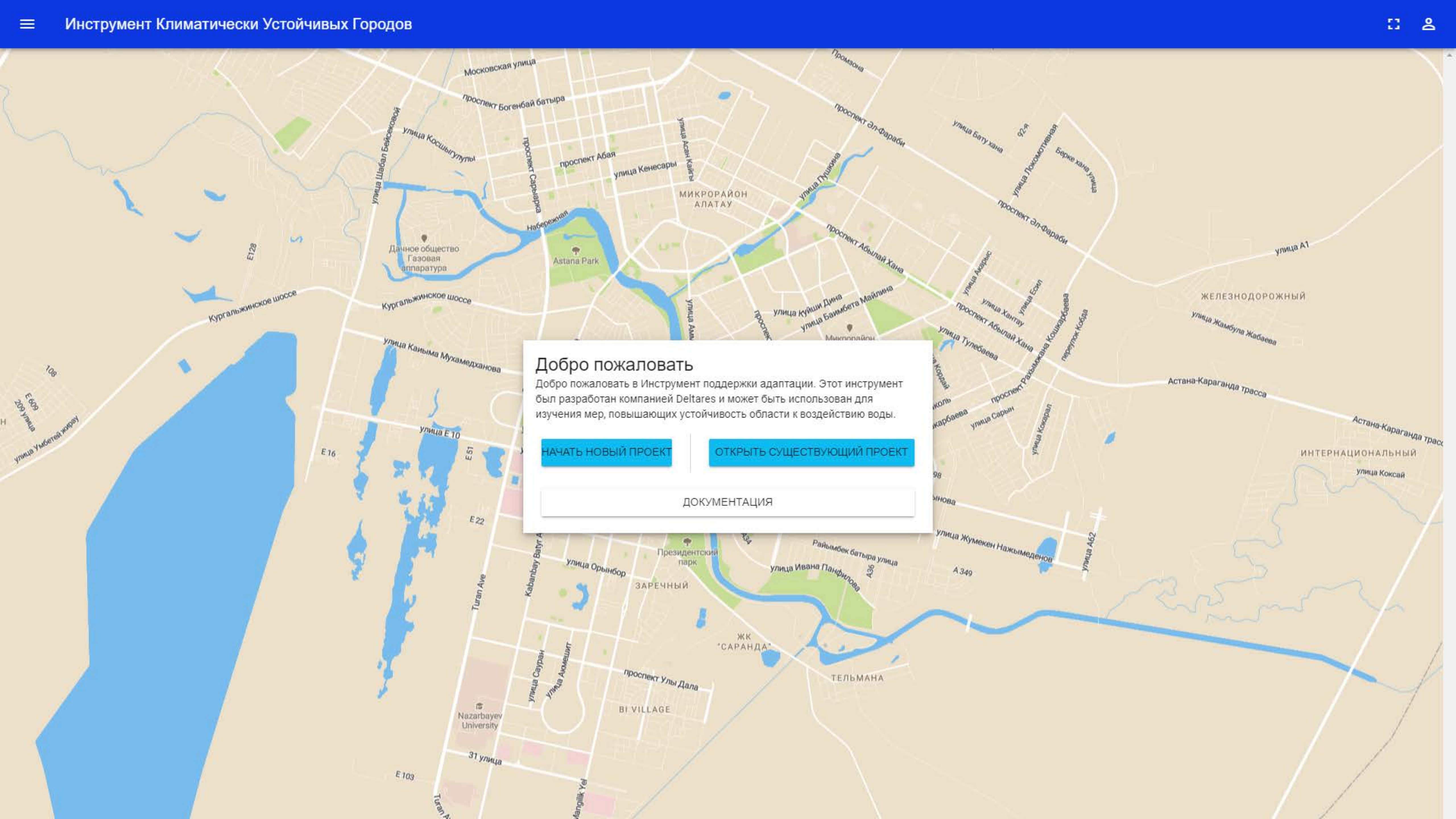
Please read this User Agreement carefully.

This is a legal agreement between you, acting on behalf of a legal entity, and Stichting Deltares (hereinafter "Deltares"). The use of this Toolbox Klimaatbestendige Stad (Climate Resilient City Toolbox) website and of the resulting outcomes of its use (e.g. a data-file) is subject to the conditions of this User Agreement as set out below. The website and the resulting outcomes of its use are hereinafter jointly referenced to as "Website".

By marking the "I Agree"-checkbox:

1. You expressly declare being authorized to act on behalf of the legal entity (hereinafter "User") you represent for the purposes of accepting this User Agreement;
2. User expressly accepts this User Agreement and accepts to be legally bound by the terms and conditions contained therein.

If you are not authorized to act on behalf of User to agree upon this User Agreement, please do not mark the "I agree" checkbox and exit this Website. Furthermore do not mark the "I Accept" checkbox and end the visit to this Website if User does not agree with the User Agreement.


Инструмент Климатически Устойчивых Городов
Добро пожаловать
Добро пожаловать в Инструмент поддержки адаптации. Этот инструмент был разработан компанией Deltares и может быть использован для изучения мер, повышающих устойчивость области к воздействию воды.
НАЧАТЬ НОВЫЙ ПРОЕКТ
ОТКРЫТЬ СУЩЕСТВУЮЩИЙ ПРОЕКТ
ДОКУМЕНТАЦИЯ

Инструмент Климатически Устойчивых Городов

Область проекта

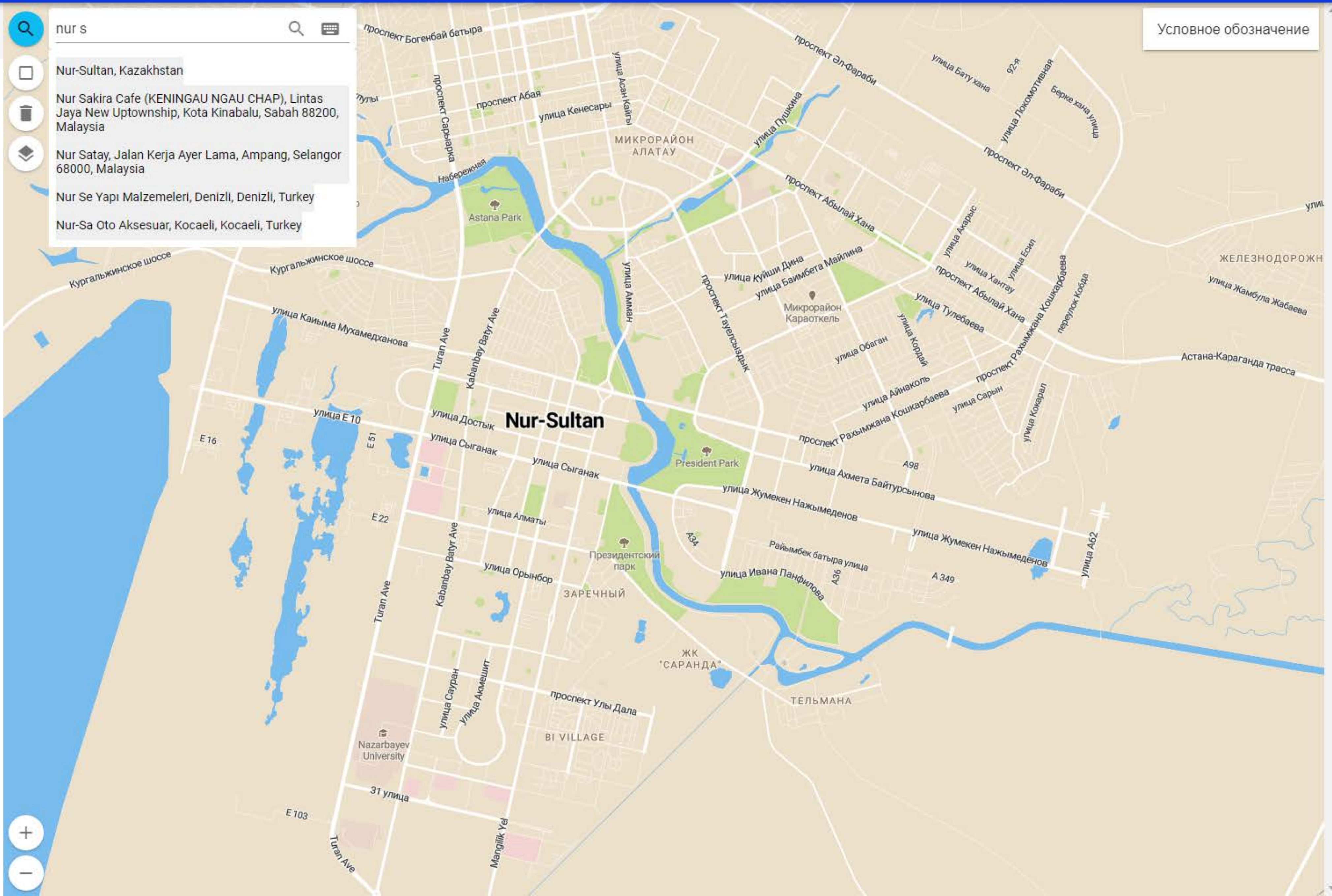
☐ Нарисуйте на карте область, охватывающую местоположение проекта.<\n>В левом верхнем углу окна карты выберите кнопку полигона (polygon) и кликните на карту, чтобы начать рисование и завершить рисование области проекта двойным кликом.<\n> Область не должна превышать 10.000.000м2 (10км2).

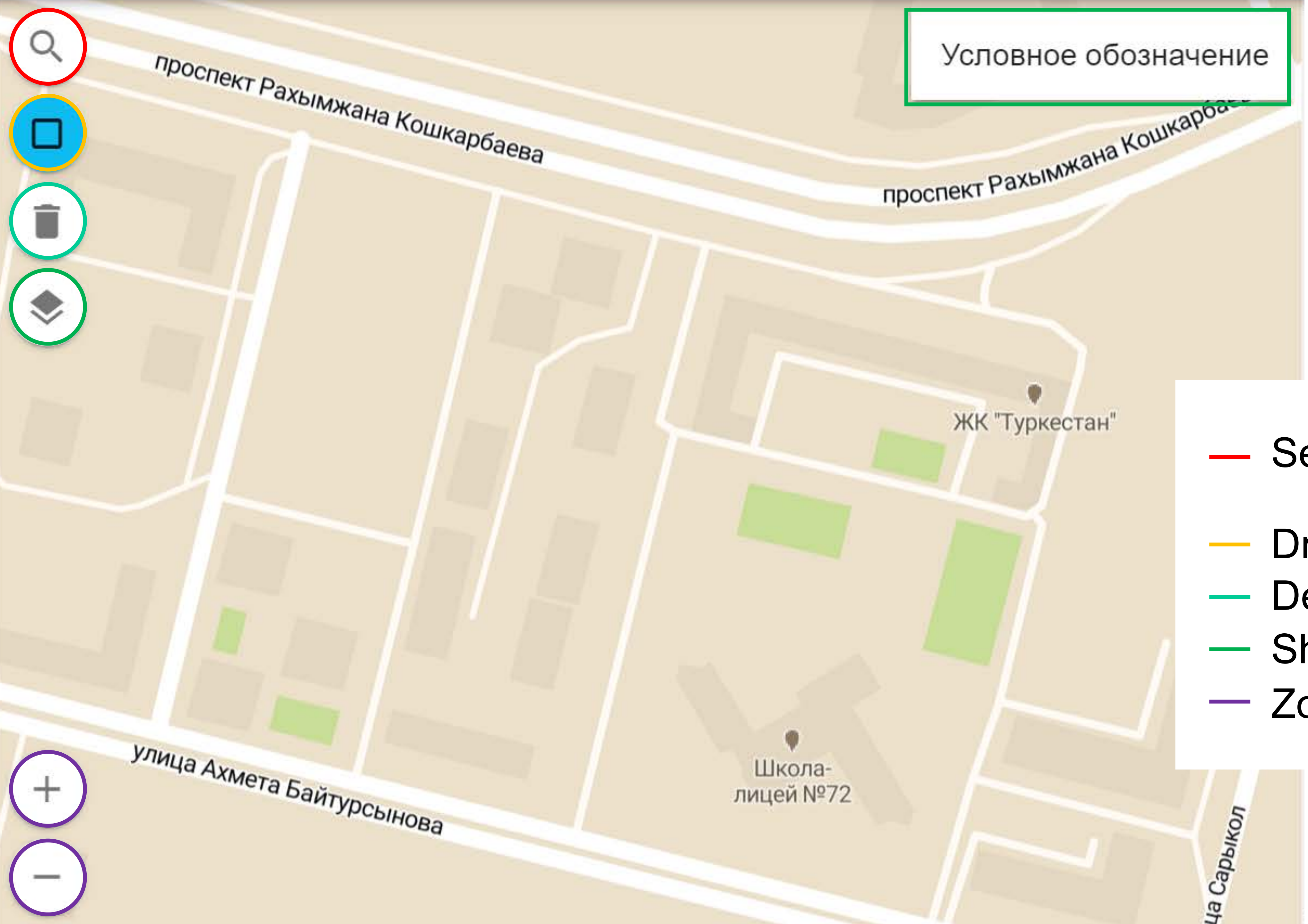
СЛЕДУЮЩИЙ

nur s

- Nur-Sultan, Kazakhstan
- Nur Sakira Cafe (KENINGAU NGAU CHAP), Lintas Jaya New Uptownship, Kota Kinabalu, Sabah 88200, Malaysia
- Nur Satay, Jalan Kerja Ayer Lama, Ampang, Selangor 68000, Malaysia
- Nur Se Yapı Malzemeleri, Denizli, Denizli, Turkey
- Nur-Sa Oto Aksesuar, Kocaeli, Kocaeli, Turkey

Условное обозначение





— Search location

— Draw project area

— Delete project area

— Show map layers

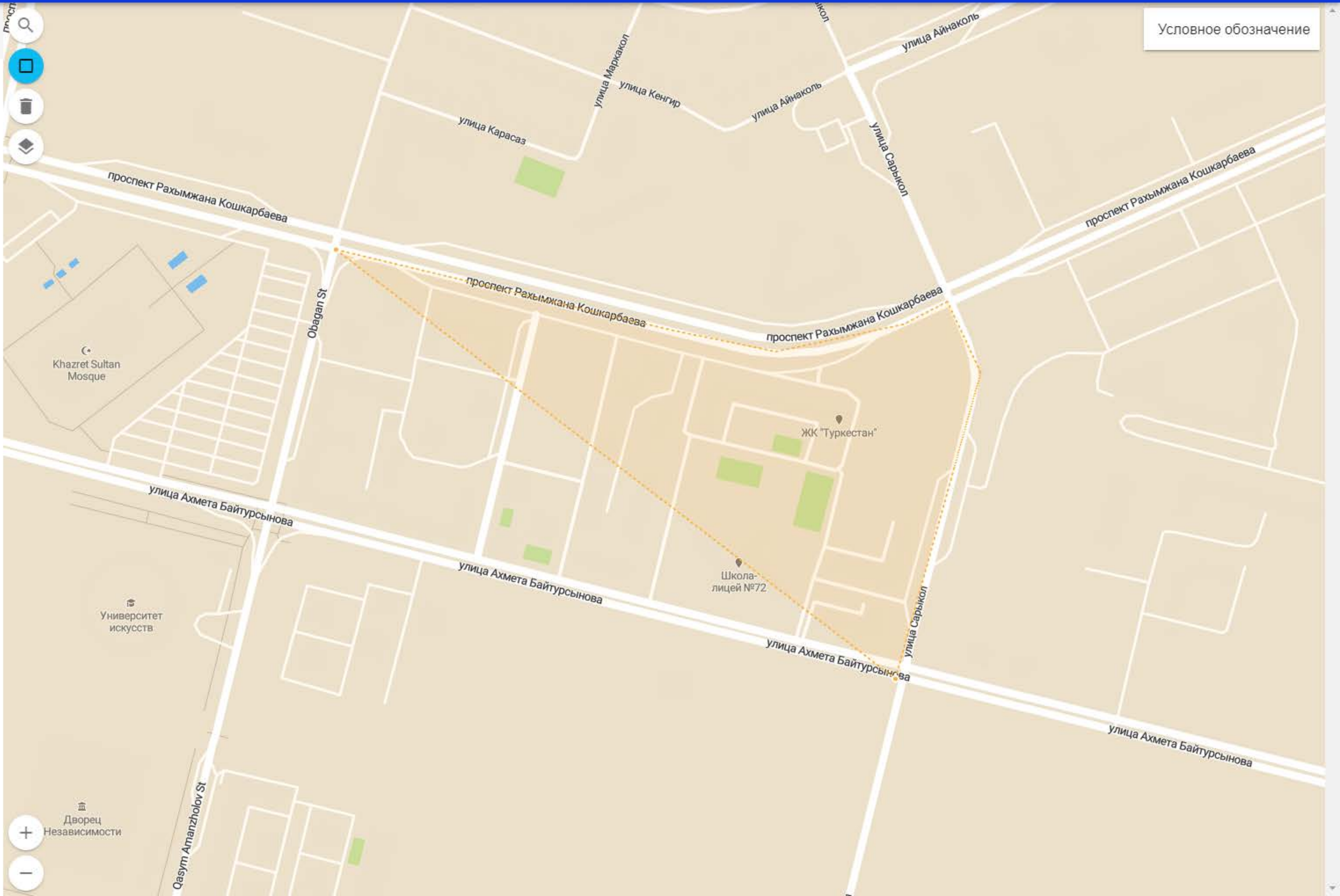
— Zoom map

Инструмент Климатически Устойчивых Городов

Область проекта

Нарисуйте на карте область, охватывающую местоположение проекта.<\n>В левом верхнем углу окна карты выберите кнопку полигона (polygon) и кликните на карту, чтобы начать рисование и завершить рисование области проекта двойным кликом.<\n> Область не должна превышать 10.000.000м2 (10км2).

СЛЕДУЮЩИЙ

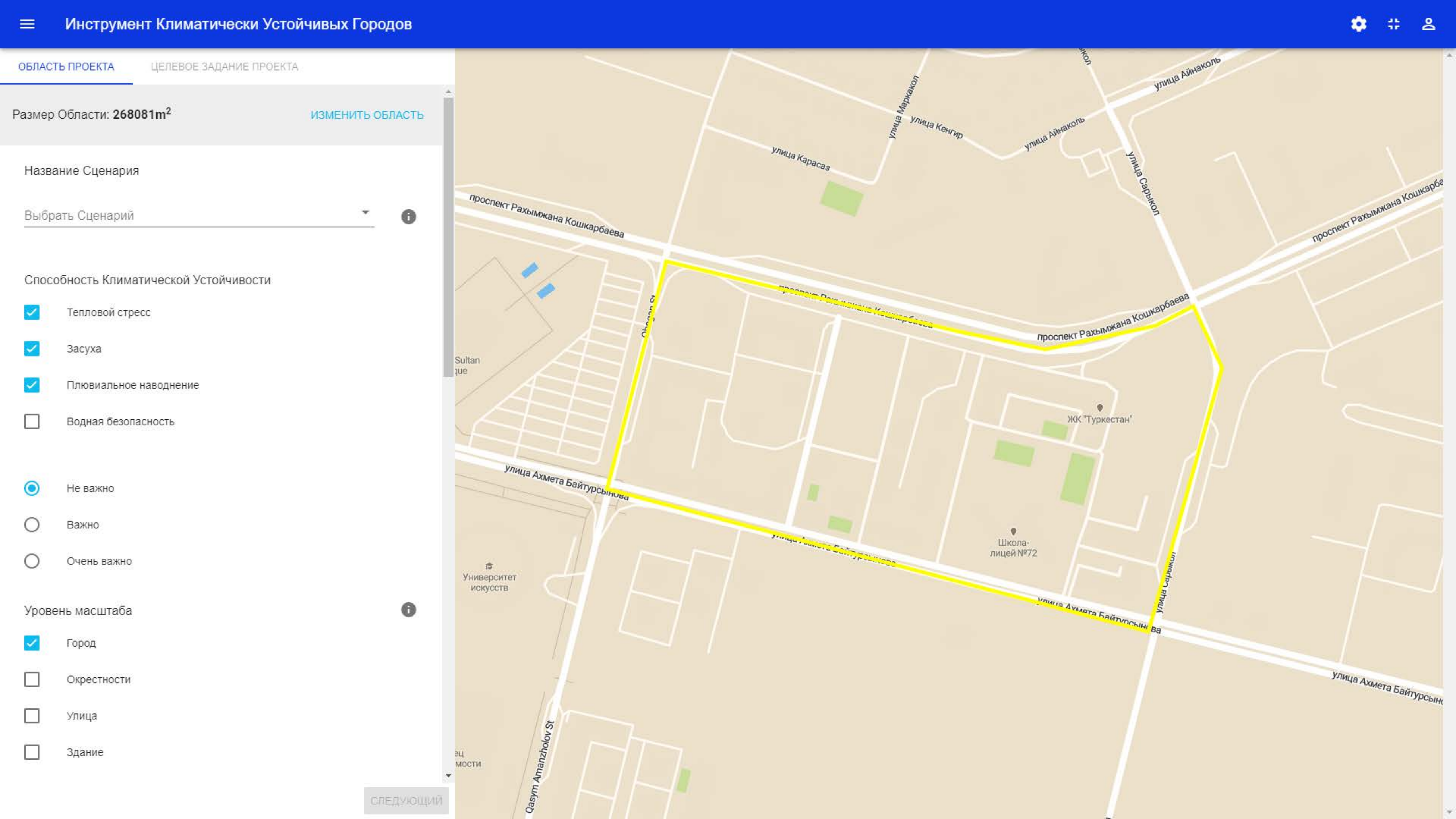


Инструмент Климатически Устойчивых Городов

Область проекта

Размер Области:
$268081 m^2$

СЛЕДУЮЩИЙ


Инструмент Климатически Устойчивых Городов
ОБЛАСТЬ ПРОЕКТА
ЦЕЛЕВОЕ ЗАДАНИЕ ПРОЕКТА
Размер Области: 268081m2
ИЗМЕНИТЬ ОБЛАСТЬ
Название Сценария
Выбрать Сценарий
Способность Климатической Устойчивости
Тепловой стресс
Засуха
Плювиальное наводнение
Водная безопасность
Не важно
Важно
Очень важно
Уровень масштаба
Город
Окрестности
Улица
Здание
СЛЕДУЮЩИЙ
проспект Рахымжана Кошкарбаева
улица Ахмета Байтурсынова
улица Карасаз
улица Кенгир
улица Маркакол
улица Айнаколь
улица Сарыкол
ЖК "Туркестан"
Школа-лицей №72
Университет искусств
Qasym Amanzholov St

Инструмент Климатически Устойчивых Городов

ОБЛАСТЬ ПРОЕКТА | ЦЕЛЕВОЕ ЗАДАНИЕ ПРОЕКТА

Доступность подповерхностного слоя

- (•) Очень низкий
- ( ) Низкий
- ( ) Средний
- ( ) Высокий

Характеристика крыши

- (•) Плоские крыши
- ( ) Склон крыш менее чем на 35 градусов
- ( ) Склон крыш более чем на 35 градусов

Тип почвы

- (•) Песок
- ( ) Торф
- ( ) Глина
- ( ) Материковая порода

Склон

- (•) Область с наклоном
- ( ) Плоская область на возвышенности
- ( ) Плоская область на низменности

СЛЕДУЮЩИЙ | СДЕЛАНО

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

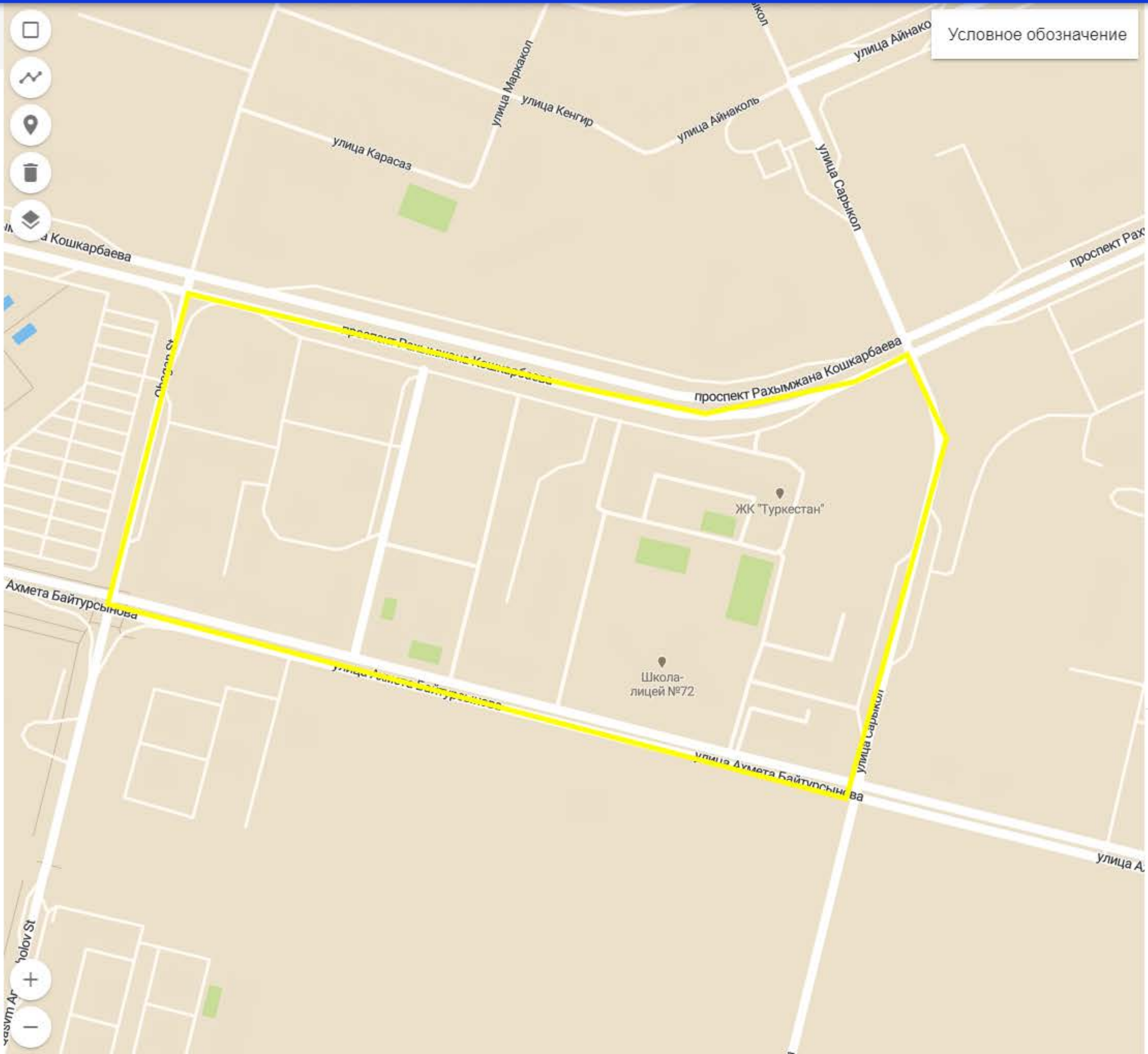
ПОКАЗАТЬ В ВИДЕ ТАБЛИЦЫ

Инструмент Климатически Устойчивых Городов

Применяемые Меры

Вы не применили никаких мер. Кликните кнопку +Мера, чтобы начать добавление мер в область проекта.

+ МЕРА



Результаты

Климат

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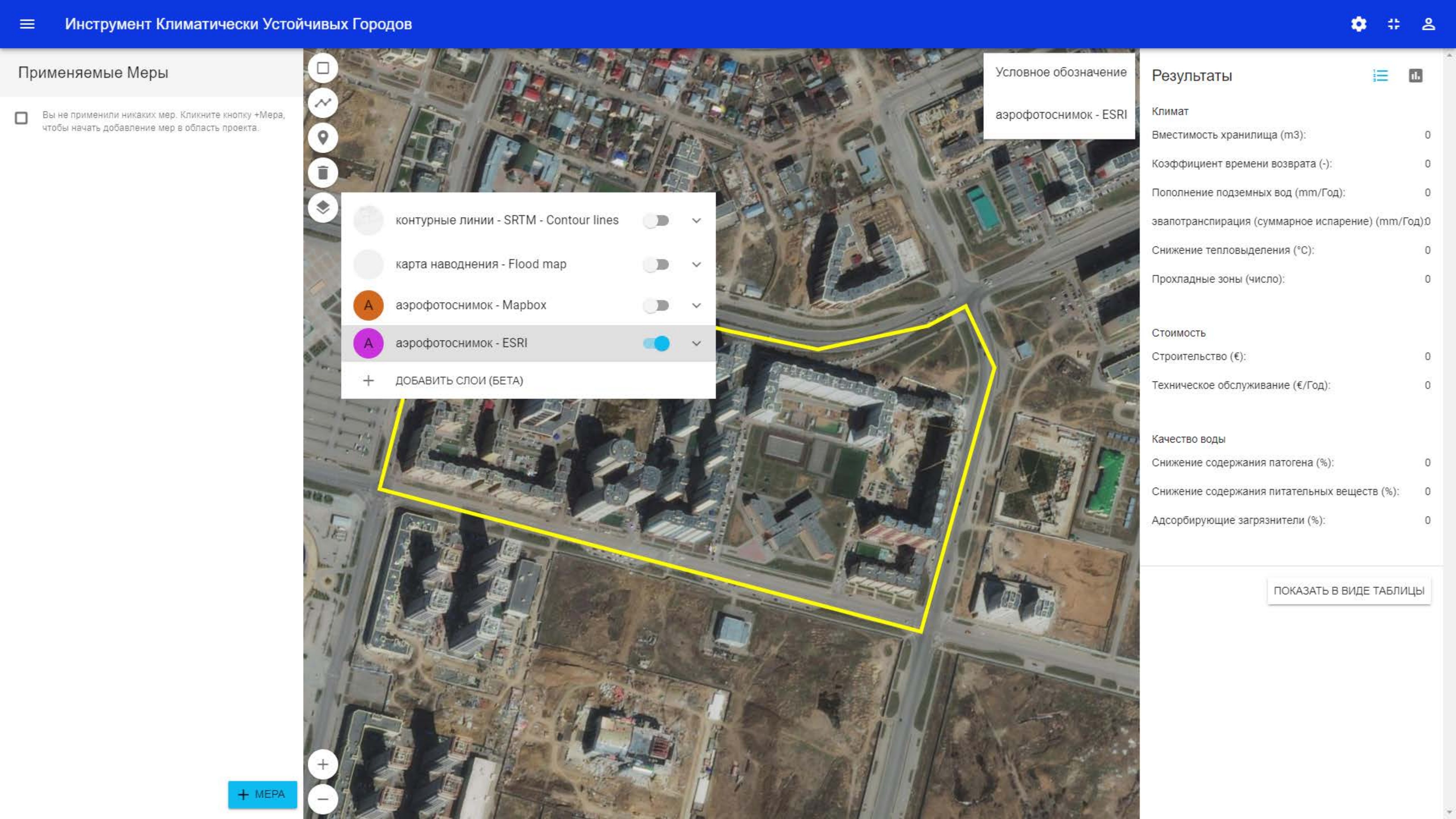
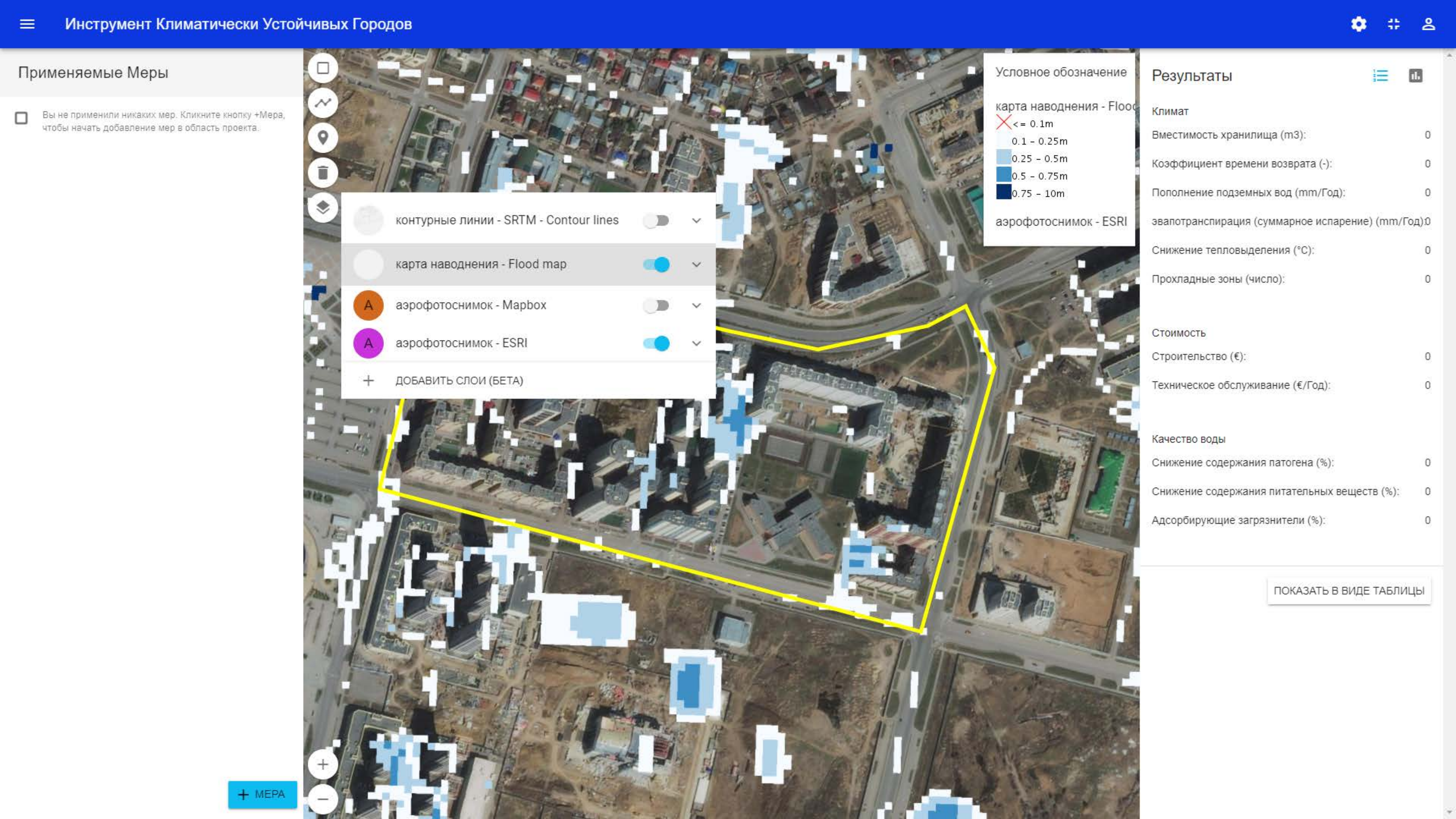
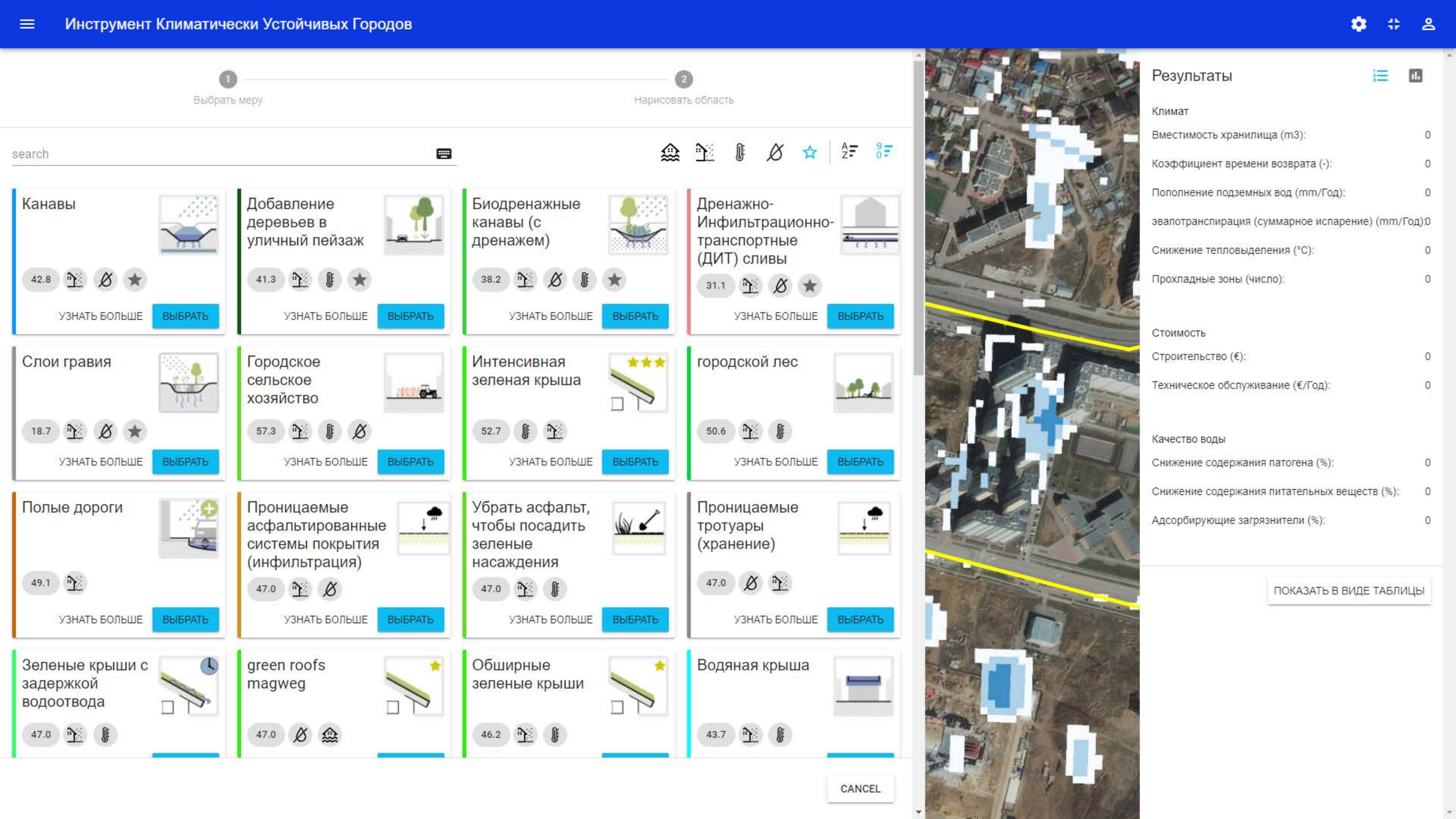
ПОКАЗАТЬ В ВИДЕ ТАБЛИЦЫ


Инструмент Климатически Устойчивых Городов
Применяемые Меры
Вы не применили никаких мер. Кликните кнопку +Мера, чтобы начать добавление мер в область проекта.
+ МЕРА
контурные линии - SRTM - Contour lines
карта наводнения - Flood map
A
аэрофотоснимок - Mapbox
A
аэрофотоснимок - ESRI
ДОБАВИТЬ СЛОИ (БЕТА)
Условное обозначение
аэрофотоснимок - ESRI
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


Инструмент Климатически Устойчивых Городов
Применяемые Меры
Вы не применили никаких мер. Кликните кнопку +Мера, чтобы начать добавление мер в область проекта.
+ МЕРА
контурные линии - SRTM - Contour lines
карта наводнения - Flood map
аэрофотоснимок - Mapbox
аэрофотоснимок - ESRI
ДОБАВИТЬ СЛОИ (БЕТА)
Условное обозначение
карта наводнения - Flood
<= 0.1m
0.1 - 0.25m
0.25 - 0.5m
0.5 - 0.75m
0.75 - 10m
аэрофотоснимок - ESRI
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


Инструмент Климатически Устойчивых Городов
Выбрать меру
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

Инструмент Климатически Устойчивых Городов

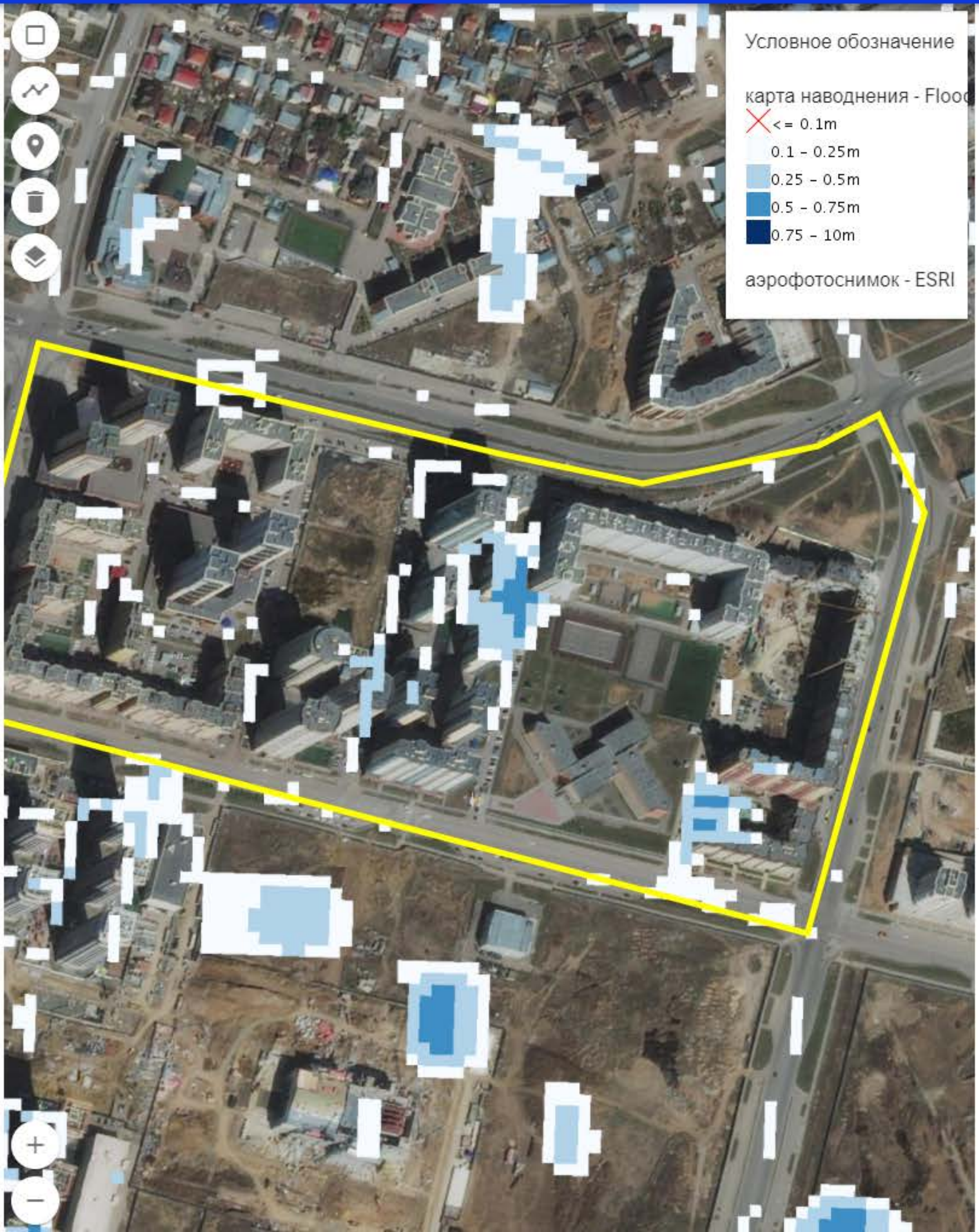
< НАЗАД

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

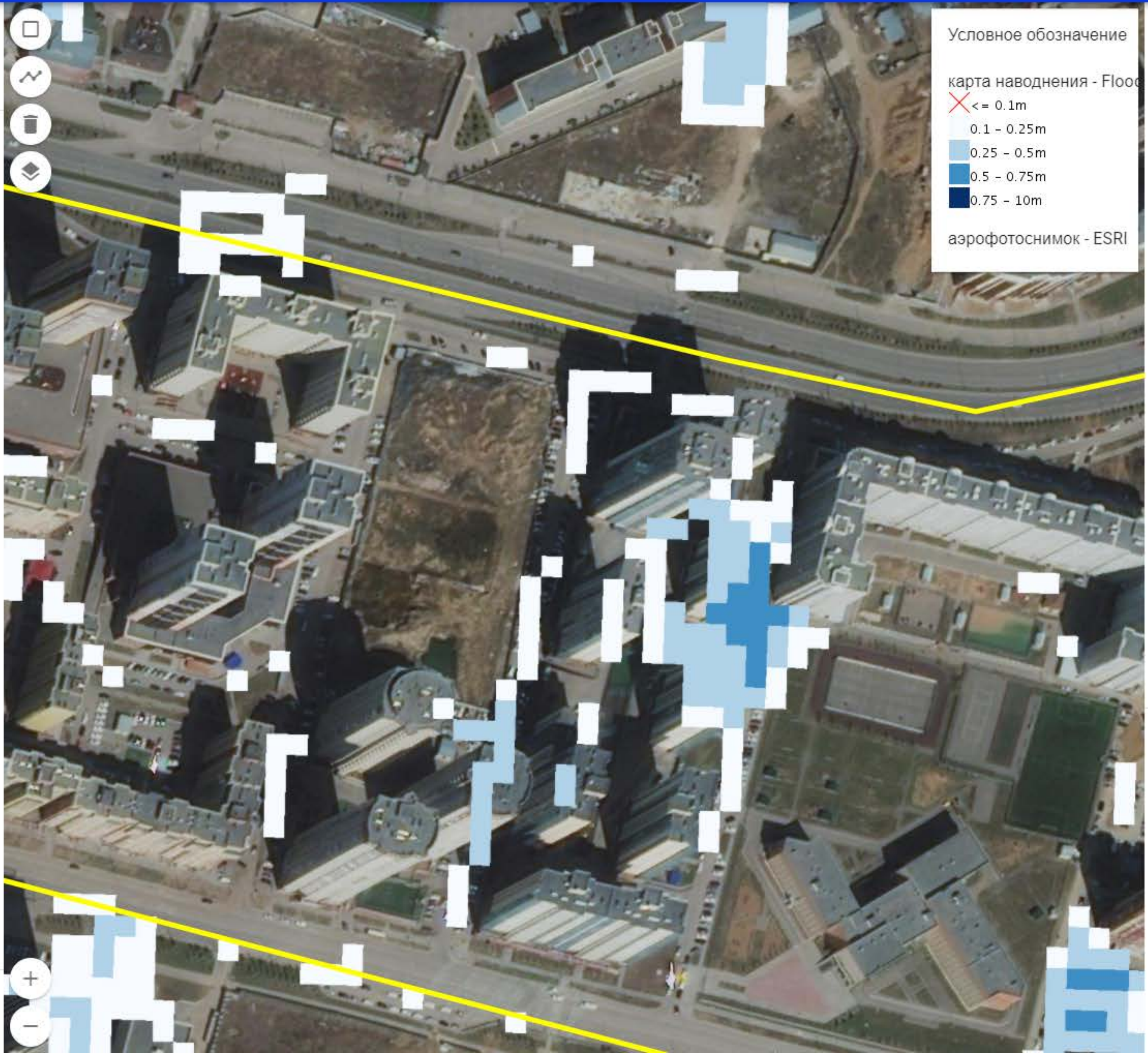
ПОКАЗАТЬ В ВИДЕ ТАБЛИЦЫ

Инструмент Климатически Устойчивых Городов

Выбрать меру — 2 Нарисовать область

Биодренажные канавы (с дренажем)

38.2



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

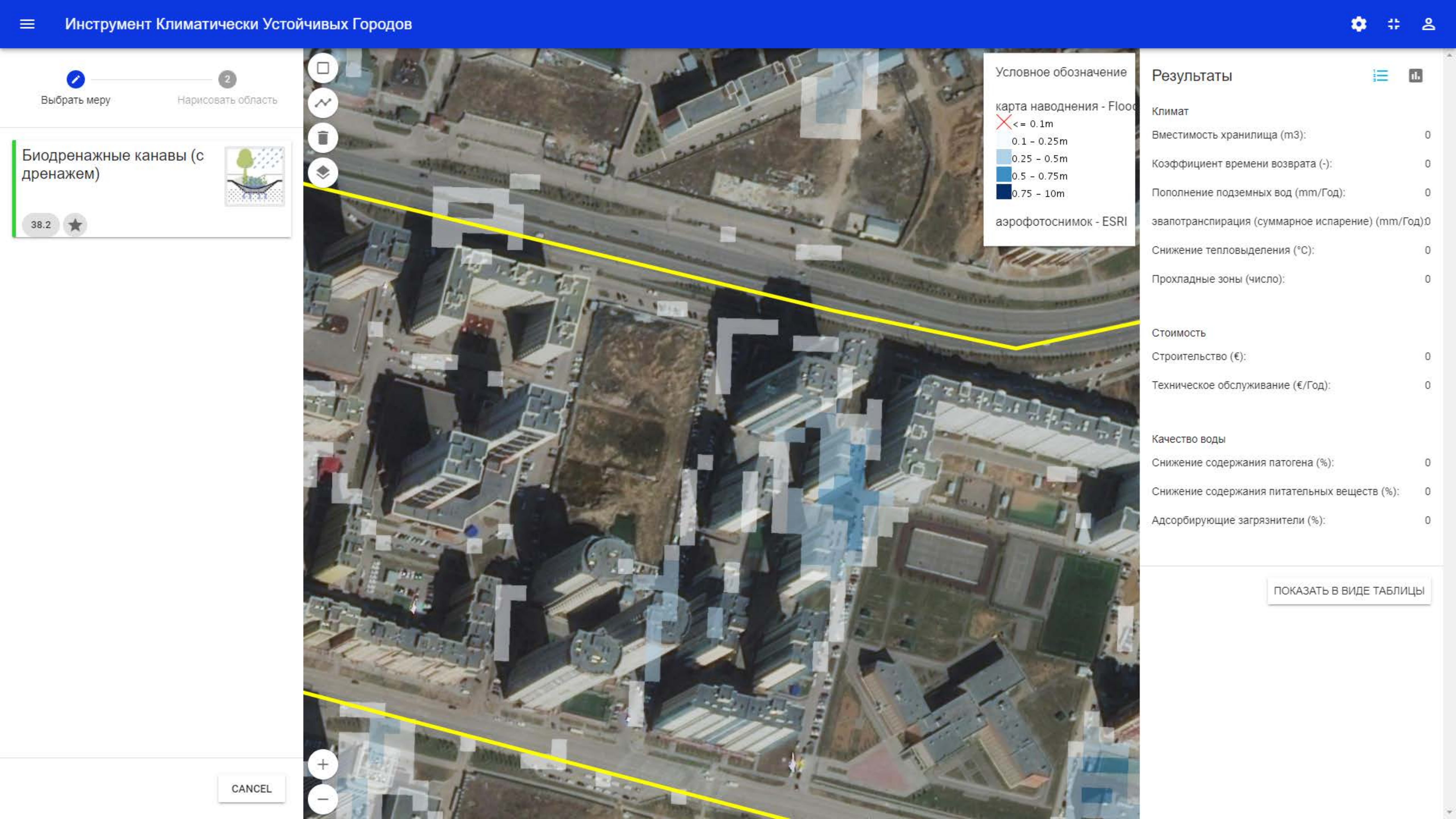
Стоимость

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

Качество воды

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

ПОКАЗАТЬ В ВИДЕ ТАБЛИЦЫ


Инструмент Климатически Устойчивых Городов
Выбрать меру
2
Нарисовать область
Биодренажные канавы (с дренажем)
38.2
CANCEL
Условное обозначение
карта наводнения - Flood
<= 0.1m
0.1 - 0.25m
0.25 - 0.5m
0.5 - 0.75m
0.75 - 10m
аэрофотоснимок - ESRI
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

Инструмент Климатически Устойчивых Городов

Выбранные меры

Area-1
Биодренажные канавы (с дренажем)

Название Области
Area-1

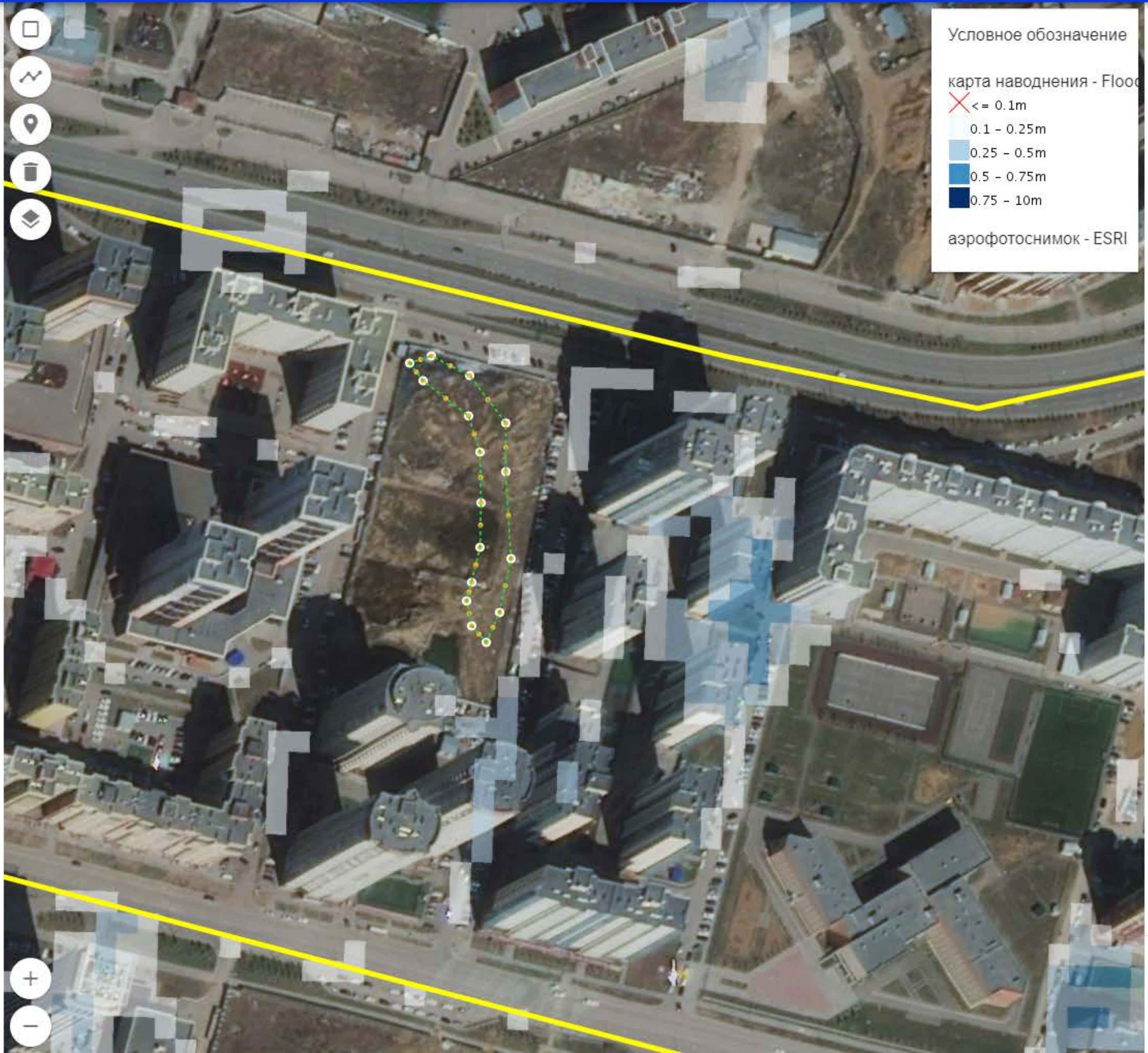
Мера
Биодренажные канавы (с дренажем)

ИЗМЕНИТЬ МЕРУ

Глубина хранения воды (м)
0.35

Приток области (x)
10

СДЕЛАНО



Результаты

Климат

Вместимость хранилища (m3):	716
Мера	716 m3
Коэффициент времени возврата (-):	4.19
Мера	3.19 -
Пополнение подземных вод (mm/Год):	14.54
Мера	14.54 mm/Год
эвапотранспирация (суммарное испарение) (mm/Год):	-0.18
Мера	-0.18 mm/Год
Снижение тепловыделения (°C):	0.02
Мера	0.02 °C
Прохладные зоны (число):	0
Мера	0 число

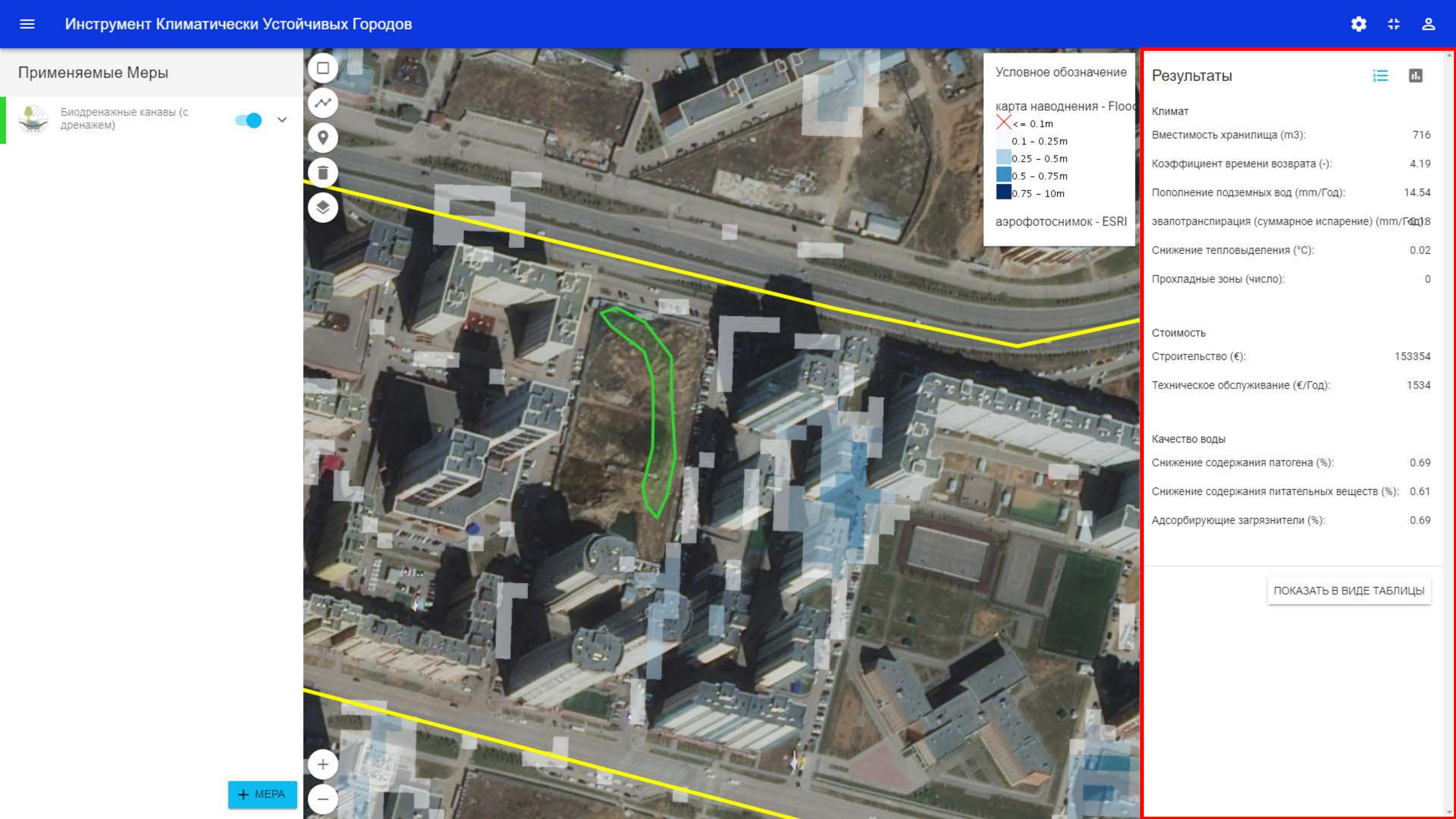
Стоимость

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

Качество воды

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

ПОКАЗАТЬ В ВИДЕ ТАБЛИЦЫ


Инструмент Климатически Устойчивых Городов
Применяемые Меры
Биодренажные канавы (с дренажем)
МЕРА
Условное обозначение
карта наводнения - Flood
<= 0.1m
0.1 - 0.25m
0.25 - 0.5m
0.5 - 0.75m
0.75 - 10m
аэрофотоснимок - ESRI
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

Инструмент Климатически Устойчивых Городов

ОБЛАСТЬ ПРОЕКТА | ЦЕЛЕВОЕ ЗАДАНИЕ ПРОЕКТА

Цели и Ключевые показатели Эффективности

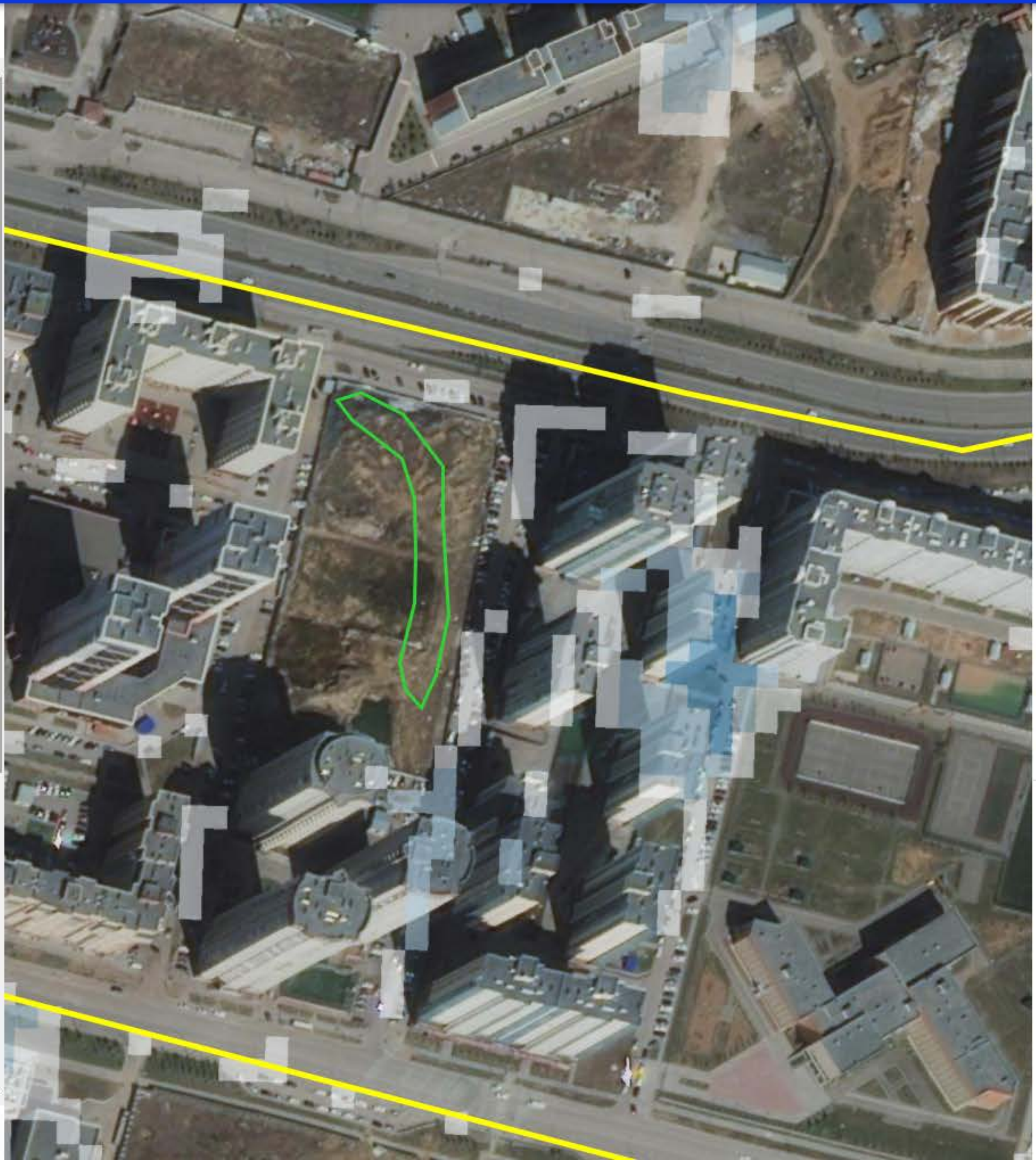
Климат

Цель	Целевое значение	
Вместимость хранилища	5000	m3
Коэффициент времени возврата	5	-
Пополнение подземных вод	0	mm/Год
эвапотранспирация (суммарное испарение)	0	mm/Год
Снижение тепловыделения	0	°C
Прохладные зоны	0	число

Стоимость

Цель	Целевое значение	
Строительство	0	€
Техническое	0	€/Год

СДЕЛАНО



Результаты

Климат

Вместимость хранилища:

Коэффициент времени возврата:

Пополнение подземных вод:

эвапотранспирация (суммарное испарение):

Снижение тепловыделения:

Прохладные зоны:

Стоимость

Строительство:

Техническое обслуживание:

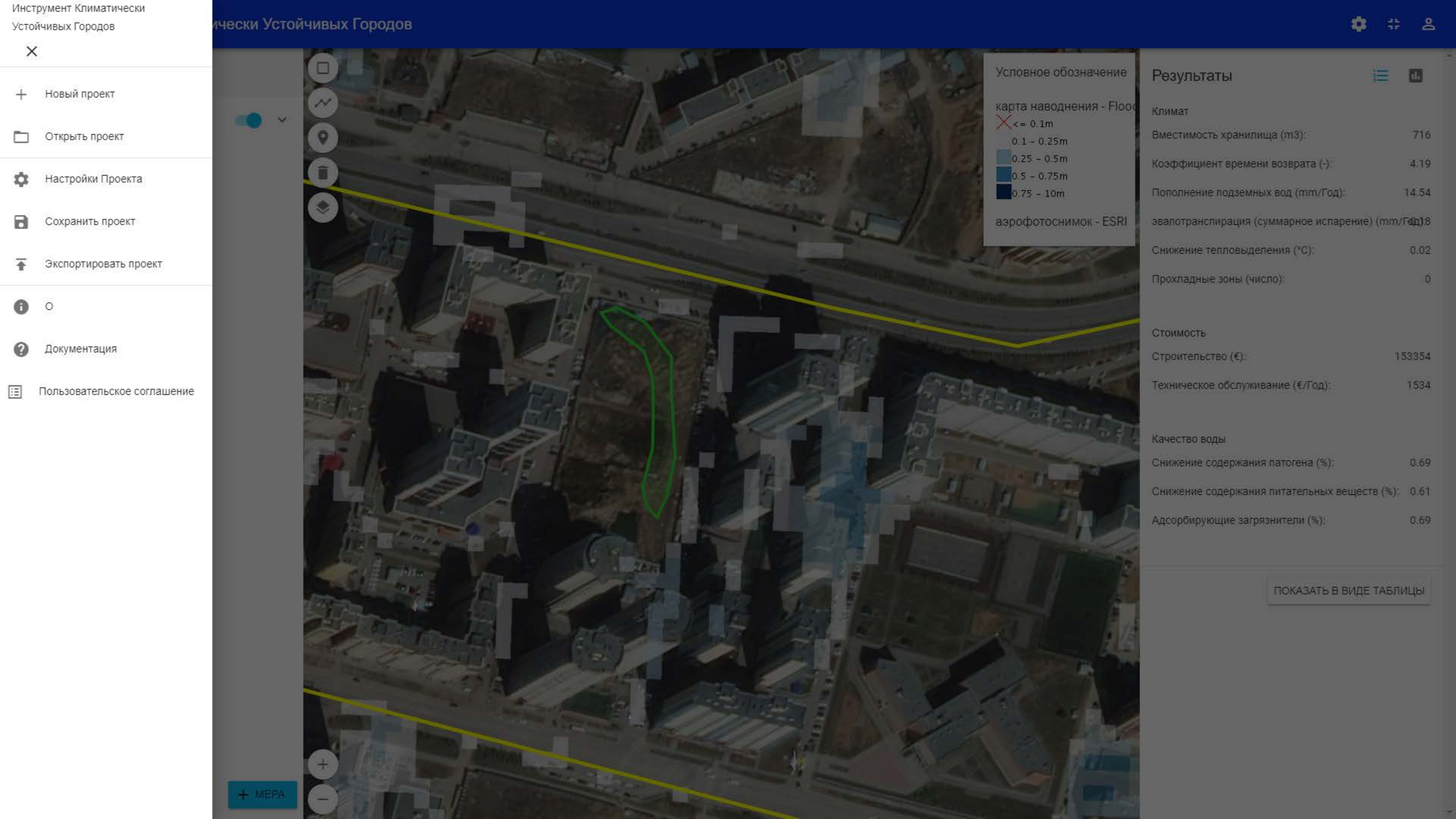
Качество воды

Снижение содержания патогена:

Снижение содержания питательных веществ:

Адсорбирующие загрязнители:

ПОКАЗАТЬ В ВИДЕ ТАБЛИЦЫ


Инструмент Климатически
Устойчивых Городов
Новый проект
Открыть проект
Настройки Проекта
Сохранить проект
Экспортировать проект
О
Документация
Пользовательское соглашение
ически Устойчивых Городов
Условное обозначение
карта наводнения - Flood
<= 0.1m
0.1 - 0.25m
0.25 - 0.5m
0.5 - 0.75m
0.75 - 10m
аэрофотоснимок - ESRI
Результаты
Климат
Вместимость хранилища (m3): 716
Коэффициент времени возврата (-): 4.19
Пополнение подземных вод (mm/Год): 14.54
эвапотранспирация (суммарное испарение) (mm/Год):
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
+ МЕРА

Инструмент Климатически Устойчивых Городов

Выбранные меры

Area-2
Нет

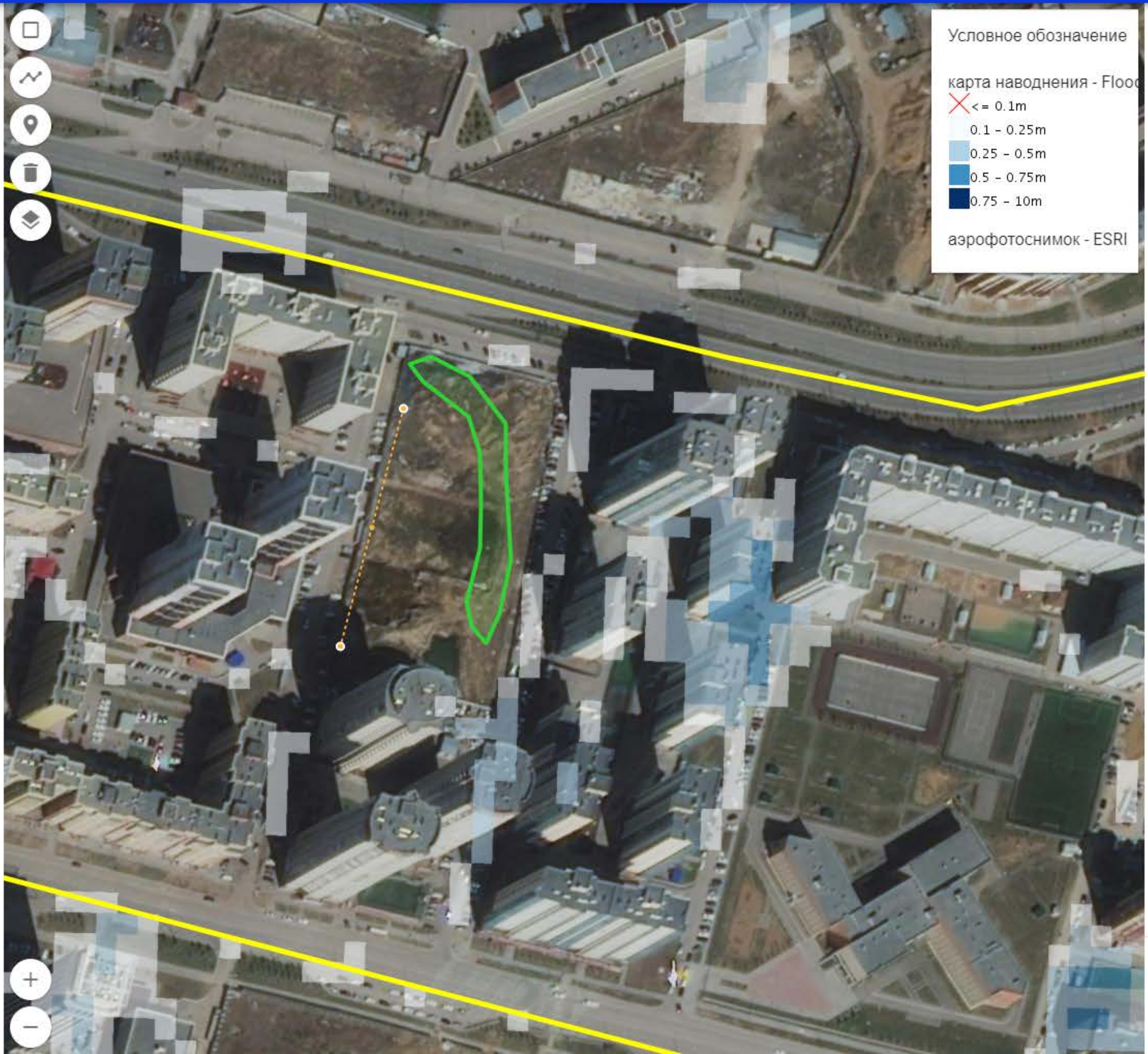
Название Области
Area-2

Мера

Нет

ИЗМЕНИТЬ МЕРУ

СДЕЛАНО



Результаты

Климат

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

Стоимость

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

Качество воды

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

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

ADB Deltares

Using the CRCTool online

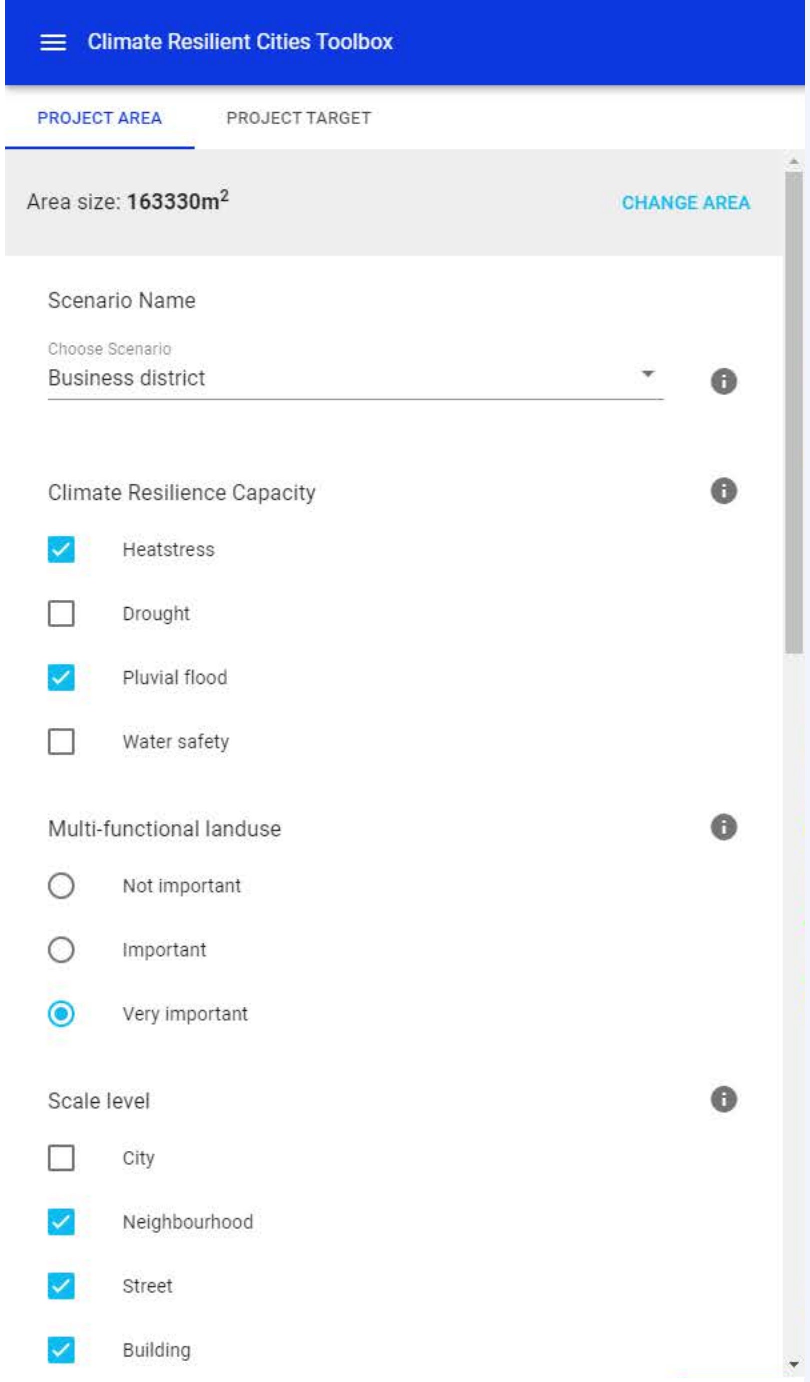
- Manual steps
  - **Setup and map manipulation**: determine layers to use
  - **Scenario metrics:** determine the metrics to evaluate performance
  - **Exporting data**: select areas to implement measures, or measures to implement;
  - **Save** and export the map and corresponding effectiveness results to your computer

Using the CRCTool online

Draw project area!

Choose:

- Type of scenario: Пилотная область
- Climate resilience capacity: heat-stress, drought, pluvial flood, water safety
- Multi-functional landuse: not important to very important
- Scale level: city to building scale
- Existsing space types: current existing space typology
- Sub-surface availability: very low to high
- Surface characteristics: flat roofs to sloped roofs
- Soil type: sand, peat, clay, bed rock
- Slope: sloping or flat area, low or high ground



ADB Deltares

Using the CRCTool online

- Targets have been defined
- Select a location for a measure OR
- Select a measure you would like to implement

ADB Deltares

CRCTool - Measure properties

Geometry of measures

All measures are given a **measure area**, an **inflow area**, and a **measure depth**

- **Measure area [m2]** is the surface area of an adapation measure, it is obtained from the measure drawn on the map and the width and radius in case of a line or point measure

Measures drawn as a line have the additional property:

- **Width [m]** is the width of the measure that stores water. This value is set by the user.

Measures drawn as a point have the additional property:

- **Radius [m]** is the radius of the measure that stores water This value is set by the user.
- **Measure depth [m]** is the depth of water that can be stored in the facility, or **the depth of water that can be stored on the area of the measure**. This depth is set by the user.

ADB Deltares

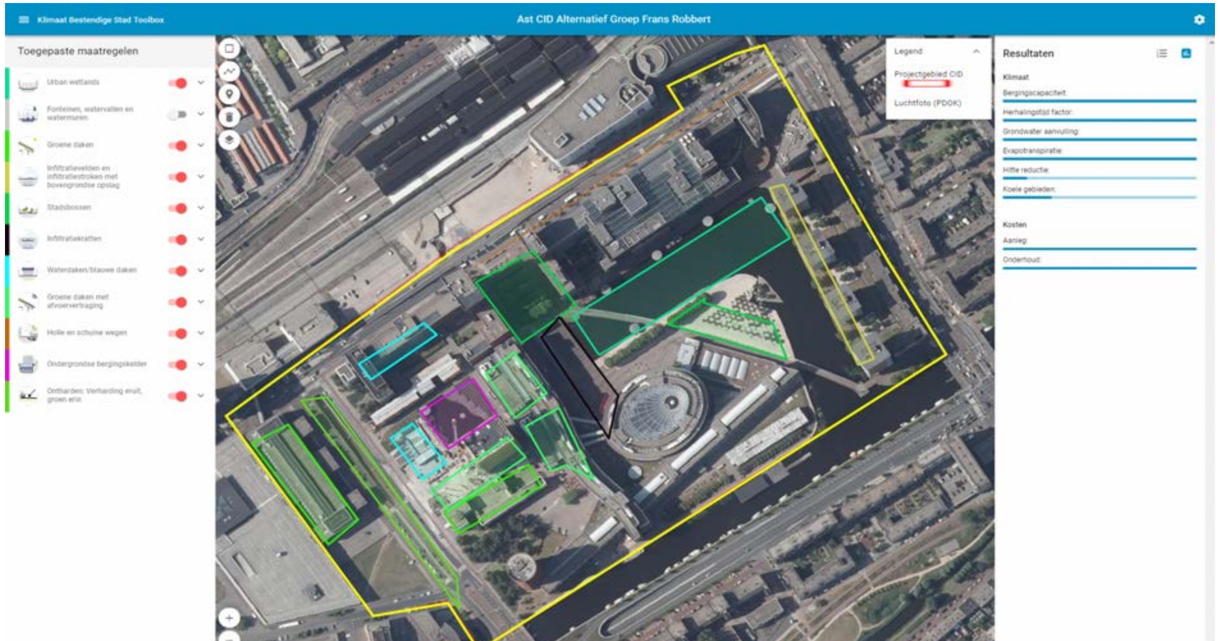
CRCTool - Measure properties

- **Inflow area [m2]** is the surface area that drains towards a measure, it is set by the user as a multiplier of the measure area.
  - Measures at roof level normally have an inflow area **i**that has the same size as the measure area (Inflow area factor =1)
  - Measures at ground level can have an **inflow area** that is (sometimes much) larger than the measure area (Inflow area factor > 1)

ADB Deltares

What is the CRCTool meant for?

- The CRCTool can be used to **co-create packages of adaptation measures** for a more climate-resilient urban environment.
- Planners, water managers and other stakeholders (local representatives, experts, constructors, financers, etc.) are supported by the CRCTool in **their dialogue about options and alternatives**;
- The CRCTool can also be used **individually, to explore options and preferences**
- The CRCTool provides the user with an **overview of different measures** and **a first estimate of hydrological effectiveness and costs**, so that alternatives can be discussed and evaluated.



ADB Deltares

Results and output

- Results of design workshops: one or more **alternative conceptual plans for retrofitting adaptation measures in an area** – district and/or sub-district scale; to be used in the next phase to be elaborated and evaluated in more detail.
- **The output of the CRCTool** is **input for the designers** – landscape architects, urban planners, architects – to make more **detailed preliminary designs**.

What the CRCTool cannot do:

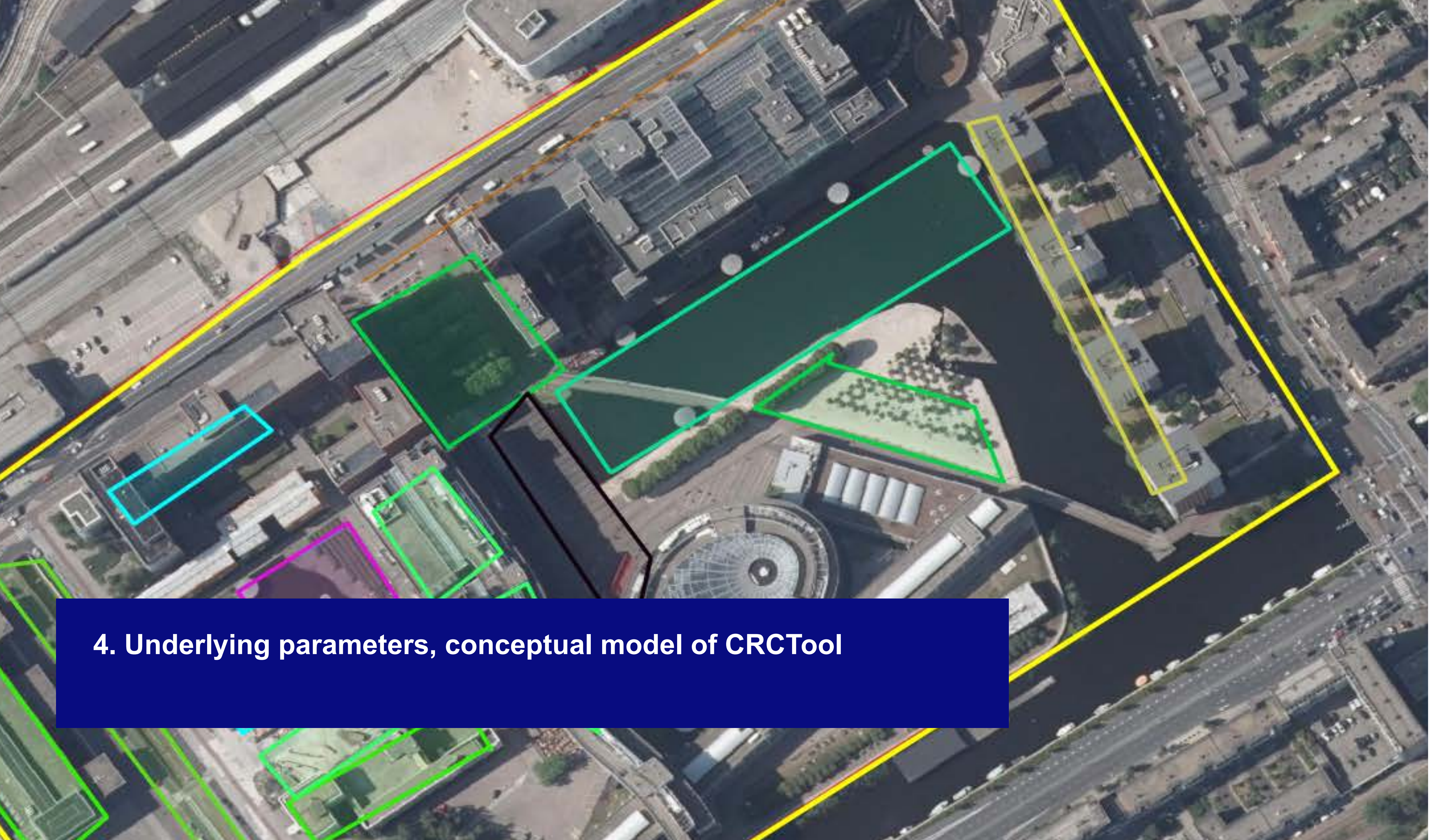
- Calculated effectiveness, costs and benefits by the CRCTool are **first-order estimates;** reliability depends on **available local data.**

- Local conditions will be **different in practice** and so will be the actual on-the-ground performance and costs.

- Differences in estimated performance of less than 5-10 % should not be taken as significant. First-order estimates can however be used to discuss and compare alternative plans.

- Discussions among the stakeholders are important even when the differences in estimates are small as experts and stakeholders **each place a different weight** or value on each performance metric.

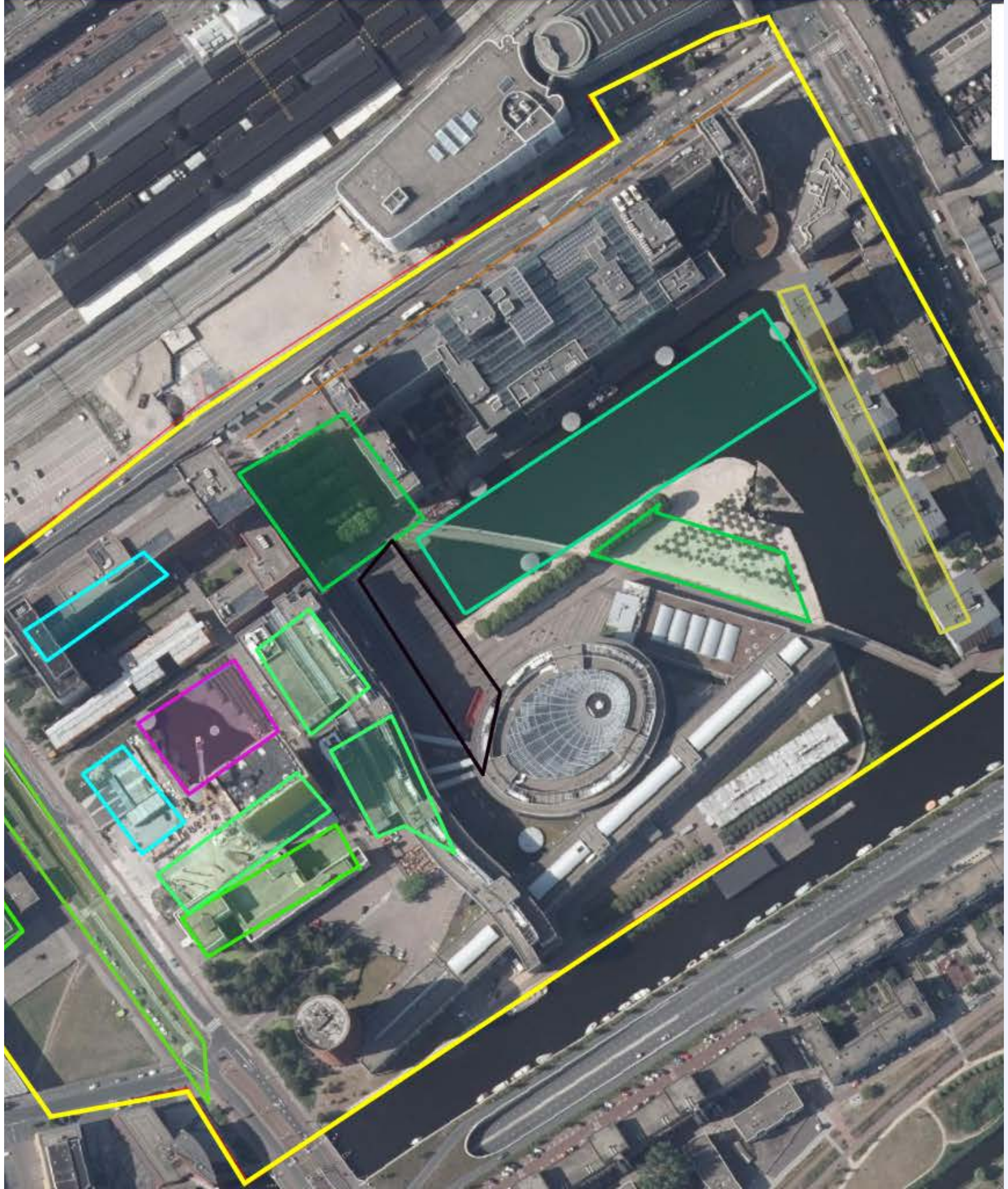
ADB Deltares



4. Underlying parameters, conceptual model of CRCTool

4. Underlying parameters, model of CRCTool

- How is the CRCTool built up?
- What are the underlying parameters, assumptions?
- CRCTool conceptual model
- Considerations for local application

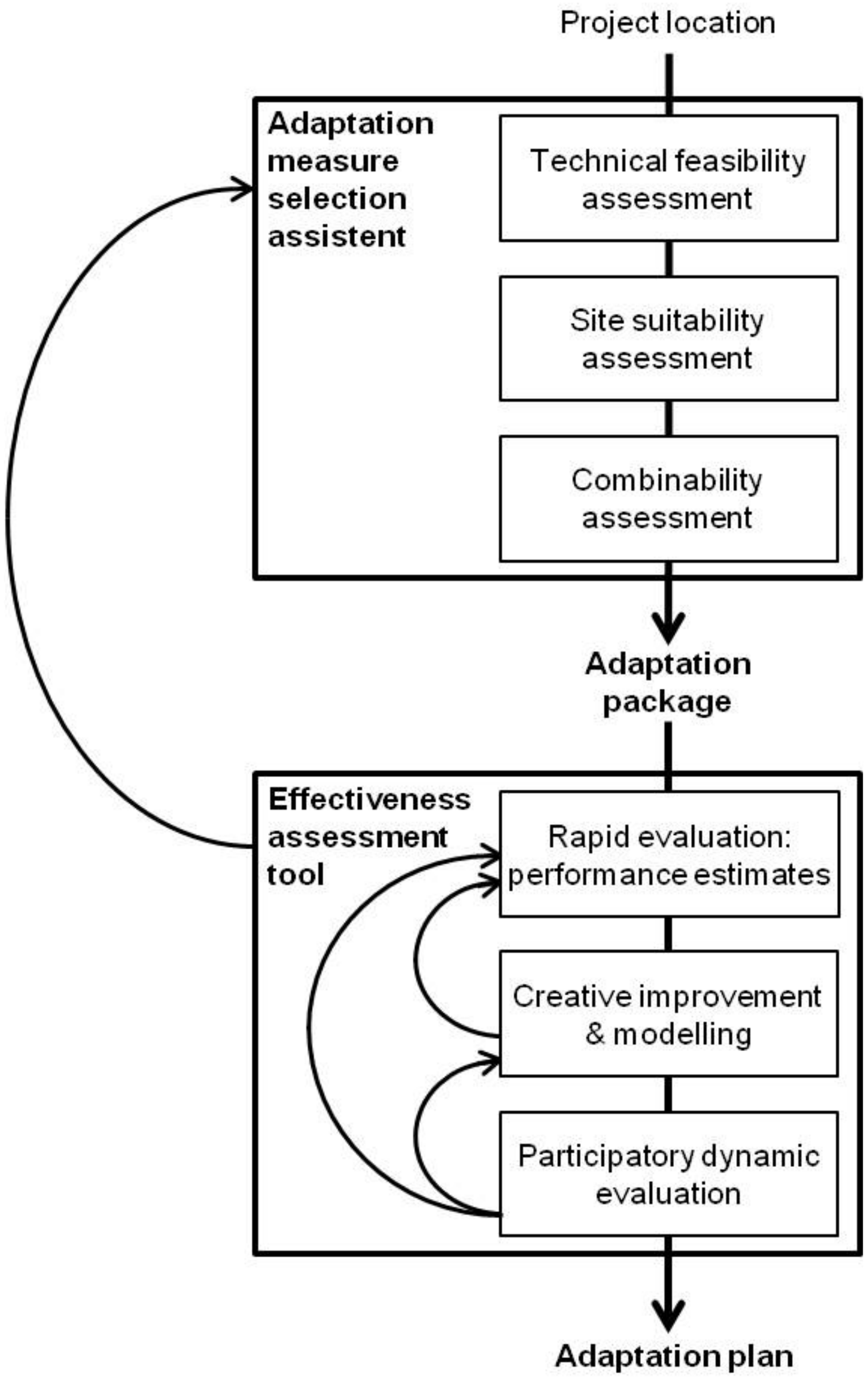


ADB Deltares

How is CRCTool built up?

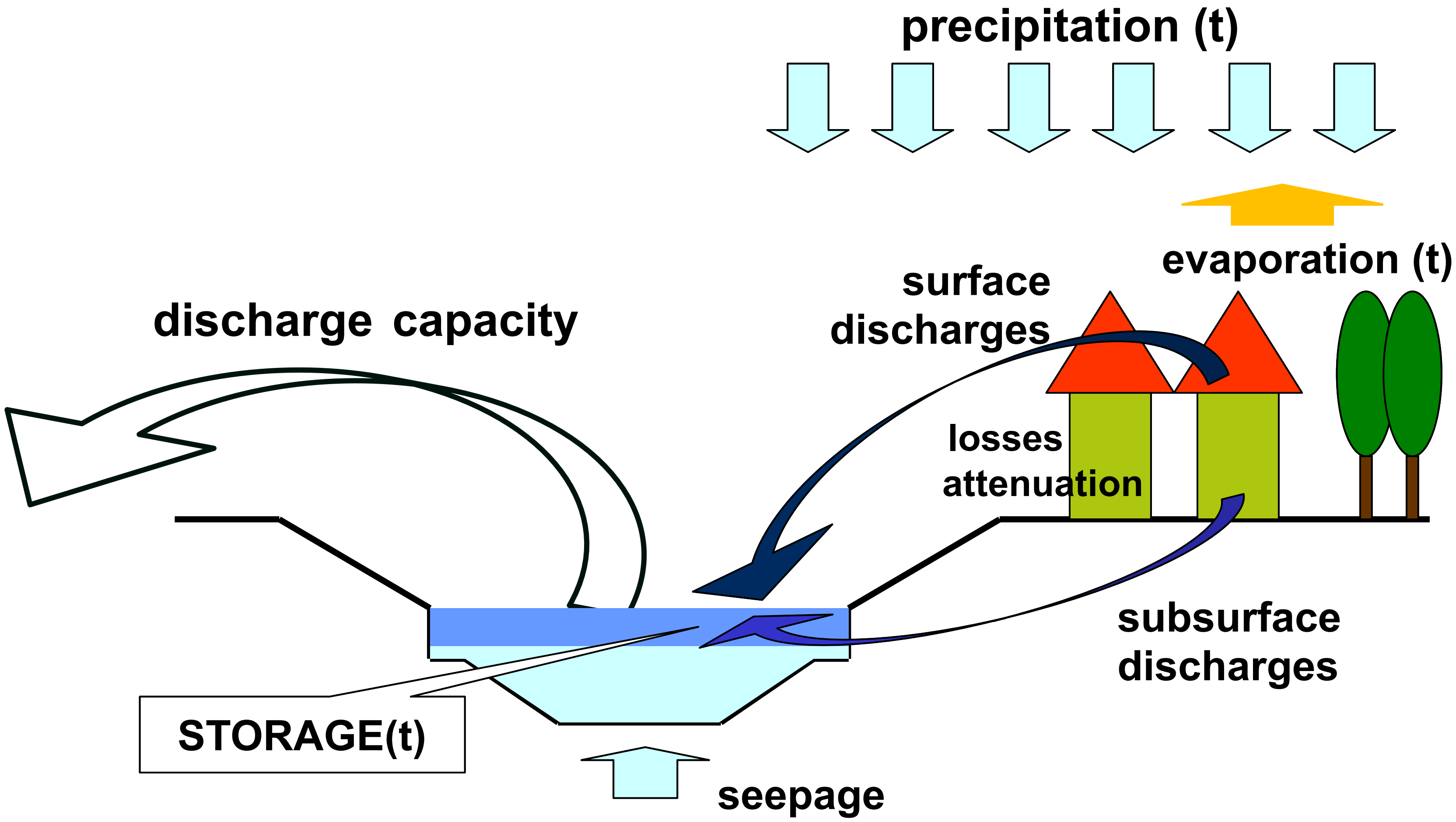
- An adaptation measures selection assistant
  - technical feasibility
  - site suitability
  - combinability assessment

- An effectiveness assessment tool



ADB Deltares

Assessment of required stormwater detention capacity:
Conceptual model of the sponge



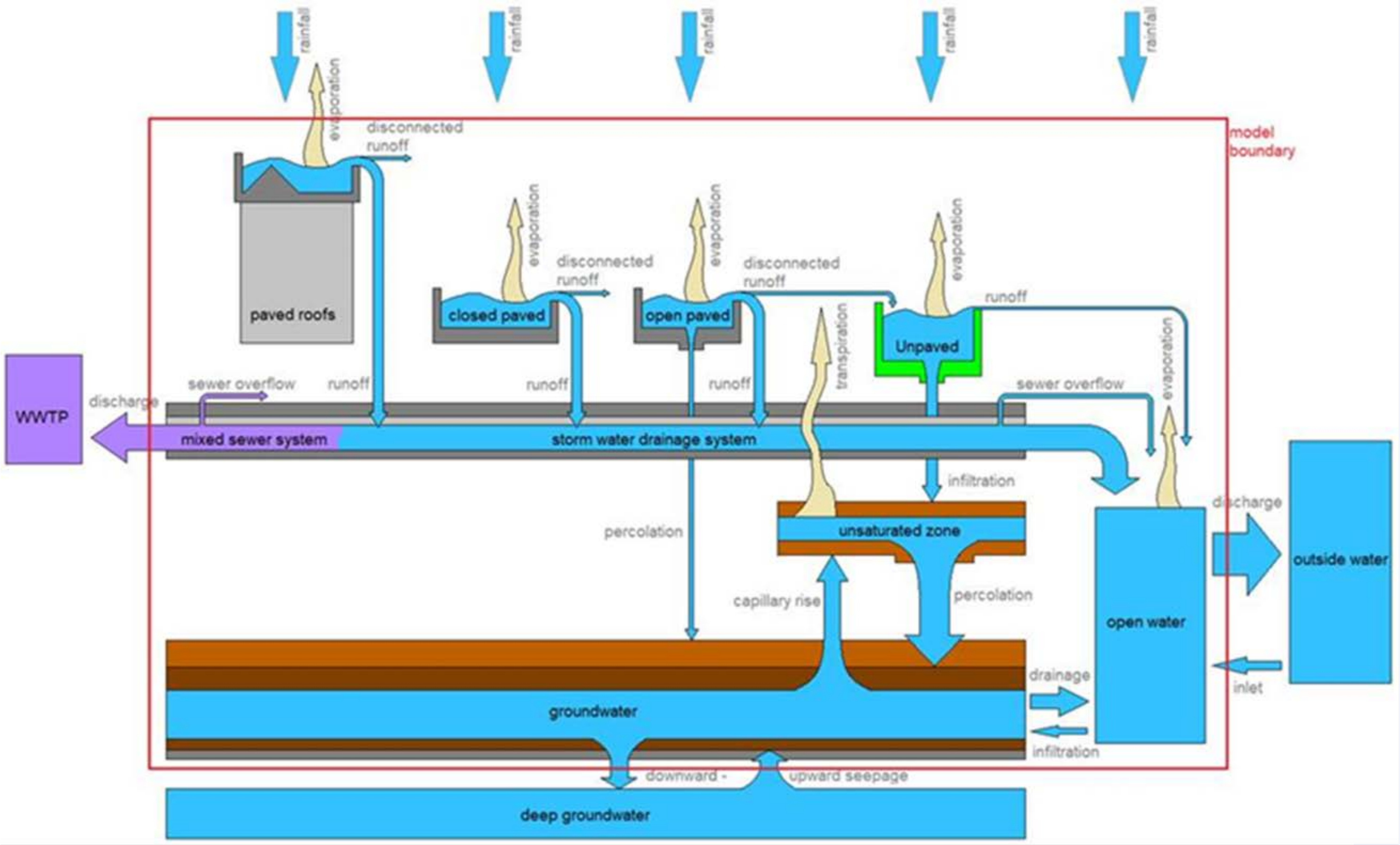
ADB Deltares

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.



ADB Deltares

Storage – Discharge – Frequency curves

to assess sponge capacity as function of discharge capacity

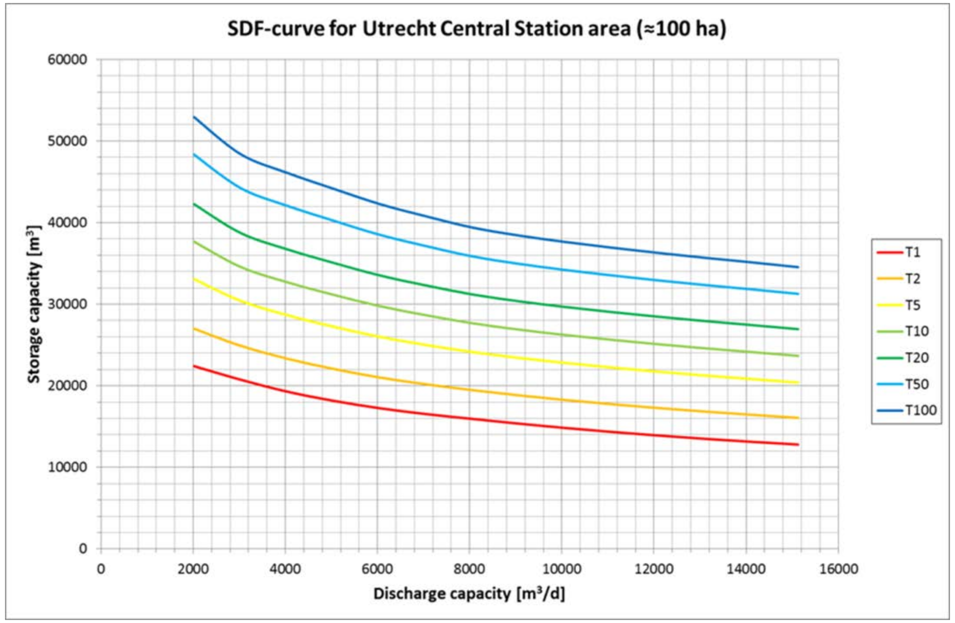
Input:
- land use data
- soil property data
- long series rainfall data
- long series evaporation data
- climate change assumptions

Water Balance Model

Output:
- discharge capacity
- long series of stored volumes

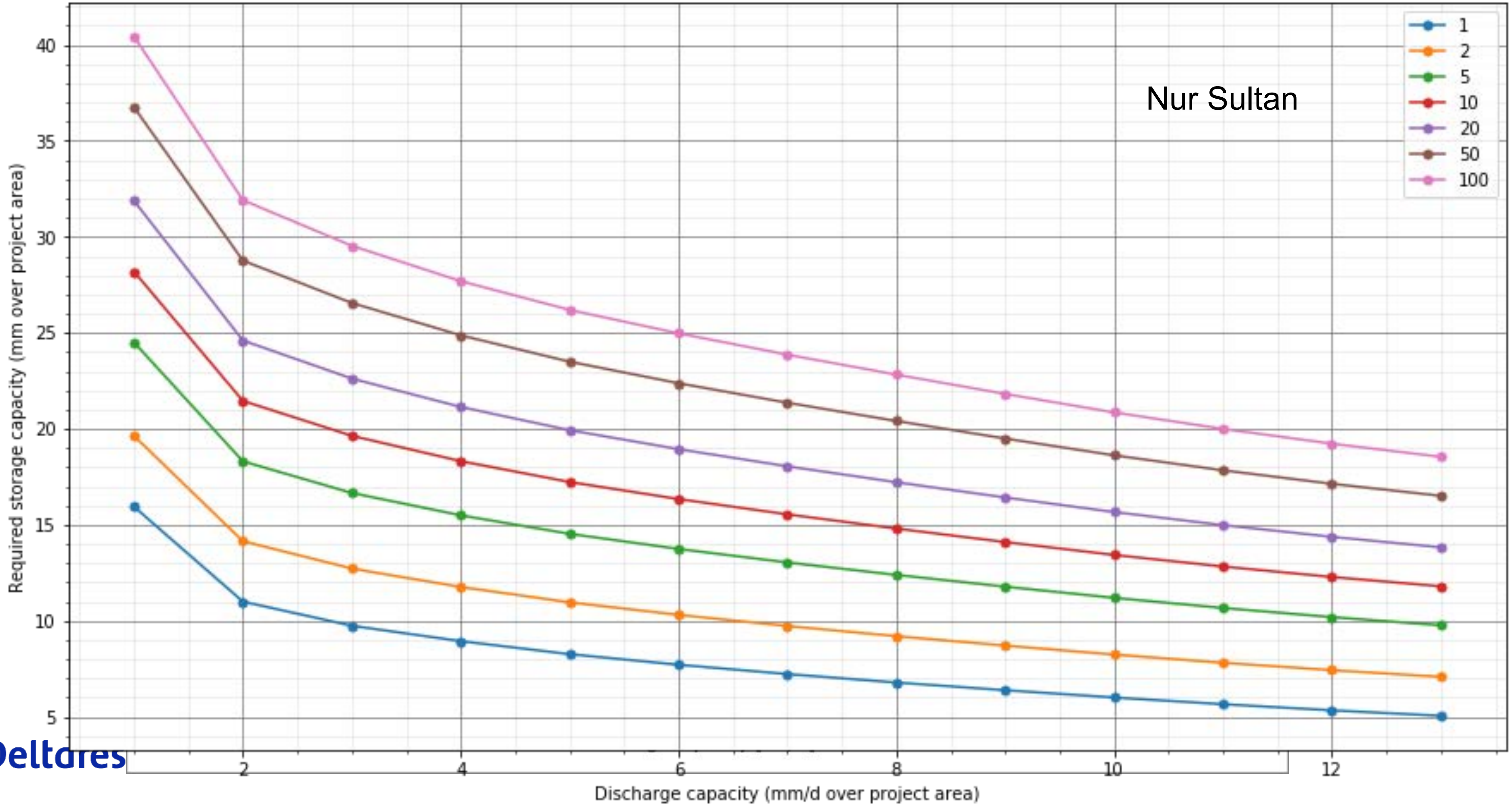
extreme value statistics

Storage – Discharge – Frequency (SDF) curves



ADB Deltares

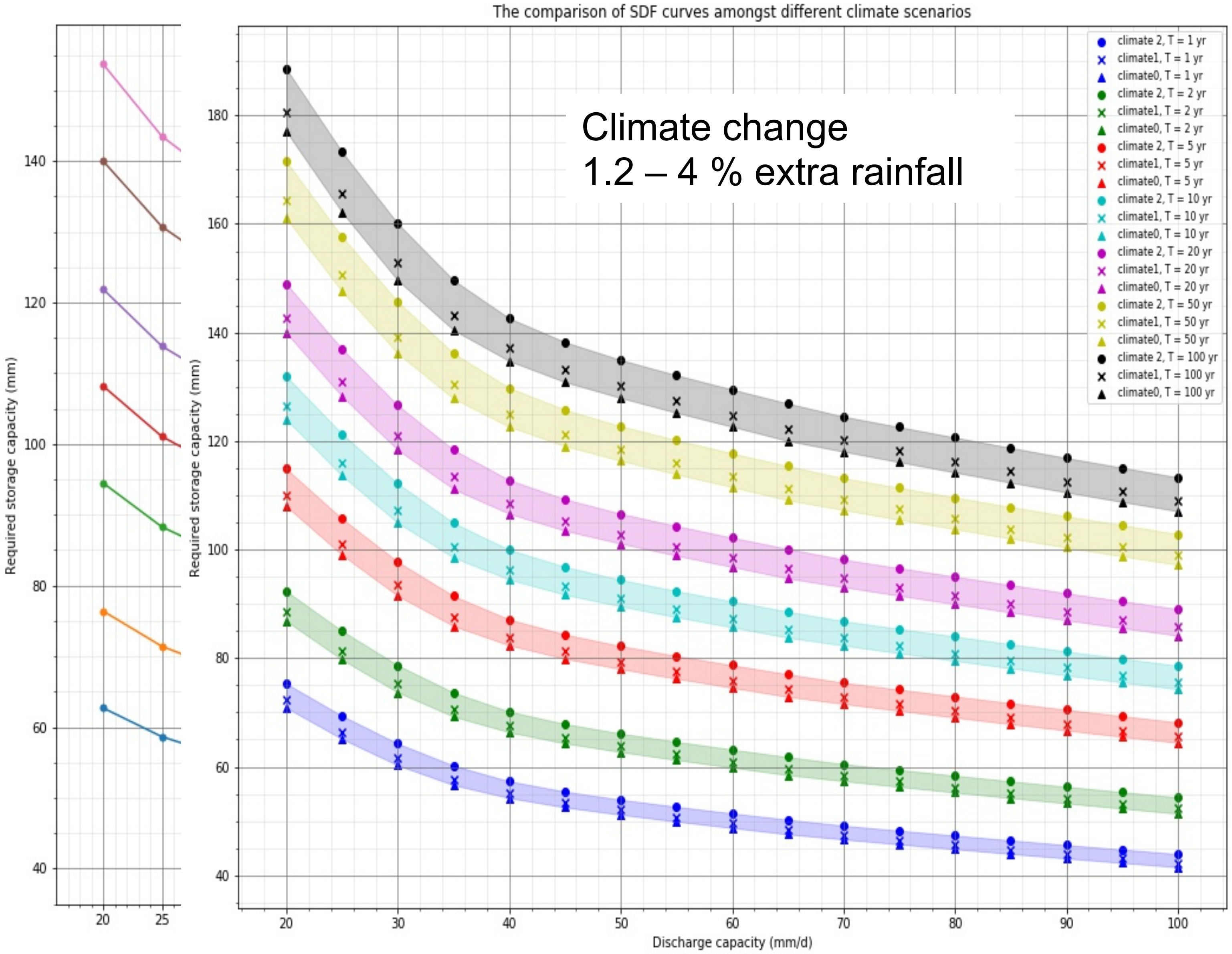
Storage-Discharge Frequency curves Nur Sultan



ADB Deltares

Storage – Discharge – Frequency curves

to assess sponge capacity as function of discharge capacity



ADB Deltares

Storage capacity [m3] (stormwater detention)

Detention capacity of a measure =

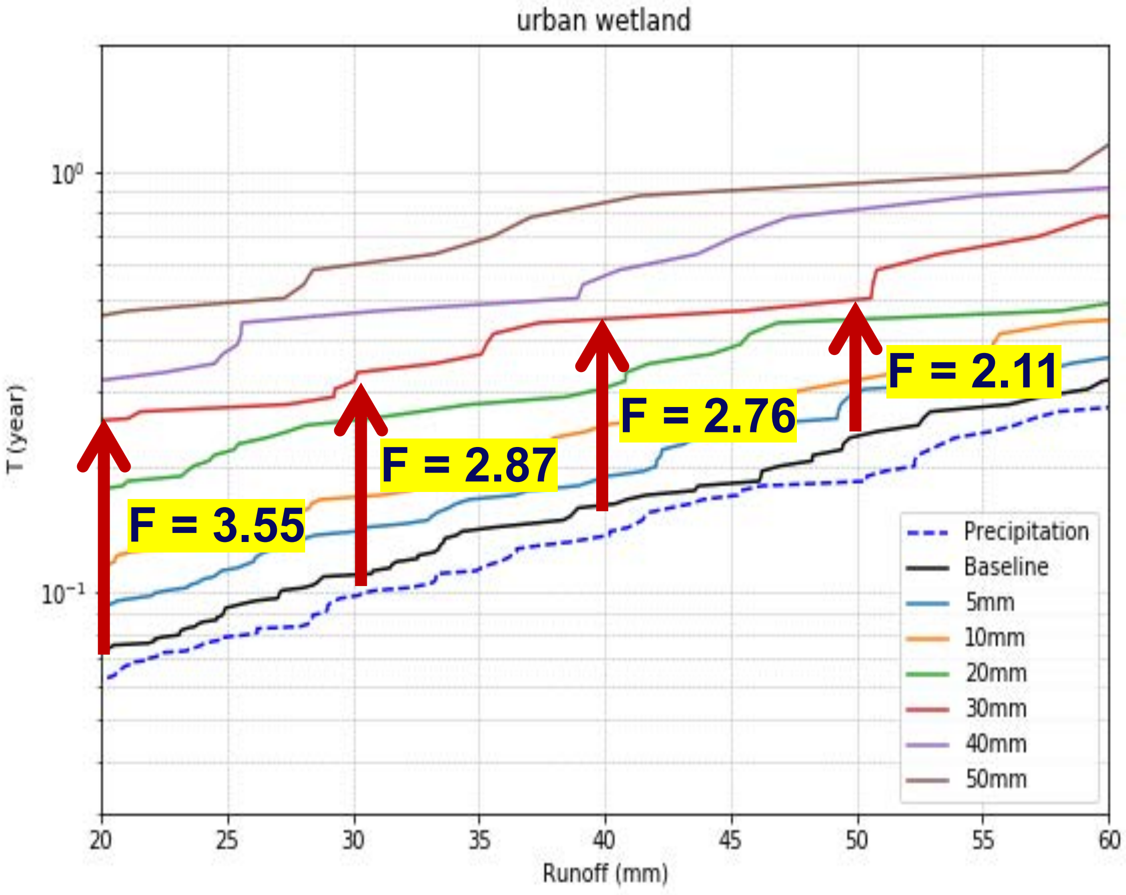
- the depth of water [m] that can be stored on the area of the measure X area of the measure [m2]

Detention capacity of all measures =

- Sum of all detention capacities of measures in the project area

Return time factor [-]

- The **runoff return time** (T, in years) is the statistically determined average time it takes for a runoff
  - For instance, when a rainstorm with a total depth of 7 inches occurs 50 times in a period of 100 years, the estimated return time of this rainstorm is 2 years to reoccur
- The total runoff volumes depend on the rainstorm and on the characteristics of the urban area, hence so do the runoff return times.
  - For example when an adaptation measure doubles the return time of a runoff that causes damage, this damage will occur only half as often, thus roughly reducing the damage by a factor two.
  - This doubling is an example of the **return time factor**



Example of effect of a measure with retention X on the runoff return time of CM Hospital catchment area. Coloured lines represent gross runoff storage depth in the swale

ADB Deltares

Groundwater recharge [mm/y]

- **Groundwater recharge** is defined as the average net annual flux (mm/year) from the unsaturated zone towards the saturated zone (P_gw in Figure).
- It is calculated with the same **urban water balance model** that is used for calculating effective storage and is also forced with the same meteorological data.
- Applying a **measure with infiltration possibilities**, like a grassed swale, can **increase the groundwater recharge** of the inflow area of the measure.
- In the model the groundwater recharge is **divided equally over the entire area**
- The **additional groundwater recharge** (over the measure area) is expressed in mm/year over the inflow area, according:

$$GWrecharge_{inflow\ area} = GWrecharge_{measure\ area} \cdot \frac{measure\ area}{inflow\ area}$$

ADB Deltares

Thermal cooling effects

- Cooling effects of blue-green measures are **hard to quantify** in general terms. Introduction of green infrastructure leads to **an increase in evapotranspiration** – unless there is an extreme drought.
- The **energy that is used for evaporation** is **no longer available** for producing sensible heat.
- The **more water evaporates**, the **less air temperature** will go **up**.
- So, as evaporation is an important variable for thermal effect, the **estimated annual evaporation** that stems from our blue-green measures is estimated and presented as an **indicative metric for cooling**.
- **Shading** is another important mechanism to **reduce temperatures at street level**. The cooling effect of shading by green infrastructure is only relevant for trees that are planted.
- **Cool spots** are defined as places > 200 m2 with abundant shade and evapotranspiration.

Water quality parameters

- Water quality is extremely important for the functions and services that water can provide.
- **Three groups of water quality parameters** are considered:
  - Nutrients (determine the eutrophication level)
  - particle bound pollution (many relevant chemical pollutants tend to absorb on suspended organic particles, clay particles and iron-coated sand particles)
  - pathogenic organisms (influence public health risk)
- Most measures influence the quality of stormwater runoff by different treatment processes (not all measures perform all treatment processes):
  - Capturing
  - Settling
  - Filtering
  - Degradation
- Capturing of pollutants takes place at the **inlet of the measure**. Also vegetation growing on/in a measure can capture pollution, for example by intercepting rainfall. Moreover, many pollutants degrade while still in the water column, in solution or adsorbed on suspended sediment particles.

Costs

- Included are both **construction** and **maintenance costs**
- Based on a **unit cost price per square meter** of one or multiple implementations
- Cost per square meter has been determined based on **local information and experience**
- Costs **scale linearly** with measure size. For some measures an **additional non-scalable constant cost** has been included.
- **!! Based on local conditions and actual implementation the actual cost may in reality vary significantly.**
  - For instance, costs of implementing adaptation measures in city centres are usually higher than in suburbs.

5. CRCTool examples, best practices and case studies

5. CRCTool examples, best practices, case studies

- Examples of CRCTool applications
- Different levels of detail
- Availability of data

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Utrecht Center – Fair area - AST 2015

- Stakeholders involved: Municipality + Fair
- Ambition: Most green, climate resilient and healthy urban area in Europe
- CRCTool used with stakeholders to
  - collaboratively explore potential adaptation meas
- Funding: City of Utrecht, Fair, EU

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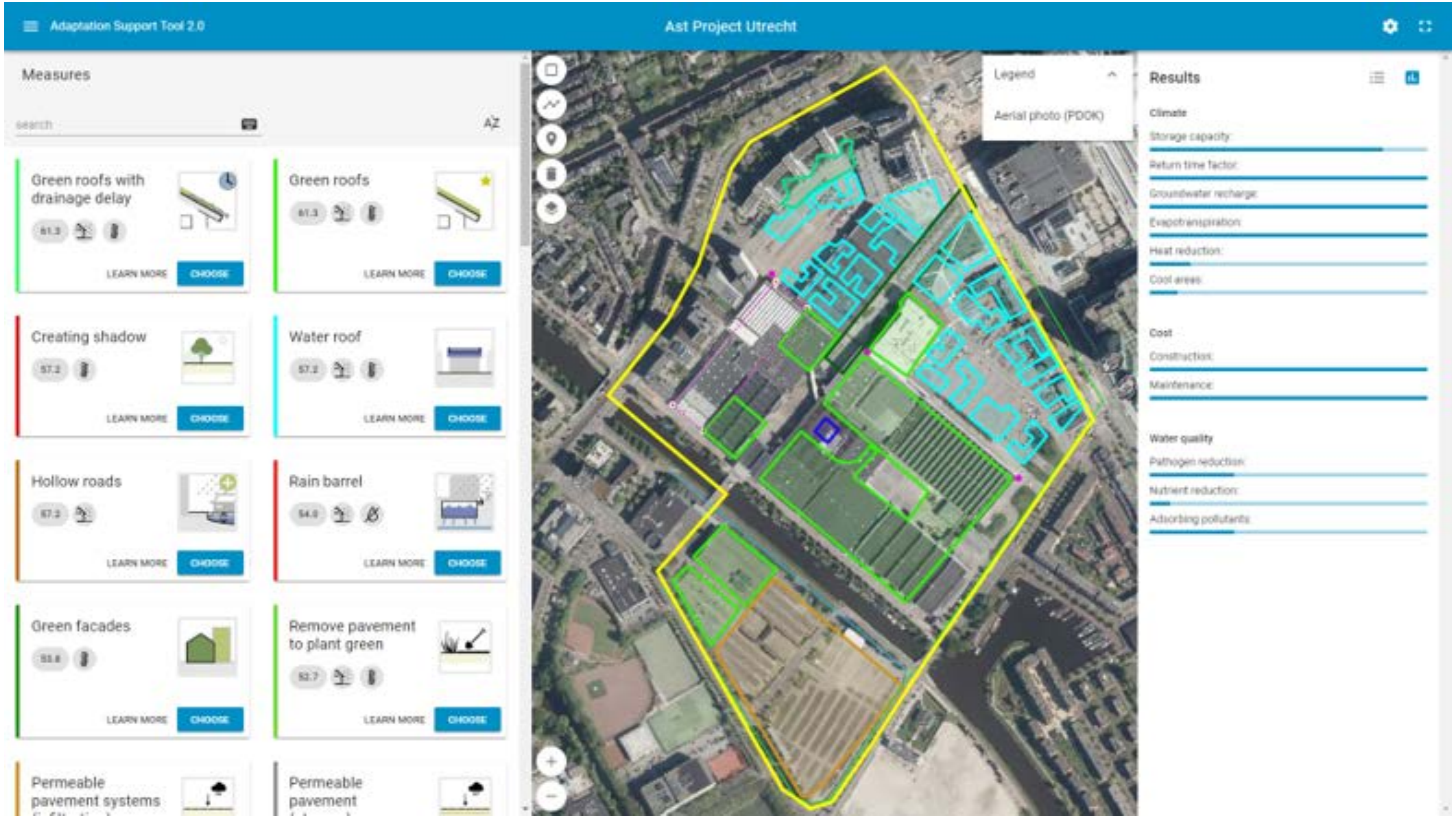
Utrecht Center – Fair area



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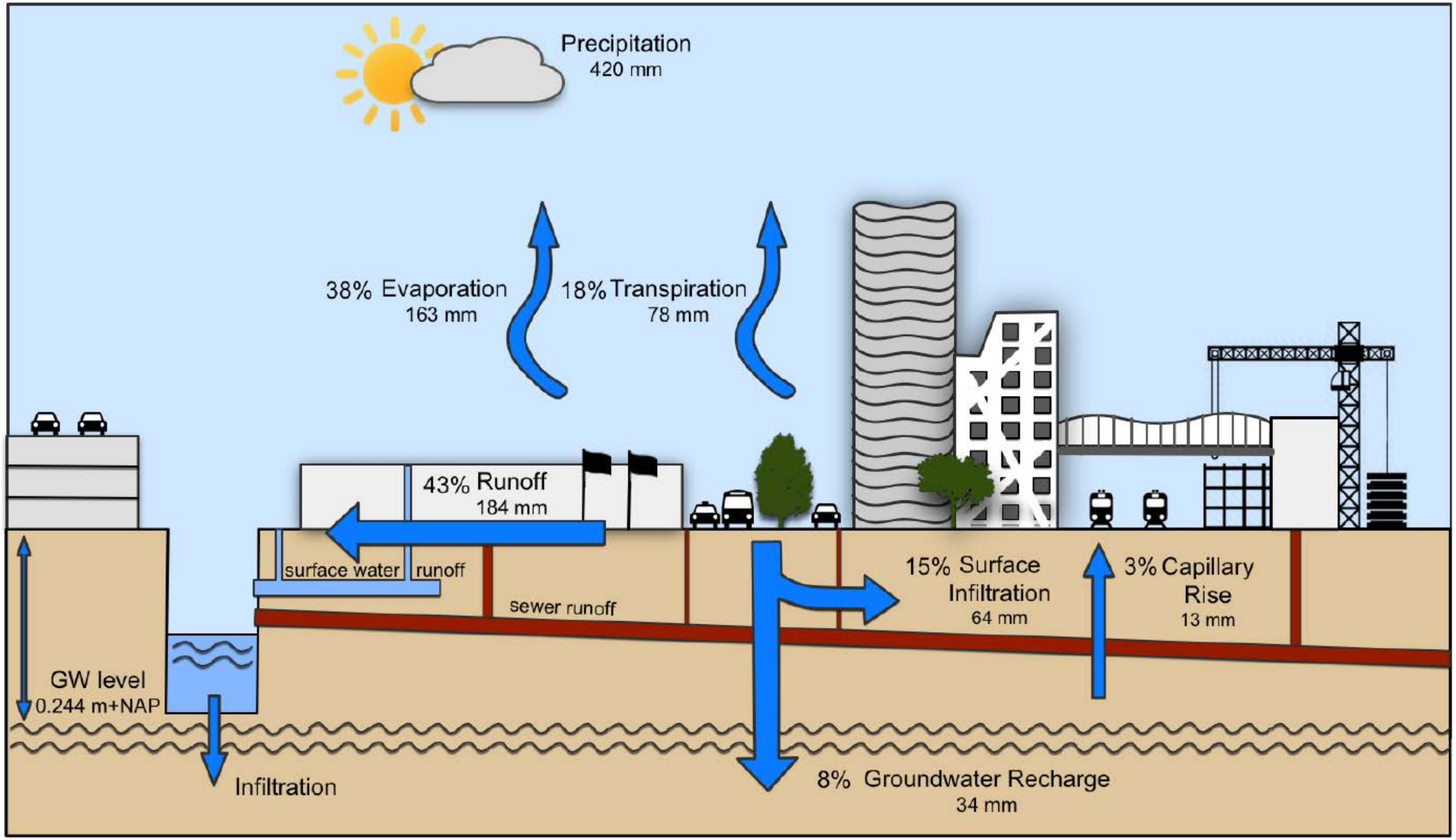
Utrecht Center – Change water flow to increase resilience



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Utrecht Center – CRCTool to implementation 2020-2030

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宜水环境 Ewaters

ADB

Deltares

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

Deltares
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Ewaters
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20 November 2020

Context of the project

- Xiangtan, Hunan province China
- Extreme storms, heat and drought => flooding, economic loss, societal damage
- Climate change is expected to aggravate the problem

Objective of Xiangtan municipal government:

Transform Xiangtan from a carbon-intensive, heavily polluting city to a low-carbon, climate resilient and livable city

ADB supports this development with

The Xiangtan Low-Carbon Transformation Sector Development Program

In this context

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

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

Project assignments:

- urban resilience and adaptation assessment
- development of an adaptation planning support tool
- provide training on applications of blue-green/nature-based solutions for flood protection and climate resilience and climate adaptation tool
- priority list of climate adaptation measures and estimate resilience improvement due to those measures
- prepare conceptual designs for three pilot areas
- propose suitable ecosystem-based adaptation measures for 20 low carbon communities
- pre-feasibility study on suitable ecosystem-based adaptation (EbA) measures

Pilot areas

Fuxing Middle Road

New Chinese Medicine Hospital design and building site

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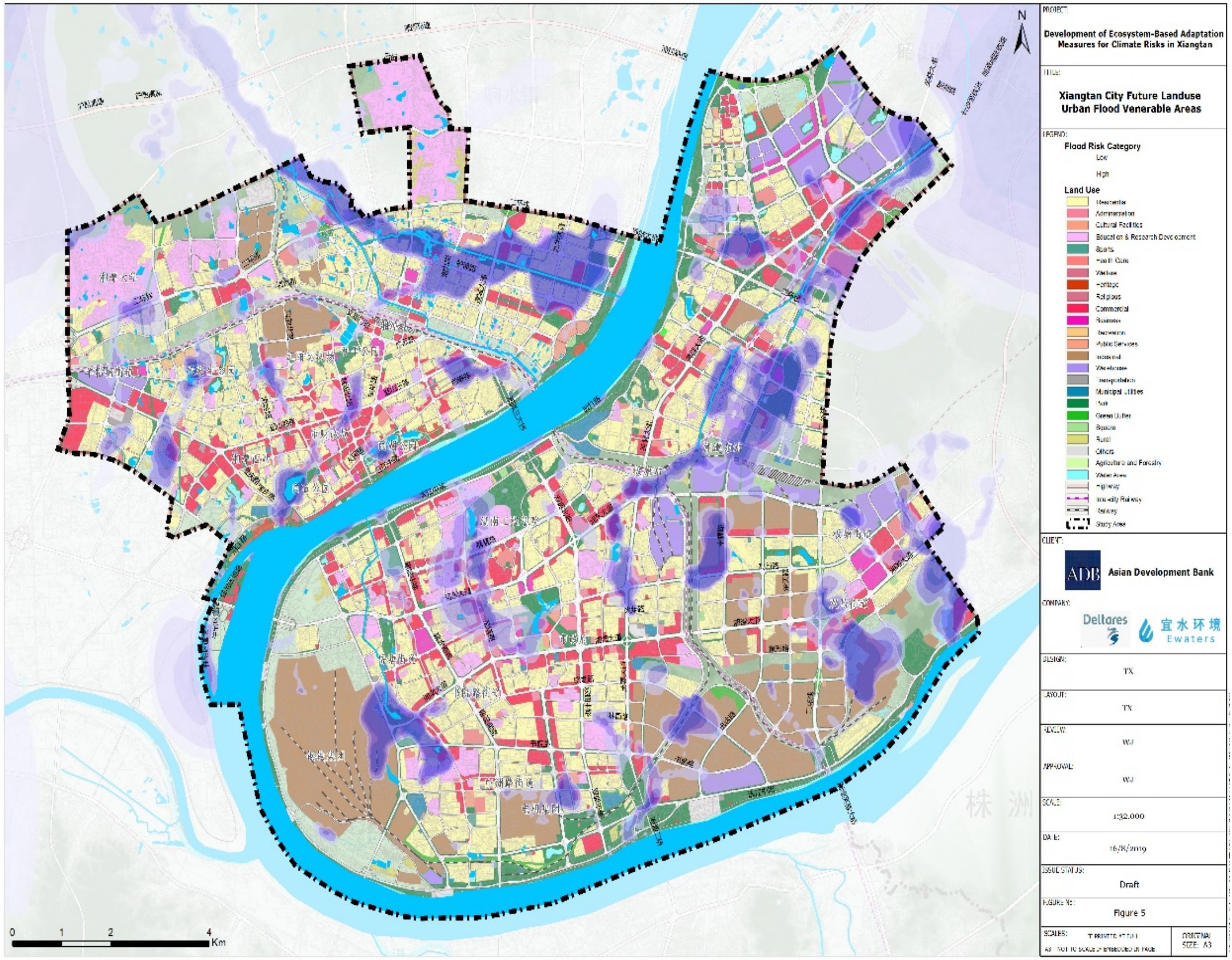
Flood risk assessment

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

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



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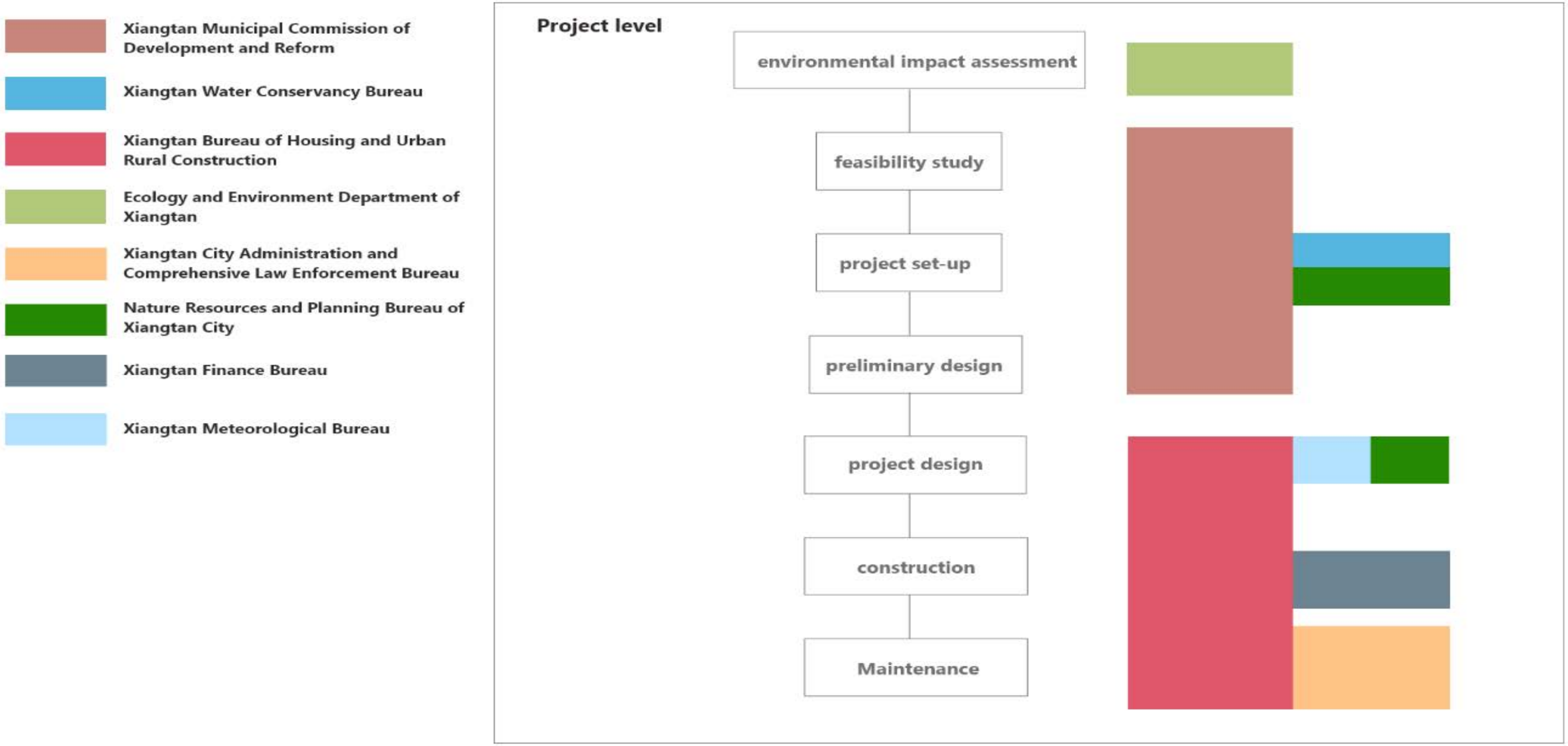
Relevant actors



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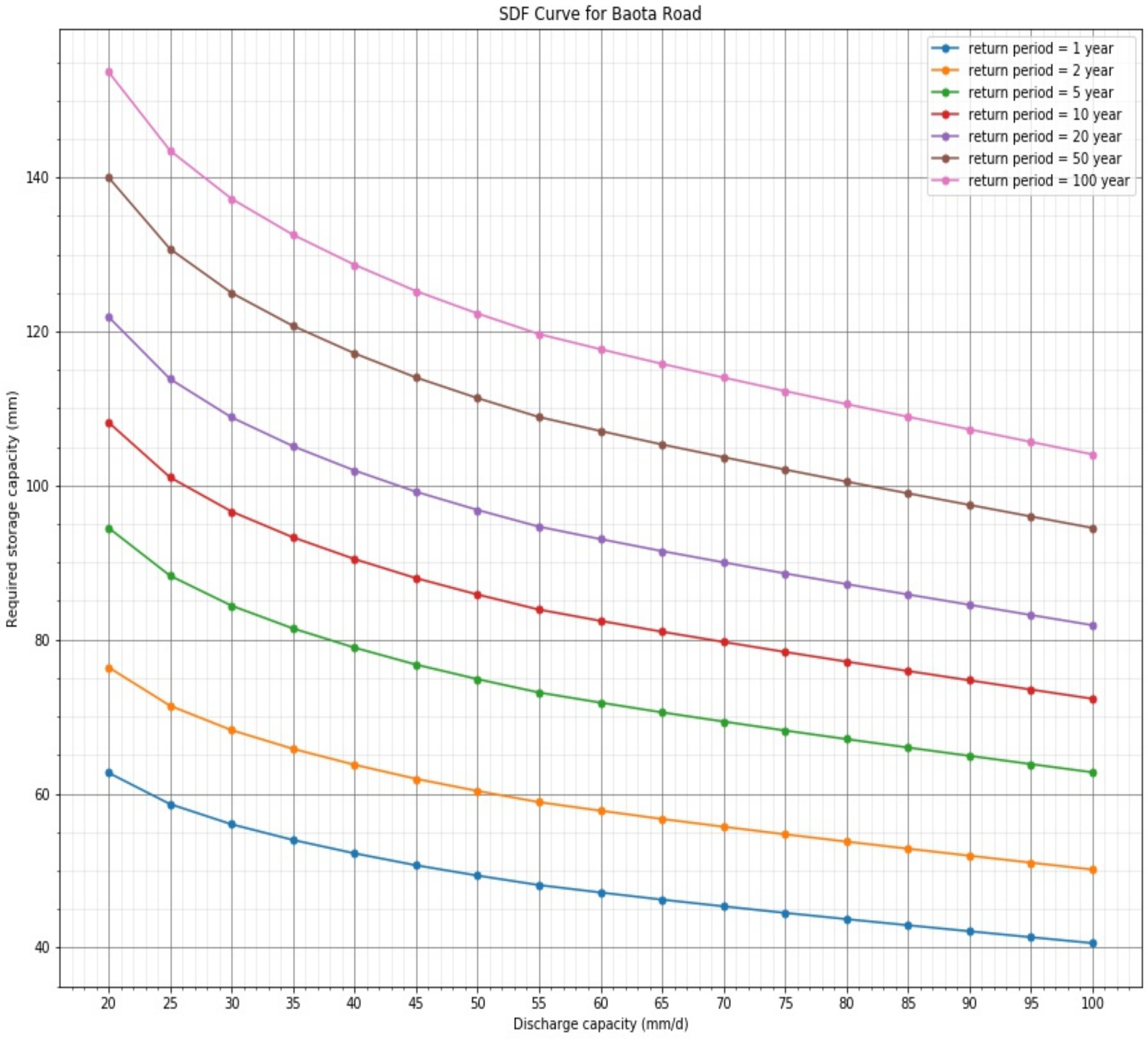
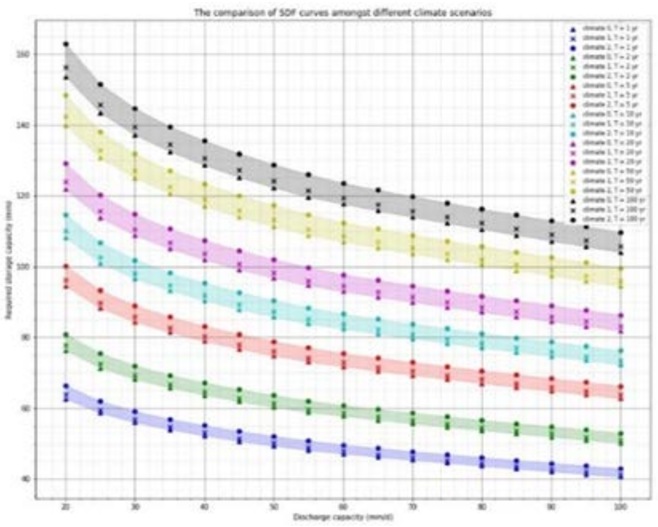
Required storage (sponge) capacity assessment

Storage – Discharge - Frequency curves are assessed using rainfall and land use data.



Sensitivity of the SDF curves for climate change scenarios is assessed



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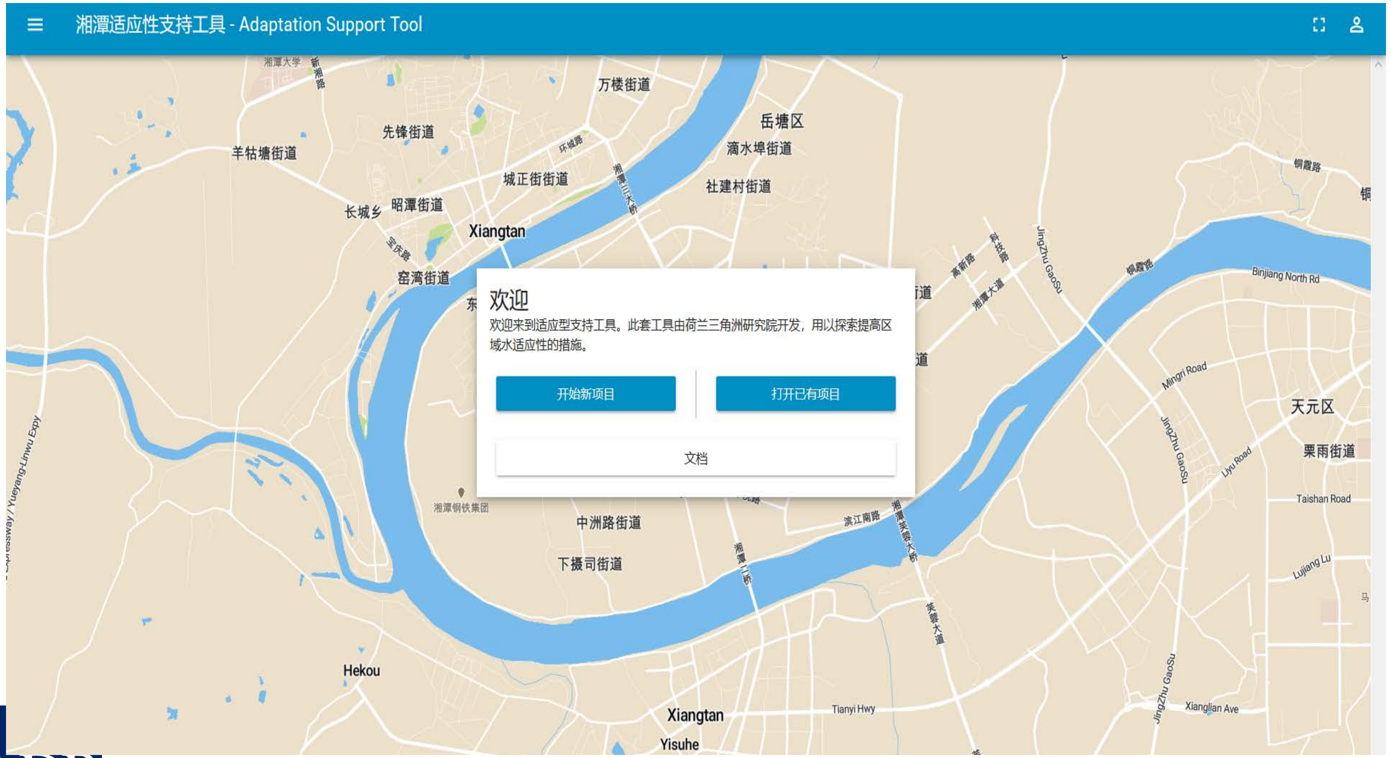
Xiangtan Climate Resilient City Tool
https://xiangtan.crctool.org/zh_cn/)

- 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



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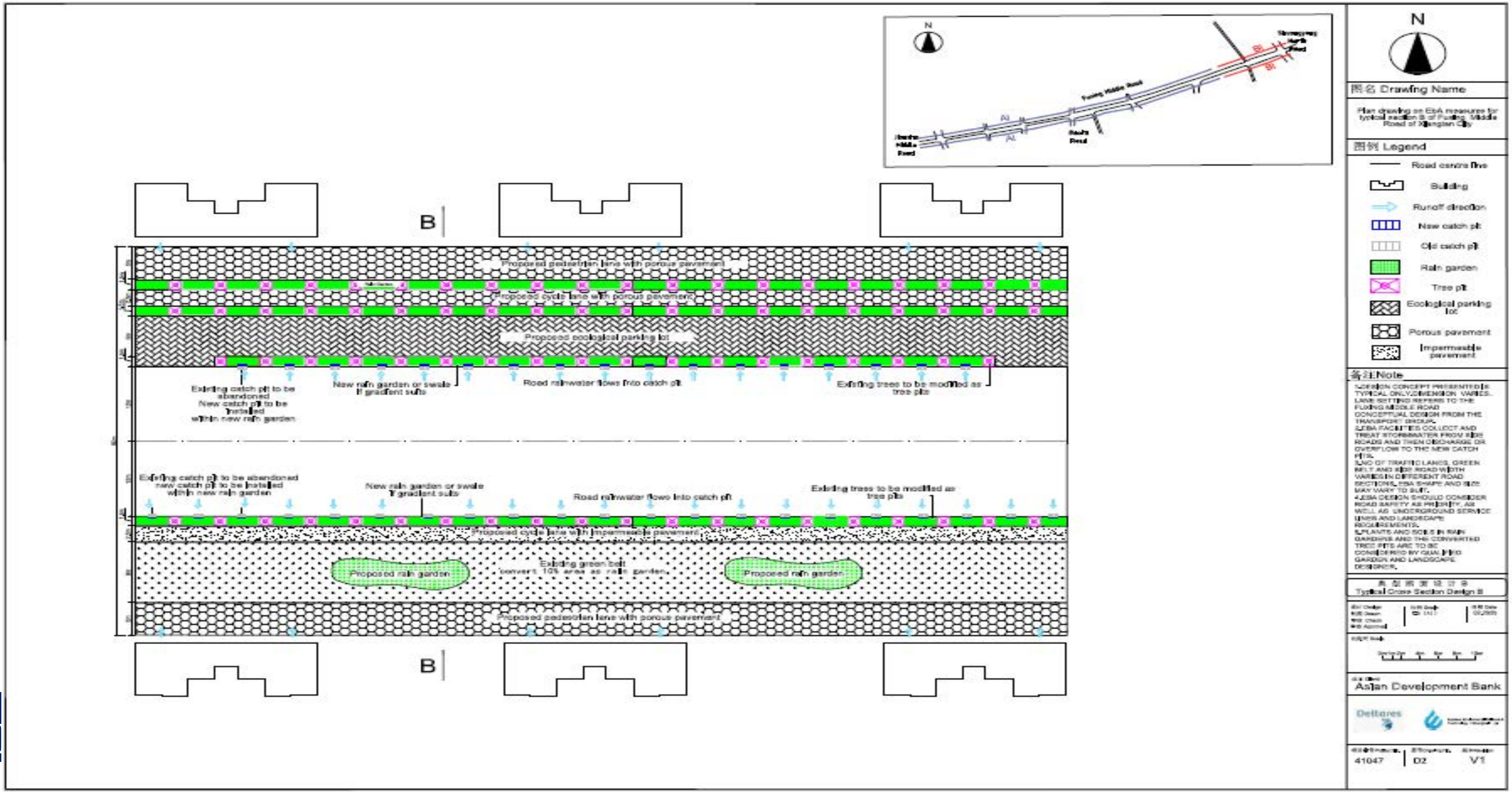
Training sessions and design workshop

Conceptual design Fuxing Middle Road



Indicative cost estimate CMH design

Similar analysis was also made for Fuxing Middle Road and Baota Road adaptation project

3.1. Certified Green building demonstration with resilient rain garden/EbA facilities design (new Xiangtan No.1 Hospital) 经过认证的绿色建筑示范，具有适应性的雨水花园/ 生态适应设施（湘潭市新中医院）

	数量 (Amout)	单位 (unit)	单价 Unit Price（RMB 元）	费用（RMB，万元）	Cost (USD,Million)	备注(Note)
3.1.2. Detailed engineering design for green and inclusive building and rain garden/EbA facilities 绿色、被动式建筑和雨水花园/ EbA设施的详细工程设计						
（1）Detailed engineering design for eco-system based adaptation (EbA) measures专项设计费				50.00	0.08	包括设计和现场指导
3.1.3 .Civil works土建工程						
（1）raingarden雨水花园	2610	m2	800	208.80	0.32	
（2）permeable pavement透水铺装	3150	m2	200	63.00	0.10	
（3）urban wetland城市湿地	3650	m2	600	219.00	0.33	
（4）green area草地	8225	m2	50	41.13	0.06	
土建合计total cost for civil works				531.93	0.81	
3.1.4. Equipment/goods设备/货物						
（1）Sentinel catchpits环保型雨水口	6	个	5000	3.00	0.00	
（2）newly-built catchpits新建雨水篦	20	个	2000	4.00	0.01	
设备合计total cost for equipments				7.00	0.01	
总计 Total Cost				588.93	0.89	

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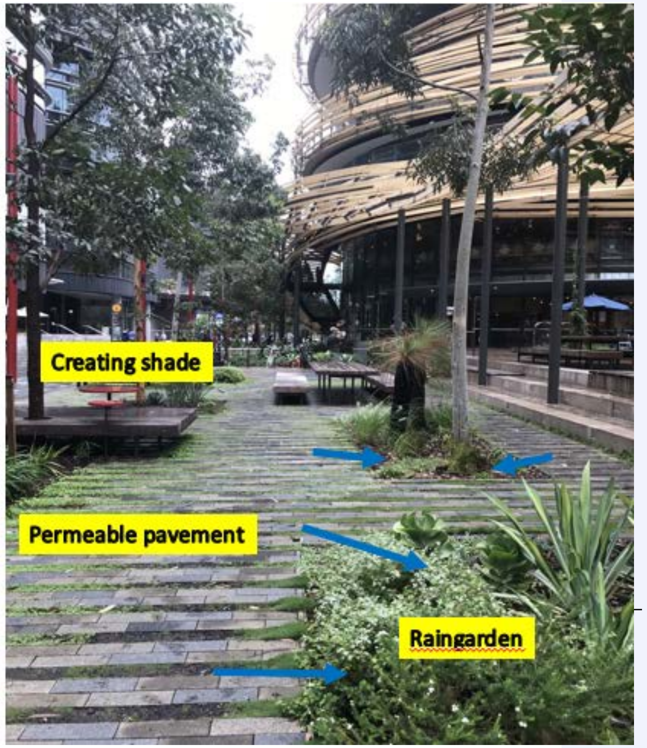
Applicability of EbA measures in the low carbon communities

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	✓	✓	✓	✓	

Examples of typical EbA measures (Sydney, Australia)



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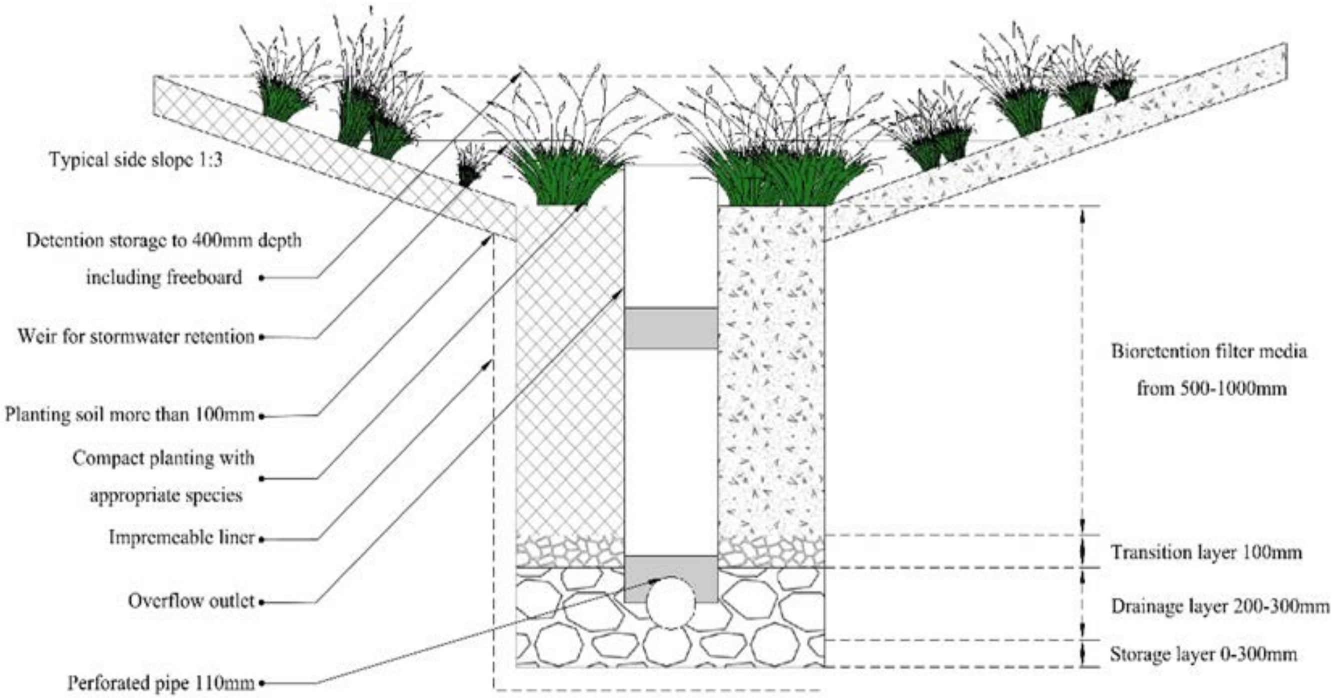
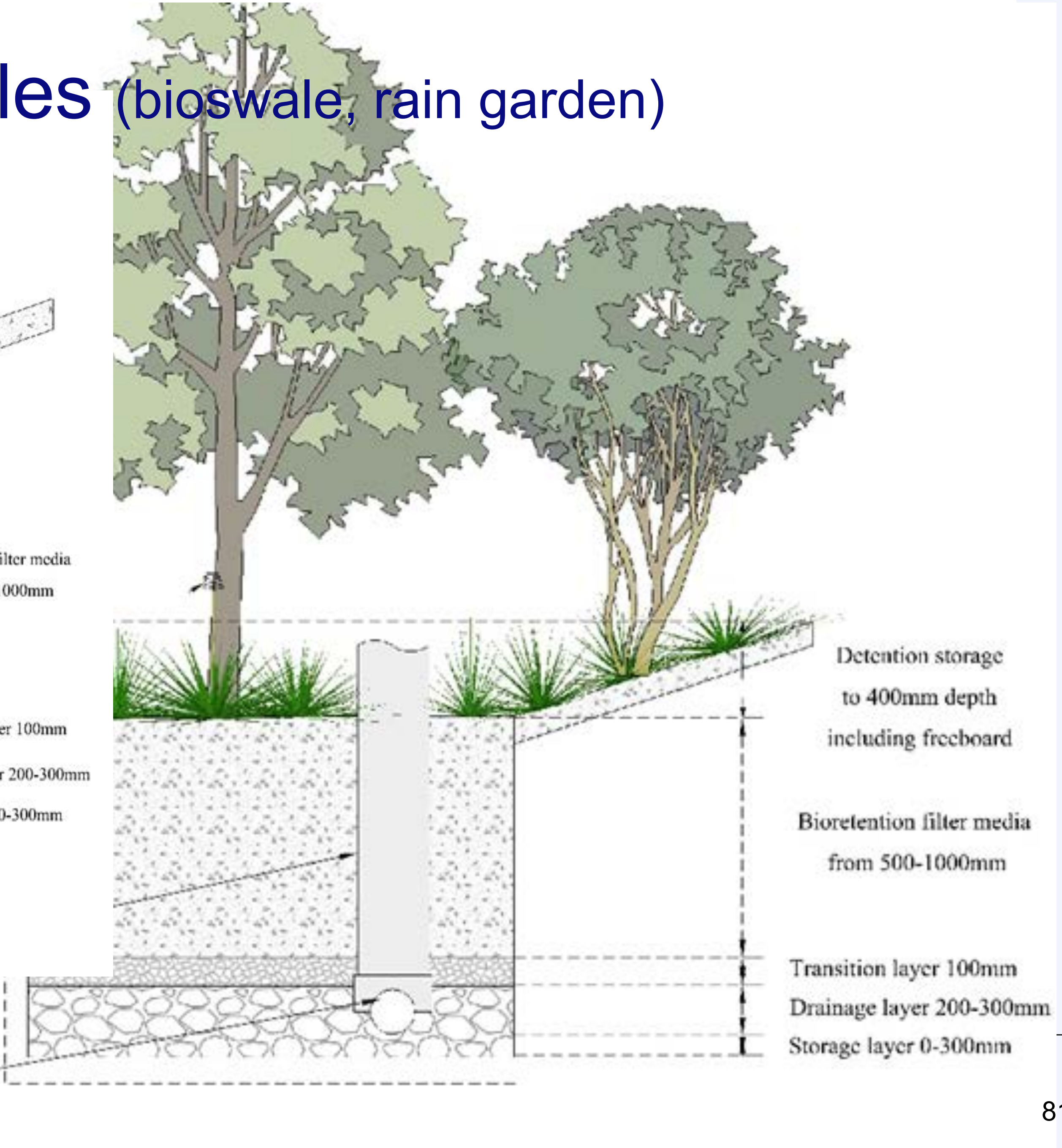
Design components examples (bioswale, rain garden)





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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

6. Use of the CRCTool in the planning process

6. Steps to take to use the CRC Tool

- The CRCTool workshop setup
- More information
- Training exercises with the CRCTool

Adaptation planning process

Initiative phase

research and analysis
program development

Design phase

conceptual design
preliminary design
site plan
implementation plan
construction

The CRCTool workshop setup

Workshop agenda

0. Define the project area, collect data on land use, land level, drainage system, soil, subsurface, etc.

1. **Discuss current challenges,** especially exposure to flooding, heat and drought
2. Make inventory of potential **vulnerable objects, networks, people** in the project area
3. Define **adaptation targets**
   - When is the area climate proof?
   - Required detention (sponge) capacity
4. **Short-list** potential adaptation measures (using hard-copy handout of adaptation measures list)
   - Dialogue on property of measures, geometry, effects and effectivenes, costs, benefits, co-benefits
5. **Plan adaptation measures,** using the Toolbox
   - Discuss which measures can be implemented where and why. See how effective this is. Study alternatives
   - **Save results** to be able to compare alternative solutions later on.
6. **Compare** alternative plans.
   - Who recieves the benefits?
   - Who carries the costs?

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CRCTool Training Exercises

- First group brainstorm
  - Promising locations;
  - Specific challenges;
  - Vulnerable objects
  - Adaptation targets
- Then work in teams to practise
  - Set-up the CRCTool for use
  - Go through adaptation measures list to evaluate suitability of measures for this location / area / problem
  - Start exploring application of various measures
- Present initial outcomes and discuss

More information

- **https://publicwiki.deltares.nl/display/AST/AST2.0+Documentation**
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- Van de Ven FHM , RPH Snep, S Koole, RJ Brolsma, R van der Brugge, J Spijker, T Vergroesen (2016) Adaptation Planning Support Toolbox: Measurable performance information based tools for co-creation of resilient, ecosystem-based urban plans with urban designers, decision-makers and stakeholders, Environmental Science & Policy, Volume 66, 2016, Pages 427-436, https://doi.org/10.1016/j.envsci.2016.06.010
- McEvoy S, FHM van de Ven, MW Blind, JH Slinger (2018) Planning support tools and their effects in participatory urban adaptation workshops, Journal of Environmental Management, Volume 207, 1 February 2018, Pages 319-333, https://doi.org/10.1016/j.jenvman.2017.10.041
- Mc Evoy S (2019) Planning support tools in urban adaptation practice. PhD thesis, TU Delft, https://doi.org/10.4233/uuid:48b7649c-5062-4c97-bba7-970fc92d7bbf or https://repository.tudelft.nl/islandora/object/uuid%3A48b7649c-5062-4c97-bba7-970fc92d7bbf
- https://development.asia/explainer/how-ecosystem-based-solutions-can-develop-climate-resilient-cities

Thank you for your attention

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