ClimAct2Adapt conference

ACTING TOGETHER FOR CLIMATE RESILIENCE

NBS solutions

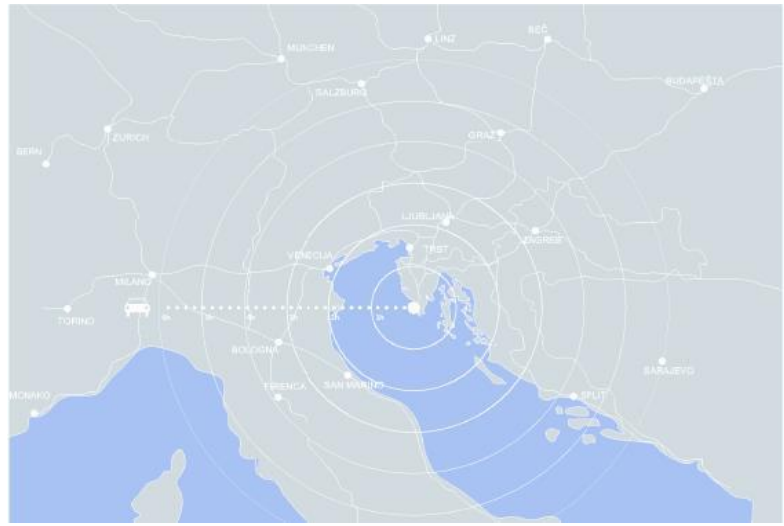
Examples of the city of Pula

Karmela Maren
Antonija Babić
City of Pula, Croatia

Esztergom, Hungary, 8-9 October 2025

CITY OF PULA

- ✓ situated in the south of the Istrian peninsula
- ✓ the largest town of the Region of Istria
- ✓ present area of the town is 5 165 ha:
  land: 4 150 ha
  sea: 1 015 ha



CITY OF PULA

- ✓ 3000 years old city
- ✓ 52200 inhabitants (census in 2021)

Adriatic Adaptation Award – A3, promoted by the CREATE project

A3 Award aimed to identify and promote successful climate adaptation initiatives, inspiring other coastal regions to implement sustainable solutions

A3 Award Goals:

1. Recognize successful climate adaptation initiatives that have been implemented or are in progress.
2. Encourage knowledge sharing and inspire stakeholders across the Adriatic region to adopt sustainable practices.

The A3 competition sought to highlight practical and scalable nature-based solutions, foster collaboration, and accelerate environmental transitions in coastal areas.

RECOGNITION & IMPACT:

- **Awarded initiatives are featured in the Adaptation Handbook, a key publication of the CREATE project**

- **Winners presented their initiatives at the CREATE Conference in Venice (June 2023)**

Interreg Italy - Croatia CREATE EUROPEAN UNION

Rain gardens and other NBS systems to reduce pluvial floods

BRIEF DESCRIPTION AND CHALLENGES

The city of Pula is characterized by a low amount of annual precipitation and problems with the drainage of stormwater. During the last years, it was documented that rain lasting for 20 minutes is able to cause floods inconvenience; unfortunately, the application of usual drainage systems is not sufficient for the present situation and also for the predicted ones. Besides, the development of adequate infrastructural systems for the reception and drainage of rainwater is proceeding slower compared to the expansion of the city; these constraints lead to the impossibility to manage correctly the amount of water and the incapacity to correctly retain and purify it. To face and overcome these problems, Natura Based Solutions (NBSs) have been planned and applied, permitting to undertake a process of adaption to climate change. The works implemented permitted the reduction of the flood zones in the city, starting from Vladimira Nazor Street, furthermore, another drainage system has been introduced in another part of the city.

CONTACTS

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Green infrastructure, spatial planning, GIS

Adaptation measures applied

A NBS is found as a suitable system in the most heavily loaded central part of the city, becoming an ideal solution in

https://green.hr/pula-je-grad-spuzva-s-vise-od-10-kisnih-vrtova/

Početak | SWING Paperless Office | fondovieu portal | EU fondovi Hrvatska –... | Google Prevoditelj | Europski strukturni i in... | ESI vijesti | NEB - Nacionalna plat... | Ministarstvo znanosti i...

greenhr GREENLIVING BUSINESS GREENSTYLE 5 DO 12 DIY GREENCAJT

GREENLIVING

Pula je grad spužva: Kružni tok nije običan, on upija kišu

SANJA MATASIĆ

23.06.2023.

ADRIATIC ADAPTATION AWARD

Create
14. srpnja 2023. ·

A3 - Adriatiac Adaptation Award, nagrada našeg projekta je dodijeljena Puli za način na koji je dizajnirala i implementirala svoje kišne vrtove, odnosno infiltracijske sustave, koji pomoću prirodnih struktura štite od poplava u slučaju obilnih kiša i istovremeno rasterećuju mješovite sustave sanitarne odvodnje te prihranjuju podzemne vode.
Detaljnije pročitajte ispod, klik na link👇

#interreg #createclusterproject #climatechange #adaptation #FromSharedResources #ToJointSolution #cmcc

INDEXHR

Pula postala primjer prilagodbe klimatskim promjenama

Index Native
09:00, 13. srpnja 2023.

Foto: Starum; Natalija Dunić, Pierluigi Giorgi

NAJNOVIJE NAJČITANIJE VE

6 min VIDEO U Valenciji strahuju o poplava. Na snazi crveno upozorenje, nema nastave

16 min Trump opet napao Zelensko Britanski premijer: Na raskri

16 min Reuters: Bijela kuća traži pla moguće ublažavanje sankci

33 min Pet europskih vojnih sila pot podršku Ukrajini

45 min Trump objavio veliko ulagan moglo razljutiti Kinu

PRIKAŽI JOŠ VIJESTI

PULA je 14. lipnja dobila nagradu Adriatic Adaptation Award za kišne vrtove u sklopu Interreg projekta prilagodbe klimatskim promjenama CREATE.

Nagrada je Puli dodijeljena za način na koji je dizajnirala i implementirala svoje kišne vrtove, odnosno infiltracijske sustave, koji pomoću prirodnih struktura štite od poplava u slučaju obilnih kiša i istovremeno rasterećuju mješovite sustave sanitarne odvodnje te prihranjuju podzemne vode.

Nature-based solutions for a resilient city

How we started?

2011.

Concept of stormwater drainage management of the City of Pula

Integrated in urban plan

Implemented pilot project: Rain garden in Nazorova street

- Over the years, the problem of **flooding** of certain areas in the city of Pula-Pola was so intensified that it began to block further urban development of the city
- In **2011**., the concept of stormwater drainage management of the City of Pula-Pola was developed, which was integrated into the GUP of the City of Pula-Pola.
- In 2011, **the first pilot project** of the NBS system was carried out in Nazorova street, and it was the beginning of **solving the problem of flooding in the city**

Rain garden in Nazorova street

Facts:

- Today, **rain gardens** are well established and implemented in the stormwater drainage system of the city of Pula, and in addition to rain gardens, other **SuDs*** elements for flood protection have been implemented at about 10 locations in the city of Pula-Pola: **wet lagoons, lagoons with extended retention, infiltration fields and ditches, and underground and above-ground retentions**

- Rain gardens have been **part of the green infrastructure** of the city of Pula-Pola for more than a decade and are deeply embedded in strategic and spatial planning and planning the future of the city of Pula.

- The development of green infrastructure and the integration of NBS solutions are the backbone of the **strategy of the green urban renewal of the city of Pula until 2030.**, which was adopted in 2024.

** Sustainable Drainage Systems*

King Tomislav Square
All stormwater drainage is planned through rain gardens

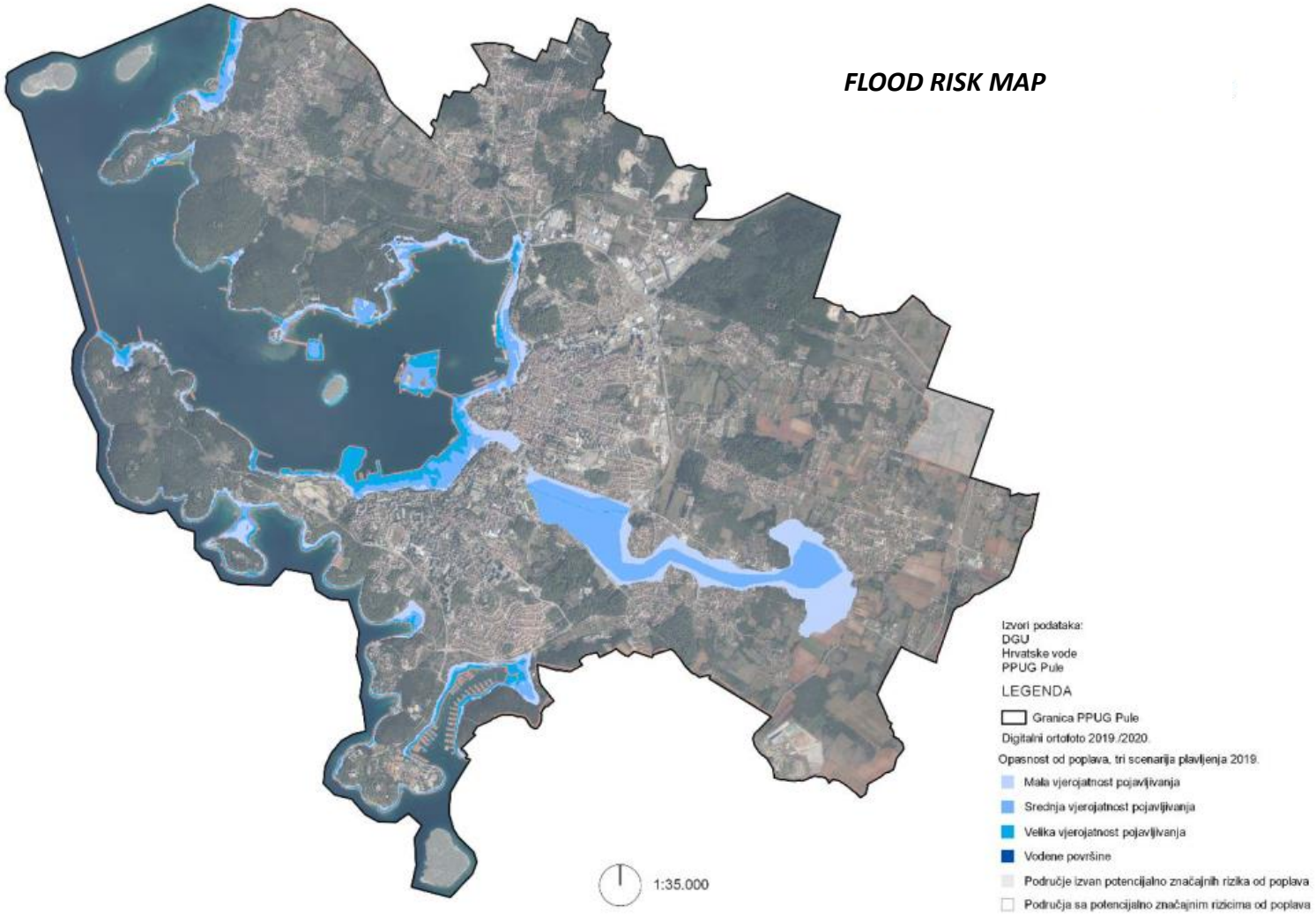
Rounabout on state road D66
includes the central roundabout, with all the surrounding "catchment" roads on the state road D66
Some of the systems used:
- rain gardens
- wet lagoons and lagoons with extended retention
- infiltration ditches
- "green swales" – rain garden with grass cover

Strategy of the green urban renewal of the city of Pula until 2030.

City of open, green and sustainable areas with rich cultural heritage based on the principles of green infrastructure.

- ✓ refers to the achievement of green infrastructure development goals,
- ✓ integration of NBS solutions,
- ✓ improvement of circular management of space and buildings,
- ✓ achievement of energy efficiency goals,
- ✓ adaptation to climate change and strengthening of resistance to risks.

Strategy of the green urban renewal of the city of Pula until 2030.



The NBS (Nature-Based Solutions) *approach to drainage means* ***mimicking natural drainage as much as possible using more economically viable solutions compared to the conventional system, with minimal environmental impact within the watershed.*** *This is achieved through collection,* ***slowing down, retention, infiltration, evapotranspiration, and natural water purification before releasing it into the environment****.*

This is in contrast to conventional drainage systems, where water is quickly removed from the watershed and point-source treated before being discharged into the final recipient. Solutions provided through the NBS approach should be such that the proposed system is easy to manage, requires little or no energy (except from environmental sources like solar energy, etc.), and is ***ecologically and aesthetically not only acceptable but also attractive****.*

The NBS approach to design and planning in both urban and rural areas is the basis for addressing the existing and growing problems imposed by conventional stormwater solutions.

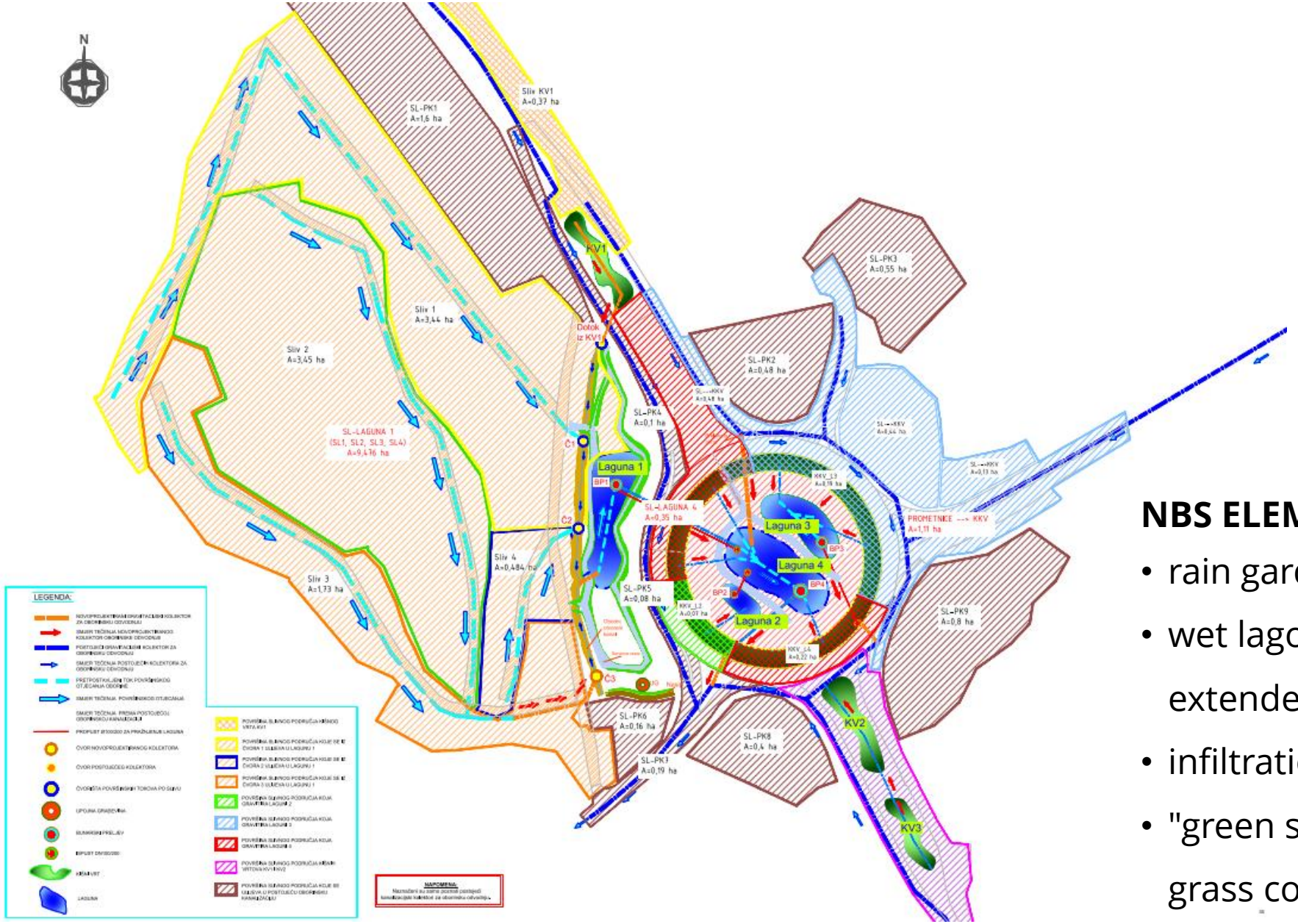
The NBS approach to stormwater drainage highlights the ***positive economic, aesthetic, and ecological impacts at the ecosystem level****, in contrast to the one-disciplinary approach of conventional drainage solutions.*

In EU, USA, and AU countries, the NBS approach to drainage is also known as SuDS (Sustainable Drainage System), WSUD (Water Sensitive Urban Design), LID (Low Impact Development), BMP (Best Management Practice), and in our country, there is also the term NPU (Best Management Practices), NWRM, etc.

Example 1. Rain garden in Nazorova street (implementation in 2011.)

The function of "rain gardens" is to absorb part of the rainwater. In this way, the water would calm down in its origin and slowly direct it towards main city sawage canal Pragrande. With this project, the problem of the well-known flooding od city center during every heavy rain in Pula, and the relief of the Pragrande sewage canal, is being solved.

Example 2. Roundabout on road D66

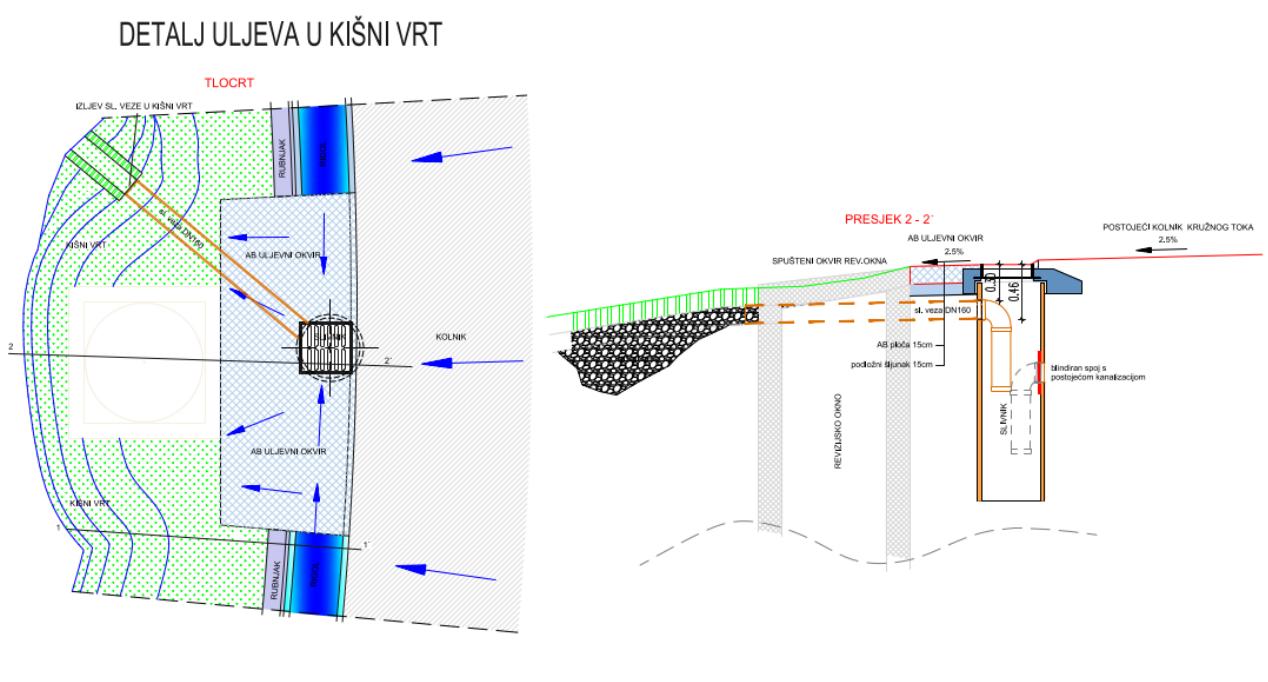


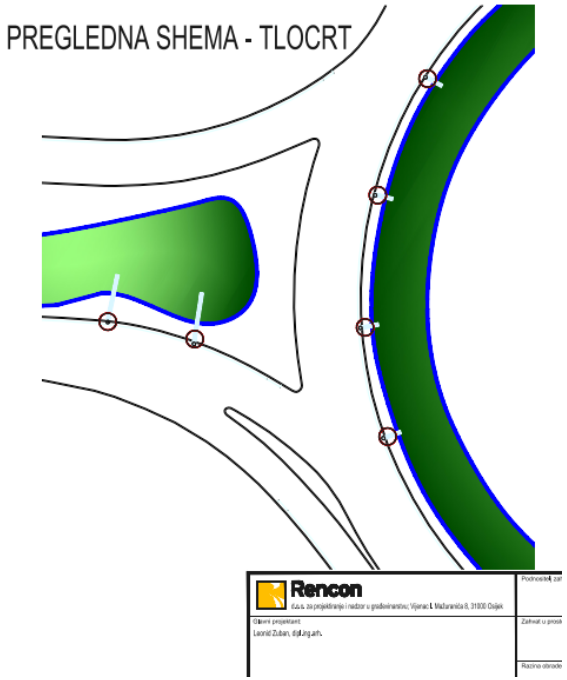
NBS ELEMENTS:

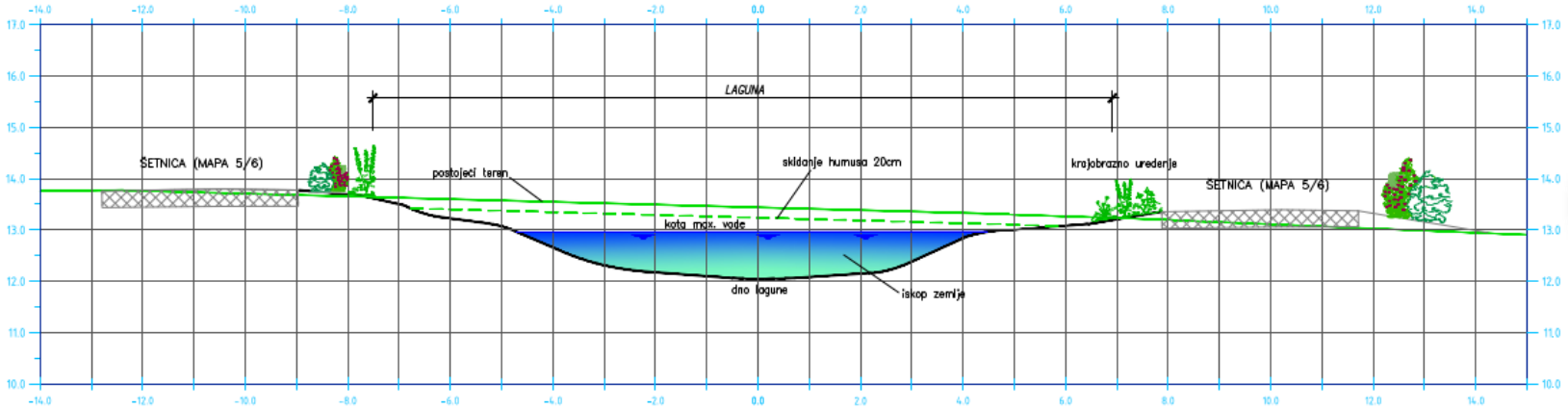
- rain gardens
- wet lagoons and lagoons with extended retention
- infiltration ditches
- "green swales" – rain garden with grass cover

Example 2. Roundabout on road D66 (implementation in 2017.)

Example 2. Roundabout on road D66







Example 2. Roundabout on road D66

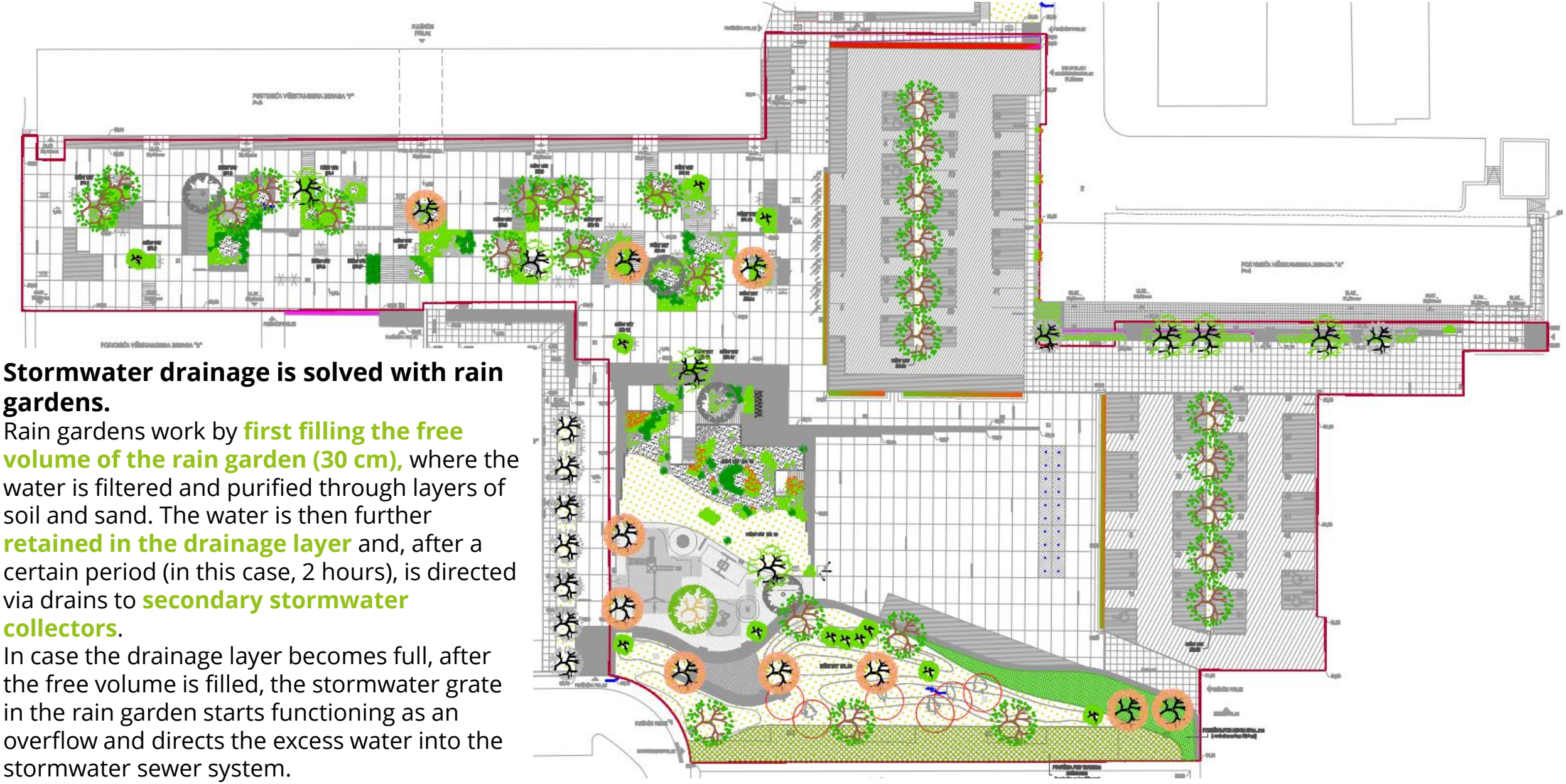
Example 2. Roundabout on road D66

Example 3. King Tomislav square

URBAN FLOOD PROBLEMS BEFORE IMPLEMENTATION

Climate change is causing an **increase in the frequency and intensity of extreme weather events**, including **heavy rainfall**, which further exacerbates the problem of **urban flooding**.
Urban flooding is becoming a serious issue in many large cities, so it is essential to take measures to reduce and manage it.

Example 3. King Tomislav square

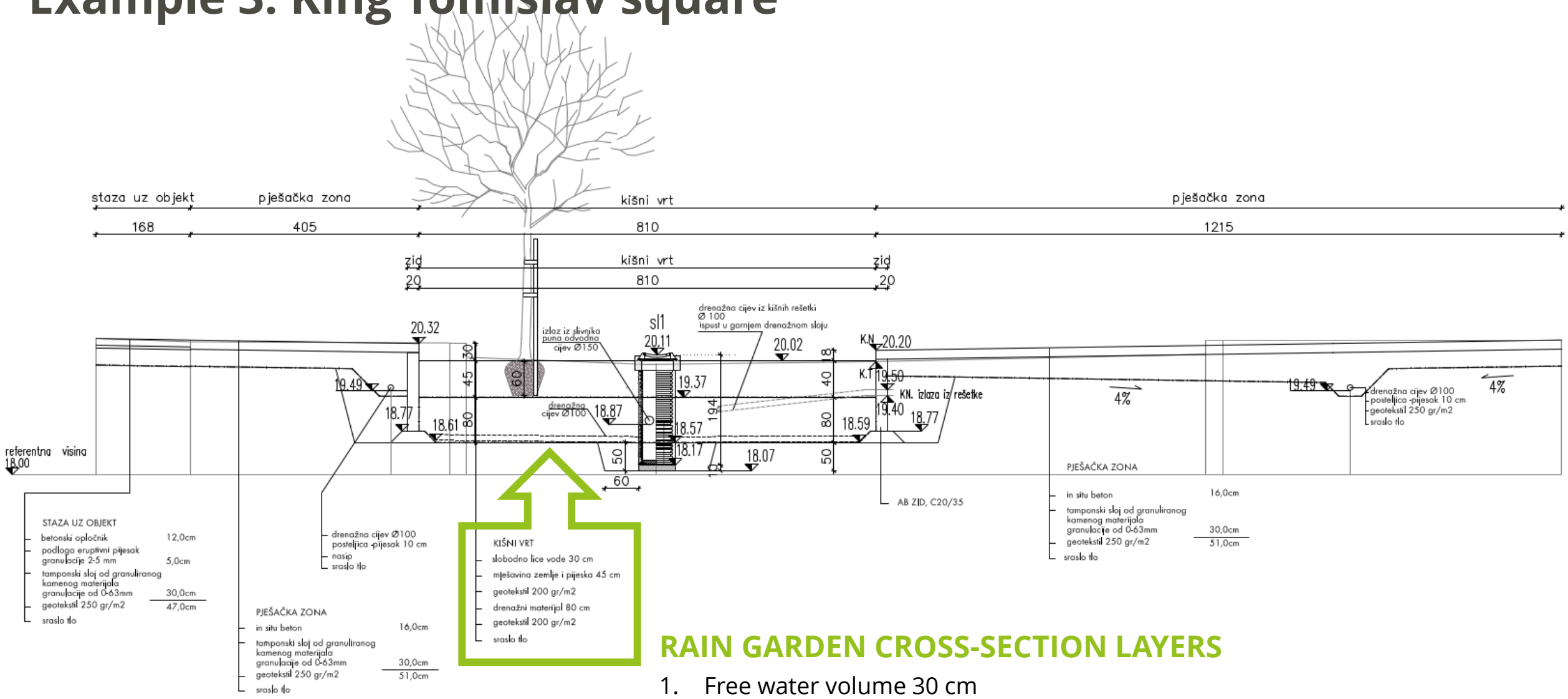


Stormwater drainage is solved with rain gardens.

Rain gardens work by **first filling the free volume of the rain garden (30 cm),** where the water is filtered and purified through layers of soil and sand. The water is then further **retained in the drainage layer** and, after a certain period (in this case, 2 hours), is directed via drains to **secondary stormwater collectors**.

In case the drainage layer becomes full, after the free volume is filled, the stormwater grate in the rain garden starts functioning as an overflow and directs the excess water into the stormwater sewer system.

Example 3. King Tomislav square



RAIN GARDEN CROSS-SECTION LAYERS

1. Free water volume 30 cm
2. Soil material (mix of soil and sand) with planting material 45 cm
3. Geotextile for filtration 250 g/m²
4. Drainage layers (gravel grading 40-80 mm) 80 cm

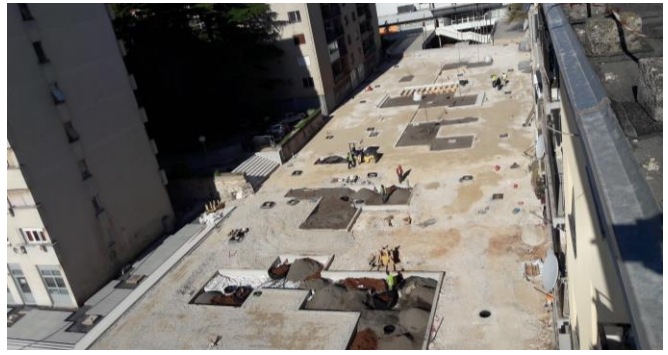
Example 3. King Tomislav sqaere (implementation in 2017.)










Example 3. King Tomislav square

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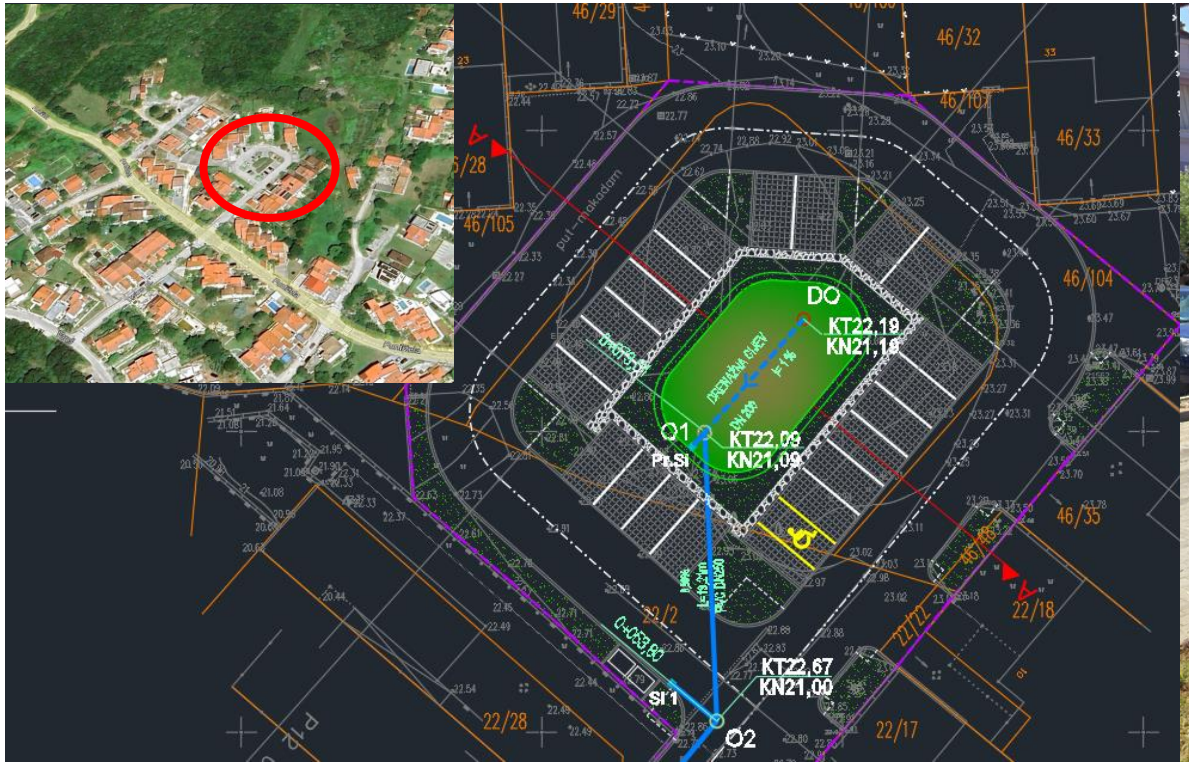
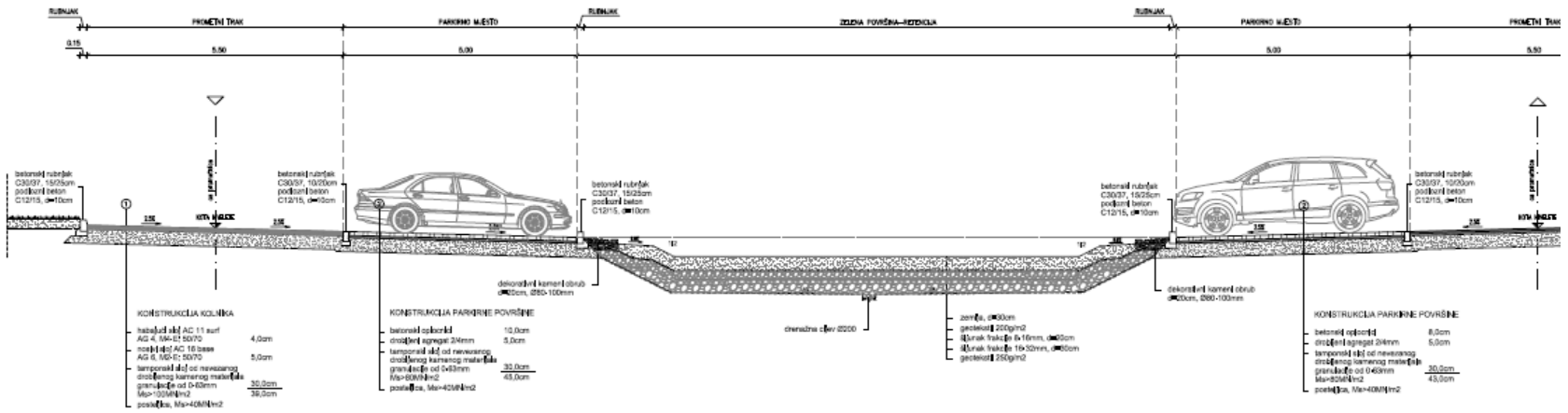
Example 4. Neighborhood NBS Solution



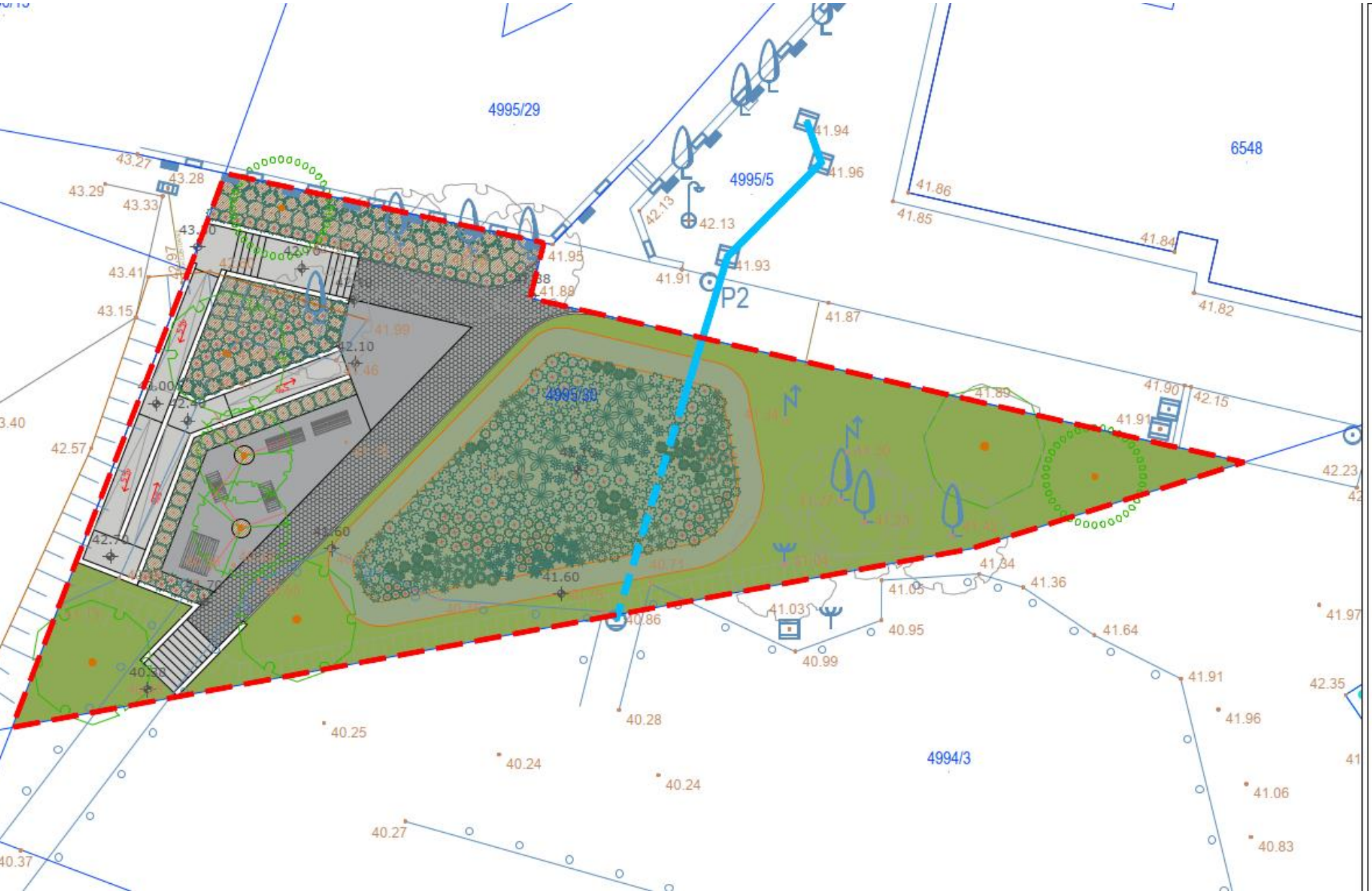


Example of Local, Neighborhood NBS
(Štinjan, Trsine Street)

An example of a **rain garden construction on a dead-end street** in a residential neighborhood of family houses. At the end of the dead-end street, a circular road was formed with public parking spaces arranged along it. A rain garden is placed in the center and all public surfaces are sloped toward the rain garden, allowing for surface collection of stormwater and filtering through the layers of the rain garden.

Various small scale examples in the city

Various small scale examples in the city



LEGENDA

- Granica obuhvata; k.č. 4995/30, k.o. Pula
- Travnjak
- Retencija
- Ostale zelene površine
- Pokos terena
- Opločenje - tvrdi materijal
- Postojeća/izvedena oborinska odvodnja
- Postojeća/izvedena oborinska odvodnja - dio trase koji se ukida

Urbana oprema

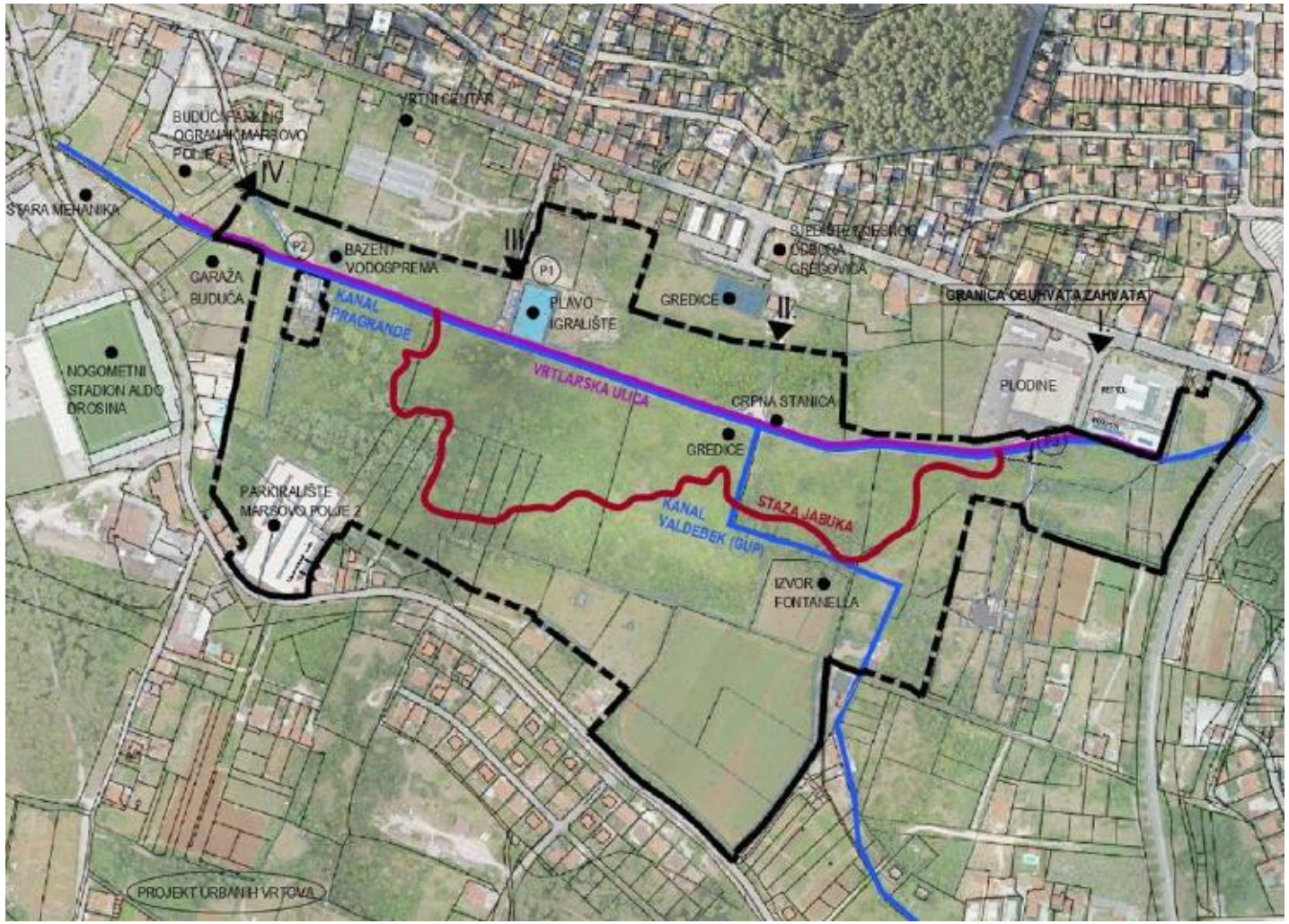
- Klupa s naslonom
- Stol s klupama i motivom šaha
- Piknik stol

Biljni materijal

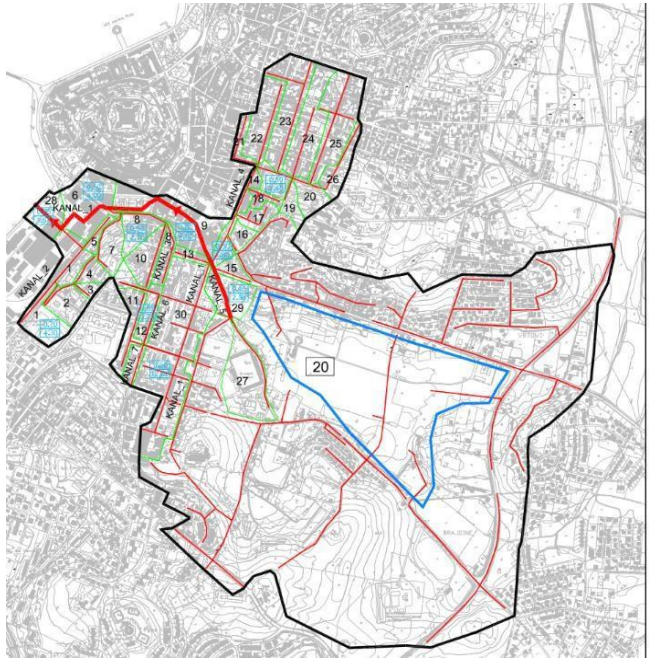
- Postojeće stablašice
- Planirane stablašice
- Ukrasni grmovi i trajnice
- Trajnice i ukrasne trave planirane u sklopu retencije

Pragrande

A landscape-architectural urban planning competition is in preparation. One of the two **main drainage canals in Pula**, which makes the drainage theme one of the key features. The area is a flood zone due to its low elevation, which is one of the main reasons why it has been preserved as a valuable green oasis.



Eco-remediation refers to the process of **restoring or improving the health of an ecosystem** that has been degraded or contaminated, typically through natural methods or the use of environmentally friendly techniques. This process often involves the use of plants, microorganisms, or other natural elements to restore soil, water, and air quality, while promoting biodiversity and reducing environmental pollution.



SREDIŠNJI GRADSKI SLIV
PRAGRANDE, SLIV 20

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Thank you for your attention...

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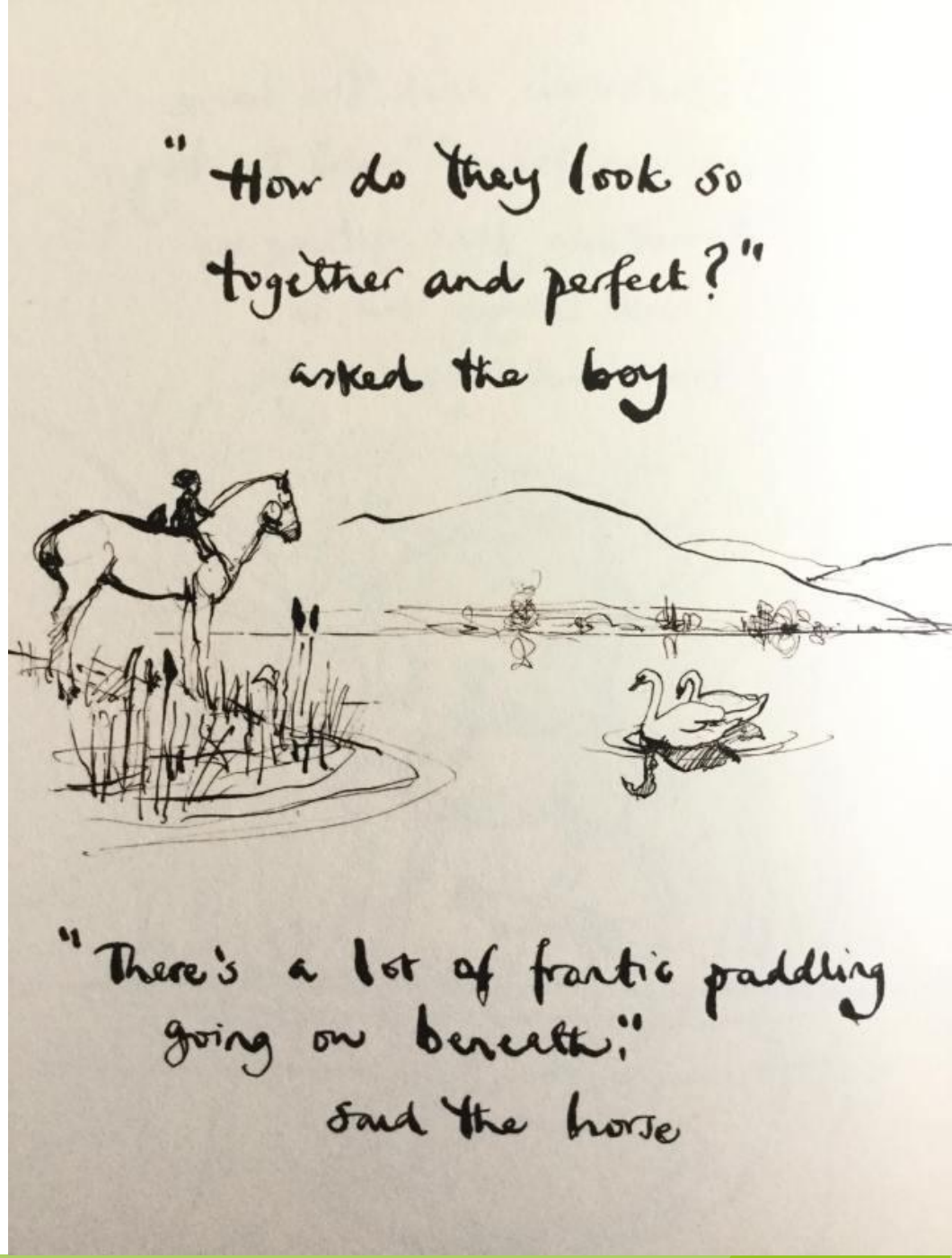

"The Boy, the Mole, the Fox and the Horse" Charlie Mackesy