CLOSURE WEBINAR OF THE PROJECT TITLED
ADAPTATION TO CLIMATE CHANGE: PLANNING AND MODELLING TASKS IN A VULNERABLE CITY TO SUPPORT THE PREVENTION OF DAMAGE CAUSED BY CLOUDBURST

7th September, 2022, MS Teams

WESTERN BALKANS GREEN CENTER

MEGÉRTI

The project was supported by the Western Balkans Green Center Nonprofit Llc.

RESULTS ON THE CLIMATE EXPOSURE STUDY OF THE CITY

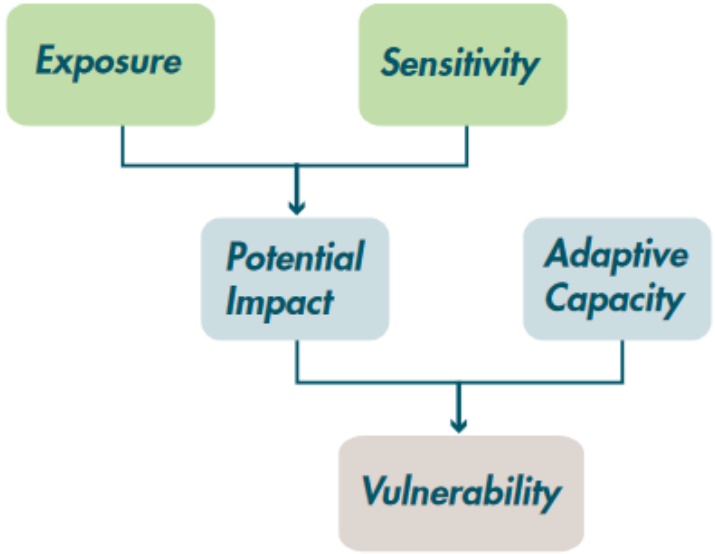
CLIMATE EXPOSURE OF VINICA

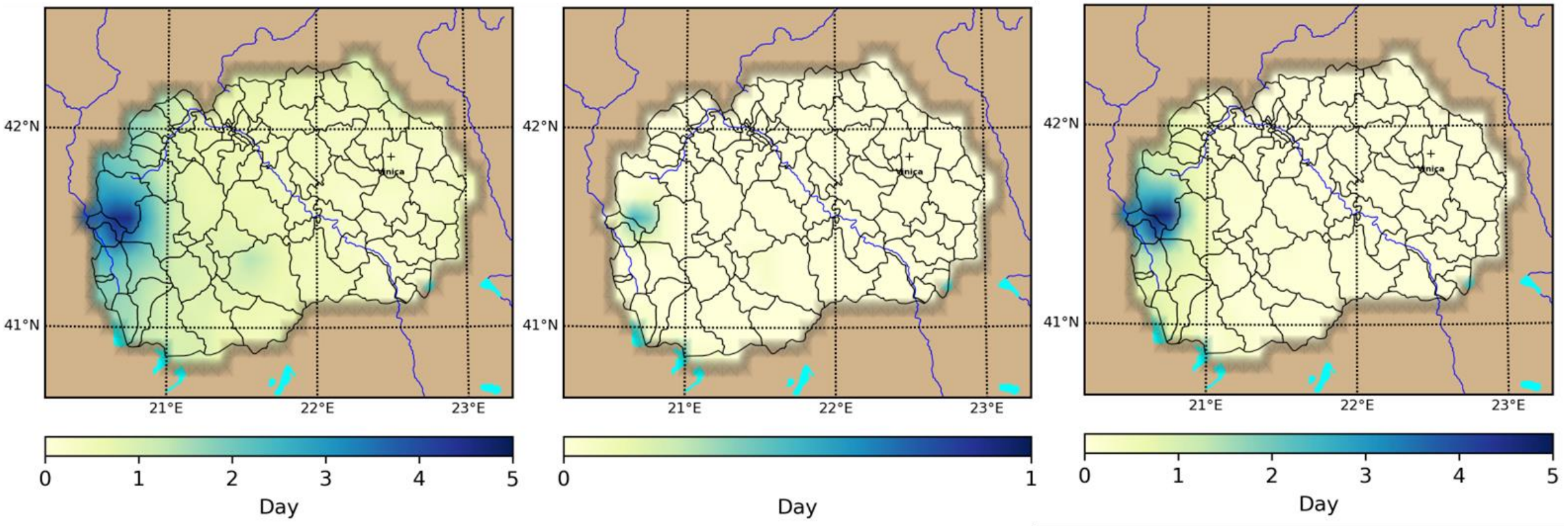
Main risk: Intense precpitation events or cloudbursts

Why: These events may result in flash floods and/or landslides which could cause not only huge economic loss in the form of damage to houses, industries, public utilities but human injuries and loss

Complex solution: adaptation of the infrastructure system, buildings, early-warning systems, strong social net, prepared health-system etc.

It's complicated to develop all the systems at once so it is important to find the most vulnerable elements →





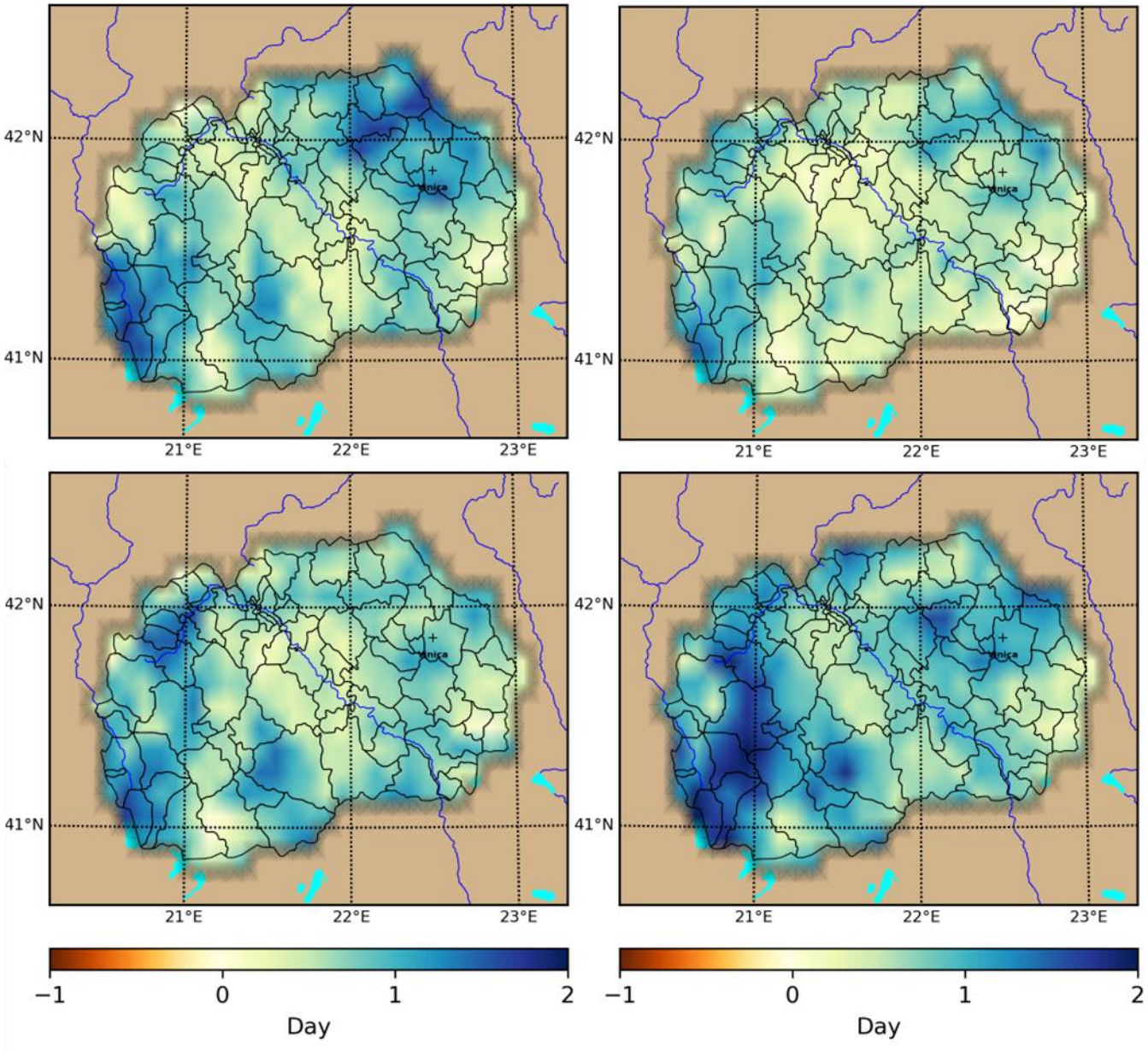
CLIMATE EXPOSURE OF VINICA

The number of days with precipitation amount > 20 mm (RR20, left), > 40 mm (RR40, middle) and number of multi-day precipitation events with precipitation > 60 mm in 5 days (RR5D60, right) during the reference period (1986–2005) based on the E-OBS data. Note that the scale is different for RR40. Source: own calculation

CLIMATE EXPOSURE OF VINICA

Changes in number of days with precipitation amount > 20 mm (RR20) according to the CNRM-CM5-RCA4 model pair. Top maps are projections for the middle of the century (2031–2050) and bottom ones for the end of the century (2081–2100). Left maps are based on the RCP4.5 and the right ones on the RPC8.5 scenario.

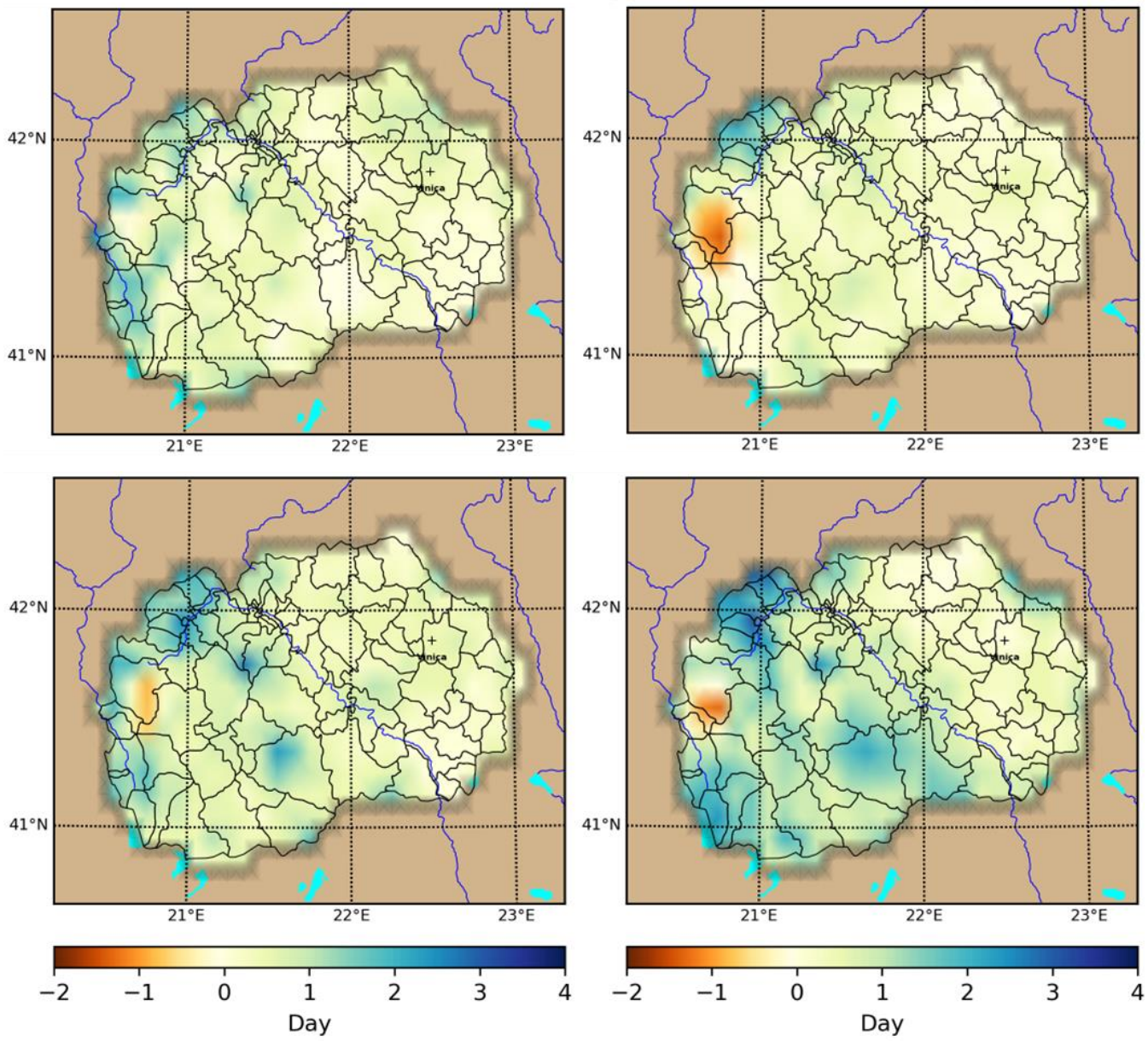
Source: own calculation



CLIMATE EXPOSURE OF VINICA

Changes in number of multiday precipitation events with precipitation > 60 mm in 5 days (RR5D60) according to the CNRM-CM5-RCA4 model pair. Top maps are projections for the middle of the century (2031–2050) and bottom ones for the end of the century (2081–2100). Left maps are based on the RCP4.5 and the right ones on the RPC8.5 scenario.

Source: own calculation





VULNERABLE ELECTRIC INFRASTRUCTURE AND DRAINAGE SYSTEM PIECES IN VINICA

RECOMMENDED FUTURE STEPS

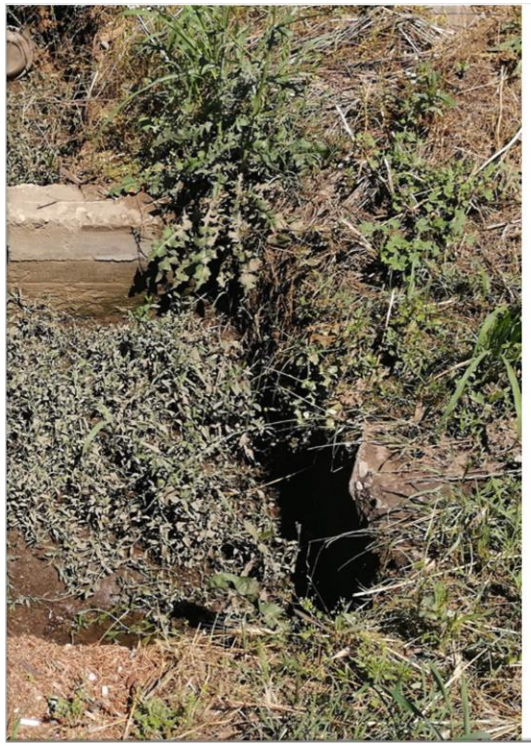
- Observed and projected climate change using local station data
- Climate exposure study based on multiple climate change projection → to indicate the possible range of extreme events

→ **The better quality of the dataset and the more reliable information could be provided about the expected changes in the climatic indicators of the region which would be important for the most cost-effective adaptation steps**

FINAL GOAL FOR PROPER CLIMATE ADAPTATION STRATEGY PLANNING:

- ✓ Implementing of a complex climate vulnerability study → more fund is needed to a project on such scale

CLOUDBURST ISSUES OF THE CITY AND ADAPTATION OPTIONS



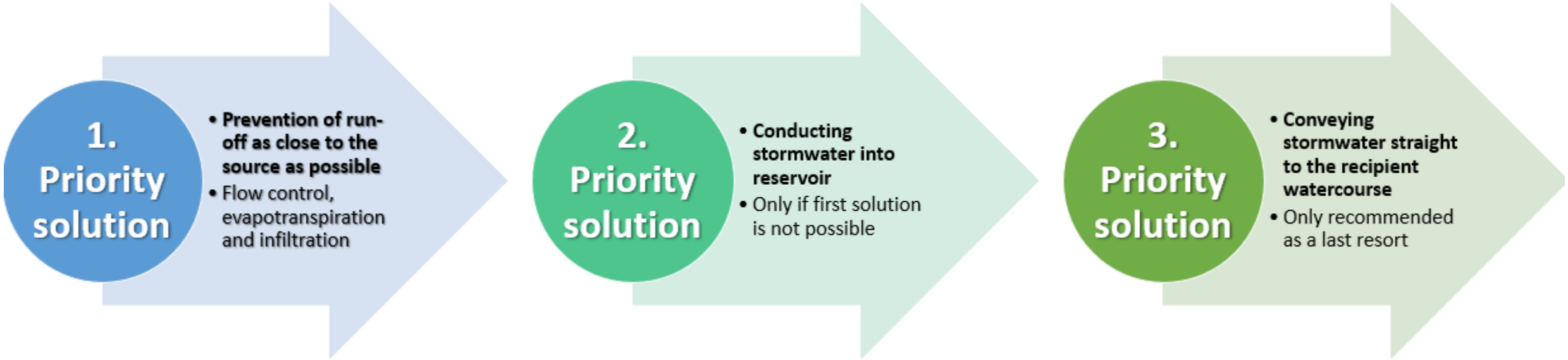
ADAPTATION CAPACITY OF VINICA

- Inadequate drainage infrastructure
- Existing drainage system and riverbeds are not maintained properly
- Lack of early warning system (no information to alert the population)
- No disaster/risk management plan
- **Lack of financial sources in the region (pre-condition of all other factors mentioned)**

STRATEGIC APPROACH

Preparation for flash floods caused by cloudbursts must be integrated into strategic planning at the regional level and urban planning

→ Integrated stormwater management plan:



IMPLEMENTATION

- **Excess water must be expected and calculated into designing drainage system**
- To create the most efficient **technical solution for draining excess water the following must be considered:**
  - water volume of heavy precipitation events
  - flow conditions
  - slope conditions
  - settlement spatial structure and land use
  - financial capacities

→ **Integrated solution - a system suitable for both draining excess water and storing water for droughts!**

POSSIBLE FINANCIAL SOLUTIONS

Involving private sector

- more stakeholder can attract investments

Partnership building throughout North Macedonia

- regional and national relations must strengthen

It is necessary to orientate towards international sources

- United Nations Development Program
- United States Agency for International Development
- West Balkan Green-Centre
- **for the acquisition of financial resources for infrastructure investment only joining the European Union could represent a breakthrough**

IPA FLOODS AND FIRES PROGRAM

Objectives:

to improve the legal and institutional framework related to the ***EU floods directive*** (EUFD),

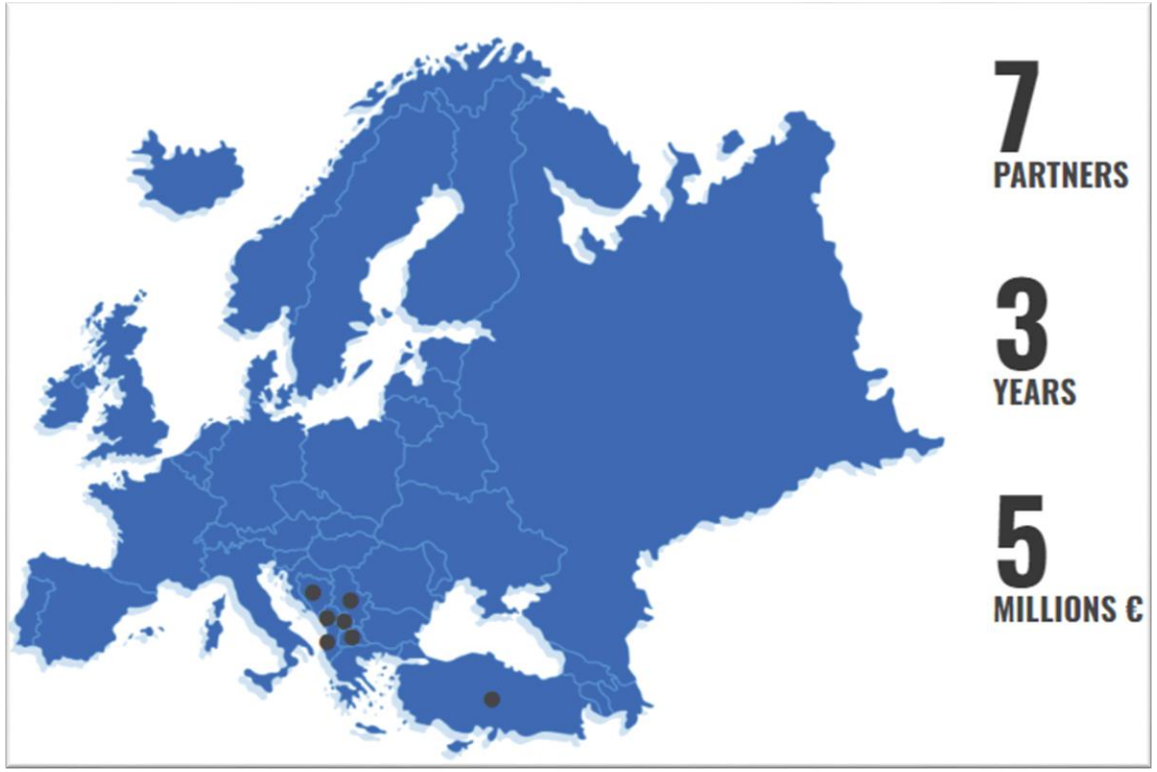
and institutional coordination among all the actors involved in the EUFD implementation, and to improve prevention, preparedness and capacity to respond to forest fires at central

Activities:

workshops, trainings, table-top and field exercises, exchange of experts, procurement of ground forest firefighting equipment and awareness raising campaigns

Financial source: European Union-funded

Albania, Bosnia and Herzegovina, Kosovo, Montenegro, **North Macedonia**, Serbia, and Turkey



IMPROVING RESILIENCE TO FLOODS IN THE POLOG REGION

Objectives:

- to instigate transformational change in managing flood risk in the region

Activities:

- improving knowledge of region's flood risk
- promoting flood risk management planning in line with EU legislation
- strengthening recovery capacity thanks to improved governance
- supporting flood risk-based urban and economic development
- demonstration projects, of flood control infrastructure (repair and construction)
- creation of a flash-flood early warning and public-alert system

Financial source: United Nations Development Program

THANK YOU FOR JOINING US TODAY!

WESTERN BALKANS
GREEN CENTER

The project was supported by the Western Balkans Green Center Nonprofit Llc.

MONITORING OF SEWERS – ISSUES AND PERFORMANCE ANALYZES POTENTIALS

7th September, 2022,

WESTERN BALKANS GREEN CENTER

MEGÉRTI

The project was supported by the Western Balkans Green Center Nonprofit Llc.

MONITORING

RAINFALL MEASUREMENTS

MEASUREMENTS IN THE COLLECTION SYSTEM NETWORK

RAINFALL ISSUES

Reccomended , established for urban hydrology support

Ability to record rainfall events in 1 minute timestep

Aim is to

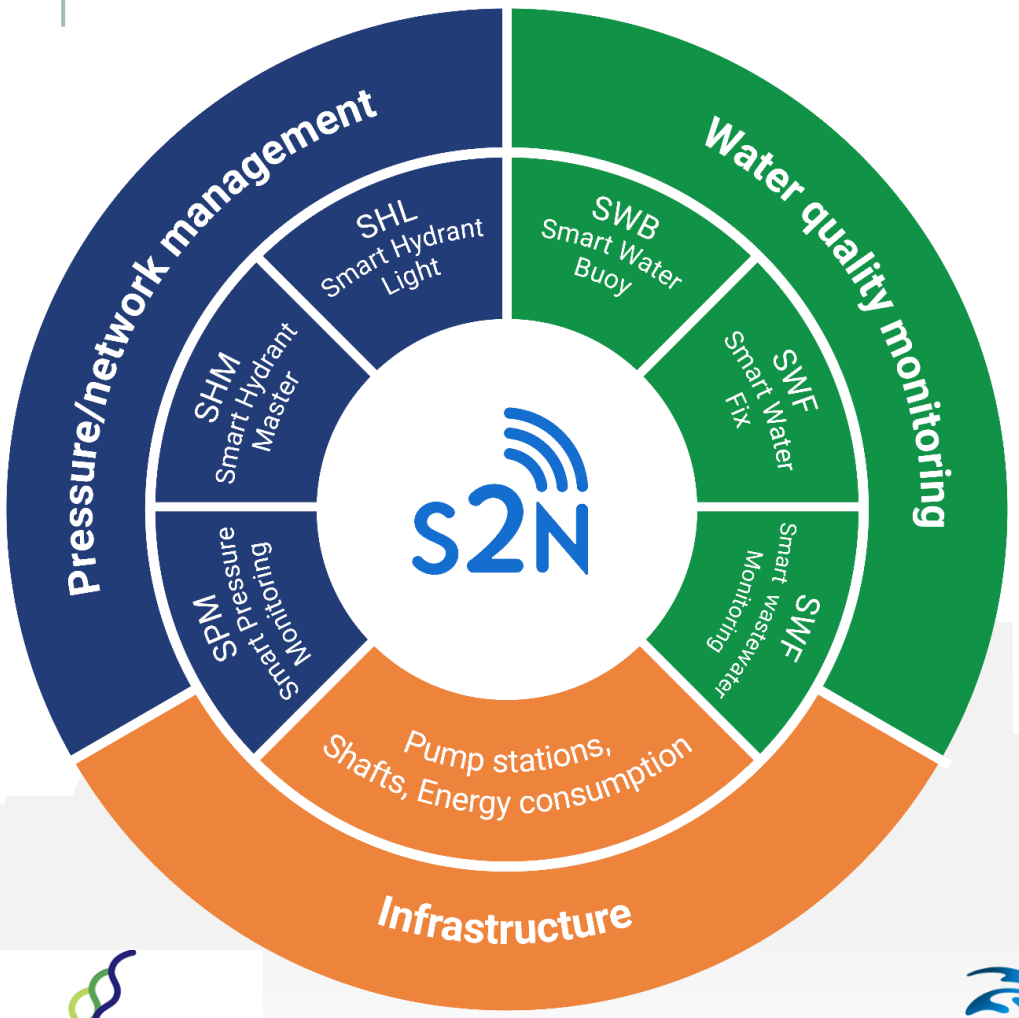
-check system performance (pipe filling – capacity issues; velocity

-Get picture about the infiltration location and amounts

-check new system performance –if works as designed

MONITORING OF COLLECTION SYSTEMS

Possible directions of monitoring



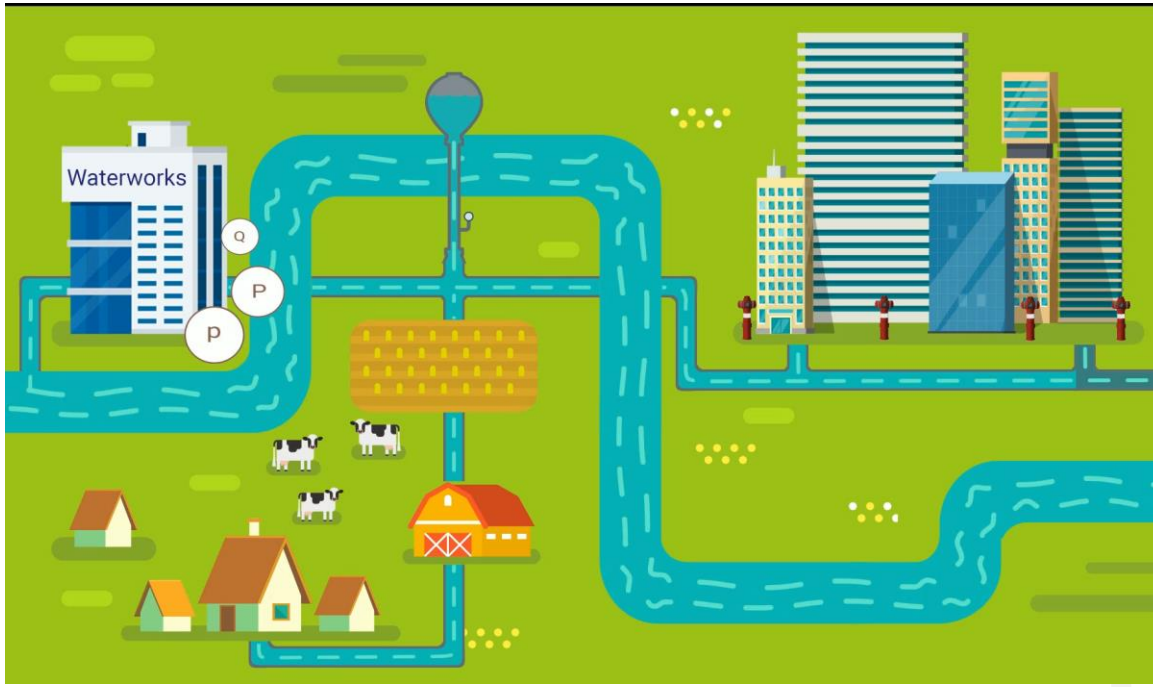
- Measurement and data collection from various location
- Data transfer: Wireless data transmission – LoRaWAN
- Data upload possibility to the server, database storage option
- Reliable operation even on places with poor infrastructure (mimimalization of losing data)
- Database analysis by BI/AI and various algoritm, partnering in data analyzes

waterscope

DHI

Advantages of smart monitoring systems

- ✓ Accurate and realtime information on water quality
- ✓ Visualization of water quality parameters on central dashboard or smart phone
- ✓ Flow and quantity monitoring
- ✓ Sensored measurements without human intervention
- ✓ Automatic forecast, trend monitoring
- ✓ Alarms and warning signals
- ✓ Low operation and maintenance cost
- ✓ Affordable price

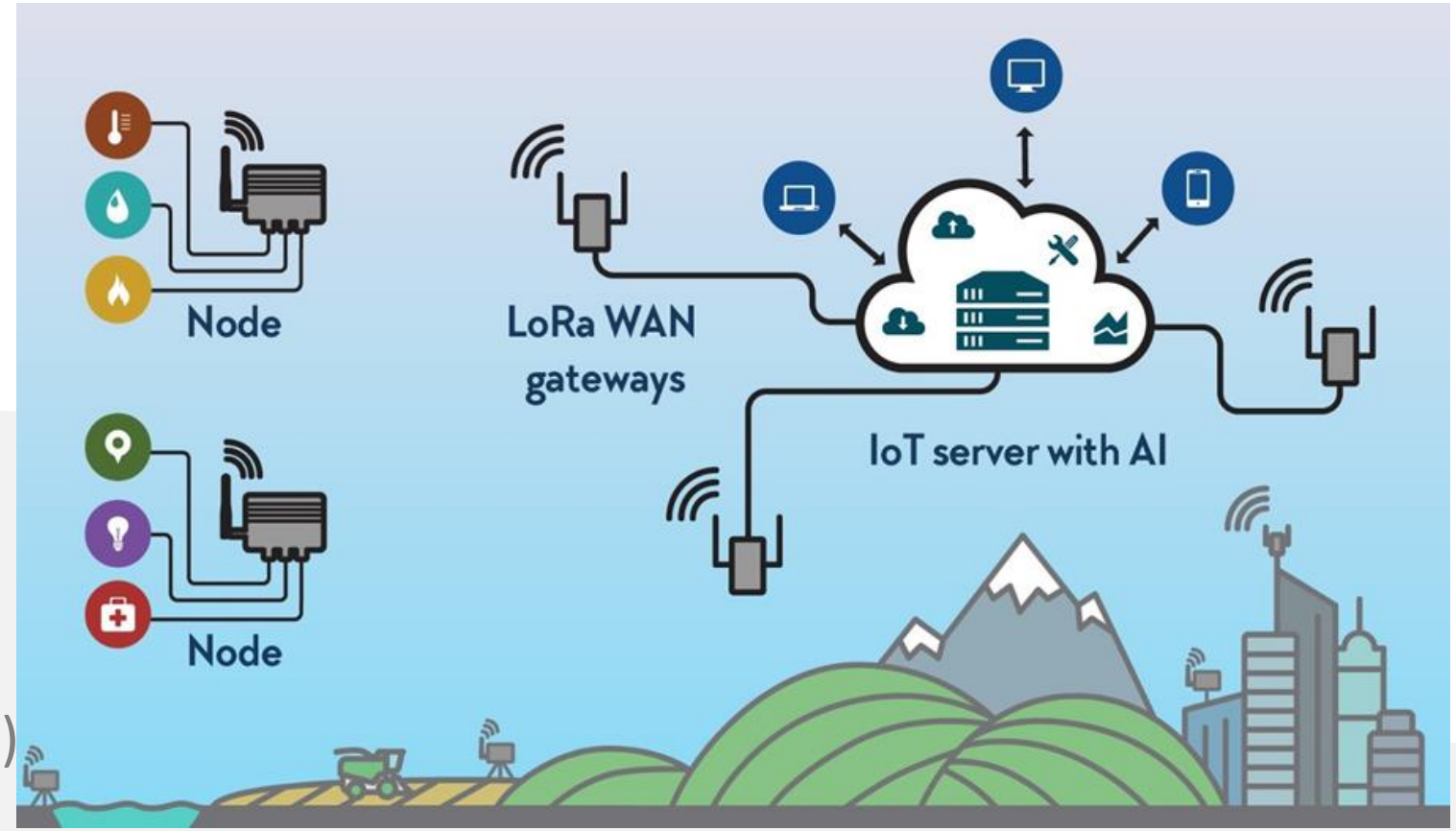


- Urban models for streams, networks
- Urban system alarming solutions
- Forecast models

SMART measurement in the network

Standard sensors (examples):

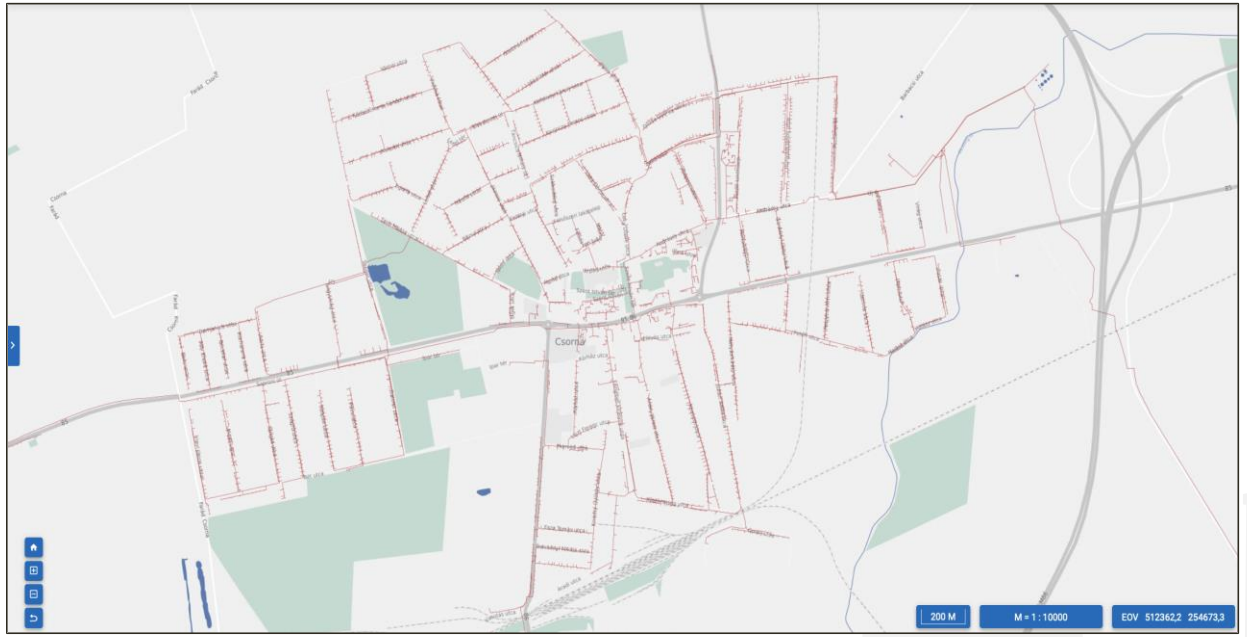
- ✓ Water flow
- ✓ Water level
- ✓ Temperature
- ✓ Turbidty
- ✓ Color
- ✓ pH
- ✓ ORP (redox potential)
- ✓ Conductivity



waterscope

Fields of application

- ✓ Obtaining overview of pipe flow loads
- ✓ Follow-up of havaria cases
- ✓ Protection of sewage plant biology
- ✓ Infiltration monitoring
- ✓ Discovery of illegal connections



water scope

PROJECT OUTPUT

- We provide study on cloudburst issue and reccomendations for design, inputs for catchment scale water management plans for protection of Vinica settlement
- We provide suggested montitoring options to avoid or be prepared of urban flooding

The project was supported by the Western Balkans Green Center Nonprofit Llc.

WESTERN BALKANS GREEN CENTER

MEGÉRTI

IF THERE IS ANY QUESTIONS PLS CONTACT US

OFFICE @DHI.HU

Cloudburst analyzes with expected effects on urban areas and planning

Trabak Zoltán
dr. Zsuzsanna Nagy

DHI Hungary Llc.

The project was supported by the Western Balkans Green Center Nonprofit Llc.

Aim of the pilot project

1. Delineate endangered areas, where inundation can occur during heavy rainfalls

2. Delineate subcatchments and flowpathes to have an overview of the natural runoff system

3. Define discharges of rainwater runoff to give basic information for drainage network design

4. Outlook and lesson learnt for similar projects, investment support

What happens once it is raining (in the urbanized area)?

- Event based analyzes
  - Cloudburst
  - Other type of rain events

Monthly, yearly based –longer period analyzes – hydrology, urban catchments' water balance

Surface runoff

- 1. First overview– ***screening-cloudburst and fast analyzes***
- 2. Detailed analyzes – inundation/flood migration

Shows: How water flows (where,velocity, depth)—*2D models*

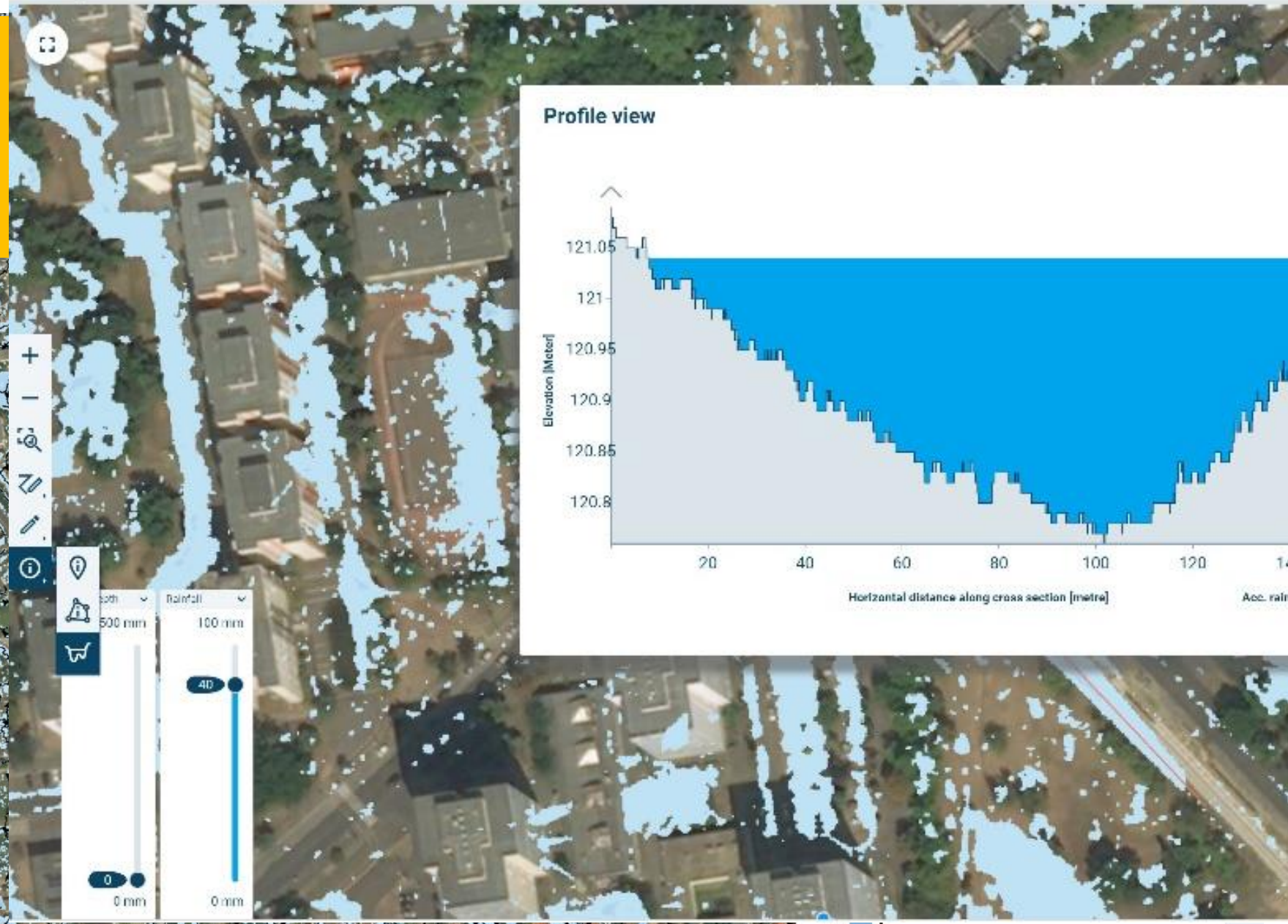
Network analyzes

3. (network capacity)– 1D hydraulic models

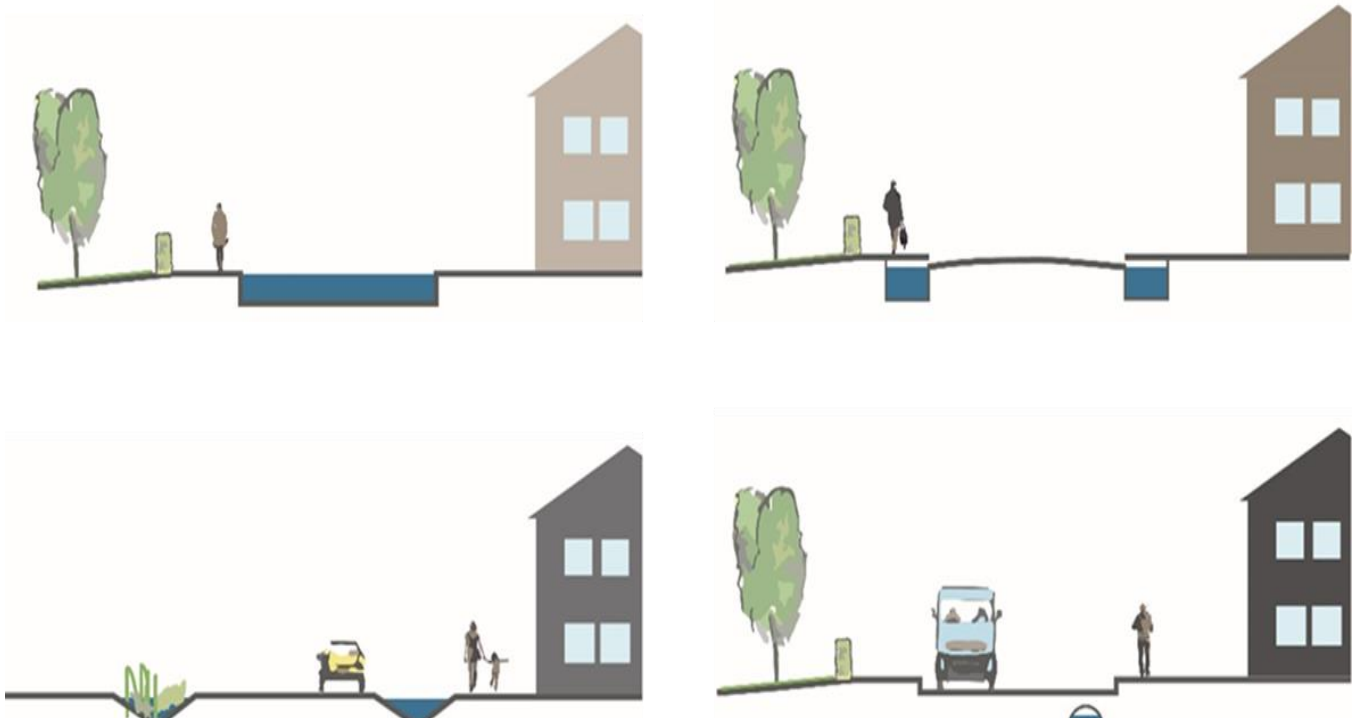
WESTERN BALKANS GREEN CENTER

DHI

-set values (accumulative rainfall value) and see result
-ponding/excess water
-flow path



Screening impact of cloudburst event – first analyzes



Master plans of cloud burst floodings are being created for all parts of the city.

after screening the detailed hydraulic analyzes can come, where there are higher level of data requirements….

The cloud burst flood maps are used usually by the Planning authority at municipality and the Water department (unit) for Master Planning of cloud burst Management as first step (review), to evaluate measures and plans **for reducing the risks of urban flooding** from heavy cloud burst rainfall.

WESTERN BALKANS GREEN CENTER

Area location (pilot area)

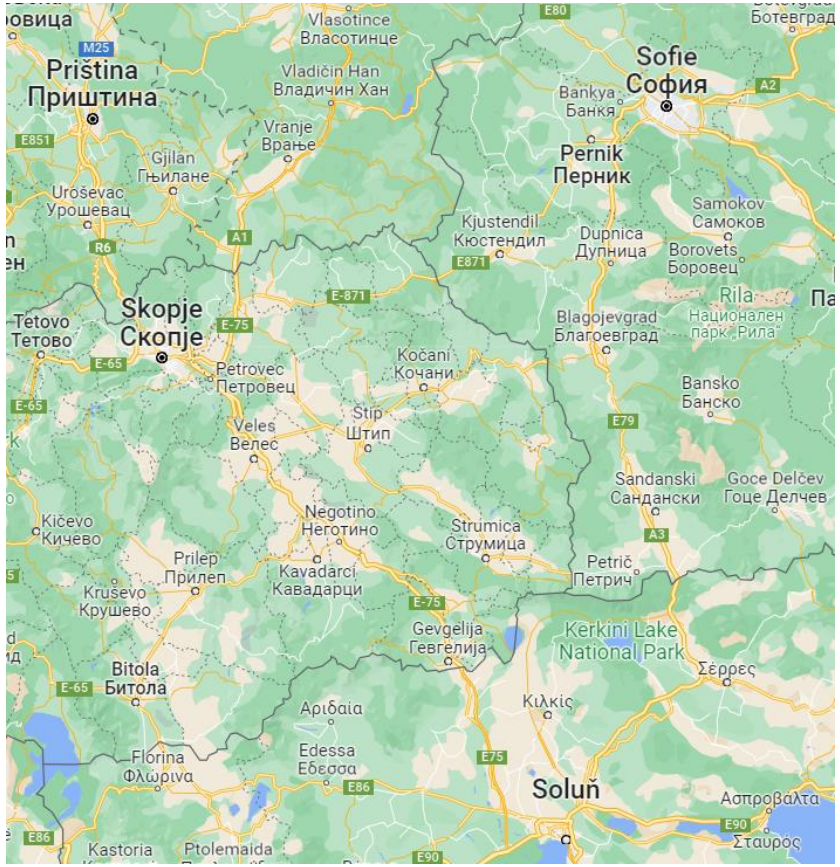
The project was supported by the Western Balkans Green Center Nonprofit Llc.

Data used

- Digital terrain model – SRTM product of NASA (Farr, T. G., and M. Kobrick, 2000, Shuttle Radar Topography Mission produces a wealth of data. Eos Trans. AGU, 81:583-583.)
- Statistical data of expected precipitations based on different climate models - EnviGraph Bt.
- Precipitation data for simulations - Intensive Rainfall in the Republic of Macedonia by Prof. Zivko Shkoklevski and Blagoja Todorovski
- Information and drawings of drainage network, earlier damages from GTI – GEOTEHNICKI INZENERING Limited Liability Company
- Land use map – CORINE Land Cover , European Union, Copernicus Land Monitoring Service 2018, European Environment Agency (EEA)
- Watercourses and streets - OpenStreetMap (https://planet.openstreetmap.org)
- Field survey made by DHI Hungary Kft.

Tools applied

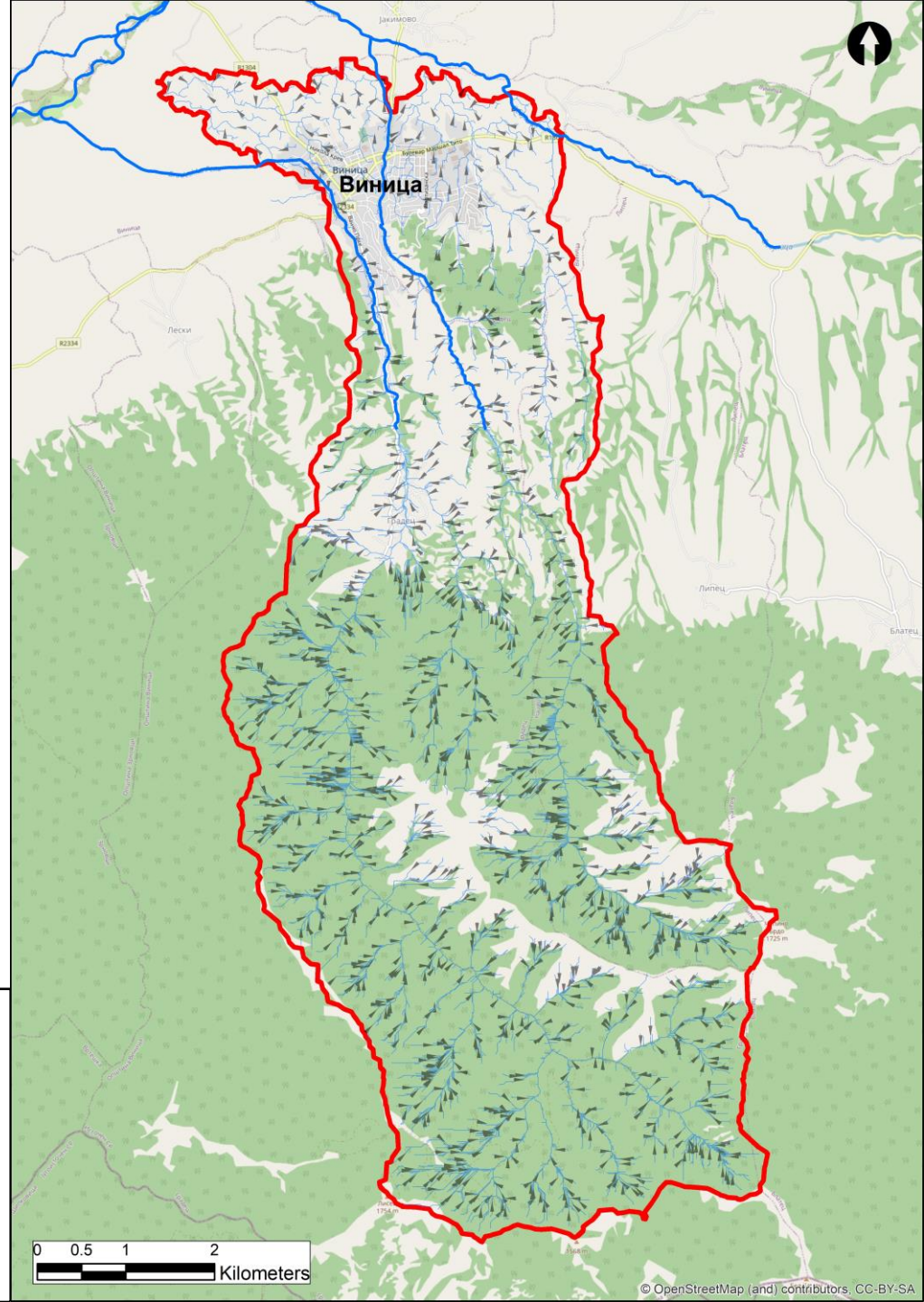
- Terrain model based flood analyzes tool (flowpath analyzes)
- MIKE+ software for hydrological analyzes (runoff simulations)



Flow paths

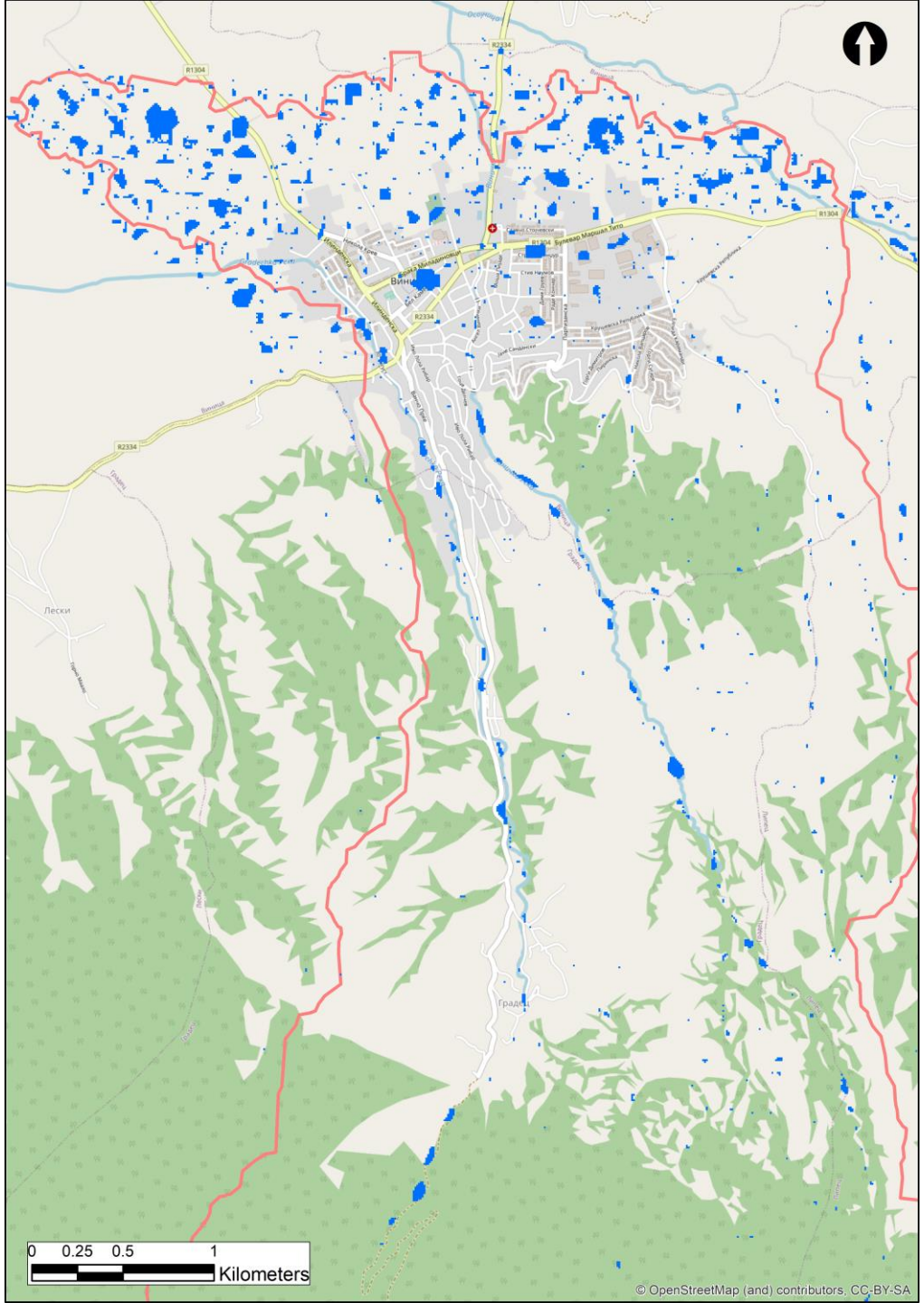
Flow paths show the routes of the rainfall runoff, based on terrain model

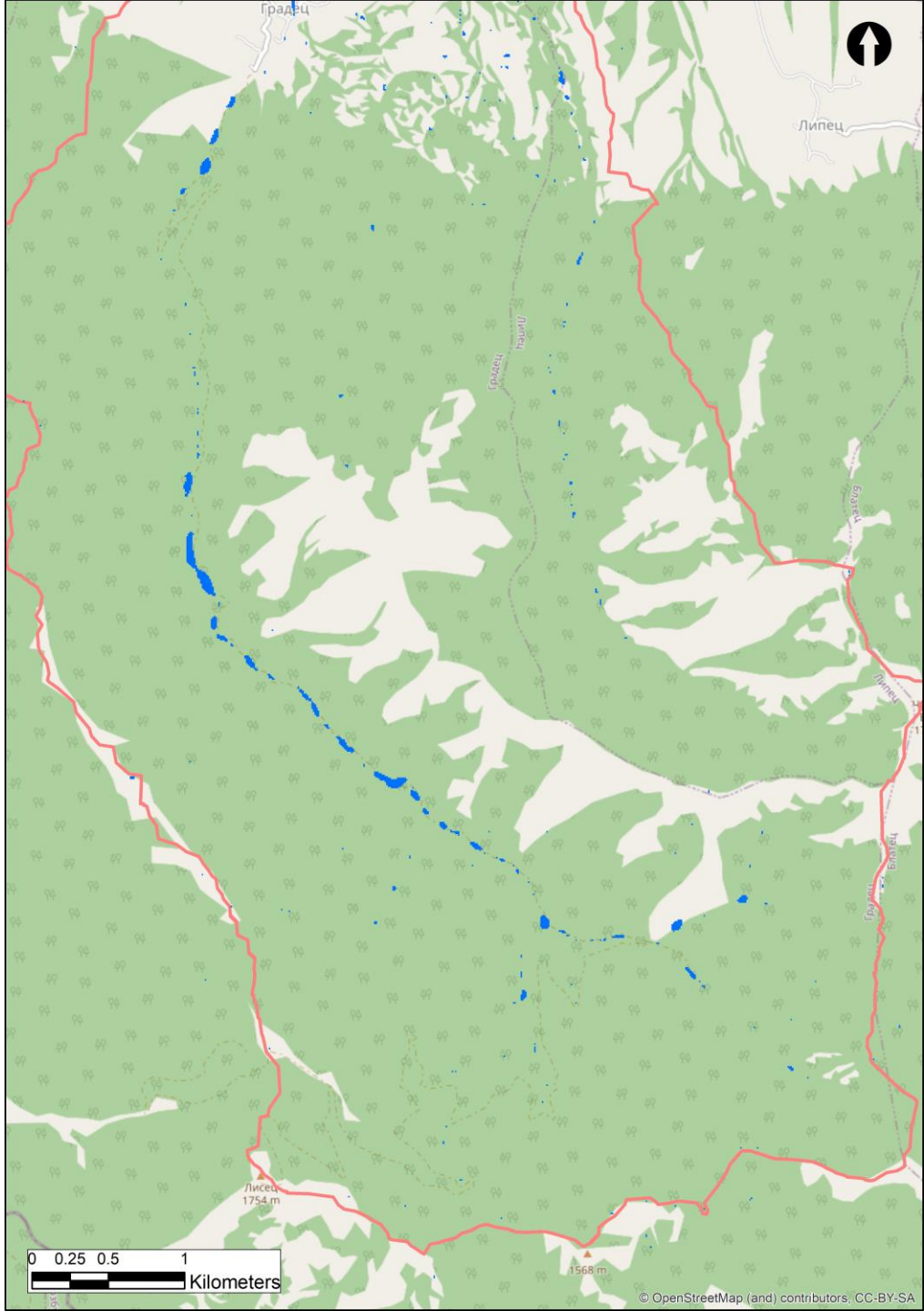
Flow paths are essential for hydrodynamic model building



Flood screening

The analysis shows the terrain depressions where rainwater can collect during cloudbursts





Legend

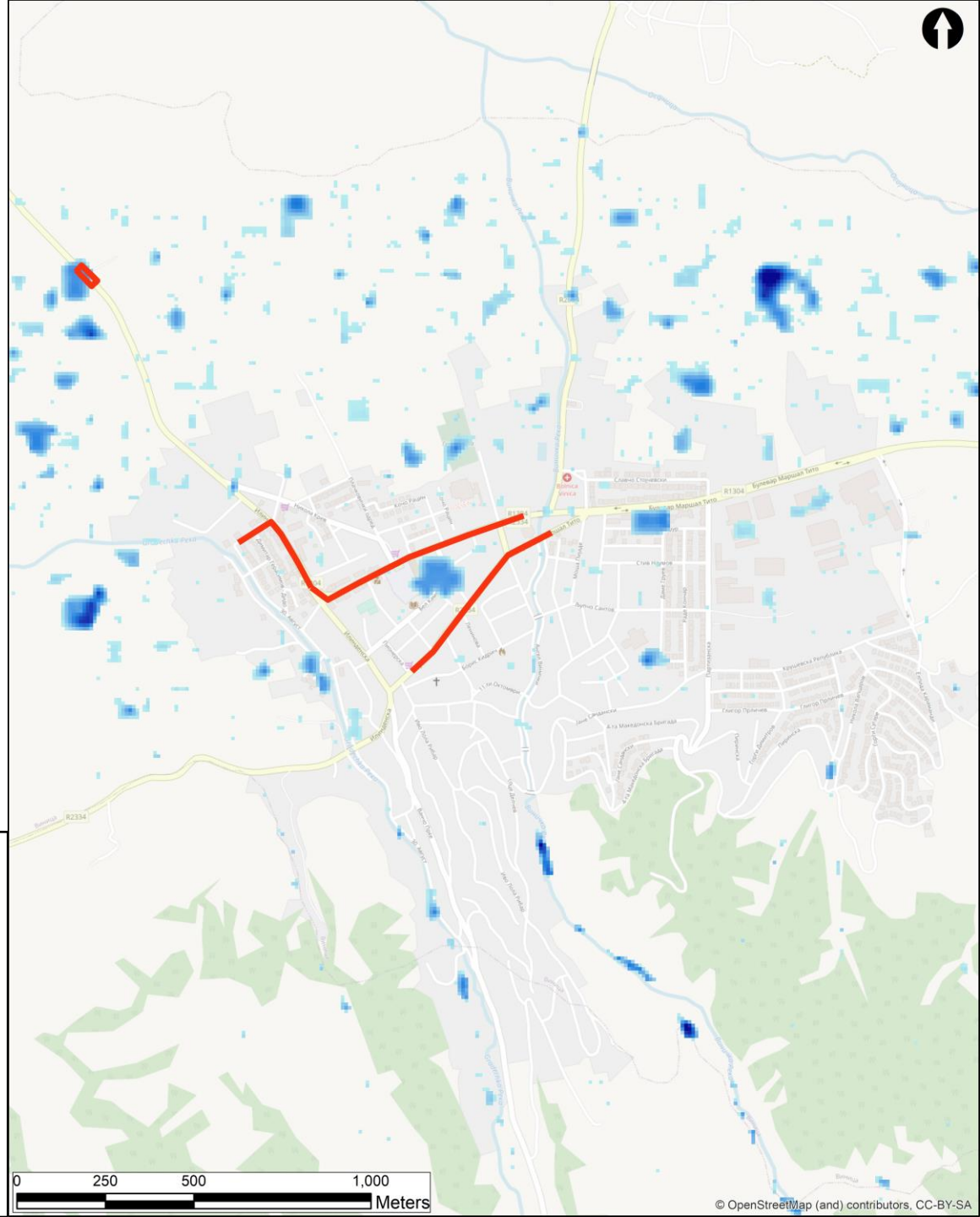
Catchment of Vinica

Inundation

Flood screening

Based on DTM data there are some places both in the residential and industrial / commercial area where rainwater may collect.

In the process of land use planning and drainage design these depressions need to be considered.



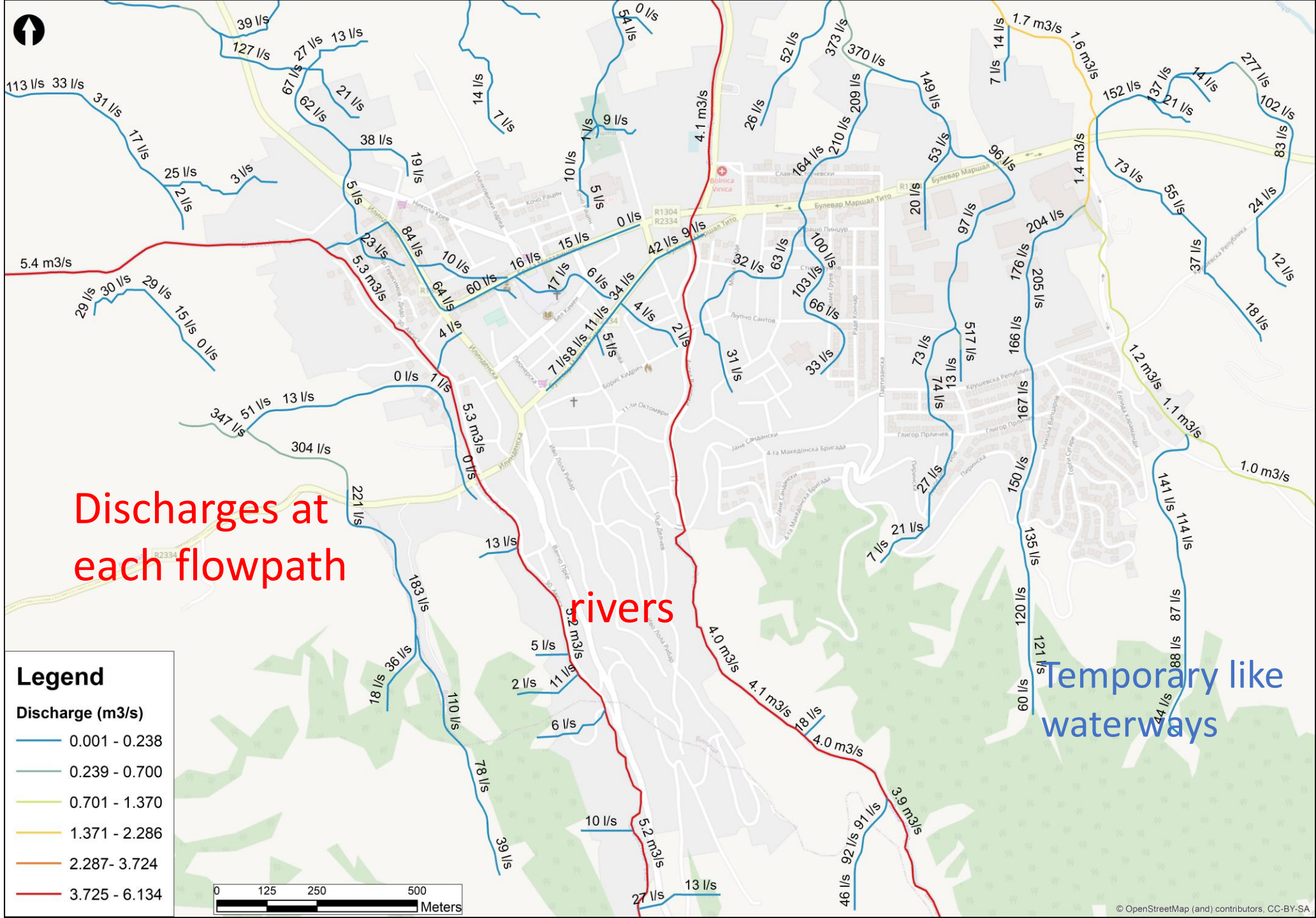
Hydrological analyzes

- Scenarios analyzes to be able to see catchment behavour on rain events of 12 and 24-h lasting rain event

…but possible to check the impacts for other rainfall events

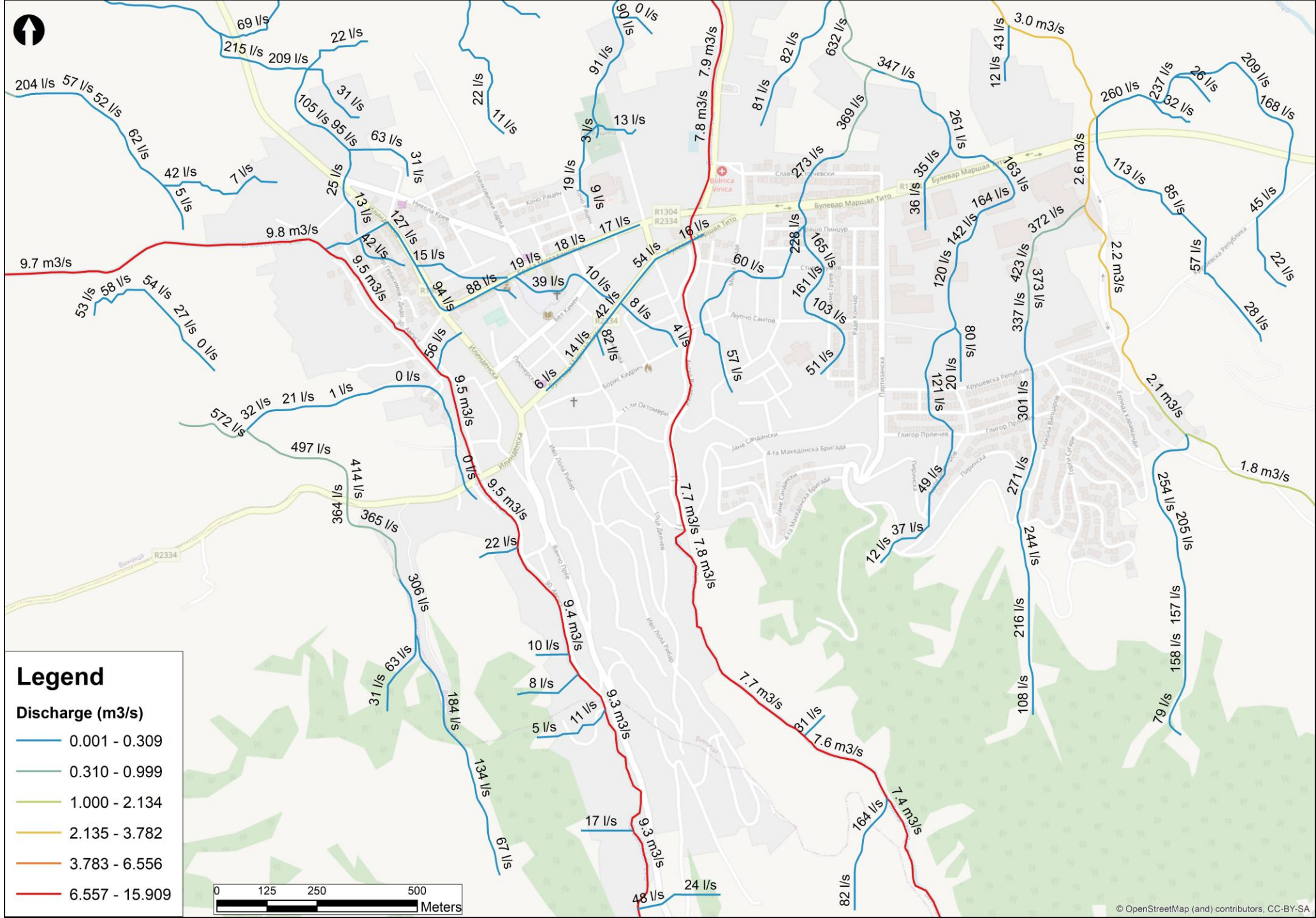
Runoff simulation results

Maximum discharges of 12 hour long 5 year return period rain event



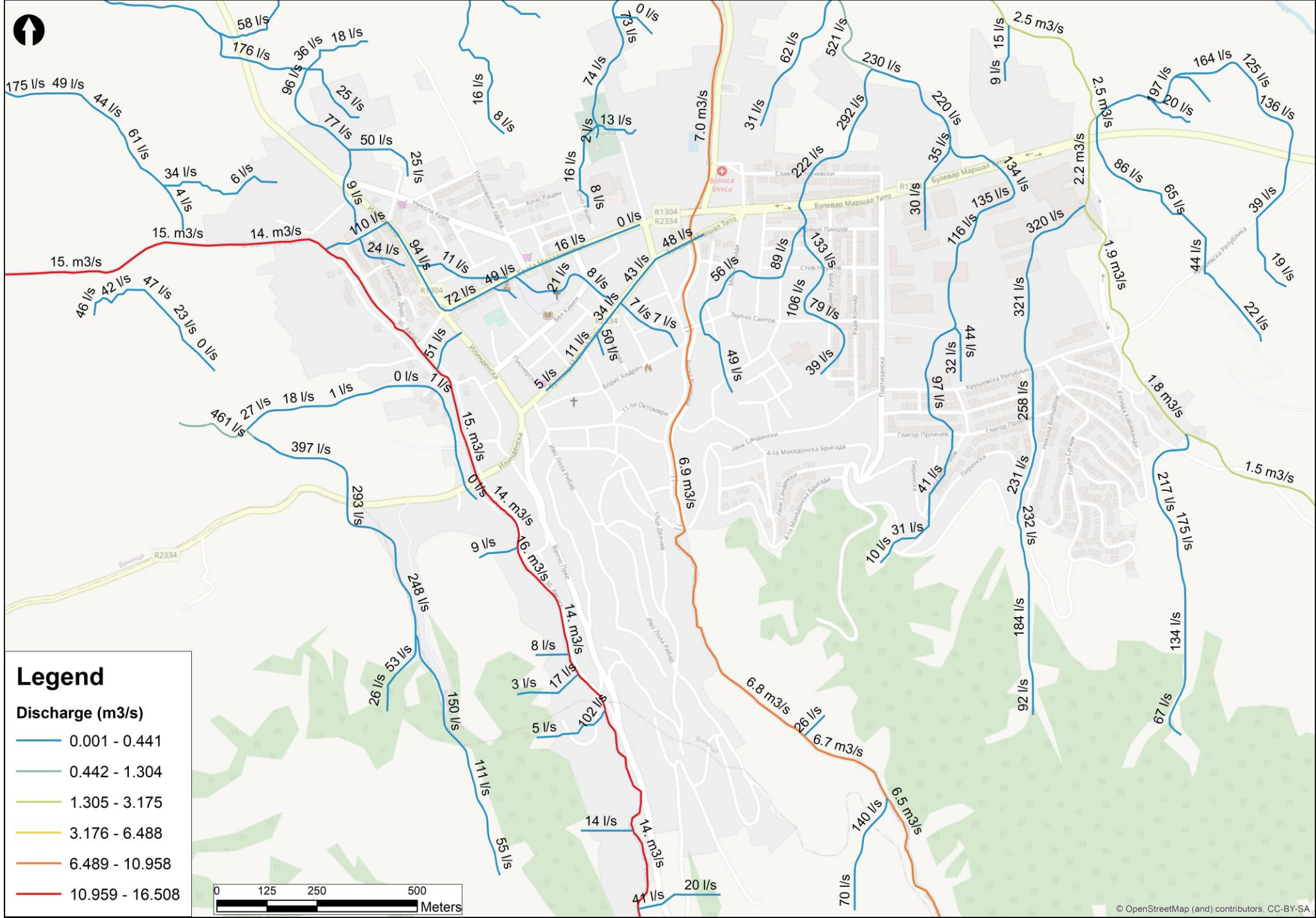
Runoff simulation results

Maximum discharges of 12 hour long 10 year return period rain event



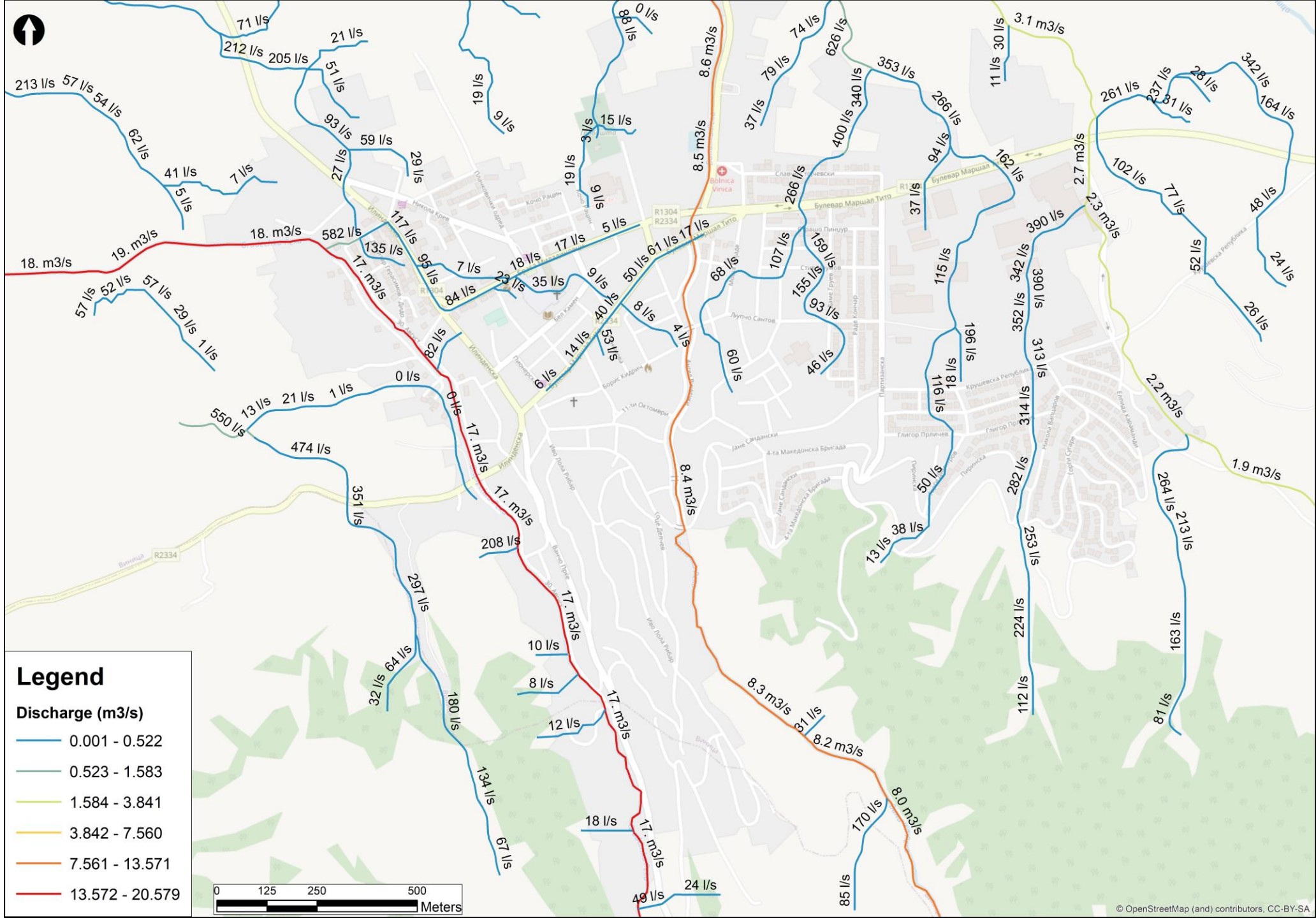
Runoff simulation results

Maximum discharges of 24 hour long 5 year return period rain event



Runoff simulation results

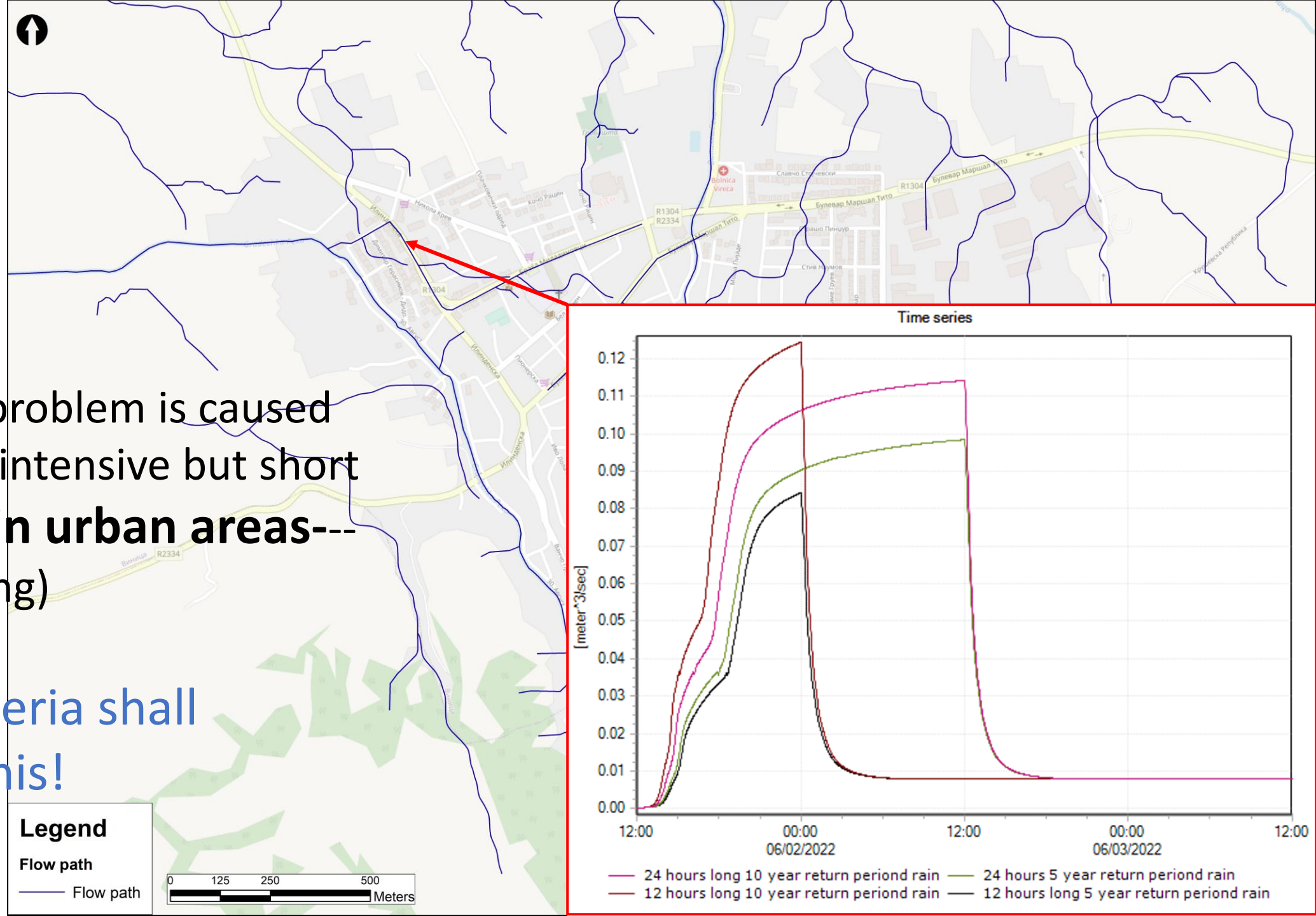
Maximum discharges of 24 hour long 10 year return period rain event



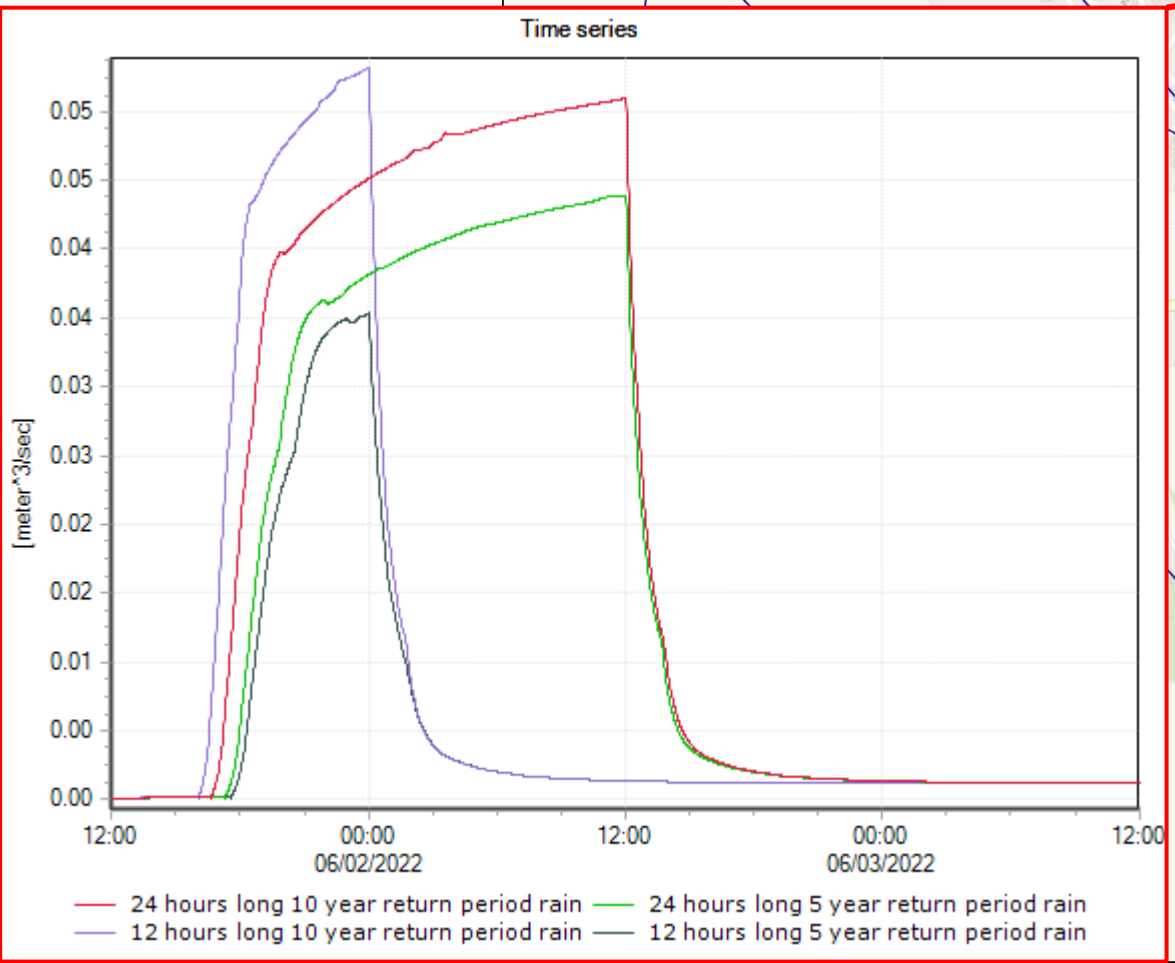
Discharge time-series at specific points

The biggest problem is caused by the more intensive but short rain events (**in urban areas**---urban flooding)

Design criteria shall consider this!



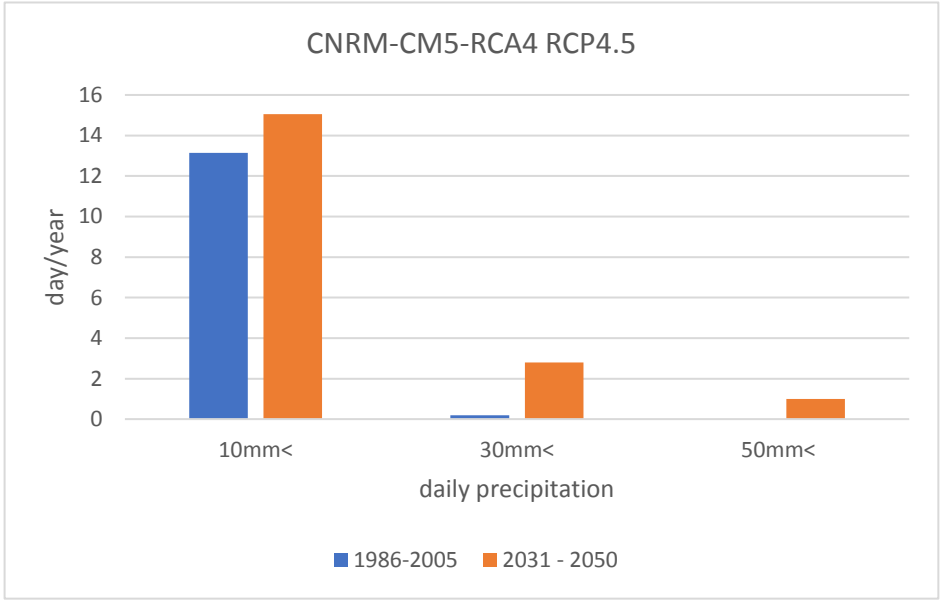
Discharge time-series at specific points

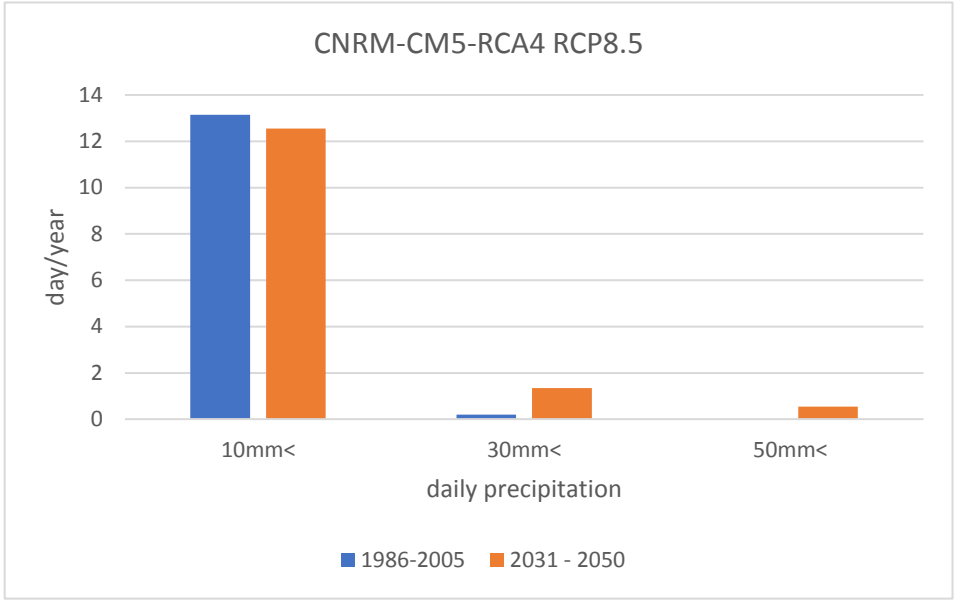


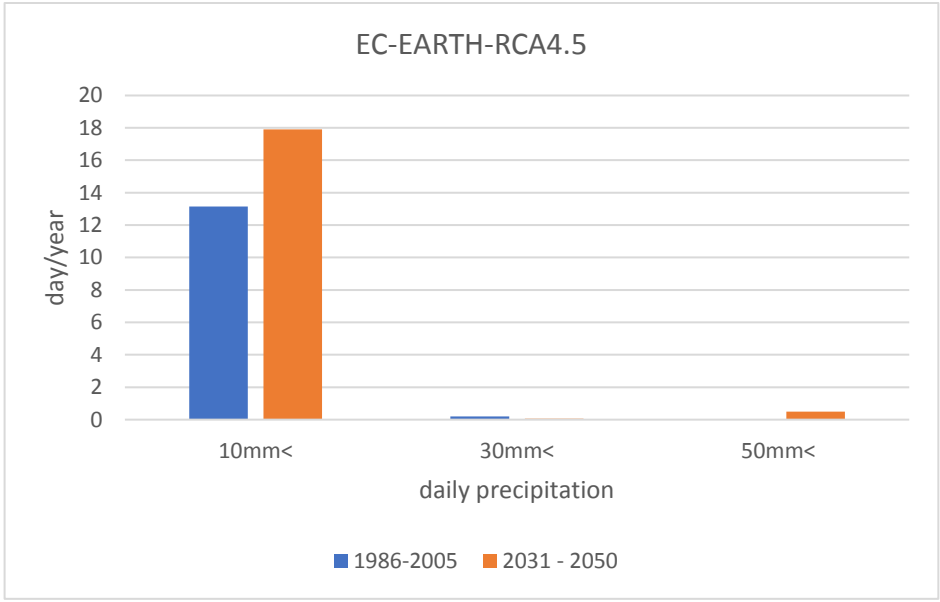
The biggest problem is caused by the more intensive but short rain events (**in urban areas**---urban flooding)

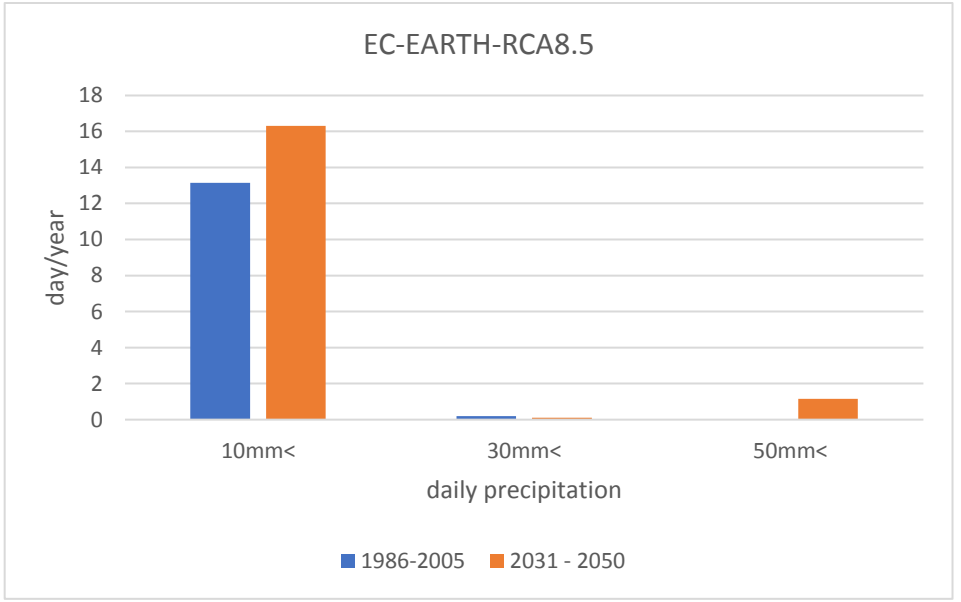
Predicted changes of different precipitation amounts

The occurrence of extreme daily precipitation will be more frequent, so the analyzes results are likely to be associated with a higher probability in the future.









„The occurrence of extreme daily precipitation will be more frequent, so the rainfall analyses results described in this study, are likely to be associated with a higher probability in the future.”

- The need for climate proofed design is preferably needed for the future, to elaborate the increasing risk for the higher precipitation/intensive summer rainfall events.

Resilience building with increasing flexibility of the system, storage capacities in catchment level

Lesson learnt:

Urgent need to get better picture of catchments – especially those where current urban flooding events happens to be able to support the infrastructure design (water management, city development)

National CLIMATE CHANGE STRATEGY-UNFCC

WATER MANAGEMENT BODIES, HYDROMET. iNSTITUTION

RIVER BASIN MANAGEMENT PLAN– WATER FRAMEWORK DIRECTIVE

MUNICIPALiTY LEVEL:

LOCAL STUDIES– MUNICIPALITY FOCUSED STUDIES

URBAN CATCHMENT PLANS –INTERGRATED URBAN WATER MANAGEMENT PLANS: INTERGRATES ALL WATER RELATED ISSUES FOR THE MINUCIPLAITY

URBAN DESIGNS, INCL.INFASTRUCTURE DESIGNS

Summary and outlook

- Good design is a result of team work. Experts, local knowledge integration. Knowledge of Past events and consequences


Thank you for your attention!
office@dhi.hu