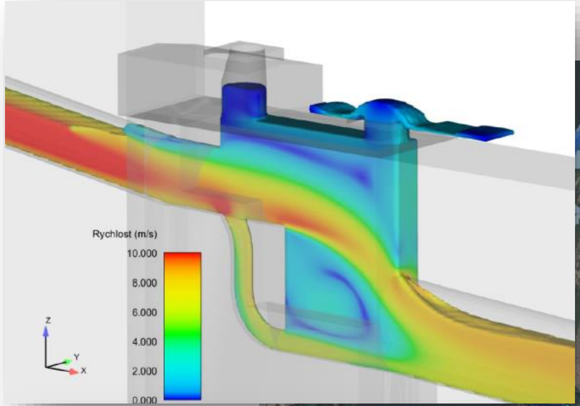
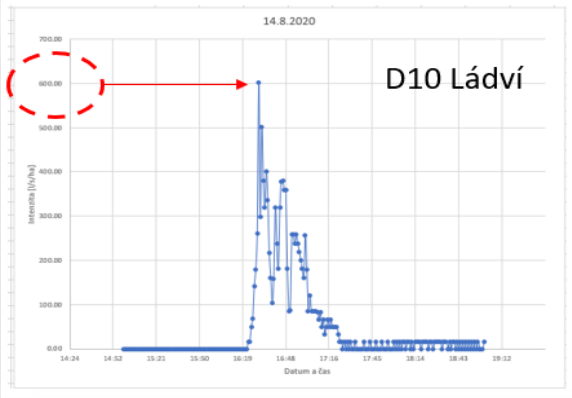
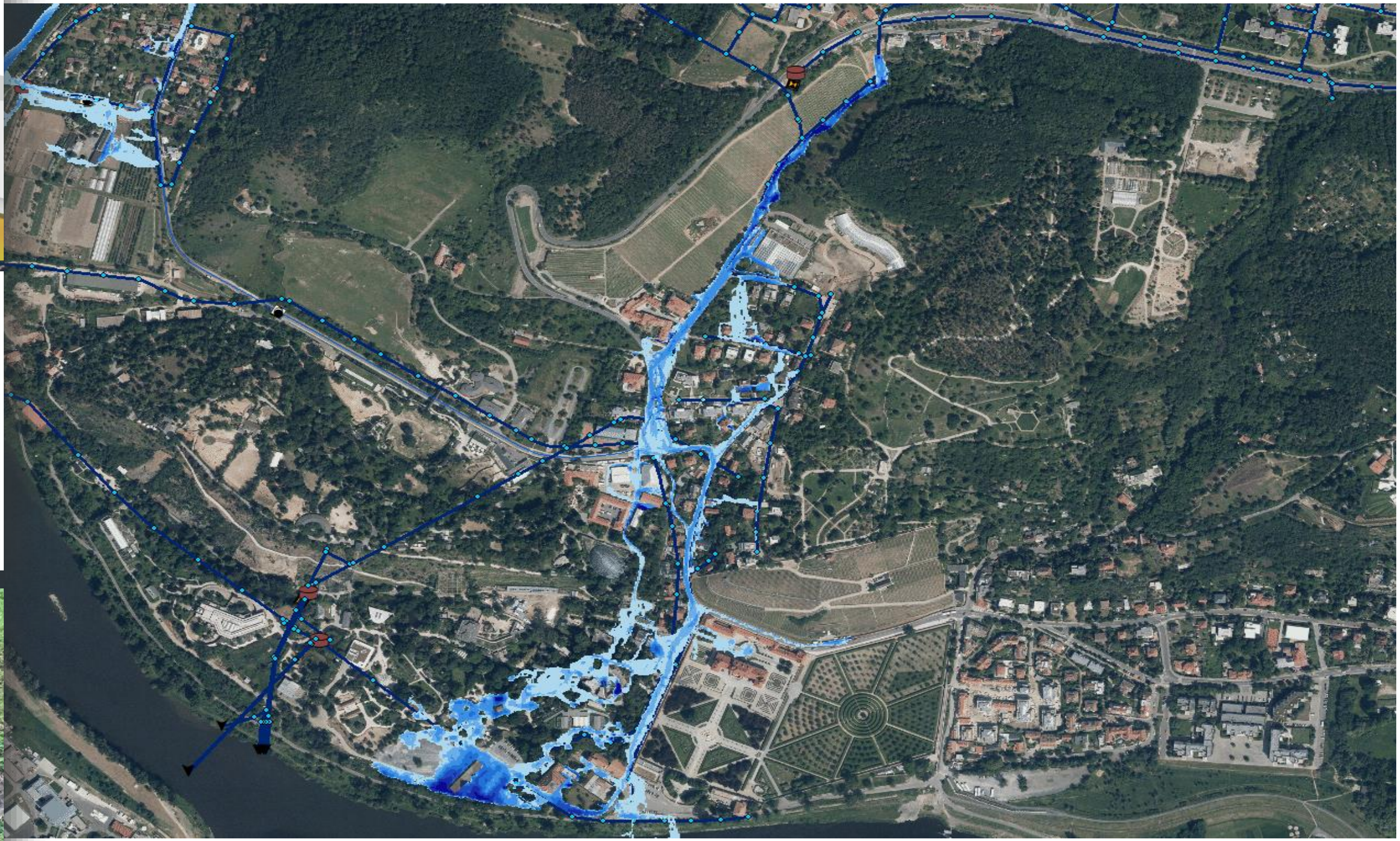
Cloudburst Projects

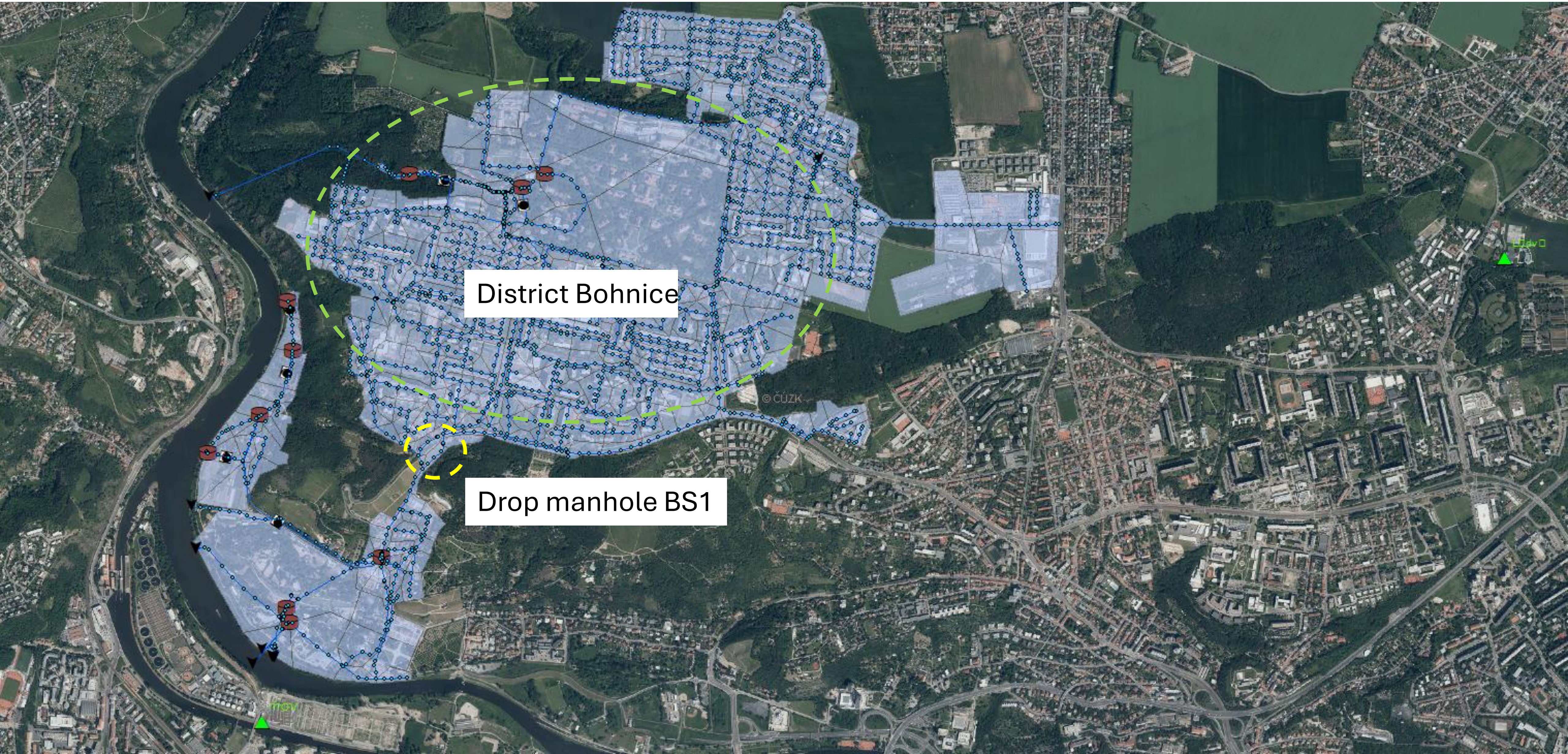
Cloudburst assessment study for Bohnice urban drainage





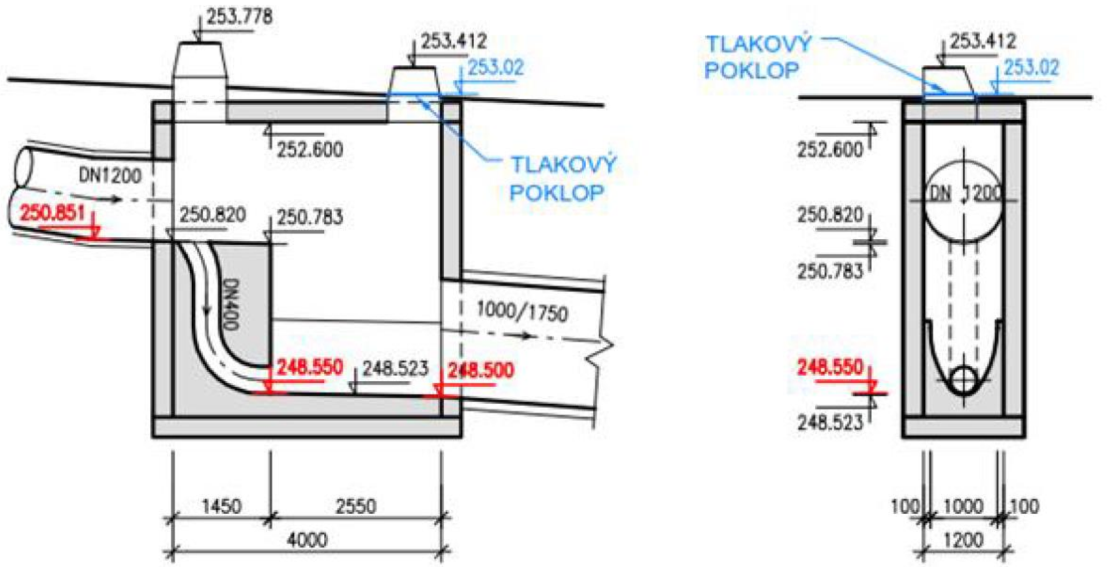


Project area

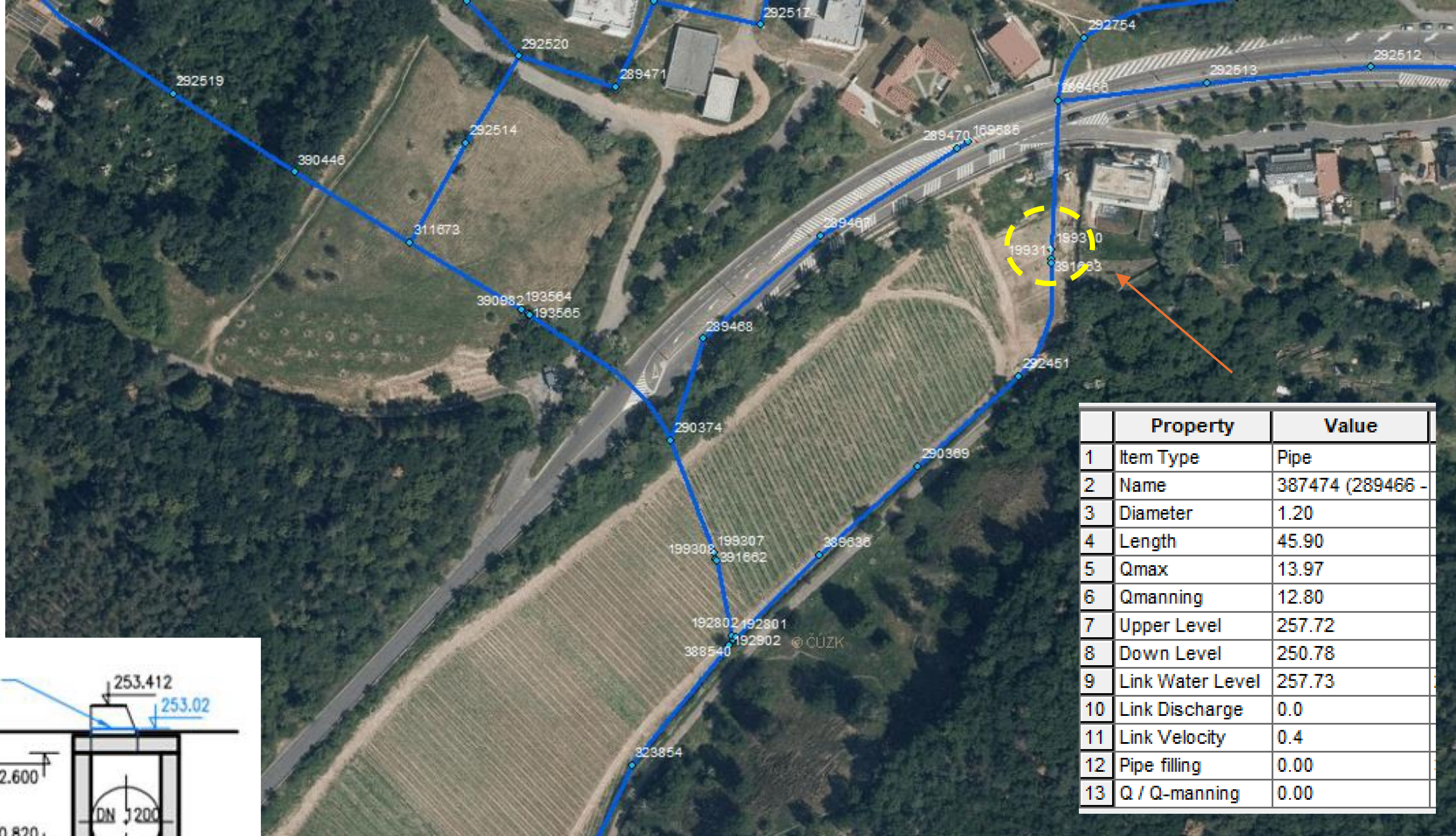


Drop manhole BS1

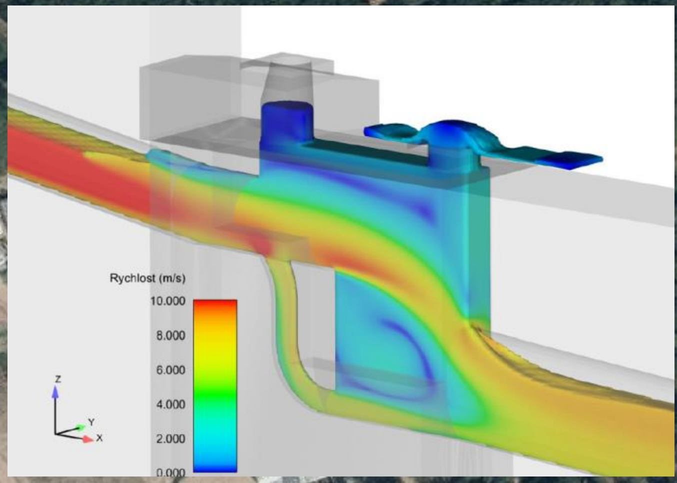
Capacity: 12-14m3/s
Slope : 15%
Discharge: 4,4m3/s



Obr. 3. Schéma stávajícího spadiště na větvi BS1 Bohnického sběrače – dle zaměření z roku 2000



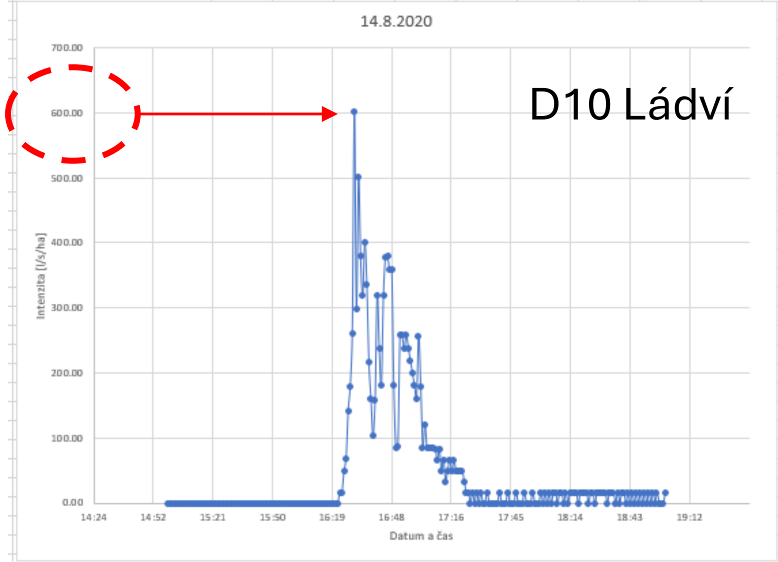
	Property	Value
1	Item Type	Pipe
2	Name	387474 (289466 -
3	Diameter	1.20
4	Length	45.90
5	Qmax	13.97
6	Qmanning	12.80
7	Upper Level	257.72
8	Down Level	250.78
9	Link Water Level	257.73
10	Link Discharge	0.0
11	Link Velocity	0.4
12	Pipe filling	0.00
13	Q / Q-manning	0.00



Extreme rainfall from 14.8.2020 (16,00 – 18,00)

Clourburst 14.8.2020

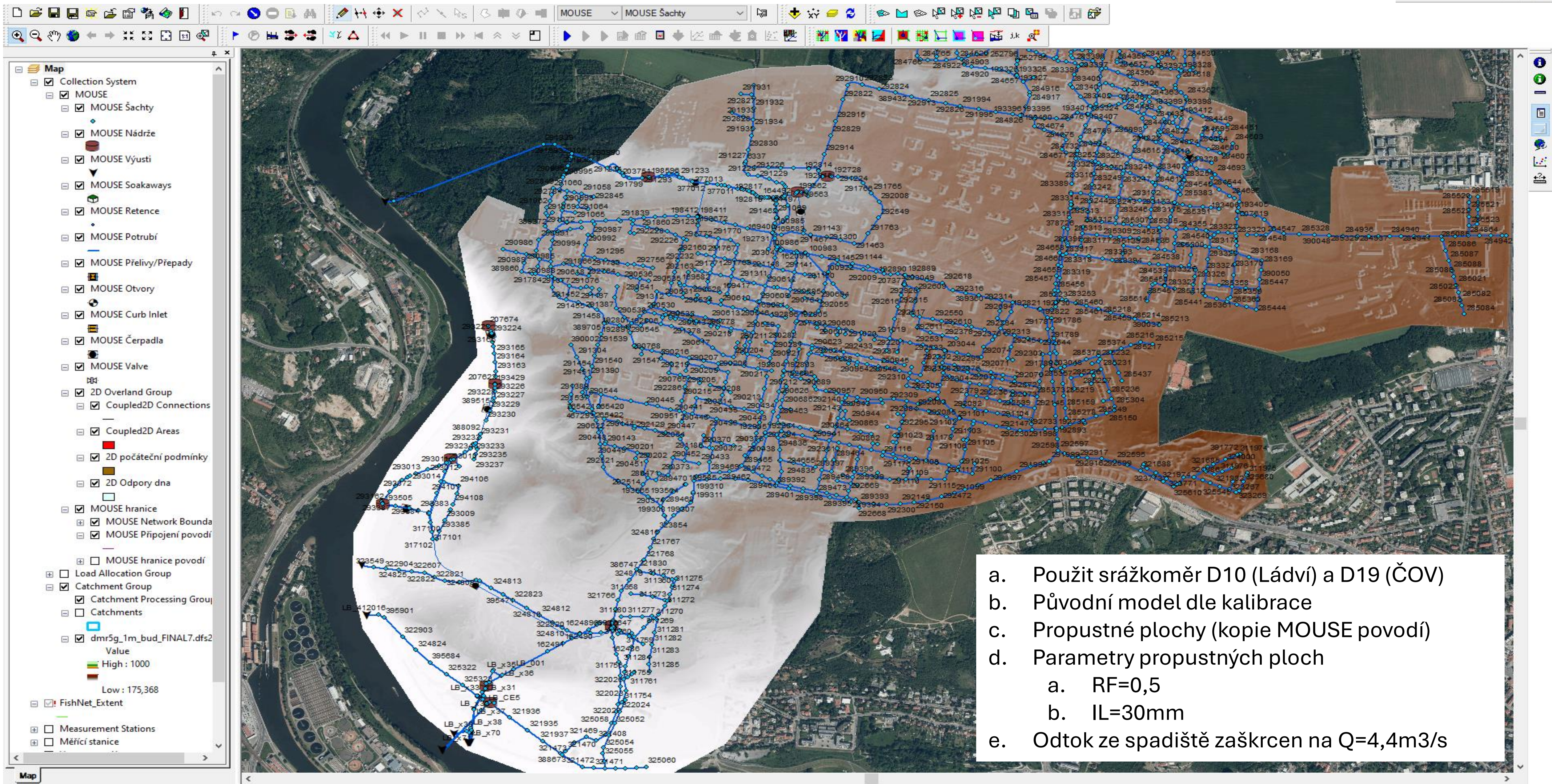
Srážkoměr	lokalita	max. intenzita	úhrn
D22	Miškovice	634	61.6
D10	Ládví	601	65.8
D19	ČOV	400	21.3
D06	Suchdol	194	18.7



Rainfall sum: **65,8mm**
Duration: **63 minut**
Maximum intensity: **601 l/s/ha**
Average intensity: **174 l/s/ha**
IDF – 100y/60min intensity: **154 l/s/ha**

We recognise heavy rainfall
With return period higher than
100 years/ 60 minutes

Simulation model – 1D+2D



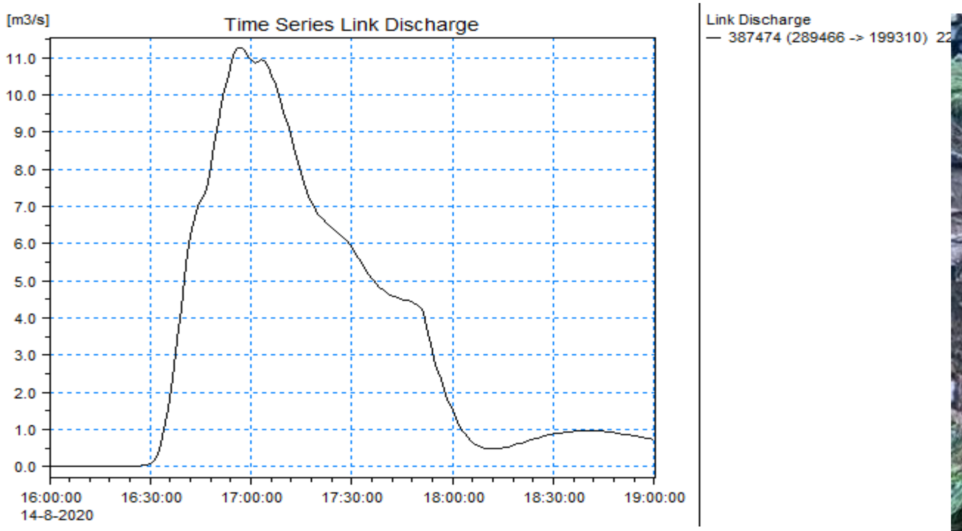
a. Použit srážkoměr D10 (Ládví) a D19 (ČOV)
b. Původní model dle kalibrace
c. Propustné plochy (kopie MOUSE povodí)
d. Parametry propustných ploch
   a. RF=0,5
   b. IL=30mm
e. Odtok ze spadiště zaškrcen na Q=4,4m3/s

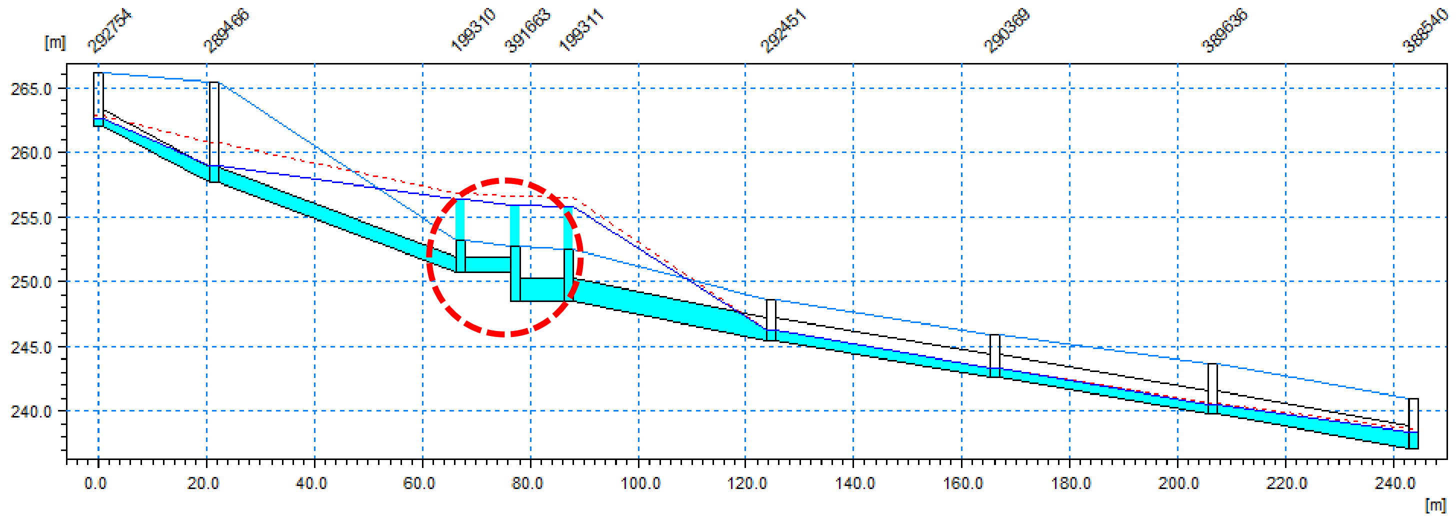
1D simulation results for cloudburst on 14.8.2020

Nátok do spadiště
- Qmax= 11,3 m3/s
- Vtot = 37 000 m3

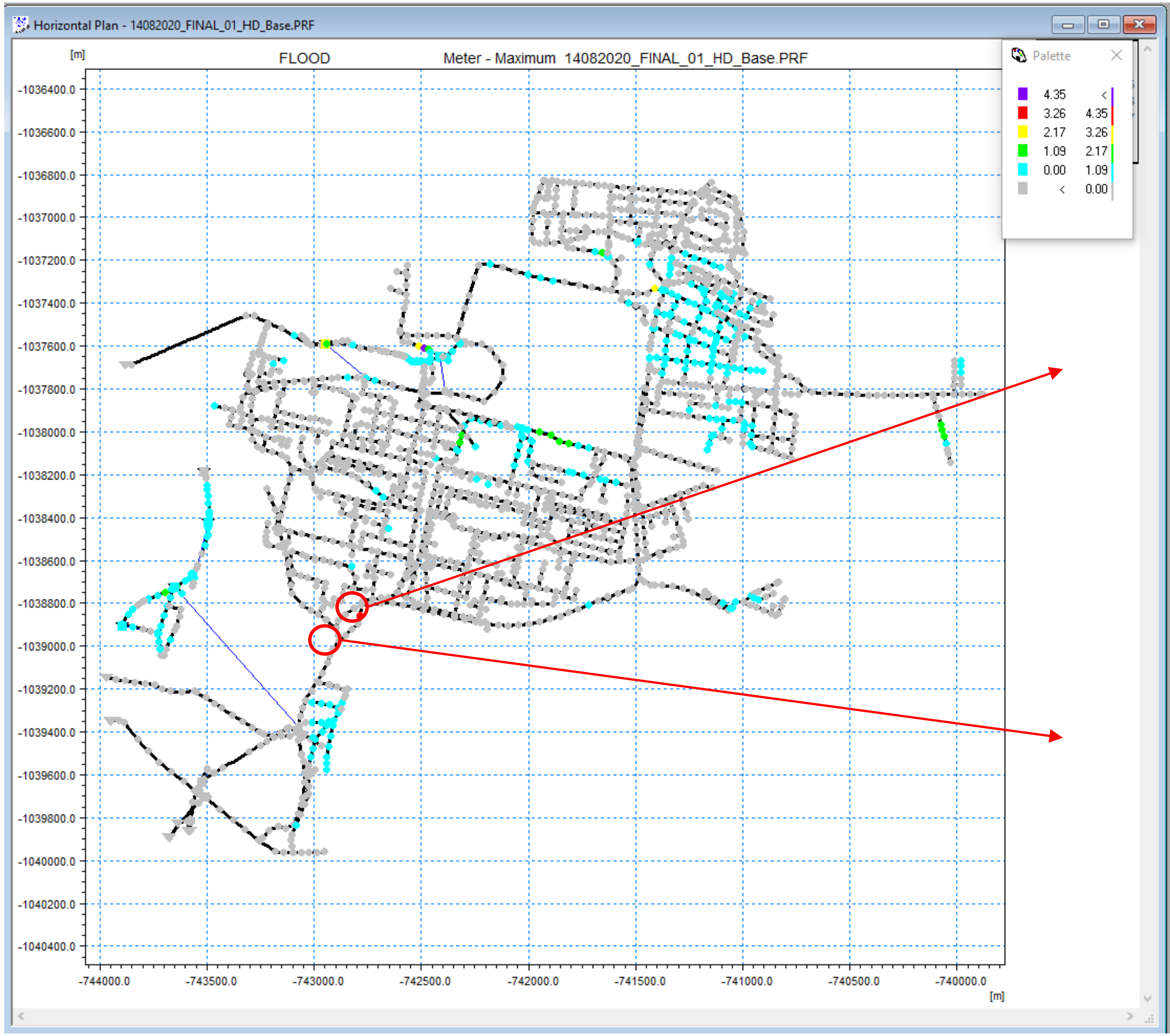
Odtok ze spadiště
- Qmax= 4,4 m3/s

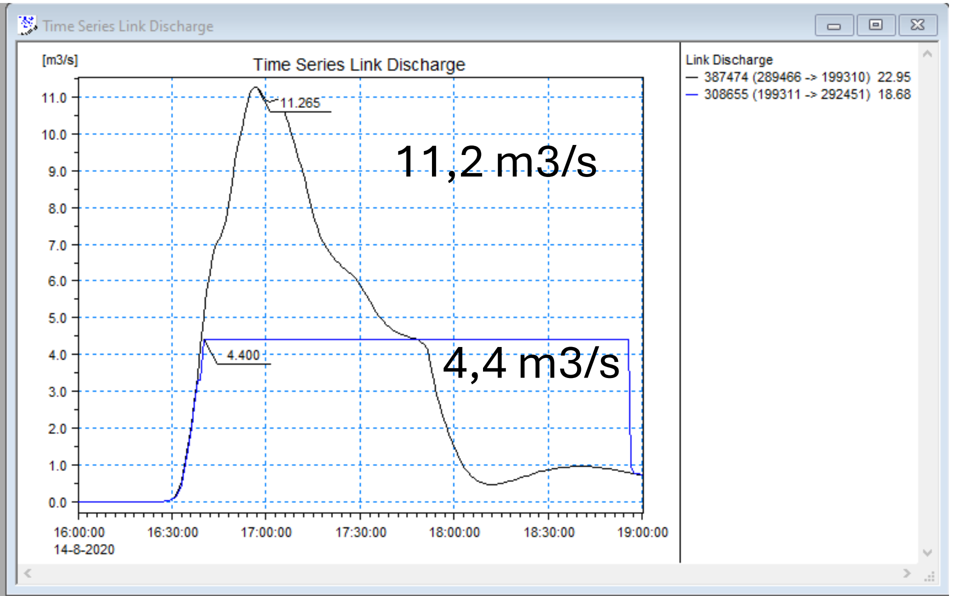
Záplava ze spadiště
- Qmax= 7,0 m3/s

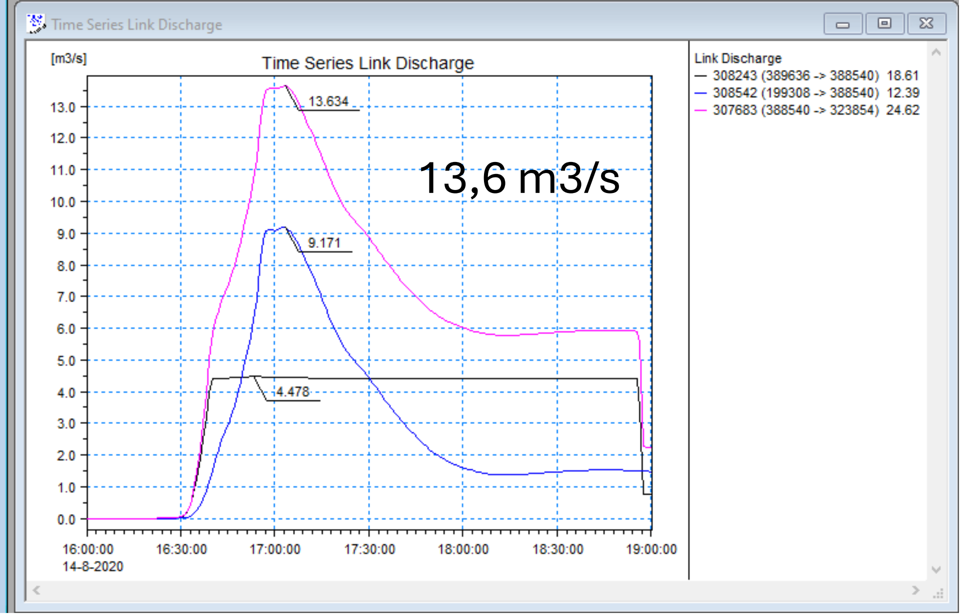




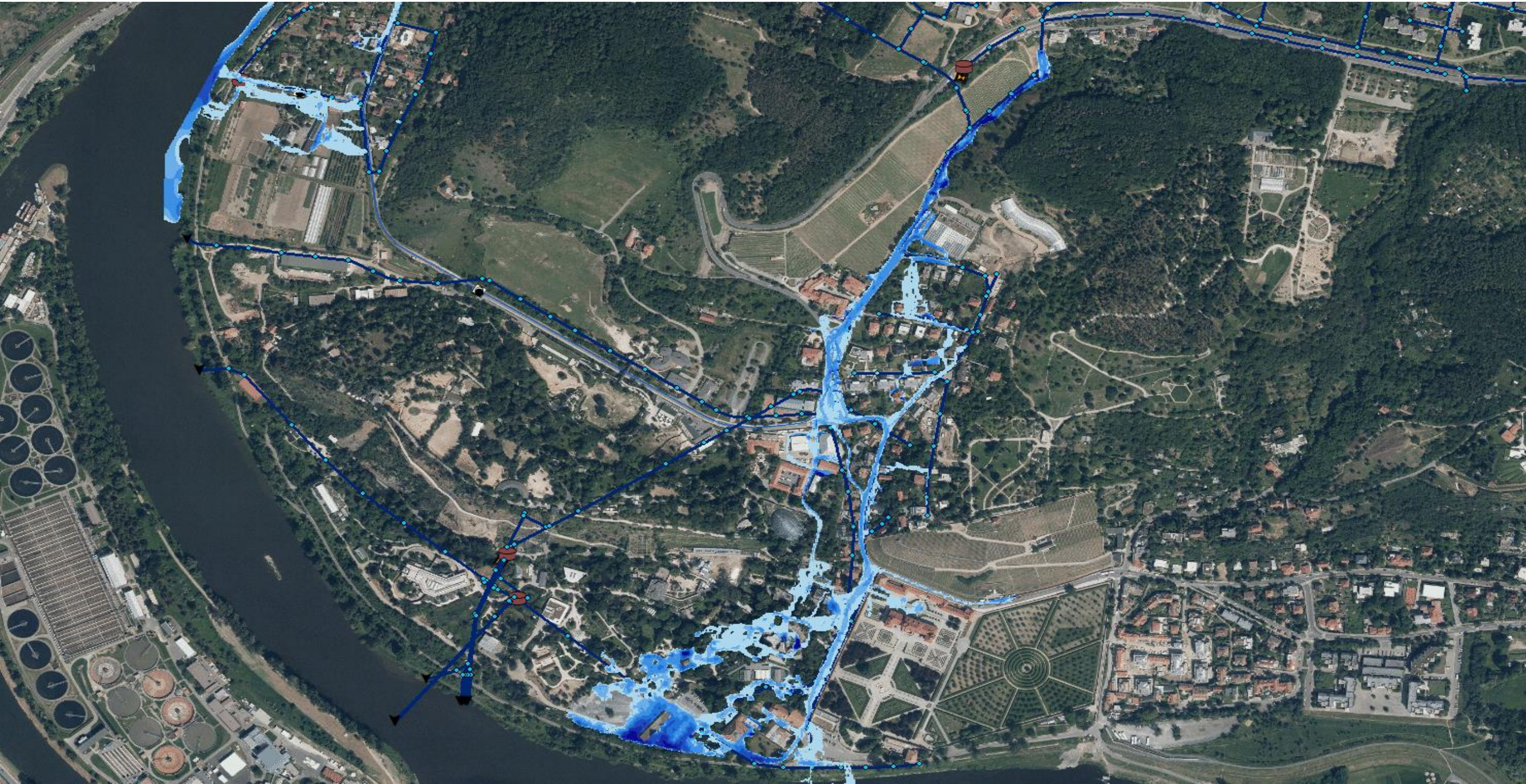
1D simulation results for cloudburst on 14.8.2020





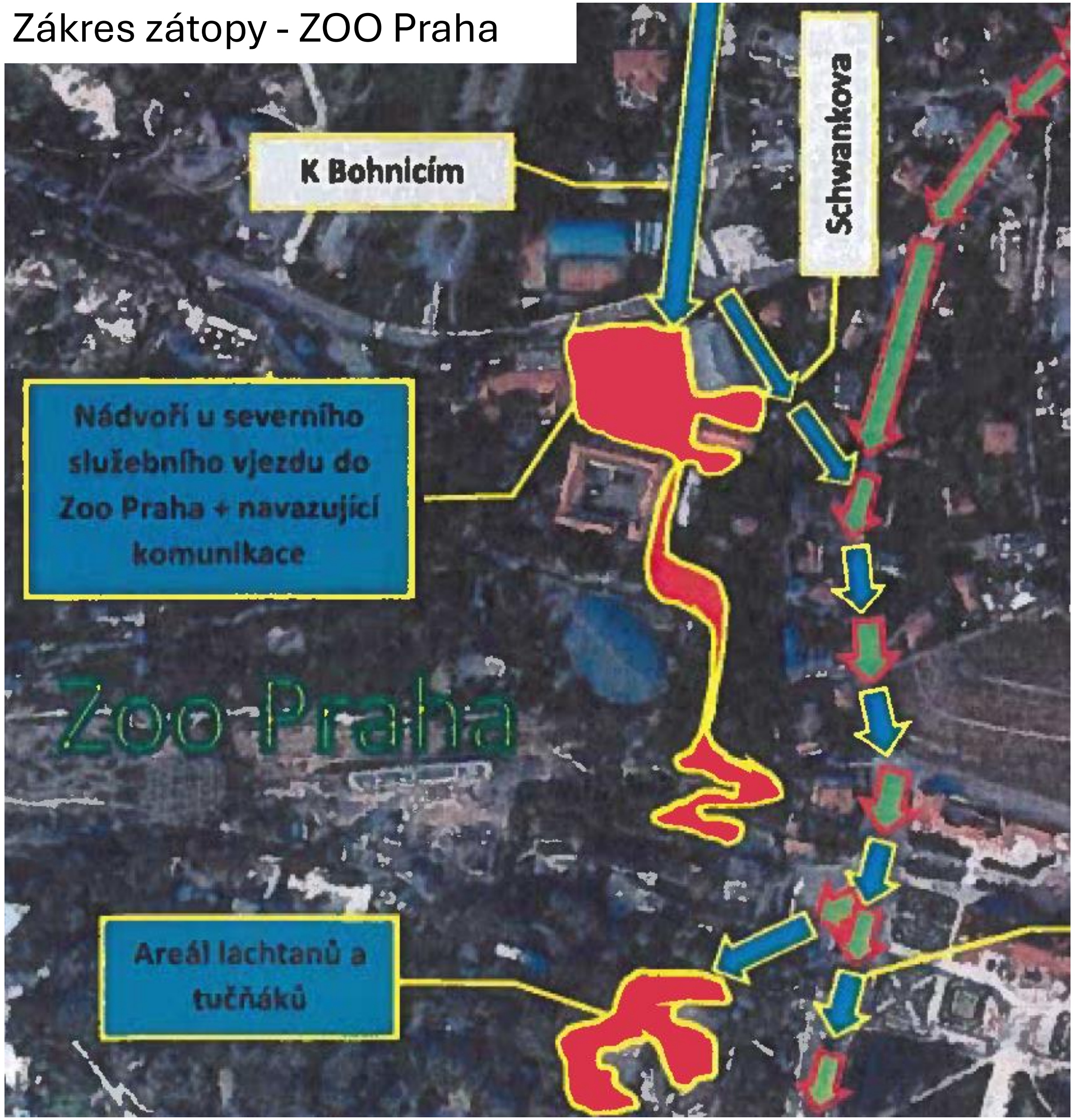


2D simulation results for cloudburst on 14.8.2020

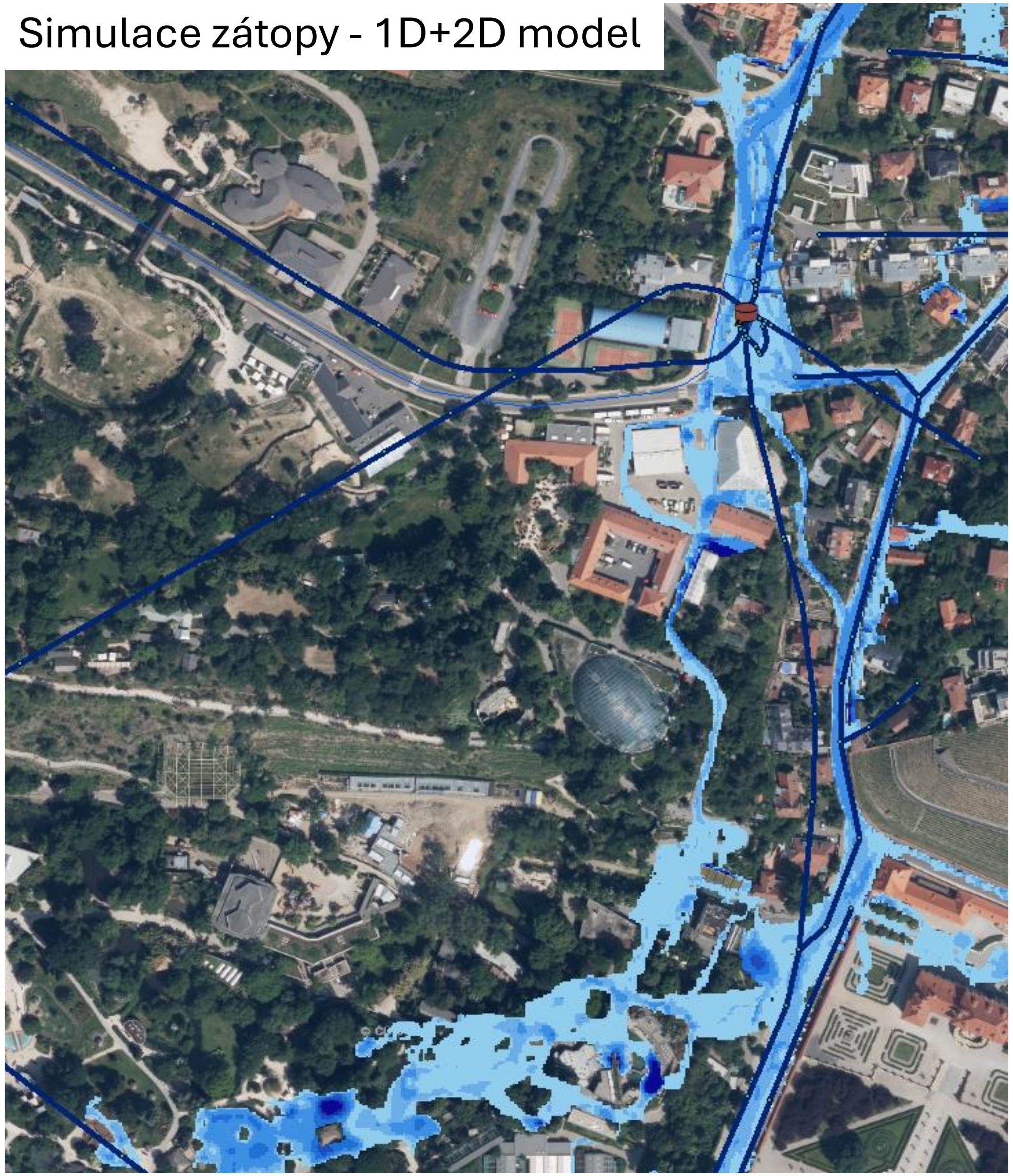


Recorded and simulated Flood in ZOO Praha

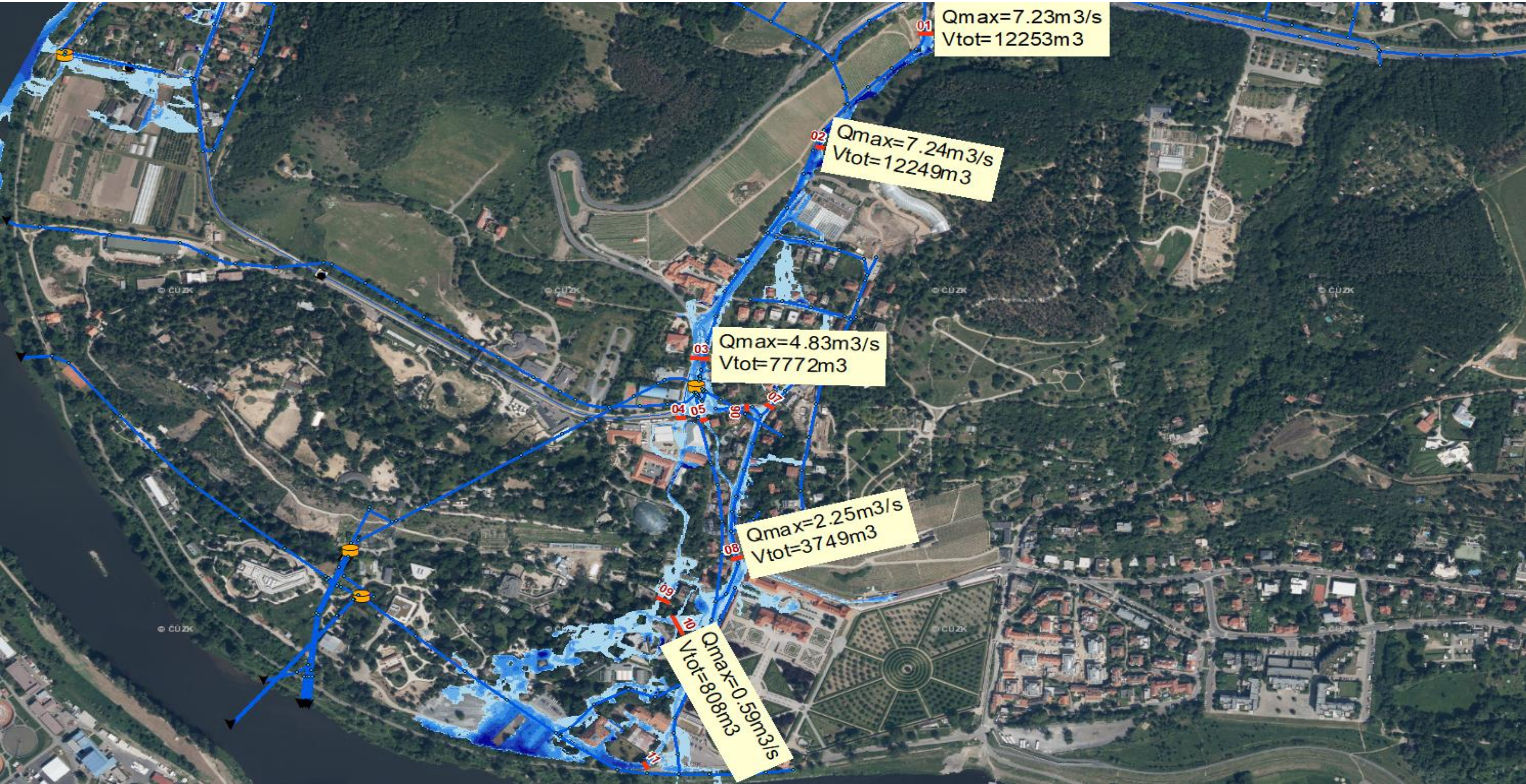
Zákres zátopy - ZOO Praha



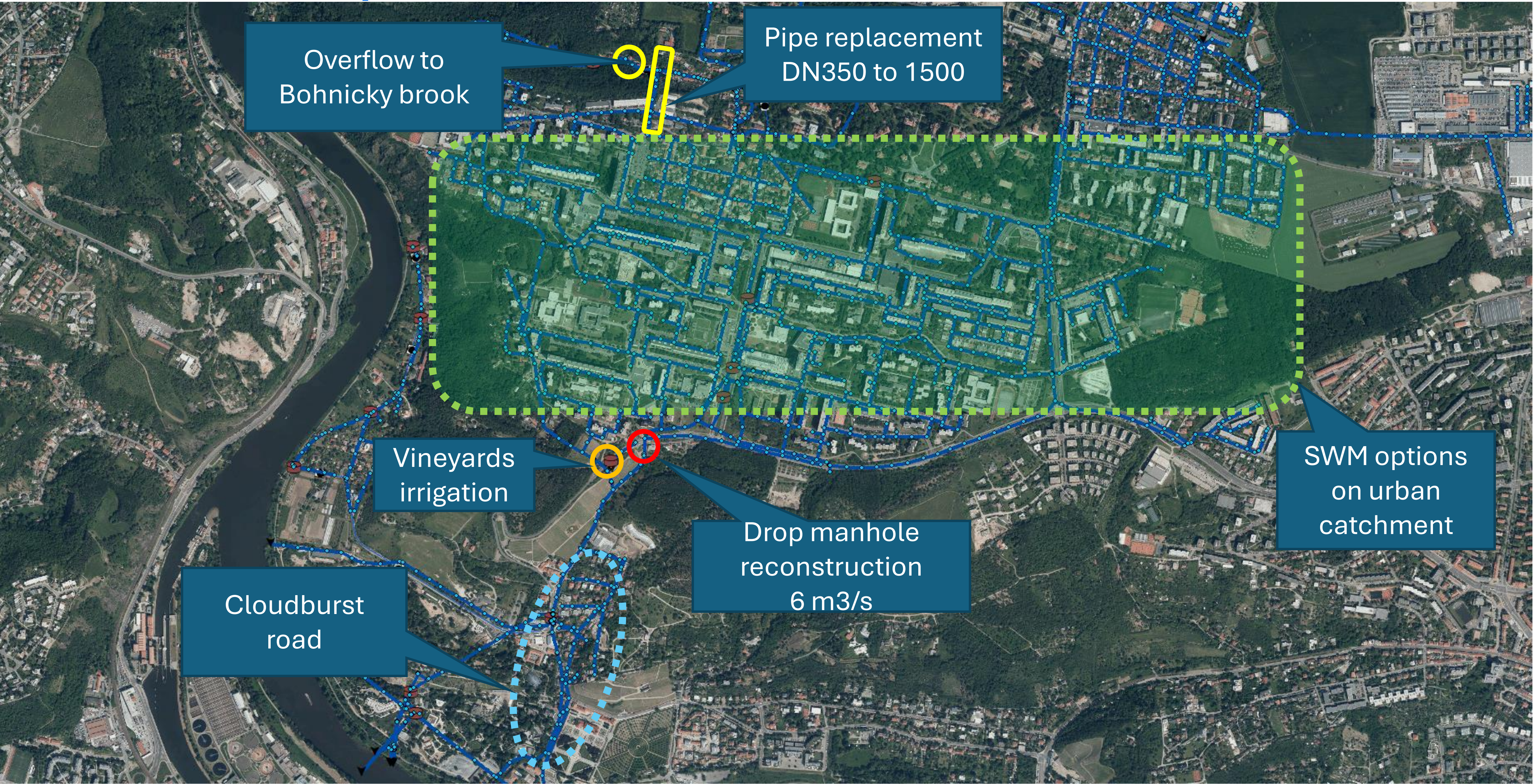
Simulace zátopy - 1D+2D model



Flooding discharges and volumes for cloudburst on 14.8.2020

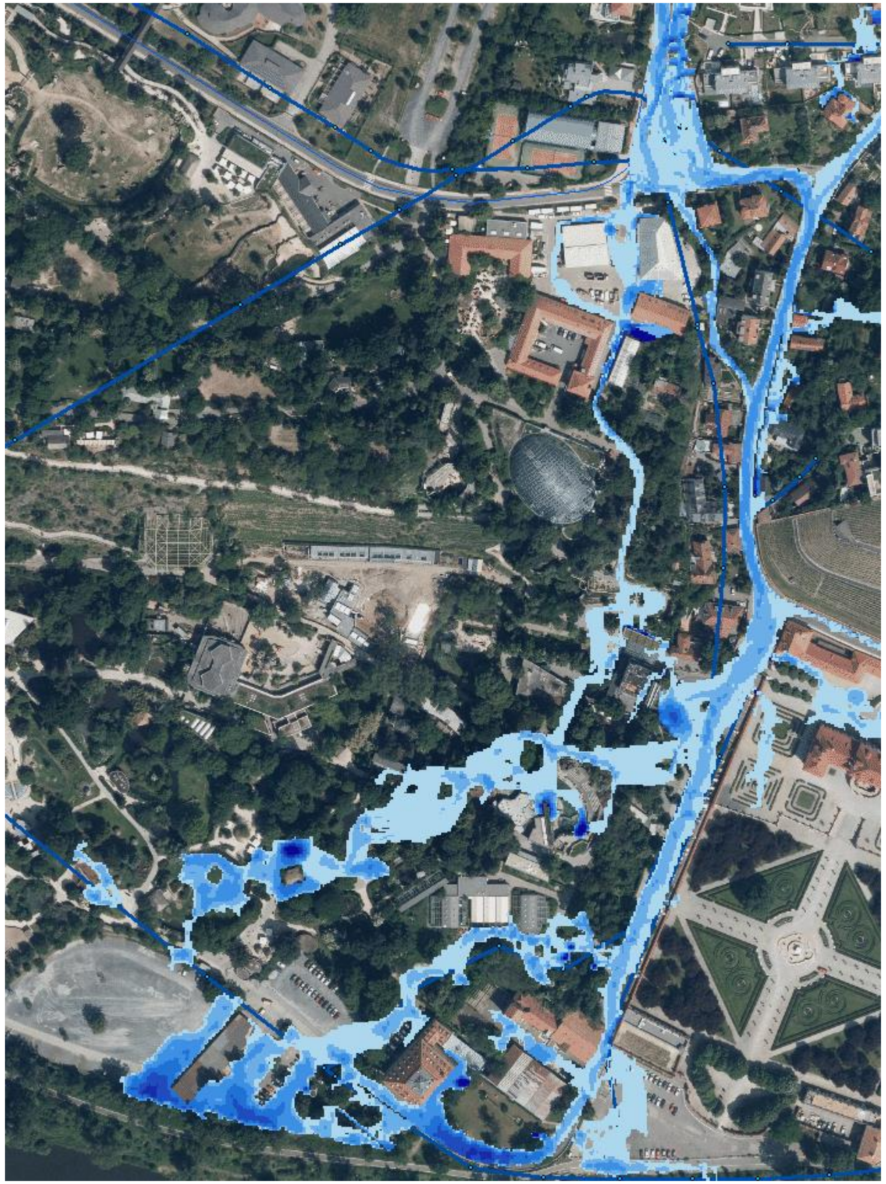


Alleviation options

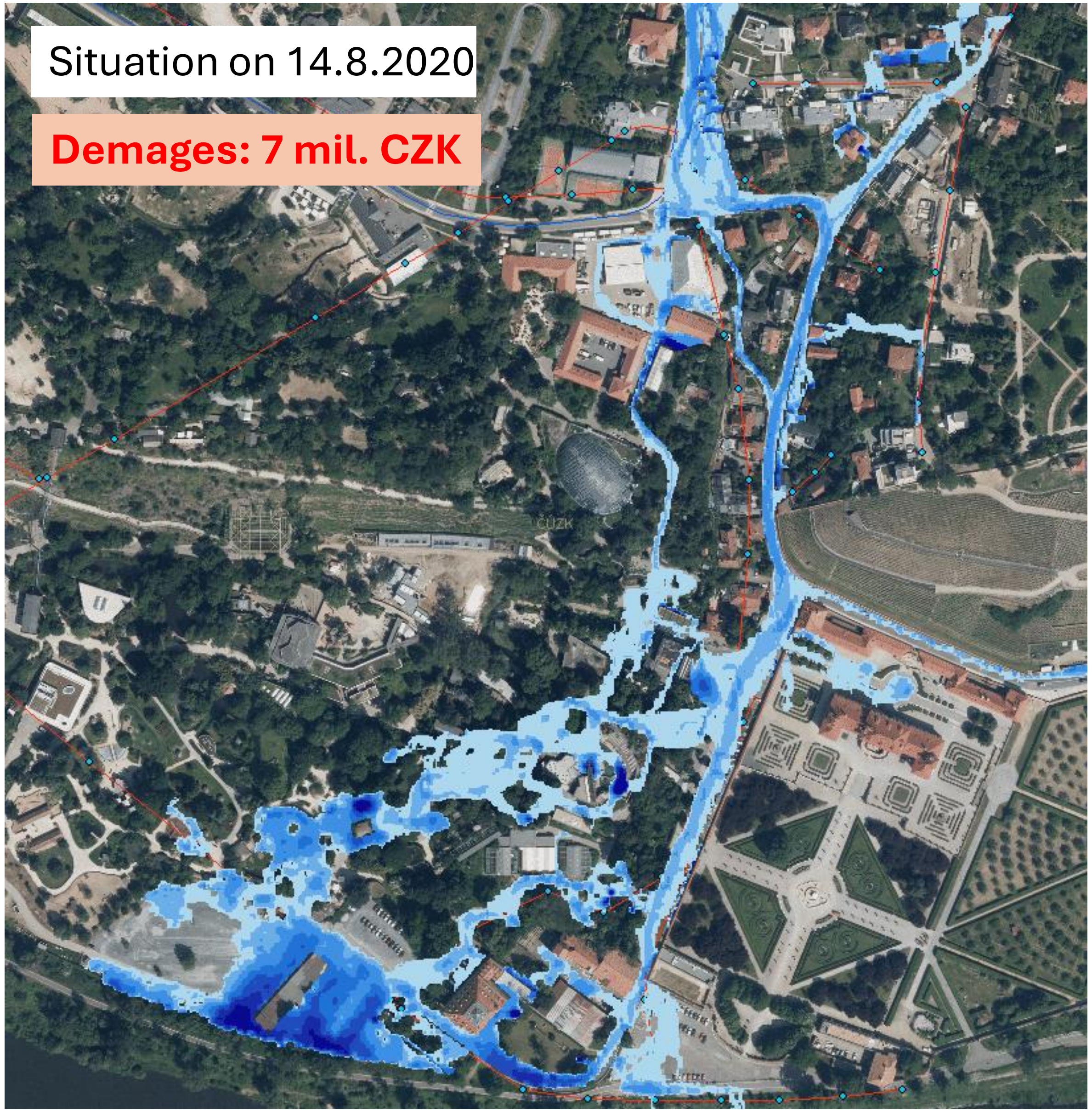


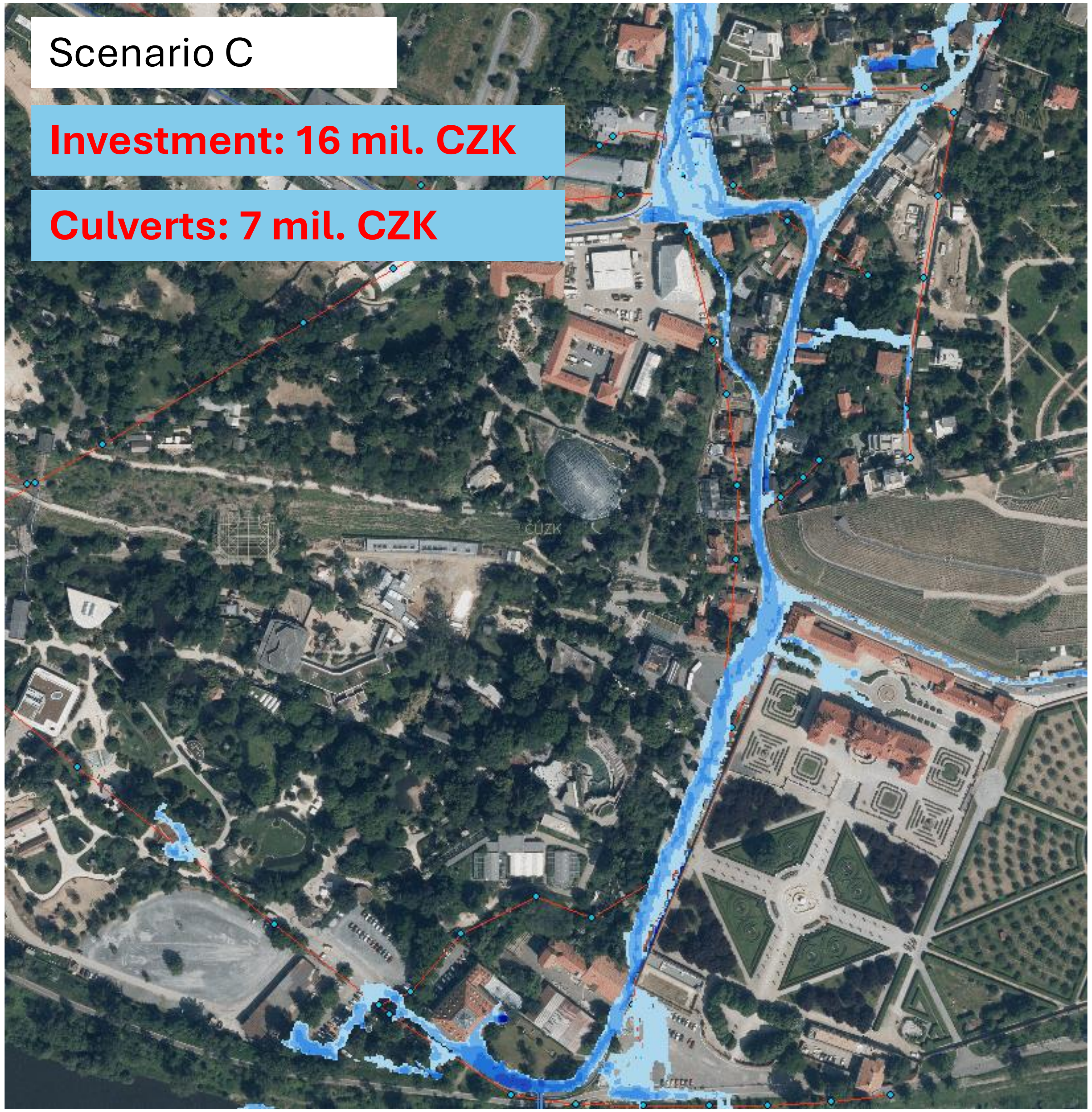
Scenario C - cloudburst road

Výron srážkových vod na povodí



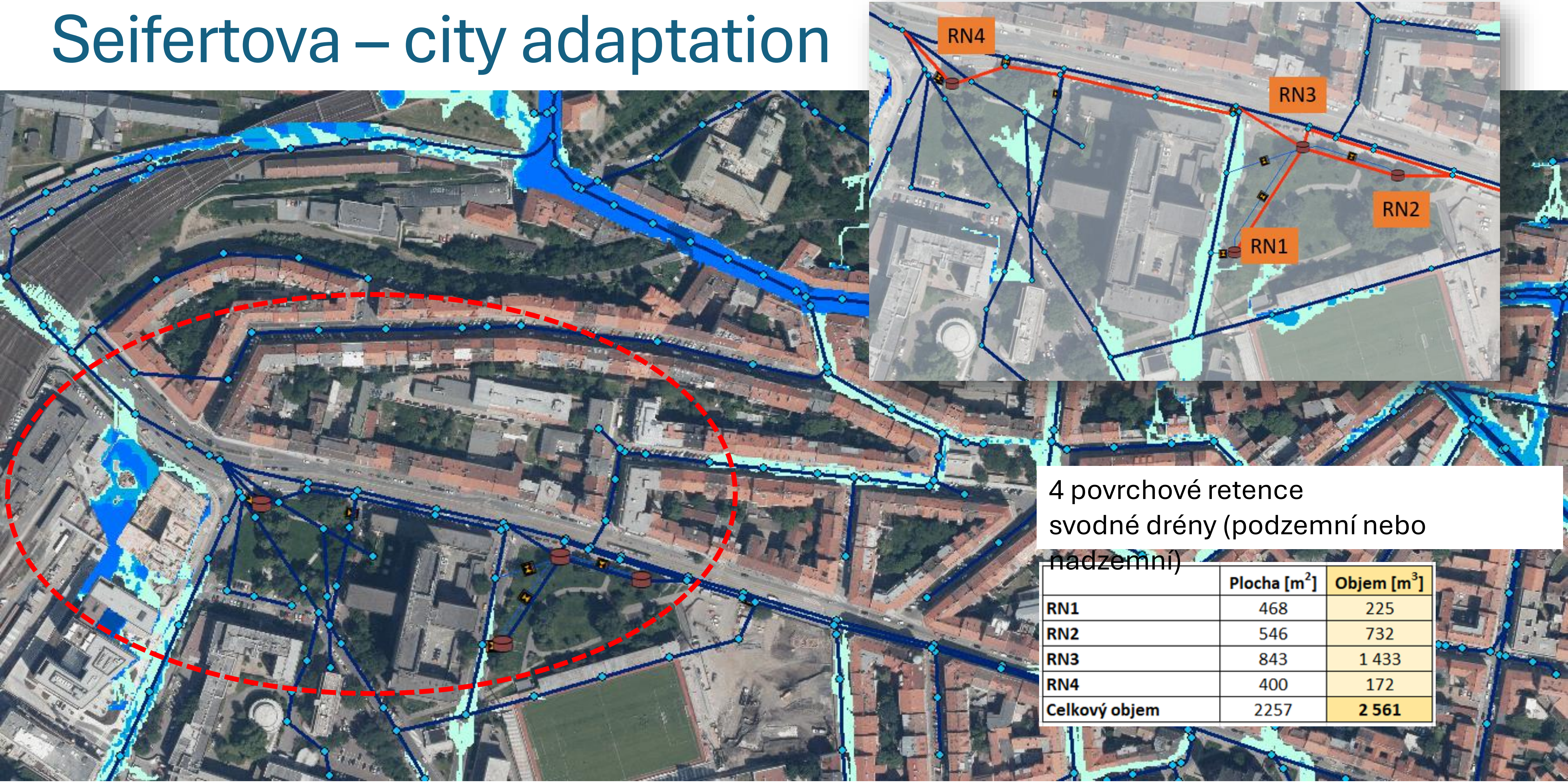
Scenario C: Zoo Prague protection





Husitská – Climate Change adaptation

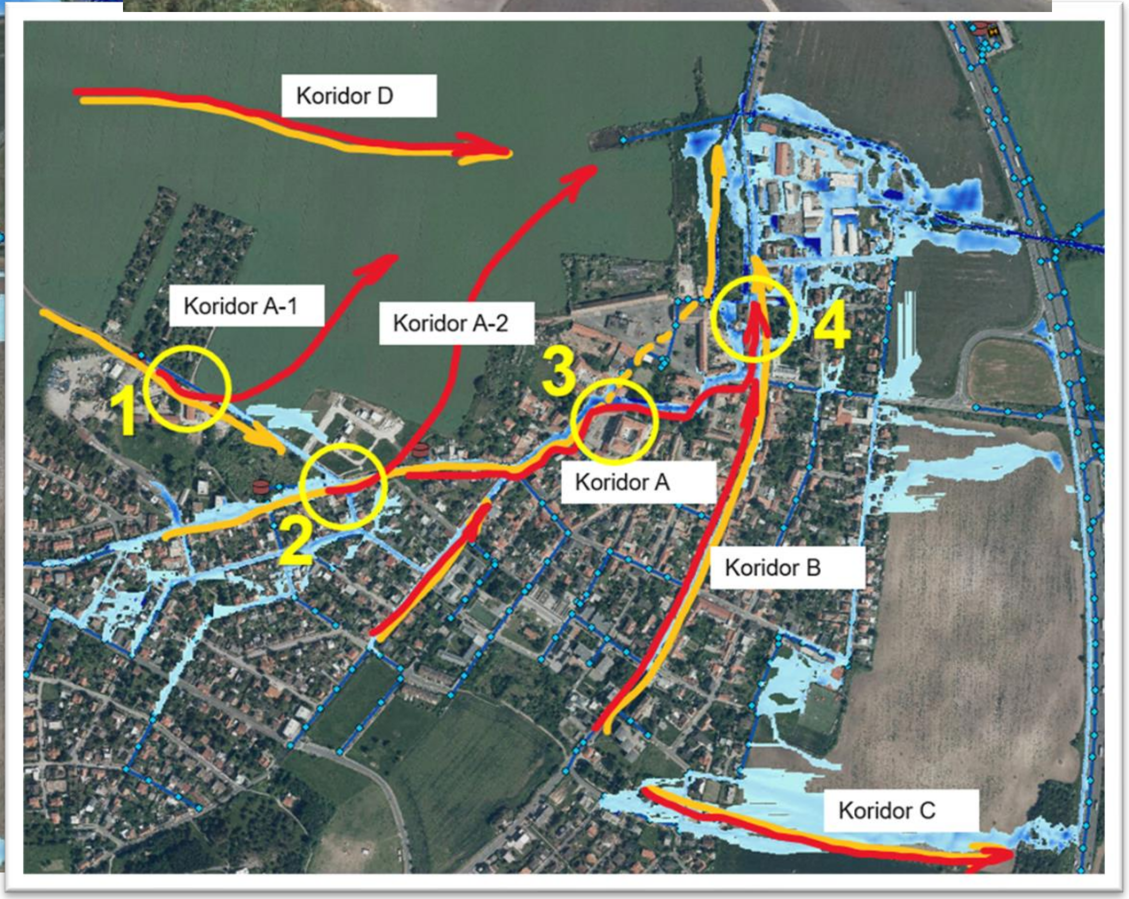
Seifertova – city adaptation



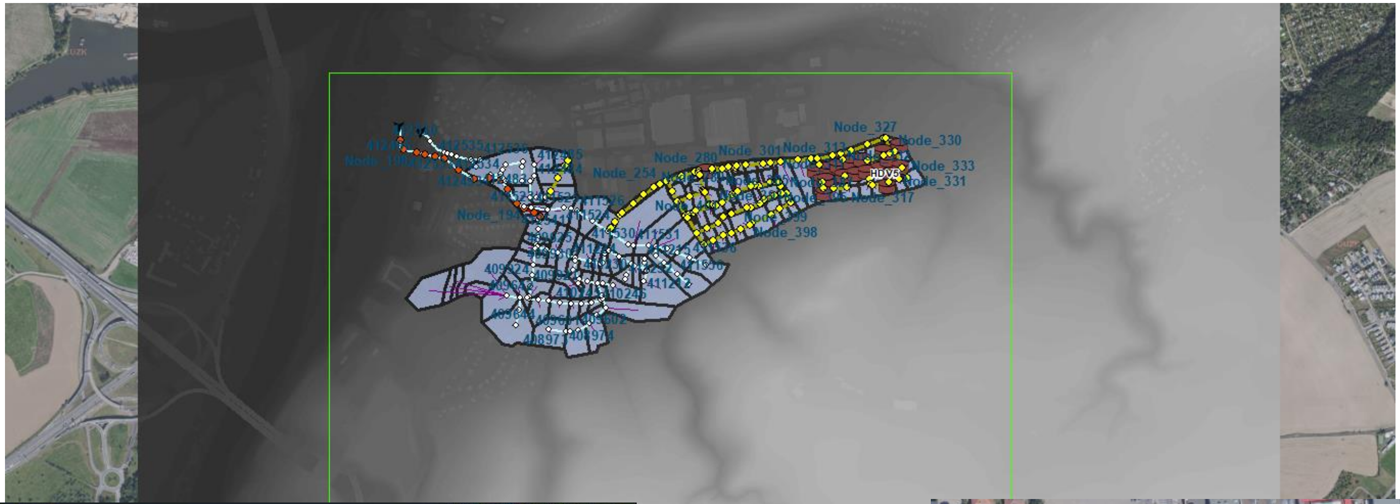
4 povrchové retence
svodné drény (podzemní nebo nadzemní)

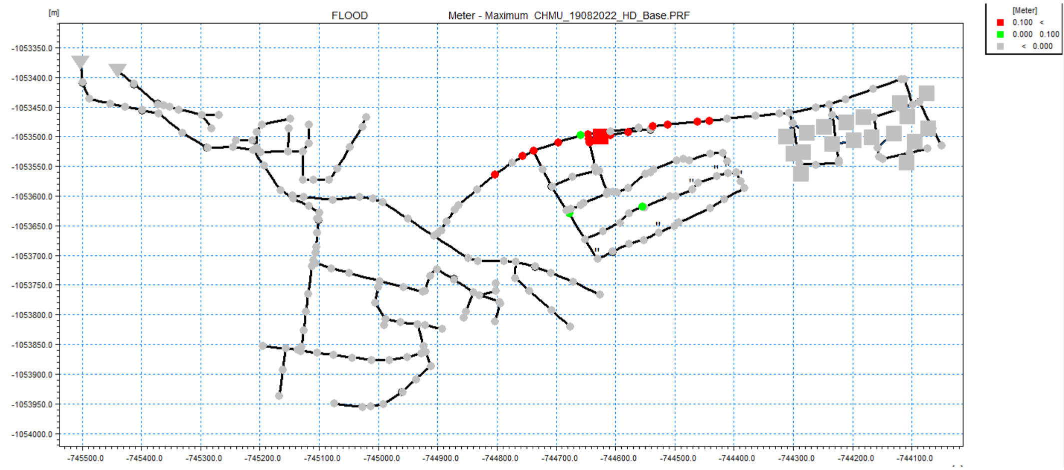
	Plocha [m²]	Objem [m³]
RN1	468	225
RN2	546	732
RN3	843	1 433
RN4	400	172
Celkový objem	2257	**2 561**

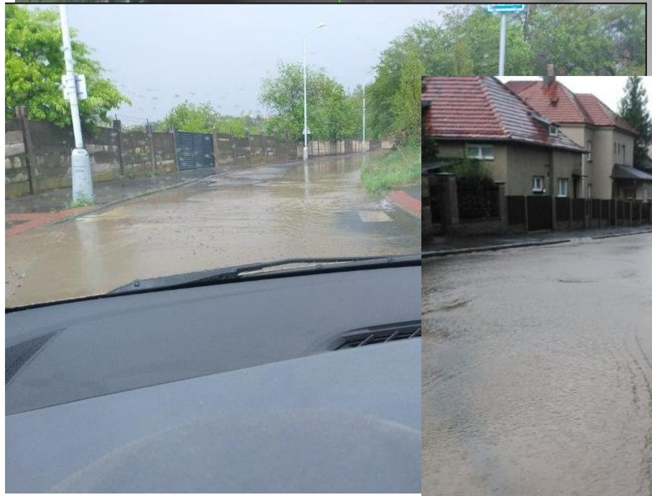
Cloudburst protection of district Dablice

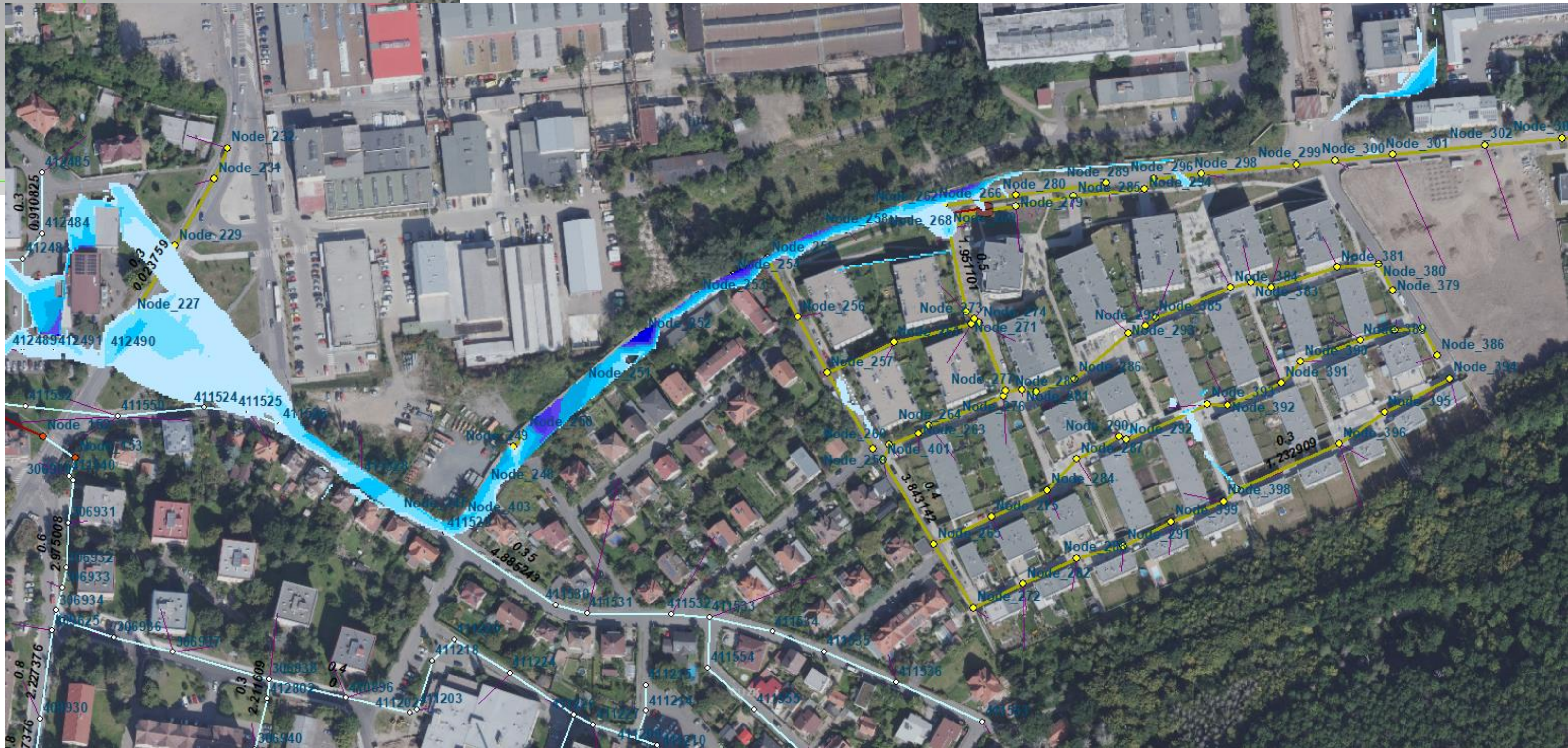


Cloudburst protection of district Komorany

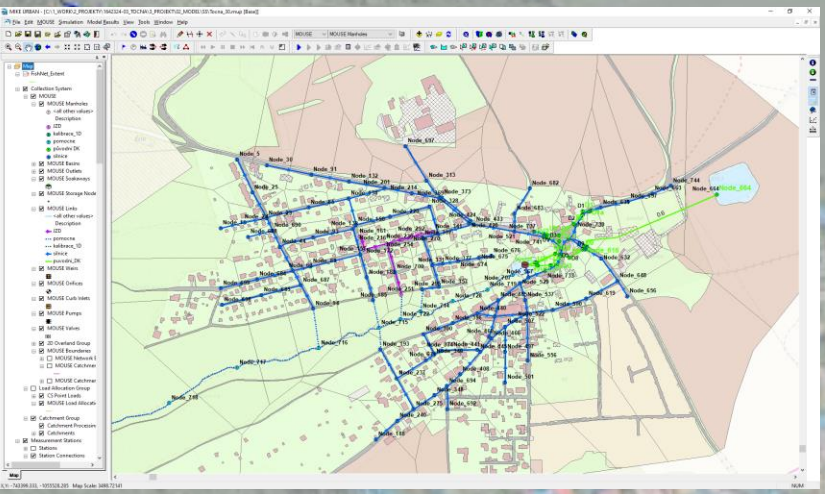


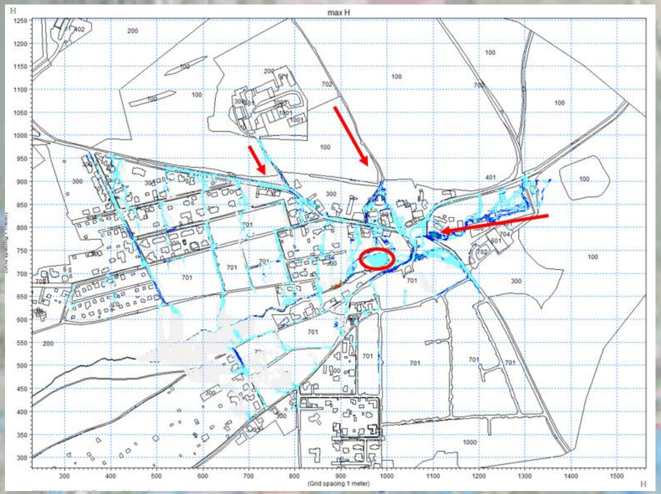


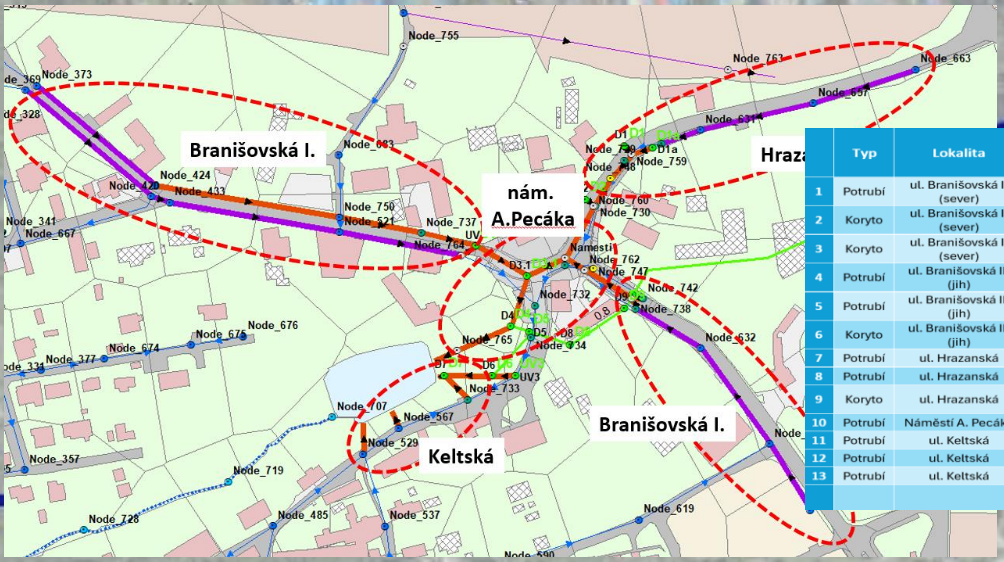




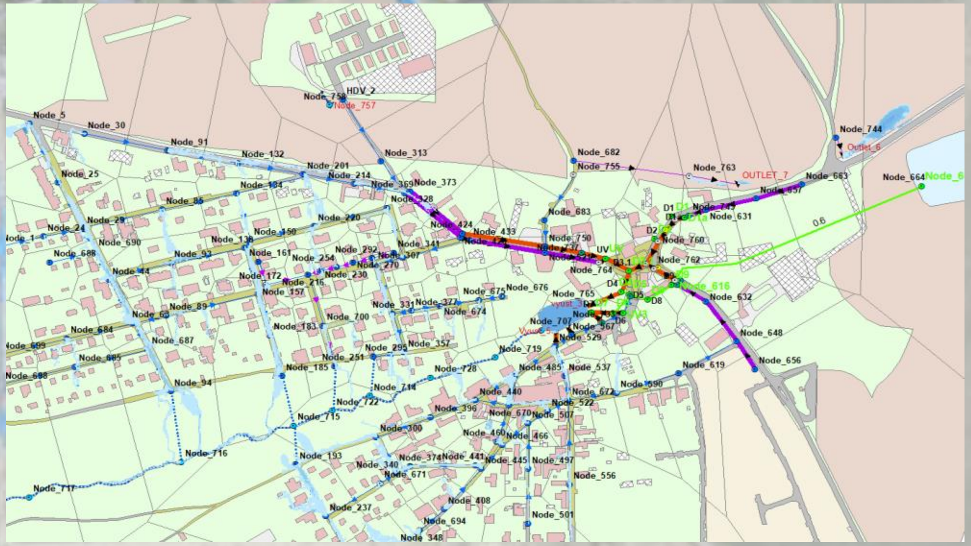
Extreme rainfall Water management –TOČNÁ district







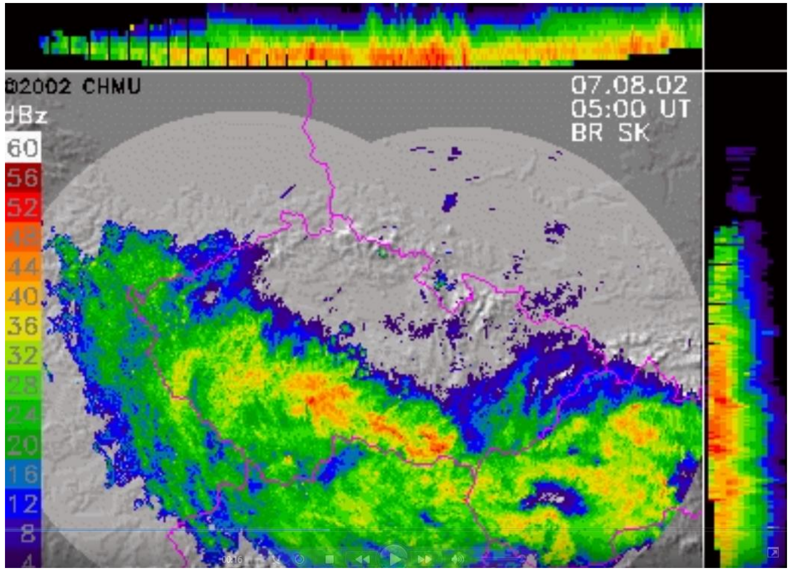
	Typ	Lokalita	Délka [m]	Rozměry			Materiál	Jednotková cena [Kč/bm]	Náklady bez DPH [kč]
				DN	H [m]	Š [m]			
1	Potrubí	ul. Branišovská I. (sever)	210	500	[-]	[-]	Beton	25 900	5 439 000
2	Koryto	ul. Branišovská I. (sever)	186	[-]	0.4	0.4	Dešťový záhon	9 200	1 711 200
3	Koryto	ul. Branišovská I. (sever)	146	[-]	0.6	0.7	Dešťový záhon	16 000	2 336 000
4	Potrubí	ul. Branišovská II. (jih)	11	300	[-]	[-]	Beton	20 000	220 000
5	Potrubí	ul. Branišovská II. (jih)	46	500	[-]	[-]	Beton	25 900	1 191 400
6	Koryto	ul. Branišovská II. (jih)	141	[-]	0.6	0.7	Dešťový záhon	16 000	2 256 000
7	Potrubí	ul. Hrazanská	56	300	[-]	[-]	Beton	20 000	1 120 000
8	Potrubí	ul. Hrazanská	31	500	[-]	[-]	Beton	25 900	802 900
9	Koryto	ul. Hrazanská	143	[-]	0.4	0.4	Dešťový záhon	9 200	1 315 600
10	Potrubí	Náměstí A. Pecáka	94	500	[-]	[-]	Beton	25 900	2 434 600
11	Potrubí	ul. Keltská	13	200	[-]	[-]	Beton	13 800	179 400
12	Potrubí	ul. Keltská	44	300	[-]	[-]	Beton	20 000	880 000
13	Potrubí	ul. Keltská	29	500	[-]	[-]	Beton	25 900	751 100
								Celkem	20 637 200

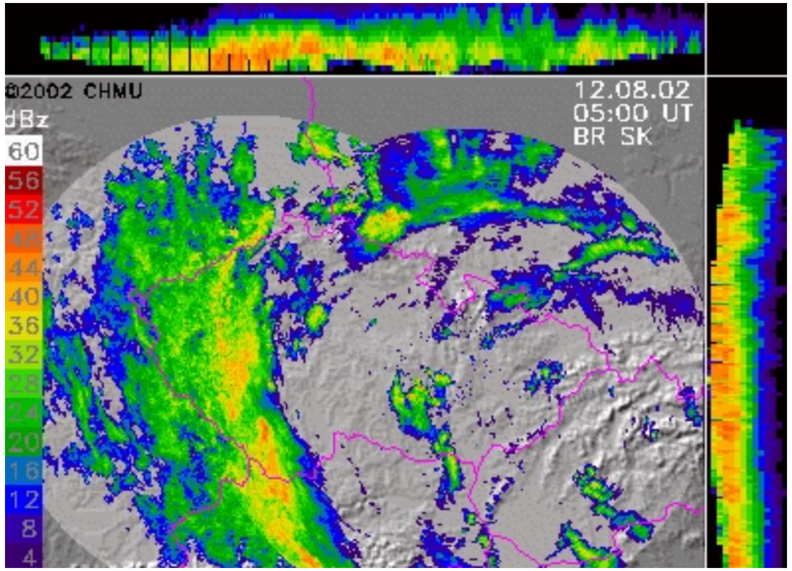


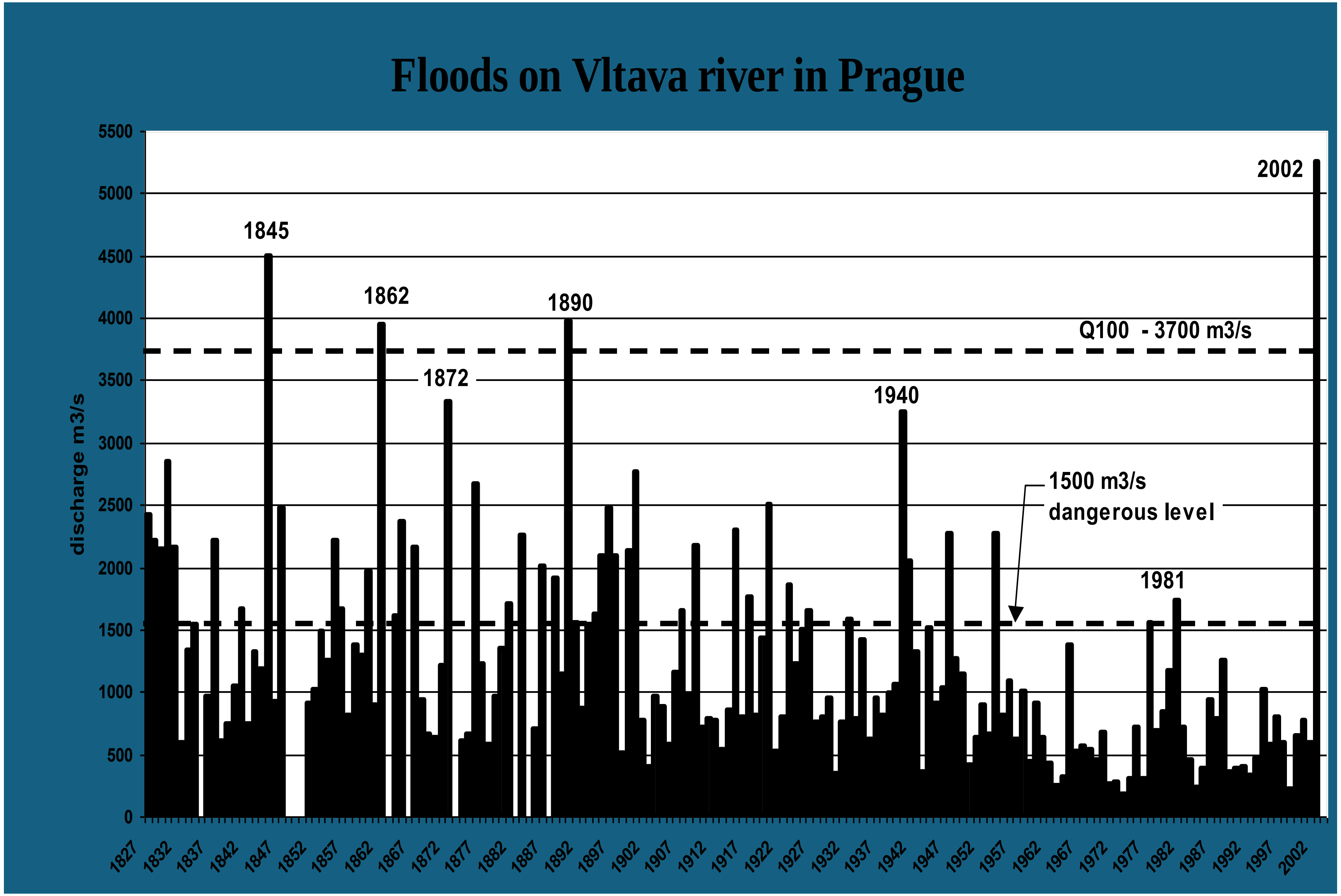
Urban Flooding

Selected Case studies

Prague Flood 07-12.8.2002



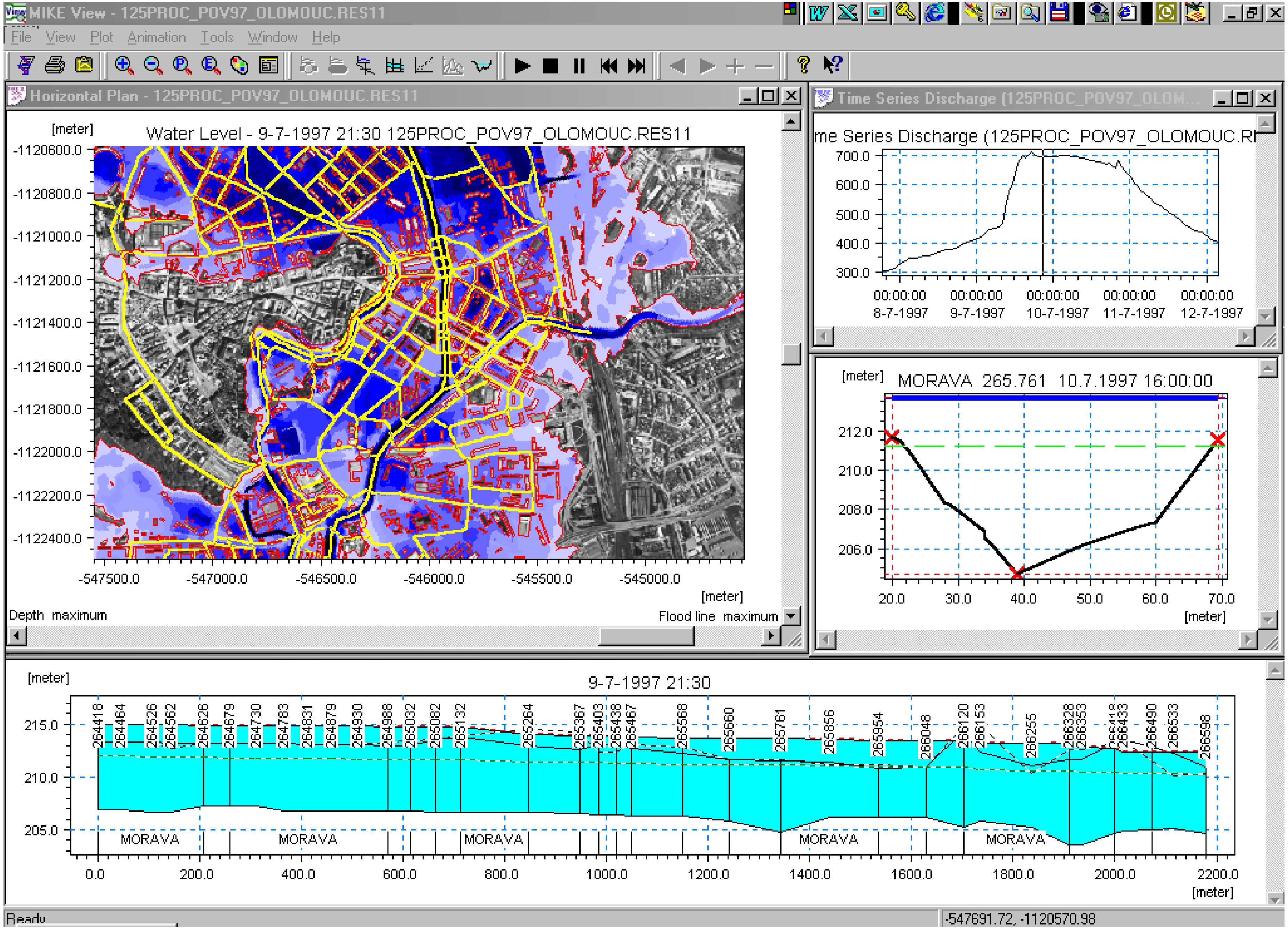




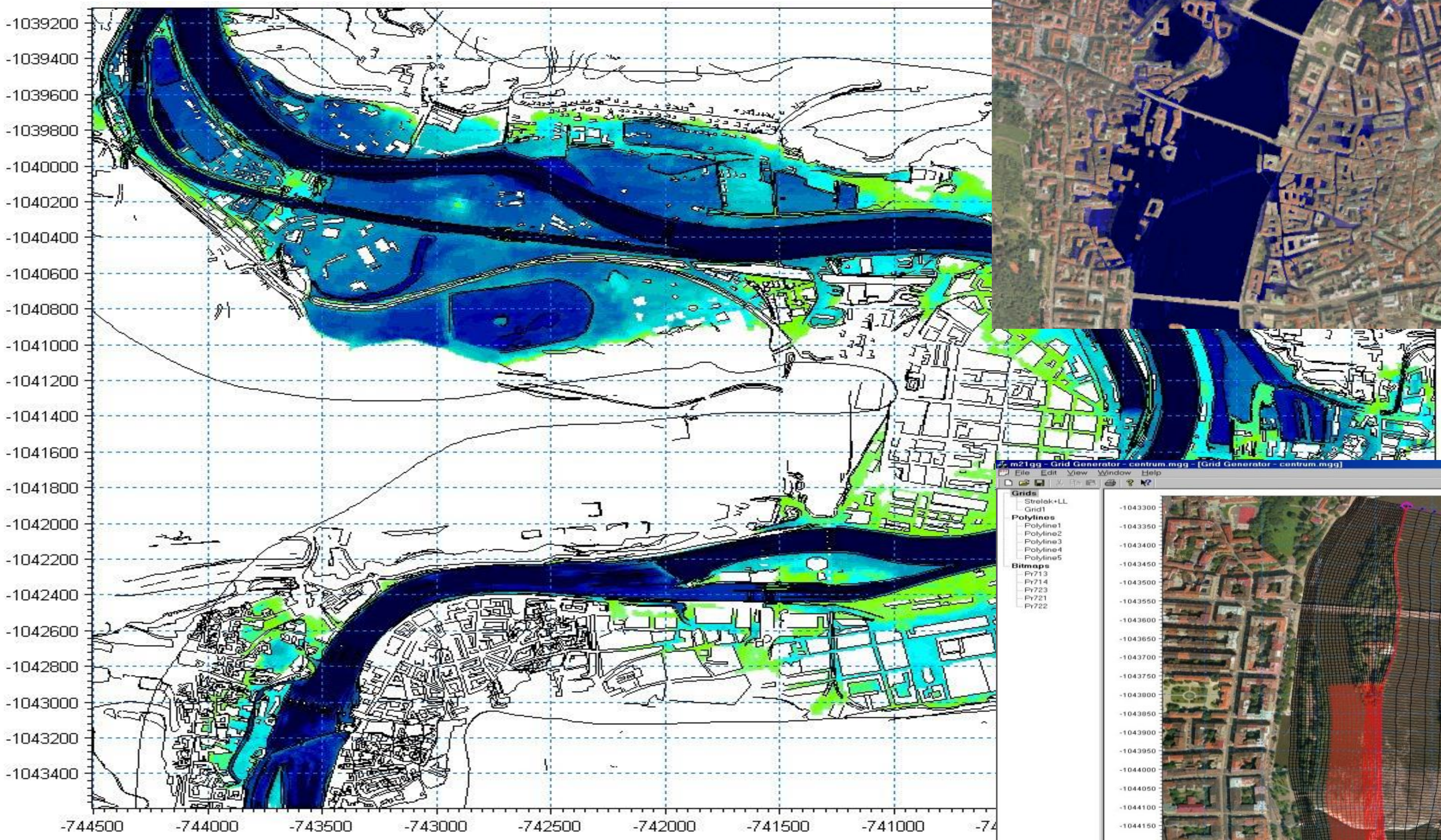

+ 1,4 m
1890

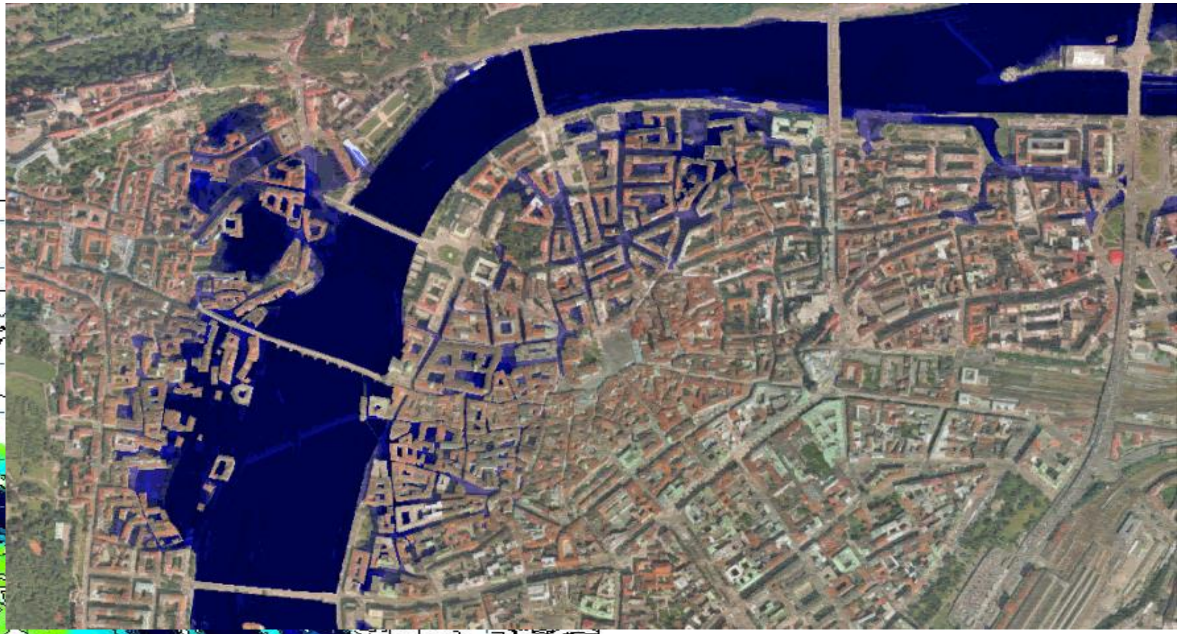
Prague reconstruction measures

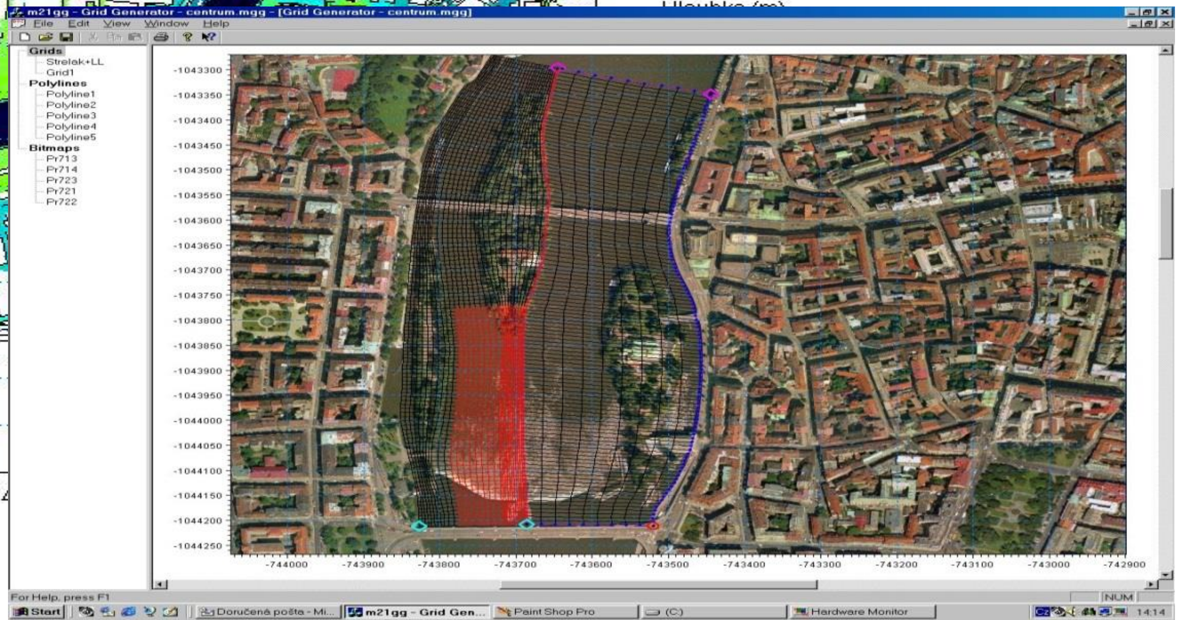
Prague reconstruction measures


MIKE View - 125PROC_POV97_OLOMOUC.RES11
File View Plot Animation Tools Window Help
Horizontal Plan - 125PROC_POV97_OLOMOUC.RES11
Water Level - 9-7-1997 21:30 125PROC_POV97_OLOMOUC.RES11
[meter]
-1120600.0
-1120800.0
-1121000.0
-1121200.0
-1121400.0
-1121600.0
-1121800.0
-1122000.0
-1122200.0
-1122400.0
-547500.0
-547000.0
-546500.0
-546000.0
-545500.0
-545000.0
Depth maximum
Flood line maximum
Time Series Discharge (125PROC_POV97_OLOM...
700.0
600.0
500.0
400.0
300.0
00:00:00 8-7-1997
00:00:00 9-7-1997
00:00:00 10-7-1997
00:00:00 11-7-1997
00:00:00 12-7-1997
MORAVA 265.761 10.7.1997 16:00:00
212.0
210.0
208.0
206.0
20.0
30.0
40.0
50.0
60.0
70.0
9-7-1997 21:30
215.0
205.0
MORAVA
0.0
200.0
400.0
600.0
800.0
1000.0
1200.0
1400.0
1600.0
1800.0
2000.0
2200.0
Ready
-547691.72, -1120570.98

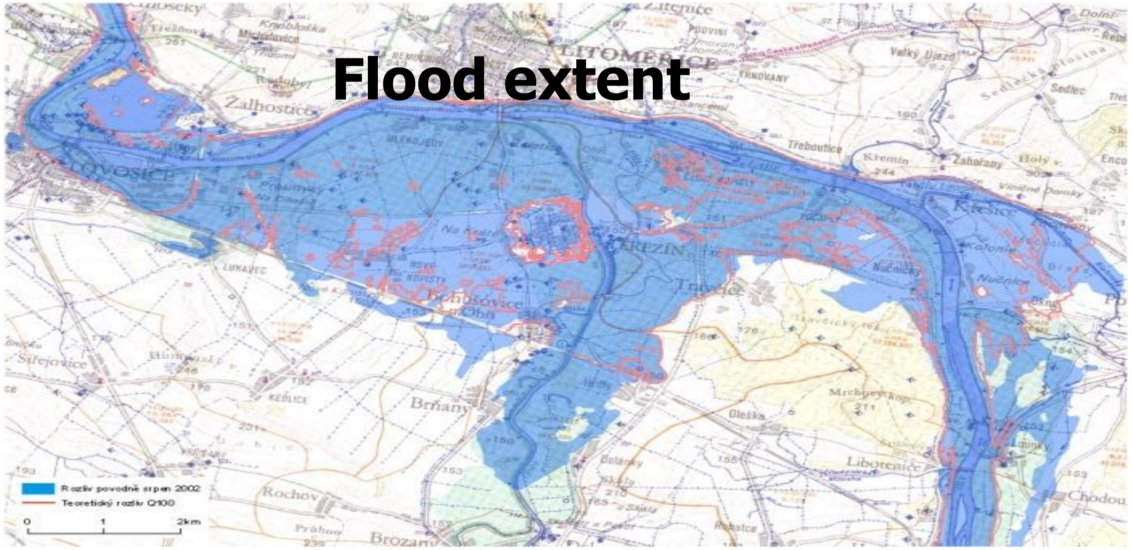
Prague 2D Flood Model

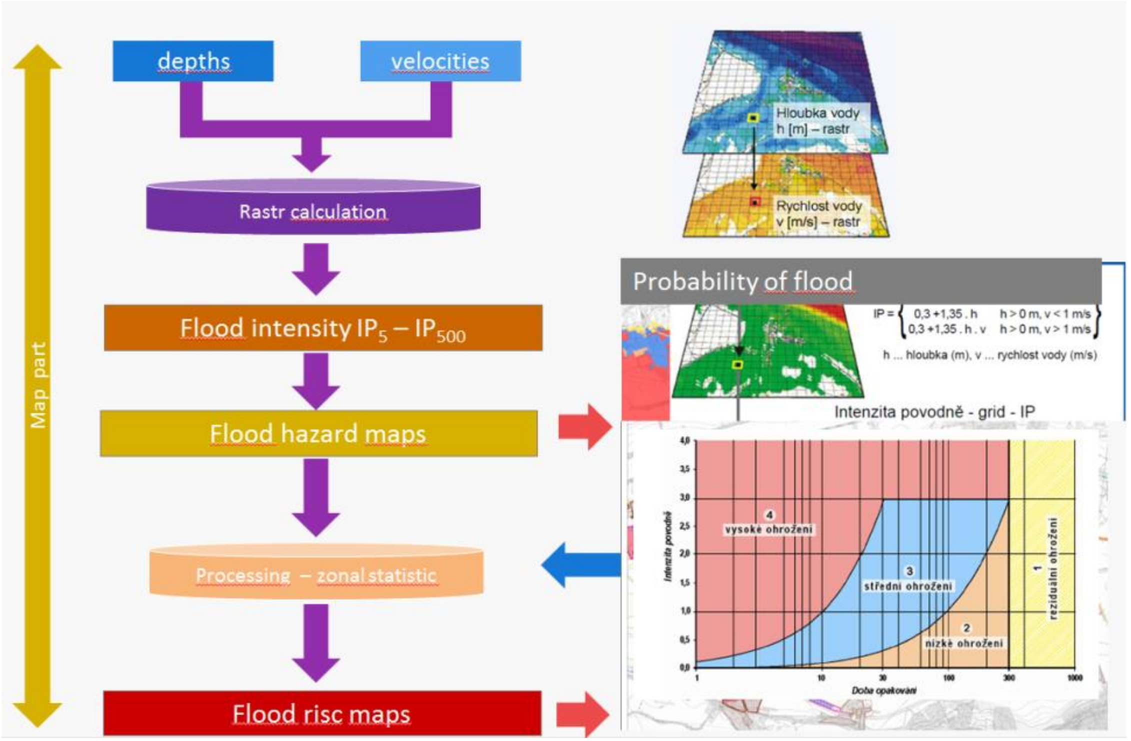


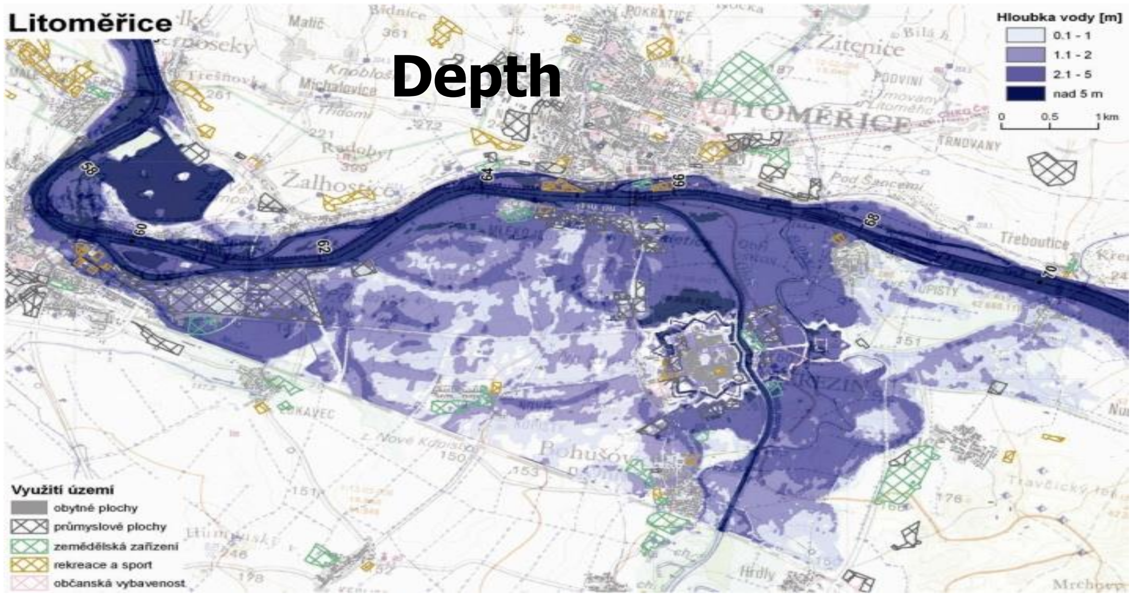


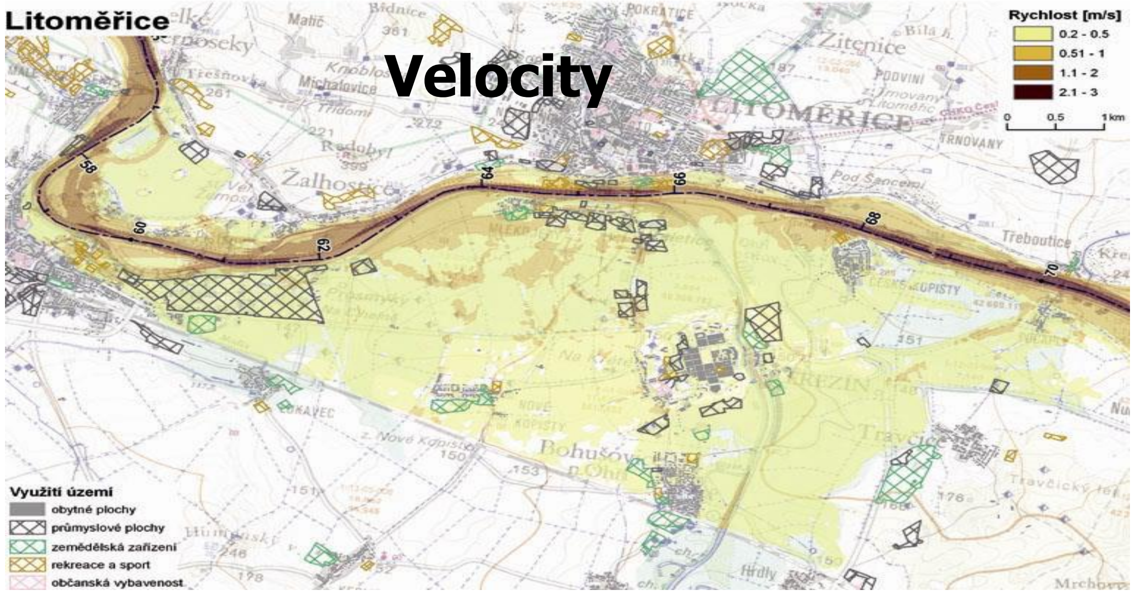


Flood Hazard Mapping









Hydroinformatics

as Game Changer in Water Management

Hydroinformatics as Game Changer

- **Ecological aspects of HIS**
  - Understanding of complexity of natural ecosystems
  - Integrated modelling
  - Quantification of impact on environment – EIA
  - Warning systems
- **Economical aspects of HIS**
  - What – if scenarios
  - Cost-benefit optimization
  - Risk and uncertainty understanding
  - Problem of low income counties
  - Investment in data collection
  - Parallel designing

Hydroinformatics as Game Changer

- **Political aspects**
  - Influence on legislation
  - Independent communication platform
  - Risk and uncertainty understanding
  - Legislative demands
- **Social aspects of HIS**
  - Demands on education and skills
  - Information sharing
  - Knowledge and learning
  - Potential conflict of generations
  - Transparency and focus on **responsibility**
  - Legislative pressure and **demands on institutional relations**
  - Changes in **employment structure**
  - **Role of experts to experts**

Expert in Hydroinformatics - needs and skills

1. Understanding of natural processes
2. Programming skills
3. GIS, database skills
4. Understanding of model background and limitations (interpretation of reality)
5. Legislative knowledge
6. IT skills

HIS and Computational Intelligence (CI)

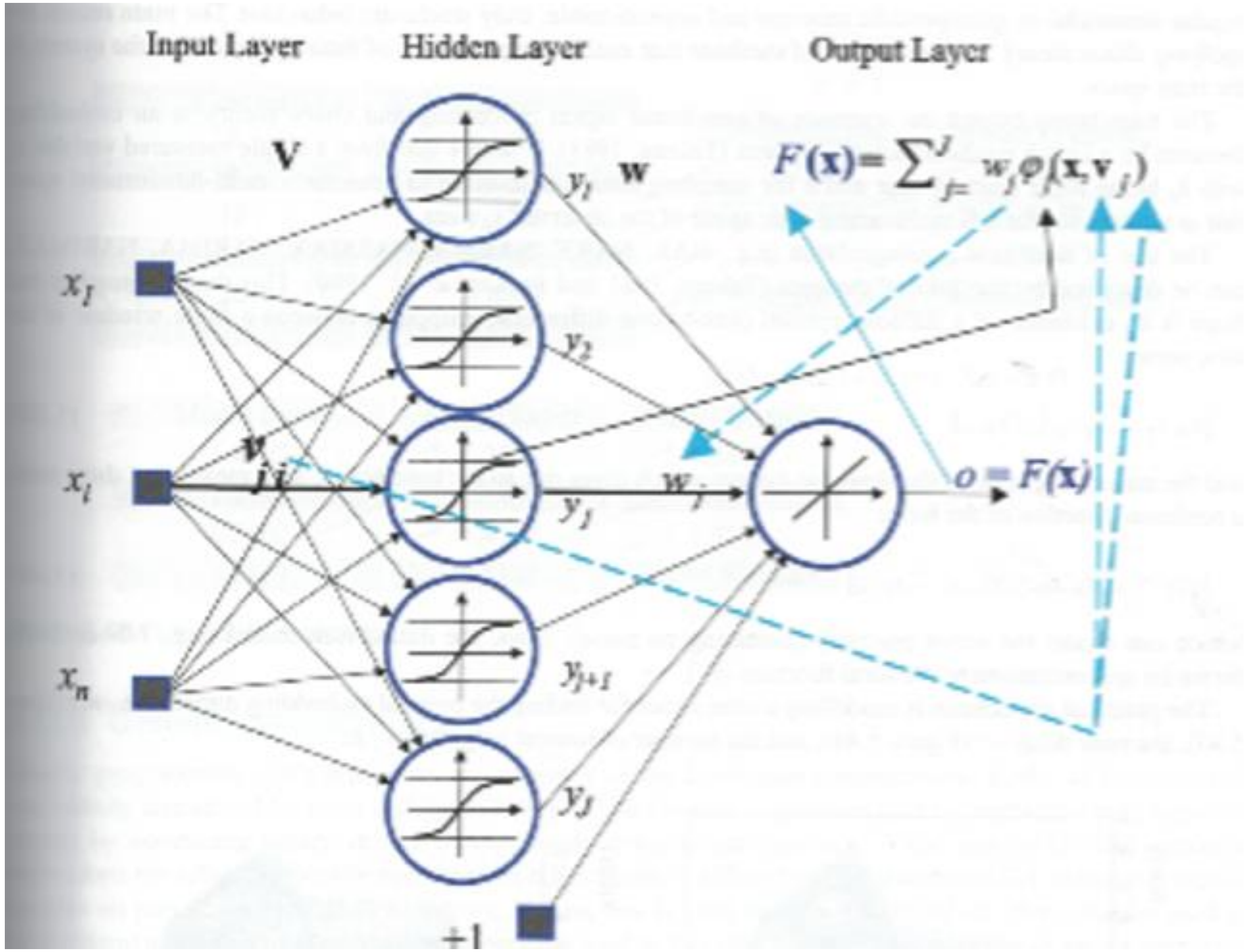
CI – methods and modelling principles are characterized by such properties as learning and adaptation , evolution and Fuzzy logic to create the programs that have **some characteristic of intelligence. But not have aiming at achieving it .**

- **Neural networks** as models of **human brain**

- **Evolutionary computing and optimization** - exploiting the principles of **natural evolution and adaptivity** (growth curve, competition, symbiosis)
- **Expert system** describing processes as IF-THEN sequence of rules
- **Fuzzy logics** as a way how **to handle uncertainty** and perform computing with words **m**

Hydroinformatics is incorporating **CI** as in the situation of **increasing data availability and quality** . It offers many new techniques complementing the traditional simulation modelling.

Neural Networks
Principles

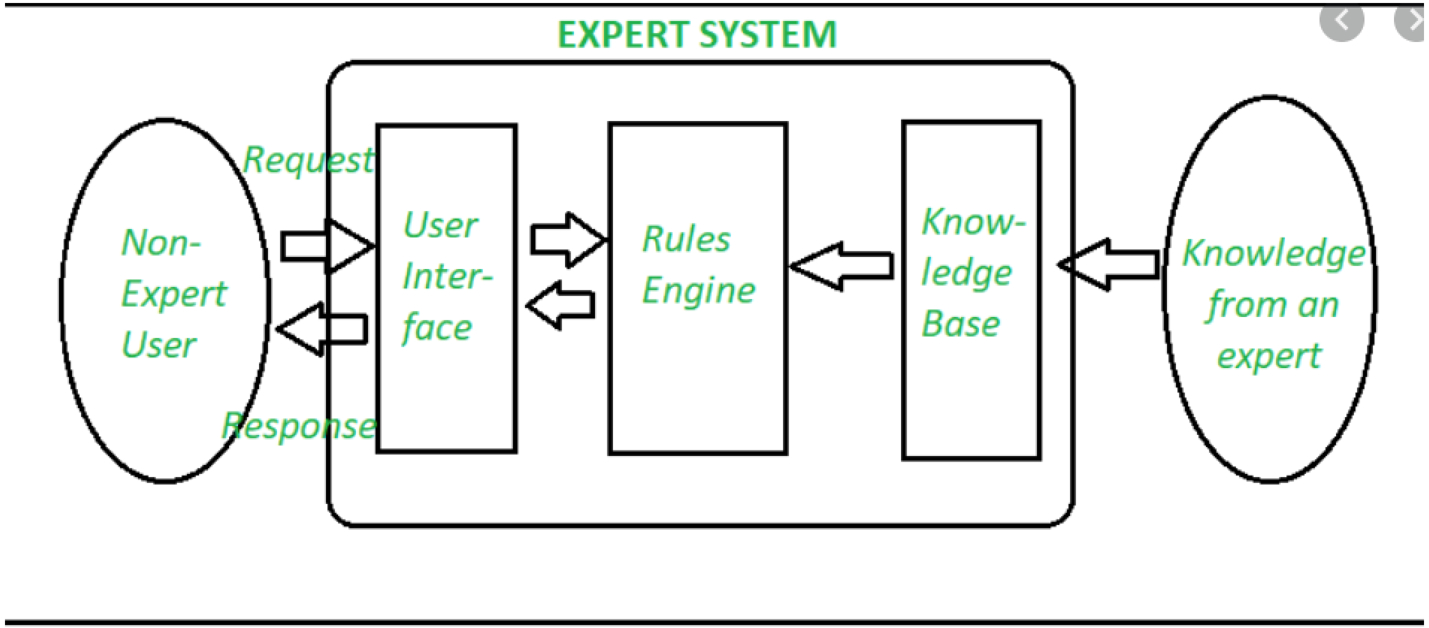


Key design parameters:

- Number of input variables
- Number of hidden layers and hidden layers weights
- Size of the training data sets
- Sampling frequency

Expert Systems

In artificial intelligence, an expert system is a computer system emulating the **decision-making ability of a human expert**. Expert systems are designed to solve complex problems by reasoning through bodies of knowledge, represented mainly as **if–then rules** rather than through conventional procedural code.



Fuzzy Logic

In fuzzy mathematics, **fuzzy logic** is a form of many-valued logic in which the truth value of variables may be any real number between 0 and 1 both inclusive.

It is employed to handle the **concept of partial truth**, where the true value may range between completely true and completely false. By **contrast, in Boolean logic**, the truth values of variables may only be the integer values 0 or 1.

The term *fuzzy logic* was introduced with the 1965 proposal of fuzzy set theory by Lotfi Zadeh. Fuzzy logic had, however, been studied since the 1920s, as infinite-valued logic—notably by Łukasiewicz and Tarski.

Fuzzy logic is based on the observation that **people make decisions based on imprecise and non-numerical information**. Fuzzy models or sets are mathematical means of representing vagueness and imprecise information (hence the term fuzzy).

These models have the capability of recognizing, representing, manipulating, interpreting, and utilising **data and information that are vague and lack certainty.**

Fuzzy logic has been applied to many fields, from control theory to artificial intelligence.

HIS and Artificial Intelligence (AI)

Artificial intelligence (**AI**) is an area of computer science that **focuses on creating intelligent machines** that can **perceive their environment** and make **decisions to optimise** towards a given goal.

Two disciplines worth highlighting in the context of **AI** are **machine learning** (ML) and **computer vision (CV)**.

- ML aims to provide computers with the ability **to learn iteratively**, to improve predictive models and find insights from data **without being explicitly programmed (neural networks)**.
- CV aims computers **to recognise itś environment (object recognisîon)** and to react on changes in this environrnent

Artificial Intelligence in Hydroinformatics

Hydroinformatics must deal with the **relationship between models and data.**

AI should serve as a **conduit between raw data and synthetized model knowledge** by producing useful analyses and reports – it looks as breaking down the current principles