METHODOLOGY PROPOSAL FOR A DETERMINATION OF FLOOD AND FLOODING RISK AND DAMAGES IN THE CZECH REPUBLIC

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Floods in Czech Republic

experiences from the past and preparedness for a future

Prague, 14th August 2002

Prague, 7th April 2005

METHODOLOGY PROPOSAL FOR A DETERMINATION OF FLOOD / FLOODING RISK AND DAMAGES IN THE FLOODPLAIN AREA AND RESPECTIVE VERIFICATION WITHIN THE ELBE RIVER BASIN

VaV/650/5/02

ORDERING AUTHORITY: Ministry of Environment of Czech Republic

PROJECT SOLUTION TIME : October 2002 – December 2005

PROJECT SPECIALISTS from:

T.G.Masaryk Water Research Institute Praha, Branch Brno

Czech Technical University, Civil Engineering Faculty Prague

Technical University, Civil Engineering Faculty Brno

Elbe River Basin Administration, Hradec Kralove

Hydroprojekt, company for project proposals, Prague

PROJECT OBJECTIVES

- to specify for floodplain areas, for areas threatened by possible flooding, mainly for return period N=100 years:
  * flood damages potential
  * flood / flooding risk
- to take into account special failure cases

- general methodology for a determination of flood / flooding risk degree that results from a flood hazard
- general methodology in order to describe potential flood / flooding damages
- specific approach by failures of flood defence measures
- practical application within the Elbe River Basin
  - determination of flood / flooding risks
  - quantification of potential flood / flooding damages

ATTRIBUTES OF THE METHODOLOGY

- Problems of risk analysis with a view to floodplain areas
- Specification of applicable data sources
- Description of procedures and methods
  - selection and specification due to qualitative demands
  - selection and specification due to quantitative demands

  with regard to consequences of flood / flooding hazard
- GIS tools: ArcView 8.2 – 9
- Methodology would represent an open system – as a prerequisite of process development, following up and integration
- Methodology does not aimed at processes dealing with proposals focusing efforts on flood protection measures
- Efficiency of flood defence measures would not be assessed by solutions resulting from the methodology

Principal features of the methodology

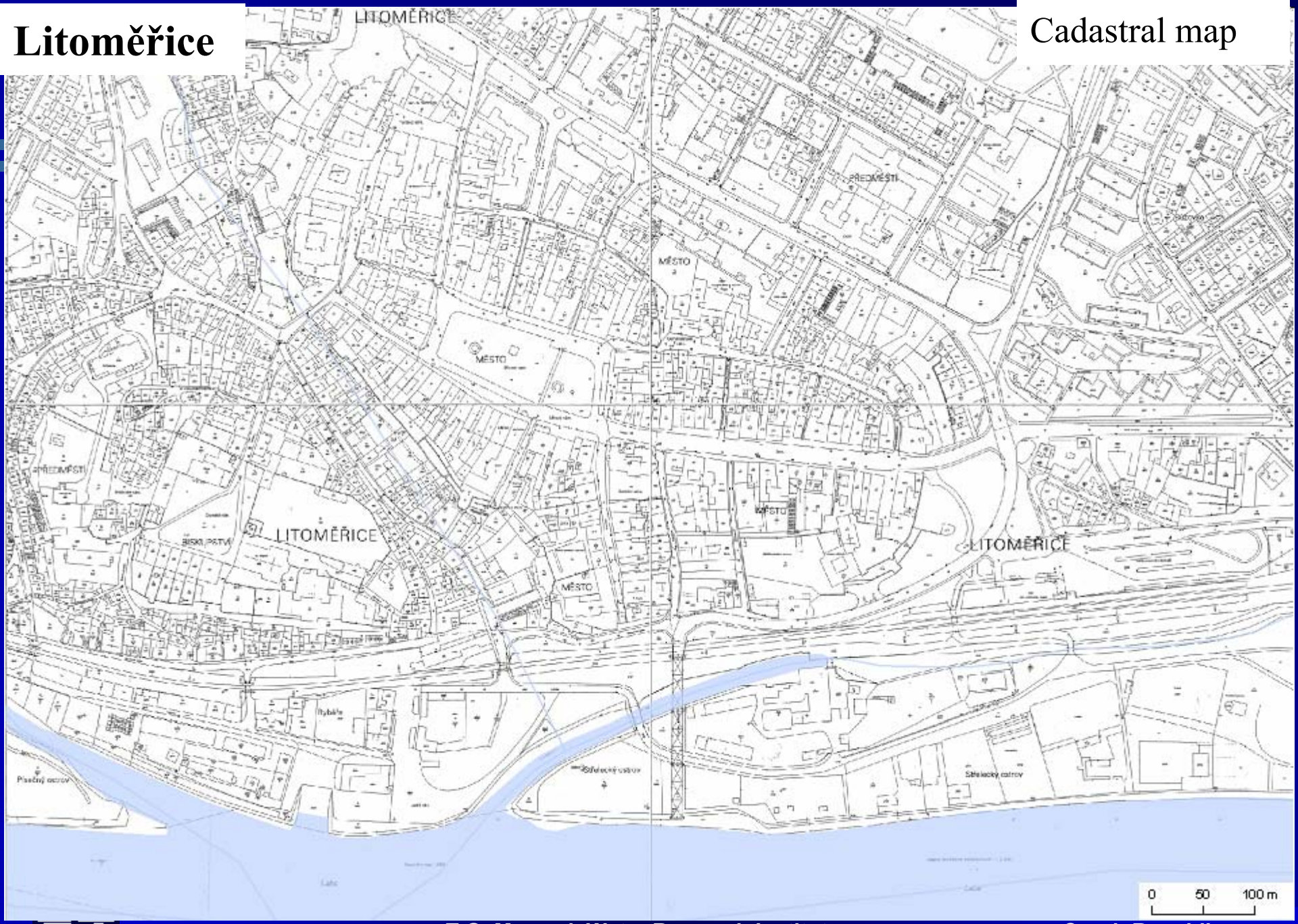
A. Procedures recommended by the methodology have been connected to the utmost to standard database established, operated and administrated within the Czech Republic

Standard „flood / flooding database“ in Czech Republic:

1. Ordnance survey maps / Cadastral maps (1:2 880, 1:2 000)
2. Basic lined and columned maps 1:10 000
3. State map 1:5 000
4. Maps in the system „ZABAGED“ 1:10 000 – vector
5. Ortophoto-maps
6. Territorial planning documentation related to regions, districts etc.
7. Territorial planning documentation related to municipalities
8. Register of census perimeters (Czech Statistical Office) (RSO)
9. Administrative register of economic subjects (Ministry of Finance)

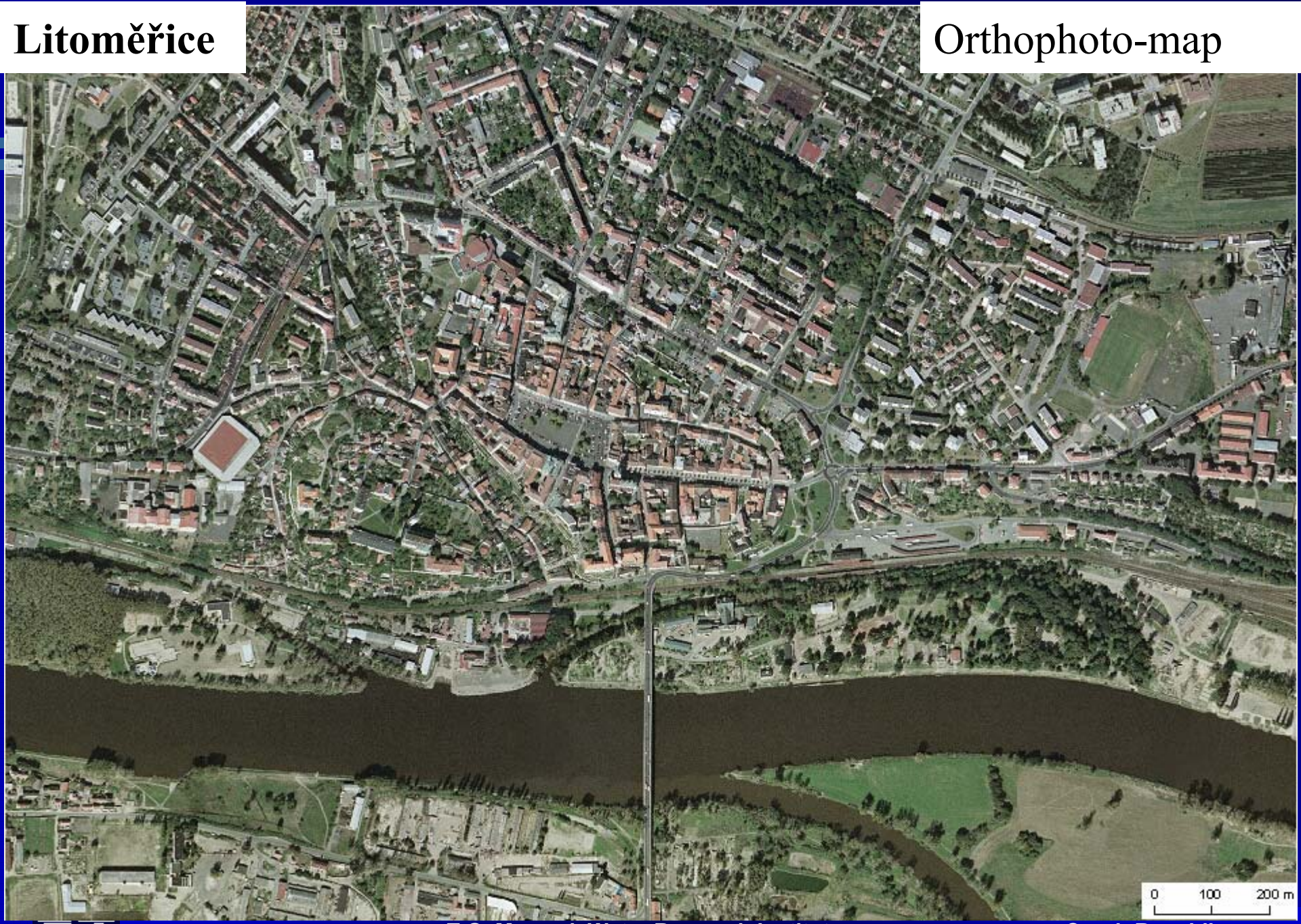
Litoměřice

Cadastral map



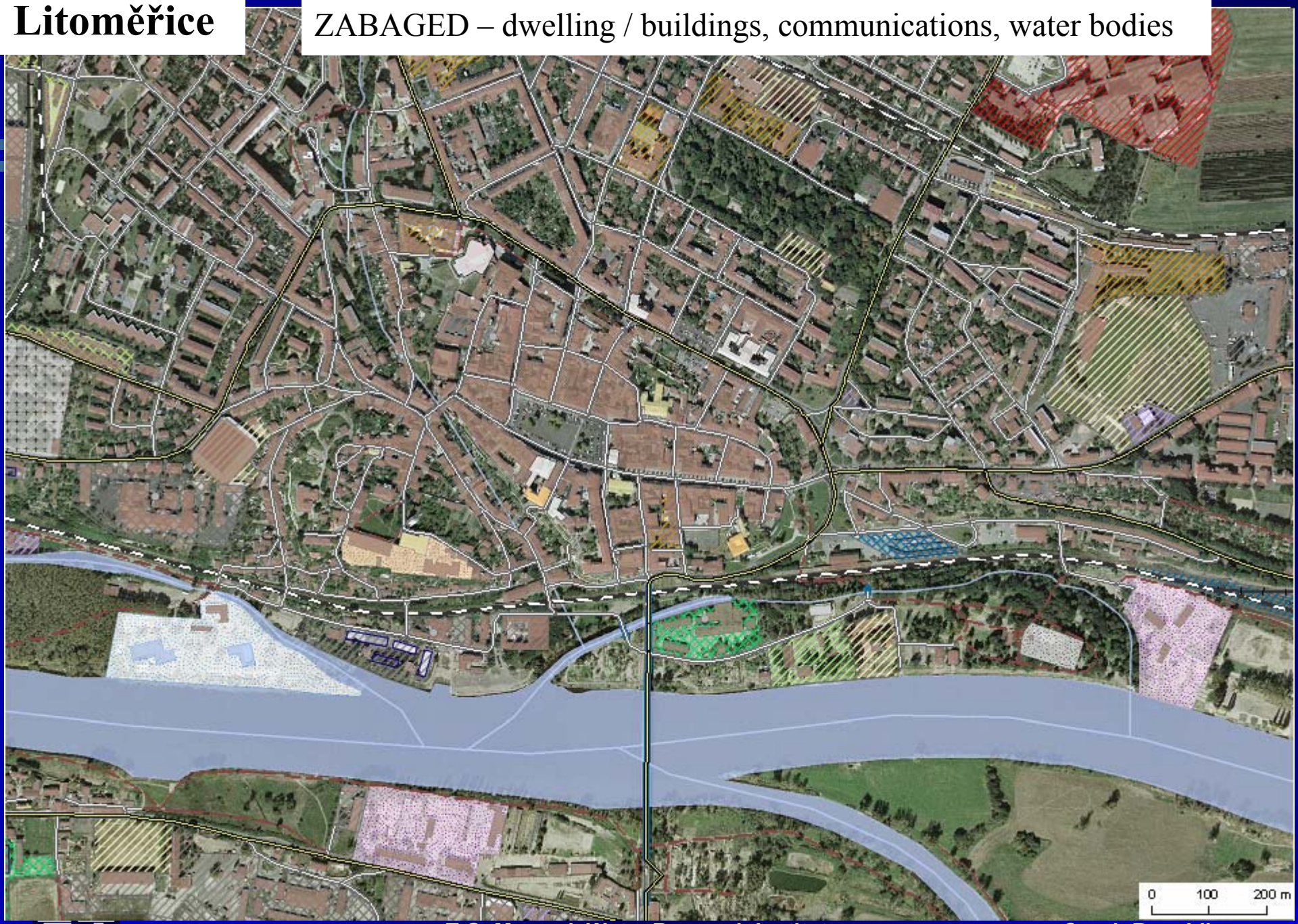
Litoměřice

Orthophoto-map



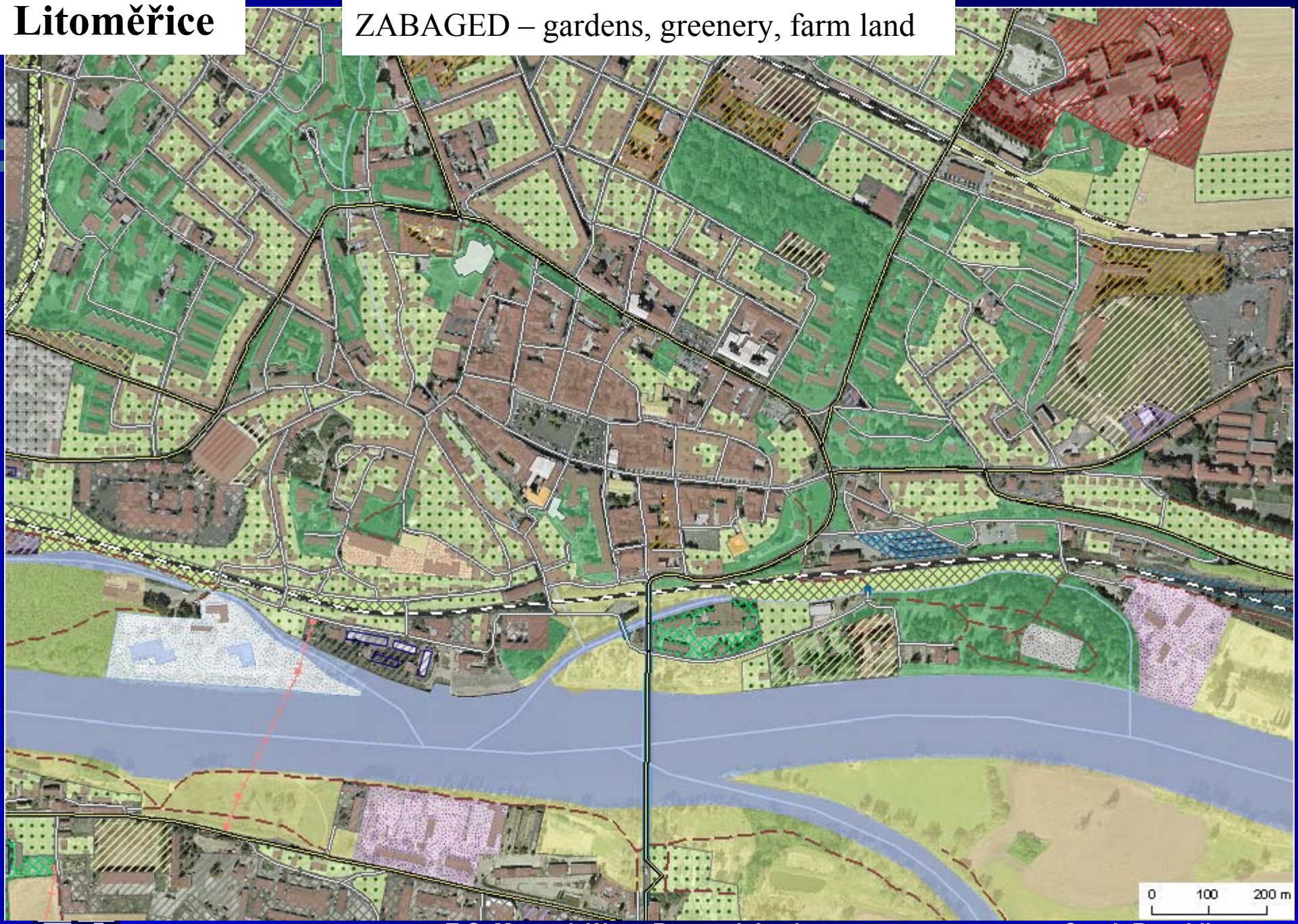
Litoměřice

ZABAGED – dwelling / buildings, communications, water bodies



Litoměřice

ZABAGED – gardens, greenery, farm land



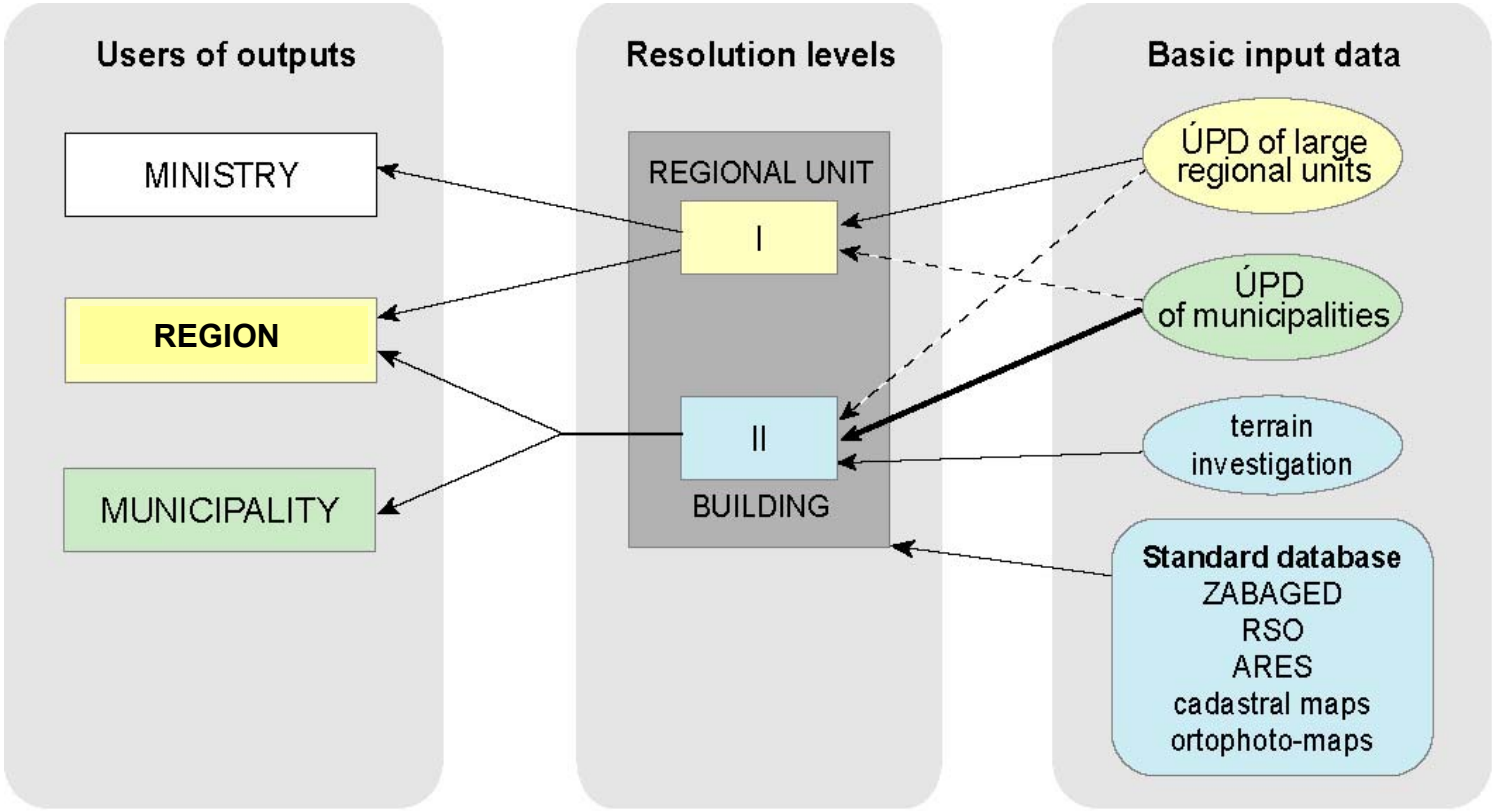
Principal features of the methodology

B. **Application ways of outputs, reliability and accessibility of input data, costs related to respective solution have defined a detailed degree with a view to threatened area in terms to specify fields of suitable procedures and methods for two regional levels :**

I – region, district or otherwise defined area or its part,

II – structure, object

Levels of methodology



ÚPD - planning documents of land use zoning

ZABAGED - Fundamental Base of Geographic Data (1:10 000)

RSO - Census District Register (database with information on houses and census districts derived from Population and Housing Census 2001 maintained by the Czech Statistical Office)

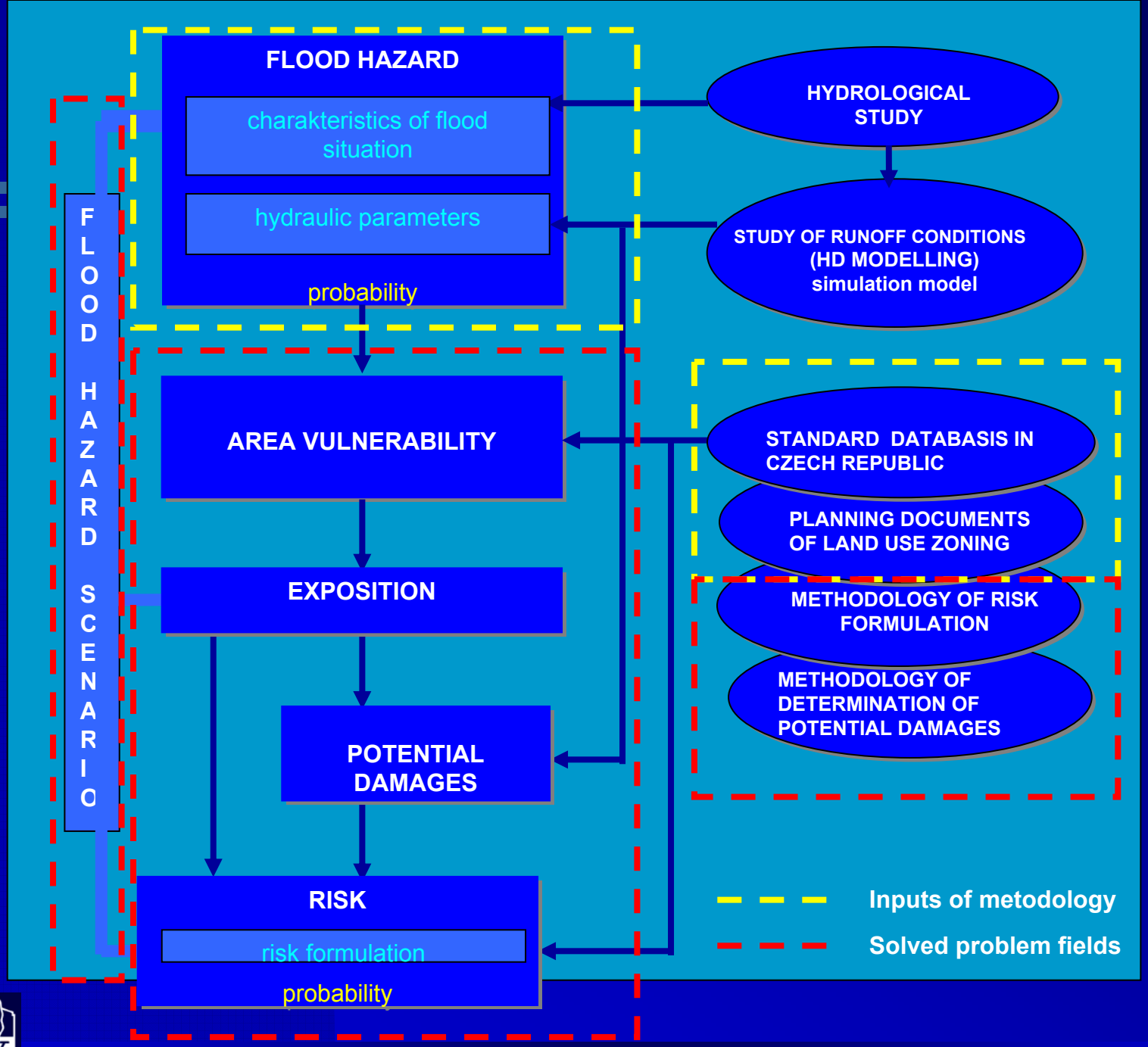
ARES - Registers of Economic Subjects

Principal features of the methodology

C. Successions of main procedures :

- identification of the flood / flooding hazard
- determination of vulnerability and exposition
- qualitative / semiquantitative implication of a risk
- assessment of potential damages
- quantitative implication of a risk

represent a framework of the methodology and successions in the question are applied for both regional levels in terms of detailed view


FLOOD HAZARD
charakteristics of flood situation
hydraulic parameters
probability
HYDROLOGICAL STUDY
STUDY OF RUNOFF CONDITIONS (HD MODELLING) simulation model
FLOOD HAZARD SCENARIO
AREA VULNERABILITY
EXPOSITION
POTENTIAL DAMAGES
RISK
risk formulation
probability
STANDARD DATABASIS IN CZECH REPUBLIC
PLANNING DOCUMENTS OF LAND USE ZONING
METHODOLOGY OF RISK FORMULATION
METHODOLOGY OF DETERMINATION OF POTENTIAL DAMAGES
Inputs of metodology
Solved problem fields

Flood / flooding hazard

Inputs:

- **Documentation of floodplain areas**
- **Studies of runoff conditions**
- **Historical floods**
- **Mathematical modelling**

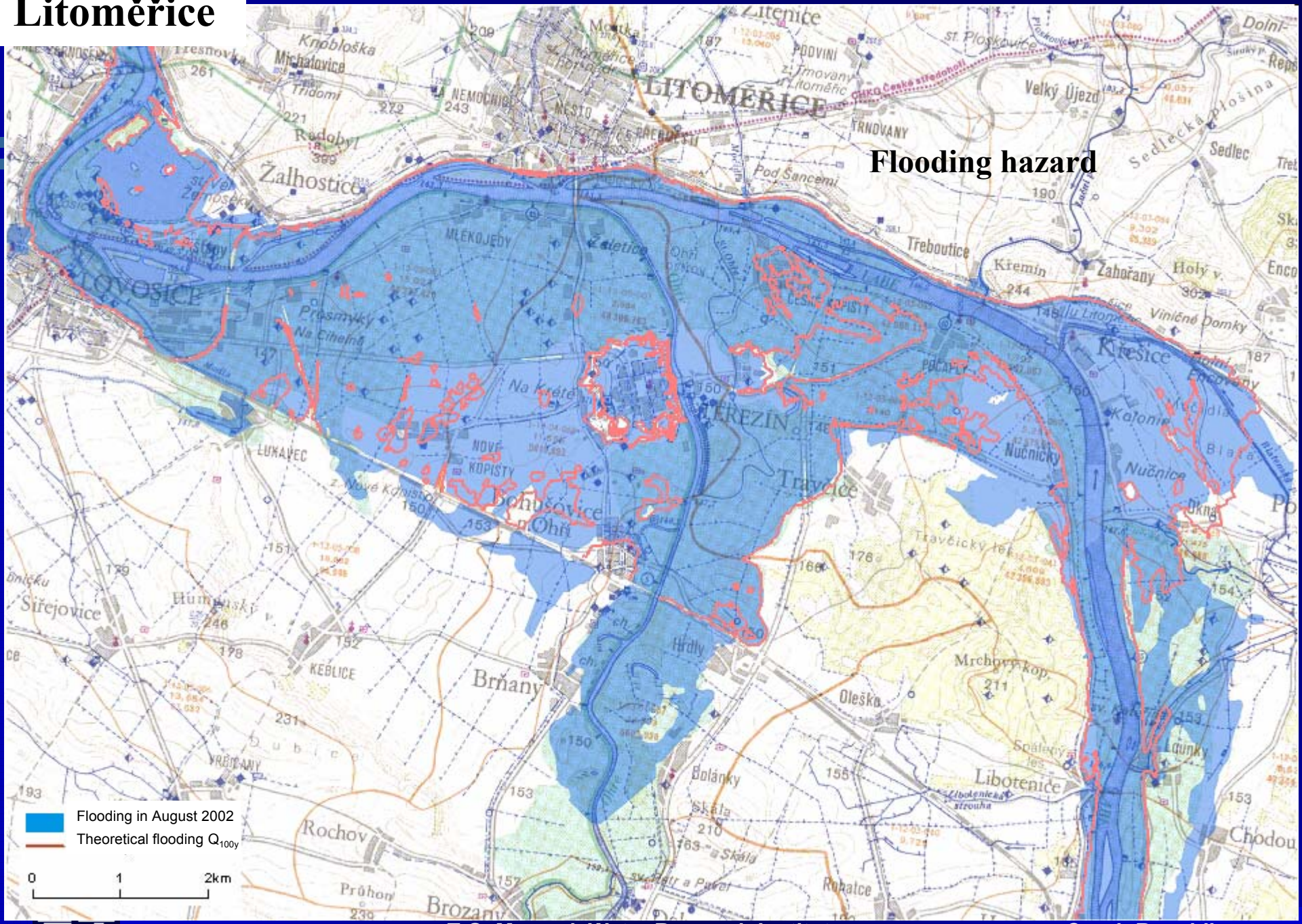
Outputs:

Legislative — Methodology

Maps of flooding hazard (min. Q_{5yr}, Q_{20yr}, Q_{100yr}), $Q_{200yr,....}$

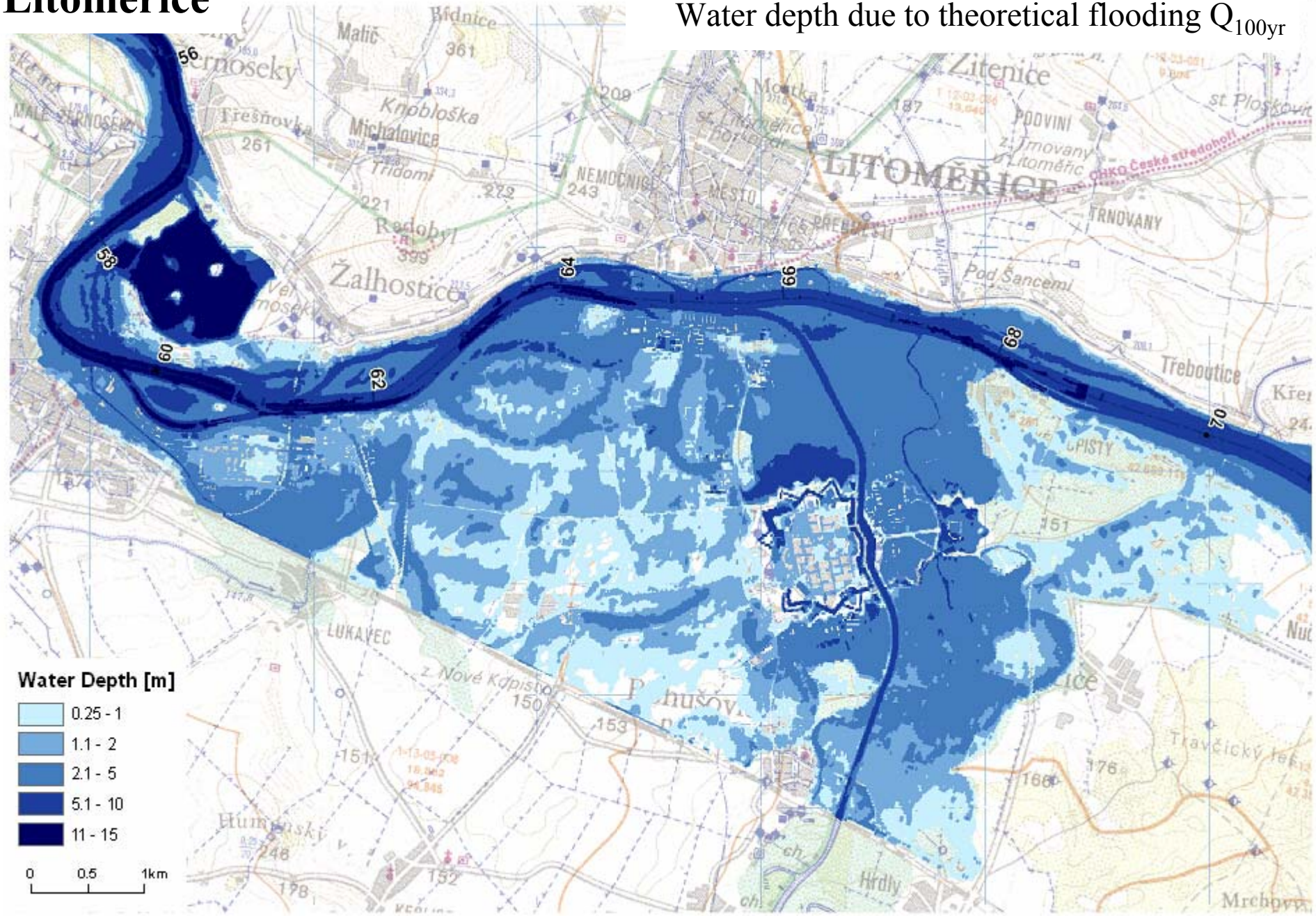
- **map of flooding / inundation**
- **map of depths**
- **map of water flow velocity**

Litoměřice


Flooding hazard
LITOMĚŘICE
Žalhostice
Treboutice
Křesice
Travčice
Brňany
Libotenice
Flooding in August 2002
Theoretical flooding Q_{100y}
0
1
2km

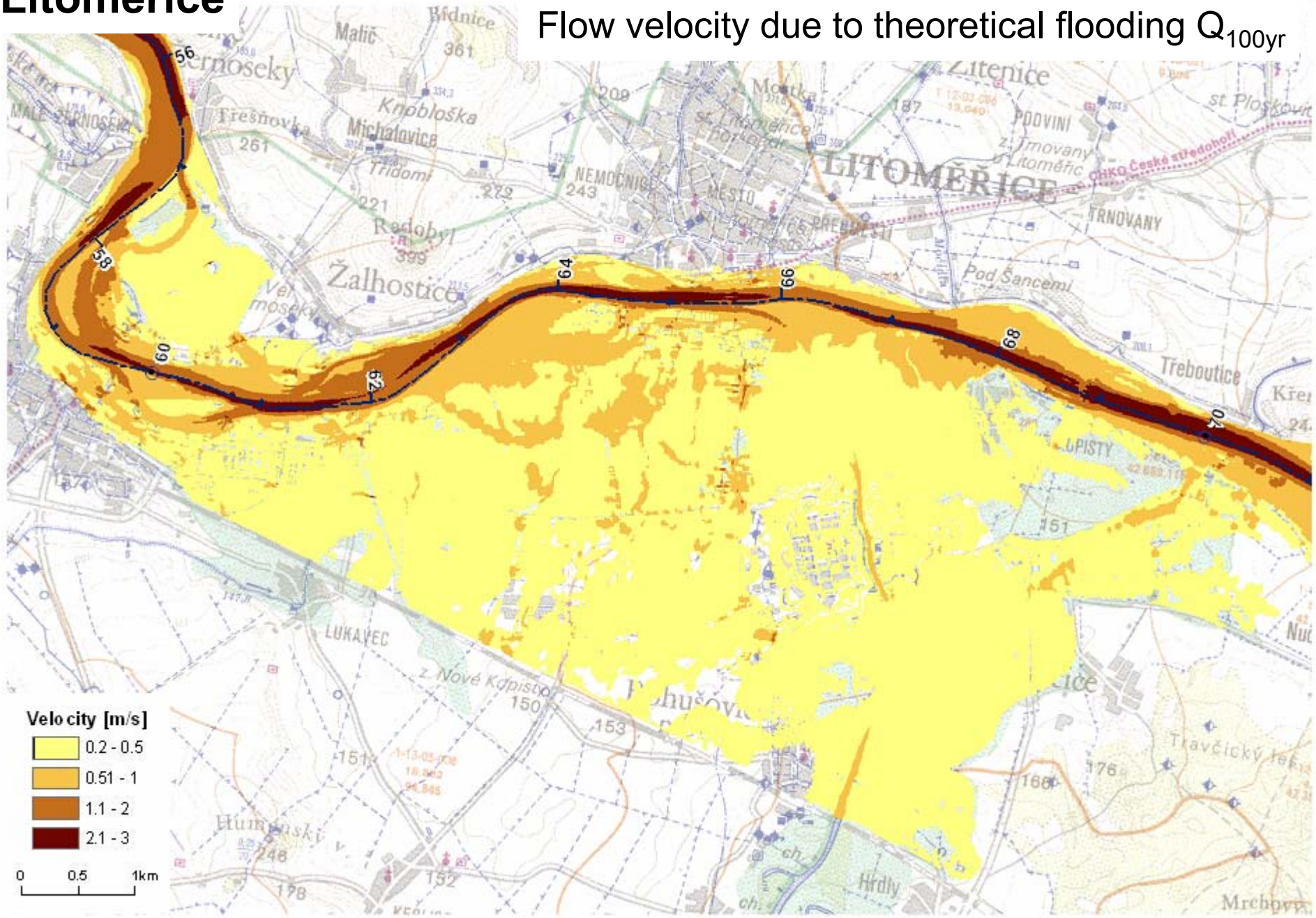
Litoměřice

Water depth due to theoretical flooding Q_{100yr}



Litoměřice

Flow velocity due to theoretical flooding Q_{100yr}



Vulnerability and exposition

Application of subject maps and databases

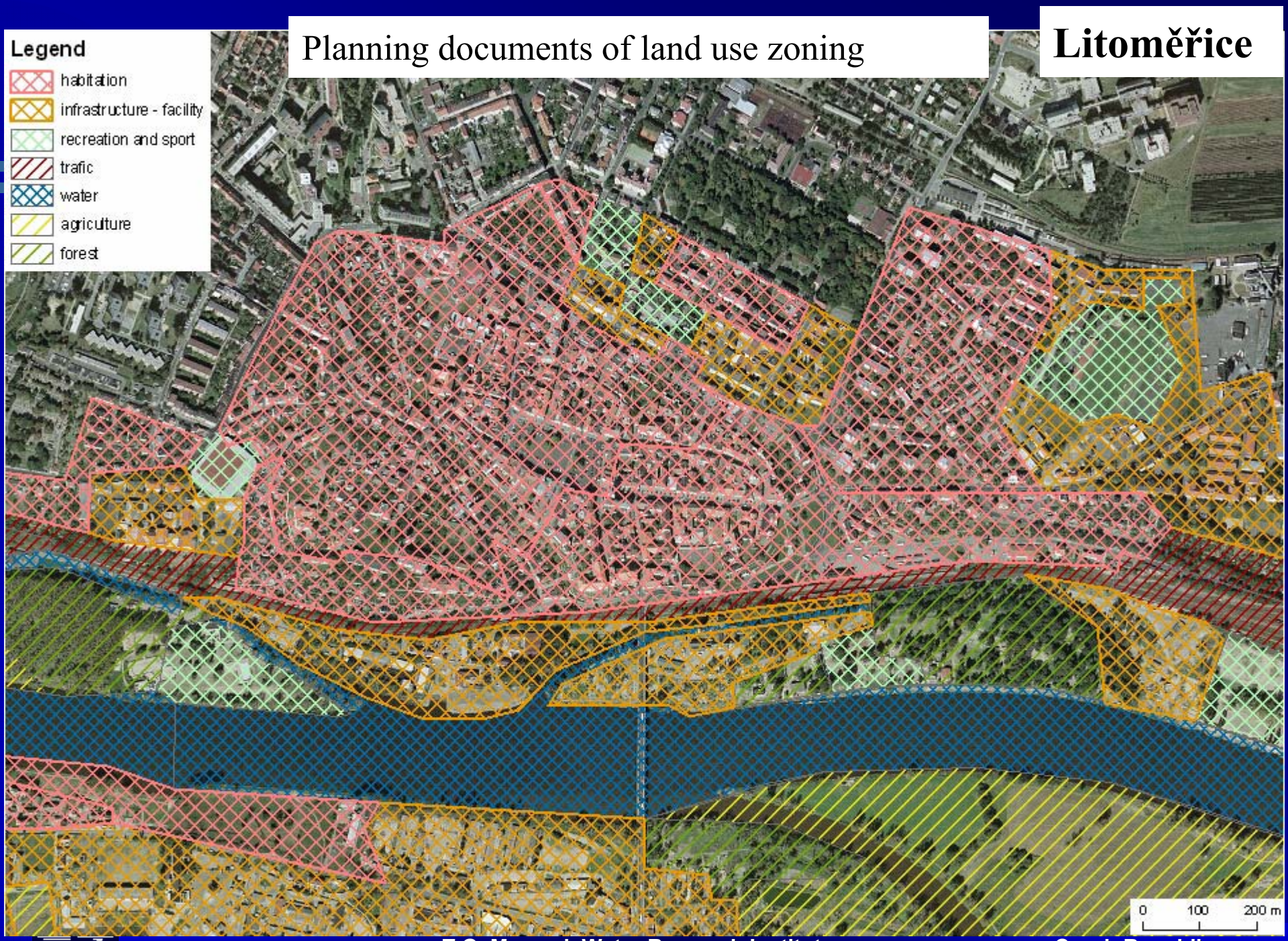
Categorization of the area / region

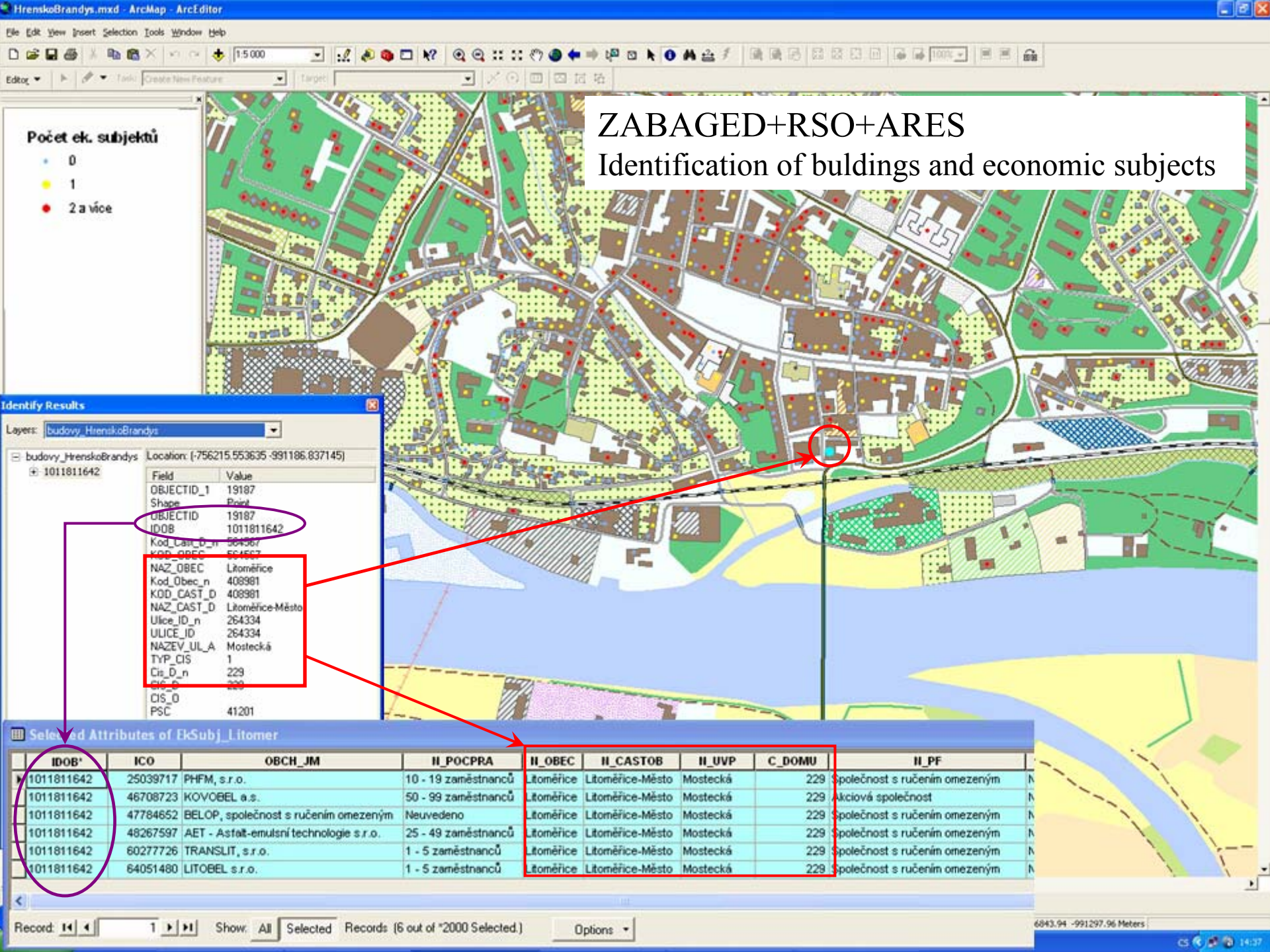
1. **ZABAGED maps 1:10 000 – vector**
2. **Ortophoto-maps**
3. **Cadastral maps**
4. **Territorial planning documentation related to regions**
5. **Territorial planning documentation related to municipalities**
6. **Register of census perimeters (Czech Statistical Authority)**
7. **Administrative register of economic subjects (Ministry of Finance)**

Group	Category
A	Dwelling areas including equipment
B	Areas of industrial facilities and technical equipment
C	Areas of agricultural facilities
D	Civic amenities
E	Traffic / communication infrastructure
F	Civil engineering network / constructions
G	Recreation and sport amenities
H	Farm land / Agricultural land
I	Forests
J	Water management constructions and equipment, watercourses, reservoirs
K	Waste management constructions and equipment

Planning documents of land use zoning

Litoměřice




HrenskoBrandys.mxd - ArcMap - ArcEditor
Počet ek. subjektů
0
1
2 a více
ZABAGED+RSO+ARES
Identification of buldings and economic subjects
Identify Results
Layers: budovy_HrenskoBrandys
budovy_HrenskoBrandys
1011811642
Location: (-756215.553635 -991186.837145)
Field Value
OBJECTID_1 19187
Shape Point
OBJECTID 19187
IDOB 1011811642
NAZ_OBEC Litoměřice
Kod_Obec_n 408981
KOD_CAST_D 408981
NAZ_CAST_D Litoměřice-Město
Ulice_ID_n 264334
ULICE_ID 264334
NAZEV_UL_A Mostecká
TYP_CIS 1
Cis_D_n 229
CIS_0
PSC 41201
Selected Attributes of EkSubj_Litomer
IDOB* ICO OBCH_JM N_POCPRA N_OBEC N_CASTOB N_UVP C_DOMU N_PF
1011811642 25039717 PHFM, s.r.o. 10 - 19 zaměstnanců Litoměřice Litoměřice-Město Mostecká 229 Společnost s ručením omezeným
1011811642 46708723 KOVOBEL a.s. 50 - 99 zaměstnanců Litoměřice Litoměřice-Město Mostecká 229 Akciová společnost
1011811642 47784652 BELOP, společnost s ručením omezeným Neuvedeno Litoměřice Litoměřice-Město Mostecká 229 Společnost s ručením omezeným
1011811642 48267597 AET - Asfalt-emulsní technologie s.r.o. 25 - 49 zaměstnanců Litoměřice Litoměřice-Město Mostecká 229 Společnost s ručením omezeným
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1011811642 64051480 LITOBEL s.r.o. 1 - 5 zaměstnanců Litoměřice Litoměřice-Město Mostecká 229 Společnost s ručením omezeným
Record: 1 Show: All Selected Records: (6 out of *2000 Selected.) Options
6843.94 -991297.96 Meters

Methods of risk determination

Qualitative analysis

- identification of hazard scenarios
- definition of system elements
- analysis

Semiquantitative methods

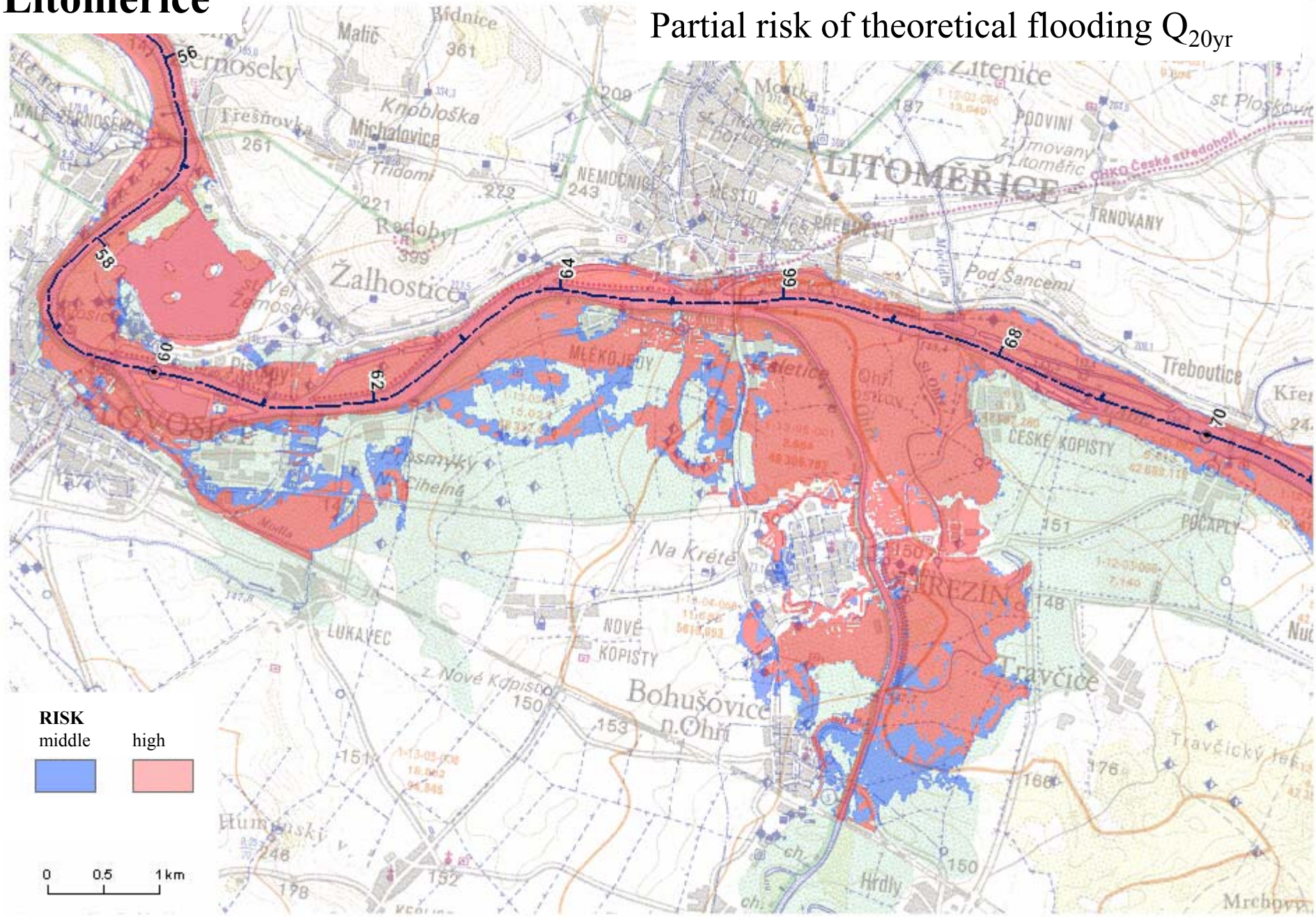
- at most acceptable risk
- matrix of risk
- Failure Modes and Effect and Criticality Analysis - FMECA

Quantitative methods

input – potential damages

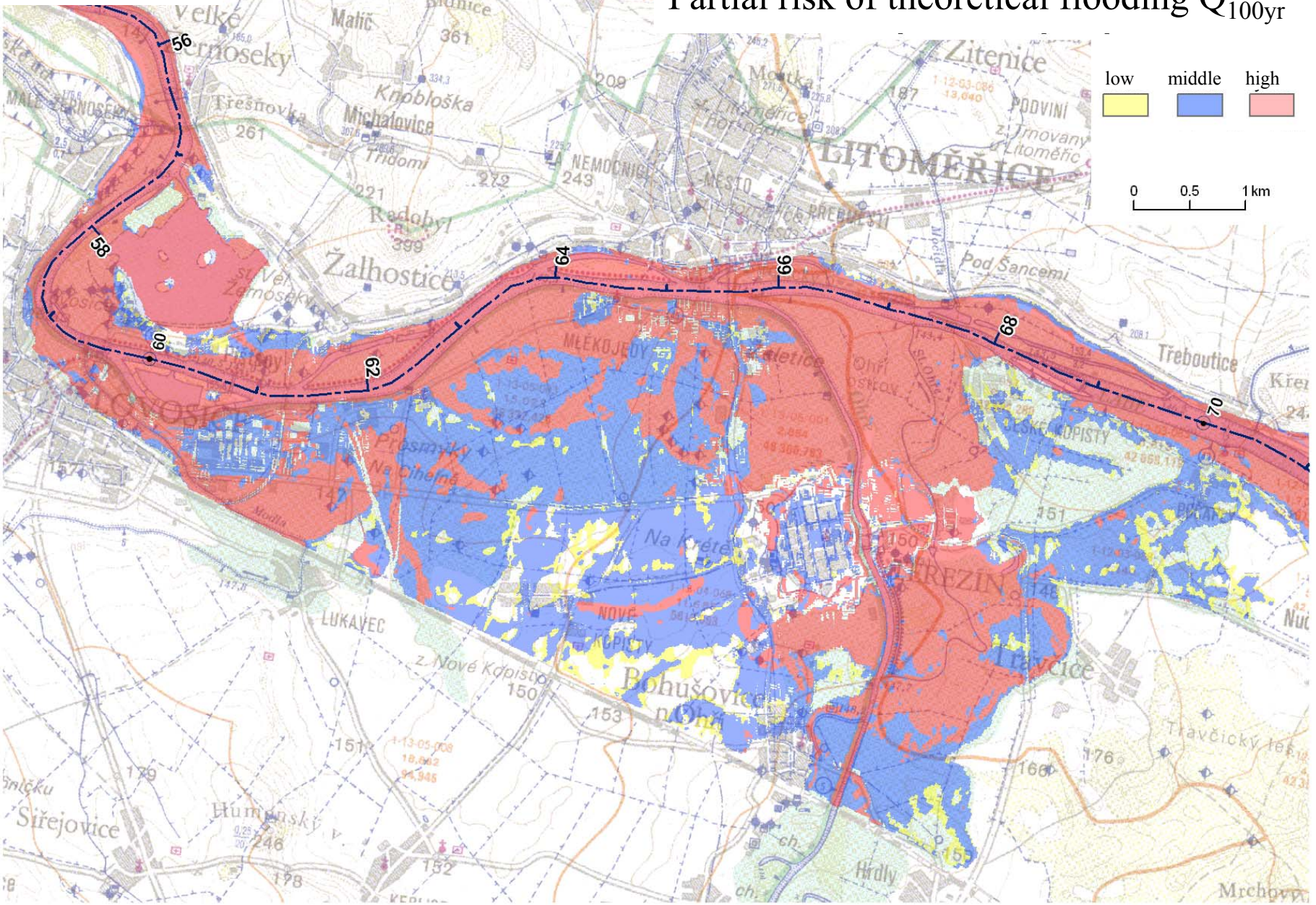
Litoměřice

Partial risk of theoretical flooding Q_{20yr}

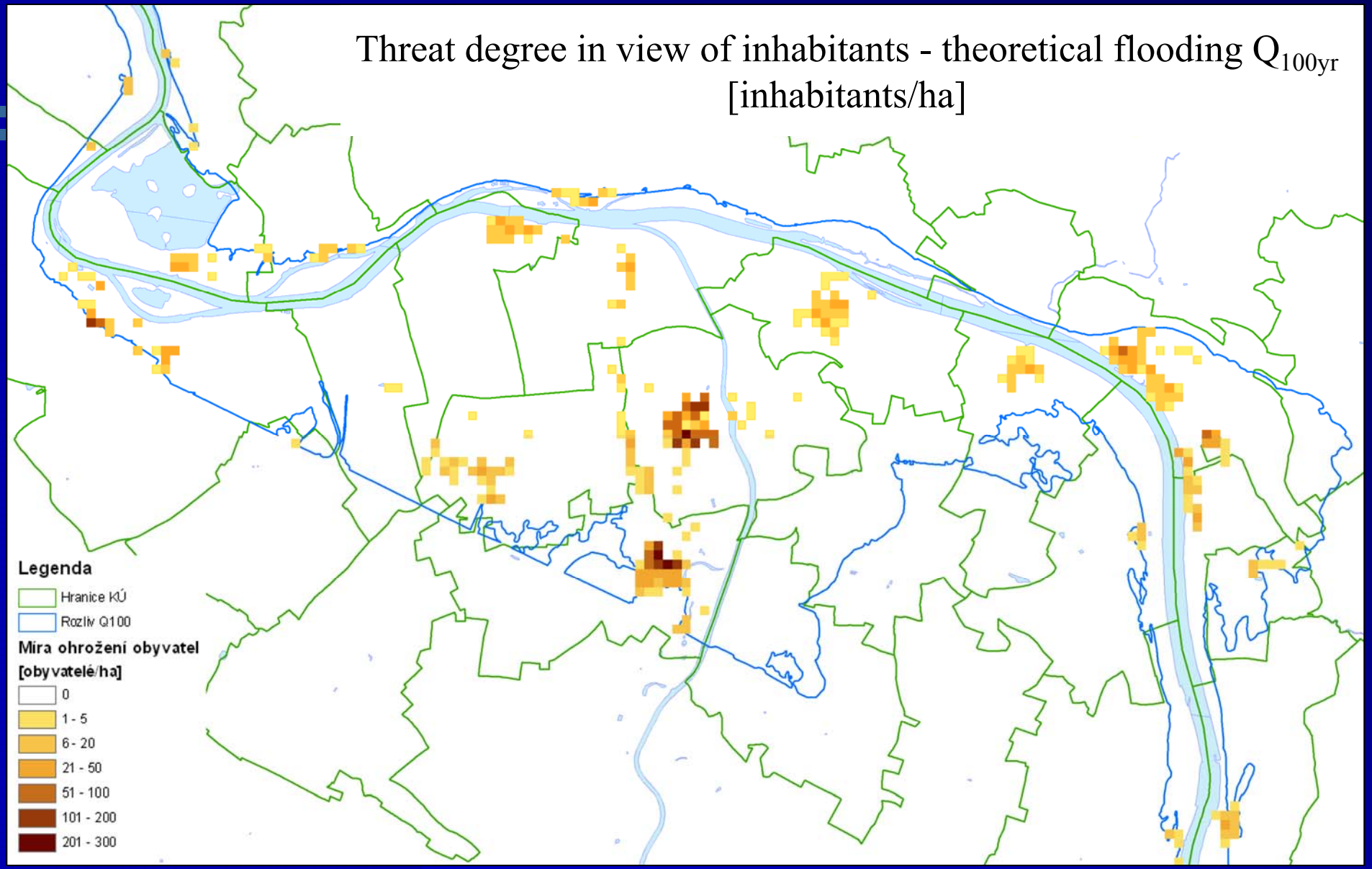


Litoměřice

Partial risk of theoretical flooding Q_{100yr}



Threat degree in view of inhabitants - theoretical flooding Q_{100yr} [inhabitants/ha]



Principal features of the methodology

D. Potential damages are implicitely determined as a sum of direct damages.

They are implied as a share from the equivalent related to a property value that equals to a reproduction value of fixed capital.

Procedures of the estimation in a view of potential damages

Application of loss curves (purchase prices and loss curve functions)
– in terms of interval implication concerning damage values

More detailed estimation – individual appraisal of objects and equipment (level II … e.g. Important economic subjects)

Direct damages:

- dwelling fund and amenities
- civic amenities (schools, health service, stores and shops, sport areas, etc.)
- traffic and communication infrastructure
- systems of the civil engineering network
- water management infrastructure
- agriculture and forestry
- industry, power engineering, mining and services
- damages affected miscellaneous components of the environment

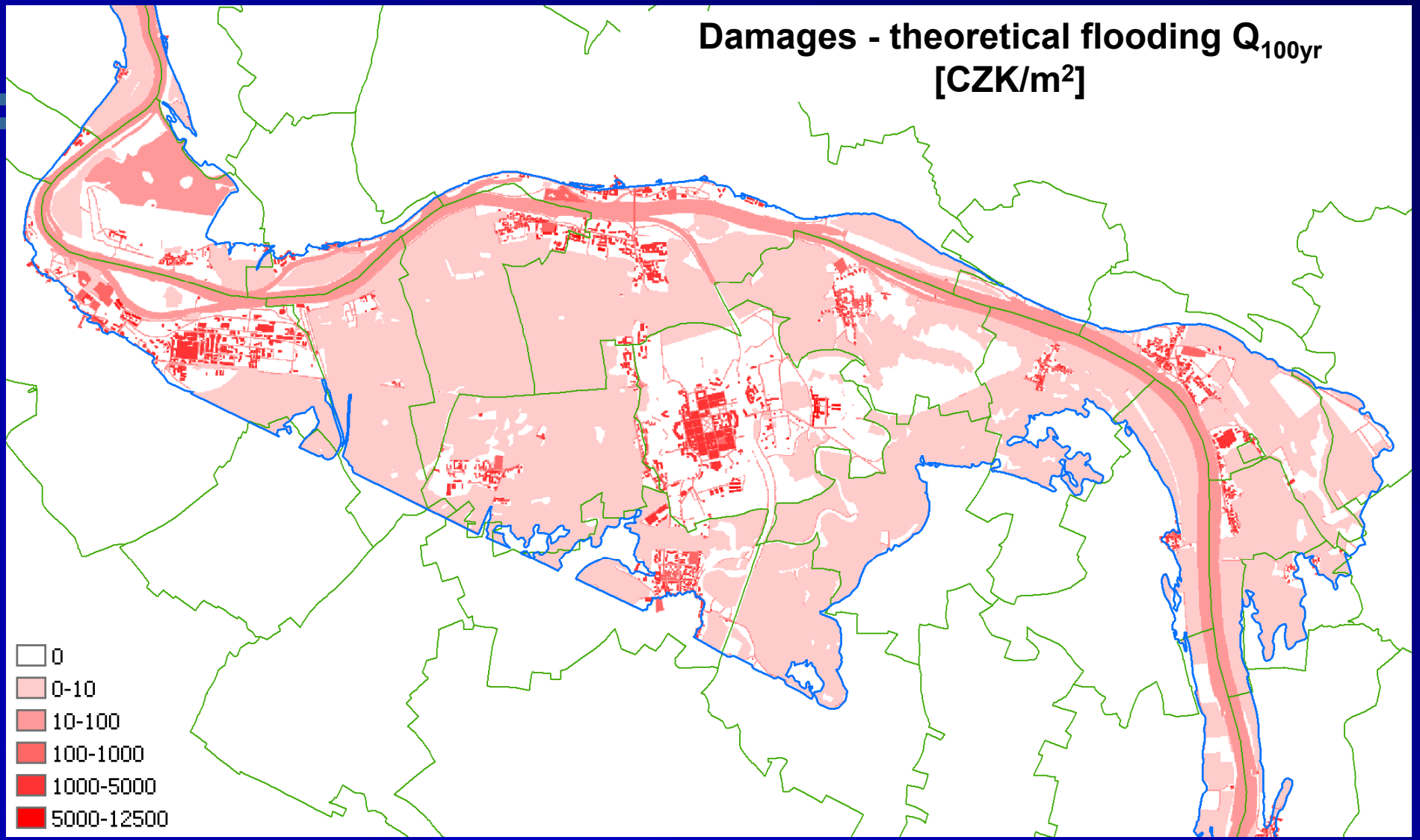
Indirect damages, intangible damages, other various losses

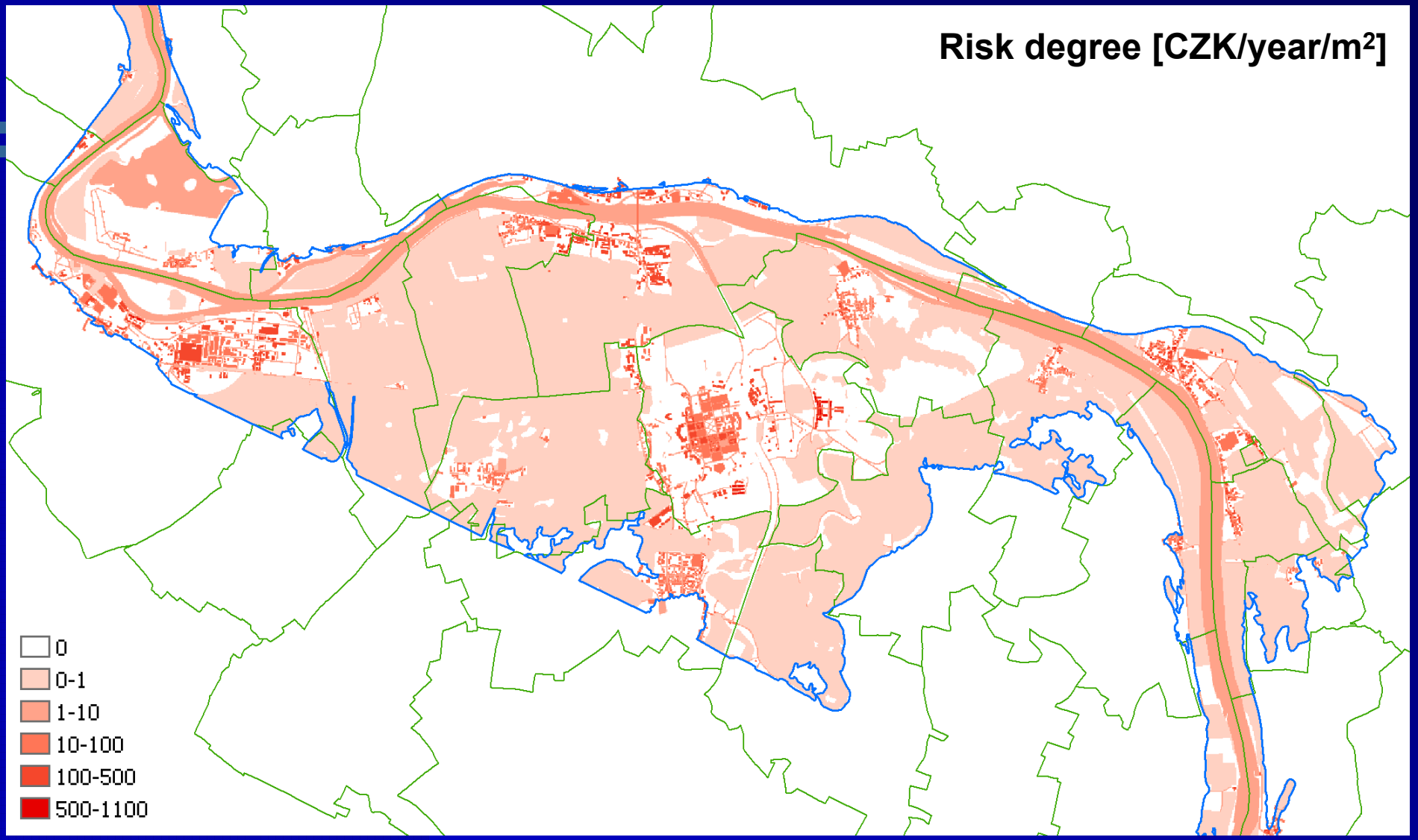
Principal features of the methodology

E. In regards to very difficult objectivization referring to procedures needful to determinate levels of indirect tangible damages and of intangible ones, there is recommended to involve them separately outside of direct damages.

Very important characteristics aimed at groups of indirect tangible and intangible damages consist in presumptions forming a basis for an implementation of respective calculations.

Damages - theoretical flooding Q_{100yr} [CZK/m^2]




Risk degree [CZK/year/m²]
0
0-1
1-10
10-100
100-500
500-1100

CONCLUSIONS AND RECOMMENDATIONS

Conclusions in the view of hitherto results

- Variability of approaches, methods and solutions
- Application possibilities resulting from project outputs, recent working activities– together with the methodology proposal in the frame of tools of the Czech Republic

Recommendations adequate to the present phase in a view of the methodology application

- To complete - in cooperation with Czech Statistical Office (Cesky statisticky urad) – an application of the PIM method (perpetual inventory management) in order to determinate values of various properties
- To deduce applicable procedures (with regard to possible aggregation rate) for determination of properties values relative to all groups of the system OKEC (= sector classification of economic activities)

CONCLUSIONS AND RECOMMENDATIONS - continuation

Conclusions and recommendations in a view of strategic objectives and to meet general principles

Monitoring and research of flood / flooding phenomena and events

- Hydrological characteristics (e.g. return periods due to volumes of flood waves, application of historical and paleohydrological bases …)
- Extremes connected with miscellaneous reasons of flood / flooding events (e.g. flush precipitations as a cause of local exceptional floods and inundations…)
- Presumption corrections of the stationarity relative to hydrological regime – in connection with possible climate changes, etc.
- Objectivization of methods dealing with implication of negative impacts of flood / flooding events: risk, potential damages

CONCLUSIONS AND RECOMMENDATIONS - continuation

Conclusions and recommendations in a view of strategic objectives and to meet general principles

- **Application of methods in processes aimed at preparation and elaboration of River Basin Management Plans and other water management or water protection documents in the Czech Republic**
- **Exigency to reflect main results of the risk analysis and of the evaluation concerned with a potential of flood / flooding damages - towards other systems of state administration, self-government and institutions of public sector**
  - land-use planning
  - information, crisis and safety systems
  - proposals of effective tools (legislation amendments, efficient changes in fields of competences, responsibilities, institutional amenities, capacity building, flood insurance, etc…)

Enforcement of generally received principles

- principle of respective territory, principle of subsidiarity
- principles of sustainable development, integration, precautionary approach, best available environmental practice
- approach to be fully respectful to future generations
- cooperation, partnership, contacts with stakeholders, partnership, public awareness

CONCLUSIONS AND RECOMMENDATIONS - continuation

Conclusions and recommendations in a view of strategic objectives and to meet general principles

Application of open system connected with the methodology – as one of key attributes of this document:

- **to enforce consistently and step by step strategic approaches of the methodology in all political, economic, social and administration systems of the Czech Republic – in order to determinate promptly flood / flooding risk and damages potential in the whole area of the Czech Republic, by means of the most simple and the most efficient measures**
- **to enforce system concepts of flood defence, flood prevention and flood mitigation in all sectors of state administration, public benefits, self-government and in fields of all economic and market activities**