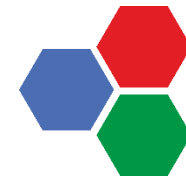

Urban Planner

Analytical Tool for Land Suitability Evaluation

Jaroslav Burian



DEPARTMENT OF GEOINFORMATICS
Palacký University in Olomouc



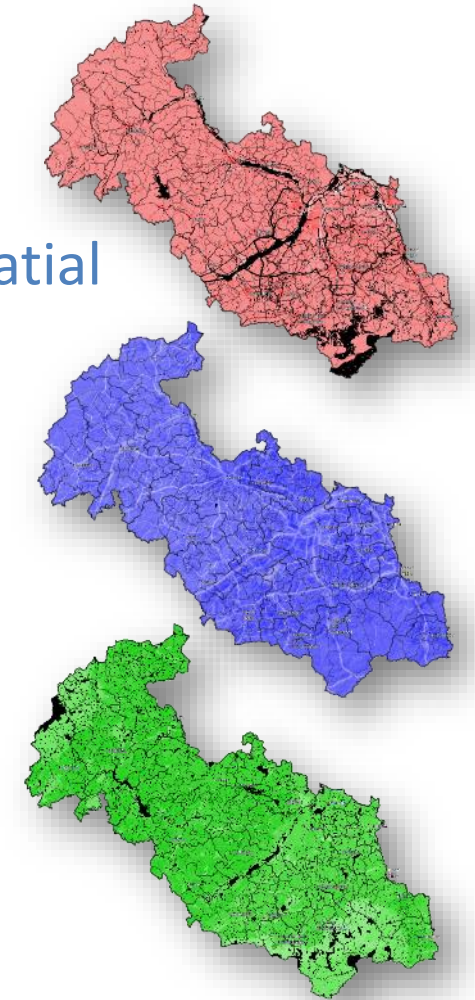
URBAN
PLANNER

Company Introduction

- Since 2009 – development at Palacky University in Olomouc
- 2015 – establishing private company Urban Planner s.r.o.
 - In 2015 2nd company in CZ supported by Esri startup program
- Main area of focus
 - Urban Planner – development, analysis
 - Analytical material for planning
 - Spatial analysis, web application

Urban Planner

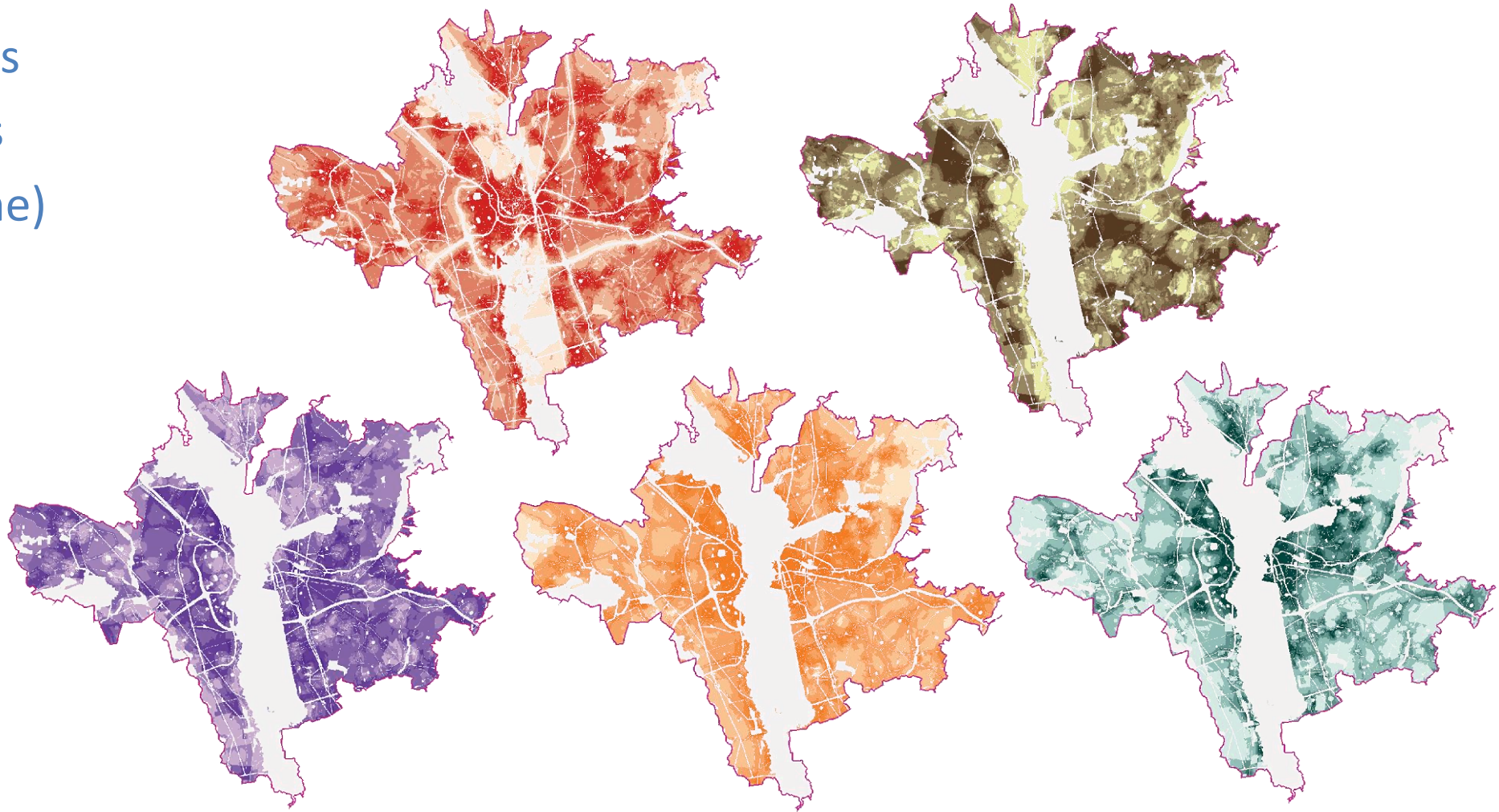
- Models focused on:
 - **Land suitability calculation**
 - **Land use allocation** – detection of the most suitable areas for spatial development
 - Evaluation of existing proposals for new development
- „UAP“ data as the main input (analytical material for planning)
- Multi-criteria analysis – weights of the input data
- Several scenarios of land suitability calculation
- Connection to pillars of sustainability
- **Add-In ArcGIS for Desktop 10.x**



Categories of Land Use

- 5 main categories
- possible changes
(delete, add, rename)

1.  Residential
2.  Recreation
3.  Commercial
4.  Production
5.  Roads



Urban Planner Development

2009 – v 1.0



- ArcGIS 9.3
- Python Script 2.5
- Visual Basic (GUI)
- Exe file
- Vlastní DM

2013 – v 2.0



- ArcGIS 10.1
- VB.NET
- dll library

2015 – v 3.0



- ArcGIS 10.2, 10.3
- VB.NET
- Add-In
- Database
- Customisable
- Data models support

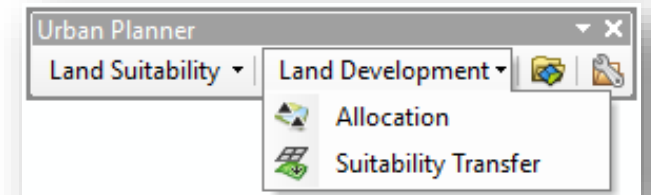
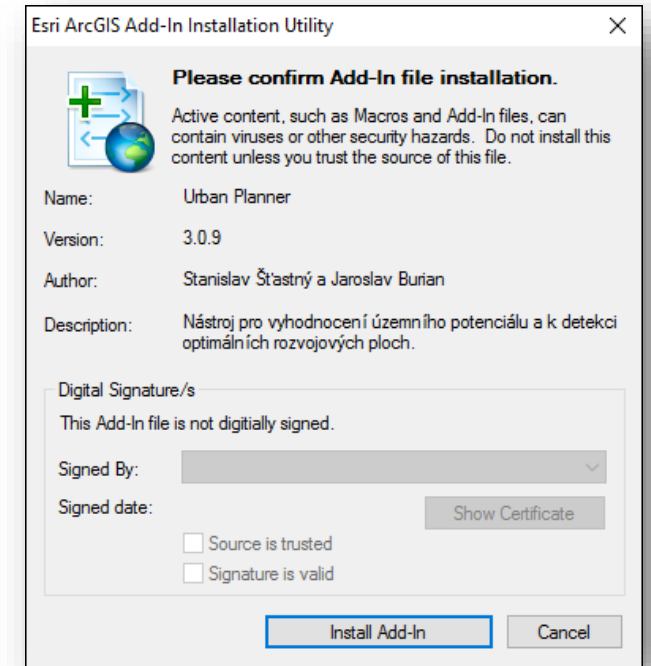
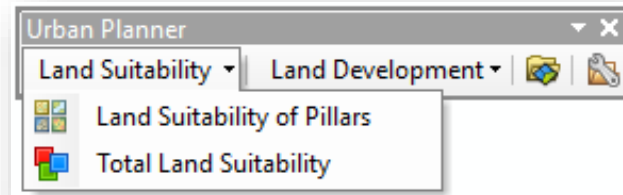
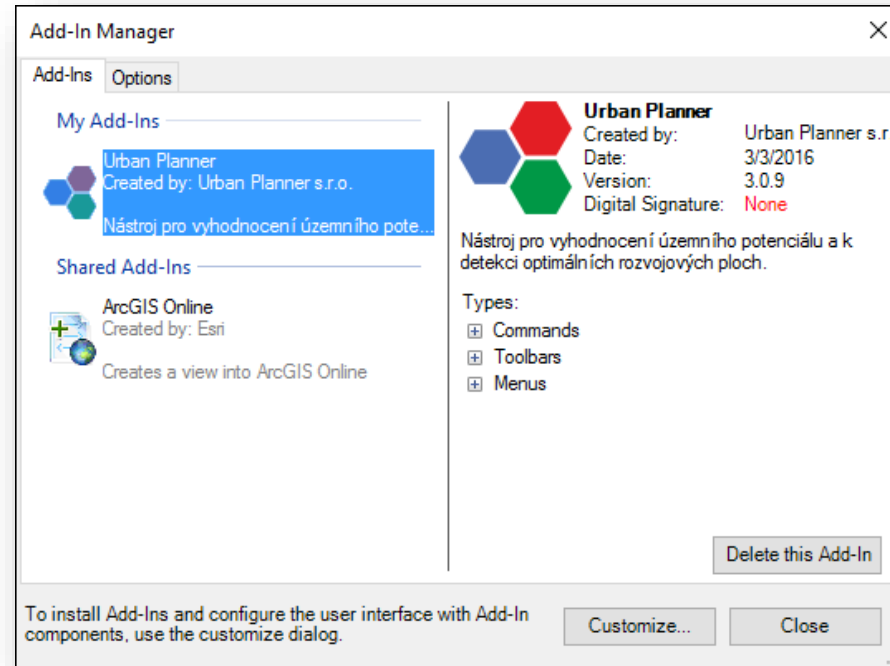
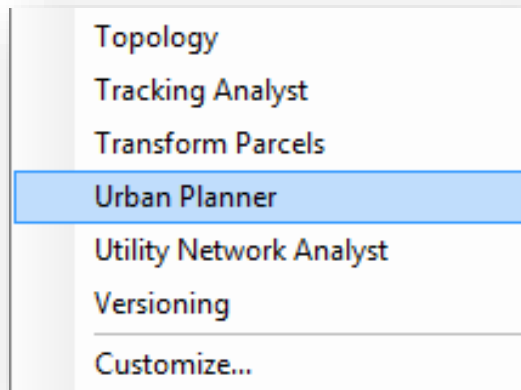
2016 – v 3.1



- ArcGIS 10.2 – 10.4
- VB.NET
- Add-In
- Profile import
- Data preparation

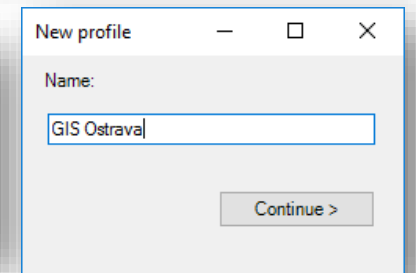
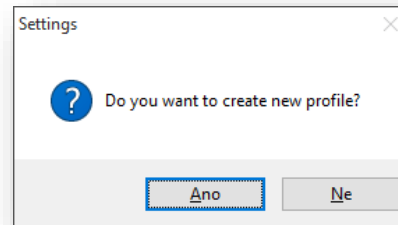
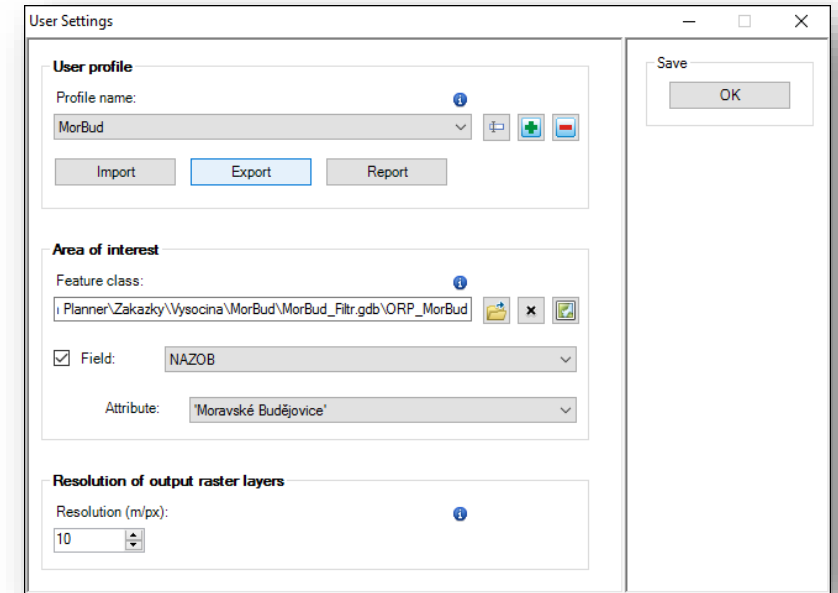
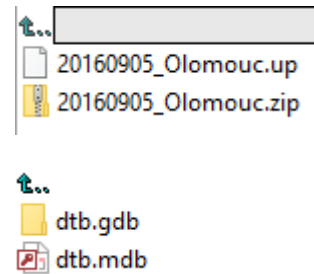
Installation

- Esri Add-In
- CZ and EN version
- Demo version



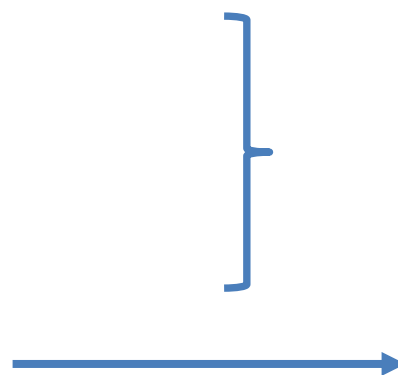
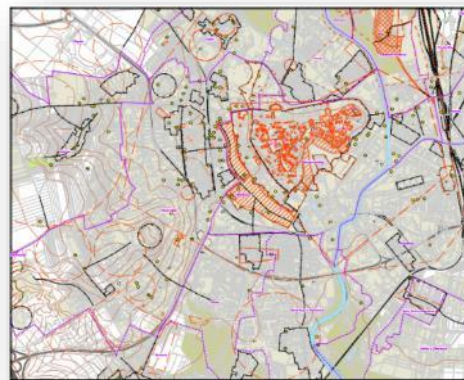
Basic Settings

- User profile settings
 - Calculation resolution, area of interest
- Profile transfer
 - Possible to export and import data and settings to another computer
 - Export to file *.up* (possible to rename to zip file), which includes:
 - Urban Planner Settings (.mdb)
 - Output Data (.gdb)



Input data

- **Supported formats of input data**
 - File Geodatabase - *.gdb
 - Personal Geodatabase - *.mdb
 - Esri Shapefile - *.shp
- **Supported formats of output data**
 - File Geodatabase - *.gdb
- **Supported data models of „AMP“:**
 - DMG ÚAP 4.2 (Hydrosoft Veleslavín)
 - ÚAP 3.3, 3.2, 3.12, 3.0 (T-MAPY)
 - Data model of Olomouc region
 - Urban Planner Data Model (CZ/EN)
 - Data stored in any other data model



Automatic import of
paths to the data

Manual paths settings

Data Manager

- Not necessary and not real to dispose by all input data
- Data control, topology control/repair, data selection

Import of layers from data model

#	Faktor	Topics	Feature class	Field	Attribute	Description	
✓	1	Water bodies protection	1st degree protective zone of water source	ft_07_OVZ_vodni_zdroj_op_p	JEV	'07OVZ_1_O...	OK
✓	2	Water bodies protection	2nd degree protective zone of water source	ft_07_OVZ_vodni_zdroj_op_p	JEV	'07OVZ_2_O...	OK
✗	3	Water bodies protection	2nd degree protective zone of water source - a.intenal	ft_07_OVZ_vodni_zdroj_op_p	JEV	'07OVZ_2A...	Feature class exists, attribute not found
✓	4	Water bodies protection	2nd degree protective zone of water source - a.external	ft_07_OVZ_vodni_zdroj_op_p	JEV	'07OVZ_2B...	OK
✗	5	Water bodies protection	3nd degree protective zone of water source	ft_07_OVZ_vodni_zdroj_op_p	JEV	'07OVZ_3_O...	Feature class exists, attribute not found
✗	6	Water bodies protection	Protective zone of water source - unsorted	ft_07_OVZ_vodni_zdroj_op_p	JEV	'07OVZ_NEU...	Feature class exists, attribute not found
✗	7	Water bodies protection	1st degree protective zone of natural healing spring	ft_07_LAZ_leviv_zdroj_op_p	POZNAMKA	'I'	Feature class not exists
✗	8	Water bodies protection	2nd degree protective zone of natural healing spring	ft_07_LAZ_leviv_zdroj_op_p	POZNAMKA	'II'	Feature class not exists
✗	9	Water bodies protection	Protective area of peloids	ODJ_peloidy_op_P	-	-	Feature class not exists
✗	10	Water bodies protection	Spas - intenal spa area	ft_07_LAZ_lazen_misto_p	JEV	'07LAZ_VNI10'	Feature class not exists
✗	11	Water bodies protection	Spas - external spa area	ft_07_LAZ_lazen_misto_p	JEV	'07LAZ_VNE...	Feature class not exists
✗	12	Water bodies protection	Water streams	ODJ_povrch_vod_t_P	-	-	Feature class not exists
✓	13	Water bodies protection	Water bodies	ft_07_VODU_vodni_plocha_p	KOD_STAV	1	OK
✓	14	Water bodies protection	Area designated for water flow management	ODJ_sprava_vt_P	-	-	OK
✗	15	Water bodies protection	Protected area of natural water accumulation	ft_07_OVZ_chopav_p	JEV	'07OVZ_CHO...	Feature class not exists
✓	16	Water bodies protection	Vulnerable area	ft_07_OVZ_zranitelna_oblast_p	JEV	'07OVZ_ZO10'	OK
✗	17	Nature protection	National park - 1. zone of protection	ft_02_ZCHU_zony_chko_np_p	JEV	'02ZCHU_NP...	Feature class not exists
✗	18	Nature protection	National park - 2. zone of protection	ft_02_ZCHU_zony_chko_np_p	JEV	'02ZCHU_NP...	Feature class not exists
✗	19	Nature protection	National park - 3. zone of protection	ft_02_ZCHU_zony_chko_np_p	JEV	'02ZCHU_NP...	Feature class not exists
✗	20	Nature protection	Protected landscape area - 1. zone of protection	ft_02_ZCHU_zony_chko_np_p	JEV	'02ZCHU_CH...	Feature class not exists
✗	21	Nature protection	Protected landscape area - 2. zone of protection	ft_02_ZCHU_zony_chko_np_p	JEV	'02ZCHU_CH...	Feature class not exists
✗	22	Nature protection	Protected landscape area - 3. zone of protection	ft_02_ZCHU_zony_chko_np_p	JEV	'02ZCHU_CH...	Feature class not exists
✗	23	Nature protection	Protected landscape area - 4. zone of protection	ft_02_ZCHU_zony_chko_np_p	JEV	'02ZCHU_CH...	Feature class not exists
✗	24	Nature protection	National natural reservation	ft_02_ZCHU_npr_o	JEV	'02ZCHU_NP...	Feature class not exists

Save to File

Import

Storno

Data Manager

Import of layers from data model

Data model version:

Hydrosoft DMG ÚAP v4.2

T-Mapy ÚAP v3.3

T-Mapy ÚAP v3.2

T-Mapy ÚAP v3.1.2

T-Mapy ÚAP v3.0

T-Mapy ÚAP v2.0

Hydrosoft DMG ÚAP v4.2

Olomoucký kraj DM ÚAP

Deleting paths to the layers:

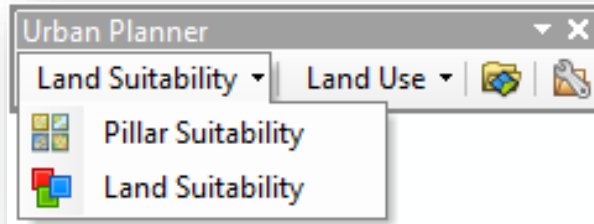
Start

Data editor

Data filter:

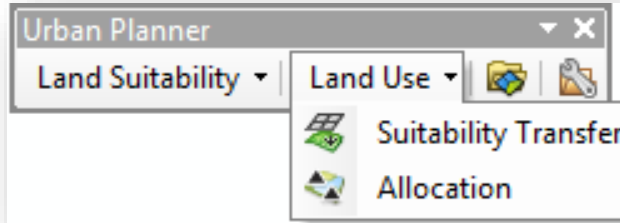
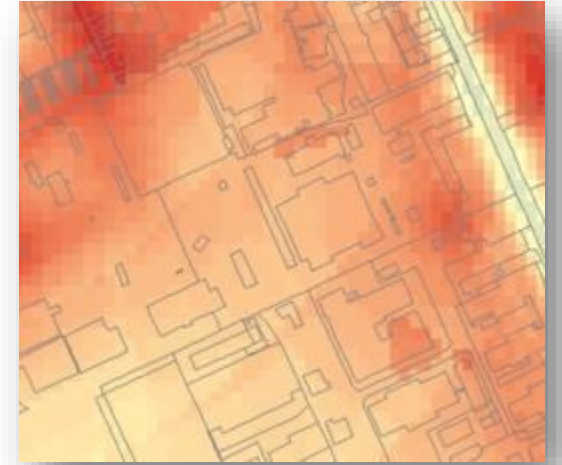
Launch

Urban Planner



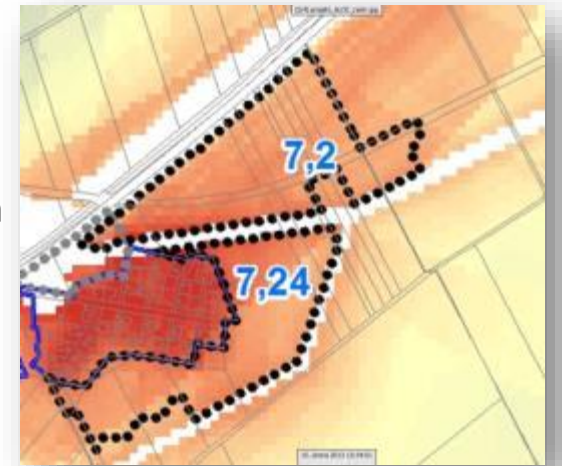
Land Suitability

- ❖ Multi-criteria analysis
- ❖ Raster output

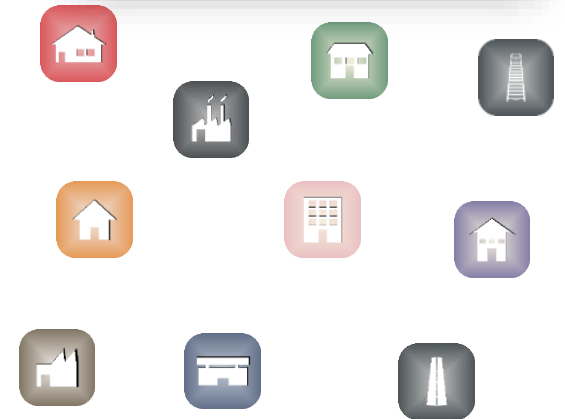
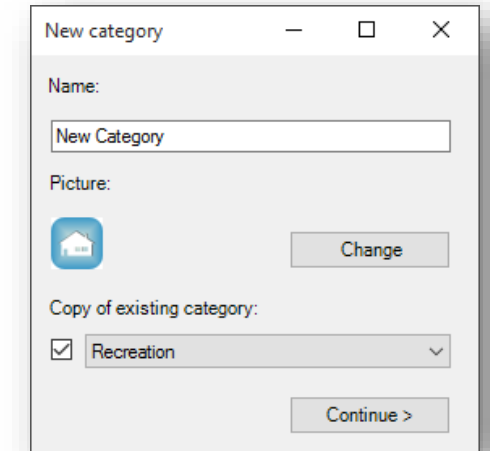
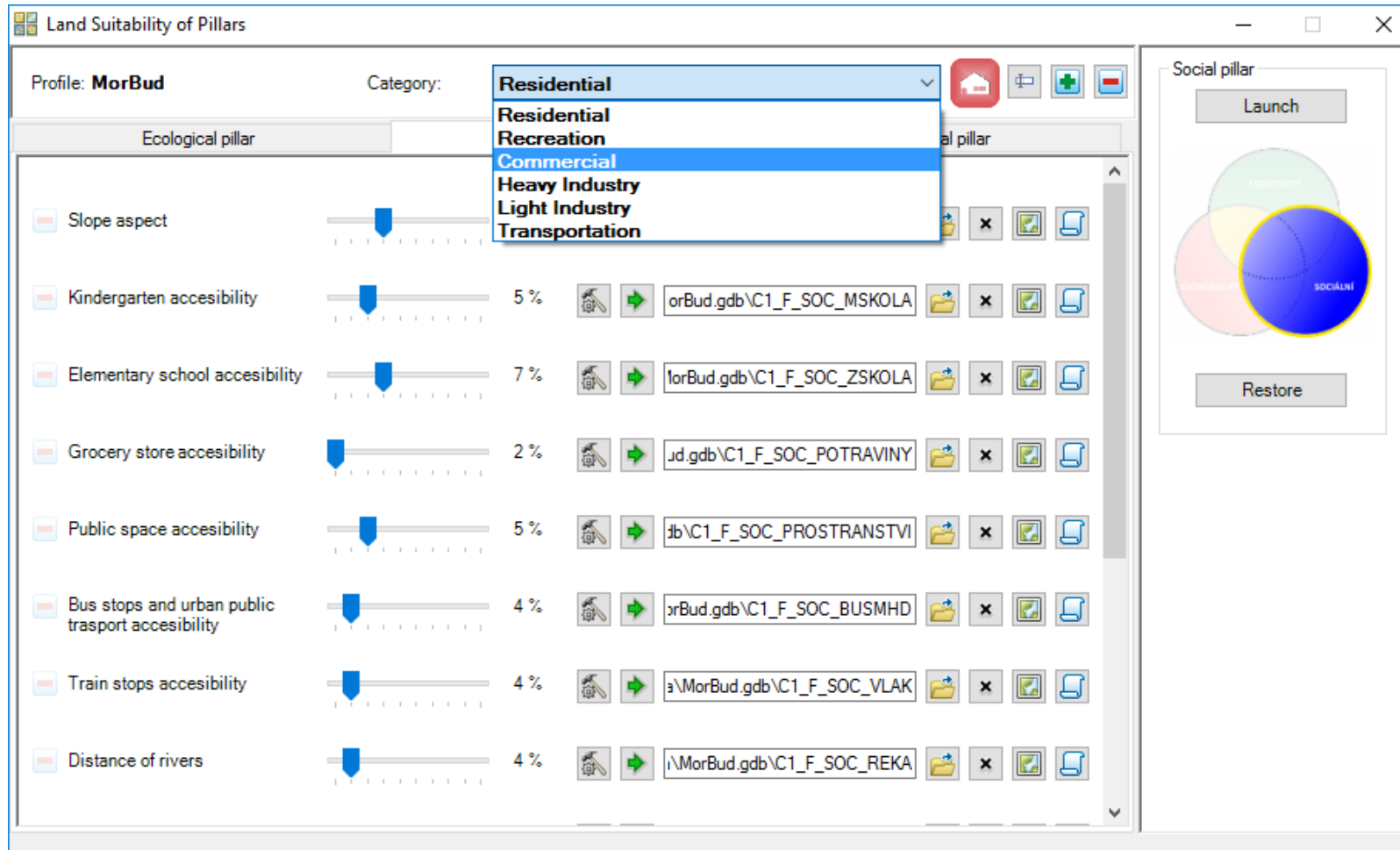


Land Use

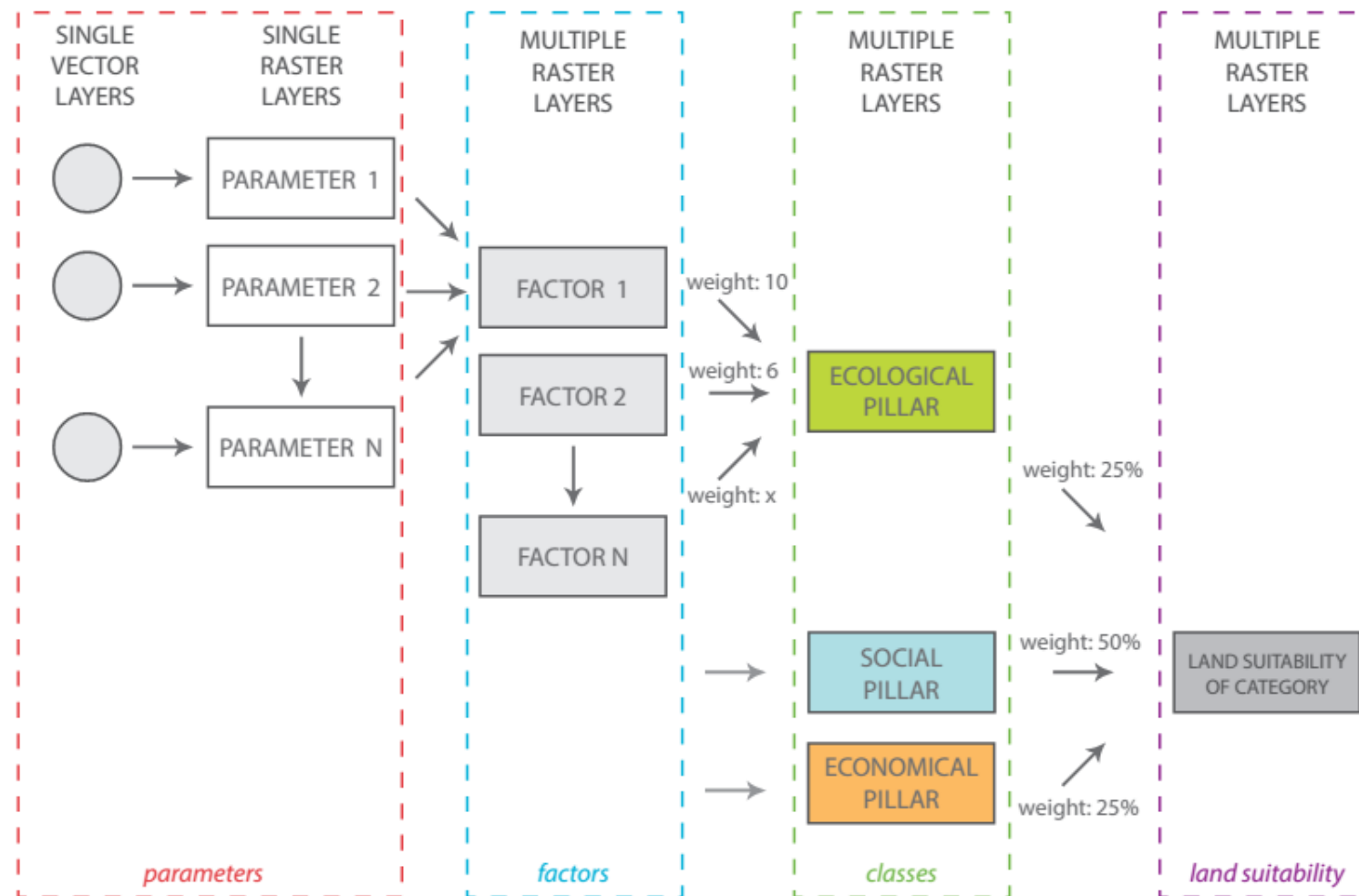
- ❖ Land suitability - allocation
- ❖ Vector output



Category Selection/Modification



Land Suitability Calculation



Parameters' Settings/Modification

The screenshot displays the 'Land Suitability of Pillars' software interface. The main window is titled 'Land Suitability of Pillars' and shows a profile named 'MorBud' with a category of 'Residential'. The interface is divided into three tabs: 'Ecological pillar', 'Social pillar', and 'Economic pillar'. The 'Ecological pillar' tab is active, showing four factors with their respective weights and paths:

Factor	Weight	Path
Water bodies protection	28 %	d.gdb\C1_F_EKL_VODNIREZIM
Nature protection	22 %	orBud.gdb\C1_F_EKL_PRIRODA
Mineral resources protection	28 %	lorBud.gdb\C1_F_EKL_NEROST
Soil and forest protection	22 %	orBud.gdb\C1_F_EKL_PUDALES

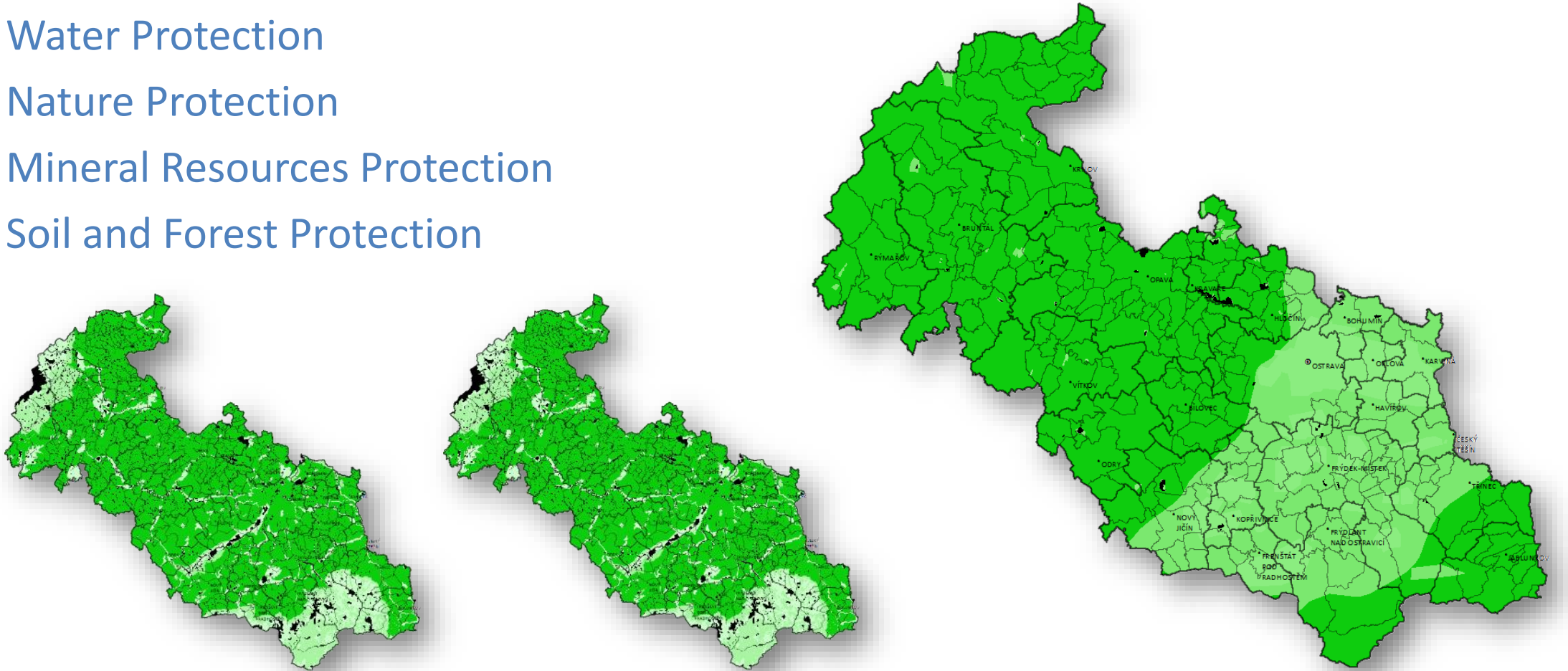
Below the table, there are three 3D maps showing the land suitability results. An 'Add factor' dialog box is open, displaying a list of factors to select. The factors listed are:

- Slope aspect
- Slope aspect
- Kindergarten accessibility
- Elementary school accessibility
- Grocery store accessibility
- Public space accessibility
- Bus stops and urban public transport accessibility
- Train stops accessibility
- Density of forests
- Distance of rivers
- Density of development
- Air pollution
- Noise
- Population density
- Radon hazard
- Cultural and social protection
- Slope
- Electric power supply
- Drinking water supply
- Gas supply
- Sewerage (waste water)
- Heat supply

The 'Add factor' dialog box has 'OK' and 'Cancel' buttons.

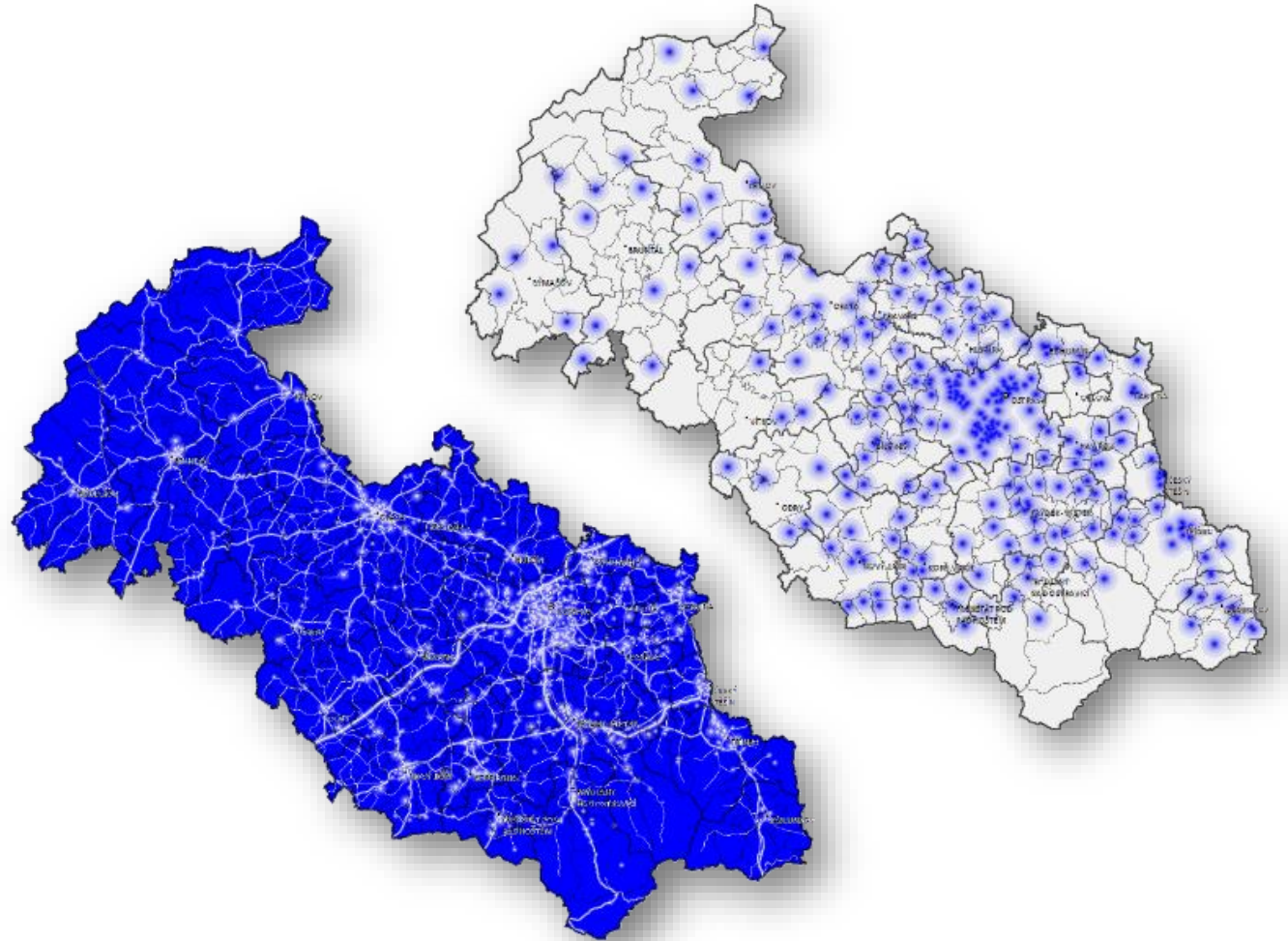
Ecological Pillar Factors

- Water Protection
- Nature Protection
- Mineral Resources Protection
- Soil and Forest Protection



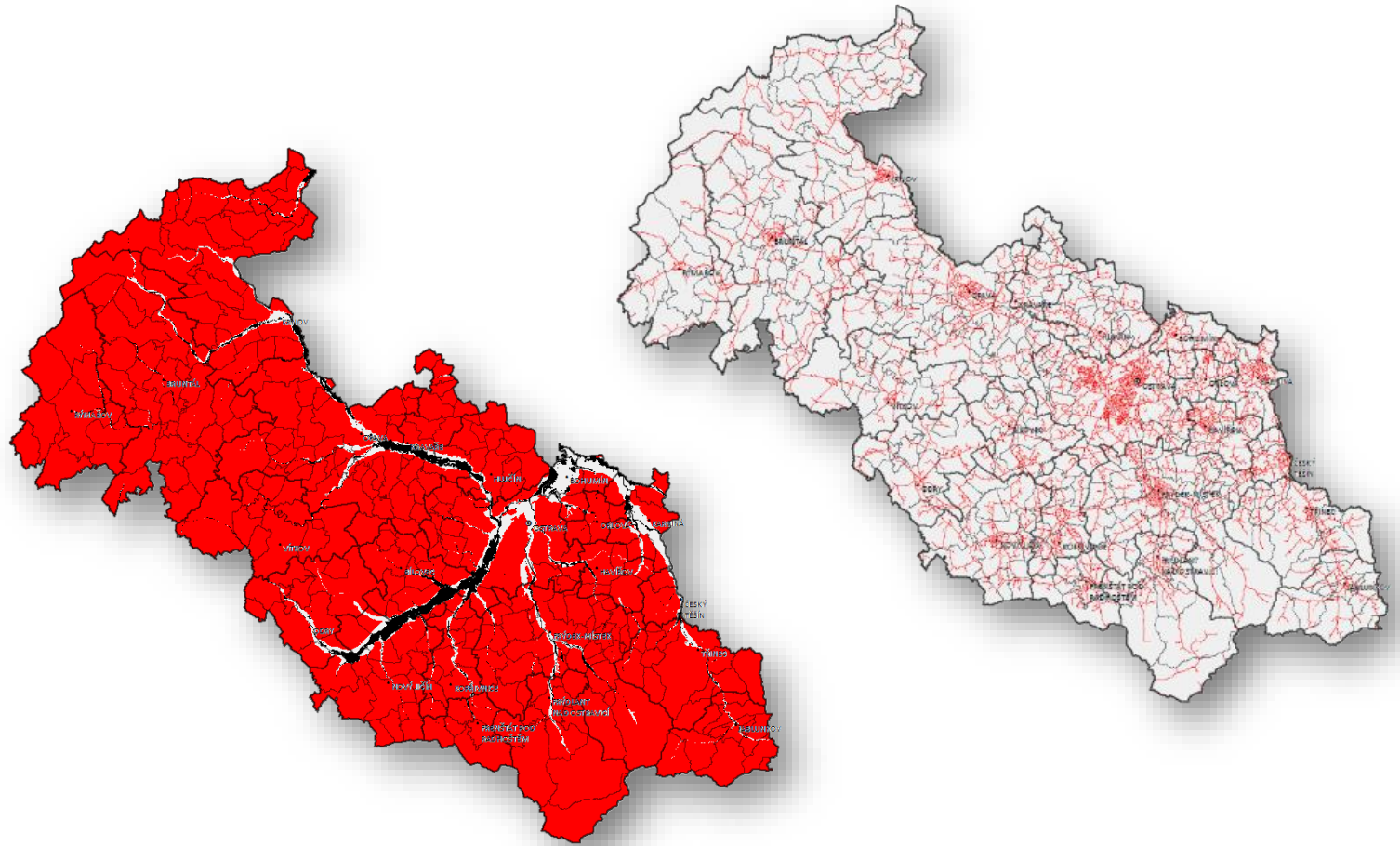
Social Pillar Factors

- Kindergarten Accessibility
- Elementary School Accessibility
- Grocery Store Accessibility
- Public Space Accessibility
- Bus Stops Accessibility
- Train Stops Accessibility
- Air and Noise Pollution
- Density of Population
- Radon Risk
- Cultural Protection



Economic Pillar Factors

- Density of Population
- Radon Risk
- Slope
- Electric Power Supply
- Water Supply
- Gas Supply
- Heat Supply
- Distance from Roads
- Distance from Railroad
- Flood Hazard
- Geological Hazard



Parameter Settings

Nature protection

Regional biocenter

Feature class:

☒ Field:

Attribute:

Value:

Regional biocorridor

Feature class:

☒ Field:

Attribute:

Value:

Local biocentre

Feature class:

Value	Suitability
X	Eliminated
0	Unsuitable
1	Very low
2	Low
3	Very low average
4	Low average
5	Average
6	High average
7	Very high average
8	High
9	Very high
10	Optimal

Elementary school accessibility

Elementary school

Feature class:

☐ Field:

Attribute:

	Category:	Value	Distance [m]
▶	Optimal	10	0-100
	Very high	9	100-200
	High	8	200-300
	Very high average	7	300-400
	Hight average	6	400-500
	Average	5	500-600
	Low average	4	600-800
	Very low average	3	800-1000
	Low	2	1000-1400
	Very low	1	1400-2000
	Unsuitable	0	2000-100000
	Eliminated	X	

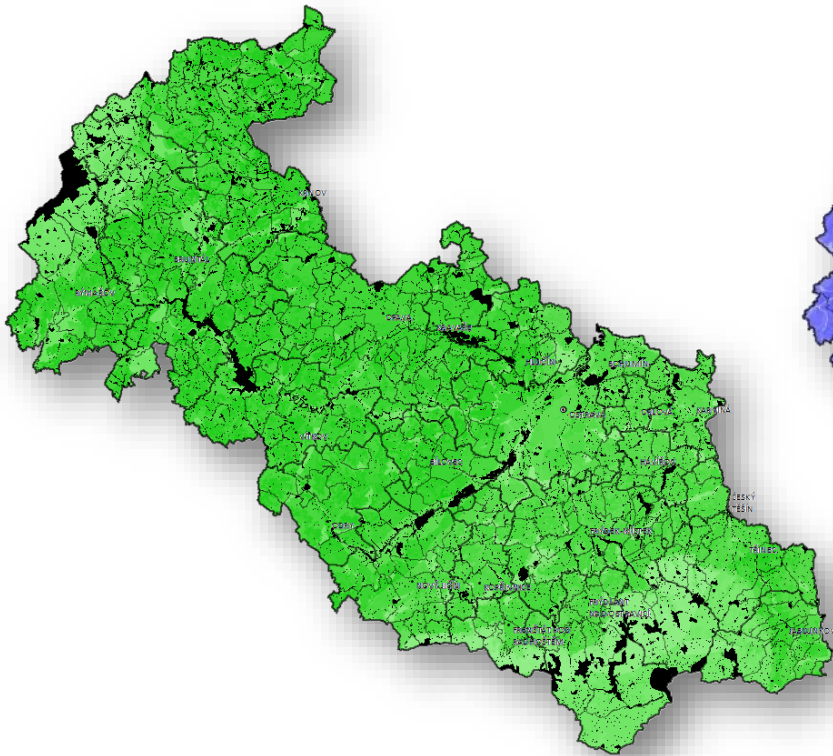
Setting of Factors' Weights - Saaty Method

- Relative ratio between factors
- Information about relationship between all possible pairs of factors (subjective importance estimation by pair comparison)
- Calculation of factors' weights

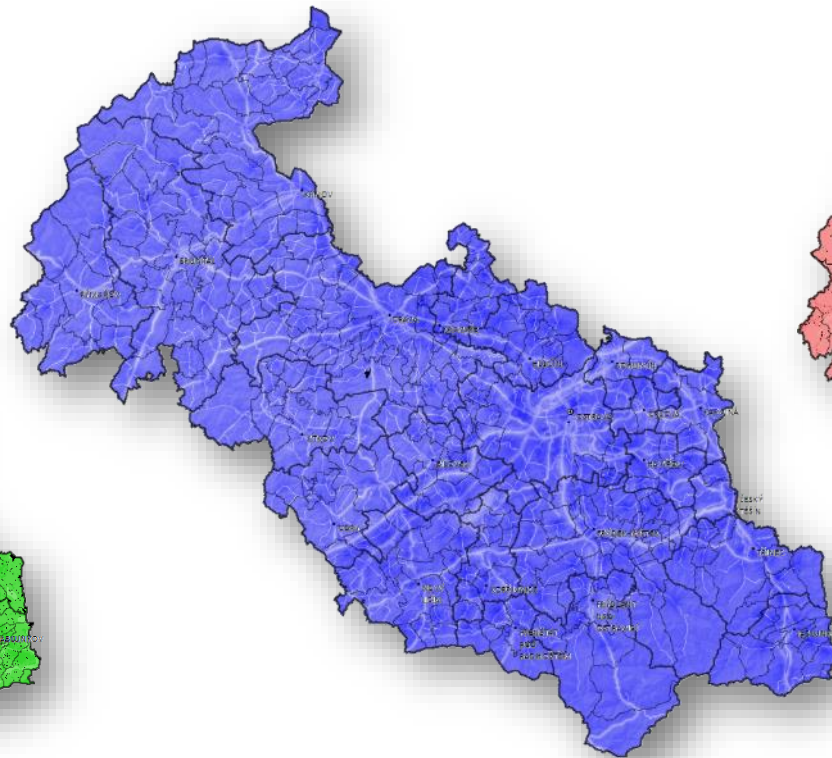
2.Dostupnost předškolní výchovy	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	3.Dostupnost základní školy
	Recorded																	
2.Dostupnost předškolní výchovy	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	4.Dostupnost zdravotnického zařízení
	Recorded																	
2.Dostupnost předškolní výchovy	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	5.Dostupnost veřejné zeleně
	Recorded																	
2.Dostupnost předškolní výchovy	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	7.Dostupnost autobusových zastávek
	Recorded																	
Criteria ratings for objective 'Bydlení - Sociální piliř'																		
	1.Morfologie t...	2.Dostupnost...	3.Dostupnost z...	4.Dostupnost z...	5.Dostupnost v...	7.Dostupnost a...	8.Dostupnost v...	9.Čistota ovzduší	10.Hlučnost pr...	13.Radonové ri...								
1.Morfologie t...		0.333	0.2	0.143	0.111	0.167	0.143	0.167	0.5	3								
2.Dostupnost...	3		0.5	0.25	0.143	2	0.125	0.333	6	3								
3.Dostupnost z...	5	2		3	0.167	1	0.2	0.5	3	1								
4.Dostupnost z...	7	4	0.333		0.5	2	0.2	3	4	5								
5.Dostupnost v...	9	7	6	2		6	2	1	3	2								
7.Dostupnost a...	6	0.5	1	0.5	0.167		0.333	1	3	2								
8.Dostupnost v...	7	8	5	5	0.5	3		6	6	3								
9.Čistota ovzduší	6	3	2	0.333	1	1	0.167		3	1								
10.Hlučnost pr...	2	0.167	0.333	0.25	0.333	0.333	0.167	0.333		0.5								
13.Radonové ri...	0.333	0.333	1	0.2	0.5	0.5	0.333	1	2									

Pillars of Land Suitability

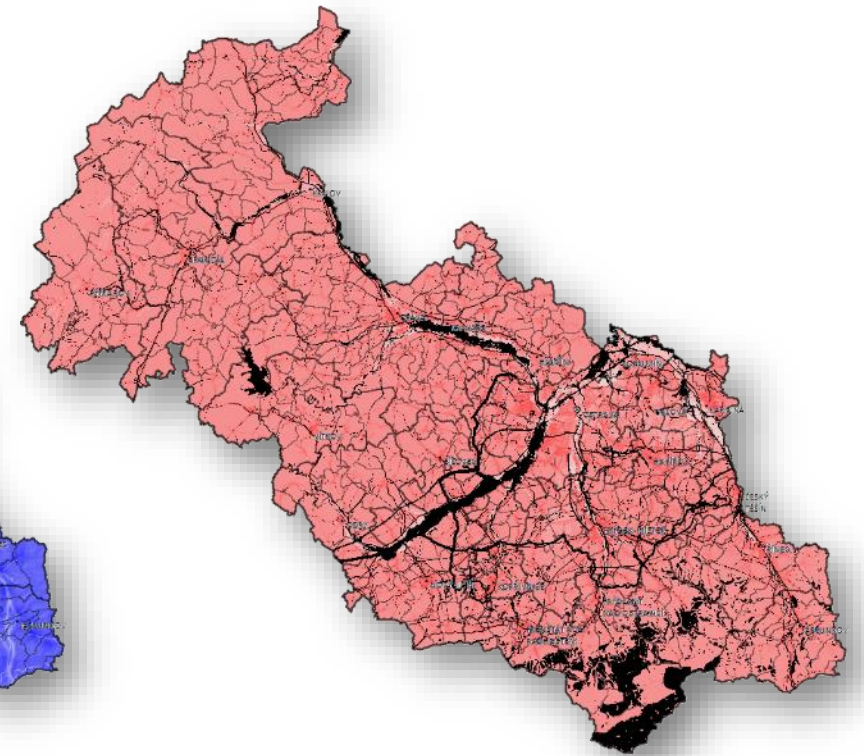
Ecological



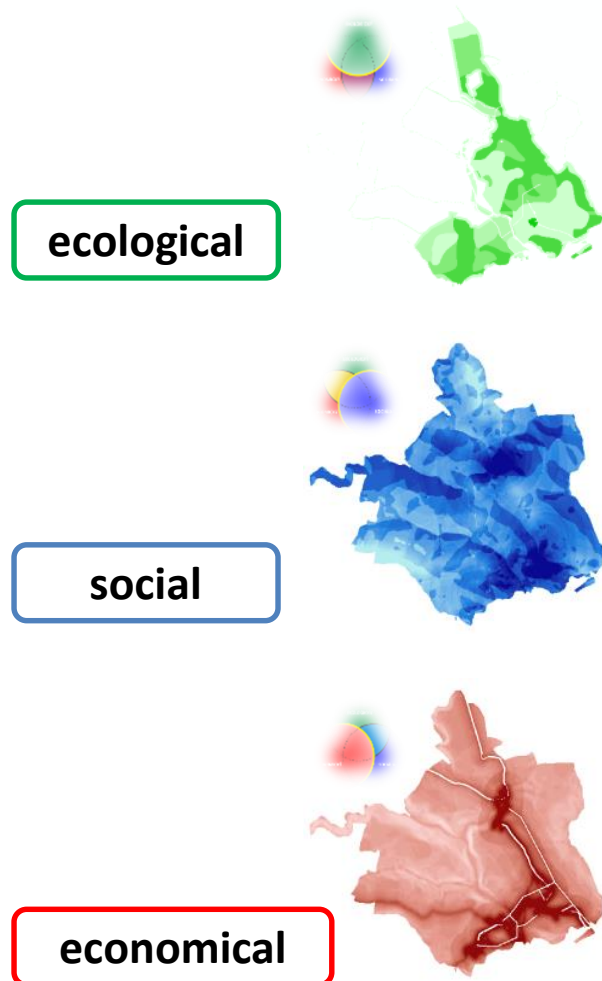
Social



Economical



Scenarios of Land Suitability



Scenario	Ecologic	Social	Economic
Sustainable	33 %	33 %	33 %
Acceptable	40 %	40 %	20 %
Viable	40 %	20 %	40 %
Fair	20 %	40 %	40 %
Ecological pillar priority	60 %	20 %	20 %
Social pillar priority	20 %	60 %	20 %
Economic pillar priority	20 %	20 %	60 %
Custom	? %	? %	? %

Total Land Suitability

Total Land Suitability

Profile: **MorBud** Category: **Residential**

Scenario of development: **Sustainable**

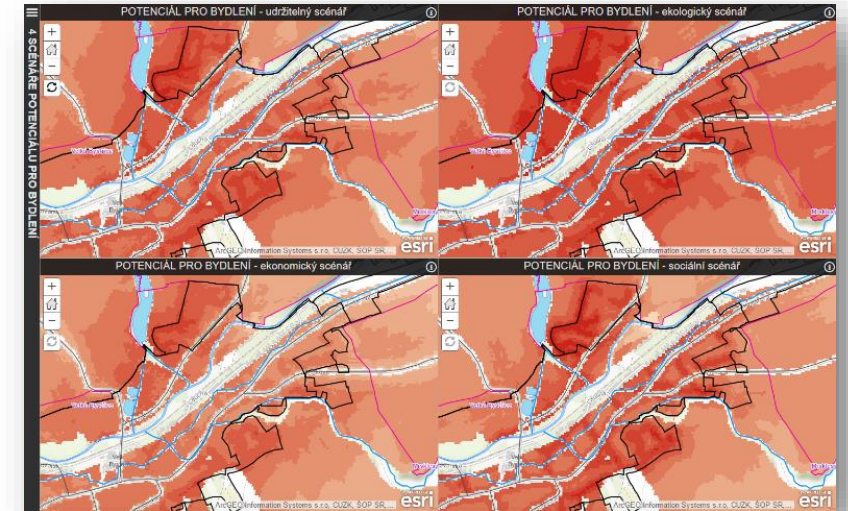
Weight of ecological pillar: **33,33** % Ecological pillar: **BF3DCC2B\\Data\\MorBud.gdb\\C1_P_EKL**

Weight of social pillar: **33,33** % Social pillar: **BF3DCC2B\\Data\\MorBud.gdb\\C1_P_SOC**

Weight of economical pillar: **33,33** % Raster of Economical pillar: **BF3DCC2B\\Data\\MorBud.gdb\\C1_P_EKN**

Total land suitability

Launch



Total Land Suitability

Profile: **MorBud** Category: **Residential**

Scenario of development: **Sustainable**

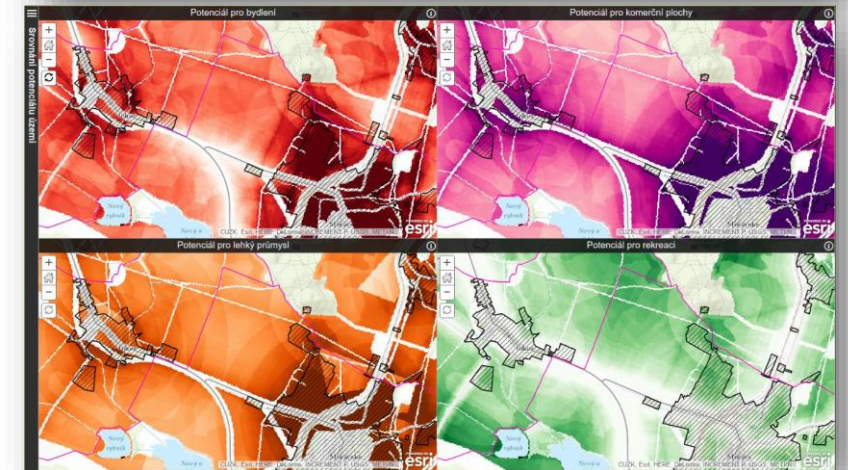
Weight of ecological pillar: **33,33** % Raster of Ecological pillar: **BF3DCC2B\\Data\\MorBud.gdb\\C1_P_EKL**

Weight of social pillar: **33,33** % Raster of Social pillar: **BF3DCC2B\\Data\\MorBud.gdb\\C1_P_SOC**

Weight of economical pillar: **33,33** % Raster of Economical pillar: **BF3DCC2B\\Data\\MorBud.gdb\\C1_P_EKN**

Total land suitability

Launch



Land Suitability

Housing

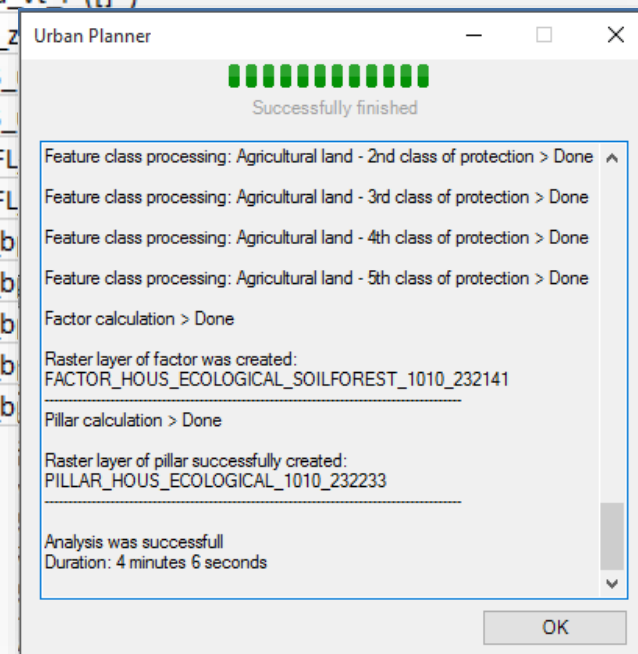
Commercial
areas

Recreation

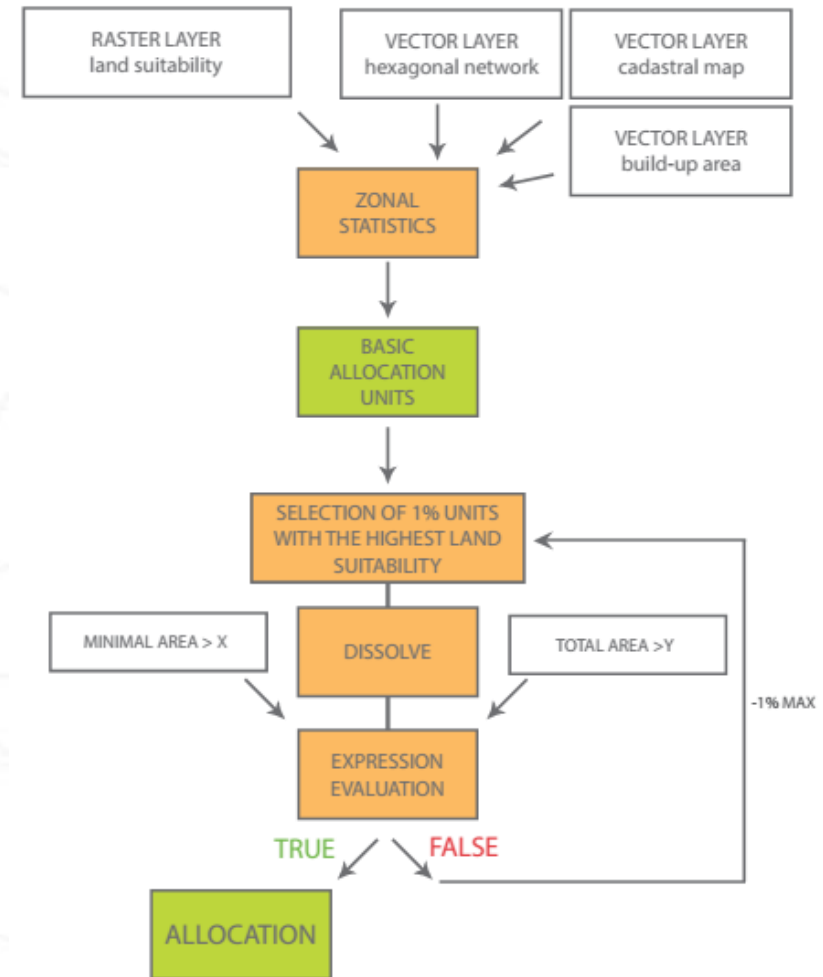
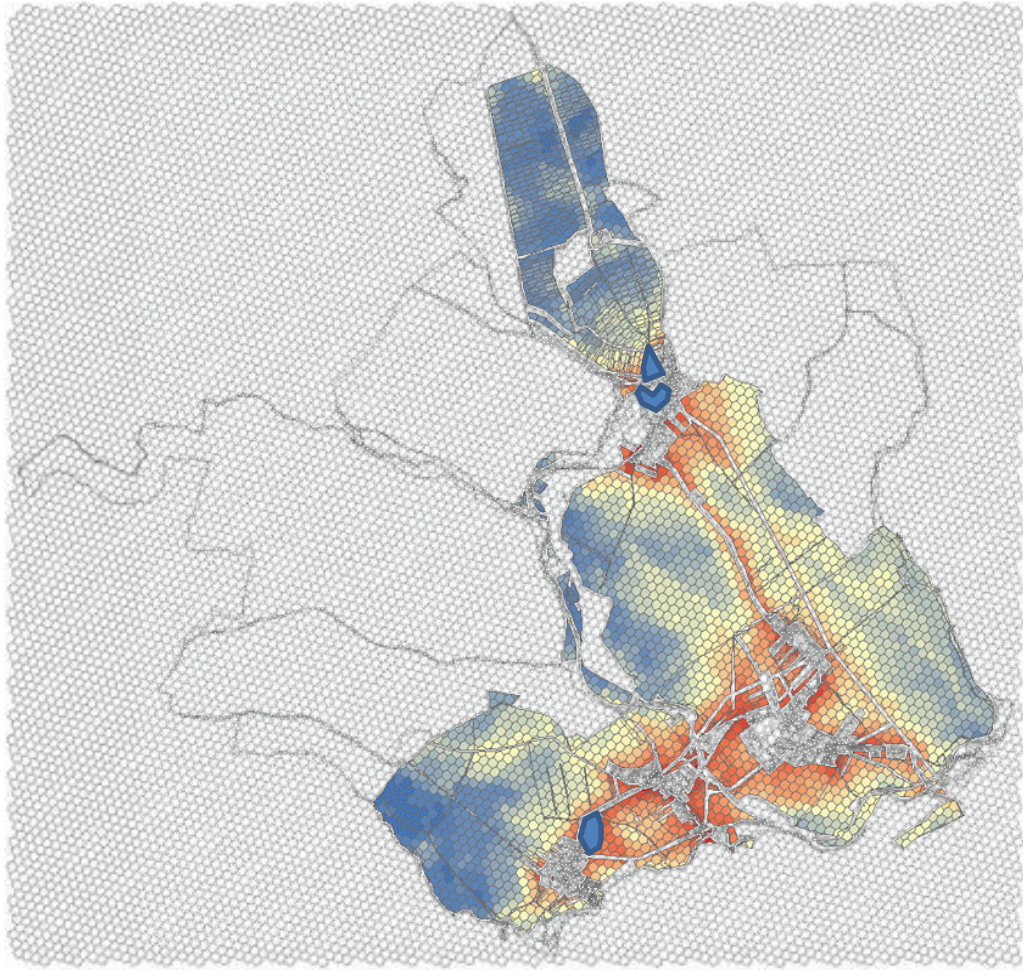
Industry

Summary of Results

	A	B	C	D	E	F	G
1	Category	Pillar	Factor	Factor we	Feature	Feature w	Source
2	Bydlení	Ecological	Water bodies protection	10	1st degree protective zone of water source	X	ft_07_OVZ_vodni_zdroj_op_p ([JEV]='07OVZ_1_OPVZ10')
3	Bydlení	Ecological	Water bodies protection	10	2nd degree protective zone of water source	8	ft_07_OVZ_vodni_zdroj_op_p ([JEV]='07OVZ_2_OPVZ10')
4	Bydlení	Ecological	Water bodies protection	10	2nd degree protective zone of water source -	8	ft_07_OVZ_vodni_zdroj_op_p ([JEV]='07OVZ_2B_OPVZ10')
5	Bydlení	Ecological	Water bodies protection	10	Water bodies	X	ft_07_VODU_vodni_plocha_p ([KOD_STAV]=1)
6	Bydlení	Ecological	Water bodies protection	10	Area designated for water flow management	X	ODJ_sprava_vt_P ([J]=)
7	Bydlení	Ecological	Water bodies protection	10	Vulnerable area	10	ft_07_OVZ_z
8	Bydlení	Ecological	Nature protection	8	Local biocentre	X	ft_02_USES_
9	Bydlení	Ecological	Nature protection	8	Local biocorridor	X	ft_02_USES_
10	Bydlení	Ecological	Soil and forest protection	8	Production forest area	0	ft_11_PUPFL
11	Bydlení	Ecological	Soil and forest protection	8	Area at the forest edge with a conditional use	2	ft_11_PUPFL
12	Bydlení	Ecological	Soil and forest protection	8	Agricultural land - 1st class of protection	2	ft_11_ZPF_b
13	Bydlení	Ecological	Soil and forest protection	8	Agricultural land - 2nd class of protection	3	ft_11_ZPF_b
14	Bydlení	Ecological	Soil and forest protection	8	Agricultural land - 3rd class of protection	5	ft_11_ZPF_b
15	Bydlení	Ecological	Soil and forest protection	8	Agricultural land - 4th class of protection	7	ft_11_ZPF_b
16	Bydlení	Ecological	Soil and forest protection	8	Agricultural land - 5th class of protection	7	ft_11_ZPF_b



Land Use Allocation



Land Use Allocation

Allocation

Profile: **MorBud** Category: **Mixed H**

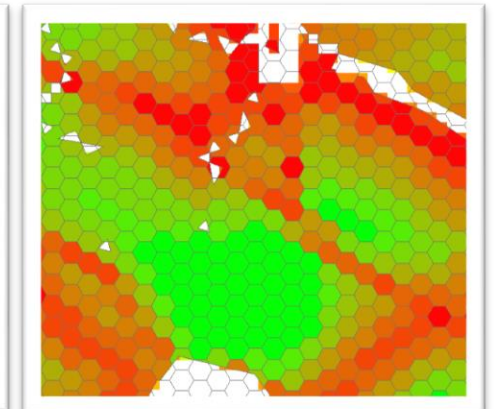
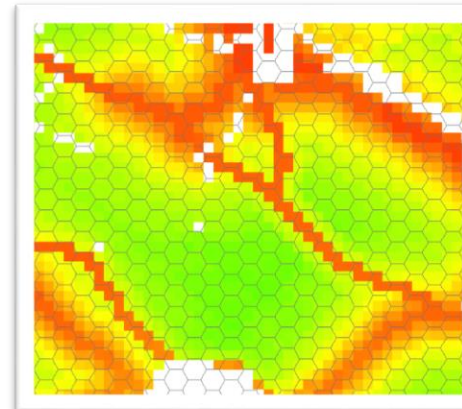
Raster layer of land suitability: e:\5FD12B29-7FD5-423D-8F81-916BBF3DCC2B\Data\MorBud.gdb\C1_S_33_33_33

Build-up and reserved area: C:\Dropbox\Urban Planner\Zakazky\Vysocina\MorBud\MorBud_Filtr.gdb\ZastUz_p

Minimal area of allocation: **5000** m² Total area of allocation: **1000000** m²

Allocation

Launch



Suitability Transfer

Profile: **MorBud** Category: **Mixed H**

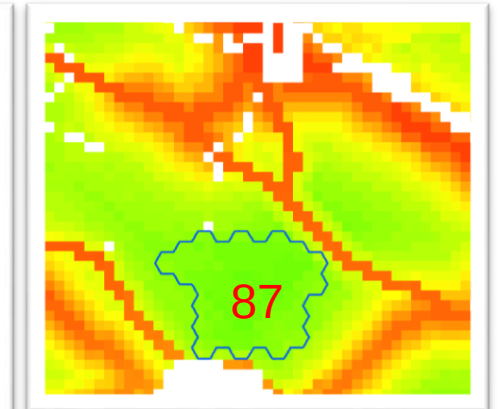
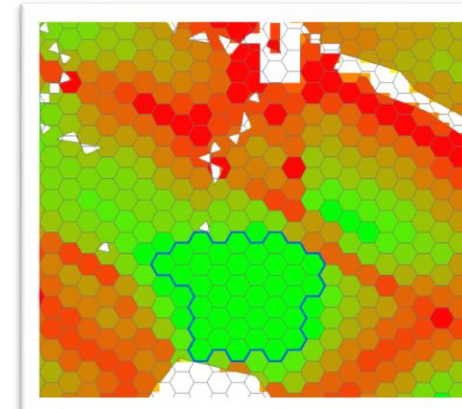
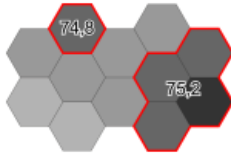
Raster layer of land suitability: e:\5FD12B29-7FD5-423D-8F81-916BBF3DCC2B\Data\MorBud.gdb\C1_S_33_33_33

Feature Class to Transfer: e:\5FD12B29-7FD5-423D-8F81-916BBF3DCC2B\Data\MorBud.gdb\PIZmenUP_pl

Zonal statistics of category: ☒ Zonal statistics of pillars: ☐ Zonal statistics of factors: ☐

Suitability Transfer

Launch



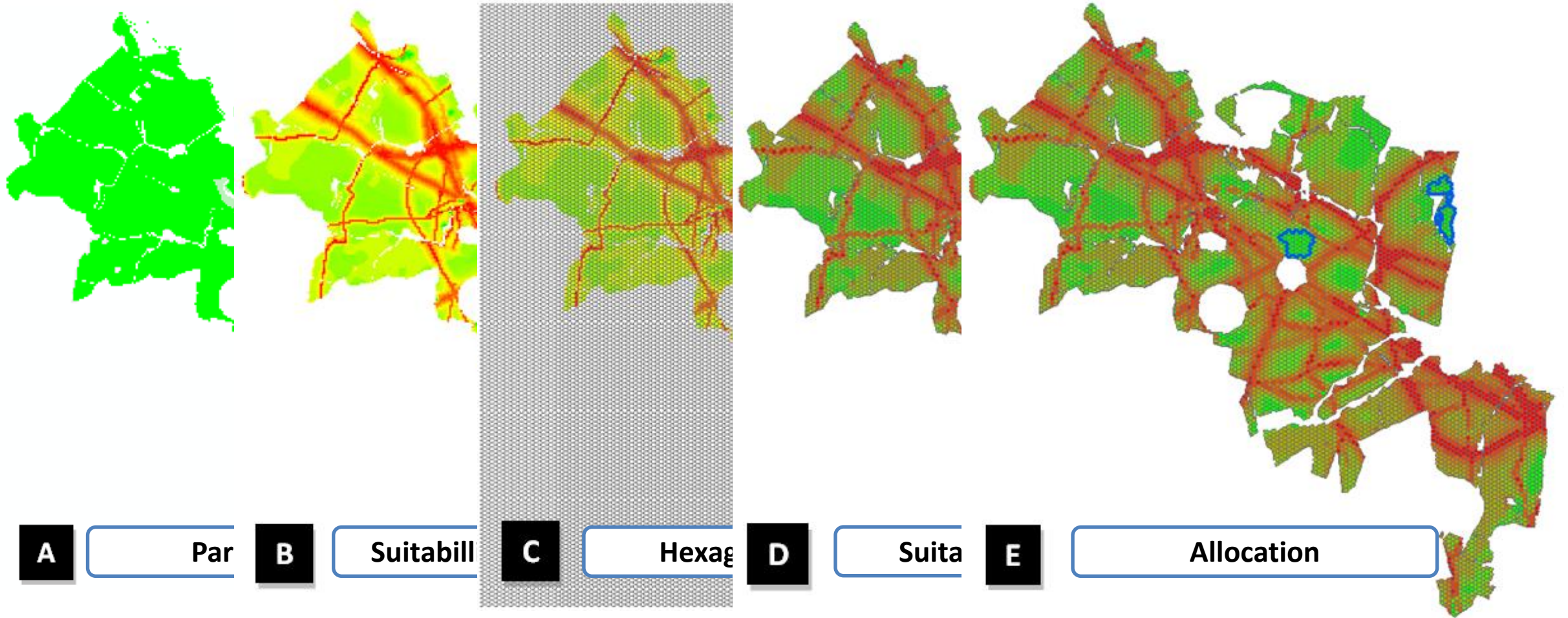
Statistics

	OBJE	Shape	SUIT	EKL	SOC	EKN	VODNIREZI	PRIRODA	NEROST	PUDALES	ORIENTACE	MSKOLA	ZSKOLA	POTRAVINY	PROSTRANSTVI	BUSMHD	VLAK	REKA
	1	Polygon	65,8	84,4	48,5	64,5	100	100	100	30	100	0	0	0	20	30	0	0
	2	Polygon	68,3	83,6	58,6	62,7	100	100	100	26,1	89,6	0	0	0	36,3	40,8	0	6,7
	3	Polygon	66	82,2	60,1	55,7	100	100	100	20	100	0	0	0	40	61,9	0	20
	4	Polygon	68,7	82,2	57,9	65,8	100	100	100	20	84,6	0	0	0	47,8	70,8	0	18,6
	5	Polygon	66	92,9	52,8	52,2	100	100	100	68	100	0	0	0	30	30	0	20
	6	Polygon	68,1	85,9	52,8	65,6	100	100	100	36,7	43,1	0	0	0	42,8	32,2	0	0
	7	Polygon	66,9	82,2	60,5	57,9	100	100	100	20	75,3	0	0	0	44,3	59	0	13,1
	8	Polygon	65,9	92,2	53,2	52,2	100	100	100	65,1	95,4	0	0	0	21,5	30	0	26,1
	9	Polygon	68,7	83,9	56,8	65,6	100	100	100	27,4	60,2	0	0	0	53,1	45,2	0	0
	10	Polygon	67,5	84,2	57,1	61,3	100	100	100	28,7	72,4	0	0	0	33,1	51,5	0	10,2
	11	Polygon	65,9	84,4	45,1	68,2	100	100	100	30	96,7	0	0	0	36,7	85,8	0	0
	12	Polygon	66,2	84,4	54,3	60,2	100	100	100	30	100	0	0	0	20	30	0	20
	13	Polygon	68,5	78,9	55,2	71,5	80	100	100	30	64,2	0	0	0	27,4	51,8	0	8,6
	14	Polygon	67,2	92,6	47,4	61,5	100	100	100	66,9	9,2	0	0	0	30	40	0	0
	15	Polygon	67	92,9	50,6	57,6	100	100	100	68,1	70,5	0	0	0	30	40	0	0
	16	Polygon	67,9	79,6	55,8	68,5	82,3	100	100	30	100	0	0	0	20	39,2	0	10
	17	Polygon	67,3	79,1	55,1	67,8	80,8	100	100	30	100	0	0	0	20	33,6	0	10
	18	Polygon	66,8	88,8	47,8	63,9	100	100	100	49,7	100	0	0	0	0	7,7	0	30,5
	19	Polygon	66,8	84,2	50	66,5	83	100	100	50	92,2	0	0	0	10	20	0	10
	20	Polygon	66,2	83,3	48,2	66,7	80	100	100	50	100	0	0	0	10	20	0	10
	21	Polygon	66,6	88,9	49,5	61,4	100	100	100	50	93,3	0	0	0	6,3	22,2	0	11,2

< 0 > (0 out of 21 Selected)

C1_X_S_33_33_33

Results

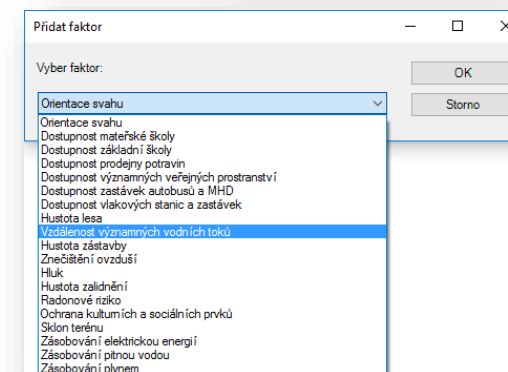
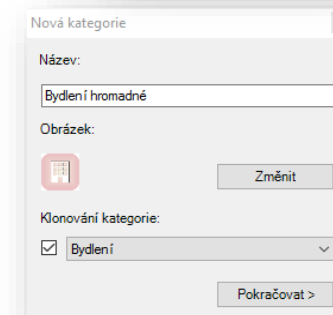
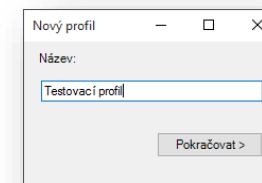


Automatic Outputs' Labelling

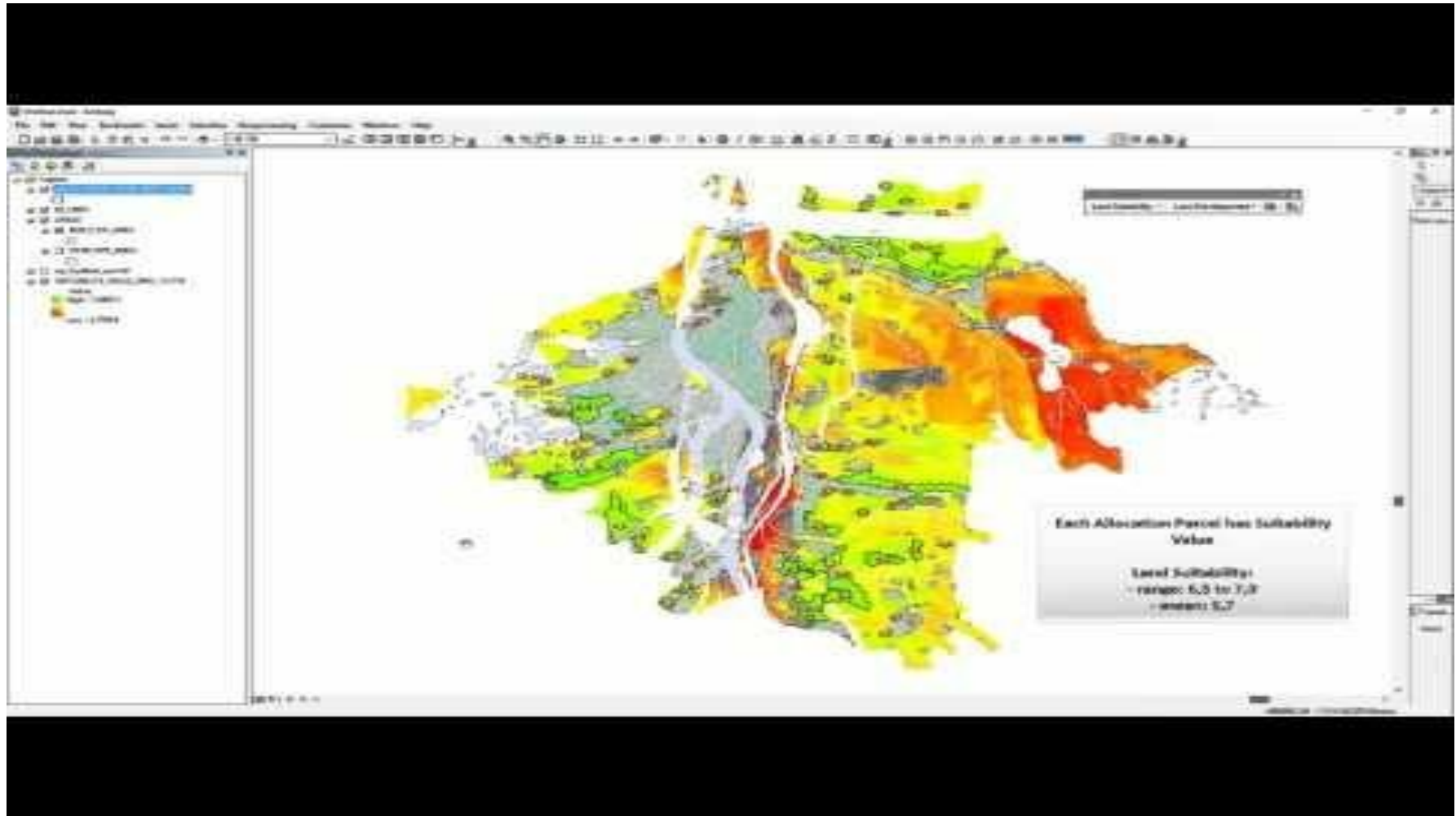
- **Pillars' abbreviations:**
 - EKL - ecological
 - EKN - economic
 - SOC - social
- **Categories' Abbreviations:**
 - C1 - housing
 - C2 - recreation
 - C3 - commercials
 - C4 - industry
 - C5 - transportation
- **factor:** C1_F_EKL_VODREZIM
 - category_F_pillar_factor
- **pillar:** C1_P_EKL
 - category_P_pillar
- **suitability:** C1_S_33_33_33
 - category_S_weights of pillars in ordering EKL_EKN_SOC
- **allocation:** C1_A_30_30_30
 - category_A_weights of pillars
- **statistics:** C1_X_33_33_33
 - category_X_weights of pillars

Main Features

- Automatic retrieval of the data paths from the data model
- User profiles creation and transferability
- User profiles and calculation parameters are stored in the database
- Custom categories of the land use
- Custom factors' and pillars' weights setting
- Custom factors' selection



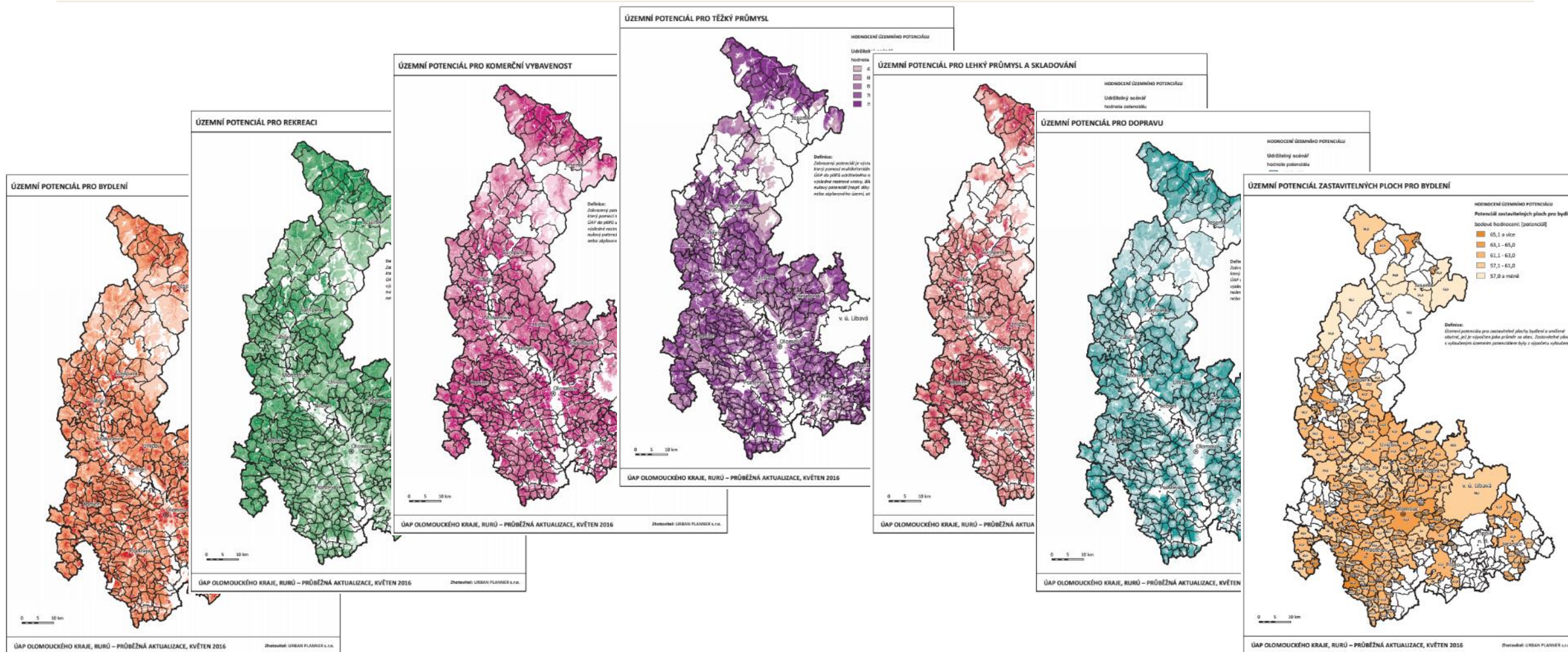
Video Preview



Practical Application

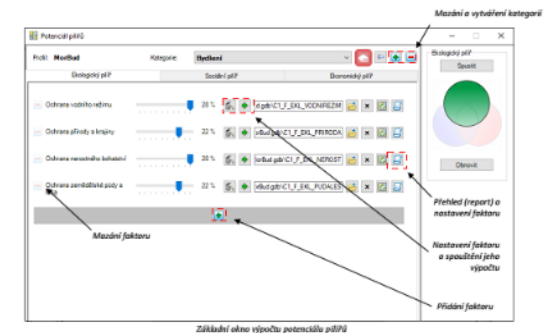
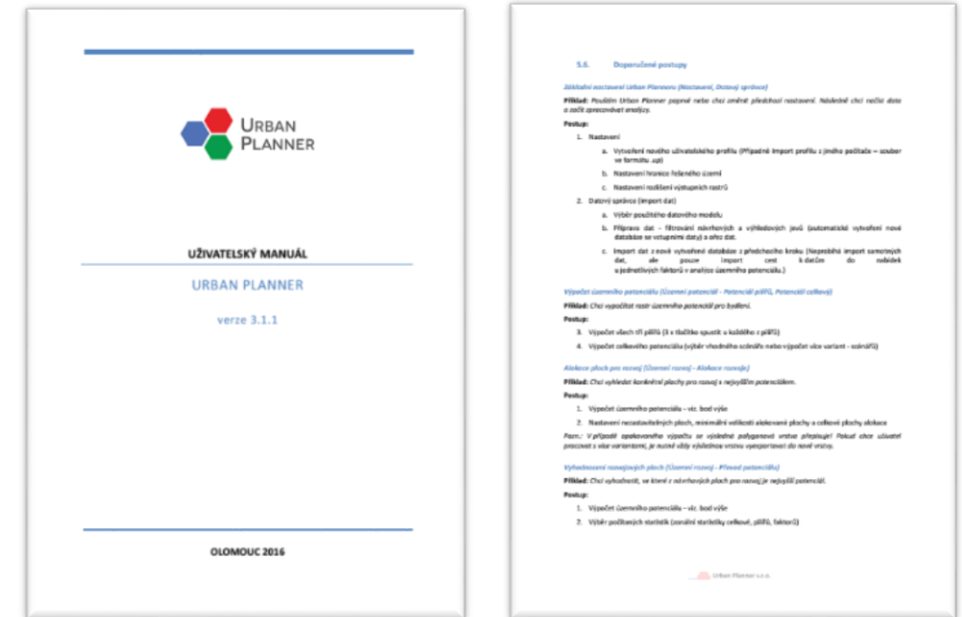


Part of Analytical Material for Planning in Olomouc Region

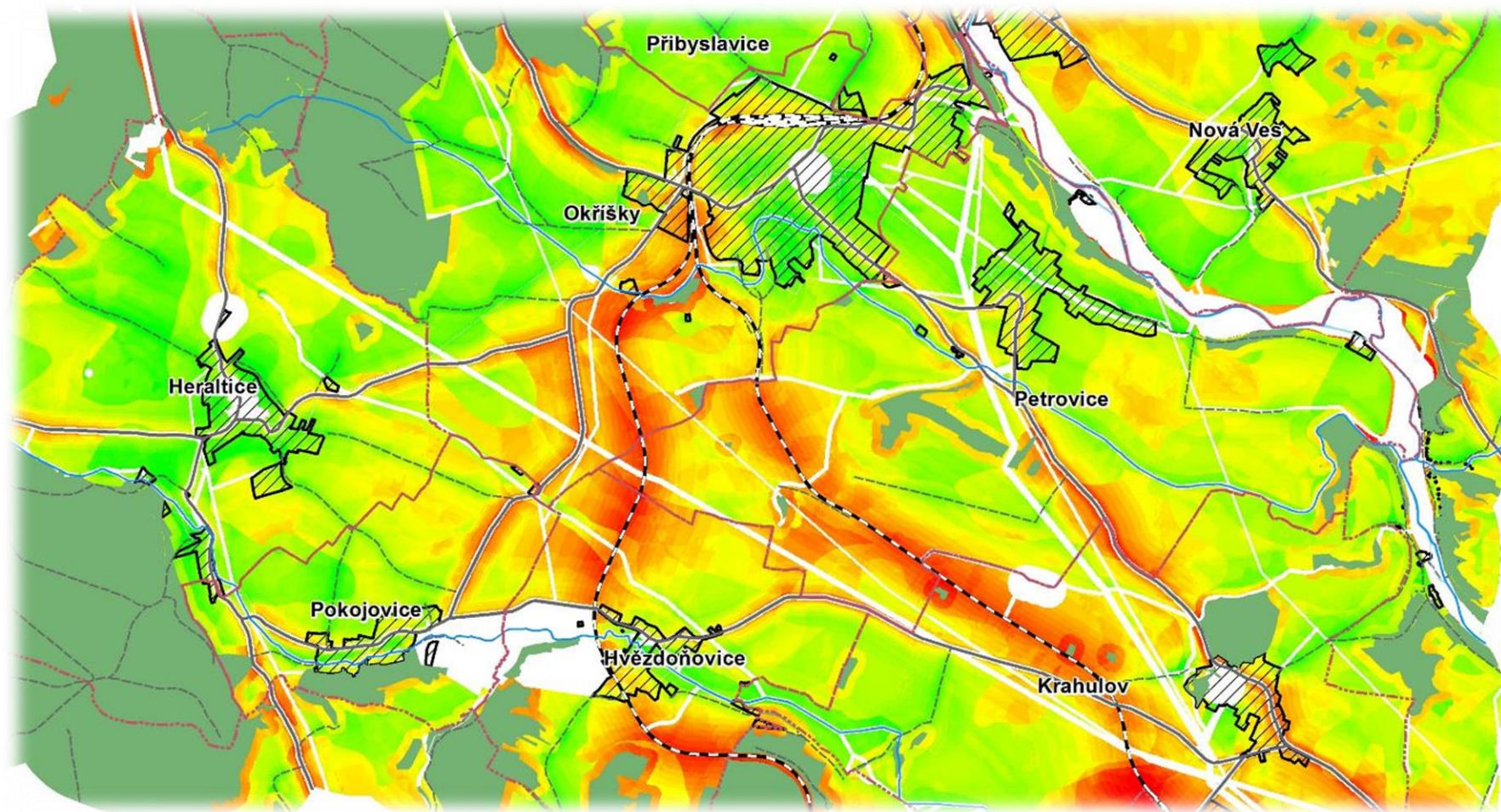


Practical Application in Vysocina Region

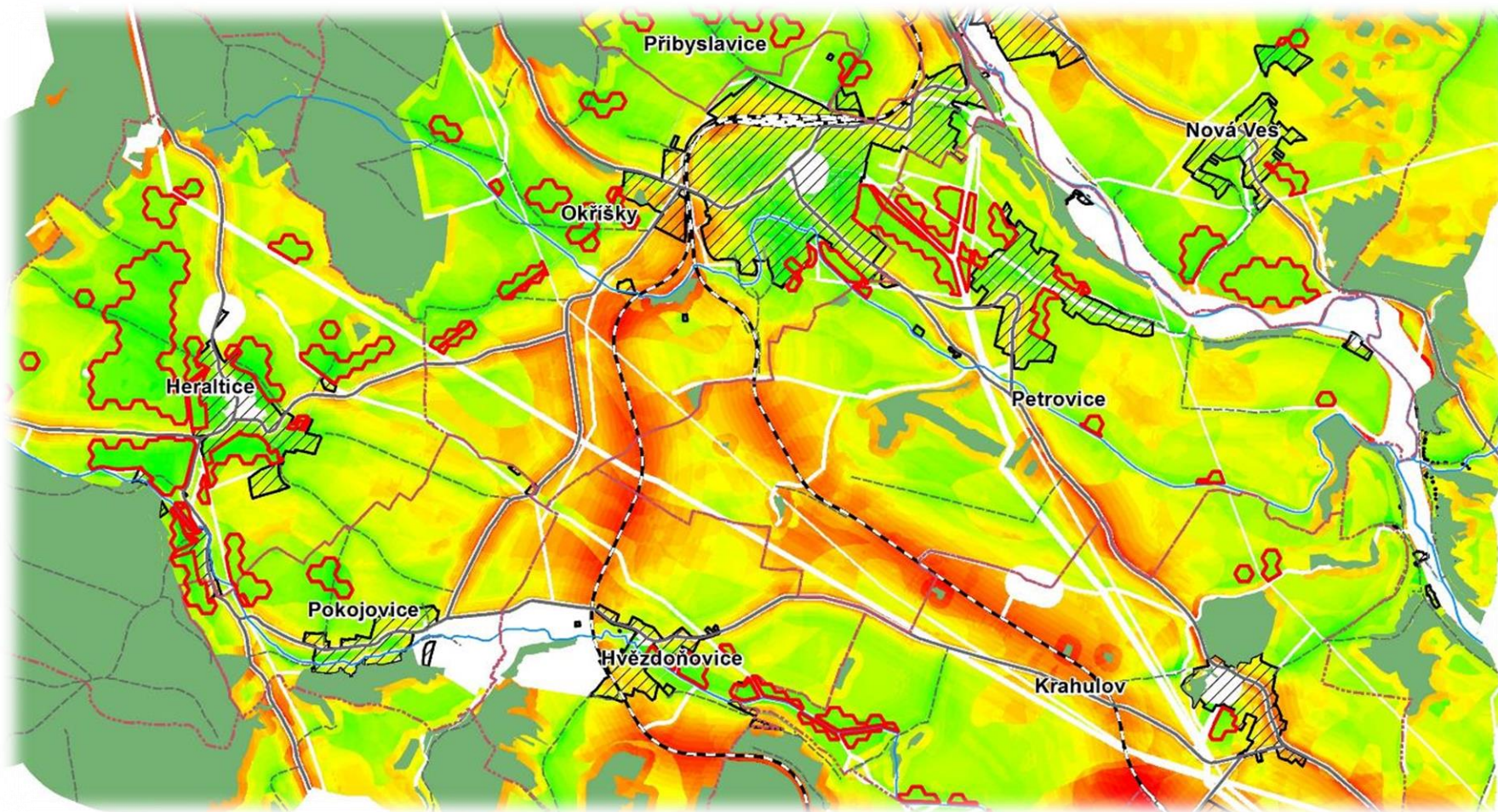
- Lecturing, tutorial
- Data Processing
 - Address Points, Schools
 - DEM, public transportation stops
- Data processing in Urban Planner
 - Data selection
- Testing Area
 - Okříšky Area
 - Moravské Budějovice Region



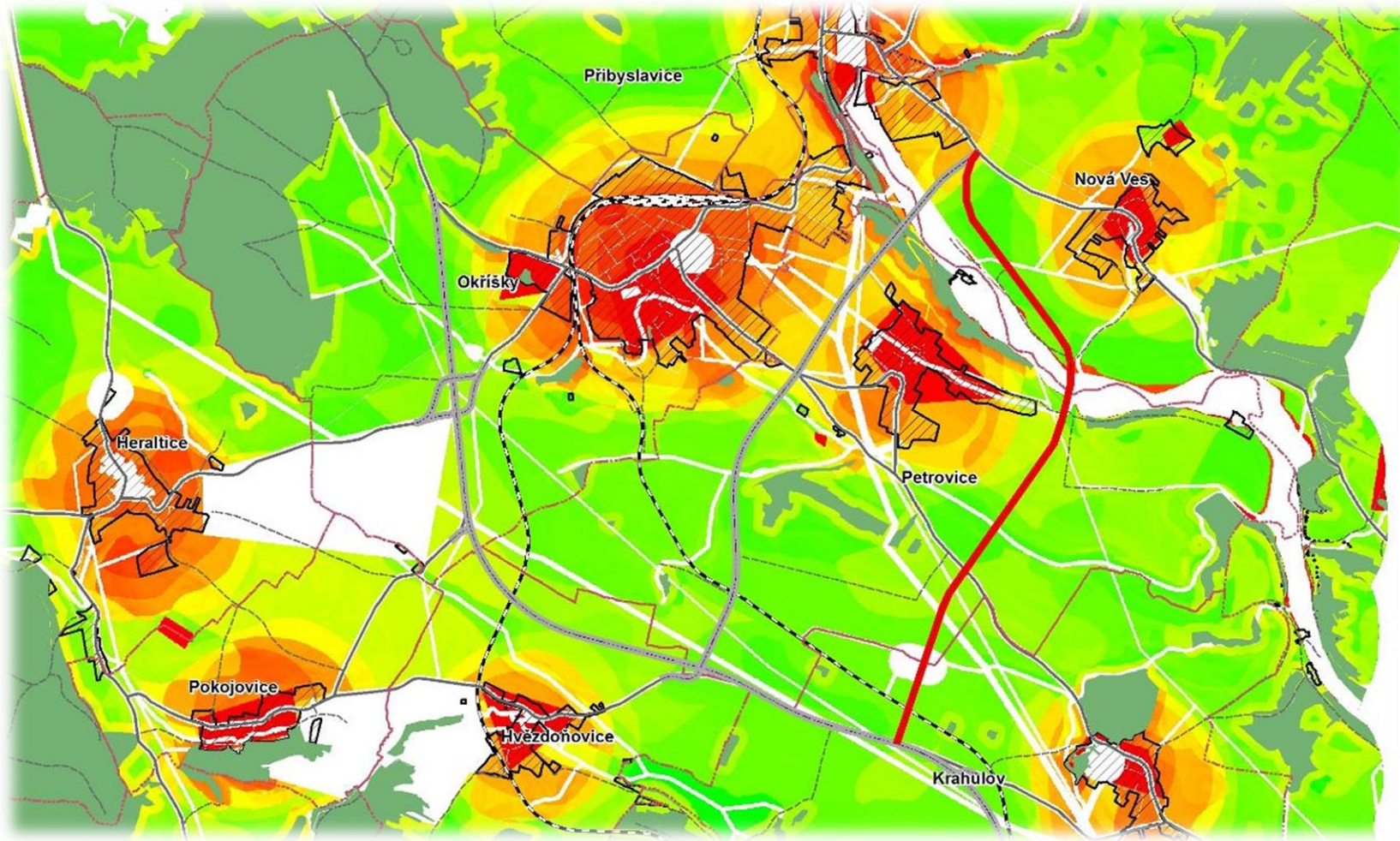
Land Suitability for Housing



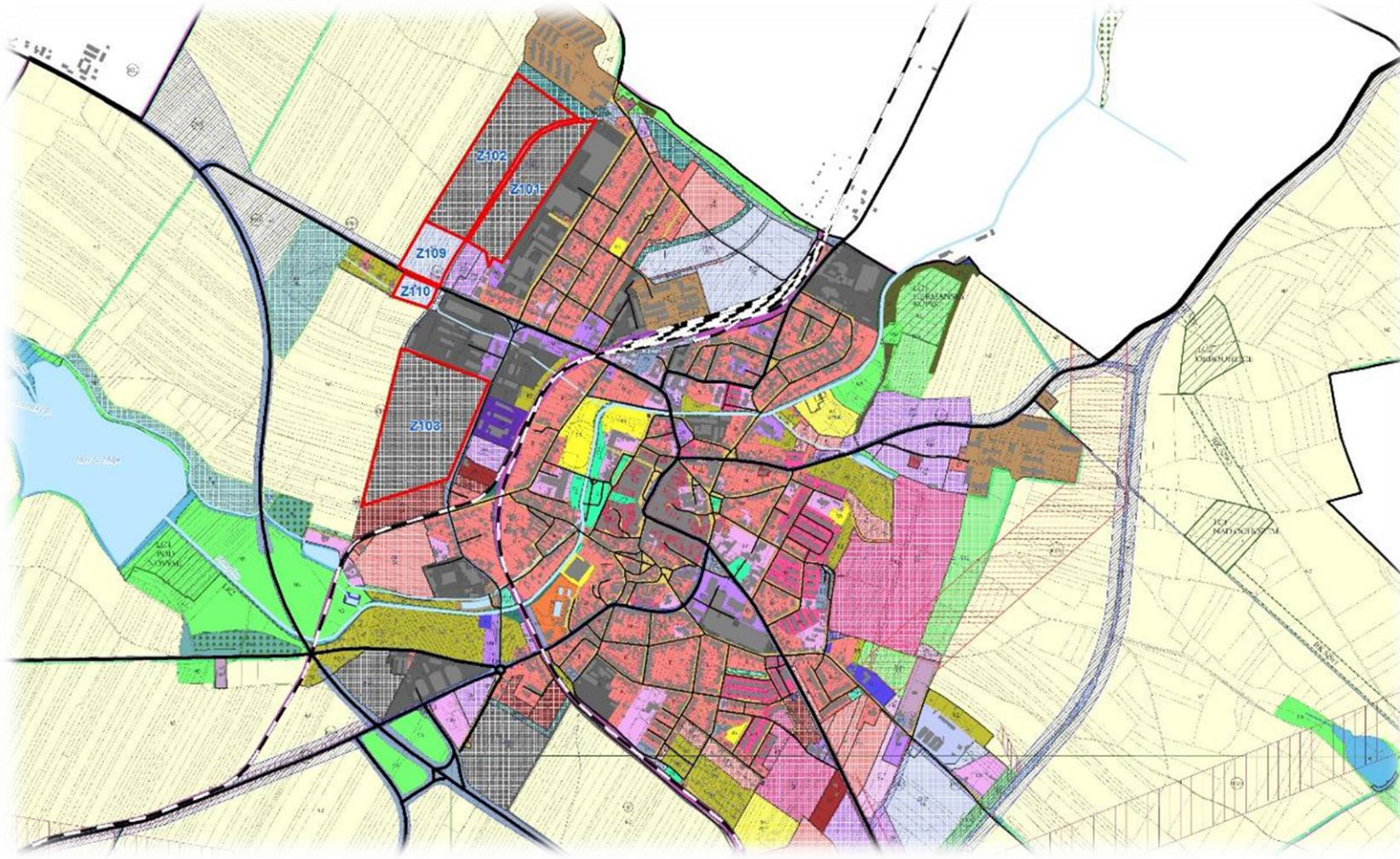
Land Allocation for Housing



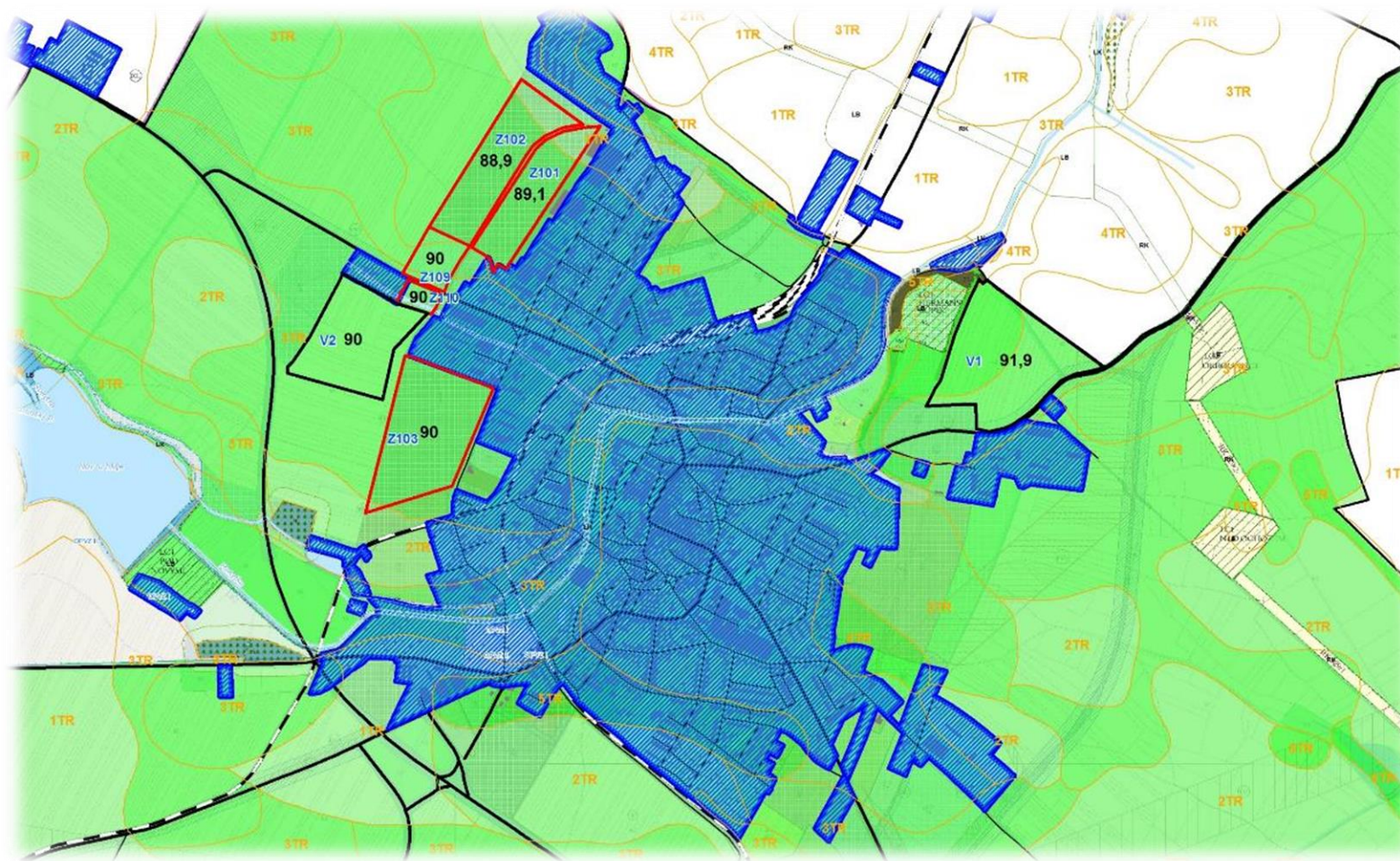
Land Suitability for Transportation



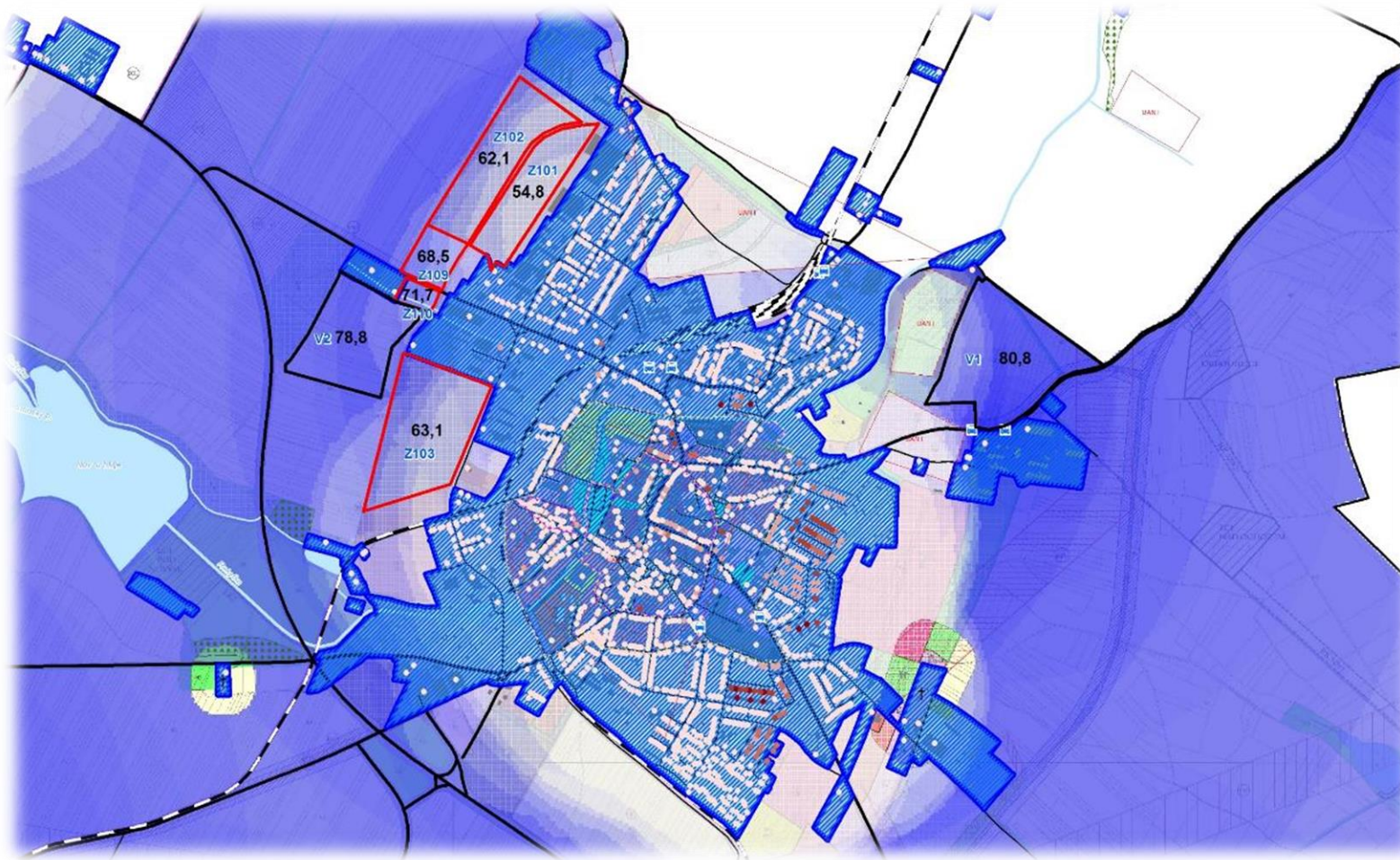
Evaluation of existing proposals for housing



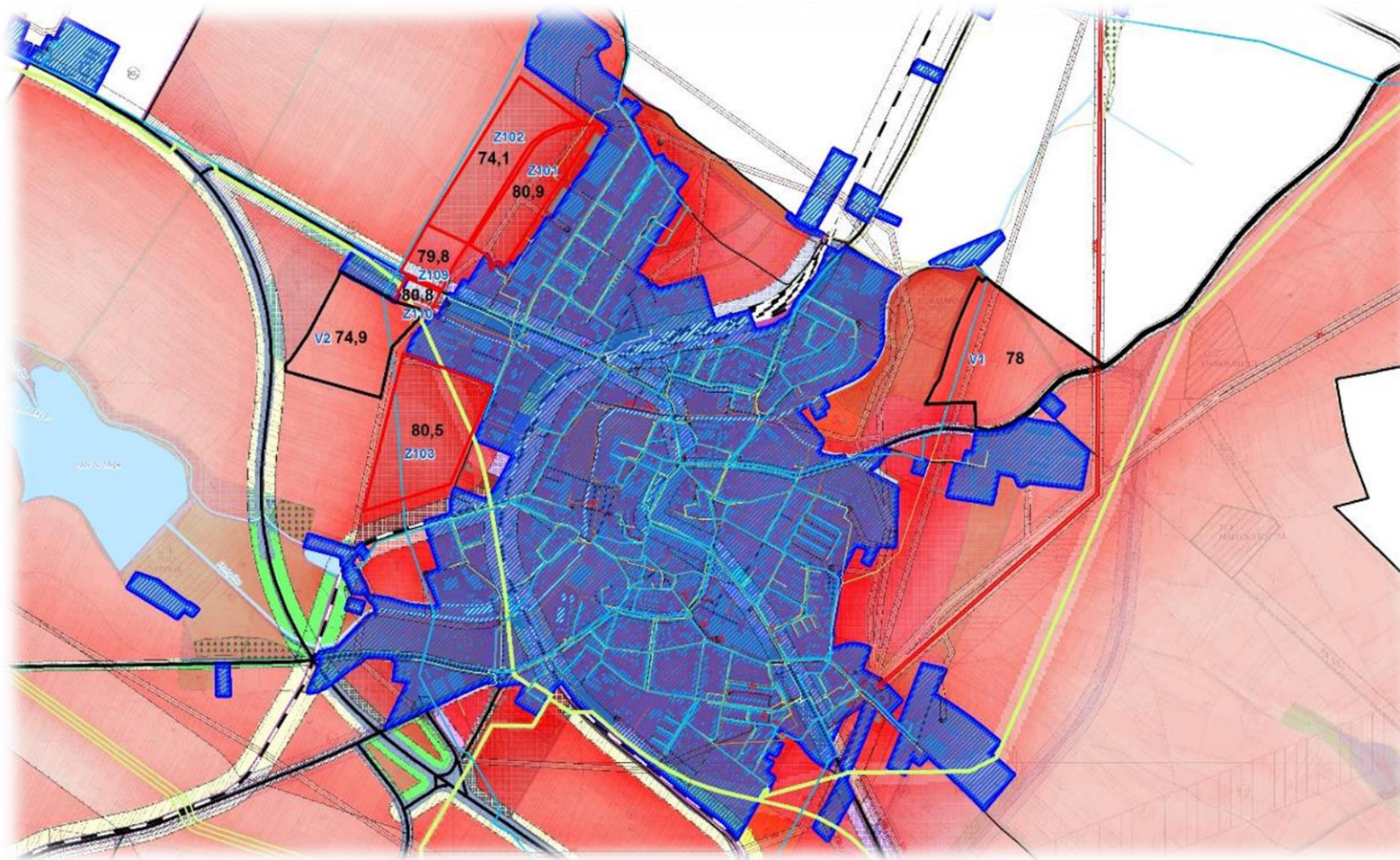
Ecologic Pillar



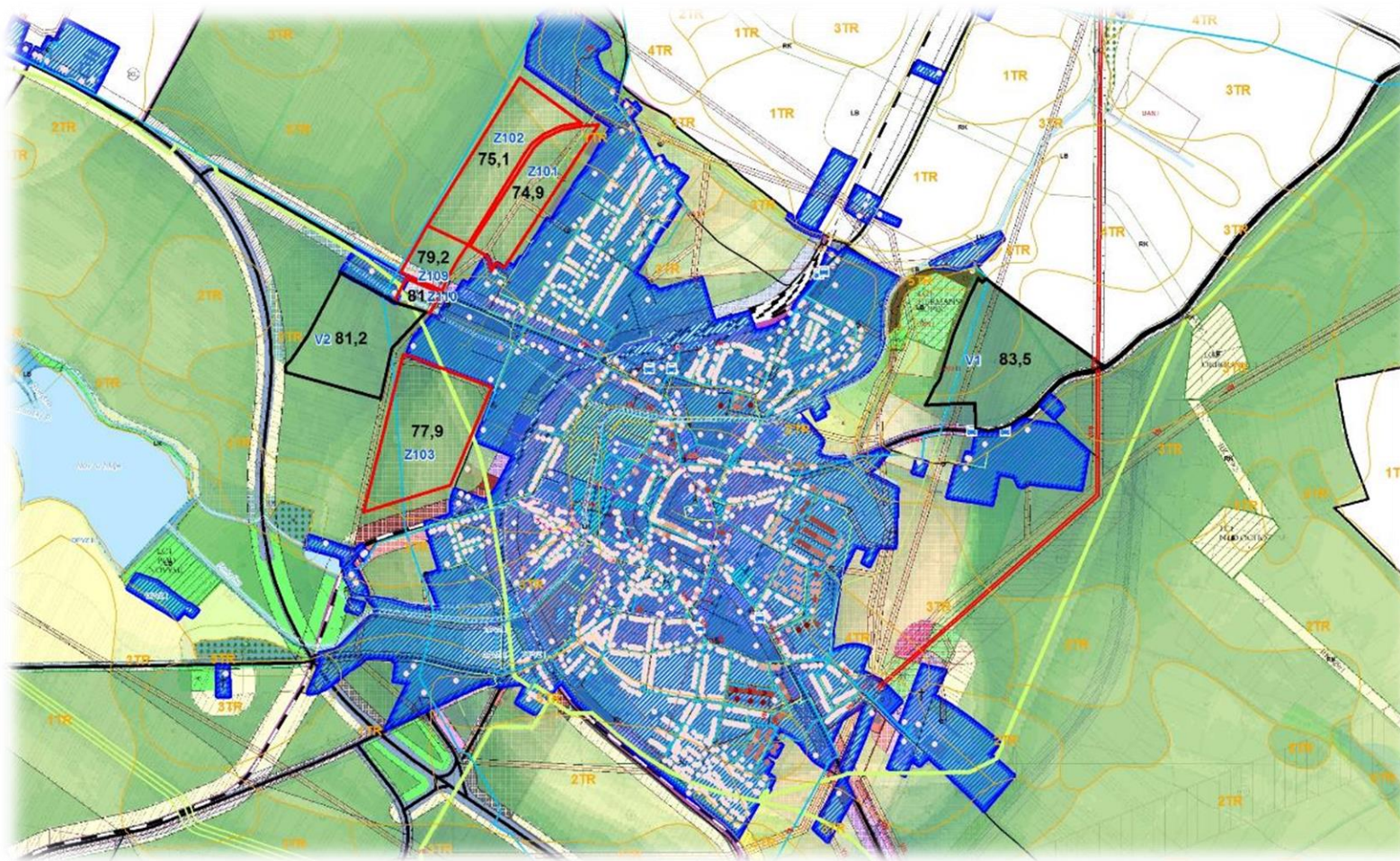
Social Pillar



Economic Pillar

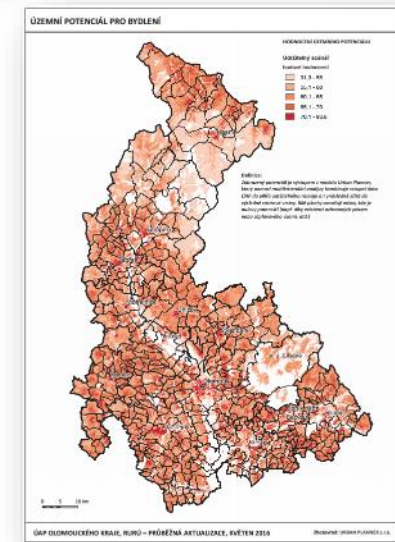
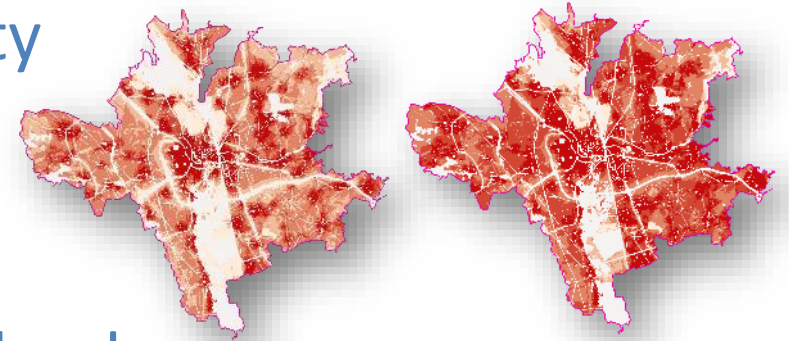


Total Land Suitability



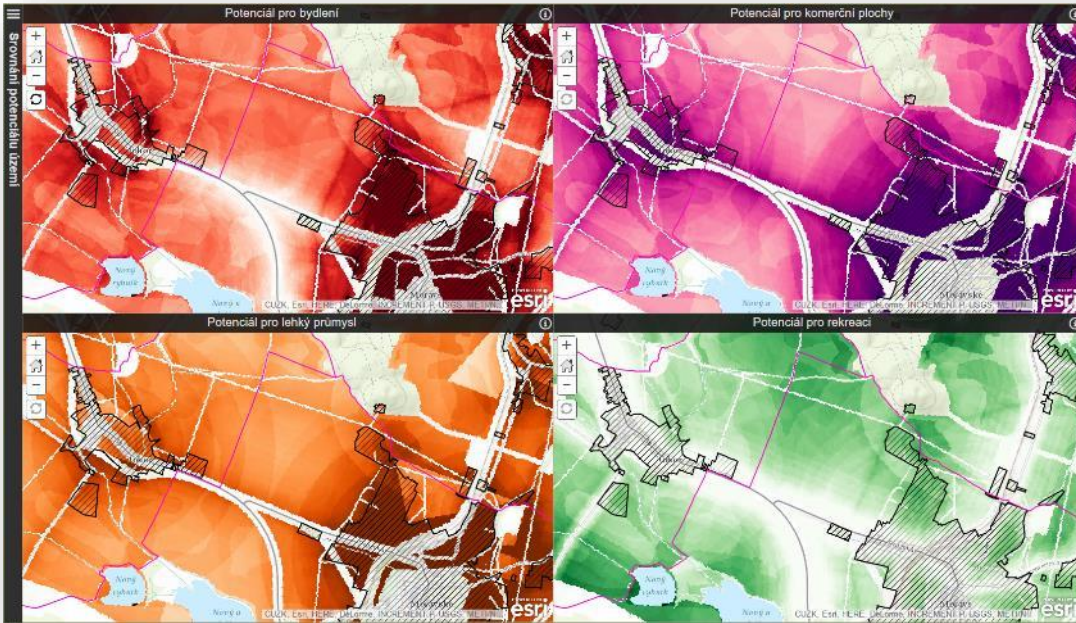
Applications

- Analysis and interpretation of the land suitability
- Optimal development areas allocation
- Scenario calculations
- Comparison of possible variants of land development
- Verification of current or proposed activities
- Verification of principles of sustainability
- Urban plans, analytical material for planning

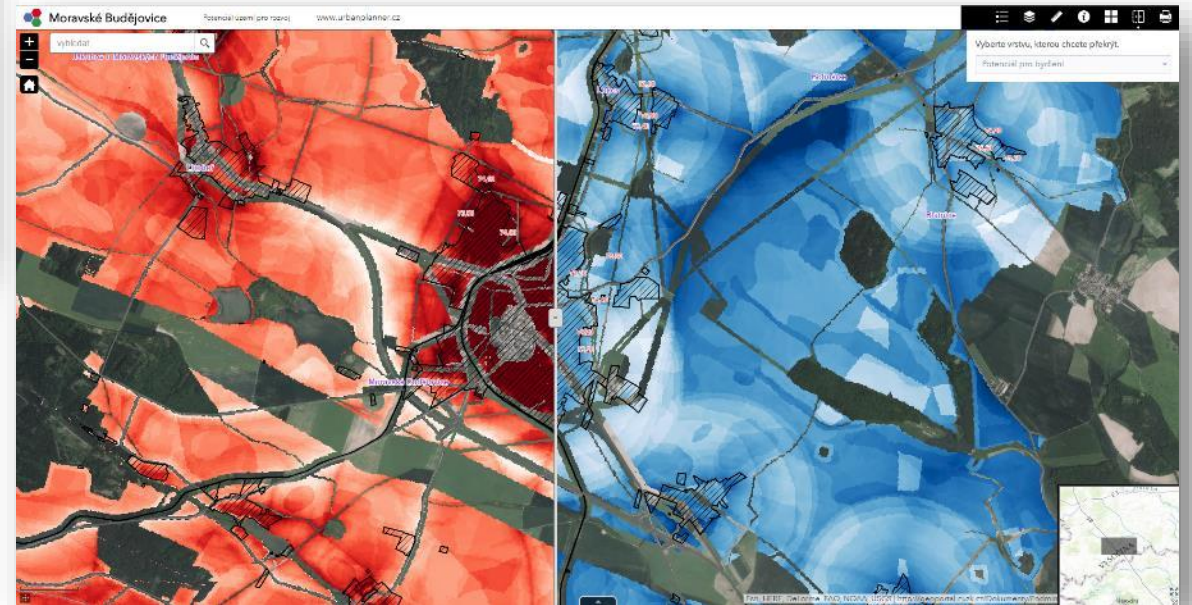


Practical Application in Vysocina Region

- Comparison of Land Suitability of Moravské Budějovice Region



- Land Suitability of Moravské Budějovice Region



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KATEDRA GEOINFORMATIKY
Univerzita Palackého v Olomouci



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