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EUROPEAN UNION

Curriculum

for

using the GIS data and Service Center

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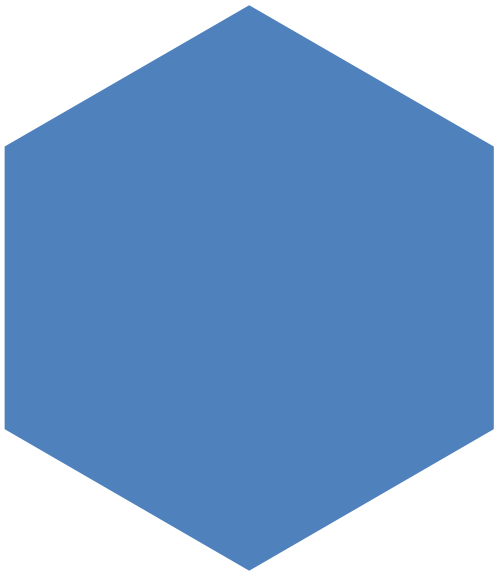

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THEORETICAL KNOWLEDGE

1 Topic 1: The system of spatial and settlement planning in Slovakia and Hungary

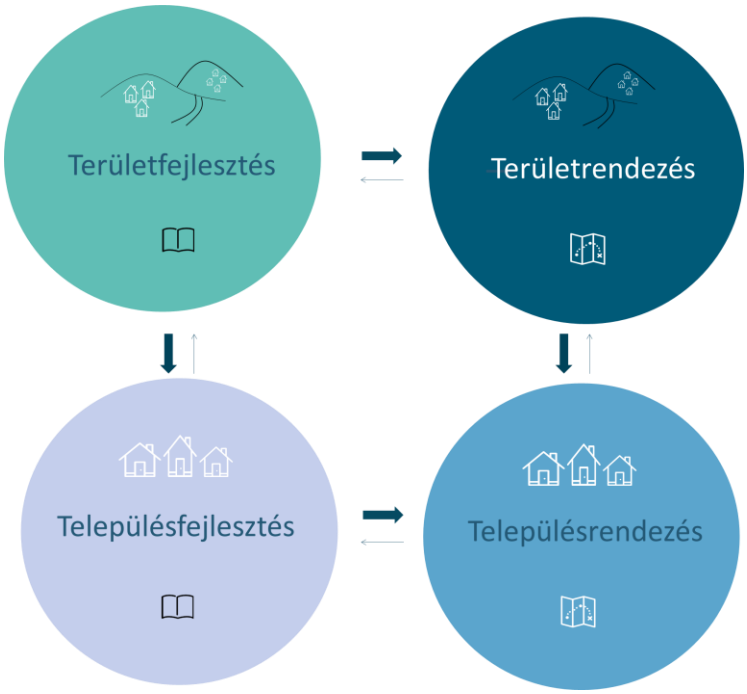
Target group: university students, decision makers

Duration: 1.5 hours

Method: Online or in-person training

Content of the topic

There are basically four genres of spatial and settlement planning in Hungary. On the one hand, we distinguish between regional and settlement-level planning, and on the other hand, we talk about planning and development-type planning at both levels. The individual areas interact closely with each other.



1. Figure: Spatial and settlement planning system in Hungary (source: Lechner Knowledge Center)

1.1 Spatial development and spatial planning

Spatial planning is the development and development planning of the country and its regions (counties, priority areas). The basic concepts and tools of spatial planning, as well as the spatial planning tasks of the National Assembly, the Government, public administration bodies and local governments are laid down in Act XXI of 1996 on Spatial Development and Spatial Planning. (Tftv.), according to which:

regional development

monitoring and evaluating the social, economic and environmental territorial processes covering the country and its regions, defining the necessary planned directions of intervention,

- defining, coordinating and implementing short-, medium- and long-term overall development goals, concepts and measures in the framework of development programmes.

spatial planning

establishing the order and rules of land use for the country or its regions, including:

- exploration of resources, determination of the load and load capacity of the landscape, their joint assessment, preparation of forecasts,
- elaboration of proposals for the appropriate utilization of territorial conditions,
- defining the spatial, technical-physical system of development concepts and programmes,

coordination of European and cross-border spatial planning activities in the framework of international cooperation and the treaty.

There is a strong link between spatial development and spatial planning, both with an important mission to integrate and harmonize sectoral objectives, so that spatial plans create balance between, for example, transport development ideas and landscape and nature conservation interests, or align valuable aspects of the conservation of forest or agricultural land with development needs.

1.2 Spatial plans

The most important tools for spatial planning are spatial plans (spatial development plan and spatial planning plan).

The regional development plans include the regional development concept and the regional development programme.

- **The regional development concept** is a planning document that establishes and influences the comprehensive long-term development of the country and a region, which defines the long-term, comprehensive development goals of the region, provides guidelines and information for sectoral and related spatial planning and regional development actors.

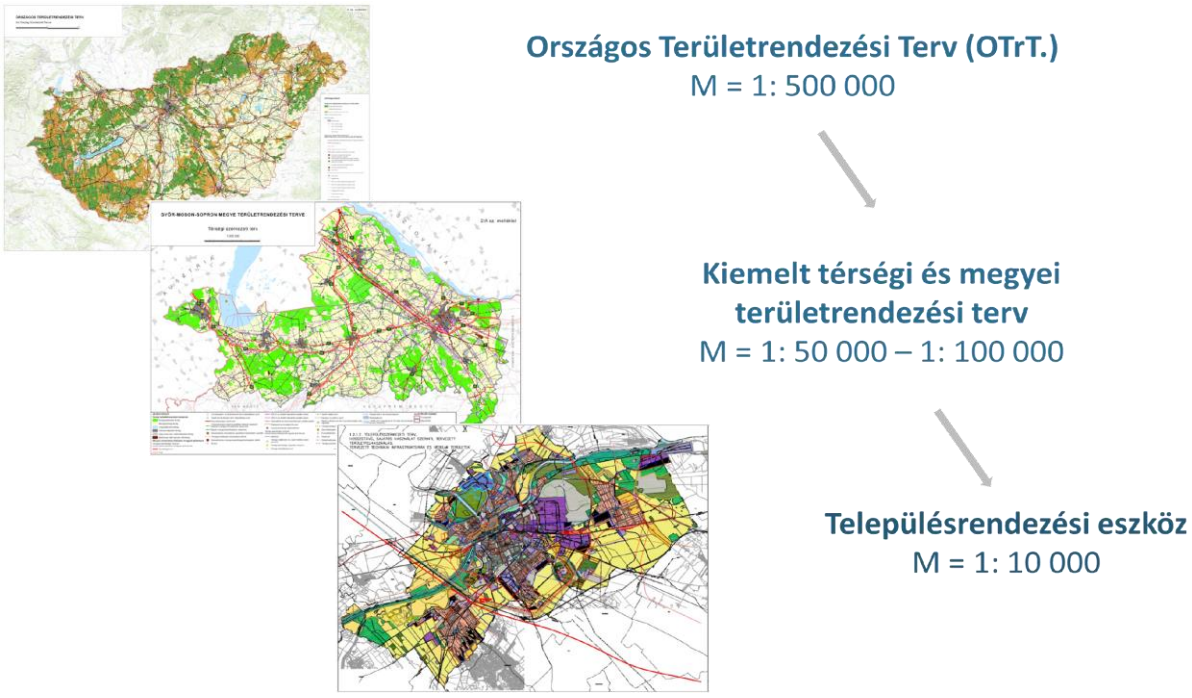
- T**he regional development program** is a medium-term action plan based on the regional development concept. (*Pursuant to Act XXI of 1996*)

The **spatial planning plan** is a planning document defining and influencing the technical and physical structure of the country and certain areas, which ensures the long-term and long-term utilization and protection of spatial features and resources, the enforcement of ecological principles, the coordinated placement of technical and infrastructure networks and land use. system, optimal long-term spatial structure. (*Pursuant to Act XXI of 1996*)

The county is an important arena for regional development and spatial planning, and the county self-government is a key player. The spatial development plan is approved by a county municipal resolution, and the spatial planning plan is approved by a county municipal decree.

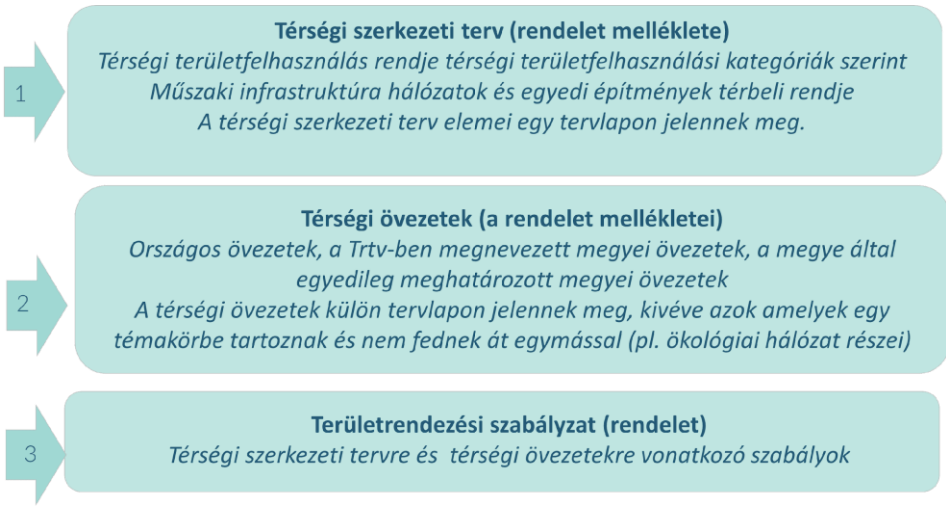
1.3 Hierarchy and key elements of spatial planning

The Act on Spatial Development and Spatial Planning entrusts regional coordination related to spatial planning to the Parliament and county self-governments. The Parliament approves the zoning plan of the country, the Balaton Priority Resort Area (BKÜTrT.) and the Budapest Agglomeration (BATRT.) by law. The framework-type regulations of the National Spatial Planning Plan (OTrT.) are conveyed to the settlements by the priority regional and county spatial planning plans, supplemented with the regulations of regional significance.



2. Figure: Spatial planning hierarchy in Hungary (source: Lechner Knowledge Centre)

The three main elements of spatial plans are the regional structural plan, the regional zones and the spatial planning regulations (the latter includes the rules for the regional structural plan and the regional zones).



3. Figure: Elements of spatial planning plans in Hungary (source: Lechner Knowledge Centre)

The regional structural plan defines the system of land use, the spatial order of settlements, the spatial order of technical infrastructure networks and individual structures, and their connections. The **spatial zone**

however, is a geographic unit with unique characteristics, having its own borders and definitions independent from land use categories, serving mainly for protection purposes.

1.4 Settlement planning

The task of settlement development and the settlement development plan

The task of settlement development is to improve the quality of life and the environment of the inhabitants of the settlement, to strengthen the environmental safety, the vision based on the settlement resources, ensuring the sustainability of the resources, in line with the short, medium and long-term development directions, goals and interventions, programmes and instruments, together with their development action areas, taking the national and regional interests and the settlement plans of neighbouring and other ways interested municipalities into account.

The instrument of settlement development is the settlement development plan, in which the local government includes its settlement development intentions in the short, medium and long term, taking the territorial conditions and contexts into account, within the framework of which:

- determines the vision of the settlement,
- defines the integrated strategic development objectives and the tasks for achieving the objectives in order to achieve the vision,
- fixes the development target data and development action areas for each integrated strategic development objective and task, and makes a proposal - fitting into the spatial, physical system of the settlement - the nature and manner of utilization of the action areas, together with other areas to be preserved and serving development objectives,

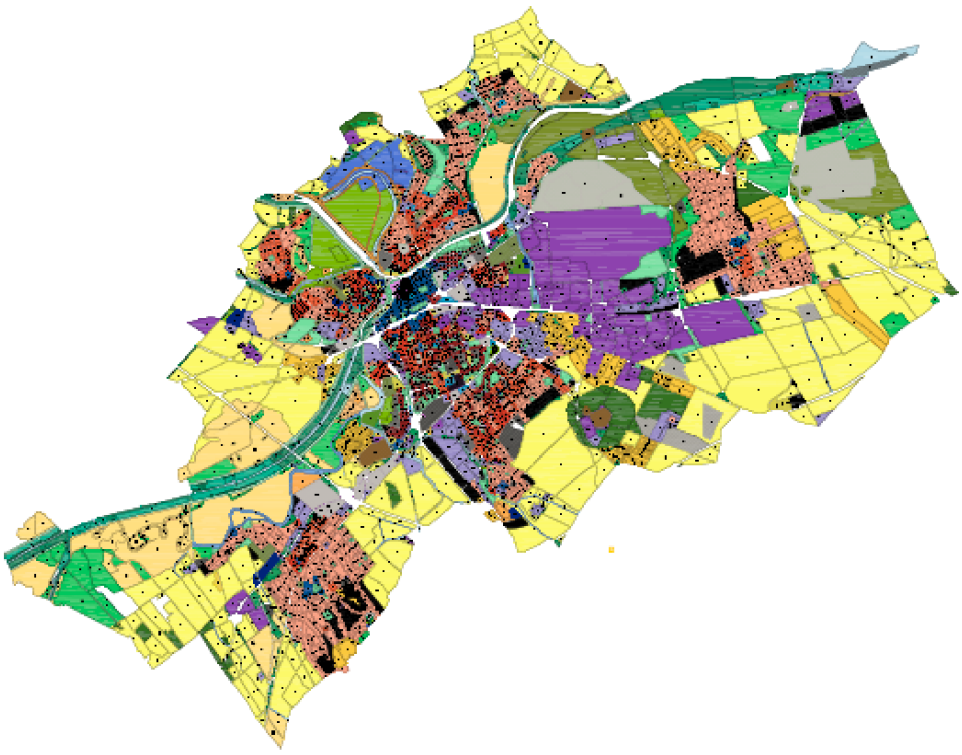
defines the spatial, temporal and economic system of the foregoing.

The settlement development plan is approved by a resolution of the Board of Representatives. (Pursuant to Act LXXVIII of 1997)

The task of settlement planning and the settlement planning plan

The task of the settlement planning - in accordance with the settlement development - by establishing rules for the use of the area and plots of the settlement and the local order of construction, is to

- define the spatial-physical framework for the coordinated, orderly and sustainable development of the settlement,
- make effective use of the potential and opportunities of the settlement while promoting its operability while minimizing environmental damage,
- provide the infrastructure network necessary for the operation of the settlement, displaying the green infrastructure of the settlement,
- ensure the protection of the characteristic, valuable structure, construction, architectural, natural and landscape image of the settlement worth preserving.
  (Pursuant to Act LXXVIII of 1997)



4. Figure: Győr's settlement structure plan (source: Lechner Knowledge Centre)

1.5 Spatial and settlement planning and the TPLAB application

Spatial information and map data are essential for the elaboration and implementation of spatial and settlement plans, as well as for spatial monitoring. In the case of the planning and development of border areas, the knowledge of the plans, concepts and social, economic and environmental information of the neighbouring (cross-border) settlements and areas is essential.

The TPLAB application provides both data related to domestic spatial planning, as well as harmonized data on the other side of the border, thus facilitating spatial planning activities in the region.

2 Topic 2: Data sources for spatial planning

Target group: university students, decision makers

Duration: 1.5 hours

Method: Online or in-person training

Content of the topic

2.1 Copernicus programme

Copernicus is the European Union's Earth observation programme that monitors our planet and its environment for the benefit of European citizens. It offers information services based on satellite earth observation and data. The programme is coordinated and managed by the European Commission. Enormous amounts of global data from satellites, as well as from land, air and sea measurement systems will be used to provide information that service providers, authorities and other international organizations can improve the quality of life of European citizens. Information services are freely and openly accessible to users. (www.lechnerkozpont.hu)

European CORINE land cover database

Perhaps the best-known product of the Copernicus terrestrial subsystem is Corine Land Cover. The time series of the European land cover mapping programme launched in the mid-1980s (CLC1990, CLC2000, CLC2006, CLC2018) has been expanded to 5 elements with the state layer in 25-hectare distribution, and the map of land cover change between 2012 and 2018 in 5 hectares. The database depicts the continent's land cover divided into 44 thematic classes. The database is created for the territory of Hungary by visual interpretation of space images, meeting strict quality requirements. (Based on www.lechnerkozpont.hu)

5. Figure: Corine Land Cover, 2018 (source: www.copernicus.eu)

High resolution coating layers

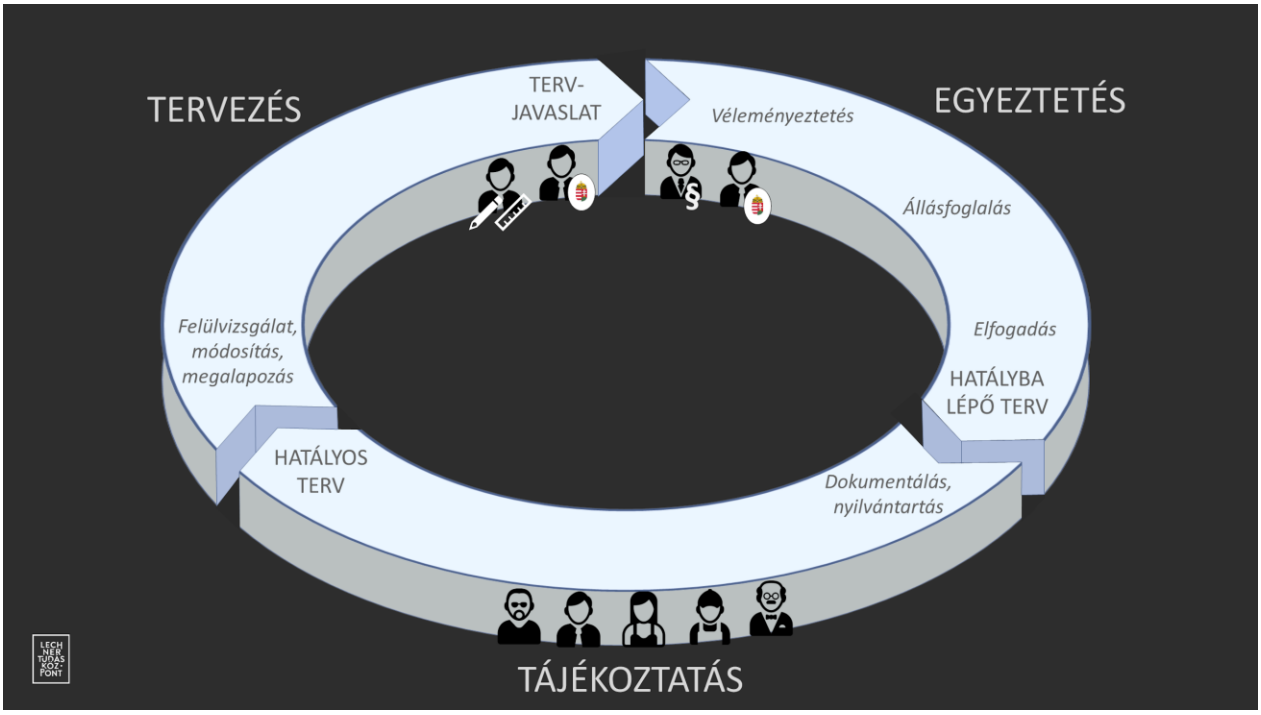
The Copernicus Land programme has also produced high-resolution layers (20x20 m) that are accessible regarding the whole area of Europe. These are:

- soil cover (%),
- wooded areas,
- grassy areas,
- waters and wetlands,
- other wooded areas.

2.2 Electronic Spatial Planning Support System (E-SPACE)

The basic concept of the creation of E-SPACE was the widest possible web support for all actors involved in spatial planning throughout its whole life cycle, from the selection of the designer to the planning, consultation and availability of the approved plans, to all actors involved in spatial planning.

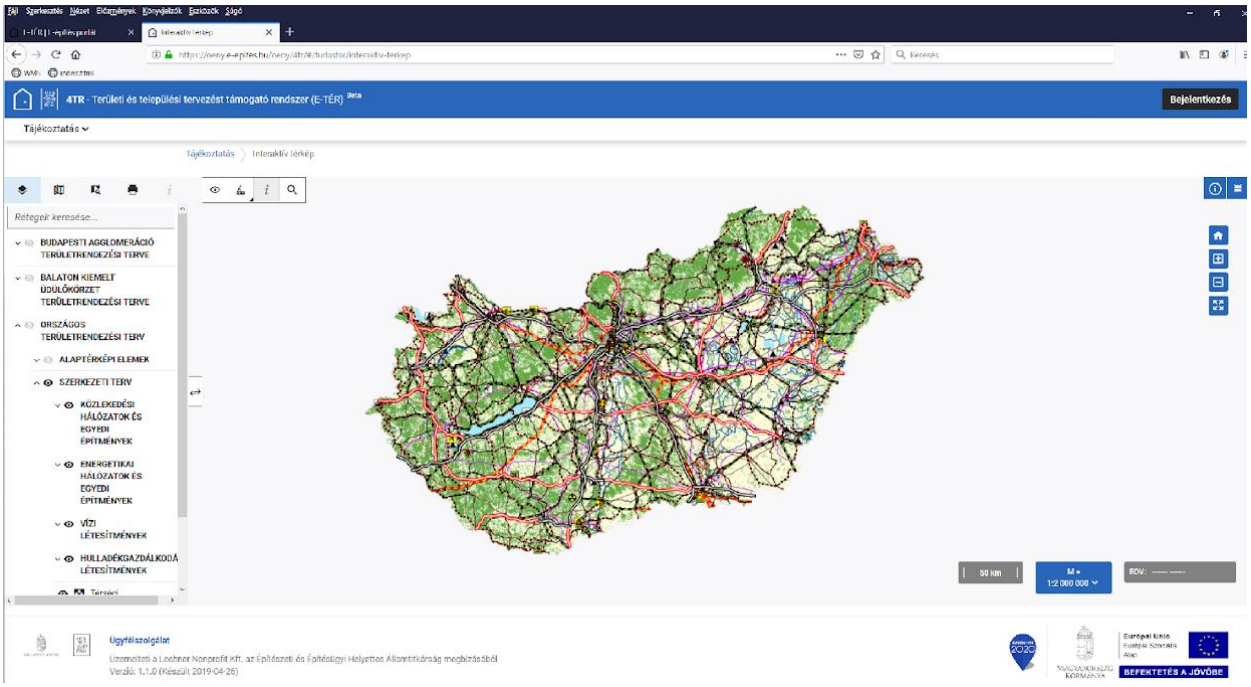
In order to achieve this goal, in three modules of the system under development - Information, Coordinator, Designer - E-SPACE will make the settlement and territorial regulations available that determine the construction possibilities - known to architects and settlement planners but less known to the average person.



6. Figure: E-SPACE subsystems (source: Lechner Knowledge Centre)

On the other hand, it provides an interface for the participants in the formal consultation to conduct the review process, to officially document it, to examine the compliance with the higher-level settlement plans laid down by law, and to cooperate with the plans prepared at the same time. In addition to the official consultation, the interface of E-SPACE also facilitates participation, during which those interested and key players will be involved during the planning process, and will have the opportunity to get to know the documents and to cooperate between the planning actors.

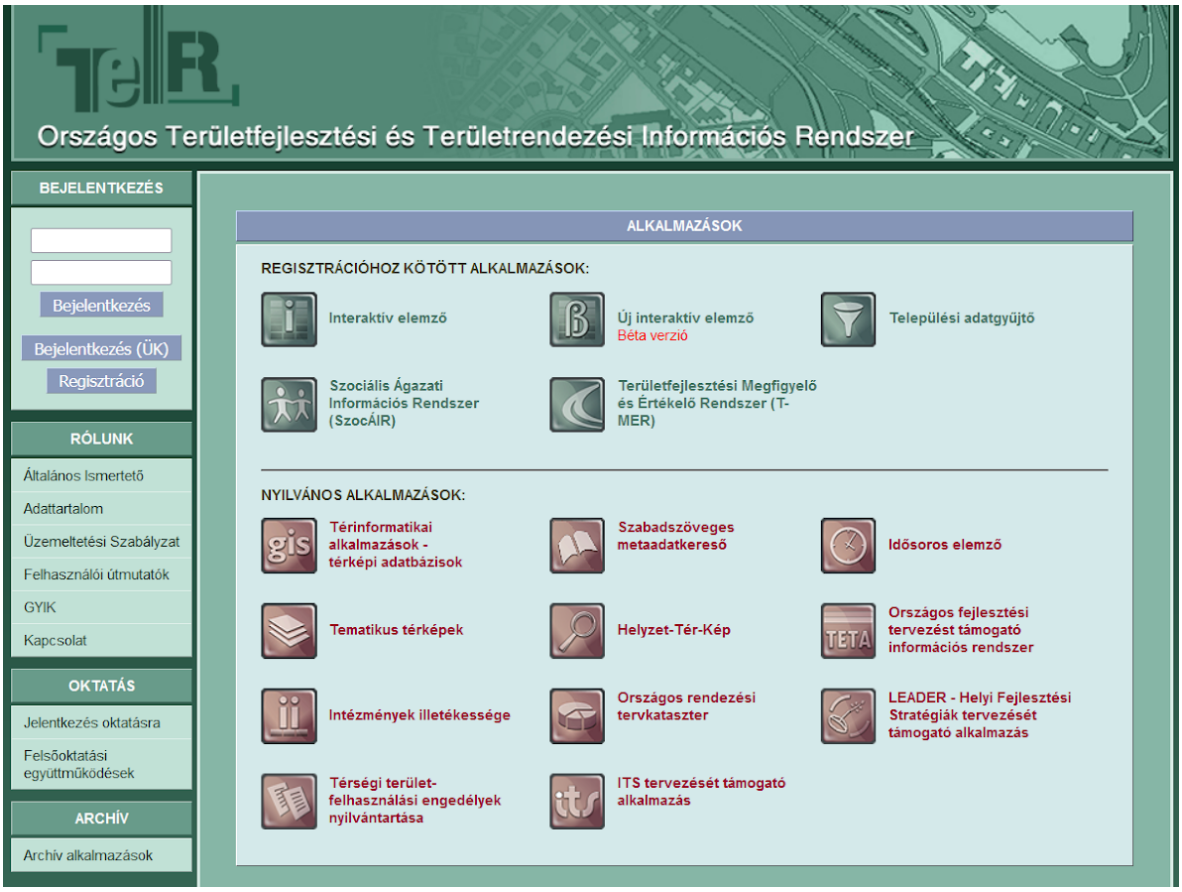
The third task of E-SPACE is to ensure the design access of the GIS and other databases serving as a starting and alignment point in order to ensure the building plan of the complete plan hierarchy of national, priority regional, county and settlement plans. The map appendices of the National Spatial Plan, the Spatial Plan of the Budapest Agglomeration and the Spatial Plan of the Balaton Priority Resort Area can be viewed for the first time on the online interface of the currently available information module. (www.lechnerkozpont.hu)



7. Figure: E-SPACE information module (source: Lechner Knowledge Centre, e-epites.hu)

2.3 Spatial Planning and Spatial Development Data Service (TeIR)

The National Spatial Development and Spatial Planning Information System (TeIR) makes the settlement and regional (county, regional) statistical data of different data owners available in one system, supporting planning and evaluation activities from the national to the settlement level. It provides an opportunity to gain information about the state and territorial characteristics of the society, the economy, the built, landscape and natural environment, as well as to monitor its changes. It assists regional and sectoral actors engaged in development and development activities at the regional and settlement level in the preparation of plans, the preparation of decisions, as well as the analysis of the effects of decisions and the performance of activities related to monitoring. (www.lechnerkozpont.hu)



8. Figure: TeIR interface in Hungary (source: Lechner Knowledge Centre)

With public applications available to everyone, the user can generate charts and maps at the touch of a button using specific metrics that allow time series and area comparisons of area units. In addition, registered users have the opportunity to create individual indicators for each type of area and period, based on data from different sources.

For the two decades since its inception, TeIR has become an indispensable information base for spatial planning, evaluation and research professionals. In response to the dominant territorial processes, it supports the actors of regional development and spatial planning with continuously expanding data content and functions, and in addition to the closer circle of professionals, it also provides information to the general public interested in each region or settlement. (www.lechnerkozpont.hu)

3 Topic 3: The use of GIS tools in spatial planning practice

Target group: university students

Duration: 1.0 hour

Method: individual preparation

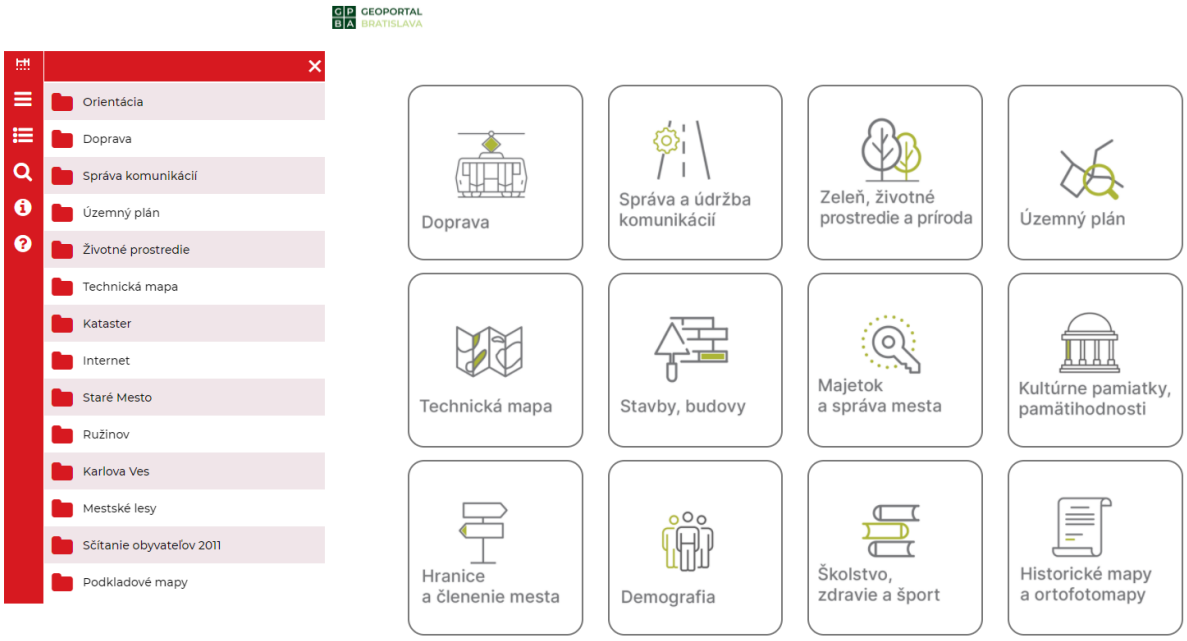
GIS-based technologies cover a wide range of disciplines, from design to architecture, geophysical and engineering sciences to human health sciences (Grind GIS, 2021). Within this educational material, we focus on their use and potential in spatial planning and related sciences.

GIS systems primarily help to analyze the condition of the area, but can also be used to predict future changes in spatial planning and functional use of the area, or to find areas suitable for future development based on criteria such as accessibility, infrastructure condition, topography, etc.

3.1 Inventory of sources and spatial information

One of the basic functions of GIS is to inventory information available about the area in the form of relevant information, using background maps (orthophoto maps, thematic maps, etc.) or for functional use, transport and infrastructure, land and landscape, and so on. Theoretically, the amount of data is unlimited, although in practice it has its limitations, especially in terms of transparency and practicality, as it is not easy to get a huge amount of data in a short period of time, especially if these data concern different time periods. A further limitation is the protection of personal data in the form of the recently adopted GDPR Directive, which can be addressed through proper data collection.

Recently, several cities and districts have created and published Internet map portals, where spatial information is made available to the public (often only for viewing, without the ability to download or process data). An example is Pozsony / Bratislava, which provides information on transport, a layout plan, a technical map of the city and much more on its map portal, and more data can be obtained from GIS portals such as demographics or urban real estate. Besides Pozsony / Bratislava (Figure 2), the trend of open data has been adopted by many districts and cities in Slovakia, such as Trencsény / Trenčín, Máriatölgyes / Dubnica nad Váhom, Poprád / Poprad and dozens of other cities. This trend contributes to transparency and encourages public participation in urban governance. Nowadays, when many non-commercial open-source solutions are available, it is relatively easy and inexpensive to create similar web applications with the help of experienced technicians.



9. Figure: Example of data available on the map portal of the city of Bratislava (left) and example of data available on the geoportal of Bratislava (right).

3.2 Analysis of the current status

GIS provides simple and efficient ways to present the current state of a selected area through the selection of appropriate data, layering, and appropriate symbology. It is possible to present the data in a time series, to identify conflicts between environmental and development intentions in a timely manner, and to identify potential areas for development in the light of existing regulations and constraints. This data can be directly incorporated into decision-making at all levels that affects current and future use.

If the city has the right amount of data in the right structure, scale and format, activities such as analyzing the current situation for the needs of zoning and zoning plans or different studies can be easily carried out and the process of creating such documents can be shortened, so to save on the preparation of the plans, their consultation, the involvement of stakeholders and the implementation itself. However, these are areas where ISO standards for GIS[1] are missing, are not used in our circumstances, and this is a significant constraint on the use of the data.

[1] E.g. ISO/TC211 https://www.isotc211.org/

3.3 Modeling and projection

One of the main tasks of spatial planning is to manage the changes in the area, and to predict the effects of the planned interventions (Bragagnolo and Geneletti, 2012), which also covers the expected population growth or economic development of the area. Trajectory modeling for future land use is an advanced feature of GIS solutions that is possible as long as the input data is accurate and correctly arranged. Spatial modeling provides an opportunity to estimate a wide range of population, environmental, or economic trends. In terms of environmental change, in practice, modeling of landscape change is often used to assess possible infrastructural interventions in a given country. It is possible to identify conflicts between nature conservation and regional development interests in the country in advance. Using information on the socio-economic situation of the area, it is similarly possible to identify conflicting or conflicting interests in development projects.

3.4 Assessing the possibilities

When designing spatial plans or development projects, one of the key parts of the process is developing and evaluating solution options. In addition, the assessment of the options is an integral part of the SEA and EIA processes for the environmental impact assessment of projects and plans. In this assessment, the GIS assessment repository provides tools that anticipate their impact on each component of the environment and are able to list relevant arguments to formulate the final decision.

Last but not least, it should be noted that the selection of the final option, as well as the final form of the plan as such, is by nature a political process involving factual and strong arguments. These arguments are provided by the planning, and spatial data, their processing and interpretation, play a key role in trying to provide a solid basis for reasoning.

3.5 Monitoring the implementation of plans, strategies and projects

GIS tools are also an integral part of monitoring the impact of plans, strategies and projects. The possibilities of data processing from monitoring provide an effective tool for the progress of project implementation, the monitoring of the effects on the surrounding area and landscape, as well as the possibility of interim modification of projects during implementation. For example, in monitoring the effects of linear infrastructure projects, monitoring the occurrence of species is essential to properly locate barriers to green road elements, such as green bridges or protectors that stop wildlife getting on the highways, and then to monitor the effectiveness of these elements (Hlaváč et al, 2019; Finka et al, 2021). In this case, GIS tools are used almost exclusively for data collection and processing.

4 Topic 4: Theoretical background of GIS

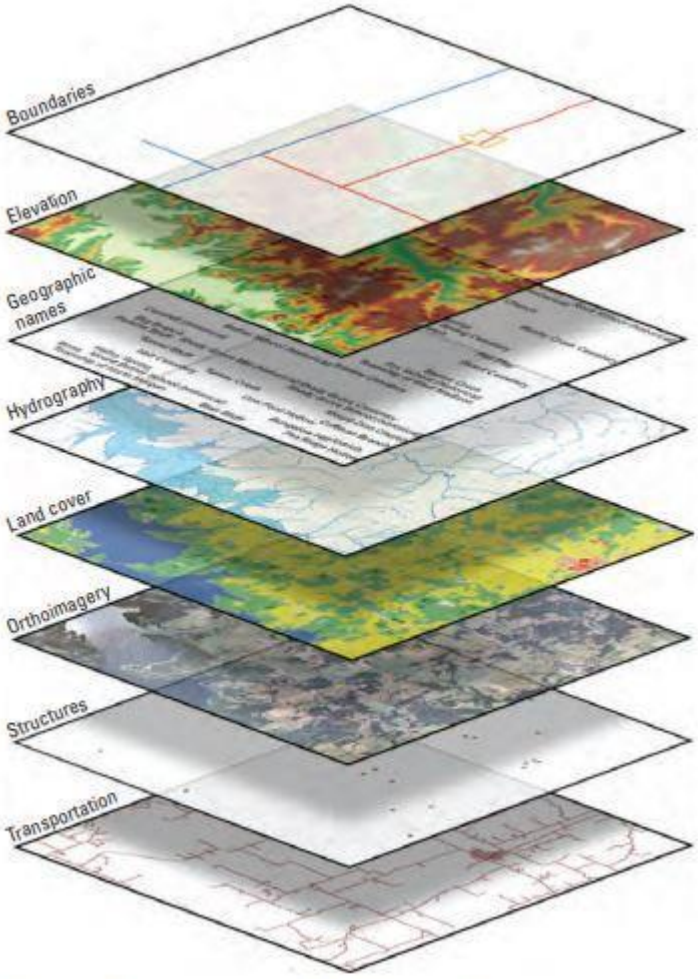
Target group: university students

Duration: 1.0 hour

Method: individual preparation / classroom lessons

Geographic Information Systems (GIS) are computer systems designed to analyze, process, and display spatial information related to geography (USGS, 2021). These are pieces of information related to a specific geographic location. Simply put, these are data that have a specific position in space (so-called georeferenced).

These tools provide an opportunity to overlap and layer map data (layers) containing different information (Figure 3). The operation is digital and simple, according to the user's needs, during which thematic maps can be created to show the status of the area or to identify conflicts.



10. Figure: Example of map layering (USGS, 2021)

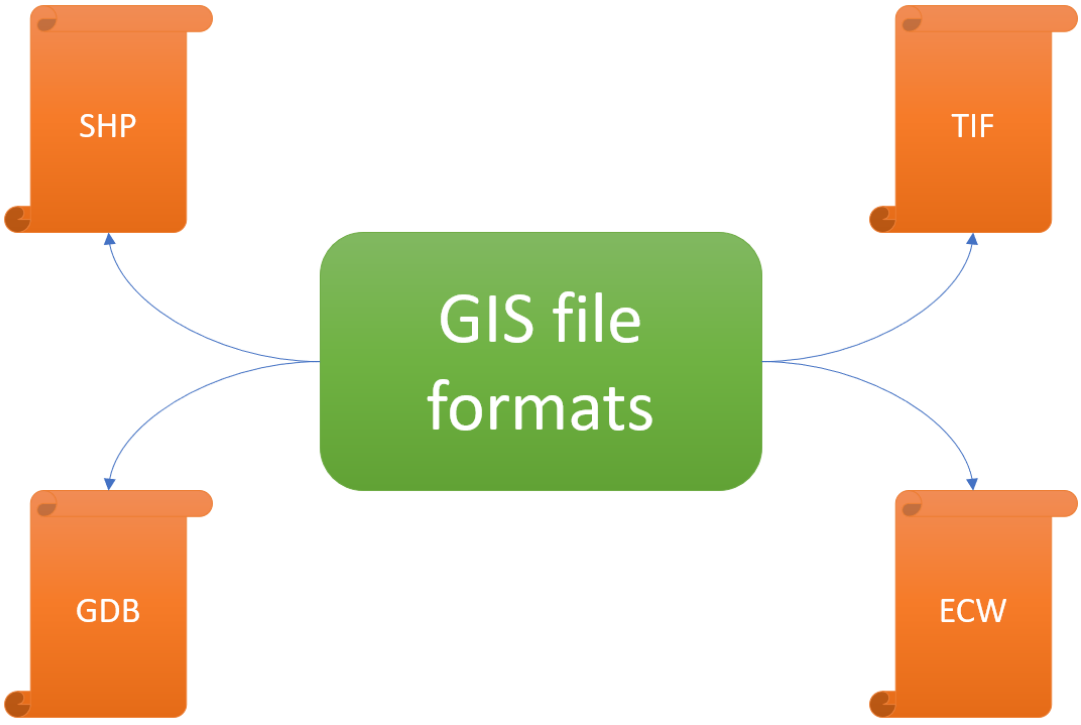
It was previously believed that GIS did not produce beautiful maps, CAD-based programmes or graphical programmes were available for this purpose (Adobe, Corel, or GIMP packages), but there has been a significant change in graphical output options in recent years, and GIS outputs clean and eye-catching maps that are professional in display so they can be presented in any field.

Above all, GIS provides the opportunity to import huge amounts of data from different sources, use different types of services, organize, edit, layer, and finally map our work. The range of supported formats at the input and output is constantly expanding, and the possibilities of data import, for example from the cadastral portal, are expanding. In the same way, the possibilities for displaying maps are increasing. Maps can be exported to graphic format (JPG, PNG, etc.), PDF or CAD. The presentation of data online is also becoming increasingly trendy through web interfaces, for which there are a number of commercial and non-commercial

solutions supported by programming teams that can customize the output and operation of the web client as desired.

4.1 GIS file formats

GIS works with a relatively large number of file formats, which can be divided into several categories (Figure 4). Files in the SHP group are called shapefiles, which contain georeferenced data in the form of a database in GIS format. Any GIS software can read and process them, it is a standardized format. The GDB format is the ESRI format, which is a geographic database. Unlike SHP files, it also contains information about the location of the files (relative paths) and thus links to other SHP files or other elements of the GIS project. Raster formats are primarily represented by the TIFF format, which contains raster data (usually an image of evenly spaced pixels) and the pixels in it contain some information (e.g., a digital terrain model pixels processed in TIFF format and their associated elevation information). tectonics of the topography). The ECW format represents so-called compressed raster data because a high-quality raster image can be several gigabytes in size, which slows down a traditional computer. ECW is one of the most widely used satellite image formats, providing high compression with relatively good image quality.



11. Figure: GIS file formats

However, there are dozens of GIS file formats, tables 1-4 below show the most commonly used ones (developed according to (GIS Geography, 2021)).

Table 1: Vector GIS file format

File format	Extension	Description
Esri Shapefile	.shp .dbf .shx	This is the most common type of file a user encounters. It is used by all common GIS programmes, so it has become the standard. It is important to transfer all three files - SHP (contains geometry), SHX (contains position), and DBF (attribute data) when transferring files. In addition, other subfiles can be transferred, but this is not required - PRJ (project system metadata), XML (related metadata), SBN (spatial index to optimize demand), and SBX (stretch time optimization).
Geographic JavaScript Object Notation (GeoJSON)	.geojson .json	The GeoJSON format is used primarily for web mapping services, and it contains coordinates in text format such as JavaScript Object Notation (JSON). It contains vector dots, lines and polygons, and tabular information. This file can be easily modified by opening it in a text editor. Web browsers automatically recognize JavaScript, making it the most widely used web format.
Geographic Markup Language (GML)	.gml	GML allows the use of XML geographic coordinate extensions. It stores geographic entities (properties) in text form. Similarly to GeoJSON, GML can be updated with any text editor. Each element has the list of properties, geometry (points, lines, and polygons) and a spatial reference system.
Google Keyhole Markup Language (KML/KMZ)	.kml	This GIS format is XML-based and is used primarily in Google Earth. KML was developed by Keyhole Inc., which was later acquired by Google. KML-Zipped (KMZ) has replaced KML as the default GIS format for Google Earth because it is a compressed version of the file. In 2008, KML

		/ KMZ became the international standard for the Open Geospatial Consortium. The longitude and latitude components (degrees) are defined by the 1984 World Geodetic System (WGS84). The vertical component (height) is measured in metres from the vertical zero of the WGS84 EGM96 geoid.

Table 2. Raster GIS file formats

File format	Extension	Description
ERDAS Imagine (IMG)	.img	ERDAS Imagine files are a proprietary file format developed by Hexagon Geospatial. These files are typically used for raster data to store one or more tracks of satellite data. IMG files use a hierarchical format (HFA) that is optional for storing basic file information. These may include, for example, file information, ground control points, and sensor type. Each raster layer contains information about the values of the data as part of the IMG file. This includes, for example, projection, statistics, attributes, pyramids, and whether it is a continuous or discrete type of raster.
American Standard Code for Information Interchange ASCII Grid	.asc	ASCII uses a set of numbers (including decimal numbers) from 0 to 255 to store and process information. They also contain header set information. ASCII text files, in their native form, store GIS data in a delimited format. This can be a comma, space, or tab-separated format. By moving from non-spatial data to spatial data, the process can begin by converting ASCII to raster.
GeoTIFF	.tif .tiff .ovr	GeoTIFF has become the industry standard image file for GIS and satellite remote sensing applications. Other files can be added to GeoTIFF: TFW is a global file needed to provide raster geolocation; XML optionally belongs to GeoTIFF and represents metadata; AUX help files store

		projections and other information; and OVR files improve raster rendering performance.

Table 3. Complex raster file formats

File format	Extension	Description
ER Mapper Enhanced Compression Wavelet	.ecw	ECW is a compressed image format commonly used for aerial and satellite imagery. This type of GIS file is known for its high compression ratio while maintaining high image contrast. The ECW format was developed by ER Mapper, however, it is currently owned by Hexagon Geospatial.
Joint Photographic Experts Group JPEG2000	.jp2	JPEG 2000 usually has the JP2 file extension. This is a waveform compression with the latest JPG format that allows lossy or lossless compression. JPEG 2000 GIS formats require a global file that geolocalizes the raster. Due to their lossy compression, they are the optimal choice for wallpapers. The JPEG 2000 compression ratio is 20: 1, which is similar to the MrSID format.
LizardTech Multiresolution Seamless Image Database MrSID	.sid .sdw	LizardTech's unique MrSID format is commonly used for orthophotos that require compression. MrSID images have a SID extension and have a worldwide SDW file extension. MrSID has impressive compression ratios. Colour images can be compressed in more than 20: 1 aspect ratio. LizardTech GeoExpress is a software package that can read and write MrSID format.

Table 4: Geodatabase file formats

Fájlformátum	**Kiterjesztése**	**Leírás**
Esri File Geodatabase	.gdb	ESRI has created a geodatabase file to store multiple attribute tables, as well as vector, and raster data files. It is the successor to the MDB geodatabase. File geodatabases offer structural and performance benefits. They feature fast performance, versatile connections, compatible storage for growth images, enhanced spatial indexes, data compression, customizable configuration, and a 1-terabyte file size limit. Within geodatabases, geographic datasets are called feature classes. However, geodatabases can store more complex data, such as networks, raster mosaics, and feature datasets.
Esri Personal Geodatabase/	.mdb	Personal geodatabases use the default extension for the Microsoft Access database (.mdb). These were once the most common types of database for handling spatial data. Personal geodatabases were advantageous because multiple attribute tables, vector and raster datasets could be managed, and connection classes could be created. However, their biggest drawback was their limited storage capacity of 2 GB.
OGC GeoPackage	.gpkg	GPKGs are standalone, serverless SQLite databases that can contain anything from vectors to tiles and rasters to layer attributes and even extensions. Unlike shapefiles, which have 3 required files, this open standard GIS repository is easy to share because a single file contains it.

4.2 Coordinate systems

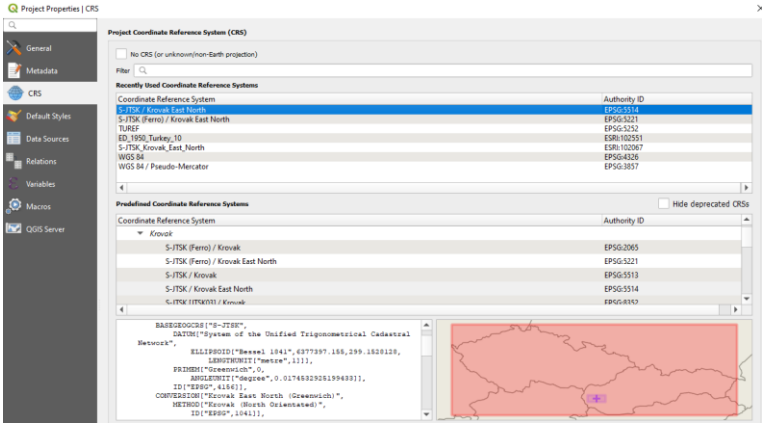
Like all data, spatial data is a series of numbers, but it also contains information about their spatial position. This data is part of a coordinate system that allows the data to be placed in space, and helps to reconcile the data with other spatial data. It allows accurate spatial analysis and mapping. All spatial data (points, lines, polygons, rasters) are created in a certain coordinate system. This coordinate system can be specified in several ways - degrees, yards, metres.

In order for the user to work with accurate data, it is essential to set up an appropriate coordinate system in the project. If this setting is incorrect, the spatial position of the data will be inaccurate, and other output and processing will be incorrect automatically, as well. These differences are due to the curvature of the Earth's surface. Today, conversion between coordinate systems is simple, and relatively accurate, so when a user adds data from another country, and another coordinate system to their project, GIS can convert it.

The EPSG register has been set up to simplify the search for coordinate systems. Each coordinate system is assigned a unique EPSG code that allows you to identify and find information based on specific properties. The main register of EPSG codes is available at https://epsg.io/.

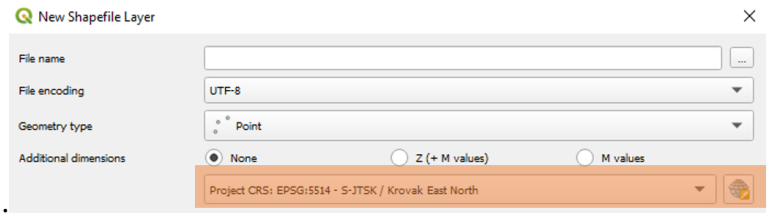
Within Slovakia, the "S-JTSK / Krovak East North (EPSG: 5514)" coordinate system is the most widely used, covering the territory of Slovakia and the Czech Republic. Its accuracy is given with a tolerance of 1 metre, which is sufficient for everyday needs.

When creating a new project on GIS platforms, it is essential to define the coordinate system correctly in the default settings (Figure 5).



12. Figure Setting up a coordinate system when starting a new project

Similarly, when creating a new layer in an existing project, it is also important to properly set the coordinate system so that the data "fits" during transmission (Figure 6).



13. Figure Setting up a coordinate system for a new layer

5 Topic 5: QGIS environment

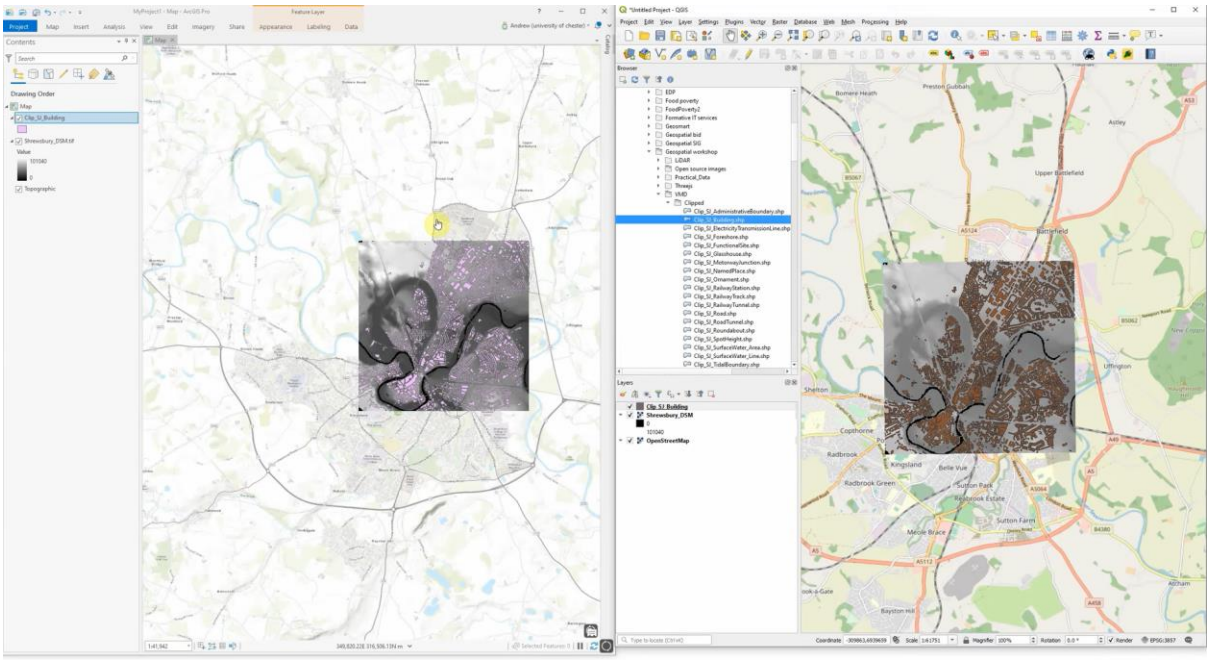
Target group: university students, decision makers

Duration: 1 + 1 hour

Method: Online or in-person training

QGIS is a freely accessible, open source platform for geographic information systems that allows you to view, edit, analyze, and process spatial data. GNU is subject to General Public License. It runs on Linux, Unix, Mac OSX, Windows, and Android operating systems and supports a number of vector, raster, and database formats and features (QGIS, 2021).

It is one of the most widely used GIS platforms in the world. Globally, QGIS is the second most widely used GIS platform in the world after ESRI's commercial ArcGIS platform. Both platforms offer a similarly user-friendly interface to the user. Many users who work with GIS use both platforms because each has its own strengths and weaknesses, and the transition from one platform to another is easy because the basic interface is similar (Figure 14).



14. Figure: Example of ArcGIS (ESRI) (left) and (QGIS right) user interface (AMDGS, 2020)

Table 5 shows the main differences between the two most common GIS platforms.

Table 5: Comparison of ArcGIS and QGIS in their basic attributes

ArcGIS	QGIS
• Commercial software, not freely available • It only works under Windows operating system • It operates in a secure ESRI environment • Extensibility with extensions and extension elements • Ability to print map sheets through data-driven pages • It includes advanced mapping functions and several functions within spatial analysis (terrain shading, overlays, map algebra, network analysis). • Ability to publish maps through ArcGIS online.	• Open source free software • Works on various operating systems (including iOS) • Not licensed • Developed by programmers from around the world • Possibility to be extended with extensions (plugin library) • Ability to print map sheets using QGIS Atlas • Load time (application load speed) is higher than for ArcGIS. • Ability to publish maps via plugins such as qgis2web or qgis2threejs

In this tutorial, we are further discussing the operation of the QGIS platform. The basic format of the QGIS platform is the .qgz file. In QGIS, the entire project is saved in a file of this format (e.g., Project1.qgz) that contains references to the layers used, the style of each layer, the zoom level, and other user-defined information. When sending a project to other users, it is possible to send the entire .qgz file along with the other layers (shapefile .shp, .shx, .dbf, and .prj files).

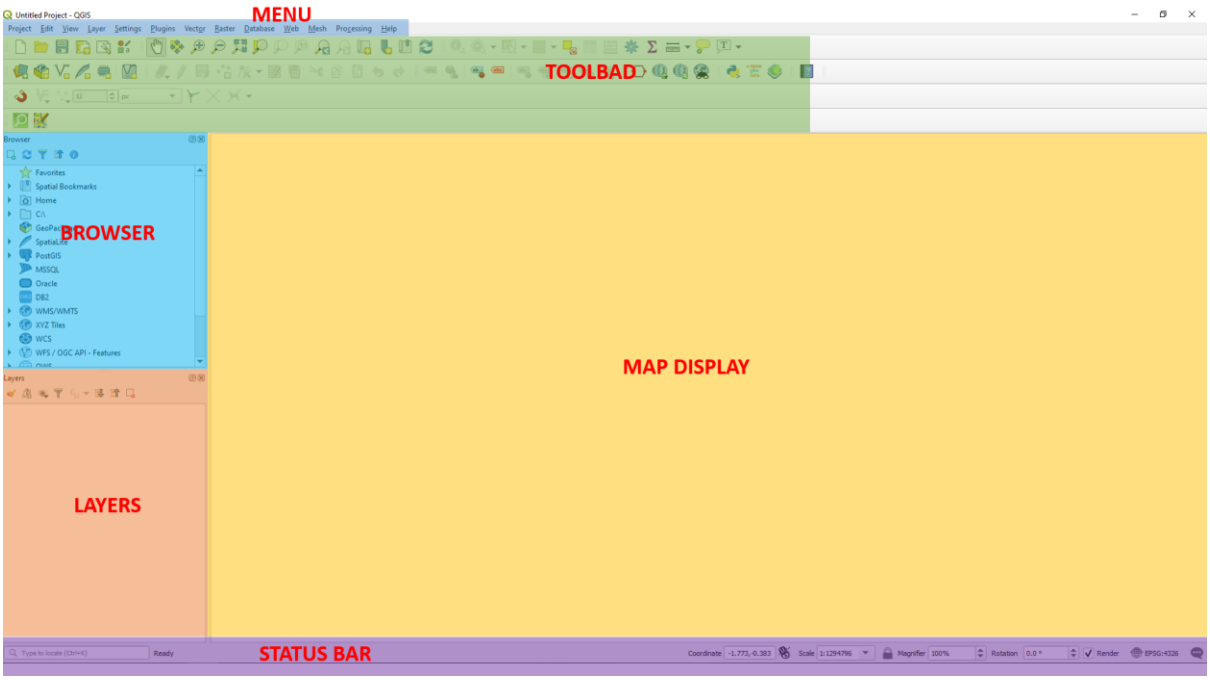
The QGIS platform can be downloaded from the official QGIS website: https://qgis.org/en/site/. In the "Download" section, the user can find the appropriate version for their operating system and the latest version can be downloaded (QGIS version 3.22 is the latest from 5.12.2021).

5.1 Basic orientation

After installing and running the QGIS platform, the user will see the basic layout of the software. Figure 8 shows the basic layout, which may vary depending on the version installed by the user or the operating system, but the basic components of the programme should look as shown.

- Menu: Allows you to configure basic project settings, preview settings, scales, vector and raster tools, access to plug-ins, and access to geospatial tools, and more.
- Toolbar: This is an adjustable toolbar where the user can select the layout according to his or her own preferences. Panels and toolbars provide tools for work with project layers, data, images, and more.

- Browser: Allows you to browse files on your computer, attach layers, web services (WMS, WFS, PostGIS databases, etc.).
- Layers: This panel allows you to control, view, turn on and off the layers in a given project, set their style, make them visible, and more.
- Map preview: the main panel of the programme, where the map and data are previewed, zoomed in / out.
- Status Bar: Displays basic information about the project, such as the cursor position, the current map scale in the map preview, or the EPSG coordination system.

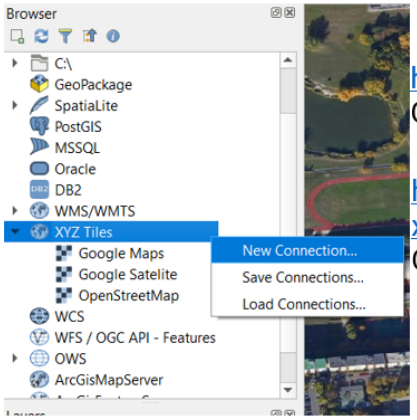


15. Figure Basic elements of a QGIS environment

5.2 Basic maps

There are several maps to choose from as a base map. The most commonly used data in QGIS are Open Street Maps, which can be imported with extensions such as "QuickMapServices" or "QuickOSM" (see below). Open Street Maps is a non-commercial, regularly updated map service that provides data for much of the world.

It is also possible to select Google Maps as the bases with the "XYZ Tiles" option (Figure 16). Plug-ins allow you to connect and continue working with other map sources as needed. The advantage of QGIS is that its users can be found all over the world, and can advise in various forums on how to get the map or the publicly available data they need, as the digitization status of such data is different in each country. QGIS provides the ability to connect different maps and layers using services such as WMS, WFS, WCS, GIS servers or databases from public sources such as Slovakia (national GIS database, cadastre, environmental data through environmental agencies and much more). One of the main benefits of using GIS is that many public institutions are moving to share spatial data, and import it into the desktop version of GIS, and then work with the data. If the user has an idea of what data he or she needs, where to get it from, and how to get it technically, he or she will have a lot of data about the area in a short amount of time without having to inaccurately redraw or otherwise approximate it.



https://mt1.google.com/vt/lyrs=r&x={x}&y={y}&z={z}
Google mapy

http://www.google.com/maps/vt?lyrs=s@189&gl=cn&x={x}&y={y}&z={z}
Google Satelite

16. Figure: Linking Google Maps as a base map in QGIS

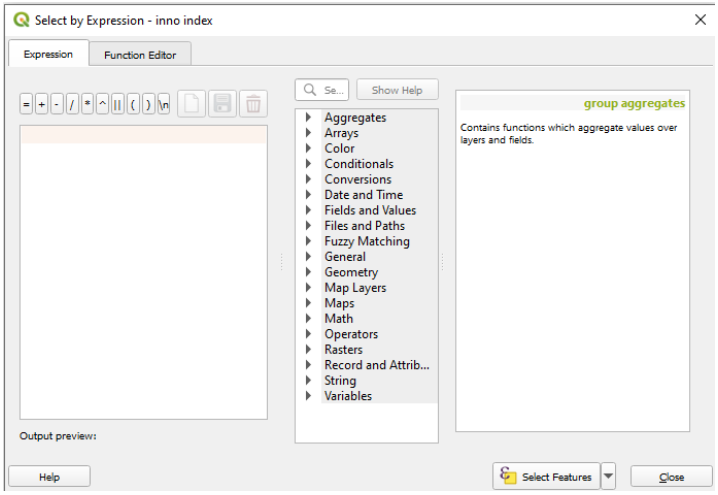
5.3 Attribute table

The attribute table allows you to view and edit spatial data. In this table, you can edit each piece of data, select it according to the selected formula, filter it, or add it manually or by field calculation (Figure 17). Before you can start editing data, you must turn on the edit mode by pressing the pencil symbol to the left of the top bar of the attribute table.

	NL_NAME_1	VARNAME_1	ID	20JAN2021_NUTS3	20JAN2021_PROVINCE	20JAN2021_INOV_INDE
1	NULL	NULL	31	TR631	Hatay	7.17
2	NULL	NULL	63	TRA23	I?d?r	6.5
3	NULL	Muğla	10	TR323	Mu?la	7.41
4	NULL	Muş	70	TRB22	Mu?	6.75
5	NULL	NULL	78	TRC31	Mardin	6.37
6	NULL	İçel	30	TR622	Mersin	7.71
7	NULL	NULL	53	TR902	Ordu	6.84
8	NULL	NULL	33	TR633	Osmaniye	7.15
9	NULL	Nevşehir	37	TR714	Nev?ehir	6.92
10	NULL	Niğde	36	TR713	Ni?de	6.92
11	NULL	Kırklareli	4	TR213	K?rklareli	7.55
12	NULL	Kırşehir	38	TR715	K?r?ehir	6.92

17. Figure: Attribute table in QGIS

The data selection by formula is completed by pressing the data selection option, which creates a separate window where the selected formula can be selected (Figure 18). The range of formula choices is virtually endless, with the ability to use mathematical functions, geometric functions, map base selection, data series, data properties, selection based on variables, and more. The purpose of this window is to help the user select the data according to predefined criteria. This data can be extensive and manual selection would take too long, or it would be ineffective, so when the user determines what formula they want to use to select the data, the output will be the selection of data according to the selected criteria. These commands can be as simple as selecting fields with a value greater than X, or you can enter more complex commands. as well.

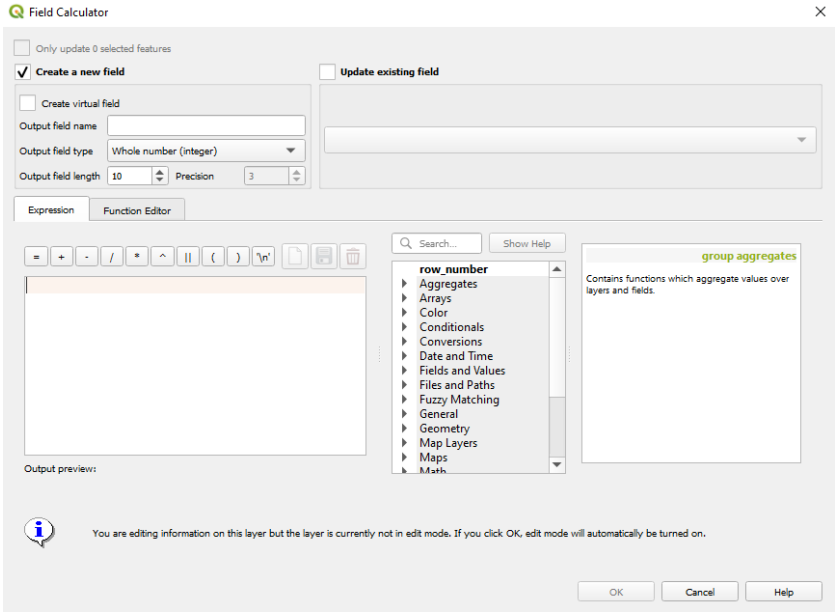


18. Figure: Data selection according to the formula selected in the attribute table

Alternatively, the data can be filtered by filter selection. This dialog box is called up by the user by pressing the Filter Data Selection button (Figure 19). The rows show each variable in that layer, and for each layer you can specify, for example, the value by which the variable should be equal (for example, when selecting districts within the Slovak Republic, the user enters the word "Prievidza" and the system selects lines in the district of Prievidza, Slovakia) or lines in a certain interval.

19. Figure: Selection of data by filter

When working with an attribute table, the user often has to mathematically calculate some values from the data in that layer. This is what the field calculator function is for (Fig. 20). It is possible to specify the calculation using a number of predefined functions and enter the result in a new field (create a new field) or overwrite an existing field (update an existing field). The user has hundreds of predefined functions or can combine them as desired.



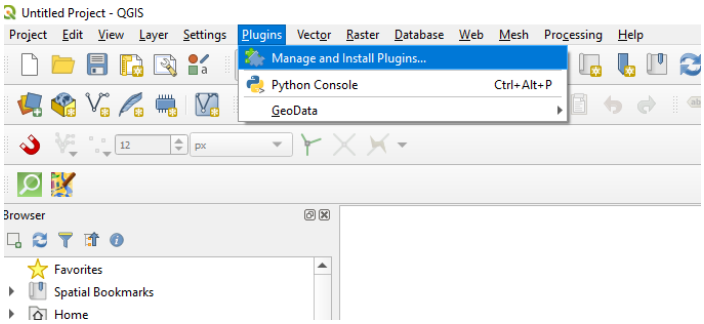
20. Figure: Field calculator to calculate the value of a new field or to update an existing field

The attribute table and working with it is one of the most commonly used QGIS features, so it's important for novice users to learn how to work with it and simplify their work with GIS.

5.4 Useful extensions

QGIS includes a number of functionalities in the basic installation after installation, but it is possible to increase and improve these features by installing so-called plugins. These are freely installable add-ons to the programme. These extensions come from programmers all around the world, and expand the possibilities of using QGIS. There are currently nearly 1,500 extensions, and that number is gradually changing as new ones are added, and the previous ones are no longer deleted from the database. With so many extensions, and theoretically anyone can add new ones, it's hard to navigate between them. In order to better differentiate them and select the right one, we can see the ratings of other users in the plugin browser (1..5 stars) + see how many votes the selected plugin received.

In QGIS, the plugin configuration menu is accessed by clicking on the "Plugins" menu and then on "Manage and Install Plugins ...". *(Figure 21).*



21. Figure: Accessing extensions in QGIS

Table 6 below lists some basic add-ons that may be useful for a novice user. This is a short list to help you find your way.

Table 6: Commonly used plugins for QGIS (plugin is in the plugin search bar)*

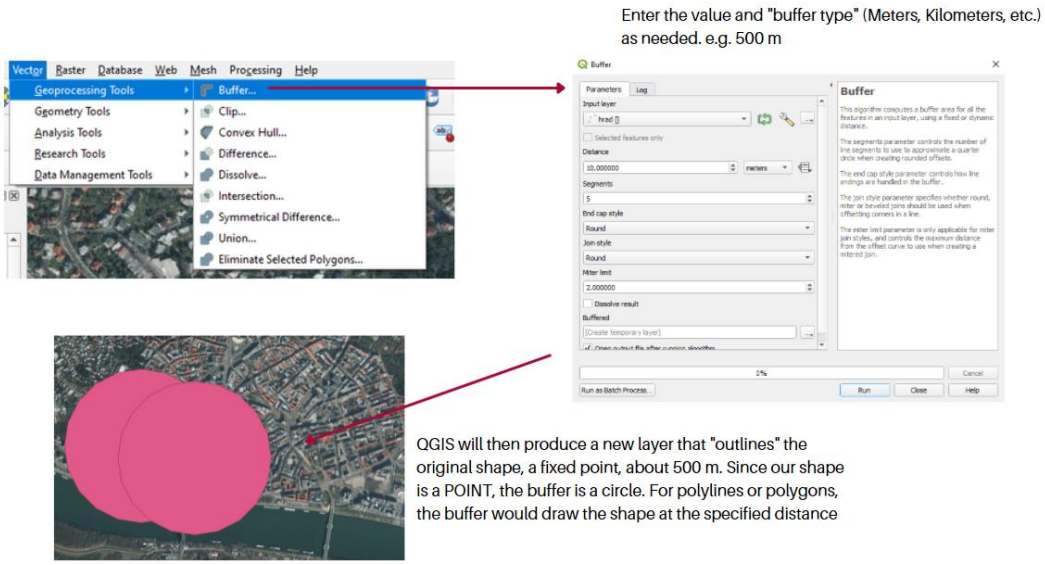
Plugin name*	Plugin description
QuickMapServices	It allows you to easily add Open Street Maps as a background map to your project.
QuickOSM	It allows you to download data from Open Street Maps based on user needs, such as buildings with a "hotel" function in Pozsony / Bratislava.
GeoData CZ/SK	The domestically produced plugin allows you to connect map data for Slovakia and the Czech Republic.

ORS Tools	An Open Street Maps based plugin that allows you to measure isochrons taken by car, bike, and on foot from selected points per unit time. These calculations and distances can be exported as a matrix, including duration, route length and departure / arrival time.
QGIS Cloud Plugin	Plugin for publishing maps, data and services to the web.
qgis2web	Another plugin that allows you to publish maps, data, and services on the web.
Qgis2threejs	A plugin that allows you to display a digital terrain model and vector data in 3D on the web.
Street View	it allows you to open Google Street View in a web browser with two locations identified by QGIS points.
Google Earth Engine	Support for integrating Google Earth into QGIS.
Raster Tracer	Plugin for automatic drawing of the underlying raster map.
Maps Printer	A tool that supports printing the map base to PDF, SVG, or image files, especially when printing multiple projects / layouts at once.
mmqgis	A set of plugins for Python for manipulating vector map layers in QGIS: connection to input / output / CSV format, geocoding, geometry transformation, caching, node analysis, simplification, column editing, and simple animation.
Digitalizing Tools	A document-assisted plug-in created as a compilation of tools not included in the basic configuration of QGIS.

6 Topic 6: Basic geoprocessing tools

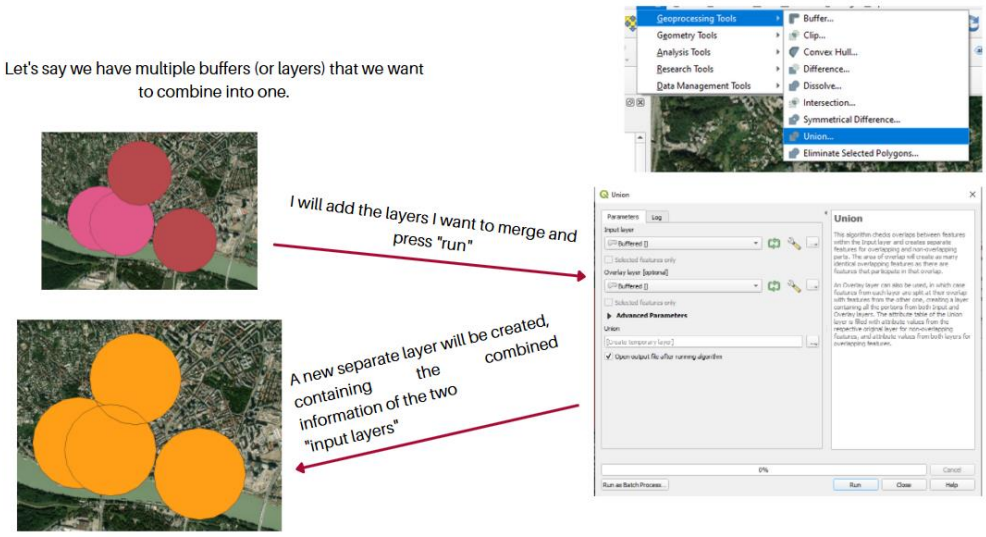
In this section, we briefly present three basic tools for spatial analysis within a QGIS environment (Figure 22-24).

6.1 Buffer



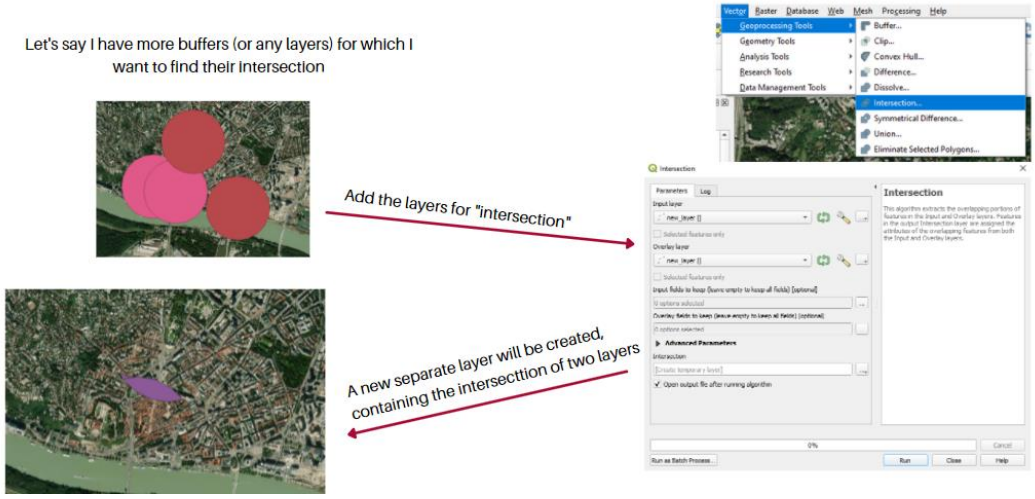
22. Figure: Buffer function

6.2 Union



23. Figure: Union function

6.3 6.3. Intersect of overlays



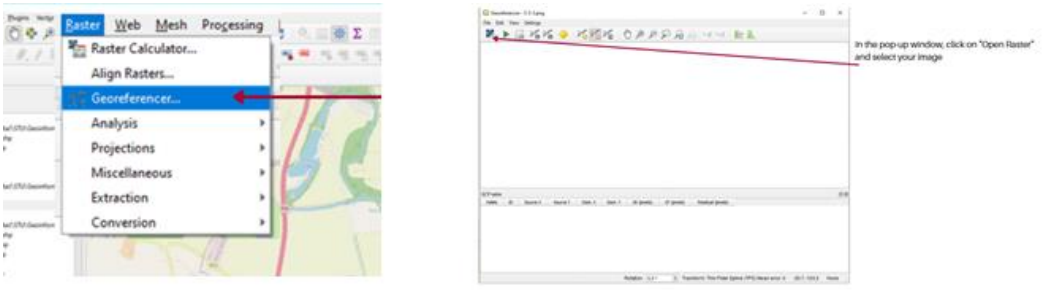
24. Figure Intersection function

6.4 Georeferencing

Georeferencing means linking the internal coordinate system of a map or aerial view to a geographic coordinate system. The corresponding coordinate transformations are usually stored in a single image file (examples: GeoPDF and GeoTIFF), although there are several possible mechanisms for implementing georeferencing. The most spectacular effect of georeferencing is that imaging software is able to display ground coordinates (such as latitude / longitude coordinates or UTM), as well as to measure ground distances and areas.

In other words, georeferencing means associating a digital image file with a location in physical space. In the field of geographic information systems, the term usually refers to the process of associating a physical map or raster map with a spatial location. Georeferencing can be applied to any type of object or structure that can be associated with a geographic location, such as landmarks, roads, locations, bridges, or buildings (Figure 25-31).

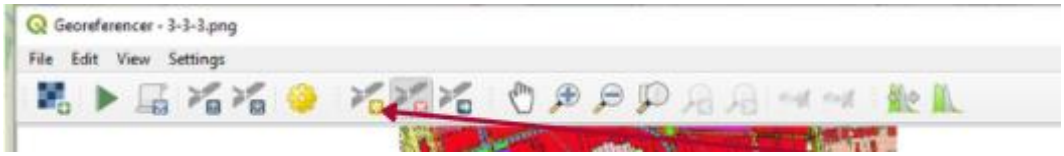
To insert and georeference a raster image, the user selects "Raster" - "Georeferencer" in the top bar, and after a new window appears, the selected image is inserted via the "Open Raster" menu item.



25. Figure: Georeferencing process 1

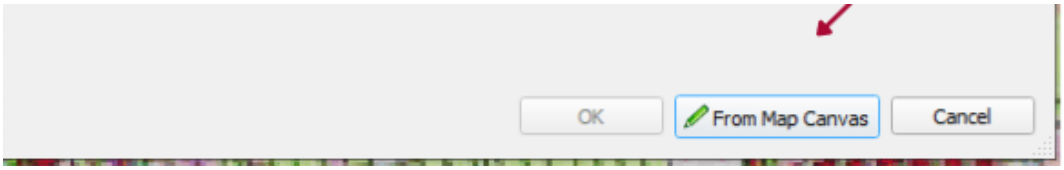
After loading the image, the user can start adding georeferenced points (left click on the yellow square icon).

You should choose a point that is easy to identify on the map. You can pair the selected point with the GIS by clicking on the same location on the underlying map.

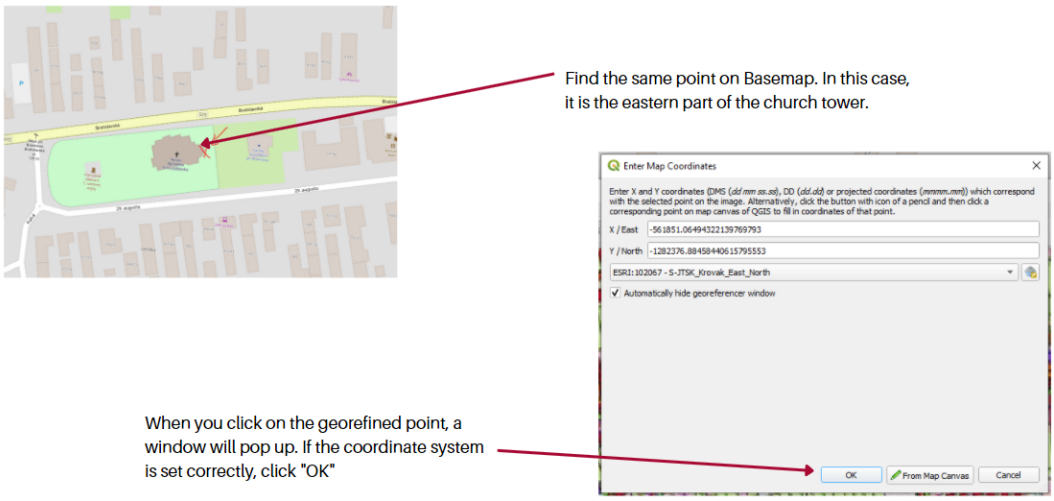


26. Figure: Georeferencing process 2

After clicking on a point in the raster image, the option to insert coordinates appears. Instead of entering the coordinates by clicking the "From Map Canvas" button, the user can manually enter the spatial location of the point on the underlying map.

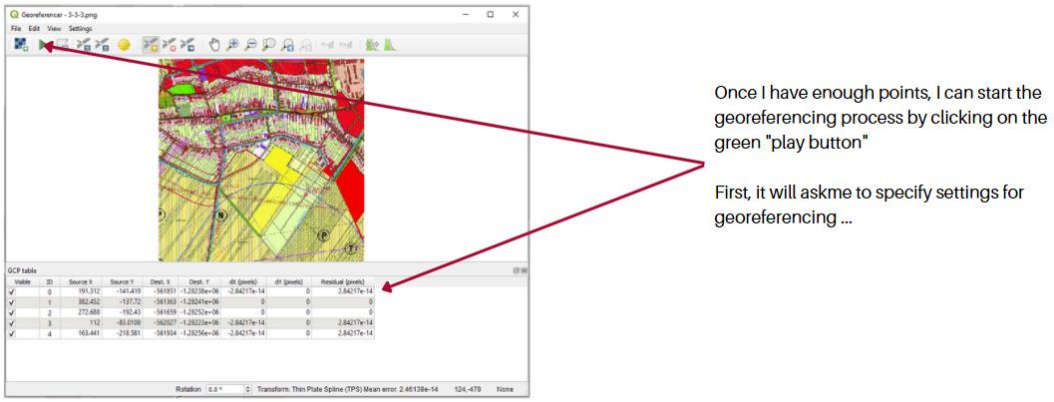


27. Figure: Georeferencing process 3

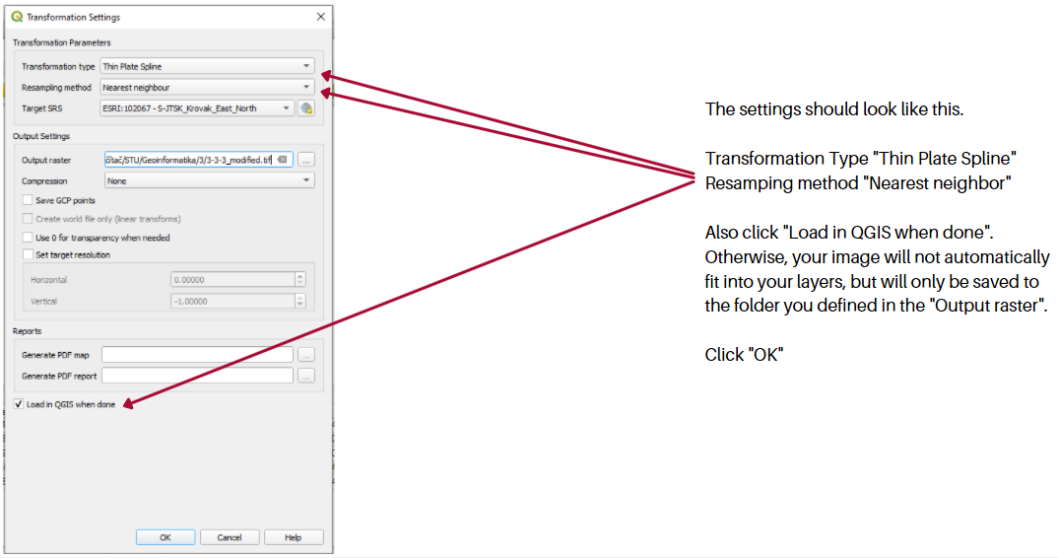


28. Figure: Georeferencing process 4

The georeferenced point is shown in the table in Figure 29. We need at least one more point for georeferencing. Based on these points, the GIS programme can then stretch, rotate, zoom in, zoom out, and so on, it can adjust the raster figure to be on the right scale and "fit reality". We will use more points for more accurate georeferencing. Repeat the above process, selecting points that are easily recognizable on the map. In this case, for example, an intersection, corners of real estate, and so on. Ideally, we select points that are not close to each other, for example, the points in the corners and the centre of the image.

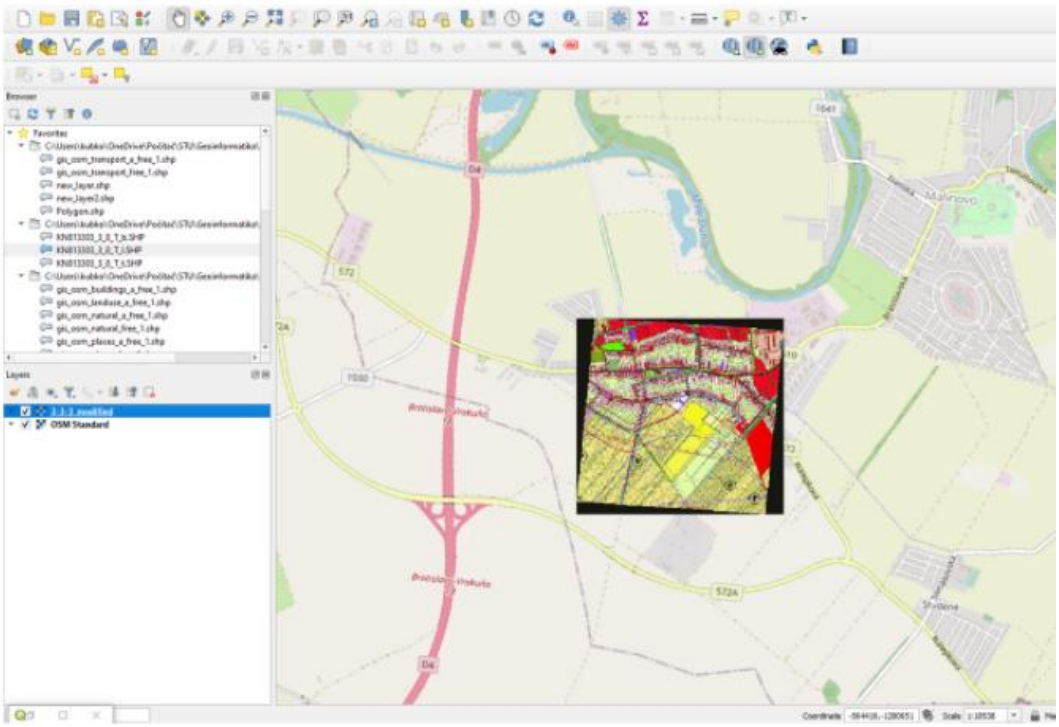


29. Figure: Georeferencing process 5



30. Figure: Georeferencing process 6

After setting the georeferencing parametres, the user starts the process again by clicking on the green icon, the georeferenced figure is then displayed in the "Layers" menu. By turning the layer on and off, the user can check the accuracy of georeferencing.

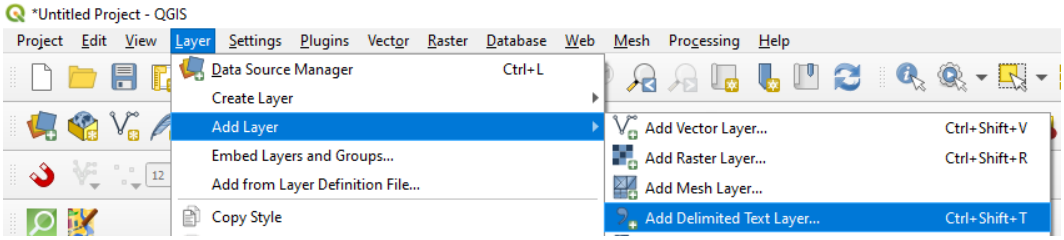


31. Figure: The result of a georeferencing process

6.5 Presentation of statistical data on maps

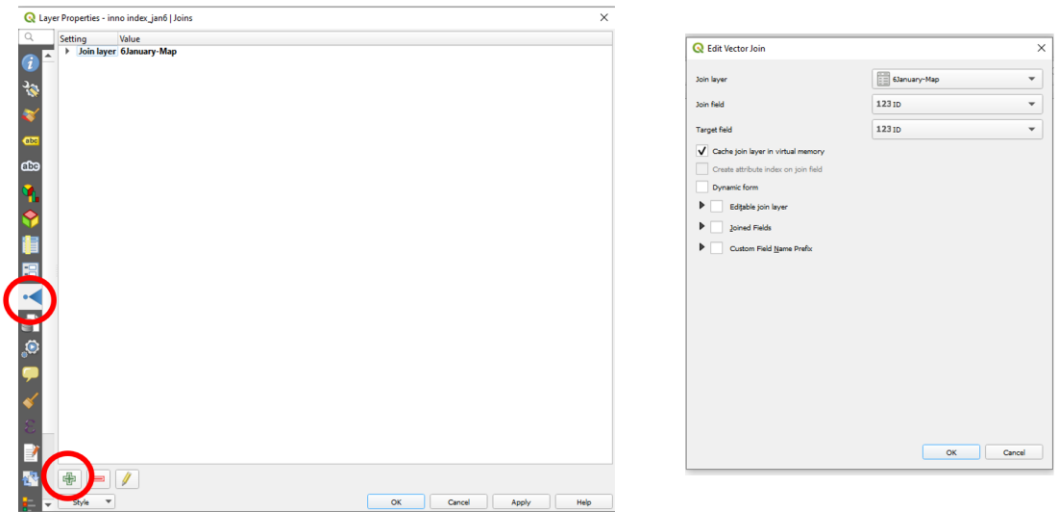
One of the interesting features of QGIS is that the information on the map output can be displayed in an attribute table. For example, displaying data on unemployment in Slovakia at the district level.

This is a simple task that can be done in a few steps. QGIS cannot handle Excel .xls / .xlsx files, so the first step is to save the spreadsheet in .csv (semicolon-separated value) format. You can then insert this table into QGIS (Layer - Add layer - Add delimited text layer, Figure 32).



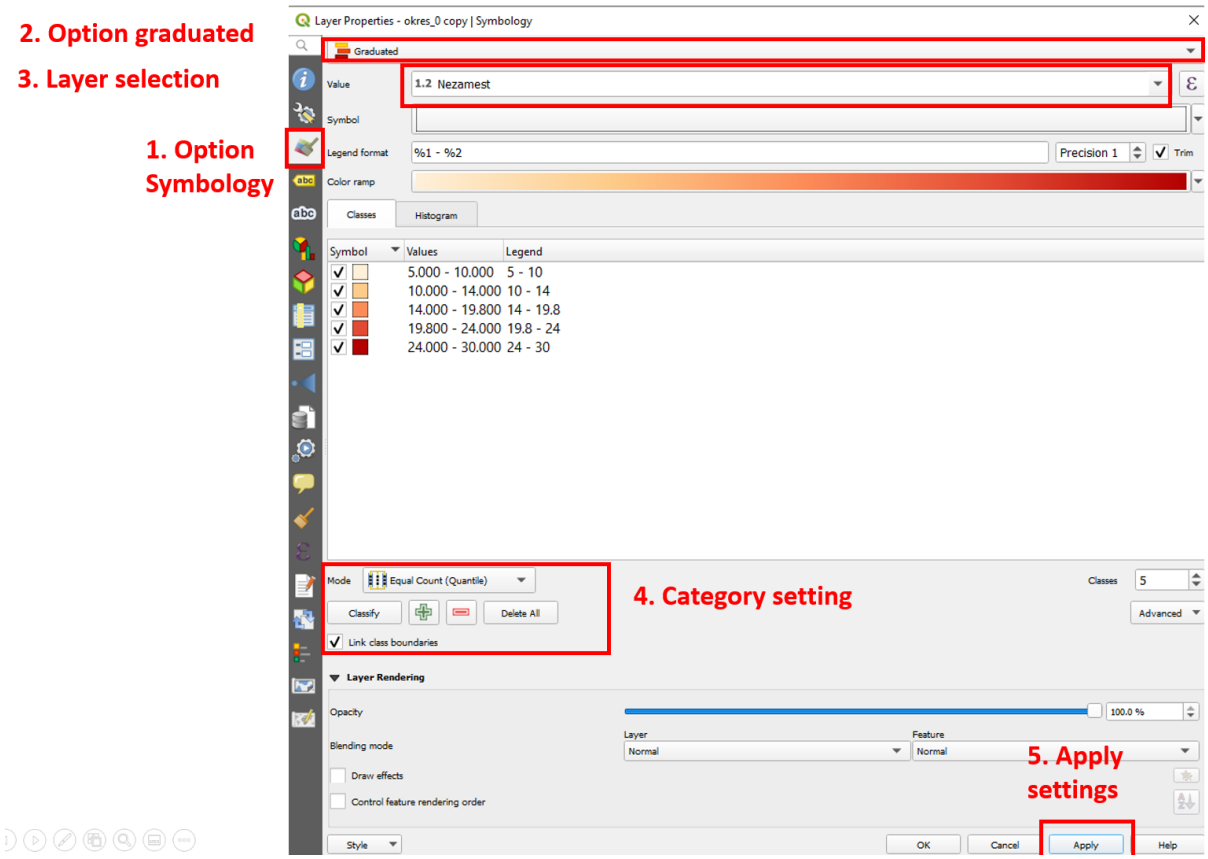
32. Figure: Loading a text file (.csv)

The data to be displayed by the user must then be inserted into the district boundary layer (in this example we use a background map containing the NUTS4 administrative units of Slovakia). To do this, use the "Manage joins to other layers" function in the layer's properties. In this menu, click on the "+" symbol (add new join), where you select the layer from which you want to join the data and select a field that is the same in both datasets (for example, district ID or district name) (page 33). figure). If you have done this process correctly, the country's unemployment data will appear in the district boundary layer.



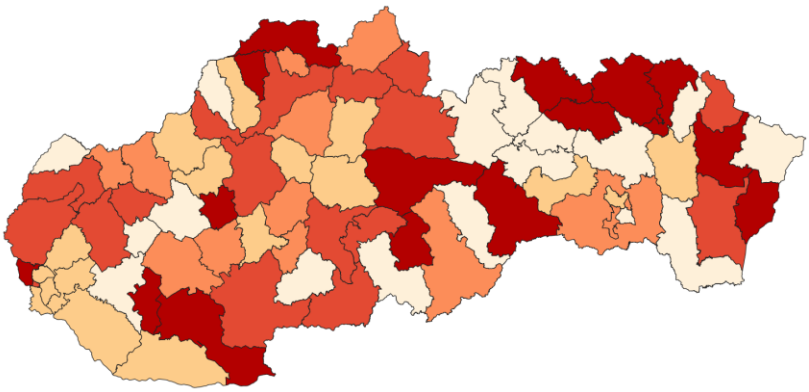
33. Figure: Attaching data from a CSV file to another layer type

Then select the settings for displaying the data in the layer in the properties of the layer containing the district boundaries and unemployment data. In the symbology settings, select the option; "graduated". Then select which attribute you want to display (in this case, unemployment). At the bottom of the dialog, set up the categories and click the "apply" button (Figure 34).



34. Figure: Example of setting the data to be displayed on the map

Figure 35 shows an example of the result.

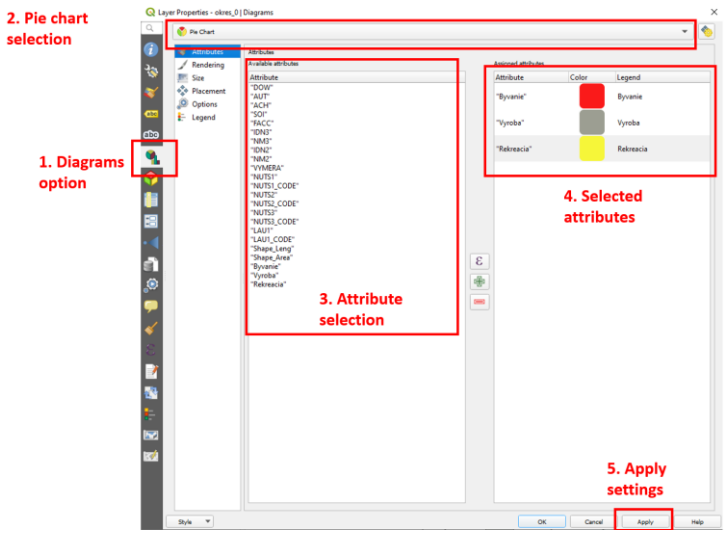


35. Figure: Example of the result

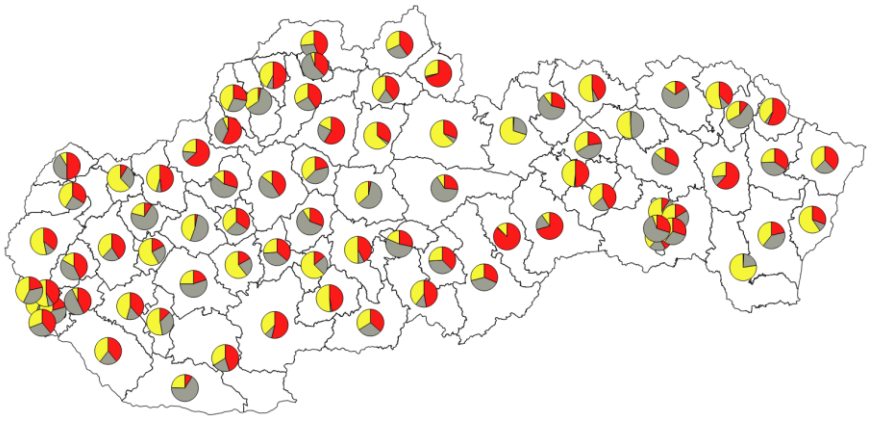
6.6 Presenting data on a map using a pie chart

The second function that can effectively interpret spatial data is to display the data in the attribute table as a ratio between the values, for example in the form of a pie chart.

To illustrate it, imagine a map of the districts of Slovakia showing the percentage of land use of the district in the three categories - housing, production and recreation - in the attribute table. The attribute table contains these ratios, and the task is to display them at the output of the map. After opening the properties of the layer, select the "Diagrams" table and select "Pie chart" in the top bar. Then select the data you want to display from the layer's attributes and click the "apply" button (Figure 36). The result is shown in Figure 37. Chart size, colour, starting position, etc. can be set as desired.



36. Figure: Pie chart settings in QGIS

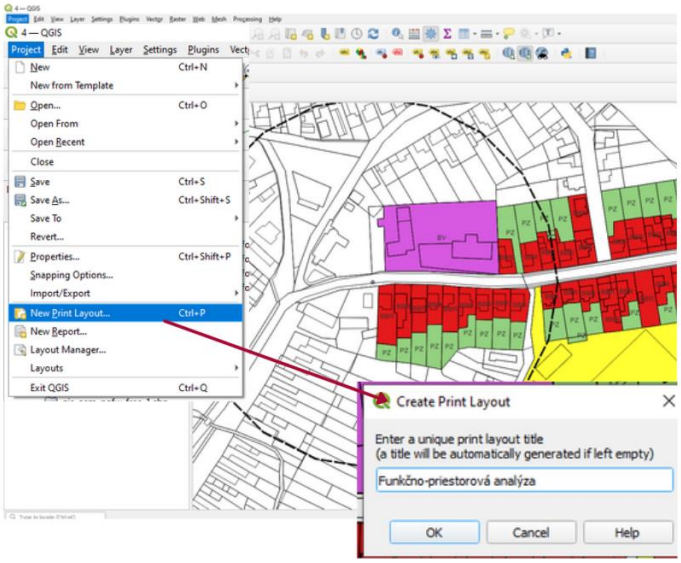


37. Figure: Example of displaying a pie chart in QGIS

7 Topic 7: Finalization and publication of results

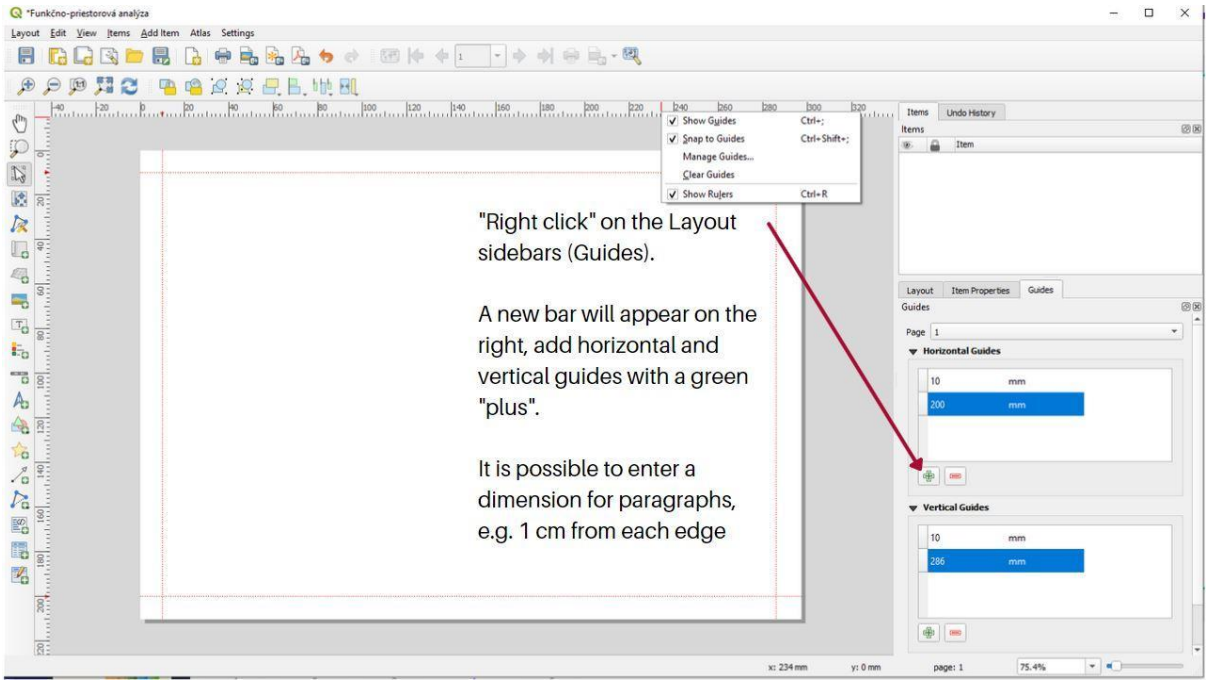
7.1 Create a layout

To export a map (e.g. to PDF), the user must first create a layout (print layout). Select "new print layout ..." in the top bar - or use "Ctrl + P".

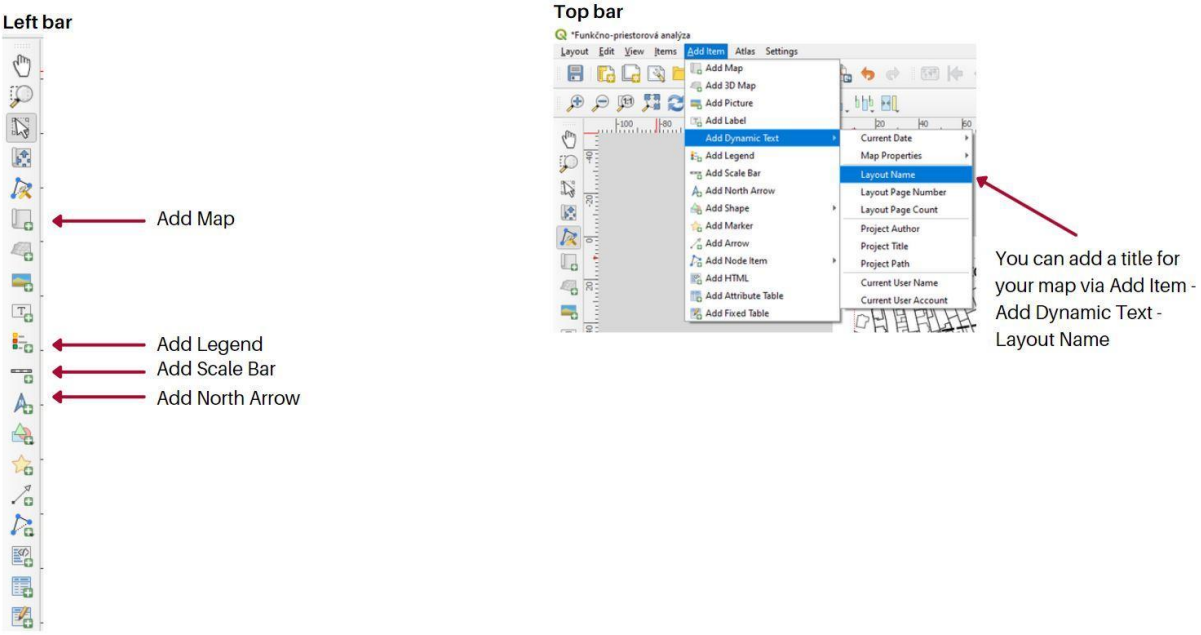


38. Figure: Creating a layout 1

Specify the drawing format: "Layout" - "Page Print Setup". The user can then change the size and orientation of the drawing as needed.



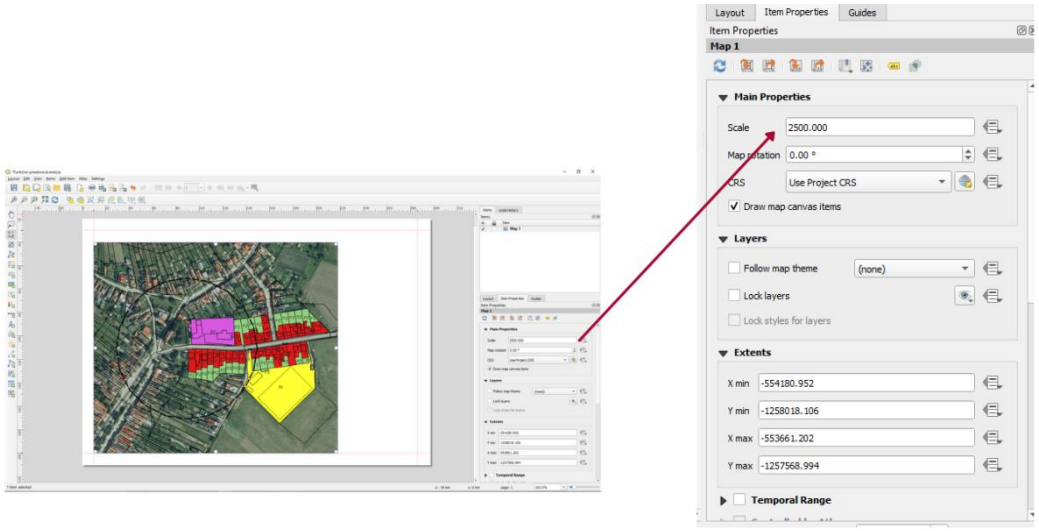
39. Figure: Creating a layout 2



40. Figure: Creating a layout 3

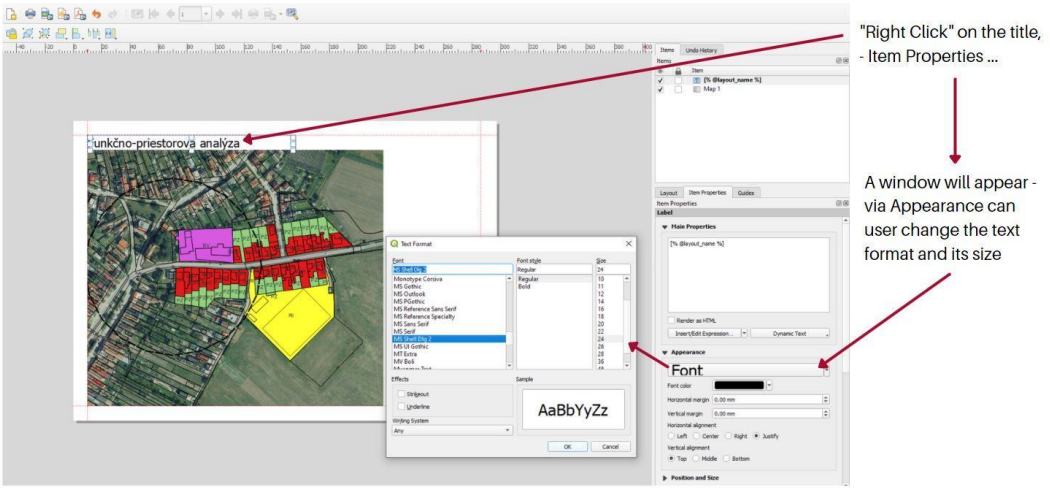
The user can add the contents of the drawing to the Layout via the left bar or the top bar under "add items". Once added to the layout, each item is free to edit in the right bar.

For example, after adding a map view, you can right-click on it and select "item properties". A window will appear in the right bar, where you can change the scale in the "Scale" field, for example.



41. Figure: Creating a layout 4

If you want to change the size or text of the title, you can do so as described above (see Figure 42).

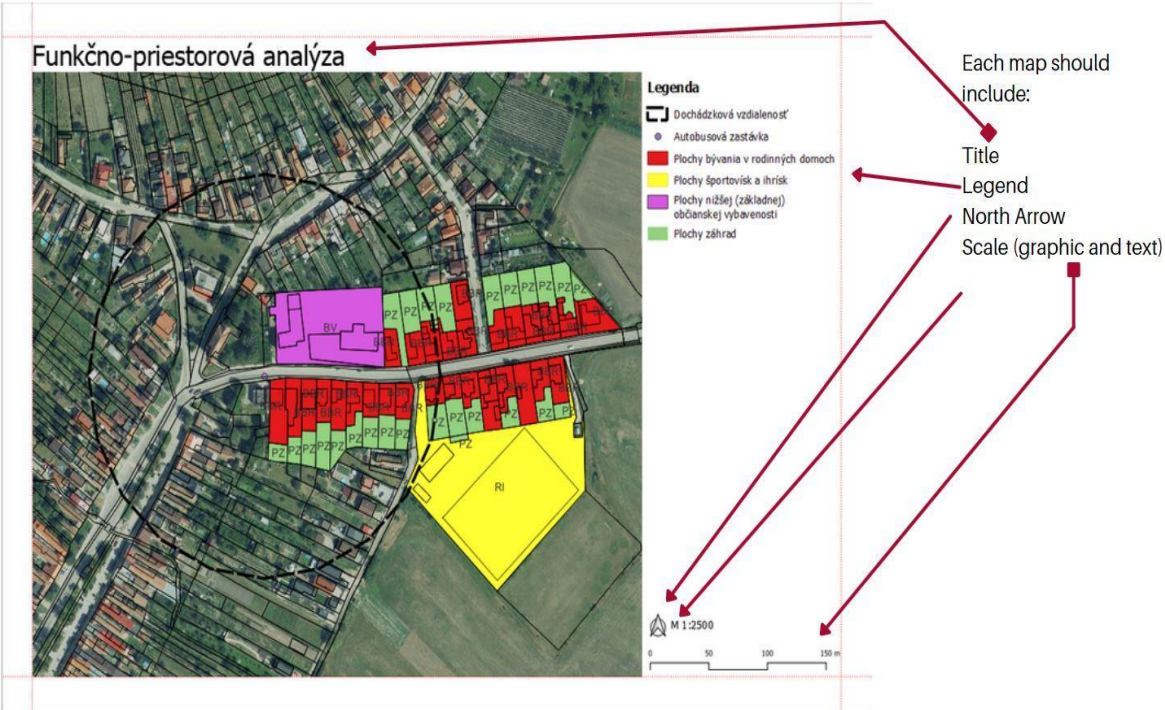


42. Figure: Creating a layout 5

The user can edit all the elements in the layout similarly - right-click on the element, click on the properties, and the options window will appear on the right.

You can delete/add elements/layers from the sign legend, add a title, edit the graphic scale (quantity, number of segments, its graphical representation, size etc.), choose another north-sign icon.

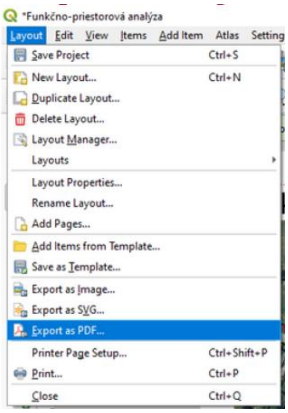
43. Figure: Creating a layout 6



8 Topic 8: Finalization and publication of results

8.1 Export map

When the layout is complete, the drawing is ready to be exported. The user can then export with a simple Layout to PDF operation by clicking the "Layout" and "Export as PDF" ("Export as Image" or "Export as SVG") buttons in the top bar (Figure 44).

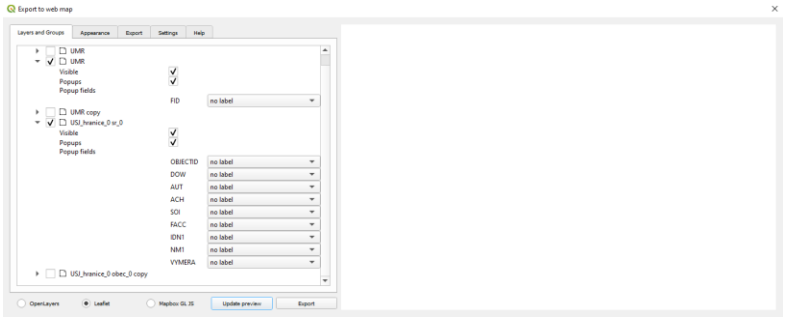


44. Figure: Exporting the output map

8.2 Publish the scorecard online

We have already described how to export a project on the QGIS platform as a static map. Publishing maps with a web application is becoming increasingly popular. For QGIS, there are several such options - directly through the QGIS interface, through extensions, or using a third-party environment.

The qgis2web plugin helps you generate a map from an ongoing project. The advantage is that there is no need to use other software on the server side. This is an easy way to try publishing your projects. After launching the plugin, a dialog box with all the settings will open, the user can select the layers to be published here; the map layout, scale and other basic functions (Figure 45) and a project preview will appear within a few minutes depending on the project size and computer performance in the browser.



45. Figure: The qgis2web plugin dialog box

If you want to publish a project online, you need to specify a website, and a domain where you will store the project. One of the most popular solutions is the QGISCloud plugin, which offers 50 MB of free storage, but you can purchase more storage with a monthly subscription (e.g., $ 65 per month for 500 MB of storage), as well. The plugin runs directly in QGIS and is intuitive and easy to control. Once set up, the plugin will provide a web link that you can share and present publicly about your project.

In addition to these two solutions, there are a number of other ready-made applications on the market that can be configured and shared for free or for a fee. They include QGIS Web Client 2 (QWC2)[2], OSGeoLive[3], and more. Commercial solutions are dominated by the ArcGIS platform and ArcGIS Enterprise, which offers the widest range of solutions and fast customer service.

[2] https://github.com/qgis/qwc2-demo-app
[3] https://live.osgeo.org/en/index.html

9 Topic 9: TPLAB Lab Use

Target group: users, decision makers

Duration: 0.5 hours

Method: Online or in-person training

9.1 LivingLab is the place to use the TPLAB application

Users can receive information and training on how to try, test and use the functions of the TPLab portal in Pozsony / Bratislava and Győr at the so-called LivingLab sites, i.e. in local service offices, and in the form of online tutorials that guide users through the application's functions step by step. The local offices operate as live laboratories with trained staff to help users use and test the area information web service.

Regional and local development professionals, decision-makers and university students can use the service to gain experience and knowledge, as well as to contribute to the further development of the established system.

The manual describes the operating and usage conditions and possibilities of the office, and also contains the user manual of the TP LAB Web Service as the GIS service of the project.

Contact details of the Győr office: https://westpannon.hu/living-lab

Contact details of the TPLAB manuals: http://tplab.lechnerkozpont.hu/hu/eredmenyek

Living Labs (living labs in local service offices) will continue to operate as online and onsite labs during development and during the maintenance period after the project closes. The aim is for organizations providing digital services with databases to be as close as possible to potential users, so that services can be easily targeted to decision-makers, those who prepare the decisions, data analysts, local authorities, actors, entrepreneurs and NGOs based on real needs and communicating real facts. The use of the application is ensured by these laboratories, and the data providers continue to update the data and information, and they are regularly updated depending on the data. Users will also have the opportunity to provide feedback on system failures during the maintenance period, which will be corrected by system maintainers to ensure continued uninterrupted operation.

In short, the aim of the creators and designers, after exploring local needs, is the creation of a living laboratory with the participation of the participating partners - municipal representatives involved in regional and urban development, architects, designers, professionals, environmental civilians, educators and university students and any local residents, in which the web data and information service can be jointly developed, tested, exploited and updated based on suggestions. Although the web application was developed as part of a short pilot project, it is suitable for partner institutions and contributors to further develop the initiative, expand it

territorially, and broaden the knowledge according to different user intentions.

The main benefits of the system (project) as a whole can be summarized in the following main points:

- A unique cross-border system will be built that will reach stakeholders on both sides of the border not only virtually, but also through the laboratories in Pozsony / Bratislava and Győr.
- As a result, a network of cooperation is formed, which crosses the border and whose members can work together on a sub-problem.
- This joint interdisciplinary work cannot only mean better use of data, but also lay the foundations for future initiatives that will lead to actions that can have a significant impact on the future of the border region, either in the form of specific projects or individual initiatives.

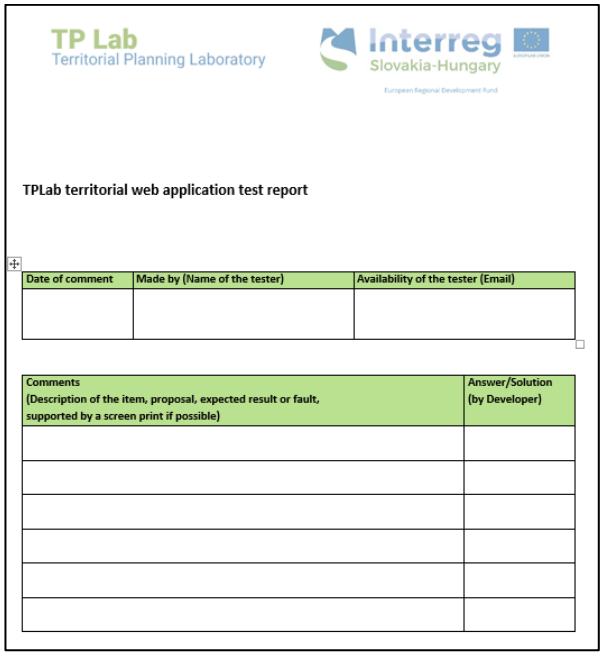
9.2 Personal and online use of the app

Use of the office is possible after prior registration. The venue is also suitable for consultation, and for workshops for small groups. For personal use, in addition to learning about the web application and running it on a dedicated computer, it is possible for the service user to learn the details of the data in the application database, including their technical and spatial planning professional properties.
The laboratories in Győr and Pozsony / Bratislava also operate as a kind of regional information centres, which go beyond a simple IT consulting. Representatives, staff and users of the office can explore a number of synergies, cross-border challenges or solutions that are interesting for spatial development that would not otherwise be possible or would be difficult to identify.

In case of online use, the web service can be accessed directly from the official website of the TP LAB project (tplab.lechnerkozpont.hu) with the help of a web browser. The service is completely public - its viewing or use is not subject to authentication (login), it is available in three languages - English, Hungarian and Slovak. Online use is also aided by an in-app user manual and tutorial video.

9.3 Contribution to the development

In the application development process, users can assess how well the planned application fits their data and information needs, how easy they can use it, how satisfied they are, and how useful they find it in their work or daily life.
Written comments can be submitted to the developer by a simple report template that includes the feature tested, data, trial date, and the result and proposed changes, illustrated with screenshots where possible for easier understanding.



TP Lab
Territorial Planning Laboratory

Interreg
Slovakia-Hungary
European Regional Development Fund

TPLab territorial web application test report

Date of comment	Made by (Name of the tester)	Availability of the tester (Email)

Comments (Description of the item, proposal, expected result or fault, supported by a screen print if possible)	Answer/Solution (by Developer)

46. Figure: Report template

10 Topic 10: Introducing the data structure and spatial data service

Target group: users, decision makers

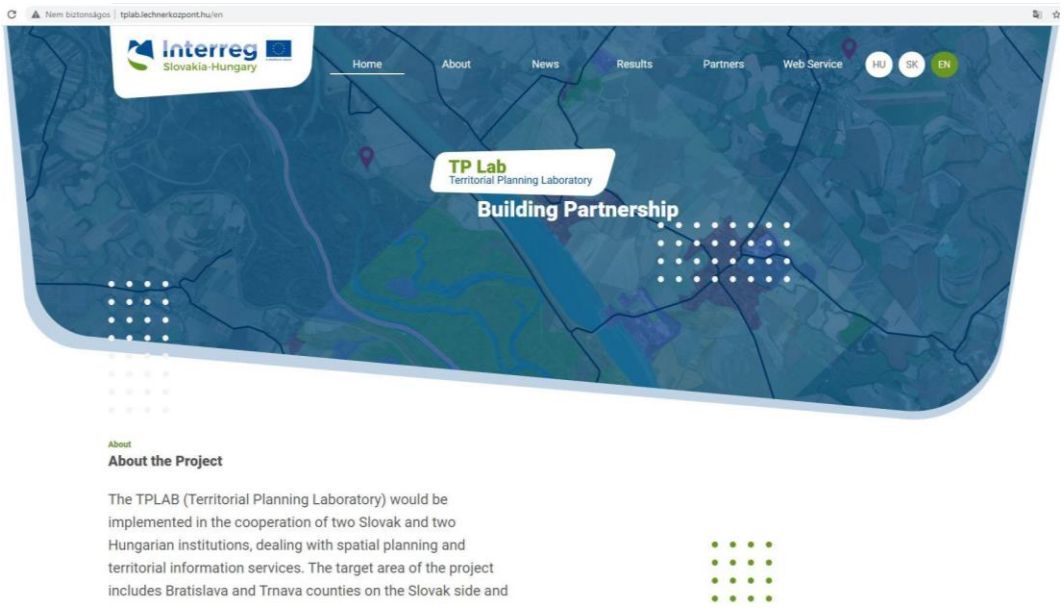
Duration: 0.5 hours

Method: Online or in-person training

10.1 Accessing the web service

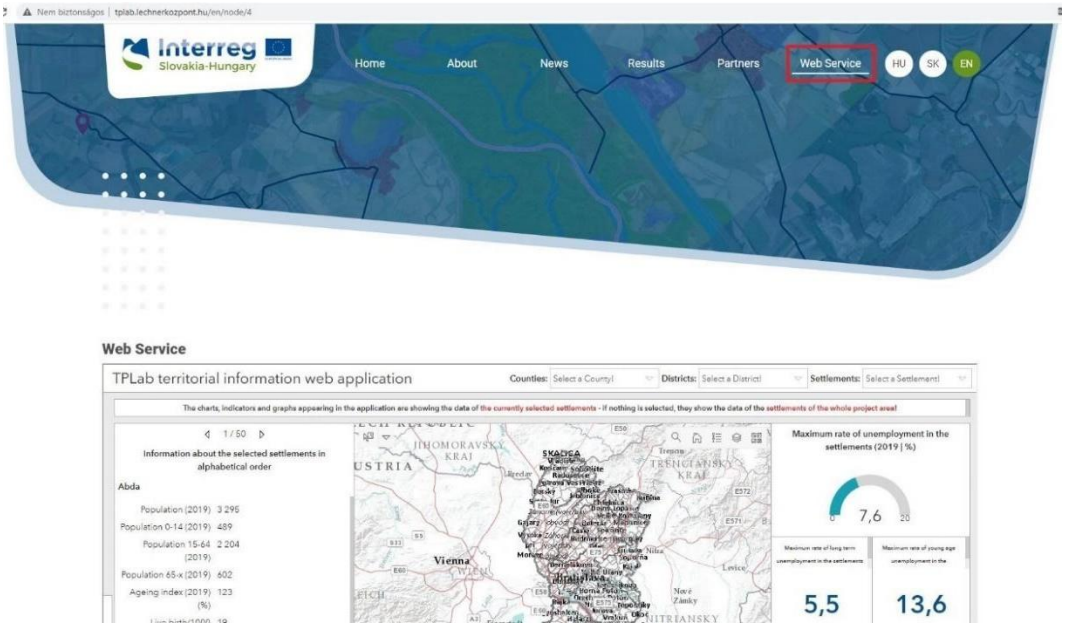
One of the main goals of the **TPLAB (Spatial Planning Laboratory)** project is to create a **common information platform** in the Slovak-Hungarian border region, in the territory of the three participating counties (Győr-Moson-Sopron county, Bratislavsky kraj, Trnavsky kraj) using spatial data collected during the cooperation. The spatial data and other map information generated for this purpose will be made available on a public interface in the form of a common service to **interested professional organizations, universities, decision-makers, non-governmental organizations and other actors**. The application available in this way can serve the mapping of the **current social, economic and environmental processes characteristic of the region, as well as their spatial connections**, and thus can be useful in the foundation and decision-making work. Furthermore, the analytical, querying and other information interfaces of the web GIS service may be of interest to the world of science (students, researchers).

The web GIS service can be accessed directly from the **official website of the TPLAB project** (tplab.lechnerkozpont.hu) using a web browser. The service is completely public - you do not have to log in or use it to log in.



47. Figure: Accessing the TPLab website

Clicking on the “Web Service” menu item will open the web map application interface embedded in the website.



48. Figure: Accessing the web application

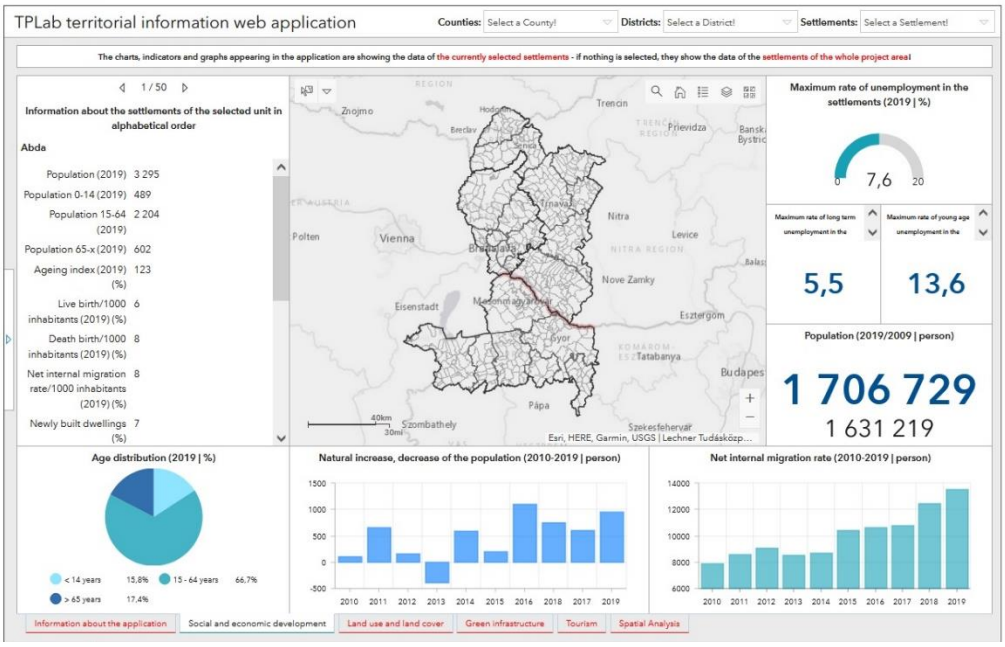
10.2 Possibility to choose the language

The TPLAB website, and the map service, accordingly, is available in three languages - **English, Hungarian and Slovak**. You can switch between the languages by choosing from the three icons at the top right hand of the website (HU - Hungarian / SK - Slovak / EN - English; by clicking on the icon).

49. Figure: Language selection

10.3 Full screen view of the web service

When using the embedded Web service, certain items may slip on smaller devices and displays, mainly due to the dynamic resizing of individual panels, so clicking on **"View in Full Screen"** will open the application in full size in a new browser tab.



50. Figure: Full screen display

10.4 The main elements that make up the web service

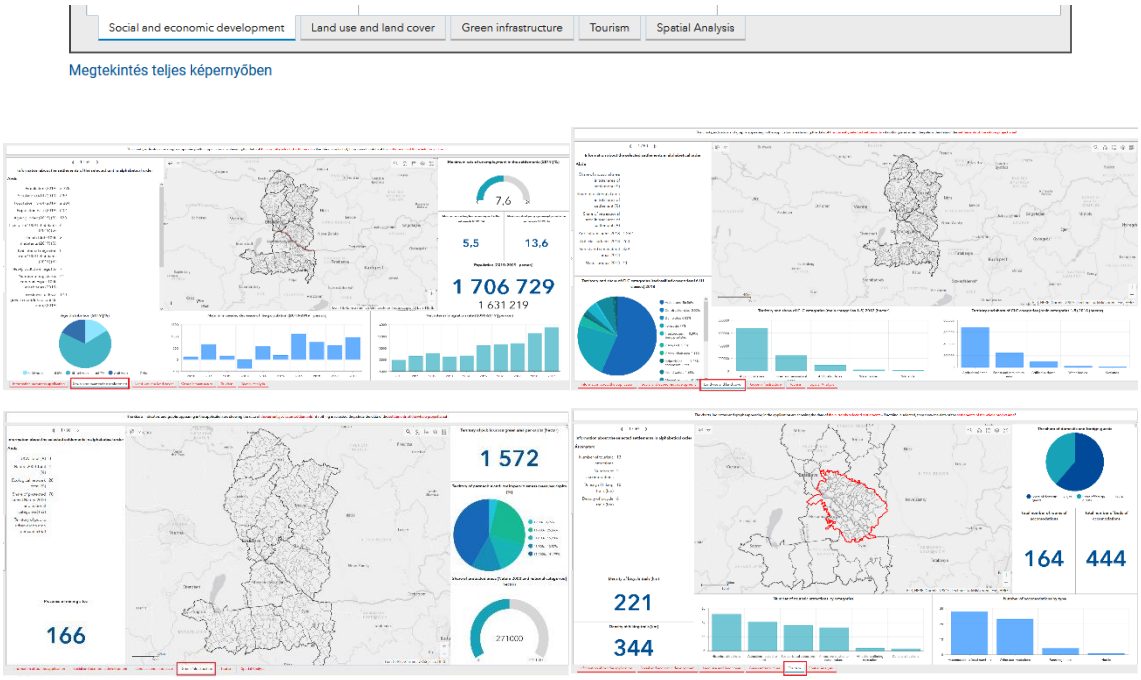
Dashboard technology enables the compilation of a map analysis interface that is **user-friendly, data-driven, and information-centric,** as well as visually easy to interpret.

- Indicators
- Charts (bar and pie chart)
- Lists and textual content
- Embedded content
- Analytical tools

The purpose of the thematic interfaces is to make the most important **social, economic and environmental information** about each territorial unit available to users in a simple and visually comprehensible way.

- **Social and economic development**

- **Land use and land cover**
- **Green infrastructure**
- **Tourism**



51. Figure: Thematic interfaces

10.5 Data source and types

The data in the application comes from several sources. Most of the data on the Hungarian side have been queried from the **TeIR** (National Spatial Development and Spatial Planning Information System). Data related to spatial planning, such as data on economic, residential and recreational areas, have been derived from **E-TÉR** (Electronic Spatial Planning Support System). Land cover data for the entire design area have been queried from **Copernicus** service

The data collected has been divided into four major groups:

- **Social and economic development**
- **Land cover and land use**
- **Green infrastructure**
- **Tourism**

- There are different types of data in each group. The "Social and Economic Development" topic provides data on institutional accessibility, demographics, and income, as well as taxation.

The topic "**Land cover and land use**" includes land cover data for 2012 and 2018, changes in land cover between 2012 and 2018, and current land use planning data (economic, residential and recreational areas).

Data related to "**Green Infrastructure**" include natural and protected areas as well as some natural hazards, among others.

The topic of "**Tourism**" contains data collected manually from the settlement websites, Google Maps and szallas.hu. In addition to the availability and type of accommodation and the number of places, the number and type of tourist attractions have also been surveyed. However, this data is only available for the sample area. In addition, bike paths and hiking trails for the entire area can be found in the app.

11 Topic 11: Using TPLab

Target group: users, decision makers

Duration: 2 hours

Method: Online or in-person training

11.1 Queries on thematic interfaces

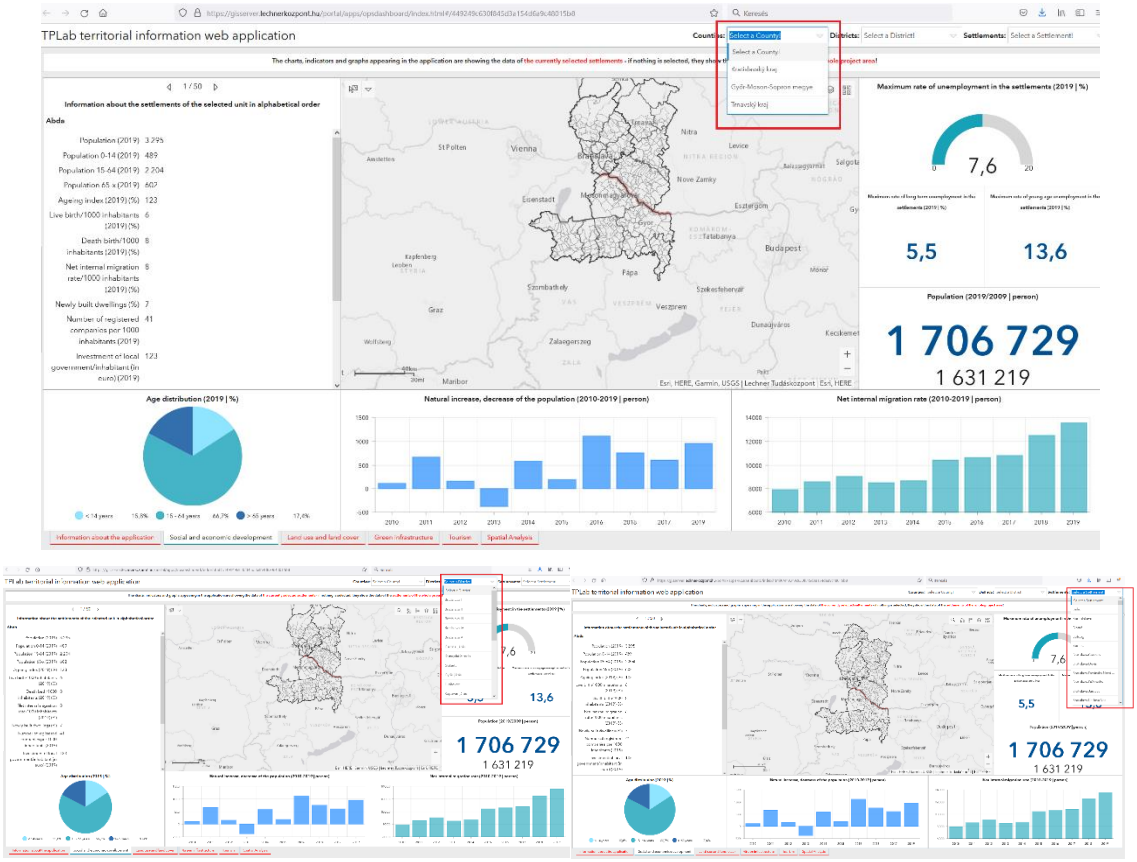
On the thematic interfaces it is possible to filter the data by county, district and settlement. By default, the information displayed on the panels covers the entire project area - aggregated into the three counties in the project. In the information panel on the left, you can see the settlement data of the project area in alphabetical order; including the (□ □) arrows that allow you to change between them.

The drop-down menu items in the header allow you to filter the area according to the administrative levels.

52. Figure: Selecting a territorial unit

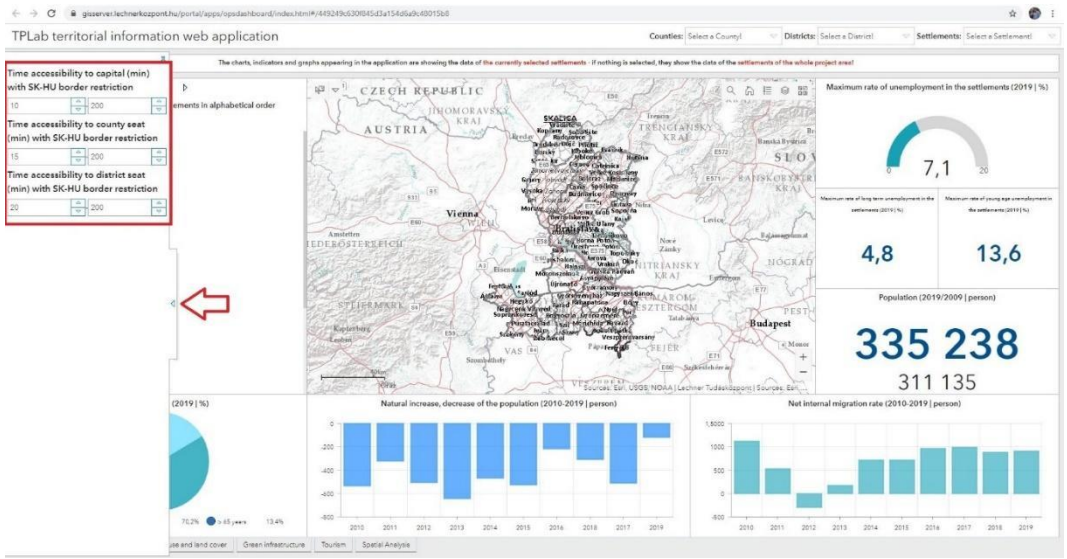
By clicking on the arrow in the text box next to the **"Counties; Districts; Settlements"** panely you can choose from the territorial units in the project in the drop-down panel. If you select a specific territorial unit, only the corresponding data will be displayed on the map (this only applies to the territorial administrative layers, the filtering is not valid for the other thematic layers!)

- Simultaneously with the map filtering, the other graphic elements of the interface (figures, diagrams, indicators) will also show the values of the selected unit.
- For example, if you select Győr-Moson-Sopron County from the drop-down list, the aggregated values for that county will be displayed automatically.



53. Figure: Selecting a territorial unit

There is an **openable panel** on the left side of the thematic interfaces that appears briefly when the application starts, it is closed by default.



54. Figure: Accessibility information

Three filter parametres can be set in this menu:

Accessibility of the capital, taking the separating role of the Slovak-Hungarian border into account (measured in minutes)

Accessibility of the capital of the district taking the separating role of the Slovak-Hungarian border into account (measured in minutes)

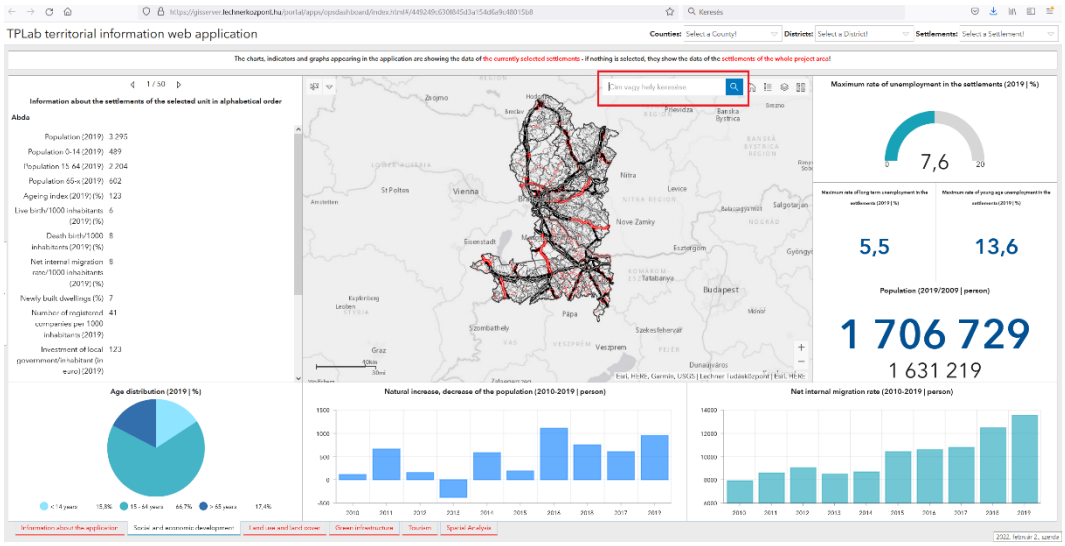
Accessibility of the capital of the county taking the separating role of the Slovak-Hungarian border into account (measured in minutes)

By default, an interval value of 0-200 minutes is specified, which can be changed as the user wants it. The minimum value (minimum number of minutes) can be set in the left box, and the maximum value (maximum number of minutes) can be set in the right box. You can enter the values or scroll with the arrows at the edge of the box.

11.2 Basic web map features

The following additional functions are available on the maps of the thematic interfaces to facilitate spatial orientation and map search:

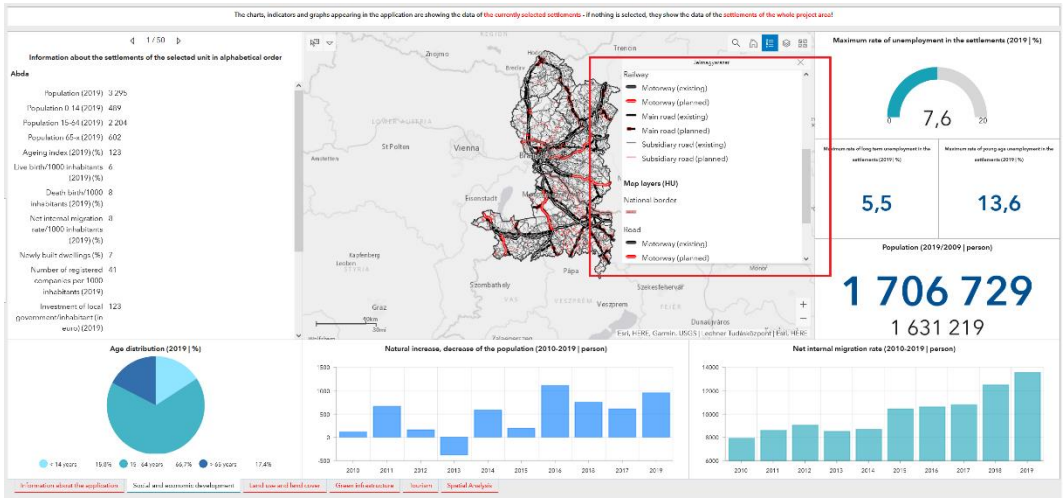
Search: Clicking on the  icon will open a text entry field where you can enter the name or address of the town you are looking for.



55. Figure: Accessing the search function

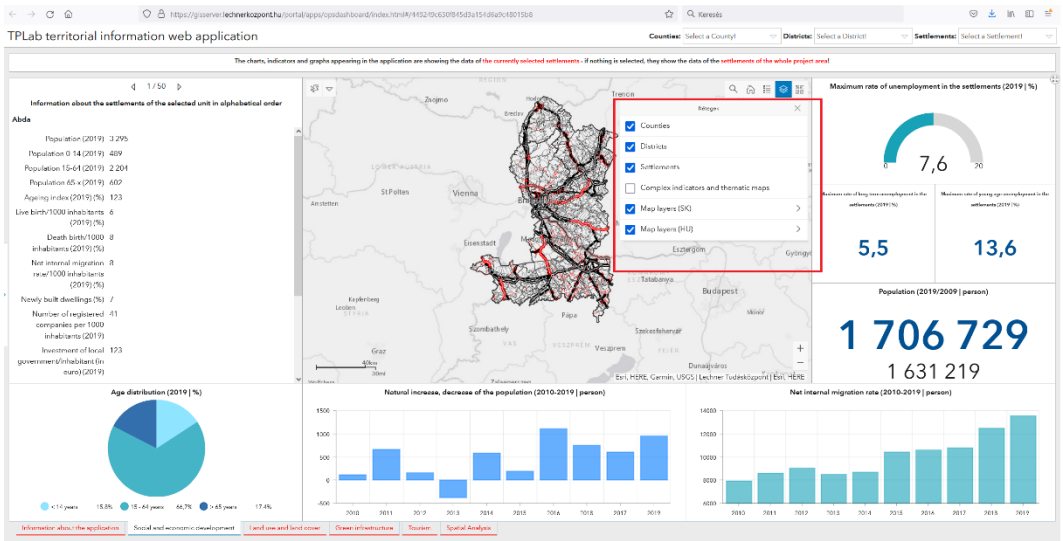
Full view: Clicking on the icon will zoom the map to the initial view (extent).

Legend: Clicking on the icon opens a window with the names of the map layers and their associated symbols.



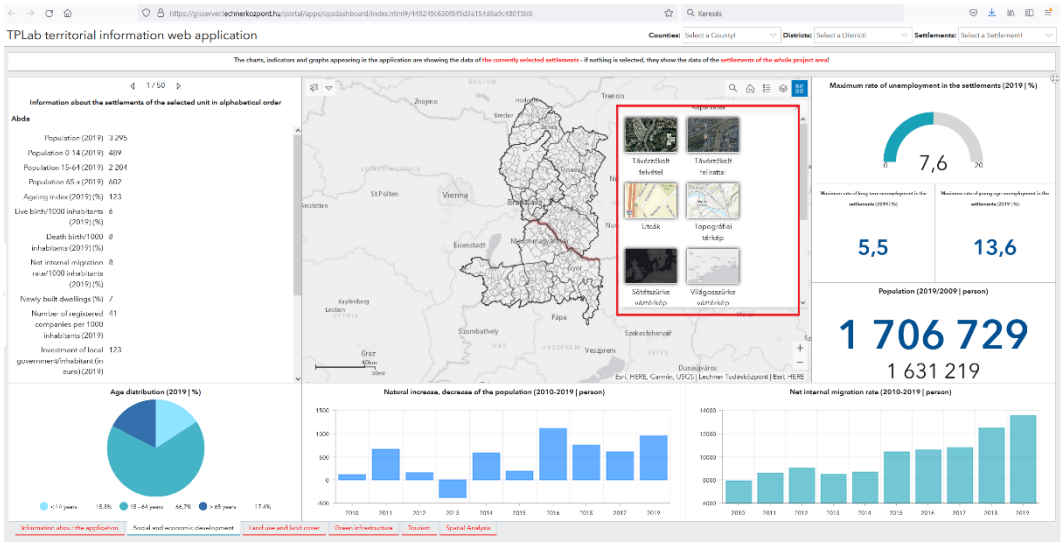
56. Figure: Accessing legend

Layer Manager: Clicking the icon opens a window listing and (grouping) the map layers. You can adjust the map visibility of the layers by turning the checkbox in front of the layers on and off.



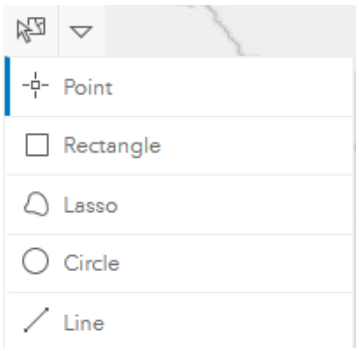
57. Figure: Accessing the layer management function

Base Maps: Clicking on the  icon opens a window showing the different base maps. Clicking on the selected base map icon changes the base map on the map interface.



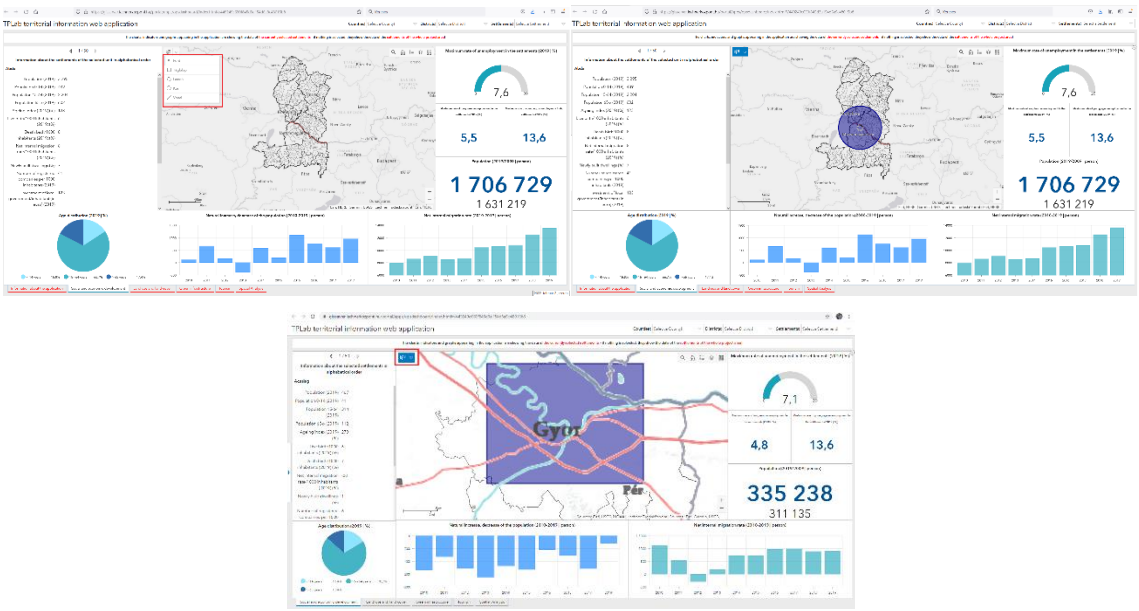
58. Figure: Setting the base map

Map queries (selection of area units) can be performed not only with the filters in the header, but also by selecting them on the maps. The map selection menu is located in the upper left corner of the thematic interface maps.



59. Figure: Map selection tools

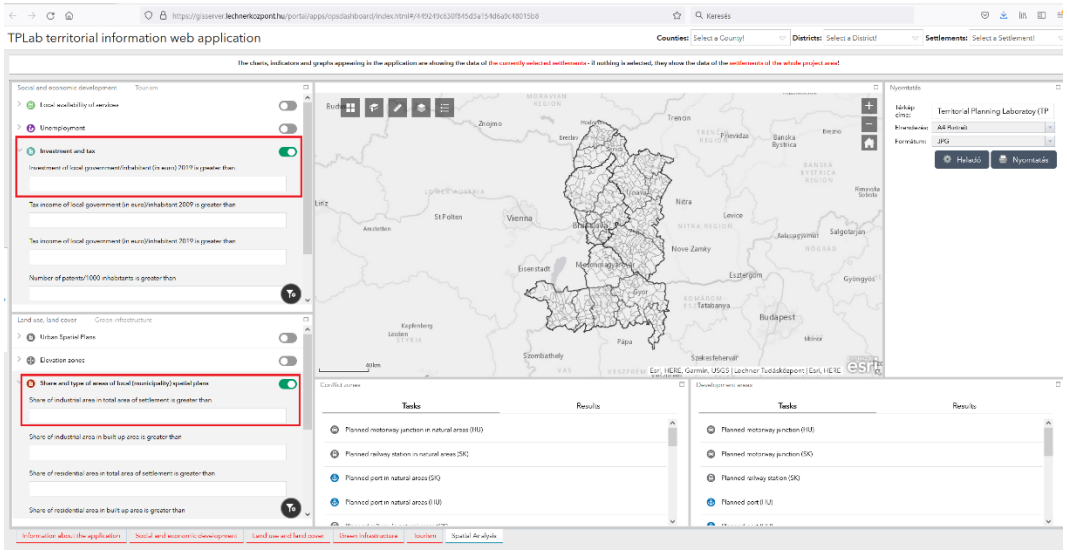
Click the down arrow next to the selection button to display the geometry types you can select (point, square, lasso, circle, line):



60. Figure: Map selection (point, circle, square)

11.3 Parts of the analysis interface

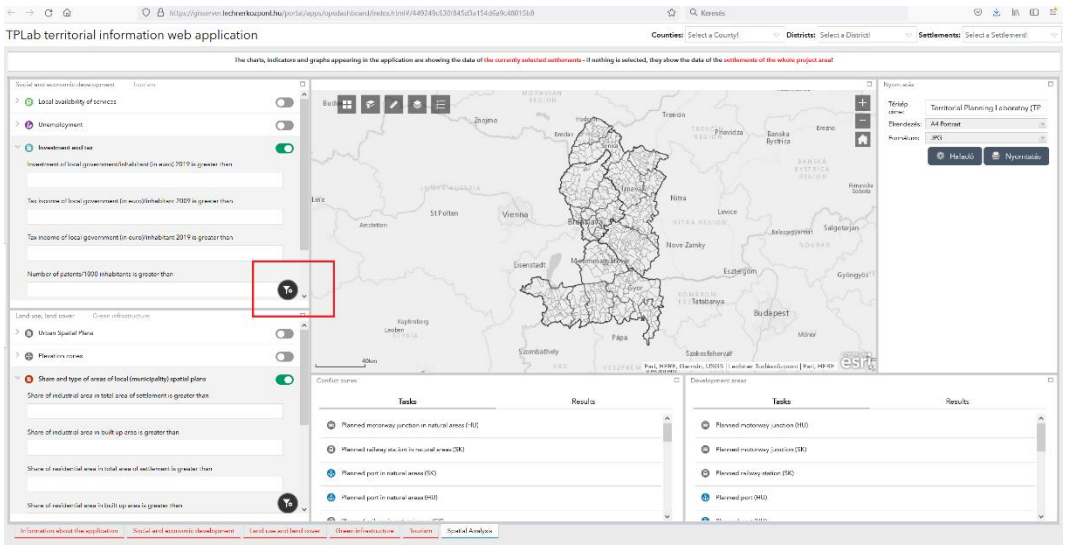
The left panels of the analysis interface allow you to perform predefined queries related to the four main topics. In the top left panel, you can switch between the indicators for the two topics by clicking on “Social and Economic Development” and “Tourism”. The main topics are listed one after the other with icons and the name of the data group.



61. Figure: Analysis interface - query

Scroll down the text box below the indicators to select a value or enter a number in a number type field.

If you have set filter criteria for more than one indicator at a time, they will take effect together.
To activate the set filter, turn the switch behind the indicator name - and to deactivate the filter, reset it.
When filtering, only area units (settlements) that meet the set conditions will be displayed on the map.
In addition to the predefined filters, you can click on the icon to compile your own filter criteria and more complex filters, as well.



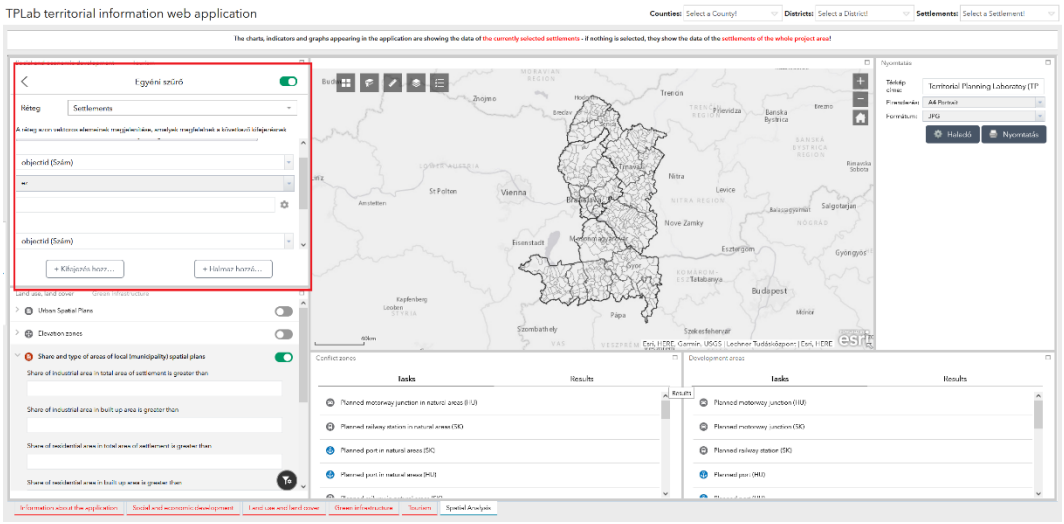
62. Figure: Specifying your own filter criteria

In the "Layer Name", you must first select the layer you want to filter on. Click the "Add a term" button to create your own filtering criteria.

- the field you want to filter must be entered first
- depending on the field type, you can select a filtering relation
- then you can specify the value of the condition

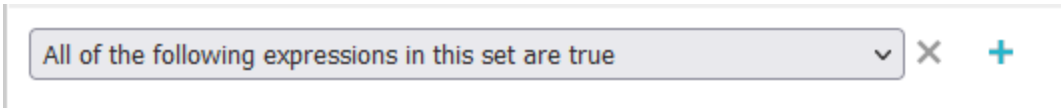
To activate the set filter, turn the switch behind the indicator name on - and to deactivate the filter, reset it.

After selecting the layer you want to filter, you can specify more than one condition at a time by clicking the "Add Expression" button. You must do these steps at least twice, but you can click the + button to add any number of additional criteria to the filter.



63. Figure: Specifying your own filter criteria

In addition, you can set each condition to take effect at the same time, or if one of the conditions applies, the corresponding items will already appear on the map!



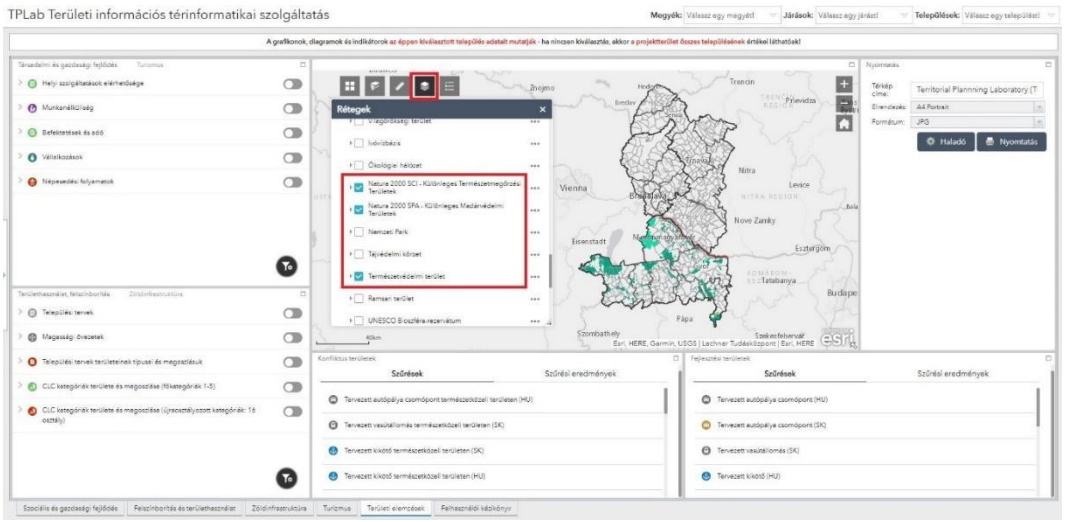
64. Figure: Specifying your own filter criteria

To activate the set filter, turn the switch behind the indicator name on - and to deactivate the filter, reset it.

11.4 Practical examples

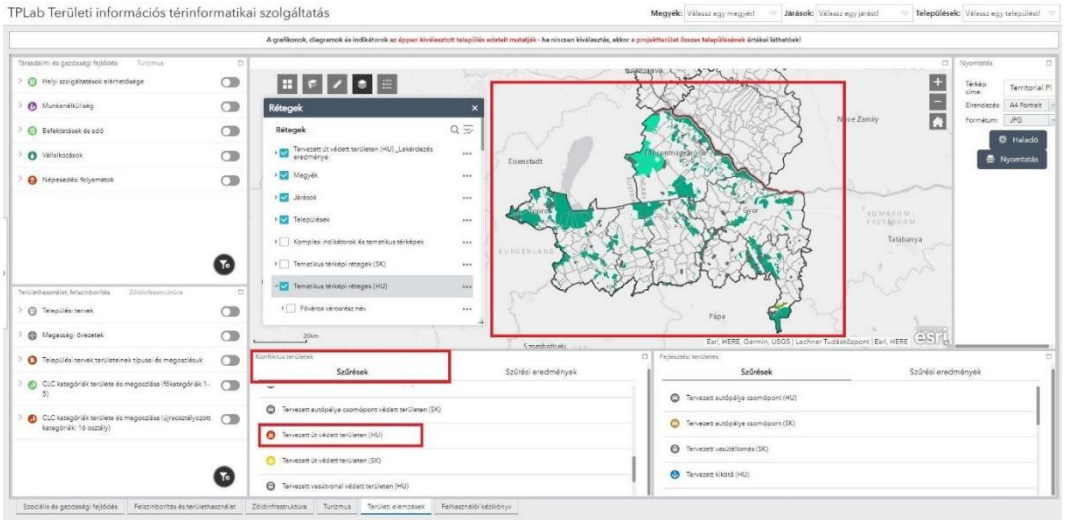
Conflicts-Planned Road in nature and Natura 2000 areas

Click the Layer Manager icon on the Thematic Map Layers (HU) layer to turn on the Natura 2000 Areas and Nature Reserves layers.

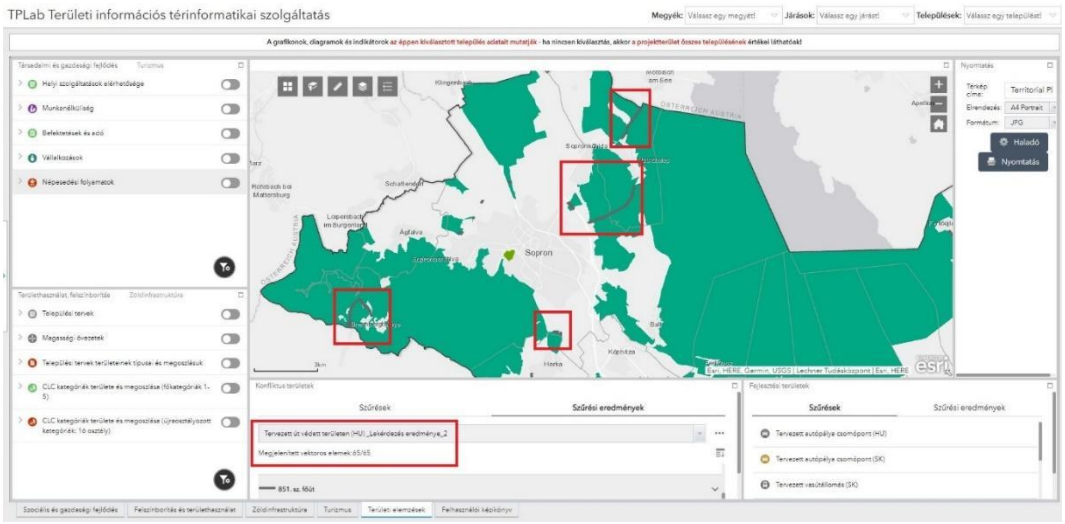


65. Figure: Selecting layers

*In the **Conflict Areas panel**, select the Planned Path in Protected Area (EN) layer.*



66. Figure: Selecting Conflict Areas



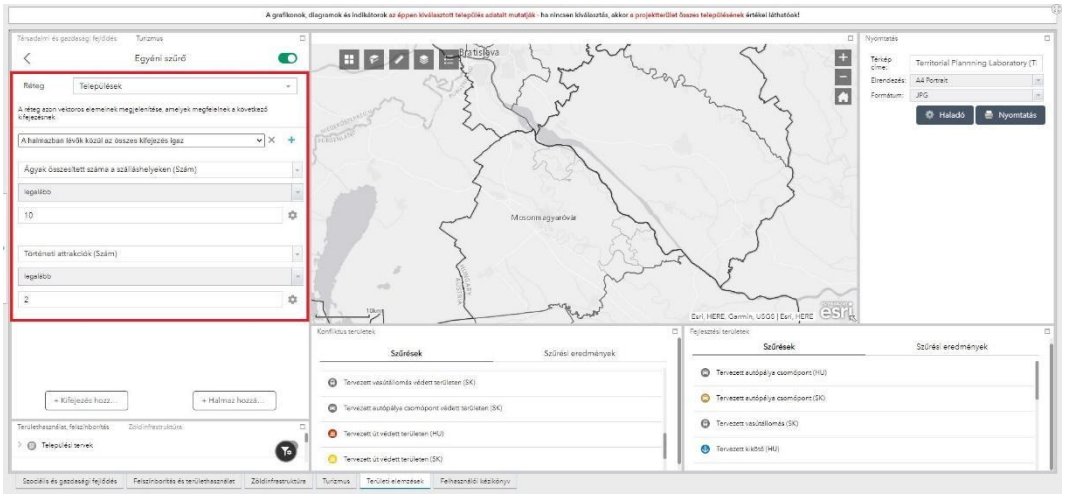
67. Figure: Reading the results

Tourism - Number of places and historical attractions

Click the icon to perform a custom filter. Click the Add Set button to specify the filter criteria:

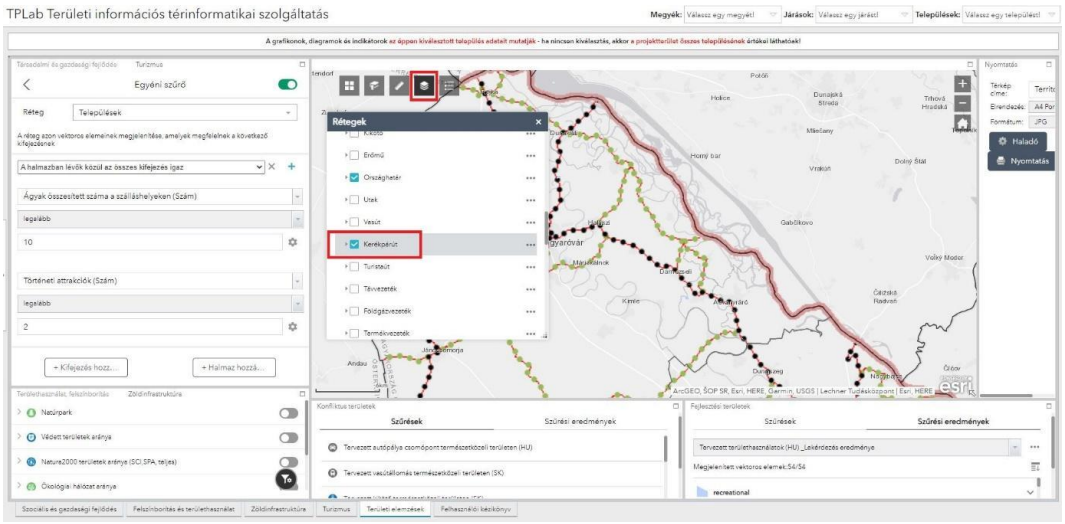
Total number of beds in accommodation - at least - 10

Historical attractions - at least - 2



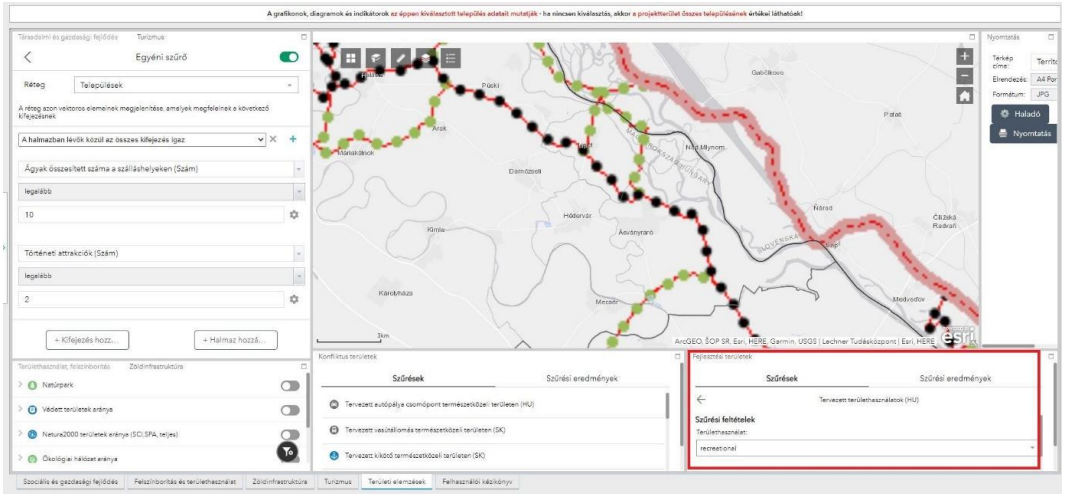
68. Figure: Setting custom filters

Click the Layer Manager icon  *on the Thematic Map Layers (HU) layer to turn on the Cycle Layers layer.*



69. Figure: Selecting layers

In the Development Areas panel, select the Planned Land Use (HU) layer and then the type of recreation area.



70. Figure: Selection of development areas

Four settlements meet the screening criteria: Dunakiliti, Lipót, Hédervár and Mecsér.

Planned residential areas - availability of secondary school and kindergarten

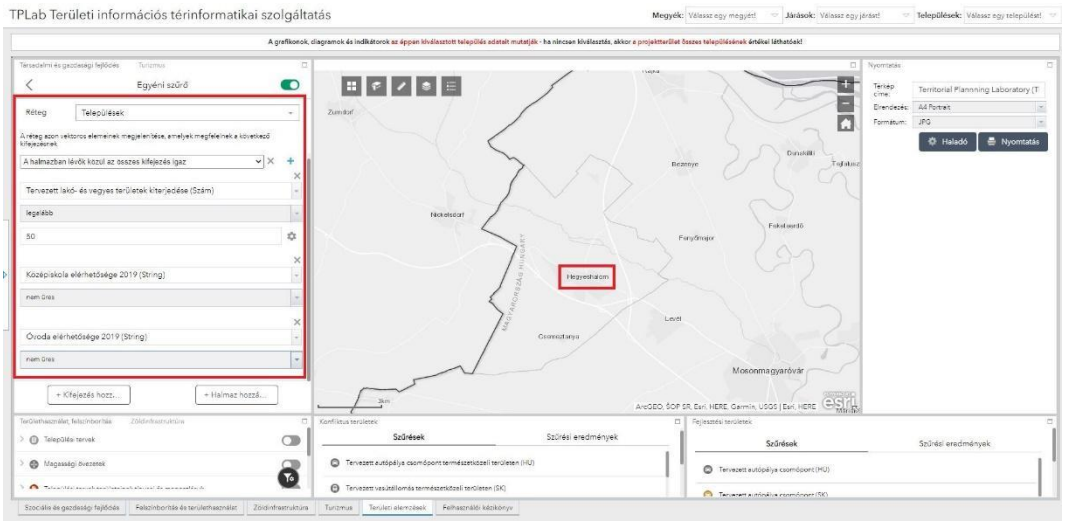
Click the icon to perform a custom filter. Click the Add Set button to specify the filter criteria:

Extent of planned residential and mixed areas - at least - 50

Secondary school availability (2019) - not empty

Kindergarten availability (2019) - not empty

-



71. Figure: Setting custom filters

One settlement meets the screening criteria: Hegyeshalom.

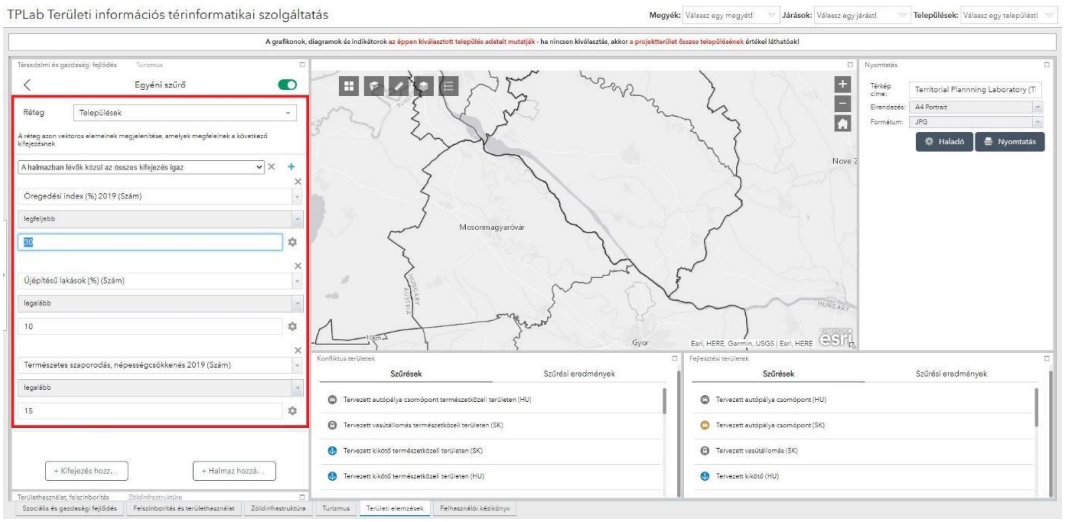
<u>Developing settlements - Growing population, low aging rate, high proportion of new dwellings</u>

Click the icon to perform a custom filter. Click the Add Set button to specify the filter criteria:

Aging index (2019) - up to - 30

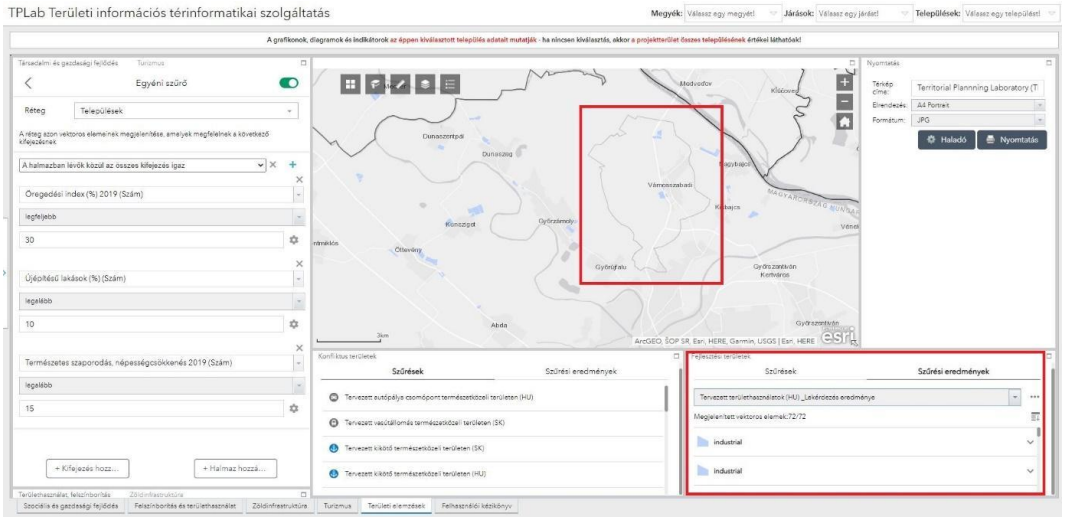
Newly built dwellings (%) - at least - 10

Natural increase, population decline (2019) - at least - 15



72. Figure: Setting custom filters

In the Development Areas panel, select the Planned Land Use (HU) layer and then the industrial area type.



73. Figure Selection of development areas, reading of results

One settlement meets the screening criteria: Vámosszabadi.

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