WORK PACKAGE 2
DELIVERABLE D.T2.1.3

GIS-based databases for municipalities
08/2017

D.T2.1.3: GIS-based databases for municipalities

A.T2.1 Exploring energy saving potentials and potentials to reduce light pollution

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Summary:	A geographical information system (GIS) allows its users to create, organize and analyze geographical data and to create plans on the exact location of all existing components of a public lighting system. GIS-based databases for municipalities include technical information on lighting infrastructure as well photometric data.
Purpose:	This document is designed to have a complete and comprehensive vision on dataset collected by project partners. The goal was to collect geo-information about poles / luminaires, energy consumption, etc. in involved municipalities / cities and store them in the geo-database (geo_DB) which can be handle, access, visualize in GIS environment.
Objectives:	- to show functionality of GIS-based databases with respect to storing information on street lighting system and its energy consumption - to plan retrofits to save energy and improve light quality (planning of public works and investments) - to monitor the impact of the investments on street lighting system - to help local authorities to improve its knowledge of the status quo of the lighting system
Audience:	- municipal planners and managers of urban lighting systems
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Introduction / Background

Lwówek Śląski is an urban-rural municipality in Lower Silesian Voivodeship, in south-western part of Poland. Total administrative area is 240,37 square kilometers its total population is 18,189 (of which the population of Lwówek Śląski is 9,687, and the population of the rural part of the gmina is 8,502)[1]. In the municipality there are 28 villages, most of which are located in its northern part. Lwówek Śląski is one of the oldest cities in Lower Silesia.

The Town Lwówek Śląski mostly consists of residential areas and the park. In addition, there are monuments, a gastronomic area, single stores, a police station, a fire department and a kindergartens.

The municipality of Lwówek Śląski is an associate partner within the Dynamic Light project and therefore the GIS database was developed in this area.
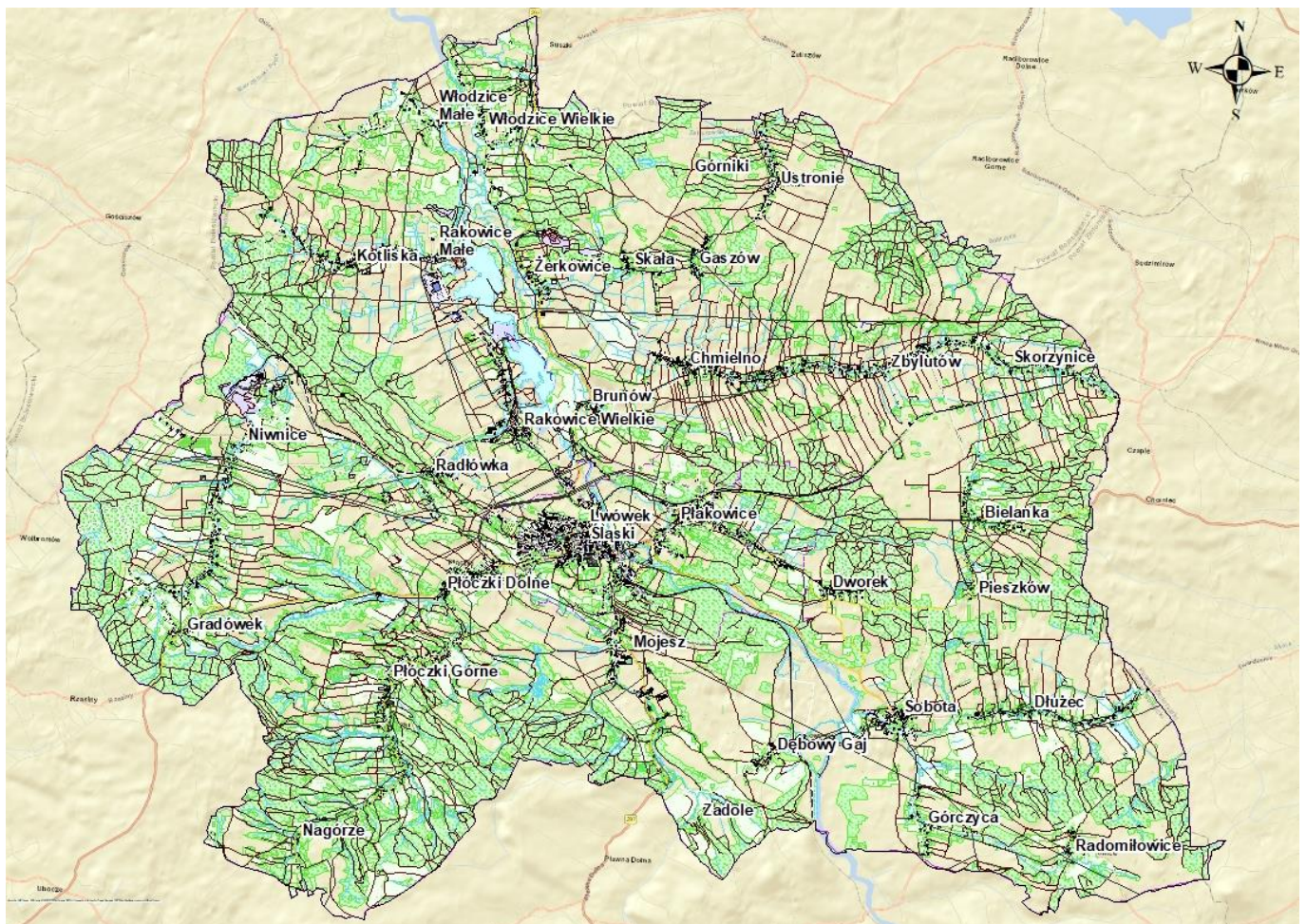

Figure 1Map of the Lwówek Śląski area

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[1] https://pl.wikipedia.org/wiki/Lw%C3%B3wek_%C5%9Al%C4%85ski_(gmina)

1. Data acquisition / Survey and collection of data

1.1 Data sources and methodology used

The area of the Lwówek Śląski has been selected as the area for the Pilot Action in Poland. To create the spatial geodatabase for the street lighting infrastructure it was necessary to collect technical information for each luminaire, lighting poles and switchboards geographical localization, energy consumption data as well as photometric data. The majority of technical information and data was gained from ENERGY AUDIT OF STREET LIGHTING Prepared for the Municipality and Town of Lwówek Śląski by the ECOENERGY company from Cieszyn. Based on the Energy Audit which was made in 2017 and information gained from the municipality about the consumption of electricity, the GIS database was developed. Most of the the GPS coordinates come from the shapefiles elaborated by the ECO-ENERGY company, but it was obligatory to check the geographical localization accuracy of each luminaire as well as switchboards. Photometric data are include in the geodatabase as a .jpeg file which is spatially connected with each luminaire (Figure 2).

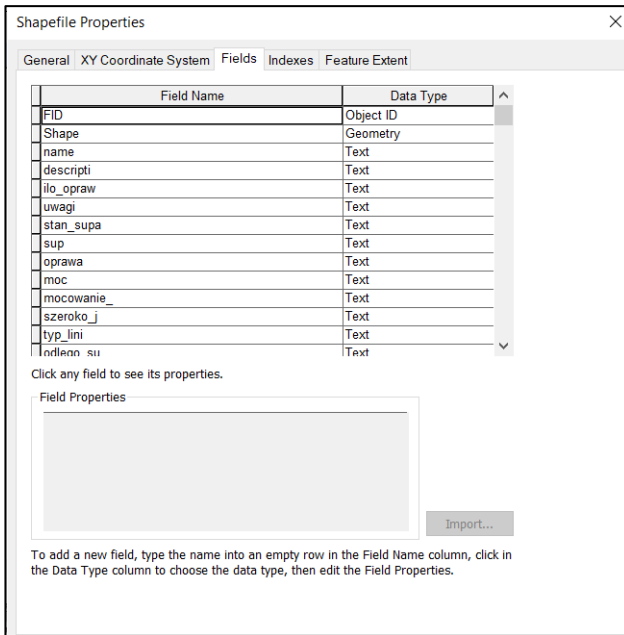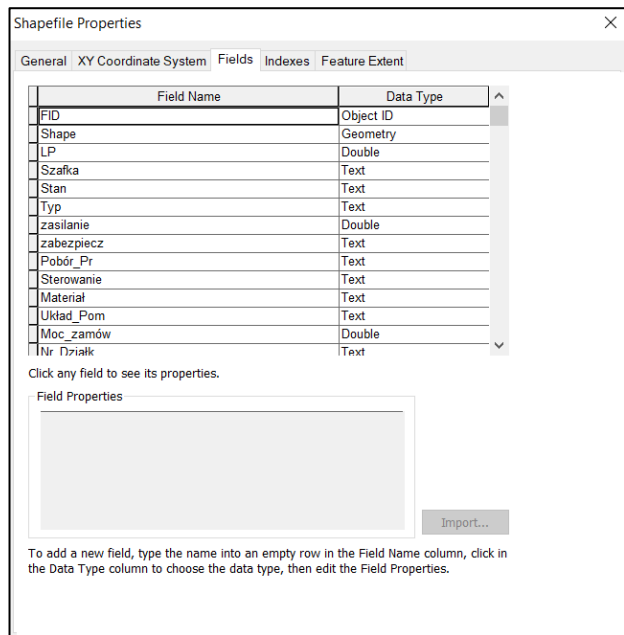| 01 FID	02 Shape	03 name	15 Wysokość	16 Nawierzchn	17 Kategoria	(-) Wysokść	21 chodnik	27 xcoord	28 ycoord	(-) Kategoria	(-) Lokalizacja	(-) Sytuacja	(-) Styl oprawy	(-) Modernizac	(-) Strumień świetlny	(-) Strumień świetlny	(-) link
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445	Multipoint	punkt 4	8	asfalt	droga	6,5	brak	15,492035	51,12477373	powiatowa	ł. mapowy nr	23	drogowa	Wymiana	6603	6609	023.PNG
446	Multipoint	punkt 5	8	asfalt	droga	6,5	brak	15,492378	51,12511435	powiatowa	ł. mapowy nr	22	drogowa	Wymiana	5545	5550	022.PNG
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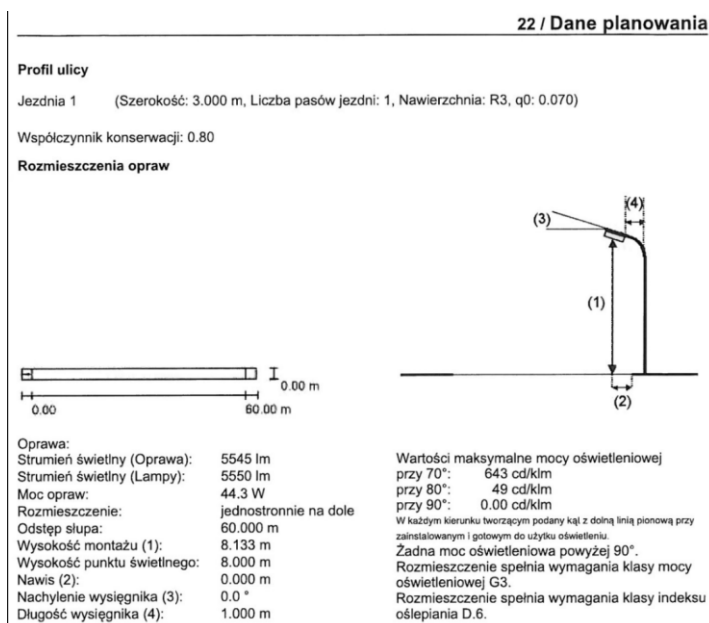
Figure 2 Photometric data

1.2 Structure and naming of the data

The data such as: luminaires and switchboard are vector data with the spacial reference. The visible base map is raster data taken as WMS from OpenStreetMap (free and open source).

Figure 3 Structure of the Luminaires shapefile

Figure 4 Structure of the Switchboardsshapefile

1.3 Software

To create geodatabase and visualize the spatial data of the lighting infrastructure "Poltegor-Institute" is using ESRI ArcGIS software (http://www.esri.com/arcgis/about-arcgis).
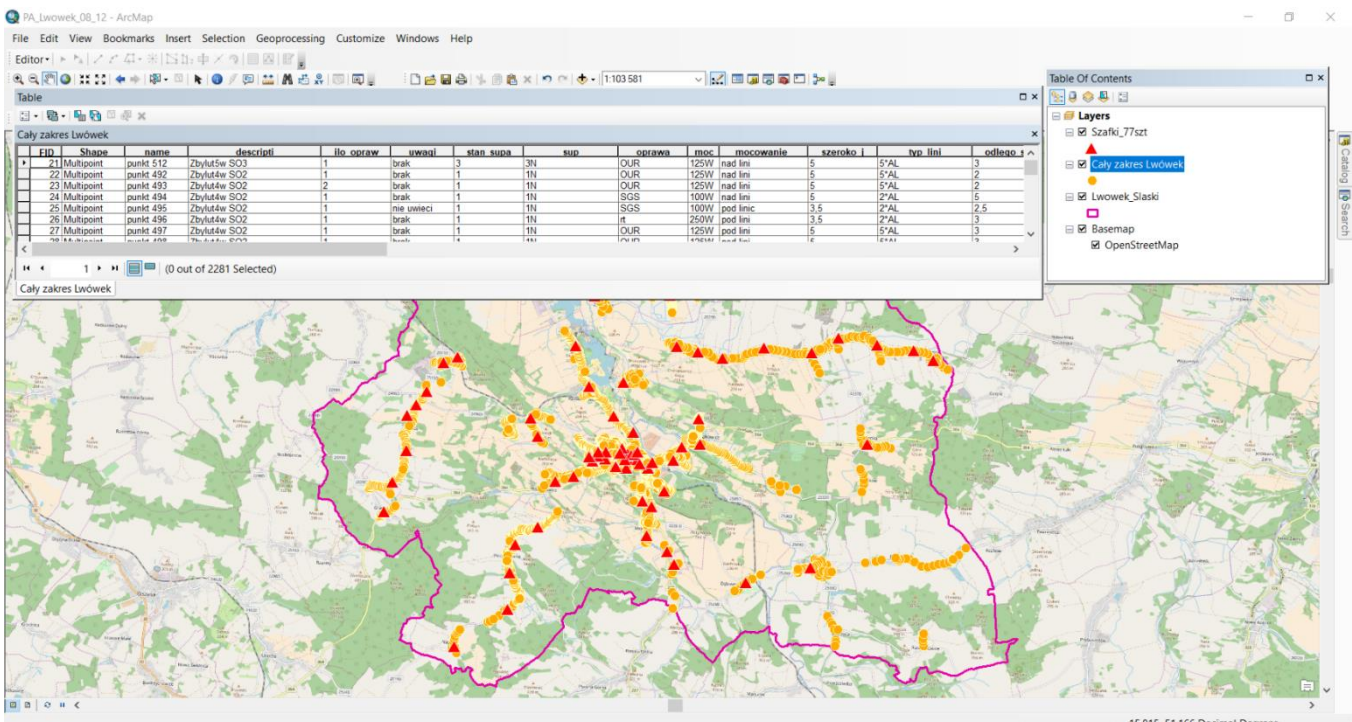
2. Visualization of the collected data

In the geodatabase 2281 luminaires and 76 switchboards are placed. The Figure 5 presents the spatial distribution of luminaires and switchboards.
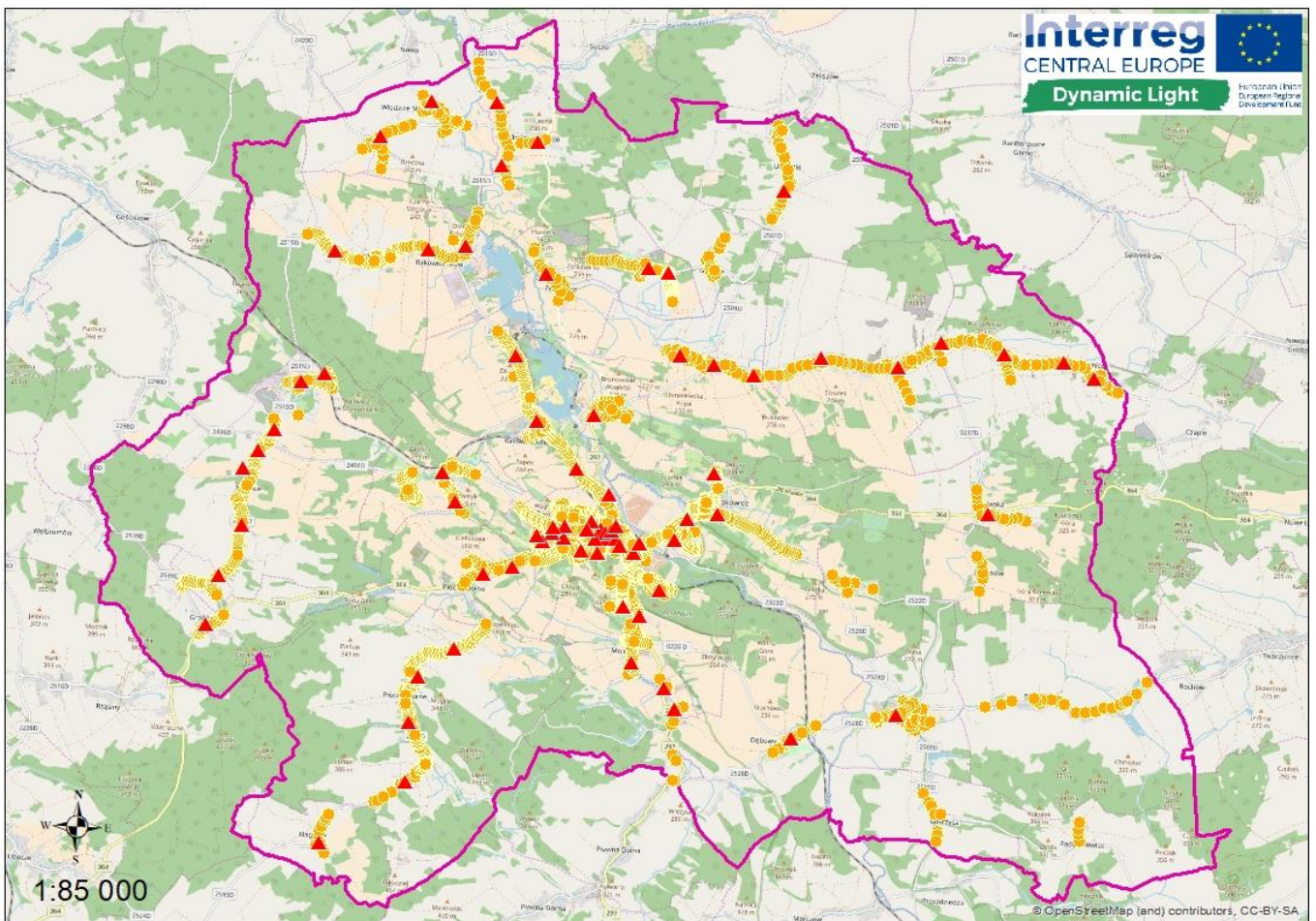

Figure 5 Spatial distribution of luminaires and switchboards in Lwówek Śląski

Based on the GIS database it is possible to find a places where e.g. power of mounted bulbs is definitely too high. To fins such places the tool "Hot Spot Analysis" were used. This tool identifies statistically significant spatial clusters of high values (hot spots) and low values (cold spots). The results are presented on the Figure 6. To present the streetlight light pollution in the Municipality of Lwówek Śląski the analysis was carried by using the Kernel density function. The Kernel Density tool calculates the density of features in a neighborhood around those features. The high Wattage streetlights and therefore the light pollution within the city are presented on the Figure 7.
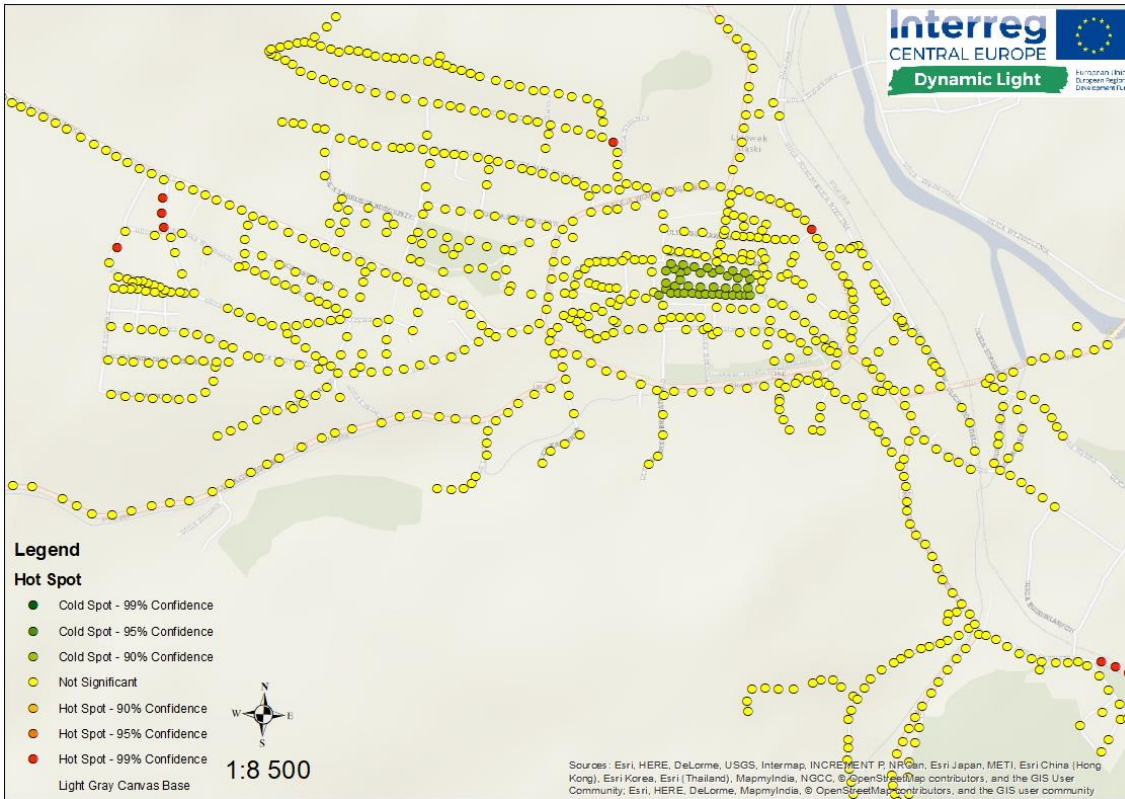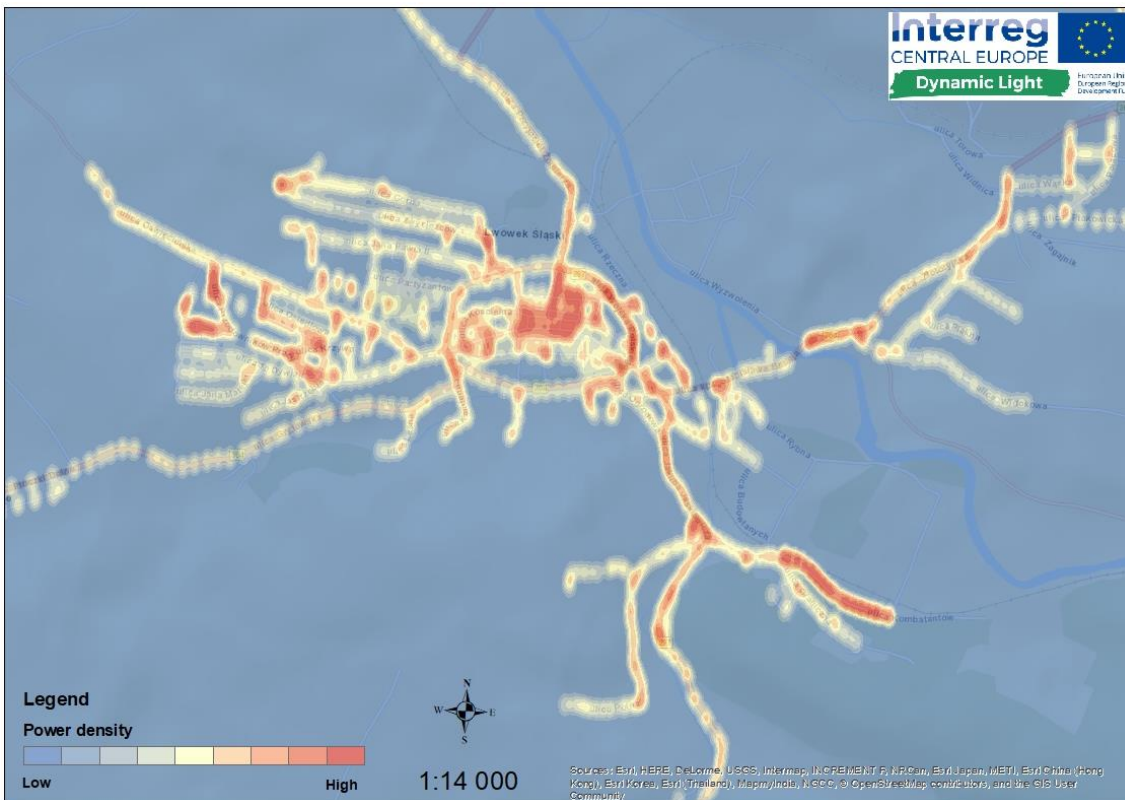
Figure 6 Hot spots map

Figure 7 Streetlight pollution patterns (HeatMap)

3. Future use of the GIS database

The Municipality of Lwówek Śląski did not have any GIS database on street lighting as well as was not familiar with any GIS solutions. The gathered information served to elaborate successive deliverables such as: D.T2.2.1 Analysis of lighting situations and will be used to create Strategies and action plans in WPT2 (O.T2.2 Strategies with action plans for city lighting & reduction of light pollution including dynamic lighting). The GIS database should help to control the luminaires and monitor the energy consumption.

4. Expected impact and benefits of the tool for the concerned territories and target groups

Elaborated GIS database will provide spatial information on each luminaires and switchboards located within the Lwówek Sląski administrative area. Owner of public lighting (Municipality of Lwówek Sląski) and Tauron (National Elektricity Company) where contacted in order to collect all relevant data about public lighting, which was base for quality GIS database. The owner of public lighting has additionally provided information and data of new luminaires which were installed in meantime (support from external company ECOENERGY). Expected impact and benefits of the crated GIS database will cause decrease of the energy consumption by luminaires, will help monitor the impact of the investments on street lighting system as well as support the planning process of the retrofits.

5. Sustainability of the tool and its transferability to other territories and stakeholders

Nowadays the GIS solutions are becoming ubiquitous in our society and GIS technology is also used as a method to ensure the sustainability and to show how easy is to use it technology in different countries. The elaborated tool within the Dynamic Light project will serve as transferable models of how the planning of lighting should be implemented. Anyone who deals with urban planning, electric networks and services will need different information, yet all those groups may be drawing on the same data sets. With GIS better special planning is possible.

6. Lessons learned from the development/implementation process of the tool and added value of transnational cooperation

The international cooperation within the project has shown much diversity in the street lighting planning process between the Central Europe countries as well as enables to take advantage of complementarities and to benefit from similarities. The further exchange will help to improve the GIS database, to classify which data extension is important and necessary.