MANUAL
## *Adding Lublin Ortophotomap 1944 XYZ tile layer to QGIS*

1. Download, install and open a new project in QGIS 3.16 or newer. The latest version of the programme can be found at https://qgis.org

2. Add some Lublin City reference data, e.g. administrative boundaries.[1] One can be found at https://ortolub.umcs.pl/data/Lublin_2020.zip - download and unzip the Lublin_2020.geojson file. Add it to the project:
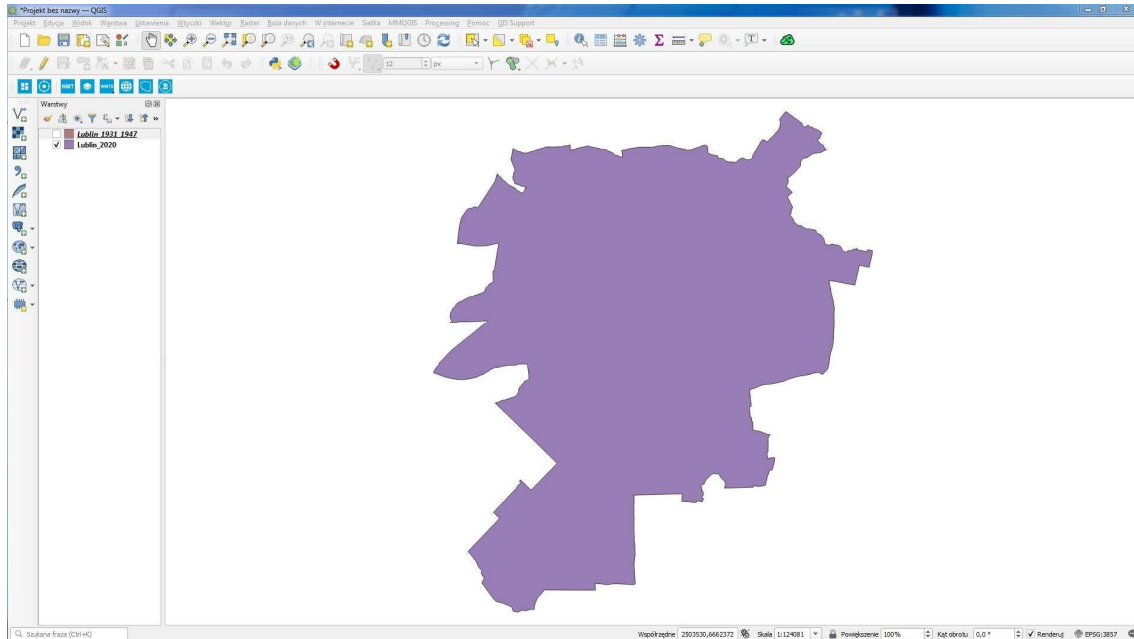

3. In the next step use the following panels: *Layers → Add Layer→ Add XYZ Layer...*
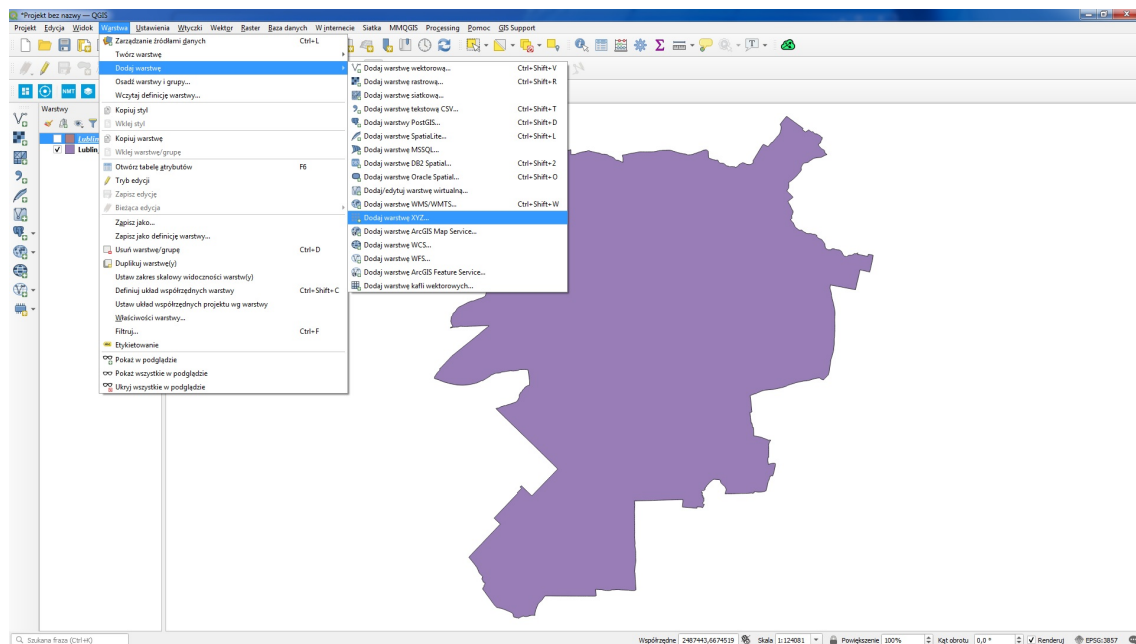
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4. In the *XYZ Connection* settings choose → **New**, then paste the following URL address ***https://ortolub.umcs.pl/data/tiles_3857/{z}/{x}/{y}.png*** and name the layer (e.g. Ortolub 1944) - optionally you can define the zoom levels (0-18) and the tile resolution (256x256 / 96 DPI). Approve the settings by clicking → *OK* and then → **Add** the XYZ layer to your project.
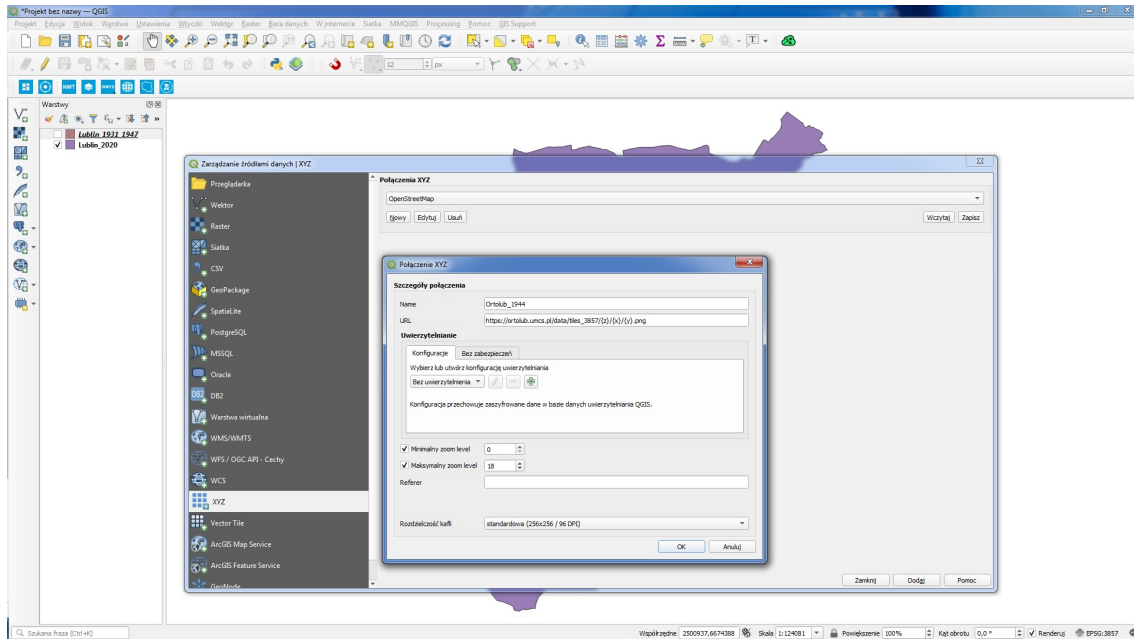

5. *Lublin Ortophotomap 1944* service should load the tiles regardless of other settings. To improve the appearance of the project it is worth changing:

   a. order and style of existing layers - rightclick the name of the layer in layer panel → *Properties* → *Style* → choose symbol, e.g. *outline red* or other you'd like;

   b. cartographic projection to e.g. **EPSG: 3857** (web-mercator) or **2180** (polish transverse mercator) - there are many tutorials and videos on changing projections and their properties in the Net.
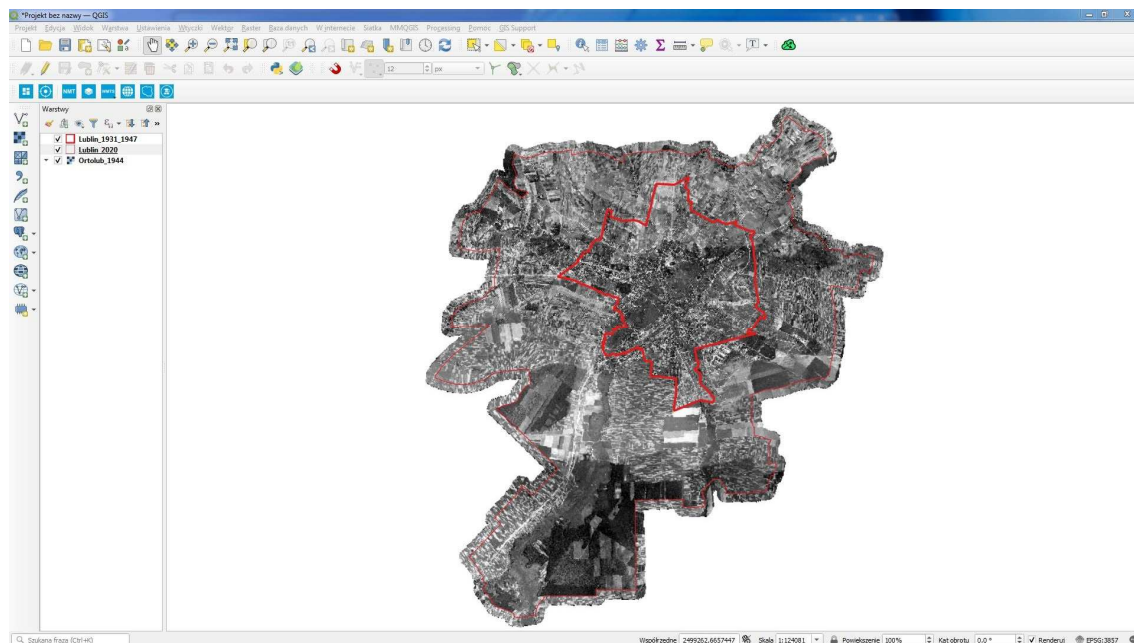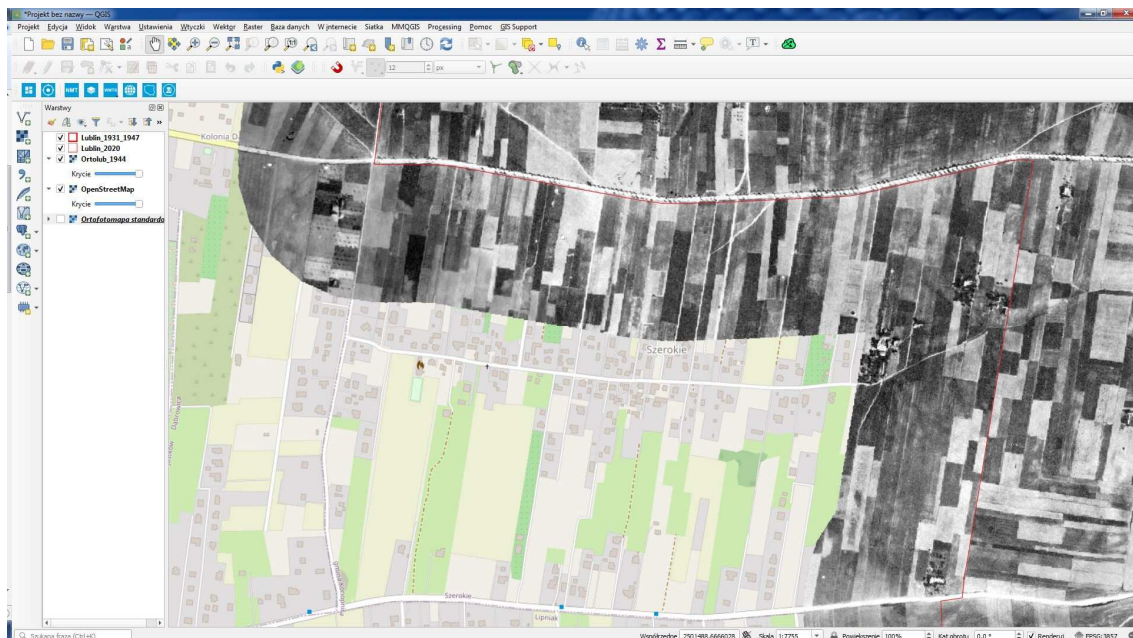

6. *Lublin Ortophotomap 1944* is ready.

7. To compare the historical situation with the current state, you can add an OpenStreetMap basemap. This is also the XYZ service, therefore the process is the same as in step 4. The OSM tile address is ***https://tile.openstreetmap.org/{z}/{x}/{y}.png***
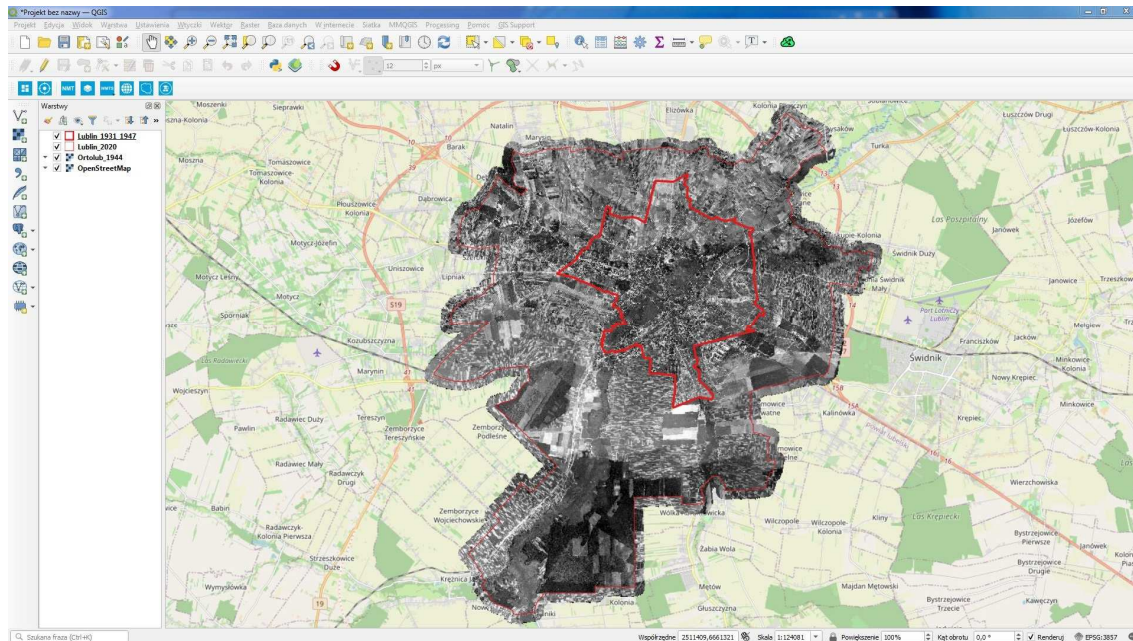

8. With a good internet connection the XYZ layers load smoothly. When zooming in, there is an impression of slight shifting of the content, so called "waving" of tiles, which is caused by averaging of pixel values in the image. After zooming and loading tiles of the proper level, the *Lublin Ortophotomap 1944* presents very high compatibility with contemporary spatial data.


9. Due to the nature of source data (age and scale of archival aerial photographs and quality of scanning) *Lublin Ortophotomap 1944* is inferior in quality to modern aerial orthophotomaps made available by the Main Office of Geodesy and Cartography (GUGiK). You can read about adding the GUGiK Ortophotomap as a WMTS service here (polish only!): http://geoinformatyka.com.pl/podlaczanie-uslug-wmts-z-geoportalu-2-do-qgis-2-0-1/

10. Depending on the number of ground control points (GCPs) used for calibration of individual photographs, the accuracy of point elements varies from about 0.1 m to values slightly exceeding

1 m. The base pixel size of the mosaic of the aerial photographs taken is 0.42 x 0.42m, the mosaic file has dimensions of 38397 x 44310 px and occupies respectively: 828 MB - geoTIFF file in 8-bit greyscale and LZW compression; 3160 MB - geoTIFF file with alpha channel, masking residual fragments of the photos located outside the present administrative area of Lublin.
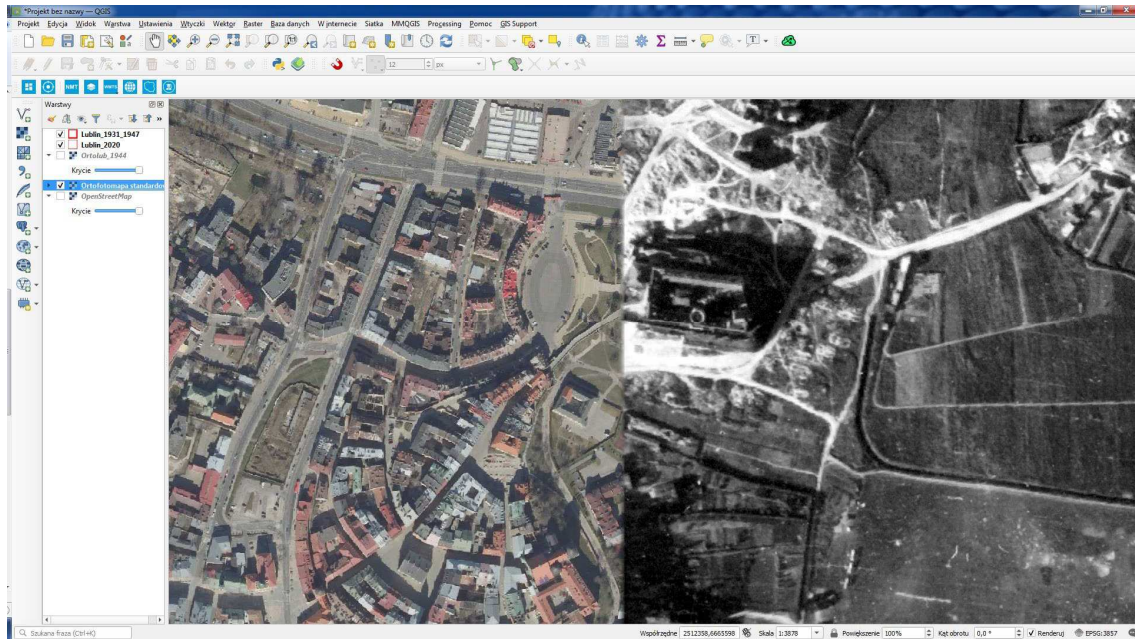

11. The list of images used to develop the Ortophotomap is available as a table at https://ortolub.umcs.pl/tab_en.html and as an interactive map index at https://ortolub.umcs.pl/map_en.html. You may also download it as a geojson file from https://ortolub.umcs.pl/data/Ortolub_1944_geojson_3.zip. The historical city boundary from the first half of the 20th century can be found in the same location in file Lublin_1931_1947.zip.
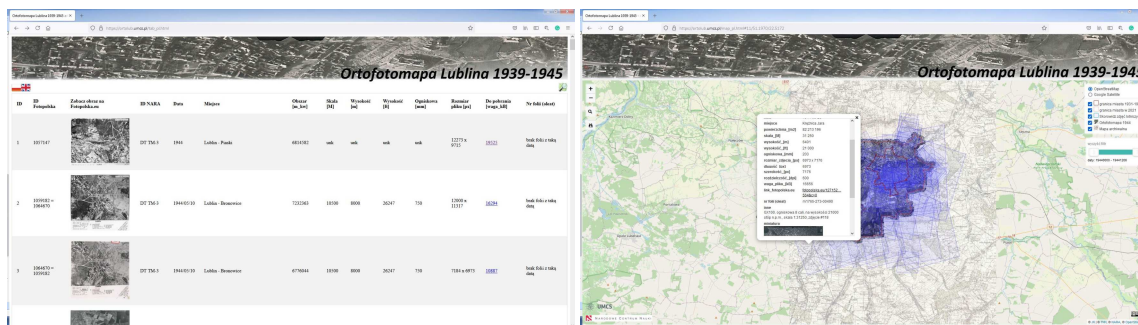
12. **Short version (for lazy people).**

Download the file https://ortolub.umcs.pl/data/Ortolub_1944_QGIS.zip, extract all files into one folder and open the file *Ortolub_1944_QGIS_3_16.qgz*. Once the project is open, refresh the existing basemap or add a new basemap. Use historical Ortophotomap and index of aerial photographs of Lublin in QGIS desktop application:
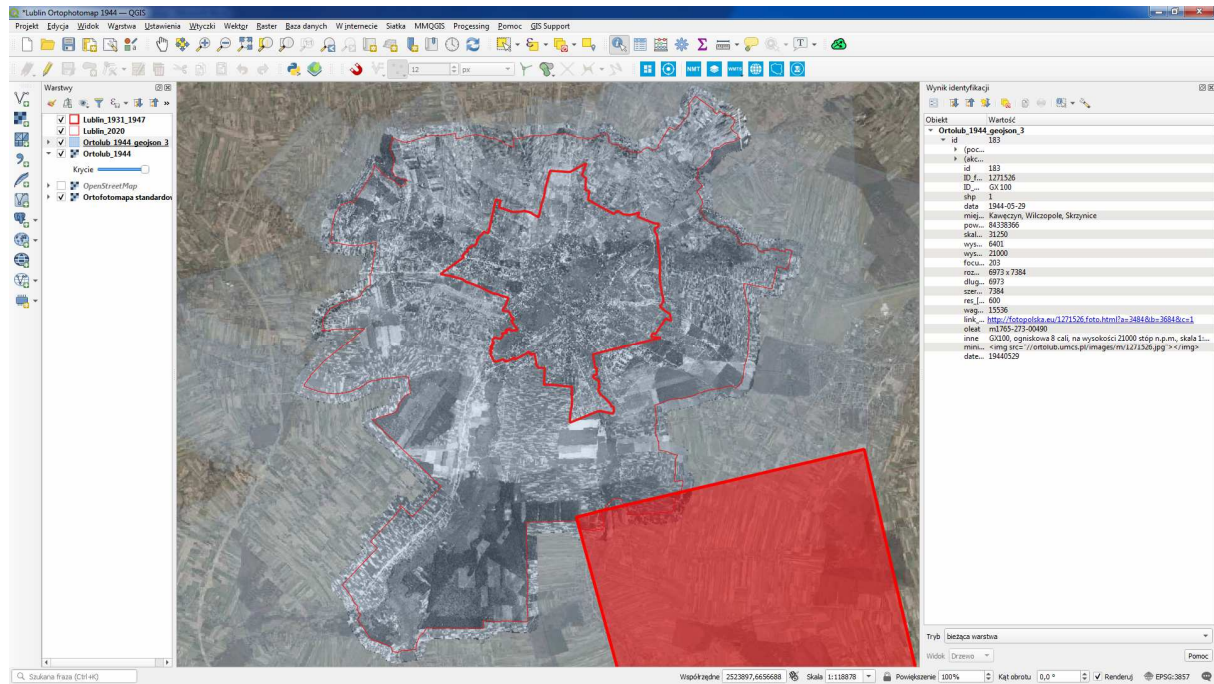
13. The project was carried out under the Polish National Science Centre (*pol. Narodowe Centrum Nauki*, NCN). grant programme Miniatura 4.0. '*Development of the Ortophotomap of Lublin 1939–1945*' (ref. no. 2020/04/X/HS4/00382).

14. The results of my work are made available under a Creative Commons **CC BY-SA 4.0 license** (attribution - under the same conditions).

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16. Good luck!