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Extended Abstracts

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title: **The best location for a public supply well – an analysis
using a GIS**

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INTRODUCTION

In order to determine a site within the regional aquifer for a location of a new water supply well, the detailed study of severe pumping and recharge conditions has to be performed. The geological and hydrogeological parameters, such as: the depth, thickness, permeability and conductivity of the aquifer; as well as the economic factors, such as: the distance from the water supply network, electric lines, roads; and the environmental features, such as: protected areas or sources of water pollution, have to be taken into account. To maintain such an amount of spatial and descriptive data, the computer procedure basing on the geographical information system (GIS) is the best approach. The results of the study searching for the best location of the public water supply for Jaworzno town are presented in this paper.

Jaworzno (population 97 000; area 152 square km) is located in the southern Poland, near Katowice. The distinctive for this town is that 32 % of its area is covered by forests and 50% are the rural areas, but 10% are dense urban and 5% industrial areas.

Three major aquifers identified beneath Jaworzno are: the Quaternary sands and gravels which fill the Przemsza river valley, the Triassic karstic-fissured dolomites and limestones, and the Carboniferous sandstones. The long-term mining of coal, zinc and lead ores and sand, along with the other industries connected with mining, caused many changes in the natural environment in Jaworzno, among them the development of the extensive cones of depression and groundwater pollution. Whilst the Carboniferous aquifer is influenced by a coal mine drainage and the Quaternary aquifer is shallow and vulnerable to water pollution, the main source of drinking water is the Triassic aquifer. The resources of three wells (Dobra, Galmany and Bielan) abstracting water from the Triassic aquifer are not sufficient for the water supply of the town and the Jaworzno Waterworks must purchase water for the public supply. For this reason they decided to enquire a study searching for a new source of drinking water.



Figure 1. A map of Jaworzno town.

METHODS

The study was conducted in the Upper Silesian Branch of the Polish Geological Institute. It was divided into 5 steps:

- 1 - the analysis groundwater resources basing on the published and archival materials,

- 2 - the field investigations (measurements of depth of water table and water sampling for the chemical and bacteriological analyses),
- 3 - the verification and the updating of geological and hydrogeological data,
- 4 - the construction of a GIS (using Geomedia software), which consists of 26 data layers,
- 5 - the series of a computer analyses. The following factors were analysed: land surface, climate, surface waters, the land use, sources of groundwater pollution, geology, hydrogeology (recharge, discharge, water level, wells), the water-supply network, quality of groundwaters, aquifer vulnerability as well as the mining of coal, zinc and lead ores and sand, industrial and urban activities.

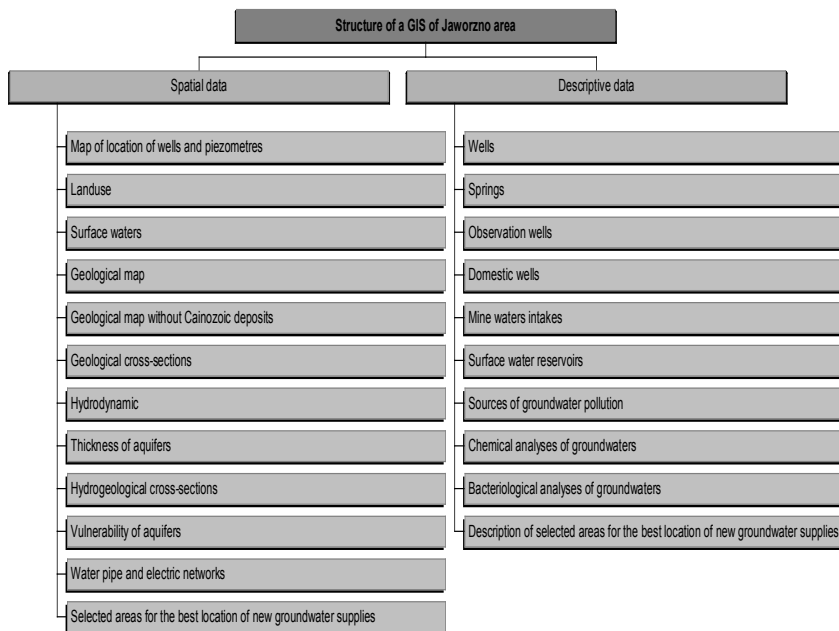


Figure 2. A structure of a GIS of Jaworzno area designed for this study.

The series of the topological operations such as: overlying, buffering and extraction of these data layers were performed. The figure 1 presents the structure of a GIS with the descriptive data and spatial features.

Initially, all the collected data were entered into this system, and 26 data layers have been created. The data layer which was analyzed firstly was the "land use". The first topological operation was the extraction of the forests, dense urban and industrial areas. Then the surface water reservoirs, as well as wetlands were extracted (Fig. 3). Following that the resulting map was overlain by the map of the Triassic aquifer in order to leave only the areas with the Triassic aquifer of the thickness more than 40 m (Fig. 4). Then the intersection operation removed the areas under groundwater drainage including mine drainage (Fig 5). The operation of negative buffering around the roads and rivers removed areas located too close to them. The operation of positive buffering around water supply network and electric line network left the areas located close enough to this network due to the economical reason (Fig. 6).



Figure 3. Areas in the town (blue) after the extraction of forests, urban and industrial areas and surface water reservoirs.

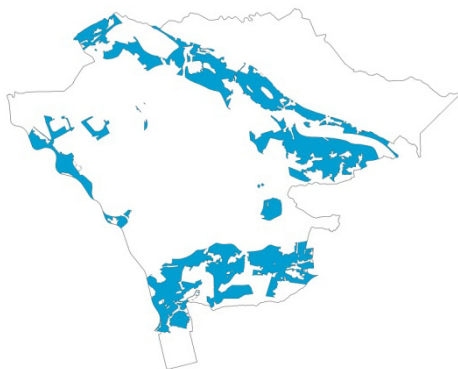


Figure 4. Areas in the town (blue) after the intersection of the areas in the figure 3 with the Triassic aquifer of a thickness more than 40 m.



Figure 5. Areas in the town (blue) after the extraction from the areas in the figure 4 of the areas of groundwater drainage by mining and the operating wells.

RESULTS

The analysis resulted in the selection of the sites with the best hydrogeological conditions. A final map (Fig. 6) contains 8 small areas suitable for the location of public water supply wells in Jaworzno. Within each of them the location of water abstraction well may be considered with the depth of 20-80 m and the discharge of 70-120 m³/h. All determined areas are located within the Middle Triassic aquifer. Before the drilling of a public supply well, the further detailed study have to be performed in order to determine the depth and the potential groundwater resources of the Triassic aquifer within each of the selected site.

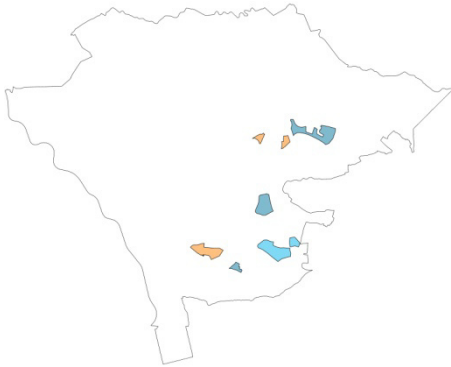


Figure 6. A final product — areas suitable for the location of public water supply wells in Jaworzno town. Orange colour depicts the best sites.

CONCLUSIONS

Although beneath the total area of Jaworzno lie the Quaternary, Triassic and Carboniferous aquifers of high water resources; due to a forestation, urban and industrial development and mine drainage, the sites suitable for the location of public water supply wells occupy only 3% of the town area.

All of these sites are located within the Middle Triassic aquifer of high resources and good water quality, which is built of the fissured-porous dolomites and limestones.

A GIS analysis is very useful for this kind of study, but it requires a high computer proficiency and a wide geological and hydrogeological experience. The results of this analysis may be furthermore used by the waterworks and the local and regional administration.

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