



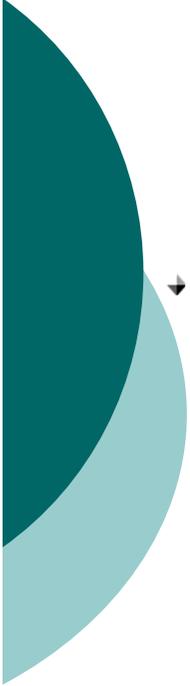
*Emergency water supply for the population from
groundwaters in the Upper Silesia (Poland)*

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Emergency situation

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- This is a potential situation, when a total lack of ability of using surface waters as well as groundwaters connected to the water supply systems appears, as a result of:
 - contamination with radioactive substances of surface waters and water supply systems, e.g. from the explosion of the nuclear power plant,
 - contamination with toxic substances of surface waters and water supply systems,
 - damage of water supply systems, e.g. as a result of the earthquake or warfare.

In such emergency situation - groundwater intakes which are not connected to any water supply systems - will be the only safe sources of water supply of the population.

Guidelines for survival water supply in emergency

Minimum requirements for survival water supply in response to emergencies have been developed by the Sphere project (WHO, 2011), a collaborative initiative of a large number of international humanitarian organisations

Standard	Survival supply in an emergency	Longer term supply after an emergency	Development supply
Water availability per beneficiary	5-7 l per person per day	15 l per person per day	20-50 l per person per day
Number of water collection points	1 point per 500-750 persons	1 point per 250 – 500 persons	1 point per 200-300 persons
Distance from water collection points	1 km	500-700 m	100-400 m
Maximum waiting time at water collection points	2 hours	20 minutes	no guideline
Conductivity	< 3000 $\mu\text{S}/\text{c}$	< 2000 $\mu\text{S}/\text{cm}$	< 1400 $\mu\text{S}/\text{cm}$



Emergency water supply for the population from groundwaters

- Polish Hydrogeological Survey, during 2004-2009 years, performed a strategic task: "Determination of sources of emergency water supply for the population from groundwaters, in conditions of extreme events, in cities supplied mainly by surface waters".
- This study was conducted for 42 biggest cities in Poland, including 18 cities in the Silesian province.
- The study was based on analysis of existing hydrogeological maps and projects.
- As a result of this project, the potential areas for the location of emergency water supply wells have been selected for each city.
- Then the study was performed in order to merge all these areas for the whole Upper Silesian urban area.

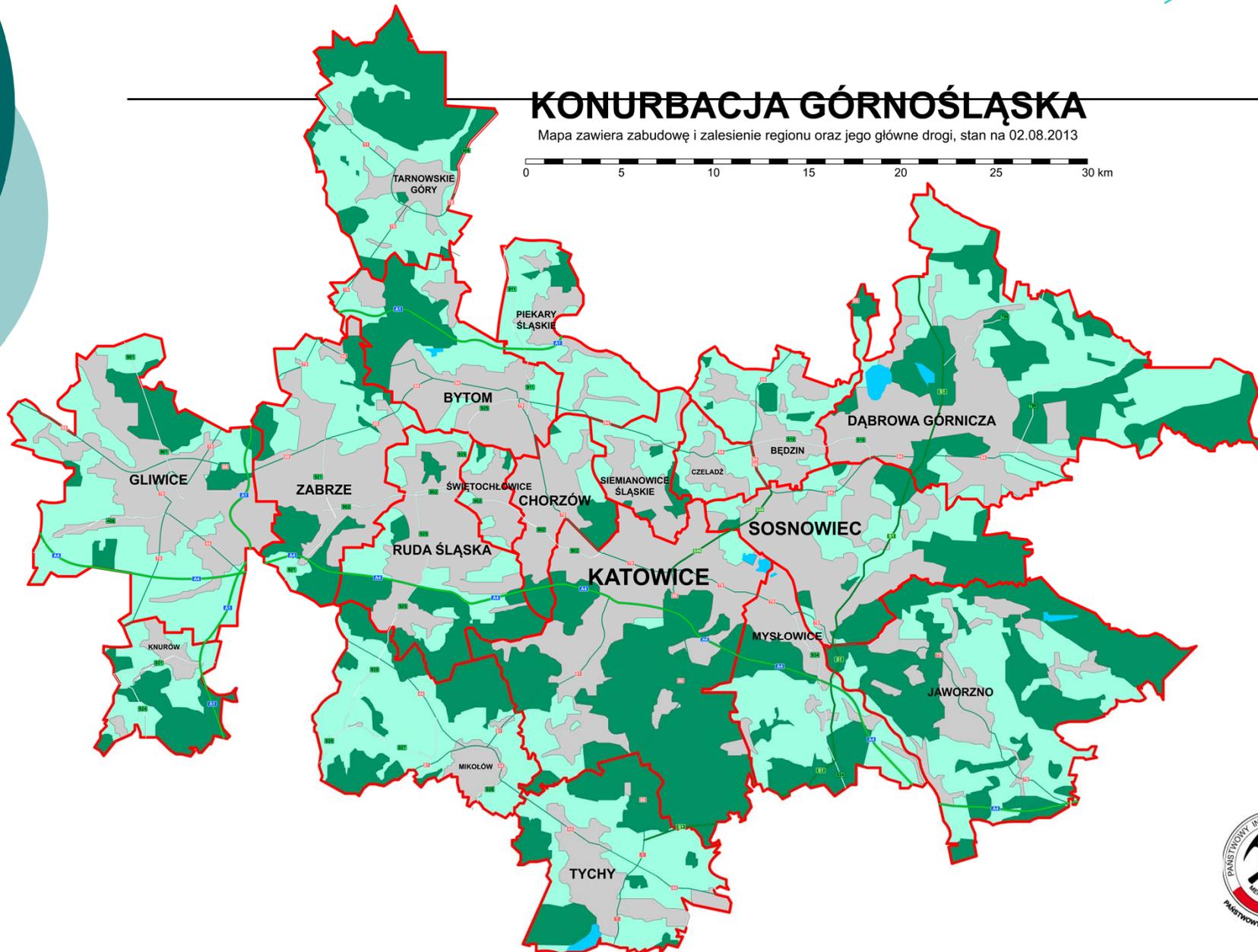
Upper Silesian urban area



KONURBACJA GÓRNOŚLĄSKA

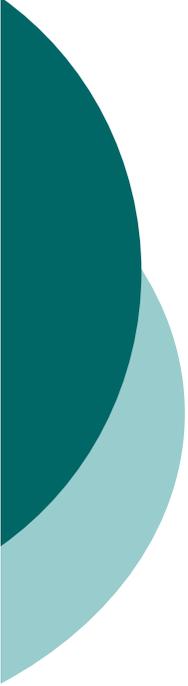
Mapa zawiera zabudowę i zalesienie regionu oraz jego główne drogi, stan na 02.08.2013

0 5 10 15 20 25 30 km



Upper Silesian urban area

- ↘ This is the largest urban area in Poland and one of the largests in Europe,
 - ↘ its population is **2.2 mln**, and an area is **1500 km²**.
 - ↘ it doesn't represent one municipal organism from an administrative point of view, but consists of 19 cities,
 - ↘ the biggest cities are: Katowice, Gliwice, Sosnowiec, Bytom, Chorzów, Dąbrowa Górnicza, Jaworzno, Mysłowice, Ruda Śląska, Tychy and Zabrze.
- ↘ Although the majority of cities in Poland has action plans in a case of an emergency and has emergency wells, the situation in the Upper Silesian urban area is very difficult:
 - ↘ this area is supplied mostly from surface water intakes, by one contributor (Upper Silesian Waterworks) who has emergency wells, but their productivity wouldn't be sufficient for the entire agglomeration in emergency...



Methods

- The GIS project was created using Geomedia software, and the computer analysis was carried out.
- The following data layers were analyzed:
 - land surface, surface waters, the landuse, sources of groundwater pollution, geology, hydrogeology (resources, abstraction), quality of groundwaters, aquifer vulnerability and the mining of coal.
- The series of the topological operations were performed such as: overlying, buffering and extraction of data layers.
- The analysis resulted in the selection of the areas with the best conditions for the location of emergency well.
- A final map contains potential areas suitable for the location of emergency water supply wells:
 - within each of them, the location of one or more wells may be considered (discharge: 10 - 120 m³/h).

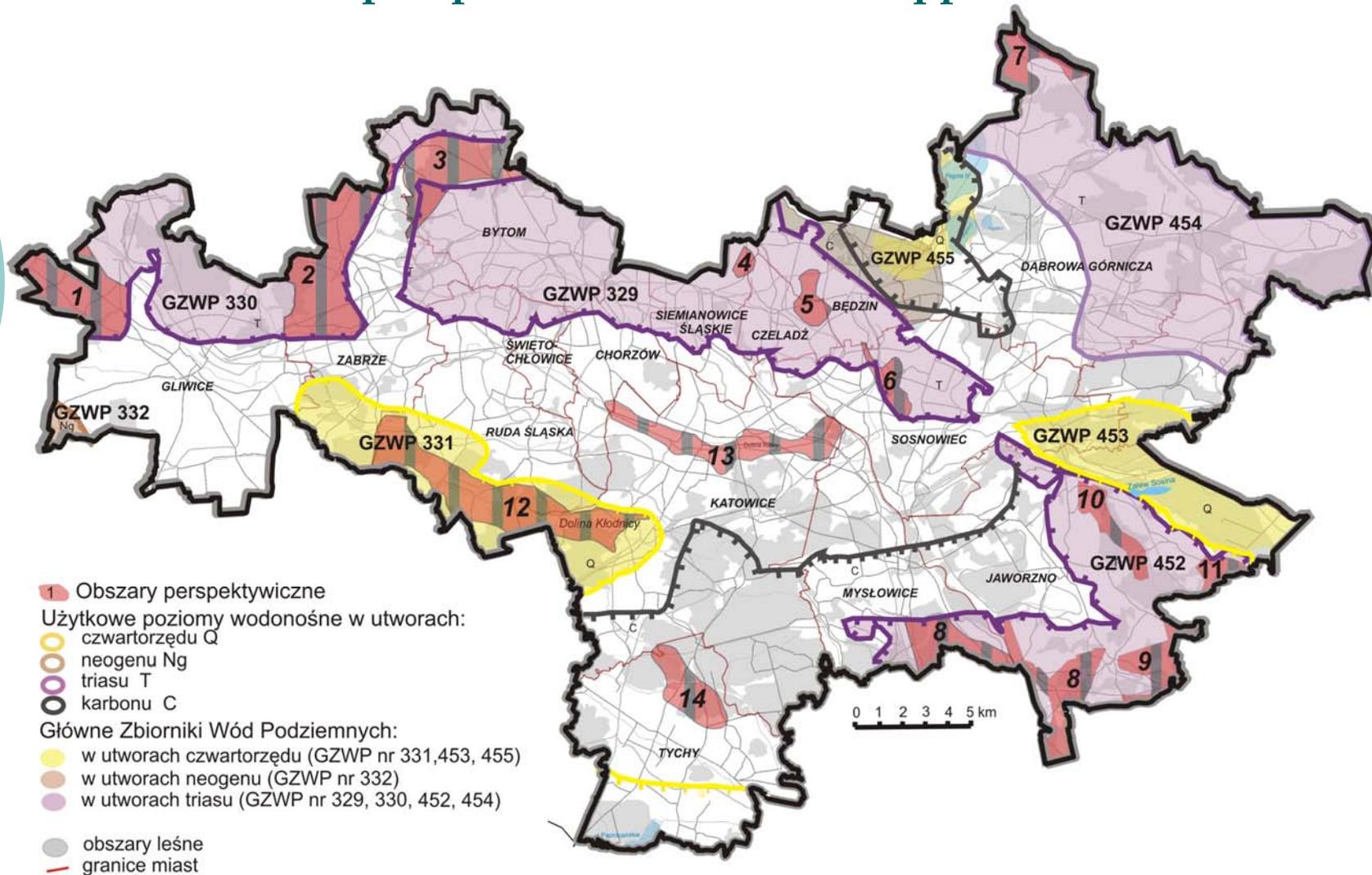
Potential areas for water supply in emergency situations

- As a result of this study, **14 potential areas**, with possibility to locate emergency wells were outlined in the Upper Silesian area.
- The main criteria, based on which potential areas were chosen were:
 - sufficient (for the given population) productivity of the aquifer,
 - location in these parts of aquifers which are naturally protected from pollution from the surface,
 - good water quality, which allows direct consumption by the population.
- The additional criteria for wells located in these areas were:
 - independence from the water supply systems,
 - supply the population with the minimal amount of water c.a. 15 litres per day per person (*according to Sphere (2011) guidelines and decree of the Polish Minister of the Spatial Development and the Construction on principles of providing functioning of public devices of the supply of water in special conditions*).

Potential areas in the Upper Silesia

Potential area	Age	Aquifer characteristics	Number of wells	Potential discharge of well [m ³ /h]
1, 2	T _{1,2}	Karstic and fissured dolomite and limestone	4	10-50
3, 4, 5, 6			5	10-50
7			1	20-50
8, 9	T _{1,2}	Karstic and fissured dolomite and limestone	4	50-70
10, 11			2	100 - 120
12, 13	Q	Fluvial and fluvioglacial sands and gravels of Holocene and Pleistocene	5	10 - 50
14	Q	Fluvial and fluvioglacial sands and gravels of Holocene and Pleistocene	1	60-70
Total			22	620 – 1270 14 880 – 30 480 m ³ /d

Map of potential areas in the Upper Silesia



Emergency well requirements

- Large diameter - which allows placing more pumps on the same well in order to increase the aquifer abstraction,
 - Upper Silesian urban area needs c.a. **10 000 m³** of water per day for survival supply in a case of an emergency, or even **30 000 m³** per day for longer-term supply after an emergency.
- The direct area of a well will need to be fenced and possibly guarded in order to
 - avoid contamination of the groundwater,
 - keep away people and their livestock,
 - protect against theft and vandalism.
- The quality and quantity of water should be monitored, at least once a year.

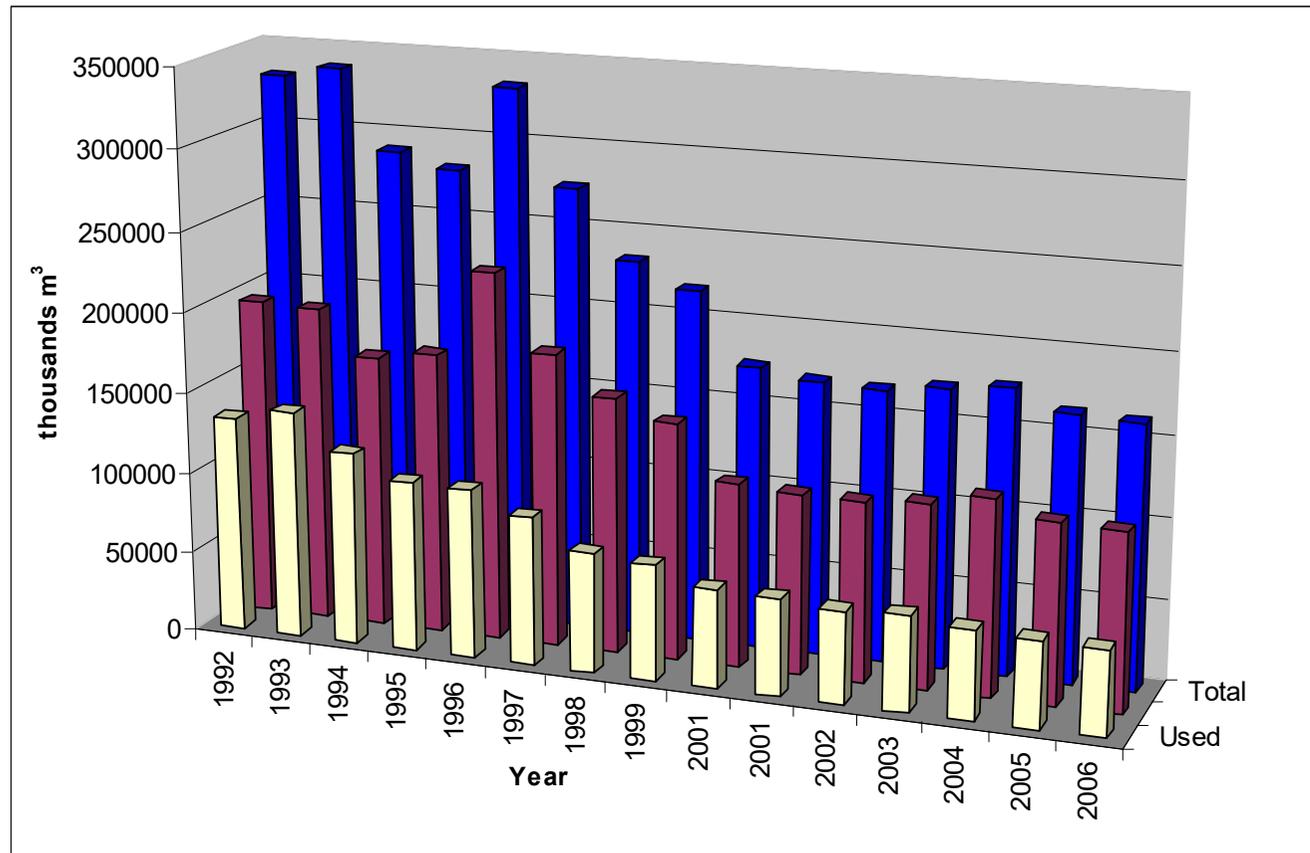


The usage of fresh mine waters in the Upper Silesia

- TDS of waters pumped from the shallow levels (to 300-400 m) of coal mines are below 1g/l, but their quality is not stable, due to penetration of mine workings or flooded old workings as well as due to mixing with old waters from deeper levels.
- Mine waters are used by mines mainly for sanitations and for the circulation in central heating, air-conditioning, etc, and also as a source of drinking water.
- Pumping of fresh mine waters in the Upper Silesia (2009):
 - total - 9 203 m³/h,
 - mine waters used - 3 553 m³/h (38%),
 - discharges to the rivers - 5 650 m³/h (62%).

Mine waters pumped from coal mines may be considered as an alternative source of water supply in emergency in the Upper Silesian urban area.

Mine waters pumped from the coal mines in the Upper Silesia



Conclusions

- For the Upper Silesian urban area a cooperation of cities would be an appropriate solution in order to search and outline a few shared potential areas providing water supply in emergency.
- This cooperation is particularly important in case of cities without any potential areas, such as Świętochłowice or Chorzów.
- Location of potential areas should ensure the convenient transfer of water to all cities.
- Potential areas in the Triassic and Quaternary aquifers are most suitable due to:
 - significant water resources,
 - beneficial location.

Conclusions

- Potential areas have limited extent as aquifers in this region are strongly affected by mine drainage and industrial activity.
- Fresh mine waters pumped from coal mines may be considered as an alternative source of water supply in emergency in the Upper Silesian urban area.
- Although described areas were indicated as the perspective for the location of emergency wells, however in some parts they can also be considered as potential sources of the public water supply.



Thank you

