Groundwater Bodies in implementation of Water Framework Directive in Slovenia

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Legal basis for delineation and determining Groundwater Bodies

SLO: Pravilnik o metodologiji za določanje vodnih teles podzemnih voda. (Ur.l.RS, št. 65/2003)
ENG: Rules on methods for determining water bodies of groundwater.

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SLO: Uredba o načrtu upravljanja voda za vodni območji Donave in Jadranskega morja. (Ur.l.RS, št. 61/2011)
ENG: Decree on Danube river basin and Adriatic sea management plan.

Slovenian territory: 20 273 km²

Groundwater body in the public water supply system: 6.105 m³/s

Groundwater body in the abstraction on geothermal energy: 0.358 m³/s

Estimated available groundwater body: 55 m³/s

Groundwater Bodies in Slovenia:

- **21 GWB**
- **165 aquifer systems**

- **Average GWB area: 965 km²**
- **Minimum GWB area: 97 km²**
- **Maximum GWB area: 3 355 km²**

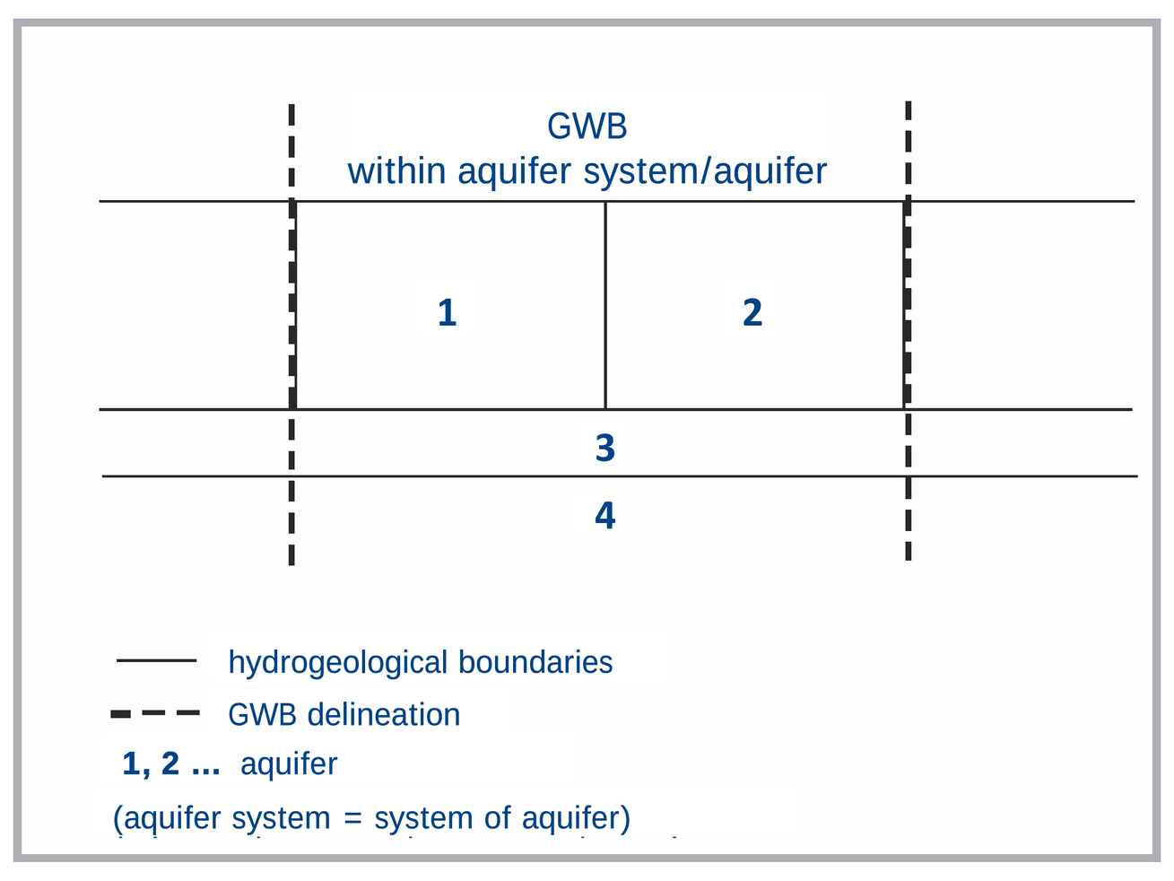
GROUNDWATER BODIES DELINEATION MODEL IN SLOVENIA (2004)

Basic GWB delineation principle:

Groundwater body has to be delineated by hydrogeological boundaries*

Hydrogeological boundaries:

1. **In homogenous geological layers:**
   - flowline,
   - groundwater divide,
   - surface stream communication with aquifer (draining, recharging);
2. **In nonhomegeneous geological layers:**
   - change of porosity, tranmisivity (alteration of lithology, sedimentation, geometry and structure,...)
   - change of hydrodinamic condition (unconfined, confined, semi-confined, semi-unconfined).



* The approximation to the exact and relevant hydrogeological boundaries is processed through the initial and further characterisation procedure by defining:

- **hydrogeological characteristics,**
- **pressures and impacts.**

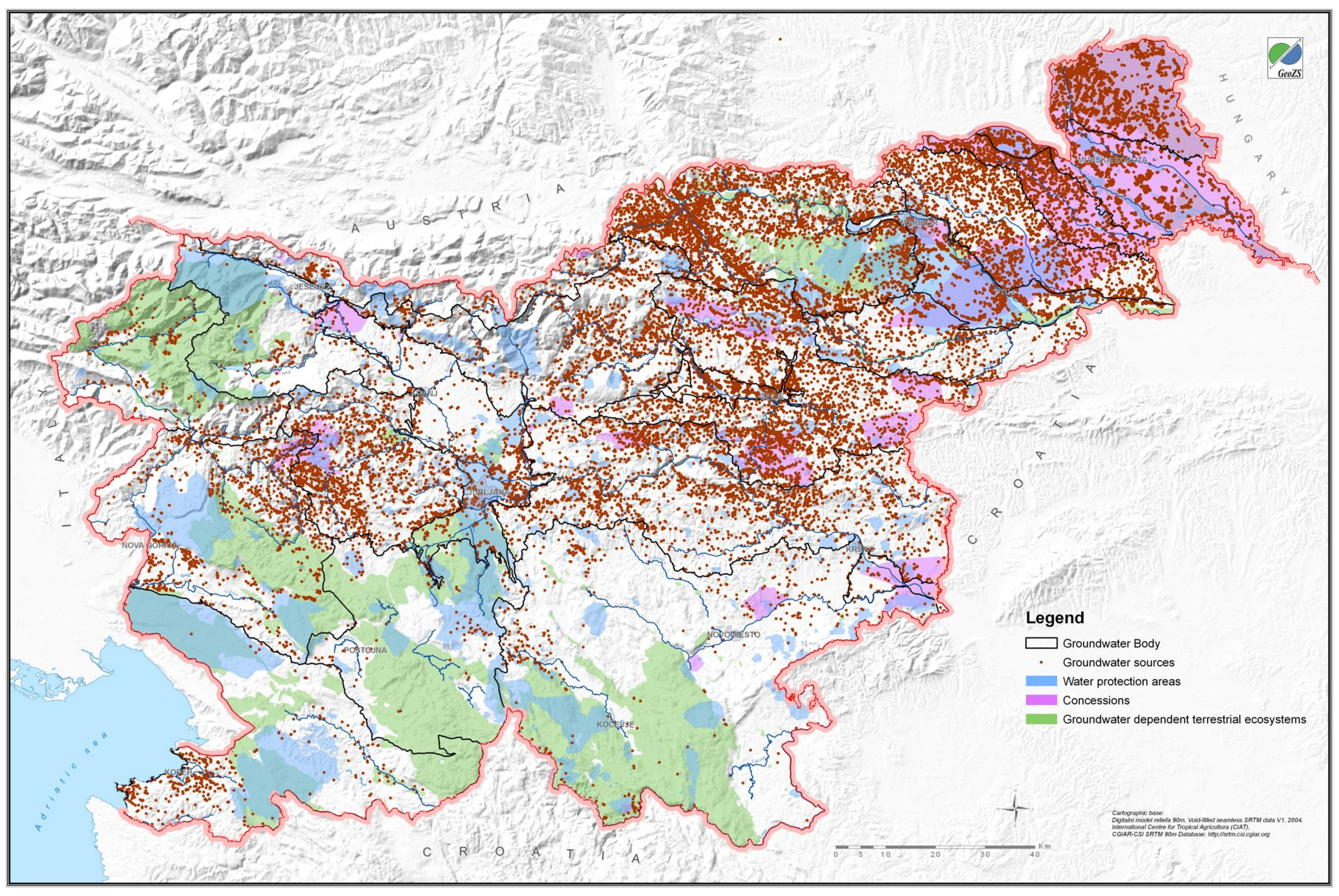
Depending on the stage of existing knowledge of the hydrogeological condition and of the pressures and impacts, the approximation could be performed mainly by:

- hydrographic basin – surface water divide,
- surface stream and affluents,
- lithology and tectonic boundaries,

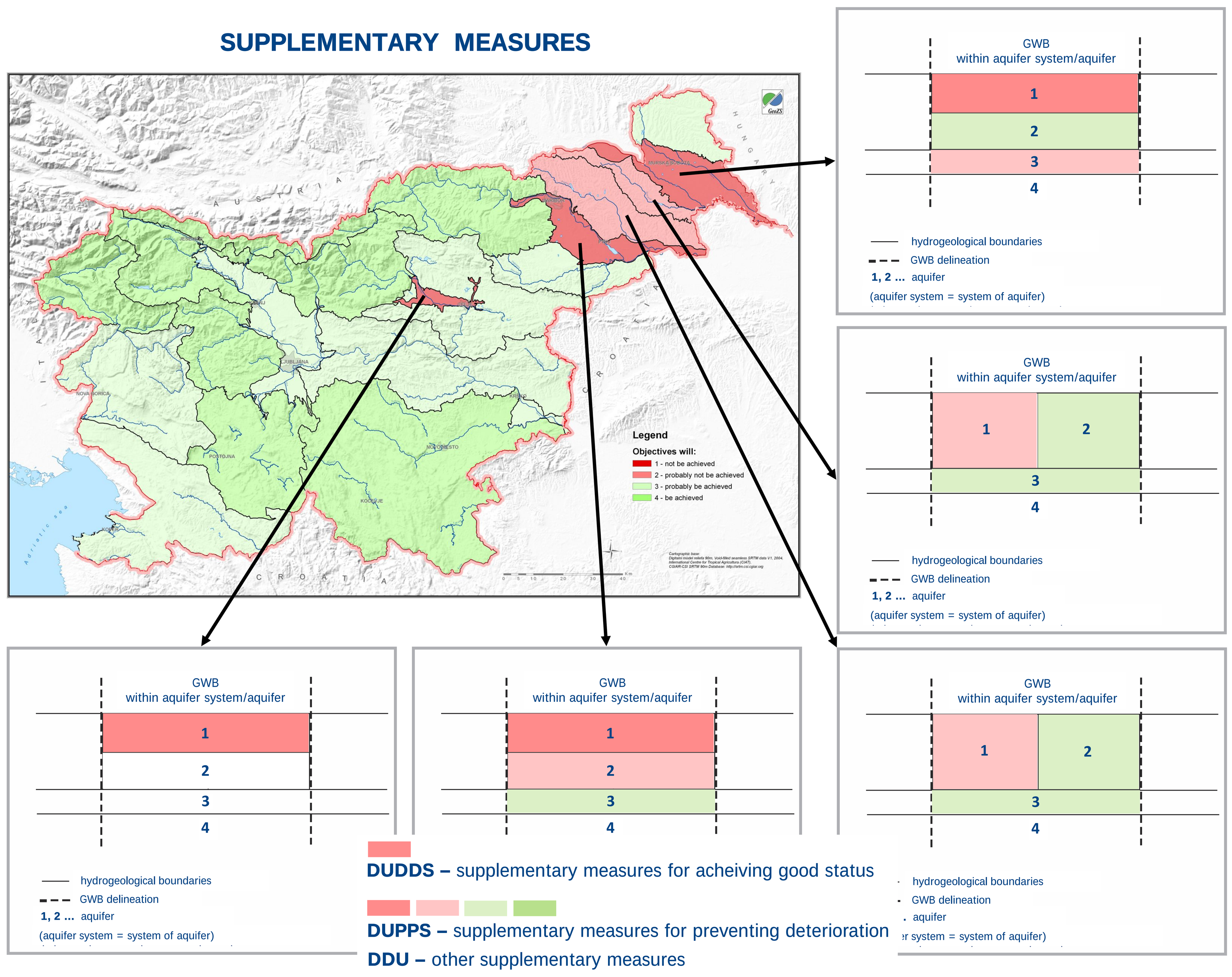
- landuse,
- areas of important potential of exploitable natural resources,
- important ecosystem areas.

RISK OF MEETING THE ENVIRONMENTAL OBJECTIVES TO 2015 AND MEASURES

BASIC MEASURES



SUPPLEMENTARY MEASURES



DUDDS – supplementary measures for acheiving good status

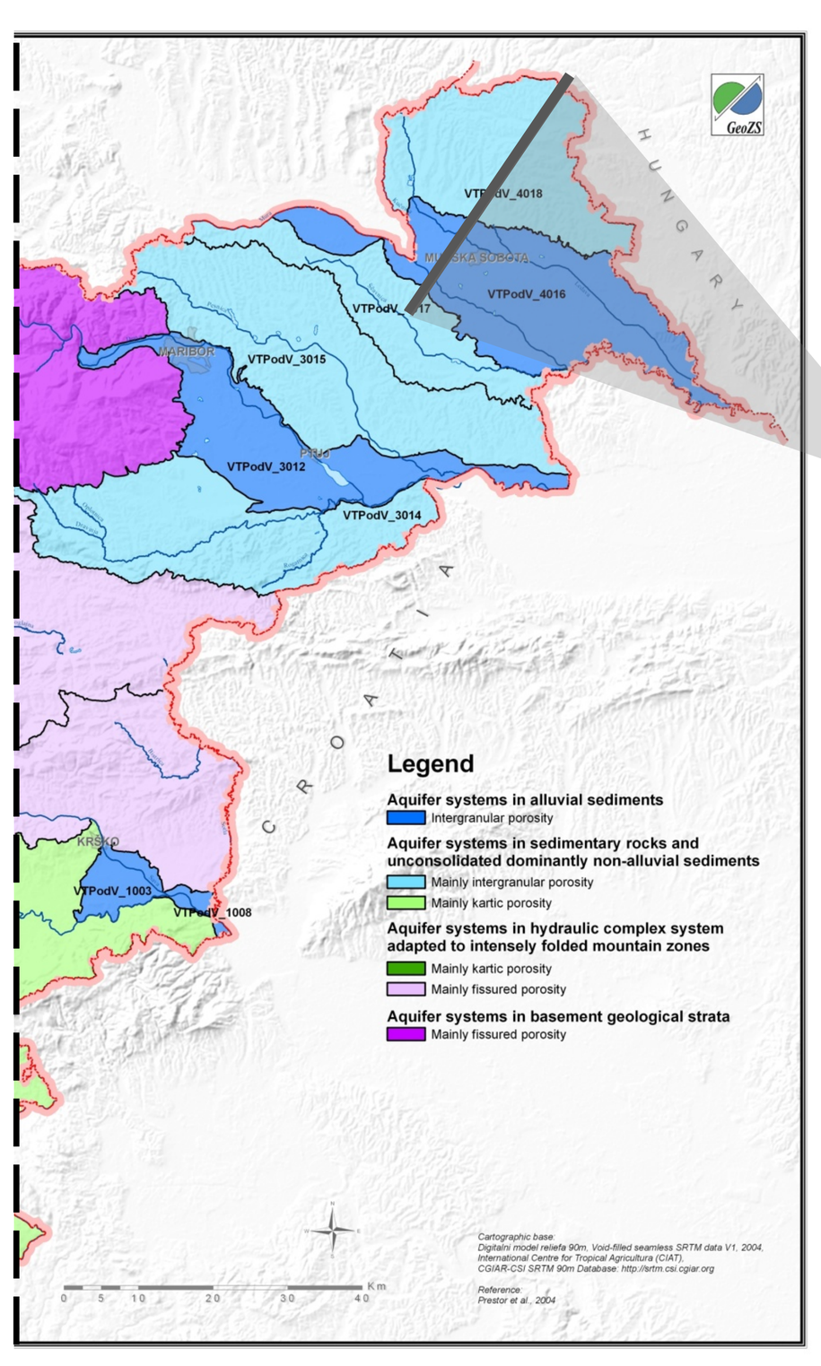
DUPPS – supplementary measures for preventing deterioration

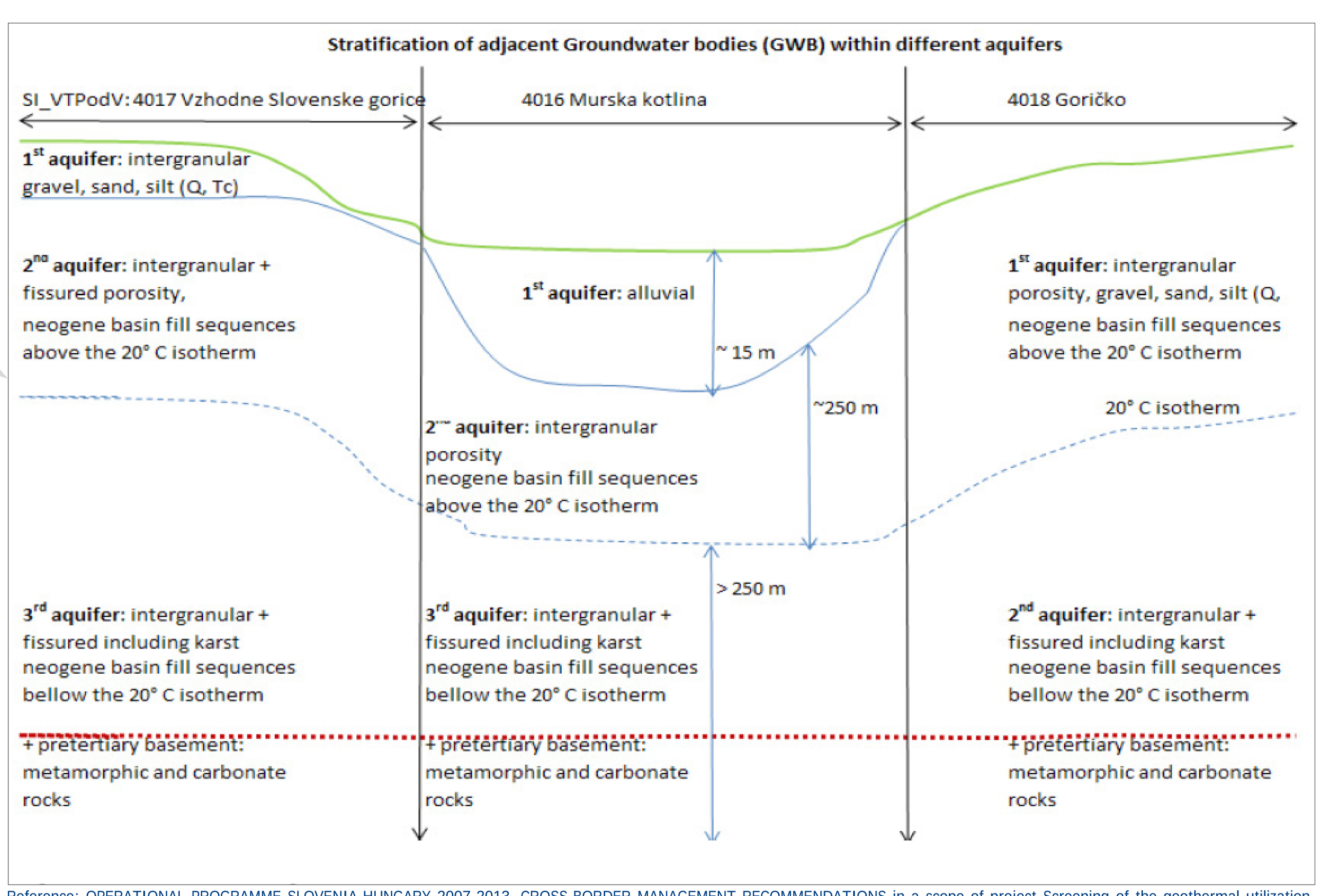
DDU – other supplementary measures

PS – climate change addaptational measures

PROPOSED COMMON DELINEATION OF ADDITIONAL TRANSBOUNDARY GROUNDWATER BODY

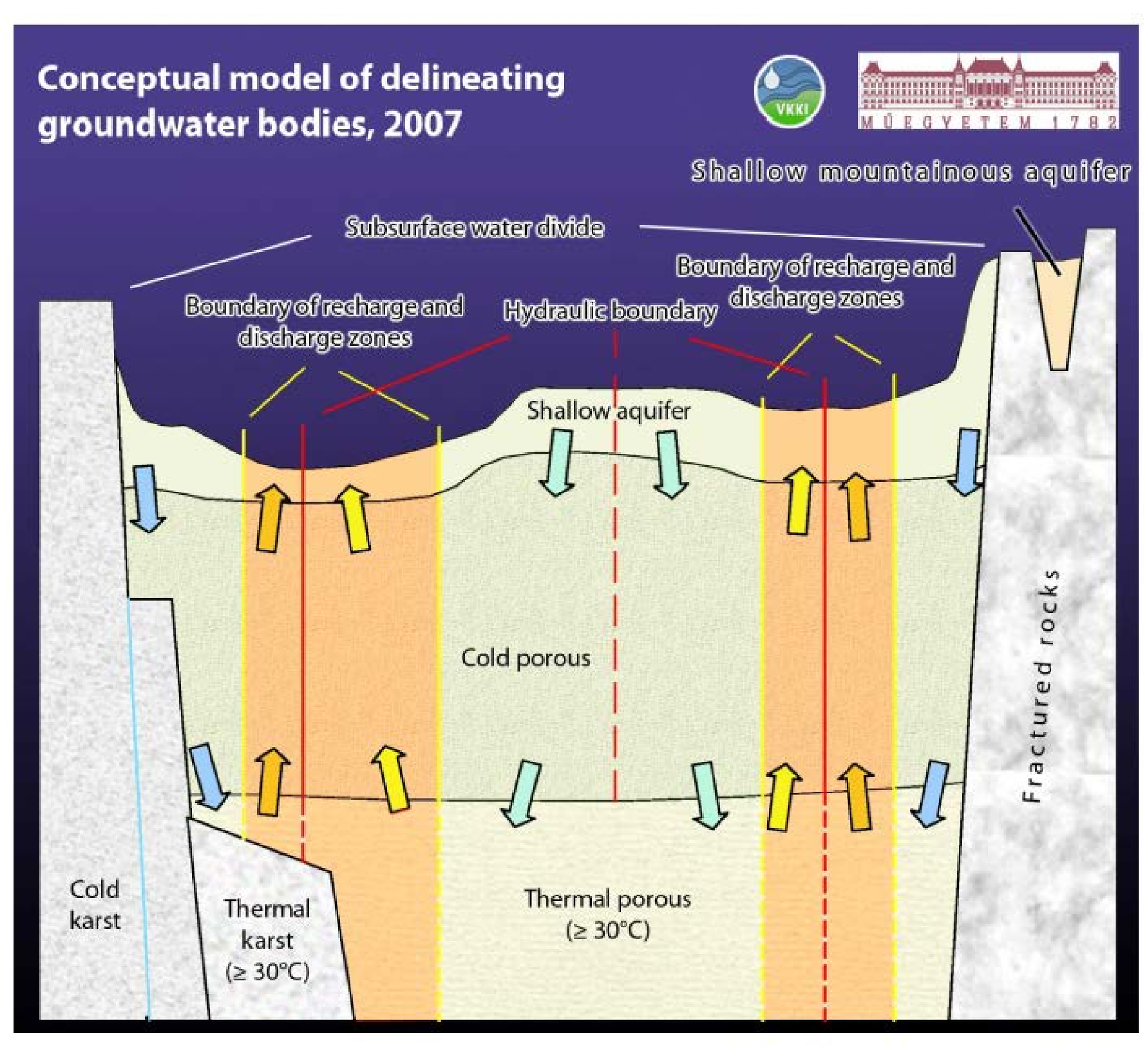
SLOVENIAN DELINEATION MODEL

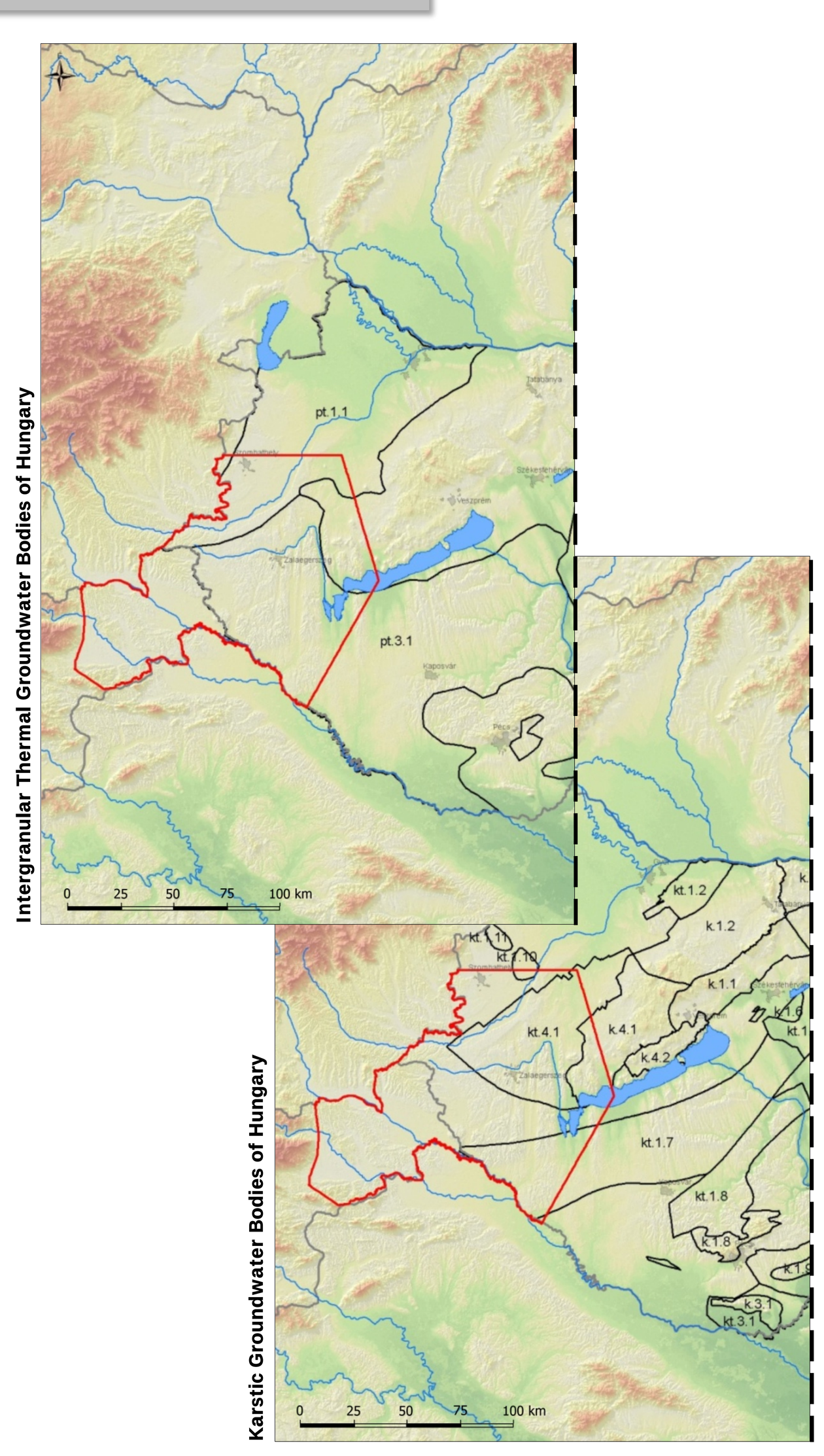




Reference: OPERATIONAL PROGRAMME SLOVENIA-HUNGARY 2007-2013. CROSS-BORDER MANAGEMENT RECOMMENDATIONS in a scope of project Screening of the geothermal utilization, evaluation of the thermal groundwater bodies and preparation of the joint aquifer management plan in the Mura-Zala basin, T-JAM (GeoZS & MAFI, 2011).

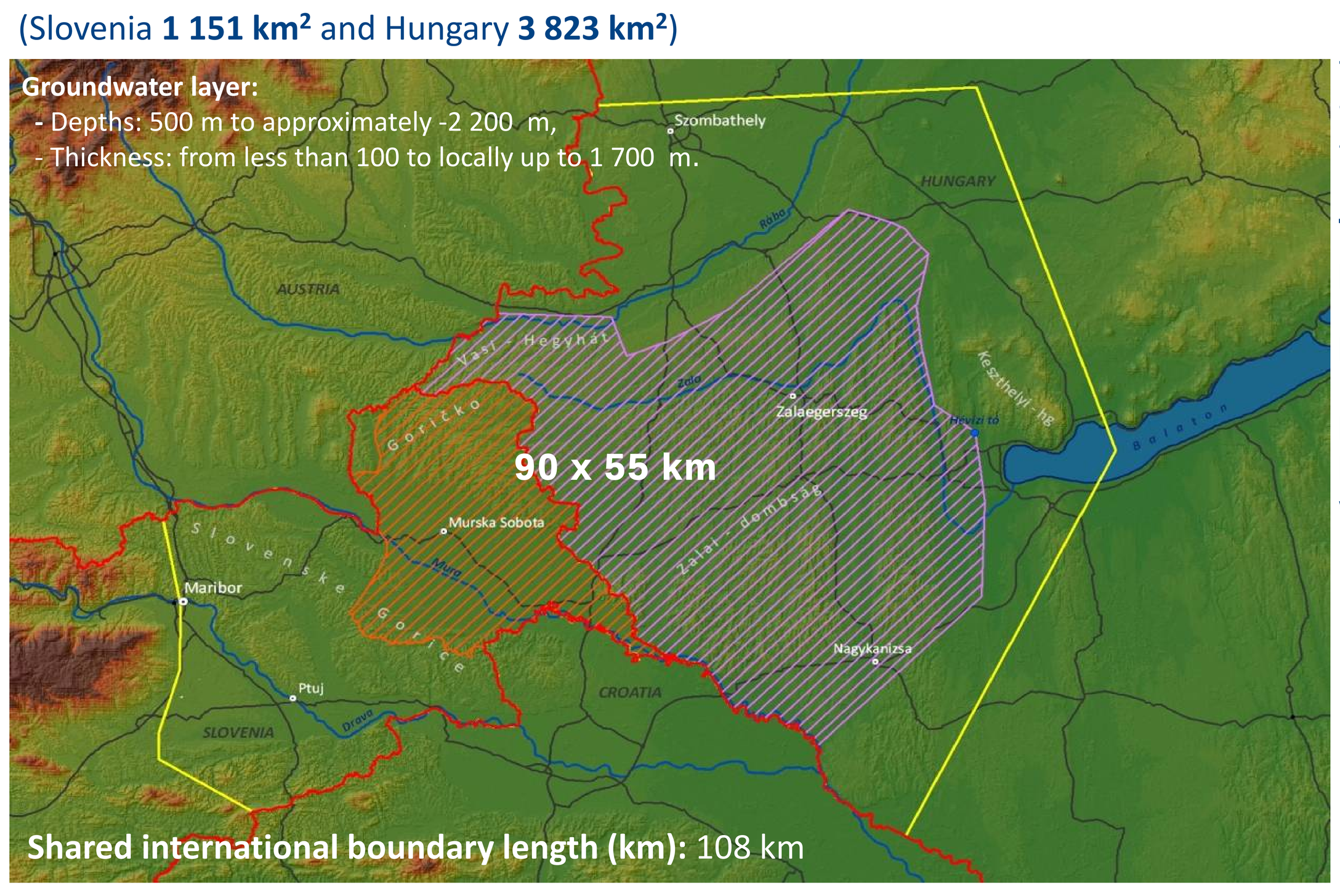
HUNGARYAN DELINEATION MODEL





COMMON DELINEATION MODEL OF TRANSBOUNDARY THERMAL GROUNDWATER BODY (TTGWB) MURA-ZALA

Area : 4 974 km²
(Slovenia **1 151 km²** and Hungary **3 823 km²**)



TTGWB Mura-Zala is not hydodinamicaly confined except at the bottom. It is opened to the neighbouring cold and thermal intergranular groundwater bodies. Open boundaries also occur across the state borders (HU-SI, HU-CR, SI-CR, HU-AT). The proposed transboundary groundwater body is recharged from the hydrodynamically connected cold and thermal, neighbouring intergranular, fissured and karst aquifers.

Top of the thermal groundwater layer is 500 m depth, and somewhere the 30 C isotherm. This isobath and isotherm are not bound to a hydraulic boundary. Overlying delta plain and alluvial plain aquifer system mainly contains lukewarm (20-30 C) waters. At present these units are not used extensively.

Bottom of thermal aquifer is the clayey aquitard-aquiclude complex of the Upper Miocene Lendava and Algyö Formations. The deepest bottom of the aquifer is about 2 200 m bellow surface.

Lateral hydraulic boundaries: The delta front sediments are outcropping in the Slovenian part, delineating the model borders. In the Hungarian part, just a few kilometres west from Lake - Hévíz, the delta front is connected to the underlying Lower Pannonian and Sarmatian sand and gravels, thus form a good hydraulic connection to the thermal karst system in the basement. The waters from the Újfalu formation supply water to the thermal karst, and they are mixing before they would reach the Lake-Hévíz area.

PROPOSED COMMON SUPPLEMENTARY MEASURES

Water rights for new or additional abstractions in Mura-Zala basin could be granted depending on the trend of water level taking into account the critical level point and critical point of abstraction.
Water right for individual well should define:
- depth of the water intake,
- production section entirely or partly situated in TTGWB Mura Zala,
- activation of new aquifer layers in the existing well.
Increased thermal efficiency on both sides.
Information has to be regularly exchanged between both sides (defined monitoring data, intended abstraction increment and intended drilling activities
Common monitoring network: 17 observation wells (5 observation wells in Slovenia + 12 in Hungary).

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Geological Survey of Slovenia