



## PROTECTION OF GROUNDWATER INTENDED FOR HUMAN CONSUMPTION IN THE WATER FRAMEWORK DIRECTIVE: STRATEGIES AND REGULATIONS APPLIED IN SOME EUROPEAN COUNTRIES

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**Abstract.** Present analysis of treatment of groundwater protection areas in different European countries, existence of specific regulations, considered criteria for delineation and applied or recommended methodology for each case by qualified organisations has been reviewed in the frame of the Water Framework Directive transposition to each country's regulations. This analysis, made for Germany, France, the United Kingdom, Spain, Italy, Portugal, the Netherlands, Ireland and Switzerland, has revealed a huge disparity of criteria for delineation of groundwater catchment protection areas between the considered countries. The most relevant differentiating aspects of the protection areas treatment, analysed in each country, were as follows:

- existence or lack of a specific norm on the delineation of protection areas;
- number of zones into which a protection area is divided, and the possibility of their further subdivision;
- employed criteria and methods with degree of their definition in the norms;
- specific treatment of karst and fissured aquifers;
- how the source is protected: quality and/or quantity;
- use of vulnerability mapping as a basic criterion in the protection zones delineation.

**Key words:** source protection areas, regulations, groundwater quality, groundwater resources, aquifer media.

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**Abstrakt.** W artykule przedstawiono analizę ochrony wód podziemnych w różnych krajach europejskich, a także specjalne przepisy, związane z wprowadzaniem do krajowych przepisów Ramowej Dyrektywy Wodnej. Ponadto zapoznano się z kryteriami przyjmowanymi przez wyspecjalizowane organizacje do wyznaczania granic obszarów ochronnych oraz stosowaną przez nie lub rekomendowaną metodologię.

Analizą objęto Niemcy, Francję, Wielką Brytanię, Hiszpanię, Włochy, Portugalię, Holandię, Irlandię i Szwajcarię. Stwierdzono bardzo duże rozbieżności w kryteriach przyjmowanych przez różne kraje do określania zasięgu obszarów ochronnych. Do najpoważniejszych różnic w traktowaniu przez poszczególne kraje obszarów ochronnych należą:

- istnienie lub brak specjalnych kryteriów wyznaczania granic obszarów chronionych;
- liczba stref, na które podzielony jest obszar chroniony i możliwość ich dalszego dzielenia;
- zastosowane kryteria i metody badań oraz stopień ich zdefiniowania w normach;
- szczególne traktowanie krasowych i szczelinowych zbiorników wód podziemnych;
- sposób ochrony obszarów źródłowych wód podziemnych: jakość i/lub ilość wód podziemnych;
- wykorzystanie map podatności na zanieczyszczenie jako podstawowego kryterium wyznaczania stref ochronnych.

**Słowa kluczowe:** strefy ochronne, przepisy prawne, jakość wód podziemnych, zasoby wód podziemnych, zbiorniki wód podziemnych.

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## INTRODUCTION

Protection of the groundwater sources, by means of the establishing protection areas in their surroundings, is specifically considered in the Water Framework Directive (Directive..., 2000) through articles 6 and 7. It expresses the need to elaborate a register of all the areas included in each hydrographic district, declared as an object of special protection by virtue of the specific commune norm related to surface water and groundwater protection or to habitat and species that depend on water conservation.

Specifically, it establishes in article 7.3 that “*Member States shall ensure the necessary protection for the bodies of water identified with the aim of avoiding deterioration in their quality in order to reduce the level of purification treatment required in the production of drinking water. Member States may establish safeguard zones for those bodies of water*”, among which all the groundwater bodies used for delivering water intended for human consumption, with an average volume of 10 m<sup>3</sup> or which serve to supply more than 50 persons,

and all of those intended for human supply in the future, were included.

Application of the Water Framework Directive in relation to the establishment of protection areas makes it necessary to elaborate technical projects after the completion of the groundwater protected bodies registration (December 2004). They should be completed by December 2009, as they must be included into the programme of measures (article 11.3.d) becoming functional in December 2012, because there is a need to include them into each river basin management plan (annex VII.A.7).

Present analysis of the treatment of groundwater protection areas in different European countries, existence of specific regulations, considered criteria for delineation, and applied or recommended methodology in each case by qualified organisations, has been made in the framework of the transposition of this Directive to each country’s regulations (that took place in December 2003 for most of the states).

## ANALYSIS OF THE GROUNDWATER PROTECTION AREAS TREATMENT IN DIFFERENT EUROPEAN COUNTRIES

This analysis, made for Germany, France, the United Kingdom, Spain, Italy, Portugal, the Netherlands, Ireland and Switzerland, has revealed a huge disparity of criteria for delineation of groundwater catchment protection areas between the considered countries. This is reflected in different legal treatments devoted to protection areas in each country (Table 1), even though all of them included into their national legislation information on existence or not of the specific zoning in the legal norms, and existence of activities regulation for each protection zone.

The most relevant aspects of the protection areas treatment in each country are as follows:

**Germany.** Commitment to have Protected Water Areas (Umweltbundesamt, 2002), generally is applying standard W 101 from the DVGW for delineation of three zones, having the possibility of dividing the last one, that considers the aquifer type (granular porosity, karst), potentiometric level, groundwater velocity and protective cover, finally defining the size of the protection zones using travel time, catchment zone and fixed distances criteria (Fig. 1A).

**France.** Establishes that protection areas will have three zones, considering a possibility of establishing satellite zones by means of hydrogeological as well as vulnerability and pollution risk assessment research (Fig. 1B) as a function of the travel time, hydrogeological criteria and fixed distance (Lallemand-Barrès, Roux, 1999).

**United Kingdom.** Legally established the Water Protection Zones. Their establishment is a competence given by the government to the Environment Agency (Policy..., 1998) which uses an arrangement of aquifer material and type (water table, confined) for delineating zones on a basis of volumetric

equation and fixed distances. Usually three zones are delineated and special protection ones are optional (Fig. 1C).

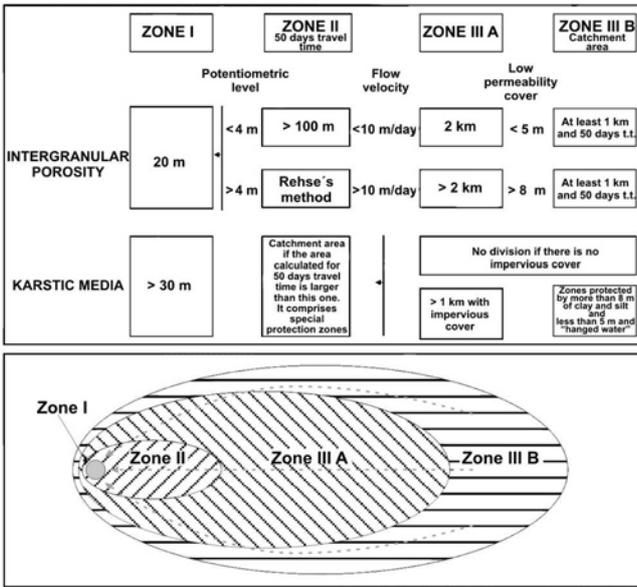
**Spain.** Legislation indicates that conditions may be imposed inside the protection area on the activities that may affect water quality (Martínez Navarrete, García García, 2003). Even though the zones are to be considered and the restrictions should be set for each research, it is usual to consider three zones for the absolute, bacteriological, and chemical protection of the catchment, taking travel time as the most used delineation criterion.

Table 1

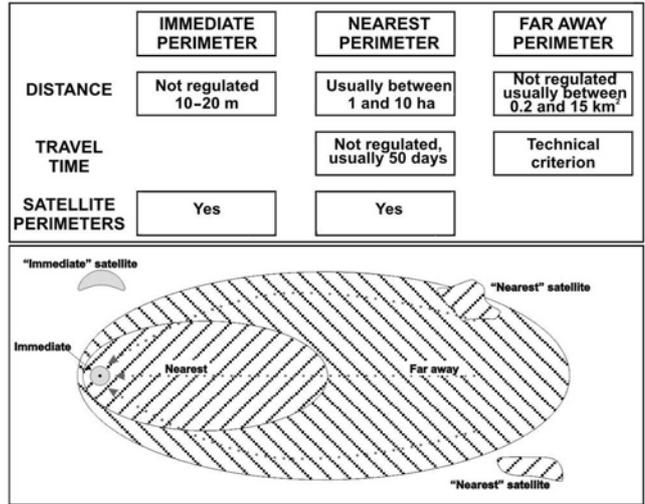
Specific zoning and/or activities regulation inside protected areas in the European countries

Country	Specific zoning in legislation	Activities regulation in legislation
Germany	state	state
France	national	national
United Kingdom	no	no
Spain	no	no
Italy	national	national
Portugal	national	national
Netherlands	national	provincial
Ireland	national	national
Switzerland	national	national

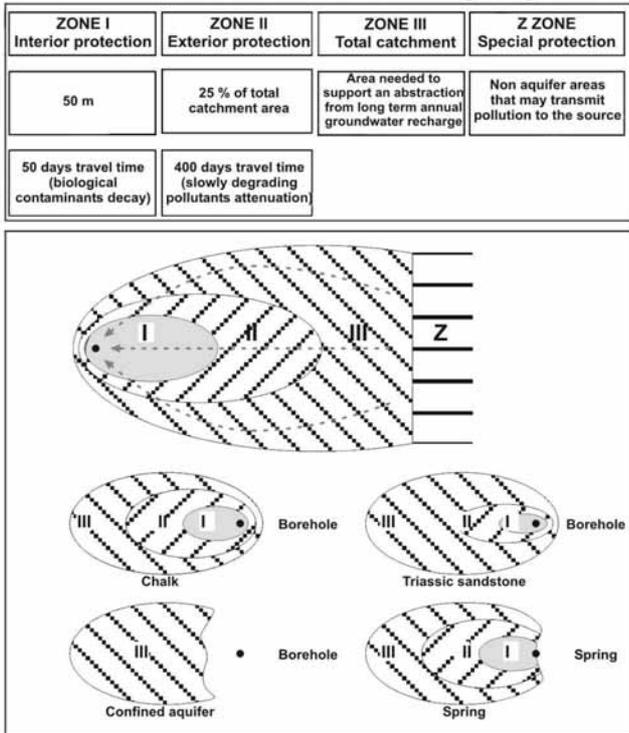
**A Standard W 101 from DVGW in Germany**



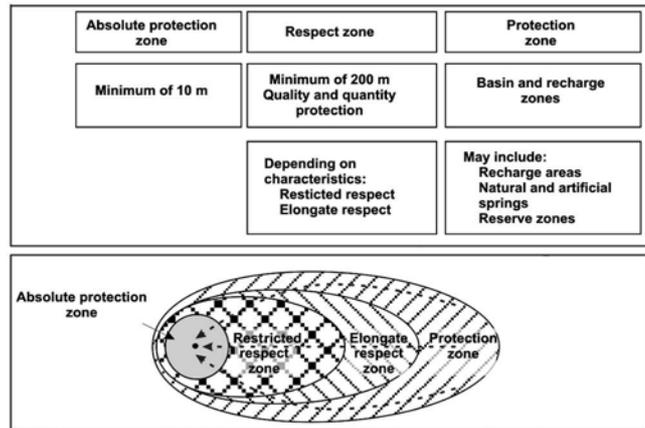
**B Zones inside the Protection Perimeters as for the BRGM**



**C Source protection zones as for the Environment Agency**



**D Safeguard areas in Italian legislation**



**E Protection Zones in Portuguese legislation**

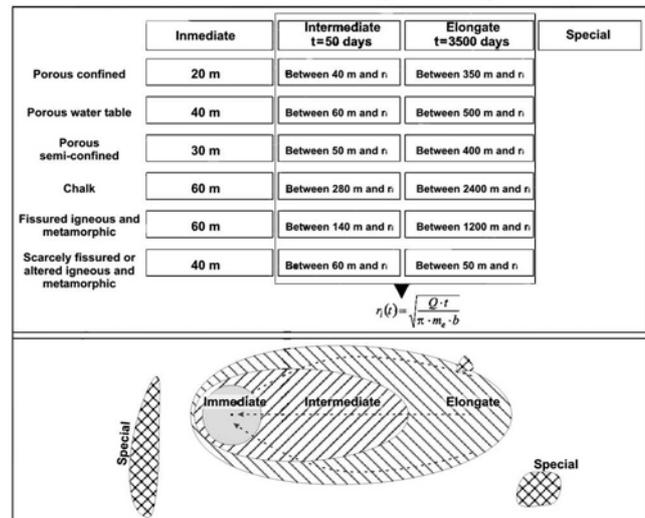


Fig. 1. Source protection areas delineation in Germany (A), France (B), the United Kingdom (C), Italy (D) and Portugal (E) (from Martínez Navarrete, García García, 2003, modified)

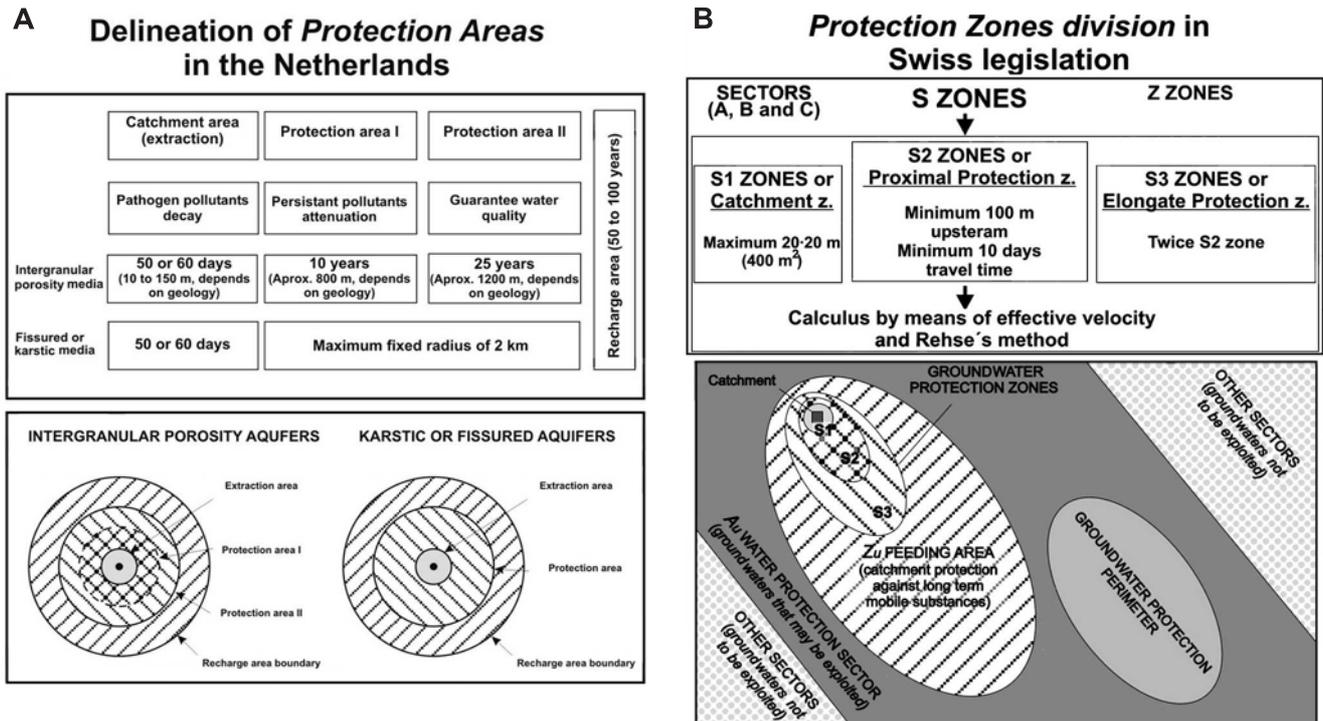


Fig. 2. Source protection areas delineation in Netherlands (A) (from Martínez Navarrete, García García, 2003, modified) and Switzerland (B) (from OFEFP, 2003, modified)

**Italy.** Hydro Sources Safeguard Areas were established (Sito giuridico..., 2003) for qualitative and quantitative protection, with very concrete regulations established through specific laws, usually with three zones or, as a function of pollution risk, four by subdividing the second one (Fig. 1D).

**Portugal.** There is a specific legislation on the protection areas that shows the need for three zones and, additionally, for special ones (Fig. 1E), delineated by means of volumetric equation for travel times or an arbitrary measurement, which may vary as a function of the aquifer materials (Krijgsmanan, Lobo-Ferreira, 2001).

**Netherlands.** Environmental Protection Areas are delineated, being in their application to groundwater divided usually into three zones, except for karst and fissured aquifers, as a

function of travel time, regulated by provincial ordinances (Fig. 2A).

**Ireland.** Catchment Protection Zones are divided usually into two zones using travel time, calculus of the area needed to provide the discharge of given water volume, and restrictions area established through matrixes for each pollutant activity, considering aquifer vulnerability and its importance (Daly, Misstear, 2001).

**Switzerland.** It is established legally the need for Groundwater Protection Zones (Confoederatio Helvetica, 2003), among which source protection areas are composed of three zones with arbitrary minimal radii or calculated with travel time, and considering aquifer vulnerability in karst and fissured aquifers (Fig. 2B).

## CONCLUSIONS

Water Framework Directive establishes a general framework for delineation of the source protection areas. However, a wide diversity of strategies and methods for their implementation across the different countries of the European Union makes it convenient to develop some summarising guidelines which should be considered as an orientation for this implementation.

These guidelines should consider, in a flexible way, all different potential problems that may occur in order to get the target objective that would be to collaborate in increasing the efficiency and accuracy of groundwater protection intended for human consumption.

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