

## **NEW APPROACH FOR SUSTAINABLE SUPPLY OF CLEAN WATER ON THE BASE OF PRIVATE WELLS**

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### **Abstract**

*Supplying the population with good for use drinking water in the event of a crisis is an outstanding problem that respective governments decide in different ways. The main source of such water is lakes, rivers, wetlands. But in crisis situations, access to these sources may become more difficult or water resources in them to be compromised. It is therefore necessary to align ready for use groundwater. One approach is to create sustainable conditions for the use of private wells in crisis situations to provide the population with drinking water. This is the purpose of this publication to present the basic requirements for the organizational procedures for ensuring the use of water resources supplied by private wells in crisis situations.*

*Keywords: Water Management, Drinking Water, Groundwater, Private Wells, Crisis Situations, Environmental Protection*

## INTRODUCTION

Protection of water resources, of fresh and salt water ecosystems and of the water we drink and bathe in is therefore one of the cornerstones of environmental protection in Europe. The stakes are high, the issues transcend national boundaries, and concerted action at the level of the EU is necessary to ensure effective protection. The latter is vital in terms of the need to provide the population with fresh water in times of crisis. The main sources of such water are lakes, rivers, wetlands. But in crisis situations, access to these sources may become more difficult or water resources in them to be compromised.

On 18 December 2012, the European Commission has launched a European Innovation Partnership (EIP) on Water (EIP 2012) with the aim to support and facilitate the development of innovative solutions to water related challenges and to create market opportunities by doing so. The EIP on Water will bring together all relevant stakeholders to identify the priority areas for action, to identify barriers to innovation and to propose solutions to break down these barriers. The EIP on Water will take a problem oriented approach and will make use of the various existing European, national and regional initiatives.

As a matter of fact, groundwater (water found underground in the cracks and spaces in soil, sand and rock, stored in and moves slowly through geologic formations of soil, sand and rocks) constitutes the largest reservoir of fresh water in the world, accounting for over 97% of all fresh waters available on earth (excluding glaciers and ice caps). The remaining 3 % is composed mainly of surface water (lakes, rivers, wetlands) and soil moisture. Until recently, focus on groundwater mainly concerned its use as drinking water (e.g. about 75 % of EU inhabitants depend on groundwater for their water supply) (European Commission, Environment DG, 2008). Groundwater is also an important resource for industry (e.g. cooling waters) and agriculture (irrigation). It has, however, become increasingly obvious that groundwater should not only be viewed as a drinking water reservoir – mainly via private wells, but also protected for its environmental value.

On the other hand, a private water supply, (incl. wells), is one which is not provided by a water company (where rigorous quality control can be assured). More than 5 % of the population in Europe has a private water supply to their homes (World Health Organization, 2011). Most private water supplies are in rural locations and are from wells, boreholes, springs or streams.

The owners of a private water supply are responsible for its safeguarding and treatment and ensuring the water meets the requirements of quality standards. Poorly managed private water supplies may be supplying contaminated water that could cause illness.

That is why for those owners and for all levels of management in government organizations should be established clear and precise rules for the preparation and use of private wells in crisis situations.

Purpose of the study - it is well known, that over the years, the Health Protection Agencies in many countries have documented outbreaks of disease due to private water supplies and across Europe, small household and community water supplies have been identified as a significant risk to human health. In that case, the main idea of the publication is to develop and present a comprehensive approach for evaluation of hazardous environments and to provide a systematic means and mechanisms in order to ensure clean and qualitative water (drinking, bathing and for industrial needs), from private wells in crisis situation.

### **CURRENT EU LEGISLATIVE FRAMEWORK RELATED TO THE GROUNDWATER**

Above all, it is necessary to clarify how stands the issue at EU level and in leading countries in the discussed area for the organization and management of the preparation of private wells for their water use in crisis situations. This brief analysis enables us to identify the problem, if any, and suggest measures for its solution.

#### **Management of Water Sources at European Level**

Of course, detailed analysis of the documents / sources of requirements for management of groundwater and in particular of private wells cannot be performed within such publication. But the focus on the main ones can give us information about the formulation of the problem that has been identified below in this manuscript.

#### ***Groundwater in the European Water Framework Directive - 2000/60/EC (22.12.2000)***

This Directive lays down requirements in the following areas:

- Defines groundwater bodies within River Basin Districts to be designated and reported to the European Commission by Member States;
- Establishes registers of protected areas within each river basin districts for those groundwater areas or habitats and species directly dependent on water;
- Establishes groundwater monitoring networks - provide a comprehensive overview of groundwater chemical and quantitative status;
- Sets up a river basin management plan (RBMP) (European Commission, 14.11.2012) for each river basin district which must include a summary of pressures and impacts of human activity on groundwater status, a presentation in map form of monitoring results, a summary of the economic analysis of water use.

***The EU Groundwater Directive – 2006/118/EC (27.12.2006)***

This Directive establishes a regime which sets groundwater quality standards and introduces measures to prevent or limit inputs of pollutants into groundwater. The directive establishes quality criteria that takes account local characteristics and allows for further improvements to be made based on monitoring data and new scientific knowledge. Member States will have to establish the standards at the most appropriate level and take into account local or regional conditions.

***The Common Implementation Strategy (CIS) Working Group on groundwater – EC (Directive 2000/60/EC, 2 May 2001)***

The CIS Working Group on groundwater published till now one of the following documents:

- Guidance Document on Risk Assessment and the Use of Conceptual Models (No 26);
- Guidance Document on Groundwater Status and Trend Assessment (No 18);
- Guidance Document on Direct and indirect inputs in the light of the Directive 2006/118/EC (No 17);
- Guidance Document on Groundwater in Drinking Water Protected Areas (No 16);
- Guidance Document on Groundwater Monitoring (No 15);

The CIS Working Group on groundwater worked out the following technical reports:

- Technical Report on Groundwater Dependent Terrestrial Ecosystems (No 6);
- Technical Report on Groundwater Risk Assessment (No 4);
- Technical Report on Groundwater Monitoring (No 3);
- Technical Report on Groundwater Characterization (No 2);
- Technical Report on Groundwater Trends (No 1).

***The Water Information System for Europe (2007)***

The Water Information System for Europe, managed by DG “Environment” – EC and European Environment Agency is a gateway to information on European water issues. It comprises a wide range of data and information collected by EU institutions to serve several stakeholders.

The Water Data Centre provides the European entry point for water related data as part of the Water Information System for Europe. It is possible to browse the catalogue of European datasets, interactive maps and indicators – but without significant, or even no information about private water supply, especially wells.

## **Management of Water Sources in Leading Countries in Discussed Area**

### ***UK policy – mainly in England and Wales***

The Drinking Water Inspectorate (DWI) in the UK (October 2010) is responsible about the policy and regulations and is the superior of the local councils.

From January 2010 local councils are required to provide the Drinking Water Inspectorate with details of all private supplies, incl. wells in their area and DWI is publishing summaries of this information on its website.

Local councils are responsible for ensuring the safety of all private water supplies and they may have carried out checks, depending on how many people use the supply.

Local authorities are responsible for regulating private water supplies used for domestic purposes (such as drinking, cooking, and washing) in both domestic and commercial premises. Generally only the larger private supplies are checked regularly, but from January 2010, under new regulations, local councils carrying out risk assessments for all supplies in their area except those serving a single household with no commercial activity.

### ***US Policy for Private Drinking Water Wells – lead by US Environmental Protection Agency (EPA) ([www.epa.gov/safewater](http://www.epa.gov/safewater))***

EPA regulates public water systems; it does not have the authority to regulate private drinking water wells. Approximately 15 % of Americans rely on their own private drinking water supplies, and these supplies are not subject to EPA standards, although some state and local governments do set rules to protect users of these wells (EPA 816-K-02-003, January 2002). Unlike public drinking water systems serving many people, they do not have experts regularly checking the water's source and its quality before it is sent to the tap.

## **FINDINGS**

### **What are the Challenges?**

Private water supplies pose a risk to public health because they may be contaminated with bacteria, protozoa, parasites and viruses or other substances. In the same time however, the private sources of water (wells), can be a reliable source to the satisfaction of drinking, bathing or industrial water needs in the event of significant natural and manmade disasters and they can be contaminated that does not allow the authorities to ensure, for a long time, water for the population of a country or several countries. For the wells there are regulations for the safety of the water in them but do not exist any requirements for their protection and for their use as a source of water in crisis situations. The survey of the conditions for the management and

protection of the private water supply system, through cost-effective investments, can lead to the following positives:

- Securing them as an *alternative source* for the population, for drinking, bathing and industrial water in crisis;
- They can contaminate groundwater and their protection can ensure the safety of groundwater for the needs of the population and for the safety of soil and plantations;
- The methodology will ensure indicators for evaluating the process of drought and forecasting of landslides;
- Their protection can become reliable source for early warning of floods;
- The characteristics of the water quality and quantity can provide information on the accompanying risks.

The ensuring the protection of the wells can create reliable mechanisms and methodologies for the prevention of multiple risks to people and critical infrastructure from disasters. That is why we must first have built a streamlined system for their management (of the wells). The last will enhance the cooperation, exchange of good practices and support for capacity building in prevention actions outlined in chapter 2 of Decision No 1313/2013/EU - Union Civil Protection Mechanism (20.12.2013).

### **Possible Solutions**

Because of the above mentioned facts and circumstances and analyse has been made, the authors of the present publication, developed and are offering to the attention of concerned community current article.

It is important to underline, that a new approach, described in the article bellow, in advance has been discussed with colleagues from different scientific and business organizations, as follows:

- University of Ruse “Angel Kanchev” – Bulgaria;
- Athena Research and Innovation Center in Information, Communication and Knowledge Technologies - Greece;
- Metasphere Ltd -UK;
- Tehnoinstrument IMPEX SRL - Romania.

Discussions carried out, gave to the authors good reason to prepare current publication and to believe that after detailed development, a new approach will be successfully applied at European, regional, national and local level, in the frame and light of the Union Civil Protection Mechanism of the EU.

The Main objective, which is pursued by development of that new approach, is to increase the level of protection and sustainability of urban areas through prevention against adverse effects of disasters, natural and manmade, on the sources of groundwater.

That objective can be achieved, but not only, by some specific objects, for example:

- Modeling a comprehensive approach for analysis and assessment of hazardous threats, caused by natural or manmade activities and which can affect quality of the water, especially from private wells and associated infrastructure to them;
- Closing the cycle of activities to enhance the *protection of private water supply system* against environmental threats;
- Designing, developing, testing and implementing new prevention or disaster risk management approaches, related to the protection of private water supply system;
- Developing of systematic approach related to the process of creating database, including precise mapping of the private wells and their supporting systems.

One of the main idea among others, is to assess the benefits of investment in the area of supplying the clean water by wells during crisis and how these investments will have a positive impact on some or all elements of the processes related to the prevention of natural or manmade disasters (including analysis, planning and implementation of measures for mitigating the damage from the inability for the use of waters from the wells on the entire system of prevention against natural or manmade disasters).

## **THE MAIN ELEMENTS OF THE NEW APPROACH**

Therefore, to achieve the above mentioned objective, the new approach is based and may include, but not only, the following steps:

### **Step 1**

Development of Risks Assessment Methodology concerning private water wells, including development of complete methodology, assessing the effectiveness of expenditure of risk prevention measure and local and regional authorities training, on the basis of costs-benefits analysis

Risk Assessment looks at the source of the supply and the surrounding area to see if contamination during the crisis is possible. It also involves checks of the storage tanks, any treatment systems and the pipework. The risk assessment identifies actual and potential hazards that may affect the health of those drinking the water. Apart from anything else, Risk Assessment will determine:

- The measures to be implemented in advance to ensure the clean drinking, bathing and industrial water needs of private wells in the conditions of a crisis situation;
- The criteria upon which will be further appreciated the level of preparedness of private wells to provide the clean drinking, bathing and industrial water needs from private wells in crisis situations. Those criteria can be exchange as good practices on preparing local, national and regional authorities (national civil protection systems) to cope with regard to the resilience of investments and integration of prevention.

The process of Risk Assessment requires the local, national and regional authorities to carry out a risk assessment of private water supplies, as example, every two years, in order to promote and support the sharing of good practices in urban prevention and facilitating access to specific knowledge and expertise on issues of common interest.

Once the Risk Assessment is complete, the next step is to identify and evaluate options for Risk Management such as pre-treating the source material, enhancing the engineering measures (for example, a different landfill liner) or tightening the operational and aftercare controls – actions which will promote and support the development and implementation of Risk Management through the sharing of good practices and facilitating access to specific knowledge and expertise on issues of common interest in certain area.

That is why, in order to manage the identified risks it should be developed Water Security Plans, concerning private water supplies – aiming integration of Risk Assessment and Risk Management capacity building in to the planning process.

## **Step 2**

Development a model of Water Security Plans, concerning private water supplies – it is an effective way of ensuring that a water supply from the wells is safe for human consumption and that it meets the health based standards and other regulatory requirements. It is based on a comprehensive risk assessment and risk management approach to all the steps in a water supply process. That fact is promoting the development of common risk assessment, risk management capability assessment and risk management planning methodologies, practices and processes. Water Security Plans are different as Safety Plans known in some European Countries. They can include the Safety Plans, but they are expanded with the measures, requirements and tools of the need to provide clean water from private wells for the population at the local, national and regional level in situations of crisis.

Essentially a Security Water Plan may contains, but not only, three key components, as follows:

- System assessment to determine whether the water supply process as a whole - during the normal life and during the crisis (floods, earthquake, storms, fires, etc.), can deliver water of a quality that meets health-based targets and new legislation in the field of private wells;
- Operational monitoring of an appropriate nature and frequency at an appropriate point in the water supply process;
- Documentation of management arrangements including details of the system assessment, operational monitoring and measures validation together with a description of the actions to be taken in normal operation and incident conditions.

Based on the above, Water Security Plans can be developed (and divided) in the medium and long term perspective. In the medium term perspective may be included requirements for developing a dataset / mapping of the wells on a local, national and regional level, as well as the development of new or update current legislative base, related to the management of private wells and training programs. In the long term perspective, i.e., strategically, in that plans can be included requirements for development of a standard/s in the field of private water supplies, incl. private wells.

### **Step 3**

Development a model of dataset (or wells base), including precise process of mapping of the wells on a local and national level.

The model of dataset (well base) may contains data related to the place and owners of the wells, data on nutrients, organic matter, hazardous substances and other chemical determinands in water and biological quality elements, phytobenthos and macroinvertebrates from local monitoring stations.

National dataset or wells base may contain timely, reliable and policy-relevant data collected from local monitoring stations - the added value of wells base is that data collected through the national monitoring stations and bodies may or has to be comparable at the regional (European) level. It will be aimed at improving governance at all levels and across all sectors, covering in particular:

- Improved coordination mechanisms between local, national and regional authorities;
- Enhanced partnerships between different public authorities and relevant stakeholders in the area of protection of private water supply system-wells.

The model of dataset will contain interactive map/maps, showing their locations and distance between several wells in the same area.

#### **Step 4**

Development of proposals and set of requirements of new or update current legislative base, related to protection of private water supply systems-wells.

For example, it is necessary to study, explore and make legislative recommendations, to ensure that property owners of new construction with private water supply wells that serves as the source of drinking water are assured of an adequate supply of water that meets current standards for potability as defined in the regulations of Health authorities.

Also, it is possible to explore and make recommendations concerning the installation of replacement water supply wells on properties, where there is insufficient area, to meet the current separation distances as specified in the regulations of local authorities. But most of all it is need to be developed new or supplement existing regulations with requirements as to the authorities and to the owners of wells, to keep the wells ready for use the water from them to ensure the population at the local, regional and national level.

As for the owners of the wells, among other things, it should be developed requirements for their categorization (considering the requirements of ensuring the security of the wells, in order to be used in times of crisis).

#### **Step 5**

Development a proposal for new standard/s development in the field of protection of private water supply systems-wells, which will be designed to safeguard the health of consumers during the normal life and during the crisis (floods, earthquake, storms, fires, etc.), in case private water supply owners to be prepared in any cases.

It will be a process aimed at developing general principles and guidelines relating to protection of private water supply system – wells, in situations of hazards with potentially serious impact on human, environmental and economic situations.

For example, regulations concerning, as follows and many more, taking into account the need to build, maintain, make them ready and use of private wells as an alternative source of water, at local, regional and / or national level, in situations of crisis:

- Groundwater source position oriented to wastewater disposal system;
- Treatment, where groundwater is in contact with surface waters (open wells) or where water flows freely from the surface down into the groundwater;
- Inspections of the area around a groundwater supply in case to avoid floodwaters and surface runoff contaminating the source.

## Step 6

Development a model of training program - The training is aimed to all individuals involved in the management of drinking water quality, including management, operational staff (both quality assurance and engineers) of water suppliers, representatives of government bodies, community supply managers, etc. Training objectives can be:

- To improve the knowledge and skills of the participants on water security measures which they can translate in to development of Water Security Plans in their respective organizations;
- To appreciate the challenges that may be faced when developing the Water Security Plans and define possible solutions that will be derived from shared experiences and the best practices;
- To identify the linkages between Security Planning and other mandates of water service providers especially reduction of non revenue water, risks assessment, water quality assurance and planning;
- To share and learn on knowledge, expertise, and practices among different security practices around the world and to prepare action plans on the process and commitments to make water security plans on local, regional and national level.

## CONCLUSION

The private sources of water, in the case of the private wells, can be a reliable source to the satisfaction of drinking, bathing or industrial water needs in the event of significant natural disasters or crises monstrous, caused by people. In such situations open water sources can be contaminated in a way and at a rate that does not allow the authorities to ensure, for a long time, drinking, bathing and industrial water of the population of a country or several countries (practically such possible cataclysms can affect at the same time more than a one state of a certain region).

In these cases, reliable, and perhaps only one, water source may become private wells, in terms of the natural protection of water in them and their Regional dispersion, making it difficult to slaughter from natural or human causes. Before that, however, we must first have built a streamlined and sustainable system for their management (of the wells) in terms of quality assurance of the water, their protection and the using of the planned amount of water for the needs of the population at local, national and regional level.

All this imposes the need to develop a comprehensive approach for assessment and analysis of hazardous threats, which can be environmental or caused by human activities –

industrial and/or business (mainly farming) and which can affect quality of the water, especially from private wells and associated infrastructure to them.

The focus of the approach in general and particular in the article, has been to close the cycle of activities to enhance the protection of private water supply system against environment threats - floods, earthquake, storms, fires, etc., chemical agents and/or radiological materials - from the design of wells, their construction, providing them with the relevant rules for maintaining and early warning in case of contamination with such factors.

In this case, the authors of the article will be thankful to everyone of concerned community to share their

## **ACKNOWLEDGEMENTS**

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