D.T1.1.1. Report on National consultations on water supply safety mechanisms - *CROATIA*

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Contents

List of figures and tables

Abbreviations

AEWS – Accident Emergency Warning System

CECIS – Common Emergency Communication and Information System (EU civil protection mechanism)

DHMZ - National Meteorological and Hydrological Service (Državni Hidrometeorološki zavod)

DWPZ - Drinking Water Protection Zones

DWD – Drinking Water Directive

HZJZ – Hrvatski zavod za javno zdravstvo (Croatian National Institute of Public Health)

ICDPR – International Commission for the Protection of the Danube River

ISRBC – International Sava River Basin Commission

IVB – Istarski vodovod d.o.o. (Water utility of Istria for the production and distribution of water)

JVP - Jadransko vodno područje (Adriatic water area)

LNP – Lower National Plan

MIC – Monitoring and Information Centre (Centre for monitoring and informing EU)

NPM – National Plan of Measures for Sudden and Accidental Water Pollution

OG – Official Gazette

PIAC – Principal International Alert Centre

PWU – Public Water Utility

RH – Republika Hrvatska (Republic of Croatia)

VPD – Vodno područje rijeke Dunav (Danube river basin area)

WHO – World Health Organization

WMS – Water Management Strategy

WSP – Water Safety Plan

1. Introduction

Water is not a commercial product like some other products, but a heritage to be preserved, protected and used wisely and rationally. According to The Constitution of the Republic of Croatia, water is a resource specified by law as a special interest of the Republic of Croatia and enjoys its special protection. The quality of water intended for human consumption shall be determined based on indicators of the health standards of drinking water in compliance with the Act on water intended for human consumption. The Ministry of Health of the Republic of Croatia regulates drinking water quality. Local governments are responsible for water and sanitation services and provide them through 133 public utility companies, which are incorporated into 300 public water supply zones that will be aggregated until 2022 year into 40 zones. Water supply comes mainly from groundwater (78%) while the remaining portion comes from surface water (14%), mixed surface & groundwater (5%) and brackish water (3%). The quality of groundwater is generally considered good throughout the country. Despite water abundance, there are quantity problems at key localities such as the Adriatic islands, which have poor water resources and problems with saltwater intrusions and turbidity. Significant pressure on water quantity, especially on the coastal sea, is tourism.

An important measure to protect drinking water aquifers is to make and implement decisions about sanitary drinking water protection zones (DWPZ). Protection of drinking water, more precisely, the implementation of protection measures within sanitary protection zones is difficult at all pumping stations in karst and intergranular aquifers, especially where water supply sources are located near larger cities, because the process of urban industrialization, agriculture, unregulated landfills and wastewaters endangers them.

More than 87% of Croatian population uses public water supply system and drinks tap water, which is regularly controlled and conforms to health safety standards. In regards to quality, all public water supply facilities are under regular supervision. Tap water is also provided by local water resources, which are not part of the public water supply system, and are in the care of groups of citizens or local communities. Water from these water supplies is also regularly controlled, but often does not conform to health safety standards, i.e. in 2017, 56.4 % samples from local water supplies did not meet defined standards. In contrast, only 3.1% of samples from the public water supply system did not meet the standards. The most common causes of it are microbiological indicators, ammonia, nitrates, organic compounds and turbidity. In Croatia, the reach of public utilities—mostly multi-municipal—in rural areas is the most effective (67 %), followed by individual piped self-supply. Even more than in piped water supply, lack of access to improved sanitation is most prevalent in rural areas or

areas with low population density. Minorities continue to have much lower access to water supply services. Closing the rural-urban services gap and reaching universal access are important challenges requiring countries to expand services to rural areas. The enabling policies, legislative framework, and financing measures need to recognize the service delivery models required to address all rural water supply needs.

Organization of Services:

The water sector is controlled at the national level. Local service providers are regulated and controlled by a constellation of national-level actors, the most important of which are: The *Ministry of Health, The Ministry of Economy and Sustainable Development, Hrvatske Vode (Croatian Waters), State Inspectorate,* The *National Water Council,* The *Water Services Council and* The *Croatian Institute of Public Health.*

Apart from *The Ministry of Health* and *The Ministry of Economy and Sustainable Development* as specialized government organizations, water management is also led by *Hrvatske vode* founded by the Republic of Croatia as legal, executive agency that is responsible for water management, implementation and coordination of state policy in the field of water. *Hrvatske vode* grants and controls water extraction and discharge rights, collects corresponding fees, and reinvests the proceeds into sector investments. It is also in charge of flood protection policy. The Government of the Republic of Croatia (WB&DE 2012) appoints the board running this national agency. Ministry of Health and Ministry of Economy and Sustainable Development cooperate with other administrative implementing bodies, scientific and professional institutions on national, regional and local level (e.g. *Hrvatske vode*. The National Water Council, the Water Services Council, National Meteorological and Hydrological Service etc.). The *National Water Council*, appointed by the Croatian Parliament for four years, is a group of ten members representing sector professionals and policy makers who are tasked to align different interests and considerations of system questions in the field of water management at the highest level. The *Water Services Council* was established by the 2010 Water Act and is responsible for economic and service quality regulation. Nine members of the council, nominated by the government and appointed by the Parliament to a five-year term, are experts on water supply and wastewater sewerage, water management, the economy, public finance or other fields. Local and regional administrative bodies have the authority and obligations related to the water issues within their areas. The *Croatian Institute of Public Health (HZJZ - Hrvatski zavod za javno*

zdravstvo) is a central public health institute in the Republic of Croatia, which was founded in 1893 with the aim of promoting health and welfare of the population. HZJZ deals with public health, health promotion and education, disease prevention, microbiology, environmental health, school medicine, mental health care and addiction prevention. HZJZ's main tasks are to plan, promote and implement measures for the enhancement of population health and reduction of health problems. In order to protect human health, the legally prescribed controls of water safety for human consumption in the public distribution network are carried out at several levels: a) self-control carried out by public water service providers (public water utilities), b) state monitoring coordinated by the Croatian Institute of Public Health (HZJZ); and carried out by the county institutes of public health and the Teaching Institute of Public Health by Dr. Andrija Štampar, and c) official controls of the health safety of water for human consumption carried out by sanitary inspectors of the State Inspectorate.

CROATIA STATS:

- Population: 4.126 million people (World Bank, 2017)
- Share of urban population: 60 % (World Bank, 2017)
- Total renewable water availability *[m3/cap/year]*: 24,882 (FAO AquaStat, 2014)
- Annual freshwater withdrawals, domestic *[% of total withdrawal]: 80* (World Bank, 2018)
- Share of surface water as drinking water source *[%]*: 14 (HZJZ, 2019)
- Share of groundwater as drinking water source *[%]:* 78 (HZJZ, 2019)
- Share of mixed surface & groundwater as drinking water source *[%]*: 5 (HZJZ, 2019)
- Share of brackish as drinking water source *[%]*: 3 (HZJZ, 2019)
- Number of public formal water service providers: 133 (HZJZ, 2019)
- Number of local water service providers: 220 (HZJZ, 2019)
- Number of big water utilities (delivering water to >5000 inhabitants or >1000 m3/day) : 67 (HZJZ, 2019)
- Number of small water utilities (delivering water to <5000 inhabitants or <1000 m3/day) : 66 (HZJZ, 2019)
- Residential water consumption *[liters/capita/day]: 116* (Croatian Bureau of Stat. Water, 2017)
- Supply continuity *[hours/day]: 24*
- Drinking water quality *[% of water samples from the public distribution network in full compliance]:* 97,6 (HZJZ, 2019)

2. Concept of water supply safety in Croatia

2.1 Legislation related to water safety

The Republic of Croatia, as well as other European Union members, is obliged to implement all EU directives. This includes not only a mere transposition of the directive into national law, but also a practical implementation of requirements stated in the directives. Fundamental strategic, long-term planning documents for water management are The Water Management Strategy, River Basin Management Plan (2016.-2021.), Long-term Programme for Construction of Water Regulation and Protection Structures and Amelioration Structures, Long-term Programme for Construction of municipal water objects (2014.-2023.), Danube River Basin Management Plan, 1ST Flood Risk Management Plan for the Danube River Basin District and Action Programme for Sustainable Flood Protection in the Danube River Basin. Croatia is implementing Water Management Strategy (National governance Strategy) with its main target to reach full compliance with EU water legislation in period 2008 – 2023.

According to the Decree on water quality standard (Official Gazette No. 73/13) incorporated European Directives concerning water management and protection are as follows:

- Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy (Water Framework Directive); the amendment of this directive are:
  - Decision No 2455/2001/EC of the European Parliament and of the Council of 20 November 2001 establishing the list of priority substances in the field of water policy and amending Directive 2000/60/EC
  - Directive 2008/105/EC of the European Parliament and of the Council of 16 December 2008 on environmental quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC of the European Parliament and of the Council (Environmental Quality Standards Directive)
- Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration (Groundwater Directive); Commission Directive 2014/80/EU of 20 June 2014 amending Annex II to Directive 2006/118/EC of the European Parliament and of the Council on the protection of groundwater against pollution and deterioration

- Directive 2006/11/EC of the European Parliament and of the Council of 15 February 2006 on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community
- Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks
- Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources (Nitrates Directive)
- Council Directive 91/271/EEC of 21 May 1991 concerning urban waste-water treatment
- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Habitats Directive), 12 groundwater bodies protected under this directive

Regarding water safety, the most important is the EU Drinking Water Directive. The aim of the Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption (Drinking Water Directive) is protection of human health from adverse effects of any contamination of water intended for human consumption by ensuring that it is wholesome and clean. Ministry of Health of the Republic of Croatia as the central government authority responsible for water management cooperates with the regional and local self-government units in the implementation of this directive. Drinking water quality standards are under the responsibility of the Ministry of Health which is, through the Croatian Institute of Public Health (authorized laboratories) which carries out the sampling and performs analyses, responsible for the monitoring of the sanitary quality of drinking water (for monitoring the compliance with the established standards) and for informing the public. Within the Ministry of Health, The Independent public health care sector deals with the issue of food safety, genetically modified organisms and water for human consumption. The Act on the State Inspectorate (OG No. 115/18), which entered into force on 1 April 2019, regulates the organization of the State Inspectorate, management, conditions for performing inspection activities within the scope of the State Inspectorate, duties and powers of inspectors for the purpose of public interest and public health protection. Sanitary Inspection Sector, within State Inspectorate, is responsible for official controls of drinking water, controls on suppliers of water and other business who use water in their process.

Republic of Croatia requested a transitional period until the end of 2018 for the complete implementation of Council Drinking Water Directive and brought The Implementation Plan

for Water Utility Directives (2010. – 2023.). Full implementation of the Directive's requirements, including the implementation of technical measures which ensure full compliance with maximum permissible concentrations for drinking water on the entire territory of the Republic of Croatia is foreseen by the Water Management Strategy (WMS), while the objectives of implementation are accepted in the Water Act, Water Management Financing Act, by laws and are obligatory component of the Programme of Measures within the River Basin Management Plan. Therefore, Act on the water intended for human consumption (OG No. 56/13, 64/15, 104/17, 115/18, 16/20) accepted the obligations of the Drinking Water Directive related to the monitoring of health and safety of water intended for human consumption (act prescribes limit values indicating safety of water for human consumption). Furthermore, drinking water quality standards laid down by the Ordinance on the sanitary quality of drinking water are fully in line with the Directive's requirements. In addition to the limit values for mandatory parameters, it also defines the limits for a number of additional parameters, in accordance with WHO standards and the practice of drinking water quality monitoring in the Republic of Croatia.

According to the Implementation Plan for Water Utility Directives the completed actions related to the implementation of the Drinking Water Directive are:

- Identification of all relevant water distributors and determination of the state of existing infrastructure,
- The Council for Water Services ensures legality in the field of determining the price of water services. Croatian Parliament appoints council members.

Water quality control in the Republic of Croatia is regulated by the Act on the Water Intended for Human Consumption (OG No. 56/13, 64/15, 104/17, 115/18, 16/20). Water for human consumption must conform to parameters for control of conformity of water for human consumption to standards defined by the Ordinance on conformity parameters, analytical methods, monitoring and drinking water safety plans, and keeping register of legal entities, which provide public water supply (OG No. 125/17). Water safety plans (WSP) are legal obligation according to this Ordinance and starting 2023 for major water suppliers, i.e. 2029 for small suppliers. Until then, self-control activities should be carried out according to HACCP plan. The Law on the Water Intended for Human Consumption regulates the water quality, protection from adverse effects of water, institutional organization, monitoring, official controls, financing, management of water quality, reporting the Commission and obligations of water suppliers, counties and municipalities. Water for human consumption is also regulated with Ordinance on sanitary, hygienic and other conditions that must be met

by water supply facilities (OG No. 44/14) regulation. Sanitary protection of water sources (groundwater and surface water) has large part in ensuring the health of drinking water. Source water sanitary protection areas for public water systems are determined in accordance with the currently valid Regulation on the conditions determining the sanitary protection zones (OG No. 66/11, 47/13). According to the Water Act, sources that are used or reserved for public water supply must be protected from pollution and intentional or accidental pollution, and from other influences that may adversely affect health safety of waters or their abundance. The basic precondition for the implementation of spring protection is the establishment and maintenance of water protection areas (sanitary protection zones) of drinking water sources for public water supply (**Figure 1**). Water protection areas are determined based on the Ordinance on the determination of sanitary protection zones of springs, and the protection itself is realized in accordance with the Decision on protection of springs. The decision, based on previous water research works, determines the size and boundaries of water protection areas, and the implementation of water protection and monitoring measures.

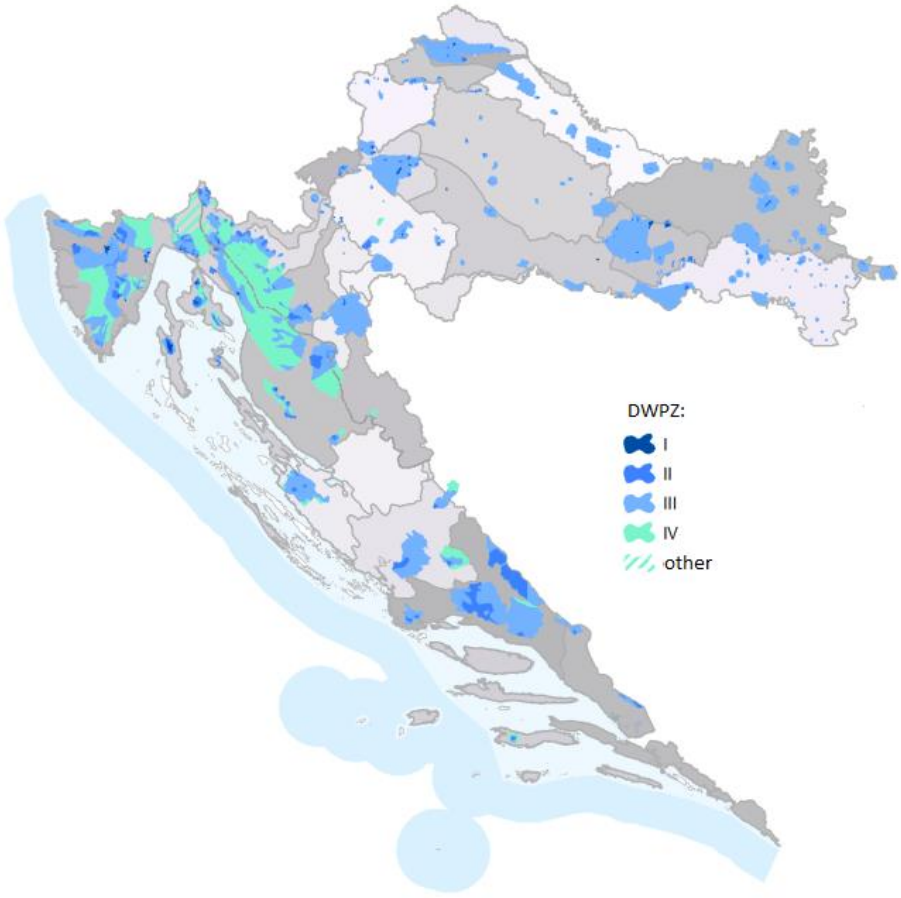

Figure 1. Sanitary protection areas of water sources intended for human consumption (DWPZ; source: Water Areas Management Plan for the period 2016 - 2021)

LEGAL FRAMEWORK:

The basic acts regulating drinking water supply in the Republic of Croatia are the following:

- The Water Act (OG No. 66/2019)
- Act on water intended for human consumption (OG No. 56/13, 64/15, 104/2017, 115/18, 16/20)
- The Utilities Act (OG No. 36/95, 70/97, 128/99, 57/00, 129/00, 59/01, 82/04, 110/04-Regulation, 178/04, 38/09, 79/09) - in transitional period according to the Water Act
- The Act on the State Inspectorate (OG No. 115/18)
- Ordinance on conformity parameters, analytical methods, monitoring and drinking water safety plans, and keeping register of legal entities, which provide public water supply (OG No. 125/17, 39/20) - Water safety plans are legally recommended with this Ordinance.
- Ordinance on sanitary, hygienic and other conditions that must be met by water supply facilities (OG No. 44/14) – implementation of HACCP is obligation with this Ordinance
- The Water Management Financing Act (OG No. 153/10, 90/11, 56/13)
- Decree on water quality standard (OG No. 96/19)
- Regulation on the conditions determining the sanitary protection zones (OG No. 66/11, 47/13)
- Water Areas Management Plan for the period 2016 – 2021
- Regulation on the content of the water areas management plan (OG No.74/13, 82/13)
- Regulation on the calculation and collection of water fees (OG No. 79/10, 76/11, 19/12, 151/13 and 83/15)
- Regulation on fees for water management (OG No. 82/10, 108/13)
- Regulation on the calculation and collection of fees for water orders (OG No. 83/10, 126/13)
- Regulation on the calculation and collection of fees for water use (OG No. 82/10, 83/12 and 10/14)
- Regulation on the calculation and collection of fees for water use (OG No. 84/10 and 146/12)
- Regulation on fees for water protection (OG No. 82/10, 83/12 and 151/13)

- Regulation on the calculation and collection of fees for water protection (OG No. 83/10 and 160/13)
- Regulation determining the vulnerable areas in the Republic of Croatia (OG No. 130/12)
- Action Programme for the protection of waters against pollution caused by nitrates from agricultural sources (OG No. 15/13)
- Act on Protection against Natural Disasters (Official Gazette No. 73/97 and 174/04)
- The Ordinance on the rules for establishing the system and procedures based on the principles of the HACCP system (OG No. 068/2015)
- The Ordinance on the issuance of water legal acts (OG No. 009/2020)
- The National Strategy for Sustainable Development (OG No. 30/2009)
- The Ordinance on the content, form and manner of keeping water documentation (OG No. 120/2010)
- Decision on the priority of water use in the County of Istria from surface and groundwater bodies during severe disturbances in water supply and other forms of water use (OG No. 95/12)

2.2 Institutions related to water safety

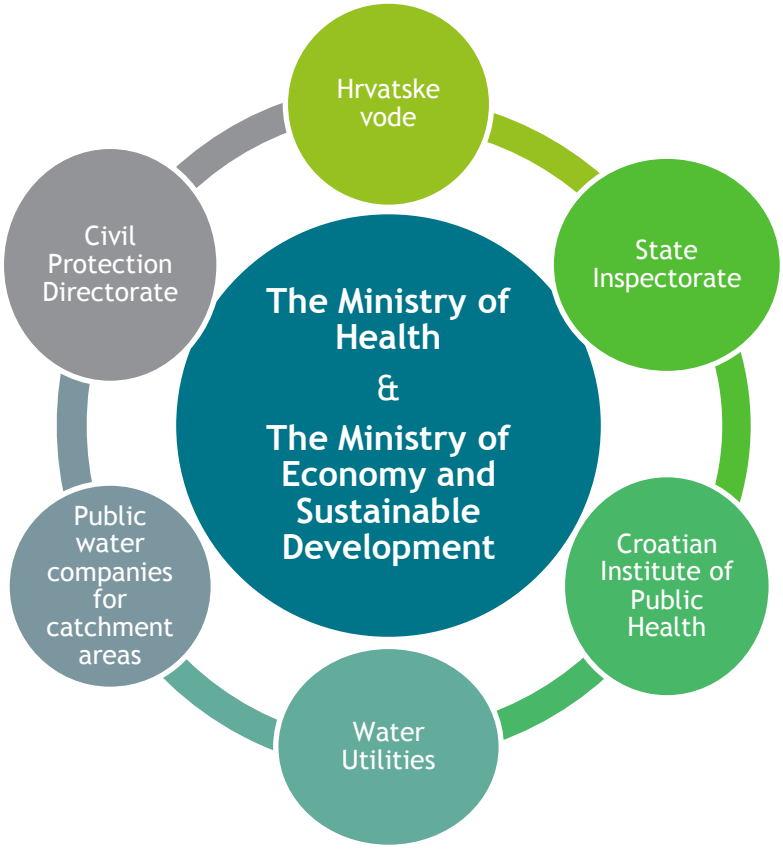

Figure 2. Schematic sketch of main institutions related to water safety in Croatia

The **Figure 2** shows in a schematic way the main institutions related to water safety in Republic of Croatia. *The Ministry of Health* is the central body of state administration in the Republic of Croatia that performs administrative and other tasks related to: health care and health insurance system, monitoring and improving the health status and health needs of the population. The Ministry performs administrative-legal and professional activities in the field of water for human consumption, conducts the procedure of authorizing official laboratories to perform analyses for the purpose of monitoring and other official controls of water for human consumption, issues decisions for registration of water supply activities. Other bodies of state governance having public authority and other legal and natural persons, public and advisory bodies contributing more significantly to the achievement of water policy objectives shall participate in drafting and implementation of the water policy. The scope of *The Ministry of Economy and Sustainable Development* includes tasks related to the protection and preservation of the environment and nature in accordance with the policy of

sustainable development of the Republic of Croatia, tasks related to water management and administrative and other tasks in the field of energy. Since environmental protection is one of the most demanding activities that affect all aspects of the organization of human society, by adopting the National Strategy for Sustainable Development, the Ministry has become a coordination point for sustainable development issues at the national level and a coordinator of multilateral environmental agreements and global issues of sustainable development at the international level. The Ministry is also responsible for administrative supervision and supervision of professional work of: a) Fund for Environmental Protection and Energy Efficiency (EPEEF), b) National Meteorological and Hydrological Service (DHMZ), c) Hrvatske vode, d) Hydrocarbon agency and e) National parks and nature parks.

Hrvatske vode is a legal entity for water management in Republic of Croatia, established by the Water Act. The institution is public, responsible for managing water and public water estate, protective and hydro-ameliorative water structures. *Hrvatske vode* is divided in two basic organizational units: the Head Office and water management departments (WMDs). The Head Office is divided into departments, services and the Water Management Institute, as well as units and the Central Water Management Laboratory, and the central Flood Defense Centre. Croatian waters provides direct expert, technical, economic and legal assistance to municipal users in defining, preparing, and implementing projects of varying complexity.

The Water Act regulates activities of *Public water companies for catchment areas*. They are engaged in water management business, construction and maintenance of water buildings (e.g. floodgates).

Civil Protection Directorate coordinates the civil protection system, carries out analyses and share information on all types of hazards and possible consequences of major accidents and catastrophes. Regarding civil protection activities, the National Plan prescribes measures and activities, and most often, they refer to assistance to utility companies in delivering drinking water to residents. The methods of seeking assistance are defined by the SOP (Standard Operative Procedure) Ordinance on the provision of assistance to a lower hierarchical level by a higher level of the civil protection system in the event of a major accident or disaster.

Water utilities are connection between the water source and end users providing a water safe for human consumption. To ensure this, they need to monitor water parameters

prescribed with regulations. Monitoring is done in accordance with DWD. Out of 133 public water utilities, 25 PWUs have an internal laboratory (19%). The services of the HZJZ are used by 93 PWUs (70%), and the services of private laboratories by 11 PWUs. Several PWUs perform analyses both in the internal laboratory and in the laboratories of the HZJZ. The state of public water supply in the Republic of Croatia is analyzed and monitored at the level of the so-called "water supply zones", areas where it is possible to organize public water supply in a broader sense. The Republic of Croatia is divided into 300 water supply zones. Water supply zones are determined predominantly by foundation technical analysis of the current situation and water supply development plans. The average water supply zone has 65,000 population and an annual water production of about 3.8 million m^3.

Monitoring of drinking water safety is carried out on a national level according to Monitoring Plan issued by the Minister of Health on a proposal of the *Croatian Institute of Public Health* (HZJZ) as a coordinating body. Monitoring plan is carried out by institutes of public health in Croatian counties and the City of Zagreb, respectively, according to their local authority and financial resources provided by their respective local authorities. Monitoring plan should be in accordance with *Ordinance on conformity parameters, analytical methods, monitoring and drinking water safety plans, and keeping register of legal entities that provide public water supply*. Water safety plans are legally recommended with this Ordinance. Some water utilities have their own laboratories for drinking water quality monitoring, as mentioned above. HZJZ publishes annual Reports on safety of water for human consumption (in Croatian) available on Periodic publications of the Croatian Institute of Public Health website. For any additional information and latest drinking water monitoring data, citizens and tourists can contact a county public health institute of their residence or visit, and information on public health network and contact information is available on the following link: https://www.hzjz.hr/mreza-zavoda/. Tap water is also provided by local water resources, which are not part of the public water supply system, and are in the care of groups of citizens or local communities. The majority of them is located in Zagreb, Krapina-Zagorje, Sisak-Moslavina, Karlovac and Varaždin counties. Water from these water supplies is also regularly controlled, but often does not conform to health safety standards, i.e. in 2017, 56.4 % samples from local water supplies did not meet defined standards. In contrast, only 3.1% of samples from the public water supply system did not meet the standards. Private wells and other individual water resources are not subject to monitoring system, but control is performed on an owner's personal request.

The water monitoring program for human consumption consists of the collection and analysis of separate water samples or measurements recorded in an ongoing monitoring process, and may also contain data from official controls, records on the functionality and condition of catchment equipment and / or infrastructure, capture, treatment, storage and water distribution. The monitoring program for water for human consumption shall be based on a risk assessment carried out in accordance with this Ordinance, which shall be confirmed or updated every five years, and earlier if necessary. If the monitoring of water for human consumption in a certain area reveals larger deviations from the compliance parameters prescribed by this Ordinance, which may endanger public health, the Minister responsible for health may adopt an amendment to the annual monitoring plan with a changed factor for a certain area or system the product. If the monitoring of water for human consumption or other means of control determines the deviation of a certain parameter or a new parameter that may endanger public health, the Minister responsible for health may by order expand the range of parameters for monitoring, other official controls and technical inspections.

2.3 Ongoing processes

2.3.1 Existing practices aiming at the drinking water safety

HACCP

Hazard Analysis Critical Control Point (HACCP) is a management system in which food safety is addressed through the analysis and control of biological, chemical, and physical hazards in all stages of its production, handling, distribution and consumption of the finished product. Addressing the drinking water safety, the Republic of Croatia was among the first countries in Europe to prescribe the obligation to establish a risk management system in water supply systems on the principles of HACCP in 2004. However, there were no guidelines for public water service providers, and all activities were based on the experience gained in the implementation of the HACCP system in food facilities. Most of the water utilities in Croatia have implemented HACCP.

Sanitary drinking water protection zones

Areas where a water source or other deposit is located that is used or reserved for public water supply, and areas where water is abstracted for the same purpose from rivers, lakes, reservoirs, etc. shall be protected from deliberate or accidental pollution and other impacts that may have an adverse effect on the sanitary quality or yield of water. The protection is achieved with sanitary protection zones implementation and regulation. For the purpose of protection of surface and groundwater resource and unique and valuable ecosystems dependent on water, Water Act and other legislatives establish protected areas. Water that is intended for human consumption or is reserved for public water supply will be identified by *Hrvatske vode* in every water basin area.

Determination of drinking water protection zones (DWPZ), obligatory measures and limitations that are conducted in them as well as the deadlines for decisions on protection and the process of making these decisions are governed by The Ordinance on the conditions for the establishment of sanitary protection zones (Official Gazette No. 66/11 and 47/13). The I zone is defined by 10 m distance from extraction spring or well, while other criteria for delineation of DWPZs differ for intergranular and aquifers with fracture and fracture-cavernous porosity (**Table 1**). Criteria in intergranular aquifers are groundwater travel time and discharge rate, while in aquifers with fracture and fracture - cavernous porosity criteria additionally take into account groundwater flow velocity.

Table 1. Criteria for drinking water protection zones (DWPZ) of springs/wells in Croatia

DWPZ	Name of the DWPZ	Water resource capacity L/s	Intergranular porosity	Fracture and fracture-cavernous porosity	
			Groundwater travel time	Groundwater travel time(day)	Apperent groundwater velocity(cm/s)
I	Zone of strict protection and surveillance		-	-	-
II	Zone of strict limitations and surveillance		50 d	<1	>3
		<20 L/s	5 y	1-10	1-3

III	Zone of limitations and surveillance	20-100 L/s	15 y		
		>100 L/s	25 y		
IV	Zone of limitations	<20 L/s		10-20	<1
		20-100 L/s		20-40	
		>100 L/s		40-50	

Almost a fifth of Croatian territory is protected by DWPZs. The territory of the Republic of Croatia is hydrographically divided into the Adriatic Sea (Adriatic water area- JVP, In Croatian: Jadransko vodno područje) basin and the Black Sea basin (Danube river basin area- VPD, In Croatian: Vodno područje rijeke Dunav). Adriatic part is mostly presented by karst aquifers and Danube part by intergranular aquifers. Overview of the areas belonging to specific DWPZ is presented in the **Table 2**.

Table 2. Overview of the areas of drinking water protection zones of water sources intended for human consumption

Drinking water protection zones		I zone	II zone	III zone	IV zone	other	TOTAL
VPD	Area (km^2)	10	271	3909	803	49	5042
JVP	Area (km^2)	21	710	2658	1892	531	5872
RH	Area (km^2)	31	1041	6567	2695	580	10914

JVP - Adriatic water area, VPD - Danube river basin area, RH - Republic of Croatia

DWPZ are embedded into the physical planning documents as implementation provisions (interdictions and protection measures for each established zone), as well as the graphical representation of the Plan. All operations and activities in the area should be harmonized with the physical planning documents that are checked and confirmed by competent administrative authorities under the applicable legal regulations at national, regional or local level. On the other hand, the situation in the field is verified by the relevant water inspection.

In the amendments to the Water Quality Directive for human consumption from 2015, the concept of risk management using water safety plans was introduced into European legislation for the first time. In order for the Republic of Croatia to harmonize its legislation with the legislation of the European Union in the amendments to the Water Act for Human Consumption of 2017 (OG 104/17), it is prescribed that large water supply systems supplying more than 5,000 inhabitants or delivering more than 1,000 m^3 / water per day must introduce a Water Safety Plan for a period of 5 years, and small systems that supply less than 5000 inhabitants or deliver less than 1000 m^3 of water per day within 10 years. Within the two-year Agreement on Cooperation between the Ministry of Health of the Republic of Croatia and the WHO for the period 2018-2019 and according to the work program of the Protocol on Water and Health for 2017-2019, a workshop on capacity building for the implementation of safety plans was held from 10 to 13 September 2018. The aim of the workshop was to educate experts from the HZJZ, the Ministry of Health, sanitary inspection and representatives of public water service providers for the implementation of education at the regional level. Regional workshops were held in the first half of 2019 with the aim of educating representatives of public water service providers and training them to move from the HACCP system to the water safety plan for human consumption. In 2020, due to COVID-19 pandemic, the activities were put on hold.

2.3.2 Level of implementation

HACCP

Most of the public water utilities in Croatia have implemented HACCP, which was obligated by law since 2004. Out of 133 public utilities, 111 (83.5 %) have implemented HACCP system, of which 63.9% (71) are certified by a certification body. Some small and local water utilities are still in the process of HACCP system implementation.

Drinking water protection zones

Republic of Croatia is still in the process of delineating and implementing new drinking water protections zones, while existing ones are undergoing the process of amendment. Implemented drinking water protection zones can be found in ARKOD system.

None of 133 public formal water utilities in Croatia has successfully implemented WSP (0%). One water utility is undergoing the process of WSP validation, according to HZJZ – Croatian Institute of Public Health. We analyzed the results of questionnaire, which was sent to public water utilities with the topic of water safety plans implementation that can be found in Appendix 2. Out of 23 received completed questionnaires, we got info on water safety plans status of implementation. Sixteen water utilities have not yet started the process of implementation, while four have. Three water utilities did not answer the question about WSP implementation status.

Croatia is implementing Water Management Strategy (National governance Strategy) with its main target to reach full compliance with EU water legislation in period 2008 – 2023. The total annual costs of the Drinking Water Directive implementation, i.e. development of water supply systems in a manner to ensure sufficient water quantities of adequate quality as well as to ensure reliable delivery and regular control of drinking water, range from EUR 300 to 483 million (2018). (*Implementation plan for water utility directives, 2010.*)

2.4 Tools

Tools that are supporting the water safety procedures implementation are regional databases, ecological maps, monitoring programs.

- Istrian part of Croatia has an accessible regional database for water quality system, which can be addressed as an external tool that is supporting water safety procedures implementation in that part of country. Unfortunately, there is no central database for the water quality system of the whole country, which can be directly accessed by public (eg. web portal).
- HZJZ is collecting data on drinking water quality and publishes annual Reports on safety of water for human consumption (in Croatian) available on Periodic publications of the Croatian Institute of Public Health website. For any additional information and latest drinking water monitoring data, citizens and tourists can contact a county public health institute of their residence or visit, and information on public health network and contact information is available on the following link: https://www.hzjz.hr/mreza-zavoda/.

- *Hrvatske vode*, as national water management agency have centralized data on water quality and monitoring for the whole country. Including surface water, groundwater, drinking water etc., regardless of its use. Data accessible on request (https://www.voda.hr/hr/pristup-informacijama).
- "Hrvatske vode Geoportal" is an interactive web portal for spatial data browsing. It enables interactive presentation and analysis of spatial data on the map, divided into thematic subgroups from different areas of *Hrvatske vode* activities (**Figure 3**). Available through WMS and KML services. Thematic subgroups include: Agglomeration register, Register of protected areas – areas of special water protection, Preliminary flood risk assessment, Flood hazards and Flood risks.

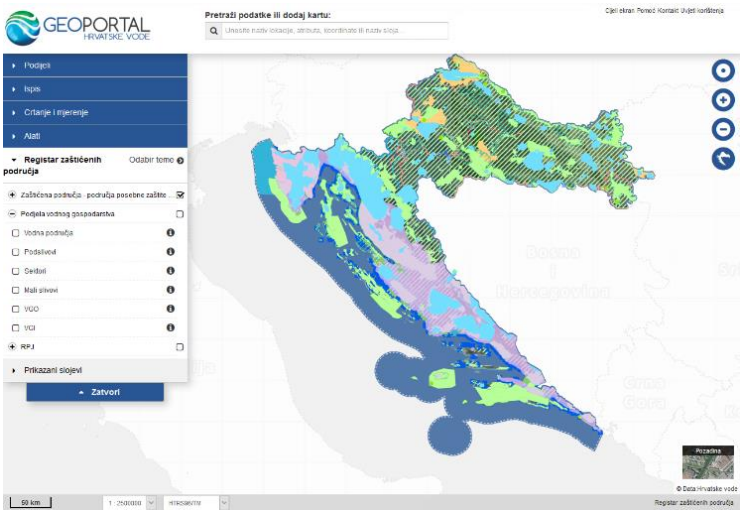

Figure 3. Hrvatske vode Geoportal - Register of protected areas (DWPZ)

- One good example is "EKO KARTA" (Ecological map) of the City of Zagreb. Ecological map of the City of Zagreb is a dynamic tool with continuous data entry based on regular monitoring, episodic measurements, new data from various sectors of environmental testing (air, water, soli), such as air quality measurements using automated sensors that allow real-time data reading and monitoring of changes in a defined time interval (**Figure 4**)

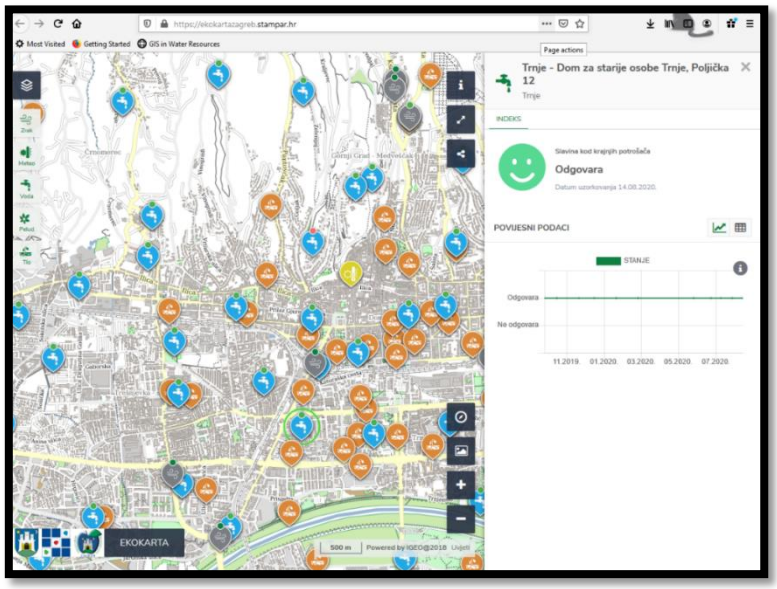

Figure 4. Ecological map of City of Zagreb - check the quality of air, water and soil in one place

- ARKOD system - ARKOD is a national system for the identification of land parcels, records of agricultural land use in the Republic of Croatia. The aim of ARKOD is to provide farmers with an easier and simpler way to apply for support as well as their transparent use. Implemented drinking water protection zones can be found in ARKOD system.

2.5 Risks, bottlenecks, challenges

Key identified risks, which might hinder the successful implementation of the improved water safety procedures are (**Table 3**):

1) Technical (describing specific status of WSS (i.e. ageing, karst…): Age of the water supply network, large length of the network and small connection in the peripheral parts of the water supply system.
2) Economic (limited funding): Income reduction due to population decline, limited funding, covid-19.
3) Political (i.e. low priority in society): Regional pumping station in another county.
4) Other: Inertness in the adoption of correct and accompanying acts adopted by legal decisions.

The information provided above is gathered via "*Questionnaire for WSP status in water utilities_PP4 Croatia*" which can be found in *Appendix 2*.

Table 3. SWOT analysis from the view of water safety in Croatia.

STRENGTHS - Historically defined water protection zones - Qualified staff with up to date knowledge - Sufficient facilities/equipment/ technology to ensure environmental neutral/positive activities	**WEAKNESSES** - No central spatial database (but planned soon to publish data on water quality for human consumption on WEB portal – delayed due to COVID-19) - Distribution areas – need for agglomeration - Difficult implementation of new measures or strategies because of the other stakeholders or general policy
OPPORTUNITIES - Improved water supply safety - Improve resilience (?) - Transboundary cooperation - EU projects/funds could help us to set in motion WSP implementation	**THREATS** - Not meeting EU legislation (adaptation process) - Hazard (drought – climate change) - Water pollution - Groundwater depletion - Pollution by agriculture - Increased administration represents the barrier of our organization development towards better environmental conservation

3. Specific hazards/risks addresses by the water safety procedures in the Croatia

a) **Risks** which are addressed by the water safety procedures are:

- **Protection of water resources** is regulated with water protection sanitary zones (Regulation on the conditions determining the sanitary protection zones, OG No. 66/11, 47/13).
- Risk due to hydrological conditions accompanied by natural turbidity of spring water, chemical and microbiological risk (bacteria, pesticide, NaCL - salinity, elemental chlorine from disinfection, toxins, heavy metals, hydraulic risk (inappropriate pressure and flow in the pipes)) - Act on water intended for human consumption (OG No. 56/13, 64/15, 104/2017, 115/18, 16/20), Ordinance on conformity parameters, analytical methods, monitoring and drinking water safety plans, and keeping register of legal entities which provide public water supply (OG No. 125/17, 39/2020).

b) **Measures against accidental pollution** (surface waters, groundwater) are described within National Plan of Measures for Sudden and Accidental Water Pollution (OG 5/2011). Pursuant to Article 70, paragraph 2 of the Water Act (Official Gazette 153/2009), the Government of the Republic of Croatia, at its session held on 7 January 2011, adopted the National Plan of Measures (NPM). The National Plan of Measures for Sudden and Accidental Water Pollution (NPM) is a document, which determines the measures and procedures to be taken in cases of extraordinary and sudden pollution of inland waters caused by land pollution. The national plan of measures refers to inland water pollution that can endanger human life and health, as well as nature and the environment as a whole.

The National Plan of Measures shall apply to the territory of the Republic of Croatia with regard to inland water pollution. In the case of coastal water pollution and in the case of land pollution as a consequence of marine pollution, the Contingency Plan for Sudden Marine Pollution (Official Gazette 92/2008) shall apply.

In case of pollution of inland waters from the vessel, the regulations in the field of inland navigation apply.

If due to a sudden case there is a danger of pollution or water pollution, the polluter is obliged to inform the central state administration body responsible for protection

and rescue - Civil Protection Directorate - immediately. Civil Protection Directorate shall notify the central state administration body responsible for water management inspections, the head of the Main International Alert Center in the Republic of Croatia and Hrvatske vode about the pollution or the danger of water pollution. Measures proposed with National plan of Measures for sudden and accidental water pollution shall be applied by: (1) legal entity which has the obligation to adopt a lower plan of measures in relation to water pollution originating from its territory, (2) the supplier of water services in relation to water pollution that originated from municipal water buildings or originally occurred in municipal water buildings and (3) Hrvatske vode in all other cases of water pollution. The person obliged to apply the measures referred to in paragraph 3 of National Plan of Measures, immediately after observing the occurrence of the danger of water pollution or water pollution, take measures for urgent prevention or elimination. The polluter, according to article 81 of NPM, shall pay the costs of taken measures. If the polluter is unknown, the costs of taking the measures shall covered by Hrvatske vode. If the pollution, regardless of the place of origin, originally occurred in municipal water structures, stormwater drainage structures in the area of the road or airport, privately owned water buildings or internal water supply or drainage systems - costs of taking measures referred to in NPM shall be covered by the owner of these buildings or the person who is in accordance with a special regulation responsible for the management or administration of the building. The decision on the calculation and payment of costs referred to in paragraph 1 of this Article in relation to the polluter and his insurer shall be issued by Hrvatske vode in an administrative procedure.

Obligors that are obliged to apply Lower National Plan of Measures (Lower national plans, LNP) are defined by article 72, par.3 Water Act.

Lower National Plans are:

(1) Operational plan of measures in case of a sudden and accidental water pollution by Hrvatske vode (Hrvatske vode Operational plan of measures),
(2) Operational plan of measures in case of a sudden and accidental water pollution of legal entity which is obliged to obtain a water permit for water discharge or a decision on integrated environmental protection conditions for water pollution originating from the area covered by these administrative acts,
(3) Operational plan of measures in case of a sudden and accidental water pollution of water utilities (water service providers) for water pollution that

originated from utilities buildings or firstly occurred in them. For example, Istrian water utility is obliged to have such operational plan (including all public water utilities).

LNP contain information especially about:

- Description of the location and environment, list of hazardous and polluting substances, maximum amount of these substances, list of possible sources of danger, assessment of possible causes and dangers of water pollution;
- Water risk assessment in case of water pollution;
- Measures to prevent water pollution;
- Organization of actions, scope and manner of implementation of measures in case of water pollution and manner of disposal of hazardous and polluting substances that caused pollution, which is carried out in accordance with special regulations;
- Responsible persons and necessary professional staff in the measures implementation
- Etc.

Measures in the event of accidental water pollution are applied in accordance with Article 72 of the Water Act, and include:

1) Informing the competent authorities and the public, and the implementation of National Plan of Measures and Lower National Plans in order to reduce the spread and eliminate sudden water pollution;

2) Determining the causes, perpetrators, type and extent of water pollution, assessment of the degree of endangerment of water and the aquatic environment and human health and life, as well as the possibility of spreading pollution;

3) Control over pollution and its spread, informing the public and water users about the state of water and the aquatic environment and, if necessary, banning the use of water;

4) Elimination of the causes of sudden pollution, prevention of the spread of pollution and implementation of works on remediation of the consequences of water pollution;

Assessment and direct inspection of pollution performed by Hrvatske vode (Expert Unit) and the State Water Inspector (Decision Making Unit). Degree (1.-3., 3. - the most severe) of water threat is declared by the state water inspector.

In the case when the pollution occurred within the borders of the Republic of Croatia with possible transboundary consequences national authorities shall inform the ICPDR, ISRBC and PIAC of neighboring countries using the AEWS and, if necessary, alerting in the Danube River Basin in the territory of the Republic of Croatia. They shall inform the affected Member States of the European Union through the MIC, using CECIS. If necessary, Hrvatske vode hire authorized laboratories and professionally and technically qualified persons for rehabilitation operations.

c) **Measures addressing floods:**

Bodies responsible for flood defense are: Ministry of Agriculture, *Hrvatske vode*, Companies certified for works in implementation of preventive, regular and emergency flood defence, National Meteorological and Hydrological Service (DHMZ), National Protection and Rescue Directorate, Units of local and regional self-government, other competent state administration bodies.

Pursuant to the Water Act, flood defense is managed by *Hrvatske vode*. Operational flood risk management and immediate implementation of flood defense measures are regulated by: National Flood Defense Plan, Master Flood Defense Implementation Plan, and Flood Defense Implementation Plans for defended areas. *Hrvatske vode* also drafts planning documents for flood protection foreseen by the Water Act: Flood Risk Management Plan, River Basin Management Plan, Long-Term Programme for Construction of Water Regulation and Protection Structures and Amelioration Structures (adopted by the Croatian Government). The Government adopts the National Flood Defense Plan.

In 2010 started EU IPA 2010 TWINNING PROJECT "Development of Flood Hazard Maps and Flood Risk Maps" (http://twinning.voda.hr/). The **purpose of this project** was to implement requirements of the EU Floods Directive and to that end to prepare flood hazard maps and flood risk maps in the Republic of Croatia.

Sava HIS application - **real time data - Sava river basin**

Sava HIS is web-based application for real time data management and processed data management. Hydrological Information System for the Sava River Basin (Sava HIS) provides tools for collecting, storing, analysing and reporting a sufficiently high quality data hydrological and meteorological data. Those data and information will be used in decision-

making system in all aspects of water resources management, in the wide range of operational applications as well as in research.

d) Measures addressing **droughts** as separate hazard/problem.

Drought protection measures are in the form of reductions declared by the county, which limit the use of water.

For example, The Ministry of Agriculture issues a decision based on the Water Act, with the prior opinion of the County of Istria - Decision on the priority of water use in the County of Istria from surface and groundwater bodies during severe disturbances in water supply and other forms of water use (OG No. 95/12). This *Decision* determines:

- The order of priority of water use in the Istria County during severe disturbances in water supply and other forms of water use;
- Establishment of unfavorable hydrological conditions in the area of Istria County which have caused severe disturbances in water supply and other forms of water use;
- It is established that the Istria County Representative (Župan) has issued a Decision on restricting the use of water for public water supply in the water supply area in the County of Istria, which regulates restrictions on water supplied to users of water services through public buildings for public water supply;
- After County Representative has issued the Decision, local self-government units in the territory of the Istrian County are authorized to enable individual users to use water from springs.

e) Measures addressing **earthquake** as separate hazard/problem.

City of Zadar Example:

Pursuant to Article 17, paragraph 3, indent 7 of the Civil Protection System Act (OG No. 82/15) the executive body of the local self-government unit prepares and submits a risk assessment proposal to the representative body of major accidents, and pursuant to Article 17 (1), indent 2, the representative body shall issue a risk assessment of major accidents. By the decision of the Mayor on the procedure of making the Risk Assessment of Major Accidents for the Area of the City of Zadar and the establishment of the Working Group for the preparation of the Major Accident Risk Assessment for the area of the City of Zadar (hereinafter text: Decision),

composition and responsibilities of the Assessment Working Group. An assessment of the risk of major accidents for the area of the City of Zadar (hereinafter: the Assessment) is being prepared in accordance with the Guidelines for the preparation of risk assessment of major accidents for the Zadar County. The procedure for making the Assessment is in accordance with the HRN ISO 31000: 2012 - Risk management - Principles and guidelines, which serve the purpose of improving understanding risk at all levels, especially in terms of increasing the effectiveness of already established risk reduction measures of major accidents as well as defining new ones. The main coordinator of the risk assessment is the Mayor. The decision determines the coordinators for each individual risk and the holders and executors of risk development. Coordinators organize and coordinate the development of each individual risk, the holders create scenarios for certain risks, contact the competent authorities and scientific institutions for the purpose of collection information, while executors are obliged to cooperate and, within their competence, contribute to the elaboration of risk.

The risk assessment of major accidents for the area of the City of Zadar will address the following risks: **earthquake**, fire open type, floods, epidemics and pandemics and extreme weather events - heat wave. Assessment is a complex process of identifying, analyzing and evaluating risk, and is made based on scenarios for any specified risk. The scenario is, in the context of risk assessment, a way of presenting the estimated largest possible and most likely risks. Therefore, for each identified risk, at least two scenarios will be developed. The assessment is made at least once every three years and harmonization.

Risk response measures include coordination of operational civil protection system forces, health system protection and available capacities for care and nutrition in case of post-earthquake emergency. For the City of Zadar, in case of destructive earthquakes, according to their Major Accident Risk Assessment document for the City of Zadar (2018), existing operational forces civil system protections would not be enough and it would be necessary to engage forces from the state level. Regarding water supply, damage of water supply system pipelines is predicted on several specific locations.

4. Conclusions

General conclusions with key messages for the country (priorities).

- We can improve measures and cooperation with civil protection directorate in addressing earthquake and drought throughout MUHA project.
- Spatial central database of water quality is planned to be published soon on the WEB portal. In this way, civil protection will have an overview of overall situation and have faster and more coordinated response. Real time data availability would be a great improvement.
- Public water utilities proposed measures to improve the quality of water intended for human consumption and the public water supply system, namely: connection of smaller water supply systems to regional water supply systems; construction of waterproof sewerage system in the water protection area and implementation of the decisions on water source protection, purchase of land in the water protection area and expansion of the I sanitary drinking water protection zone (DWPZ), continuous preventive deaeration and desilting of water supply systems, upgrade and construction of new water treatment plants, improving the operation of pumping stations and new investments; abandoning the pumping station, replacement and rehabilitation of the old water supply installation, work on the rehabilitation of losses in the water supply system. Further improvement and upgrade of telemetry, ie measurement and monitoring of all parameters necessary for proper and efficient operation of the water supply system.

Appendix 1:

List of organizations and contact persons, which the draft was communicated:

1) Istarski Vodovod d.o.o. (IVB) – Melita Čohilj

- We made a short questionnaire for public water utilities in which we asked PWUs to define key identified risks, which might hinder the successful implementation of the improved water safety procedures, to address current water safety procedures at their utility and to provide information about collaboration with the Civil protection. Istarski Vodovod d.o.o. distributed the questionnaire to all PWUs in Croatia. We analyzed data gathered from 23 public water utilities.
- We received significant contribution for development and upgrade of the draft document from our project partner "Istarski vodovod d.o.o. (IVB)".

2) Civil Protection Directorate (Zagreb) – Zaviša Šimac

- We contacted Civil Protection Directorate in Zagreb City to get their input on their role in water safety procedures and hazardous events (especially drought). They provided us with desired information based on relevant legislation (May 2020).

3) Croatian Institute of Public Health (HZJZ) – Magdalena Ujević Bošnjak

- We had a short e-mail consultation with National Institute of Public Health on progress of WSP implementation in water utilities in Croatia (June 2020).
- The draft document was communicated with target national organization, the Croatian Institute of Public Health (HZJZ) via e-mail. All received comments and updates were of great help and support for making this document and providing the updated and relevant information (September 2020).

4) Hrvatske vode (Croatian Waters) - Daria Čupić

- The draft document was communicated with associated partner Hrvatske vode via e-mail. They provided us with comments and up to date information, which helped this document to be more relevant (September 2020).

5) Civil Protection Service at the Fire Department of the Istrian County – Boris Rogić

- Contact person read the draft document and provided us with comments (October 2020).

6) State Inspectorate – Andrija Mikulić

- „The State Inspectorate is the body responsible in the Republic of Croatia for the revision of water safety plans for human consumption, in accordance with Article 28 of Act on water intended for human consumption (OG. No. 56/13, 64/15, 104/17, 115/18, 16/20) and we provide you with comments in English embedded in your

submitted text. Comments and corrections relate primarily to corrections to the roles of all stakeholders in water control as well as corrections to the legislative framework. As for the part of the establishment of water safety plans, the submitted text deals very briefly with risk analysis as well as further steps on risk management, so we are of the opinion that it needs to be refined to be applicable in practice with a more detailed analysis of the pumping, treatment and water supply system.“ (October 2020).

Appendix 2 - *"Questionnaire for WSP status in water utilities_PP4 Croatia"*

Please answer the questions below regarding the status of implementation of water safety plans. The questionnaire is for informational purposes only. Thank you in advance!

1) HACCP control system is implemented into the water supply system of your water utility.

   YES/ NO

2) When was the HACCP system implemented? _____

3) Are you familiar with the Water Safety Plan - Croatian legislation ?
   YES/ NO

   In the amendments to the Water Quality Directive for human consumption from 2015, the concept of risk management using water safety plans was introduced into European legislation for the first time (EU directive 2015/1787). In order for the Republic of Croatia to harmonize its legislation with the legislation of the European Union, in the amendments to the Water Act for Human Consumption of 2017 (OG 104/17), it is prescribed that large water supply systems supplying more than 5,000 inhabitants or delivering more than 1,000 m^3 of water must introduce a Water Safety Plan in a period of 5 years, and small systems that supply less than 5000 inhabitants or deliver less than 1000 m^3 of water per day within 10 years (Croatian source).

4) Are you planning to shift from the HACCP control system to the Water Safety Plan for human consumption?
   _____

5) Is collaboration with the Civil protection during ongoing crisis (droughts, earthquakes, floods, accidental pollution) prescribed with the HACCP control system or some other water utility document?

   YES/ NO
   Link to the related document:

6) Is there a water utility action plan during ongoing crisis (drought, earthquake, accidental pollution or seawater intrusion)?

   e.g. in case of summer droughts and water reduction - who decides when to proclaim drought crisis, who contacts the Civil protection services for a mobile water tank distribution, etc..

   _____
   _____

7) Please describe identified risks that can obstruct successful implementation of improved water safety plans (WSP):

   1)Technical: *(e.g. complexity of the karstic aquifer)*_____
   2)Economical: *(e.g. limited financing)*_____

3)Political: *(e.g. shifting to WSP is low on the priority list)*_____

4)Other: _____

5. Sources:

HZJZ (2013) Croatian Health Service Yearbook. Zagreb: Croatian national institute of Public health.

HZJZ (2019) Croatian Health Service Yearbook for 2018. Zagreb: Croatian national institute of Public health.

Risk Assessment of Major Accidents for the Area of the City of Zadar (2018)

Statistical Yearbook 2013 of the Republic of Croatia. Zagreb: Croatian Bureau of Statistics

WB&DE (2012): Study on Institutional options in the Water Supply and Waste Water Sector. Zagreb: Witteveen+Bos and Dvokut ECRO.

World Bank. 2013a. Implementation Completion and Result Report (IBRD-72260 TF-54882), on a Loan for a Coastal Cities Pollution Control Project. Utility Performance information, Washington, dc: World Bank.

Strategies

Water Areas Management Plan for the period 2016 – 2021

Water Management Strategy (2009)

National Strategy for Sustainable Development (2009)

Acts, ordinances and regulations

Act on water intended for human consumption (Official Gazette No. 56/13)

Civil Protection System Act (Official Gazette No. 82/15)

Decree on water quality standard (Official Gazette No. 73/13)

Decision on the priority of water use in the County of Istria from surface and groundwater bodies during severe disturbances in water supply and other forms of water use (OG No. 95/12)

EU IPA 2010 TWINNING PROJECT "Development of Flood Hazard Maps and Flood Risk Maps" (http://twinning.voda.hr/)

Ordinance on the conditions for the establishment of sanitary protection zones (Official Gazette No. 66/11 and 47/13)

Regulation on fees for water management (Official Gazette No. 82/10 and 108/13)

Regulation on fees for water protection (Official Gazette No. 82/10, 83/12 and 151/13)

Regulation on the parameters of assessment and methods of analysis of water for human consumption (Official Gazette No. 125/13)

Regulations on parameters compliance and analysis methods for water intended for human consumption (Official Gazette No. 125/13)

Water Act (Official Gazette No. 153/09, 130/11, 56/13, 14/14)

Directives, international agreements and conventions

Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption

Institutions

Hrvatske vode (Croatian Waters) (http://www.voda.hr/en)

HZJZ – Croatian Institute of Public Health (https://www.hzjz.hr/)

Information systems

ARKOD system (ARKOD system)

Ecological Map of the City of Zagreb (https://ekokartazagreb.stampar.hr/)

Sava HIS Real-Time Data (http://savahis.org/his)