

X. Évfolyam 1. szám - 2015. március

RÁCZ LÁSZLÓ ISTVÁN  
[laszlo-antal.hu@t-online.hu](mailto:laszlo-antal.hu@t-online.hu)

## WATER SUPPLY AS A CRITICAL INFRASTRUCTURE ELEMENT IN LIGHT OF THE METROPOLITAN WATERWORKS ACTIVITY

### *Abstract*

*Water is a critical infrastructure element, and it requires great attention. This arises, because everywhere in the world the reduction of water resources creates great problems. Today our water supply is exposed to a great stain; as a result, the protection of the existing water resources is essential. The water supply in our country is a public service and the water supply of the citizens is safe. It is our common interest to protect our water resources. Hungary's capital Budapest with close to 2 million inhabitants has administrative, industrial, commercial, transportation, education, culture, arts and sports centres as well as being Hungary's most popular tourist destination. The Metropolitan Waterworks Ltd. with its high quality professional work provides the water supply of Budapest. In this article, I would like to highlight its wide range of activity, the mode of the water supply and its importance.*

*A víz, mint kritikus infrastruktúra elem nagy figyelmet érdemel, mert a világon mindenhol problémát jelent a vízkészletek csökkenése. Napjainkban a vizeink igen nagy terhelésnek vannak kitéve, ennek következtében a meglévő vízbázisok védelme elengedhetetlen. A vízellátás hazánkban közérdekű szolgáltatás, a lakosság vízellátása biztonságos. Közös ügyünk a vízkészleteink megóvása. Hazánk fővárosa Budapest, közel kétmilliós lélekszámú közigazgatási, ipari, kereskedelmi, közlekedési, oktatási, kulturális, művészeti és sportcentrum, Magyarország leglátogatottabb idegenforgalmi célpontja. Vízellátását a Fővárosi Vízművek Zrt. látja el magas színvonalú szakmai tevékenységével. Cikkemmel szeretnék rávilágítani e széleskörű tevékenységre a vízellátás módjára, fontosságára.*

**Keywords:** *infrastructure, water supply, water protection, drinking water source ~ infrastruktúra, vízellátás, vízvédelem, ivóvíz forrás*

## **INTRODUCTION**

Under the topic of critical infrastructure, we mean interconnected, interactive and mutually dependent infrastructure elements. These are the networks of facilities, services, systems and processes. They have vital importance and a meaningful role in the country's operation (inhabitants, economy and government), in a socially accepted minimal level of rule of law, public safety, national safety, economic viability, public health and environmental status. Critical infrastructures include those things whose disruption, malfunction, loss or destruction would have a severe impact on the citizen's economic and social welfare. These are communication networks, resources, services, products, physical or information technology systems, equipment, tools and their components. These are important since their disruption or malfunction, directly or indirectly, in the short or long term, can have serious consequences for public health, public safety, national security, national economy and the functioning of the government. (1). For easier use, the infrastructure can be divided to subgroups. (Figure 1.) The infrastructure can be divided into areas, too. Within the areas, there are the branches and within the branches, there are the specific parts called sectors. Based on preliminary analysis the below sectors and sub-systems may qualify as critical for the economic and social welfare of the citizens', public health, public safety and national safety. The list of branches and sub-branches may be modified during the analysis of the critical services and products.

<b>Branches</b>	<b>Sub branches</b>
I. Energy	1. crude oil production, refinement, storage and distribution 2. natural gas production, storage, transport and system control, distribution 3. electricity production, transmission and system control, distribution 4. information systems and networks
II. Information and communication technologies	5. equipment,-automation and control systems 6. internet, infrastructure and access 7. landline and mobile telecommunication services 8. radio communication and navigation 9. satellite communication and navigation 10. broadcasting 11. postal services 12. government IT and electronic networks
III. Transport	13. road transport 14. rail transport 15. air transport 16. water transport 17. logistics centres
IV. Water	18. drinking water service 19. checking the quality of surface and ground water 20. wastewater collection and purification 21. protection of water resources 22. flood protection structures and dams
V. Food	23. food production 24. food safety
VI. Health care	25. hospital care 26. rescue control 27. health care reserves and blood stocks 28. high-security biological laboratories 29. health insurance
VII. Finance	30. payment, stock clearance and settlement infrastructures and systems

	31. security for banks and credit institutes
VIII. Industry	32. production, processing and storage of chemicals
	33. transport of dangerous substances
	34. handling and storage of hazardous waste
	35. production, storage, processing of nuclear materials
	36. nuclear research equipment
	37. military industrial production
	38. production of vaccines and medicines
IX. Law and Order-Government	39. government facilities, tools
	40. administrative services
	41. justice
X. Public Safety-Protection	42. defence facilities, devices, networks
	43. infrastructure of law enforcement bodies

**Figure 1.** Examples for the areas, the branches and the sectors of infrastructure

(Source: <http://www.kozlonyok.hu/kozlonyok/Kozlonyok/10/PDF/2008/31.pdf>, download 2014. december 06.)

The sub-branches of water utility and service belong under the National Critical Infrastructure Protection program of 2080/2008.Decision (VI. 30.) as critical infrastructures. Ensuring the appropriate efficiency of protection is the task of the operator of the utility.

The quality standards for the water are controlled by legislations, which need to be considered by the service provider. Ensuring the quality of drinking water is essential for human life.

„In order to ensure the adequate quality of drinking water Directive 98/83 / EC of the EU Parliament and the Council feel it necessary that there be available and appropriate security measures in relation to surface and ground waters. Some of these are directly related to the water supply service, however some decrees are occasionally necessary such as those involving the environmental risks and protect water resources. For example 91/676 / EEC on the protection of agricultural nitrate pollution associated with the enforcement of pollution risk limiting activity that contributes to water protection. In 2012 the Parliament adopted a law on the identification, designation and protection of vital systems and facilities in the legislation (2012 CLXVI.). Annex 1. of this piece of legislation also touches on the water branches. According to the legislation the Government must annually submit a report to the Commission, which shall include on one hand the number of essential component elements by branches, which are designated as critical branch elements in Europe, on the other hand a number of member states in the European Union are dependent on the European critical system elements. "[2].

## **THE ACTIVITY OF THE WATER SUPPLY ASSURING SERVICE**

The drinking water supply for the capital of Hungary is provided by the Danube river and the drinking water service is carried out by the Metropolitan Waterworks, in accordance with legal regulations.

The Metropolitan Waterworks performs activities such as supplying the capital of Hungary and related agglomerations with drinking and industrial water supply and water transfer, through its subsidiaries, it attends on water and wastewater obligations.

The Szentendre island, the Csepel island and the banks of the Danube have 740 drinking water production wells, each of which has a capacity of 1 million cubic meters water production per day. The total length of pipelines for the city is 5100 km. The water supply is assured for the capital of Hungary and the agglomerations with world-class technology. In Budapest and its surroundings, several manufacturing and service organizations are demanding significant amount of water for industrial purposes. For them there is a separate pipe system that is water

intended for human consumption is strictly separated from industrial water. There are also strict rules for industrial water; therefore, this is only applied in case of such systems like cooling equipment or machinery.

These wells are capable of producing 1 million 200 thousand cubic meters of drinking water per day and allowing the transmission of this water. This is about 700 thousand cubic meters more than the population of Budapest consumes during a typical day. Despite the “water abundance” the supplier always keeps an eye on the natural treasure they are working with, which needs to be protected under all circumstances. [3]

The Metropolitan Waterworks activity is closely linked to the state and the purity of the environment. Thanks to environmental conscious corporate governance, during their activity they do not cause risk to the workplace, the urban and natural environment and of course the health of the population. As a service provider it is committed protecting the environment.

During its activity it pays a lot of attention to reduce environmental pollution and to raise awareness in protection of the environment. The Metropolitan Waterworks operates an environmental management system; an environmental work plan is in place that includes correction as well as prevention programs. Their environmental regulation is mandatory for them as well as for the subcontractors and partners. The supplier has a number of real estate properties, which are located at water base protection zones.

Their activities are regulated by the following legislations:

The 1997 CLV.Consumer Protection Act to keep consumers' interests in mind.

1991 XLV.Law of Metrology on metrology organization activities, and the use of units of measurement and measurements associated with legal operation.

The 2009 LXXVII Law provides guidance for the start and continuation of the service activity as well as taking part in the internal market activity.

1995 Act LVII.on water management is dealing with water utilization, utilization conservation, prevention of possible damages associated with the fundamental rights and obligations and takes into consideration the environment and environmental protection the as well as the legislations issued and implemented with reference to the Act.In particular the 38/1995. (IV.5.)

Government Decree on public utility water supply and disposal of sewage prevails. The 1959 IV Civil Code regulates the citizen's, the state's, municipality's, business and civil organization's certain personal relations.

In order for the marketing economy to function it is inevitable that the players on the market provide objective information on assets, financial and earning situation and this information would be accessible for decision making for both entrepreneurs and non-profit organizations, as well as other management bodies. The Accounting Act C of 2000.supports this.

The basic rules of personal data protection as well as the right to public information are laid down in the 1992. LXIII. law.

The 8/2000. (X.18) KöViM regulation is about the state owned water utility requisitioning related discount, while the 201/2001. (X.25) government regulation is about the quality requirements of drinking water and its monitoring rules.

Water resources and long-term resources and about the protection of drinking water facilities Government Decree No.123/1997. (VII.18.) is determinative. 21/2002. (IV.25.) KöVim Regulation regulates the operation of water utilities.

Drinking water serviced by municipality owned water utilities as well as municipality owned support for wastewater treatment as well as wastewater purification and treatment determining the highest official charge in the civil service area of Budapest, furthermore on the conditions of the use of the fees the 4/1995. (II, 13).Főv. Kgy regulation gives guidance. Based on this regulation the rate of the highest official fees are determined which the service provider can use in the Budapest civil service area.

## **WATER SUPPLY**

The Metropolitan Waterworks ensures the capital's and the surrounding agglomerations' water supply with north and south water utilities, settlements, water towers and water pipe networks.

### **Northern water resource**

Leaving the Visegrád cove the flow of the Danube is substantially slower, it disposes its river deposit, this is how the 31 km long, with an average width of 3-3.5 km Szentendre Island developed. Its surface was formed by the sediments of the Danube water and by the wind. Its geological feature is that the pebble layer is surrounded by clay at the bottom and sand on the top. This way it assures excellent water filtration and purification and thus provides good drinking water to the capital, and of course to the local residents. These areas are protected. It provides 70% of the drinking water need of the capital, ensuring the water supply for 1,5 million people. It is an outstanding water resource complex. The quality of the water is outstanding, real drinking water quality. Further purification is not required after disinfection; it can directly go to the water network. Coastal filtration wells supply 600,000 cubic meters of high quality drinking water per day.

### **Southern water resource**

The section of the Danube near Budapest, includes the areas located between Csepel-island, Ráckeve and Szigetszentmiklós, and provides 30% of the capital's water need.

In the Csepel island dwarf tentacle wells were built to meet the growing demand for water. Unfortunately, the southern water resource's wastewater load is significant, iron and manganese contamination can be detected. That is the reason that at the Csepel water treatment plant the water is first purified using an ozone treatment and then disinfected with chlorine and only after these treatments does it reach the consumers.

### **Plants providing water supply**

- Káposztásmegyer site
- Békásmegyer site
- Újlak site
- Krisztinaváros site
- Csepel site
- Kőbánya site
- Rákosszentmihály site
- Gilice square site

The aforementioned sites provide the water supply of Budapest in portions. We can distinguish about 60 zones in the capital's water supply network. In addition to the main establishments, they have about 90 different size and capacity machinery rooms. These mainly serve the small mountainous zones as well as the housing estates.

### **Water towers**

Water towers were built at Margitsziget, Kispest, Csepel, Kelenföld, a Szabadság mountain and the newest water tower was built at Budafok.

New water towers were built in Budapest and Csepel to supply ten-story houses. The 60-metre high tower's cup capacity is 3,000 cubic meters. The Diana street engine room fills the tower built from ferro-concrete at the Szabadság mountain on Eötvös street. The latest Budafok water tower provides a 3,000-cubic-meter capacity, was built on the Nagytétény plateau, and provides the water supply for Budafok and the surrounding areas.

## **Water pipe networks and water tube types**

In Budapest the water pipe network now reaches 5,100 km in length. The water pipe network can be divided into various sizes and sections.

The Metropolitan Waterworks of the capital possesses excellent water quality to satisfy the water needs of the people in the agglomerations also, by transferring water to the surrounding water plants.

The use of aqueducts was different at different ages. With the evolution of technology new tube types appeared. To build a such vast plumbing system is a serious task. Many aspects and rules should be kept in mind. Consideration should be given to the utility system, the surface ground ratios and the smooth functioning of urban life. Water supply for the public should be assured in case of pipe leak, replacement or while new pipeline system being established.

The Metropolitan Waterworks uses 8 types of water pipes. The gray cast iron pipe made by conventional technology, with added magnesium made into a spherical graphite coated cast iron pipe, cement tyred eternity pipe made with flatted pipe production technology, HDPE high density polyethylene pipes, PVC plastic pipes, Sentab stretched ferro-concrete pipes, Hobas fibreglass pipes and steel pipes. [4]

The basic need for the water supply is the constant monitoring of the quality of drinking water, from the wells supplying the water, through the water plant handling to the consumer's tap. The frequency and the spectrum of quality control are regulated by legislations as well as Hungarian and European standards.

## **ANALYSIS OF WATER QUALITY**

Existing legislations applicable to the analysis of the quality of water are: the 1995 Act LVII on water management and Government regulation 201/2001.(X.25.) on the quality requirements of drinking water and the orderliness of the analyses. [5]

In Hungary the analysis and the control of drinking water is done by the National Institute of Environmental Health and the National Public Health and Medical Services (Public Health Service). The public health requirements for cooking, dishwashing, water for personal hygiene require the same properties as for drinking water.

The Metropolitan Waterworks also has its own laboratory. The National Accreditation Board certified the laboratory according to the requirements of MSZ EN ISO/IEC 17025:2005, standard, (NAT-1-0681/2011).

According to the standards the drinking water should have the following properties:

- Colourless, transparent. Iron oxide makes the water reddish; algae make it greenish, while turbary soil makes it yellowish. The algae, bacteria, clay and sand may make the water clouded.
- Odourless. Hydrogen sulphide, chlorine, chlorophenols, organic substances, factory products and gases may make the water unpalatable and harmful to the health.
- It has a pleasant taste: water originating from turbary soil has a swamp taste, magnesium salts make it bitter, nitric acid salts make it sweet, chlorides make it salty, and iron results in an ink flavoured water.
- It should have a pleasant temperature. The best is the 10-14 ° C for water.
- It should not be too soft or too hard. The dissolved calcium and magnesium salts give the hardness of the water.
- Should not contain pollutants or infectious agents which are harmful for the health. It is possible that water is contaminated with faeces, in this case the person may have diarrhoea caused by coliform bacteria. In order to stop this the water is boiled, irradiated it with ultra violet light or ozone or chlorinated, or purified with silver ions.

From the chemicals the nitrates but especially the nitrite contamination makes the water unsuitable. While greater amounts of fluorine cause discoloration of teeth, or tooth decay as well. Iron and manganese impurities can be improved by aeration or sand and activated carbon filtration. People can get goiter from iodine deficiency. The testing laboratories can detect the amount of pollutants added from the air or the soil.

[6]

The water quality is constantly monitored. The experts in the sampling crew in the sampling car take samples on a weekly basis at several parts of Budapest. They sample wells, conduits, pools and water treatment plants. The number of samples per year is 12,000 water samples. Water samples are classified based on physical, chemical, microbiological and radiological features.

The water hardness in Budapest area corresponds to medium hardness. In Budapest many people complain about the hard water. People overlook the fact that for the human body and for machines used by them different water hardness is optimal. For drinking the better tasting hard water is the best, while operating machinery and equipment the soft water is preferable. Organic and inorganic chemical, bacteriological and toxicological tests are carried out on the samples. For the toxicological tests, they use plantlets, mussels and ornamental fish.

In addition to the laboratory tests, 24-hour automated water quality testing is done. However, with this test it is only possible to analyse few components. In the 24 hours on call system, it is possible to operate from the control centre 700 wells, 83 powerhouses, 64 pools, 14 chlorinators and 2 water treatment plants. [7]

## SUMMARY

The water utility service is a critical infrastructural element. Ensuring its protection is the responsibility of the utility operators. Tap water is one of most strictly controlled food. The domestic regulation in light of the analysed parameters contains more analysis requirements and for some of the chemical characteristics the acceptable limits are more stringent than the European regulations. Drinking water supplied by the Metropolitan Waterworks is produced by a high technology giving excellent quality water that contains the essential minerals for the human body. Today, several institutions cooperate to insure water quality, including the National Public Health institute and the National Public Health and Medical Officer Service. With these institutions, the specialized Public Health program objectives can be achieved as well as the international obligations.

Budapest the capital possesses such drinking water base, which is almost unique in the world. The Metropolitan Waterworks is able to supply the capital and the associated agglomerations with high quality drinking water. Szentendre island provides 70% of the drinking water supply of Budapest. The drinking water as “our national treasure” is high grade if we measure it with European standards. In our capital, it was barely necessary that our everyday life would be limited by water shortage.

The preservation of our water resources is our common goal. To achieve this goal collaboration is needed with the people living in the water resource areas and within the municipalities. We need to call people's attention to environmental protection at certain events. Contamination of water resources would cause immense damage; therefore, it is essential to prevent this.

I suggest the following:

- Public opinions and comments related to the water supply of the Metropolitan Waterworks – if it has not been already done so – should be centrally recorded on a computer and should be taken into account during the design and construction works.

- Make safer the level of protection of water source wells and reservoirs operated by the Metropolitan Waterworks – as critical elements of infrastructure – because of defense against terrorism.

## **References:**

- [1] Critical Infrastructure Protection of the National Programme in 2080/2008. (VI. 30.)
- [2] Tamás Berek - László István Rácz: Protection of water resources as a national vital system component Military Engineering VIII. Volume no.2. – June 2013  
ISSN1788-1919  
[http://www.hadmernok.hu/132\\_11\\_berekt\\_rli.pdf](http://www.hadmernok.hu/132_11_berekt_rli.pdf)
- [3] Metropolitan Waterworks  
<http://vizmuvek.hu/hu/fovarosi-vizmuvek/tarsasagi-informaciok/vizellatas/vizellatas>,  
(18 August 2014.)
- [4] Metropolitan Waterworks  
<http://vizmuvek.hu/hu/fovarosi-vizmuvek/tarsasagi-informaciok/vizellatas/vizesohalozat>, (15 August 2014.)
- [5] National Public Health and Medical Officer Service  
[https://www.antsz.hu/felso\\_menu/ugyfeleknek/hatosagi\\_ugyintezes/egyeb\\_ugydonto\\_hatosagi\\_eljarasok/kornyezet\\_es\\_telepules\\_egeszsegugy/ivoviz\\_vizminosegi\\_jellemzok\\_reszletes\\_vizsgalata.html](https://www.antsz.hu/felso_menu/ugyfeleknek/hatosagi_ugyintezes/egyeb_ugydonto_hatosagi_eljarasok/kornyezet_es_telepules_egeszsegugy/ivoviz_vizminosegi_jellemzok_reszletes_vizsgalata.html), (15 August 2014.)
- [6] Water, pH and what is in the water  
[http://www.vizlabor.shp.hu/hpc/web.php?azonosito=vizlabor&oldalkod=viz\\_labor\\_a\\_kony%20hamban\\_yoNE](http://www.vizlabor.shp.hu/hpc/web.php?azonosito=vizlabor&oldalkod=viz_labor_a_kony%20hamban_yoNE), (15 August 2014.)
- [7] NATIONAL GEOGRAPHIC Hungary  
[http://www.ng.hu/Civilizacio/2007/10/Hogyan\\_jut\\_a\\_Dunabol\\_a\\_furdokadba\\_a\\_viz](http://www.ng.hu/Civilizacio/2007/10/Hogyan_jut_a_Dunabol_a_furdokadba_a_viz),  
(15 August 2014.)