engineering proceedings

Proceeding Paper

Assessment of the Risks to the Drinking Water Supply System of the Nový Malín Communal Waterworks †

Silvie Drabinová *, Miroslav Kyncl and Martin Minář

Faculty of Mining and Geology, VŠB-Technical University of Ostrava, 17. listopadu 2172/15, 708 00 Ostrava-Poruba, Czech Republic; miroslav.kyncl@vsb.cz (M.K.); martin.minar.st@vsb.cz (M.M.)

* Correspondence: silvie.drabinova@vsb.cz

† Presented at the 4th International Conference on Advances in Environmental Engineering, Ostrava, Czech Republic, 20–22 November 2023.

Abstract: This article addresses an important task for the operators of public water supply systems. It is to ensure the long-term security, reliability, and provision of the required quantity and prescribed quality of drinking water systems. To fulfill this task, a program called "Risk Assessment" has been developed. The risk assessment program for the drinking water supply system is incorporated into current legislation, which mandates that all operators of public water supply systems assess the waterworks that they operate. The objective of this article is to assess the risks of the drinking water supply system of the Nový Malín communal waterworks in accordance with the applicable legislation and recommended methodology. These waterworks constitute communal waterworks and encompass 7 underground water sources serving 3 municipalities and 7 settlements totaling 3500 residents. The results of this analysis should serve as a basis for updating the operational regulations of the waterworks and for assessing whether the methodology used is suitable for this type of water supply system.

Keywords: risk assessment; supply system; safe operation; drinking water

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Citation: Drabinová, S.; Kyncl, M.; Minář, M. Assessment of the Risks to the Drinking Water Supply System of the Nový Malín Communal Waterworks. *Eng. Proc.* **2023**, *57*, 27. https://doi.org/10.3390/engproc2023057027

Academic Editors: Adriana Estokova, Natalia Junakova, Tomas Dvorsky, Vojtech Vaclavik and Magdalena Balintova

Published: 6 December 2023

1. Introduction

Since 2004, the World Health Organization (WHO) has proposed a concept known as "Water Safety Plans" or "Safe Drinking Water Supply Plans". This concept was introduced in the third edition of the "Guidelines for Drinking-water Quality". This methodology is based on over 50 years of experience and serves as the foundation for national regulations and standards for drinking water safety. In accordance with Council Directive 98/83/EC on the quality of water intended for human consumption, as specified in Commission Directive (EU) 2015/1787, this approach is referred to as "risk assessment." The International Water Association (IWA), comprising water utilities and experts from around the world, supports this strategy. This approach also forms the basis of current Czech legislation, where the term "risk assessment" has been used since 2017 [1,2].

The risk assessment of water supply systems is already established and conducted in more than ten European and several non-European countries. The main anticipated benefits of this process include the improvement of drinking water quality, reduction of the number and severity of incidents, enhanced protection of water resources, a decrease in acute illnesses among the population, better monitoring of the water supply system's operation, gaining a comprehensive understanding of the entire supply system's functioning, corrective measure cost reduction, and improved oversight and control by regulatory authorities [3].

However, it is important to note that for water utility operators, performing a risk analysis can entail increased administrative complexity and associated costs.

An amendment to Public Health Protection Act No. 258/2000 Coll., effective from 1 November 2017, imposed a new requirement on producers and suppliers of drinking

water for public distribution to prepare risk assessments, also known as "water safety plans." These assessments will be part of the operational regulations of public water supply systems and the monitoring program, thus complying with Council Directive 98/83/EC on the quality of water intended for human consumption [4].

2. Legislation of the Risk Assessment Process

The entire drinking water supply system in the Czech Republic is based on several key legal regulations. The foundation includes the Water Act (Act No. 254/2001 Coll.), the Act on Water Supply and Sewerage Systems for Public Needs (Act No. 274/2001 Coll.), and the implementing decree (Decree No. 428/2001 Coll.). Furthermore, for risk assessment, Act No. 258/2000 Coll. on Public Health Protection and its implementing decree No. 252/2004 Coll. are essential, as they define the indicators of drinking water quality.

2.1. Act No. 258/2000 Coll. on Public Health Protection

The risk assessment of drinking water is an obligation for entities such as water utility operators or commercial wells that supply drinking water to public water supply systems or produce it from an individual source as part of their business activities, for example, farms, hotels, and guesthouses where drinking water is used for operational purposes.

The risk assessment is methodically processed as a document that comprehensively describes the risk analysis process within the drinking water supply system. This document also includes proposals for corrective and monitoring measures designed to address risk situations.

The risk assessment must be integrated into the operational regulations, as stated in Section 3c, Paragraph 1 of Act No. 258/2000 Coll. [4], as amended. The operator of the drinking water supply system is obliged to keep these operational regulations up to date and submit them for approval to the relevant public health protection authority [5].

The operator of the drinking water supply system is required to prepare (or update) the operational regulations, including the risk assessment of the drinking water supply system, and submit them for approval to the relevant public health protection authority no later than 31 October 2025 (see Article IV of Act No. 202/2017 Coll., as amended) [5]. These regulations must be approved by the appropriate hygiene station. The State Health Institute, the Czech Water Association, and the Association of Water Supply and Sewerage Field play significant roles in the professional oversight of this process [6,7].

2.2. Decree No. 252/2004 Coll. Laying down Hygiene Requirements for Drinking and Hot Water, and the Frequency and Scope of Drinking Water Monitoring

The detailed procedure for risk assessment is contained in this decree, which specifies the hygiene requirements for drinking and hot water and the regularity of drinking water inspections. This decree was amended in 2018 by Decree No. 70/2018 Coll., which stipulates that the risk assessment will be conducted in accordance with Annex No. 7 to this decree. It also mandates the updating of existing operational regulations [8].

Important requirements for risk assessment include:

- Risk assessment is moderate and high in the case of non-compliance. For water utility systems with many identified risks, only those with significant consequences are considered unacceptable.
- Risk assessments are conducted independently by individual water supply systems. If they are part of a communal waterworks and have a single operator, that operator is responsible for risk assessment. If there are multiple operators for a communal waterworks, the risk assessment is carried out in such a way that individual components complement each other [8].

The individual procedures are divided into 8 steps, which were applied in a specific location, the Nový Malín communal waterworks (Section 4).

3. Methodological Guide for Conducting Risk Assessments of Drinking Water Supply Systems in Accordance with the Public Health Protection Act

A methodology has also been developed by the SZÚ for risk assessment, which corresponds to Annex No. 7 of Decree No. 252/2004 Coll. This methodology is based on international standards and previous studies with the aim of ensuring the delivery of safe and high-quality drinking water that meets the requirements of all users. It is essential for this water not only to comply with hygiene standards but also with organoleptic parameters such as taste, odor, and color which influence the initial impression when drinking tap water [6]. This methodology can be continuously supplemented and updated by processors based on new insights and experiences [6].

The methodological guide for the risk assessment of drinking water supply systems is based on the Public Health Protection Act. It encompasses systematic procedures to ensure the delivery of safe water from its source to consumers. This integrated approach is key to securing high-quality and safe drinking water for all [9].

As part of the risk assessment, the operator of the drinking water supply system forms a team with the goal of verifying whether the operated drinking water supply system is documented (from the water source to the consumer). Another task of the team is to identify hazardous events that have previously jeopardized or could jeopardize the quality or quantity of the supplied drinking water [10].

The objective is to assess the level of risk for a given hazardous event (incident) and subsequently manage the risks (determine corrective and control measures, verification, etc.) in a way that minimizes the danger to the quality and delivery of drinking water [5].

4. Application of the Risk Assessment Methodology at a Specific Location

The selected water supply systems to be described are located in the Šumperk district in the cadastral areas of the municipalities of Nový Malín, Hrabišín, and Dolní Studénky. The land area of the Nový Malín municipality is approximately 30.1 km^2 and consists of three parts: the Mladoňov u Oskavy settlement, the Plechy part, and the Nový Malín part. The land area of the Hrabišín municipality is 13.9 km^2, with individual parts being Dolní Olešná, Horní Olešná, and Loučky. The land area of the Třemešek satellite is less than 1 km^2 [11]. The total amount of water produced in the group water supply system Nový Malín in individual sources in the years 2018–2022 can be seen in Table 1.

Table 1. Water produced in the Nový Malín communal waterworks [11].

Source Name	2018 *	2019 *	2020 *	2021 *	2022 *
Luže	57.7	61.9	41.5	55.4	72.3
Malínský les	150.3	141.8	218.1	197.9	142.1
Pod lesem	48.0	24.9	10.9	14.9	39.7
Vrt Mladoňov	9.4	9.6	9.2	9.3	9.9

* in thousands of cubic meters. Sources of drinking water.

As of 31 December 2022, the Mladoňov settlement had 209 residents and is supplied with water from a single public water supply. All water connections are equipped with FLOW 2200 ultrasonic water meters (Kamstrup, Roskilde, Denmark)with remote reading capability and water leak detection. The water supply infrastructure was built between 2005 and 2007, along with sewage and wastewater treatment facilities. In the Mladoňov settlement, there is a predominance of family houses, recreational cottages, hospitality establishments, and an environmental education center. The highest point of the water supply system is located at an altitude of 597 m above sea level, and the lowest point is at 460 m above sea level.

The main water supply network is situated in the Nový Malín municipality, where there were 3459 residents as of 31 December 2022. This network comprises three catchment areas: Malínský les, Lokalita pod lesem, and Luže. The history of the water supply system in the municipality dates back to 1929. In the Malínský les area, a small hydroelectric power

plant was built on the feeder. The municipality of Nový Malín owns three water reservoirs that serve for water distribution. The water supply is divided into three pressure zones, and pressure ratios are controlled through the use of water reservoirs. The highest point in the municipality is Kamenný vrch, with an elevation of 947 m above sea level, while the populated part of the municipality lies between 316 m above sea level and 464 m above sea level [11].

In the Třemešek area, there is an industrial zone and approximately 30 family houses. These houses are supplied with water from a water supply network that is operationally integrated into the Nový Malín water supply, although it falls within the cadastral territory of the Dolní Studénky municipality [11].

The Hrabišín municipality owns a single water reservoir where water is pumped from the reservoir in Nový Malín. As of 31 December 2022, the municipality had 836 residents. Water connections have been provided to most houses, but approximately half of them do not use the supplied water as they have their own wells. In total, 210 water meters are installed, of which 200 are residential water meters with remote reading and leak detection on Multical Flow 2200 connections [11].

The minimum usable quantity from all four underground water sources (Malinský les, Pod lesy—boreholes no. 1, 2, and 3, Luže—boreholes no. 17 and 20, and Mladoňov catchment areas) owned by the Nový Malín municipality is 29.78 L per second. It can be concluded that for the Nový Malín, Hrabišín, and Třemešek communal waterworks, there is a sufficient quantity of water available for supplying the population. There is also enough water to supply the surrounding municipalities, even after accounting for reserves in case of potential climate changes or other natural disasters (in Table 2). The existing underground sources ensure an adequate water supply even during dry periods [11,12].

Table 2. Clear information about the water sources of the Nový Malín municipality [11].

Source Name	Annual Permitted Abstraction (m^3)	Permit for Water Handling Into:	Water Source Origin	Maximum Permitted Abstraction (L/s)
Malínský les	157,721	31 January 2056	shallow groundwater	10.0
Vrt č.1	9999	31 December 2030	groundwater	1.5
Vrt č.2	94,600	31 December 2030	groundwater	3.5
Vrt č.3	94,608	31 December 2050	groundwater	5.0
Vrt č.17	78,840	31 January 2056	groundwater	7.0
Vrt č.20	78,840	31 January 2056	groundwater	7.0
Mladoňov	20,004	31 December 2031	groundwater	1.5

The water from all sources, in terms of quality, complies with Decree No. 252/2004 Coll., which sets out the hygiene requirements for drinking and hot water. Only disinfection for water safety during its transportation is provided. Disinfection is ensured by the dosing of sodium chlorite.

4.1. Water Reservoirs

The water reservoirs in Nový Malín, Mladoňov, and Hrabišín are always underground tanks with a water volume designed for the seamless supply of water. A list of water reservoirs located in the subject area is provided in Table 3. Their main purpose is to accumulate drinking water and create suitable pressure conditions at the point of use. Chlorination may also take place in these reservoirs. The water reservoirs are fully functional without any apparent defects [11].

Table 3. Clear information about the water reservoirs [11].

Name of the Water Reservoir	Annual Permitted Abstraction (m^3)	Permit for Water Handling Into:	Water Source Origin
VDJ * Mladoňov	593	597	50
VDJ * Hrabišín	407	410	100
VDJ * 40	476	479	40
VDJ * 200	411	415	200
VDJ * 300	375	379	300

* VDJ—water reservoir.

4.2. Distribution Water Mains

The distribution mains for the supply and delivery of water in the group waterworks of Nový Malín, Hrabišín, and the Třemešek satellite have been under construction since 1928 up to the present day (in Table 4). The renovation of water mains is being carried out according to the approved renovation plan from 2022.

Table 4. Basic information about the water supply networks of the Nový Malín group waterworks [11].

Water Supply Name	Owner	DN	Length in Kilometers	Material	Number of Connections
Water Supply Mladoňov	village Nový Malín	3.5	63 a 90	HDPE	89
Water Supply Nový Malín	village Nový Malín	29.6	from 50 up to 150	1/2 cast iron a 1/2 plastic	1022
Water Supply Hrabišín	village Hrabišín	11.4	90 a 110	PVC	275
Water Supply satelit Třemešek	village Dolní Studénky	1.0	90	HDPE	38

In 2022, a water loss of 11.5% was identified across the entire pipeline network, which is assessed as a good condition, well below the Czech Republic's average [11].

On the Hrabišín and Mladoňov water supply systems, pressure-reducing valves are installed in control shafts. In Hrabišín, an ATS (automatic transfer switch) is also installed to secure pressure conditions in the upper pressure zone of the Hrabišín municipality towards the Libina municipality [11].

The potential risks that may arise within the operation of the group water supply are:

- Natural disasters;
- Unauthorized entry into protective zones or buildings and water contamination;
- Exceeding the prescribed dosage of disinfectant;
- Inadequate hygiene protection of drinking water;
- Agricultural activities in the vicinity of raw water sources;
- Malfunction of source pumps or ATS;
- Infiltration of surface water into sources and contamination of raw water.

5. Conclusions

When evaluating the drinking water supply system of the Nový Malín group waterworks company, it was found that there were 21 risks (in Table 5) with low danger levels, for which possible corrective and monitoring measures were proposed. A total of 5 identified risks had parameters indicating a medium level of risk, for which corrective measures and a date for implementation were established (in Table S1). No risk was assessed as high, indicating a low level of threat to the operational system.

The obtained results were incorporated into the operational regulations and monitoring program. Furthermore, it was determined that the methodology used is suitable for this type of group water supply.

Table 5. Summary of identified hazards and associated risks according to the individual parts of the supply system risk matrix as per [6].

Part of the System	Risk Level			
	High	Medium	Low	Total
Sources	–	2	11	13
accumulation and treatment	–	2	5	7
distribution	–	1	5	6
Total	0	5	21	26

A detailed schedule is attached.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/engproc2023057027/s1, Table S1: Medium risk level and corrective measures.

Author Contributions: Conceptualization, S.D.; writing—review and editing, M.K.; investigation, M.M. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Data supporting reported results can be found at Supplementary Materials.

Conflicts of Interest: The authors declare no conflict of interest.

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