Water Safety Plans for small DWSS: public summary

Deliverable D7.2, WP7

Project Number	**101081980**
Project Title	Climate-resilient management for safe disinfected and non-disinfected water supply systems
Project Acronym	SafeCREW
Project Duration	1 November 2022 – 30 April 2026
Call identifier	HORIZON-CL6-2022-ZEROPOLLUTION-01
Due date of Deliverable	Month 36, 31.10.2025
Final version date	Month 36, 30.10.2025
Dissemination Level	PU (Public)
Deliverable No.	D7.2
Work Package	WP7
Task	T7.2
Lead Beneficiary	NUWEE
Contributing Beneficiaries	KWB, POLIMI, DVGW-TUHH, EUT
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This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101081980.

History of Changes		
Version	**Publication Date**	**Change**
0.3	06.10.2025	1st version sent to the coordinator
0.5	29.10.2025	Final review
1	30.10.2025	Submitted to commission

Part. No.	**Participant organisation name**	**Short name**
1 (Coordinator)	German Association for Gas and Water, local research branch at Hamburg University of Technology	DVGW-TUHH
2	Politecnico di Milano	POLIMI
3	Berlin Centre of Competence for Water	KWB
4	BioDetection Systems B.V.	BDS
5	Centre Tecnológic de Catalunya (EURECAT)	EUT
6	German Environment Agency	UBA
7	Helmholtz-Centre for Environmental Research	UFZ
8	Consorci Concessionari d'Aigües per als Ajuntaments i Industries de Tarragona	CAT
9	Tutech Innovation GmbH	TUTECH
10	Metropolitana Milanese SPA	MM
11	Multisensor Systems Ltd.	MSS
12	The National University of Water and Environmental Engineering	NUWEE

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Abstract

The harmonization of the activities of Ukraine’s water supply enterprises in accordance with EU directives is an important step in the process of European integration. To this end, amendments are being made to Ukraine’s legislative documents; EU financial support is being implemented to improve the quality of water supply through the professional development of drinking water specialists, the provision of loans to local self-government bodies, and the fulfilment of drinking water quality requirements established by EU directives, among other measures. One of the strategic tools ensuring continuous access to safe drinking water is the Water Safety Plan (WSP). These plans acquire particular importance in situations of emergency, technical failure, or military conflict.

The report describes the development of WSPs for three small drinking water supply systems located in the western regions of Ukraine. It outlines the formation of a water safety planning team. Based on the study of technical documentation from water supply enterprises, inspections of water supply system components, interviews with enterprise staff and water consumers, as well as selected field measurements and verification calculations, the systems were described and assessed. An additional source of information was the results of a year-long monitoring of water quality in the three small water supply systems. The report provides a concise description of characteristic hazards and hazardous events, presents the results of risk assessment, and outlines subsequent actions to address them. The next steps in implementation include the development of procedures to be followed under normal conditions, during incidents, or in emergencies. The effective implementation of WSPs will take into account the input and expectations of stakeholders from all categories.

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Abbreviations

DWSS	Drinking Water Supply System
DWDN	Drinking Water Distribution Network
DSanPiN	National Sanitary Rules and Standards
DWTP	Drinking Water Treatment Plant
DWSU	Drinking Water Supply Utility
ERP	Emergency response plan
EU	European Union
MHU	Ministry of Health of Ukraine
NUWEE	National University of Water and Environmental Engineering
SOP	Standard Operating Procedure
SAWRU	State Agency of Water Resources of Ukraine
WHO	World Health Organization
WSP	Water Safety Plan
WU	Western Ukraine

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1. Introduction

Ukraine's aspiration to join the community of highly developed countries requires continuous improvement and harmonization of legislation and policies in line with EU requirements. An important direction of this effort is the enhancement of water supply safety.

At the United Nations Conference on Environment and Development (Rio de Janeiro, 1992) [1], water-related problems, including its use and scarcity, were identified as factors constraining the development of many countries, as well as sources of interstate conflicts and instability, causes of declining quality of life, poor sanitation, and increased morbidity.

Among the existing mechanisms for water quality management, the water safety plan (WSP), developed by the UN and WHO, represents an implementation of a systematic approach. The WSP is a strategic document designed to ensure the continuous safety of drinking water at all stages of supply – from the source to the consumer [2]. Accordingly, the key components of a WSP include: assessment of the source and the water supply system; operational monitoring of control measures within the supply system; management plans (all documentation concerning risk assessment and monitoring under both normal and emergency conditions, as well as measures to optimize the state and functioning of the water supply system); documentation and communication; and an independent oversight system for WSP implementation aimed at safeguarding public health.

The main objectives of a WSP are risk identification: detection of potential threats to water quality at every stage of the supply chain; pollution prevention: implementation of measures to avoid the entry of harmful substances into water; control and monitoring: continuous supervision of treatment effectiveness and compliance with quality standards; emergency response: preparedness for accidents, disasters, or other events that may compromise water safety. The WSP is necessary for drinking water providers (utilities, municipal services), local self-government bodies, health care institutions, and private enterprises that use water in production. In the context of the current military attack by Russia and resulting infrastructure destruction, access to safe water has become critically important. The efforts with a view to WSP helps restore public trust in water supply systems, attract international support and investment, and comply with EU requirements for drinking water quality.

This report outlines the development process of Water Safety Plans (WSPs) for three small water supply systems located in western Ukraine. In view of the current situation in the country, the information presented has been prepared with due consideration of sensitive technical data. The further expansion of the WSP will serve as a reliable tool for collective engagement of all stakeholders in enhancing the safety of water consumed by all users.

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2. Formation of the Water Safety Planning Team

At the initial stage, meetings were organized with representatives of NUWEE. The recommendations [2] were analyzed, and NUWEE's capacity for preparing WSPs was assessed. In parallel with this process, meetings were held with the heads of three DWSUs, during which they were introduced to the objectives of the SafeCREW project and the purpose of developing WSPs. Following positive feedback, technical staff from these utilities were included in the Water Safety Planning Team. Further analysis of the WSP tasks revealed the need to involve an external drinking water safety specialist from the Regional Center for Disease Control and Prevention of the MHU. Considering that the water abstraction for Site#3 is linked to the condition of surface water sources (rivers), an additional external expert specializing in the management, use, and restoration of surface water resources from the Basin Water Resources Management Authority of the SAWRU was also engaged. It was further planned to obtain feedback from local executive authorities and water consumers from various categories (households, local industries, and municipal institutions). Their role was to provide input on the quality of water supply services, helping to identify hidden potential hazards that might not be known to the utilities. Communication with these stakeholders took place during site visits for water sampling from the DWSS. For example, Table 2.1 presents information about the Water Safety Planning Team for Site#3.

Table 2.1. Water Safety Planning Team

Full name	Position	Skills, knowledge and expertise related to WSP	Role in WSP team
S. Martynov	Operations Manager	Operation of water supply systems – design, construction, and planning. Head of the Department of Water Supply, Sewerage and Drilling at NUWEE	Team leader. Responsible for coordination with external stakeholders. Expert in water supply system
V. Moshynskyi	Scientific Consultant	Anthropogenic impact on natural systems. Rector of NUWEE.	Expert in assessing the impact on centralized water supply sources
M. Khlapuk	Scientific Consultant	Hydraulic systems. Professor at the Department of Hydraulic Engineering and Hydraulics at NUWEE.	Expert in the design and operation of hydraulic systems
S. Klimov	Technical Specialist	Operation of catchment facilities. Associate Professor at the Department of Hydraulic Engineering and Hydraulics at NUWEE.	Expert in catchment facilities. Responsible for water quality monitoring.
L. Perehinets	Water Supply System Operator	Management and technical maintenance of the water supply system. Chief Engineer of DWSU.	Responsible for contact with the drinking water supply company and city authorities. Expert in water supply systems
N. Sedliar	Drinking Water Safety Specialist	Specialist in public health and water quality. Head of the Department of Epidemiological Surveillance and Non-Communicable Diseases Prevention at the Regional Centre for Disease Control and Prevention.	Responsible for assessment and analysis of water quality indicators

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Full name	Position	Skills, knowledge and expertise related to WSP	Role in WSP team
V. Andriichuk	Specialist in Surface Water Resource Management, Use and Restoration	Deputy Head of the Basin Water Resources Department of the State Agency for Water Resources of Ukraine	Responsible for contact with the central executive body, implementing state policy in water resource management, use and restoration. Expert in water resource management
T. Romanenko	Water Quality Indicators Specialist	Specialist in the analysis of groundwater, surface water, tap water, and recycled water quality indicators. Head of the Hydro-chemical Laboratory at NUWEE	Responsible for sampling and determination of water quality indicators

3. Description of Small Water Supply Systems

At this stage, information was collected, documented, and analyzed for the water supply systems of three facilities located in the WU. This made it possible to assess and manage risks within the subsequent modules of the WSP framework. Data collection was carried out through the review of DWSU documentation, inspection of water supply system components, selected measurements of key parameters (such as water quality, flow rates, and pressure), and interviews with individual water consumers. The following structure was chosen for describing each small DWSS: Location of the Facility; Water Consumers; Existing Water Supply Scheme; Monitoring of Water Quality in the DWSS.

The “Location of the Facility” subsection provides a territorial and geographical description of the water supply facility.

The “Water Consumers” subsection analyzes the types of water users, including the population, local industries, and municipal institutions. This information was collected based on documentation provided by the DWSUs. Below is a characterization of water consumers for each facility.

The DWSS of Site #1 provides centralized water supply services to an urban-type settlement with a population of 5,360 residents and a population density of 756 persons/km². The consumers of the DWDN are classified into groups according to the level of housing amenities (Table 3.1).

Table 3.1. Characteristics of water consumers (population) by level of housing amenities

No.	Level of amenities	Norm, L/day	Number of consumers, residents
1	Street water street water column	50	581
2	Water supply, sewerage without bathtub	95	26
3	Water supply without sewerage	100	718
4	Water supply, sewerage without bathtub, gas supply	120	555
5	Water supply, local sewerage, bathtub, solid-fuel water heater	125	444
6	Yard water street water column	150	1393
7	Water supply, local sewerage, bathtub, gas water heater	150	1036
8	Water supply, sewerage, bathtub, solid-fuel water heater	150	5

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No.	Level of amenities	Norm, L/day	Number of consumers, residents
9	Water supply, sewerage, bathtub, gas water heater (gas boiler)	190	36
10	Water supply, sewerage, bathtub, multi-flow water heater (gas column)	210	94
	Total consumers:		4888

Approximately 470 residents are not connected to the centralized water supply system due to having individual water sources (wells or boreholes) and based on an average estimate of the population from open-source data.

Most local enterprises consume relatively small amounts of water and can therefore be accounted for with a coefficient of 1.1-1.2. However, among these enterprises, five were identified as the largest consumers, with individual monthly consumption ranging from 82 to 1,549 m³/month, and total consumption by the largest users amounting to 2,463 m³/month.

The DWSU of Site #2 provides water supply services to eight small settlements (villages) with a total population of 2,940 residents, all of which have local DWSS. One DWSS, serving 150 households (approximately 450 consumers), was analyzed. All water consumers have individual water meters; however, access to this information is classified as “for official use only.” During water quality monitoring, it was found that some consumers also have private water sources. In such cases, water from the DWDN is used for drinking, personal hygiene, and cooking. Analyses of water quality from private sources indicated non-compliance with DSanPiN [3] standards for the following parameters: salt content, Ca^{2+}, total hardness, and alkalinity.

The DWSS of Site #3 provides centralized water supply services for two settlements – a city and a village. The city has a population of approximately 6,086 persons, an area of 24.67 km², and a population density of 256 persons/km². The village has 2,403 residents, an area of 14.153 km², and a density of 169.79 persons/km².

The DWSU serves 1,662 subscribers, totalling 4,980 water consumers: City: 1,347 subscribers (4,040 consumers); Village: 315 subscribers (940 consumers).

The approved water consumption standards are:

- 120 L/(day·person) for private households and multi-storey buildings;
- 57 L/(day·person) for dormitory residents (two five-storey dormitories, 120 residents).

Based on these norms (excluding individual water meters), water consumption accounts for approximately 1% of all subscribers.

Regarding water supply and wastewater usage, 100 private enterprises consume 593 m³/month, and 40 municipal institutions consume 1,320 m³/month. Seven of the largest consumers were identified, with individual monthly consumption ranging from 79 to 146 m³/month, and a total of 1,239 m³/month for the largest consumers.

The “Existing Water Supply Scheme” subsection describes the operational DWSS.

The DWSS of Site #1 consists of catchment wells (1 operational and 1 reserve), rapid sand filters, a disinfectant dosing unit (sodium hypochlorite), two clean water storage tanks (300 m³), a booster pumping station, and a water distribution network (Figure 3.1).

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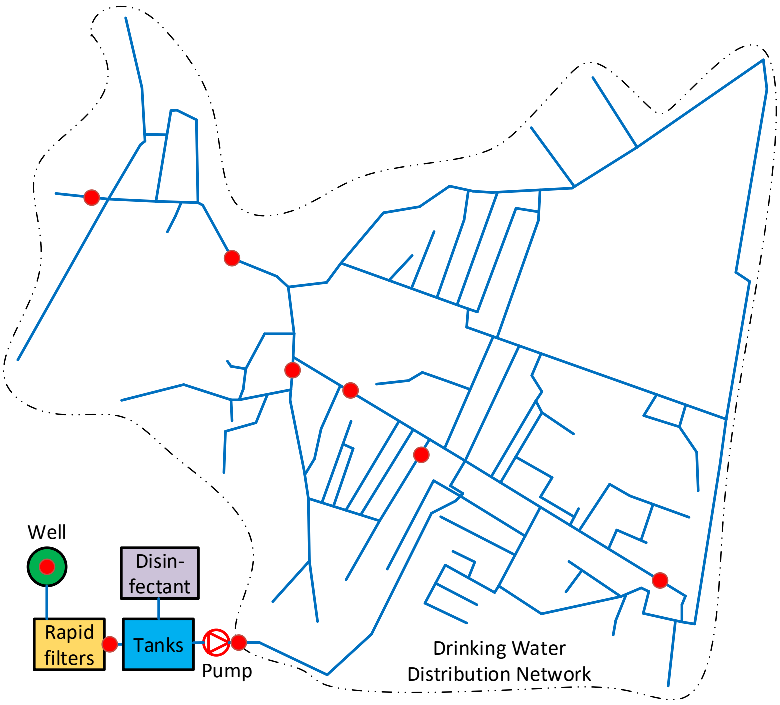

Figure 3.1. DWSS (site #1)

The operational well is located on the premises of the DWTP. It has a depth of 100 m and is equipped with a Grundfos SP-77-5RpS 3x380-415/50 pump. To reduce iron concentration, simplified aeration and filtration through rapid filters are used. The water is then disinfected with a sodium hypochlorite solution, with the required contact time taking place in the storage tanks. Water from the DWTP is supplied to the network by a K100-80-160 centrifugal pump equipped with a VFD (variable frequency drive). The DWDN is mainly constructed of cast iron pipes, with a total network length of 30.78 km, including: Ø200 mm – 2.70 km; Ø150 mm – 7.36 km; Ø125 mm – 0.05 km; Ø100 mm – 10.51 km; Ø50 mm – 1.55 km.

The actual daily capacity of the DWSS is 700–1,200 m³/day.

The DWSS of Site #2 consists of a catch well, a steel water tower (25 m³) containing water treatment equipment, and a distribution network (Figure 3.2). Technical documentation for the well is unavailable. No disinfection is carried out. The DWDN is made of polyethylene pipes, with a total network length of 4,075 m, including: Ø110 mm – 440 m; Ø90 mm – 360 m; Ø60 mm – 453 m; Ø50 mm – 200 m. The estimated daily water consumption is 42–64 m³/day.

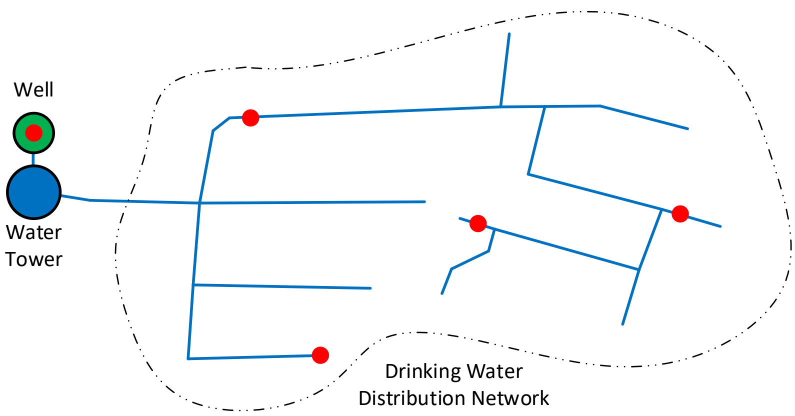

Figure 3.2. DWSS (site #2)

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The DWSS of Site #3 consists of two operational catchment wells, reinforced concrete pressure storage tanks of 1,000 m³ each, equipment for sodium hypochlorite dosing, and a DWDN. (Figure 3.3).

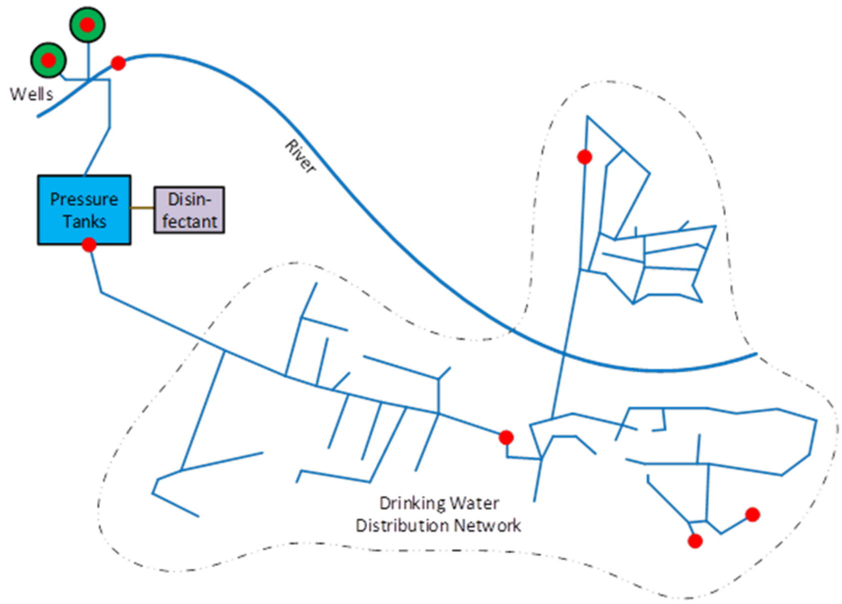

Figure 3.3. DWSS (site #3)

The catchment wells are located near a surface water source (river) and have depths of 23.0 m and 24.8 m. The wells are fed by river bank filtration (RBF) water. No additional water treatment is carried out. Water from the catchment is supplied to a pressure storage tank. One of the storage tanks is unsealed and requires restoration. Sodium hypochlorite solution is periodically added to the operational storage tank. From there, water flows by gravity through polyethylene pipes to consumers. The total length of the network is 17.77 km, including: Ø250 mm – 2.82 km; Ø200 mm – 0.73 km; Ø160 mm – 3.81 km; Ø110 mm – 5.23 km; Ø50 mm – 2.77 km; Ø32 mm – 1.46 km; Ø25 mm – 1.47 km. The actual daily capacity of the DWSS is 450–530 m³/day.

The "Monitoring of Water Quality in the DWSS subsection describes the DWSU's water quality monitoring program. Water quality parameters and their measurement frequency were analyzed. At Site #1, water quality parameters were determined in the utility's own chemical and bacteriological laboratory; however, this laboratory lacks equipment for trihalomethanes analysis. Sites #2 and #3 do not have their own laboratories and therefore use the services of the Regional Centre for Disease Control and Prevention.

For each facility, water consumption calculations were carried out according to [4]. These calculations were later used for DWDN modelling in EPANET, which helped identify potential weak points and hazards. Specifically: For Site #1, sections of the water distribution network with excessive pressure losses and high pressures were identified, and the "governing node" was determined and verified by DWSU staff. For Site #3, a critical pressure drop was identified in the network in the event of a fire at the local hospital. In this scenario, the DWDN cannot provide the design fire-fighting water flow. It was also proposed that the DWSU consider expanding the existing water supply system to serve the entire settlement. For this purpose, an extended DWDN model was created, and locations for a booster pumping station were determined. The need for the station is caused by insufficient pressure provided by the pressure storage tank (Figure 3.3).

To assess water quality and develop soft sensors, water quality monitoring was carried out for all three facilities. The following sampling points were selected for monitoring:

Site #1 – (1) water abstraction well, (2) after the rapid filter, (3) after the clean water storage tank, into which a sodium hypochlorite solution is dosed, (4–9) six points within the water distribution network (Figure 3.1).

Site #2 – (1) water abstraction well, (2–5) four points within the water distribution network (Figure 3.2).

Site #3 – (1) river near the wells, (2–3) two water abstraction wells, (4) after the clean water storage tank, (5–8) four points within the water distribution network (Figure 3.3).

The following water quality parameters were measured:

- Chemicals: Free chlorine, Bound chlorine, Chlorites (periodically since 2025), Chlorates (periodically since 2025), Bromides (periodically since 2025), Iron, Manganese, Calcium, Magnesium, Ammonium, Chlorides, Sulphates, Nitrates, Phosphates, Silicates, pH, Alkalinity, Permanganate oxidation ($KMnO_4$), Conductivity, UV Absorbance 254 nm (since 2025), Trihalomethanes, Temperature, Potassium + Sodium, ORP (since 2025), Turbidity (since 2025).

- Microbial: Total coliforms, E.coli, Enterococci, Coliphages, Salmonella, Pseudomonas aeruginosa, Eggs, larvae of helminths, Oocysts of intestinal pathogenic protozoa, Cysts of intestinal pathogenic protozoa. According to Ukrainian regulations, microbial parameters – with the exception of the Total microbial count – are determined qualitatively (Found / Not Found). Since 2025, the following parameters were measured quantitatively: Total coliforms, E.coli, Enterococci, Coliphages, Salmonella, Pseudomonas aeruginosa.

The parameters pH, Conductivity, Temperature, and ORP were measured on-site at the sampling locations.

The parameters Free chlorine, Bound chlorine, Iron, Manganese, Calcium, Magnesium, Ammonium, Chlorides, Sulphates, Nitrates, Phosphates, Silicates, Alkalinity, Permanganate oxidation, UV Absorbance 254 nm, Turbidity were measured in the NUWEE hydrochemical laboratory.

The parameters Trihalomethanes, Bromides, Chlorites, Chlorates, and Microbial were analysed in the laboratories of the Rivne Regional Centre for Disease Control and Prevention.

The following equipment and methods were used to measure water quality parameters: pH, ORP (EZODO 8200M), Temperature, Conductivity (GMH 3410), Chlorine (DSTU ISO 7393-1:2003 or Mi404), Iron (KFK-3 / DR 6000, MPM N 081/12-175-05), Manganese (KFK-3, MPM N 081/12-0107-03), Calcium (KFK-3 / DR 6000, DSTU ISO 6058:2003), Magnesium (KFK-3 / DR 6000, MPM N 081/12-0107-03), Ammonium (KFK-3 / DR 6000, MPM N 081/12-0106-03), Chlorides (KFK-3 / DR 6000, MPM N 081/12-0644-09), Sulphates (KFK-3 / DR 6000, MPM N 03-06-12), Nitrates (KFK-3 / DR 6000, MPM N 081/12-0644-09), Phosphates (KFK-3 / DR 6000, MPM N 081/12-0005-01), Silicates (KFK-3 / DR 6000, MPM N 081/12-0015-01), Alkalinity (DSTU ISO 9963-1:2007), Permanganate oxidation (MPM N 081/12-0016-01), UV Absorbance 254 nm (DR 6000), Potassium + Sodium (calculation method), Turbidity (KFK-3 / DR 6000, MPM N 03-06-17), Trihalomethanes (DSTU ISO 10301-2004), Chlorites (DSTU ISO 10304-1:2003), Chlorates (DSTU ISO 10304-1:2003), Bromides (DSTU ISO 10304-1:2003), Total coliforms (MPM N 10.2.1-113-2005), E.coli (MPM N 10.2.1-113-2005), Enterococci (MPM N 2285-81), Coliphages (MPM N 10.2.1-113-2005), Salmonella (MPM N 10.2.1-113-2005).

Water quality parameters have been measured on a monthly basis since July 2024, for a duration of one year. An additional set of measurements is planned for each of the three sites.

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4. Identification of Hazards and Hazardous Events, and Validation of Existing Control Measures and Risk Assessment

The identification of potential hazards and hazardous events was carried out through the analysis of technical documentation, discussions with DWSU representatives and water consumers, evaluation of water quality monitoring results, assessment calculations, and EPANET modelling.

Among the main hazards, hazardous events, and measures to mitigate them, the following should be highlighted:

Site #1:

- Inefficient operation of rapid filters: Water quality monitoring results indicate periodic elevated iron concentrations in the filtrate.
- Need for internal steel tank protection: To prevent secondary contamination of water by corrosion products.
- Enhanced control of water disinfection: Monitoring indicates occasional low concentrations of active chlorine at the point of entry into the DWDN.
- Elevated turbidity at one DWDN monitoring point: This highlights the need for closer analysis and strengthening of preventive network flushing at this location.
- Lack of backup power sources: Leads to pump stoppages and water supply interruptions or deterioration of water quality for consumers.

Site #2:

- Absence of technical documentation on the well's construction and condition.
- No backup well available: Non-compliance with [4] requirements, potentially leading to a complete cessation of water supply.
- Periodic detection of microbial contamination in the network water, which may cause gastrointestinal infections.

For Site #3, the most significant hazards and hazardous events are presented in Table 4.1.

Table 4.1. Hazards and hazardous events in the water supply system

No.	Process step	Hazard Type	Hazardous Event (Following the X-Y Template)
1	Catchment	C	Contamination of the river with chemical substances (X) due to the application of herbicides and pesticides to agricultural crops, subsequently entering the rivers via surface and subsurface runoff with infiltration into the catchment wells (Y).
2	Catchment	M	Intensive development of microbial contamination in the river during warm periods (X) and its subsequent entry into the catchment wells (Y).

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No.	Process step	Hazard Type	Hazardous Event (Following the X-Y Template)
3	Catchment	C, M	Uncontrolled channel-forming processes in the river within the catchment area (X), thereby deteriorating water quality (Y).
4	Catchment	M, C	Intrusion of unauthorized persons or animals into the catchment protection zone (X), potentially causing microbial or chemical contamination and mechanical damage to equipment (Y).
5	Catchment	Q	Colmatation of the near-filter zones of wells (X), causing increased hydraulic resistance (Y).
6	Catchment	Q, C, M	Failure of the pumping unit (X), resulting in interruption of water supply to the storage tanks (Y).
7	Catchment	Q	Failure of catchment pumps (X) due to electrical system malfunction caused by flooding of the switchgear during high water events (Y).
8	Catchment	Q, C, M	Interruptions in power supply to the catchment (X), potentially causing water supply stoppages to consumers (Y).
9	Catchment	Q	Freezing of the collector pipeline (X) supplying water to storage tanks, potentially leading to emptying of the storage tanks (Y).
10	Storage tank	К	Leakage in one storage tank (X), reducing water supply reliability due to the shutdown or maintenance of the operational storage tank (Y).
11	Storage tank	M, C	Inadequate storage tank operation (untimely cleaning and disinfection) (X) increases the risk of microbial contamination in the storage tank (Y) and further spread of contamination into the distribution network (Y).
12	Water disinfection	M	Lack of reliable disinfectant suppliers (X) may lead to interruption of water disinfection and proliferation of pathogenic microorganisms in storage tanks and distribution networks (Y).
13	Water disinfection	M	Malfunction of the dosing pump and disruption of disinfectant dosing (X), increasing the risk of microbial contamination in the distribution network (Y).
14	Water disinfection	M, C	Absence of a reliable mixing method for disinfectant in storage tanks (X), potentially leading to inadequate water disinfection (Y).

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No.	Process step	Hazard Type	Hazardous Event (Following the X-Y Template)
15	Water disinfection	C	Leakage of disinfectant storage tanks (X), which may result in harm to operating personnel (Y).
16	Water distribution network	Q, A, C, M	Pipeline bursts in the distribution network (X) due to critical wear, reducing water supply reliability (Y) and increasing contamination risks from soil and fecal water, as well as water losses (Y).
17	Water mains	Q, A, C, M	Water main rupture (X), causing interruption of water supply to consumers and potential contamination of distribution water (Y).
18	Water distribution network	Q	Freezing of a section of the distribution network (X) laid across the Dniester River bridge, potentially stopping water supply (Y) to the left-bank part of the town.
19	Water distribution network	Q	Insufficient hydraulic head (X) from the clean water storage tank, unable to meet required flow rates (Y) for fire-fighting at the Municipal Hospital.
20	Lack or insufficient qualification of water utility personnel	Q, M, C, A	Insufficient number or qualifications of water utility staff (X) causes delays in preventive maintenance and repair works on the water supply system (Y).
21	Financial factor	Q, A, M	Critical shortage of operating funds for the water utility (X), leading to disconnection of the catchment from power supply and incomplete execution of planned preventive and emergency works (Y), resulting in reduced water quantity and quality or prolonged supply interruptions.
22	Water quality monitoring	C, M	Absence of proper water quality monitoring (X) in the supply system prevents assessment of potential hazards of supplying unsafe water to consumers (Y).
23	War-related factor	Q, A, C	Damage to critical elements of the water supply system by aerial weapons (X), potentially causing prolonged disruption of water supply to consumers (Y).
24	War-related factor	Q, C, M	Vandalism or intentional contamination of water (X) at the catchment or storage tanks, potentially leading to water supply stoppages or mass poisoning (Y).

Legend: C – chemical hazard; M – microbiological hazard; Q – water quantity hazard; A – acceptance hazard.

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Within the framework of semi-quantitative risk assessment, a risk matrix is applied [2]. For each identified hazard or hazardous event, this matrix defines: A – likelihood of occurrence and B – severity. A five-by-five (5 × 5) risk matrix is used (Table 4.4) – that is there are five rating options for likelihood (Table 4.2) and severity (Table 4.3).

Table 4.2. Likelihood contextual definitions

Rating	Description	Definition
1	Very unlikely	The hazard has not been observed in the past and is very unlikely to occur in the future.
2	Unlikely	The hazard is possible; it cannot be completely disregarded.
3	Very likely	The hazard is possible and, under certain circumstances, may become real.
4	Very likely	The hazard has been observed in the past and may occur again.
5	Almost certain	The hazard has been observed in the past and is expected to occur in the future.

Table 4.3. Severity contextual definitions

Rating	Description	Definition
1	Insignificant risk	Negligible impact on water quality, acceptability, or quantity
2	Minor risk	Short-term or localized non-compliance, quantity, or acceptability issue (not health-related).
3	Moderate risk	Long-term or widespread non-compliance, quantity, or acceptability issue (not health-related).
4	Major risk	Potential long-term health effects
5	Catastrophic risk	Potential illness or death.

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Table 4.4. 5 × 5 Risk Assessment Matrix

		Severity				
		1	2	3	4	5
Likelihood	1	1	2	3	4	5
	2	2	4	6	8	9
	3	3	6	9	12	15
	4	4	8	12	16	20
	5	5	10	15	20	25

RISK SCORE (likelihood × severity)	RISK LEVEL
≤ 5	Low
6–14	Medium
≥ 15	High

A single-stage risk assessment was applied. The evaluation of individual risks for Site #3 is presented in Table 4.5.

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Table 4.5. Risk assessment in the water supply system

No.	Stage of the process	Hazardous event	Type of hazard	Description of existing control measures	Validation information	Are existing control measures effective?			Risk addressed by control measures			Level of risk
						Yes	No	Partially	Likelihood	Severity	Risk assessment	
2	Catchment	Intensive development of microbial contamination in the river during warm periods (X) and its subsequent entry into the catchment wells (Y).	M	Microbiological indicators of water quality in rivers and catchment wells.	Water quality monitoring in rivers is not carried out by the water utility. Monitoring of microbiological parameters in groundwater catchment wells has not indicated any exceedances of permissible limits. However, annual monitoring of microbiological water quality in rivers revealed consistent exceedances of total coliform levels, as well as periodic exceedances of Escherichia coli (E. coli) and enterococci. In catchment wells, periodic exceedances of total coliforms, enterococci, and E. coli were also observed.			+	3	2	6	Medium

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No.	Stage of the process	Hazardous event	Type of hazard	Description of existing control measures	Validation information	Are existing control measures effective?			Risk addressed by control measures			
						Yes	No	Partially	Likelihood	Severity	Risk assessment	Level of risk
5	Catchment	Colmatation of the near-filter zones of wells (X), causing increased hydraulic resistance (Y).	Q	The condition of well filters is assessed indirectly through water meter readings and, during scheduled maintenance activities, by means of visual inspection using a downhole camera	A functional water meter is installed on the common pipeline collecting water from the wells at the catchment site. In 2023, rehabilitation works were carried out on Wells No. 2 and No. 5 by a specialized organization. In April 2025, yield measurements of the operational wells were conducted, with the following results: Well No. 2: 44.27 m^3/h; Well No. 5: 38.84 m^3/h; Combined output (Wells No. 2 + No. 5): 76.00 m^3/h			+	4	3	12	Medium
9	Catchment	Freezing of the collector pipeline (X) supplying water to storage tanks, potentially leading to emptying of the storage tanks (Y).	Q	Visual Inspection of the Main Water Conduit.	The main water conduit is installed on the overpass and consists of polyethylene pipes with thermal insulation, which is partially damaged in some areas. There is a secondary branch of the conduit, which is currently non-operational.	+			3	3	9	Medium

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No.	Stage of the process	Hazardous event	Type of hazard	Description of existing control measures	Validation information	Are existing control measures effective?			Risk addressed by control measures			
						Yes	No	Partially	Likelihood	Severity	Risk assessment	Level of risk
10	Storage tank	Leakage in one storage tank (X), reducing water supply reliability due to the shutdown or maintenance of the operational storage tank (Y).	Q	Visual inspection of water level decline in the storage tank	This information has been validated using data provided by the water utility. According to regulations [4], there should be at least two storage tanks, all of which must be operational.	+			3	4	12	Medium
11	Storage tank	Inadequate storage tank operation (untimely cleaning and disinfection) (X) increases the risk of microbial contamination in the storage tank (Y) and further spread of contamination into the distribution network (Y).	M, C	Preventive flushing and disinfection of the storage tank	The storage tank does not undergo preventive flushing and disinfection, as such measures require a suspension of water supply to consumers.		+		5	3	15	High

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No.	Stage of the process	Hazardous event	Type of hazard	Description of existing control measures	Validation information	Are existing control measures effective?			Risk addressed by control measures			
						Yes	No	Partially	Likelihood	Severity	Risk assessment	Level of risk
12	Water disinfection	Lack of reliable disinfectant suppliers (X) may lead to interruption of water disinfection and proliferation of pathogenic microorganisms in storage tanks and distribution networks (Y).	M	Monitoring of disinfectant suppliers	Sodium hypochlorite, sourced from foreign suppliers, is used as the disinfectant. The water utility does not perform control testing of the active chlorine concentration in the purchased product. The utility lacks in-house equipment for producing disinfectant reagents or alternative water disinfection technologies.			+	3	4	12	Medium
15	Water disinfection	Leakage of disinfectant storage tanks (X), which may result in harm to operating personnel (Y).	C	Visual Inspection of Chemical Storage Tanks by Maintenance Personnel	The sodium hypochlorite storage tank is located in an easily accessible area for inspection.	+			1	4	4	Low

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No.	Stage of the process	Hazardous event	Type of hazard	Description of existing control measures	Validation information	Are existing control measures effective?			Risk addressed by control measures			
						Yes	No	Partially	Likelihood	Severity	Risk assessment	Level of risk
18	Water distribution network	Freezing of a section of the distribution network (X) laid across the Dniester River bridge, potentially stopping water supply (Y) to the left-bank part of the town.	Q	Visual inspection and consumer complaints regarding water supply interruptions	The pipeline is installed on the surface of an old steel bridge as a single polyethylene pipe within a thermal insulation casing, which is partially damaged along its entire length. An electric heating cable runs along the entire length of the pipeline.			+	1	2	2	Low
19	Water distribution network	Insufficient hydraulic head (X) from the clean water storage tank, unable to meet required flow rates (Y) for fire-fighting at the Municipal Non-Commercial Enterprise “Halych Hospital.”	Q	No active monitoring is conducted	This hazardous condition was identified during hydraulic modelling of the water supply network for fire-fighting flow requirements in the city.				2	5	10	Medium

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No.	Stage of the process	Hazardous event	Type of hazard	Description of existing control measures	Validation information	Are existing control measures effective?			Risk addressed by control measures			
						Yes	No	Partially	Likelihood	Severity	Risk assessment	Level of risk
20	Lack or insufficient qualification of water utility personnel	Insufficient number or qualifications of water utility staff (X) causes delays in preventive maintenance and repair works on the water supply system (Y).	Q, M, C, A	Staffing structure and vacancies at the enterprise	An analysis of current vacancies at the enterprise has been conducted. Low wages, delays in salary payments, and the lack of deferment from military mobilization are negative factors affecting the recruitment and retention of qualified personnel required for the operation and maintenance of water supply systems.	+			5	3	15	High
24	War-related factor	Vandalism or intentional contamination of water (X) at the catchment or storage tanks, potentially leading to water supply stoppages or mass poisoning (Y).	Q, C, M	Perimeter security, guard dogs, and site inspections by water utility staff	The storage tank area is enclosed by a perimeter fence with a locked gate. The site is guarded by security dogs. During working hours, maintenance personnel are present on the premises.			+	2	5	10	Medium

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5. Planning for improvement

This stage involves the development and implementation of a gradual improvement plan for new or enhanced control measures aimed at reducing risk levels to an acceptable standard.

The gradual improvement plan has been prepared for Site #3, while plans for the other sites are still in the preparation stage.

For Site #3 future work is planned to address risks with a threshold value of 9.

For hazardous events that do not require improvement (i.e., those currently under control), no additional measures within this module have been undertaken.

The improvement plan (Table 5.1) should address:

1. the specific improvement action needed;
2. which issue the improvement arises from;
3. the person(s) or party(ies) responsible for the improvement;
4. the estimated cost of the improvement (or indicative costs such as low, medium or high cost);
5. the proposed source of funding (e.g., internal budgets, stakeholder budgets, regional/national funds);
6. the due date for completing the improvement; and
7. the status of the improvement (e.g., not yet started, delayed, in progress, completed).

The DWSU did not develop an improvement plan for the year 2025.

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Table 5.1. Improvement Plan (individual measures)

Specific Improvement Action	Arising from	Responsible Party(ies)	Estimated Cost	Source of Funding	Due Date	Status
Cooperation with government agencies and other stakeholders to develop a capital investment program aimed at improving the operation of the water supply system.	No. 9. Medium risk (risk score 9). Freezing of the main water pipeline supplying water to storage tanks, which may lead to storage tank depletion.	Water utility management	Low financial costs	Local funding	2 years for review and final decision-making	At initial stage
Cooperation with government agencies and other stakeholders to develop a capital investment program aimed at improving the operation of the water supply system.	No. 10. Medium risk (risk score 12). Loss of integrity in one of the water storage tanks, which decreases the reliability of water supply in case the functioning storage tank fails or is taken out of service for maintenance.	Water utility management	Low financial costs	Local and national budgets, charitable organizations, grant projects	2 years for review and final decision-making	At initial stage
Expansion of the list of certified sodium hypo-chlorite suppliers.	No. 12. Medium Risk (Risk Score: 12) The absence of reliable disinfectant suppliers may lead to the suspension of water disinfection processes and the subsequent develop-ment of pathogenic	Water utility management	None. Low capital expenditures may be required if equipment for the on-site production of sodium hypo-chlorite is procured.	In the case of equipment procu-rement – local or national govern-ment budgets, charitable organizations, or	Two years for review and adop-tion of final decisions	Suppliers are available. The feasibility of procuring equip-ment for the production of sodium hypo-chlorite is currently

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Specific Improvement Action	Arising from	Responsible Party(ies)	Estimated Cost	Source of Funding	Due Date	Status
	microflora in water storage tanks and the water distribution			grant-funded projects.		under preliminary consideration.
Collaboration with government authorities and other stakeholders, including higher education institutions, to develop a capital investment program aimed at improving the performance of the water supply system	No. 20. High Risk (Risk Score: 15) A shortage of adequately qualified and sufficient personnel at the water utility results in delays in performing preventive maintenance and repair works within the water supply system.	Local Government Authorities, Water Utility Management	Low (no capital expenditures required), but potentially high political costs.	Local or national government budgets, charitable organizations, or grant-funded projects	Two years for review and final decision-making.	At initial stage
Collaboration with government authorities and other stakeholders to develop a capital investment program for enhancing the water supply system	No. 24. Medium Risk (Risk Score: 12) Acts of vandalism and deliberate contamination of water at catchment points or clean water storage tanks may result in interruption of water supply to consumers or widespread poisoning incidents.	Water Utility Management; Government Agency Responsible for Food Safety and Consumer Protection.	The extent of financial expen-ditures will depend on the measures specified in the relevant plan.	Local and national government budgets, charitable organizations, and grant-funded projects.	Two years for review and final decision-making.	Some organiza-tional and technical measures have been implemented and require evaluation

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6. Monitoring control measures

This stage involves defining and implementing an operational monitoring plan, which determines whether the control measures applied within the water supply system are functioning as intended. Selected elements of the plan for Site #3 are presented in Table 6.1.

Table 6.1. Operational Monitoring Plan

Process Step	Control Measure	What to Monitor	Where	When	How	Who	Critical Limit(s)	Corrective action if Acceptable Limits are Breached
Catchment / collection pipeline on overpass	Freezing of collection pipeline (No. 9)	Water meter readings	Switching chamber and water metering unit	Daily	Visual inspection	Maintenance technician	No water flow or critical decrease	Check pump operation. If water supply exists, notify water utility dispatcher by phone.
Storage tank / inactive clean water storage tank	Confirmed hazard, no additional control needed (No. 10)	–	Storage tank site	–	–	–	Storage tank not sealed	Plan measures to eliminate malfunc-tion.
Storage tank / disinfectant dosing unit	Concentration of active chlorine in the product (No. 12)	Active chlorine concentration per specifica-tion	Sodium hypochlorite solution container	Weekly	Titrimetric method with distilled water dilution	Operator	50% decrease in active chlorine concentration	Recalculate disinfectant volumes. Replace product with fresh batch.
Water supply system	Water utility personnel (No. 20)	Adequate number of qualified water utility staff	Water utility	Monthly	Analysis of actual person-nel	Water utility management	Critical inability to perform planned and emergency repairs	Enhance staff skills with cross-training. Recruit personnel with deferment documentation where applicable.

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Process Step	Control Measure	What to Monitor	Where	When	How	Who	Critical Limit(s)	Corrective action if Acceptable Limits are Breached
Water Supply System / Facilities and Water Quality	Protection of facilities from unauthorized access (No. 24)	Presence of unauthorized access to water supply facilities	Water supply facilities	Monthly	Visual inspec-tion	Maintenance staff	Visible signs of unauthorized access	Increase surveillance; promptly assess malfunctions and risks of chemical, microbial, or radiological contami-nation.

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7. Next steps

The next steps in the implementation of WSPs are:

- Verification of water safety planning effectiveness: This involves checking whether the WSP functions effectively as an integrated system. During implementation, communication with water consumers will be strengthened, feedback from them will be collected, and the most active consumer representatives will be invited to join the WSP planning team.
- Strengthening management procedures: This ensures that documented procedures are followed under normal conditions, during incidents, or in emergencies. Standard Operating Procedures (SOPs) and an Emergency Response Plan (ERP) will be developed.
- Enhancing supporting programs for the WSP: These programs support the effective implementation of water safety planning. They promote the stability of the WSP by ensuring broad support for the safe supply of drinking water and create a favorable environment for WSP execution.
- Review and update of the WSP: This ensures the WSP remains current and incorporates lessons learned from its practical application. Once the WSP is prepared, it will be shared with external stakeholders, taking into account any sensitive information it contains. As a result, the working group may be expanded to include representatives of local government and water consumer stakeholders.

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