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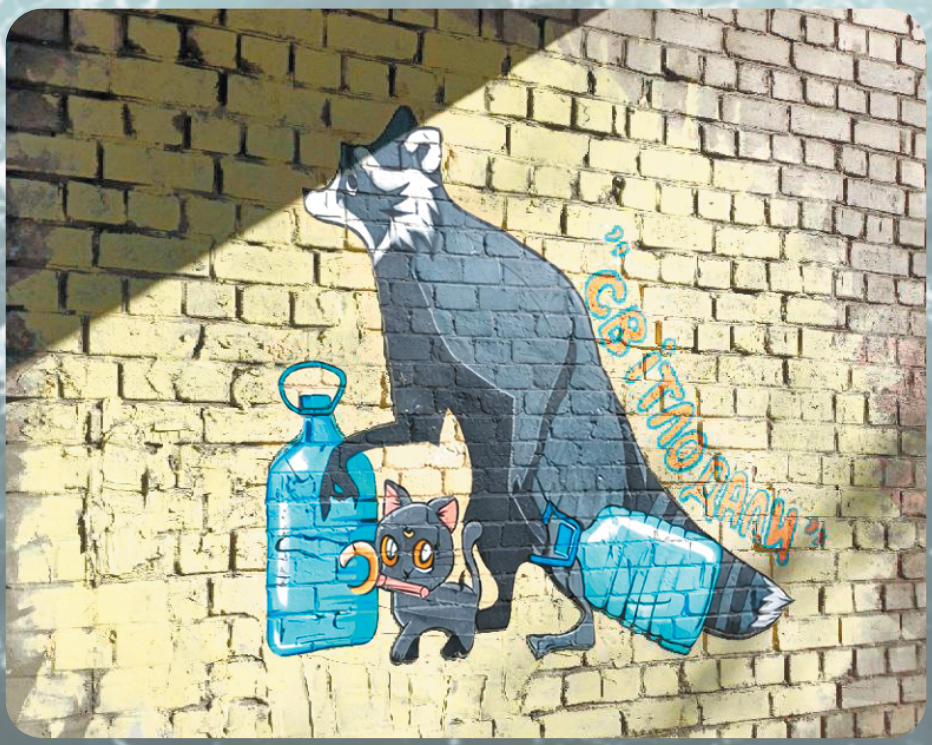
CHRONICLES OF THIRST: DOCUMENTING MYKOLAIV'S WATER SECURITY CHALLENGES AND SOLUTIONS IN A WAR-AFFECTED CITY



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Monograph

Mykolaiv 2026

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The book explores the unique experience of transforming water infrastructure and social resilience of Mykolaiv during wartime, during 2022–2026. Through the prism of hydrochemical indicators and personal narratives of residents, the transformation of the social paradigm has been traced: from forced adaptation to the scarcity of resources to a conscious request for environmental safety and environmental restoration. The publication contains an analysis of the degradation of aquatic ecosystems, the development of the "blue economy" and the role of the cultural front in overcoming the water crisis.
The publication is addressed to environmentalists, urban planners, municipal management specialists, as well as a wide range of readers who are interested in the issues of civil sustainability and ecological restoration of cities in times of crisis.

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CONTENTS

FOREWORD

For Mykolaiv, the war began not only with explosions, but also with silence that suddenly fell in the main pipes. On April 12, 2022, water in the city ceased to be just a communal good — it turned into a target. The purposeful explosion of a water supply system in the occupied Kherson region was the beginning of an unprecedented experiment in the survival of a city of half a million, which the enemy tried to break with thirst.

The monograph "Chronicles of thirst…" is a chronicle of the transformation of the "city on the water" into a city that fights for every drop. This is the result of recording events in real time, where behind each digit of laboratory analysis there are queues with eggplants, the noise of generators near wells and the bitter taste of salt in the taps.

The relevance of this work lies in its documentary uniqueness. Mykolaiv has become a modern polis that has been teetering on the brink of ecocide for more than four years. This experience — harsh, painful, but technologically invaluable — is a manifesto of how a community is able to transform a critical vulnerability into a new architecture of resilience.

The central platforms for this fixation were the Petro Mohyla Black Sea National University and the NGO "Open Ecological University", and the aspects of the analysis of the problem in the book unfold through three vectors:

A hydrochemical chronicle where the analysis of the waters of the Buh estuary and city networks becomes a chronicle protocol. We document how the chemical composition of water changed from the "salt catastrophe" of 2023 to the fragile stabilization of 2026, when the turbidity of 7 NTU remains a mute witness to the corroded pipes.

The social dimension of the study of the "blue economy" and the everyday narratives of residents, when we describe how plastic containers have become the main attribute of the cityscape, and access to water has formed a special military culture — harsh and patient.

Aesthetics of Resistance and Children's Perspective through the Artistic Rethinking of the Ecological Situation of Mykolaiv. From large-scale murals "Big Fish" and "Tree of Life", which have become visual amulets of the city, to children's eco-drawings. It is in children's creativity that thirst appears most naked, and hope for clear water — the most sincere. Art and photography have been able to document what numbers cannot convey.

This book is about the experience of preserving the life of the city in the face of a critical shortage of resources. It offers a new look at water security as a strategic shield that

holds defenses no worse than military fortifications. It is a chronicle of the transition from a survival strategy to a strategy for restoring the quality of life.

I express my sincere gratitude to the Documenting Ukraine Programme of the Institute for Human Sciences in Vienna (IWM) for the opportunity to implement this research. Thanks for support, this intellectual resistance has become part of the global memory of Ukraine's struggle for its future.

Prof. Olena Mitryasova

Mykolaiv, March 2026

CHAPTER I

GENESIS AND WATER INFRASTRUCTURE BEFORE, AND AFTER 2022

1.1. MYKOLAIV IS A CITY ON THE WATER: THE HISTORY OF WATER SUPPLY

An outpost on the water and a strategic hub in the South of Ukraine

If you look at Mykolaiv from a bird's eye view, the first thing that strikes is the dominant presence of water. The city doesn't just stand on the shore; It grows into rivers, occupying a large peninsula, which resembles a piece of land clamped in the palms of the water arteries. In the west and south, it is washed by the majestic Southern Buh (ancient Hypanis), and in the north and east — by the winding Inhul (Fig. 1.1; 1.2).

It is here, at the confluence of these rivers, that the Buh estuary is formed - a huge mirror of water stretching for tens of kilometers to the Black Sea. The geography of Mykolaiv is the story of "Knee", as the first settlers called this bend of the river. The high shores of the peninsula created a natural fortress, and the deep channel allowed sea vessels to come close to the shore. This landscape determined the fate of the city for centuries to come: it was doomed to become a sea gateway, where the steppe wind mixes with the smell of salt.

The history of Mykolaiv is not a gradual rural growth, but a volitional act of creating an industrial center. Founded in 1789 as a shipyard, it got its name in honor of St. Nicholas, the patron saint of sailors. From the very beginning, every stone in the city was laid with the fleet in mind.

During the nineteenth century, Mykolaiv turned into the intellectual and technical headquarters of the South. One of the oldest naval observatories in Eastern Europe was founded here so that captains could check the time by the stars. The city was built according to a strict regular plan: straight, wide streets that pierced the peninsula allowed the breeze to purify the city air.

In the twentieth century, Mykolaiv became a "city of shipbuilders" on a global scale. Giants were born at its shipyards: from civilian bulk carriers to complex aircraft carrier cruisers. This formed a special type of citizen — engineer, craftsman, worker. The closure of the city in Soviet times only strengthened this internal cohesion and pride in their work.

The economic profile of Mykolaiv until 2022 was an example of a powerful export model, which combined heavy industry and modern logistics.

The first element is Metal and Machines. Three gigantic shipyards determined the industrial rhythm of the city. Together with them, the world leader in gas turbine construction — the Zorya-Mashproekt plant worked. Its products propelled ships and pumped gas in dozens of countries around the world. It was an economy of high redistribution, based on the experience of generations.

The second element is Grain and Ports. Mykolaiv was a key link in global food security. The city's port infrastructure — from the state seaport to modern private terminals like Nibulon —

turned the Ukrainian harvest into a golden stream of exports. Hundreds of ships entered the estuary every year, linking Mykolaiv berths with the ports of Egypt, China and Europe.

The third element is Aluminum and Resources. The Mykolaiv Alumina Plant, one of the largest in Europe, added weight to the city as an important node in the non-ferrous metallurgy chain.

Mykolaiv has never been just an industrial zone. It was a city of universities, where science served the practical needs of life. The Petro Mohyla Black Sea National University and the National University of Shipbuilding have become the forges of the elite.

Before the war, Mykolaiv was a comfortable southern city with chestnut alleys, a yacht club (the oldest in Ukraine) and a special rhythm of life, where the working day ended with a walk on the riverbank. The social stability of the community was tempered by the awareness of the importance of its work for the whole world. It is this foundation — geographical isolation, proud history and economic self-sufficiency — that has become the basis on which Mykolaiv residents will hold the defense when water from the source of life suddenly turns into an instrument of pressure and scarcity).

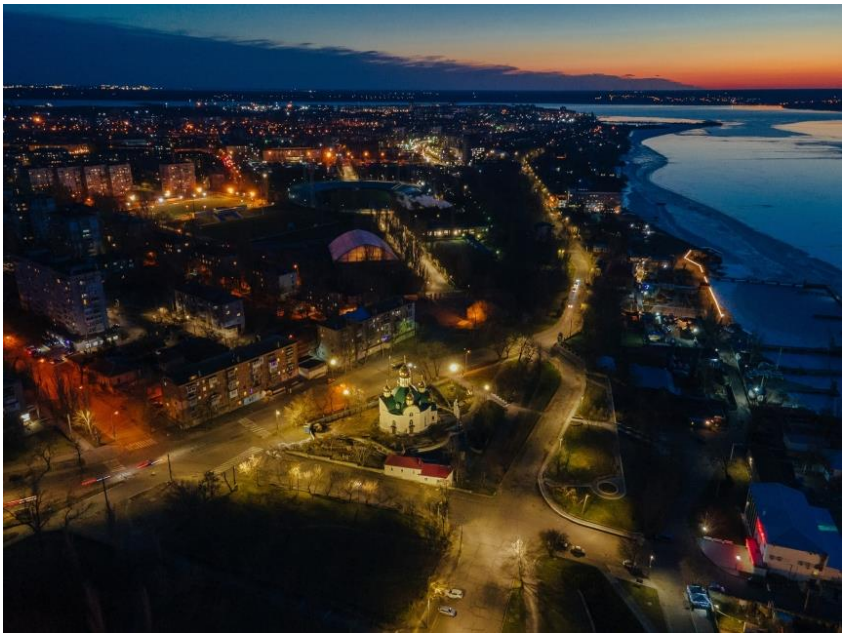

Fig. 1.1. Mykolaiv from a bird's eye view (photo by Dmytro Berin).

First steps to curb thirst

Today, when Mykolaiv residents turn on the tap or stand in line at water distribution points, few people think that the history of our water supply system began long before the appearance of cast iron pipes, electric pumps and familiar columns. The highway, which gave life to the city, originated not from industrial zones and not from the Dnieper

estuary, but from the picturesque slopes, where the heart of the "wild" Mykolaiv beat at that time - from the Spassky spring.

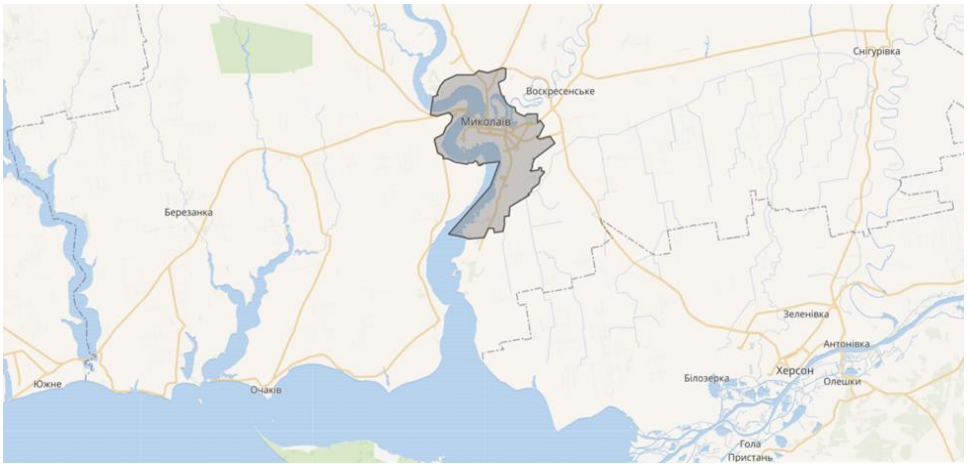

Fig. 1.2. Map of the location of the city.

The first city water supply system was laid not at all for the public needs of the general public, but as an exclusive engineering solution for the residence of the founder of the city.

The central point of the water map of Mykolaiv at that time was the palace of Prince Potemkin in Spask. It was here from the source that the first water supply system in the history of the city was laid. The engineering thought of that time relied on natural materials: the pipes were wooden. The carefully hollowed out trunks were connected to each other, creating an airtight system through which life-giving moisture under pressure flowed directly to the prince's chambers.

It was a real revolution in comfort. Water flowed into the kitchen, ensured the operation of the bath and, which was the pinnacle of luxury for the steppe city, fed the fountain in the palace garden. The murmur of water in the middle of the arid steppe was not only aesthetics, but also a symbol of human victory over the elements.

However, the ambitions of the builders of Mykolaiv were not limited to palace comfort. The system was of strategic importance. From the palace, the water supply system stretched further - to the Spasskaya pier. Today this place is well known to every citizen. It is where the pedestrian bridge in the yacht club is now located that the sea heart of the city once beat (Fig. 1.3).

Fig. 1.3. Pedestrian bridge in the Yacht Club (author's photo).

For decades, the pier served as the main bunkering point for warships. The fleet needed water no less than gunpowder or sails. That is why it was called the War Pier in the people and official documents for a long time.

Over time, the status of the object increased even more. During the visits of the imperial family to Mykolaiv, it was here that the royal yacht was moored. Thus, the Military Pier received its second name - Tsarskaya. The taste of water from the Spassky spring, delivered by wooden pipes, became known not only to sailors, but also to the top management.

In 1849, after the completion of a large-scale reconstruction of the palace, a monumental obelisk was erected in front of the Spasskaya pier. The date of completion of construction was engraved on it. This monument has become more than just a mark on the map. It symbolized the completion of the first stage of the formation of urban space, where water, architecture and the fleet merged into a single whole (Fig. 1.4).

The pier worked well and was maintained in good condition until 1927. For almost eight decades, it witnessed how Mykolaiv turned from an admiralty town into a large industrial hub. The tragedy of the 1920s did not bypass this object. In the whirlpool of revolutionary transformations and subsequent indifference to the "imperial" heritage, the pier was destroyed along with the memorial obelisk. Subsequently, a diving tower and the same bridge that we see today were erected at this historic site. The new object erased the visual memory of the first water supply, but could not erase the history itself.

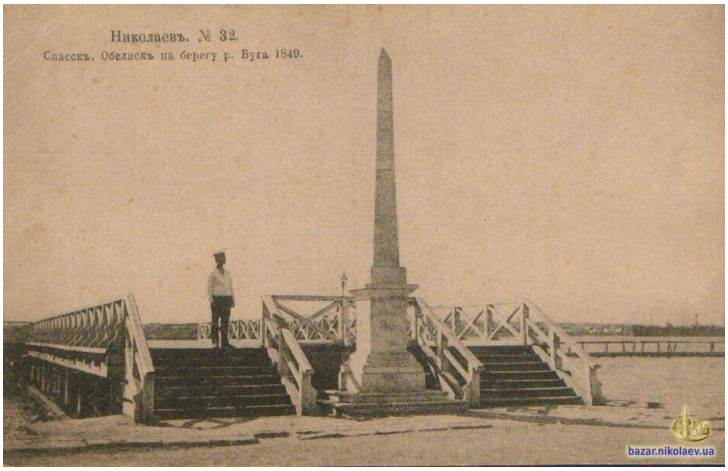

Fig. 1.4. Obelisk in front of the Spasskaya Pier (photo from open sources).

Why is it important to know about these wooden pipes and the Spassky Spring right now, in 2026? Because the history of Mykolaiv is the story of the eternal struggle for water. When new dukers, filtration stations and wells are created today, the work of those first workers who dragged tree trunks from the source to the pier continues.

Understanding that our city began with water makes it possible to protect it today. Each drop in the Mykolaiv network has its own price, measured by centuries of labor, wars and revival. Mykolaiv water is the blood of our fleet and the lives of our people, and the deeper we dive into these details, the clearer we see the value of our common past.

Despite the fact that Mykolaiv has been surrounded by a water mirror of rivers and estuaries since its birth, its relationship with drinking water has never been simple. It was a paradox laid down by nature itself. The city on the peninsula breathed the moisture of two rivers, but their waters, mixed with the sea, remained unsuitable for quenching thirst.

In the first decades of Mykolaiv's existence, water was a precious commodity. It was harvested from rooftops during rains, extracted from shallow wells where it was often bitter, or brought in barrels on carts from distant sources, sold for a lot of money. The issue of water was not just a matter of comfort — it was a matter of survival and development of the city, which was rapidly turning into an industrial giant.

It was this "natural injustice" that forced Mykolaiv residents to become pioneers of engineering. Realizing that without a reliable source of fresh water, the future of shipbuilding and maritime trade would be threatened, the city began its long journey towards building one of the most complex water supply systems in the region.

The history of the Mykolaiv water supply system is not just a chronicle of pipes and pumps. This is an epic about how human will and engineering genius tamed the steppe drought, paving the way for the first artesian wells and, ultimately, the ambitious project of the Dnipro water pipeline. This is the story of how the city learned to overcome its natural thirst, not yet knowing that in a century water will again become the main tool for testing its invincibility.

To comprehend the scale of water security of modern Mykolaiv, it is worth looking into the depths of the mine, to the very origins of the city in the Northern Black Sea region. When in 1789 the first stones of the shipyard were laid at the mouth of the Inhul, pioneer shipbuilders found themselves alone with the harsh steppe climate. The first settlers relied on single wells, but the rapid economic growth of the city quickly revealed the limitations of underground sources.

The realization that without a reliable water supply the city would have no future came instantly. Already in 1791, the military governor Nikolai Mordvinov approved an ambitious project for the first gravity water pipeline, called "Spassky". For its implementation, five thousand ceramic pipes were sent to Mykolaiv - a technological miracle of that time. However, despite the determination of the plans, this first large-scale idea remained on paper, not being implemented due to the technical and logistical challenges of the era of traits. 1.5.

In parallel with the engineering searches, another story unfolded — the story of natural blessing. Back in 1790, a powerful source of fresh water was discovered in Bogoyavlensk (modern Korabelny district), which was capable of producing an incredible 100 thousand buckets every day. This spring not only gave fresh water to people, but also gave almost half of its strength to the waters of the Southern Buh.

Legends arose around this place, which still live in the memory of the city. Legends say that the name "Bogoyavlensk" appeared after God himself took pity on the first settlers. Striking His staff on dry ground, He opened the spring, giving the populace "a treasure for all time." This legend of the Lord's apparition became a symbolic reminder that for Mykolaiv, water was never just a resource, it was always a sacred gift, on which the very existence of life in the steppe depended.

The Bohoyavlenk spring became not only a legend, but also the true heart of the city's first water supply system. The complex of structures erected around it was an example of functionality and aesthetics of the time. It consisted of a special prefabricated pool and a fountain, the architectural center of which was a patterned cylinder buried one and a half meters into the ground.

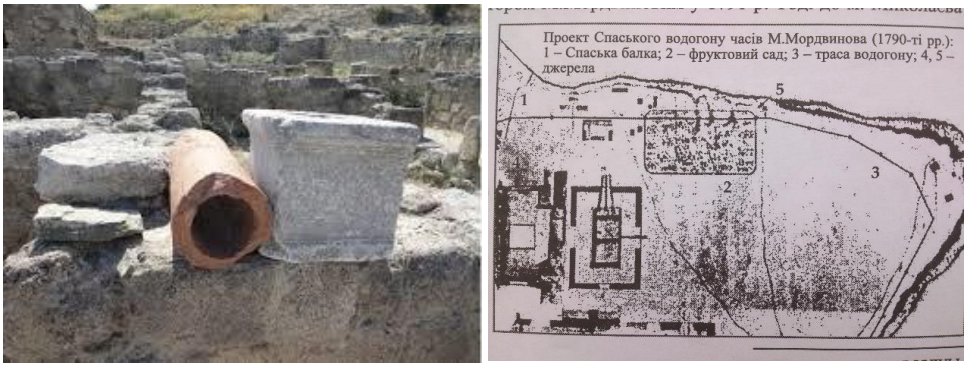

Fig. 1.5. Project of the first water supply system of the city.

The network of springs and the era of water carriers

Over time, technology has improved. The first fragile clay pipes were replaced by reliable cast-iron lines, which made it possible to reduce water losses and ensure its stable flow to city blocks. This system has become a source of special pride for Mykolaiv residents, and not only because of its technical implementation.

The water supply system received real scientific recognition thanks to the visit of the outstanding hygienist Fyodor Erisman. Having conducted a thorough analysis of Nikolaev water, he was amazed by its indicators. In his reports, he noted the exceptional purity and softness of the resource, which was a real rarity for the arid South (Fig. 1.6; 1.7).

In addition to Bogoyavlensk, a spring at the top of the Spassky River played a critical role. Opened through a system of catchments back in 1790, it simultaneously fed both city fountains and individual water intake points. However, access to this good even then had its price, which emphasized the strategic value of water: the right to use the water supply cost residents three rubles in silver per year, a significant amount, which, however, guaranteed access to the source of life.

These first steps — from catchments to cast-iron pipes — laid the foundation for the culture of water use in Mykolaiv. The city learned to value quality, realizing that every drop of fresh water in this region is the result of a lot of work and engineering calculation.

Fig. 1.6. Bohoyavlensk spring, 1950.

Fig. 1.7. Professor Fyodor Erisman The first investigated the quality drinking water of the city of Mykolaiv.

According to the development plans of that time, the Spasskaya district became a real "water hub" of the city. The following main arteries operated here: the glorious Spassky Fountain, a spring at the top of the Varvarovsky Descent; The palace fountain, which the inhabitants later dubbed "Dry". The latter was located on the corner of the State Orchard, and its name eventually became a symbol of the variability of water resources in the steppe.

The city grew, and with it new wells were bitten deep into the earth. If in 1809 there were only 11 of them in the center, then in other parts of the city there were already 35. These mines reached a depth of up to 10 fathoms (more than 21 meters) - incredible work for that time. However, even such a number of wells could not quench the thirst of Mykolaiv.

A special caste of professionals appeared on the streets — water carriers (Fig. 1.8). In 1863, a whole army of 60 men and two hundred barrels traveled daily between the springs and the houses of the townspeople. However, the hot southern summer was unforgiving. Water was chronically scarce, and its price during drought became exorbitant for the poor.

Unsuccessful contract and hygienist's verdict

The critical situation with water forced the authorities to act more decisively. In 1883, the city seemingly found salvation. An agreement was signed with the entrepreneur A. von Brunhof. The conditions were tough but promising. Brunhof pledged 50 thousand rubles and undertook to create a full-fledged network in three years, in return receiving a monopoly on operation for 45 years.

However, Professor Fyodor Erisman became an obstacle. When the project proposed to take water in the Vodopoy area, Erisman conducted a meticulous examination. His verdict was devastating: the water quality in the area did not meet sanitary standards. For a city that cared about the health of its residents, this was a decisive factor. After five years of difficult negotiations, the contract with Brunhof was terminated.

First wells

Mykolaiv did not give up and returned attention to artesian horizons. The era of drilling began. It was a real lottery, since out of seven drilled wells, only two - the second and third - produced water that was recognized as suitable for consumption.

This period was an important lesson for the city. It became clear that disparate springs and wells were only a temporary solution. Mykolaiv needed a single, powerful and scientifically based system that would not depend on the vagaries of the summer heat or accidental finds. There was a time of great engineering solutions ahead that would forever change the look of the city.

Fig. 1.8. Water supply professionals – water carriers.

The birth of the centralized system and the loss of the "Spas"

The history of water supply in Mykolaiv is not only about achievements, but also about painful losses. One of the oldest and most respected springs, Spasskoye, which fed the city for centuries, went down in history in 1959 (Fig. 1.9). During the large-scale construction of the Central City Stadium, the spring was filled up, forever hidden under the foundations of the sports arena, leaving behind only a memory in the names of districts and in old yellowed photos.

However, long before this loss, at the turn of the XIX and XX centuries, Mykolaiv realized that the era of scattered springs and private water carriers had exhausted itself.

The city needed a single, powerful "organism" that would deliver water to every house. The key figure of this breakthrough was the talented engineer Victor Weber. It was he who presented the revolutionary project of a centralized water supply system, which finally took into account the rapid pace of urbanization of Mykolaiv.

The implementation of such a scale required enormous resources. May 18, 1904 became a historic date for the city community, when the issue of financing was finally resolved. The city took a huge loan of 3 million rubles from the Bessarabian-Tavria Land Bank, pledging the Mykolaiv land itself. It was a risk, but a risk for the sake of the future.

On May 22, 1904, a solemn event took place - the official laying of the Mykolaiv water supply system. It wasn't just building another building; It was an act of declaring the technical independence of the city from drought. Ahead was a difficult path of installing kilometers of pipes and erecting structures that would later become architectural symbols of Mykolaiv, including the legendary Shukhov Tower.

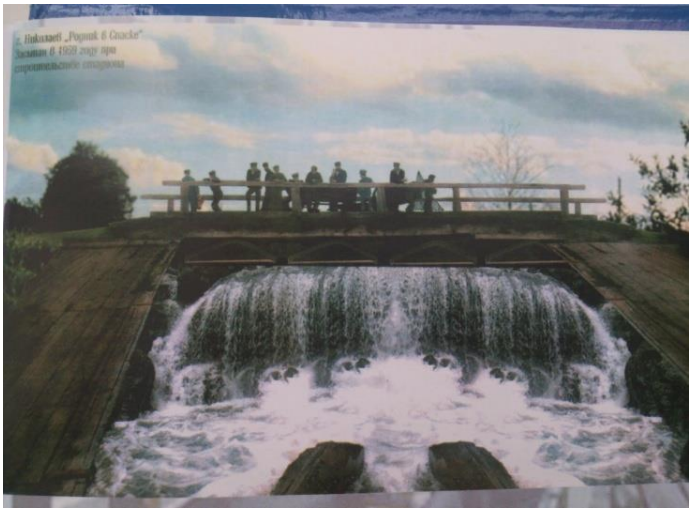

Fig. 1.9. Spassky spring of the city before the construction of the central stadium (photo from open sources).

The Steel Revolution and the electric pulse of the city

The implementation of Victor Weber's project was a real technological marathon. The construction unfolded on several fronts at the same time. The primary task was to create a powerful underground water intake capable of supplying the city with 1 million buckets of water (about 12.300 m³) every day. This was the foundation on which the entire future system rested.

In parallel with the construction, large-scale scientific work continued. Engineers and hydrochemists did not rely on chance. They conducted a thorough audit of all water resources in the city. River water in different areas was analyzed and hundreds of private sources were checked. As a result, scientists selected 58 best wells, the water from which was divided into three quality classes. This was the first example in the history of Mykolaiv of systematic management of water resources quality at the municipal level.

The year 1905 was a turning point. when the city was entangled by a network of new pipes 37 kilometers long. An important element of safety was 123 fire hydrants, which forever changed the level of protection of wooden and stone quarters of Mykolaiv.

However, the real breakthrough that delighted contemporaries was the use of high-pressure electric pumps. At a time when most of the world's cities relied on steam or gravity, Mykolaiv integrated a water pipeline with a city power plant. The energy of light became the energy of water. This not only reduced the cost of operating the system, but also gave a powerful impetus to the industrial development of the city, turning the water supply system into the economic engine of the region.

Shukhov's Tower

The appearance of the water tower in Mykolaiv became a real world sensation in the field of industrial construction. Its author, the outstanding engineer Vladimir Shukhov (Fig. 1.10), created a design that was ahead of its time. Although for the first time the prototype of such a mesh structure was demonstrated as an exhibit at the Nizhny Novgorod exhibition in 1896, it was the Mykolaiv tower that became the world's first hyperboloid structure that was put into permanent operation in the city water supply system.

The path of the tower to Mykolaiv was no less amazing than its design. The structure was made at a plant in Moscow, and then disassembled, like a giant metal designer, it was transported by rail to the south.

The secret of its incredible strength and at the same time visual lightness lay in the unique mesh structure. The frame of the tower consisted of 48 steel corners, which, according to the author's idea, were intertwined with nine powerful horizontal rings. At each point of intersection, the elements were securely connected with rivets. Thanks to this solution, the mesh surface of the skeleton has turned into a single, monolithic system capable of withstanding colossal loads — both the weight of a giant tank of water and the insane pressure of steppe winds.

Fig. 1.10. Volodymyr Shukhov is the author of the city's water tower (photo from open sources).

The hyperboloid shape was not just an aesthetic choice, it allowed the use of a minimum of metal with maximum structural stability. The Mykolaiv Tower became the embodiment of the principle of "elegant expediency". Light as lace, it carried thousands of tons of water, providing the necessary pressure in the newly built networks of the city.

Commissioned in February 1907, the Shukhov Tower marked the transition of Mykolaiv to the top league of technologically advanced cities. It became the water "heart" of the system, pulsing to the rhythm of new electric pumps, and a beacon of hope for residents who finally forgot about exhausting thirst (Fig. 1.11).

This is the largest tank of the Intze system among all others, isolated from any neighboring structures, and does not require heating at all, since water from different wells circulates and is evenly mixed, and the level is controlled at the central power plant.

Between peace and World War II

Although 1907 was a year of technical triumph, the official and solemn consecration of the entire complex of structures of the Mykolaiv water supply system took place only on May 17, 1909. This holiday marked the beginning of a new era, when water became available to the general population. The statistics of those years are impressive in terms of growth rates. Thus, if in 1911 the flow rate of city sources was more than 664 thousand cubic meters per year, then by 1913 it had increased to a record 874 thousand cubic meters.

Fig. 1.11. Water tower and its strong frame (author's photo).

However, the city grew faster than the capabilities of its water system. Even despite such volumes, there was still a lack of water, which forced the authorities to continue drilling new wells. In 1925, the system already had a clear economic model — the tariff for the population was 33 kopecks per cubic meter. But over time, a new problem arose: intensive exploitation of underground horizons led to a deterioration in water quality. Hydrogeological studies of the late 30s increasingly signaled mineralization and depletion of springs.

On the threshold of 1941, the city's water infrastructure consisted of 17 mine and tubular wells, 14 of which were operating at full capacity. It was a well-established system that seemed to guarantee stability until war came to the city.

Bombing in March 1944 as an instrument of terror

During World War II, Mykolaiv was under occupation. When Soviet troops launched an offensive on the city in the spring of 1944, the Nazi occupiers, retreating, used the tactics of "scorched earth". Their goal was to destroy critical infrastructure in order to leave the city completely unviable.

March 12, 1944 became a black day for the Mykolaiv Vodokanal. German sappers planted explosives under the foundation and supporting structures of the Shukhov Tower. The explosion of great power was intended to completely destroy the tower.

Archival photos of that time (Fig. 1. 12) Terrible consequences are visible: the openwork steel mesh was mutilated, the water tank was thrown to the ground, and the structure itself fell like a wounded giant. The tower, which symbolized progress, turned into a pile of scrap. Along with the tower, pumping stations and sewage treatment plants were disabled. The city was on the verge of an epidemiological catastrophe — without a drop of water in the network.

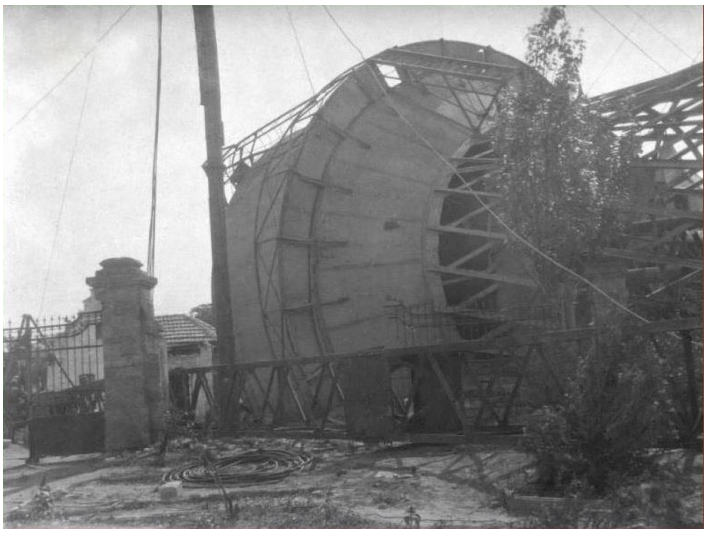

Fig. 1.12. Shukhov Tower after the Nazis blew up in March 1944 (photo from open archival sources).

The restoration of the Shukhov Tower after the Second World War became a symbol of the revival of Mykolaiv (Fig. 1.13). Then, in 1944-1945, engineers and ordinary citizens did the almost impossible. The unique hyperboloid design has been leveled and repaired. Although after the launch of the Dnipro water supply system, the tower ceased to perform its direct function and became an architectural monument, it remained the "guardian" of water supply.

Analyzing the events of the Second World War, it is impossible to avoid parallels with modernity. The methods of the aggressors have changed only technically, but their essence has remained unchanged. In 1944, the enemy blew up the tower to stop life in the city; in 2022, Russian troops blew up the pipe of the Dnipro-Mykolaiv water pipeline in the Kyselivka area, causing a water blockade. In both cases, water was used as a weapon. The destruction of the Shukhov Tower in 1944 was the first large-scale "document of thirst" in Mykolaiv. Today's resilience of Mykolaiv residents lining up for water is a continuation of the same genetic code of resistance that was laid down eight decades ago.

Fig. 1.13. Restoration of the Shukhov Tower after the liberation of the city from the Nazis (photo from open archival sources).

The destruction of the Shukhov Tower is not just an episode from the past. This is proof that the city's water security has always been its most vulnerable point. As we document the challenges of 2022-2026, we must remember that Mykolaiv has already gone through the "thirst" caused by the war. And, if in 1944 the city was able to revive its openwork tower, today it has all the strength to build a new, even more reliable water security system.

Ruins and revival after World War II

March 1944 was a time of liberation for Mykolaiv, but at the same time a time of bitter reckoning. Retreating, the occupiers tried to leave the city "dead": 16 wells were blown up, pumping equipment was destroyed, and the pride of the city — the Shukhov Tower — lay collapsed in ruins. The pumping station of the second lift actually ceased to exist. The city again, as a century and a half ago, found itself in the face of thirst.

However, the history of Mykolaiv is the story of people who do not know how to give up. Under the leadership of the talented organizer I.Y. Grinberg, folk building really began. The work was carried out around the clock. Incredibly, in 1944 alone, all the wells were cleared and restored, and the glorious Shukhov Tower rose above the city again, symbolizing the victory of life over destruction.

Mykolaiv came to life. The restoration of the water supply system became the foundation on which the reconstruction of factories, enterprises, and residential areas

began. However, this experience of military destruction was a stark warning for the future: local underground springs, despite their value, were too vulnerable for a large city striving for development.

Verkhneingulets system and Zhovtneve reservoir

The post-war revival of Mykolaiv was accompanied by rapid industrial growth, which required resources of a completely different order. The underground springs that had saved the city for centuries could no longer satisfy the appetites of the shipbuilding giant. The era of exploration and conquest of river arteries began.

In the period from 1949 to 1953, the construction of a strategically important facility — the Verkhnioingulets water supply system in the village of Zhovtneve — began. This was the first attempt to use the resource of the Ingulets River on a large scale. The results were impressive. If in 1950 the system produced 6.000 m³ of water per day, then in a year its capacity almost doubled to 10.000 m³.

However, the real engineering heart of this system was the Zhovtneve reservoir. With a usable capacity of 26.8 million m³, it has become a strategic reservoir of the city. The water has come a long way to it. Powerful pumping stations took it from the Ingulets River in the Snihurivka area and transported it to Mykolaiv. At the beginning of 1960, the city already received 60 thousand. m³ of water per day, two-thirds of which was provided by the Verkhnoingulets system, forever pushing underground sources into the background.

The 1960s were the time of the final formation of modern water infrastructure. The city's needs grew exponentially, which forced engineers to start work to increase the capacity of the water supply. The cost-effectiveness of the system was also impressive. Thus, due to the scale of production, the cost of one cubic meter of water in 1964 was only 3.57 kopecks.

Along with quantity, the problem of quality arose. River water required serious preparation before getting to the taps of the townspeople. In 1968, the second stage of the water supply treatment plant with a capacity of 77 thousand tons was put into operation. m³ per day. It was a complex facility where water passed through a multi-stage filtration and disinfection system, which allowed Mykolaiv to become one of the most clean water cities in the south.

This period became the golden age of Mykolaiv hydraulic engineering: the city learned not only to extract water, but also to manage its huge massifs, creating reserves that should guarantee safety for years to come. However, the most ambitious project in the history of the city was ahead — a step towards the mighty Dnipro.

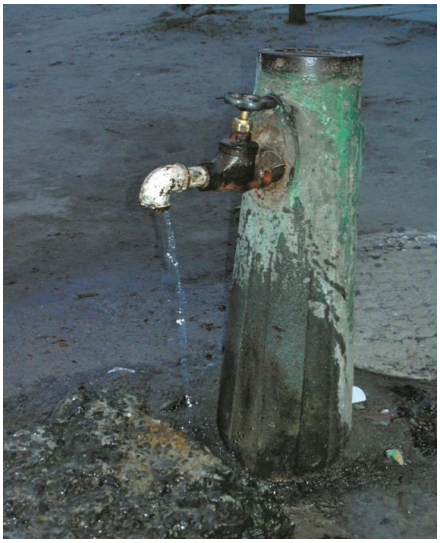

Fig. 1.14. Traditional water columns were distributed in the city (photo by Dmytro Mats).

Ultimatum for the sake of life: how the Dnieper came to Mykolaiv

Even with the powerful Oktyabrsky reservoir of 26.7 million m³ and modern treatment facilities that passed through 120 thousand cubic meters. m³ of water every day, Mykolaiv continued to feel thirsty. The development of industry and population growth required solutions of a different scale. The key to solving the problem was 73 kilometers from the city — in the waters of the Dnieper.

In 1974, after thorough research, scientists made a verdict: the water near the village of Mykilske, Kherson region, is ideal for drinking supply. However, the construction of such a gigantic water pipeline required enormous funds, which the city budget did not have. The chance appeared along with plans for the construction of the Mykolaiv Alumina Plant (MGZ).

It was a moment of high political play. The then head of the Mykolaiv region, Volodymyr Vaslyaev, put forward a strict condition to the Ministry of Non-Ferrous Metallurgy of the USSR: consent to the construction of the plant would be given only on condition of simultaneous financing and construction of the Dnipro-Mykolaiv water pipeline. This "ultimatum" became fateful. In 1979, the first products of the plant and the first Dnieper streams appeared in city networks almost simultaneously.

The launch of the Dnieper water radically changed the city's economy. In 1983, water consumption soared to 166.2 thousand cubic meters. m³ per day. Most of this volume was absorbed by industrial giants, which made Mykolaiv one of the most powerful

industrial centers. The end of the 80s brought a new wave of modernization: in 1988, electric drives and automated control systems began to be massively introduced at pumping stations, which allowed the system to work as a single well-coordinated mechanism.

With the advent of Dnieper water, the need for old springs began to disappear. During 1984–1992, nine wells in Zhovtneve were permanently mothballed due to the rapid deterioration of water quality — underground horizons were depleted and salted. Priority was finally given to the Dnieper (Fig. 1.15).

The final chord for the development of this system in peacetime was the completion of the construction of the fourth stage of the water pipeline in 2002. At that time, Mykolaiv had one of the longest and most complex water supply systems in Ukraine. The city is accustomed to the fact that Dnipro water is a natural and inexhaustible good. No one could imagine then that this 73-kilometer steel network, which became the key to the prosperity of Mykolaiv, would one day turn into its most vulnerable point and target for enemy attack.

Fig. 1.15. Water intake structures on the Dnieper River in the village of Mykilske, Kherson region (photo from open sources).

Tech giant on feet of clay: ahead of 2022

Before the full-scale invasion, the water infrastructure of Mykolaiv was a colossal engineering complex. It was a well-coordinated ecosystem of buildings spread over a huge area of 175 hectares. A single technological process — from taking water from the Dnieper, transporting it through a 73-kilometer aqueduct to multi-stage treatment and distribution through city networks — worked like a clock that ensured the life of the entire city.

The city completely relied on the Dnieper artery. The old Oktyabrsky reservoir, which served as a backup source for decades, was decommissioned and closed for long-term reconstruction. This decision, dictated by technical necessity, actually left the city without a "plan B", making it one hundred percent hostage to a single pipeline.

At the same time, an alarming reality was hidden behind the façade of powerful numbers. Despite the introduction of new technologies, for example, a modern water chlorination system, launched in 2001, the main farm of the MCP "Mykolaivvodokanal" was inexorably aging. The main buildings, machinery and equipment, which have been operating at the limit of their capabilities since Soviet times, needed immediate modernization.

At the beginning of 2022, the service life of many critical units exceeded all standards — some elements of the system worked out their service life 20 years ago. The Mykolaiv water system was like an old Atlantean, it still held the city on its shoulders, but its internal resources were critically depleted. It was in this state — technically worn-out, logistically uncontested, but still vital — that the infrastructure of Vodokanal met the morning of February 24, 2022.

How drinking water was born

Behind every drop of water in the city tap there was a complex multi-stage process, the heart of which was the Inhulets Water Supply Treatment Plant (VIOS). This is a whole industrial town designed to purify 140 thousand cubic meters of water every day.

The history of this technological complex developed in parallel with the growth of Mykolaiv itself.

1. The first line (1958) was put into operation in the midst of post-war reconstruction, the first stage of treatment facilities (40 thousand m^3/day) laid the classical standards for water treatment. The process began in the mixing chamber, where the water was prepared for a chemical reaction. Then, in the coagulation workshop, with the help of special substances, small particles of contaminants "clumped together" into larger flakes, which settled in horizontal sedimentation tanks. a quick filter unit where water passed through layers of sand and anthracite, accumulating in a clean water tank.

2. The second stage is power and control (1965). The expansion of the city required new volumes, so the second stage appeared, which added another 75 thousand m^3 of daily capacity. It became more perfect: there were mesh chambers that retained large debris and algae at the entrance. In addition to the main production workshops, the second stage included a modern laboratory. adjusting the doses of reagents depending on the time of year and the condition of the river.

These structures were designed with a huge margin of safety. A two-stage purification system made it possible to cope even with severe turbidity of river water during floods. The city's sanitary shield rested on these concrete tanks and sand filters, creating the illusion of an infinite and safe resource.

The pre-war experience of Mykolaiv showed that the combination of classical methods of settling and modern (at that time) quality control made the city water one of the best in the region. It was a well-established life machine, the work of which was taken for granted, until in February 2022, the war began to test the strength of not only pipes, but also the very logic of centralized life support.

After a long journey along a 73-kilometer steel track through the Kherson steppes, water from the Dnieper finally reached Mykolaiv. It was here, at the treatment plant, that it was met by a mesh chamber — the initial link in a complex filtration chain (Fig. 1.16).

This object is a massive buried reinforced concretecontainer measuring 8 by 6 meters and 3 meters deep, securely sheltered in a brick building. This is the "front door" of the entire water supply system of the city. Main water pipelines of three different calibers — diameters of 0.7 m, 1 m and 1.2 m — are suitable for the chamber.

The internal structure of the camera has been thought out for maximum reliability. It is divided by reinforced concrete partitions into three separate compartments. This three-section design made it possible to clean or repair one of the compartments without stopping the entire water supply system. Here, through a system of special nets, the water left large river debris, algae and silt, preparing for the next, chemical stage of purification.

This building was a symbol of stability: as long as the Dnieper water entered the pressurized mesh chamber, Mykolaiv could live and develop. For decades, reinforced concrete partitions held the river's pressure well, until in April 2022, the pressure in the pipes disappeared, and silence fell in the chamber halls, which marked the beginning of the most difficult test in the history of the city water utility.

After the water passed through the mechanical obstacles of the mesh chamber, it fell into the zone of intensive chemical treatment. This was the first frontier in the fight against the biological life of the river, which could interfere with the work of the entire system.

Just before entering the mixing chamber, chlorine water was injected into the main pipelines with a diameter of one meter. This process, known as primary chlorination, was intended to instantly disinfect bacteria and viruses. However, the role of chlorine at this stage was much broader than just disinfection.


Fig. 1.16. Mesh chambers where filtration takes place – the first stage of water treatment (photo by Marina Ilyasova).

In a special ejector unit, a stream of water was mixed with chlorine and coagulant solutions. It was a complex open-air physicochemical laboratory (1.17):

1. The previous introduction of chlorine became a real salvation during the flowering periods of the river. It effectively destroyed blue-green and diatoms that could otherwise quickly clog filters and give the water an unpleasant odor.
2. Chlorine acted as a kind of catalyst, which greatly facilitated the process of "gluing" small particles of dirt. Thanks to him, the coagulant worked more efficiently, forming heavy sediment flakes faster.

The water mixed with the reagents became cloudy, but already safe. At this point, it resembled a "raw material" ready for fine cleaning. Huge pipelines continuously carried this solution further, to the mixing chamber, where the next act began - the birth of crystal purity.

The process of introducing chlorine into the system is not just the addition of a reagent, but a high-tech operation, where vacuum plays a major role. The use of vacuum chlorinators at the MCP "Mykolaivvodokanal" provided the highest level of safety: chlorine gas was not under pressure, which practically excluded the possibility of its leakage into the atmosphere.

The dosage of chlorine has never been static. The laboratory of the water utility adjusted it daily, focusing on the "breathing" of the river and the change of seasons:

In winter (1.0–1.5 mg/dm³), when the water is cold and microbiological activity is minimal, the doses were reduced.

Fig. 1.17. Ejector, where the process of chlorination of water takes place (photo by Marina Ilyasova).

The summer period (1.0–2.5 mg/dm³), when the heat and active algal blooms in the Dnieper required increased protection. Increasing the dose helped to overcome bacterial threats and prevent spoilage of water in the sun-heated pipes of the city network.

After the initial disinfection, the water was directed to the mixing chambers, where the coagulation process began. Since the Dnieper water contains many small suspended particles that are too light to settle on their own, special substances — coagulants — were added to it.

For water purification in Mykolaiv, the following were traditionally used:

Aluminum sulfate, as the most common reagent, which, when it enters water, forms flakes similar to "white snow". These flakes, like magnets, attract dirt particles, bacteria and algae residues.

Polyaluminum chloride, a more modern coagulant that works effectively even at low water temperatures, ensuring stable cleaning quality in winter.

As a result of this chemical reaction, heavy "flakes" (floccules) were formed, which, under the influence of gravity, began to settle to the bottom of the sedimentation tanks. It was at this stage that the muddy river water began to acquire the transparency to which Mykolaiv residents were accustomed.

This decades-old chain — vacuum chlorination + precision coagulation — was ideal for working with fresh water. However, it is these structures and chemical algorithms that will be completely powerless when, in April 2022, salt water from the estuary, the chemistry of which is fundamentally different from the Dnieper, enters the system.

Fig. 1.18. Technical equipment for adding coagulants (photo by Marina Ilyasova).

The analysis of many years of experience of Mykolaivvodokanal leads to the conclusion that the classic three-link scheme — coagulation, filtration and chlorination — which was the reference in the twentieth century, began to exhaust its potential in the twenty-first century.

This was not only a problem for Mykolaiv; This is a nationwide challenge for all water utilities of the Dnipro cascade. The main reasons were as follows:

1. The water quality in the river gradually deteriorated due to industrial discharges and outdated wastewater treatment systems in upstream cities.
2. Traditional coagulation did a good job of turbidity, but was less effective against modern contaminants — pesticides, drug residues, and microplastics.
3. Chlorine remained the most reliable disinfectant, but when interacting with organic compounds in river water, it could form by-products that required additional control.

Mykolaiv sewage treatment plants worked at the limit of their capabilities, trying to bring the quality of water to hygienic standards.

However, history decreed otherwise. Instead of the planned modernization that the city hoped for, the war came. And the very "fragile balance" that was maintained by the specialists of the water utility was destroyed on one day, when, instead of problematic, but fresh Dnipro water, aggressive salt water from the estuary had to be released into the system.

1.2. TRANSFORMING A FUNDAMENTAL RIGHT: HOW ACCESS TO WATER HAS BECOME A DAILY STRUGGLE FOR SURVIVAL

"Mykolaiv is a city on a wave" — this slogan, born in peacetime, symbolized movement forward, the energy of two rivers and the inextricable connection of the community with the water space. However, February 2022 turned this symbol into an ironic reminder of vulnerability. The wave that was supposed to bring development suddenly receded, leaving a city of half a million on the verge of a humanitarian catastrophe. As of the end of 2022 and the beginning of 2023, Mykolaiv found itself in a unique and at the same time crisis situation: the city, surrounded by water, was actually left without a drop of drinking water in the taps.

The point of no return was April 12, 2022. It was on this day that the usual life of Mykolaiv residents was divided into "before" and "after". As a result of the deliberate blowing up of the Dnipro-Mykolaiv main water pipeline in the Kherson region by Russian troops, the pressure in the system disappeared. It was not an accidental accident — it was an act of ecocide and a deliberate attempt to paralyze the fortress city, depriving it of the basic condition for existence (Fig. 1.19).

Fig. 1.19. Damaged water pipeline "Dnipro-Mykolaiv" on the territory of the Kherson region, 2022 (photo from open sources)

The supercritical situation was geography: 73 kilometers of steel artery, which had fed Mykolaiv with Dnieper water for decades, passed through the territory that was under temporary

occupation at that time. This made any quick repair work impossible. The city was held hostage by the enemy, who turned the fundamental human right to water into an instrument of blackmail and terror. Since that date, the struggle for every liter of water has become not just a household chore for every Mykolaiv resident, but a daily act of resistance and survival.

The first weeks without water: queues at springs, rainwater collection and volunteer help

When the water went out in the taps on April 12, 2022, Mykolaiv fell silent in long, endless queues. The social portrait of these queues became monotonous and sad: the main burden of the water crisis fell on the shoulders of the elderly. The city, which yesterday lived in the rhythm of a modern metropolis, was thrown back to the Middle Ages in a matter of days in terms of the level of domestic comfort.

Already on the third day without water, the city began to change in appearance. People appeared on the streets with all possible containers: plastic bottles, buckets, canisters, large bottles, which were carried on strollers or garden wheelbarrows. Each well, each well near enterprises or private houses instantly became strategic objects (Fig. 1.20).

Fig. 1.20. Drinking water supply of the city during wartime (author's photo).

Queues at springs became a new center of social life. The queue for water in 2022 is not a place for heated discussions. This is the silent standing of people with plastic bottles, frayed canisters and cans. The most common sound of Mykolaiv yards was the roar of "tailors" and old baby carriages, on which 40-60 liters of cargo were carried. For a person aged 70+ years, such a trip

to the pick-up point became the main and most difficult task of the day. There was no pathos in these queues — there was fatigue.

Fig. 1.21. Queues for drinking water are the hallmark of wartime Mykolaiv (author's photo).

The May rains of 2022 made it possible to at least partially solve the issue of technical water. This was not a mass phenomenon, but there were isolated cases when Mykolaiv residents tried to use bad weather to their advantage. In particular, during heavy rains, I collected water directly from the drains.

It looked as prosaic as possible: substitute a bucket or canister under the stream gushing from the gutter, wait a few minutes and bring a heavy container into the apartment. Such water was dirty, washed away dust and debris from the roofs of houses, but it was free and available right at the entrance. It was used exclusively for technical needs: pour it into the toilet cistern or wash the floor. Such episodes only emphasized the depth of the crisis — the townspeople were forced to provide themselves with minimal sanitary conditions, which were previously guaranteed by a simple turn of the tap.

Those who had vehicles went to the Ingul and Southern Buh rivers. Despite the fact that the water there was salty due to its proximity to the estuary, it was collected in hundreds of liters to be able to maintain basic hygiene

When we talk about wartime Mykolaiv, we see not only the front line, but also a map of tram and trolleybus routes that have complemented their purpose. In a city where water has disappeared from taps and every liter has become scarce, municipal transport has taken on an additional mission that was not spelled out in any job description. He became a supplier of life to the most remote corners of the city.

It was a period when the logistics of drinking water in Mykolaiv resembled a complex military operation. Large volunteer trucks and water carriers were often concentrated in the center or on the streets where it was convenient to unload. However, for residents of remote areas, for the elderly who lived in the depths of working neighborhoods, these central points were

unattainable. The pensioner could not carry several five-liter eggplants through three microdistricts. And that's when electric transport came to the rescue.

Trolleybuses and trams of "special purpose"

The transformation took place quickly and prosaically. Mykolaivelectrotrans has converted part of its fleet into mobile water distribution points. Cabins where passengers used to go to work or home were now occupied by huge plastic containers - "cubes" filled with purified water (Fig. 1.22).

Mykolaiv residents are used to the new, military aesthetics of bus stops. The usual trolleybus appeared on the horizon, but instead of the route number, the board could say "Water" or simply hung a sign with a red cross or volunteer symbols. It was not a pretentious gesture — it was daily, exhausting work. Electric transport drivers, who often worked to the sound of sirens, went on flights not to transport people, but in order to deliver the resource on time to those who were waiting for it the most.

Fig. 1.22. The process of filling eggplants through municipal transport (author's photo).

The special value of tram routes was their ability to penetrate remote areas where the private sector stretched for kilometers. The tram became a gathering point for the entire street. People learned the schedule of the "water voyage" by word of mouth or through district chats.

The stop turned into a microcosm of military life. As soon as the car stopped and the driver opened the door, hoses were removed from there. The queue, consisting mainly of elderly people, silently and disciplined approached the cranes. There was no hustle and bustle here — there was a common misfortune that taught people to appreciate every minute of the work of utility workers.

The driver of municipal transport in Mykolaiv is not just an employee of the depot. This is a person who was responsible for ensuring that thousands of people had a chance to cook dinner or wash their hands. Public transport became a link between the large water treatment plants that began to appear in the city and the end user in the residential area. It was a victory for logistics over chaos. Municipal transport reached places where there were no tracks, covering the needs of the "gray zones" of urban infrastructure.

For many Mykolaiv residents, the appearance of a trolleybus carrying water has become a symbol of the fact that the city lives, that the authorities have not removed themselves, but are looking for a way out even in a hopeless situation. This was an example of how civilian infrastructure can be mobilized for humanitarian purposes faster and more efficiently than any international mission.

The Mykolaiv experience of using electric transport as a water carrier is unique. It is about the ingenuity of desperation and how old Soviet rails and copper wires suddenly became part of a system that saves from dehydration. It was a daily routine: collect water, go to the line, distribute, return, dial again. And so it was under fire, in heat and cold, until the first stationary backfiltration points appeared in the city.

This period will go down in history as the time when public transport in Mykolaiv finally ceased to be just a business or service, but became part of a fortress city that refused to surrender to the mercy of the enemy and thirst.

Volunteer front

"Water for Mykolaiv" has become a matter of neighboring regions of Ukraine. Already in April, an unprecedented logistics operation began. Caravans of trucks and water carriers stretched from Odesa, Kropyvnytskyi, Dnipro and other cities. Volunteers carried bottled drinking water, large tanks were placed on railway platforms (Fig. 1.23).

A separate page in history was the "amphibious assault" from Odesa, a neighboring city that was the first to "lend a shoulder". Odessa water carriers have become a common occurrence on the streets of Mykolaiv. The organization of water distribution required clarity: online maps of pick-up points were created, volunteers coordinated queues to avoid stampede and conflicts. International organizations such as the Red Cross and UNICEF began to install large water tanks ("cubes") in sleeping areas, which were filled daily.

Fig. 1.23. Volunteer water movement (photo from open sources).

Salty compromise

Since the city could not function with an empty sewerage, in May 2022 it was decided to fill the system with water from the Buh estuary. It was a choice between no water at all and water that was technically unsuitable for the grid.

When the pressure finally appeared in the taps, the joy was short-lived. The water was salty in taste, had a yellowish color and a characteristic smell. It was impossible to use it for cooking - salt made the products bitter and unfit for consumption. Even after boiling, a thick layer of white coating remained on the walls of the kettles.

The salt began to act on the old iron pipes instantly. Within a few weeks, the number of gusts in the city increased significantly. Salt "ate" the metal from the inside, rust clogged faucets and filters in apartments. Household appliances — washing machines, dishwashers, boilers — began to fail en masse. There was no point in repairing them as long as aggressive salt water remained in the system.

This decision saved Mykolaiv from epidemics and sewage shutdowns, but in fact signed a death sentence to the city water supply, which began to crumble before our eyes.

Alternative ways and technology of "technical" water supply

After the destruction of the Dnipro-Mykolaiv water pipeline, the city was in a complete water vacuum for almost a month. Only on May 9, 2022, the pressure in the system was restored, but it was completely different water - exclusively technical, unsuitable for consumption and even cooking.

Throughout 2022, local authorities and specialists of Mykolaivvodokanal were in a continuous search for alternative sources that could replace the lost Dnipro artery. Two main strategic directions were considered:

1. Underground horizons. An attempt to return to the origins. The first logical step was to drill new wells directly within the city. The idea was to supply artesian water directly to the apartments. However, this plan faced a harsh geological reality: hydrogeological conditions near Mykolaiv do not allow the extraction of fresh water in the volumes necessary for a city of half a million. Deposits are limited, and the quality of water often does not meet drinking standards.

Despite this, it was decided to drill wells where possible. This made it possible to obtain at least a small amount of water that could be mixed with the general flow or purified at local reverse osmosis stations. But this was not enough for the stable operation of the network.

2. Use of the Southern Buh River. A critical decision was made: to use water from the Southern Buh. Because this water has a high salt content (due to mixing with seawater in the estuary), it has never before been considered as the main source for centralized supply.

Technological cycle of purification

Before getting to the taps of Mykolaiv residents, water from the river and wells underwent an accelerated preparation cycle. Unlike in the pre-war period, then the main emphasis was shifted to disinfection in order to prevent epidemics. The process looked like this:

Sampling and mixing. Through special shore structures, water was taken from the river and added to the volumes received from wells.

Primary chlorination is the first and most important barrier. High doses of chlorine were administered immediately to instantly kill pathogenic bacteria that may be contained in an open body of water.

Settling. The water was in the horizontal sedimentation tanks for some time. Here, under the influence of gravity, large mechanical particles and suspensions were deposited.

Filtration. Passing through the units of quick filters helped to get rid of smaller debris.

Secondary chlorination is the final stage of disinfection before sending water to the consumer, which ensured that the water remained safe (in terms of bacteriology) while driving on long urban networks.

Distribution. The water purified in this way was accumulated in clean water tanks, from where pumping stations pumped it to the districts of the city.

This scheme (Fig. 1.24) allowed Mykolaiv to function: the sewerage system worked, firefighters had water to extinguish the fire after shelling, and people had the opportunity to maintain basic hygiene. However, this method did not solve the main problem - the chemical composition of water. Salt and chlorine became a "slow poison" for the city's metal pipes, starting an irreversible process of destruction of the entire underground infrastructure.

Fig. 1.24. Scheme of water purification of the city (from open sources).

In general, the water that has been filling the centralized water supply system of Mykolaiv since May 2022, in most physical and chemical indicators, not only did not meet the standards of the State Sanitary and Epidemiological Code, but was outside the permissible values for drinking water. This was confirmed by laboratory tests, the results of which are striking in their deviation from state standards.

Salt stroke and health threats

The key problem was extreme mineralization. The **dry residue** indicator, which reflects the total amount of dissolved salts, reached **10,408 mg/l** in 2022. This is actually brine and not fresh water (Table 1.1).

The concentration of **chlorides (4400 mg/l with a norm of 250)** made the water not just salty in taste, but dangerous. The use of such a liquid, even after boiling, causes disorders of the gastrointestinal tract. No less threatening is **the hardness (32 mg-eq/l).** Such water "clogs" not only the pipes, but also the human body: long-term use of technical water with such indicators inevitably leads to the development of urolithiasis due to the accumulation of calcium and magnesium salts.

Hygienic paradox

The only indicator that remained within the normal range was bacteriological safety. Thanks to the aggressive method of chlorination, the indicator of "coli forms common" was stably equal to 0. This indicated the complete absence of Escherichia coli and other pathogens. However, the city paid a high price for this "sterile" tranquility: the intense smell of chlorine became a constant companion of every bathroom, and the water itself, due to an excess of reagents, irritated the skin, hair and mucous membranes.

Thus, Mykolaiv found itself in a state of hygienic paradox: the water in the taps was bacteriologically safe (it could be used to flush the sewer and clean), but chemically it was an aggressive brine that destroyed household appliances, corroded metal and threatened health with any internal use. The taste of such water — salty and bitter — has become the taste of the city's military life, reminding us that access to real drinking water remains a daily victory for Mykolaiv residents, and not a guaranteed right.

Table 1.1

Average values of water quality indicators supplied to the centralized water supply system of the city of Mykolaiv compared to the standards of Ukraine and the EU

Inticator	Units of measurement	Meaning	MPC, Ukraine	MPC, EU
pH		**8,1**	**6,5 – 8,5**	**6,5 – 8,5**
Taste, aftertaste	points	0	до 2	до 2
Smell, 20ºC	points	1	до 2	до 2
Chroma	points	14	до 20	до 20
Coli index	CFU/100K	0	0	0
Microbial number	CFU/l	12	до 100	
Phytoplankton	cells/l	5000		
Dry residue	**mg/l**	**10408**	**1000**	**1500**
Oxidative permanganate	mgO_2/l	5,2	5,0	5,0
Total rigidity	**mg-eq/l**	**32**	**1,5–7**	**1,2**
Alkalinity	mg-eq/l	4,1	0,5–6,5	
Chlorides	**mg/l**	**4400**	**350**	**250**
Nitrates	**mg/l**	**81,1**	**45**	**50**
Nitrites	mg/l	0,015	3	0,5
Sulfates	**mg/l**	**712**	**500**	**250**
Phosphate	mg/l	0,43	3,5	0,7
Cyanides	mg/l	0	0,035	0,05
Phenols	mg/l	0	0,001	0
Common ferrum	mg/l	0,2	0,3	0,2
Ammonium Nitrogen	mg/l	0,1	2,0	0,5
Aluminum	mg/l	0	0,5	0,2
Arsen	mg/l	0	0,05	0,01
Sodium	**mg/l**	**4380**	**1000**	
Nickel	mg/l	0	0,1	
Organic carbon	mg/l	18,3		
Mangan	mg/l	0	0,1	0,05
Molybdenum	mg/l	0	0,25	
Cobalt	mg/l	0	0,1	
Cuprum	mg/l	0,065	1,0	2,0
Plumbum	mg/l	0	0,03	0,01
Silicon	mg/l	1,16	10,0	-
Common chromium	mg/l	0	0,55	0,05
Zinc	mg/l	0,048	5,0	5,0

Periodization and mechanisms of transition to water intake from the Ingulets River

The use of the Inhulets River as the main backup source of water supply to Mykolaiv covered the period from 2023 to 2025. This time period can be divided into several key stages, each of which was accompanied by specific man-made and natural challenges.

The transition to water from Inhulets became possible due to the functioning of the Main Pumping Station of the Inhulets River Canal Administration (GNS Ukri), which provided water

supply not only for the city's drinking needs, but also for irrigation of agricultural land in the Kherson and Mykolaiv regions. The operation of this station in wartime was a heroic feat of the staff, especially after the disaster at the Kakhovka hydroelectric power station, when the units were completely flooded. The resumption of the station's operation took place in record time — in two weeks, which made it possible to restore the supply of technical water to Mykolaiv on June 22, 2023.

Water quality of the Inhulets River

One of the most difficult issues of using Inhulets as a source of water supply was the unstable and unsatisfactory quality of its water. Throughout the entire period of 2023-2024, the quality of water did not meet the requirements of DSanPiN 2.2.4-171-10 "Hygienic requirements for drinking water intended for human consumption". The main reason for this was the long-term anthropogenic impact associated with the activities of enterprises of the Kryvyi Rih iron ore basin.

The Inhulets River is a receiver of highly mineralized return waters from the reservoirs of mine and quarry waters of Kryvbas. The largest source of pollution is the state-owned enterprise Kryvbasshakhtozakryt, which discharges excess water from the storage pond in the Svistunov gully. According to official data, about 11 million cubic meters of mine water with mineralization of up to 4000 mg/l are discharged into the river annually.

In March 2024, the situation became critical. On the basis of the order of the Cabinet of Ministers of Ukraine No. 121-r, it was allowed to discharge mine water in the period until March 15 to prevent accidents at hydraulic structures. The results of laboratory tests during this period showed shocking figures.

For example, the level of mineralization exceeded by 3-4 times, which led to the appearance of a specific yellow or brown color of water, which was noticed by residents of all districts of Mykolaiv. Experts explained this phenomenon by a combination of natural factors and "man-made leaching": a high concentration of chlorides stimulates aggressive corrosion of pipes, as a result of which rust from the inner walls falls directly into the water flowing from the taps.

In addition to mineral salts, studies of water in Mykolaiv networks in 2022–2023 revealed the presence of pathogenic microflora. In particular, the presence of enterococci and Pseudomonas aeruginosa (Pseudomonas aeruginosa) was recorded in the technical water. It was also noted that the content of toxic elements was exceeded, which made such water dangerous not only for drinking, but also for hygiene procedures without preliminary boiling or filtration.

Corrosion processes and destruction of urban infrastructure

The use of highly mineralized water from Ingulets (and before that from the estuary) led to catastrophic consequences for the physical condition of city networks. The chemical aggressiveness of water became a catalyst for the rapid wear of materials that were not designed to work under such conditions.

The consequences of using aggressive water are reflected in the official reports of the enterprise and the statements of its management. The number of accidents per day has increased significantly, creating an extraordinary burden on repair crews and the city budget.

Indicator	Until 2022 (fresh water)	2023–2024 (Inhulets/Lyman)	Multiplicity
Average number of accidents per day	2 – 3	15	Growth 5-7 times
Maximum number of accidents	Up to 5 per day	10 – 15 per day	Growth by 10-15 times
Length of pipes to be replaced	—	240 km of steel pipes	Critical
Service life of concrete pipes	50 years	The destruction began much earlier	Accelerated degradation

In total, more than 240 kilometers of steel pipes in the city, which suffered the most, need to be replaced. Salt water also negatively affects reinforced concrete structures, where corrosion of reinforcement leads to cracking of concrete from the inside, which threatens even large-diameter main manifolds.

Ecological aspects and degradation of the river ecosystem

The use of Ingulets as a source of water supply during the war has exacerbated the existing environmental problems of the region. The river found itself in the center of a vicious circle of man-made influence, where the interests of industry, agriculture and the municipal sector came into sharp conflict.

The Inhulets River is the main source for the Inhulets irrigation system. The use of water with high mineralization for irrigation of lands in the Mykolaiv and Kherson regions has catastrophic consequences for agrocenoses. Experts warn of the development of the processes of salinization and salinization of soils, which leads to the destruction of their structure, a decrease in fertility and the accumulation of toxic salts in plant products. This poses a threat to the food security of the region, since the restoration of salt marsh soils is an extremely complex and expensive process that requires washing the lands with large volumes of fresh water and applying chemical ameliorants.

Regular cycles of "pollution – washing" have led to the fact that the Inhulets River has lost its natural biological identity. Instead of a natural hydrological regime, the river operates in the mode of a man-made canal. Constant discharges of return waters (up to 11 million m³ per year) disrupt the hydrochemical balance, which makes the reservoir unsuitable for the existence of many species of river flora and fauna. Environmentalists emphasize that even if the discharges stop, it will take decades for the ecosystem to restore natural biodiversity.

The high salinity of water entering the sewerage system of the city negatively affects the processes of biological treatment at the city OSC (Galitsynove). Microorganisms that carry out wastewater treatment in aeration tanks (activated sludge) are sensitive to changes in osmotic pressure. An increase in the concentration of salts leads to inhibition of their vital activity or complete death, which worsens the quality of wastewater treatment before their discharge into the Buh estuary. In 2024, an increase in the volume of discharge of insufficiently treated

wastewater was recorded, which is directly related to the operation of the "salty" water supply system.

Calls of the Main Pumping Station and the Kakhovka disaster

The functioning of the water intake system from Ingulets is impossible without the operation of the Main Pumping Station of the Inhulets River Canal Administration. This facility has become a symbol of the resilience of Ukrainian infrastructure.

On June 6, 2023, after Russian troops blew up the dam of the Kakhovka hydroelectric power station, a huge wave of water reached the Snihuriv region, where the State Emergency Service is located. The station was flooded, and its unique equipment, which had been operating for decades, ended up under water and silt. This created a real threat of a complete shutdown of water supply for Mykolaiv.

The process of restoring the STS has become a unique case. The head of the station, Valery Voronov, who has been working at the facility since 1978, headed the work on the resuscitation of the units. Despite the complexity of the damage, the team managed to:

Clean engines and pumps from sludge and debris.

Carry out multi-stage drying of electrical components.

Perform commissioning work in conditions of a shortage of spare parts.

On June 22, 2023, the station started working again. This made it possible to restore the filling of canals and the supply of water to the city treatment facilities of Mykolaiv. Against the backdrop of these events, international partners also helped the communities of the Snihuriv region to equip artesian wells with a depth of 70 meters, which provided alternative drinking water supply to about 30% of the local population.

Realizing that the Inhulets River is only a temporary and extremely unsatisfactory solution, the government of Ukraine and international donors initiated the construction of a new water pipeline, which should finally solve the problem of fresh water for Mykolaiv. The project was called "Water supply from New Odesa".

Socioeconomic consequences and conclusions

The period of water supply to Mykolaiv from the Ingulets River has become one of the most difficult tests for the city community. This stage went down in history as an example of unprecedented resilience, but also as a lesson about the vulnerability of centralized systems in times of total war.

The inhabitants of the city suffered significant financial losses due to the quality of the water. Aggressive water from Inhulets massively disabled: electric boilers; washing machines and dishwashers; mixers and shut-off valves in apartments; toilet flush systems.

This forced people to spend thousands of hryvnias on repairs and replacement of plumbing, in addition to the cost of buying drinking water at bottling points (there are more than 250 points of issue in the city).

An analysis of the situation around the use of the Inhulets River allows us to draw several fundamental conclusions for the future recovery of Ukraine:

No major city can depend on one main water supply, especially if it passes through areas with a high risk of hostilities.

The issue of mine water discharge should be transferred from the plane of annual "permits" to the plane of technological modernization (construction of desalination plants or closed loops), since the Inhulets River is a strategic reserve for the entire South.

Supplying fresh water from a new water supply system is only half the solution. The other half is a complete replacement of intra-city networks that were critically damaged by salt water. Without this, water losses will remain at 40-50% due to constant leaks.

The experience of restoring the State Emergency Service and building a new water supply system with solar stations shows that critical infrastructure should be as energy-independent as possible and protected from terrorist acts.

The use of water from Inhulets was a forced step that saved Mykolaiv from the deportation of the population due to lack of water, but it also became the price that the city paid for its resilience to the aggressor. The effects of this period will be felt for decades to come due to the state of underground communications and changes in the river's ecosystem. However, the transition to a stable supply of fresh water in October 2025 marked the end of this crisis stage and the beginning of a large-scale recovery of the region's hydraulic sector.

Relic of war Mykolaiv: a treasure of 330 milliliters

Among the numerous "water plots" of wartime Mykolaiv, there are those that do not fit into dry statistics or technical descriptions. They are stored not in archives, but on the shelves of home sideboards, next to the most expensive things. One such symbol is a small aluminum jar with the inscription "Drinking Water" and a large red heart on a silver background.

This flask came to me as a gift from my first teacher, Nina Kalnova (Fig. 1.25). During that most difficult period, she, like many other elderly people, received such jars as part of volunteer assistance. What seemed like a trifle in peaceful life, in Mykolaiv, especially in 2022, was the highest manifestation of care. Breweries poured water into containers instead of the usual drinks so that people could simply survive.

Nina Vladimirovna shared this water with me, and now I keep this still filled flask as a precious memory. It is about the same "water" Mykolaiv, where thirst was common, and every sip of pure water tasted solidarity. It is a testimony of a city that has survived thanks to caring hearts, and of people who, even in the darkest of times, shared the last. For me, this jar is not just a flask, it is a materialized story of our struggle for life and the right to remain human.

Transformation of fundamental law

Since April 2022, this has been the period when the city learned to live according to the new, strict rules of water hygiene. In every Mykolaiv family, there was a silent revision of the household: what used to be an automatic movement of the hand to the faucet now required analysis and planning. Mykolaiv residents have clearly learned: water in pipes is not drinking, it is only a means for the survival of the infrastructure.

A rigid hierarchy has been established in everyday life. Salt water from the central network has become a "technical appendage". It was used to wash floors, drain toilets, and - with great care - use it for short showers. However, even here there were risks: after such a wash, the skin was

pulled from salt, and the hair became stiff, as if after swimming in the sea. Housewives watched with pain how home flowers, which had been pleasing to the eye for years, began to turn yellow. It turned out that even nature is not ready for such a concentration of chlorides and sulfates.

Fig. 1.25. Wartime artifact: a jar of drinking water is the best gift (photo by the author).

Cooking with this water has become completely impossible. Any attempt to cook soup or make tea turned into a fiasco: salt made the dish bitter, and the chemical smell of chlorine did not disappear even after prolonged boiling. Mykolaiv turned into a city of queues, which became its new social face.

Typical water scenes of that time are the moments captured in the photo (Fig. 1.20-1.22) where human endurance borders on despair. The main sources of life were three parallel streams. First, wells. People were drawn to private courtyards or territories of enterprises and institutions, where fresh water could still be obtained from the ground. Secondly, volunteer and imported water. Odesa water carriers and trucks from other cities have become a symbol for Mykolaiv that it has not been forgotten. And finally, bottled water, which for many has become the only guarantor of safety, although its purchase every day significantly "hit" the modest budgets of families, especially the elderly.

The city has adapted. Mykolaiv residents have learned to distinguish water by taste, color and smell, knowing by heart the schedules of delivery and the addresses of the nearest drinking water points. It was a transformation of a fundamental right: what is considered a basic service around the world has become a daily quest here, where the prize was the opportunity to simply drink clean water or cook lunch.

It was at this time that a painful break in consciousness occurred. Water has ceased to be something that appears after turning the tap. It was the result of hard physical labor and waiting. Each liter was counted: how much for cooking, how much for hygiene, how much for technical needs. Access to water has turned from a "natural right" into a "spoil of war".

1.3. BIG WATER IN THE FRONTLINE CITY

June 6, 2023 was the day when the water crisis in Mykolaiv took on a new, surreal dimension. The explosion of the dam of the Kakhovka hydroelectric power plant resonated in the city not because of the taps — where salt water had prevailed for more than a year — but because of the sudden and threatening rise in the level of the rivers. At that time, Mykolaiv had already pushed the enemy away from its gates, but remained within the reach of missile strikes and, most importantly, was in a state of prolonged water blockade.

The explosion of the Kakhovka hydroelectric power plant on June 6, 2023 was an event for Mykolaiv that finally cemented the status of the city as a "water island". Although the main blow of the elements fell on the Kherson region, the geographical location of Mykolaiv, covering the Southern Buh and Inhul, made it a direct participant in this disaster.

When the river flows backwards

The morning of June 6, 2023 began for Mykolaiv residents with alarming reports of a rise in the water level. Due to the fact that the Dnieper and the Southern Buh have a common estuary, the colossal volume of water that escaped from the Kakhovka reservoir created the so-called "back-up effect". The great water of the Dnieper did not have time to go out to sea and began to "press" on the Southern Buh and Inhul, forcing their waters to rise and overflow.

During the first days, the water level in Mykolaiv increased by more than a meter. It wasn't an instant tsunami, it was a slow, inexorable rise. The townspeople watched as the water gradually absorbed the lower embankment, flooded the beaches of the Namyv microdistrict and approached the shores of the Yacht Club. In some areas, the water rose 105 cm above the zero mark. This led to the fact that not only recreation areas, but also part of coastal communications was under water (Fig. 1.26).

This photographic evidence (Fig. 1.26-1.28), taken on June 8, 2023, captures one of the most surreal moments in the military history of Mykolaiv. The picture shows the territory of the Mykolaiv Yacht Club, the oldest in Ukraine, which, instead of the usual harbor for sailboats, has turned into a flooded area, where the border between the river and the city has finally disappeared.

In the photo, the alley of the yacht club, completely covered with a water column. This is a direct consequence of the explosion of the dam of the Kakhovka hydroelectric power plant, which occurred two days earlier. Due to the back-up effect, the water from the estuary rose so much that the Southern Buh literally "went for a walk" along the city embankments.

Fig. 1.26. Yacht Club area on June 8, 2023 (author's photo).

The mirror surface of the water, which filled the space between the concrete fences, created the illusion of a canal. The water level here reached the knees of an adult, which can be seen from the figures in the background. People who used to walk here looking at yachts are now forced to wander in the water, trying to understand the scale of what is happening.

In the right plan, behind the fence, the hulls of sailboats that stand on keel blocks rise. They were lifted out of the water for storage or repair, and now paradoxically look "safer" than the alley itself, which should have been dry land. The figures of teenagers in the water reflect that special Mykolaiv adaptability. For children, it is an adventure, a way to explore a changed world, while for adults, it is a visualization of the collapse of hopes for the imminent return of fresh water and the restoration of the region. A concrete fence stretching along the alley usually separates the yacht club area from the river. In the picture, it looks like the last bastion trying to contain the pressure of the elements, but the water has already overflowed, flooding the space where Mykolaiv residents have been making dates and celebrating regattas for generations.

Symbolism of the moment

These photos are not just about flooding (Fig. 1.27). This is about Mykolaiv as a peninsula city, which has always been inextricably linked with water. However, here water appears not as a life-giving force or a way for trade, but as an element that has become a weapon in the hands of the enemy.

Fig. 1.27. The area of the Yacht Club under the pressure of the Kakhovka wave on June 8, 2023 (author's photo).

Another photo taken on June 8, 2023 (Fig. 1.28) shows the consequences of the rise in the level of rivers in Mykolaiv two days after the tragedy at the Kakhovka hydroelectric power station. In front of us is a coastal recreation area, and now quiet, still water reigns.

The picture shows a gazebo of a café that was "captured" near the Southern Buh. The water rose so much that it completely flooded the paving stones, turning the walking area into a mirror surface. The clear reflection of the roof of the structure and the leaves of the trees in the water creates the illusion of calm, but this calm is deceptive. The water level reaches a considerable height, flooding the foundations and lower parts of the walls, which means inevitable deformation and destruction for light park structures.

Especially striking is how the water leveled the usual boundaries. The tree growing near the gazebo now stands in the middle of the river, and the lanterns and fences in the background look like strange installations growing straight out of the water. This is a visual testament to how quickly nature can regain the space reclaimed by man when a catastrophe of this magnitude occurs.

For Mykolaiv, this rise of the river became another test in the chain of endless crises. In a city where drinking water was scarce, this sudden excess of dirty, muddy water was seen as a bitter irony of fate. In the photo, we see the sun's glare on the water - nature

seems to ignore the human tragedy, creating a picturesque, but at the same time terrible picture of the consequences of a terrorist act.

Fig. 1.28. "Venice" of the frontline city: flooded terraces of Mykolaiv (author's photo).

Environmental echoes and threats to wells

The explosion of the Kakhovka hydroelectric power plant created a unique problem for Mykolaiv. If in the Kherson region the disaster was in the nature of rapid physical destruction, where the water element acted like a battering ram, demolishing entire houses and changing landscapes, then Mykolaiv faced a more insidious and long-lasting consequence — critical pollution of the water area. The city, which at that time had been surviving without access to the drinking system for more than a year, received a "double blow" to its water resources.

Along with the gradual but inexorable rise in the level of rivers, everything that had been accumulating at the bottom of the Kakhovka reservoir for decades and that had been washed out of peaceful homes upstream arrived on the banks of Mykolaiv. It was a real "toxic landing". The large water raised silt from the bottom, in which industrial

waste, pesticides from the fields of the Kherson region and heavy metals had been deposited for years. This cocktail of chemicals gushed into the Southern Buh and Ingul. For Mykolaiv residents who used water from the estuary for technical needs, this meant that the already aggressive environment in the pipes became even more dangerous. The water changed not only its chemical composition, but also its color and smell, becoming cloudy and heavy.

The biggest challenge for city services and residents was the bacteriological condition of rivers. The water, which flooded hundreds of cattle burial grounds, cemeteries, sewer sedimentation tanks and cesspools on its way, has become an ideal breeding ground for dangerous microorganisms. The corpses of animals that the current nailed to the Mykolaiv shores only aggravated the situation, creating a risk of outbreaks of cholera, dysentery and hepatitis A.

It was during this period that a strict ban on swimming, fishing and the use of river water even for the simplest economic purposes was introduced in Mykolaiv. For the frontline city, where the river has always been a place of psychological relief, empty beaches flooded with dirty water have become a symbol of a new, even deeper isolation. Water quality control became a matter of national security: laboratories worked around the clock, monitoring indicators that went off scale according to all sanitary standards.

Hitting alternative sources

The special drama of the situation was that the rise of polluted river water began to affect the state of groundwater. Many water distribution points in the city and private wells, on which residents had high hopes, were at risk. Rising river levels put pressure on aquifers, which could lead to infections and toxins entering underground sources.

Mykolaiv residents, who have already learned how to be professional logisticians and save every liter, are now faced with a new phobia: is the water they collect in wells near the coast safe? Even the reverse osmosis systems at the issuing points required more frequent replacement of filters due to the increased turbidity and chemical load of the incoming water.

The price of "big water"

Thus, the Kakhovka tragedy for Mykolaiv was not an episode of flooding, but an environmental sentence for many months. If the Kherson region struggled with the destructive force of the flow, then Mykolaiv entered into a long struggle with its poisonous consequences. The city was once again convinced: water is not just a liquid in pipes or a river, it is a vulnerable system that the enemy tried to poison at all levels — from the centralized water intake to the last coastal well. This experience finally imprinted in the minds of the townspeople: the real value is not just water, but its purity and safety. This created a critical situation for those residents of Mykolaiv who used private wells or wells in the coastal zone. The rise of river water caused a change in pressure in underground horizons, which led to groundwater pollution. Since the city

had been dependent on every fresh well found for more than a year, it was a blow to the city's self-sufficiency system.

The Kakhovka tragedy in Mykolaiv was perceived as another link in the chain of terror against the critical infrastructure of the south. While the townspeople continued their daily ritual of collecting water at osmosis points and transporting it by carts, the river next to them lived its own, now dangerous life.

This was the paradox of the frontline city: it was surrounded by billions of cubic meters of water approaching the roads, but in its homes, every drop of fresh water remained the result of huge logistical efforts. The explosion of the hydroelectric power plant did not change the taste of salt water in the system, but it destroyed the very hope for the rapid restoration of the Dnipro water carrier, making the city's water independence a matter of strategic survival for years to come.

Transformation and state of quality of the Buh estuary

The man-made disaster caused by the explosion of the dam of the Kakhovka hydroelectric power plant on June 6, 2023, provoked a cascade of hydrological, geochemical and biological processes that radically changed the state of aquatic ecosystems in the South of Ukraine. The Buh estuary, as an integral part of the Dnieper-Buh estuarine system, has become one of the main recipients of a colossal volume of fresh water saturated with alluvial sediments, organic residues and anthropogenic pollutants.

The Buh estuary, immediately adjacent to the zone of mixing river and sea waters, experienced a sharp decrease in salinity. During the peak periods of June 2023, the salinity in the Dnieper-Buh estuary fell to the level of 0.2‰, which actually meant complete desalination of the water area. This phenomenon caused the mass death of stenohaline (marine) aquatic organisms, which could not adapt to the abrupt change in osmotic pressure. Simultaneously with desalination, large-scale pollution occurred: the total area of the affected water area, including the Black Sea, was more than 6800 km2

The most critical aspect of water quality in the Buh estuary near Mykolaiv was the state of microbiological indicators. During the summer period of 2023, the Mykolaiv Regional Center for Disease Control and Prevention of the Ministry of Health of Ukraine recorded extreme exceedances of bacterial contamination standards. In particular, cholera-like vibrio was found in the water of the Buh estuary (the area of the Chaika beach and the Namyv recreational area). Although it was not a direct causative agent of Asian cholera, its presence indicated the presence of conditions favorable for the circulation of pathogenic strains and was an indicator of fecal contamination. Analysis of the content of lactose-positive Escherichia coli (LCP) revealed a catastrophic situation. At the permissible level of 5000 units/dm3, in the Dnieper-Buh estuary, the indicators varied between 6200 and 13000 units. However, these figures were relatively moderate compared to the Inhulets River, where the level of paintwork

reached 240 million. units, which testified to the direct ingress of untreated sewage and eroded cemeteries and cattle burial grounds into the waterway.

In 2024 and 2025, monitoring continued weekly. As of July 22, 2024, the LCP index on the beaches of Mykolaiv exceeded epidemic safety by 3.1--4.8 times. However, by the summer of 2025, the situation began to stabilize: data for July 18, 2025 indicate that only one sample from the Chaika beach recorded an excess of Escherichia coli by 1.3 times, while in the "Namyv" and Strelka zones, deviations from microbiological standards were no longer recorded. This indicated the processes of self-purification of the aquatic environment, although the risk of "secondary waves" of pollution remained relevant during heavy rains or hydrological fluctuations.

Chemical contamination and toxicological parameters

The chemical profile of the waters of the Buh estuary was subjected to significant pressure due to the influx of nitrogenous compounds, iron and organic matter. Already in the first weeks after the accident, the maximum permissible concentrations (MPC) for ammonia were exceeded in the estuary. This was a direct consequence of the decay of a huge amount of organic biomass, which was washed away from the land and formed as a result of the death of hydrobionts.

As of 2025, it was recorded that in different locations of the estuarine system, the concentration of pollutants exceeded the permissible values by 1.1–51.8 times. It is important to note that although petroleum products and pesticides in the first samples of 2023 directly in the Buh estuary were not detected in critical volumes, the overall level of toxic load increased due to the leaching of bottom sediments.

Of particular concern was the phenomenon of secondary pollution. The bottom of the northwestern part of the Black Sea and adjacent estuaries is covered with silt deposits that have deposited heavy metals and persistent organic compounds for decades. Any disturbance of these sediments (due to storms or heavy vessel traffic) leads to the return of toxicants to the water column. This process can be compared to a chronic disease that worsens at the slightest irritation.

Eutrophication of the water area of the Buh estuary has become one of the most noticeable consequences. Excessive accumulation of nutrients led to an increase in the concentration of algae and the accumulation of chlorophyll, the level of which in 2025 was 2.9 times higher than normal. This not only changes the color and transparency of the water, but also creates zones of "dead water" near the bottom, where dissolved oxygen is spent on the oxidation of dead organic matter.

Ecological transformation and ecosystem degradation

The consequences of the destruction of the hydroelectric power plant for the biota of the Buh estuary and adjacent territories became catastrophic. Only in the Kakhovka reservoir itself before the terrorist attack, 43 species of fish lived, of which 20 were of commercial importance; Annual catches reached 2.6 thousand tons. tons. Much of this

resource was destroyed or washed into the sea, where freshwater fish died from osmotic shock.

In the Buh estuary, both commercial fish species and food supply were hit. The ban on amateur and commercial fishing, introduced in June 2023, covered not only the estuary, but also the Southern Buh, Inhul and Inhulets rivers. Control over compliance with these restrictions was carried out by fish protection patrols and water police, which conducted regular raids to prevent poaching and poisoning of the population with potentially dangerous products.

Interesting, but alarming is the dynamic development of vegetation on the drained bottom of the Kakhovka reservoir. By September 2024, the area of vegetation cover there increased to 135 thousand hectares. ha, of which 48 thousand hectares. hectares were made up of tree-like plants (willow, poplar). However, the abnormal heat of 2024 +40.5-42.0°C led to the massive drying of these plants: 75% of the territory showed signs of degradation. This was an additional risk for the Buh estuary — dust storms from the drained bottom bring toxic particles of soil and shells into the water, which increases the chemical load on the water area of Mykolaiv.

Socio-economic and regulatory implications

Providing Mykolaiv and surrounding communities with quality water remains one of the most difficult humanitarian and engineering problems of modern Ukraine. The destruction of the Kakhovka hydroelectric power plant in June 2023 was a point of no return for the old water use system, as the Kakhovka reservoir was a source of water for more than 4 million people. The loss of more than 14 cubic kilometers of fresh water (72.5% of the reservoir's volume) led to the immediate drainage of key water intakes, forcing the region to switch to emergency alternative sources, including deep-sea artesian wells and mobile reverse osmosis plants. However, the water quality in the Dnieper-Buh estuary itself, which previously served as a natural buffer, underwent irreversible degradation after the disaster. The first stage (summer 2023) was characterized by acute bacteriological contamination, the presence of cholera-like vibrios and a critical decrease in salinity. The second stage (2024) was marked by the processes of intensive eutrophication and the accumulation of toxicants in the bottom sediments.

As of 2025–2026, there is a certain stabilization of microbiological indicators, but the chemical state of the water remains unsatisfactory due to the chronic excess of ammonia and biogen concentrations. Secondary pollution of sludge remains a "time bomb" that threatens water quality in the long term.

Further restoration of the water area requires not only natural self-purification, but also large-scale measures for the reclamation of territories, restoration of the hydrological balance and enhanced control over wastewater discharges. Changes in the microclimate caused by the drainage of the reservoir will continue to affect the water balance of the

region, which makes monitoring the water quality in the Buh estuary a priority for national security and health protection of the population of the South of Ukraine.

In the context of the inability of the local budget to overcome the crisis on its own, international partners, in particular Denmark and international financial institutions, played a key role. Denmark has taken patronage over Mykolaiv, directing significant resources to restore the water sector. The Ministry of Foreign Affairs of Denmark has allocated 7.2 million euros for the complete reconstruction of networks in the area, where water losses due to gusts reached 40%. The Danish Refugee Council (DRC) and the Nordic Environment Finance Corporation (NEFCO) have secured the supply of more than 24.5 km of modern polyethylene pipes that are resistant to corrosion and aggressive environments. In 2025, a three-year project "Mykolaiv Strategic Partnership" was launched with a budget of more than $36 million, which focuses on creating water quality monitoring systems and restoring the ecological balance of the region.

1.4. SYNCHRONIZATION OF WATER SUPPLY WITH ENERGY SUPPLY SCHEDULES AND WATER WAR CULTURE

The period of 2024-2025 brought significant adjustments to the already established survival system of Mykolaiv. Massive military attacks on Ukraine's energy infrastructure have led to

before the introduction of scheduled and emergency power outages. For Mykolaiv, this meant that access to water now depended not only on the availability of the water itself in the source, but also on the availability of electricity for the operation of pumps and filtration systems.

Energy dependence of pick-up points Most of the free drinking water distribution points in the city are based on reverse osmosis technology. This is an energy-intensive process: to push water through the membranes, you need a stable high pressure, which is created by electric pumps. Accordingly, when the microdistrict was de-energized according to the schedule of "queues", the water supply point automatically stopped working.

This created new domestic inconveniences. If earlier a resident could come for water at any convenient time during daylight hours, now it was necessary to first check the outage schedule of Mykolaivoblenergo. A situation arose when, at the moments of the availability of electricity, significant queues formed near the distribution points, because everyone was trying to stock up until the next shutdown.

The logistics of the "light hours" of the life of Mykolaiv residents turned into a constant synchronization of two schedules. A typical day looked like this:

Checking that your home belongs to a specific shutdown queue.

Coordination with neighbors or through Telegram channels on whether a particular point of issue is working (after all, the network schedule did not always coincide with the technical condition of the equipment).

Quick collection of tanks during the period when the pumps were running.

The problem was aggravated by the fact that after turning on the light, the reverse osmosis system needed a certain time (from 15 to 30 minutes) to enter the operating mode and start dispensing purified water. This further reduced the usable time during which people could collect drinking water.

In order to reduce dependence on the power grid, the city and volunteer organizations began to gradually equip strategic issuing points with generators. However, this did not solve the problem completely. Firstly, the power of the generators was not always enough for the full operation of large purification systems. Secondly, it significantly increased the cost of water due to fuel costs and required the constant presence of personnel to maintain equipment.

Thus, during the blackouts, drinking water in Mykolaiv became a resource that had to be "hunted" for in short periods of energy stability. This taught the townspeople even more discipline: water supplies in each apartment became a prerequisite, and eggplants on balconies or corridors became an integral part of the interior. Access to water ceased to be a continuous process and turned into a discrete service tied to the general state of the country's energy system.

During the periods of the longest blackouts, when the city was left without a stable power supply for hours, the issue of the autonomy of water distribution points became critical. The expectation of "daylight hours" became less and less predictable, so the technical re-equipment of the issuing points became the next logical stage in the struggle for water.

Some of the points, especially those created with the support of international humanitarian organizations and large volunteer foundations, began to be equipped with autonomous power sources. The appearance of diesel and gasoline generators near the points of issue changed the sound background of Mykolaiv yards. The characteristic roar of a running engine became a signal for the inhabitants of the surrounding houses: "there is water, the point is working."

Generators made it possible to keep pumps and reverse osmosis systems running even when the entire area was immersed in darkness. This relieved some of the tension, because queues for water ceased to depend on the schedules of regional power companies. People could plan their day, knowing that a certain point has its own power resource and will give out water regardless of the state of the general network.

In addition to generators, less energy-consuming facilities — for example, small wells or points where deep filtration under high pressure was not required — began to use systems with batteries and inverters. These were quieter, but no less effective solutions that allowed automation and cranes to work during short-term outages.

However, autonomy came at a price. Work on generators required constant fuel delivery, engine maintenance and the presence of duty officers who would monitor the equipment. It was a complex logistics network, where fuel became as important a component of the water supply as the filters themselves.

The presence of such autonomous points has become a real salvation for the areas where the energy infrastructure was most damaged. This created a certain stability in the chaos of blackouts: even if there was no light in the apartment and the elevator did not work,

but at the corner of the house, thanks to the rumbling generator, it was always possible to fill the eggplant with clean drinking water. A hybrid model of infrastructure management, which combined technical expertise and volunteer resources, became an effective response to the city's energy destabilization strategy.

The role of religious communities

Among the network of pick-up points scattered around the city, the point at the Seventh-day Adventist Church gained a special reputation (Fig. 1.29). When most of the townspeople are already accustomed to the mediocre quality of technical water, this point has become a benchmark for true purity. The water quality here was good, so information about it quickly spread beyond the boundaries of the microdistrict. People from other parts of the city specially came here, loading trunks with dozens of eggplants to provide their families with water, which was not inferior in taste and properties to the best bottled water.

Fig. 1.29. A point for distributing purified water, equipped with a generator for uninterrupted operation in conditions of a power outage (photo by the author).

The atmosphere in the queues at this point was special. There were no lively discussions or arguments here. People, as a rule, waited in silence for their turn. This silence was a manifestation of deep fatigue and at the same time focus on the process. Everyone was aware of the value of the resource they received and the value of time, especially during blackouts.

Thanks to autonomous power systems (generators and batteries), this point continued to work even when the surrounding houses were dark. In the twilight of the blackout, to the monotonous sound of the generator, the figures of people with eggplants looked like shadows in the theater of military life. Collecting water has turned into a silent ritual: substitute the container, wait for the filling, tighten the lid tightly and make room for the next one.

It was this point that became an example of the fact that even in the darkest times, a high standard of care can be provided. The activities of the issuing point at the Adventist Church became an example of effective decentralization of water supply. During the systemic infrastructure crisis, such locations provided not only resource support, but also compliance with sanitary and humanitarian standards, which was critically important for maintaining social stability.

Ethics and automatism of the "water" queue

Over time, in the Mykolaiv queues near the distribution points, a special, almost military etiquette was developed. People have learned to bring the process of collecting water to automatism. This was not the result of briefings — it was the result of thousands of repetitions (Fig. 1.30). The main goal was to reduce the time spent at the tap, because everyone understood: the faster I dialed, the faster the person behind me would dial, and the more likely we were to have time for the next power outage or air raid.

The art of preparation began at home. Each eggplant was checked for integrity, the lids were unscrewed in advance. No one stood in line just like that. People prepared containers: they removed extra bags, put the bottles in the order in which it is more convenient to substitute them under the stream (Fig. 1.31).

The recruitment process itself resembled the work of a conveyor. A person approached the point, and his movements were honed: substitute the first eggplant, fill it, instantly replace it with the next, and only then, stepping aside, calmly tighten the lids. This simple action — tightening the lids "outside the dialing area" — has become the golden rule of Mykolaiv etiquette. Occupying the tap while you tighten five or six caps was considered a manifestation of extreme disrespect for the queue.

In these queues, people have learned to appreciate water on a physical level. When you carry every liter to the car or to the floor without an elevator with your own hands, the value of the resource increases significantly. Special hoses, taps - everything was used to prevent water from splashing. The everyday behavior of the townspeople was transformed in the direction of extreme frugality. Even insignificant losses of resources during recruitment or transportation began to be recorded by consciousness as inefficient use of a scarce good.

Fig. 1.30. A queue of Mykolaiv residents for water at the issuing point at the Seventh-day Adventist Church (author's photo).

Fig. 1.31. The process of collecting water is brought to automatism (author's photo).

This frugality was carried over into the home. Water from the issuing points was used exclusively for drinking and cooking. For everything else, there was a different kind of water — technical from the tap or collected in another way. In everyday life, the concept of "second life of water" appeared: the water used to wash vegetables could later be watered with single surviving flowerpots or used for primary flushing.

The queue for water has become a place of action for specific social norms. Mutual assistance was silent but functional: from hose support to logistical arrangement of the space around the pick-up points. The rational organization of the queue and respect for the efforts of other residents made it possible to minimize conflicts and optimize the process of collecting water.

This period etched in the character of the Mykolaiv people a trait that is difficult to understand for those who did not live under such conditions — rational calm. No panic, minimum words and maximum efficiency. Humans turned into a well-lubricated mechanism that worked synchronously with generators and light schedules.

For many who came by car, this trip became a kind of expedition. Loading the trunk with dozens of containers required efficiency and speed. It wasn't just a household chore — it was a form of life. Effective logistics of self-sufficiency has become an important element of civilian life. The ability of citizens to autonomously solve water supply issues leveled the aggressor's expectations of destabilizing the situation due to the destruction of critical infrastructure."

"Mykolaiv truck": trolley as the main vehicle

Wheeled carts, which in peacetime were considered an attribute exclusively of summer residents or the elderly going to the market, suddenly turned into the most important vehicle in the city. In Mykolaiv during the war years, they became a kind of "trucks" on a microdistrict scale. If earlier such a stroller could cause a smile, now it has become a sign of economic thoughtfulness (Fig. 1.32).

The logistics were simple but effective: the design of the standard trolley made it possible to compactly place up to six plastic eggplants on the platform. Each is 6 liters. The mathematics of survival was simple: one flight is 36 liters of water. For a city dweller who lives in a high-rise building without a working elevator, such a volume was the golden mean between physical capabilities and the needs of the family for several days.

The narrative of Mykolaiv streets of that time is the continuous, rhythmic sound of metal wheels on the asphalt. This roar became part of the city noise against the background of the constant noise of generators and the wailing of air raid sirens. The cart made the process of "extracting" water democratic. Thanks to him, a heavy load of 36 kilograms ceased to be an unbearable burden. He could be dragged by a teenager, a woman on whose shoulders the whole burden of domestic life fell; or an elderly person. The wheels

and the trolley lever gave the necessary advantage that allowed you to cover the distance from the pick-up point to the house.

Fig. 1.32. Culture of special water carts (author's photo).

The loading process was brought to automatism: the filled bottles quickly took their places, and then they were fixed with elastic rubber harnesses with hooks. These "rubber bands" have become a necessary commodity, because without reliable fixation on the very first curb, all valuable water could end up on the ground. People have learned to fill every centimeter of the cart area, creating a stable structure made of transparent plastic.

It was interesting to watch the transformation of urban space. The entrances of houses were filled with this "transport". Wheelchairs were not hidden — they were left at the doors of apartments or in vestibules, always ready for a new flight. They have become a symbol of mobility. 36 liters at a time was autonomy, it was an opportunity not to go for water tomorrow, saving time and energy for other things. Each such "truck" on wheels was silent proof that Mykolaiv was not going to stop. People simply picked up these simple devices and began to transport life to their homes, step by step, overcoming fatigue and circumstances.

However, private cars have become an equally important element of urban logistics. An invariable attribute of every Mykolaiv motorist was the presence of empty or filled eggplants in the trunk. Even if the driver went on business that did not concern water, a set of containers was always "on duty" in the luggage compartment. It was almost impossible to see an empty trunk in Mykolaiv at that time. The car turned into a mobile tank: passing by the issuing point without queuing or seeing a water carrier, the driver instantly stopped to replenish the supply. This "trunk stock" has become a form of insurance against unexpected power outages or technical accidents at checkpoints.

How caps became the "currency" of aid

Near the water distribution points in the city, you could almost always see homemade containers - usually these were the same five-liter eggplants, but with cut holes, attached to fences or poles. Their purpose was simple, but strategically important: the collection of plastic bottle caps (Fig. 1.33).

This initiative, which spread massively in the city, had a deep meaning that went far beyond conventional waste recycling.

Fig. 1.33. Containers near water distribution points for collecting lids from plastic containers (author's photo).

In wartime, the collection of plastic caps turned into a large-scale volunteer campaign. The main goal is to finance the production of prostheses for wounded soldiers.

The caps are made of high-quality plastic (high-density polyethylene, marked "2" or HDPE). This type of plastic is easier to recycle than the bottle itself, and recycling plants pay a higher price for it.

Volunteer foundations collected significant amounts of such plastic and handed it over for recycling. The funds received were used to purchase raw materials or pay for the manufacture of prostheses and their components. The collection of caps helped to structure this process, isolating the most valuable plastic for a useful cause.

The placement of such "collection points" near the points of water supply was an ideal logistical solution. A person, coming for water, seeing such a bottle-container on the fence, automatically joined the charity.

This photo (Fig. 1.32) demonstrates another feature of the Mykolaiv character — the ability to create complex assistance systems from improvised means. An old bottle, a rope and a rusty fence turned into a tool of life. Each bright cap inside (Fig. 1.33) is not just waste, it is a small part of a large contribution to the rehabilitation of the military. For many Mykolaiv residents, this ritual has become familiar: "product" of water, throw the lid of a plastic bottle into a container. It was a tacit confirmation that even in the struggle for basic needs such as water, people did not forget about those who needed help even more.

Synchronization of water supply with energy supply schedules and water war culture

The military existence of Mykolaiv formed a special type of social interaction — water military culture. Its characteristic feature was the strict dependence of access to the basic resource on the stability of the power system and the temperature regime. During the periods of blackouts and winter cold in 2026, the city's critical infrastructure faced the challenge of "double scarcity": the lack of electricity automatically meant the shutdown of pumps, and the frost turned street pick-up points into ice traps. The analysis of the logistics of the points of invincibility and the issuance of clean water highlights deep technical gaps. The lack of autonomous power sources made it impossible for water points to work uninterruptedly. Under conditions of low temperatures, technological paralysis occurred. Systems froze, requiring a long process of "thawing" during thaws. The level of load on the social sphere during this period became critical, revealing vulnerabilities in the system of informal communications and urban logistics. The thesis "no light, no water" has become the main formula of military life...

1.5. FRESH WATER WITH A TASTE OF ANTICIPATION IN MYKOLAIV IN 2026

The period from 2022 to 2026 was the time of the most radical transformation of the city's critical infrastructure in the history of its existence. As of the beginning of 2026, the city is entering a new stage of overcoming the water crisis, which was caused by an act of man-made terrorism in April 2022, when the main water supply from the Dnipro River was destroyed. As a result, the city of half a million was forced to use salt water from the Buh estuary and then from the Inhulets for a long time, which led to large-scale chemical degradation of underground communications and put forward an unprecedented level of complexity for the community and the state: the construction of a new water supply system from scratch.

Strategic change of water supply sources: from the Dnieper to the Southern Buh

By the beginning of 2026, Mykolaiv has completely switched to a new model of water supply, which is based on diversification of sources and minimization of safety risks. Until 2022, the main source was the Dnipro River, but the vulnerability of the 73-kilometer water pipeline passing through the frontline territories forced the government and local authorities to look for alternatives. The main source of drinking water supply for the city is now officially identified as the Southern Buh River near the city of Nova Odesa.

This transition was not just a logistical decision, it became a fundamental engineering reorientation. The Southern Buh River has a different hydrochemical composition compared to the Dnieper, which requires qualitatively different approaches to treatment. The Mykolaiv Water Pipeline project, implemented during 2024-2025, includes not only a pipeline, but also a whole ecosystem of structures, from water intake to modern filtration stations.

The choice of the Southern Buh was dictated by the critical need to quickly restore fresh water supply, since the long-term use of salt water from the estuary, and then from the Inhulets River, made the damage to the city network irreversible. The use of the Southern Buh made it possible to create an autonomous system that does not depend on the state of the territories in the Kherson region that remain under the threat of shelling.

Technical architecture and stability of the new water supply system

At the beginning of 2026, the Mykolaiv water supply system is a unique engineering system for Ukraine with an extremely high level of automation and physical protection. The project worth UAH 6.3 billion was implemented with significant cost savings (the initial estimate was UAH 8.7 billion), and the saved UAH 2.4 billion was used to expand the capabilities of treatment systems.

Given the risks of attacks on the power system, the water utility facilities are equipped with multi-level protection at the beginning of 2026. All cable lines and key substation nodes are hidden underground to protect against debris damage.

At the first section of the water supply system, a solar power plant with a capacity of 1.5 MW was put into operation, which at the beginning of the year is operating at full capacity. In addition, powerful diesel generators (1400 kW each) are installed, capable of maintaining the operation of pumps in the event of a complete blackout. The second stage of physical protection facilities for critical infrastructure, including shelters for personnel and reinforced concrete structures for above-ground equipment, has been completed.

The system is also designed to support the region's agricultural sector by providing an additional 50,000 cubic meters of water daily for irrigation, which is critical for the economic recovery of the Mykolaiv region.

Drinking Water Quality: From the "Salty" Past to 2026 Standards

As of January 2026, Mykolaiv has been receiving fresh river water from the Southern Buh for more than three months, which has significantly improved the quality of life of residents, but the official status of water in the network remains transitional.

The issue of water quality at the beginning of 2026 should be considered through the prism of two factors: the quality of water treatment at treatment plants and secondary pollution in damaged networks.

The new treatment plants, the construction of which was completed at the end of 2025, use a multi-stage water treatment system adapted to the characteristics of the Southern Buh. Since the river water in this region has an increased level of organic matter and a specific smell, the system includes the following stages: dosing activated carbon in the form of pulp directly into the pipeline to adsorb organic substances and improve organoleptic parameters (taste, smell); chemical stabilization through the use of sulfuric acid to correct the pH level and sodium permanganate or sodium hypochlorite for primary disinfection and oxidation of pollutants, and mechanical microfiltration through the use of DynaDiscs, which provide automatic cleaning of fine fractions without stopping the supply process. Before supplying clean water tanks, sodium hypochlorite is injected. This technology allows the system to automatically respond to seasonal changes in water quality in the river.

At the beginning of January 2026, the water in the taps of Mykolaiv residents is described by experts as "almost drinkable". Although most of the parameters comply with DSTU, there are comments on two key criteria.

Due to the fact that at the beginning of the year the purification system is still undergoing the final adjustment of the reagent mode, filtration does not always have time to completely remove suspended particles at peak loads.

An increase in oxidation is recorded. This indicator indicates the presence of residual organic matter. Its complete elimination is expected by the end of March 2026, when the reagent system will operate in automatic mode with a full dosing cycle.

However, even after achieving ideal water quality at the exit from the treatment plant, residents of Mykolaiv may face unsatisfactory water quality in apartments. The reason for this is the catastrophic condition of underground pipelines. The use of water with a high chloride content for a long time caused accelerated corrosion of metal pipes. The total length of the network is about 1200 kilometers. In many places, the pipes are actually destroyed, leading to constant accidents. At the beginning of 2026, the number of daily bursts remains critically high. Clean water, getting into rusty pipes, is saturated with iron oxides and other corrosion products, which neutralizes the efforts of new treatment facilities

So, after years of a "salt era" that destroyed household appliances and burned metal pipes, the return of a fresh resource to a centralized system would seem to be the final point in the water drama. However, the reality turned out to be more complicated: although the salt has disappeared, the water quality is still far from ideal, and the trust of citizens in the central water supply system remains undermined.

Contrary to expectations, 2026 did not change the usual regime of Mykolaiv residents. Despite a significant decrease in the overall mineralization of water at the beginning of 2026, its organoleptic indicators remain unstable. Secondary pollution caused by critical wear and tear of in-house networks often manifests itself in the form of increased turbidity and a specific odor, which is a consequence of complex processes of water treatment and leaching of corrosion residues from pipes, formed in the most difficult years, continues to live (Fig. 1.34).

On the streets of the city, you can still meet people who carry large volumes of water in plastic eggplants, trusting only trusted pick-up points. Mykolaiv residents continue to go to the points of free distribution of purified water. For many, this has become not just a necessity, but an ingrained habit. People continue to rely on the drinking water system from bottling points, because tap water still has the status of "improved technical" in their minds. Even simple trifles, such as collecting plastic lids in special containers near such points, remain an integral attribute of the urban environment.

Man-made exam: duker accident

Mykolaiv felt the true face of the "new reality" on January 12, 2026. When it seemed that the worst was already over, there was a large-scale man-made accident on a duker across the Ingul River. More than 40 thousand residents of the Pivnichnyi, Solyany and Ternivka microdistricts in an instant again found themselves in front of empty taps.

Fig. 1.34. 2026: Mykolaiv residents continue to go to the points of dispensing purified water (author's photo).

This incident was a verdict on the old infrastructure. The damaged duker, put into operation back in 1988, has exhausted its physical resource. Two strands of steel pipes, which ran under the riverbed at a distance of 190 meters, could not withstand decades of operation and the aggressive effects of salt water of past years. The cost of repairing this section — almost 47 million hryvnias — has become the price that the city is forced to pay for years of inaction and forced compromises.

The narrative of the Mykolaiv queues has changed again. Now people were discussing complex engineering terms: "sanitation with a polyethylene pipe", "specialized installation organizations", "duker" (Fig. 1.35). The repair work, scheduled for January 18, 2026, has forced thousands of people to take out their legendary carts again and remember the addresses of nearby wells.

This accident also brought to the surface the painful issue of managerial effectiveness. The documents recalled that back in the summer of 2023, at the height of the Kakhovka disaster, it was planned to reconstruct the same duker. However, due to bureaucratic delays and terminated contracts with contractors in 2024, time was lost. At the beginning of 2026, the city had to correct these errors in an emergency mode, patching up the system, which literally fell apart under the riverbed.

Fig. 1.35. While repair work is being carried out on the duker, people are standing in queues for water (photo from open sources).

Logistics that has become a tradition

On the threshold of 2026, Mykolaiv lives in a state of "hybrid" consumption. Fresh water in the tap is perceived only as a base for hygiene and technical needs, while purified water from the points remains the only source of life.

In the trunks of cars, as in 2022, there are always empty bottles. Seeing a pick-up point without queuing up is still a reason to stop and "refuel" with clean water. The legendary carts loaded with eggplants have not disappeared from the entrances. Mykolaiv residents continue their weekly ritual, because trust in the "water from the pipe" is restored much more slowly than the supply of the resource itself.

The city no longer harbors illusions. Mykolaiv residents know that the return of fresh water is only the beginning of a long path of major reconstruction. Every pipe break, every accident is a reminder that the real solution to the water crisis will not be a change

in the chemical composition of water, but a complete restructuring of the city's water service, which has withstood the unbelievable, but needs a new foundation.

The current stage is a time of great anticipation and engineering transformation. Mykolaiv residents remember June 2023 well, when, after the explosion of the Kakhovka hydroelectric power plant, the river level rose so much that the water flooded the embankments and the Yacht Club. Those shots of flooded gazebos and alleys of the yacht club, which turned into canals, forever captured an understanding of the fragility of urban infrastructure.

The main task of 2026 is not just water supply, but a large-scale modernization of treatment facilities and replacement of networks. Mykolaiv is looking to the future, where the water in the tap will finally be equal in quality to the one that now has to go to the point. In 2026, a stable pattern of "hybrid consumption" was recorded in Mykolaiv. Despite the restoration of fresh water supply, citizens do not give up the created network of autonomous issuing points. This approach indicates a profound change in the culture of water use, where individual and collective autonomy acts as a guarantor of the quality of life in wartime.

CHAPTER II

HYDROCHEMICAL WAR CHRONICLE

2.1. BUH ESTUARY: CHRONICLES OF DEGRADATION AND RESTORATION CHALLENGES

The fragile balance of nature of the Buh estuary

Mykolaiv is a city whose fate is inextricably linked with water. The Buh estuary, which washes its shores, is a unique hydrological system, where the fresh waters of the Southern Buh and Inhul meet the salty breath of the Black Sea. It is an estuary that, by nature, is extremely sensitive to any external influence. The hydrological characteristics of the Buh estuary limit its self-cleaning ability. Shallow water and slow circulation of masses turn it into a zone of accumulation of pollution, where natural filtration mechanisms cannot withstand excessive man-made load caused by hostilities. By 2022, the estuary was already under significant pressure from industrial discharges, port activities, and obsolete sewage treatment plants, but the full-scale war turned this chronic condition into an acute crisis (Fig. 2.1-2.2).

Fig. 2.1. Image of the Buh estuary within the city of Mykolaiv:

1 – the area of the Varvarovsky bridge; 2 – Seaport (Cabotage pier).

By what indicators did they "listen" to the water

In order to understand the scale of changes that have occurred in the water area, the systematization of hydrochemical data by key indicators was carried out. The study was based on the analysis of three main blocks of water quality:

1. **Salt composition:** chloride content, sulfates and hardness index. These are critical parameters for Mykolaiv, since they determine the aggressiveness of water against metal structures of city networks.

2. **Tropho-saprobiological indicators:** pH level, dissolved oxygen content, BSC5 (biochemical oxygen consumption), as well as the concentration of phosphates and suspended solids. These data make it possible to assess the level of organic pollution and the ability of the reservoir to self-purify.

3. **Specific toxic effect: concentration** of heavy metals (Cuprum, Zinc) and petroleum products. It is this block of indicators that demonstrates the direct impact of hostilities: from sunken ships to explosions and destruction of port infrastructure.

Transformation of the estuary ecosystem before and after 2022

A comparative analysis of the state of the Buh estuary before the full-scale invasion and after the outbreak of active hostilities reveals alarming dynamics. Until 2022, the state of the water ranged from "polluted" to "dirty", which was a consequence of decades of industrial development. However, after 2022, the environmental situation has entered a phase of degradation.

The main factor in the changes was salinity. Due to the destruction of the water supply system and changes in the hydrological regime, the content of chlorides and sulfates in some samples began to show rapid growth. But the real challenge was the increase in toxic load. Significant exceedances of maximum permissible concentrations (MPC) for the content of petroleum products and copper compounds (Cuprum) were recorded. Shelling of the coastal zone, destruction of oil storage infrastructure, and flooding of watercraft had a cumulative impact on the ecosystem. These factors formed a multicomponent man-made load, which significantly changed the hydrochemical profile of the water area during the war. Organic pollution (BSC5) has also increased, indicating that the estuary is overloaded with untreated effluents due to constant accidents on the networks.

Chemical aggression and heavy metals

In the general list of threats to the Buh estuary, heavy metal pollution occupies a special place. If organic pollution can be recycled by the ecosystem over time, then metals are "eternal" pollutants. They do not disappear, but only change shape, accumulating in the bottom sediments and tissues of living organisms. For Mykolaiv, which was at the epicenter of hostilities, this indicator became an indicator of the direct impact of the war on water.

The analysis of the quality of surface waters of the Buh estuary was carried out according to a block of indicators of specific toxic action, among which the key ones were Cuprum and Zinc. These metals are essential components of many alloys used in shipbuilding, port infrastructure and, most importantly, in the production of ammunition and machinery, and are also part of many pesticides.

Fig. 2.2. Buh estuary around Mykolaiv (author's photo).

The results of the studies revealed a worrying trend. The indicators of the content of these metals in the water area of the city consistently exceed the maximum permissible concentrations (MPC). This issue became especially acute after 2022, when the intensity of fire impact on the coastal zone peaked.

The cuprum has become one of the most problematic for the Buh estuary. According to the ecological classification, according to the content of Cuprum, the quality of water often corresponds to the categories of "dirty" or "very dirty". The sources of receipt were not only industrial effluents, but also corrosion of sunken watercraft, shell residues and destruction of structures that had been protected by special anti-corrosion coatings for decades.

The situation with Zinc also remains tense. Its concentrations in the water of the estuary indicate constant man-made pressure. As in the case of Cuprum, the main growth factor was destruction and direct hostilities in the port waters.

Along with metals, studies have recorded significant exceedances in the content of petroleum products. In the context of heavy metal pollution, this creates a synergy effect: the oil film on the surface of the water prevents gas exchange, which changes the level of pH and dissolved oxygen, and this, in turn, affects the form in which the metals are in the water.

The greatest danger of heavy metals lies in their ability to bioaccumulate. Once in water, Cuprum and Zinc enter food chains. Microorganisms absorb them, then they accumulate in fish, and can eventually enter the human body.

For Mykolaiv, as of 2026, this factor remains critical. Even when switching to drinking water supply from alternative sources, the state of the Buh estuary as a recreational and economic zone directly depends on how deeply the metals have soaked the ecosystem. Forecasts indicate that self-cleaning of the estuary from heavy metals is a process that will last for decades. This requires the city not only to use new methods of water purification, but also to carefully monitor the state of bottom sediments, which have now become a "repository" of metallic echoes of war.

Environmental Forecasts

The future of the Buh estuary in 2026 and beyond looks ambiguous. Expert forecasts point to several possible scenarios:

1. **Risk of secondary pollution.** Even if active discharges are stopped, bottom sediments that have accumulated toxic substances and heavy metals during the war years will remain a source of danger. Any disturbance of the bottom (for example, during the resumption of shipping) can lead to a new surge in toxicity.

2. **Soil salinity.** Long-term use of estuarine water (even for technical purposes) and an increase in the overall level of salinity in the water area threatens with irreversible changes in coastal ecosystems and deterioration of groundwater.

3. **The path to recovery.** An optimistic scenario is possible only if the latest treatment technologies are introduced and the city wastewater treatment facilities are completely reconstructed. The experience of 2022-2025 has proven that old methods are not able to cope with challenges of such complexity.

The Buh estuary today is no longer just a part of the landscape, but a "mirror" reflecting the price of Mykolaiv's struggle for water. Its restoration will be a long process that will require not only engineering solutions, but also a radical change in the attitude to the city's water resources.

2.2. HYDROCHEMICAL PASSPORT OF THE ESTUARY AND SPATIO-TEMPORAL MAP OF THE WATER CRISIS

Why does water need a "passport"

When we talk about the water crisis in Mykolaiv, we often use the concepts of "salty" or "dirty". However, for scientists and engineers who are developing a strategy for the restoration of the city until 2026, these words are not enough. They need a "hydrochemical passport" — a detailed document that records the dynamics of changes in each chemical element in time and space. The study, conducted by a group of scientists from the Petro Mohyla Black Sea National University, became the foundation for understanding how exactly hostilities and man-made disasters transformed the water area of the Southern Buh, Ingul and Buh estuaries.

Methodology and Four Vectors of Monitoring

Assessing the state of surface waters in the frontline city required the creation of a dynamic monitoring network that would cover four strategic locations. Each of them is a separate section in the "diagnosis" of the city's waterway.

The scientific study was based on regular sampling at four representative points that allow you to trace the path of water from a relatively clean area to the epicenter of urban and marine influence (Fig. 2.3).

Point No. 1: ST "Lazurne", Vesnyanska territorial community (46.991186, 31.876144). This point is located upstream from the main urban area. It serves as a kind of "background" indicator. Studies here allow us to understand the quality of water that approaches Mykolaiv without having yet absorbed the main volume of urban wastewater and the consequences of the destruction of internal infrastructure. This is a point of comparison: everything that appears in the water downstream is already a direct "contribution" of the war and the man-made collapse of the city.

Point No. 2: Nizhnyaya Naberezhnaya microdistrict (46.980002, 31.985235). This is the heart of the city, the area of the Ingul Bridge and the confluence of rivers. Here Ingul becomes part of the urban landscape, facing the densest buildings and a network of communications. It is here that the most complex indicators for the block of specific toxic action were recorded. Concrete embankments and bridge structures, under conditions of aggressive chemical composition of water, begin to "give" heavy metals

into the river, and the proximity of damaged collectors constantly fuels the level of organic pollution.

Point number 3: Yacht Club microdistrict (46.977016, 31.960774). The legendary resting place of Mykolaiv residents has become one of the most interesting monitoring points. There is a unique mixing of waters here. The yacht club is the first to feel the consequences of rising water (as it was during the Kakhovka tragedy) and accumulates oil products and surface debris lingering in its cozy water area. Measurements here have shown how recreational areas are turning into environmental risk zones.

Point No. 4: Namiv microdistrict (46.947273, 31.932793). The extreme point of urban monitoring before entering the open estuary. The Namiv area is a specific contact zone where fresh river waters directly interact with salty sea support. This determines the high dynamics of hydrochemical indicators and makes this location an indicator of the intensity of penetration of sea waters deep into the estuary. Here are the highest rates of chlorides and sulfates. This is the point of "maximum concentration" of all urban problems. Everything that the water "collected" in Vesnyany, on the Embankment and in the Yacht Club finally mixes here with the salts of the estuary, creating the very aggressive brine that Mykolaiv residents were forced to see in their homes (Fig. 2.3).

Fig. 2.3. Map of sampling points.

1. GC "Lazurne", Vesnyanska Territorial Community (46.991186, 31.876144);
2. Microdistrict. Nizhnyaya Naberezna (46.980002, 31.985235);
3. Microdistrict. Yacht Club (46.977016, 31.960774);
4. Microdistrict. Namyv (46.947273, 31.932793).

Salt composition analysis

The key indicator of the transformation of the aquatic environment during the war period was the dynamics of salt composition indicators. An abnormal increase in the concentration of chlorides and sulfates is the most indicative factor of man-made impact, which caused intensive corrosion of urban infrastructure and degradation of the estuary ecosystem. If for a natural reservoir fluctuation in mineralization are an element of the natural hydrological cycle, then for the engineering infrastructure of Mykolaiv such indicators turned out to be critically destructive. A sharp increase in the content of salts led to the loss of operational suitability of metal pipelines and the failure of a significant part of the distribution network. After April 2022, when the water pipeline from the Dnipro was destroyed, the city found itself in a situation where the chemical composition of the water in the taps became identical to the composition of the water in open water. The results of monitoring in four strategic locations — from the Lazurne ST to the Namyv microdistrict — indicate the formation of a critically aggressive hydrochemical regime. The data obtained confirm that prolonged exposure to water with a high content of chlorides and sulfates has caused systemic degradation of metal elements of urban networks and intensive corrosion of infrastructure facilities. Chlorides are the main marker of salinity. Under normal conditions, fresh river water has a minimum content of these compounds, but the Buh estuary is an estuary where fresh water mixes with sea water. Studies have confirmed that after the cessation of the supply of Dnipro water and the transition to the intake from the estuary, chloride indicators in the water area and, as a result, in the water supply system began to demonstrate dangerous instability.

The spatial dynamics recorded at the monitoring points showed a clear trend. At point No. 1 (ST "Lazurne"), the level of chlorides remained relatively stable, since this zone is upstream and less exposed to sea support. However, already at point No. 4 (Namyv microdistrict), chloride indicators in some places reached values that were ten times higher than the norms for drinking water. This "instability" depended on the wind strain: when the south wind drove water from the sea into the estuary, the concentration of salt increased rapidly.

The combination of high concentrations of chlorides, sulfates and the overall hardness of the water (which was also studied in detail at points No. 2 on the Lower Embankment and No. 3 at the Yacht Club) led to the creation of an effect that scientists call "electrolytic broth" (Fig. 2.4).

The pipes of the Mykolaiv Vodokanal, built mainly in the Soviet period with the expectation of soft Dnieper water, ended up in an environment for which they were not intended. Salt water works as an ideal electrolyte, triggering irreversible oxidation processes. What under normal conditions took decades happened in Mykolaiv in two or three years.

Analysis of the salt composition showed that the metals were not just oxidized - they literally dissolved in this "chemical brine" from the inside. This explains the phenomenal number of outbursts in the city, which in 2024-2025 increased by 5-10 times compared to the pre-war period. Even when fresh water began to be supplied to the system at the beginning of 2026, the pipes' "memory" of salt aggression remained: the walls became so thin that any water hammer leads to new accidents.

The data of the hydrochemical passport on salt composition have become the scientific basis for strategic decision-making. A four-point study proved that a simple return to water intake from the estuary is impossible without an expensive industrial-scale demineralization (reverse osmosis) system.

This section of the "chronicle" is evidence of how chemical elements invisible to the eye - chloride, ions and sulfate ions - can become an instrument for the destruction of an entire metropolis. As of 2026, Mykolaiv continues to struggle with the consequences of this salt strike, and each replaced section of the pipe is an attempt to escape from the captivity of the "brine" that the war brought with it. The safety of the city depends not only on the strength of the walls, but also on the stability of the chemical composition of the water flowing through its arteries.

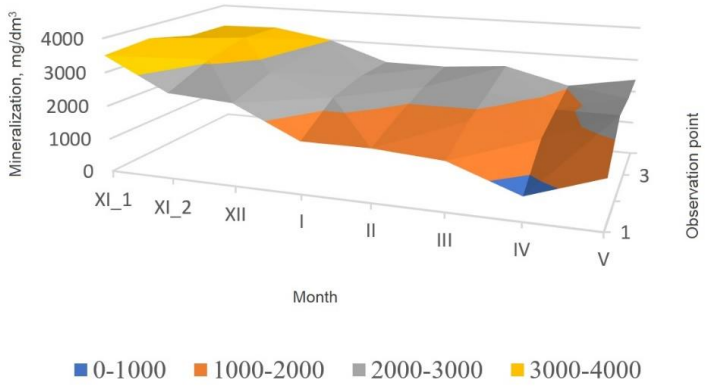

Fig. 2.4. Dynamics of the level of mineralization by observation points.

Acid-puddle balance of the estuary

In the general system of hydrochemical indicators of the war period, pH and alkalinity are key regulatory factors. They determine the state of carbonate-calcium equilibrium, influencing the stability of water and the intensity of corrosion or scale-forming processes in distribution networks. If we taste chlorides and sulfates, then the change in hydrogen index (pH) and general alkalinity often remains imperceptible to the average consumer, until the consequences become catastrophic for the ecosystem and technical networks of the city. The study, conducted within the framework of four key points of

Mykolaiv, reveals the dynamics of these indicators as an important part of the "passport" of the water crisis (Fig. 2.5).

pH as a pulse of chemical activity

The hydrogen index, or pH, is an indicator of how acidic or alkaline an environment is. For the natural waters of the Buh estuary and the Southern Buh and Inhul rivers, a slightly alkaline state is considered normal (usually in the range of 7.2–8.5). However, war and man-made interventions have made their own adjustments to this natural balance.

The analysis of the data showed that at point No. 1 (ST Lazurne), the pH indicator remained closest to the natural background. This is water that has not yet had time to react with urban wastewater. However, moving to point No. 2 (Lower Embankment) and point No. 3 (Yacht Club), the researchers recorded interesting dynamics. Under the influence of organic pollution and decay processes, which intensified after the Kakhovka disaster, the pH began to show instability.

A change in pH is not just a number. This is a factor that determines the "behavior" of other chemical elements. For example, at certain pH values, heavy metals such as Cuprum and Zinc become more mobile and toxic. The hydrochemical passport recorded that during the periods of summer flowering of water (especially in 2024-2025), the pH at point No. 4 (Alluvium) shifted towards higher alkalinity due to intensive photosynthesis of algae. This creates a vicious circle: the ecological degradation of the estuary changes its chemistry, and the altered chemistry further inhibits the river flora and fauna.

Fig. 2.5. During water sampling (author's photo).

Buffer Capacity and Technical Challenge

Total alkalinity is a key indicator of the buffer capacity of water, which determines its ability to neutralize acidic compounds and maintain the relative stability of the pH value. In the context of water supply in Mykolaiv, this parameter is critical for assessing the aggressiveness of the environment and predicting the rate of corrosion processes in distribution networks. In the context of Mykolaiv, this indicator is of great importance for the operation of reverse osmosis systems and the durability of pipes. The hydrochemical profile of the Buh estuary is characterized by naturally higher alkalinity indicators compared to the waters of the Dnieper River. This difference is due to the specifics of estuarine processes and the genesis of water masses, which has become a critical factor in changing the source of water supply for urban networks designed for Dnipro indicators.

Studies have confirmed that high alkalinity combined with rigidity caused the pipes to rapidly overgrow with mineral deposits. If the "salt brine" dissolved the metal, then high alkalinity created conditions for the formation of a solid precipitate. This led to the fact that the throughput of the surviving sections of the water pipeline significantly decreased at the beginning of 2026.

For engineers, data on alkalinity is key. High alkalinity requires additional reagents to correct the composition of the water before filtration. At point No. 4 (Alluv), where the exposure of seawater is maximum, alkalinity correlated with a high sulfate content, creating a complex chemical cocktail that became a real test for reverse osmosis membranes.

Domino effect in the interaction of indicators

The hydrochemical passport clearly demonstrates the relationship: when salinity increases (the marker is chlorides), alkalinity also changes, which entails fluctuations in pH. This "domino effect" was especially clearly traced during spatio-temporal analysis. At points with the highest anthropogenic load (Embankment and Yacht Club), pH buffer stability was the lowest. This means that the water in these areas is the most "sensitive" to any new contaminants.

In particular, after the shelling of the coastal zone, when fuel residues and construction debris got into the water, local "shock" pH changes were observed. This once again confirms that the Buh estuary within Mykolaiv has lost its natural ability to self-regulate.

The transformation of the acid-base characteristics of water reflects the scale of the infrastructure challenge faced by Mykolaiv. Detailed documentation of these processes allows us to ensure the transition to a qualitatively new stage of water supply, where fresh water will meet all criteria of hydrochemical safety and stability.

2.3. HYDROCHEMICAL PORTRAIT OF THE URBAN WATER NETWORK

When we talk about the "Hydrochemical Chronicle of War", we often imagine the shores of the estuary. However, the most dramatic part of this story unfolds every day in every apartment where the resident turns on the tap. In the period from 2023 to 2024, a group of researchers from the Petro Mohyla Black Sea National University conducted a detailed "scan" of water flowing through the "arteries" of Mykolaiv using the high-precision photometric system eXact Strip Micro 20 (Fig. 2.6). This study covered all districts of the city: Zavodskyi, Central, Korabelny and Ingulsky.

Chemical "stability" in question

In the large puzzle of hydrochemical monitoring of Mykolaiv, the hydrogen index (pH) and total alkalinity take the place of fundamental constants. These are not just numbers in laboratory journals, but basic characteristics that determine the nature of the water. During the study period, these indicators became silent witnesses of a profound transformation of the city's water system.

According to the results of measurements, the pH indicator in Mykolaiv taps steadily fluctuated between 7.6–8.1. At first glance, for the average consumer, these data may seem quite acceptable, because they confidently fit into the established state sanitary standards (6.5–8.5). However, scientific analysis reveals alarming trends behind this external stability.

The shift of the hydrogen index towards a slightly alkaline environment is a direct indicator of high mineralization. Water in Mykolaiv is no longer just a liquid; It turned into a complex chemical solution oversaturated with salts. The pH values indicated that the water buffer systems were working at the limit of their capabilities, trying to stabilize the cocktail of chlorides and sulfates that got into the network after the forced transition to the intake from the estuary.

Alkalinity as a technical and domestic challenge

If pH is the "pulse" of water, then the total alkalinity is its "capacity", the ability to resist changes in acidity. The study recorded that in all districts of the city — from Korabelny to Central — alkalinity reached 5.6–6.0 mmol/dm³. For comparison: this value significantly exceeds the parameters of the "soft" Dnipro water, for which the city infrastructure has been preparing for decades.

High alkalinity directly affects the daily life of every Mykolaiv resident. It radically changes the way water interacts with organic matter, in particular detergents. Residents of the city noticed: the usual soap or shampoo in such water almost does not foam, and

after washing, a feeling of tightness and dryness remains on the skin. This is because an excess of alkaline components reacts with the skin's natural lipid layer, destroying its protective barrier.

Fig. 2.6. When measuring water quality indicators (author's photo).

Corrosion tandem of alkalinity and hardness

The real danger of high alkalinity is revealed in combination with excessive rigidity. This duo creates the effect of "heavy" water. For Mykolaiv networks and household appliances of citizens, this means the accelerated formation of scale and mineral deposits. In boilers, boilers and washing machines, high alkalinity stimulates the precipitation of calcium salts, which leads to premature equipment failure.

Moreover, this chemical activity makes the water aggressive towards metal pipes. Even if water is not acidic, its high alkalinity in combination with salts creates conditions for electrochemical corrosion. The inner surfaces of the highways, which have already suffered from the "salt era", continue to degrade under the influence of this alkaline environment, which explains the constant presence of iron in the samples - the decay products of city pipes.

Chemical cocktail in taps

If pH and alkalinity create the "background" of the water crisis, then the dynamics of specific ions and metals reveal the true depth of the man-made load on Mykolaiv. The

study, conducted in four districts of the city, recorded the alarming stability of high concentrations of substances that are usually subject to strict control in peacetime.

Nitrogen-containing compounds are direct indicators of organic pollution and environmental imbalance in water intake sources.

Throughout the entire observation period, the level of nitrates in the network remained at a high level of 38.0–42.0 mg/dm³. Although this does not formally exceed the MPC limit (50 mg/dm³), this concentration is abnormally high for a stable water supply. The dynamics showed a slight increase in spring, which is associated with the melting of snow and the washing of fertilizers from the fields into the river basin.

The content of nitrites ranged from 0.04–0.10 mg/dm³, and ammonium ions — about 0.1–0.2 mg/dm³. The presence of these substances at the same time as nitrates indicates that the treatment plants worked at the limit of their capabilities, trying to neutralize organic matter entering the system through damaged collectors.

Sulfates are one of the most problematic indicators. The dynamics recorded consistently high values — 360–410 mg/dm³. This is almost twice the level comfortable for domestic use. Sulfates in Mykolaiv are of "estuary" origin, and their high concentration directly correlates with the salinity of water. It is sulfates that give water the same "heaviness" and bitterness.

The sulfite content was negligible (<0.5 mg/dm³), which is a positive signal, since sulfites usually appear only when there is a complete oxygen deficiency and intensive decay processes.

The phosphate level ranged from 0.2–0.4 mg/dm³. This is a typical value for city water, reflecting the massive use of synthetic detergents. However, in combination with nitrates, phosphates become fuel for the "blooming" of water in water intake sources, which Mykolaiv residents observe every summer.

The dynamics of total iron showed a level of 0.15–0.25 mg/dm³. This is the "rusty memory" of networks. The high concentration of iron is the result of constant contact of aggressive salt water with the metal walls of pipes.

The content of Cuprum remained in the range of 0.02–0.05 mg/dm³, which is safe. However, the total content of divalent metals (which determines the calcium hardness at the level of 15.0–17.5 mmol/dm³) indicates extreme mineralization. Such water literally "clogs" the equipment with mineral stone.

The chlorine level remained at a high level of 0.6–0.8 mg/dm³. This is a forced strategy of Mykolaivvodokanal. Hyperchlorination is necessary so that water, passing through numerous gusts and leaky pipes, does not become a source of intestinal infections. Chlorine dynamics reflects the struggle for the biological safety of the city.

Addiction Psychology and Perspective 2026

The most painful and difficult to analyze conclusion of this paragraph is not so much chemical indicators as metamorphoses of human perception. The 2023–2024 study recorded not only nitrate or chloride figures, but also a disturbing social trend. Such an extreme level of domestic discomfort gradually became a new, distorted "norm" for Mykolaiv residents.

High hardness and mineralization of water led to a radical change in the everyday habits of Mykolaiv residents. The negative impact on health (skin and hair condition) and the critical increase in household chemical costs due to the low foaming capacity of water have become part of daily social experiences. The psychological acceptance of these conditions as the "new normal" indicates the high adaptability of the community, but such normalization of the crisis hid the risks of long-term degradation of living standards. However, the figures and facts of our "Hydrochemical Chronicle" do not tire of emphasizing: what flows in Mykolaiv taps is not a natural state of affairs. This is a consequence of a deep, artificial imbalance of the entire aquatic ecosystem and engineering network. Getting used to such indicators is dangerous, because the human body, unlike psychology, does not know how to adapt to the chronic effects of salt aggression without health consequences.

Looking into 2026 through the lens of these studies gives us a very different perspective. We understand that a return to "pre-war" life is impossible only because of mechanical repair of pipes. We need mental de-occupation from the habit of "technical" life. Monitoring data has become the foundation on which the recovery strategy is built: refusal to compromise on quality, the introduction of industrial reverse osmosis, and the transition to sources protected from seasonal surges.

The prospect of 2026 is not just tap water. This is the return of Mykolaiv residents to the right to comfort, health and water, which does not destroy, but restores. The hydrochemical studies of the period of great anxiety (2023–2024) will forever go down in history as proof of the price the city paid for its resilience and how it was eventually able to break the cycle of psychological addiction to the crisis, choosing the path of technological and ecological revival. Mykolaiv has learned to appreciate every liter of cleanliness, and this experience will be a safeguard against similar disasters in the future.

Return to hydrochemical status standards in early 2026

The transformation of the chemical composition of water in the networks of Mykolaiv in the period 2023-2026 has become a mirror of the environmental and engineering challenges faced by the city. If 2023 was marked by critical mineralization and aggressive impact of estuarine water on pipelines, then the beginning of 2026 demonstrates a qualitatively new phase — the phase of "fragile stabilization".

At the beginning of 2026, the results of monitoring in all districts of the city indicate a significant improvement in the quality of tap water in terms of key indicators:

- The sulfate level stabilized in the range of 100–170 mg/dm³, which corresponds to the MPC (250 mg/dm³). This is a drastic change, since it was these indicators that previously determined the impossibility of water consumption.
- Calcium hardness at the beginning of 2026 is fixed at the level of 107-145 units, which indicates a softening of water compared to the peak loads of previous years.
- There is a slight shift towards an acidic environment (6.1–6.6), which may be due to the peculiarities of technological water treatment at treatment facilities or the state of outdated in-house networks.

Comparing current data with the results of 2023 allows you to estimate the scale of the path traveled. 2023 was a period of extreme hydrochemical anomalies.

Based on the obtained "hydrochemical passport", the following forecasts can be made: provided that the current source of water intake is maintained, mineralization will continue to stay within normal limits. However, there remains a risk of "salt echo" - leaching of salt residues accumulated in the sediments of old pipes.

The hydrochemical state of Mykolaiv's water resources as of 2026 indicates a transition from the phase of acute crisis to the stage of systemic stabilization. The city has gone from industrial water to water that is close to drinking standards in terms of chemical parameters. However, the systemic vulnerability of networks requires continued monitoring and further modernization of the infrastructure.

The phenomenon of "constant turbidity" as stagnation of physical indicators of the network

A special place in the hydrochemical portrait of Mykolaiv is occupied by the turbidity index. Unlike sulfates and hardness, which showed dynamics to decline in early 2026, turbidity turned out to be the most inert and problematic parameter.

According to the monitoring results, in all districts of the city, the turbidity index during 2023-2026 was stable at the level of at least 7 NTU. This is 4.5–7 times higher than the established sanitary standards (DSanPiN 2.2.4-171-10), which limit turbidity to 1.0–1.5 NTU.

This situation indicates that the replacement of the water intake source with a fresher one (which we can see from the drop-in salt levels) was insufficient to clean the distribution network itself.

Indicator	MPC	2023	End 2025	January 2026	System Status
Turbidity (NTU)	1.0–1.5	> 7.5	> 7.2	> 7.0	Critically stable

Why does turbidity not decrease when sulfates decrease? We distinguish three main factors:

1. Long-term use of aggressive salt water in 2022-2024 led to irreversible corrosion. Even "clean" water, passing through these highways, is enriched with fine iron and sediment.

2. Constant pressure drops and repairs on the lines keep corrosion products in suspension. With a turbidity of 7 NTU, the water has a distinct yellowish tint, which makes it visually unacceptable to the public.

3. A change in the chemical composition of water in early 2026 (including a slight drop in pH) contributes to the further dissolution of old scale and rust, which only keeps the NTU levels high.

An indicator of 7 NTU and above is a critical barrier to the city's "water war culture". This means that household reverse osmosis filters and flow cartridges fail 5-10 times faster than the standard period; water remains "technical.

The stability of the turbidity index at the level of 7 + NTU against the background of improvement in other parameters allows us to draw an important conclusion: Mykolaiv is faced with the effect of "contaminated network memory". Even if the water at the outlet of the treatment plant is ideal, the condition of the city pipes will continue to generate high turbidity. The forecast for 2026 is still disappointing: without a massive replacement of intra-block networks or the use of special stabilization reagents, the indicator of 7 NTU will remain constant, leveling the success of demineralization.

CHAPTER III

RESIDENTS' PERSONAL NARRATIVES

3.1. "BLUE ECONOMY" OF MYKOLAIV: THE PHILOSOPHY OF THE PLASTIC PEN

When historians of the future study the resistance of Mykolaiv in 2022-2026, they will probably pay attention not only to fortifications, but also to ordinary plastic eggplant. It has become the main symbol of urban life, and the path from the water spill point to the apartment is a daily survival route. In social networks, where Mykolaiv residents shared pain and humor, a unique "water folklore" was imprinted, which best conveys the atmosphere of these years.

Household fitness

For many citizens, the turn of 2026 has become a symbolic mark — more than four years of daily rising of water to the floors. In apartment buildings, especially in "Stalinka" and "Khrushchev" without elevators, this process has turned into a special ritual. One of the residents aptly described this experience not as a burden, but as "positive physical activity".

This self-irony became a defensive reaction of the city. Instead of falling into despair from the hard routine, Mykolaiv residents turned bringing bottles to the upper floors into a kind of "frontline fitness". Over the years, family responsibilities have finally been redistributed around plastic containers: someone was responsible for delivery, someone was responsible for climbing to the floor, and someone was responsible for rational use.

Trivia Engineering: Color and Reliability Test

In this specific life, over the years, its own folk "science of plastic" has been developed. It turned out that in the survival system of Nikolaev, even the color of the removable eggplant handle is of strategic importance. This became a topic for lively discussions in urban communities, where people shared experiences that cannot be found in any textbook on ecology.

"Blue pens last significantly longer than red ones," this observation has become almost an axiom for local "water carriers". People have learned to instantly assess the reliability of containers by the shade of plastic and the shape of fasteners. Red handles often failed at the most crucial moment, and imported containers from humanitarian goods, as it turned out, were not designed for repeated use in the harsh realities of the Ukrainian city at all — the handles on them were torn after several trips to the bottling point (Fig. 3.1).

Fig. 3.1. "Blue pens last much longer than red ones" (photo from social networks).

In response to these domestic challenges, folk ingenuity blossomed. When standard plastic could not withstand, homemade solutions were used: from wire hooks wrapped with electrical tape to ergonomic holders printed on 3D printers or machined in garages. Someone ironically called this phenomenon the "Blue Economy of the Mykolaiv Region", to which others aptly answered - "this is our mokrukha". In these short dialogues, there is a mixture of fatigue, black humor and absolute invincibility (Fig. 3.2).

Here's one of those conversations on the city's social media:

Pavlo: Once in 2023 I received 20 bottles of Czech humanitarian aid with yellow handles - they all broke very quickly)) they are not designed for multiple uses, apparently))

Ivan: Isn't this a political advertisement?

Yuriy: Apolitical.

Alexander: Try another solution...

Ethics of the queue

Even when fresh water was already filling city highways at the beginning of 2026, spill points remained the main social nodes. They didn't just collect water here, they exchanged experience here. Helping an elderly person carry a heavy bottle to the entrance or sharing advice where handles are "more reliable" has become the norm of etiquette.

Fig. 3.2. Mr. Oleksandr's decision regarding the bottle handle (photo from social networks).

The psychology of the resident has changed forever: the plastic eggplant has become not just a container, but a symbol of autonomy and readiness for any challenges. This narrative is a monument to thousands of nameless "blue hands" that held the life of a big city. This is the story of how Mykolaiv, waiting for a major restoration of the system, learned to find a reason for irony in the usual rise of water to the floor, turning an exhausting routine into a chronicle of his own strength (Fig. 3.3).

Fig. 3.3. "Blue economy" of Mykolaiv.

3.2. SOCIAL DIMENSION OF WATER DANGER

Is it possible to measure the level of human anxiety at the moment when the usual life is destroyed to the ground? How to assess the impact of a sudden loss of access to a basic resource on residents of a city under fire? To record these changes "in hot pursuit", in 2022 — during the most difficult period of the city's adaptation to the water crisis — a large-scale questionnaire "Water danger of the city of Mykolaiv during martial law" was conducted.

This study, conducted in 2022, became not just a scientific work, but a unique "cross-section" of the social state in real time, capturing the moment when the familiar world of thousands of people stopped and began to rebuild according to completely different, previously unthinkable laws. April 2022 forever divided the life of Mykolaiv into "before" and "after", when after the blowing up of the water pipeline in the taps, the sign of civilization disappeared. It was during this critical period, when the city was under constant shelling, and the logistics of water supply was just emerging, that scientists came out to people to record the depth of social trauma.

The survey was conducted among residents of all four administrative districts of the city — Zavodskyi, Central, Korabelny and Ingulsky. Such geography was fundamental, since each district had its own characteristics of survival. The ship area, geographically distant, faced some challenges; Central, with its high-rise buildings and population density — with others. It was important for researchers to understand whether this "water danger" is uniform or whether it creates new centers of social injustice within the same city.

The survey took place in conditions when Mykolaiv residents had just begun to build their new, extreme survival strategies. It was the time of the "first eggplants", the first wells at the entrances and the first tragic queues for water under fire. People are not yet used to the crisis, they were in a state of acute stress, and their answers in questionnaires became the sincerest evidence of how a person feels when he is deprived of the basic right to water.

The questionnaire "Water danger of the city of Mykolaiv in wartime" was designed together with Oleksandra Kovalska, head of the Ecology Department of Petro Mohyla Black Sea National University, not as a dry list of technical issues, but as a tool for identifying deep destructive processes in the life of the community. The authors of the study set out to find out how the absence or critical lack of water distorts work schedules and professional activities. When a person, instead of working or resting, is forced to spend time on queues for water or count every cup of water for cooking, his social role

changes. Work fades into the background, and life turns into a continuous cycle of "search and delivery".

A separate, extremely important block of the study was the analysis of psychological stability. The water crisis of 2022 was a powerful destabilizer. The constant expectation of water, the fear that it would not be enough for the child's hygiene or for the elementary preparation of dinner, created the effect of "chronic anxiety". The questionnaire recorded these emotional outbursts: from despair to indignation. This made it possible to see how the material shortage of resources develops into mental exhaustion of the whole city.

However, perhaps the most sensitive aspect of the study was the question of elementary human dignity. Dignity in 2022 was measured by the ability to wash, wash your hands after the street, or use the restroom without feeling ashamed and uncomfortable. What used to be an automatic action has become subject to strict control and economy. The survey showed that sanitary and hygienic problems have become the most humiliating consequence of the war for many.

So, the results of this survey became the foundation of our "Hydrochemical Chronicle". They prove that the water crisis in Mykolaiv is not limited to damage to pipes or changes in the chemical composition of water. It was a large-scale attack on the social fabric of the city, on the usual way of life and on the internal state of each person. The data from 2022 are invaluable, because they remind us in 2026: the restoration of water supply is not just an engineering victory, it is an act of returning people to their dignity, stability and right to a normal future. This study forever captured the moment when Mykolaiv, being deprived of water, did not lose his humanity, but felt the full weight of water danger on his own life. The questionnaire is presented in Table. 3.1.

Table 3.1

Questionnaire "Water danger of the city of Mykolaiv during martial law"

Questions	Answer options
1. In which district of the city of Mykolaiv do you live?	*1) Zavodsy* *2) Central* *3) Korabelny* *4) Ingulsky* *5) Other*
2. How often during the war did you or someone in your family worry that you would not have enough water to meet all your household needs?	*1) Very often* *2) Uncommon* *3) Sometimes* *4) Never*

3. How often during the war did you or someone in your family have had to not wash your hands after dirty activities (e.g. defecating or changing diapers, cleaning up after animals) due to water problems?	*1) Very often* *2) Uncommon* *3) Sometimes* *4) Never*
4. How often during the war did you or someone in your family have had to change schedules/plans due to water problems, for example, due to problems with obtaining or distributing water in the family? (Activities that may have been interrupted include caring for others and doing household chores)?	*1) Very often* *2) Uncommon* *3) Sometimes* *4) Never*
5. How often during the war period did you or any of your family members not drink as much water as you would like?	*1) Very often* *2) Uncommon* *3) Sometimes* *4) Never*
6. How often during the war period has the water supply to your household from the main water source been interrupted or limited (e.g. water pressure, less water than expected)?	*1) Very often* *2) Uncommon* *3) Sometimes* *4) Never*
7. How often during the war there was not enough water in the household or because of poor quality you could not wash clothes?	*1) Very often* *2) Uncommon* *3) Sometimes* *4) Never*
8. How often during the war did you or someone in your family have to change food due to water problems (for example, for washing food and cooking)?	*1) Very often* *2) Uncommon* *3) Sometimes* *4) Never*
9. How often during the war did you or someone in your family have to go without washing your body due to water problems (for example, lack of water, dirt and danger)?	*1) Very often* *2) Uncommon* *3) Sometimes* *4) Never*
10. How often during the war did you or any of your family members resent the water situation?	*1) Very often*

	2) Uncommon *3) Sometimes* *4) Never*
11. During the war, how often was there no usable or potable water in your household?	*1) Very often* *2) Uncommon* *3) Sometimes* *4) Never*
12. How often did you or someone in your family go to the river to fetch water, or collect rainwater?	*1) Very often* *2) Uncommon* *3) Sometimes* *4) Never*
13. How often did you or any of your family members use wells during the war?	*1) Very often* *2) Uncommon* *3) Sometimes* *4) Never*
14. How often did pipes/plumbing/household appliances deteriorate during the war due to poor water quality?	*1) Very often* *2) Uncommon* *3) Sometimes* *4) Never*
15. How often did you or someone in your family have to see a doctor during the war due to poor water quality or lack thereof?	*1) Very often* *2) Uncommon* *3) Sometimes* *4) Never*
16. How often did you or any of your family members go to fetch water during an air raid?	*1) Very often* *2) Uncommon* *3) Sometimes* *4) Never*
17. How often have you had thoughts/intentions to leave the city due to water supply problems?	*1) Very often* *2) Uncommon* *3) Sometimes*

	4) Never
18. Your age rating	*1) 14-25* *2) 26-35* *3) 36-45* *4) 46-60* *5) Over 60*
19. Your Education	*1) Secondary* *2) Incomplete higher education* *3) Higher*
20. Your gender	*1) F* *2) M* *3) Non-binary*

2022, when water became a headache and an exam of humanity

The results of the survey conducted in 2022 recorded not just statistical deviations from the norm, but a real shock state of the Mykolaiv community. It was a unique and at the same time tragic period in the history of the city, when the usual infrastructure ceased to exist, and the basic resource turned into an object of scarcity. 2022 was a time when every exit from the house for water resembled a lottery, where the stake was not only health, but also life under constant shelling. The water in the tap, which was previously taken for granted, turned into an aggressive technical solution - cloudy, salty, dangerous both for the human body and for any household appliances.

Household determinism

The numbers of the questionnaire are impressive. 45% of respondents noted that "very often" they had to completely redraw their plans, work schedules and daily routine. In 2022, the life of an ordinary Mykolaiv resident began to revolve around new, forced centers of gravity — a queue for a water carrier, the schedule of a well at the next entrance, or news about the launch of another spill point.

This phenomenon can be called "water determinism". Work meetings, distance learning, visits to doctors, or even a short vacation — everything receded into the background before the need to provide the family with a minimum amount of fluid. Social ties and professional activities were deformed under the pressure of physical need. A violation of a stable rhythm of life, which lasted for months, turned into a chronic stress factor. People lived in a state of constant "water alarm? Will I have enough strength to carry

the eggplants to the top floor? Will the water in the cistern run out right in front of me? These questions have become the main internal monologue of many people.

Sanitary and hygienic fault

The most eloquent and at the same time painful indicator of the study was the state of the sanitary and hygienic sphere. More than half of the respondents (53%) admitted that they "very often" faced the inability to comply with basic hygiene standards. For a modern European metropolis in the XXI century, where standards of cleanliness are an integral part of personal dignity, this has become a real test of endurance and moral stability.

The inability to take a shower after a hard day, restrictions on washing clothes, difficulties in maintaining cleanliness in the home — these household restrictions had a deep psychological effect. They created a feeling of humiliation and helplessness. The hygiene crisis of 2022 showed how thin the layer of civilization is when water disappears. Mykolaiv residents were forced to invent methods of "dry" washing, use wet wipes as the main means of hygiene and calculate each liter of technical water for flushing in the toilet. It was not just discomfort — it was a daily struggle to preserve one's own human form in inhuman circumstances.

Gastronomic adaptation

The water crisis of 2022 even reached the dining tables. A quarter of residents (25%) were "very often" forced to change their diet. It wasn't a matter of taste or diet — it was a direct consequence of resource scarcity. People refused to cook dishes that require long cooking or a lot of water to rinse the ingredients. Fresh vegetables and fruits, cereals, soups - everything that required significant water consumption was replaced by fast food or dry food.

This change in diet directly affected the quality of life and health. The lack of a good hot meal combined with stress undermined the immune system. Water became the main "price tag" of any dish: if it cost too many "eggplant liters" to wash or boil, it was refused. It was the survival economy in its most primitive and cruel manifestation.

Conclusions of the "crisis year"

The 2022 questionnaire recorded the moment of the city's highest vulnerability. It showed that water danger is a complex phenomenon that affects the psyche, health, social ties and professional future. The statistics of this period are a monument to the patience of Mykolaiv residents. She reminds us that even in a state of shock, when life revolved around plastic containers and the queue at the water carrier, the city did not break. However, the price of this resilience, expressed as a percentage of broken schedules and lost hygiene, will remain one of the most difficult chapters in our history, forever defining 2022 as the year of the great "water pain".

Geography of danger and emotional explosion

How exactly did scientists turn the results of a survey of city residents into an objective indicator? The level of water danger was determined by the sum of points obtained during the questionnaire. According to this methodology, three levels were distinguished: low, medium and high. For Mykolaiv of the 2022 sample, the calculated index showed that the city is in a state of medium water danger. However, if we delve into the details, this "average" indicator bordered on critical, especially in matters of psychological pressure and violation of sanitary standards.

The 2022 questionnaire clearly localized the "pain zones". Although the water crisis was citywide, the highest level of water danger was felt by residents of the Central District. This is due to the high density of buildings and the complexity of the logistics of water supply to multi-storey areas. It was followed by Zavodskyi, Ingulskyi and Korabelny districts in terms of tension.

59% of respondents reported a "very frequent" feeling of indignation. This is not just anger — it is a reaction to a violation of a stable lifestyle, which was experienced by 73% of respondents.

This data from 2022 is invaluable for our "Hydrochemical Chronicle". They prove that water hazards are not only chemical formulas, but also social trauma. Statistics collected in the midst of the crisis remind us of what the city has gone through and why the issue of sustainable water supply in 2026 is not just a technical task, but the main condition for the social rehabilitation of Mykolaiv.

Water danger is not only about physical health. It is about **a productive life**. The lack of adequate and safe water led to the fact that the city began to lose its socio-economic dynamics.

3.3. FROM SURVIVAL TO QUALITY: REFLECTION 2026

At the beginning of 2026, when Mykolaiv had already begun to emerge from the most acute phase of the infrastructure crisis, a second large-scale survey was conducted. This study was a logical continuation of the work of 2022, but its results showed a radical change in public demand and the evolution of the "water consciousness" of citizens.

Transformation of expectations from "at least some" to "safe" water

If in 2022 the headache of residents was the very fact of the presence of water in the network and the physical exhaustion of its extraction, then the 2026 survey recorded a qualitative leap in the requirements of the community. The fundamental difference between these two points of research lies in the content of the concept of "water danger":

- In 2022, the danger was existential: the inability to wash your hands, a change in diet, and the complete destruction of plans (45% of respondents).
- In 2026, the danger became scientific and technical: residents assessed the quality of indicators, dynamics and its impact on health.

The results of the 2026 pilot survey record a transformation in the role of residents: from recipients of humanitarian support to active subjects of public environmental monitoring. If in 2022 59% of respondents felt acute indignation — an emotion directed to the past, to lost comfort — then in 2026 constructive anxiety directed to the future dominates. People analyze forecasts, are interested in cleaning methods, and demand transparency in monitoring.

The 2026 survey took place against the backdrop of prolonged energy supply restrictions, which made it possible to record a new level of understanding among citizens of the interdependence of critical systems. The experience of blackouts has demonstrated that the stability of water supply is not only a matter of resource availability, but also a derivative of energy sustainability.

The survey conducted in early 2026 was the final touch to our study. It confirmed that the city has not just returned water — it has regained the right to quality of life. The water danger, which paralyzed everyday life in 2022, has become a manageable challenge in 2026, which is solved through science, technology and the active position of every Mykolaiv resident. This is a transition from a survival strategy to a sustainable development strategy, where water is not just a scarce treasure, but a safe and reliable foundation for urban life.

CHAPTER IV

WATER AND WAR THROUGH THE EYES OF ART: REFLECTION OF THE WATER CRISIS

4.1. AMULET ON THE WALL: "WHALE HOLDING THE CITY"

Art during the war in Mykolaiv became not just a way to decorate the mutilated walls, but a powerful tool for reflection and support of the collective spirit. One of the most iconic street art objects that appeared in the midst of the water crisis was a mural that combined the maritime identity of the city and the belief in its steadfastness.

This work is popularly known as "The Whale" or "Nicholas on the Whale". Mykolaiv artists Alyona Voloshyna and Dmytro Slepukha worked on the mural. The work was completed in the summer of 2022, becoming a symbolic gift to the city for the winter holidays in an extremely difficult year. The mural is located in the Central district of the city, on the wall of the house No. 15 on Velyka Morskaya Street (Fig. 4.1).

The composition of the mural "Big Fish" skillfully appeals to ancient, almost archetypal mythological ideas about the universe. In the iconography of many peoples of the world, there is an image of a cosmogonic animal — a giant tortoise, an elephant or a whale — holding the earthly firmament on its back. This is a symbol of support, without which the world will plunge into primordial chaos. However, in the Mykolaiv interpretation of 2022, this image has lost its abstraction, acquiring extremely sharp, modern and deeply local meanings.

In the center of the plot we see a majestic blue whale. It floats not just in the oceanic depths, but through an amazing expanse where the deep blue of the water merges with the infinity of star-studded space. This is a metaphor for Mykolaiv as a separate universe — self-sufficient, proud and lonely in its struggle. The whale here is not just an animal, but the embodiment of the very vitality of water, which in the year of the creation of the mural became the highest value for the city and at the same time the greatest pain.

On its back, this leviathan carries not abstract structures, but the recognizable, throbbing heart of Mykolaiv. The bowls were collected on the "island" formed on the back of a whale, the genetic code of urban architecture. The center of the composition is the building of the Admiralty - the starting point of the Nikolaev time. Its spire, confidently directed upwards, symbolizes the continuity of generations of shipbuilders. Next to it rises the Shukhov Tower, a steel openwork structure, which, in the conditions of the water blockade of 2022, turned from an engineering monument into a sacred symbol of hope. It seems to remind us that the city that tamed the water more than a century ago is able to do it again.

This "city island" on the back of a whale is an image of Mykolaiv as a fortress. When the storms of war raged around and the infrastructure was torn apart under the blows, the inhabitants felt exactly like this: on a small piece of native land, which is kept afloat only thanks to supernatural endurance. The whale personifies that invisible force —

volunteers, utility workers, soldiers, and ordinary citizens with eggplants in their hands — who, with their daily work, put their backs to the heavy array of city life.

Fig. 4.1. Mural "Mykolaiv on a whale" (photo by the author).

The stars around the whale can be interpreted both as the souls of fallen defenders, protecting the city from heaven, and as sparks of hope that do not fade in the darkness of blackouts. So, the mural transforms the ancient legend of the "world fish" into a modern epic. This is no longer just a myth about the creation of the world — it is an artistic manifesto about the preservation of peace in a single city by the sea. Mykolaiv on the back of a whale is a symbol of the fact that as long as the memory of our roots (the Admiralty) and the will to live (Shukhov Tower) live in us, our "spaceship" will continue its movement through any darkness.

The entire composition is framed by the inscription in capital letters: "Free City — Free Ukraine!", which makes this art object an open political and civic statement.

4.2. ART MANIFESTO "TREE OF LIFE"

The art of Mykolaiv develops according to its own, special logic — the logic of spiritual protection. When the material pillars of the city — water supply, power grids, residential buildings — were destroyed under shelling, the artists began to erect metaphysical supports. The mural "Tree of Life", presented in October 2022 in the Korabelny district, became another link in a unique "amulet cycle" designed to sacralize the space of the frontline city.

Art manifesto in the Korabelnyi district

While the city center was reflecting on the image of the "Big Fish", the remote Korabelnyi district, the area that suffered almost the most from shelling and logistical difficulties with water delivery, received its symbol. The authors of the canvas measuring three meters high and nine meters wide were the tandem known to Mykolaiv residents - Alyona Voloshyna and Dmytro Slepukha.

The choice of location was strategic. The Korabelny district became a kind of "island" inside the city, where domestic difficulties, including the water crisis, were felt more acutely due to the remoteness from the main spill points. It was here, on the wall of the building of Bogoyavlensky Avenue, that the "Tree of Life" appeared — a work created in record time, but filled with deep semantic meaning (Fig. 4.2).

Fig. 4.2. Mural "Tree of Life" in the Korabelny district of Mykolaiv (photo from open sources).

The visual language of the mural is not accidental. Alyona Martynova and Dmytro Slepukha turned to Tavrian painting, a unique artistic tradition of the Mykolaiv region, which they studied under the guidance of Lyubov Paraniuk. In the context of water danger, this is critical: Taurida painting is historically associated with the sea, river and steppe springs.

In the center of the composition is a stylized tree, each detail of which is a coded security sign:

The flower of life is the central element, symbolizing the continuity of the community's existence even in the driest times.

The guardian Chur is an ancient symbol of the border and protection of one's own territory. In 2022, the "Chur" on the wall in the Korabelnyi district was perceived as a spiritual checkpoint protecting the district from invaders and infrastructural chaos.

Protective signs are special graphic elements that, according to the tradition of Taurian painting, invoked grace and water.

Water as a sacred element of the "Tree"

Although the mural does not directly depict eggplants or cranes, it is imbued with the theme of water through its palette and origin. Tavrian painting is the "blue blood" of Mykolaiv. The blue, blue and ultramarine colors of the mural at a time when fresh water was scarce acted on the subconscious of the inhabitants as a visual oasis.

The "Tree of Life" became a metaphor for Mykolaiv himself: deep roots (the history of the Admiralty and the Navy), a strong trunk (the resilience of people) and bright flowers (faith in rebirth). When the roots of a tree do not receive enough moisture from the soil, it begins to look for it in the depths of the spirit — this is exactly what happened to Mykolaiv residents during the war years.

Social synergy

The story of the creation of the "Tree of Life" is also a story about the horizontal connections that saved the city. The sources recorded a touching detail: the artists stored their equipment and paints in the garage of a local resident, Tamara Mykolaivna. This detail is not just an everyday fact, but a symbol of how art united people. The paint for the mural — 10 liters of acrylic and enamel — was purchased with the support of patrons (including Mykola Marinov), but the community provided a physical place for the project.

The "Tree of Life" in the Korabelny district became proof that the water danger could not dry up the creative potential of the city. On the contrary, it forced artists to turn to the oldest layers of folk culture to find symbols of survival there.

4.3. COSSACK ATLANTIS: HYDROLOGICAL MEMORY THROUGH THE PRISM OF THE LOST AND FOUND

In December 2025, the cultural landscape of Mykolaiv was enriched with an event that is directly related to the philosophical understanding of the water crisis and the ecological fate of our region. Mykolaiv artist Olga Artym donated her iconic triptych "Cossack Atlantis" to the funds of the Mykolaiv Regional Art Museum named after V. V. Vereshchagin (Fig. 4.3). This work, created back in 2023 — after the explosion of the Kakhovka hydroelectric power plant and Mykolaiv's ongoing struggle for drinking water.

The transfer of the triptych to the V.V. Vereshchagin Museum at the end of 2025 is a deeply symbolic act. As the director of the museum Serhiy Roslyakov noted, this gift is evidence that the Mykolaiv school of painting continues to live and reflect on the most difficult topics of today.

Artistic archipelago of memory

The triptych "Cossack Atlantis" is not just landscape painting. This is a complex metaphor for a flooded history, where water acts both as a destructive element and as a thickness of time that preserves memory. The work consists of three parts, which together form a panoramic vision of Velykyi Luh, a sacred territory for the Ukrainian Cossacks, which was sacrificed to Soviet industrialization and the creation of the Kakhovka reservoir in the 1950s (Fig. 4.4).

For Mykolaiv, which in 2022-2026 itself became the epicenter of the water crisis, this work was a painful reminder that water has always been a political tool. Olha Artym's Cossack "Atlantis" is the voice of those lands that went under water to power the turbines of the hydroelectric power plant, which 70 years later became an instrument of ecocide.

Triptych Symbolism in the Context of Water Hazard

In the context of our "Chronicle", Artym's work acts as a cultural bridge between two tragedies:

Historical flooding (1950s), when there was a loss of the Great Meadow, floodplain forests and Cossack siches under the thickness of the artificial sea;

The current crisis (2023–2026) during the drainage of the Kakhovka reservoir after the terrorist attack on the hydroelectric power plant, which caused a humanitarian

catastrophe in the region and further exacerbated the issue of the shortage of fresh water for Mykolaiv.

On the canvases we see ghostly silhouettes of Cossack churches and boats, as if appearing through the haze of water. This is a visualization of the same "medium level of danger", but on a historical scale. The artist captures the moment when water ceases to be a source of life and becomes a "danger" that absorbs identity.

Fig. 4.3. Transfer of the triptych "Cossack Atlantis" by Olga Artym to the Mykolaiv Regional Art Museum named after V. V. Vereshchagin, December 2025 (photo from open sources).

For residents of Mykolaiv, who are used to evaluating water only by hydrochemistry or availability in the tap, "Cossack Atlantis" offers another dimension — ethical and environmental. We must understand that the struggle for water in 2026 is not only about building a new water supply system, but also about preserving the memory of the price that our region has already paid for "taming" the water crisis.

If the murals of Olena Voloshyna and Dmytro Slepukha on the streets of the city served as "operative therapy" during the shelling, then the triptych of Olha Artim in the

museum hall is a fundamental philosophical study. "Cossack Atlantis" reminds us that when the big water leaves, the truth about our roots remains on the surface.

Fig. 4.4. Elements of the triptych "Cossack Atlantis", artist - Olga Artym (photo by the author).

4.4. MURAL "MYKOLAIV SPRING" AS A VISUAL ANCHOR OF WATER MEMORY

In the artistic chronicle of Mykolaiv, a special place is occupied by an object that became a symbol of invincibility long before the start of a full-scale war. The mural on the fence at the foot of the Shukhov Tower, presented to the community in June 2016, is the oldest visual evidence of how the city tried to rethink its water identity through street art (Fig. 4.5).

From urban action to historical document

In 2016, Mykolaiv residents were presented with the result of large-scale creative work, which lasted about a month. The author of the idea and the main performer was the famous Mykolaiv muralist Dmytro Slepukha. The project was implemented with the support of the MriyDiy platform and local authorities, which was one of the first examples of a successful dialogue between the street art community and the city's official institutions.

Fig. 4.5. Mural by Dmytro Slepukha (2016), as a color embodiment of the city's hydraulic energy, which has preserved its water identity through the years of war (author's photo).

The mural with an area of more than 100 square meters radically changed the perception of the space around the Shukhov Tower. Its concept was based on the idea of a vibrant,

vibrant city, where water and engineering heritage are not frozen monuments, but part of a dynamic present.

The central element was the stylized design of the Shukhov Tower, made in a bright, almost neon palette. This allowed the viewer to see the "soul" of old metal through modern colors. The use of a wide range of colors (from deep ultramarine to sunny yellow) symbolized the versatility of Mykolaiv as a "city on water". Even in 2016, in peacetime, this mural reminded of the importance of preserving man-made objects that ensure the life of the city.

The Test of Time

This mural is of exceptional value due to its durability. At the time of the start of the water crisis in April 2022, Slepukha's work was already six years old. The paints, somewhat faded under the scorching southern sun, became a metaphor for an exhausted but not broken city.

When the site near the Shukhov Tower turned into one of the main gathering points for residents in queues for water, the mural of 2016 became a visual reference point for them. People standing with empty eggplants saw a bright version of their tower on the wall — a reminder that Mykolaiv was and remains a city where water is a value. The very story of the mural near the Shukhov Tower proves that art in Mykolaiv began to prepare the ground for ecological reflection long before this problem became critical. Dmytro Slepukha's work is the foundation on which other art objects later grew. This is evidence that the cultural code of Mykolaiv has always been inextricably linked with water. The mural, which withstood the winds and shelling, is today not just a decoration, but a "senior witness" of our struggle for water — from peace initiatives in 2016 to survival strategies in 2026.

4.5. CHRONICLES OF THIRST THROUGH BRUSH AND PHOTO LENS AS MIRRORS OF WATER RESISTANCE

In February 2026, Mykolaiv witnessed a unique event that united the scientific platform of the Petro Mohyla Black Sea National University and the creative energy of young and adult artists. The art project "Chronicles of Thirst" has become not just a contest of drawings and photos, but a confession of young Mykolaiv residents about their lives in the conditions of the water crisis.

The concept of the "Chronicles of Thirst"

The theme "Chronicles of Thirst: Water and Life during the War in Mykolaiv" was chosen as the most resonant point of contact between environmental safety and human sustainability. Students of gymnasiums and lyceums were offered to become "the voice of the indomitable city". At a time when the city had already begun to gradually restore a stable water supply, there was an urgent need to prevent this memory from being erased.

The contest had a clear goal — to turn the subjective experience of survival into a "document of the era." Works made in arbitrary techniques — from classical watercolors to graphics and mixed media — have become a visual archive of how "water tastes of life". For many teenagers, participation in the project has become a form of art therapy, an opportunity to put on paper what was difficult to express in words during the previous four years.

The project received wide support on social networks, uniting activists, teachers, and the public. The culmination of the project was an exhibition that opened in February 2026.

Difficulty in choosing a commission

Evaluating children's drawings on the theme "Water and War" is a task where the usual criteria like "execution technique" often fade into the background. For the high school students of Mykolaiv, who participated in the competition on February 26, 2026, it was not just a creative work, but an attempt to record their life over the past four years. When the members of the commission (art critics, teachers, graduate students and students) laid out the works, it became clear that they were not just drawings, but a visual diary of the city (Fig. 4.6).

The controversy in determining the winners arose precisely because of this emotional aspect. It's hard to give a lower score to a job where the technique may be imperfect, but the idea hits the mark. The main result of the competition is the formation of active

subjectivity in children. The works reflect the understanding that the quality of tap water directly depends on the state of the ecosystem and the stability of the infrastructure, and the environmental consequences of the war are perceived as a personal challenge.

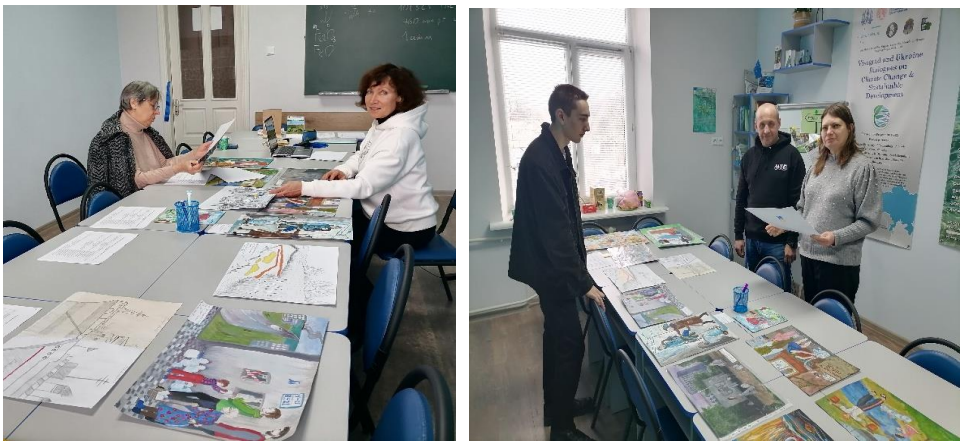

Fig. 4.6. During the work of the competition commission, February 2026 (photo by the author).

Between the report and the symbol

The works of the participants can be roughly divided into two types: direct fixation of reality and an attempt to comprehend the crisis through images.

The first group of drawings is almost a "reportage". On them we see what has become everyday life: plastic eggplants of various calibers, characteristic automatic water dispensers and queues (Fig. 4.7). It is interesting how accurately children convey details: people's clothes, the texture of walls cut by debris and the concentrated faces of people in line. There is no decoration in these works, only a statement of how the life of Mykolaiv residents has narrowed down to the search and transfer of water.

The second group of works is metaphors. Here the water appears as something living and very fragile. Often there is an image of hands protecting a single drop, inside of which a peaceful city, sailboats on the river or green trees are depicted (Fig. 4.8). The drawings show the loss of the illusion of the availability of water as a given. Teenagers began to perceive water supply as a complex process, where every drop has its price and requires efforts to conserve."

The use of colors is particularly impressive. Works describing the period 2022-2026 are often made in gray, brown and ocher tones - this is the "color of rust and drought". However, pure blue and green appear in drawings relating to the future. This is not pathos, this is a visualization of the hope that the water will finally become clean and safe.

Fig. 4.7. Drawings – reports "Chronicles of Thirst".

"The Thirst Chronicles" is a fixation of the moment. Art here worked like a mirror: it showed us not only our problems, but also our ability to adapt and remain human even in line for water during the next blackout.

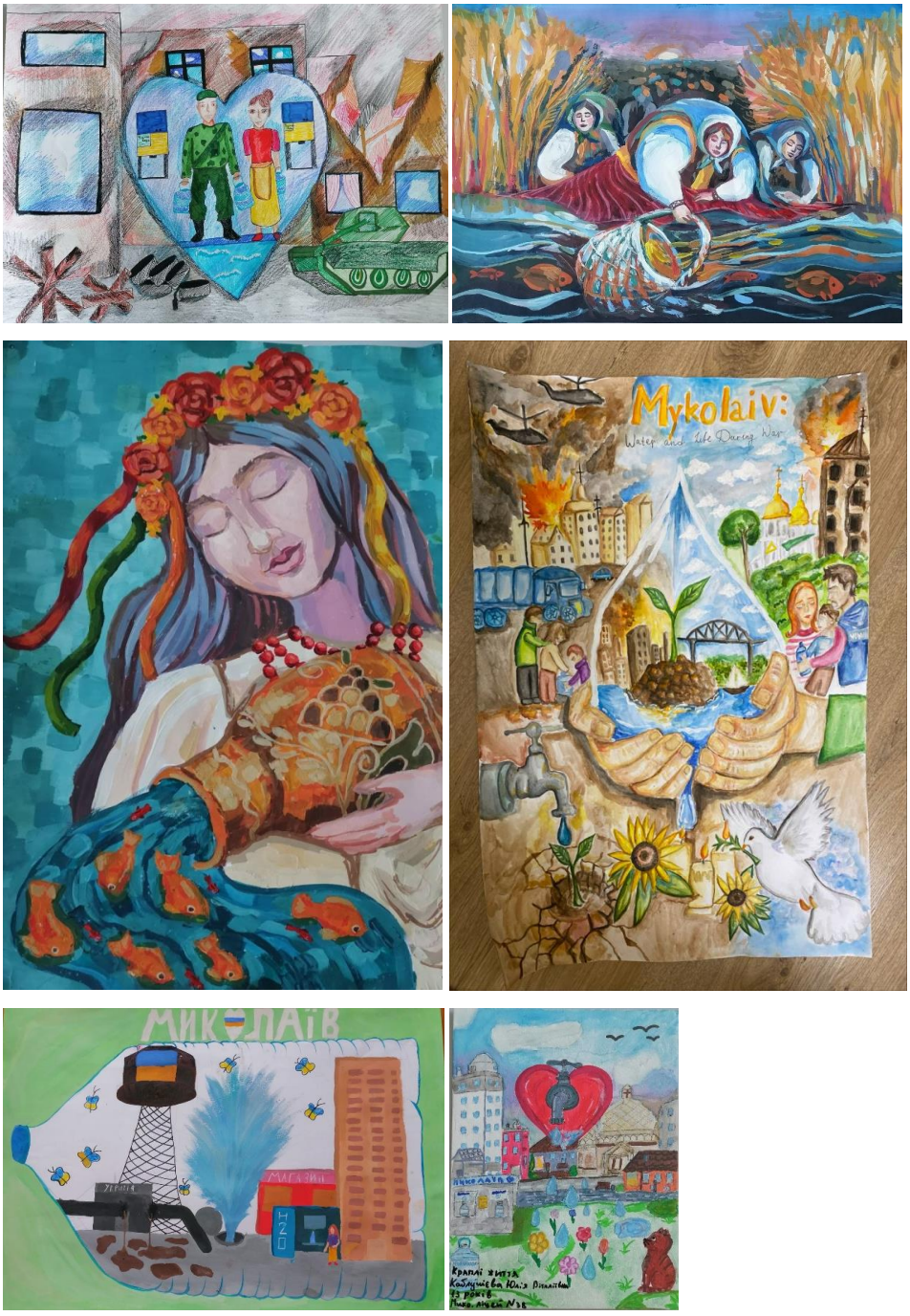

Fig. 4.8. Drawings – images of the "Chronicles of Thirst".

The exhibition, which opened on February 26, 2026, combined children's drawings with reportage photographs that recorded the water military history of the city (Fig. 4.9; 4.10).

Fig. 4.9. Photo-report "Chronicles of Thirst" (photo by the author).

The analysis of the presented works confirmed the hypothesis put forward earlier: teenagers perceive the environmental safety of the city not as an abstract category, but as a basic condition for social sustainability. The participants' works demonstrated the ability to deeply emotionally fix everyday challenges.

Fig. 4.10. During the opening of the exhibition "Chronicles of Thirst" at Petro Mohyla Chernobyl National University, February 26, 2026 (photo by the author).

In the work of Anastasia Bon's "When there is no water in the tap" (Fig. 4.7, upper right), the state of the infrastructure vacuum, which has become part of the collective memory of Mykolaiv residents, is recorded.

The projects of Sofia Makarova "A Drop of Hope" and Ulyana Siya "Healing Water of Mykoliv Region" (Fig. 4.8, top and center on the right) focused on the healing potential

of water resources of their native land, which indicates the demand of young people for the ecological revitalization of the region.

The creative approach of Daria Kalyniuk (Fig. 4.7, right, center), Polina Kalinichenko (Fig. 4.8, left, center) and Kateryna Sidenko (Fig. 4.7, left, bottom) became an example of a direct and sincere understanding of the crisis period, where art acted as a therapeutic tool along with the "chronicles of thirst".

"Chronicles of thirst..." proved that creativity is the sincerest report on the state of environmental water safety of the city. Each work became part of the environmental story of how Mykolaiv not only existed during the water crisis, but preserved the source of spiritual invincibility.

AFTERWORD

Concluding this "chronicle", it can be stated that the experience of Mykolaiv in 2022-2026 went far beyond the local communal crisis. This study recorded a unique precedent in world history, when a large industrial city became the object of purposeful "water terror", but not only survived, but also transformed its vulnerability into a new model of resilience.

The book analyzes three key aspects of the Mykolaiv phenomenon. Firstly, it is technological resistance, the way from overcoming critical water quality indicators, which were several times higher than the normative values, to the introduction of modern water treatment protocols and the design of the most modern treatment facilities in Ukraine.

Secondly, it is a socio-ecological transformation. Questionnaires and hydrochemical monitoring confirmed that Mykolaiv residents have ceased to be passive consumers. The community has evolved from forced adaptation to water scarcity to a deeper understanding of the causes of this crisis. Even if alternative sources of supply are preserved, Mykolaiv residents have a clear request to restore the ecosystem of the Southern Buh as the primary basis for a stable quality of life. This applied environmental awareness has become an important element of the new urban identity.

Thirdly, it is cultural reflection. The artistic front of Mykolaiv, from children's reportage and figurative drawings to large-scale projects by professional authors, has become an integral part of urban sustainability. Visual documentation of the experience of "thirst" turned out to be as critical as the modernization of pumping stations, because it was culture that helped to fix the emotional code during the war and water crisis and form a vision of the restoration of the city, which retains its identity in the "dark time".

The symbolic end of the stage of the systemic water crisis for Mykolaiv was the launch of an ambitious project for the construction of new treatment facilities worth more than 800 million hryvnias. This initiative is not just an attempt to restore the city's access to quality water, but an application for the creation of the most technologically advanced water supply complex in Ukraine. If the period 2022-2025 was a time of desperate struggle for every liter, then 2026 marked the transition to strategic design of the future. The new water supply system was launched on October 7, 2025. The implementation of a project of such a scale proves that the experience of Mykolaiv has ceased to be a local story of survival. The city went through a unique military test in world history, where water played the role of a weapon. The current investment in treatment technologies is the final victory over the strategy of "water terror", which was aimed at making the city

uninhabitable. Mykolaiv does not just return water, but forms new standards of water environmental safety for the whole country.

Now, when unprecedented funds are allocated for the implementation of new infrastructure projects, Mykolaiv is on the verge of becoming a European benchmark for water resources management. The prospect of 2026 is the creation of a system that is energy independent, digitalized and environmentally responsible.

The construction of modern sewage treatment plants is the final point in the history of "salt water", but at the same time it is only the beginning of a major revitalization of the entire Northern Black Sea region. The experience of the city will now serve as a methodological guide for international institutions studying the sustainability of cities in the twenty-first century.

Mykolaiv proved that the urban ecosystem is not only a set of buildings and communications, but a living organism where the will of people is the main energy resource. As the outstanding scientist Volodymyr Vernadsky said: "Humanity is becoming a powerful geological force." Mykolaiv showed this power in action: when the destruction of life support systems became an impetus not for decline, but for the conscious design of the future. This study is evidence that the city has chosen the path of evolution, where environmental water security has become an integral part of the social contract.

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